Appendix A:
Consultation and Coordination

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COR West Wash Dam: cooperation, coordination and public participation list				
Agency	**Contact Name**	**Email**	**Address**	**Additional address**
State and Federal Agencies				
US Fish and Wildlife	Joanna Gilkeson	joanna_gilkeson@fws.gov	U.S. Fish and Wildlife Service Reno Fish & Wildlife Office 1340 Financial Blvd., Suite 234 Reno, Nevada 89502 (775) 861-6300	
EPA- Region 9		Email: r9.info@epa.gov	US EPA Pacific Southwest, Region 9 75 Hawthorne St. San Francisco, CA 94105 Phone: (415) 947-8000 (866) EPA-WEST) Fax: (415) 947-3553	
Nevada Division of Wildlife	Julie Meadows - Special Licenses and Permits and/or Alan Jenne - Habitat Division Chief	jmeadows@ndow.org ajenne@ndow.org	Regional Office: 1100 Valley Rd. Reno, NV 89512 Phone: (775) 688-1506 Fax: (775) 688-1595	Headquarters: 6980 Sierra Center Pkwy #120 Reno, NV 89511 Phone: (775) 688-1500 Fax: (775) 688-1495 Email: ndowinfo@ndow.org
USACE- Reno Field Office	Jennifer Thomason	Jennifer.C.Thomason@usace.army.mil	Jennifer C. Thomason Senior Project Manager US Army Corps of Engineers, Sacramento District Reno Regulatory Field Office 300 Booth Street, Room 3050 Reno, NV 89509-1361	USACE- Reno Field Office

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Agency	**Contact Name**	**Email**	**Address**	**Additional address**
State and Federal Agencies				
			Office: (775) 784-5304 Mobile: (775) 525-0384	
NV SHPO	Robin Reed, Deputy Director	rreed@shpo.nv.gov	Nevada State Historic Preservation Office Department of Conservation and Natural Resources 901 South Stewart Street, Suite 3002 Carson City, NV 89701 (O): 775-684-3437 I (F) 775-684-3442 rreed@shpo.nv.gov	
Reno Historical Commission	Megan Berner, Arts and Culture Manager	Bernerm@reno.gov	City of Reno Art & Culture One East First Street Reno, NV 89501	Reno Historical Commission

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Agency	**Contact Name**	**Email**	**Address**	**Additional address**
State and Federal Agencies				
NDSL- Nevada State Clearinghouse	Scott Carey	nevadaclearinghouse@lands.nv.gov	NDSL Nevada State Cleaeringhouse 901 South Stewart Street, Suite 5003 Carson City, NV 89701	NDSL- Nevada State Clearinghouse
Nevada Division of Water Resources (NDWR)- Safety of Dams Section	Chris Thorson, P.E.	cthorson@water.nv.gov	Nevada Division of Water Resources 901 South Stewart Street, Suite 2002 Carson City, NV 89701 (O): 775 -684-2803	Nevada Division of Water Resources (NDWR)- Safety of Dams Section

COR West Wash Dam: cooperation, coordination and public participation list				
Agency	**Contact Name**	**Email**	**Address**	**Additional address**
State and Federal Agencies				
NDEP- BWPC (may also include permitting and compliance divisions) and NDEP-BSDW	Andrew Dixon-stormwater	andrew.dixon@ndep.nv.gov	901 S. Stewart Street, Suite 4001 Carson City, Nevada 89701 Phone: 775-687-4670	NDEP- BWPC (may also include permitting and compliance divisions) and NDEP-BSDW
Nevada National Heritage Program	Kristin Szabo	kszabo@heritage.nv.gov	Nevada Natural Heritage Program 901 S. Stewart St., Suite 5002 Carson City, NV 89701-5245 Main Phone Number: (775) 684-2900 Fax Number: (775) 684-2909	Nevada National Heritage Program

COR West Wash Dam: cooperation, coordination and public participation list				
Agency	**Contact Name**	**Email**	**Address**	**Additional address**
State and Federal Agencies				
Nevada Department of Transportation (NDOT) - Stormwater	No contacts listed on site, only questions or comments for for email	https://www.nevadadot.com/doing-business/about-ndot/ndot-divisions/stormwater/questions-or-comments	(O): (775) 888-7771	Nevada Department of Transportation (NDOT) - Stormwater
Northern Neavada Water Policy Commission (NNWPC)	Jim Smitherman (Water Resources Program Manager)	jsmitherman@washoecounty.us	1001 East Ninth St. Reno, NV 89512 (O): (775) 954-4657	Northern Neavada Water Policy Commission (NNWPC)

COR West Wash Dam: cooperation, coordination and public participation list				
Agency	**Contact Name**	**Email**	**Address**	**Additional address**
State and Federal Agencies				
Western Regional Water Commission (WRWC)	Jim Smitherman (Water Resources Program Manager)	jsmitherman@washoecounty.us	1001 East Ninth St. Reno, NV 89512 (O): (775) 954-4657	Western Regional Water Commission (WRWC)

COR West Wash Dam: cooperation, coordination and public participation list				
Agency	**Agency**	**Agency**	**Agency**	**Agency**
Local Government				
Washoe County	Dave Solaro (Community Services Department Director)	dsolaro@washoecounty.us	Community Services Department Planning and Development 1001 E. Ninth Street Reno, NV 89512 (O): (775) 328-3600	
Truckee River Flood Management Authority (TRFMA)	George Robison	grobison@washoecounty.us	TRFMA, 9635 Gateway Drive, Suite A, Reno, NV 89521	
Washoe County Emergency Management	Dr. Aaron Kenneston	akenneston@washoecounty.us	Washoe County Emergency Management 1001 East Ninth Street, Building A Reno, NV 89512	
Truckee Meadows Storm Water Permit Coordinating Committee	Theresa Jones (SWPCC Coordinator)	jonest@reno.gov	1 E. 1st Street Reno, NV 89501 (775) 334-3311	
Washoe Co. Central Truckee Meadows Remediation District (CTMRD)	Chris Benedict (Program Manager)	cbenedict@washoecounty.us	1001 E. Ninth Street, Building C Reno, NV 89512 (775) 954-4642	

COR West Wash Dam: cooperation, coordination and public participation list				
Agency	**Agency**	**Agency**	**Agency**	**Agency**
Local Government				
Trucke Meadows Regional Planning Agency (TMRPA)	Dr. Jeremy Smith (Director of Regional Planning)	jsmith@tmrpa.org	1105 Terminal Way #316 Reno, NV 89502 (O): (775) 321-8385 (Direct): (775) 321-8390	
Washoe Storey Conservation District	Bret Tyler (WSCD Chairman)	brettyler2@gmail.com washoestoreycd@gmail.com	1365 Corporate Drive Sparks, NV 89431 (O): (775) 722-6302	
Truckee Meadows Water Authority	Scott Estes (Director of System Planning & Engineering)	sestes@tmwa.com	1355 Capital Blvd Reno, NV 89502	Mailing address: P.O. Box 30013 Reno, NV 89520-3013
Elected Officials				
City of Reno Mayor	Hillary Schieve	mayor@reno.gov	City of Reno 1 E. First Street PO Box 1900 Reno, NV 89505 phone: 775-334-2001	

COR West Wash Dam: cooperation, coordination and public participation list				
Agency	**Agency**	**Agency**	**Agency**	**Agency**
Local Government				
City of Reno Neighborhood Advisory Board Ward 1	Jenny Brekhus (Council Member)	brekhusj@reno.gov	City of Reno 1 E. First Street PO Box 1900 Reno, NV 89505 Phone: 775-334-2011	
City of Reno Neighborhood Advisory Board Ward 2	Naomi Duerr (Council Member)	duerrn@reno.gov	City of Reno 1 E. First Street PO Box 1900 Reno, NV 89505 Phone: 775-334-2017	
City of Reno Neighborhood Advisory Board Ward 3	Oscar Delgado (Coucil Member)	delgadoo@reno.gov	City of Reno 1 E. First Street PO Box 1900 Reno, NV 89505 Phone: 775-334-2021	
City of Reno Neighborhood Advisory Board Ward 4	Bonnie Weber (Coucil Member)	weberb@reno.gov	City of Reno 1 E. First Street PO Box 1900 Reno, NV 89505 Phone: 775-334-2015	
City of Reno Neighborhood Advisory Board Ward 5	Neoma Jardon (Council Member)	jardon@reno.gov	City of Reno 1 E. First Street PO Box 1900 Reno, NV 89505	

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Agency	**Agency**	**Agency**	**Agency**	**Agency**
Local Government				
Reno City Counsel Member at Large	Devon Reese City Counsel at Large	reesed@reno.gov	City of Reno 1 E. First Street PO Box 1900 Reno, NV 89505 Phone: 775-334-2014	
Washoe County Commissioners District 1	Alexis Hill	AHILL@WASHOECOUNTY.US	1001 E 9th St. Reno, NV 89512 Phone: (775) 328-2005	
State Representative 2nd district	Mark Amodei (U.S. Congressman)	https://amodei.house.gov/	5310 Kietzke Lane, Suite 103 Reno, NV 89511 Phone: (775) 686-5760 Fax: (775) 686-5711	
Senior Senator	Catherine Cortez Masto	https://www.cortezmasto.senate.gov/	400 South Virginia Street Suite 902 Reno, NV 89501 P: (775) 686-5750 F: (775) 686-5757	313 Hart Senate Office Building Washington, DC 20510 P: (202) 224-3542
Junior Senator	Jacky Rosen	https://www.rosen.senate.gov/	Bruce Thompson Federal Building 400 S. Virginia Street, Suite 738 Reno, NV 89501	144 Russell Senate Office Building Washington, DC 20510 Phone: 202-224-6244

Community Organizations				
Agency	**Contact Name**	**Email**	**Address**	**Additional address**
Reno Sparks Neighborhoods (**West University Neighborhood**)		community@renosparks.org	3983 S McCarran Blvd. #191 Reno, NV 89502 (775) 391-4005	
Nextdoor Neighborhood	Old Northwest and N McCarren communities	Unable to find any way to contact people within these neighborhoods without being a part of that community on the website		
One Truckee River (OTR) (Nevada Land Trust)		https://nevadalandtrust.org/contact-us/	2601 Plumas St. Reno, NV 89509 (O): (775) 851-5180 (F): (775) 851-5182	Mailing address: Nevada Land Trust P.O. Box 20288 Reno, NV 89515
Keep Truckee Meadows Beautiful (KTMB)		staff@ktmb.org	2601 Plumas St. Reno, NV 89510 (O): (775) 851-5185	Mailing address: P.O. Box 7412 Reno, NV 89510
The Nature Conservancy (TNC)		nevada@tnc.org	1 East First St., Suite 1007 Reno, NV 89501 (O): (775) 322-4990	
Sierra Nevada Journeys (SNJ)	Eaton Dunkelberger (CEO)	https://www.sierranevadajourneys.org/contact-us	190 East Liberty St. Reno, NV 89501 (O): (775) 355-1688	
Reno Cyclery	Jared Fisher (owner of Bomb Voyage, LLC)		10575 Discovery Drive Las Vegas, NV 89135 (702) 274-3862	

Local Tribes (NRCS will consult)				
Tribal Nation	**Contact Name**	**Email**	**Address**	**Additional address**
Reno-Sparks Indian Colony	Bethany B. Sam (PR/Community Information Officer) and Chairman Arlan Melendez	bsam@rsic.org	34 Reservation Road Reno, NV 89502 (O): (775) 329-2936 (F): (775) 329-8710	
Fallon Paiute	Chairwoman Cathi Williams-Tuni		565 Rio Vista Drive Fallon, Nevada 89406	
Pyramid Lake Paiute Tribe	Donna Noel	Donna Noel <DNoel@plpt.nsn.us>	P.O. Box 256 Nixon, NV 89424	
Pyramid Lake Paiute Tribe	Chairwoman Janet Davis		P.O. Box 256 Nixon, NV 89425	
Summit Lake Paiute Tribe	Mr. James Simmons		2255 Green Vista Dr. #402 Sparks, NV 89431	
Washoe Tribe of Nevada and California	Chairman Serrell Smoey		919 Highway 395 South Gardnerville, NV 89410	
Residents w/in 1,000 ft of direct project area				
Agency	**Contact Name**	**Email**	**Address**	**Additional address**

Residents near the area (w/in 1,000 ft)	See **Area Residents** tab			
Residents w/in downstream inundation area	See **Downstream Residents** Tab			

Residents w/in 1,000 ft of direct project area										
APN	STREETNUM	STREET	CITY	ZIP	FIRST NAME	LAST NAME	MAILING1	MAILCITY	MAILSTATE	MAILZIP
104104	3405	GULLING RD	RENO	89503		TEMPLE SINAI	3405 GULLING RD	RENO	NV	89503
104143	2940	BRYAN ST	RENO	89503	DIEGO A	LOZADA et al	2940 BRYAN ST	RENO	NV	89503
104147	2705	GULLING CT	RENO	89503	RANDALL R	LAMAY TRUST	2705 GULLING CT	RENO	NV	89503
104148	2715	GULLING CT	RENO	89503	TONG T & BONNIE R N	LE	3093 CREEKSIDE LN	SPARKS	NV	89431
104149	2725	GULLING CT	RENO	89503	JATINDER & KANWALJEET	CHANA	3004 MELINA DR	EL DORADO HILLS	CA	95762
104150	2735	GULLING CT	RENO	89503	JOSE P	LOPEZ-MEDINA	PO BOX 20601	RENO	NV	89515
104151	2730	GULLING CT	RENO	89503	TIEMING	HE et al	1225 MORRISON CANYON RD	FREMONT	CA	94536
104152	2720	GULLING CT	RENO	89503	PAMELA L & JOHN	UMEK	2720 GULLING CT	RENO	NV	89503
104153	2710	GULLING CT	RENO	89503	JOEL	JAYME LIVING TRUST	6401 ADOBE SPRINGS CT	SPARKS	NV	89436
104154	2700	GULLING CT	RENO	89503	MERIAM	BURBANK LIVING TRUST	2700 GULLING CT	RENO	NV	89503
104156	2890	BRYAN ST	RENO	89503	JOSE	SEGURA	2890 BRYAN ST	RENO	NV	89503
104157	2880	BRYAN ST	RENO	89503	RANDOLPH & KIMBERLY	BRANDT LIVING TRUST	5635 ELDER CIR	LIVERMORE	CA	94550
104158	2870	BRYAN ST	RENO	89503	DENNIS B & JOCELYN	HOUSTON	2870 BRYAN ST	RENO	NV	89503
104159	2860	BRYAN ST	RENO	89503	STEVEN D	HILL	2860 BRYAN ST	RENO	NV	89503
104162	2930	BRYAN ST	RENO	89503		PICONE FAMILY TRUST	1340 TAPADERO TRL	RENO	NV	89521
104164	2928	BRYAN ST	RENO	89503	JOHANNES & SWENJA	ZIEGLER	10378 SUGAR PINE RD	TRUCKEE	CA	96161
104165	2924	BRYAN ST	RENO	89503	LOREN T	NELSON	9001 TIMOTHY DR	RENO	NV	89511
104166	2920	BRYAN ST	RENO	89503	PINAK S	LONKAR et al	2920 BRYAN ST	RENO	NV	89503
104167	2916	BRYAN ST	RENO	89503	MAX & MEGAN	CONELLY	2916 BRYAN ST	RENO	NV	89503
104168	2912	BRYAN ST	RENO	89503	STEVEN Z	HELLER	2912 BRYAN ST	RENO	NV	89503
104169	2908	BRYAN ST	RENO	89503	JOHN C	HANCOCK TRUST	2908 BRYAN ST	RENO	NV	89503
104170	2904	BRYAN ST	RENO	89503	GENEVIEVE M	CASTILLO	6888 W SERENERA WAY APT 386	WEST JORDAN	UT	84081
104171	2900	BRYAN ST	RENO	89503	GERARDO & BRENDA G	CASALLAS	2900 BRYAN ST	RENO	NV	89503
104173	3343	GULLING RD	RENO	89503	JUWHAN	EOM et al	3343 GULLING RD	RENO	NV	89503
104174	3353	GULLING RD	RENO	89503	DANIEL F & KELLY L	COONS	PO BOX 1460	DAYTON	NV	89403
104175	3345	GULLING RD	RENO	89503	GARRETT D	PETERSON et al	3345 GULLING RD	RENO	NV	89503
104176	3347	GULLING RD	RENO	89503	THOMAS E JR & ALISA D	BLACK 2016 TRUST	600 YELLOW PINE RD	RENO	NV	89511
104177	3349	GULLING RD	RENO	89503	WILLIAM B	KICE	3349 GULLING RD	RENO	NV	89503
104178	3351	GULLING RD	RENO	89503	WILLIAM J & HEATHER N	EATON	3351 GULLING RD	RENO	NV	89503
105112	2700	HACIENDA WAY	RENO	89503		HIGHLAND CONG JEHOVAHS WITNESS	PO BOX 33537	RENO	NV	89533
105206	2650	SUNRAY DR	RENO	89503		CHAUCER LIVING TRUST	PO BOX 5782	RENO	NV	89513-5782
105216	2985	ANDREA ST	RENO	89503	MATTHEW & TAUNI	LIEDTKE	2985 ANDREA ST	RENO	NV	89503
105217	2615	EMILY ST	RENO	89503	SHIRLEY L	ROMAN TRUST	1070 MILL CREEK RD	INCLINE VILLAGE	NV	89451
105218	2625	EMILY ST	RENO	89503	SUSAN K	SUPANCHECK TRUST	2625 EMILY ST	RENO	NV	89503
105219	2635	EMILY ST	RENO	89503	JOHN L & CAROLYN L	CORSTORPHINE	15850 ROCKY VISTA RD	RENO	NV	89521
105220	2630	EMILY ST	RENO	89503	LECIA C	MOJICA	2630 EMILY ST	RENO	NV	89503
105221	2620	EMILY ST	RENO	89503	PHILIP R	BUTLER	2620 EMILY ST	RENO	NV	89503
105222	2610	EMILY ST	RENO	89503		MUNCY LIVING TRUST et al	4984 SIERRA PINE DR	RENO	NV	89519
105223	2937	ANDREA ST	RENO	89503		WEISSGERBER FAMILY TRUST	213 SADDLE CT	FOLSOM	CA	95630
105224	2905	ANDREA ST	RENO	89503	MARK D & CHARLOTTE R	STOCK	561 KEYSTONE AVE # 411	RENO	NV	89503
105231	2617	SUNRAY DR	RENO	89503		BUI FAMILY TRUST	2508 HART AVE	SANTA CLARA	CA	95050
105232	2637	SUNRAY DR	RENO	89503	JEFFREY K	WHITE	2637 SUNRAY DR	RENO	NV	89503
105233	2627	SUNRAY DR	RENO	89503		LUMMUS FAMILY 2020 TRUST	1212 BROKEN FEATHER CT	RENO	NV	89511
105245	2945	BRYAN ST	RENO	89503	PETER & SHARON K	CHAMBERLIN	2945 BRYAN ST	RENO	NV	89503
105246	2935	BRYAN ST	RENO	89503	KYLE P	MORRIS	2935 BRYAN ST	RENO	NV	89503
105251	2640	EMILY ST	RENO	89503	JAMES V	SHEEHAN	2640 EMILY ST	RENO	NV	89503
105252	0	EMILY ST	RENO	89503		RENEW RENOVATIONS LLC	PO BOX 17267	RENO	NV	89511
105253	0	EMILY ST	RENO	89503		RENEW RENOVATIONS LLC	PO BOX 17267	RENO	NV	89511
105255	0	EMILY ST	RENO	89503		RENEW RENOVATIONS LLC	PO BOX 17267	RENO	NV	89511
105256	0	EMILY ST	RENO	89503		RENEW RENOVATIONS LLC	PO BOX 17267	RENO	NV	89511
105257	0	EMILY ST	RENO	89503		RENEW RENOVATIONS LLC	PO BOX 17267	RENO	NV	89511
105258	0	EMILY ST	RENO	89503		RENEW RENOVATIONS LLC	PO BOX 17267	RENO	NV	89511
105261	2905	BRYAN ST	RENO	89503	JUAN O	DELANEY	2905 BRYAN ST	RENO	NV	89503
105262	2895	BRYAN ST	RENO	89503	MELISSANORA C	FLORES	1640 SILVERTHREAD DR	RENO	NV	89521
105263	2630	SUNRAY DR	RENO	89503	RONALDO & MYLENE	LERON	5441 S ELK RIVER RD	RENO	NV	89511
105264	2620	SUNRAY DR	RENO	89503	MARK V & SHEILA M	CAMPBELL	3360 QUILICI LN	RENO	NV	89511
105265	2610	SUNRAY DR	RENO	89503	BRIAN	GRAHAM	2610 SUNRAY DR	RENO	NV	89503
105266	2606	SUNRAY DR	RENO	89503	JEFFREY M	HARDCASTLE	2606 SUNRAY DR	RENO	NV	89503
105267	2875	BRYAN ST	RENO	89503	RAYMUNDO C & GINA M	ENRIQUEZ	2875 BRYAN ST	RENO	NV	89503
105268	2855	BRYAN ST	RENO	89503	JESSICA R B & MARK D	NOLAN	2855 BRYAN ST	RENO	NV	89503

105270	2644	SUNRAY DR	RENO	89503	CLIFFORD & NUANANONG	HOWARD	1115 LOS PADRES ST SE	ALBUQUERQUE	NM	87123
105271	2640	SUNRAY DR	RENO	89503	DONALD L & SHELBY K	LUNDQUIST	2640 SUNRAY DR	RENO	NV	89503
105272	2925	BRYAN ST	RENO	89503	SEAN	OSTERHAGEN et al	2925 BRYAN ST	RENO	NV	89503
105273	2915	BRYAN ST	RENO	89503	OLIVIA M	RODRIGUES LIVING TRUST	5712 BRETT DR	SACRAMENTO	CA	95842
105275	11000	MCCARRAN BLVD	RENO	89503	ANGELA	HEREDIA-BONNET et al	PO BOX 33714	RENO	NV	89533
110101	2800	SEVERN DR	RENO	89503	ANTHONY R & PATRICIA A	DULDULAO	PO BOX 4002	MANTECA	CA	95337
110102	2810	SEVERN DR	RENO	89503	SCOTT R	LAKE et al	2810 SEVERN DR	RENO	NV	89503
110103	2820	SEVERN DR	RENO	89503	VALON	BISHOP	PO BOX 50041	RENO	NV	89513
110104	2840	SEVERN DR	RENO	89503	DUSTIN & JESSICA	DUNBAR	2840 SEVERN DR	RENO	NV	89503
110105	2860	SEVERN DR	RENO	89503		CHARTSIRI TRUST	2860 SEVERN DR	RENO	NV	89503
110107	0	UNSPECIFIED	RENO	89503		RENO CITY OF	PO BOX 1900	RENO	NV	89505
110108	2890	SEVERN DR	RENO	89503		MORRIS FAMILY TRUST	PO BOX 5172	TAHOE CITY	CA	96145
110109	2910	SEVERN DR	RENO	89503	STEVEN & DEBORAH L	KATERS	2910 SEVERN DR	RENO	NV	89503
110110	2930	SEVERN DR	RENO	89503	GLEN V	WEATHERSON	2930 SEVERN DR	RENO	NV	89503
110111	2950	SEVERN DR	RENO	89503	LINDA A	SEALOCK TRUST	2950 SEVERN DR	RENO	NV	89503
110116	2970	SEVERN DR	RENO	89503	KIM	ARNOTT	2970 SEVERN DR	RENO	NV	89503
110119	2990	SEVERN DR	RENO	89503	HUGH J	GALLAGHER	PO BOX 492	VIRGINIA CITY	NV	89440
110203	2965	SEVERN DR	RENO	89503	JOSE W & EUGENIA M	HERRERA	2965 SEVERN DR	RENO	NV	89503
110204	2945	SEVERN DR	RENO	89503	JOSHUA M & SARA N	SKROCH	1481 WASHINGTON ST	RENO	NV	89503
110205	2935	SEVERN DR	RENO	89503		JENSEN FAMILY TRUST	PO BOX 253	VERDI	NV	89439
110206	2915	SEVERN DR	RENO	89503	JAMES K & KAY M	WILSON TRUST	2689 HIGHLAND DR	BISHOP	CA	93514
110207	2485	SUNRAY DR	RENO	89503	TRAVIS	TEBBE	2485 SUNRAY DR	RENO	NV	89503
110208	2495	SUNRAY DR	RENO	89503	JEFFREY G	ACTON LIVING TRUST et al	932 KINGS CANYON CT	SCOTTS VALLEY	CA	95066
110209	2910	HARDING CIR	RENO	89503	NICKOLE	SEABORG	2910 HARDING CIR	RENO	NV	89503
110210	2920	HARDING CIR	RENO	89503	TOBY G	ROSS LIVING TRUST et al	PO BOX 8030	RENO	NV	89507
110211	2930	HARDING CIR	RENO	89503	KYLE N	SCHELLER	5535 DAYBREAK DR	RENO	NV	89523
110212	2940	HARDING CIR	RENO	89503	GAGE L	KABISCH	2940 HARDING CIR	RENO	NV	89503
110213	2950	HARDING CIR	RENO	89503	BRENT & RACHEL	OLIVEIRA	1246 LOMA VERDE CT	SPARKS	NV	89436
110214	2960	HARDING CIR	RENO	89503	JEFFREY S	ATEN	2960 HARDING CIR	RENO	NV	89503
110215	2995	SEVERN DR	RENO	89503	HEATHER D	BEDFORD	2995 SEVERN DR	RENO	NV	89503
110216	2975	SEVERN DR	RENO	89503	CRYSTAL P & ROBERT H	ZEYER	2975 SEVERN DR	RENO	NV	89503
110301	2965	HARDING CIR	RENO	89503	DANA N	BOSLEY	2965 HARDING CIR	RENO	NV	89503
110302	2955	HARDING CIR	RENO	89503		O'BRIEN LIVING TRUST	2955 HARDING CIR	RENO	NV	89503
110303	2945	HARDING CIR	RENO	89503	LINDA	FELDMAN TRUST	4541 FELTON ST # 7	SAN DIEGO	CA	92116
110304	2935	HARDING CIR	RENO	89503	CHARLES P & CHERIE D	ADAMS	2935 HARDING CIR	RENO	NV	89503
110305	2925	HARDING CIR	RENO	89503	ERIKA & MATTHEW A	SHAUL	2544 E 125TH WAY	THORNTON	CO	80241
110306	2915	HARDING CIR	RENO	89503	MICHAEL P & SIERRA M	ARONSON	2915 HARDING CIR	RENO	NV	89503
110307	2505	SUNRAY DR	RENO	89503		WAHL FAMILY TRUST	PO BOX 8012	MAMMOTH LAKES	CA	93546
110308	2515	SUNRAY DR	RENO	89503	MARIA J	RAMOS et al	2515 SUNRAY DR	RENO	NV	89503
110309	2915	ANDREA ST	RENO	89503	J'NEAL	HACHQUET et al	2915 ANDREA ST	RENO	NV	89503
110310	2935	ANDREA ST	RENO	89503	HAMILTON H & NATALEE R	KIZER	2935 ANDREA ST	RENO	NV	89503
110311	2945	ANDREA ST	RENO	89503		SILVER BRIDGE LLC ANDREA SERIES	PO BOX 17414	RENO	NV	89511
110312	2965	ANDREA ST	RENO	89503	SHEILA A	FITZPATRICK	2965 ANDREA ST	RENO	NV	89503
110313	2975	ANDREA ST	RENO	89503	CRISTINA	RUSU	2975 ANDREA ST	RENO	NV	89503
110314	2995	ANDREA ST	RENO	89503	BRET T	PECORARO	2995 ANDREA ST	RENO	NV	89503
110401	2510	SUNRAY DR	RENO	89503	ALLISON C	PODNAR	2510 SUNRAY DR	RENO	NV	89503
110402	2865	HARDING WAY	RENO	89503	HUGH D	FONDER	2865 HARDING WAY	RENO	NV	89503
110403	2845	HARDING WAY	RENO	89503		DISCOVERY COVE TRUST	3445 SAN MATEO AVE	RENO	NV	89509
110404	2825	HARDING WAY	RENO	89503	THOR E & TRISCA G	ARVIDSON	2825 HARDING WAY	RENO	NV	89503
110405	2815	HARDING WAY	RENO	89503	TERRY W	FITCH et al	2815 HARDING WAY	RENO	NV	89503
110406	2505	BRYAN ST	RENO	89503		GEXIN WANG & MIN YANG LIVING TRUST	495 SYSONBY CT	RENO	NV	89521
110501	2800	HARDING WAY	RENO	89503	SHARLYN K	MAYEDA	2800 HARDING WAY	RENO	NV	89503
110502	2810	HARDING WAY	RENO	89503	ALEX W & ELIZABETH H	PIERSON	2810 HARDING WAY	RENO	NV	89503
110503	2820	HARDING WAY	RENO	89503	CAMERON	INDA	474 KUEHNIS DR	CAMPBELL	CA	95008
110504	2830	HARDING WAY	RENO	89503	ELIZABETH A	HARDING	2830 HARDING WAY	RENO	NV	89503
110505	2840	HARDING WAY	RENO	89503	ALBERT	TOBIASSON	3708 LAKESIDE DR STE 202	RENO	NV	89509
110506	2860	HARDING WAY	RENO	89503	PAUL	RIPLEY et al	1220 COLUSA DR	RENO	NV	89503
110507	2490	SUNRAY DR	RENO	89503	KEVIN E & JESSICA S	QUINN TRUST	PO BOX 1610	CORDOVA	AK	99574
110508	2865	SEVERN DR	RENO	89503		WOO FAMILY TRUST	15065 NAPOLEON DR	RENO	NV	89511
110509	2845	SEVERN DR	RENO	89503	MARY L	HAWKS LIVING TRUST	2845 SEVERN DR	RENO	NV	89503
110510	2825	SEVERN DR	RENO	89503		ATTINGER-SNARR LIVING TRUST	10415 W LYNX TRL	COEUR D ALENE	ID	83814
110511	2815	SEVERN DR	RENO	89503		DIEFENBACHER FAMILY TRUST	PO BOX 33561	RENO	NV	89533
110512	2805	SEVERN DR	RENO	89503		MEAD FAMILY TRUST	PO BOX 5554	RENO	NV	89513

111101	2700	SEVERN DR	RENO	89503	CYNTHIA R	FERRIS et al	2700 SEVERN DR	RENO	NV	89503
111102	2710	SEVERN DR	RENO	89503	IRENE M	SEELYE	2710 SEVERN DR	RENO	NV	89503
111103	2720	SEVERN DR	RENO	89503	TABITHA V	MAHER	2720 SEVERN DR	RENO	NV	89503
111104	2730	SEVERN DR	RENO	89503		NIEHAUS FAMILY 2015 TRUST	2730 SEVERN DR	RENO	NV	89503
111105	2740	SEVERN DR	RENO	89503		SIMS FAMILY TRUST	2740 SEVERN DR	RENO	NV	89503
111106	2750	SEVERN DR	RENO	89503	PETER	KOSTAN et al	2750 SEVERN DR	RENO	NV	89503
111107	2760	SEVERN DR	RENO	89503		PILCHER LIVING TRUST	2760 SEVERN DR	RENO	NV	89503
111108	2780	SEVERN DR	RENO	89503	JOHN J	RIGDON	2780 SEVERN DR	RENO	NV	89503
111109	2790	SEVERN DR	RENO	89503	JELANI T SR	SMITH et al	2790 SEVERN DR	RENO	NV	89503
111110	0	GULLING RD	RENO	89503		RENO CITY OF	PO BOX 1900	RENO	NV	89505
111111	3215	GULLING RD	RENO	89503		TRUCKEE MEADOWS WATER AUTHORITY	PO BOX 30013	RENO	NV	89520
111201	2785	SEVERN DR	RENO	89503	RANDALL C & SARA L	HALL	4163 FLORIDA CT	LIVERMORE	CA	94550
111202	2775	SEVERN DR	RENO	89503	BRADLEY F	ROMINE	2775 SEVERN DR	RENO	NV	89503
111203	2765	SEVERN DR	RENO	89503	GEORGE & STEPHANIE	WILKINSON et al	1275 OLD FOOTHILL RD S	GARDNERVILLE	NV	89460
111204	2755	SEVERN DR	RENO	89503	JOEY D	BINARD	2755 SEVERN DR	RENO	NV	89503
111205	2745	SEVERN DR	RENO	89503	IAN	SANTA CRUZ	308 CARENTAN RD	SEASIDE	CA	93955
111206	2735	SEVERN DR	RENO	89503	GARY W	SMITH	2735 SEVERN DR	RENO	NV	89503
111207	2725	SEVERN DR	RENO	89503	ALAN & LISA	HESS	2725 SEVERN DR	RENO	NV	89503
111208	2715	SEVERN DR	RENO	89503	ELIZABETH B	PATETA	2715 SEVERN DR	RENO	NV	89503
111209	2705	SEVERN DR	RENO	89503		STICE FAMILY TRUST	980 FERRIS DR	MINDEN	NV	89423
111210	2702	HARDING WAY	RENO	89503	JOSEPH I & LESLIE K	MOYA	749 PUTNAM DR	RENO	NV	89503
111211	2710	HARDING WAY	RENO	89503	JOSEPH E & STACY M	BARRAGAN	2710 HARDING WAY	RENO	NV	89503
111212	2722	HARDING WAY	RENO	89503	DELIA	RAMILO	560 CRANLEIGH DR	RENO	NV	89512
111213	2732	HARDING WAY	RENO	89503	JOHN	GERTZ	2732 HARDING WAY	RENO	NV	89503
111214	2742	HARDING WAY	RENO	89503	JAMES A	WILLIAMSON	2742 HARDING WAY	RENO	NV	89503
111215	2756	HARDING WAY	RENO	89503	ROBERT J & SUSAN C	CLOBUCKER TRUST	2756 HARDING WAY	RENO	NV	89503
111216	2766	HARDING WAY	RENO	89503		RAMOCIOTTI LIVING TRUST	2766 HARDING WAY	RENO	NV	89503
111217	2776	HARDING WAY	RENO	89503	COLLEEN L	ROGERS	2776 HARDING WAY	RENO	NV	89503
111218	2792	HARDING WAY	RENO	89503	RICHARD G & WENDY A	HUTCHINGS	2792 HARDING WAY	RENO	NV	89503
111304	2791	HARDING WAY	RENO	89503	JOHN B	SWARTZ	2791 HARDING WAY	RENO	NV	89503
111305	2781	HARDING WAY	RENO	89503	KRISTI G	BORACCHIA	1575 GEARY ST	RENO	NV	89503
111306	2771	HARDING WAY	RENO	89503	CHRIS M	CUNNINGHAM	2771 HARDING WAY	RENO	NV	89503
111307	2761	HARDING WAY	RENO	89503	GEORGE & DOREEN	CORTISSE FAMILY TRUST	2761 HARDING WAY	RENO	NV	89503
111308	2751	HARDING WAY	RENO	89503	DIANA	PFULLER	2751 HARDING WAY	RENO	NV	89503
111309	2741	HARDING WAY	RENO	89503	RYAN M	ROBNETT	2741 HARDING WAY	RENO	NV	89503
111310	2731	HARDING WAY	RENO	89503	NGOI D L & EMMANUEL W	QUINAIN	2731 HARDING WAY	RENO	NV	89503
111311	2721	HARDING WAY	RENO	89503	MIGUEL A & MARTA C	MARTIR	2721 HARDING WAY	RENO	NV	89503
111312	2711	HARDING WAY	RENO	89503	FELIX O & BRIDGET A	IGBEKOYI	2711 HARDING WAY	RENO	NV	89503
119012	0	MCCARRAN BLVD	RENO	89503		BOMB VOYAGE LLC	10575 DISCOVERY DR	LAS VEGAS	NV	89135
119014	0	MCCARRAN BLVD	RENO	89503		NEVADA STATE OF	1263 S STEWART ST	CARSON CITY	NV	89701
119015	0	GULLING RD	RENO	89503		RENO CITY OF	PO BOX 1900	RENO	NV	89505
119016	0	GULLING RD	RENO	89503		RENO CITY OF	PO BOX 1900	RENO	NV	89505
124101	2535	GELLERT DR	RENO	89503	KOLLIN S & KENDALL J	GEORGE	2535 GELLERT DR	RENO	NV	89503
124102	2565	GELLERT DR	RENO	89503	JOY C	KING	2565 GELLERT DR	RENO	NV	89503
124103	2595	GELLERT DR	RENO	89503	JANET N	DAVIS	2595 GELLERT DR	RENO	NV	89503
124104	2635	GELLERT DR	RENO	89503	ERIC T & JANELLE C	DYE	2635 GELLERT DR	RENO	NV	89503
124105	2645	GELLERT DR	RENO	89503		CASHELL FAMILY TRUST	1200 FINANCIAL BLVD	RENO	NV	89502
124106	2685	GELLERT DR	RENO	89503	BRIAN & JULIE	MERICA	1985 BLACK SAND DR	RENO	NV	89521
124107	2701	GELLERT DR	RENO	89503	JOHN	BESAW	2701 GELLERT DR	RENO	NV	89503
124108	2715	GELLERT DR	RENO	89503	MATTHEW & JENNIFER	STARK	2715 GELLERT DR	RENO	NV	89503
124109	2725	GELLERT DR	RENO	89503	ROSS	ALBRIGHT et al	4530 MOUNTAINGATE DR	RENO	NV	89519
124110	2745	GELLERT DR	RENO	89503	BRANDON B & JULIE K	SMITH	2745 GELLERT DR	RENO	NV	89503
124111	2755	GELLERT DR	RENO	89503	PATRICK S	TEBBUTT	2755 GELLERT DR	RENO	NV	89503
124112	2765	GELLERT DR	RENO	89503		THOMAS LIVING TRUST	2765 GELLERT DR	RENO	NV	89503
124113	2775	GELLERT DR	RENO	89503	JACKIE M	HAGER	2775 GELLERT DR	RENO	NV	89503
124114	1420	LOCKSLEY WAY	RENO	89503	BRIAN A	SORRELL	1420 LOCKSLEY WAY	RENO	NV	89503
124115	1430	LOCKSLEY WAY	RENO	89503		MEAD FAMILY TRUST	PO BOX 5554	RENO	NV	89513
124201	1435	LOCKSLEY WAY	RENO	89503	SAMARA W	WENTEN	1502 WASHINGTON AVE	BERKELEY	CA	94707
124202	1425	LOCKSLEY WAY	RENO	89503	MARY J	HARDIMAN	200 DESERT ROSE DR	SPARKS	NV	89441
124203	1401	LOCKSLEY WAY	RENO	89503	WILLIAM A JR & KELLEY A	DINKINS	1401 LOCKSLEY WAY	RENO	NV	89503
124204	2798	GELLERT DR	RENO	89503	HELEN E	O'BRIEN 2000 TRUST et al	4415 BRIDLE WAY	RENO	NV	89519
124205	2790	GELLERT DR	RENO	89503	HELEN E	O'BRIEN 2000 TRUST et al	4415 BRIDLE WAY	RENO	NV	89519
124206	2780	GELLERT DR	RENO	89503	MELANIE K	GUMP	2780 GELLERT DR	RENO	NV	89503

124207	2760	GELLERT DR	RENO	89503		AABEL FAMILY TRUST	1402 MARINER WY	ROHNERT PARK	CA	94928
124208	2750	GELLERT DR	RENO	89503	NANCY C	SAULT 2014 TRUST	2750 GELLERT DR	RENO	NV	89503
124209	2740	GELLERT DR	RENO	89503	BARBARA	MADER-SCHERRER	2740 GELLERT DR	RENO	NV	89503
124210	2720	GELLERT DR	RENO	89503	CHRISTINA P	FORD	2720 GELLERT DR	RENO	NV	89503
124211	2710	GELLERT DR	RENO	89503	GAIL M	FULCHER	2710 GELLERT DR	RENO	NV	89503
124212	2701	VAN BUREN DR	RENO	89503	AMANDA	KARVONEN	PO BOX 8963	TRUCKEE	CA	96162
124213	2735	VAN BUREN DR	RENO	89503		PTJ INVESTMENTS LLC	PO BOX 4860	KETCHUM	ID	83340
124214	2765	VAN BUREN DR	RENO	89503	ROBERT R	SEITZLER	2765 VAN BUREN DR	RENO	NV	89503
124215	2775	VAN BUREN DR	RENO	89503	KENNETH N & JANICE M	WISE	2775 VAN BUREN DR	RENO	NV	89503
124216	2801	VAN BUREN DR	RENO	89503	STEVEN F	GIBBONS et al	2801 VAN BUREN DR	RENO	NV	89503
124217	2825	VAN BUREN DR	RENO	89503		NGO-HAI FAMILY TRUST	3150 PLATTE RIVER DR	RENO	NV	89503
124218	2835	VAN BUREN DR	RENO	89503	TAYO	LARRIEU et al	2835 VAN BUREN DR	RENO	NV	89503
124219	2865	VAN BUREN DR	RENO	89503	MATTHEW S	GEYER	2865 VAN BUREN DR	RENO	NV	89503
124220	1410	EXETER WAY	RENO	89503	SHERRY	COOPS	1410 EXETER WAY	RENO	NV	89503
124221	1420	EXETER WAY	RENO	89503	SEAN M	REDMOND	1420 EXETER WAY	RENO	NV	89503
124222	1430	EXETER WAY	RENO	89503	STACEY & TIM	CROWLEY FAMILY TRUST	4265 PALOMINO CIR	RENO	NV	89519
124223	1440	EXETER WAY	RENO	89503	RONALD & PHYLLISS	FAGG TRUST	2005 HUMBOLDT ST	RENO	NV	89509
124224	1450	EXETER WAY	RENO	89503	JOHN P & DONNA M	BERA LIVING TRUST	1450 EXETER WAY	RENO	NV	89503
124225	1454	EXETER WAY	RENO	89503	JAMES R	ARNICH	1454 EXETER WAY	RENO	NV	89503
124226	1470	EXETER WAY	RENO	89503	JERE D & KAY L	MARBLE	106 LINDBERGH CT	DAYTON	NV	89403
124301	1465	EXETER WAY	RENO	89503	GUMERCINDO & REINA C	MALDONADO	1465 EXETER WAY	RENO	NV	89503
124313	2850	VAN BUREN DR	RENO	89503	TITO A	BONILLA-REYES	2850 VAN BUREN DR	RENO	NV	89503
124314	2830	VAN BUREN DR	RENO	89503		HANOVER PROPERTIES LLC SERIES FOUR	10423 ST JAMES PL	TRUCKEE	CA	96161
124315	2790	VAN BUREN DR	RENO	89503		O'NEILL FAMILY 2010 TRUST	1580 SCOTT VALLEY RD	RENO	NV	89523
124316	2780	VAN BUREN DR	RENO	89503	DAVID P	MATTHEWS et al	2780 VAN BUREN DR	RENO	NV	89503
124317	2760	VAN BUREN DR	RENO	89503	HAI VAN & SUE W	QUAN	6145 GREENBROOK DR	RENO	NV	89511
124318	2730	VAN BUREN DR	RENO	89503	NINA N	CAMPANARO	2730 VAN BUREN DR	RENO	NV	89503
124319	2700	VAN BUREN DR	RENO	89503	RONALD D III	COLEMAN et al	2700 VAN BUREN DR	RENO	NV	89503
124320	2701	KINGS ROW	RENO	89503	JERRY W & JULIA R	BUMPS	2701 KINGS ROW	RENO	NV	89503
124321	2735	KINGS ROW	RENO	89503	DEBORAH	NELSON et al	2735 KINGS ROW	RENO	NV	89503
124322	2745	KINGS ROW	RENO	89503		TAH 2018-1 BORROWER LLC	1508 BROOKHOLLOW DR	SANTA ANA	CA	92705
124323	2775	KINGS ROW	RENO	89503	DEBORA A	WRIGHT et al	2775 KINGS ROW	RENO	NV	89503
124324	2785	KINGS ROW	RENO	89503	ANA MARIE	MARQUEZ	2785 KINGS ROW	RENO	NV	89503
124401	1300	POLSON ST	RENO	89503	PETER	SCHUSTER	1300 POLSON ST	RENO	NV	89503
124402	1330	POLSON ST	RENO	89503		PELEAU TRUST	4282 MUIRWOOD CIR	RENO	NV	89509
124403	2690	VAN BUREN DR	RENO	89503	TIMOTHY A & RISHA L	SIMPSON	2690 VAN BUREN DR	RENO	NV	89503
124501	2415	VAN BUREN DR	RENO	89503	MICHAEL D	NELMS	2415 VAN BUREN DR	RENO	NV	89503
124502	2425	VAN BUREN DR	RENO	89503	KALI & JON	ERIKSEN	2425 VAN BUREN DR	RENO	NV	89503
124503	2475	VAN BUREN DR	RENO	89503	MAUREEN L	KELLY LIVING TRUST	2475 VAN BUREN DR	RENO	NV	89503
124504	2495	VAN BUREN DR	RENO	89503		KED PROPERTIES LLC	1805 PALISADE DR	RENO	NV	89509
124505	2535	VAN BUREN DR	RENO	89503	MIKE	GEMME	PO BOX 6612	RENO	NV	89513
124506	2565	VAN BUREN DR	RENO	89503	SOMNUK & AMY	PITAK	4735 HUNTER PEAK CT	ANTIOCH	CA	94531
124507	2601	VAN BUREN DR	RENO	89503	OSCAR H & ROXANA	ORTIZ	2601 VAN BUREN DR	RENO	NV	89503
124508	2635	VAN BUREN DR	RENO	89503	ALICIA M	FERRARO	2635 VAN BUREN DR	RENO	NV	89503
124509	1360	POLSON ST	RENO	89503	PHIL B	GURULE et al	1360 POLSON ST	RENO	NV	89503
124510	1390	POLSON ST	RENO	89503	MARGARITO	HERNANDEZ	517 BRINKBY AVE APT 807	RENO	NV	89509
124511	2640	GELLERT DR	RENO	89503	ANN	MITCHELL et al	2640 GELLERT DR	RENO	NV	89503
124512	2610	GELLERT DR	RENO	89503	KATIE	LINDSTROM	2610 GELLERT DR	RENO	NV	89503
124513	2600	GELLERT DR	RENO	89503	SYDNII	RAY	2600 GELLERT DR	RENO	NV	89503
124514	2570	GELLERT DR	RENO	89503	WILLIAM A JR & FIANNA B	SAXTON	2570 GELLERT DR	RENO	NV	89503
124515	2540	GELLERT DR	RENO	89503	JAMES W	BYRNE	2540 GELLERT DR	RENO	NV	89503
124516	2510	GELLERT DR	RENO	89503	GRETCHEN L	KELLY et al	790 BROOKFIELD DR	RENO	NV	89503
124517	2500	GELLERT DR	RENO	89503	THOMAS C & BARBARA A	RICH	2500 GELLERT DR	RENO	NV	89503
124518	1400	KIRKHAM WAY	RENO	89503	PETER A	TOMAINO TRUST	201 W MOANA LN	RENO	NV	89509
124519	1430	KIRKHAM WAY	RENO	89503		MINTER LLC	5151 KOMATITE CT	SPARKS	NV	89436
124520	1450	KIRKHAM WAY	RENO	89503	KATRINA M	PARISENA	1450 KIRKHAM WAY	RENO	NV	89503
126084	2505	KINGS ROW	RENO	89503		CORP OF PRES BISHOP CHURCH LDS	50 E NORTH TEMPLE	SALT LAKE CITY	UT	84150
137101			RENO	89503		NOT AVAILABLE	NOT SUPPLIED	NOT SUPPLIED	NV	00000
137102	2625	SCHOLL DR	RENO	89503	LEAH M & DANIEL	LEYVA	2625 SCHOLL DR	RENO	NV	89503
137103	2645	SCHOLL DR	RENO	89503	RAYMOND C & WHILMA N	HILLIS	2645 SCHOLL DR	RENO	NV	89503
137104	2665	SCHOLL DR	RENO	89503		BOYNTON FAMILY TRUST	17435 N 58TH ST	SCOTTSDALE	AZ	85254
137105	2695	SCHOLL DR	RENO	89503	SHERYN	LAPLUME LIVING TRUST	2695 SCHOLL DR	RENO	NV	89503
137106	2705	SCHOLL DR	RENO	89503	LEE C	AUSTIN TRUST	2705 SCHOLL DR	RENO	NV	89503

137107	2735	SCHOLL DR	RENO	89503	RICHARD A JR	CAMERON	PO BOX 10732	RENO	NV	89503
137108	2765	SCHOLL DR	RENO	89503	IVAN D	PEREZ	2765 SCHOLL DR	RENO	NV	89503
137201	1450	LOCKSLEY WAY	RENO	89503	CHELSEY M & AUSTIN A	MILLER	1450 LOCKSLEY WAY	RENO	NV	89503
137202	1460	LOCKSLEY WAY	RENO	89503		MDR PROPERTIES LLC	790 WILD HAWK DR	SPARKS	NV	89436
137203	1480	LOCKSLEY WAY	RENO	89503	DANIEL C	ROCOVITS et al	1480 LOCKSLEY WAY	RENO	NV	89503
137204	1490	LOCKSLEY WAY	RENO	89503	PAMELA M	MITCHELL TRUST	1490 LOCKSLEY WAY	RENO	NV	89503
137205	2700	SCHOLL DR	RENO	89503	VIRGINIA F	BEAR TRUST	2001 DIPINTO AVE	HENDERSON	NV	89052
137206	2680	VALMAR PL	RENO	89503	JOHN D	FLEMING LIVING TRUST	2680 VALMAR PL	RENO	NV	89503
137207	2670	VALMAR PL	RENO	89503	KYLE	ANDERSON et al	2670 VALMAR PL	RENO	NV	89503
137208	2650	VALMAR PL	RENO	89503	KATHERINE A	MCCARTHY	2650 VALMAR PL	RENO	NV	89503
137209	2630	VALMAR PL	RENO	89503	JAMES A & SONYA L	VASQUEZ	3793 PROSPECT DR	CARSON CITY	NV	89703
137210	2610	VALMAR PL	RENO	89503	FRANK SR	LAWSON	2610 VALMAR PL	RENO	NV	89503
137211	2600	VALMAR PL	RENO	89503	TIAN-TWU	HSIEH et al	1401 EXETER	RENO	NV	89503
137212	2590	VALMAR PL	RENO	89503	DUNG T & SHUI Y	LEUNG	PO BOX 901	RENO	NV	89504
137213	2580	VALMAR PL	RENO	89503	RODGER & LORA	STONE	2955 OUTLOOK DR	RENO	NV	89509
137214	2560	VALMAR PL	RENO	89503	DAVID L	GEORGE et al	2560 VALMAR PL	RENO	NV	89503
137215	2550	VALMAR PL	RENO	89503	GARY W & PATRICIA G	OEHLERT	885 MEADOW SPRINGS DR	RENO	NV	89509
137216	2540	VALMAR PL	RENO	89503	L & K	KOLBET TRUST	2540 VALMAR PL	RENO	NV	89503
137217	2530	VALMAR PL	RENO	89503	HOWARD L & PEGGY L	TUNE	2530 VALMAR PL	RENO	NV	89503
137218	2520	VALMAR PL	RENO	89503	CHARLENE K	SULLIVAN LIVING TRUST	2520 VALMAR PL	RENO	NV	89503
137219	2500	VALMAR PL	RENO	89503	BRYTON	LEWIS	2500 VALMAR PL	RENO	NV	89503
137301	1460	KIRKHAM WAY	RENO	89503	PHILIP S	BARBER FAMILY TRUST	1460 KIRKHAM WAY	RENO	NV	89503
137302	1470	KIRKHAM WAY	RENO	89503	ERIKA M	NIELSEN et al	1470 KIRKHAM WAY	RENO	NV	89503
137303	1480	KIRKHAM WAY	RENO	89503	TERRY J	PETERSON	1480 KIRKHAM WAY	RENO	NV	89503
137304	1490	KIRKHAM WAY	RENO	89503		MLT INVESTMENTS LLC	316 CALIFORNIA AVE # 17	RENO	NV	89509
137401	2505	VALMAR PL	RENO	89503	JOAN A	MULLER	2505 VALMAR PL	RENO	NV	89503
137402	2515	VALMAR PL	RENO	89503	DAVID M & DARLARAE A	MONROE	2515 VALMAR PL	RENO	NV	89503
137403	2525	VALMAR PL	RENO	89503	SCHOLASTIKA M & CHARLES M	MUTISYA	PO BOX 9244	RENO	NV	89507
137404	2535	VALMAR PL	RENO	89503	LOREN S	STALEY et al	2535 VALMAR PL	RENO	NV	89503
137405	2555	VALMAR PL	RENO	89503	GERALD L & DIANE M	FRANZEN	2555 VALMAR PL	RENO	NV	89503
137406	2575	VALMAR PL	RENO	89503	CURTIS J	RISLEY et al	2575 VALMAR PL	RENO	NV	89503
137407	2595	VALMAR PL	RENO	89503	PAUL & JANELLE	ZAHTILLA FAMILY TRUST	2595 VALMAR PL	RENO	NV	89503
137408	2605	VALMAR PL	RENO	89503	MARILYN I	ARNOLD	6036 CITATION CT	RENO	NV	89523
137409	2615	VALMAR PL	RENO	89503	PEGGY	SCHWEIKERT	2615 VALMAR PL	RENO	NV	89503
137410	2675	VALMAR PL	RENO	89503	ANNA M	OUTLAND TRUST	2675 VALMAR PL	RENO	NV	89503
137411	2685	VALMAR PL	RENO	89503	RANDY S	LUNAK	2685 VALMAR PL	RENO	NV	89503
137412	2630	SCHOLL DR	RENO	89503	HUNTER	NOBLE et al	2630 SCHOLL DR	RENO	NV	89503
137413	2600	SCHOLL DR	RENO	89503	SARA	HUNT et al	2600 SCHOLL DR	RENO	NV	89503
137414	2560	SEVERN DR	RENO	89503		HSU FAMILY TRUST	2851 SAGE RIDGE DR	RENO	NV	89509
137415	2550	SEVERN DR	RENO	89503	UFFE & SHEILA D	NIELSEN	2550 SEVERN DR	RENO	NV	89503
137416	2540	SEVERN DR	RENO	89503	SUSAN M	DIXON	2540 SEVERN DR	RENO	NV	89503
137417	2530	SEVERN DR	RENO	89503		JHM FAMIL TRUST	1885 CALLOWAY CIR	AUBURN	CA	95603
137418	2510	SEVERN DR	RENO	89503	KATHLEEN	FRAZIER	2510 SEVERN DR	RENO	NV	89503
137419	2500	SEVERN DR	RENO	89503	MARY	BARKER	1412 WESSEX CIR	RENO	NV	89503
137501	2670	SEVERN DR	RENO	89503	ANDREA K & JESSE K	NORTHROP	2670 SEVERN DR	RENO	NV	89503
137502	2680	SEVERN DR	RENO	89503	DAVID & PATRICIA	HALTERMAN	775 PORTO MIO WAY	LAS VEGAS	NV	89138
137503	2690	SEVERN DR	RENO	89503	GARY	HAMMERSMITH	2690 SEVERN DR	RENO	NV	89503
137504	0	SEVERN DR	RENO	89503		RENO CITY OF	PO BOX 1900	RENO	NV	89505
138302	1495	EXETER WAY	RENO	89503	MAX H	HATCH	1495 EXETER WAY	RENO	NV	89503
138303	1485	EXETER WAY	RENO	89503	DAVID A	KELLY	1485 EXETER WAY	RENO	NV	89503
138304	1475	EXETER WAY	RENO	89503	JANE	GAMMEL 2017 TRUST	1475 EXETER WAY	RENO	NV	89503
138401	1480	EXETER WAY	RENO	89503	DONALD H & SUSAN E	OLSON	1480 EXETER WAY	RENO	NV	89503
138402	1484	EXETER WAY	RENO	89503	STACEY L	BONZER	1484 EXETER WAY	RENO	NV	89503
138403	1490	EXETER WAY	RENO	89503	CATHERINE J	RAIL	1490 EXETER WAY	RENO	NV	89503
138404	2800	SCHOLL DR	RENO	89503	CHRISTIAN G	BOLANOS et al	2800 SCHOLL DR	RENO	NV	89503
138405	1475	LOCKSLEY WAY	RENO	89503	LOGAN E	FOLEY	1475 LOCKSLEY WAY	RENO	NV	89503
138406	1455	LOCKSLEY WAY	RENO	89503	ROGER A & JACQUELINE K	PORTS	1455 LOCKSLEY WAY	RENO	NV	89503
138407	1445	LOCKSLEY WAY	RENO	89503	BETTE H	HEATH	1445 LOCKSLEY WAY	RENO	NV	89503
138501	2795	SCHOLL DR	RENO	89503	KYLIE	KEENAN et al	2795 SCHOLL DR	RENO	NV	89503
138502	2805	SCHOLL DR	RENO	89503	LEATH M	HAYDEN 2018 TRUST	2805 SCHOLL DR	RENO	NV	89503
138503	2835	SCHOLL DR	RENO	89503	GREGORY R & WILMA J	HOWE	3075 SOCRATES DR	RENO	NV	89512
138504	2865	SCHOLL DR	RENO	89503		FORTUNE RENO PROPERTIES LLC	PO BOX 34541	RENO	NV	89533
138505	2895	SCHOLL DR	RENO	89503	RICHARD & DALE	TAMBELLINI TRUST	1552 MARSEILLE LN	ROSEVILLE	CA	95747

138506	2905	SCHOLL DR	RENO	89503	JEFFREY S & LILA J	SPRINGER	6645 SW NYBERG LN	TUALATIN	OR	97062
139101	1555	WYOMING AVE	RENO	89503	CAROL J	DUSEK	1555 WYOMING AVE	RENO	NV	89503
139102	1535	WYOMING AVE	RENO	89503	ANDREW S & ANNETTE E	ROTHMAN	40 MEMORY CIR	RENO	NV	89509
139103	2401	VAN BUREN DR	RENO	89503	CHARLES B & CARLY	CRONIN	2401 VAN BUREN DR	RENO	NV	89503
139104	2405	VAN BUREN DR	RENO	89503	RICK W & LORRIE K	EDNEY	20 MILLER RIDGE RD	WELLINGTON	NV	89444
139105	2411	VAN BUREN DR	RENO	89503	DAVID & AMBER	RODRIGUEZ	2411 VAN BUREN DR	RENO	NV	89503
139201	2406	VAN BUREN DR	RENO	89503	ISIDRO & CLAUDIA	NAVA	2406 VAN BUREN DR	RENO	NV	89503
139202	1485	WYOMING AVE	RENO	89503	JOSEPH R & GLENNYS A	FEAZEL	1485 WYOMING AVE	RENO	NV	89503
139308	1490	WYOMING AVE	RENO	89503	JENNIFER	EDWARDS	1490 WYOMING AVE	RENO	NV	89503
139314	2385	VAN BUREN CT	RENO	89503	MARVIN L & DEANNA M	SMALL	10635 SUMMER GLEN DR	RENO	NV	89521
139315	1540	WYOMING AVE	RENO	89503	ROBERT J	DOYLE	1540 WYOMING AVE	RENO	NV	89503
139325	1558	WYOMING CT	RENO	89503	DANIEL M	MCKEE	1558 WYOMING CT	RENO	NV	89503
139326	1560	WYOMING CT	RENO	89503	RAYMON D & CINDY	FOOTE	1675 PINECREST CT	RENO	NV	89523
139331	1561	WYOMING CT	RENO	89503	WILLIAM E	BARSTYS TRUST	1561 WYOMING CT	RENO	NV	89503
140101	2450	SEVERN DR	RENO	89503	MELVIN	GOOD	2450 SEVERN DR	RENO	NV	89503
140102	1595	BOYER CT	RENO	89503	JONATHAN D & HILARY M	SHIPMAN	1595 BOYER CT	RENO	NV	89503
140103	1585	BOYER CT	RENO	89503		325 WEST LIBERTY LLC	540 CITADEL WAY	RENO	NV	89503
140104	1575	BOYER CT	RENO	89503	HOWARD J & SHEILA M	MICHAELS	1575 BOYER CT	RENO	NV	89503
140105	1565	BOYER CT	RENO	89503		GOODWIN FAMILY 2011 TRUST	PO BOX 398	CEDARVILLE	CA	96104
140106	1555	BOYER CT	RENO	89503	S	STOPPER LIVING TRUST	1555 BOYER CT	RENO	NV	89503
140107	1545	BOYER CT	RENO	89503		DICKERSON FAMILY TRUST	1545 BOYER CT	RENO	NV	89503
140108	1540	BOYER CT	RENO	89503	JERICA	HARASYMCHUK	1540 BOYER CT	RENO	NV	89503
140109	1550	BOYER CT	RENO	89503	BEVERLY C	JOHNSON	1550 BOYER CT	RENO	NV	89503
140110	1560	BOYER CT	RENO	89503	MATTHEW S	SNYDER	1560 BOYER CT	RENO	NV	89503
140111	1580	BOYER CT	RENO	89503		ET TRUST	538 SANTA MARGUARITA DR	APTOS	CA	95003
140112	1595	WYOMING AVE	RENO	89503	CECELIA A	NICHOLS	1595 WYOMING AVE	RENO	NV	89503
140113	1585	WYOMING AVE	RENO	89503	DAVID M JR	MIDDLETON LIVING TRUST	1585 WYOMING AVE	RENO	NV	89503
140114	1565	WYOMING AVE	RENO	89503	LISA R & JOSEPH D G	METZGAR	1565 WYOMING AVE	RENO	NV	89503
140201	1795	WYOMING AVE	RENO	89503	TORREY B & ROSEMARY W	CARROLL	PO BOX 4196	CRESTED BUTTE	CO	81224
140202	1775	WYOMING AVE	RENO	89503	JESUS D	RIVAS et al	1775 WYOMING AVE	RENO	NV	89503
140203	1765	WYOMING AVE	RENO	89503	MEGAN E	WOOD et al	1765 WYOMING AVE	RENO	NV	89503
140204	1755	WYOMING AVE	RENO	89503	EVGENY & TATIANA	SOKOLOVA	2210 THOMAS JEFFERSON DR	RENO	NV	89509
140205	1725	WYOMING AVE	RENO	89503	THOMAS H	ENGLISH	1725 WYOMING AVE	RENO	NV	89503
140206	1695	WYOMING AVE	RENO	89503		TAH 2018-1 BORROWER LLC	1508 BROOKHOLLOW DR	SANTA ANA	CA	92705
140207	1665	WYOMING AVE	RENO	89503	AMY S	TAYLOR	1665 WYOMING AVE	RENO	NV	89503
140208	1645	WYOMING AVE	RENO	89503	SAMUEL G	DUNER	1645 WYOMING AVE	RENO	NV	89503
140209	1625	WYOMING AVE	RENO	89503		O'BRIEN FAMILY TRUST	PO BOX 662	TAHOE CITY	CA	96145
140210	2405	SEVERN DR	RENO	89503	JOHN M & KATHERINE H	KELLY	PO BOX 5711	RENO	NV	89513
140211	1720	BECKY CT	RENO	89503	MARIANNE I	HODGE FAMILY TRUST	1720 BECKY CT	RENO	NV	89503
140212	1730	BECKY CT	RENO	89503	PATRICK J	FITZGERALD LIVING TRUST	305 W MOANA LN STE C	RENO	NV	89509
140213	1750	BECKY CT	RENO	89503	JACOB J & JANELLE B	WILDSCHUT	1750 BECKY CT	RENO	NV	89503
140214	1780	BECKY CT	RENO	89503	NICK & LINDA	ANDERSON FAMILY TRUST	1780 BECKY CT	RENO	NV	89503
140215	1790	BECKY CT	RENO	89503	PATRICK L	CAMPBELL	1790 BECKY CT	RENO	NV	89503
140216	1815	BECKY CT	RENO	89503	JONAS & JESSICA	BUCHHOLZ	1815 BECKY CT	RENO	NV	89503
140217	1835	BECKY CT	RENO	89503	THOMAS E	HAWKINS	1835 BECKY CT	RENO	NV	89503
140218	1855	BECKY CT	RENO	89503	GEORGE O	KOHL	1855 BECKY CT	RENO	NV	89503
140219	1875	BECKY CT	RENO	89503	VICTOR M	LEONARDI	3778 SPITZE DR	LAS VEGAS	NV	89103
140220	1885	BECKY CT	RENO	89503	BRANDON J	MORALES	1885 BECKY CT	RENO	NV	89503
140221	1895	BECKY CT	RENO	89503	NANCY S	STEVENS	1895 BECKY CT	RENO	NV	89503
140222	1880	BECKY CT	RENO	89503	DARBY	MEYER et al	12550 STILLWATER WAY	RENO	NV	89511
140223	1870	BECKY CT	RENO	89503		WARREN FAMILY TRUST	1870 BECKY CT	RENO	NV	89503
140224	1765	BECKY CT	RENO	89503	RUTH J	EACHUS FAMILY TRUST	1765 BECKY CT	RENO	NV	89503
140225	1745	BECKY CT	RENO	89503		VINCI FAMILY TRUST	1745 BECKY CT	RENO	NV	89503
146101	3001	SKY COUNTRY DR	RENO	89503	DAVID & JANE	ROBERTI LIVING TRUST	PO BOX 917	LOYALTON	CA	96118
146107	3011	SKY COUNTRY DR	RENO	89503	BONIFACIO & SILVERIA	BUSTARDE	3011 SKY COUNTRY DR	RENO	NV	89503
146108	3021	SKY COUNTRY DR	RENO	89503	ALAN	COGHLAN	3021 SKY COUNTRY DR	RENO	NV	89503
146109	3031	SKY COUNTRY DR	RENO	89503	PETER	MIKHALEV et al	6800 CHESTERFIELD LN	RENO	NV	89523
146110	3041	SKY COUNTRY DR	RENO	89503	DOMINGO Y	PINEDA et al	3041 SKY COUNTRY DR	RENO	NV	89503
146201	3305	BIG SKY DR	RENO	89503		CHARDI KALAA CORP	7245 SOUVERAIN LN	RENO	NV	89506
146202	3315	BIG SKY DR	RENO	89503	JESSIE N	YEAGER	PO BOX 625	VERDI	NV	89439
146203	3325	BIG SKY DR	RENO	89503	JASON A	THOMPSON et al	3325 BIG SKY DR	RENO	NV	89503
146204	3335	BIG SKY DR	RENO	89503	CHRISTOPHER J & AMANDA G	LACROIX	3335 BIG SKY DR	RENO	NV	89503
146205	3355	BIG SKY DR	RENO	89503	MAJOR S & RAJINDER K	BOUGHAN	3355 BIG SKY DR	RENO	NV	89503

146306	3350	BIG SKY DR	RENO	89503	JAMLONG	SRIPHONGNGARM et al	3350 BIG SKY DR	RENO	NV	89503
146307	3340	BIG SKY DR	RENO	89503	JOSE S & MARIA J	RODRIGUEZ	3340 BIG SKY DR	RENO	NV	89503
146308	3330	BIG SKY DR	RENO	89503	CHARLES S V B	WAGEMANS	3330 BIG SKY DR	RENO	NV	89503
146309	3320	BIG SKY DR	RENO	89503		SINGH FAMILY TRUST	3320 BIG SKY DR	RENO	NV	89503
146310	3310	BIG SKY DR	RENO	89503	LORENZO	TRIMBLE	3310 BIG SKY DR	RENO	NV	89503
146311	3300	BIG SKY DR	RENO	89503	FRED S	NAVARRO et al	3300 BIG SKY DR	RENO	NV	89503
147102	3020	SEVERN DR	RENO	89503	PAMELA C	FITCH	3020 SEVERN DR	RENO	NV	89503
147103	3030	SEVERN DR	RENO	89503	AARON M	WOOD et al	3030 SEVERN DR	RENO	NV	89503
147104	3040	SEVERN DR	RENO	89503	ELIZABETH K	BRACKETT 1990 TRUST	3380 BELFORD RD	RENO	NV	89509
147105	3050	SEVERN DR	RENO	89503	ANTHONY E	WALKER	3050 SEVERN DR	RENO	NV	89503
147106	3060	SEVERN DR	RENO	89503	GARY L	MAY	3060 SEVERN DR	RENO	NV	89503
147107	3070	SEVERN DR	RENO	89503	CAROL	WRIGHT TRUST	3070 SEVERN DR	RENO	NV	89503
147108	3080	SEVERN DR	RENO	89503	BRANDON A	DREELAN	3080 SEVERN DR	RENO	NV	89503
147109	4045	ANDREA ST	RENO	89503		EMERSON-BOATNER FAMILY TRUST	4045 ANDREA ST	RENO	NV	89503
147110	4035	ANDREA ST	RENO	89503		DOONAN TRUST	4035 ANDREA ST	RENO	NV	89503
147111	4025	ANDREA ST	RENO	89503	PATRICK S	DOLAN et al	4025 ANDREA ST	RENO	NV	89503
147112	4015	ANDREA ST	RENO	89503		CLIFFHOUSE INVESTMENTS LLC	16771 SOUTHVIEW DR	PIONEER	CA	95666
147113	4005	ANDREA ST	RENO	89503	ANTONIO E & MARIA L	DE LA TORRE	4005 ANDREA ST	RENO	NV	89503
147114	3095	ANDREA ST	RENO	89503	JOSHUA	KEMP	3095 ANDREA ST	RENO	NV	89503
147115	3085	ANDREA ST	RENO	89503	SUSAN C	STOTLER	3085 ANDREA ST	RENO	NV	89503
147116	3075	ANDREA ST	RENO	89503	JOANNE C	TYSON FAMILY TRUST	2601 BURR CT	RENO	NV	89509
147117	3065	ANDREA ST	RENO	89503	ADAM M	AUERBACH TRUST	2075 ROCK HAVEN DR	RENO	NV	89511
147118	3055	ANDREA ST	RENO	89503	MARK D	MIDDLETON	5637 ADOBE RD	ROCKLIN	CA	95765
147119	3045	ANDREA ST	RENO	89503	CHERRY A	CASTILLO et al	11360 TORINO WAY	RENO	NV	89521
147120	3035	ANDREA ST	RENO	89503	WARNER W	WHIPPLE	975 5TH ST	ELKO	NV	89801
147121	3025	ANDREA ST	RENO	89503	BRADLEY J & KIMBERLY	WASS	3025 ANDREA ST	RENO	NV	89503
147122	3015	ANDREA ST	RENO	89503	FEDERICO	LIM	PO BOX 6172	RENO	NV	89513
147123	3005	ANDREA ST	RENO	89503	MICHAEL & MICHELLE	MOODY	3005 ANDREA ST	RENO	NV	89503
147125	3010	SEVERN DR	RENO	89503	DAVID F & CHELSEA H	MAYNARD	3010 SEVERN DR	RENO	NV	89503
147301	2490	SERENA DR	RENO	89503	DAVID & CHARLENE	KANAK LIVING TRUST	100 STERLING OAKS DR APT 244	CHICO	CA	95928-9461
147302	2478	SERENA DR	RENO	89503	JEANNIE S	SELIM 2015 LIVING TRUST	2478 SERENA DR	RENO	NV	89503
147303	2466	SERENA DR	RENO	89503	DONALD J & KATHLEEN J	BEATY	12484 STONY CREEK CT	TRUCKEE	CA	96161
147304	2452	SERENA DR	RENO	89503	KATELYNN	MASON	2452 SERENA DR	RENO	NV	89503
147305	2440	SERENA DR	RENO	89503	THOMAS J	GORDON	2440 SERENA DR	RENO	NV	89503
147306	2428	SERENA DR	RENO	89503	ALAN & EUPHEMIA M	WRIGHT	2428 SERENA DR	RENO	NV	89503
147307	2416	SERENA DR	RENO	89503	DANA J	JULIAN	2416 SERENA DR	RENO	NV	89503
147308	2404	SERENA DR	RENO	89503		EMERALD SAGE LLC	2885 SANFORD AVE SW # 20562	GRANDVILLE	MI	49418
147401	2405	SERENA DR	RENO	89503	JASON & SANDY	HAGGERTY	2405 SERENA DR	RENO	NV	89503
147402	2417	SERENA DR	RENO	89503		NOBLE LIVING TRUST	2417 SERENA DR	RENO	NV	89503
147403	2429	SERENA DR	RENO	89503	PHILIP A	SHARP	2429 SERENA DR	RENO	NV	89503
147404	2441	SERENA DR	RENO	89503	ROBERT A & TAYLOR C	SEARS et al	2441 SERENA DR	RENO	NV	89503
147405	2453	SERENA DR	RENO	89503	DAVID R	SPEGAL	2453 SERENA DR	RENO	NV	89503
147406	2467	SERENA DR	RENO	89503		BARAKAT LIVING TRUST	695-825 GOLD RUN RD	SUSANVILLE	CA	96130
147407	2479	SERENA DR	RENO	89503	DUSTIN W	MILLS	2479 SERENA DR	RENO	NV	89503
147408	4010	ANDREA ST	RENO	89503	TERRENCE	SPAMPANATO	2855 SAGITTARIUS DR	RENO	NV	89509
147409	4020	ANDREA ST	RENO	89503		VERBURG-USELMAN FAMILY 2019 TRUST	4020 ANDREA ST	RENO	NV	89503
147410	4030	ANDREA ST	RENO	89503	JUAN & ELVIA	SANCHEZ	4030 ANDREA ST	RENO	NV	89503
147411	4040	ANDREA ST	RENO	89503		SEMPRE INSIEME TRUST	PO BOX 5548	FALLON	NV	89407
148101	3290	SNAKE RIVER DR	RENO	89503		RENO CITY OF	PO BOX 1900	RENO	NV	89505
149101	3101	PLATTE RIVER DR	RENO	89503	IQBAL S	SIDHU	3101 PLATTE RIVER DR	RENO	NV	89503
149201	3100	PLATTE RIVER DR	RENO	89503	KEVIN T	SHOEMAKER	3100 PLATTE RIVER DR	RENO	NV	89503
149202	3071	SKY COUNTRY DR	RENO	89503	SUNNY & TU	NGUYEN	3071 SKY COUNTRY DR	RENO	NV	89503
149203	3081	SKY COUNTRY DR	RENO	89503	VINHSONHAI	LUAN et al	3081 SKY COUNTRY DR	RENO	NV	89503
149301	3303	SNAKE RIVER DR	RENO	89503	VIRGILIO D	VALLO	3303 SNAKE RIVER DR	RENO	NV	89503
149302	3311	SNAKE RIVER DR	RENO	89503	SHAHZAD	AHMAD	6700 KISKADEE DR	SPARKS	NV	89436
149303	3327	SNAKE RIVER DR	RENO	89503	MARK S & JOYCE E	LARSEN	3327 SNAKE RIVER DR	RENO	NV	89503
149406	3326	SNAKE RIVER DR	RENO	89503	MONICA N	SALLIOTTE et al	3326 SNAKE RIVER DR	RENO	NV	89503
149407	3318	SNAKE RIVER DR	RENO	89503	JOSE L & AIDA	ARIAS	3318 SNAKE RIVER DR	RENO	NV	89503
149408	3310	SNAKE RIVER DR	RENO	89503		BENSON LIVING TRUST	3310 SNAKE RIVER DR	RENO	NV	89503
149409	3302	SNAKE RIVER DR	RENO	89503	LAP T	PHAN et al	3302 SNAKE RIVER DR	RENO	NV	89503
150101	3061	GREEN RIVER CT	RENO	89503	DENAE	GRANGER et al	3061 GREEN RIVER CT	RENO	NV	89503
150102	3071	GREEN RIVER CT	RENO	89503	RICHARD J & DE ANNA J	ZUNINO	3071 GREEN RIVER CT	RENO	NV	89503
150103	3081	GREEN RIVER CT	RENO	89503	SYDNEY	SIMAS et al	3081 GREEN RIVER CT	RENO	NV	89503

150104	3091	GREEN RIVER CT	RENO	89503	ALVIN T & MARISSA J	VU	1547 PRINCETON DR	SAN JOSE	CA	95118
150105	3101	GREEN RIVER DR	RENO	89503	BRIAN M & CASEY M	FLEISCHER	3101 GREEN RIVER DR	RENO	NV	89503
150106	3111	GREEN RIVER DR	RENO	89503	ARNOLD C	LEONG TRUST	3111 GREEN RIVER DR	RENO	NV	89503
150107	3121	GREEN RIVER DR	RENO	89503	STEVE	HIGLEY	3121 GREEN RIVER DR	RENO	NV	89503
150108	3131	GREEN RIVER DR	RENO	89503	ROBIN	BUTLER	3131 GREEN RIVER DR	RENO	NV	89503
150204	3140	GREEN RIVER DR	RENO	89503	BRUCE S & BARBARA D	HARPER TRUST	3140 GREEN RIVER DR	RENO	NV	89503
150205	3130	GREEN RIVER DR	RENO	89503	NERIO C & ANICETA D	GALIMA	3130 GREEN RIVER DR	RENO	NV	89503
150206	3120	GREEN RIVER DR	RENO	89503	ENRIQUETA	CORONA-MEDEROS	1344 S WELLS AVE	RENO	NV	89502
150207	3110	GREEN RIVER DR	RENO	89503	ROLAND E	MANABAT et al	3110 GREEN RIVER DR	RENO	NV	89503
150208	3100	GREEN RIVER DR	RENO	89503	BRIAN R & BARBARA J	COLLIER	3100 GREEN RIVER DR	RENO	NV	89503
150209	3111	PLATTE RIVER DR	RENO	89503	JEFFREY S & MARIA T M	SINOCRUZ	3111 PLATTE RIVER DR	RENO	NV	89503
150210	3121	PLATTE RIVER DR	RENO	89503	ADRIENNE R	PETERSEN	3121 PLATTE RIVER DR	RENO	NV	89503
150211	3131	PLATTE RIVER DR	RENO	89503	NOEL L & ELEANOR G	MONZON	3131 PLATTE RIVER DR	RENO	NV	89503
150212	3141	PLATTE RIVER DR	RENO	89503		PURDY TRUST	3141 PLATTE RIVER DR	RENO	NV	89503
150303	3140	PLATTE RIVER DR	RENO	89503		PHILLIPS TRUST	3140 PLATTE RIVER DR	RENO	NV	89503
150304	3130	PLATTE RIVER DR	RENO	89503	DANNY L & DEBRA L	FOSTER	3130 PLATTE RIVER DR	RENO	NV	89503
150305	3120	PLATTE RIVER DR	RENO	89503	CRISTINA	TURCAN	3120 PLATTE RIVER DR	RENO	NV	89503
150306	3110	PLATTE RIVER DR	RENO	89503	RAYMOND L & DEBRA G	POLAK	3110 PLATTE RIVER DR	RENO	NV	89503
150307	3091	SKY COUNTRY DR	RENO	89503	MARSHA H	LEE	3091 SKY COUNTRY DR	RENO	NV	89503
150308	3101	SKY COUNTRY DR	RENO	89503	DAVID G & KATHY W	REID	3101 SKY COUNTRY DR	RENO	NV	89503
150402	3110	SKY COUNTRY DR	RENO	89503	PATRICK & JANET	HAMILL LIVING TRUST	3110 SKY COUNTRY DR	RENO	NV	89503
150501	3080	GREEN RIVER CT	RENO	89503	STEVEN M	GHIGLIERI	880 KIRMAN AVE	RENO	NV	89502
150502	3070	GREEN RIVER CT	RENO	89503	CARINA A	BLACK	3070 GREEN RIVER CT	RENO	NV	89503
150503	3060	GREEN RIVER CT	RENO	89503	JAMES S	DUTHIE	3060 GREEN RIVER CT	RENO	NV	89503
161001										
161002										
161004										
161005										
161301										
202014	0	MCCARRAN BLVD	RENO	89503		CHARDI KALAA CORPORATION	7245 SOUVERAIN LN	RENO	NV	89506
202015	300	MCCARRAN BLVD	WASHOE COUNTY	89503		WASHOE COUNTY	1001 E 9TH ST BLDG A	RENO	NV	89512
202017	0	MCCARRAN BLVD	WASHOE COUNTY	89503		WASHOE COUNTY	1001 E 9TH ST BLDG A	RENO	NV	89512
202019	0	KEYSTONE AVE	RENO	89503		CHARDI KALAA CORPORATION	7245 SOUVERAIN LN	RENO	NV	89506
202020	0	KEYSTONE AVE	RENO	89503		RENO CITY OF	PO BOX 1900	RENO	NV	89505
202021	0	MCCARRAN BLVD	RENO	89503		LEADERSHIP MASTER LLC	11890 DONNER PASS RD # 4	TRUCKEE	CA	96161
202022	0	MCCARRAN BLVD	RENO	89503		LEADERSHIP MASTER LLC	11890 DONNER PASS RD # 4	TRUCKEE	CA	96161
207107	2315	COTTAGE CT	RENO	89503	KEVIN	SAWYER et al	2315 COTTAGE CT	RENO	NV	89503
207108	1720	PEAVINE RD	RENO	89503	LEROY G	DRACE	1720 PEAVINE RD	RENO	NV	89503
207109	1740	PEAVINE RD	RENO	89503	BRANDON	CARLSON	1740 PEAVINE RD	RENO	NV	89503
207110	1750	PEAVINE RD	RENO	89503	GLENN & PATRICIA	MELOSH FAMILY TRUST	2685 SUNRISE AVE	SANTA ROSA	CA	95409
207201	1745	PEAVINE RD	RENO	89503		SLAGLE FAMILY TRUST	1745 PEAVINE RD	RENO	NV	89503
207202	1735	PEAVINE RD	RENO	89503	ROXANNE D	BROWN TRUST et al	PO BOX 6534	RENO	NV	89513
207203	1725	PEAVINE RD	RENO	89503	ANDREW V	HANKS	1725 PEAVINE RD	RENO	NV	89503
207204	1715	PEAVINE RD	RENO	89503		DIGENAN FAMILY TRUST	201 SKYLINE DR	ELKO	NV	89801
207205	1705	PEAVINE RD	RENO	89503	LINDA D	METZGER	11524 DEODAR WAY	RENO	NV	89506
207206	1695	PEAVINE RD	RENO	89503	WALTER JR & CHRISTINA	CAMARENA	13344 RIDGELANE DR NW	SILVERDALE	WA	98383
207207	1685	PEAVINE RD	RENO	89503	ROCKLIN & SHAWNA	DRAFTON	1685 PEAVINE RD	RENO	NV	89503
207208	1675	PEAVINE RD	RENO	89503	BRIAN	DELUCA	1675 PEAVINE RD	RENO	NV	89503
207209	2540	KEYSTONE AVE	RENO	89503	MATTHEW L	LEATHEN	2540 KEYSTONE AVE	RENO	NV	89503
207210	2550	KEYSTONE AVE	RENO	89503	AARON J	MILLER et al	2550 KEYSTONE AVE	RENO	NV	89503
207211	2560	KEYSTONE AVE	RENO	89503		PPMC FAMILY TRUST	PO BOX 278484	SACRAMENTO	CA	95827
207212	2570	KEYSTONE AVE	RENO	89503	RAMONCITO L	REYES	1448 SNOW SUMMIT DR	RENO	NV	89523
207213	2580	KEYSTONE AVE	RENO	89503		SLAGLE FAMILY TRUST	1745 PEAVINE RD	RENO	NV	89503
207214	2590	KEYSTONE AVE	RENO	89503	TRAVIS	BURROUGHS	2590 KEYSTONE AVE	RENO	NV	89503
207215	2600	KEYSTONE AVE	RENO	89503	RODNEY M & GILDA H	KINGSBURY	2600 KEYSTONE AVE	RENO	NV	89503
208207	1605	PEAVINE RD	RENO	89503	ROBIN & MICHAEL P	URSITTI	3939 SILVER LACE LN	REDDING	CA	96001
208208	2470	KEYSTONE AVE	RENO	89503	KENT	WONG et al	PO BOX 22521	CARSON CITY	NV	89721
208209	2480	KEYSTONE AVE	RENO	89503	DAVID J & KELLY J	DUELL et al	2480 KEYSTONE AVE	RENO	NV	89503
208211	2500	KEYSTONE AVE	RENO	89503	ELLEN	CAMPBELL	331 STONEY RIDGE CIR	PRESCOTT	AZ	86303
208212	2510	KEYSTONE AVE	RENO	89503	ALEX T	LOOBY	2510 KEYSTONE AVE	RENO	NV	89503
208213	2520	KEYSTONE AVE	RENO	89503	TODD	BARBER	2520 KEYSTONE AVE	RENO	NV	89503
208214	2530	KEYSTONE AVE	RENO	89503	DARBY M & JOHN D	BRYANT	10180 GOLD MINE DR	RENO	NV	89521
208301	2455	KEYSTONE AVE	RENO	89503	SEAN R & KATHERINE L	MICKEY	2455 KEYSTONE AVE	RENO	NV	89503

209101	2855	KEYSTONE AVE	RENO	89503	EDWARD F & ERLINDA	MONDRAGON	2855 KEYSTONE AVE	RENO	NV	89503
209103	2685	KEYSTONE AVE	RENO	89503	JOHN C & JACQUELYN	DUKE	2685 KEYSTONE AVE	RENO	NV	89503
209201	1995	PEAVINE RD	RENO	89503	TODD A & ROSE C	BELCHER	1995 PEAVINE RD	RENO	NV	89503
209202	1975	PEAVINE RD	RENO	89503		BARKER-HILL 2006 FAMILY TRUST	1975 PEAVINE RD	RENO	NV	89503
209203	1965	PEAVINE RD	RENO	89503	MEAGANROSE K	CASTRO	1965 PEAVINE RD	RENO	NV	89503
209204	1955	PEAVINE RD	RENO	89503	MELISSA A & STEVEN G	BANAS	1955 PEAVINE RD	RENO	NV	89503
209205	1935	PEAVINE RD	RENO	89503	M BUFORD & SHIRLEY	ROBEY	1935 PEAVINE RD	RENO	NV	89503
209206	1915	PEAVINE RD	RENO	89503	JAMES A & SONJA L	COX	1915 PEAVINE RD	RENO	NV	89503
209207	1895	PEAVINE RD	RENO	89503	SIONE S & SELA	MOKOFISI	4151 HUBBLE CT	SPARKS	NV	89436
209208	1865	PEAVINE RD	RENO	89503	RAYMON	FOOTE	1675 PINECREST CT	RENO	NV	89523
209209	1845	PEAVINE RD	RENO	89503	NOAH	GLICK et al	1845 PEAVINE RD	RENO	NV	89503
209210	1835	PEAVINE RD	RENO	89503	GRANT	WELLER	1835 PEAVINE RD	RENO	NV	89503
209211	1795	PEAVINE CT	RENO	89503		SHILES LIVING TRUST	1795 PEAVINE CT	RENO	NV	89503
209212	1785	PEAVINE CT	RENO	89503	PHILIP J & PAULA A	GLOVER FAMILY TRUST	1785 PEAVINE CT	RENO	NV	89503
209213	1775	PEAVINE CT	RENO	89503	MARK W	SINGLETON et al	1775 PEAVINE CT	RENO	NV	89503
209214	1765	PEAVINE CT	RENO	89503	CHRISTOPHER M & JAIMIE A	TRIBBLE	1765 PEAVINE CT	RENO	NV	89503
209215	1755	PEAVINE CT	RENO	89503	DAN A	JENKINS	1755 PEAVINE CT	RENO	NV	89503
209217	2610	KEYSTONE AVE	RENO	89503	QUYEN Q	TRAN et al	2610 KEYSTONE AVE	RENO	NV	89503
209218	2620	KEYSTONE AVE	RENO	89503	ASHLEY R	HENSLEY et al	2620 KEYSTONE AVE	RENO	NV	89503
209219	2630	KEYSTONE AVE	RENO	89503	DEMETRIUS J & LINDSEY A	MCBRIDE	2630 KEYSTONE AVE	RENO	NV	89503
209220	2640	KEYSTONE AVE	RENO	89503	WILLIAM III	ANDERSON	2640 KEYSTONE AVE	RENO	NV	89503
209221	2420	DURANGO CT	RENO	89503	JOHN J & PATRICIA A	MCDONALD	2420 DURANGO CT	RENO	NV	89503
209222	2410	DURANGO CT	RENO	89503	CYNTHIA M	BARTL	2410 DURANGO CT	RENO	NV	89503
209223	2400	DURANGO CT	RENO	89503	JUDITH A	PURSER TRUST	2400 DURANGO CT	RENO	NV	89503
209224	2405	DURANGO CT	RENO	89503	JIMMY L & SARALEE	KWEK	2405 DURANGO CT	RENO	NV	89503
209225	2415	DURANGO CT	RENO	89503	JOHN T & KRISTI M	SARIKAKIS	2415 DURANGO CT	RENO	NV	89503
209226	2660	KEYSTONE AVE	RENO	89503		SORENSON FAMILY 2020 TRUST	100 SHELTER CT	RENO	NV	89521
209227	2680	KEYSTONE AVE	RENO	89503	RUSSELL C & MELISSA	WHIPPLE	2680 KEYSTONE AVE	RENO	NV	89503
209301	1770	PEAVINE RD	RENO	89503	BEVERLY A & JOHN	GEYER	1770 PEAVINE RD	RENO	NV	89503
209302	1790	PEAVINE RD	RENO	89503	SHANON & SCOTT	TAYLOR	1790 PEAVINE RD	RENO	NV	89503
209303	1800	PEAVINE RD	RENO	89503	JOSE L	CUEVAS-VERA et al	1800 PEAVINE RD	RENO	NV	89503
209304	1820	PEAVINE RD	RENO	89503	ALFONSO G & MARTHA L	ARREDONDO	1820 PEAVINE RD	RENO	NV	89503
209305	1830	PEAVINE RD	RENO	89503		RUBINSTEIN FAMILY TRUST	1830 PEAVINE RD	RENO	NV	89503
209306	1850	PEAVINE RD	RENO	89503	FRANCIS E	BURNS	PO BOX 5533	RENO	NV	89513
209307	1870	PEAVINE RD	RENO	89503	DAVID W & ANALISA U	ZIMMERMAN	575 COUNTRY DR	FERNLEY	NV	89408
209308	1890	PEAVINE RD	RENO	89503	JAMES A	CREMEANS	1890 PEAVINE RD	RENO	NV	89503
209309	1900	PEAVINE RD	RENO	89503	ANNE E	WALLACE	1900 PEAVINE RD	RENO	NV	89503
209310	1920	PEAVINE RD	RENO	89503	RICHARD A & JENNIFER R	CHRISTIAN	1920 PEAVINE RD	RENO	NV	89503
209311	1940	PEAVINE RD	RENO	89503	JOAN M	HALLAHAN	1940 PEAVINE RD	RENO	NV	89503
209312	1950	PEAVINE RD	RENO	89503		WELLS FAMILY TRUST	PO BOX 4081	STATELINE	NV	89449
209313	1960	PEAVINE RD	RENO	89503	STEVEN & CHRISTINE	BRANUM	1960 PEAVINE RD	RENO	NV	89503
209314	1990	PEAVINE RD	RENO	89503	LYNNE M	NELSON	1990 PEAVINE RD	RENO	NV	89503
209315	2910	KEYSTONE AVE	RENO	89503		FU LIVING TRUST	1790 KING EDWARD DR	RENO	NV	89503
209316	2920	KEYSTONE AVE	RENO	89503	ANTONIO S & ROSA ELENA G	MIRAMONTES	470 N TRESCOTT AVE SPC A	BATTLE MOUNTAIN	NV	89820-2822
209501	0	UNSPECIFIED	RENO	89503		RENO CITY OF	PO BOX 1900	RENO	NV	89505
209601	1880	VAN NESS AVE	RENO	89503	ANDREW C	BROWN	1880 VAN NESS AVE	RENO	NV	89503
209602	1890	VAN NESS AVE	RENO	89503		DAM PROPERTIES LLC	3565 LONE TREE LN	RENO	NV	89511
209603	1900	VAN NESS AVE	RENO	89503	DONNA R	CAREY	1900 VAN NESS AVE	RENO	NV	89503
209604	1930	VAN NESS AVE	RENO	89503	IRENA & SIGITAS	JAKAITIENE	1930 VAN NESS AVE	RENO	NV	89503
209605	1960	VAN NESS AVE	RENO	89503	JOHN B & PAULA J	CRANDELL	1960 VAN NESS AVE	RENO	NV	89503
209606	1980	VAN NESS AVE	RENO	89503		TRAVELLA FAMILY TRUST	1980 VAN NESS AVE	RENO	NV	89503
209607	1990	VAN NESS AVE	RENO	89503	JAY W & SARA J	LAWRENCE	1990 VAN NESS AVE	RENO	NV	89503
209701	1965	VAN NESS AVE	RENO	89503	DONALD E JR	BUTTERFIELD et al	1965 VAN NESS AVE	RENO	NV	89503
209702	1925	VAN NESS AVE	RENO	89503	WENDY L	BROADHEAD	1925 VAN NESS AVE	RENO	NV	89503
209703	1901	VAN NESS AVE	RENO	89503	JUDY F	EDDY LIVING TRUST	1901 VAN NESS AVE	RENO	NV	89503
211001	2315	IVES CT	RENO	89503		BOARDWALK HEALTH HOLDINGS LLC	PO BOX 128109	NASHVILLE	TN	37212
211002	2325	IVES CT	RENO	89503		BOARDWALK HEALTH HOLDINGS LLC	PO BOX 128109	NASHVILLE	TN	37212
211003	2335	IVES CT	RENO	89503		BOARDWALK HEALTH HOLDINGS LLC	PO BOX 128109	NASHVILLE	TN	37212
211004	2345	IVES CT	RENO	89503		BOARDWALK HEALTH HOLDINGS LLC	PO BOX 128109	NASHVILLE	TN	37212
211005	2355	IVES CT	RENO	89503		BOARDWALK HEALTH HOLDINGS LLC	PO BOX 128109	NASHVILLE	TN	37212
211006	2365	IVES CT	RENO	89503		BOARDWALK HEALTH HOLDINGS LLC	PO BOX 128109	NASHVILLE	TN	37212
211007	2360	IVES CT	RENO	89503		BOARDWALK HEALTH HOLDINGS LLC	PO BOX 128109	NASHVILLE	TN	37212
211008	2350	IVES CT	RENO	89503		BOARDWALK HEALTH HOLDINGS LLC	PO BOX 128109	NASHVILLE	TN	37212

211009	2330	IVES CT	RENO	89503		BOARDWALK HEALTH HOLDINGS LLC	PO BOX 128109	NASHVILLE	TN	37212
211010	2320	IVES CT	RENO	89503		BOARDWALK HEALTH HOLDINGS LLC	PO BOX 128109	NASHVILLE	TN	37212
211011	2305	IVES CT	RENO	89503		BOARDWALK HEALTH HOLDINGS LLC	PO BOX 128109	NASHVILLE	TN	37212
213103	2245	IVES AVE	RENO	89503	LESLIE G & VIRGINIA	MACHEN TRUST	2245 IVES AVE	RENO	NV	89503
213104	2255	IVES AVE	RENO	89503	AMANDA	ROBERTSON	2255 IVES AVE	RENO	NV	89503
213105	2265	IVES AVE	RENO	89503	MARVELL L	KELLEN FAMILY TRUST	2265 IVES AVE	RENO	NV	89503
213106	2275	IVES AVE	RENO	89503	NICKOLAS E	NIEMANN	2275 IVES AVE	RENO	NV	89503
213107	2285	IVES AVE	RENO	89503	STEVEN	ZUVICICH	2285 IVES AVE	RENO	NV	89503
213108	2295	IVES AVE	RENO	89503	JASON L	HANSEN	2295 IVES AVE	RENO	NV	89503
213109	2301	IVES AVE	RENO	89503	SHELLIE	SCHOPPE	2301 IVES AVE	RENO	NV	89503
213110	2325	IVES AVE	RENO	89503	JACOB L & NICOLE L	CHATELLE	2325 IVES AVE	RENO	NV	89503
213111	2355	IVES AVE	RENO	89503	BRIN T & STEPHANIE A	REYNOLDS	2355 IVES AVE	RENO	NV	89503
213201	2295	ARCANE AVE	RENO	89503	BRIAN E & DESIREE A	VALLES	2295 ARCANE AVE	RENO	NV	89503
213202	2270	IVES AVE	RENO	89503		DIMINIO LLC SERIES 13	890 NEPTUNE CT	RENO	NV	89512
213204	2250	IVES AVE	RENO	89503	THOMAS	CALHOUN et al	2565 S GAYLORD ST	DENVER	CO	80210
213205	2240	IVES AVE	RENO	89503	PHILLIP C	LONGBALLA et al	2240 IVES AVE	RENO	NV	89503
213211	2255	WARD PL	RENO	89503	PAUL G	HUBBARD	2255 WARD PL	RENO	NV	89503
213213	2295	WARD PL	RENO	89503		MARTINI FAMILY TRUST	2295 WARD PL	RENO	NV	89503
213214	2285	ARCANE AVE	RENO	89503	GARY D	WALKER	2285 ARCANE AVE	RENO	NV	89503
213215	2275	WARD PL	RENO	89503	KEVIN	HALL	2275 WARD PL	RENO	NV	89503
213216	2260	IVES AVE	RENO	89503	VIDUR	MAHADEVA	2260 IVES AVE	RENO	NV	89503
213302	2290	ARCANE AVE	RENO	89503		SULLIVAN MATTHEWS FAMILY TRUST	2290 ARCANE AVE	RENO	NV	89503
213314	2280	ARCANE AVE	RENO	89503	BILLY F JR & COLLEEN	BAKER	2280 ARCANE AVE	RENO	NV	89503
213315	2260	ARCANE AVE	RENO	89503	GERALD G	STOTLER	2260 ARCANE AVE	RENO	NV	89503
213316	2250	ARCANE AVE	RENO	89503	DANIEL L & TETIANA V	GERBER	2250 ARCANE AVE	RENO	NV	89503
213317	2240	ARCANE AVE	RENO	89503	SUSAN J	MILES	2240 ARCANE AVE	RENO	NV	89503
213318	2230	ARCANE AVE	RENO	89503	KEVIN P	RYAN	4881 RAMCREEK TRL	RENO	NV	89519
213326	2340	IVES AVE	RENO	89503	JAMES E & CAROL L	ARDEN	2340 IVES AVE	RENO	NV	89503
213327	2288	ARCANE AVE	RENO	89503	MARSHA L	JAMISON	2288 ARCANE AVE	RENO	NV	89503
213328	0	IVES AVE	RENO	89503	JAMES E & CAROL L	ARDEN	2340 IVES AVE	RENO	NV	89503
213401	2290	WARD PL	RENO	89503	BOHDAN & HALYNA	KINASH	914 COLUMBIA CT	GARDNERVILLE	NV	89460
219401	1510	PEAVINE RD	RENO	89503		EARDLEY LIVING TRUST	1510 PEAVINE RD	RENO	NV	89503
219402	1530	PEAVINE RD	RENO	89503	GREGORY J	HOFF et al	1530 PEAVINE RD	RENO	NV	89503
219403	1550	PEAVINE RD	RENO	89503	GREGORY	GULLA	1550 PEAVINE RD	RENO	NV	89503
219406	1570	PEAVINE RD	RENO	89503	MARK J & VIRGINIA B	LENZ JOINT LIVING TRUST	1570 PEAVINE RD	RENO	NV	89503
219407	2375	KEYSTONE AVE	RENO	89503	MICHAEL J	LINDBERG et al	2375 KEYSTONE AVE	RENO	NV	89503
219409	2365	KEYSTONE AVE	RENO	89503	HEATHER	SLOANE	2365 KEYSTONE AVE	RENO	NV	89503
219504	1620	PEAVINE RD	RENO	89503	ASHLEY L	SANTTI	1620 PEAVINE RD	RENO	NV	89503
219506	2370	KEYSTONE AVE	RENO	89503		TJ MACH I LLC	450 VERA DR	RENO	NV	89511
219507	2350	KEYSTONE AVE	RENO	89503	CLINTON	FOLTZ	2350 KEYSTONE AVE	RENO	NV	89503
219508	2340	KEYSTONE AVE	RENO	89503	DANIELLE	LECLAIR	4033 STATE ST	BRIDGEPORT	MI	48722
220101	0	UNSPECIFIED	RENO	89503		RENO CITY OF	PO BOX 1900	RENO	NV	89505
220201	0	UNSPECIFIED	RENO	89503		RENO CITY OF	PO BOX 1900	RENO	NV	89505
221106	2250	PUTNAM DR	RENO	89503	SHERYL L & STEVE A	LAGUNA	2250 PUTNAM DR	RENO	NV	89503
221108	2141	COBBLESTONE CT	RENO	89503	SCOTT & NATALIE	FENLEY	2141 COBBLESTONE CT	RENO	NV	89503
221109	2151	COBBLESTONE CT	RENO	89503	MICHAEL L	BELLI et al	450 SUNSHINE LN	RENO	NV	89502
221110	2181	COBBLESTONE CT	RENO	89503		RENO KOREAN PRESBYTERIAN CHURCH	148 RICHARDS WAY	SPARKS	NV	89431
221111	2195	COBBLESTONE CT	RENO	89503	SCHOLASTIKA M & CHARLES M	MUTISYA	PO BOX 9244	RENO	NV	89507
221112	2225	COBBLESTONE CT	RENO	89503	STEPHANIE A	HIX	2225 COBBLESTONE CT	RENO	NV	89503
221113	2245	COBBLESTONE CT	RENO	89503	RICHARD & MONICA	ANDERSON	1701 HANOVER ST	RENO	NV	89523
221114	2261	COBBLESTONE CT	RENO	89503	BRYCE K	POLLOCK	2261 COBBLESTONE CT	RENO	NV	89503
221115	2290	PUTNAM DR	RENO	89503		FERNHOFF RESIDENTIAL PROPERTIES LLC	680 JUNIPER HILL RD	RENO	NV	89519
221201	1345	PEAVINE RD	RENO	89503	NANCY K & RANDALL R	RHEW et al	1285 COMMERCE ST	SPARKS	NV	89431
221202	1385	PEAVINE RD	RENO	89503	MICHAEL W & KELLI A	PILCHER	PO BOX 886	VERDI	NV	89439
221203	1380	VAN NESS AVE	RENO	89503	MAXWELL J	GEORGESON et al	1380 VAN NESS AVE	RENO	NV	89503
221204	2325	PUTNAM DR	RENO	89503	DANIEL L & SANDRA J	GOTTA	2325 PUTNAM DR	RENO	NV	89503
221205	1350	VAN NESS AVE	RENO	89503		CHATELLE FAMILY TRUST	1350 VAN NESS AVE	RENO	NV	89503
221301	2326	PUTNAM DR	RENO	89503	KEVIN	PORTER	2326 PUTNAM DR	RENO	NV	89503
221302	2260	COBBLESTONE CT	RENO	89503		MOJO-001 LLC	4272 DANT BLVD	RENO	NV	89519
221303	2250	COBBLESTONE CT	RENO	89503	DARLEEN	AZIZISEFAT LIVING TRUST	PO BOX 5480	RENO	NV	89513
221304	2240	COBBLESTONE CT	RENO	89503	SHARON M & BRUCE V	FERRIGNO	2240 COBBLESTONE CT	RENO	NV	89503
221305	2230	COBBLESTONE CT	RENO	89503	SEAN P	PATTERSON	540 CITADEL WAY	RENO	NV	89503
221306	2220	COBBLESTONE CT	RENO	89503	JOSE M	TIBADUIZA et al	2220 COBBLESTONE CT	RENO	NV	89503

221307	2210	COBBLESTONE CT	RENO	89503	THOMAS M	ALDRICH et al	2210 COBBLESTONE CT	RENO	NV	89503
221308	2200	COBBLESTONE CT	RENO	89503	JOSE M	TIBADUIZA	2200 COBBLESTONE CT	RENO	NV	89503
221309	2190	COBBLESTONE CT	RENO	89503	DANIEL J	SCHWARTZ	2190 COBBLESTONE CT	RENO	NV	89503
221310	2180	COBBLESTONE CT	RENO	89503	REX A & ALICE M	MAXWELL	2180 COBBLESTONE CT	RENO	NV	89503
221311	2170	COBBLESTONE CT	RENO	89503	NICHOLAS R	POLINKO	6400 SHARLANDS AVE APT J2057	RENO	NV	89523
221312	2160	COBBLESTONE CT	RENO	89503	SANDRA L	CASEY	2160 COBBLESTONE CT	RENO	NV	89503
221313	2150	COBBLESTONE CT	RENO	89503		RICHARD MAZZA & ESTHER ISAAC FAMILY TRUST	5998 N WHITE SANDS RD	RENO	NV	89511
221314	2140	COBBLESTONE CT	RENO	89503	CATHLEEN A	GREEN et al	195 STAGS LEAP CIR	SPARKS	NV	89441
221316	0	PUTNAM DR	RENO	89503		TRUCKEE MEADOWS WATER AUTHORITY	PO BOX 30013	RENO	NV	89520
222245	0	UNSPECIFIED	RENO	89503		HIGH SIERRA CONSTRUCTION	59 DAMONTE RANCH PKWY # B355	RENO	NV	89521-1907
223204	2060	BONNEVILLE AVE	RENO	89503	BERNARD	FLETCHER	2060 BONNEVILLE AVE	RENO	NV	89503
223205	2050	BONNEVILLE AVE	RENO	89503	MAJID L	KAZEMI TRUST	2050 BONNEVILLE AVE	RENO	NV	89503
223206	2040	BONNEVILLE AVE	RENO	89503	DAVID & GWEN	KUBIN	2040 BONNEVILLE AVE	RENO	NV	89503
223207	2030	BONNEVILLE AVE	RENO	89503	MELANIE C	YOUNG	2030 BONNEVILLE AVE	RENO	NV	89503
223208	2020	BONNEVILLE AVE	RENO	89503	JACK B & CAROLYN	LEGGETT TRUST	2020 BONNEVILLE AVE	RENO	NV	89503
223232	2080	BONNEVILLE AVE	RENO	89503	KATHY	MCGARR LIVING TRUST	2080 BONNEVILLE AVE	RENO	NV	89503
223233	2070	BONNEVILLE AVE	RENO	89503	SCOTT A & MONIQUE S	SADY	2070 BONNEVILLE AVE	RENO	NV	89503
223234	2090	BONNEVILLE AVE	RENO	89503	RAYMOND G	ALBRECHT	5015 PLEASANT VIEW DR	SPARKS	NV	89434
223238	1975	PUTNAM DR	RENO	89503		PROULX LIVING TRUST	1975 PUTNAM DR	RENO	NV	89503
223239	2110	KEYSTONE AVE	RENO	89503	JUAN R & PATRICIA	FIGUEROA	2110 KEYSTONE AVE	RENO	NV	89503
223240	2120	KEYSTONE AVE	RENO	89503	ARIELLE	KOSHKIN	2120 KEYSTONE AVE	RENO	NV	89503
223242	2130	KEYSTONE AVE	RENO	89503	STACI J	BONE	2130 KEYSTONE AVE	RENO	NV	89503
223243	2140	KEYSTONE AVE	RENO	89503		PADILLA FAMILY TRUST	280 W HIGHLAND DR	HENDERSON	NV	89015
223244	2150	KEYSTONE AVE	RENO	89503	LEO D	LEIGHTON	2150 KEYSTONE AVE	RENO	NV	89503
223245	2160	KEYSTONE AVE	RENO	89503	R	RANALLO LIVING TRUST	2160 KEYSTONE AVE	RENO	NV	89503
223301	0	PUTNAM DR	RENO	89503		TRUCKEE MEADOWS WATER AUTHORITY	PO BOX 30013	RENO	NV	89520
223403	1500	PEAVINE RD	RENO	89503	CODY M	FAJARDO et al	1500 PEAVINE RD	RENO	NV	89503
223404	1450	PEAVINE RD	RENO	89503	CURT C	MILLER et al	1450 PEAVINE RD	RENO	NV	89503
223405	1430	PEAVINE RD	RENO	89503	KENNETH M & CATHERINE D	EARDLEY	1510 PEAVINE RD	RENO	NV	89503
223406	1400	PEAVINE RD	RENO	89503	YVONNE & ALAN J	DESLONGCHAMP	1400 PEAVINE RD	RENO	NV	89503
223407	1370	PEAVINE RD	RENO	89503	BARRY R	GIBSON et al	1015 FLANDERS RD	RENO	NV	89511
223408	1350	PEAVINE RD	RENO	89503		FLOYD FAMILY TRUST	1350 PEAVINE RD	RENO	NV	89503
223409	2265	PUTNAM DR	RENO	89503	NANCY K	TUN	1501 DIAMOND COUNTRY DR	RENO	NV	89521
223410	2295	PUTNAM DR	RENO	89503		MOLEZZO FAMILY TRUST	3201 PLUMAS ST # 312	RENO	NV	89509
227102	75	PENROSE DR	RENO	89503	MALIA	MITOOKA-FERRANTO et al	75 PENROSE DR	RENO	NV	89503
227103	65	PENROSE DR	RENO	89503	CONRAD V & LUZ D	VALDEZ	65 PENROSE DR	RENO	NV	89503
227104	55	PENROSE DR	RENO	89503	VICTORIA	GRAY TRUST	55 PENROSE DR	RENO	NV	89503
227105	45	PENROSE DR	RENO	89503	KILEY	SAUER et al	45 PENROSE DR	RENO	NV	89503
227106	35	PENROSE DR	RENO	89503	CHARLES E & JOAN	MUELLER TRUST et al	35 PENROSE DR	RENO	NV	89503
227107	25	PENROSE DR	RENO	89503	CHRISTOPHER S & CHRISTINA	SARMAN et al	5530 AMBROSE DR	RENO	NV	89519
227109	1830	WESLEY DR	RENO	89503	REED A	KOBEMIK	1830 WESLEY DR	RENO	NV	89503
227110	15	PENROSE DR	RENO	89503	DIANA J	MARTIN TRUST	15 PENROSE DR	RENO	NV	89503
227111	2125	KEYSTONE AVE	RENO	89503	HUMBERTO & EVAN	VISCARRA	409 STANFORD WAY	SPARKS	NV	89431
227201	2065	KEYSTONE AVE	RENO	89503	RICARDO A	RIVAS-BONILLA	2065 KEYSTONE AVE	RENO	NV	89503
227224	1790	HAROLD DR	RENO	89503	ROBERT L JR	RALSTON	1790 HAROLD DR	RENO	NV	89503
227225	60	PENROSE DR	RENO	89503	MICHAEL C & CASSANDRA K	JOHNSON	60 PENROSE DR	RENO	NV	89503
227301	1785	HAROLD DR	RENO	89503	CHRISTINE M & MARK R	FAULSTICH	1785 HAROLD DR	RENO	NV	89503
227320	1760	WESLEY DR	RENO	89503	ERIC T	HOWSLEY et al	1760 WESLEY DR	RENO	NV	89503
227321	1780	WESLEY DR	RENO	89503	ROBERT M	BRIM	1780 WESLEY DR	RENO	NV	89503
227322	20	PENROSE DR	RENO	89503	DAVID L	BAKKE	20 PENROSE DR	RENO	NV	89503
227401	1845	WESLEY DR	RENO	89503	ZACHARY & ANNA	CHATELLE	1845 WESLEY DR	RENO	NV	89503
227402			RENO	89503		NOT AVAILABLE	NOT SUPPLIED	NOT SUPPLIED	NV	00000
227403	1805	WESLEY DR	RENO	89503	BRANDON R	CARLSON	1805 WESLEY DR	RENO	NV	89503
227404	1795	WESLEY DR	RENO	89503	ROSALIND & BRENDAN	BUCY	1795 WESLEY DR	RENO	NV	89503
227405	1785	WESLEY DR	RENO	89503	KRIST-ANN	PEHRSON	1785 WESLEY DR	RENO	NV	89503
227406	1765	WESLEY DR	RENO	89503	VICTORIA	WEISER	1765 WESLEY DR	RENO	NV	89503
229242	0	KEYSTONE AVE	RENO	89503		RENO CITY OF	PO BOX 1900	RENO	NV	89505
229701	0	UNSPECIFIED	RENO	89503		RENO CITY OF	PO BOX 1900	RENO	NV	89505
242101	1690	VAN NESS AVE	RENO	89503	DONALD & JUDITH	PEITZ FAMILY TRUST	1690 VAN NESS AVE	RENO	NV	89503
242102	1700	VAN NESS AVE	RENO	89503	ALFREDO E & CLEO E	EYZAGUIRRE	1700 VAN NESS AVE	RENO	NV	89503
242103	1730	VAN NESS AVE	RENO	89503	DANIELLE	MOLLET TRUST	2010 MARGOT CIR	RENO	NV	89509
242104	1750	VAN NESS AVE	RENO	89503		LAMONT FAMILY TRUST	2210 ARCANE AVE	RENO	NV	89503
242105	1780	VAN NESS AVE	RENO	89503	TOBIN W & HEATHER G	SMITH	1780 VAN NESS AVE	RENO	NV	89503

242106	1800	VAN NESS AVE	RENO	89503		WELTY FAMILY TRUST	1800 VAN NESS AVE	RENO	NV	89503
242107	1820	VAN NESS AVE	RENO	89503		GIUSTI FAMILY TRUST	1820 VAN NESS AVE	RENO	NV	89503
242108	1830	VAN NESS AVE	RENO	89503	JAMES	PLATT TRUST	1830 VAN NESS AVE	RENO	NV	89503
242109	1840	VAN NESS AVE	RENO	89503	ELAINE W	FIELD et al	1840 VAN NESS AVE	RENO	NV	89503
242110	1850	VAN NESS AVE	RENO	89503		ALLEN FAMILY TRUST	100 W PUEBLO ST	RENO	NV	89509
242111	1860	VAN NESS AVE	RENO	89503	DANIEL G	WAGNER	1860 VAN NESS AVE	RENO	NV	89503
242112	1870	VAN NESS AVE	RENO	89503	ANDREW C	BROWN	1870 VAN NESS AVE	RENO	NV	89503
242204	1865	O'FARRELL ST	RENO	89503	MATTHEW J & MAE D	DILLON	1865 O'FARRELL ST	RENO	NV	89503
242205	1835	O'FARRELL ST	RENO	89503	JOHN	GREEN et al	1835 O'FARRELL ST	RENO	NV	89503
242206	1801	O'FARRELL ST	RENO	89503		PS & SP LLC SERIES L	1510 STAR WAY	RENO	NV	89511
242207	1765	O'FARRELL ST	RENO	89503		BOSSOB LIVING TRUST	9530 OAKLEY LN	RENO	NV	89521
242208	1745	O'FARRELL ST	RENO	89503		LABRANCH FAMILY TRUST	1745 O'FARRELL ST	RENO	NV	89503
242209	1715	O'FARRELL ST	RENO	89503	STEPHEN	LEVITT	1715 O'FARRELL ST	RENO	NV	89503
242210	1685	O'FARRELL ST	RENO	89503		FRAZZETTA FAMILY TRUST	1685 O'FARRELL ST	RENO	NV	89503
242211	1665	O'FARRELL ST	RENO	89503		RABENSTINE FAMILY TRUST	1665 O'FARRELL ST	RENO	NV	89503
242212	1625	O'FARRELL ST	RENO	89503		WASSON DECEDENTS TRUST	204 DANA ST	PETALUMA	CA	94952
242213	1615	O'FARRELL ST	RENO	89503	TAMARA S	WRIGHT-WALDHOR et al	1615 O'FARRELL ST	RENO	NV	89503
242214	1565	O'FARRELL ST	RENO	89503	WALTER D	REXRODE et al	1565 O'FARRELL ST	RENO	NV	89503
242215	1545	O'FARRELL ST	RENO	89503	ELIAS M	VASQUEZ	1545 O'FARRELL ST	RENO	NV	89503
242216	1525	O'FARRELL ST	RENO	89503	SANDRA	DE LA ROSA	1525 O'FARRELL ST	RENO	NV	89503
242301	1520	O'FARRELL ST	RENO	89503	TOM N II & JUDITH G	HASPERIS	1520 O'FARRELL ST	RENO	NV	89503
242302	1540	O'FARRELL ST	RENO	89503	BILLIE R	TOUT	1540 O'FARRELL ST	RENO	NV	89503
242303	1560	O'FARRELL ST	RENO	89503	RONALD W & MARILAN	JOHNSON	1560 O'FARRELL ST	RENO	NV	89503
242304	1600	O'FARRELL ST	RENO	89503	VALARIE Y	CAVALLO	1600 O'FARRELL ST	RENO	NV	89503
242305	1620	O'FARRELL ST	RENO	89503	NELSON & SHEILA	ROJAS FAMILY TRUST	1620 O'FARRELL ST	RENO	NV	89503
242306	1650	O'FARRELL ST	RENO	89503	WILLIAM C	ARNDT	1650 O'FARRELL ST	RENO	NV	89503
242307	1670	O'FARRELL ST	RENO	89503	RITA	TRAUTMAN	1670 O'FARRELL ST	RENO	NV	89503
242308	1700	O'FARRELL ST	RENO	89503		PRITCHETT 2008 FAMILY TRUST	1700 O'FARRELL ST	RENO	NV	89503
242309	1710	O'FARRELL CT	RENO	89503	GARY K & JACQUELINE L	RAY	1710 O'FARRELL CT	RENO	NV	89503
242310	1720	O'FARRELL CT	RENO	89503	RICHARD J & CHRISTINE	HOUK	1720 O'FARRELL CT	RENO	NV	89503
242311	1730	O'FARRELL CT	RENO	89503	DEBRA J	HENDRICKSON TRUST	1730 O'FARRELL CT	RENO	NV	89503
242312	1750	O'FARRELL ST	RENO	89503	SARAH H	VOSS	1750 O'FARRELL ST	RENO	NV	89503
242313	1770	O'FARRELL ST	RENO	89503	CATHERINE A	BERRY FAMILY TRUST	1770 O'FARRELL ST	RENO	NV	89503
242314	1800	O'FARRELL ST	RENO	89503	BRIAN	ALLEN	12428 GREENWOOD DR	TRUCKEE	CA	96161
242315	1830	O'FARRELL ST	RENO	89503	CRYSTAL M & TIMOTHY	FINN	1830 O'FARRELL ST	RENO	NV	89503
242316	1885	VAN NESS AVE	RENO	89503	DAVID W	WEEKS et al	1885 VAN NESS AVE	RENO	NV	89503
242317	1875	VAN NESS AVE	RENO	89503		JACOBS FAMILY TRUST	15511 DE LA CRUZ DR	SLOUGHHOUSE	CA	95683
242318	1865	VAN NESS AVE	RENO	89503		SMB & AME LIVING TRUST	1865 VAN NESS AVE	RENO	NV	89503
242319	1845	VAN NESS AVE	RENO	89503		SMYTH LIVING TRUST	PO BOX 5663	RENO	NV	89513
242320	1835	VAN NESS AVE	RENO	89503		LAMPSON-MALCOLM LIVING TRUST	1835 VAN NESS AVE	RENO	NV	89503
242321	1825	VAN NESS AVE	RENO	89503	KATHERINE & RICHARD J	GODBEY	PO BOX 193	WELLINGTON	NV	89444
242322	1795	GEARY ST	RENO	89503		COLLINS FAMILY TRUST	1795 GEARY ST	RENO	NV	89503
242323	1775	GEARY ST	RENO	89503	CONSTANCE E	HUNING	1775 GEARY ST	RENO	NV	89503
242324	1745	GEARY ST	RENO	89503		TAH MS BORROWER LLC	1508 BROOKHOLLOW DR	SANTA ANA	CA	92705
242325	1725	GEARY ST	RENO	89503	LYNN D & SHELLEY	MINEDEW	1725 GEARY ST	RENO	NV	89503
242326	1701	GEARY ST	RENO	89503	RUSSELL C & JILL S	CARTWRIGHT	1701 GEARY ST	RENO	NV	89503
242327	1685	GEARY ST	RENO	89503	TAYLOR & SHANE	KOCKENMEISTER	1685 GEARY ST	RENO	NV	89503
242328	1675	GEARY ST	RENO	89503	MARY	WHEELER	1675 GEARY ST	RENO	NV	89503
242329	1665	GEARY ST	RENO	89503	TRUDY M	MILLER	1665 GEARY ST	RENO	NV	89503
242330	1655	GEARY ST	RENO	89503		RICE FAMILY TRUST	1655 GEARY ST	RENO	NV	89503
242401	1650	GEARY ST	RENO	89503		MEAD FAMILY TRUST	PO BOX 5554	RENO	NV	89513
242402	1670	GEARY ST	RENO	89503	GUY H & MARY A	RECTOR FAMILY TRUST	1670 GEARY ST	RENO	NV	89503
242403	1700	GEARY ST	RENO	89503	JOSEPH & CAROL	MISCHEL	1700 GEARY ST	RENO	NV	89503
242404	1730	GEARY ST	RENO	89503	CHRISTINE	ANDERSON	1730 GEARY ST	RENO	NV	89503
242406	1770	GEARY ST	RENO	89503	GLENNA E	SMITH	PO BOX 2920	CARSON CITY	NV	89702
242407	1775	VAN NESS AVE	RENO	89503	JASON	BACCIGALUPPI et al	1775 VAN NESS AVE	RENO	NV	89503
242408	1755	VAN NESS AVE	RENO	89503	DOUGLAS D & JANELL L	ADAMS	1641 SATURNO HEIGHTS DR	RENO	NV	89523
242409	1735	VAN NESS AVE	RENO	89503	ROBERT & KAREN	ELLIS et al	1735 VAN NESS AVE	RENO	NV	89503
242410	1701	VAN NESS AVE	RENO	89503	SANDORAT & ERIN R	DURAN	1701 VAN NESS AVE	RENO	NV	89503
242411	2445	SUTTER CIR	RENO	89503	MICHAEL S & ADLETA	MCGUIRE	2445 SUTTER CIR	RENO	NV	89503
242412	2465	SUTTER CIR	RENO	89503	ANTHONY R & AMBER C	SPENCER	2465 SUTTER CIR	RENO	NV	89503
242413	2495	SUTTER CIR	RENO	89503	STEPHAN J	HOLLANDSWORTH	2495 SUTTER CIR	RENO	NV	89503
243101	1401	PEAVINE RD	RENO	89503	PAMELA H	GORMLY-OLSEN et al	1401 PEAVINE RD	RENO	NV	89503

243102	1400	VAN NESS AVE	RENO	89503		WILLSEY FAMILY TRUST	1400 VAN NESS AVE	RENO	NV	89503
243103	1430	VAN NESS AVE	RENO	89503	BAYARD C	CATRON	1430 VAN NESS AVE	RENO	NV	89503
243104	1460	VAN NESS AVE	RENO	89503	THERESA L	CROWLEY	1460 VAN NESS AVE	RENO	NV	89503
243105	1480	VAN NESS AVE	RENO	89503		LARK FAMILY LIVING TRUST	2952 ASPENDALE DR	RENO	NV	89503
243106	1500	VAN NESS AVE	RENO	89503	CHRISTOPHER M	RUSBY	1500 VAN NESS AVE	RENO	NV	89503
243107	1520	VAN NESS AVE	RENO	89503	MARTHA	WILLIAMS	1520 VAN NESS AVE	RENO	NV	89503
243108	1540	VAN NESS AVE	RENO	89503	RONALD A	DEL SOLDATO TRUST	1540 VAN NESS AVE	RENO	NV	89503
243109	1560	VAN NESS AVE	RENO	89503	ROBIN	STODDARD	1560 VAN NESS AVE	RENO	NV	89503
243110	1580	VAN NESS AVE	RENO	89503	THERESA A	MOORE	1580 VAN NESS AVE	RENO	NV	89503
243111	1600	VAN NESS AVE	RENO	89503	DENNIS W & ALAINE L	FLYNN	1600 VAN NESS AVE	RENO	NV	89503
243112	1630	VAN NESS AVE	RENO	89503	MARIO	TRINIDAD	1660 VAN NESS AVE	RENO	NV	89503
243113	1660	VAN NESS AVE	RENO	89503	MARIO R & SUSANA A	TRINIDAD	1660 VAN NESS AVE	RENO	NV	89503
243114	1585	PEAVINE RD	RENO	89503	TAWNA T	GALLI	1585 PEAVINE RD	RENO	NV	89503
243115	1545	PEAVINE RD	RENO	89503	RICHARD J & DEANNA M	NURGE	11780 CAMEL ROCK DR	RENO	NV	89506
243116	1525	PEAVINE RD	RENO	89503	GORDON & ISLEAN	QUONG FAMILY TRUST	1525 PEAVINE RD	RENO	NV	89503
243117	1511	PEAVINE RD	RENO	89503		HARGER FAMILY TRUST	2305 EVA ADAMS DR	RENO	NV	89509
243118	1475	PEAVINE RD	RENO	89503	FRANCES G	MEYER et al	1475 PEAVINE RD	RENO	NV	89503
243119	1455	PEAVINE RD	RENO	89503	CAM	MCFADDIN et al	1516 LOMBARD ST APT 3	SAN FRANCISCO	CA	94123
243120	1435	PEAVINE RD	RENO	89503	GREGORY & DIANE	HOFF	1530 PEAVINE RD	RENO	NV	89503
243201	2490	SUTTER CIR	RENO	89503	CLAIRE M	WHITESIDE et al	2490 SUTTER CIR	RENO	NV	89503
243202	2460	SUTTER CIR	RENO	89503	RALPH	BETTS et al	2460 SUTTER CIR	RENO	NV	89503
243203	2440	SUTTER CIR	RENO	89503	JOHN E	HADDER et al	2440 SUTTER CIR	RENO	NV	89503
243204	1675	VAN NESS AVE	RENO	89503	ELIZABETH L	KRAYK	1675 VAN NESS AVE	RENO	NV	89503
243205	1645	VAN NESS AVE	RENO	89503	LINDA A	ROUSH	1930 MARLA DR	RENO	NV	89509
243206	1625	VAN NESS AVE	RENO	89503	JANICE	ATKIN	6033 CONNESS WAY	RENO	NV	89523
243207	1595	VAN NESS AVE	RENO	89503	JAMES M	MORNING	1595 VAN NESS AVE	RENO	NV	89503
243208	1565	VAN NESS AVE	RENO	89503	KRISTINE M	WILBRECHT	1565 VAN NESS AVE	RENO	NV	89503
243209	1535	VAN NESS AVE	RENO	89503	CHRISTOPHER	BAKER	1535 VAN NESS AVE	RENO	NV	89503
243210	1501	VAN NESS AVE	RENO	89503	DANA L	BUCHHOLZ et al	1501 VAN NESS AVE	RENO	NV	89503
243211	1485	VAN NESS AVE	RENO	89503	MATHEW L & ADRIANNA P	BANOVICH	80 BITTERBRUSH RD	RENO	NV	89523
243212	1465	VAN NESS AVE	RENO	89503	TOBY M	EBENS	1465 VAN NESS AVE	RENO	NV	89503
243213	1435	VAN NESS AVE	RENO	89503	YVONNE R	LEWELLIN	1435 VAN NESS AVE	RENO	NV	89503
243214	1401	VAN NESS AVE	RENO	89503	SHARON	VASQUEZ TRUST	1401 VAN NESS AVE	RENO	NV	89503
243215	2475	POLK ST	RENO	89503	CUAUHTEMOC & LUCY	CASTILLO	2475 POLK ST	RENO	NV	89503
243216	1420	GEARY ST	RENO	89503	BRIAN C	FILIPPINI et al	4953 145TH AVE SE	BELLEVUE	WA	98006
243217	1430	GEARY ST	RENO	89503	STEVEN	ANDERSON	1430 GEARY ST	RENO	NV	89503
243218	1440	GEARY ST	RENO	89503	ASHLEY B	HALL	1440 GEARY ST	RENO	NV	89503
243219	1450	GEARY ST	RENO	89503		MARSHALL LIVING TRUST	1450 GEARY ST	RENO	NV	89503
243220	1460	GEARY ST	RENO	89503	CHRISTOPHER C	PEARSON	1460 GEARY ST	RENO	NV	89503
243221	1470	GEARY ST	RENO	89503	DENNY & KATHIE	WILLIAMS FAMILY TRUST	1470 GEARY ST	RENO	NV	89503
243222	1480	GEARY ST	RENO	89503		SMITH LIVING TRUST	1480 GEARY ST	RENO	NV	89503
243223	1490	GEARY ST	RENO	89503	BRENT A & KATHRYN	MERRITT	1490 GEARY ST	RENO	NV	89503
243224	1530	GEARY ST	RENO	89503	ALAINE F	BARREA	1530 GEARY ST	RENO	NV	89503
243225	1560	GEARY ST	RENO	89503		GONZALES FAMILY LIVING TRUST	1560 GEARY ST	RENO	NV	89503
243226	1590	GEARY ST	RENO	89503	KATHLEEN E	ALBANESE	1590 GEARY ST	RENO	NV	89503
243227	1630	GEARY ST	RENO	89503	LINDA J	CIAMPOLI-HARDDONIERE TRUST	3112 SKYE TER	SPARKS	NV	89431
243301	1625	GEARY ST	RENO	89503	GEORGE A	WALDEN et al	1625 GEARY ST	RENO	NV	89503
243302	1621	GEARY ST	RENO	89503	C JAMES & SHAREN	GEORGESON FAMILY TRUST et al	4280 MUIRWOOD CIR	RENO	NV	89509
243303	1615	GEARY ST	RENO	89503	MEGAN E & MICHAEL B	MACHADO	1615 GEARY ST	RENO	NV	89503
243304	1607	GEARY ST	RENO	89503	RICK	LEWIS	1607 GEARY ST	RENO	NV	89503
243305	1585	GEARY ST	RENO	89503		GAEDTKE LIVING TRUST	1585 GEARY ST	RENO	NV	89503
243306	1575	GEARY ST	RENO	89503	KRISTI G	BORACCHIA	1575 GEARY ST	RENO	NV	89503
243307	1555	GEARY ST	RENO	89503	ZACHARY	LANNOY	1435 O'FARRELL ST	RENO	NV	89503
243308	1525	GEARY ST	RENO	89503	LAUREN J & MARK G	GANDOLFO	2590 THOMAS JEFFERSON DR	RENO	NV	89509
243309	1495	GEARY ST	RENO	89503	LESLIE E	SKINNER	1495 GEARY ST	RENO	NV	89503
243310	1435	GEARY ST	RENO	89503	ANTHONY	DEMARTINO	1435 GEARY ST	RENO	NV	89503
243311	2501	POLK ST	RENO	89503		VERNON FAMILY 2008 TRUST	2501 POLK ST	RENO	NV	89503
243312	2535	POLK ST	RENO	89503	GENE E & CLAIRE E	MOWREY	2535 POLK ST	RENO	NV	89503
243313	2565	POLK ST	RENO	89503	FRANK S & SUSANNE M	HOWELL TRUST	2565 POLK ST	RENO	NV	89503
243314	2595	POLK ST	RENO	89503	KURT	BARNICA	2595 POLK ST	RENO	NV	89503
243315	2625	POLK ST	RENO	89503	JOYCE M	PATTERSON TRUST	2625 POLK ST	RENO	NV	89503
243316	2645	POLK ST	RENO	89503	DOUGLAS J & CHRISTINE M	WILCOX	2645 POLK ST	RENO	NV	89503
243317	2685	POLK ST	RENO	89503		TAH 2018-1 BORROWER LLC	1508 BROOKHOLLOW DR	SANTA ANA	CA	92705

243318	1420	O'FARRELL ST	RENO	89503		ATKINSON FAMILY TRUST	1420 O'FARRELL ST	RENO	NV	89503
243319	1460	O'FARRELL ST	RENO	89503	MEGAN	ALMANSOORI	1460 O'FARRELL ST	RENO	NV	89503
243320	1490	O'FARRELL ST	RENO	89503	DANIEL T & MARY A	ALLEN	3565 LONE TREE LN	RENO	NV	89511
243401	1485	O'FARRELL ST	RENO	89503	ROBERT	STACK	1485 O'FARRELL ST	RENO	NV	89503
243402	1465	O'FARRELL ST	RENO	89503	MICHELLE K	HOCHREIN	1465 O'FARRELL ST	RENO	NV	89503
243403	1435	O'FARRELL ST	RENO	89503	ANN-MARIE	VOLLSTEDT et al	1435 O'FARRELL ST	RENO	NV	89503
243404	1401	O'FARRELL ST	RENO	89503	KAREN E	VARGAS	1401 O'FARRELL ST	RENO	NV	89503
243405	2680	POLK ST	RENO	89503	LUKE E & CORY L	FREY	2680 POLK ST	RENO	NV	89503
243406	2670	POLK ST	RENO	89503		WINCHELL LIVING TRUST	2670 POLK ST	RENO	NV	89503
243407	2660	POLK ST	RENO	89503	TESSA	LANNOY	2660 POLK ST	RENO	NV	89503
243408	2640	POLK ST	RENO	89503	TRAVIS	WILKEY	2640 POLK ST	RENO	NV	89503
243409	2620	POLK ST	RENO	89503	JOHN & PEGGY	EWALD FAMILY TRUST	25 CHINCHILLA LN	RENO	NV	89511
243410	2600	POLK ST	RENO	89503	CRAIG T	REYNOLDS	2600 POLK ST	RENO	NV	89503
243411	2570	POLK ST	RENO	89503	LUCAS	ANDERSON et al	2570 POLK ST	RENO	NV	89503
243412	2540	POLK ST	RENO	89503	THOMAS W	RENNIE	2540 POLK ST	RENO	NV	89503
243413	2520	POLK ST	RENO	89503	JENNIFER D & ANTHONY W	STEVENS	2520 POLK ST	RENO	NV	89503
243414	2500	POLK ST	RENO	89503	KRISTAL E	CURRY LIVING TRUST	2500 POLK ST	RENO	NV	89503
243415	2480	POLK ST	RENO	89503		ANDREATTA FAMILY TRUST	2480 POLK ST	RENO	NV	89503
243416	2450	POLK ST	RENO	89503	BRIAN	DAVIS	1997 PLUMAS ST	RENO	NV	89509
243417	2430	POLK ST	RENO	89503	BRIAN	DAVIS	2430 POLK ST	RENO	NV	89503
243418	2400	POLK ST	RENO	89503		LUKE LIVING TRUST	2400 POLK ST	RENO	NV	89503
243501	1390	VAN NESS AVE	RENO	89503	DEBRA & DONALD	KAMKA	1390 VAN NESS AVE	RENO	NV	89503
243502	2330	POLK ST	RENO	89503	ALLEN	VARNEY	36 WOODCREST AVE	ITHACA	NY	14850
243503	1395	PEAVINE RD	RENO	89503		FRASER TRUST	1395 PEAVINE RD	RENO	NV	89503
249108	1680	SEVERN DR	RENO	89503	MARLYS J	MAYS	1680 SEVERN DR	RENO	NV	89503
250104	1710	SEVERN DR	RENO	89503		AMARO FAMILY TRUST	3387 JORDAN RD	OAKLAND	CA	94602
250105	1750	SEVERN DR	RENO	89503	CHRISTINA L & RICHARD J	AMORE	1750 SEVERN DR	RENO	NV	89503
250106	1780	SEVERN DR	RENO	89503	ROGER B & MARIE D	WIERE	1780 SEVERN DR	RENO	NV	89503
250107	1800	SEVERN DR	RENO	89503	ADAM R	BEESON	1800 SEVERN DR	RENO	NV	89503
250108	1820	SEVERN DR	RENO	89503	LARRY V JR	ROBERTS et al	1820 SEVERN DR	RENO	NV	89503
250109	1860	SEVERN DR	RENO	89503	JEFFREY D	HACKER et al	1860 SEVERN DR	RENO	NV	89503
250110	1890	SEVERN DR	RENO	89503	FARRELL B & JAMIE D	VAUGHN	1890 SEVERN DR	RENO	NV	89503
250202	1885	SEVERN DR	RENO	89503	FABIAN & TINA	REYNOSO	1885 SEVERN DR	RENO	NV	89503
250203	1855	SEVERN DR	RENO	89503	ZACHARY D & HEATHER C	BAUTISTA	7659 MANDOLIN WAY	ROHNERT PARK	CA	94928
250204	1815	SEVERN DR	RENO	89503	THOMAS C & MICHELLE L	BROWN	15560 CHERRYWOOD DR	RENO	NV	89511
250205	1795	SEVERN DR	RENO	89503		TONDA FAMILY TRUST	9760 RIM ROCK CIR	LOOMIS	CA	95650
250206	1765	SEVERN DR	RENO	89503	RYAN M	HIGH	1765 SEVERN DR	RENO	NV	89503
250207	1715	SEVERN DR	RENO	89503	JOSE E & LILIA	RECINOS	1715 SEVERN DR	RENO	NV	89503
250208	1695	SEVERN DR	RENO	89503	LINO	RICO-RIVERA et al	1695 SEVERN DR	RENO	NV	89503
250214	1740	KING EDWARD DR	RENO	89503	DEBRA J	GALLET et al	1740 KING EDWARD DR	RENO	NV	89503
250215	1790	KING EDWARD DR	RENO	89503		FU LIVING TRUST	1790 KING EDWARD DR	RENO	NV	89503
250216	1830	KING EDWARD DR	RENO	89503	RAYMOND K SR	SCOW	1830 KING EDWARD DR	RENO	NV	89503
250217	1850	KING EDWARD DR	RENO	89503	DANIEL W & ASHLEY K	SMITH	1850 KING EDWARD DR	RENO	NV	89503
250218	1880	KING EDWARD DR	RENO	89503		TAH 2018-1 BORROWER LLC	1508 BROOKHOLLOW DR	SANTA ANA	CA	92705
250219	1940	KING EDWARD DR	RENO	89503	FRED K & EVA L	DELLERA	1940 KING EDWARD DR	RENO	NV	89503
250220	1980	KING EDWARD DR	RENO	89503	JOSE & OLGA L	SILVERIO	1980 KING EDWARD DR	RENO	NV	89503
250301	2020	SEVERN DR	RENO	89503	FREDERICK T JR & CAROLE S	PASCUCCI	2020 SEVERN DR	RENO	NV	89503
250303	1935	KING EDWARD DR	RENO	89503	MARIE D	BURNSTEIN LIVING TRUST	PO BOX 1257	KETTLE FALLS	WA	99141
250304	1905	KING EDWARD DR	RENO	89503	JOSHUA P	STECKLINE LIVING TRUST	3045 ROXBURY DR	RENO	NV	89523
250305	1885	KING EDWARD DR	RENO	89503		MCCULLOCH FAMILY TRUST	1885 KING EDWARD DR	RENO	NV	89503
250306	1855	KING EDWARD DR	RENO	89503	JOHN A JR	BAKER et al	1855 KING EDWARD DR	RENO	NV	89503
250307	1835	KING EDWARD DR	RENO	89503	JOHN T & CHRISTINE M	MORAN	1835 KING EDWARD DR	RENO	NV	89503
250312	1600	VAN PETTEN ST	RENO	89503		FINN LIVING TRUST	1600 VAN PETTEN ST	RENO	NV	89503
250313	1620	VAN PETTEN ST	RENO	89503	CHARLOTTE	POINDEXTER	1620 VAN PETTEN ST	RENO	NV	89503
250314	1640	VAN PETTEN ST	RENO	89503	CHARMAANE R	BUEHRLE	1640 VAN PETTEN ST	RENO	NV	89503
250315	1660	VAN PETTEN ST	RENO	89503	JOSE L	RODRIGUEZ et al	1660 VAN PETTEN ST	RENO	NV	89503
250316	1670	VAN PETTEN ST	RENO	89503	MICHAEL R & MARY J	SUDANO	1670 VAN PETTEN ST	RENO	NV	89503
250317	1680	VAN PETTEN ST	RENO	89503	CHRISTOPHER	COLBORN	9890 SILVER DEW ST	LAS VEGAS	NV	89183
250318	2090	SEVERN DR	RENO	89503	LAURIE A	ARAGON et al	2090 SEVERN DR	RENO	NV	89503
250319	2070	SEVERN DR	RENO	89503	MARY K	DIETHRICH	2070 SEVERN DR	RENO	NV	89503
250320	2040	SEVERN DR	RENO	89503	CAM & JODY N	ROBLIN	2040 SEVERN DR	RENO	NV	89503
250401	1699	VAN PETTEN ST	RENO	89503	PAMELA C & BRANDON F	SILAR	1699 VAN PETTEN ST	RENO	NV	89503
250403	1685	VAN PETTEN ST	RENO	89503	SUSAN J	ENGLESBY TRUST #2	16045 PINE VALLEY DR	RENO	NV	89511

250404	1675	VAN PETTEN ST	RENO	89503		TAH 2017-2 BORROWER LLC	1508 BROOKHOLLOW DR	SANTA ANA	CA	92705
250405	1665	VAN PETTEN ST	RENO	89503	GARY & FRANCENE	LINDENSCHMITT 2010 TRUST	8285 ROYALL OAKS DR	GRANITE BAY	CA	95746
250406	1655	VAN PETTEN ST	RENO	89503	FELIPE	CHAVEZ-GONZALEZ et al	1655 VAN PETTEN ST	RENO	NV	89503
250407	1625	VAN PETTEN ST	RENO	89503	JOSEPH & CAMIE J	LOPEZ	1625 VAN PETTEN ST	RENO	NV	89503
250413	1580	CROWN DR	RENO	89503	MICHELLE M	ZITO	1580 CROWN DR	RENO	NV	89503
250414	1600	CROWN DR	RENO	89503	TAMMARA M	CAGNEY	1600 CROWN DR	RENO	NV	89503
250415	1620	CROWN DR	RENO	89503		WEISS FAMILY TRUST	1620 CROWN DR	RENO	NV	89503
250416	1640	CROWN DR	RENO	89503	GARY S & STEPHANIE L	BOCKMAN	1640 CROWN DR	RENO	NV	89503
250417	1670	CROWN DR	RENO	89503		GERHART LIVING TRUST	1670 CROWN DR	RENO	NV	89503
250418	1690	CROWN DR	RENO	89503	TIFFANY	REGALIA	1690 CROWN DR	RENO	NV	89503
250501	1675	CROWN DR	RENO	89503	SHELBY L	GRANA et al	1675 CROWN DR	RENO	NV	89503
250502	1655	CROWN DR	RENO	89503	JORGE M	ARELLANO et al	1655 CROWN DR	RENO	NV	89503
250503	1635	CROWN DR	RENO	89503	WILLIAM J & WENDY E	BUNNEL	1635 CROWN DR	RENO	NV	89503
250504	1605	CROWN DR	RENO	89503	LAURIE J	LARKIN LIVING TRUST	1605 CROWN DR	RENO	NV	89503
251102	1960	SEVERN DR	RENO	89503	MICHAEL A	HAMILTON et al	1960 SEVERN DR	RENO	NV	89503
251103	2010	SEVERN DR	RENO	89503	ROBERT E	BUHLER et al	PO BOX 8256	RENO	NV	89507
251104	2050	KING EDWARD DR	RENO	89503	EILEEN F	CARPENTER	2050 KING EDWARD DR	RENO	NV	89503
251113	2140	KING EDWARD DR	RENO	89503	NOEL C & ELAINE M	MANOUKIAN	2140 KING EDWARD DR	RENO	NV	89503
251115	2130	KING EDWARD DR	RENO	89503	PHILLIP J & PEGGY L	PERT	2130 KING EDWARD DR	RENO	NV	89503
251117	2100	KING EDWARD DR	RENO	89503	KELSIE	HIEBER	2100 KING EDWARD DR	RENO	NV	89503
251119	2080	KING EDWARD DR	RENO	89503	LUIS	ANGUIANO-CERVANTES et al	2080 KING EDWARD DR	RENO	NV	89503
251121	1920	SEVERN DR	RENO	89503	MICHELLE & PAUL	DZIEDZIC	698 TARN WAY	RENO	NV	89503
251122	2150	KING EDWARD DR	RENO	89503	FRED & FLORENCE	PURA	2150 KING EDWARD DR	RENO	NV	89503
251201	2155	KING RICHARD CT	RENO	89503	JANE A	HARRELL	2155 KING RICHARD CT	RENO	NV	89503
251202	2165	KING EDWARD DR	RENO	89503		FOX FAMILY TRUST	2165 KING EDWARD DR	RENO	NV	89503
251203	2175	KING EDWARD DR	RENO	89503	ERIC & LAURA L	RUUD	2175 KING EDWARD DR	RENO	NV	89503
251204	2185	KING EDWARD DR	RENO	89503	THERESA M	SMITH	2185 KING EDWARD DR	RENO	NV	89503
251205	2205	JESTER CT	RENO	89503	BELINDA G	IRVIN	2205 JESTER CT	RENO	NV	89503
251206	2225	JESTER CT	RENO	89503	NENA A	VALERA et al	5815 TAPPAN DR	RENO	NV	89523
251207	2245	JESTER CT	RENO	89503	YOSHIE	KADOWAKI et al	2245 JESTER CT	RENO	NV	89503
251208	2265	JESTER CT	RENO	89503	JESUS C	LANDEROS et al	2100 WINDSOR WAY	RENO	NV	89503
251209	2275	JESTER CT	RENO	89503	LEANNDRA	COPELAND FAMILY TRUST	808 CRAIN ST	CARSON CITY	NV	89703
251210	2285	JESTER CT	RENO	89503	MELISSA L	MORRISON	14460 RIM ROCK DR	RENO	NV	89521
251211	2295	JESTER CT	RENO	89503	PAUL	ADAMS	2295 JESTER CT	RENO	NV	89503
251212	2280	JESTER CT	RENO	89503	BENJAMIN J & DEBORAH A	MCALISTER	2280 JESTER CT	RENO	NV	89503
251213	2270	JESTER CT	RENO	89503	JACQUELINE G	TIBADUIZA TRUST	2270 JESTER CT	RENO	NV	89503
251214	2260	JESTER CT	RENO	89503	WILLIAM H	KELDERMAN et al	2260 JESTER CT	RENO	NV	89503
251215	2240	JESTER CT	RENO	89503	GARY D	MACLEAN	2240 JESTER CT	RENO	NV	89503
251216	2215	KING EDWARD DR	RENO	89503	DAVID E	CARLSON	7610 JASMINE CT	RENO	NV	89506
251217	2235	KING EDWARD DR	RENO	89503	JANET	WITT et al	2235 KING EDWARD DR	RENO	NV	89503
251218	2255	KING EDWARD DR	RENO	89503		MEGLAND LLC	PO BOX 127	BLUE DIAMOND	NV	89004
251219	2275	KING EDWARD DR	RENO	89503	KRISTINE & ANDREW	WISSEL	2275 KING EDWARD DR	RENO	NV	89503
251220	2285	KING EDWARD DR	RENO	89503	CURTIS L & MARY E	FREEMONT	2285 KING EDWARD DR	RENO	NV	89503
251221	2295	KING EDWARD DR	RENO	89503	JESSE R & KATHLEEN S	JENSEN	2295 KING EDWARD DR	RENO	NV	89503
251301	2290	KING EDWARD DR	RENO	89503	JENNIFER L	HINTON	2290 KING EDWARD DR	RENO	NV	89503
251302	2280	KING EDWARD DR	RENO	89503		TAH 2018-1 BORROWER LLC	1508 BROOKHOLLOW DR	SANTA ANA	CA	92705
251303	2270	KING EDWARD DR	RENO	89503	EVAN M	BREWER	2270 KING EDWARD DR	RENO	NV	89503
251304	2250	KING EDWARD DR	RENO	89503	NATHAN	CORONA	2250 KING EDWARD DR	RENO	NV	89503
251305	2240	KING EDWARD DR	RENO	89503	YOUNESS & LAVONNE	GHANAVATI	2240 KING EDWARD DR	RENO	NV	89503
251306	2230	KING EDWARD DR	RENO	89503	SALLY L	MYERS et al	PO BOX 5555	RENO	NV	89513
251307	2220	KING EDWARD DR	RENO	89503	SHARON L	BAIRD	2220 KING EDWARD DR	RENO	NV	89503
251308	2210	KING EDWARD DR	RENO	89503	LYNDSEY	DARROW et al	2210 KING EDWARD DR	RENO	NV	89503
251310	2190	KING EDWARD DR	RENO	89503	BARBARA M	KRAUSE	2190 KING EDWARD DR	RENO	NV	89503
251311	2180	KING EDWARD DR	RENO	89503	THOMAS J	BARRESI	1638 WHEATGRASS DR	RENO	NV	89509
251312	2160	KING EDWARD DR	RENO	89503	DINA	WARREN	2160 KING EDWARD DR	RENO	NV	89503
251313	2145	KING EDWARD DR	RENO	89503	STEPHEN B & TERESA L	ROTHSCHILD	2145 KING EDWARD DR	RENO	NV	89503
251314	2015	KING EDWARD CT	RENO	89503	STACEY L	SPAIN	2015 KING EDWARD CT	RENO	NV	89503
251315	2035	KING EDWARD CT	RENO	89503		HUMMEL & SKELTON FAMILY TRUST	2040 KING EDWARD CT	RENO	NV	89503
251316	2040	KING EDWARD CT	RENO	89503		HUMMEL & SKELTON FAMILY TRUST	2040 KING EDWARD CT	RENO	NV	89503
251317	2020	KING EDWARD CT	RENO	89503	LEE B & LILIAN T	DENT	2020 KING EDWARD CT	RENO	NV	89503
251318	2000	KING EDWARD CT	RENO	89503	CATHERINE M	GREENE	2000 KING EDWARD CT	RENO	NV	89503
251319	2005	KING EDWARD DR	RENO	89503	SARA & MIGUEL	MENDOZA	2005 KING EDWARD DR	RENO	NV	89503
251320	2035	SEVERN DR	RENO	89503		SIBLEY FAMILY TRUST	845 MOUNT ROSE ST	RENO	NV	89509

251321	2055	SEVERN DR	RENO	89503	JAMES G & KAREN A	HUDSON FAMILY TRUST	2055 SEVERN DR	RENO	NV	89503
251322	2075	SEVERN DR	RENO	89503	JODI	WALLACE	2075 SEVERN DR	RENO	NV	89503
251323	2085	SEVERN DR	RENO	89503	RODGER W & LORA A	STONE	2955 OUTLOOK DR	RENO	NV	89509
251324	2105	SEVERN DR	RENO	89503		HAUTE ROUTE RS LLC	2955 OUTLOOK DR	RENO	NV	89509
251325	2125	SEVERN DR	RENO	89503	LOIS & KEVIN	CRAIK	2125 SEVERN DR	RENO	NV	89503
251326	2145	SEVERN DR	RENO	89503	MELANIE	HEILIG et al	2145 SEVERN DR	RENO	NV	89503
251327	2165	SEVERN DR	RENO	89503	THEODOR M	MEEK	2165 SEVERN DR	RENO	NV	89503
251328	2205	SEVERN DR	RENO	89503	FRANK A & DARLENE D	EURONIS	2205 SEVERN DR	RENO	NV	89503
251329	1620	WYOMING AVE	RENO	89503	JOHN L	LASLEY	8825 WINTER PEACE CT	RENO	NV	89523
251401	1695	CROWN DR	RENO	89503	BEVERLY E	TAYLOR	1695 CROWN DR	RENO	NV	89503
251402	1685	CROWN DR	RENO	89503		BRADLEY FAMILY TRUST	2225 KEEVER CT	RENO	NV	89509
253101	2355	KEYSTONE AVE	RENO	89503	MELANIE B & DALLAS T	DUNLOP	8905 ARABIAN FILLY AVE	LAS VEGAS	NV	89143
253102	2345	KEYSTONE AVE	RENO	89503	DEREK A & STEPHANIE L	OLIJAR	2345 KEYSTONE AVE	RENO	NV	89503
253103	2335	KEYSTONE AVE	RENO	89503	DIANA	YORK 2018 FAMILY TRUST	2335 KEYSTONE AVE	RENO	NV	89503
253104	2325	KEYSTONE AVE	RENO	89503	TILDA	ROGNEY	2325 KEYSTONE AVE	RENO	NV	89503
253105	2315	KEYSTONE AVE	RENO	89503		MOON FAMILY TRUST	2315 KEYSTONE AVE	RENO	NV	89503
253106	2305	KEYSTONE AVE	RENO	89503	LEDA	MORA	2305 KEYSTONE AVE	RENO	NV	89503
253113	2255	PUTNAM DR	RENO	89503		SMITH LIVING TRUST	2255 PUTNAM DR	RENO	NV	89503
253115	2295	KEYSTONE AVE	RENO	89503		MOON FAMILY TRUST	2315 KEYSTONE AVE	RENO	NV	89503
253116	2275	KEYSTONE AVE	RENO	89503	SERGIO R & SANDRA H	LOPEZ	2275 KEYSTONE AVE	RENO	NV	89503
253117	2255	KEYSTONE AVE	RENO	89503	STEVEN & SUSAN	SMITH	2255 KEYSTONE AVE	RENO	NV	89503
253118	2235	KEYSTONE AVE	RENO	89503	KOURTNEY L	DAVIS	1601 ROCKY COVE LN	RENO	NV	89521
253119	2225	PUTNAM DR	RENO	89503		WESTRUP FAMILY TRUST	2225 PUTNAM DR	RENO	NV	89503
253120	2235	PUTNAM DR	RENO	89503	JOSEPH D	BRADSHAW	2235 PUTNAM DR	RENO	NV	89503
253121	2201	PUTNAM DR	RENO	89503	ELIZABETH A	BEDARD ESTATE	728 GLEN MEADOW DR	SPARKS	NV	89434
8263104	0	LEADERSHIP PKWY	RENO	89503		TRUCKEE MEADOWS WATER AUTHORITY	PO BOX 30013	RENO	NV	89520
8263105	0	MCCARRAN BLVD	RENO	89503		RENO CITY OF	PO BOX 1900	RENO	NV	89505
8263113	0	MCCARRAN BLVD	WASHOE COUNTY	89503		WASHOE COUNTY	1001 E 9TH ST BLDG A	RENO	NV	89512
8263114	0	LEADERSHIP PKWY	RENO	89503		LEADERSHIP MASTER LLC	11890 DONNER PASS RD # 4	TRUCKEE	CA	96161
8263115	0	LEADERSHIP PKWY	RENO	89503		LEADERSHIP MASTER LLC	11890 DONNER PASS RD # 4	TRUCKEE	CA	96161
8263126	3030	LEADERSHIP PKWY	RENO	89503		KEYSTONE CANYON LLC	11890 DONNER PASS RD STE 4	TRUCKEE	CA	96161
8263127	0	LEADERSHIP PKWY	RENO	89503		LEADERSHIP MASTER LLC	11890 DONNER PASS RD # 4	TRUCKEE	CA	96161

UTILITY SERVICES DEPARTMENT
1 East 1st Street, 7th Floor
PO Box 1900
Reno, NV 89505

September 17, 2021

West Wash Dam Rehabilitation Project

Notice of Public Scoping Meeting

Dear Representative,

You are invited to participate in the planning process for the West Wash Dam Rehabilitation Project in Northwest Reno. This notice is for a public scoping meeting on **October 19, 2021 from 6-8pm**. Due to the ongoing challenges and restrictions of COVID-19, this meeting will be held virtually. The meeting will take place via Zoom and can be joined by registering using the following link:
https://zoom.us/webinar/register/WN_b2vEBhrTQMingA3ib8BbPw

The purpose of the meeting is to inform the public about the planning effort and to scope issues to be considered during development of the Supplemental Plan and Environmental Document.

Project Description
West Wash Dam, in the Peavine Mountain Watershed of Washoe County, Nevada, is included in a United States Department of Agriculture Natural Resources Conservation Service (USDA NRCS) funded rehabilitation partnership project. The dam provides protection against flooding to about 30,000 Nevadans who live and work downstream. Additionally, the dam protects downstream city roads, one state highway, and an interstate highway. Among other critical infrastructure, the dam also protects power lines and railroad tracks.

West Wash Dam was constructed in 1960 under the direction and authority of the Watershed Protection and Flood Prevention Act (Public Law 83-566). East Wash Diversion Dam, constructed in 1961 under the same program, contributes storm water flow from Peavine Mountain Watershed into West Wash Dam. The original watershed plans for these dams used an evaluated life of 50 years. Having reached over 50 years in age, the dams are eligible for rehabilitation through the NRCS's Watershed and Flood Prevention Operations Program. The goals of the program include prevention of erosion, floodwater and sediment damage; to further the conservation, use and disposal of water; and to further the conservation and proper use of land in authorized watersheds.

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Project Location
The East Wash Diversion Dam is located at the intersection of Keystone Avenue and North McCarran Boulevard at the intersection of Township 20 North, Range 19 East, Sections 33 and 34 with Township 19 North, Range 19 East, Sections 3 and 4. Inflow to the East Wash Dam comes from 2.64 square miles of watershed on the southeast flank of Peavine Mountain. West Wash Detention Dam is located at the intersection of Wyoming and Gulling Streets at the intersection of Township 19 North, Range 19 East, Sections 3 and 4. Inflow to the West Wash Dam comes from approximately 3.56 square miles of watershed, which includes roughly 2.64 square miles of East Wash Dam's watershed.

For additional project information please go to:
Reno.gov/WestWashDamRehabilitationProject.

The public is welcome to participate in this project to learn about soil and water conservation issues, express views, and to participate throughout the decision-making process related to proposed actions in the West Wash Dam Rehabilitation Project. Written questions and comments may be submitted by mail or email to City of Reno Project lead, Steve Gamilis. The subject line should include "**West Wash Dam Rehabilitation Project**."

Steve Gamilis
Project Coordinator
City of Reno
Utility Services Department
PO Box 1900
Reno, NV 89505
Email: gamiliss@reno.gov
Office (775) 334-2461

Sincerely,

Steve Gamilis

Steve Gamilis
Project Coordinator
City of Reno
Utility Services Department

20 Years!
FARR WEST
ENGINEERING
5510 Longley Lane
Reno, NV 89511
(775) 851-4788
www.farrwestengineering.com

N

1" = 500'

Scoping:
Project Location Figure

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

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West Wash Dam Rehabilitation Project Schedule

Event	Date	Description
Public Scoping meeting	October 19, 2021	Project Scoping to identify all reasonable alternatives and collect public comment
Public Comment ends	December 19, 2021	Invitation and Acceptance of public comments and questions regarding scoping
Draft Environmental Document available for review	July 2022	Notice of Availability of this draft document will be published for the public and sent to interested parties
Public comment	July 2022-September 2022	Collection of all public comments and questions, which will be incorporated in the final environmental document.
Publish Final Environmental Document	October 2022	Availability of this document will be provided to the public
Record of Decision or FONSI issued by NRCS	November 2022	Will be noticed to the public
Project Design	2023-2024	Tentative schedule, actual timing depends on selected project alternative.
Construction Start	2025	Tentative schedule, actual timing depends on selected project alternative, and construction variables.

United States Department of Agriculture

NRCS

Natural Resources Conservation Service
1365 Corporate Blvd.
Reno, NV 89502
Telephone: (775) 857-8500 ext.132
Fax: (775) 857-8525

April 23, 2015

Attn: Jessica Axsom
Nevada State Historic Preservation Office
Department of Conservation and Natural Resources
901 S. Stewart Street, Suite 5004
Carson City, Nevada 89701

Re: West Wash Detention Dam Rehabilitation Project

Dear Jessica:

The Natural Resources Conservation Service (NRCS) is involved with a Preliminary Draft Plan Environmental Assessment (PLAN-EA) for the West Wash Detention Dam Rehabilitation Project. For this undertaking, the NRCS is providing technical and financial assistance to the City of Reno to rehabilitate the West Wash Dam so that is meets current USDA-NRCS and Nevada Dam Safety regulations and current engineering standards. The dam was constructed in 1960 as a Class "C" (high) hazard site, meaning there was a high probability of loss–of-life if the dam should fail. The dam was planned and constructed for the primary purpose of flood control. It was designed to have a 50-year economic life This NRCS undertaking will extend the life of the dam to continue to provide economic benefits through the flood damage reduction potential and sediment accumulation.

The project location legal location is:

T19N; R19E
Sections 3, 4
Reno 7.5' quadrangle map

The consulting firm Amec Foster Wheeler Environmental Infrastructure (AMEC Foster) completed the Preliminary Draft Plan Environmental Assessment (EA) for the project. To complete the cultural resource section of the EA, Amec Foster has done a literature review (see attached letter report) and recommended to the NRCS that depending upon which PLAN-EA alternative is selected there will be impact to the West Wash Dam. They have further determined that the West Wash Dam is over 50 years old.

At this point the areas of potential effect of the proposed project are unknown. Once the design for the project has been determined the NRCS will initiate Section 106 compliance under the National Historic Preservation Act (NHPA) [36 Code of Regulations (CFR) Part 800, as amended].

Though the project is not within the boundaries of any formally recognized tribal lands, as a federally-funded and sponsored project, government-to-government consultation would allow local Native American groups the opportunity to comment on the project's possible effects to traditional cultural properties.

The project area is within the territory traditionally associated with the Washoe people. The Truckee Meadows is also known to have been used by several Northern Paiute bands. Given that both groups have occupied the project area, they may have input regarding the project alternatives.

The following local tribes have been identified and were included in the notification of the scoping meeting and will be included in distribution of the draft EA submittal for comment:

- The Tribal Councils of the Washoe Tribe of Nevada and California;
- The Reno-Sparks Indian Colony; and
- The Pyramid Lake Paiute Tribe

Please provide the NRCS with any comments that you may have. If you have any questions or concerns please contact me at (775) 857-8500 ext 132 or email at charles.armitage@nv.usda.gov .

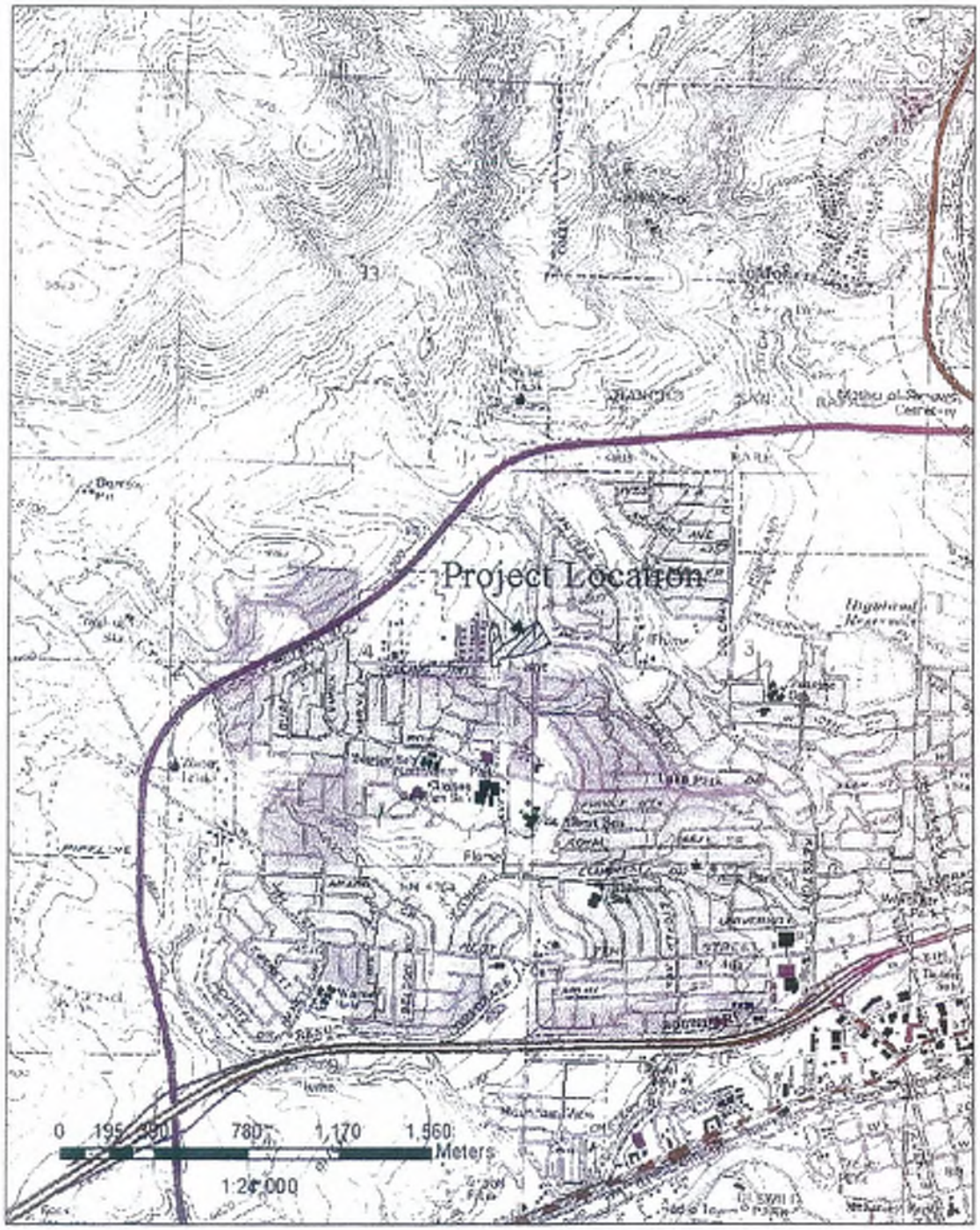
Sincerely;

Charles Armitage

Charles L. Armitage; PhD.
NRCS State Cultural Resources Specialist/Archaeologist

cc: William D. Elder, NRCS, State Resource Conservationist, Reno
Glen Daily (City of Reno)
Deborah Farris (DSE)
Cathy Dougherty (DSE)

Attachment 1. Letter report concerning the results of the literature review Amec Foster conducted for the West Wash Detention Dam Rehabilitation Project.
Attachment 2. Map showing project location.


Project Location
0
195
390
780
1,170
1,560
Meters
1:24,000

April 23, 2015

Attn: Jessica Axsom
Nevada State Historic Preservation Office
Department of Conservation and Natural Resources
901 S. Stewart Street, Suite 5004
Carson City, Nevada 89701

RE: West Wash Detention Dam Rehabilitation Project

Dear Jessica:

As part of the Natural Resources Conservation Service (NRCS) effort to prepare the cultural resources section of the Preliminary Draft Plan Environmental Assessment (PLAN-EA) for the West Wash Detention Dam Rehabilitation project proposed in Reno, Nevada, Amec Foster Wheeler Environmental Infrastructure, Inc. (AMEC Foster) conducted a literature review and record search for cultural resources at Nevada state and local repositories. The following describes the cultural resources Amec Foster identified (Table 1, Table 2, and Table 3) and information provided to the NRCS during the review. The literature review identified previously recorded archaeological sites that are located within a one-mile radius of the West Wash Detention Dam (West Wash Dam). Once the West Wash Dam project areas of potential effect have been determined Section 106 compliance , under the National Historic Preservation Act (NHPA) [36 Code of Regulations (CFR) Part 800, as amended] will be completed.

1.1 Purpose and Need

The West Wash Dam is over 50 years old, in fair condition and is satisfactory for its intended use based on visual inspection and review of available historical documentation. According to annual inspection reports, the dam embankment and associated primary and secondary spillways appear free from any major deficiencies. According to the 2011 Dam Assessment Report, conducted by HDR Engineering, Inc., although the condition is listed as fair, meaning that although the dam exhibits signs of normal aging and no major deficiencies are visibly present, the emergency spillway discharges directly into a residential neighborhood and previous modeling efforts indicate that dam-overtopping will occur in a probable maximum flood (PMF) event. A PMF is the largest flood that could potentially occur at a particular location. It is usually an estimate based on maximum precipitation conditions, snow melt, and flooding.

The purpose of the proposed project is to provide increased flood protection, by dam rehabilitation, to the downstream communities within the City of Reno in accordance with current USDA-NRCS and Nevada Dam Safety standards and performance criteria. Action is needed to address the public health and safety issues related to the potential for water flows to overtop the existing dam embankment during a PMF event and the need to bring the existing dam embankment and emergency spillway into compliance with current federal and state safety standards. The proposed project involves rehabilitating the West Wash Dam by raising the top of the dam by approximately 4.6 feet and repairing and armoring the deficient sections of the channel embankment. These

improvements would ensure West Wash dam complies with current USDA-NRCS and Nevada Dam Safety standards and reduces the likelihood of potential dam failure during the PMF.

A Photo Log provided by Amec Foster showing the West Wash Dam and basin area from ground level and overhead, a close up view of the Dam area to be modified, a close-up ground-level view of the Emergency Spillway and Dam, as well as and overhead view of the area of "recommended improvements" is included at the end of this letter report.

1.2 Proposed Alternatives

NRCS is in the process of preparing a Draft Environmental Assessment (EA). The EA will evaluate a number of potential resources. SHPO will be copied on all draft, final and/or FONSI submittals. Currently, the EA addresses four Alternatives, which include one "No Action," two separate actions and a fourth action to simultaneously complete both separate actions at the same time. This fourth action is considered to be the "Preferred Action" due to the fact that both separate actions will need to be completed eventually in order for the West Wash Dam to comply with safety standards and provide increased flood protection.

Alternative 1 – No Action

Under this alternative, the USDA-NRCS and the City of Reno would continue to operate and maintain the West Wash Dam "as is" under existing conditions. This alternative would not conform to current NRCS Dam standards. This alternative does not necessitate any capital improvement costs or repairs and would continue to provide the current level of flood protection. This alternative also represents a future scenario where the existing dam embankment could fail during an extreme flood event. According to the NEPA, a "No Action Alternative" must be evaluated.

Alternative 2 – Repairing & Armoring the Emergency Spillway

Historical photographs indicate that prior to 1978 an approximate 12-foot long section of the western bank of the emergency spillway was temporarily breached for road or utility construction (possibly a sanitary sewer line), across the historical path of Gulling Road east of Severn Drive. Since the road and utility construction, site inspections show that the western bank of the emergency spillway was never properly re-constructed. This deficiency has exposed adjacent homeowners, who would be protected by the originally designed emergency spillway, to a flooding hazard during large and extreme storm events. Additionally, the current configuration of the emergency spillway needs to be repaired and rehabilitated. The sides of the channel (1 horizontal:1 vertical) are steeper than those currently recommended for unprotected earthen slopes (3:1 preferred, 1.5:1 sometimes utilized), and exhibit numerous signs of sloughing. To preserve the design intent of the emergency spillway embankment, this alternative involves repairing and armoring the deficient sections of the channel embankment to match the adjacent sections of the channel embankment. This alternative also includes the implementation of common operation and maintenance structure repairs, retrofits, and modifications. All repair and armor modifications under this alternative would be constructed in accordance with established USDA-NRCS and Nevada Dam Safety standards and current engineering requirements. While this alternative would improve flood protection it would not fully comply with USDA-NRCS and Nevada Dam Safety standards.

During very large and extreme events, such as the PMF, high velocity spillway discharges could occur. During the PMF, approximately 10-foot flow depths and 12-foot per second velocities could occur within the emergency spillway. Such conditions could create tractive forces, which could readily erode earthen material. This erosion could compromise private property adjacent to the spillway, as well as compromise the dam embankment. Therefore, under this alternative, the slopes and the bottom of the channel would be protected with revetment, or other sloping and armoring structures, to improve stabilize the area from erosion. This alternative would also involve the implementation of long-term operation and maintenance structural repairs and retrofits.

A common revetment to repair and armor the emergency spillway may consist of 6-inch thick slab-on-grade reinforced concrete with a minimum of 3-foot deep cut-off walls along all four edges of the structure. An alternative may include the installation of an, articulated concrete block, also known as cabled concrete. An articulated concrete block would provide sufficient protection against erosion, while still allowing for differential settlement. Further, each revetment structure would include void spaces to allow for native vegetation to grow up through it, effectively discouraging pedestrian traffic and helping to hide the material.

Under Alternative 2, common long-term operation and maintenance structural repairs and retrofits would include restoring the spillway to match as-built engineering plans, armoring spillway embankments, installing maintenance access, improving conduit outlet structures, and re-surfacing the dam crest. Given that road and utility construction and soil erosion have occurred over time, rehabilitation activities would involve the removal and replacement of sloughed material from the spillway embankment and repairing the west embankment where a sanitary sewer line was constructed under the spillway. Rehabilitation and maintenance would involve armor spillway embankment stabilization to prevent erosion. This activity would occur concurrently with the installation of reinforced concrete or cabled concrete blocks. Specific rehabilitation and maintenance would also include constructing a permanent maintenance access point at the downstream end of the culvert to facilitate routine inspections and improving conduit outlet structures and other intake structures in the drainage basin. Further, rehabilitation would include paving the dam crest, or the top of the dam, to prevent and reduce soil erosion related to pedestrian traffic.

The recommendation to repair and armor the emergency spillway is based on engineering judgment and the findings of the 2011 Dam Assessment Report, given that the spillway is earthen, contains over-steep side slopes, and is situated adjacent to residential development. According to the State of Nevada Dam Safety Guidelines for Spillway Design, if the banks of the spillway are made of erosive material, provision must be made for their protection. Further, these guidelines state consideration must be given to the hazard to human life and potential property damage that may result from the failure of the dam or excessive flow rates through the spillway. As a result, this alternative involves substantial repair and armoring to the existing emergency spillway in order to restore the deficient sections of the channel embankment to match the sections of the channel embankment that are in acceptable condition. This alternative would also help to reduce damage to nearby adjacent homes during emergency spillway discharge and would stabilize the emergency spillway so as to provide protection against dam failure.

Alternative 3 – Raising the Top of the Dam

This alternative would involve raising the top of the dam by adding new fill material both upstream and downstream of the dam embankment. The design concept involves increasing the height of the dam by approximately 5 feet by adding new fill material to the downstream and upstream face of the dam, moving the existing dam crest to the southeast, constructing two new 5-foot wide benches on the downstream face, and constructing a 5-foot high retaining wall along the west face of the existing dam. The design modification would be implemented to preserve storage volumes upstream of the dam and protect downstream development during large and extreme storm events. This alternative also includes the implementation of common operation and maintenance structure repairs, retrofits, and modifications. This alternative would be constructed in accordance with established USDA-NRCS and Nevada Dam Safety standards and current engineering requirements. While this alternative would improve flood protection, it would not fully comply with USDA-NRCS and Nevada Dam Safety standards.

According to the 2011 Dam Assessment and the Nevada Administrative Code (NAC), the existing dam embankment must be increased 4.6 feet in height. To preserve storage volumes upstream of the dam, all new fill material would have to be added to the downstream face, and the 3:1 upstream dam face would have to be extended upward. Once the fill material is added, the existing dam crest would be relocated to the southeast of its current location. The two new 5-foot wide benches would be included on the downstream face, as sufficient room exists between the current dam toe and Wyoming Street/Putnam Avenue to accommodate the additional fill for a new 2:1 sloped downstream dam face. Also, a 5-foot high retaining wall would be constructed along the west fences of both 2680 Polk Street and 1401 O'Farrell Street. The transition from the earthen dam embankment into the emergency spillway berm along the southwest side would be elevated and the berm would be extended to the south towards 1885 Becky Court. Extending the transition from the dam embankment to the emergency spillway berm would ensure spillway flows do not flow down the embankment or the historic path of Gulling Road.

Similar to the rehabilitation activities that would occur under Alternative 2, common long-term operation and maintenance structural repairs and retrofits under Alternative 3 would include restoring the spillway to match as-built engineering plans, armoring spillway embankments, installing maintenance access, improving conduit outlet structures, and resurfacing the dam crest. Given road and utility construction and soil erosion have occurred over time, rehabilitation activities would involve the removal and replacement of sloughed material from the spillway embankment and repairing the west embankment where a sanitary sewer line was constructed under the spillway. Rehabilitation and maintenance would involve armor spillway embankment stabilization to prevent erosion. This activity would occur concurrently with the installation of reinforced concrete or cabled concrete blocks. Specific rehabilitation and maintenance would also include constructing a permanent maintenance access point at the downstream end of the culvert to facilitate routine inspections and improving conduit outlet structures, and other intake structures in the drainage basin. Further, rehabilitation would include paving the dam crest, or the top of the dam, to prevent and reduce soil erosion related to pedestrian traffic.

Assuming the structural integrity of the West Wash Dam holds up during a major storm, this alternative would contain the PMF within the dam drainage basin without overtopping. By

containing the PMF without overtopping, the potential for dam failure is reduced. This alternative would bring the West Wash Dam into compliance with established USDA-NRCS and Nevada Dam Safety standards and current engineering requirements.

Alternative 4 – (Preferred Action) Combination of Raising the Top of the Dam and Repairing & Armoring the Emergency Spillway

The preferred alternative is the proposed action the lead agency, the USDA-NRCS, and the sponsoring local agency, the City of Reno, agree would meet their statutory mission and responsibilities. In selecting the preferred alternative, the USDA and the City of Reno consider economic, environmental, engineering and design factors and the requirements of the EWP program.

Alternative 4 would involve both raising the top of the dam and constructing dam and spillway upgrades. The combination of modifications would ensure the dam structure meets current dam safety regulations and engineering standards. Alternatives 2 and 3, described above, if developed independently would not provide a comprehensive solution to protect against dam breach during major storms. Spillway improvements without inclusion of raising the top of the dam present a scenario where dam overtopping could occur. Dam overtopping presents a significant threat of rapid dam failure. Likewise, raising the dam without inclusion of emergency spillway improvements presents a scenario where, during large and extreme storms, erosion of the dam embankment could occur. Further, raising the top of the dam without emergency spillway improvements could cause significant erosion of the dam embankment, which, in turn, would pose a serious threat of rapid dam failure. Alternative 4, the combination of raising the top of the dam by approximately 4.6 feet and repairing and armoring the deficient sections of the channel embankment, presents a coordinated approach to bringing the West Wash Dam into compliance with current USDA-NRCS and Nevada Dam Safety standards and reducing damage and a potential dam failure during the PMF. Alternative 4 also includes the implementation of the same common operation and maintenance structure repairs, retrofits, and modifications that would be implemented under Alternatives 2 and 3.

1.4 Record Search Results

In March 2015, Amec Foster conducted a records search and literature review several state and local repositories, including:

- Nevada Cultural Resources Information System (NVCRIS) maintained by the SHPO;
- Nevada Historical Society;
- Washoe County Assessor's Office;
- University of Nevada, Reno (UNR) Library;
- Special Collections at UNR Library; and
- Online repositories for historic land surveys and maps and maintained by the Bureau of Land Management (BLM) and UNR.

The boundary for the record searches extended one mile from the West Wash Dam. The literature review included information about general Reno history, as well as the vicinity of the West Wash

Dam. The dam (constructed in 1962) is not within any previously established historic districts, and the dam has not been evaluated for the National Register.

Archaeological and Architectural Reports

The results of the NVCRIS search Amec Foster completed on March 20, 2015 are summarized below. A total of 13 archaeological reports have been completed within one mile of the West Wash Dam (see Table 1 and Figure 1).

A total of five architectural reports have been completed within one mile of the West Wash Dam (see Table 2 and Figure 2). The Watershed Work Plan for the Peavine Mountain Watershed (Report no. 16-346) includes the West Wash Dam. It was completed in 1958 (prior to the passage of

Table 1. Archaeological Reports Completed Within One-Mile of West Wash Dam

Report No.	Date	Title	Author
16-346	1958	Watershed Work Plan, Peavine Mountain Watershed, City of Reno, Washoe County, Nevada	Shutler, R.
16-41/3-409	1976	Report of Preliminary Archeological Reconnaissance: Preliminary Archeological Reconnaissance of the Ring Road from U.S. 40 N & E T U.S. 395 Nevada Highway Dept. RS-Su-821(5) Ea# 70473	Townsend, G., and C. Covington
16-157/3-227	1978	Cultural Resources Report: Tup 030-203, Reno Hills Limited Partnership: Cr Report #: 3-227(N) (from NADB)	Pinzl, J. J.
16-303/3/1103	1986	NDOT Cultural Resources Report	Bunch, J.
16-521	1991	Murphy Brothers Construction Co. Housing Development	Momteleone, S.A.
16-707	1994	A Class III Cultural Resource Inventory of the Proposed Verdi Gas Pipeline Loop for Sierra Pacific Power Co., Washoe County, Nevada	Mariah Associates, Inc.
16-858/ TY-99-1289	1999	USFS Heritage Resources Negative Inventory Report: Peavine Map Project	Birk, T.
DBI-NV-2008-43	2007	Keystone Non-Motorized Area Fencing and Hiking Trail Construction	Garrotto, J.
DBI-NV-2007-378	2007	The Peavine Rock Art Restoration and Exclosure Fence Project	Garrotto, J., and F. Frampton
TY97-1196	–	No info	–
R200804170186 9	2008	A Cultural Resources Inventory for Sierra Pacific Power Company #141 Line Rebuild Project, Washoe County, Nevada	Drewn, M.

Report No.	Date	Title	Author
6003	2010	Cultural Resources Inventory for Washoe County Department of Regional Parks and Open Space, Rancho San Rafael Regional Park Northern Region Trail Maintenance, Washoe County, Nevada	Bennett, L.
5566/ WA 10-011R	2010	An Archaeological Assessment for the I-80 Corridor, Robb Drive to Vista Boulevard Project	Smith, B. P.

NHPA) and did not involve an archaeological survey. Two architectural inventories have been completed that include the West Wash Dam within its inventory boundary. However, the scope of work for the inventories were limited to specific topics (river rock structures in Reno and Sparks and architecture designed by Frederick DeLongchamps) and did not include the West Wash Dam (Lockett and Pierce 1984; Porter 1986).

Table 2. Architectural Reports Completed Within One Mile of West Wash Dam

Report No.	Date	Title	Author
A_426 (WAS-HAR-1996)	1996	Sierra Pacific Power Company Highland Water Treatment Plant Conversion Project, Cultural Resources Investigation, Final Technical Report	Brown, J. L.
A_473 (WAS-LOC-1984)	1984	Survey of River Rock Structures in Reno and Sparks, Nevada	Lockett, C., and C. Pierce
A_624 (WAS-POR-1986-00)	1986	Revised Nevada State Historic Preservation Plan DeLongchamps Study Unit	Porter, J.
A_637 (WAS-AND-1984-0000)	1984	Family Locally Operated Grocery Stores in Reno and Sparks, Washoe County, Nevada	Anderson, J.
5207	2010	Intersections Along I-80, from Robb Drive to Vista Boulevard	Mactec Engineering and Consulting, Inc., and NDOT

Recorded Archaeological Sites and Architectural Resources

Seventeen archaeological sites have been recorded within one mile of the West Wash Dam (see Table 3 and Figure 3).

Table 3. Sites within One Mile of West Wash Dam

Site No.	Agency No.	Age	Description	NRHP Eligibility
26WA1401	CrNV-03-999	Prehistoric	Lithic scatter with Martis point	No info
26WA1404	CrNV-03-1001	Prehistoric	No info	No info

Site No.	Agency No.	Age	Description	NRHP Eligibility
26WA1602	CrNV-03-2606	Prehistoric	Camp	No info
26WA1675	CrNV-31-853	Historic	House foundation	No info
26WA1696	CrNV-03-854	Prehistoric	Lithic scatter	No info
26WA1697	CrNV-03-855	Prehistoric	Lithic scatter	Eligible
26WA1698	CrNV-03-856	Prehistoric	Lithic scatter	No info
26WA1700	CrNV-03-858	Prehistoric	Lithic scatter	Eligible
26WA3215	–	Prehistoric	Rock art with talus pits	No info
26WA5365	CrNV-16-552	Historic	Trash concentration	Non-significant
26WA5888	CrNV-16-702/ TY-3780	Prehistoric/ Historic	Prehistoric Camp/ Historic Isolate	Eligible
26WA6678	–	Prehistoric	Lithic Scatter	Non-significant
26WA6679	–	Prehistoric	Lithic Scatter	Non-significant
26WA7186	–	Historic	Roadside trash scatter	Non-significant
26WA7242	CrNV-16-1106/ TY-5334	Prehistoric	Toolstone source	Non-significant
26WA9070		Prehistoric	Lithic scatter	Non-significant
–	CrNV-16-750/ TY94-1032	No info	No info	No info

Nine architectural resources have been recorded within one mile of the West Wash Dam (Table 4).

Table 4. Architectural Resources within One Mile of the West Wash Dam

SHPO ID	Historic Name	Current Name	Resource Type	Style	Date	NRHP Eligibility
B2521	Nelson House	Potter House	Building	No Style Stated	1932	Eligible
B2522	Pistone House	McKeon House	Building	No Style Stated	1928	Eligible
B4286	L. H. Arvin House	Unknown	Building	Post-World War II - Ranch	1953, 1954	No Info
B4316	L.D. Graham - servants' quarters	Sigma Nu Complex	Building	No Style Stated	Unknown	No Info
B4404	Barnes Cash Grocery	Unknown	Building	No Style Stated	Unknown	No Info
B10589	962 W. 7th Street	962 W. 7th Street	Building	Minimal Traditional	1920	Ineligible

SHPO ID	Historic Name	Current Name	Resource Type	Style	Date	NRHP Eligibility
B10593	660 Alvaro Street	660 Alvaro Street	Building	Early 20th Century American Movements - Craftsman	1936	Ineligible
B10594	670 Alvaro Street	670 Alvaro Street	Building	Late Victorian - Second Empire	1875	Eligible
S95	Highland Reservoir	Highland Reservoir	Structure	No Style Stated	1879, 1887, 1905, 1939	Eligible

An archaeological survey for the northwest portion of McCarran Boulevard conducted in 1976 by the Nevada Archaeological Survey (NAS) identified three archaeological sites north of the West Wash Dam (FHA and NDOT 1977). The sites were tested in 1977 by the Nevada State Highway Department (now the Nevada Department of Transportation [NDOT]) and two of the sites (26WA1697 and 26WA1700) were determined to be eligible for the NRHP. Site 26WA1697 (located just outside the northwest edge of the West Wash Dam) is a prehistoric base camp that contained at least three rock-lined hearths and a surface scatter of flakes, groundstone, and other tools. Site 26WA1700 was a surficial lithic scatter and rock alignment. Both were within the right-of-way for McCarran Boulevard and were completely removed during construction of the road.

Potential Cultural Resources

Based on the archival research and literature review, there are several potential cultural resources that are 50 years old or older within the vicinity of the West Wash Dam, including the Highland Ditch, the West Wash Detention Dam, the East Wash Diversion Dam, and surrounding single-family residences.

The West Wash Detention Dam, including both structural and non-structural components, was completed in 1962. The West Wash Detention Dam is a small earthen dam facility with a reservoir that does not normally contain water on a permanent basis. The East Wash Detention Dam, which diverts water into the reservoir behind the West Wash Detention Dam, was completed during the same time. Both dams were conceived as a way to protect the rapidly developing City of Reno from the impacts of flood events that originated within the Peavine Watershed. Several damaging floods in the 1950s prompted local officials to initiate a number of flood control projects along the Truckee River and in the surrounding area in the 1950s and 1960s (Bledsoe 2015; City of Reno 1958). The West Wash Detention Dam and the East Wash Detention Dam were designed as part of a system of three flood control dams and a flood control dam with a diversion channel to reduce flood flows and sediment deposition from the Peavine Watershed.

To be eligible for the NRHP, a cultural resource must be over 50 years old (unless the property is of exceptional significance) and meet at least one of the following eligibility criteria:

- Criterion A establishes whether a property can be "associated with events that have made a significant contribution to the broad patterns of our history;"
- Criterion B establishes whether a property is "associated with the lives of persons significant in our past;"
- Criterion C establishes whether a property "embodies the distinctive characteristic of type, period, or method of construction that represent the work of a master or that possesses high artistic value, or that represent a significant and distinguishable entity whose components may lack individual distinction;" or
- Criterion D establishes whether a property has "yielded or may be likely to yield, information important in prehistory or history" (Andrus and Shrimpton 2002).

Based on the results of the record search and the literature review, the Highland Ditch, the West Wash Detention Dam, and the East Wash Diversion Dam have the most potential to be recommended as eligible for the NRHP. Because these resources have not been formally recorded or evaluated with respect to their NRHP eligibility, the following potential eligibility discussion is based on the information that was gathered during the informal record search and literature review.

The West Wash Detention Dam and the East Wash Detention Dam are generally associated with the development of the City of Reno and, in particular, the series of flood control projects that were initiated as a response to large flood events in the 1950s. As such, the West Wash Detention Dam and the East Wash Detention Dam could be recommended as eligible under Criterion A for their association with the continuing development of the City of Reno. Based on the record search, neither the West Wash Detention Dam nor the East Wash Detention Dam appear to be directly associated with a significant individual (Criterion B). As constructed features, their eligibility under Criterion C could also be considered, though, based on the record search results, they do not appear to be unique or distinctive with respect to their architectural elements. It is also not likely that either detention dam could yield additional information important in prehistory or history (Criterion D).

1.6 Evaluation of Project Alternatives

To appropriately evaluate the alternatives in accordance with Section 106 of the NHPA, official eligibility determinations should be made for the cultural resources identified within the project area. Further consultation with the Nevada SHPO and applicable Native American Tribes is also recommended to confirm eligibility determinations. Based on the results of consultation and possibly a cultural resources pedestrian survey, the project alternatives can be evaluated for a "determination of effect" for the proposed actions under each alternative.

The following is a preliminary analysis of the environmental consequences that may occur from each alternative identified in the Draft EA. This analysis relies on the information that has been identified through a records search and literature review. It does not account for any potentially unidentified cultural resources that could be discovered through a pedestrian survey and Section 106 consultation.

Alternative 1 – No Action
Under the No Action alternative, there would be no direct impacts to existing archaeological or historic architectural resources at the project site, other than from routine maintenance and repair activities. The West Wash Detention Dam would continue to be used and maintained in its current state. There would be no impacts to the West Wash Detention Dam or East Wash Detention Dam.

Alternative 2 – Repairing and Armoring the Emergency Spillway
Under Alternative 2, repairing the emergency spillway would result in direct impacts to the West Wash Detention Dam. Alternative 2 would involve restoring the spillway to match as-built engineering plans, armoring the spillway embankments, installing maintenance access, improving conduit outlet structures, and resurfacing the dam crest with concrete. These actions would result in impacts to the West Wash Detention Dam.

Alternative 3 – Raising the Top of the Dam
Under Alternative 3, operation of the raised West Wash Detention Dam would result in direct impacts to the dam. The height of the dam would be raised approximately five feet by adding new fill material to the downstream and upstream face of the dam. This would result in moving the dam crest to the southeast. In addition, two new five-foot wide benches would be constructed on the downstream face and a 5-foot high retaining wall would be constructed along the west face of the existing dam. These modifications would alter the massing, height, construction materials, and appearance of the dam. Most of these impacts will be extremely beneficial to dam functionality.

Alternative 4 – (Preferred Action) Combination of Raising the Top of the Dam and Repairing and Armoring the Emergency Spillway
Under Alternative 4 (which includes activities proposed under both Alternatives 2 and 3 to be completed simultaneously), the repairs to the spillway and the operation of the raised dam would directly impact the West Wash Detention Dam, as previously discussed. By combining Alternatives 2 and 3, the project will likely be more cost effective, as well. No specific engineered design has been decided on, at this time.

1.7 Potential Mitigation Measures

The following mitigation measures could be enacted to avoid or reduce the potential impacts of the proposed alternatives.

1.7.1 During the final planning and design for the rehabilitation of the West Wash Detention Dam, the USDA-NRCS State Conservation Engineer and the City of Reno Public Works Department can select design concepts and Best Management Practices (BMPs) that incorporate construction materials that are resistant to graffiti and similar in appearance to the existing dam.

1.7.2 To prevent the accumulation of debris and graffiti on the potential concrete surfaces of the dam structure, the City of Reno could incorporate the following or similar measures, if not already addressed, into their Annual Operation and Maintenance Plan:

a. Every concrete structure shall be maintained in a safe and satisfactory condition, and generally, free from graffiti, debris, trash, overgrown vegetation, or other forms of vandalism.
b. A system of notification can be developed to address complaints of clearly visible trash, graffiti, or over grown vegetation in a timely fashion.
c. As a long-term measure, the City of Reno could incorporate a public art program within the West Wash Detention Dam and Reservoir area and on the facility structures, where appropriate and feasible. The City could also integrate the art into the rehabilitated structures and concrete armoring, as long as the art does not affect dam or spillway functionality.

17.3 During construction, the USDA-NRCS and the City of Reno, in coordination with the construction contractor, should implement the following plans due to the fact that there was no baseline study available that includes the project area:

a. Ensure that all site workers have awareness and sensitivity of the potential to discover artifacts, features, or other potentially culturally significant items;
b. Address and develop procedures to be followed in the case of unanticipated buried cultural or paleontological resources during ground-disturbing activities;
c. Establish that if an unanticipated discovery occurs, work shall stop in that area and within 100 feet of the resource until a qualified archaeologist or paleontologist can assess the significance of the resource; and
d. Notify the USDA-NRCS, City of Reno, the Nevada SHPO, and other appropriate agencies, immediately so that responsible treatment can be completed.
e. The use of BMPs such as slope stabilization and erosion and sediment control could help mitigate any possible indirect impacts to cultural resources that are adjacent to the construction footprint.
f. Construction specifications should contain provision for minimizing subsurface disturbance by use of temporary gravel roadways or other additions.

The implementation of these mitigation measures would avoid or minimize potential subsurface resources and lower the risk of adverse effects to potential cultural resources within the project area, as no excavation or subsurface disturbance is planned with any Alternative.
If you have any questions concerning the records search and literature review summarized in this letter, please contact Ms. Juliana Prosperi (Project Manager) at (303) 503-7794 or Ms. Sarah Branch (Registered Professional Archaeologist) at (775) 326-5364.

Sincerely;

Charles L. Armitage; PhD.
NRCS State Cultural Resources Specialist/Archaeologist

cc: William D. Elder, NRCS, State Resource Conservationist, Reno

Attachments: Photo Log
Figure 1. Locations of Existing Archaeological Inventories
Figure 2: Locations of Existing Architectural Inventories
Figure 3: Locations of Existing Cultural Resources

References

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Timko, S. 2008. Water Supply Safe Despite Flume Break. Reno Gazette Journal 4 April. Reno, Nevada.

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PHOTO LOG

PHOTO 1 ►

View of West Wash Dam basin from north end, off Van Ness Avenue.

Taken by: Curtis Franklin
Date: August 13, 2014
Direction: South

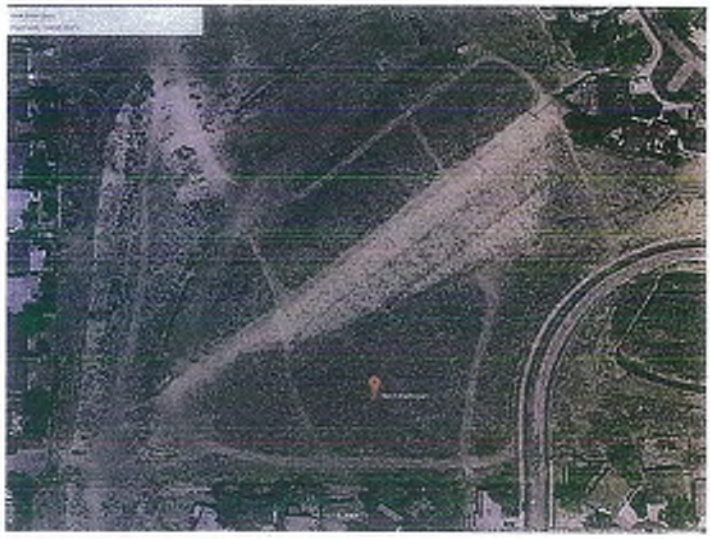
PHOTO 2 ►

Overhead view of West Wash Dam.

Taken by: Google Maps
Date: April 2015
Direction: Overhead

PHOTO 3 ►

Close up of Dam area to be modified.



Taken by: Google Maps
Date: April 2015
Direction: Overhead

PHOTO LOG

PHOTO 4 ►

Emergency Spillway and Dam, from West Crest of Emergency Spillway

Source: USDA NRCS May 2011 West Wash Dam Assessment Report

Taken by: HDR Engineering, Inc.
Date: May 2011
Direction: Northeast

PHOTO 5 ►

West Wash Dam Recommended Improvements

Source: USDA NRCS May 2011 West Wash Dam Assessment Report

Prepared by: HDR Engineering, Inc.
Date: May 2011
Direction: Overhead

January 12, 2022

Attn: Ashley Wiley
Nevada State Historic Preservation Office
Department of Conservation and Natural Resources
901 S. Stewart Street, Suite 5004
Carson City, Nevada 89701

Re: Section 106 Consultation: West Wash Dam Project NRCS 22WA01

Dear Ashley:

Enclosed find a copy of a cultural resource report titled **"Cultural Resources Inventory Report for the West Wash Dam Supplemental Watershed Plan Project, Reno, Nevada"**. This report is for NRCS Project 22WA01 West Wash Dam Watershed Project. The cultural resource survey and report was completed by Broadbent and Associates, Reno, Nevada, (Broadbent) for the City of Reno, Farr West Engineering, and the Natural Resources Conservation Service. The Natural Resources Conservation Service, Nevada, is the lead federal agency for this project.

The City of Reno (City) has entered into an agreement with the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) to rehabilitate the West Wash Dam and East Wash Dam in northwest Reno, Nevada to meet current NRCS, City, and State of Nevada Division of Water Resources (DWR) dam safety criteria and performance standards.

The project is in northwest Reno, Nevada, at the intersection of Wyoming Avenue and Putnam Drive immediately south of McCarran Boulevard. The Area of Potential Effects (APE) for direct physical effects comprises 53.23 acres and the APE for indirect effects is 133.49 acres, which includes the footprint of the direct effects APE and an additional 80.26 acres surrounding the direct effects APE.

On June 10, 2021, Broadbent archaeologists conducted an intensive pedestrian Cultural Resources Inventory of the 53.23-acre APE. The inventory was completed according to the standards and guidelines provided by NRCS and the Nevada State Historic Preservation Office (SHPO). All fieldwork was completed under direct supervision of Broadbent permitted archaeologist Ms. Margo Memmott and was conducted according to the terms of Broadbent's State of Nevada Antiquities Permit No. 618. Ms. Lauren Culleton served as the Architectural Historian for the Project.

The intensive pedestrian cultural resources inventory resulted in the identification and recordation of three historic structures and a historic district. The historic structures include the

East Wash Dam (S2872), the West Wash Dam (S2873), and a segment of the previously recorded Highland Ditch (S808). Because the East and West Wash Dams function as a unit, they were also included in the East and West Wash Dam Historic District (D390). No archaeological sites or isolated cultural resources were identified during the intensive cultural resources inventory. An attempt was made to relocate previously recorded prehistoric archaeological site 26WA1697, but it is presumed destroyed in its entirety by the construction ofMcCarran Boulevard and continuing modern development of the area.

Based upon the recommendations of Broadbent, the NRCS has determined that the segment of the Highland Ditch (S808) recorded for the Project be considered a non-contributing segment to the National Register of Historic Places (NRHP) eligibility of the whole resource and not individually eligible for NRHP inclusion. The NRCS has determined, based upon Broadbent recommendations that the East Wash Dam (S2872) and West Wash Dam(S2873) are eligible for NRHP inclusion under Criterion A. Broadbent also recommended and the NRCS has determined that the East and West Wash Dam Historic District (D390) is eligible for NRHP inclusion under Criterion A. Structures S2872 and S2873 are recommended by Broadbent and determined by the NRCS to be contributing resources to Historic District D390; Structure S808 was recommended by Broadbent and determined by the NRCS to be a non-contributing element to the historic district.

The five project design alternatives (with the Alternative numbers that had been used in previous Project-relateddocuments) to be considered in the Plan/EA as of October 19, 2021 include:

Alternative 1 (previously Alternative 1): Future Without Project/No Action;
Alternative 2 (previously Alternative 2): Flood Proofing;
Alternative 3 (previously Alternative 3a): Remediate both dams;
Alternative 4 (previously Alternative 5a): Remove both dams; and
Alternative 5 (previously Alternative 6a): Remove both dams with flood proofing downstream of both dams.

If Alternative 1 is chosen, no changes will be made to any of the historic structures identified during the survey, and Broadbent recommends and the NRCS would determine a finding of No Historic Properties Affected for the Project.

Alternative 2 includes modifying property and infrastructure to improve flood conveyance downstream of West Wash Dam (S2873) but does not include modifications to the historic structures identified duringthe survey. Because the potential modifications proposed in Alternative 2 extend beyond the current APE,selection of Alternative 2 would require additional Section 106 review to analyze the potential effects of the new design elements. As such, a determination of project effect for Alternative 2 can only be made once the expanded APE has been established and the identification of historic properties within the expanded APE has been completed.

Alternative 3 (Alternative 3a in previous documents related to the Project) includes modifications to both East Wash Dam (S2872) and West Wash Dam (S2873). Per the information presented at the West Wash Dam Rehabilitation Project Public Scoping Meeting held on October 19, 2021,

the current plan for Alternative 3 includes increasing the capacity of the East Wash Dam by excavating material from the existing basin and reseeding it with native vegetation, restoring the west embankment upstream of the spillway to its original height, improve the grading of the spillway, and armor the west embankment and the spillway to reduce erosion. For the West Wash Dam, Alternative 3 includes raising the dam crest and adding wall to the southeast side of the dam, and restoring the spillway to its original design before armoring it. Armoring could include rip rap or other similar methods, to be decided during the design process. If the final design elements included in Alternative 3 repair and rehabilitate the dams using the same materials and with the same design as the original structures (i.e., maintain and repair the structure with like materials), Broadbent recommends and the NRCS would determine that a finding of No Adverse Effect would be appropriate. If the final design of Alternative 3 would substantially alter the design of the East and West Wash Dams and their accessory structures or would involve the use or addition of materials that are not in keeping with the original materials used in the construction of these structures, Broadbent recommends and the NRCS would determine that a Historic PropertiesTreatment Plan (HPTP) be developed to resolve the adverse effect to these historic properties through mitigation. Appropriate mitigation methods may involve public interpretation, such as the production of a brochure or other publications, web-based and published articles, public presentations, museum exhibits, or historic markers. As the significance of S2872, S2873, and D390 is based on their association with the theme of Land Usage (specifically the subtheme of Townsite Development/City Planning) and their ability to convey that significance, mitigation through excavation or similar data recovery and reporting methods would not be considered appropriate.

Alternatives 4 and 5 (Alternatives 5a and 6a in previous documents related to the Project) involve removing both East Wash Dam (S2872) and West Wash Dam (S2873) and returning the area to a natural drainage landscape. In addition to removing the dams, Alternative 5 would include the flood proofing measures described in Alternative 2. If either of these alternatives are selected, Broadbent recommends and the NRCS would determine that a HPTP be developed to resolve the adverse effects to these historic properties through mitigation as described above.

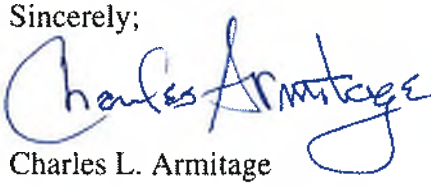
There are no NRHP-listed properties within the indirect effects APE, and the single previously recorded archaeological site (26WA1697) within the indirect effects APE is presumed destroyed by the constructionof McCarran Avenue. A total of 46 parcels within the indirect effects APE contain structures that are at least 50 years old. Most are single-family residences, with the oldest constructed in 1964, three years after the completion of the East Wash Dam; all remain unevaluated for NRHP inclusion. The 46 unevaluated properties of historic age that are within the indirect APE have experienced loss of integrity of association, setting, and feeling due to ongoing landscape-scale alterations outside of their historic period. Further, they are elevated above the level of the West Wash and East Wash Dams, and either faceaway from the dams or have the view of the dams obscured by the neighboring houses. As such, implementation of any of the five Design Alternatives would not constitute an adverse effect to the unevaluated properties located within the indirect effects APE.

The NRCS has agreed to the recommendations provided by the Broadbent and the NRCS shall send to the State Historic Preservation Office ,when available, the final design alternative selected for this NRCS funded watershed project, for final concurrence on West Wash Dam

project effects. The NRCS has determined and requesting SHPO concurrence that the segment of the Highland Ditch (S808) recorded for the Project be considered a non-contributing segment to the National Register of Historic Places (NRHP) eligibility of the whole resource and not individually eligible for NRHP inclusion. That the East Wash Dam (S2872) and West Wash Dam (S2873) are eligible for NRHP inclusion under Criterion A, that the East and West Wash Dam Historic District (D390) is eligible for NRHP inclusion under Criterion A, that Structures S2872 and S2873 are contributing resources to Historic District D390; and Structure S808 is a non-contributing element to the historic district.

If you have any questions or concerns, please contact me at (775) 834-0901 or email at charles.armitage@usda.gov .

Sincerely;



Charles L. Armitage
NRCS State Cultural Resources Specialist/Archaeologist

Attachment: Cultural Resources Inventory Report for the West Wash Dam Supplemental Watershed Plan Project, Reno, Nevada.

March 2, 2022

Attn: Ashley Wiley
Nevada State Historic Preservation Office
Department of Conservation and Natural Resources
901 S. Stewart Street, Suite 5004
Carson City, Nevada 89701

Re NRCS 322022 Consultation Response Letter to UT 2021-6645;28997 for the Natural Resources Conservation Service (NRCS) West Wash Dam Project

Dear Ashley:

Thank you for the consultation response letter UT 2021-6645;28997 for the Natural Resources Conservation Service (NRCS) West Wash Dam Project dated February 16, 2022. The Nevada State Historic Preservation Office (SHPO) has requested additional clarification for this project including:

- The age of a water tank and justification as why the water tank was not included in historic district D390.
- A description of what the labyrinth within the West Wash dam is and justification that this does not affect the integrity of the West Wash Dam (S2873) or D390.
- Narrative summary with results of consultation for SHPO administrative records.

The NRCS response is provided below:

- the Water Tank SHPO is referring to is not within the project area of direct effects and is on the northeastern fringe of the project area of indirect effects. Table 4.4 of the submitted report has identified this resource as Washoe County APN 082-631-04 Truckee Meadows Water Authority Water Tank with no available date of construction. The NRCS has followed-up on the age of this resource with the City of Reno, and the City has responded that the water tank was constructed in 1964, after the West Wash and East Wash Dams were constructed and was associated with the houses that developed around the dam fringe and surrounding area. It is not included in the Historic District D390 because it is not related to flood control as are the other elements of the district, and it is an unevaluated resource outside the project area of direct effect.

- The labyrinth is a designed pattern of small rocks in the shape of a labyrinth (see attached) with an entrance and a logbook. I have attached photos. The labyrinth was constructed in 2008 and there were no public concerns expressed with this feature at the

project public meetings. This feature could be classified as a recreational designed rock pattern. This design feature has no effects on the integrity of the dams or the historic district 390. Three photos are included. One of these is the logbook and two are overviews. Depending upon the final alternative selected the labyrinth may or may not be impacted.

- Tribal consultation is ongoing, and tribes have not expressed interest in participating. Final report will be submitted to concerned tribes when the final alternative in known. Our final letter to SHPO will have a narrative description of tribal and public consultation and will also be part of our NEPA compliance process.

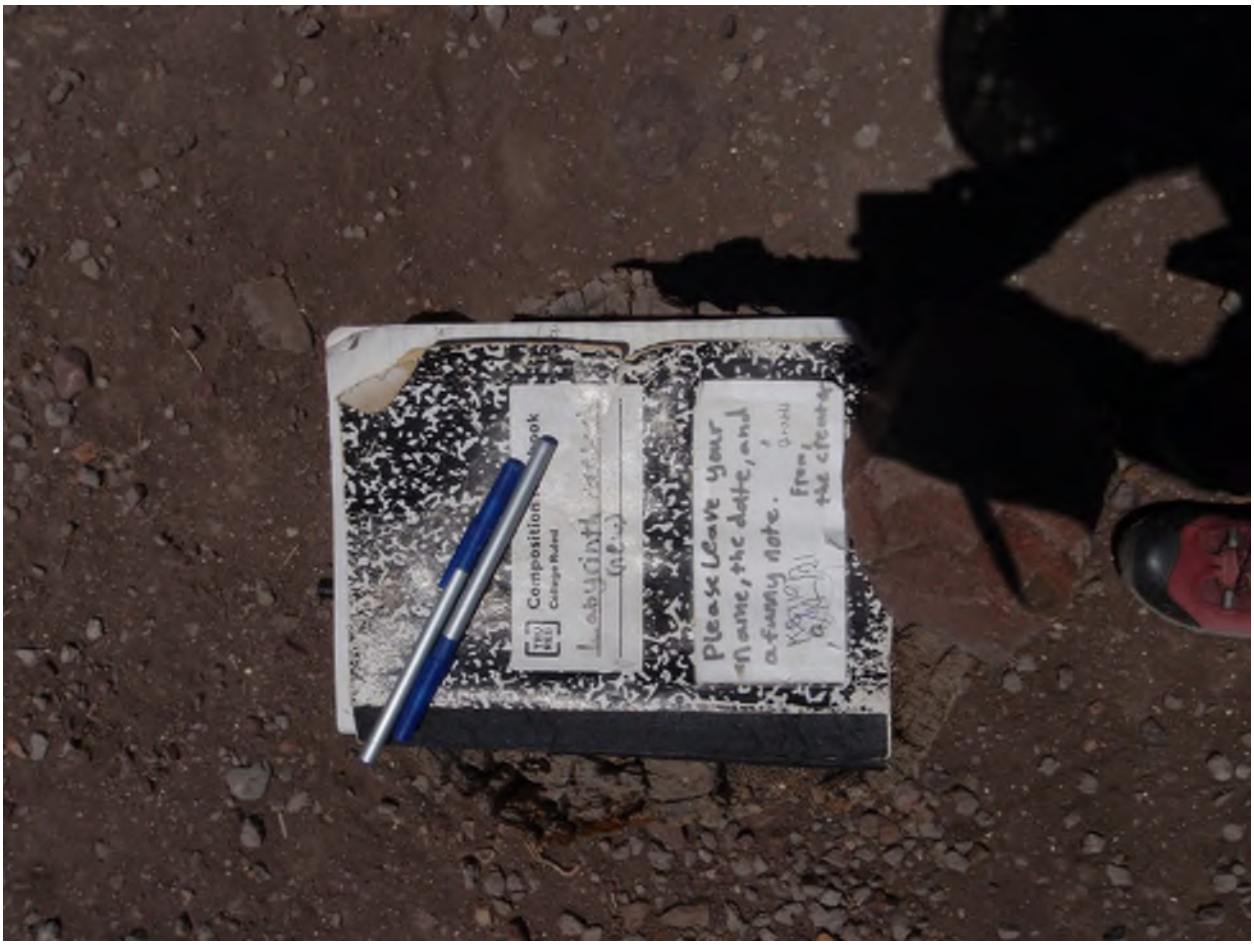
The NRCS is responding to the questions that the SHPO had concerning the NRCS West Wash Dam Project and is requesting that SHPO continue consultation and concurrence on the NRCS National Register of Historic Places (NRHP) determinations that the segment of the Highland Ditch (S808) recorded for the Project be considered a non-contributing segment to the National Register of Historic Places (NRHP) eligibility of the whole resource and not individually eligible for NRHP inclusion. That the East Wash Dam (S2872) and West Wash Dam (S2873) are eligible for NRHP inclusion under Criterion A, that the East and West Wash Dam Historic District (D390) is eligible for NRHP inclusion under Criterion A, that Structures S2872 and S2873 are contributing resources to Historic District D390; and Structure S808 is a non-contributing element to the historic district.

After the NRCS has developed a final project alternative design, the alternative will be submitted to SHPO for consultation on project effects to historic properties along with a record of public and tribal consultation completed for the project. If you have any questions or concerns, please contact me at (775) 834-0901 or email at charles.armitage@usda.gov .

Sincerely,

Charles L. Armitage
NRCS State Cultural Resources Specialist/Archaeologist

Attachment: Three photos of labyrinth



Attachment 1a. logbook for labyrinth.

Attachment 1b. Labyrinth overview.

Attachment 1c. Labyrinth overview.

NEVADA
STATE HISTORIC PRESERVATION OFFICE

STATE OF NEVADA
Department of Conservation and Natural Resources
Steve Sisolak, *Governor*
Bradley Crowell, *Director*
Rebecca L. Palmer, *Administrator, SHPO*

March 25, 2022

Charles L. Armitage
NRCS State Cultural Resources Specialist/Archaeologist
Natural Resources Conservation Service
1365 Corporate Blvd.
Reno, NV 89502

RE: Section 106 consultation with the Natural Resources Conservation Service for the West Wash Dam, NRCS Project 22WA01, Washoe County, Nevada (UT 2021-6645; 29098 and 29125)

Dear Mr. Armitage:

The Nevada State Historic Preservation Office (SHPO) has reviewed the subject documents received February 25 and March 4, 2022 in accordance with Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended.

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) has submitted additional information in response to SHPO correspondence dated February 4, 2022.

The SHPO understands that the Water Tank within the visual, auditory, atmospheric, and cumulative APE was constructed in 1964 and is not related to the East and West Wash Dam Historic District (D390).

NRCS states that the labyrinth was constructed in 2008 and does not affect the integrity of East and West Wash Dam Historic District (D390), East Wash Dam (S2872), or the West Wash Dam (S2873).

NRCS is only requesting SHPO concurrence with National Register eligibility determinations at this time.

NRCS is leaving the Water Tank unevaluated for listing in the National Register of Historic Places (NRHP) and treating it as National Register eligible for the purpose of this undertaking.

The SHPO **concurs** with NRCS's determination that the recorded segment only of S808 (Highland Ditch) is individually **not eligible** for listing in the NRHP under any of the Secretary of the Interior's Significance Criteria (A-D) and is **non-contributing** to the overall unrecorded and unevaluated ditch resource.

The SHPO **concurs** with NRCS's determination that the East and West Wash Dam Historic District D390 is **eligible** for listing in the NHRP under Criterion A.

The SHPO **concurs** with NRCS's determination that S2872 the East Wash Dam and S2873 the West Wash Dam are individually **eligible** for listing in the NRHP under Criterion A and are **contributing** to D390.

The SHPO looks forward to receipt of a summary of consultation efforts regarding this undertaking.

The SHPO looks forward to NRCS's forthcoming Finding of Effect for this undertaking.

Should you have questions concerning this correspondence, please contact SHPO staff archaeologist Ashley Wiley at (775) 684-3450 or email awiley@shpo.nv.gov.

Sincerely,

Robin K. Reed
Deputy State Historic Preservation Officer

USDA

United States Department of Agriculture

October 6, 2022

Attn: Betty Aleck, THPO
Pyramid Lake Paiute Tribe
P.O. Box
Nixon, Nevada, 256 89424
Re: Consultation: NRCS Peavine Mountain Watershed West Wash Dam Rehabilitation project

Dear Betty:

Pursuant to the National Historic Preservation Act (NHPA) as amended, and the implemented regulations found in 36 CFR Part 800, the Nevada (NV) Natural Resources Conservation Service (NRCS) is contacting your office and requesting the Pyramid Lake Paiute Tribe provide comments on Tribal concerns related to historic properties; traditional cultural properties, and/or sacred sites.

The project sponsor, the City of Reno, is seeking funding from NRCS to complete the project through the Watershed Protection and Flood Prevention Program (Public Law 83-566). While the City of Reno is the sponsoring/proposing entity, NRCS retains all responsibility to consult with Tribes on projects, we may fund. The project is in northwest Reno, Nevada, at the intersection of Wyoming Avenue and Putnam Drive immediately south of McCarran Boulevard. The Area of Potential Effects (APE)for direct physical effects comprises 53.23 acres and the APE for indirect effects is 133.49 acres, which includes the footprint of the direct effects APE and an additional 80.26 acres surrounding the direct effects APE.

On June 10, 2021, Broadbent archaeologists conducted an intensive pedestrian cultural resources inventory of the 53.23-acre APE. The inventory was completed according to the standards and guidelines provided by NRCS and the Nevada State Historic Preservation Office (SHPO). All fieldwork was completed under direct supervision of Broadbent permitted archaeologist Ms. Margo Memmott and was conducted according to the terms of Broadbent's State of Nevada Antiquities Permit No. 618. Ms. Lauren Culleton served as the Architectural Historian for the Project. Broadbent, as the consulting firm, has completed a cultural resource survey for the proposed project and has provided National Register of Historic Places recommendations and a cultural resource report for the project. The NRCS has determined that there will be no adverse effects to historic from the proposed project.

The project proposes to preserve the flood protection function of the West Wash Dam, protect lives and property in the surrounding urban area, while complying with current performance and safety standards in a cost effective and environmentally acceptable manner. The proposed project will address current deficiencies at West Wash and East Wash Dams to bring both dams

Natural Resources Conservation Service
C. Clifton Young Federal Building
300 Booth Street, Room 2070
Reno, Nevada 89509
Phone: (775) 857-8500 Toll Free Fax: (855) 816-0893
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into compliance with current dam safety regulations, engineering standards and performance criteria of High Hazard Dams. It will also ensure the watershed structure is properly maintained to minimize the risk to lives and property in the surrounding and downstream area which has been developed into a thriving, urban residential and commercial center since the original construction of the dams.

Attachment 1 shows the legal locations and descriptions of the proposed practices. Attachment 2 contains maps showing the proposed project area of potential effect (APE), and attachment 3 is a copy of the Broadbent cultural resource report for the project.

After you have had an opportunity to review the proposed attached maps and report, please advise our office of any concerns you may have regarding potential impacts to historic properties or sites of religious or cultural significance associated with the proposed project. Please respond within 30 days. If additional review time is needed, we would appreciate your notification.

Please contact me at (775) 834-0901, or charles.armitage@usda.gov , if the Pyramid Lake Paiute Tribe has any questions or concerns related to proposed project.

Sincerely,

Charles Armitage

Charles Armitage, PhD.
NRCS State Cultural Resource Specialist
Reno, Nevada

Attachment 1: Project Location and Description
Attachment 2: Figure 1 and Figure 2 Project Maps
Attachment 3: Cultural Resource Inventory Report for the West Wash Dam Supplemental Watershed Plan Project, Reno, Nevada

Natural Resources Conservation Service
C. Clifton Young Federal Building
300 Booth Street, Room 2070
Reno, Nevada 89509
Phone: (775) 857-8500 Toll Free Fax: (855) 816-0893
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Attachment 1. Project Location and Description

NRCS Peavine Mountain Watershed West Wash Dam Rehabilitation project
T19N; R19E Sections 3, 4
T20N; R19E Sections 33, 34
Reno 7.5 Minute Quadrangle Map
Washoe County, Nevada

REMEDIATE BOTH EAST WASH AND WEST WASH DAMS

This includes remediation of both dams to meet the safety requirements of the NRCS and the Nevada Division of Water Resources Division of Dams. East Wash Dam is classified as a diversion dam while West Wash Dam is classified as a detention dam. Both Dams have been identified as High Hazard Dams by the Division of Dams. Currently, the East Wash Dam meets NRCS criteria for Earthen Dams with the exception of excessive damage to the spillway in a PMF event (USDA NRCS, 2019). The West Wash Dam does not meet NRCS criteria and would overtop in a PMF event (USDA NRCS, 2019). The United States Army Corps of Engineers Phase I inspection report indicates that the existing structures meet applicable seismic safety requirements. However, neither the original calculations performed, nor the original parameters utilized are available for review. Due to data gaps and potential advances in the knowledge of seismic activity in the area, seismic stability will be investigated as a part of the final design of this project.

Remediation of both dams will be confined to the already disturbed areas of the structures. East Wash Dam will have the west dike of the principal spillway approach restored to the original design elevation. West Wash Dam will have the embankment raised five feet to a new elevation of 4798 feet, the auxiliary spillway widened to the original design width of 80 feet and lowered to a crest elevation of 4782.5 feet, the impoundment area to the west of the existing flow line will be regraded to allow for more water storage, and a two-foot-tall parapet wall will be built on the east corner of the dam. Re-grading the impoundment area of West Wash Dam will consist of steepening the western slope to a 2:1 slope and the total cut and fill associated with the grading will be approximately 421,683 yd^3 and 28,588 yd^3, respectively.
With these proposed changes, the West Wash Dam auxiliary spillway will not be activated until the 500-year storm event (currently it activates during a 200-year storm event). The improvements to the West Wash Dam will supply three feet of freeboard during the Local PMP event, and the dam will no longer overtop or be in jeopardy of breaching.
Other minor improvements that will be made under this alternative include:

- Stripping of vegetation, debris, and weathered fill from crest and downstream face of West Wash Dam
- Stripping of vegetation, debris, and weathered fill from crest and both faces of East Wash Dam's Auxiliary spillway
- Cleaning out Principal Spillway and sediment drain conduits

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- Replacement of sediment drain trash rack
- Corrosion resistant coating of sediment drain riser (and potentially interior of conduit to outfall in Principal Spillway riser)
- Repair of principal spillway riser concrete spalls and damage (both East and West Wash Dams).
- Daylighting of West Wash Dam Principal Spillway downstream invert
- Excavation along Principal Spillway conduit for installation of seep intercept system
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United States Department of Agriculture

October 6, 2022

Attn: Chairwoman Cathi Williams-Tuni
Fallon Paiute Tribe
565 Rio Vista Drive
Fallon, NV 89406

Re: Consultation: NRCS Peavine Mountain Watershed West Wash Dam Rehabilitation project

Dear Cathi Williams-Tuni:

Pursuant to the National Historic Preservation Act (NHPA) as amended, and the implemented regulations found in 36 CFR Part 800, the Nevada (NV) Natural Resources Conservation Service (NRCS) is contacting your office and requesting the Fallon Paiute Tribe provide comments on Tribal concerns related to historic properties; traditional cultural properties, and/or sacred sites.

The project sponsor, the City of Reno, is seeking funding from NRCS to complete the project through the Watershed Protection and Flood Prevention Program (Public Law 83-566). While the City of Reno is the sponsoring/proposing entity, NRCS retains all responsibility to consult with Tribes on projects, we may fund. The project is in northwest Reno, Nevada, at the intersection of Wyoming Avenue and Putnam Drive immediately south of McCarran Boulevard. The Area of Potential Effects (APE)for direct physical effects comprises 53.23 acres and the APE for indirect effects is 133.49 acres, which includes the footprint of the direct effects APE and an additional 80.26 acres surrounding the direct effects APE.

On June 10, 2021, Broadbent archaeologists conducted an intensive pedestrian cultural resources inventory of the 53.23-acre APE. The inventory was completed according to the standards and guidelines provided by NRCS and the Nevada State Historic Preservation Office (SHPO). All fieldwork was completed under direct supervision of Broadbent permitted archaeologist Ms. Margo Memmott and was conducted according to the terms of Broadbent's State of Nevada Antiquities Permit No. 618. Ms. Lauren Culleton served as the Architectural Historian for the Project. Broadbent, as the consulting firm, has completed a cultural resource survey for the proposed project and has provided National Register of Historic Places recommendations and a cultural resource report for the project. The NRCS has determined that there will be no adverse effects to historic from the proposed project.

The project proposes to preserve the flood protection function of the West Wash Dam, protect lives and property in the surrounding urban area, while complying with current performance and safety standards in a cost effective and environmentally acceptable manner. The proposed

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project will address current deficiencies at West Wash and East Wash Dams to bring both dams into compliance with current dam safety regulations, engineering standards and performance criteria of High Hazard Dams. It will also ensure the watershed structure is properly maintained to minimize the risk to lives and property in the surrounding and downstream area which has been developed into a thriving, urban residential and commercial center since the original construction of the dams.

Attachment 1 shows the legal locations and descriptions of the proposed practices. Attachment 2 contains maps showing the proposed project area of potential effect (APE), and attachment 3 is a copy of the Broadbent cultural resource report for the project.

After you have had an opportunity to review the proposed attached maps and report, please advise our office of any concerns you may have regarding potential impacts to historic properties or sites of religious or cultural significance associated with the proposed project. Please respond within 30 days. If additional review time is needed, we would appreciate your notification.

Please contact me at (775) 834-0901, or charles.armitage@usda.gov , if the Fallon Paiute Tribe has any questions or concerns related to proposed project.

Sincerely,

Charles Armitage, PhD.
NRCS State Cultural Resource Specialist
Reno, Nevada

Attachment 1: Project Location and Description
Attachment 2: Figure 1 and Figure 2 Project Maps
Attachment 3: Cultural Resource Inventory Report for the West Wash Dam Supplemental Watershed Plan Project, Reno, Nevada

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Attachment 1. Project Location and Description

NRCS Peavine Mountain Watershed West Wash Dam Rehabilitation project
T19N; R19E Sections 3, 4
T20N; R19E Sections 33, 34
Reno 7.5 Minute Quadrangle Map
Washoe County, Nevada

REMEDIATE BOTH EAST WASH AND WEST WASH DAMS

This includes remediation of both dams to meet the safety requirements of the NRCS and the Nevada Division of Water Resources Division of Dams. East Wash Dam is classified as a diversion dam while West Wash Dam is classified as a detention dam. Both Dams have been identified as High Hazard Dams by the Division of Dams. Currently, the East Wash Dam meets NRCS criteria for Earthen Dams with the exception of excessive damage to the spillway in a PMF event (USDA NRCS, 2019). The West Wash Dam does not meet NRCS criteria and would overtop in a PMF event (USDA NRCS, 2019). The United States Army Corps of Engineers Phase I inspection report indicates that the existing structures meet applicable seismic safety requirements. However, neither the original calculations performed, nor the original parameters utilized are available for review. Due to data gaps and potential advances in the knowledge of seismic activity in the area, seismic stability will be investigated as a part of the final design of this project.

Remediation of both dams will be confined to the already disturbed areas of the structures. East Wash Dam will have the west dike of the principal spillway approach restored to the original design elevation. West Wash Dam will have the embankment raised five feet to a new elevation of 4798 feet, the auxiliary spillway widened to the original design width of 80 feet and lowered to a crest elevation of 4782.5 feet, the impoundment area to the west of the existing flow line will be regraded to allow for more water storage, and a two-foot-tall parapet wall will be built on the east corner of the dam. Re-grading the impoundment area of West Wash Dam will consist of steepening the western slope to a 2:1 slope and the total cut and fill associated with the grading will be approximately 421,683 yd^3 and 28,588 yd^3, respectively.
With these proposed changes, the West Wash Dam auxiliary spillway will not be activated until the 500-year storm event (currently it activates during a 200-year storm event). The improvements to the West Wash Dam will supply three feet of freeboard during the Local PMP event, and the dam will no longer overtop or be in jeopardy of breaching.
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United States Department of Agriculture

October 6, 2022

Attn: Michon Eben, Tribal Historic Preservation Officer
Reno-Sparks Indian Colony
34 Reservation Rd
Reno, NV 89502

Re: Consultation: NRCS Peavine Mountain Watershed West Wash Dam Rehabilitation project

Dear Michon:

Pursuant to the National Historic Preservation Act (NHPA) as amended, and the implemented regulations found in 36 CFR Part 800, the Nevada (NV) Natural Resources Conservation Service (NRCS) is contacting your office and requesting the Reno-Sparks Indian Colony provide comments on Tribal concerns related to historic properties; traditional cultural properties, and/or sacred sites.

The project sponsor, the City of Reno, is seeking funding from NRCS to complete the project through the Watershed Protection and Flood Prevention Program (Public Law 83-566). While the City of Reno is the sponsoring/proposing entity, NRCS retains all responsibility to consult with Tribes on projects, we may fund. The project is in northwest Reno, Nevada, at the intersection of Wyoming Avenue and Putnam Drive immediately south of McCarran Boulevard. The Area of Potential Effects (APE)for direct physical effects comprises 53.23 acres and the APE for indirect effects is 133.49 acres, which includes the footprint of the direct effects APE and an additional 80.26 acres surrounding the direct effects APE.

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safety standards in a cost effective and environmentally acceptable manner. The proposed project will address current deficiencies at West Wash and East Wash Dams to bring both dams into compliance with current dam safety regulations, engineering standards and performance criteria of High Hazard Dams. It will also ensure the watershed structure is properly maintained to minimize the risk to lives and property in the surrounding and downstream area which has been developed into a thriving, urban residential and commercial center since the original construction of the dams.

Attachment 1 shows the legal locations and descriptions of the proposed practices. Attachment 2 contains maps showing the proposed project area of potential effect (APE), and attachment 3 is a copy of the Broadbent cultural resource report for the project.

After you have had an opportunity to review the proposed attached maps and report, please advise our office of any concerns you may have regarding potential impacts to historic properties or sites of religious or cultural significance associated with the proposed project. Please respond within 30 days. If additional review time is needed, we would appreciate your notification.

Please contact me at (775) 834-0901, or charles.armitage@usda.gov , if the Reno-Sparks Indian Colony has any questions or concerns related to proposed project.

Sincerely,

Charles Armitage

Charles Armitage, PhD.
NRCS State Cultural Resource Specialist
Reno, Nevada

Attachment 1: Project Location and Description
Attachment 2: Figure 1 and Figure 2 Project Maps
Attachment 3: Cultural Resource Inventory Report for the West Wash Dam Supplemental Watershed Plan Project, Reno, Nevada

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Attachment 1. Project Location and Description

NRCS Peavine Mountain Watershed West Wash Dam Rehabilitation project
T19N; R19E Sections 3, 4
T20N; R19E Sections 33, 34
Reno 7.5 Minute Quadrangle Map
Washoe County, Nevada

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United States Department of Agriculture

October 6, 2022

Mr. James Simmons
Summit Lake Paiute Tribe
2255 Green Vista Dr, #402
Sparks, NV 89431

Re: Consultation: NRCS Peavine Mountain Watershed West Wash Dam Rehabilitation project

Dear James:

Pursuant to the National Historic Preservation Act (NHPA) as amended, and the implemented regulations found in 36 CFR Part 800, the Nevada (NV) Natural Resources Conservation Service (NRCS) is contacting your office and requesting the Summit Lake Paiute Tribe provide comments on Tribal concerns related to historic properties; traditional cultural properties, and/or sacred sites.

The project sponsor, the City of Reno, is seeking funding from NRCS to complete the project through the Watershed Protection and Flood Prevention Program (Public Law 83-566). While the City of Reno is the sponsoring/proposing entity, NRCS retains all responsibility to consult with Tribes on projects, we may fund. The project is in northwest Reno, Nevada, at the intersection of Wyoming Avenue and Putnam Drive immediately south of McCarran Boulevard. The Area of Potential Effects (APE)for direct physical effects comprises 53.23 acres and the APE for indirect effects is 133.49 acres, which includes the footprint of the direct effects APE and an additional 80.26 acres surrounding the direct effects APE.

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project will address current deficiencies at West Wash and East Wash Dams to bring both dams into compliance with current dam safety regulations, engineering standards and performance criteria of High Hazard Dams. It will also ensure the watershed structure is properly maintained to minimize the risk to lives and property in the surrounding and downstream area which has been developed into a thriving, urban residential and commercial center since the original construction of the dams.

Attachment 1 shows the legal locations and descriptions of the proposed practices. Attachment 2 contains maps showing the proposed project area of potential effect (APE), and attachment 3 is a copy of the Broadbent cultural resource report for the project.

After you have had an opportunity to review the proposed attached maps and report, please advise our office of any concerns you may have regarding potential impacts to historic properties or sites of religious or cultural significance associated with the proposed project. Please respond within 30 days. If additional review time is needed, we would appreciate your notification.

Please contact me at (775) 834-0901, or charles.armitage@usda.gov , if the Summit Lake Paiute Tribe has any questions or concerns related to proposed project.

Sincerely,

Charles Armitage

Charles Armitage, PhD.
NRCS State Cultural Resource Specialist
Reno, Nevada

Attachment 1: Project Location and Description
Attachment 2: Figure 1 and Figure 2 Project Maps
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Attachment 1. Project Location and Description

NRCS Peavine Mountain Watershed West Wash Dam Rehabilitation project
T19N; R19E Sections 3, 4
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Reno 7.5 Minute Quadrangle Map
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United States Department of Agriculture

October 6, 2022

Attn: Darrel Cruz, Tribal Historic Preservation Officer
Washoe Tribe of Nevada and California
919 Highway 395 South
Gardnerville, NV 89410

Re: Consultation: NRCS Peavine Mountain Watershed West Wash Dam Rehabilitation project

Dear Darrel:

Pursuant to the National Historic Preservation Act (NHPA) as amended, and the implemented regulations found in 36 CFR Part 800, the Nevada (NV) Natural Resources Conservation Service (NRCS) is contacting your office and requesting the Washoe Tribe provide comments on Tribal concerns related to historic properties; traditional cultural properties, and/or sacred sites.

The project sponsor, the City of Reno, is seeking funding from NRCS to complete the project through the Watershed Protection and Flood Prevention Program (Public Law 83-566). While the City of Reno is the sponsoring/proposing entity, NRCS retains all responsibility to consult with Tribes on projects, we may fund. The project is in northwest Reno, Nevada, at the intersection of Wyoming Avenue and Putnam Drive immediately south of McCarran Boulevard. The Area of Potential Effects (APE)for direct physical effects comprises 53.23 acres and the APE for indirect effects is 133.49 acres, which includes the footprint of the direct effects APE and an additional 80.26 acres surrounding the direct effects APE.

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Please contact me at (775) 834-0901, or charles.armitage@usda.gov , if the Washoe Tribe has any questions or concerns related to proposed project.

Sincerely,

Charles Armitage

Charles Armitage, PhD.
NRCS State Cultural Resource Specialist
Reno, Nevada

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October 6, 2022

Attn: Ashley Wiley
Nevada State Historic Preservation Office
Department of Conservation and Natural Resources
901 S. Stewart Street, Suite 5004
Carson City, Nevada 89701

Re: Section 106 NRCS Consultation for the Natural Resources Conservation Service (NRCS) West Wash Dam Project with Final Alternative

Dear Ashley:

The City of Reno (City) has entered into an agreement with the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) to rehabilitate the West Wash Dam and East Wash Dam in northwest Reno, Nevada, to meet current NRCS, City, and State of Nevada Division of Water Resources (DWR) dam safety criteria and performance standards. The Natural Resources Conservation Service, Nevada, is the lead federal agency for this project.

The project is in northwest Reno, Nevada, at the intersection of Wyoming Avenue and Putnam Drive immediately south of McCarran Boulevard. The Area of Potential Effects (APE) for direct physical effects comprises 53.23 acres and the APE for indirect effects is 133.49 acres, which includes the footprint of the direct effects APE and an additional 80.26 acres surrounding the direct effects APE. The legal description for this project is:

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T20N; R19E Sections 33, 34
Reno 7.5 Minute Quadrangle Map
Washoe County, Nevada

On June 10, 2021, Broadbent and Associates (Broadbent) archaeologists conducted an intensive pedestrian cultural resources inventory of the 53.23-acre APE. The inventory was completed according to the standards and guidelines provided by NRCS and the Nevada State Historic Preservation Office (SHPO). All fieldwork was completed under direct supervision of Broadbent permitted archaeologist Ms. Margo Memmott and was conducted according to the

Natural Resources Conservation Service
C. Clifton Young Federal Building
300 Booth Street, Room 2070
Reno, Nevada 89509
Phone: (775) 857-8500 Toll Free Fax: (855) 816-0893
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terms of Broadbent's State of Nevada Antiquities Permit No. 618. Ms. Lauren Culleton served as the Architectural Historian for the Project.

The intensive pedestrian cultural resources inventory resulted in the identification and recordation of three historic structures and a historic district. The historic structures include the East Wash Dam (S2872), the West Wash Dam (S2873), and a segment of the previously recorded Highland Ditch (S808). Because the East and West Wash Dams function as a unit, they were also included in the East and West Wash Dam Historic District (D390). No archaeological sites or isolated cultural resources were identified during the intensive cultural resources inventory. An attempt was made to relocate previously recorded prehistoric archaeological site 26WA1697, but it is presumed destroyed in its entirety by the construction of McCarran Boulevard and continuing modern development of the area.

Based upon the recommendations of Broadbent, the NRCS determined that the segment of the Highland Ditch (S808) recorded for the Project be considered a non-contributing segment to the National Register of Historic Places (NRHP) eligibility of the whole resource and not individually eligible for NRHP inclusion. The NRCS has determined, based upon Broadbent recommendations that the East Wash Dam (S2872) and West Wash Dam(S2873) are eligible for NRHP inclusion under Criterion A. Broadbent also recommended and the NRCS has determined that the East and West Wash Dam Historic District (D390) is eligible for NRHP inclusion under Criterion A Structures S2872 and S2873 are recommended by Broadbent and determined by the NRCS to be contributing resources to Historic District D390; Structure S808 was recommended by Broadbent and determined by the NRCS to be a non-contributing element to the historic district. The SHPO concurred with these determinations in a letter to the NRCS dated March 25, 2022.

Five project design alternatives (with the Alternative numbers that had been used in previous Project-related documents) were considered in the Plan/EA as of October 19, 2021 include:

Alternative 1 (previously Alternative 1): Future Without Project/No Action; Alternative 2 (previously Alternative 2): Flood Proofing;
Alternative 3 (previously Alternative 3a): Remediate both dams; Alternative 4 (previously Alternative 5a): Remove both dams; and
Alternative 5 (previously Alternative 6a): Remove both dams with flood proofing downstream of both dams.

Alternative 3 (Alternative 3a in previous documents related to the Project) was the final design alternative agreed upon. This alternative involves modifications to both East Wash Dam (S2872) and West Wash Dam (S2873). Per the information presented at the West Wash Dam Rehabilitation Project Public Scoping Meeting held on October 19, 2021. Alternative 3

includes remediation of both dams to meet the safety requirements of the NRCS and the Nevada Division of Water Resources Division of Dams. East Wash Dam is classified as a diversion dam while West Wash Dam is classified as a detention dam. Both Dams have been identified as High Hazard Dams by the Division of Dams. Currently, the East Wash Dam meets NRCS criteria for Earthen Dams with the exception of excessive damage to the spillway in a PMF event (USDA NRCS, 2019). The West Wash Dam does not meet NRCS criteria and would overtop in a PMF event (USDA NRCS, 2019). The United States Army Corps of Engineers Phase I inspection report indicates that the existing structures meet applicable seismic safety requirements. However, neither the original calculations performed, nor the original parameters utilized are available for review. Due to data gaps and potential advances in the knowledge of seismic activity in the area, seismic stability will be investigated as a part of the final design of this project.

Remediation of both dams will be confined to the already disturbed areas of the structures. East Wash Dam will have the west dike of the principal spillway approach restored to the original design elevation. West Wash Dam will have the embankment raised five feet to a new elevation of 4798 feet, the auxiliary spillway widened to the original design width of 80 feet and lowered to a crest elevation of 4782.5 feet, the impoundment area to the west of the existing flow line will be regraded to allow for more water storage, and a two-foot-tall parapet wall will be built on the east corner of the dam. Re-grading the impoundment area of West Wash Dam will consist of steepening the western slope to a 2:1 slope and the total cut and fill associated with the grading will be approximately 421,683 yd^3 and 28,588 yd^3, respectively.

With these proposed changes, the West Wash Dam auxiliary spillway will not be activated until the 500-year storm event (currently it activates during a 200-year storm event). The improvements to the West Wash Dam will supply three feet of freeboard during the Local PMP event, and the dam will no longer overtop or be in jeopardy of breaching. Other minor improvements that will be made under this alternative include:

- Stripping of vegetation, debris, and weathered fill from crest and downstream face of West Wash Dam.
- Stripping of vegetation, debris, and weathered fill from crest and both faces of East Wash Dam's Auxiliary spillway.
- Cleaning out Principal Spillway and sediment drain conduits.
- Replacement of sediment drain trash rack.
- Corrosion resistant coating of sediment drain riser (and potentially interior of conduit to outfall in Principal Spillway riser).
- Repair of principal spillway riser concrete spalls and damage (both East and West Wash Dams).
- Daylighting of West Wash Dam Principal Spillway downstream invert.

• Excavation along Principal Spillway conduit for installation of seep intercept system.
• Backfill for repair of right spillway guide "wall" at crossing of Gulling Dr.

Tribal consultation for the project has been completed with the Fallon Paiute Tribe, Pyramid Lake Indian Tribe, Reno Sparks Indian Colony, Summit Lake Paiute Tribe and the Washoe Tribe of Nevada and California and the tribes consulted have expressed no concerns.

There are no NRHP-listed properties within the indirect effects APE, and the single previously recorded archaeological site (26WA1697) within the indirect effects APE is presumed destroyed by the construction of McCarran Avenue. A total of 46 parcels within the indirect effects APE contain structures that are at least 50 years old. Most are single-family residences, with the oldest constructed in 1964, three years after the completion of the East Wash Dam; all remain unevaluated for NRHP inclusion. The 46 unevaluated properties of historic age that are within the indirect APE have experienced loss of integrity of association, setting, and feeling due to ongoing landscape-scale alterations outside of their historic period. Further, they are elevated above the level of the West Wash and East Wash Dams, and either face away from the dams or have the view of the dams obscured by the neighboring houses.

Broadbent recommended a finding of no adverse effects to historic properties, in the cultural resource report that they submitted to the NRCS and the NRCS then submitted to SHPO, if Alternative 3 was selected, and that similar materials and design were used in the repair and rehabilitation of the dam.

The NRCS has agreed to the recommendations provided by the Broadbent and the NRCS has determined and requesting SHPO concurrence that the proposed project will use similar materials and design in the repair and rehabilitation of the dam and that there will be no indirect effects to historic properties and that there will be no adverse effects to historic properties from the proposed project.

If you have any questions or concerns, please contact me at (775) 834-0901, or email at charles.armitage@usda.gov .

Sincerely,

Charles Armitage

Charles L. Armitage
NRCS Nevada State Cultural Resources Specialist/Archaeologist

Attachment: Design map for West Wash Dam Alternative 3.

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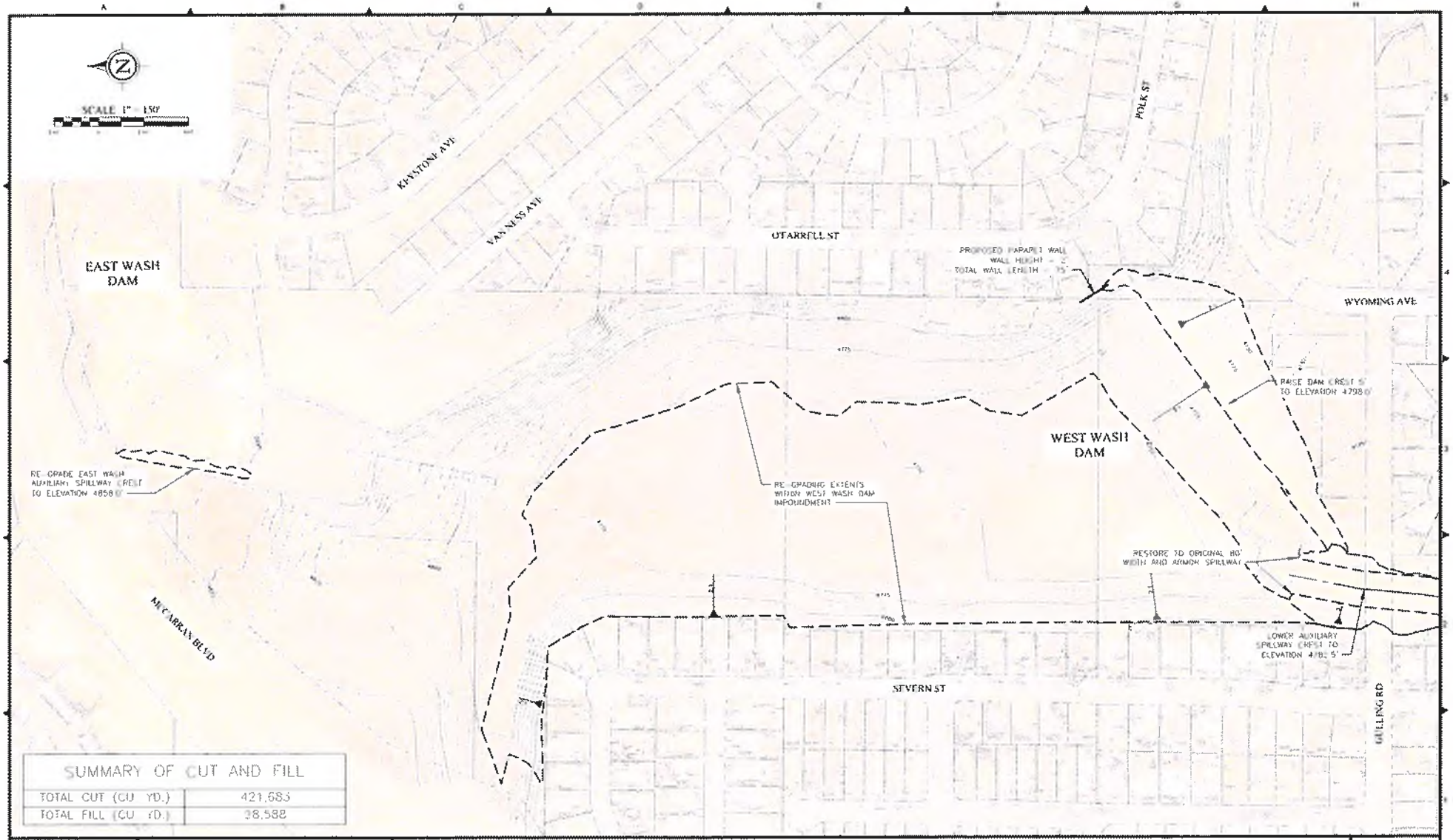

SUMMARY OF CUT AND FILL	
TOTAL CUT (CU. YD.)	421,683
TOTAL FILL (CU. YD.)	38,588

DATE
SCALE
DESIGNED
DRAWN
CHECKED

FARR WEST ENGINEERING
5510 LONGLEY LANE
RENO, NEVADA 89511
PHONE: (775) 851-4788
FAX: (775) 851-0766

CITY OF RENO

SUPPLEMENTAL WATERSHED PLAN AND ENVIRONMENTAL DOCUMENT FOR THE PEAVINE MOUNTAIN WATERSHED

ALTERNATIVE 3 - REMEDIATE EAST AND WEST WASH DAMS

WASHOE COUNTY NEVADA

USDA

United States Department of Agriculture

December 2, 2022

Attn: Ashley Wiley
Nevada State Historic Preservation Office
Department of Conservation and Natural Resources
901 S. Stewart Street, Suite 5004
Carson City, Nevada 89701

Re: NRCS Determination of Adverse Effects to Historic Properties West Wash Dam Watershed Project

Dear Ashley:

Thank you for meeting with the Nevada Natural Resources Conservation Service (NRCS) on December 1, 2022 to discuss adverse effect determinations and possible mitigation alternatives for mitigating identified adverse effects to the West Wash Dam, located in Reno, Nevada.

After consultation with the Nevada State Historic Preservation Office (SHPO), the NRCS has determined and agreed with the SHPO that the NRCS West Wash Dam Watershed Project will have an adverse effect on the West Wash Dam (SHPO structure number S2873), and SHPO Historic District D390 in which the West Wash Dam is included.

The NRCS will notify the Advisory Council on Historic Preservation (ACHP) of the adverse effect determination, as well as the National NRCS Federal Preservation Officer. The NRCS will then develop a Memorandum of Agreement (MOA) with the SHPO concerning measures needed to mitigate the adverse effects to the West Wash Dam from the proposed NRCS West Wash Dam Watershed Project, and once the MOA is signed implement the agreed upon migration measures.

If you have any questions or concerns, please contact me at (775) 834 0901 or email at charles.armitage@usda.gov .

Sincerely,

Charles L. Armitage
NRCS State Cultural Resources Specialist/Archaeologist

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Advisory Council on Historic Preservation
Electronic Section 106 Documentation Submittal System (e106) Form
MS Word format

Send to: *e106@achp.gov*

Please review the instructions at www.achp.gov/e106-email-form **prior to completing this form. Questions about whether to use the e106 form should be directed to the assigned ACHP staff member in the Office of Federal Agency Programs.**

I. Basic information

1. **Purpose of notification.** Indicate whether this documentation is to:
   - ☐ Notify the ACHP of a finding that an undertaking may adversely affect historic properties
   - ☐ Invite the ACHP to participate in a Section 106 consultation
   - ☐ Propose to develop a project Programmatic Agreement (project PA) for complex or multiple undertakings in accordance with 36 C.F.R. 800.14(b)(3)
   - ☐ Supply additional documentation for a case already entered into the ACHP record system
   - ☒ File an executed MOA or PA with the ACHP in accordance with 800.6(b)(iv) (where the ACHP did not participate in consultation)
   - ☐ Other, please describe
     Click here to enter text.

2. ACHP Project Number (If the ACHP was previously notified of the undertaking and an ACHP Project Number has been provided, enter project number here and skip to Item 7 below): ACHP 19069

3. **Name of federal agency** (If multiple agencies, list them all and indicate whether one is the lead agency):

4. **Name of undertaking/project** (Include project/permit/application number if applicable):

5. **Location of undertaking** (Indicate city(s), county(s), state(s), land ownership, and whether it would occur on or affect historic properties located on tribal lands):

6. **Name and title of federal agency official and contact person for this undertaking**, including email address and phone number:

II. Information on the Undertaking*

7. **Describe the undertaking and nature of federal involvement** (if multiple federal agencies are involved, specify involvement of each):

The City of Reno (City) has entered into an agreement with the United States Department of Agriculture

(USDA) Natural Resources Conservation Service (NRCS) to rehabilitate the West Wash Dam and East Wash Dam in northwest Reno, Nevada to meet current NRCS, City, and State of Nevada Division of Water Resources (DWR) dam safety criteria and performance standards. Farr West Engineering (FWE) has been retained to assist the City in meeting the requirements of the NRCS Watershed Program, which include the development of a Supplemental Watershed Plan and Environmental Assessment (Plan/EA). FWE has been tasked with developing design alternatives for the project and preparing the Plan/EA in accordancewith PL-83-566, the National Environmental Policy Act (NEPA), the Principles and Requirements for Federal Investments in Water Resources (PR&G), the NRCS National Watershed Program Manual (NWPM), the National Watershed Program Handbook (NWPH), and all other applicable laws, regulations,and policies. The rehabilitation measures that are to be proposed in the Plan/EA will be considered with public input and prioritized through the City and NRCS.

The purpose of this submission is to notify the Advisory Council (ACHP) of the signed Memorandum of Agreement (MOA) that the NRCS has developed with the Nevada State Historic Preservation Office (SHPO) to mitigate adverse effects to the West Wash Dam.

8. Describe the Area of Potential Effects (APE):

Constructed in 1961 and 1960, respectively, the City-owned East Wash and West Wash Dams were originally constructed as high hazard dams using technical and financial assistance provided under the authority of the Watershed Protection and Flood Prevention Act of 1954 (Public Law (PL)-83-566). These dams currently provide flood protection for city residents and critical infrastructure, including US Interstate 80 (I-80), numerous city streets, powerlines, and the railroad tracks through Reno. The dams are now both over 50 years old and a breach in either could result in a flooding event that causes excessive property damage and loss of life.

The proposed Project would update the West Wash Dam to meet current NRCS and State Standards to increase public safety downstream of the dam. In consultation with the Nevada State Historic Preservation Office (SHPO), NRCS and the City determinedan indirect effects APE of 133.49 acres, which includes the footprint of the direct effects APE and an additional 80.26 acres surrounding the direct effects APE.

9. Describe steps taken to identify historic properties:

The City of Reno (City) has entered into an agreement with the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) to rehabilitate the West Wash Dam and East WashDam in northwest Reno, Nevada to meet current NRCS, City, and State of Nevada Division of Water Resources (DWR) dam safety criteria and performance standards. Farr West Engineering (FWE) has been retained to assist the City in meeting the requirements of the NRCS Watershed Program, which include the development of a Supplemental Watershed Plan and Environmental Assessment (Plan/EA). FWE has been tasked with developing design alternatives for the project and preparing the Plan/EA in accordancewith PL-83-566, the National Environmental Policy Act (NEPA), the Principles and Requirements for Federal Investments in Water Resources (PR&G), the NRCS National Watershed Program Manual (NWPM), the National Watershed Program Handbook (NWPH), and all other applicable laws, regulations,and policies. The rehabilitation measures that are to be proposed in the Plan/EA will be considered with public input and prioritized through the City and NRCS.

Because the West Wash Dam Supplemental Watershed Plan Project (Project) is considered a federal undertaking, it must comply with Section 106 of the National Historic Preservation Act of 1966 (NHPA),

asamended (54 U.S.C. § 300101 et seq.), and its implementing regulations (36 CFR Part 800.4[b]). In May 2021, FWE contracted with Broadbent & Associates Inc. (Broadbent) to conduct an intensive cultural resource inventory for the Project, which is in northwest Reno, Nevada, at the intersection of Wyoming Avenue and Putnam Drive immediately south of McCarran Boulevard. The Area of Potential Effects (APE)for direct physical effects comprises 53.23 acres and the APE for indirect effects is 133.49 acres, which includes the footprint of the direct effects APE and an additional 80.26 acres surrounding the direct effects APE.

On June 10, 2021, Broadbent archaeologists conducted an intensive pedestrian Cultural Resources Inventory of the 53.23-acre APE. The inventory was completed according to the standards and guidelines provided by NRCS and the Nevada State Historic Preservation Office (SHPO). All fieldwork was completedunder direct supervision of Broadbent permitted archaeologist Ms. Margo Memmott and was conductedaccording to the terms of Broadbent's State of Nevada Antiquities Permit No. 618. Ms. Lauren Culleton served as the Architectural Historian for the Project. Project maps are included in Attachment 1.

Five American Indian Tribes and the Reno Historical Commission were consulted with to identify potential project concerns and public meetings have been and more are scheduled to be held. The SHPO was involved with the identification of the area of project direct and indirect effects and consultation under the National Historic Preservation Act.

10. Describe the historic property (or properties) and any National Historic Landmarks within the APE (or attach documentation or provide specific link to this information):

The intensive pedestrian cultural resources inventory resulted in the identification and recordation of three historic structures and a historic district. The historic structures include the East Wash Dam (S2872), the West Wash Dam (S2873), and a segment of the previously recorded Highland Ditch (S808). Because the East and West Wash Dams function as a unit, they were also included in the East and West Wash Dam Historic District (D390). No archaeological sites or isolated cultural resources were identified during the intensive cultural resources inventory. An attempt was made to relocate previously recorded prehistoric archaeological site 26WA1697, but it is presumed destroyed in its entirety by the construction of McCarran Boulevard and continuing modern development of the area.

Based upon the recommendations of Broadbent, the NRCS determined that the segment of the Highland Ditch (S808) recorded for the Project be considered a non-contributing segment to the National Register of Historic Places (NRHP) eligibility of the whole resource and not individually eligible for NRHP inclusion. The NRCS has determined, based upon Broadbent recommendations that the East Wash Dam (S2872) and West Wash Dam(S2873) are eligible for NRHP inclusion under Criterion A. Broadbent also recommended and the NRCS has determined that the East and West Wash Dam Historic District (D390) is eligible for NRHP inclusion under Criterion A Structures S2872 and S2873 are recommended by Broadbent and determined by the NRCS to be contributing resources to Historic District D390; Structure S808 was recommended by Broadbent and determined by the NRCS to be a non-contributing element to the historic district. The SHPO concurred with these determinations in a letter to the NRCS dated March 25, 2022.

There are no National Historic Landmarks within the APE.

11. Describe the undertaking's effects on historic properties:

The proposed remediation activities for the West Wash Dam (S2873) will adversely affect the character defining features that qualify the property for listing in the National Register of Historic Places (NRHP), notably its physical and spatial proportions and slope. Additionally, the proposed activities may diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association pursuant to 36 CFR §800.S(a)(l). In particular, increasing the height of the West Wash Dam embankment will alter its original design and the regrading of the impoundment area may alter the integrity of workmanship, materials, design, and setting.

12. Explain how this undertaking would adversely affect historic properties (include information on any conditions or future actions known to date to avoid, minimize, or mitigate adverse effects):

The West Wash Dam (S2873) will have the following:

1. embankment raised five feet to a new elevation of 4,798 ft.
2. the auxiliary spillway widened to the original design width of 80 ft. and lowered to a crest elevation of 4,782.5 ft.
3. regrading the impoundment area west of the existing flow line by steepening the western slope to a 2:1 slope and 421,683 cubic yards of cut with 28,588 cubic yards of fill associated with the grading

13. Provide copies or summaries of the views provided to date by any consulting parties, Indian tribes or Native Hawai'ian organizations, or the public, including any correspondence from the SHPO and/or THPO. * see *Instructions for Completing the ACHP* e*106 Form*

See attachments.

III. Additional Information

14. Please indicate the status of any consultation that has occurred to date, including whether there are any unresolved concerns or issues the ACHP should know about in deciding whether to participate in consultation. Providing a list of consulting parties, including email addresses and phone numbers if known, can facilitate the ACHP's review response.

The NRCS has a signed MOA with the SHPO to mitigate adverse effects for this project. Five American Indian Tribes and the Reno Historical Commission have been notified of the project and the NRCS determination of adverse effects to historic properties. No unresolved concerns.

15. Does your agency have a website or website link where the interested public can find out about this project and/or provide comments? Please provide relevant links:
No web site.

16. Is this undertaking considered a "major" or "covered" project listed on the Federal Infrastructure Projects Permitting Dashboard? If so, please provide the link:
No.

The following are attached to this form (check all that apply):

- ☒ Section 106 consultation correspondence
- ☐ Maps, photographs, drawings, and/or plans
- ☐ Additional historic property information
- ☐ Consulting party list with known contact information
- ☒ Other: signed copy of MOA

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

December 17, 2021

Mike Callahan, PE
USDA - Natural Resources Conservation Service
1365 Corporate Blvd.
Reno, Nevada 89502

Subject: Scoping Comments for the West Wash Dam Rehabilitation Supplemental Watershed Plan and Environmental Document, Washoe County, Nevada

Dear Mike Callahan:

The U.S. Environmental Protection Agency has reviewed information for the Natural Resources Conservation Service's project available at the City of Reno's website.[1] Our review and comments are provided pursuant to NEPA, Council on Environmental Quality regulations (40 CFR Parts 1500-1508), and Section 309 of the Clean Air Act.

The EPA accepted the Service's invitation to serve as a Cooperating Agency for the subject Environmental Document on September 3, 2021. We offer the enclosed comments for consideration in preparing the Environmental Document. These comments are provided with the assumption that the Service is preparing an Environmental Assessment for the proposed project and the EPA may have additional scoping comments if the Service decides to prepare an Environmental Impact Statement. For an EIS, the Service would be required to publish a Notice of Intent in the Federal Register (40 CFR 1501.9(d)).

We appreciate the opportunity to provide these scoping comments and are available to discuss. When the public Environmental Document is released for public review, please send notification and provide an electronic copy. If you have questions, please contact me at (415) 972-3929 or hoffman.hugo@epa.gov.

Sincerely,

Hugo Hoffman
Environmental Review Branch

Enclosure: EPA's Detailed Comments
Cc (via email): Jose Rosado, Natural Resources Conservation Service
Steve Gamilis, City of Reno

[1] Available at https://www.reno.gov/government/departments/public-works/west-wash-dam-rehabilitation, accessed December 15, 2021

U.S. EPA DETAILED COMMENTS ON THE SCOPING NOTICE FOR THE WEST WASH DAM REHABILITATION SUPPLEMENTAL WATERSHED PLAN AND ENVIRONMENTAL DOCUMENT, WASHOE COUNTY, NEVADA – DECEMBER 17, 2020

Purpose and Need

The U.S. Environmental Protection Agency recommends that the Draft Environmental Document for the proposed action clearly identify the underlying purpose and need. The purpose and need should be a clear, objective statement of the rationale for the proposed project, as it provides the framework for identifying project alternatives. The *purpose* of the proposed action is typically the specific objective(s) of the activity and is essential for defining the range of alternatives to be considered for the project. The *need* for the proposed action may be to eliminate a broader underlying problem or take advantage of an opportunity.

Alternatives Analysis

A robust range of alternatives will include options for avoiding significant environmental impacts. The document should clearly describe the criteria used to determine whether impacts of an alternative are significant or not. Thresholds of significance should be determined by considering the context and intensity, or setting and degree, of an action and its effects.

The environmental impacts of the proposed action and alternatives should be presented in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decision maker and the public. The potential environmental impacts of each alternative should be quantified to the greatest extent possible (e.g. acres of habitat impacted; change in water quality).

Water Resources

Clean Water Act Section 404

Describe the status of the Service's coordination with the U.S. Army Corps of Engineers for determination of jurisdictional waters of the U.S. and whether or not the project is subject to Clean Water Act Section 404 Permit requirements for discharge of dredged or fill material into waters of the United States, including wetlands and other "special aquatic sites."

The EPA strongly recommends that the Service coordinate with the Corps on permitting requirements for the project and include in the Environmental Document a robust description of potential impacts to waters of the U.S. and mitigation requirements. When the Corps issues a Public Notice (PN) for their CWA 404 Permit, the EPA will review the PN and may provide additional comments.

To avoid potentially conflicting alternatives analyses, ensure that the range of NEPA alternatives includes what could be considered the *Least Environmentally Damaging Practicable Alternative* (LEDPA) for purposes of the required CWA 404(b)(1) alternatives analysis as would be required under the *CWA Section 404 (b)(1) Guidelines* (40 CFR 230.10(a)). Include the 404(b)(1) alternatives analysis in the Environmental Document to demonstrate that the project is avoiding and minimizing damage to waters of the U.S. to the maximum extent practicable and is in compliance with the Guidelines. The discussion should demonstrate that relatively less impactful alternatives are not practicable, as defined by the Guidelines.

Water Quality

Provide a complete hydrologic characterization of the project vicinity and the cumulative impact area, describing all existing water resources and baseline groundwater and surface water quality, quantity,

flow regimes, and groundwater/surface water adjudication. Include information on groundwater properties and groundwater/surface water connections.

Discuss all direct, indirect, and cumulative impacts to surface water and groundwater quality and quantity from the proposed project and alternatives both during construction and in operations. Describe all potential project discharges, seepage, temporary ponding, diversions, as well as the potential effects of these activities on water rights, quality, and flow; beneficial uses; and wildlife.

Drainages and Floodplains

Describe how drainage patterns would change under each alternative. Include hydrologic and topographic maps of the project area and affected area. Identify any components of the proposed project that would fall within 25- and 100-year floodplains, as well as any facilities that would pose a risk within the 500-year floodplain. Discuss the potential for runoff to transport sediment or contaminants from disturbed areas at the mine to any surface waters, as well as any potential sensitive receptors.

Dam Safety

Use of a Failure Mode Effects Analysis (FMEA) may be appropriate for identification of potential failure modes and effects of a dam failure, as well as design and mitigation measures.

Consider a formal Emergency Action Plan (EAP). An EAP serves to document the procedures to be undertaken in the event of an emergency. It can help to prevent the occurrence or exacerbation of a failure. Include information in the Environmental Document on how to identify a potential failure event, notify the public, and expected public services response procedures.

Air Quality

According to NEPAssist, the project area is a Maintenance Area for PM_{10} (1987 standard)
Describe existing air quality in the project vicinity. Discuss the National Ambient Air Quality Standards (NAAQS) applicable to air quality in the project area. Explain impacts to the NAAQS from projected emissions of the project and alternatives.

The project would take place in a federal maintenance area for PM_{10} (1987 standard). The EPA recommends that Service coordinate closely with the Washoe County Air Quality Management Division to ensure that the project moves forward in a manner that reduces air quality impacts to the greatest extent possible. We recommend that the Environmental Document provide a robust air quality impact analysis, including ambient air conditions (baseline or existing conditions), National Ambient Air Quality Standards (NAAQS), criteria pollutant nonattainment areas, and potential air quality impacts of the proposed action, including indirect and cumulative impacts. Such an evaluation is necessary to ensure compliance with state and federal air quality regulations, and to disclose the potential impacts from temporary or cumulative degradation of air quality.

Estimate emissions of criteria pollutants from the proposed project and discuss the timeframe for release of these emissions over the construction period of the project. Specify emission sources by pollutant from mobile sources, stationary sources, and ground disturbance. Use source-specific information to identify appropriate mitigation measures and areas in need of the greatest attention.

Construction Emissions

Include a list of all mitigation measures to be implemented as part of the construction emissions mitigation plan developed for the project. In addition to measures necessary to meet all applicable local,

state, and federal requirements, the EPA recommends the following mitigation measures be included in the construction emissions mitigation plan:

Fugitive Dust Source Controls:

- Stabilize open storage piles and disturbed areas by covering and/or applying water or chemical/organic dust palliative where appropriate. This applies to both active and inactive sites during workdays, weekends, holidays, and windy conditions.
- Install wind fencing and phase grading operations where appropriate and operate water trucks for stabilization of surfaces under windy conditions.
- When hauling material and operating non-earthmoving equipment, prevent spillage and limit speeds to 15 miles per hour (mph). Limit speed of earth-moving equipment to 10 mph.

Mobile and Stationary Source Controls:

- Reduce unnecessary idling from heavy equipment.
- Prohibit engine tampering to increase horsepower, except when meeting manufacturer's recommendations.
- Lease or buy newer, cleaner equipment using the best available emissions control technologies.
  - Use lower-emitting engines and fuels, including electric, liquified gas, hydrogen fuel cells, and/or alternative diesel formulations, if feasible.
  - *On-Highway Vehicles* - On-highway vehicles should meet, or exceed, the U.S. EPA exhaust emissions standards for model year 2010 and newer heavy-duty on-highway compression-ignition engines (e.g., drayage trucks, long haul trucks, refuse haulers, shuttle buses, etc.).[2]
  - *Nonroad Vehicles & Equipment* - Nonroad vehicles and equipment should meet, or exceed, the U.S. EPA Tier 4 exhaust emissions standards for heavy-duty nonroad compression-ignition engines (e.g., nonroad trucks, construction equipment, cargo handlers, etc.).[3]

Administrative Controls:

- Coordinate with appropriate air quality agencies to identify a construction schedule that minimizes cumulative impacts from other planned projects in the region, if feasible.
- Locate diesel engines, motors, and equipment staging areas as far as possible from residential areas and other sensitive receptors (e.g., schools, daycare centers, hospitals, senior centers, etc.).
- Avoid routing truck traffic near sensitive land uses to the fullest extent feasible.
- Use cement blended with the maximum feasible amount of fly ash or other materials that reduce GHG emissions from cement production.
- Use lighter-colored pavement where feasible.
- Recycle construction debris to the maximum extent feasible.
- Prepare an inventory of all equipment prior to construction and identify the suitability of add-on emission controls for each piece of equipment before groundbreaking.[4]
- Reduce construction-related trips of workers and equipment, including trucks.
- Develop a construction traffic and parking management plan that minimizes traffic interference and maintains traffic flow.
- Identify all commitments to reduce construction emissions and quantify air quality improvements

[2] See https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100O9ZZ.pdf

[3] See https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100OA05.pdf

[4] Suitability of control devices is based on: whether there is reduced normal availability of the construction equipment due to increased downtime and/or power output, whether there may be significant damage caused to the construction equipment engine, or whether there may be a significant risk to nearby workers or the public.

that would result from adopting specific air quality measures.
- Identify where implementation of mitigation measures is rejected based on economic infeasibility.

General Conformity

The EPA's General Conformity Rule, established under Section 176(c)(4) of the Clean Air Act, provides a specific process for ensuring that federal actions do not interfere with a state's plans to attain or maintain NAAQS. For any criteria pollutants in the air basin of the project area where the air quality status is in nonattainment or attainment – maintenance, complete a general conformity applicability analysis (i.e., a comparison of direct and indirect emissions for each alternative with *de minimis* thresholds of 40 CFR 93.153). We recommend including a draft general conformity determination, if applicable, in the draft environmental document to fulfill the public participation requirements of 40 CFR 93.156. Maintenance areas redesignated to attainment more than twenty years in the past are no longer required to comply with general conformity.

Biological Resources

The document should identify all petitioned and listed threatened and endangered species and critical habitat that might occur within the project area. Quantify which species or critical habitat might be directly, indirectly, or cumulatively affected by each alternative. The EPA recommends engaging the U.S. Fish and Wildlife Service as early in the analysis as possible to assure that the proposed alternatives account for the following:

- River restoration, flow and channel modifications, wetlands, and habitat fragmentation regarding species' habitat requirements;
- Migratory Bird Treaty Act compliance; and
- Protection from invasive species.

Climate Change & Greenhouse Gases

We recommend that the Draft EA consider how climate change could potentially influence the project area, and how implementation of the proposed project activities could lessen or potentially mitigate for these impacts. In this discussion, include anticipated changes to the watershed in terms of quantity and timing of snowpack, runoff, and precipitation and how these changes may impact the hydrology in the project area and the operations of the project. This discussion should include impacts to water temperature, flow, sediment transport, and beneficial uses. The following outline covers the topics that we recommend be addressed by the Environmental Document.

I. Contributions to Climate Change - Emissions Estimates, Context, and Mitigation

1. *Quantify GHG emissions*
    a. Estimate direct and indirect, annual and total, GHG emissions for each alternative, for major GHGs (e.g. CO_2, N_2O, methane – CO_2 equivalent can be ok, but if using SC-GHG below you need it broken down by constituent)
2. *Provide context for the impacts of GHG emissions*

Options include:

    a. Discussion of how emissions help or hinder meeting GHG reduction targets set at the federal, state or local level (40 § 1506.2(d)). For example, discuss how project emissions and other operational elements interact with the goals of the State of Nevada Climate Initiative (https://climateaction.nv.gov/our-goals/) and national and international GHG emissions reduction goals, including the U.S. 2030 Paris GHG reduction target and 2050 net-zero pathway (https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/22/fact-sheet-president-biden-sets-2030-greenhouse-gas-pollution-reduction-target-aimed-at-

creating-good-paying-union-jobs-and-securing-u-s-leadership-on-clean-energy-technologies/). This discussion should address the increasing conflict over time between continued GHG emissions and GHG emissions reduction goals over the project lifetime, and ways to avoid or mitigate that conflict.

b. Consider including the Social Cost of GHG to aid in the disclosure of impacts and to include in the Cost-Benefit Analysis. A discussion of the SC-GHG estimates used in recent federal benefit cost analysis in the regulatory context can be found in EPA's supporting documents for the Revised Cross-State Air Pollution Rule (CSAPR) Update Rule. Specifically, the estimates used in the BCA of the Revised CSAPR rule are the interim SC-GHG estimates that EPA and other members of the IWG developed under E.O. 13990 for use in BCA until an improved estimate of the impacts of climate change can be developed based on the best available science and economics taking into consideration recommendations from the National Academies of Sciences, Engineering, and Medicine (National Academies, 2017). Additional information on the SC-GHG, including interim cost estimates, can be found at https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf.

   Even absent a full benefit-cost analysis, where it is possible to develop a reasonable estimate of the net changes in direct and indirect GHG emissions resulting from a proposed project (i.e., relative to a no action alternative), the use of SC-GHG estimates can provide useful information in the environmental review to help interpret GHG emissions results for the public.

c. Compare to other emissions, such as "annual emissions of x cars." One online tool that can help with comparison can be found here: https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator.

3. *Include measures to mitigate GHG emissions*

   a. *Identify and include measures to avoid, reduce and minimize GHG emissions.* Many air quality mitigation measures for criteria pollutants have the co-benefits of reducing GHGs. Practicable measures to reduce mobile sources could include:

      - Idling best management practices (BMPs) to limit truck and equipment idling on site, including strict enforcement of idling limits. At the same time, the practice will result in fuel savings.
      - Require advanced pollution controls and clean fuels for new equipment, and for older equipment to be retrofitted. Use particle traps and other appropriate controls to reduce emissions of DPM and other air pollutants. Traps control approximately 80 percent of DPM, and specialized catalytic converters (oxidation catalysts) control approximately 20 percent of DPM, 40 percent of carbon monoxide emissions, and 50 percent of hydrocarbon emissions.
      - Minimize construction-related trips of workers and equipment, including trucks and heavy equipment.
      - Lease or buy newer, cleaner equipment (1996 or newer model).
      - Employ periodic, unscheduled inspections to ensure that construction equipment is properly maintained at all times and does not unnecessarily idle, is tuned to manufacturer's specifications, and is not modified to increase horsepower except in accordance with established specifications.

   Design and operational elements that could minimize air pollutant emissions could include.

- Use conveyors rather than haul trucks where possible, e.g., for transporting or placing materials
- Incorporate alternative energy components into the project, such as on-site solar
- Offer ride sharing or shuttle opportunities for employees commuting to the site from both nearby and distant communities.

Consider estimating the emissions reduction from these measures.

b. Consider including project elements to offset carbon (carbon offsets) or the voluntary purchase of carbon offset credits

II. Assess Climate Risk and Incorporate Mitigation

1. *Describe the affected environment under Climate Change over the time period of impacts and the life of the project*
   a. Include bracketing climate scenarios in describing the affected environment to explain the reasonably foreseeable effects of climate change in the area. Use the National Climate Assessment as an initial resource for identifying potential risks. See https://nca2018.globalchange.gov/. EPA's EnviroAtlas can also aid in identifying local climate change effects. See https://enviroatlas.epa.gov/enviroatlas/interactivemap/. Consider whether the proposal, its purpose and need, or alternatives may be affected by those changes. Consider in context of local vulnerability analyses, if available.
2. *Consider the interaction between impacts from the project and those due to Climate Change*
   a. Climate change can make the environment more susceptible to many types of impacts, which can exacerbate the impacts from the proposed project or alternatives. For example, the risk of a catastrophic dam failure be higher under Climate Change effects?
3. *Mitigation - Adaptation and Resilience* (Incorporate practicable measures to address risks in the proposal's design or alternatives)
   a. Consider project design elements to make the project resilient to climate change effects on the project (e.g. emergency spillway)

Environmental Justice

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" (February 16, 1994), directs federal agencies to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations. It further directs agencies to develop a strategy for implementing environmental justice and providing minority and low-income communities access to public information and public participation. As such, we recommend that the Service address adverse environmental effects of the proposed project on these communities, as well as any disproportionate distribution of flood risk reduction benefits, and outline measures to mitigate for impacts.

We encourage the Service to use EPA's EJSCREEN and/or the most recent American Community Survey from the U.S. Census Bureau for the Environmental Document to determine the presence of minority and low-income populations. However, it is important to note that minority and low-income can be measured in various ways.

The NEPA Committee of the Federal Interagency Working Group on Environmental Justice has noted that, in some cases, it may be appropriate to use a threshold for identifying low-income populations that

exceeds the poverty level.[5] A minority population does not need to meet a 50 percent standard if "the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis."[6] To best illustrate the presence of a minority population, we recommend that the Service analyze block groups, the smallest geographical unit that the U.S. Census Bureau publishes data for. We caution using larger tracts in the analysis, such as counties or cities, as these may dilute the presence of minority populations.

After the Service has determined if minority and low-income populations exist in the project area, we recommend that the Environmental Document discuss whether these communities would be potentially affected by individual or cumulative actions of the proposed action. We also recommend addressing whether any of the alternatives would cause any disproportionate adverse impacts, such as higher exposure to construction noise; changes in existing ecological, cultural, economic, or social resources or access; cumulative or multiple adverse exposures from environmental hazards; or community disruption.

If it is determined that minority and low-income populations may be disproportionately impacted, describe in the Environmental Document the measures taken by the Service to fully analyze the environmental effects of the action on minority communities and low-income populations and identify potential mitigation measures.

Present opportunities for affected communities to provide input into the NEPA process. In the Environmental Document, include information describing what was done to inform these communities about the project and the potential impacts it will have on their communities (notices, mailings, fact sheets, briefings, presentations, translations, newsletters, reports, community interviews, surveys, canvassing, telephone hotlines, question and answer sessions, stakeholder meetings, and on-scene information), what input was received from the communities, and how that input was utilized in the decisions that were made regarding the project.

CEQ has developed guidance[7] to address EJ in the environmental review process. *Promising Practices for Environmental Justice Methodologies in NEPA Reviews*[8] may also serve as a useful resource during the environmental review process. This document is a compilation of methodologies from current agency practices identified by the NEPA Committee of the Federal Interagency Working Group on Environmental Justice. The document focuses on the interface of EJ considerations through NEPA processes and provides recommendations on applying EJ methodologies that have been established in federal NEPA practice.

In the environmental document, discuss potential environmental justice concerns, such as air quality, water quality, noise, vibration, odors, etc. Include any environmental justice issues raised during scoping meetings. Clearly define the "reference community" and the "affected community." These definitions are used to determine whether there are disproportionately high and adverse human health or environmental impacts by comparing the impacts to the affected community with the impacts to the

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[5] Federal Interagency Working Group on Environmental Justice & NEPA Committee. Promising Practices for EJ Methodologies in NEPA Reviews. March 2016. Available at: https://www.epa.gov/sites/production/files/2016-08/documents/nepa_promising_practices_document_2016.pdf.

[6] Council on Environmental Quality. Environmental Justice: Guidance Under the National Environmental Policy Act. December 1997. Available at https://www.epa.gov/sites/production/files/2015-02/documents/ej_guidance_nepa_ceq1297.pdf.

[7] Council on Environmental Quality (1997). Environmental Justice: Guidance Under the National Environmental Policy Act. Available at: https://www.epa.gov/sites/production/files/2015-02/documents/ej_guidance_nepa_ceq1297.pdf

[8] Available at: https://www.epa.gov/sites/production/files/2016-08/documents/nepa_promising_practices_document_2016.pdf

reference community. A well-defined affected community will accurately reflect the demographic characteristics of the populations likely to be adversely impacted by the proposed project. A well-defined reference community will reflect the characteristics of the general population (e.g., municipal, regional, state).

The EPA's EJScreen is an online mapping tool that can aid the agencies in developing outreach for EJ communities. The tool is available at https://ejscreen.epa.gov/mapper/.

Consultation with Tribal Governments

It is important that formal government-to-government consultation take place early in the scoping phase of the project to ensure that all issues are adequately addressed in the Environmental Document. The principles for interactions with tribal governments are outlined in the presidential "Memorandum on Government-to Government Relations with Native American Tribal Governments" (April 29, 1994) and Executive Order 13175, "Consultation and Coordination with Indian Tribal Governments" (November 6, 2000).

In the Environmental Document, summarize the results of tribal consultation and identify the main concerns expressed by tribes (if any), and how those concerns were addressed. As a resource, we recommend the document *Tribal Consultation: Best Practices in Historic Preservation*[9], published by the National Association of Tribal Historic Preservation Officers.

National Historic Preservation Act

Consultation for tribal cultural resources is required under Section 106 of the National Historic Preservation Act. Historic properties under the NHPA are properties that are included in the National Register of Historic Places or that meet the criteria for the NRHP. Section 106 of the NHPA requires a federal agency, upon determining that activities under its control could affect historic properties, to consult with the appropriate State Historic Preservation Office/Tribal Historic Preservation Office. Under NEPA, any impacts to tribal, cultural, or other treaty resources must be disclosed in the Environmental Document. Section 106 of the NHPA requires that federal agencies consider the effects of their actions on cultural resources, following the regulation at 36 CFR 800.

In the Environmental Document, discuss how the Service would avoid or minimize adverse effects on the physical integrity, accessibility, or use of cultural resources or archaeological sites, including traditional cultural properties, throughout the project area. Clearly discuss mitigation measures for archaeological sites and TCPs. We encourage the Service to append any Memoranda of Agreements to the Environmental Document, after redacting specific information about these sites that is sensitive and protected under Section 304 of the NHPA. We also recommend providing a summary of all coordination with Tribes and with the State and Tribal Historic Preservation Offices, including identification of NRHP eligible sites and development of a Cultural Resource Management Plan.

Executive Order 13007

Executive Order 13007, "Indian Sacred Sites" (May 24, 1996), requires federal land managing agencies to accommodate access to, and ceremonial use of, Indian sacred sites by Indian religious practitioners, and to avoid adversely affecting the physical integrity, accessibility, or use of sacred sites. It is important to note that a sacred site may not meet the NRHP criteria for a historic property and that, conversely, a historic property may not meet the criteria for a sacred site. It is also important to note that sacred sites

[9] National Association of Tribal Historic Preservation Officers. May 2005. Tribal Consultation: Best Practices in Historic Preservation. Available at http://www.nathpo.org/PDF/Tribal_Consultation.pdf.

may not be identified solely in consulting with tribes located within geographic proximity of the project. Tribes located outside the direct impact area the plan area may also have religiously significant ties to lands within the plan area and should be included in the consultation process.

In the Environmental Document, address the existence of Indian sacred sites in the project areas, including seeps and springs, that may be considered spiritual sites by regional tribal nations. Discuss how the Service would ensure that the proposed action would avoid or mitigate for the impacts to the physical integrity, accessibility, or use of sacred sites.

Monitoring and Mitigation

Identify and describe appropriate mitigation measures associated with the project, specifying which ones would be required by the Service or another federal, state, or local agency. Explain how each measure would specifically mitigate the targeted impact, provide substantial detail on the means of implementing each mitigation measure, identify who would be responsible for implementing it, indicate whether it is enforceable, and describe its anticipated effectiveness. We recommend that for each impact area, the Environmental Document describe the specific mitigation implementation thresholds, any mitigation implementation and effectiveness monitoring deemed necessary, and the criteria by which success would be determined once mitigation is fully implemented. Furthermore, for some mitigation measures, it may be necessary to describe the contingency planning and adaptive management options in place in the event that mitigation is found to be less than fully successful.

Clearly identify the monitoring and mitigation framework that will be used to ensure that adjustments to management that may be made do not cause undesirable effects beyond those analyzed in the Environmental Document. In developing monitoring and mitigation plans, consider CEQ's 2011 Guidance, *Appropriate Use of Mitigation and Monitoring and Mitigated FONSIs* (available at https://ceq.doe.gov/docs/ceq-regulations-and-guidance/Mitigation_and_Monitoring_Guidance_14Jan2011.pdf), including ways to incorporate continued public involvement in monitoring via periodic publishing of monitoring results.

Cumulative Impacts

Understanding the cumulative impacts associated with the proposed project can help identify opportunities for minimizing pressures to resources as a whole. In the Environmental Document, identify which resources are analyzed for cumulative impacts, which ones are not, and why. Define the geographic boundary for each resource and describe its current health and historic context. Identify other on-going, planned, and reasonably foreseeable projects in the study area that may contribute to cumulative impacts. Use existing studies on the environmental impacts of these other projects to quantify cumulative impacts where feasible. We suggest the methodology developed by Federal Highways Administration and Caltrans, with assistance from EPA, for use in assessing cumulative impacts.[10] While this guidance was prepared for highway projects in California, the principles and the 8-step process outlined therein can be applied to other types of projects, including canals. Propose mitigation for any adverse cumulative impacts identified. Clearly state Reclamation's mitigation responsibilities, the mitigation responsibilities of other entities (such as Friant Division contractors), and the mechanism to be used for implementation.

In analyzing cumulative impacts associated with each alternative, we recommend describing past diversion impacts in the project area including incremental impacts from historical water management operations and their impacts to streams, associated wetlands and aquatic habitat. If there are other

[10] Available at https://dot.ca.gov/ser/cumulative_guidance/approach.htm

reasonably foreseeable water diversion and water management projects that will have a relationship with this project, we recommend that the Environmental Document identify those relationships to aid in the disclosure of any cumulative impacts to the affected environment.

Pyramid Lake Paiute Tribe
Tribal Historic Preservation Office
P. O. Box 256
Nixon, NV 89424

NRCS West-East Wash Dam
Nov. 15, 2022

Charles Armitage
NRCS State Cultural Resource Specialist
C. Clifton Young Federal Building
300 Booth Street, Room 2070
Reno, NV 89509

Dear Mr. Armitage,

The Pyramid Lake Paiute Tribal THPO is in receipt of your letter dated Nov. 6, 2022 regarding the West and East Wash Dams.

This letter merely points out the cultural significance of Peavine Mountain/Peak, an area where practitioners seek medicinal plants and prayer. Peavine has been evaluated for inclusion as a Traditional Cultural Property and certain locations were determined to be eligible for such designation. As such, many tribal people view the peak/mountain as a TCP, where traditional and cultural activity continues to this day. In reviewing the project and maps, THPO has determine the West and East Wash Dams project does not have an impact on Peavine.

However, once the project is underway, THPO does recommend a cultural resources monitor to be on hand during ground disturbing activities. Additionally, THPO asks that state and federal laws governing the discovery of human remains to be followed.

If you have any questions concerning this letter, please contact THPO Betty Aleck at 775-3345-5625 or by email at thpo@plpt.nsn.us

Sincerely,

Betty J. Aleck

Betty Aleck
PLPT THPO

December 27, 2022

Charles Armitage
NRCS State Cultural Resource Specialist Nevada
Natural Resources Conservation Service
C. Clifton Young Federal Building
300 Booth Street, Room 2070
Reno, Nevada 89509

Ref: *West and East Wash Dam Supplemental Watershed Plan Project*
City of Reno, Washoe County, Nevada
ACHP Project Number: 19069

Dear Mr. Armitage:

On December 19, 2022, the Advisory Council on Historic Preservation (ACHP) received your notification and supporting documentation regarding the potential adverse effects of the referenced undertaking on a property or properties listed or eligible for listing in the National Register of Historic Places. Based upon the information you provided, we have concluded that Appendix A, *Criteria for Council Involvement in Reviewing Individual Section 106 Cases,* of Section 106 of the National Historic Preservation Act (NHPA) and its implementing regulations, "Protection of Historic Properties" (36 CFR Part 800), does not apply to this undertaking. Accordingly, we do not believe our participation in the consultation to resolve adverse effects is needed.

However, if we receive a request for participation from the Nevada State Historic Preservation Officer (SHPO), Tribal Historic Preservation Officer, affected Indian tribe, a consulting party, or other party, we may reconsider this decision. Should the undertaking's circumstances change, consulting parties cannot come to consensus, or you need further advisory assistance to conclude the consultation process, please contact us.

Pursuant to 36 CFR § 800.6(b)(1)(iv), you will need to file the final Section 106 agreement document (Agreement), developed in consultation with the Nevada SHPO and any other consulting parties, and related documentation with the ACHP at the conclusion of the consultation process. The filing of the Agreement and supporting documentation with the ACHP is required in order to complete the requirements of Section 106 of the NHPA.

Thank you for providing us with your notification of adverse effect. If you have any questions or require our further assistance, please contact Alexis Clark at (202) 517-0208 or by e-mail at aclark@achp.gov and reference the ACHP Project Number above.

Sincerely,

LaShavio Johnson

LaShavio Johnson
Historic Preservation Technician
Office of Federal Agency Programs

Melissa Hafey
Arts & Culture
Management Assistant
Office of the City Manager

(775) 334-2253
hafeym@reno.gov
www.reno.gov

"Creating a community that people are proud to call home."

January 12, 2023

Charles Armitage, PhD. - Natural Resources Conservation Service
C. Clifton Young Federal Building
300 Booth Street, Room 2070
Reno, Nevada 89509

Re: Section 106 review - West Wash Dam Rehabilitation Project

Dear Charles,

Thank you for the opportunity to review the above referenced project. The Historical Resources Commission (HRC) has reviewed the project and has no concerns. The following are the comments provided by members of the HRC:

- There was no indication of the preferred alternative, which is not unusual at this time. However, the report noted that Alternative 3 has potential adverse effects and recommends a Historic Properties Treatment Plan to resolve these while both Alternatives 4 and 5 will have adverse effects, and a Historic Properties Treatment Plan is recommended to resolve.
- It's obvious that the proposed improvements to the flood protection facilities will lower the risk of flooding in this area, and have significant health & safety benefits. It is a solid project, moving forward in the best public interest.
- The HRC commissioners request a follow up that includes a summary of the selected alternative, and any mitigations included in the Historic Properties Treatment Plan.

Sincerely,

Melissa Hafey
Arts & Culture Management Assistant

NEVADA
STATE HISTORIC PRESERVATION OFFICE

STATE OF NEVADA
Department of Conservation and Natural Resources

Joe Lombardo, *Governor*
James A. Settelmeyer, *Director*
Rebecca L. Palmer, *Administrator*

February 2, 2023

Charles L. Armitage, Ph.D.
Cultural Resources Specialist/Archaeologist
Natural Resources Conservation Service
C. Clifton Young Federal Building
300 Booth St., Room 2070
Reno, Nevada 89509

RE: Section 106 consultation with the Natural Resources Conservation Service for the West Wash Dam Project, Final Alternative, Washoe County, Nevada
SHPO UT 2021-6645; 29965

Dear Mr. Armitage:

The Nevada State Historic Preservation Office (SHPO) has reviewed the subject documents received in hardcopy on January 6 and electronically on January 6, 17, 30, and February 2, 2023 in accordance with Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended.

The SHPO **concurs** with NRCS's finding of **Adverse Effect** to the East and West Wash Dam Historic District (D390) and the West Wash Dam (S2873).

Please submit a draft MOA in Microsoft Word format to all interested parties who will be negotiating this agreement. For our office, please submit this document to SHPO Rebecca Palmer at rlpalmer@shpo.nv.gov.

Should you have questions concerning this correspondence, please contact SHPO staff archaeologist Ashley Wiley at (775) 684-3450 or email awiley@shpo.nv.gov.

Sincerely,

Robin K. Reed
Deputy State Historic Preservation Officer

USDA

United States Department of Agriculture

January 16, 2024

Attn: Megan Berner
Arts and Culture Manager
City of Reno
One East First Street
Reno, Nevada 89501

Re: Consultation: NRCS Peavine Mountain Watershed West Wash Dam Rehabilitation project

Dear Megan:

Pursuant to the National Historic Preservation Act (NHPA) as amended, and the implemented regulations found in 36 CFR Part 800, the Nevada (NV) Natural Resources Conservation Service (NRCS) is contacting your office and requesting the Reno Historical Commission provide comments on concerns related to historic properties.

The project sponsor, the City of Reno, is seeking funding from NRCS to complete the project through the Watershed Protection and Flood Prevention Program (Public Law 83-566). While the City of Reno is the sponsoring/proposing entity, NRCS retains all responsibility to consult with concerned parties on projects, we may fund. The project is in northwest Reno, Nevada, at the intersection of Wyoming Avenue and Putnam Drive immediately south of McCarran Boulevard. The Area of Potential Effects (APE)for direct physical effects comprises 53.23 acres and the APE for indirect effects is 133.49 acres, which includes the footprint of the direct effects APE and an additional 80.26 acres surrounding the direct effects APE.

On June 10, 2021, Broadbent archaeologists conducted an intensive pedestrian cultural resources inventory of the 53.23-acre APE. The inventory was completed according to the standards and guidelines provided by NRCS and the Nevada State Historic Preservation Office (SHPO). All fieldwork was completed under direct supervision of Broadbent permitted archaeologist Ms. Margo Memmott and was conducted according to the terms of Broadbent's State of Nevada Antiquities Permit No. 618. Ms. Lauren Culleton served as the Architectural Historian for the Project. Broadbent, as the consulting firm, has completed a cultural resource survey for the proposed project and has provided National Register of Historic Places recommendations and a cultural resource report for the project. A copy of this report has been previously sent to the Reno Historical Commission for review.

Originally, the NRCS determined that there would be no adverse effects to historic properties from the proposed project. After consultation with the SHPO the NRCS has revised its determination

Natural Resources Conservation Service
C. Clifton Young Federal Building
300 Booth Street, Room 2070
Reno, Nevada 89509
Phone: (775) 857-8500 Toll Free Fax: (855) 816-0893
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and has determined that there will be adverse effects to historic property S873 (West Wash Dam) from the proposed project. The proposed project design has not changed, however, the NRCS National Register of Historic Places (NRHP) determination has. The adverse effects will occur from changing the slope of the West Wash earthen dam and raising the height of the dam. Both proposed practices will alter the original design of the historic property.

The project proposes to preserve the flood protection function of the West Wash Dam, protect lives and property in the surrounding urban area, while complying with current performance and safety standards in a cost effective and environmentally acceptable manner. The proposed project will address current deficiencies at West Wash and East Wash Dams to bring both dams into compliance with current dam safety regulations, engineering standards and performance criteria of High Hazard Dams. It will also ensure the watershed structure is properly maintained to minimize the risk to lives and property in the surrounding and downstream area which has been developed into a thriving, urban residential and commercial center since the original construction of the dams.

To mitigate potential adverse effects the NRCS will enter into a Memorandum of Agreement (MOA) with the SHPO Office. The mitigation efforts will include providing SHPO digital copies of photographs taken of the 1958 Peavine Mountain Watershed Project during dam construction and monitoring, provide SHPO a copy of the 1958 Peavine Mountain Watershed Engineering Report that includes descriptions of the dams and their engineering designs, a brief description of the Peavine 1958 Watershed Project, of which the East and West Wash Dams were a part, and the City of Reno will place an historic sign that meets SHPO requirements at the West Wash Dam site detailing the historic importance of the Peavine Mountain Watershed Project and East and West Wash Dams. This MOA is in draft stage and has been sent to SHPO for final review and signature.

Attachment 1 shows the legal locations and descriptions of the proposed practices. Attachment 2 contains maps showing the proposed project area of potential effect (APE).

After you have had an opportunity to review the proposed attached maps and revised NRCS NRHP determination, please advise our office of any concerns you may have regarding potential impacts to historic properties associated with the proposed project. Please respond within 30 days. If additional review time is needed, we would appreciate your notification.

Natural Resources Conservation Service
C. Clifton Young Federal Building
300 Booth Street, Room 2070
Reno, Nevada 89509
Phone: (775) 857-8500 Toll Free Fax: (855) 816-0893
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Please contact me at (775) 834-0901, or charles.armitage@usda.gov , if the Reno Historical Commission has any questions or concerns related to proposed project.

Sincerely,

Charles Armitage, Ph.D.
NRCS State Cultural Resource Specialist
Reno, Nevada

Attachment 1: Project Location and Description
Attachment 2: Figure 1 and Figure 2 Project Maps

Natural Resources Conservation Service
C. Clifton Young Federal Building
300 Booth Street, Room 2070
Reno, Nevada 89509
Phone: (775) 857-8500 Toll Free Fax: (855) 816-0893
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Attachment 1. Project Location and Description

NRCS Peavine Mountain Watershed West Wash Dam Rehabilitation project
T19N; R19E Sections 3, 4
T20N; R19E Sections 33, 34
Reno 7.5 Minute Quadrangle Map
Washoe County, Nevada

REMEDIATE BOTH EAST WASH AND WEST WASH DAMS

This includes remediation of both dams to meet the safety requirements of the NRCS and the Nevada Division of Water Resources Division of Dams. East Wash Dam is classified as a diversion dam while West Wash Dam is classified as a detention dam. Both Dams have been identified as High Hazard Dams by the Division of Dams. Currently, the East Wash Dam meets NRCS criteria for Earthen Dams with the exception of excessive damage to the spillway in a PMF event (USDA NRCS, 2019). The West Wash Dam does not meet NRCS criteria and would overtop in a PMF event (USDA NRCS, 2019). The United States Army Corps of Engineers Phase I inspection report indicates that the existing structures meet applicable seismic safety requirements. However, neither the original calculations performed, nor the original parameters utilized are available for review. Due to data gaps and potential advances in the knowledge of seismic activity in the area, seismic stability will be investigated as a part of the final design of this project.

Remediation of both dams will be confined to the already disturbed areas of the structures. East Wash Dam will have the west dike of the principal spillway approach restored to the original design elevation. West Wash Dam will have the embankment raised five feet to a new elevation of 4798 feet, the auxiliary spillway widened to the original design width of 80 feet and lowered to a crest elevation of 4782.5 feet, the impoundment area to the west of the existing flow line will be regraded to allow for more water storage, and a two-foot-tall parapet wall will be built on the east corner of the dam. Re-grading the impoundment area of West Wash Dam will consist of steepening the western slope to a 2:1 slope and the total cut and fill associated with the grading will be approximately 421,683 yd^3 and 28,588 yd^3, respectively.
With these proposed changes, the West Wash Dam auxiliary spillway will not be activated until the 500-year storm event (currently it activates during a 200-year storm event). The improvements to the West Wash Dam will supply three feet of freeboard during the Local PMP event, and the dam will no longer overtop or be in jeopardy of breaching. Other minor improvements that will be made under this alternative include:

- Stripping of vegetation, debris, and weathered fill from crest and downstream face of West Wash Dam
- Stripping of vegetation, debris, and weathered fill from crest and both faces of East Wash Dam's Auxiliary spillway
- Cleaning out Principal Spillway and sediment drain conduits

Natural Resources Conservation Service
C. Clifton Young Federal Building
300 Booth Street, Room 2070
Reno, Nevada 89509
Phone: (775) 857-8500 Toll Free Fax: (855) 816-0893
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- Replacement of sediment drain trash rack
- Corrosion resistant coating of sediment drain riser (and potentially interior of conduit to outfall in Principal Spillway riser)
- Repair of principal spillway riser concrete spalls and damage (both East and West Wash Dams).
- Daylighting of West Wash Dam Principal Spillway downstream invert
- Excavation along Principal Spillway conduit for installation of seep intercept system
- Backfill for repair of right spillway guide "wall" at crossing of Gulling Dr.

Natural Resources Conservation Service
C. Clifton Young Federal Building
300 Booth Street, Room 2070
Reno, Nevada 89509
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January 16, 2024

Attn: Lellah Shepard, Tribal Historic Preservation Officer
Fallon Paiute Tribe
565 Rio Vista Drive
Fallon, NV 89406

Re: Consultation: NRCS Peavine Mountain Watershed West Wash Dam Rehabilitation project-Adverse Effects

Dear Lellah Shepard:

Pursuant to the National Historic Preservation Act (NHPA) as amended, and the implemented regulations found in 36 CFR Part 800, the Nevada (NV) Natural Resources Conservation Service (NRCS) is contacting your office and requesting the Fallon Paiute Tribe provide comments on Tribal concerns related to historic properties; traditional cultural properties, and/or sacred sites.

The project sponsor, the City of Reno, is seeking funding from NRCS to complete the project through the Watershed Protection and Flood Prevention Program (Public Law 83-566). While the City of Reno is the sponsoring/proposing entity, NRCS retains all responsibility to consult with Tribes on projects, we may fund. The project is in northwest Reno, Nevada, at the intersection of Wyoming Avenue and Putnam Drive immediately south of McCarran Boulevard. The Area of Potential Effects (APE)for direct physical effects comprises 53.23 acres and the APE for indirect effects is 133.49 acres, which includes the footprint of the direct effects APE and an additional 80.26 acres surrounding the direct effects APE.

On June 10, 2021, Broadbent archaeologists conducted an intensive pedestrian cultural resources inventory of the 53.23-acre APE. The inventory was completed according to the standards and guidelines provided by NRCS and the Nevada State Historic Preservation Office (SHPO). All fieldwork was completed under direct supervision of Broadbent permitted archaeologist Ms. Margo Memmott and was conducted according to the terms of Broadbent's State of Nevada Antiquities Permit No. 618. Ms. Lauren Culleton served as the Architectural Historian for the Project. Broadbent, as the consulting firm, has completed a cultural resource survey for the proposed project and has provided National Register of Historic Places recommendations and a cultural resource report for the project. A copy of this report has been previously sent to the Fallon Paiute Tribe for review.

Originally, the NRCS determined that there would be no adverse effects to historic properties from the proposed project. After consultation with the SHPO the NRCS has revised its determination and has determined that there will be adverse effects to historic property S873 (West Wash Dam)

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from the proposed project. The proposed project design has not changed, however, the NRCS National Register of Historic Places (NRHP) determination has. The adverse effects will occur from changing the slope of the West Wash earthen dam and raising the height of the dam. Both proposed practices will alter the original design of the historic property.

The project proposes to preserve the flood protection function of the West Wash Dam, protect lives and property in the surrounding urban area, while complying with current performance and safety standards in a cost effective and environmentally acceptable manner. The proposed project will address current deficiencies at West Wash and East Wash Dams to bring both dams into compliance with current dam safety regulations, engineering standards and performance criteria of High Hazard Dams. It will also ensure the watershed structure is properly maintained to minimize the risk to lives and property in the surrounding and downstream area which has been developed into a thriving, urban residential and commercial center since the original construction of the dams.

To mitigate potential adverse effects the NRCS will enter into a Memorandum of Agreement (MOA) with the SHPO Office. The mitigation efforts will include providing SHPO digital copies of photographs taken of the 1958 Peavine Mountain Watershed Project during dam construction and monitoring, provide SHPO a copy of the 1958 Peavine Mountain Watershed Engineering Report that includes descriptions of the dams and their engineering designs, a brief description of the Peavine 1958 Watershed Project, of which the East and West Wash Dams were a part, and the City of Reno will place an historic sign that meets SHPO requirements at the West Wash Dam site detailing the historic importance of the Peavine Mountain Watershed Project and East and West Wash Dams. This MOA is in draft stage and has been sent to SHPO for final review and signature.

Attachment 1 shows the legal locations and descriptions of the proposed practices. Attachment 2 contains maps showing the proposed project area of potential effect (APE).

After you have had an opportunity to review the proposed attached maps and revised NRCS NRHP determination, please advise our office of any concerns you may have regarding potential impacts to historic properties or sites of religious or cultural significance associated with the proposed project. Please respond within 30 days. If additional review time is needed, we would appreciate your notification.

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Please contact me at (775) 834-0901, or charles.armitage@usda.gov , if the Fallon Paiute Tribe has any questions or concerns related to proposed project.

Sincerely,

Charles Armitage

Charles Armitage, Ph.D.
NRCS State Cultural Resource Specialist
Reno, Nevada

Attachment 1: Project Location and Description
Attachment 2: Figure 1 and Figure 2 Project Maps

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Attachment 1. Project Location and Description

NRCS Peavine Mountain Watershed West Wash Dam Rehabilitation project
T19N; R19E Sections 3, 4
T20N; R19E Sections 33, 34
Reno 7.5 Minute Quadrangle Map
Washoe County, Nevada

REMEDIATE BOTH EAST WASH AND WEST WASH DAMS

This includes remediation of both dams to meet the safety requirements of the NRCS and the Nevada Division of Water Resources Division of Dams. East Wash Dam is classified as a diversion dam while West Wash Dam is classified as a detention dam. Both Dams have been identified as High Hazard Dams by the Division of Dams. Currently, the East Wash Dam meets NRCS criteria for Earthen Dams with the exception of excessive damage to the spillway in a PMF event (USDA NRCS, 2019). The West Wash Dam does not meet NRCS criteria and would overtop in a PMF event (USDA NRCS, 2019). The United States Army Corps of Engineers Phase I inspection report indicates that the existing structures meet applicable seismic safety requirements. However, neither the original calculations performed, nor the original parameters utilized are available for review. Due to data gaps and potential advances in the knowledge of seismic activity in the area, seismic stability will be investigated as a part of the final design of this project.

Remediation of both dams will be confined to the already disturbed areas of the structures. East Wash Dam will have the west dike of the principal spillway approach restored to the original design elevation. West Wash Dam will have the embankment raised five feet to a new elevation of 4798 feet, the auxiliary spillway widened to the original design width of 80 feet and lowered to a crest elevation of 4782.5 feet, the impoundment area to the west of the existing flow line will be regraded to allow for more water storage, and a two-foot-tall parapet wall will be built on the east corner of the dam. Re-grading the impoundment area of West Wash Dam will consist of steepening the western slope to a 2:1 slope and the total cut and fill associated with the grading will be approximately 421,683 yd^3 and 28,588 yd^3, respectively.
With these proposed changes, the West Wash Dam auxiliary spillway will not be activated until the 500-year storm event (currently it activates during a 200-year storm event). The improvements to the West Wash Dam will supply three feet of freeboard during the Local PMP event, and the dam will no longer overtop or be in jeopardy of breaching.
Other minor improvements that will be made under this alternative include:

- Stripping of vegetation, debris, and weathered fill from crest and downstream face of West Wash Dam
- Stripping of vegetation, debris, and weathered fill from crest and both faces of East Wash Dam's Auxiliary spillway

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- Cleaning out Principal Spillway and sediment drain conduits
- Replacement of sediment drain trash rack
- Corrosion resistant coating of sediment drain riser (and potentially interior of conduit to outfall in Principal Spillway riser)
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- Daylighting of West Wash Dam Principal Spillway downstream invert
- Excavation along Principal Spillway conduit for installation of seep intercept system
- Backfill for repair of right spillway guide "wall" at crossing of Gulling Dr.

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United States Department of Agriculture

January 16, 2024

Attn: Betty Aleck, THPO
Pyramid Lake Paiute Tribe
P.O. Box 256
Nixon, Nevada, 89424

Re: Consultation: NRCS Peavine Mountain Watershed West Wash Dam Rehabilitation project-Adverse Effects

Dear Betty:

Pursuant to the National Historic Preservation Act (NHPA) as amended, and the implemented regulations found in 36 CFR Part 800, the Nevada (NV) Natural Resources Conservation Service (NRCS) is contacting your office and requesting the Pyramid Lake Paiute Tribe provide comments on Tribal concerns related to historic properties; traditional cultural properties, and/or sacred sites.

The project sponsor, the City of Reno, is seeking funding from NRCS to complete the project through the Watershed Protection and Flood Prevention Program (Public Law 83-566). While the City of Reno is the sponsoring/proposing entity, NRCS retains all responsibility to consult with Tribes on projects, we may fund. The project is in northwest Reno, Nevada, at the intersection of Wyoming Avenue and Putnam Drive immediately south of McCarran Boulevard. The Area of Potential Effects (APE)for direct physical effects comprises 53.23 acres and the APE for indirect effects is 133.49 acres, which includes the footprint of the direct effects APE and an additional 80.26 acres surrounding the direct effects APE.

On June 10, 2021, Broadbent archaeologists conducted an intensive pedestrian cultural resources inventory of the 53.23-acre APE. The inventory was completed according to the standards and guidelines provided by NRCS and the Nevada State Historic Preservation Office (SHPO). All fieldwork was completed under direct supervision of Broadbent permitted archaeologist Ms. Margo Memmott and was conducted according to the terms of Broadbent's State of Nevada Antiquities Permit No. 618. Ms. Lauren Culleton served as the Architectural Historian for the Project. Broadbent, as the consulting firm, has completed a cultural resource survey for the proposed project and has provided National Register of Historic Places recommendations and a cultural resource report for the project. A copy of this report has been previously sent to the Pyramid Lake Paiute Tribe for review.

Originally, the NRCS determined that there would be no adverse effects to historic properties from the proposed project. After consultation with the SHPO the NRCS has revised its determination and has determined that there will be adverse effects to historic property S873 (West Wash Dam)

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from the proposed project. The proposed project design has not changed, however, the NRCS National Register of Historic Places (NRHP) determination has. The adverse effects will occur from changing the slope of the West Wash earthen dam and raising the height of the dam. Both proposed practices will alter the original design of the historic property.

The project proposes to preserve the flood protection function of the West Wash Dam, protect lives and property in the surrounding urban area, while complying with current performance and safety standards in a cost effective and environmentally acceptable manner. The proposed project will address current deficiencies at West Wash and East Wash Dams to bring both dams into compliance with current dam safety regulations, engineering standards and performance criteria of High Hazard Dams. It will also ensure the watershed structure is properly maintained to minimize the risk to lives and property in the surrounding and downstream area which has been developed into a thriving, urban residential and commercial center since the original construction of the dams.

To mitigate potential adverse effects the NRCS will enter into a Memorandum of Agreement (MOA) with the SHPO Office. The mitigation efforts will include providing SHPO digital copies of photographs taken of the 1958 Peavine Mountain Watershed Project during dam construction and monitoring, provide SHPO a copy of the 1958 Peavine Mountain Watershed Engineering Report that includes descriptions of the dams and their engineering designs, a brief description of the Peavine 1958 Watershed Project, of which the East and West Wash Dams were a part, and the City of Reno will place an historic sign that meets SHPO requirements at the West Wash Dam site detailing the historic importance of the Peavine Mountain Watershed Project and East and West Wash Dams. This MOA is in draft stage and has been sent to SHPO for final review and signature.

Attachment 1 shows the legal locations and descriptions of the proposed practices. Attachment 2 contains maps showing the proposed project area of potential effect (APE).

After you have had an opportunity to review the proposed attached maps and revised NRCS NRHP determination, please advise our office of any concerns you may have regarding potential impacts to historic properties or sites of religious or cultural significance associated with the proposed project. Please respond within 30 days. If additional review time is needed, we would appreciate your notification.

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Please contact me at (775) 834-0901, or charles.armitage@usda.gov , if the Pyramid Lake Paiute Tribe has any questions or concerns related to proposed project.

Sincerely,

Charles Armitage

Charles Armitage, Ph.D.
NRCS State Cultural Resource Specialist
Reno, Nevada

Attachment 1: Project Location and Description
Attachment 2: Figure 1 and Figure 2 Project Maps

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Attachment 1. Project Location and Description

NRCS Peavine Mountain Watershed West Wash Dam Rehabilitation project
T19N; R19E Sections 3, 4
T20N; R19E Sections 33, 34
Reno 7.5 Minute Quadrangle Map
Washoe County, Nevada

REMEDIATE BOTH EAST WASH AND WEST WASH DAMS

This includes remediation of both dams to meet the safety requirements of the NRCS and the Nevada Division of Water Resources Division of Dams. East Wash Dam is classified as a diversion dam while West Wash Dam is classified as a detention dam. Both Dams have been identified as High Hazard Dams by the Division of Dams. Currently, the East Wash Dam meets NRCS criteria for Earthen Dams with the exception of excessive damage to the spillway in a PMF event (USDA NRCS, 2019). The West Wash Dam does not meet NRCS criteria and would overtop in a PMF event (USDA NRCS, 2019). The United States Army Corps of Engineers Phase I inspection report indicates that the existing structures meet applicable seismic safety requirements. However, neither the original calculations performed, nor the original parameters utilized are available for review. Due to data gaps and potential advances in the knowledge of seismic activity in the area, seismic stability will be investigated as a part of the final design of this project.

Remediation of both dams will be confined to the already disturbed areas of the structures. East Wash Dam will have the west dike of the principal spillway approach restored to the original design elevation. West Wash Dam will have the embankment raised five feet to a new elevation of 4798 feet, the auxiliary spillway widened to the original design width of 80 feet and lowered to a crest elevation of 4782.5 feet, the impoundment area to the west of the existing flow line will be regraded to allow for more water storage, and a two-foot-tall parapet wall will be built on the east corner of the dam. Re-grading the impoundment area of West Wash Dam will consist of steepening the western slope to a 2:1 slope and the total cut and fill associated with the grading will be approximately 421,683 yd^3 and 28,588 yd^3, respectively.
With these proposed changes, the West Wash Dam auxiliary spillway will not be activated until the 500-year storm event (currently it activates during a 200-year storm event). The improvements to the West Wash Dam will supply three feet of freeboard during the Local PMP event, and the dam will no longer overtop or be in jeopardy of breaching.
Other minor improvements that will be made under this alternative include:

- Stripping of vegetation, debris, and weathered fill from crest and downstream face of West Wash Dam
- Stripping of vegetation, debris, and weathered fill from crest and both faces of East Wash Dam's Auxiliary spillway
- Cleaning out Principal Spillway and sediment drain conduits

- Replacement of sediment drain trash rack
- Corrosion resistant coating of sediment drain riser (and potentially interior of conduit to outfall in Principal Spillway riser)
- Repair of principal spillway riser concrete spalls and damage (both East and West Wash Dams).
- Daylighting of West Wash Dam Principal Spillway downstream invert
- Excavation along Principal Spillway conduit for installation of seep intercept system
- Backfill for repair of right spillway guide "wall" at crossing of Gulling Dr.

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January 16, 2024

Attn: Michon Eben, Tribal Historic Preservation Officer
Reno-Sparks Indian Colony
34 Reservation Rd
Reno, NV 89502

Re: Consultation: NRCS Peavine Mountain Watershed West Wash Dam Rehabilitation project-Adverse Effects

Dear Michon:

Pursuant to the National Historic Preservation Act (NHPA) as amended, and the implemented regulations found in 36 CFR Part 800, the Nevada (NV) Natural Resources Conservation Service (NRCS) is contacting your office and requesting the Reno Sparks Indian Colony provide comments on Tribal concerns related to historic properties; traditional cultural properties, and/or sacred sites.

The project sponsor, the City of Reno, is seeking funding from NRCS to complete the project through the Watershed Protection and Flood Prevention Program (Public Law 83-566). While the City of Reno is the sponsoring/proposing entity, NRCS retains all responsibility to consult with Tribes on projects, we may fund. The project is in northwest Reno, Nevada, at the intersection of Wyoming Avenue and Putnam Drive immediately south of McCarran Boulevard. The Area of Potential Effects (APE)for direct physical effects comprises 53.23 acres and the APE for indirect effects is 133.49 acres, which includes the footprint of the direct effects APE and an additional 80.26 acres surrounding the direct effects APE.

On June 10, 2021, Broadbent archaeologists conducted an intensive pedestrian cultural resources inventory of the 53.23-acre APE. The inventory was completed according to the standards and guidelines provided by NRCS and the Nevada State Historic Preservation Office (SHPO). All fieldwork was completed under direct supervision of Broadbent permitted archaeologist Ms. Margo Memmott and was conducted according to the terms of Broadbent's State of Nevada Antiquities Permit No. 618. Ms. Lauren Culleton served as the Architectural Historian for the Project. Broadbent, as the consulting firm, has completed a cultural resource survey for the proposed project and has provided National Register of Historic Places recommendations and a cultural resource report for the project. A copy of this report has been previously sent to the Reno Sparks Indian Colony for review.

Originally, the NRCS determined that there would be no adverse effects to historic properties from the proposed project. After consultation with the SHPO the NRCS has revised its determination

and has determined that there will be adverse effects to historic property S873 (West Wash Dam) from the proposed project. The proposed project design has not changed, however, the NRCS National Register of Historic Places (NRHP) determination has. The adverse effects will occur from changing the slope of the West Wash earthen dam and raising the height of the dam. Both proposed practices will alter the original design of the historic property.

The project proposes to preserve the flood protection function of the West Wash Dam, protect lives and property in the surrounding urban area, while complying with current performance and safety standards in a cost effective and environmentally acceptable manner. The proposed project will address current deficiencies at West Wash and East Wash Dams to bring both dams into compliance with current dam safety regulations, engineering standards and performance criteria of High Hazard Dams. It will also ensure the watershed structure is properly maintained to minimize the risk to lives and property in the surrounding and downstream area which has been developed into a thriving, urban residential and commercial center since the original construction of the dams.

To mitigate potential adverse effects the NRCS will enter into a Memorandum of Agreement (MOA) with the SHPO Office. The mitigation efforts will include providing SHPO digital copies of photographs taken of the 1958 Peavine Mountain Watershed Project during dam construction and monitoring, provide SHPO a copy of the 1958 Peavine Mountain Watershed Engineering Report that includes descriptions of the dams and their engineering designs, a brief description of the Peavine 1958 Watershed Project, of which the East and West Wash Dams were a part, and the City of Reno will place an historic sign that meets SHPO requirements at the West Wash Dam site detailing the historic importance of the Peavine Mountain Watershed Project and East and West Wash Dams. This MOA is in draft stage and has been sent to SHPO for final review and signature.

Attachment 1 shows the legal locations and descriptions of the proposed practices. Attachment 2 contains maps showing the proposed project area of potential effect (APE).

After you have had an opportunity to review the proposed attached maps and revised NRCS NRHP determination, please advise our office of any concerns you may have regarding potential impacts to historic properties or sites of religious or cultural significance associated with the proposed project. Please respond within 30 days. If additional review time is needed, we would appreciate your notification.

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Please contact me at (775) 834-0901, or charles.armitage@usda.gov , if the Reno Sparks Indian Colony has any questions or concerns related to proposed project.

Sincerely,

Charles Armitage, Ph.D.
NRCS State Cultural Resource Specialist
Reno, Nevada

Attachment 1: Project Location and Description
Attachment 2: Figure 1 and Figure 2 Project Maps

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NRCS Peavine Mountain Watershed West Wash Dam Rehabilitation project
T19N; R19E Sections 3, 4
T20N; R19E Sections 33, 34
Reno 7.5 Minute Quadrangle Map
Washoe County, Nevada

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This includes remediation of both dams to meet the safety requirements of the NRCS and the Nevada Division of Water Resources Division of Dams. East Wash Dam is classified as a diversion dam while West Wash Dam is classified as a detention dam. Both Dams have been identified as High Hazard Dams by the Division of Dams. Currently, the East Wash Dam meets NRCS criteria for Earthen Dams with the exception of excessive damage to the spillway in a PMF event (USDA NRCS, 2019). The West Wash Dam does not meet NRCS criteria and would overtop in a PMF event (USDA NRCS, 2019). The United States Army Corps of Engineers Phase I inspection report indicates that the existing structures meet applicable seismic safety requirements. However, neither the original calculations performed, nor the original parameters utilized are available for review. Due to data gaps and potential advances in the knowledge of seismic activity in the area, seismic stability will be investigated as a part of the final design of this project.

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January 16, 2024

Attn: Randi Lone Eagle, Tribal Historic Preservation Officer
Summit Lake Paiute Tribe
2255 Green Vista Dr, #402
Sparks, NV 89431

Re: Consultation: NRCS Peavine Mountain Watershed West Wash Dam Rehabilitation project-Adverse Effects

Dear Randi Lone Eagle:

Pursuant to the National Historic Preservation Act (NHPA) as amended, and the implemented regulations found in 36 CFR Part 800, the Nevada (NV) Natural Resources Conservation Service (NRCS) is contacting your office and requesting the Summit Lake PaiuteTribe provide comments on Tribal concerns related to historic properties; traditional cultural properties, and/or sacred sites.

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Sincerely,

Charles Armitage, Ph.D.
NRCS State Cultural Resource Specialist
Reno, Nevada

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T19N; R19E Sections 3, 4
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Reno 7.5 Minute Quadrangle Map
Washoe County, Nevada

REMEDIATE BOTH EAST WASH AND WEST WASH DAMS

This includes remediation of both dams to meet the safety requirements of the NRCS and the Nevada Division of Water Resources Division of Dams. East Wash Dam is classified as a diversion dam while West Wash Dam is classified as a detention dam. Both Dams have been identified as High Hazard Dams by the Division of Dams. Currently, the East Wash Dam meets NRCS criteria for Earthen Dams with the exception of excessive damage to the spillway in a PMF event (USDA NRCS, 2019). The West Wash Dam does not meet NRCS criteria and would overtop in a PMF event (USDA NRCS, 2019). The United States Army Corps of Engineers Phase I inspection report indicates that the existing structures meet applicable seismic safety requirements. However, neither the original calculations performed, nor the original parameters utilized are available for review. Due to data gaps and potential advances in the knowledge of seismic activity in the area, seismic stability will be investigated as a part of the final design of this project.

Remediation of both dams will be confined to the already disturbed areas of the structures. East Wash Dam will have the west dike of the principal spillway approach restored to the original design elevation. West Wash Dam will have the embankment raised five feet to a new elevation of 4798 feet, the auxiliary spillway widened to the original design width of 80 feet and lowered to a crest elevation of 4782.5 feet, the impoundment area to the west of the existing flow line will be regraded to allow for more water storage, and a two-foot-tall parapet wall will be built on the east corner of the dam. Re-grading the impoundment area of West Wash Dam will consist of steepening the western slope to a 2:1 slope and the total cut and fill associated with the grading will be approximately 421,683 yd^3 and 28,588 yd^3, respectively.
With these proposed changes, the West Wash Dam auxiliary spillway will not be activated until the 500-year storm event (currently it activates during a 200-year storm event). The improvements to the West Wash Dam will supply three feet of freeboard during the Local PMP event, and the dam will no longer overtop or be in jeopardy of breaching.
Other minor improvements that will be made under this alternative include:

- Stripping of vegetation, debris, and weathered fill from crest and downstream face of West Wash Dam
- Stripping of vegetation, debris, and weathered fill from crest and both faces of East Wash Dam's Auxiliary spillway
- Cleaning out Principal Spillway and sediment drain conduits

- Replacement of sediment drain trash rack
- Corrosion resistant coating of sediment drain riser (and potentially interior of conduit to outfall in Principal Spillway riser)
- Repair of principal spillway riser concrete spalls and damage (both East and West Wash Dams).
- Daylighting of West Wash Dam Principal Spillway downstream invert
- Excavation along Principal Spillway conduit for installation of seep intercept system
- Backfill for repair of right spillway guide "wall" at crossing of Gulling Dr.

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United States Department of Agriculture

January 16, 2024

Attn: Patrick Burtt, Tribal Historic Preservation Officer
Washoe Tribe of Nevada and California
919 Highway 395 South
Gardnerville, NV 89410

Re: Consultation: NRCS Peavine Mountain Watershed West Wash Dam Rehabilitation project-Adverse Effects

Dear Patrick Burtt:

Pursuant to the National Historic Preservation Act (NHPA) as amended, and the implemented regulations found in 36 CFR Part 800, the Nevada (NV) Natural Resources Conservation Service (NRCS) is contacting your office and requesting the Washoe Tribe of Nevada and California provide comments on Tribal concerns related to historic properties; traditional cultural properties, and/or sacred sites.

The project sponsor, the City of Reno, is seeking funding from NRCS to complete the project through the Watershed Protection and Flood Prevention Program (Public Law 83-566). While the City of Reno is the sponsoring/proposing entity, NRCS retains all responsibility to consult with Tribes on projects, we may fund. The project is in northwest Reno, Nevada, at the intersection of Wyoming Avenue and Putnam Drive immediately south of McCarran Boulevard. The Area of Potential Effects (APE)for direct physical effects comprises 53.23 acres and the APE for indirect effects is 133.49 acres, which includes the footprint of the direct effects APE and an additional 80.26 acres surrounding the direct effects APE.

On June 10, 2021, Broadbent archaeologists conducted an intensive pedestrian cultural resources inventory of the 53.23-acre APE. The inventory was completed according to the standards and guidelines provided by NRCS and the Nevada State Historic Preservation Office (SHPO). All fieldwork was completed under direct supervision of Broadbent permitted archaeologist Ms. Margo Memmott and was conducted according to the terms of Broadbent's State of Nevada Antiquities Permit No. 618. Ms. Lauren Culleton served as the Architectural Historian for the Project. Broadbent, as the consulting firm, has completed a cultural resource survey for the proposed project and has provided National Register of Historic Places recommendations and a cultural resource report for the project. A copy of this report has been previously sent to the Washoe Tribe of Nevada and California for review.

Originally, the NRCS determined that there would be no adverse effects to historic properties from the proposed project. After consultation with the SHPO the NRCS has revised its determination

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and has determined that there will be adverse effects to historic property S873 (West Wash Dam) from the proposed project. The proposed project design has not changed, however, the NRCS National Register of Historic Places (NRHP) determination has. The adverse effects will occur from changing the slope of the West Wash earthen dam and raising the height of the dam. Both proposed practices will alter the original design of the historic property.

The project proposes to preserve the flood protection function of the West Wash Dam, protect lives and property in the surrounding urban area, while complying with current performance and safety standards in a cost effective and environmentally acceptable manner. The proposed project will address current deficiencies at West Wash and East Wash Dams to bring both dams into compliance with current dam safety regulations, engineering standards and performance criteria of High Hazard Dams. It will also ensure the watershed structure is properly maintained to minimize the risk to lives and property in the surrounding and downstream area which has been developed into a thriving, urban residential and commercial center since the original construction of the dams.

To mitigate potential adverse effects the NRCS will enter into a Memorandum of Agreement (MOA) with the SHPO Office. The mitigation efforts will include providing SHPO digital copies of photographs taken of the 1958 Peavine Mountain Watershed Project during dam construction and monitoring, provide SHPO a copy of the 1958 Peavine Mountain Watershed Engineering Report that includes descriptions of the dams and their engineering designs, a brief description of the Peavine 1958 Watershed Project, of which the East and West Wash Dams were a part, and the City of Reno will place an historic sign that meets SHPO requirements at the West Wash Dam site detailing the historic importance of the Peavine Mountain Watershed Project and East and West Wash Dams. This MOA is in draft stage and has been sent to SHPO for final review and signature.

Attachment 1 shows the legal locations and descriptions of the proposed practices. Attachment 2 contains maps showing the proposed project area of potential effect (APE).

After you have had an opportunity to review the proposed attached maps and revised NRCS NRHP determination, please advise our office of any concerns you may have regarding potential impacts to historic properties or sites of religious or cultural significance associated with the proposed project. Please respond within 30 days. If additional review time is needed, we would appreciate your notification.

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Please contact me at (775) 834-0901, or charles.armitage@usda.gov , if the Washoe Tribe of Nevada and California has any questions or concerns related to proposed project.

Sincerely,

Charles Armitage, Ph.D.
NRCS State Cultural Resource Specialist
Reno, Nevada

Attachment 1: Project Location and Description
Attachment 2: Figure 1 and Figure 2 Project Maps

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300 Booth Street, Room 2070
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Attachment 1. Project Location and Description

NRCS Peavine Mountain Watershed West Wash Dam Rehabilitation project
T19N; R19E Sections 3, 4
T20N; R19E Sections 33, 34
Reno 7.5 Minute Quadrangle Map
Washoe County, Nevada

REMEDIATE BOTH EAST WASH AND WEST WASH DAMS

This includes remediation of both dams to meet the safety requirements of the NRCS and the Nevada Division of Water Resources Division of Dams. East Wash Dam is classified as a diversion dam while West Wash Dam is classified as a detention dam. Both Dams have been identified as High Hazard Dams by the Division of Dams. Currently, the East Wash Dam meets NRCS criteria for Earthen Dams with the exception of excessive damage to the spillway in a PMF event (USDA NRCS, 2019). The West Wash Dam does not meet NRCS criteria and would overtop in a PMF event (USDA NRCS, 2019). The United States Army Corps of Engineers Phase I inspection report indicates that the existing structures meet applicable seismic safety requirements. However, neither the original calculations performed, nor the original parameters utilized are available for review. Due to data gaps and potential advances in the knowledge of seismic activity in the area, seismic stability will be investigated as a part of the final design of this project.

Remediation of both dams will be confined to the already disturbed areas of the structures. East Wash Dam will have the west dike of the principal spillway approach restored to the original design elevation. West Wash Dam will have the embankment raised five feet to a new elevation of 4798 feet, the auxiliary spillway widened to the original design width of 80 feet and lowered to a crest elevation of 4782.5 feet, the impoundment area to the west of the existing flow line will be regraded to allow for more water storage, and a two-foot-tall parapet wall will be built on the east corner of the dam. Re-grading the impoundment area of West Wash Dam will consist of steepening the western slope to a 2:1 slope and the total cut and fill associated with the grading will be approximately 421,683 yd^3 and 28,588 yd^3, respectively.
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Other minor improvements that will be made under this alternative include:

- Stripping of vegetation, debris, and weathered fill from crest and downstream face of West Wash Dam
- Stripping of vegetation, debris, and weathered fill from crest and both faces of East Wash Dam's Auxiliary spillway
- Cleaning out Principal Spillway and sediment drain conduits

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- Replacement of sediment drain trash rack
- Corrosion resistant coating of sediment drain riser (and potentially interior of conduit to outfall in Principal Spillway riser)
- Repair of principal spillway riser concrete spalls and damage (both East and West Wash Dams).
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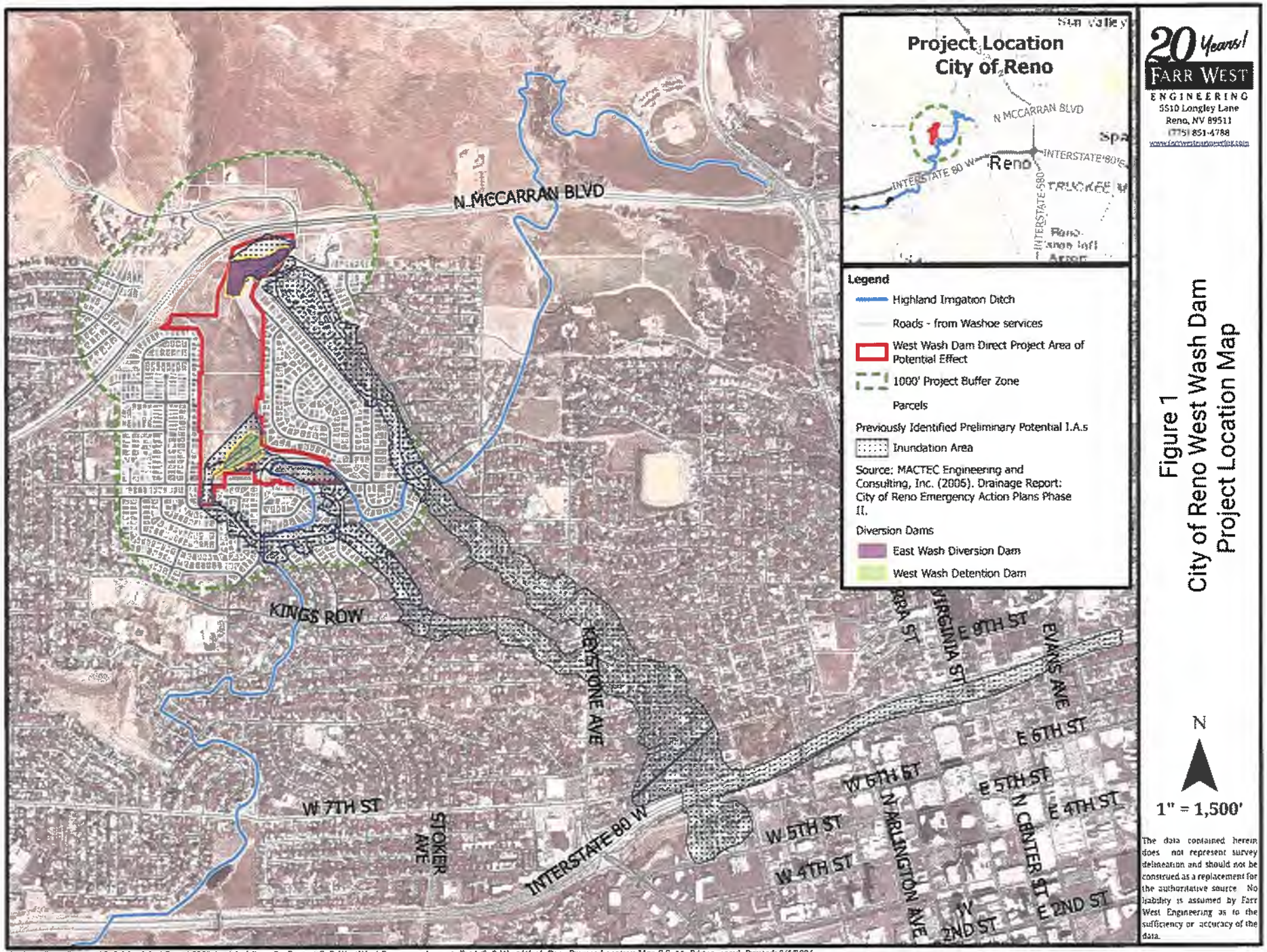

20 Years!
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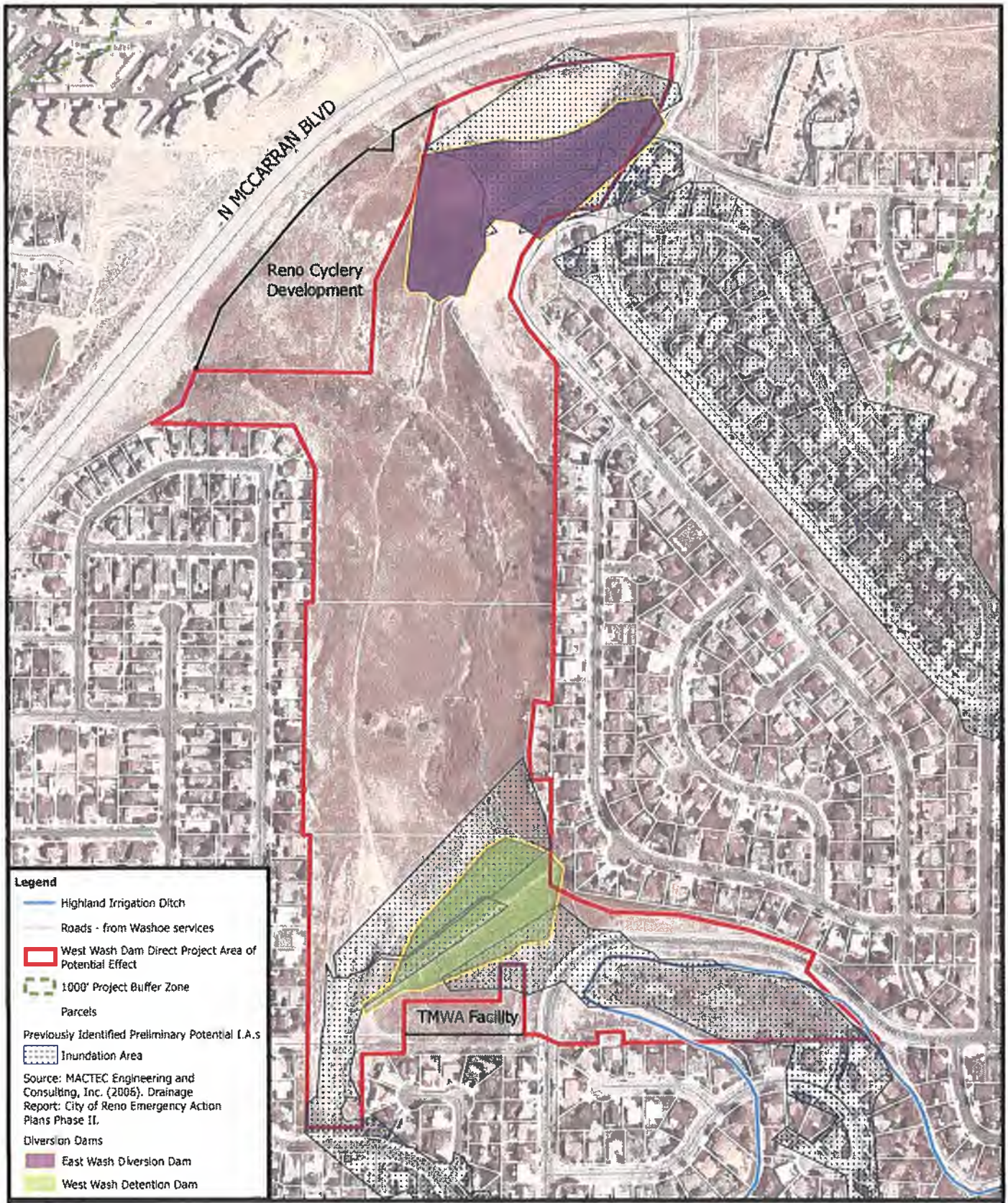
Reno, NV 89511
(775) 851-4788
www.farrwestengineering.com

Figure 1
City of Reno West Wash Dam
Project Location Map

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

Q:\client\Reno Projects\CoR WestWashDam\1930\WestWashDam_ProProject\CoR_WestWashDam.aprx, Layout: Fig 1 CoR West Wash Dam Project Location Map 8.5x11, Editor: areid, Printed: 3/4/2021



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N

1" = 400'

Figure 2
City of Reno West Wash Dam
Direct Project Area of Potential Effects

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

From: THPO Museum
To: Armitage, Charles - FPAC-NRCS, NV
Subject: [External Email]Peavine Mountain Watershed
Date: Monday, February 5, 2024 2:27:50 PM

[External Email]
If this message comes from an **unexpected sender** or references a **vague/unexpected topic;**
Use caution before clicking links or opening attachments.
Please send any concerns or suspicious messages to: Spam.Abuse@usda.gov

Hi Pete, I hope all is well with you. The PLPT THPO will defer to the RSIC on the Peavine Mountain Watershed West Wash Dam project. Thank you for considering Pyramid Lake in the consultation process, I really appreciate it.

Betty J. Aleck

Betty J. Aleck
PLPT THPO
775-574-2404
775-345-5625

USDA

United States Department of Agriculture

February 13, 2024

Attn: Megan Berner
Arts and Culture Manager
City of Reno
One East First Street
Reno, Nevada 89501

Re: Consultation: NRCS Peavine Mountain Watershed West Wash Dam Rehabilitation project Memorandum of Agreement

Dear Megan:

Thank you for your comments on the NRCS West Wash Dam Rehabilitation Project dated January, 12, 2023. In your letter the Historical Resources Commission (HRC) requested a follow-up from the Natural Resources Conservation Service (NRCS) that included the project alternative chosen by the NRCS and mitigation included in the Historic Property Treatment Plan (MOA). Attachment 1 shows the description of the chosen project alternative and Attachment 2 is the signed Memorandum of Agreement (MOA) that was developed between the NRCS and the Nevada State Historic Preservation Office (SHPO). This MOA details the agreed to items that will mitigate adverse effects to the historic property S873 (West Wash Dam).

Pursuant to the National Historic Preservation Act (NHPA) as amended, and the implemented regulations found in 36 CFR Part 800, the Nevada (NV) Natural Resources Conservation Service (NRCS) is contacting your office and requesting the Reno Historical Commission provide comments on concerns related to historic properties.

After you have had an opportunity to review the attachments, please advise our office of any concerns you may have regarding potential impacts to historic properties associated with the proposed project. Please respond within 30 days. If additional review time is needed, we would appreciate your notification.

Please contact me at (775) 834-0901, or charles.armitage@usda.gov , if the Reno Historical Commission has any questions or concerns related to proposed project.

Sincerely,

Charles Armitage

Charles Armitage, Ph.D.
NRCS State Cultural Resource Specialist
Reno, Nevada

Natural Resources Conservation Service
C. Clifton Young Federal Building
300 Booth Street, Room 2070
Reno, Nevada 89509
Phone: (775) 857-8500 Toll Free Fax: (855) 816-0893
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Attachment 1: Project Location and Description
Attachment 2: Memorandum of Agreement between NRCS and SHPO

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NRCS Peavine Mountain Watershed West Wash Dam Rehabilitation project
T19N; R19E Sections 3, 4
T20N; R19E Sections 33, 34
Reno 7.5 Minute Quadrangle Map
Washoe County, Nevada

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Agreement No: N3224MOU0012578

MEMORANDUM OF AGREEMENT
BETWEEN
NATURAL RESOURCES CONSERVATION SERVICE
AND
THE NEVADA STATE HISTORIC PRESERVATION OFFICER
REGARDING
WEST WASH DAM WATERSHED PROJECT
WASHOE COUNTY

WHEREAS, the Nevada Natural Resources Conservation Service (NRCS) has entered into an agreement with the City of Reno to rehabilitate the West Wash and East Wash Dams to meet current NRCS, City of Reno, and State of Nevada Division of Water Resources (DWR) dam safety criteria and performance standards. The West Wash Dam Watershed Project (undertaking) is located in Washoe County, Nevada, T19N; R19E; Sections 3 and 4, and T20N; R19E; Sections 33, 34; and

WHEREAS, the NRCS is the responsible Federal agency and has determined that the West Wash Dam Watershed Project is an undertaking pursuant to Title 54 U.S.C. § 300101, et. seq. commonly known as the National Historic Preservation Act of 1966, as amended (NHPA), and Title 54 U.S.C. § 306108, commonly known as Section 106 of the NHPA (Section 106), and its implementing regulations 36 Code of Federal Regulations (CFR) Part 800; and

WHEREAS, the undertaking consists of the following items: Restoring the original design elevation to the principal spillway approach. West Wash Dam will have the embankment raised five feet to a new elevation of 4798 feet, the auxiliary spillway widened to the original design width of 80 feet and lowered to a crest elevation of 4782.5 feet, the impoundment area to the west of the existing flow line will be regraded to allow for more water storage, and a two-foot-tall parapet wall will be built on the east corner of the dam. Re-grading the impoundment area of West Wash Dam will consist of steepening the western slope to a 2:1 slope and the total cut and fill associated with the grading will be approximately 421,683 yd3 and 28,588 yd3, respectively; and

WHEREAS, the NRCS has defined the area of potential effects (APE) for the undertaking as a 133.49-acre area that encompasses all potential effects of the undertaking (Attachment 1); and

WHEREAS, the NRCS has determined that the undertaking will have an adverse effect on the existing West Wash Dam (S2873), which is a contributing element to historic property district 390 (comprised of the East and the West Wash Dam), eligible for the National Register of Historic Places (NRHP) under the Secretary of Interior's Significance Criterion A, and has consulted with the Nevada State Historic Preservation Office (SHPO) pursuant to 36 CFR Part 800; and

WHEREAS, in accordance with 36 CFR § 800.6(a)(1), the NRCS has notified the Advisory Council on Historic Preservation (ACHP) of its adverse effect determination providing the specified documentation, and the ACHP has chosen not to participate in the consultation

pursuant to 36 CFR § 800.6(a)(l)(iii); and

WHEREAS, the Signatories agree that this Memorandum of Agreement (MOA) may be signed in counterparts, and the executed MOA, and each signature, will be effective and binding as if all parties had signed the same document; and

NOW, THEREFORE, the NRCS, and the SHPO agree that the undertaking shall be implemented in accordance with the following stipulations in order to take into account the effect of the undertaking on historic properties.

STIPULATIONS

The NRCS shall ensure that the following measures are carried out:

I. MITIGATION

A. Archival Record Submission: The NRCS will provide the SHPO with digital copies of archival information currently in the NRCS administrative records within one year of the execution of the MOA. This information pertains to the 1958 Peavine Mountain Watershed Project (Project), of which the East and West Wash Dams were a part. The digital copies shall be no less than 600dpi in quality. The archival information will consist of, but not be limited to, the following:

1. Available archival scans of photographs (color and black and white) of the construction phase of the Project; and
2. Color negative scans of the construction phase of the Project; and
3. Scans of photographs from the inspection updates of the Project in 1978; 1983 and 1988; and
4. A Project Plan Report from 1958. The 1958 report includes a description of the Project and plan maps of the four structures associated with the Project (East Wash Dam, West Wash Dam, Upper Peavine Creek Dam and Lower Peavine Creek Dam).

B. Nevada Historical Marker Development and Installation: The NRCS, in coordination with the SHPO and the Nevada Division of State Parks who is responsible for the maintenance of the Nevada Historical Markers, will oversee the development and installation of Nevada State Historical Marker #275 near the West Wash Dam within one year of completion of undertaking construction activities consistent with the requirements of the program (NRS 383.091).

NRCS will place the historical marker in a publicly accessible location acceptable to the property owner. The historical marker will describe the importance of the West and East Wash Dams to the history of flood protection to the City of Reno, the development of the 1958 Project, and the Watershed Protection and Flood Preservation Act of 1954.

Creation, review, and fabrication of Historical Marker #275 will proceed as follows:

1. NRCS shall submit a draft design with interpretive text for the marker to the SHPO for review and comment. SHPO review will include, but not be limited to, a determination that the design is adequate, appropriate, and sufficient for a Nevada Historical Marker consistent with NRS 383.091. The SHPO shall have forty-five (45) days from receipt of the submission to respond to NRCS. If the SHPO concurs or does not respond to the NRCS in a timely fashion, NRCS may finalize the design and proceed with fabrication and installation of the marker.

2. NRCS will revise the design and interpretive text to address any SHPO comments within forty-five (45) days of receipt of those comments. NRCS shall submit the revised draft final design with interpretive text for the marker to the SHPO for review and comment. The SHPO shall have thirty (30) days from receipt of the revised draft final to respond to NRCS. If the SHPO concurs or does not respond to the NRCS in a timely fashion, NRCS may finalize the design and proceed to fabrication and installation of the marker.

II. DURATION

This MOA will expire if its terms are not carried out within two (2) years from the date of its execution or if the mitigation stipulations 1A and 1B are not carried out in the time specified, whichever comes first. Prior to such time, the NRCS may consult with the SHPO to reconsider the terms of the MOA and amend it in accordance with Stipulation V below.

At such time, and prior to work continuing on the undertaking, the NRCS shall either (a) execute a MOA pursuant to 36 CFR § 800.6, or (b) request, take into account, and respond to the comments of the ACHP under 36 CFR § 800.7.

III. POST-REVIEW DISCOVERIES

If unanticipated potential historic properties are discovered within the APE or unanticipated effects on historic properties found during the undertaking, all work will halt in the immediate vicinity of the discovery and NRCS shall follow the procedures found at 36 CFR § 800.13(c).

IV. DISPUTE RESOLUTION

Should any signatory to this MOA object at any time to actions proposed or the manner in which the terms of this MOA are implemented, the NRCS shall consult with such party to resolve the objection. If the NRCS determines that such objections cannot be resolved, the NRCS will:

A. Forward all documentation relevant to the dispute, including the NRCS's proposed resolution, to the ACHP. The ACHP shall provide NRCS with its advice on the resolution of the objection within thirty (30) days of receiving adequate documentation. Prior to reaching a final decision on the dispute, NRCS shall prepare a written response that takes into account any timely advice or comments regarding the dispute from the

ACHP and the SHPO, and provide them with a copy of this written response. NRCS will then proceed according to its final decision.

B. If the ACHP does not provide its advice regarding the dispute within thirty (30) days, the NRCS may make a final decision on the dispute and proceed accordingly. Prior to reaching such a final decision, the NRCS shall prepare a written response that takes into account any timely comments regarding the dispute from the SHPO and provide the SHPO and the ACHP with a copy of such written response.

V. AMENDMENTS

This MOA may be amended when such an amendment is agreed to in writing by the signatories. The amendment will be effective on the date a copy signed by all the signatories are filed with the ACHP.

VI. TERMINATION

If any signatory to this MOA determines that its terms will not or cannot be carried out, that party shall immediately consult with the other parties to attempt to develop an amendment per Stipulation V above. If within thirty (30) days (or another time period agreed to by the signatories) an amendment cannot be reached, any signatory may terminate the MOA upon written notification to the other signatory.

Once the MOA is terminated, and prior to work continuing on the undertaking, the NRCS must either execute an MOA pursuant to 36 CFR § 800.6, or (b) request, take into account, and respond to the comments of the ACHP under 36 CFR § 800.7. NRCS shall notify the SHPO as to the course of action it will pursue.

VII. IT IS MUTUALLY AGREED

A. The US Department of Agriculture - NRCS and the SHPO will handle their own activities and utilize their own resources, including the expenditure of their own funds, in pursuing these objectives. Each party will carry out its separate activities in a coordinated and mutually beneficial manner.

B. Nothing in this MOA shall obligate either the NRCS or the SHPO to obligate or transfer any funds. Specific work projects or activities that involve the transfer of funds, services, or property among the various agencies and offices of the NRCS and the SHPO will require execution of separate agreements and be contingent upon the availability of appropriated funds. Such activities must be independently authorized by appropriate statutory authority. This MOA does not provide such authority. Negotiation, execution, and administration of each such agreement must comply with all applicable statutes and regulations.

C. This MOA takes effect upon the signature of the US Department of Agriculture - NRCS

and the Nevada State Historic Preservation Office.

D. This MOA is not intended to, and does not create, any right, benefit, or trust responsibility, substantive or procedural, enforceable at law or equity, by a party against the United States, its agencies, its officers, or any person.

E. Nothing in this Agreement shall be construed as requiring a Party to expend funds in violation of the Federal Anti-deficiency Act codified at 31 U.S.C. § 1341.

EXECUTION of this MOA by the NRCS and the SHPO and implementation of its terms evidence that NRCS has taken into account the effects of this undertaking on historic properties and afforded the ACHP an opportunity to comment.

[Remainder of Page Intentionally Blank]

Signatures:

In witness whereof, the parties to this MOA through their duly authorized representatives have executed this MOA on the days and dates set out below, and certify that they have read, understood, and agreed to the terms and conditions of this MOA as set forth herein.

USDA-NATURAL RESOURCES CONSERVATION SERVICE

2/6/2024

Heidi M. Ramsey
Nevada State Conservationist

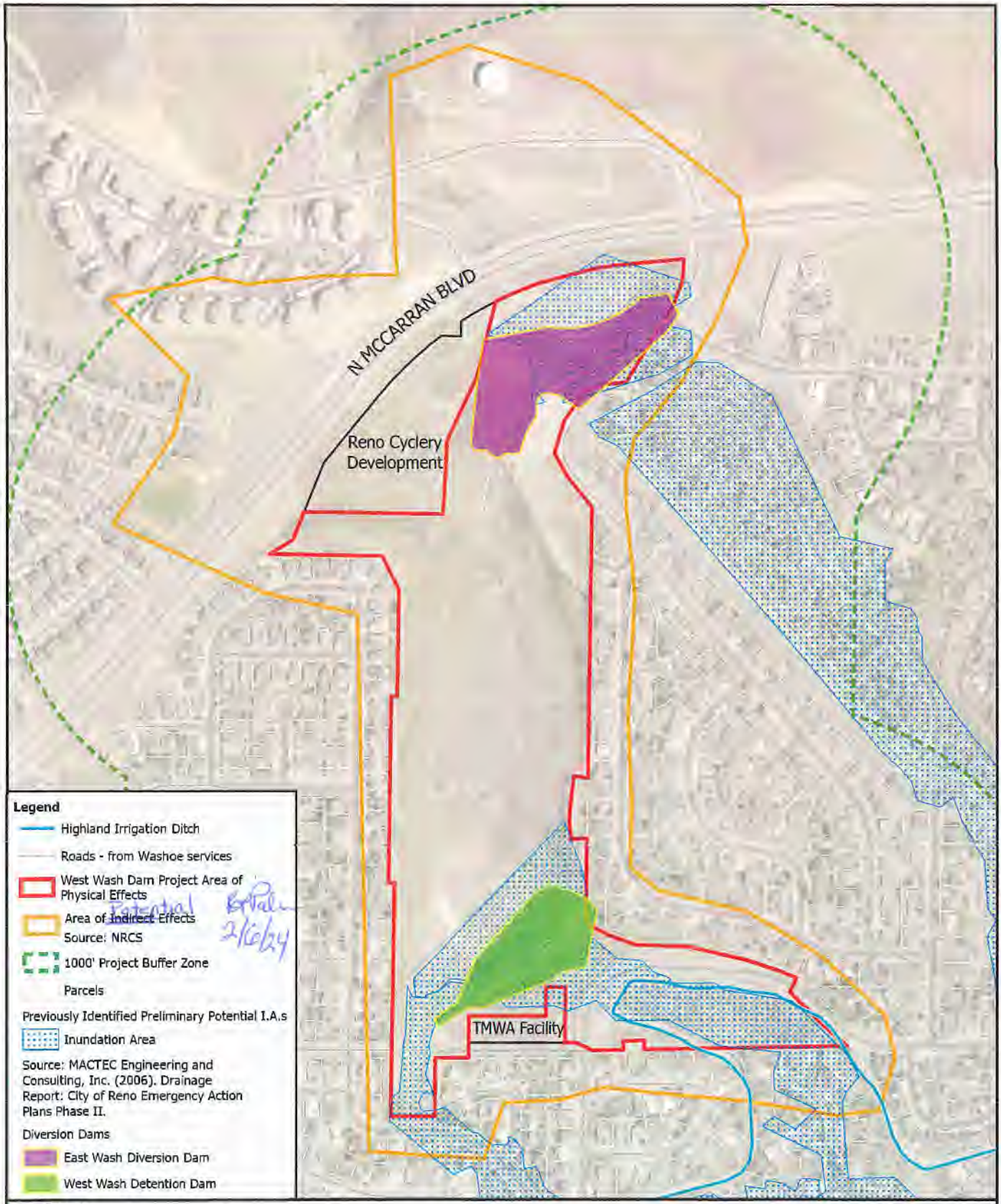
Date

THE NEVADA STATE HISTORIC PRESERVATION OFFICE

2/6/2024

Rebecca L. Palmer
State Historic Preservation Officer

Date



20 Years!
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N

1" = 500'

Project Area of Potential Effects

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

Q:\client\Reno\Projects\CoR-WestWashDam-1930\WestWashDam-ProProject\CoR-WestWashDam.aprx, Layout: Fig 3 Indirect & Direct Area Effects. Editor: areid. Printed: 3/4/2021

Northwestern Pond Turtle Conservation Recommendations

January 2, 2024 – based on recommendations provided by Mark Enders, NDOW

Construction Avoidance/Minimization Measures

1. Determine whether pond turtles are occupying the site prior to project implementation
    a. Visual encounter surveys (Mar-Nov)
        i. Search for basking turtles along both banks of the river.
        ii. Surveys should be done during environmental conditions when turtles are most likely to be basking.
        iii. Minimum four surveys needed to confirm absence.
        iv. NDOW can provide a copy of survey protocol, or it can be found in Chapter 4 (pages 29-35) in Bury, R. B., H. H. Welsh, Jr., D. J. Germano, and D. Ashton (eds.). 2012. Western Pond Turtle: Sampling Techniques, Inventory and Monitoring, Conservation and Management. Northwest Fauna 7. (Book). Society for Northwestern Vertebrate Biology. 128 pp.
        v. If absence is determined, construction activities have low likelihood of impacting adult turtles. Nesting surveys should still be done.
        vi. If presence is determined, construction activities could impact pond turtles, and additional avoidance measures are needed. Nesting surveys should be done.
    b. Nesting surveys (May-Jul)
        i. Search for nests in upland areas with sparse vegetation and southern aspect within 100 m of river
        ii. If turtle nests are encountered, mark with temporary flagging and surround with silt fencing to protect it, then contact NDOW biologist Mark Enders (menders@ndow.org) for assistance.
        iii. All individual nests should remain marked and be avoided for the duration of the nesting and hatchling seasons (combined May 15 – Oct 31), and unnecessary ground-breaking activities should be avoided in potential nesting areas during that time period
        iv. If absence is determined, construction activities have low likelihood of impacting the Truckee River population of pond turtles
2. Continue monitoring for turtle presence and activity during construction, and make construction staff and personnel aware of the possibility of turtle presence.
3. Locate temporary work areas, staging areas, and access routes at least 50 m from the river if possible.

Project Maintenance Avoidance/Minimization Measures

1. All floodplain maintenance activities in future years should be done from April 1 through May 15 to avoid impacts to nesting females, laid eggs, overwintering hatchlings, and emerged hatchlings.
2. Maintenance activities should be implemented to retain suitable turtle nesting habitat as described below.

Habitat features and recommendations

- Enhancing nesting habitat

    - Nesting is the most important part of the pond turtle's life cycle and is what allows populations to persist. NDOW would like to recommend the following features to enhance turtle nesting opportunities in the future
    - South and southwest facing upland areas within 100 m of river should have less than 15% slope to increase probability of turtle nesting
    - Ideal nesting sites have sparse, low-growing vegetation with patchy grasses and forbs, but bare soil is preferable. Herbaceous cover is no more than 40%, total shrub cover no more than 20 %, and tree canopy cover no more than 10%
    - Allow some areas of open canopy, especially on south-facing aspects to allow solar exposure for proper egg development
    - Maintaining soil types of the following percentages facilitates nest digging:
        - Fine Clay 25% or less
        - Loam 25%
        - Sand 25 – 50%
        - Small Aggregate 25% or less
- Basking structures
    - Basking is an essential part of pond turtle biology, and NDOW would like to recommend that basking structures be worked into the project, especially on south-facing aspects.
    - Place logs and root wads in locations that receive full to partial sun exposure, at a variety of angles and water depths. Some can be parallel to the shoreline, but the majority should be perpendicular and extend from the bank into the open water.
    - When placing rip-rap, it would be ideal to prioritize some larger flat-topped rocks between the high and low water marks in order to provide basking rocks for turtles at various flow levels.
    - Basking structures should be anchored if possible
    - Revegetation should be minimal around the best basking structures in order to provide maximum sunlight.

United States Department of Agriculture

September 3, 2025

Kristen Jule
Field Supervisor, Nevada Field Office
U.S. Fish and Wildlife Service
1340 Financial Boulevard
Suite 234
Reno, NV 89502-7147

RE: Peavine Mountain Watershed Plan-Environmental Assessment Public Law 83-566 Section 12 Notification

Dear Ms. Jule:

The Natural Resources Conservation Service is preparing the Peavine Mountain Watershed (West Wash Dam) Plan-Environmental Assessment for dam rehabilitation in Washoe County, Nevada. In accordance with Section 12 of the Watershed Protection and Flood Prevention Act, Public Law 83-566 (U.S.C. Section 1008), this letter serves as notification to the U.S. Fish and Wildlife Service of their opportunity to submit survey reports or investigations regarding wildlife resources that will be considered in the development of the Peavine Mountain Watershed Plan-EA.

If you have any questions, please contact Project Engineer Mark Martini at Mark.Martini@usda.gov or 702-281-6727.

Sincerely,

HEIDI RAMSEY Digitally signed by HEIDI RAMSEY
Date: 2025.09.04 07:54:41 -04'00'

Heidi Ramsey
State Conservationist
USDA Natural Resources Conservation Service, Nevada

cc:
Doug Higbee, State Conservation Engineer
Mark Martini, Project Engineer
Cory Lytle, Assistant State Conservationist – Field Operations
Ariel DeLara, Assistant State Conservationist – Programs

From:	RFWO Correspondence, FW8
To:	Allai, Todd - FPAC-NRCS, NV
Cc:	Ramsey, Heidi - FPAC-NRCS, NV; Heater, Thad - FPAC-NRCS, NV; Jule, Kristen R; Panaccione, James
Subject:	Peavine Creek-Truckee River Watershed East Wash and West Wash Dam Rehabilitation Project
Date:	Friday, June 26, 2026 3:47:06 PM
Attachments:	Western Monarch Conservation Recommendations 04.29.2021.pdf NDOW NWPT Conservation Recommendations.pdf

Dear Todd Allai,

Regarding the proposed Peavine Creek-Truckee River Watershed East Wash and West Wash Dam Rehabilitation Project (project) in Washoe County, Nevada, as submitted by the Natural Resources Conservation Service (NRCS) under Public Law 83-566 (PL-566), the Reno Fish and Wildlife Office (RFWO) has reviewed the information provided in accordance with Section 12 of the Fish and Wildlife Coordination Act (FWCA; 16 U.S.C. 661 et seq.). The RFWO acknowledges the opportunity to conduct surveys and investigations and provide recommendations concerning the conservation and development of wildlife resources within the proposed project area. Based on our review of the information provided, the RFWO will not be conducting additional on-site surveys or preparing a separate FWCA report for the proposed project at this time.

According to the Biological Resources Report Addendum (NRCS 2026) and the 2021 Biological Report referenced therein, NRCS made no effect determinations for federally listed species and provided non-jeopardy statements for proposed species identified through IPaC reports 2026-0040549 and 08ENVD00-2021-SLI-0241, respectively. As such, no concurrence or conference has been requested under the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1531 et seq.).

Based on the information provided, suitable habitat for monarch butterfly (*Danaus plexippus*) and northwestern pond turtle (*Actinemys marmorata*) occurs in the proposed project area. The RFWO is providing the attached conservation recommendations for consideration during project planning and implementation. The RFWO also recommends that NRCS incorporate best management practices (BMPs) to avoid and minimize impacts to aquatic and upland habitats, including stormwater quality controls, erosion and sediment control measures, and protection of riparian vegetation where present.

Based on the project location and anticipated scope of work, it is unlikely that eagles will be directly impacted by project activities. However, it is the project proponent's responsibility to ensure compliance with the Bald and Golden Eagle Protection Act or obtaining an Eagle Take Permit as appropriate. To avoid disturbance to nesting eagles during the breeding season the Pacific Southwest Migratory Bird Program recommends a 1-mile buffer around in-use golden eagle nests, and a 660-foot buffer around in-use bald eagle nests for general construction activities (see attached). Any questions can be directed to our eagle permits email at: FW8_EaglePermits@fws.gov

If the Project scope, action area, timing, or species list changes, we recommend re-running the IPaC species list and evaluating whether additional coordination with the Service is needed.

References:

Natural Resources Conservation Service (NRCS) 2026. Biological Resources Report Addendum for the Peavine Creek-Truckee River Watershed (Washoe County, Nevada) East Wash and West Wash Dam Rehabilitation Project (January 2026). U.S. Department of Agriculture, Reno. 11 pp. + Appendix.

Send on behalf of Field Supervisor Kristen Jule.

U.S. Fish and Wildlife Service
Reno Fish & Wildlife Office
1340 Financial Blvd., Suite 234
Reno, Nevada 89502
Phone: 775-861-6300
Fax: 775-861-6301

Attachment 1: Project Location and Description
Attachment 2: Memorandum of Agreement between NRCS and SHPO

Natural Resources Conservation Service
C. Clifton Young Federal Building
300 Booth Street, Room 2070
Reno, Nevada 89509
Phone: (775) 857-8500 Toll Free Fax: (855) 816-0893
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Attachment 1. Project Location and Description

NRCS Peavine Mountain Watershed West Wash Dam Rehabilitation project
T19N; R19E Sections 3, 4
T20N; R19E Sections 33, 34
Reno 7.5 Minute Quadrangle Map
Washoe County, Nevada

REMEDIATE BOTH EAST WASH AND WEST WASH DAMS

This includes remediation of both dams to meet the safety requirements of the NRCS and the Nevada Division of Water Resources Division of Dams. East Wash Dam is classified as a diversion dam while West Wash Dam is classified as a detention dam. Both Dams have been identified as High Hazard Dams by the Division of Dams. Currently, the East Wash Dam meets NRCS criteria for Earthen Dams with the exception of excessive damage to the spillway in a PMF event (USDA NRCS, 2019). The West Wash Dam does not meet NRCS criteria and would overtop in a PMF event (USDA NRCS, 2019). The United States Army Corps of Engineers Phase I inspection report indicates that the existing structures meet applicable seismic safety requirements. However, neither the original calculations performed, nor the original parameters utilized are available for review. Due to data gaps and potential advances in the knowledge of seismic activity in the area, seismic stability will be investigated as a part of the final design of this project.

Remediation of both dams will be confined to the already disturbed areas of the structures. East Wash Dam will have the west dike of the principal spillway approach restored to the original design elevation. West Wash Dam will have the embankment raised five feet to a new elevation of 4798 feet, the auxiliary spillway widened to the original design width of 80 feet and lowered to a crest elevation of 4782.5 feet, the impoundment area to the west of the existing flow line will be regraded to allow for more water storage, and a two-foot-tall parapet wall will be built on the east corner of the dam. Re-grading the impoundment area of West Wash Dam will consist of steepening the western slope to a 2:1 slope and the total cut and fill associated with the grading will be approximately 421,683 yd^3 and 28,588 yd^3, respectively.
With these proposed changes, the West Wash Dam auxiliary spillway will not be activated until the 500-year storm event (currently it activates during a 200-year storm event). The improvements to the West Wash Dam will supply three feet of freeboard during the Local PMP event, and the dam will no longer overtop or be in jeopardy of breaching. Other minor improvements that will be made under this alternative include:

- Stripping of vegetation, debris, and weathered fill from crest and downstream face of West Wash Dam
- Stripping of vegetation, debris, and weathered fill from crest and both faces of East Wash Dam's Auxiliary spillway

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- Cleaning out Principal Spillway and sediment drain conduits
- Replacement of sediment drain trash rack
- Corrosion resistant coating of sediment drain riser (and potentially interior of conduit to outfall in Principal Spillway riser)
- Repair of principal spillway riser concrete spalls and damage (both East and West Wash Dams).
- Daylighting of West Wash Dam Principal Spillway downstream invert
- Excavation along Principal Spillway conduit for installation of seep intercept system
- Backfill for repair of right spillway guide "wall" at crossing of Gulling Dr.

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JOE LOMBARDO
Governor

STATE OF NEVADA
DEPARTMENT OF WILDLIFE
6980 Sierra Center Parkway, Suite 120
Reno, Nevada 89511
Phone (775) 688-1500 • Fax (775) 688-1595

ALAN JENNE
Director
JORDAN GOSHERT
Deputy Director
CALEB MCADOO
Deputy Director
MIKE SCOTT
Deputy Director

June 15, 2026

Douglas Higbee
State Conservation Engineer – Nevada
Natural Resources Conservation Service
300 Booth Street, Ste.2070, Reno, NV 89509
doug.higbee@usda.gov

RE: Notification of Natural Resources Conservation Service – Nevada (NRCS-NV) actions for The East Wash and West Wash Dam Remediation Project Watershed Plan and Environmental Assessment

Dear Mr. Higbee,

The Nevada Department of Wildlife (the "Department") appreciates receiving the East Wash West Wash Dam Rehabilitation Project for review. The Department has completed a review of the proposed project and has assessed potential effects to Nevada's wildlife resources. The Department supports the project's purpose to address current dam safety and regulatory deficiencies at the East Wash and West Wash Dams.

Please see Department comments below:

Both direct and indirect disturbances from development can significantly affect wildlife by altering movement and seasonal use patterns, breeding and nesting behavior, and overall demographic rates. Even when a project's physical footprint is relatively small or does not overlap with critical habitat or designated seasonal use areas, indirect and cumulative impacts from ongoing habitat encroachment can still lead to habitat loss, degradation, and fragmentation, ultimately causing long-term negative effects on wildlife populations.

Based on the prepared Environmental Assessment (EA), the project footprint is outside any mapped critical wildlife habitat. The Department's review of the EA indicates that the planned project is largely surrounded by already developed areas. Therefore, the Department anticipates relatively limited impacts to wildlife resources provided that project activities remain within the proposed disturbance footprint and impacts to adjacent riparian habitats are avoided.

The Department notes that riparian vegetation associated with East Wash and West Wash may provide important habitat for migratory birds and other wildlife despite the surrounding developed landscape. The Department supports the project's avoidance of riparian habitat and recommends that all staging, equipment storage, and construction-related activities remain within previously disturbed areas to the maximum extent practicable.

Although no direct impacts to riparian habitat are proposed, riparian vegetation adjacent to the project area may provide important nesting habitat for migratory birds protected under the Migratory Bird Treaty Act (MBTA). In addition, migratory birds may utilize vegetation and other suitable nesting substrates within and adjacent to the project area. The Department recommends that project activities avoid removing, trimming, or disturbing vegetation during the primary avian nesting season (generally February 15 through August 31). If vegetation removal or disturbance during the nesting season cannot be avoided, protocol-level nesting-bird surveys should

be conducted by a qualified biologist prior to initiating activities. Active nests should be avoided with appropriate species-specific buffers until nesting activity has concluded and the nest is no longer active.

The Department appreciates your continued coordination on this project and is available to discuss these recommendations further. Please contact me directly with questions regarding our comments.

Sincerely,

Cheyenne Trueblood
Western Region Supervising Habitat Biologist
Nevada Department of Wildlife
(775) 688-1145
cheyenne.trueblood@ndow.org

USDA

United States Department of Agriculture

SUBJECT: Notification of Natural Resources Conservation Service – Nevada (NRCS-NV) actions for The East Wash and West Wash Dam Remediation Project Watershed Plan and Environmental Assessment

DATE: June 11, 2026

Cheyenne Trueblood
Nevada Department of Wildlife
6980 Sierra Center Parkway, Suite 120
Reno, NV 89511

Dear Ms Trueblood:

In accordance with Section 12 of Pub. L. 83-566, which applies the principles of the Fish and Wildlife Coordination Act, NRCS-NV is notifying your agency that we are investigating and planning for a water resource project. The purpose of the project is to address current dam safety and regulatory deficiencies at the East Wash and West Wash Dams.

NRCS-NV is nearing completion of a draft watershed plan/environmental assessment for the Peavine Creek-Truckee River Watershed East Wash and West Wash Dam Remediation Project in Washoe County, NV. The local sponsor is the City of Reno. Through the NRCS Watershed and Flood Prevention Operations Program (WFPO), NRCS-NV is authorized to assist local municipalities with complex watershed planning projects. The preferred alternative would include remediation of both the East Wash and West Wash Dams to meet NRCS and the State of Nevada dam safety requirements.

NRCS-NV invites coordination with Nevada Department of Wildlife on the technically and economically feasible works of remediation proposed. Please reply within 30 days of receiving this notice whether your agency intends to make or provide surveys, investigations, or recommendations concerning the conservation and development of wildlife resources. If you have any questions, please contact me at 775-857-8500 or doug.higbee@usda.gov

Sincerely,

Doug Higbee
State Conservation Engineer - Nevada

Appendix B:
Project Maps and Figures

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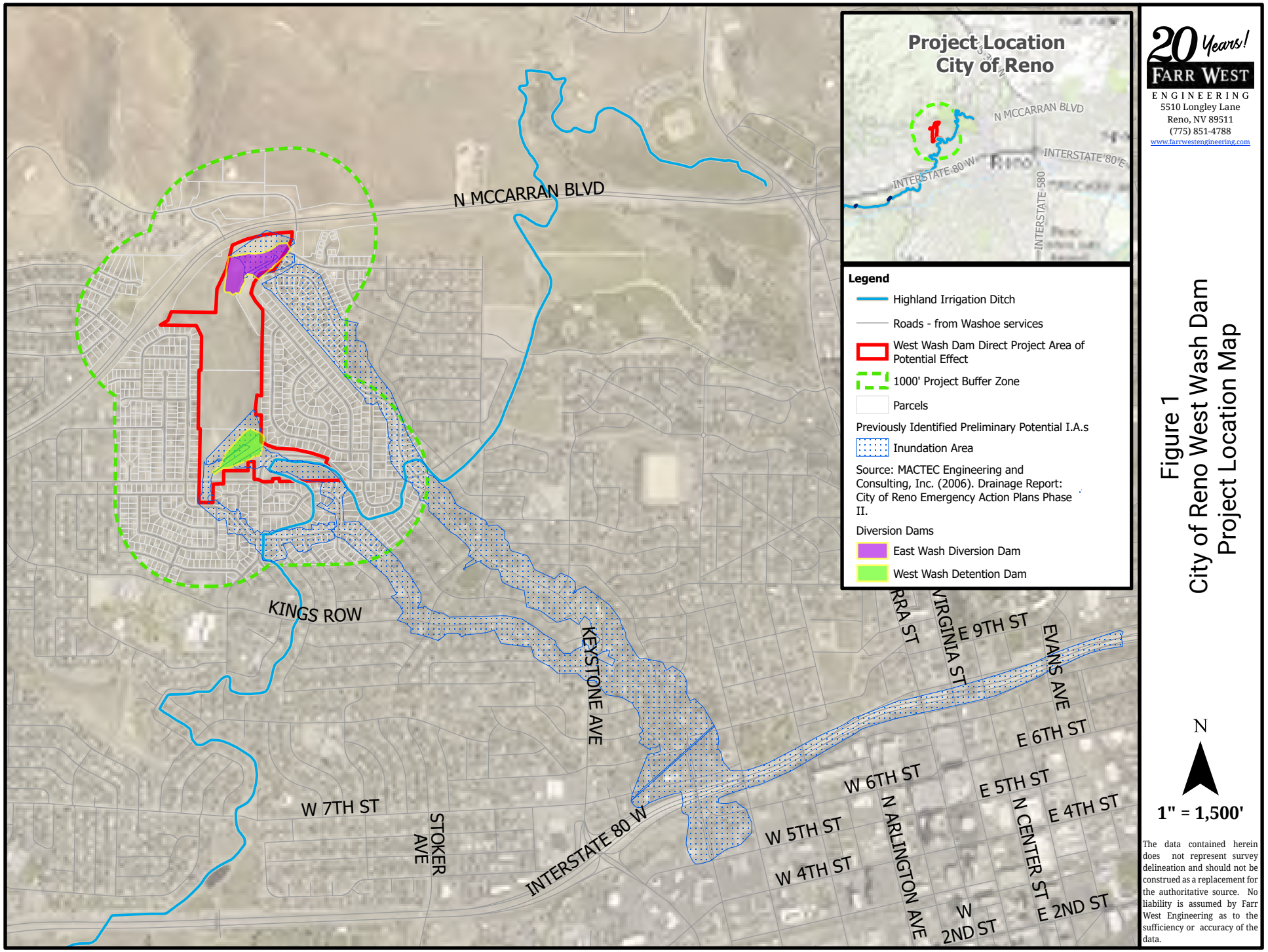

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(775) 851-4788
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Figure 1
City of Reno West Wash Dam
Project Location Map

N

1" = 1,500'

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

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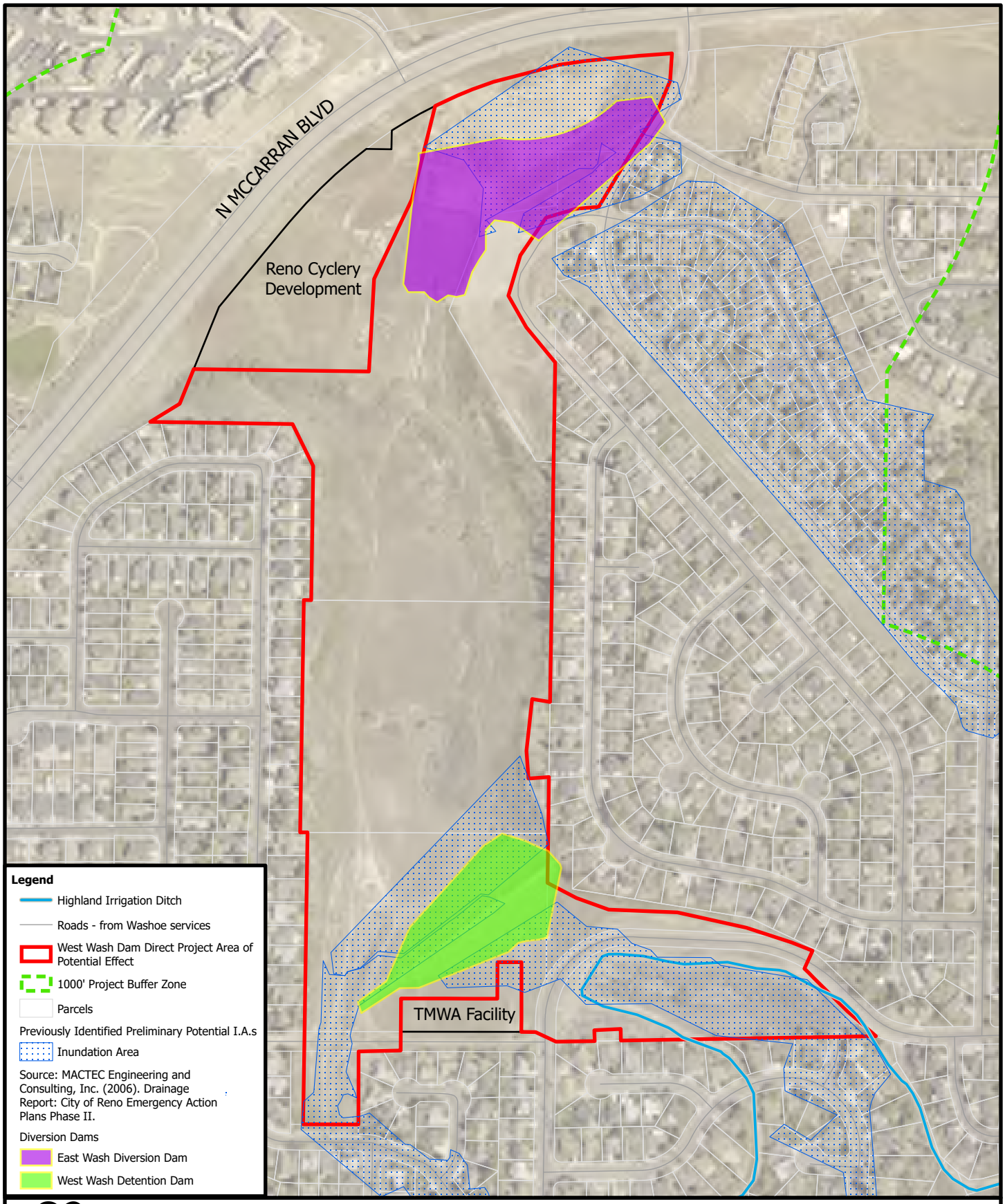

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N

1" = 400'

Figure 2
City of Reno West Wash Dam
Direct Project Area of Potential Effects

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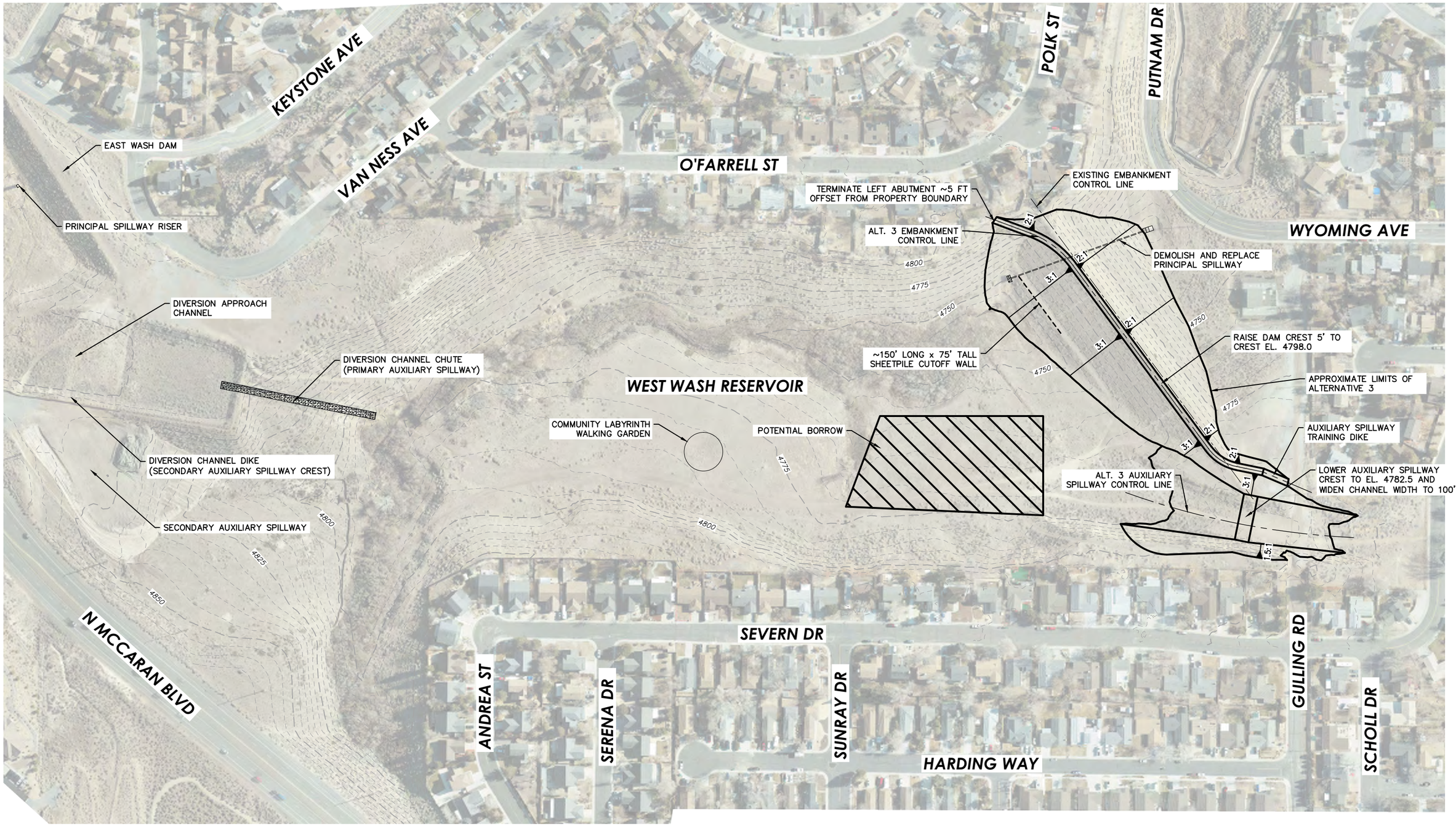

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SCALE IN FEET
CONTOUR INTERVAL = 5 FOOT

SUPPLEMENTAL WATERSHED PLAN AND ENVIRONMENTAL DOCUMENT
FOR THE PEAVINE MOUNTAIN WATERSHED

ALTERNATIVE 3 - REMEDIATE EAST AND WEST WASH DAMS

CITY OF RENO - WASHOE COUNTY - NEVADA

REVISIONS			
REV	DATE	DESCRIPTION	BY

PROJECT 4691.12674.01
DATE JUNE 2025
EXHIBIT
1

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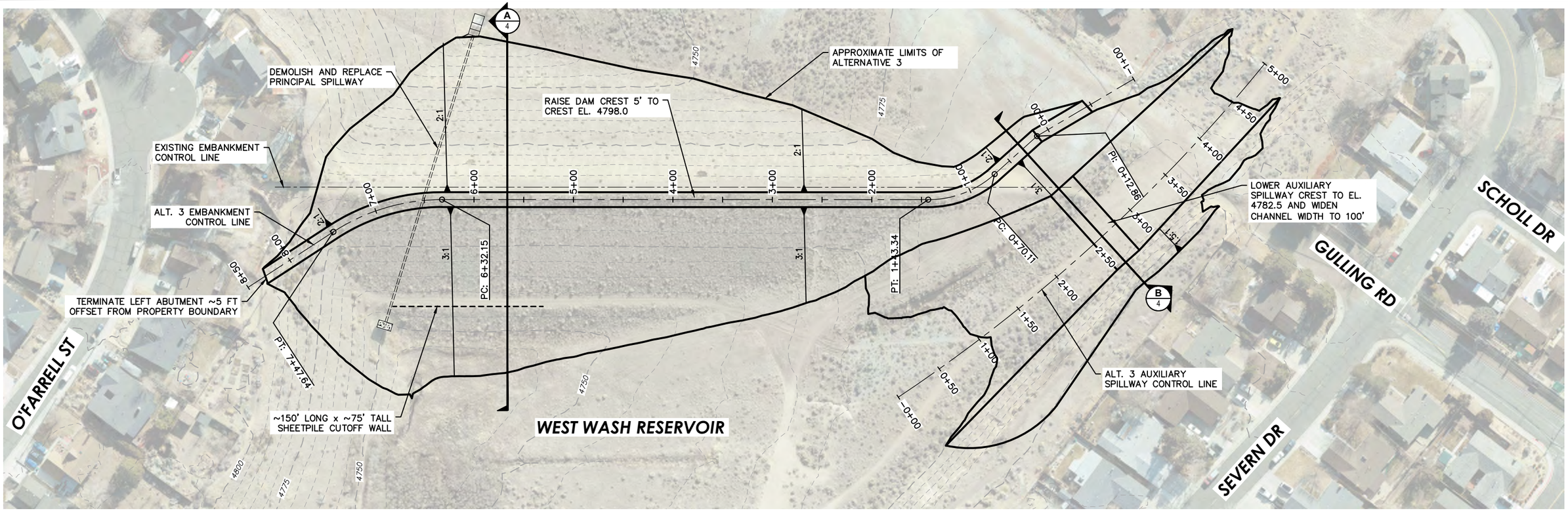

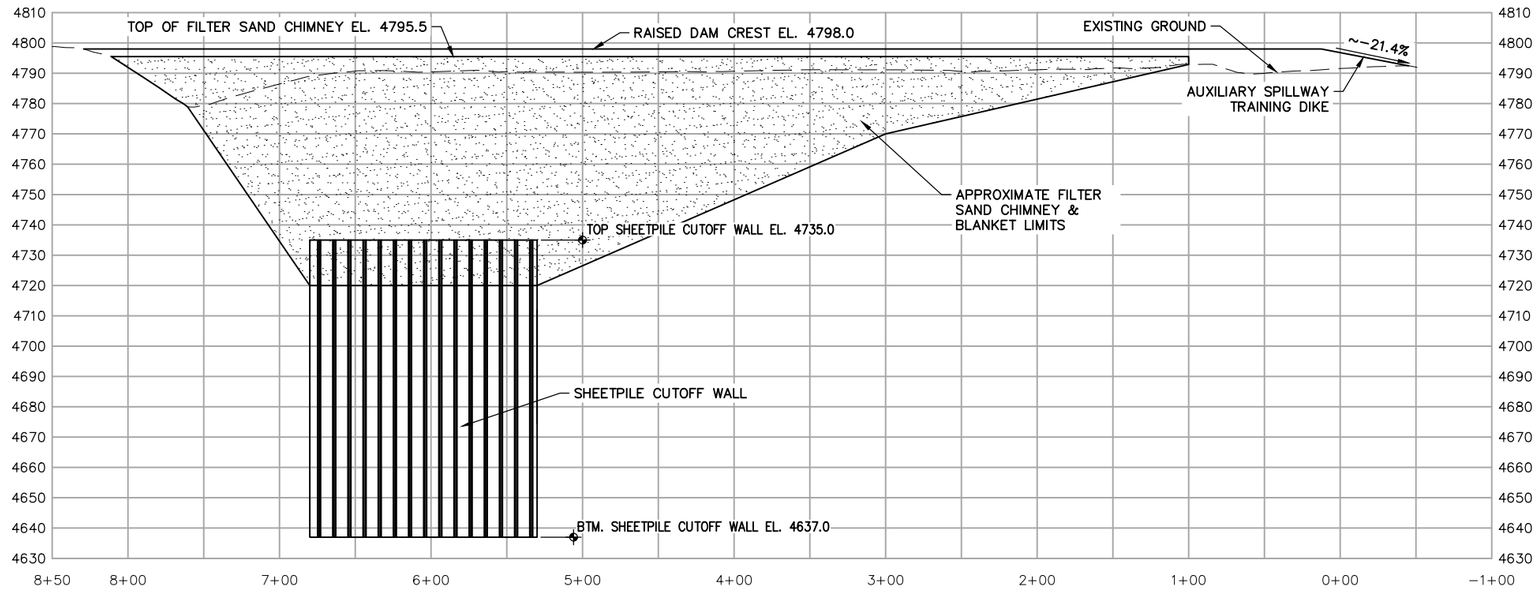

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SCALE IN FEET
CONTOUR INTERVAL = 5 FOOT

SUPPLEMENTAL WATERSHED PLAN AND ENVIRONMENTAL DOCUMENT
FOR THE PEAVINE MOUNTAIN WATERSHED

ALTERNATIVE 3 - REMEDIATE EAST AND WEST WASH DAMS

CITY OF RENO - WASHOE COUNTY - NEVADA

REVISIONS			
REV	DATE	DESCRIPTION	BY

PROJECT 4691.12674.01
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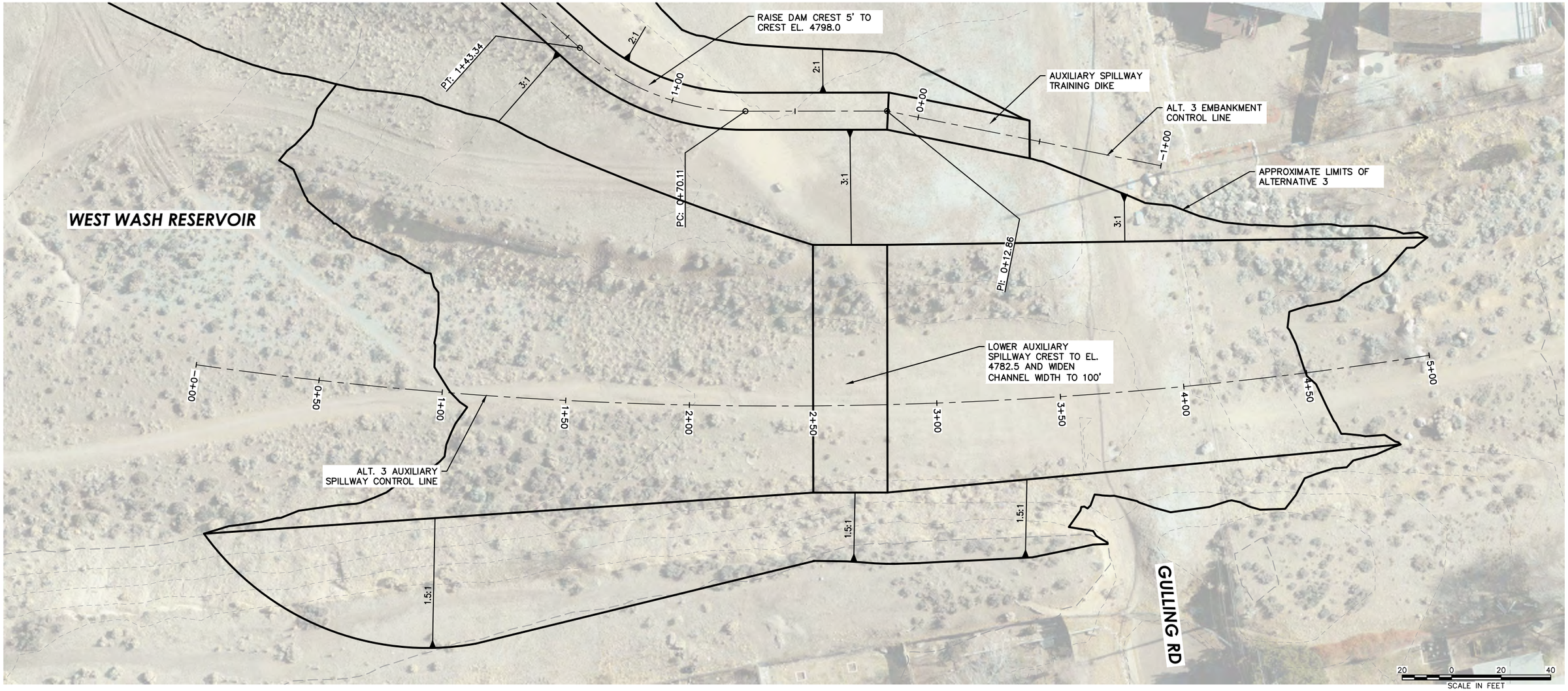

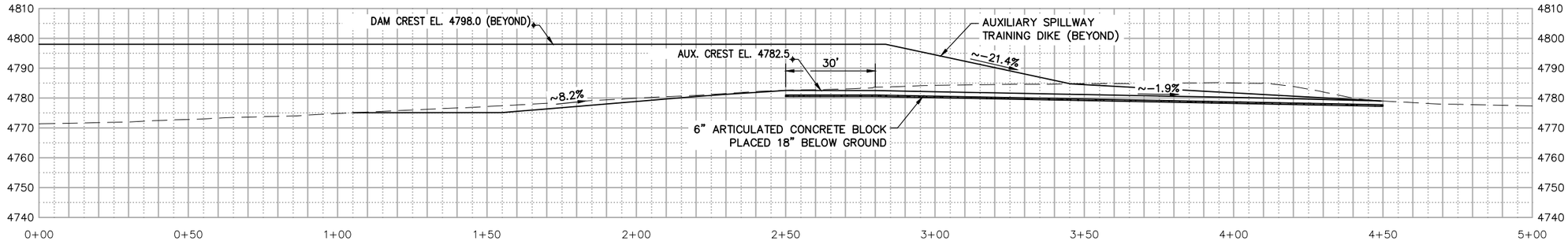

SUPPLEMENTAL WATERSHED PLAN AND ENVIRONMENTAL DOCUMENT
FOR THE PEAVINE MOUNTAIN WATERSHED

ALTERNATIVE 3 - REMEDIATE EAST AND WEST WASH DAMS

CITY OF RENO - WASHOE COUNTY - NEVADA

REVISIONS			
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PROJECT 4691.12674.01
DATE JUNE 2025
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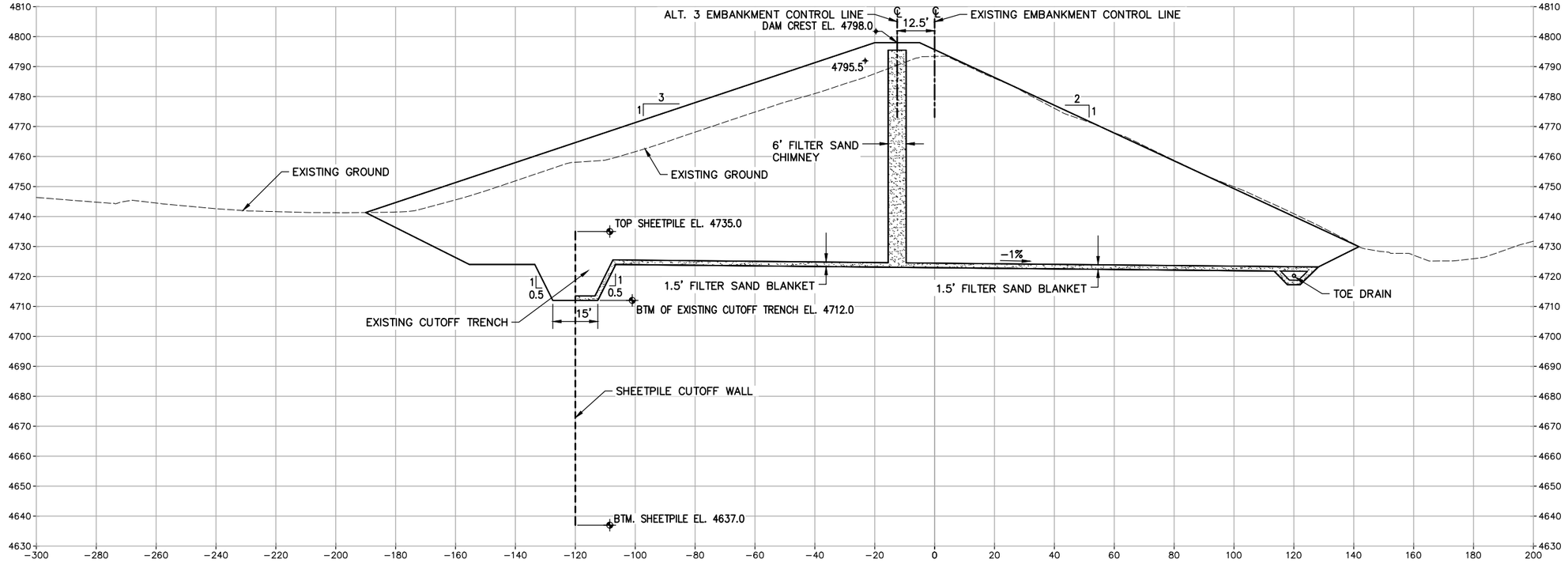

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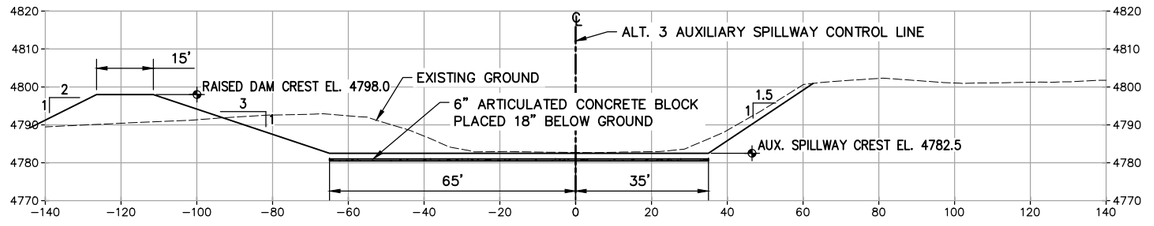

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ALTERNATIVE 3 TYPICAL AUXILIARY SPILLWAY CREST SECTION

SUPPLEMENTAL WATERSHED PLAN AND ENVIRONMENTAL DOCUMENT
FOR THE PEAVINE MOUNTAIN WATERSHED

ALTERNATIVE 3 - REMEDIATE EAST AND WEST WASH DAMS

CITY OF RENO - WASHOE COUNTY - NEVADA

REVISIONS

REV	DATE	DESCRIPTION	BY

PROJECT 4691.12674.01
DATE JUNE 2025
EXHIBIT
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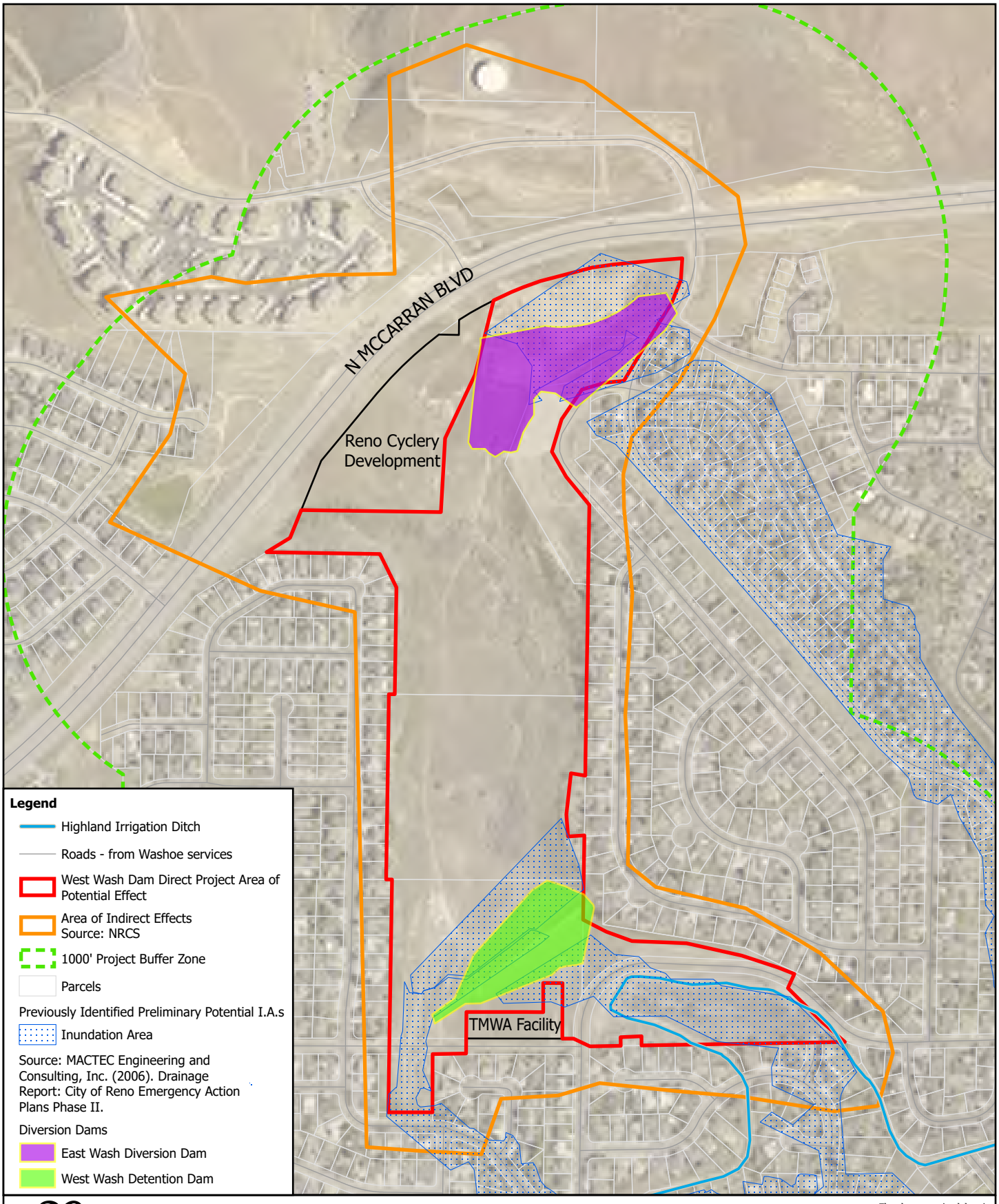

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N

1" = 500'

Figure 3
Indirect and Direct Project Area of Potential Effects

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

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Appendix C:
Supporting Maps and Figures

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SCALE: 1" = 150'

150' 0 150' 300'

EXISTING LEGEND

- EX W — WATER
- UTIL — MISCELLANEOUS/UNIDENTIFIED UTILITY
- EX SD — STORM DRAIN
- EX E — ELECTRICAL
- EX OHU — OVER HEAD UTILITY

DATE:
SCALE:
DESIGNED:
DRAWN: SHH
CHECKED:

FARR WEST ENGINEERING
5510 LONGLEY LANE
RENO, NEVADA 89511
PHONE: (775) 851-4788
FAX: (775) 851-0766

CITY OF RENO

SUPPLEMENTAL WATERSHED PLAN AND ENVIRONMENTAL DOCUMENT FOR THE PEAVINE MOUNTAIN WATERSHED

EXISTING UTILITES

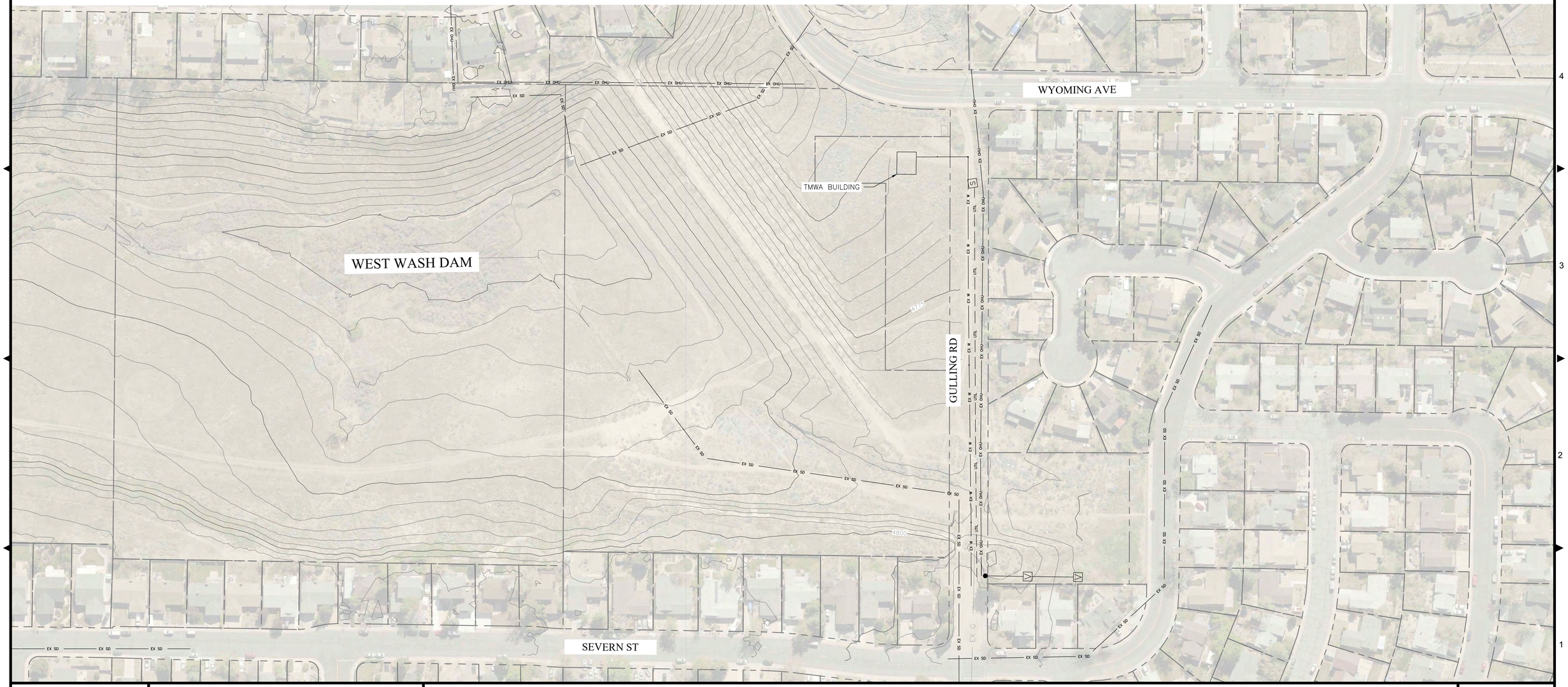
WASHOE COUNTY NEVADA

SCALE: 1" = 75'

75' 0 75' 150'

EXISTING LEGEND

- EX W — WATER
- UTIL — MISCELLANEOUS/UNIDENTIFIED UTILITY
- EX SD — STORM DRAIN
- EX E — ELECTRICAL
- EX OHU — OVER HEAD UTILITY



DATE:
SCALE:
DESIGNED:
DRAWN: SHH
CHECKED:

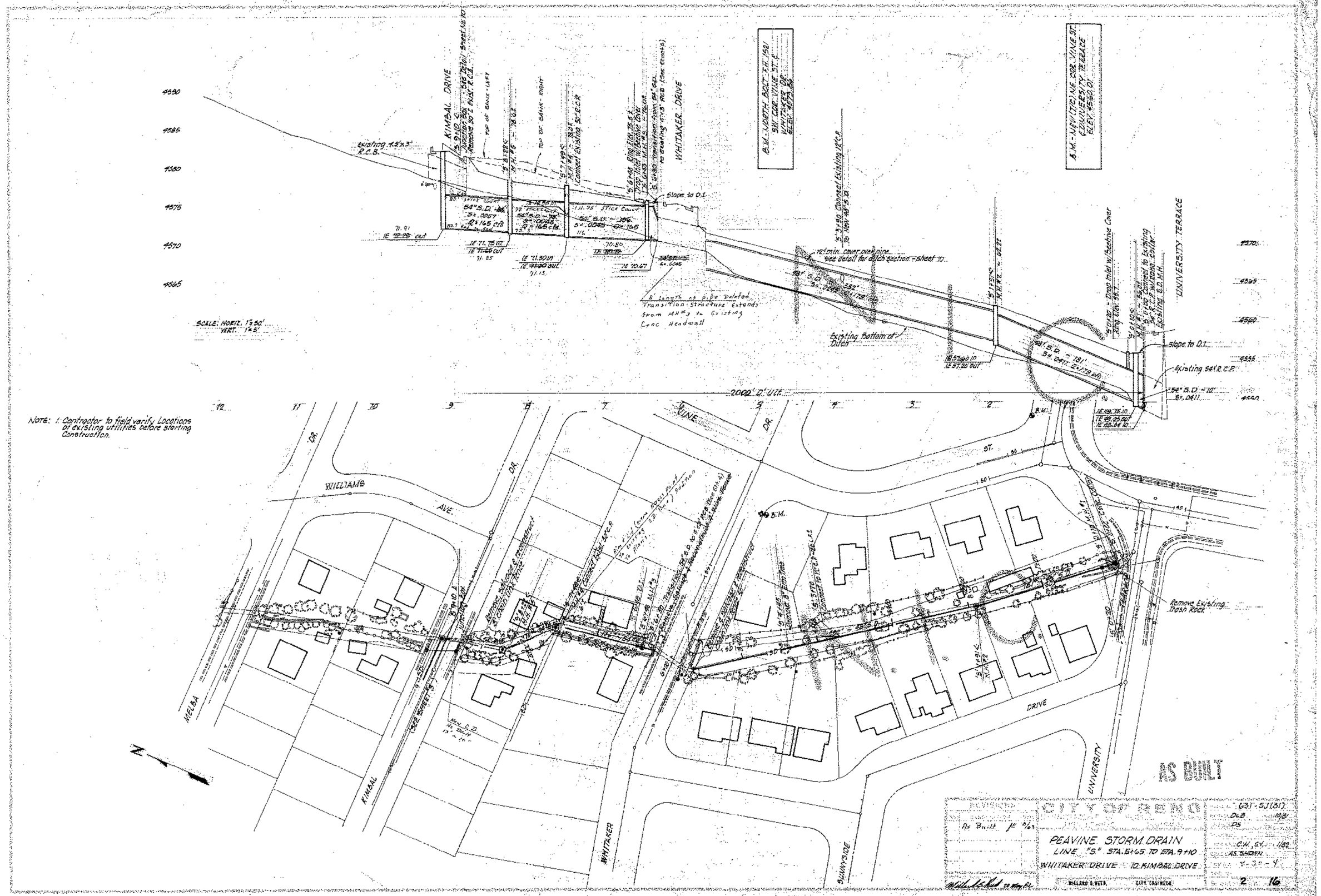
FARR WEST ENGINEERING
5510 LONGLEY LANE
RENO, NEVADA 89511
PHONE: (775) 851-4788
FAX: (775) 851-0766

CITY OF RENO

SUPPLEMENTAL WATERSHED PLAN AND ENVIRONMENTAL DOCUMENT FOR THE PEAVINE MOUNTAIN WATERSHED

EXISTING UTILITES

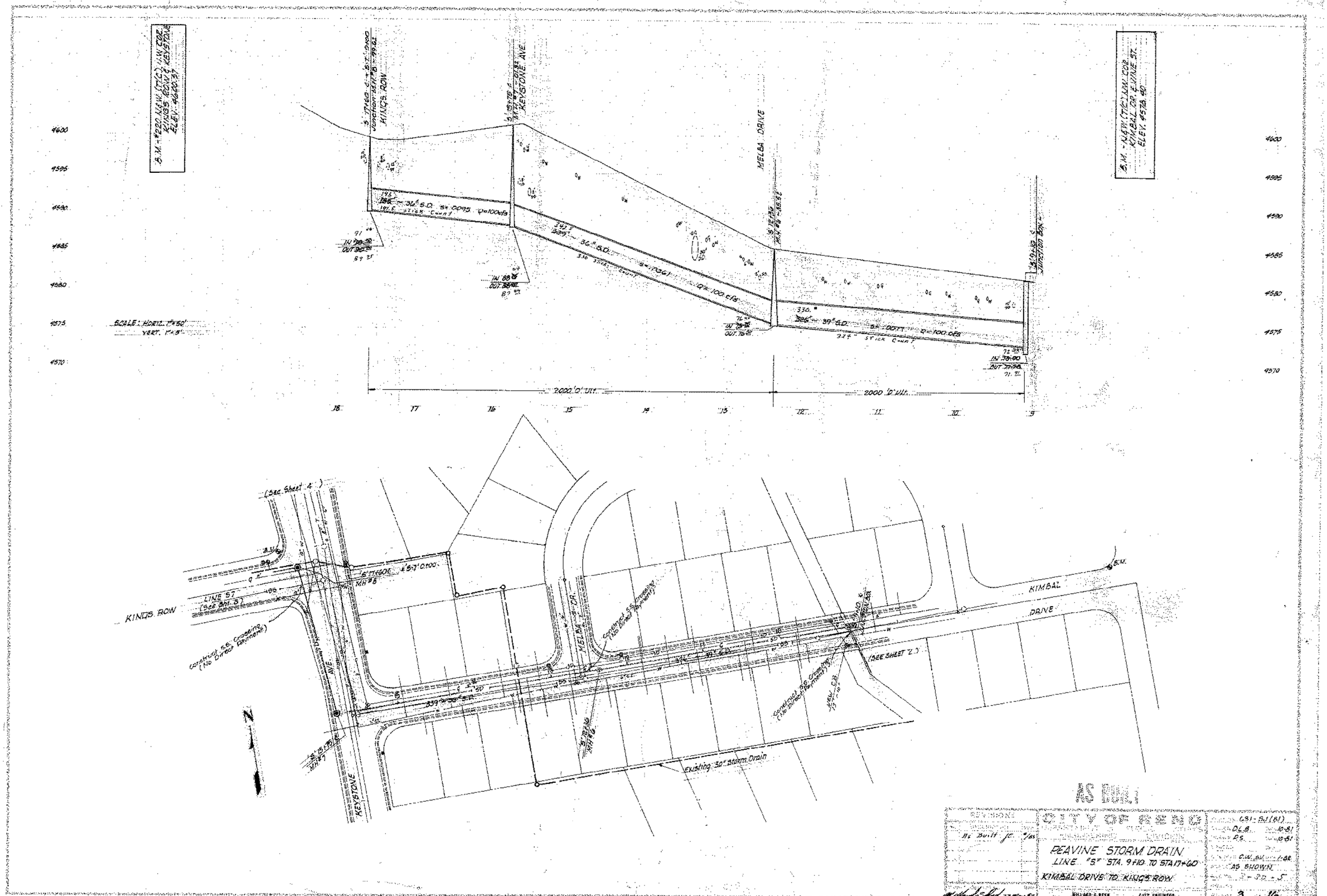
WASHOE COUNTY NEVADA



NOTE: 1. Contractor to field verify Locations of existing utilities before starting Construction.

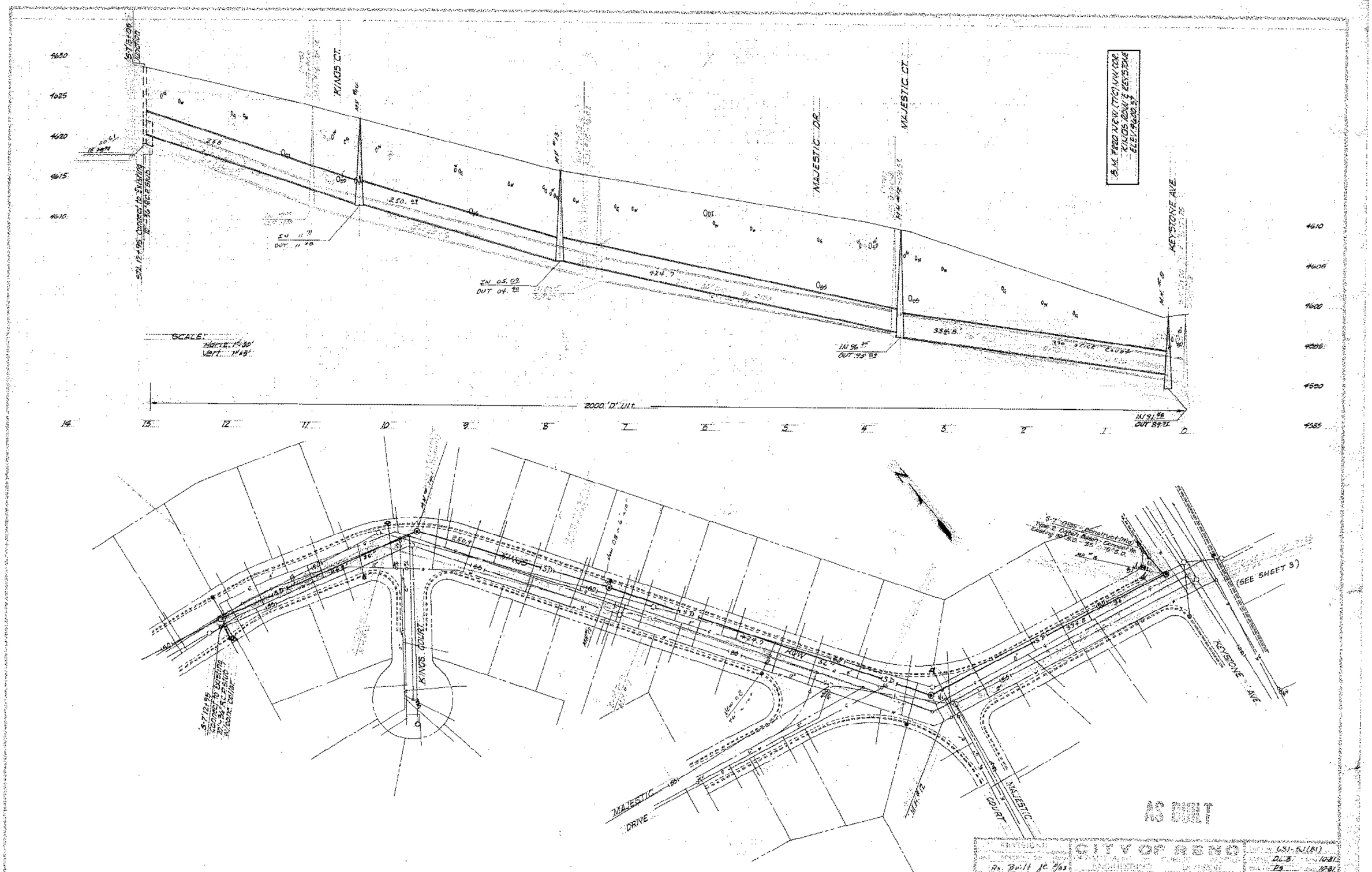
AS BUILT

REVISIONS	CITY OF RENO	631-SJ(81)
As Built 1/6/83	PEAVINE STORM DRAIN LINE "S" STA. 5+65 TO STA. 9+10 WHITAKER DRIVE TO KIMBAL DRIVE	DLB 10/81 DS C.W., S.Y. 1/82 AS SHOWN 2 16
	WILLARD G. WEBB CITY ENGINEER	



AS BUILT

REVISIONS	CITY OF RENO	
As Built JC 9/85	PEAVINE STORM DRAIN LINE "S" STA. 9+10 TO STA 17+60 KIMBAL DRIVE TO KINGS ROW	GSI-SJ(81) DLB 10-81 PS 10-81 C.W. BV 1-82 AS SHOWN 3 - 30 - 5
	MILLARD C. REED CITY ENGINEER	SHEET 3 OF 16



REVISIONS	CITY OF RENO	631-5J(B1)
As Built	ENGINEERING DIVISION	D.L.B. 10-81
		P.S. 10-81
	PEAVINE STORM DRAIN	
	LINE 'S-7' STA. 0+00 TO STA. 13+10	C.W., S.V. 1-82
	KEYSTONE AVE. ALONG KINGS ROW	AS SHOWN
	MILLARD C. ACEO. CITY ENGINEER	7-30-10
		8 16

4700
4695
4690
4685
4680

LE 97.56 in

5A' 12+85 HEADWALL

19.3 Cu. Yds. Class B Concrete

365' ~ 24" S.D. 38 Stick Count

25 Yds. 12

5A' 11+80 ± M.H. # 29

24.29 24" C 60.9% out

SA 8+25 MH # 28

586.0 ~ 24" S.D. 0.5% Grade 581.5' Stick Count

B.M. #224 - N.W. (T/C) N.W. CORN. KEYSTONE AVE. & COLEMAN DR. ELEV. 4675.07

5A' 2+85 M.H. # 27

COLEMAN DRIVE

5A' 0+00 Connect to Existing M.H.

B.M. #226 - N.W. (T/C) N.W. CORN. PENROSE DR. & KEYSTONE AVE. ELEV. 4707.45

SCALE : HORIZ. 1"=50'
VERT. 1"=5'

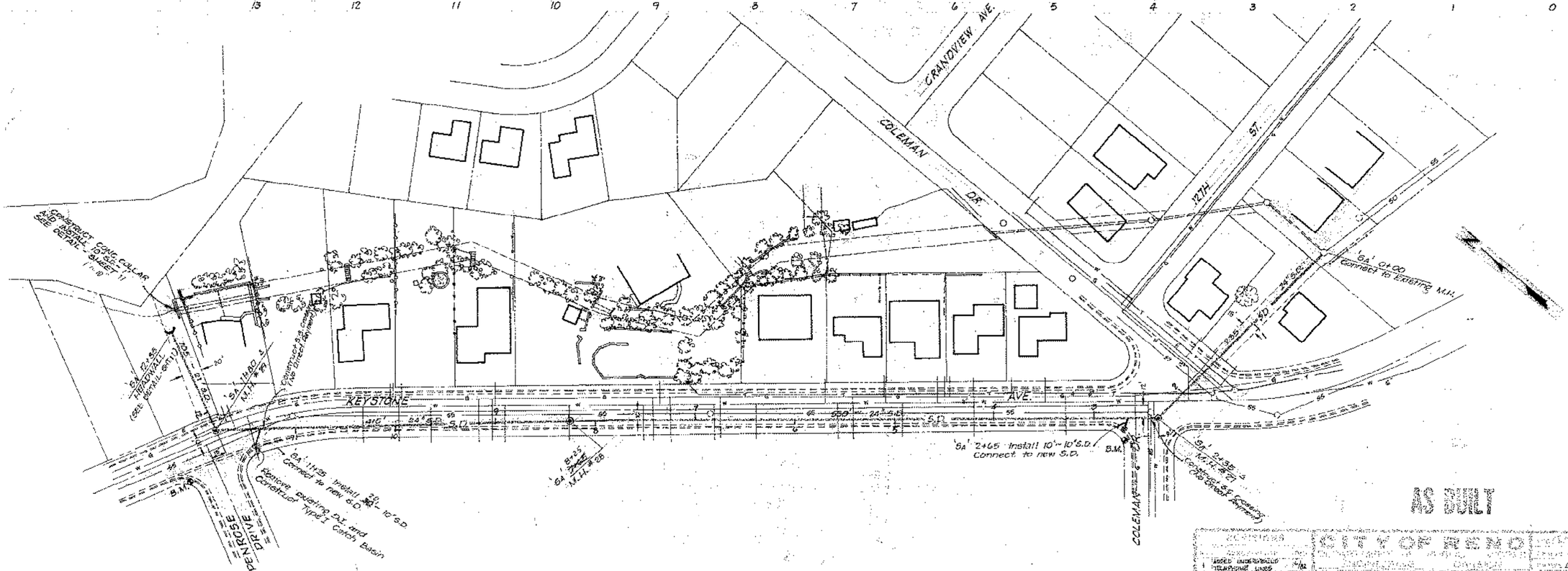
2000. 'D' ULT.

LT
IE 66.35 in
IE 66.50 out

24" 6.0% ~ 285' S.D. 23.5 Stick Count n=.0295 Q=37 CFS

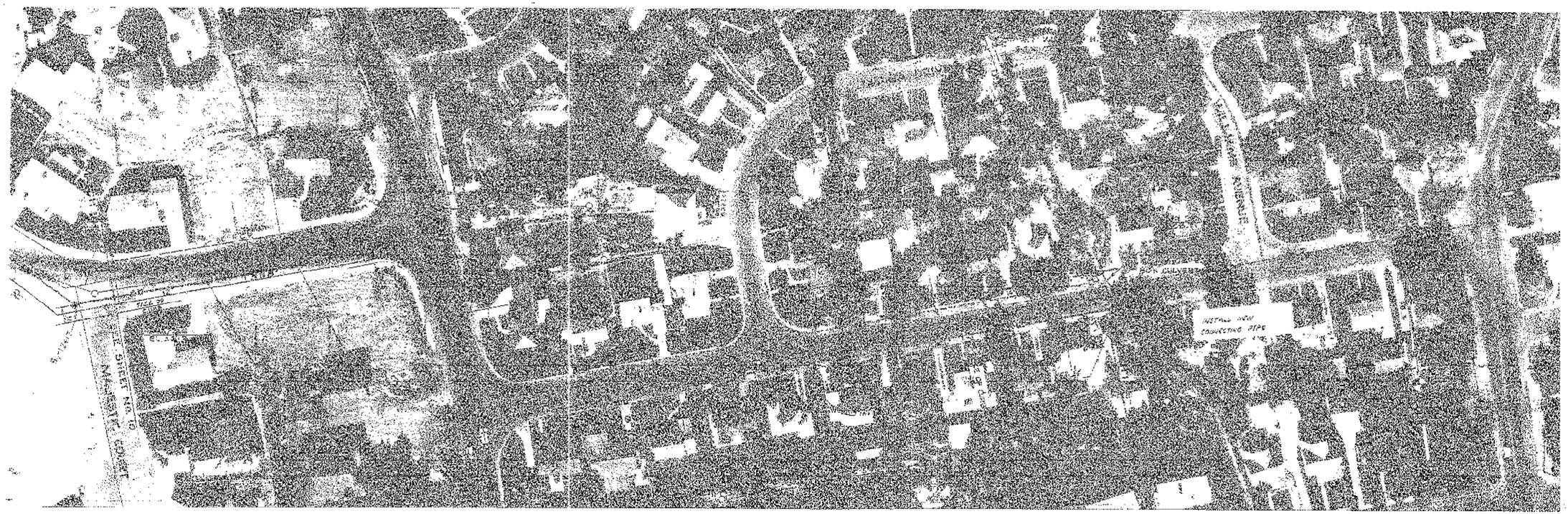
IE 59.56 in

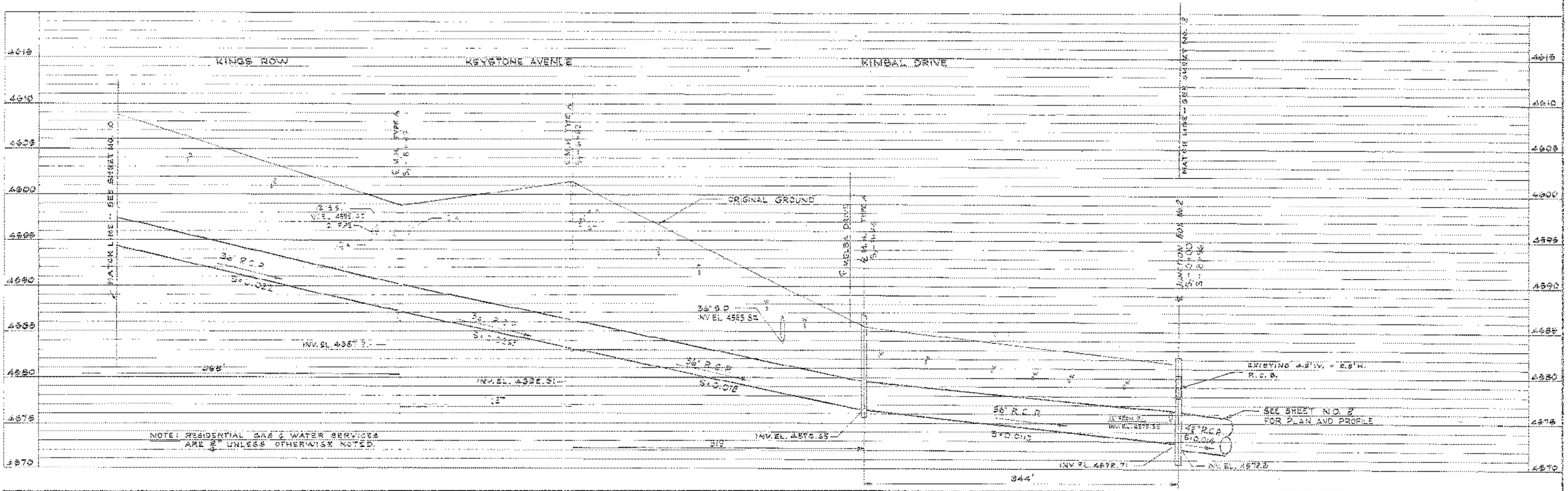
13 12 11 10 9 8 7 6 5 4 3 2 1 0



AS BUILT

NOTES: ADDED UNDERGROUND TELEPHONE LINES As Built	CITY OF RENO	(61)-SA (81) D.L.B. 2/82 DLB 2/82 SV 6/82
	PEAVINE STORM DRAIN LINE 'SA' STA. 0+00 TO STA. 12+85 COLEMAN DR. TO PENROSE DR.	AS SHOWN 7-22-11
Millard G. Reed	MILLARD G. REED CITY ENGINEER	9 16



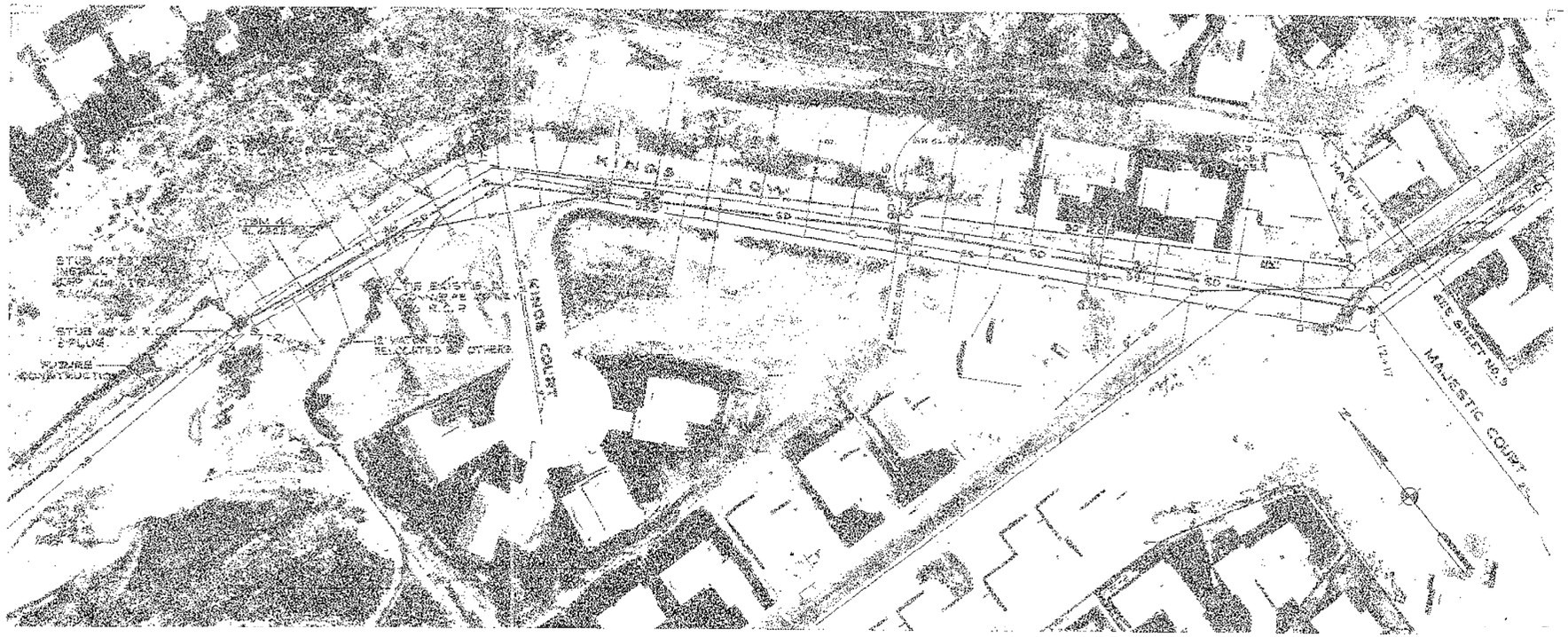


AERIAL PHOTOGRAPHY DATA	APPROVALS	REVISIONS	DATE	DESCRIPTION	BY	APPR.
BY: C.O. GREENWOOD & ASSOCIATES						
DATE FLOWN: ELEV. FLOWN:						
PHOTO SCALE:						
CAMERA DATA: MAKE FOCAL LENGTH						

PORTER, ARMSTRONG, RIPA & ASSOC.
CONSULTING ENGINEERS
247 EAST SECOND STREET RENO, NEVADA
DESIGNED BY: R.A.R. SUBMITTED BY:
DRAWN BY: A.F. REYES C.E. DATE:
CHECKED BY: R.A.R. SCALE: HORIZ. 1"=50' VERT. 1"=5'

CITY OF RENO
STORM DRAINAGE SYSTEM
PEAVINE STORM DRAIN
WEST WASH

DEPARTMENT OF PUBLIC WORKS
CITY OF RENO, NEVADA
APPROVED:
DATE: DIRECTOR OF PUBLIC WORKS



AERIAL PHOTOGRAPHY DATA	APPROVALS	REVISION	DATE	DESCRIPTION	BY	APPRVD
BY: C.O. GREENWOOD & ASSOCIATES						
DATE FLOWN: 6-13-84 ELEV. FLOWN: 5000						
PHOTO SCALE: 1"=200'						
CAMERA DATA: N-178 PACKSHIRE FOCAL LENGTH: 120						

PORTER, ARMSTRONG, RIPA & ASSOC.
CONSULTING ENGINEERS
2197 EAST SECOND STREET RENO, NEVADA

DESIGNED BY: R.H.H. SUBMITTED BY:
DRAWN BY: A.R.M. & R.E.S. C.E.: DATE:
CHECKED BY: R.H.H. SCALE: HORIZ. 1"=50' VERT. 1"=5'

CITY OF RENO
STORM DRAINAGE SYSTEM
PEAVINE STORM DRAIN
WEST WASH

DEPARTMENT OF PUBLIC WORKS
CITY OF RENO, NEVADA
APPROVED:
DATE: DIRECTOR OF PUBLIC WORKS

SHEET 10 OF 28

National Flood Hazard Layer FIRMette

FEMA

119°51'6"W 39°33'7"N

119°50'28"W 39°32'39"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 3/21/2022 at 6:17 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

National Flood Hazard Layer FIRMette

FEMA

119°51'6"W 39°32'55"N

119°50'29"W 39°32'27"N

Feet 1:6,000

0 250 500 1,000 1,500 2,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

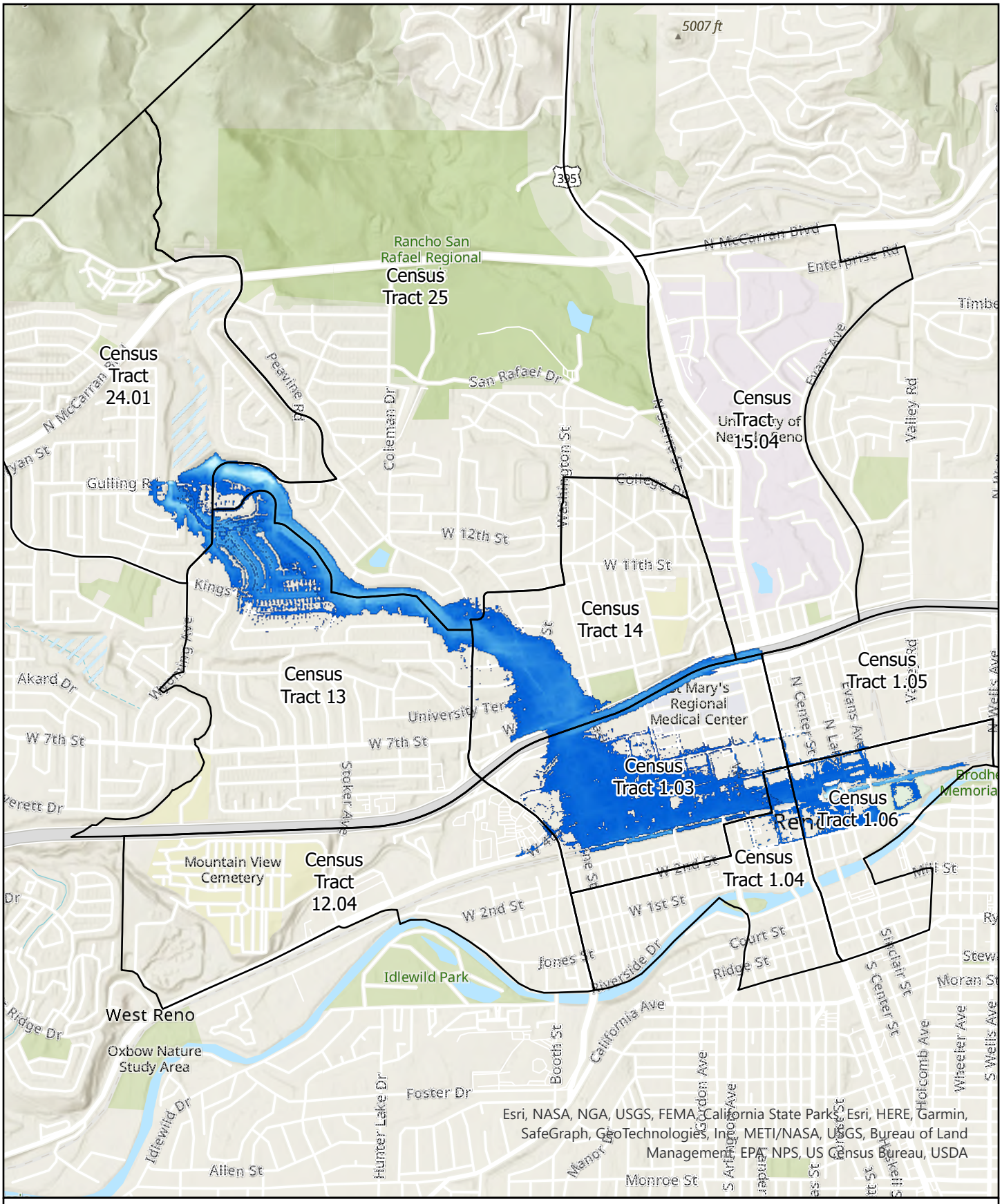
N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 3/21/2022 at 6:14 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.



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5510 Longley Lane
Reno, NV 89511
(775) 851-4788
www.farrwestengineering.com

N

1" = 2,000'

City of Reno West Wash Dam Rehabilitation Project
Census Tracts

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

Q:\client\Reno\Projects\CoR-WestWashDam-1930\WestWashDam-ProProject\CoR-WestWashDam.aprx, Layout: City of Reno West Wash Dam Rehabilitation Project Census Tracts. Editor: tbaker. Printed: 3/11/2022

SCALE: 1" = 100'

100' 0 100' 200'

KEYSTONE AVE

VAN NESS AVE

O'FARRELL ST

POLK ST

WYOMING AVE

EAST WASH DAM

WEST WASH DAM

EXISTING FLOWLINE

EXISTING R.C. CHUTE

OVERTOPPING OF WEST BERM WILL OCCUR DURING THE 100-YEAR EVENT

OVERTOPPING OF WEST WASH DAM WILL OCCUR DURING THE 3/4 LOCAL PMP EVENT

EXISTING SPILLWAY, WILL BE ACTIVATED DURING 200-YEAR EVENT

MCCARRAN BLVD

SEVERN ST

GULLING RD

DATE: 8/4/2021
SCALE:
DESIGNED: MA
DRAWN: SHH
CHECKED: CC

FARR WEST ENGINEERING
5510 LONGLEY LANE
RENO, NEVADA 89511
PHONE: (775) 851-4788
FAX: (775) 851-0766

CITY OF RENO

SUPPLEMENTAL WATERSHED PLAN AND ENVIRONMENTAL DOCUMENT FOR THE PEAVINE MOUNTAIN WATERSHED

ALTERNATIVE 1 - FUTURE WITHOUT PROJECT (NO ACTION)

WASHOE COUNTY NEVADA

1

SCALE: 1" = 150'

150' 0 150' 300'

KEYSTONE AVE

VAN NESS AVE

O'FARRELL ST

POLK ST

WEST WASH
INUNDATION AREA

WYOMING AVE

EAST WASH
DAM

WEST WASH
DAM

IMPROVE NATURAL CONVEYANCE
2.2 MI TO TRUCKEE RIVER

MCCARRAN BLVD

SEVERN ST

GULLING RD

DATE: _____

SCALE: _____

DESIGNED: _____

DRAWN: SHH

CHECKED: _____

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RENO, NEVADA 89511
PHONE: (775) 851-4788
FAX: (775) 851-0766

CITY OF RENO

SUPPLEMENTAL WATERSHED PLAN AND ENVIRONMENTAL DOCUMENT FOR THE PEAVINE MOUNTAIN WATERSHED

ALTERNATIVE 2 - FLOOD PROOFING DOWNSTREAM FROM WEST WASH

WASHOE COUNTY NEVADA

2

East Wash Dam

West Wash Dam

659

659

430

PEAVINE RD

COLEMAN DR

PUTNAM DR

PUTNAM DR

WASHINGTON ST

COLLEGE DR

ALTURAS AVE

KEYSTONE AVE

KEYSTONE AVE

WYOMING AVE

SEVERN DR

KINGS ROW

GEAR ST

W 11TH ST

SADLEIR WAY

HIGHLAND AVE

N WELLS AVE

E 9TH ST

W 9TH ST

E 9TH ST

WASHINGTON ST

UNIVERSITY TER

VALLEY RD

E 6TH ST

W 7TH ST

W 6TH ST

N SIERRA ST

N VIRGINIA ST

N CENTER ST

EVANS AVE

E 4TH ST

W 7TH ST

W 5TH ST

W 4TH ST

LAKE ST

N ARLINGTON AVE

KUENZLI ST

E 2ND ST

VINE ST

WASHINGTON ST

RALSTON ST

STOKER AVE

KEYSTONE AVE

W 2ND ST

E 1ST ST

S SIERRA ST

S CENTER ST

S LAKE ST

SINCLAIR ST

MILL ST

HOLCOMB AVE

S WELLS AVE

LOU ST

W 1ST ST

RYLAND ST

Legend

Water Depth (ft)

Value

40

0

Parcels with Water Depths ≥ 1 ft

Parcels with Water Depths < 1 ft

P:\Client Projects\Reno, City of 1461\1930 West Wash Dam\3.0 Studies_Reports\3.12 BCA\Figures\1930_BCA Figs\1930_BCA Figs_Alternatives.aprx, Editor: djones, Printed: 3/7/2022

20 Years!
FARR WEST ENGINEERING

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Reno, NV 89511
(775) 851-4788
www.farrwestengineering.com

Supplemental Watershed Plan and Environmental Document for the Peavine Mountain Watershed
Alternative 2 - Downstream Flood Improvements
Parcels with Flood Damage from West Wash Dam Breach at Local PMP

N

1:12,000

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

SCALE: 1" = 150'

150' 0 150' 300'

KEYSTONE AVE

VAN NESS AVE

O'FARRELL ST

POLK ST

WYOMING AVE

EAST WASH DAM

WEST WASH DAM

PROPOSED PARAPET WALL
WALL HEIGHT = 2'
TOTAL WALL LENGTH = 75'

RAISE DAM CREST 5'
TO ELEVATION 4798.0'

RE-GRADE EAST WASH
AUXILIARY SPILLWAY CREST
TO ELEVATION 4858.0'

RE-GRADING EXTENTS
WITHIN WEST WASH DAM
IMPOUNDMENT

RESTORE TO ORIGINAL 80'
WIDTH AND ARMOR SPILLWAY

LOWER AUXILIARY
SPILLWAY CREST TO
ELEVATION 4782.5'

MCCARRAN BLVD

SEVERN ST

GULLING RD

4800 4775 4750 4850 4825

2:1 3:1

SUMMARY OF CUT AND FILL	
TOTAL CUT (CU. YD.)	421,683
TOTAL FILL (CU. YD.)	28,588

DATE:
SCALE:
DESIGNED:
DRAWN: SHH
CHECKED:

FARR WEST ENGINEERING
5510 LONGLEY LANE
RENO, NEVADA 89511
PHONE: (775) 851-4788
FAX: (775) 851-0766

CITY OF RENO

SUPPLEMENTAL WATERSHED PLAN AND ENVIRONMENTAL DOCUMENT FOR THE PEAVINE MOUNTAIN WATERSHED

ALTERNATIVE 3 - REMEDIATE EAST AND WEST WASH DAMS

WASHOE COUNTY NEVADA

3

SCALE: 1" = 150'

150' 0 150' 300'

KEYSTONE AVE

VAN NESS AVE

O'FARRELL ST

POLK ST

WYOMING AVE

EAST WASH DAM, PRIMARY SPILLWAY, AND AUXILIARY SPILLWAY REMOVAL GRADING EXTENTS

WEST WASH DAM, PRIMARY SPILLWAY, AND AUXILIARY SPILLWAY REMOVAL GRADING EXTENTS

MCCARRAN BLVD

SEVERN ST

GULLING RD

SUMMARY OF CUT AND FILL	
TOTAL CUT (CU. YD.)	130,485
TOTAL FILL (CU. YD.)	53,215

DATE:
SCALE:
DESIGNED:
DRAWN: SHH
CHECKED:

FARR WEST ENGINEERING
5510 LONGLEY LANE
RENO, NEVADA 89511
PHONE: (775) 851-4788
FAX: (775) 851-0766

CITY OF RENO

SUPPLEMENTAL WATERSHED PLAN AND ENVIRONMENTAL DOCUMENT FOR THE PEAVINE MOUNTAIN WATERSHED

ALTERNATIVE 4 & 5 - REMOVE EAST AND WEST WASH DAMS

WASHOE COUNTY NEVADA

East Wash Dam

West Wash Dam

Van Ness Avenue Crossing

Peavine Road Crossing

Putnam Drive Crossing

Penrose Drive Crossing

Coleman Drive Crossing

Anson Drive Crossing

Wesley Drive Crossing

Butte Place Crossing

Kings Row Crossing

Whitaker Drive Crossing

University Terrace Crossing

W 7th Street Crossing

Highway 80 Crossing

W 6th Street Crossing

W 5th Street Crossing

W 4th Street Crossing

Railroad Crossing

W 2nd Street Crossing

W 1st Street Crossing

Riverside Drive Crossing

Jones Street Crossing

MacDonald Drive Crossing

Keystone Avenue Crossing

N MCCARRAN BLVD

KINGS ROW

KEYSTONE AVE

W 7TH ST

STOKER AVE

W 4TH ST

W 2ND ST

N SIERRA ST

N VIRGINIA ST

E 9TH ST

EVANS AVE

E 6TH ST

W 6TH ST

E 5TH ST

W 5TH ST

E 4TH ST

W 4TH ST

N ARLINGTON AVE

E 2ND ST

KUENZLI ST

MILL ST

RYLAND ST

E LIBERTY ST

W LIBERTY ST

CALIFORNIA AVE

PLUMAS ST

S ARLINGTON AVE

S SIERRA ST

S VIRGINIA ST

S CENTER ST

N CENTER ST

Legend

- 100-Year West Wash Trapezoidal Channel
- 100-Year East Wash Trapezoidal Channel
- 100-Year Combined Trapezoidal Channel to Truckee
- Box Culvert Road Crossings

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Reno, NV 89511
(775) 851-4788
www.farrwestengineering.com

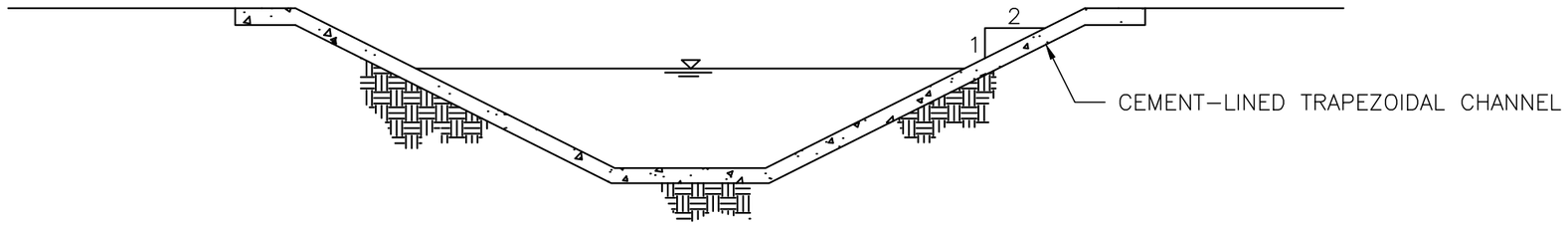
Supplemental Watershed Plan and Environmental Document for the Peavine Mountain Watershed
Alternative 5 - Remove Both Dams with Flood Conveyance to Truckee
100-Year Flood Channel Alignment with Road Crossings

N

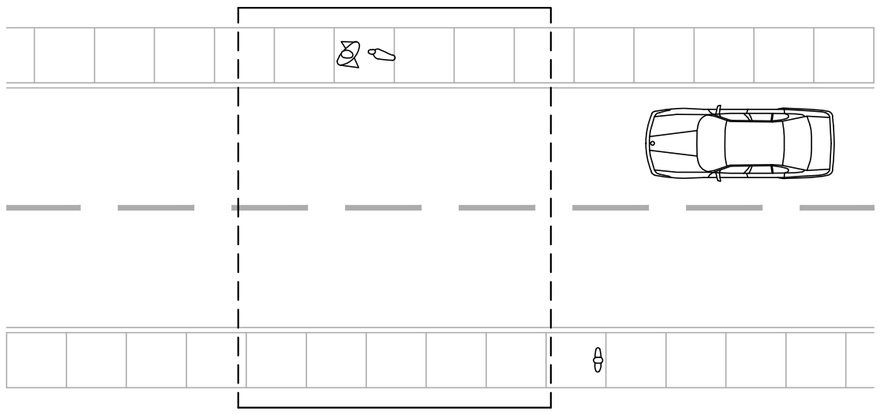
1" = 1,200'

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

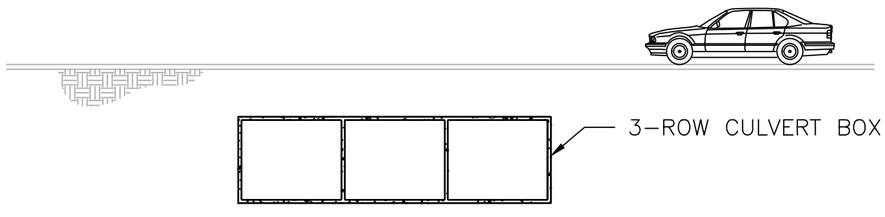
P:\Client Projects\Reno, City of 1461\1930 West Wash Dam\3.0 Studies_Reports\3.12 BCA\Channel Design\Channel Design\Channel Design.aprx, Layout: Channel Overview. Editor: ccluff. Printed: 2/16/2022



CHANNEL DESIGN PROFILE



CULVERT DESIGN PLAN



CULVERT DESIGN PROFILE

JOB NO.: 1930
DESIGN: SHH
DRAWN: SHH
CHECKED: AS
DATE: FEBRUARY 2022

FARR WEST
ENGINEERING
5510 LONGLEY LANE
RENO, NEVADA 89511
PHONE: (775) 851–4788
FAX: (775) 851–0766

WEST WASH DAM REHABILITATION
CHANNEL AND CULVERT BOX DESIGN EXHIBIT

CITY OF RENO

NEVADA

East Wash Dam

West Wash Dam

659

80

80

N-MCCARRAN BL

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-6TH-ST

W-7TH-ST

W-5TH-ST

W-4TH-ST

W-2ND-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

S-SIER

KUENZ

RYLAN

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 6

Low : 0

20 Years! FARR WEST ENGINEERING

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Reno, NV 89511
(775) 851-4788
www.farrwestengineering.com

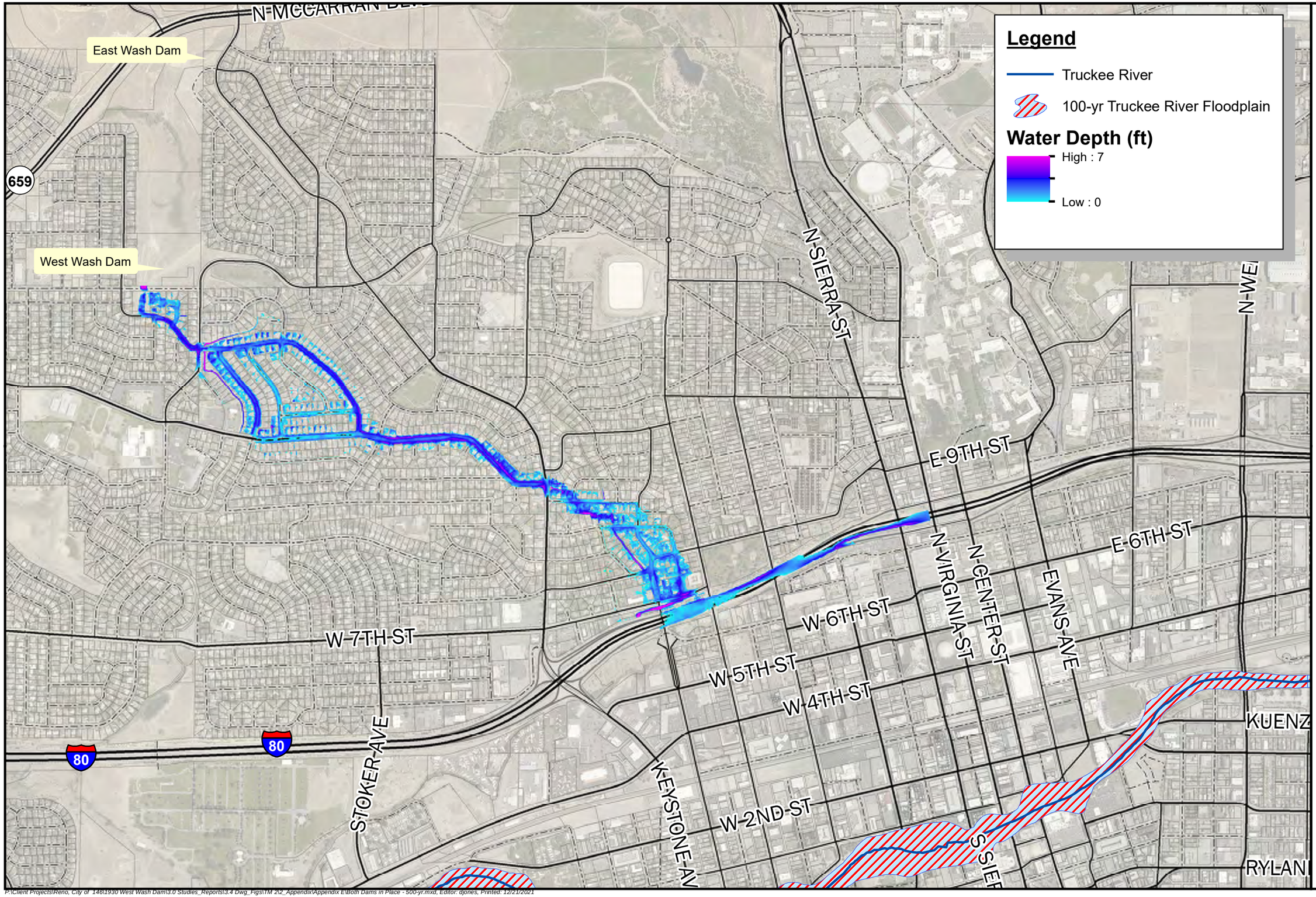
Both Dams In Place: Auxiliary Spillway Activation - 200-Year Storm Inundation

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\2_Appendix\Appendix E\Both Dams In Place - 200-yr.mxd, Editor: djones, Printed: 12/21/2021



20 Years! FARR WEST ENGINEERING

5510 Longley Lane
Reno, NV 89511
(775) 851-4788
www.farrwestengineering.com

Both Dams In Place: Auxiliary Spillway Activation - 500-Year Storm Inundation

N

1 " = 1,000 '

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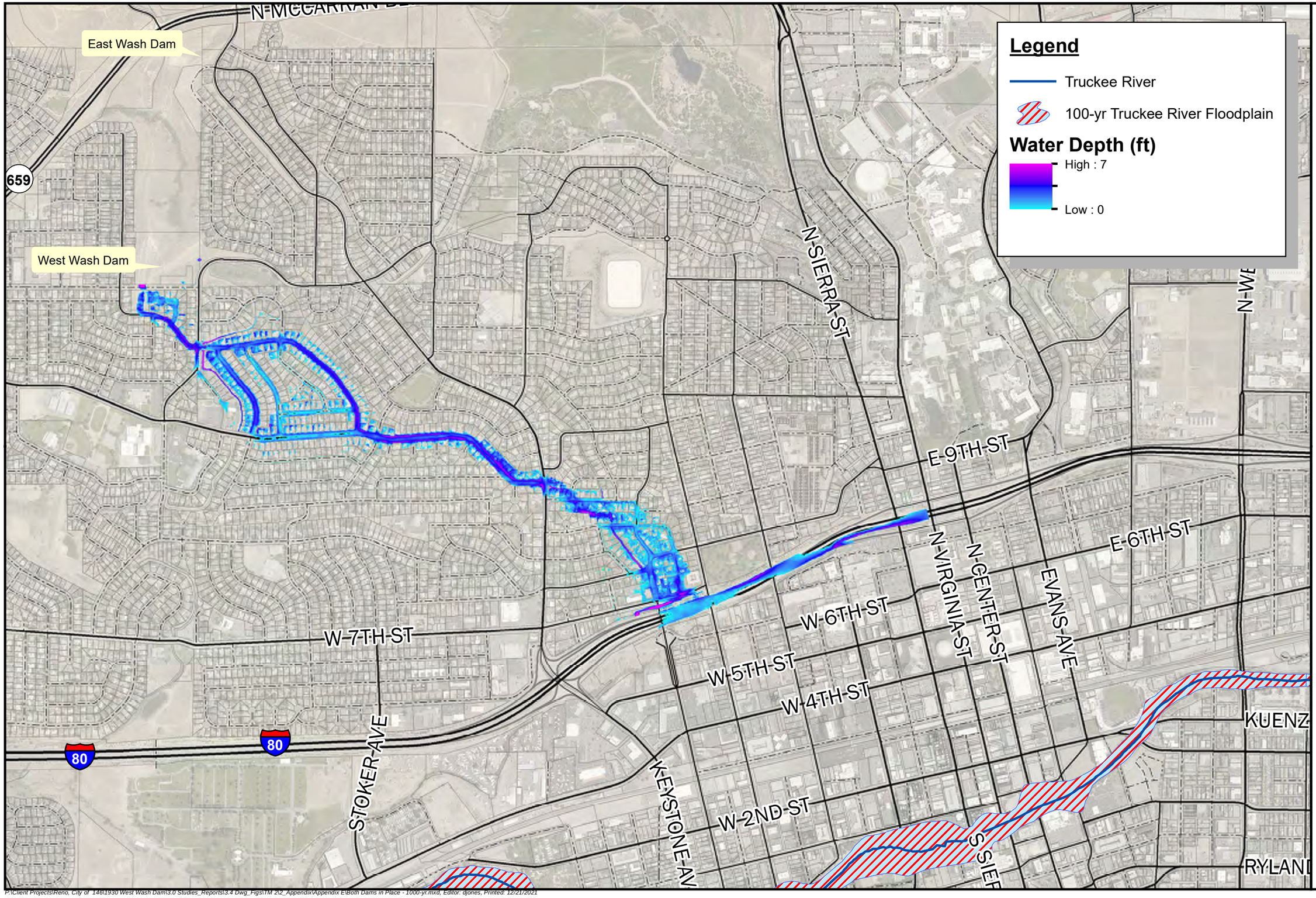
P:\Client Projects\Reno, City of_146\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\2_Appendix\Appendix E\Both Dams in Place - 500-yr.mxd, Editor: djones, Printed: 12/21/2021



20 Years! FARR WEST ENGINEERING

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Both Dams In Place: Auxiliary Spillway Activation - 1000-Year Storm Inundation

N

1 " = 1,000 '

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P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\2_Appendix\Appendix E\Both Dams in Place - 1000-yr.mxd, Editor: djones, Printed: 12/21/2021

East Wash Dam

West Wash Dam

N-MCCARRAN-BLVD

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-7TH-ST

W-6TH-ST

W-5TH-ST

W-4TH-ST

W-2ND-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

S-SIER

KUENZ

RYLAND

80

80

659

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 7

Low : 0

20 Years! FARR WEST ENGINEERING

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Both Dams In Place: Auxiliary Spillway Activation - 3/4 of General PMP Inundation

N

1 " = 1,000 '

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P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\2_Appendix\Appendix E\Both Dams in Place - 0.75 Gen PMP.mxd, Editor: djones, Printed: 12/21/2021

Both Dams In Place: Auxiliary Spillway Activation - General PMP Inundation

East Wash Dam

West Wash Dam

659

80

80

N-MCCARRAN BLVD

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-7TH-ST

W-6TH-ST

W-5TH-ST

W-4TH-ST

W-2ND-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

S-SIER

KUENZ

RYLAN

Legend

- Truckee River
- 100-yr Truckee River Floodplain

Water Depth (ft)

High : 8

Low : 0

N

1 " = 1,000 '

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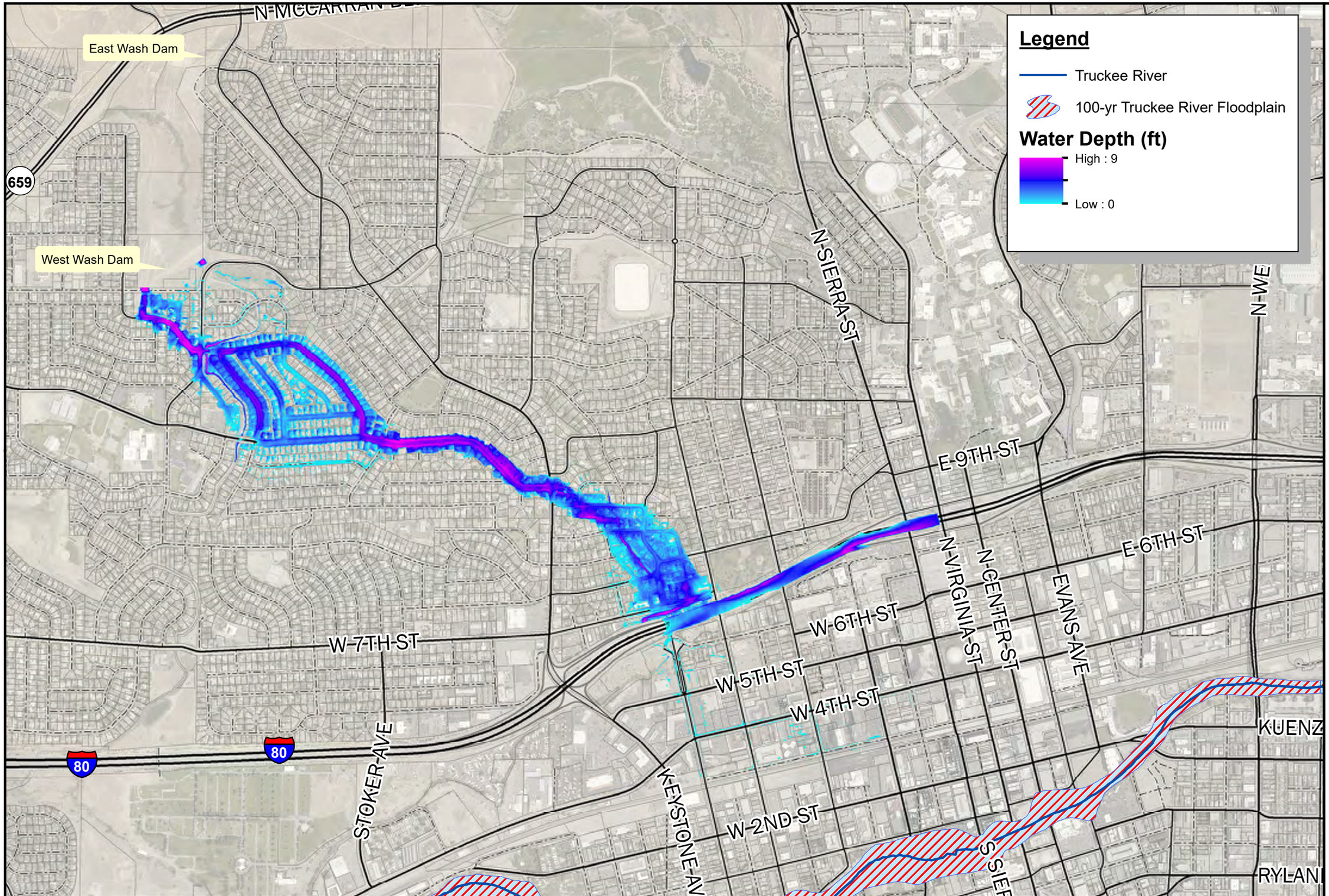

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Both Dams In Place: Auxiliary Spillway Activation - 1/2 of Local PMP Inundation

N

1 " = 1,000 '

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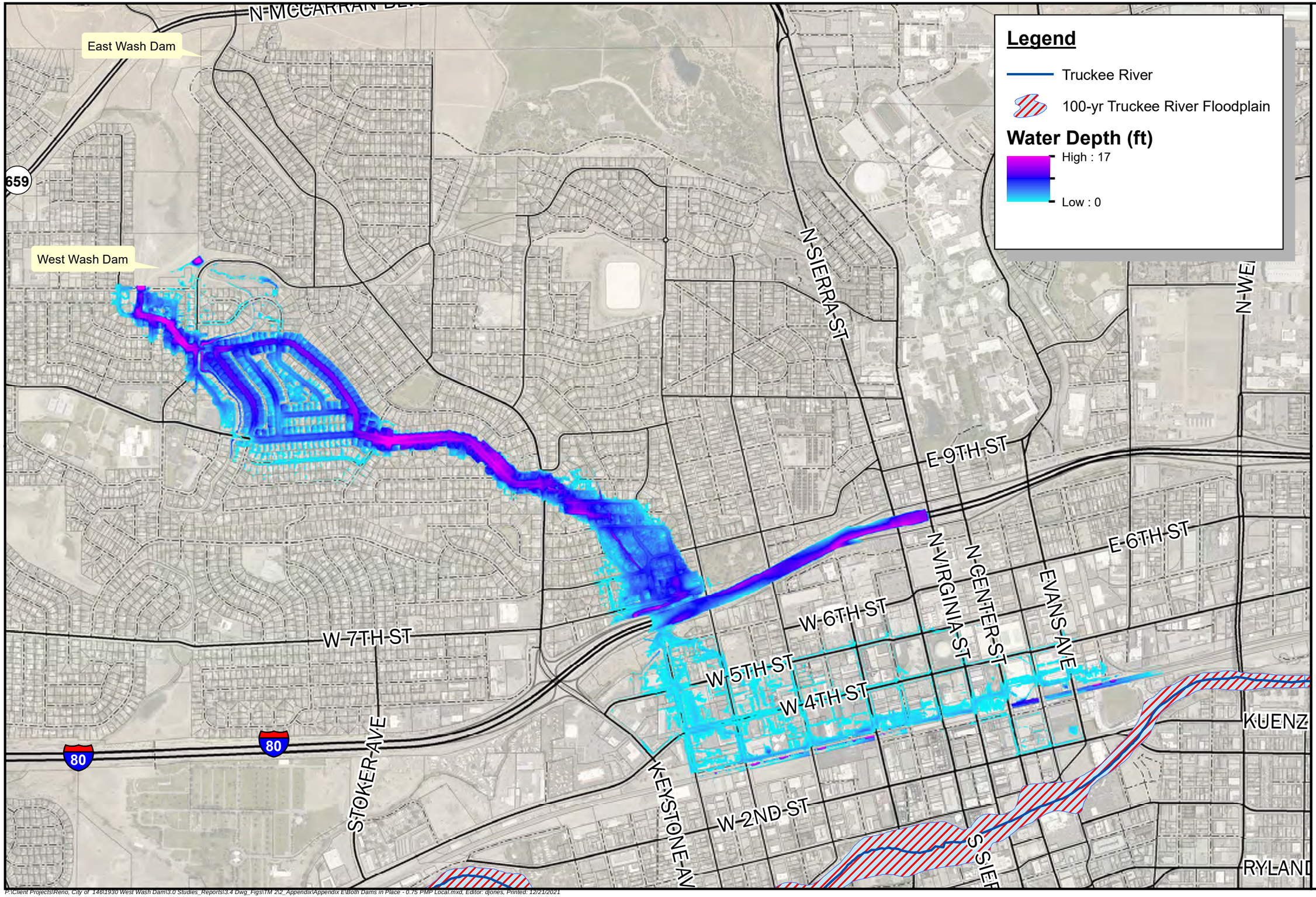

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Both Dams In Place: Auxiliary Spillway Activation - 3/4 of Local PMP Inundation

N

1 " = 1,000 '

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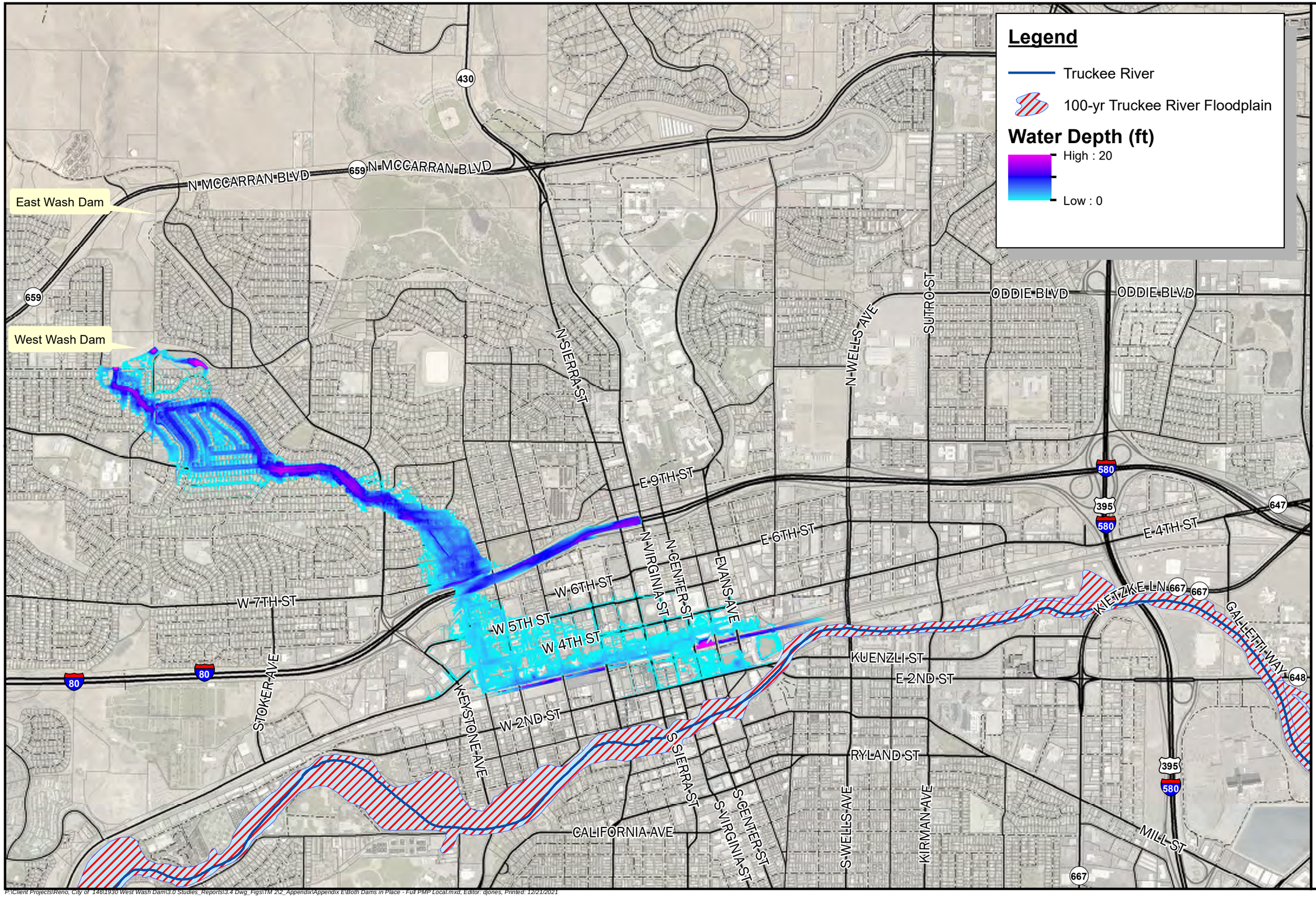
P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\2_Appendix\Appendix E\Both Dams in Place - 0.75 PMP Local.mxd, Editor: djones, Printed: 12/21/2021



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Both Dams In Place: Auxiliary Spillway Activation - Local PMP Inundation

N

1 " = 1,500 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

East Wash Dam

West Wash Dam

659

80

80

N-MCCARRAN-BL

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-7TH-ST

W-6TH-ST

W-5TH-ST

W-4TH-ST

W-2ND-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

S-SIER

KUENZ

RYLAN

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 17

Low : 0

20 Years!
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West Wash Dam Non-Existent & East Wash Dam In-Place - 10-Year Storm Inundation

N

1 " = 1,000 '

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P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\2_Appendix\Appendix F\WW Non-existent - 10yr.mxd, Editor: djones, Printed: 12/21/2021

East Wash Dam

West Wash Dam

659

80

80

N-MCCARRAN

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-7TH-ST

W-6TH-ST

W-5TH-ST

W-4TH-ST

W-2ND-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

S-SIER

KUENZ

RYLAN

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 18

Low : 0

West Wash Dam Non-Existent & East Wash Dam In-Place - 25-Year Storm Inundation

20 Years! FARR WEST ENGINEERING

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N

1 " = 1,000 '

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P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\2_Appendix\Appendix F\WW Non-existent - 25yr.mxd, Editor: djones, Printed: 12/21/2021

East Wash Dam

West Wash Dam

659

80

80

N-MCCARRAN-BL

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-7TH-ST

W-6TH-ST

W-5TH-ST

W-4TH-ST

W-2ND-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

S-SIER

KUENZ

RYLAN

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 18

Low : 0

20 Years!
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West Wash Dam Non-Existent & East Wash Dam In-Place - 50-Year Storm Inundation

N

1 " = 1,000 '

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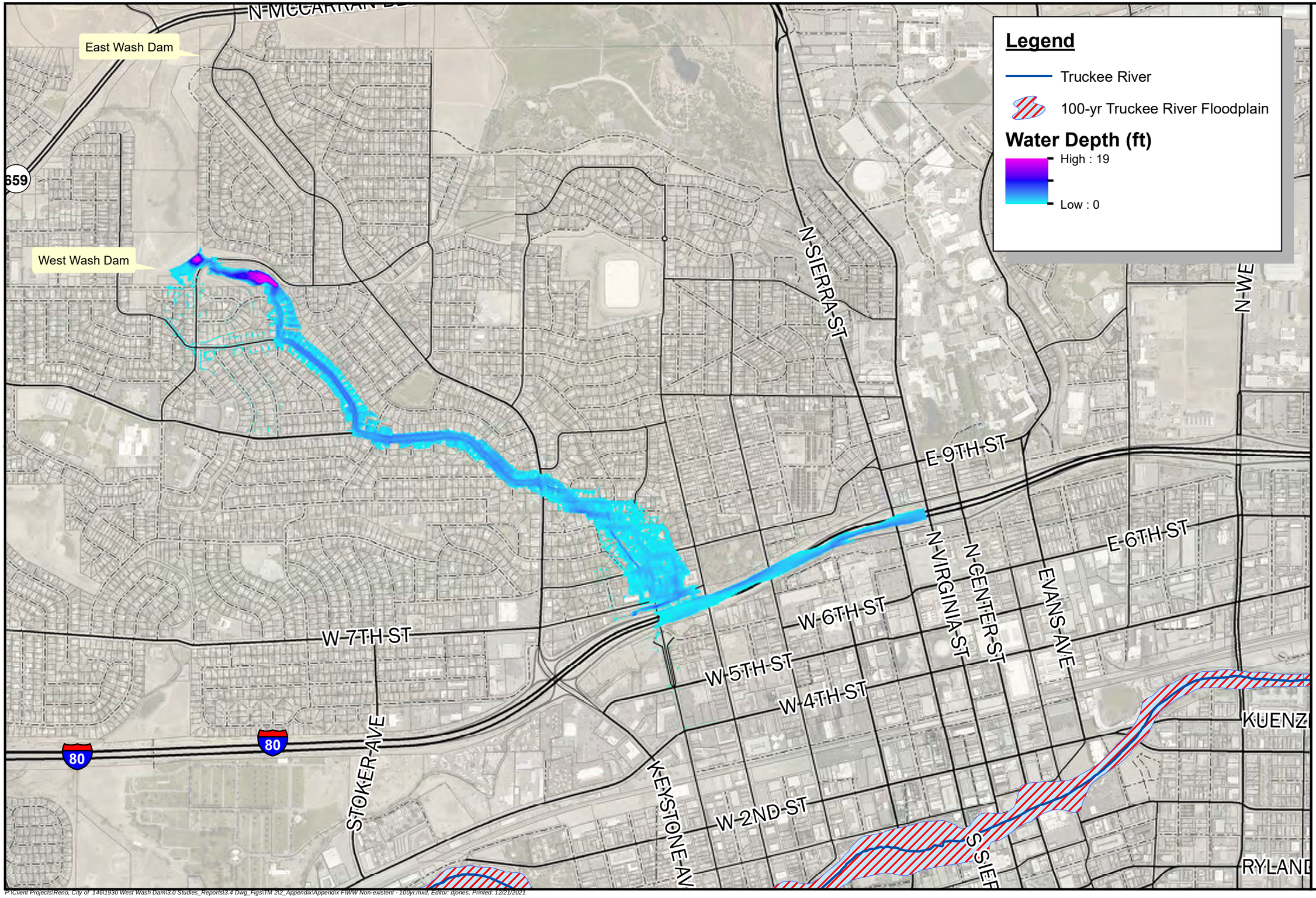

20 Years!
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Reno, NV 89511
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West Wash Dam Non-Existent & East Wash Dam In-Place - 100-Year Storm Inundation

N

1 " = 1,000 '

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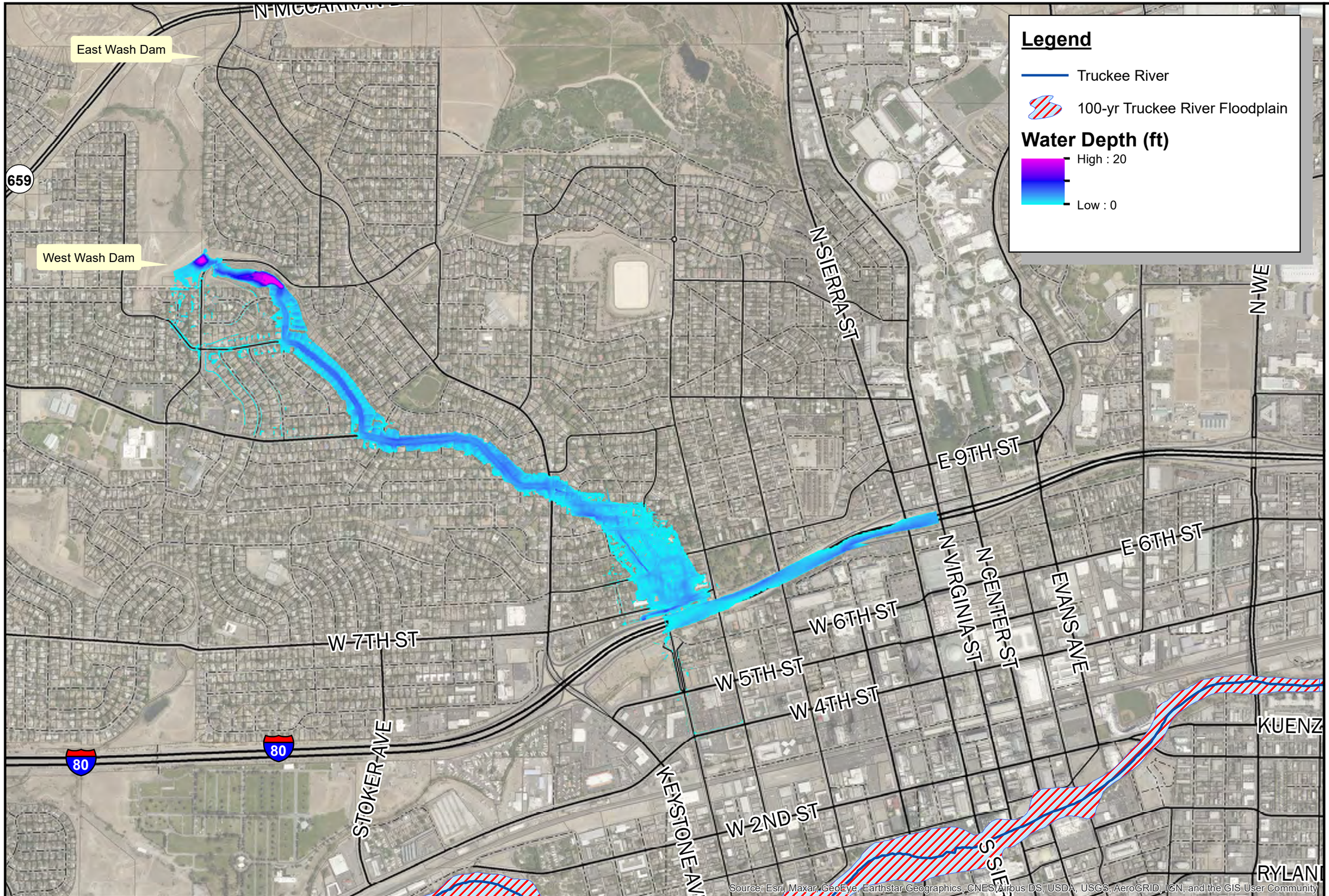

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West Wash Dam Non-Existent & East Wash Dam In-Place - 200-Year Storm Inundation

N

1 " = 1,000 '

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East Wash Dam

West Wash Dam

659

80

80

N-MCCARRAN-BLVD

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-7TH-ST

W-6TH-ST

W-5TH-ST

W-4TH-ST

W-2ND-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

S-SIER

KUENZ

RYLAN

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 21

Low : 0

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West Wash Dam Non-Existent & East Wash Dam In-Place - 500-Year Storm Inundation

N

1 " = 1,000 '

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East Wash Dam

West Wash Dam

659

80

80

N-MCCARRAN-BLVD

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-6TH-ST

W-7TH-ST

W-5TH-ST

W-4TH-ST

W-2ND-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

S-SIER

KUENZ

RYLAN

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 21

Low : 0

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West Wash Dam Non-Existent & East Wash Dam In-Place - 1000-Year Storm Inundation

N

1 " = 1,000 '

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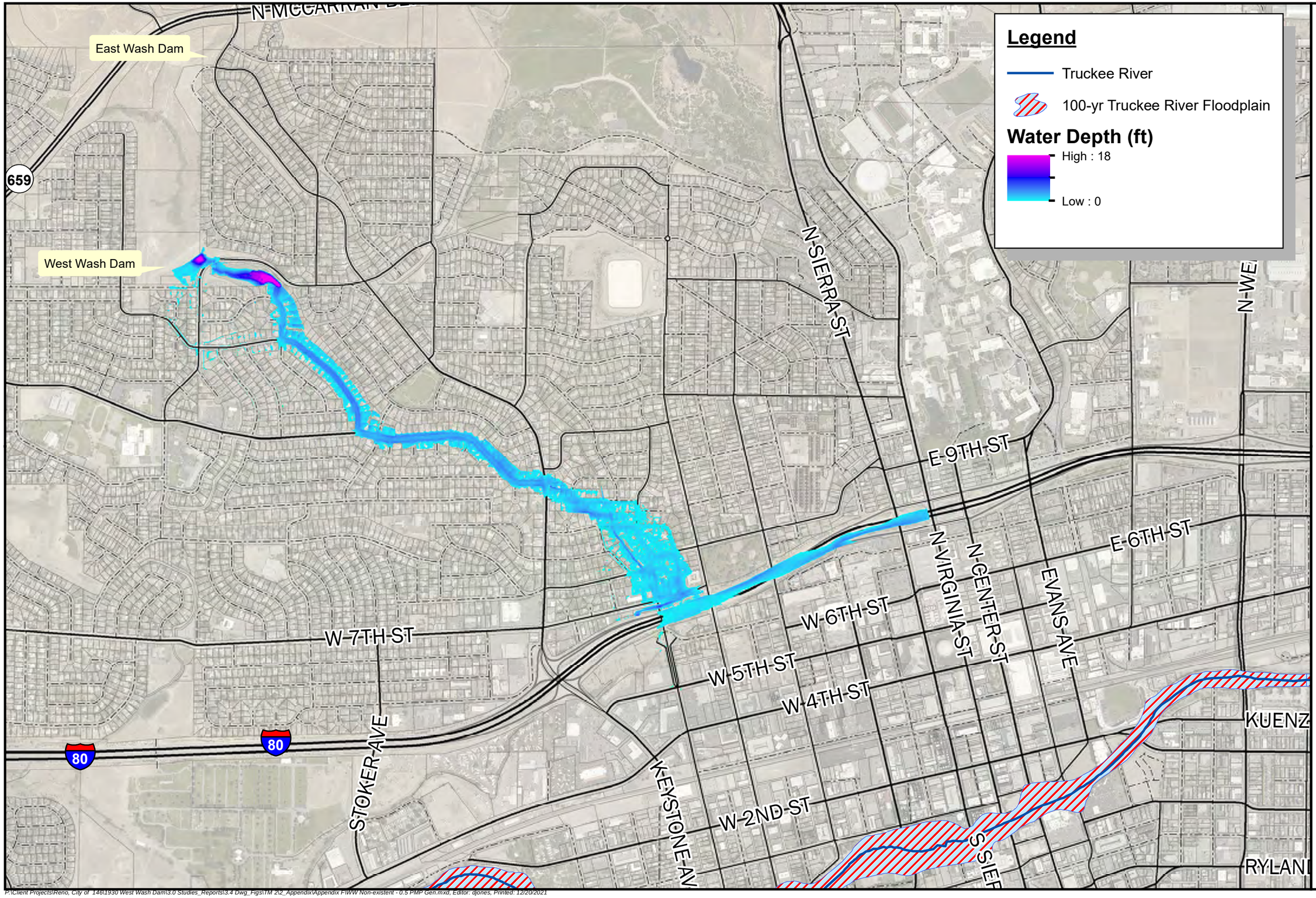

20 Years!
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West Wash Dam Non-Existent & East Wash Dam In-Place - 1/2 of General PMP Inundation

N

1 " = 1,000 '

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P:\Client Projects\Reno, City of 1461\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\2_Appendix\Appendix F\WW Non-existent - 0.5 PMP Gen.mxd, Editor: djones, Printed: 12/20/2021

East Wash Dam

West Wash Dam

659

80

80

N-MCCARRAN

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-7TH-ST

W-6TH-ST

W-5TH-ST

W-4TH-ST

W-2ND-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

S-SIER

KUENZ

RYLAN

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 21

Low : 0

20 Years!
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West Wash Dam Non-Existent & East Wash Dam In-Place - 3/4 of General PMP Inundation

N

1 " = 1,000 '

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P:\Client Projects\Reno, City of 1461930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\2_Appendix\Appendix F\WW Non-existent - 0.75 PMP Gen.mxd, Editor: djones, Printed: 12/20/2021

East Wash Dam

West Wash Dam

659

80

80

N-MCCARRAN-B

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-6TH-ST

W-7TH-ST

W-5TH-ST

W-4TH-ST

W-2ND-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

S-SIER

KUENZ

RYLAN

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 22

Low : 0

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West Wash Dam Non-Existent & East Wash Dam In-Place - General PMP Inundation

N

1 " = 1,000 '

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East Wash Dam

West Wash Dam

659

80

80

N-MCCARRAN

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-7TH-ST

W-6TH-ST

W-5TH-ST

W-4TH-ST

W-2ND-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

S-TOKER-AVE

K-EYSTONE-AVE

S-SIER

KUENZ

RY-LAN

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 23

Low : 0

West Wash Dam Non-Existent & East Wash Dam In-Place - 1/2 of Local PMP Inundation

20 Years! FARR WEST ENGINEERING

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N

1 " = 1,000 '

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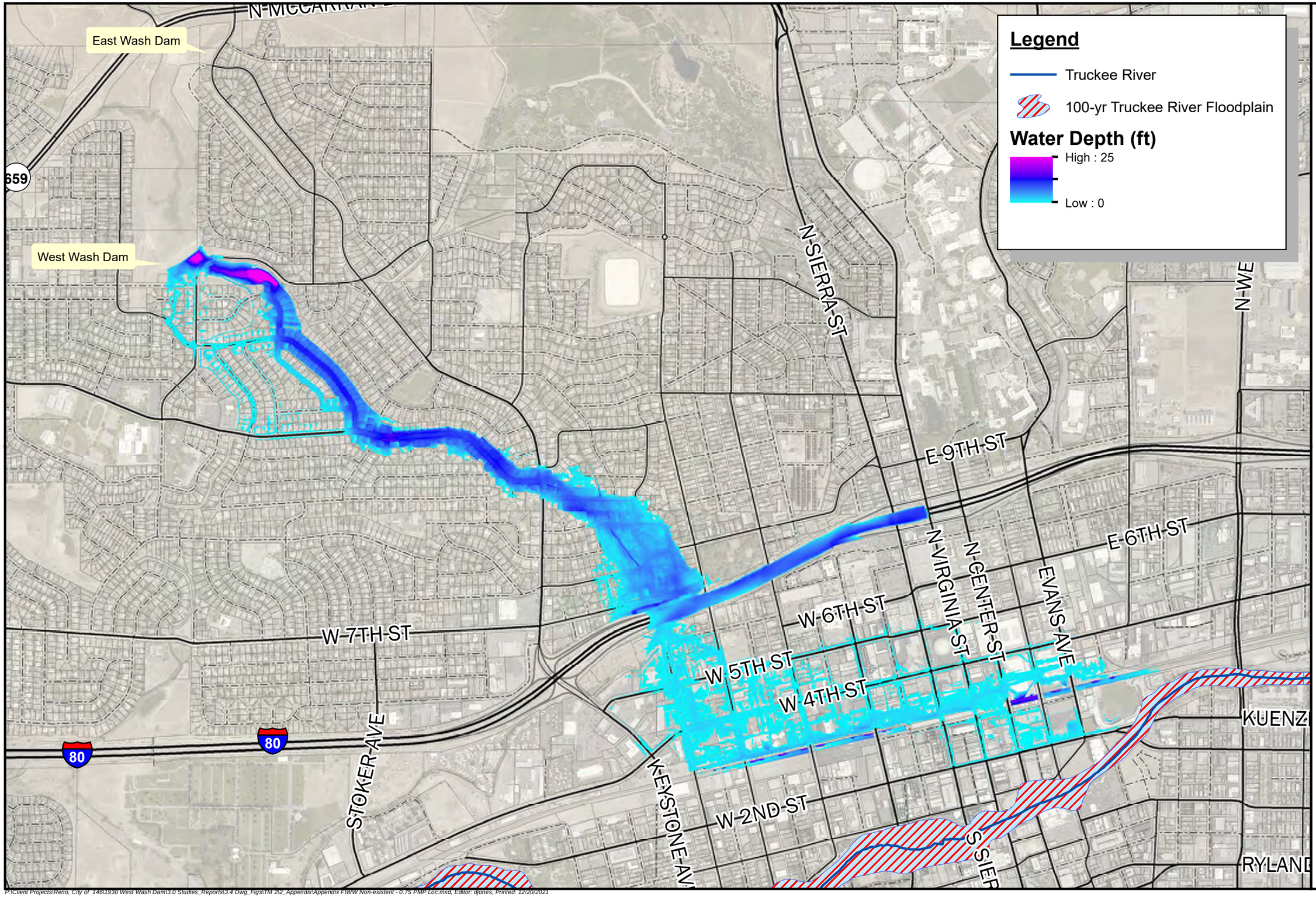

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West Wash Dam Non-Existent & East Wash Dam In-Place - 3/4 of Local PMP Inundation

N

1 " = 1,000 '

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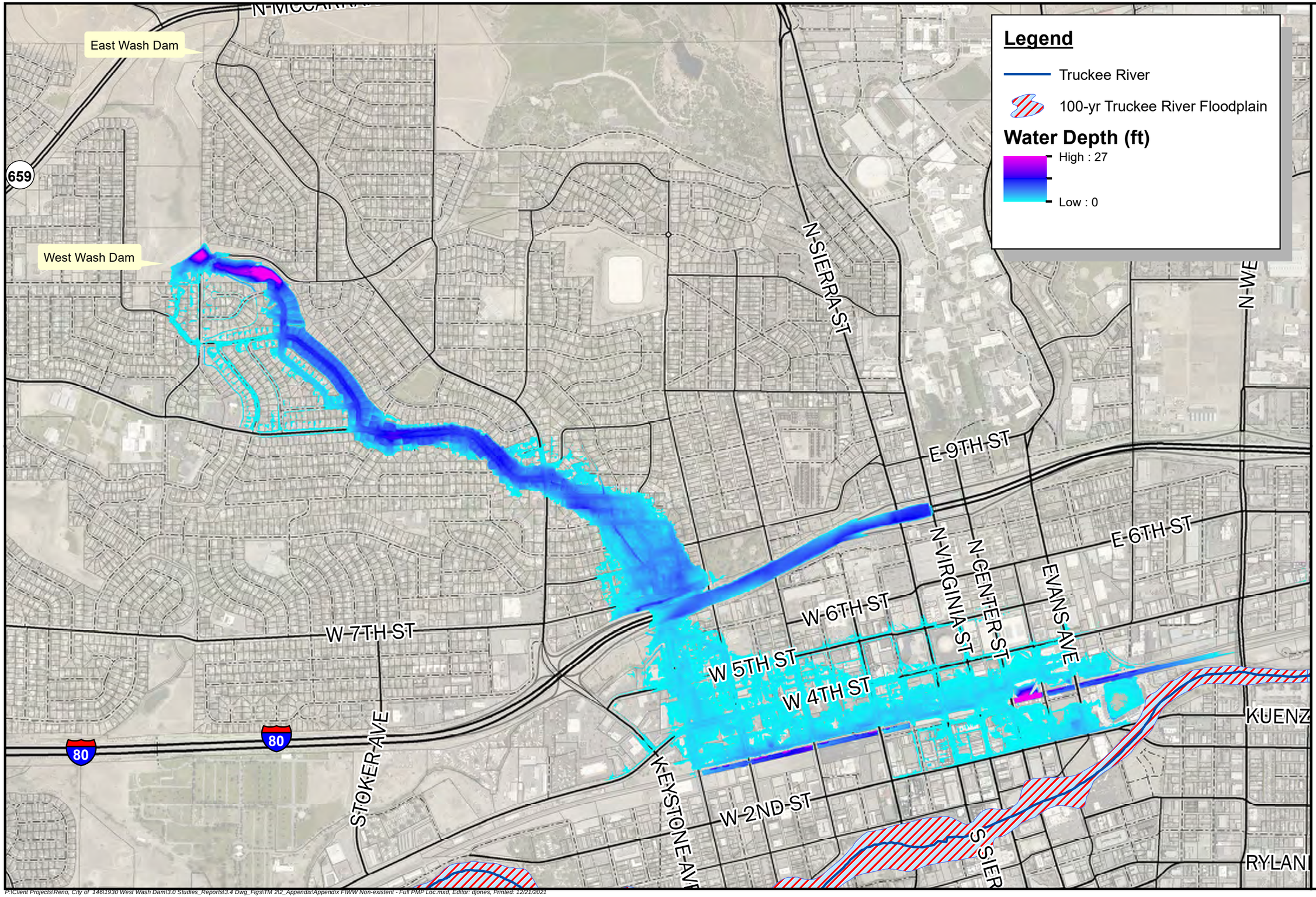

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West Wash Dam Non-Existent & East Wash Dam In-Place - Local PMP Inundation

N

1 " = 1,000 '

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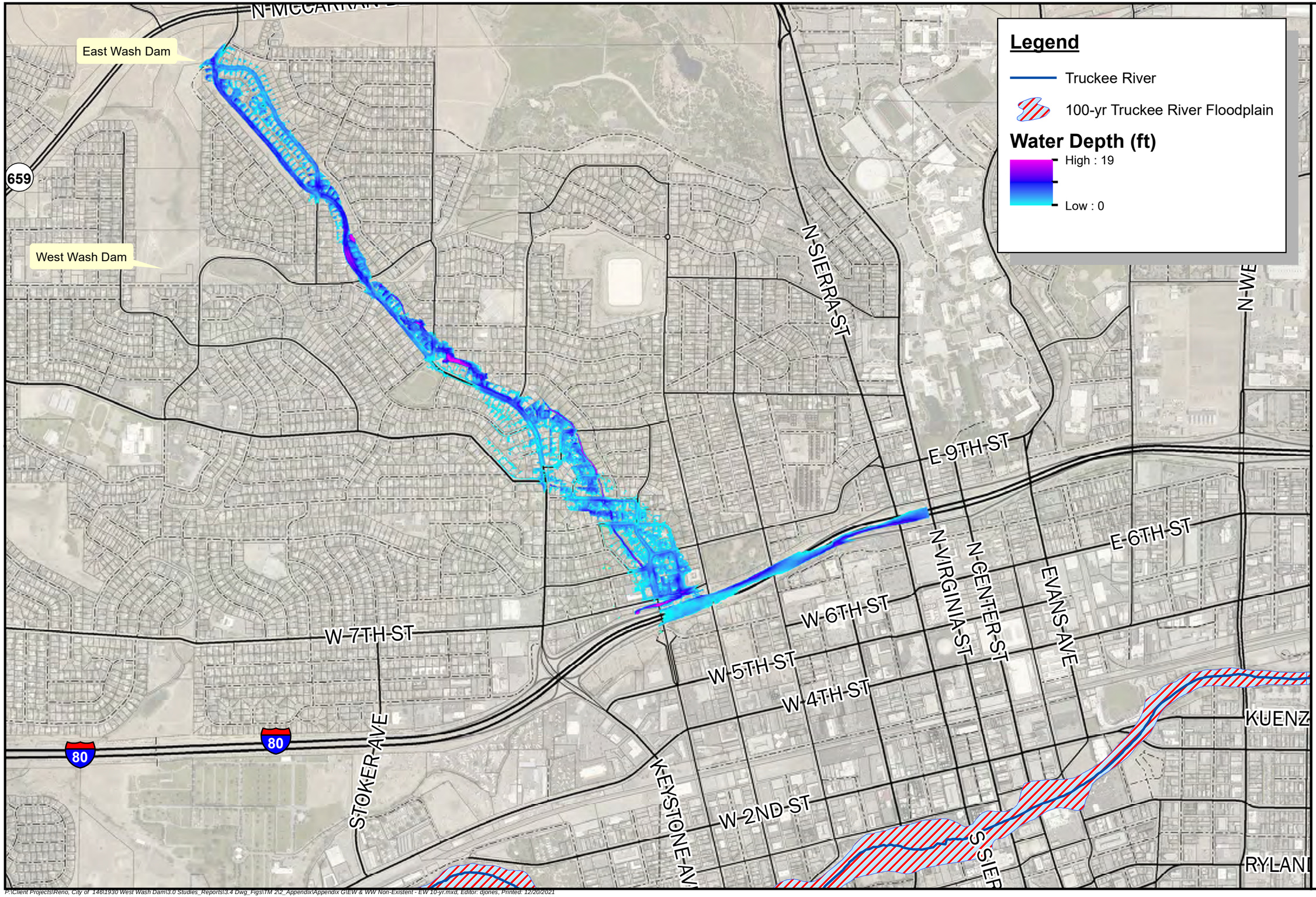

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West Wash & East Wash Dams Non-Existent - East Wash 10-Year Storm Inundation

N

1 " = 1,000 '

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East Wash Dam

West Wash Dam

659

N-MCCARRAN-BL

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-6TH-ST

W-7TH-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

W-2ND-ST

S-SIERRA-ST

KUENZ

RYLAN

80

80

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 17

Low : 0

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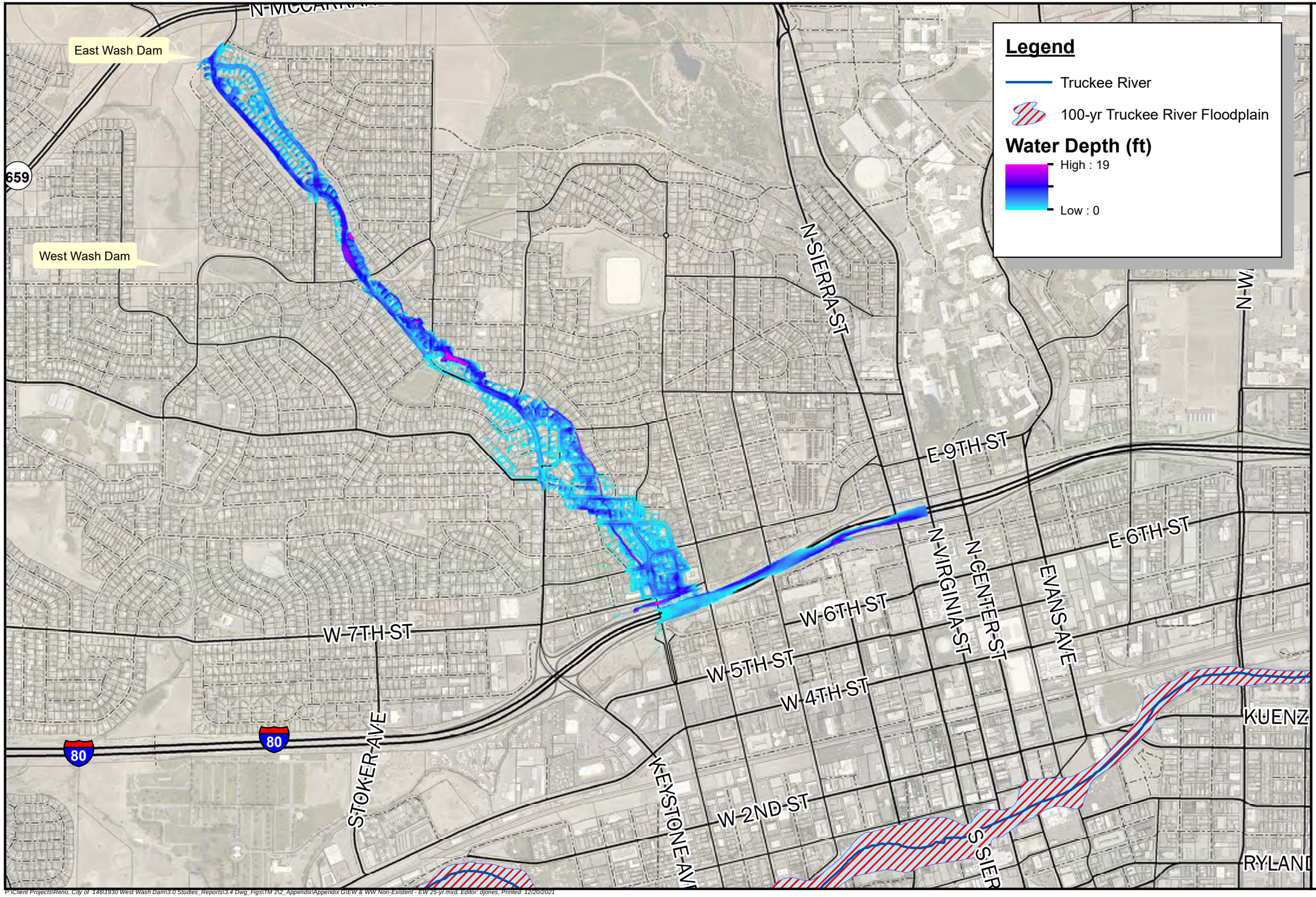
West Wash & East Wash Dams Non-Existent - West Wash 10-Year Storm Inundation

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



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(775) 851-4788
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West Wash & East Wash Dams Non-Existent - East Wash 25-Year Storm Inundation

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

East Wash Dam

West Wash Dam

N-MCCARRAN-BL

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-6TH-ST

W-7TH-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

W-2ND-ST

S-SIER

KUENZ

RYLAN

659

80

80

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 18

Low : 0

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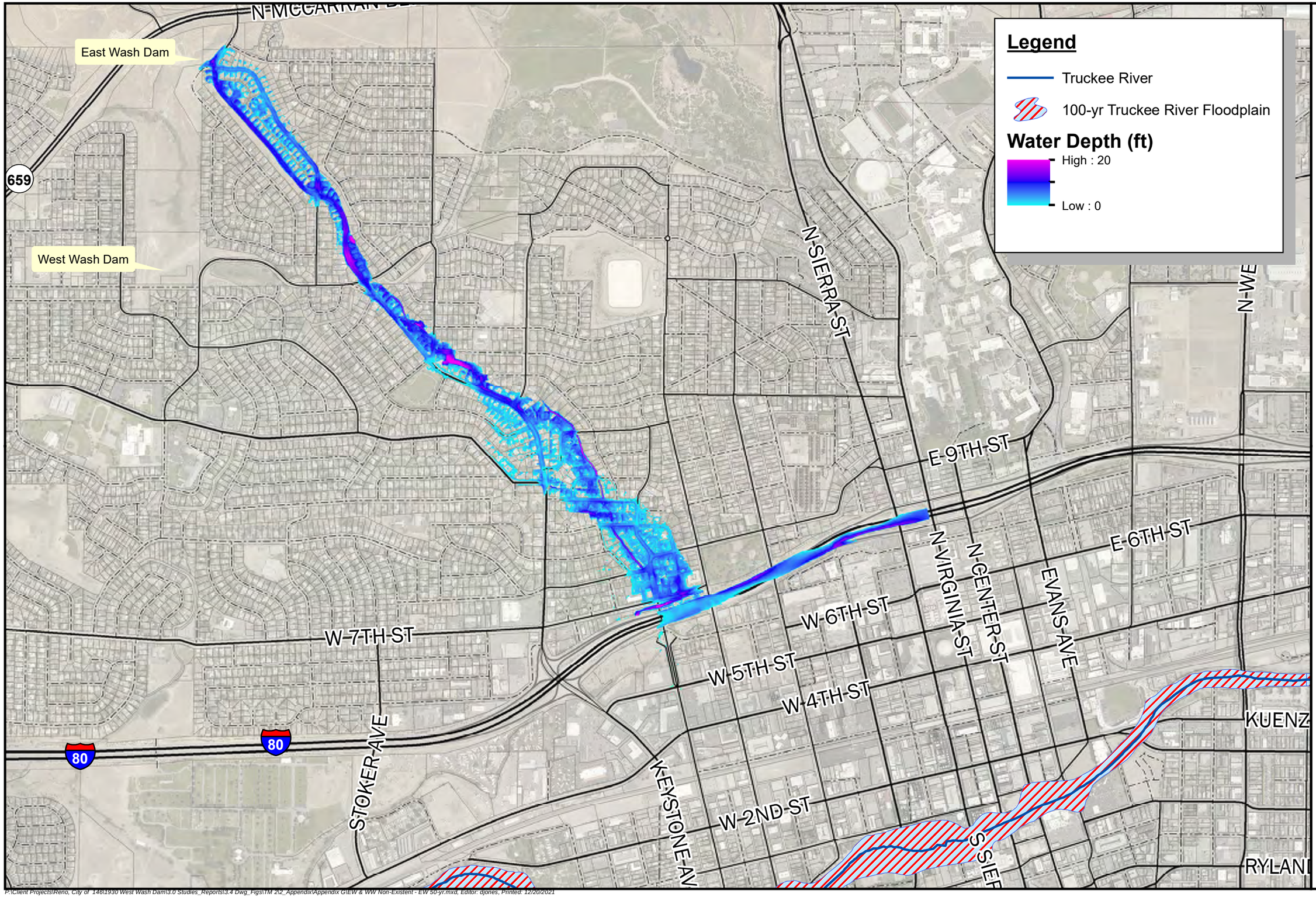
West Wash & East Wash Dams Non-Existent - West Wash 25-Year Storm Inundation

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.



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West Wash & East Wash Dams Non-Existent - East Wash 50-Year Storm Inundation

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

East Wash Dam

West Wash Dam

659

80

80

N-MCCARRAN

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-6TH-ST

W-7TH-ST

W-2ND-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AVE

S-SIER

KUENZ

RYLAN

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 18

Low : 0

20 Years! FARR WEST ENGINEERING

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www.farwestengineering.com

West Wash & East Wash Dams Non-Existent - West Wash 50-Year Storm Inundation

N

1 " = 1,000 '

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East Wash Dam

West Wash Dam

659

80

80

N-SIERRA-ST

E-9TH-ST

E-6TH-ST

W-7TH-ST

W-6TH-ST

W-5TH-ST

W-4TH-ST

W-2ND-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

KUENZ

RYLAN

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 20

Low : 0

20 Years!
FARR WEST ENGINEERING
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West Wash & East Wash Dams Non-Existent - East Wash 100-Year Storm Inundation

N

1 " = 1,000 '

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East Wash Dam

West Wash Dam

N-MCCARRAN-B

659

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-6TH-ST

W-7TH-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

W-2ND-ST

S-SIER

KUENZ

RYLAN

80

80

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 18

Low : 0

20 Years! FARR WEST ENGINEERING

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West Wash & East Wash Dams Non-Existent - West Wash 100-Year Storm Inundation

N

1 " = 1,000 '

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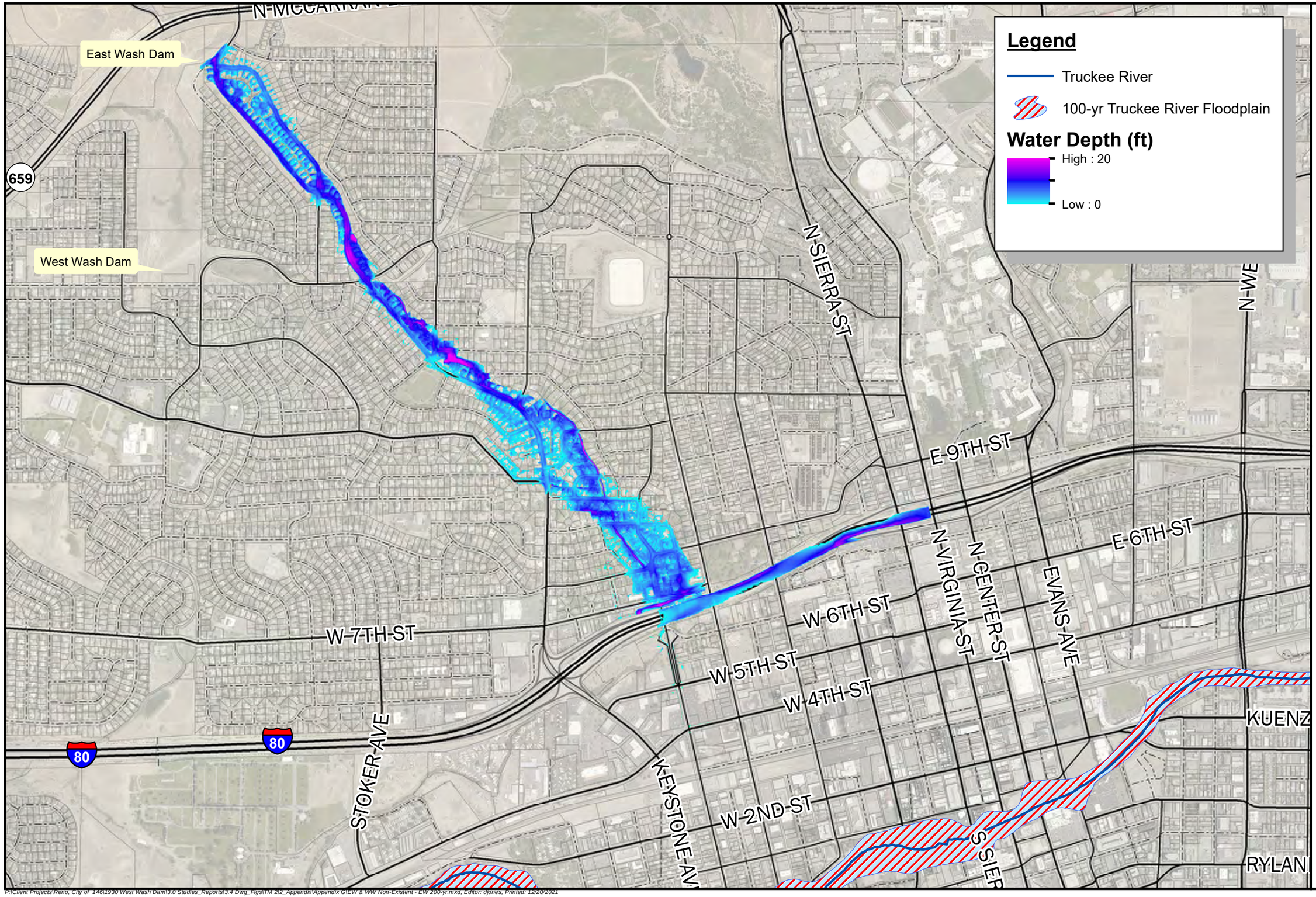

20 Years! FARR WEST ENGINEERING

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West Wash & East Wash Dams Non-Existent - East Wash 200-Year Storm Inundation

N

1 " = 1,000 '

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East Wash Dam

West Wash Dam

659

N-MCCARRAN-B

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-6TH-ST

W-7TH-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

W-2ND-ST

S-SIER

KUENZ

RYLAN

80

80

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 19

Low : 0

20 Years!
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West Wash & East Wash Dams Non-Existent - West Wash 200-Year Storm Inundation

N

1 " = 1,000 '

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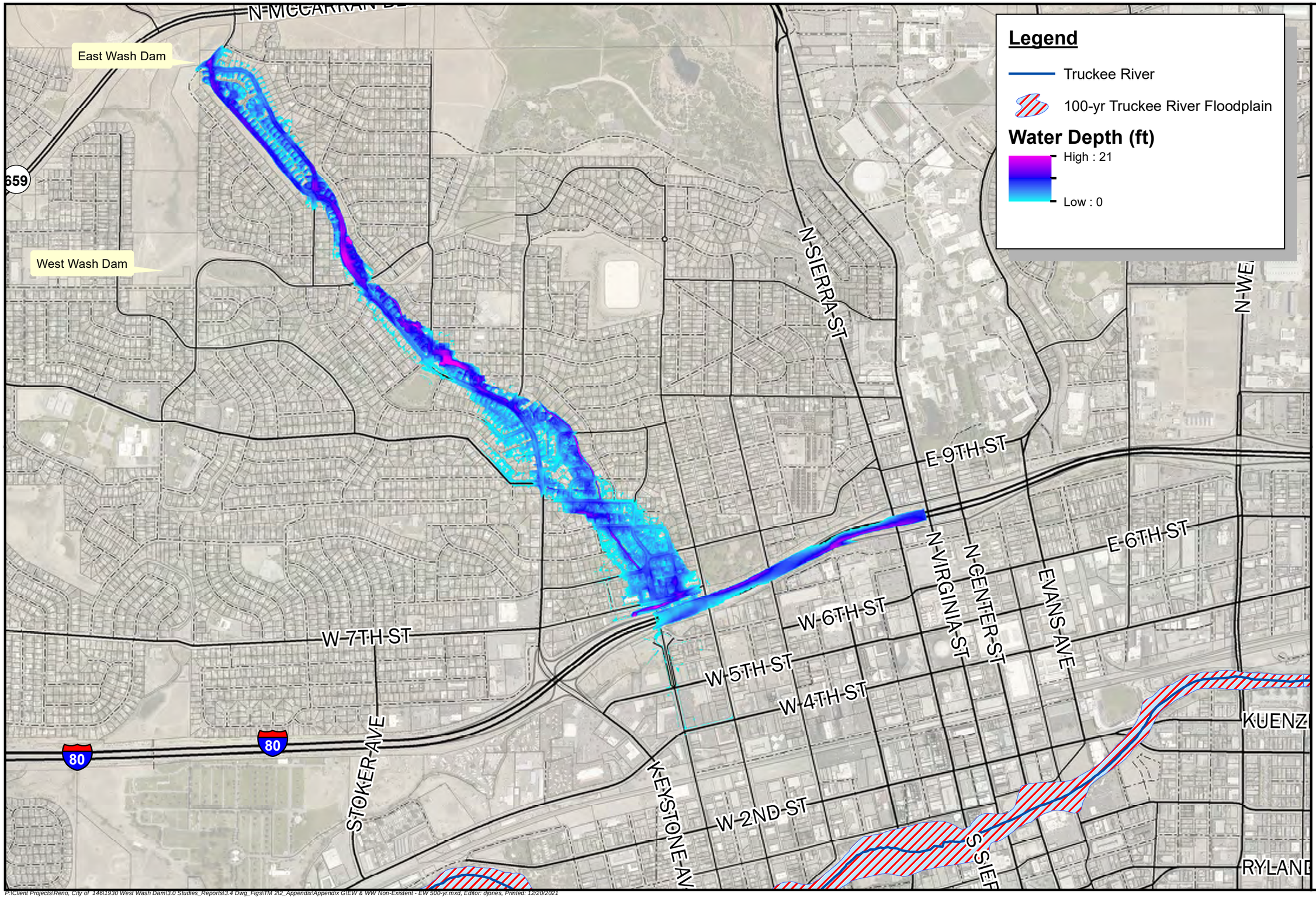

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West Wash & East Wash Dams Non-Existent - East Wash 500-Year Storm Inundation

N

1 " = 1,000 '

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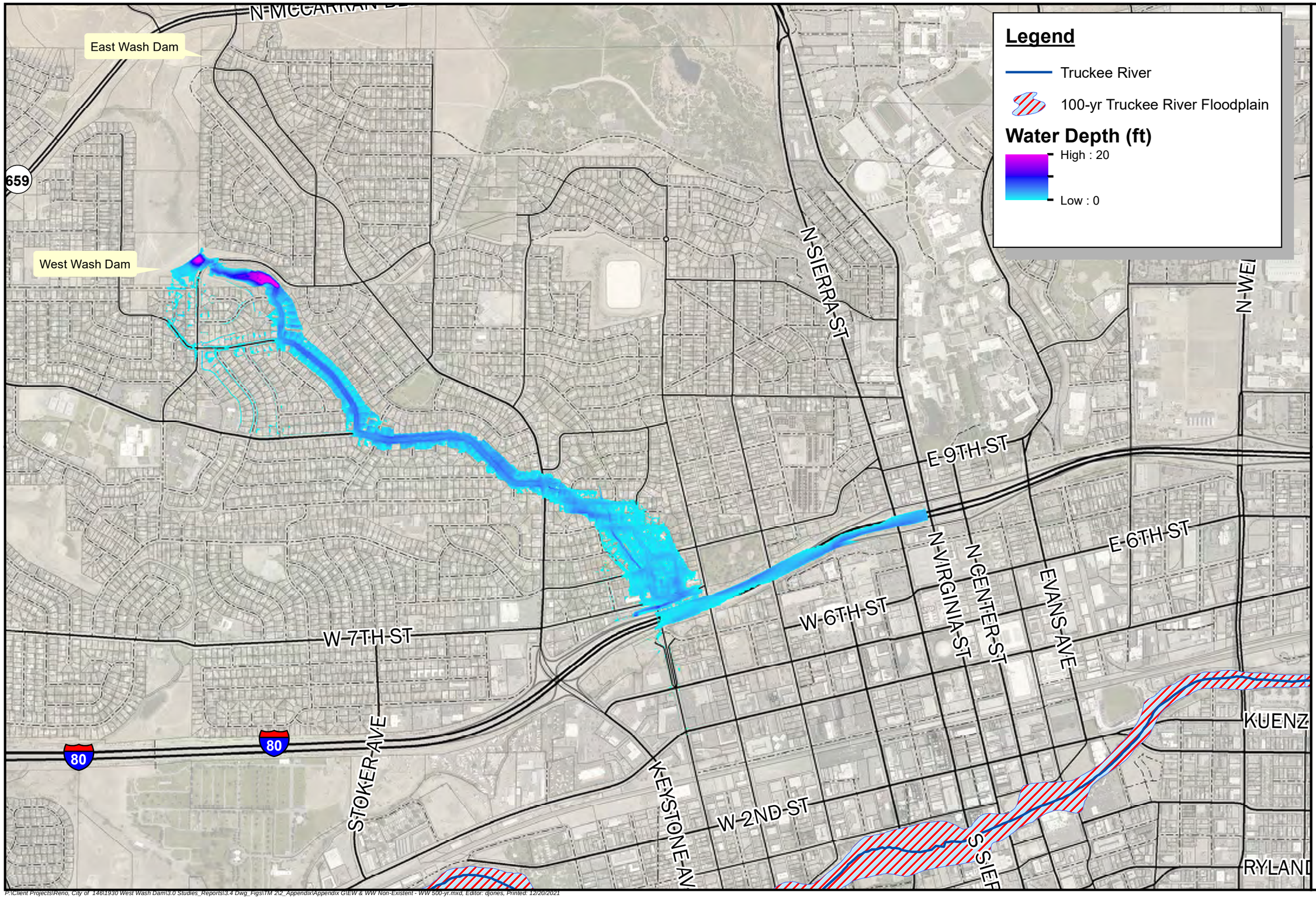

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West Wash & East Wash Dams Non-Existent - West Wash 500-Year Storm Inundation

N

1 " = 1,000 '

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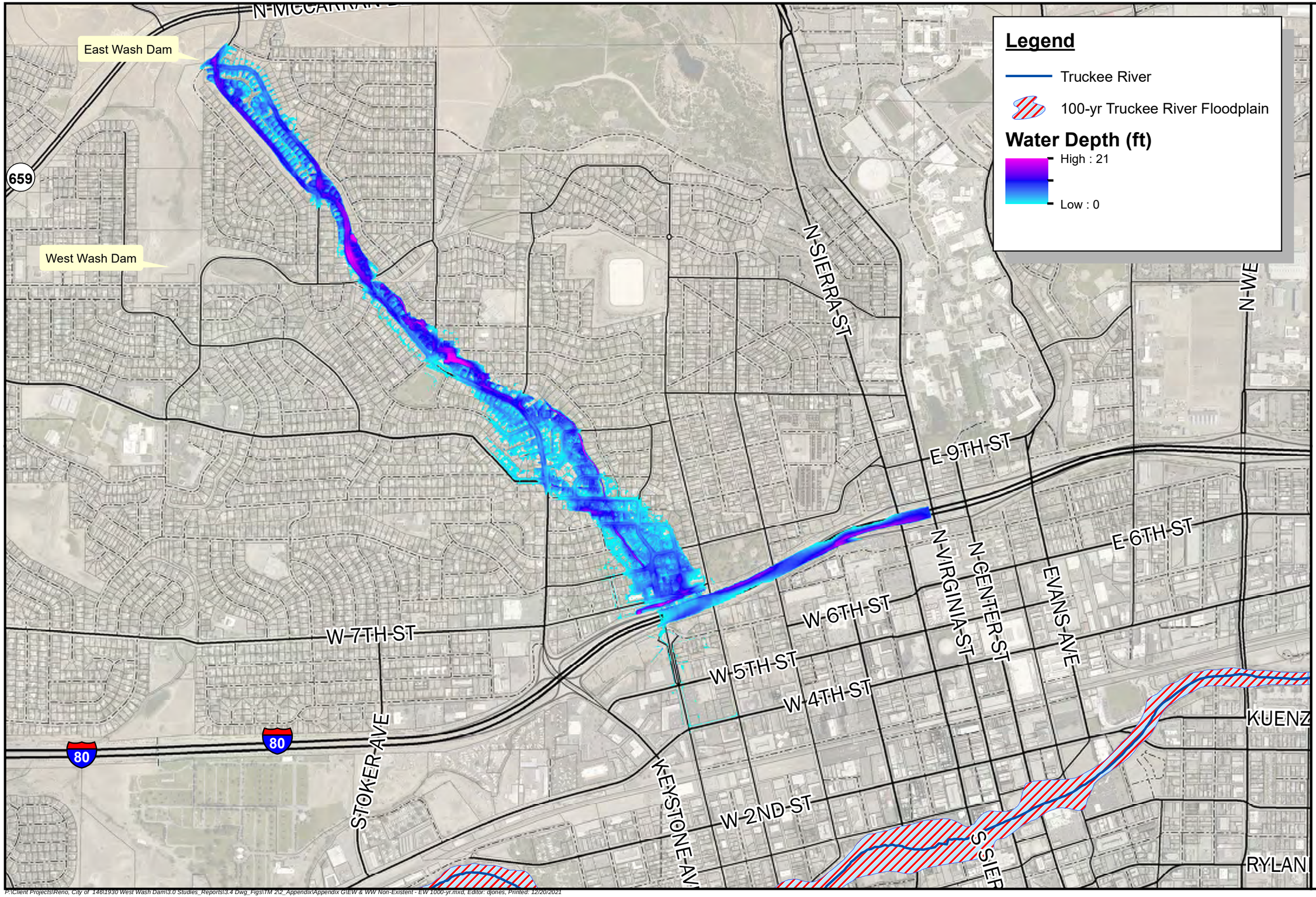

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West Wash & East Wash Dams Non-Existent - East Wash 1000-Year Storm Inundation

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

East Wash Dam

West Wash Dam

659

N-MCCARRAN-BL

N-SIERRA-ST

N-WEI

E-9TH-ST

E-6TH-ST

W-6TH-ST

W-7TH-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

W-2ND-ST

S-SIER

KUENZ

RYLAN

80

80

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 20

Low : 0

20 Years! FARR WEST ENGINEERING

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www.farrwestengineering.com

West Wash & East Wash Dams Non-Existent - West Wash 1000-Year Storm Inundation

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

West Wash & East Wash Dams Non-Existent - East Wash 1/2 of General PMP Inundation

East Wash Dam

West Wash Dam

N-MCCARRAN-BL

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-7TH-ST

W-6TH-ST

W-5TH-ST

W-4TH-ST

W-2ND-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

S-SIER

KUENZ

RYLAND

659

80

80

Legend

- Truckee River
- 100-yr Truckee River Floodplain

Water Depth (ft)

High : 20

Low : 0

N

1 " = 1,000 '

20 Years!
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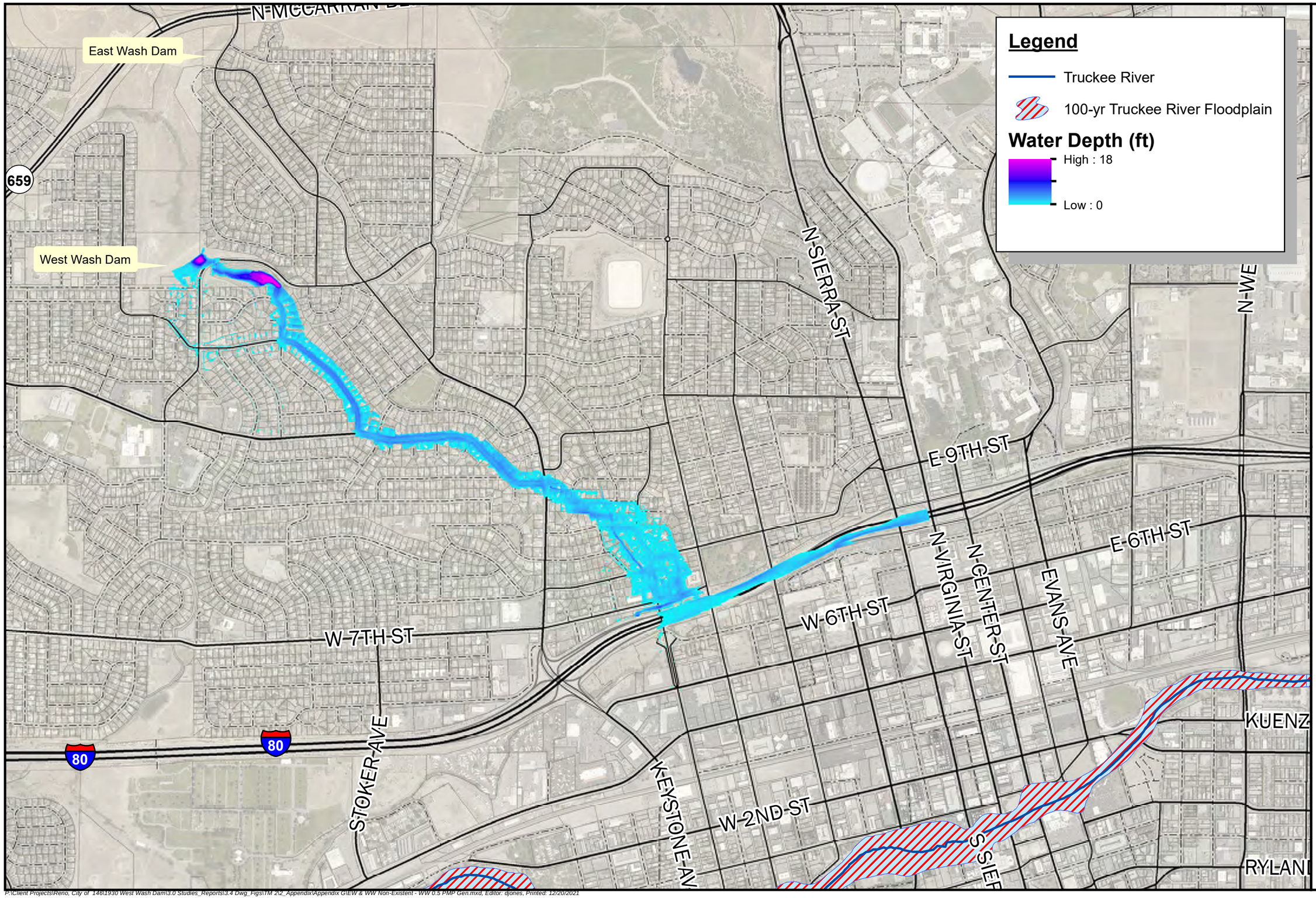

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West Wash & East Wash Dams Non-Existent - West Wash 1/2 of General PMP Inundation

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

East Wash Dam

West Wash Dam

659

80

80

N-MCCARRAN

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-6TH-ST

W-7TH-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

S-TOKER-AVE

K-EYSTONE-AV

W-2ND-ST

S-SIER

KUENZ

RYLAN

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 22

Low : 0

20 Years! FARR WEST ENGINEERING

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West Wash & East Wash Dams Non-Existent - East Wash 1/2 of Local PMP Inundation

N

1 " = 1,000 '

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East Wash Dam

West Wash Dam

659

80

80

N-MCCARRAN-B

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-6TH-ST

W-7TH-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

N-KEYSTONE-AV

W-2ND-ST

S-SIER

KUENZ

RYLAN

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 20

Low : 0

20 Years! FARR WEST ENGINEERING

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West Wash & East Wash Dams Non-Existent - West Wash 1/2 of Local PMP Inundation

N

1 " = 1,000 '

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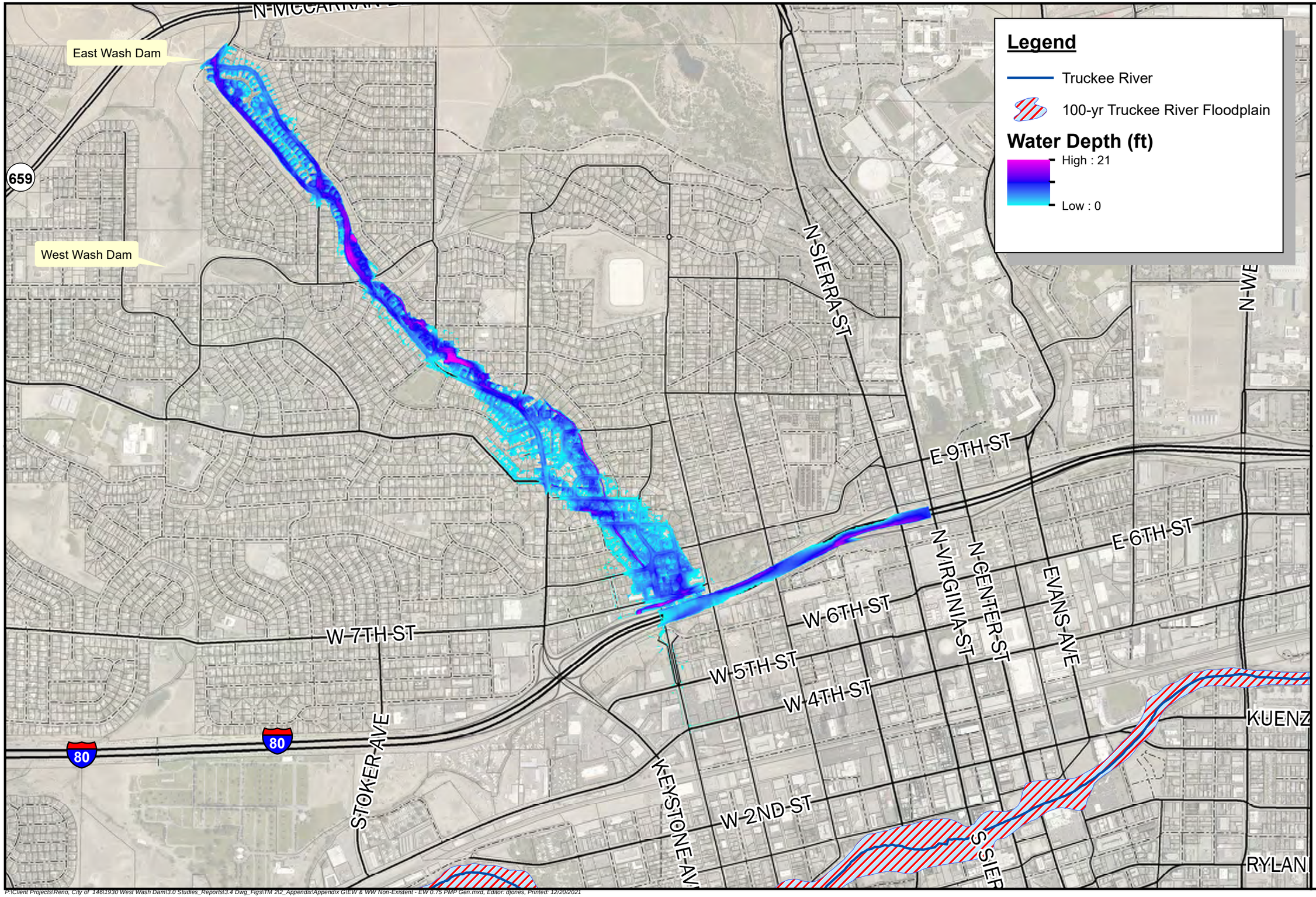

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West Wash & East Wash Dams Non-Existent - East Wash 3/4 of General PMP Inundation

N

1 " = 1,000 '

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East Wash Dam

West Wash Dam

659

80

80

N-MCCARRAN

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-6TH-ST

W-7TH-ST

W-2ND-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

S-SIER

KUENZ

RYLAN

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 19

Low : 0

20 Years!
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West Wash & East Wash Dams Non-Existent - West Wash 3/4 of General PMP Inundation

N

1 " = 1,000 '

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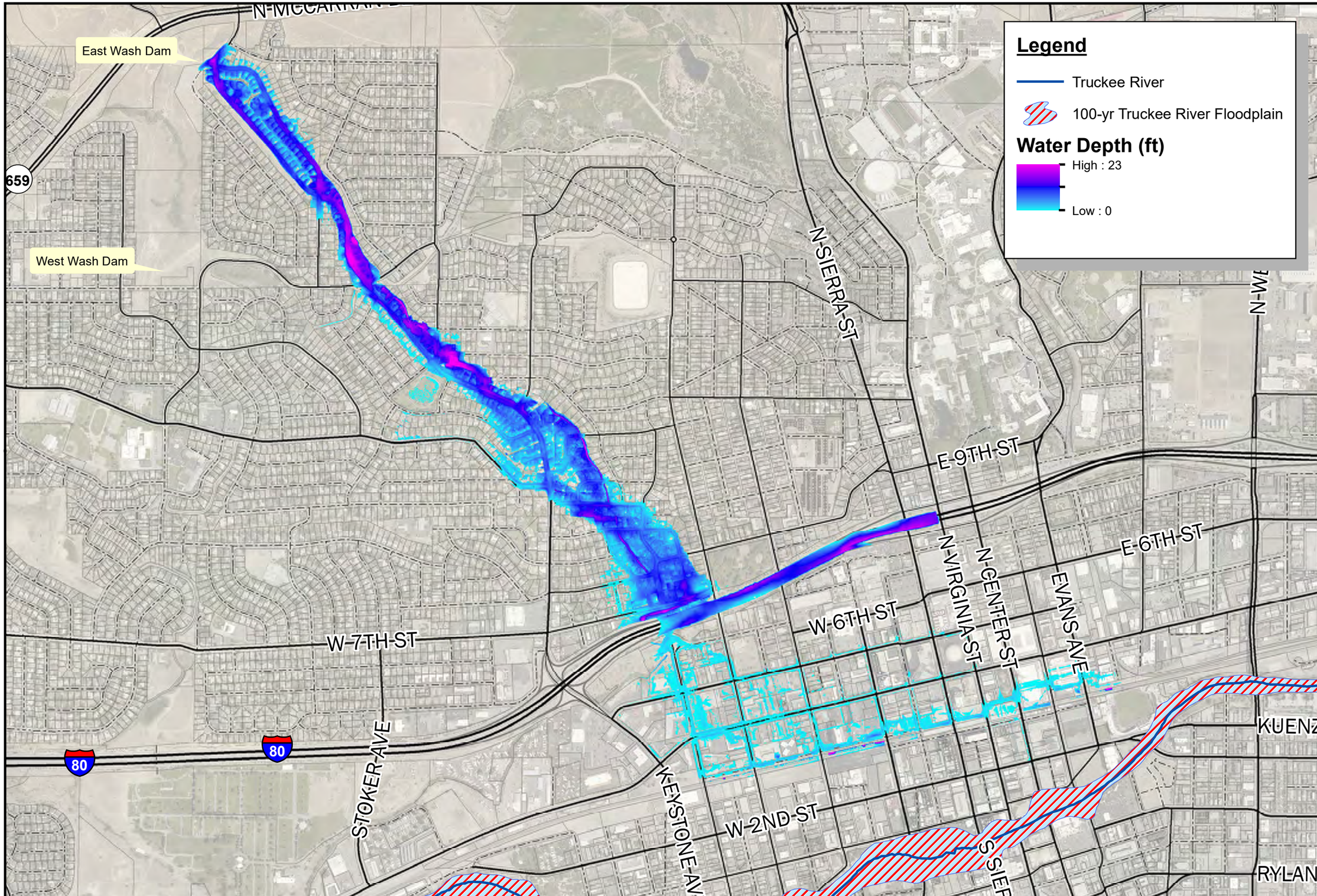

20 Years!
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www.farrwestengineering.com

West Wash & East Wash Dams Non-Existent - East Wash 3/4 of Local PMP Inundation

N

1 " = 1,000 '

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East Wash Dam

West Wash Dam

N-MCCARRAN-BLVD

659

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-6TH-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

W-7TH-ST

80

80

STOKER-AVE

KEYSTONE-AV

W-2ND-ST

S-SIER

KUENZ

RYLAN

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 21

Low : 0

20 Years! FARR WEST ENGINEERING

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West Wash & East Wash Dams Non-Existent - West Wash 3/4 of Local PMP Inundation

N

1 " = 1,000 '

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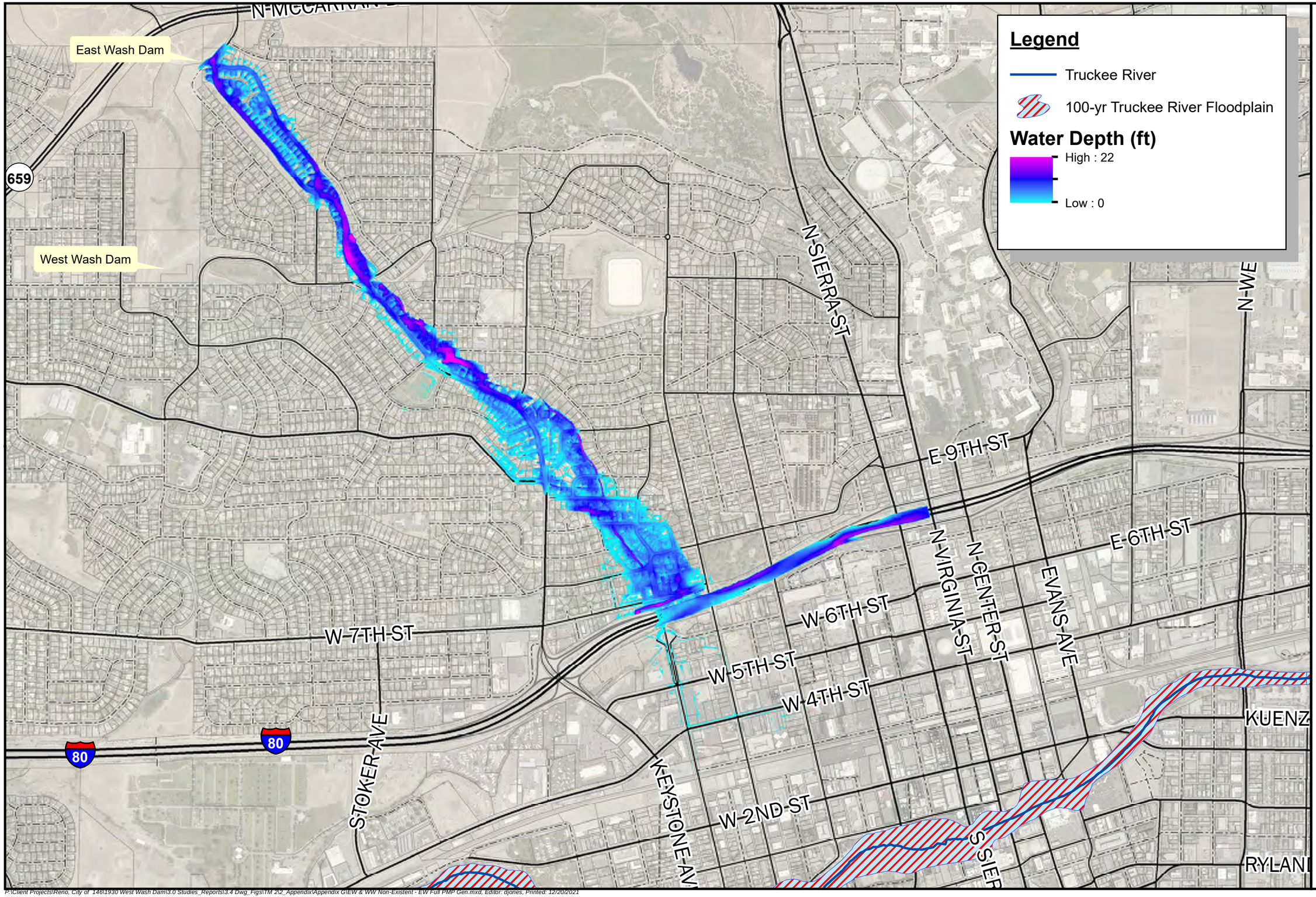

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West Wash & East Wash Dams Non-Existent - East Wash General PMP Inundation

N

1 " = 1,000 '

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East Wash Dam

West Wash Dam

659

N-MCCARRAN-BL

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-6TH-ST

W-7TH-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

W-2ND-ST

S-SIER

KUENZ

RYLAN

80

80

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 20

Low : 0

20 Years!
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West Wash & East Wash Dams Non-Existent - West Wash General PMP Inundation

N

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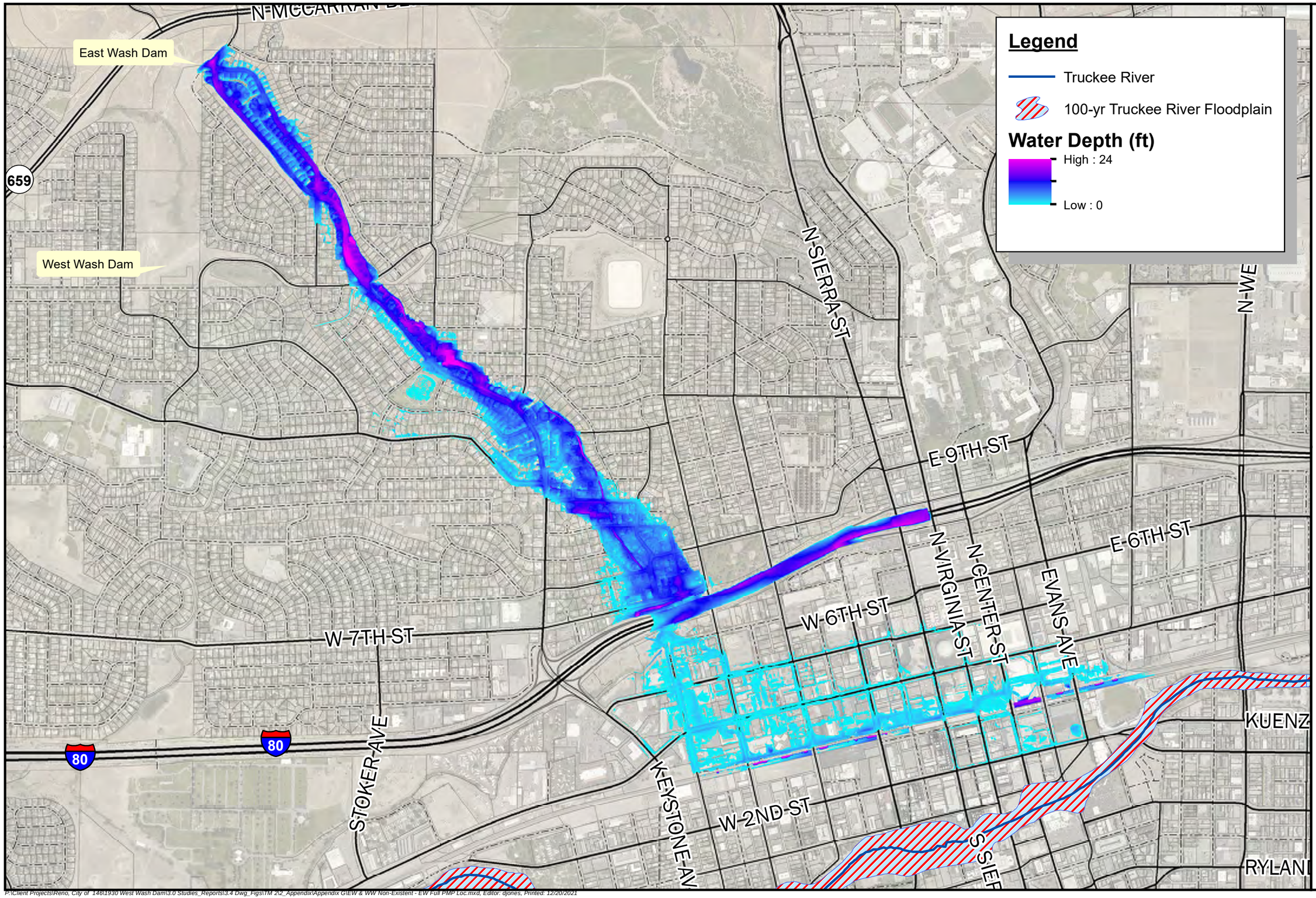

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West Wash & East Wash Dams Non-Existent - East Wash Local PMP Inundation

N

1 " = 1,000 '

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East Wash Dam

West Wash Dam

659

N-MCCARRAN-BL

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-6TH-ST

W-7TH-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

W-2ND-ST

S-SIER

KUENZ

RYLAN

80

80

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 23

Low : 0

20 Years!
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West Wash & East Wash Dams Non-Existent - West Wash Local PMP Inundation

N

1 " = 1,000 '

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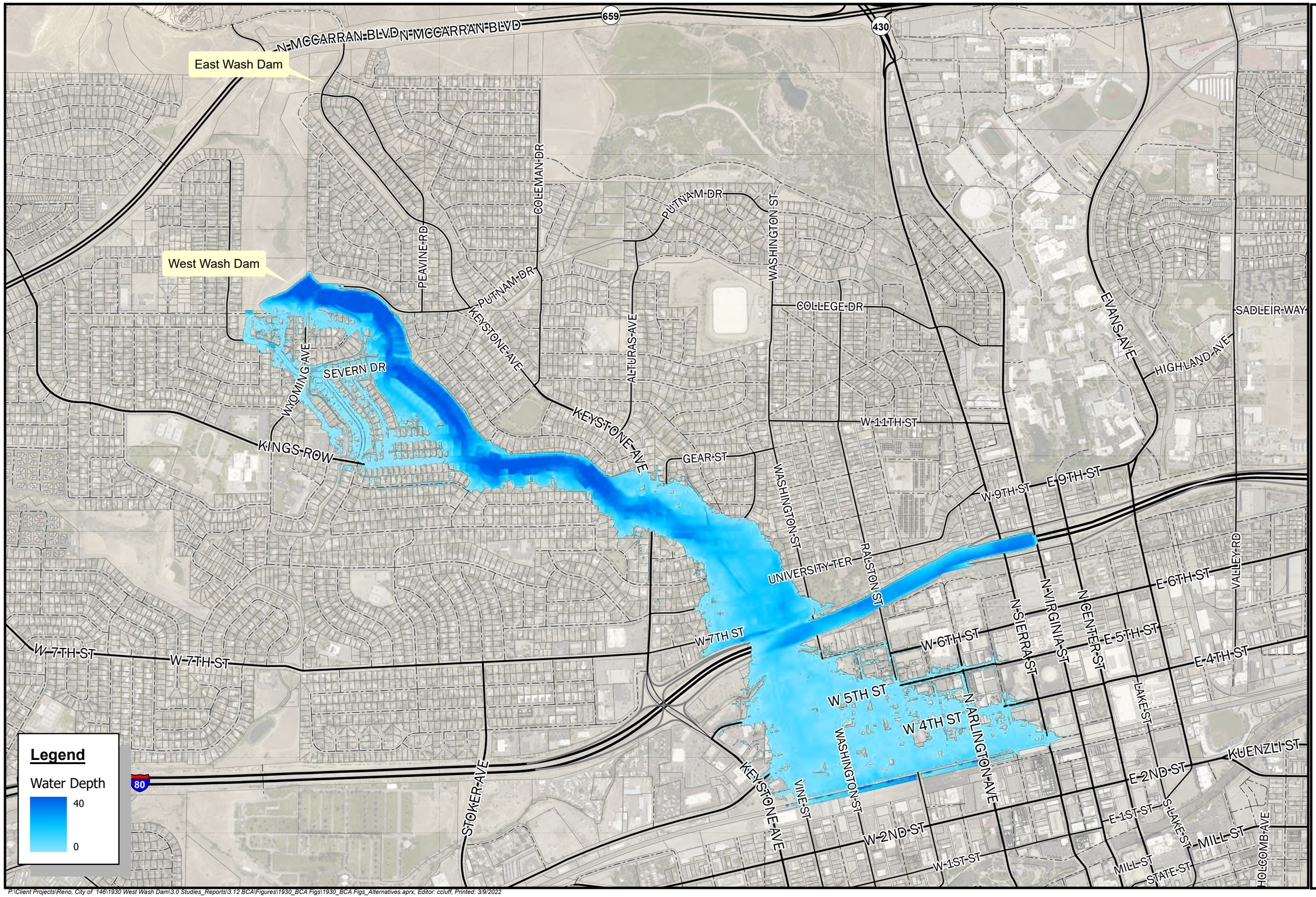

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Alternatives 1 and 2
West Wash (w/AS) Local PMP Breach (Worst Case Scenario)

N

1:12,000

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Alternative 3
500-Year AS Activation Inundation Area

East Wash Dam

West Wash Dam

N-MCCARRAN-BLVD

659

430

COLEMAN-DR

PEAVINE-RD

PUTNAM-DR

KEYSTONE-AVE

WYOMING-AVE

SEVERN-DR

KINGS-ROW

ALTURAS-AVE

WASHINGTON-ST

COLLEGE-DR

EVANS-AVE

SADLEIR-WAY

HIGHLAND-AVE

W-11TH-ST

GEAR-ST

W-9TH-ST

E-9TH-ST

UNIVERSITY-TER

RALSTON-ST

VALLEY-RD

E-6TH-ST

W-7TH-ST

N-SIERRA-ST

N-VIRGINIA-ST

N-CENTER-ST

E-5TH-ST

W-6TH-ST

E-4TH-ST

W-5TH-ST

W-4TH-ST

LAKE-ST

N-ARLINGTON-AVE

KUENZLI-ST

E-2ND-ST

E-1ST-ST

S-LAKE-ST

MILL-ST

W-2ND-ST

W-1ST-ST

VINE-ST

STOKER-AVE

80

Legend

Water Depth

7

0

N

1:12,000

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Alternative 3
Local PMP AS Activation (Worst Case Scenario)

East Wash Dam

West Wash Dam

N-MCCARRAN-BLVD

659

430

COLEMAN-DR

PEAVINE-RD

PUTNAM-DR

WASHINGTON-ST

KEYSTONE-AVE

ALTURAS-AVE

COLLEGE-DR

EVANS-AVE

SADLEIR-WAY

HIGHLAND-AVE

WYOMING-AVE

SEVERN-DR

KINGS-ROW

GEAR-ST

W-11TH-ST

W-9TH-ST

E-9TH-ST

UNIVERSITY-TER

RALSTON-ST

VALLEY-RD

E-6TH-ST

N-SIERRA-ST

N-VIRGINIA-ST

N-CENTER-ST

E-5TH-ST

W-6TH-ST

W-7TH-ST

E-4TH-ST

W 5TH ST

W 4TH ST

N-ARLINGTON-AVE

LAKE-ST

KUENZLI-ST

E-2ND-ST

W-2ND-ST

E-1ST-ST

S-LAKE-ST

MILL-ST

W-1ST-ST

STOKER-AVE

80

Legend

Water Depth

25

0

N

1:12,000

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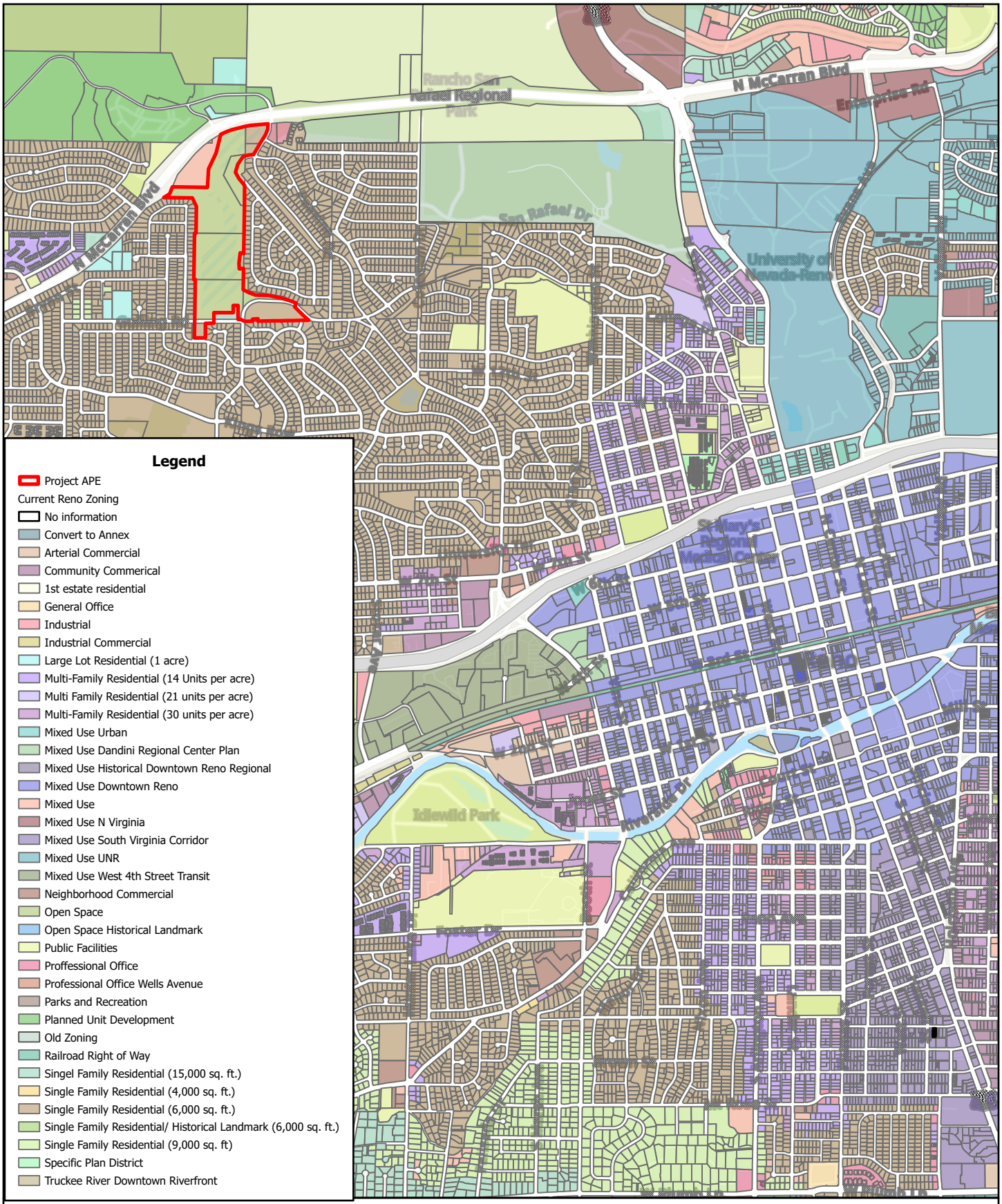

Legend

- Project APE

Current Reno Zoning

- No information
- Convert to Annex
- Arterial Commercial
- Community Commerical
- 1st estate residential
- General Office
- Industrial
- Industrial Commercial
- Large Lot Residential (1 acre)
- Multi-Family Residential (14 Units per acre)
- Multi Family Residential (21 units per acre)
- Multi-Family Residential (30 units per acre)
- Mixed Use Urban
- Mixed Use Dandini Regional Center Plan
- Mixed Use Historical Downtown Reno Regional
- Mixed Use Downtown Reno
- Mixed Use
- Mixed Use N Virginia
- Mixed Use South Virginia Corridor
- Mixed Use UNR
- Mixed Use West 4th Street Transit
- Neighborhood Commercial
- Open Space
- Open Space Historical Landmark
- Public Facilities
- Proffessional Office
- Professional Office Wells Avenue
- Parks and Recreation
- Planned Unit Development
- Old Zoning
- Railroad Right of Way
- Singel Family Residential (15,000 sq. ft.)
- Single Family Residential (4,000 sq. ft.)
- Single Family Residential (6,000 sq. ft.)
- Single Family Residential/ Historical Landmark (6,000 sq. ft.)
- Single Family Residential (9,000 sq. ft)
- Specific Plan District
- Truckee River Downtown Riverfront

FARR WEST ENGINEERING

5510 Longley Lane
Reno, NV 89511
(775) 851-4788
www.farrwestengineering.com

N

1" = 2,000'

City of Reno Zoning Surrounding The West Wash Project Area

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

P:\Client Projects\Reno, City of 146\1930 West Wash Dam\5.0 Drawings\New Folder\Zoning_WW\Zoning_WW.aprx, Layout: 8.5x11 Portrait. Editor: EParis. Printed: 10/25/2022

CALIFORNIA
NEVADA
ARIZONA
Santa Margarita Aquifer, Scott's Valley
Fresno County Aquifer
Upper Santa Cruz & Avra Basin Aquifer
Campo/Cottonwood Creek Aquifer
Ocotillo-Coyote Wells Aquifer
Bisbee-Naco Aquifer

City of Reno

Investigations & Analysis Report

Watershed Plan-ED
Peavine Mountain Watershed
West Wash Dam Rehabilitation

March 2021
Revised by DOWL May 2026

OWNER:
City of Reno
1 East First Street
Reno, NV 89501

LEAD FEDERAL AGENCY:
USDA-NRCS
1365 Corporate Blvd
Reno, NV 89502

ENGINEER:

Farr West Engineering
5510 Longley Lane
Reno, NV 89511
(775) 851-4788
(775) 851-0766 Fax

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APPENDICES

Appendix A – References

Appendix B – Preliminary Environmental Data

1.0 BACKGROUND

West Wash Dam, in the Peavine Mountain Watershed of Washoe County, Nevada, is included in a United States Department of Agriculture-Natural Resources Conservation Service (USDA-NRCS) funded rehabilitation partnership project. The dam provides protection against flooding to about 30,000 Nevadans who live and work downstream. Additionally, the dam protects downstream city roads, one state highway, and an interstate highway. Among other critical infrastructure, the dam also protects power lines and railroad tracks.

West Wash Dam was constructed in 1961 under the direction and authority of Watershed Protection and Flood Prevention Act (Public Law 83-566). East Wash diversion Dam, constructed in 1960 under the same program, contributes storm water flow from Peavine Mountain Watershed into West Wash Dam, thereby creating a linked storm water control system. The original watershed plans for these dams used an evaluated life of 50 years. Having reached over 50 years in age, the dams are eligible for rehabilitation through the Natural Resources Conservation Service's Watershed and Flood Prevention Operations Program. The goals of the program include prevention of erosion and floodwater and sediment damage; to further the conservation, use and disposal of water; and to further the conservation and proper use of land in authorized watersheds (United States Department of Agriculture Natural Resources Conservation Service, n.d.)

Both the West Wash and East Wash dams are currently classified as High Hazard Dams by the Nevada Division of Water Resources (NDWR) and do not meet the requirements for dam safety by the State of Nevada, NRCS (for reference, see rows 28-46 of Table 1). Previous studies indicate that hydrologic/hydraulic inadequacies have been identified primarily with the West Wash Dam (MACTEC Engineering and Consulting, Inc., 2006). The East Wash Dam will not pass the Probable Maximum Flood (PMF) without excessive damage to the spillway and the West Wash Dam will not pass the PMF without overtopping. See Section 4.0 for a more in-depth discussion about the hydraulics/hydrology associated with the East and West Wash Dams.

The East Wash Diversion Dam is located at the intersection of Keystone Avenue and North McCarran Boulevard at the intersection of Township 20 North, Range 19 East, Sections 33 and 34 with Township 19 North, Range 19 East, Sections 3 and 4. Inflow to the East Wash Dam comes from 2.09 square miles of watershed on the southeast flank of Peavine Mountain. West Wash Detention Dam is located at the intersection of Wyoming and Gulling Streets at the intersection of Township 19 North, Range 19 East, Sections 3 and 4. Inflow to the West Wash Dam comes from approximately 3.34 square miles of watershed, which includes roughly 2.09 square miles of East Wash Dam's watershed (City of Reno, 2006).

The City of Reno entered into an agreement with the USDA – NRCS to rehabilitate the West Wash Dam, and by extension East Wash Dam, to meet current NRCS, City of Reno and State of Nevada Division of Water Resources (DWR) dam safety criteria and performance standards. Farr West Engineering (FWE) will assist the City of Reno (The City or COR) to meet the requirements of the NRCS Watershed Program including the development of a physically, environmentally, socially, and economically sound improvement plan known as the Supplemental Watershed Plan and Environmental Document (Plan/ED).

Farr West will prepare a Supplemental Plan/ED document for the West Wash Dam Rehabilitation Project in accordance with the NWPM Part 501 Subpart D and NWPH Part 601 Subpart D. The format of the plan will follow the plan outline format as shown in NWPM 501.31. The Supplemental Plan/ED will be prepared in accordance with the Watershed Protection and Flood Protection Act (Public Law 83-566), the National Environmental Policy Act (NEPA), the Principles and Requirements for Federal Investments in Water Resources (PR&G), the NRCS National Watershed Program Manual (NWPM) and National Watershed Program Handbook (NWPH), and all other applicable laws, regulations, and policies.

This Data Collection & Analysis Report lists and summarizes existing data and information provided by The City and NRCS and collected by Farr West Engineering staff during initial project development and review. Data gaps are identified, and recommendations are made for further studies. A project location map

and a draft Purpose and Need Statement are included for review and further development. An overview of the hydrology, hydraulics, and sediment (HH&S) analysis is also included in this report.

1.1 INITIAL DOCUMENT REQUEST AND PROVIDED DOCUMENTS

During the scoping phase, initial data and reports were provided to Farr West staff to allow for project background understanding and proper definition of the project. Initial data and reports provided to Farr West and obtained in preliminary research include:

1. Drainage Report City of Reno (Mactec, 2006)
2. EAP Draft Report (Manhard, 2019)
3. Watershed Program Manual (NRCS, 2009)
4. Hydro-meteorological Report No. 49 (NOAA, 1984)
5. National Watershed Program Handbook (2014)
6. Principals and Requirements for Federal Investments in Water Resources (2013)
7. Interagency Guidelines Principals and Requirements for Federal Investments in Water resources (2014)
8. Peavine Mountain Watershed Report (1958)
9. West Wash Dam Rehabilitation Project Draft Scoping Report (DSE and Amec Foster Wheeler, 2015)

A follow up data request was sent to the City of Reno (COR) and NRCS as part of the project kick-off meeting and included the following:

a. EAP Phase II Drainage Report (City of Reno, February 2006)
b. Rehab Assessment Report, West Wash Dam (NRCS, May 2011)
c. Rehab Assessment Report, East Wash Dam (NRCS, May 2011)
d. Peavine Mountain Watershed Project Description (NRCS, August 2001)
e. Peavine Mountain Watershed Project Information (NRCS, January 1985)
f. All documentations produced by Dougherty Sprague Environmental, Inc. (dse)
g. Peavine Watershed Project, Project Reevaluation (NRCS, 1976) k. Past sediment removal, dates and quantities
h. Investigation of sediment accumulation in upper West Wash Dam impoundment in areas covered by vegetation
i. NDWR inspection reports to date
j. USACE Phase I and Phase II reports for dams
k. Status of APN 001-190-12, appetite for purchase all or portion, or generous easement
l. Past 404 permitting and correspondence, especially regarding sediment removal
m. Infrastructure, both above and below ground, at and near dam and in impoundment area
n. LIDAR data covering Peavine north of project site
o. Storm drain system GIS

Farr West Staff reviewed the documents and data provided by COR and NRCS for background information and existing West Wash and East Wash Dam data. Reports that were received were analyzed, and information that has not been yet received, includes the following:

a. Peavine Mountain Watershed Project Information (NRCS, January 1985)
b. USACE Phase II reports for dams
c. Past 404 permitting and correspondence, especially regarding sediment removal

Additional information and research needs were identified as summarized in the following sections.

2.0 DATA COLLECTION AND ANALYSIS

The original Peavine Mountain Watershed Work Plan, completed in 1958 by the City of Reno, in coordination with the USDA's Soil Conservation Service, provided the baseline information on structure, hydrology, and biological and hydrological resources in the area of the East and West Wash Dams (City of Reno, 1958). The original report was completed two decades before the federal NEPA requirements were developed, and prior to the boom of development in Reno, particularly the residential areas which now surround the dam area. Since the original plan, changes have occurred in the biological and cultural resources and the social and demographic parameters of the project area and the City of Reno.

The purpose of the original watershed plan was to reduce floodwater and sediment damages in the City of Reno including upstream land treatment measures and floodwater structures, and to eliminate floodwater and sediment damage deposition for up to "100-year" flood levels (City of Reno, 1958).

A comprehensive list of all references pertaining to the East and West Wash dams can be found in Table 1. The table lists the title of each reference, how the reference is called out in the references list in Appendix A, and a brief summary of the document. For documents that have been discussed within this report, "Incorporated herein" is noted in the summary column. Table 1 includes both previous reports on the East and West Wash Dams as well as any regulatory guidance that is anticipated to be used throughout the project.

Table 1: List and Summary of References

#	Title	Reference	Brief Summary
1	City of Reno - East Wash Flood Diversion Dam Permit Compliance Report	AMEC Environment and Infrastructure, Inc. (2012). City of Reno - East Wash Flood Diversion Dam Permit Compliance Report.	Study performed on the East Wash Dam that includes a hydrologic analysis, a reservoir storage analysis, a hydraulic analysis, geotechnical investigations and a geotechnical stability analysis. Incorporated herein.
2	Watershed Assessment for Tributaries to the Truckee River 2015 Final Report	CDM Smith. (2016). *Watershed Assessment for Tributaries to the Truckee River 2015 Final Report.*	Analyzes watersheds for all Truckee River tributaries, including Peavine Watersheds.
3	Crafting an Effective Plan for Public Participation	Center for Land Use Education. (2004). *Crafting an Effective Plan for Public Participation.*	Regulatory guidance for public participation.
4	Peavine Mountain Watershed: Watershed Work Plan	City of Reno. (1958). *Peavine Mountain Watershed: Watershed Work Plan.* US Department of Agriculture Soil Conservation Service.	The original work plan report with preliminary plans for the East Wash and West Wash dams. **Incorporated herein.**

#	Title	Reference	Brief Summary
5	Drainage Report, City of Reno Emergency Action Plans Phase II	City of Reno. (2006). *Drainage Report, City of Reno Emergency Action Plans Phase II.*	Drainage report for Dant Blvd Dam, Upper and Lower Peavine Dams, and East and West Wash Dams. Includes analyzing existing drainage system, volume analysis on dams, and emergency spillway analysis. **Incorporated herein.**
6	City of Reno Dams Sediment and Debris Removal and Flood Repairs	City of Reno. (2017). City of Reno Dams Sediment and Debris Removal and Flood Repairs.	As-built plan sheet of 1,152 cubic yards of sediment that was removed from the East wash basin.
7	City of Reno Master Plan	City of Reno. (2017). *City of Reno Master Plan*. Retrieved from Reimagine Reno Planning for the Future: https://www.reimaginereno.us/	Most recent master plan for the City of Reno.
8	Truckee Meadows Regional Drainage Manual	City of Reno; City of Sparks; Washoe County. (2009). *Truckee Meadows Regional Drainage Manual.*	Regulatory guidance for drainage design within the Truckee Meadows.
9	West Wash Dam - Application for Federal Assistance: Appendix "A" Assessment Report	City of Reno; HDR. (2011). *West Wash Dam - Application for Federal Assistance: Appendix "A" Assessment Report.*	Includes the application for Federal Assistance (Std. Form 424) as well as the narrative portion of the West Wash Dam assessment Report prepared for NRCS by HDR. **Incorporated herein.**
10	Principles, Requirements, and Guidelines (PR&G) for Federal Investments in Water Resources	Congressional Research Service. (2015). *Principles, Requirements, and Guidelines (PR&G) for Federal Investments in Water Resources.*	Regulatory guidance for federal investments in water resources.
11	Principles and Requirements for Federal Investments in Water Resources	Council on Environmental Quality. (2013). *Principles and Requirements for Federal Investments in Water Resources.*	Regulatory guidance for the principles and requirements for federal investments in water resources.
12	Chapter III - Interagency Guidelines	Council on Environmental Quality. (2014). *Chapter III - Interagency Guidelines.*	Regulatory guidance for interagency projects in water resources.

#	Title	Reference	Brief Summary
13	West Wash Dam Rehabilitation Project Final Scoping Report	Dougherty Sprague Enterprises, Inc; Amec Foster Wheeler Environment & Infrastructure, Inc. (2015). *West Wash Dam Rehabilitation Project Final Scoping Report.*	A final scoping report for the West Wash Dam rehabilitation that outlines the plan of work for the proposed project.
14	FIRM Panel 3036 of 3475	Federal Emergency Management Agency. (2009, March 16). Flood Insurance Rate Map Panel 3036 of 3475	A flood insurance rate map of the East and West Wash dams. All of project area is in Zone X (areas of 0.2% annual chance of flood). **Incorporated herein.**
15	West Wash Dam Assessment Report	HDR. (2011). *West Wash Dam Assessment Report.*	Assessment of the state of West Wash dam in 2011. Includes independent inspection, risk & economic analysis, and spillway modeling.
16	Emergency Action Plan East Wash Diversion Dam	MACTEC Engineering and Consulting, Inc. (2006). *Emergency Action Plan East Wash Diversion Dam.*	Recommends emergency actions that may become necessary at or downstream from the East Wash Dam. Includes evacuation plans and inundation maps. **Incorporated herein.**
17	Emergency Action Plan West Wash Detention Dam	MACTEC Engineering and Consulting, Inc. (2006). *Emergency Action Plan West Wash Detention Dam.*	Recommends emergency actions which may become necessary at or downstream from the West Wash Dam. Includes evacuation plans and inundation maps. **Incorporated herein.**
18	Drainage Report: City of Reno Emergency Action Plans Phase II	MACTEC Engineering and Consulting, Inc. (2006). *Drainage Report: City of Reno Emergency Action Plans Phase II.*	A drainage report to accompany EAP for East and West Wash Dams. Includes analysis of drainage systems, dam volume analysis, and auxiliary spillway analysis for East & West Wash dams. **Incorporated herein.**

#	Title	Reference	Brief Summary
19	Emergency Action Plan for City of Reno Dams	Manhard Consulting, LTD. (2019). *Emergency Action Plan for City of Reno Dams.*	An update to the EAP for all city of Reno dams, including: N Virginia, East & West Wash, Upper & Lower Peavine, West & East Logan Ridge Trail, Northgate Golf Course, Virginia Lake, and Dant Blvd dams. **Incorporated herein.**
20	National Environmental Policy Act 40 CFR Section 6.203.	National Environmental Policy Act. (1969). *42 U.S.C. §§ 4321-4370h*	Federal regulation
21	Hydrometeorological Report No. 49	NOAA, National Weather Service. (1984). *Hydrometeorological Report No. 49.* Washington, DC: U.S. Government Printing Office.	Regulatory guidance for Probable Maximum Precipitation estimates for the Great Basin drainages.
22	Preliminary revised geologic maps of the Reno urban area, Nevada: Nevada Bureau of Mines and Geology Open-File Report 2011-07, 1:24,000	Ramelli, A., Henry, C., Walker, J., with contributions by Bell, J., Cashman, P., dePolo, C., . . . Widmer, M. (2011). *Preliminary revised geologic maps of the Reno urban area, Nevada: Nevada Bureau of Mines and Geology Open-File Report 2011-07, 1:24,000.* Retrieved from United States Geological Survey: https://ngmdb.usgs.gov /Prodesc/proddesc_102355.htm	Geologic map
23	Reno Cyclery Special Use Permit Application	Rubicon Design Group, LLC. (2019). *Reno Cyclery Special Use Permit Application.*	Outlines existing conditions, land uses and zoning, project description, and preliminary sign plan. **Incorporated herein.**
24	Archeology and Historic Preservation Standards and Guidelines: Professional Qualifications Standards	Secretary of the Interior. (n.d.). *Archeology and Historic Preservation Standards and Guidelines: Professional Qualifications Standards.* Retrieved from National Park Service: https://www.nps.gov/history/local-law/arch_stnds_9.htm	Regulatory guidance
25	Watershed Workplan Peavine Mountain Watershed, City of Reno, Washoe County, Nevada	Shutler, R. (1960). Watershed Workplan Peavine Mountain Watershed, City of Reno, Washoe County, Nevada. Nevada State	Previous cultural resource survey and report

#	Title	Reference	Brief Summary
		Museum Report No. 16-346. Report on file, Nevada State Museum.	
26	Nevada Administrative Code Chapter 535 - Dams and Other Obstructions	State of Nevada. (2016). *Nevada Administrative Code Chapter 535 - Dams and Other Obstructions.*	Regulatory guidance by State for dam design**.**
27	Governor Directives and Declarations from March 22, 2020	State of Nevada. (2020, March 22). *Governor Directives and Declarations.* Retrieved from NV Health Response: https://nvhealthresponse.nv.gov/state-information/governor-directives-and-declarations/	State of Nevada emergency declaration
28	2005-2006 Dam safety inspection of Virginia Lake (NV10596), Upper Peavine (J-46), West Wash (J-47), East Wash (J-56), Lower Peavine (J-68), Dant Boulevard (J-304), North Virginia Detention (J-361), Somersett #13 (J-541) and Somersett #14 (J-548) Dams	State of Nevada Department of Conservation and Natural Resources Division of Water Resources. (2005-2006). *Dam safety inspection of Virginia Lake (NV10596), Upper Peavine (J-46), West Wash (J-47), East Wash (J-56), Lower Peavine (J-68), Dant Boulevard (J-304), North Virginia Detention (J-361), Somersett #13 (J-541) and Somersett #14 (J-548) Dams.*	2005 and 2006 inspection of dams listed in title with action items that fall under Immediate, Short Term (1 year), and Long term (3 years). Includes field notes. **Incorporated herein.**
29	2007 Dam safety inspection of the City of Reno Upper Peavine (J-46), West Wash (J-47), East Wash (J-56), Lower Peavine (J-68), Dant Blvd. (J-304) and North Virginia (J-361) Dams	State of Nevada Department of Conservation and Natural Resources Division of Water Resources. (2007). *Dam safety inspection of the City of Reno Upper Peavine (J-46), West Wash (J-47), East Wash (J-56), Lower Peavine (J-68), Dant Blvd. (J-304) and North Virginia (J-361) Dams.*	2007 inspection of dams listed in title with action items that fall under Immediate, Short Term (1 year), and Long term (3 years). Includes field notes. **Incorporated herein.**
30	2008 Dam safety inspection of the City of Reno Upper Peaving (J-46), West Wash (J-47), East Wash (J-56), Lower Peavine (J-68), Dant Blvd. (J-304) and North Virginia (J-361) Dams	State of Nevada Department of Conservation and Natural Resources Division of Water Resources. (2008). *Dam safety inspection of the City of Reno Upper Peaving (J-46), West Wash (J-47), East Wash (J-56), Lower Peavine (J-68), Dant Blvd. (J-304) and North Virginia (J-361) Dams.*	2008 inspection of dams listed in title with action items that fall under Immediate, Short Term (1 year), and Long term (3 years). Includes field notes. **Incorporated herein.**
31	2009 Dam safety inspection of the City of Reno Upper Peavine (J-46), West Wash (J-47), East Wash (J-56), Lower	State of Nevada Department of Conservation and Natural Resources Division of Water Resources. (2009). *Dam safety inspection of the City of Reno Upper Peavine (J-46), West*	2009 inspection of dams listed in title with action items that fall under Immediate, Short Term (1

#	Title	Reference	Brief Summary
	Peavine (J-68), Dant Blvd. (J-304), North Virginia (J-361) and Virginia Lake (NV-10596) Dams	*Wash (J-47), East Wash (J-56), Lower Peavine (J-68), Dant Blvd. (J-304), North Virginia (J-361) and Virginia Lake (NV-10596) Dams.*	year), and Long term (3 years). Includes field notes. **Incorporated herein.**
32	2010 Dam safety inspection of the City of Reno Upper Peavine (J-46), West Wash (J-47), East Wash (J-56), Lower Peavine (J-68), Dant Blvd. (J-304), and North Virginia (J-361) Dams	State of Nevada Department of Conservation and Natural Resources Division of Water Resources. (2010). *Dam safety inspection of the City of Reno Upper Peavine (J-46), West Wash (J-47), East Wash (J-56), Lower Peavine (J-68), Dant Blvd. (J-304), and North Virginia (J-361) Dams.*	2010 inspection of dams listed in title with action items that fall under Immediate, Short Term (1 year), and Long term (3 years). Includes field notes. **Incorporated herein.**
33	2011 Dam safety inspection of the City of Reno Upper Peavine (J-46), West Wash (J-47), East Wash (J-56), Lower Peavine (J-68), Dant Blvd. (J-304) and North Virginia (J-361) Dams	State of Nevada Department of Conservation and Natural Resources Division of Water Resources. (2011). *Dam safety inspection of the City of Reno Upper Peavine (J-46), West Wash (J-47), East Wash (J-56), Lower Peavine (J-68), Dant Blvd. (J-304) and North Virginia (J-361) Dams.*	2011 inspection of dams listed in title with action items that fall under Immediate, Short Term (1 year), and Long term (3 years). Includes field notes. **Incorporated herein.**
34	2012 Dam safety inspection of the City of Reno Upper Peavine (J-46), West Wash (J-47), East Wash (J-56/J-585), Lower Peavine (J-68), Dant Blvd. (J-304) and North Virginia (J-361) Dams	State of Nevada Department of Conservation and Natural Resources Division of Water Resources. (2012). *Dam safety inspection of the City of Reno Upper Peavine (J-46), West Wash (J-47), East Wash (J-56/J-585), Lower Peavine (J-68), Dant Blvd. (J-304) and North Virginia (J-361) Dams.*	2012 inspection of dams listed in title with action items that fall under Immediate, Short Term (1 year), and Long term (3 years). Includes field notes. **Incorporated herein.**
35	2013 Dam safety inspection of the Peavine Creek Upper (J-46), West Wash (J-47), East Wash (J-56), Peavine Creek Lower (J-68), Dant Boulevard Detention (J-304), North Virginia (J-361), West Logan Ridge Trail (J-541) and East Logan Ridge Trail (J-548) Dams	State of Nevada Department of Conservation and Natural Resources Division of Water Resources. (2013). *Dam safety inspection of the Peavine Creek Upper (J-46), West Wash (J-47), East Wash (J-56), Peavine Creek Lower (J-68), Dant Boulevard Detention (J-304), North Virginia (J-361), West Logan Ridge Trail (J-541) and East Logan Ridge Trail (J-548) Dams.*	2013 inspection of dams listed in title with action items that fall under Immediate, Short Term (1 year), and Long term (3 years). Includes field notes. **Incorporated herein.**

#	Title	Reference	Brief Summary
36	2014 Dam Safety Inspection of the Peavine Creek Upper (J-46), West Wash (J-47), East Wash (J-56), Peavine Creek Lower (J-68), Dant Boulevard Detention (J-304), North Virginia (J-361), West Logan Ridge Trail (J-541) and East Logan Ridge Trail (J-548) Dams	State of Nevada Department of Conservation and Natural Resources Division of Water Resources. (2014). *Dam Safety Inspection of the Peavine Creek Upper (J-46), West Wash (J-47), East Wash (J-56), Peavine Creek Lower (J-68), Dant Boulevard Detention (J-304), North Virginia (J-361), West Logan Ridge Trail (J-541) and East Logan Ridge Trail (J-548) Dams.*	2014 inspection of dams listed in title with action items that fall under Immediate, Short Term (1 year), and Long term (3 years). Includes field notes. **Incorporated herein.**
37	2015 Dam Safety Inspection of City of Reno Oeavine Creek Upper, West Wash, East Wash Peavine Creek Lower, Northgate Golf Course, Dant Blvd Detention, North Virginia Detention, West Logan Ridge Trail and East Logan Ridge Trail Dams	State of Nevada Department of Conservation and Natural Resources Division of Water Resources. (2015). *Dam Safety Inspection of City of Reno Oeavine Creek Upper, West Wash, East Wash Peavine Creek Lower, Northgate Golf Course, Dant Blvd Detention, North Virginia Detention, West Logan Ridge Trail and East Logan Ridge Trail Dams.*	2015 inspection of dams listed in title with action items that fall under Immediate, Short Term (1 year), and Long term (3 years). Includes field notes. **Incorporated herein.**
38	2016 Dam Safety Inspection of City of reno Peavine Creek Upper, West Wash, East Wash, Peavine Creek Lower, Northgate Golf Course, Dant Blvd, North Virginia, West Logan Ridge Trail, East Logan Ridge Trail and Virginia Lake Dams	State of Nevada Department of Conservation and Natural Resources Division of Water Resources. (2016). *Dam Safety Inspection of City of reno Peavine Creek Upper, West Wash, East Wash, Peavine Creek Lower, Northgate Golf Course, Dant Blvd, North Virginia, West Logan Ridge Trail, East Logan Ridge Trail and Virginia Lake Dams.*	2016 inspection of dams listed in title with action items that fall under Immediate, Short Term (1 year), and Long term (3 years). Includes field notes. **Incorporated herein.**
39	2017 Dam Safety Inspection of the East Wash Diversion, J-056 (NV00079)	State of Nevada Department of Conservation and Natural Resources Division of Water Resources. (2017). *Dam Safety Inspection of the East Wash Diversion, J-056 (NV00079).*	2017 inspection of East Wash dam with action items that fall under Short Term (1 year), and Long term (2 years). Includes pictures. **Incorporated herein.**
40	2017 Dam Safety Inspection of the West Wash Dam, J-047 (NV00078)	State of Nevada Department of Conservation and Natural Resources Division of Water Resources. (2017). *Dam Safety Inspection of the West Wash Dam, J-047 (NV00078).*	2017 inspection of West Wash dam with action items that fall under Short Term (1 year), and Long term (2 years). Includes pictures. **Incorporated herein.**

#	Title	Reference	Brief Summary
41	2018 Dam Safety Inspection for the East Wash Diversion, J-056, NV00079	State of Nevada Department of Conservation and Natural Resources Division of Water Resources. (2018). *Dam Safety Inspection for the East Wash Diversion, J-056, NV00079.*	2018 inspection of East Wash dam with action items that fall under Immediate and Long term (2 years). Includes pictures. **Incorporated herein.**
42	2018 Dam Safety Inspection of the West Wash Dam, J-047, NV00078	State of Nevada Department of Conservation and Natural Resources Division of Water Resources. (2018). *Dam Safety Inspection of the West Wash Dam, J-047, NV00078.*	2018 inspection of West Wash dam with action items that fall under Immediate and Long term (2 years). Includes pictures. **Incorporated herein.**
43	2019 Dam safety Inspection of the East Wash Diversion, J-056 (NV00079)	State of Nevada Department of Conservation and Natural Resources Division of Water Resources. (2019). *Dam safety Inspection of the East Wash Diversion, J-056 (NV00079).*	2019 inspection of East Wash dam with action items that fall under Long term (2 years). Includes pictures. **Incorporated herein.**
44	2019 Dam Safety Inspection of the West Wash Dam, J-047 (NV00078)	State of Nevada Department of Conservation and Natural Resources Division of Water Resources. (2019). *Dam Safety Inspection of the West Wash Dam, J-047 (NV00078).*	2019 inspection of West Wash dam with action items that fall under Short Term (1 year) and Long term (2 years). Includes pictures. **Incorporated herein.**
45	2020 Dam Safety Inspection of the East Wash Diversion Dam, J-056, (NV00079)	State of Nevada Department of Conservation and Natural Resources Division of Water Resources. (2020). *Dam Safety Inspection of the East Wash Diversion Dam, J-056, (NV00079).*	2020 inspection of East Wash dam with action items that fall under Long term (2 years). Includes pictures. **Incorporated herein.**
46	2020 Dam Safety Inspection of the West Wash Dam, J-047, (NV00078)	State of Nevada Department of Conservation and Natural Resources Division of Water Resources. (2020). *Dam Safety Inspection of the West Wash Dam, J-047, (NV00078).*	2020 inspection of West Wash dam with action items that fall under Immediate, Short Term (1 year) and Long term (2 years). Includes pictures. **Incorporated herein.**
47	Report of Preliminary Reconnaissance of the Ring Road from U.S. 40 N&E T U.S. 395	Townsend, G., & Covington, C. (1976). Report of Preliminary Reconnaissance of the Ring Road from U.S. 40 N&E T U.S. 395. Highway Department RS-Su-821(5) EA#70743. Nevada State Museum Report Number 16-41. Reference on file, Nevada State Museum.	Previous cultural resource report.

#	Title	Reference	Brief Summary
48	Watershed Protection and Flood Prevention Act	United States Congress. (1954). Public Law 83-566. *Watershed Protection and Flood Prevention Act.*	Public law
49	National Engineering Handbook Part 630 Hydrology	United States Department of Agriculture Natural Resources Conservation Service. (1997). *National Engineering Handbook Part 630 Hydrology.*	Regulatory guidance for hydrology calculations.
50	General Manual, Title 400-Public Participation Policy Part 400	United States Department of Agriculture Natural Resources Conservation Service. (2006). *General Manual, Title 400-Public Participation Policy Part 400.*	NRCS general manual
51	Common Issues in NWMC Dam Rehabilitation Plan Reviews	United States Department of Agriculture Natural Resources Conservation Service. (2008). *Common Issues in NWMC Dam Rehabilitation Plan Reviews.*	Regulatory guidance. Contains list of common issues in dam rehabilitation plan reviews.
52	National Watershed Program Manual, Third Edition	United States Department of Agriculture Natural Resources Conservation Service. (2009). *National Watershed Program Manual, Third Edition.* Washington, DC.	Regulatory guidance for development of watershed projects.
53	National Watershed Program Handbook, Second Edition	United States Department of Agriculture Natural Resources Conservation Service. (2014). *National Watershed Program Handbook, Second Edition.* Washington, DC.	Regulatory guidance for watershed programs and projects.
54	Technical Release 210-60: Earth Dams and Reservoirs	United Stated Department of Agriculture. (2019). *Technical Release 210-60: Earth Dams and Reservoirs.*	Regulatory guidance for earthen dams.
55	Custom Soil Resource Report for Washoe County, Nevada, South Part, West Wash-East Wash Project Area	United States Department of Agriculture Natural Resources Conservation Service. (2020, December 14). *Custom Soil Resource Report for Washoe County, Nevada, South Part, West Wash-East Wash Project Area.* Retrieved from Natural Resources Conservation Service Web Soil Survey: https://websoilsurvey.sc.egov.usda.gov/App/HomePage.html	Soil report that identifies soils within the West Wash and East Wash limits. **Incorporated herein.**

#	Title	Reference	Brief Summary
56	Notice of Scoping Meeting to Prepare and Environmental Assessment for the West Wash Dam Rehabilitation Project	United States Department of Agriculture Natural Resources Conservation Service; City of Reno. (2014). *Notice of Scoping Meeting to Prepare an Environmental Assessment for the West Wash Dam Rehbilitaion Project.*	An official Notice of Scoping meeting from NRCS that includes full outline of project, including Public Scoping procedures, Purpose and Need, and Alternatives they want considered
57	Plans for the Construction of West Wash Dam As-Builts	United States Department of Agriculture Soil Conservation Service. (1959, October 21). Plans for the Construction of West Wash Dam As-Builts.	As-builts of the original construction of the West Wash Dam
58	Plans for the Construction of East Wash Diversion Dam As-Builts	United States Department of Agriculture Soil Conservation Service. (1960, May 2). Plans for the Construction of East Wash Diversion Dam As-Builts.	As-builts of the original construction of the East Wash Dam
59	National Engineering Handbook Section 3 Sedimentation	United States Department of Agriculture Soil Conservation Service. (1983). *National Engineering Handbook Section 3 Sedimentation.*	Regulatory guidance for calculating sediment loads.
60	Revised Operation and Maintenance Agreement	United States Department of Agriculture Soil Conservation Service. (1987). *Revised Operation and Maintenance Agreement.*	A revised Operation and Maintenance Agreement for the floodwater control structures in the Peavine Mountain Watershed project.
61	List of threatened and endangered species that may occur in, and/or may be affected by the West Wash/East Wash project location	United States Fish and Wildlife Service. (2020, December 14). *List of threatened and endangered species that may occur in, and/or may be affected by the West Wash/East Wash project location.* Retrieved from IPaC Information for Planning and Consultation: https://ecos.fws.gov/ipac/	A list of all the possible threatened and endangered species within the project area. This list also includes migratory birds that may pass through project area. **Included herein.**
62	National Wetlands Inventory - COR West Wash Area	United States Fish and Wildlife Service. (2020, December 11). *National Wetlands Inventory - COR West Wash Area.* Retrieved from U.S. Fish & Wildlife Service Wetlands Mapper: https://www.fws.gov/wetlands/data/mapper.html	Map that shows all classified wetlands, riverines, and ponds in project area. **Included herein.**

#	Title	Reference	Brief Summary
63	Water-Supply Paper 2433	United States Geological Survey. (1997). *Water-Supply Paper 2433.*	Regulatory guidance for estimating magnitude and frequency of floods in the southwestern United States. **Incorporated herein.**
64	Fact Sheet 123-98	United States Geological Survey. (1999). *Fact Sheet 123-98.*	Regulatory guidance for estimating flood magnitude and frequency in rural areas in Nevada. **Incorporated herein.**
65	Circular No. A-95: Revised	United States Office of Management and Budget. (1974). *Circular No. A-95: Revised.*	Federal guidance for inter-agency cooperation and noticing
66	Executive Order 12372 Intergovernmental Review of Federal Programs	United States, Office of the President. (1982). Intergovernmental Review of Federal Programs. In *Executive Order 12372* (pp. 197 47 FR 30959, 3 CFR, 1982 Comp.).	Executive order relating to inter-governmental review
67	Executive Order 10584 Prescribing rules and regulations relating to the administration of the Watershed Protection and Flood Prevention Act	United States, Office of the President. (1954). Prescribing Rules and Regulations Relating to the Administration of the Watershed Protection and Flood Prevention Act. In *Executive Order 10584* (pp. 232 19 FR 8725, 3 CFR, 1954-1958 Comp.).	Executive order relating to watershed protection and flood protection
68	Washoe County Regional Hazard Mitigation Plan: 2020 Plan Update	Washoe County Emergency Management and Homeland Security. (2020). *Washoe County Regional Hazard Mitigation Plan: 2020 Plan Update.*	Regulatory guidance for hazard mitigation that includes a 2018 Flood Response Action Plan.

In addition to the references listed in Table 1, the following federal laws, regulations, and executive orders will be met under the NEPA process of this project:

- Watershed Protection and Flood Protection Act (Public Law 83-566)
- NWPM Part 501 Subpart D and NWPH Part 601 Subpart D
- National Watershed Program Handbook (NWPH)
- NRCS National Watershed Program Manual (NWPM)
- National Environmental Policy Act (NEPA)
- Principles and Requirements for Federal Investments in Water Resources (PR&G)
- Executive Order 12898 (Environmental Justice)
- Executive Order 1988 (Floodplains)
- Executive Order 11990 (Wetlands)
- Fish and Wildlife Coordination Act
- National Historic Preservation Act of 1966 (Section 106)
- Endangered Species Act of1973 (Section 107) (Pub. L. 93–205, 87 Stat. 884 (16 U.S.C. 1531 et seq.))
- Clean Water Act Section 404 and Section 401 (delegated to the States)
- Magnususon-Stevens Fishery Conservation and Management Act
- Coastal Zone Management Act
- Farmland Protection Policy
- Migratory Bird Treaty Act
- Wild and Scenic Rivers Act
- Rivers and Harbors Act
- Safe Drinking Water Act

2.1 PROJECT AREA

The Peavine Mountain Watershed Plan described the project area as being 6,300 acres; 4,650 acres above the Highland Irrigation Ditch, and 1,650 acres below the Highland Ditch, of which 1,285 acres were within the City of Reno.

Existing mapping was reviewed to identify a preliminary project area. Inundation maps and watershed areas from City of Reno's Drainage Report were reviewed (MACTEC Engineering and Consulting, Inc., 2006). A preliminary project area map was created using COR existing LIDAR data, publicly available topographic data and inundation drawings from the Dam's Emergency Action Plans (EAPs). The project team discussed this preliminary project area during the project kick-off meeting and feedback was provided on the scope of the area for review in this project. After discussion and review, a project area map was developed (Figure 1).

Effects discussed in this report include ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic (such as the effects on employment), social, or health effects. Effects may also include those resulting from actions that may have both beneficial and detrimental effects, even if on balance the agency believes that the effect will be beneficial. A "but for" causal relationship is insufficient to make an agency responsible for a particular effect under NEPA. Effects should generally not be considered if they are remote in time, geographically remote, or the product of a lengthy causal chain. Effects do not include those effects that the agency has no ability to prevent due to its limited statutory authority or would occur regardless of the proposed action. An agency's analysis of effects shall be consistent with this paragraph".

In accordance with the NEPA definition of effects, the direct project area of potential effects will be used to determine the extent of further data collection and analysis of the potential project, including soils and

geological data, hydrology and hydrologic data, biological resources, cultural resources, social and demographic factors.

2.1.1 Development in Northwest Project Area

In 1958, when the original Peavine Mountain Watershed Plan was written the population of Reno was 52,500 with an estimated 4 million people travelling to Reno annually for tourism and business. Southern and Western Pacific Railroads, US 40, US 395 and "upcoming I-80 freeway" were mentioned as important routes in the impact area (City of Reno, 1958).

Since 1958, Reno has experienced significant development. Today, the City of Reno has a population of over 180,000 (City of Reno, 2017). The City is expected to grow by more than 62,000 residents between 2015 and 2036, reaching a population of over 301,000 in 2036 (City of Reno, 2017). The dam is estimated to provide protection against flooding to about 30,000 Nevadans who live and work downstream. Additionally, the dam protects downstream city roads, one state highway (395), and Interstate 80.

Land uses surrounding the project area include single and multi-family residential, commercial and retail. An example of current nearby development in the area is located immediately adjacent to the East Wash Dam. The property, which sits directly west of the East Wash Dam, is a 6.05-acre parcel (APN #001-190-12) located south of McCarren Blvd. and approximately 900 feet west of the intersection of Keystone Ave. and McCarren Blvd. The development, approved by the City of Reno Planning Commission, consists of a stand-alone bicycle retail building, two buildings with mixed retail/office and residential, and 2.5-3 acres of off-road bike trails. The name of the developed commercial center will be Reno Cyclery (Rubicon Design Group, LLC, 2019). The exact location of this development can be found in Figure 2.

According to the Special Use Permit Application submitted for Reno Cyclery, a stormwater management system will be constructed to convey water across the post-developed site in the same way that it flowed pre-development. Water entering the property from the north and west, through existing culverts that cross McCarren Blvd., will flow south into an existing channel. The development also calls for building a detention pond on the southern end of the parcel (Rubicon Design Group, LLC, 2019). However, no provision for storm water conveyance deriving from auxiliary spillway activation at East Wash Dam was required or included in the plans. No construction schedule has been approved.

2.1.2 Truckee Meadows Water Authority (TMWA) Facility

Truckee Meadows Water Authority (TMWA) is the owner of a parcel immediately downstream from the West Wash Dam embankment and east of the auxiliary spillway. An existing TMWA facility building is on Washoe County APN #001-111-11. The function of this facility is currently unknown. The exact location of this existing building is noted in Figure 2. The Highland Ditch, a historic and operational irrigation ditch, is owned and managed by TMWA. Highland Ditch is located in near downstream proximity to the embankment and near the project area.

2.1.3 Inundation Areas

Previously identified potential inundation areas are shown on the project location map to provide a reference to the public during scoping meetings. Modeling efforts associated with this Plan- ED will identify updated potential inundation areas, if any.

Figure 1: City of Reno West Wash Dam Project Location Map

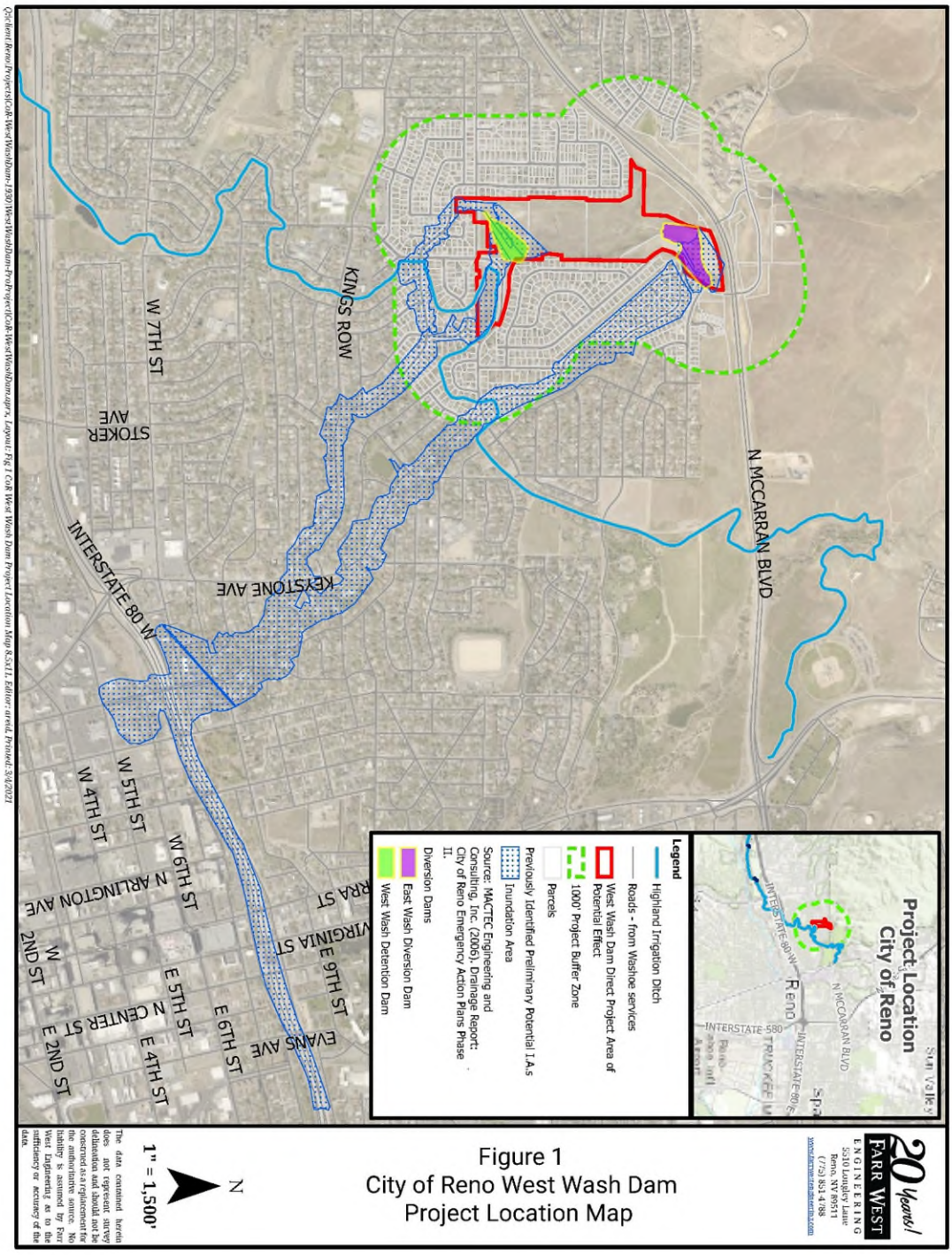
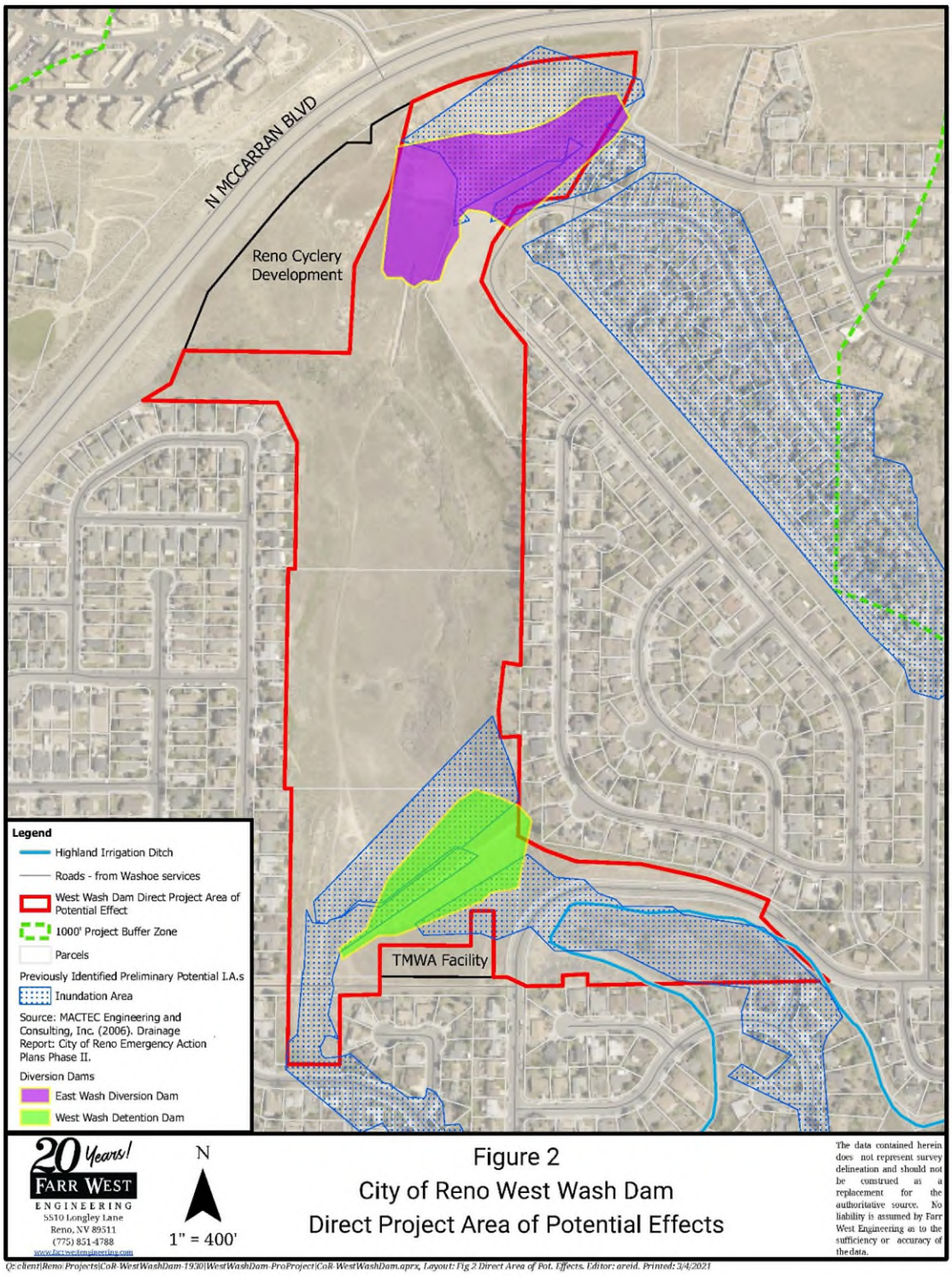


Figure 2: Direct Project Area of Potential Effects



2.1.4 Data Gaps and Recommendations

Data gaps and recommendations were made during initial stages of the project; however, a the project progressed, additional data was collected, as described below, to properly evaluate alternatives.

2.2 SOILS AND GEOLOGIC DATA

The East Wash and West Wash Dam is located within the Reno Basin on the western edge of the Basin and Range physiographic province. Within the province, the earth's crust (and upper mantle) has been stretched up to 100% of its original width. As the crust expanded, it thinned and cracked, creating large faults. Along the trending faults, mountains were pushed up, and valleys were carved below, creating a distinctive alternating pattern of ranges and valleys. West Wash Dam is located in an area of high seismicity and with significant Quaternary faulting. Publications include documentation that many of these faults were offset during the Holocene (the last 15,000 years).

The original Peavine Mountain Watershed Workplan characterized soils in the watershed as shallow and of medium texture with underlying dense clay or igneous rock (City of Reno, 1958). Soil permeability is low and results in considerable run off from storm events. At the time of the 1958 watershed work plan all the area above the Highland Ditch was rangeland of varying sub-optimal conditions (City of Reno, 1958).

Because the channels in the upper watershed pass principally through erosion-resistant volcanic bedrock, lack significant alluvial deposits, and do not appear to be actively incising or widening, , streambank erosion is reasonably assumed not to be a significant source of sediment delivered to- and deposited behind East- and West Wash dams Rather, sheet and rill erosion likely contributes the greatest proportion of sediment yield to the dams; the most severe erosion has occurred at the steep headwater areas of the watershed where vegetative cover is extremely sparse or non-existent (City of Reno, 1958). The trap efficiencies of the dams are not known, but a portion of the sediment passes through the structures and is transported through downtown Reno to the Truckee River.

The geotechnical investigation, as part of the original design, found that the dam sites are underlain by compact but poorly lithified lake sediments, which includes layers of shale, silt-stones, sandstone, impure diatomite, and ash. The spillways for both the East and West Wash Dams were cut into poorly lithified lake sediments, which is resistant to normal erosion but can be expected to rapidly erode during high flow stages (City of Reno, 1958).

Based on the record drawings (US Department of Agriculture Soil Conservation Service, 1960), the embankment consists of one homogeneous layer. In 2025, DOWL advanced two borings through the west wash dam embankment. Based on exploration and classification testing, the embankment generally consists of silty sand or clayey sand with gravel and cobbles throughout. The consistency ranges from medium dense to very dense.

West Wash Dam is on an unnamed tributary to Peavine Creek, which includes a sequence of intermediate and old fan deposits. As is common with many continental deposits, the stratigraphy of the Tertiary-age deposits within short distances varies greatly. The area also contains Pre-Donner Lake-age deposits (USGS, 2025). The bedrock in the area is exposed to the north and consists of Andesite Lava of the Peavine Mountains. The bedrock is Miocene in age.

A mixture of granular and cohesive soil was encountered in alluvial fan deposits in the dam foundation. Granular alluvial soils were encountered in the foundation soils below the dam embankment, and at the upstream and downstream toes of the dam. The alluvium classifications range from poorly graded sand to clayey sand. The consistency ranges from dense to very dense.

Clayey soils were observed below the embankment and at the upstream and downstream toes. The classifications of clayey soil range from sandy clay to lean clay and silty clay. The consistency ranges from

stiff to hard. Silty soil was observed below the embankment and at the upstream and downstream toes. The silty soil classifications range from sandy silt to silt. The consistency ranges from dense to very dense.

Phreatic water was not encountered within the embankment; however, groundwater was encountered in the alluvium below the dam embankment during drilling. The groundwater appeared to be confined below a low-permeability layer, and it rose approximately 10 feet above the elevation at which it was encountered. Groundwater at the downstream toe rose above the ground surface elevation and flowed out of the top of the augers

2.2.1 Data Gaps and Recommendations

A geotechnical investigation was conducted in 2025 to evaluate the subsurface soil. In addition, the geotechnical data were used to perform seepage analysis, slope stability analysis, seismic modeling, and spillway erodibility analysis. Those investigations and analyses filled the geotechnical and geologic data gaps. A wetlands report including potential wetland delineation will be necessary to identify and characterize the soils and biomes in the project area. Updated soils data will allow for a more informed Sediment Storage Rationale, as well as accurate determination of curve numbers for drainage basins used in the hydrologic model.

2.3 HYDROLOGY AND HYDRAULIC DATA

The Peavine Mountain Watershed Plan describes the general topography of the watershed. Drainage from the watershed flows southeast to the Truckee River which flows east and then north to Pyramid Lake. The primary watercourses are Peavine Creek, West Wash and East Wash, which are intermittent streams (City of Reno, 1958).

On July 20, 1956, there occurred a flood described as the largest flood in the previous 50 years which caused damages estimated at $739,6000 ($6.7 million in 2020). In response to that flood, the Peavine Watershed Plan was created to eliminate damage from 1% chance of exceedance floods (City of Reno, 1958).

The Peavine watershed is described as having steep gradient intermittent streams (City of Reno, 1958). It is important to note that the West Wash in the area of the dam appears to now have some perennial flow. It is unknown when this flow started but observations from a recent site visit confirm that it is active in the winter months as of the date of this report. The average precipitation used in the original Peavine Mountain Watershed Plan was 6.96 inches. For higher elevations of Peavine Mountain, an average precipitation of about 12 inches was used, 60% of which came as snow. Rain-on-snow were mentioned in the report as significant events, but convective storms were emphasized as the most destructive flood-wise per the record. It was noted that channel erosion was insignificant but that delivery of the sediment present in the channels to the East Wash impoundment was nearly 100% (City of Reno, 1958).

In 2006 MACTEC, Inc. compiled a drainage report that contained an extremely thorough overview of hydrology related to the East Wash and West Wash dams. The information in this report was later used in formation of the 2019 Consolidated EAP. The most notable point in the 2006 drainage report is that it is the first indication of possible overtopping issues at the West Wash dam (MACTEC Engineering and Consulting, Inc., 2006).

Analysis of the City storm drain system was performed as part of Farr West Engineering's (FWE's) Hydrology, Hydraulics, and Sediment Analysis (HH&S) Technical Memoranda (TM) (Farr West Engineering, 2022). A stormwater culvert runs under N McCarran Boulevard and carries storm water into the drainage structures. Storm waters from the surrounding developed residential neighborhood discharge to the project area through the City's stormwater drainage structures. The East Wash Primary Spillway is directly connected to the storm drain system, and the West Wash Primary Spillway directs flows to a downstream open channel that is connected to the storm drain system. The storm drain system downstream of the East Wash and West Wash Dams consists of individual catch basins that feed lateral pipes. The lateral

pipes then feed into the storm drain mains. The mains flow in a southeasterly fashion until they reach their ultimate outfall at the Truckee River (Farr West Engineering, 2022). An in-depth discussion about the hydraulics/hydrology associated with the East Wash and West Wash Dams is in TM #2 produced by FWE (Farr West Engineering, 2022).

2.3.1 Data Gaps and Recommendations

There are no hydrology and hydraulic data gaps; and therefore, there are no recommendations.

2.4 WETLANDS

The East Wash has classified riverine flowing from northern culverts that cross McCarran Blvd. to the bottom of the drop inlet spillway. Similarly, the West Wash has riverine flowing from western culverts that cross McCarran Blvd. Less than 100 feet into the West Wash, the riverine turns into freshwater forested/shrub wetland until it reaches the dam outlet. At the West Wash dam outlet, the water is classified as a freshwater pond with two branches of riverine flowing downstream of the dam via the outlet and spillway (United States Fish and Wildlife Service, 2020).

An aquatic resources delineation was completed for the project area in June 2021. The delineation was completed in accordance with the *Corps of Engineers Wetlands Delineation Manual* (USACE, 1987) and the *Regional Supplement to the Corps of Engineers Wetlands Delineation Manual: Arid West Region (Version 2)* (USACE, 2008).

Two potential wetlands (Area 1 and Area 2) were evaluated to determine if they met the USACE definition of wetlands. Both areas were found to contain hydroponic vegetation; however, neither contained hydric soils or appropriate wetland hydrology. Therefore, it is believed that neither Area 1 or 2 are USACE jurisdictional wetlands (Wood Rodgers, 2022). A request for an approved jurisdictional determination was submitted to the USACE in January 2022.

2.4.1 Data Gaps and Recommendations

No data gaps exist for wetlands; therefore, there are no recommendations.

Plants and Animals

There are four threatened, endangered or candidate species listed in the project area (United States Fish and Wildlife Service, 2020). This list is preliminary and was obtained using the U.S. Fish and Wildlife Service's online mapper for informational purposes only.

- Amphibians: Sierra Nevada Yellow-legged Frog *Rana sierrae*, Status: Endangered, the project location is outside the critical habitat
- Fish: Cui-ui *Chamistes cujus*, Status: Endangered, no critical habitat has been identified for this species
- Fish: Lohontan Cutthroat Trout *Oncorhynchus clarkia henshawi*, Status: Threatened, no critical habitat has been designated for this species
- Flowering plants: Webber's Ivesia *Ivesia webberi*, Status: Threatened, project location is outside the critical habitat

There are also nine species of migratory birds most likely present in the project area and may be species of concern, including: Bald Eagle, Brewer's Sparrow, Golden Eagle, Green-tailed Towhee, Lewis's Woodpecker, Olive-sided Flycatcher, Pinyon Jay, Williamson's Sapsucker, and the Willow Flycatcher (United States Fish and Wildlife Service, 2020).

A botanical survey was conducted on June 7, 2021. The botanical survey followed the intuitive controlled method. Prominent topographic features (e.g., wetlands and disturbed landscapes) within the Project Area

were targeted. No federally- or State-protected species were reported by the USFWS and the NDNH as occurring, or having the potential to occur, in the Project Area. No protected plant species were observed or recorded during the survey (Strategies, EM, 2021).

Two Southwest Regional Gap Analysis Project (SWReGAP) vegetation communities, Inter-Mountain Basins Big Sagebrush Shrubland and Great Basin Lowland Riparian, were identified by field staff. Inter-Mountain Basins Big Sagebrush Shrubland vegetation community makes up the majority of the Project Area, covering 45.2 acres. The Great Basin Lowland Riparian vegetation community occurs along the flowing stream in the central portion of the Project Area, covering eight acres. In addition, field surveys identified the presence of the following five noxious weeds, as defined in Nevada Department of Agriculture in Nevada Administrative Code 555.010 (Strategies, EM, 2021).

- Perennial pepperweed (*Lepidium latifolium*);
- Nodding thistle (*Carduus nutans*);
- Hoary cress (*Cardaria draba*);
- Medusahead grass (*Taeniatherum caput-medusae*); and
- Jointed goat grass (*Aegilops cylindrica*).

Noxious weed species were distributed throughout the Project Area, with heavier concentrations in the northern disturbed area and along the streambanks.

A wildlife survey was completed as part of the June 7, 2021, field survey. A riparian corridor which enters the Project Area from the west and curves south to the West Wash embankment dam was observed, the area was found to provide suitable habitat to many native species as well as migratory birds. Milkweed (*Asclepias* sp.) an important hose plant for the monarch butterfly, was observed throughout the Project Area. Overall, 15 migratory birds, three mammals, and one reptile species were directly observed. Day-roosting habitat for bats is present in the project area near the riparian corridor (Strategies, EM, 2021).

2.4.2 Data Gaps and Recommendations

No data gaps exist for plants and animals; therefore, there are no recommendations.

2.5 WATER RESOURCES

Based on a desktop review, the project area has no identified streams, rivers or ponds located within it. The East and West Wash Dams are generally dry dams. There is a storm water drain in the general area, but outside of the project area, on the north end of the project area. A culvert runs under McCarran Boulevard and carries storm water into the drainage. This is located on a parcel owned by a private developer, and currently planned for mixed use development. Storm waters from the surrounding developed residential neighborhood enter the project area through City of Reno stormwater drainage structures. The storm water drainage eventually flows to the Truckee River by a storm water drain located south of the project area.

The Federal Emergency Management Agency provides a flood insurance rate map (FIRM) that encompasses the project area, as shown by Appendix B. The entire project area consisting of the East and West Wash lies within Zone X, which is defined as “areas of 0.2% annual chance of flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood” (Federal Emergency Management Agency, 2009).

Following the completion of the desktop review, an aquatic resources delineation was completed for the project area in June 2021. The delineation was completed in accordance with the *Corps of Engineers Wetlands Delineation Manual* (USACE, 1987) and the *Regional Supplement to the Corps of Engineers Wetlands Delineation Manual: Arid West Region (Version 2)* (USACE, 2008).

Two reaches of improved ephemeral channels (1A and 2A) were evaluated to determine the streamflow duration using the Streamflow Duration Assessment Method for the Arid West (SDAM AW) and in accordance with *A Field Guide to Identification of the Ordinary High Water Mark in the Arid Region of the Western United States* (USACE, 2008). Although improved ephemeral channels 1A and 2A have no evidence of consistent annual flow providing a surface water connection to a traditional navigable water, these drainages may be under the regulatory jurisdiction of the USACE (Wood Rodgers, 2022).

2.5.1 Data Gaps and Recommendations

No data gaps exist for plants and animals; therefore, there are no recommendations.

2.6 CLIMATE

Climate, as described in the 1958 Watershed Plan, is generally mild with average January temps close to freezing and July temps averaging 60-70 degrees (City of Reno, 1958). Since Reno is a high desert environment with very low relative humidity, diurnal temperature fluctuations can be extreme, often exceeding 50 degrees during the summer (City of Reno, 2006). The frost-free growing period is 154 days and average rainfall for Reno airport was 6.96 inches. The estimated average rainfall in the upper watershed was nearly 12 inches. Approximately 60% of precipitation occurs November through March in the form of snow. Rainfall occurs via at least one large thunderstorm per year with large run-off. Large run-off events can also occur due to melting snowpack (City of Reno, 1958).

The Sierra Nevada mountain range to the west of Reno forms a barrier to weather systems coming from the Pacific, which leaves Reno in a rain shadow. In the summer high-pressure systems from the southeast mix with low-pressure in the eastern Pacific which fuels afternoon and evening thunderstorms. These storms are generally based in higher elevations with locally heavy downpours that can cause localized flash flooding of dry creek beds and washes in the Reno and eastern Truckee Meadows areas (City of Reno, 2006).

According to the City of Reno Drainage Plan, there have been several notable floods in the last decade in the Reno area. The Flood of 1997 was determined to be a “100-year” flooding event for the Truckee River. More recently, the New Year’s Flood that occurred in 2005 was determined to be a “50-year” flood event for the Truckee River (City of Reno, 2006).

2.6.1 Data Gaps and Recommendations

The Peavine Mountain Watershed Work Plan was completed prior to the current regulatory regime. Many Federal statutes and regulations regarding public participation and environmental resources have been passed since then including NEPA, the Clean Water and Clean Air Acts, and the Endangered Species Act, to name a few. A significant amount of biological and environmental resource data and analysis that was not included in the Work Plan is now a requirement. Current climate resource study needs are outlined below.

Climate is more stable and has a more accurate long-term set of parameters than weather and storm events. However, climate change has become an important factor in comprehensive environmental project review. Updated climate data from (NOAA) and the National Weather Service will need to be obtained to provide analysis of the impacts of the proposed project related to climate change. Air quality and potential impacts to air quality posed by the proposed project alternative will be addressed in the Environmental Document. Greenhouse gas analysis is not anticipated to be required for this project and is not included in this scope of work.

2.7 CULTURAL AND HISTORIC RESOURCES

In consultation with the Nevada SHPO, NRCS, and the City, a direct and indirect Area of Potential Effect (APE) was determined for the project, in accordance with Section 106. The direct APE includes the area

that would be directly affected by the project, an area of approximately 53.23 acres. The indirect APE includes the areas that may be impacted directly or indirectly by the project, an area of approximately 133.49 acres. A letter was mailed to the Reno Historical Commission, who requested an update following selection of the alternative. A subsequent letter with an update was sent to the Reno Historical Commission and no response was received. Letters were also mailed to the Tribes depicting the proposed APE; no responses to the proposed APE were received. See Appendix B for a direct and indirect APE Figure. A Cultural Resource Inventory (CRI) was completed for the direct and indirect APE under the supervision of a state certified archeologist (Broadbent and Associates, 2021).

A literature review was conducted, which summarized existing surveys near the direct and indirect APE. The CRI noted that 16 archaeological sites and 139 architectural resources have been previously identified within one (1) mile of the direct APE. None of these sites are located within the direct APE; only one (1) is located within the indirect APE. The 139 architectural resources within one (1) mile of the direct APE include structures and buildings, none of which are located within the direct APE.

Based on the Nevada CRI System search results, there are seven (7) eligible resources for NRHP listing within one (1) mile of the direct APE, none of which are within the direct APE; only one (1) is located within the indirect APE, but is presumed destroyed by the construction of McCarren Avenue (Broadbent and Associates, 2021). According to the list maintained by SHPO, there are no resources that have been listed on the Nevada State Register of Historic Places within one (1) mile of the indirect APE.

The indirect APE encompasses 141 parcels, most of which contain residences constructed between 1964 and 2015; 46 of the parcels contain structures that are historic in age (at least 50 years old). All the structures within the Indirect APE were constructed after the East Wash and West Wash Dams were completed. The historic aged resources within the Indirect APE have not been evaluated for their eligibility for inclusion in the NRHP. The NRCS has determined, and SHPO has concurred, that raising the projected height of the dam and changing the slope will not have an effect on the viewshed of the historic sites or structures that are within the indirect APE.

The survey of the direct APE resulted in the identification of three (3) architectural resources of historic age including the West Wash Dam and associated structures, the East Wash Dam and associated structures, and a segment of the Highland Ditch. The East Wash and West Wash Dams were recorded as individual structures and as elements of the East Wash and West Wash Dam Historic District. Broadbent recommended, and the NRCS has determined, that the East Wash and West Wash Dams as eligible for NRHP listing, both separately and together as a historic district. Broadbent also recommended, and the NRCS has determined, that the segment of the Highland Ditch (S808) recorded for the project is not eligible for NRHP inclusion and should be considered a non-contributing segment to the NRHP-eligibility of the whole resource. The Nevada SHPO has concurred with all NRCS determinations of eligibility. The NRCS has further determined that there will be no indirect effects to historic properties from the project and SHPO has concurred with this determination. Refer to Section 11.5 for a timeline of Consultation with SHPO, American Indian Tribes and other concerned parties for The Project.

In consultation with SHPO, the NRCS has determined that there will be adverse effects to the West Wash Dam from the proposed project activities of changing the slope of the dam and raising the height of the dam. The Advisory Council on Historic Preservation was notified of the determination of adverse effects and declined to participate. The NRCS in consultation with SHPO has developed a Memorandum of Agreement to mitigate the project adverse effects to historic properties.

Tribal consultation was conducted in accordance with the NHPA and Executive Order 13175 to maintain a relationship between NRCS and native tribes and to ensure local tribal populations were notified of the scoping process. Per EPA's Policy on Consultation and Coordination with Indian Tribes, a four-phase consultation process was followed including identification, notification, input, and follow-up (U.S. Environmental Protection Agency, 2021).

NRCS sent a letter to the THPOs requesting Tribe delegate input and to make local tribal communities aware of the planning process. The following Tribes were consulted for the project (no responses were received):

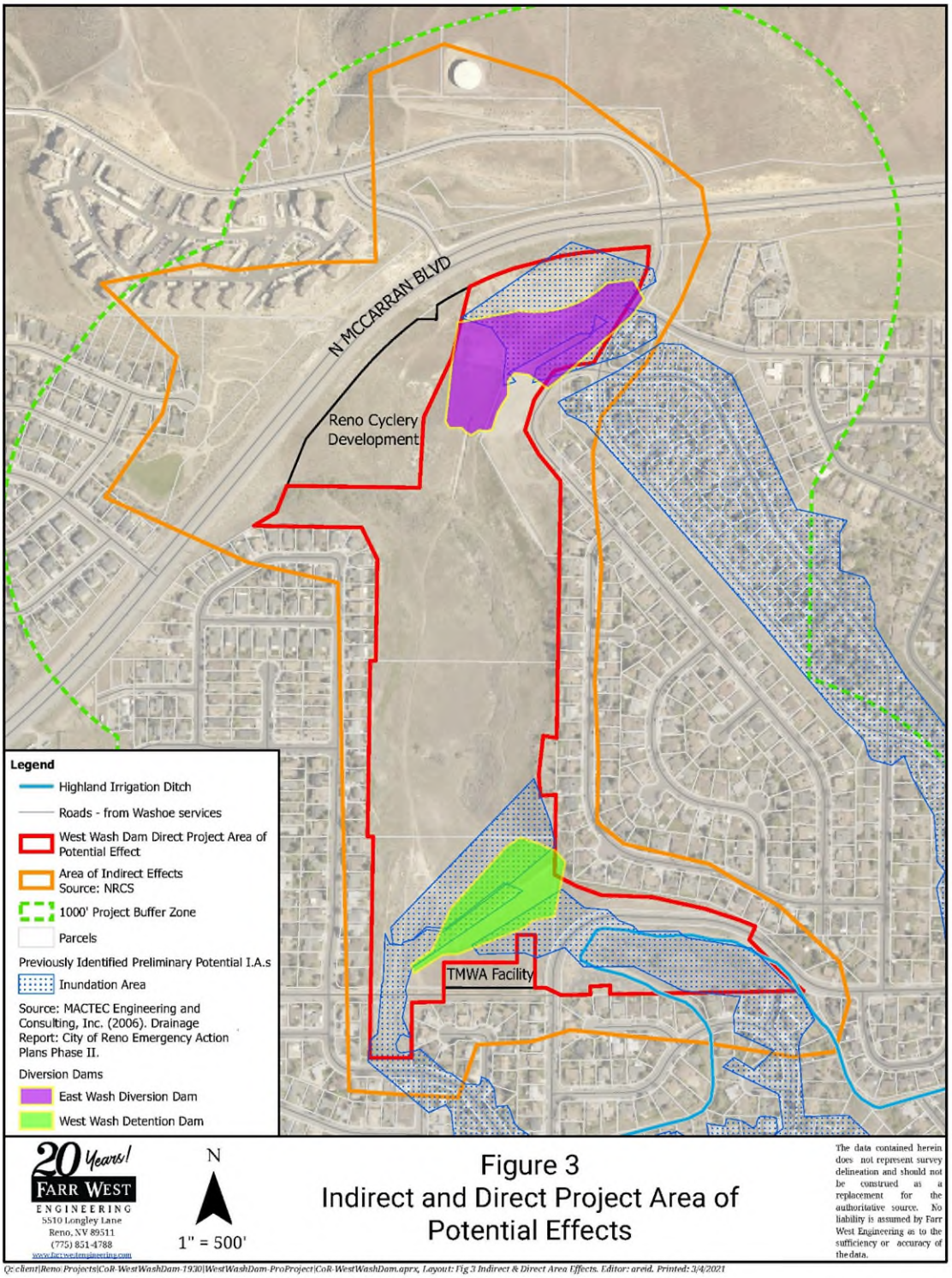
- Reno-Sparks Indian Colony
- Fallon Paiute
- Pyramid Lake Paiute Tribe
- Summit Lake Paiute Tribe
- Washoe Tribe of Nevada and California

Additionally, these five American Indian Tribes were asked for comments on the proposed APE and the cultural resource inventory report that was completed for the project and any concerns that they might have with the proposed project. On November 15, 2022 the Pyramid Lake Paiute Tribal Historic Preservation Officer responded that they had no concerns but reminded the NRCS that the Tribe considers the Peavine Mountains to be a Traditional Cultural Place (TCP). No other tribes responded with comments. Additionally, on January 16, 2024 the same five tribes were asked in separate letters to the tribal chairs for any other comments concerning the project with no responses. One response was received from Pyramid Lake Paiute Tribe stating that they had no concerns. No response was received from the other Tribes.

2.7.1 Data Gaps and Recommendations

There are no data gaps for cultural resources; and therefore, no recommendations.

Figure 3: Indirect and Direct Project Area of Potential Effects



2.8 SOCIAL AND DEMOGRAPHICS

At the time of the construction of the East and West Wash dams the population of Reno was 52,000, with 5,000 people living within the area subject to damage and floods of Peavine Mountain (City of Reno, 1958). Today, the City of Reno has a population of over 180,000 (City of Reno, 2017). The City is expected to grow by more than 62,000 residents between 2015 and 2036, reaching a population of over 301,000 in 2036 (City of Reno, 2017).

The dam is estimated to provide protection against flooding to about 30,000 Nevadans who live and work downstream. Additionally, the dam protects downstream city roads, one state highway, and an interstate highway. Among other critical infrastructure, the dam also protects power lines and transcontinental railroad tracks (City of Reno, 2006).

Economic data was used to perform a Benefit Cost Analysis (BCA) of the proposed project alternatives. A BCA was be performed for each alternative to evaluate the economic, social, and environmental effects, which may be quantified and/or described qualitatively. The BCA was performed using guidance from the National Watershed Program Manual (NWPM) 501.45 D. and National Watershed Program Handbook (NWPH) 601.45 D. Policies and procedures will be consistent with NWPM, NWPH, and Principles and Requirements for Federal Investments in Water Resources (PR&G).

2.8.1 Data Gaps and Recommendations

There are no social and demographic data gaps; and therefore, there are no recommendations.

2.9 EXISTING STRUCTURE

The original design parameters of the dams are outlined in the Peavine Mountain Watershed Plan (City of Reno, 1958). The Peavine Mountain Watershed Plan outlines the original plan of controlling drainage coming from Peavine Mountain into housed areas of Reno. This workplan includes upstream land treatment measures for flood protection as well as the construction of several “floodwater retarding structures” to reduce sediment yields and flood discharges to rates that can be handled by the existing storm drain system” (City of Reno, 1958). The West Wash and East Wash Dams were part of the dam system that was constructed.

The original cost estimate included in the Peavine Mountain Watershed Plan included brushing and seeding of most of watershed by both Reno and the Bureau of Land Management (BLM). The overall ratio of benefit/cost was about 2.5. Estimated annual maintenance costs in 1958 was $3,600.00, which translates to $32,600 in 2020 dollars (City of Reno, 1958).

Original design assumptions from the 1958 Peavine Mountain Watershed Plan includes the estimation of 50 years of cumulative sediment storage to the primary spillway crest. The East Wash primary spillway flow was to be split between the bathtub concrete overflow structure to West Wash and the riser to existing downstream conveyance. Since it was designed to operate as a dry dam, there was assumed to be no water storage once the dam storage area was full of sediment to the design limit. Both the West Wash and East Wash Dam’s auxiliary spillways were to be earthen and over their right abutments. East Wash Dam’s auxiliary spillway also flows directly into West Wash. Both auxiliary spillways were designed with a capacity of 2.5 times the design storm (City of Reno, 1958). Table 2 summarizes all of the original design parameters of the East Wash and West Wash dam.

Final design and construction resulted in embankments that were slightly taller than originally planned for and the West Wash Dam primary spillway was moved downstream and slightly to the east to reduce concrete quantities (City of Reno, 1958) (United States Department of Agriculture Soil Conservation Service, 1959) (United States Department of Agriculture Soil Conservation Service, 1960).

In 2006 MACTEC, Inc. updated the Emergency Action Plans (EAP) for both the East Wash and West Wash dams. In the updated EAPs MACTEC recalculated the reservoir storage capacities of the East and West Wash dams, as well as the upstream tributary areas, runoff volumes, and spillway capacities. The EAPs also include informative figures of the inundation area, tributary areas, stage-volume, and stage-area curves (MACTEC Engineering and Consulting, Inc, 2006) (MACTEC Engineering and Consulting, Inc, 2006).

In 2011 HDR developed a West Wash Dam Assessment Report where the current state and capacity of the dam was analyzed. An independent inspection and evaluation of the dam was performed, which most notably found that the West Wash dam has settled 8-12 inches since its initial construction. HDR's report also included a risk analysis, economic analysis, and spillway capacity analysis of the 10-day "100-year" storm, 24-hour "100-year" storm, 6-hour "100-year" storm, and the Probable Maximum Precipitation event utilizing the SITES for spillway version 2007.1.3. It is important to note that this analysis did not include the East Wash diversion into the West Wash basin (HDR, 2011).

In 2012 AMEC Environment and Infrastructure, Inc. developed an East Wash Compliance Report, where the capacity of the East Wash Dam was again analyzed. Overall, the Compliance Report is a very thorough investigation of the East Wash Dam including survey to 1-foot vertical intervals, an analysis of outlet modification hydraulics, new rating curves for spillways, a new hydrologic analysis, a geotechnical study of dam shell materials (2 to 4 feet in depth), and several different storm recurrence intervals analyzed ("100-year", TR-60 auxiliary spillway precipitation, and Probable Maximum Precipitation events) (AMEC Environment and Infrastructure, Inc, 2012).

In 2017 there was a plan sheet made by the City of Reno that located the area where 1,152 cubic yards of sediment were removed from the East Wash dam basin (City of Reno, 2017).

In 2019 MACTEC, Inc. once again updated the EAP for the East and West Wash Dams. In juxtaposition to the previous EAP update in 2006 where each dam had its own EAP report, the EAP for 2019 consists of one comprehensive EAP report for all City of Reno dams. The 2019 EAP includes the most recent summary of past efforts, site descriptions, maps and figures (Manhard Consulting, LTD, 2019).

Currently, the East Wash Dam meets TR-60 criteria with the exception of excessive damage to the spillway in a PMF event. The West Wash Dam does not meet TR-60 criteria and would overtop in a PMF event. Both the East and West Wash Dams are classified as diversion dams and neither dam has had the auxiliary spillways activated during a storm event.

Table 2: Original Design Parameters for East Wash and West Wash Dams (City of Reno, 1958)

Item	Unit	West Wash Dam	East Wash Dam	Total
Drainage Area	sq. mi.	0.92	2.64	3.56
Storage Capacity				
Sediment	ac. ft.	20	50	70
Floodwater detention	ac. ft.	273	0	273
Total	ac. ft.	293	50	343
Surface Area				
Sediment pool	ac.	3.8	4.4	8.2
Floodwater detention pool	ac.	17.3	0	17.3
Maximum height of dam	ft.	64.5	40	
Volume of fill	cu. yds.	142,425	62,000	204,425
Emergency Spillway				
Type		earth	earth	
Frequency of use	yrs.	100	100	
Design storm				
Rainfall duration	hrs.	2	2	
Total	in.	3	3	
Bottom Width	ft.	80	150	
Design capacity	c.f.s.	850	2,320	
Total freeboard	ft.	7.4	3.4	
Total capacity	c.f.s.	6,550	6,050	
Principal Spillway Capacity	c.f.s.	74	2,356	
Capacity Equivalents				
Sediment volume	in.	0.17	0.35	
Detention volume	in.	1.44	0	
Spillway storage	in.	1.00	0.28	
Class of structure		C	C	

Every year both the East and West Wash dams are inspected by the Division of Water Resources at the State of Nevada's Department of Conversation and Natural Resources. Table 3 and Table 4 contain comprehensive lists of all of the items that need attention based off of the inspections for the East and West Wash dams, respectively. Table 3 and Table 4 also list the year that the inspection called for a particular action and the timeline of that action (Immediate, Short-Term, or Long-Term). Full references for these reports can be found in rows 28-46 of Table 1 and in the reference list of Appendix A. Maintenance was performed in response to condition inspections, as was documented in the inspection reports (State of Nevada Department of Conservation and Natural Resources Division of Water Resources, 2008).

Table 3: East Wash Dam Inspection Action Items

		Years	I/S/L*
1	Clear brush from outlet access manhole at toe	2013	I
2	Update Emergency Action Plan	2018	I
3	Clear outlets, drains and spillways of debris	2006, 2007	S
4	Remove brush and trees	2006, 2007	S
5	Move next port cover down to ground level	2006, 2007	S
6	Uncover and protect outlet manhole cover at toe	2006, 2007	S
7	Remove tree at toe near manhole	2007	S
8	Compact fill in rodent burrows	2012	S
9	Replace embankment material under fence at bathtub spillway	2013, 2014, 2015	S
10	Update Emergency Action Plan	2015, 2016	S
11	Replace embankment material at west training dike	2015	S
12	Seal cracks and expansion joints in concrete of spillway	2015	S
13	Create Operation & Maintenance Plan	2016	S
14	Fill in gully on embankment	2016	S
15	Remove vegetation on and within 25’ of embankments	2017	S
16	Evaluate silt accumulation and confirm adequate capacity	2017	S
17	Build up and level crest of embankment	2007, 2008	L
18	Monitor for rodents and remove	2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020	L
19	Inspect outlet conduits	2007, 2008, 2009, 2010, 2011	L
20	Vegetation abatement program	2013, 2014, 2015, 2016, 2018, 2019, 2020	L
21	Create Operation & Maintenance Plan	2015	L
22	Monitor erosion gullies and fill if they grow	2017, 2019, 2020	L
23	Repair damage from vandalism and consider more effective exclusion measures	2017	L
24	Monitor cracks in spillway and repair as needed	2019	L
25	Monitor siltation	2020	L

*I – Immediate Action, S – Short Term Action (1 year), L – Long Term Action (2-3 years)

Table 4: West Wash Dam Inspection Action Items

		Years	I/S/L*
1	Advise owner of APN 002-422-05 to remove encroaching garden	2013	I
2	Update EAP	2018	I
3	Remove stored material in spillway	2020	I
4	Evaluate altered grading of spillway and provide report	2020	I
5	Repair right wing wall	2020	I
6	Clear outlets, drains and spillways of debris	2006, 2007	S
7	Remove brush and trees	2006, 2007	S
8	Remove tree at heel of embankment	2008, 2009, 2011	S
9	Install or clear outlet dissipator drains	2013, 2014	S
10	Remove encroaching garden at APN 002-422-05	2014	S
11	Repair sediment drain CMP riser	2014	S
12	Clear area around sediment drain riser	2014	S
13	Update EAP	2015, 2016	S
14	Reminder that Permit required for larger projects	2015	S
15	Create O&M Plan	2016	S
16	Repair hinge on access grate over outlet at toe	2017	S
17	Clean out principal spillway tower and sediment drain	2019	S
18	Remove accumulated debris from sediment drain trash rack	2019	S
19	Investigate spalling concrete in principal spillway tower	2019	S
20	Remove accumulated debris from sediment drain riser	2020	S
21	Foot traffic damage, repair and discourage or provide appropriate paths	2006, 2007, 2008, 2009, 2010, 2011, 2012,	L
22	Clear or install drains in outlet energy dissipator	2006, 2007, 2008	L
23	Monitor for rodents and remove	2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020	L
24	Inspect outlet conduits	2007, 2008, 2009, 2010, 2011	L
25	Vegetation abatement program	2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020	L
26	Create O&M Plan	2015	L
27	Monitor erosion gullies and fill if they grow	2017, 2018	L
28	Analyze impact of unauthorized encroachment into spillway	2017, 2018	L

29	Repair loss of crest width and uneven elevation	2017, 2018	L
30	Consider more robust exclusion measures	2018, 2020	L
31	Remove vegetation on and within 25 feet of embankments	2018, 2019	L
32	Repair erosion gullies and consider riprap	2020	L
33	Investigate potential seep area	2020	L

* I – Immediate Action, S – Short Term Action (1 year), L – Long Term Action (2-3 years)

2.9.1 Data Gaps and Recommendations

Since the 1958 Peavine Mountain Watershed Plan formulation, the status of the rangeland in the area tributary to East and West Washes has changed. The USDI Bureau of Land Management will have current range condition assessments that will need to be reviewed. In addition, wildfire is a constant threat in the area, so a determination of potential impact to runoff and sediment loading from a partially or fully burned over watershed must also be determined.

The City of Reno has removed sediment from the East Wash Dam impoundment (City of Reno, 2017). Sediment accumulation so handled can help extend the project life of the structures indefinitely. A determination of the willingness of the City of Reno to continue such sediment removal activities will need to be made.

Maintenance activities, including those pursuant to recommendations by NDWR in annual inspection reports, appear to have been routinely performed (see rows 28-46 of Table 1 and return correspondence to City). Specific documentation of such activities should be located and reviewed for any issues or indications of structure performance or difficulties in accomplishing recommended activities.

Modifications to the as-built structures have taken place, including utility work (see rows 28-46 of Table 1). Any documentation of alterations or addition of facilities on or near the structures should be located and reviewed for potential impacts to the project. East Wash Dam has documented alterations to the impoundment, main embankment, and outlet that are documented in East Wash Dam J-585 (AMEC Environment and Infrastructure, Inc, 2012). West Wash Dam has had an alteration to the outlet and encroachments by underground utilities (water or wastewater), aerial utilities (power poles), neighboring residents (landscaping), nearby development (TMWA facility near embankment toe), and may have additional unknown encroachments. The documentation for the myriad alterations and encroachments needs to be located and analyzed for potential impact on planning, project alternatives and design/construction.

3.0 PURPOSE AND NEED FOR ACTION

The Purpose and Need for Action statement will be refined with consultation and coordination with COR and NRCS. A draft statement of purpose and need is included here.

3.1 PURPOSE AND NEED STATEMENT

The purpose of the project is to (1) preserve the flood protection function of the West Wash Dam, which is classified as a high hazard dam by NDWR, and meet the requirements of state and federal agency regulations; (2) Protect lives and properties in the surrounding urban area; and (3) comply with current performance and safety standards in a cost-effective and environmentally acceptable manner. The project is needed to (1) Address current deficiencies at West Wash and East Wash Dams to bring both dams into compliance with current dam safety regulations, engineering standards and performance criteria for High Hazard Dams state and federal regulations; and (2) ensure the watershed structure is properly maintained to minimize the risk to lives and property in the surrounding and downstream area which has been developed into a thriving, urban residential and commercial center since the original construction of the dams.

Compliance with current NDWR and NRCS Safety of Dams regulations, engineering standards, and performance criteria is necessary to ensure the protection of lives and property surrounding and downstream of the dams. The following challenges were identified:

- Repairs and necessary maintenance identified in yearly dam inspection reports,
- Hydraulic inadequacy of current dam design
- High hazard dam classification
- Possible sediment accumulation that reduces runoff volume stored by the dams.

3.2 CHALLENGES

The following challenges were identified during data collection for this planning effort:

1. Increased Urbanization
    - Change to urban land use around and below the dam area
    - Continuing growth in the City of Reno
    - Reliance on the open space as an informal recreation area
    - Infrastructure encroachment across facility features
2. Compliance with current safety of dams regulations, engineering standards and performance criteria to ensure protection of lives and property
    a. When compared to current design and performance standards, the following deficiencies were identified:
        i. See inspection reports summarized herein (referenced in rows 28-46 of Table 1)
    b. Hydraulic inadequacy (MACTEC Engineering and Consulting, Inc., 2006)
    c. High hazard dam rehabilitation
    d. Sediment damage identification and possible reduction

3.3 OPPORTUNITIES

1. Maintain downstream flood protection and reduce risk of loss of life and damage to property
2. Reduce possibility of dam failure and protect downstream communities, real estate and infrastructure
3. Full compliance with NDWR and NRCS criteria
4. Sediment damage identification and possible reduction

4.0 HH&S ANALYSIS APPROACH

4.1 TECHNICAL MEMORANDUM #1

The hydrology, hydraulics, and sediment (HH&S) analysis will be broken up into two distinct technical memorandums (TMs). The first TM will review the topographic survey of the area and rainfall data collected and give a summary of the dam design criteria for the project. Both TMs will be submitted per the schedule that has been created by Farr West and approved by NRCS and City of Reno.

The effort for TM 1 will begin upon completion of the topographic survey. Utilizing the survey data, the stage-storage-discharge curve will be calculated for the box culvert that acts as the inlet for the East Wash Diversion Dam using the methods outlined in NEH Part 630 Chapter 14 (United States Department of Agriculture Natural Resources Conservation Service, 1997).

In addition to the stage-storage-discharge curve, the topographic survey data will be utilized in creating a topographic map of the East Wash Diversion and West Wash Dams sites. The site survey data will be integrated into existing Lidar data provided by the City of Reno. The map will include all parts of the project location including, but not limited to, the watershed, structures, embankments, principal spillways, auxiliary spillways, and downstream areas.

Rainfall amounts and distributions will be determined per NRCS TR 210-60 and Nevada State Dam Safety criteria and cataloged in TM 1 (United States Department of Agriculture Natural Resources Conservation Service, 2019). Rainfall data for the area will be collected using the point precipitation frequency estimates in the NOAA Atlas 14 per the Truckee Meadows Regional Drainage Manual (City of Reno; City of Sparks; Washoe County, 2009). Storm frequencies that will be collected are the 10-, 25-, 50-, 100-, 200-, 500-, and 1,000-year, 24-hour storms. The probable maximum precipitation (PMP) estimates for the local and general area will also be determined using NWS HMR No. 49 (NOAA, National Weather Service, 1984). In addition to the full PMP, 1/3 and 1/2 PMP estimates will be calculated. Durations for the storm events will be determined by NRCS TR 210-60 (United States Department of Agriculture Natural Resources Conservation Service, 2019) and Nevada State Safety of Dams criteria (State of Nevada, 2016)

TM 1 will also contain a summary of all applicable dam design criteria and performance standards set forth by NRCS, City of Reno, and NDWR. A table showing the dam components and their corresponding dam safety criteria from the three entities will be present within TM 1, and the most restrictive of the criteria will be identified and applied to all aspects of the project moving forward. Criteria will be pulled from NAC 535 and NRCS TR 210-60 (State of Nevada, 2016) (United States Department of Agriculture Natural Resources Conservation Service, 2019).

4.2 TECHNICAL MEMORANDUM #2

TM 2 will be completed in five distinct sections: sediment analysis, SITES modeling, spillway evaluations, inundation routings, and City of Reno storm sewer analyses. The calculations performed for TM 2 will utilize the rainfall data summarized in TM 1, and dam design parameters used will be those identified as most restrictive in TM 1. TM 2 will summarize all assumptions, methods, calculations, and conclusions from the analyses performed.

For the sediment analysis, existing stage-storage ratings will be calculated using the topographic data obtained from the TM 1 effort. The existing ratings will be compared to the as-built stage-storage ratings for both dams. This comparison will be used to compute the historic sediment yields and annual-sediment-rates for both dams. Future annual sediment yield rates will be projected based on historic rates. Sediment yield calculations will be governed by NEH Section 3 Chapter 6 and stage-storage ratings will be governed by NEH Part 630 Chapter 14 (United States Department of Agriculture Soil Conservation Service, 1983) (United States Department of Agriculture Natural Resources Conservation Service, 1997). A Sediment Storage Rationale will be developed per the requirements outlined in NWPM 505.35B and C (United States

Department of Agriculture Natural Resources Conservation Service, 2009). Guidance on the Sediment Storage Rationale will also be found in NWPH 605.35D and all nomenclature will conform to the definitions provided in NWPM 506.15 and NRCS TR 210-60 (United States Department of Agriculture Natural Resources Conservation Service, 2014) (United States Department of Agriculture Natural Resources Conservation Service, 2009) (United States Department of Agriculture Natural Resources Conservation Service, 2019). Utilizing the Sediment Storage Rationale and the future annual sediment yield rates, a worst-case scenario will be projected for the sediment storage life and stage-storage rating curves will be calculated for this scenario.

Hydrologic modeling of the dams will be performed using the NRCS SITES program. Drainage basins for the East Wash Diversion and West Wash Dams will be delineated utilizing the topographic data obtained in TM 1 via Aquaveo WMS. Once basins are delineated, hydrologic parameters for the basins (time of concentration, curve number, etc.) will be calculated per the Truckee Meadows Regional Drainage Manual (City of Reno; City of Sparks; Washoe County, 2009). Rainfall data obtained in TM 1 will also be used for the SITES models. Three different scenarios will be modeled: the West Wash Dam is non-existent (East Wash Diversion in-place), the East Wash Diversion and West Wash Dams are non-existent, and the East Wash Diversion and West Wash Dams are in-place. The ten storms determined in TM 1 will be modeled for all three scenarios. Model outputs that will be reported in this section are the inflow and outflow hydrographs and the maximum reservoir elevations. Peak inflow discharges determined by the SITES modeling will then be compared to USGS regression equation results to check reasonableness of assumptions made in the model. USGS regression equations will be governed by USGS WSP 2433 and USGS Fact Sheet 123-98 (United States Geological Survey, 1997) (United States Geological Survey, 1999).

Spillway evaluations will be performed for both principal and auxiliary spillways of the dams. The evaluations will be performed based on the East Wash Diversion and West Wash Dams in-place scenario. Frequency stage-discharge rating curves will be plotted to interpolate the frequency of use of the auxiliary spillways . A SITES hydrograph analysis will be performed to determine the principal spillway hydrograph, stability design hydrograph, and freeboard hydrograph. The hydrograph analysis will then be used to determine the required embankment raise required to meet the critical NRCS, City of Reno, and DWR auxiliary spillway capacity requirement for a high hazard dam. An evaluation of the condition of the West Wash Dam principal spillway will also be performed utilizing video recorded by the City of Reno using a CCTV camera-crawler.

Inundation routings will be broken up into two distinct categories: dam breach inundation routings and no dam-failure routings. Dam breach minimum peak discharges and hydrographs will be calculated using the NRCS TR-60 dam breach spreadsheet. Discharges and hydrographs will be calculated for two water surface elevation scenarios: reservoir WSE at the crest of the auxiliary spillway and reservoir WSE at the routed maximum during a flood produced by the PMP event. Both scenarios will have breach hydrographs routed from each dam downstream using HEC-RAS 2D modeling. Inundation routings will extend downstream to the point where the breach inundation water surface elevations converge with the 100-year flood profile of the Truckee River. Inundation maps will be prepared showing maximum elevations, maximum velocities, and times to peak.

No-dam failure routings will be modeled as steady peak-discharge floods from the downstream of the West Wash Dam to the Truckee River. All rainfall events modeled for the three scenarios will be used in the HEC-RAS 2D model. Inundation maps will be prepared showing flood extents, elevations, and flood depths. However, if any storm events do not produce an outflow hydrograph for any of the conditions, then no modeling will be necessary and inundation maps will not be prepared. In addition to the routings mentioned, two scenarios will be modeled at the 1/3, 1/2, and full PMP, with the assumption that the East Wash Diversion Dam embankment raise determined previously in the spillway evaluation section has been completed. One scenario will assume that the West Wash Dam embankment raise determined has also taken place and its auxiliary spillway location is unchanged. The other scenario will assume that the West Wash

Dam auxiliary spillway flow is immediately re-directed in the natural drainage way and that the embankment raise required for a high hazard dam has occurred.

The final section of TM 2 will include an analysis of the City of Reno storm sewer system. The system will be modeled for all storms and all scenarios based on the maximum reservoir elevations determined from the SITES modeling. This will determine the effects of the impounded water on the storm sewer system which is tied directly to the primary spillways of both the East Wash Diversion and West Wash Dams. The storm sewer system model will be built using City of Reno GIS data of the system in an InfoSWMM hydraulic model. Topographic data from TM 1 will be used as needed to complete the model.

5.0 SUMMARY

In summary, the following documents are still needed to complete the document review and to assist with development of the Supplemental Plan/ED:

a. Peavine Mountain Watershed Project Information (NRCS, January 1985)
b. USACE Phase II reports for dams
c. Past 404 permitting and correspondence, especially regarding sediment removal

In addition to the documents needed to fully understand the project background and work done to date, additional research and data collection in the area is required to move forward with the next steps of this project. The additional research and data collection needed is summarized below:

1. Supplemental survey
2. Additional information is needed regarding the existing facility building on TMWA owned Washoe County APN #001-111-11
3. Updated soils and geologic data
4. An aquatic resources and wetland verification report to be completed by a qualified wetlands specialist
5. A biological survey and assessment completed by a qualified biological resource specialist
6. Updated climate data from (NOAA) and the National Weather Service
7. A cultural resource survey of the project area of potential effects by an Archaeologist and Architectural Historian. Economic data to perform a Benefit Cost Analysis of the proposed project alternatives
8. A determination of potential impact to runoff and sediment loading from a partially or fully burned over watershed
9. A determination of the willingness of the City of Reno to continue sediment removal activities of the East and West Wash Dams (provided by the City of Reno)
10. Any documentation of alterations or addition of facilities on or near the East and West Wash Dams should be located and reviewed for potential impacts to the project (provided by the City of Reno/NRCS)
11. A full HH&S analysis to determine the current hydrology of the watershed and the potential impacts of identified project alternatives

Hydrologic modeling is needed to determine watershed runoff, flood routing and to inform project alternative selection. Hydrologic modeling is also needed to show updated potential inundation areas. Past reports evaluated in the document review indicate that there are facility deficiencies to watch for in the HH&S and alternative analysis. The HH&S will be discussed in depth in future Technical Memorandum #1: Rainfall/Hydrology and Technical Memorandum #2: HH&S.

The next steps are to begin the supplemental survey necessary for the modeling of the East and West Wash basins, begin the HH&S analysis, begin development of preliminary alternative with involvement of public and cooperating agencies, and obtain review comments from the City of Reno and NRCS on the Purpose and Needs Statement and the Data Collection & Analysis report.

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APPENDIX B – PRELIMINARY ENVIRONMENTAL DATA

Include following reports in this section:

- Custom Soil Resource Report for Washoe County, Nevada, South Part, West Wash-East Wash_Project
  - \\fwe-reno-file\Public\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.1 ReferenceMaterials\09_References List\NRCS_2020_Custom Soil Resource Report for Washoe County Nevada South Part West Wash East Wash Project Area.pdf
- National Wetlands Inventory – COR West Wash Area
  - \\fwe-reno-file\Public\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.1 ReferenceMaterials\09_References List\US Fish and Wildlife Service_2020_National Wetlands Inventory COR West Wash Area.pdf
- List of threatened & endangered species that may occur in the proposed project location and/or may be affected by the proposed project
  - \\fwe-reno-file\Public\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.1 ReferenceMaterials\09_References List\US Fish and Wildlife Service_2020_List of threatened and endangered species that may occur in project location.pdf
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Peavine Mountain Watershed - West Wash Dam Rehabilitation

Economic Appendix

USDA United States Department of Agriculture

Natural Resources Conservation Service

September 27, 2022, Revised July, 2025

HEC No. 200333

This Economic Appendix to the Peavine Mountain Watershed – West Wash Dam Rehabilitation was prepared by Hansford Economic Consulting LLC and revised DOWL, LLC based on comments provided by the NRCS.

The analyses and findings contained within this report are based on primary and secondary data available as of the date of this report and the methodologies used to conduct the work, which were provided by the United States Department of Agriculture, Natural Resources Conservation Science, and the United States Army Corps of Engineers. Updates to information used in this report could change or invalidate the findings contained herein. While it is believed that the primary and secondary sources of information are accurate, this is not guaranteed.

Every reasonable effort has been made in order that the data contained in this study reflect the most accurate and timely information possible. No responsibility is assumed for inaccuracies in reporting by the client, its consultants and representatives, or any other data source used in the preparation of this study. No warranty or representation is made that any projected values or results contained in this report would actually be achieved. Changes in economic and social conditions that may impact the findings of this report include, but are not limited to, national and local economic recessions, climate change, major environmental problems and natural disasters.

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Section 1: INTRODUCTION AND FINDINGS

1.1 INTRODUCTION

This document presents the economic analysis prepared as input to the Peavine Mountain Watershed – West Wash Dam Rehabilitation Project (Project), sponsored by the City of Reno (City or Reno) and the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS).

The West Wash Dam was built in 1960 under the direction and authority of the Watershed Protection and Flood Prevention Act (Public Law 83-566). The East Wash diversion dam was built in the same year under the same program to move storm water flow from the Peavine Mountain watershed into the West Wash Dam. Both the East and West Wash dams are eligible for rehabilitation through the USDA Watershed and Flood Prevention Operations Program. Both dams are currently classified as High Hazard dams by the Nevada Division of Water Resources and do not meet requirements for dam safety as prescribed by either the State of Nevada or the NRCS.

While flooding does occur in the City of Reno (predominantly in the Truckee River corridor), there haven't been any damages resulting from flood waters at the West Wash Dam since the impoundment was constructed in 1960. In the event that a local Probable Maximum Precipitation Event (PMP) were to occur in the Peavine Watershed, the City would deploy its Emergency Action Plan (EAP). The EAP uses a Yellow Alert and Red Alert. Yellow alert provides warning up to 5 days in advance of the anticipated flood event, and Red Alert evacuation approximately 24 to 48 hours in advance (2018 Washoe County Regional Flood Response Action).

1.2 PURPOSE OF THE ECONOMIC ANALYSIS

The Economic and Environmental Principles and Guidelines (P&G) for Water and Related Land Resource Implementation Studies (Executive Order 11747) Chapter 1, Section II is the guiding document used for the enclosed economic analysis[1]. Other key documents used in the development of the economic analysis are listed in Section 6.

The purpose of the economic analysis is to identify, among the reasonable alternatives both required and selected, the alternative that best meets the Federal Objective.

The Federal Objective.

> The Federal objective of water and related land resources planning is to contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements.

The National Economic Development (NED) Plan is further defined in P&G § 1.6.3:

[1] The plan follows the P&G guidelines as was selected and approved by the team including the State NRCS office at the commencement of this analysis.

"A plan that reasonably maximizes net national economic development benefits, consistent with the Federal objective, is to be formulated. This plan is to be identified as the national economic development plan."

The NED Plan consistent with protecting the Nation's environment must be selected for funding to be provided through the USDA Watershed and Flood Prevention Operations Program unless the Secretary of a department or head of an independent agency grants an exception when there is some overriding reason for selecting another plan, based upon other Federal, State, local, and international concerns.

The following only applies to the Watershed Rehabilitation Program: National Watershed Program Handbook Section 502.2, states, "In cases where human life is at risk in the event of catastrophic failure of an existing dam that does not meet current safety and performance standards, an overriding reason for an exception to the NED plan requirement exists.

(1) To avoid seeking individual exceptions in such cases, the NED plan is defined as the federally assisted alternative with the greatest net economic benefits. ***Thus, for rehabilitation projects, the no-action alternative may not be identified as the NED alternative, but will continue to be included to allow a valid comparison of the reasonable alternatives.***

(2) Rehabilitation alternatives, required by legislation and policy to be evaluated, include no action, decommissioning, rehabilitation, and, where applicable, relocation of at-risk dwellings, as well as additional alternatives, as appropriate.

(3) If all reasonable alternatives result in the same benefits, use a least-cost analysis to evaluate alternatives and select the NED plan. ***If benefits of all alternatives are not the same, a benefit-cost analysis will be completed for all reasonable alternatives***. A project-specific exception would be required if the policy-identified NED plan is not selected."

The West Wash Dam economic analysis, presented in this appendix, conducts a Benefit-Cost Analysis (BCA) for all reasonable and required alternatives, and identifies the NED plan.

1.3 PROJECT ALTERNATIVES

Through a series of public workshops and consultation between the project sponsors and the consulting engineer for the project, Farr West Engineering, four reasonable and required project alternatives have been identified. **Table 1-1** provides a summary of the project alternatives.

Alternatives 1 through 3 keep or rehabilitate the West Wash Dam. Flooding under the 100-year, 200-year, 500-year, and local PMP events were simulated for these alternatives. Alternatives 4 and 5 remove the dams; flooding under the 10-year, 25-year, 50-year, and 100-year events were simulated for these alternatives.

Table 1-1
Summary of the Project Alternatives

Alternatives	Analysis Flood Event	The Project	Conditions
1 Future Without Project	100-YR	City continues maintenance of existing dams. No improvements. **Does not meet State dam standards for the PMP.**	Existing dam does not release any water over the AS until the 200-yr storm. EW will not breach during a PMP event. **WW will breach during a PMP event.**
2 Downstream Flood Improvements	100-YR	**No improvements to existing dams; flood-proof downstream.** Purchase all structures within the WW Local PMP breach inundation areas that will have over a foot of water on property and repair damages to structures that will have under a foot of water on property. **Does not meet State dam standards for the PMP.**	Existing dam does not release any water over the AS until the 200-yr storm. EW will not breach during a PMP event. **WW will breach during a PMP event.**
3 Remediate West Wash Dam to contain PMP	100-YR **Improve existing WW dam**. Raise WW dam 5 feet, add 2 foot parapet wall on eastern berm near dam, regrade western slope of impoundment area to hold more water, widen AS to 80 feet, lower AS crest height by 2.4 feet.	AS will not activate until 500-year storm. Local PMP will have 3ft of freeboard and there will be **no breach of dam.**	
4 Remove both Dams	100-YR	**Remove both dams** and regrade impoundment areas to reflect pre-development conditions.	**All storm events will flood structures downstream of both dams.**
5 Remove both Dams - Flood Conveyance to Truckee River	100-YR	**Remove both dams**; **construct a channel that will convey 100-year flood flows to the Truckee River**. Purchase and demo all structures in proposed channel alignment and construct box culvert crossings under all perpendicular roads and RR.	**Channel will not flood in any instances**; will hold 100-yr storm with freeboard.

Notes: EW = East Wash, WW= West Wash, AS = Auxiliary Spillway, RR= Railroad.

1.4 Methodology Overview

Alternatives 2 and 5 include significant land acquisitions as part of the project. Only the acquisition costs are included in the economic analysis; however, moving and relocation expenses could be a significant factor in selecting the alternative project. It is here noted that the requirements of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91- 646), as amended, include real property acquisition relocation payments to a displaced person, business, or farm operation. Such payments include moving and related expenses for a displaced person, business, or farm operation; financial assistance for replacement housing for a displaced person who qualifies and whose dwelling is acquired because of the project; and termination payments for dislocated businesses whose owners choose to close out. In addition, replacement dwellings must be decent, safe, and sanitary. If a displaced homeowner's current dwelling does not meet these minimum requirements, then it requires a betterment by replacing the dwelling with a structure that meets the minimum requirement.

The BCA is performed in a series of steps that are described here:

BCA	Step	Table(s) in Report	Description
Background and	1	Maps 3-1, 3-2, and 3-3	Identify the Affected Area (performed by Farr West Engineering).
Engineering	2		Identify the properties and assets in the Affected Area (performed by Farr West Engineering).
	3		Determine flood depth, velocity and duration of flooding (performed by Farr West Engineering).
	4	Table 3-1	Determine the useful life of the project, period of the BCA analysis, and the discount factor.
	5		Create a database of parcels with depth of flooding on each parcel for each flood event under each alternative (completed by Farr West Engineering).
Benefits Analysis	6	Tables 3-2 through 3-4	Categorize properties to perform damages analysis and refine database for queries. Inventory damages from single flood events.
	7	Tables 3-5 through 3-10	Determine the depth-damage curves for physical property damages (structures and contents).
	8	Table 3-11	Calculate damage costs for each event under each alternative.
	9	Tables 4-1 and 4-2	Determine the damage-frequency (probability of the event) and Expected Annual Damage (EAD) for each alternative.
	10	Tables 4-3 through 4-6	Calculate the average annual equivalent benefits for each alternative.
Costs Analysis	11	Tables 4-7 and 4-8	Estimate installation project costs at base year - 2025 dollars – (completed by Farr West Engineering).
	12	Tables 4-9 and 4-10	Estimate project maintenance costs (completed by the City of Reno).

	13	Tables 4-11 and 4-12	Calculate the average annual equivalent project installation and maintenance costs.
Results	14	Tables 5-1 through 5-4	Compute Net Benefits and Benefit-Cost Ratios
	15	Table 5-5	Display Results and the NED Alternative

The BCA does not include all potential benefits and costs that could be monetized in the NED account. **Table 1-2** summarizes the economic impacts included and excluded from the analysis.

Table 1-2
Economic Impacts Included and Excluded in the NED

Benefits	Costs
Included in the BCA Damages to buildings/structures & contents	**Included in the BCA** Design & other soft costs, project construction, land/property purchases, maintenance costs for life of project
Excluded from the BCA Erosion, recreation loss, income loss (wages & profits), relocation costs, emergency costs & post-flood clean-up costs, vehicle damages, time lost due to detours (road & rail); damage to special and unique facilities	**Excluded from the BCA** Existing structure demolition costs, flood-proofing of existing structures costs, permanent relocation costs, land restoration costs, long-term environmental control costs

Given the scope and budget of the economic analysis for the Peavine Mountain Watershed - West Wash Dam Rehabilitation Project, damages analysis was limited to structural damages. In review of other recently completed flood control project economic analyses, structural (including contents) damages comprise the vast majority of total damages identified and monetized. In the Saint Vrain Creek, Longmont, Colorado economic analysis (completed in 2020), which conducted a thorough analysis of different measurable damages, 87% of total damages monetized in the NED were structural.

Although additional damages and costs could be monetized, their addition is not anticipated to change the results of the economic analysis for these reasons:

- There is little recreation value from the current project. The only recreation is for activities such as dog-walking and riding bicycles. These activities have been a by-product of building the West Wash Dam, they were not an intended recreational use of the facilities.

- The EAP Red Alert gives approximately 24 to 48 hours advance notice to evacuate. This is sufficient time for most residents to remove vehicles from the premises, as well as key items of value and sentiment. Economic Guidance Memorandum (EGM) 09-04 provides that only 12% of respondents to a survey would not move at least one vehicle to higher ground with warning time greater than 12 hours.

- Even a local PMP event would result in traffic re-routing of no more than 12 hours (City of Reno estimate based on prior floods in the City). Delays to railroad activities could be more significant; however, these were not included in the analysis due to budgetary constraints.
- Due to the short duration of even the worst possible flood event, temporary relocation costs are not anticipated to be significant compared to the cost of the structural and content damages.

- Income loss was excluded from the benefits analysis due to the short duration of the potential worst flood. Income loss would be greater under some alternatives than other alternatives.

- Local share of clean-up costs from flooding is a cost item that the City budgets for. The most recent floods, from the Truckee River, cost the City $2.13 million (in 2005) and $3.92 million (in 2017), with the local cost share approximately 4%, and 96% of costs reimbursed by the Federal Emergency Management Agency (FEMA). It is anticipated that there would be emergency and clean-up costs incurred under all alternatives except alternative 5. This item was not included in the analysis due to time and budgetary constraints.

- Existing structure demolition costs were excluded from the analysis given the high-level of planning at this stage of the project. Flood-proofing of existing structures would only be required for Alternative 2, which is already the most expensive project (addition of such costs would not change the outcome of the analysis). Land restoration and long-term environmental control costs are not monetized but are discussed in the Environmental Assessment.

1.5 FINDINGS

Results of the NED account analysis are shown in **Table 1-3**. The table displays the differences between the forecasted conditions with the projects (alternatives 2 through 5) and forecasted conditions without a project (Alternative 1).

The NED Plan is Alternative 3 because it addresses the threat to human life posed by these dams with the least reduction in net economic benefits from the No Action alternative, which does not. Under Alternative 3, all existing properties are protected as they are currently in the 100- year flood event, and better in the 200-year, 500-year, and local PMP events. Further, in a local PMP event, Alternative 3 would allow a controlled release through the auxiliary spillway; fewer properties in total would be damaged than in the future without a project, and both East and Wash dams would be in compliance with State and NRCS requirements.

The RED account monetizes the property tax loss from property acquisitions under alternatives 2 and 5, as this information is readily available in the data from the Washoe County Assessor (Assessor) used to conduct the economic analysis. Property taxes (which are allocated among the State of Nevada (State), and local service providers) would be reduced by $69.7 million per year under Alternative 2 and $6.7 million per year under Alternative 5. Other municipal revenue losses were not monetized but would increase the negative benefits in the RED account. Some rebound revenue from new building elsewhere in the City is a possibility, but because this region of the City is at build out, much rebound revenue from the relocated population is likely to end up in surrounding jurisdictions and for this reason, it is not included in the analysis.

Table 1-3
NED Results

Alternative	Equivalent Annual Net Benefit *	Benefit-Cost Ratio	Benefit-Cost Ratio
	In $1,000s		
Alt. 1 Future Without Project [1]	--	--	--
Alt. 2 Downstream Flood Improvements [1]	($42,570)	0.00:1	0
Alt. 3 Remediate West Wash Dam to contain PMP	**($510)**	**0.16:1**	**.2**
Alt. 4 Remove both Dams	($13,570)	-96.3:1	-96
Alt. 5 Remove Dams - Flood Conveyance to Truckee River	($4,130)	0.00:1	0

** Rounded to the nearest ten thousand dollars.*
The Alternative 3 net benefit is negative $510,000, for example.

The values shown in this table are relative to the values associated with the No Action Alternative hence the lack of values for Alt 1. Under both of these alternatives, the West Wash Dam Auxiliary Spillway breaches during the PMP. Pursuant to the National Watershed Program Manual Section 502.2, existing dams not meeting current safety and performance standards cannot be identified as the NED alternative, but will continue to be included to allow a valid comparison of the alternatives.

The OSE account measures some of the social and other impacts that would occur under alternatives 2 and 5. Alternative 2 displaces about 2,000 permanent residents, causes an estimated almost 2,500 jobs to be lost or relocated out of the area, and reduces annual visitation to Reno's Downtown by about 18,000 people per year.

Alternative 1, the do-nothing option, does not meet the State or NRCS standards and it does not address a significant risk to the City. For this reason, it is not recommended. Alternatives 2, 4, and 5 fundamentally alter the economic fabric and character of the City of Reno. Downtown Reno is the historical heart of the "Biggest Little City". In addition, the socioeconomic description of the Affected Area (see Section 2) shows there is a high proportion of minorities living in Downtown Reno compared with the City of Reno, as well as a lower income, more transitory and older population with a higher proportion of the population having a disability, and living in poverty than in the City of Reno, the State, and the US. These disadvantaged persons would be severely impacted as much of Downtown Reno becomes a flood plain under alternatives 2, 4, and 5; they would not be impacted under alternative 3.

Given the results of the NED account analysis, and the findings of the RED and OSE accounts, as well as description of the socioeconomic characteristics of the Affected Area, Alternative 3 is the recommended alternative.

Section 2: STUDY AREA

2.1 LOCATION AND LAND USE

West Wash Dam lies within northwest Reno, as shown in **Map 1**. The City of Reno has a population of 250,900, and is itself part of the Reno-Sparks Metropolitan Area, which has a population of 468,300[2]. The area protected by the West Wash Dam is urban, containing mostly residential and non-residential uses, some governmental and quasi-governmental uses, and two public parks.

Map 1
West Wash Dam Location

Photo from Google Earth.

The "Affected Area", which is the area in the City of Reno containing properties that could potentially be damaged by a flooding event in the local area of the West Wash Dam, is displayed in **Map 2**. Land uses of the properties shown in blue (flooded in the local PMP event) in Map 2 are summarized in **Table 2-1**. In total, 364 acres could be flooded.

The Affected Area encompasses six census tracts; 13, 14, and 24.01 located north of Interstate 80 (I-80), and 1.03, 1.04, and 1.06 located south of I-80. Other census tracts shown on **Map 2** are not included in the following description of the Affected Area.

[2] Table DP05, US Census Bureau – 2020 American Community Survey 5-year estimates.

Map 2
Map of the Affected Area

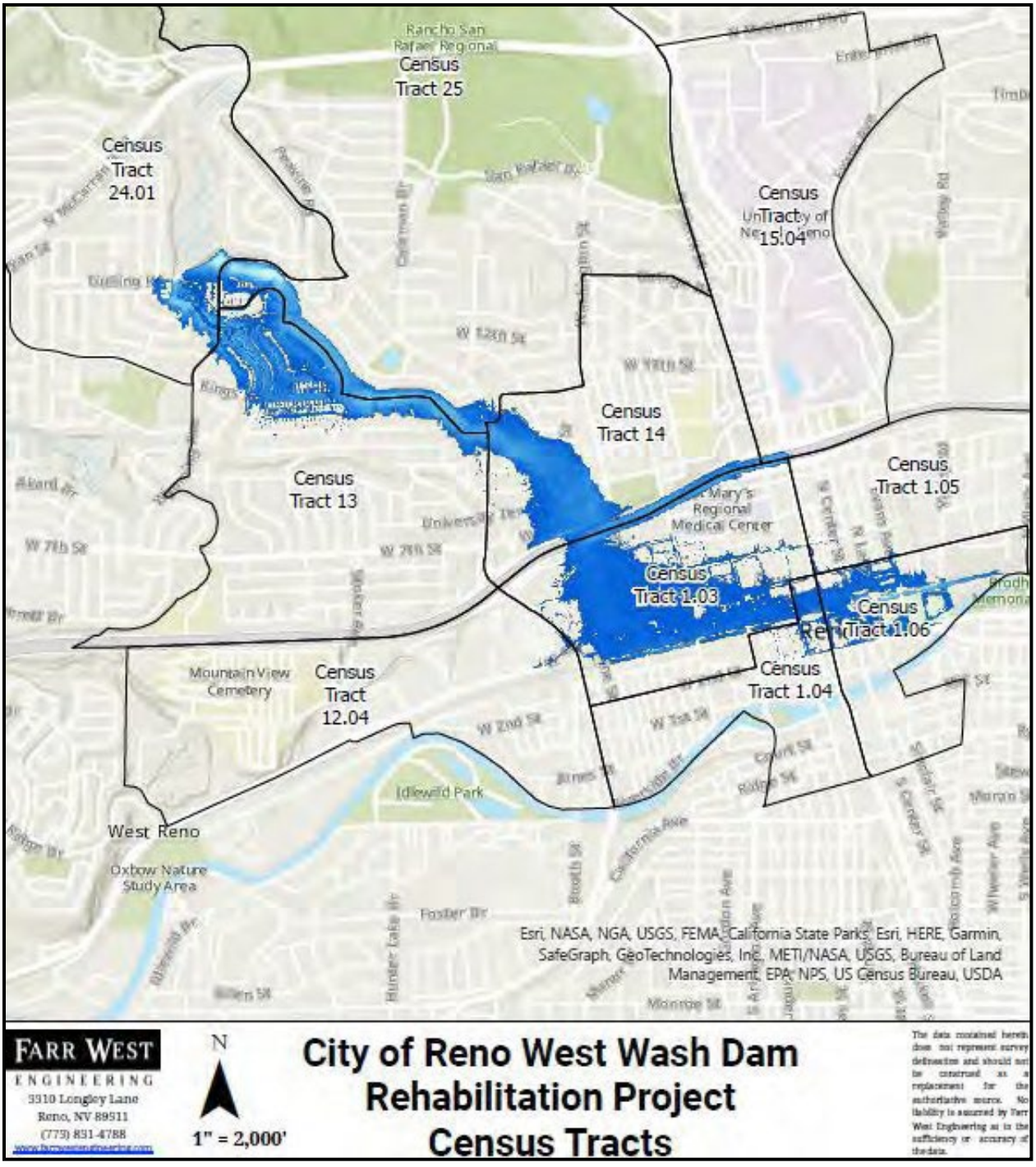


Table 2-1
Acreage Potentially Flooded (Future without Project)

Land Use	Acres	Percentage of Area
Single Family Residential	123	34%
General Commercial [1]	84	23%
Vacant	68	19%
Entertainment (casinos, hotels, resorts) [2]	40	11%
Public Parks	6	2%
Apartments & Townhomes	12	3%
Office & Professional Uses	11	3%
Common Area	13	3%
Industrial & Warehouse	4	1%
Public Utility	3	1%
Total	**364**	**100%**

Source: Farr West Engineering and Washoe County Assessor, March 2022.

[1] Includes retail, restaurants, fast food, churches, convenience stores, a railroad passenger terminal, and St. Mary's Hospital.

[2] Includes the bowling center and convention center owned by the City of Reno.

About a third of the total land area that is estimated to be inundated during a local PMP event is used for single family (attached and detached) housing. The majority of the single-family housing is located north of I-80. General commercial uses are found both north and south of I-80, with the greatest concentration being along Keystone Avenue. General commercial encompasses a wide variety of uses including retail, restaurants, fast food, churches, and convenience stores, as well as some specialty uses including a railroad passenger terminal, and St. Mary's Hospital. Office and professional uses are scattered around the downtown core, with many of the buildings having been converted from residential to office use.

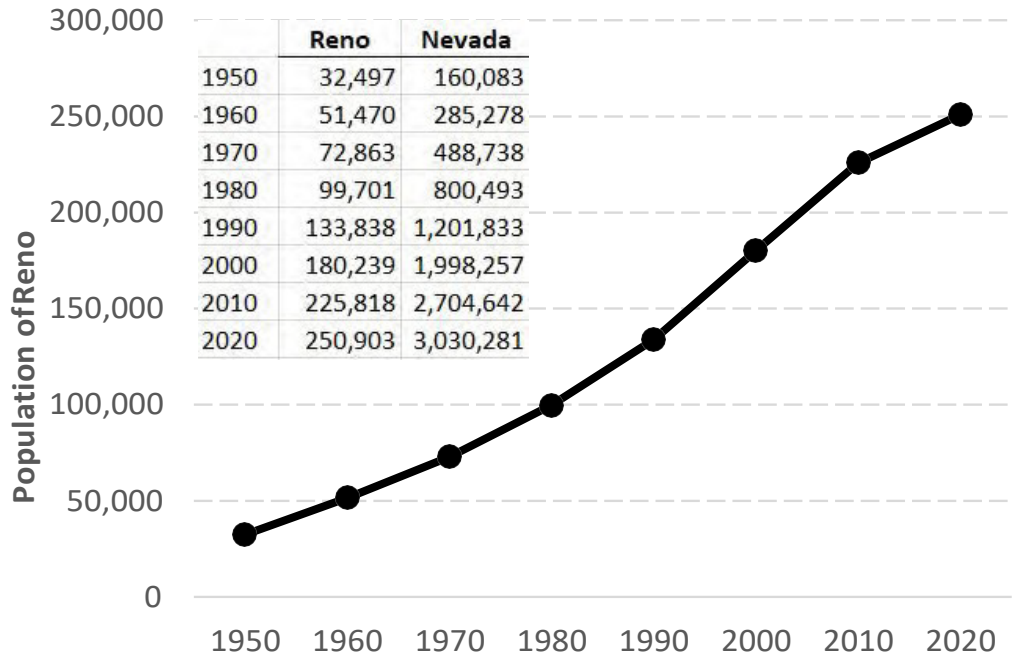
There are several other specialty uses of land in Downtown Reno. Casinos, once the primary source of municipal revenues to Northern Nevada, still line Virginia Street, interspersed with some large and moderate-sized hotels. The National Bowling Stadium and the Convention Center, both owned by the City of Reno, lie in the flood inundation area, as well as Greater Nevada Field, home of the Reno Aces (triple-A baseball team). The Union Pacific Railroad track, which reached Reno 154 years ago, runs through the heart of downtown.

2.2 POPULATION AND HOUSING

The City of Reno is a thriving economic hub with a growing population. **Figure 1** shows population growth in the City of Reno and State of Nevada since 1950, the last decennial Census before the West Wash Dam was constructed.

The City of Reno has sustained an average annual population growth of 3.0% since 1950, while the State of Nevada has seen average annual population growth of 4.3% during the same period.

Figure 1
City of Reno Historical Population Growth



	Reno	Nevada
1950	32,497	160,083
1960	51,470	285,278
1970	72,863	488,738
1980	99,701	800,493
1990	133,838	1,201,833
2000	180,239	1,998,257
2010	225,818	2,704,642
2020	250,903	3,030,281

Source: US Census Bureau.

Table 2-2 compares socioeconomic variables that describe the Affected Area with the City of Reno, the State of Nevada (State), and the United States (US).

Population. There are about 16,200 residents (6% of Reno's total population) living in the Affected Area, although not all of the homes would sustain damage in the event of a local PMP event and subsequent expected breach of the West Wash Dam auxiliary spillway. The median age of residents in Reno is 38.5 years, about the same as in the US and the State; in the Affected Area, the median age is much greater in three of the census tracts (48.6 years, 49.4 years, and 56.2 years). These three census tracts lie south of I-80.

Compared with the City of Reno, the State, and the US, there is a much larger percentage of persons living below the poverty level in three of the census tracts, including two of the tracts south of I-80, and census tract 14. There is also a much higher proportion of people living with a disability in two of the census tracts south of I-80 (32% and 26% compared with 12% in Reno, the State, and the US). Median household income (MHI) varies widely between the census tracts; from 53% of the City's MHI to 122% of the City's MHI. Generally, household income is higher in the mostly residential areas north of I-80. Conversely, there is a high proportion of residents receiving food stamps/SNAP benefits in Downtown Reno.

The unemployment rate is similar to the State and the US in most of the census tracts (5% to 7%), but it is much higher in Downtown Reno (at least 15%). The percentage of households without a vehicle is much greater in Downtown Reno (18% to 45%) compared with the State and the US (8%); the same as the City of Reno in census tract 14, and lower than the State average of 7% in census tract 13 (5%) and census tract 24.01 (2%).

Housing. There is a total of 7,900 housing units in the Affected Area (7% of the City's housing stock). Most of the housing units are north of I-80; however, there is also a relatively large number of homes located in census tract 1.04, which is south of I-80. Note that the vast majority of the homes in this census tract lie outside of the flooded portion of the census tract.

A large share of the housing units are studio and 1-bedroom units south of I-80. In the City, 21% of units have 1-bedroom or less; in the tracts south of I-80, 86% of units are this size in census tract 1.03, 61% in census tract 1.04, and 95% in census tract 1.06. A third of the housing units in census tract 14 are studio or 1-bedroom units. These statistics indicate a very transitory population living in the Affected Area, particularly in the area south of I-80, which is Downtown Reno.

With the exception of census tract 24.01, the housing stock is generally older than for the City of Reno, and much older than the State, reflecting the rapid growth in other parts of the State in the past 50 years. Occupancy is similar to that of the City, State, and the US in most of the census tracts, but it is lower in census tract 1.03, where many older homes have been repurposed from residential to commercial uses. The percentage of units that are occupied by owners is significantly low south of I-80. Only 4% of units are occupied by owners in some parts of Downtown Reno. This is much lower than the City's average of 48%, the State's average of 57%, and the US average of 64%. Two of the census tracts north of I-80 have much higher owner occupancy than the City, State, and US.

As expected with the high proportion of studio and one-bedroom units south of I-80, in and around downtown Reno, household sizes are smaller in and around Downtown Reno.

The socioeconomic variables point to a generally older, more transitory, lower-income, and disabled population south of I-80, and a more typical residential population (meaning more similar to the City, State, and the US) living in the Affected Area north of I-80.

Table 2-2
Socioeconomic Characteristics

Variable	United States	State of Nevada	City of Reno	Census Tract (South of I-80) 1.03	1.04	1.06	Census Tract (North of I-80) 13	14	24.01
Population	**326,569,308**	**3,030,281**	**250,903**	**963**	**2,922**	**1,175**	**3,465**	**3,439**	**4,190**
Median Age	**38.1**	**38.0**	**38.5**	**48.6**	**49.4**	**56.2**	**38.0**	**22.5**	**32.2**
Persons below the Poverty Level	40,910,326	381,695	31,049	280	455	566	477	1,139	360
Percent below the Poverty Level	*13%*	*13%*	*12%*	*29%*	*16%*	*48%*	*14%*	*33%*	*9%*
Population with a Disability	40,786,461	375,254	29,390	308	485	307	555	197	449
Percent with a Disability	*12%*	*12%*	*12%*	*32%*	*17%*	*26%*	*16%*	*6%*	*11%*
Median Household Income	**$64,994**	**$62,043**	**$58,790**	**$30,906**	**$49,754**	**n.a.**	**$70,464**	**$38,884**	**$71,912**
Percent of State MHI				*53%*	*85%*	*n.a.*	*120%*	*66%*	*122%*
Households receiving Food Stamp/SNAP Benefits	11%	12%	11%	18%	12%	42%	11%	5%	4%
Total Housing Units	**138,432,751**	**1,268,533**	**112,516**	**904**	**1,819**	**600**	**1,459**	**1,593**	**1,582**
Occupied	122,354,219	1,130,011	105,321	699	1,749	511	1,347	1,383	1,530
Vacant	16,078,532	138,522	686	205	70	89	112	210	52
Occupancy	*88%*	*89%*	*94%*	*77%*	*96%*	*85%*	*92%*	*87%*	*97%*
Owner-Occupied	78,801,376	644,864	50,244	30	618	22	953	295	1,023
Percent occupied by Owners	*64%*	*57%*	*48%*	*4%*	*35%*	*4%*	*71%*	*21%*	*67%*
Studio / 1-bdrm Units	18,545,872	172,138	23,267	774	1,101	569	107	532	181
2+ Bedroom Units	119,886,879	1,096,395	89,249	130	718	31	1,352	1,061	1,401
Percent of Units less than 2 Bedrooms	*13%*	*14%*	*21%*	*86%*	*61%*	*95%*	*7%*	*33%*	*11%*
Built since 1970	85,996,081	1,131,168	88,029	590	829	405	645	639	1,345
Older than 50 Years	52,436,670	137,365	24,487	314	990	195	814	954	237
Percent of Units older than 50 Years	*38%*	*11%*	*22%*	*35%*	*54%*	*33%*	*56%*	*60%*	*15%*
Persons per Household	**2.67**	**2.68**	**2.38**	**1.38**	**1.67**	**2.30**	**2.57**	**2.49**	**2.74**
Civilian Labor Force	**164,759,496**	**1,525,262**	**138,697**	**620**	**1,969**	**518**	**1,726**	**2,451**	**2,655**
Employed	155,888,980	1,425,040	131,317	528	1,867	367	1,662	2,265	2,419
Unemployment Rate	*5%*	*7%*	*5%*	*15%*	*5%*	*29%*	*4%*	*8%*	*9%*
Average Travel Time to Work (minutes)	27	25	21	21	23	21	20	20	26
Households with Vehicles									
No Vehicle	10,344,521	82,002	9,243	188	318	228	71	131	34
At least 1 Vehicle	112,009,698	1,048,009	96,078	511	1,431	283	1,276	1,252	1,496
Percentage Households without a Vehicle	8%	7%	9%	27%	18%	45%	5%	9%	2%

Source: 2020 American Community Survey 5-year estimates, US Census Bureau.

Table 2-3 shows that there is a high proportion of minorities living in Downtown Reno compared with the City of Reno. North of I-80, minorities are a smaller percentage of the total population. Latino and Asian minorities represent the largest number of minorities.

Table 2-3
Race and Ethnicity

Race and Ethnicity	City of Reno	Census Tract (South of I-80) 1.03	1.04	1.06	Census Tract (North of I-80) 13	14	24.01
Minorities							
Black	7,967	23	60	327	10	64	196
American Indian and Alaska Native	2,778	59	33	38	8	112	0
Asian	18,057	121	494	57	320	316	711
Native Hawaiian and Pacific Islander	1,975	0	0	8	1	26	0
Latino Ethnicity (any race)	60,270	107	873	105	368	685	441
Total Minorities	**91,047**	**310**	**1,460**	**535**	**707**	**1,203**	**1,348**
Total Population	**250,903**	**963**	**2,922**	**1,175**	**3,465**	**3,439**	**4,190**
Minorities as Percentage of Total	**36%**	**32%**	**50%**	**46%**	**20%**	**35%**	**32%**

Source: 2020 American Community Survey 5-year estimates, US Census Bureau.

2.3 EMPLOYMENT

Reno's labor force primarily works in educational services, health care, social assistance, arts, entertainment, recreation, accommodation and food services, and retail trade. **Table 2-4** shows that the primary employment industry for residents in the Affected Area is arts, entertainment, and recreation, and accommodation and food services. In the census tracts north of I-80, a high proportion of residents are employed in educational services, and health care and social assistance. The labor force in the Affected Area works in industries that reflect the overall City employment.

The percentage of workers working from home is similar in the Affected Area as in the City. For those who travel to work, driving alone is the main form of transportation in all census tracts, except 1.06. Only 40% of workers drive alone in census tract 1.06 (downtown), 59% of workers drive alone in census tract 1.04 (downtown), and 60% drive alone in census tract 14 (close to downtown but north of I-80 and connected by bridges). In two of these census tracts, a high proportion (20%-25%) of workers walk to work. In the area south of I-80, a much higher proportion of workers use public transit than in the City.

The employment figures also point to a lower-income, more transitory population living in or near the downtown core working in lower-paying service industry jobs (at the casinos, hotels, and restaurants for example).

Table 2-4
Employment by Industry Sector and Means of Travel to Work

Occupation	City of Reno	Census Tract (South of I-80) 1.03	1.04	1.06	Census Tract (North of I-80) 13	14	24.01
Industry							
Agriculture, forestry, fishing & hunting, and mining	1%	0%	1%	0%	0%	2%	1%
Construction	7%	0%	4%	3%	6%	4%	7%
Manufacturing	7%	15%	7%	7%	4%	3%	4%
Wholesale trade	3%	3%	3%	0%	2%	6%	2%
Retail trade	12%	15%	11%	2%	17%	8%	14%
Transportation & warehousing, and utilities	6%	16%	5%	13%	5%	2%	6%
Information	2%	0%	0%	0%	2%	0%	1%
Finance & insurance, and real estate & rental and leasing	5%	8%	7%	4%	6%	1%	11%
Professional, scientific, & management, and administrative & waste management services	11%	13%	14%	17%	12%	15%	8%
Educational services, and health care & social assistance	20%	8%	13%	10%	17%	28%	22%
Arts, entertainment, & recreation, and accommodation & food services	18%	16%	26%	44%	20%	26%	14%
Other services, except public administration	4%	0%	2%	1%	5%	2%	3%
Public administration	4%	6%	6%	0%	4%	3%	7%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Percentage of the Labor Force							
Working from Home	4%	0%	10%	7%	6%	6%	2%
Working Elsewhere	96%	100%	90%	93%	94%	94%	98%
Means of Transportation to Work							
Driving Alone	79%	73%	59%	40%	79%	60%	79%
Carpooling	13%	10%	5%	20%	10%	13%	14%
Using Public Transportation	2%	11%	20%	12%	6%	1%	1%
Walking to Work	4%	6%	9%	23%	2%	21%	1%
Other Means	2%	0%	7%	6%	2%	5%	4%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Source: 2020 American Community Survey 5-year estimates, US Census Bureau.

Section 3: ECONOMIC ANALYSIS COMPONENTS

The Economic and Environmental Principles and Guidelines (P&G) for Water and Related Land Resource Implementation Studies (Executive Order 11747) provides four accounts in which to record information that may be relevant to decision makers. These include:

a) National economic development (NED) - shows effects on the national economy,

b) Environmental quality (EQ) - shows effects on ecological, cultural, and aesthetic attributes of significant natural and cultural resources that cannot be measured in monetaryterms,

c) Regional economic development (RED) - shows the regional incidence of NED effects, income transfers, and employment effects, and

d) Other social effects (OSE) - shows urban and community impacts and effects on life, health and safety.

The NED account (P&G § 1.7.2) is the only required account. Other information that is required by law or that will have a material bearing on the decision-making process should be included in the other accounts (EQ, RED, and OSE) or in some other appropriate format used to organize information on effects. Effects in the NED account must be expressed in monetary units. EQ effects can be expressed in appropriate numeric units or non-numeric terms. RED and OSE effects can be expressed in monetary units, other numeric units, or non-numeric terms. Monetary values must be expressed in average annual equivalents by appropriate discounting and annualizing techniques using the applicable discount rate.

3.1 NED ACCOUNT

The NED analysis used the following general methodologies:

- The BCA is conducted for a 56-year period to include six years of planning and construction and the estimated useful life of the project (50 years). A sensitivity analysis was run with a 100-year evaluation period, the maximum allowable evaluation period; it did not change the results of the analysis. While each of the alternatives have different planning and construction timeframes, the schedule for Alternative 3 (Dam Remediation) is used for all of the alternatives. Per P&G § 1.4.12 (a) The period of analysis is to be the same for each alternative plan.

- Benefits and costs for this study are computed at the 2025 price level as appropriate.

- The analysis uses the Federal Water Projects discount rate of 2.25 percent. The discount rate is used to discount benefits and costs projected to be realized. The discount rate can be commonly thought of as the cost of money, or the interest rate.

- The analysis estimates the annualized damages the community can expect to suffer over the 56-year period for each alternative. The calculated damages for each alternative are based on the probability of exceedance of each of the flood events modeled. The annualized damages represent the average of different sized storm events. During many years there will be no damages while, in others, damages may be much greater than the estimated annualized damages.

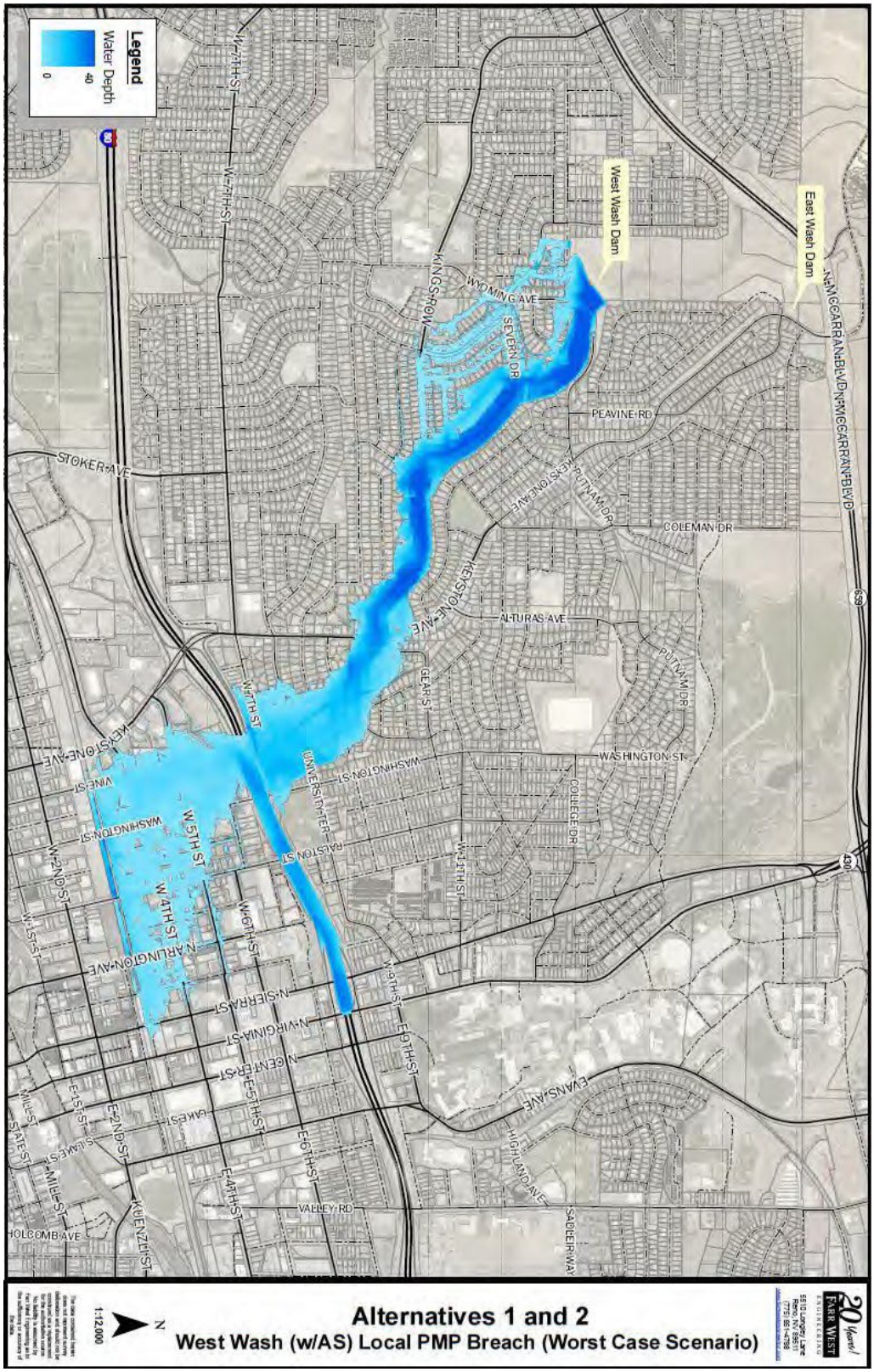
3.2 Structures and Depth-Damage Relationships

Farr West Engineering provided the maps and databases for each flood event modeled under each alternative. Inundation of properties is illustrated in **Map 3-1** for the local PMP event under alternatives 1 and 2, **Map 3-2** for the local PMP event under Alterative 3, and **Map 3-3** for the 100-year flood event under alternatives 4 and 5. A flood depth for every Assessor parcel was provided under each storm event. To conduct the damage calculations, every developed parcel (a building exists on the parcel) was assigned to a Structural Depth Damage Function Category (SDDF Category). **Table 3-1** provides the list of land use and building types provided by Washoe County, and the SDDF Category assigned for the analysis. There are some building uses that are not described well by the Assessor for purposes of the BCA. Google Earth and the Assessor's online maps were used to conduct a survey of the non-residential buildings to assign the parcel to the best SDDF Category.

The greatest number of buildings are damaged under the Future without Project (Alternative 1) local PMP event. **Table 3-2** shows the number of parcels with structural damage by SDDF Category. Single Family Residential has been further categorized according to building layout. This information is provided in the Assessor's records. Of the 676 single family residences, almost 70% are one-story (the majority of which without a basement), 14% are two-story, and 17% are split level. Most homes do not have a basement; 17% do have a basement. The majority of the non-residential parcels (62%) have been developed as apartments. Retail clothing and hotel uses occupy the next largest number of parcels.

The number of parcels with damaged structures by alternative is shown in **Table 3-3**. While alternatives 4 and 5 can only be compared with alternatives 1, 2, and 3 for the 100-year storm, the increased protection under alternatives 2 and 3 compared with alternative 1 is evident, particularly the protection under the 200-year storm.

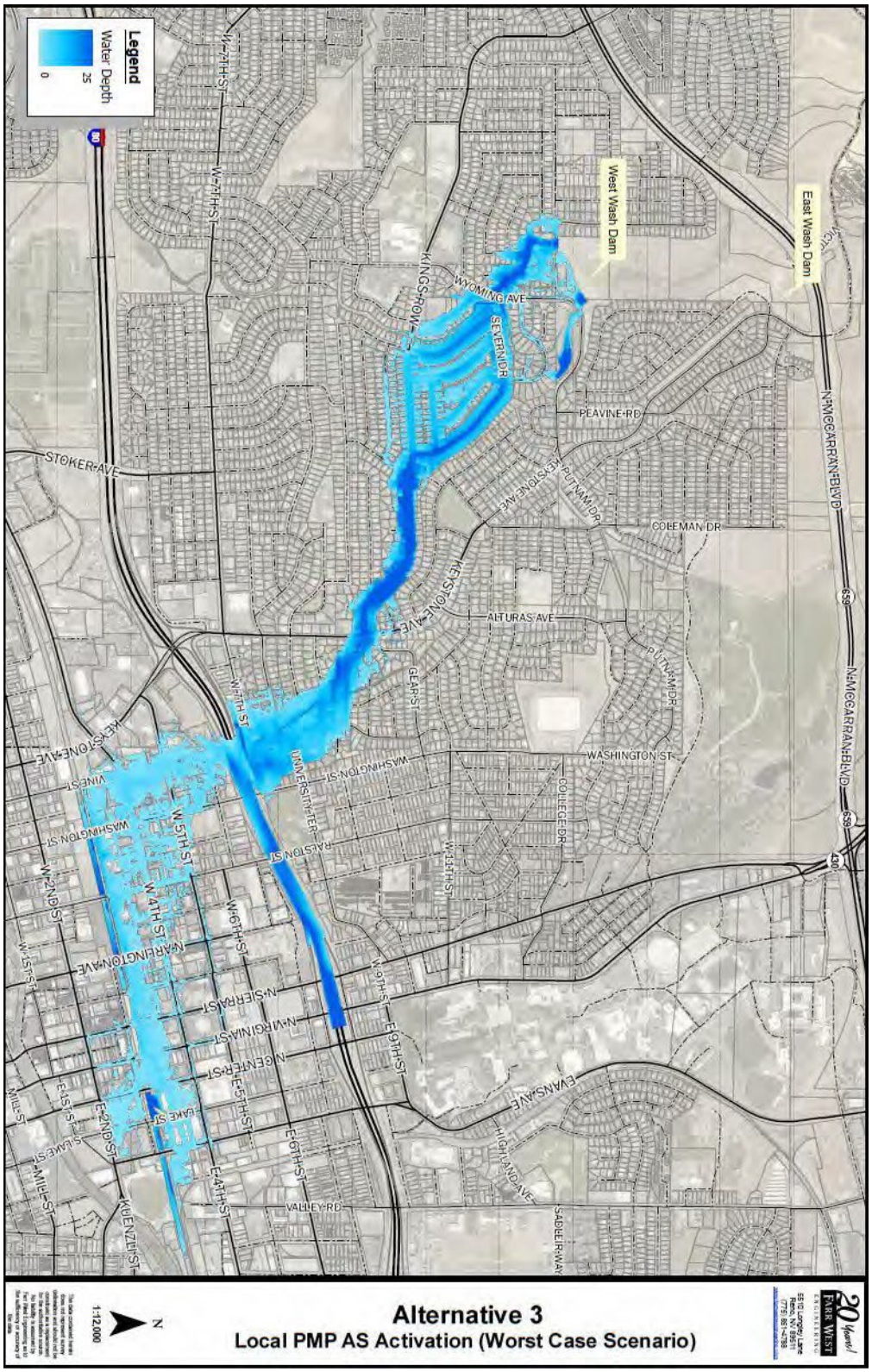
Map 3-1



Alternatives 1 and 2 Inundation Map

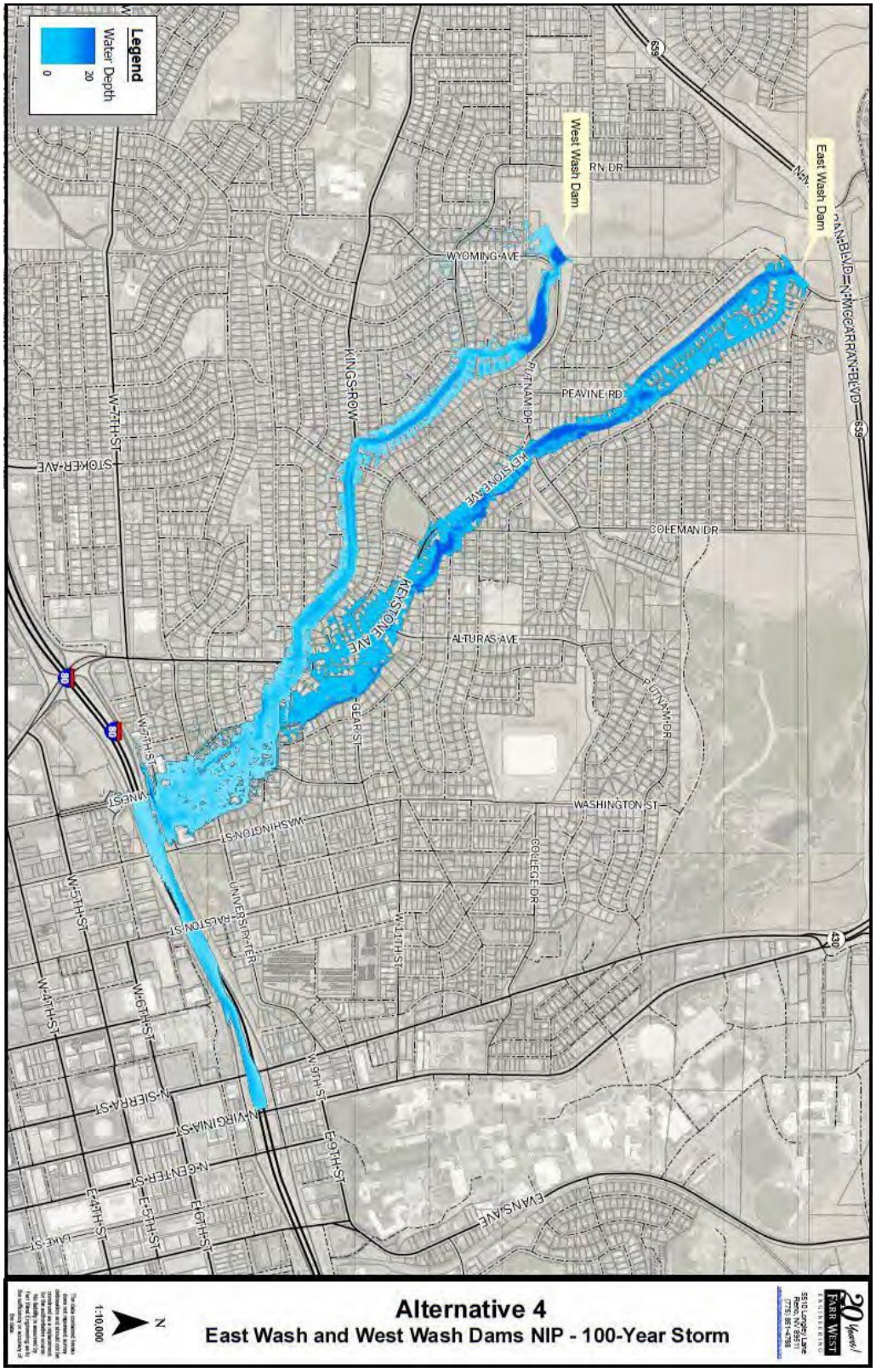
(Unit of Measure in Feet, hospital on 6th and Arlington)

Map 3-2
Alternative 3 Inundation Map



(Unit of Measure in Feet, hospital on 6th and Arlington)

Map 3-3
Alternative 4 Inundation Map



(Unit of Measure in Feet)

Table 3-1
SDDF Land Use Categories in the NED

Land Use & Bldg Type	SDDF Category	Land Use & Bldg Type	SDDF Category
200Single Family Residence	SF	400Neighborhood Shopping Ctr	Supermarket
210Luxury Apartment	Apartment	400Office Building	Office
210Parking Level	Apartment	400Parking Structure	Apartment
210Retail Store	Apartment	400Passenger Terminal	Warehouse, Refrigerated
250Condo/Townhouse	Apartment	400Restaurant	Non-Fast Food
300Conversion	SF	400Retail Store	Retail - Clothing
300Duplex	SF	400Rooming House	Apartment
310Single Family Residence	SF	400Shell, Neigh. Shop. Ctr.	Retail - Furniture
320Conversion	SF	400Single Family Residence	Retail - Clothing
320Multiple Res (Low Rise)	SF	410Conversion	Office
320Single Family Residence	SF	410Day Care Center	Schools
330Conversion	Apartment	410Dental Office/Clinic	Medical Office
340Apartment	Apartment	410Medical Office	Medical Office
340Conversion	Apartment	410Office Building	Office
340Multiple Res (Low Rise)	Apartment	410Restaurant	Non-Fast Food
400Bar/Tavern	Non-Fast Food	420Casino	Hotel
400Cocktail Lounge	Non-Fast Food	420Hotel, Full Service	Hotel
400Community Service Building	Religious Facilities	420Parking Structure	Hotel
400Convention Center	Retail - Furniture	420Restroom Building	Hotel
400Conversion	Retail - Clothing	420Storage Warehouse	Hotel
400Church	Religious Facilities	420Theater - Live Stage	Hotel
400Discount Store	Retail - Electronic	430Hotel, Full Service	Hotel
400Discount Warehouse Store	Retail - Furniture	430Motel	Hotel
400Fast Food Restaurant	Fast Food	430Restaurant	Hotel
400General Commercial	Retail - Clothing	430Retail Store	Hotel
400Hospital	Hospital	440Bowling Center	Recreation
400Industrials, Heavy Mftg.	Protective Services	440Convention Center	Recreation
400Medical Office	Medical Office	440Industrial Flex Building	Recreation
400Mini-Lube Garage	Automotive Repair	500Convenience Market	Convenience Store
400Mini-Mart Convenience Store	Convenience Store	500Service Repair Garage	Automotive Repair
400Multiple Res (Low Rise)	Apartment	500Storage Warehouse	Warehouse, Non-Refrig.
		710Utility	Protective Services

Table 3-2
Future Without Project Parcels with Damage

SDDF Category	# Parcels with Structural Damage	Percentage of Subtotals
Single Family Residential		
One-Story	373	55%
One-Story, with Basement	94	14%
Two-Story	88	13%
Two-Story, with Basement	6	1%
Split Level	101	15%
Split Level with Basement	14	2%
Subtotal SF Residential	**676**	**100%**
Non-Residential (includes Apartments)		
Apartment	334	62%
Convenience Store	2	0%
Fast Food	9	2%
Hospital [1]	1	0%
Hotel [2]	57	11%
Medical Office	7	1%
Non-Fast Food	11	2%
Office	20	4%
Protective Services	3	1%
Recreation [3]	3	1%
Religious Facilities	4	1%
Retail - Clothing	78	14%
Retail - Furniture	3	1%
Schools	1	0%
Warehouse, Non-Refrig.	4	1%
Warehouse, Refrigerated	2	0%
Supermarket	2	0%
Automotive Repair	1	0%
Subtotal Non-Residential	**542**	**100%**
TOTAL	**1,218**	

[1] St. Mary's Hospital.

[2] Includes hotel casinos such as Circus Circus, El Dorado, Silver Legacy, Sands, and Gold Dust West, as well as some large hotels including Whitney Peak, and numerous boutique hotels.

[3] Includes the National Bowling Stadium, the Convention Center, and a large flex-use building; all owned by the City of Reno.

Table 3-3
Number of Parcels with Damaged Structures

Flood Event	Alt 1	Alt 2	Alt 3	Alt 4[1]	Alt 5[1]
	Number of Parcels with Damaged Structures				
10-YR	0	0	0	493	0
25-YR	0	0	0	520	0
50-YR	0	0	0	539	0
100-YR	0	0	0	556	0
200-YR	304	0	0	n.a.	n.a.
500-YR	364	6	361	n.a.	n.a.
PMP	1,218	593	1,086	n.a.	n.a.

Source: Farr West Engineering and HEC, April 2022.

[1] Alternative 4 and 5 do not include dams and therefor are not regulated to any event larger than the 100-YR event. Because only a 100-YR event will be eligible for possible future funding, the NRCS directed those events to not be included in the study. Also, no damages would be sustained under Alternative 5 because all the properties that could be damaged would be acquired.

Depth-Damage Relationships. Residential inundation damage employs the generic depth-damage relationships specified in EGM 04-01 dated December 4, 2000**.** Depth-damage functions (DDFs) for non-residential structures were taken from the URS draft report "*Solicitation of Expert Opinion Depth-Damage Function Calculations for the Benefit-Cost Analysis Tool*" (2008). The DDFs are different for non-residential buildings depending on whether the structures are pre-engineered or engineered. Pre-engineered structures may be of stock design and easily replicated in different locations and they are more easily combustible. Engineered structures are primarily built of non-combustible materials, and they require greater design effort prior to construction. The structures are defined as follows:

Pre-engineered Structures – the shell of the structure may be Class D (Wood or Steel framed exterior walls), Class P (Wood and Metal Walls, pole frame), or Class S (Metal Frame and Walls).

Engineered Structures – the shell of the structure may be Class A (Fireproof Structural Steel Frame), Class B (Reinforced Concrete Frame), Class C (Masonry Bearing Walls), or Class M (Mill Type Construction).

The Washoe County Assessor data includes class of structure for all non-residential buildings. Table **3-4** provides the pre-engineered DDFs at the mean, and **Table 3-5** provides the engineered DDFs at the mean.

3.3 Structure and Content Valuation

Structure Valuation. For every building, the DDFs (for the correlating flood depth on the property) are multiplied by the structure replacement value to determine the estimate of damage in monetary units. Structure replacement values for every property are determined using Assessor data. The State of Nevada uses Marshall & Swift cost data to determine structure values; however, the taxable value of structures reported by the Assessor includes a 1.5% per year depreciation allowance for up to 50 years. The appropriate depreciation factor had to be applied to every

property to ensure that the structure replacement value used in the analysis does not include the statutory applied depreciation. The structure valuations represent the estimated cost to rebuild the structures.

Table 3-4
DDF for Non-Residential Structure Damage Value (Pre-Engineered Structures)

	Pre-Engineered (One-Story)									
Depth (feet)	Apartment	Hotel	Recreation	Non-Fast Food	Religious Facilities	Retail - Clothing	Fast Food	Hospital [1]	Protective Services	Convenience Store
					Mean of Damage					
0.5	8.5%	8.2%	8.8%	14.8%	10.2%	9.1%	11.1%	9.0%	7.1%	11.1%
1	12.5%	11.7%	13.5%	19.4%	16.4%	13.2%	15.9%	14.1%	10.5%	16.0%
1.5	16.1%	15.1%	18.2%	25.3%	22.1%	16.9%	22.5%	18.2%	14.0%	21.6%
2	20.4%	18.1%	23.6%	32.4%	28.3%	20.5%	28.7%	24.7%	17.3%	25.3%
3	25.9%	23.9%	31.3%	41.0%	35.9%	26.6%	37.4%	34.5%	22.3%	34.1%
4	31.7%	29.1%	38.6%	49.6%	42.9%	33.3%	47.3%	44.6%	28.2%	41.9%
5	33.5%	31.8%	42.1%	56.3%	48.4%	36.4%	52.1%	51.4%	32.1%	45.4%
6	37.5%	35.3%	47.6%	63.9%	54.2%	41.0%	58.3%	61.7%	35.5%	51.4%
7	39.4%	38.1%	50.3%	67.2%	58.1%	43.9%	63.5%	67.8%	38.9%	57.0%
8	42.2%	40.8%	54.2%	71.3%	62.1%	47.7%	67.0%	75.5%	42.7%	60.6%
9	45.1%	44.4%	57.5%	72.7%	65.3%	51.3%	70.9%	79.6%	45.7%	62.8%
10	46.6%	45.7%	59.1%	73.5%	66.1%	52.4%	72.2%	81.3%	47.1%	63.6%
11	46.6%	45.7%	59.1%	73.5%	66.1%	52.4%	72.2%	81.3%	47.1%	63.6%
12	46.6%	45.7%	59.1%	73.5%	66.1%	52.4%	72.2%	81.3%	47.1%	63.6%
13	46.6%	45.7%	59.1%	73.5%	66.1%	52.4%	72.2%	81.3%	47.1%	63.6%
14	46.6%	45.7%	59.1%	73.5%	66.1%	52.4%	72.2%	81.3%	47.1%	63.6%
15	46.6%	45.7%	59.1%	73.5%	66.1%	52.4%	72.2%	81.3%	47.1%	63.6%
16	46.6%	45.7%	59.1%	73.5%	66.1%	52.4%	72.2%	81.3%	47.1%	63.6%

Depth (feet)	Retail - Furniture	Retail - Electronic	Automotive Repair	Supermarket	Warehouse, Refrig.	Office	Medical Office	Schools	Warehouse, Non-Refrig.
0.5	7.9%	8.7%	7.5%	7.6%	8.2%	9.9%	8.4%	9.9%	7.6%
1	11.8%	12.9%	11.1%	11.6%	13.0%	13.5%	12.8%	14.2%	11.8%
1.5	15.1%	16.8%	15.0%	15.7%	16.9%	16.8%	16.3%	18.1%	16.1%
2	18.7%	20.4%	18.1%	19.5%	21.5%	19.4%	21.0%	23.9%	19.9%
3	25.2%	26.8%	23.5%	25.9%	29.1%	25.4%	27.9%	30.2%	25.4%
4	32.1%	33.2%	29.5%	32.9%	36.7%	30.5%	37.2%	36.9%	31.4%
5	35.0%	36.5%	31.9%	35.3%	40.2%	33.5%	40.9%	39.4%	34.2%
6	39.5%	40.3%	36.8%	41.1%	46.2%	38.6%	51.9%	43.9%	39.0%
7	42.7%	43.9%	40.9%	44.6%	49.9%	45.7%	56.6%	45.8%	41.8%
8	47.1%	48.3%	45.1%	48.1%	54.3%	51.1%	61.7%	48.4%	45.7%
9	51.3%	51.5%	48.3%	51.4%	58.9%	55.0%	66.0%	51.1%	50.4%
10	52.5%	52.6%	49.7%	52.9%	60.9%	59.1%	67.8%	52.8%	51.7%
11	52.5%	52.6%	49.7%	52.9%	60.9%	59.1%	67.8%	52.8%	51.7%
12	52.5%	52.6%	49.7%	52.9%	60.9%	59.1%	67.8%	52.8%	51.7%
13	52.5%	52.6%	49.7%	52.9%	60.9%	59.1%	67.8%	52.8%	51.7%
14	52.5%	52.6%	49.7%	52.9%	60.9%	59.1%	67.8%	52.8%	51.7%
15	52.5%	52.6%	49.7%	52.9%	60.9%	59.1%	67.8%	52.8%	51.7%
16	52.5%	52.6%	49.7%	52.9%	60.9%	59.1%	67.8%	52.8%	51.7%

Source: URS 2008 Solicitation of Expert Opinion Depth-Damage Function Calculations for the Benefit-Cost Analysis Tool.

[1] Hospital is the only prototype modeled with two stories.

Table 3-5
DDF for Non-Residential Structure Damage Value (Engineered Structures)

Depth (feet)	Engineered (One-Story)									
	Apartment	Hotel	Recreation	Non-Fast Food	Religious Facilities	Retail - Clothing	Retail - Fast Food	Hospital [1]	Protective Services	Convenience Store
	Mean of Damage									
0.5	7.9%	7.6%	8.1%	13.7%	9.5%	8.3%	10.4%	8.7%	6.7%	10.2%
1	11.0%	10.2%	11.9%	17.7%	14.7%	11.4%	14.4%	13.3%	9.2%	14.1%
1.5	13.6%	12.5%	15.4%	22.7%	19.3%	13.9%	19.9%	16.9%	11.5%	18.5%
2	17.4%	15.3%	20.2%	29.1%	24.8%	17.2%	25.6%	23.0%	14.5%	21.9%
3	21.3%	19.2%	26.0%	36.4%	30.9%	21.4%	32.8%	31.8%	17.7%	28.7%
4	26.2%	23.6%	32.2%	44.1%	37.0%	26.9%	41.6%	41.2%	22.6%	35.5%
5	29.6%	27.8%	26.8%	51.2%	43.2%	31.5%	47.1%	48.3%	27.9%	40.0%
6	32.1%	29.8%	40.7%	57.5%	47.6%	34.3%	52.0%	57.4%	29.7%	44.4%
7	34.1%	32.5%	43.4%	60.7%	51.3%	37.2%	56.9%	63.2%	32.9%	49.5%
8	37.2%	35.6%	47.4%	64.9%	55.4%	41.2%	60.5%	70.7%	36.8%	53.3%
9	38.9%	37.7%	49.4%	65.7%	57.5%	43.2%	63.4%	74.1%	38.4%	54.5%
10	41.1%	39.8%	51.6%	67.0%	59.0%	45.0%	65.1%	76.1%	40.5%	56.0%
11	41.1%	39.8%	51.6%	67.0%	59.0%	45.0%	65.1%	76.1%	40.5%	56.0%
12	41.1%	39.8%	51.6%	67.0%	59.0%	45.0%	65.1%	76.1%	40.5%	56.0%
13	41.1%	39.8%	51.6%	67.0%	59.0%	45.0%	65.1%	76.1%	40.5%	56.0%
14	41.1%	39.8%	51.6%	67.0%	59.0%	45.0%	65.1%	76.1%	40.5%	56.0%
15	41.1%	39.8%	51.6%	67.0%	59.0%	45.0%	65.1%	76.1%	40.5%	56.0%
16	41.1%	39.8%	51.6%	67.0%	59.0%	45.0%	65.1%	76.1%	40.5%	56.0%

Depth (feet)	Retail - Furniture	Retail - Electronic	Automotive Repair	Supermarket	Warehouse, Refrig.	Office	Medical Office	Schools	Warehouse, Non-Refrig.
0.5	7.3%	8.0%	7.0%	7.1%	7.7%	9.3%	8.0%	9.3%	7.1%
1	10.3%	11.2%	9.7%	10.1%	44.5%	12.3%	11.7%	13.0%	10.2%
1.5	12.5%	13.9%	12.4%	13.0%	14.5%	14.9%	14.5%	16.2%	13.3%
2	15.7%	17.1%	15.3%	16.4%	18.6%	17.5%	18.9%	21.5%	16.7%
3	20.3%	21.6%	18.9%	20.8%	24.3%	22.2%	24.4%	26.7%	20.4%
4	26.0%	26.9%	24.0%	26.7%	30.9%	26.8%	32.7%	32.7%	25.5%
5	30.4%	31.6%	27.9%	30.6%	35.5%	30.7%	37.2%	36.2%	29.7%
6	33.1%	33.8%	31.0%	34.4%	39.8%	34.7%	46.3%	39.7%	32.8%
7	36.2%	37.1%	34.8%	37.8%	43.3%	41.2%	50.7%	41.6%	35.5%
8	40.7%	41.7%	39.1%	41.5%	47.8%	46.5%	55.8%	44.5%	39.6%
9	13.2%	43.4%	40.8%	43.3%	50.9%	49.4%	58.9%	46.4%	42.5%
10	43.2%	45.3%	43.0%	45.5%	53.4%	53.6%	61.2%	48.5%	44.5%
11	43.2%	45.3%	43.0%	45.5%	53.4%	53.6%	61.2%	48.5%	44.5%
12	43.2%	45.3%	43.0%	45.5%	53.4%	53.6%	61.2%	48.5%	44.5%
13	43.2%	45.3%	43.0%	45.5%	53.4%	53.6%	61.2%	48.5%	44.5%
14	43.2%	45.3%	43.0%	45.5%	53.4%	53.6%	61.2%	48.5%	44.5%
15	43.2%	45.3%	43.0%	45.5%	53.4%	53.6%	61.2%	48.5%	44.5%
16	43.2%	45.3%	43.0%	45.5%	53.4%	53.6%	61.2%	48.5%	44.5%

Source: URS 2008 Solicitation of Expert Opinion Depth-Damage Function Calculations for the Benefit-Cost Analysis Tool.

[1] Hospital is the only prototype modeled with two stories.

Content Valuation. To determine content damage valuation for single family residential, the structure replacement value is multiplied by the contents DDF shown in **Table 3-6**. Residential contents are valued at about 50% of the residential structure values.

Table 3-6
DDF for Residential Contents Damage Value

Depth in Feet		Single Family with Basement			Single Family NO Basement		
		SF1	SF2	SFSplit	SF1B	SF2B	SFSplitB
		Mean of Contents Damage			Mean of Contents Damage		
0.5	[1]	16.0%	11.9%	11.6%	8.1%	5.0%	2.9%
1		18.9%	13.8%	13.8%	13.3%	8.7%	4.7%
1.5	[2]	21.8%	15.7%	16.1%	17.9%	12.2%	7.5%
2		21.8%	15.7%	16.1%	17.9%	12.2%	7.5%
3		24.7%	17.7%	18.2%	22.0%	15.5%	11.1%
4		27.4%	19.8%	20.2%	25.7%	18.5%	15.3%
5		30.0%	22.0%	22.1%	28.8%	21.3%	20.1%
6		32.4%	24.3%	23.6%	31.5%	23.9%	25.2%
7		34.5%	26.7%	24.9%	33.8%	26.3%	30.5%
8		36.3%	29.1%	25.8%	35.7%	28.4%	35.7%
9		37.7%	31.7%	26.3%	37.2%	30.3%	40.9%
10		38.6%	34.4%	26.3%	38.4%	32.0%	45.8%
11		39.1%	37.2%	26.3%	39.2%	33.4%	50.2%
12		39.1%	40.0%	26.3%	39.7%	34.7%	54.1%
13		39.1%	43.0%	26.3%	40.0%	35.6%	57.2%
14		39.1%	46.1%	26.3%	40.0%	36.4%	59.4%
15		39.1%	49.3%	26.3%	40.0%	36.9%	60.5%
16		39.1%	52.6%	26.3%	40.0%	37.2%	60.5%

Source: EGM 04-01.

[1] Uses the 0.5ft values for inundations zero to 0.5 feet.

[2] Uses the 2ft values for inundations 1.01 to 2.0 feet; no DDF values for 1.5ft depth in EGM 04-01.

For non-residential structures there is an additional computation. First, content valuation is expressed as a percentage of structure replacement valuation, as shown in **Table 3-7**. Second, the content value is multiplied by the content DDFs shown in **Table 3-8**.

Table 3-7
Content Value to Structure Ratio for Non-Residential SDDF Categories

Assessor Building Occupancy		SDDF Use Category	Content Value to Structure Ratio	
			Pre-Engineered	Engineered
Multi-Family Residential		*Source: USB 2008 Study*		
Luxury Apartment		Apartment	12%	10%
Condo/Townhouse		Apartment	12%	10%
Multi-Family 5-9 Units		Apartment	12%	10%
Multi-Family / Apartments 10+ Units		Apartment	12%	10%
Resort / Entertainment				
Casino & Hotel Casino		Hotel	19%	15%
Hotel / Motel		Hotel	19%	15%
Bowling / Convention Center		Recreation	30%	25%
Commercial				
Bar/Tavern		Non-Fast Food	26%	23%
Cocktail Lounge		Non-Fast Food	26%	23%
Community Service Building		Religious Facilities	8%	7%
Convention Center		Retail - Furniture	18%	14%
Conversion	[1]	Retail - Clothing	36%	29%
General Commercial		Retail - Clothing	36%	29%
Discount Store		Retail - Electronic	81%	65%
Discount Warehouse Store		Retail - Furniture	18%	14%
Fast Food Restaurant		Fast Food	17%	15%
Hospital		Hospital	30%	28%
Industrials, Heavy Mftg	[2]	Protective Services	88%	69%
Mini-Lube Garage		Automotive Repair	83%	66%
Mini-Mart Convenience Store		Convenience Store	62%	52%
Neighborhood Shopping Ctr		Supermarket	106%	85%
Rooming House		Apartment	12%	10%
Passenger Terminal		Warehouse, Refrigerated	43%	36%
Restaurant		Non-Fast Food	26%	23%
Retail Store		Retail - Clothing	36%	29%
Shell, Neigh. Shop. Ctr		Retail - Furniture	18%	14%
Offices				
Conversion		Office	14%	12%
Restaurant		Non-Fast Food	26%	23%
Medical Office		Medical Office	15%	13%
Office Building		Office	14%	12%
Day Care Center		Schools	7%	6%
Dental Office/Clinic		Medical Office	15%	13%
Industrial				
Service Repair Garage		Automotive Repair	83%	66%
Convenience Market		Convenience Store	62%	52%
Storage Warehouse		Warehouse, Non-Refrig.	47%	37%
Religious & Other				
Church		Religious Facilities	8%	7%
Utility		Protective Services	88%	69%
Parking Structure			0%	0%

Source: USB 2008 Study, Washoe County Assessor, and HEC April 2022.

[1] Use is currently changing.

[2] Building exclusive use is power units / generators for casinos.

Table 3-8
DDF for Non-Residential Contents Damage Value

Depth (feet)	All Building Types (One-Story)									
	Apartment	Hotel	Recreation	Non-Fast Food	Religious Facilities	Retail - Clothing	Fast Food	Hospital [1]	Protective Services	Convenience Store
	Mean of Damage									
0.5	14.3%	11.8%	16.9%	17.1%	19.7%	12.3%	10.6%	10.3%	5.0%	11.6%
1	21.7%	16.1%	25.7%	27.7%	29.3%	29.0%	21.3%	14.6%	15.0%	23.1%
1.5	26.6%	18.6%	31.4%	35.9%	41.3%	38.4%	29.4%	18.4%	20.0%	32.1%
2	30.4%	26.3%	43.7%	48.9%	48.4%	46.3%	38.6%	27.0%	25.0%	39.9%
3	39.0%	34.1%	62.7%	57.3%	60.0%	55.4%	52.7%	37.0%	40.0%	52.9%
4	45.0%	39.7%	72.9%	71.9%	69.3%	70.0%	62.6%	53.4%	50.0%	70.7%
5	47.9%	48.7%	80.0%	79.7%	76.4%	79.0%	73.0%	70.0%	58.0%	79.3%
6	51.9%	52.4%	84.0%	84.9%	81.4%	89.0%	79.3%	79.1%	65.0%	88.0%
7	55.7%	58.4%	91.1%	92.9%	88.4%	95.7%	88.3%	85.6%	78.0%	94.1%
8	59.3%	61.3%	95.0%	93.4%	94.3%	97.9%	94.9%	92.5%	90.0%	95.7%
9	60.6%	63.1%	95.0%	94.3%	97.1%	97.9%	98.6%	95.6%	90.0%	97.1%
10	63.4%	64.9%	95.0%	94.3%	97.1%	99.3%	98.6%	96.3%	92.0%	98.6%
11	63.4%	64.9%	95.0%	94.3%	97.1%	99.3%	98.6%	96.3%	92.0%	98.6%
12	63.4%	64.9%	95.0%	94.3%	97.1%	99.3%	98.6%	96.3%	92.0%	98.6%
13	63.4%	64.9%	95.0%	94.3%	97.1%	99.3%	98.6%	96.3%	92.0%	98.6%
14	63.4%	64.9%	95.0%	94.3%	97.1%	99.3%	98.6%	96.3%	92.0%	98.6%
15	63.4%	64.9%	95.0%	94.3%	97.1%	99.3%	98.6%	96.3%	92.0%	98.6%
16	63.4%	64.9%	95.0%	94.3%	97.1%	99.3%	98.6%	96.3%	92.0%	98.6%

Depth (feet)	Retail - Furniture	Retail - Electronic	Automotive Repair	Supermarket	Warehouse, Refrig.	Office	Medical Office	Schools	Warehouse, Non-Refrig.
0.5	39.9%	10.9%	11.7%	24.0%	20.7%	14.3%	9.0%	14.3%	13.4%
1	46.9%	23.0%	16.4%	30.7%	29.7%	10.0%	14.3%	21.7%	20.7%
1.5	53.3%	28.7%	21.9%	36.8%	37.6%	26.0%	18.4%	26.6%	27.6%
2	61.9%	34.1%	28.9%	40.9%	48.0%	34.3%	26.9%	30.4%	33.7%
3	68.1%	44.3%	40.9%	52.9%	59.1%	45.4%	40.4%	39.0%	47.4%
4	79.1%	67.0%	57.7%	64.0%	65.7%	55.0%	57.1%	45.0%	56.9%
5	85.7%	77.7%	63.3%	75.4%	74.3%	63.9%	67.3%	47.9%	65.6%
6	90.7%	86.7%	70.7%	87.3%	79.7%	73.3%	75.4%	51.9%	73.6%
7	97.1%	95.4%	79.3%	98.9%	84.0%	76.4%	82.3%	55.7%	81.3%
8	99.3%	97.4%	84.3%	100.0%	89.9%	83.4%	91.3%	59.3%	88.4%
9	99.3%	98.6%	87.1%	100.0%	93.6%	89.3%	96.3%	60.6%	91.6%
10	99.3%	98.6%	87.1%	100.0%	93.6%	91.4%	96.9%	63.4%	93.6%
11	99.3%	98.6%	87.1%	100.0%	93.6%	91.4%	96.9%	63.4%	93.6%
12	99.3%	98.6%	87.1%	100.0%	93.6%	91.4%	96.9%	63.4%	93.6%
13	99.3%	98.6%	87.1%	100.0%	93.6%	91.4%	96.9%	63.4%	93.6%
14	99.3%	98.6%	87.1%	100.0%	93.6%	91.4%	96.9%	63.4%	93.6%
	99.3%	98.6%	87.1%	100.0%	93.6%	91.4%	96.9%	63.4%	93.6%
	99.3%	98.6%	87.1%	100.0%	93.6%	91.4%	96.9%	63.4%	93.6%

Source: URS 2008 Solicitation of Expert Opinion Depth-Damage Function Calculations for the Benefit-Cost Analysis Tool.

[1] Hospital is the only prototype modeled with two stories.

3.4 Structure and Content Damages by Alternative

Valuation of structures and contents is provided in **Table 3-9** for the worst flood events by alternative. Alternative 5 is not included because by purchasing all the properties that would be damaged in the 100-year event there would not be any damage to properties. The greatest estimated damage from a single flood event is under Alternative 1 (local PMP event); however, the damages under Alternative 3 (local PMP event) are very similar because although fewer parcels are damaged, flood depths would be greater at some high value non-residential properties; in particular, the hospital, some non-fast food eating establishments, and some large and medium-sized stores that would not be flooded under Alternative 1.

Table 3-9
Estimate of Structures and Contents Values by SDDF Category

	Alt. 1 (PMP Event)		Alt. 2 (PMP Event)		Alt. 3 (PMP Event)		Alt. 4 (100-YR Event)	
SDDF Category	Structures	Contents	Structures	Contents	Structures	Contents	Structures	Contents
Single Family Residential								
One-Story	$34,180,858	$18,082,977	$4,925,542	$2,994,827	$32,163,299	$16,930,145	$22,973,811	$12,614,713
One-Story, with Basement	$7,204,230	$3,958,759	$1,013,961	$595,165	$6,082,114	$3,315,197	$5,255,694	$2,897,840
Two-Story	$8,568,221	$4,604,825	$630,727	$398,507	$7,702,685	$4,146,801	$4,801,680	$2,681,430
Two-Story, with Basement	$599,213	$348,825	$70,098	$39,299	$520,395	$305,034	$414,501	$239,259
Split Level	$9,558,425	$4,726,243	$691,010	$415,196	$8,864,219	$4,445,484	$5,750,839	$3,173,000
Split Level with Basement	$712,415	$448,088	$161,922	$68,902	$600,901	$402,498	$415,370	$258,890
Subtotal SF Residential	**$60,823,362**	**$32,169,716**	**$7,493,260**	**$4,511,896**	**$55,933,611**	**$29,545,159**	**$39,611,895**	**$21,865,131**
Non-Residential (includes Apartments)								
Apartment	$9,529,988	$1,752,650	$2,439,667	$484,835	$8,096,082	$1,473,101	$428,078	$81,083
Convenience Store	$262,460	$227,621	$262,460	$227,621	$262,460	$227,621	$0	$0
Fast Food	$569,386	$109,083	$521,972	$98,575	$527,091	$92,112	$0	$0
Hospital	$14,788,319	$6,041,920	$0	$0	$17,751,738	$6,827,370	$2,589,394	$889,025
Hotel	$10,474,711	$2,757,694	$5,817,169	$1,529,540	$9,525,699	$2,534,798	$0	$0
Medical Office	$2,929,916	$573,169	$966,895	$154,774	$1,963,021	$418,395	$957,829	$192,366
Non-Fast Food	$2,322,346	$815,511	$933,833	$304,592	$4,464,287	$1,611,763	$0	$0
Office	$5,070,358	$982,939	$1,601,919	$209,910	$4,578,934	$933,182	$34,472	$6,361
Protective Services	$100,647	$142,734	$0	$0	$100,647	$142,734	$21,942	$26,216
Recreation	$15,335,813	$7,738,856	$3,657,117	$2,106,998	$15,188,397	$7,653,925	$0	$0
Religious Facilities	$1,625,767	$218,813	$86,513	$13,367	$1,539,254	$205,446	$0	$0
Retail - Clothing	$2,136,781	$1,381,702	$1,445,838	$852,555	$2,049,292	$1,339,765	$38,193	$18,585
Retail - Furniture	$3,096,687	$2,020,972	$199,883	$180,446	$3,096,687	$2,020,972	$0	$0
Schools	$167,509	$14,915	$0	$0	$167,509	$14,915	$0	$0
Warehouse, Non-Refrig.	$232,911	$197,543	$139,261	$115,404	$450,516	$370,741	$0	$0
Warehouse, Refrigerated	$1,950,047	$1,522,569	$0	$0	$1,950,047	$1,522,569	$0	$0
Retail - Electronic	$0	$0	$0	$0	$1,109,094	$1,569,136	$0	$0
Supermarket	$690,813	$1,750,776	$107,219	$300,787	$690,813	$1,750,776	$282,504	$945,645
Automotive Repair	$0	$0	$0	$0	$279,408	$342,640	$0	$0
Subtotal Non-Residential	**$71,284,460**	**$28,249,466**	**$18,179,747**	**$6,579,404**	**$73,790,976**	**$31,051,960**	**$4,352,413**	**$2,159,281**
TOTAL	**$132,107,823**	**$60,419,181**	**$25,673,006**	**$11,091,300**	**$129,724,587**	**$60,597,120**	**$43,964,307**	**$24,024,412**
Residential	46%	53%	29%	41%	43%	49%	90%	91%
Non-Residential	54%	47%	71%	59%	57%	51%	10%	9%

3.5 RED and OSE Accounts

As described earlier, the RED and OSE accounts may or may not be monetized, and should be included whenever impacts are considerable and may influence selection of the project alternative, potentially overriding the NED plan.

OSE Account. Other social and economic considerations for this project are accounted for by measuring the loss in permanent residents, the loss in jobs, and loss in annual visitation to Downtown Reno.

RED Account. The regional economic development account impacts may include direct, indirect, and induced impacts. For this project, only the direct impact of property acquisition in the form of lost annual property taxes was estimated and annualized.

The OSE and RED account impacts are estimated in Section 5 of the report.

Section 4: PROJECT ALTERNATIVES BENEFITS AND COSTS

Alternative 1, the Future without Project condition, represents expected conditions over the next 56 years if there is no change to the current flood protection infrastructure and management measures. The relative benefits of flood risk management alternatives can be gauged by comparison to this baseline condition.

4.1 EXPECTED ANNUAL DAMAGES

This section describes the calculations to determine Expected Annual Damages (EAD) under each alternative. The estimated damages resulting from a single-year event occurring are summarized in **Table 4-1**.

Total damages occurring from a single event are calculated to be greatest under Alternative 1 (local PMP event), followed by Alternative 3 (local PMP event), then by Alternative 4 (100-year event). Alternative 2 would have the least damage from a single event occurring because all properties expected to have flooding greater than one foot on the property would be acquired. No damages would be sustained under Alternative 5 because all the properties that could be damaged would be acquired.

Table 4-1
Summary of Damages as a Result of a Single-Year Event Occurring

	Alternative 1				Alternative 2			
	100-YR	200-YR	500-YR	PMP	100-YR	200-YR	500-YR	PMP
Parcels Damaged [1]	***0***	***304***	***364***	***1,218***	***0***	***0***	***6***	***593***
Damages	*$ damages from a single event*				*$ damages from a single event*			
Structural	$0	$17,730,273	$23,719,121	$132,107,823	$0	$0	$287,760	$25,673,006
Contents	$0	$10,092,775	$13,187,792	$60,419,181	$0	$0	$174,210	$11,091,300
Total Damages	**$0**	**$27,823,048**	**$36,906,913**	**$192,527,004**	**$0**	**$0**	**$461,970**	**$36,764,306**

	Alternative 3				Alternative 4			
	100-YR	200-YR	500-YR	PMP	10-YR	25-YR	50-YR	100-YR
Parcels Damaged [1]	***0***	***0***	***361***	***1,086***	***493***	***520***	***539***	***556***
Damages	*$ damages from a single event*				*$ damages from a single event*			
Structural	$0	$0	$23,447,507	$129,724,587	$32,806,909	$36,299,123	$41,464,815	$43,964,307
Contents	$0	$0	$13,498,939	$60,597,120	$18,109,824	$19,867,751	$22,000,189	$24,024,412
Total Damages	**$0**	**$0**	**$36,946,446**	**$190,321,707**	**$50,916,733**	**$56,166,874**	**$63,465,004**	**$67,988,719**

Source: HEC May 2022.

[1] Number of parcels with structures; excludes vacant parcels (as a result, does not match Farr West reported parcels affected by alternative).

The damage-frequency relationship for each event is expressed in **Table 4-2.** The EAD is the cumulative damages calculated at the exceedance probability for each flood event. Note that the local PMP does not have a specified probability of occurrence. Sensitivity analysis was run with the PMP at different interval periods. It was found that any time interval greater than 5,000 years had negligible impact on the result.

Table 4-2
Expected Average Annual Damages by Alternative

Alternative	Return Period (years)	Damage-Frequency Relationship: Exceedance Probability	Estimated Damages [1]	Mean Damage	Probability Interval	Interval Damages	Estimated Cumulative Damages
Alt. 1							
100-YR	100	0.01000	$0				**annual**
				$13,911,524	0.005	$69,558	$69,558
200-YR	200	0.00500	$27,823,048				
				$32,364,981	0.003	$97,095	$166,653
500-YR	500	0.00200	$36,906,913				
				$114,716,959	0.002	$223,698	$390,351
PMP [2]	20,000	0.00005	$192,527,004				
			EXPECTED ANNUAL DAMAGES (EAD) - Alt. 1				**$390,351**
Alt. 2							
100-YR	100	0.01000	$0				**annual**
				$0	0.005	$0	$0
200-YR	200	0.00500	$0				
				$230,985	0.003	$693	$693
500-YR	500	0.00200	$461,970				
				$18,613,138	0.002	$36,296	$36,989
PMP [2]	20,000	0.00005	$36,764,306				
			ESTIMATED TOTAL ANNUAL DAMAGES (EAD) - Alt. 2				**$36,989**
Alt. 3							
100-YR	100	0.01000	$0				**annual**
				$0	0.005	$0	$0
200-YR	200	0.00500	$0				
				$18,473,223	0.003	$55,420	$55,420
500-YR	500	0.00200	$36,946,446				
				$113,634,077	0.002	$221,586	$277,006
PMP [2]	20,000	0.00005	$190,321,707				
			ESTIMATED TOTAL ANNUAL DAMAGES (EAD) - Alt. 3				**$277,006**
Alt. 4							
2-YR	2	0.50000	$0				**annual**
				$25,458,367	0.400	$10,183,347	$10,183,347
10-YR	10	0.10000	$50,916,733				
				$53,541,804	0.060	$3,212,508	$13,395,855
25-YR	25	0.04000	$56,166,874				
				$59,815,939	0.020	$1,196,319	$14,592,174
50-YR	50	0.02000	$63,465,004				
				$65,726,862	0.010	$657,269	$15,249,442
100-YR	100	0.01000	$67,988,719				
			ESTIMATED TOTAL ANNUAL DAMAGES (EAD) - Alt. 4				**$15,249,442**

Source: Farr West Engineering, Hydrometeorological Report No. 49, NOAA, 1984 (PMP recurrence), and Part 611

Water Resources Handbook for Economics, 1998, USDA-NRCS.

[1] Includes structural and content damages.

[2] The PMP return period and therefore the probability of exceedance is not known; the analysis uses 20,000 years for the computations. Any period greater than 5,000 years results in negligible change to the EAD.

4.2 Average Annual Equivalent Benefits

P&G § 2.1.3 future discusses the procedure to properly calculate monetized (Average Annual Equivalent terms) data in order to allow proper comparison:

> Net NED benefits of the plan are calculated in average annual equivalent terms. To perform this calculation, discount the benefit stream, deferred installation costs, and operation, maintenance and Replacement (OM&R) costs to the beginning of the evaluation period using the applicable project discount rate. Installation expenditures are brought forward to the end of the period of installation by charging compound interest at the project discount rate from the date the costs are incurred. Use the project discount rate to convert the present worth values to average annual equivalent terms.

Average annual equivalents account for the difference in timing between when the cost of a project component begins and when the component's benefits begin. The EAD is the same every year because there is no project. The discounted and amortized values are calculated to determine average annual equivalent damages for Alternative 1.

The amortization schedule is required to be the same in section 5, so a time period of 56 years was selected as it coincides with the Alternative 3, the most likely alternative to be selected.

4.3 ESTIMATED COSTS

Project Installation Costs. Project installation costs for each of the alternatives were estimated by Farr West Engineering. The construction costs include the planning "soft" costs associated with each of the projects, management during construction, and 30% cost contingency since these estimates are early in the planning process.

Added to the estimated construction cost is an estimate of property acquisition cost under alternatives 2 and 5. Real property is described in National Watershed Program Manual (NPWM) Section 506.50 K (11&12). Real property includes all costs associated with

the purchase of real property, which may include planning, design, administrative, etc. This includes purchases of land, buildings, changes to utilities, roads, etc. Real property is a cost-shareable item in rehabilitation; however, only up to the point where NRCS pays 100% of construction costs. Any real property purchased is owned by the sponsor as NRCS cannot own land.

The cost estimates are summarized in **Table 4-3**. Alternative 2 is estimated to cost more than $2.0 billion, with $1.6 billion of the total cost attributed to property acquisition. Alternative 5 has a cost estimate of $172.2 million. Alternative 3 is estimated to cost $23.0 million, and Alternative 4 has a cost estimate of $5.5 million.

Table 4-3
Estimated Total Project Costs

Project Item	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
	All figures in 2025 $s (estimates rounded up to nearest $1,000)				
Estimated Construction Cost	**N.A.**	**$233,148,000**	**$12,000,000**	**$3,457,000**	**$37,390,000**
10% Engineering		$23,315,000	$1,200,000	$346,000	$3,739,000
10% Construction Management		$23,315,000	$1,200,000	$346,000	$3,739,000
10% Effective Inflation		$23,315,000	$1,200,000	$346,000	$3,739,000
30% Contingency		$69,945,000	$3,600,000	$1,038,000	$11,217,000
Base Bid Total	**N.A.**	**$373,038,000**	**$19,200,000**	**$5,533,000**	**$59,824,000**
Property Acquisition Estimate	**N.A.**	**$1,639,138,000**	**N.A.**	**N.A.**	**$112,388,000**
Grand Total Cost Estimate	**N.A.**	**$2,012,176,000**	**$19,200,000**	**$5,533,000**	**$172,212,000**

Source: Farr West Engineering April, 2022, and HEC May, 2022.

The project installation costs occur over different time periods for each alternative. **Table 4-4** provides an estimated schedule for each project to be completed. Alternative 4, which removes both dams, would likely be completed soonest, by the end of 2025. It is estimated that Alternative 3 (rehabilitation) would likely be completed by the end of 2027. Alternatives 2 and 5 are expected to take much longer to complete due to the number of property acquisitions that would be necessary. Alternative 2 would likely not be complete until the end of 2048, and alternative 5 by the end of 2034.

Table 4-4
Alternative Projects Installation Costs in 2025$

Calendar Year	Alt. 1	Alternative 2 Project Phase [1]	Alternative 2 Estimated Cost 2025 $s	Alternative 3 Project Phase [1]	Alternative 3 Estimated Cost 2025 $s	Alternative 4 Project Phase [1]	Alternative 4 Estimated Cost 2025 $s	Alternative 5 Project Phase [1]	Alternative 5 Estimated Cost 2025 $s
		All estimated costs rounded to nearest $1,000 - totals may not exactly match engineer's estimates due to rounding							
2025	$0	Planning	$0	Planning	$0	Planning	$0	Planning	$0
2026	$0	Planning	$0	Planning	$0	Planning	$0	Planning	$0
2027	$0	Engineering	$4,663,000	Engineering	$1,200,000	Engineering	$346,000	Engineering	$1,869,000
2028	$0	Engineering	$4,663,000	Engineering	$1,200,000	Construction	$5,187,000	Engineering	$1,869,000
2029	$0	Engineering	$4,663,000	Construction	$8,400,000		$0	ROW	$22,478,000
2030	$0	Engineering	$4,663,000	Construction	$8,400,000		$0	ROW	$22,478,000
2031	$0	Engineering	$4,663,000		$0		$0	ROW	$22,478,000
2032	$0	ROW	$163,914,000		$0		$0	ROW	$22,478,000
2033	$0	ROW	$163,914,000		$0		$0	ROW	$22,478,000
2034	$0	ROW	$163,914,000		$0		$0	Construction	$14,021,000
2035	$0	ROW	$163,914,000		$0		$0	Construction	$14,021,000
2036	$0	ROW	$163,914,000		$0		$0	Construction	$14,021,000
2037	$0	ROW	$163,914,000		$0		$0	Construction	$14,021,000
2038	$0	ROW	$163,914,000		$0		$0		$0
2039	$0	ROW	$163,914,000		$0		$0		$0
2040	$0	ROW	$163,914,000		$0		$0		$0
2041	$0	ROW	$163,914,000		$0		$0		$0
2042	$0	Construction	$34,973,000		$0		$0		$0
2043	$0	Construction	$34,973,000		$0		$0		$0
2044	$0	Construction	$34,973,000		$0		$0		$0
2045	$0	Construction	$34,973,000		$0		$0		$0
2046	$0	Construction	$34,973,000		$0		$0		$0
2047	$0	Construction	$34,973,000		$0		$0		$0
2048	$0	Construction	$34,973,000		$0		$0		$0
2047	$0	Construction	$34,973,000		$0		$0		$0
2049	$0	Construction	$34,973,000		$0		$0		$0
2050	$0	Construction	$34,973,000		$0		$0		$0
TOTAL	**$0**		**$2,012,185,000**		**19,200,000**		**$5,533,000**		**$172,212,000**

Source: Farr West Engineering April 26, 2022.

[1] ROW = Property acquisitions.

Maintenance Costs. Annual maintenance costs at the East and West Wash Dams, and downstream of the current dams under alternatives 4 and 5, were estimated by the City of Reno using known current maintenance costs. As represented by Alternative 1, the City currently spends about $20,000 per year, on average, to maintain the dams site area. Under Alternative 2, the estimated annual maintenance cost is greater because of the maintenance associated with downstream improvements. Alternative 3 would incur greater costs than the current costs. Under alternatives 4 and 5, the annual maintenance costs are estimated to be lower.

Table 4-5
Estimated Maintenance Costs

Cost Item	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
City of Reno Estimate of Annual Maintenance Costs [1]	All Figures in 2025 $s **$20,000**	**$59,000**	**$30,000**	**$12,000**	**$11,000**

Source: City of Reno April 27, 2022.

[1] City cost estimates rounded up to the nearest thousand dollars.

Annual maintenance costs are projected **in Table 4-10**. The costs remain at $20,000 each year under each alternative until the project installation is complete.

Table 4-6
Alternative Projects Maintenance Costs in 2025 $s

Calendar Year	Project Phase [1]	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
2025	Planning	$20,000	$20,000	$20,000	$20,000	$20,000
2026	Planning	$20,000	$20,000	$20,000	$20,000	$20,000
2027	Planning	$20,000	$20,000	$20,000	$20,000	$20,000
2028	Planning	$20,000	$20,000	$20,000	$20,000	$20,000
2029	Construction	$20,000	$20,000	$20,000	**$12,000**	$20,000
2030	Construction	$20,000	$20,000	$20,000	$12,000	$20,000
2031	**1**	$20,000	$20,000	**$30,000**	$12,000	$20,000
2032	2	$20,000	$20,000	$30,000	$12,000	$20,000
2033	3	$20,000	$20,000	$30,000	$12,000	$20,000
2034	4	$20,000	$20,000	$30,000	$12,000	$20,000
2035	5	$20,000	$20,000	$30,000	$12,000	$20,000
2036	6	$20,000	$20,000	$30,000	$12,000	$20,000
2037	7	$20,000	$20,000	$30,000	$12,000	$20,000
2038	8	$20,000	$20,000	$30,000	$12,000	**$11,000**
2039	9	$20,000	$20,000	$30,000	$12,000	$11,000
2040	10	$20,000	$20,000	$30,000	$12,000	$11,000
2041	11	$20,000	$20,000	$30,000	$12,000	$11,000
2042	12	$20,000	$20,000	$30,000	$12,000	$11,000
2043	13	$20,000	$20,000	$30,000	$12,000	$11,000
2044	14	$20,000	$20,000	$30,000	$12,000	$11,000
2045	15	$20,000	$20,000	$30,000	$12,000	$11,000
2046	16	$20,000	$20,000	$30,000	$12,000	$11,000
2047	17	$20,000	$20,000	$30,000	$12,000	$11,000
2048	18	$20,000	$20,000	$30,000	$12,000	$11,000
2049	19	$20,000	$20,000	$30,000	$12,000	$11,000
2050	20	$20,000	$20,000	$30,000	$12,000	$11,000
2051	21	$20,000	$20,000	$30,000	$12,000	$11,000
2052	22	$20,000	**$59,000**	$30,000	$12,000	$11,000
2053	23	$20,000	$59,000	$30,000	$12,000	$11,000
2054	24	$20,000	$59,000	$30,000	$12,000	$11,000
TOTAL		**$1,120,000**	**$2,251,000**	**$1,620,000**	**$704,000**	**$733,000**

Source: City of Reno and Farr West Engineering, May 2022.

[1] Uses Alternative 3 implementation phase and useful life of rehabilitated West Wash dam (50 years). Timing of projects for alternatives 2, 4, and 5 shown in Table 4-4.

Due to table size, only the first 30 years of the analysis is shown*

4.4 AVERAGE ANNUAL EQUIVALENT COSTS

The calculated average annual equivalent installation cost is greatest under Alternative 2, and smallest under Alternative 4. Calculated average annual equivalent project maintenance cost, shown in **Table 4-8**, is also greatest under Alternative 4.

Table 4-7
Present Value and Average Annual Equivalent Project Installation Costs

Calendar Year	Project Year [1]	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
	Index			*Present Values [2]*		
2025	Planning	$0	$0	$0	$0	$0
2026	Planning	$0	$0	$0	$0	$0
2027	Planning	$0	$3,990,453	$615,298	$296,096	$1,599,433
2028	Planning	$0	$3,902,644	$601,759	$4,341,199	$1,564,238
2029	Construction	$0	$3,816,766	$8,827,756	$0	$18,398,729
2030	Construction	$0	$3,732,779	$8,633,502	$0	$17,993,867
2031	1	$0	$3,650,639	$0	$0	$17,597,914
2032	2	$0	$125,503,619	$0	$0	$17,210,674
2033	3	$0	$122,741,925	$0	$0	$16,831,955
2034	4	$0	$120,041,003	$0	$0	$10,268,158
2035	5	$0	$117,399,514	$0	$0	$10,042,209
2036	6	$0	$114,816,150	$0	$0	$9,821,231
2037	7	$0	$112,289,634	$0	$0	$9,605,116
2038	8	$0	$109,818,713	$0	$0	$0
2039	9	$0	$107,402,164	$0	$0	$0
2040	10	$0	$105,038,791	$0	$0	$0
2041	11	$0	$102,727,424	$0	$0	$0
2042	12	$0	$21,435,811	$0	$0	$0
2043	13	$0	$20,964,118	$0	$0	$0
2044	14	$0	$20,502,805	$0	$0	$0
2045	15	$0	$20,051,643	$0	$0	$0
2046	16	$0	$19,610,409	$0	$0	$0
2047	17	$0	$19,178,884	$0	$0	$0
2048	18	$0	$18,756,855	$0	$0	$0
2049	19	$0	$18,344,112	$0	$0	$0
2050	20	$0	$17,940,452	$0	$0	$0
2051	21	$0	$17,545,675	$0	$0	$0
2052	22	$0	$0	$0	$0	$0
2053	23	$0	$0	$0	$0	$0
2054	24	$0	$0	$0	$0	$0
Total [1]		**$0**	**$1,351,202,983**	**$18,678,314**	**$4,637,295**	**$130,933,522**
Average Annual Equivalent Cost			**$42,678,152**	**$589,960**	**$146,470**	**$4,135,575**

Source: Farr West Engineering March 18, 2022, and the NRCS Discount Rate for Federal Water Projects.

[1] Uses Alternative 3 implementation phase and useful life of rehabilitated West Wash dam (50 years).

[2] Discount Rate 2.25% 56 years

***Due to table size, only the first 30 years of the analysis is shown**

Table 4-8
Present Value and Average Annual Equivalent Maintenance Costs

Calendar Year	Project Year [1]	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
2025				*Present Values [2]*		
	Planning	$19,560	$19,560	$19,560	$19,560	$19,560
2026	Planning	$19,129	$19,129	$19,129	$19,129	$19,129
2027	Planning	$18,709	$18,709	$18,709	$18,709	$18,709
2028	Planning	$18,297	$18,297	$18,297	$18,297	$18,297
2029	Construction	$17,894	$17,894	$17,894	$10,737	$17,894
2030	Construction	$17,500	$17,500	$17,500	$10,500	$17,500
2031	1	$17,115	$17,115	$25,673	$10,269	$17,115
2032	2	$16,739	$16,739	$25,108	$10,043	$16,739
2033	3	$16,370	$16,370	$24,556	$9,822	$16,370
2034	4	$16,010	$16,010	$24,015	$9,606	$16,010
2035	5	$15,658	$15,658	$23,487	$9,395	$15,658
2036	6	$15,313	$15,313	$22,970	$9,188	$15,313
2037	7	$14,976	$14,976	$22,465	$8,986	$14,976
2038	8	$14,647	$14,647	$21,970	$8,788	$8,056
2039	9	$14,325	$14,325	$21,487	$8,595	$7,878
2040	10	$14,009	$14,009	$21,014	$8,406	$7,705
2041	11	$13,701	$13,701	$20,552	$8,221	$7,536
2042	12	$13,400	$13,400	$20,099	$8,040	$7,370
2043	13	$13,105	$13,105	$19,657	$7,863	$7,208
2044	14	$12,816	$12,816	$19,224	$7,690	$7,049
2045	15	$12,534	$12,534	$18,801	$7,521	$6,894
2046	16	$12,258	$12,258	$18,388	$7,355	$6,742
2047	17	$11,989	$11,989	$17,983	$7,193	$6,594
2048	18	$11,725	$11,725	$17,587	$7,035	$6,449
2049	19	$11,467	$11,467	$17,200	$6,880	$6,307
2050	20	$11,215	$11,215	$16,822	$6,729	$6,168
2051	21	$10,968	$10,968	$16,452	$6,581	$6,032
2052	22	$10,726	$31,643	$16,090	$6,436	$5,900
2053	23	$10,490	$30,947	$15,736	$6,294	$5,770
2054	24	$10,260	$30,266	$15,389	$6,156	$5,643
Total		**$633,206**	**$1,085,169**	**$894,264**	**$410,201**	**$448,736**
Avg. Annual Equivalent Cost [2]		**$20,000**	**$34,275**	**$28,246**	**$12,956**	**$14,173**

Source: City of Reno & Farr West Engineering, May 2022; NRCS Discount Rate for Federal Water Projects.

[1] Uses Alternative 3 implementation phase and useful life of rehabilitated West Wash dam (50 years).

[2] Discount Rate 2.25% 56 years

******Due to table size, only the first 30 years of the analysis is shown**

Section 5: COMPARISON OF ALTERNATIVES AND CONCLUSIONS

Benefits and costs for each of the alternatives in the NED account is compared in this section and OSE and RED account impacts are determined.

5.1 NED COMPARISON OF ALTERNATIVES BENEFITS AND COSTS

The net benefit by flood event under Alternative 2 is provided in **Table 5-1.**

Table 5-1
Alternative 2 Net Benefit by Flood Event

National Economic Development		
Estimated Annual Equivalent Cost [1]		$42,712,427
Downstream Flood Improvements	d	
Future Without Project	e	$20,000
Net Annual Equivalent Costs	**f = d-e**	**$42,692,427**
Estimated Net Benefit	**g = c-f**	**($42,712,427)**

[1] Includes project installation and annual maintenance costs.

Annual costs are much lower than under Alternative 2 but the net benefit is still negative. Net benefits for Alternative 3 and 4 are shown in **Tables 5-2** and **5-3**, respectively.

Table 5-2
Alternative 3 Net Benefit by Flood Event

National Economic Development		
Estimated Annual Equivalent Cost [1]		
Remediate West Wash Dam to contain PMP		$ $603,342
Future Without Project		$20,000
Net Annual Equivalent Costs		**$583,342**
Estimated Net Benefit	**g = c-f**	**($583,342)**
Benefit-Cost Ratio	h = c/f	0.00

[1] Includes project installation and annual maintenance costs.

Costs are lowest for Alternative 4 but the benefit- cost ratio is negative.

Table 5-3
Alternative 4 Net Benefit by Flood Event

National Economic Development		
Estimated Annual Equivalent Cost [1]		
Remove both Dams	d	$159,427
Future Without Project	e	$20,000
Net Annual Equivalent Costs	**f = d-e**	**$139,427**
Estimated Net Benefit	**g = c-f**	**($13,565,918)**
Benefit-Cost Ratio	h = c/f	-96.30

[1] Includes project installation and annual maintenance costs.

Alternative 5 protects the Affected Area to the same level as the Future without Project by purchasing all the properties that would be damaged during the modeled storm events. Similar to Alternative 2, estimated net benefit is negative, and the benefit-cost ratio is zero. The calculation of net benefits for Alternative 5 is shown in **Table 5-4**.

Table 5-4
Alternative 5 Net Benefit by Flood Event

National Economic Development		
Estimated Annual Equivalent Cost [2]		
Remove both Dams - Flood Conveyance to Truckee River	d	**$4,149,748**
Future Without Project	e	$20,000
Net Annual Equivalent Costs	**f = d-e**	**$4,129,748**
Estimated Net Benefit	**g = c-f**	**($4,129,748)**
Benefit-Cost Ratio	h = c/f	0.00

[1] Includes structures and contents damages.
[2] Includes project installation and annual maintenance costs.

A summary of net benefits and the benefit-cost ratio under each event for each alternative is provided in **Table 5-5.**

Table 5-5
Comparison of Net Benefit and BCR in the NED Account

Discount Rate of 2.25%, 56 Years	**Alternative 2**		**Alternative 3**
	Downstream Flood Improvements		**Remediate West Wash Dam to contain PMP**
	100-YR)	100-YR	
	Thousands of Dollars		*Thousands of Dollars*
Benefit Cost Ratio	0.00		0.00
NED - Net Benefits	**($42,712)**		**($598)**

Discount Rate of 2.25%, 56 Years	**Alternative 4**		**Alternative 5**
	Remove both Dams		**Remove Dams - Flood Conveyance to Truckee River**
		100-YR	100-YR
	Thousands of Dollars		*Thousands of Dollars*
Benefit Cost Ratio		-96.30	0.00
NED - Net Benefits		**($13,566)**	**($4,130)**

5.2 RED AND OSE ACCOUNTS

In addition to the NED, there are impacts that can be measured in the RED and OSE accounts for alternatives 2 and 5 because under these two alternatives there is substantial property acquisition. The following predictive analysis is based on the following assumptions for displacements, relocations, visitors and jobs lost, etc.; however, the percentage of vacated properties, jobs and lost visitors and the effects on tax revenue from relocation payments will vary which will impact the financial results to the community over time. The following provides an averaged long term view. **Table 5-6** calculates an estimate of persons displaced, visitors lost, and jobs lost as a result of the necessary property acquisitions. The calculations are based on the census tract data provided in Table 2-1. The estimated number of permanent residents displaced is 1,990 under Alternative 2 and 325 under Alternative 5. The number of visitors staying at hotel/motel units that are lost from Downtown Reno is estimated at 18,150 per year under Alternative 2[3]. No hotel/motel units are acquired under Alternative 5. Using estimates of occupancy and building square feet per employee, it is calculated that about 2,466 jobs would be lost under Alternative 2, and 170 jobs would be lost under Alternative 5. No casino/recreation buildings would be acquired under Alternative 5.

Using the Assessor's database, the amount of property taxes that would be lost in the first fiscal year is shown in **Table 5-7**. The loss of property taxes increases with the number of properties acquired (over ten years under Alternative 2 and five years under Alternative 5). The annual property tax losses are discounted and amortized to determine average annual equivalent losses in **Table 5-8**.

RED and OSE impacts are summarized in **Table 5-9**. Alternative 2 would result in severe losses of revenues to the City of Reno and State of Nevada.

Table 5-9
RED and OSE Accounts Impacts under Alternatives 2 and 5

	Alt. 2 Downstream Flood Improvements	Alt. 5 Remove both Dams - Flood Conveyance to Truckee River
Regional Economic Development (RED)		
Avg. Annual Equivalent Loss of Property Taxes	($69,718,659)	($6,704,781)
Other Social Effects (OSE)		
Persons Displaced	1,990	325
Jobs Lost	2,466	170
Annual Number of Visitors Lost	18,150	0

[3] It is assumed that these accommodation units are not replaced elsewhere in Reno.

Table 5-6
Jobs Lost, Persons Displaced, and Visitors Lost from Property Acquisitions

Land Use	**Alternative 2** Downstream Flood Improvements	**Alternative 5** Remove Dams - Flood Conveyance to Truckee River
Single Family Homes		
Number of Units	527	155
Est. Persons per Unit	2.24	2.24
Occupancy	91%	91%
Total Est. Displaced Persons	**1,070**	**315**
Apartments		
Number of Units	453	5
Est. Persons per Unit	2.24	2.24
Occupancy	91%	91%
Total Est. Displaced Persons	**920**	**10**
Est. Permanent Residents Displaced	**1,990**	**325**
Hotels/Motels		
Number of Units	153	0
Avg. No. Visitors per Unit per Day	2.0	2.0
Annual Max. Visitor Days	111,690	0
Est. Occupancy	65%	65%
Est. Visitor Stay (Days)	4	4
Est. Annual Visitors Lost	**18,150**	**0**
Casinos / Entertainment		
First Floor Building Square Feet	86,778	0
Estimated Occupancy	100%	100%
Est. Employees per Bldg. Sq. Ft.	200	200
Total Est. Jobs Lost	**434**	**0**
Commercial		
Building Square Feet	660,889	49,551
Estimated Occupancy	90%	90%
Est. Employees per Bldg. Sq. Ft.	300	300
Total Est. Jobs Lost	**1,983**	**149**
Industrial		
Building Square Feet	24,888	10,880
Estimated Occupancy	90%	90%
Est. Employees per Bldg. Sq. Ft.	450	450
Total Est. Jobs Lost	**50**	**22**
Est. Total Jobs Lost	**2,466**	**170**

Source: Washoe County Assessor, Farr West Engineering, and HEC May 2022.

Table 5-7
Estimated Loss of Property Taxes from Property Acquisitions

Calendar Year	Project Year [1]	Alternative 2	Alternative 5
2025	Planning	$0	$0
2026	Planning	$0	$0
2027	Planning	$0	$0
2028	Planning	$0	$0
2029	Construction	$0	$1,625,070
2030	Construction	$0	$3,250,140
2031	1	$0	$4,875,209
2032	2	$10,173,574	$6,500,279
2033	3	$20,347,148	$8,125,349
2034	4	$30,520,721	$8,125,349
2035	5	$40,694,295	$8,125,349
2036	6	$50,867,869	$8,125,349
2037	7	$61,041,443	$8,125,349
2038	8	$71,215,017	$8,125,349
2039	9	$81,388,590	$8,125,349
2040	10	$91,562,164	$8,125,349
2041	11	$101,735,738	$8,125,349
2042	12	$101,735,738	$8,125,349
2043	13	$101,735,738	$8,125,349
2044	14	$101,735,738	$8,125,349
2045	15	$101,735,738	$8,125,349
2046	16	$101,735,738	$8,125,349
2047	17	$101,735,738	$8,125,349
2048	18	$101,735,738	$8,125,349
2049	19	$101,735,738	$8,125,349
2050	20	$101,735,738	$8,125,349
2051	21	$101,735,738	$8,125,349
2052	22	$101,735,738	$8,125,349
2053	23	$101,735,738	$8,125,349
2054	24	$101,735,738	$8,125,349

Source: Washoe County Assessor, Farr West Engineering, and HEC May 2022.

[1] Uses Alternative 3 implementation phase and useful life of rehabilitated West Wash dam (50 years).

Due to table size, only the first 30 years of the analysis is shown*

Table 5-8 ***Due to table size, only the first 30 years of the analysis is shown****

Present Value and Average Annual Equivalent Annual Loss of Property Taxes

Calendar Year	Project Year [1]	Alternative 2	Alternative 5
		Present Values [2]	
2025	Planning	$0	$0
2026	Planning	$0	$0
2027	Planning	$0	$0
2028	Planning	$0	$0
2029	Construction	$0	$1,453,970
2030	Construction	$0	$2,843,951
2031	1	$0	$4,172,055
2032	2	$8,514,654	$5,440,333
2033	3	$16,654,580	$6,650,774
2034	4	$24,432,147	$6,504,424
2035	5	$31,859,360	$6,361,295
2036	6	$38,947,873	$6,221,315
2037	7	$45,708,995	$6,084,416
2038	8	$52,153,703	$5,950,529
2039	9	$58,292,647	$5,819,588
2040	10	$64,136,164	$5,691,529
2041	11	$69,694,283	$5,566,288
2042	12	$68,160,668	$5,443,802
2043	13	$66,660,800	$5,324,012
2044	14	$65,193,937	$5,206,857
2045	15	$63,759,351	$5,092,281
2046	16	$62,356,334	$4,980,226
2047	17	$60,984,189	$4,870,637
2048	18	$59,642,239	$4,763,459
2049	19	$58,329,818	$4,658,640
2050	20	$57,046,277	$4,556,127
2051	21	$55,790,980	$4,455,870
2052	22	$54,563,306	$4,357,819
2053	23	$53,362,646	$4,261,925
2054	24	$52,188,407	$4,168,142
Total		**$2,207,313,501**	**$212,275,373**
Avg. Annual Equivalent Loss [2]		**$69,718,659**	**$6,704,781**

Source: Washoe County Assessor, Farr West Engineering, and HEC May 2022.

[1] Uses Alternative 3 implementation phase and useful life of rehabilitated West Wash dam (50 years).

[2] Discount Rate 2.25% 56 years

5.3 CONCLUSIONS

A BCR greater than 1 means the project is expected to deliver a positive net present value relative to the no action alternative. It is a worthwhile investment. A negative BCA ratio means that the project is expected to generate greater disbenefits than actual benefits – making conditions worse rather than better. A positive BCA ratio that is less than 1 means the project's costs outweigh the benefits however, an overarching concern associated with dam rehabilitation analyses is the intent of the program to minimize threat to human life. Agency policy allows for use of the OSE account to make the case for rehabilitating any given floodwater detention structure, even if the associated benefit-cost ratio is less than 1:1. This is due to a priority placed on protecting lives. Also, trying to monetize the value of life, or in the case of dams, avoidance of loss of life, is fraught with subjective value judgements. Threat to human life can therefore be used to supersede purely economic considerations when deemed appropriate.

Alternative 3 is the NED Plan. Alternative 3 has the least negative net benefits of the action alternatives. Under alternative 3, all existing properties are protected as they are currently in the 100- year flood event, and better in the 200-year, 500-year, and local PMP events. Further, in a local PMP event, Alternative 3 would allow a controlled release through the auxiliary spillway; fewer properties in total would be damaged than in the future without a project, and both East and Wash dams would be in compliance with State dam requirements. OSE and RED accounts further decrease the net benefits of alternatives 2 and 5, and reaffirm that alternative 3 is the best project alternative.

The RED account monetizes the property tax loss from property acquisitions under alternatives 2 and 5, as this information is readily available in the data from the Assessor used to conduct the economic analysis. Property taxes (which are allocated among the State and local service providers) would be reduced by $69.7 million per year under Alternative 2 and $6.7 million per year under Alternative 5. Other municipal revenue losses (property taxes, sales taxes, consolidated taxes, and hotel room taxes, for example) were not monetized but would increase the negative benefits in the RED account.

The OSE account measures some of the social and other impacts that would occur under alternatives 2 and 5. Alternative 2 displaces about 2,000 permanent residents, causes an estimated almost 2,500 jobs to be lost, and reduces annual visitation to Reno's Downtown by about 18,000 people per year.

Alternatives 2, 4, and 5 fundamentally alter the economic fabric and character of the City of Reno. Downtown Reno is the historical heart of the "Biggest Little City". In addition, the socioeconomic description of the Affected Area (see Section 2) shows there is a high proportion of minorities living in Downtown Reno compared with the City of Reno, as well as a lower income, more transitory and older population with a higher proportion of the population having a disability, and living in poverty than in the City of Reno, the State, and the US. These disadvantaged persons would be severely impacted as much of Downtown Reno becomes a flood plain under alternatives 2, 4, and 5; they would not be impacted under Alternative 3.

Given the results of the NED account analysis shown in **Table 5-10,** and the findings of the RED and OSE accounts, as well as description of the socioeconomic characteristics of the Affected Area, Alternative 3 is the recommended alternative.

Table 5-10
Summary of Equivalent Annual Net Benefit and BCR by Alternative

Alternative	Equivalent Annual Net Benefit *	Benefit-Cost Ratio
	In $1,000s	
Alt. 1 Future Without Project [1], [2]	N/A	N/A
Alt. 2 Downstream Flood Improvements [1]	($42,570)	0.00:1
Alt. 3 Remediate West Wash Dam to contain PMP	**($510)**	**0.16:1**
Alt. 4 Remove both Dams	($13,570)	-96.3:1
Alt. 5 Remove Dams - Flood Conveyance to Truckee River	($4,130)	0.00:1

** Rounded up to the nearest ten thousand dollars.*
The Alternative 3 net benefit is negative $510,000, for example.

[1] Under both of these alternatives, the West Wash Dam Auxiliary Spillway breaches during the PMP.

[2] Pursuant to the National Watershed Program Manual Section 502.2, existing dams not meeting current safety and performance standards cannot be identified as the NED alternative, but will continue to be included to allow a valid comparison of the alternatives.

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Watershed Rules 7 Code of Federal Regulations Part 622 (Projects funded under Public Law 83-566).

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CITY OF RENO

WEST WASH DAM PROJECT
RENO, NEVADA

2021 BASELINE BIOLOGICAL SURVEY REPORT

November 2021

CITY OF RENO

WEST WASH DAM REHABILITATION PROJECT
RENO, NEVADA

2021 BASELINE BIOLOGICAL SURVEY REPORT

November 2021

Prepared for:

Farr West Engineering
5510 Longley Lane
Reno, Nevada 89511

Prepared by:

EM STRATEGIES

Reno:
1650 Meadow Wood Lane
Reno, Nevada 89502
Phone: (775) 826-8822 | Fax: (775) 826-8857

FARR WEST ENGINEERING
WEST WASH DAM REHABILITATION PROJECT
2021 BASELINE BIOLOGY REPORT

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CITY OF RENO
WEST WASH DAM REHABILITATION PROJECT
2021 BASELINE BIOLOGICAL SURVEY REPORT

1 INTRODUCTION

EM Strategies, Inc. (EMS) was contracted by Farr West Engineering to conduct field surveys to document baseline biological conditions for the West Wash Dam Rehabilitation Project (Project). The Project encompasses 53.2 acres on land owned by the City of Reno. The Project is in portions of Sections 33 and 34, Township 20 North, Range 19 East (T20N, R19E), and Sections 3 and 4, T19N, R19E, Mount Diablo Base and Meridian, Washoe County, Nevada (Project Area). The Project is in the City of Reno, south of McCarran Boulevard and west of Keystone Avenue (Figure 1; all figures are in Appendix A).

1.1 Project Description

The Project will rehabilitate the West Wash Dam and East Wash Dam to meet current dam safety criteria and performance standards set by the National Resources Conservation Service (NRCS), City of Reno, and the State of Nevada Division of Water Resources. During the Preliminary Alternatives Workshop, the following five alternatives were selected for further detailed analysis:

- Alternative 1: Future Without Project (No Action)
- Alternative 2: Flood Proofing
- Alternative 3a: Remediate both dams
- Alternative 5a: Remove both dams
- Alternative 6a: Remove both dams with flood proofing downstream of both dams

Alternatives 2, 5, and 6 may include purchase of property for creating a flood way and increasing storm drain infrastructure. The properties that would be acquired under the floodproofing alternatives are privately owned commercial and residential proprieties along the floodway below the dams and were not included in this survey.

1.2 Environmental Setting

The Project is located southeast of Peavine Peak. Topography within the Project Area is generally flat, with anthropogenic modifications including embankments, culverts, and recreational trails. Elevations range from 4,700 to 4,900 feet above mean sea level (amsl). According to the Western Regional Climate Center (WRCC), the average maximum temperature in Reno, Nevada, located just south of the Project Area, is 91.7 degrees (°) Fahrenheit (F) in July, and the average minimum temperature is 20.9 °F in January. The average annual precipitation is 7.2 inches and tends to peak during the month of January. Annual snowfall averages 22.9 inches and tends to peak in the month of January (WRCC 2016).

2 DESKTOP ANALYSIS

EMS reviewed existing literature, United States Geological Survey (USGS) topographic maps, aerial imagery, NRCS soils data, NRCS ecological site data, and USGS Southwest Regional Gap

Analysis Project (SWReGAP) vegetation community data to determine the vegetation communities, wildlife associations, and soils that are expected to occur within the Project Area. The information is summarized in Sections 2.1 through 2.5 of this report.

2.1 Soils and Ecological Site Correlations

The Project Area is in Major Land Resource Area 26, Carson Basin and Mountains. There are three soil map units with at least one acre in the Project Area (NRCS 2021) (Figure 2). Most soils in the Project Area are well-drained clays, with some sandy loams. The NRCS soil survey map units occupying at least one acre and their associated ecological sites are included in Table 1. The Custom Soils Report is included in Appendix B.

Table 1. NRCS Mapped Soil Units and Associated Ecological Sites in the Project Area

Soil Map Unit	Ecological Site		Acres
Waspo clay, 15 to 30 percent slopes	Churning Clay 10-12" P.Z.	R026XY019NV	38.3
Xeric Torriorthents-Urban land complex	n/a	n/a	11.5
Reno stony sandy loam, 2 to 8 percent slopes	Claypan 10-12" P.Z.	R026SXY023NV	1.9

2.2 Ecological Sites

The NRCS defines an ecological site as "a distinctive kind of land with specific soil and physical characteristics that differ from other kinds of land in its ability to produce a distinctive kind and amount of vegetation and its ability to respond similarly to management actions and natural disturbances." Each site is designated by soil type and texture, landscape position, and climate. Native vegetation communities found within each site are typified by an association of species that differs from that of other sites, either in the kind of species, or in the amount of biomass that the site can produce.

There are two dominant ecological sites mapped by the NRCS within the Project Area (NRCS 2021) (Figure 3 and Table 1). The ecological site descriptions (ESDs) are summarized below.

Churning Clay 10-12" P.Z., R026XY019NV

The Churning Clay 10-12" P.Z. ecological site typically occurs on piedmont slopes, hills, mountains, lake terraces, and fan remnants on slopes ranging from zero to 50 percent and elevations from 4,750 to 6,200 feet amsl. Soils associated with this ecological site are moderately deep and well drained, formed in mixed pedisediment and residuum from tuff. The ESD indicates that the reference plant community is dominated by Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*, littleleaf horsebush (*Tetradymia glabrata*), western wheatgrass (*Pascopyrum smithii*), and bottlebrush squirreltail (*Elymus elymoides*).

Claypan 10-12" P.Z., R026SXY023NV

The Claypan 10-12" P.Z. ecological site is typically found on alluvial fans, fan remnants, plateaus, ridges and sideslopes of hills, upper piedmont slopes, and lower mountains. This ecological site occurs on slopes ranging from two to 50 percent and elevations from 4,400 to 8,000 feet amsl.

Soils associated with the Claypan 10-12" P.Z. ecological site are shallow to moderately deep and well-drained and derived from residuum of rhyolite and granodiorite. According to the ESD, the reference plant community for this ecological site is dominated by low sagebrush (*Artemisia arbuscula*) and Thurber's needlegrass (*Achnatherum thurberianum*).

2.3 SWReGAP Vegetation Communities

The Project Area is located within the Intermountain Region, Great Basin Division floristic zone (Cronquist et al. 1972). The SWReGAP (USGS 2004) identified five landcover types within the Project Area (Figure 4). The communities covering at least one acre are listed in Table 2, along with the associated habitat type assigned to them in the Nevada Department of Wildlife (NDOW) State Wildlife Action Plan (WAP) (Wildlife Action Plan Team [WAPT] 2013). The SWReGAP data is mapped at the landscape level, so project-level vegetation communities can differ from the SWReGAP maps. Field-verified vegetation communities in the Project Area are discussed in Section 3.2.1.

Table 2. SWReGAP Vegetation Communities in the Project Area

Vegetation Community	NDOW WAP Habitat	Acres in Project Area	Percent of Project Area
Inter-Mountain Basins Big Sagebrush Shrubland	Sagebrush	26.8	50.4
Developed, Open Space – Low Intensity	Developed Landscapes	19.8	37.2
Developed, Medium – High Intensity		3.2	6.0
Great Basin Pinyon-Juniper Woodland	Lower Montane Woodlands and Chaparral	2.2	4.1
Inter-Mountain Basins Montane Sagebrush Steppe	Sagebrush	1.2	2.3

2.4 Hydrology

The National Hydrography Dataset (NHD) reported the presence of three ephemeral streams trending north to south through the Project Area, and one canal in the southeast corner of the Project Area (USGS 2016) (Figure 5). The National Wetland Inventory (NWI) describes the central portion and the southeast corner of the Project Area as forested/shrub wetland (PSS1B). In addition, the NWI shows two ponded areas (PUSJ) in the central portion of the Project Area, and one emergent wetland (PEM1A) in the southern portion of the Project Area (United States Fish and Wildlife Service [USFWS] 1999).

2.5 Agency Data

EMS contacted the USFWS, the NDOW, the Nevada Division of Natural Heritage (NDNH), and the Nevada Division of Minerals (NDOM) for information pertaining to sensitive or special status species that have the potential to occur in the Project Area or vicinity. The agency data responses are included in Appendix C.

2.5.1 United States Fish and Wildlife Service, Reno Fish & Wildlife Office

A species list was requested from USFWS (Consultation Code 08ENVD00-2021-SLI-0241) for species listed under the Endangered Species Act (ESA) that have the potential to occur in the Project Area and its vicinity. Three listed and one candidate species were reported:

- Sierra Nevada yellow-legged frog (*Rana sierrae*), Endangered;
- Cui-ui (*Chasmistes cujus*), Endangered;
- Lahontan cutthroat trout (LCT) (*Oncorhynchus clarkii henshawi*), Threatened; and
- Monarch butterfly (*Danaus plexippus*), Candidate.

No critical habitats were reported within the Project Area.

2.5.2 Nevada Department of Wildlife

Occupied mule deer (*Odocoileus hemionus*) distribution exists outside the Project Area within the four-mile buffer area. No known occupied bighorn sheep (*Ovis canadensis*), elk (*Cervus canadensis*), or pronghorn antelope (*Antilocapra americana*) distributions exist in the vicinity of the Project Area. There is no greater sage-grouse (*Centrocercus urophasianus*) habitat or leks within four miles of the Project Area. LCT are known to exist in the vicinity of the Project Area in the Truckee River watershed.

There are 22 species of raptors with ranges that overlap the Project Area or vicinity. Of these, 13 species have been directly observed in the vicinity of the Project Area (Table 3). Two raptor species with ranges that are not known to overlap with the Project Area have also been recorded in the vicinity. There are five known raptor nest sites within ten miles of the Project Area.

Table 3. Raptor Species with Ranges that Overlap Project Area and Vicinity

Common Name	Species	Observed in the Vicinity of the Project Area (Y/N)
American kestrel	*Falco sparverius*	Y
Bald eagle	*Haliaeetus leucocephalus*	Y
Barn owl	*Tyto alba*	Y
Burrowing owl	*Athene cunicularia*	N
Cooper's hawk	*Accipiter cooperii*	Y
Ferruginous hawk	*Buteo regalis*	N
Flammulated owl	*Psiloscops flammeolus*	N
Golden eagle	*Aquila chrysaetos*	Y
Great horned owl	*Bubo virginianus*	Y
Long-eared owl	*Asio otus*	N
Merlin	*Falco columbarius*	Y
Northern goshawk	*Accipiter gentilis*	Y
Northern harrier	*Circus hudsonius*	N
Northern saw-whet owl	*Aegolius acadicus*	N

Common Name	Species	Observed in the Vicinity of the Project Area (Y/N)
Osprey	*Pandion haliaetus*	Y
Peregrine falcon	*Falco peregrinus*	Y
Prairie falcon[1]	*Falco mexicanus*	Y
Red-tailed hawk	*Buteo jamaicensis*	Y
Rough-legged hawk	*Buteo lagopus*	Y
Sharp-shinned hawk	*Accipiter striatus*	Y
Short-eared owl	*Asio flammeus*	N
Snowy owl[1]	*Bubo scandiacus*	Y
Swainson's hawk	*Buteo swainsoni*	N
Turkey vulture	*Cathartes aura*	N
Western screech owl	*Megascops kennicottii*	N

[1]Mapped range does not overlap with Project Area

Forty-nine Nevada State Protected or WAP Species of Conservation Priority (SoCP) (WAPT 2013) have been directly observed within four miles of the Project Area (Table 4). Most of these species are migratory birds protected under the Migratory Bird Treaty Act (MBTA) (USFWS 2020).

Table 4. State Protected and SoCP Species Observed in the Project Area and Vicinity

Common Name	Species	State Protected	SoCP	MBTA
Mammals				
Brazilian free-tailed bat	*Tadarida brasiliensis*	Y	Y	-
North American river otter	*Lontra canadensis*	N	Y	-
Spotted bat	*Euderma maculatum*	Y	Y	-
Fish				
Lahontan cutthroat trout	*Oncorhynchus clarkii henshawi*	ESA	Y	-
Mountain whitefish	*Prosopium williamsoni*	N	Y	-
Reptiles				
Great Basin collared lizard	*Crotaphytus bicinctores*	N	Y	-
Long-nosed leopard lizard	*Gambelia wislizenii*	N	Y	-
Northern rubber boa	*Charina bottae*	N	Y	-
Western pond turtle	*Clemmys marmorata*	N	Y	-
Western toad (including ssp. *halophilus*)	*Anaxyrus boreas*	N	Y	-
Birds				
American goldfinch	*Spinus tristus*	Y	N	Y
American robin	*Turdus migratorius*	Y	N	Y
Anna's hummingbird	*Calypte anna*	Y	N	Y
Black-chinned hummingbird	*Archilochus alexandri*	Y	N	Y
Black-headed grosbeak	*Pheucticus melanocephalus*	Y	N	Y

Common Name	Species	State Protected	SoCP	MBTA
Brewer's blackbird	*Euphagus cyanocephalus*	Y	N	Y
Brown-headed cowbird	*Molothrus ater*	Y	N	Y
Brown creeper	*Certhia americana*	Y	N	Y
Cassin's finch	*Haemorhous cassinii*	Y	Y	Y
Cedar waxwing	*Bombycilla cedrorum*	Y	N	Y
Common raven	*Corvus corax*	Y	N	Y
Dark-eyed junco (including ssp. *oreganus*)	*Junco hyemalis*	Y	N	Y
Eastern kingbird	*Tyrannus tyrannus*	Y	N	Y
Evening grosbeak	*Coccothraustes vespertinus*	Y	N	Y
Glaucous-winged gull	*Larus glaucescens*	Y	N	Y
Glaucous gull	*Larus hyperboreus*	Y	N	Y
Green heron	*Butorides virescens*	Y	N	Y
Hermit thrush	*Catharus guttatus*	Y	N	Y
House finch	*Haemorhous mexicanus*	Y	N	Y
House wren	*Troglodytes aedon*	Y	N	Y
Lesser goldfinch	*Spinus psaltria*	Y	N	Y
Mew gull	*Larus canus*	Y	N	Y
Mountain chickadee	*Poecile gambeli*	Y	N	Y
Northern flicker	*Colaptes auratus*	Y	N	Y
Northern mockingbird	*Mimus polyglottos*	Y	N	Y
Pine siskin	*Spinus pinus*	Y	N	Y
Red-breasted sapsucker	*Sphyrapicus ruber*	Y	N	Y
Rufous hummingbird	*Selasphorus rufus*	Y	N	Y
Spotted towhee	*Pipilo maculatus*	Y	N	Y
Thayer's (Iceland) gull	*Larus glaucoides*	Y	N	Y
Townsend's solitaire	*Myadestes townsendii*	Y	N	Y
Vermillion flycatcher	*Pyrocephalus rubinus*	Y	N	Y
Western kingbird	*Tyrannus verticalis*	Y	N	Y
Western tanager	*Piranga ludoviciana*	Y	N	Y
White-crowned sparrow	*Zonotrichia leucophrys*	Y	N	Y
White-headed woodpecker	*Dryobates albolarvatus*	Y	Y	Y
Williamson's sapsucker	*Sphyrapicus thyroideus*	Y	N	Y
Wilson's warbler	*Cardellina pusilla*	Y	N	Y
Yellow-rumped warbler	*Setophaga coronata*	Y	N	Y

2.5.3 Nevada Division of Natural Heritage

There are no at-risk taxa recorded within the Project Area. Suitable habitat may be present in the Project Area for the following species:

- Golden eagle (*Aquila chrysaetos*);
- Northern rubber boa (*Charina bottae*); and
- Spotted bat (*Euderma maculatum*).

2.5.4 Nevada Division of Minerals

There are no historic mining features (i.e., adits, shafts, tunnels) that would provide bat habitat within the Project Area.

3 FIELD SURVEYS

3.1 Hydrologic Features

All water features within the Project Area were visited and conditions were noted. A riparian corridor enters the Project Area from the west side and flows south through the central portion. This feature corresponds to one of the ephemeral streams mapped by the NHD, and the riparian corridor created by this stream corresponds to the forested/shrub wetland mapped by the NWI. This main ephemeral stream possessed flowing water at the time of the field survey. The remaining two ephemeral streams mapped by the NHD were not flowing.

In June of 2021, Woods Rogers completed a routine onsite investigation to determine the location and extent of resources that may have potential to be under the regulatory jurisdiction of the U.S. Army Corps of Engineers in accordance with Section 404 of the Clean Water Act for the Project. The following description of the hydrologic features south of the West Wash Dam are excerpted from their report:

"The survey area includes a concrete riser spillway, manmade channel and earthen emergency spillway above Wyoming Ave./Putnam Dr. Below Putnam Dr., the Highland Ditch is in a concrete lined ditch except where it follows the curvature of Putnam Dr., where it is in an elevated open top corrugated metal flume. The concrete lined ditch portion includes an emergency overtopping facility that allows high flows to escape the ditch and continue downslope in the manmade channel. Both the wetland and manmade channel that starts under the flume portion of the Highland Ditch, that has severe leaks ("Leaky ditch wetland"), do not appear to be under the regulatory jurisdiction of the USACE. Although the Highland Ditch is regulated by the USACE as an intermittent WOUS, this wetland is not considered to be regulated pursuant to CESPK-CO-R Regulatory Branch Memorandum 2004-03 "Leaky Ditch" Wetlands."

A photo of the wetland is included in Appendix F, Photo Plate 3.

3.2 Botanical Surveys

A botanical survey was conducted in the Project Area on June 7, 2021, by Sarah Harrelson, EMS' Botanist. Surveyor qualifications are in Appendix D. The botanical survey followed the intuitive controlled method. Prominent topographic features (e.g., wetlands and disturbed landscapes) within the Project Area were targeted. All Geographic Information System (GIS) data and survey tracks were recorded in the Universal Transverse Mercator (UTM) coordinate system in the North

American Datum of 1983 (NAD83) for Zone 11 North (meters) with a Garmin 60 CSx unit (Figure 6).

No federally- or State-protected species were reported by the USFWS and the NDNH as occurring, or having the potential to occur, in the Project Area. No protected plant species were observed or recorded during the survey; therefore, they will not be discussed further.

3.2.1 Vegetation Community Survey

The SWReGAP vegetation communities within the Project Area were field-verified and re-mapped when adjustments were needed. Field data were supplemented using aerial imagery. The resulting vegetation map consists of manually constructed vegetation polygons to reflect areas where vegetation mapped from the SWReGAP did not match field conditions.

Field verification identified two vegetation communities within the Project Area (Figure 7; Table 5). Portions of the Project Area were largely unvegetated and moderately disturbed due to several walking trails in the area and use by the public, as well as construction activities and the earthen dams. Field-verified vegetation communities are described below. A complete list of plant species identified within the Project Area is presented in Appendix E.

Table 5. Field-Verified Vegetation Communities in the Project Area

Vegetation Community	NDOW WAP Habitat[1]	Acres in Project Area	Percent of Project Area
Inter-Mountain Basins Big Sagebrush Shrubland	Sagebrush	45.2	85.0
Great Basin Lowland Riparian	Intermountain Rivers and Streams	8.0	15.0

[1]WAPT 2013

3.2.1.1 Inter-Mountain Basins Big Sagebrush Shrubland

The Inter-Mountain Basins Big Sagebrush Shrubland vegetation community makes up the majority of the Project Area, covering 45.2 acres (Appendix F, Photo Plate 1). The shrub layer consists of several co-dominant species including fourwing saltbush (*Atriplex canescens*), rubber rabbitbrush (*Ericameria nauseosa*), basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*), and broom snakeweed (*Gutierrezia sarothrae*). The herbaceous layer in this vegetation community was sparse, with large areas nearly devoid of vegetation. Dominant forbs observed include tall tumblemustard (*Sisymbrium altissimum*), cheatgrass (*Bromus tectorum*), and hare barley (*Hordeum murinum* ssp. *leporinum*).

3.2.1.2 Great Basin Lowland Riparian

The Great Basin Lowland Riparian vegetation community occurs along the flowing stream in the central portion of the Project Area, covering eight acres (Appendix F, Photo Plate 2). Vegetation in this riparian area is dominated by narrowleaf willow (*Salix exigua*). A few large trees occur within this area, namely Fremont cottonwood (*Populus freemontii*), Russian olive (*Elaeagnus angustifolia*), and mature willow trees. The narrowleaf willow stands are very dense, preventing the development of any significant herbaceous layer. In more open areas, dominant forb species

included annual rabbitsfoot grass (*Polypogon monspeliensis*), Arctic rush (*Juncus arcticus*), Kentucky bluegrass (*Poa pratensis*), and cattail (*Typha* sp.). A sub-type within this community is a wetland lacking a mature tree canopy located in the southeastern corner of the Project Area (Appendix F, Photo Plate 3). This area is dominated almost exclusively by a dense stand of narrowleaf willow with some cattail and Arctic rush along the edges. A small stand of tree of heaven (*Ailanthus altissima*) occurs on the north side of the wetland.

3.2.2 Noxious Weed Survey

The purpose of the noxious weed survey was to record and map occurrences of invasive and exotic plant species managed under the Nevada Revised Statutes Chapter 555 and included on the 2021 Noxious Weed List maintained by the Nevada Department of Agriculture in Nevada Administrative Code 555.010. Noxious weeds are classified into the following categories:

- Category A weeds are not found or are limited in distribution throughout the state. Category A weeds are actively excluded from the State, actively eradicated wherever found, and actively eradicated from nursery stock dealer premises. Control is required by the State in all infestations.

- Category B weeds are established in scattered populations in some counties of the State. Category B weeds are actively excluded where possible and actively eradicated from nursery stock dealer premises. Control is required by the State in areas where populations are not well established or previously unknown to occur.

- Category C weeds are currently established and generally widespread in many counties of the State. Category C weeds are actively eradicated from nursery stock dealer premises.

Five noxious weed species were observed and mapped within the Project Area (Appendix F, Photo Plates 4 and 5):

1. Perennial pepperweed (*Lepidium latifolium*);
2. Nodding thistle (*Carduus nutans*);
3. Hoary cress (*Cardaria draba*);
4. Medusahead grass (*Taeniatherum caput-medusae*); and
5. Jointed goat grass (*Aegilops cylindrica*).

Noxious weed species were distributed throughout the Project Area, with heavier concentrations in the northern disturbed area and along the streambanks (Figure 8).

3.3 Wildlife Surveys

General wildlife surveys were conducted within the Project Area on foot on June 7, 2021, by Vicki Thill, EMS' biologist. Surveyor qualifications are included in Appendix D. The fenced off wetland portion of the Project Area in the southeast corner was not fully accessible but was scanned with binoculars from the fence line (Figure 5).

3.3.1 General Wildlife Habitat and Inventory

3.3.1.1 Methodology

Foot surveys focused on habitat features attractive to wildlife, including ecotones, drainages, springs, and rock outcrops. Observations were aided by 10x42 binoculars. Accessible sources of water within the Project Area were surveyed. A list of all vertebrate species detected visually, by their call/song, or by their sign (e.g., tracks, scat, pellets, feathers, eggshells, burrows, prey remains) within and adjacent to the Project Area was compiled. Federally- or State-protected species occurrences and/or their sign (e.g., scat) were recorded on a Garmin, if encountered. All UTM coordinates are in (NAD83) for Zone 11 North (meters).

3.3.1.2 Results

The survey occurred on June 7, 2021, from 8:30 a.m. until 11:45 a.m. Pacific Daylight Time. The temperature ranged from 70 °F to 80 °F, with clear or partially clear skies and occasional breezes. The Project Area consists of thick weeds and escaped cultivated plant species. The outer edges of the Project Area are extremely disturbed, with heavily utilized walking trails present. Trash and debris were commonly found along the fence lines that border the Project Area and near the culvert located at the extreme northwest corner of the Project Area.

A riparian corridor is present in the Project Area which enters from the west and then curves south to the West Wash embankment dam. There was a small rivulet of running water which was surrounded by thick, mature mixed willows, along with cottonwood trees (Appendix F, Photo Plate 6). The non-jurisdictional wetland adjacent to Highland Ditch (Appendix F, Photo Plate 3) also possesses mature willows, cottonwood trees, and tree of heaven. These willows and trees provide potential nesting habitat for migratory birds. Additional nesting habitat is present in the form of powerlines and other tall artificial structures within the Project Area (Appendix F, Photo Plate 6). Adjacent homes with landscaped backyards provide attractive foraging habitat for many migratory birds.

Milkweed (*Asclepias* sp.), an important genus of host plant for the monarch butterfly, is present in the Project Area (Appendix F, Photo Plate 7). It is most dense near the central riparian corridor, but also occurred occasionally throughout the Project Area (Figure 8). Two species of milkweed were seen: Narrowleaf milkweed (*Asclepias fascicularis*) and showy milkweed (*A. speciosa*). Milkweed individuals and stands were scanned for butterfly eggs or caterpillars when seen, but none were recorded. One stand of milkweed had an infestation of aphids (Appendix F, Photo Plate 7).

Table 6. Wildlife Species Observed in or from the Project Area

Common Name	Scientific Name	MBTA[1]
Birds		
American robin	*Turdus migratorius*	Y
Black-billed magpie	*Pica hudsonia*	Y
California scrub jay	*Aphelocoma californica*	Y

Common Name	Scientific Name	MBTA[1]
Cliff swallow	*Petrochelidon pyrrhonota*	Y
House finch	*Haemorhous mexicanus*	Y
House sparrow	*Passer domesticus*	N
Lesser goldfinch	*Spinus psaltria*	Y
Loggerhead shrike	*Lanius ludovicianus*	Y
Mourning dove	*Zenaida macroura*	Y
Northern flicker	*Colaptes auratus*	Y
Red-tailed hawk	*Buteo jamaicensis*	Y
Red-winged blackbird	*Agelaius phoeniceus*	Y
Rock pigeon	*Columba livia*	N
Turkey vulture	*Cathartes aura*	Y
Unidentified hummingbird	Trochilidae	Y
Mammals		
California ground squirrel	*Otospermophilus beecheyi*	
Desert cottontail	*Sylvilagus audubonii*	
Domestic dog[2]	*Canis lupus*	
Reptiles		
Western fence lizard	*Sceloporus occidentalis*	

[1] Protected by the Migratory Bird Treaty Act
[2] Detected by sign (e.g., tracks, burrows, scat, skeletal remains)

Raptors

Nesting substrate for raptors in the Project Area consists of powerlines and other artificial structures as well as large trees in the riparian corridor (Appendix F, Photo Plate 6). Nearby powerlines and trees were scanned with 10x42 binoculars, and no raptor nests were detected; however, some foliage was thick enough to obscure visibility.

Several turkey vultures (*Cathartes aura*) were seen circling high to the north of the Project Area. One red-tailed hawk (*Buteo jamaicensis*) was observed soaring slowly over the central portion of the Project Area.

Bats

Day-roosting habitat for bats is present in the mature trees located near the riparian corridor. No habitat suitable for hibernacula or maternity roosting is in the Project Area.

4 SURVEY RESULTS SUMMARY

4.1 Plants

1. The Project Area is comprised of two vegetation communities:
   a. Inter-Mountain Basins Big Sagebrush Shrubland (45.2 acres); and

b. Great Basin Lowland Riparian (8.0 acres).

2. Five noxious weed species (perennial pepperweed, nodding thistle, hoary cress, jointed goat grass, and medusahead grass) were recorded in the Project Area.

3. No federally- or State-protected plant species were recorded in the Project Area.

4.2 Wildlife

1. A total of 15 bird, three mammal, and one reptile species were directly observed or detected by sign (e.g., tracks, burrows, scat, skeletal remains) in the Project Area.

2. Nesting habitat for raptors is present in the riparian corridor of the Project Area and on the power poles that border the Project Area. No raptor nests were recorded in the Project Area.

3. Fifteen avian species protected by the MBTA were observed in the Project Area.

4. Day-roosting habitat for bats is present in the Project Area in the mature trees of the riparian corridor.

5 EFFECTS ANALYSIS

There are four ESA listed or candidate species reported by the USFWS as potentially occurring in the vicinity of the Project Area (Section 2.5.1). Two of these listed species, the Sierra Nevada yellow-legged frog and the Cui-ui, have relatively well-defined, limited ranges that do not overlap with the Project Area. The Sierra Nevada yellow-legged frog (SNYLF) is found at high elevations in wet mountain meadows of the Sierra Nevada mountains (USFWS 2019). The SNYLF is considered highly aquatic and requires water of sufficient depth or flow to avoid freezing (USFWS 2021). Cui-ui are found only in Pyramid Lake and the mouth of the Truckee River; historically this species was also present in Winnemucca Lake, which is now dry (USFWS 1977). Therefore, the proposed Project will have no effect on the SNYLF or cui-ui. The remaining two listed or candidate species and potential effects are described in Sections 5.1 and 5.2. Migratory birds are protected under the MBTA, and potential effects are described in Section 5.3.

5.1 Lahontan Cutthroat Trout

LCT is listed as threatened under the ESA. This native fish historically inhabited the Truckee River drainage from Lake Tahoe to Pyramid Lake but was extirpated from the Tahoe Basin by the early- to mid-1900s. Restocking efforts by NDOW and other agencies (i.e., California Department of Fish and Wildlife) have reintroduced LCT into Lake Tahoe and the headwaters of the Truckee River. Now a popular game fish, LCT were historically a valuable food source for the Pyramid Lake Paiute Tribe, the Washoe Tribe, and early explorers (Fowler and Bath 1981).

LCT require specific habitat for spawning, characterized mainly by cool water, pools with nearby cover, stream banks that are stable and well vegetated, and riffle-run areas with rocky substrate (USFWS 1995). Outside of spawning season, LCT occupies both lakes and streams.

Non-native salmonid fish are generally considered to be the greatest threat to LCT populations. These non-native salmonids threaten LCT persistence through hybridization and by increasing competition for habitat and resources (USFWS 1995). LCT are also threatened by altered watersheds that may have increased turbidity and high flows, which reduce the spawning habitat quality. Warmer water temperatures and drought can affect the survival rate of young LCT (USFWS 1995).

Potential for Occurrence

LCT are documented in the Truckee River, including within the Reno city limits (NDOW 2018). The ephemeral drainages in the Project Area do not represent suitable habitat as described by USFWS (1995) and do not have connectivity with suitable habitat for LCT (i.e., as a tributary or perennial stream). Movement of LCT into the Project Area is also impeded by multiple physical barriers (i.e., embankment dam, cement canals). Given that there is no possibility of occurrence in the Project Area, the proposed Project will have no effect on LCT.

5.2 Monarch Butterfly

The monarch butterfly is a distinctively colored orange, black, and white butterfly. Monarch butterflies in Nevada lay eggs during spring and summer. Larvae feed on plants in the subfamily Asclepiadoidae which contain toxins that monarch butterflies can sequester as an anti-predation defense (Jepson et al. 2015). Adult monarch butterflies utilize a wide variety of plant species for nectar.

The main threat to monarch butterflies is disturbance (i.e., logging, land conversion) to their overwintering sites (Jepson et al. 2015). Monarch butterfly populations breeding in Nevada are likely to overwinter on the Pacific coast of California. No known overwintering sites occur in Nevada (Western Monarch Count 2021). Additional threats include the use of herbicides (i.e., glyphosates) in agricultural areas and effects of climate change (e.g., extreme weather conditions) (Jepson et al. 2015).

Potential for Occurrence

Monarch butterflies are assumed to use the Project Area for breeding due to the presence of milkweed (Figure 8). Citizen science records exist for monarch butterflies in the vicinity of the Project Area (Western Monarch Milkweed Mapper 2021). The timeframe for monarch butterflies to arrive and breed in Reno is likely to extend from May through August (Jepson et al. 2015).

Determination of Effects and Protection Measures

Given the early stage of the Project, a proposed disturbance footprint is not available. Where possible, milkweed stands should not be removed during the summer breeding period (May through August) to prevent impacts to breeding monarch butterflies. Plants that will be disturbed should be salvaged and replanted in appropriate habitat when practical.

5.3 Migratory Birds

Analysis of the migratory birds with potential to occur in the Project Area are grouped by focal habitats found in the Project Area as defined by the Nevada Bird Conservation Plan (Great Basin Bird Observatory [GBBO] 2010). Table 7 summarizes the priority bird species and habitat indicator bird species expected within the two focal habitat types of sagebrush shrubland and Great Basin lowland riparian. The migratory bird species presented are not an exhaustive list and are intended to show the general suite of priority and indicator bird species that could be expected in the focal habitats. This does not consider the small size of the Project Area or the heavily developed urban surroundings.

Determination of Effects and Protection Measures

Given the early stage of the Project, a proposed disturbance footprint is not available. However, the proponent agrees to adhere to migratory bird clearance survey requirements during migratory bird breeding season (April 1 through July 31). If ground disturbance must occur within this time, a migratory bird nesting clearance survey would be conducted within a three-day period prior to the disturbance. The proponent would then have 14 days to complete the disturbance. If a nest is found, a species-appropriate no-disturbance buffer would be placed around the nest until the young have fledged, or until the nest fails.

Table 7. Migratory Bird Species by Focal Habitat Type

Vegetation Community	Common Name	Scientific Name
Sagebrush shrubland	Greater sage-grouse[1]	*Centrocercus urophasianus*
	Swainson's hawk	*Buteo swainsoni*
	Ferruginous hawk	*Buteo regalis*
	Golden eagle	*Aquila chrysaetos*
	Prairie falcon	*Falco mexicanus*
	Burrowing owl[1]	*Athene cunicularia*
	Common poorwill	*Phalaenoptilus nuttallii*
	Gray flycatcher	*Empidonax wrightii*
	Sage thrasher	*Oreoscoptes montanus*
	Brewer's sparrow	*Spizella breweri*
	Sage sparrow	*Artemisiospiza nevadensis*
Great Basin Lowland Riparian	Snowy egret	*Egretta thula*
	Bald eagle[1]	*Haliaeetus leucocephalus*
	Swainson's hawk	*Buteo swainsoni*
	Sandhill crane	*Antigone canadensis*
	Yellow-billed cuckoo[1]	*Coccyzus americanus*
	White-throated swift	*Aeronautes saxatalis*
	Rufous hummingbird	*Selasphorus rufus*
	Willow flycatcher	*Empidonax traillii*

Vegetation Community	Common Name	Scientific Name
	Yellow warbler	*Setophaga petechia*
	Wilson's warbler	*Cardellina pusilla*

[1]Unlikely to occur due to inappropriate habitat size and/or anthropogenic disturbance

6 CONTACT INFORMATION

If you have any questions or require additional information pertaining to the proposed study methodologies, please contact our office by phone at 775-826-8822 or via e-mail at kris@emstrats.com.

7 REFERENCES

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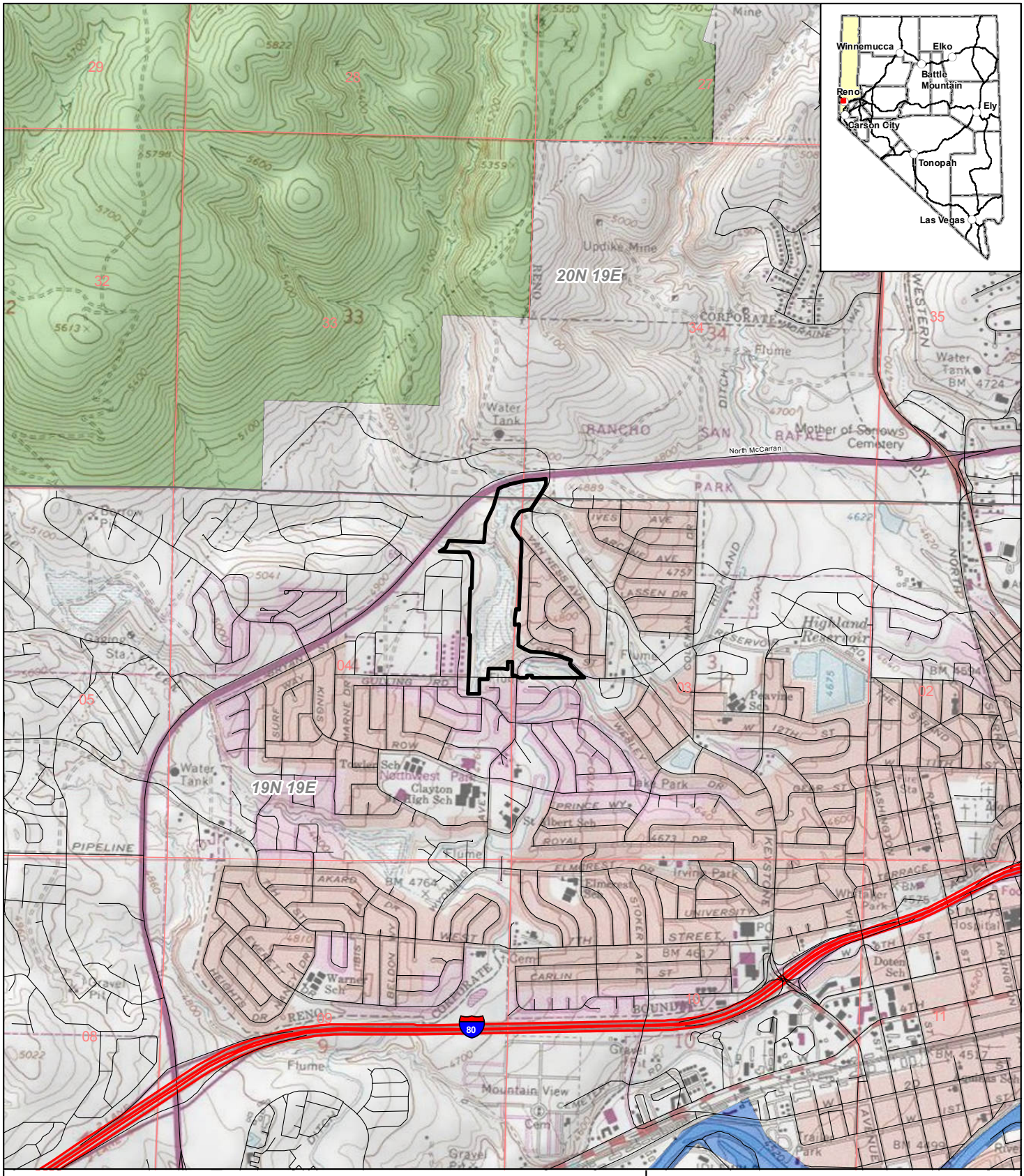
APPENDIX A

Figures



Explanation

Project Area (53.2 acres)

Land Status

- Forest Service
- Private
- Water

0 0.25 0.5 Miles

N

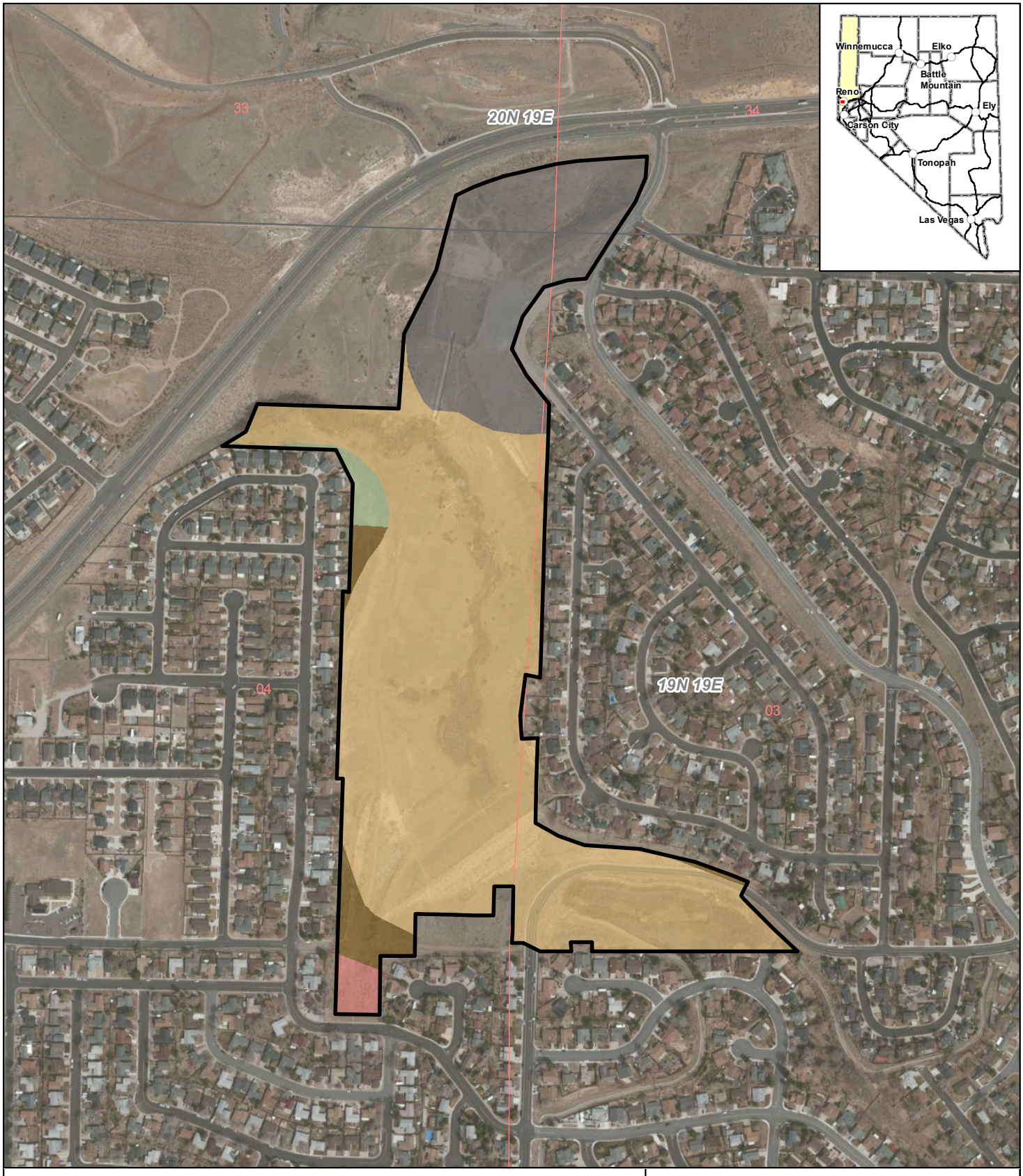
CITY OF RENO

WEST WASH DAM

Project Location, Access, and Land Status

Label: Figure 1	Drawn By: TLF
Date: 08/14/2021	Project No.: 4452
Base Map: Basemap: USGS 7.5' quad: Reno	
File Name: 4452T_WestWash_Fig1_Loc.mxd	

EM STRATEGIES



Explanation

- Project Area (53.2 acres)
- Waspo Clay, 15 to 30 percent Slopes (38.3 acres)
- Xeric Torriorthents-Urban Land Complex (11.5 acres)
- Reno Stony Sandy Loam, 2 to 8 percent Slopes (1.9 acres)
- Chalco Very Stony Clay Loam, 15 to 30 percent Slopes (0.8 acre)
- Waspo Gravelly Clay, 2 to 8 percecnt Slopes (0.7 acre)

0 200 400 Feet N

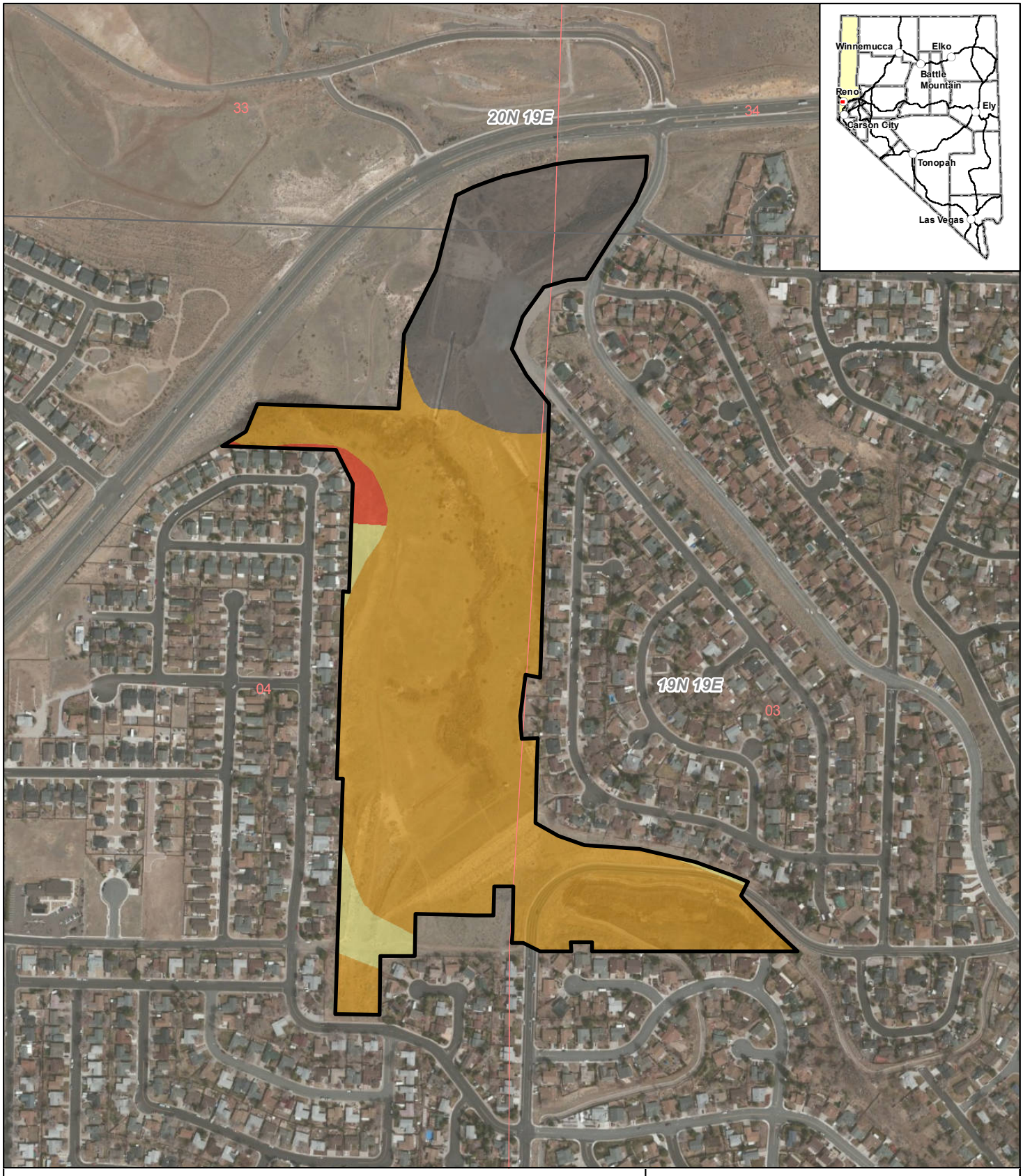
CITY OF RENO

WEST WASH DAM

NRCS Mapped Soils in the Project Area

Label: Figure 1	Drawn By: TLF
Date: 08/14/2021	Project No.: 4452
Base Map: Basemap: ArcGIS Imagery (Clarity)	
File Name: 4452T_WestWash_Fig2_Soils.mxd	

EM STRATEGIES



Explanation

- Project Area (53.2 acres)
- Churning Clay 10-12 P.Z., R026XY019NV (39.1 acres)
- Not Rated (11.4 acres)
- Claypan 10-12 P.Z., R026SXY023NV (1.9 acres)
- Shallow Loam 10-12 P.Z., R026XY015NV (0.8 acre)

0 200 400 Feet

N

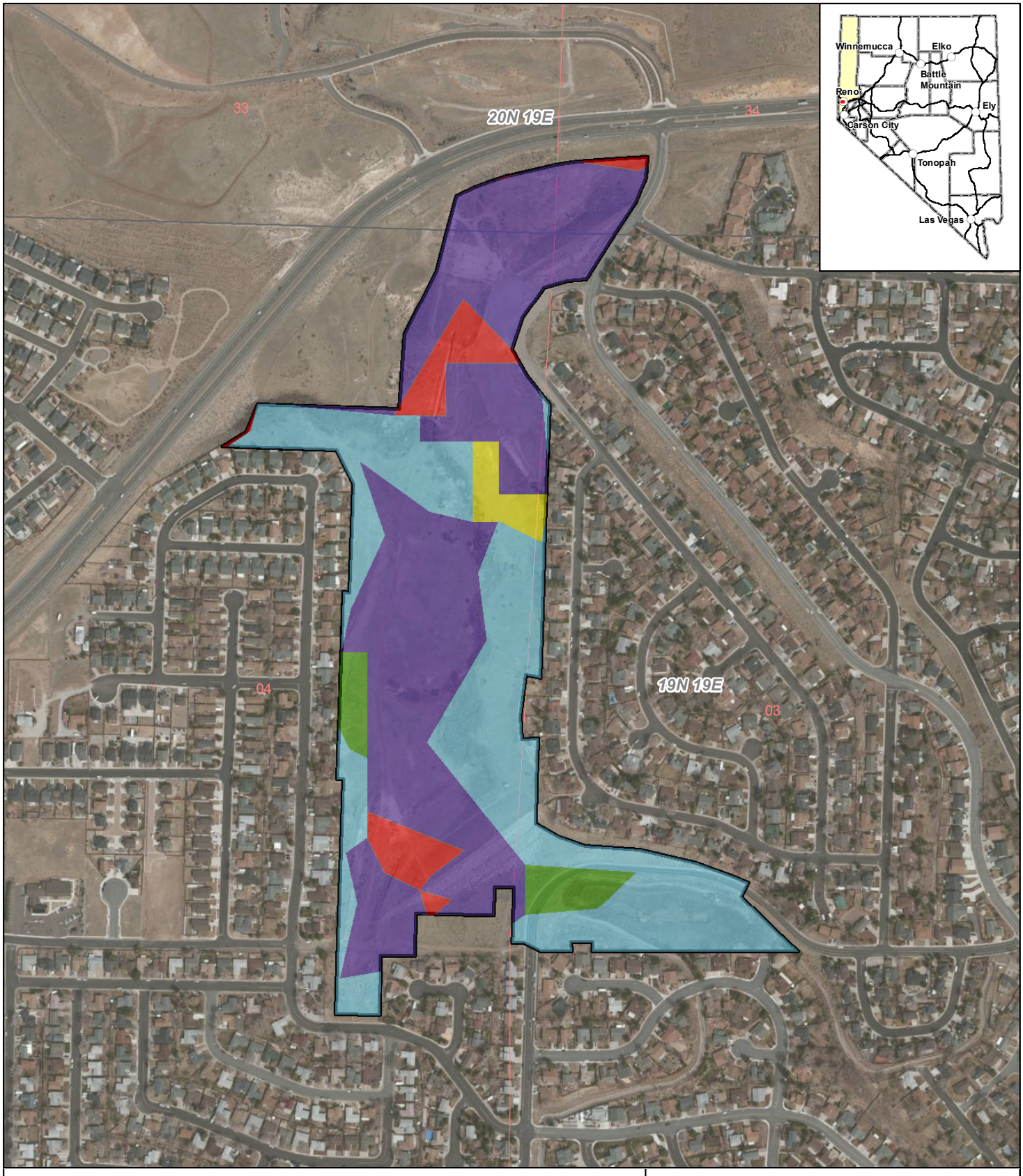
CITY OF RENO

WEST WASH DAM

NRCS Mapped Ecological Sites in the Project Area

Label: Figure 3	Drawn By: TLF
Date: 08/14/2021	Project No.: 4452
Base Map: Basemap: ArcGIS Imagery (Clarity)	
File Name: 4452T_WestWash_Fig3_EcoSites.mxd	

EM STRATEGIES



Explanation

- Project Area (53.2 acres)
- Inter-Mountain Basins Big Sagebrush Shrubland (26.8 acres)
- Developed, Open Space - Low Intensity (19.8 acres)
- Developed, Medium - High Intensity (3.2 acres)
- Great Basin Pinyon-Juniper Woodland (2.2 acres)
- Inter-Mountain Basins Montane Sagebrush Steppe (1.2 acres)

0 200 400 Feet N

CITY OF RENO

WEST WASH DAM

SWReGAP Vegetation Communities in the Project Area

Label: Figure 4	Drawn By: TLF
Date: 08/14/2021	Project No.: 4452
Base Map: Basemap: ArcGIS Imagery (Clarity)	
File Name: 4452T_WestWash_Fig4_SWReGAP.mxd	

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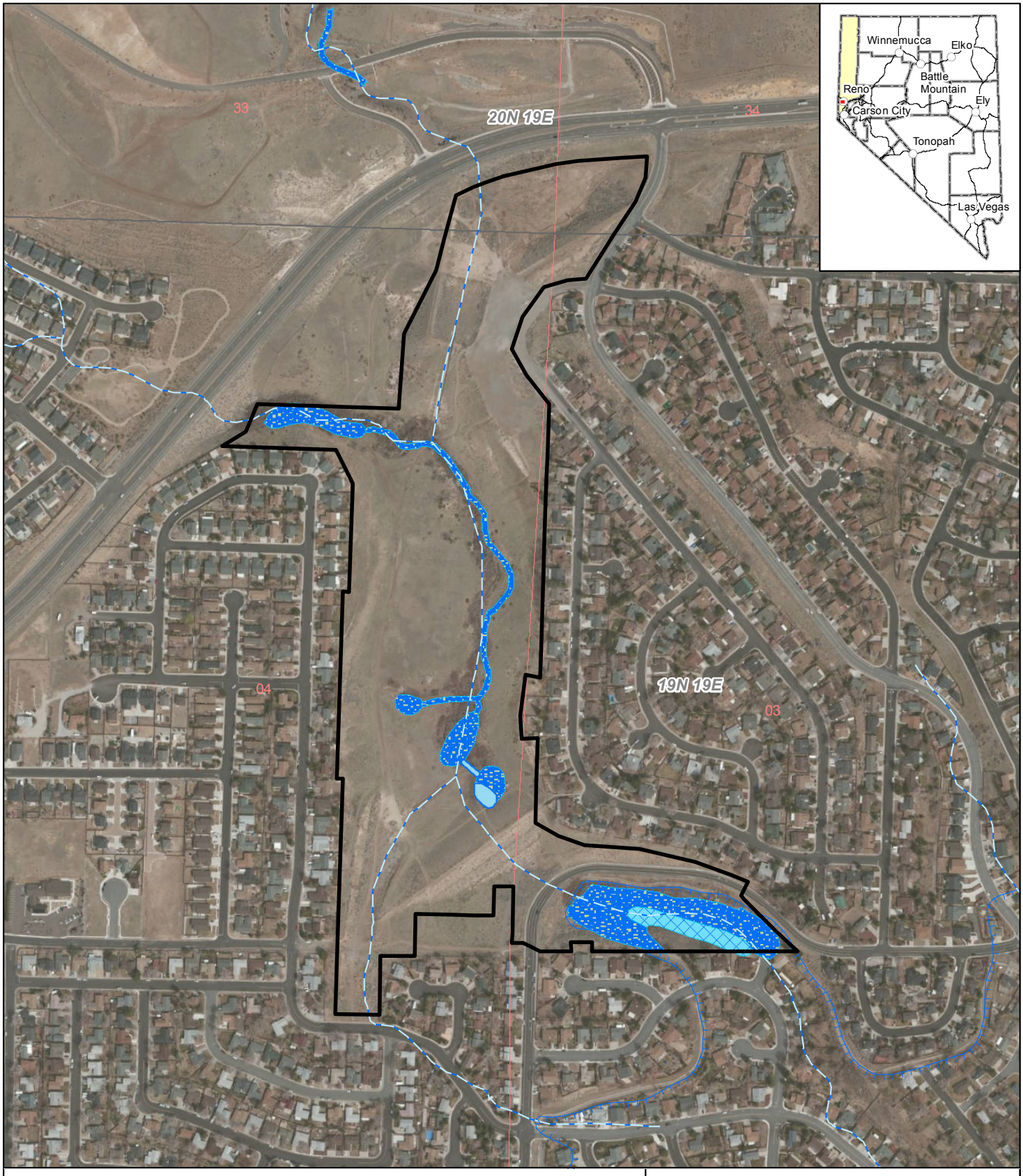

Explanation

- Project Area (53.2 acres)

NHD Data

- Ephemeral Stream
- Canal Ditch

NWI Data

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

0 200 400 Feet

N

CITY OF RENO

WEST WASH DAM

Hydrologic Features in the Vicinity of the Project Area

Label: Figure 5	Drawn By: TLF
Date: 08/14/2021	Project No.: 4452
Base Map: Basemap: ArcGIS Imagery (Clarity)	
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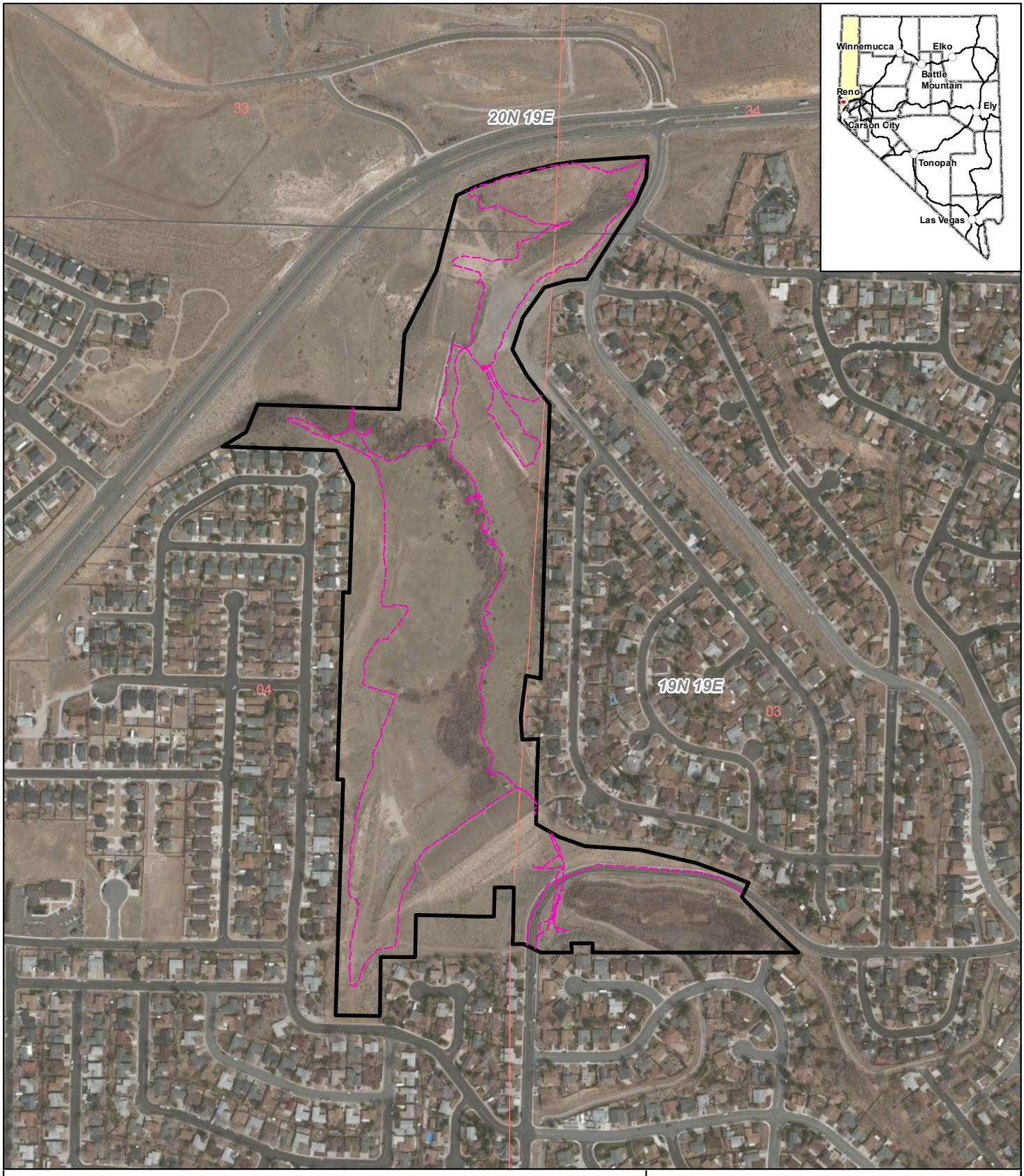


Explanation

Project Area (53.2 acres)

Survey Tracks

0 200 400 Feet N

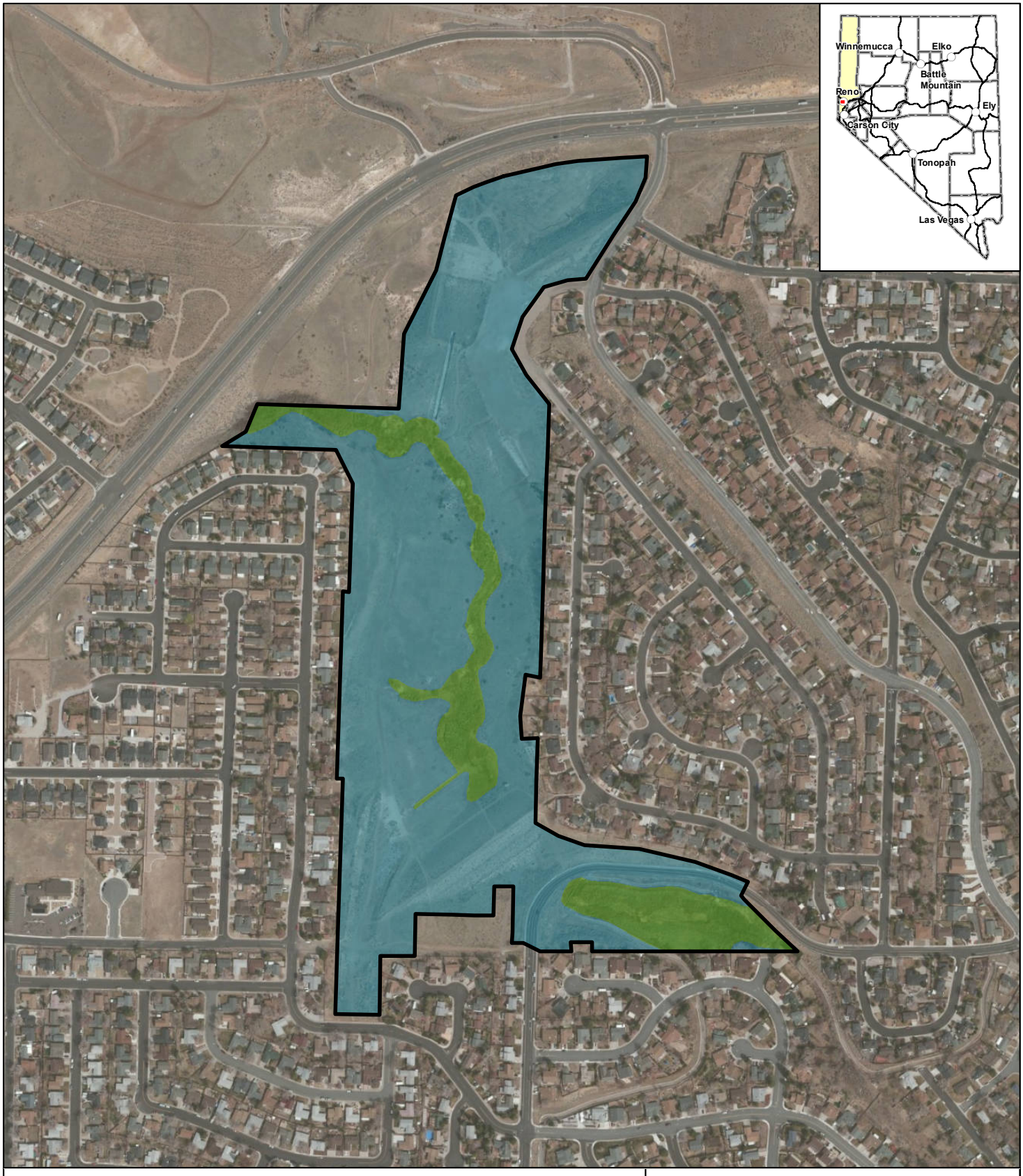
CITY OF RENO

WEST WASH DAM

Survey Tracks

Label: Figure 6	Drawn By: TLF
Date: 08/14/2021	Project No.: 4452
Base Map: Basemap: ArcGIS Imagery (Clarity)	
File Name: 4452T_WestWash_Fig6_Survey.mxd	

EM STRATEGIES



Explanation

- Project Area (53.2 acres)
- Inter-Mountain Basins Big Sagebrush Shrubland (45.2 acres)
- Great Basin Lowland Riparian (8.0 acres)

0 200 400 Feet

N

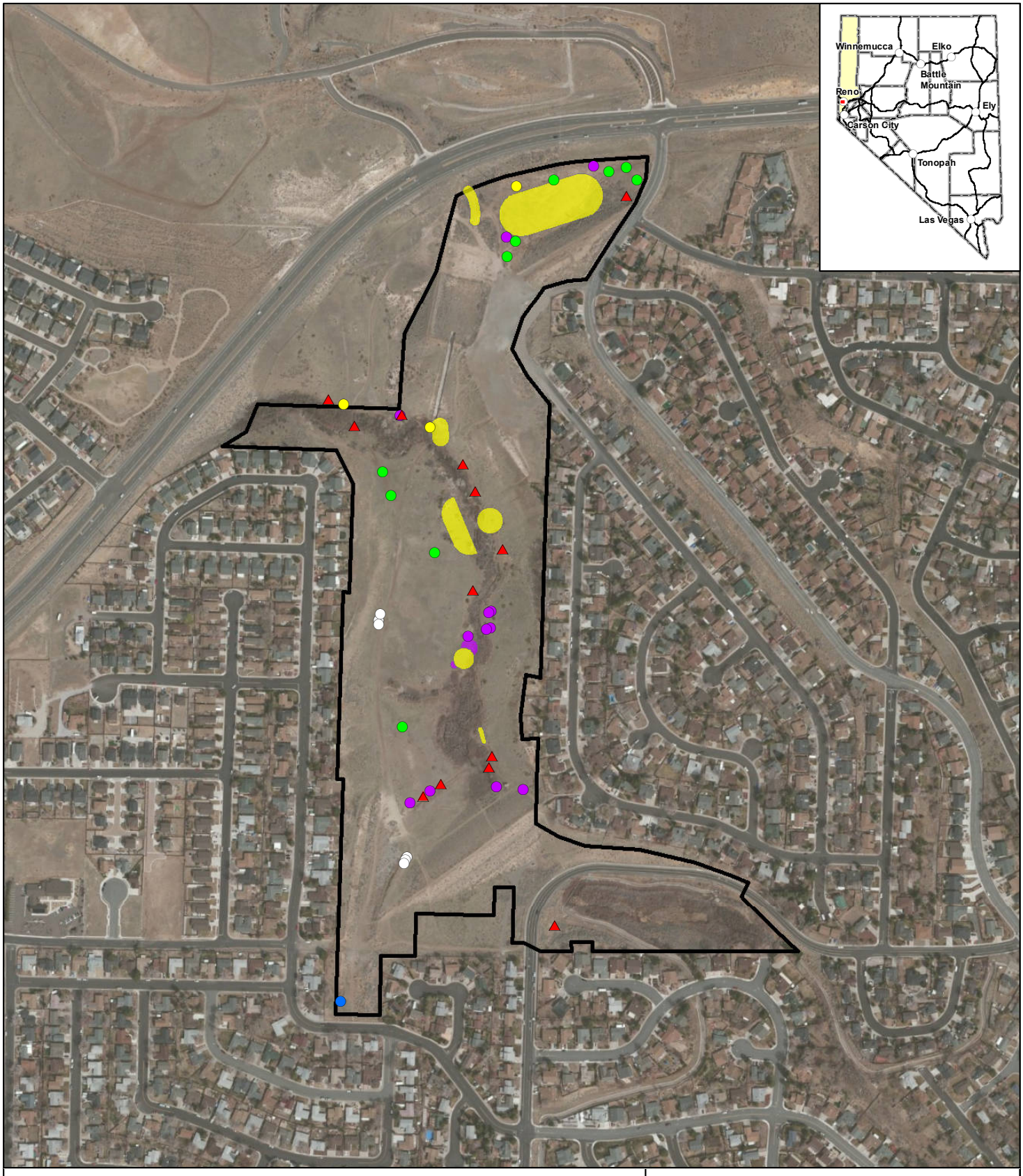
CITY OF RENO

WEST WASH DAM

Field-Verified Vegetation Communities in the Project Area

Label: Figure 7	Drawn By: SMH/TLF
Date: 08/14/2021	Project No.: 4452
Base Map: Basemap: ArcGIS Imagery (Clarity)	
File Name: 4452H_WestWash_Fig07_FV_VegComms.mxd	

EM STRATEGIES



Explanation

- Project Area (53.2 acres)
- Milkweed
- Hoary Cress
- Nodding Thistle
- Jointed Goatgrass
- Perennial Pepperweed
- Medusahead Grass
- Nodding Thistle
- Perennial Pepperweed

0 200 400 Feet

N

CITY OF RENO

WEST WASH DAM

Botanical Survey Results

Label: Figure 8	Drawn By: SMH/TLF
Date: 08/14/2021	Project No.: 4452
Base Map: Basemap: ArcGIS Imagery (Clarity)	
File Name: 4452T_WestWash_Fig08_Botanical.mxd	

EM STRATEGIES

APPENDIX B

NRCS Soils Report

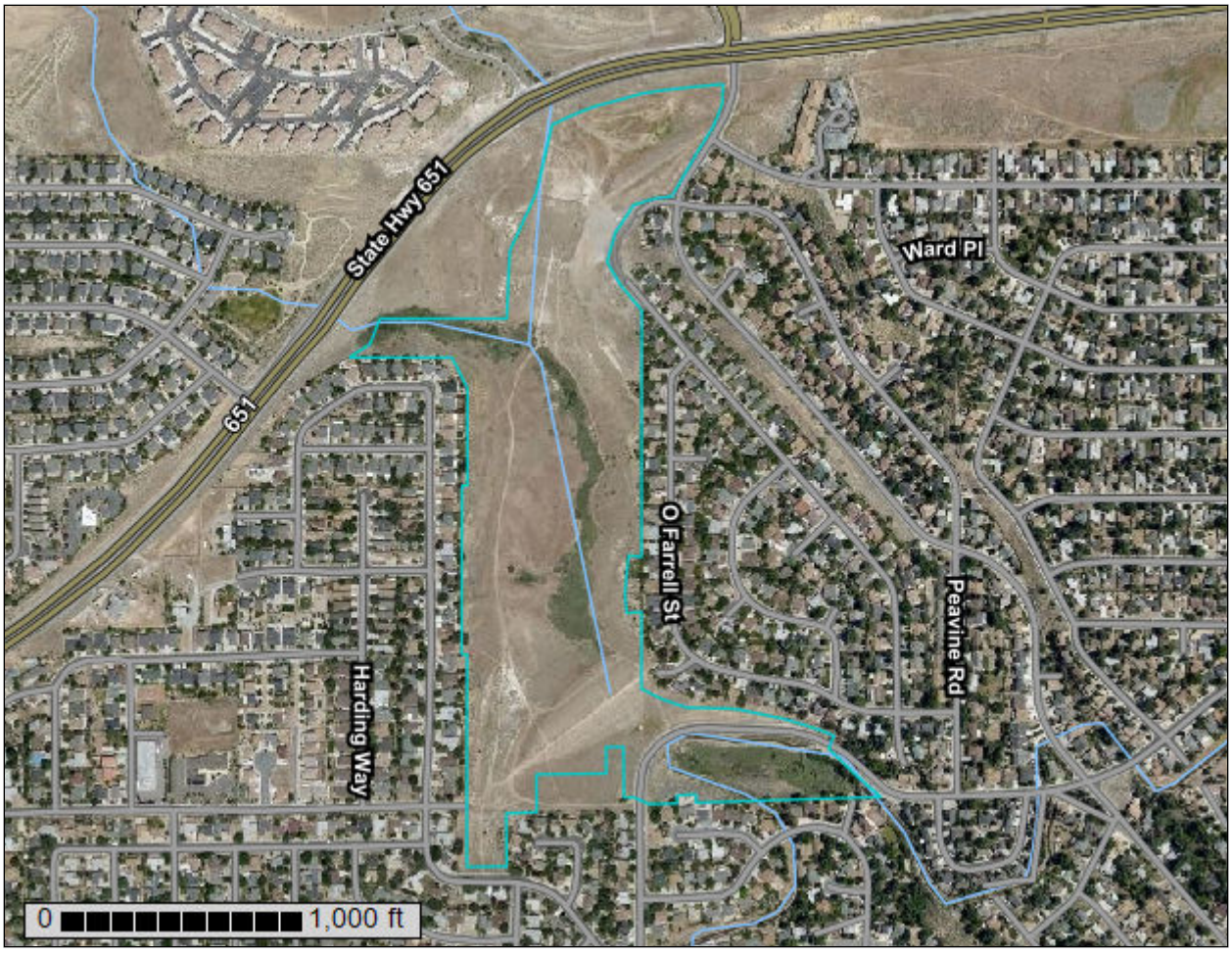
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Washoe County, Nevada, South Part



July 23, 2021

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

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Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:5,780 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 250 500 1000 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Washoe County, Nevada, South Part
Survey Area Data: Version 17, Aug 26, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 1, 2018—Oct 1, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
312	Risley cobbly loam, 15 to 30 percent slopes	0.0	0.0%
650	Chalco very stony clay loam, 15 to 30 percent slopes	0.8	1.5%
683	Reno stony sandy loam, 2 to 8 percent slopes	1.9	3.5%
991	Xeric Torriorthents-Urban land complex	11.5	21.5%
1050	Waspo clay, 15 to 30 percent slopes	38.3	72.0%
1054	Waspo gravelly clay, 2 to 8 percent slopes	0.8	1.4%
Totals for Area of Interest		**53.2**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it

was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Washoe County, Nevada, South Part

312—Risley cobbly loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: hxhy
Elevation: 4,500 to 6,000 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 47 to 49 degrees F
Frost-free period: 100 to 110 days
Farmland classification: Not prime farmland

Map Unit Composition

Risley and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Risley

Setting

Landform: Hills
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Residuum and colluvium derived from altered volcanic rocks

Typical profile

H1 - 0 to 6 inches: cobbly loam
H2 - 6 to 28 inches: clay
Cr - 28 to 60 inches: bedrock

Properties and qualities

Slope: 15 to 30 percent
Surface area covered with cobbles, stones or boulders: 1.0 percent
Depth to restrictive feature: 20 to 39 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Available water capacity: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: R026XY017NV - LOAMY HILL 10-12 P.Z.
Hydric soil rating: No

Minor Components

Rock outcrop

Percent of map unit: 4 percent
Landform: Peaks

Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Mizel

Percent of map unit: 4 percent
Landform: Hills
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R026XY029NV - ERODED SLOPE 10-12 P.Z.
Hydric soil rating: No

Old camp

Percent of map unit: 4 percent
Landform: Hills
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R026XY022NV - STONY SLOPE 8-10 P.Z.
Hydric soil rating: No

Indiano

Percent of map unit: 3 percent
Landform: Hills
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R026XY010NV - LOAMY 10-12 P.Z.
Other vegetative classification: LOAMY 10-12 P.Z. (023XY020NV_1)
Hydric soil rating: No

650—Chalco very stony clay loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: hxlj
Elevation: 4,900 to 5,400 feet
Mean annual precipitation: 8 to 10 inches
Mean annual air temperature: 47 to 49 degrees F
Frost-free period: 90 to 100 days
Farmland classification: Not prime farmland

Map Unit Composition

Chalco and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chalco

Setting

Landform: Pediments
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum and colluvium derived from lake-laid tuff

Typical profile

H1 - 0 to 3 inches: stony clay loam
H2 - 3 to 15 inches: clay
Cr - 15 to 60 inches: bedrock

Properties and qualities

Slope: 15 to 30 percent
Surface area covered with cobbles, stones or boulders: 11.0 percent
Depth to restrictive feature: 10 to 20 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: R026XY015NV - SHALLOW LOAM 10-12 P.Z.
Hydric soil rating: No

Minor Components

Badland

Percent of map unit: 5 percent
Landform: Pediments
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Stodick

Percent of map unit: 5 percent
Landform: Pediments
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R026XY015NV - SHALLOW LOAM 10-12 P.Z.
Hydric soil rating: No

Reno

Percent of map unit: 5 percent
Landform: Fan remnants
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R026XY023NV - CLAYPAN 10-12 P.Z.
Hydric soil rating: No

683—Reno stony sandy loam, 2 to 8 percent slopes

Map Unit Setting

National map unit symbol: hxm3
Elevation: 4,800 to 5,300 feet
Mean annual precipitation: 8 to 10 inches
Mean annual air temperature: 49 to 50 degrees F
Frost-free period: 90 to 100 days
Farmland classification: Not prime farmland

Map Unit Composition

Reno and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Reno

Setting

Landform: Fan remnants
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Mixed alluvium

Typical profile

H1 - 0 to 4 inches: stony sandy loam
H2 - 4 to 24 inches: clay
H3 - 24 to 47 inches: cemented material
Cr - 47 to 60 inches: bedrock

Properties and qualities

Slope: 2 to 8 percent
Surface area covered with cobbles, stones or boulders: 2.0 percent
Depth to restrictive feature: 20 to 39 inches to duripan; 39 to 59 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: R026XY023NV - CLAYPAN 10-12 P.Z.
Hydric soil rating: No

Minor Components

Barnard

Percent of map unit: 5 percent
Landform: Fan remnants
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R026XY017NV - LOAMY HILL 10-12 P.Z.
Hydric soil rating: No

Northmore

Percent of map unit: 5 percent
Landform: Fan remnants
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R026XY010NV - LOAMY 10-12 P.Z.
Hydric soil rating: No

Leviathan

Percent of map unit: 5 percent
Landform: Fan remnants
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R026XY010NV - LOAMY 10-12 P.Z.
Hydric soil rating: No

991—Xeric Torriorthents-Urban land complex

Map Unit Setting

National map unit symbol: hxp2
Elevation: 4,250 to 5,590 feet
Mean annual precipitation: 9 to 12 inches
Mean annual air temperature: 50 to 52 degrees F
Frost-free period: 165 to 175 days
Farmland classification: Not prime farmland

Map Unit Composition

Xeric torriorthents and similar soils: 50 percent
Urban land: 40 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Xeric Torriorthents

Setting

Landform: Fan piedmonts
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Mixed alluvium

Typical profile

H1 - 0 to 60 inches: variable

Properties and qualities

Slope: 0 to 30 percent
Surface area covered with cobbles, stones or boulders: 10.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to very high (0.06 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydrologic Soil Group: A
Hydric soil rating: No

Description of Urban Land

Setting

Landform: Fan piedmonts
Down-slope shape: Convex
Across-slope shape: Convex

Typical profile

H1 - 0 to 60 inches: variable

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydric soil rating: No

Minor Components

Dumps

Percent of map unit: 10 percent
Landform: Fan piedmonts
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

1050—Waspo clay, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: hxc5
Elevation: 4,800 to 5,200 feet

Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 49 to 50 degrees F
Frost-free period: 100 to 110 days
Farmland classification: Not prime farmland

Map Unit Composition

Waspo and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Waspo

Setting

Landform: Pediments
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum and colluvium derived from lacustrine tuff

Typical profile

H1 - 0 to 7 inches: clay
H2 - 7 to 24 inches: clay
Cr - 24 to 60 inches: bedrock

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: 20 to 39 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Ecological site: R026XY019NV - CHURNING CLAY 10-12 P.Z.
Hydric soil rating: No

Minor Components

Chalco

Percent of map unit: 6 percent
Landform: Pediments
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R026XY029NV - ERODED SLOPE 10-12 P.Z.
Hydric soil rating: No

Reno

Percent of map unit: 5 percent
Landform: Fan remnants
Down-slope shape: Linear
Across-slope shape: Convex

Ecological site: R026XY023NV - CLAYPAN 10-12 P.Z.
Hydric soil rating: No

Manogue

Percent of map unit: 4 percent
Landform: Hills
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R026XY027NV - CHURNING CLAY 8-10 P.Z.
Hydric soil rating: No

1054—Waspo gravelly clay, 2 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2w4cb
Elevation: 4,430 to 5,900 feet
Mean annual precipitation: 10 to 13 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 90 to 110 days
Farmland classification: Not prime farmland

Map Unit Composition

Waspo and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Waspo

Setting

Landform: Pediments
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Pedisediment derived from tuff and/or residuum weathered from tuff

Typical profile

A1 - 0 to 7 inches: gravelly clay
A2 - 7 to 24 inches: clay
Cr - 24 to 60 inches: bedrock

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: 20 to 39 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None

Frequency of ponding: None
Calcium carbonate, maximum content: 3 percent
Maximum salinity: Nonsaline to moderately saline (0.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum: 5.0
Available water capacity: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: R026XY019NV - CHURNING CLAY 10-12 P.Z.
Hydric soil rating: No

Minor Components

Chalco

Percent of map unit: 3 percent
Landform: Pediments
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Nose slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R026XY025NV - CLAYPAN 8-10 P.Z.
Hydric soil rating: No

Tunnison

Percent of map unit: 3 percent
Landform: Plateaus
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Mountaintop, crest
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R026XY027NV - CHURNING CLAY 8-10 P.Z.
Hydric soil rating: No

Manogue

Percent of map unit: 3 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Head slope
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: R026XY027NV - CHURNING CLAY 8-10 P.Z.
Hydric soil rating: No

Boondock

Percent of map unit: 3 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R026XY029NV - ERODED SLOPE 10-12 P.Z.
Hydric soil rating: No

Reno

Percent of map unit: 3 percent

Landform: Fan remnants
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R026XY023NV - CLAYPAN 10-12 P.Z.
Hydric soil rating: No

Soil Information for All Uses

Ecological Sites

Individual soil map unit components can be correlated to a particular ecological site. The Ecological Site Assessment section includes ecological site descriptions, plant growth curves, state and transition models, and selected National Plants database information.

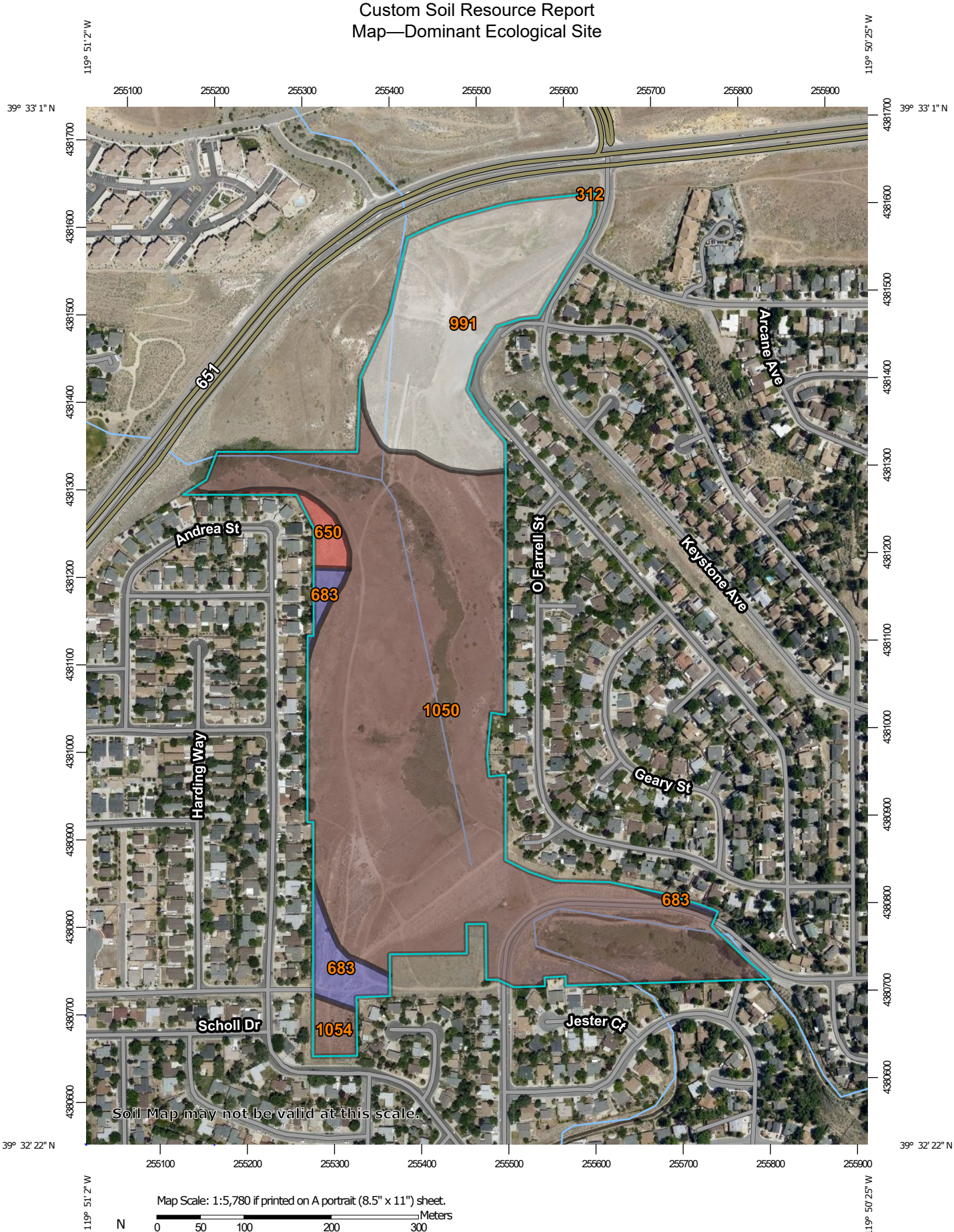
All Ecological Sites —

An "ecological site" is the product of all the environmental factors responsible for its development. It has characteristic soils that have developed over time; a characteristic hydrology, particularly infiltration and runoff, that has developed over time; and a characteristic plant community (kind and amount of vegetation). The vegetation, soils, and hydrology are all interrelated. Each is influenced by the others and influences the development of the others. For example, the hydrology of the site is influenced by development of the soil and plant community. The plant community on an ecological site is typified by an association of species that differs from that of other ecological sites in the kind and/or proportion of species or in total production.

An ecological site name provides a general description of a particular ecological site. For example, "Loamy Upland" is the name of a rangeland ecological site. An "ecological site ID" is the symbol assigned to a particular ecological site.

The map identifies the dominant ecological site for each map unit, aggregated by dominant condition. Other ecological sites may occur within each map unit. Each map unit typically consists of one or more components (soils and/or miscellaneous areas). Each soil component is associated with an ecological site. Miscellaneous areas, such as rock outcrop, sand dunes, and badlands, have little or no soil material and support little or no vegetation and therefore are not linked to an ecological site. The table below the map lists all of the ecological sites for each map unit component in your area of interest.

Custom Soil Resource Report
Map—Dominant Ecological Site



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- R026XY015NV
- R026XY017NV
- R026XY019NV
- R026XY023NV
- Not rated or not available

Soil Rating Lines
- R026XY015NV
- R026XY017NV
- R026XY019NV
- R026XY023NV
- Not rated or not available

Soil Rating Points
- R026XY015NV
- R026XY017NV
- R026XY019NV
- R026XY023NV
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

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Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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Soil Survey Area: Washoe County, Nevada, South Part
Survey Area Data: Version 17, Aug 26, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 1, 2018—Oct 1, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Ecological Sites by Map Unit Component

Map unit symbol	Map unit name	Component name (percent)	Ecological site	Acres in AOI	Percent of AOI
312	Risley cobbly loam, 15 to 30 percent slopes	Risley (85%)	R026XY017NV — LOAMY HILL 10-12 P.Z.	0.0	0.0%
		Mizel (4%)	R026XY029NV — ERODED SLOPE 10-12 P.Z.		
		Old camp (4%)	R026XY022NV — STONY SLOPE 8-10 P.Z.		
		Rock outcrop (4%)			
		Indiano (3%)	R026XY010NV — LOAMY 10-12 P.Z.		
650	Chalco very stony clay loam, 15 to 30 percent slopes	Chalco (85%)	R026XY015NV — SHALLOW LOAM 10-12 P.Z.	0.8	1.5%
		Badland (5%)			
		Reno (5%)	R026XY023NV — CLAYPAN 10-12 P.Z.		
		Stodick (5%)	R026XY015NV — SHALLOW LOAM 10-12 P.Z.		
683	Reno stony sandy loam, 2 to 8 percent slopes	Reno (85%)	R026XY023NV — CLAYPAN 10-12 P.Z.	1.9	3.5%
		Barnard (5%)	R026XY017NV — LOAMY HILL 10-12 P.Z.		
		Leviathan (5%)	R026XY010NV — LOAMY 10-12 P.Z.		
		Northmore (5%)	R026XY010NV — LOAMY 10-12 P.Z.		
991	Xeric Torriorthents-Urban land complex	Xeric Torriorthents (50%)		11.5	21.5%
		Urban land (40%)			
		Dumps (10%)			
1050	Waspo clay, 15 to 30 percent slopes	Waspo (85%)	R026XY019NV — CHURNING CLAY 10-12 P.Z.	38.3	72.0%
		Chalco (6%)	R026XY029NV — ERODED SLOPE 10-12 P.Z.		

Map unit symbol	Map unit name	Component name (percent)	Ecological site	Acres in AOI	Percent of AOI
		Reno (5%)	R026XY023NV — CLAYPAN 10-12 P.Z.		
		Manogue (4%)	R026XY027NV — CHURNING CLAY 8-10 P.Z.		
1054	Waspo gravelly clay, 2 to 8 percent slopes	Waspo (85%)	R026XY019NV — CHURNING CLAY 10-12 P.Z.	0.8	1.4%
		Boondock (3%)	R026XY029NV — ERODED SLOPE 10-12 P.Z.		
		Chalco (3%)	R026XY025NV — CLAYPAN 8-10 P.Z.		
		Manogue (3%)	R026XY027NV — CHURNING CLAY 8-10 P.Z.		
		Reno (3%)	R026XY023NV — CLAYPAN 10-12 P.Z.		
		Tunnison (3%)	R026XY027NV — CHURNING CLAY 8-10 P.Z.		
Totals for Area of Interest				**53.2**	**100.0%**

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APPENDIX C

Agency Data Responses (NDOW, NDNH, USFWS)

STATE OF NEVADA

DEPARTMENT OF WILDLIFE

6980 Sierra Center Parkway, Suite 120
Reno, Nevada 89511
Phone (775) 688-1500 • Fax (775) 688-1595

STEVE SISOLAK
Governor

TONY WASLEY
Director

BONNIE LONG
Deputy Director

JACK ROBB
Deputy Director

Vicki Thill
Biologist
EM Strategies
1650 Meadow Wood Lane
Reno, Nevada 89502

March 25, 2021

Re: WestWashDam

Dear Vicki Thill:

I am responding to your request for information from the Nevada Department of Wildlife (NDOW) on the known or potential occurrence of wildlife resources in the vicinity of the WestWashDam located in Washoe County, Nevada. In order to fulfill your request, an analysis was performed using the best available data from the NDOW's wildlife occurrences, raptor nest sites and ranges, greater sage-grouse leks and habitat, and big game distributions databases. No warranty is made by the NDOW as to the accuracy, reliability, or completeness of the data for individual use or aggregate use with other data. These data should be considered **sensitive** and may contain information regarding the location of sensitive wildlife species or resources. All appropriate measures should be taken to ensure that the use of this data is strictly limited to serve the needs of the project described on your GIS Data Request Form. Abuse of this information has the potential to adversely affect the existing ecological status of Nevada's wildlife resources and could be cause for the denial of future data requests.

To adequately provide wildlife resource information in the vicinity of the proposed project the NDOW delineated an area of interest that included a four-mile buffer around the project area provided by you on Tuesday, March 23, 2021. Wildlife resource data was queried from the NDOW databases based on this area of interest. The results of this analysis are summarized below.

Big Game - Occupied mule deer distribution exists outside of the project area within portions of the four-mile buffer area. No known occupied bighorn sheep, elk, or pronghorn antelope distributions exist in the vicinity of the project area. Please refer to the attached maps for details regarding big game distributions relative to the proposed project area.

Greater Sage-Grouse - There is no known greater sage-grouse habitat in the vicinity of the project area. Greater sage-grouse activity in the vicinity of the project area has been documented by 209 tracking locations generated by at least three radio-marked birds in the vicinity of the project area. There are no known greater sage-grouse lek sites in the vicinity of the project area.

Lahontan Cutthroat Trout - are known to exist in the vicinity of the project area in the City of Reno-Truckee River watershed.

Raptors - Various species of raptors, which use diverse habitat types, may reside in the vicinity of the project area. American kestrel, bald eagle, barn owl, burrowing owl, Cooper's hawk, ferruginous hawk, flammulated owl, golden eagle, great horned owl, long-eared owl, merlin, northern goshawk, northern harrier, northern saw-whet owl, osprey, peregrine falcon, red-tailed hawk, rough-legged hawk, sharp-shinned hawk, short-eared owl, Swainson's hawk, turkey vulture, and western screech owl have distribution ranges that include the project area and four-mile buffer area. Furthermore, the following raptor species have been directly observed in the vicinity of the project area:

American kestrel	great horned owl	prairie falcon
bald eagle	merlin	red-tailed hawk
barn owl	northern goshawk	rough-legged hawk
burrowing owl	osprey	sharp-shinned hawk
Cooper's hawk	peregrine falcon	snowy owl
golden eagle		

Raptor species are protected by State and Federal laws. In addition, bald eagle, burrowing owl, California spotted owl, ferruginous hawk, flammulated owl, golden eagle, northern goshawk, peregrine falcon, prairie falcon, and short-eared owl are NDOW species of special concern and are target species for conservation as outlined by the Nevada Wildlife Action Plan. Per the *Interim Golden Eagle Technical Guidance: Inventory and Monitoring Protocols; and Other Recommendations in Support of Golden Eagle Management and Permit Issuance* (United States Fish and Wildlife Service 2010) we have queried our raptor nest database to include raptor nest sites within ten miles of the proposed project area. There are five known raptor nest sites within ten miles of the project area:

Probable Use	Last Check	Last Active	Township/Range/Section
Burrowing Owl	7/29/1977	7/29/1977	21 0190N 0200E 020
Buteo	3/2/1978	3/2/1978	21 0200N 0200E 029
Eagle	5/26/1979	5/26/1979	21 0190N 0200E 013
Eagle	6/22/2012		21 0190N 0180E 029
Northern Goshawk	1/1/1980	1/1/1980	21 0200N 0180E 019

Other Wildlife Resources

There are no water developments in the vicinity of the project area. Additional species have also been observed in the vicinity of the project area. Please refer to the appendix for details regarding these species.

The proposed project area may also be in the vicinity of abandoned mine workings, which often provide habitat for state and federally protected wildlife, especially bat species, many of which are protected under NAC 503.030. To request data regarding known abandoned mine workings in the vicinity of the project area please contact the Nevada Division of Minerals (http://minerals.state.nv.us/).

The above information is based on data stored at our Reno Headquarters Office and does not necessarily incorporate the most up to date wildlife resource information collected in the field. Please contact the Habitat Division Supervising Biologist at our Western Region Reno Office (775.688.1500) to discuss the current environmental conditions for your project area and the interpretation of our analysis. Furthermore, it should be noted that the information detailed above is preliminary in nature and not necessarily an identification of every wildlife resource concern associated with the proposed project. Consultation with the Supervising Habitat biologist will facilitate the development of appropriate survey protocols and avoidance or mitigation measures that may be required to address potential impacts to wildlife resources.

Mark Freese - Western Region Supervising Habitat Biologist (775.688.1145)

Federally listed Threatened and Endangered species are also under the jurisdiction of the United States Fish and Wildlife Service. Please contact them for more information regarding these species.

If you have any questions regarding the results or methodology of this analysis, please do not hesitate to contact Jinna Larkin at (775) 688-1580.

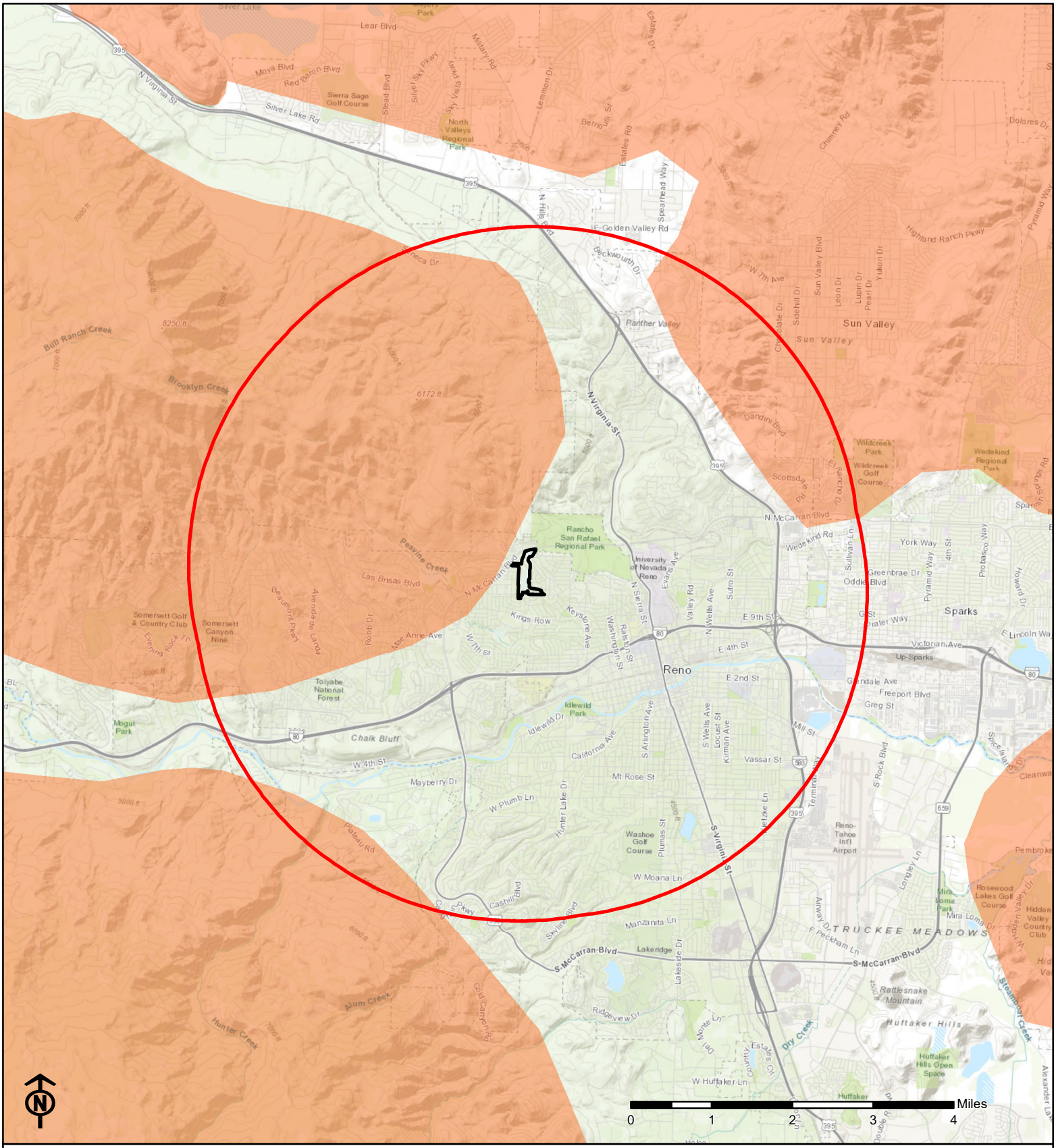
Appendix: Other Wildlife Species Table

Common Name	ESA	State	SWAP SoCP
American beaver		Furbearer	
American black bear			
American crow			
American goldfinch		Protected	
American mink		Furbearer	
American robin		Protected	
Anna's hummingbird		Protected	
Barrow's goldeneye			
black-chinned hummingbird		Protected	
black-headed grosbeak		Protected	
black bullhead			
bluegill			
Brazilian (Mexican) free-tailed bat		Protected	Yes
Brewer's blackbird		Protected	
brook trout			
brown-headed cowbird		Protected	
brown creeper		Protected	
brown trout			
bullfrog			
bullhead (unknown)			
California ground squirrel			
California quail			
California toad			Yes
Canada goose			
Cassin's finch		Protected	Yes
cedar waxwing		Protected	
chisel-toothed kangaroo rat			
common carp			
common kingsnake			
common muskrat		Furbearer	
common raven		Protected	
coyote		Unprotected	
cutbow trout			
dark-eyed junco		Protected	
desert tortoise	Threatened	Threatened	Yes
desert woodrat			
eastern kingbird		Protected	
Eurasian wigeon			
European starling		Unprotected	
evening grosbeak		Protected	
falcon (unknown)			
fathead minnow			
flycatcher (unknown)			
glaucous-winged gull		Protected	
glaucous gull		Protected	

golden-mantled ground squirrel			
Great Basin collared lizard			Yes
Great Basin fence lizard			
Great Basin gophersnake			
Great Basin pocket mouse			
greater scaup			
green heron		Protected	
green sunfish			
hawk (unknown)			
hermit thrush		Protected	
house finch		Protected	
house mouse			
house sparrow		Unprotected	
house wren		Protected	
Lahontan cutthroat trout	Threatened		Yes
Lahontan redside			
Lahontan speckled dace			
largemouth bass			
lesser goldfinch		Protected	
long-nosed leopard lizard			Yes
mallard			
mew gull		Protected	
montane vole			
mountain chickadee		Protected	
mountain lion			
mountain sucker			
mountain whitefish			Yes
mourning dove			
nighthawk (unknown)			
North American deermouse			
North American porcupine			
North American river otter		Furbearer	Yes
northern flicker		Protected	
northern mockingbird		Protected	
northern pike		Injurious	
northern rubber boa			Yes
Ord's kangaroo rat			
Oregon junco		Protected	
Pacific chorus frog			
Paiute sculpin			
pine siskin		Protected	
quail (unknown)			
raccoon			
rainbow trout			
red-breasted sapsucker		Protected	
redside shiner			
rock dove			
roof rat			

ruddy duck		
rufous hummingbird	Protected	Yes
Sacramento perch		
skunk (unknown)		
sora		
speckled dace		
spotted bass		
spotted bat	Threatened	Yes
spotted towhee	Protected	
sucker (unknown)		
Tahoe sucker		
terrestrial gartersnake		
Thayer's gull	Protected	
toad (unknown)		
Toquerville pyrg		
Townsend's solitaire	Protected	
trout (unknown)		
tui chub		
turtle (unknown)		
vermilion flycatcher	Protected	
Virginia rail		
western fence lizard		
western harvest mouse		
western kingbird	Protected	
western pond turtle		Yes
western rattlesnake		
western scrub-jay		
western tanager	Protected	
western toad		Yes
western yellow-bellied racer		
white-crowned sparrow	Protected	
white-headed woodpecker	Protected	Yes
white-tailed antelope squirrel		
Williamson's sapsucker	Protected	
Wilson's warbler	Protected	
Woodhouse's toad		
yellow-bellied marmot		
yellow-rumped warbler	Protected	
yellow bullhead		

ESA: Endangered Species Act Status
State: State of Nevada Special Status
SWAP SoCP: Nevada State Wildlife Action Plan (2012) Species of Conservation Priority



WestWashDam
Mule Deer Distribution

March 25, 2021

Projection: UTM Zone 11 North, NAD83

No warranty is made by the Nevada Department of Wildlife as to the accuracy, reliability, or completeness of the data for individual use or aggregate use with other data.

V:\ActiveProjects\DataRequests\Template\Data Request - Response Template.mxd

NEVADA
DIVISION OF
NATURAL HERITAGE

STATE OF NEVADA
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
Division of Natural Heritage

Steve Sisolak
Governor

Bradley Crowell
Director

Kristin Szabo
Administrator

25 March 2021

Vicki Thill
EM Strategies, Inc.
1651 Meadow Wood Lane
Reno, NV 89502

RE: Data request received 23 March 2021

Dear Ms. Thill:

We are pleased to provide the information you requested on endangered, threatened, candidate, and/or At Risk plant and animal taxa recorded within or near the West Wash Dam Project area in Washoe County. We searched our database and maps for the following, a 2-kilometer radius around shapefiles provided, including:

Township 19N	Range 19E	Sections 03 and 04
Township 20N	Range 19E	Sections 33 and 34

There are no at-risk taxa recorded within the given area. However, habitat may be available for: the Golden Eagle, *Aquila chrysaetos*, a Nevada Bureau of Land Management (BLM) Sensitive Species; the northern rubber boa, *Charina bottae*, a Nevada BLM Sensitive Species; and the spotted bat, *Euderma maculatum*, a Nevada BLM Sensitive Species. The Nevada Department of Wildlife (NDOW) manages, protects, and restores Nevada's wildlife resources and associated habitat. Please contact Jinna Larkin, NDOW GIS Coordinator (775) 688-1580 to obtain further information regarding wildlife resources within and near your area of interest. Removal or destruction of state protected flora species requires a special permit from Nevada Division of Forestry (NRS 527.270).

Please note that our data are dependent on the research and observations of many individuals and organizations and in most cases are not the result of comprehensive or site-specific field surveys. Natural Heritage reports should never be regarded as final statements on the taxa or areas being considered, nor should they be substituted for on-site surveys required for environmental assessments.

Thank you for checking with our program. Please contact us for additional information or further assistance.

Sincerely,

Eric S. Miskow
Biologist/Data Manager

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Reno Fish And Wildlife Office
1340 Financial Boulevard, Suite 234
Reno, NV 89502-7147
Phone: (775) 861-6300 Fax: (775) 861-6301
http://www.fws.gov/reno/

In Reply Refer To:
Consultation Code: 08ENVD00-2021-SLI-0241
Event Code: 08ENVD00-2021-E-00791
Project Name: West Wash Dam

April 12, 2021

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The attached species list indicates threatened, endangered, proposed, and candidate species and designated or proposed critical habitat that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act of 1973, as amended (ESA, 16 U.S.C. 1531 *et seq*.), for projects that are authorized, funded, or carried out by a Federal agency. Candidate species have no protection under the ESA but are included for consideration because they could be listed prior to the completion of your project. Consideration of these species during project planning may assist species conservation efforts and may prevent the need for future listing actions. For additional information regarding species that may be found in the proposed project area, visit http://www.fws.gov/nevada/es/ipac.html.

The purpose of the ESA is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the ESA and its implementing regulations (50 CFR 402 *et seq*.), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2) (c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or

designated or proposed critical habitat. Guidelines for preparing a Biological Assessment can be found at: http://www.fws.gov/midwest/endangered/section7/ba_guide.html.

If a Federal action agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species, and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at: http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF.

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this species list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally listed, proposed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the ESA, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally, as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation, for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the attached list.

The Nevada Fish and Wildlife Office (NFWO) no longer provides species of concern lists. Most of these species for which we have concern are also on the Animal and Plant At-Risk Tracking List for Nevada (At-Risk list) maintained by the State of Nevada’s Natural Heritage Program (Heritage). Instead of maintaining our own list, we adopted Heritage's At-Risk list and are partnering with them to provide distribution data and information on the conservation needs for at-risk species to agencies or project proponents. The mission of Heritage is to continually evaluate the conservation priorities of native plants, animals, and their habitats, particularly those most vulnerable to extinction or in serious decline. In addition, in order to avoid future conflicts, we ask that you consider these at-risk species early in your project planning and explore management alternatives that provide for their long-term conservation.

For a list of at-risk species by county, visit Heritage's website (http://heritage.nv.gov). For a specific list of at-risk species that may occur in the project area, you can obtain a data request form from the website (http://heritage.nv.gov/get_data) or by contacting the Administrator of Heritage at 901 South Stewart Street, Suite 5002, Carson City, Nevada 89701-5245, (775) 684-2900. Please indicate on the form that your request is being obtained as part of your coordination with the Service under the ESA. During your project analysis, if you obtain new information or data for any Nevada sensitive species, we request that you provide the information to Heritage at the above address.

Furthermore, certain species of fish and wildlife are classified as protected by the State of Nevada (http://www.leg.state.nv.us/NAC/NAC-503.html). You must first obtain the appropriate license, permit, or written authorization from the Nevada Department of Wildlife (NDOW) to

take, or possess any parts of protected fish and wildlife species. Please visit http://www.ndow.org or contact NDOW in northern Nevada (775) 688-1500, in southern Nevada (702) 486-5127, or in eastern Nevada (775) 777-2300.

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq*.), and projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/eagle_guidance.html). Additionally, wind energy projects should follow the Service's wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

The Service's Pacific Southwest Region developed the *Interim Guidelines for the Development of a Project Specific Avian and Bat Protection Plan for Wind Energy Facilities* (Interim Guidelines). This document provides energy facility developers with a tool for assessing the risk of potential impacts to wildlife resources and delineates how best to design and operate a bird- and bat-friendly wind facility. These Interim Guidelines are available upon request from the NFWO. The intent of a Bird and Bat Conservation Strategy is to conserve wildlife resources while supporting project developers through: (1) establishing project development in an adaptive management framework; (2) identifying proper siting and project design strategies; (3) designing and implementing pre-construction surveys; (4) implementing appropriate conservation measures for each development phase; (5) designing and implementing appropriate post-construction monitoring strategies; (6) using post-construction studies to better understand the dynamics of mortality reduction (*e.g.*, changes in blade cut-in speed, assessments of blade "feathering" success, and studies on the effects of visual and acoustic deterrents) including efforts tied into Before-After/Control-Impact analysis; and (7) conducting a thorough risk assessment and validation leading to adjustments in management and mitigation actions.

The template and recommendations set forth in the Interim Guidelines were based upon the Avian Powerline Interaction Committee's Avian Protection Plan template (http://www.aplic.org/) developed for electric utilities and modified accordingly to address the unique concerns of wind energy facilities. These recommendations are also consistent with the Service's wind energy guidelines. We recommend contacting us as early as possible in the planning process to discuss the need and process for developing a site-specific Bird and Bat Conservation Strategy.

The Service has also developed guidance regarding wind power development in relation to prairie grouse leks (sage-grouse are included in this). This document can be found at: http://www.fws.gov/southwest/es/Oklahoma/documents/te_species/wind%20power/prairie%20grouse%20lek%205%20mile%20public.pdf.

Migratory Birds are a Service Trust Resource. Based on the Service's conservation responsibilities and management authority for migratory birds under the Migratory Bird Treaty Act of 1918, as amended (MBTA; 16 U.S.C. 703 *et seq*.), we recommend that any land clearing or other surface disturbance associated with proposed actions within the project area be timed to avoid potential destruction of bird nests or young, or birds that breed in the area. Such destruction may be in violation of the MBTA. Under the MBTA, nests with eggs or young of migratory birds may not be harmed, nor may migratory birds be killed. Therefore, we recommend land clearing be conducted outside the avian breeding season. If this is not feasible,

we recommend a qualified biologist survey the area prior to land clearing. If nests are located, or if other evidence of nesting (*i.e.*, mated pairs, territorial defense, carrying nesting material, transporting food) is observed, a protective buffer (the size depending on the habitat requirements of the species) should be delineated and the entire area avoided to prevent destruction or disturbance to nests until they are no longer active.

Guidance for minimizing impacts to migratory birds for projects involving communications towers (*e.g.*, cellular, digital television, radio, and emergency broadcast) can be found at: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm; http://www.towerkill.com; and http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html.

If wetlands, springs, or streams are are known to occur in the project area or are present in the vicinity of the project area, we ask that you be aware of potential impacts project activities may have on these habitats. Discharge of fill material into wetlands or waters of the United States is regulated by the U.S. Army Corps of Engineers (ACOE) pursuant to section 404 of the Clean Water Act of 1972, as amended. We recommend you contact the ACOE's Regulatory Section regarding the possible need for a permit. For projects located in northern Nevada (Carson City, Churchill, Douglas, Elko, Esmeralda, Eureka, Humboldt, Lander, Lyon, Mineral, Pershing, Storey, and Washoe Counties) contact the Reno Regulatory Office at 300 Booth Street, Room 3060, Reno, Nevada 89509, (775) 784-5304; in southern Nevada (Clark, Lincoln, Nye, and White Pine Counties) contact the St. George Regulatory Office at 321 North Mall Drive, Suite L-101, St. George, Utah 84790-7314, (435) 986-3979; or in California along the eastern Sierra contact the Sacramento Regulatory Office at 650 Capitol Mall, Suite 5-200, Sacramento, California 95814, (916) 557-5250.

We appreciate your concern for threatened and endangered species. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

The table below outlines lead FWS field offices by county and land ownership/project type. Please refer to this table when you are ready to coordinate (including requests for section 7 consultation) with the field office corresponding to your project, and send any documentation regarding your project to that corresponding office. Therefore, the lead FWS field office may not be the office listed above in the letterhead.

Lead FWS offices by County and Ownership/Program

County	Ownership/Program	Species	Office Lead*
Alameda	Tidal wetlands/marsh adjacent to Bays	Salt marsh species, delta smelt	BDFWO
Alameda	All ownerships but tidal/estuarine	All	SFWO
Alpine	Humboldt Toiyabe National Forest	All	RFWO

Alpine	Lake Tahoe Basin Management Unit	All	RFWO
Alpine	Stanislaus National Forest	All	SFWO
Alpine	El Dorado National Forest	All	SFWO
Colusa	Mendocino National Forest	All	AFWO
Colusa	Other	All	By jurisdiction (see map)
Contra Costa	Legal Delta (Excluding ECCHCP)	All	BDFWO
Contra Costa	Antioch Dunes NWR	All	BDFWO
Contra Costa	Tidal wetlands/marsh adjacent to Bays	Salt marsh species, delta smelt	BDFWO
Contra Costa	All ownerships but tidal/estuarine	All	SFWO
Del Norte	All	All	AFWO
El Dorado	El Dorado National Forest	All	SFWO
El Dorado	LakeTahoe Basin Management Unit		RFWO
Glenn	Mendocino National Forest	All	AFWO
Glenn	Other	All	By jurisdiction (see map)
Humboldt	All except Shasta Trinity National Forest	All	AFWO
Humboldt	Shasta Trinity National Forest	All	YFWO
Lake	Mendocino National Forest	All	AFWO
Lake	Other	All	By jurisdiction (see map)
Lassen	Modoc National Forest	All	KFWO
Lassen	Lassen National Forest	All	SFWO
Lassen	Toiyabe National Forest	All	RFWO
Lassen	BLM Surprise and Eagle Lake Resource Areas	All	RFWO

Lassen	BLM Alturas Resource Area	All	KFWO
Lassen	Lassen Volcanic National Park	All (includes Eagle Lake trout on all ownerships)	SFWO
Lassen	All other ownerships	All	By jurisdiction (see map)
Marin	Tidal wetlands/marsh adjacent to Bays	Salt marsh species, delta smelt	BDFWO
Marin	All ownerships but tidal/estuarine	All	SFWO
Mendocino	Russian River watershed	All	SFWO
Mendocino	All except Russian River watershed	All	AFWO
Modoc	Modoc National Forest	All	KFWO
Modoc	BLM Alturas Resource Area	All	KFWO
Modoc	Klamath Basin National Wildlife Refuge Complex	All	KFWO
Modoc	BLM Surprise and Eagle Lake Resource Areas	All	RFWO
Modoc	All other ownerships	All	By jurisdiction (See map)
Mono	Inyo National Forest	All	RFWO
Mono	Humboldt Toiyabe National Forest	All	RFWO
	All ownerships but tidal/estuarine	All	SFWO
Napa			
Napa	Tidal wetlands/marsh adjacent to San Pablo Bay	Salt marsh species, delta smelt	BDFWO
Nevada	Humboldt Toiyabe National Forest	All	RFWO
Nevada	All other ownerships	All	By jurisdiction (See map)

Placer	Lake Tahoe Basin Management Unit	All	RFWO
Placer	All other ownerships	All	SFWO
Sacramento	Legal Delta	Delta Smelt	BDFWO
Sacramento	Other	All	By jurisdiction (see map)
San Francisco	Tidal wetlands/marsh adjacent to San Francisco Bay	Salt marsh species, delta smelt	BDFWO
San Francisco	All ownerships but tidal/estuarine	All	SFWO
San Mateo	Tidal wetlands/marsh adjacent to San Francisco Bay	Salt marsh species, delta smelt	BDFWO
San Mateo	All ownerships but tidal/estuarine	All	SFWO
San Joaquin	Legal Delta excluding San Joaquin HCP	All	BDFWO
San Joaquin	Other	All	SFWO
Santa Clara	Tidal wetlands/marsh adjacent to San Francisco Bay	Salt marsh species, delta smelt	BDFWO
Santa Clara	All ownerships but tidal/estuarine	All	SFWO
Shasta	Shasta Trinity National Forest except Hat Creek Ranger District (administered by Lassen National Forest)	All	YFWO
Shasta	Hat Creek Ranger District	All	SFWO
Shasta	Bureau of Reclamation (Central Valley Project)	All	BDFWO
Shasta	Whiskeytown National Recreation Area	All	YFWO

Shasta	BLM Alturas Resource Area	All	KFWO
Shasta	Caltrans	By jurisdiction	SFWO/AFWO
Shasta	Ahjumawi Lava Springs State Park	Shasta crayfish	SFWO
Shasta	All other ownerships	All	By jurisdiction (see map)
Shasta	Natural Resource Damage Assessment, all lands	All	SFWO/BDFWO
Sierra	Humboldt Toiyabe National Forest	All	RFWO
Sierra	All other ownerships	All	SFWO
Siskiyou	Klamath National Forest (except Ukonom District)	All	YFWO
Siskiyou	Six Rivers National Forest and Ukonom District	All	AFWO
Siskiyou	Shasta Trinity National Forest	All	YFWO
Siskiyou	Lassen National Forest	All	SFWO
Siskiyou	Modoc National Forest	All	KFWO
Siskiyou	Lava Beds National Volcanic Monument	All	KFWO
Siskiyou	BLM Alturas Resource Area	All	KFWO
Siskiyou	Klamath Basin National Wildlife Refuge Complex	All	KFWO
Siskiyou	All other ownerships	All	By jurisdiction (see map)
Solano	Suisun Marsh	All	BDFWO
Solano	Tidal wetlands/marsh adjacent to San Pablo Bay	Salt marsh species, delta smelt	BDFWO
Solano	All ownerships but tidal/estuarine	All	SFWO
Solano	Other	All	By jurisdiction (see map)

Sonoma	Tidal wetlands/marsh adjacent to San Pablo Bay	Salt marsh species, delta smelt	BDFWO
Sonoma	All ownerships but tidal/estuarine	All	SFWO
Tehama	Mendocino National Forest	All	AFWO
Tehama	Shasta Trinity National Forest except Hat Creek Ranger District (administered by Lassen National Forest)	All	YFWO
Tehama	All other ownerships	All	By jurisdiction (see map)
Trinity	BLM	All	AFWO
Trinity	Six Rivers National Forest	All	AFWO
Trinity	Shasta Trinity National Forest	All	YFWO
Trinity	Mendocino National Forest	All	AFWO
Trinity	BIA (Tribal Trust Lands)	All	AFWO
Trinity	County Government	All	AFWO
Trinity	All other ownerships	All	By jurisdiction (See map)
Yolo	Yolo Bypass	All	BDFWO
Yolo	Other	All	By jurisdiction (see map)
All	FERC-ESA	All	By jurisdiction (see map)
All	FERC-ESA	Shasta crayfish	SFWO
All	FERC-Relicensing (non-ESA)	All	BDFWO

***Office Leads:**

AFWO=Arcata Fish and Wildlife Office

BDFWO=Bay Delta Fish and Wildlife Office

KFWO=Klamath Falls Fish and Wildlife Office

RFWO=Reno Fish and Wildlife Office

YFWO=Yreka Fish and Wildlife Office

Attachment(s):

- Official Species List
- USFWS National Wildlife Refuges and Fish Hatcheries
- Migratory Birds
- Wetlands

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

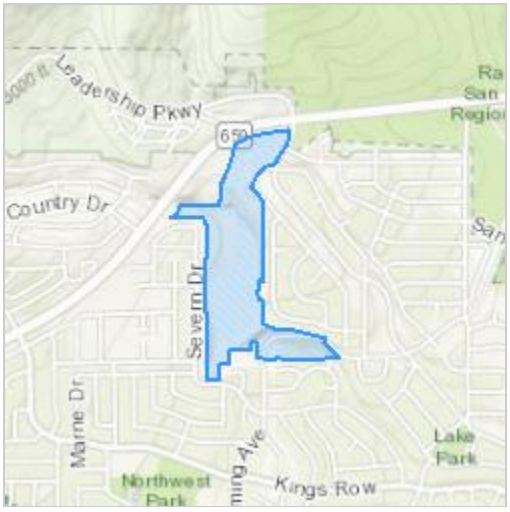
This species list is provided by:

Reno Fish And Wildlife Office
1340 Financial Boulevard, Suite 234
Reno, NV 89502-7147
(775) 861-6300

Project Summary

Consultation Code: 08ENVD00-2021-SLI-0241
Event Code: 08ENVD00-2021-E-00791
Project Name: West Wash Dam
Project Type: DAM
Project Description: West Wash Dam environmental evaluation in Reno, NV
Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@39.54504145,-119.84642972256998,14z



Counties: Washoe County, Nevada

Endangered Species Act Species

There is a total of 5 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Amphibians

NAME	STATUS
Sierra Nevada Yellow-legged Frog *Rana sierrae* There is **final** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/9529	Endangered

Fishes

NAME	STATUS
Cui-ui *Chasmistes cujus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/456	Endangered
Lahontan Cutthroat Trout *Oncorhynchus clarkii henshawi* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/3964	Threatened

Insects

NAME	STATUS
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate

Flowering Plants

NAME	STATUS
Webber's Ivesia *Ivesia webberi*	Threatened

There is **final** critical habitat for this species. The location of the critical habitat is not available.
Species profile: https://ecos.fws.gov/ecp/species/4682

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

USFWS National Wildlife Refuge Lands And Fish Hatcheries

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS OR FISH HATCHERIES WITHIN YOUR PROJECT AREA.

Migratory Birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

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1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

The birds listed below are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ below. This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the E-bird data mapping tool (Tip: enter your location, desired date range and a species on your list). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found below.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
Bald Eagle *Haliaeetus leucocephalus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Dec 1 to Aug 31
Brewer's Sparrow *Spizella breweri* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/9291	Breeds May 15 to Aug 10

NAME	BREEDING SEASON
Golden Eagle *Aquila chrysaetos* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/1680	Breeds Dec 1 to Aug 31
Green-tailed Towhee *Pipilo chlorurus* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/9444	Breeds May 1 to Aug 10
Lewis's Woodpecker *Melanerpes lewis* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9408	Breeds Apr 20 to Sep 30
Olive-sided Flycatcher *Contopus cooperi* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3914	Breeds May 20 to Aug 31
Pinyon Jay *Gymnorhinus cyanocephalus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9420	Breeds Feb 15 to Jul 15
Williamson's Sapsucker *Sphyrapicus thyroideus* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/8832	Breeds May 1 to Jul 31
Willow Flycatcher *Empidonax traillii* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/3482	Breeds May 20 to Aug 31

Probability Of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read and understand the FAQ "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see

below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

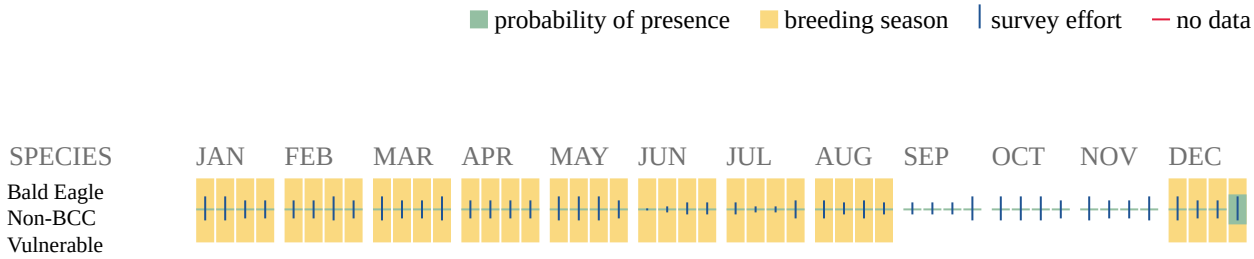
1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

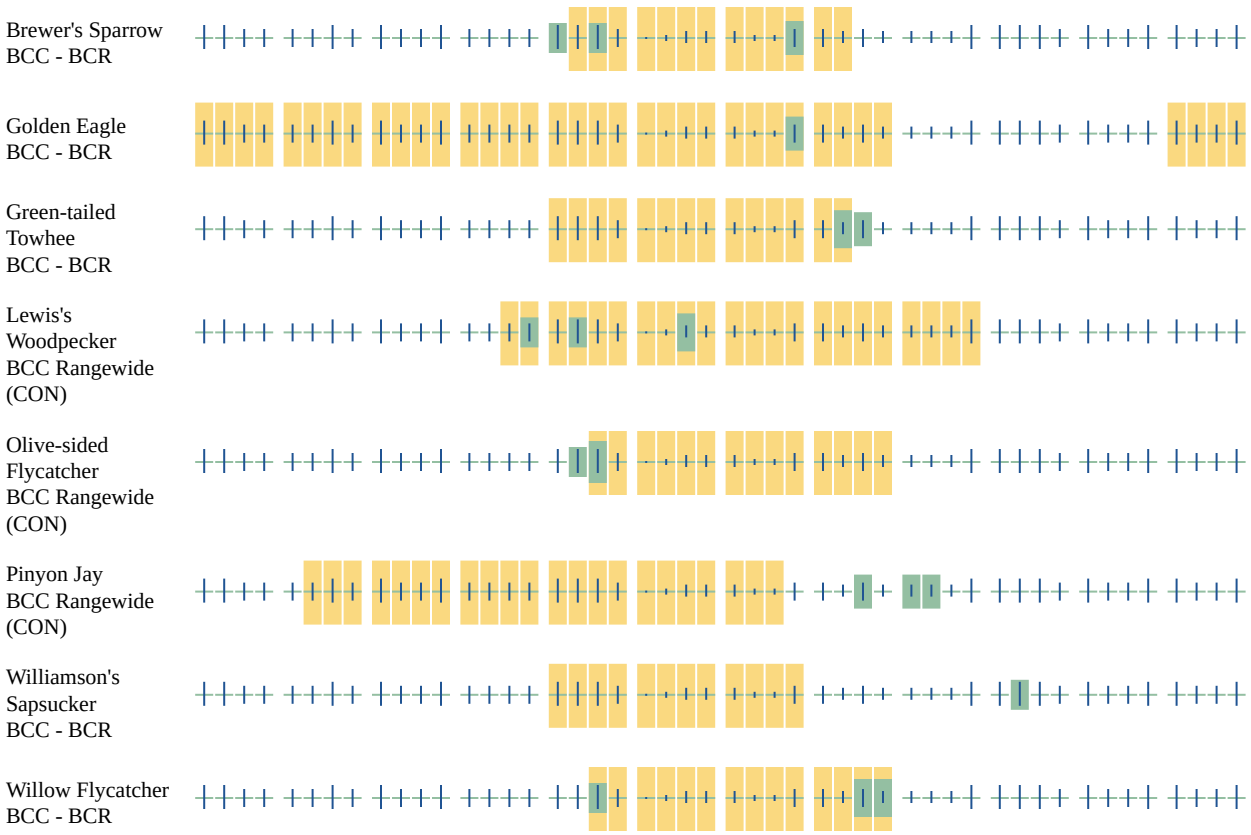
Breeding Season (■)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.





Additional information can be found using the following links:

- Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Measures for avoiding and minimizing impacts to birds http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php
- Nationwide conservation measures for birds http://www.fws.gov/migratorybirds/pdf/management/nationwidestandardconservationmeasures.pdf

Migratory Birds FAQ

Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures or permits

may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?
The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the AKN Phenology Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?
The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets .

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?
To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: The Cornell Lab of Ornithology All About Birds Bird Guide, or (if you are unsuccessful in locating the bird of interest there), the Cornell Lab of Ornithology Neotropical Birds guide. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?
Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);

2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities,

should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

Wetlands

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

FRESHWATER EMERGENT WETLAND

- PEM1C

FRESHWATER FORESTED/SHRUB WETLAND

- PSSB
- PSSC
- PSSCh

FRESHWATER POND

- PUBFh

RIVERINE

- R3UBHx
- R4SBC
- R4SBJ
- R5UBFx

APPENDIX D

Resumés of Key Field Personnel

Vicki L. Thill, M.S.

Environmental Specialist I

Biologist

vicki@emstrats.com · www.emstrats.com

EDUCATION

Certifications and Training

CCS Verifier – Field Certified	Jan 2021
Wilderness First Aid Training	Feb 2021
Mine Safety Health Administration Miner Training	Feb 2021

Degrees

MS University of Nevada, Reno, Ecology, Evolution and Conservation Biology — Dec 2019
Thesis – *Understanding Patterns of Venom Resistance in Lizards: Ecology and Phylogeny Matter*
Committee: Dr. Chris Feldman, Dr. Mike Teglas, Dr. Jennifer Hoy

BS University of Nevada, Reno, Wildlife Ecology and Conservation — May 2015
Graduated cum laude, 3.96 GPA

AS Truckee Meadows Community College, Reno, NV — Dec 2012
Graduated with distinction

AWARDS AND GRANTS

UNR GSA Travel Grant ($500)	2019
UNR Graduate Student Association Research Grant ($2000)	2018-2019
Graduate State Access Grant ($1500)	2018-2019
SSAR Travel Grant ($500)	2018
2nd place, UNR Graduate Student Poster Symposium – Biology ($500)	2018
2nd place, UNR 3-Minute Thesis Competition – Masters Category ($1000)	2018
UNR GSA Travel Grant ($250)	2018
Graduate State Access Grant ($3000)	2017 - 2018

RESEARCH AND WORK EXPERIENCE

Environmental Specialist I

EM Strategies, Reno, Nevada — 2020 – Present
Supervisor: Kris Kuyper

- Prepare technical reports
  - Pre-field work plans
  - Technical memoranda
  - Baseline biological survey reports
  - Biological evaluations
- Biological surveys
  - General wildlife
  - Special status species surveys
  - Botanical surveys
  - Spring sampling for hydrologic surveys

Curatorial Assistant of Vertebrate Collections 2017 - 2019
Natural History Museum, University of Nevada, Reno
Supervisor: Dr. Chris Feldman

- Assisted curator with maintenance of dry and wet collections
- Managed loans and exchanges
- Intake processing of new accessions
- Directed a rotating crew of up to four volunteers and interns per semester
- Digitized specimen records using ARCTOS data management system
- Specimen preparation for herpetological collection
- Disseminated information to general public through outreach events

Graduate Research Assistant 2016 - 2019
Understanding Patterns of Venom Resistance in Reptiles: Ecology and Phylogeny Matter
University of Nevada, Reno
Advisors: Dr. Chris Feldman, Dr. Mike Teglas

- Field collection
  - Traveled to remote locations on 4x4 roads
  - Supervised field assistants, and set up backcountry overnight sites
  - Maintained positive relationships with public and professional hosts (incl. Sonoma State University, private land owners)
- Created and implemented protocol for managing lab population of up to 100 of lizards
- Created, edited, and upheld IACUC and EH&S protocols
- Trained husbandry technicians in care protocols
- Utilized video (Physlets, VSDC) and imaging software (ImageJ) for data collection
- Manipulated and analyzed data in statistical language R

Sawyer Crew Member – Sage Grouse Habitat Restoration Summer 2016
Great Basin Institute (Americorps), Eastern NV (various sites)
Supervisors: Leela Hospach, Sean Kellar

- Maintained and operated gas-powered chainsaw
- Maintained and inspected field vehicle
- Performed nest clearance surveys
- Camped in primitive conditions
- Mapped post-treated area with GPS hand-held unit

Ichthyological Specimen Collection Assistant 2015-2016
Natural History Museum, University of Nevada, Reno
Supervisor: Jade Keehn, MS

- Transcribed original collector data to database
- Cleaned, buffered, pressed, and archived original collector labels
- Performed fluid density and pH tests on legacy specimens
- Followed fluid exchange protocols for legacy specimens housed in non-standard fluids
- Cleaned, measured, and photographed sensitive specimens (LCT, Cui-ui, etc.)
- Rehydrated desiccated specimens
- Created new and updated museum labels

Independent Field Technician 2015
Bureau of Land Management and Great Basin Institute, Winnemucca, NV
Supervisors?
- Identified and collected voucher botanical specimens
- Collected and processed native grass seeds for Seeds of Success
- Scouted remote locations for future collection sites

Herbarium Assistant 2014 - 2017
Herbarium, University of Nevada, Reno
Supervisors: Dr. Elizabeth Leger, Arnold Tiehm
- Created protocol for specimen imaging and trained staff and volunteers
- Entered database records (IRHN) and assisted with data quality control

Lab Assistant 2014 - 2016
Leger Lab, University of Nevada, Reno
Supervisors: Dr. Sarah Barga, Dr. Elizabeth Leger
- Assisted with seed germination and seedbank study
- Performed a self-directed seed germination trial
- Georeferenced historical collection records
- Built a protocol for comparative morphometric study

TEACHING

University of Nevada, Reno
- Biology 290 – Proctor exams
- Herpetology – Guest lab & field trip assistant
- Ichthyology – Guest Lecturer - *"Museum of Natural History: UNR's Ichthyological Collection"*
- Biology Help Center – manager & tutor for various classes
- First Year Science & Math transition course

PUBLICATIONS

Peer-reviewed Publications

Thill, V.L., M.B. Teglas, H.A. Moniz, M.J. Wasley and C.R. Feldman. *Preying Dangerously: Black widow spider venom resistance in sympatric lizards*. Masters thesis, Ch.1. *In prep.*

Reimche, J.R., E.D. Brodie, Jr., A.N. Stokes, E.J. Ely, J.M. Hallas, H.A. Moniz, **V.L. Thill**, M.E. Pfrender, E.D. Brodie III and C.R. Feldman. 2020. The geographic mosaic in parallel: matching patterns of newt tetrodotoxin levels and snake resistance in a novel predator-prey pair. *Journal of Animal Ecology*.

Thill, V.L. and C.R. Feldman (2019). ELGARIA MULTICARINATA (Southern Alligator Lizard). PREDATION. *Herpetological Review*.

Online Publications

Thill, V.L. (2015). *Alsodes vanzolinii* (Vanzolini's Spiny-Chest Frog) species account. Edited G. Lau. *Amphibiaweb.org*

PRESENTATIONS

Thill, V.L., M.B. Teglas, C.R. Feldman. (Oct 2018). "You Lose, Spidey! Untangling Venom Resistance in Reptiles." Graduate Student Poster Symposium, University of Nevada, Reno.
Awarded X

Thill, V.L., M.B. Teglas, C.R. Feldman (July 2018). "You Lose, Spidey! Untangling Venom Resistance in Reptiles." Joint Meeting of Ichthyologists and Herpetologists, Rochester, NY.

Thill, V.L. (April 2018). "Untangling the Strands of Venom Resistance in Reptiles." 3-Minute Thesis competition, University of Nevada, Reno.
Awarded 2nd Place in Master's Division

Thill, V.L., M.B. Teglas, C.R. Feldman (Jan 2018). "You Lose, Spidey! Evidence for resistance to black widow spider venom in sympatric lizards." Annual Meeting of the Society for Integrative and Comparative Biology. San Francisco, CA.

PROFESSIONAL TRAINING

Mine Health and Safety Administration, Mine Safety Training – New Miner Surface, Metal and Non-Metal	Jan 2021
Joint Meeting of Ichthyologists and Herpetologists, Rochester, NY Carl Gans Workshop on Careers and Best Practices in Natural History Collection	July 2018
Museum of Vertebrate Zoology, University of California, Berkeley, CA ARCTOS online database training led by Dr. Carla Cicero	Jun 2017
Intermountain Herbarium, Utah State University, Logan, UT Museum imaging workshop led by Dr. Mary Barkworth	Feb 2015

PROFESSIONAL AFFILIATIONS

Society for the Preservation of Natural History Collections	2019 – Present
UNR Herpetology Club	2018 – Present
Society for the Study of Amphibians and Reptiles	2017 – Present

PROFESSIONAL AND COMMUNITY SERVICE

Treasurer and Co-founder UNR Herpetology Club	2018 – Present
Copy Editor Herpetological Review	2019
Peer-Reviewer Herpetological Conservation and Biology	2019
Consultant Davidson Academy Herpetology Team for Science Olympiad	2018 & 2019

Career Panel Speaker Women in Science and Engineering (WiSE) 2018 & 2019

Mentor

- Molly McVicar, lab assistant 2019
- Taylor Disbrow, research assistant and animal care technician 2018 - 2020
- Amber Durfee, animal lab manager 2018 - 2020
- Sean Cridland, NVTeach museum intern 2018 - 2019
- McKenzie Wasley, research assistant 2017 - 2018
  Recently received her MS at Stephen F. Austin, TX

Volunteer

- Truckee Meadows Park Foundation live reptile presentation 2019
- GradFIT research presentation 2019
- Big Brother Big Sisters Museum Day 2019
- UNR Museum Day 2018 & 2019
- UNR Museum K-12 outreach 2017 – 2019
- UNR Earth Day – Museum of Natural History 2018
- High Sierra Xtreme Ability Challenge 2017 – 2019
- Nature Conservancy, Truckee Meadows Restoration Project 2015

COMPUTER SKILLS

Software and Applications

- Video and Imaging Software: VSDC, ImageJ, Physlets, Adobe Lightbox, Inkscape
- Data Analysis: R Studio, R Markdown, MARK, STATA
- Mapping: ArcGIS, QGIS
- General: Microsoft Suite

Sarah M. Harrelson, M.S., WPIT

Environmental Specialist II

Botanist

sarah@emstrats.com • www.emstrats.com

EDUCATION

2005 M.S. Plant Biology – Ohio University, Athens, Ohio

2000 B.S. Botany – Kent State University, Kent, Ohio

EXPERTISE

- Baseline and Monitoring and Vegetation Surveys, and Field Data Analysis
- Special Status Species Habitat Assessments
- Waters of the U.S. and Wetland Delineations
- Threatened & Endangered Species Surveys
- Technical Writing and Editing
- Environmental Compliance Monitoring
- GIS Data Analysis and Cartography

PROFESSIONAL PROFILE

Ms. Harrelson is an Environmental Specialist and Botanist at EM Strategies, Inc. (EM Strategies). She has over 15 years of experience as a field botanist and ten years of experience as a wetland delineator. Ms. Harrelson has demonstrated success in field data collection and analysis, report production, GIS data analysis and cartography. As a wetland delineator, she has conducted numerous field delineations in Nevada, Ohio, Oklahoma, and Texas. As a botanist, she has planned and conducted botanical field surveys (baseline, monitoring, special status species, invasive species mapping and removal, and habitat restoration) throughout Nevada, Ohio and Texas. She is a certified Wetland Professional in Training (WPIT) by the Society of Wetland Scientists (SWS).

In addition to biological surveys, she has worked on ecological restoration, habitat assessment, and has experience working with volunteers in the field. Ms. Harrelson has assisted in the preparation of numerous documents for the National Environmental Policy Act (NEPA), Biological Assessments (BAs) for the United States Fish and Wildlife Service (USFWS) Section 7 and 10 consultations, Biological Evaluations (BEs), and Waters of the United States (WoUS) assessments. Ms. Harrelson as has four years of experience working with Geographic Information Systems (GIS).

PROJECT EXPERIENCE

Botanical Surveys

Ms. Harrelson has performed plant surveys for special status plant species and noxious weeds, as well as plant community mapping and comprehensive species lists for projects throughout Nevada. Specific tasks included species mapping, population evaluation, and habitat restoration. Species surveyed for include numerous plant species on the Bureau of Land Management's (BLM) special status plant species list. Outside of Nevada, Ms. Harrelson has performed plant surveys for spreading rock cress (*Arabis patens*; endangered in Ohio), butterfly pea (*Clitoria mariana*; potentially threatened in Ohio); bunchberry (*Cornus canadensis*; endangered in Ohio); running

buffalo clover (*Trifolium stoloniferum*; federally endangered), small whirled pagonia (*Isotria medeoloides*; federally threatened), bracted twistflower (*Streptanthus bracteatus*, federal candidate species), Tobusch fishhook cactus (*Sclerocactus brevihamatus* subsp. *tobuschii*, federally endangered), south Texas ambrosia (*Ambrosia cheiranthifolia*, federally endangered), Texas ayenia (*Ayenia limitaris*, federally endangered), Johnston's Frankenia (*Frankenia johnstonii*, endangered in Texas), slender rushpea (*Hoffmannseggia tenella*, federally endangered), and ashy dogweed (*Thymophylla tephroleuca*, federally endangered).

Waters of the United States Delineations

Ms. Harrelson has performed numerous wetland and surface water delineations throughout Nevada, Texas, Oklahoma, and Ohio during her ten years of experience. Her efforts involved pre-field analysis of potential wetland conditions, performance of wetland delineations in the field, and post-field determination of waters' connectivity. Ms. Harrelson's experience also includes writing surface water delineation reports and United States Army Corps of Engineers (USACE) wetland permits. In addition to wetland delineation for permitting purposes, Ms. Harrelson performs wetland/stream functional analysis, wetland/stream habitat evaluation, wetland/stream mitigation design, and mitigation monitoring.

Wildlife Habitat Evaluation

In Texas, Ms. Harrelson conducted numerous surveys for rare, threatened, and endangered species habitat including golden-cheeked warbler (*Setophaga chrysoparia*), black-capped vireo (*Vireo atricapilla*), and karst invertebrates. Habitat evaluations were conducted in support of transportation, oil and gas, renewable energy, and residential development projects. In Ohio, Ms. Harrelson has conducted surveys for habitat for numerous species of rare, threatened, and endangered plants, for projects involving trail construction, road widening, residential development, and renewable energy.

Geographic Information Systems

Ms. Harrelson has four years of experience working with GIS creating, acquiring, and managing all geographic data needed for a variety of projects including endangered species habitat management, storm water pollution prevention plans, environmental constraints analysis, oil and gas pipeline installation, and wind energy farm construction. She has used GIS to compile and transform scientific and ecological data into the appropriate formats for analysis and mapping. She has created accurate, visually appealing maps in electronic and print formats for presentations, reports, and scientific posters, including information-rich, wall-sized base maps for presentation to clients.

WORK HISTORY

January 2017 - Present	Botanist/Environmental Specialist, EM Strategies, Reno, Nevada
October 2012 – November 2016	Botanist, SWCA Environmental Consultants, San Antonio, Texas

March 2012 – June 2012	Wetland Delineator, Natural Resource Group, LLC, Houston, Texas
May 2011 – August 2011	Botanist, Lumberjack Resource Conservation & Development Council, Inc., Rhinelander, Wisconsin
January 2007 – August 2010	Botanist/Scientist I, Hull & Associates, Inc., Dublin, Ohio
Sept 2005 – November 2006	Biological Sciences Technician, Botany, Wayne National Forest, Ironton, Ohio
April 2005 – Sept 2005	Conservation Intern, The Holden Arboretum, Kirtland, Ohio

PROJECT EXPERIENCE

Sky Tavern, Wetland Delineation and Report, 404 Individual Permit, Washoe County, Nevada.

Coeur Sterling, Inc. Crown Botanical Surveys and Reports, Nye County, Nevada.

Corvus Gold Nevada, Inc. Noxious Weed Surveys and Reports, Nye County, Nevada.

Rye Patch Mining US Inc. Noxious Weed Surveys and Reports, Pershing County, Nevada.

Newmont USA Limited Chevas and High Desert Reclamation Assessment and Release, Eureka County, Nevada.

Clover Nevada II LLC, Pony Creek Botanical Surveys and Reports, Elko County, Nevada.

Copper One USA Inc. Carlin Vanadium Botanical Surveys and Reports, Elko and Eureka Counties, Nevada.

REGISTRATIONS, AFFILIATIONS, AND TRAINING

- Proper Functional Condition Training 2019
- CCS Verifier Certification 2017, 2018, and 2019
- 24-Hour Mine Safety and Health Administration (MSHA) Surface Training 2019
- Certified Inspector of Sediment and Erosion Control (CESEC #1562); 2014
- Wetland Delineation, Texas No. 000022497; Texas Department of Transportation; 2014
- Nationwide Permit, Texas No. 000022497; Texas Department of Transportation; 2014
- Protected Species Determination (Habitat), Texas No. 000022497; Texas Department of Transportation; 2014
- Impact Evaluation Assessments, Texas No. 000022497; Texas Department of Transportation; 2014
- Biological Surveys, Texas No. 000022497; Texas Department of Transportation; 2014
- Stream Habitat Assessments; Ohio EPA; 2007-2010
- 40-hour Wetland Delineation Training; Ohio State University; 2007

PUBLICATIONS

Harrelson, S.M. and P.D. Cantino. 2006. The terrestrial vascular flora of Strouds Run State Park, Athens County, Ohio. Rhodora; vol. 108.

Harrelson, S.M. and G.R. Matlack. 2006. Influence of stand age and physical environment on the herb composition of second-growth forest, Strouds Run, Ohio, USA. Journal of Biogeography.

APPENDIX E

Plant List

Symbol	Latin Name	Common Name
Trees		
AIAL	*Ailanthus altissima*	tree of heaven
ELAN	*Elaeagnus angustifolia*	Russian olive
FRAN2	*Fraxinus anomala*	singleleaf ash
PLATA	*Platanus* sp.	sycamore
POFR2	*Populus fremontii*	Fremont cottonwood
SAEX	*Salix exigua*	narrowleaf willow
ULPA	*Ulmus parvifolia*	Chinese elm
Shrubs		
ARTRT	*Artemisia tridentata* ssp. *tridentata*	basin big sagebrush
ATCA2	*Atriplex canescens*	fourwing saltbush
CHVI8	*Chrysothamnus viscidiflorus*	yellow rabbitbrush
EPVI	*Ephedra viridis*	mormon tea
ERNA10	*Ericameria nauseosa*	rubber rabbitbrush
GUSA2	*Gutierrezia sarothrae*	broom snakeweed
PRAN2	*Prunus andersonii*	desert peach
PUTR2	*Purshia tridentata*	antelope bitterbrush
RUBUS	*Rubus* sp.	blackberry
TEGL	*Tetradymia glabrata*	littleleaf horsebrush
Forbs		
AMTE3	*Amsinckia tessellata*	bristly fiddleneck
ARMU	*Argemone munita*	flatbud pricklypoppy
ASFA	*Asclepias fascicularis*	Mexican whorled milkweed
ASSP	*Asclepias speciosa*	showy milkweed
BASC5	*Bassia scoparia*	burningbush
CADR	*Cardaria draba*	whitetop
CANU4	*Carduus nutans*	nodding plumeless thistle
CHAL7	*Chenopodium album*	lambsquarters
CHTE2	*Chorispora tenella*	blue mustard
CRAC2	*Crepis acuminata*	tapertip hawksbeard
DELPH	*Delphinium* sp.	delphinium
DESO2	*Descurainia sophia*	herb sophia
EPBR3	*Epilobium brachycarpum*	tall annual willowherb
ERCI6	*Erodium cicutarium*	redstem stork's bill
GRSQ	*Grindelia squarrosa*	curlycup gumweed
HAGL	*Halogeton glomeratus*	saltlover
HEAN3	*Helianthus annuus*	common sunflower
IVAX	*Iva axillaris*	povertyweed
LASE	*Lactuca serriola*	prickly lettuce
LEMI3	*Lemna minor*	common duckweed
LELA2	*Lepidium latifolium*	broadleaved pepperweed
MAVU	*Marrubium vulgare*	horehound
MEIN2	*Melilotus indicus*	annual yellow sweetclover
MEOF	*Melilotus officinalis*	sweetclover

Symbol	Latin Name	Common Name
MEAL6	*Mentzelia albicaulis*	whitestem mentzelia
MIRAB	*Mirabilis* sp.	four o'clock
PAQU2	*Parthenocissus quinquefolia*	Virginia creeper
POAV	*Polygonum aviculare*	prostrate knotweed
RUCR	*Rumex crispus*	curly dock
SATR12	*Salsola tragus*	prickly Russian thistle
SIAL2	*Sisymbrium altissimum*	tall tumblemustard
TAOF	*Taraxacum officinale*	common dandelion
TRDU	*Tragopogon dubius*	yellow salsify
TYAN	*Typha angustifolia*	narrowleaf cattail
VETH	*Verbascum thapsus*	common mullein
XAST	*Xanthium strumarium*	rough cocklebur
Grasses and Grass-like Plants		
ACHY	*Achnatherum hymenoides*	Indian ricegrass
AECY	*Aegilops cylindrica*	jointed goatgrass
AGCR	*Agropyron cristatum*	crested wheatgrass
BRTE	*Bromus tectorum*	cheatgrass
ELEOC	*Eleocharis* sp.	spikerush
ELEL5	*Elymus elymoides*	squirreltail
HOJU	*Hordeum jubatum*	foxtail barley
HOMUL	*Hordeum murinum ssp. leporinum*	hare barley
JUAR2	*Juncus arcticus*	arctic rush
LECI4	*Leymus cinereus*	basin wildrye
POPR	*Poa pratensis*	Kentucky bluegrass
POMO5	*Polypogon monspeliensis*	annual rabbitsfoot grass
TACA8	*Taeniatherum caput-medusae*	medusahead
THIN6	*Thinopyrum intermedium*	intermediate wheatgrass

APPENDIX F

Photographic Log

West Wash Dam Project – Baseline Biological Survey

Photo Plate 1

Inter-Mountain Basins Big Sagebrush Shrubland

West Wash Dam Project – Baseline Biological Survey

Photo Plate 2

Great Basin Lowland Riparian

Flowing water amidst willow thicket

West Wash Dam Project – Baseline Biological Survey

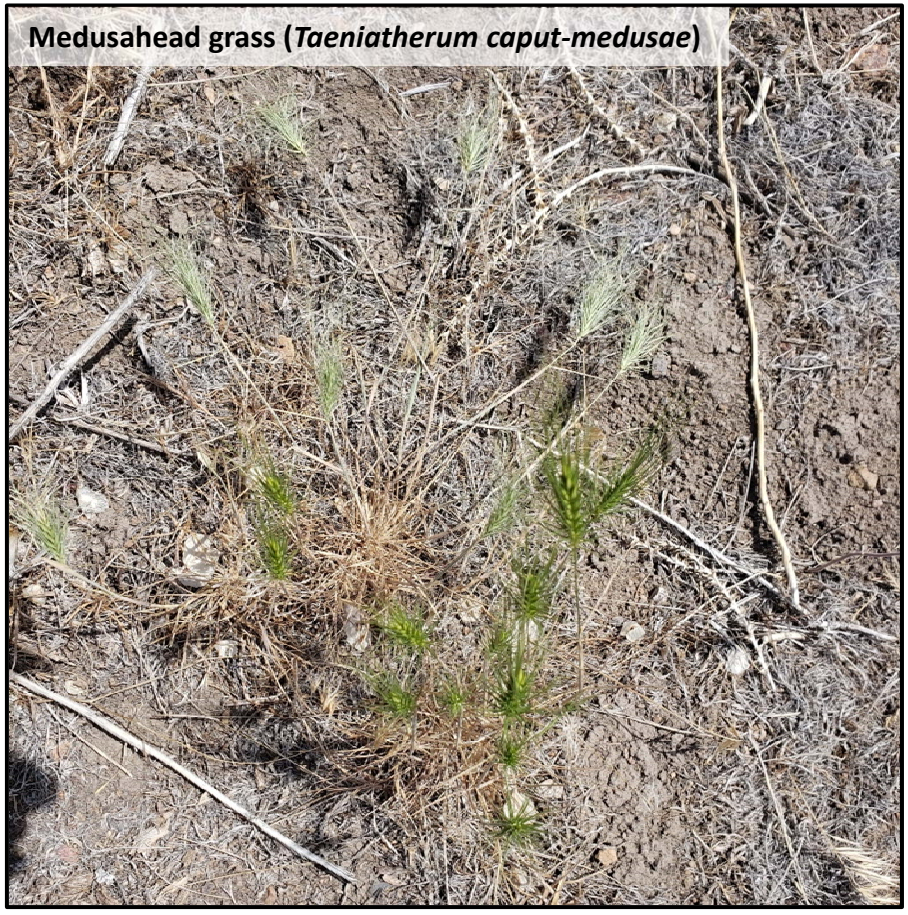
Photo Plate 3

Great Basin Lowland Riparian

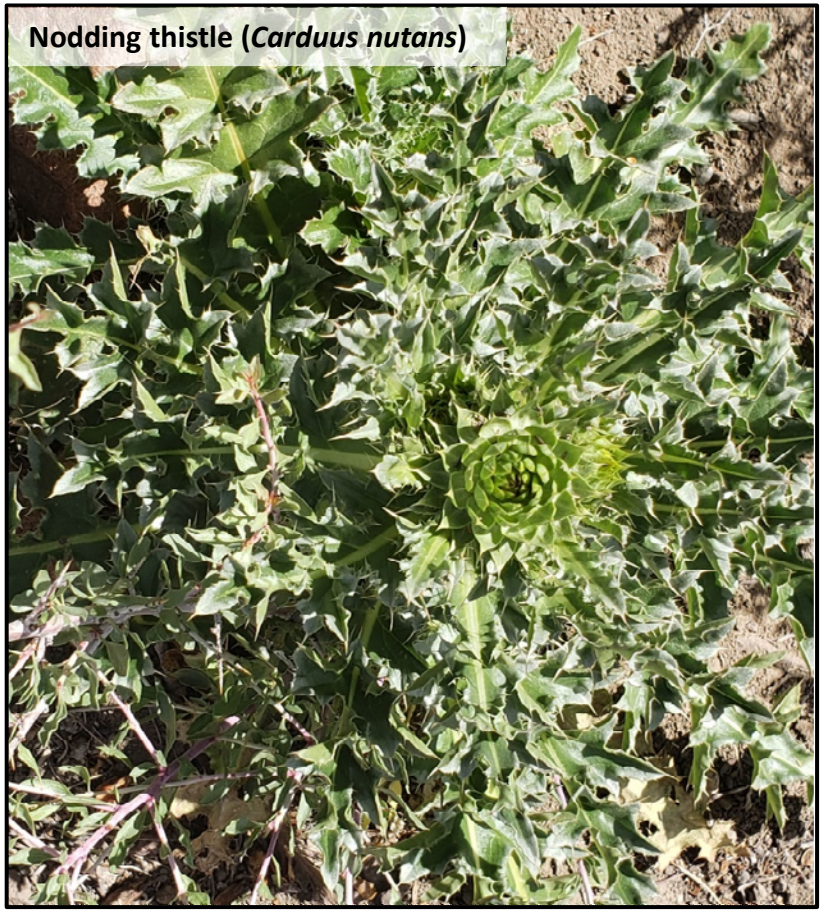
West Wash Dam Project – Baseline Biological Survey

Photo Plate 4

Noxious Weeds



Medusahead grass (*Taeniatherum caput-medusae*)

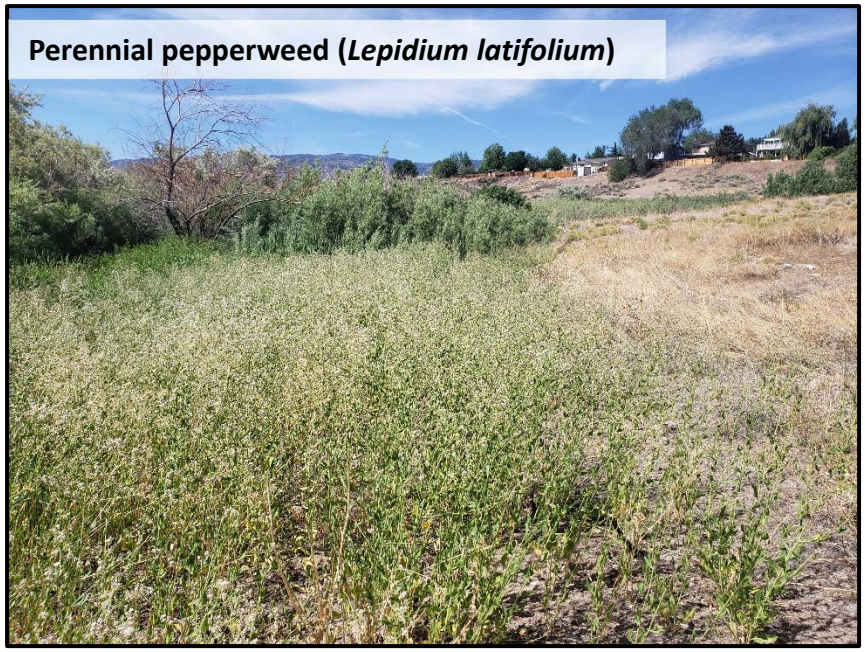


Nodding thistle (*Carduus nutans*)

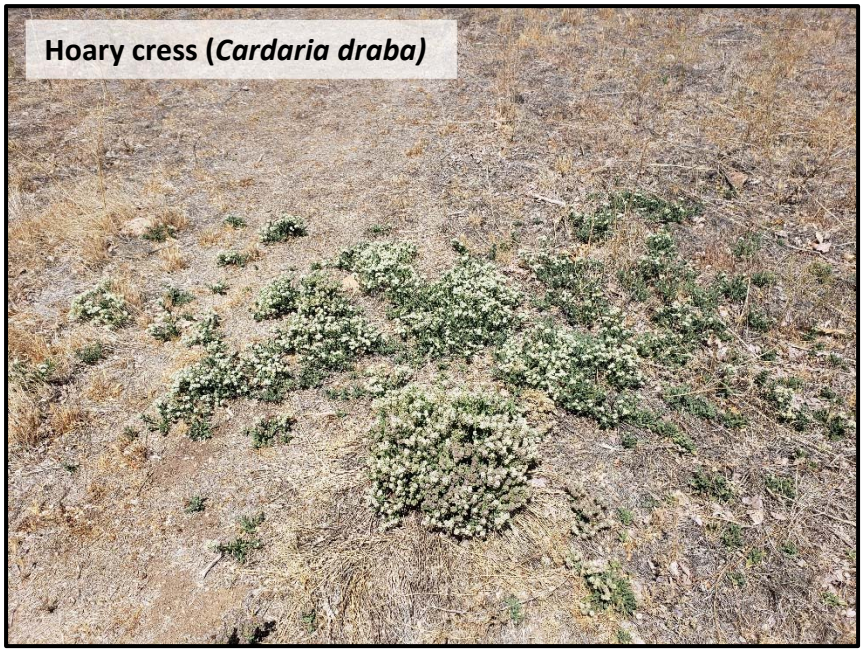
West Wash Dam Project – Baseline Biological Survey

Photo Plate 5

Noxious Weeds



Perennial pepperweed (*Lepidium latifolium*)



Hoary cress (*Cardaria draba)*

West Wash Dam Project – Baseline Biological Survey

Photo Plate 6

Wildlife Survey Results

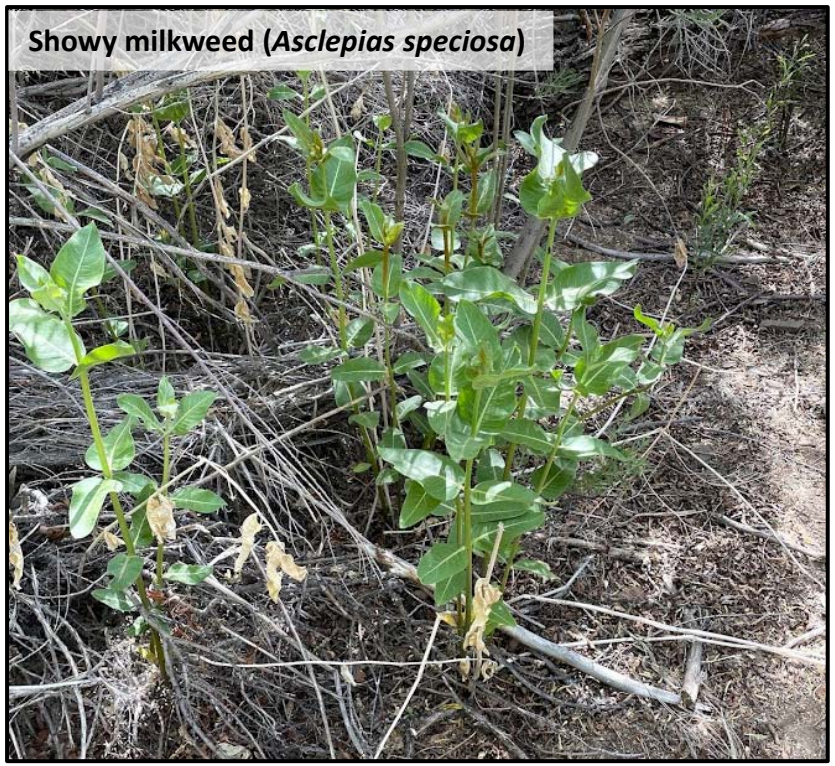
Trees and powerline poles provide nesting substrate for raptors

West Wash Dam Project – Baseline Biological Survey

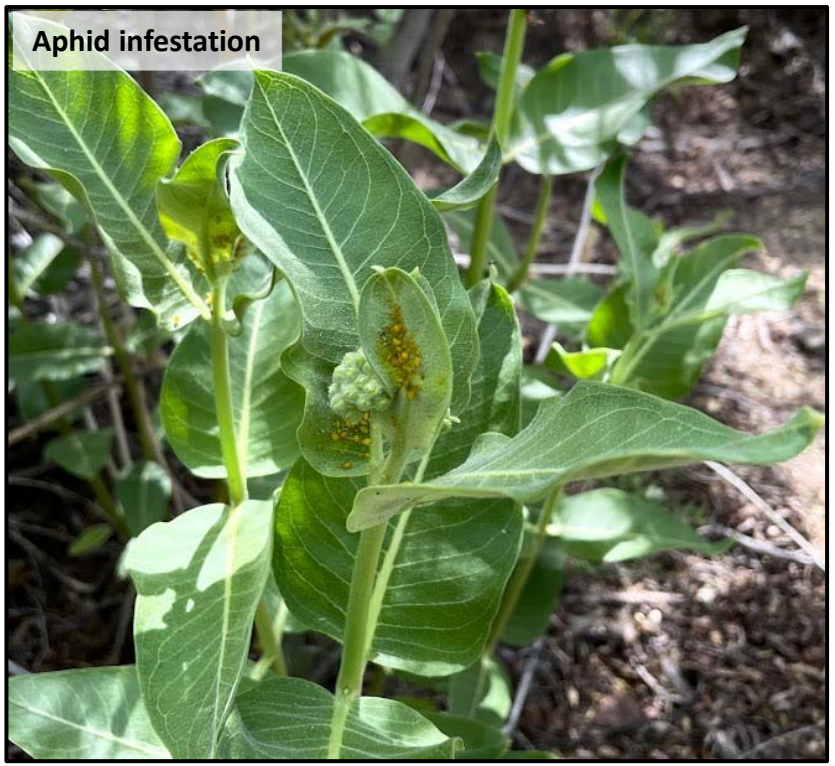
Photo Plate 7

Wildlife Survey Results

Milkweed (*Asclepias* sp.) provides monarch butterfly (*Danaus plexippus*) breeding habitat



Showy milkweed (*Asclepias speciosa*)



Aphid infestation

City of Reno

Technical Memorandum #1

Watershed Plan-ED
Peavine Mountain Watershed
West Wash Dam Rehabilitation

August 2021

OWNER:
City of Reno
1 East First Street
Reno, NV 89501

LEAD FEDERAL AGENCY:
USDA-NRCS
1365 Corporate Blvd
Reno, NV 89502

ENGINEER:

Farr West Engineering
5510 Longley Lane
Reno, NV 89511
(775) 851-4788
(775) 851-0766 Fax

PROFESSIONAL ENGINEER STATE OF NEVADA
ALEX R. STODTMEISTER
Exp: 6/30/22
CIVIL
No. 24604
8/4/21

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Appendix B – Cumulative Rainfall Tables for Sites

Appendix C – PMP Tables and Figures

Appendix D – Dam Design Criteria Table

1.0 INTRODUCTION

This is the first of two technical memoranda (TM) that discuss the hydrology, hydraulics, and sediment (HH&S) analysis associated with the Peavine Mountain Watershed East Wash Diversion and West Wash Dam analysis. This first TM focuses on the data collection prior to the analysis performed in SITES, which includes the site survey efforts, rainfall data (precipitation frequency storms and the probable maximum precipitation), and the dam design criteria that is governed by local ordinance. The data discussed in this TM will be the boundary conditions and settings for the SITES models used to analyze the East Wash Diversion and West Wash Dams. Results and details of the SITES models will be discussed in TM #2.

2.0 SITE SURVEY

Topographic data for the project area was a part of the initial data request from Farr West to the City of Reno. Lidar data with a two foot resolution comprising of the immediate project area surrounding the East Wash Diversion and West Wash Dams was initially provided. Additional Lidar data was required that covered the entire possible drainage basin. The Lidar data was utilized in delineating the drainage basins of the two dams, as well as determining the basin characteristics. However, lidar data is not accurate enough to provide proper dam dimensions for future SITES modeling, so site survey was required to provide more accurate topographic data for both the East Wash Diversion and West Wash Dams.

Field survey was performed by the Farr West survey crew. Manual topography shots acquired within the project area were collected using survey grade trimble GPS equipment to verify elevations of primary spillways, crest of the dams, emergency spillway elevations, storm drain outlets into the detention basins, and inverts for culverts draining into the project area. The manual topography shots were supplemented by data collected from an aerial drone survey utilizing SFM photogrammetry technology. The two data types were combined to create an existing surface.

The Basis of Bearings used for the manual topography shots and aerial drone survey is the Nevada State Plane coordinate system, West Zone, North American Datum of 1983/1994, High Accuracy Reference Network (NAD 83/94-HARN), as determined used Real Time Kinematic (RTK) GPS observations with corrections transmitted by the Northern Nevada Cooperative Real Time Network GPS (NNCRN GPS). The bearing between GPS reference station “RNW RENO” - N74SM01028 and "RSTEAD" - N22SM01037 is taken as north 01°54'46" east. All dimensions shown are ground distances. The combined grid-to-ground factor is 1.000197939. The Basis of Elevations used is the NACD88, as taken from City of Reno Benchmark #1322 with a published elevation of 4870.98’ and marked by a found 1 ½” diameter steel cap.

2.1 EAST WASH BOX CULVERT

The box culvert that conveys flows under McCarran Blvd. and into the East Wash Diversion Dam detention basin was surveyed in order to calculate the flow characteristics (i.e. the stage storage and stage discharge curves) of the culvert. The culvert is an 84-inch corrugated metal pipe that is 138-feet long. The culvert lies at a slope of 1.54%. The upstream side of the culvert has an invert elevation of 4,850.54 feet and a maximum water surface elevation of 4,859 feet (top of McCarran Blvd.). The downstream side of the culvert has an invert elevation of 4,848.21 feet. A photograph of the culvert in its existing condition at the time of this report can be found in Appendix A. A stage storage volume table was generated from the topographic surface in AutoCAD Civil 3D for the drainage area just above the upstream inlet of the culvert. Two different calculation methods are used by AutoCAD to create the stage storage table: average end method and conic method. Figure 1, below, compares the stage storage curves calculated from the two different methods. The curve generated using the conic method will be utilized in the SITES model as it represents a more conservative boundary condition.

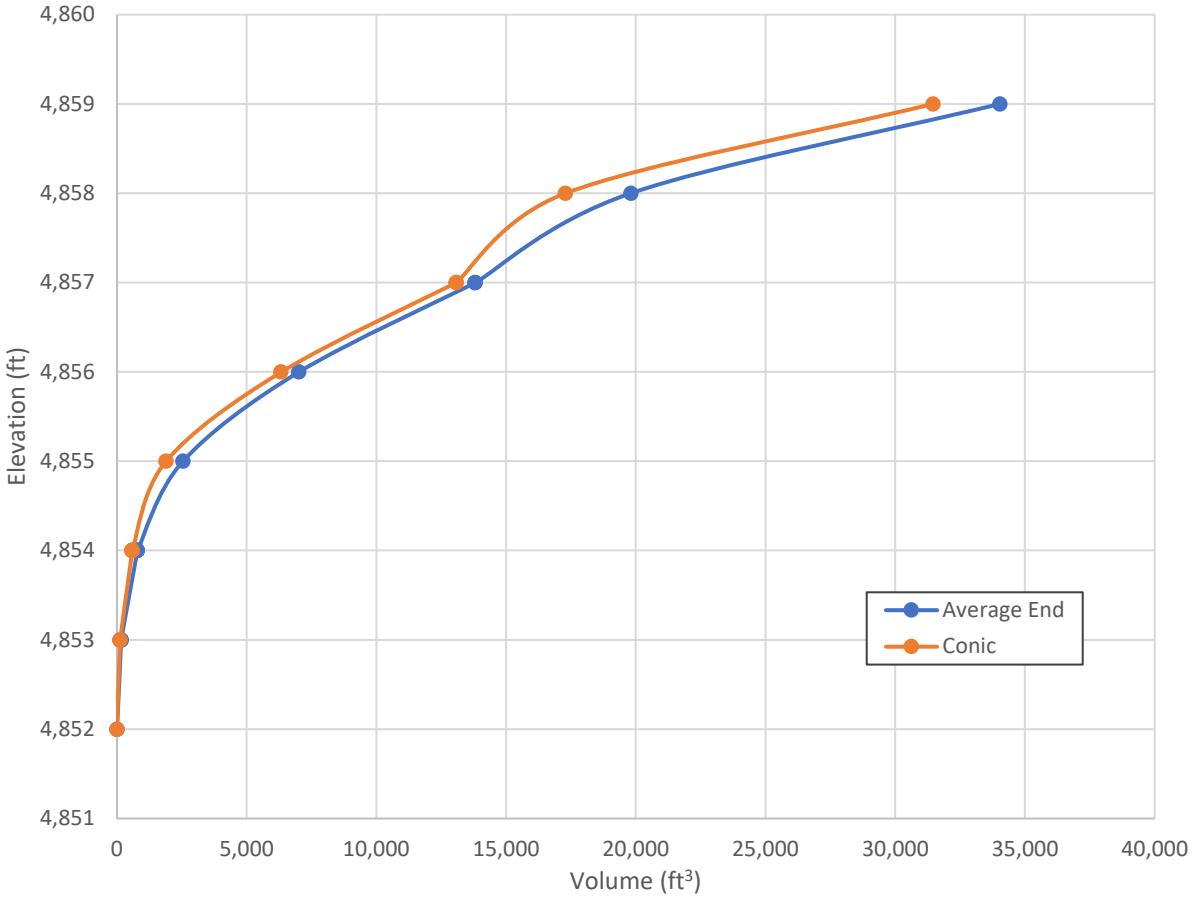


Figure 1: East Wash Inlet Culvert Stage Storage Curves

A stage discharge curve was then calculated for the culvert. Chapter 14 of Part 630 of the National Engineering Handbook (NEH) was used as guidance to calculate the stage discharge curve (USDA NRCS, 1997). Procedure outlined in the NEH was followed and curves representing inlet control and outlet control culverts were calculated. The inlet control curve was calculated using the methods described in 630.1405.e.1 and the nomograph found in Exhibit 14-9 of the NEH was used to determine headwater depth for a range of flows (USDA NRCS, 1997). For the outlet control curve, the method outlined in 630.1405.e.2 was followed, including the use of the nomograph found in Exhibit 14-14 to determine headloss through the culvert (USDA NRCS, 1997). Discharge over McCarran Blvd. was also calculated using the modified broad crested weir equation described in 630.1405.c (USDA NRCS, 1997). The resulting curves calculated from the aforementioned process can be found in Figure 2.

While these methods yielded reasonable results, the head loss values derived from Exhibit 14-14 would not be accurate since the nomograph is for a CMP culvert flowing full and the downstream condition of the analyzed culvert is a normally dry detention basin with no set water surface elevation (USDA NRCS, 1997). Since the outlet is not submerged, the headwater must be calculated by methods described in Hydraulic Design of Highway Culverts (1985) published by the U.S. Department of Transportation Federal Highway Administration (FHWA) (USDOT FHA, 2012). The methods described in the FHWA design manual are automated in the computer program HY-8 and were then used to determine the proper performance curve for the culvert (USDOT FHA, 2012). The culvert dimensions and boundary conditions were input into the program and the stage discharge curves were calculated. Boundary conditions entered into the HY-8

program are listed in Appendix A. The resulting inlet control and outlet control curves are also displayed in Figure 2.

The two differing methods produced nearly identical inlet control curves, as both the FHWA manual and the NEH utilize the same nomograph to calculate inlet control headwater. As expected, the outlet control curves showed a larger difference due to the headloss differences between partially full pipe flow and full pipe flow. However, the outlet control curve proved to be inconsequential as the culvert is inlet controlled through the entire flow profile. The performance curve derived from HY-8 was then selected for future use in SITES models, as it was calculated using computerized methods that do not rely on graphical interpretations from a nomograph.

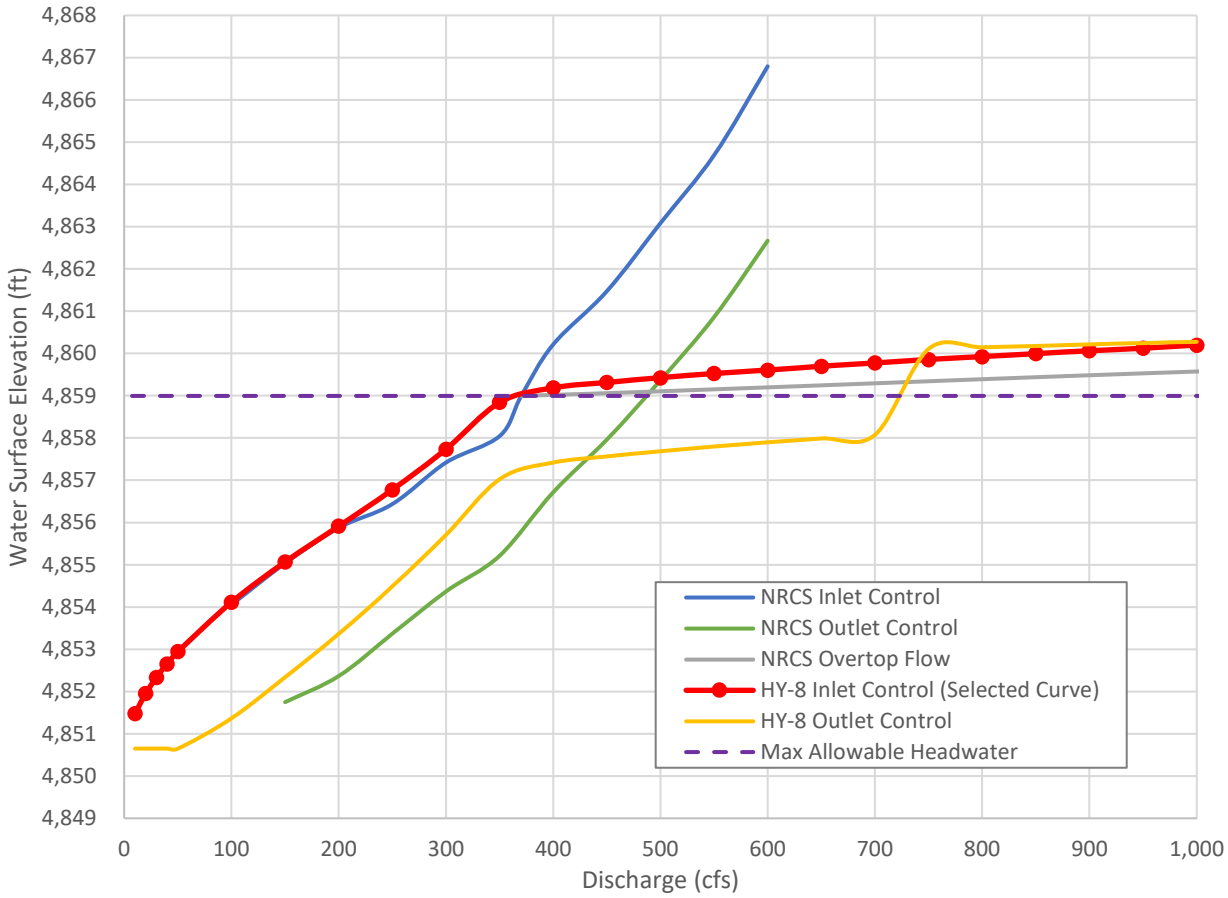


Figure 2: East Wash Inlet Culvert Stage Discharge Curves

3.0 RAINFALL DATA

The hydrologic analysis of the East Wash Diversion and West Wash Dams requires modeling of simulated rainfall events. Two types of rainfall data were gathered as input data for the SITES model:

- precipitation frequency data, and
- the probable maximum precipitation.

Rainfall totals and distributions used for the hydrologic modeling will be based on the 10-, 25-, 50, 100-, 200-, 500-, 1,000-year, 24-hr storms and the ½, ¾, and full PMP (Local and General) for the durations specified in TR-60 and Nevada Dam Safety criteria (USDA NRCS, 2019) (Nevada Legislature, 2016). The methodology used to determine the rainfall amounts and distributions will be discussed in the following sections.

3.1 FREQUENCY PRECIPITATION EVENTS

The drainage basins for the East Wash Diversion and West Wash Dam were delineated using the Watershed Modeling System (WMS) software Version 11.0.7 developed by Aquaveo, LLC (Aquaveo, 2020). Lidar data provided by the City of Reno was uploaded to WMS and outlet points were chosen where the drainage basins discharge into the East Wash and West Wash. Based on the outlet points, the WMS software analyzed the contour lines from the Lidar data and delineated the drainage basins for the East Wash and West Wash, as well as analyzed all possible flow routes within each main drainage basin. Subbasins were then delineated by identifying outlet points at locations where branches of flow intersected the main flow path and having the WMS program analyze the extents of each subbasin.

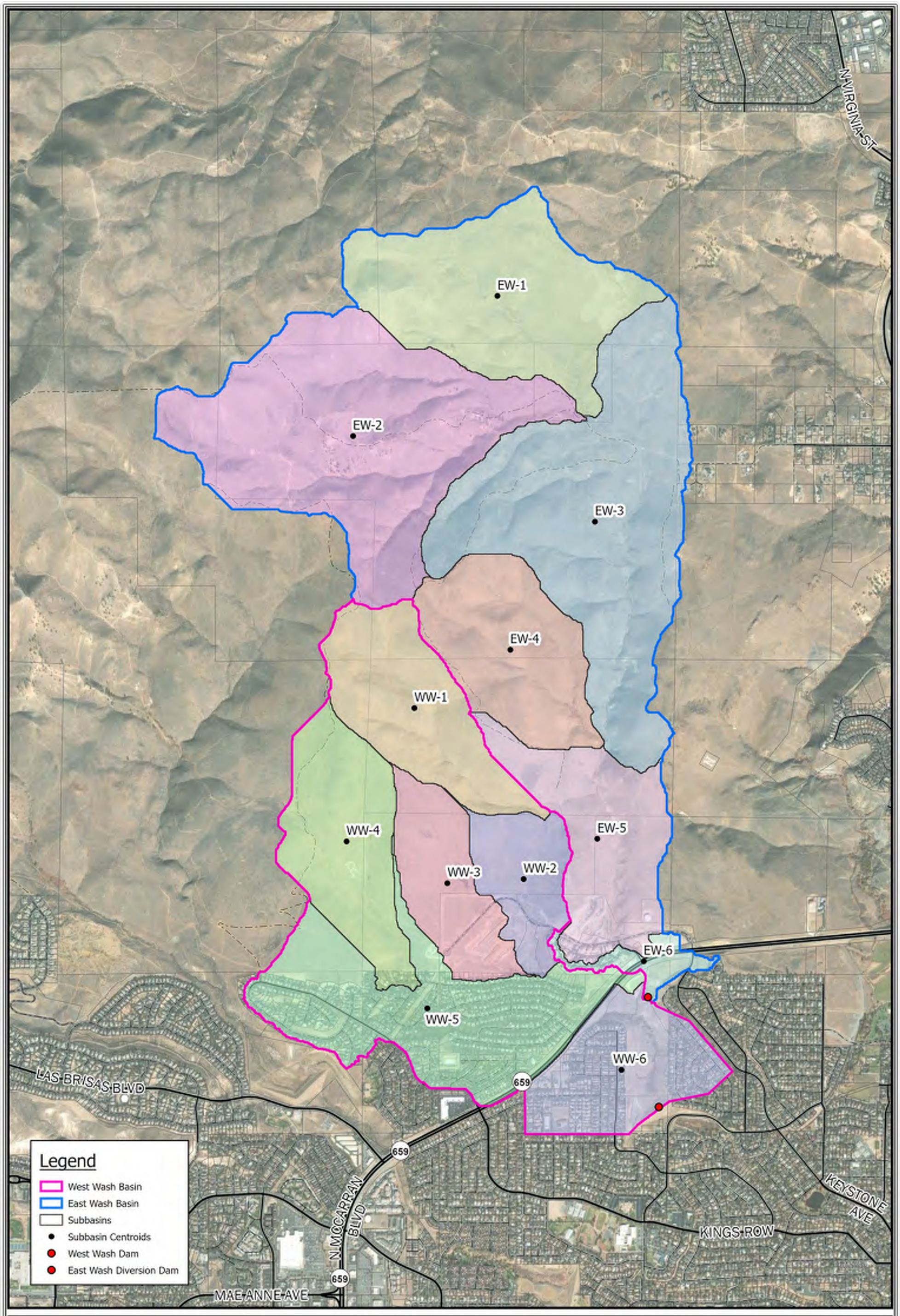
Once the extents of the basins and subbasins for the East Wash Diversion and West Wash Dams were identified, the shapefiles were exported from WMS for analysis in ArcGIS Pro Version 2.7.1 developed by Esri, Inc. The centroid of each individual subbasin was then calculated using ArcGIS Pro. The extents of the East Wash and West Wash drainage basins and subbasins, as well as the centroid location for each subbasin, is shown in Figure 3. The hydrologic characteristics of the subbasins will be documented in the second TM of the HH&S.

The latitudes and longitudes for each subbasin were entered into the NOAA Atlas 14 Precipitation Frequency Data Server to obtain the point precipitation frequency estimates with 90% confidence intervals (NOAA, National Weather Service, 2017). Table 1 lists the 24-hour precipitation depths for each subbasin for the average recurrence intervals of 10-, 25-, 50-, 100-, 200-, 500-, and 1,000-years. Additionally, the 100-year 10 day precipitation depth is listed in Table 1 for each subbasin. This value is used to help determine the Principal Spillway Hydrograph for the East Wash and West Wash dams. The rainfall totals listed in Table 1 were then converted into site specific rainfall distributions using the Win TR-20 program for analysis in the SITES model. The rainfall distribution tables for each subbasin and recurrence interval can be found in Appendix B. The raw data presented in Appendix B is formatted to be directly read by the program.

Table 1: Point Precipitation Frequency Estimates (inches)

Subbasin	10-Year	25-Year	50-Year	100-Year	100-Year (10 day)	200-Year	500-Year	1,000-Year
EW-1	2.80	3.37	3.83	4.31	10.30	4.81	5.51	6.06
EW-2	2.91	3.51	3.99	4.50	11.00	5.02	5.75	6.33
EW-3	2.52	3.03	3.43	3.86	8.82	4.30	4.92	5.40
EW-4	2.66	3.20	3.64	4.09	9.62	4.56	5.22	5.74
EW-5	2.41	2.90	3.29	3.69	8.30	4.11	4.70	5.16
EW-6	2.30	2.77	3.13	3.52	7.76	3.92	4.47	4.91
WW-1	2.54	3.06	3.47	3.90	9.02	4.35	4.97	5.46
WW-2	2.30	2.77	3.13	3.52	7.76	3.92	4.47	4.91
WW-3	2.42	2.91	3.30	3.71	8.39	4.13	4.72	5.18
WW-4	2.69	3.23	3.67	4.13	9.80	4.61	5.27	5.80
WW-5	2.42	2.91	3.30	3.71	8.39	4.13	4.72	5.18
WW-6	2.21	2.65	3.01	3.37	7.30	3.76	4.28	4.70

*EW – East Wash Subbasin, WW – West Wash Subbasin



The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

N

1 IN = 1,500 FT

Figure 3: Delineated Subbasins

FARR WEST
ENGINEERING
5510 Longley Lane
Reno, NV 89511
(775) 851-4788
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3.2 PROBABLE MAXIMUM PRECIPITATION EVENT

The Probable Maximum Precipitation (PMP) event was calculated following the guidelines set forth in the Hydrometeorological Report No. 49 (HMR-49) for the Colorado River and Great Basin Drainages (NOAA, National Weather Service, 1984). The PMP is defined as the "theoretically greatest depth of precipitation for a given duration that is physically possible over a particular drainage basin at a particular time of year" (NOAA, National Weather Service, 1984). Since there are so many unknowns when it comes to extreme precipitation events, methods for calculating the PMP include making judgements based on previously recorded storms and the meteorological processes related to them. Unlike the frequency precipitation events, there is no recurrence interval associated with the PMP.

The HMR-49 provides tables to assist in the calculation of both the General and Local PMP (NOAA, National Weather Service, 1984). The latitude, longitude, and area of the centroid of the drainage basin under consideration are used in conjunction with figures throughout the HMR-49 to determine the PMP storm characteristics and rainfall depths (NOAA, National Weather Service, 1984). Details regarding the calculation of the General and Local PMP will be discussed in-depth in the following sections.

3.2.1 General PMP Event

The General PMP consists of two components: the convergence PMP and the orographic PMP. The convergence PMP is defined as "precipitation due to atmospheric processes" and is calculated following steps A1-A9 in Table 6.1 of HMR-49 (NOAA, National Weather Service, 1984). The orographic PMP is defined as "the precipitation from moist air forced upward by mountain slopes and the triggering of rainfall near upslopes" and is calculated following steps B1-B6 in Table 6.1 of HMR-49 (NOAA, National Weather Service, 1984). The convergence PMP and the orographic PMP are then added together to calculate the General PMP. The aforementioned process is performed for every month of the year and the highest monthly PMP is then selected for modeling input. The HMR-49 calculates General PMP values for 6-, 12-, 18-, 24-, 48-, and 72-hour durations. Per TR-60 The highest 24-hour and 6-hour PMPs will be modeled through the East Wash Diversion and West Wash Dam system. For the drainage basin that drains into the East Wash Diversion, the highest 6-hour PMP value was calculated to occur in September and is estimated to be 3.4 inches in depth. The highest 24-hour PMP value was calculated to occur in October and is estimated to be 6.8 inches in depth.

Table 6.1 and the associated figures used to calculate the General PMP for January through December can be found in Appendix C.

3.2.2 Local PMP Event

The Local PMP, also called the Thunderstorm PMP, is caused by the strong convective lifting of moist air. Most of these storms are thunderstorms, but since thunder is not always present during these types of events, the term local storm is used. Record storms used as the basis for the Local PMP are defined as unusually heavy rains exceeding 3.0 inches in 3 hours or less that are reasonably isolated from surrounding rains. This definition was chosen because many of the most extreme storms are independent of widespread rain patterns, and so a separate PMP analysis is needed. These local storms typically occur in the summer or early fall and while they produce the most intense point rainfalls of record, they rapidly decrease in rainfall with increasing area (NOAA, National Weather Service, 1984).

The method used to develop Local PMP values was to adjust extreme storm values for maximum precipitation and develop a 1-hour PMP map for 1 square mile drainage basins (NOAA, National Weather Service, 1984). The regional pattern of this map takes into account both the broad-scale terrain features and historical data from recorder stations. Record storms were used to extend the estimate to other durations and larger areas based on depth-duration and depth-areal variations (NOAA, National Weather Service, 1984).

The Local PMP is calculated by following steps 1-9 in Table 6.3A, which computes 6 hourly increments and four (4), 15-minute increments (NOAA, National Weather Service, 1984). Table 6.3A and the associated figures used to calculate the Local PMP can be found in Appendix C. A 6-hour Local PMP of 13.5 inches was selected overall as the PMP for the East Wash and West Wash basins. This selected PMP will be used in TM 2 to develop Auxiliary Spillway Hydrographs and Freeboard Hydrographs for both dams.

4.0 DAM DESIGN CRITERIA

Design criteria for both dams differs depending on the regulatory agency governing the dams. Both dams are subject to City of Reno, Washoe County, NRCS, and Nevada Division of Water Resources (NDWR) regulations. At times these regulations can conflict one another. A comparison of the design criteria listed in Truckee Meadows Regional Drainage Manual (TMRDM), NRCS TR-60, and NAC 535 (the governing documents for City of Reno/Washoe County, NRCS, and NDWR respectively) was performed and the most restrictive criteria was chosen (Nevada Legislature, 2016) (Nevada Legislature, n.d.) (USDA NRCS, 2008). Design criteria, where it was found that the TR-60 was the most restrictive, follows the documents guidance for Dams in Series (USDA NRCS, 2019). A full table of all design criteria and the controlling document reference can be found in Appendix D. As both structures are existing, some important conditions need to be considered:

1) The structure is existing and the basic design parameters are difficult (expensive) to alter.
2) The structure has successfully withstood the forces tending to degrade or cause failure of the structure for 50 years.
3) The structure has settled, somewhat, reducing the crest elevation, but has no other indications of instability or seep paths.
4) The structure is considered “high hazard” and all design elements will be selected under this designation.
5) The magnitude of the Probable Maximum Precipitation may have altered since initial design and construction of the structure.
6) The nature of the tributary area to the structure may have altered since initial design and construction of the structure thereby altering runoff.
7) Development has occurred near and around the structure, including below it in the natural channel and at the end of the spillway channel, restricting options for conveyance of flow.
8) The basic need for the structure has not altered, nor have the parameters for discharge of collected runoff.

The primary regulatory parameter for the design of a dam and its component parts is the hazard classification. By all definitions, the hazard classification of both East Wash Diversion and West Wash Dam is “high.” As a result, the controlling inflow design flood (IDF) for spillway adequacy is the Probable Maximum Flood (PMF). In the interior west, the convective storm (thunderstorm or cloudburst) is generally the condition under which the largest combination of runoff volume and rate is experienced. This situation is further emphasized by the relatively small tributary area to the subject dams. The secondary design parameter is to eliminate downstream flooding at all precipitation events at or below the 1% chance of annual exceedance (the “100-year” event). The tertiary regulatory parameter for the design of the subject dams is limiting the primary spillway flow to that which the downstream conveyances can accommodate.

The original design was made to meet these criteria with the exception of the spillway adequacy. The primary regulatory parameter has undergone evolution since the original design, as has the ability to determine a maximum possible rainfall event, and the recognition of the consequences of a failure to accommodate such improved information. The result is that application of the State of Nevada practice

methods reveals that the West Wash Dam will overtop the crest and emergency spillway in the event of a PMF.

East Wash Diversion, however, will not overtop under such conditions, however the function of the emergency spillway, as designed, will result in inundation of a developed private property and, potentially, excessive damage to the spillway.

Therefore, the primary spillways will not be altered and basic embankment designs are anticipated to remain essentially unchanged. This leaves the impoundments, embankment heights and the emergency spillway configurations as elements to be optimized in response to this analysis.

Stability of the embankments under various loading conditions will be verified as will the drain times, sediment capture, local seismicity, and seep rates. The primary determination will be the response of the structures to a PMF. The secondary determination will be the optimal balance of impoundment volume to emergency spillway capacity.

5.0 KEY FINDINGS

The boundary conditions of the SITES models, as well as the design criteria are listed above in their respective sections. The stage discharge and stage storage curves of the East Wash inlet culvert, as well as the frequency precipitation events and probable maximum precipitation event will be utilized in all SITES models to determine inflow and outflow hydrographs during the second phase of the HH&S analysis. The SITES models will also be used to evaluate the dam spillways by producing primary spillway hydrographs, stability design hydrographs, and freeboard hydrographs for both dams. The dam design criteria listed in Appendix D will be utilized in determining the main deficiencies in both structures during the HH&S. Possible design alternatives will be selected on the basis that they address these deficiencies and meet the minimum design criteria shown here.

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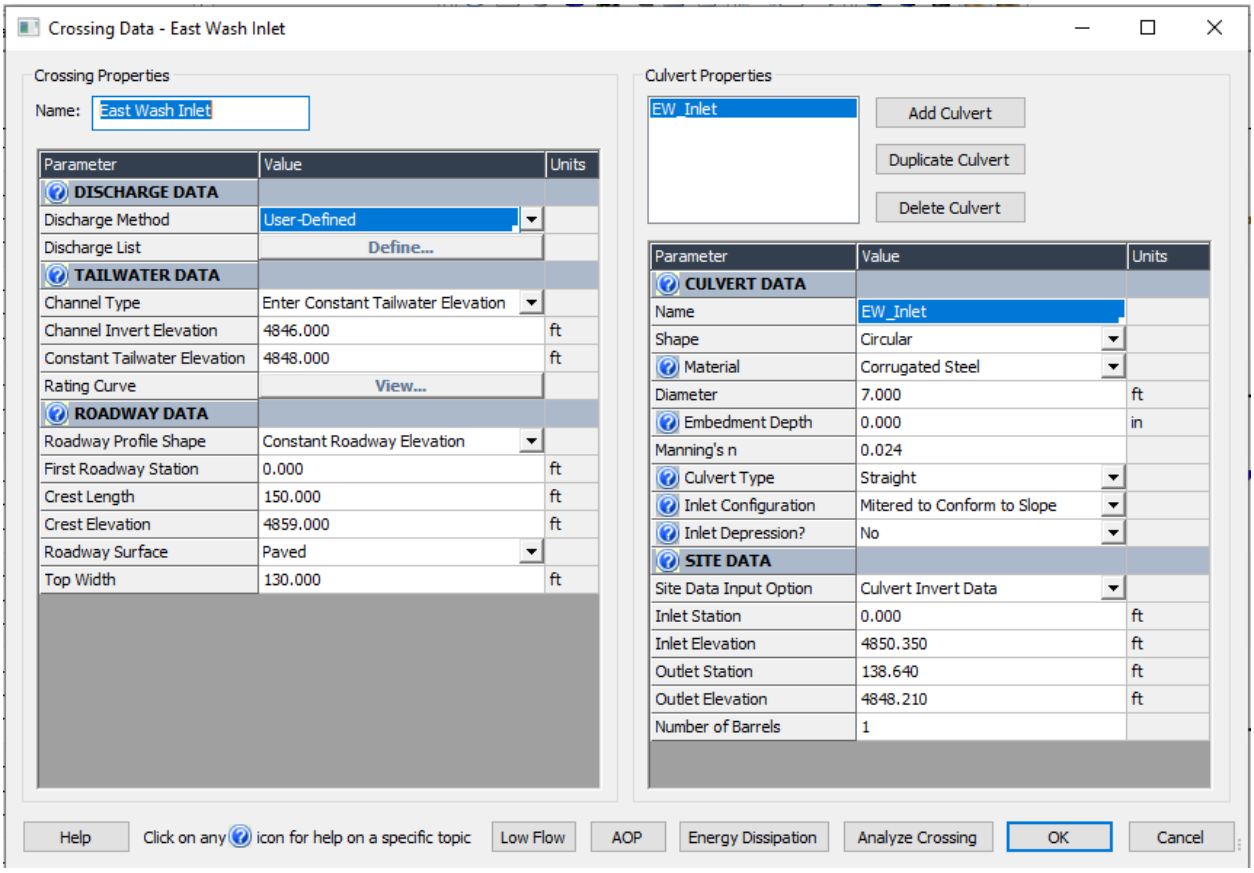
APPENDIX A – HY-8 INPUT AND CULVERT PHOTO


Crossing Data - East Wash Inlet
Crossing Properties
Name: East Wash Inlet
Parameter
Value
Units
DISCHARGE DATA
Discharge Method
User-Defined
Discharge List
Define...
TAILWATER DATA
Channel Type
Enter Constant Tailwater Elevation
Channel Invert Elevation
4846.000
ft
Constant Tailwater Elevation
4848.000
ft
Rating Curve
View...
ROADWAY DATA
Roadway Profile Shape
Constant Roadway Elevation
First Roadway Station
0.000
ft
Crest Length
150.000
ft
Crest Elevation
4859.000
ft
Roadway Surface
Paved
Top Width
130.000
ft
Culvert Properties
EW_Inlet
Add Culvert
Duplicate Culvert
Delete Culvert
Parameter
Value
Units
CULVERT DATA
Name
EW_Inlet
Shape
Circular
Material
Corrugated Steel
Diameter
7.000
ft
Embedment Depth
0.000
in
Manning's n
0.024
Culvert Type
Straight
Inlet Configuration
Mitered to Conform to Slope
Inlet Depression?
No
SITE DATA
Site Data Input Option
Culvert Invert Data
Inlet Station
0.000
ft
Inlet Elevation
4850.350
ft
Outlet Station
138.640
ft
Outlet Elevation
4848.210
ft
Number of Barrels
1
Help
Click on any icon for help on a specific topic
Low Flow
AOP
Energy Dissipation
Analyze Crossing
OK
Cancel

APPENDIX B – CUMULATIVE RAINFALL TABLES FOR SITES

EW-1 CUMULATIVE RAINFALL TABLES

10_yr_sm 0.1 hr increment

0	0.00222	0.00444	0.00666	0.0089
0.01114	0.01339	0.01565	0.01792	0.0202
0.02248	0.02477	0.02707	0.02938	0.0317
0.03402	0.03636	0.0387	0.04105	0.04341
0.04577	0.04815	0.05053	0.05292	0.05532
0.05773	0.06015	0.06257	0.065	0.06744
0.06989	0.07235	0.07482	0.07729	0.07977
0.08226	0.08476	0.08727	0.08978	0.0923
0.09484	0.09738	0.09992	0.10248	0.10504
0.10762	0.1102	0.11279	0.11538	0.11799
0.1206	0.12322	0.12585	0.12849	0.13114
0.13379	0.13646	0.13913	0.14181	0.1445
0.14719	0.14992	0.15268	0.15548	0.15831
0.16117	0.16406	0.16699	0.16995	0.17294
0.17597	0.17903	0.18212	0.18524	0.1884
0.19159	0.19481	0.19807	0.20136	0.20468
0.20804	0.21143	0.21485	0.2183	0.22179
0.22531	0.22886	0.23245	0.23607	0.23972
0.2434	0.24718	0.25105	0.25501	0.25906
0.26321	0.26744	0.27177	0.27619	0.2807
0.2853	0.29	0.29478	0.29966	0.30463
0.30969	0.31504	0.32066	0.32656	0.33273
0.33919	0.346	0.35317	0.36069	0.36857
0.37679	0.38618	0.39607	0.41097	0.43397
0.47939	0.56603	0.58903	0.60393	0.61382
0.62321	0.63143	0.63931	0.64683	0.654
0.66081	0.66727	0.67344	0.67934	0.68496
0.69031	0.69537	0.70034	0.70522	0.71
0.7147	0.7193	0.72381	0.72823	0.73256
0.73679	0.74094	0.74499	0.74895	0.75282
0.7566	0.76028	0.76393	0.76755	0.77114
0.77469	0.77821	0.7817	0.78515	0.78857
0.79196	0.79532	0.79864	0.80193	0.80519
0.80841	0.8116	0.81476	0.81788	0.82097
0.82403	0.82706	0.83005	0.83301	0.83594
0.83883	0.84169	0.84452	0.84732	0.85008
0.85281	0.8555	0.85819	0.86087	0.86354
0.86621	0.86886	0.87151	0.87415	0.87678
0.8794	0.88201	0.88462	0.88721	0.8898
0.89238	0.89496	0.89752	0.90008	0.90262
0.90516	0.9077	0.91022	0.91273	0.91524
0.91774	0.92023	0.92271	0.92518	0.92765
0.93011	0.93256	0.935	0.93743	0.93985
0.94227	0.94468	0.94708	0.94947	0.95185
0.95423	0.95659	0.95895	0.9613	0.96364
0.96598	0.9683	0.97062	0.97293	0.97523

0.97752	0.9798	0.98208	0.98435	0.98661
0.98886	0.9911	0.99334	0.99556	0.99778
1				

25_yr_sm	0.1 hr increment			
0	0.00203	0.00406	0.00609	0.00813
0.01018	0.01224	0.01431	0.01638	0.01847
0.02056	0.02266	0.02477	0.02689	0.02902
0.03116	0.03331	0.03546	0.03762	0.0398
0.04198	0.04417	0.04637	0.04858	0.05079
0.05302	0.05525	0.05749	0.05975	0.06201
0.06428	0.06655	0.06884	0.07114	0.07344
0.07575	0.07808	0.08041	0.08275	0.08509
0.08745	0.08982	0.09219	0.09458	0.09697
0.09937	0.10178	0.1042	0.10663	0.10906
0.11151	0.11396	0.11642	0.11889	0.12137
0.12386	0.12636	0.12887	0.13138	0.13391
0.13644	0.13901	0.14161	0.14425	0.14692
0.14963	0.15238	0.15515	0.15797	0.16082
0.1637	0.16662	0.16958	0.17257	0.17559
0.17865	0.18175	0.18488	0.18804	0.19124
0.19448	0.19775	0.20105	0.2044	0.20777
0.21118	0.21463	0.21811	0.22163	0.22518
0.22877	0.23246	0.23625	0.24014	0.24413
0.24822	0.25241	0.25671	0.2611	0.2656
0.27019	0.27489	0.27969	0.28459	0.28959
0.29469	0.30011	0.30584	0.31189	0.31826
0.32494	0.33204	0.33957	0.34752	0.3559
0.36469	0.37502	0.3859	0.40224	0.42743
0.47727	0.57257	0.59776	0.6141	0.62498
0.63531	0.6441	0.65248	0.66043	0.66796
0.67506	0.68174	0.68811	0.69416	0.69989
0.70531	0.71041	0.71541	0.72031	0.72511
0.72981	0.7344	0.7389	0.74329	0.74759
0.75178	0.75587	0.75986	0.76375	0.76754
0.77123	0.77482	0.77837	0.78189	0.78537
0.78882	0.79223	0.7956	0.79895	0.80225
0.80552	0.80876	0.81196	0.81512	0.81825
0.82135	0.82441	0.82743	0.83042	0.83338
0.8363	0.83918	0.84203	0.84485	0.84762
0.85037	0.85308	0.85575	0.85839	0.86099
0.86356	0.86609	0.86862	0.87113	0.87364
0.87614	0.87863	0.88111	0.88358	0.88604
0.88849	0.89094	0.89337	0.8958	0.89822
0.90063	0.90303	0.90542	0.90781	0.91018
0.91255	0.91491	0.91725	0.91959	0.92192
0.92425	0.92656	0.92886	0.93116	0.93345

0.93572	0.93799	0.94025	0.94251	0.94475
0.94698	0.94921	0.95142	0.95363	0.95583
0.95802	0.9602	0.96238	0.96454	0.96669
0.96884	0.97098	0.97311	0.97523	0.97734
0.97944	0.98153	0.98362	0.98569	0.98776
0.98982	0.99187	0.99391	0.99594	0.99797
1				

50_yr_sm	0.1 hr increment			
0	0.00188	0.00374	0.0056	0.00748
0.00937	0.01126	0.01316	0.01508	0.017
0.01893	0.02087	0.02282	0.02478	0.02675
0.02872	0.03071	0.0327	0.03471	0.03672
0.03874	0.04078	0.04282	0.04487	0.04693
0.049	0.05107	0.05316	0.05526	0.05736
0.05948	0.0616	0.06373	0.06588	0.06803
0.07019	0.07236	0.07454	0.07672	0.07892
0.08113	0.08334	0.08557	0.0878	0.09005
0.0923	0.09456	0.09683	0.09911	0.1014
0.1037	0.106	0.10832	0.11065	0.11298
0.11532	0.11768	0.12004	0.12241	0.12479
0.12718	0.12961	0.13207	0.13457	0.13711
0.13968	0.14229	0.14494	0.14762	0.15034
0.1531	0.15589	0.15872	0.16159	0.1645
0.16744	0.17041	0.17343	0.17648	0.17956
0.18269	0.18585	0.18905	0.19228	0.19555
0.19886	0.2022	0.20559	0.209	0.21246
0.21595	0.21955	0.22326	0.22707	0.231
0.23503	0.23918	0.24343	0.24779	0.25226
0.25684	0.26152	0.26632	0.27122	0.27623
0.28135	0.28682	0.29264	0.2988	0.30531
0.31217	0.31952	0.32736	0.33569	0.34451
0.35379	0.36498	0.37677	0.39444	0.42162
0.47544	0.57838	0.60556	0.62323	0.63502
0.64621	0.65549	0.66431	0.67264	0.68048
0.68783	0.69469	0.7012	0.70736	0.71318
0.71865	0.72377	0.72878	0.73368	0.73848
0.74316	0.74774	0.75221	0.75657	0.76082
0.76497	0.769	0.77293	0.77674	0.78045
0.78405	0.78754	0.791	0.79441	0.7978
0.80114	0.80445	0.80772	0.81095	0.81415
0.81731	0.82044	0.82352	0.82657	0.82959
0.83256	0.8355	0.83841	0.84128	0.84411
0.8469	0.84966	0.85238	0.85506	0.85771
0.86032	0.86289	0.86543	0.86793	0.87039
0.87282	0.87521	0.87759	0.87996	0.88232
0.88468	0.88702	0.88935	0.89168	0.894

0.8963	0.8986	0.90089	0.90317	0.90544
0.9077	0.90995	0.9122	0.91443	0.91666
0.91887	0.92108	0.92328	0.92546	0.92764
0.92981	0.93197	0.93412	0.93627	0.9384
0.94052	0.94264	0.94474	0.94684	0.94893
0.951	0.95307	0.95513	0.95718	0.95922
0.96126	0.96328	0.96529	0.9673	0.96929
0.97128	0.97325	0.97522	0.97718	0.97913
0.98107	0.983	0.98492	0.98684	0.98874
0.99063	0.99252	0.9944	0.99626	0.99812
1				

100_yr_sm 0.1 hr increment

0	0.00166	0.00332	0.00499	0.00667
0.00836	0.01006	0.01177	0.01348	0.01521
0.01695	0.0187	0.02045	0.02222	0.024
0.02578	0.02758	0.02938	0.0312	0.03302
0.03486	0.0367	0.03855	0.04041	0.04229
0.04417	0.04606	0.04796	0.04987	0.05179
0.05372	0.05566	0.05761	0.05957	0.06154
0.06352	0.06551	0.06751	0.06951	0.07153
0.07356	0.07559	0.07764	0.07969	0.08176
0.08383	0.08592	0.08801	0.09012	0.09223
0.09435	0.09649	0.09863	0.10078	0.10294
0.10511	0.10729	0.10948	0.11168	0.11389
0.11611	0.11837	0.12067	0.123	0.12538
0.12779	0.13024	0.13273	0.13526	0.13782
0.14043	0.14307	0.14575	0.14847	0.15123
0.15403	0.15687	0.15974	0.16265	0.16561
0.1686	0.17162	0.17469	0.1778	0.18094
0.18413	0.18735	0.19061	0.19391	0.19724
0.20062	0.20411	0.20773	0.21146	0.2153
0.21927	0.22336	0.22756	0.23188	0.23632
0.24088	0.24555	0.25035	0.25526	0.26029
0.26544	0.27097	0.2769	0.28321	0.28992
0.29701	0.30467	0.31291	0.32172	0.33111
0.34107	0.35328	0.36613	0.38535	0.41489
0.47334	0.58511	0.61465	0.63387	0.64672
0.65893	0.66889	0.67827	0.68709	0.69533
0.70299	0.71008	0.71679	0.7231	0.72903
0.73456	0.73971	0.74474	0.74965	0.75445
0.75912	0.76368	0.76812	0.77244	0.77664
0.78073	0.7847	0.78854	0.79227	0.79589
0.79938	0.80276	0.80609	0.80939	0.81265
0.81587	0.81906	0.8222	0.82531	0.82838
0.8314	0.83439	0.83735	0.84026	0.84313
0.84597	0.84877	0.85153	0.85425	0.85693

0.85957	0.86218	0.86474	0.86727	0.86976
0.87221	0.87462	0.877	0.87933	0.88163
0.88389	0.88611	0.88832	0.89052	0.89271
0.89489	0.89706	0.89922	0.90137	0.90351
0.90565	0.90777	0.90988	0.91199	0.91408
0.91617	0.91824	0.92031	0.92236	0.92441
0.92644	0.92847	0.93049	0.93249	0.93449
0.93648	0.93846	0.94043	0.94239	0.94434
0.94628	0.94821	0.95013	0.95204	0.95394
0.95583	0.95771	0.95959	0.96145	0.9633
0.96514	0.96698	0.9688	0.97062	0.97242
0.97422	0.976	0.97778	0.97955	0.9813
0.98305	0.98479	0.98652	0.98823	0.98994
0.99164	0.99333	0.99501	0.99668	0.99834
1				

200_yr_sm 0.1 hr increment

0	0.00147	0.00294	0.00442	0.00591
0.0074	0.00891	0.01043	0.01195	0.01349
0.01504	0.01659	0.01816	0.01974	0.02132
0.02292	0.02453	0.02614	0.02777	0.0294
0.03105	0.03271	0.03437	0.03605	0.03773
0.03943	0.04113	0.04285	0.04457	0.04631
0.04805	0.04981	0.05157	0.05335	0.05513
0.05692	0.05873	0.06054	0.06237	0.0642
0.06604	0.0679	0.06976	0.07163	0.07352
0.07541	0.07731	0.07923	0.08115	0.08308
0.08502	0.08698	0.08894	0.09091	0.09289
0.09489	0.09689	0.0989	0.10092	0.10295
0.105	0.10708	0.1092	0.11136	0.11356
0.1158	0.11808	0.1204	0.12275	0.12515
0.12759	0.13007	0.13258	0.13514	0.13773
0.14037	0.14304	0.14576	0.14851	0.15131
0.15414	0.15701	0.15993	0.16288	0.16587
0.1689	0.17197	0.17508	0.17823	0.18142
0.18465	0.188	0.19149	0.19509	0.19883
0.20269	0.20667	0.21078	0.21502	0.21938
0.22387	0.22849	0.23323	0.2381	0.24309
0.24822	0.25376	0.25974	0.26614	0.27297
0.28022	0.28814	0.29671	0.30595	0.31586
0.3264	0.33971	0.35371	0.37464	0.40683
0.47071	0.59317	0.62536	0.64629	0.66029
0.6736	0.68414	0.69405	0.70329	0.71186
0.71978	0.72703	0.73386	0.74026	0.74624
0.75178	0.75691	0.7619	0.76677	0.77151
0.77613	0.78062	0.78498	0.78922	0.79333
0.79731	0.80117	0.80491	0.80851	0.812

0.81535	0.81858	0.82177	0.82492	0.82803
0.8311	0.83413	0.83712	0.84008	0.84299
0.84586	0.84869	0.85149	0.85424	0.85696
0.85963	0.86227	0.86486	0.86742	0.86993
0.87241	0.87485	0.87725	0.8796	0.88192
0.8842	0.88644	0.88864	0.8908	0.89292
0.895	0.89705	0.89908	0.9011	0.90311
0.90511	0.90711	0.90909	0.91106	0.91302
0.91498	0.91692	0.91885	0.92077	0.92269
0.92459	0.92648	0.92837	0.93024	0.9321
0.93396	0.9358	0.93763	0.93946	0.94127
0.94308	0.94487	0.94665	0.94843	0.95019
0.95195	0.95369	0.95543	0.95715	0.95887
0.96057	0.96227	0.96395	0.96563	0.96729
0.96895	0.9706	0.97223	0.97386	0.97547
0.97708	0.97868	0.98026	0.98184	0.98341
0.98496	0.98651	0.98805	0.98957	0.99109
0.9926	0.99409	0.99558	0.99706	0.99853
1				

500_yr_sm 0.1 hr increment

0	0.00117	0.00234	0.00353	0.00472
0.00593	0.00714	0.00837	0.0096	0.01085
0.01211	0.01337	0.01465	0.01594	0.01723
0.01854	0.01985	0.02118	0.02252	0.02387
0.02522	0.02659	0.02797	0.02936	0.03075
0.03216	0.03358	0.03501	0.03645	0.0379
0.03935	0.04082	0.0423	0.04379	0.04529
0.0468	0.04832	0.04985	0.05139	0.05294
0.0545	0.05607	0.05765	0.05924	0.06084
0.06245	0.06408	0.06571	0.06735	0.069
0.07066	0.07233	0.07402	0.07571	0.07741
0.07912	0.08085	0.08258	0.08432	0.08607
0.08784	0.08964	0.09149	0.09337	0.0953
0.09726	0.09927	0.10132	0.1034	0.10553
0.1077	0.10991	0.11216	0.11445	0.11678
0.11916	0.12157	0.12402	0.12651	0.12905
0.13162	0.13424	0.1369	0.13959	0.14233
0.14511	0.14793	0.15078	0.15368	0.15662
0.15961	0.16272	0.16598	0.16937	0.17291
0.17658	0.18038	0.18433	0.18841	0.19263
0.19699	0.20149	0.20612	0.21089	0.2158
0.22085	0.22638	0.23241	0.23892	0.24593
0.25342	0.26172	0.27084	0.28078	0.29153
0.30309	0.31821	0.33412	0.35787	0.39437
0.46679	0.60563	0.64213	0.66588	0.68179
0.69691	0.70847	0.71922	0.72916	0.73828

0.74658	0.75407	0.76108	0.76759	0.77362
0.77915	0.7842	0.78911	0.79388	0.79851
0.80301	0.80737	0.81159	0.81567	0.81962
0.82342	0.82709	0.83063	0.83402	0.83728
0.84039	0.84338	0.84632	0.84922	0.85207
0.85489	0.85767	0.86041	0.8631	0.86576
0.86838	0.87095	0.87349	0.87598	0.87843
0.88084	0.88322	0.88555	0.88784	0.89009
0.8923	0.89447	0.8966	0.89868	0.90073
0.90274	0.9047	0.90663	0.90851	0.91036
0.91216	0.91393	0.91568	0.91742	0.91915
0.92088	0.92259	0.92429	0.92598	0.92767
0.92934	0.931	0.93265	0.93429	0.93592
0.93755	0.93916	0.94076	0.94235	0.94393
0.9455	0.94706	0.94861	0.95015	0.95168
0.9532	0.95471	0.95621	0.9577	0.95918
0.96065	0.9621	0.96355	0.96499	0.96642
0.96784	0.96925	0.97064	0.97203	0.97341
0.97478	0.97613	0.97748	0.97882	0.98015
0.98146	0.98277	0.98406	0.98535	0.98663
0.98789	0.98915	0.9904	0.99163	0.99286
0.99407	0.99528	0.99647	0.99766	0.99883
1				

EW-2 CUMULATIVE RAINFALL TABLES

10_yr_sm 0.1 hr increment

0	0.00226	0.00452	0.00678	0.00906
0.01134	0.01363	0.01593	0.01823	0.02055
0.02287	0.0252	0.02754	0.02988	0.03224
0.0346	0.03697	0.03935	0.04174	0.04413
0.04654	0.04895	0.05137	0.05379	0.05623
0.05867	0.06113	0.06359	0.06605	0.06853
0.07101	0.07351	0.07601	0.07851	0.08103
0.08356	0.08609	0.08863	0.09118	0.09374
0.0963	0.09887	0.10146	0.10405	0.10664
0.10925	0.11186	0.11449	0.11712	0.11975
0.1224	0.12505	0.12772	0.13039	0.13307
0.13575	0.13845	0.14115	0.14386	0.14658
0.14931	0.15207	0.15486	0.15769	0.16054
0.16343	0.16635	0.16931	0.17229	0.17531
0.17837	0.18145	0.18457	0.18771	0.1909
0.19411	0.19736	0.20063	0.20394	0.20729
0.21066	0.21407	0.21751	0.22099	0.22449
0.22803	0.2316	0.2352	0.23884	0.2425
0.2462	0.24999	0.25387	0.25784	0.2619
0.26605	0.27029	0.27461	0.27903	0.28354
0.28813	0.29282	0.2976	0.30246	0.30742
0.31246	0.31778	0.32336	0.32922	0.33535
0.34175	0.34849	0.35558	0.363	0.37077
0.37887	0.38809	0.3978	0.41244	0.43504
0.4797	0.56496	0.58756	0.6022	0.61191
0.62113	0.62923	0.637	0.64442	0.65151
0.65825	0.66465	0.67078	0.67664	0.68222
0.68754	0.69258	0.69754	0.7024	0.70718
0.71187	0.71646	0.72097	0.72539	0.72971
0.73395	0.7381	0.74216	0.74613	0.75001
0.7538	0.7575	0.76116	0.7648	0.7684
0.77197	0.77551	0.77901	0.78249	0.78593
0.78934	0.79271	0.79606	0.79937	0.80264
0.80589	0.8091	0.81229	0.81543	0.81855
0.82163	0.82469	0.82771	0.83069	0.83365
0.83657	0.83946	0.84231	0.84514	0.84793
0.85069	0.85342	0.85614	0.85885	0.86155
0.86425	0.86693	0.86961	0.87228	0.87495
0.8776	0.88025	0.88288	0.88551	0.88814
0.89075	0.89336	0.89595	0.89854	0.90113
0.9037	0.90626	0.90882	0.91137	0.91391
0.91644	0.91897	0.92149	0.92399	0.92649
0.92899	0.93147	0.93395	0.93641	0.93887
0.94133	0.94377	0.94621	0.94863	0.95105
0.95346	0.95587	0.95826	0.96065	0.96303
0.9654	0.96776	0.97012	0.97246	0.9748

0.97713	0.97945	0.98177	0.98407	0.98637
0.98866	0.99094	0.99322	0.99548	0.99774
1				

25_yr_sm 0.1 hr increment

0	0.00209	0.00417	0.00625	0.00835
0.01045	0.01256	0.01468	0.0168	0.01894
0.02108	0.02324	0.0254	0.02757	0.02975
0.03194	0.03413	0.03634	0.03855	0.04078
0.04301	0.04525	0.04749	0.04975	0.05202
0.05429	0.05657	0.05887	0.06117	0.06347
0.06579	0.06812	0.07045	0.0728	0.07515
0.07751	0.07988	0.08226	0.08464	0.08704
0.08944	0.09185	0.09427	0.0967	0.09914
0.10159	0.10404	0.10651	0.10898	0.11146
0.11395	0.11645	0.11896	0.12148	0.124
0.12653	0.12908	0.13163	0.13418	0.13675
0.13933	0.14194	0.14459	0.14727	0.14998
0.15273	0.15551	0.15833	0.16118	0.16407
0.16699	0.16995	0.17294	0.17596	0.17902
0.18212	0.18525	0.18841	0.19161	0.19484
0.19811	0.20141	0.20475	0.20812	0.21152
0.21496	0.21844	0.22195	0.22549	0.22907
0.23268	0.23639	0.2402	0.24411	0.24811
0.25222	0.25642	0.26072	0.26512	0.26961
0.27421	0.2789	0.2837	0.28859	0.29358
0.29866	0.30405	0.30975	0.31575	0.32206
0.32867	0.33569	0.34311	0.35095	0.35919
0.36781	0.37791	0.38854	0.40451	0.42912
0.47781	0.57088	0.59549	0.61146	0.62209
0.63219	0.64081	0.64905	0.65689	0.66431
0.67133	0.67794	0.68425	0.69025	0.69595
0.70134	0.70642	0.71141	0.7163	0.7211
0.72579	0.73039	0.73488	0.73928	0.74358
0.74778	0.75189	0.75589	0.7598	0.76361
0.76732	0.77093	0.77451	0.77805	0.78156
0.78504	0.78848	0.79188	0.79525	0.79859
0.80189	0.80516	0.80839	0.81159	0.81475
0.81788	0.82098	0.82404	0.82706	0.83005
0.83301	0.83593	0.83882	0.84167	0.84449
0.84727	0.85002	0.85273	0.85541	0.85806
0.86067	0.86325	0.86582	0.86837	0.87092
0.87347	0.876	0.87852	0.88104	0.88355
0.88605	0.88854	0.89102	0.89349	0.89596
0.89841	0.90086	0.9033	0.90573	0.90815
0.91056	0.91296	0.91536	0.91774	0.92012
0.92249	0.92485	0.9272	0.92955	0.93188

0.93421	0.93653	0.93883	0.94113	0.94343
0.94571	0.94798	0.95025	0.95251	0.95475
0.95699	0.95922	0.96145	0.96366	0.96587
0.96806	0.97025	0.97243	0.9746	0.97676
0.97892	0.98106	0.9832	0.98532	0.98744
0.98955	0.99165	0.99375	0.99583	0.99791
1				

50_yr_sm 0.1 hr increment

0	0.00189	0.00379	0.0057	0.00761
0.00954	0.01147	0.01341	0.01537	0.01733
0.0193	0.02128	0.02326	0.02526	0.02727
0.02929	0.03131	0.03334	0.03539	0.03744
0.0395	0.04157	0.04365	0.04574	0.04784
0.04995	0.05207	0.05419	0.05633	0.05847
0.06062	0.06279	0.06496	0.06714	0.06933
0.07153	0.07373	0.07595	0.07818	0.08041
0.08266	0.08491	0.08718	0.08945	0.09173
0.09402	0.09632	0.09863	0.10095	0.10327
0.10561	0.10795	0.11031	0.11267	0.11504
0.11743	0.11982	0.12222	0.12463	0.12705
0.12947	0.13194	0.13444	0.13697	0.13955
0.14216	0.14481	0.14749	0.15021	0.15297
0.15576	0.15859	0.16146	0.16436	0.1673
0.17028	0.17329	0.17634	0.17942	0.18255
0.18571	0.1889	0.19213	0.1954	0.19871
0.20205	0.20543	0.20884	0.2123	0.21578
0.21931	0.22294	0.22668	0.23053	0.23448
0.23854	0.24271	0.24699	0.25137	0.25586
0.26046	0.26516	0.26997	0.27489	0.27992
0.28505	0.29053	0.29634	0.3025	0.30899
0.31583	0.32314	0.33093	0.33919	0.34793
0.35714	0.3681	0.37963	0.39691	0.42348
0.47604	0.57652	0.60309	0.62037	0.6319
0.64286	0.65207	0.66081	0.66907	0.67686
0.68417	0.69101	0.6975	0.70366	0.70947
0.71495	0.72008	0.72511	0.73003	0.73484
0.73954	0.74414	0.74863	0.75301	0.75729
0.76146	0.76552	0.76947	0.77332	0.77706
0.78069	0.78422	0.7877	0.79116	0.79457
0.79795	0.80129	0.8046	0.80787	0.8111
0.81429	0.81745	0.82058	0.82366	0.82671
0.82972	0.8327	0.83564	0.83854	0.84141
0.84424	0.84703	0.84979	0.85251	0.85519
0.85784	0.86045	0.86303	0.86556	0.86806
0.87053	0.87295	0.87537	0.87778	0.88018
0.88257	0.88496	0.88733	0.88969	0.89205

0.89439	0.89673	0.89905	0.90137	0.90368
0.90598	0.90827	0.91055	0.91282	0.91509
0.91734	0.91959	0.92182	0.92405	0.92627
0.92847	0.93067	0.93286	0.93504	0.93721
0.93938	0.94153	0.94367	0.94581	0.94793
0.95005	0.95216	0.95426	0.95635	0.95843
0.9605	0.96256	0.96461	0.96666	0.96869
0.97071	0.97273	0.97474	0.97674	0.97872
0.9807	0.98267	0.98463	0.98659	0.98853
0.99046	0.99239	0.9943	0.99621	0.99811
1				

100_yr_sm 0.1 hr increment

0	0.00173	0.00346	0.0052	0.00694
0.0087	0.01047	0.01224	0.01402	0.01582
0.01762	0.01943	0.02126	0.02309	0.02493
0.02678	0.02864	0.03051	0.03239	0.03428
0.03618	0.03808	0.04	0.04193	0.04386
0.04581	0.04776	0.04973	0.0517	0.05369
0.05568	0.05768	0.0597	0.06172	0.06375
0.06579	0.06784	0.0699	0.07197	0.07405
0.07613	0.07823	0.08034	0.08246	0.08458
0.08672	0.08886	0.09102	0.09318	0.09536
0.09754	0.09973	0.10193	0.10415	0.10637
0.1086	0.11084	0.11309	0.11535	0.11761
0.11989	0.12221	0.12456	0.12695	0.12938
0.13185	0.13436	0.1369	0.13948	0.1421
0.14476	0.14746	0.15019	0.15296	0.15577
0.15862	0.16151	0.16443	0.16739	0.17039
0.17343	0.17651	0.17962	0.18277	0.18596
0.18919	0.19246	0.19576	0.1991	0.20248
0.2059	0.20943	0.21308	0.21684	0.22072
0.22471	0.22882	0.23304	0.23738	0.24183
0.2464	0.25108	0.25588	0.26079	0.26582
0.27096	0.27648	0.28237	0.28864	0.29528
0.30229	0.30986	0.31797	0.32662	0.33582
0.34556	0.35744	0.36994	0.38863	0.41734
0.47413	0.58266	0.61137	0.63006	0.64256
0.65444	0.66418	0.67338	0.68203	0.69014
0.69771	0.70472	0.71136	0.71763	0.72352
0.72904	0.73418	0.73921	0.74412	0.74892
0.7536	0.75817	0.76262	0.76696	0.77118
0.77529	0.77928	0.78316	0.78692	0.79057
0.7941	0.79752	0.8009	0.80424	0.80754
0.81081	0.81404	0.81723	0.82038	0.82349
0.82657	0.82961	0.83261	0.83557	0.83849
0.84138	0.84423	0.84704	0.84981	0.85254

0.85524	0.8579	0.86052	0.8631	0.86564
0.86815	0.87062	0.87305	0.87544	0.87779
0.88011	0.88239	0.88465	0.88691	0.88916
0.8914	0.89363	0.89585	0.89807	0.90027
0.90246	0.90464	0.90682	0.90898	0.91114
0.91328	0.91542	0.91754	0.91966	0.92177
0.92387	0.92595	0.92803	0.9301	0.93216
0.93421	0.93625	0.93828	0.9403	0.94232
0.94432	0.94631	0.9483	0.95027	0.95223
0.95419	0.95614	0.95807	0.96	0.96192
0.96382	0.96572	0.96761	0.96949	0.97136
0.97322	0.97507	0.97691	0.97874	0.98057
0.98238	0.98418	0.98598	0.98776	0.98953
0.9913	0.99306	0.9948	0.99654	0.99827
1				

200_yr_sm 0.1 hr increment

0	0.00153	0.00305	0.00459	0.00613
0.00768	0.00924	0.01081	0.01239	0.01398
0.01558	0.01719	0.01881	0.02044	0.02208
0.02373	0.02539	0.02706	0.02874	0.03042
0.03212	0.03383	0.03555	0.03728	0.03901
0.04076	0.04252	0.04429	0.04606	0.04785
0.04965	0.05145	0.05327	0.0551	0.05693
0.05878	0.06064	0.0625	0.06438	0.06626
0.06816	0.07006	0.07198	0.0739	0.07584
0.07778	0.07973	0.0817	0.08367	0.08566
0.08765	0.08965	0.09166	0.09369	0.09572
0.09776	0.09982	0.10188	0.10395	0.10603
0.10812	0.11025	0.11243	0.11463	0.11688
0.11917	0.1215	0.12387	0.12627	0.12872
0.1312	0.13373	0.13629	0.13889	0.14154
0.14422	0.14694	0.1497	0.1525	0.15534
0.15822	0.16113	0.16409	0.16709	0.17012
0.1732	0.17631	0.17947	0.18266	0.18589
0.18916	0.19256	0.19608	0.19972	0.20349
0.20738	0.2114	0.21553	0.2198	0.22419
0.2287	0.23333	0.23809	0.24298	0.24799
0.25312	0.25867	0.26463	0.27101	0.27781
0.28503	0.29288	0.30138	0.31051	0.32029
0.33068	0.34373	0.35747	0.37798	0.40943
0.47166	0.59057	0.62202	0.64253	0.65627
0.66932	0.67971	0.68949	0.69862	0.70712
0.71497	0.72219	0.72899	0.73537	0.74133
0.74688	0.75201	0.75702	0.76191	0.76667
0.7713	0.77581	0.7802	0.78447	0.7886
0.79262	0.79651	0.80028	0.80392	0.80744

0.81084	0.81411	0.81734	0.82053	0.82369
0.8268	0.82988	0.83291	0.83591	0.83887
0.84178	0.84466	0.8475	0.8503	0.85306
0.85578	0.85846	0.86111	0.86371	0.86627
0.8688	0.87128	0.87373	0.87613	0.8785
0.88083	0.88312	0.88537	0.88757	0.88975
0.89188	0.89397	0.89605	0.89812	0.90018
0.90224	0.90428	0.90631	0.90834	0.91035
0.91235	0.91434	0.91633	0.9183	0.92027
0.92222	0.92416	0.9261	0.92802	0.92994
0.93184	0.93374	0.93562	0.9375	0.93936
0.94122	0.94307	0.9449	0.94673	0.94855
0.95035	0.95215	0.95394	0.95571	0.95748
0.95924	0.96099	0.96272	0.96445	0.96617
0.96788	0.96958	0.97126	0.97294	0.97461
0.97627	0.97792	0.97956	0.98119	0.98281
0.98442	0.98602	0.98761	0.98919	0.99076
0.99232	0.99387	0.99541	0.99695	0.99847
1				

500_yr_sm 0.1 hr increment

0	0.00125	0.00249	0.00375	0.00501
0.00629	0.00757	0.00887	0.01017	0.01149
0.01281	0.01415	0.01549	0.01685	0.01822
0.01959	0.02098	0.02237	0.02378	0.0252
0.02662	0.02806	0.02951	0.03096	0.03243
0.03391	0.03539	0.03689	0.0384	0.03991
0.04144	0.04298	0.04453	0.04608	0.04765
0.04923	0.05082	0.05241	0.05402	0.05564
0.05727	0.05891	0.06056	0.06221	0.06388
0.06556	0.06725	0.06895	0.07066	0.07238
0.07411	0.07585	0.07759	0.07935	0.08112
0.0829	0.08469	0.08649	0.0883	0.09012
0.09195	0.09382	0.09573	0.09769	0.09968
0.10171	0.10378	0.10589	0.10805	0.11024
0.11247	0.11475	0.11706	0.11942	0.12181
0.12425	0.12673	0.12924	0.1318	0.1344
0.13703	0.13971	0.14243	0.14519	0.14799
0.15083	0.15371	0.15663	0.15959	0.16259
0.16563	0.16881	0.17212	0.17557	0.17915
0.18286	0.18671	0.1907	0.19482	0.19908
0.20347	0.20799	0.21266	0.21745	0.22238
0.22745	0.23299	0.239	0.24549	0.25245
0.25988	0.26809	0.27708	0.28685	0.29739
0.3087	0.3234	0.33888	0.36197	0.39743
0.46777	0.60257	0.63803	0.66112	0.6766
0.6913	0.70261	0.71315	0.72292	0.73191

0.74012	0.74755	0.75451	0.761	0.76701
0.77255	0.77762	0.78255	0.78734	0.79201
0.79653	0.80092	0.80518	0.8093	0.81329
0.81714	0.82085	0.82443	0.82788	0.83119
0.83437	0.83741	0.84041	0.84337	0.84629
0.84917	0.85201	0.85481	0.85757	0.86029
0.86297	0.8656	0.8682	0.87076	0.87327
0.87575	0.87819	0.88058	0.88294	0.88525
0.88753	0.88976	0.89195	0.89411	0.89622
0.89829	0.90032	0.90231	0.90427	0.90618
0.90805	0.90988	0.9117	0.91351	0.91531
0.9171	0.91888	0.92065	0.92241	0.92415
0.92589	0.92762	0.92934	0.93105	0.93275
0.93444	0.93612	0.93779	0.93944	0.94109
0.94273	0.94436	0.94598	0.94759	0.94918
0.95077	0.95235	0.95392	0.95547	0.95702
0.95856	0.96009	0.9616	0.96311	0.96461
0.96609	0.96757	0.96904	0.97049	0.97194
0.97338	0.9748	0.97622	0.97763	0.97902
0.98041	0.98178	0.98315	0.98451	0.98585
0.98719	0.98851	0.98983	0.99113	0.99243
0.99371	0.99499	0.99625	0.99751	0.99875
1				

EW-3 CUMULATIVE RAINFALL TABLES

10_yr_sm 0.1 hr increment

0	0.00212	0.00422	0.00633	0.00845
0.01058	0.01272	0.01486	0.01701	0.01918
0.02135	0.02352	0.02571	0.02791	0.03011
0.03232	0.03455	0.03678	0.03901	0.04126
0.04352	0.04578	0.04805	0.05034	0.05263
0.05492	0.05723	0.05955	0.06187	0.0642
0.06654	0.06889	0.07125	0.07362	0.07599
0.07838	0.08077	0.08317	0.08558	0.088
0.09043	0.09286	0.09531	0.09776	0.10022
0.10269	0.10517	0.10765	0.11015	0.11265
0.11517	0.11769	0.12022	0.12275	0.1253
0.12785	0.13042	0.13299	0.13557	0.13816
0.14076	0.14339	0.14606	0.14876	0.15149
0.15426	0.15706	0.1599	0.16277	0.16568
0.16862	0.17159	0.1746	0.17764	0.18072
0.18383	0.18698	0.19016	0.19337	0.19662
0.1999	0.20322	0.20657	0.20995	0.21337
0.21683	0.22031	0.22383	0.22739	0.23098
0.2346	0.23833	0.24215	0.24606	0.25008
0.25419	0.2584	0.2627	0.26711	0.27161
0.27621	0.28091	0.2857	0.29059	0.29558
0.30067	0.30606	0.31175	0.31774	0.32403
0.33062	0.33761	0.34499	0.35276	0.36092
0.36944	0.37938	0.38984	0.40562	0.43
0.47814	0.57	0.59438	0.61016	0.62062
0.63056	0.63908	0.64724	0.65501	0.66239
0.66938	0.67597	0.68226	0.68825	0.69394
0.69933	0.70442	0.70941	0.7143	0.71909
0.72379	0.72839	0.73289	0.7373	0.7416
0.74581	0.74992	0.75394	0.75785	0.76167
0.7654	0.76902	0.77261	0.77617	0.77969
0.78317	0.78663	0.79005	0.79343	0.79678
0.8001	0.80338	0.80663	0.80984	0.81302
0.81617	0.81928	0.82236	0.8254	0.82841
0.83138	0.83432	0.83723	0.8401	0.84294
0.84574	0.84851	0.85124	0.85394	0.85661
0.85924	0.86184	0.86443	0.86701	0.86958
0.87215	0.8747	0.87725	0.87978	0.88231
0.88484	0.88735	0.88985	0.89235	0.89483
0.89731	0.89978	0.90224	0.90469	0.90714
0.90957	0.912	0.91442	0.91683	0.91923
0.92162	0.92401	0.92638	0.92875	0.93111
0.93346	0.9358	0.93813	0.94045	0.94277
0.94508	0.94737	0.94966	0.95195	0.95422
0.95648	0.95874	0.96099	0.96322	0.96545
0.96768	0.96989	0.97209	0.97429	0.97648

0.97865	0.98082	0.98299	0.98514	0.98728
0.98942	0.99155	0.99367	0.99578	0.99788
1				

25_yr_sm 0.1 hr increment

0	0.00188	0.00376	0.00565	0.00754
0.00945	0.01137	0.0133	0.01523	0.01718
0.01913	0.02109	0.02307	0.02505	0.02704
0.02904	0.03105	0.03306	0.03509	0.03713
0.03917	0.04123	0.04329	0.04537	0.04745
0.04954	0.05164	0.05375	0.05587	0.058
0.06014	0.06228	0.06444	0.06661	0.06878
0.07096	0.07316	0.07536	0.07757	0.07979
0.08202	0.08426	0.0865	0.08876	0.09103
0.0933	0.09559	0.09788	0.10018	0.1025
0.10482	0.10715	0.10949	0.11184	0.11419
0.11656	0.11894	0.12132	0.12372	0.12612
0.12854	0.13099	0.13347	0.136	0.13856
0.14115	0.14379	0.14646	0.14916	0.15191
0.15469	0.1575	0.16036	0.16325	0.16618
0.16914	0.17214	0.17518	0.17825	0.18136
0.18451	0.1877	0.19092	0.19418	0.19747
0.2008	0.20417	0.20757	0.21102	0.21449
0.21801	0.22163	0.22536	0.2292	0.23315
0.23721	0.24138	0.24565	0.25003	0.25452
0.25912	0.26383	0.26864	0.27356	0.2786
0.28374	0.28922	0.29505	0.30123	0.30775
0.31461	0.32196	0.32978	0.33808	0.34685
0.35611	0.3671	0.37868	0.39607	0.42288
0.47587	0.57712	0.60393	0.62132	0.6329
0.64389	0.65315	0.66192	0.67022	0.67804
0.68539	0.69225	0.69877	0.70495	0.71078
0.71626	0.7214	0.72644	0.73136	0.73617
0.74088	0.74548	0.74997	0.75435	0.75862
0.76279	0.76685	0.7708	0.77464	0.77837
0.78199	0.78551	0.78898	0.79243	0.79583
0.7992	0.80253	0.80582	0.80908	0.8123
0.81549	0.81864	0.82175	0.82482	0.82786
0.83086	0.83382	0.83675	0.83964	0.8425
0.84531	0.84809	0.85084	0.85354	0.85621
0.85885	0.86144	0.864	0.86653	0.86901
0.87146	0.87388	0.87628	0.87868	0.88106
0.88344	0.88581	0.88816	0.89051	0.89285
0.89518	0.8975	0.89982	0.90212	0.90441
0.9067	0.90897	0.91124	0.9135	0.91574
0.91798	0.92021	0.92243	0.92464	0.92684
0.92904	0.93122	0.93339	0.93556	0.93772

0.93986	0.942	0.94413	0.94625	0.94836
0.95046	0.95255	0.95463	0.95671	0.95877
0.96083	0.96287	0.96491	0.96694	0.96895
0.97096	0.97296	0.97495	0.97693	0.97891
0.98087	0.98282	0.98477	0.9867	0.98863
0.99055	0.99246	0.99435	0.99624	0.99812
1				

50_yr_sm 0.1 hr increment

0	0.00172	0.00343	0.00514	0.00687
0.00861	0.01036	0.01212	0.01388	0.01566
0.01745	0.01924	0.02105	0.02286	0.02468
0.02652	0.02836	0.03021	0.03207	0.03395
0.03583	0.03772	0.03962	0.04153	0.04345
0.04537	0.04731	0.04926	0.05122	0.05318
0.05516	0.05714	0.05914	0.06114	0.06316
0.06518	0.06721	0.06926	0.07131	0.07337
0.07544	0.07752	0.07961	0.08171	0.08382
0.08594	0.08807	0.09021	0.09235	0.09451
0.09668	0.09885	0.10104	0.10323	0.10544
0.10765	0.10987	0.11211	0.11435	0.1166
0.11886	0.12116	0.1235	0.12587	0.12829
0.13074	0.13323	0.13576	0.13832	0.14093
0.14357	0.14625	0.14897	0.15172	0.15452
0.15735	0.16022	0.16313	0.16607	0.16906
0.17208	0.17514	0.17824	0.18137	0.18455
0.18776	0.19101	0.1943	0.19762	0.20099
0.20439	0.20791	0.21154	0.21529	0.21916
0.22314	0.22724	0.23145	0.23578	0.24022
0.24478	0.24946	0.25425	0.25916	0.26418
0.26932	0.27483	0.28073	0.287	0.29365
0.30068	0.30825	0.31638	0.32505	0.33427
0.34402	0.35592	0.36845	0.38725	0.41623
0.47369	0.58377	0.61275	0.63155	0.64408
0.65598	0.66573	0.67495	0.68362	0.69175
0.69932	0.70635	0.713	0.71927	0.72517
0.73068	0.73582	0.74084	0.74575	0.75054
0.75522	0.75978	0.76422	0.76855	0.77276
0.77686	0.78084	0.78471	0.78846	0.79209
0.79561	0.79901	0.80238	0.8057	0.80899
0.81224	0.81545	0.81863	0.82176	0.82486
0.82792	0.83094	0.83393	0.83687	0.83978
0.84265	0.84548	0.84828	0.85103	0.85375
0.85643	0.85907	0.86168	0.86424	0.86677
0.86926	0.87171	0.87413	0.8765	0.87884
0.88114	0.8834	0.88565	0.88789	0.89013
0.89235	0.89456	0.89677	0.89896	0.90115

0.90332	0.90549	0.90765	0.90979	0.91193
0.91406	0.91618	0.91829	0.92039	0.92248
0.92456	0.92663	0.92869	0.93074	0.93279
0.93482	0.93684	0.93886	0.94086	0.94286
0.94484	0.94682	0.94878	0.95074	0.95269
0.95463	0.95655	0.95847	0.96038	0.96228
0.96417	0.96605	0.96793	0.96979	0.97164
0.97348	0.97532	0.97714	0.97895	0.98076
0.98255	0.98434	0.98612	0.98788	0.98964
0.99139	0.99313	0.99486	0.99657	0.99828
1				

100_yr_sm 0.1 hr increment

0	0.00153	0.00305	0.00459	0.00613
0.00768	0.00924	0.01081	0.01239	0.01398
0.01558	0.01719	0.01881	0.02044	0.02208
0.02372	0.02538	0.02705	0.02873	0.03042
0.03212	0.03382	0.03554	0.03727	0.03901
0.04075	0.04251	0.04428	0.04605	0.04784
0.04963	0.05144	0.05326	0.05508	0.05692
0.05876	0.06062	0.06248	0.06436	0.06624
0.06813	0.07004	0.07195	0.07388	0.07581
0.07775	0.0797	0.08167	0.08364	0.08562
0.08761	0.08962	0.09163	0.09365	0.09568
0.09772	0.09977	0.10183	0.10391	0.10599
0.10808	0.11021	0.11237	0.11458	0.11683
0.11912	0.12144	0.12381	0.12621	0.12866
0.13114	0.13366	0.13622	0.13882	0.14146
0.14414	0.14686	0.14962	0.15241	0.15525
0.15812	0.16104	0.16399	0.16698	0.17002
0.17309	0.1762	0.17935	0.18254	0.18577
0.18903	0.19242	0.19594	0.19958	0.20334
0.20723	0.21124	0.21537	0.21963	0.22402
0.22852	0.23315	0.23791	0.24278	0.24779
0.25291	0.25845	0.26441	0.27079	0.27758
0.28479	0.29263	0.3011	0.31021	0.31996
0.33031	0.3433	0.35698	0.37745	0.40896
0.47142	0.59104	0.62255	0.64302	0.6567
0.66969	0.68004	0.68979	0.6989	0.70737
0.71521	0.72242	0.72921	0.73559	0.74155
0.74709	0.75221	0.75722	0.76209	0.76685
0.77148	0.77598	0.78037	0.78463	0.78876
0.79277	0.79666	0.80042	0.80406	0.80758
0.81097	0.81423	0.81746	0.82065	0.8238
0.82691	0.82998	0.83302	0.83601	0.83896
0.84188	0.84475	0.84759	0.85038	0.85314
0.85586	0.85854	0.86118	0.86378	0.86634

0.86886	0.87134	0.87379	0.87619	0.87856
0.88088	0.88317	0.88542	0.88763	0.88979
0.89192	0.89401	0.89609	0.89817	0.90023
0.90228	0.90432	0.90635	0.90837	0.91038
0.91239	0.91438	0.91636	0.91833	0.9203
0.92225	0.92419	0.92612	0.92805	0.92996
0.93187	0.93376	0.93564	0.93752	0.93938
0.94124	0.94308	0.94492	0.94674	0.94856
0.95037	0.95216	0.95395	0.95572	0.95749
0.95925	0.96099	0.96273	0.96446	0.96618
0.96788	0.96958	0.97127	0.97295	0.97462
0.97628	0.97792	0.97956	0.98119	0.98281
0.98442	0.98602	0.98761	0.98919	0.99076
0.99232	0.99387	0.99541	0.99695	0.99847
1				

200_yr_sm 0.1 hr increment

0	0.00133	0.00264	0.00397	0.0053
0.00665	0.00801	0.00937	0.01075	0.01213
0.01353	0.01493	0.01635	0.01777	0.01921
0.02065	0.02211	0.02357	0.02505	0.02653
0.02803	0.02954	0.03105	0.03258	0.03411
0.03566	0.03721	0.03878	0.04035	0.04194
0.04353	0.04514	0.04676	0.04838	0.05002
0.05166	0.05332	0.05498	0.05666	0.05834
0.06004	0.06175	0.06346	0.06519	0.06692
0.06867	0.07042	0.07219	0.07396	0.07575
0.07755	0.07935	0.08117	0.08299	0.08483
0.08667	0.08853	0.0904	0.09227	0.09416
0.09605	0.09799	0.09996	0.10198	0.10404
0.10613	0.10827	0.11044	0.11266	0.11492
0.11721	0.11955	0.12192	0.12434	0.1268
0.12929	0.13183	0.13441	0.13702	0.13968
0.14237	0.14511	0.14789	0.1507	0.15356
0.15646	0.15939	0.16237	0.16539	0.16844
0.17154	0.17477	0.17813	0.18162	0.18525
0.189	0.19289	0.19691	0.20107	0.20535
0.20977	0.21432	0.219	0.22381	0.22876
0.23383	0.23937	0.24536	0.25181	0.25873
0.2661	0.2742	0.28304	0.29262	0.30293
0.31395	0.32819	0.34318	0.36561	0.40011
0.46858	0.59989	0.63439	0.65682	0.67181
0.68605	0.69707	0.70738	0.71696	0.7258
0.7339	0.74127	0.74819	0.75464	0.76063
0.76617	0.77124	0.77619	0.781	0.78568
0.79023	0.79465	0.79893	0.80309	0.80711
0.811	0.81475	0.81838	0.82187	0.82523

0.82846	0.83156	0.83461	0.83763	0.84061
0.84354	0.84644	0.8493	0.85211	0.85489
0.85763	0.86032	0.86298	0.86559	0.86817
0.87071	0.8732	0.87566	0.87808	0.88045
0.88279	0.88508	0.88734	0.88956	0.89173
0.89387	0.89596	0.89802	0.90004	0.90201
0.90395	0.90584	0.90773	0.9096	0.91147
0.91333	0.91517	0.91701	0.91883	0.92065
0.92245	0.92425	0.92604	0.92781	0.92958
0.93133	0.93308	0.93481	0.93654	0.93825
0.93996	0.94166	0.94334	0.94502	0.94668
0.94834	0.94998	0.95162	0.95324	0.95486
0.95647	0.95806	0.95965	0.96122	0.96279
0.96434	0.96589	0.96742	0.96895	0.97046
0.97197	0.97347	0.97495	0.97643	0.97789
0.97935	0.98079	0.98223	0.98365	0.98507
0.98647	0.98787	0.98925	0.99063	0.99199
0.99335	0.9947	0.99603	0.99736	0.99867
1				

500_yr_sm 0.1 hr increment

0	0.000994	0.00199	0.003	0.00402
0.00505	0.00609	0.00714	0.0082	0.00927
0.01035	0.01144	0.01254	0.01365	0.01477
0.0159	0.01704	0.0182	0.01936	0.02053
0.02171	0.0229	0.0241	0.02532	0.02654
0.02777	0.02901	0.03027	0.03153	0.0328
0.03408	0.03538	0.03668	0.03799	0.03932
0.04065	0.04199	0.04335	0.04471	0.04609
0.04747	0.04887	0.05027	0.05169	0.05311
0.05455	0.05599	0.05745	0.05891	0.06039
0.06187	0.06337	0.06488	0.06639	0.06792
0.06945	0.071	0.07256	0.07412	0.0757
0.07729	0.07892	0.08059	0.08229	0.08404
0.08583	0.08766	0.08954	0.09145	0.0934
0.09539	0.09743	0.0995	0.10161	0.10377
0.10596	0.1082	0.11048	0.1128	0.11515
0.11755	0.11999	0.12247	0.12499	0.12755
0.13015	0.13279	0.13548	0.1382	0.14096
0.14377	0.14672	0.14981	0.15304	0.15642
0.15995	0.16361	0.16743	0.17138	0.17548
0.17972	0.18411	0.18864	0.19332	0.19814
0.2031	0.20859	0.21461	0.22115	0.22822
0.23582	0.24434	0.25378	0.26414	0.27541
0.2876	0.30399	0.32124	0.34694	0.38637
0.4644	0.61363	0.65306	0.67876	0.69601
0.7124	0.72459	0.73586	0.74622	0.75566

0.76418	0.77178	0.77885	0.78539	0.79141
0.7969	0.80186	0.80668	0.81136	0.81589
0.82028	0.82452	0.82862	0.83257	0.83639
0.84005	0.84358	0.84696	0.85019	0.85328
0.85623	0.85904	0.8618	0.86452	0.86721
0.86985	0.87245	0.87501	0.87753	0.88001
0.88245	0.88485	0.8872	0.88952	0.8918
0.89404	0.89623	0.89839	0.9005	0.90257
0.90461	0.9066	0.90855	0.91046	0.91234
0.91417	0.91596	0.91771	0.91941	0.92108
0.92271	0.9243	0.92588	0.92744	0.929
0.93055	0.93208	0.93361	0.93512	0.93663
0.93813	0.93961	0.94109	0.94255	0.94401
0.94545	0.94689	0.94831	0.94973	0.95113
0.95253	0.95391	0.95529	0.95665	0.95801
0.95935	0.96068	0.96201	0.96332	0.96462
0.96592	0.9672	0.96847	0.96973	0.97099
0.97223	0.97346	0.97468	0.9759	0.9771
0.97829	0.97947	0.98064	0.9818	0.98296
0.9841	0.98523	0.98635	0.98746	0.98856
0.98965	0.99073	0.9918	0.99286	0.99391
0.99495	0.99598	0.997	0.99801	0.999006
1				

EW-4 CUMULATIVE RAINFALL TABLES

10_yr_sm 0.1 hr increment

0	0.00215	0.00431	0.00648	0.00865
0.01083	0.01303	0.01523	0.01743	0.01965
0.02188	0.02411	0.02635	0.0286	0.03086
0.03313	0.03541	0.03769	0.03998	0.04228
0.04459	0.04691	0.04924	0.05157	0.05392
0.05627	0.05863	0.061	0.06337	0.06576
0.06815	0.07055	0.07296	0.07538	0.07781
0.08025	0.08269	0.08514	0.0876	0.09007
0.09255	0.09504	0.09753	0.10004	0.10255
0.10507	0.1076	0.11013	0.11268	0.11523
0.11779	0.12036	0.12294	0.12553	0.12813
0.13073	0.13334	0.13596	0.13859	0.14123
0.14388	0.14656	0.14927	0.15202	0.1548
0.15761	0.16046	0.16334	0.16626	0.16921
0.17219	0.17521	0.17826	0.18134	0.18446
0.18761	0.1908	0.19402	0.19727	0.20056
0.20388	0.20723	0.21062	0.21404	0.21749
0.22098	0.2245	0.22806	0.23165	0.23527
0.23893	0.24268	0.24652	0.25046	0.2545
0.25863	0.26286	0.26718	0.27159	0.2761
0.2807	0.2854	0.2902	0.29508	0.30007
0.30515	0.31051	0.31617	0.32212	0.32836
0.33489	0.34179	0.34907	0.35671	0.36473
0.37312	0.38274	0.39288	0.40818	0.43184
0.47865	0.56816	0.59182	0.60712	0.61726
0.62688	0.63527	0.64329	0.65093	0.65821
0.66511	0.67164	0.67788	0.68383	0.68949
0.69485	0.69993	0.70492	0.7098	0.7146
0.7193	0.7239	0.72841	0.73282	0.73714
0.74137	0.7455	0.74954	0.75348	0.75732
0.76107	0.76473	0.76835	0.77194	0.7755
0.77902	0.78251	0.78596	0.78938	0.79277
0.79612	0.79944	0.80273	0.80598	0.8092
0.81239	0.81554	0.81866	0.82174	0.82479
0.82781	0.83079	0.83374	0.83666	0.83954
0.84239	0.8452	0.84798	0.85073	0.85344
0.85612	0.85877	0.86141	0.86404	0.86666
0.86927	0.87187	0.87447	0.87706	0.87964
0.88221	0.88477	0.88732	0.88987	0.8924
0.89493	0.89745	0.89996	0.90247	0.90496
0.90745	0.90993	0.9124	0.91486	0.91731
0.91975	0.92219	0.92462	0.92704	0.92945
0.93185	0.93424	0.93663	0.939	0.94137
0.94373	0.94608	0.94843	0.95076	0.95309
0.95541	0.95772	0.96002	0.96231	0.96459
0.96687	0.96914	0.9714	0.97365	0.97589

0.97812	0.98035	0.98257	0.98477	0.98697
0.98917	0.99135	0.99352	0.99569	0.99785
1				

25_yr_sm	0.1 hr increment			
0	0.00196	0.00392	0.00588	0.00786
0.00984	0.01184	0.01384	0.01585	0.01787
0.0199	0.02194	0.02399	0.02604	0.02811
0.03018	0.03226	0.03435	0.03646	0.03857
0.04068	0.04281	0.04495	0.04709	0.04925
0.05141	0.05358	0.05577	0.05796	0.06016
0.06236	0.06458	0.06681	0.06904	0.07129
0.07354	0.0758	0.07807	0.08036	0.08264
0.08494	0.08725	0.08957	0.09189	0.09422
0.09657	0.09892	0.10128	0.10365	0.10603
0.10842	0.11081	0.11322	0.11563	0.11806
0.12049	0.12293	0.12538	0.12784	0.13031
0.13279	0.1353	0.13785	0.14043	0.14305
0.14571	0.1484	0.15113	0.1539	0.1567
0.15953	0.1624	0.16531	0.16826	0.17124
0.17425	0.1773	0.18039	0.18351	0.18667
0.18987	0.1931	0.19636	0.19967	0.203
0.20638	0.20979	0.21323	0.21671	0.22023
0.22379	0.22744	0.2312	0.23507	0.23904
0.24312	0.24729	0.25158	0.25597	0.26046
0.26505	0.26975	0.27456	0.27947	0.28448
0.2896	0.29504	0.30082	0.30692	0.31335
0.32011	0.32732	0.33498	0.34308	0.35164
0.36062	0.37125	0.38243	0.39925	0.42518
0.47654	0.57482	0.60075	0.61757	0.62875
0.63937	0.64836	0.65692	0.66502	0.67268
0.67989	0.68665	0.69308	0.69918	0.70496
0.7104	0.71552	0.72053	0.72544	0.73025
0.73495	0.73954	0.74403	0.74842	0.75271
0.75688	0.76096	0.76493	0.7688	0.77256
0.77621	0.77977	0.78329	0.78677	0.79021
0.79362	0.797	0.80033	0.80364	0.8069
0.81013	0.81333	0.81649	0.81961	0.8227
0.82575	0.82876	0.83174	0.83469	0.8376
0.84047	0.8433	0.8461	0.84887	0.8516
0.85429	0.85695	0.85957	0.86215	0.8647
0.86721	0.86969	0.87216	0.87462	0.87707
0.87951	0.88194	0.88437	0.88678	0.88919
0.89158	0.89397	0.89635	0.89872	0.90108
0.90343	0.90578	0.90811	0.91043	0.91275
0.91506	0.91736	0.91965	0.92193	0.9242
0.92646	0.92871	0.93096	0.93319	0.93542

0.93764	0.93984	0.94204	0.94423	0.94642
0.94859	0.95075	0.95291	0.95505	0.95719
0.95932	0.96143	0.96354	0.96565	0.96774
0.96982	0.97189	0.97396	0.97601	0.97806
0.9801	0.98213	0.98415	0.98616	0.98816
0.99016	0.99214	0.99412	0.99608	0.99804
1				

50_yr_sm 0.1 hr increment

0	0.00179	0.00356	0.00535	0.00714
0.00894	0.01075	0.01258	0.01441	0.01625
0.0181	0.01996	0.02182	0.0237	0.02559
0.02749	0.02939	0.03131	0.03323	0.03517
0.03711	0.03906	0.04103	0.043	0.04498
0.04697	0.04897	0.05098	0.053	0.05503
0.05706	0.05911	0.06117	0.06323	0.06531
0.06739	0.06949	0.07159	0.07371	0.07583
0.07796	0.0801	0.08225	0.08441	0.08658
0.08876	0.09095	0.09315	0.09535	0.09757
0.09979	0.10203	0.10427	0.10653	0.10879
0.11106	0.11335	0.11564	0.11794	0.12025
0.12257	0.12493	0.12732	0.12975	0.13222
0.13473	0.13728	0.13986	0.14248	0.14514
0.14784	0.15057	0.15334	0.15615	0.15899
0.16188	0.1648	0.16776	0.17076	0.17379
0.17686	0.17997	0.18312	0.1863	0.18953
0.19279	0.19608	0.19942	0.20279	0.2062
0.20965	0.21321	0.21689	0.22067	0.22457
0.22859	0.23271	0.23695	0.24131	0.24577
0.25035	0.25504	0.25985	0.26477	0.2698
0.27494	0.28045	0.28633	0.29257	0.29918
0.30616	0.31366	0.32169	0.33024	0.33932
0.3489	0.36054	0.37279	0.39112	0.41927
0.47482	0.58073	0.60888	0.62721	0.63946
0.6511	0.66068	0.66976	0.67831	0.68634
0.69384	0.70082	0.70743	0.71367	0.71955
0.72506	0.7302	0.73523	0.74015	0.74496
0.74965	0.75423	0.75869	0.76305	0.76729
0.77141	0.77543	0.77933	0.78311	0.78679
0.79035	0.7938	0.79721	0.80058	0.80392
0.80721	0.81047	0.8137	0.81688	0.82003
0.82314	0.82621	0.82924	0.83224	0.8352
0.83812	0.84101	0.84385	0.84666	0.84943
0.85216	0.85486	0.85752	0.86014	0.86272
0.86527	0.86778	0.87025	0.87268	0.87507
0.87743	0.87975	0.88206	0.88436	0.88665
0.88894	0.89121	0.89347	0.89573	0.89797

0.90021	0.90243	0.90465	0.90685	0.90905
0.91124	0.91342	0.91559	0.91775	0.9199
0.92204	0.92417	0.92629	0.92841	0.93051
0.93261	0.93469	0.93677	0.93883	0.94089
0.94294	0.94497	0.947	0.94902	0.95103
0.95303	0.95502	0.957	0.95897	0.96094
0.96289	0.96483	0.96677	0.96869	0.97061
0.97251	0.97441	0.9763	0.97818	0.98004
0.9819	0.98375	0.98559	0.98742	0.98925
0.99106	0.99286	0.99465	0.99644	0.99821
1				

100_yr_sm 0.1 hr increment

0	0.00162	0.00322	0.00483	0.00645
0.00808	0.00972	0.01137	0.01303	0.0147
0.01638	0.01807	0.01977	0.02147	0.02319
0.02492	0.02665	0.0284	0.03016	0.03192
0.0337	0.03548	0.03728	0.03908	0.0409
0.04272	0.04455	0.0464	0.04825	0.05011
0.05198	0.05387	0.05576	0.05766	0.05957
0.06149	0.06342	0.06536	0.06731	0.06927
0.07124	0.07322	0.0752	0.0772	0.07921
0.08123	0.08326	0.08529	0.08734	0.08939
0.09146	0.09354	0.09562	0.09772	0.09982
0.10194	0.10406	0.10619	0.10834	0.11049
0.11265	0.11485	0.11709	0.11937	0.12169
0.12405	0.12644	0.12888	0.13135	0.13386
0.13641	0.139	0.14163	0.14429	0.147
0.14974	0.15252	0.15534	0.1582	0.1611
0.16404	0.16702	0.17003	0.17309	0.17618
0.17931	0.18248	0.18569	0.18894	0.19222
0.19555	0.19899	0.20256	0.20624	0.21005
0.21398	0.21803	0.22219	0.22648	0.23089
0.23542	0.24007	0.24484	0.24973	0.25474
0.25988	0.26541	0.27134	0.27767	0.28441
0.29154	0.29928	0.30761	0.31655	0.32608
0.33619	0.34879	0.36205	0.38188	0.41234
0.47257	0.58766	0.61812	0.63795	0.65121
0.66381	0.67392	0.68345	0.69239	0.70072
0.70846	0.71559	0.72233	0.72866	0.73459
0.74012	0.74526	0.75027	0.75516	0.75993
0.76458	0.76911	0.77352	0.77781	0.78197
0.78602	0.78995	0.79376	0.79744	0.80101
0.80445	0.80778	0.81106	0.81431	0.81752
0.82069	0.82382	0.82691	0.82997	0.83298
0.83596	0.8389	0.8418	0.84466	0.84748
0.85026	0.853	0.85571	0.85837	0.861

0.86359	0.86614	0.86865	0.87112	0.87356
0.87595	0.87831	0.88063	0.88291	0.88515
0.88735	0.88951	0.89166	0.89381	0.89594
0.89806	0.90018	0.90228	0.90438	0.90646
0.90854	0.91061	0.91266	0.91471	0.91674
0.91877	0.92079	0.9228	0.9248	0.92678
0.92876	0.93073	0.93269	0.93464	0.93658
0.93851	0.94043	0.94234	0.94424	0.94613
0.94802	0.94989	0.95175	0.9536	0.95545
0.95728	0.9591	0.96092	0.96272	0.96452
0.9663	0.96808	0.96984	0.9716	0.97335
0.97508	0.97681	0.97853	0.98023	0.98193
0.98362	0.9853	0.98697	0.98863	0.99028
0.99192	0.99355	0.99517	0.99678	0.99838
1				

200_yr_sm 0.1 hr increment

0	0.00137	0.00274	0.00413	0.00553
0.00693	0.00835	0.00977	0.01121	0.01266
0.01411	0.01558	0.01705	0.01854	0.02004
0.02154	0.02306	0.02459	0.02612	0.02767
0.02922	0.03079	0.03237	0.03395	0.03555
0.03716	0.03878	0.0404	0.04204	0.04369
0.04534	0.04701	0.04869	0.05038	0.05207
0.05378	0.0555	0.05723	0.05896	0.06071
0.06247	0.06424	0.06601	0.0678	0.0696
0.07141	0.07323	0.07505	0.07689	0.07874
0.0806	0.08247	0.08435	0.08623	0.08813
0.09004	0.09196	0.09389	0.09583	0.09778
0.09973	0.10173	0.10377	0.10585	0.10797
0.11013	0.11233	0.11457	0.11685	0.11917
0.12153	0.12394	0.12638	0.12886	0.13138
0.13394	0.13655	0.13919	0.14187	0.14459
0.14736	0.15016	0.153	0.15589	0.15881
0.16178	0.16478	0.16783	0.17091	0.17404
0.1772	0.1805	0.18392	0.18748	0.19117
0.19499	0.19894	0.20302	0.20723	0.21157
0.21604	0.22064	0.22537	0.23024	0.23523
0.24036	0.24593	0.25195	0.25842	0.26534
0.27271	0.28078	0.28957	0.29906	0.30927
0.32018	0.33404	0.34863	0.3704	0.40381
0.4699	0.59619	0.6296	0.65137	0.66596
0.67982	0.69073	0.70094	0.71043	0.71922
0.72729	0.73466	0.74158	0.74805	0.75407
0.75964	0.76477	0.76976	0.77463	0.77936
0.78396	0.78843	0.79277	0.79698	0.80106
0.80501	0.80883	0.81252	0.81608	0.8195

0.8228	0.82596	0.82909	0.83217	0.83522
0.83822	0.84119	0.84411	0.847	0.84984
0.85264	0.85541	0.85813	0.86081	0.86345
0.86606	0.86862	0.87114	0.87362	0.87606
0.87847	0.88083	0.88315	0.88543	0.88767
0.88987	0.89203	0.89415	0.89623	0.89827
0.90027	0.90222	0.90417	0.90611	0.90804
0.90996	0.91187	0.91377	0.91565	0.91753
0.9194	0.92126	0.92311	0.92495	0.92677
0.92859	0.9304	0.9322	0.93399	0.93576
0.93753	0.93929	0.94104	0.94277	0.9445
0.94622	0.94793	0.94962	0.95131	0.95299
0.95466	0.95631	0.95796	0.9596	0.96122
0.96284	0.96445	0.96605	0.96763	0.96921
0.97078	0.97233	0.97388	0.97541	0.97694
0.97846	0.97996	0.98146	0.98295	0.98442
0.98589	0.98734	0.98879	0.99023	0.99165
0.99307	0.99447	0.99587	0.99726	0.99863
1				

500_yr_sm 0.1 hr increment

0	0.00111	0.00221	0.00332	0.00444
0.00557	0.00671	0.00785	0.00901	0.01018
0.01136	0.01255	0.01375	0.01496	0.01619
0.01742	0.01866	0.01991	0.02117	0.02244
0.02372	0.02501	0.02631	0.02762	0.02894
0.03028	0.03162	0.03297	0.03433	0.0357
0.03709	0.03848	0.03988	0.04129	0.04272
0.04415	0.04559	0.04704	0.04851	0.04998
0.05146	0.05296	0.05446	0.05597	0.0575
0.05903	0.06057	0.06213	0.06369	0.06527
0.06685	0.06844	0.07005	0.07166	0.07329
0.07492	0.07657	0.07822	0.07989	0.08156
0.08325	0.08497	0.08674	0.08855	0.09039
0.09228	0.09421	0.09618	0.09819	0.10024
0.10233	0.10446	0.10663	0.10884	0.11109
0.11338	0.11571	0.11809	0.1205	0.12295
0.12545	0.12798	0.13056	0.13317	0.13583
0.13852	0.14126	0.14404	0.14685	0.14971
0.15261	0.15565	0.15883	0.16215	0.1656
0.1692	0.17294	0.17682	0.18084	0.185
0.1893	0.19374	0.19832	0.20304	0.2079
0.2129	0.21841	0.22442	0.23093	0.23795
0.24548	0.25386	0.26311	0.27321	0.28418
0.29598	0.31171	0.32827	0.35295	0.39081
0.46578	0.60919	0.64705	0.67173	0.68829
0.70402	0.71582	0.72679	0.73689	0.74614

0.75452	0.76205	0.76907	0.77558	0.78159
0.7871	0.7921	0.79696	0.80168	0.80626
0.8107	0.815	0.81916	0.82318	0.82706
0.8308	0.8344	0.83785	0.84117	0.84435
0.84739	0.85029	0.85315	0.85596	0.85874
0.86148	0.86417	0.86683	0.86944	0.87202
0.87455	0.87705	0.8795	0.88191	0.88429
0.88662	0.88891	0.89116	0.89337	0.89554
0.89767	0.89976	0.90181	0.90382	0.90579
0.90772	0.90961	0.91145	0.91326	0.91503
0.91675	0.91844	0.92011	0.92178	0.92343
0.92508	0.92671	0.92834	0.92995	0.93156
0.93315	0.93473	0.93631	0.93787	0.93943
0.94097	0.9425	0.94403	0.94554	0.94704
0.94854	0.95002	0.95149	0.95296	0.95441
0.95585	0.95728	0.95871	0.96012	0.96152
0.96291	0.9643	0.96567	0.96703	0.96838
0.96972	0.97106	0.97238	0.97369	0.97499
0.97628	0.97756	0.97883	0.98009	0.98134
0.98258	0.98381	0.98504	0.98625	0.98745
0.98864	0.98982	0.99099	0.99215	0.99329
0.99443	0.99556	0.99668	0.99779	0.99889
1				

EW-5 CUMULATIVE RAINFALL TABLES

10_yr_sm 0.1 hr increment

0	0.00207	0.00412	0.00618	0.00825
0.01033	0.01242	0.01451	0.01662	0.01873
0.02085	0.02298	0.02512	0.02727	0.02943
0.03159	0.03377	0.03595	0.03814	0.04034
0.04255	0.04477	0.047	0.04923	0.05147
0.05373	0.05599	0.05826	0.06054	0.06282
0.06512	0.06742	0.06974	0.07206	0.07439
0.07673	0.07908	0.08143	0.0838	0.08617
0.08856	0.09095	0.09335	0.09576	0.09817
0.1006	0.10303	0.10548	0.10793	0.11039
0.11286	0.11534	0.11783	0.12032	0.12283
0.12534	0.12786	0.13039	0.13293	0.13548
0.13804	0.14063	0.14325	0.14591	0.14861
0.15134	0.15411	0.15691	0.15974	0.16261
0.16551	0.16845	0.17143	0.17444	0.17748
0.18056	0.18367	0.18682	0.19	0.19322
0.19647	0.19976	0.20308	0.20643	0.20982
0.21325	0.21671	0.22021	0.22374	0.2273
0.2309	0.2346	0.2384	0.2423	0.2463
0.2504	0.2546	0.25889	0.26329	0.26779
0.27239	0.27709	0.28189	0.28678	0.29178
0.29688	0.30229	0.30801	0.31404	0.32038
0.32704	0.3341	0.34156	0.34944	0.35772
0.36639	0.37652	0.38719	0.40332	0.42825
0.47755	0.57175	0.59668	0.61281	0.62348
0.63361	0.64228	0.65056	0.65844	0.6659
0.67296	0.67962	0.68596	0.69199	0.69771
0.70312	0.70822	0.71322	0.71811	0.72291
0.72761	0.73221	0.73671	0.74111	0.7454
0.7496	0.7537	0.7577	0.7616	0.7654
0.7691	0.7727	0.77626	0.77979	0.78329
0.78675	0.79018	0.79357	0.79692	0.80024
0.80353	0.80678	0.81	0.81318	0.81633
0.81944	0.82252	0.82556	0.82857	0.83155
0.83449	0.83739	0.84026	0.84309	0.84589
0.84866	0.85139	0.85409	0.85675	0.85937
0.86196	0.86452	0.86707	0.86961	0.87214
0.87466	0.87717	0.87968	0.88217	0.88466
0.88714	0.88961	0.89207	0.89452	0.89697
0.8994	0.90183	0.90424	0.90665	0.90905
0.91144	0.91383	0.9162	0.91857	0.92092
0.92327	0.92561	0.92794	0.93026	0.93258
0.93488	0.93718	0.93946	0.94174	0.94401
0.94627	0.94853	0.95077	0.953	0.95523
0.95745	0.95966	0.96186	0.96405	0.96623
0.96841	0.97057	0.97273	0.97488	0.97702

0.97915	0.98127	0.98338	0.98549	0.98758
0.98967	0.99175	0.99382	0.99588	0.99793
1				

25_yr_sm 0.1 hr increment

0	0.00187	0.00371	0.00556	0.00742
0.0093	0.01118	0.01307	0.01497	0.01687
0.01879	0.02072	0.02265	0.0246	0.02655
0.02851	0.03049	0.03247	0.03446	0.03646
0.03847	0.04049	0.04252	0.04455	0.0466
0.04865	0.05072	0.05279	0.05487	0.05697
0.05907	0.06118	0.0633	0.06543	0.06757
0.06971	0.07187	0.07403	0.07621	0.07839
0.08059	0.08279	0.085	0.08722	0.08945
0.09169	0.09394	0.0962	0.09846	0.10074
0.10303	0.10532	0.10762	0.10994	0.11226
0.11459	0.11693	0.11928	0.12164	0.12401
0.12638	0.1288	0.13125	0.13374	0.13626
0.13882	0.14142	0.14405	0.14673	0.14943
0.15218	0.15496	0.15778	0.16064	0.16353
0.16646	0.16942	0.17243	0.17546	0.17854
0.18165	0.1848	0.18799	0.19121	0.19447
0.19777	0.20111	0.20448	0.20788	0.21133
0.21481	0.2184	0.2221	0.22591	0.22983
0.23386	0.23799	0.24224	0.2466	0.25106
0.25564	0.26033	0.26512	0.27002	0.27504
0.28016	0.28563	0.29146	0.29764	0.30416
0.31104	0.31841	0.32627	0.33462	0.34346
0.35276	0.36397	0.37577	0.39353	0.42093
0.47521	0.57907	0.60647	0.62423	0.63603
0.64724	0.65654	0.66538	0.67373	0.68159
0.68896	0.69584	0.70236	0.70854	0.71437
0.71984	0.72496	0.72998	0.73488	0.73967
0.74436	0.74894	0.7534	0.75776	0.76201
0.76614	0.77017	0.77409	0.7779	0.7816
0.78519	0.78867	0.79212	0.79552	0.79889
0.80223	0.80553	0.80879	0.81201	0.8152
0.81835	0.82146	0.82454	0.82757	0.83058
0.83354	0.83647	0.83936	0.84222	0.84504
0.84782	0.85057	0.85327	0.85595	0.85858
0.86118	0.86374	0.86626	0.86875	0.8712
0.87362	0.87599	0.87836	0.88072	0.88307
0.88541	0.88774	0.89006	0.89238	0.89468
0.89697	0.89926	0.90154	0.9038	0.90606
0.90831	0.91055	0.91278	0.915	0.91721
0.91941	0.92161	0.92379	0.92597	0.92813
0.93029	0.93243	0.93457	0.9367	0.93882

0.94093	0.94303	0.94513	0.94721	0.94928
0.95135	0.9534	0.95545	0.95748	0.95951
0.96153	0.96354	0.96554	0.96753	0.96951
0.97149	0.97345	0.9754	0.97735	0.97928
0.98121	0.98313	0.98503	0.98693	0.98882
0.9907	0.99258	0.99444	0.99629	0.99813
1				

50_yr_sm 0.1 hr increment

0	0.00165	0.0033	0.00497	0.00664
0.00832	0.01001	0.01171	0.01342	0.01514
0.01687	0.01861	0.02036	0.02212	0.02389
0.02567	0.02746	0.02925	0.03106	0.03288
0.0347	0.03654	0.03839	0.04024	0.04211
0.04398	0.04587	0.04776	0.04966	0.05158
0.0535	0.05543	0.05737	0.05933	0.06129
0.06326	0.06524	0.06723	0.06923	0.07124
0.07326	0.07529	0.07733	0.07937	0.08143
0.0835	0.08558	0.08766	0.08976	0.09187
0.09398	0.09611	0.09824	0.10039	0.10254
0.1047	0.10688	0.10906	0.11125	0.11346
0.11567	0.11792	0.12021	0.12254	0.1249
0.12731	0.12975	0.13223	0.13475	0.13731
0.13991	0.14255	0.14522	0.14794	0.15069
0.15348	0.15631	0.15918	0.16208	0.16503
0.16801	0.17103	0.17409	0.17719	0.18033
0.18351	0.18672	0.18997	0.19327	0.1966
0.19997	0.20345	0.20706	0.21079	0.21463
0.21859	0.22267	0.22687	0.23119	0.23563
0.24018	0.24486	0.24965	0.25456	0.25959
0.26474	0.27028	0.27621	0.28253	0.28924
0.29634	0.30401	0.31226	0.32108	0.33047
0.34043	0.35263	0.36547	0.38474	0.41441
0.47317	0.58559	0.61526	0.63453	0.64737
0.65957	0.66953	0.67892	0.68774	0.69599
0.70366	0.71076	0.71747	0.72379	0.72972
0.73526	0.74041	0.74544	0.75035	0.75514
0.75982	0.76437	0.76881	0.77313	0.77733
0.78141	0.78537	0.78921	0.79294	0.79655
0.80003	0.8034	0.80673	0.81003	0.81328
0.81649	0.81967	0.82281	0.82591	0.82897
0.83199	0.83497	0.83792	0.84082	0.84369
0.84652	0.84931	0.85206	0.85478	0.85745
0.86009	0.86269	0.86525	0.86777	0.87025
0.87269	0.8751	0.87746	0.87979	0.88208
0.88433	0.88654	0.88875	0.89094	0.89312
0.8953	0.89746	0.89961	0.90176	0.90389

0.90602	0.90813	0.91024	0.91234	0.91442
0.9165	0.91857	0.92063	0.92267	0.92471
0.92674	0.92876	0.93077	0.93277	0.93476
0.93674	0.93871	0.94067	0.94263	0.94457
0.9465	0.94842	0.95034	0.95224	0.95413
0.95602	0.95789	0.95976	0.96161	0.96346
0.9653	0.96712	0.96894	0.97075	0.97254
0.97433	0.97611	0.97788	0.97964	0.98139
0.98313	0.98486	0.98658	0.98829	0.98999
0.99168	0.99336	0.99503	0.9967	0.99835
1				

100_yr_sm 0.1 hr increment

0	0.00145	0.00289	0.00434	0.00581
0.00728	0.00877	0.01026	0.01176	0.01328
0.0148	0.01634	0.01788	0.01943	0.021
0.02257	0.02415	0.02575	0.02735	0.02897
0.03059	0.03222	0.03387	0.03552	0.03718
0.03886	0.04054	0.04223	0.04393	0.04565
0.04737	0.0491	0.05085	0.0526	0.05436
0.05613	0.05792	0.05971	0.06151	0.06333
0.06515	0.06698	0.06882	0.07068	0.07254
0.07441	0.07629	0.07818	0.08009	0.082
0.08392	0.08585	0.08779	0.08975	0.09171
0.09368	0.09566	0.09765	0.09966	0.10167
0.10369	0.10575	0.10785	0.10999	0.11217
0.11439	0.11666	0.11896	0.1213	0.12368
0.1261	0.12856	0.13106	0.13359	0.13617
0.13879	0.14145	0.14415	0.14689	0.14967
0.15249	0.15534	0.15824	0.16118	0.16416
0.16717	0.17023	0.17333	0.17646	0.17964
0.18286	0.1862	0.18967	0.19327	0.197
0.20086	0.20484	0.20895	0.21319	0.21755
0.22205	0.22667	0.23142	0.23629	0.2413
0.24643	0.252	0.258	0.26443	0.2713
0.27861	0.28658	0.29523	0.30455	0.31455
0.3252	0.33865	0.35281	0.37397	0.40648
0.47076	0.59352	0.62603	0.64719	0.66135
0.6748	0.68545	0.69545	0.70477	0.71342
0.72139	0.7287	0.73557	0.742	0.748
0.75357	0.7587	0.76371	0.76858	0.77333
0.77795	0.78245	0.78681	0.79105	0.79516
0.79914	0.803	0.80673	0.81033	0.8138
0.81714	0.82036	0.82354	0.82667	0.82977
0.83283	0.83584	0.83882	0.84176	0.84466
0.84751	0.85033	0.85311	0.85585	0.85855
0.86121	0.86383	0.86641	0.86894	0.87144

0.8739	0.87632	0.8787	0.88104	0.88334
0.88561	0.88783	0.89001	0.89215	0.89425
0.89631	0.89833	0.90034	0.90235	0.90434
0.90632	0.90829	0.91025	0.91221	0.91415
0.91608	0.918	0.91991	0.92182	0.92371
0.92559	0.92746	0.92932	0.93118	0.93302
0.93485	0.93667	0.93849	0.94029	0.94208
0.94387	0.94564	0.9474	0.94915	0.9509
0.95263	0.95435	0.95607	0.95777	0.95946
0.96114	0.96282	0.96448	0.96613	0.96778
0.96941	0.97103	0.97265	0.97425	0.97585
0.97743	0.979	0.98057	0.98212	0.98366
0.9852	0.98672	0.98824	0.98974	0.99123
0.99272	0.99419	0.99566	0.99711	0.99855
1				

200_yr_sm 0.1 hr increment

0	0.00125	0.0025	0.00376	0.00503
0.00631	0.0076	0.0089	0.01021	0.01153
0.01286	0.0142	0.01555	0.01691	0.01828
0.01966	0.02105	0.02245	0.02386	0.02528
0.02672	0.02816	0.02961	0.03107	0.03254
0.03402	0.03551	0.03701	0.03853	0.04005
0.04158	0.04312	0.04467	0.04623	0.04781
0.04939	0.05098	0.05258	0.0542	0.05582
0.05745	0.05909	0.06075	0.06241	0.06408
0.06576	0.06746	0.06916	0.07087	0.0726
0.07433	0.07607	0.07783	0.07959	0.08137
0.08315	0.08494	0.08675	0.08856	0.09039
0.09222	0.09409	0.09601	0.09796	0.09996
0.102	0.10407	0.10619	0.10835	0.11054
0.11278	0.11506	0.11738	0.11974	0.12214
0.12458	0.12706	0.12958	0.13214	0.13474
0.13738	0.14006	0.14278	0.14554	0.14835
0.15119	0.15407	0.157	0.15996	0.16296
0.16601	0.16919	0.1725	0.17595	0.17954
0.18325	0.18711	0.1911	0.19522	0.19948
0.20387	0.2084	0.21306	0.21786	0.22279
0.22786	0.2334	0.23942	0.2459	0.25286
0.2603	0.2685	0.27748	0.28722	0.29773
0.309	0.32364	0.33904	0.36208	0.39751
0.46779	0.60249	0.63792	0.66096	0.67636
0.691	0.70227	0.71278	0.72252	0.7315
0.7397	0.74714	0.7541	0.76058	0.7666
0.77214	0.77721	0.78214	0.78694	0.7916
0.79613	0.80052	0.80478	0.8089	0.81289
0.81675	0.82046	0.82405	0.8275	0.83081

0.83399	0.83704	0.84004	0.843	0.84593
0.84881	0.85165	0.85446	0.85722	0.85994
0.86262	0.86526	0.86786	0.87042	0.87294
0.87542	0.87786	0.88026	0.88262	0.88494
0.88722	0.88946	0.89165	0.89381	0.89593
0.898	0.90004	0.90204	0.90399	0.90591
0.90778	0.90961	0.91144	0.91325	0.91506
0.91685	0.91863	0.92041	0.92217	0.92393
0.92567	0.9274	0.92913	0.93084	0.93254
0.93424	0.93592	0.93759	0.93925	0.94091
0.94255	0.94418	0.9458	0.94742	0.94902
0.95061	0.95219	0.95377	0.95533	0.95688
0.95842	0.95995	0.96147	0.96299	0.96449
0.96598	0.96746	0.96893	0.97039	0.97184
0.97328	0.97472	0.97614	0.97755	0.97895
0.98034	0.98172	0.98309	0.98445	0.9858
0.98714	0.98847	0.98979	0.9911	0.9924
0.99369	0.99497	0.99624	0.9975	0.99875
1				

500_yr_sm 0.1 hr increment

0	0.000963	0.00191	0.00287	0.00384
0.00482	0.00581	0.00681	0.00782	0.00884
0.00987	0.01091	0.01196	0.01302	0.01409
0.01517	0.01626	0.01736	0.01847	0.01959
0.02072	0.02187	0.02302	0.02418	0.02535
0.02653	0.02772	0.02892	0.03013	0.03135
0.03258	0.03382	0.03507	0.03633	0.0376
0.03889	0.04018	0.04148	0.04279	0.04411
0.04544	0.04678	0.04813	0.04949	0.05087
0.05225	0.05364	0.05504	0.05645	0.05787
0.0593	0.06074	0.0622	0.06366	0.06513
0.06661	0.0681	0.0696	0.07112	0.07264
0.07417	0.07574	0.07735	0.07901	0.0807
0.08243	0.0842	0.08602	0.08787	0.08976
0.09169	0.09367	0.09568	0.09774	0.09983
0.10196	0.10414	0.10635	0.1086	0.1109
0.11323	0.11561	0.11802	0.12048	0.12297
0.12551	0.12808	0.1307	0.13335	0.13605
0.13879	0.14167	0.14469	0.14786	0.15118
0.15464	0.15824	0.16199	0.16588	0.16992
0.1741	0.17843	0.1829	0.18752	0.19228
0.19718	0.20263	0.2086	0.21512	0.22217
0.22976	0.2383	0.24778	0.25822	0.2696
0.28191	0.29875	0.31647	0.34287	0.38336
0.46348	0.61664	0.65713	0.68353	0.70125
0.71809	0.7304	0.74178	0.75222	0.7617

0.77024	0.77783	0.78488	0.7914	0.79737
0.80282	0.80772	0.81248	0.8171	0.82157
0.8259	0.83008	0.83412	0.83801	0.84176
0.84536	0.84882	0.85214	0.85531	0.85833
0.86121	0.86395	0.86665	0.8693	0.87192
0.87449	0.87703	0.87952	0.88198	0.88439
0.88677	0.8891	0.8914	0.89365	0.89586
0.89804	0.90017	0.90227	0.90432	0.90633
0.90831	0.91024	0.91213	0.91398	0.9158
0.91757	0.9193	0.92099	0.92265	0.92426
0.92583	0.92736	0.92888	0.9304	0.9319
0.93339	0.93487	0.93634	0.9378	0.93926
0.9407	0.94213	0.94355	0.94496	0.94636
0.94775	0.94914	0.95051	0.95187	0.95322
0.95456	0.95589	0.95721	0.95852	0.95982
0.96111	0.9624	0.96367	0.96493	0.96618
0.96742	0.96865	0.96987	0.97108	0.97228
0.97347	0.97465	0.97582	0.97698	0.97813
0.97928	0.98041	0.98153	0.98264	0.98374
0.98483	0.98591	0.98698	0.98804	0.98909
0.99013	0.99116	0.99218	0.99319	0.99419
0.99518	0.99616	0.99713	0.99809	0.999037
1				

EW-6 CUMULATIVE RAINFALL TABLES

10_yr_sm 0.1 hr increment

0	0.002	0.00399	0.006	0.00801
0.01002	0.01205	0.01409	0.01613	0.01819
0.02025	0.02233	0.02441	0.0265	0.0286
0.0307	0.03282	0.03495	0.03708	0.03922
0.04138	0.04354	0.04571	0.04789	0.05007
0.05227	0.05448	0.05669	0.05891	0.06115
0.06339	0.06564	0.0679	0.07016	0.07244
0.07473	0.07702	0.07932	0.08163	0.08396
0.08629	0.08862	0.09097	0.09333	0.09569
0.09807	0.10045	0.10284	0.10524	0.10765
0.11007	0.1125	0.11494	0.11738	0.11984
0.1223	0.12477	0.12725	0.12974	0.13224
0.13475	0.13729	0.13987	0.14248	0.14513
0.14782	0.15054	0.15329	0.15608	0.15891
0.16177	0.16467	0.1676	0.17057	0.17358
0.17662	0.17969	0.1828	0.18595	0.18913
0.19235	0.1956	0.19889	0.20222	0.20558
0.20897	0.2124	0.21587	0.21937	0.22291
0.22648	0.23016	0.23393	0.23782	0.2418
0.24589	0.25008	0.25438	0.25878	0.26328
0.26788	0.27259	0.2774	0.28231	0.28733
0.29245	0.2979	0.30366	0.30976	0.31617
0.32291	0.33008	0.33768	0.34571	0.35417
0.36304	0.37346	0.38443	0.401	0.42659
0.47709	0.57341	0.599	0.61557	0.62654
0.63696	0.64583	0.65429	0.66232	0.66992
0.67709	0.68383	0.69024	0.69634	0.7021
0.70755	0.71267	0.71769	0.7226	0.72741
0.73212	0.73672	0.74122	0.74562	0.74992
0.75411	0.7582	0.76218	0.76607	0.76984
0.77352	0.77709	0.78063	0.78413	0.7876
0.79103	0.79442	0.79778	0.80111	0.8044
0.80765	0.81087	0.81405	0.8172	0.82031
0.82338	0.82642	0.82943	0.8324	0.83533
0.83823	0.84109	0.84392	0.84671	0.84946
0.85218	0.85487	0.85752	0.86013	0.86271
0.86525	0.86776	0.87026	0.87275	0.87523
0.8777	0.88016	0.88262	0.88506	0.8875
0.88993	0.89235	0.89476	0.89716	0.89955
0.90193	0.90431	0.90667	0.90903	0.91138
0.91371	0.91604	0.91837	0.92068	0.92298
0.92527	0.92756	0.92984	0.9321	0.93436
0.93661	0.93885	0.94109	0.94331	0.94552
0.94773	0.94993	0.95211	0.95429	0.95646
0.95862	0.96078	0.96292	0.96505	0.96718
0.9693	0.9714	0.9735	0.97559	0.97767

0.97975	0.98181	0.98387	0.98591	0.98795
0.98998	0.99199	0.994	0.99601	0.998
1				

25_yr_sm 0.1 hr increment

0	0.0018	0.00359	0.00538	0.00718
0.009	0.01082	0.01265	0.01449	0.01634
0.0182	0.02007	0.02195	0.02384	0.02573
0.02764	0.02956	0.03148	0.03342	0.03536
0.03731	0.03927	0.04125	0.04323	0.04522
0.04722	0.04923	0.05125	0.05327	0.05531
0.05736	0.05941	0.06148	0.06355	0.06564
0.06773	0.06983	0.07195	0.07407	0.0762
0.07834	0.08049	0.08265	0.08481	0.08699
0.08918	0.09137	0.09358	0.09579	0.09802
0.10025	0.10249	0.10475	0.10701	0.10928
0.11156	0.11385	0.11615	0.11846	0.12077
0.1231	0.12547	0.12787	0.13031	0.13278
0.1353	0.13785	0.14044	0.14306	0.14573
0.14843	0.15116	0.15394	0.15675	0.1596
0.16249	0.16542	0.16838	0.17138	0.17442
0.17749	0.1806	0.18375	0.18694	0.19016
0.19342	0.19672	0.20006	0.20343	0.20684
0.21029	0.21385	0.21753	0.22131	0.22521
0.22922	0.23334	0.23758	0.24193	0.24639
0.25096	0.25565	0.26045	0.26536	0.27038
0.27551	0.28101	0.28688	0.2931	0.29969
0.30665	0.31411	0.3221	0.33059	0.3396
0.3491	0.3606	0.3727	0.39092	0.41902
0.47463	0.58098	0.60908	0.6273	0.6394
0.6509	0.6604	0.66941	0.6779	0.68589
0.69335	0.70031	0.7069	0.71312	0.71899
0.72449	0.72962	0.73464	0.73955	0.74435
0.74904	0.75361	0.75807	0.76242	0.76666
0.77078	0.77479	0.77869	0.78247	0.78615
0.78971	0.79316	0.79657	0.79994	0.80328
0.80658	0.80984	0.81306	0.81625	0.8194
0.82251	0.82558	0.82862	0.83162	0.83458
0.83751	0.8404	0.84325	0.84606	0.84884
0.85157	0.85427	0.85694	0.85956	0.86215
0.8647	0.86722	0.86969	0.87213	0.87453
0.8769	0.87923	0.88154	0.88385	0.88615
0.88844	0.89072	0.89299	0.89525	0.89751
0.89975	0.90198	0.90421	0.90642	0.90863
0.91082	0.91301	0.91519	0.91735	0.91951
0.92166	0.9238	0.92593	0.92805	0.93017
0.93227	0.93436	0.93645	0.93852	0.94059

0.94264	0.94469	0.94673	0.94875	0.95077
0.95278	0.95478	0.95677	0.95875	0.96073
0.96269	0.96464	0.96658	0.96852	0.97044
0.97236	0.97427	0.97616	0.97805	0.97993
0.9818	0.98366	0.98551	0.98735	0.98918
0.991	0.99282	0.99462	0.99641	0.9982
1				

50_yr_sm 0.1 hr increment

0	0.00157	0.00315	0.00474	0.00634
0.00795	0.00957	0.0112	0.01284	0.01449
0.01615	0.01782	0.0195	0.02119	0.02289
0.0246	0.02631	0.02804	0.02978	0.03153
0.03328	0.03505	0.03683	0.03861	0.04041
0.04222	0.04403	0.04586	0.04769	0.04954
0.05139	0.05326	0.05513	0.05702	0.05891
0.06081	0.06273	0.06465	0.06658	0.06853
0.07048	0.07244	0.07441	0.0764	0.07839
0.08039	0.0824	0.08442	0.08645	0.08849
0.09054	0.09261	0.09468	0.09676	0.09884
0.10094	0.10305	0.10517	0.1073	0.10944
0.11159	0.11377	0.116	0.11827	0.12057
0.12292	0.1253	0.12772	0.13018	0.13268
0.13522	0.1378	0.14042	0.14307	0.14577
0.14851	0.15128	0.15409	0.15695	0.15984
0.16277	0.16574	0.16875	0.17179	0.17488
0.17801	0.18117	0.18438	0.18762	0.1909
0.19422	0.19767	0.20123	0.20492	0.20873
0.21266	0.21672	0.22089	0.22519	0.22961
0.23415	0.23881	0.2436	0.2485	0.25353
0.25868	0.26424	0.2702	0.27657	0.28334
0.29052	0.2983	0.30669	0.31568	0.32527
0.33546	0.34802	0.36124	0.38109	0.41168
0.47229	0.58832	0.61891	0.63876	0.65198
0.66454	0.67473	0.68432	0.69331	0.7017
0.70948	0.71666	0.72343	0.7298	0.73576
0.74132	0.74647	0.7515	0.7564	0.76119
0.76585	0.77039	0.77481	0.77911	0.78328
0.78734	0.79127	0.79508	0.79877	0.80233
0.80578	0.8091	0.81238	0.81562	0.81883
0.82199	0.82512	0.82821	0.83125	0.83426
0.83723	0.84016	0.84306	0.84591	0.84872
0.85149	0.85423	0.85693	0.85958	0.8622
0.86478	0.86732	0.86982	0.87228	0.8747
0.87708	0.87943	0.88173	0.884	0.88623
0.88841	0.89056	0.8927	0.89483	0.89695
0.89906	0.90116	0.90324	0.90532	0.90739

0.90946	0.91151	0.91355	0.91558	0.9176
0.91961	0.92161	0.9236	0.92559	0.92756
0.92952	0.93147	0.93342	0.93535	0.93727
0.93919	0.94109	0.94298	0.94487	0.94674
0.94861	0.95046	0.95231	0.95414	0.95597
0.95778	0.95959	0.96139	0.96317	0.96495
0.96672	0.96847	0.97022	0.97196	0.97369
0.9754	0.97711	0.97881	0.9805	0.98218
0.98385	0.98551	0.98716	0.9888	0.99043
0.99205	0.99366	0.99526	0.99685	0.99843
1				

100_yr_sm 0.1 hr increment

0	0.00139	0.00278	0.00418	0.00559
0.00701	0.00845	0.00989	0.01134	0.0128
0.01427	0.01576	0.01725	0.01875	0.02026
0.02178	0.02331	0.02486	0.02641	0.02797
0.02954	0.03112	0.03272	0.03432	0.03593
0.03755	0.03918	0.04083	0.04248	0.04414
0.04581	0.04749	0.04919	0.05089	0.0526
0.05432	0.05606	0.0578	0.05955	0.06131
0.06308	0.06487	0.06666	0.06846	0.07027
0.0721	0.07393	0.07577	0.07762	0.07948
0.08136	0.08324	0.08513	0.08703	0.08895
0.09087	0.0928	0.09474	0.0967	0.09866
0.10063	0.10264	0.1047	0.10679	0.10892
0.11109	0.11331	0.11556	0.11785	0.12019
0.12256	0.12497	0.12743	0.12992	0.13245
0.13502	0.13764	0.14029	0.14299	0.14572
0.14849	0.15131	0.15416	0.15705	0.15999
0.16296	0.16597	0.16903	0.17212	0.17526
0.17843	0.18173	0.18517	0.18873	0.19242
0.19625	0.2002	0.20428	0.20849	0.21284
0.21731	0.22191	0.22664	0.2315	0.23649
0.24161	0.24718	0.25319	0.25964	0.26654
0.27388	0.28192	0.29066	0.30009	0.31021
0.32102	0.33472	0.34914	0.37075	0.40399
0.46987	0.59601	0.62925	0.65086	0.66528
0.67898	0.68979	0.69991	0.70934	0.71808
0.72612	0.73346	0.74036	0.74681	0.75282
0.75839	0.76351	0.7685	0.77336	0.77809
0.78269	0.78716	0.79151	0.79572	0.7998
0.80375	0.80758	0.81127	0.81483	0.81827
0.82157	0.82474	0.82788	0.83097	0.83403
0.83704	0.84001	0.84295	0.84584	0.84869
0.85151	0.85428	0.85702	0.85971	0.86236
0.86498	0.86755	0.87008	0.87257	0.87503

0.87744	0.87981	0.88215	0.88444	0.88669
0.88891	0.89108	0.89321	0.8953	0.89736
0.89937	0.90134	0.9033	0.90526	0.9072
0.90913	0.91105	0.91297	0.91487	0.91676
0.91864	0.92052	0.92238	0.92423	0.92607
0.9279	0.92973	0.93154	0.93334	0.93513
0.93692	0.93869	0.94045	0.9422	0.94394
0.94568	0.9474	0.94911	0.95081	0.95251
0.95419	0.95586	0.95752	0.95917	0.96082
0.96245	0.96407	0.96568	0.96728	0.96888
0.97046	0.97203	0.97359	0.97514	0.97669
0.97822	0.97974	0.98125	0.98275	0.98424
0.98573	0.9872	0.98866	0.99011	0.99155
0.99299	0.99441	0.99582	0.99722	0.99861
1				

200_yr_sm 0.1 hr increment

0	0.00118	0.00236	0.00355	0.00475
0.00597	0.00719	0.00842	0.00966	0.01092
0.01218	0.01345	0.01473	0.01603	0.01733
0.01864	0.01997	0.0213	0.02265	0.024
0.02536	0.02674	0.02812	0.02952	0.03092
0.03234	0.03376	0.0352	0.03664	0.0381
0.03956	0.04104	0.04253	0.04402	0.04553
0.04704	0.04857	0.05011	0.05165	0.05321
0.05478	0.05635	0.05794	0.05954	0.06115
0.06276	0.06439	0.06603	0.06768	0.06934
0.071	0.07268	0.07437	0.07607	0.07778
0.0795	0.08123	0.08297	0.08472	0.08648
0.08825	0.09006	0.09191	0.0938	0.09573
0.0977	0.09972	0.10177	0.10386	0.106
0.10817	0.11039	0.11265	0.11494	0.11728
0.11966	0.12208	0.12454	0.12703	0.12958
0.13216	0.13478	0.13744	0.14014	0.14288
0.14567	0.14849	0.15136	0.15426	0.15721
0.16019	0.16332	0.16658	0.16998	0.17351
0.17719	0.181	0.18495	0.18904	0.19326
0.19762	0.20212	0.20676	0.21153	0.21644
0.22149	0.22703	0.23305	0.23957	0.24657
0.25406	0.26235	0.27145	0.28135	0.29206
0.30357	0.3186	0.33441	0.35808	0.39451
0.46682	0.60549	0.64192	0.66559	0.6814
0.69643	0.70794	0.71865	0.72855	0.73765
0.74594	0.75343	0.76043	0.76695	0.77297
0.77851	0.78356	0.78847	0.79324	0.79788
0.80238	0.80674	0.81096	0.81505	0.819
0.82281	0.82649	0.83002	0.83342	0.83668

0.83981	0.84279	0.84574	0.84864	0.85151
0.85433	0.85712	0.85986	0.86256	0.86522
0.86784	0.87042	0.87296	0.87546	0.87792
0.88034	0.88272	0.88506	0.88735	0.88961
0.89183	0.894	0.89614	0.89823	0.90028
0.9023	0.90427	0.9062	0.90809	0.90994
0.91175	0.91352	0.91528	0.91703	0.91877
0.9205	0.92222	0.92393	0.92563	0.92732
0.929	0.93066	0.93232	0.93397	0.93561
0.93724	0.93885	0.94046	0.94206	0.94365
0.94522	0.94679	0.94835	0.94989	0.95143
0.95296	0.95447	0.95598	0.95747	0.95896
0.96044	0.9619	0.96336	0.9648	0.96624
0.96766	0.96908	0.97048	0.97188	0.97326
0.97464	0.976	0.97735	0.9787	0.98003
0.98136	0.98267	0.98397	0.98527	0.98655
0.98782	0.98908	0.99034	0.99158	0.99281
0.99403	0.99525	0.99645	0.99764	0.99882
1				

500_yr_sm 0.1 hr increment

0	0.000875	0.00175	0.00263	0.00353
0.00443	0.00534	0.00627	0.0072	0.00815
0.0091	0.01006	0.01104	0.01202	0.01302
0.01402	0.01503	0.01606	0.01709	0.01814
0.01919	0.02025	0.02133	0.02241	0.02351
0.02461	0.02573	0.02685	0.02799	0.02913
0.03028	0.03145	0.03262	0.03381	0.035
0.03621	0.03742	0.03865	0.03988	0.04112
0.04238	0.04364	0.04492	0.0462	0.0475
0.0488	0.05012	0.05144	0.05278	0.05412
0.05548	0.05684	0.05822	0.0596	0.061
0.0624	0.06382	0.06524	0.06668	0.06812
0.06958	0.07107	0.07261	0.07418	0.0758
0.07745	0.07915	0.08088	0.08266	0.08448
0.08633	0.08823	0.09016	0.09214	0.09416
0.09621	0.09831	0.10045	0.10262	0.10484
0.1071	0.10939	0.11173	0.11411	0.11653
0.11898	0.12148	0.12402	0.1266	0.12921
0.13187	0.13468	0.13763	0.14073	0.14397
0.14737	0.15091	0.1546	0.15843	0.16242
0.16655	0.17082	0.17525	0.17982	0.18454
0.1894	0.19482	0.2008	0.20732	0.2144
0.22204	0.23067	0.2403	0.25093	0.26255
0.27517	0.29253	0.31081	0.33804	0.37979
0.46238	0.62021	0.66196	0.68919	0.70747
0.72483	0.73745	0.74907	0.7597	0.76933

0.77796	0.7856	0.79268	0.7992	0.80518
0.8106	0.81546	0.82018	0.82475	0.82918
0.83345	0.83758	0.84157	0.8454	0.84909
0.85263	0.85603	0.85927	0.86237	0.86532
0.86813	0.87079	0.8734	0.87598	0.87852
0.88102	0.88347	0.88589	0.88827	0.89061
0.8929	0.89516	0.89738	0.89955	0.90169
0.90379	0.90584	0.90786	0.90984	0.91177
0.91367	0.91552	0.91734	0.91912	0.92085
0.92255	0.9242	0.92582	0.92739	0.92893
0.93042	0.93188	0.93332	0.93476	0.93618
0.9376	0.939	0.9404	0.94178	0.94316
0.94452	0.94588	0.94722	0.94856	0.94988
0.9512	0.9525	0.9538	0.95508	0.95636
0.95762	0.95888	0.96012	0.96135	0.96258
0.96379	0.965	0.96619	0.96738	0.96855
0.96972	0.97087	0.97201	0.97315	0.97427
0.97539	0.97649	0.97759	0.97867	0.97975
0.98081	0.98186	0.98291	0.98394	0.98497
0.98598	0.98698	0.98798	0.98896	0.98994
0.9909	0.99185	0.9928	0.99373	0.99466
0.99557	0.99647	0.99737	0.99825	0.999125
1				

WW-1 CUMULATIVE RAINFALL TABLES

10_yr_sm 0.1 hr increment

0	0.00214	0.00425	0.00637	0.0085
0.01064	0.01279	0.01495	0.01711	0.01929
0.02147	0.02366	0.02586	0.02807	0.03028
0.03251	0.03474	0.03698	0.03923	0.04149
0.04376	0.04603	0.04832	0.05061	0.05291
0.05522	0.05754	0.05987	0.0622	0.06455
0.0669	0.06926	0.07163	0.07401	0.0764
0.07879	0.08119	0.08361	0.08603	0.08846
0.0909	0.09334	0.0958	0.09826	0.10073
0.10321	0.1057	0.1082	0.1107	0.11322
0.11574	0.11827	0.12081	0.12336	0.12592
0.12849	0.13106	0.13364	0.13623	0.13883
0.14144	0.14408	0.14676	0.14947	0.15222
0.15499	0.15781	0.16065	0.16354	0.16645
0.1694	0.17238	0.1754	0.17845	0.18154
0.18466	0.18781	0.191	0.19422	0.19748
0.20077	0.20409	0.20745	0.21084	0.21427
0.21773	0.22123	0.22475	0.22832	0.23191
0.23555	0.23927	0.2431	0.24702	0.25104
0.25516	0.25937	0.26368	0.26809	0.27259
0.27719	0.28189	0.28668	0.29157	0.29656
0.30165	0.30703	0.31272	0.3187	0.32498
0.33157	0.33854	0.3459	0.35365	0.36178
0.37028	0.38017	0.39058	0.40629	0.43052
0.47833	0.56948	0.59371	0.60942	0.61983
0.62972	0.63822	0.64635	0.6541	0.66146
0.66843	0.67502	0.6813	0.68728	0.69297
0.69835	0.70344	0.70843	0.71332	0.71811
0.72281	0.72741	0.73191	0.73632	0.74063
0.74484	0.74896	0.75298	0.7569	0.76073
0.76445	0.76809	0.77168	0.77525	0.77877
0.78227	0.78573	0.78916	0.79255	0.79591
0.79923	0.80252	0.80578	0.809	0.81219
0.81534	0.81846	0.82155	0.8246	0.82762
0.8306	0.83355	0.83646	0.83935	0.84219
0.84501	0.84778	0.85053	0.85324	0.85592
0.85856	0.86117	0.86377	0.86636	0.86894
0.87151	0.87408	0.87664	0.87919	0.88173
0.88426	0.88678	0.8893	0.8918	0.8943
0.89679	0.89927	0.90174	0.9042	0.90666
0.9091	0.91154	0.91397	0.91639	0.91881
0.92121	0.9236	0.92599	0.92837	0.93074
0.9331	0.93545	0.9378	0.94013	0.94246
0.94478	0.94709	0.94939	0.95168	0.95397
0.95624	0.95851	0.96077	0.96302	0.96526
0.96749	0.96972	0.97193	0.97414	0.97634

0.97853	0.98071	0.98289	0.98505	0.98721
0.98936	0.9915	0.99363	0.99575	0.99786
1				

25_yr_sm 0.1 hr increment

0	0.0019	0.0038	0.00572	0.00764
0.00957	0.01151	0.01346	0.01542	0.01738
0.01936	0.02134	0.02334	0.02534	0.02736
0.02938	0.03141	0.03345	0.0355	0.03756
0.03962	0.0417	0.04379	0.04588	0.04798
0.0501	0.05222	0.05435	0.05649	0.05864
0.0608	0.06297	0.06515	0.06733	0.06953
0.07173	0.07394	0.07617	0.0784	0.08064
0.08289	0.08515	0.08742	0.08969	0.09198
0.09428	0.09658	0.09889	0.10122	0.10355
0.10589	0.10824	0.1106	0.11297	0.11535
0.11773	0.12013	0.12254	0.12495	0.12737
0.12981	0.13227	0.13478	0.13732	0.1399
0.14251	0.14517	0.14785	0.15058	0.15334
0.15614	0.15897	0.16184	0.16475	0.16769
0.17067	0.17369	0.17674	0.17983	0.18296
0.18612	0.18932	0.19255	0.19582	0.19913
0.20248	0.20586	0.20928	0.21273	0.21622
0.21975	0.22338	0.22712	0.23097	0.23493
0.23899	0.24316	0.24744	0.25182	0.25632
0.26092	0.26562	0.27044	0.27536	0.28038
0.28552	0.29099	0.29681	0.30297	0.30946
0.3163	0.32361	0.33138	0.33963	0.34834
0.35752	0.3684	0.37987	0.39709	0.42363
0.47611	0.57637	0.60291	0.62013	0.6316
0.64248	0.65166	0.66037	0.66862	0.67639
0.6837	0.69054	0.69703	0.70319	0.70901
0.71448	0.71962	0.72464	0.72956	0.73438
0.73908	0.74368	0.74818	0.75256	0.75684
0.76101	0.76507	0.76903	0.77288	0.77662
0.78025	0.78378	0.78727	0.79072	0.79414
0.79752	0.80087	0.80418	0.80745	0.81068
0.81388	0.81704	0.82017	0.82326	0.82631
0.82933	0.83231	0.83525	0.83816	0.84103
0.84386	0.84666	0.84942	0.85215	0.85483
0.85749	0.8601	0.86268	0.86522	0.86773
0.87019	0.87263	0.87505	0.87746	0.87987
0.88227	0.88465	0.88703	0.8894	0.89176
0.89411	0.89645	0.89878	0.9011	0.90342
0.90572	0.90802	0.91031	0.91258	0.91485
0.91711	0.91936	0.9216	0.92383	0.92606
0.92827	0.93047	0.93267	0.93485	0.93703

0.9392	0.94136	0.94351	0.94565	0.94778
0.9499	0.95202	0.95412	0.95621	0.9583
0.96038	0.96244	0.9645	0.96655	0.96859
0.97062	0.97264	0.97466	0.97666	0.97866
0.98064	0.98262	0.98458	0.98654	0.98849
0.99043	0.99236	0.99428	0.9962	0.9981
1				

50_yr_sm 0.1 hr increment

0	0.00175	0.00348	0.00523	0.00699
0.00875	0.01053	0.01231	0.0141	0.01591
0.01772	0.01954	0.02137	0.02322	0.02507
0.02693	0.0288	0.03067	0.03256	0.03446
0.03637	0.03828	0.04021	0.04215	0.04409
0.04605	0.04801	0.04998	0.05197	0.05396
0.05596	0.05797	0.05999	0.06202	0.06406
0.06611	0.06817	0.07024	0.07231	0.0744
0.0765	0.0786	0.08072	0.08284	0.08498
0.08712	0.08927	0.09143	0.09361	0.09579
0.09798	0.10018	0.10239	0.10461	0.10684
0.10907	0.11132	0.11358	0.11584	0.11812
0.12041	0.12273	0.12509	0.12749	0.12992
0.1324	0.13491	0.13746	0.14005	0.14267
0.14534	0.14804	0.15078	0.15355	0.15637
0.15922	0.16211	0.16504	0.168	0.17101
0.17405	0.17713	0.18024	0.1834	0.18659
0.18982	0.19309	0.19639	0.19974	0.20312
0.20654	0.21007	0.21372	0.21748	0.22136
0.22535	0.22946	0.23368	0.23801	0.24246
0.24702	0.2517	0.25649	0.2614	0.26642
0.27155	0.27706	0.28294	0.28919	0.29582
0.30281	0.31034	0.31841	0.32702	0.33616
0.34582	0.35758	0.36996	0.38855	0.4172
0.47399	0.5828	0.61145	0.63004	0.64242
0.65418	0.66384	0.67298	0.68159	0.68966
0.69719	0.70418	0.71081	0.71706	0.72294
0.72845	0.73358	0.7386	0.74351	0.7483
0.75298	0.75754	0.76199	0.76632	0.77054
0.77465	0.77864	0.78252	0.78628	0.78993
0.79346	0.79688	0.80026	0.80361	0.80691
0.81018	0.81341	0.8166	0.81976	0.82287
0.82595	0.82899	0.832	0.83496	0.83789
0.84078	0.84363	0.84645	0.84922	0.85196
0.85466	0.85733	0.85995	0.86254	0.86509
0.8676	0.87008	0.87251	0.87491	0.87727
0.87959	0.88188	0.88416	0.88642	0.88868
0.89093	0.89316	0.89539	0.89761	0.89982

0.90202	0.90421	0.90639	0.90857	0.91073
0.91288	0.91502	0.91716	0.91928	0.9214
0.9235	0.9256	0.92769	0.92976	0.93183
0.93389	0.93594	0.93798	0.94001	0.94203
0.94404	0.94604	0.94803	0.95002	0.95199
0.95395	0.95591	0.95785	0.95979	0.96172
0.96363	0.96554	0.96744	0.96933	0.9712
0.97307	0.97493	0.97678	0.97863	0.98046
0.98228	0.98409	0.9859	0.98769	0.98947
0.99125	0.99301	0.99477	0.99652	0.99825
1				

100_yr_sm 0.1 hr increment

0	0.00156	0.00311	0.00466	0.00623
0.0078	0.00939	0.01098	0.01259	0.0142
0.01583	0.01746	0.01911	0.02076	0.02242
0.0241	0.02578	0.02747	0.02917	0.03089
0.03261	0.03434	0.03608	0.03783	0.03959
0.04136	0.04314	0.04494	0.04674	0.04855
0.05036	0.05219	0.05403	0.05588	0.05774
0.05961	0.06149	0.06338	0.06527	0.06718
0.0691	0.07103	0.07296	0.07491	0.07686
0.07883	0.08081	0.08279	0.08479	0.08679
0.08881	0.09083	0.09287	0.09491	0.09697
0.09903	0.1011	0.10319	0.10528	0.10738
0.10949	0.11165	0.11384	0.11607	0.11834
0.12064	0.12299	0.12538	0.1278	0.13027
0.13277	0.13531	0.13789	0.14051	0.14317
0.14587	0.14861	0.15139	0.1542	0.15706
0.15995	0.16288	0.16586	0.16887	0.17192
0.17501	0.17814	0.1813	0.18451	0.18776
0.19104	0.19445	0.19798	0.20163	0.20541
0.2093	0.21333	0.21747	0.22174	0.22613
0.23064	0.23527	0.24003	0.24491	0.24991
0.25504	0.26058	0.26652	0.27288	0.27965
0.28683	0.29464	0.30306	0.31211	0.32178
0.33205	0.34491	0.35844	0.37871	0.40989
0.47171	0.59011	0.62129	0.64156	0.65509
0.66795	0.67822	0.68789	0.69694	0.70536
0.71317	0.72035	0.72712	0.73348	0.73942
0.74496	0.75009	0.75509	0.75997	0.76473
0.76936	0.77387	0.77826	0.78253	0.78667
0.7907	0.79459	0.79837	0.80202	0.80555
0.80896	0.81224	0.81549	0.8187	0.82186
0.82499	0.82808	0.83113	0.83414	0.83712
0.84005	0.84294	0.8458	0.84861	0.85139
0.85413	0.85683	0.85949	0.86211	0.86469

0.86723	0.86973	0.8722	0.87462	0.87701
0.87936	0.88166	0.88393	0.88616	0.88835
0.89051	0.89262	0.89472	0.89681	0.8989
0.90097	0.90303	0.90509	0.90713	0.90917
0.91119	0.91321	0.91521	0.91721	0.91919
0.92117	0.92314	0.92509	0.92704	0.92897
0.9309	0.93282	0.93473	0.93662	0.93851
0.94039	0.94226	0.94412	0.94597	0.94781
0.94964	0.95145	0.95326	0.95506	0.95686
0.95864	0.96041	0.96217	0.96392	0.96566
0.96739	0.96911	0.97083	0.97253	0.97422
0.9759	0.97758	0.97924	0.98089	0.98254
0.98417	0.9858	0.98741	0.98902	0.99061
0.9922	0.99377	0.99534	0.99689	0.99844
1				

200_yr_sm 0.1 hr increment

0	0.00136	0.0027	0.00406	0.00542
0.00679	0.00818	0.00957	0.01098	0.01239
0.01381	0.01525	0.01669	0.01814	0.0196
0.02108	0.02256	0.02405	0.02556	0.02707
0.02859	0.03013	0.03167	0.03322	0.03479
0.03636	0.03794	0.03953	0.04114	0.04275
0.04437	0.04601	0.04765	0.0493	0.05096
0.05264	0.05432	0.05601	0.05771	0.05943
0.06115	0.06288	0.06462	0.06638	0.06814
0.06991	0.07169	0.07349	0.07529	0.0771
0.07892	0.08076	0.0826	0.08445	0.08631
0.08819	0.09007	0.09196	0.09386	0.09577
0.0977	0.09966	0.10166	0.1037	0.10578
0.1079	0.11007	0.11227	0.11451	0.11679
0.11911	0.12147	0.12387	0.12631	0.12879
0.13131	0.13388	0.13648	0.13912	0.1418
0.14452	0.14728	0.15008	0.15292	0.1558
0.15872	0.16167	0.16467	0.16771	0.17079
0.17391	0.17716	0.18054	0.18405	0.1877
0.19147	0.19537	0.19941	0.20357	0.20787
0.2123	0.21685	0.22154	0.22636	0.23131
0.23639	0.24193	0.24791	0.25435	0.26124
0.26859	0.27665	0.28544	0.29494	0.30517
0.31609	0.33017	0.34499	0.36715	0.40125
0.46894	0.59875	0.63285	0.65501	0.66983
0.68391	0.69483	0.70506	0.71456	0.72335
0.73141	0.73876	0.74565	0.75209	0.75807
0.76361	0.76869	0.77364	0.77846	0.78315
0.7877	0.79213	0.79643	0.80059	0.80463
0.80853	0.8123	0.81595	0.81946	0.82284

0.82609	0.82921	0.83229	0.83533	0.83833
0.84128	0.8442	0.84708	0.84992	0.85272
0.85548	0.8582	0.86088	0.86352	0.86612
0.86869	0.87121	0.87369	0.87613	0.87853
0.88089	0.88321	0.88549	0.88773	0.88993
0.8921	0.89422	0.8963	0.89834	0.90034
0.9023	0.90423	0.90614	0.90804	0.90993
0.91181	0.91369	0.91555	0.9174	0.91924
0.92108	0.9229	0.92471	0.92651	0.92831
0.93009	0.93186	0.93362	0.93538	0.93712
0.93885	0.94057	0.94229	0.94399	0.94568
0.94736	0.94904	0.9507	0.95235	0.95399
0.95563	0.95725	0.95886	0.96047	0.96206
0.96364	0.96521	0.96678	0.96833	0.96987
0.97141	0.97293	0.97444	0.97595	0.97744
0.97892	0.9804	0.98186	0.98331	0.98475
0.98619	0.98761	0.98902	0.99043	0.99182
0.99321	0.99458	0.99594	0.9973	0.99864
1				

500_yr_sm 0.1 hr increment

0	0.00104	0.00208	0.00313	0.00419
0.00526	0.00634	0.00743	0.00853	0.00965
0.01077	0.0119	0.01304	0.01419	0.01535
0.01652	0.0177	0.0189	0.0201	0.02131
0.02253	0.02376	0.02501	0.02626	0.02752
0.02879	0.03008	0.03137	0.03267	0.03399
0.03531	0.03664	0.03799	0.03934	0.0407
0.04208	0.04346	0.04486	0.04626	0.04767
0.0491	0.05053	0.05198	0.05343	0.0549
0.05637	0.05786	0.05935	0.06086	0.06237
0.0639	0.06543	0.06698	0.06854	0.0701
0.07168	0.07326	0.07486	0.07647	0.07808
0.07971	0.08138	0.08309	0.08483	0.08662
0.08845	0.09032	0.09223	0.09418	0.09617
0.0982	0.10027	0.10239	0.10454	0.10673
0.10897	0.11124	0.11355	0.11591	0.11831
0.12074	0.12322	0.12573	0.12829	0.13089
0.13353	0.13621	0.13893	0.14168	0.14449
0.14733	0.15031	0.15343	0.1567	0.16011
0.16366	0.16735	0.17119	0.17516	0.17928
0.18355	0.18795	0.19249	0.19718	0.20201
0.20698	0.21247	0.21848	0.225	0.23204
0.2396	0.24805	0.25739	0.26762	0.27874
0.29074	0.30682	0.32374	0.34899	0.38778
0.46474	0.61222	0.65101	0.67626	0.69318
0.70926	0.72126	0.73238	0.74261	0.75195

0.7604	0.76796	0.775	0.78152	0.78753
0.79302	0.79799	0.80282	0.80751	0.81205
0.81645	0.82072	0.82484	0.82881	0.83265
0.83634	0.83989	0.8433	0.84657	0.84969
0.85267	0.85552	0.85831	0.86107	0.86379
0.86647	0.86911	0.87171	0.87427	0.87678
0.87926	0.88169	0.88409	0.88645	0.88876
0.89103	0.89327	0.89546	0.89761	0.89973
0.9018	0.90383	0.90582	0.90777	0.90968
0.91155	0.91338	0.91517	0.91691	0.91862
0.92029	0.92192	0.92353	0.92514	0.92674
0.92832	0.9299	0.93146	0.93302	0.93457
0.9361	0.93763	0.93914	0.94065	0.94214
0.94363	0.9451	0.94657	0.94802	0.94947
0.9509	0.95233	0.95374	0.95514	0.95654
0.95792	0.9593	0.96066	0.96201	0.96336
0.96469	0.96601	0.96733	0.96863	0.96992
0.97121	0.97248	0.97374	0.97499	0.97624
0.97747	0.97869	0.9799	0.9811	0.9823
0.98348	0.98465	0.98581	0.98696	0.9881
0.98923	0.99035	0.99147	0.99257	0.99366
0.99474	0.99581	0.99687	0.99792	0.99896
1				

WW-2 CUMULATIVE RAINFALL TABLES

10_yr_sm 0.1 hr increment

0	0.002	0.00399	0.006	0.00801
0.01002	0.01205	0.01409	0.01613	0.01819
0.02025	0.02233	0.02441	0.0265	0.0286
0.0307	0.03282	0.03495	0.03708	0.03922
0.04138	0.04354	0.04571	0.04789	0.05007
0.05227	0.05448	0.05669	0.05891	0.06115
0.06339	0.06564	0.0679	0.07016	0.07244
0.07473	0.07702	0.07932	0.08163	0.08396
0.08629	0.08862	0.09097	0.09333	0.09569
0.09807	0.10045	0.10284	0.10524	0.10765
0.11007	0.1125	0.11494	0.11738	0.11984
0.1223	0.12477	0.12725	0.12974	0.13224
0.13475	0.13729	0.13987	0.14248	0.14513
0.14782	0.15054	0.15329	0.15608	0.15891
0.16177	0.16467	0.1676	0.17057	0.17358
0.17662	0.17969	0.1828	0.18595	0.18913
0.19235	0.1956	0.19889	0.20222	0.20558
0.20897	0.2124	0.21587	0.21937	0.22291
0.22648	0.23016	0.23393	0.23782	0.2418
0.24589	0.25008	0.25438	0.25878	0.26328
0.26788	0.27259	0.2774	0.28231	0.28733
0.29245	0.2979	0.30366	0.30976	0.31617
0.32291	0.33008	0.33768	0.34571	0.35417
0.36304	0.37346	0.38443	0.401	0.42659
0.47709	0.57341	0.599	0.61557	0.62654
0.63696	0.64583	0.65429	0.66232	0.66992
0.67709	0.68383	0.69024	0.69634	0.7021
0.70755	0.71267	0.71769	0.7226	0.72741
0.73212	0.73672	0.74122	0.74562	0.74992
0.75411	0.7582	0.76218	0.76607	0.76984
0.77352	0.77709	0.78063	0.78413	0.7876
0.79103	0.79442	0.79778	0.80111	0.8044
0.80765	0.81087	0.81405	0.8172	0.82031
0.82338	0.82642	0.82943	0.8324	0.83533
0.83823	0.84109	0.84392	0.84671	0.84946
0.85218	0.85487	0.85752	0.86013	0.86271
0.86525	0.86776	0.87026	0.87275	0.87523
0.8777	0.88016	0.88262	0.88506	0.8875
0.88993	0.89235	0.89476	0.89716	0.89955
0.90193	0.90431	0.90667	0.90903	0.91138
0.91371	0.91604	0.91837	0.92068	0.92298
0.92527	0.92756	0.92984	0.9321	0.93436
0.93661	0.93885	0.94109	0.94331	0.94552
0.94773	0.94993	0.95211	0.95429	0.95646
0.95862	0.96078	0.96292	0.96505	0.96718
0.9693	0.9714	0.9735	0.97559	0.97767

0.97975	0.98181	0.98387	0.98591	0.98795
0.98998	0.99199	0.994	0.99601	0.998
1				

25_yr_sm 0.1 hr increment

0	0.0018	0.00359	0.00538	0.00718
0.009	0.01082	0.01265	0.01449	0.01634
0.0182	0.02007	0.02195	0.02384	0.02573
0.02764	0.02956	0.03148	0.03342	0.03536
0.03731	0.03927	0.04125	0.04323	0.04522
0.04722	0.04923	0.05125	0.05327	0.05531
0.05736	0.05941	0.06148	0.06355	0.06564
0.06773	0.06983	0.07195	0.07407	0.0762
0.07834	0.08049	0.08265	0.08481	0.08699
0.08918	0.09137	0.09358	0.09579	0.09802
0.10025	0.10249	0.10475	0.10701	0.10928
0.11156	0.11385	0.11615	0.11846	0.12077
0.1231	0.12547	0.12787	0.13031	0.13278
0.1353	0.13785	0.14044	0.14306	0.14573
0.14843	0.15116	0.15394	0.15675	0.1596
0.16249	0.16542	0.16838	0.17138	0.17442
0.17749	0.1806	0.18375	0.18694	0.19016
0.19342	0.19672	0.20006	0.20343	0.20684
0.21029	0.21385	0.21753	0.22131	0.22521
0.22922	0.23334	0.23758	0.24193	0.24639
0.25096	0.25565	0.26045	0.26536	0.27038
0.27551	0.28101	0.28688	0.2931	0.29969
0.30665	0.31411	0.3221	0.33059	0.3396
0.3491	0.3606	0.3727	0.39092	0.41902
0.47463	0.58098	0.60908	0.6273	0.6394
0.6509	0.6604	0.66941	0.6779	0.68589
0.69335	0.70031	0.7069	0.71312	0.71899
0.72449	0.72962	0.73464	0.73955	0.74435
0.74904	0.75361	0.75807	0.76242	0.76666
0.77078	0.77479	0.77869	0.78247	0.78615
0.78971	0.79316	0.79657	0.79994	0.80328
0.80658	0.80984	0.81306	0.81625	0.8194
0.82251	0.82558	0.82862	0.83162	0.83458
0.83751	0.8404	0.84325	0.84606	0.84884
0.85157	0.85427	0.85694	0.85956	0.86215
0.8647	0.86722	0.86969	0.87213	0.87453
0.8769	0.87923	0.88154	0.88385	0.88615
0.88844	0.89072	0.89299	0.89525	0.89751
0.89975	0.90198	0.90421	0.90642	0.90863
0.91082	0.91301	0.91519	0.91735	0.91951
0.92166	0.9238	0.92593	0.92805	0.93017
0.93227	0.93436	0.93645	0.93852	0.94059

0.94264	0.94469	0.94673	0.94875	0.95077
0.95278	0.95478	0.95677	0.95875	0.96073
0.96269	0.96464	0.96658	0.96852	0.97044
0.97236	0.97427	0.97616	0.97805	0.97993
0.9818	0.98366	0.98551	0.98735	0.98918
0.991	0.99282	0.99462	0.99641	0.9982
1				

50_yr_sm 0.1 hr increment

0	0.00157	0.00315	0.00474	0.00634
0.00795	0.00957	0.0112	0.01284	0.01449
0.01615	0.01782	0.0195	0.02119	0.02289
0.0246	0.02631	0.02804	0.02978	0.03153
0.03328	0.03505	0.03683	0.03861	0.04041
0.04222	0.04403	0.04586	0.04769	0.04954
0.05139	0.05326	0.05513	0.05702	0.05891
0.06081	0.06273	0.06465	0.06658	0.06853
0.07048	0.07244	0.07441	0.0764	0.07839
0.08039	0.0824	0.08442	0.08645	0.08849
0.09054	0.09261	0.09468	0.09676	0.09884
0.10094	0.10305	0.10517	0.1073	0.10944
0.11159	0.11377	0.116	0.11827	0.12057
0.12292	0.1253	0.12772	0.13018	0.13268
0.13522	0.1378	0.14042	0.14307	0.14577
0.14851	0.15128	0.15409	0.15695	0.15984
0.16277	0.16574	0.16875	0.17179	0.17488
0.17801	0.18117	0.18438	0.18762	0.1909
0.19422	0.19767	0.20123	0.20492	0.20873
0.21266	0.21672	0.22089	0.22519	0.22961
0.23415	0.23881	0.2436	0.2485	0.25353
0.25868	0.26424	0.2702	0.27657	0.28334
0.29052	0.2983	0.30669	0.31568	0.32527
0.33546	0.34802	0.36124	0.38109	0.41168
0.47229	0.58832	0.61891	0.63876	0.65198
0.66454	0.67473	0.68432	0.69331	0.7017
0.70948	0.71666	0.72343	0.7298	0.73576
0.74132	0.74647	0.7515	0.7564	0.76119
0.76585	0.77039	0.77481	0.77911	0.78328
0.78734	0.79127	0.79508	0.79877	0.80233
0.80578	0.8091	0.81238	0.81562	0.81883
0.82199	0.82512	0.82821	0.83125	0.83426
0.83723	0.84016	0.84306	0.84591	0.84872
0.85149	0.85423	0.85693	0.85958	0.8622
0.86478	0.86732	0.86982	0.87228	0.8747
0.87708	0.87943	0.88173	0.884	0.88623
0.88841	0.89056	0.8927	0.89483	0.89695
0.89906	0.90116	0.90324	0.90532	0.90739

0.90946	0.91151	0.91355	0.91558	0.9176
0.91961	0.92161	0.9236	0.92559	0.92756
0.92952	0.93147	0.93342	0.93535	0.93727
0.93919	0.94109	0.94298	0.94487	0.94674
0.94861	0.95046	0.95231	0.95414	0.95597
0.95778	0.95959	0.96139	0.96317	0.96495
0.96672	0.96847	0.97022	0.97196	0.97369
0.9754	0.97711	0.97881	0.9805	0.98218
0.98385	0.98551	0.98716	0.9888	0.99043
0.99205	0.99366	0.99526	0.99685	0.99843
1				

100_yr_sm 0.1 hr increment

0	0.00139	0.00278	0.00418	0.00559
0.00701	0.00845	0.00989	0.01134	0.0128
0.01427	0.01576	0.01725	0.01875	0.02026
0.02178	0.02331	0.02486	0.02641	0.02797
0.02954	0.03112	0.03272	0.03432	0.03593
0.03755	0.03918	0.04083	0.04248	0.04414
0.04581	0.04749	0.04919	0.05089	0.0526
0.05432	0.05606	0.0578	0.05955	0.06131
0.06308	0.06487	0.06666	0.06846	0.07027
0.0721	0.07393	0.07577	0.07762	0.07948
0.08136	0.08324	0.08513	0.08703	0.08895
0.09087	0.0928	0.09474	0.0967	0.09866
0.10063	0.10264	0.1047	0.10679	0.10892
0.11109	0.11331	0.11556	0.11785	0.12019
0.12256	0.12497	0.12743	0.12992	0.13245
0.13502	0.13764	0.14029	0.14299	0.14572
0.14849	0.15131	0.15416	0.15705	0.15999
0.16296	0.16597	0.16903	0.17212	0.17526
0.17843	0.18173	0.18517	0.18873	0.19242
0.19625	0.2002	0.20428	0.20849	0.21284
0.21731	0.22191	0.22664	0.2315	0.23649
0.24161	0.24718	0.25319	0.25964	0.26654
0.27388	0.28192	0.29066	0.30009	0.31021
0.32102	0.33472	0.34914	0.37075	0.40399
0.46987	0.59601	0.62925	0.65086	0.66528
0.67898	0.68979	0.69991	0.70934	0.71808
0.72612	0.73346	0.74036	0.74681	0.75282
0.75839	0.76351	0.7685	0.77336	0.77809
0.78269	0.78716	0.79151	0.79572	0.7998
0.80375	0.80758	0.81127	0.81483	0.81827
0.82157	0.82474	0.82788	0.83097	0.83403
0.83704	0.84001	0.84295	0.84584	0.84869
0.85151	0.85428	0.85702	0.85971	0.86236
0.86498	0.86755	0.87008	0.87257	0.87503

0.87744	0.87981	0.88215	0.88444	0.88669
0.88891	0.89108	0.89321	0.8953	0.89736
0.89937	0.90134	0.9033	0.90526	0.9072
0.90913	0.91105	0.91297	0.91487	0.91676
0.91864	0.92052	0.92238	0.92423	0.92607
0.9279	0.92973	0.93154	0.93334	0.93513
0.93692	0.93869	0.94045	0.9422	0.94394
0.94568	0.9474	0.94911	0.95081	0.95251
0.95419	0.95586	0.95752	0.95917	0.96082
0.96245	0.96407	0.96568	0.96728	0.96888
0.97046	0.97203	0.97359	0.97514	0.97669
0.97822	0.97974	0.98125	0.98275	0.98424
0.98573	0.9872	0.98866	0.99011	0.99155
0.99299	0.99441	0.99582	0.99722	0.99861
1				

200_yr_sm 0.1 hr increment

0	0.00118	0.00236	0.00355	0.00475
0.00597	0.00719	0.00842	0.00966	0.01092
0.01218	0.01345	0.01473	0.01603	0.01733
0.01864	0.01997	0.0213	0.02265	0.024
0.02536	0.02674	0.02812	0.02952	0.03092
0.03234	0.03376	0.0352	0.03664	0.0381
0.03956	0.04104	0.04253	0.04402	0.04553
0.04704	0.04857	0.05011	0.05165	0.05321
0.05478	0.05635	0.05794	0.05954	0.06115
0.06276	0.06439	0.06603	0.06768	0.06934
0.071	0.07268	0.07437	0.07607	0.07778
0.0795	0.08123	0.08297	0.08472	0.08648
0.08825	0.09006	0.09191	0.0938	0.09573
0.0977	0.09972	0.10177	0.10386	0.106
0.10817	0.11039	0.11265	0.11494	0.11728
0.11966	0.12208	0.12454	0.12703	0.12958
0.13216	0.13478	0.13744	0.14014	0.14288
0.14567	0.14849	0.15136	0.15426	0.15721
0.16019	0.16332	0.16658	0.16998	0.17351
0.17719	0.181	0.18495	0.18904	0.19326
0.19762	0.20212	0.20676	0.21153	0.21644
0.22149	0.22703	0.23305	0.23957	0.24657
0.25406	0.26235	0.27145	0.28135	0.29206
0.30357	0.3186	0.33441	0.35808	0.39451
0.46682	0.60549	0.64192	0.66559	0.6814
0.69643	0.70794	0.71865	0.72855	0.73765
0.74594	0.75343	0.76043	0.76695	0.77297
0.77851	0.78356	0.78847	0.79324	0.79788
0.80238	0.80674	0.81096	0.81505	0.819
0.82281	0.82649	0.83002	0.83342	0.83668

0.83981	0.84279	0.84574	0.84864	0.85151
0.85433	0.85712	0.85986	0.86256	0.86522
0.86784	0.87042	0.87296	0.87546	0.87792
0.88034	0.88272	0.88506	0.88735	0.88961
0.89183	0.894	0.89614	0.89823	0.90028
0.9023	0.90427	0.9062	0.90809	0.90994
0.91175	0.91352	0.91528	0.91703	0.91877
0.9205	0.92222	0.92393	0.92563	0.92732
0.929	0.93066	0.93232	0.93397	0.93561
0.93724	0.93885	0.94046	0.94206	0.94365
0.94522	0.94679	0.94835	0.94989	0.95143
0.95296	0.95447	0.95598	0.95747	0.95896
0.96044	0.9619	0.96336	0.9648	0.96624
0.96766	0.96908	0.97048	0.97188	0.97326
0.97464	0.976	0.97735	0.9787	0.98003
0.98136	0.98267	0.98397	0.98527	0.98655
0.98782	0.98908	0.99034	0.99158	0.99281
0.99403	0.99525	0.99645	0.99764	0.99882
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500_yr_sm 0.1 hr increment

0	0.000875	0.00175	0.00263	0.00353
0.00443	0.00534	0.00627	0.0072	0.00815
0.0091	0.01006	0.01104	0.01202	0.01302
0.01402	0.01503	0.01606	0.01709	0.01814
0.01919	0.02025	0.02133	0.02241	0.02351
0.02461	0.02573	0.02685	0.02799	0.02913
0.03028	0.03145	0.03262	0.03381	0.035
0.03621	0.03742	0.03865	0.03988	0.04112
0.04238	0.04364	0.04492	0.0462	0.0475
0.0488	0.05012	0.05144	0.05278	0.05412
0.05548	0.05684	0.05822	0.0596	0.061
0.0624	0.06382	0.06524	0.06668	0.06812
0.06958	0.07107	0.07261	0.07418	0.0758
0.07745	0.07915	0.08088	0.08266	0.08448
0.08633	0.08823	0.09016	0.09214	0.09416
0.09621	0.09831	0.10045	0.10262	0.10484
0.1071	0.10939	0.11173	0.11411	0.11653
0.11898	0.12148	0.12402	0.1266	0.12921
0.13187	0.13468	0.13763	0.14073	0.14397
0.14737	0.15091	0.1546	0.15843	0.16242
0.16655	0.17082	0.17525	0.17982	0.18454
0.1894	0.19482	0.2008	0.20732	0.2144
0.22204	0.23067	0.2403	0.25093	0.26255
0.27517	0.29253	0.31081	0.33804	0.37979
0.46238	0.62021	0.66196	0.68919	0.70747
0.72483	0.73745	0.74907	0.7597	0.76933

0.77796	0.7856	0.79268	0.7992	0.80518
0.8106	0.81546	0.82018	0.82475	0.82918
0.83345	0.83758	0.84157	0.8454	0.84909
0.85263	0.85603	0.85927	0.86237	0.86532
0.86813	0.87079	0.8734	0.87598	0.87852
0.88102	0.88347	0.88589	0.88827	0.89061
0.8929	0.89516	0.89738	0.89955	0.90169
0.90379	0.90584	0.90786	0.90984	0.91177
0.91367	0.91552	0.91734	0.91912	0.92085
0.92255	0.9242	0.92582	0.92739	0.92893
0.93042	0.93188	0.93332	0.93476	0.93618
0.9376	0.939	0.9404	0.94178	0.94316
0.94452	0.94588	0.94722	0.94856	0.94988
0.9512	0.9525	0.9538	0.95508	0.95636
0.95762	0.95888	0.96012	0.96135	0.96258
0.96379	0.965	0.96619	0.96738	0.96855
0.96972	0.97087	0.97201	0.97315	0.97427
0.97539	0.97649	0.97759	0.97867	0.97975
0.98081	0.98186	0.98291	0.98394	0.98497
0.98598	0.98698	0.98798	0.98896	0.98994
0.9909	0.99185	0.9928	0.99373	0.99466
0.99557	0.99647	0.99737	0.99825	0.999125
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WW-3 CUMULATIVE RAINFALL TABLES

10_yr_sm 0.1 hr increment

0	0.00208	0.00415	0.00623	0.00831
0.0104	0.0125	0.01461	0.01673	0.01886
0.02099	0.02314	0.02529	0.02745	0.02962
0.0318	0.03399	0.03619	0.03839	0.0406
0.04283	0.04506	0.0473	0.04955	0.0518
0.05407	0.05634	0.05862	0.06092	0.06322
0.06553	0.06784	0.07017	0.0725	0.07485
0.0772	0.07956	0.08193	0.08431	0.08669
0.08909	0.09149	0.09391	0.09633	0.09876
0.1012	0.10364	0.1061	0.10857	0.11104
0.11352	0.11601	0.11851	0.12102	0.12354
0.12606	0.12859	0.13114	0.13369	0.13625
0.13882	0.14142	0.14406	0.14673	0.14944
0.15218	0.15496	0.15777	0.16061	0.16349
0.16641	0.16936	0.17234	0.17536	0.17841
0.1815	0.18463	0.18778	0.19097	0.1942
0.19746	0.20076	0.20409	0.20745	0.21085
0.21429	0.21776	0.22126	0.2248	0.22837
0.23198	0.23569	0.23949	0.2434	0.2474
0.25151	0.25571	0.26001	0.26442	0.26892
0.27352	0.27822	0.28302	0.28792	0.29291
0.29801	0.30342	0.30913	0.31515	0.32149
0.32813	0.33517	0.34262	0.35047	0.35872
0.36736	0.37744	0.38805	0.40409	0.42885
0.47778	0.57115	0.59591	0.61195	0.62256
0.63264	0.64128	0.64953	0.65738	0.66483
0.67187	0.67851	0.68485	0.69087	0.69658
0.70199	0.70709	0.71208	0.71698	0.72178
0.72648	0.73108	0.73558	0.73999	0.74429
0.74849	0.7526	0.7566	0.76051	0.76431
0.76802	0.77163	0.7752	0.77874	0.78224
0.78571	0.78915	0.79255	0.79591	0.79924
0.80254	0.8058	0.80903	0.81222	0.81537
0.8185	0.82159	0.82464	0.82766	0.83064
0.83359	0.83651	0.83939	0.84223	0.84504
0.84782	0.85056	0.85327	0.85594	0.85858
0.86118	0.86375	0.86631	0.86886	0.87141
0.87394	0.87646	0.87898	0.88149	0.88399
0.88648	0.88896	0.89143	0.8939	0.89636
0.8988	0.90124	0.90367	0.90609	0.90851
0.91091	0.91331	0.91569	0.91807	0.92044
0.9228	0.92515	0.9275	0.92983	0.93216
0.93447	0.93678	0.93908	0.94138	0.94366
0.94593	0.9482	0.95045	0.9527	0.95494
0.95717	0.9594	0.96161	0.96381	0.96601
0.9682	0.97038	0.97255	0.97471	0.97686

0.97901	0.98114	0.98327	0.98539	0.9875
0.9896	0.99169	0.99377	0.99585	0.99792
1				

25_yr_sm	0.1 hr increment			
0	0.00188	0.00373	0.0056	0.00747
0.00935	0.01125	0.01315	0.01506	0.01698
0.01891	0.02084	0.02279	0.02475	0.02671
0.02869	0.03067	0.03266	0.03467	0.03668
0.0387	0.04073	0.04277	0.04481	0.04687
0.04894	0.05101	0.0531	0.05519	0.05729
0.05941	0.06153	0.06366	0.0658	0.06795
0.07011	0.07227	0.07445	0.07664	0.07883
0.08103	0.08325	0.08547	0.0877	0.08994
0.09219	0.09445	0.09672	0.099	0.10128
0.10358	0.10588	0.1082	0.11052	0.11285
0.11519	0.11755	0.11991	0.12227	0.12465
0.12704	0.12946	0.13193	0.13442	0.13696
0.13953	0.14214	0.14478	0.14746	0.15018
0.15293	0.15573	0.15855	0.16142	0.16432
0.16726	0.17023	0.17324	0.17629	0.17938
0.1825	0.18566	0.18885	0.19208	0.19535
0.19866	0.202	0.20538	0.20879	0.21225
0.21573	0.21933	0.22304	0.22685	0.23078
0.23481	0.23896	0.24321	0.24757	0.25204
0.25662	0.2613	0.2661	0.27101	0.27602
0.28114	0.28662	0.29244	0.29861	0.30513
0.312	0.31935	0.3272	0.33552	0.34434
0.35361	0.36477	0.37653	0.3942	0.42146
0.4754	0.57854	0.6058	0.62347	0.63523
0.64639	0.65566	0.66448	0.6728	0.68065
0.688	0.69487	0.70139	0.70756	0.71338
0.71886	0.72398	0.72899	0.7339	0.7387
0.74338	0.74796	0.75243	0.75679	0.76104
0.76519	0.76922	0.77315	0.77696	0.78067
0.78427	0.78775	0.79121	0.79462	0.798
0.80134	0.80465	0.80792	0.81115	0.81434
0.8175	0.82062	0.82371	0.82676	0.82977
0.83274	0.83568	0.83858	0.84145	0.84427
0.84707	0.84982	0.85254	0.85522	0.85786
0.86047	0.86304	0.86558	0.86807	0.87054
0.87296	0.87535	0.87773	0.88009	0.88245
0.88481	0.88715	0.88948	0.8918	0.89412
0.89642	0.89872	0.901	0.90328	0.90555
0.90781	0.91006	0.9123	0.91453	0.91675
0.91897	0.92117	0.92336	0.92555	0.92773
0.92989	0.93205	0.9342	0.93634	0.93847

0.94059	0.94271	0.94481	0.9469	0.94899
0.95106	0.95313	0.95519	0.95723	0.95927
0.9613	0.96332	0.96533	0.96734	0.96933
0.97131	0.97329	0.97525	0.97721	0.97916
0.98109	0.98302	0.98494	0.98685	0.98875
0.99065	0.99253	0.9944	0.99627	0.99812
1				

50_yr_sm 0.1 hr increment

0	0.00166	0.00331	0.00498	0.00665
0.00834	0.01003	0.01174	0.01345	0.01517
0.01691	0.01865	0.0204	0.02216	0.02394
0.02572	0.02751	0.02931	0.03112	0.03294
0.03477	0.03661	0.03846	0.04032	0.04218
0.04406	0.04595	0.04785	0.04975	0.05167
0.0536	0.05553	0.05748	0.05943	0.0614
0.06337	0.06536	0.06735	0.06935	0.07137
0.07339	0.07542	0.07746	0.07952	0.08158
0.08365	0.08573	0.08782	0.08992	0.09203
0.09415	0.09628	0.09842	0.10056	0.10272
0.10489	0.10707	0.10925	0.11145	0.11366
0.11587	0.11813	0.12042	0.12275	0.12512
0.12753	0.12998	0.13246	0.13499	0.13755
0.14015	0.14279	0.14547	0.14819	0.15094
0.15374	0.15657	0.15945	0.16236	0.1653
0.16829	0.17132	0.17438	0.17749	0.18063
0.18381	0.18703	0.19029	0.19359	0.19692
0.20029	0.20379	0.2074	0.21113	0.21498
0.21894	0.22303	0.22723	0.23156	0.236
0.24056	0.24524	0.25004	0.25496	0.25999
0.26515	0.27069	0.27663	0.28295	0.28967
0.29678	0.30446	0.31272	0.32154	0.33094
0.34091	0.35312	0.36597	0.38523	0.41485
0.47338	0.58515	0.61477	0.63403	0.64688
0.65909	0.66906	0.67846	0.68728	0.69554
0.70322	0.71033	0.71705	0.72337	0.72931
0.73485	0.74001	0.74504	0.74996	0.75476
0.75944	0.764	0.76844	0.77277	0.77697
0.78106	0.78502	0.78887	0.7926	0.79621
0.79971	0.80308	0.80641	0.80971	0.81297
0.81619	0.81937	0.82251	0.82562	0.82868
0.83171	0.8347	0.83764	0.84055	0.84343
0.84626	0.84906	0.85181	0.85453	0.85721
0.85985	0.86245	0.86501	0.86754	0.87002
0.87247	0.87488	0.87725	0.87958	0.88187
0.88413	0.88634	0.88855	0.89075	0.89293
0.89511	0.89728	0.89944	0.90158	0.90372

0.90585	0.90797	0.91008	0.91218	0.91427
0.91635	0.91842	0.92048	0.92254	0.92458
0.92661	0.92863	0.93065	0.93265	0.93464
0.93663	0.9386	0.94057	0.94252	0.94447
0.9464	0.94833	0.95025	0.95215	0.95405
0.95594	0.95782	0.95968	0.96154	0.96339
0.96523	0.96706	0.96888	0.97069	0.97249
0.97428	0.97606	0.97784	0.9796	0.98135
0.98309	0.98483	0.98655	0.98826	0.98997
0.99166	0.99335	0.99502	0.99669	0.99834
1				

100_yr_sm 0.1 hr increment

0	0.00149	0.00297	0.00447	0.00597
0.00748	0.00901	0.01054	0.01208	0.01363
0.0152	0.01677	0.01835	0.01994	0.02154
0.02315	0.02478	0.02641	0.02805	0.0297
0.03136	0.03303	0.03471	0.0364	0.0381
0.03981	0.04153	0.04326	0.045	0.04675
0.04851	0.05028	0.05206	0.05385	0.05565
0.05746	0.05928	0.06111	0.06294	0.06479
0.06665	0.06852	0.0704	0.07228	0.07418
0.07609	0.07801	0.07993	0.08187	0.08382
0.08578	0.08774	0.08972	0.09171	0.0937
0.09571	0.09772	0.09975	0.10179	0.10383
0.10589	0.10798	0.11012	0.11229	0.1145
0.11676	0.11905	0.12138	0.12375	0.12616
0.12861	0.1311	0.13363	0.1362	0.13881
0.14146	0.14414	0.14687	0.14964	0.15244
0.15529	0.15817	0.1611	0.16406	0.16706
0.1701	0.17319	0.17631	0.17947	0.18267
0.18591	0.18927	0.19276	0.19638	0.20012
0.20399	0.20798	0.2121	0.21634	0.22071
0.22521	0.22983	0.23457	0.23944	0.24444
0.24956	0.25511	0.26108	0.26748	0.27429
0.28154	0.28943	0.29798	0.30717	0.31701
0.32749	0.34067	0.35455	0.37534	0.40736
0.47088	0.59264	0.62466	0.64545	0.65933
0.67251	0.68299	0.69283	0.70202	0.71057
0.71846	0.72571	0.73252	0.73892	0.74489
0.75044	0.75556	0.76056	0.76543	0.77017
0.77479	0.77929	0.78366	0.7879	0.79202
0.79601	0.79988	0.80362	0.80724	0.81073
0.81409	0.81733	0.82053	0.82369	0.82681
0.8299	0.83294	0.83594	0.8389	0.84183
0.84471	0.84756	0.85036	0.85313	0.85586
0.85854	0.86119	0.8638	0.86637	0.8689

0.87139	0.87384	0.87625	0.87862	0.88095
0.88324	0.8855	0.88771	0.88988	0.89202
0.89411	0.89617	0.89821	0.90025	0.90228
0.90429	0.9063	0.90829	0.91028	0.91226
0.91422	0.91618	0.91813	0.92007	0.92199
0.92391	0.92582	0.92772	0.9296	0.93148
0.93335	0.93521	0.93706	0.93889	0.94072
0.94254	0.94435	0.94615	0.94794	0.94972
0.95149	0.95325	0.955	0.95674	0.95847
0.96019	0.9619	0.9636	0.96529	0.96697
0.96864	0.9703	0.97195	0.97359	0.97522
0.97685	0.97846	0.98006	0.98165	0.98323
0.9848	0.98637	0.98792	0.98946	0.99099
0.99252	0.99403	0.99553	0.99703	0.99851
1				

200_yr_sm 0.1 hr increment

0	0.00126	0.00252	0.00379	0.00507
0.00636	0.00766	0.00897	0.01029	0.01162
0.01295	0.0143	0.01566	0.01703	0.01841
0.0198	0.0212	0.02261	0.02403	0.02546
0.0269	0.02835	0.02981	0.03128	0.03276
0.03425	0.03576	0.03727	0.03879	0.04032
0.04186	0.04341	0.04497	0.04654	0.04812
0.04972	0.05132	0.05293	0.05455	0.05618
0.05782	0.05948	0.06114	0.06281	0.06449
0.06619	0.06789	0.0696	0.07132	0.07306
0.0748	0.07655	0.07831	0.08009	0.08187
0.08366	0.08547	0.08728	0.0891	0.09094
0.09278	0.09467	0.09659	0.09855	0.10056
0.10261	0.10469	0.10682	0.10898	0.11119
0.11344	0.11573	0.11805	0.12042	0.12283
0.12528	0.12777	0.1303	0.13287	0.13548
0.13813	0.14082	0.14355	0.14632	0.14914
0.15199	0.15488	0.15781	0.16079	0.1638
0.16686	0.17004	0.17337	0.17683	0.18042
0.18415	0.18801	0.192	0.19614	0.2004
0.2048	0.20934	0.21401	0.21881	0.22375
0.22883	0.23437	0.24039	0.24688	0.25384
0.26128	0.26948	0.27844	0.28818	0.29868
0.30993	0.32453	0.3399	0.36286	0.39815
0.46806	0.60185	0.63714	0.6601	0.67547
0.69007	0.70132	0.71182	0.72156	0.73052
0.73872	0.74616	0.75312	0.75961	0.76563
0.77117	0.77625	0.78119	0.78599	0.79066
0.7952	0.7996	0.80386	0.808	0.81199
0.81585	0.81958	0.82317	0.82663	0.82996

0.83314	0.8362	0.83921	0.84219	0.84512
0.84801	0.85086	0.85368	0.85645	0.85918
0.86187	0.86452	0.86713	0.8697	0.87223
0.87472	0.87717	0.87958	0.88195	0.88427
0.88656	0.88881	0.89102	0.89318	0.89531
0.89739	0.89944	0.90145	0.90341	0.90533
0.90722	0.90906	0.9109	0.91272	0.91453
0.91634	0.91813	0.91991	0.92169	0.92345
0.9252	0.92694	0.92868	0.9304	0.93211
0.93381	0.93551	0.93719	0.93886	0.94052
0.94218	0.94382	0.94545	0.94707	0.94868
0.95028	0.95188	0.95346	0.95503	0.95659
0.95814	0.95968	0.96121	0.96273	0.96424
0.96575	0.96724	0.96872	0.97019	0.97165
0.9731	0.97454	0.97597	0.97739	0.9788
0.9802	0.98159	0.98297	0.98434	0.9857
0.98705	0.98838	0.98971	0.99103	0.99234
0.99364	0.99493	0.99621	0.99748	0.99874
1				

500_yr_sm 0.1 hr increment

0	0.000992	0.00197	0.00295	0.00395
0.00495	0.00597	0.00699	0.00802	0.00907
0.01012	0.01119	0.01226	0.01335	0.01444
0.01555	0.01666	0.01779	0.01892	0.02007
0.02122	0.02239	0.02356	0.02475	0.02595
0.02715	0.02837	0.02959	0.03083	0.03207
0.03333	0.03459	0.03587	0.03715	0.03845
0.03975	0.04107	0.0424	0.04373	0.04508
0.04643	0.0478	0.04917	0.05056	0.05195
0.05336	0.05478	0.0562	0.05764	0.05908
0.06054	0.062	0.06348	0.06497	0.06646
0.06797	0.06948	0.07101	0.07255	0.07409
0.07565	0.07724	0.07888	0.08056	0.08227
0.08403	0.08583	0.08766	0.08954	0.09146
0.09342	0.09541	0.09745	0.09953	0.10164
0.1038	0.106	0.10824	0.11052	0.11283
0.11519	0.11759	0.12003	0.12251	0.12502
0.12758	0.13018	0.13282	0.1355	0.13822
0.14098	0.14388	0.14693	0.15012	0.15345
0.15693	0.16055	0.16431	0.16822	0.17227
0.17647	0.18081	0.18529	0.18991	0.19468
0.1996	0.20504	0.21101	0.21752	0.22455
0.23212	0.24062	0.25004	0.26041	0.2717
0.2839	0.30054	0.31806	0.34418	0.38427
0.4637	0.61573	0.65582	0.68194	0.69946
0.7161	0.7283	0.73959	0.74996	0.75938

0.76788	0.77545	0.78248	0.78899	0.79496
0.8004	0.80532	0.81009	0.81471	0.81919
0.82353	0.82773	0.83178	0.83569	0.83945
0.84307	0.84655	0.84988	0.85307	0.85612
0.85902	0.86178	0.8645	0.86718	0.86982
0.87242	0.87498	0.87749	0.87997	0.88241
0.88481	0.88717	0.88948	0.89176	0.894
0.8962	0.89836	0.90047	0.90255	0.90459
0.90658	0.90854	0.91046	0.91234	0.91417
0.91597	0.91773	0.91944	0.92112	0.92276
0.92435	0.92591	0.92745	0.92899	0.93052
0.93203	0.93354	0.93503	0.93652	0.938
0.93946	0.94092	0.94236	0.9438	0.94522
0.94664	0.94805	0.94944	0.95083	0.9522
0.95357	0.95492	0.95627	0.95761	0.95893
0.96025	0.96155	0.96285	0.96413	0.96541
0.96667	0.96793	0.96917	0.97041	0.97163
0.97285	0.97405	0.97525	0.97644	0.97761
0.97878	0.97993	0.98108	0.98221	0.98334
0.98445	0.98556	0.98665	0.98774	0.98881
0.98988	0.99093	0.99198	0.99301	0.99403
0.99505	0.99605	0.99705	0.99803	0.999008
1				

WW-4 CUMULATIVE RAINFALL TABLES

10_yr_sm 0.1 hr increment

0	0.00218	0.00436	0.00655	0.00875
0.01096	0.01317	0.01539	0.01763	0.01987
0.02212	0.02437	0.02664	0.02891	0.03119
0.03348	0.03578	0.03809	0.04041	0.04273
0.04506	0.0474	0.04975	0.05211	0.05447
0.05685	0.05923	0.06162	0.06402	0.06643
0.06884	0.07127	0.0737	0.07614	0.07859
0.08105	0.08352	0.08599	0.08847	0.09096
0.09346	0.09597	0.09849	0.10101	0.10354
0.10608	0.10863	0.11119	0.11376	0.11633
0.11892	0.12151	0.12411	0.12672	0.12933
0.13196	0.13459	0.13723	0.13988	0.14254
0.14521	0.14791	0.15064	0.15341	0.15621
0.15904	0.16191	0.16481	0.16774	0.17071
0.17371	0.17674	0.17981	0.18291	0.18605
0.18922	0.19242	0.19565	0.19892	0.20222
0.20556	0.20893	0.21233	0.21576	0.21923
0.22273	0.22627	0.22984	0.23344	0.23708
0.24075	0.24451	0.24837	0.25232	0.25636
0.2605	0.26473	0.26906	0.27348	0.27799
0.2826	0.2873	0.29209	0.29698	0.30196
0.30704	0.3124	0.31804	0.32398	0.3302
0.33671	0.34358	0.35082	0.35842	0.36639
0.37472	0.38426	0.39431	0.40946	0.43285
0.47903	0.56715	0.59054	0.60569	0.61574
0.62528	0.63361	0.64158	0.64918	0.65642
0.66329	0.6698	0.67602	0.68196	0.6876
0.69296	0.69804	0.70302	0.70791	0.7127
0.7174	0.72201	0.72652	0.73094	0.73527
0.7395	0.74364	0.74768	0.75163	0.75549
0.75925	0.76292	0.76656	0.77016	0.77373
0.77727	0.78077	0.78424	0.78767	0.79107
0.79444	0.79778	0.80108	0.80435	0.80758
0.81078	0.81395	0.81709	0.82019	0.82326
0.82629	0.82929	0.83226	0.83519	0.83809
0.84096	0.84379	0.84659	0.84936	0.85209
0.85479	0.85746	0.86012	0.86277	0.86541
0.86804	0.87067	0.87328	0.87589	0.87849
0.88108	0.88367	0.88624	0.88881	0.89137
0.89392	0.89646	0.89899	0.90151	0.90403
0.90654	0.90904	0.91153	0.91401	0.91648
0.91895	0.92141	0.92386	0.9263	0.92873
0.93116	0.93357	0.93598	0.93838	0.94077
0.94315	0.94553	0.94789	0.95025	0.9526
0.95494	0.95727	0.95959	0.96191	0.96422
0.96652	0.96881	0.97109	0.97336	0.97563

0.97788	0.98013	0.98237	0.98461	0.98683
0.98904	0.99125	0.99345	0.99564	0.99782
1				

25_yr_sm	0.1 hr increment			
0	0.00198	0.00396	0.00595	0.00794
0.00995	0.01196	0.01399	0.01602	0.01806
0.02011	0.02216	0.02423	0.02631	0.02839
0.03049	0.03259	0.0347	0.03682	0.03895
0.04109	0.04324	0.04539	0.04756	0.04973
0.05192	0.05411	0.05631	0.05852	0.06074
0.06297	0.0652	0.06745	0.0697	0.07197
0.07424	0.07652	0.07881	0.08111	0.08342
0.08574	0.08806	0.0904	0.09274	0.09509
0.09745	0.09982	0.1022	0.10459	0.10699
0.1094	0.11181	0.11423	0.11667	0.11911
0.12156	0.12402	0.12649	0.12897	0.13145
0.13395	0.13648	0.13905	0.14165	0.14429
0.14696	0.14967	0.15241	0.1552	0.15801
0.16086	0.16375	0.16668	0.16963	0.17263
0.17566	0.17873	0.18183	0.18497	0.18814
0.19135	0.19459	0.19787	0.20119	0.20454
0.20793	0.21135	0.21481	0.2183	0.22183
0.2254	0.22907	0.23284	0.23672	0.2407
0.24478	0.24897	0.25326	0.25765	0.26215
0.26675	0.27145	0.27626	0.28117	0.28618
0.2913	0.29674	0.3025	0.3086	0.31501
0.32175	0.32894	0.33656	0.34463	0.35314
0.36207	0.37262	0.38372	0.4004	0.42608
0.47688	0.57392	0.5996	0.61628	0.62738
0.63793	0.64686	0.65537	0.66344	0.67106
0.67825	0.68499	0.6914	0.6975	0.70326
0.7087	0.71382	0.71883	0.72374	0.72855
0.73325	0.73785	0.74235	0.74674	0.75103
0.75522	0.7593	0.76328	0.76716	0.77093
0.7746	0.77817	0.7817	0.78519	0.78865
0.79207	0.79546	0.79881	0.80213	0.80541
0.80865	0.81186	0.81503	0.81817	0.82127
0.82434	0.82737	0.83037	0.83332	0.83625
0.83914	0.84199	0.8448	0.84759	0.85033
0.85304	0.85571	0.85835	0.86095	0.86352
0.86605	0.86855	0.87103	0.87351	0.87598
0.87844	0.88089	0.88333	0.88577	0.88819
0.8906	0.89301	0.89541	0.8978	0.90018
0.90255	0.90491	0.90726	0.9096	0.91194
0.91426	0.91658	0.91889	0.92119	0.92348
0.92576	0.92803	0.9303	0.93255	0.9348

0.93703	0.93926	0.94148	0.94369	0.94589
0.94808	0.95027	0.95244	0.95461	0.95676
0.95891	0.96105	0.96318	0.9653	0.96741
0.96951	0.97161	0.97369	0.97577	0.97784
0.97989	0.98194	0.98398	0.98601	0.98804
0.99005	0.99206	0.99405	0.99604	0.99802
1				

50_yr_sm 0.1 hr increment

0	0.00185	0.00367	0.00551	0.00736
0.00921	0.01108	0.01295	0.01483	0.01673
0.01863	0.02054	0.02246	0.02439	0.02633
0.02827	0.03023	0.0322	0.03417	0.03616
0.03815	0.04015	0.04217	0.04419	0.04622
0.04826	0.05031	0.05236	0.05443	0.05651
0.05859	0.06069	0.06279	0.06491	0.06703
0.06916	0.0713	0.07346	0.07562	0.07778
0.07996	0.08215	0.08435	0.08655	0.08877
0.09099	0.09323	0.09547	0.09772	0.09998
0.10225	0.10453	0.10682	0.10912	0.11143
0.11374	0.11607	0.11841	0.12075	0.1231
0.12547	0.12787	0.1303	0.13278	0.13529
0.13783	0.14042	0.14304	0.1457	0.14839
0.15113	0.15389	0.1567	0.15954	0.16242
0.16534	0.16829	0.17128	0.17431	0.17738
0.18048	0.18361	0.18679	0.19	0.19325
0.19654	0.19986	0.20322	0.20661	0.21005
0.21352	0.2171	0.22079	0.22459	0.2285
0.23252	0.23665	0.24089	0.24523	0.24969
0.25426	0.25894	0.26373	0.26863	0.27363
0.27875	0.28422	0.29005	0.29622	0.30275
0.30963	0.31701	0.32489	0.33327	0.34215
0.3515	0.3628	0.3747	0.39258	0.42014
0.47488	0.57986	0.60742	0.6253	0.6372
0.6485	0.65785	0.66673	0.67511	0.68299
0.69037	0.69725	0.70378	0.70995	0.71578
0.72125	0.72637	0.73137	0.73627	0.74106
0.74574	0.75031	0.75477	0.75911	0.76335
0.76748	0.7715	0.77541	0.77921	0.7829
0.78648	0.78995	0.79339	0.79678	0.80014
0.80346	0.80675	0.81	0.81321	0.81639
0.81952	0.82262	0.82569	0.82872	0.83171
0.83466	0.83758	0.84046	0.8433	0.84611
0.84887	0.85161	0.8543	0.85696	0.85958
0.86217	0.86471	0.86722	0.8697	0.87213
0.87453	0.8769	0.87925	0.88159	0.88393
0.88626	0.88857	0.89088	0.89318	0.89547

0.89775	0.90002	0.90228	0.90453	0.90677
0.90901	0.91123	0.91345	0.91565	0.91785
0.92004	0.92222	0.92438	0.92654	0.9287
0.93084	0.93297	0.93509	0.93721	0.93931
0.94141	0.94349	0.94557	0.94764	0.94969
0.95174	0.95378	0.95581	0.95783	0.95985
0.96185	0.96384	0.96583	0.9678	0.96977
0.97173	0.97367	0.97561	0.97754	0.97946
0.98137	0.98327	0.98517	0.98705	0.98892
0.99079	0.99264	0.99449	0.99633	0.99815
1				

100_yr_sm 0.1 hr increment

0	0.0016	0.00321	0.00483	0.00646
0.0081	0.00975	0.01141	0.01308	0.01476
0.01644	0.01814	0.01985	0.02157	0.02329
0.02503	0.02678	0.02853	0.0303	0.03207
0.03386	0.03565	0.03746	0.03927	0.0411
0.04293	0.04477	0.04663	0.04849	0.05036
0.05225	0.05414	0.05604	0.05795	0.05988
0.06181	0.06375	0.0657	0.06766	0.06963
0.07161	0.0736	0.0756	0.07761	0.07963
0.08166	0.0837	0.08575	0.0878	0.08987
0.09195	0.09404	0.09613	0.09824	0.10036
0.10248	0.10462	0.10677	0.10892	0.11109
0.11326	0.11548	0.11773	0.12002	0.12235
0.12472	0.12713	0.12958	0.13207	0.13459
0.13716	0.13976	0.1424	0.14509	0.14781
0.15057	0.15337	0.1562	0.15908	0.162
0.16495	0.16794	0.17098	0.17405	0.17716
0.18031	0.1835	0.18672	0.18999	0.1933
0.19664	0.20011	0.20369	0.2074	0.21123
0.21517	0.21924	0.22343	0.22774	0.23217
0.23672	0.2414	0.24619	0.2511	0.25614
0.26129	0.26684	0.2728	0.27915	0.28591
0.29306	0.30081	0.30916	0.3181	0.32764
0.33777	0.35025	0.36339	0.38303	0.41319
0.47284	0.58681	0.61697	0.63661	0.64975
0.66223	0.67236	0.6819	0.69084	0.69919
0.70694	0.71409	0.72085	0.7272	0.73316
0.73871	0.74386	0.7489	0.75381	0.7586
0.76328	0.76783	0.77226	0.77657	0.78076
0.78483	0.78877	0.7926	0.79631	0.79989
0.80336	0.8067	0.81001	0.81328	0.8165
0.81969	0.82284	0.82595	0.82902	0.83206
0.83505	0.838	0.84092	0.8438	0.84663
0.84943	0.85219	0.85491	0.8576	0.86024

0.86284	0.86541	0.86793	0.87042	0.87287
0.87528	0.87765	0.87998	0.88227	0.88452
0.88674	0.88891	0.89108	0.89323	0.89538
0.89752	0.89964	0.90176	0.90387	0.90596
0.90805	0.91013	0.9122	0.91425	0.9163
0.91834	0.92037	0.92239	0.9244	0.9264
0.92839	0.93037	0.93234	0.9343	0.93625
0.93819	0.94012	0.94205	0.94396	0.94586
0.94775	0.94964	0.95151	0.95337	0.95523
0.95707	0.9589	0.96073	0.96254	0.96435
0.96614	0.96793	0.9697	0.97147	0.97322
0.97497	0.97671	0.97843	0.98015	0.98186
0.98356	0.98524	0.98692	0.98859	0.99025
0.9919	0.99354	0.99517	0.99679	0.9984
1				

200_yr_sm 0.1 hr increment

0	0.00142	0.00285	0.00428	0.00572
0.00717	0.00864	0.01011	0.01159	0.01309
0.01459	0.0161	0.01762	0.01916	0.0207
0.02225	0.02381	0.02539	0.02697	0.02856
0.03016	0.03177	0.0334	0.03503	0.03667
0.03832	0.03999	0.04166	0.04334	0.04503
0.04673	0.04845	0.05017	0.0519	0.05364
0.05539	0.05715	0.05893	0.06071	0.0625
0.0643	0.06611	0.06793	0.06977	0.07161
0.07346	0.07532	0.07719	0.07907	0.08096
0.08287	0.08478	0.0867	0.08863	0.09057
0.09252	0.09448	0.09645	0.09843	0.10042
0.10243	0.10447	0.10655	0.10867	0.11083
0.11303	0.11527	0.11755	0.11987	0.12223
0.12463	0.12707	0.12954	0.13206	0.13462
0.13722	0.13986	0.14254	0.14526	0.14801
0.15081	0.15365	0.15653	0.15944	0.1624
0.1654	0.16844	0.17151	0.17463	0.17779
0.18098	0.18431	0.18776	0.19134	0.19505
0.19889	0.20285	0.20695	0.21117	0.21552
0.22	0.2246	0.22934	0.2342	0.23919
0.24431	0.24986	0.25586	0.26229	0.26915
0.27646	0.28444	0.29311	0.30246	0.3125
0.32321	0.33676	0.35103	0.37236	0.40515
0.4702	0.59485	0.62764	0.64897	0.66324
0.67679	0.6875	0.69754	0.70689	0.71556
0.72354	0.73085	0.73771	0.74414	0.75014
0.75569	0.76081	0.7658	0.77066	0.7754
0.78	0.78448	0.78883	0.79305	0.79715
0.80111	0.80495	0.80866	0.81224	0.81569

0.81902	0.82221	0.82537	0.82849	0.83156
0.8346	0.8376	0.84056	0.84347	0.84635
0.84919	0.85199	0.85474	0.85746	0.86014
0.86278	0.86538	0.86794	0.87046	0.87293
0.87537	0.87777	0.88013	0.88245	0.88473
0.88697	0.88917	0.89133	0.89345	0.89553
0.89757	0.89958	0.90157	0.90355	0.90552
0.90748	0.90943	0.91137	0.9133	0.91522
0.91713	0.91904	0.92093	0.92281	0.92468
0.92654	0.92839	0.93023	0.93207	0.93389
0.9357	0.9375	0.93929	0.94107	0.94285
0.94461	0.94636	0.9481	0.94983	0.95155
0.95327	0.95497	0.95666	0.95834	0.96001
0.96168	0.96333	0.96497	0.9666	0.96823
0.96984	0.97144	0.97303	0.97461	0.97619
0.97775	0.9793	0.98084	0.98238	0.9839
0.98541	0.98691	0.98841	0.98989	0.99136
0.99283	0.99428	0.99572	0.99715	0.99858
1				

500_yr_sm 0.1 hr increment

0	0.00115	0.00229	0.00343	0.00459
0.00576	0.00693	0.00812	0.00932	0.01052
0.01174	0.01297	0.01421	0.01545	0.01671
0.01798	0.01926	0.02054	0.02184	0.02315
0.02447	0.02579	0.02713	0.02848	0.02984
0.03121	0.03259	0.03397	0.03537	0.03678
0.0382	0.03963	0.04107	0.04252	0.04397
0.04544	0.04692	0.04841	0.04991	0.05142
0.05294	0.05447	0.05601	0.05756	0.05912
0.06069	0.06227	0.06386	0.06546	0.06707
0.06869	0.07032	0.07196	0.07361	0.07527
0.07694	0.07862	0.08031	0.08201	0.08372
0.08544	0.08721	0.08901	0.09085	0.09273
0.09465	0.09662	0.09862	0.10066	0.10275
0.10487	0.10704	0.10924	0.11149	0.11377
0.1161	0.11846	0.12087	0.12332	0.1258
0.12833	0.1309	0.13351	0.13616	0.13884
0.14157	0.14434	0.14715	0.15	0.15289
0.15582	0.15889	0.1621	0.16545	0.16893
0.17255	0.17632	0.18022	0.18425	0.18843
0.19275	0.1972	0.2018	0.20653	0.2114
0.21641	0.22191	0.22791	0.23441	0.2414
0.24889	0.25722	0.26638	0.27638	0.28722
0.29886	0.31434	0.33063	0.35492	0.39222
0.46616	0.60778	0.64508	0.66937	0.68566
0.70114	0.71278	0.72362	0.73362	0.74278

0.75111	0.7586	0.76559	0.77209	0.77809
0.78359	0.7886	0.79347	0.7982	0.8028
0.80725	0.81157	0.81575	0.81978	0.82368
0.82745	0.83107	0.83455	0.8379	0.84111
0.84418	0.84711	0.85	0.85285	0.85566
0.85843	0.86116	0.86384	0.86649	0.8691
0.87167	0.8742	0.87668	0.87913	0.88154
0.8839	0.88623	0.88851	0.89076	0.89296
0.89513	0.89725	0.89934	0.90138	0.90338
0.90535	0.90727	0.90915	0.91099	0.91279
0.91456	0.91628	0.91799	0.91969	0.92138
0.92306	0.92473	0.92639	0.92804	0.92968
0.93131	0.93293	0.93454	0.93614	0.93773
0.93931	0.94088	0.94244	0.94399	0.94553
0.94706	0.94858	0.95009	0.95159	0.95308
0.95456	0.95603	0.95748	0.95893	0.96037
0.9618	0.96322	0.96463	0.96603	0.96741
0.96879	0.97016	0.97152	0.97287	0.97421
0.97553	0.97685	0.97816	0.97946	0.98074
0.98202	0.98329	0.98455	0.98579	0.98703
0.98826	0.98948	0.99068	0.99188	0.99307
0.99424	0.99541	0.99657	0.99771	0.99885
1				

WW-5 CUMULATIVE RAINFALL TABLES

10_yr_sm 0.1 hr increment

0	0.00208	0.00415	0.00623	0.00831
0.0104	0.0125	0.01461	0.01673	0.01886
0.02099	0.02314	0.02529	0.02745	0.02962
0.0318	0.03399	0.03619	0.03839	0.0406
0.04283	0.04506	0.0473	0.04955	0.0518
0.05407	0.05634	0.05862	0.06092	0.06322
0.06553	0.06784	0.07017	0.0725	0.07485
0.0772	0.07956	0.08193	0.08431	0.08669
0.08909	0.09149	0.09391	0.09633	0.09876
0.1012	0.10364	0.1061	0.10857	0.11104
0.11352	0.11601	0.11851	0.12102	0.12354
0.12606	0.12859	0.13114	0.13369	0.13625
0.13882	0.14142	0.14406	0.14673	0.14944
0.15218	0.15496	0.15777	0.16061	0.16349
0.16641	0.16936	0.17234	0.17536	0.17841
0.1815	0.18463	0.18778	0.19097	0.1942
0.19746	0.20076	0.20409	0.20745	0.21085
0.21429	0.21776	0.22126	0.2248	0.22837
0.23198	0.23569	0.23949	0.2434	0.2474
0.25151	0.25571	0.26001	0.26442	0.26892
0.27352	0.27822	0.28302	0.28792	0.29291
0.29801	0.30342	0.30913	0.31515	0.32149
0.32813	0.33517	0.34262	0.35047	0.35872
0.36736	0.37744	0.38805	0.40409	0.42885
0.47778	0.57115	0.59591	0.61195	0.62256
0.63264	0.64128	0.64953	0.65738	0.66483
0.67187	0.67851	0.68485	0.69087	0.69658
0.70199	0.70709	0.71208	0.71698	0.72178
0.72648	0.73108	0.73558	0.73999	0.74429
0.74849	0.7526	0.7566	0.76051	0.76431
0.76802	0.77163	0.7752	0.77874	0.78224
0.78571	0.78915	0.79255	0.79591	0.79924
0.80254	0.8058	0.80903	0.81222	0.81537
0.8185	0.82159	0.82464	0.82766	0.83064
0.83359	0.83651	0.83939	0.84223	0.84504
0.84782	0.85056	0.85327	0.85594	0.85858
0.86118	0.86375	0.86631	0.86886	0.87141
0.87394	0.87646	0.87898	0.88149	0.88399
0.88648	0.88896	0.89143	0.8939	0.89636
0.8988	0.90124	0.90367	0.90609	0.90851
0.91091	0.91331	0.91569	0.91807	0.92044
0.9228	0.92515	0.9275	0.92983	0.93216
0.93447	0.93678	0.93908	0.94138	0.94366
0.94593	0.9482	0.95045	0.9527	0.95494
0.95717	0.9594	0.96161	0.96381	0.96601
0.9682	0.97038	0.97255	0.97471	0.97686

0.97901	0.98114	0.98327	0.98539	0.9875
0.9896	0.99169	0.99377	0.99585	0.99792
1				

25_yr_sm	0.1 hr increment			
0	0.00188	0.00373	0.0056	0.00747
0.00935	0.01125	0.01315	0.01506	0.01698
0.01891	0.02084	0.02279	0.02475	0.02671
0.02869	0.03067	0.03266	0.03467	0.03668
0.0387	0.04073	0.04277	0.04481	0.04687
0.04894	0.05101	0.0531	0.05519	0.05729
0.05941	0.06153	0.06366	0.0658	0.06795
0.07011	0.07227	0.07445	0.07664	0.07883
0.08103	0.08325	0.08547	0.0877	0.08994
0.09219	0.09445	0.09672	0.099	0.10128
0.10358	0.10588	0.1082	0.11052	0.11285
0.11519	0.11755	0.11991	0.12227	0.12465
0.12704	0.12946	0.13193	0.13442	0.13696
0.13953	0.14214	0.14478	0.14746	0.15018
0.15293	0.15573	0.15855	0.16142	0.16432
0.16726	0.17023	0.17324	0.17629	0.17938
0.1825	0.18566	0.18885	0.19208	0.19535
0.19866	0.202	0.20538	0.20879	0.21225
0.21573	0.21933	0.22304	0.22685	0.23078
0.23481	0.23896	0.24321	0.24757	0.25204
0.25662	0.2613	0.2661	0.27101	0.27602
0.28114	0.28662	0.29244	0.29861	0.30513
0.312	0.31935	0.3272	0.33552	0.34434
0.35361	0.36477	0.37653	0.3942	0.42146
0.4754	0.57854	0.6058	0.62347	0.63523
0.64639	0.65566	0.66448	0.6728	0.68065
0.688	0.69487	0.70139	0.70756	0.71338
0.71886	0.72398	0.72899	0.7339	0.7387
0.74338	0.74796	0.75243	0.75679	0.76104
0.76519	0.76922	0.77315	0.77696	0.78067
0.78427	0.78775	0.79121	0.79462	0.798
0.80134	0.80465	0.80792	0.81115	0.81434
0.8175	0.82062	0.82371	0.82676	0.82977
0.83274	0.83568	0.83858	0.84145	0.84427
0.84707	0.84982	0.85254	0.85522	0.85786
0.86047	0.86304	0.86558	0.86807	0.87054
0.87296	0.87535	0.87773	0.88009	0.88245
0.88481	0.88715	0.88948	0.8918	0.89412
0.89642	0.89872	0.901	0.90328	0.90555
0.90781	0.91006	0.9123	0.91453	0.91675
0.91897	0.92117	0.92336	0.92555	0.92773
0.92989	0.93205	0.9342	0.93634	0.93847

0.94059	0.94271	0.94481	0.9469	0.94899
0.95106	0.95313	0.95519	0.95723	0.95927
0.9613	0.96332	0.96533	0.96734	0.96933
0.97131	0.97329	0.97525	0.97721	0.97916
0.98109	0.98302	0.98494	0.98685	0.98875
0.99065	0.99253	0.9944	0.99627	0.99812
1				

50_yr_sm 0.1 hr increment

0	0.00166	0.00331	0.00498	0.00665
0.00834	0.01003	0.01174	0.01345	0.01517
0.01691	0.01865	0.0204	0.02216	0.02394
0.02572	0.02751	0.02931	0.03112	0.03294
0.03477	0.03661	0.03846	0.04032	0.04218
0.04406	0.04595	0.04785	0.04975	0.05167
0.0536	0.05553	0.05748	0.05943	0.0614
0.06337	0.06536	0.06735	0.06935	0.07137
0.07339	0.07542	0.07746	0.07952	0.08158
0.08365	0.08573	0.08782	0.08992	0.09203
0.09415	0.09628	0.09842	0.10056	0.10272
0.10489	0.10707	0.10925	0.11145	0.11366
0.11587	0.11813	0.12042	0.12275	0.12512
0.12753	0.12998	0.13246	0.13499	0.13755
0.14015	0.14279	0.14547	0.14819	0.15094
0.15374	0.15657	0.15945	0.16236	0.1653
0.16829	0.17132	0.17438	0.17749	0.18063
0.18381	0.18703	0.19029	0.19359	0.19692
0.20029	0.20379	0.2074	0.21113	0.21498
0.21894	0.22303	0.22723	0.23156	0.236
0.24056	0.24524	0.25004	0.25496	0.25999
0.26515	0.27069	0.27663	0.28295	0.28967
0.29678	0.30446	0.31272	0.32154	0.33094
0.34091	0.35312	0.36597	0.38523	0.41485
0.47338	0.58515	0.61477	0.63403	0.64688
0.65909	0.66906	0.67846	0.68728	0.69554
0.70322	0.71033	0.71705	0.72337	0.72931
0.73485	0.74001	0.74504	0.74996	0.75476
0.75944	0.764	0.76844	0.77277	0.77697
0.78106	0.78502	0.78887	0.7926	0.79621
0.79971	0.80308	0.80641	0.80971	0.81297
0.81619	0.81937	0.82251	0.82562	0.82868
0.83171	0.8347	0.83764	0.84055	0.84343
0.84626	0.84906	0.85181	0.85453	0.85721
0.85985	0.86245	0.86501	0.86754	0.87002
0.87247	0.87488	0.87725	0.87958	0.88187
0.88413	0.88634	0.88855	0.89075	0.89293
0.89511	0.89728	0.89944	0.90158	0.90372

0.90585	0.90797	0.91008	0.91218	0.91427
0.91635	0.91842	0.92048	0.92254	0.92458
0.92661	0.92863	0.93065	0.93265	0.93464
0.93663	0.9386	0.94057	0.94252	0.94447
0.9464	0.94833	0.95025	0.95215	0.95405
0.95594	0.95782	0.95968	0.96154	0.96339
0.96523	0.96706	0.96888	0.97069	0.97249
0.97428	0.97606	0.97784	0.9796	0.98135
0.98309	0.98483	0.98655	0.98826	0.98997
0.99166	0.99335	0.99502	0.99669	0.99834
1				

100_yr_sm 0.1 hr increment

0	0.00149	0.00297	0.00447	0.00597
0.00748	0.00901	0.01054	0.01208	0.01363
0.0152	0.01677	0.01835	0.01994	0.02154
0.02315	0.02478	0.02641	0.02805	0.0297
0.03136	0.03303	0.03471	0.0364	0.0381
0.03981	0.04153	0.04326	0.045	0.04675
0.04851	0.05028	0.05206	0.05385	0.05565
0.05746	0.05928	0.06111	0.06294	0.06479
0.06665	0.06852	0.0704	0.07228	0.07418
0.07609	0.07801	0.07993	0.08187	0.08382
0.08578	0.08774	0.08972	0.09171	0.0937
0.09571	0.09772	0.09975	0.10179	0.10383
0.10589	0.10798	0.11012	0.11229	0.1145
0.11676	0.11905	0.12138	0.12375	0.12616
0.12861	0.1311	0.13363	0.1362	0.13881
0.14146	0.14414	0.14687	0.14964	0.15244
0.15529	0.15817	0.1611	0.16406	0.16706
0.1701	0.17319	0.17631	0.17947	0.18267
0.18591	0.18927	0.19276	0.19638	0.20012
0.20399	0.20798	0.2121	0.21634	0.22071
0.22521	0.22983	0.23457	0.23944	0.24444
0.24956	0.25511	0.26108	0.26748	0.27429
0.28154	0.28943	0.29798	0.30717	0.31701
0.32749	0.34067	0.35455	0.37534	0.40736
0.47088	0.59264	0.62466	0.64545	0.65933
0.67251	0.68299	0.69283	0.70202	0.71057
0.71846	0.72571	0.73252	0.73892	0.74489
0.75044	0.75556	0.76056	0.76543	0.77017
0.77479	0.77929	0.78366	0.7879	0.79202
0.79601	0.79988	0.80362	0.80724	0.81073
0.81409	0.81733	0.82053	0.82369	0.82681
0.8299	0.83294	0.83594	0.8389	0.84183
0.84471	0.84756	0.85036	0.85313	0.85586
0.85854	0.86119	0.8638	0.86637	0.8689

0.87139	0.87384	0.87625	0.87862	0.88095
0.88324	0.8855	0.88771	0.88988	0.89202
0.89411	0.89617	0.89821	0.90025	0.90228
0.90429	0.9063	0.90829	0.91028	0.91226
0.91422	0.91618	0.91813	0.92007	0.92199
0.92391	0.92582	0.92772	0.9296	0.93148
0.93335	0.93521	0.93706	0.93889	0.94072
0.94254	0.94435	0.94615	0.94794	0.94972
0.95149	0.95325	0.955	0.95674	0.95847
0.96019	0.9619	0.9636	0.96529	0.96697
0.96864	0.9703	0.97195	0.97359	0.97522
0.97685	0.97846	0.98006	0.98165	0.98323
0.9848	0.98637	0.98792	0.98946	0.99099
0.99252	0.99403	0.99553	0.99703	0.99851
1				

200_yr_sm 0.1 hr increment

0	0.00126	0.00252	0.00379	0.00507
0.00636	0.00766	0.00897	0.01029	0.01162
0.01295	0.0143	0.01566	0.01703	0.01841
0.0198	0.0212	0.02261	0.02403	0.02546
0.0269	0.02835	0.02981	0.03128	0.03276
0.03425	0.03576	0.03727	0.03879	0.04032
0.04186	0.04341	0.04497	0.04654	0.04812
0.04972	0.05132	0.05293	0.05455	0.05618
0.05782	0.05948	0.06114	0.06281	0.06449
0.06619	0.06789	0.0696	0.07132	0.07306
0.0748	0.07655	0.07831	0.08009	0.08187
0.08366	0.08547	0.08728	0.0891	0.09094
0.09278	0.09467	0.09659	0.09855	0.10056
0.10261	0.10469	0.10682	0.10898	0.11119
0.11344	0.11573	0.11805	0.12042	0.12283
0.12528	0.12777	0.1303	0.13287	0.13548
0.13813	0.14082	0.14355	0.14632	0.14914
0.15199	0.15488	0.15781	0.16079	0.1638
0.16686	0.17004	0.17337	0.17683	0.18042
0.18415	0.18801	0.192	0.19614	0.2004
0.2048	0.20934	0.21401	0.21881	0.22375
0.22883	0.23437	0.24039	0.24688	0.25384
0.26128	0.26948	0.27844	0.28818	0.29868
0.30993	0.32453	0.3399	0.36286	0.39815
0.46806	0.60185	0.63714	0.6601	0.67547
0.69007	0.70132	0.71182	0.72156	0.73052
0.73872	0.74616	0.75312	0.75961	0.76563
0.77117	0.77625	0.78119	0.78599	0.79066
0.7952	0.7996	0.80386	0.808	0.81199
0.81585	0.81958	0.82317	0.82663	0.82996

0.83314	0.8362	0.83921	0.84219	0.84512
0.84801	0.85086	0.85368	0.85645	0.85918
0.86187	0.86452	0.86713	0.8697	0.87223
0.87472	0.87717	0.87958	0.88195	0.88427
0.88656	0.88881	0.89102	0.89318	0.89531
0.89739	0.89944	0.90145	0.90341	0.90533
0.90722	0.90906	0.9109	0.91272	0.91453
0.91634	0.91813	0.91991	0.92169	0.92345
0.9252	0.92694	0.92868	0.9304	0.93211
0.93381	0.93551	0.93719	0.93886	0.94052
0.94218	0.94382	0.94545	0.94707	0.94868
0.95028	0.95188	0.95346	0.95503	0.95659
0.95814	0.95968	0.96121	0.96273	0.96424
0.96575	0.96724	0.96872	0.97019	0.97165
0.9731	0.97454	0.97597	0.97739	0.9788
0.9802	0.98159	0.98297	0.98434	0.9857
0.98705	0.98838	0.98971	0.99103	0.99234
0.99364	0.99493	0.99621	0.99748	0.99874
1				

500_yr_sm 0.1 hr increment

0	0.000992	0.00197	0.00295	0.00395
0.00495	0.00597	0.00699	0.00802	0.00907
0.01012	0.01119	0.01226	0.01335	0.01444
0.01555	0.01666	0.01779	0.01892	0.02007
0.02122	0.02239	0.02356	0.02475	0.02595
0.02715	0.02837	0.02959	0.03083	0.03207
0.03333	0.03459	0.03587	0.03715	0.03845
0.03975	0.04107	0.0424	0.04373	0.04508
0.04643	0.0478	0.04917	0.05056	0.05195
0.05336	0.05478	0.0562	0.05764	0.05908
0.06054	0.062	0.06348	0.06497	0.06646
0.06797	0.06948	0.07101	0.07255	0.07409
0.07565	0.07724	0.07888	0.08056	0.08227
0.08403	0.08583	0.08766	0.08954	0.09146
0.09342	0.09541	0.09745	0.09953	0.10164
0.1038	0.106	0.10824	0.11052	0.11283
0.11519	0.11759	0.12003	0.12251	0.12502
0.12758	0.13018	0.13282	0.1355	0.13822
0.14098	0.14388	0.14693	0.15012	0.15345
0.15693	0.16055	0.16431	0.16822	0.17227
0.17647	0.18081	0.18529	0.18991	0.19468
0.1996	0.20504	0.21101	0.21752	0.22455
0.23212	0.24062	0.25004	0.26041	0.2717
0.2839	0.30054	0.31806	0.34418	0.38427
0.4637	0.61573	0.65582	0.68194	0.69946
0.7161	0.7283	0.73959	0.74996	0.75938

0.76788	0.77545	0.78248	0.78899	0.79496
0.8004	0.80532	0.81009	0.81471	0.81919
0.82353	0.82773	0.83178	0.83569	0.83945
0.84307	0.84655	0.84988	0.85307	0.85612
0.85902	0.86178	0.8645	0.86718	0.86982
0.87242	0.87498	0.87749	0.87997	0.88241
0.88481	0.88717	0.88948	0.89176	0.894
0.8962	0.89836	0.90047	0.90255	0.90459
0.90658	0.90854	0.91046	0.91234	0.91417
0.91597	0.91773	0.91944	0.92112	0.92276
0.92435	0.92591	0.92745	0.92899	0.93052
0.93203	0.93354	0.93503	0.93652	0.938
0.93946	0.94092	0.94236	0.9438	0.94522
0.94664	0.94805	0.94944	0.95083	0.9522
0.95357	0.95492	0.95627	0.95761	0.95893
0.96025	0.96155	0.96285	0.96413	0.96541
0.96667	0.96793	0.96917	0.97041	0.97163
0.97285	0.97405	0.97525	0.97644	0.97761
0.97878	0.97993	0.98108	0.98221	0.98334
0.98445	0.98556	0.98665	0.98774	0.98881
0.98988	0.99093	0.99198	0.99301	0.99403
0.99505	0.99605	0.99705	0.99803	0.999008
1				

WW-6 CUMULATIVE RAINFALL TABLES

10_yr_sm 0.1 hr increment

0	0.00196	0.00391	0.00587	0.00783
0.00981	0.0118	0.01379	0.0158	0.01781
0.01983	0.02187	0.02391	0.02596	0.02801
0.03008	0.03216	0.03424	0.03634	0.03844
0.04055	0.04267	0.04481	0.04694	0.04909
0.05125	0.05342	0.05559	0.05777	0.05997
0.06217	0.06438	0.0666	0.06883	0.07107
0.07331	0.07557	0.07783	0.08011	0.08239
0.08468	0.08698	0.08929	0.09161	0.09394
0.09628	0.09862	0.10098	0.10334	0.10571
0.10809	0.11048	0.11288	0.11529	0.11771
0.12014	0.12257	0.12502	0.12747	0.12993
0.1324	0.13491	0.13745	0.14003	0.14265
0.1453	0.14798	0.15071	0.15346	0.15626
0.15909	0.16195	0.16486	0.16779	0.17077
0.17378	0.17682	0.1799	0.18302	0.18618
0.18936	0.19259	0.19585	0.19915	0.20248
0.20585	0.20925	0.21269	0.21617	0.21968
0.22323	0.22688	0.23064	0.2345	0.23847
0.24255	0.24672	0.25101	0.2554	0.25989
0.26449	0.26919	0.274	0.27891	0.28393
0.28906	0.29451	0.3003	0.30642	0.31287
0.31965	0.32687	0.33454	0.34265	0.3512
0.36018	0.37076	0.38189	0.39875	0.42483
0.47645	0.57517	0.60125	0.61811	0.62924
0.63982	0.6488	0.65735	0.66546	0.67313
0.68035	0.68713	0.69358	0.6997	0.70549
0.71094	0.71607	0.72109	0.726	0.73081
0.73551	0.74011	0.7446	0.74899	0.75328
0.75745	0.76153	0.7655	0.76936	0.77312
0.77677	0.78032	0.78383	0.78731	0.79075
0.79415	0.79752	0.80085	0.80415	0.80741
0.81064	0.81382	0.81698	0.8201	0.82318
0.82622	0.82923	0.83221	0.83514	0.83805
0.84091	0.84374	0.84654	0.84929	0.85202
0.8547	0.85735	0.85997	0.86255	0.86509
0.8676	0.87007	0.87253	0.87498	0.87743
0.87986	0.88229	0.88471	0.88712	0.88952
0.89191	0.89429	0.89666	0.89902	0.90138
0.90372	0.90606	0.90839	0.91071	0.91302
0.91532	0.91761	0.91989	0.92217	0.92443
0.92669	0.92893	0.93117	0.9334	0.93562
0.93783	0.94003	0.94223	0.94441	0.94658
0.94875	0.95091	0.95306	0.95519	0.95733
0.95945	0.96156	0.96366	0.96576	0.96784
0.96992	0.97199	0.97404	0.97609	0.97813

0.98017	0.98219	0.9842	0.98621	0.9882
0.99019	0.99217	0.99413	0.99609	0.99804
1				

25_yr_sm 0.1 hr increment

0	0.00172	0.00344	0.00517	0.00691
0.00865	0.01041	0.01217	0.01395	0.01573
0.01752	0.01933	0.02114	0.02296	0.02479
0.02663	0.02849	0.03035	0.03222	0.03409
0.03598	0.03788	0.03979	0.04171	0.04363
0.04557	0.04751	0.04947	0.05143	0.05341
0.05539	0.05739	0.05939	0.0614	0.06342
0.06545	0.06749	0.06955	0.0716	0.07367
0.07575	0.07784	0.07994	0.08205	0.08416
0.08629	0.08843	0.09057	0.09273	0.09489
0.09706	0.09925	0.10144	0.10364	0.10586
0.10808	0.11031	0.11255	0.1148	0.11706
0.11933	0.12163	0.12398	0.12636	0.12878
0.13124	0.13374	0.13628	0.13885	0.14146
0.14411	0.1468	0.14952	0.15229	0.15509
0.15793	0.16081	0.16372	0.16668	0.16967
0.1727	0.17577	0.17887	0.18202	0.1852
0.18842	0.19168	0.19497	0.19831	0.20168
0.20509	0.20862	0.21226	0.21602	0.21989
0.22388	0.22799	0.23221	0.23655	0.241
0.24557	0.25026	0.25506	0.25997	0.26501
0.27016	0.27569	0.28159	0.28788	0.29454
0.30158	0.30917	0.31729	0.32596	0.33517
0.34491	0.35676	0.36923	0.38799	0.41689
0.47402	0.58311	0.61201	0.63077	0.64324
0.65509	0.66483	0.67404	0.68271	0.69083
0.69842	0.70546	0.71212	0.71841	0.72431
0.72984	0.73499	0.74003	0.74494	0.74974
0.75443	0.759	0.76345	0.76779	0.77201
0.77612	0.78011	0.78398	0.78774	0.79138
0.79491	0.79832	0.80169	0.80503	0.80832
0.81158	0.8148	0.81798	0.82113	0.82423
0.8273	0.83033	0.83332	0.83628	0.83919
0.84207	0.84491	0.84771	0.85048	0.8532
0.85589	0.85854	0.86115	0.86372	0.86626
0.86876	0.87122	0.87364	0.87602	0.87837
0.88067	0.88294	0.8852	0.88745	0.88969
0.89192	0.89414	0.89636	0.89856	0.90075
0.90294	0.90511	0.90727	0.90943	0.91157
0.91371	0.91584	0.91795	0.92006	0.92216
0.92425	0.92633	0.9284	0.93045	0.93251
0.93455	0.93658	0.9386	0.94061	0.94261

0.94461	0.94659	0.94857	0.95053	0.95249
0.95443	0.95637	0.95829	0.96021	0.96212
0.96402	0.96591	0.96779	0.96965	0.97151
0.97337	0.97521	0.97704	0.97886	0.98067
0.98248	0.98427	0.98605	0.98783	0.98959
0.99135	0.99309	0.99483	0.99656	0.99828
1				

50_yr_sm 0.1 hr increment

0	0.00157	0.00312	0.00468	0.00625
0.00783	0.00942	0.01102	0.01262	0.01424
0.01587	0.01751	0.01916	0.02081	0.02248
0.02416	0.02585	0.02754	0.02925	0.03096
0.03269	0.03443	0.03617	0.03793	0.03969
0.04147	0.04325	0.04504	0.04685	0.04866
0.05048	0.05232	0.05416	0.05601	0.05788
0.05975	0.06163	0.06352	0.06542	0.06733
0.06925	0.07118	0.07312	0.07507	0.07703
0.079	0.08098	0.08297	0.08497	0.08698
0.089	0.09103	0.09306	0.09511	0.09717
0.09924	0.10131	0.1034	0.1055	0.1076
0.10972	0.11187	0.11407	0.1163	0.11857
0.12088	0.12323	0.12562	0.12805	0.13052
0.13302	0.13557	0.13815	0.14077	0.14343
0.14613	0.14887	0.15165	0.15447	0.15733
0.16022	0.16316	0.16613	0.16915	0.1722
0.17529	0.17842	0.18159	0.18479	0.18804
0.19133	0.19474	0.19827	0.20192	0.2057
0.2096	0.21362	0.21776	0.22203	0.22642
0.23093	0.23557	0.24032	0.2452	0.25021
0.25533	0.26087	0.26682	0.27317	0.27994
0.28712	0.29491	0.30332	0.31235	0.32199
0.33223	0.34501	0.35847	0.37869	0.40986
0.47169	0.59014	0.62131	0.64153	0.65499
0.66777	0.67801	0.68765	0.69668	0.70509
0.71288	0.72006	0.72683	0.73318	0.73913
0.74467	0.74979	0.7548	0.75968	0.76443
0.76907	0.77358	0.77797	0.78224	0.78638
0.7904	0.7943	0.79808	0.80173	0.80526
0.80867	0.81196	0.81521	0.81841	0.82158
0.82471	0.8278	0.83085	0.83387	0.83684
0.83978	0.84267	0.84553	0.84835	0.85113
0.85387	0.85657	0.85923	0.86185	0.86443
0.86698	0.86948	0.87195	0.87438	0.87677
0.87912	0.88143	0.8837	0.88593	0.88813
0.89028	0.8924	0.8945	0.8966	0.89869
0.90076	0.90283	0.90489	0.90694	0.90897

0.911	0.91302	0.91503	0.91703	0.91902
0.921	0.92297	0.92493	0.92688	0.92882
0.93075	0.93267	0.93458	0.93648	0.93837
0.94025	0.94212	0.94399	0.94584	0.94768
0.94952	0.95134	0.95315	0.95496	0.95675
0.95853	0.96031	0.96207	0.96383	0.96557
0.96731	0.96904	0.97075	0.97246	0.97415
0.97584	0.97752	0.97919	0.98084	0.98249
0.98413	0.98576	0.98738	0.98899	0.99058
0.99217	0.99375	0.99532	0.99688	0.99843
1				

100_yr_sm 0.1 hr increment

0	0.00136	0.00269	0.00404	0.0054
0.00677	0.00815	0.00953	0.01093	0.01234
0.01376	0.01519	0.01662	0.01807	0.01953
0.021	0.02248	0.02396	0.02546	0.02697
0.02849	0.03002	0.03155	0.0331	0.03466
0.03623	0.0378	0.03939	0.04099	0.0426
0.04422	0.04584	0.04748	0.04913	0.05079
0.05246	0.05413	0.05582	0.05752	0.05923
0.06095	0.06267	0.06441	0.06616	0.06792
0.06969	0.07146	0.07325	0.07505	0.07686
0.07868	0.0805	0.08234	0.08419	0.08605
0.08792	0.08979	0.09168	0.09358	0.09549
0.09741	0.09936	0.10136	0.1034	0.10548
0.10759	0.10975	0.11195	0.11419	0.11647
0.11878	0.12114	0.12354	0.12598	0.12846
0.13097	0.13353	0.13613	0.13877	0.14144
0.14416	0.14692	0.14972	0.15256	0.15543
0.15835	0.16131	0.16431	0.16734	0.17042
0.17354	0.17679	0.18017	0.18368	0.18733
0.1911	0.19501	0.19905	0.20322	0.20752
0.21195	0.21651	0.22121	0.22604	0.231
0.23609	0.24163	0.24763	0.25409	0.261
0.26837	0.27646	0.28527	0.29481	0.30507
0.31602	0.33013	0.34499	0.36722	0.40142
0.46911	0.59858	0.63278	0.65501	0.66987
0.68398	0.69493	0.70519	0.71473	0.72354
0.73163	0.739	0.74591	0.75237	0.75837
0.76391	0.769	0.77396	0.77879	0.78349
0.78805	0.79248	0.79678	0.80095	0.80499
0.8089	0.81267	0.81632	0.81983	0.82321
0.82646	0.82958	0.83266	0.83569	0.83869
0.84165	0.84457	0.84744	0.85028	0.85308
0.85584	0.85856	0.86123	0.86387	0.86647
0.86903	0.87154	0.87402	0.87646	0.87886

0.88122	0.88353	0.88581	0.88805	0.89025
0.89241	0.89452	0.8966	0.89864	0.90064
0.90259	0.90451	0.90642	0.90832	0.91021
0.91208	0.91395	0.91581	0.91766	0.9195
0.92132	0.92314	0.92495	0.92675	0.92854
0.93031	0.93208	0.93384	0.93559	0.93733
0.93905	0.94077	0.94248	0.94418	0.94587
0.94754	0.94921	0.95087	0.95252	0.95416
0.95578	0.9574	0.95901	0.96061	0.9622
0.96377	0.96534	0.9669	0.96845	0.96998
0.97151	0.97303	0.97454	0.97604	0.97752
0.979	0.98047	0.98193	0.98338	0.98481
0.98624	0.98766	0.98907	0.99047	0.99185
0.99323	0.9946	0.99596	0.99731	0.99864
1				

200_yr_sm 0.1 hr increment

0	0.00114	0.00226	0.00339	0.00454
0.00569	0.00685	0.00803	0.00921	0.01041
0.01161	0.01282	0.01405	0.01528	0.01653
0.01778	0.01905	0.02032	0.02161	0.0229
0.0242	0.02552	0.02685	0.02818	0.02953
0.03088	0.03225	0.03362	0.03501	0.0364
0.03781	0.03922	0.04065	0.04209	0.04353
0.04499	0.04646	0.04793	0.04942	0.05092
0.05242	0.05394	0.05547	0.057	0.05855
0.06011	0.06167	0.06325	0.06484	0.06644
0.06804	0.06966	0.07129	0.07293	0.07457
0.07623	0.0779	0.07958	0.08127	0.08297
0.08467	0.08642	0.08821	0.09004	0.09191
0.09382	0.09577	0.09776	0.0998	0.10187
0.10398	0.10613	0.10832	0.11056	0.11283
0.11514	0.1175	0.11989	0.12233	0.1248
0.12732	0.12988	0.13247	0.13511	0.13779
0.1405	0.14326	0.14606	0.1489	0.15178
0.1547	0.15775	0.16095	0.16429	0.16777
0.17138	0.17514	0.17903	0.18306	0.18724
0.19155	0.196	0.20059	0.20532	0.21019
0.2152	0.22071	0.22672	0.23322	0.24023
0.24774	0.25609	0.26528	0.27531	0.28618
0.29787	0.3134	0.32974	0.35417	0.39171
0.46604	0.60829	0.64583	0.67026	0.6866
0.70213	0.71382	0.72469	0.73472	0.74391
0.75226	0.75977	0.76678	0.77328	0.77929
0.7848	0.78981	0.79468	0.79941	0.804
0.80845	0.81276	0.81694	0.82097	0.82486
0.82862	0.83223	0.83571	0.83905	0.84225

0.8453	0.84822	0.8511	0.85394	0.85674
0.8595	0.86221	0.86489	0.86753	0.87012
0.87268	0.8752	0.87767	0.88011	0.8825
0.88486	0.88717	0.88944	0.89168	0.89387
0.89602	0.89813	0.9002	0.90224	0.90423
0.90618	0.90809	0.90996	0.91179	0.91358
0.91533	0.91703	0.91873	0.92042	0.9221
0.92377	0.92543	0.92707	0.92871	0.93034
0.93196	0.93356	0.93516	0.93675	0.93833
0.93989	0.94145	0.943	0.94453	0.94606
0.94758	0.94908	0.95058	0.95207	0.95354
0.95501	0.95647	0.95791	0.95935	0.96078
0.96219	0.9636	0.96499	0.96638	0.96775
0.96912	0.97047	0.97182	0.97315	0.97448
0.9758	0.9771	0.97839	0.97968	0.98095
0.98222	0.98347	0.98472	0.98595	0.98718
0.98839	0.98959	0.99079	0.99197	0.99315
0.99431	0.99546	0.99661	0.99774	0.99886
1				

500_yr_sm 0.1 hr increment

0	0.000814	0.00164	0.00247	0.00331
0.00416	0.00502	0.00589	0.00677	0.00766
0.00856	0.00948	0.0104	0.01133	0.01227
0.01322	0.01418	0.01515	0.01613	0.01712
0.01812	0.01913	0.02016	0.02119	0.02223
0.02328	0.02434	0.02541	0.02649	0.02758
0.02868	0.02979	0.03091	0.03204	0.03318
0.03433	0.03549	0.03666	0.03784	0.03903
0.04023	0.04145	0.04267	0.0439	0.04514
0.04639	0.04765	0.04892	0.0502	0.05149
0.05279	0.0541	0.05542	0.05675	0.05809
0.05944	0.0608	0.06217	0.06355	0.06494
0.06634	0.06778	0.06926	0.07078	0.07234
0.07393	0.07557	0.07725	0.07897	0.08073
0.08253	0.08437	0.08625	0.08817	0.09013
0.09212	0.09416	0.09624	0.09836	0.10052
0.10271	0.10495	0.10723	0.10955	0.11191
0.1143	0.11674	0.11922	0.12174	0.12429
0.12689	0.12964	0.13253	0.13557	0.13876
0.1421	0.14559	0.14923	0.15301	0.15694
0.16102	0.16525	0.16963	0.17416	0.17883
0.18366	0.18905	0.195	0.20151	0.20859
0.21623	0.2249	0.23459	0.24532	0.25708
0.26986	0.28753	0.30614	0.33391	0.37658
0.46122	0.62342	0.66609	0.69386	0.71247
0.73014	0.74292	0.75468	0.76541	0.7751

0.78377	0.79141	0.79849	0.805	0.81095
0.81634	0.82117	0.82584	0.83037	0.83475
0.83898	0.84306	0.84699	0.85077	0.85441
0.8579	0.86124	0.86443	0.86747	0.87036
0.87311	0.87571	0.87826	0.88078	0.88326
0.8857	0.88809	0.89045	0.89277	0.89505
0.89729	0.89948	0.90164	0.90376	0.90584
0.90788	0.90987	0.91183	0.91375	0.91563
0.91747	0.91927	0.92103	0.92275	0.92443
0.92607	0.92766	0.92922	0.93074	0.93222
0.93366	0.93506	0.93645	0.93783	0.9392
0.94056	0.94191	0.94325	0.94458	0.9459
0.94721	0.94851	0.9498	0.95108	0.95235
0.95361	0.95486	0.9561	0.95733	0.95855
0.95977	0.96097	0.96216	0.96334	0.96451
0.96567	0.96682	0.96796	0.96909	0.97021
0.97132	0.97242	0.97351	0.97459	0.97566
0.97672	0.97777	0.97881	0.97984	0.98087
0.98188	0.98288	0.98387	0.98485	0.98582
0.98678	0.98773	0.98867	0.9896	0.99052
0.99144	0.99234	0.99323	0.99411	0.99498
0.99584	0.99669	0.99753	0.99836	0.999186
1				

APPENDIX C – PMP TABLES AND FIGURES

Table 6.1 - General-storm PMP computations for the Colorado River and Great Basin

Drainage: East Wash/West Wash Basin
Area: 3.4 mi^2

Latitude: 39.6 °
Longitude: 119.9 °

Step		Duration (hrs) 6	12	18	24	48	72
A. Convergence PMP							
1. Drainage average value from one of figures 2.5 to 2.16	January	8.8					
	February	8.7					
	March	8.6					
	April	8.2					
	May	7.7					
	June	7.8					
	July	8.2					
	August	8.3					
	September	8.6					
	October	9.0					
	November	8.8					
	December	8.8					
2 Reduction for barrier elevation (Fig. 2.18)		51 %					
3. Barrier-elevation reduced PMP (step 1 X step 2)	January	4.5					
	February	4.4					
	March	4.4					
	April	4.2					
	May	3.9					
	June	4.0					
	July	4.2					
	August	4.2					
	September	4.4					
	October	4.6					
	November	4.5					
	December	4.5					

4. Durational variation (Figs. 2.25 to 2.27 and Table 2.7)

	Duration (hrs)						
	6	12	18	24	48	72	
January	52	77	90	100	127	146	%
February	52	77	90	100	127	146	%
March	54	78	91	100	126	142	%
April	56	79	91	100	124	138	%
May	58	80	92	100	122	135	%
June	60	81	92	100	120	132	%
July	64	83	93	100	117	126	%
August	64	83	93	100	117	126	%
September	64	83	93	100	117	126	%
October	60	81	92	100	120	132	%
November	54	78	91	100	126	142	%
December	52	77	90	100	127	146	%

5. Convergence PMP for indicated durations (step 3 x step 4)

	6	12	18	24	48	72	
January	2.3	3.5	4.0	4.5	5.7	6.6	in
February	2.3	3.4	4.0	4.4	5.6	6.5	in
March	2.4	3.4	4.0	4.4	5.5	6.2	in
April	2.3	3.3	3.8	4.2	5.2	5.8	in
May	2.3	3.1	3.6	3.9	4.8	5.3	in
June	2.4	3.2	3.7	4.0	4.8	5.3	in
July	2.7	3.5	3.9	4.2	4.9	5.3	in
August	2.7	3.5	3.9	4.2	5.0	5.3	in
September	2.8	3.6	4.1	4.4	5.1	5.5	in
October	2.8	3.7	4.2	4.6	5.5	6.1	in
November	2.4	3.5	4.1	4.5	5.7	6.4	in
December	2.3	3.5	4.0	4.5	5.7	6.6	in

6. Incremental 10 mi^2 PMP (succession subtraction in step 5)

	6	12	18	24	48	72	
January	2.3	1.1	0.6	0.4	1.2	0.9	in
February	2.3	1.1	0.6	0.4	1.2	0.8	in
March	2.4	1.1	0.6	0.4	1.1	0.7	in
April	2.3	1.0	0.5	0.4	1.0	0.6	in
May	2.3	0.9	0.5	0.3	0.9	0.5	in
June	2.4	0.8	0.4	0.3	0.8	0.5	in
July	2.7	0.8	0.4	0.3	0.7	0.4	in
August	2.7	0.8	0.4	0.3	0.7	0.4	in
September	2.8	0.8	0.4	0.3	0.7	0.4	in
October	2.8	1.0	0.5	0.4	0.9	0.6	in
November	2.4	1.1	0.6	0.4	1.2	0.7	in
December	2.3	1.1	0.6	0.4	1.2	0.9	in

7. Areal reduction (select from Figs. 2.28 and 2.29)

Duration (hrs)

	6	12	18	24	48	72	
January	100	100	100	100	100	100	%
February	100	100	100	100	100	100	%
March	100	100	100	100	100	100	%
April	100	100	100	100	100	100	%
May	100	100	100	100	100	100	%
June	100	100	100	100	100	100	%
July	100	100	100	100	100	100	%
August	100	100	100	100	100	100	%
September	100	100	100	100	100	100	%
October	100	100	100	100	100	100	%
November	100	100	100	100	100	100	%
December	100	100	100	100	100	100	%

8. Areally reduced PMP (step 6 x step 7)

	6	12	18	24	48	72	
January	2.3	1.1	0.6	0.4	1.2	0.9	in
February	2.3	1.1	0.6	0.4	1.2	0.8	in
March	2.4	1.1	0.6	0.4	1.1	0.7	in
April	2.3	1.0	0.5	0.4	1.0	0.6	in
May	2.3	0.9	0.5	0.3	0.9	0.5	in
June	2.4	0.8	0.4	0.3	0.8	0.5	in
July	2.7	0.8	0.4	0.3	0.7	0.4	in
August	2.7	0.8	0.4	0.3	0.7	0.4	in
September	2.8	0.8	0.4	0.3	0.7	0.4	in
October	2.8	1.0	0.5	0.4	0.9	0.6	in
November	2.4	1.1	0.6	0.4	1.2	0.7	in
December	2.3	1.1	0.6	0.4	1.2	0.9	in

9. Drainage average PMP (accumulated values of step 8)

	6	12	18	24	48	72	
January	2.3	3.5	4.0	4.5	5.7	6.6	in
February	2.3	3.4	4.0	4.4	5.6	6.5	in
March	2.4	3.4	4.0	4.4	5.5	6.2	in
April	2.3	3.3	3.8	4.2	5.2	5.8	in
May	2.3	3.1	3.6	3.9	4.8	5.3	in
June	2.4	3.2	3.7	4.0	4.8	5.3	in
July	2.7	3.5	3.9	4.2	4.9	5.3	in
August	2.7	3.5	3.9	4.2	5.0	5.3	in
September	2.8	3.6	4.1	4.4	5.1	5.5	in
October	2.8	3.7	4.2	4.6	5.5	6.1	in
November	2.4	3.5	4.1	4.5	5.7	6.4	in
December	2.3	3.5	4.0	4.5	5.7	6.6	in

B. Oropgraphic PMP

1. Drainage average orographic index from Fig. 3.11a-d: 2.0 in

2 Areal reduction (Fig. 3.20): 100 %

3. Adjustment for month (one of Figs. 3.12 to 3.17)

January	107	%
February	106	%
March	102	%
April	95	%
May	92	%
June	93	%
July	96	%
August	100	%
September	105	%
October	108	%
November	110	%
December	109	%

4. Areally and seasonally adjusted PMP (steps 1 x 2 x 3)

January	2.1	in
February	2.1	in
March	2.0	in
April	1.9	in
May	1.8	in
June	1.9	in
July	1.9	in
August	2.0	in
September	2.1	in
October	2.2	in
November	2.2	in
December	2.2	in

5. Durational variation (Table 3.9)

Duration (hrs)						
6	12	18	24	48	72	
30	57	80	100	158.2	186.2	%

6. Orographic PMP for given durations (steps 4 x 5)

	Duration (hrs)						
	6	12	18	24	48	72	
January	0.6	1.2	1.7	2.1	3.4	4.0	in
February	0.6	1.2	1.7	2.1	3.4	3.9	in
March	0.6	1.2	1.6	2.0	3.2	3.8	in
April	0.6	1.1	1.5	1.9	3.0	3.5	in
May	0.6	1.0	1.5	1.8	2.9	3.4	in
June	0.6	1.1	1.5	1.9	2.9	3.5	in
July	0.6	1.1	1.5	1.9	3.0	3.6	in
August	0.6	1.1	1.6	2.0	3.2	3.7	in
September	0.6	1.2	1.7	2.1	3.3	3.9	in
October	0.6	1.2	1.7	2.2	3.4	4.0	in
November	0.7	1.3	1.8	2.2	3.5	4.1	in
December	0.7	1.2	1.7	2.2	3.4	4.1	in

C. Total PMP

1. Add steps A9 and B6

	6	12	18	24	48	72	
January	3.0	4.7	5.8	6.6	9.1	10.5	in
February	2.9	4.6	5.7	6.6	9.0	10.4	in
March	3.0	4.6	5.6	6.4	8.8	10.0	in
April	2.9	4.4	5.3	6.1	8.2	9.3	in
May	2.8	4.2	5.1	5.8	7.7	8.7	in
June	2.9	4.3	5.1	5.8	7.7	8.7	in
July	3.3	4.6	5.4	6.1	7.9	8.8	in
August	3.3	4.7	5.5	6.2	8.1	9.1	in
September	3.4	4.8	5.8	6.5	8.5	9.4	in
October	3.4	4.9	6.0	6.8	8.9	10.1	in
November	3.1	4.8	5.8	6.7	9.1	10.5	in
December	3.0	4.7	5.8	6.7	9.1	10.6	in

2. PMP for other durations from smooth curve fitted to plot of computed data

3. Comparison with local-storm PMP (see section 6.3)

Information from HMR 49
Numbers derived from calculation
Selected PMP

Table 6.3A - Local-storm PMP computation, Colorado River, Great Basin, and California Drainages. For drainage average depth PMP.

Drainage: East Wash/West Wash Basin Latitude: 39.6 °

Area: 3.4 mi^2 Longitude: 119.9 °

Minimum Elevation: _____ ft.

Step

A. Convergence PMP

1. Avg. 1-hr 1-mi^2 PMP for drainage (Fig. 4.5) — 8.5 in

2 a. Reduction for elevation. (No adjustment for elevations up to 5,000 ft. 5% decrease per 1,000 ft. above 5,000 ft.) — 100 %

b. Mltiply step 1 by step 2a. — 8.5 in

3. Average 6/1-hr ratio for drainage (Fig. 4.7) — 1.64 in

Duration (hrs)

	0.25	0.5	0.75	1	2	3	4	5	6	
4. Durational Variation for 6/1-hr ratio of step 3 (Table 4.4)	43	70	87	100	125.2	140.2	149.8	157.4	164	%
5. 1-mi2 PMP for indicated durations (step 2b x step 4).	3.7	6.0	7.4	8.5	10.6	11.9	12.7	13.4	13.9	in
6. Areal reduction (Fig. 4.9).	89	92	93	94	95	95	96	97	97	%
7. Areal reduced PMP (step 5 x step 6)	3.3	5.5	6.9	8.0	10.1	11.3	12.2	13.0	13.5	in
8. Incremental PMP (successive subration in step 7).				8.0	2.1	1.2	0.9	0.8	0.5	in
	3.3	2.2	1.4	1.1	} 15-min. increments					

9. Time sequence of incremental PMP according to:

Hourly increments (Table 4.7). — 0.8 | 1.2 | 8.0 | 2.1 | 0.9 | 0.5 in.

Four largest 15-min. increments (Table 4.8). — 3.3 | 2.2 | 1.4 | 1.1 in.

Information from HMR 49
Numbers derived from calculation
Selected PMP

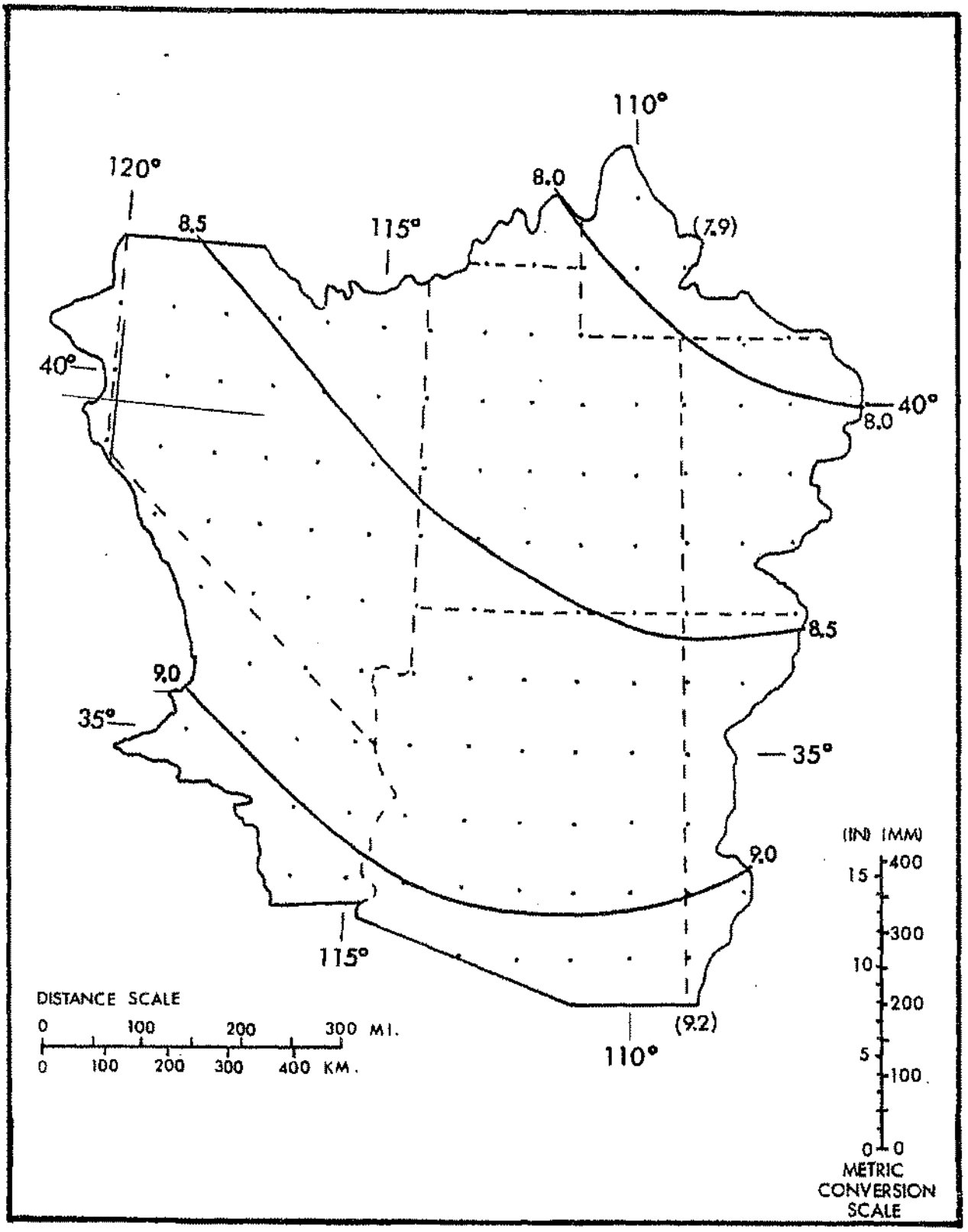


Figure 2.5.--1000-mb (100-kPa) 24-hr convergence PMP (inches) for 10 mi^2 (26 km^2) for January. Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

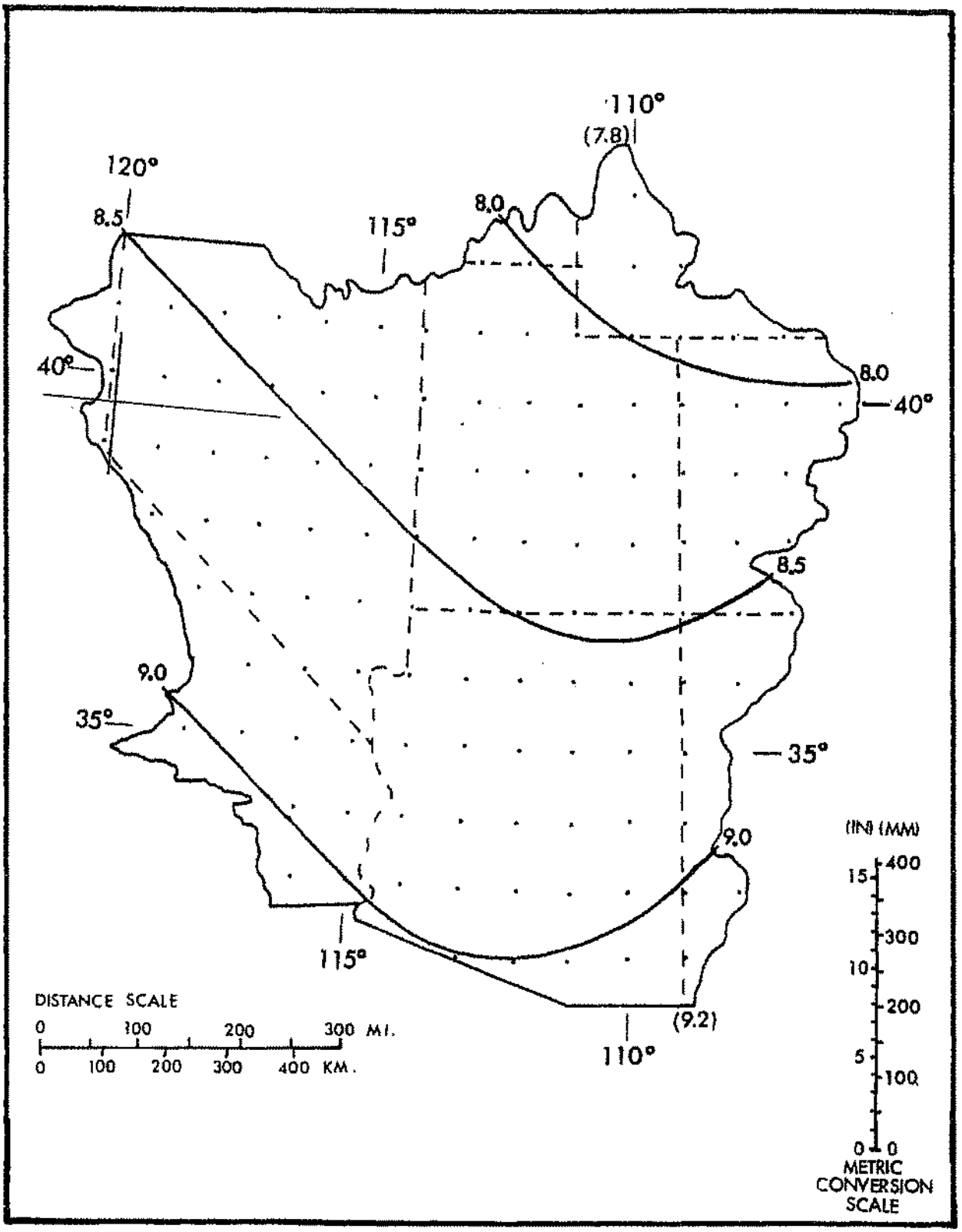


Figure 2.6.--1000-mb (100-kPa) 24-hr convergence PMP (inches) for 10 mi^2 (26 km^2) for February. Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

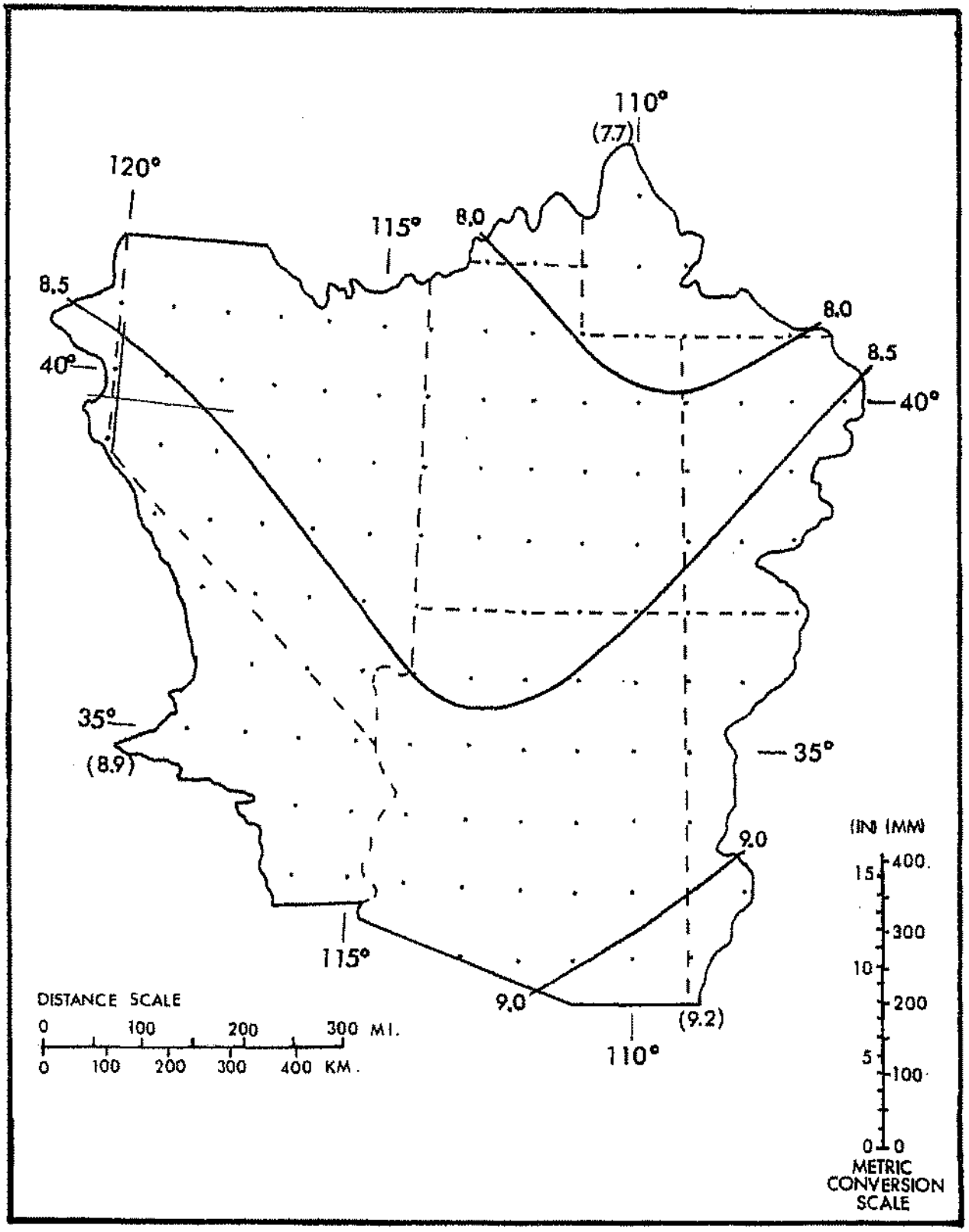


Figure 2.7.--1000-mb (100-kPa) 24-hr convergence PMP (inches) for 10 mi^2 (26 km^2) for March. Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

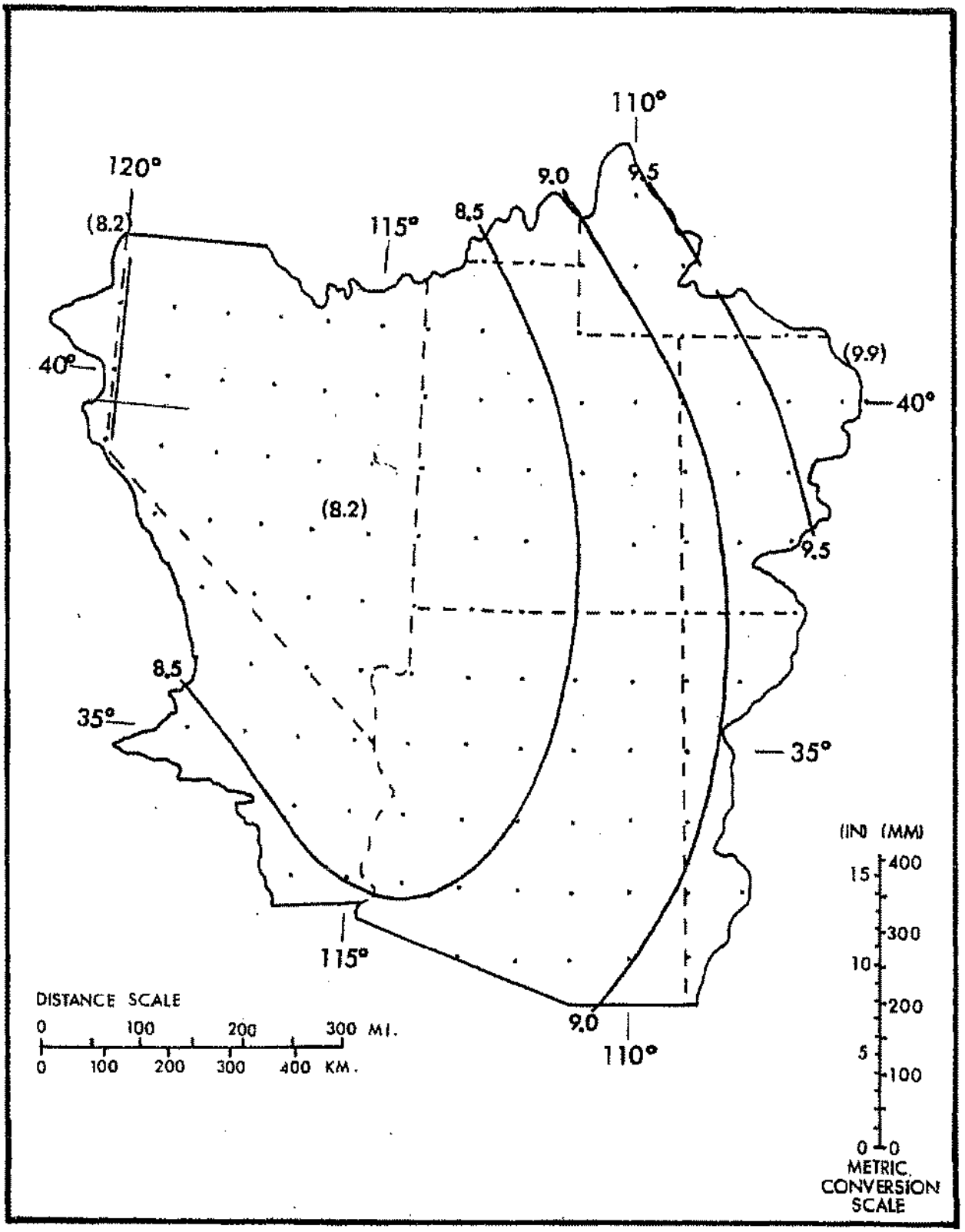


Figure 2.8.--1000-mb (100-kPa) 24-hr convergence PMP (inches) for 10 mi^2 (26 km^2) for April. Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

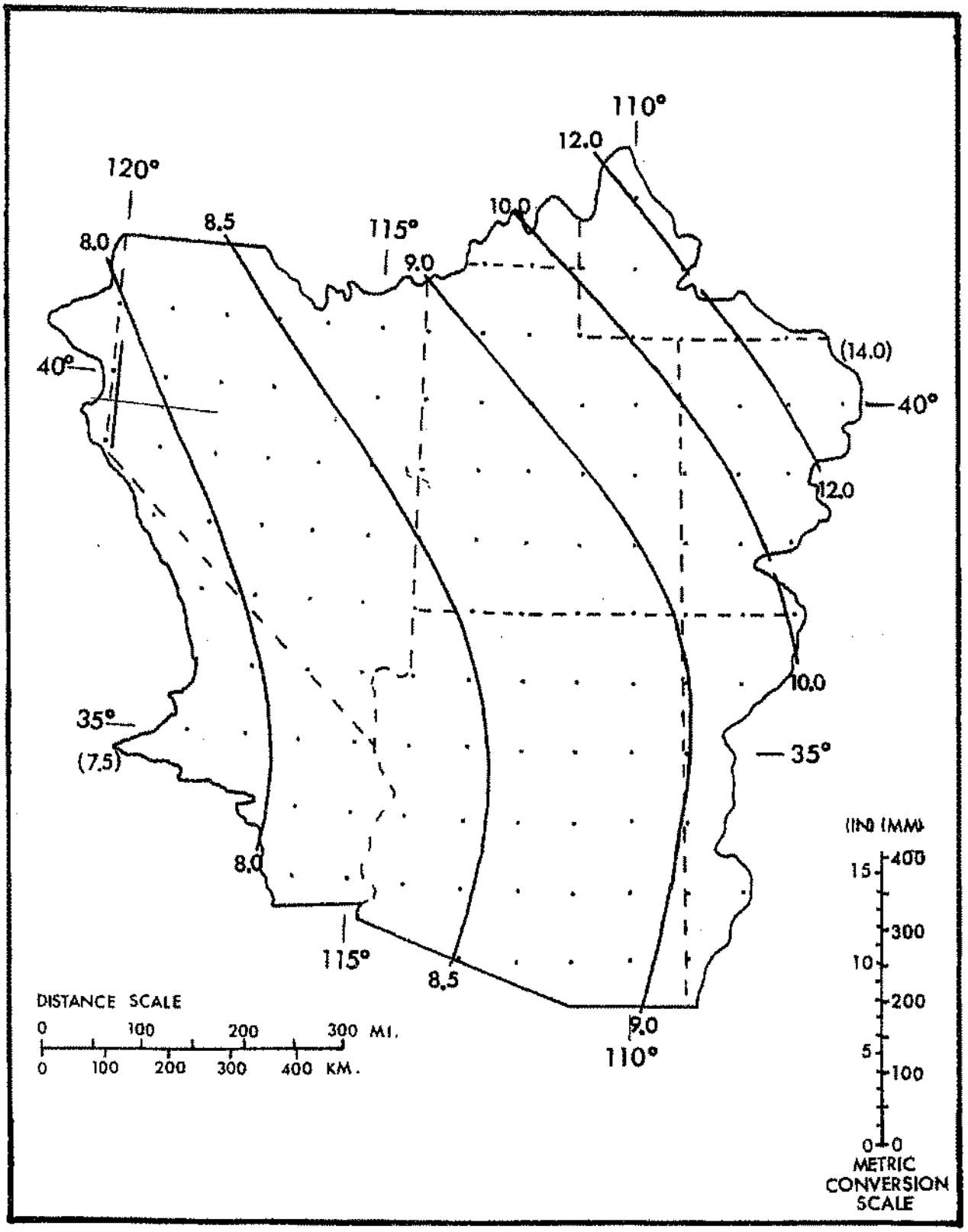


Figure 2.9.--1000-mb (100-kPa) 24-hr convergence PMP (inches) for 10 mi^2 (26 km^2) for May. Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

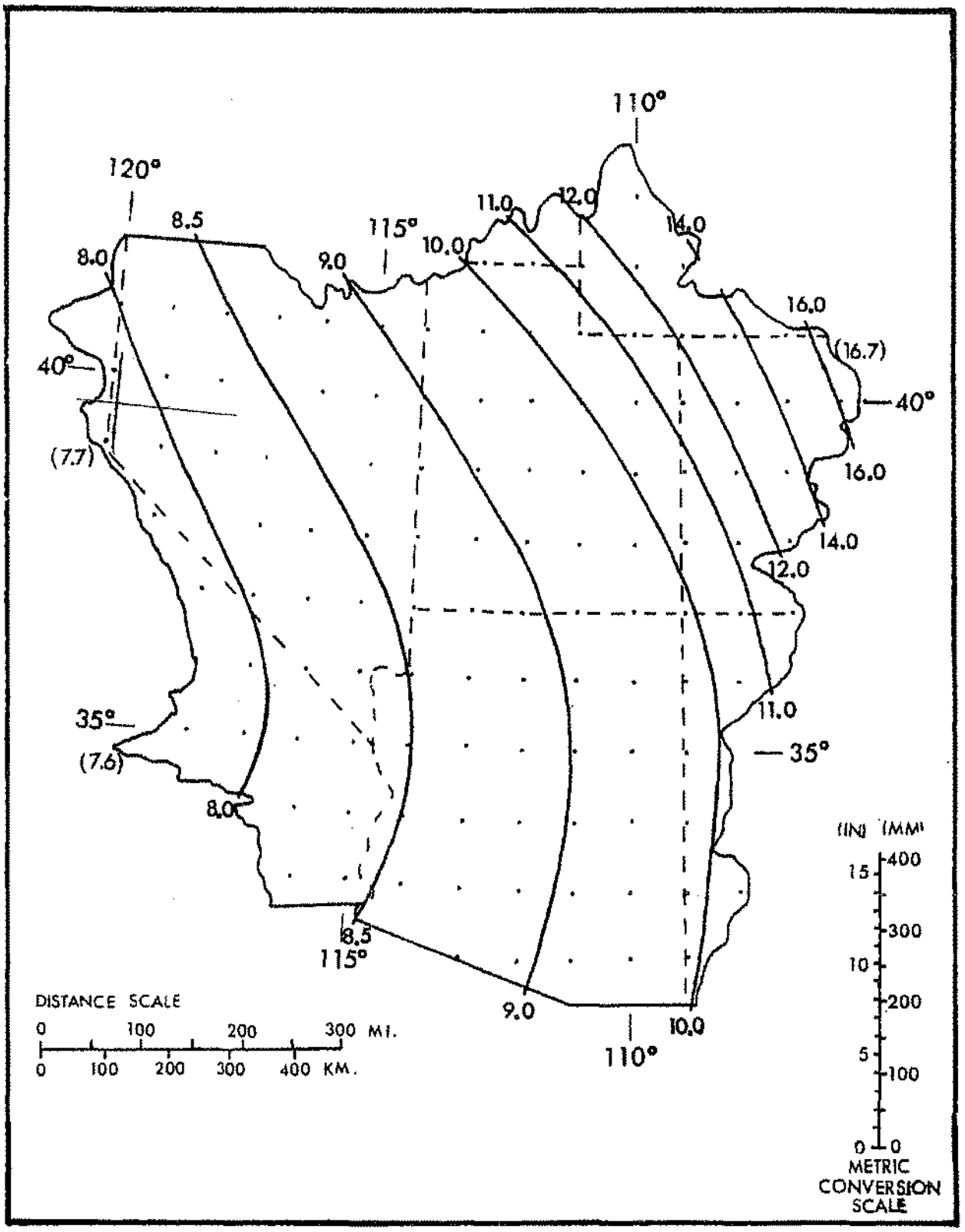


Figure 2.10.--1000-mb (100-kPa) 24-hr convergence PMP (inches) for 10 mi^2 (26 km^2) for June. Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

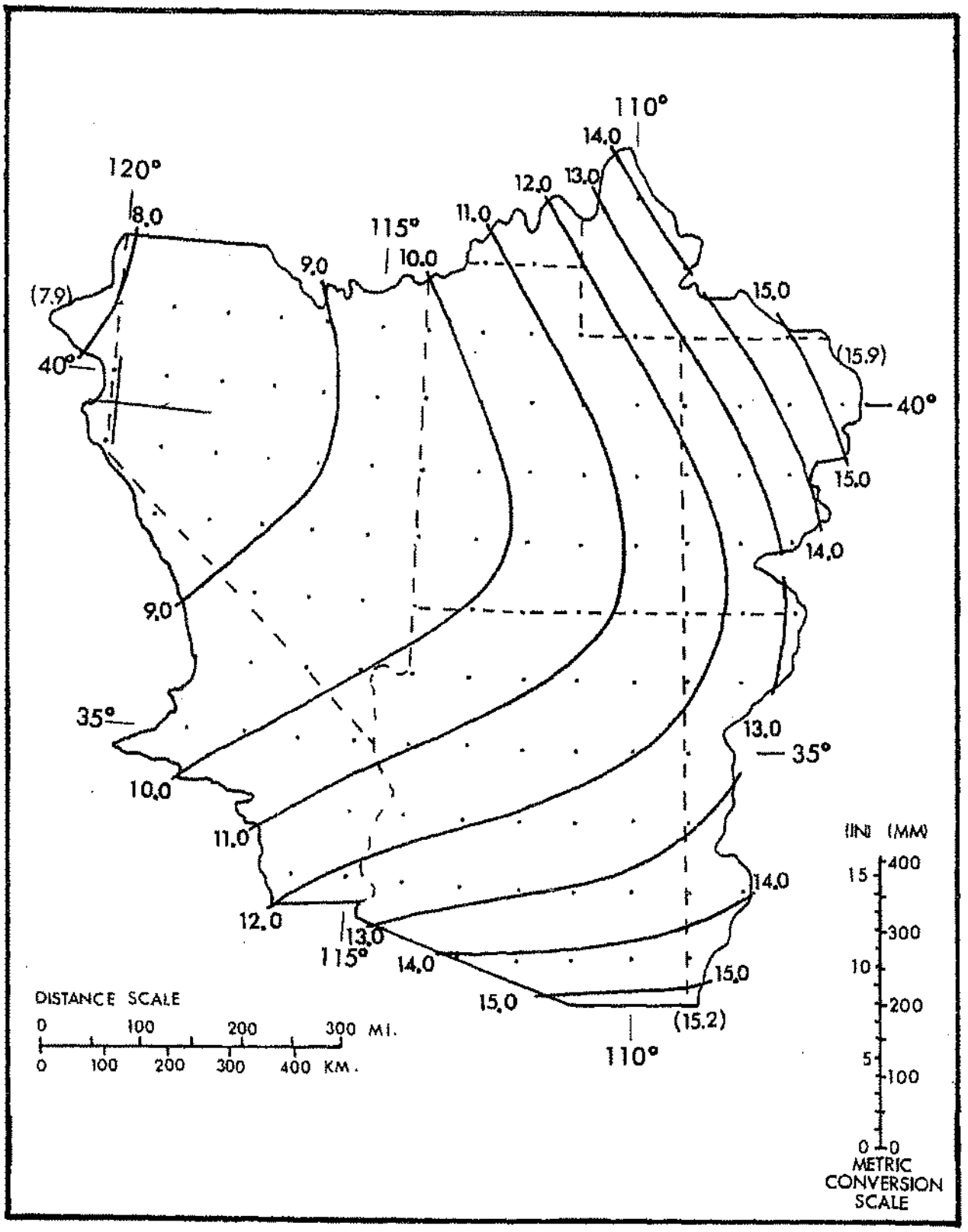


Figure 2.11.--1000-mb (100-kPa) 24-hr convergence PMP (inches) for 10 mi² (26 km²) for July. Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

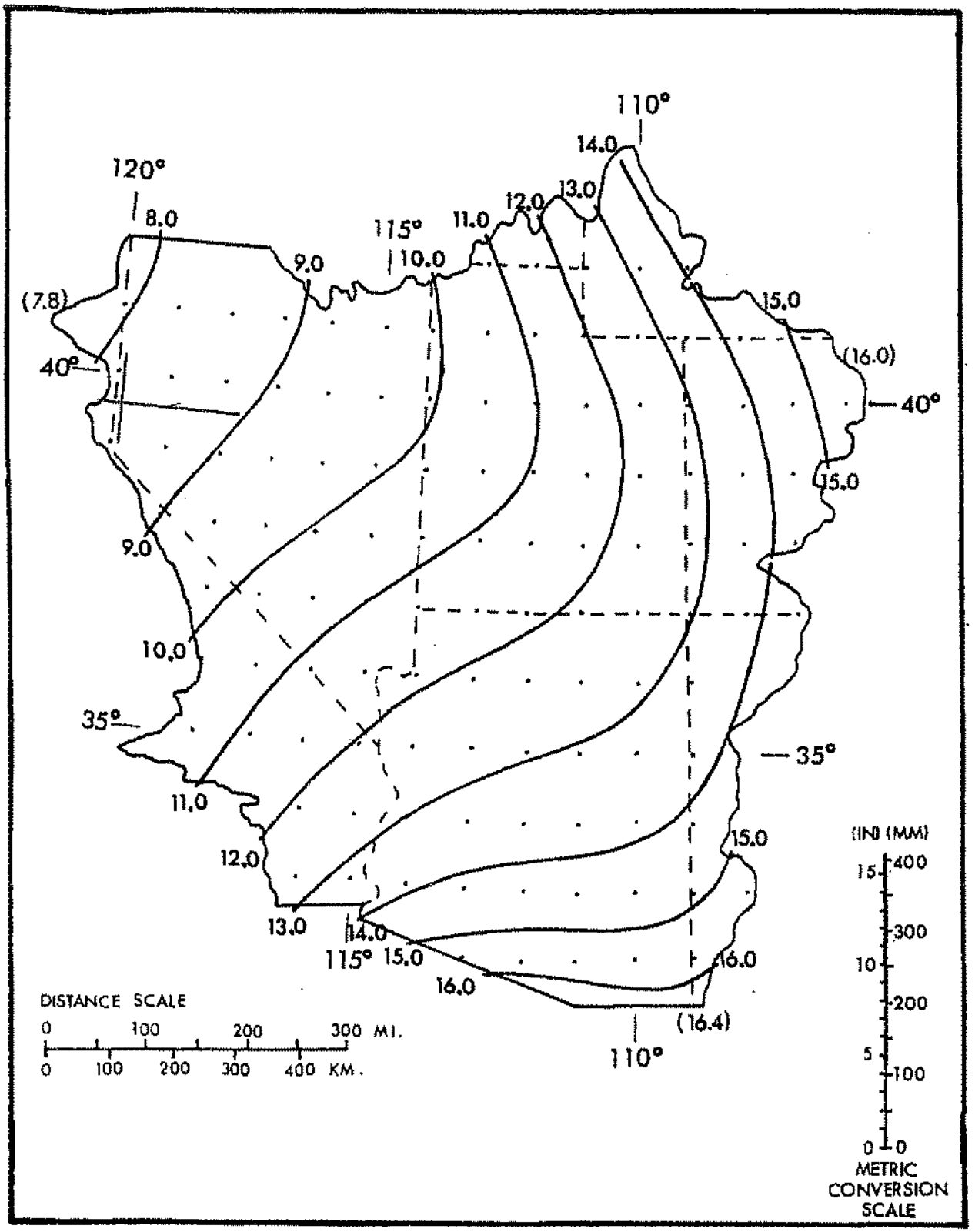


Figure 2.12.--1000-mb (100-kPa) 24-hr convergence PMP (inches) for 10 mi^2 (26 km^2) for August. Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

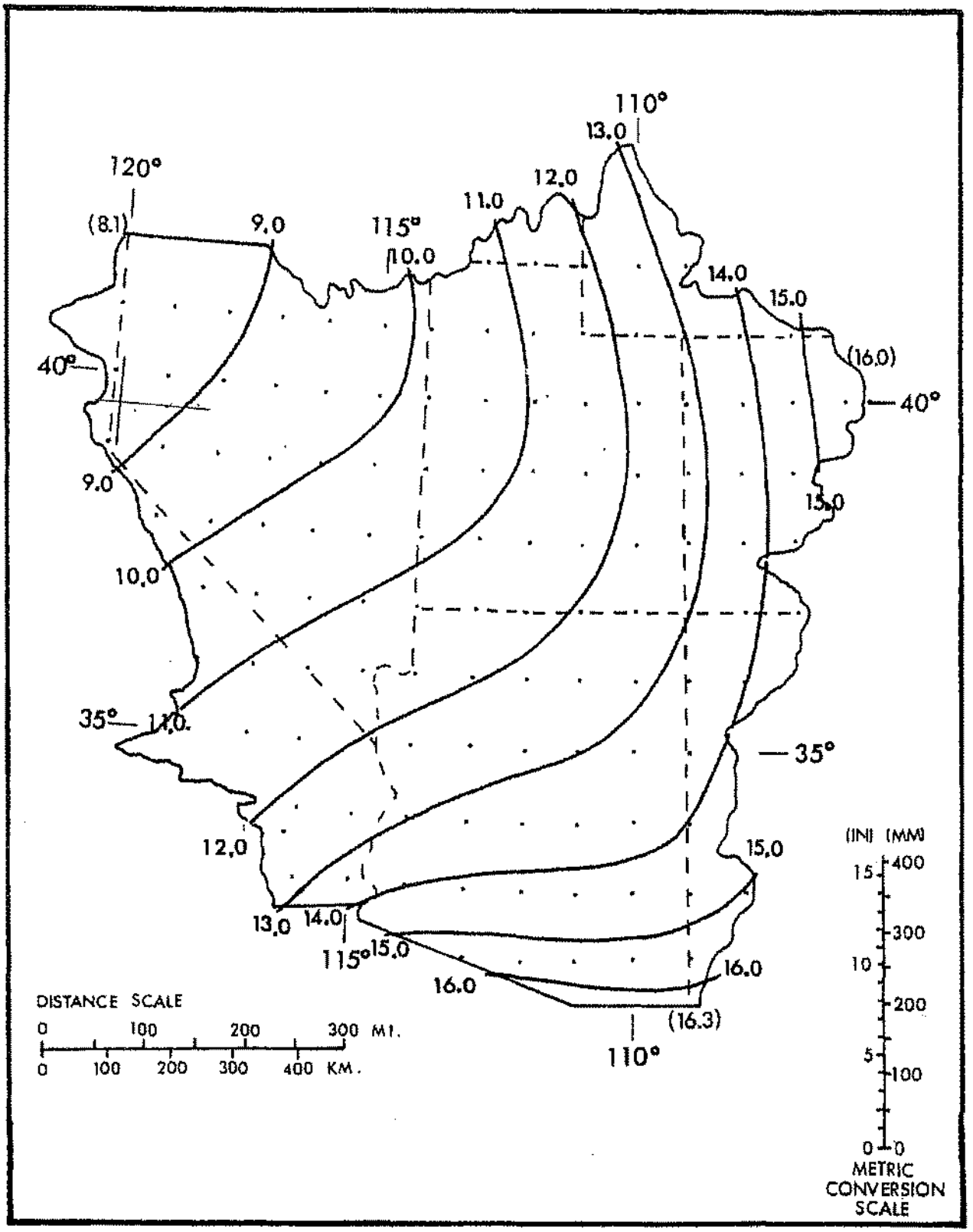


Figure 2.13.--1000-mb (100-kPa) 24-hr convergence PMP (inches) for 10 mi^2 (26 km^2) for September. Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

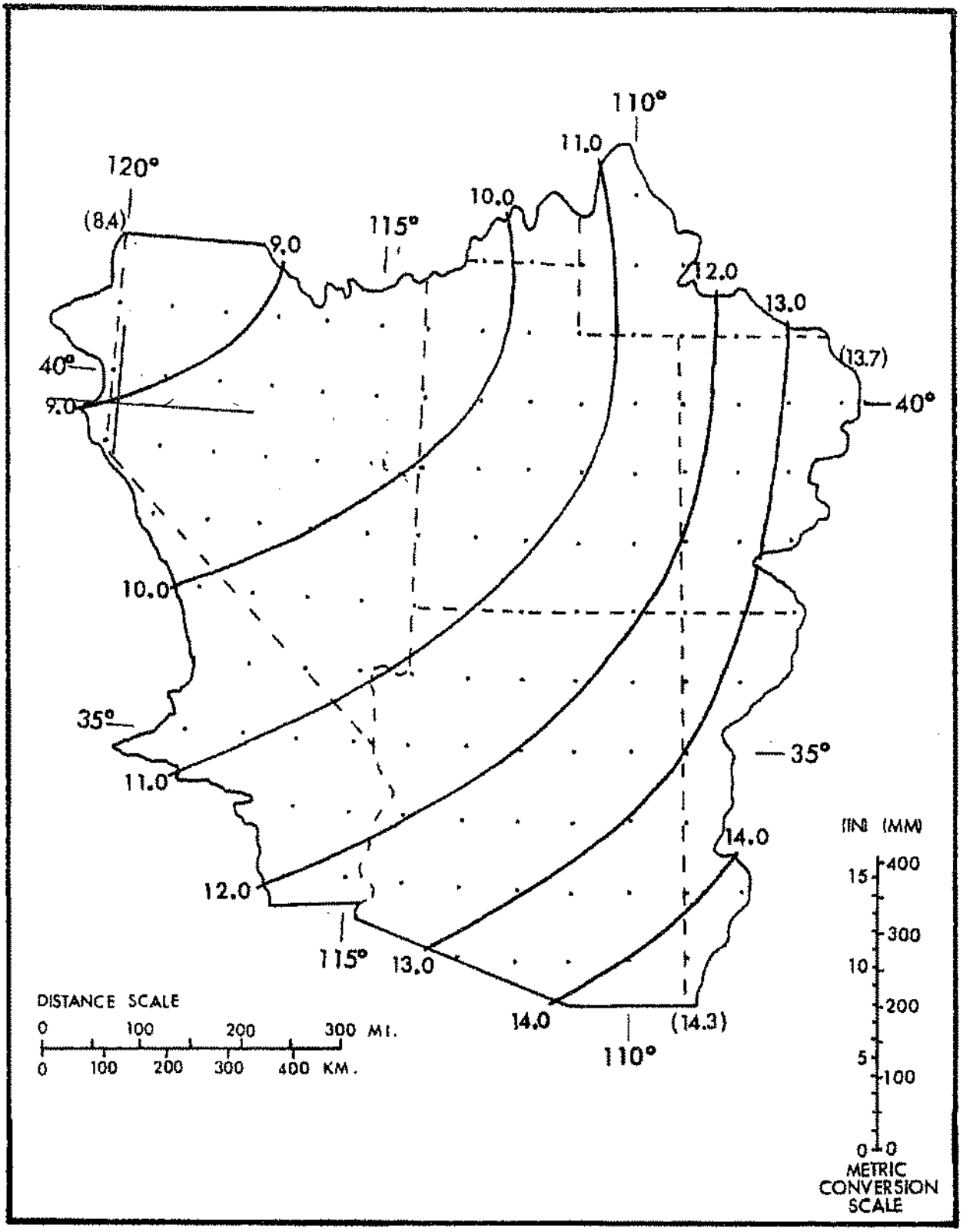


Figure 2.14.--1000-mb (100-kPa) 24-hr convergence PMP (inches) for 10 mi^2 (26 km^2) for October. Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

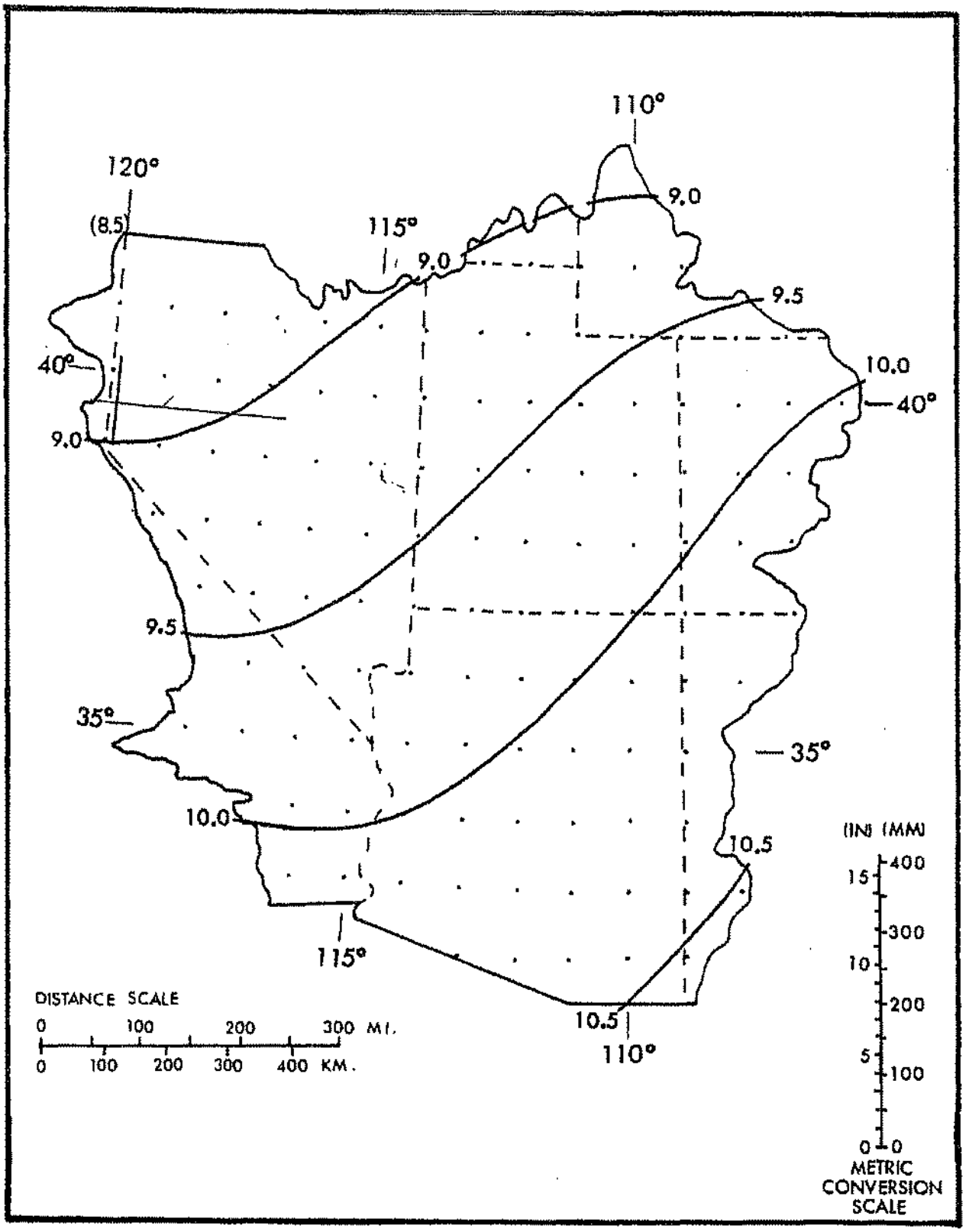


Figure 2.15.--1000-mb (100-kPa) 24-hr convergence PMP (inches) for 10 mi^2 (26 km^2) for November. Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

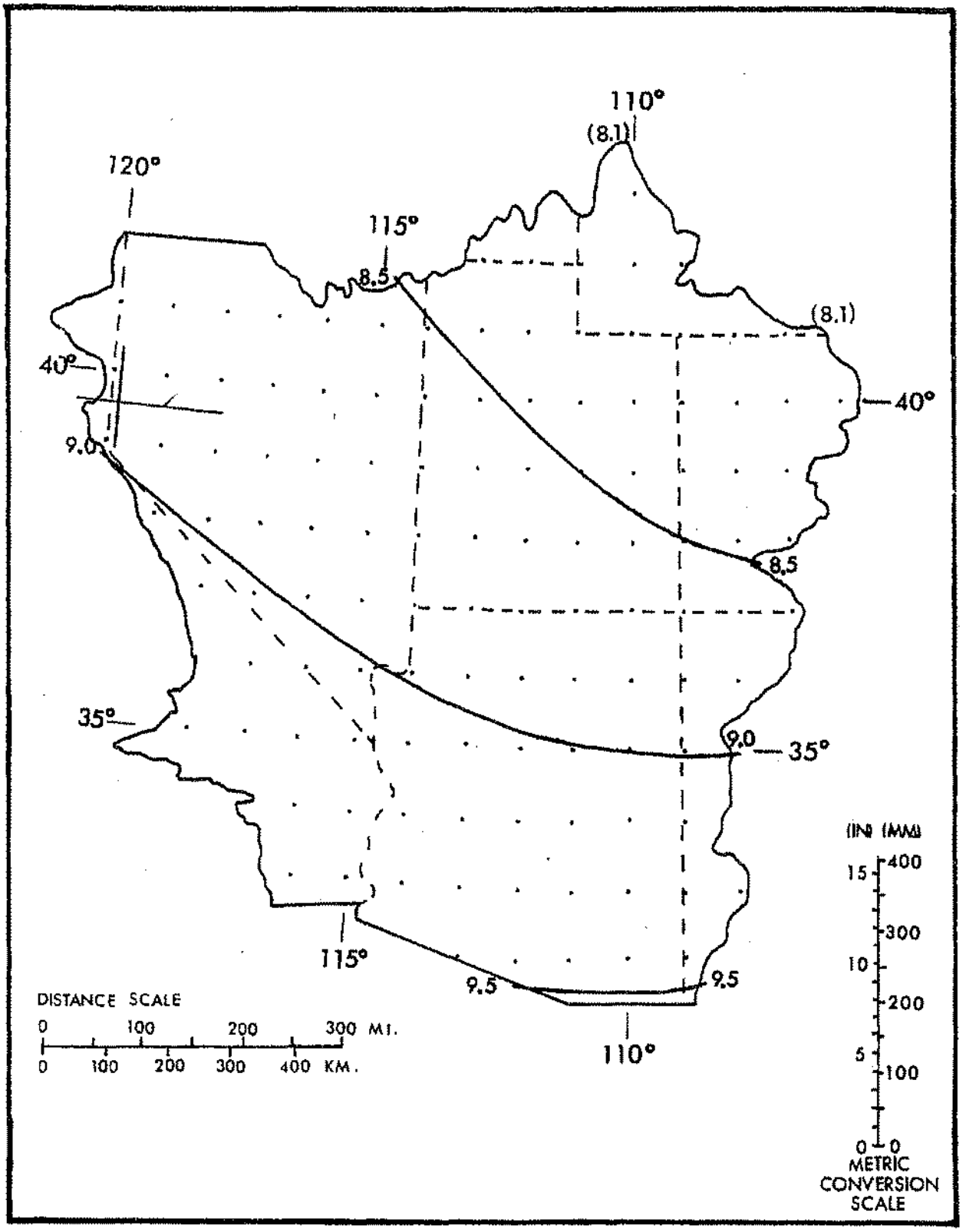


Figure 2.16.--1000-mb (100-kPa) 24-hr convergence PMP (inches) for 10 mi^2 (26 km^2) for December. Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

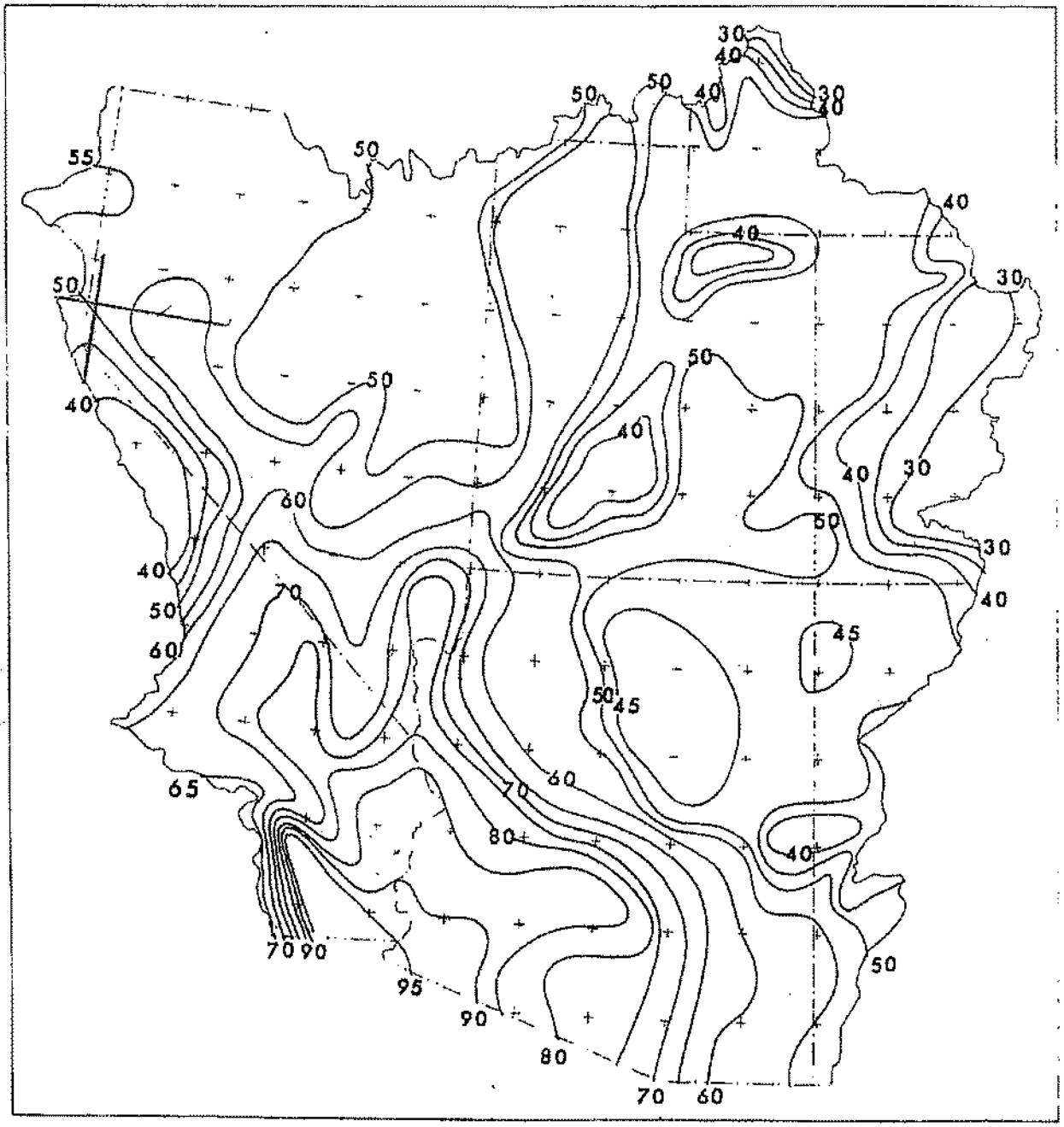
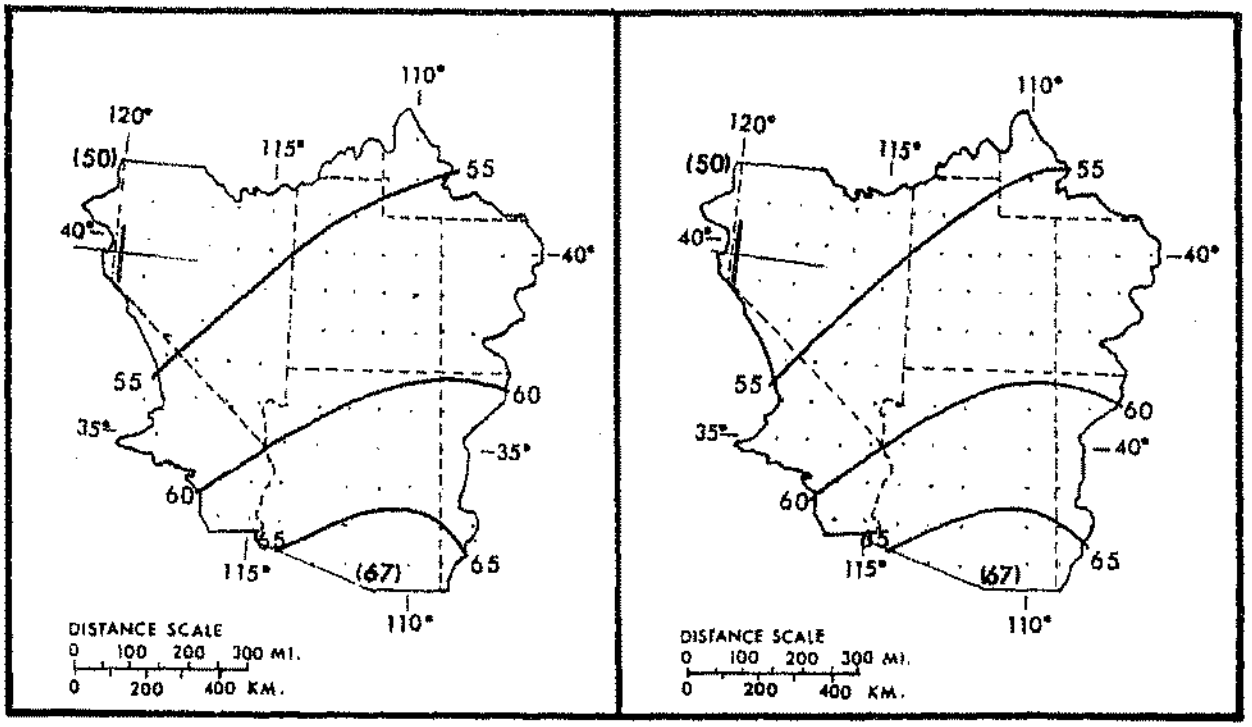
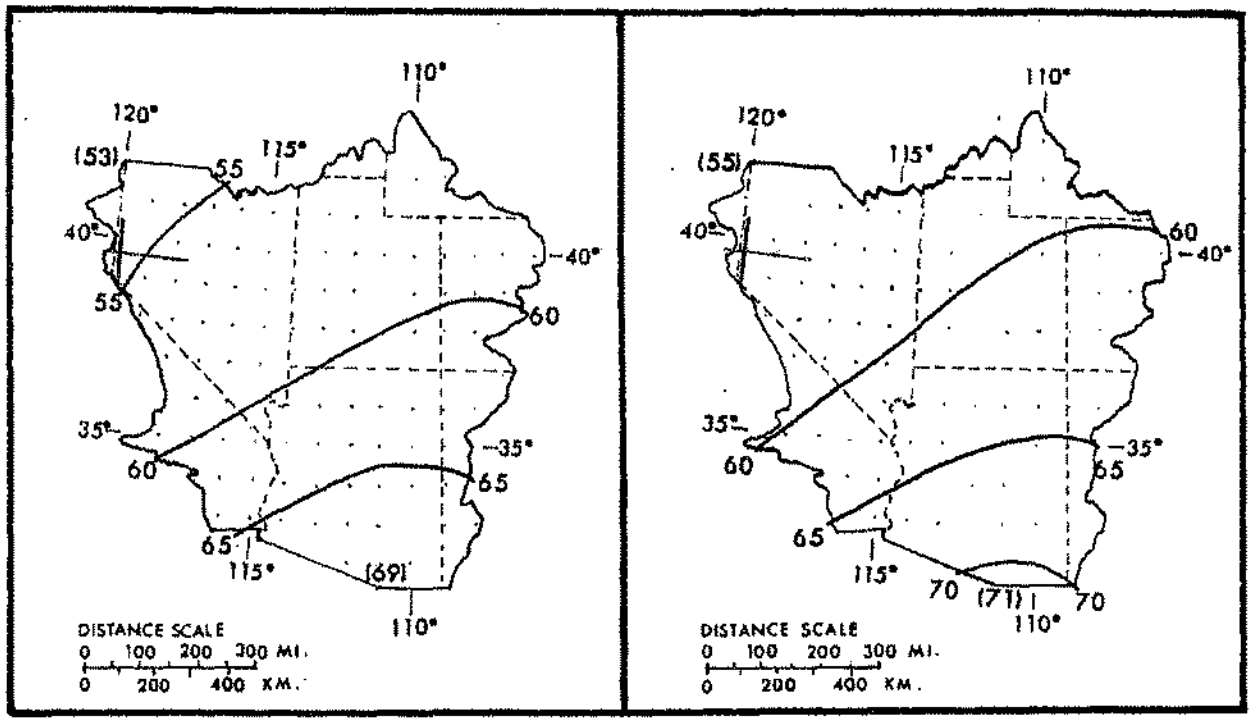


Figure 2.18.--Percent of 1000-mb (100-kPa) convergence PMP resulting from effective elevation and barrier considerations. Isolines drawn for every five percent.

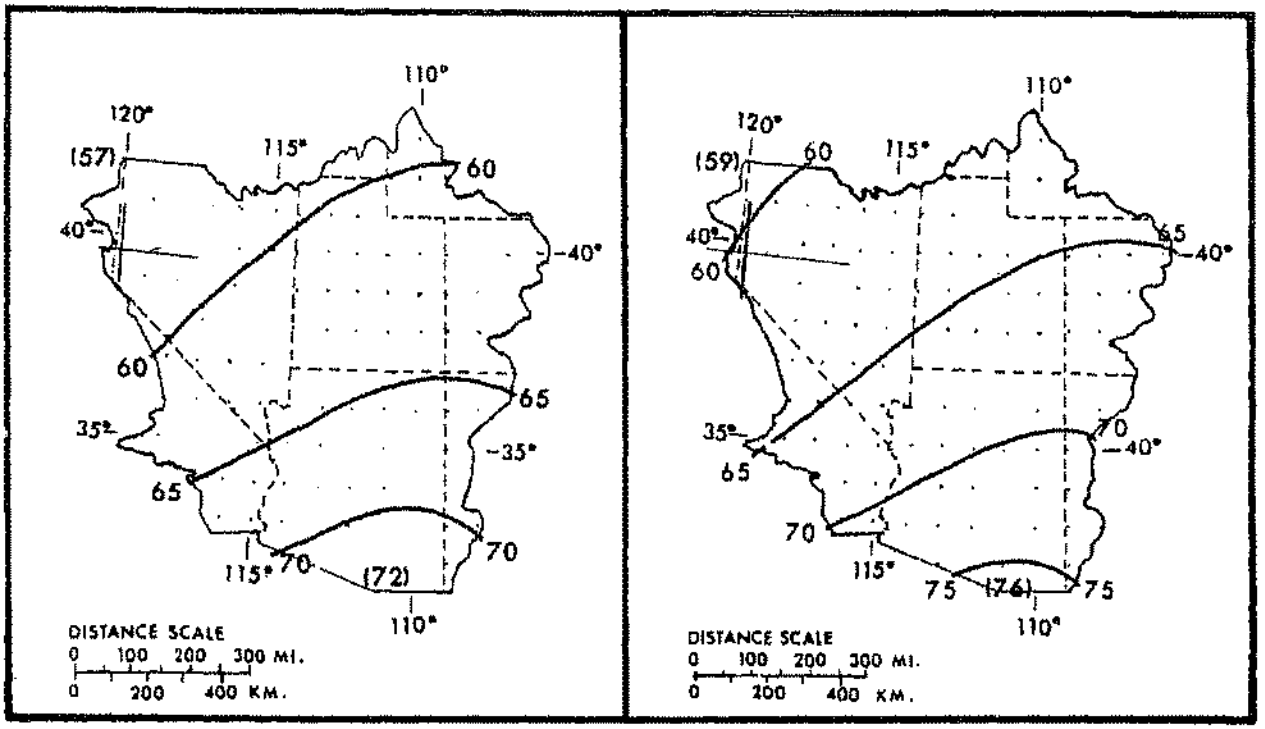


January *February*

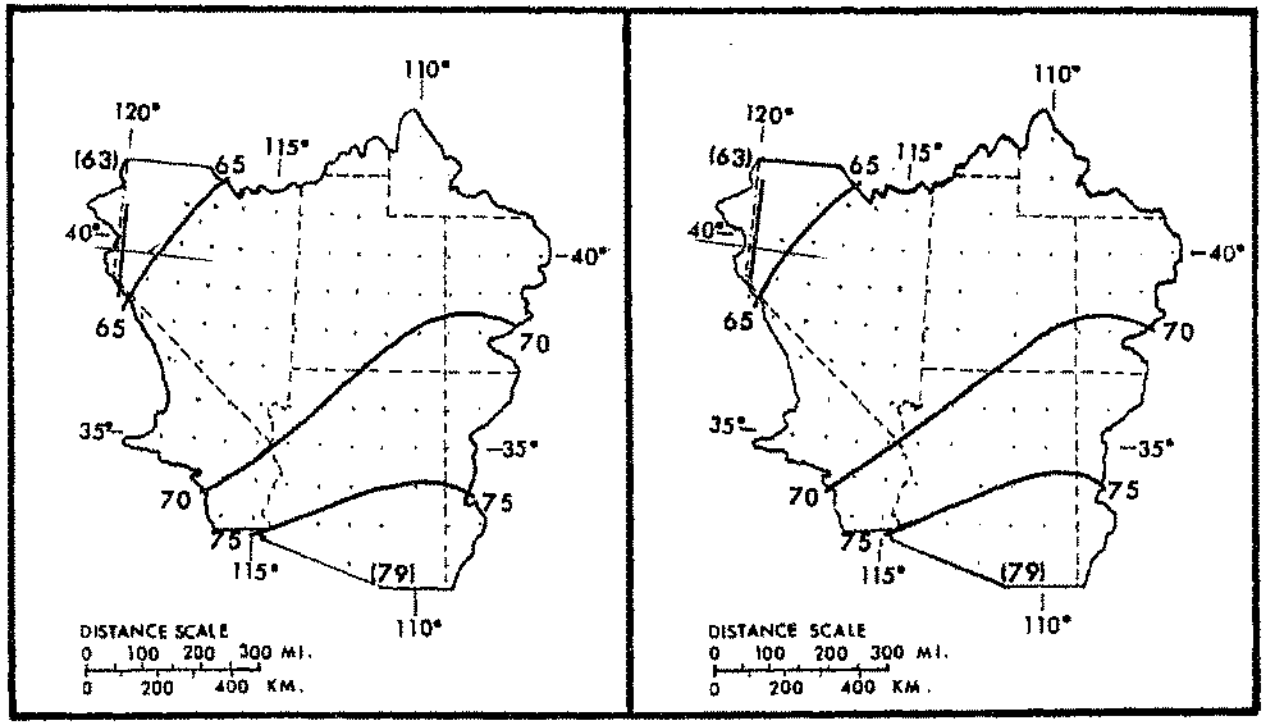


March *April*

Figure 2.25.--Regional variation of 6/24-hr ratios by month (percent). Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

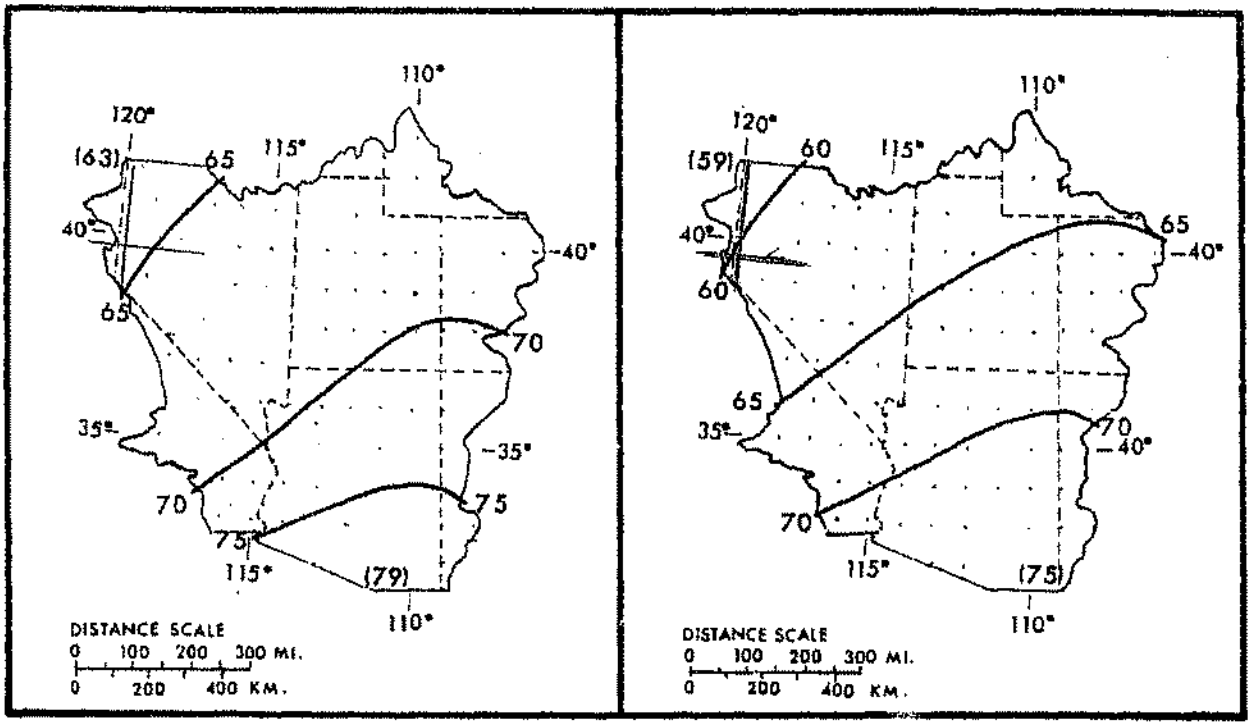


May *June*

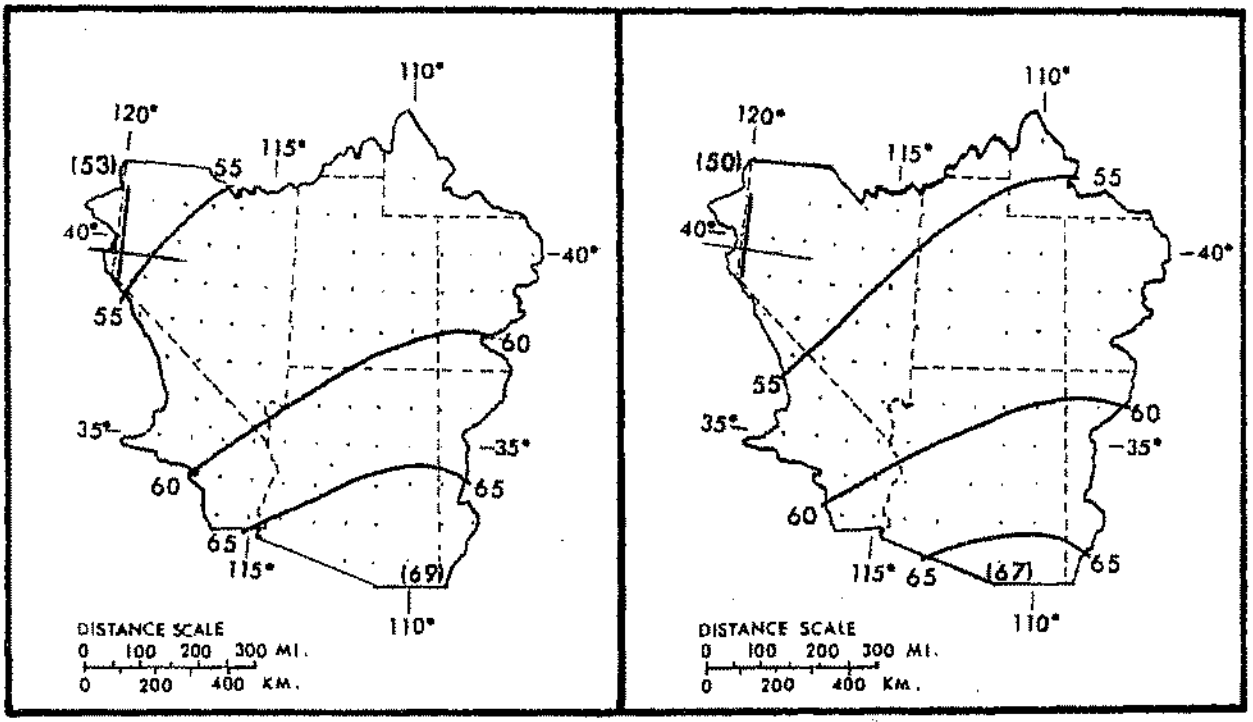


July *August*

Figure 2.26.--Regional variation of 6/24-hr ratios by month (percent). Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.



September *October*



November *December*

Figure 2.27.--Regional variation of 6/24-hr ratios by month (percent). Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

For the range of 6/24-hr ratios included in figures 2.25 to 2.27, depth-duration values in percent of 24-hr amounts are found in table 2.7. The regional ratio maps, and the depth-duration curves presented in figure 2.20 were used in adjusting the major storm data to 24-hr amounts listed in table 2.1.

Table 2.7.--Durational variation of convergence PMP (in percent of 24-hr amount).

Duration (Hrs)						Duration (Hrs)					
6	12	18	24	48	72	6	12	18	24	48	72
50	76	90	100	129	150	66	84	93	100	116	124
51	77	90	100	128	148	67	85	94	100	116	123
52	77	90	100	127	146	68	85	94	100	115	122
53	77	91	100	127	144	69	86	94	100	115	121
54	78	91	100	126	142						
55	78	91	100	125	140	70	87	94	100	114	120
56	79	91	100	124	138	71	87	95	100	114	119
57	79	92	100	123	137	72	88	95	100	113	118
58	80	92	100	122	135	73	88	95	100	113	118
59	80	92	100	121	134	74	89	95	100	112	117
						75	89	96	100	112	116
60	81	92	100	120	132	76	90	96	100	111	115
61	81	92	100	120	131	77	90	96	100	110	114
62	82	93	100	119	129	78	91	96	100	110	114
63	82	93	100	118	128	79	92	97	100	109	113
64	83	93	100	117	126						
65	84	93	100	117	125	80	92	97	100	109	113

Note: For use, enter first column (6 hr) with 6/24-hr ratio from figures 2.25 to 2.27.

2.5 Areal Reduction for Basin Size

For operational use, basin average values of convergence PMP are needed rather than 10-mi^2 (26-km^2) values. Preferably, the method for reducing 10-mi^2 (26-km^2) values to basin average rainfalls should be derived from depth-area relations of storms in the region. However, all general storms in the region include large proportions of orographic precipitation.

Our solution was to use generalized depth-area relations developed for PMP estimates within bordering zones in the Central and Eastern United States (Riedel et al. 1956). The smoothed areal variations adopted for the Southwestern States are shown in figures 2.28 and 2.29 for each month or a combination of months where differences are insignificant.

Figures 2.28 and 2.29 give depth-area relations that reduce 10-mi^2 (26-km^2) convergence PMP for basin sizes up to 5,000 mi^2 (12,950 km^2) for each month. Areal variations are given for the 4 greatest (1st to 4th) 6-hr PMP increments. After the 4th increment no reduction for basin size is required. Application of these figures will become clear through consideration of an example of PMP computation in chapter 6.

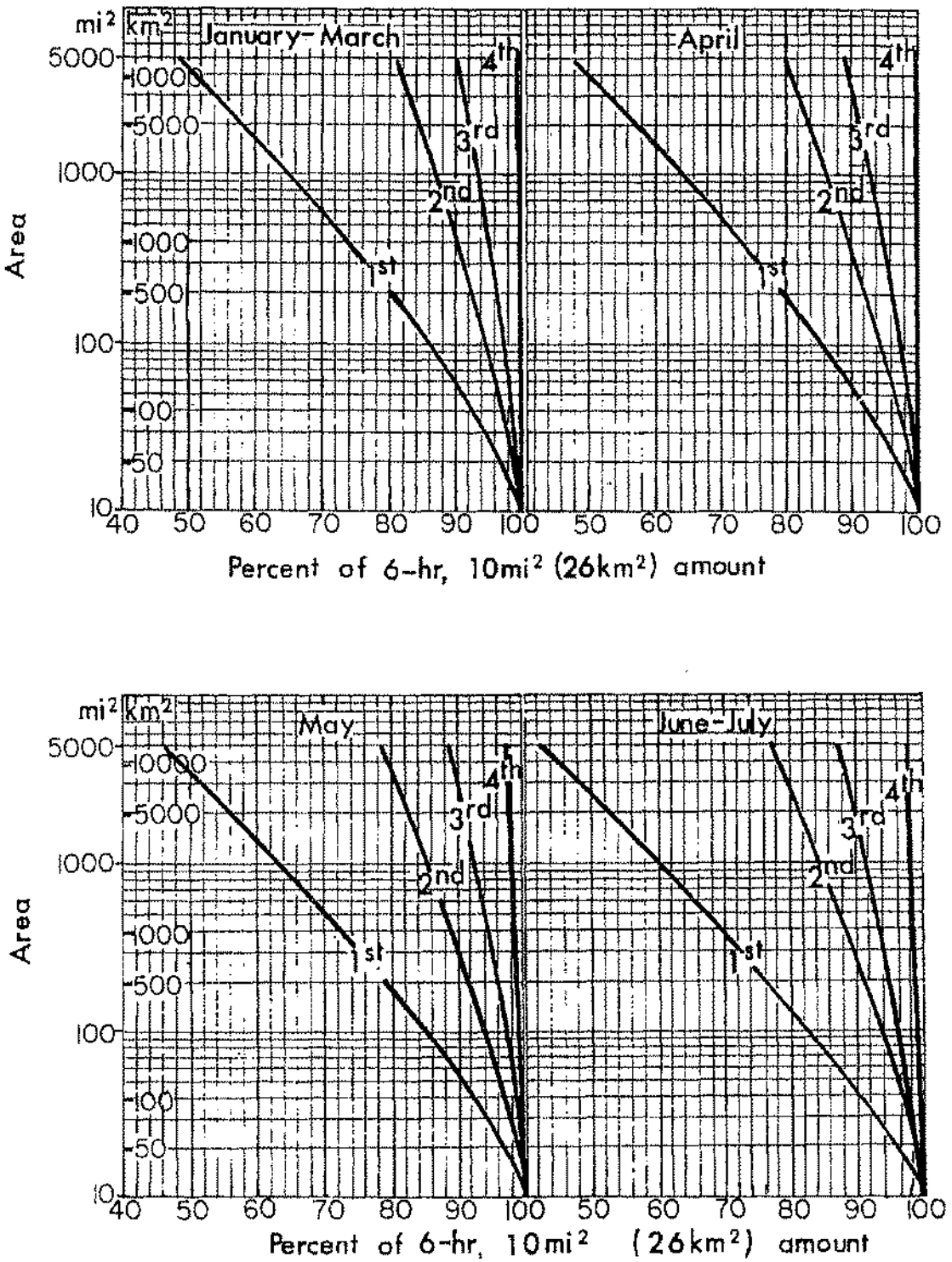
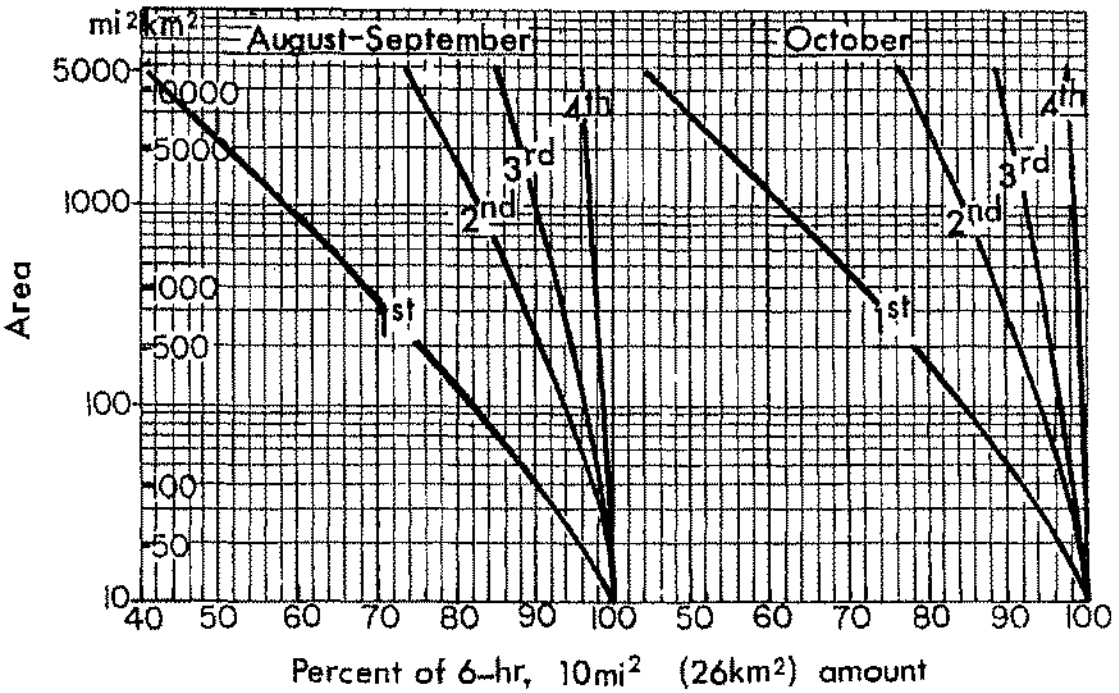


Figure 2.33.--Depth-area variation for convergence PMP for first to fourth 6-hr increments.



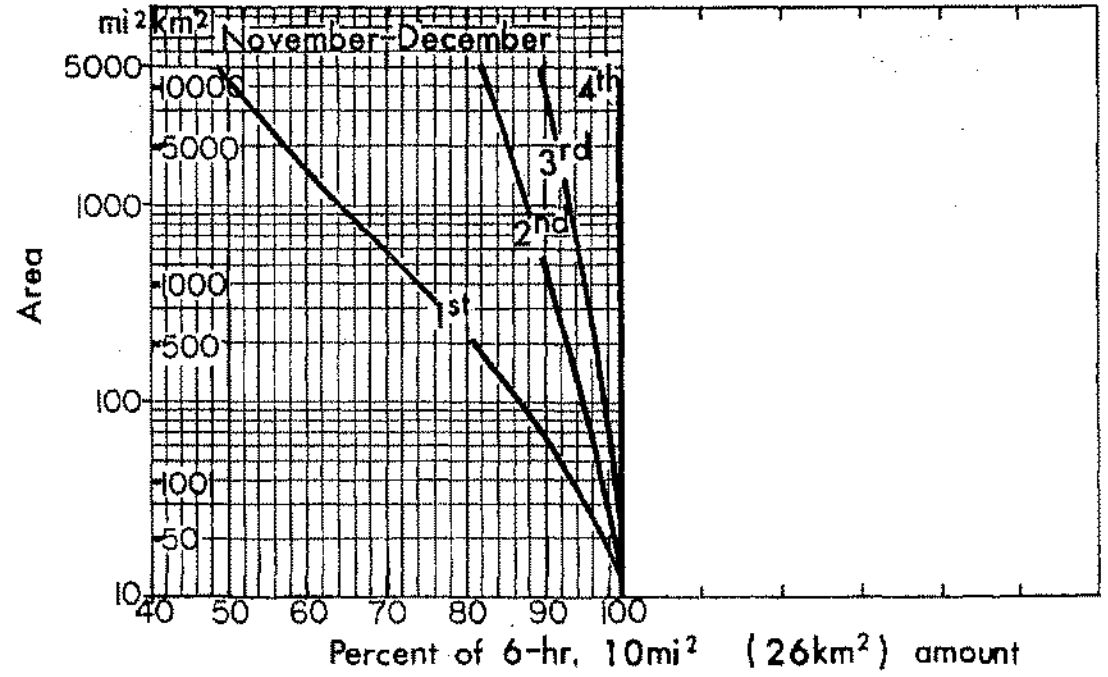
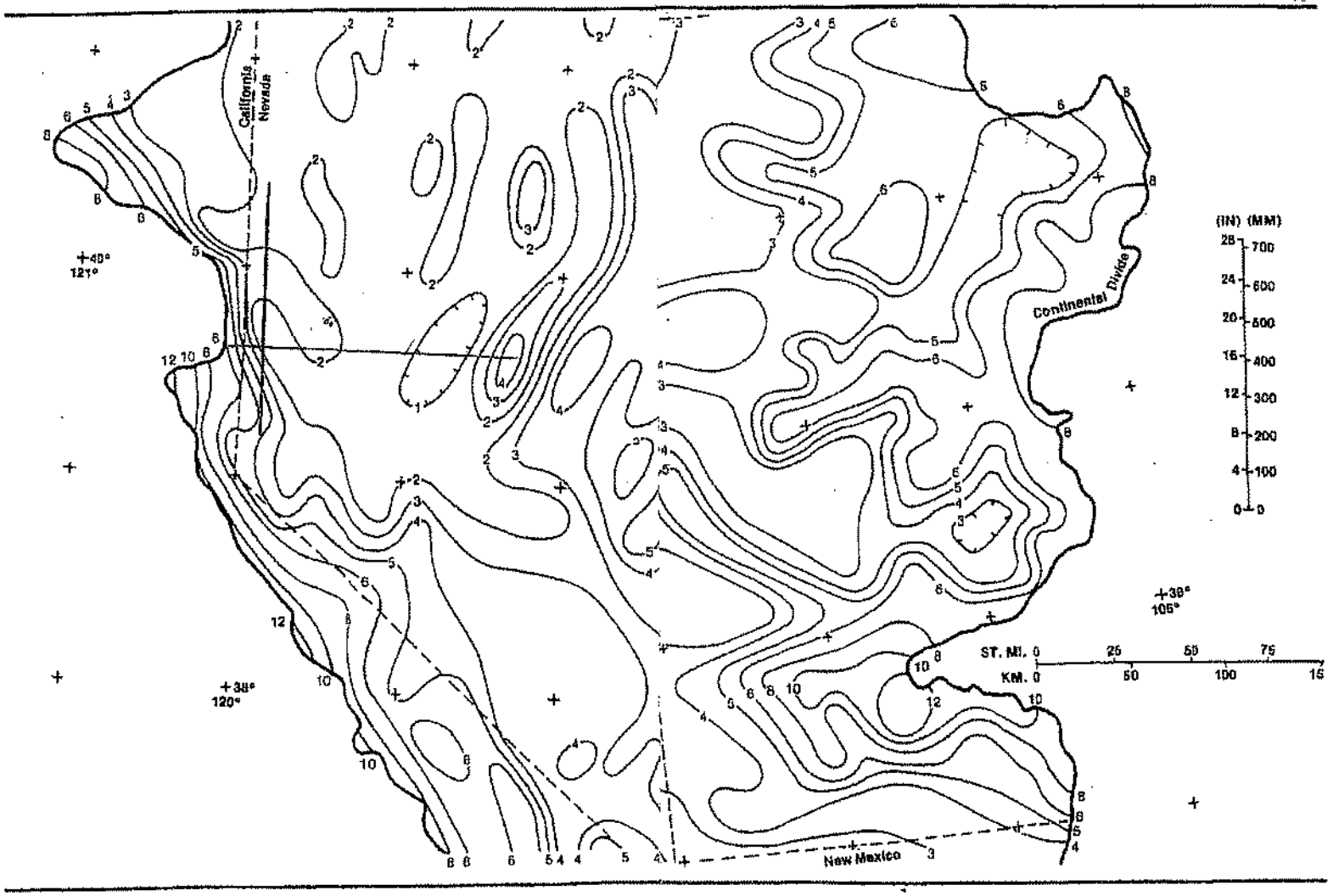


Figure 2.29.--Depth-area variation for convergence PMP for first to fourth 6-hr increments.



(Revised) — 10-mi² (26-km²) 24-hr orographic PMP index map (inches), north-central section.

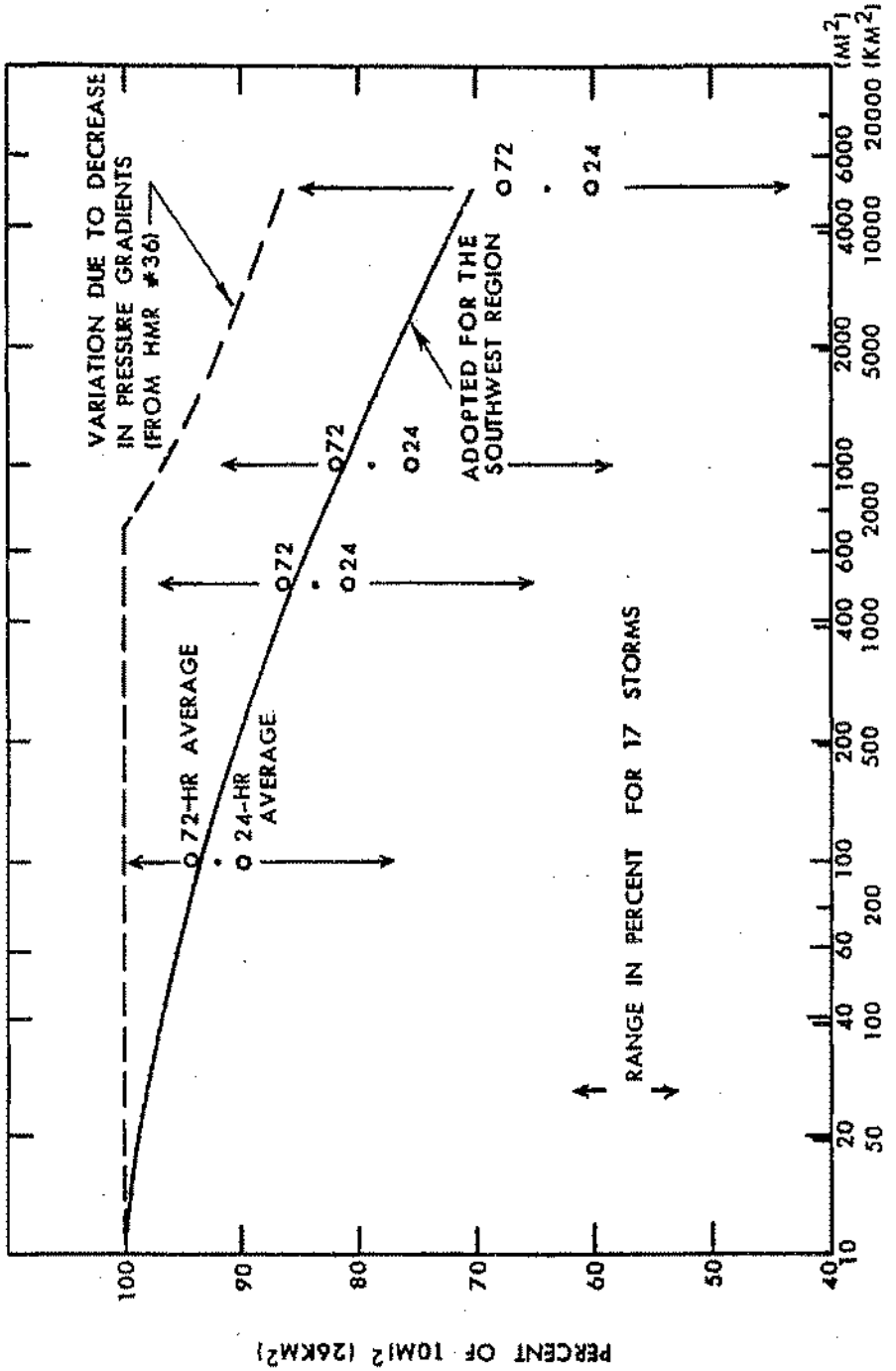


Figure 3.30.--Variation of orographic PMP with basin size.

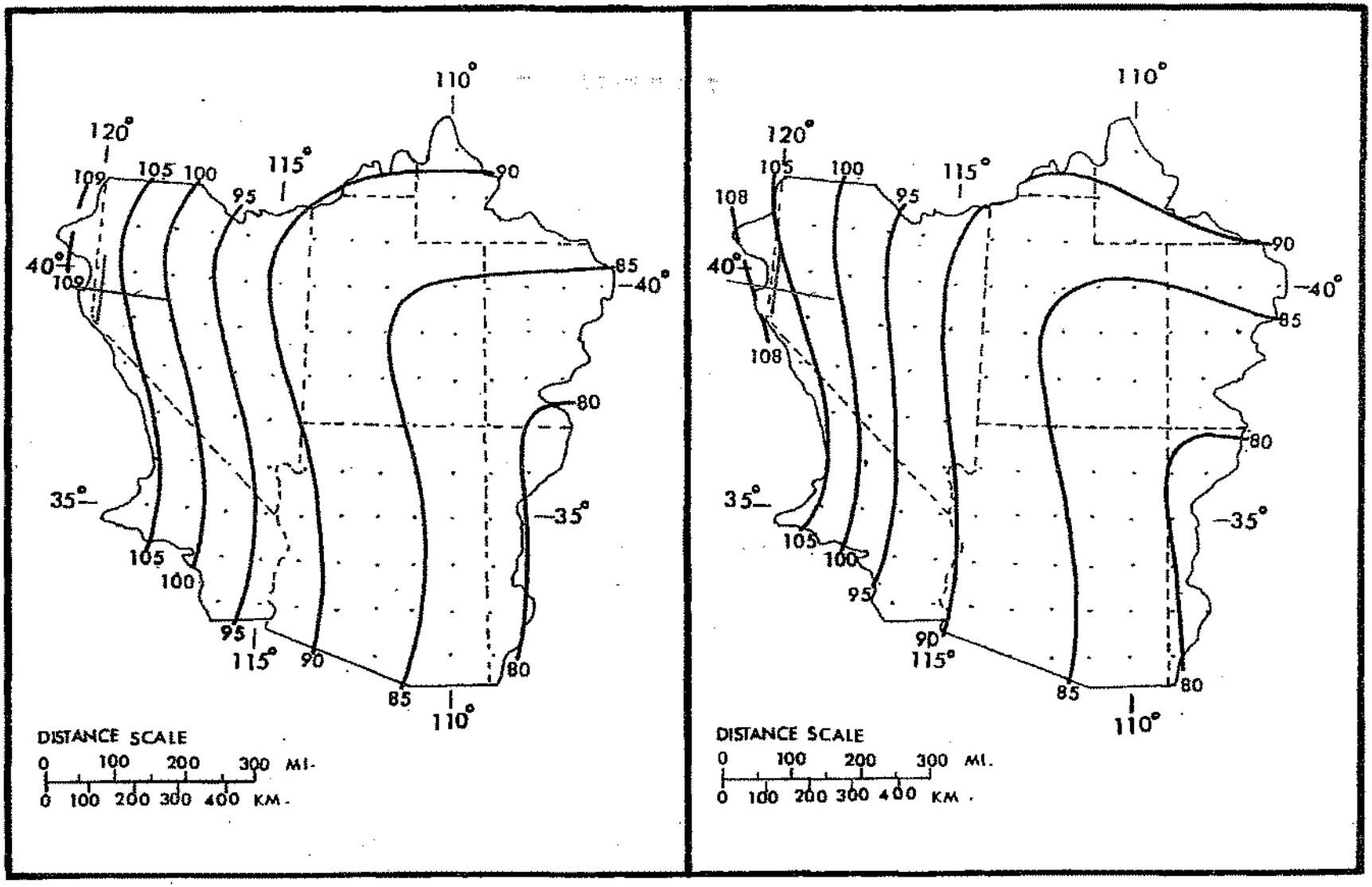
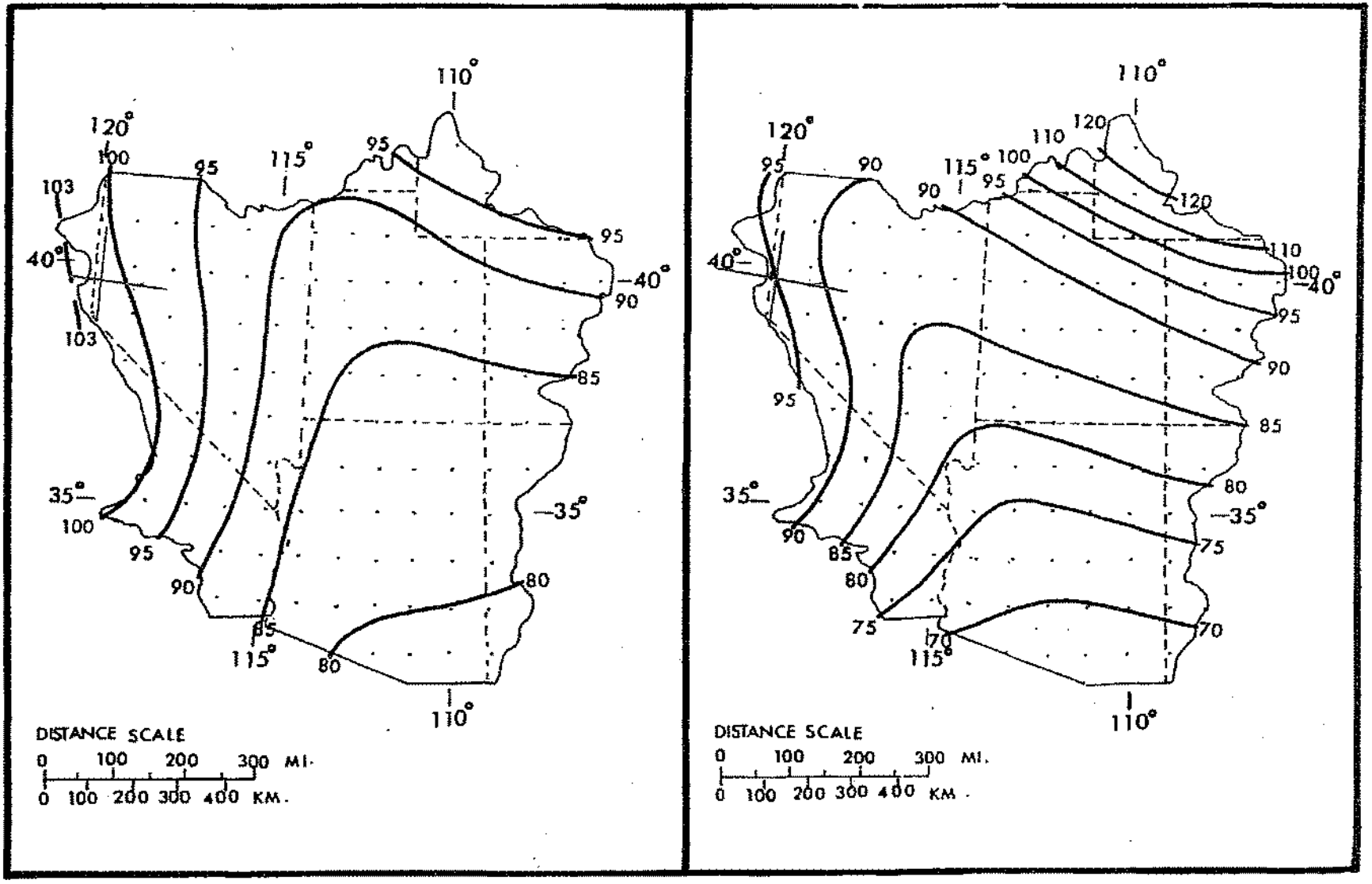


Figure 3.12.--Seasonal variation in 10-mi^2 (26-km^2) 24-hr orographic PMP for the study region (in percent of values in figure 3.11).



March *April*

Figure 3.13.--Seasonal variation in 10-mi^2 (26-km^2) 24-hr orographic PMP for the study region (in percent of values in figure 3.11).

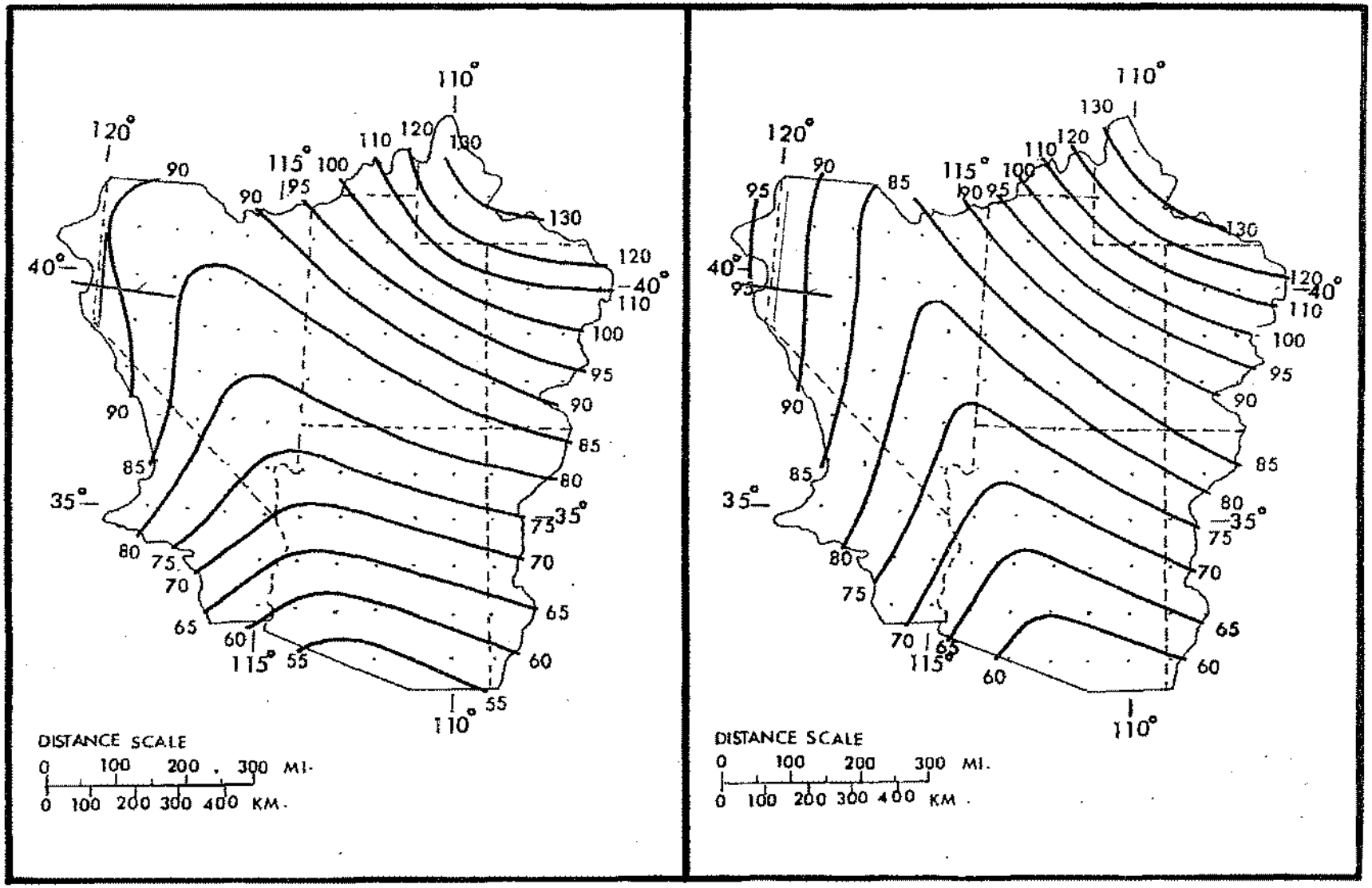
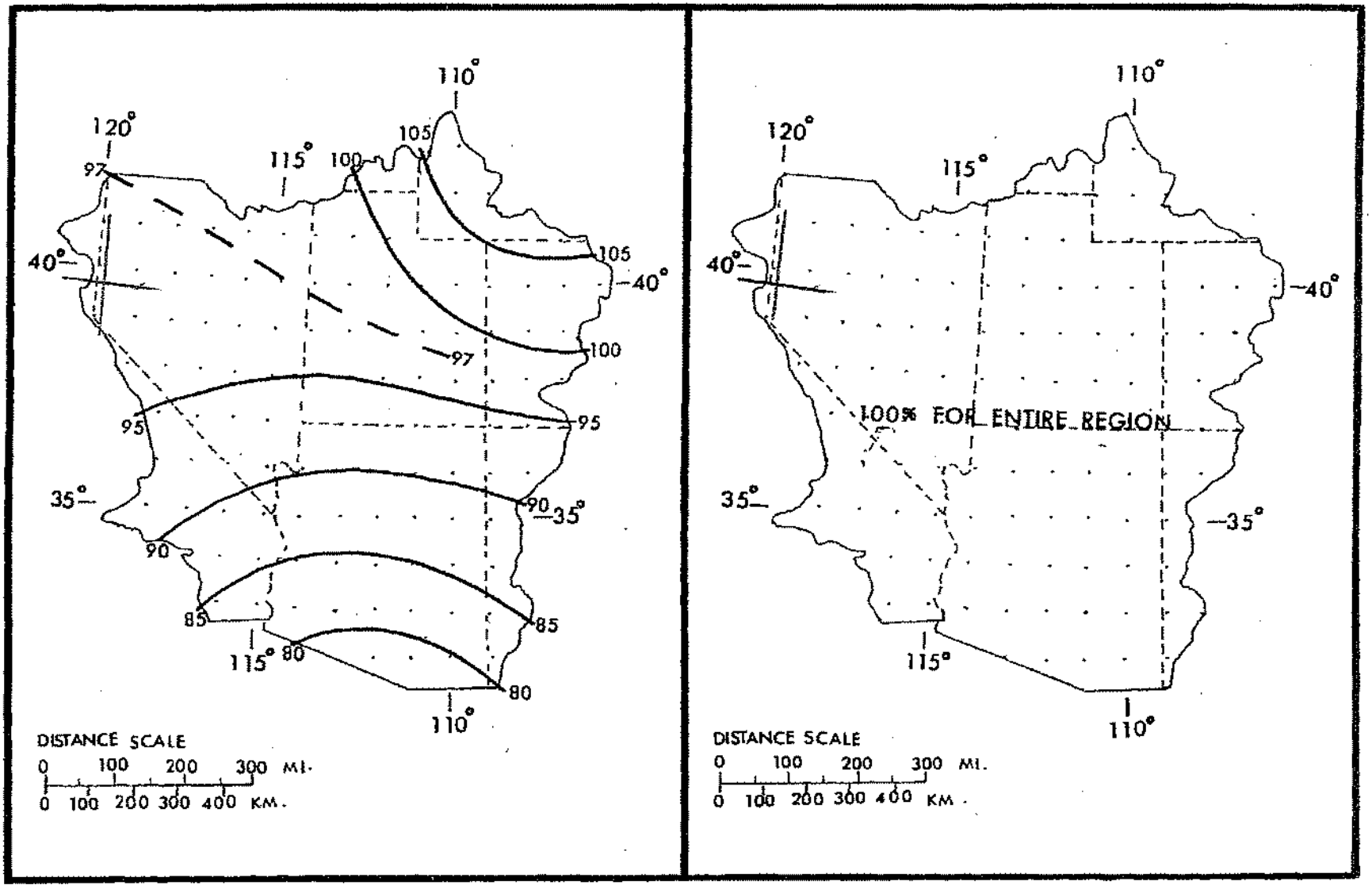
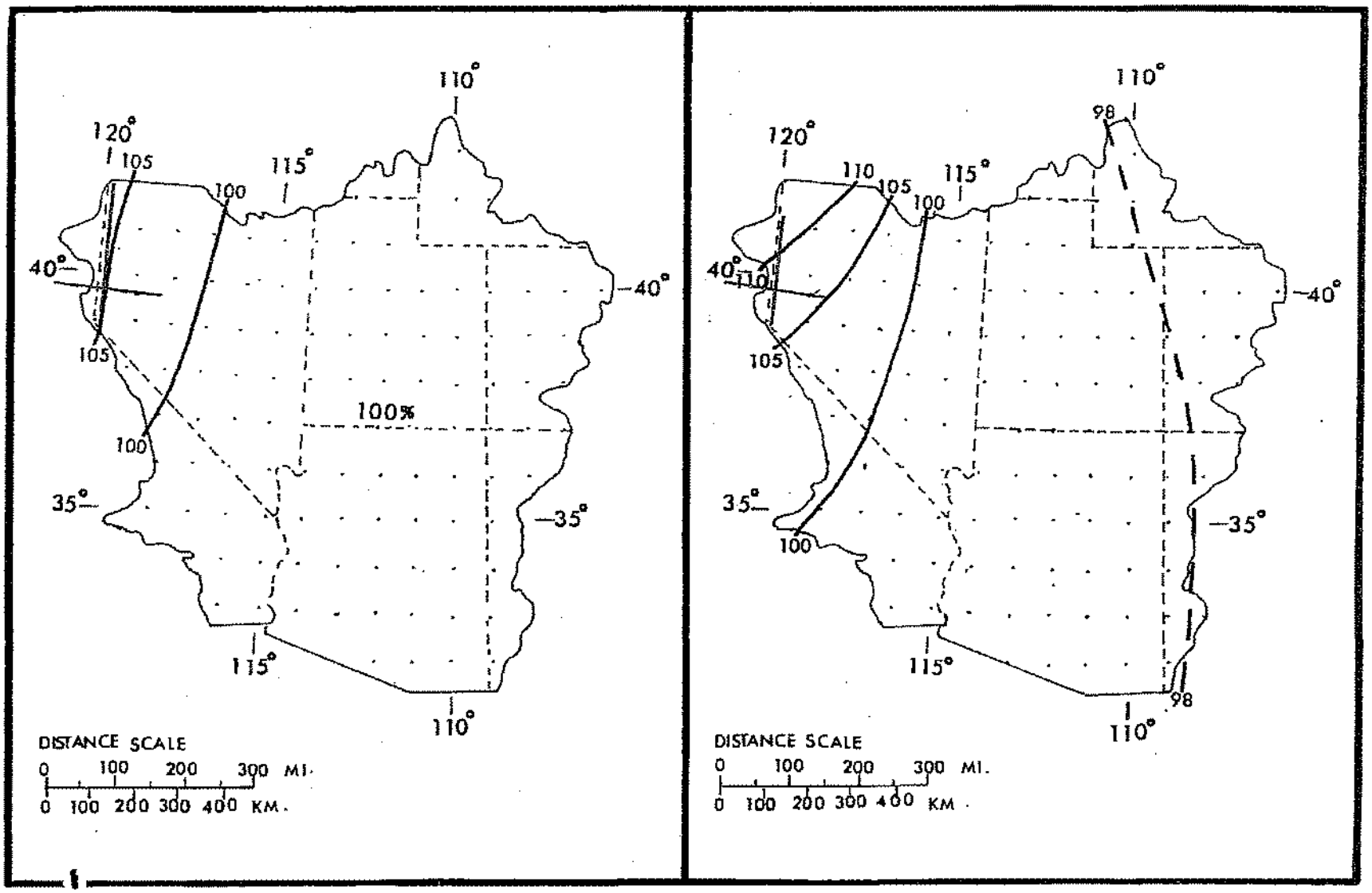


Figure 3.14.--Seasonal variation in 10-mi^2 (26-km^2) 24-hr orographic PMP for the study region (in percent of values in figure 3.11).



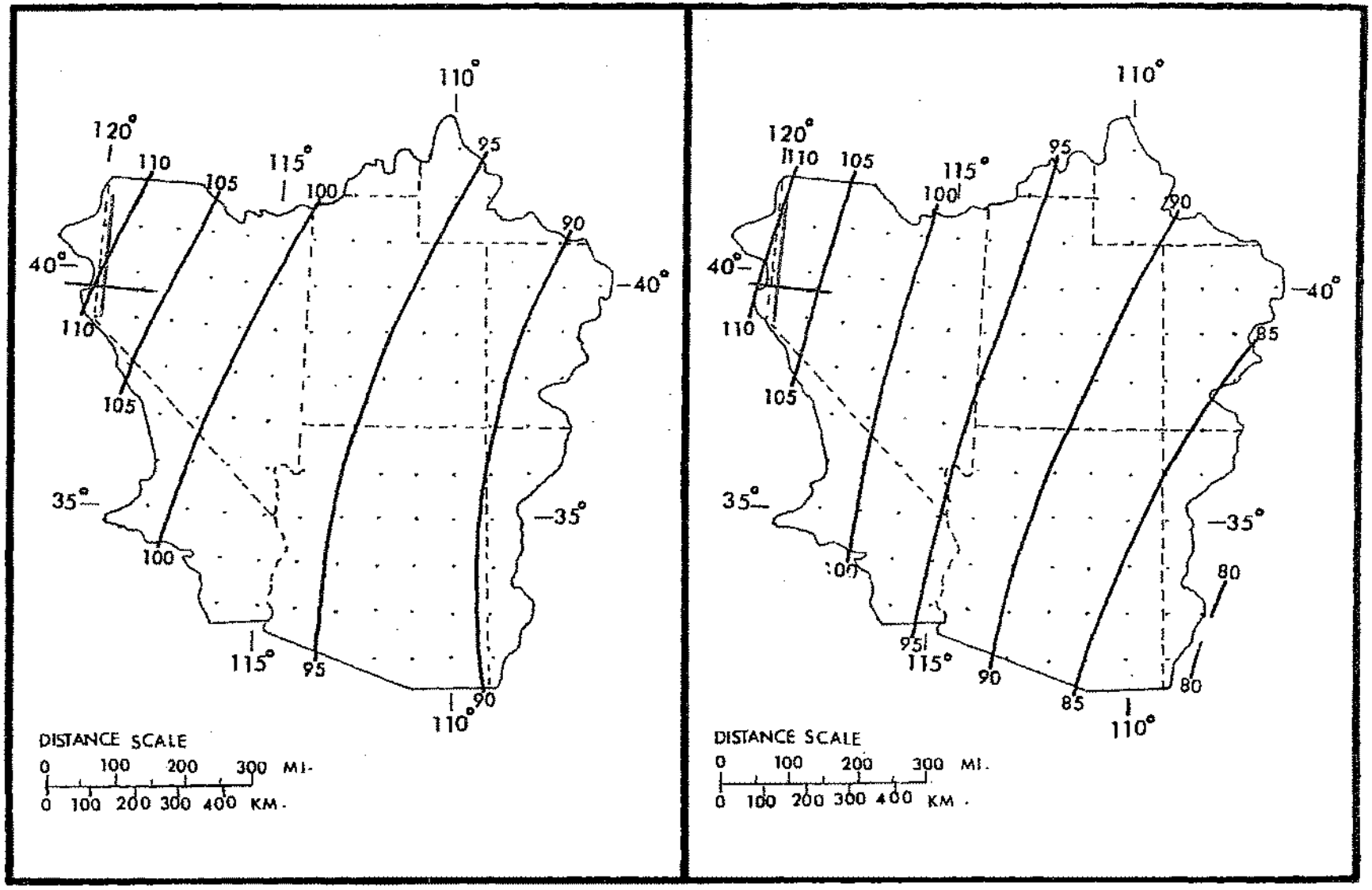
July *August*

Figure 3.15.--Seasonal variation in 10-mi^2 (26-km^2) 24-hr orographic PMP for the study region (in percent of values in figure 3.11).



September *October*

Figure 3.16.--Seasonal variation in 10-mi^2 (26-km^2) 24-hr orographic PMP for the study region (in percent of values in figure 3.11).



November *December*

Figure 3.17.--Seasonal variation in 10-mi^2 (26-km^2) 24-hr orographic PMP for the study region (in percent of values in figure 3.11).

Table 3.9.--Durational variation of orographic PMP

Latitude °N	Percent of 24-hr value					
	6 hr	12	18	24	48	72
42	28	55	79	100	161	190
41	29	56	79	100	160	189
40	30	57	80	100	159	187
39	30	57	80	100	157	185
38	31	58	81	100	155	182
37	32	59	81	100	152	177
36	33	60	82	100	149	172
35	34	61	82	100	146	167
34	35	62	83	100	143	162
33	36	63	84	100	139	157
32	37	64	84	100	135	152
31	39	66	85	100	132	146

4. LOCAL-STORM PMP FOR THE SOUTHWESTERN REGION AND CALIFORNIA

4.1 Introduction

This chapter provides generalized estimates of local or thunderstorm probable maximum precipitation. By "generalized" is meant that mapped values are given from which estimates of PMP may be determined for any selected drainage.

4.1.1 Region of Interest

Local-storm PMP was not included in the "Interim Report, Probable Maximum Precipitation in California" (HMR No. 36). During the formulation of the present study, we decided that the local-storm part of the study should include California west of the Sierra Nevada. It was also noted that PMP for summer thunderstorms was not considered west of the Cascade Divide in the Northwestern Region (HMR No. 43). As stated in the latter report, "No summer thunderstorms have been reported there (west of the Divide) of an intensity of those to the east, for which the moisture source is often the Gulf of Mexico or Gulf of California. The Cascade Divide offers an additional barrier to such moisture inflows to coastal areas where, in addition, the Pacific Ocean to the west has a stabilizing influence on the air to hinder the occurrence of intense summer local storms." Therefore, it was necessary to establish some continuation of the Cascade Divide into California so that the local-storm PMP definition would have continuity between the two regions.

The stabilizing influence of the Pacific air is at times interrupted by the warm moist tropical air from the south pushing into California, although it is difficult to determine where the limit of southerly flow occurs. General storms having the tropical characteristic of excessive thunderstorm rains are observed as far north as the northern end of the Sacramento Valley. Thus, a northern boundary has been selected for this study, excluding that portion of

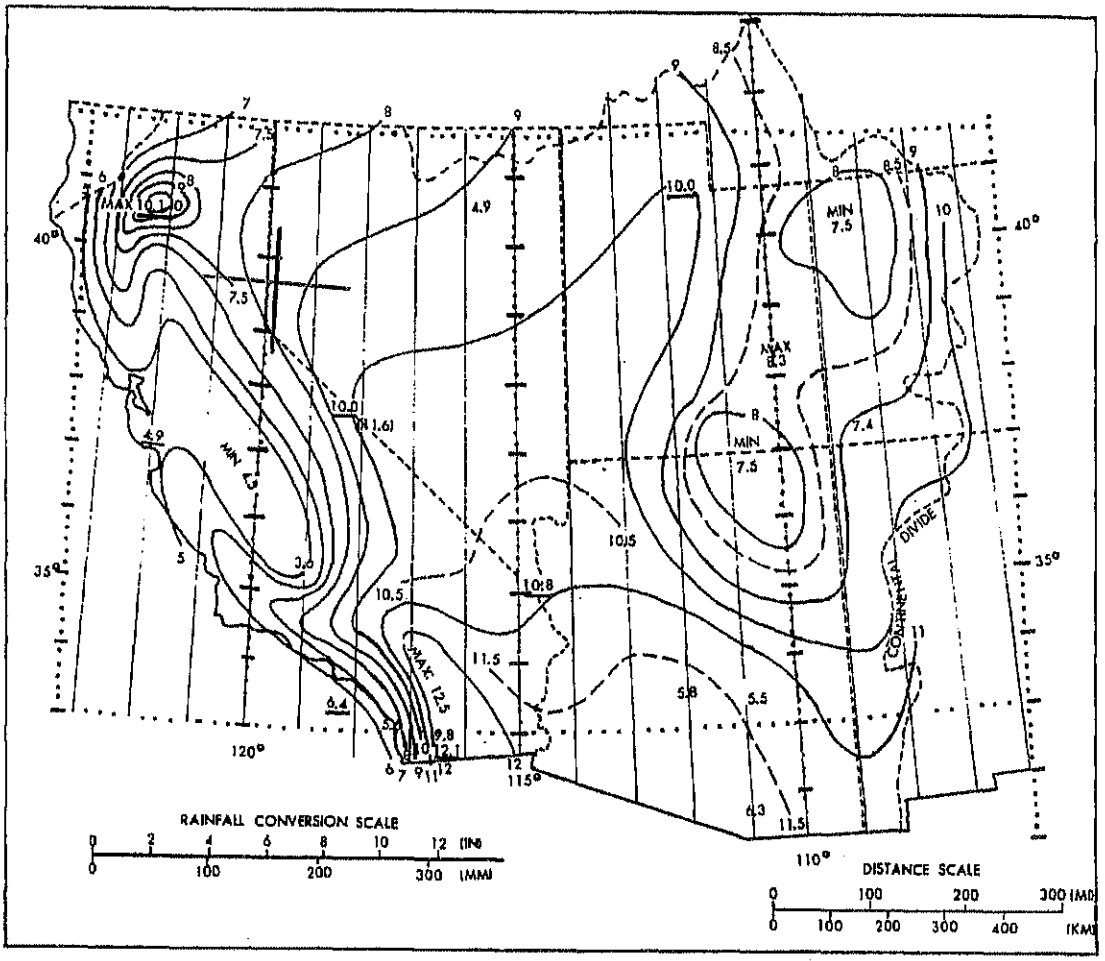


Figure 4.5--Local-storm PMP for 1 mi^2 (2.6 km^2) 1 hr. Directly applicable for locations between sea level and 5000 ft (1524 m). Elevation adjustment must be applied for locations above 5000 ft.

events. In contrast to figure 4.4, figure 4.5 maintains a maximum between these two locations. There is no known meteorological basis for a different solution. The analysis suggests that in the northern portion of the region maximum PMP occurs between the Sierra Nevada on the west and the Wasatch range on the east.

A discrete maximum (> 10 inches, 254 mm) occurs at the north end of the Sacramento Valley in northern California because the northward-flowing moist air is increasingly channeled and forced upslope. Support for this PMP center comes from the Newton, Kennett, and Red Bluff storms (fig. 4.1). Although the analysis in this region appears to be an extension of the broad maximum through the center of the Southwestern Region, it does not indicate the direction of moist inflow. The pattern has evolved primarily as a result of attempts to tie plotted maxima into a reasonable picture while considering inflow directions, terrain effects, and moisture potential.

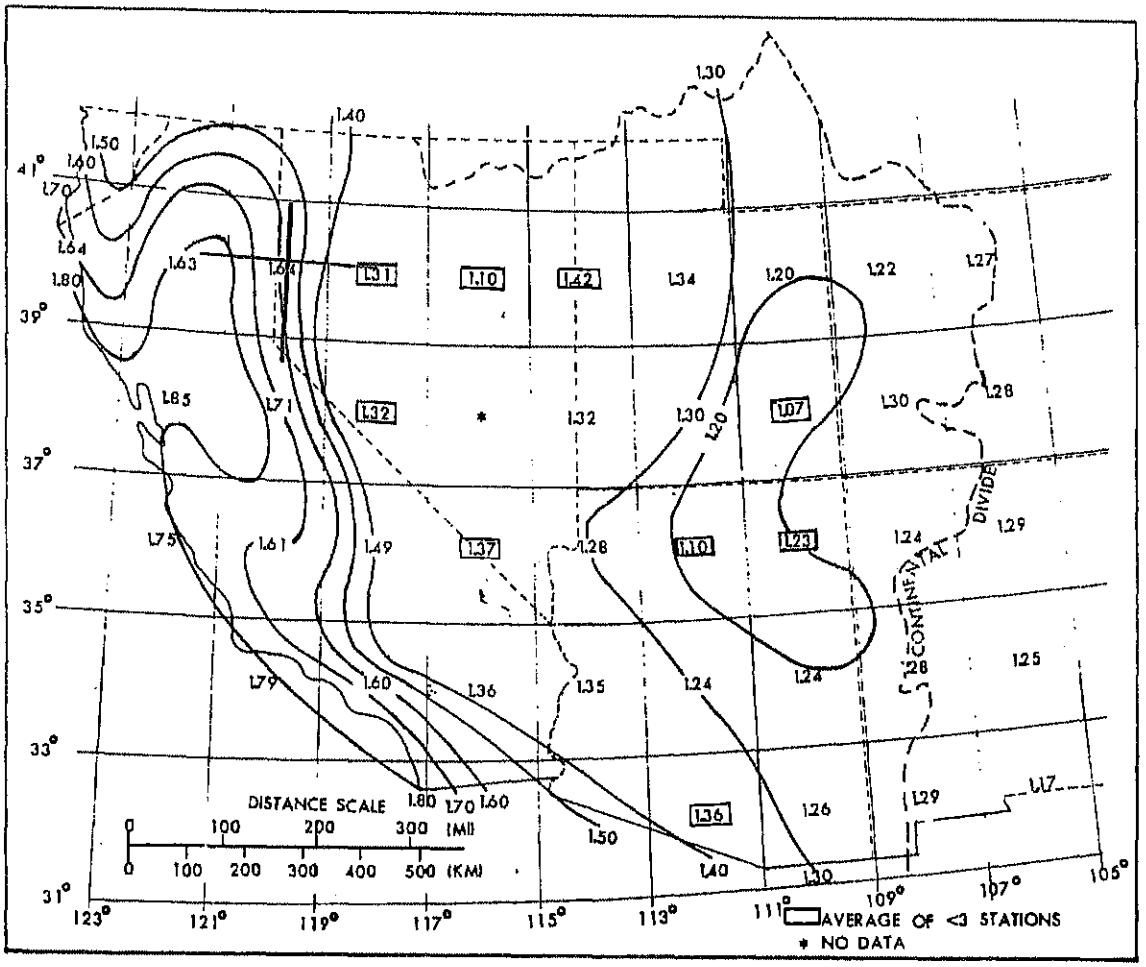


Figure 4.7.--Analysis of 6/1-hr ratios of averaged maximum station data (plotted at midpoints of a 2° latitude-longitude grid).

establish the basic depth-duration curve, then structure a variable set of depth-duration curves to cover the range of 6/1-hr ratios that are needed.

Three sets of data were considered for obtaining a base relation (see table 4.3 for depth-duration data).

a. An average of depth-duration relations from each of 17 greatest 3-hr rains from summer storms (1940-49) in Utah (U. S. Weather Bureau 1951b) and in unpublished tabulations for Nevada and Arizona (1940-63). The 3-hr amounts ranged from 1 to 3 inches (25 to 76 mm) in these events.

b. An average depth-duration relation from 14 of the most extreme short-duration storms listed in Storm Rainfall (U. S. Army, Corps of Engineers 1945-). These storms come from Eastern and Central States and have 3-hr amounts of 5 to 22 inches (127 to 559 mm).

ratios than storms with high 3/1-hr ratios. The geographical distribution of 15-min to 1-hr ratios also were inversely correlated with magnitudes of the 6/1-hr ratios of figure 4.7. For example, Los Angeles and San Diego (high 6/1-hr ratios) have low 15-min to 1-hr ratios (approximately 0.60) whereas the 15-min to 1-hr ratios in Arizona and Utah (low 6/1-hr ratios) were generally higher (approximately 0.75).

Depth-duration relations for durations less than 1 hour were then smoothed to provide a family of curves consistent with the relations determined for 1 to 6 hours, as shown in figure 4.3. Adjustment was necessary to some of the curves to provide smoother relations through the common point at 1 hour.

We believe we were justified in reducing the number of the curves shown in figure 4.3 for durations less than 1 hour, letting one curve apply to a range of 6/1-hr ratios. The corresponding curves have been indicated by letter designators, A-D, on figure 4.3. As an example, for any 6-hr amount between 115% and 135% of 1-hr, 1-mi^2 (2.6-km^2) PMP, the associated values for durations less than 1 hour are obtained from the curve designated as "B".

Table 4.4 lists durational variations in percent of 1-hr PMP for selected 6/1-hr rain ratios. These values were interpolated from figure 4.3.

To determine 6-hr PMP for a basin, use figure 4.3 (or table 4.4) and the geographical distribution of 6/1-hr ratios given in figure 4.7.

Table 4.4.--Durational variation of 1-mi^2 (2.6-km^2) local-storm PMP in percent of 1-hr PMP (see figure 4.3)

6/1-hr ratio	Duration (hr)								
	1/4	1/2	3/4	1	2	3	4	5	6
1.1	86	93	97	100	107	109	110	110	110
1.2	74	89	95	100	110	115	118	119	120
1.3	74	89	95	100	114	121	125	128	130
1.4	63	83	93	100	118	126	132	137	140
1.5	63	83	93	100	121	132	140	145	150
1.6	43	70	87	100	124	138	147	154	160
1.8	43	70	87	100	130	149	161	171	180
2.0	43	70	87	100	137	161	175	188	200

4.5 Depth-Area Relation

We have thus far developed local-storm PMP for an area of 1 mi^2 (2.6 km^2). To apply PMP to a basin, we need to determine how 1-mi^2 (2.6-km^2) PMP should decrease with increasing area. We have adopted depth-area relations based on rainfalls in the Southwest and from consideration of a model thunderstorm.

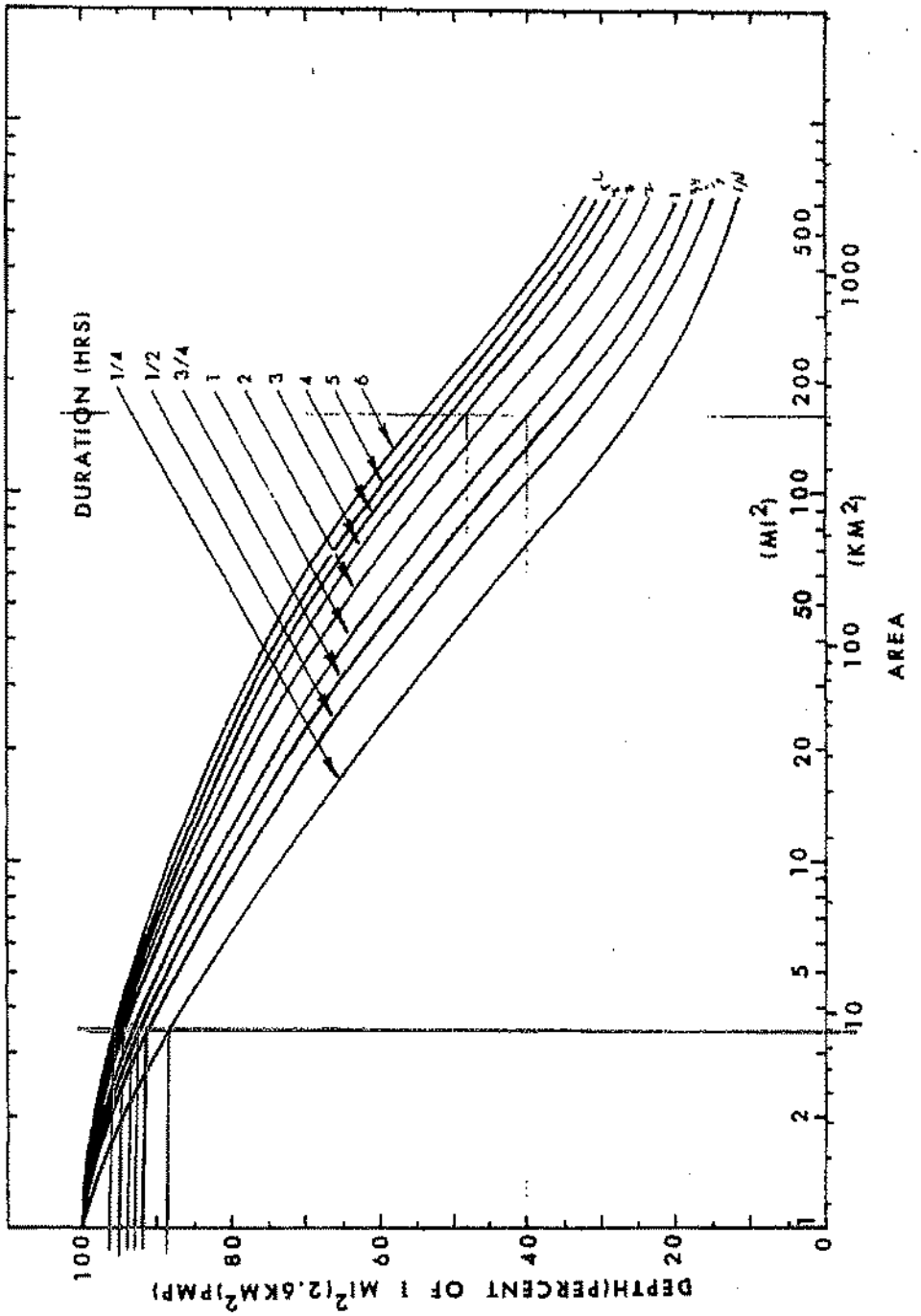


Figure 4.9.--Adopted depth-area relations for local-storm PMP.

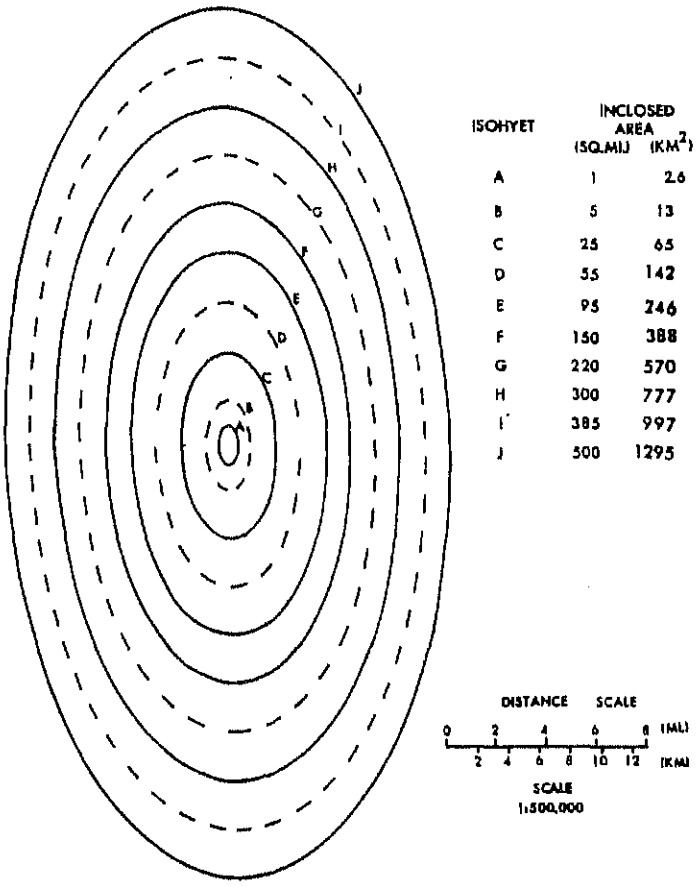


Figure 4.10.--Idealized local-storm isohyetal pattern.

storm period. The sequence of hourly incremental PMP for the Southwest 6-hr thunderstorm in accord with this study is presented in column 2 of table 4.7. A small variation from this sequence is given in Engineering Manual 1110-2-1411 (U. S. Army, Corps of Engineers 1965). The latter, listed in column 3 of table 4.7, places greater incremental amounts somewhat more toward the end of the 6-hr storm period. In application, the choice of either of these distributions is left to the user since one may prove to be more critical in a specific case than the other.

Table 4.7.--Time sequence for hourly incremental PMP in 6-hr storm

Increment	HMR No. 5[1] Sequence Position	EM1110-2-1411[2] Sequence Position
Largest hourly amount	Third	Fourth
2nd largest	Fourth	Third
3rd largest	Second	Fifth
4th largest	Fifth	Second
5th largest	First	Last
least	Last	First

[1]U. S. Weather Bureau 1947.
[2]U. S. Corps of Engineers 1952.

Also of importance is the sequence of the four 15-min incremental PMP values. We recommend a time distribution, table 4.8, giving the greatest intensity in the first 15-min interval (U.S. Weather Bureau 1947). This is based on data from a broad geographical region. Additional support for this time distribution is found in the reports of specific storms by Keppell (1963) and Osborn and Renard (1969).

Table 4.8.--Time sequence for 15-min incremental PMP within 1 hr.

Increment	Sequence Position
Largest 15-min amount	First
2nd largest	Second
3rd largest	Third
least	Last

4.8 Seasonal Distribution

The time of the year when local-storm PMP is most likely is of interest. Guidance was obtained from analysis of the distribution of maximum 1-hr thunderstorm events through the warm season at the recording stations in Utah, Arizona, and in southern California (south of 37°N and east of the Sierra Nevada ridgeline). The period of record used was for 1940-72 with an average record length for the stations considered of 27 years. The month with the one greatest thunderstorm rainfall for the period of record at each station was noted. The totals of these events for each month, by States, are shown in table 4.9.

Table 4.9.--Seasonal distribution of thunderstorm rainfalls.

(The maximum event at each of 108 stations, period of record 1940-72.)

	Month						
	M	J	J	A	S	O	No. of Cases
Utah	1	5	9	14	5		34
Arizona		4	16	19	4		43
S. Calif.*		14	10	7			31
No. of cases/mo.	1	23	35	40	9	0	

*South of 37°N and east of Sierra Nevada ridgeline.

APPENDIX D – DAM DESIGN CRITERIA TABLE

Design Documentation	System	Parameter	Standard	Controlling Document	Document Citation	Notes
EDR, Plan	Regulatory	height (68-74')	20' tall or higher	NDWR - NRS/NAC	NRS 535.010, NAC 535.120	NDWR provides a definition; NRCS provides design considerations
EDR, Plan	Regulatory	volume	20 AF or more	NDWR - NRS	NRS 535.010	NDWR provides a definition
EDR, O (could be separate Doc)	Regulatory	Hazard classification	Downstream impact analysis	NDWR - NAC	NAC 535.140, NAC 535.210(6)	NDWR provides definitions; NRCS provides design considerations and parameters
EDR, Plan, S	Outlet (Primary spillway)	material	NOT CMP			NDWR provides some exceptions; NRCS cites guidance in 210-NEM-636
EDR, Plan, S	Outlet (Primary spillway)	size (D)	24" or 30"	NRCS - TR-60	pg. 6-4	Minimum, depending on foundation conditions
EDR	Outlet (Primary spillway)	flow (min)	See Notes	NRCS - TR-60	pg. 6-1	85% of Principal Spillway Hydrograph (PSH) in 10 days or less (from peak impoundment elevation); if 15% or more remains after 10 days, raise crest of auxiliary spillway sufficiently to impound initial storage volume plus remainder
EDR	Outlet (Primary spillway)	flow (max)	N/A			
	Outlet (Primary spillway)	crest elevation	yes	NRCS - TR-60	pg. 6-1	at top of submerged sediment storage or higher
	Outlet (Primary spillway)	routing	yes	NRCS - TR-60	pg. 6-2	initial reservoir elevation at top of expected sediment storage or lowest ungated inlet, whichever is higher
EDR, Plan, S	Outlet (Primary spillway)	controls	N/A			Upstream control strongly preferred
EDR, Plan	Auxiliary (Emergency) Spillway	height	N/A			
EDR, Plan	Auxiliary (Emergency) Spillway	width	See Notes	NRCS - TR-60	pg. 7-3	must ensure flow remains supercritical in discharge channel for all flow 25% of max flow or higher
EDR, HR	Auxiliary (Emergency) Spillway	activation	Yes	NRCS - TR-60	pg. 7-2	not less than the elevation necessary to contain the initial storage volume plus any 10-day remainder of the PSH
EDR, HR	Auxiliary (Emergency) Spillway	capacity	Adequate to pass IDF	NDWR - NAC	NAC 535.240	IDF based on size and hazard. Impoundment surcharge may be counted
EDR, Plan, S	Auxiliary (Emergency) Spillway	materials	See Notes	NRCS - TR-60	pg. 7-4	210-NEH-51 and -52
EDR, Plan, S	Auxiliary (Emergency) Spillway	armoring	yes	NRCS - TR-60	pg. 7-3	no damage
EDR, HR	Auxiliary (Emergency) Spillway	velocity	N/A			
EDR, HR	Auxiliary (Emergency) Spillway	slope	N/A			
EDR, Plan	Impoundment	dead pool	N/A			Water right required for any long-term impoundment of intercepted water
EDR, HR, Plan	Impoundment	freeboard	3'	NDWR - NAC	NAC 535.240	May be reduced if calculations show a lesser amount is justified
EDR, HR	Impoundment	wave runup	N/A			Optional to alter freeboard
EDR, HR, Plan	Impoundment	sediment	yes	NRCS - TR-60	pg. 3-1	Calculate using 210-NEH-3; if sediment yield exceeds 2 watershed inches in 50 years, consider other means to control sediment.
EDR, Plan	Impoundment	multiple uses	yes	NRCS - TR-60	multiple	Changes initial criteria for most hydraulic calculations
EDR, GR, Plan, S	Embankment	materials	N/A			non-deleterious, clean (without ice, clumps, organic matter or over-size stones)
EDR, GR, Plan	Embankment	slope upstream	N/A			Per stability standards

Design Documentation	System	Parameter	Standard	Controlling Document	Document Citation	Notes
EDR, GR, Plan	Embankment	slope downstream	N/A			Per stability standards
EDR, GR, Plan, S	Embankment	armoring	Structural	NRCS - TR-60	Pg. 5-15, 5-16	Recommended, not required; i.e. riprap
EDR, GR, Plan, S	Embankment	zoning	Maybe	NRCS - TR-60	Pg. 5-15	provides dimension guidance
EDR, GR, Plan, S	Embankment	filters	yes	NRCS - TR-60	pg. 5-many, 6-8	for zoned embankments and outlet conduits
EDR, GR, Plan, S	Embankment	drains	yes	NRCS - TR-60	pg. 5-many, 6-8	for zoned embankments and outlet conduits
EDR, GR	Geotechnical Investigation	stability FOS end of construction	1.3	NDWR - NAC	NAC 535.210(9)	
EDR, GR	Geotechnical Investigation	stability FOS rapid drawdown	1.25	NDWR - NAC	NAC 535.210(9)	NRCS = Assume drains (if any) plugged; infinite slope may be critical case (1.1)
EDR, GR	Geotechnical Investigation	stability FOS steady state	1.4	NDWR - NAC	NAC 535.210(9)	NRCS = Assume drains (if any) plugged; infinite slope may be critical case (1.3); 1.4 and 1.2 for "flood surcharge"
EDR, GR	Geotechnical Investigation	stability FOS seismic	1.1	NDWR - NAC	NAC 535.210(9), NAC 535.250	NDWR = MCE; NRCS = If active fault under site, must withstand potential offset; if potential for loss of strength, post earthquake stability (1.2)
EDR, GR, Plan	Embankment	crest width	14'	NRCS - TR-60	Table 5-1	
EDR, GR, Plan, S	Embankment	crest treatment	slope to U/S side			
EDR, GR, Plan, S	Embankment	borrow	Clean and well-graded			
EDR, GR, S	Embankment	moisture content	Per compaction requirements			
EDR, GR, S	Embankment	lift thickness	Per compaction requirements			stated in loose "as placed" dimension
EDR, GR, S	Embankment	compaction	Per stability assumptions			
EDR, S	Embankment	equipment	Specify			Adequate to meet compaction requirements
EDR, GR, Plan, S	Geotechnical Investigation	borrow	nature and quantity of soils	NRCS - TR-60	pg. 4-1	use publications 210-NEM-531 and 210-NEH-531
EDR, GR	Geotechnical Investigation	area conditions	surficial features			
EDR, GR, Plan	Geotechnical Investigation	seismic conditions	locally and regionally	NRCS - TR-60	pg. 4-2	NDWR - Include faults within project area; NRCS - PGA = 1 x10(-4), aka 1/10,000 years aka 0.5% chance of exceedence in 50 years; OR FEMA 65
EDR, GR, Plan	Geotechnical Investigation	site exploration - test pits	required			typically at least one per borrow, foundation and impoundment
EDR, GR, Plan	Geotechnical Investigation	site exploration - boreholes	required			Optional, strongly recommended for larger impoundments/taller embankments
EDR, GR	Geotechnical Investigation	soil parameters - foundation	type, extent, treatment			
EDR, GR, Plan, S	Geotechnical Investigation	stripping	yes			expected depth and areas
EDR, GR	Geotechnical Investigation	soil parameters - abutments	type, extent, treatment			
EDR, GR, S	Geotechnical Investigation	soil parameters - fill	type, extent, availability			
EDR, GR	Geotechnical Investigation	seep analysis	yes	NRCS - TR-60	pg. 5-10 to 5-13	NRCS - Will only need to do so for foundation and u/s slope assuming blocked primary spillway/drain
EDR, GR, S	Geotechnical Investigation	filter/drain requirements	Yes	NRCS - TR-60	pg. 5-12 to 5-13	all materials must be filter compatible or filters designed

Design Documentation	System	Parameter	Standard	Controlling Document	Document Citation	Notes
EDR, GR	Geotechnical Investigation	lab analyses	seive, classification, Proctor	NRCS - TR-60	Fig. 5-4	
EDR, GR, Plan (if discrete spot)	Geotechnical Investigation	special	Yes	NRCS - TR-60	pg. 4-2	Sulfate, sodium, liquifaction, expansive, dispersive or collapsing conditions, etc.
	Appurtenances	instrumentation	visual	NRCS - TR-60	pg. 5-16	at a minimum
EDR, Plan, S	Appurtenances	controls	location and type			typically on crest, valves on upstream end of conduit(s)
EDR, Plan, S (if physical)	Appurtenances	security	Yes	NRCS - TR-60	pg. 1-4	NDWR - reasonable efforts expected; NRCS - keep public from hazardous areas
EDR, GR, Plan (details), S	Appurtenances	concrete	min 3ksi			must be properly specified for soil conditions (sulfates) and non-alkali-aggregate reactive
EDR, GR, Plan (details), S	Appurtenances	steel				
EDR, Plan	Appurtenances	trash rack	yes			required on outlet/primary spillway
EDR, Plan	Appurtenances	landscaping	n/a			ANY vegetation on embankment dams in Nevada discouraged
EDR, Plan, S	Appurtenances	prefabricated materials	n/a			Provide cut-sheets and include in Specifications
EDR, HR, Plan	Hydrology	tributary area				
EDR, HR	Hydrology	precipitation frequency	PMP local storm	NDWR - NAC	NAC 535.240	
EDR, HR	Hydrology	runoff method	ARC II or greater	NRCS - TR-60	pg. 2-1	210-NEH-630-9 and 210-NEH-630-10
EDR, HR	Hydrology	transport method				
EDR, HR	Hydrology	IDF	PMF	NDWR - NAC	NAC 535.240	NRCS - Principal Spillway IDF not less than "100-year" precipitation, not less than 10-days duration pursuant to 210-NEH-630-9, -10, -16 and -21; Freeboard hydrograph IDF = PMF, Auxiliary Spillway IDF = that runoff caused by a p[recipitation on the watershed of P100 + 0.26(PMP-P100)
EDR, HR, Plan	Hydraulics	maximum impoundment elevation	Freeboard Hydrograph	NRCS - TR-60	pg. 5-6	
EDR, HR, Plan	Hydraulics	outlet capacity curve				
EDR, HR, Plan	Hydraulics	spillway capacity curve				
EDR, HR	Hydraulics	drawdown time/curve	Preferred 48 hours, less than 7 days	TMRDM	1302.1	
EDR, HR	Hydrology/Hydraulics	spillway activation flood				

EDR = Engineering Design Report
GR = Geotechnical Report
Plan = Plans
HR = Hydrology/Hydraulic Report
S = Specifications
Where alternatives exist, stated standards are for a "dry" detention dam.

WOOD RODGERS

January 24, 2022

Ms. Jessica Dugan, Project Manager
Farr West Engineering
5510 Longley Lane
Reno, Nevada 89511

RE: City of Reno West Wash Dam Rehabilitation Project Aquatic Resource Delineation

Dear Ms. Dugan:

On behalf of the City of Reno, Project Applicant, Wood Rodgers, Inc. has completed the enclosed Aquatic Resources Delineation Report and Request for an Approved Jurisdictional Determination.

Please let me know if you may have any questions.

Respectfully,

Leslie M Burnside

Leslie Burnside, Associate
WOOD RODGERS, INC.

Attachments:
Request for Approved Jurisdictional Determination
Aquatic Resources Delineation Report

Appendix 1 - REQUEST FOR CORPS JURISDICTIONAL DETERMINATION (JD)

To: District Name Here

- I am requesting a JD on property located at: Wyoming and Gulling Streets
  (Street Address)
  City/Township/Parish: Reno County: Washoe State: Nevada
  Acreage of Parcel/Review Area for JD: 53
  Section: 3 and 4 Township: 19N Range: 19E
  Latitude (decimal degrees): 39.54471588 N Longitude (decimal degrees): -119.84604645 W
  (For linear projects, please include the center point of the proposed alignment.)
- Please attach a survey/plat map and vicinity map identifying location and review area for the JD.
- ☐ I currently own this property. ___ I plan to purchase this property.
  ☑ I am an agent/consultant acting on behalf of the requestor.
  ☐ Other (please explain): _____
- Reason for request: (check as many as applicable)
  ☐ I intend to construct/develop a project or perform activities on this parcel which would be designed to avoid all aquatic resources.
  ☐ I intend to construct/develop a project or perform activities on this parcel which would be designed to avoid all jurisdictional aquatic resources under Corps authority.
  ☐ I intend to construct/develop a project or perform activities on this parcel which may require authorization from the Corps, and the JD would be used to avoid and minimize impacts to jurisdictional aquatic resources and as an initial step in a future permitting process.
  ☐ I intend to construct/develop a project or perform activities on this parcel which may require authorization from the Corps; this request is accompanied by my permit application and the JD is to be used in the permitting process.
  ☐ I intend to construct/develop a project or perform activities in a navigable water of the U.S. which is included on the district Section 10 list and/or is subject to the ebb and flow of the tide.
  ☑ A Corps JD is required in order to obtain my local/state authorization.
  ☐ I intend to contest jurisdiction over a particular aquatic resource and request the Corps confirm that jurisdiction does/does not exist over the aquatic resource on the parcel.
  ☐ I believe that the site may be comprised entirely of dry land.
  ☑ Other: Emergency Flood Facility and Leaky Ditch wetland below the dam and Highland Ditch
- Type of determination being requested:
  ☑ I am requesting an approved JD.
  ☐ I am requesting a preliminary JD.
  ☐ I am requesting a "no permit required" letter as I believe my proposed activity is not regulated.
  ☐ I am unclear as to which JD I would like to request and require additional information to inform my decision.

By signing below, you are indicating that you have the authority, or are acting as the duly authorized agent of a person or entity with such authority, to and do hereby grant Corps personnel right of entry to legally access the site if needed to perform the JD. Your signature shall be an affirmation that you possess the requisite property rights to request a JD on the subject property.

*Signature: Leslie M. Burnside Date: January 24, 2022

- Typed or printed name: Leslie M. Burnside

Company name: Wood Rodgers, Inc.

Address: 1361 Corporate Blvd.

Reno, Nevada 89502

Daytime phone no.: 775-721-5412

Email address: lburnside@woodrodgers.com

*Authorities: Rivers and Harbors Act, Section 10, 33 USC 403; Clean Water Act, Section 404, 33 USC 1344; Marine Protection, Research, and Sanctuaries Act, Section 103, 33 USC 1413; Regulatory Program of the U.S. Army Corps of Engineers; Final Rule for 33 CFR Parts 320-332.
Principal Purpose: The information that you provide will be used in evaluating your request to determine whether there are any aquatic resources within the project area subject to federal jurisdiction under the regulatory authorities referenced above.
Routine Uses: This information may be shared with the Department of Justice and other federal, state, and local government agencies, and the public, and may be made available as part of a public notice as required by federal law. Your name and property location where federal jurisdiction is to be determined will be included in the approved jurisdictional determination (AJD), which will be made available to the public on the District's website and on the Headquarters USACE website.
Disclosure: Submission of requested information is voluntary; however, if information is not provided, the request for an AJD cannot be evaluated nor can an AJD be issued.

Aquatic Resources Delineation Report
Request for AJD
West Wash Dam

Submitted to U.S. Army Corps of Engineers

January 24, 2022

Prepared for

Steve Gamilis, Project Coordinator
City of Reno, Utilities Services Department
PO Box 1900
Reno, Nevada 89505

Prepared by

WOOD RODGERS
BUILDING RELATIONSHIPS ONE PROJECT AT A TIME
1361 Corporate Blvd • Reno, NV 89502 • Tel: 775.823.4068 • www.woodrodgers.com

Executive Summary

This Aquatic Resources Delineation has been completed in accordance with the *Corps of Engineers Wetlands Delineation Manual* (USACE 1987) and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region* (Version 2.) (USACE 2008) and *A Field Guide to Identification of the Ordinary High Water Mark in the Arid Region of the Western United* States (USACE 2008, 2010). Furthermore, this report and it proposed findings is in accordance with current Corps' guidance (September 3, 2021).

In June of 2021, on behalf of Farr West Engineering and the City of Reno, Wood Rodgers Wetlands Specialist completed a routine onsite investigation to determine the location and extent of resources that may have potential to be under the regulatory jurisdiction of the U.S. Army Corps of Engineers (USACE) in accordance with Section 404 of the Clean Water Act for the West Wash Dam Rehabilitation Project.

The survey area is located in the City of Reno, Washoe County, Nevada and is located east and north of the intersection of Wyoming and Gulling Streets. The survey area includes an improved drainage feature that conveys nuisance flows from the northwest under McCarran Blvd to the site, an improved earthen channel, a concrete riser spillway (East Wash Spillway), dam embankment and earthen emergency spillway above Wyoming Ave./Putnam Dr. Below Putnam Dr., the Highland Ditch is in a concrete lined ditch except where it follows the curvature of Putnam Dr., where it is in an elevated open top corrugated metal flume. The concrete lined ditch portion includes an emergency overtopping facility that allows high flows to escape the ditch and continue downslope in the improved channel.

The 53-acre survey area is located in Sections 3 and 4, Township 19 North and Range 19 East in a 3.34 square mile watershed that includes 2.09 square miles of the East Wash watershed. Stormwater flows to the West Wash Dam come through the East Wash Dam with very little attenuation (City of Reno 2006).

USGS Reno, Nevada 7.5-minute quadrangle indicates that there are two "dashed line" (ephemeral) channels that have potential to drain into the East and then West Wash Dam flood control facilities.

Two reaches of improved ephemeral channels (1A and 2A, Exhibit 6) were evaluated to determine the streamflow duration using the Streamflow Duration Assessment Method for the Arid West (SDAM AW) and in accordance with *A Field Guide to Identification of the Ordinary High Water Mark in the Arid Region of the Western United* States (USACE 2008, 2010). Although improved ephemeral channels 1A and 2A have no evidence of consistent annual flow providing a surface water connection to a traditional navigable water, these drainages and vegetated Areas 1 and 2 may be under the regulatory jurisdiction of the USACE.

Unnamed channels 1A and 2A are both primarily supported by upslope development nuisance water and stormwater discharge, neither of which meet the criteria of consistent/annual flow. Both channels largely support vegetation that meet the criteria for hydrophytic vegetation, however soils do not meet the criteria for hydridic soils and wetland hydrology is not present. Therefore, Area 1 and Area 2 appear to not fulfill the required 3-parameter approach criteria to meet the definition of jurisdictional wetlands.

The wetland located under the flume portion of the Highland Ditch is supported by has severe leaks and thus is a "Leaky ditch wetland". Given that this wetland (Area 1) has primarily developed and is

sustained by the leaky ditch, it is likely that this wetland may not be regulated by the USACE pursuant to CESPK-CO-R Regulatory Branch Memorandum 2004-03 “Leaky Ditch” Wetlands (Appendix F).

These findings are subject to review and concurrence by the USACE.

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1.0 INTRODUCTION

1.1 Project Contact Information

Steve Gamilis, Project Coordinator
City of Reno
Utilities Services Department
PO Box 1900
Reno, Nevada 89505
Email: gamiliss@reno.gov
Office: (775) 334-2461

Please see Appendix G for a signed statement from the property owner authoring access by the Corps to collect data.

1.2 Survey Area Location and Setting

The survey area is located in the City of Reno, Washoe County, Nevada east and north of the intersection of Wyoming and Gulling Streets (Appendix A, Exhibits 1, 2 and 3). The survey area includes a concrete riser spillway (East Wash Spillway), manmade channel and earthen emergency spillway above Wyoming Ave./Putnam Dr. Below Putnam Dr., the Highland Ditch is in a concrete lined ditch except where it follows the curvature of Putnam Dr., where it is in an elevated open top corrugated metal flume. The concrete lined ditch portion includes an emergency overtopping facility that allows high flows to escape the ditch and continue downslope in the manmade channel.

The 53-acre survey area is located in Sections 3 and 4, Township 19 North and Range 19 East in a 3.34 square mile watershed that includes 2.09 square miles of the East Wash watershed. Stormwater and nuisance flow from above McCarran Blvd are conveyed to the West Wash Dam via a manmade ditch and culvert under McCarran Blvd. In addition, flows from the East Wash Dam are conveyed to the West Wash Dam via the East Wash Spillway with very little attenuation.

USGS Reno, Nevada 7.5-minute quadrangle indicates that there are two “dashed line” (ephemeral) channels that have potential to drain into the East and then West Wash Dam flood control facilities (Exhibit 2). In addition, the National Wetlands Inventory was queried (Exhibit 5).

1.2.1 Site Access

Access to the survey area is gained via North McCarran Blvd. to south on Kings Row, east on Bryan Street, south on Rayburn drive to east on Gulling Road.

1.2.2 Sensitive Species and Habitats

Please see Appendix C for sensitive species documentation.

The Nevada Natural Heritage Program (NNHP, March 2021) indicated that there are no at-risk taxa recorded in the survey area. However, habitat may be available for Golden Eagle and northern rubber boa, and spotted bat, Nevada BLM Sensitive Species.

The Nevada Department of Wildlife (NDOW, March 2021) queried NDOW’s databases for wildlife resource data and reported that there are no known big game distributions (mule deer, bighorn sheep, elk, pronghorn antelope) in the survey area. There is no known greater sage-grouse habitat, including

leks in the vicinity of the survey area. Lahontan cutthroat trout and various species of raptors are known to occur in the Truckee River watershed.

The U.S. Fish and Wildlife Service (FWS) Information for Planning and Consultation (IPaC), a project planning tool that streamlines the FWS environmental review process for compliance with the Endangered Species Act was queried. A Formal Species List (Consultation Code 08ENVD00-2021-E-00791, USFWS, April 2021, Appendix C) was obtained for the project area. The Formal Species List indicated that there is "Final" critical habitat for Sierra Nevada yellow-legged frog and Webber's Ivesia, however the location of the critical habitat is unknown. In proximity to the survey area there is potential habitat for Cui-ui and Lahontan cutthroat trout, assumed to be the Truckee River, and there is potential habitat for monarch butterfly in proximity to the survey area, however no critical habitat has been designated for these three species.

1.2.3 Cultural/Historic Resources

On June 10, 2021, Broadbent archaeologists conducted the intensive pedestrian Cultural Resources Inventory of the 53.23-acre APE. The inventory was completed according to the standards and guidelines provided by NRCS and the Nevada State Historic Preservation Office (SHPO). All fieldwork was completed under direct supervision of Broadbent permitted archaeologist Ms. Margo Memmott and was conducted according to the terms of Broadbent's State of Nevada Antiquities Permit No. 618. Ms. Lauren Culleton served as the Architectural Historian for the Project.

The intensive pedestrian cultural resources survey resulted in the identification and recordation of three historic structures and a historic district. The historic structures include the East Wash Dam (S2872), the West Wash Dam (S2873), and a segment of the previously recorded Highland Ditch (S808). Because the East and West Wash Dams function as a unit, they were also included in the East and West Wash Dam Historic District (D390). No archaeological sites or isolated cultural resources were identified during the intensive cultural resources inventory. An attempt was made to relocate previously recorded prehistoric archaeological site 26WA1697, but it is presumed destroyed in its entirety by the construction of McCarran Boulevard and continuing modern development of the area.

Broadbent recommends that the segment of the Highland Ditch (S808) recorded for the Project be considered a non-contributing segment to the NRHP-eligibility of the whole resource and not individually eligible for NRHP inclusion. Broadbent recommends that the East Wash Dam (S2872) and West Wash Dam (S2873) are eligible for NRHP inclusion. Broadbent also recommends that the East and West Wash Dam Historic District (D390) is eligible for NRHP inclusion. Structures S2872 and S2873 are recommended as contributing resources to Historic District D390; Structure S808 is recommended as non-contributing to the historic district.

A total of 46 parcels within the indirect effects APE contain structures that are at least 50 years old. Most are single-family residences, with the oldest constructed in 1964, three years after the completion of the East Wash Dam; all remain unevaluated for NRHP inclusion.

Through the Nationwide Permit (NWP)Application Process (if applicable), the USACE will determine an Area of Potential Effect (APE) appropriate for the regulated activities that require an USACE NWP. Once an APE has been determined by the USACE, the applicant will provide a Class III Survey Report to support the permitting process and the USACE's consultation with the State Historic Preservation Office (SHPO). Please see Appendix D for the Cultural Resources Inventory Report Summary.

1.2.4 Soils

Please refer to Appendix A, Exhibit 4. Soil map units within the survey area were obtained from the Washoe County Central Soil Survey via the National Cooperative Soil Survey, Web Soil Survey on July 27, 2021. Soil map units and their attributes are summarized below in Table 1.

Table 1. Survey Area Soil Map Units

Map Unit Symbol	Map Unit Name	Hydric Soil Rating*
312	Risley cobbly loam, 15 to 30 percent slopes	No
650	Chalco very stony clay loam, 15 to 30 percent slopes	No
683	Reno stony sandy loam, 2 to 8 percent slopes	No
991	Xeric Torriorthents – Urban Land complex	No
1050	Waspo clay, 15 to 30 percent slopes	No
1054	Waspo gravelly clay, 2 to 8 percent slopes	No

*Includes major and minor components

1.2.5 Vegetation

Vegetation of the survey area largely consists of cheatgrass (*Bromus tectorum*), Basin big sagebrush (*Artemesia tridentata tridentata*), and gray rabbitbrush (*Ericameria nauseosus*) on the slopes surrounding the flood control facility as well as seed crested wheatgrass (*Agropyron cristatum*) and a variety of annual weeds.

The manmade channel supports Freemont cottonwood (*Populus fremontii*), coyote willow (*Salix exigua*), silver buffaloberry, (*Shepherdia argentea*), Baltic rush (*Juncus balticus*), inland saltgrass (*Distichlis spicata*), and crested wheatgrass.

2.0 PURPOSE

2.1 Background

The City of Reno has entered into an agreement with the Natural Resources Conservation service (NRCS) to rehabilitate the West Wash Dam that had a life expectancy of 50 years (1963 – 2013) to meet current NRCS, City of Reno and State of Nevada Division of Water Resources (DWR) dam safety criteria and performance standards.

The West Wash Dam is one of four flood control detention dams constructed in 1960 by the Soil Conservation Service (a.k.a. Natural Resources Conservation Service) to provide flood protection. The dam has been in continuous service since its construction and is owned and maintained by the City of Reno. All four of these dams have been classified as high hazard by the State Engineer's Office (DWR 2021). High hazard is defined by the Federal Emergency Management Agency (FEMA) as those where failure or mis-operation will probably cause loss of human life (FEMA 1998). The West Wash Dam being the priority for rehabilitation and improvement work needed for the 50-year-old earthen embankment structures.

The purpose of this Aquatic Resource Routine Onsite investigation to determine the location and extent of resources that may have potential to be under the regulatory jurisdiction of the U.S. Army Corps of Engineers in accordance with Section 404 of the Clean Water Act.

2.2 Waters of the United States

The Ordinary High Water Mark (OHWM) is a defining element for identifying the lateral limits of non-wetland waters. Federal jurisdiction over a non-wetland WOUS extends to the OHWM, defined in Chapter 33, Part 328, Section 3 of the Code of Federal Regulations, (33 CFR 328, 3) as the line on the bank established by fluctuations of water and indicated physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of the soils, destruction of terrestrial vegetation, or the presence of litter and debris. In the Arid West, waters are variable and include ephemeral/intermittent and perennial channel forms and include all non-tidal waters that are currently, or were used in the past, or may be susceptible to interstate commerce; all interstate waters including wetlands; all other waters such as intrastate lakes, rivers, streams (including intermittent streams), mud flats, sand flats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate commerce; and all impoundments of waters otherwise defined as WOUS under this definition.

The limits of jurisdiction in non-tidal waters are defined according to 33 CFR Part 328, Section 4 (33 CFR 328, 4). In the absence of adjacent wetlands, jurisdiction extends to the OHWM; when adjacent wetlands are present, the jurisdiction extends beyond the OHWM to the limit of the adjacent wetlands; and when the WOUS consists only of wetlands, the jurisdiction extends to the limit of the wetland.

Criteria used to determine whether a drainage feature constitutes a WOUS include presence of a defined bed (a linear bed in a topographic depression which would transport surface water from a watershed), presence of defined banks (near vertical or steep-sided banks formed by erosion from flowing water), and evidence of an OHWM (some indicator(s) that the drainage is subject to surface water flows on an average annual basis; such indicators include a scoured bed, shelving, an absence of terrestrial vegetation [particularly perennial], and recent alluvial or litter deposition).

This Report was completed in accordance with A Field Guide to Identification of the Ordinary High Water Mark in the Arid Region of the Western United States (USACE 2008). Data forms provided in USACE 2008 were completed to collect data to document the OHWM for waters of the United States (Appendix E).

2.3 Arid West Streamflow Duration Assessment Method (SDAM AW)

In mid-March 2021, the USACE, Sacramento, San Francisco, Los Angeles, and Albuquerque Districts (South Pacific Division), the Corps Omaha District, and the U.S. Environmental Protection Agency (EPA), Regions 6, 8, and 9 jointly announced the availability of the Beta Streamflow Duration Assessment Method (SDAM) for the Arid West (dated February 2021). The method is a rapid assessment tool to help distinguish between ephemeral, intermittent, and perennial streamflow at the reach scale. The SDAM may help in providing technical guidance for identifying waters that may be subject to regulatory jurisdiction under the Clean Water Act; however, this method does not imply or represent a change in the definition of "Waters of the U.S."

The SDAM for the Arid West was developed for use in the arid regions of the states of Arizona, California, Colorado, Montana, Nevada, New Mexico, Texas, Utah, and Wyoming. This beta method results from a validation study conducted at approximately 90 stream reaches across the range of hydrologic landscapes of the arid west from 2017 to 2019. Developed through statistical analyses of field data, it provides a data-driven approach using five reliable indicators to provide information on

streamflow duration class at the reach scale. The agencies are making this beta SDAM available for a one-year preliminary implementation period while the agencies continue an expanded data collection effort in 2021 to inform the refinement of the final SDAM for the Arid West.

The beta SDAM for the Arid West can be applied whenever there is uncertainty regarding streamflow duration class and a rapid method of evaluation is desired. The method provides a scientifically supported, rapid assessment framework to support best professional judgment in a consistent, robust, repeatable, and defensible way. Use of the method may result in timelier and more predictable jurisdictional determinations and is also useful where knowledge of streamflow duration class improves ecological assessment, management, and decision-making.

2.4 Wetlands

As used in this report, the term "wetlands" has a regulatory definition as defined in Chapter 33, Part 328, Section 7(b) of the Code of Federal Regulations (33 CFR 328, 7(b)). The term "wetlands" means "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marches, bogs and similar areas." Note that the frequency and duration of saturation may vary by geographical region, and is largely dependent upon local climatic conditions.

The USACE Delineation Manual (USACE 1987) and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region (Version 2.) (USACE 2008) describe delineating wetlands as a three-parameter approach. An area cannot be considered a jurisdictional wetland if one of these three parameters (hydric soil, wetland vegetation, and wetland hydrology) is not present.

3.0 ANALYSIS METHOD

3.1 Wetlands

For the West Wash Dam survey area, wetlands, if documented in the field were delineated in accordance with the methodology outlined in the USACE Corps of Engineers Wetlands Delineation Manual (USACE 1987), and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region (USACE 2008). Data forms provided in this document were used to compile wetland data during the investigation as applicable to the Interior Deserts Land Resource Region (LRR D).

Please note, in the analysis contained herein, if areas meeting the definition of "wetlands" were located at or below the OHWM of a drainage, the elevational boundaries of the OHWM, if present for intermittent or perennial drainages, delineated the area of potential USACE jurisdiction.

Furthermore, in accordance with the guidance provided in the NWPR, if areas meeting the definition of "wetlands" were located at or below the OHWM of an ephemeral drainage, the aquatic resource was determined to be an "isolated" and supported by nuisance stormwater runoff with no surface water connection to a Traditional Navigable Water or Navigable-In-Fact Water and thus, potentially not regulated by the USACE.

3.2 SDAM AW and NWPR

In the absence of hydrologic data (which was the condition for this analysis per the City of Reno "***I searched all our files, as well as the Contrail stream gage monitoring, and found no actual flow data, past or present.***), an assessment of five biological indicators was completed to provide documentation of streamflow classification for drainage features that were not perennial. The five biological indicators assessed were:

1. Quantity of hydrophytic plant species
2. Quantity of aquatic macroinvertebrate individuals
3. Evidence of aquatic stages of *Ephemeroptera, Plecoptera, or Trichoptera* (EPT) taxa
4. Presence of streambed algae
5. Documentation of a single indicator of intermittent or perennial

Please see Appendix E for completed SDAM AW Data Forms.

4.0 FINDINGS

4.1 SDAM AW

Two reaches of an improved channel were evaluated to determine the streamflow duration using the SDAM AW.

Please refer to Appendix A, Exhibit 6, and Appendix E for completed Data Forms and investigation location photographs. Table 1. summarizes those findings.

Given that improved channels 1 and 2 are ephemeral with no evidence of consistent annual flow providing a surface water connection to a traditional navigable water, these drainages may not be regulated by the USACE under Section 404 of the Clean Water USACE.

Table 1. Summary of Application of SDAM AW and NWPR

Feature Identifier	Cowardin Classification	Latitude/ Longitude	SDAM AW (Per, Int, Eph)[1]	Resource Size (LF)	Potential Regulatory Status
Highland Ditch	U - Uplands	39.542/ -119.844	**Int**	1,006	**Regulated** - tributary to Truckee River
Unnamed Channel 1A	R6- Ephemeral – Improved flood control/drainage facility	39.542/ -119.843	Eph[2]	1,006	**Non-regulated** - Upland leaky ditch discharge[3]
Unnamed Channel 2A	R6- Ephemeral – Improved flood control/drainage facility	39.545/ -119.846	Eph[2]	1,970	**Not regulated** Improved flood control/drainage facility
		Total LF		**3,982**	

[1] Per = Perennial, Int = Intermittent, Eph = Ephemeral

[2] No evidence of consistent annual flow providing a surface water connection to a traditional navigable water

[3] Please see Appendix F, CESPK-CO-R Regulatory Branch Memorandum 2004-03 "Leaky Ditch" Wetlands

4.2 Wetlands

Unnamed channel 1A and 2A are both primarily supported by upslope development nuisance water and stormwater discharge, neither of which meet the criteria of consistent/annual flow. Both channels largely support vegetation that meet the criteria for hydrophytic vegetation, however soils do not meet the criteria for hydridic soils and wetland hydrology is not present. Therefore, Area 1 and Area 2 do not fulfill the required 3-parameter approach criteria to meet the definition of jurisdictional wetlands. Please refer to Appendix A, Exhibit 6, and Appendix E for completed Data Forms and investigation location photographs. Table 2. summarizes those findings.

Table 2. Summary of Potential Wetlands

Feature Identifier	Cowardin Classification	Latitude/ Longitude	NWPR/SDAM AW (Per, Int, Eph)[1]	Resource Size (Ac)	Potential Regulatory Status
Area 1	Upland – Leaky Ditch Wetland	39.542/ -119.843	Eph[2]	2.4	**Non-regulated** - Upland leaky ditch discharge[3]
Location D	U - Uplands	39.542/ -119.845	Eph[2]		**Non-regulated -** Wetland hydrology is absent
Area 2	R6- Ephemeral – Manmade Channel	39.545/ -119.846	Eph[2]	3.1	**Non-regulated** – Eph per NWPR
Data Collection Location A	R6- Ephemeral – Manmade Channel	39.544/ -119.846	Eph[2]		**Non-regulated** - Wetland hydrology is absent
Data Collection Location B	R6- Ephemeral – Manmade Channel	39.545/ -119.846	Eph[2]		**Non-regulated** - Wetland hydrology is absent
Data Collection Location C	R6- Ephemeral – Manmade Channel	39.546/ -119.848	Eph[2]		**Non-regulated** - Wetland hydrology is absent
			Total Acres	**5.5**	

[1] Per = Perennial, Int = Intermittent, Eph = Ephemeral

[2] No evidence of consistent annual flow providing a surface water connection to a traditional navigable water

[3] Please see Appendix F, CESPK-CO-R Regulatory Branch Memorandum 2004-03 "Leaky Ditch" Wetlands

Both the wetland and manmade channel that starts under the flume portion of the Highland Ditch, that has severe leaks ("Leaky ditch wetland"), do not appear to be under the regulatory jurisdiction of the USACE. Although the Highland Ditch is regulated by the USACE as an intermittent WOUS, this wetland (Area 1) is not considered to be regulated pursuant to CESPK-CO-R Regulatory Branch Memorandum 2004-03 "Leaky Ditch" Wetlands (Appendix F).

These findings are subject to review and concurrence by the USACE.

5.0 References

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Appendix A Exhibits

Exhibit 1 Vicinity Map
Exhibit 2 Survey Area – USGS Base
Exhibit 3 Survey Area – Aerial Base
Exhibit 4 Survey Area Soils
Exhibit 5 National Wetlands Inventory
Exhibit 6 Resources Potentially Regulated by the USACE

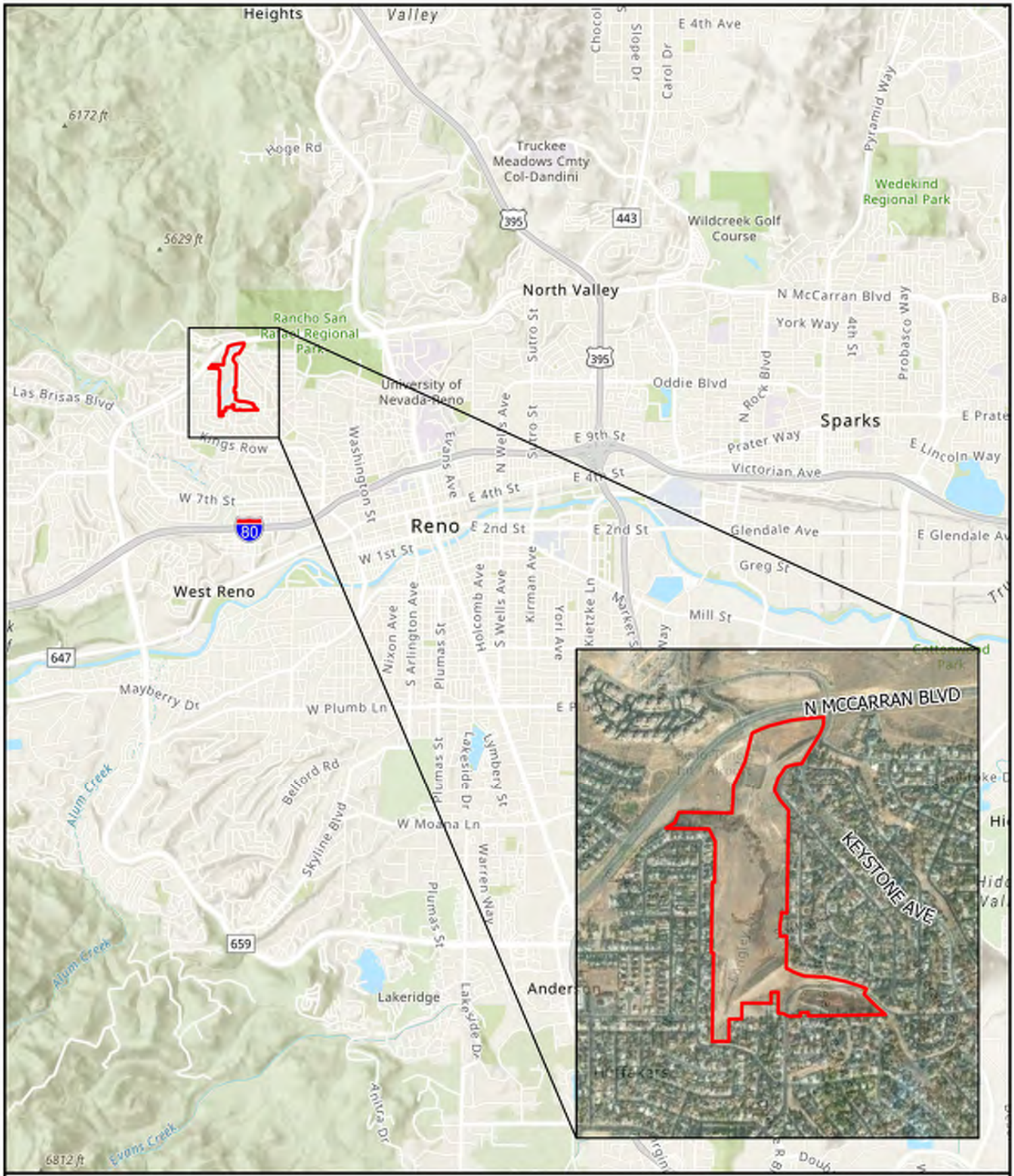

Exhibit 1

VICINITY AND LOCATION MAP

WEST WASH DAM

RENO, NV

JULY 2021

Project Area

0 0.5 1 2

Miles

NORTH

WOOD RODGERS

\\woodrodgers.loc\Production\Data\Jobs-Reno\Jobs\3677_FairWest\006_CoR_WestWashDam_GA\GIS\ArcGIS_Pro\Watershed_20210510\Watershed_20210510.aprx 7/29/2021 12:46 PM sbarrow

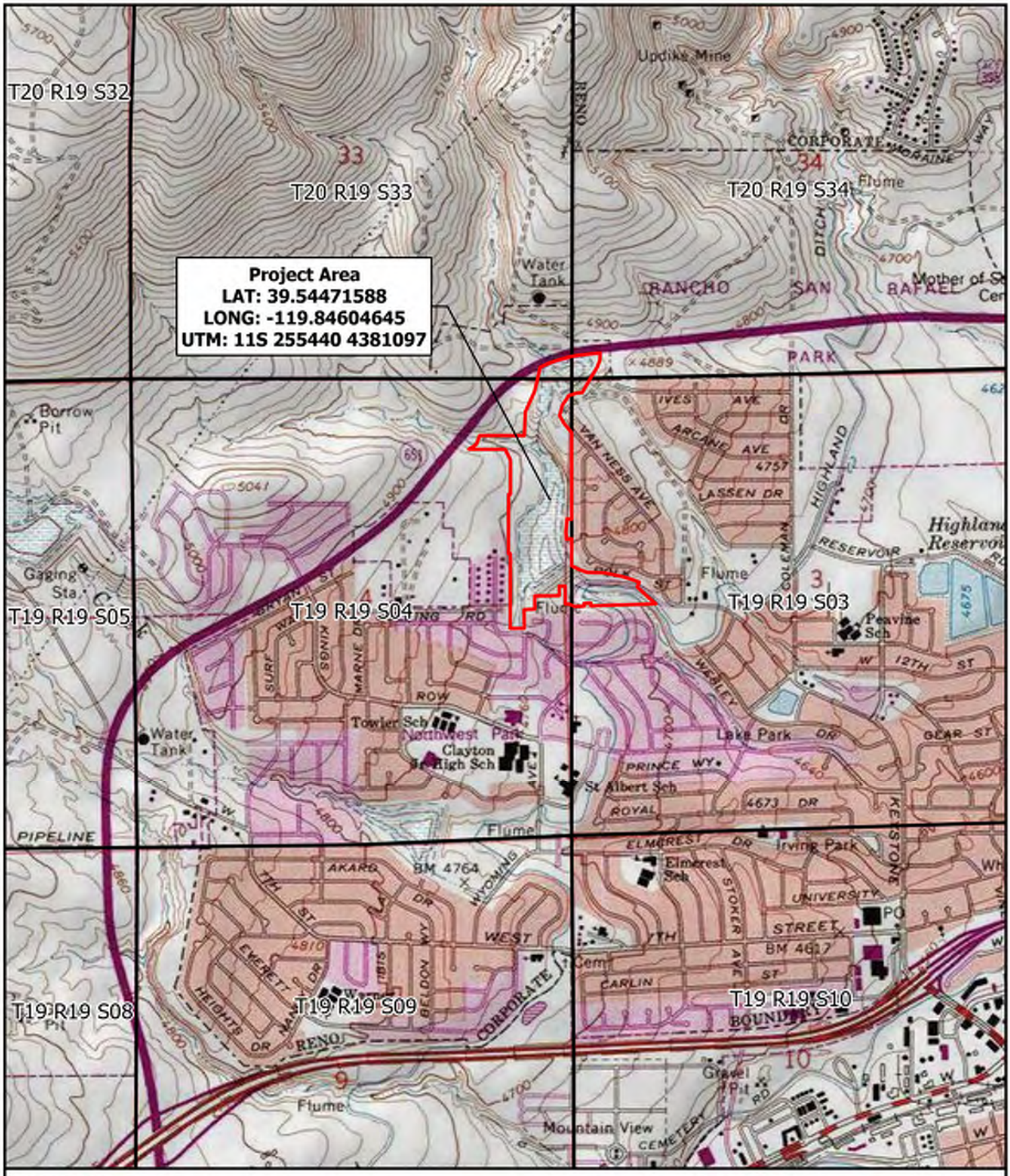

EXHIBIT 2

SURVEY AREA - USGS

WEST WASH DAM

RENO, NV

JULY 2021

Project Area

0 500 1,000 2,000

Feet

NORTH

WOOD RODGERS

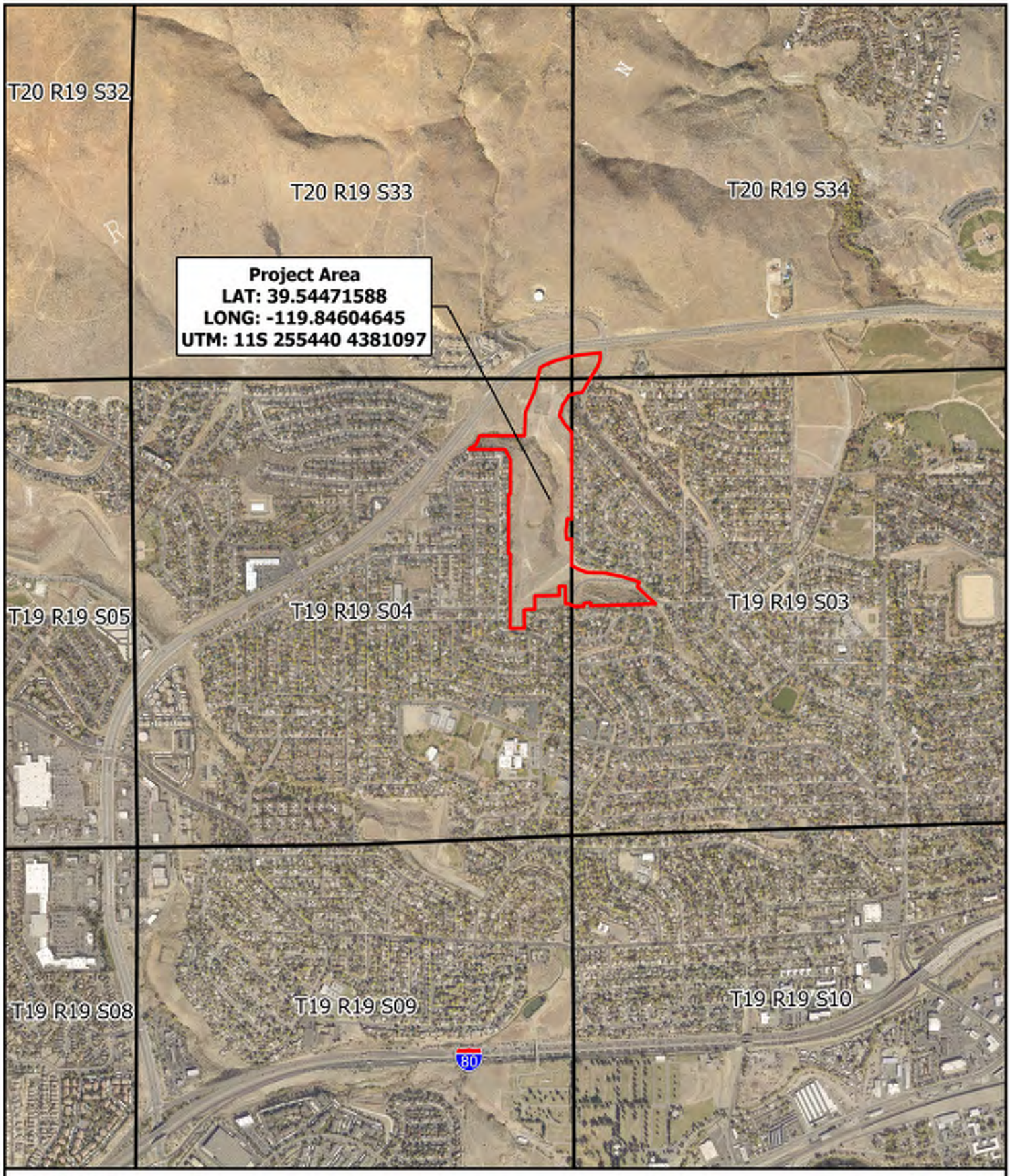

EXHIBIT 3

SURVEY AREA - AERIAL

WEST WASH DAM

RENO, NV

JULY 2021

Project Area

0 500 1,000 2,000

Feet

NORTH

WOOD RODGERS

\woodrodgers.loc\Production\Data\Jobs-Reno\Jobs\3677_FairWest\006_CoR_WestWashDam_OA\GIS\ArcGIS_Pro\Watershed_20210510\Watershed_20210510.aprx 7/29/2021 3:14 PM sbarrow

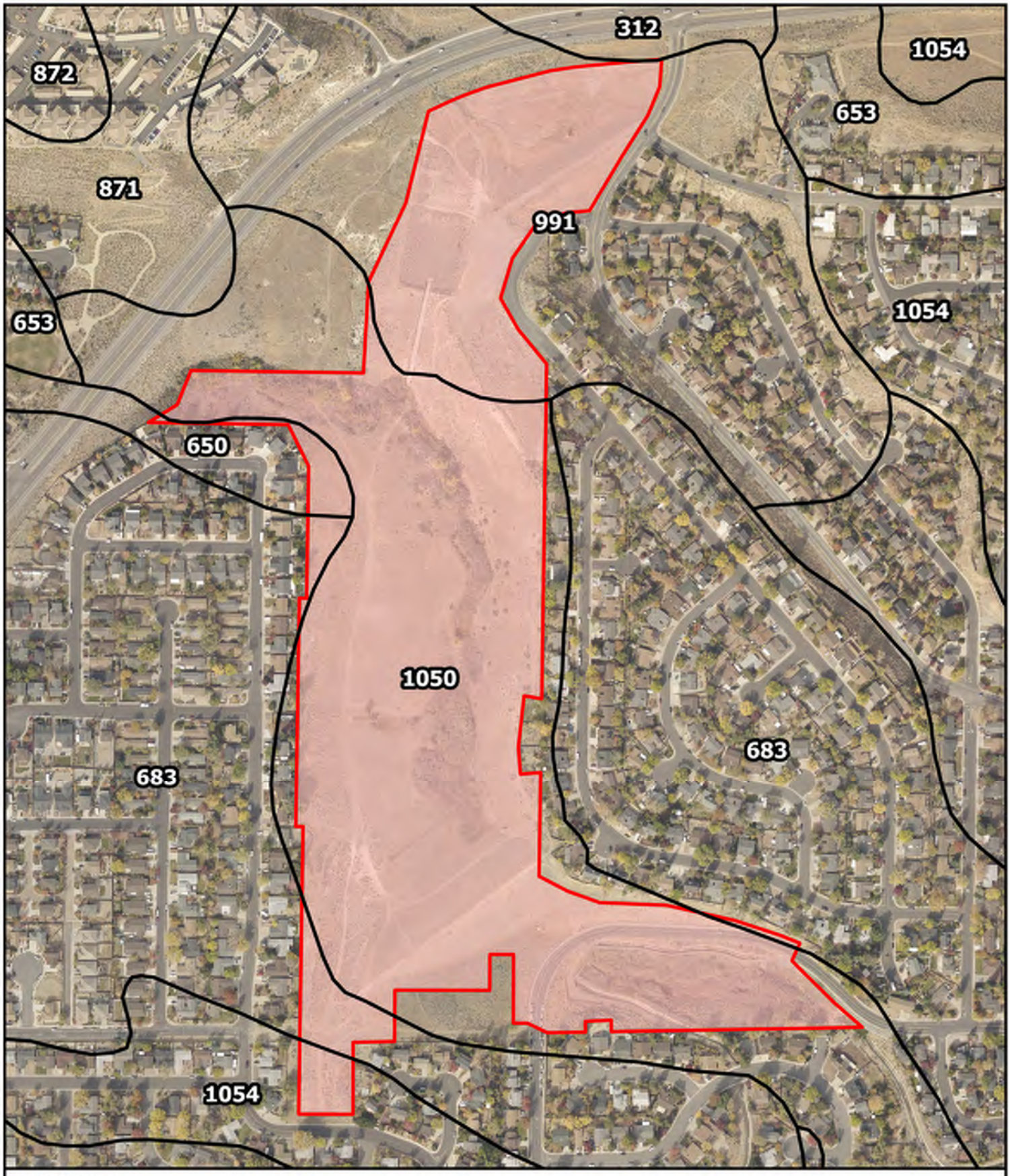

EXHIBIT 4

SURVEY AREA SOILS

WEST WASH DAM

RENO, NV

JULY 2021

Project Area

Soil Groups

0 200 400 800

Feet

NORTH

WOOD RODGERS

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EXHIBIT 5

NATIONAL WETLANDS INVENTORY

WEST WASH DAM

RENO, NV

JULY 2021

0 500 1,000 2,000

Feet

NORTH

WOOD RODGERS

\\woodrodgers\oc\Production\Data\Jobs-Reno\Jobs\3677_FairWest\006_CoR_WestWashDam_OA\GIS\ArcGIS_Pro\Watershed_20210510\Watershed_20210510.aprx 7/29/2021 1:37 PM sbarrow

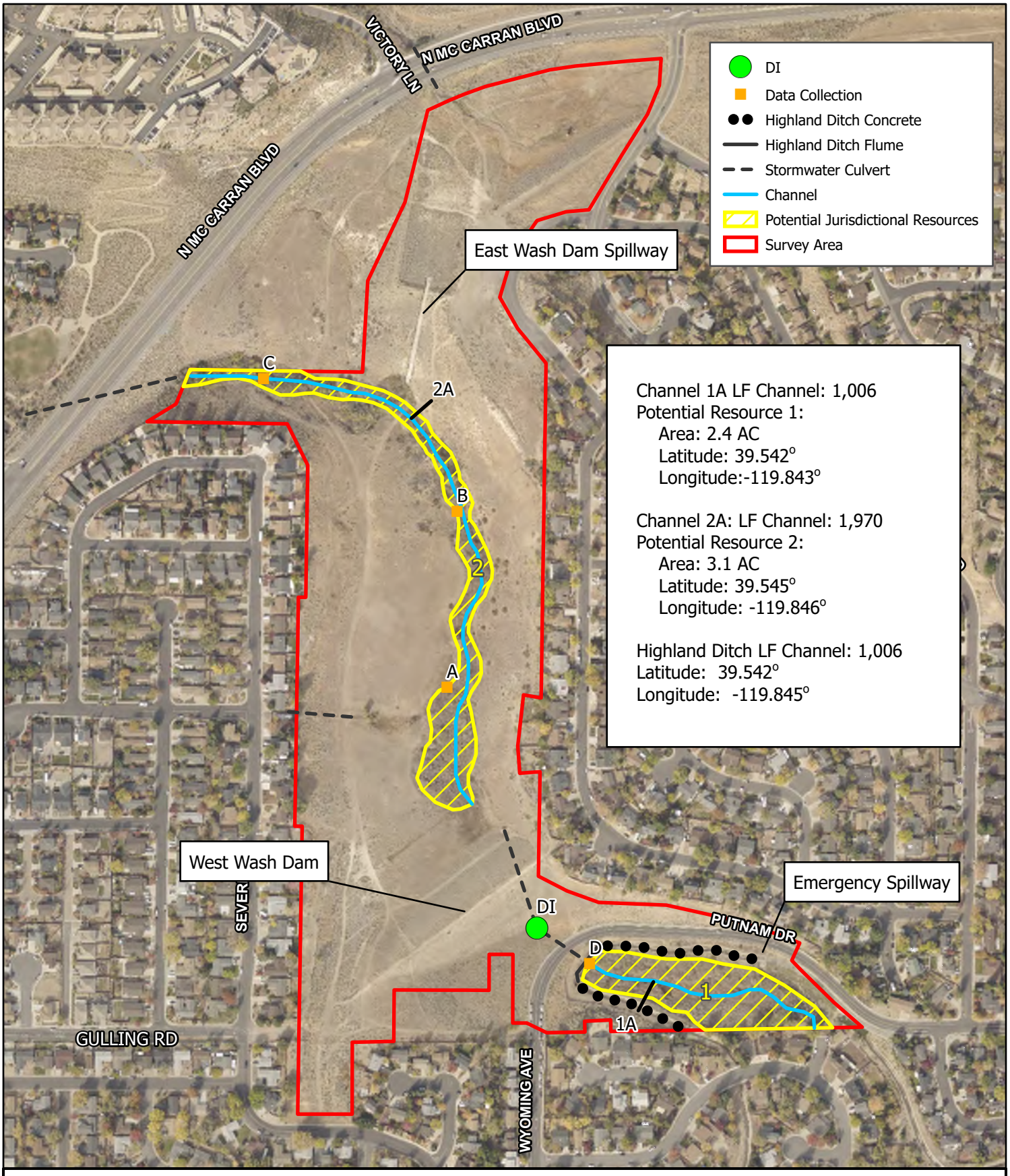

EXHIBIT 6

POTENTIAL JURISDICTIONAL RESOURCES

WEST WASH DAM

RENO, NV

AUGUST 2021

0 500 1,000 2,000

Feet

NORTH

WOOD RODGERS

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Appendix B City of Reno Emergency Action Plans, February 2006

DRAINAGE REPORT

CITY OF RENO
EMERGENCY ACTION PLANS
PHASE II

RENO, NEVADA

Prepared for:

CITY OF RENO

Reno, Nevada

February 13, 2006

DRAINAGE REPORT

CITY OF RENO
EMERGENCY ACTION PLANS
PHASE II

RENO, NEVADA

Prepared for:

CITY OF RENO

Reno, Nevada

MACTEC Engineering and Consulting, Inc.
Reno, Nevada

February 13, 2006
Project 4307-05-0009

PROFESSIONAL ENGINEER-STATE OF NEVADA
CHRISTOPHER H ANDERSON
12/31/06
CIVIL
No. 14728
2/13/06

COPY

ACKNOWLEDGEMENTS

MACTEC would like to acknowledge and recognize the staff and personnel of the following agencies with whose help and assistance, this report was made possible.

City of Reno Public Works

City of Reno Maintenance and Operations Division

Nevada Division of Water Resources

NOAA National Weather Service

USDA-Natural Resources Conservation Service

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1.0 INTRODUCTION

On June 8, 2005, MACTEC E&C, Inc. (MACTEC) contracted with the City of Reno (City) to provide additional services for completion of the Emergency Action Plans (EAP's) for six high hazard flood detention dams within the city limits. This contract was a continuation of the Phase I EAP work performed by MACTEC for the City. Phase I EAP's were developed and finalized for the East and West Logan Ridge Trail Detention Dams. Phase II EAP's developed for the City by MACTEC includes the following dams:

- Upper and Lower Peavine Detention Dams
- East Wash Diversion and West Wash Detention Dams
- North Virginia Street Detention Dam
- Dant Boulevard Detention Dam

Since North Virginia Street Detention Dam was designed in 1994, it was felt that the hydrology was current and a new hydrologic modeling would not be necessary for this dam. Due to the age of some of these dams, it was scoped as part of the Phase II work to provide contemporary hydrologic and hydraulic analysis for five of the Phase II dams, as follows:

- Upper and Lower Peavine Creek Detention Dams
- East Wash Diversion and West Wash Detention Dams
- Dant Boulevard Detention Dam

Four of the dams, Upper and Lower Peavine Detention Dams, and East Wash Diversion and West Wash Detention Dams, date back to the late 1950's and early 1960's. These dams were designed by the Natural Resources Conservation Service (NRCS; f.k.a. Soil Conservation Service) and utilize concrete riser principle spillways and earthen channel emergency spillways. These four dams will hereafter be referenced as the NRCS dams throughout this report. Due to the potential for erosion and degradation of these emergency spillway channels over time, an evaluation of the existing capacity of the emergency spillways for the NRCS dams was also performed as part of the Phase II work.

This drainage report presents the hydrologic and hydraulic analysis performed under the EAP Phase II contract. The results of the hydrologic analysis performed by MACTEC on these dams were used as the hydrologic basis for the inundation mapping provided in the EAP's for these five facilities. Inundation mapping of the North Virginia Street Detention Dam breach was based on

the original HEC-1 model results (SEA, 1994). The following describes the scope of the work presented in this drainage report:

- Develop contemporary hydrologic models for the dams as listed above
- Perform hydraulic analysis of NRCS dams' emergency spillways
- Perform a storage-volume analysis for the dams as listed above

1.1 LOCATION AND DESCRIPTION OF PROJECT AREAS

All five dams are located at various locations around the City as shown in *Figure 1 Vicinity Map*. This section describes the general location and brief site description of the five detention dams presented in this report.

1.1.1 Dant Boulevard Detention Dam

Dant Boulevard Detention Dam is located on Dant Boulevard at the intersection with Pioneer Drive in Township 19 North, Range 19 East, Section 27. Inflow to the Dant Boulevard Dam comes from a 1.13 square mile tributary area. The upper two-thirds are undeveloped lands in Washoe County that are part of a planned unit development for one acre single family homes with an open space component. Elevations in the watershed range from 6,300 feet North American Vertical Datum 1929 (NAVD 29) at the west end of the watershed to 4,680 feet NAVD 29 at the dam. Slopes are steep to very steep on the Forest Service land. Soils in these upper watersheds exhibit slow to very slow infiltration rates with ground cover consisting of moderate brush, grasses and scattered evergreens with abundant rock outcrops. Steep upland slopes, relatively low permeability soils and rock and impervious construction surfaces combine to rapidly shed most precipitation falling in the upper tributary area. The lower third of the watershed below McCarran Boulevard partially consists of residential developments that are primarily located on the upper slopes of the drainage with the main portion of the drainage consisting of open space with steep slopes with a moderately dense cover of wild grasses. There is little likelihood of these steep slopes being developed in the future. Watersheds below the dam drain down to the intersection of Moana Lane and Plumas Street. At this point there is no defined overland drainage and existing drainage facilities consist entirely of storm drain systems. *Figure 4 Watershed Map Dant Boulevard Detention Dam* shows the location and layout of the watershed above the dam.

Since its construction in 1990, the drainage between the upper and lower portion of the Dant watershed has been modified with the construction of that portion of McCarran Boulevard as shown in *Figure 4 Watershed Map*. The hydraulic and hydrologic effects of McCarran are taken into account in the HEC-HMS modeling.

1.1.2 Upper and Lower Peavine Detention Dams

Upper Peavine Creek Detention Dam is located adjacent to Las Brisas Boulevard in Township 19 North, Range 19 East, Section 5. Inflow to the Upper Peavine Creek Detention Dam comes from approximately 2.14 square miles of watershed. Lower Peavine Creek Detention Dam is located northeasterly of Elmcrest Drive in Township 19 North, Range 19 East, Sections 4 and 9. Inflow to the Lower Peavine Creek Dam comes from approximately 2.91 square miles of watershed, which includes the 2.14 square miles of sub-watersheds of Upper Peavine Creek Watershed, which acts as a tributary to the Lower Peavine Creek Watershed. Discharge from Upper Peavine dam flows to the Lower Peavine Creek Dam. Elevations in the Peavine Creek watershed range from 6,720 feet (NAVD 29) in the north part of the tributary area to 4,970 feet (NAVD 29) at the toe of Lower Peavine Creek Detention dam. The major portion of the Peavine watershed consists of undeveloped land, however, some new development has occurred within those portions of the sub-watersheds of Upper and Lower Peavine located in T19N, R19E, Section 5 since the dam was constructed. The 0.78 square mile watershed that feeds runoff directly to the lower dam is mostly covered by residential and commercial development. Soils exhibit very slow infiltration rates and ground cover consists of moderate to sparse sage brush, shrubs and grasses with some rock outcrops and sparse areas of bare soil. Steep slopes, relatively low permeability soils, rock outcrops, impervious developed surfaces and storm drain systems in the upper and lower dam watersheds combine to rapidly shed most precipitation falling in the tributary area. *Figure 3 Watershed Map Upper and Lower Peavine Detention Dams* shows the location and layout of the watershed above the dams.

Since their construction in 1963, the drainage between Upper and Lower Peavine Dams have been modified with the construction of the portion of McCarran Boulevard between Interstate 80 and North Virginia Street. The hydraulic and hydrologic effects of McCarran are taken into account in the HEC-HMS modeling.

1.1.3 East and West Wash Detention Dams

East Wash Diversion Dam is located at the intersection of Keystone Avenue and North McCarran Boulevard at the intersection of Township 20 North, Range 19 East, Sections 33 and 34 with Township 19 North, Range 19 East, Sections 3 and 4. Inflow to the East Wash Dam comes from 2.09 square miles of watershed on the southeast flank of Peavine Mountain. West Wash Detention Dam is located at the intersection of Wyoming and Gulling Streets at the intersection of Township 19 North, Range 19 East, Sections 3 and 4. Inflow to the West Wash Dam comes from 3.34 square miles of watershed, which includes 2.09 square miles of East Wash Dam's watershed. The East Wash Dam has a very small detention basin and is designed so major flood flow is diverted to West Wash without significant attenuation. Elevations in the watershed range from 6,320 feet (NAVD 29) in the mountainous northwest part of the tributary area to 4,742 feet (NAVD 29) at the toe of West Wash Detention Dam. The watershed is primarily undeveloped Forest Service land with moderate to relatively steep slopes, abundant rock outcrops and some bare soil patches. Soils exhibit very slow infiltration rates, and Ground cover consists of moderate to sparse sage brush, shrubs and grasses. Relatively low permeability soils and rock outcrops combine to rapidly shed most precipitation falling in the tributary area.

Since their construction in 1961 and 1963, respectively, North McCarran Boulevard was constructed directly above and adjacent to East and West Wash dams. Since McCarran does not form a large embankment at these locations, any potential effects of McCarran on overall hydrology are considered to be very minimal, and therefore it is not modeled as a storage structure or Dam in the HEC-HMS model. As part of the construction of McCarran Boulevard, additional storage volume was added to East Wash by excavation in the dam. *Figure 2 Watershed Map East and West Wash Detention Dams* shows the location and layout of the watershed above the dams.

1.2 PREVIOUS STUDIES

The studies and documentation in the following sections was either obtained from the Nevada Division of Water Resources (NDWR) or the NRCS.

1.2.1 NRCS Dams

MACTEC has obtained the hydrologic and design studies pertaining to the five flood detention dams. The NRCS has conducted two separate hydrological investigations, covering the watersheds of Upper, Lower Peavine Dams, and East, West Wash Detention Dams. *Watershed Work Plan-Peavine Mountain Watershed* (NRCS, 1958) was the design report first produced by NRCS, and uses two storm events for the runoff estimation:

- 100-year, 2-hour
- Emergency Spillway Storm-2 hour

In 1976, the NRCS in conjunction with the Washoe-Storey Conservation District re-evaluated the hydrology used in the original design, based on newer methodology and updated storm frequency data (NRCS, 1976). In 1978, the U.S. Army Corps of Engineers (USCOE) performed independent dam inspections under the National Dam Inspection Act, Public Law 92-367. These inspections included all the NRCS dams and performed hydrologic, spillway hydraulic, and storage volume analysis using the same NRCS criteria for the storm durations and return periods as follows:

- 100 –year, 3-hour, 6-hour, 12-hour, 24-hour, 10-day
- Emergency Spillway Storm
- Freeboard Storm

The results of the NRCS studies were published in the *Peavine Watershed Project, Project Reevaluation* (NRCS, 1976). The USCOE investigations were published under titles specific to each site. The USCOE considered East and West Wash as one facility and published the results under on investigation (USCOE, 1978a; USCOE, 1978b; USCOE, 1978c). Other information regarding these dams included the as-built or as-constructed plans for the NRCS dams.

For the purposes of comparison, this study used the following:

- Use the NRCS Reevaluation and the USCOE Investigations for comparison of the hydrologic results.
- Use the USCOE investigations for comparison of detention volumes and emergency spillway rating curves since they represent the latest work at these facilities prior to this study.

1.2.2 Dant Boulevard

MACTEC has found one hydrologic study related to the Dant Boulevard Detention Dam, which was designed fairly recently in 1988. The results of this study are contained in *Design Report-Dant Boulevard Storm Water Detention Dam* (Kennedy/Jenks/Chilton, 1988). The following rainfall events were modeled in this hydrologic investigation:

- 100-year 24-hour
- ½ Probable Maximum Precipitation (PMP)

2.0 HYDROLOGIC AND HYDRAULIC ANALYSIS METHODOLOGY

This section of the report describes the procedures and methodology used for the development of the U.S. Army Corps of Engineers' (USCOE) Hydrologic Engineering Center-Hydrologic Modeling System (HEC-HMS) rainfall-runoff simulations used in the development of the inundation mapping in the EAP's. Also contained in this section are brief descriptions of the methods used in the hydraulic analysis for evaluating spillway rating curves and the procedures used to estimate storage-volumes of dams.

2.1 HYDROLOGIC PROCEDURE

Three separate HEC-HMS models were built to simulate the watershed response for the given precipitation events at the dams.

Since Lower Peavine Detention Dam receives flow from the Upper Peavine Detention Dam, it was decided to model contributing watersheds of these dams in a single hydrologic model. The same method was used for the East and West Wash Detention Dams' watersheds, and therefore a single hydrologic model was built for these also. The third hydrologic model simulates the Dant Boulevard watershed response for the rainfall events per Section 1.2.2. Each watershed was sub divided into several sub-watersheds, or sub-catchments, based on the distinctive topographic and hydrologic modeling criteria. The following sections describe the original design criteria used to size the components of these dams.

2.1.1 NRCS Dams

The original and re-evaluated hydrologic and hydraulic design criteria used to size the components of the NRCS dams follows the criteria outlined in Technical Release 60 (NRCS, 1960) and Technical Release 2 (NRCS, 1956), and are as follows:

- 100–year, 2-hour Hydrograph – Used to size low level outlets
- Emergency spillway hydrograph- Used to size the emergency spillway
- Free board hydrograph or PMF (Probable Maximum Flood) – Used to estimate maximum elevation of the dam

MACTEC performed contemporary hydrological modeling for the NRCS dams as follows:

- Estimating hydrological parameters (see Sections 2.3.1 and 2.3.2)
- Develop the 100–year, 24-hour rainfall hydrograph (see Section 2.3.5)
- Develop emergency spillway hydrograph (see Section 2.3.5.2)
- Develop the PMF hydrograph (see Section 2.3.5.3)
- Include the impact of McCarran Boulevard on Upper and Lower Peavine Creek Watersheds, and include in the HEC-HMS model.
- Develop storage volumes (see Section 2.3.3)

2.1.2 Dant Boulevard Detention Dam

Dant Boulevard Detention Dam was designed by Kennedy/Jenks/Chilton in 1988 and the design utilized the following design criteria to size the dam components:

- 100-year, 24-hour Hydrograph – Used to size detention volume and low level outlets
- ½ PMF – Used to size emergency spillway and design the maximum elevation of the dam

MACTEC used the original HEC-1 model built by Kennedy/Jenks/Chilton with few modifications, such as:

- Convert the HEC-1 model to HEC-HMS.
- Update the NRCS Curve Number (CN) values to represent the future full built-out conditions with the best available data (see Section 2.3.1).
- Develop 100-year, 24-hour hydrograph (see Section 2.3.5.1).
- Use the *Hydrometeorological Report No. 49 (HMR-49) Probable Maximum Precipitation Estimates, Colorado River and Great Basin Drainages* to develop the ½ PMP (NOAA, 1984).
- Develop the ½ PMF Hydrograph as discussed in the *Design Report-Dant Boulevard Stormwater Detention Dam* (Kennedy/Jenks/Chilton, 1988).
- Analyze the impact of McCarran Boulevard on the overall watershed, and use the results in building the HEC-HMS model.

The rest of the modeling components such as lag time, channel routing parameters and dam parameters have not been modified and were directly imported into the HEC-HMS model. However, the elevations reported in the original HEC-1 model were adjusted to match North American Vertical Datum 1988 (NAVD 88) datum in order to be consistent with the current mapping standards and topographic mapping provided by the City. Additionally, all supplemental surveying performed by MACTEC used NAVD 88.

The results of the contemporary hydrologic modeling performed by MACTEC for all the dams were compared with the original hydrologic studies and design values, wherever possible, and are discussed in Section 6.0.

2.2 BACKGROUND OF HYDROLOGIC MODELING WITH HEC-HMS

The U.S. Army Corps of Engineers' (USCOE) Hydrologic Engineering Center-Hydrological Modeling System Version 2.2.2 (HEC-HMS) was used for hydrologic modeling. HEC-HMS is the next generation windows version of the popular HEC-1 program, developed by USCOE. It is capable of modeling various catchment components such as infiltration/evapotranspiration losses, runoff transformations, and a variety of open channel routing methods. HEC-HMS includes eight different methods for the use of historical or synthetic precipitation.

A HEC-HMS hydrologic model consists of three basic components:

- A basin model consisting of physical representation of watersheds.
- A meteorological model consisting of precipitation, evapotranspiration, and snowmelt data.
- A control specifications consisting of information such as hydrologic simulations time span.

2.2.1 Basin Model

In order to estimate excess runoff generated from any particular precipitation event the following input information should be entered in the basin model of HEC-HMS.

- Loss Rate Parameters
- Transformation Parameters
- Base flow Parameters
- Reach Parameters

An assortment of different methods is available in HEC-HMS to physically represent these parameters. However, per the recommendations and guidelines in the *Washoe County Hydrologic Criteria Drainage Design Manual* (WCHCDDM), the following methodologies were used in developing the hydrologic models (Washoe County, 1996):

- Loss Rate: NRCS Curve Number Method

- Transformation: NRCS Unit Hydrograph Method
- Reach Routing: Muskingum-Cunge Standard Method

Base flow is assumed to be negligible and therefore is not taken into account in developing these hydrologic models. It should be noted that in the original Dant Boulevard hydrologic model, developed by Kennedy/Jenks/Chilton, the Kinematic Wave method was used for channel routing. The rest of the methodology used in the original model is consistent with those specified in the WCHCDDM.

2.2.2 Meteorological Model

In the meteorological model, only the information pertaining to precipitation is entered. Out of several possible methods available to enter precipitation data, the hypothetical storm method is selected for use in developing the meteorological model. The wide availability of data and the simplicity of this method was the main driving force behind selecting this particular method and is the method recommended in the WCHCDDM.

2.2.3 Control Specifications

Control specifications will govern the model simulation time or the duration of the runoff. The duration of the simulation as defined by the starting date, starting time, ending date, and the ending time in the control specifications and is selected so that it exceeds the duration of the rainfall duration specified in the meteorological model.

2.3 HYDROLOGIC MODEL PARAMETERS

This section presents the methods used for estimating the following hydrologic model parameters:

- NRCS Curve Numbers (CN)
- Lag Time (TLAG)
- Storage volume
- Spillway discharge capacity
- Rainfall depth and distribution analysis.

2.3.1 NRCS Curve Numbers

The NRCS Curve Number (CN) method uses a soil cover complex number for computing excess runoff.

The CN is related to the following:

- The Land Use type
- Hydrologic Soil Group (HSG)
- Antecedent Moisture Condition (AMC)

The City of Reno provided MACTEC with the GIS land use mapping for the land use coverage associated with the studied project areas and can be broadly categorized as follows:

- Industrial, Public Facility
- Single Family Residential, Mixed Residential, Urban Residential/Commercial
- Parks, Tourist Commercial, Undeveloped Area, Special Planning Area

Since the land use coverage maps provided by the City do not cover the entire project area, and in some cases may not represent full built out conditions, the land use coverage was supplemented by the field investigations or the specific planned unit developments for an area. The land use maps for the various watersheds are shown in *Figures 6, 8, and 10 – Land Use Map and Curve Numbers* for East and West Wash, Upper and Lower Peavine, and Dant Boulevard, respectively.

Infiltration rate of soils vary widely and are affected by sub surface permeability as well as surface intake rates. Soils are classified into four HSG's based on their minimum infiltration rate, which is obtained for bare soil after prolonged wetting (NRCS, 1997; Washoe County, 1996).

- HSG 'A' – High infiltration rates (e.g.: sand, loamy sand or sandy loam)
- HSG 'B' – Moderate infiltration rates (e.g.: silty loam or loam)
- HSG 'C' – Low infiltration rates (e.g.: sandy clay loam)
- HSG 'D' – Very low infiltration rates (e.g.: clay loam, silty clay loam, sandy clay etc)

Most of the soils in the project watersheds being modeled consist of HSG B and C. The hydrologic soil group mapping was obtained from the NRCS website and is shown in *Figures 5, 7, and 9 - Soils Map and Curve Numbers* for East and West Wash, Upper and Lower Peavine, and Dant Boulevard, respectively (NRCS, 1976).

The amount of rainfall in a period of 5 to 30 days preceding a particular storm is referred to as antecedent rainfall, and the resulting condition of the watershed in regard to potential runoff is referred to as an Antecedent Moisture Condition (AMC). Because of the difficulties of determining antecedent storm conditions from the data normally available, the conditions are reduced to three classes, AMC-1, AMC-II, and AMC-III. According to the WCHCDDM, for the Washoe County area, an AMC-II condition should be used for determining storm water runoff. An exception would be in the case of modeling a specific rainfall and runoff event, which does not apply for the purposes of this project.

Due to the variation of land use, vegetation density and type, percentage of imperviousness and hydrologic soil groups across any particular sub-basin, the CN values are independently calculated for each land use characteristic within that sub-basin using the weighted curve number method. The CN's used to describe a particular sub-basin and are used in the weighting consist of:

- Land use type/vegetation
- Hydrologic Soil Group

The watershed map consisting of the delineated sub watersheds is overlaid on the land use map and hydrologic soil group map to obtain the area required for calculating the weighted-average curve numbers. Once all the information is gathered, *Table 702 of the WCHCDDM* is used to obtain the appropriate CN values (NRCS, 1997; Washoe County, 1996). The weighted curve number for each sub watershed is calculated as follows:

$$CN_{weighted} = (A_1*CN_1 + A_2*CN_2 + A_3*CN_3 + \ldots\ldots A_nCN_n) / A_{total}$$

Where $CN_{weighted}$ = weighted CN of the sub basin
A_1 = area (acres)
CN_1 = assigned curve number of the area A_1
A_{total} = area of the sub basin (acres)

Curve number calculations for various watersheds are contained in the Appendix A.

2.3.2 Lag Time

Lag time (TLAG) is the only required parameter used in the NRCS transformation method. Basin lag time is the lag between the center of mass of rainfall excess and the peak of the unit hydrograph, or in other words, it is the time required for fifty percent of the volume of runoff to

reach the basin outlet. All the sub-basins in this study area are less than one square mile. For small drainage basins, less than one square mile and basin slopes less than ten percent the lag time may be related to the time of concentration (t_c) by the following empirical relationship.

$$TLAG = 0.6*t_c$$

Time of concentration (t_c) is a combination of:

- Initial overland flow time (t_i) - Sheet flow
- Channel flow time (t_t) – Concentrated flow

In Washoe County, the minimum t_c for non-urban watershed is ten (10) minutes; therefore, for calculated t_c of less than ten (10) minutes, the minimum t_c will be used. The initial overland flow time (t_i) may be calculated using the following equation:

$$t_i = 1.8*(1.1-R)*L_o^{1/2} / S^{1/3}$$

Where t_i = Initial overland flow time (minute)
R = Flow runoff coefficient
L_o = Length of overland flow (ft, 500-feet maximum)
S = Average overland basin slope (percent)

The runoff flow coefficient (R) can be calculated as:

$$R = 0.0132*CN-0.39$$

Where CN = runoff curve number

The overland flow length is defined as the length of flow over which the flow characteristics appear as sheet flow or very shallow flow in grassed swales. Per the *WCHCDDM*, a maximum overland flow length of 500 feet will be used. The initial overland flow typically ends where the flow enters drainage ditches or gullies or maximum length of 500 ft, whichever comes first.

The channel flow time (t_t) is calculated using the hydraulic properties of swale, ditch or channel. It may be calculated as follows:

$$t_t = L*60 / V$$

Where t_t = channel flow time (minute)
L = channel flow length (ft)
V = travel time velocity (ft/s)

The average slope, overland flow length, and channel flow length can be estimated by overlaying delineated watersheds on the two foot contour topography supplied by the City. Where there is no topography available, as is the case for all the upper portions of the project watersheds, the United States Geological Survey (USGS) quadrangle maps in a digital format are utilized for these calculations. Travel time velocity for various channels of ground cover as a function of slope of the channel is graphically represented in *Figure 705 of the WCHCDDM* (Washoe County, 1996). Since this figure is limited in the type of channels represented, MACTEC assumed all channels are grassed waterways, and corresponding travel velocities were obtained from the Figure 705 of the WCHCDDM for use in the channel flow time calculations. This is a reasonable assumption given that channel roughness characteristics are negligible under the conditions of high flow that are being modeled for the project watersheds. Lag time supporting calculations are contained in Appendix B.

2.3.3 Storage Volumes

In order to accurately model the hydrology of each detention facility, the storage volume data of the dams needs to be entered in the HEC-HMS model. Although storage volumes for each dam were calculated in previous studies, MACTEC performed an independent storage-volume analysis using the 2-foot contour mapping provided by the City. This new analysis is justified based on the fact that all of the NRCS dams are earthen dams that were designed and built in the late 1950's and there is a potential for land use encroachment or sediment deposition, resulting in the alteration of original dam storage capacity. Additionally, the accuracy of contemporary methodology was considered to be a more accurate method over the available technology and methodology utilized in the 1950's or 1970's. MACTEC used the latest tools, such as ArcGIS 9.1 with the Spatial Analyst and 3-D Analyst and Autodesk Land Desktop 2004 to perform storage-volume analysis, and the results were compared with the original storage-volume calculations reported in the NRCS design reports. The results are discussed in Section 5.0 and calculations included in Appendix C.

In order to compare the storage volume calculations to the original values, all the original dam elevations were adjusted to, and are referenced to, the NAVD 1988. The following correction factors were applied to the elevations reported in the original reports for the project watersheds:

- NRCS dams: +3.2 ft
- Dant Boulevard Detention Dam: +4.0 ft

These adjustment factors were verified by identifying well defined points in the vicinity of the dam embankment, and comparing MACTEC's survey elevations with that of the NRCS or Dant Boulevard elevations at the identified locations (Kennedy/Jenks/Chilton, 1988; NRCS, 1961; NRCS, 1960; NRCS, 1959a; NRCS, 1959b). After a careful review of the results, and discussion with the City, MACTEC used our calculated storage volume data in the HEC-HMS models so that the models reflect the current present conditions.

During MACTEC's analysis of the dams, it was determined that sediment loading to the facilities has been much lower than expected in the original design.

The West Wash storage analysis showed vast discrepancies between the MACTEC results and the original NRCS reported and the USCOE values (NRCS, 1976; NRCS, 1958; USCOE, 1978a). Due to the large discrepancy, the storage volume results produced using ArcGIS and Spatial Analyst was checked with an independent analysis using Land Development 2004 (LD2004) utilizing the Washoe County 2 foot contour mapping. This independent analysis also included the use of the original 10 foot contours reported by the NRCS in the original design plans (NRCS, 1959b). This review process can be summarized as follows:

- Digitize the NRCS 10 foot contours (NRCS, 1959b)
- Select a best-fit horizontal control of digitized contours and overlayed on the Washoe County 2 foot contours with an adjustment to NAVD 88
- Produce storage-volume results

The results of this analysis closely match with the results produced by using ArcGIS with Spatial Analyst and the LD2004, but deviate from the NRCS and USCOE reported values (NRCS, 1976; USCOE, 1978). After a careful review of all the results, it was decided to use the ArcGIS generated storage-volume values in the HEC-HMS model. A detailed comparison of the storage volume calculations by each method is presented in Section 5.0 and the results in Appendix C.

2.3.4 Spillway Rating Curves

Spillway capacity data is the other input component required to accurately define Dam stage-storage capacity in the HEC-HMS model. Generally, the spillway rating curve used in the HEC-HMS models is a combination of from the following:

- Low level outlets
- Emergency Spillways
- Dam overtopping/overflow, wherever it is applicable

For all of the NRCS dams, except for East and West Wash Dams, spillway rating curves were directly adopted from the dam inspection reports done by the USCOE in 1978 (USCOE, 1978a; USCOE, 1978b; USCOE, 1978c). In the case of East and West Wash Dams, the initial HEC-HMS modeling showed that the emergency spillway dike and dam crest over topped for the East Wash and West Wash, respectively. In these cases, the USCOE rating curves were supplemented by the spillway dike overtopping calculations performed by using the CulvertMaster™ hydraulic software and the results were appended to the USCOE rating curves. The overtopping of the dam was analyzed as flow over a broad-crested weir. These modified USCOE rating curves are shown in *Figures 14 through 17 Discharge Rating Curves* and are also included in Appendix E.

In the Upper and Lower Peavine Creek and Dant Boulevard Watersheds, McCarran Boulevard forms a large embankment which results in the formation of an artificial dam at this location. This artificial dam is expected to have an impact on the overall hydrology of these watersheds primarily at the PMF scale as most culverts under McCarran Boulevard; therefore, it was decided to model it as a reservoir in the HEC-HMS model. The stage-discharge data comprising of the underlying culverts and overtopping of the road is obtained using Culvert Master. The stage-volume data was calculated using the methodology described in Section 2.3.3.

In the case of Dant Boulevard Detention Dam, the original spillway rating curves developed by Kennedy/Jenks/Chilton were used without any modifications other than the elevation data was adjusted to NAVD 1988 as mentioned in Section 2.3.3.

2.3.5 Rainfall Depth and Rainfall Distribution

The following sections describe the references and methodology used in determining the precipitation input into the HEC-HMS models.

2.3.5.1 100-year, 24-hour Precipitation

The following procedure describe the steps involved in the estimation of 100–year, 24-hour rainfall distribution (Washoe County, 1996).

- Overlay the delineated watersheds on the digital depth-duration-frequency (DDF) maps for the 2-year, 1-hour, 6-hour, and 24-hour average rainfall depths obtained from Washoe County as adapted from the NOAA Atlas 14 (NOAA, 2004; Washoe County, 1996).
- Arrange sub-basins into groups, based on their vicinity to the DDF curves. Depending on the geography of the sub-basins and the routing of the reaches, there may be two (2) to four (4) different sub basin groups for each major watershed. This was done to account for orographic, or elevation differences, in the DDF lines.
- The average 100-year, 1-hour, 6-hour and 24-hour event rainfall depth was calculated for each group of sub-basins by multiplying the 2 Year, 1 hour, 6 hour, and 24 hour NOAA DDF values with the corresponding regional growth factors presented in Table 601 of the WCHCDDM.
- 100-year, 5-minute, 15-minute rainfall depths were calculated by multiplying the 100-year, 1-hour values calculated in the previous step with the corresponding conversion ratios listed in Table 602 of the WCHCDDM.
- The 100-year, 2-hour, 3-hour, and 12-hour rainfall depths were calculated using equations 606, 607, and 608 respectively as contained in the WCHCDDM.

Once all the required duration rainfall depths were obtained, a depth-area reduction factor was applied, and 100-year, 24-hour hydrograph was tabulated for use in the meteorological model of HEC-HMS. In the meteorological model, it was assumed that the unit hydrograph would peak at fifty (50) percent of the storm duration with maximum intensity duration of five (5) minutes.

2.3.5.2 Emergency Spillway Design Precipitation

As mentioned previously in Section 2.1, all the NRCS dams' emergency spillways were sized based on the emergency spillway hydrograph design criteria (NRCS, 1985). However, there is no reference or specific information available in the NRCS reports regarding the estimation of emergency spillway design precipitation. MACTEC's literature review revealed that there is enough information present in the Technical Release 60 (TR-60) that can be used to estimate emergency spillway design distribution (NRCS, 1985). The following design criteria is directly

adopted form the TR-60, and the emergency spillway design hydrograph was produced for use in all the NRCS dam HEC-HMS models.

$$P_{spillway} = P_{100} + 0.26 * (PMP - P_{100})$$

Where $P_{spillway}$ = emergency spillway design precipitation (in)
P_{100} = 100-year, 6-hour precipitation (in)
PMP = local 6-hour PMP (in)

It is evident from the above equation, that the emergency spillway design precipitation is a function of local 6-hour PMP and the 100-year, 6-hour precipitation events. The 100-year, 6-hour precipitation values were calculated as part of the 100-year, 24-hour values and are contained in Appendix D. It should be noted that in the case of the PMP value, it is the same across all watersheds, whereas, the 100-year, 6-hour values vary according the sub-basin locations to the DDF lines as described in Section 2.3.5.1. However, due to the much larger value of the PMP, these differences are relatively small. The distribution of emergency spillway design precipitation follows that of a local 6-hour PMP as described in Appendix D (NOAA, 2004).

2.3.5.3 Local 6-hour Probable Maximum Precipitation (PMP)

A review of previous hydrologic studies performed by the NRCS and Kennedy/Jenks/Chilton showed that there is a lack of details information regards to the methodology applied in obtaining the PMP distribution. During the literature review, MACTEC determined through personal communication with the National Weather Service, that the HMR-49 is the appropriate document for determining the PMP in this area (Bonnin, 2005).

Therefore, MACTEC estimated PMP distribution for the study area using *Table 6.3A* of *Hydrometeorological Report No. 49* and other pertinent information presented in the report (NOAA, 1984).

According to HMR-49, the greatest short-duration rainfalls over small areas in the intermountain region come from intense local storms (thunderstorms) as opposed to general storm situations. Furthermore, intense local summer thunderstorms can produce rainfall for short durations over small basins that exceed the rainfall potential from the general storms. Therefore, the chosen method of determining 6-hour PMP will result in the hydrological computation of the most extreme

rainfall event probable for these watersheds. This was also consistent with the criteria agreed with the NDWR's as described in Section 2.2.

The 6-hour local PMP follows the temporal distribution as described in the *Precipitation-Frequency Atlas of the United States Volume I* (NOAA, 2004). The NOAA report presents the aerial divisions for the temporal distribution based on the precipitation pattern observed and report the project watersheds as belonging to the general precipitation area. The distribution is further divided into the first, second, third, and fourth quartile during which the greatest percentage of the total precipitation falls. The PMP values used in the HEC-HMS model are based on the 6-hour, 1st quartile case with a ten percent of cumulative probability of occurrence. It was estimated that a PMP of 6-hour duration would produce 11.26 inches of rainfall. The calculations and worksheets are included in Appendix D.

2.4 EMERGENCY SPILLWAY ANALYSIS

As part of the contract agreement with the City, the existing capacity of the emergency spillways of the following detention dams were analyzed:

- Upper Peavine Detention Dam
- Lower Peavine Detention Dam
- West Wash Detention Dam

The basis for this analysis was to determine the existing capacities since the nature of the earthen spillways are subject to erosion or man-made modifications that could affect their discharge capacity. A literature review was performed by MACTEC in order to determine the appropriate way to model the spillways. The East Wash Detention Dam emergency spillway was not analyzed since the USCOE investigation indicated that the spillway curve was adequate (USCOE, 1978a)).

The earthen emergency spillways listed above were designed by the NRCS using the standard step method, according to the design criteria outlined in Technical Release 2 (TR-2; NRCS, 1956). Therefore, in order to mimic the original hydraulic calculations, MACTEC used HEC-RAS, which uses the same standard step methodology for performing hydraulic modeling of emergency spillways. The USCOE investigations did not reference the method used in their investigation.

Three separate steady state HEC-RAS models were built using MACTEC's site survey information, which is referenced to NAVD 1988. The following initial boundary conditions were assumed in building these models.

- Known water surface elevation (WSEL) is used as upstream boundary condition
- Normal depth is used as downstream boundary condition

Known WSEL's used in each model were obtained from the corresponding elevations resulting from the hydrologic models of the dams. Normal depth was estimated based on the slope of natural ground immediately downstream of the emergency spillways. An assumption had to be made due to the lack of information regarding the Manning's n-value used in the original design calculations. A sensitivity analysis was done by varying the Manning's n-value for a HEC-RAS model built using the as-built map for Lower Peavine. The results of this analysis, contained in Appendix E, shows that varying the Manning's n-value at the control section of the spillway showed little or no variation in the discharge curve. Other assumptions include:

- Manning's n-value of 0.22 (earthen channel)
- Sub-critical flow

In order to compare the spillway rating curves produced by the HEC-RAS analysis with the USCOE reported curves, the results of both were plotted in Microsoft Excel so the rating curves overlaid each other. Since the USCOE elevations were referenced to NAVD 29, an adjustment factor was applied to bring these elevations to NAVD 1988 datum. An adjustment factor of +3.2 feet was applied to the USCOE data, as explained in Section 2.3.3. A detailed discussion of MACTEC's hydraulic modeling results in conjunction with the USCOE spillway analysis is presented in Section 5.0 (USCOE, 1978a; USCOE, 1978b; USCOE, 1978c).

The existing spillway rating curves produced by MACTEC using HEC-RAS were not used in the HEC-HMS models. Per discussion with the City of Reno staff, it was decided to use NRCS produced spillway rating curves in the HEC-HMS modeling. Recommendations for the spillways are discussed in Section 8.0.

3.0 CLIMATE

This section briefly discusses the climate for the project watershed areas. The City of Reno is located on the Truckee Meadow Valley east of the Sierra Nevada mountain range at an elevation of approximately 4,400 feet NAVD 29. The following information was obtained form the National Weather Service (NOAA, 2000).

To the west of Reno the Sierra Nevada range forms a formidable barrier to weather systems coming from the Pacific, interrupted only by the broad, blue expanse of 6,200 foot high Lake Tahoe. The mountains, rising to elevations of 9,000 to 11,000 feet in the vicinity of Reno, effectively intercept most storm moisture before it can reach the Truckee Meadows. This leaves Reno in a rain shadow, with annual precipitation amounting to 7.53 inches at the Reno-Tahoe International Airport, more than half of which occurs between December and March as mixed rain and snow. Fortunately, the reservoirs which supply the populace with an ample water supply are fed from high altitude areas, which receive 50-75 annual inches of precipitation. Since most of this falls during the winter months, snow depths at higher elevations can reach 15 to 30 feet, while total annual snowfall in Reno averages around two feet, with snow depths rarely exceeding a few inches, or lasting for more than three or four days.

In summer, high pressure over the Four-corners region of the southwestern United States, and low pressure in the eastern Pacific, can combine to push a moist sub-tropical monsoon northward into Nevada. Depending on the intensity, this can supply fuel for afternoon and evening thunderstorms across the area. These are characterized as being high-based with locally heavy downpours that can cause localized flash flooding of dry creek beds and washes, generally limited in the Reno area to the eastern edge of the Truckee Meadows.

Temperatures in the Truckee Meadows on the whole are mild, but as is the case in high desert environments with very low relative humidity, daily ranges can be considerable, often exceeding 50 degrees during the summer. This may be attributed to downslope winds and resultant warming producing very low humidity’s during the summer and moderately low humidity’s during the winter. Even when the summer afternoon maximum reaches the upper 90's, temperatures quickly drop into the 60's after sunset, and reach the 40's by morning. Summer nights with minima over 60 degrees are rare and freezing temperatures have been observed in every month. Afternoon temperatures in mid-winter are moderate, and on the average, the temperature never rises to the freezing point on only six days a year.

In the summer months moderate downslope winds usually occur regularly in the late afternoons, essentially following the Truckee River, fanning out through the Truckee Meadows, before diminishing shortly after sunset. These winds were labeled "Washoe Zephyrs" by Mark Twain in the late 1880's, and that name continues to this day. In general, however, Washoe Zephyrs are gentle breezes compared to those winds which sweep through the valley ahead of winter Pacific storms. In those cases gusts in excess of 50 knots are not uncommon.

Otherwise, sunshine is abundant throughout the year in the rain shadow of the Sierra. Although development has overtaken much of the arable land in the Truckee Meadows, the principal crop on what remains is hay, and the growing season averages 103 days.

Over the last decade, the Truckee River has seen significant flooding events. The Flood of 1997 was determined to be a 100-year flooding event for the Truckee River. The recent New Years Flood that occurred on December 31, 2005, was a more regional event with significant rainfall falling in the Truckee Meadows and causing flooding of local tributaries and along the Truckee River. The flood on the Truckee River has been estimated to be a 50-year flood event. Flooding on the local tributaries varied by watershed, with significant flooding occurring in some while little or no flooding occurred on others. The following is a summary of rainfall totals over the period of December 30, 2005 to January 3, 2006 as reported by the National Weather Service on January 3, 2006.

Reno and Carson City. Douglas and Storey counties:

- Reno airport, 3.07 inches. Reno, NV, netted a daily-record rainfall of 1.42 inches on December 31, which contributed to the Truckee River rising 2.4 feet above flood stage at that location on New Year's Eve.
- North Reno at NWS office, 3.17 inches.
- Sparks, 2.49 inches.
- Stead, 5.28 inches.
- Spanish springs, 3.39 inches.

These totals are included herein, as this was the type of event that the flood detention dams included in this study were meant to protect against.

4.0 EXISTING DRAINAGE SYSTEM AND PATTERN

This section describes the drainage pattern of the contributing watersheds and existing drainage structures including dams, outlet works, and emergency spillways.

4.1 EAST AND WEST WASH DETENTION DAMS

4.1.1 East Wash Diversion Dam

The drainage area, or watershed, of East Wash dam is 1,968 acres (2.09 square miles) and is divided into eight (8) sub-basins (labeled EW1 through EW8) as shown on *Figure 2 Watershed Map East and West Wash Detention Dams*. The largest sub-basin is EW6 with 459 acres (0.49 square mile) and the smallest sub-basin is EW5 with 26 acres (0.03 square mile). All sub-basins are not necessarily contributing their runoff at the same point (East Wash Dam) and at the same time due to difference in the lag time of the sub-basins. The sub-basins EW2 and EW3 have the same contributing point and the combined runoff is routed to the next contributing point where EW1, EW4, and EW5 contribute their runoff. This combined runoff is conveyed downstream to the point where EW6 and EW7 then contribute their runoff, and ultimately, the total runoff is carried to East Wash Dam where EW8 contributes its runoff. Drainage structures upstream of the East Wash Dam consist of:

- 84 inch x 136 foot corrugated metal pipe under McCarran (NDOT, _____a)
- Unknown structure under Leadership Parkway

As part of the construction of McCarran Boulevard, the Nevada Department of Transportation (NDOT) plans show an excavation for the East Wash (NDOT, _____a). The excavation was performed as part of the McCarran Boulevard construction so that there would not be a net loss of storage area in the East Wash storage volume.

The dam is ~680 feet long and ~27 feet high measured from the downstream toe. Prior to the construction of Keystone Avenue and the Cimarron Subdivision in 1985, the downstream embankment height was ~43 feet high and the principal spillway discharged directly to a ravine that existed under Keystone Avenue at that time. The East Wash Dam is primarily a diversion structure and was never designed or intended to detain large volumes of water (NRCS, 1958).

There are two outlet structures that include an outlet works underneath the dam and through the emergency spillway adjacent to the dam on the southwest corner. The principal spillway outlet is a

36-inch reinforced concrete pipe (RCP) that is 174 feet long and currently discharges to a downstream stormdrain manhole constructed as part of the Cimarron Subdivision. This storm drain system consists of a 30 inch class III RCP pipe that continues down Keystone Avenue to the south.

The 36 inch RCP is connected to a multi-port intake structure with seven ports of varying sizes and varying elevations that should be closed prior to the sediment level reaching that particular port. Observation from recent field-walks and the topographic survey shows that sediment accumulation is very small and all ports still remain open.

The emergency spillway is a compacted-earth structure that leads to a concrete chute spillway that is located ~300 feet to the southwest from the right abutment of the dam. If the water surface elevation (WSEL) is above the crest of the emergency spillway, most of the excess runoff will be discharged into the West Wash Dam and the principal spillway will discharge only a small portion which is conveyed downstream of East Wash Dam toward the Interstate-80 highway (I-80) and away from the West Wash Dam via city storm drains. Full descriptions and figures of the facility are contained the design reports, construction plans and the EAP for the East Wash Diversion Dam (NRCS, 1958; NRCS, 1960; NRCS, 1976; MACTEC, 2006a).

4.1.2 West Wash Detention Dam

The drainage area of West Wash dam is 2,137 acres (3.34 square miles) and is divided into six (6) sub-basins (WW1 through WW6) and eight (8) sub-basins (EW1 through EW9) as shown in *Figure 2 Watershed Map East and West Wash Detention Dams*. The largest direct sub-basin is WW3 with 463 acres (0.50 square mile) and the smallest sub-basin is WW2 with 92 acres (0.02 square mile). WW1 runoff is routed to contributing point of WW5 and the combined runoff is routed to West Wash Dam where WW4 and WW6 contribute their runoff. WW2 is routed to contributing point of WW3 and the combined runoff is routed to the Dam. Facilities upstream of the West Wash consist of:

- 72 inch x 316 foot structural plate pipe (SPP) under McCarran (NDOT, _____a)

When the subdivisions along Sky Country Drive and Kings Row were constructed, the majority of the drainage within the City limits was converted to storm drainage. Currently, there is a small

detention basin and inlet facility that connected to the inlet of the NDOT 72 inch SPP at what is currently Sky Country Park.

The West Wash Detention Dam receives all runoff from its contributing sub-basins and runoff discharged from East Wash Diversion Dam emergency spillway. Discharge from the Dam also flows downstream toward I-80 highway.

The dam is ~780 feet long and 65.5 feet high measured from the crest to the downstream toe. The principal spillway outlet is a 300 feet long 24-inch RCP of and discharges to an existing storm drain downstream of the dam. The principal spillway for the dam is a 2 foot x 6 foot x 24 foot high concrete riser, open at the top and protected by a grate of 2 inch steel bars with 5 inch openings. Seventeen feet of the riser are below ground, where it feeds the 24 inch diameter RCP. There is an 18 inch CMP pipe that drains the sediment pool and connects to the principal spillway.

The emergency spillway is a compacted-earth structure and is located 50 feet to the west of the end of the dam embankment and discharges to Severn Drive. Full descriptions and figures of the facility are contained the design reports, construction plans and the EAP for the West Wash Detention Dam (NRCS, 1958; NRCS, 1959b; NRCS, 1976; MACTEC, 2006d).

4.2 UPPER AND LOWER PEAVINE CREEK DETENTION DAMS

4.2.1 Upper Peavine Detention Dam

The watershed area of Upper Peavine dam is 1,367 acres (2.14 square miles) and is divided into six (6) sub-basins (UP1 through UP6) as shown in *Figure 3 Watershed Map Upper and Lower Peavine Detention Dam*. The largest sub-basin is UP3 with 371 acres (0.58 square mile) and the smallest sub-basin is UP6 with 54 acres (0.085 square mile). Runoff from UP1 is routed to the contributing point of UP4 and UP5. This contributing point also receives combined runoff from UP2 and UP3. The total runoff from the five (5) sub-basins is then routed to Upper Peavine Dam where UP6 contributes its runoff. There are no major upstream drainage facilities or structures as the Upper Peavine Dam is directly adjacent to the boundary with National Forest lands. Facilities downstream of the Upper Peavine Dam consist of:

- 48 inch x 300 foot CMP under McCarran (NDOT, _____a)

The dam is ~1,550 feet long and 79 feet high measured from the downstream toe. The principal spillway outlet is a 320 foot long 24-inch RCP and discharges to a ravine downstream of the dam adjacent to Las Brisas Boulevard. The principal spillway for the dam is a 3 foot x 8 foot x 24 foot high concrete riser with sediment ports. Twelve feet of the riser is below ground, where it picks up the 18 inch diameter CMP sediment pool drain.

The emergency spillway is a compacted-earth structure and located 25 feet to the northeast beyond the left end of the dam embankment. Upper Peavine Dam discharges runoff directly downstream of the dam then underneath McCarran Boulevard and past Conway Lane before entering the Lower Peavine Dam. The majority of the drainage between McCarran and the Lower Peavine Dam is open space with some residential encroachment into the drainage. Full descriptions and figures of the facility are contained the design reports, construction plans and the EAP's for the Upper and Lower Peavine Detention Dams (NRCS, 1958; NRCS, 1959a; NRCS, 1976; MACTEC, 2006c).

4.2.2 Lower Peavine Detention Dam

The drainage area of Lower Peavine dam is 497 acres (0.78 square mile) and divided into seven (7) sub-basins (LP1 through LP7) as shown in *Figure 3 Watershed Map Upper and Lower Peavine Detention Dam*. The largest sub-basin is LP2of 143 acres (0.22 square mile) and the smallest is LP5 of 15 acres (0.02 square mile). Runoff from the Upper Peavine Dam is routed to McCarran Dam where LP4 contributes its runoff. The runoff is then routed to the next contributing point where LP1, LP2, LP3, and LP6 discharge their runoff. The combined runoff is again routed to Lower Peavine Dam where LP 7 contributes its runoff.

The dam is 755 feet long and 44 feet high as measured to the downstream the toe. The principal spillway outlet works is a 24-inch steel cylinder pipe of 184 feet long and discharges into an energy dissipater baffle in a concrete junction box which is in turn connected to the city storm drainage system via a 36 inch diameter reinforced concrete pipe.

The principal spillway for the dam is a 4 foot x 8 foot x 26 foot high concrete riser. The principal spillway riser bears six 12 inch x 16 inch ports at various levels on its face and back, their purpose being to drain the sediment pool at the upstream toe of the dam during periods of normal runoff. Only the lowest port above the level of sediment accumulation in the detention basin should be open at any time for the dam to efficiently perform its flood control function. The emergency

spillway is located 50 feet southwest of the end of dam embankment and is constructed of compacted-earth. Discharge from the emergency spillway flows down onto Wyoming Way.

Full descriptions and figures of the facility are contained the design reports, construction plans and the EAP for the Lower Peavine Detention Dam (NRCS, 1958; NRCS, 1961; NRCS, 1976; MACTEC, 2006b).

4.3 DANT BOULEVARD DETENTION DAM

The watershed area of Dant Boulevard dam is 723 acres (1.13 square miles) and is divided into four (4) sub-basins (Plum1 through Plum4 as shown in *Figure 4 Watershed Map Dant Boulevard Detention Dam*. The largest sub-basin is Plum1 consisting of 224 acres (0.35 square mile) and the smallest is Plum2 of 116 acres (0.182 square mile). Runoff from Plum1 and Plum2 are routed to McCarran Boulevard where Plum3 contributes its runoff. Then the combined runoff is routed to Dant Boulevard Dam where Plum4 contributes its runoff. Drainage structures upstream of the Dant Boulevard Dam consist of:

- 6 foot x 6 foot reinforced concrete box culvert (RCBC) with slope tapered inlet under McCarran Boulevard (SEA, 1988)
- McCarran Boulevard forms a 78 foot high embankment as measured from the top of roadway to the downstream toe

The dam is ~550 feet long and 54 feet high measured to the downstream toe near the emergency spillway outlet. Dant Boulevard was designed and built across the top of the dam. The principal spillway outlet works is a 36 inch RCP that discharges to the energy dissipater at the bottom of the emergency spillway chute. The principal spillway also acts as the sediment pool drain and has an anti-vortex and debris structure constructed at the inlet.

The emergency spillway consists of two - 12 foot by 8 foot RCBC's. They discharge to an open-top concrete chute 24 feet wide with side-walls ranging from 4 to 15 feet high. The chute slopes 0.33 ft per ft for 140 feet down the downstream face of the dam to a 24 ft wide by 60 ft long stilling basin of the U.S. Bureau of Reclamation Type III configuration. The stilling basin bears concrete chute blocks to dissipate the energy of floodwater exiting the spillway chute prior to entering a short section of riprap lined channel. The riprap channel gives way to the pre-existing, earthen drainage.

Drainage features, other facilities, and development downstream of the Dant Boulevard Dam consist of:

- Last Chance Ditch
- Lake Ditch
- Residential lots that encroach into the drainage channel

5.0 RESULTS OF DETENTION DAM VOLUME ANALYSIS

This section presents the results of the detention dam storage analysis as previously discussed in Section 2.3.3. All the tables presented in this section are also included in Appendix C along with the supporting data sets.

5.1 DANT BOULEVARD DETENTION DAM

Table 5.1 gives the results of the calculations and comparisons between the original design and the volumes calculated under this study.

Table 5.1 Dant Boulevard Storage Volume Comparison and Results

Elev. (ft)	Storage (Acre Ft)		Type
	MACTEC	K/J/C	
4,702.0	36.7	39.0	100 year, 24 hour Event
4,704.0	43.8	46.8	Spillway Crest Elevation
4,711.0	74.3	78.0	1/2 Probable Maximum Flood Pool
4,714.0	90.8	94.0	Top of the Dam

5.2 UPPER AND LOWER PEAVINE CREEK DETENTION DAMS

Tables 5.2 and 5.3 give the results of the calculations and comparisons between the USCOE investigations and the volumes calculated under this study for the Peavine Creek Detention Dams.

Table 5.2 Upper Peavine Storage Volume Comparison and Results

Elev. (ft)	Area (Acres)		Storage (Acre Ft)		Type
	MACTEC	USCOE	MACTEC	USCOE	
5,010.2	8.68	8.00	78.24	80.00	Sediment Pool
5,025.7	18.11	18.00	281.55	315.00	Flood Control Pool
5,031.9	22.31	23.00	407.32	380.00	Spillway Design Flood Pool

Table 5.3 Lower Peavine Storage Volume Comparison and Results

Elev. (ft)	Area (Acres)		Storage (Acre Ft)		Type
	MACTEC	USCOE	MACTEC	USCOE	
4,753.8	2.90	3.00	13.60	22.00	Sediment Pool
4,768.2	9.03	92.00	94.21	100.00	Flood Control Pool
4,776.4	11.82	95.00	179.63	190.00	Probable Maximum Flood Pool

5.3 EAST WASH DIVERSION AND WEST WASH DETENTION DAMS

Table 5.3 gives the results of the calculations and comparisons between the USCOE investigations and the volumes calculated under this study for the Peavine Wash Dams.

Table 5.4 East Wash Storage Volume Comparison and Results

Elev. (ft)	Area (Acres)		Storage (Acre Ft)		Type
	MACTEC	USCOE	MACTEC	USCOE	
4,851.2	4.79	19	34.28	50	Sediment Pool
4,853.2	5.62	19+	44.72	60	Flood Control Pool
4,860.0	8.36	7.5	91.27	88+	Probable Maximum Flood Pool
4,861.25	9.45		101.99	93	Top Of Dam

Table 5.5 West Wash Storage Volume Comparison and Results

Elev. (ft)	Area (Acres)		Storage (Acre Ft)		Type
	MACTEC	USCOE	MACTEC	USCOE	
4,748.2	1.38	4.00	4.53	20.00	Sediment Pool
4,782.2	16.39	96.00	260.93	360	Flood Control Pool
4,792.5	26.22	106.00	464.91	-	Probable Maximum Flood WSEL[(1)]
4,791.7	26.12	-	451.82	532	Top Of Dam

[(1)] NRCS, 1976

The values presented in Table 5.6 are the comparison performed using the digitized ten foot contours from the original as-built construction plans for West Wash as described in Section 2.3.3 (NRCS, 1959b).

Table 5.6 West Wash Comparison with Digitized NRCS Contours

	Volume (Acre Ft)		
Elev. (ft)	**MACTEC NRCS Digitized**	**USCOE Capacity Curve**	**MACTEC**
4,733.00	0	0.00	0.00
4,743.00	3.3	10.00	1.20
4,748.20	-	20.00	4.06
4,753.00	18.3	40.00	16.13
4,763.00	58.2	115.00	55.97
4,773.00	138.7	230.00	141.03
4,782.20	-	360.00	251.57
4,783.00	270.7	375.00	281.74
4,791.70	-	532.00	440.50
4,793.00	462.7	550+	478.60

6.0 RESULTS OF EMERGENCY SPILLWAY ANALYSIS

The results of the emergency spillway discharge analysis are presented in this section. These results compare the USCOE investigation rating curve values against those produced in the steady state HEC-RAS models. It should be noted that this steady state HEC-RAS models were independent of the hydrologic analysis and do not reflect any modeled water surfaces per the HEC-HMS modeling. The HEC-HMS models utilized the USCOE investigation rating curves.

6.1 UPPER AND LOWER PEAVINE CREEK DAMS

For the purpose of comparison, the rating curve from the USCOE investigation was plotted against the rating curve from the steady state HEC-RAS models used to model the current capacities for the Upper and Lower Peavine Dams. The methodology for the comparison and the development of the HEC-RAS models is described in Section 2.3.4. The curves and the supporting tables and HEC-RAS output are contained in Appendix E.

6.1.1 Upper Peavine Creek Detention Dam

The figure titled *Upper Peavine Emergency Spillway Rating Curves* contained in Appendix E shows the two curves superimposed. Up until 3,000 cubic feet per second (cfs), the two curves are virtually identical. At the PMF peak WSEL of ~5,032 feet NAVD 88, the curves show a difference of ~1,000 cfs with the HEC-RAS curve yielding a higher flow. Table 6.1 presents the results in a tabular format. Supporting methodology and assumptions as well as HEC-RAS output are included in Appendix E.

Table 6.1 Upper Peavine Emergency Spillway Analysis

	USCOE Investigation	MACTEC
Q Total (cfs)	WSEL (ft)	WSEL (ft)
-	5,025.2	5,025.4
200	5,026.7	5,026.6
300	5,026.9	5,026.9
500	5,027.2	5,027.3
1,000	5,027.9	5,028.0
2,000	5,028.9	5,029.0
3,000	5,029.8	5,029.8
4,000	5,030.7	5,030.5
5,000	5,031.6	5,031.1
6,000	5,032.3	5,031.7
7,000	5,033.0	5,032.2
8,000	5,033.5	5,032.7

Comparison between the original as-built design and the site survey performed by MACTEC shows that the Upper Peavine emergency spillway is only slightly different from its original configuration.

6.1.2 Lower Peavine Creek Detention Dam

The figure titled *Lower Peavine Emergency Spillway Rating Curves* contained in Appendix E shows the two discharge curves superimposed. Up until 4,000 cfs, the two curves show differences. At a flow of 1,000 cfs, the current analysis shows the emergency spillway carrying about 750 cfs less than the USCOE curve. At the USCOE PMF peak WSEL of 4,776.32 feet NAVD 88, the curves show a difference of ~900 cfs with the HEC-RAS curve yielding a higher flow. At the MACTEC PMF peak WSEL of ~4,773.8 feet NAVD 88, there is a difference of ~250 cfs with the USCOE curve yielding the higher flow. Table 6.2 presents the results in a tabular format. Supporting methodology and assumptions as well as HEC-RAS output is included in Appendix E.

Table 6.2 Lower Peavine Emergency Spillway Analysis

	USCOE Investigation	MACTEC
Q Total (cfs)	WSEL (ft)	WSEL (ft)
-	4,768.2	4,768.4
500	4,769.7	4,771.1
1,000	4,770.7	4,771.9
1,500	4,771.5	4,772.5
2,000	4,772.2	4,773.0
3,000	4,773.5	4,773.8
4,000	4,774.6	4,774.5
5,000	4,775.4	4,775.2
6,000	4,776.2	4,775.7
7,000	4,776.7	4,776.3
8,000	4,777.0	4,776.8
9,000	4,777.6	4,777.2
10,000	4,777.8	4,777.7

Comparison between the original design and the site survey performed by MACTEC shows that the Lower Peavine emergency spillway is different from its original configuration and geometry.

6.2 WEST WASH DETENTION DAM

The figure titled *West Wash Emergency Spillway Rating Curves* contained in Appendix E shows the two curves superimposed. Up until 3,000 cfs, the two curves are virtually identical. Since the hydrologic modeling showed that West Wash overtops, the comparisons presented here utilize non-overtopping flow and water surface values. At the NRCS spillway design peak WSEL of ~4,784.4 feet NAVD 88, the curves show a difference of ~620 cfs with the NRCS curve yielding a higher flow. At the MACTEC spillway design peak WSEL of ~4,786.2 feet NAVD 88, there is a difference of ~1,000 cfs with the NRCS yielding the higher flow. Table 6.3 presents the results in a tabular format. Supporting methodology and assumptions as well as HEC-RAS output is included in Appendix E.

Table 6.3 West Wash Emergency Spillway Analysis

	USCOE Investigation	MACTEC
Q Total (cfs)	WSEL (ft)	WSEL (ft)
0	4,782.3	4,784.0
500	4,783.6	4,785.5
1,000	4,784.6	4,786.2
2,000	4,786.1	4,787.3
3,000	4,787.5	4,788.1
4,000	4,788.6	4,788.9
5,000	4,789.6	4,789.6
6,000	4,790.5	4,790.3
7,000	4,791.5	4,790.9
8,000	4,792.3	4,791.4
9,000	4,792.9	4,791.9

Comparison between the original design and the site survey performed by MACTEC shows that the West Wash emergency spillway is different from its original configuration and geometry. The current crest spillway is 1.8 feet higher than the original NRCS crest elevation.

7.0 RESULTS OF HYDROLOGIC COMPUTATIONS

This section presents and discusses the results of the HEC-HMS hydrologic modeling and the comparison to the hydrology from the *Watershed Work Plan* and the *Project Reevaluation* (NRCS, 1958; NRCS, 1976) and the USCOE investigations (USCOE 1978a; USCOE 197ba; USCOE 1978c). All of the elevations values presented herein are given in NAVD 1988. The following sections provide written summaries of the hydrology table presented in Appendix F. When reading the results as presented in this section, the reader should be aware that all emergency spillway discharges reported are with respect to the original NRCS design or the USCOE investigation curves and the as-built configurations. These values are not necessarily reflective of the current condition and rating curves for the emergency spillways (see Section 6.0).

7.1 EAST WASH DIVERSION AND WEST WASH DETENTION DAMS

The results from HEC-HMS hydrologic modeling of East and West Wash are shown in the *East and West Wash Hydrology Summary and Comparison* table in Appendix F including the peak WSEL and peak emergency spillway discharges.

7.1.1 East Wash Diversion Dam

The 100-year, 24-hour HEC-HMS computation of East Wash Dam results in a maximum WSEL of 4,855.30 feet and a peak discharge at the emergency spillway of 619 cfs. The 100-year flood does not overtop the dam (top of dam is 4,861.25 feet) but does discharge to the emergency spillway with a WSEL of 2.1 feet above the emergency spillway crest by 2.1 feet (crest of spillway is 4,853.25 feet). The *NRCS Project Reevaluation* study reported a maximum 100-year, 24-hour WSEL of 4,854.75 feet and a peak discharge of 600 cfs over the emergency spillway. Table 7.1 summarizes the results for the 100-year WSEL's and discharge to the emergency spillway.

Table 7.1 East Wash 100-year, 24-hour Storm

Structure and Storm Frequency	WSEL, ft	Emergency Spillway Discharge, cfs
100-yr 24-hr - NRCS Reevaluated	4,855.30	619
100-yr 24-hr – MACTEC HEC-HMS Model	4,854.75	600

The differences in the maximum WSEL and peak discharges are small, 0.55 feet and 19 cfs, respectively.

According to the HEC-HMS results, East Wash dam is not overtopped by the emergency spillway design flood, however, the crest of the emergency spillway is topped by 4.05 feet with a WSEL of 4,857.30 feet and a peak discharge of 2,091 cfs. The spillway design flood does not overtop McCarran Boulevard. The PMF does not overtop the East Wash dam but is only 1.25 feet below the top of dam and discharges 7,655 cfs over the emergency spillway. The *NRCS Project Reevaluation* study reports a PMF with a WSEL of 4861.20 right at the top of the dam and a discharge of 5,990 cfs at the emergency spillway.

The emergency spillway design flood, as reported in *Watershed Work Plan*, results in a maximum WSEL of 4,856.35 feet and a peak discharge of 3,970 cfs while the *NRCS Project Reevaluation* reports an elevation of 4,856.35 feet and discharge of 1,510 cfs (NRCS, 1958; NRCS, 1976). Table 7.2 summarizes the values for the spillway design flood and the PMF.

Table 7.2 East Wash Spillway Design Flood and PMF Summary

Structure and Storm Frequency	WSEL, feet	Emergency Spillway Discharge, cfs
Spillway Design Flood - Watershed Work Plan	4,859.35	3,970
Spillway Design Flood (100 yr & PMF) - NRCS Reevaluated	4,856.35	1,510
Spillway Design Flood (100 yr & PMF) - MACTEC HEC-HMS Model	4,857.90	2,601
Freeboard Design Flood (PMF) - NRCS Reevaluated	4,861.20	5,990
Freeboard Design Flood –USCOE	4,860	6,000
Freeboard Design Flood (PMF) - MACTEC HEC-HMS Model	4,860.40	9,564

7.1.2 West Wash Detention Dam

For West Wash dam, the maximum WSEL of the 100-year, 24-hour event is 4,776.80 feet and is well below the crest of the emergency spillway elevation of 4,784.00 feet and the top dam elevation of 4,793.50 feet. It is also reported in the *NRCS Project Reevaluation* that 100-year flood is fully contained by the dam and maximum WSEL does not reach crest of emergency spillway. Table 7.3 summarizes the results for the 100-year WSEL's.

Table 7.3 West Wash 100-year, 24-hour Storm

Structure and Storm Frequency	WSEL, feet	Emergency Spillway Discharge, cfs
100-yr 24-hr - NRCS Reevaluated	4,773.05	0
100-yr 24-hr - HEC-HMS Model	4,774.20	0

The HEC-HMS results show the West Wash dam overtops by 1.3 feet and discharges 14,162 cfs during the PMF, including weir flow over the dam.

The *NRCS Project Reevaluation* reports a PMF WSEL of 4,792.50 feet and a discharge of 8,530 cfs at West Wash dam emergency spillway.

The HEC-HMS modeling shows that the spillway design flood does not overtop the West Wash Dam at a WSEL of 4,786.20 feet and a discharge of 1,592 cfs at the emergency spillway.

The *Watershed Workplan* reports a spillway design flood WSEL of 4,789.30 feet and is 5.3 feet above the crest of the spillway with a discharge of 5,000 cfs (NRCS, 1958). The *NRCS Project Reevaluation* reports a spillway design flood WSEL of 4,784.40 feet that is 5.4 feet above crest of spillway and a discharge of 8,530 cfs. Table 7.2 summarizes the values for the spillway design flood and the PMF.

Table 7.4 West Wash Spillway Design Flood and PMF Summary

Structure and Storm Frequency	WSEL, feet	Emergency Spillway Discharge, cfs
Spillway Design Flood - Watershed Work Plan[(1)]	4,789.3	5,000
Spillway Design Flood (100 yr & PMF) - NRCS Revaluated[(2) (4)]	4,784.4	1,145
Spillway Design Flood (100 yr & PMF) - MACTEC HEC-HMS Model	4,786.20	1,592
Freeboard Design Flood (PMF) - NRCS Reevaluated	4,792.50	8,530
Freeboard Design Flood (PMF) - MACTEC HEC-HMS Model	4,794.80	14,162

7.2 UPPER AND LOWER PEAVINE CREEK DETENTION DAMS

The results from HEC-HMS hydrologic modeling of Upper and Lower Peavine are shown in *Upper and Lower Peavine Hydrology Summary and Comparison* table in Appendix F including peak WSEL's and peak emergency spillway discharges.

7.2.1 Upper Peavine Creek Detention Dam

In all the studies and including the HEC-HMS results, the 100-year, 24-hour flood is contained in the Upper Peavine dam, with the top of the dam at 5,033.20 feet, and the WSEL is below the crest of the spillway, with the crest of the spillway at 5,025.70 feet. Table 7.5 shows the results of this study and the previous *Watershed Work Plan* and *NRCS Project Reevaluation* study.

Table 7.5 Upper Peavine 100-year, 24-hour Storm

Structure and Storm Frequency	WSEL, feet	Emergency Spillway Discharge, cfs
100-yr 24-hr - Watershed Work Plan	5,017.60	0
100-yr 24-hr - NRCS Reevaluated	5,013.40	0
100-yr 24-hr - MACTEC HEC-HMS Model	5,012.00	0

As computed by HEC-HMS, the spillway design flood is contained 4.3 feet below the original emergency spillway crest at a WSEL of 5,021.40 feet.

For the spillway design flood, the *Watershed Work Plan* reports a WSEL of 5,029.30 feet which is 3.6 feet above the original crest of the emergency spillway with a discharge of 2,300 cfs. Note that this WSEL was computed with a storm duration of 2 hours. The *NRCS Project Reevaluation* reports a WSEL of 5,026.30 which is 0.6 feet above crest of the original emergency spillway elevation.

The freeboard design flood, computed by HEC-HMS, has a WSEL of 5,032.60 feet and is 6.9 feet above the crest of the emergency spillway with a spillway discharge of 6,678 cfs.

The *NRCS Project Reevaluation* reports a WSEL of 5,031.30 feet and a spillway discharge of 4,700 cfs. Table 7.6 summarizes the values for the spillway design flood and the PMF.

Table 7.6 Upper Peavine Spillway Design Flood and PMF Summary

Structure and Storm Frequency	WSEL, feet	Emergency Spillway Discharge, cfs
Spillway Design Flood - Watershed Work Plan	5,029.30	2,300
Spillway Design Flood (100yr & PMF) - NRCS Reevaluated	5,026.30	75
Spillway Design Flood (100yr & PMF) - MACTEC HEC-HMS Model	5,021.40	0
Freeboard Design Flood (PMF) - NRCS Reevaluated	5,031.30	4,700
Freeboard Design Flood (PMF) - USCOE Investigation[7]	5,031.20	5,030
Freeboard Design Flood (PMF) - MACTEC HEC-HMS Model	5,032.60	6,678

The HEC-HMS modeling also shows the WSEL of the 100-year flood with a WSEL of 4,897.70 feet at McCarran Boulevard is below the crown of the roadway. The freeboard design flood, or PMF, overtops McCarran Boulevard by 3.8 feet at WSEL of 4,937.80 feet. There are no WSEL's reported by the NRCS study's as McCarran Boulevard was not built at the time these studies were done.

7.2.2 Lower Peavine Creek Detention Dam

For the Lower Peavine dam, both the *NRCS Project Reevaluation* and HEC-HMS modeling report 100-year, 24-hour WSEL's below the top of dam and crest of the emergency spillway as 4,759.00 feet and 4,757.30, respectively. Table 7.7 shows the results of this study and the previous *NRCS Project Reevaluation study.*

Table 7.7 Lower Peavine 100-year, 24-hour Storm

Structure and Storm Frequency	WSEL, feet	Emergency Spillway Discharge, cfs
100-yr 24-hr - Watershed Work Plan	n/a	n/a
100-yr 24-hr - NRCS Reevaluated	4,759.00	0
100-yr 24-hr - MACTEC HEC-HMS Model	4,757.30	0

The HEC-HMS results show a spillway design flood WSEL of 4,768.3 feet and an emergency spillway discharge of 618 cfs.

Both the *Watershed Workplan* and *NRCS Project Reevaluation* report spillway design WSEL's above the crest of the emergency spillway of the Lower Peavine dam at 4,773.00 feet and 4,768.50 feet, respectively.

At the Lower Peavine dam, *NRCS Project Reevaluation* reports a PMF WSEL of 4,776.40 feet and a spillway discharge of 5,950 cfs while the HEC-HMS shows a PMF WSEL of 4,773.80 feet and a spillway discharge of 3,333 cfs. The USCOE Investigation shows the same WSEL as the *NRCS Project Reevaluation* but resulted in a higher emergency spillway discharge of 6,039 cfs. Table 7.8 summarizes the values for the spillway design flood and the PMF.

Table 7.8 Lower Peavine Spillway Design Flood and PMF Summary

Structure and Storm Frequency	WSEL, feet	Emergency Spillway Discharge, cfs
Spillway Design Flood - Watershed Work Plan	4,773.00	2,725
Spillway Design Flood (100yr & PMF) - NRCS Reevaluated	4,768.50	70
Spillway Design Flood (100yr & PMF) - MACTEC HEC-HMS Model (5)	4,768.30	618
Freeboard Design Flood (PMF) – NRCS Reevaluated	4,776.40	5,950
Freeboard Design Flood (PMF) - USCOE Investigation	4,776.40	6,039
Freeboard Design Flood (PMF) - MACTEC HEC-HMS Model	4,773.80	3,333

7.3 DANT BOULEVARD DETENTION DAM

The results from the HEC-HMS hydrologic modeling of Dant Boulevard are shown in *Dant Hydrology Summary and Comparison* table in Appendix F and include peak WSEL and peak emergency spillway discharges.

The HEC-HMS results for the 100-year, 24-hour flood yield a WSEL of 4,698.20 feet at the Dant Boulevard dam. The *Dant Boulevard Storm Water Detention Dam* report states a 100-year WSEL of 4,702.00 feet. Table 7.9 shows the results of this study and the report by Kennedy/Jenks/Chilton.

Table 7.9 Dant Boulevard 100-year, 24-hour Storm

Structure and Storm Frequency	WSEL, feet	Emergency Spillway Discharge, cfs
100 yr- 24 hr - Original	4,702.00	0
100 yr - 24 hr – MACTEC HEC- HMS	4,698.20	0

The HEC-HMS output shows a spillway design flood produces a WSEL of 4,711.30 feet and a spillway discharge of 1,544 cfs. At this WSEL there is 2.7 feet to the top of the dam and is 6.3 feet above the spillway. The original Kennedy/Jenks/Chilton document reports a WSEL of 4,710.94 feet which is 3.1 feet below top of the dam and an emergency spillway discharge of 1,438 cfs. Table 7.10 summarizes the values for the spillway design flood.

Table 7.10 Dant Boulevard Spillway Design Flood

Structure and Storm Frequency	WSEL, feet	Emergency Spillway Discharge, cfs
Spillway Design Flood (1/2 PMP) - Original [(2)]	4,710.94	1,438
Spillway Design Flood (1/2 PMP) – MACTEC HEC-HMS [(3)]	4,711.30	1,544.7

8.0 FINDINGS

This section summarizes the findings and makes recommendations regarding the following:

- Hydrologic Modeling
- Detention Dam Volume Analysis
- Emergency Spillway Analysis

The hydrologic modeling for the five dams was performed in support of the preparation of the inundation maps and Emergency Action Plans (MACTEC, 2006; MACTEC, 2006a MACTEC, 2006b MACTEC, 2006c MACTEC, 2006d). Each hydrologic model was built using the best available information and tools that have been prepared using sound engineering judgment and standard of care. Some assumptions have been made where a lack of information or the dubious nature of information existed. Assumptions, when made, have been included in the body of this report.

The results of the hydrologic modeling were obtained after many trials and runs during which parameters were reviewed and adjusted as necessary to reflect the existing conditions. The comparison between the HEC-HMS results and results from the *Watershed Work Plan* and *NRCS Project Reevaluation* illustrates the discrepancies that can result from the difference in precipitation data, methodology, parameter estimation, and hydrologic assumptions. MACTEC has made a good faith effort to follow and utilize the same methodology as the original design reports.

The discussion below only discusses results pertaining to the HEC-HMS hydrologic and HEC-RAS hydraulic analysis with respect to the original design parameters or construction of the facilities. Some recommendations are also based on field observations or previous studies.

The recommendations are informal and only based on the results of the findings herein and are not intended to imply that the dams are inadequate for their intended purpose. The recommendations are only meant to suggest possible further action or analysis on the part of the City of Reno.

8.1 EAST WASH DIVERSION AND WEST WASH DETENTION DAMS

8.1.1 East Wash Diversion Dam

East Wash Diversion Dam results are consistent with those of earlier studies. Given that the 100-year precipitation value for the HEC-HMS model is higher than the value used in the *NRCS Project Reevaluation*, the resulting water surface was and emergency spillway flows were very close to those reported by the NRCS (NRCS, 1976). Since East Wash was originally intended to divert up to 1,000 cfs into West Wash, the results are acceptable within the design intention of the dam.

The spillway design flood results are higher than those presented in the *NRCS Project Reevaluation*. The results of the modeling show that the spillway design flood is within 0.3 foot from the top of the wall at the emergency spillway. However, the emergency spillway dike has settled in places, and the site survey performed by MACTEC shows low spots in the dike that would lead to an overtopping of emergency spillway dike by as much as 0.75 feet at the location directly adjacent to the east wall of the emergency spillway. Under these conditions, the emergency spillway does not meet the criteria per TR-60.

For the PMP per HR-49, the precipitation is less than that used in the *NRCS Project Reevaluation* or the USCOE investigation. The resulting water surface is less than that calculated in the *NRCS Project Reevaluation* but matches the USCOE WSEL very closely. At the WSEL of 4,860.4 feet, there is a nominal freeboard of 1.6 feet, which is more than the 1.5 feet recommended by the USCOE. This is somewhat misleading since the current emergency spillway discharge is higher than the *NRCS Project Reevaluation*, however, it should be noted that this study calculates flow over the emergency spillway dike as weir flow and therefore increases the discharge to West Wash and decreases the WSEL in East Wash. At the PMF elevation, the modeling indicates that the emergency spillway dike would be overtopped to a depth of up to 2.2 feet for a period of ~1.5 hours. This could potentially cause a failure of the emergency spillway dike.

8.1.2 West Wash Detention Dam

Results for West Wash were surprising due to the discovery of the storage volume discrepancies as summarized in Section 5.3 and Table 5.5. This discrepancy is approximately a loss of 100 acre-feet of storage at the flood control elevation at the emergency spillway crest.

Per the *NOAA Atlas 14* and the methodology in the *WCHCDDM*, the precipitation values are higher for the 100-year, 24-hour event than in the *NRCS Project Reevaluation*. Per HMR-49, the PMP value is less than the value used in the *NRCS Project Reevaluation* or the USCOE investigation.

The HEC-HMS results for the 100-year, 24-hour event are very similar to the results from the *NRCS Project Reevaluation* study as shown in Section 7.1.2. The resulting water surface is well below the emergency spillway by 9.8 feet. The 100-year, 24-hour WSEL at 4,774.2 is 14.2 feet above the top of the principal spillway.

The emergency spillway design flood closely matches the results of the *NRCS Project Reevaluation* with respect to discharge. This is primarily due to the storage discrepancy between the original design and the volume analysis performed in this study that showed a net difference of ~100 acre-feet.

The PMF, or freeboard design flood, results were significantly higher than the *NRCS Project Reevaluation*, again, mostly due to the ~100 acre-foot differences in the storage. The PMP value per HMR-49 is 1.84 inches less than that used in the *NRCS Project Reevaluation*, and the watershed characteristics were only slightly different than the reevaluation, primarily from the development between Sky Country Drive and Kings Row. The HEC-HMS results in an overtopping of the West Wash dam embankment for a duration of approximately 40 minutes.

The emergency spillway has been altered and shows other signs of degradation since the dam's construction. The current spillway crest elevation is 1.8 feet higher than the original design and there is a loss of cross-sectional area as well. The original design shows a spillway crest width of 80 feet, while the site survey performed by MACTEC shows a minimum spillway width of 55 feet just upstream of the spillway crest. Additionally, the construction of a sanitary sewer line that crosses under the spillway, in conjunction with adjacent development, has modified the spillway embankment such that at the spillway crest, there is no left channel embankment. The original

design shows an embankment height of 12 feet and a side slope of 1:1 (H:V) at this location. At the elevation of the spillway design flood, the analysis indicates a net loss of 1,000 cfs. At the levels of flow expected during a PMF event, the HEC-RAS analysis indicates that the current configuration would pass more flow on the order of ~1,200 cfs. There were some assumptions made when modeling the emergency spillway, and an effort was made to have a reasonable comparison between this study and the original design, however the results of the analysis and the site survey performed by MACTEC, do show that there is a loss of capacity in the spillway.

8.2 UPPER AND LOWER PEAVINE CREEK DETENTION DAMS

8.2.1 Upper Peavine Creek Detention Dam

The detention volume comparison performed indicates that storage volumes are comparable, with the only discrepancy being the storage volume at the flood control pool at the emergency spillway crest elevation. The total volume at the PMF flood level is 14 acre-feet more than the USCOE analysis performed in 1978 (USCOE, 1978c).

The 100-year, 24-hour HEC-HMS results show that the Upper Peavine dam contains the 100-year event at a WSEL of 5,012 feet. This is 22 feet below the current elevation of the emergency spillway crest and is 0.45 feet above the top of the principal spillway riser.

The HEC-HMS modeling shows that the spillway design flood WSEL of 5,021.4 is 4 feet below the emergency spillway crest. Considering that this criteria was meant to size the emergency spillway, the dam does not meet the original design criteria.

The PMF or freeboard design flood, while utilizing a smaller PMP as calculated per HMR-49, does yield a higher WSEL than the *NRCS Project Reevaluation*. A detailed explanation for the difference would have to utilize the modeling parameters used in the *NRCS Project Reevaluation,* which MACTEC was not able to obtain from the NRCS. The resulting WSEL of 5,032.6 comes to within one-third of a foot of the lowest elevation along the dam crest according to the site survey performed by MACTEC. This also may not meet USCOE freeboard criteria.

The emergency spillway capacity analysis shows a good similarity with some divergence at the higher flows and elevations. At the PMF WSEL's, the analysis indicates that the NRCS curve may be underestimating the discharge by approximately 1,000 cfs. The discharge channel itself shows

little sign of alteration or erosion. What erosion or degradation there is, would likely be washed away in the event of an emergency spillway discharge. The USCOE investigation reports that the Upper Peavine emergency spillway is the most erodable of all the NRCS dams and that an emergency spillway discharge would result in considerable erosion of the spillway crest and possibly endanger the adjacent dam embankment (USCOE, 1978c). MACTEC did not perform any analysis that would support this claim. The "as-constructed" plans for Upper Peavine show a crest width of 120 feet, however, the site survey performed by MACTEC, shows a crest width of 100 feet. It does not appear that the spillway was altered to such an extent to narrow the channel by 20 feet and additionally, the hydraulic analysis indicates that the spillway capacity is the same as that investigated by the USCOE. It would appear that the "as-constructed" plans dated June of 1959 may not be correct as to the final as-built configuration (NRCS, 1959a).

8.2.2 Lower Peavine Creek Detention Dam

The storage volume analysis shows values less than those calculated in the USCOE investigation (USCOE, 1978b). At the USCOE PMF elevation of 4,776.4, the analysis shows approximately 10 acre-feet less storage than the USCOE value. Since the values include the sediment pool storage, which also shows approximately 10 acre-feet less storage than the USCOE value, it is likely that the difference could be attributed to sediment accumulation.

The 100-year, 24-hour HEC-HMS modeling results show that the Lower Peavine dam contains 100-year flood at a level 11.2 feet below the emergency spillway crest and 0.3 feet below the top of the principal spillway.

The HEC-HMS results for the spillway design flood are very close to the results of the *NRCS Project Reevaluation* (NRCS, 1976). These values are not comparable to the original *Watershed Workplan* values since they utilized storms of different duration, 2-hours versus 6-hours (NRCS, 1958).

The PMF results from the HEC-HMS model shows a water surface and emergency spillway discharge that are on the order of 3 feet lower and 2,000 cfs less than the *USCOE Inspection* and the *NRCS Project Reevaluation* (USCOE, 1978b; NRCS, 1976). These results are consistent with expectations given the slight differences in detention storage and a lower PMP value than that used in the USCOE and NRCS studies. The construction of McCarran Boulevard and the resulting

detention of a portion of the PMF may possibly play a role in the lower WSEL at the Lower Peavine dam. The resulting freeboard is 3.6 feet below the current crest of the dam.

The emergency spillway analysis and the site survey performed by MACTEC show that the spillway is different from the as-built dimensions. The spillway originally was designed with a spillway crest width of 80 feet. The current spillway crest bottom width is ~65 feet. However, given the HEC-HMS model results, the current configuration of the spillway, and a PMF discharge of 3,333 cfs, the spillway performs well and has a minimum freeboard of ~2 feet at the left bank at the spillway crest.

8.3 DANT BOULEVARD DETENTION DAM

The volume analysis performed under this study shows only a difference from the original Kennedy/Jenks/Chilton design. At the top of the dam elevation, there is a 4 acre-foot difference in volume.

The HEC-HMS results for the 100-year, 24-hour event is 3.8 feet lower than the original modeling done by Kennedy/Jenks/Chilton. This WSEL is 5.3 feet below the invert of the emergency spillway. The storage volume available between this WSEL and the spillway invert would be ~17 acre-feet. The construction of McCarran Boulevard has little effect on the 100-year event as it was designed to pass the 100-year event. The primary difference between the Kennedy/Jenks/Chilton report and this study is the difference in the curve numbers. The Kennedy/Jenks/Chilton HEC-1 model utilizes a curve number of 85 for all basins, which equates to quarter-acre residential lots throughout the basins for a HSG C. MACTEC could not find any reference to HSG or land use planning in the Kennedy/Jenks/Chilton report.

The curve numbers for this study ranged from 74 to 76 which also were developed to take into account future conditions and HSG's per the Washoe County Soil Survey.. As discussed in Section 2.3.1, the curve numbers were developed from the land use mapping, and in the case of Dant, a planned unit development which covered the area within the Plum 1, Plum 2, and the Washoe County portion of Plum 3 sub-catchments. The planned unit development Whispering Pines consists of one acre lots with a large percentage of open space. Additionally, the area within Plum 4 that is shown as open space in *Figure 10 Land Use and Curve Numbers Dant Boulevard* was

changed from single family residential, as it is unlikely that City of Reno hillside development criteria would allow development in this portion.

The spillway design flood, or ½ PMF, results show a slight increase of 0.36 feet in WSEL from the original design. At this elevation the water surface would be within 0.7 feet from the crown of the twin 11' 8' x 8' RCBC's. Per the Kennedy/Jenks/Chilton report, the spillway was designed as a weir. At WSEL's at or above the crown of the RCBC's, the spillway would then perform as a submerged culvert, and the hydraulic characteristics would change. Under the modeled conditions, the dam functions as intended.

Under the ½ PMF, the WSEL at McCarran Boulevard is ~41 feet below the crown of the road. At a PMF WSEL of 4,967.7 feet, McCarran has a detention affect, and therefore lowers peak flows downstream.

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FIGURES

UPPER PEAVINE DETENTION DAM

EAST WASH DIVERSION DAM

WEST WASH DETENTION DAM

LOWER PEAVINE DETENTION DAM

DANT BLVD DETENTION DAM

395

80

N

LEGEND

Watershed Boundary

City of Reno

City of Sparks

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ENGINEER: CA	SCALE: 1" = 5000'
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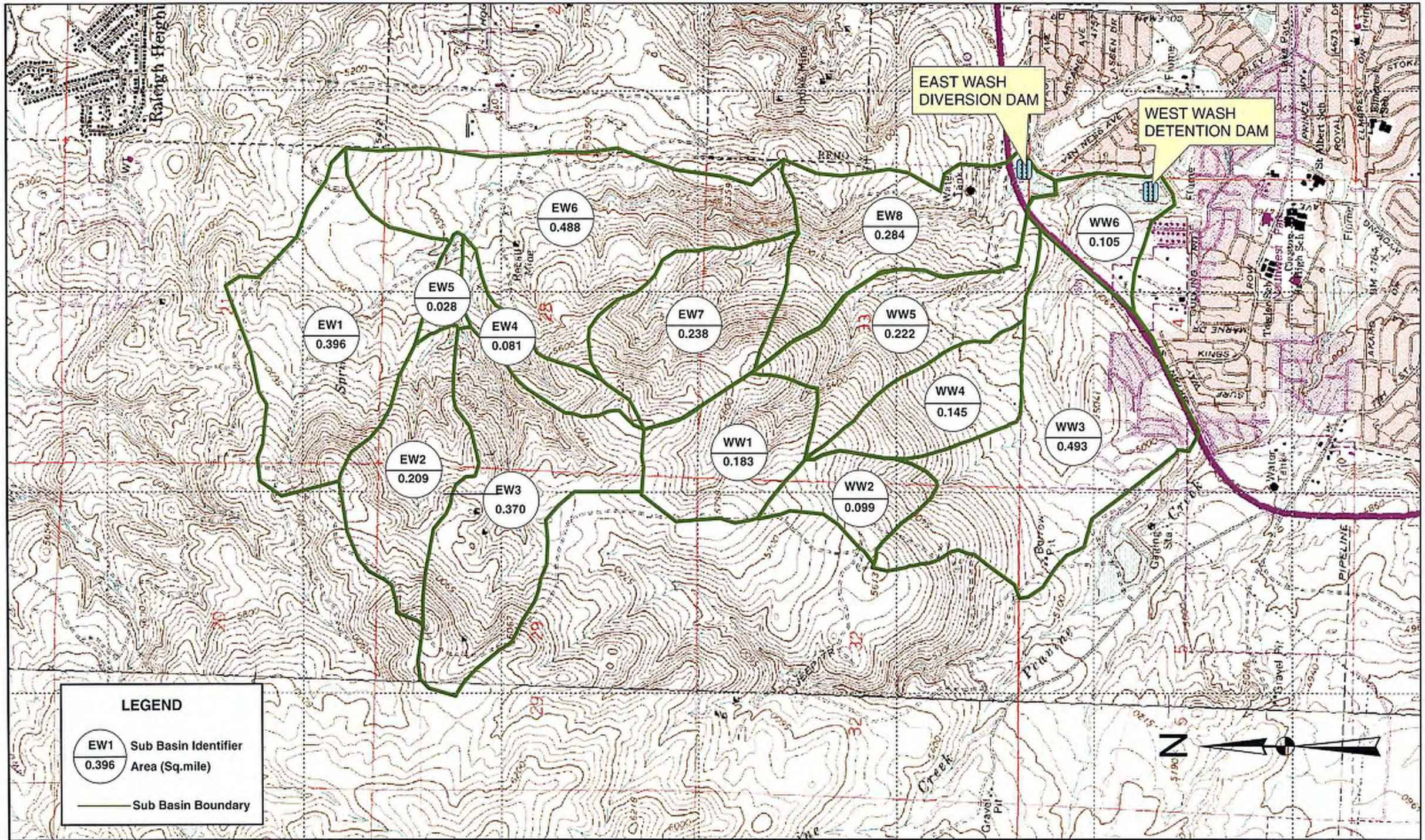
VICINITY MAP
DAMS AND TRIBUTARY WATERSHEDS
CITY OF RENO EMERGENCY ACTION PLAN
RENO, WASHOE COUNTY, NEVADA

FIGURE.
1



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WATERSHED MAP
EAST AND WEST WASH DETENTION DAMS
CITY OF RENO EMERGENCY ACTION PLAN
RENO, WASHOE COUNTY, NEVADA

FIGURE. 2

NOTE:

ELEVATIONS ARE REFERRED TO NAVD 1929 DATUM AND CONTOUR INTERVAL IS 20 FT.

UP1 0.327

UP2 0.286

UP3 0.579

UP4 0.472

UP5 0.390

UP6 0.085

LP1 0.189

LP2 0.223

LP3 0.092

LP4 0.067

LP5 0.023

LP6 0.070

LP7 0.112

UPPER PEAVINE DETENTION DAM

LOWER PEAVINE DETENTION DAM

LEGEND

UP1 / 0.327 — Sub Basin Identifier / Area (Sq.mile)

——— Sub Basin Boundary

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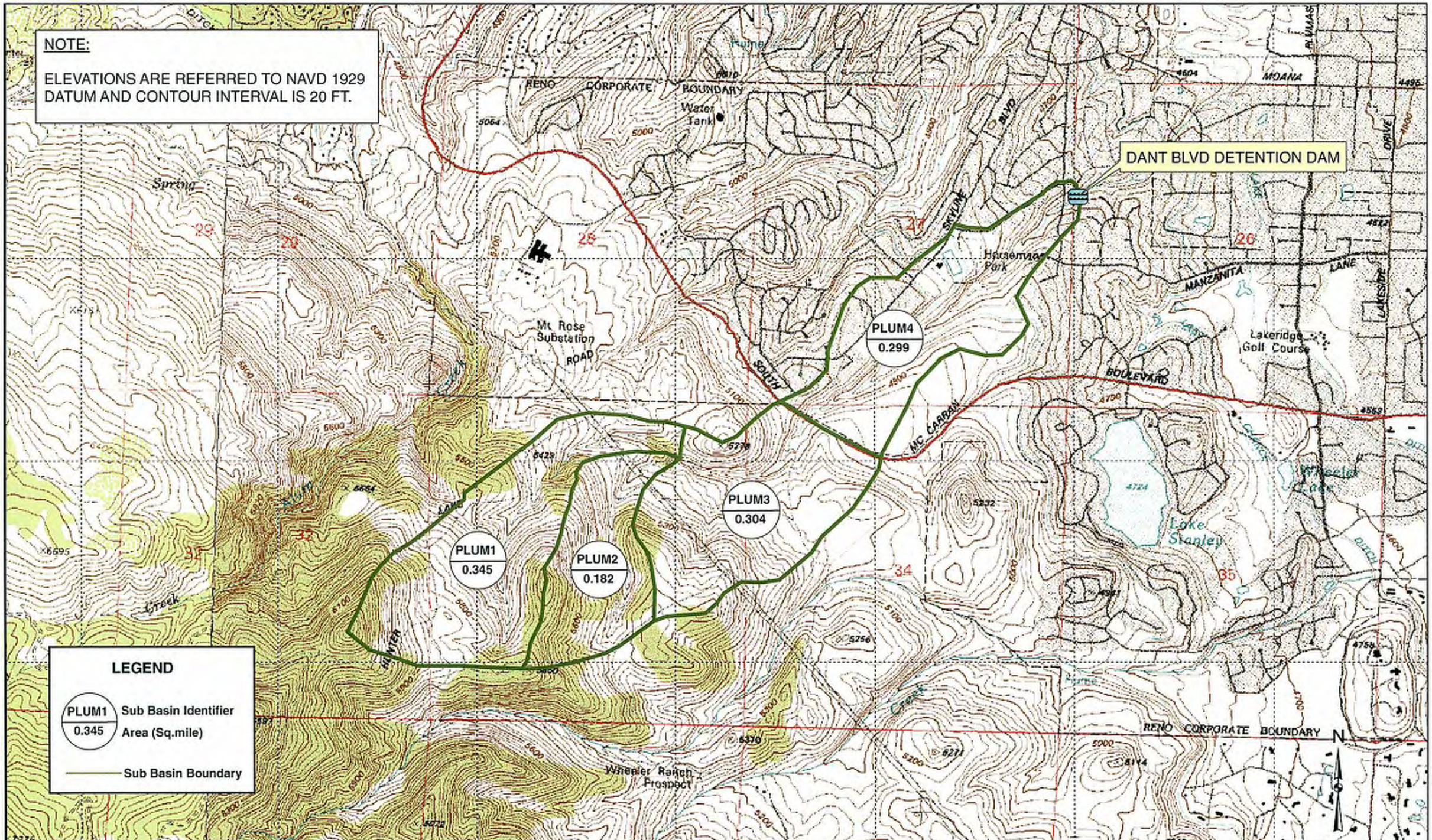
WATERSHED MAP
UPPER AND LOWER PEAVINE DETENTION DAMS
CITY OF RENO EMERGENCY ACTION PLAN
RENO, WASHOE COUNTY, NEVADA

FIGURE. 3



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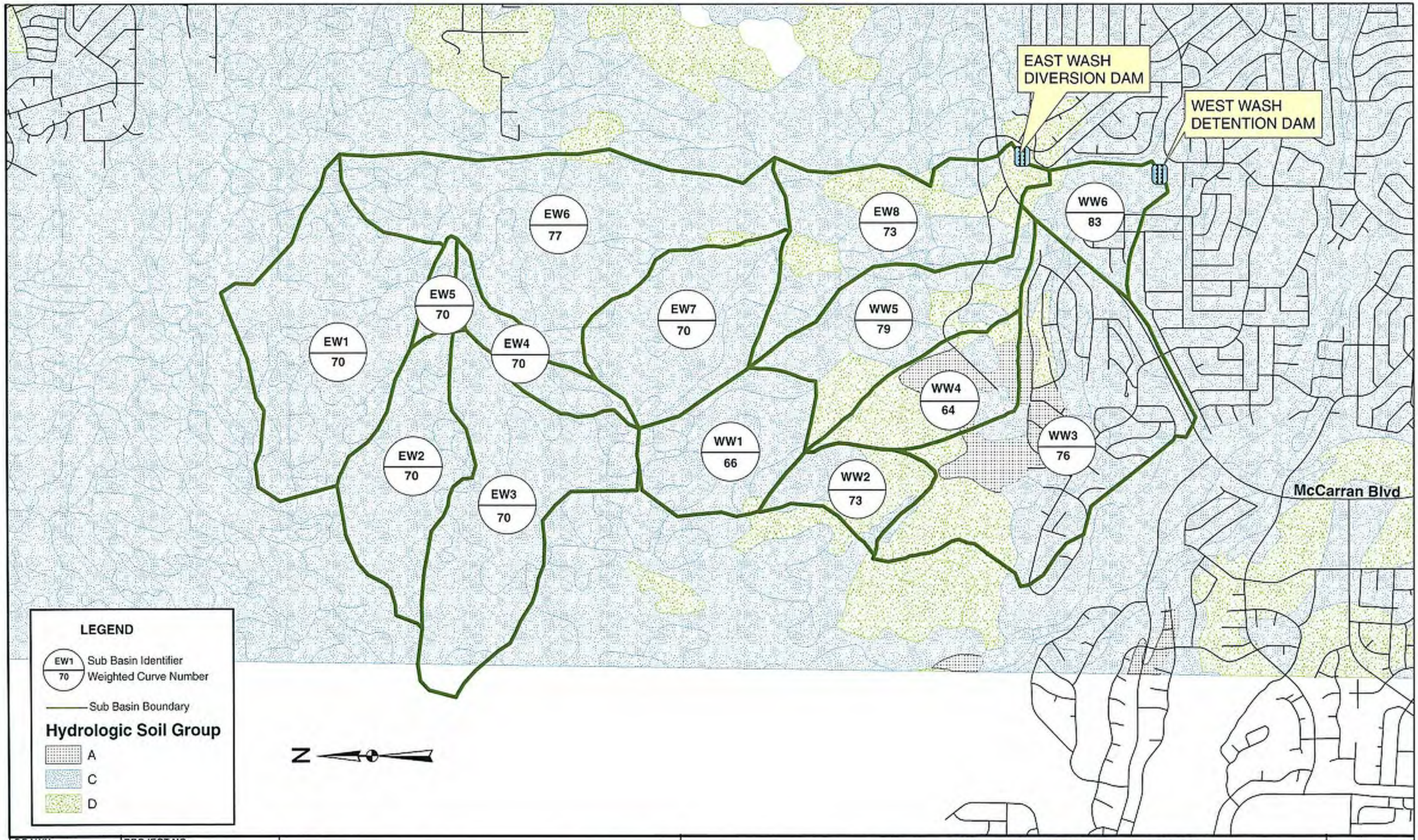
WATERSHED MAP
DANT BOULEVARD DETENTION DAM
CITY OF RENO EMERGENCY ACTION PLAN
RENO, WASHOE COUNTY, NEVADA

FIGURE.
4



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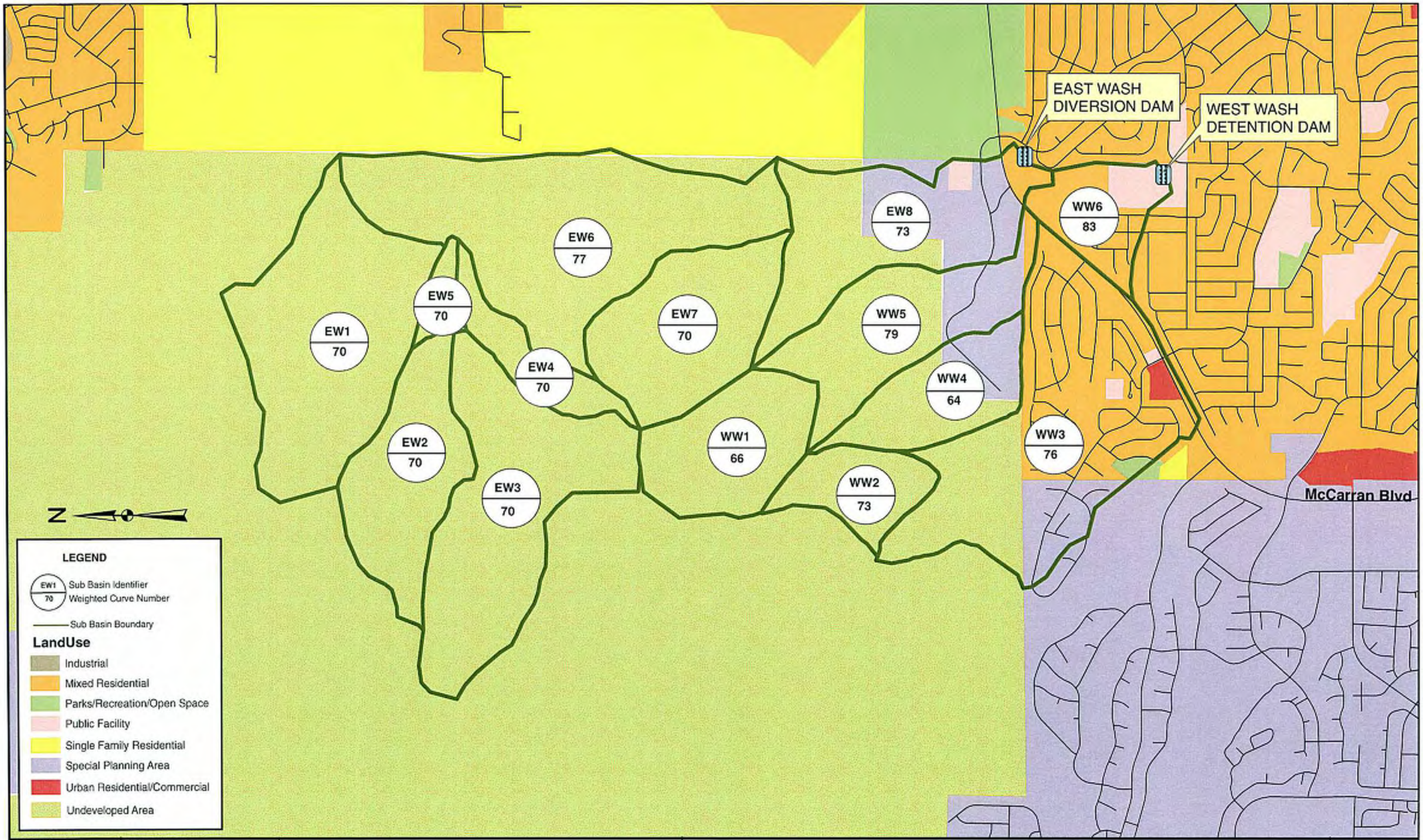
SOILS MAP AND CURVE NUMBERS
EAST AND WEST WASH DETENTION DAMS
CITY OF RENO EMERGENCY ACTION PLAN
RENO, WASHOE COUNTY, NEVADA

FIGURE.
5



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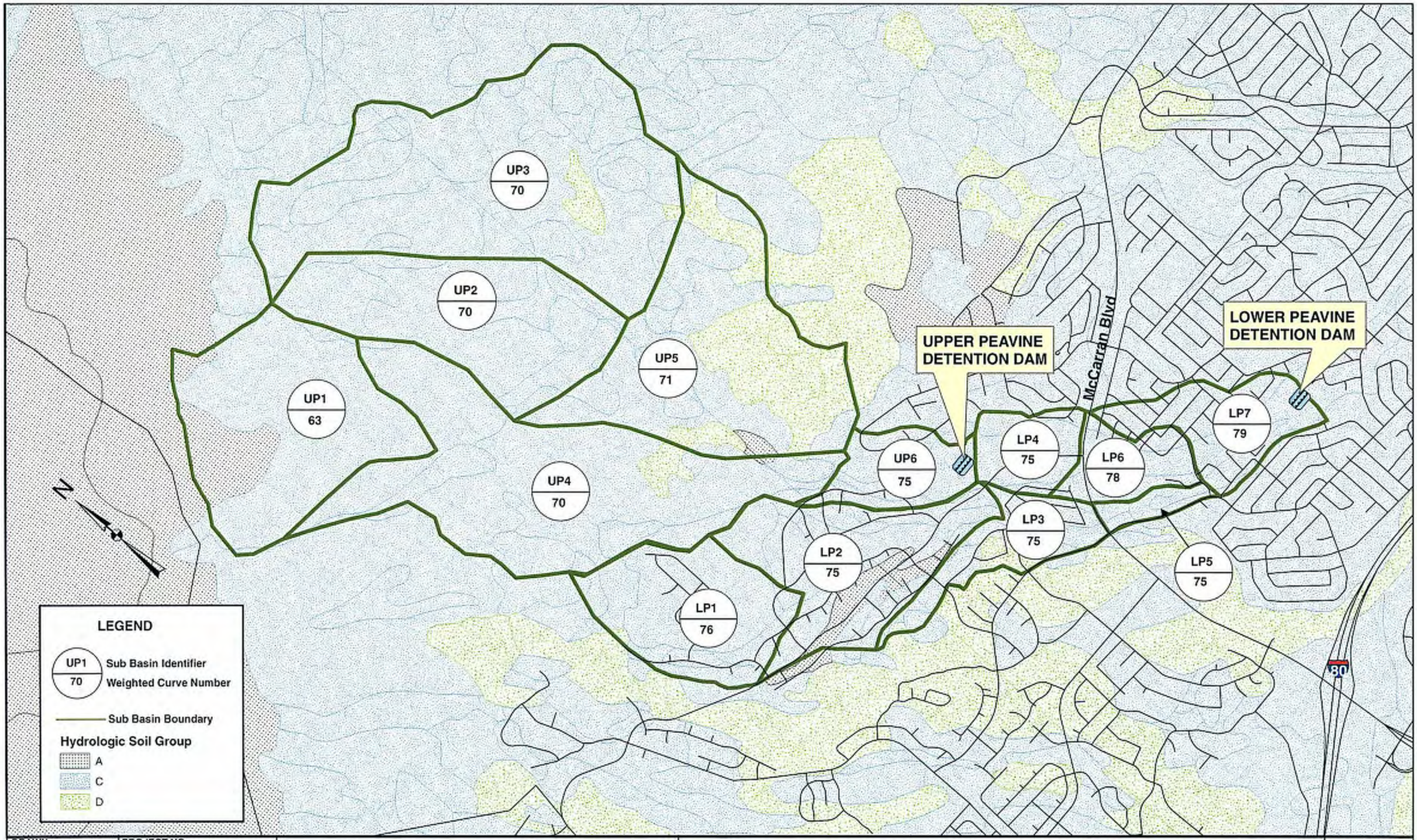
LAND USE MAP AND CURVE NUMBERS EAST AND WEST WASH DETENTION DAMS

CITY OF RENO EMERGENCY ACTION PLAN
RENO, WASHOE COUNTY, NEVADA

FIGURE. 6



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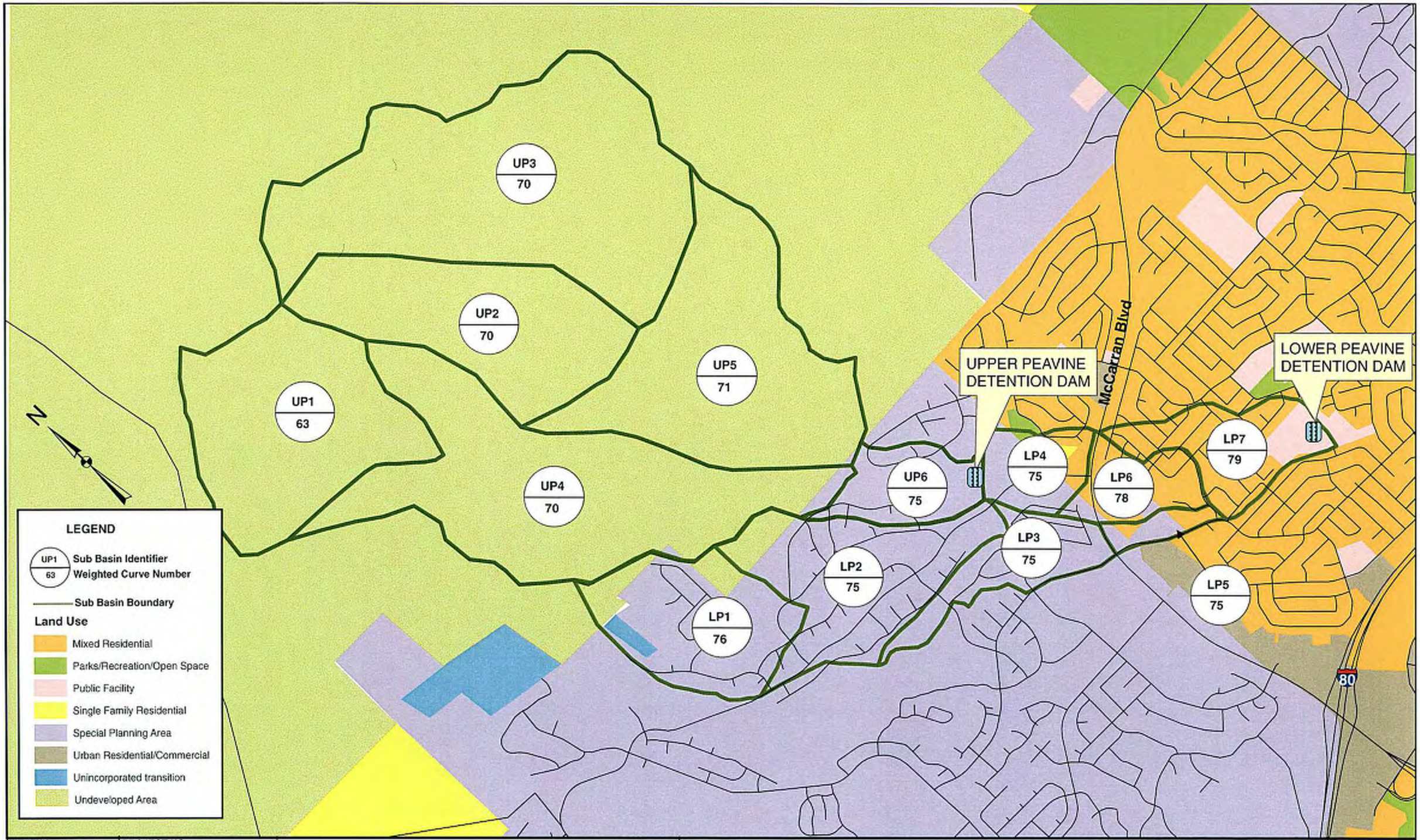
SOILS MAP AND CURVE NUMBERS
UPPER AND LOWER PEAVINE DETENTION DAMS
CITY OF RENO EMERGENCY ACTION PLAN
RENO, WASHOE COUNTY, NEVADA

FIGURE.
7



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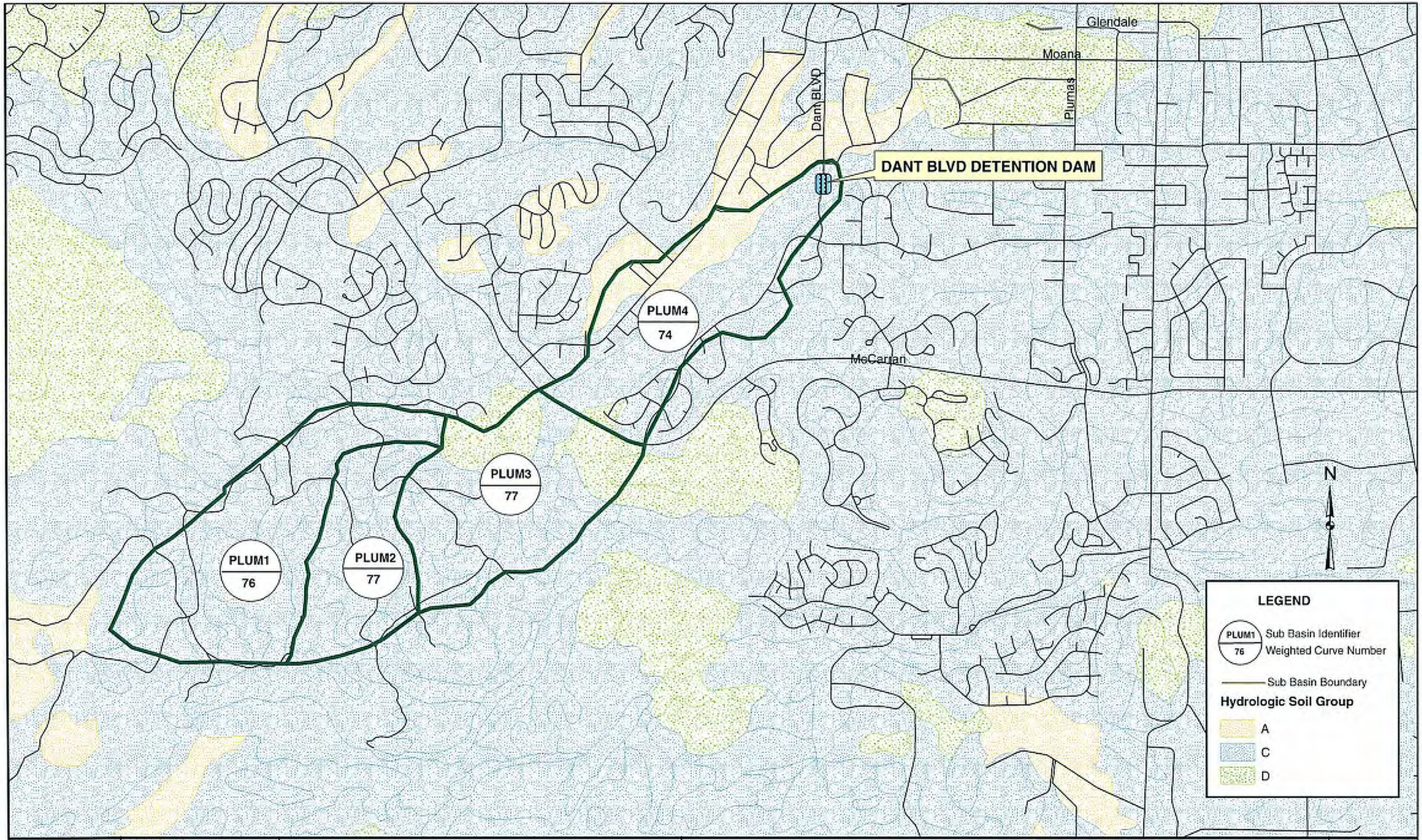
LAND USE MAP AND CURVE NUMBERS
UPPER AND LOWER PEAVINE DETENTION DAMS
CITY OF RENO EMERGENCY ACTION PLAN
RENO, WASHOE COUNTY, NEVADA

FIGURE.
8



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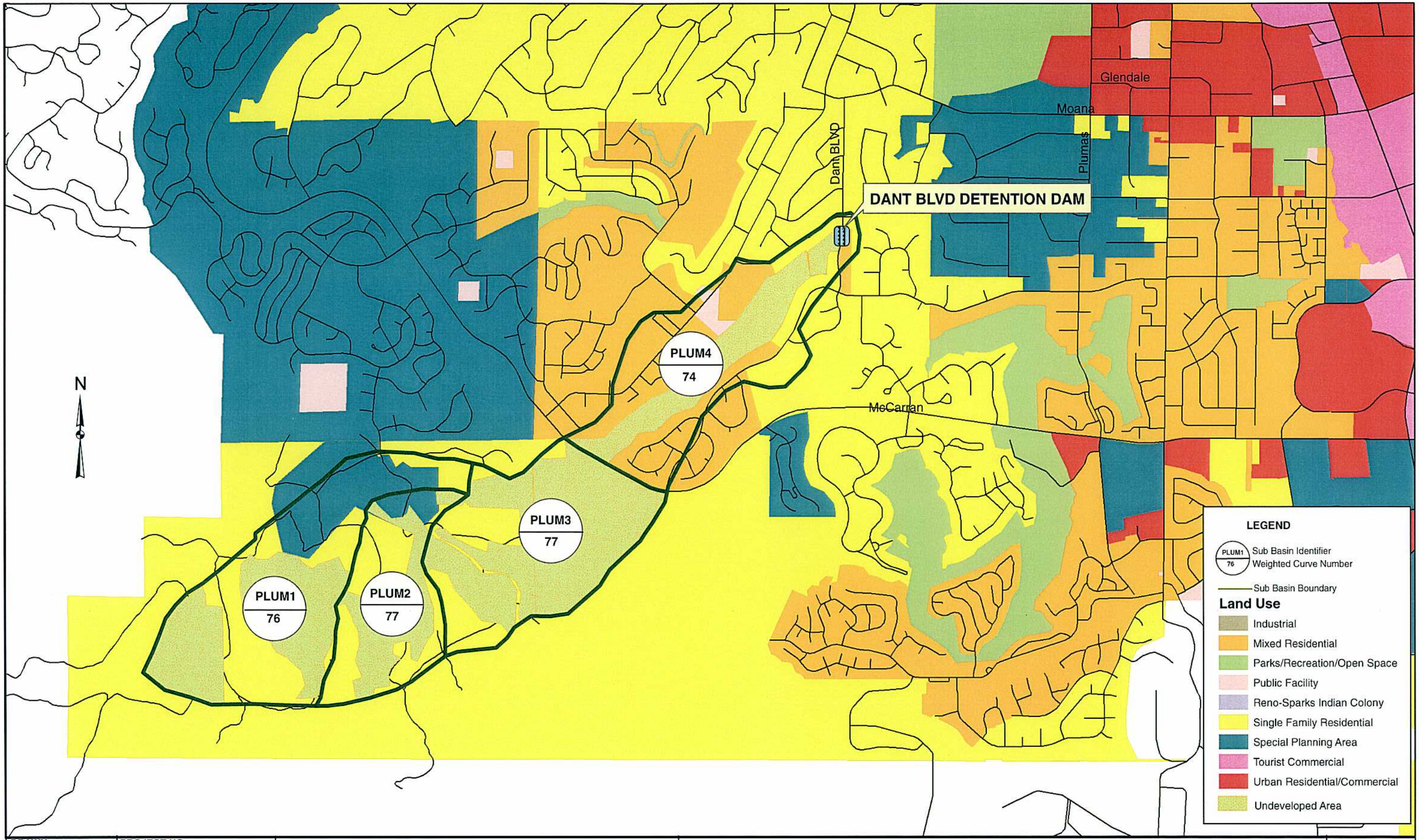
SOILS MAP AND CURVE NUMBERS
DANT BOULEVARD DETENTION DAM
CITY OF RENO EMERGENCY ACTION PLAN
RENO, WASHOE COUNTY, NEVADA

FIGURE.
9



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LAND USE MAP AND CURVE NUMBERS
DANT BOULEVARD DETENTION DAM
CITY OF RENO EMERGENCY ACTION PLAN
RENO, WASHOE COUNTY, NEVADA

FIGURE.
10

LEGEND

1.10 in

0.80 in

1.30 in

0.90 in

0.90 in

EAST WASH DIVERSION DAM

WEST WASH DETENTION DAM

80

MCCARRAN BLVD

EW1	0.396	
EW2	0.209	
EW3	0.370	
EW4	0.081	
EW5	0.028	
EW6	0.488	
EW7	0.238	
EW8	0.284	
WW1	0.183	
WW2	0.099	
WW3	0.493	
WW4	0.145	
WW5	0.222	
WW6	0.105	

LEGEND

EW1 / 0.396 — Sub Basin Identifier / Area (Sq.mile)

Sub Basin Boundary

ISOHYETALS

1 hour

6 hour

24 hour

DRAWN: SG	PROJECT NO: 4307050009
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CHECKED: CA	DATE: 12/02/05
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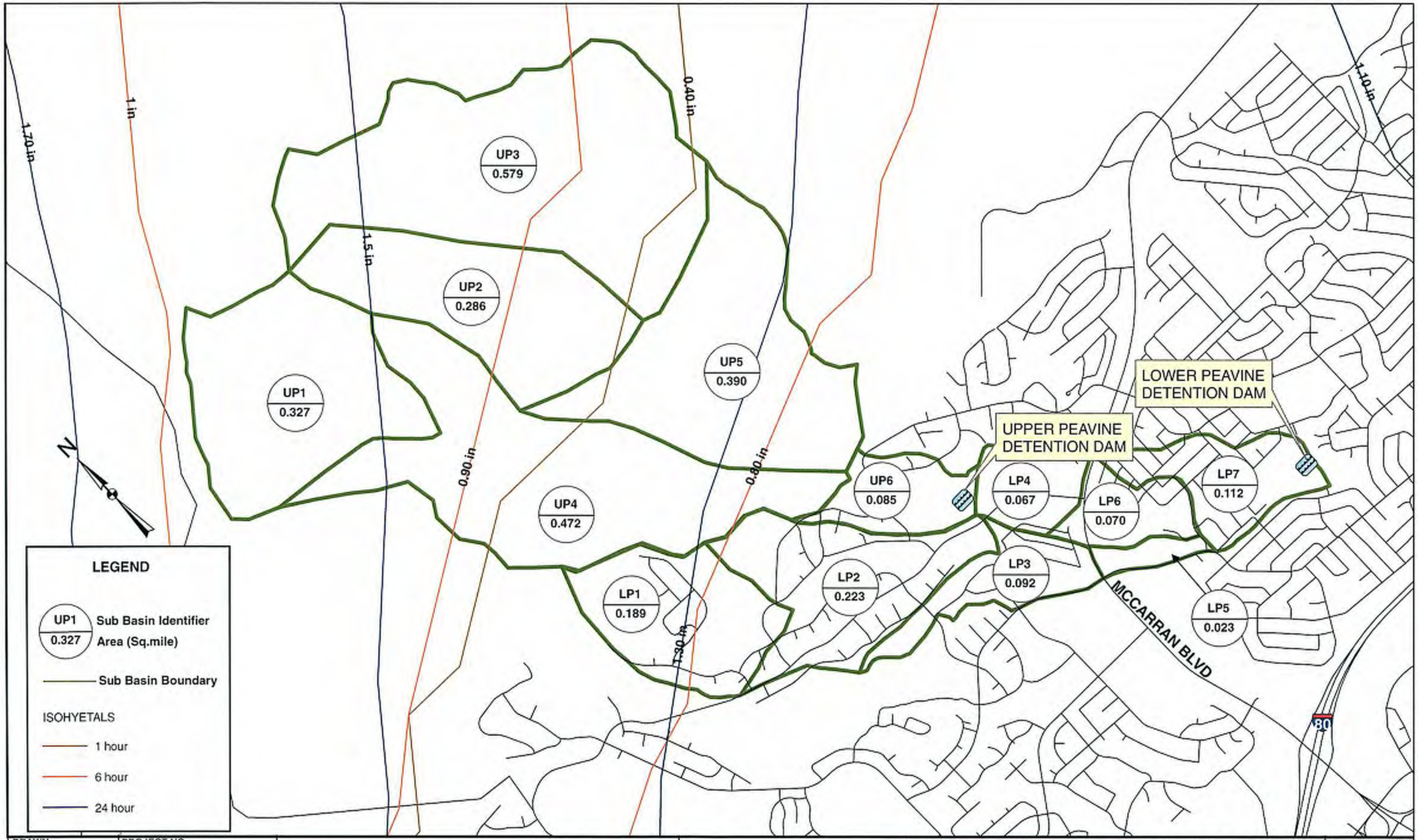
NOAA ATLAS 14 - 2 YEAR ISOHYETALS
EAST AND WEST WASH DETENTION DAMS
CITY OF RENO EMERGENCY ACTION PLAN
RENO, WASHOE COUNTY, NEVADA

FIGURE. 11



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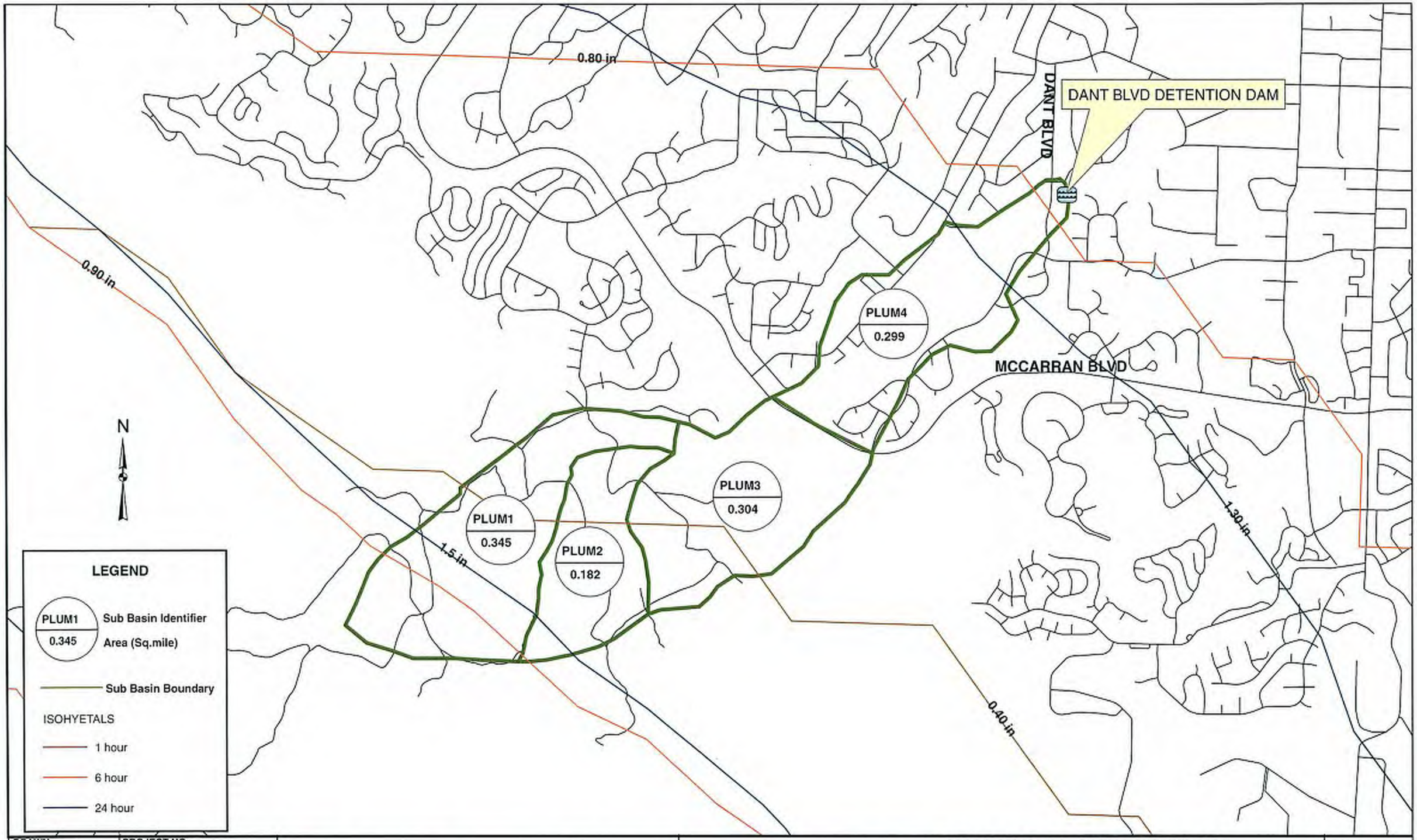
NOAA ATLAS 14 - 2 YEAR ISOHYETALS
UPPER AND LOWER PEAVINE DETENTION DAMS
CITY OF RENO EMERGENCY ACTION PLAN
RENO, WASHOE COUNTY, NEVADA

FIGURE.
12



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NOAA ATLAS 14 - 2 YEAR ISOHYETALS
DANT BLVD DETENTION DAM
CITY OF RENO EMERGENCY ACTION PLAN
RENO, WASHOE COUNTY, NEVADA

FIGURE.
13

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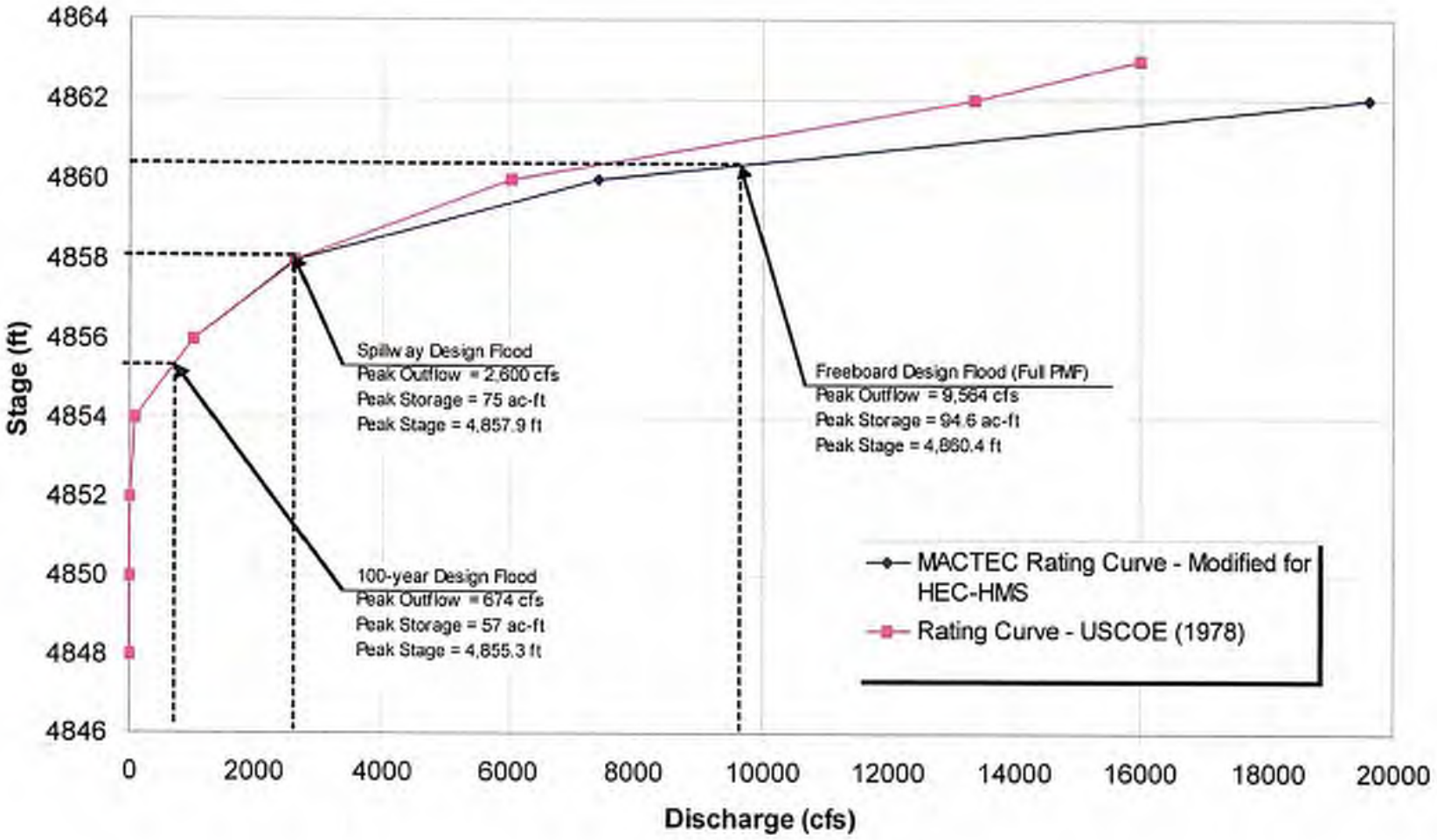

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DISCHARGE RATING CURVES
EAST WASH DIVERSION DAM
CITY OF RENO
RENO, WASHOE COUNTY, NEVADA

FIGURE
14

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
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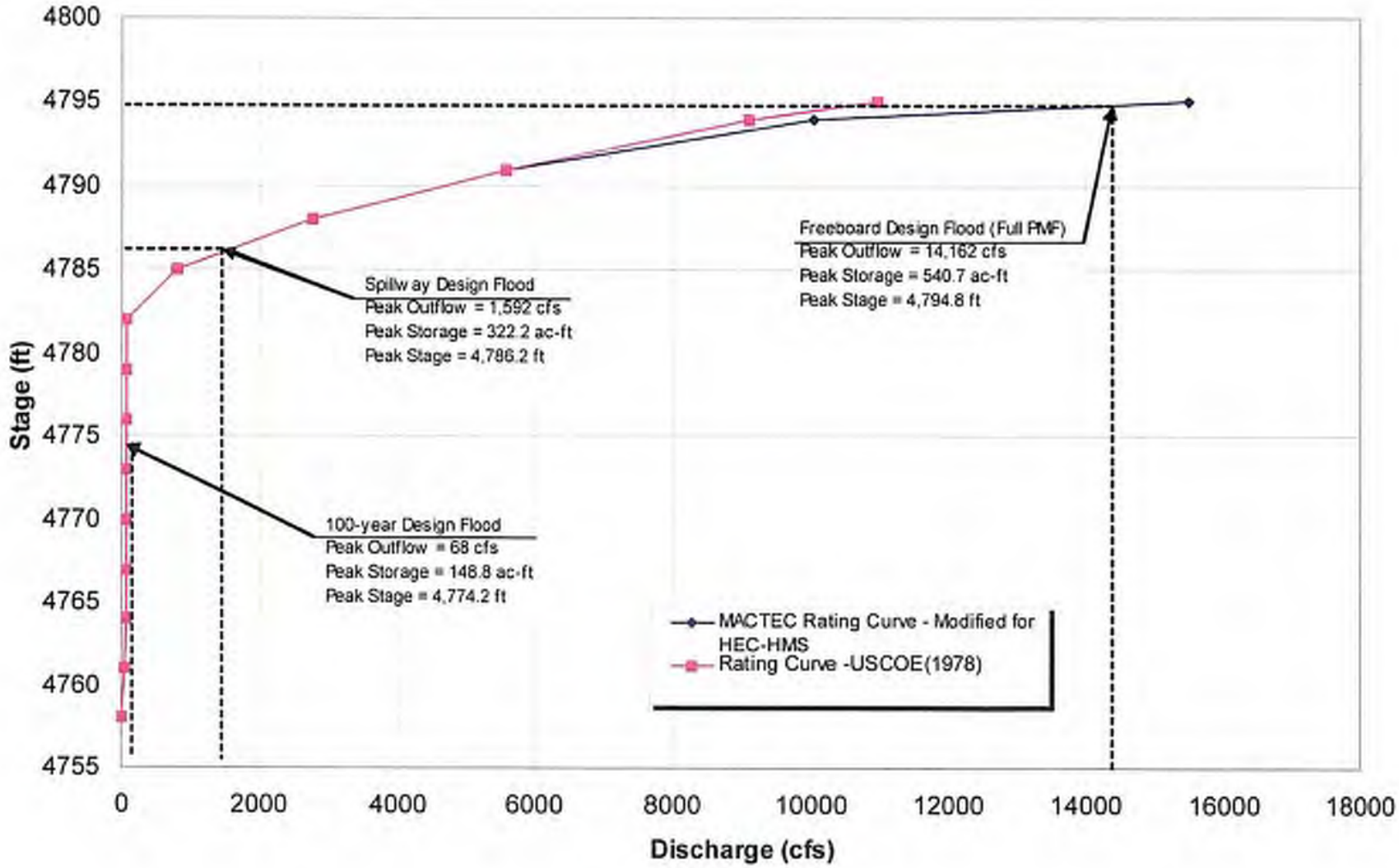

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DISCHARGE RATING CURVES
WEST WASH DETENTION DAM
CITY OF RENO
RENO, WASHOE COUNTY, NEVADA

FIGURE
15

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
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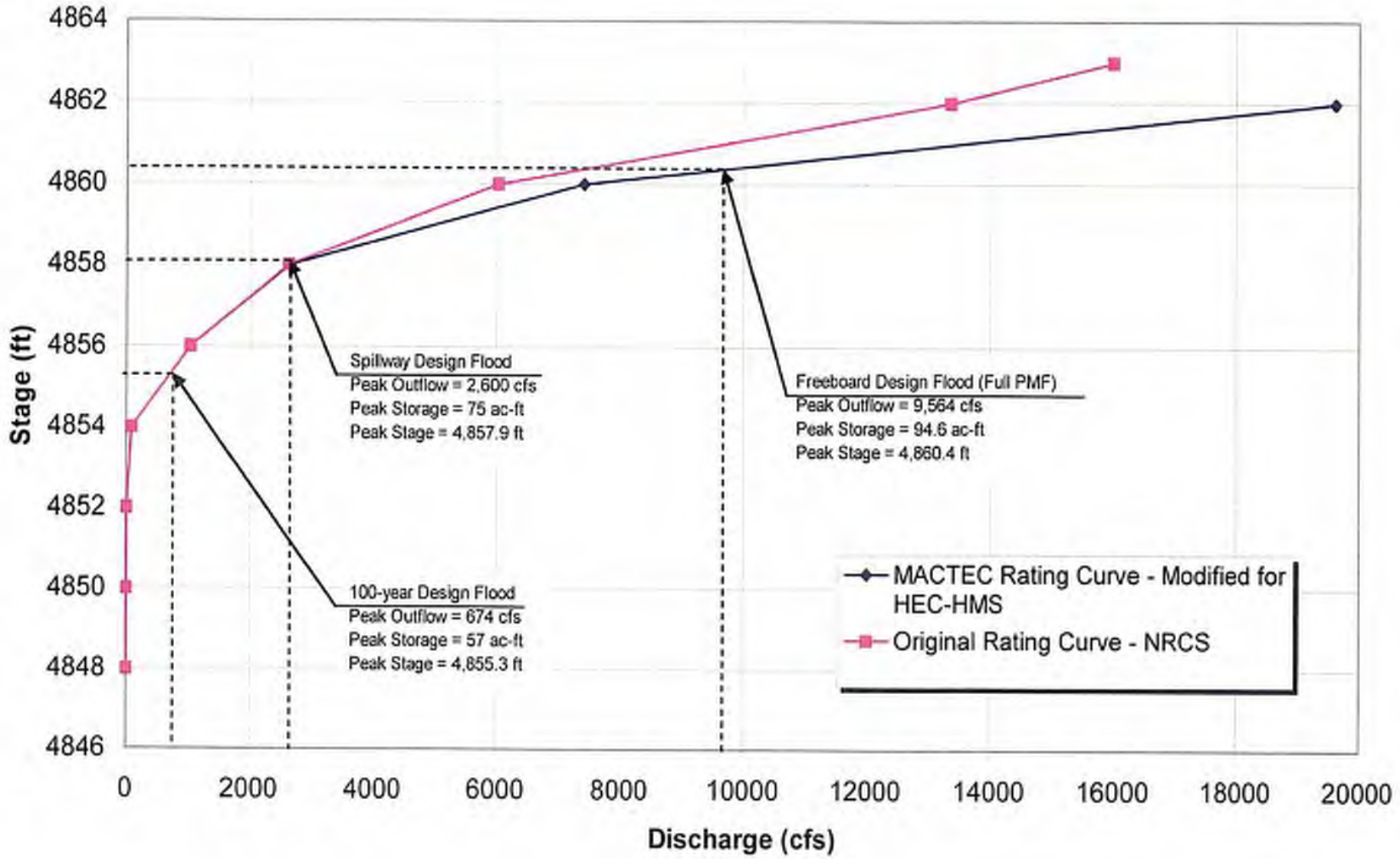

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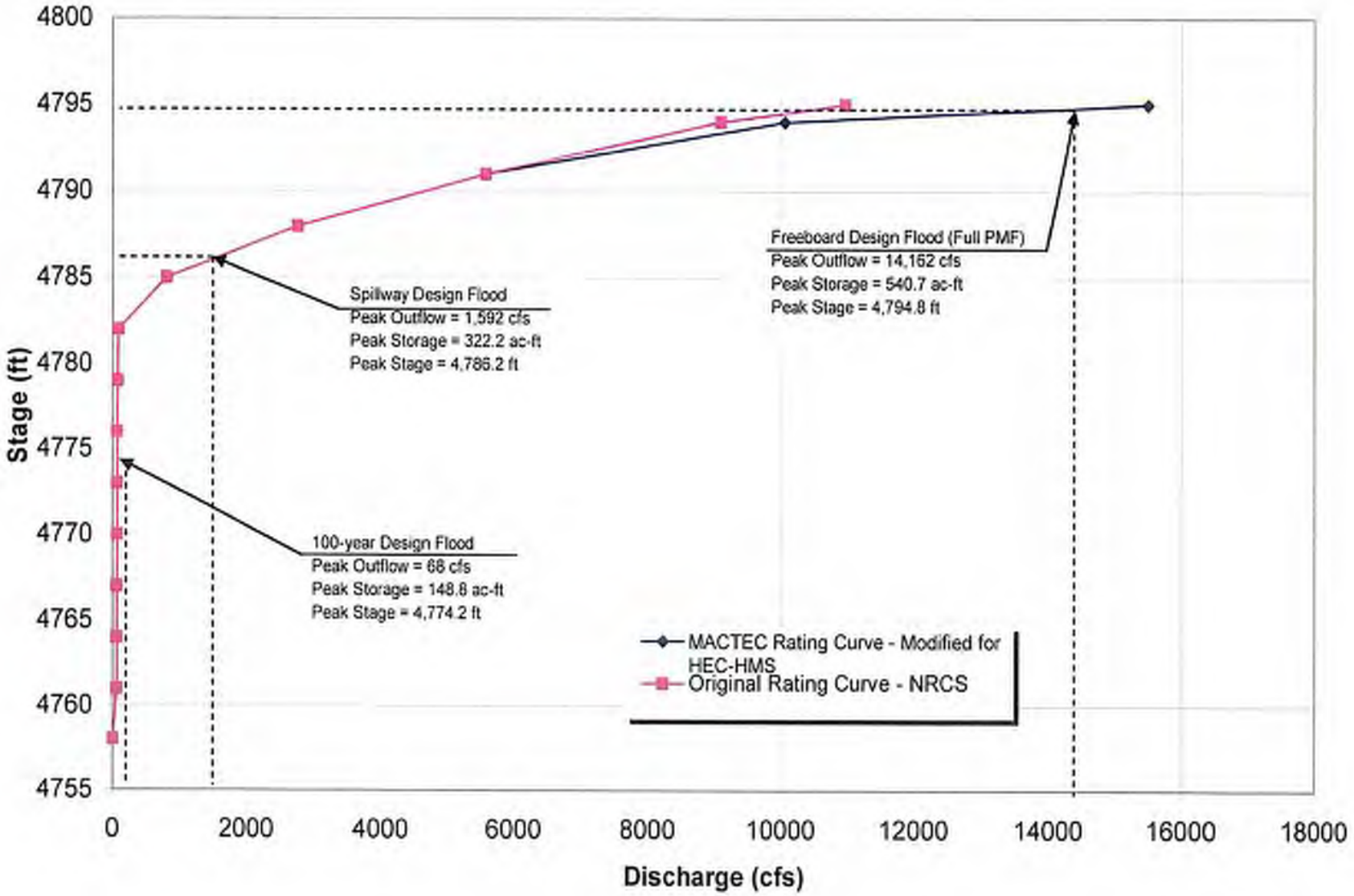
DISCHARGE RATING CURVE
UPPER PEAVINE DETENTION DAM
CITY OF RENO
RENO, WASHOE COUNTY, NEVADA

FIGURE
16

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
RWF	4307050009	CA	11-11-05		



MACTEC
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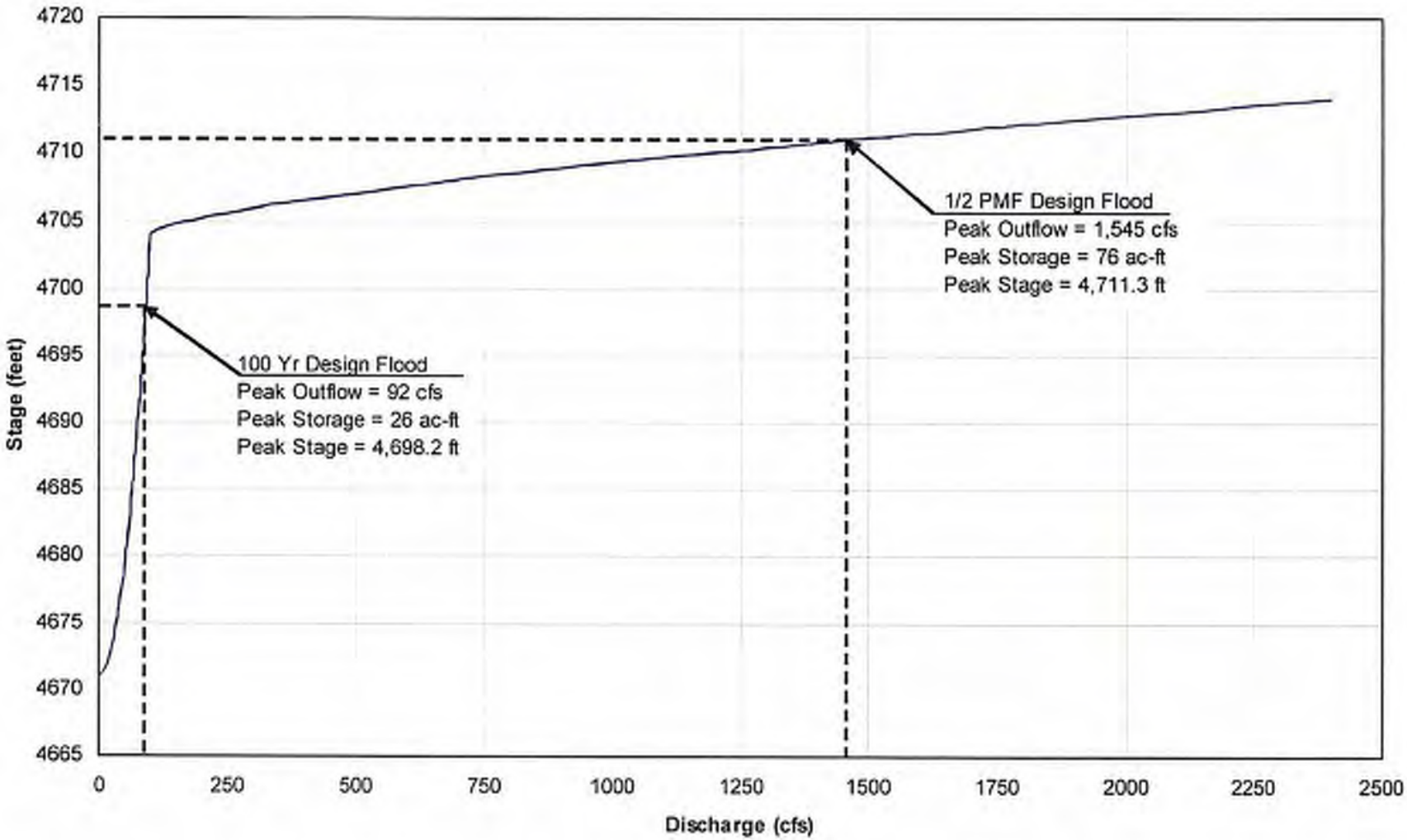
DISCHARGE RATING CURVE
LOWER PEAVINE DETENTION DAM
CITY OF RENO
RENO, WASHOE COUNTY, NEVADA

FIGURE
17

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
RWF	4307050009	CA	11-11-05		

P:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz 6\Design\Drawings\ACAD\Dam Fig 18.dwg
Feb 13, 2006 - 3:24pm



NOTES:

1. ADAPTED FROM KENNEDY/JENKS/CHILTON, 1988

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DISCHARGE RATING CURVES
DANT BOULVEVARD DETENTION DAM
CITY OF RENO
RENO, WASHOE COUNTY, NEVADA

FIGURE
18

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
RWF	4307050009	CA	11-11-05		

APPENDIX A

NRCS Curve Numbers

MACTEC

MACTEC Engineering and Consulting, Inc.
961 Matley Lane
Suite # 110
Reno, NV 89502

JOB NO. 43070500009 SHEET 1 OF 5
PHASE II TASK 5
JOB NAME Reno EAP - EAST WASH WATERSHED
BY SG DATE 07/07/05
CHECKED BY CA DATE 8/10/05

CURVE NUMBER CALCULATIONS

EAST WASH WATERSHED (1.81 Sq. miles) = 1157 ACRES

	SOIL	LAND USE	CN	AREA (Sq. mile
EW1:	SOIL 'C'	Shrub/Brush	70	0.344
EW2	C	Shrub/Brush	70	0.181
EW3	C	"	70	0.321
EW4	C	"	70	0.07
EW5	C	"	70	0.024
EW6	D	"	77	0.01
	'C'	"	70	0.414
		weighted CN	70	
EW7	'C'	"	70	0.207
Recalculate → EW8	D	Special Planning/Mixed Grass Shrub/brush	77	0.061
	'D'	Multi Family Residential	86	0.014 (Assume 1/2 Acres)
	'C'	Special Planning/Mixed Grass Shrub/brush	70	0.162
		Weighted CN	73	

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MACTEC Engineering and Consulting, Inc.
961 Matley Lane
Suite # 110
Reno, NV 89502

JOB NO. 43070050009 SHEET 2 OF ____
PHASE II TASK 5
JOB NAME Reno EAP - E&W Wash Dams
BY SG DATE 07/08/05
CHECKED BY ____ DATE 8/10/05

CURVE NUMBER CALCULATIONS

WEST WASH WATERSHED (798.6 Acres) = 1.25 Sq miles.

SUBSHED	SOIL	LANDUSE	CN	AREA (Sq. miles)
WW1	C	Shrub/Brush	66	0.183
WW2	D	Shrub/Brush	77	0.042
WW2	C	Shrub/Brush	70	0.057
				0.099
		Weighted CN	73	
WW3	D	Shrub/Brush	77	0.071
	D	Multi Family	86	0.017 (Assume 1/3 Acre)
	A	~~Shrub~~ Multi Family	57	0.038 (1/3)
	A	Shrub/Brush	35	0.027
	C	Parks/Recreation	75	0.005
Assumed Residential Area (1 Acre)	C	Urban Residential	79	0.008
	C	Public Facilities	79	0.005
	C	Multi Family	81	0.322
		Weighted CN	76	

MACTEC

MACTEC Engineering and Consulting, Inc.
961 Matley Lane
Suite # 110
Reno, NV 89502

JOB NO. 43020500009 SHEET 3 OF ____
PHASE II TASK 5
JOB NAME Reno EAP - E&W Dams
BY SG DATE 07/08/05
CHECKED BY CA DATE 8/10/05

CURVE NUMBER CALCULATIONS

WESTWASH WATERSHED (198.6 Acres) = 1.25 Sq miles

SUBSHED	SOIL	LANDUSE	CN	AREA (SQ. MILES)
WW4	A	Shrub/Bush	35	0.043
	D	Shrub/Bush	77	0.051
	D	Mixed Grass & Shrub	82	0.008
	C	Mixed Grass/Shrub	73	0.043
		Weighted CN	64	
WW5	D	Shrub/Bush	77	0.032
Assume Mix Grass & Shrub	D	Special Planning Area	82	0.022
(Assumed 1/3 Acre Residential)	D	Mixed Residential	86	0.002
	C	Shrub/Bush	77	0.029
Assume mix grass & shrub	C	Special Planning	73	0.029
		Weighted CN	79 ← OK	
WW6	D	Multi Family	86	0.006
Assumed Outcrops →	C	Public Facility	91	0.02
	C	Multi Family	81	0.079
		Weighted CN =	83	

RUNOFF CURVE NUMBERS

Land Use or Surface Characteristics	Aver. % Impervious Area	Runoff Curve Numbers Soil Comp A	Soil Comp B	Soil Comp C	Soil Comp D
Business/Commercial:					
Downtown Areas	85	89	92	94	95
Neighborhood Areas	70	80	87	91	93
Residential:					
(Average Lot Size)					
1/8 Acre or Less (Multi-Unit) (0.125)	65	77	85	90	92
1/4 Acre (0.25)	38	61	75	83	87
1/3 Acre (0.33)	30	57	72	81	86
1/2 Acre (0.50)	25	54	70	80	85
1 Acre (1.00)	20	51	68	79	84
Industrial:	72	81	88	91	93
Irrigated Areas:					
Lawns, Parks, Golf Courses/	5	41	62	75	81
Agriculture	0	39	61	74	80
Undeveloped Areas (Open Space):					
Herbaceous (grasses)	0	40	62	74	85
Mixed Grass and Shrub	0	39	61	73	82
Shrub/Brush	0	35	56	70	77
Forest (Evergreen)	0	30	54	66	75
Outcrops	70	77	86	91	94
Street/Roads:					
Paved	100	98	98	98	98
Gravel	20	76	85	89	91
Drives/Walks:	95	97	97	97	97
Roofs:	90	95	95	95	95

Notes:

1. Grass - Grassed Landscaping or Irrigated Vegetation

Weighted Curve Number Calculations

Subshed Area LP1 121.42 Acres

Land Use	Acres	HSG A [2]	Acres	HSG B [2]	Acres	HSG C [2]	Acres	HSG D [2]	Weighted	% Impervious [3]	Weighted [4]
Business/Commercial											
Downtown Areas		89		92		94		95	0	85	0
Neighborhhod Areas		80		87		91		93	0	70	0
Residential											
1/8 Acres or Less		77		85	0	90		92	0	65	0
1/4 Acre		61		75		83		87	0	38	0
1/3 Acre		57		72	11.69	81		86	946.89	30	350.7
1/2 Acre		54		70	10.37	80		85	829.6	25	259.25
1 Acre		51		68	1.76	79		84	139.04	20	35.2
Industrial		81		88		91		93		72	0
Irrigated Areas									0		
Lawns, Parks, Golf Courses		41		62		75		81	0	5	0
Agricultural		39		61		74		80	0	0	0
Undeveloped Areas (Open Space)											
Herbaceous		40		62		74		85	0	0	0
Mixed Grass and Shrub		39		61		73		82	0	0	0
Shrub/Brush		35		56	65.85	70		77	4609.5	0	0
Forest (Evergreen)		30		54	12.82	66		75	846.12	0	0
Outcrops		77		86		91		94	0	70	0
Streets/Roads											
Paved		98		98	7.654	98		98	750.092	100	765.4
Gravel		76		85		89		91	0	20	0
Drives/Walks		97		97		97		97		95	0
									0		
Roofs		95		95		95		95		90	0
									0		
Weighted CN					110.1				74		13

NOTES:

1. This table is adopted from Washoe County Hydrologic Criteria and Design Manual (December, 1996).
2. Information on Hydrologic Soil groups is obtained from NRCS Soil Survey available online in shapefile format.
   See Figure 7 - Upper and Lower Peavine - Soils Map and Curve Numbers
3. See Figure 8 - Upper and Lower Peavine - Land Use Map and Curve Numbers
4. Weighted Curve Number Calculation from Washoe County Hydrologic Criteria and Design Mannual (December, 1996):

$$WeightedCN = \frac{CN_A \times A_1 + CN_B \times A_2 + CN_C \times A_3 + CN_D \times A_4}{A_1 + A_2 + A_3 + A_4}$$

Weighted Curve Number Calculations

Subshed Area **LP2** **142.807 Acres**

Land Use	Acres	HSG A [2]	Acres	HSG B [2]	Acres	HSG C [2]	Acres	HSG D [2]	Weighted	% Impervious [3]	Weighted [4]
Business/Commercial											
Downtown Areas		89		92		94		95	0	85	0
Neighborhhod Areas		80		87		91		93	0	70	0
Residential											
1/8 Acres or Less	0	77		85	0.068	90		92	6.12	65	4.42
1/4 Acre	4.25	61		75	36.6	83		87	3297.05	38	1552.3
1/3 Acre	4	57		72	11.5	81		86	1159.5	30	465
1/2 Acre	3.08	54		70	8.04	80		85	809.52	25	278
1 Acre	1.17	51		68	3.12	79		84	306.15	20	85.8
Industrial		81		88		91		93	0	72	0
Irrigated Areas											
Lawns, Parks, Golf Courses		41		62		75		81	0	5	0
Agricultural		39		61		74		80	0	0	0
									0		
Undeveloped Areas (Open Space)											
Herbaceous		40		62		74		85	0	0	0
Mixed Grass and Shrub		39		61		73		82	0	0	0
Shrub/Brush	0	35		56	33.51	70		77	2345.7	0	0
Forest (Evergreen)		30		54	14.21	66		75	937.662	0	0
Outcrops		77		86		91		94	0	70	0
Streets/Roads											
Paved	23.213	98		98		98		98	2274.874	100	2321.3
Gravel		76		85		89		91	0	20	0
Drives/Walks		97		97		97		97	0	95	0
Roofs		95		95		95		95	0	90	0
Weighted CN					142.8				78		33

NOTES:

1. This table is adopted from Washoe County Hydrologic Criteria and Design Manual (December, 1996).
2. Information on Hydrologic Soil groups is obtained from NRCS Soil Survey available online in shapefile format.
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3. See Figure 8 - Upper and Lower Peavine - Land Use Map and Curve Numbers
4. Weighted Curve Number Calculation from Washoe County Hydrologic Criteria and Design Mannual (December, 1996):

$$WeightedCN = \frac{CN_A \times A_1 + CN_B \times A_2 + CN_C \times A_3 + CN_D \times A_4}{A_1 + A_2 + A_3 + A_4}$$

Weighted Curve Number Calculations

Subshed Area LP3 59.083 Acres

Land Use	Acres	HSG A [2]	Acres	HSG B [2]	Acres	HSG C [2]	Acres	HSG D [2]	Weighted	% Impervious [3]	Weighted [4]
Business/Commercial											
Downtown Areas		89		92		94		95	0	85	0
Neighborhhod Areas		80		87		91		93	0	70	0
Residential											
1/8 Acres or Less	0	77		85	5.862	90		92	527.58	65	381.03
1/4 Acre	6.49	61		75	9.72	83		87	1202.65	38	615.98
1/3 Acre	1.15	57		72	2.734	81		86	287.004	30	116.52
1/2 Acre	0.704	54		70	4.45	80		85	394.016	25	128.85
1 Acre	0	51		68	0.503	79		84	39.737	20	10.06
Industrial		81		88		91		93	0	72	0
Irrigated Areas											
Lawns, Parks, Golf Courses		41		62		75		81	0	5	0
Agricultural		39		61		74		80	0	0	0
Undeveloped Areas (Open Space)											
Herbaceous		40		62		74		85	0	0	0
Mixed Grass and Shrub		39		61		73		82	0	0	0
Shrub/Brush	0	35		56	13.3	70		77	931	0	0
Forest (Evergreen)		30		54	5	66		75	330	0	0
Outcrops		77		86		91		94	0	70	0
Streets/Roads											
Paved		98		98	9.883	98		98	968.534	100	988.3
Gravel		76		85		89		91	0	20	0
Drives/Walks		97		97		97		97	0	95	0
Roofs		95		95		95		95	0	90	0
Weighted CN					59.8				**78**		**37**

NOTES:

1. This table is adopted from Washoe County Hydrologic Criteria and Design Manual (December, 1996).
2. Information on Hydrologic Soil groups is obtained from NRCS Soil Survey available online in shapefile format.
   See Figure 7 - Upper and Lower Peavine - Soils Map and Curve Numbers
3. See Figure 8 - Upper and Lower Peavine - Land Use Map and Curve Numbers
4. Weighted Curve Number Calculation from Washoe County Hydrologic Criteria and Design Mannual (December, 1996):

$$WeightedCN = \frac{CN_A \times A_1 + CN_B \times A_2 + CN_C \times A_3 + CN_D \times A_4}{A_1 + A_2 + A_3 + A_4}$$

Weighted Curve Number Calculations

Subshed Area **LP4** **43.029 Acres**

Land Use	Acres	HSG A [2]	Acres	HSG B [2]	Acres	HSG C [2]	Acres	HSG D [2]	Weighted	% Impervious [3]	Weighted [4]
Business/Commercial											
Downtown Areas		89		92		94		95	0	85	0.00
Neighborhhod Areas		80		87		91		93	0	70	0.00
Residential											
1/8 Acres or Less		77		85	1.256	90		92	113.04	65	81.64
1/4 Acre		61		75	2.25	83		87	186.75	38	85.50
1/3 Acre		57		72	0.302	81		86	24.462	30	9.06
1/2 Acre		54		70	1.07	80		85	85.6	25	26.75
1 Acre		51		68	0.723	79		84	57.117	20	14.46
Industrial		81		88		91		93	0	72	0.00
Irrigated Areas											
Lawns, Parks, Golf Courses		41		62		75		81	0	5	0.00
Agricultural		39		61		74		80	0	0	0.00
Undeveloped Areas (Open Space)											
Herbaceous		40		62		74		85	0	0	0.00
Mixed Grass and Shrub		39		61		73		82	0	0	0.00
Shrub/Brush		35		56	25	70		77	1750	0	0.00
Forest (Evergreen)		30		54	7.5	66		75	495	0	0.00
Outcrops		77		86		91		94	0	70	0.00
Streets/Roads											
Paved		98		98	5	98		98	490	100	500.00
Gravel		76		85		89		91	0	20	0.00
Drives/Walks		97		97		97		97	0	95	0.00
Roofs		95		95		95		95	0	90	0.00
Weighted CN					43.1				74		16.64

NOTES:

1. This table is adopted from Washoe County Hydrologic Criteria and Design Manual (December, 1996).
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4. Weighted Curve Number Calculation from Washoe County Hydrologic Criteria and Design Mannual (December, 1996):

$$WeightedCN = \frac{CN_A \times A_1 + CN_B \times A_2 + CN_C \times A_3 + CN_D \times A_4}{A_1 + A_2 + A_3 + A_4}$$

Weighted Curve Number Calculations

Subshed Area LP5 15.064 Acres

Land Use	Acres	HSG A [2]	Acres	HSG B [2]	Acres	HSG C [2]	Acres	HSG D [2]	Weighted	% Impervious [3]	Weighted [4]
Business/Commercial											
Downtown Areas		89		92		94		95	0	85	0
Neighborhhod Areas		80		87		91		93	0	70	0
Residential											
1/8 Acres or Less		77		85	0.272	90		92	24.48	65	17.68
1/4 Acre		61		75	1.69	83		87	140.27	38	64.22
1/3 Acre		57		72	0.276	81		86	22.356	30	8.28
1/2 Acre		54		70	0.346	80		85	27.68	25	8.65
1 Acre		51		68	0.76	79		84	60.04	20	15.2
Industrial		81		88		91		93	0	72	0
Irrigated Areas											
Lawns, Parks, Golf Courses		41		62		75		81	0	5	0
Agricultural		39		61		74		80	0	0	0
Undeveloped Areas (Open Space)											
Herbaceous		40		62		74		85	0	0	0
Mixed Grass and Shrub		39		61		73		82	0	0	0
Shrub/Brush		35		56		70		77	0	0	0
Forest (Evergreen)		30		54	9.85	66		75	650.1	0	0
Outcrops		77		86		91		94	0	70	0
Streets/Roads											
Paved		98		98	2.486	98		98	243.628	100	248.6
Gravel		76		85		89		91	0	20	0
Drives/Walks		97		97		97		97	0	95	0
Roofs		95		95		95		95	0	90	0
Weighted CN					15.68				75		23.13

NOTES:

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3. See Figure 8 - Upper and Lower Peavine - Land Use Map and Curve Numbers
4. Weighted Curve Number Calculation from Washoe County Hydrologic Criteria and Design Mannual (December, 1996):

$$WeightedCN = \frac{CN_A \times A_1 + CN_B \times A_2 + CN_C \times A_3 + CN_D \times A_4}{A_1 + A_2 + A_3 + A_4}$$

Weighted Curve Number Calculations

Subshed Area LP6 44.612 Acres

Land Use	Acres	HSG A [2]	Acres	HSG B [2]	Acres	HSG C [2]	Acres	HSG D [2]	Weighted	% Impervious [3]	Weighted [4]
Business/Commercial											
Downtown Areas		89		92		94		95		85	0
Neighborhhod Areas		80		87		91		93		70	0
Residential											
1/8 Acres or Less		77		85	1.8	90		92	162	65	117
1/4 Acre		61		75	8.5	83		87	705.5	38	323
1/3 Acre		57		72	1.37	81		86	110.97	30	41.1
1/2 Acre		54		70	0.737	80		85	58.96	25	18.425
1 Acre		51		68	1.962	79		84	154.998	20	39.24
Industrial		81		88		91		93	0	72	0
Irrigated Areas											
Lawns, Parks, Golf Courses		41		62		75		81	0	5	0
Agricultural		39		61		74		80	0	0	0
Undeveloped Areas (Open Space)											
Herbaceous		40		62		74		85	0	0	0
Mixed Grass and Shrub		39		61		73		82	0	0	0
Shrub/Brush		35		56	18.78	70		77	1314.6	0	0
Forest (Evergreen)		30		54		66		75	0	0	0
Outcrops		77		86		91		94	0	70	0
Streets/Roads											
Paved		98		98	11.62	98		98	1139.152	100	1162.4
Gravel		76		85		89		91	0	20	0
Drives/Walks		97		97		97		97	0	95	0
Roofs		95		95		95		95	0	90	0
Weighted CN					44.77				81		38.00

NOTES:

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3. See Figure 8 - Upper and Lower Peavine - Land Use Map and Curve Numbers
4. Weighted Curve Number Calculation from Washoe County Hydrologic Criteria and Design Mannual (December, 1996):

$$WeightedCN = \frac{CN_A \times A_1 + CN_B \times A_2 + CN_C \times A_3 + CN_D \times A_4}{A_1 + A_2 + A_3 + A_4}$$

Weighted Curve Number Calculations

Subshed Area LP7 72.024 Acres

Land Use	Acres	HSG A [2]	Acres	HSG B [2]	Acres	HSG C [2]	Acres	HSG D [2]	Weighted	% Impervious [3]	Weighted [4]
Business/Commercial											
Downtown Areas		89		92		94		95	0	85	0
Neighborhhod Areas		80		87		91		93	0	70	0
Residential											
1/8 Acres or Less		77		85	7.81	90		92	702.9	65	507.65
1/4 Acre		61		75	23.9	83		87	1983.7	38	908.2
1/3 Acre		57		72	0.254	81		86	20.574	30	7.62
1/2 Acre		54		70	0	80		85	0	25	0
1 Acre		51		68	0	79		84	0	20	0
Industrial		81		88		91		93	0	72	0
Irrigated Areas											
Lawns, Parks, Golf Courses		41		62		75		81	0	5	0
Agricultural		39		61		74		80	0	0	0
											0
Undeveloped Areas (Open Space)											
Herbaceous		40		62		74		85	0	0	0
Mixed Grass and Shrub		39		61	17.55	73		82	1281.15	0	0
Shrub/Brush		35		56	13.21	70		77	924.7	0	0
Forest (Evergreen)		30		54		66		75	0	0	0
Outcrops		77		86		91		94	0	70	0
Streets/Roads											
Paved		98		98	9.304	98		98	911.792	100	930.4
Gravel		76		85		89		91	0	20	0
Drives/Walks		97		97		97		97	0	95	0
Roofs		95		95		95		95	0	90	0
Weighted CN					72.028				81		32.67993003

NOTES:

1. This table is adopted from Washoe County Hydrologic Criteria and Design Manual (December, 1996).
2. Information on Hydrologic Soil groups is obtained from NRCS Soil Survey available online in shapefile format.
   See Figure 7 - Upper and Lower Peavine - Soils Map and Curve Numbers
3. See Figure 8 - Upper and Lower Peavine - Land Use Map and Curve Numbers
4. Weighted Curve Number Calculation from Washoe County Hydrologic Criteria and Design Mannual (December, 1996):

$$WeightedCN = \frac{CN_A \times A_1 + CN_B \times A_2 + CN_C \times A_3 + CN_D \times A_4}{A_1 + A_2 + A_3 + A_4}$$

Weighted Curve Number Calculations

Subshed Area UP1 209.388 Acres

Land Use	Acres	HSG A [2]	Acres	HSG B [2]	Acres	HSG C [2]	Acres	HSG D [2]	Weighted	% Impervious [3]	Weighted [4]
Business/Commercial											
Downtown Areas		89		92		94		95	0	85	0
Neighborhhod Areas		80		87		91		93	0	70	0
Residential											
1/8 Acres or Less		77		85		90		92	0	65	0
1/4 Acre		61		75		83		87	0	38	0
1/3 Acre		57		72		81		86	0	30	0
1/2 Acre		54		70		80		85	0	25	0
1 Acre		51		68		79		84	0	20	0
Industrial		81		88		91		93	0	72	0
Irrigated Areas											
Lawns, Parks, Golf Courses		41		62		75		81	0	5	0
Agricultural		39		61		74		80	0	0	0
									0		
Undeveloped Areas (Open Space)											
Herbaceous		40		62		74		85	0	0	0
Mixed Grass and Shrub		39		61		73		82	0	0	0
Shrub/Brush		35		56		70		77	0	0	0
Forest (Evergreen)	40.929	30		54	168.459	66		75	12346.164	0	0
Outcrops		77		86		91		94	0	70	0
Streets/Roads											
Paved		98		98		98		98	0	100	0
Gravel		76		85		89		91	0	20	0
Drives/Walks		97		97		97		97	0	95	0
Roofs		95		95		95		95	0	90	0
Weighted CN					209.388				59		0

NOTES:

1. This table is adopted from Washoe County Hydrologic Criteria and Design Manual (December, 1996).
2. Information on Hydrologic Soil groups is obtained from NRCS Soil Survey available online in shapefile format.
   See Figure 7 - Upper and Lower Peavine - Soils Map and Curve Numbers
3. See Figure 8 - Upper and Lower Peavine - Land Use Map and Curve Numbers
4. Weighted Curve Number Calculation from Washoe County Hydrologic Criteria and Design Mannual (December, 1996):

$$WeightedCN = \frac{CN_A \times A_1 + CN_B \times A_2 + CN_C \times A_3 + CN_D \times A_4}{A_1 + A_2 + A_3 + A_4}$$

Weighted Curve Number Calculations

Subshed Area UP2 183.336 Acres

Land Use	Acres	HSG A [2]	Acres	HSG B [2]	Acres	HSG C [2]	Acres	HSG D [2]	Weighted	% Impervious [3]	Weighted [4]
Business/Commercial											
Downtown Areas		89		92		94		95	0	85	0
Neighborhhod Areas		80		87		91		93	0	70	0
Residential											
1/8 Acres or Less		77		85		90		92	0	65	0
1/4 Acre		61		75		83		87	0	38	0
1/3 Acre		57		72		81		86	0	30	0
1/2 Acre		54		70		80		85	0	25	0
1 Acre		51		68		79		84	0	20	0
Industrial		81		88		91		93	0	72	0
Irrigated Areas											
Lawns, Parks, Golf Courses		41		62		75		81	0	5	0
Agricultural		39		61		74		80	0	0	0
									0		
Undeveloped Areas (Open Space)											
Herbaceous		40		62		74		85	0	0	0
Mixed Grass and Shrub		39		61		73		82	0	0	0
Shrub/Brush		35		56		70		77	0	0	0
Forest (Evergreen)		30		54	183.336	66		75	12100.176	0	0
Outcrops		77		86		91		94	0	70	0
Streets/Roads											
Paved		98		98		98		98	0	100	0
Gravel		76		85		89		91	0	20	0
Drives/Walks		97		97		97		97	0	95	0
Roofs		95		95		95		95	0	90	0
Weighted CN					183.336				66		0

NOTES:

1. This table is adopted from Washoe County Hydrologic Criteria and Design Manual (December, 1996).
2. Information on Hydrologic Soil groups is obtained from NRCS Soil Survey available online in shapefile format.
   See Figure 7 - Upper and Lower Peavine - Soils Map and Curve Numbers
3. See Figure 8 - Upper and Lower Peavine - Land Use Map and Curve Numbers
4. Weighted Curve Number Calculation from Washoe County Hydrologic Criteria and Design Mannual (December, 1996):

$$WeightedCN = \frac{CN_A \times A_1 + CN_B \times A_2 + CN_C \times A_3 + CN_D \times A_4}{A_1 + A_2 + A_3 + A_4}$$

Weighted Curve Number Calculations

Subshed Area **UP3** **371.05 Acres**

Land Use	Acres	HSG A [2]	Acres	HSG B [2]	Acres	HSG C [2]	Acres	HSG D [2]	Weighted	% Impervious [3]	Weighted [4]
Business/Commercial											
Downtown Areas		89		92		94		95	0	85	0
Neighborhhod Areas		80		87		91		93	0	70	0
Residential											
1/8 Acres or Less		77		85		90		92	0	65	0
1/4 Acre		61		75		83		87	0	38	0
1/3 Acre		57		72		81		86	0	30	0
1/2 Acre		54		70		80		85	0	25	0
1 Acre		51		68		79		84	0	20	0
Industrial		81		88		91		93	0	72	0
Irrigated Areas											
Lawns, Parks, Golf Courses		41		62		75		81	0	5	0
Agricultural		39		61		74		80	0	0	0
									0		
Undeveloped Areas (Open Space)											
Herbaceous		40		62		74		85	0	0	0
Mixed Grass and Shrub		39		61		73		82	0	0	0
Shrub/Brush		35		56		70		77	0	0	0
Forest (Evergreen)		30		54	361.22	66	9.83	75	24577.77	0	0
Outcrops		77		86		91		94	0	70	0
Streets/Roads											
Paved		98		98		98		98	0	100	0
Gravel		76		85		89		91	0	20	0
Drives/Walks		97		97		97		97	0	95	0
Roofs		95		95		95		95	0	90	0
Weighted CN					371.05				66		0

NOTES:

1. This table is adopted from Washoe County Hydrologic Criteria and Design Manual (December, 1996).
2. Information on Hydrologic Soil groups is obtained from NRCS Soil Survey available online in shapefile format.
   See Figure 7 - Upper and Lower Peavine - Soils Map and Curve Numbers
3. See Figure 8 - Upper and Lower Peavine - Land Use Map and Curve Numbers
4. Weighted Curve Number Calculation from Washoe County Hydrologic Criteria and Design Mannual (December, 1996):

$$WeightedCN = \frac{CN_A \times A_1 + CN_B \times A_2 + CN_C \times A_3 + CN_D \times A_4}{A_1 + A_2 + A_3 + A_4}$$

Weighted Curve Number Calculations

Subshed Area **UP4** **302.411 Acres**

Land Use	Acres	HSG A [2]	Acres	HSG B [2]	Acres	HSG C [2]	Acres	HSG D [2]	Weighted	% Impervious [3]	Weighted [4]
Business/Commercial											
Downtown Areas		89		92		94		95	0	85	0
Neighborhhod Areas		80		87		91		93	0	70	0
Residential											
1/8 Acres or Less		77		85		90		92	0	65	0
1/4 Acre		61		75		83		87	0	38	0
1/3 Acre		57		72		81		86	0	30	0
1/2 Acre		54		70		80		85	0	25	0
1 Acre		51		68		79		84	0	20	0
Industrial		81		88		91		93	0	72	0
Irrigated Areas											
Lawns, Parks, Golf Courses		41		62		75		81	0	5	0
Agricultural		39		61		74		80	0	0	0
									0		
Undeveloped Areas (Open Space)											
Herbaceous		40		62		74		85	0	0	0
Mixed Grass and Shrub		39		61		73		82	0	0	0
Shrub/Brush		35		56		70		77	0	0	0
Forest (Evergreen)		30		54	292.463	66	9.948	75	20048.658	0	0
Outcrops		77		86		91		94	0	70	0
Streets/Roads											
Paved		98		98		98		98	0	100	0
Gravel		76		85		89		91	0	20	0
Drives/Walks		97		97		97		97	0	95	0
Roofs		95		95		95		95	0	90	0
Weighted CN					302.411				66		0

NOTES:

1. This table is adopted from Washoe County Hydrologic Criteria and Design Manual (December, 1996).
2. Information on Hydrologic Soil groups is obtained from NRCS Soil Survey available online in shapefile format.
   See Figure 7 - Upper and Lower Peavine - Soils Map and Curve Numbers
3. See Figure 8 - Upper and Lower Peavine - Land Use Map and Curve Numbers
4. Weighted Curve Number Calculation from Washoe County Hydrologic Criteria and Design Mannual (December, 1996):

$$WeightedCN = \frac{CN_A \times A_1 + CN_B \times A_2 + CN_C \times A_3 + CN_D \times A_4}{A_1 + A_2 + A_3 + A_4}$$

Weighted Curve Number Calculations

Subshed Area UP5 249.925 Acres

Land Use	Acres	HSG A [2]	Acres	HSG B [2]	Acres	HSG C [2]	Acres	HSG D [2]	Weighted	% Impervious [3]	Weighted [4]
Business/Commercial											
Downtown Areas		89		92		94		95	0	85	0
Neighborhhod Areas		80		87		91		93	0	70	0
Residential											
1/8 Acres or Less		77		85		90		92	0	65	0
1/4 Acre		61		75		83		87	0	38	0
1/3 Acre		57		72		81		86	0	30	0
1/2 Acre		54		70		80		85	0	25	0
1 Acre		51		68		79		84	0	20	0
Industrial		81		88		91		93	0	72	0
Irrigated Areas											
Lawns, Parks, Golf Courses		41		62		75		81	0	5	0
Agricultural		39		61		74		80	0	0	0
									0		
Undeveloped Areas (Open Space)											
Herbaceous		40		62		74		85	0	0	0
Mixed Grass and Shrub		39		61		73		82	0	0	0
Shrub/Brush		35		56		70		77	0	0	0
Forest (Evergreen)	3.983	30		54	185.113	66	60.829	75	16899.123	0	0
Outcrops		77		86		91		94	0	70	0
Streets/Roads											
Paved		98		98		98		98	0	100	0
Gravel		76		85		89		91	0	20	0
Drives/Walks		97		97		97		97	0	95	0
Roofs		95		95		95		95	0	90	0
Weighted CN					249.925				68		0

NOTES:

1. This table is adopted from Washoe County Hydrologic Criteria and Design Manual (December, 1996).
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   See Figure 7 - Upper and Lower Peavine - Soils Map and Curve Numbers
3. See Figure 8 - Upper and Lower Peavine - Land Use Map and Curve Numbers
4. Weighted Curve Number Calculation from Washoe County Hydrologic Criteria and Design Mannual (December, 1996):

$$WeightedCN = \frac{CN_A \times A_1 + CN_B \times A_2 + CN_C \times A_3 + CN_D \times A_4}{A_1 + A_2 + A_3 + A_4}$$

Weighted Curve Number Calculations

Subshed Area UP6 54.552 Acres

Land Use	Acres	HSG A [2]	Acres	HSG B [2]	Acres	HSG C [2]	Acres	HSG D [2]	Weighted	% Impervious [3]	Weighted [4]
Business/Commercial											
Downtown Areas		89		92		94		95	0	85	0
Neighborhhod Areas		80		87		91		93	0	70	0
Residential											
1/8 Acres or Less		77		85	2.253	90		92	202.77	65	146.445
1/4 Acre		61		75	10.353	83		87	859.299	38	393.414
1/3 Acre		57		72	3.545	81		86	287.145	30	106.35
1/2 Acre		54		70		80		85	0	25	0
1 Acre		51		68		79		84	0	20	0
Industrial		81		88		91		93	0	72	0
Irrigated Areas											
Lawns, Parks, Golf Courses		41		62		75		81	0	5	0
Agricultural		39		61		74		80	0	0	0
									0		
Undeveloped Areas (Open Space)											
Herbaceous		40		62		74		85	0	0	0
Mixed Grass and Shrub		39		61		73		82	0	0	0
Shrub/Brush		35		56	34.576	70		77	2420.32	0	0
Forest (Evergreen)		30		54		66		75	0	0	0
Outcrops		77		86		91		94	0	70	0
Streets/Roads											
Paved		98		98	4.168	98		98	408.464	100	416.8
Gravel		76		85		89		91	0	20	0
Drives/Walks		97		97		97		97	0	95	0
Roofs		95		95		95		95	0	90	0
Weighted CN					54.895				76		19

NOTES:

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3. See Figure 8 - Upper and Lower Peavine - Land Use Map and Curve Numbers
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$$WeightedCN = \frac{CN_A \times A_1 + CN_B \times A_2 + CN_C \times A_3 + CN_D \times A_4}{A_1 + A_2 + A_3 + A_4}$$

RUNOFF CURVE NUMBERS

Land Use or Surface Characteristics	Aver. % Impervious Area	Runoff Curve Numbers: Soil Comp A	Soil Comp B	Soil Comp C	Soil Comp D
Business/Commercial:					
Downtown Areas	85	89	92	94	95
Neighborhood Areas	70	80	87	91	93
Residential:					
(Average Lot Size)					
1/8 Acre or Less (Multi-Unit) (0.125)	65	77	85	90	92
1/4 Acre (0.25)	38	61	75	83	87
1/3 Acre (0.33)	30	57	72	81	86
1/2 Acre (0.50)	25	54	70	80	85
1 Acre (1.00)	20	51	68	79	84
Industrial:	72	81	88	91	93
Irrigated Areas:					
Lawns, Parks, Golf Courses/	5	41	62	75	81
Agriculture	0	39	61	74	80
Undeveloped Areas (Open Space):					
Herbaceous (grasses)	0	40	62	74	85
Mixed Grass and Shrub	0	39	61	73	82
Shrub/Brush	0	35	56	70	77
Forest (Evergreen)	0	30	54	66	75
Outcrops	70	77	86	91	94
Street/Roads:					
Paved	100	98	98	98	98
Gravel	20	76	85	89	91
Drives/Walks:	95	97	97	97	97
Roofs:	90	95	95	95	95

Notes:

1. Grass - Grassed Landscaping or Irrigated Vegetation

MACTEC

MACTEC Engineering and Consulting, Inc.
961 Matley Lane
Suite # 110
Reno, NV 89502

JOB NO. 4307050009 SHEET 1 OF 2
PHASE II TASK 2
JOB NAME Reno EAP - Dant Blvd Hydrology
BY SG DATE 11/29/05
CHECKED BY _____ DATE _____

CN CALCULATIONS

SUBSHED	LANDUSE	HSG	CN	AREA (Acres)
PLUM 1	OPEN SPACE (MIXED GRASS & SHRUB)	C	73	100.12
	Residential (1 Acre)	C	79	110.97

WEIGHTED AVG. CN = $\frac{100.12 \times 73 + 110.97 \times 79}{100.12 + 110.97} = \boxed{76}$

PLUM 2.	OPEN SPACE (MIXED GRASS & SHRUB)	C	73	48.09
	RESIDENTIAL (1 Acre)	C	79	68.69

WEIGHTED AVG. CN = $\frac{48.09 \times 73 + 68.69 \times 79}{68.69 + 48.09} = \boxed{77}$

PLUM 3:	OPEN SPACE (MIXED GRASS & SHRUB)	D	82	50.34
	OPEN SPACE (MIXED GRASS & SHRUB)	C	73	101.53
	RESIDENTIAL (1 Acre)	C	79	34.86
	RESIDENTIAL (1 Acre)	D	84	6.40

weighted Avg. CN = $\frac{50.34 \times 82 + 101.53 \times 73 + 34.86 \times 79 + 6.4 \times 84}{50.39 + 101.53 + 34.86 + 6.4}$

$= \boxed{77}$

PLUM 4	OPEN SPACE (MIXED GRASS & SHRUB)	C	73	58.63
	RESIDENTIAL ($\frac{1}{3}$ Acre)	D	86	4.2
	RESIDENTIAL ($\frac{1}{3}$ Acre)	A	57	39.61
	Residential ($\frac{1}{3}$ Acre)	C	81	90.61

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MACTEC Engineering and Consulting, Inc.
961 Matley Lane
Suite # 110
Reno, NV 89502

JOB NO. 4307050009 SHEET 2 OF 2

PHASE II TASK 2

JOB NAME Reno EAP - Dam Blvd Hydrology

BY SG DATE 11-29-05

CHECKED BY _____ DATE _____

Weighted Avg. CN = $\dfrac{72 \times 58.63 + 86 \times 4.2 + 67 \times 39.61 + 91 \times 90.61}{58.63 + 4.2 + 39.61 + 90.61}$

$= 73.77 \approx \boxed{74}$

RUNOFF CURVE NUMBERS

Land Use or Surface Characteristics	Aver. % Impervious Area	Runoff Curve Numbers Soil Comp A	Soil Comp B	Soil Comp C	Soil Comp D
Business/Commercial:					
Downtown Areas	85	89	92	94	95
Neighborhood Areas	70	80	87	91	93
Residential:					
(Average Lot Size)					
1/8 Acre or Less (Multi-Unit) (0.125)	65	77	85	90	92
1/4 Acre (0.25)	38	61	75	83	87
1/3 Acre (0.33)	30	57	72	81	86
1/2 Acre (0.50)	25	54	70	80	85
1 Acre (1.00)	20	51	68	79	84
Industrial:	72	81	88	91	93
Irrigated Areas:					
Lawns, Parks, Golf Courses/	5	41	62	75	81
Agriculture	0	39	61	74	80
Undeveloped Areas (Open Space):					
Herbaceous (grasses)	0	40	62	74	85
Mixed Grass and Shrub	0	39	61	73	82
Shrub/Brush	0	35	56	70	77
Forest (Evergreen)	0	30	54	66	75
Outcrops	70	77	86	91	94
Street/Roads:					
Paved	100	98	98	98	98
Gravel	20	76	85	89	91
Drives/Walks:	95	97	97	97	97
Roofs:	90	95	95	95	95

Notes:

1. Grass - Grassed Landscaping or Irrigated Vegetation

The Pines (Washoe County)

The Pines, occupying the entire southern section of the Ranch, will be the site of the lowest density housing at the Caughlin Ranch. Vegetation in this section is typical of lower elevations in the Sierras. Pines and mountain mahogany predominate. The terrain is hilly, with both gentle and steep slopes. The one-acre+ lots are sited to take advantage of gentle slopes, panoramic views and the forest cover. Much of the site will remain open, preserving the integrity and characteristics of the forested terrain. As shown in the plan area graphic, a loop road services many small roads which will provide access to the lots.

The vast open space of the Pines will be maintained by an active homeowners association set up specifically for The Pines area. Conceptual Development statistics are noted below. Although part of the Caughlin Ranch Master Plan, this is not currently part of the PUD.

The Pines Development Statistics (Conceptual)

Subareas	Use	Unit Count	Acreage	Density	Minimum Sq. Ft.
The Pines	Single Family Estate	174	517	0.34 du/ac	2000

Whispering Pines (City of Reno)

Whispering Pines was a portion of The Pines annexed to the City in December 2000. It provides a transition in density from the abutting Castleridge (Mountainshyre)area and The Pines. Vegetation in this section is typical of lower elevations in the Sierras. Pines and mountain mahogany predominate. The terrain is hilly, with both gentle and steep slopes. The ½ acre + custom lots are sited to take advantage of gentle slopes, panoramic views and the forest cover. Much of the site will remain open, preserving the integrity and characteristics of the forested terrain. As shown in the plan area graphic, a loop road services many small roads which will provide access to the lots. The vast open space of Whispering Pines will be maintained by the Caughlin Ranch homeowners association. Development statistics are noted below. Note: all areas greater than 30% slope in the open space area designated in the Whispering Pines Subdivision on page 22 will remain as open space.

Whispering Pines Development Statistics

Subareas	Use	Unit Count	Acreage	Density	Minimum Sq. Ft.
Whispering Pines	Single Family Estate	25	42.76	0.58 du/ac	2000

Caughlin Village - 557 Units

Subarea Name	Existing	2000+	Totals
Vantage Point	106		106 HLI
Castle Ridge (Units 1,2, 4 thru 7)	113	15 IV	128 HLIV
CastleRidge Unit 3/ Mountainshyre	58		58 HLII
Village Green	69 HLIII		69 HLIII
Heritage On The Green	74HLII		74 HLII
Traditions at Caughlin Ranch	122		122 HLIII
Caughlin Ranch Shopping Center	120,000 s.f.		120,000 s.f. commercial
Caughlin Village Professional Office	85,000 s.f.		85,000 s.f. post office
Child Care	x		
Caughlin Ranch Elementary School	Complete		
RV Storage		x	
Totals	542	15	557 Units

Notes:
1. Village Green Park - 1992/93
2. School Site Offered for Dedication - 1969/Construction - 1990 (by Washoe County School District (complete)
3. Fire Station site to be Offered for Dedication (2002)

The Pines - 174 Unit

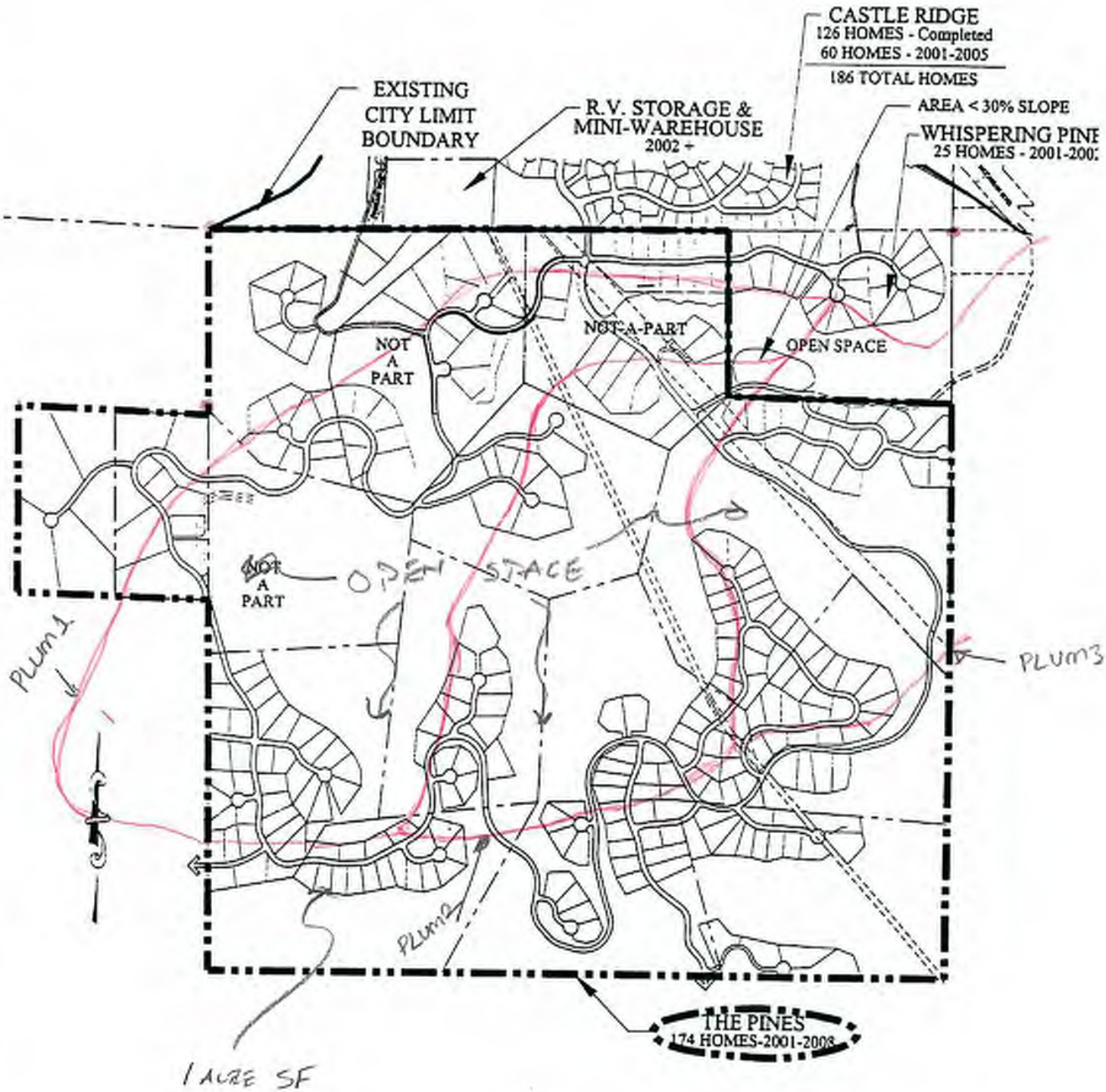
(Conceptual requires PUD approval to determine number of allowed units)

Subarea Name	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Totals
Phase I	12	12	13	11								48 HLIV
Phase II				15	10	10	16	24	22	10	29	126 HLIV
Totals	12	12	13	26	10	10	16	24	22	10	29	174

Whispering Pines - 25 Units

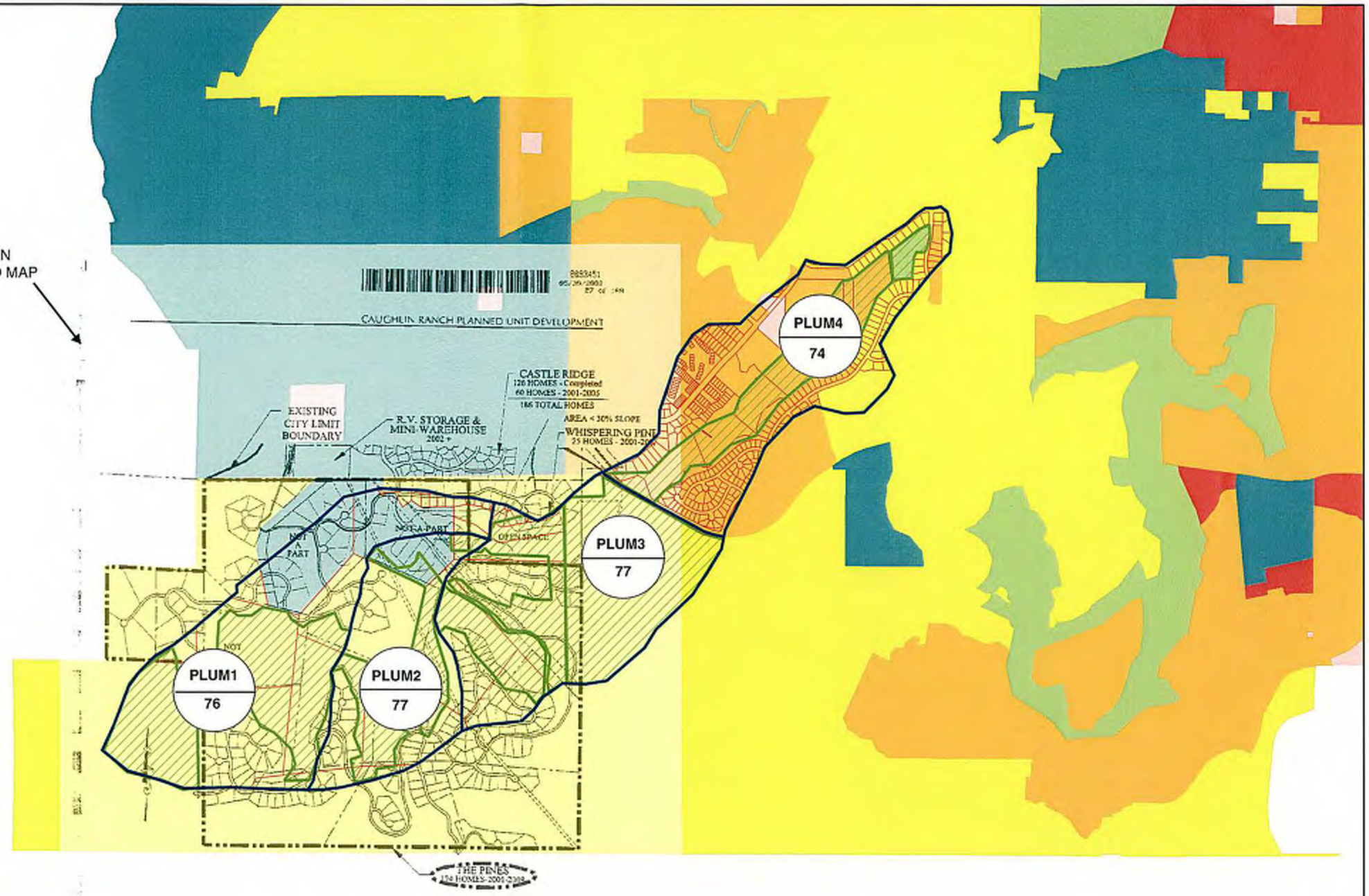
Subarea Name	2001	2002	Totals
Phase I	12		12 HLIV
Phase II		13	13 HLIV
Totals	12	13	25

Project # 4307050009
Task # 02



The Pines & Whispering Pines Plan

PINES & WHISPERING PINES PLAN
OVER LAY ON DANT WATERSHED MAP



Legend

LandUse

- Industrial
- Mixed Residential
- Parks/Recreation/Open Space
- Public Facility
- Reno-Sparks Indian Colony
- Single Family Residential
- Special Planning Area
- Tourist Commercial
- Urban Residential/Commercial
- Undeveloped Area
- Parcels
- PLUM1 / 76 — Sub Basin Identifier / Weighted Curve Number
- Sub Basin Boundary

The Pines & Whispering Pines Plan

DRAWN: SG	PROJECT NO: 4307050009
ENGINEER: CA	SCALE: 1" = 1500'
CHECKED: CA	DATE: 12-03-05
APPROVED DC	DATE: 12-03-05

MACTEC
MACTEC ENGINEERING & CONSULTING

MACTEC Engineering and Consulting
961 Matley Lane, Suite 110
Reno, Nevada 89502
Phone: (775) 329 - 6123

WORKING MAP-USED FOR CN CALCULATIONS
DANT BLVD DETENTION DAM
CITY OF RENO EMERGENCY ACTION PLAN
RENO, WASHOE COUNTY, NEVADA

FIGURE.

APPENDIX B

Time of Concentration

Job No. 4307-05-0009
Created by: DLT 08-02-05
Checked by: CA 08-10-05

SCS Lag Time
(East and West Wash)

Reno EAP Phase II
Client: City of Reno

Sub-Basin Data				Initial/Overland Time[2] (t_i)			Travel Time[3] (t_t)				t_c[4] ($t_i + t_t$)	t_{lag}[5] (min)
Identification	CN[1]	R	Area (sqmile)	Length (ft)	Slope (%)	t_i (min)	Length (ft)	Slope (%)	Velocity (ft/s)	t_t (min)	t_c (min)	
EW1	70	0.534	0.396	500	26	7.7	2150	5.6	2.4	14.9	36.6	21.9
							2925	11.3	3.5	13.9		
EW2	70	0.534	0.209	500	20.0	8.4	4500	12.9	3.7	20.3	28.7	17.2
EW3	70	0.534	0.37	500	14.0	9.5	6650	10.8	3.4	32.6	42.1	25.2
EW4	70	0.534	0.081	500	26.0	7.7	1925	14.5	3.9	8.2	27.4	16.4
							1925	7.8	2.8	11.5		
EW5	70	0.534	0.028	500	17	8.9	1500	5.7	2.4	10.4	19.3	11.6
EW6	77	0.626	0.488	500	9	9.2	6550	3.9	2	54.6	63.8	38.3
EW7	70	0.534	0.238	500	36	6.9	3900	14.9	4	16.3	23.2	13.9
EW8	73	0.574	0.284	500	32	6.7	3975	5	2.3	28.8	35.5	21.3
WW1	66	0.481	0.183	500	24	8.6	2950	10.8	3.4	14.5	23.1	13.9
WW2	73	0.574	0.099	500	26	7.2	975	18.5	4.4	3.7	10.9	6.5
WW3	76	0.613	0.493	500	26	6.6	5375	7.6	2.8	32.0	38.6	23.2
WW4	64	0.455	0.145	500	24	9.0	2075	12.5	3.7	9.3	18.4	11.0
WW5	79	0.653	0.222	500	32	5.7	2425	17.3	4.3	9.4	39.4	23.6
							3350	4.8	2.3	24.3		
WW6	83	0.706	0.105	500	14	6.6	1500	3.3	1.8	13.9	20.5	12.3

Formulas (Washoe County Drainage Manual)

$$t_i = 1.8 * (1.1 - R) * L^{1/2} / S^{1/3}$$

R = flow runoff coefficient
L = length of overland flow (ft, 500-feet maximum)
S = average overland basin slope (percent)

SCS Lag Time
(East and West Wash)

$R = 0.132 * CN - 0.39$

CN = curve number for the basin

$t_{lag} = 0.6 * t_c$

NOTES:

1) See Curve Numbers table for more information.
2) Per Washoe County Drainage Manual, maximum initial overland flow length is 500 ft.
   For measured overland flow length greater than 500 ft, the maximum value of 500 will be used.
3) Channel is assumed to be grassed waterway. Figure 705 of Washoe County Drainage Manual is used to obtain travel velocity.
4) t_c will be used to calculated SCS t_{lag}.
5) t_{lag} are SCS lag time and will be used in HEC-HMS hydrologic modelings of East and West Wash detention dams.

Job No. 4307-05-0009
Created by: DLT 08-10-05
Checked by: CA 08-12-05

SCS Lag Time
(Upper and Lower Peavine)

Reno EAP Phase II
Client: City of Reno

Sub-Basin Data				Initial/Overland Time[2] (t_i)			Travel Time[3] (t_t)				t_c[4] ($t_i + t_t$)	t_{lag}[5] (min)
Identification	CN[1]	R	Area (sqmile)	Length (ft)	Slope (%)	t_i (min)	Length (ft)	Slope (%)	Velocity (ft/s)	t_t (min)	t_c (min)	
UP1	63	0.442	0.327	500	12.9	11.3	3933	9.1	3.2	20.5	31.8	19.1
UP2	70	0.534	0.286	500	13.6	9.6	5550	8.7	3.0	30.8	40.4	24.2
UP3	70	0.534	0.579	500	12.2	9.9	2601	5.4	2.3	18.8	53.8	32.3
							5110	9.8	3.4	25.1		
UP4	70	0.534	0.472	0	0.0	0.0	4641	7.7	2.8	27.6	69.7	41.8
							5051	4.1	2.0	42.1		
UP5	71	0.547	0.390	250	7.7	8.0	3946	10.6	3.3	19.9	39.7	23.8
				250	18.9	11.8						
UP6	75	0.600	0.085	500	13.2	8.5	2332	3.4	1.9	21.0	29.5	17.7
LP1	76	0.613	0.189	500	8.3	9.7	3769	3.4	1.9	33.1	42.7	25.6
LP2	75	0.600	0.223	500	20	7.4	3900	4.4	2.1	31.0	38.4	23.0
LP3	75	0.600	0.092	500	14.6	8.2	1100	8.2	3.8	4.8	22.6	13.6
							1200	4.5	2.1	9.5		
LP4	75	0.600	0.067	500	16	8.0	1825	7.5	2.8	10.9	18.9	11.3
LP5	75	0.600	0.023	125	4.8	6.0	1050	5.4	2.3	7.6	13.6	8.1
LP6	78	0.640	0.070	500	10	8.6	2000	5.3	2.3	14.5	23.1	13.9
LP7	79	0.653	0.112	500	3.2	12.2	2325	3.4	1.9	20.4	32.6	19.6

Formulas (Washoe County Drainage Manual)

$t_i = 1.8 * (1.1 - R) * L^{1/2} / S^{1/3}$

R = flow runoff coefficient
L = length of overland flow (ft, 500-feet maximum)
S = average overland basin slope (percent)

SCS Lag Time
(Upper and Lower Peavine)

$R = 0.132 * CN - 0.39$

CN = curve number for the basin

$t_{lag} = 0.6 * t_c$

NOTES:

1) See Curve Numbers table for more information.
2) Per Washoe County Drainage Manual, maximum initial overland flow length is 500 ft.
   For measured overland flow length greater than 500 ft, the maximum value of 500 will be used.
3) Channel is assumed to be grassed waterway. Figure 705 of Washoe County Drainage Manual is used to obtain travel velocity.
4) t_c will be used to calculated SCS t_{lag}.
5) t_{lag} are SCS lag time and will be used in HEC-HMS hydrologic modelings of East and West Wash detention dams.

APPENDIX C

Storage Volumes

East Wash Diverson Dam
Stage-Area-Storage Tabulations
(HEC-HMS)

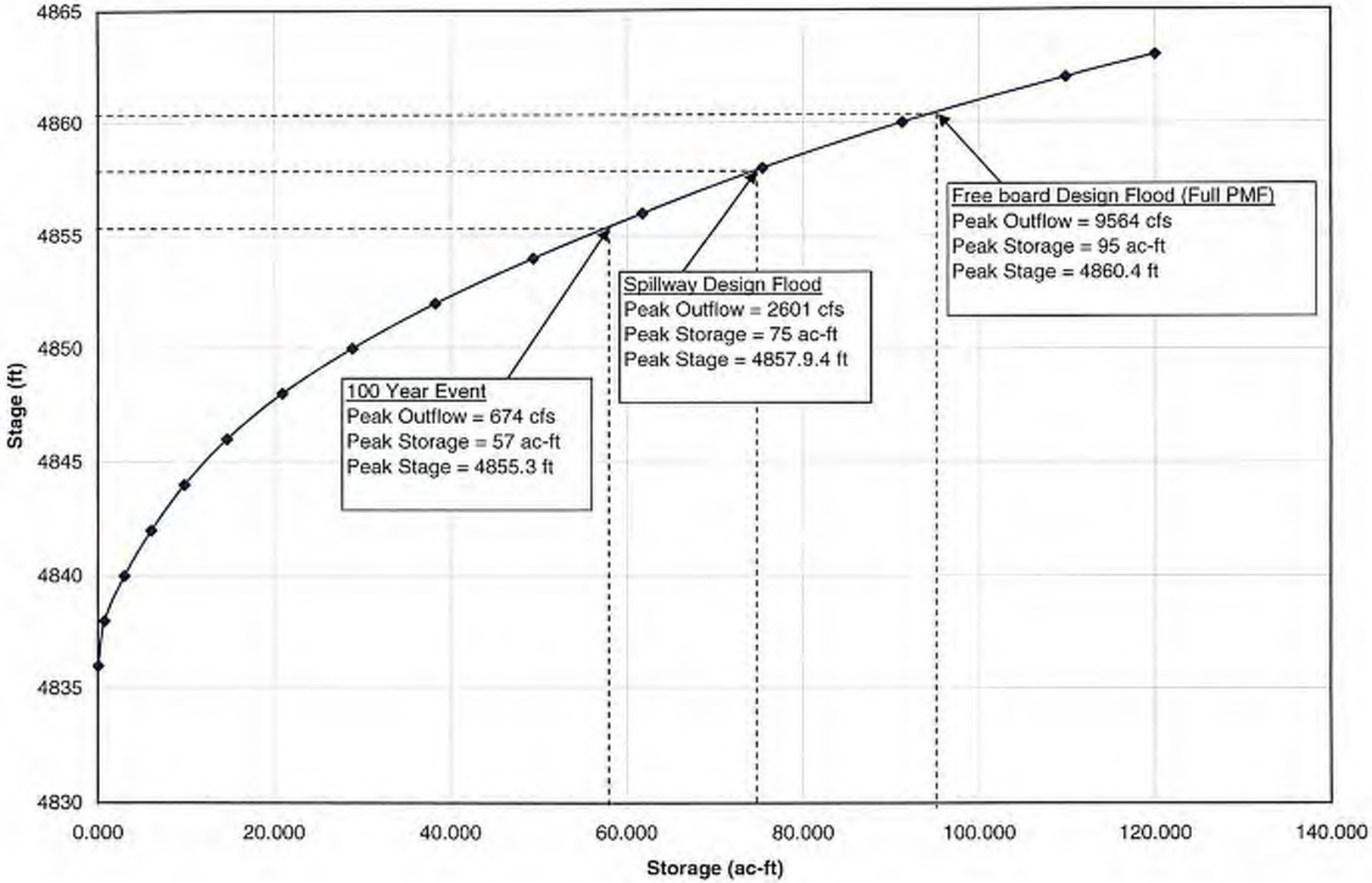
Elev. (ft)	Area		Storage	
	(ft^2)	(Acres)	(ft^3)	(Acre-ft)
4836	0	0.0000	0	0.0000
4838	31104.01	0.7154	30219.17	0.6950
4840	59373.99	1.3656	129597	2.9807
4842	72312.91	1.6632	261280.76	6.0095
4844	90756.61	2.0874	425996.78	9.7979
4846	119486.86	2.7482	635055.92	14.6063
4848	154015.06	3.5423	907950.03	20.8829
4850	188760.83	4.3415	1252397.1	28.8051
4852	222476.76	5.1170	1662748.43	38.2432
4854	257303.34	5.9180	2145147.81	49.3384
4856	281683.19	6.4787	2684757.63	61.7494
4858	311861.73	7.1728	3277252.43	75.3768
4860	363491.11	8.3603	3968408.12	91.2734
4862	44560.75	1.0249	4776691.52	109.8639

NOTES:

(1) Shown elevations are from current NAVD 1988 datum.

(2) Area and storage volumes are calculated using Arc-GIS computer software. The storage volumes will be used in HEC-HMS hydrologic modeling of East Wash detention dam.

East Wash Diversion Dam Storage Volume (HEC-HMS)



East Wash Dam
Storage Volume Comparison

Elev. (ft)	Area (Acres)		Storage (ac-ft)		Type
	MACTEC[1]	USCOE[2]	MACTEC[1]	USCOE[2]	
4851.2	4.79	19	34.28	50	Sediment Pool
4853.2	5.62	19+	44.72	60	Flood Control Pool[3]
4860	8.36	7.5	91.27	88+	Probable Maximum Flood Pool
4861.25	9.45		101.99	93	Top Of Dam

NOTES:

(1) Calculations are based on Cityof Reno 2-ft contours (NAVD 1988 datum) and is taken as 3.2 ft above the NRCS datum (NAVD 1929). This difference is from the comparision of the MACTEC actual survey of the site and the reported elevation in the as-built plans. Refer to section 2.3.3 of this Hydrology Report for more information. See attached for storage volume calculations.

(2) Storage Volume values obtained from the hydrology reevaluation reports produced by USCOE (1978) and were based on NAVD 1929 datum.

(3) Defined by the emergency spillway crest elevation.

Supporting Calculations for East Wash Diversion Dam Storage Volume Analysis
Used ArcGis, and 3D Analyst to perform Storage Volume Calulations
Elevations are reported in US Feet, referenced to NAVD.
Area is expressed in Square Feet, and Volume in Cubic Feet.

DATASET: P:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz II\Design\GIS\ReservoirVolumes\EastWash\maxpool101205
TYPE: TIN
ZFACTOR: 1.00
PLANE_HEIGHT: 4851.20
REFERENCE: BELOW_PLANE
2D_AREA: 208117.15
3D_AREA: 211057.80
VOLUME: 1490614.61

DATASET: P:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz II\Design\GIS\ReservoirVolumes\EastWash\maxpool101205
TYPE: TIN
ZFACTOR: 1.00
PLANE_HEIGHT: 4853.20
REFERENCE: BELOW_PLANE
2D_AREA: 244337.97
3D_AREA: 248204.84
VOLUME: 1944507.78

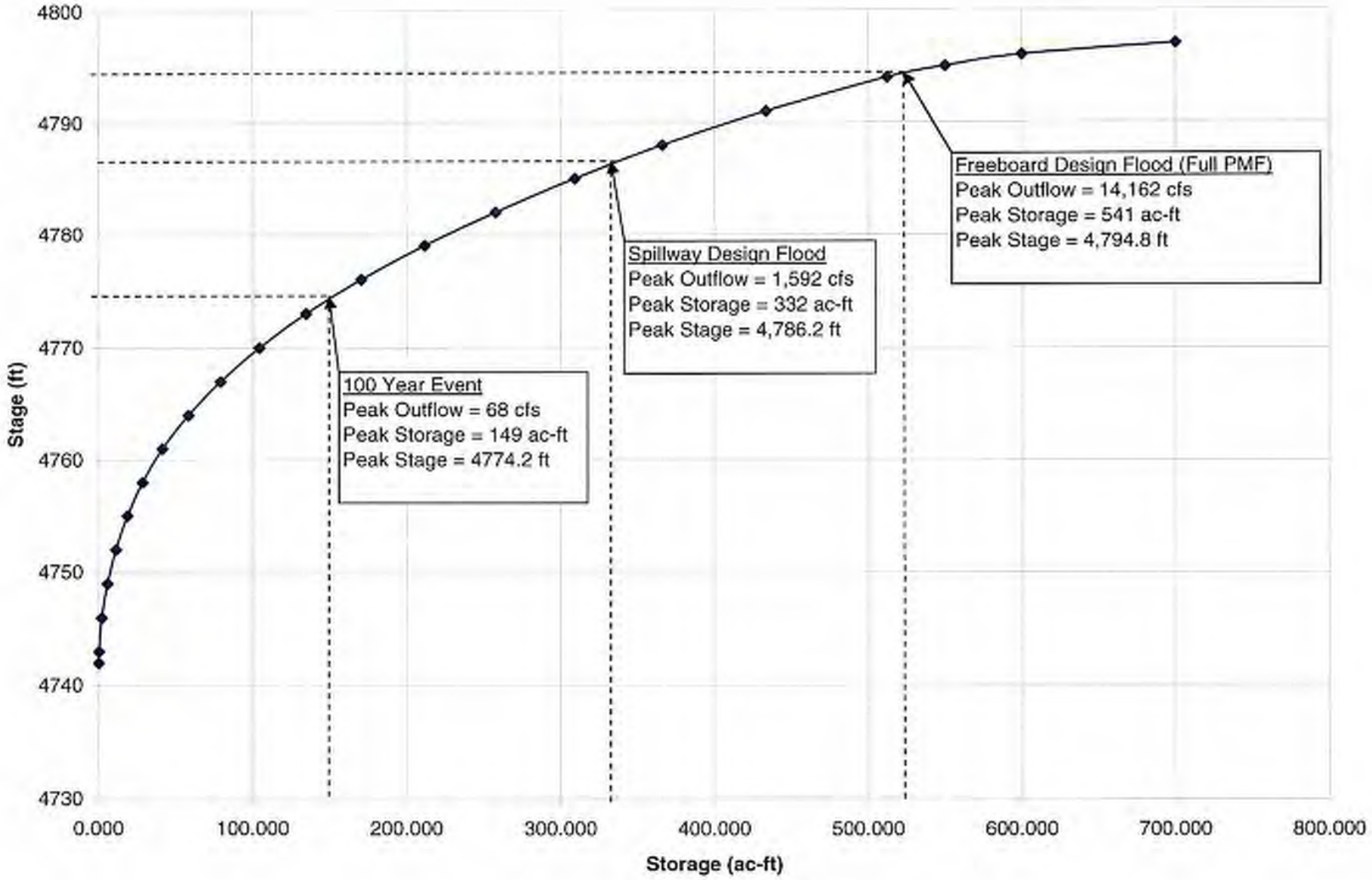
DATASET: P:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz II\Design\GIS\ReservoirVolumes\EastWash\maxpool101205
TYPE: TIN
ZFACTOR: 1.00
PLANE_HEIGHT: 4860.00
REFERENCE: BELOW_PLANE
2D_AREA: 363491.11
3D_AREA: 370520.52
VOLUME: 3968408.12

DATASET: P:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz II\Design\GIS\ReservoirVolumes\EastWash\maxpool101205
TYPE: TIN
ZFACTOR: 1.00
PLANE_HEIGHT: 4861.20
REFERENCE: BELOW_PLANE
2D_AREA: 410687.53
3D_AREA: 417962.46
VOLUME: 4434507.41

Project No. 4307-05-0009
Created by: SG
Checked by: CA

West Wash Detention Dam Storage Volume (HEC-HMS)

Reno EAP Phase II
Client: City of Reno



West Wash Detention Dam
Stage-Area-Storage Tabulations
(HEC-HMS)

Elevation	ArcGIS Generated			
	Area		Storage	
(ft)	(ft^2)	(Acres)	(ft^3)	(Acre-ft)
4742	0	0.0000	0	0.0000
4743	8675.43	0.1995	6259.84	0.1440
4746	40681.68	0.9357	86260.91	1.9840
4749	66012.53	1.5183	247456.51	5.6915
4752	91393.32	2.1020	484009.78	11.1322
4755	123658.97	2.8442	807563.56	18.5740
4758	160870.26	3.7000	1231949.5	28.3348
4761	217271.95	4.9973	1800290.61	41.4067
4764	271526.22	6.2451	2532940.92	58.2576
4767	331586.62	7.6265	3435655.81	79.0201
4770	397622.61	9.1453	4529369.97	104.1755
4773	481263.08	11.0691	5850066.94	134.5515
4776	557449.6	12.8213	7407183.06	170.3652
4779	632831.28	14.5551	9193595.15	211.4527
4782	706835	16.2572	11202909.23	257.6669
4785	787217.99	18.1060	13442275.35	309.1723
4788	864354.76	19.8802	15920196.46	366.1645
4791	1129769.01	25.9847	18851337.71	433.5808
4794	1146755.39	26.3754	22271582.67	512.2464

NOTES:

(1) Shown elevations are from current NAVD 1988 datum.

(2) Areas and storage volumes are calculated using Arc-GIS comput
rechecked using AutoCAD. See section 2.3.3 of Reno EAP Phase
information. Storage volumes generated by Arc-GIS will be used i
of West Wash detention dam.

West Wash Dam
Storage Volume Comparison

Elevation (ft)	Volume (Acre Ft)		
	MACTEC Digitized [1]	USCOE Capacity Curve[2]	MACTEC [3]
4733.00	0	0.00	0.00
4743.00	3.3	10.00	0.14
4748.20	-	20.00	4.53
4753.00	18.3	40.00	1.34
4763.00	58.2	115.00	52.22
4773.00	138.7	230.00	134.55
4782.20	-	360.00	260.93
4783.00	270.7	375.00	274.23
4791.70	-	532.00	451.82
4793.00	462.7	550+	485.91

NOTES:

(1) Calculations are based on the 10 foot contours from the original construction plans (NRCS, 1959b).
The contours were digitized and referenced to the Nevada State Plane and elevation data converted to NAVD 88.
A surface tin was created and the volumes calculated using AutoDesk Land Development 2004.
Methodology is outlined in Section 2.3.3

(2) Storage Volume values obtained from the dam investigation reports produced by USCOE (1978) and were based on NAVD 1929 datum.

(3) Calculations are based on Cityof Reno 2-ft contours (NAVD 1988 datum) and is taken as 3.2 ft above the NRCS datum (NAVD 1929). This difference is from the comparision of the MACTEC actual survey of the site and the reported elevations in the as-built plans. Refer to section 2.3.3 of this Hydrology Report for more information. See attached for storage volume calculations.

West Wash Dam
Storage Volume Comparison

Elev. (ft)	Area (Acres)		Storage (ac-ft)		Type
	MACTEC[1]	USCOE[2]	MACTEC[1]	USCOE[2]	
4748.2	1.38	4.00	4.53	20.00	Sediment Pool
4782.2	16.39	96.00	260.93	360	Flood Control Pool[3]
4792.2	26.22	106.00	464.91	-	Probable Maximum Flood Pool
4791.7	26.12	-	451.82	532	Top Of Dam

NOTES:

(1) Calculations are based on Cityof Reno 2-ft contours (NAVD 1988 datum) and is taken as 3.2 ft above the NRCS datum (NAVD 1929). This difference is from the comparision of the MACTEC actual survey of the site and the reported elevation in the as-built plans. Refer to section 2.3.3 of Reno EAP Phase II Hydrology Report for more information. See attached for storage volume calculations.

(2) Storage Volume values obtained from the dam investigation reports produced by USCOE (1978) and were based on NAVD 1929 datum.

Supporting Calculations for West Wash Detention Dam Storage Volume Analysis
Used ArcGis, and 3D Analyst to perform Storage Volume Calulations
Elevations are reported in US Feet, referenced to NAVD.
Area is expressed in Square Feet, and Volume in Cubic Feet.

DATASET: P:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz II\Design\GIS\ReservoirVolumes\WestWash\maxpool101005
TYPE: TIN
ZFACTOR: 1.00
PLANE_HEIGHT: 4748.20
REFERENCE: BELOW_PLANE
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3D_AREA: 60589.33
VOLUME: 197062.32

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TYPE: TIN
ZFACTOR: 1.00
PLANE_HEIGHT: 4782.20
REFERENCE: BELOW_PLANE
2D_AREA: 712394.09
3D_AREA: 725360.67
VOLUME: 11344887.46

DATASET: P:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz II\Design\GIS\ReservoirVolumes\WestWash\maxpool101005
TYPE: TIN
ZFACTOR: 1.00
PLANE_HEIGHT: 4792.20
REFERENCE: BELOW_PLANE
2D_AREA: 1140110.31
3D_AREA: 1160535.35
VOLUME: 20213184.83

DATASET: P:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz II\Design\GIS\ReservoirVolumes\WestWash\maxpool101005
TYPE: TIN
ZFACTOR: 1.00
PLANE_HEIGHT: 4791.70
REFERENCE: BELOW_PLANE
2D_AREA: 1135547.99
3D_AREA: 1155672.03
VOLUME: 19644235.50

Upper Peavine Dam
Storage Volume Comparison

Elev (ft)	Area (Acres)		Storage (ac-ft)		Type
	MACTEC[1]	USCOE[2]	MACTEC[1]	USCOE[2]	
5010.2	8.68	8.00	78.24	80.00	Sediment Pool
5025.7	18.11	18.00	281.55	315.00	Flood Control Pool[3]
5031.9	22.31	23.00	407.32	380.00	Probable Maximum Flood Pool

NOTES:

(1) Calculations are based on Cityof Reno 2-ft contours (NAVD 1988 datum) and is taken as 3.2 ft above the NRCS datum (NAVD 1929). This difference is from the comparision of the MACTEC actual survey of the site and the reported elevations in the as-built plans. Refer to section 2.3.3 of Reno EAP Phase II Hydrology Report for more information. See attached for storage volume calculations.

(2) Storage Volume values obtained from the hydrology reevaluation reports produced by USCOE (1978) and were based on NAVD 1929 datum.

(3) Defined by the emergency spillway crest elevation.

Upper Peavine Detention Dam
Stage-Storage-Area Tabulations
(HEC-HMS)

Elevation (ft)	Area		Storage	
	(ft^2)	(Acres)	(ft^3)	(ac-ft)
4992	0	0.0000	0	0.0000
4993	35387.12	0.8139	26679.49	0.6136
4996	91160.89	2.0967	213918.23	4.9201
4999	148680.3	3.4196	575040.62	13.2259
5002	194887.35	4.4824	1092179.99	25.1201
5005	253825.69	5.8380	1768533.87	40.6763
5008	323189.79	7.4334	2632417.19	60.5456
5011	395400.2	9.0942	3710973.39	85.3524
5014	462418.95	10.6356	4999781.23	114.9950
5017	540110.18	12.4225	6498982.99	149.4766
5020	620030.58	14.2607	8239567.13	189.5100
5023	704956.89	16.2140	10226469.28	235.2088
5026	796550.53	18.3207	12478955.84	287.0160
5029	887025.33	20.4016	15015088.36	345.3470
5030	914721.39	21.0386	15915868.89	366.0650
5032	972747.49	22.3732	17806414.41	409.5475
5034	1029525.18	23.6791	19810988.78	455.6527

NOTES:

(1) Shown elevations are from current NAVD 1988 datum.

(2) Area and storage volumes are calculated using Arc-GIS computer software. The storage volumes will be used in HEC-HMS hydrologic modeling of Upper Peavine detention dam.

Supporting Calculations for Upper Peavine Detention Dam Storage Volume Analysis
Used ArcGis, and 3D Analyst to perform Storage Volume Calulations
Elevations are reported in US Feet, referenced to NAVD.
Area is expressed in Square Feet, and Volume in Cubic Feet.

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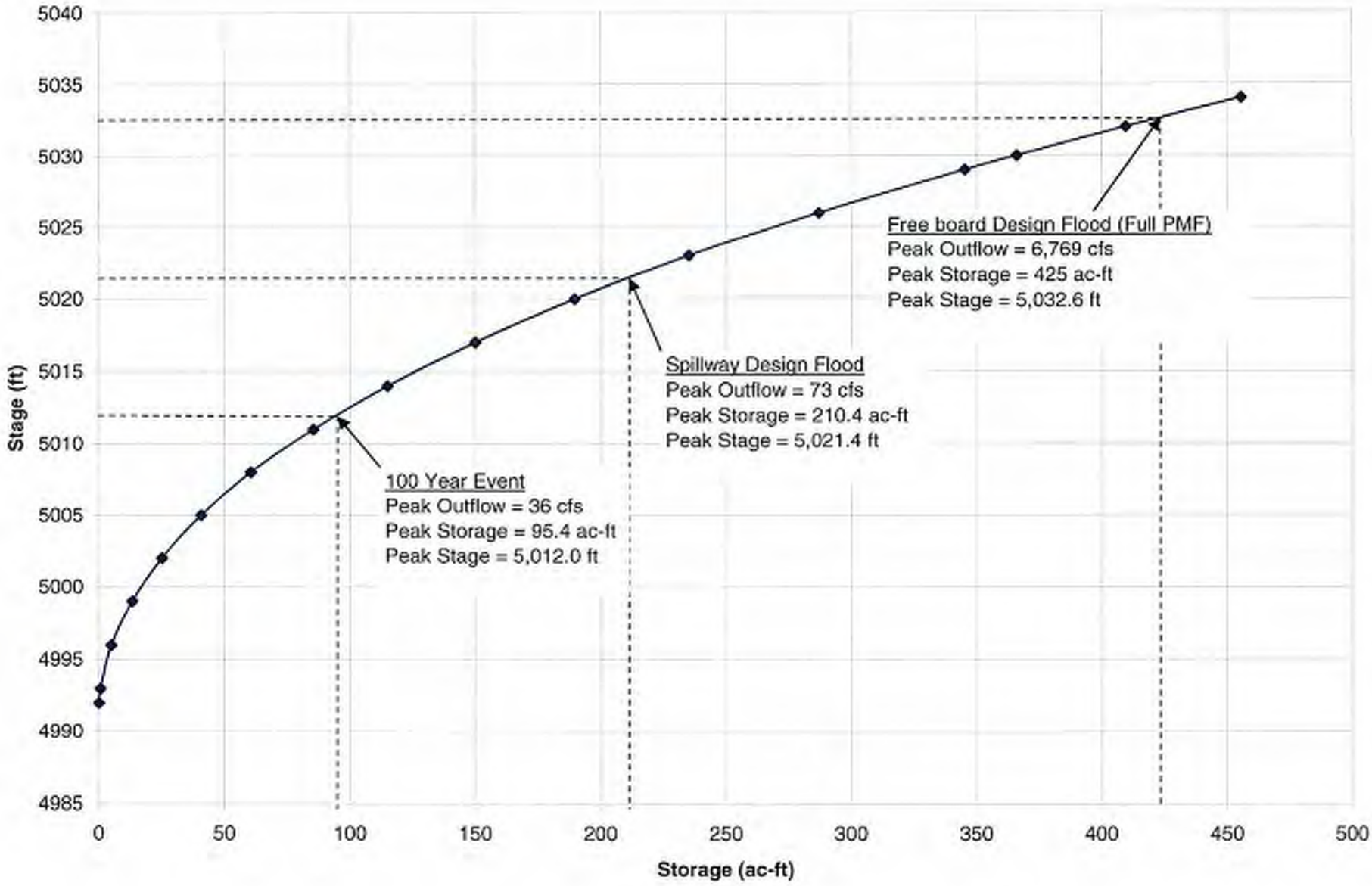
REFERENCE: BELOW_PLANE
2D_AREA: 377340.56
3D_AREA: 380597.16
VOLUME: 3401926.69

DATASET: P:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz II\Design\GIS\ReservoirVolumes\UpperPeavine\maxpool101105
TYPE: TIN
ZFACTOR: 1.00
PLANE_HEIGHT: 5025.70
REFERENCE: BELOW_PLANE
2D_AREA: 787397.76
3D_AREA: 796190.00
VOLUME: 12241365.38

DATASET: P:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz II\Design\GIS\ReservoirVolumes\UpperPeavine\maxpool101105
TYPE: TIN
ZFACTOR: 1.00
PLANE_HEIGHT: 5031.90
REFERENCE: BELOW_PLANE
2D_AREA: 957522.57
3D_AREA: 963510.14
VOLUME: 17986388.03

Upper Peavine Detention Dam Storage Volume (HEC-HMS)



Lower Peavine Detention Dam
Stage-Area-Storage Tabulations
(HEC-HMS)

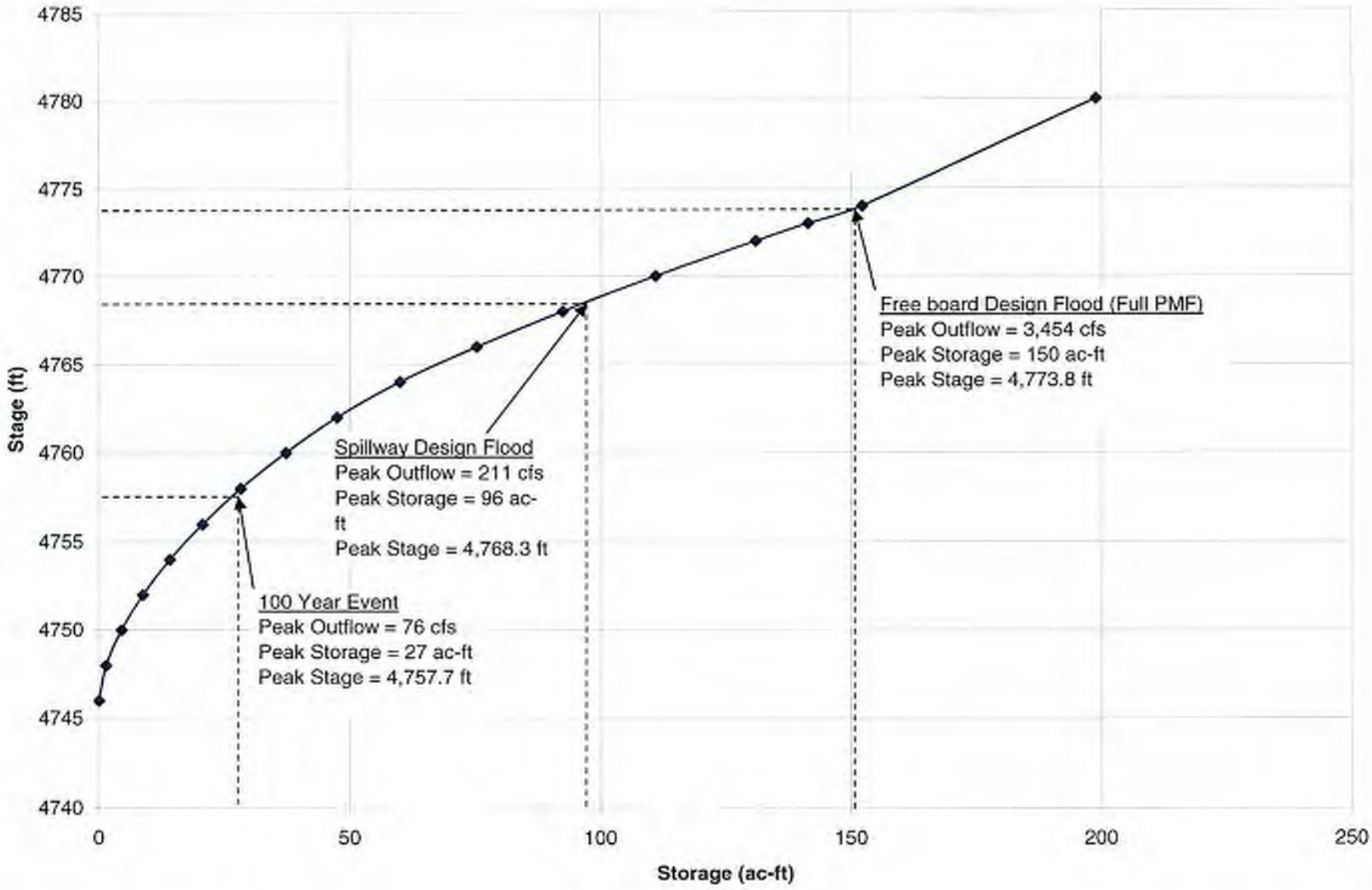
Elevation (ft)	Area		Storage	
	(ft^2)	(acres)	(ft^3)	(ac-ft)
4746	0	0.0000	0	0.0000
4748	52937.69	1.2176	60904.47	1.4008
4750	80604.61	1.8539	195390.34	4.4940
4752	103920.75	2.3902	380228.45	8.7453
4754	127486.78	2.9322	614341.82	14.1299
4756	150450.29	3.4604	894144.74	20.5653
4758	179913.66	4.1380	1227442.61	28.2312
4760	208896.2	4.8046	1618119.29	37.2167
4762	233966.37	5.3812	2061899.58	47.4237
4764	307003.61	7.0611	2608443.62	59.9942
4766	353172.93	8.1230	3272362.74	75.2643
4768	387745.28	8.9181	4017983.91	92.4136
4770	417766.91	9.6086	4825116.76	110.9777
4772	448737.11	10.3210	5692840.15	130.9353
4773	462664.11	10.6413	6148616.71	141.4182
4774	476716.58	10.9645	6618279.32	152.2204
4776	508105.7	11.6864	7605464.51	174.9257
4780	536982.94	12.3506	8650501	198.96152

NOTES:

(1) Shown elevations are from current NAVD 1988 datum.

(2) Area and storage volumes are calculated using Arc-GIS computer software. The storage volumes will be used in HEC-HMS hydrologic modeling of Lower Peavine detention dam.

Lower Peavine Detention Dam Storage Volume (HEC-HMS)



Lower Peavine Dam
Storage Volume Comparison

Elev. (ft)	Area (Acres)		Storage (ac-ft)		Type
	MACTEC[1]	USCOE[2]	MACTEC[1]	USCOE[2]	
4753.8	2.90	3.00	13.60	22.00	Sediment Pool
4768.2	9.03	92.00	94.21	100.00	Flood Control Pool[3]
4776.4	11.82	95.00	179.63	190.00	Probable Maximum Flood Pool

NOTES:

(1) Calculations are based on Cityof Reno 2-ft contours (NAVD 1988 datum) and is taken as 3.2 ft above the NRCS datum (NAVD 1929). This difference is from the comparision of the MACTEC actual survey of the site and the reported elevation in the as-built plans. Refer to section 2.3.3 of Reno EAP Phase II Hydrology Report for more information. See attached for storage volume calculations.

(2) Storage Volume values obtained from the hydrology reevaluation reports produced by USCOE (1978) and were based on NAVD 1929 datum.

(3) Defined by the emergency spillway crest elevation.

Supporting Calculations for Dant Boulevard Detention Dam Storage Volume Analysis
Used ArcGis, and 3D Analyst to perform Storage Volume Calulations
Elevations are reported in US Feet, referenced to NAVD.
Area is expressed in Square Feet, and Volume in Cubic Feet.

DATASET: P:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz II\Design\GIS\ReservoirVolumes\LowerPeavine\maxpool101105
TYPE: TIN
ZFACTOR: 1.00
PLANE_HEIGHT: 4753.80
REFERENCE: BELOW_PLANE
2D_AREA: 125216.60
3D_AREA: 126106.20
VOLUME: 589072.56

DATASET: P:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz II\Design\GIS\ReservoirVolumes\LowerPeavine\maxpool101105
TYPE: TIN
ZFACTOR: 1.00
PLANE_HEIGHT: 4768.20
REFERENCE: BELOW_PLANE
2D_AREA: 392519.20
3D_AREA: 398410.07
VOLUME: 4096221.64

DATASET: P:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz II\Design\GIS\ReservoirVolumes\LowerPeavine\maxpool101105
TYPE: TIN
ZFACTOR: 1.00
PLANE_HEIGHT: 4776.40
REFERENCE: BELOW_PLANE
2D_AREA: 514103.17
3D_AREA: 525938.46
VOLUME: 7810054.10

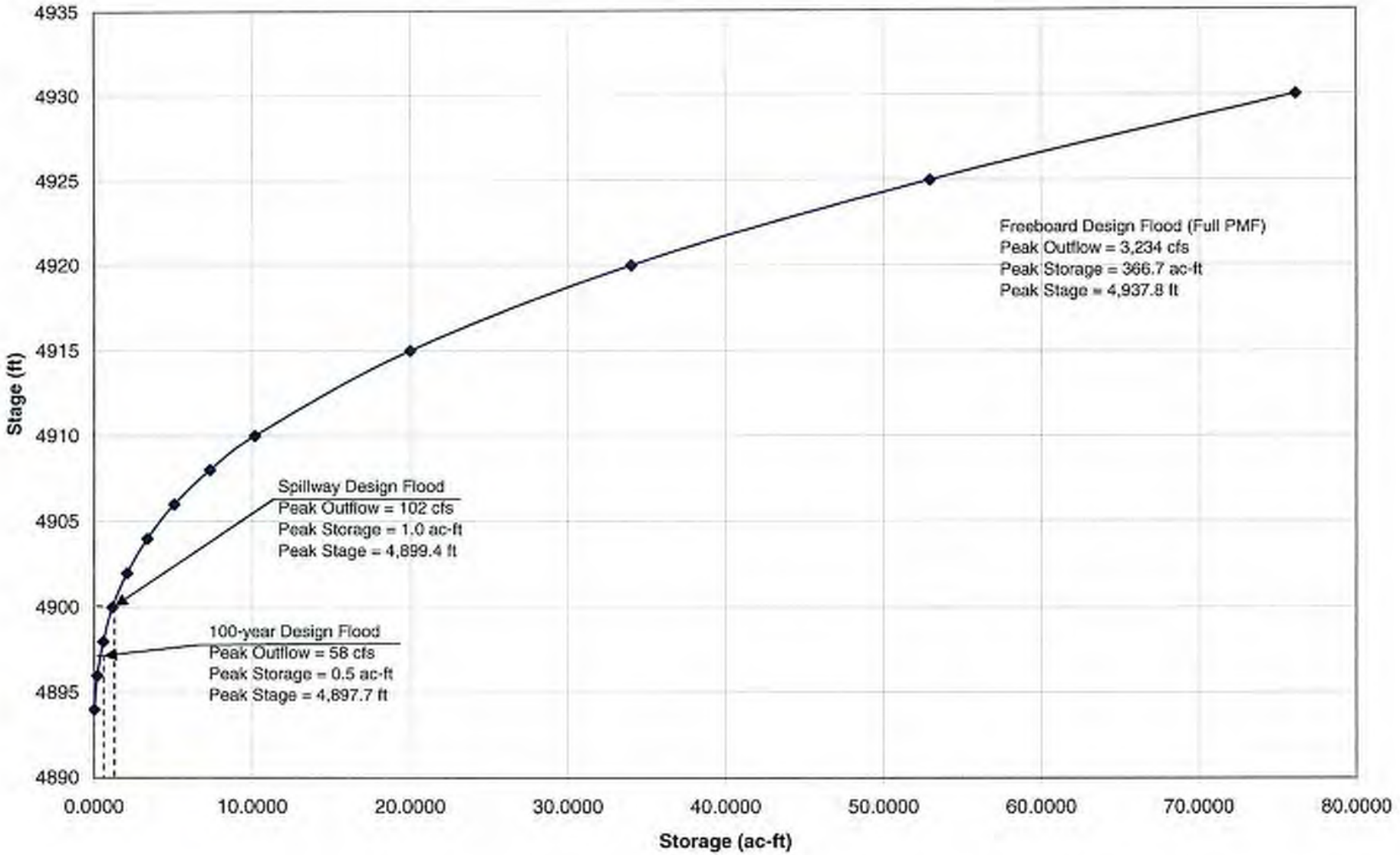
McCarran Boulevard- Upper and Lower Peavine
Stage-Area-Storage Volume
(Upper and Lower Peavine HEC-HMS)

Elevation (ft)	Area		Storage	
	(ft^2)	(Acres)	(ft^3)	(ac-ft)
4894	0	0.0000	0	0.0000
4896	6131	0.1410	8721.46	0.2006
4898	9598.52	0.2208	24494.48	0.5634
4900	15091.91	0.3471	49328.66	1.1346
4902	23609.2	0.5476	89989.56	2.0698
4904	32303.33	0.7430	145921.92	3.3562
4906	41715.21	0.9594	219964.43	5.0592
4908	55147.3	1.2684	318140.27	7.3172
4910	68120.31	1.5668	442128.18	10.1689
4915	103335	2.3767	869038.11	19.9879
4920	142938.58	3.2876	1477957.9	33.9930
4925	184857.13	4.2517	2301930.77	52.9444
4930	218686.65	5.0298	3310470.16	76.1408

NOTE:

City of Reno 2 ft Contours NAVD 1988 is taken as 3.2 ft above the NAVD 1929.

McCarran Storage Volume
(Upper and Lower Peavine HEC-HMS)



Dant Boulevard Detention Dam
Storage Volumes

MACTEC HMS Model Output	
Elevation (ft)	Storage (ac-ft)
4670	0
4670.2	0.001
4671	0.002
4671.1	0.003
4671.5	0.004
4674.8	0.014
4676.5	0.096
4678	0.309
4679	0.64
4680	0.946
4680.1	0.993
4680.9	1.365
4681.7	1.752
4682.5	2.154
4683.2	2.57
4683.9	2.998
4684.4	3.312
4684.6	3.438
4685.2	3.889
4685.9	4.35
4686.5	4.821
4687.1	5.301
4687.7	5.79
4688.2	6.287
4688.7	6.791
4689.2	7.303
4689.4	7.504
4689.7	7.821
4690.1	8.346
4690.5	8.877
4690.8	9.413
4691.2	9.953
4691.5	10.498
4691.9	11.048
4692.2	11.602
4692.5	12.161
4692.8	12.723
4693.1	13.289
4693.3	13.588
4693.4	13.859
4693.7	14.433
4694	15.011
4694.3	15.592
4694.5	16.176
4694.8	16.764
4695.1	17.355
4695.3	17.949

MACTEC HMS Model Output (cont)	
Elevation (ft)	Storage (ac-ft)
4695.6	18.547
4695.9	19.147
4696.1	19.751
4696.3	20.357
4696.6	20.967
4696.8	21.579
4696.9	21.805
4697	22.193
4697.2	22.81
4697.5	23.43
4697.7	24.053
4697.9	24.678
4698.2	25.305
4698.4	25.936
4698.6	26.569
4698.9	27.204
4699.1	27.842
4699.3	28.483
4699.6	29.126
4699.8	29.772
4700	30.42
4700.2	31.071
4700.4	31.459
4700.4	31.723
4700.6	32.378
4700.8	33.034
4701.1	33.692
4701.3	34.352
4701.5	35.013
4701.7	35.677
4701.9	36.343
4702.1	37.01
4702.3	37.678
4702.5	38.347
4702.6	39.017
4702.8	39.687
4703	40.356
4703.2	41.024
4703.4	41.69
4703.5	41.992
4703.6	42.351
4703.8	43.007
4703.9	43.654
4704.1	44.298
4704.3	44.963
4704.5	45.675
4704.7	46.453

MACTEC HMS Model Output (cont)	
Elevation (ft)	Storage (ac-ft)
4704.9	47.319
4705.1	48.295
4705.4	49.412
4705.7	50.705
4706.1	52.23
4706.1	52.214
4706.5	53.967
4706.9	55.994
4707.5	58.346
4708	60.783
4708.1	61.068
4708.8	64.153
4709.4	67.092
4709.5	67.479
4710.2	70.78
4710.3	71.385
4710.8	73.646
4710.9	74.116
4711.2	75.689
4711.2	75.571
4711.3	76.39
4711.3	76.394

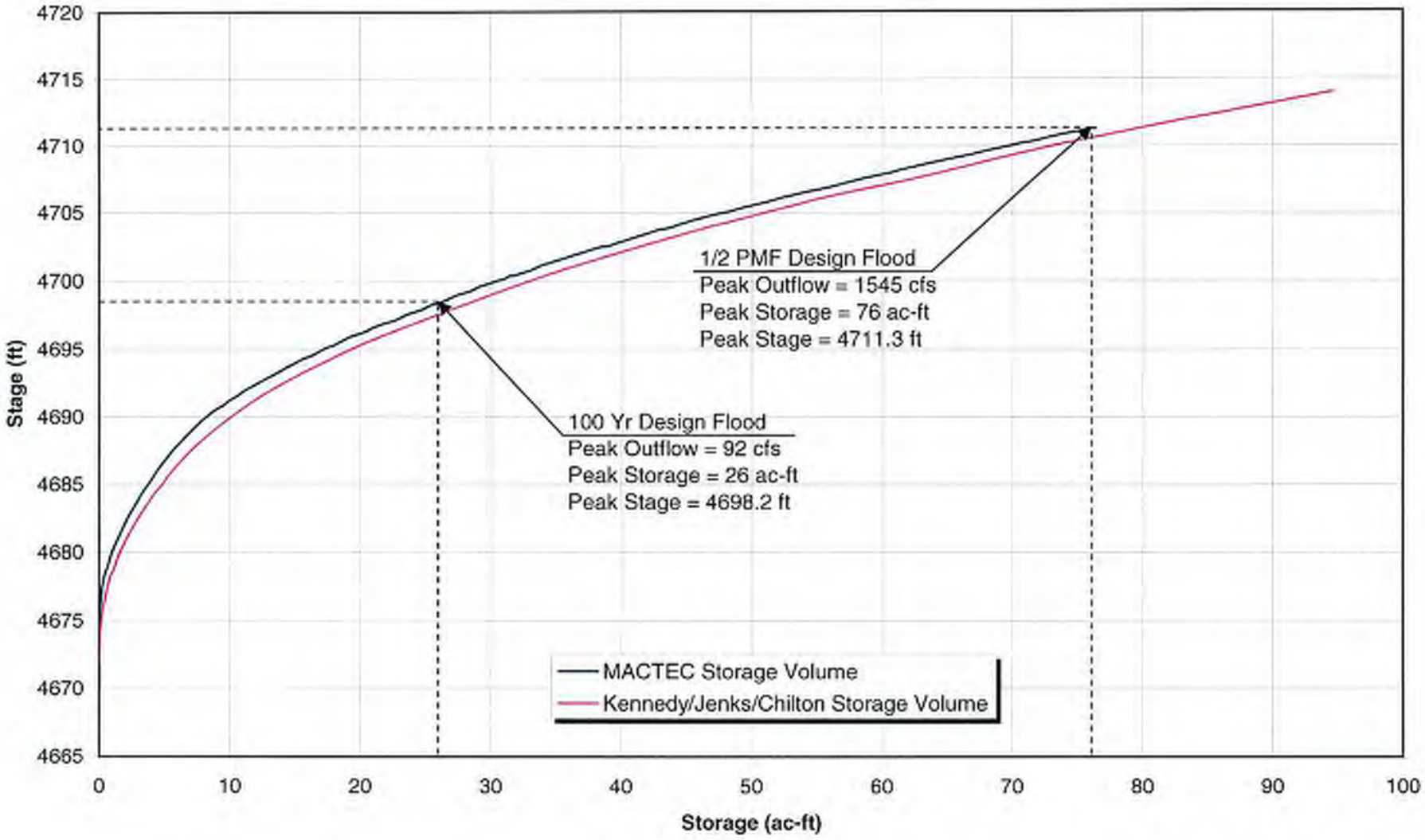
Kennedy/Jenks HEC-1 Model Output	
Elevation (ft)	Storage (ac-ft)
4672.0	0.0
4672.2	0.0
4672.5	0.0
4672.9	0.0
4673.5	0.0
4674.0	0.0
4674.4	0.1
4675.9	0.3
4676.0	0.3
4678.0	0.8
4678.8	1.1
4680.0	1.6
4682.0	2.7
4684.0	4.0
4685.1	4.9
4686.0	5.6
4688.0	7.6
4690.0	10.1
4692.0	13.2
4694.0	17.1
4696.0	21.7
4700.0	32.9
4702.0	39.5
4704.0	46.8
4704.1	47.2
4704.4	48.5
4704.9	50.5
4705.6	53.4
4706.0	54.9
4706.5	57.3
4707.6	62.7
4708.9	68.2
4710.0	73.1
4710.4	75.2
4712.0	83.4
4712.1	84.0
4714.0	94.6

NOTE:
(1) HEC-HMS model is a direct coversion from HEC-1 model of Dant Blvd Dentention Dam performed by Kenendy/Jenks/Chilton (1988)

Project No. 4307-05-0009
Created by: SG
Checked by: CA

Dant Boulevard Detention Dam
Storage Volumes

Reno EAP Phase II
Client: City of Reno



Dant Boulevard Detention Dam
Storage Volume Comparison

Elev. (ft)	Storage (ac-ft)		Type[2]
	MACTEC[1]	Kennedy[2]	
4702.0	36.71	39.00	100 Year Event
4703.5	43.84	46.80	Spillway Crest Elevation
4710.9	74.33	78.00	1/2 Probable Maximum Flood Pool
4714.0	90.84	94.00	Top of the Dam

NOTES:

(1) Calculations are based on City of Reno 2 ft Contours (NAVD 1988) and is taken as 4.0 ft above the NAVD 1929. This difference is from the comparision of the MACTEC actual survey of the site and the reported elevation in the Design report produced by Kenny/Jenks/Chilton (1976). Refer to section 2.3.3 of Reno EAP Phase II Hydrology Report for more information. See attached for storage volume calculations.

(2) Storage Volume values obtained from the design report produced by Kennedy/Jenks/Chilton (1988), and were based on NAVD 1929 datum.

Dant Blvd Detention Reservoir

Elevation	Volume (Acre Ft)	
(Ft)[1]	KJ[2]	COR[3]
4676	0.28	0.02
4678	0.77	0.30
4680	1.57	0.96
4682	2.66	1.89
4684	4.00	3.03
4686	5.60	4.41
4688	7.58	6.08
4690	10.10	8.17
4692	13.20	11.19
4694	17.10	14.97
4696	21.70	19.47
4700	32.90	30.32
4702	39.50	36.71
4704	46.80	43.84
4706	54.90	51.75
4710	73.10	69.68
4712	83.40	79.78
4714	94.60	90.84

NOTE:

1. Elevation reported in NAVD 1988 (+4.0 ft from NAVD 1929.)

2. Reservoir Volumes are obtained from 'Design Report, Dant Blvd Stormwater Detention Dam", Kennedy/Jenks/Chilton (1998).

3. Used City Of Reno provided 2 ft contours to produce a TIN, which is analysed using 3D Analyst to calculate Reservoir Volumes.

Supporting Calculations for Dant Boulevard Detention Dam Storage Volume Analysis
Used ArcGis, and 3D Analyst to perform Storage Volume Calulations
Elevations are reported in US Feet, referenced to NAVD.
Area is expressed in Square Feet, and Volume in Cubic Feet.

DATASET: P:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz II\Design\GIS\ReservoirVolumes\DantBLVD\maxpooltin_010406_Latest
TYPE: TIN
ZFACTOR: 1.00
PLANE_HEIGHT: 4702.00
REFERENCE: BELOW_PLANE
2D_AREA: 146476.56
3D_AREA: 151920.93
VOLUME: 1596120.68

DATASET: P:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz II\Design\GIS\ReservoirVolumes\DantBLVD\maxpooltin_010406_Latest
TYPE: TIN
ZFACTOR: 1.00
PLANE_HEIGHT: 4704.00
REFERENCE: BELOW_PLANE
2D_AREA: 162938.03
3D_AREA: 169216.66
VOLUME: 1906123.36

DATASET: P:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz II\Design\GIS\ReservoirVolumes\DantBLVD\maxpooltin_010406_Latest
TYPE: TIN
ZFACTOR: 1.00
PLANE_HEIGHT: 4710.94
REFERENCE: BELOW_PLANE
2D_AREA: 219098.96
3D_AREA: 228806.52
VOLUME: 3231616.30

DATASET: P:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz II\Design\GIS\ReservoirVolumes\DantBLVD\maxpooltin_010406_Latest
TYPE: TIN
ZFACTOR: 1.00
PLANE_HEIGHT: 4714.00
REFERENCE: BELOW_PLANE
2D_AREA: 251868.70
3D_AREA: 263070.57
VOLUME: 3949409.71

DATASET: P:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz II\Design\GIS\ReservoirVolumes\DantBLVD\maxpooltin_010406_Latest
TYPE: TIN
ZFACTOR: 1.00
PLANE_HEIGHT: 4707.00
REFERENCE: BELOW_PLANE
2D_AREA: 186940.40
3D_AREA: 194637.69
VOLUME: 2433527.39

APPENDIX D

Rainfall Depth and Rainfall Distribution

Job No. 4307-05-0009
Created by: DLT 08-19-05
Checked by: CA 10-04-05

East and West Wash Dams
Partial Duration Series 100-year Event

Reno EAP Phase II
Client: City of Reno

Input Data ⇒

$D_{2yr,1hr}$ = 0.41 inches
$D_{2yr,6hr}$ = 0.90 inches
$D_{2yr,24hr}$ = 1.45 inches

Watershed Name:
EW_Wash Group 1

RGF (100yr,1hr) =	3.62	$D_{100yr,1hr}$ =	1.48 inches
RGF (100yr,6hr) =	2.26	$D_{100yr,6hr}$ =	2.03 inches
RGF (100yr,24hr) =	2.22	$D_{100yr,24hr}$ =	3.22 inches

Ratio5 =	0.33	$D_{100yr,5min}$ =	0.49 inches
Ratio15 =	0.60	$D_{100yr,15min}$ =	0.89 inches

$D_{100yr,2hr}$ =	1.65 inches
$D_{100yr,3hr}$ =	1.77 inches
$D_{100yr,12hr}$ =	2.63 inches

Results ⇒

Partial Duration Series (100-yr event)	
Time	**Precip. Depth (in)**
5-minute	0.49
15-minute	0.89
1-hour	1.48
2-hour	1.65
3-hour	1.77
6-hour	2.03
12-hour	2.63
24-hour	3.22

Notes:
*Values of 2-year event are derived from 2-year Isohyetals Maps of NOAA Atlas.
**Values of 100-year event are calculated per Washoe Country Hydraulics and Drainage Design Manual.

Job No. 4307-05-0009
Created by: DLT 08-19-05
Checked by: CA 10-04-05

East and West Wash Dams
Partial Duration Series 100-year Event

Reno EAP Phase II
Client: City of Reno

Input Data ⇒

$D_{2yr,1hr}$ =	0.39	inches
$D_{2yr,6hr}$ =	0.83	inches
$D_{2yr,24hr}$ =	1.30	inches

Watershed Name:
EW_Wash Group 2

RGF (100yr,1hr) =	3.62	⇒	$D_{100yr,1hr}$ =	1.41 inches
RGF (100yr,6hr) =	2.26		$D_{100yr,6hr}$ =	1.88 inches
RGF (100yr,24hr) =	2.22		$D_{100yr,24hr}$ =	2.89 inches

Ratio5 =	0.33	⇒	$D_{100yr,5min}$ =	0.47 inches
Ratio15 =	0.60		$D_{100yr,15min}$ =	0.85 inches

$D_{100yr,2hr}$ =	1.55 inches
$D_{100yr,3hr}$ =	1.66 inches
$D_{100yr,12hr}$ =	2.38 inches

Results ⇒

Partial Duration Series (100-yr event)	
Time	**Precip. Depth (in)**
5-minute	0.47
15-minute	0.85
1-hour	1.41
2-hour	1.55
3-hour	1.66
6-hour	1.88
12-hour	2.38
24-hour	2.89

Notes:
*Values of 2-year event are derived from 2-year Isohyetals Maps of NOAA Atlas.
**Values of 100-year event are calculated per Washoe Country Hydraulics and Drainage Design Manual.

East and West Wash Dams
Partial Duration Series 100-year Event

Input Data ⇒

$D_{2yr,1hr}$ =	0.38	inches
$D_{2yr,6hr}$ =	0.79	inches
$D_{2yr,24hr}$ =	1.24	inches

Watershed Name: EW_Wash Group 3

RGF (100yr,1hr) =	3.62	⇒	$D_{100yr,1hr}$ =	1.38 inches
RGF (100yr,6hr) =	2.26		$D_{100yr,6hr}$ =	1.79 inches
RGF (100yr,24hr) =	2.22		$D_{100yr,24hr}$ =	2.75 inches

Ratio5 =	0.33	⇒	$D_{100yr,5min}$ =	0.45 inches
Ratio15 =	0.60		$D_{100yr,15min}$ =	0.83 inches

$D_{100yr,2hr}$ =	1.50 inches
$D_{100yr,3hr}$ =	1.59 inches
$D_{100yr,12hr}$ =	2.27 inches

Results ⇒

Partial Duration Series (100-yr event)	
Time	**Precip. Depth (in)**
5-minute	0.45
15-minute	0.83
1-hour	1.38
2-hour	1.50
3-hour	1.59
6-hour	1.79
12-hour	2.27
24-hour	2.75

Notes:
*Values of 2-year event are derived from 2-year Isohyetals Maps of NOAA Atlas.
**Values of 100-year event are calculated per Washoe Country Hydraulics and Drainage Design Manual.

Dant Boulevard Detention Dam
Partial Duration Series 100-year Event

Input Data ⇒

$D_{2yr,1hr}$ = 0.40 inches
$D_{2yr,6hr}$ = 0.87 inches
$D_{2yr,24hr}$ = 1.45 inches

Watershed Name:
Dant Group 1

RGF (100yr,1hr) =	3.62	$D_{100yr,1hr}$ =	1.45 inches
RGF (100yr,6hr) =	2.26	$D_{100yr,6hr}$ =	1.97 inches
RGF (100yr,24hr) =	2.22	$D_{100yr,24hr}$ =	3.22 inches

Ratio5 =	0.33	$D_{100yr,5min}$ =	0.48 inches
Ratio15 =	0.60	$D_{100yr,15min}$ =	0.87 inches

$D_{100yr,2hr}$ =	1.60 inches
$D_{100yr,3hr}$ =	1.72 inches
$D_{100yr,12hr}$ =	2.59 inches

Results ⇒

Partial Duration Series (100-yr event)	
Time	**Precip. Depth (in)**
5-minute	0.48
15-minute	0.87
1-hour	1.45
2-hour	1.60
3-hour	1.72
6-hour	1.97
12-hour	2.59
24-hour	3.22

NOTES:

1) Values of 2-year event are derived from 2-year Isohyetals Maps of NOAA Atlas.
2) Values of 100-year event are calculated per Washoe Country Hydraulics and Drainage Design Manual.
3) 2-year rainfall depths are interpolated to centroid of subbasin group.

Job No. 4307-05-0009
Created by: DLT 08-16-05
Checked by: CA 11-23-05

Dant Boulevard Detention Dam
Partial Duration Series 100-year Event

Reno EAP Phase II
Client: City of Reno

Input Data ⇒

$D_{2yr,1hr}$ = 0.40 inches
$D_{2yr,6hr}$ = 0.83 inches
$D_{2yr,24hr}$ = 1.33 inches

Watershed Name:
Dant Group 2

RGF (100yr,1hr) =	3.62	$D_{100yr,1hr}$ =	1.45 inches
RGF (100yr,6hr) =	2.26	$D_{100yr,6hr}$ =	1.88 inches
RGF (100yr,24hr) =	2.22	$D_{100yr,24hr}$ =	2.95 inches

Ratio5 =	0.33	$D_{100yr,5min}$ =	0.48 inches
Ratio15 =	0.60	$D_{100yr,15min}$ =	0.87 inches

$D_{100yr,2hr}$ =	1.58 inches
$D_{100yr,3hr}$ =	1.67 inches
$D_{100yr,12hr}$ =	2.41 inches

Results ⇒

Partial Duration Series (100-yr event)	
Time	**Precip. Depth (in)**
5-minute	0.48
15-minute	0.87
1-hour	1.45
2-hour	1.58
3-hour	1.67
6-hour	1.88
12-hour	2.41
24-hour	2.95

NOTES:

1) Values of 2-year event are derived from 2-year Isohyetals Maps of NOAA Atlas.
2) Values of 100-year event are calculated per Washoe Country Hydraulics and Drainage Design Manual.
3) 2-year rainfall depths are interpolated to centroid of subbasin group.

Dant Boulevard Detention Dam
Distribution of Precipitation of Emergency Spillway

$P_{total} = P_{100yr,6hr} + 0.26 * (PMP_{6hr} - P_{100,6hr})$ (from Technical Release No. 60)

	Group 1	Group 2
$P_{100yr,6hr}$ =	1.97 inches	1.88 inches
PMP_{6hr} =	11.6 inches	11.6 inches
P_{total} =	4.47 inches	4.41 inches

	Time Step (hour)												
	0	0.5	1.1	1.5	2.1	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
percent of duration	0	8.3	18.3	25.3	34.8	41.7	50	58.3	66.7	75	83.3	91.7	100
10%	0	46.7	82	95.6	100	100	100	100	100	100	100	100	100
20%	0	40.7	72.9	89.2	96.6	99.7	100	100	100	100	100	100	100
30%	0	34.1	62.5	80.7	92.2	97.7	99.4	100	100	100	100	100	100
40%	0	28.5	53.4	73	87.7	95	97.6	99	99.7	100	100	100	100
50%	0	23.1	44.8	65	81.6	90.1	93.6	96.5	98.6	99.7	99.9	100	100
60%	0	18.6	37.3	57.2	74.3	83.5	87.9	91.4	94.2	96.8	98.7	99.7	100
70%	0	15	31.5	49.9	65.4	74.3	79.9	84.9	89.3	93.1	96.2	98.4	100
80%	0	11.9	26	43.2	57.2	65.1	71.1	77.1	82.5	87.6	92.3	96.3	100
90%	0	8.4	20	35.6	49.2	55.6	61.6	67.4	73.1	79.5	86.5	93.5	100

Group 1

	0	0.5	1.1	1.5	2.1	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
10%	0.00	2.09	3.67	4.27	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47
20%	0.00	1.82	3.26	3.99	4.32	4.46	4.47	4.47	4.47	4.47	4.47	4.47	4.47
30%	0.00	1.52	2.79	3.61	4.12	4.37	4.44	4.47	4.47	4.47	4.47	4.47	4.47
40%	0.00	1.27	2.39	3.26	3.92	4.25	4.36	4.43	4.46	4.47	4.47	4.47	4.47
50%	0.00	1.03	2.00	2.91	3.65	4.03	4.18	4.31	4.41	4.46	4.47	4.47	4.47
60%	0.00	0.83	1.67	2.56	3.32	3.73	3.93	4.09	4.21	4.33	4.41	4.46	4.47
70%	0.00	0.67	1.41	2.23	2.92	3.32	3.57	3.80	3.99	4.16	4.30	4.40	4.47
80%	0.00	0.53	1.16	1.93	2.56	2.91	3.18	3.45	3.69	3.92	4.13	4.30	4.47
90%	0.00	0.38	0.89	1.59	2.15	2.49	2.75	3.01	3.27	3.55	3.87	4.18	4.47

Dant Boulevard Detention Dam
Distribution of Precipitation of Emergency Spillway

Group 2

	0	0.5	1.1	1.5	2.1	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
10%	0.00	2.06	3.62	4.22	4.41	4.41	4.41	4.41	4.41	4.41	4.41	4.41	4.41
20%	0.00	1.79	3.21	3.93	4.26	4.40	4.41	4.41	4.41	4.41	4.41	4.41	4.41
30%	0.00	1.50	2.76	3.56	4.07	4.31	4.38	4.41	4.41	4.41	4.41	4.41	4.41
40%	0.00	1.26	2.35	3.22	3.87	4.19	4.30	4.37	4.40	4.41	4.41	4.41	4.41
50%	0.00	1.02	1.98	2.87	3.60	3.97	4.13	4.26	4.35	4.40	4.41	4.41	4.41
60%	0.00	0.82	1.64	2.52	3.28	3.68	3.88	4.03	4.15	4.27	4.35	4.40	4.41
70%	0.00	0.66	1.39	2.20	2.88	3.28	3.52	3.74	3.94	4.11	4.24	4.34	4.41
80%	0.00	0.52	1.15	1.91	2.52	2.87	3.14	3.40	3.64	3.86	4.07	4.25	4.41
90%	0.00	0.37	0.88	1.57	2.13	2.45	2.72	2.97	3.22	3.51	3.81	4.12	4.41

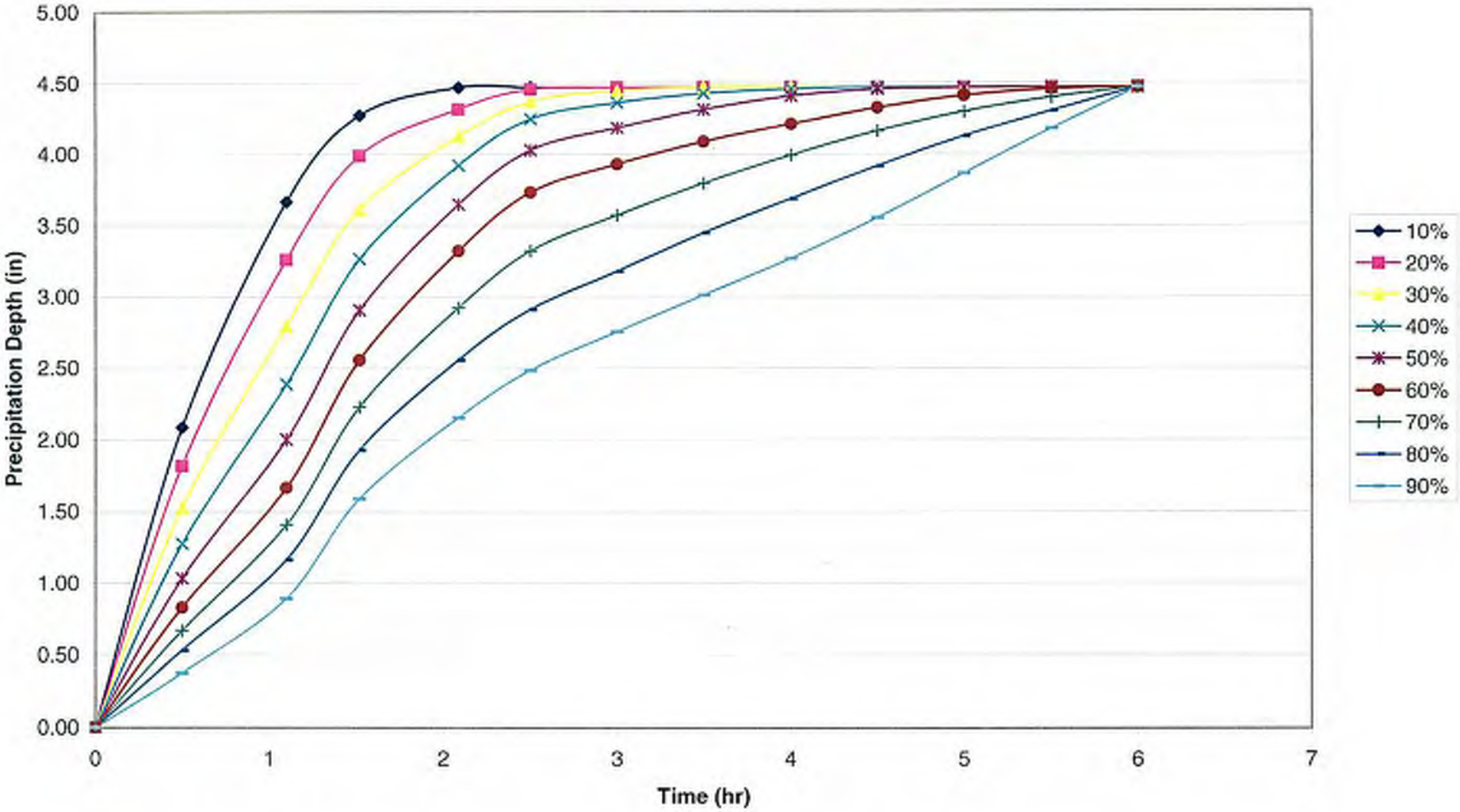
10%	
5-min	0.35
15-min	1.05
1-hr	3.41
2-hr	4.44
3-hr	4.47
6-hr	4.47

This partial duration series is derived from Group 1 and used in HEC-HMS for emergency spillway hydrologic analysis.

NOTES:

1) Partial series are obtained from Temporal Distribution of Extreme Events in NOAA Atlas 14.
2) P_{ESH} formula are from the emergency spillway design criteria in Technical Release No. 60.
3) $P_{100yr,6hr}$ is calculated per procedure from Washoe County Drainage Manual (See partial duration series table for Eash and West Wash)
4) PMP_{6hr} is calculated per procedure from Hydrometeorological Report No. 49 for extreme local event (thunderstorm). (See local 6-hour PMP calculation)
5) P_{ESH} are calculated for each subbasin group due to difference in P_{100yr} values. However, for simplicity of hydrologic modeling, rainfall depth and distribution of group 1 is the most conservative and chosen for emergency spillway analysis of East and West Wash detention dams.
6) For the study of dams in this project, ten (10) percent of cumulative probability (or percent of duration) is used as the early peak discharges and peak volumes are desired.

Emergency Spillway Hydrograph (Convective, First Quartile)
Dant



Dant Boulevard Detention Dam
Distribution of Precipitation of Freeboard

PMP_{6hr} = 11.6 inches (See PMP calculation)

	Time Step (hour)												
	0	0.5	1.1	1.5	2.1	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
percent of duration	0	8.3	18.3	25.3	34.8	41.7	50	58.3	66.7	75	83.3	91.7	100
10%	0	46.7	82	95.6	100	100	100	100	100	100	100	100	100
20%	0	40.7	72.9	89.2	96.6	99.7	100	100	100	100	100	100	100
30%	0	34.1	62.5	80.7	92.2	97.7	99.4	100	100	100	100	100	100
40%	0	28.5	53.4	73	87.7	95	97.6	99	99.7	100	100	100	100
50%	0	23.1	44.8	65	81.6	90.1	93.8	96.5	98.6	99.7	99.9	100	100
60%	0	18.6	37.3	57.2	74.3	83.5	87.9	91.4	94.2	96.8	98.7	99.7	100
70%	0	15	31.5	49.9	65.4	74.3	79.9	84.9	89.3	93.1	96.2	98.4	100
80%	0	11.9	26	43.2	57.2	65.1	71.1	77.1	82.5	87.6	92.3	96.3	100
90%	0	8.4	20	35.6	48.2	55.6	61.8	67.4	73.1	79.5	86.5	93.5	100

	0	0.5	1.1	1.5	2.1	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
percent of duration	0	5.4	9.5	11.1	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6
10%	0.00	5.42	9.51	11.09	11.60	11.60	11.60	11.60	11.60	11.60	11.60	11.60	11.60
20%	0.00	4.72	8.46	10.35	11.21	11.57	11.60	11.60	11.60	11.60	11.60	11.60	11.60
30%	0.00	3.96	7.25	9.36	10.70	11.33	11.53	11.60	11.60	11.60	11.60	11.60	11.60
40%	0.00	3.31	6.19	8.47	10.17	11.02	11.32	11.48	11.57	11.60	11.60	11.60	11.60
50%	0.00	2.68	5.20	7.54	9.47	10.45	10.86	11.19	11.44	11.57	11.59	11.60	11.60
60%	0.00	2.16	4.33	6.64	8.62	9.69	10.20	10.60	10.93	11.23	11.45	11.57	11.60
70%	0.00	1.74	3.65	5.79	7.59	8.62	9.27	9.85	10.36	10.80	11.16	11.41	11.60
80%	0.00	1.38	3.02	5.01	6.64	7.55	8.25	8.94	9.57	10.16	10.71	11.17	11.60
90%	0.00	0.97	2.32	4.13	5.59	6.45	7.15	7.82	8.48	9.22	10.03	10.85	11.60

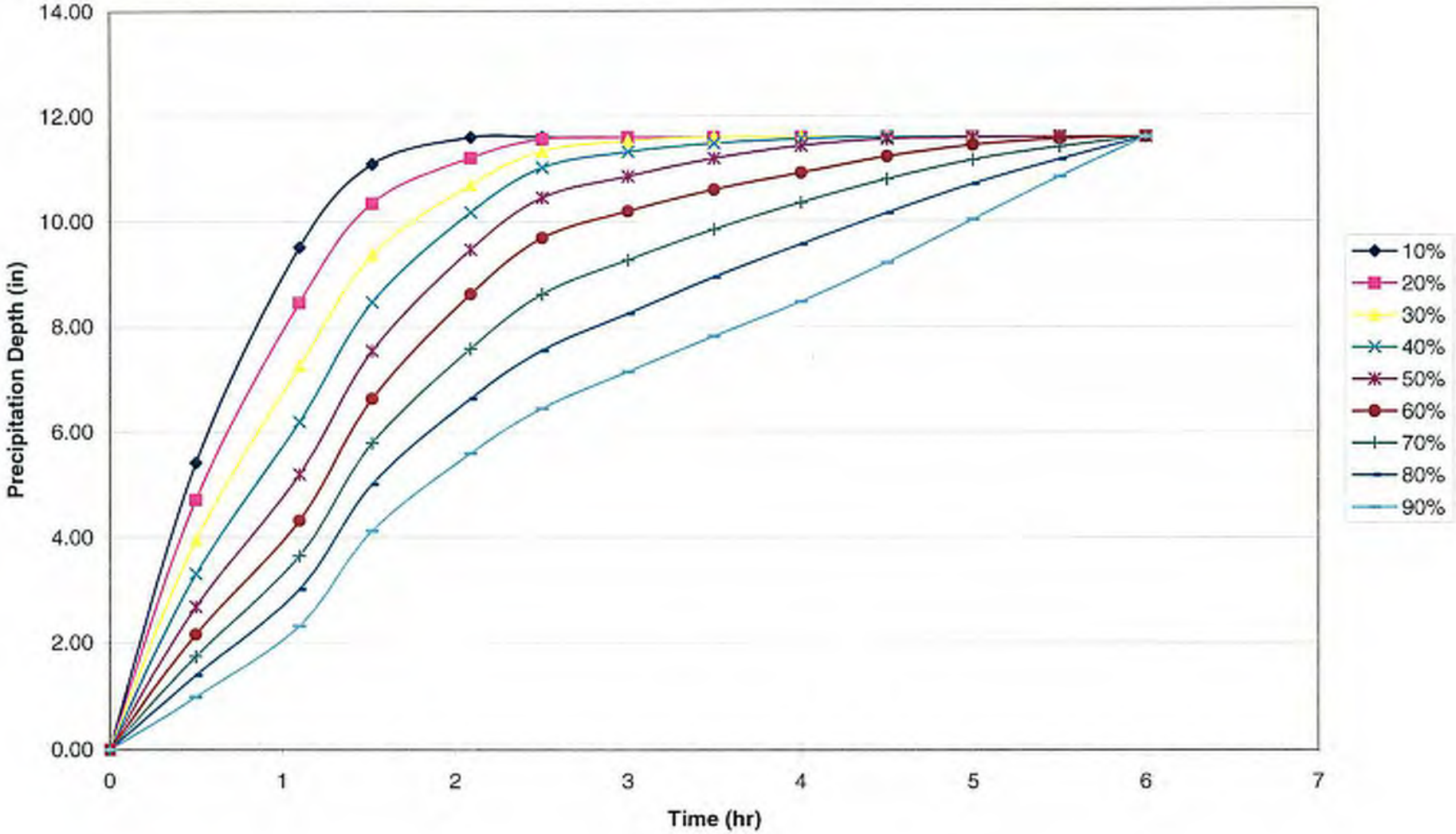
10%	
5-min	0.9
15-min	2.71
1-hr	8.83
2-hr	11.52
3-hr	11.6
6-hr	11.6

This partial duration series is used in HEC-HMS for Local 6-hour PMF analyis.

NOTES:

1) Partial series are obtained from Temporal Distribution of Extreme Events in NOAA Atlas 14.
2) PMP_{6hr} is calculated per procedure from Hydrometeorological Report No. 49 for extreme local event (thunderstorm). (See local 6-hour PMP calculation)
3) For the study of dams in this project, ten (10) percent of cumulative probability (or percent of duration) is used as the early peak discharges and peak volumes are desired.
4) PMP_{6hr} is used for freeboard analysis per design criteria in Technical Release No. 60.

Freeboard Hydrograph (Convective, First Quartile)
Dant



Job No. 4307-05-0009
Created by: DLT 08-19-05
Checked by: CA 10-04-05

Upper and Lower Peavine Dams
Partial Duration Series 100-year Event

Reno EAP Phase II
Client: City of Reno

Input Data ⇒

$D_{2yr,1hr}$ =	0.44	inches
$D_{2yr,6hr}$ =	0.93	inches
$D_{2yr,24hr}$ =	1.46	inches

Watershed Name:
UL_Peavine Group 1

RGF (100yr,1hr) =	3.62	⇒	$D_{100yr,1hr}$ =	1.59 inches
RGF (100yr,6hr) =	2.26		$D_{100yr,6hr}$ =	2.10 inches
RGF (100yr,24hr) =	2.22		$D_{100yr,24hr}$ =	3.24 inches

Ratio5 =	0.33	⇒	$D_{100yr,5min}$ =	0.53 inches
Ratio15 =	0.60		$D_{100yr,15min}$ =	0.96 inches

$D_{100yr,2hr}$ =	1.74 inches
$D_{100yr,3hr}$ =	1.86 inches
$D_{100yr,12hr}$ =	2.67 inches

Results ⇒

Partial Duration Series (100-yr event)	
Time	**Precip. Depth (in)**
5-minute	0.53
15-minute	0.96
1-hour	1.59
2-hour	1.74
3-hour	1.86
6-hour	2.10
12-hour	2.67
24-hour	3.24

NOTES:

1) Values of 2-year event are derived from 2-year Isohyetals Maps of NOAA Atlas.
2) Values of 100-year event are calculated per Washoe Country Hydraulics and Drainage Design Manual.
3) 2-year rainfall depths are interpolated to centroid of subbasin group.

Job No. 4307-05-0009
Created by: DLT 08-19-05
Checked by: CA 10-04-05

Upper and Lower Peavine Dams
Partial Duration Series 100-year Event

Reno EAP Phase II
Client: City of Reno

Input Data ⇒

$D_{2yr,1hr}$ =	0.38	inches
$D_{2yr,6hr}$ =	0.80	inches
$D_{2yr,24hr}$ =	1.28	inches

Watershed Name:
UL_Peavine Group 2

RGF (100yr,1hr) =	3.62	$D_{100yr,1hr}$ =	1.38 inches
RGF (100yr,6hr) =	2.26	$D_{100yr,6hr}$ =	1.81 inches
RGF (100yr,24hr) =	2.22	$D_{100yr,24hr}$ =	2.84 inches

Ratio5 =	0.33	$D_{100yr,5min}$ =	0.45 inches
Ratio15 =	0.60	$D_{100yr,15min}$ =	0.83 inches

$D_{100yr,2hr}$ =	1.50 inches
$D_{100yr,3hr}$ =	1.60 inches
$D_{100yr,12hr}$ =	2.32 inches

Results ⇒

Partial Duration Series (100-yr event)	
Time	**Precip. Depth (in)**
5-minute	0.45
15-minute	0.83
1-hour	1.38
2-hour	1.50
3-hour	1.60
6-hour	1.81
12-hour	2.32
24-hour	2.84

NOTES:

1) Values of 2-year event are derived from 2-year Isohyetals Maps of NOAA Atlas.
2) Values of 100-year event are calculated per Washoe Country Hydraulics and Drainage Design Manual.
3) 2-year rainfall depths are interpolated to centroid of subbasin group.

Upper and Lower Peavine Dams
Partial Duration Series 100-year Event

Input Data ⇒

$D_{2yr,1hr}$ =	0.38	inches
$D_{2yr,6hr}$ =	0.80	inches
$D_{2yr,24hr}$ =	1.28	inches

Watershed Name:
UL_Peavine Group 3

RGF (100yr,1hr) =	3.62	⇒	$D_{100yr,1hr}$ =	1.38 inches
RGF (100yr,6hr) =	2.26		$D_{100yr,6hr}$ =	1.81 inches
RGF (100yr,24hr) =	2.22		$D_{100yr,24hr}$ =	2.84 inches

Ratio5 =	0.33	⇒	$D_{100yr,5min}$ =	0.45 inches
Ratio15 =	0.60		$D_{100yr,15min}$ =	0.83 inches

$D_{100yr,2hr}$ =	1.50 inches
$D_{100yr,3hr}$ =	1.60 inches
$D_{100yr,12hr}$ =	2.32 inches

Results ⇒

Partial Duration Series (100-yr event)	
Time	**Precip. Depth (in)**
5-minute	0.45
15-minute	0.83
1-hour	1.38
2-hour	1.50
3-hour	1.60
6-hour	1.81
12-hour	2.32
24-hour	2.84

NOTES:

1) Values of 2-year event are derived from 2-year Isohyetals Maps of NOAA Atlas.
2) Values of 100-year event are calculated per Washoe Country Hydraulics and Drainage Design Manual.
3) 2-year rainfall depths are interpolated to centroid of subbasin group.

Upper and Lower Peavine Dams
Partial Duration Series 100-year Event

Input Data ⇒

$D_{2yr,1hr}$ =	0.36	inches
$D_{2yr,6hr}$ =	0.78	inches
$D_{2yr,24hr}$ =	1.21	inches

Watershed Name:
UL_Peavine Group 4

RGF (100yr,1hr) =	3.62	⇒	$D_{100yr,1hr}$ =	1.30 inches
RGF (100yr,6hr) =	2.26		$D_{100yr,6hr}$ =	1.76 inches
RGF (100yr,24hr) =	2.22		$D_{100yr,24hr}$ =	2.69 inches

Ratio5 =	0.33	⇒	$D_{100yr,5min}$ =	0.43 inches
Ratio15 =	0.60		$D_{100yr,15min}$ =	0.78 inches

$D_{100yr,2hr}$ =	1.44 inches
$D_{100yr,3hr}$ =	1.54 inches
$D_{100yr,12hr}$ =	2.22 inches

Results ⇒

Partial Duration Series (100-yr event)	
Time	**Precip. Depth (in)**
5-minute	0.43
15-minute	0.78
1-hour	1.30
2-hour	1.44
3-hour	1.54
6-hour	1.76
12-hour	2.22
24-hour	2.69

NOTES:

1) Values of 2-year event are derived from 2-year Isohyetals Maps of NOAA Atlas.
2) Values of 100-year event are calculated per Washoe Country Hydraulics and Drainage Design Manual.
3) 2-year rainfall depths are interpolated to centroid of subbasin group.

Upper and Lower Peavine
Distribution of Precipitation of Emergency Spillway

$P_{ESH} = P_{100yr,6hr} + 0.26 * (PMP_{6hr} - P_{100,6hr})$ (from Technical Release No. 60)

	Group 1	Group 2	Group 3
$P_{100yr,6hr}$ =	2.1 inches	1.81 inches	1.76 inches
PMP_{6hr} =	11.6 inches	11.6 inches	11.6 inches
P_{ESH} =	4.57 inches	4.36 inches	4.32 inches

	Time Step (hour)												
	0	0.5	1.1	1.5	2.1	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
percent of duration	0	8.3	18.3	25.3	34.8	41.7	50	58.3	66.7	75	83.3	91.7	100
10%	0	46.7	82	95.6	100	100	100	100	100	100	100	100	100
20%	0	40.7	72.9	89.2	96.6	99.7	100	100	100	100	100	100	100
30%	0	34.1	62.5	80.7	92.2	97.7	99.4	100	100	100	100	100	100
40%	0	28.5	53.4	73	87.7	95	97.6	99	99.7	100	100	100	100
50%	0	23.1	44.8	65	81.6	90.1	93.6	96.5	98.6	99.7	99.9	100	100
60%	0	18.6	37.3	57.2	74.3	83.5	87.9	91.4	94.2	96.8	98.7	99.7	100
70%	0	15	31.5	49.9	65.4	74.3	79.9	84.9	89.3	93.1	96.2	98.4	100
80%	0	11.9	26	43.2	57.2	65.1	71.1	77.1	82.5	87.6	92.3	96.3	100
90%	0	8.4	20	35.6	48.2	55.6	61.6	67.4	73.1	79.5	86.5	93.5	100

Group 1

	0	0.5	1.1	1.5	2.1	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
10%	0.00	2.13	3.75	4.37	4.57	4.57	4.57	4.57	4.57	4.57	4.57	4.57	4.57
20%	0.00	1.86	3.33	4.08	4.41	4.56	4.57	4.57	4.57	4.57	4.57	4.57	4.57
30%	0.00	1.56	2.86	3.69	4.21	4.46	4.54	4.57	4.57	4.57	4.57	4.57	4.57
40%	0.00	1.30	2.44	3.34	4.01	4.34	4.46	4.52	4.56	4.57	4.57	4.57	4.57
50%	0.00	1.06	2.05	2.97	3.73	4.12	4.28	4.41	4.51	4.56	4.57	4.57	4.57
60%	0.00	0.85	1.70	2.61	3.40	3.82	4.02	4.18	4.30	4.42	4.51	4.56	4.57
70%	0.00	0.69	1.44	2.28	2.99	3.40	3.65	3.88	4.08	4.25	4.40	4.50	4.57
80%	0.00	0.54	1.19	1.97	2.61	2.98	3.25	3.52	3.77	4.00	4.22	4.40	4.57
90%	0.00	0.38	0.91	1.63	2.20	2.54	2.82	3.08	3.34	3.63	3.95	4.27	4.57

Group 2

	0	0.5	1.1	1.5	2.1	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
10%	0.00	2.04	3.58	4.17	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36
20%	0.00	1.77	3.18	3.89	4.21	4.35	4.36	4.36	4.36	4.36	4.36	4.36	4.36
30%	0.00	1.49	2.73	3.52	4.02	4.26	4.33	4.36	4.36	4.36	4.36	4.36	4.36
40%	0.00	1.24	2.33	3.18	3.82	4.14	4.26	4.32	4.35	4.36	4.36	4.36	4.36
50%	0.00	1.01	1.95	2.83	3.56	3.93	4.08	4.21	4.30	4.35	4.36	4.36	4.36
60%	0.00	0.81	1.63	2.49	3.24	3.64	3.83	3.99	4.11	4.22	4.30	4.35	4.36
70%	0.00	0.65	1.37	2.18	2.85	3.24	3.48	3.70	3.89	4.06	4.19	4.29	4.36

Upper and Lower Peavine
Distribution of Precipitation of Emergency Spillway

80%	0.00	0.52	1.13	1.88	2.49	2.84	3.10	3.36	3.60	3.82	4.02	4.20	4.36
90%	0.00	0.37	0.87	1.55	2.10	2.42	2.69	2.94	3.19	3.47	3.77	4.08	4.36

Group 3

	0	0.5	1.1	1.5	2.1	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
10%	0.00	2.02	3.54	4.13	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32
20%	0.00	1.76	3.15	3.85	4.17	4.31	4.32	4.32	4.32	4.32	4.32	4.32	4.32
30%	0.00	1.47	2.70	3.49	3.98	4.22	4.29	4.32	4.32	4.32	4.32	4.32	4.32
40%	0.00	1.23	2.31	3.15	3.79	4.10	4.22	4.28	4.31	4.32	4.32	4.32	4.32
50%	0.00	1.00	1.94	2.81	3.53	3.89	4.04	4.17	4.26	4.31	4.32	4.32	4.32
60%	0.00	0.80	1.61	2.47	3.21	3.61	3.80	3.95	4.07	4.18	4.26	4.31	4.32
70%	0.00	0.65	1.36	2.16	2.83	3.21	3.45	3.67	3.86	4.02	4.16	4.25	4.32
80%	0.00	0.51	1.12	1.87	2.47	2.81	3.07	3.33	3.56	3.78	3.99	4.16	4.32
90%	0.00	0.36	0.86	1.54	2.08	2.40	2.66	2.91	3.16	3.43	3.74	4.04	4.32

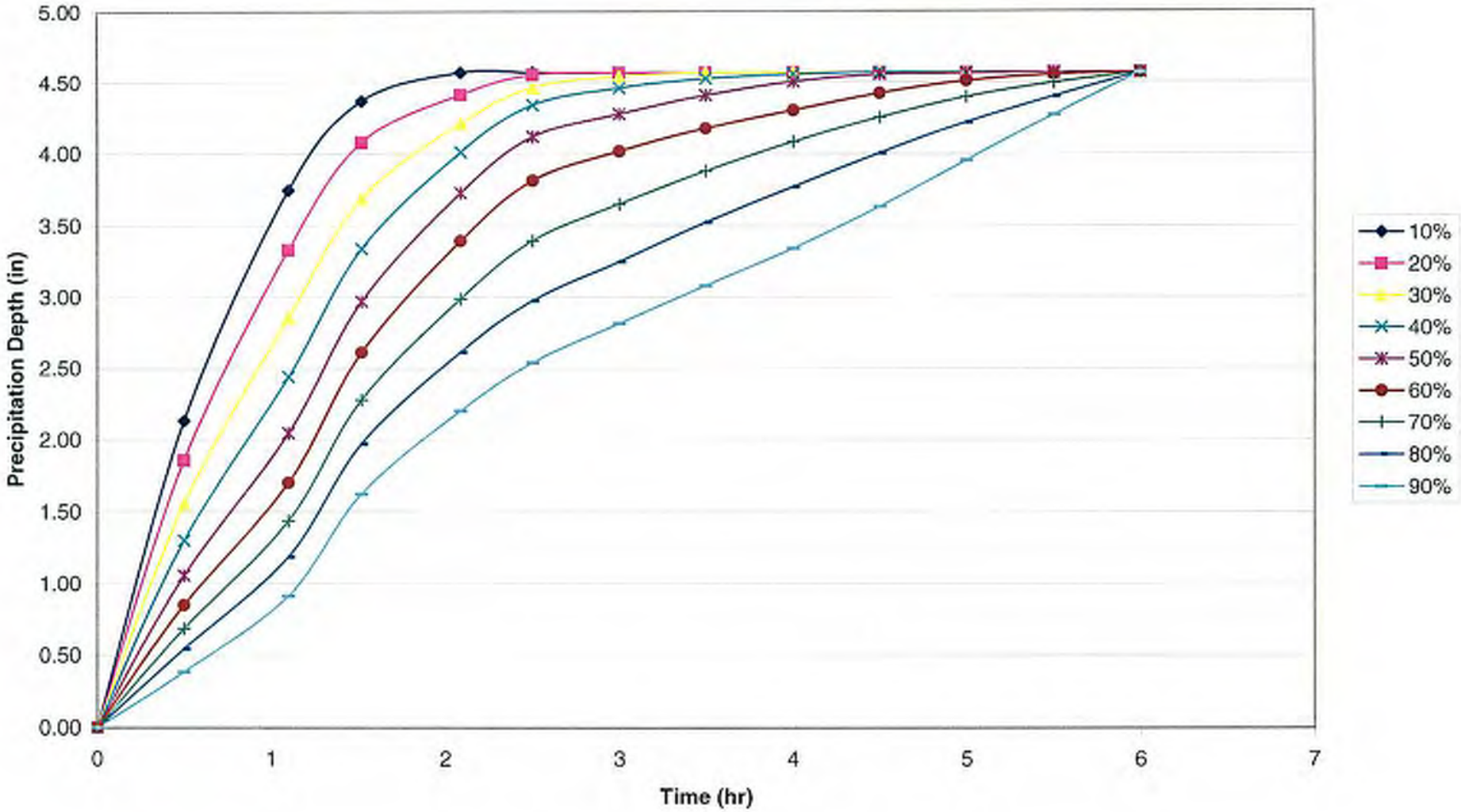
10%	
5-min	0.35
15-min	1.07
1-hr	3.48
2-hr	4.57
3-hr	4.57
6-hr	4.57

This partial duration series is derived from Group 1 and used in HEC-HMS for emergency spillway hydrologic analysis.

NOTES:

1) Partial series are obtained from Temporal Distribution of Extreme Events in NOAA Atlas 14.
2) P_{ESH} formula are from the emergency spillway design criteria of SCS dams in Technical Release No. 60.
3) $P_{100yr,6hr}$ is calculated per procedure from Washoe County Drainage Manual (See partial duration series table for Eash and West Wash).
4) PMP_{6hr} is calculated per procedure from Hydrometeorological Report No. 49 for extreme local event (thunderstorm). (See local 6-hour PMP calculation)
5) P_{ESH} are calculated for each subbasin group due to difference in P_{100yr} values. However, for simplicity of hydrologic modeling, rainfall depth and distribution of group 1 is the most conservative and chosen for emergency spillway analysis of East and West Wash detention dams.
6) For the study of dams in this project, ten (10) percent of cumulative probability (or percent of duration) is used as the early peak discharges and peak volumes are desired.

Emergency Spillway Hydrograph (Convective, First Quartile)
Upper and Lower Peavine



Upper and Lower Peavine
Distribution of Precipitation of Freeboard

PMP_{6hr} = 11.6 inches (See PMP calculation)

	Time Step (hour)												
	0	0.5	1.1	1.5	2.1	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
percent of duration	0	8.3	18.3	25.3	34.8	41.7	50	58.3	66.7	75	83.3	91.7	100
10%	0	46.7	82	95.6	100	100	100	100	100	100	100	100	100
20%	0	40.7	72.9	89.2	96.6	99.7	100	100	100	100	100	100	100
30%	0	34.1	62.5	80.7	92.2	97.7	99.4	100	100	100	100	100	100
40%	0	28.5	53.4	73	87.7	95	97.6	99	99.7	100	100	100	100
50%	0	23.1	44.8	65	81.6	90.1	93.6	96.5	98.6	99.7	99.9	100	100
60%	0	18.6	37.3	57.2	74.3	83.5	87.9	91.4	94.2	96.8	98.7	99.7	100
70%	0	15	31.5	49.9	65.4	74.3	79.9	84.9	89.3	93.1	96.2	98.4	100
80%	0	11.9	26	43.2	57.2	65.1	71.1	77.1	82.5	87.6	92.3	96.3	100
90%	0	8.4	20	35.6	48.2	55.6	61.6	67.4	73.1	79.5	86.5	93.5	100

	0	0.5	1.1	1.5	2.1	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
percent of duration	0	5.4	9.5	11.1	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6
10%	0.00	5.42	9.51	11.09	11.60	11.60	11.60	11.60	11.60	11.60	11.60	11.60	11.60
20%	0.00	4.72	8.46	10.35	11.21	11.57	11.60	11.60	11.60	11.60	11.60	11.60	11.60
30%	0.00	3.96	7.25	9.36	10.70	11.33	11.53	11.60	11.60	11.60	11.60	11.60	11.60
40%	0.00	3.31	6.19	8.47	10.17	11.02	11.32	11.48	11.57	11.60	11.60	11.60	11.60
50%	0.00	2.68	5.20	7.54	9.47	10.45	10.86	11.19	11.44	11.57	11.59	11.60	11.60
60%	0.00	2.16	4.33	6.64	8.62	9.69	10.20	10.60	10.93	11.23	11.45	11.57	11.60
70%	0.00	1.74	3.65	5.79	7.59	8.62	9.27	9.85	10.36	10.80	11.16	11.41	11.60
80%	0.00	1.38	3.02	5.01	6.64	7.55	8.25	8.94	9.57	10.16	10.71	11.17	11.60
90%	0.00	0.97	2.32	4.13	5.59	6.45	7.15	7.82	8.48	9.22	10.03	10.85	11.60

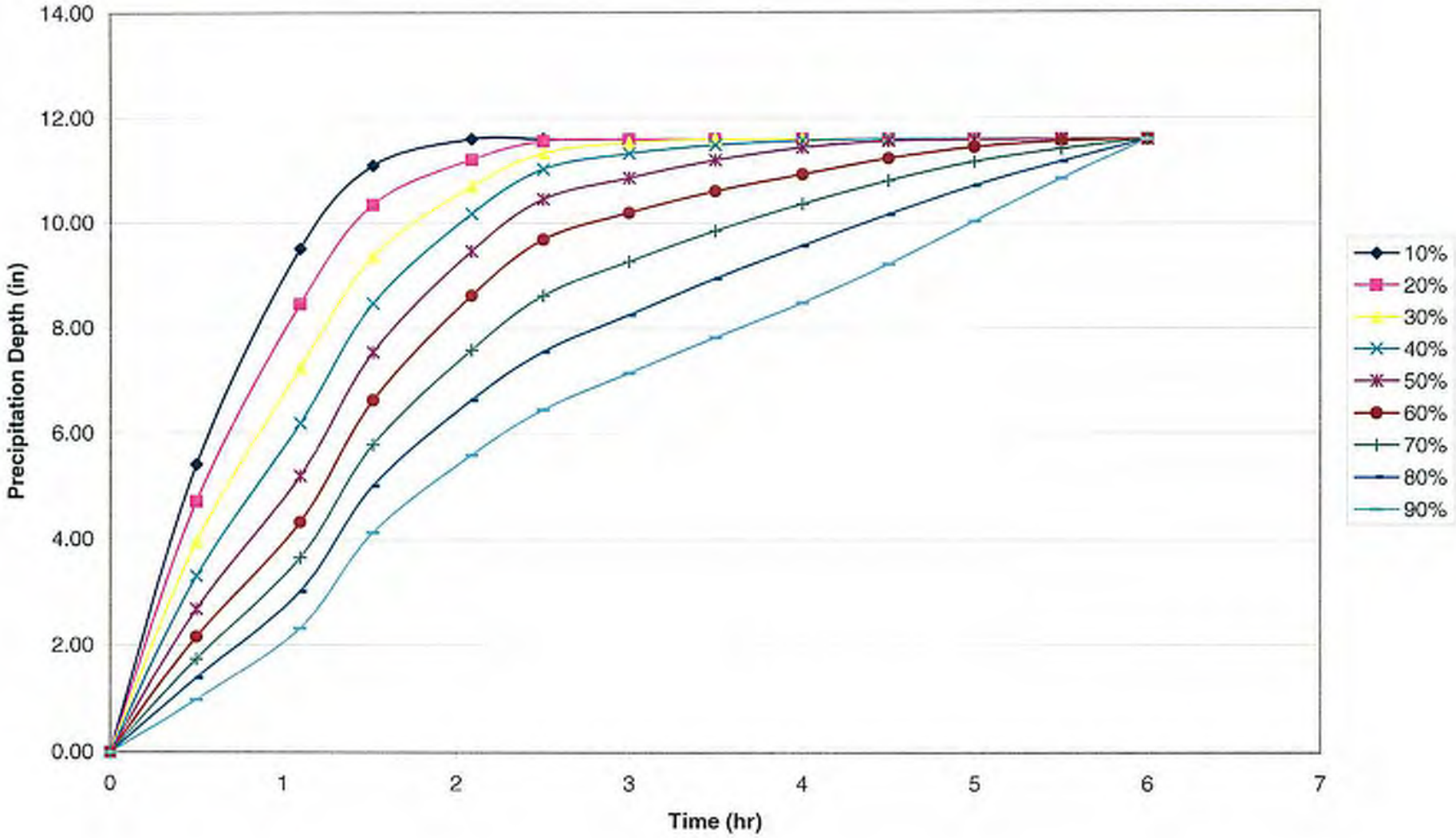
	10%
5-min	0.9
15-min	2.71
1-hr	8.63
2-hr	11.52
3-hr	11.6
6-hr	11.6

This partial duration series is used in HEC-HMS for Local 6-hour PMF analyis.

NOTES:

1) Partial series are obtained from Temporal Distribution of Extreme Events in NOAA Atlas 14.
2) PMP_{6hr} is calculated per procedure from Hydrometeorological Report No. 49 for extreme local event (thunderstorm). (See local 6-hour PMP calculation)
3) For the study of dams in this project, ten (10) percent of cumulative probability (or percent of duration) is used as the early peak discharges and peak volumes are desired.
4) PMP_{6hr} is used for freeboard analysis per design criteria of SCS dams in Technical Release No. 60.

Freeboard Hydrograph (Convective, First Quartile)
Upper and Lower Peavine



East and West Wash
Distribution of Precipitation of Emergency Spillway

$P_{ESH} = P_{100yr,6hr} + 0.26 * (PMP_{6hr} - P_{100,6hr})$ (Technical Release No. 60)

	Group 1	Group 2	Group 3
$P_{100yr,6hr}$ =	2.03 inches	1.88 inches	1.79 inches
PMP_{6hr} =	11.6 inches	11.6 inches	11.6 inches
P_{ESH} =	4.52 inches	4.41 inches	4.34 inches

Time Step (hour)

	0	0.5	1.1	1.5	2.1	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
percent of duration	0	8.3	16.3	25.3	34.8	41.7	50	58.3	66.7	75	83.3	91.7	100
10%	0	46.7	82	95.6	100	100	100	100	100	100	100	100	100
20%	0	40.7	72.9	89.2	96.6	99.7	100	100	100	100	100	100	100
30%	0	34.1	62.5	80.7	92.2	97.7	99.4	100	100	100	100	100	100
40%	0	28.5	53.4	73	87.7	95	97.6	99	99.7	100	100	100	100
50%	0	23.1	44.8	65	81.6	90.1	93.6	96.5	98.6	99.7	99.9	100	100
60%	0	18.6	37.3	57.2	74.3	83.5	87.9	91.4	94.2	96.8	98.7	99.7	100
70%	0	15	31.5	49.9	65.4	74.3	79.9	84.9	89.3	93.1	96.2	98.4	100
80%	0	11.9	26	43.2	57.2	65.1	71.1	77.1	82.5	87.6	92.3	96.3	100
90%	0	8.4	20	35.6	48.2	55.6	61.6	67.4	73.1	79.5	86.5	93.5	100

Group 1

	0	0.5	1.1	1.5	2.1	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
10%	0	2.11	3.71	4.32	4.52	4.52	4.52	4.52	4.52	4.52	4.52	4.52	4.52
20%	0	1.84	3.30	4.03	4.37	4.51	4.52	4.52	4.52	4.52	4.52	4.52	4.52
30%	0	1.54	2.83	3.65	4.17	4.42	4.49	4.52	4.52	4.52	4.52	4.52	4.52
40%	0	1.29	2.41	3.30	3.96	4.29	4.41	4.47	4.51	4.52	4.52	4.52	4.52
50%	0	1.04	2.02	2.94	3.69	4.07	4.23	4.36	4.46	4.51	4.52	4.52	4.52
60%	0	0.84	1.69	2.59	3.36	3.77	3.97	4.13	4.26	4.38	4.46	4.51	4.52
70%	0	0.68	1.42	2.26	2.96	3.36	3.61	3.84	4.04	4.21	4.35	4.45	4.52
80%	0	0.54	1.18	1.95	2.59	2.94	3.21	3.48	3.73	3.96	4.17	4.35	4.52
90%	0	0.38	0.90	1.61	2.18	2.51	2.78	3.05	3.30	3.59	3.91	4.23	4.52

Group 2

	0	0.5	1.1	1.5	2.1	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
10%	0.00	2.06	3.62	4.22	4.41	4.41	4.41	4.41	4.41	4.41	4.41	4.41	4.41
20%	0.00	1.79	3.21	3.93	4.26	4.40	4.41	4.41	4.41	4.41	4.41	4.41	4.41
30%	0.00	1.50	2.76	3.56	4.07	4.31	4.38	4.41	4.41	4.41	4.41	4.41	4.41
40%	0.00	1.26	2.35	3.22	3.87	4.19	4.30	4.37	4.40	4.41	4.41	4.41	4.41
50%	0.00	1.02	1.98	2.87	3.60	3.97	4.13	4.26	4.35	4.40	4.41	4.41	4.41
60%	0.00	0.82	1.64	2.52	3.28	3.68	3.88	4.03	4.15	4.27	4.35	4.40	4.41
70%	0.00	0.66	1.39	2.20	2.88	3.28	3.52	3.74	3.94	4.11	4.24	4.34	4.41
80%	0.00	0.52	1.15	1.91	2.52	2.87	3.14	3.40	3.64	3.86	4.07	4.25	4.41
90%	0.00	0.37	0.88	1.57	2.13	2.45	2.72	2.97	3.22	3.51	3.81	4.12	4.41

East and West Wash
Distribution of Precipitation of Emergency Spillway

Group 3

	0	0.5	1.1	1.5	2.1	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
10%	0.00	2.03	3.56	4.15	4.34	4.34	4.34	4.34	4.34	4.34	4.34	4.34	4.34
20%	0.00	1.77	3.16	3.87	4.19	4.33	4.34	4.34	4.34	4.34	4.34	4.34	4.34
30%	0.00	1.48	2.71	3.50	4.00	4.24	4.31	4.34	4.34	4.34	4.34	4.34	4.34
40%	0.00	1.24	2.32	3.17	3.81	4.12	4.24	4.30	4.33	4.34	4.34	4.34	4.34
50%	0.00	1.00	1.94	2.82	3.54	3.91	4.06	4.19	4.28	4.33	4.34	4.34	4.34
60%	0.00	0.81	1.62	2.48	3.22	3.62	3.81	3.97	4.09	4.20	4.28	4.33	4.34
70%	0.00	0.65	1.37	2.17	2.84	3.22	3.47	3.68	3.88	4.04	4.18	4.27	4.34
80%	0.00	0.52	1.13	1.87	2.48	2.83	3.09	3.35	3.58	3.80	4.01	4.18	4.34
90%	0.00	0.36	0.87	1.55	2.09	2.41	2.67	2.93	3.17	3.45	3.75	4.06	4.34

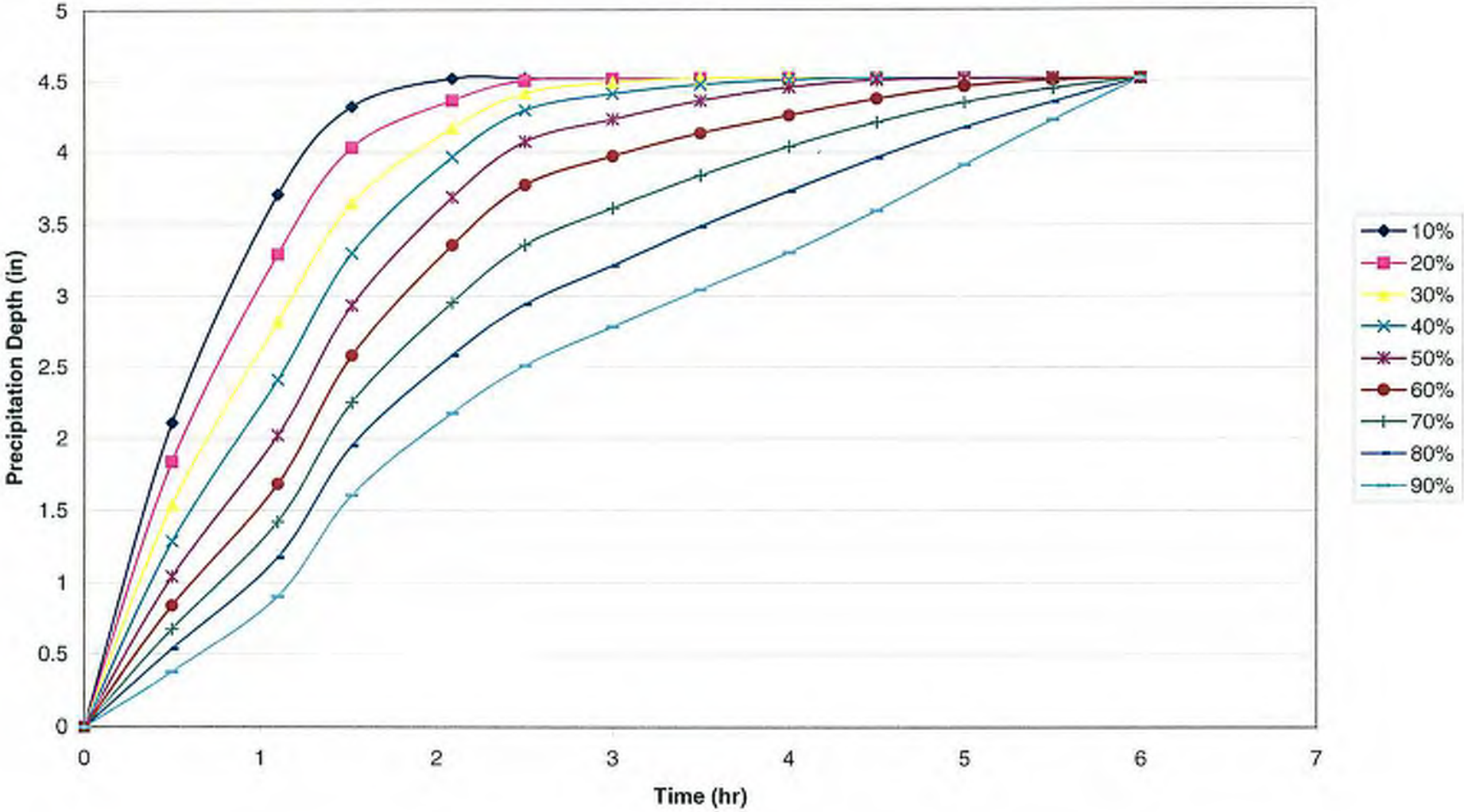
10%	
5-min	0.35
15-min	1.06
1-hr	3.44
2-hr	4.49
3-hr	4.52
6-hr	4.52

⟸ This partial duration series is derived from Group 1 and used in HEC-HMS for emergency spillway hydrologic analysis.

NOTES:

1) Partial series are obtained from Temporal Distribution of Extreme Events in NOAA Atlas 14.
2) P_{ESH} formula are from the emergency spillway design criteria of SCS dams in Technical Release No. 60.
3) $P_{100yr,6hr}$ is calculated per procedure from Washoe County Drainage Manual (See partial duration series table for Eash and West Wash).
4) PMP_{6hr} is calculated per procedure from Hydrometeorological Report No. 49 for extreme local event (thunderstorm). (See local 6-hour PMP calculation)
5) P_{ESH} are calculated for each subbasin group due to difference in P_{100yr} values. However, for simplicity of hydrologic modeling, rainfall depth and distribution of group 1 is the most conservative and chosen for emergency spillway analysis of East and West Wash detention dams.
6) For the study of dams in this project, ten (10) percent of cumulative probability (or percent of duration) is used as the early peak discharges and peak volumes are desired.

Emergency Spillway Hydrograph (Convective, First Quartile)
East and West Wash



East and West Wash
Distribution of Precipitation of Freeboard

PMP_{6hr} = 11.6 inches (Technical Release No. 60)

	Time Step (hour)												
	0	0.5	1.1	1.5	2.1	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
percent of duration	0	8.3	18.3	25.3	34.8	41.7	50	58.3	66.7	75	83.3	91.7	100
10%	0	46.7	82	95.6	100	100	100	100	100	100	100	100	100
20%	0	40.7	72.9	89.2	96.6	99.7	100	100	100	100	100	100	100
30%	0	34.1	62.5	80.7	92.2	97.7	99.4	100	100	100	100	100	100
40%	0	28.5	53.4	73	87.7	95	97.6	99	99.7	100	100	100	100
50%	0	23.1	44.8	65	81.6	90.1	93.6	96.5	98.6	99.7	99.9	100	100
60%	0	18.6	37.3	57.2	74.3	83.5	87.9	91.4	94.2	96.8	98.7	99.7	100
70%	0	15	31.5	49.9	65.4	74.3	79.9	84.9	89.3	93.1	96.2	98.4	100
80%	0	11.9	26	43.2	57.2	65.1	71.1	77.1	82.5	87.6	92.3	96.3	100
90%	0	8.4	20	35.6	48.2	55.6	61.6	67.4	73.1	79.5	86.5	93.5	100

	0	0.5	1.1	1.5	2.1	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
percent of duration	0	5.4	9.5	11.1	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6
10%	0.00	5.42	9.51	11.09	11.60	11.60	11.60	11.60	11.60	11.60	11.60	11.60	11.60
20%	0.00	4.72	8.46	10.35	11.21	11.57	11.60	11.60	11.60	11.60	11.60	11.60	11.60
30%	0.00	3.96	7.25	9.36	10.70	11.33	11.53	11.60	11.60	11.60	11.60	11.60	11.60
40%	0.00	3.31	6.19	8.47	10.17	11.02	11.32	11.48	11.57	11.60	11.60	11.60	11.60
50%	0.00	2.68	5.20	7.54	9.47	10.45	10.86	11.19	11.44	11.57	11.59	11.60	11.60
60%	0.00	2.16	4.33	6.64	8.62	9.69	10.20	10.60	10.93	11.23	11.45	11.57	11.60
70%	0.00	1.74	3.65	5.79	7.59	8.62	9.27	9.85	10.36	10.80	11.16	11.41	11.60
80%	0.00	1.38	3.02	5.01	6.64	7.55	8.25	8.94	9.57	10.16	10.71	11.17	11.60
90%	0.00	0.97	2.32	4.13	5.59	6.45	7.15	7.82	8.48	9.22	10.03	10.85	11.60

10%	
5-min	0.9
15-min	2.71
1-hr	8.83
2-hr	11.52
3-hr	11.6
6-hr	11.6

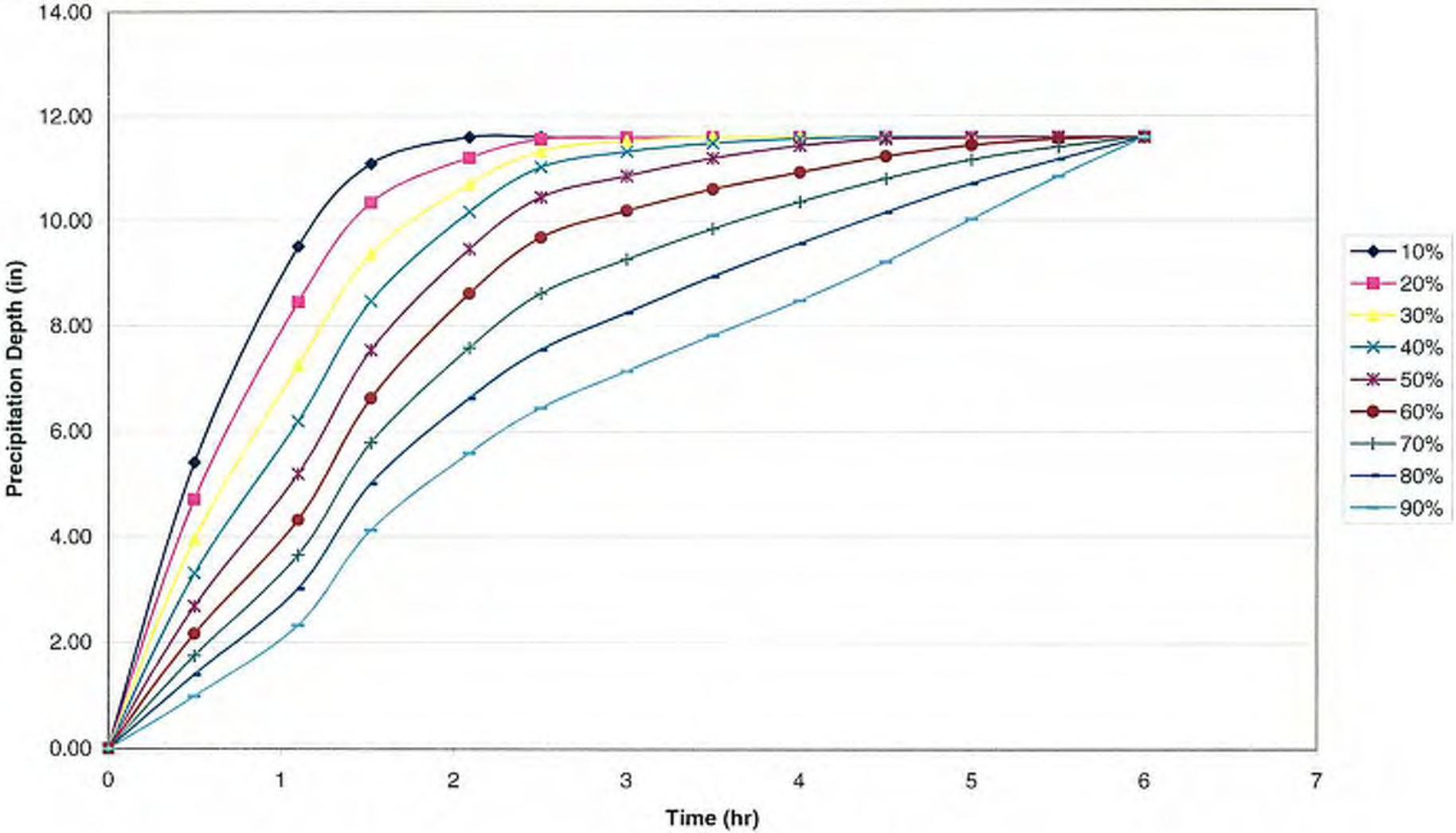
⟸ This partial duration series is used in HEC-HMS for Local 6-hour PMF analyis.

NOTES:

1) Partial series are obtained from Temporal Distribution of Extreme Events in NOAA Atlas 14.
2) PMP_{6hr} is calculated per procedure from Hydrometeorological Report No. 49 for extreme local event (thunderstorm). (See local 6-hour PMP calculation)
3) For the study of dams in this project, ten (10) percent of cumulative probability (or percent of duration) is used as the early peak discharges and peak volumes are desired.

4) PMP_{6h} is used for freeboard analysis per design criteria of SCS dams in Technical Release No. 60.

Freeboard Hydrograph (Convective, First Quartile)
East and West Wash



Anderson, Chris

From: Geoffrey Bonnin [HDSC.Questions@noaa.gov]
Sent: Friday, September 02, 2005 1:39 PM
To: Anderson, Chris; Questions HDSC
Subject: Re: General and Local PMP Estimates for Peavine Mountain near Reno, NV

OK, I'll have one of our folk look at this next Tuesday - Geoff

On Sep 2, 2005, at 4:13 PM, Anderson, Chris wrote:

HMR-59 Section 11.5.2 gives comparisons to HMR-49. For the Sierra region, HMR-49 yields higher index values for duration's up to 24 hours. This is what I meant by more "conservative" since I am interested in duration of 6 hours.

Figure 9.23 shows local storm estimates that include the Reno, NV area. I had a follow up question sent this morning:

... it appears that HMR-59 could be used for this area/Eastern Slope of Sierra Nevada. I realize I will get more conservative answers with HMR-49...but am more interested in what is the best and most current method to use. This is key, because the results will be used for hydrologic/hydraulic evaluation of existing high-hazard flood control dams in Reno, NV and incorporated into Emergency Action Plans. I am primarily interested in Local PMP values of 6-hr duration.

Any help you can provide would be greatly appreciated. We are concurrently looking at HMR-59 for local storms in Reno.

Thank You,

Christopher R. Anderson, P.E.

Senior Engineer
MACTEC Engineering and Consulting
961 Matley Lane, Suite 110
Reno, NV 89502

775/329-6123 (main)

775/326-5384 (direct)

775/322-9380 (fax)

cranderson@mactec.com

From: Geoffrey Bonnin [mailto:HDSC.Questions@noaa.gov]
Sent: Friday, September 02, 2005 11:48 AM

To: Anderson, Chris; Questions HDSC
Subject: Re: General and Local PMP Estimates for Peavine Mountain near Reno, NV

Chris,

Thanks for the enquiry. Even though HMR58/59 is more recent than HMR 49, HMR 58/59 applies to California and so the most recent HMR applying in Nevada is HMR 49. NOAA Atlas 14 will not include PMP. It is for precipitation frequency. There are currently no plans for updating any PMP documents and we're not receiving any funding for ongoing research, review, storm analysis, or public support. In the past we've received funding for our PMP activities from agencies who participate in the Interagency Committee on Dam Safety; primarily FEMA who is the coordinating agency under the National Dam Safety Act, and the U.S. Army Corps of Engineers.

By the way, can you tell me what you mean by "more conservative"? It will help my understanding of your needs.

Feel free to contact me, but please bear in mind that we're quite limited in the support we can provide.

Geoff Bonnin

Director, Hydrometeorological Design Studies Center

Chief, Hydrologic Data Systems Branch

Office of Hydrologic Development

NOAA's National Weather Service

On Sep 2, 2005, at 2:16 PM, Anderson, Chris wrote:

Hello again,

Regarding the below, it appears that HMR-59 could be used for this area/Eastern Slope of Sierra Nevada. I realize I will get more conservative answers with HMR-49...but am more interested in what is the best and most current method to use. This is key, because the results will be used for hydrologic/hydraulic evaluation of existing high-hazard flood control dams in Reno, NV and incorporated into Emergency Action Plans. I am primarily interested in Local PMP values of 6-hr duration.

I would appreciate it if I could get somebody to call and give me some input from the NWS.

Thanks You,

Christopher R. Anderson, P.E.

Senior Engineer
MACTEC Engineering and Consulting
961 Matley Lane, Suite 110
Reno, NV 89502

775/329-6123 (main)

775/326-5384 (direct)

775/322-9380 (fax)

cranderson@mactec.com

Hello,

I have a question regarding PMP estimates for the General and Local PMP Estimates for Peavine Mountain near Reno, NV./ I'm not sure that HMR-49 would be the best to use. Will NOAA Atlas 14 address PMP estimates in the future?

Can I use HMR-58/59 for the eastern slope of the Sierra Nevada for Local PMP estimates? I am basically looking for the latest methodology for PMP estimates in the Reno, NV area.

Thanks

Chris

Christopher R. Anderson, P.E.

Senior Engineer
MACTEC Engineering and Consulting
961 Matley Lane, Suite 110
Reno, NV 89502

775/329-6123 (main)

775/326-5384 (direct)

775/322-9380 (fax)

cranderson@mactec.com

APPENDIX E

Rating Curves and Capacity of Existing Spillways

East Wash Rating Curves Tabulations
(HEC-HMS)

Emergency Spillway - USCOE [1]		
Discharge (cfs)	Original Elev. (ft)	Adjusted Elev. (ft)
0	4850	4853.2
250	4851.1	4854.3
500	4851.7	4854.9
1000	4852.7	4855.9
2000	4854.2	4857.4
3000	4855.2	4858.4
4000	4855.83	4859.03
5000	4856.4	4859.6
6000	4856.8	4860
7000	4857.2	4860.4
8000	4857.45	4860.65
9000	4857.76	4860.96
10000	4858	4861.2

Principal Spillway - USCOE [2]		
Discharge (cfs)	Original Elev. (ft)	Adjusted Elev. (ft)
0	4846	4849.2
2.5	4848	4851.2
5	4848.45	4851.65
10	4849	4852.2
15	4850	4853.2
20	4851.5	4854.7
25	4853.5	4856.7
30	4856	4859.2
35	4859	4862.2

Dike Overtopping [3]	
Discharge (cfs)	Adjusted Elev. (ft)
0	4857.15
0.8	4857.4
4.54	4857.65
12.55	4857.9
25.85	4858.15
47.47	4858.4
80.41	4858.65
146.81	4858.9
281.75	4859.15
514.57	4859.4
827.08	4859.65
1203.37	4859.9
1635.84	4860.15
2118.87	4860.4
2641.2	4860.65
3213.12	4860.9
3841.05	4861.15
4513.97	4861.4
5219.62	4861.65
5948.38	4861.9
6697.87	4862.15
7478.26	4862.4

MACTEC Combined Rating Curve [4]				
Adjusted Elev. (ft)	Volume (ac-ft)	Discharge (cfs)	Diversion (cfs)	Total Discharge[5]
4836	0.000	0	0	0
4838	0.695	0	0	0
4840	2.981	0	0	0
4842	6.009	0	0	0
4844	9.798	0	0	0
4846	14.606	0	0	0
4848	20.883	0	0	0
4850	28.805	1	1	1
4852	38.243	4	4	4
4854	49.338	86	18	86
4856	61.749	1026.5	26.5	1026.5
4858	75.377	2627.6	27.6	2645.47
4860	91.273	6031.3	31.3	7407.66
4862	109.860	13367.7	34.7	19615.88
4863	120.000	16000	36	23748.18

Original Combined Rating Curve - NRCS [5]	
Adjusted Elev. (ft)	Discharge (cfs)
4836	0
4838	0
4840	0
4842	0
4844	0
4846	0
4848	0
4850	1
4852	4
4854	86
4856	1026.5
4858	2627.6
4860	6031.3
4862	13367.7
4863	16000

Notes:

(1) Emergency spillway rating curve is derived from USCOE (1978).

(2) Principal spillway rating curve is derived from USCOE (1978).

(3) Dike overtopping is the analysis of the overtopping capacity of the earthen dike of the existing emergency spillway.
See results on attached Culvertmaster calculation.

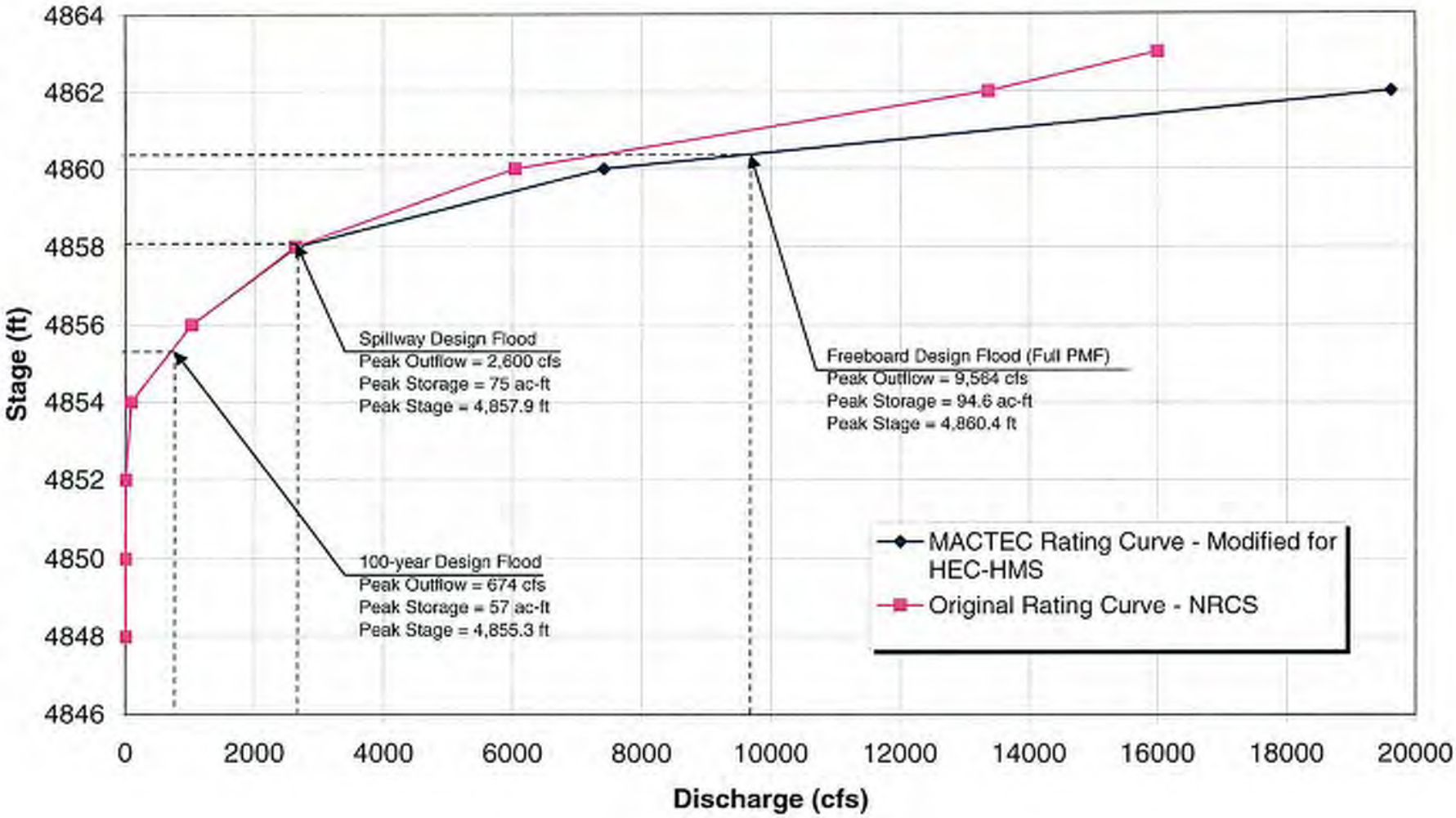
(4) Combined rating curve is a combination of all three rating curves (principal spillway, emergency spillway, and emergency spillway dike overtopping).
The outlet work discharges into Eastwash reach while the emergency spillway discharges into Westwash reach.
For the PMF analysis, the diversion is ignored due to the high overall peak discharges.
For the 100-year 24-hour analysis, the diversion by the outletwork is considered.
See attached calculation for more information about stage-volume analysis.

(5) Original combined rating curve is a combination of rating curves of principal and emergency spillway.

(6) Geometric Data: Spillway Crest: 4853.25 ft
Top of Dam: 4861.25 ft

(7) Adjusted head takes into account the elevation difference of 3.2 ft between the NAVD 1929 and the NAVD 1988.

East Wash Diversion Dam Rating Curve (HEC-HMS)



West Wash Rating Curves Tabulations (HEC-HMS)

Emergency Spillway - USCOE [1]		
Discharge (cfs)	Original Elev. (ft)	Adjusted Elev. (ft)
0	4779	4783.2
500	4780.38	4784.58
1000	4781.38	4785.58
1500	4782.25	4786.45
2000	4782.88	4787.08
3000	4784.25	4788.45
4000	4785.3	4789.5
5000	4786.38	4790.58
6000	4787.25	4791.45
7000	4788.25	4792.45
8000	4789	4793.2
9000	4789.63	4793.83

Principal Spillway - USCOE [2]		
Discharge (cfs)	Original Elev. (ft)	Adjusted Elev. (ft)
0	4754	4758.2
10	4754.1	4758.3
20	4754.15	4758.35
30	4754.2	4758.4
40	4754.25	4758.45
50	4754.3	4758.5
56.5	4754.35	4758.55
70	4773	4777.2
80	4777.5	4781.7

Dam Overtopping [3]	
Discharge (cfs)	Adjusted Elev. (ft)
0	4,792.00
0	4,792.50
9.48	4,793.00
143.19	4,793.50
958.5	4,794.00
2,495.81	4,794.50
4,536.22	4,795.00
6,975.63	4,795.50
9,616.92	4,796.00
12,765.80	4,796.50
16,174.23	4,797.00
19,759.57	4,797.50
23,637.45	4,798.00
27,618.81	4,798.50
31,801.96	4,799.00
36,177.58	4,799.50
40,737.53	4,800.00
45,474.63	4,800.50
50,382.50	4,801.00
55,455.36	4,801.50
60,688.03	4,802.00

Stage-Volume [4]		
Stage (ft)	Storage (cu.ft)	Storage (ac-ft)
4742	0	0.000
4743	6260	0.144
4746	86261	1.984
4749	247457	5.691
4752	484010	11.132
4755	807564	18.574
4758	1231950	28.335
4761	1800291	41.407
4764	2532941	58.258
4767	3435656	79.020
4770	4529370	104.176
4773	5850067	134.552
4776	7407183	170.365
4779	9193595	211.453
4782	11202909	257.667
4785	13442275	309.172
4788	15920196	366.165
4791	18851338	433.581
4794	22271583	512.246

MACTEC Combined Rating Curve [5]		
Adjusted Elev. (ft)	Volume (ac-ft)	Discharge (cfs)
4742	0.000	0
4743	0.144	0
4746	1.984	0
4749	5.691	0
4752	11.132	0
4755	18.574	0
4758	28.335	0
4761	41.407	58
4764	58.258	60
4767	79.020	63
4770	104.176	65
4773	134.552	67
4776	170.365	69
4779	211.453	74
4782	257.667	81
4785	309.172	797
4788	366.165	2766
4791	433.581	5584
4794	512.246	10065
4795	550.000	15503
4796	600.000	22173
4797	700.000	30320

Original Combined Rating Curve [6]		
Adjusted Elev. (ft)	Volume (ac-ft)	Discharge (cfs)
4742	0.000	0
4743	0.144	0
4746	1.984	0
4749	5.691	0
4752	11.132	0
4755	18.574	0
4758	28.335	0
4761	41.407	58
4764	58.258	60
4767	79.020	63
4770	104.176	65
4773	134.552	67
4776	170.365	69
4779	211.453	74
4782	257.667	81
4785	309.172	797
4788	366.165	2766
4791	433.581	5584
4794	512.246	9107
4795	550.000	10967
4796	600.000	12556
4797	700.000	14146

Notes:

(1) Emergency spillway rating curve is derived from USCOE (1978).

(2) Principal spillway rating curve is derived from USCOE (1978).

(3) Dam overtopping is the analysis of the overtopping capacity of the existing dam with station and elevation surveyed by MACTEC. See results on attached Culvertmaster calculation.

(4) See attached calculation for more information about stage-volume analysis.

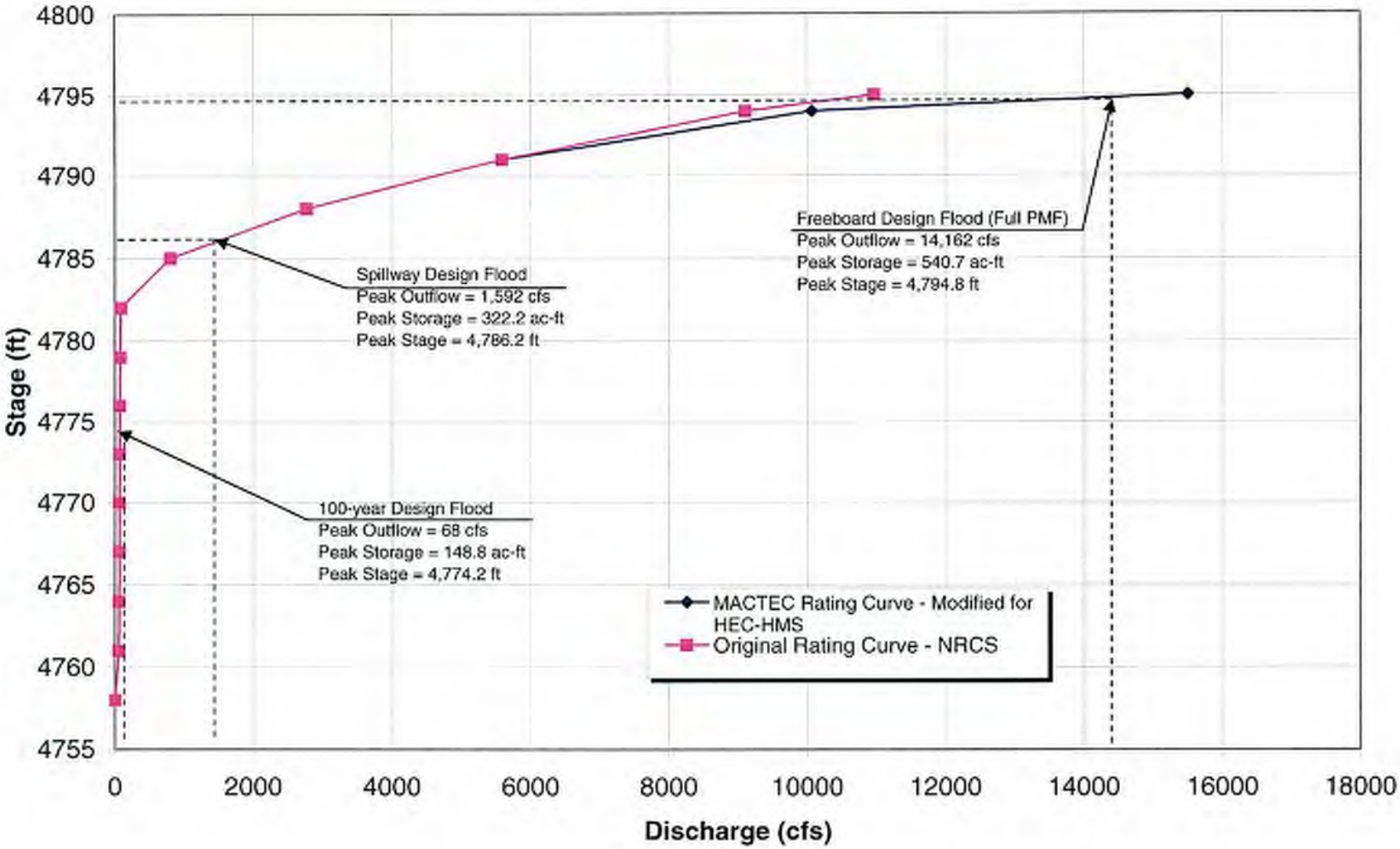
(5) MACTEC combined rating curve is a combination of all three rating curves (principal spillway, emergency spillway, and dam overtopping). Volumes at 4795, 4796, and 4797 are extrapolated to be included in the HEC-HMS model. They do not affect the final results of the model.

(6) Original combined rating curve is a combination of rating curves of principal and emergency spillways.

(7) Geometric Data: Spillway Crest: 4784 ft
Top of Dam: 4893.5 ft

(8) Adjusted head takes into account the elevation difference of 3.2 ft between the NAVD 1928 and the NAVD 1988.

West Wash Detention Dam Rating Curves (HEC-HMS)



HEC-RAS Version 3.1.3 May 2005
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X      X   X     X  X    X
X     X  X        X           X   X    X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X           X  X     X    X        X
X     X  X        X    X      X   X    X    X        X
X     X  XXXXXX    XXXX       X    X   X    X   XXXXX
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PROJECT DATA
Project Title: WestWashSpillwayHECRAS
Project File : wwspillway.prj
Run Date and Time: 1/30/2006 2:22:10 PM

Project in English units

Project Description:
West Wash Spillway Analysis
City of Reno EAP's Pz II
4307050009

MACTEC
E&C, Inc.
By: SG 11/16/05
Checked: CA 12/02/05

PLAN DATA

Plan Title: Rating111605
Plan File : p:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz II\Design\HEC-RAS\WestWash\wwspillway.p06

Geometry Title: westwashspillway111605
Geometry File : p:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz II\Design\HEC-RAS\WestWash\wwspillway.g05

Flow Title   : ratingcurve_111605
Flow File   : p:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz II\Design\HEC-RAS\WestWash\wwspillway.f05

Plan Summary Information:

Number of:	Cross Sections	= 12	Multiple Openings	=	0
	Culverts	= 0	Inline Structures	=	0
	Bridges	= 0	Lateral Structures	=	0

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01
Maximum number of iterations = 20
Maximum difference tolerance = 0.3

Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: ratingcurve_111605
Flow File : p:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz II\Design\HEC-RAS\WestWash\wwspillway.f05

Flow Data (cfs)

River	Reach	RS	PF 1	PF 2	PF 3	PF 4	PF 5	PF 6	PF 7	PF 8
West Wash	Spillway	572.6269	500	1000	2000	3000	4000	5000	6000	7000

River	Reach	RS	PF 9	PF 10	PF 11	PF 12	PF 13	PF 14	PF 15	PF 16
West Wash	Spillway	572.6269	8000	9000	10000	11000	12000	13000	14000	15000

Boundary Conditions

River	Reach	Profile	Upstream Downstream
West Wash	Spillway	PF 1	Known WS = 4782.3 Normal S = 0.05
West Wash	Spillway	PF 2	Known WS = 4783.6 Normal S = 0.05
West Wash	Spillway	PF 3	Known WS = 4784.6 Normal S = 0.05
West Wash	Spillway	PF 4	Known WS = 4786.1 Normal S = 0.05
West Wash	Spillway	PF 5	Known WS = 4787.5 Normal S = 0.05
West Wash	Spillway	PF 6	Known WS = 4788.6 Normal S = 0.05
West Wash	Spillway	PF 7	Known WS = 4789.6

```
 Normal S = 0.05
 West Wash       Spillway        PF 8                    Known WS = 4790.5
 Normal S = 0.05
 West Wash       Spillway        PF 9                    Known WS = 4791.5
 Normal S = 0.05
 West Wash       Spillway        PF 10                   Known WS = 4792.3
 Normal S = 0.05
```

GEOMETRY DATA

Geometry Title: westwashspillway111605
Geometry File : p:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz II\Design\HEC-RAS\WestWash\wwspillway.g05

CROSS SECTION

RIVER: West Wash
REACH: Spillway RS: 572.6269

INPUT
Description:
Station Elevation Data num= 17

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4793.87	4.42	4793.85	41.28	4781.12	68.36	4770.73	69.52	4770.77
75.92	4770.95	82.23	4770.31	108.08	4771.72	142.42	4771.78	183.52	4788.34
216.15	4789.17	224.94	4791.47	234.25	4797.61	242.62	4798.45	246.51	4798.45
275.68	4798.45	282.62	4797.95						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.022	4.42	.022	246.51	.022

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
4.42	246.51	96.4	94.64	105.26	.1	.3

CROSS SECTION

RIVER: West Wash
REACH: Spillway RS: 477.9823

INPUT
Description:
Station Elevation Data num= 12

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4782.99	18.65	4780.75	18.8	4780.67	22.15	4780.46	42.04	4779.2
72.62	4774.06	121.97	4774.19	134.37	4782.27	149.51	4792.67	159.29	4799.4
161.42	4799.13	184.81	4800.18						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.022	0	.022	159.29	.022

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	159.29	63.59	55.19	39.86	.1	.3

CROSS SECTION

RIVER: West Wash
REACH: Spillway RS: 422.7954

INPUT
Description:
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4787.12	4.85	4786.51	10.04	4785.82	24.16	4780.98	25.08	4780.67
67.08	4777.93	112.52	4777.31	127.56	4787.14	141.49	4796.24	148.59	4800.87
161.81	4799.13	176.23	4799.79	176.85	4800.2	177.06	4797.26		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.022	4.85	.022	148.59	.022

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
4.85	148.59	28.25	36.19	52.95	.1	.3

CROSS SECTION

RIVER: West Wash
REACH: Spillway RS: 386.6096

INPUT
Description:
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4787.97	1.68	4787.77	1.98	4787.74	20.54	4781.59	23.32	4780.67
24.53	4780.6	59.86	4780.67	99.33	4780.72	126.84	4799.78	130.12	4802.05
131.78	4802.83	132.25	4802.83	157.54	4799.54				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.022	0	.022	132.25	.022

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	132.25	64.88	63.59	61.96	.1	.3

CROSS SECTION

RIVER: West Wash
REACH: Spillway RS: 323.0202

INPUT
Description:
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4792.36	1.38	4792.25	4.89	4791.1	21.18	4785.32	29.25	4782.45
64.49	4783.09	84.69	4783.26	93.41	4788.67	116.09	4799.71	122.52	4802.83
136.9	4802.83	147.62	4801.44	148.86	4800.94				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.022	1.38	.022	122.52	.022

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1.38	122.52	17.02	23.59	32.77	.1	.3

CROSS SECTION

RIVER: West Wash
REACH: Spillway RS: 299.432

INPUT
Description:
Station Elevation Data num= 17

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4793.22	.9	4793.16	10.07	4790.03	19.62	4786.81	30.96	4782.98
36.07	4783.09	67.47	4783.41	86.25	4783.61	87.31	4783.61	87.61	4783.63
112.43	4798.54	116.91	4801.23	119.46	4802.74	119.61	4802.83	142.46	4802.83
142.91	4802.79	144.86	4802.01						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.022	.9	.022	119.46	.022

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
.9	119.46	31.15	26.43	19.88	.1 .3

CROSS SECTION

RIVER: West Wash
REACH: Spillway RS: 273.0056

INPUT
Description:
Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4793.42	16.38	4787.25	17.61	4786.79	28.55	4783.5	69.4	4783.86
82.93	4783.83	86.42	4784.11	106.62	4796.51	111.49	4799.49	116.8	4802

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.022	0	.022	116.8	.022

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	116.8	30.04	35.15	41.07	.1 .3

CROSS SECTION

RIVER: West Wash
REACH: Spillway RS: 237.8512

INPUT
Description:
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4794.17	1.65	4794.31	10.52	4790.96	20.75	4787.96	34.26	4784.01
55.45	4784.23	87.76	4784.2	96.77	4784.92	108.79	4792.22	110.72	4793.11
132.23	4803.02	138.7	4803.02	145.46	4802.08	146.06	4801.83		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.022	1.65	.022	132.23	.022

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1.65	132.23	60.25	59.49	58.45	.1 .3

CROSS SECTION

RIVER: West Wash
REACH: Spillway RS: 178.3562

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4785.78	.45	4785.8	.9	4785.86	1.2	4786.1	1.5	4785.76
3.31	4785.67	15.26	4783.49	16.39	4783.29	29.32	4784.02	39.55	4783.69
72.62	4783.85	87.21	4784.73	103.91	4786.36	107.05	4786.67	113.67	4789.79

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.022	1.2	.022	113.67	.022

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1.2	113.67	59.51	54.9	51.11	.1	.3

CROSS SECTION

RIVER: West Wash
REACH: Spillway RS: 123.4588

INPUT
Description:
Station Elevation Data num= 17

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4782.68	4.1	4781.95	7.33	4781.38	17.66	4779.56	17.96	4779.58
34.55	4779.56	44.6	4779.57	44.75	4779.57	44.75	4779.56	45.05	4779.55
57.35	4780.56	78.72	4782.3	79.2	4782.33	79.5	4782.4	88.37	4784.61
99.34	4787.35	105.71	4788.91						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.022	0	.022	105.71	.022

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	105.71	25.58	33.02	39.98	.1	.3

CROSS SECTION

RIVER: West Wash
REACH: Spillway RS: 90.44151

INPUT
Description:
Station Elevation Data num= 11

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4782.44	3.31	4782.39	10.67	4781.05	12.36	4781.07	19.84	4781.16
24.5	4779.53	81.92	4778.08	88.77	4778.51	96.94	4779.02	107.02	4781.21
108.82	4782.88								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.022	3.31	.022	108.82	.022

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
3.31	108.82	57.73	55.89	53.95	.1	.3

CROSS SECTION

RIVER: West Wash
REACH: Spillway RS: 34.55296

INPUT
Description:
Station Elevation Data num= 11

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4779.49	.15	4779.51	8.88	4779.51	9.52	4779.51	9.67	4779.5
9.97	4779.5	84.22	4776.06	95.45	4775.54	101	4776.85	110.62	4782.6
123.39	4794.63								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.022	8.88	.022	123.39	.022

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
8.88	123.39	41.76	34.55	36.84	.1	.3

SUMMARY OF MANNING'S N VALUES

River:West Wash

Reach	River Sta.	n1	n2	n3
Spillway	572.6269	.022	.022	.022
Spillway	477.9823	.022	.022	.022
Spillway	422.7954	.022	.022	.022
Spillway	386.6096	.022	.022	.022
Spillway	323.0202	.022	.022	.022
Spillway	299.432	.022	.022	.022
Spillway	273.0056	.022	.022	.022
Spillway	237.8512	.022	.022	.022
Spillway	178.3562	.022	.022	.022
Spillway	123.4588	.022	.022	.022
Spillway	90.44151	.022	.022	.022
Spillway	34.55296	.022	.022	.022

SUMMARY OF REACH LENGTHS

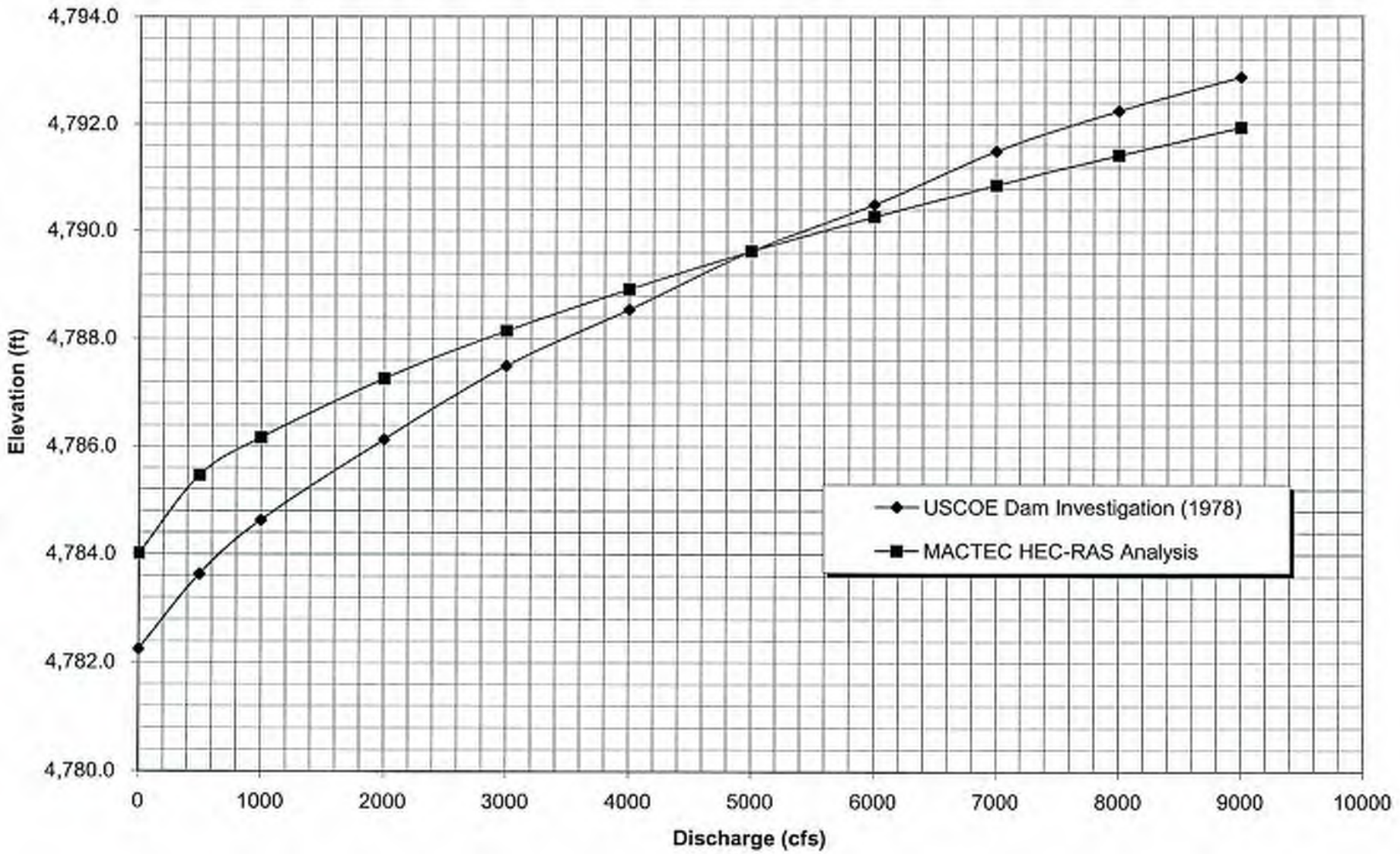
River: West Wash

Reach	River Sta.	Left	Channel	Right
Spillway	572.6269	96.4	94.64	105.26
Spillway	477.9823	63.59	55.19	39.86
Spillway	422.7954	28.25	36.19	52.95
Spillway	386.6096	64.88	63.59	61.96
Spillway	323.0202	17.02	23.59	32.77
Spillway	299.432	31.15	26.43	19.88
Spillway	273.0056	30.04	35.15	41.07
Spillway	237.8512	60.25	59.49	58.45
Spillway	178.3562	59.51	54.9	51.11
Spillway	123.4588	25.58	33.02	39.98
Spillway	90.44151	57.73	55.89	53.95
Spillway	34.55296	41.76	34.55	36.84

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: West Wash

Reach	River Sta.	Contr.	Expan.
Spillway	572.6269	.1	.3
Spillway	477.9823	.1	.3
Spillway	422.7954	.1	.3
Spillway	386.6096	.1	.3
Spillway	323.0202	.1	.3
Spillway	299.432	.1	.3
Spillway	273.0056	.1	.3
Spillway	237.8512	.1	.3
Spillway	178.3562	.1	.3
Spillway	123.4588	.1	.3
Spillway	90.44151	.1	.3
Spillway	34.55296	.1	.3

West Wash Emergency Spillway
Rating Curves



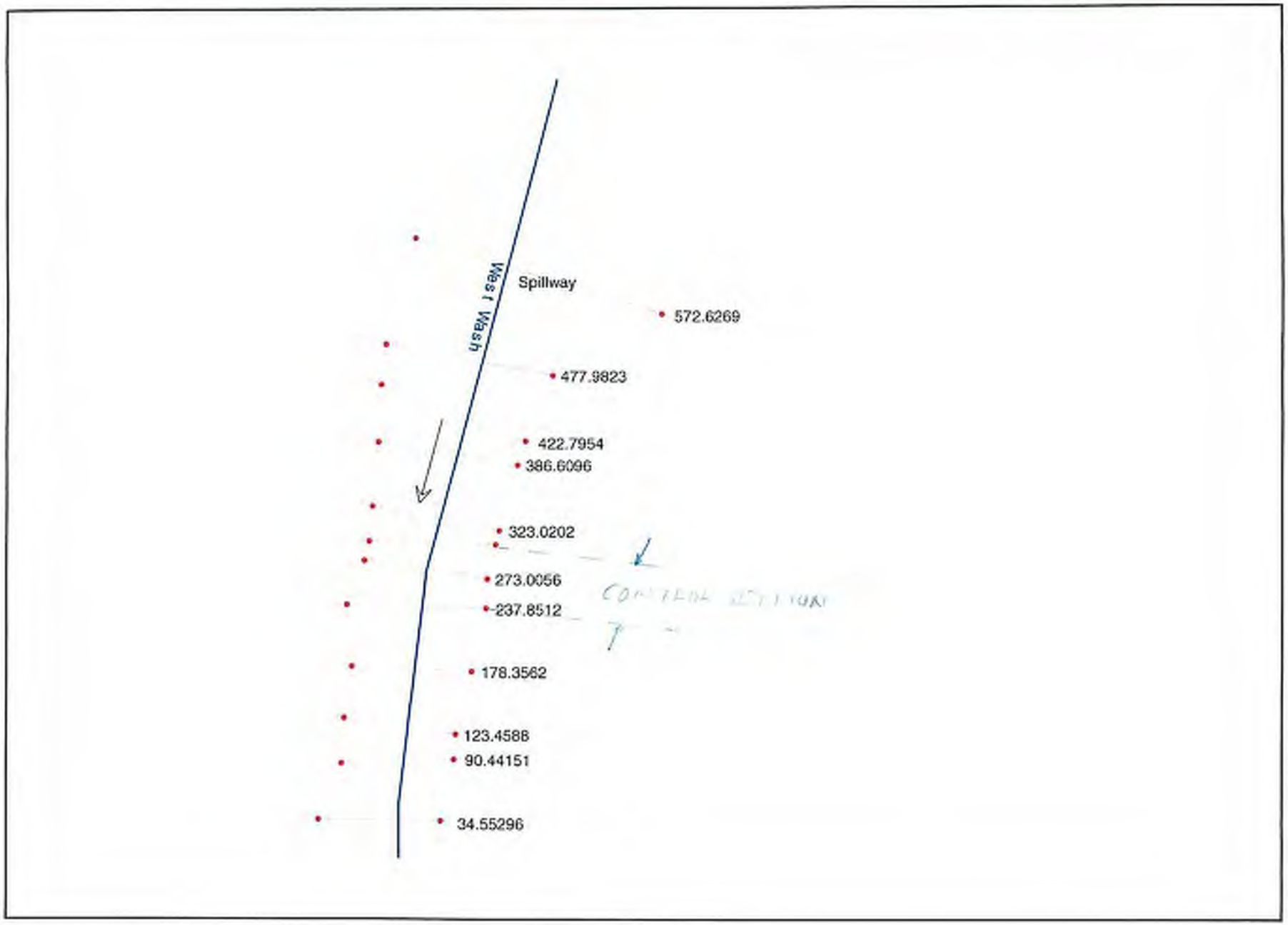
West Wash Emergency Spillway
Rating Curves

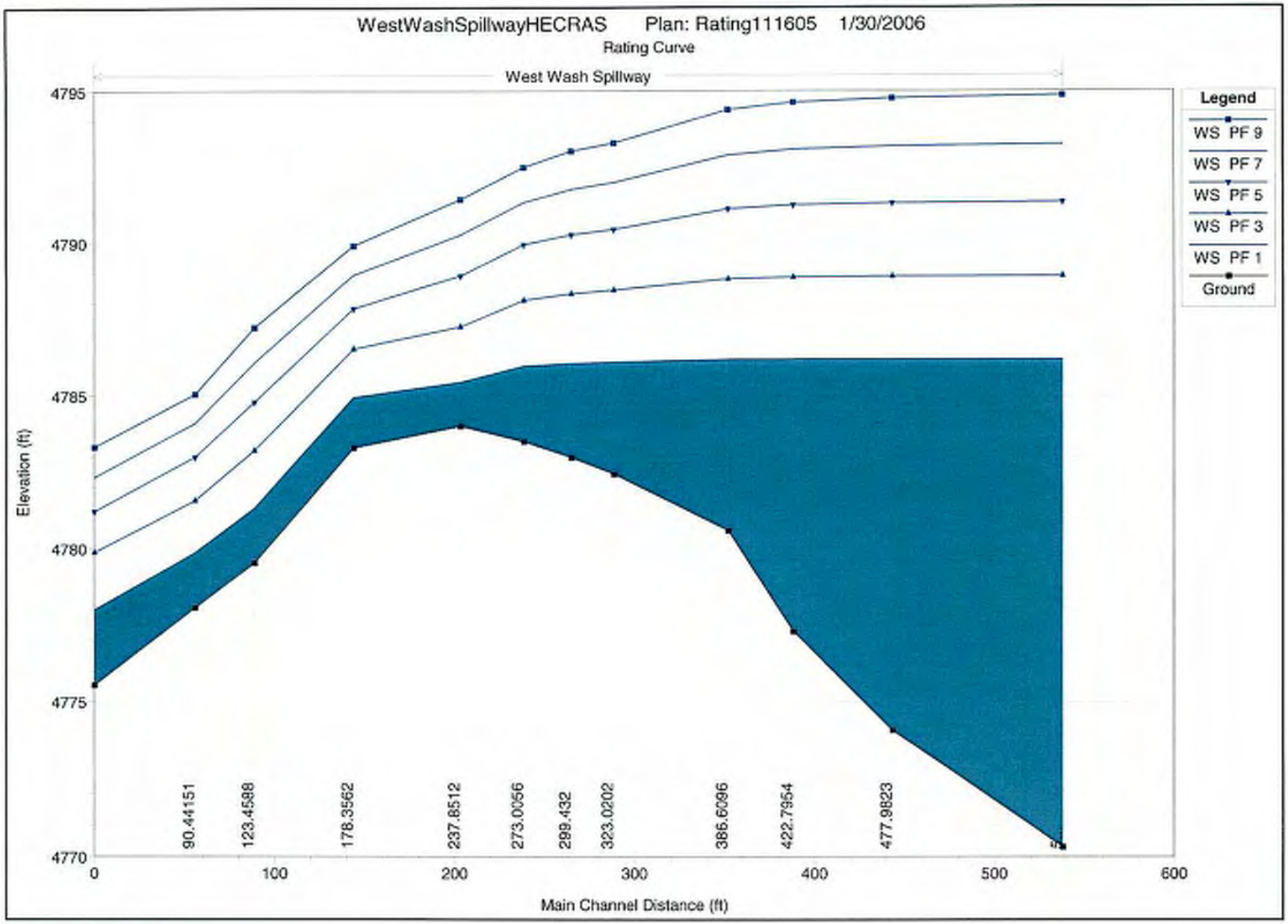
Q Total (cfs)	USCOE-SPILLWAY [1]	MACTEC [2]
	W.S. Elev (ft)	W.S. Elev (ft)
0	4,782.3	4,784.0
500	4,783.6	4,785.5
1,000	4,784.6	4,786.2
2,000	4,786.1	4,787.3
3,000	4,787.5	4,788.1
4,000	4,788.6	4,788.9
5,000	4,789.6	4,789.6
6,000	4,790.5	4,790.3
7,000	4,791.5	4,790.9
8,000	4,792.3	4,791.4
9,000	4,792.9	4,791.9

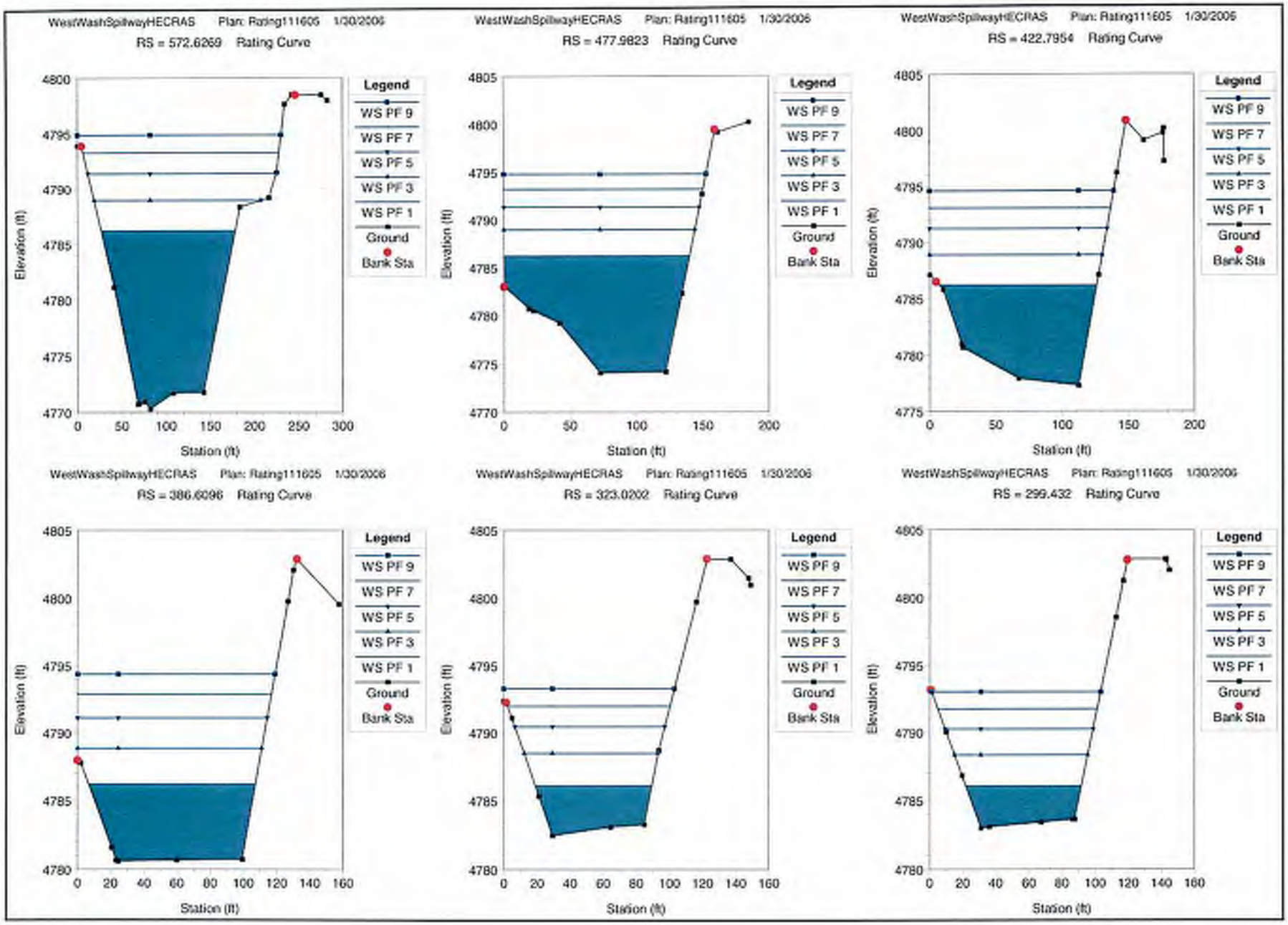
NOTES:

(1) Spillway capacity values obtained from dam investigation report, USCOE (1978)
(2) Spillway capacity values are obtained from steady state RAS model, which uses MACTEC 2005 survey data.
(3) USCOE water surface elevations are adjusted (+3.2) to match with city of reno datum.
Elevation bust is calculated using well-defined points such as top of riser, city of reno brass cap elevations etc.,
(4) RAS model uses "Known Water Surface" as upstream boundary condition, and
"Normal Depth" as downstream boundary condition
(5) Used Rating Curve for Station 1093.19, which closely represents crest of the spillway

WESTWASH

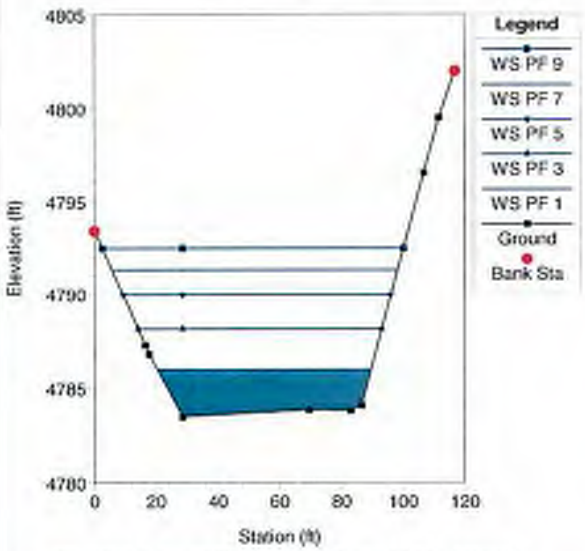

West Wash
Spillway
572.6269
477.9823
422.7954
386.6096
323.0202
273.0056
237.8512
178.3562
123.4588
90.44151
34.55296


WestWashSpillwayHECRAS Plan: Rating111605 1/30/2006
Rating Curve
West Wash Spillway
Legend
WS PF 9
WS PF 7
WS PF 5
WS PF 3
WS PF 1
Ground
Elevation (ft)
4795
4790
4785
4780
4775
4770
0
100
200
300
400
500
600
Main Channel Distance (ft)
90.44151
123.4588
178.3562
237.8512
273.0056
299.432
323.0202
386.6096
422.7954
477.9823


WestWashSpillwayHECRAS Plan: Rating111605 1/30/2006
RS = 572.6269 Rating Curve
WestWashSpillwayHECRAS Plan: Rating111605 1/30/2006
RS = 477.9823 Rating Curve
WestWashSpillwayHECRAS Plan: Rating111605 1/30/2006
RS = 422.7954 Rating Curve
WestWashSpillwayHECRAS Plan: Rating111605 1/30/2006
RS = 386.6096 Rating Curve
WestWashSpillwayHECRAS Plan: Rating111605 1/30/2006
RS = 323.0202 Rating Curve
WestWashSpillwayHECRAS Plan: Rating111605 1/30/2006
RS = 299.432 Rating Curve
Legend
WS PF 9
WS PF 7
WS PF 5
WS PF 3
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

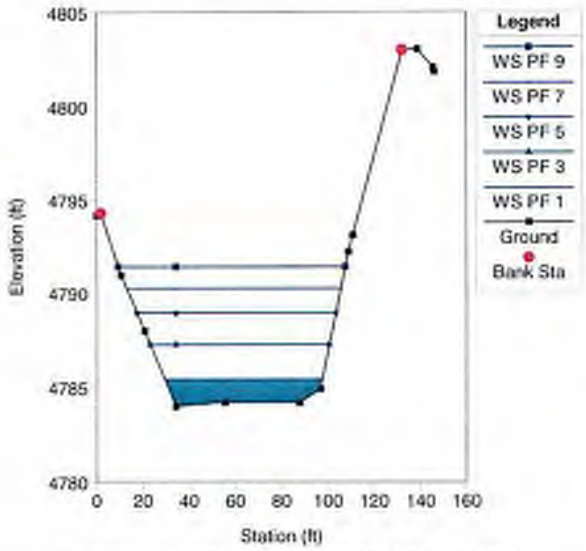
WestWashSpillwayHECRAS Plan: Rating111605 1/30/2006

RS = 273.0056 Rating Curve



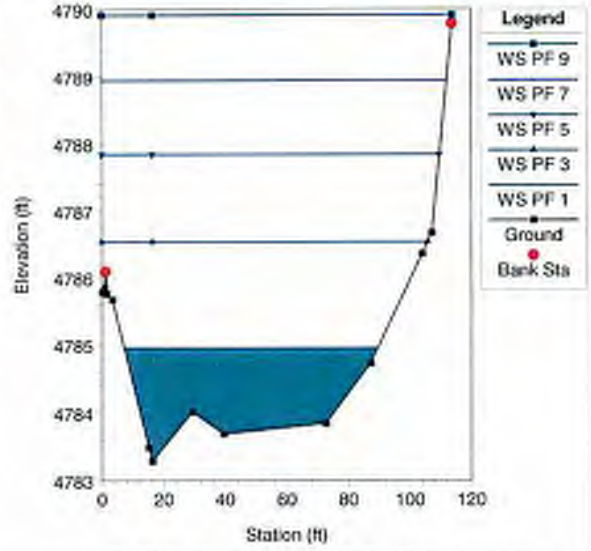
WestWashSpillwayHECRAS Plan: Rating111605 1/30/2006

RS = 237.8512 Rating Curve



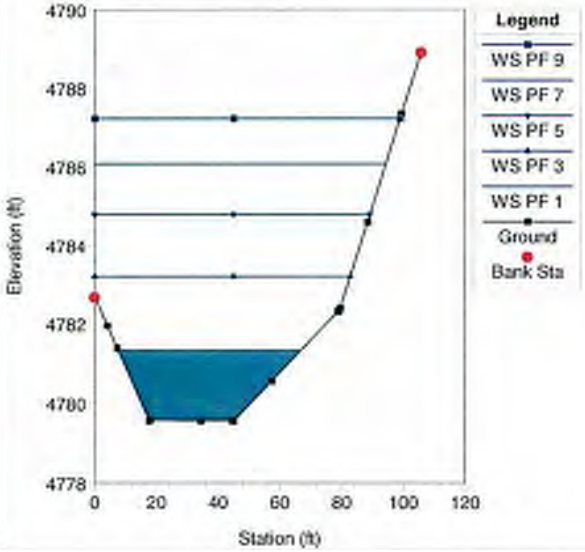
WestWashSpillwayHECRAS Plan: Rating111605 1/30/2006

RS = 178.3562 Rating Curve



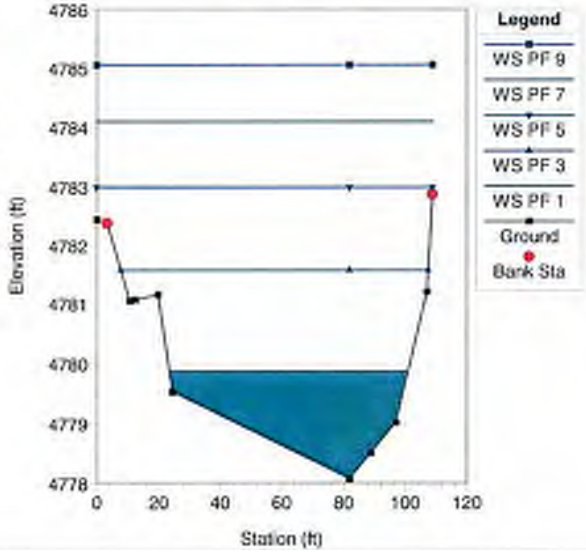
WestWashSpillwayHECRAS Plan: Rating111605 1/30/2006

RS = 123.4588 Rating Curve



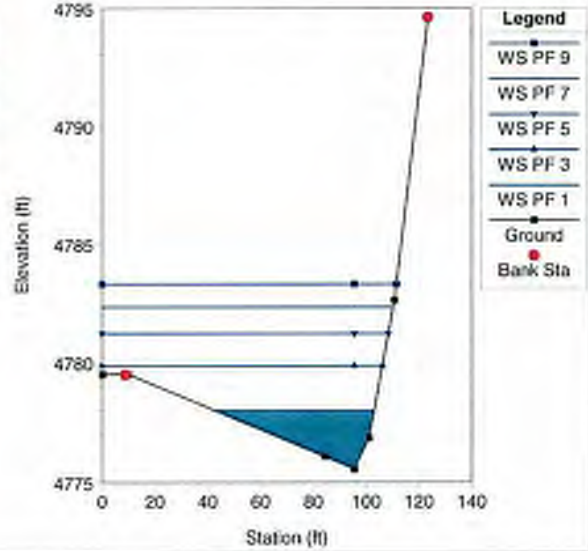
WestWashSpillwayHECRAS Plan: Rating111605 1/30/2006

RS = 90.44151 Rating Curve



WestWashSpillwayHECRAS Plan: Rating111605 1/30/2006

RS = 34.55296 Rating Curve



Upper Peavine Rating Curves Tabulations (HEC-HMS)

Emergency Spillway - USCOE [1]		
Discharge (cfs)	Original Elev. (ft)	Adjusted Elev. (ft)
0	5022	5025.2
200	5023.5	5026.7
300	5023.7	5026.9
500	5024	5027.2
1000	5024.7	5027.9
2000	5025.7	5028.9
3000	5026.6	5029.8
4000	5027.5	5030.7
5000	5028.4	5031.6
6000	5029.1	5032.3
7000	5029.8	5033
8000	5030.3	5033.5
9000	5030.7	5033.9

Principal Spillway - USCOE [2]		
Discharge (cfs)	Original Elev. (ft)	Adjusted Elev. (ft)
0	5007	5010.2
10	5007.3	5010.5
20	5007.8	5011
30	5008	5011.2
40	5008.5	5011.7
50	5008.8	5012
60	5009	5012.2
66.5	5009.3	5012.5
70	5014.5	5017.7
80	5027.5	5030.7

Original Combined Rating Curve [3]		
Adjusted Elev. (ft)	Volume (ac-ft)	Discharge (cfs)
4992	0	0
4993	0.6136	0
4996	4.9201	0
4999	13.2259	0
5002	25.1201	0
5005	40.6763	0
5008	60.5456	0
5011	85.3524	20
5014	114.995	68
5017	149.995	69
5020	189.51	71
5023	235.2088	74
5026	287.016	396
5029	345.347	2190
5030	366.065	3301
5032	409.55	5654
5034	455.6527	9090

NOTES:

(1) Emergency spillway rating curve is derived from USCOE (1978).

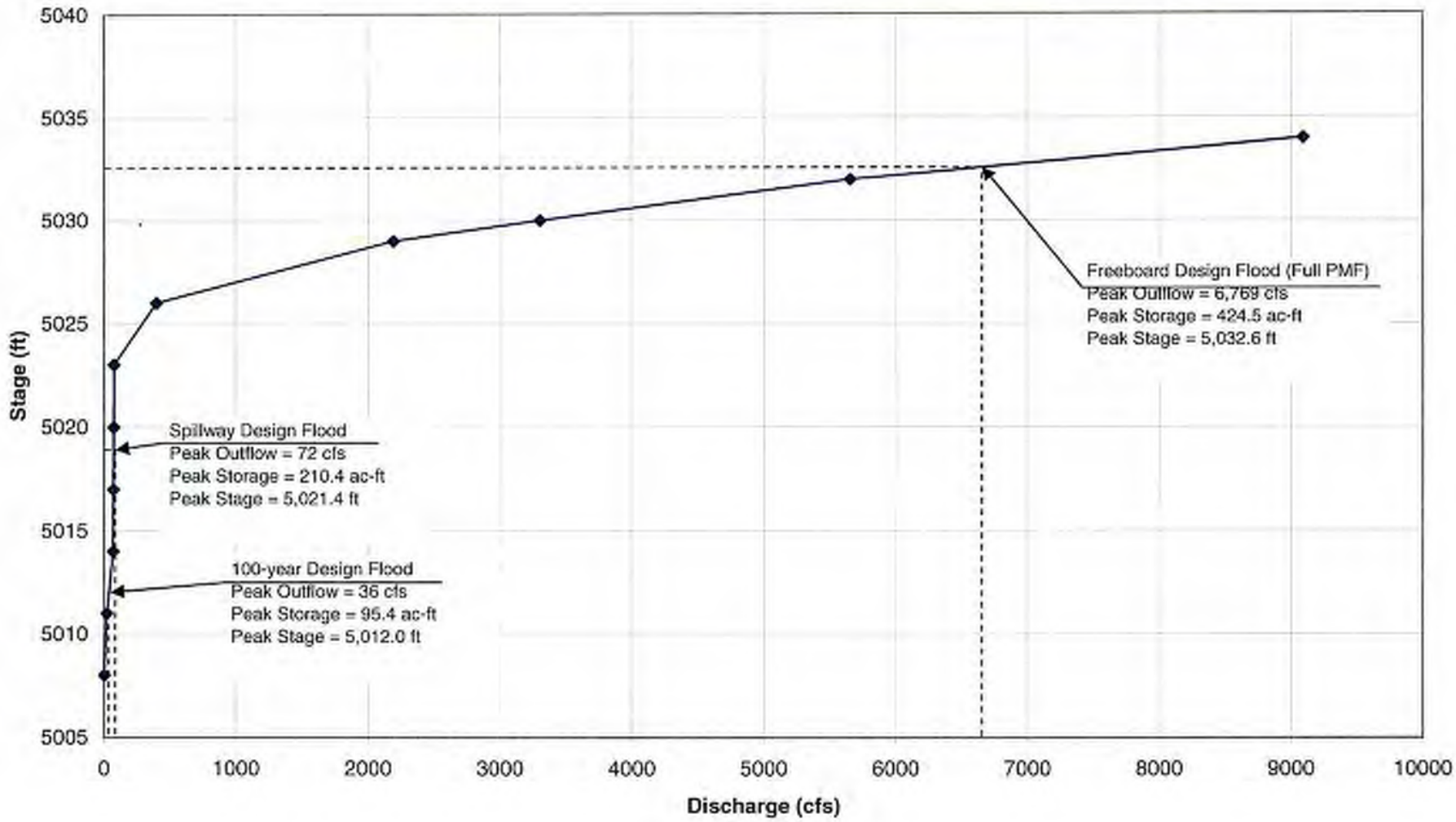
(2) Principal spillway rating curve is derived from USCOE (1978).

(3) Combined rating curve is a combination of rating curves of principal and emergency spillways. and is used in HEC-HMS hydrologic modeling of Upper and Lower Peavine. See attached calculation for more information about stage-volume analysis.

(5) Geometric Data: Spillway Crest: 5025.7 ft
Top of Dam: 5033.2 ft

(6) Adjusted elevation takes into account the elevation difference of 3.2 ft between the NAVD 1928 and the NAVD 1988

Upper Peavine Detention Dam Rating Curve (HEC-HMS)



HEC-RAS Version 3.1.3 May 2005
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X      X   X     X  X    X
X     X  X        X           X   X    X    X   X
XXXXXXX  XXXX     X      XXX  XXXX     XXXXXX    XXXX
X     X  X        X           X  X     X    X        X
X     X  X        X    X      X   X    X    X        X
X     X  XXXXXX    XXXX       X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: Upper Peavine Spillway-SteadyState
Project File : UP_Spillway.prj
Run Date and Time: 1/30/2006 2:15:01 PM

Project in English units

Project Description:
Upper Peavine Emergency Spillway Comparision
Reno EAP's Phase
II
4307050009
MACTEC

By: SG 11/16/05
Checked: CA 12/02/05

Plan
"UP_Spillway_Rating111105" is used to produce Spillway Rating Curve; Plan
"up_spillway_102605" is used to produce steady state inundation map that is
used in conjunction with existing unsteady PMF Inundation map.

PLAN DATA

Plan Title: UP_Spillway_Rating111105
Plan File : p:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz
II\Design\HEC-RAS\UpperPeavine\UP_Spillway.p03

Geometry Title: UP_Spillway_102605
Geometry File : p:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz
II\Design\HEC-RAS\UpperPeavine\UP_Spillway.g01

Flow Title : UP_Spillway_Rating111105
Flow File : p:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz
II\Design\HEC-RAS\UpperPeavine\UP_Spillway.f03

Plan Description:
Used to produce Spillway Rating Curve for Upper Peavine Detention Dam

Plan Summary Information:
Number of: Cross Sections = 17 Multiple Openings = 0
Culverts = 0 Inline Structures = 0
Bridges = 0 Lateral Structures = 0

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01
Maximum number of iterations = 20
Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: UP_Spillway_Rating111105
Flow File : p:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz II\Design\HEC-RAS\UpperPeavine\UP_Spillway.f03

Flow Data (cfs)

River	Reach	RS	PF 1	PF 2	PF 3	PF 4	PF 5	PF 6	PF 7	PF 8
Upper Peavine	Spillway	1879.647	200	300	500	1000	2000	3000	4000	5000
Upper Peavine	Spillway	2.535985	200	300	500	1000	2000	3000	4000	5000

River	Reach	RS	PF 9	PF 10	PF 11	PF 12
Upper Peavine	Spillway	1879.647	6000	7000	8000	9000
Upper Peavine	Spillway	2.535985	6000	7000	8000	9000

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Upper Peavine	Spillway	PF 1	Known WS = 5025.2	

Normal S = 0.45
Upper Peavine Spillway PF 2 Known WS = 5026.7
Normal S = 0.45
Upper Peavine Spillway PF 3 Known WS = 5026.9
Normal S = 0.45
Upper Peavine Spillway PF 4 Known WS = 5027.2
Normal S = 0.45
Upper Peavine Spillway PF 5 Known WS = 5027.9
Normal S = 0.45
Upper Peavine Spillway PF 6 Known WS = 5028.9
Normal S = 0.45
Upper Peavine Spillway PF 7 Known WS = 5029.8
Normal S = 0.45
Upper Peavine Spillway PF 8 Known WS = 5030.7
Normal S = 0.45
Upper Peavine Spillway PF 9 Known WS = 5031.6
Normal S = 0.45
Upper Peavine Spillway PF 10 Known WS = 5032.3
Normal S = 0.45
Upper Peavine Spillway PF 11 Known WS = 5033
Normal S = 0.45
Upper Peavine Spillway PF 12 Known WS = 5033.5
Normal S = 0.45

GEOMETRY DATA

Geometry Title: UP_Spillway_102605
Geometry File : p:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz II\Design\HEC-RAS\UpperPeavine\UP_Spillway.g01

CROSS SECTION

RIVER: Upper Peavine
REACH: Spillway RS: 1879.647

INPUT
Description:
Station Elevation Data num= 20

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	5031.86	25.23	5029	60.06	5026.4	108.59	5022	154.22	5019.14
226.2	5014	338.13	5009.33	355.97	5008.31	442.24	5006.76	547.71	5002
573.39	5002	591.19	5000.5	644.74	4998	844.91	4992	849.91	4992.84
936.74	4993.99	936.74	4992	989.82	5008	1004.03	5010	1072.82	5032.32

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	0	.04	1072.82	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	1072.82	223.89	223.89	223.89	.1	.3

CROSS SECTION

RIVER: Upper Peavine
REACH: Spillway RS: 1655.757

INPUT

Description:
Station Elevation Data num= 20

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	5034	113.58	5024	153.29	5021.31	225.7	5017.38	264.08	5016.49
300.64	5013.54	336.14	5009.58	376.86	5006.04	460	5001.58	501.99	5001.14
603.89	4996.06	657.64	4993.97	681.07	4993.86	708.79	5002	723.66	5004
723.66	5010.58	730.07	5006	742.21	5010	758.49	5012	819.7	5033.63

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	0	.04	819.7	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	819.7	184.46	184.46	.1	.3

CROSS SECTION

RIVER: Upper Peavine
REACH: Spillway RS: 1471.298

INPUT
Description:
Station Elevation Data num= 9

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	5024.08	2	5023.95	13.05	5023.94	14.05	5023.93	15.05	5022.48
32.37	5016.81	108.72	5015.79	264.17	5017.41	280.85	5023.27		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	0	.04	280.85	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	280.85	85.11	85.11	.1	.3

CROSS SECTION

RIVER: Upper Peavine
REACH: Spillway RS: 1386.191

INPUT
Description:
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	5042.8	35.34	5021.58	121.78	5017.93	239.05	5018.1	258.59	5027.4
260.7	5027.4								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	0	.04	260.7	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	260.7	98.95	98.95	.1	.3

CROSS SECTION

RIVER: Upper Peavine
REACH: Spillway RS: 1287.24

INPUT
Description:

Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	5048.27	50.97	5021.54	116.69	5020.28	199.83	5021.07	223.47	5034
225.99	5034								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	0	.04	225.99	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	225.99	98.76	98.76	.1	.3

CROSS SECTION

RIVER: Upper Peavine
REACH: Spillway RS: 1188.479

INPUT
Description:
Station Elevation Data num= 5

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	5048	38.48	5025.22	97.07	5023.2	161.93	5023.61	181.22	5039.06

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	0	.04	181.22	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	181.22	95.29	95.29	.1	.3

CROSS SECTION

RIVER: Upper Peavine
REACH: Spillway RS: 1093.192

INPUT
Description:
Station Elevation Data num= 5

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	5048.34	39.19	5027.46	84.47	5025.44	140.1	5025.64	167.49	5038.82

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	0	.04	167.49	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	167.49	95.28	95.28	.1	.3

CROSS SECTION

RIVER: Upper Peavine
REACH: Spillway RS: 997.9119

INPUT
Description:
Station Elevation Data num= 5

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	5048.24	39.59	5027.31	84.97	5025.21	139.44	5025.68	161.2	5035.12

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	0	.04	161.2	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	161.2	101.25	101.25	.1	.3

CROSS SECTION

RIVER: Upper Peavine
REACH: Spillway RS: 896.6617

INPUT
Description:
Station Elevation Data num= 5

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	5048.6	38.41	5025.35	89.25	5023.77	142.48	5024.32	161.32	5032.47

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	0	.04	161.32	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	161.32	99.63	99.63	.1	.3

CROSS SECTION

RIVER: Upper Peavine
REACH: Spillway RS: 797.0359

INPUT
Description:
Station Elevation Data num= 5

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	5049.17	36.96	5023.49	91.15	5022.4	144.59	5023.69	160.72	5031.64

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	0	.04	160.72	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	160.72	99.36	99.36	.1	.3

CROSS SECTION

RIVER: Upper Peavine
REACH: Spillway RS: 697.6766

INPUT
Description:
Station Elevation Data num= 5

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	5041.36	29.97	5022.13	93.13	5021.18	138.07	5021.88	155.7	5031.28

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	0	.04	155.7	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	155.7	99.24	99.24	.1	.3

CROSS SECTION

RIVER: Upper Peavine
REACH: Spillway RS: 598.4373

INPUT
Description:
Station Elevation Data num= 5

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	5032.41	31.13	5020.45	83.57	5019.74	131.11	5020.36	146.21	5028.57

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	0	.04	146.21	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	146.21	96.67	96.67	.1	.3

CROSS SECTION

RIVER: Upper Peavine
REACH: Spillway RS: 501.7658

INPUT
Description:
Station Elevation Data num= 5

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	5022.99	15.84	5020.16	70.94	5018.81	128.99	5019.21	143.12	5020.96

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	0	.04	143.12	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	143.12	51.69	51.69	.1	.3

CROSS SECTION

RIVER: Upper Peavine
REACH: Spillway RS: 450.0757

INPUT
Description:
Station Elevation Data num= 7

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	5023.76	18.84	5021.82	37.49	5018.7	78.58	5018.1	144.54	5018.26
149.4	5019.14	160	5023						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	0	.04	160	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	160	134.07	134.07	.1	.3

CROSS SECTION

RIVER: Upper Peavine
REACH: Spillway RS: 316.0059

INPUT
Description:
Station Elevation Data num= 20

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	5020.3	6.39	5018.95	12.71	5018	47.53	5014	53.62	5013.43
68.53	5012.8	78.02	5012.3	98.02	5012	114.15	5012.05	158.43	5012.08
201.75	5012.19	206.22	5012.37	234.4	5013.05	259.46	5013.59	298.95	5014.22
316.76	5015.11	333.04	5015.6	338.06	5015.48	348.69	5015.83	358.77	5015.48

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	0	.04	358.77	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	358.77	110.41	110.41	110.41	.1	.3

CROSS SECTION

RIVER: Upper Peavine
REACH: Spillway RS: 205.5936

INPUT
Description:
Station Elevation Data num= 20

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	5008.71	5.1	5009.02	9.1	5008.67	38.47	5008.3	73.91	5006.88
96.13	5004.73	135.7	5000.6	148.93	5000	154.03	4999.58	195.48	5000.62
199.09	5000.91	216.59	5000.7	244.09	5000.54	248.57	5000.84	276.43	5004
289.73	5006	297.8	5006.37	307.24	5006.38	326.15	5006	362.35	5003.79

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	0	.04	362.35	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	362.35	203.06	203.06	203.06	.1	.3

CROSS SECTION

RIVER: Upper Peavine
REACH: Spillway RS: 2.535985

INPUT
Description:
Station Elevation Data num= 20

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4936.08	57.57	4936.28	142.72	4933.87	162.08	4932.56	188.36	4930
200.42	4929.08	222.63	4928.54	272.32	4924.18	289.14	4924	303.46	4926
325.9	4926	335.14	4926.53	349.07	4928	377.16	4928	389.36	4930
401.95	4930	419.44	4931.62	453.94	4933.07	482.74	4935.49	506.19	4938.06

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.04	0	.04	506.19	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	506.19	2.54	2.54	2.54	.1	.3

SUMMARY OF MANNING'S N VALUES

River:Upper Peavine

Reach	River Sta.	n1	n2	n3
Spillway	1879.647	.04	.04	.04
Spillway	1655.757	.04	.04	.04
Spillway	1471.298	.04	.04	.04
Spillway	1386.191	.04	.04	.04
Spillway	1287.24	.04	.04	.04
Spillway	1188.479	.04	.04	.04
Spillway	1093.192	.04	.04	.04
Spillway	997.9119	.04	.04	.04
Spillway	896.6617	.04	.04	.04
Spillway	797.0359	.04	.04	.04
Spillway	697.6766	.04	.04	.04
Spillway	598.4373	.04	.04	.04
Spillway	501.7658	.04	.04	.04
Spillway	450.0757	.04	.04	.04
Spillway	316.0059	.04	.04	.04
Spillway	205.5936	.04	.04	.04
Spillway	2.535985	.04	.04	.04

SUMMARY OF REACH LENGTHS

River: Upper Peavine

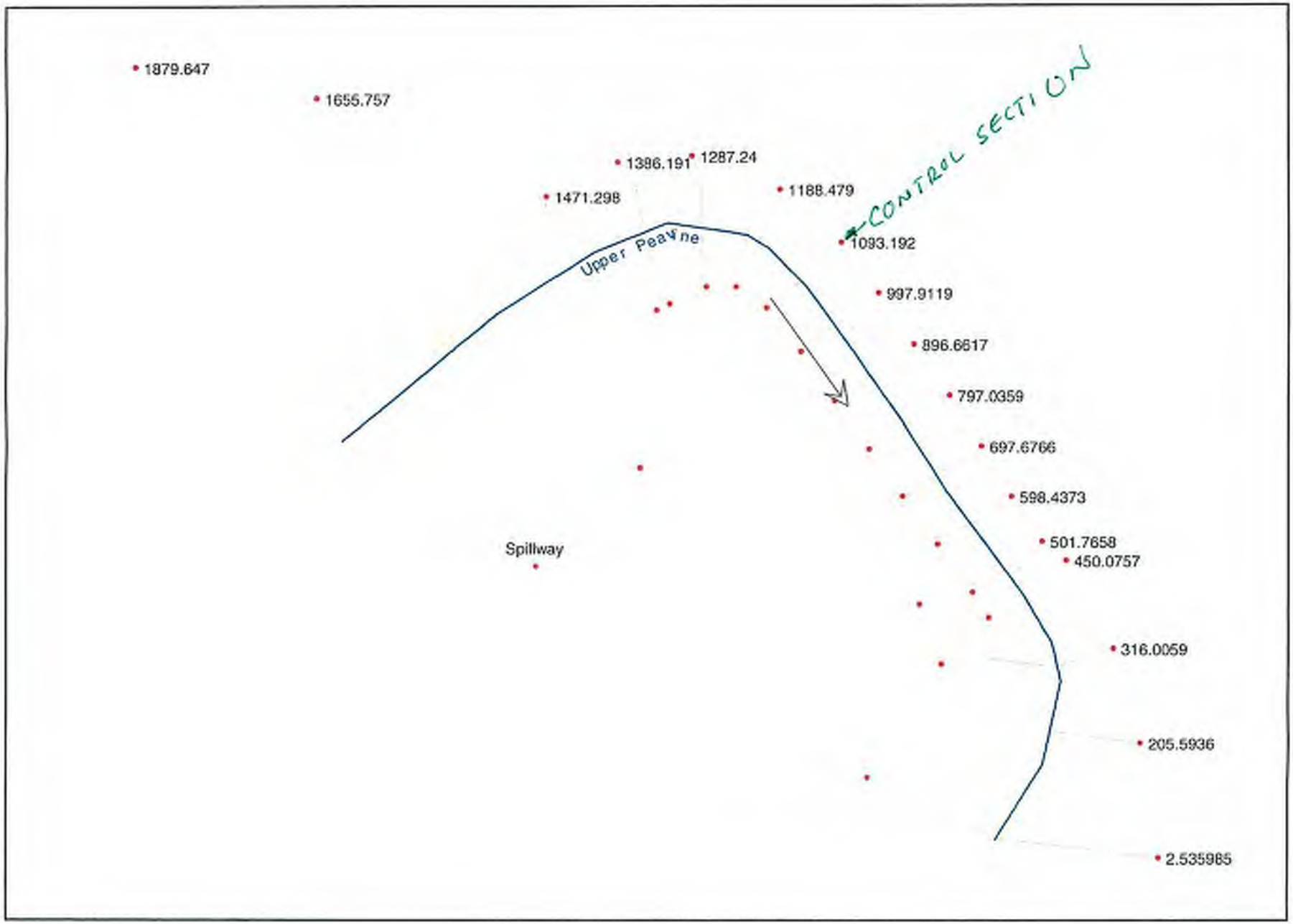
Reach	River Sta.	Left	Channel	Right
Spillway	1879.647	223.89	223.89	223.89
Spillway	1655.757	184.46	184.46	184.46
Spillway	1471.298	85.11	85.11	85.11
Spillway	1386.191	98.95	98.95	98.95
Spillway	1287.24	98.76	98.76	98.76
Spillway	1188.479	95.29	95.29	95.29
Spillway	1093.192	95.28	95.28	95.28
Spillway	997.9119	101.25	101.25	101.25
Spillway	896.6617	99.63	99.63	99.63
Spillway	797.0359	99.36	99.36	99.36
Spillway	697.6766	99.24	99.24	99.24
Spillway	598.4373	96.67	96.67	96.67
Spillway	501.7658	51.69	51.69	51.69
Spillway	450.0757	134.07	134.07	134.07
Spillway	316.0059	110.41	110.41	110.41
Spillway	205.5936	203.06	203.06	203.06
Spillway	2.535985	2.54	2.54	2.54

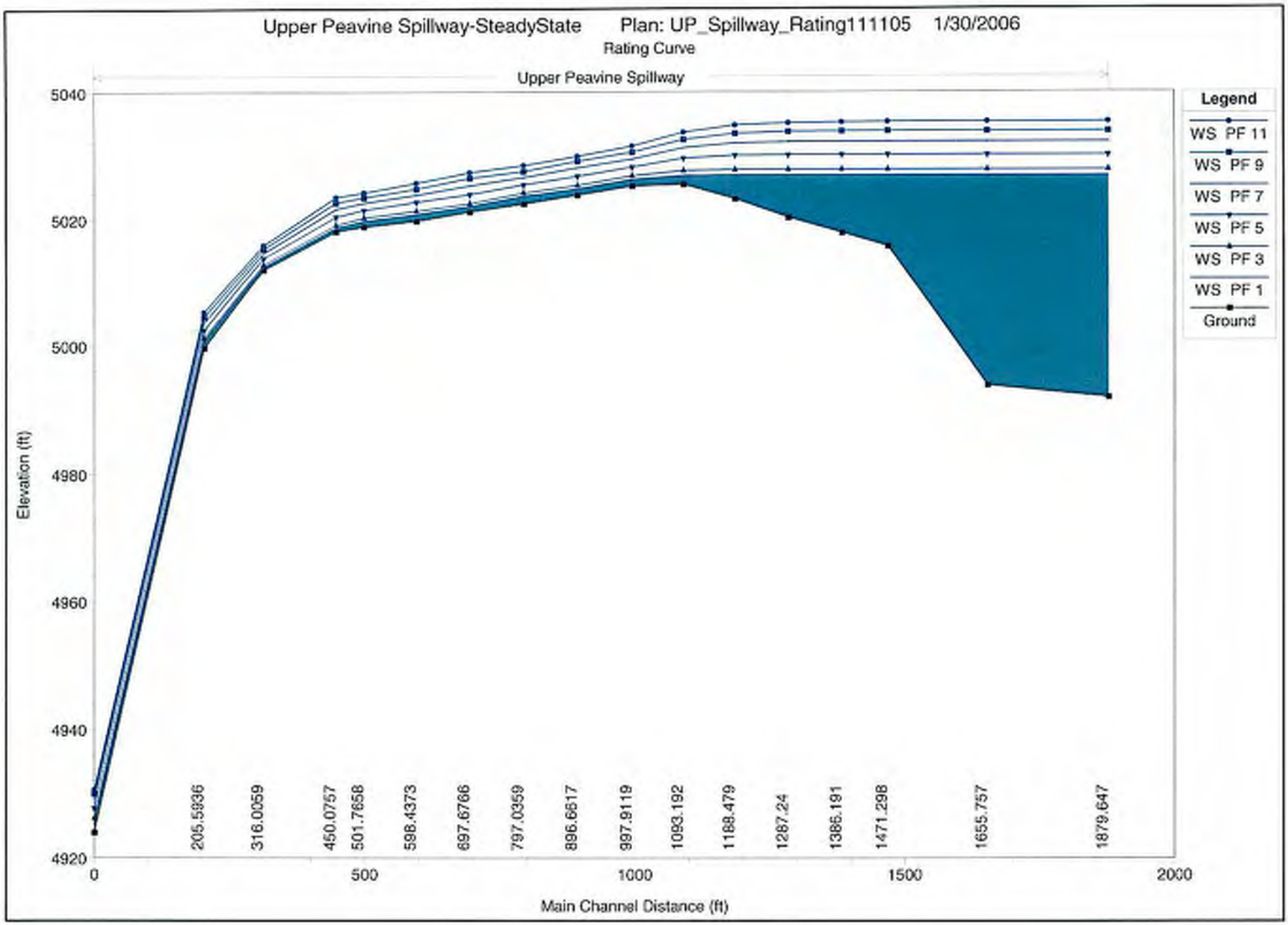
SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Upper Peavine

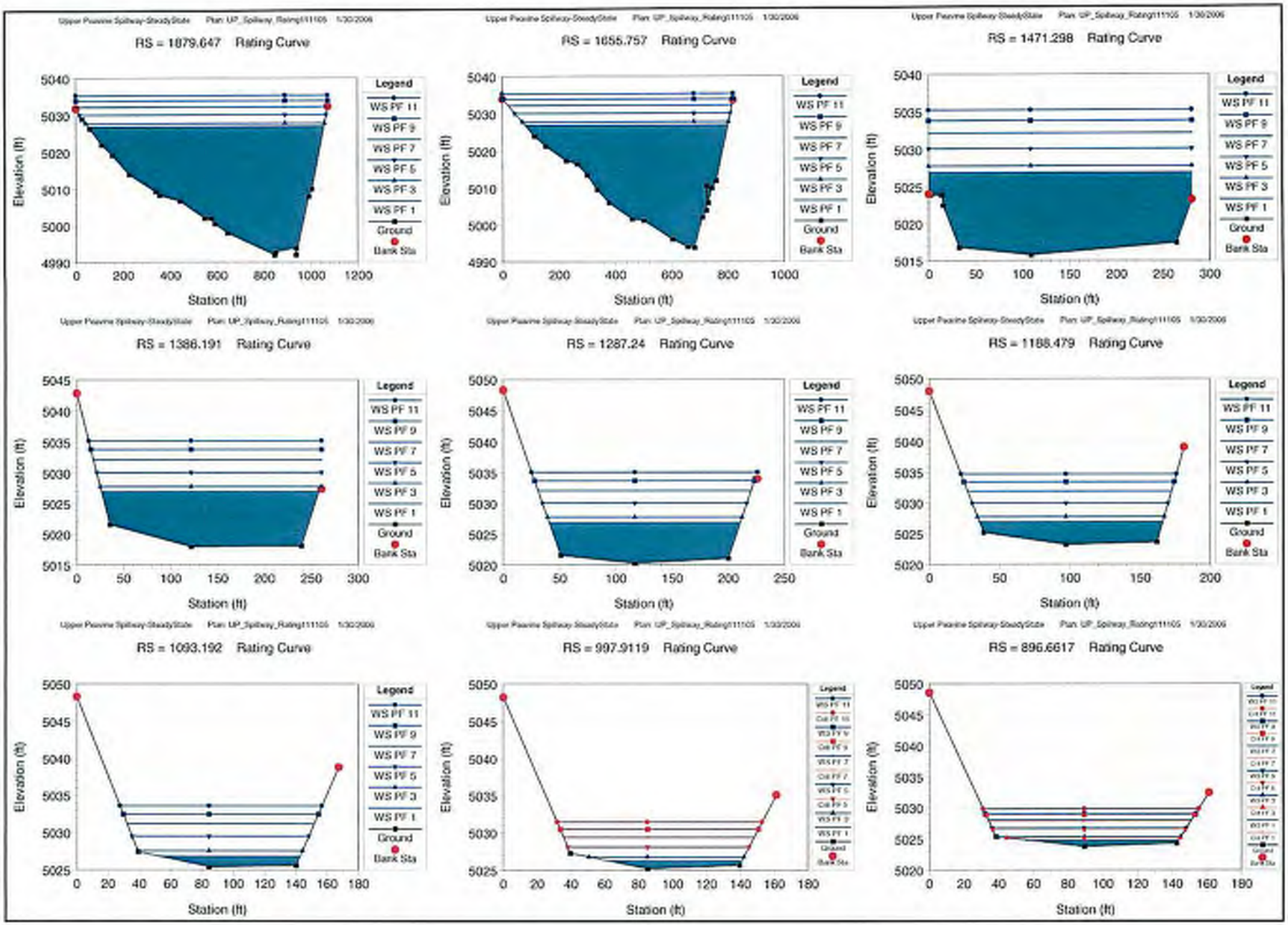
Reach	River Sta.	Contr.	Expan.
Spillway	1879.647	.1	.3
Spillway	1655.757	.1	.3
Spillway	1471.298	.1	.3

Spillway	1386.191	.1	.3
Spillway	1287.24	.1	.3
Spillway	1188.479	.1	.3
Spillway	1093.192	.1	.3
Spillway	997.9119	.1	.3
Spillway	896.6617	.1	.3
Spillway	797.0359	.1	.3
Spillway	697.6766	.1	.3
Spillway	598.4373	.1	.3
Spillway	501.7658	.1	.3
Spillway	450.0757	.1	.3
Spillway	316.0059	.1	.3
Spillway	205.5936	.1	.3
Spillway	2.535985	.1	.3

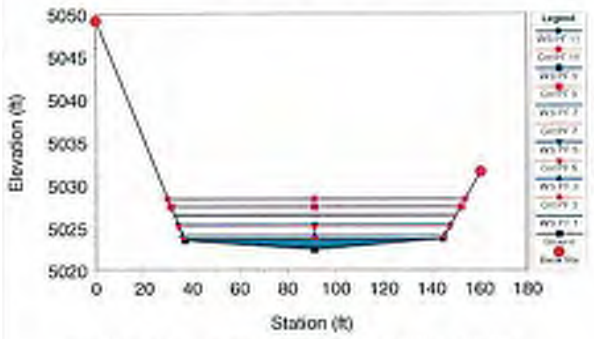
'UPPER PEAVINE'



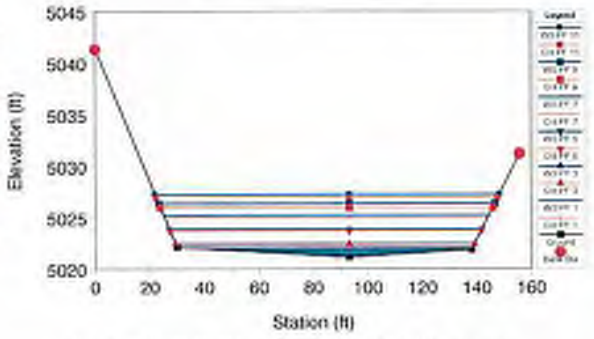

Upper Peavine Spillway-SteadyState Plan: UP_Spillway_Rating111105 1/30/2006
Rating Curve
Upper Peavine Spillway
Legend
WS PF 11
WS PF 9
WS PF 7
WS PF 5
WS PF 3
WS PF 1
Ground
Elevation (ft)
5040
5020
5000
4980
4960
4940
4920
205.5936
316.0059
450.0757
501.7658
598.4373
697.6766
797.0359
896.6617
997.9119
1093.192
1188.479
1287.24
1386.191
1471.298
1655.757
1879.647
0
500
1000
1500
2000
Main Channel Distance (ft)


RS = 1879.647 Rating Curve
RS = 1655.757 Rating Curve
RS = 1471.298 Rating Curve
RS = 1386.191 Rating Curve
RS = 1287.24 Rating Curve
RS = 1188.479 Rating Curve
RS = 1093.192 Rating Curve
RS = 997.9119 Rating Curve
RS = 896.6617 Rating Curve
Elevation (ft)
Station (ft)
Legend
WS PF 11
WS PF 9
WS PF 7
WS PF 5
WS PF 3
WS PF 1
Ground
Bank Sta

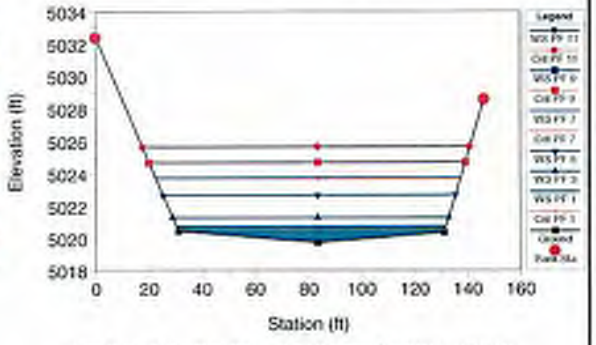
RS = 797.0359 Rating Curve



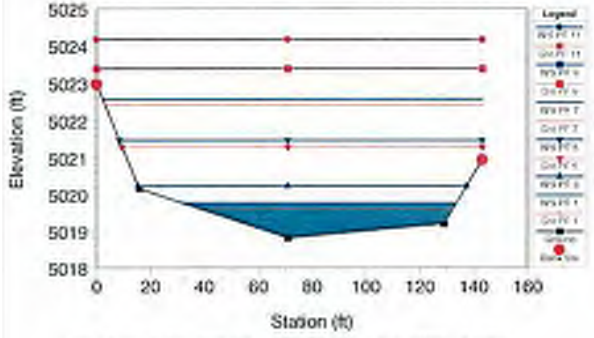
RS = 697.6766 Rating Curve



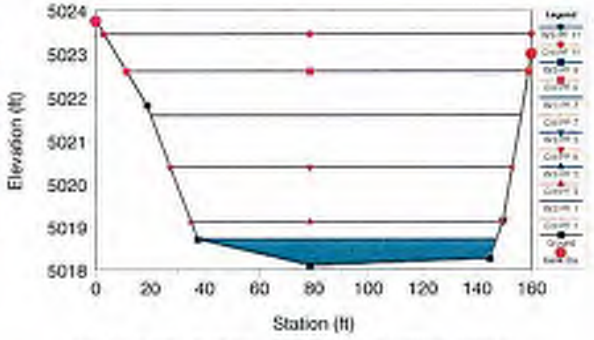
RS = 598.4373 Rating Curve



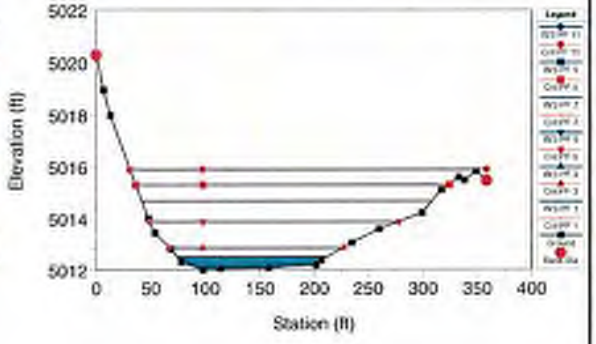
RS = 501.7658 Rating Curve



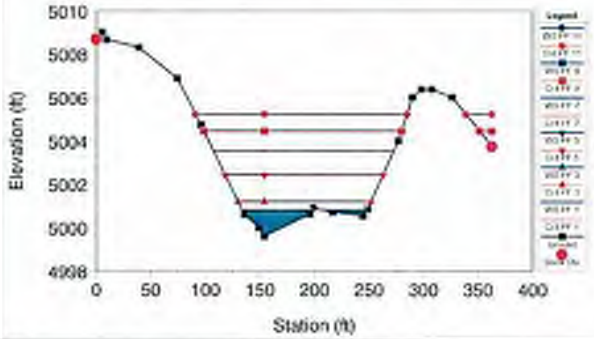
RS = 450.0757 Rating Curve



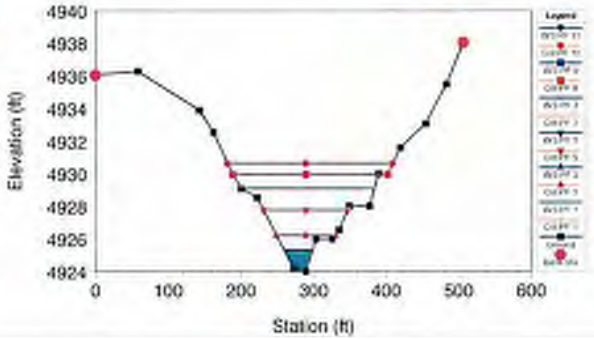
RS = 316.0059 Rating Curve



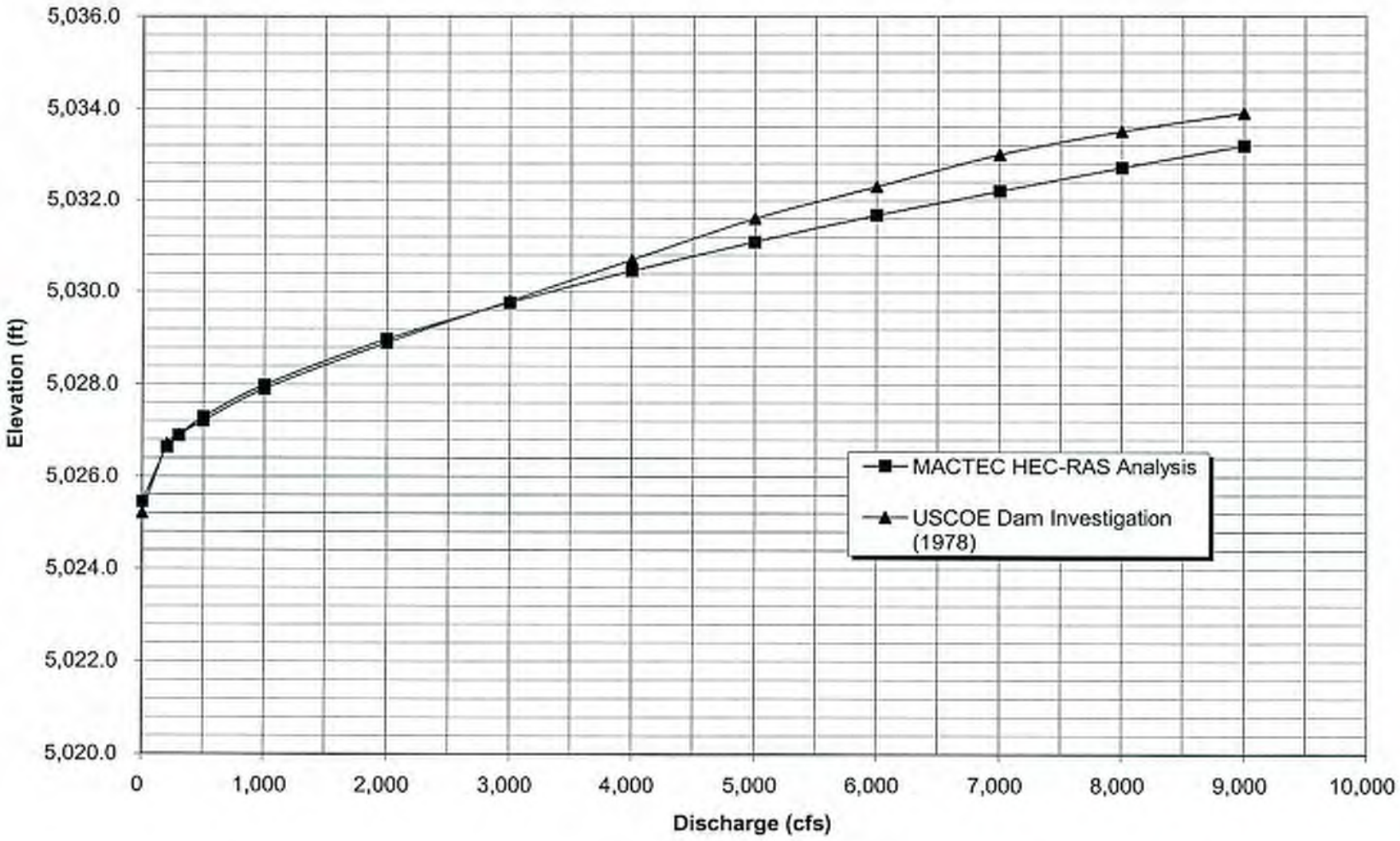
RS = 205.5936 Rating Curve



RS = 2.535985 Rating Curve



Upper Peavine Emergency Spillway
Rating Curves



Upper Peavine Emergency Spillway Rating Curves

Q Total (cfs)	USCOE-SPILLWAY [1]	MACTEC [2]
	W.S. Elev (ft)	W.S. Elev (ft)
0	5,025.2	5,025.4
200	5,026.7	5,026.6
300	5,026.9	5,026.9
500	5,027.2	5,027.3
1,000	5,027.9	5,028.0
2,000	5,028.9	5,029.0
3,000	5,029.8	5,029.8
4,000	5,030.7	5,030.5
5,000	5,031.6	5,031.1
6,000	5,032.3	5,031.7
7,000	5,033.0	5,032.2
8,000	5,033.5	5,032.7
9,000	5,033.9	5,033.2

NOTES:

(1) Spillway capacity values obtained from dam investigation report, USCOE (1978)
(2) Spillway capacity values are obtained from steady state RAS model, which uses MACTEC 2005 survey data.
(3) USCOE water surface elevations are adjusted (+3.2) to match with city of reno datum.
Elevation bust is calculated using well-defined points such as top of riser, city of reno brass cap elevations etc.,
(4) RAS model uses "Known Water Surface" as upstream boundary condition, and
"Normal Depth" as downstream boundary condition
(5) Used Rating Curve for Station 1093.19, which closely represents crest of the spillway

Lower Peavine Rating Curves Tabulations (HEC-HMS)

Emergency Spillway - USCOE [1]		
Discharge (cfs)	Original Elev. (ft)	Adjusted Elev. (ft)
0	4735	4738.2
0	4765	4768.2
500	4766.5	4769.7
1000	4767.5	4770.7
1500	4768.3	4771.5
2000	4769	4772.2
3000	4770.3	4773.5
4000	4771.4	4774.6
5000	4772.2	4775.4
6000	4773	4776.2
7000	4773.5	4776.7
8000	4773.8	4777
9000	4774.4	4777.6
10000	4774.6	4777.8

Principal Spillway - USCOE [2]		
Discharge (cfs)	Original Elev. (ft)	Adjusted Elev. (ft)
0	4750	4753.2
20	4750.5	4753.7
40	4751.3	4754.5
60	4751.8	4755
72	4752	4755.2
80	4758	4761.2
89	4765	4768.2
99	4772	4775.2

Original Combined Rating Curve [3]		
Adjusted Elev. (ft)	Storage (ac-feet)	Discharge (cfs)
4746	0	
4748	1.4008	0
4750	4.494	0
4752	8.7453	0
4754	14.1299	30
4756	20.5653	73
4758	28.231199	76
4760	37.216702	78
4762	47.423698	81
4764	59.994202	84
4766	75.264297	87
4768	92.413597	89
4770	110.9777	791
4772	130.9353	1894
4773	141.4182	2596
4774	152.2204	3697
4780	198.96152	12000

NOTES:

(1) Emergency spillway rating curve is derived from USCOE (1978).

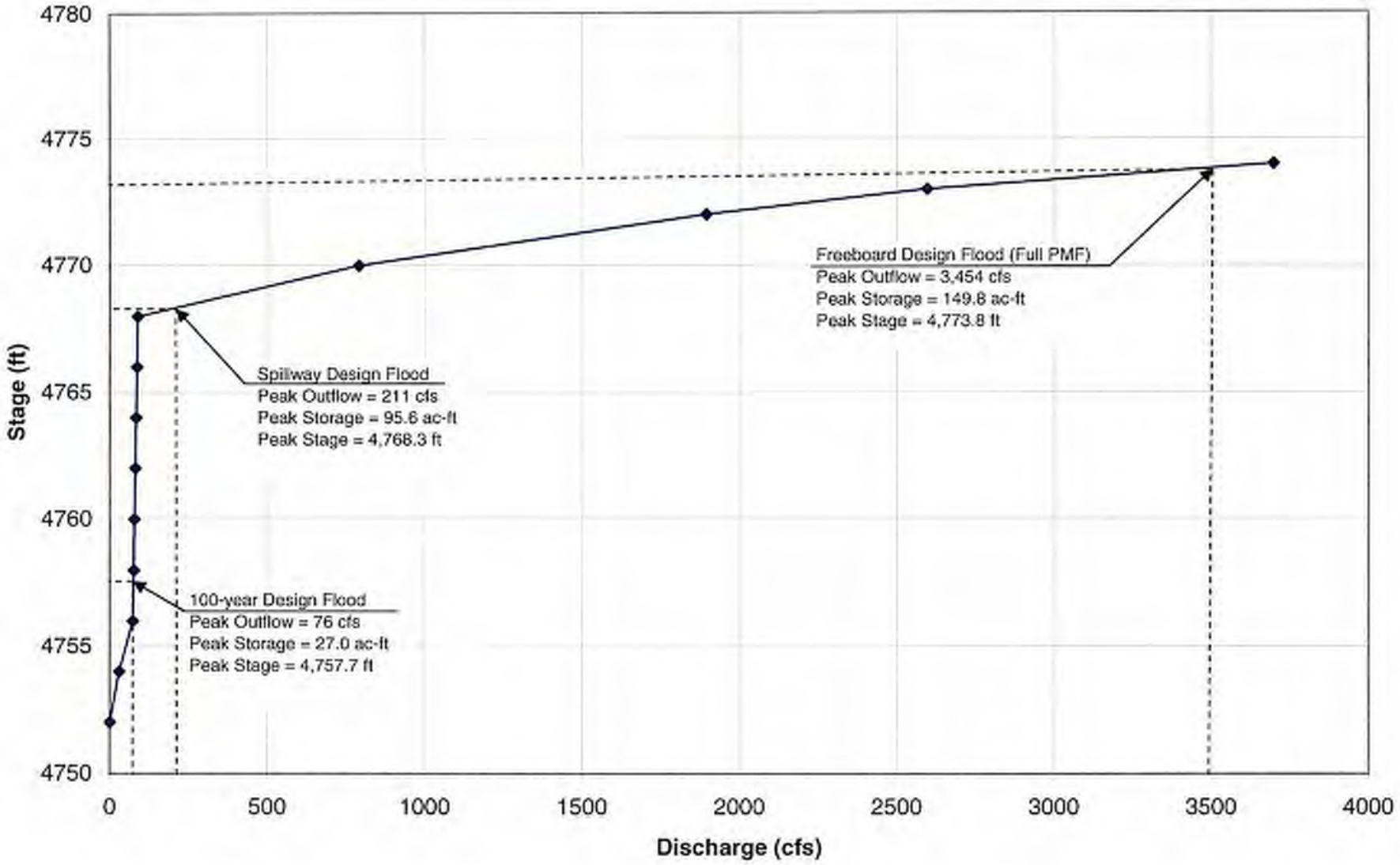
(2) Principal spillway rating curve is derived from USCOE (1978).

(3) Combined rating curve is a combination of rating curves of principal and emergency spillways.
and used in HEC-HMS hydrologic modeling of Upper and Lower Peavine.
See attached calculation for more information about stage-volume analysis.

(5) Geometric Data: Spillway Crest: 4768.2 ft
Top of Dam: 4777.2 ft

(6) Adjusted elevation takes into account the elevation difference of 3.2 ft between the NAVD 1928 and the NAVD 198

Lower Peavine Detention Dam Rating Curve (HEC-HMS)



HEC-RAS Version 3.1.3 May 2005
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X      X   X     X  X    X
X     X  X        X           X   X    X    X   X
XXXXXXX  XXXX     X      XXX  XXXX     XXXXXX    XXXX
X     X  X        X           X  X     X    X        X
X     X  X        X    X      X   X    X    X        X
X     X  XXXXXX    XXXX       X    X   X    X   XXXXX
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PROJECT DATA
Project Title: Lower Peavine Spillway
Project File : LP_Spillway.prj
Run Date and Time: 1/30/2006 1:51:38 PM

Project in English units

Project Description:
Lower Peavine Emergency Spillway Comparison
Reno EAP's Phase
II
4307050009
MACTEC

By: SG 11/16/05
Checked: CA
12/02/05

Plan"LP_Spillway_Rating_111605" is used to produce rating curve.
Plan"LP_Spillway_102705" is used for steady state PMF analysis which is used in conjuction with existing unsteady PMF inundation map.

PLAN DATA

Plan Title: LP_Spillway_Rating_111605
Plan File : p:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz II\Design\HEC-RAS\LowerPeavine\LP_Spillway.p06

Geometry Title: LP_Spillway_111605
Geometry File : p:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz II\Design\HEC-RAS\LowerPeavine\LP_Spillway.g02

Flow Title : LP_Spillway_Rating_111605
Flow File : p:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz II\Design\HEC-RAS\LowerPeavine\LP_Spillway.f06

Plan Description:
Used to produce Spillway Rating Curve for Lower Peavine Detention Dam

Plan Summary Information:
Number of: Cross Sections = 10 Multiple Openings = 0
Culverts = 0 Inline Structures = 0
Bridges = 0 Lateral Structures = 0

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01
Maximum number of iterations = 20
Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: LP_Spillway_Rating_111605
Flow File : p:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz II\Design\HEC-RAS\LowerPeavine\LP_Spillway.f06

Flow Data (cfs)

River	Reach	RS	PF 1	PF 2	PF 3	PF 4	PF 5	PF 6	PF 7	PF 8
Lower Peavine	Spillway	940.8049	500	1000	1500	2000	3000	4000	5000	6000

River	Reach	RS	PF 9	PF 10	PF 11	PF 12
Lower Peavine	Spillway	940.8049	7000	8000	9000	10000

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Lower Peavine	Spillway	PF 1	Known WS = 4769.7	Normal S = 0.02
Lower Peavine	Spillway	PF 2	Known WS = 4770.7	Normal S = 0.02
Lower Peavine	Spillway	PF 3	Known WS = 4771.5	Normal S = 0.02
Lower Peavine	Spillway	PF 4	Known WS = 4772.2	

Normal S = 0.02			
Lower Peavine	Spillway	PF 5	Known WS = 4773.5
Normal S = 0.02			
Lower Peavine	Spillway	PF 6	Known WS = 4774.6
Normal S = 0.02			
Lower Peavine	Spillway	PF 7	Known WS = 4775.4
Normal S = 0.02			
Lower Peavine	Spillway	PF 8	Known WS = 4776.2
Normal S = 0.02			
Lower Peavine	Spillway	PF 9	Known WS = 4776.7
Normal S = 0.02			
Lower Peavine	Spillway	PF 10	Known WS = 4777
Normal S = 0.02			
Lower Peavine	Spillway	PF 11	Known WS = 4777.6
Normal S = 0.02			
Lower Peavine	Spillway	PF 12	Known WS = 4777.8
Normal S = 0.02			

GEOMETRY DATA

Geometry Title: LP_Spillway_111605
Geometry File : p:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz II\Design\HEC-RAS\LowerPeavine\LP_Spillway.g02

CROSS SECTION

RIVER: Lower Peavine
REACH: Spillway RS: 940.8049

INPUT
Description:
Station Elevation Data num= 23

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4773.41	9.63	4772.14	18.3	4772.1	53.32	4767.72	54.95	4767.24
55.54	4767.24	56.79	4767.24	74.72	4766.22	77.81	4764.56	89.82	4764.38
94.45	4764.66	98.28	4764.75	121.98	4763.8	169.63	4765.11	187.51	4765.58
193.63	4765.59	203.16	4765.66	223.23	4765.25	241.08	4764.87	242.07	4764.64
246.89	4764.06	253.7	4768.11	262.08	4769.16				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.022	0	.022	262.08	.022

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	262.08	33	139.28	175	.1	.3

CROSS SECTION

RIVER: Lower Peavine
REACH: Spillway RS: 801.5223

INPUT
Description:
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4772.56	15.55	4774.91	30.53	4772.46	39.78	4771.82	58.91	4767.2
63.96	4767.08	75.39	4766.2	83.3	4766.47	119.37	4766.66	120.31	4766.33

```
  121.48 4766.42  124.76 4765.82  131.38 4769.03  145.66 4776.78

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .022       0    .022  145.66    .022

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  145.66             97.3    97.3    97.3             .1       .3

CROSS SECTION


RIVER: Lower Peavine
REACH: Spillway           RS: 704.221

INPUT
Description:
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 4778.12   10.63 4778.12    19.9 4774.29   29.39 4774.19   35.52 4772.79
   64.81 4767.46    97.3 4768.61  108.56 4769.02  109.36 4768.97  111.53  4768.7
  124.78 4776.84  132.79  4781.3  135.21 4781.36

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .022       0    .022  135.21    .022

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  135.21             68.4    68.4    68.4             .1       .3

CROSS SECTION


RIVER: Lower Peavine
REACH: Spillway           RS: 635.8168

INPUT
Description:
Station Elevation Data    num=       6
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0    4776   20.95 4768.45   55.81 4768.46   87.83 4769.35  111.49    4779
  124.02 4779.92

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .022       0    .022  124.02    .022

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  124.02             35.48   35.48   35.48             .1       .3

CROSS SECTION


RIVER: Lower Peavine
REACH: Spillway           RS: 600.337

INPUT
Description:
Station Elevation Data    num=      14
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 4772.36   11.69 4771.15   17.72 4771.12   47.08 4768.43   53.01 4768.42
   63.45 4768.42   81.87 4768.86   88.53 4769.19  107.03  4769.4  113.36 4769.57
  114.23 4769.56   114.7 4769.81   115.2 4769.64   134.4 4774.22
```

```
Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .022       0    .022   134.4    .022

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0   134.4             15.93   15.93   15.93             .1       .3

CROSS SECTION


RIVER: Lower Peavine
REACH: Spillway           RS: 584.4048

INPUT
Description:
Station Elevation Data    num=      12
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 4772.27    7.24 4772.23   39.45 4769.26   43.52 4768.42   48.53 4768.58
   63.61 4769.32   70.55  4769.4  103.33 4770.28   107.8 4770.24  110.22 4771.53
  112.74 4770.63     145 4778.33

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .022       0    .022     145    .022

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0     145             83.94   83.94   83.94             .1       .3

CROSS SECTION


RIVER: Lower Peavine
REACH: Spillway           RS: 500.461

INPUT
Description:
Station Elevation Data    num=      12
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 4770.49    7.17 4771.15   11.23 4770.91   24.92 4765.07   27.98 4765.07
    32.6 4764.88   46.48 4764.52   60.83  4764.3   79.47 4765.56  108.95 4771.55
  122.81 4774.58  135.07 4773.69

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .022       0    .022  135.07    .022

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  135.07           100.18  100.18  100.18             .1       .3

CROSS SECTION


RIVER: Lower Peavine
REACH: Spillway           RS: 400.2762

INPUT
Description:
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 4769.59    15.5 4769.06   17.04 4769.51   19.09 4769.47   75.85 4763.12
   79.32 4763.12   94.72 4761.75  106.37 4761.17  111.93 4768.89  117.47 4761.49
  118.74 4763.35  122.75 4765.15  135.07 4773.22
```

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.022	0	.022	135.07	.022

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	135.07	99.98	99.98	.1	.3

CROSS SECTION

RIVER: Lower Peavine
REACH: Spillway RS: 300.2995

INPUT
Description:
Station Elevation Data num= 12

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4765.94	9.36	4767.09	17.89	4765.15	31.89	4763.42	39.4	4762.48
51.05	4760.53	69.06	4760.18	74.83	4760.19	78.25	4760.24	89.52	4760.24
110.06	4759.24	134.65	4764.29						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.022	0	.022	134.65	.022

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	134.65	99.53	99.53	.1	.3

CROSS SECTION

RIVER: Lower Peavine
REACH: Spillway RS: 200.7709

INPUT
Description:
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4759.17	19.01	4761.91	30.25	4760.62	39.14	4760.61	56.58	4757.65
68.79	4757.69	74	4757.75	78.07	4756.98	90.65	4756.97	107.69	4756.97
113.93	4760.61	125.47	4768.52	135.53	4768.58				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.022	0	.022	135.53	.022

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	135.53	200.77	200.77	.1	.3

SUMMARY OF MANNING'S N VALUES

River:Lower Peavine

Reach	River Sta.	n1	n2	n3
Spillway	940.8049	.022	.022	.022
Spillway	801.5223	.022	.022	.022
Spillway	704.221	.022	.022	.022
Spillway	635.8168	.022	.022	.022
Spillway	600.337	.022	.022	.022

Spillway	584.4048	.022	.022	.022
Spillway	500.461	.022	.022	.022
Spillway	400.2762	.022	.022	.022
Spillway	300.2995	.022	.022	.022
Spillway	200.7709	.022	.022	.022

SUMMARY OF REACH LENGTHS

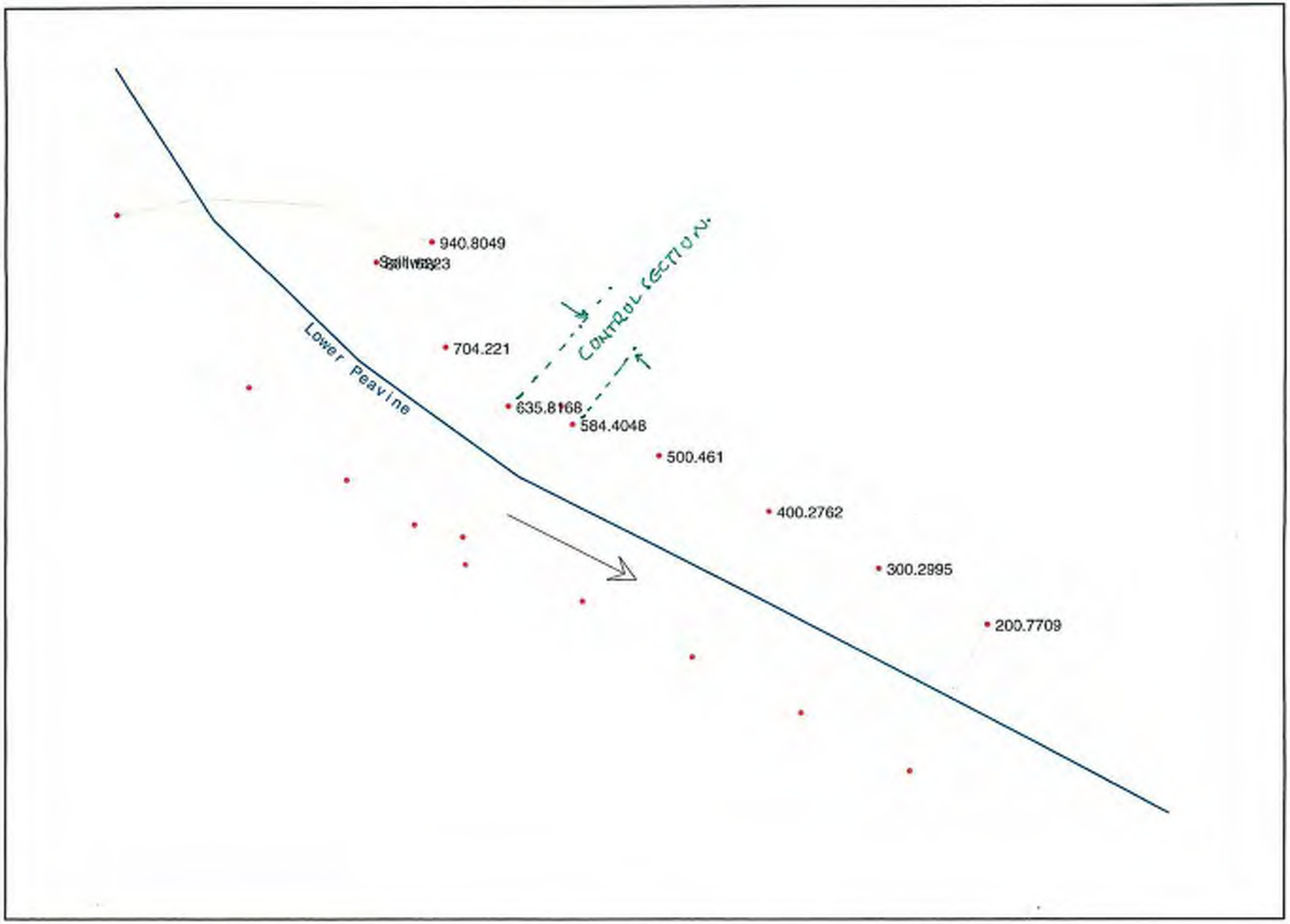
River: Lower Peavine

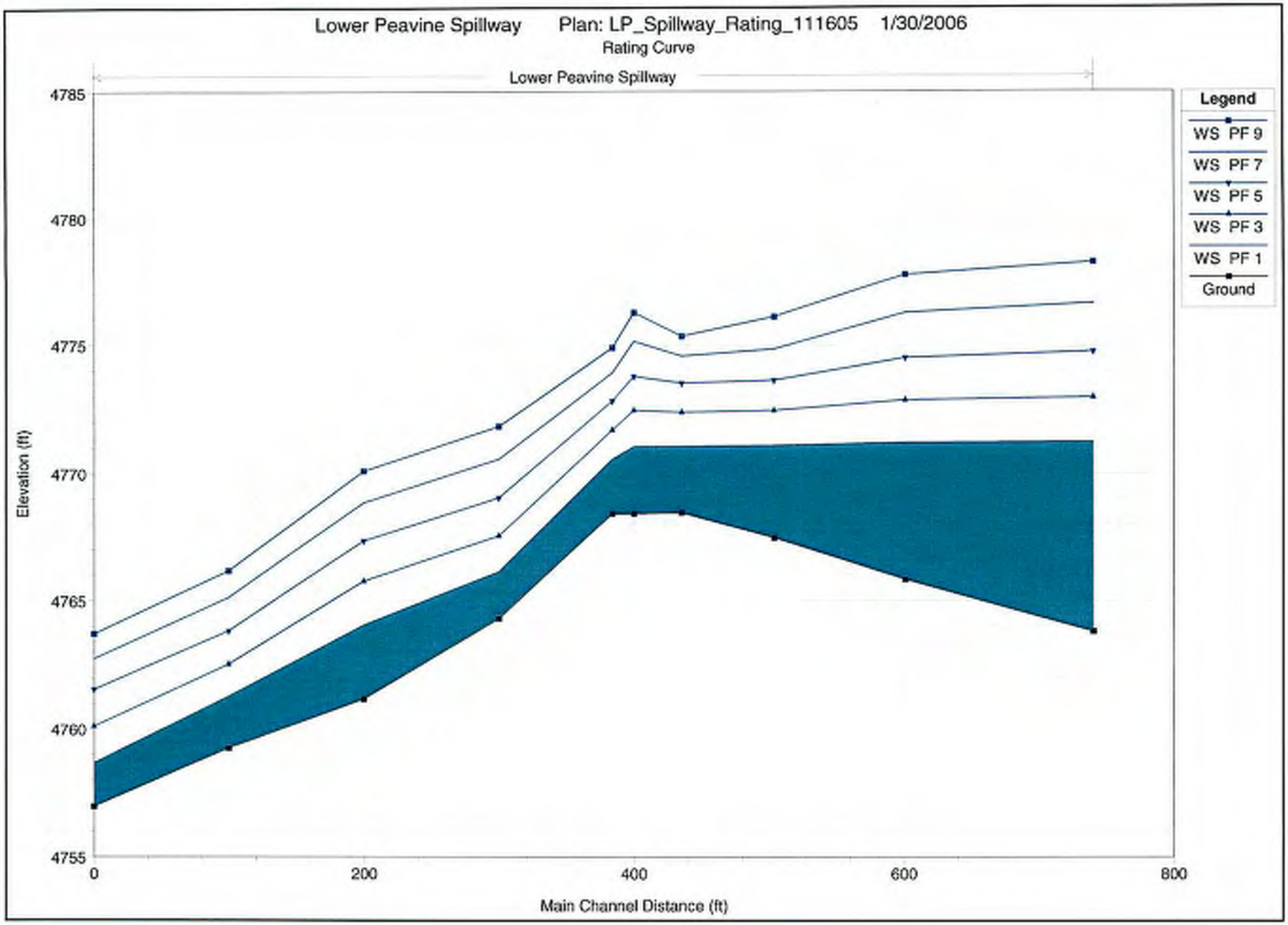
Reach	River Sta.	Left	Channel	Right
Spillway	940.8049	33	139.28	175
Spillway	801.5223	97.3	97.3	97.3
Spillway	704.221	68.4	68.4	68.4
Spillway	635.8168	35.48	35.48	35.48
Spillway	600.337	15.93	15.93	15.93
Spillway	584.4048	83.94	83.94	83.94
Spillway	500.461	100.18	100.18	100.18
Spillway	400.2762	99.98	99.98	99.98
Spillway	300.2995	99.53	99.53	99.53
Spillway	200.7709	200.77	200.77	200.77

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Lower Peavine

Reach	River Sta.	Contr.	Expan.
Spillway	940.8049	.1	.3
Spillway	801.5223	.1	.3
Spillway	704.221	.1	.3
Spillway	635.8168	.1	.3
Spillway	600.337	.1	.3
Spillway	584.4048	.1	.3
Spillway	500.461	.1	.3
Spillway	400.2762	.1	.3
Spillway	300.2995	.1	.3
Spillway	200.7709	.1	.3

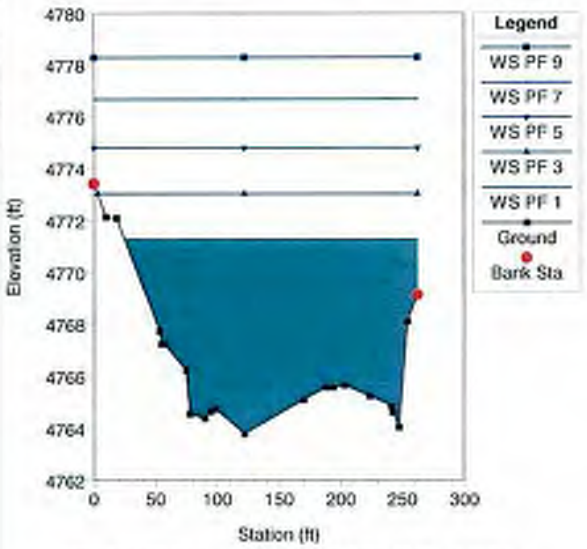
LOWER PEAVINE




Lower Peavine Spillway Plan: LP_Spillway_Rating_111605 1/30/2006
Rating Curve
Lower Peavine Spillway
Legend
WS PF 9
WS PF 7
WS PF 5
WS PF 3
WS PF 1
Ground
Elevation (ft)
4785
4780
4775
4770
4765
4760
4755
0
200
400
600
800
Main Channel Distance (ft)

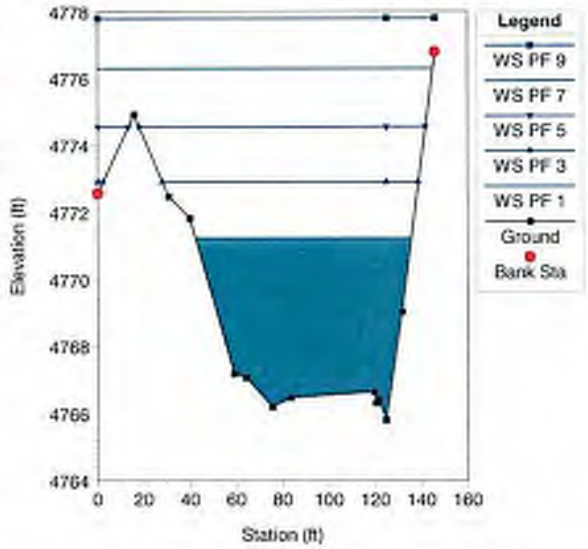
Lower Peavine Spillway Plan: LP_Spillway_Rating_111605 1/30/2006

RS = 940.8049 Rating Curve



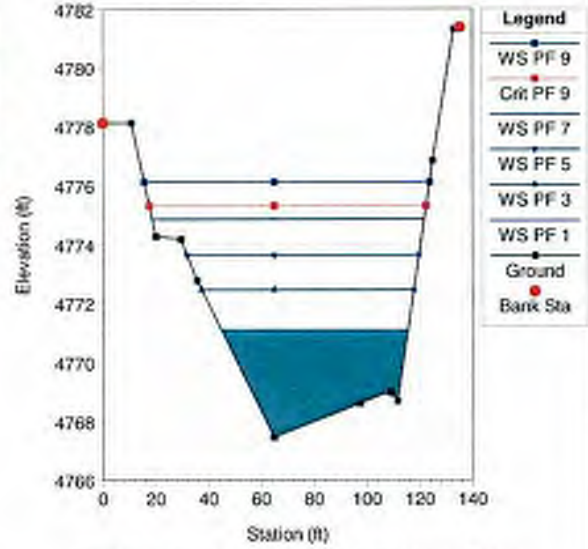
Lower Peavine Spillway Plan: LP_Spillway_Rating_111605 1/30/2006

RS = 801.5223 Rating Curve



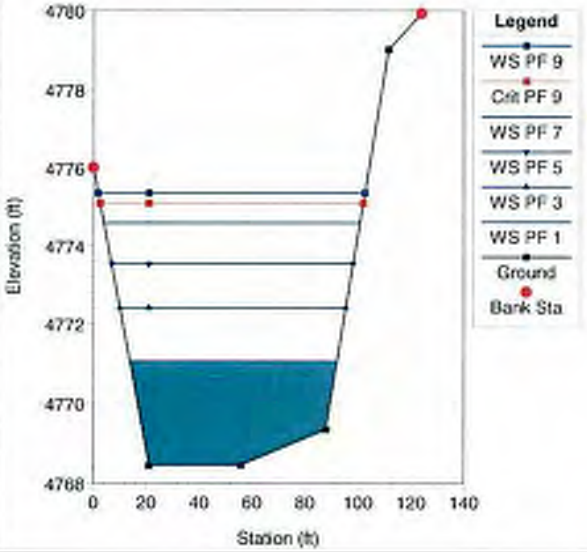
Lower Peavine Spillway Plan: LP_Spillway_Rating_111605 1/30/2006

RS = 704.221 Rating Curve



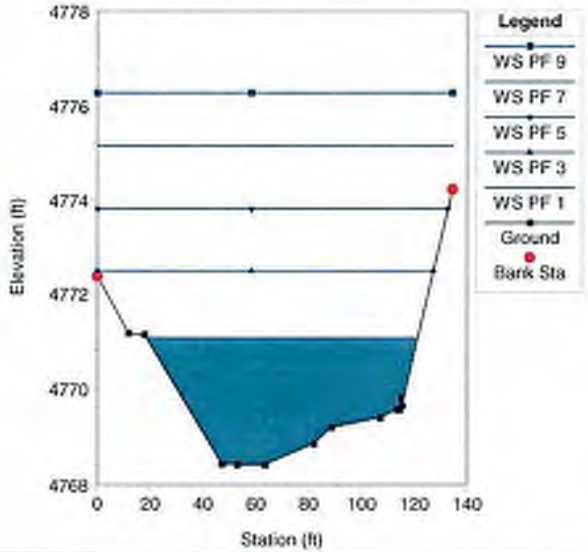
Lower Peavine Spillway Plan: LP_Spillway_Rating_111605 1/30/2006

RS = 635.8168 Rating Curve



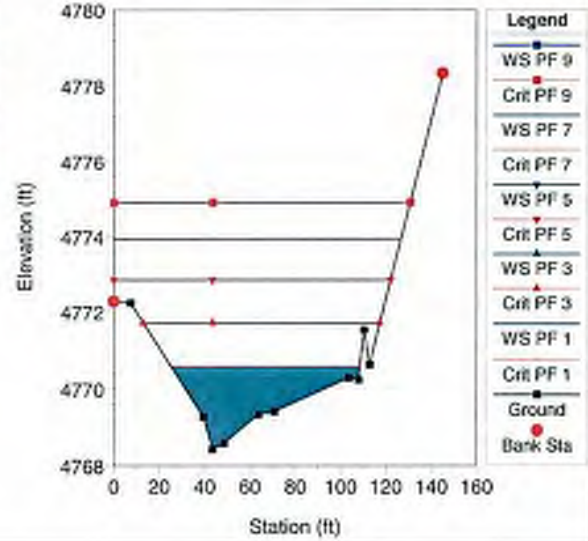
Lower Peavine Spillway Plan: LP_Spillway_Rating_111605 1/30/2006

RS = 600.337 Rating Curve



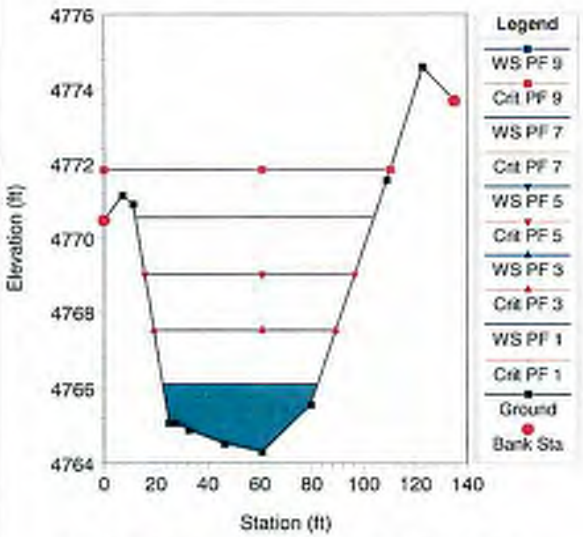
Lower Peavine Spillway Plan: LP_Spillway_Rating_111605 1/30/2006

RS = 584.4048 Rating Curve



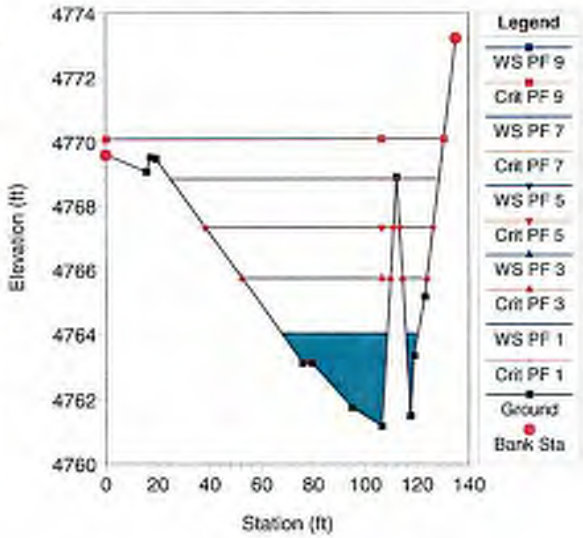
Lower Peavine Spillway Plan: LP_Spillway_Rating_111605 1/30/2006

RS = 500.461 Rating Curve



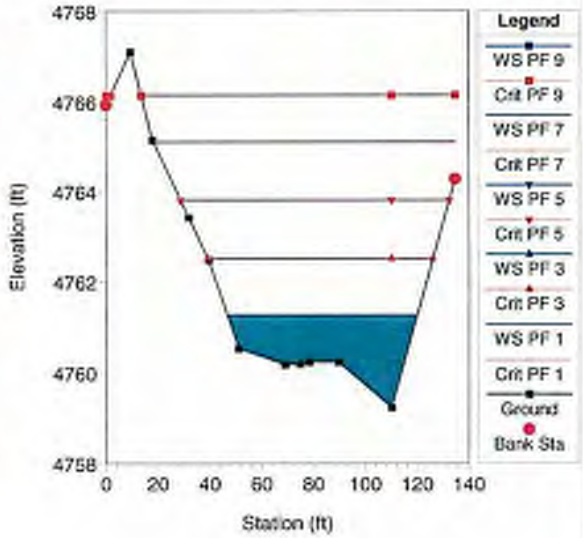
Lower Peavine Spillway Plan: LP_Spillway_Rating_111605 1/30/2006

RS = 400.2762 Rating Curve



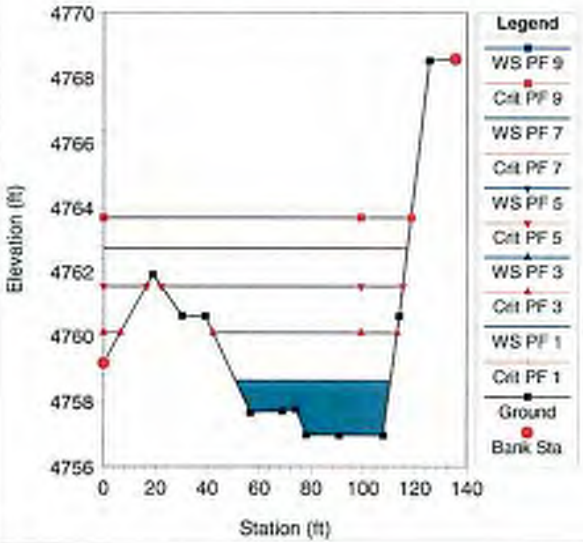
Lower Peavine Spillway Plan: LP_Spillway_Rating_111605 1/30/2006

RS = 300.2995 Rating Curve

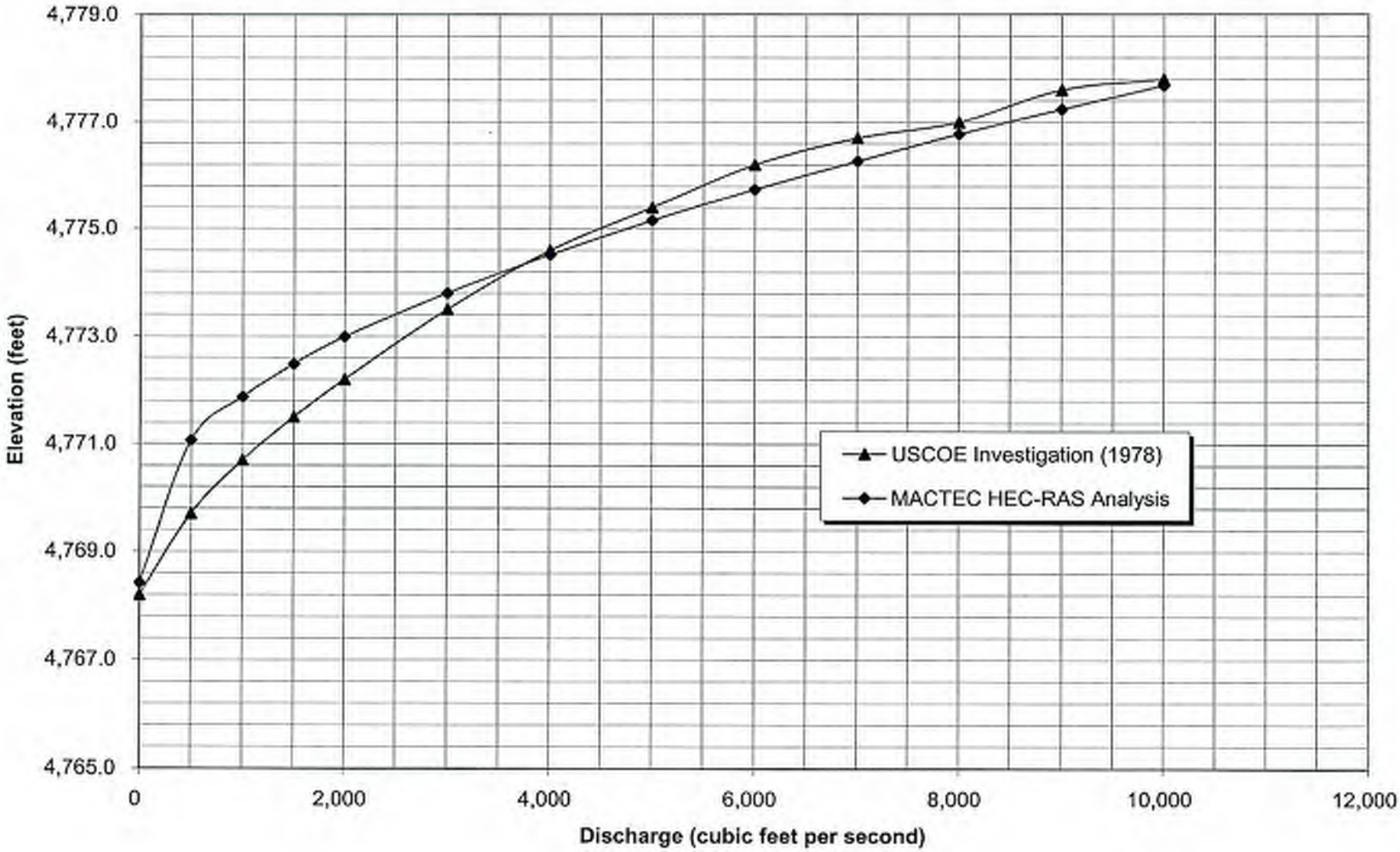


Lower Peavine Spillway Plan: LP_Spillway_Rating_111605 1/30/2006

RS = 200.7709 Rating Curve



Lower Peavine Emergency Spillway
Rating Curves



Lower Peavine Emergency Spillway
Rating Curves

Q Total (cfs)	USCOE-SPILLWAY [1]	MACTEC [2]
	W.S. Elev (ft)	W.S. Elev (ft)
0	4,768.2	4,768.4
500	4,769.7	4,771.1
1,000	4,770.7	4,771.9
1,500	4,771.5	4,772.5
2,000	4,772.2	4,773.0
3,000	4,773.5	4,773.8
4,000	4,774.6	4,774.5
5,000	4,775.4	4,775.2
6,000	4,776.2	4,775.7
7,000	4,776.7	4,776.3
8,000	4,777.0	4,776.8
9,000	4,777.6	4,777.2
10,000	4,777.8	4,777.7

NOTES:

(1) Spillway capacity values obtained from dam investigation report, USCOE (1978)
(2) Spillway capacity values are obtained from steady state RAS model, which uses MACTEC 2005 survey data.
(3) USCOE water surface elevations are adjusted (+3.2) to match with city of reno datum.
Elevation bust is calculated using well-defined points such as top of riser, city of reno brass cap elevations etc.,
(4) RAS model uses "Known Water Surface" as upstream boundary condition, and
"Normal Depth" as downstream boundary condition
(5) Used Rating Curve for Station 1093.19, which closely represents crest of the spillway

HEC-RAS Version 3.1.3 May 2005
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X       X   X     X  X    X
X     X  X        X            X   X    X    X   X
XXXXXXX  XXXX     X      XXX   XXXX     XXXXXX    XXXX
X     X  X        X            X  X     X    X       X
X     X  X        X    X       X   X    X    X       X
X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: Lower Peavine Spillway-SCS Model
Project File : LP_Spillway_SCS.prj
Run Date and Time: 1/30/2006 2:47:08 PM

Project in English units

Project Description:
Manning's Roughness (n) Sensitivity Analysis
Lower Peavine Creek Detention
Dam
4307050009
By: SG 11-25-05
Checked: CA 12-05-05

This model was
built from the spillway cross section data present in the As-built drawings
produced by NRCS (1961).

PLAN DATA

Plan Title: scs_plan_vary_wse_n2
Plan File : p:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz
II\Design\HEC-RAS\LowerPeavine\LP_Spillway_SCS.p04

Geometry Title: Scs_Geometry_n2
Geometry File : p:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz
II\Design\HEC-RAS\LowerPeavine\LP_Spillway_SCS.g03

Flow Title : scs_flow_vary_wse
Flow File : p:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz
II\Design\HEC-RAS\LowerPeavine\LP_Spillway_SCS.f02

Plan Summary Information:

Number of:	Cross Sections	= 21	Multiple Openings	=	0
	Culverts	= 0	Inline Structures	=	0
	Bridges	= 0	Lateral Structures	=	0

Computational Information
Water surface calculation tolerance = 0.01

```
    Critical depth calculation tolerance =  0.01
    Maximum number of iterations         =  20
    Maximum difference tolerance         =  0.3
    Flow tolerance factor                =  0.001

Computation Options
    Critical depth computed only where necessary
    Conveyance Calculation Method: At breaks in n values only
    Friction Slope Method:         Average Conveyance
    Computational Flow Regime:     Subcritical Flow



FLOW DATA

Flow Title: scs_flow_vary_wse
Flow File : p:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz
II\Design\HEC-RAS\LowerPeavine\LP_Spillway_SCS.f02

Flow Data (cfs)


  River           Reach           RS                PF 1            PF 2
  PF 3            PF 4            PF 5          PF 6            PF 7            PF
8
  Lower Peavine   SCS             600                500            1000
  1500            2000            3000          4000            5000
6000
  Lower Peavine   SCS             100                500            1000
  1500            2000            3000          4000            5000
6000




  River           Reach           RS                PF 9            PF 10
 PF 11           PF 12
  Lower Peavine   SCS             600               7000            8000
  9000           10000
  Lower Peavine   SCS             100               7000            8000
  9000           10000


Boundary Conditions

  River           Reach           Profile                   Upstream
    Downstream


  Lower Peavine   SCS             PF 1                Known WS = 4766.5
  Normal S = 0.05
  Lower Peavine   SCS             PF 2                Known WS = 4767.5
  Normal S = 0.05
  Lower Peavine   SCS             PF 3                Known WS = 4768.3
  Normal S = 0.05
  Lower Peavine   SCS             PF 4                  Known WS = 4769
  Normal S = 0.05
  Lower Peavine   SCS             PF 5                Known WS = 4770.3
```

```
 Normal S = 0.05
 Lower Peavine   SCS            PF 6                    Known WS = 4771.4
 Normal S = 0.05
 Lower Peavine   SCS            PF 7                    Known WS = 4772.2
 Normal S = 0.05
 Lower Peavine   SCS            PF 8                      Known WS = 4773
 Normal S = 0.05
 Lower Peavine   SCS            PF 9                    Known WS = 4773.5
 Normal S = 0.05
 Lower Peavine   SCS            PF 10                   Known WS = 4773.8
 Normal S = 0.05
 Lower Peavine   SCS            PF 11                   Known WS = 4774.4
 Normal S = 0.05
 Lower Peavine   SCS            PF 12                   Known WS = 4774.6
 Normal S = 0.05
```

GEOMETRY DATA

Geometry Title: Scs_Geometry_n2
Geometry File : p:\430NEVA\4307 DESIGN\4307050009 Reno EAP Pz II\Design\HEC-RAS\LowerPeavine\LP_Spillway_SCS.g03

CROSS SECTION

RIVER: Lower Peavine
REACH: SCS RS: 600

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4777	20	4763.85	108	4763.85	128	4777

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.018	0	.018	128	.018

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	128	25	25	25	.1	.3

CROSS SECTION

RIVER: Lower Peavine
REACH: SCS RS: 575.*

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4776.67	20	4764.23	105.33	4764.23	125.33	4776.67

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.018	0	.018	125.33	.018

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	125.33	25	25	25	.1	.3

CROSS SECTION

RIVER: Lower Peavine
REACH: SCS RS: 550.*

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4776.33	20	4764.62	102.67	4764.62	122.67	4776.33

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.018	0	.018	122.67	.018

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	122.67	25	25	.1	.3

CROSS SECTION

RIVER: Lower Peavine
REACH: SCS RS: 525

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4776	20	4765	100	4765	120	4776

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.018	0	.018	120	.018

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	120	25	25	.1	.3

CROSS SECTION

RIVER: Lower Peavine
REACH: SCS RS: 500.*

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4775	20	4765	100	4765	120	4775

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.018	0	.018	120	.018

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	120	25	25	.1	.3

CROSS SECTION

RIVER: Lower Peavine
REACH: SCS RS: 475

```
INPUT
Description:
Station Elevation Data    num=       4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0    4774      20    4765     100    4765     120    4774

Manning's n Values        num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .018       0    .018      120    .018

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
            0     120               25      25      25             .1       .3

CROSS SECTION


RIVER: Lower Peavine
REACH: SCS                RS: 450.*

INPUT
Description:
Station Elevation Data    num=       4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 4773.67      20 4764.41     100 4764.41     120 4773.67

Manning's n Values        num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .018       0    .018      120    .018

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
            0     120               25      25      25             .1       .3

CROSS SECTION


RIVER: Lower Peavine
REACH: SCS                RS: 425.*

INPUT
Description:
Station Elevation Data    num=       4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 4773.33      20 4763.83     100 4763.83     120 4773.33

Manning's n Values        num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .018       0    .018      120    .018

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
            0     120               25      25      25             .1       .3

CROSS SECTION


RIVER: Lower Peavine
REACH: SCS                RS: 400

INPUT
Description:
Station Elevation Data    num=       4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0    4773      20 4763.24     100 4763.24     120    4773
```

```
Manning's n Values        num=        3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .018       0    .018     120    .018

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
            0     120               25      25      25             .1       .3

CROSS SECTION


RIVER: Lower Peavine
REACH: SCS                RS: 375.*

INPUT
Description:
Station Elevation Data    num=        4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  4772.5      20 4762.66     100 4762.66     120  4772.5

Manning's n Values        num=        3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .018       0    .018     120    .018

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
            0     120               25      25      25             .1       .3

CROSS SECTION


RIVER: Lower Peavine
REACH: SCS                RS: 350.*

INPUT
Description:
Station Elevation Data    num=        4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0    4772      20 4762.07     100 4762.07     120    4772

Manning's n Values        num=        3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .018       0    .018     120    .018

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
            0     120               25      25      25             .1       .3

CROSS SECTION


RIVER: Lower Peavine
REACH: SCS                RS: 325.*

INPUT
Description:
Station Elevation Data    num=        4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  4771.5      20 4761.48     100 4761.48     120  4771.5

Manning's n Values        num=        3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .018       0    .018     120    .018

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
```

0	120		25	25	25	.1	.3

CROSS SECTION

RIVER: Lower Peavine
REACH: SCS RS: 300

INPUT
Description:

Station Elevation Data	num=	4					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4771	20	4760.9	100	4760.9	120	4771

Manning's n Values	num=	3			
Sta	n Val	Sta	n Val	Sta	n Val
0	.018	0	.018	120	.018

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	120	25	25	.1	.3

CROSS SECTION

RIVER: Lower Peavine
REACH: SCS RS: 275.*

INPUT
Description:

Station Elevation Data	num=	4					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4770	20	4760.31	100	4760.31	120	4770

Manning's n Values	num=	3			
Sta	n Val	Sta	n Val	Sta	n Val
0	.018	0	.018	120	.018

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	120	25	25	.1	.3

CROSS SECTION

RIVER: Lower Peavine
REACH: SCS RS: 250.*

INPUT
Description:

Station Elevation Data	num=	4					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4769	20	4759.73	100	4759.73	120	4769

Manning's n Values	num=	3			
Sta	n Val	Sta	n Val	Sta	n Val
0	.018	0	.018	120	.018

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	120	25	25	.1	.3

CROSS SECTION

RIVER: Lower Peavine

REACH: SCS RS: 225.*

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4768	20	4759.15	100	4759.15	120	4768

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.018	0	.018	120	.018

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	120	25	25	.1	.3

CROSS SECTION

RIVER: Lower Peavine
REACH: SCS RS: 200

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4767	20	4758.56	100	4758.56	120	4767

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.018	0	.018	120	.018

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	120	25	25	.1	.3

CROSS SECTION

RIVER: Lower Peavine
REACH: SCS RS: 175.*

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4766	20	4757.98	100	4757.98	120	4766

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.018	0	.018	120	.018

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	120	25	25	.1	.3

CROSS SECTION

RIVER: Lower Peavine
REACH: SCS RS: 150.*

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev

0	4765	20	4757.39	100	4757.39	120	4765

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.018	0	.018	120	.018

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	120	25	25	.1	.3

CROSS SECTION

RIVER: Lower Peavine
REACH: SCS RS: 125.*

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4764	20	4756.81	100	4756.81	120	4764

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.018	0	.018	120	.018

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	120	25	25	.1	.3

CROSS SECTION

RIVER: Lower Peavine
REACH: SCS RS: 100

INPUT
Description:
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4763	20	4756.22	100	4756.22	120	4763

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.018	0	.018	120	.018

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	120	100	100	.1	.3

SUMMARY OF MANNING'S N VALUES

River:Lower Peavine

Reach	River Sta.	n1	n2	n3
SCS	600	.018	.018	.018
SCS	575.*	.018	.018	.018
SCS	550.*	.018	.018	.018
SCS	525	.018	.018	.018
SCS	500.*	.018	.018	.018
SCS	475	.018	.018	.018
SCS	450.*	.018	.018	.018
SCS	425.*	.018	.018	.018

SCS	400	.018	.018	.018
SCS	375.*	.018	.018	.018
SCS	350.*	.018	.018	.018
SCS	325.*	.018	.018	.018
SCS	300	.018	.018	.018
SCS	275.*	.018	.018	.018
SCS	250.*	.018	.018	.018
SCS	225.*	.018	.018	.018
SCS	200	.018	.018	.018
SCS	175.*	.018	.018	.018
SCS	150.*	.018	.018	.018
SCS	125.*	.018	.018	.018
SCS	100	.018	.018	.018

SUMMARY OF REACH LENGTHS

River: Lower Peavine

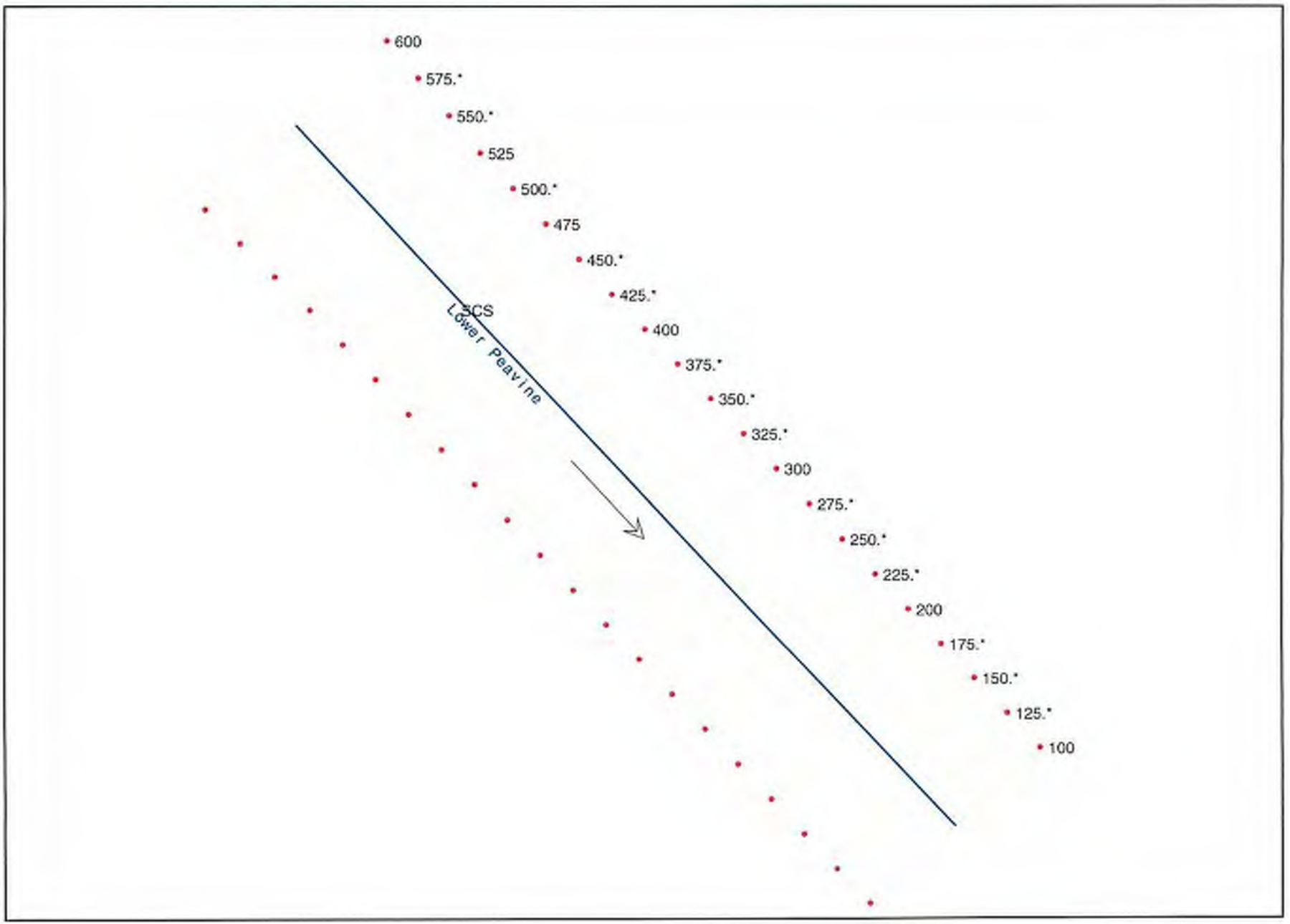
Reach	River Sta.	Left	Channel	Right
SCS	600	25	25	25
SCS	575.*	25	25	25
SCS	550.*	25	25	25
SCS	525	25	25	25
SCS	500.*	25	25	25
SCS	475	25	25	25
SCS	450.*	25	25	25
SCS	425.*	25	25	25
SCS	400	25	25	25
SCS	375.*	25	25	25
SCS	350.*	25	25	25
SCS	325.*	25	25	25
SCS	300	25	25	25
SCS	275.*	25	25	25
SCS	250.*	25	25	25
SCS	225.*	25	25	25
SCS	200	25	25	25
SCS	175.*	25	25	25
SCS	150.*	25	25	25
SCS	125.*	25	25	25
SCS	100	100	100	100

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS

River: Lower Peavine

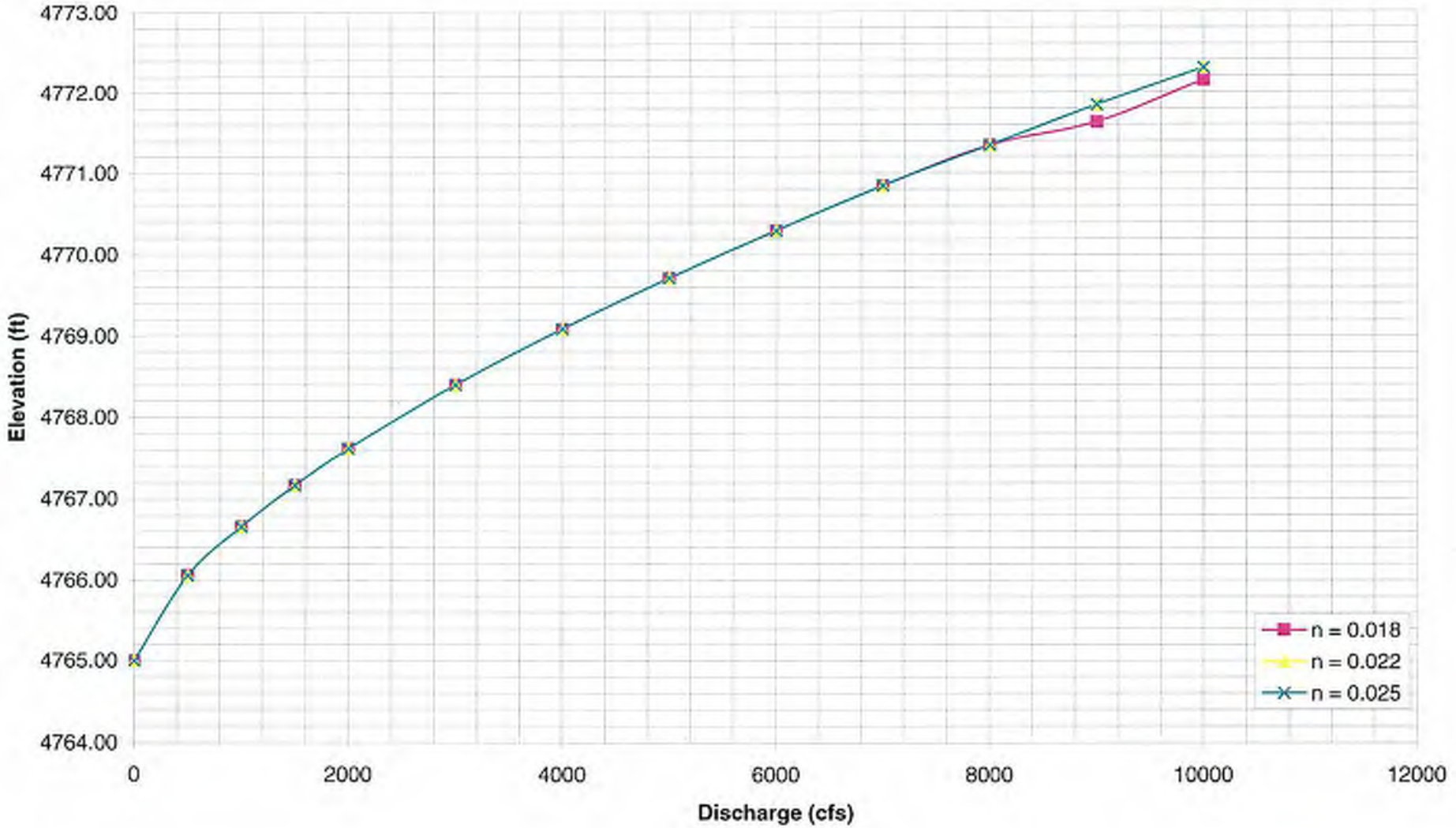
Reach	River Sta.	Contr.	Expan.
SCS	600	.1	.3
SCS	575.*	.1	.3
SCS	550.*	.1	.3
SCS	525	.1	.3
SCS	500.*	.1	.3
SCS	475	.1	.3
SCS	450.*	.1	.3
SCS	425.*	.1	.3
SCS	400	.1	.3

SCS	375.*	.1	.3
SCS	350.*	.1	.3
SCS	325.*	.1	.3
SCS	300	.1	.3
SCS	275.*	.1	.3
SCS	250.*	.1	.3
SCS	225.*	.1	.3
SCS	200	.1	.3
SCS	175.*	.1	.3
SCS	150.*	.1	.3
SCS	125.*	.1	.3
SCS	100	.1	.3


600
575.*
550.*
525
500.*
475
450.*
425.*
400
375.*
350.*
325.*
300
275.*
250.*
225.*
200
175.*
150.*
125.*
100
SCS
Lower Peavine

Lower Peavine Creek Detention Dam
Hydrology Model

Sensitivity Analysis of Manning's Roughness Coefficient (n) on Spillway Capacity
Rating Curves generated at the control section (NRCS, 1956)

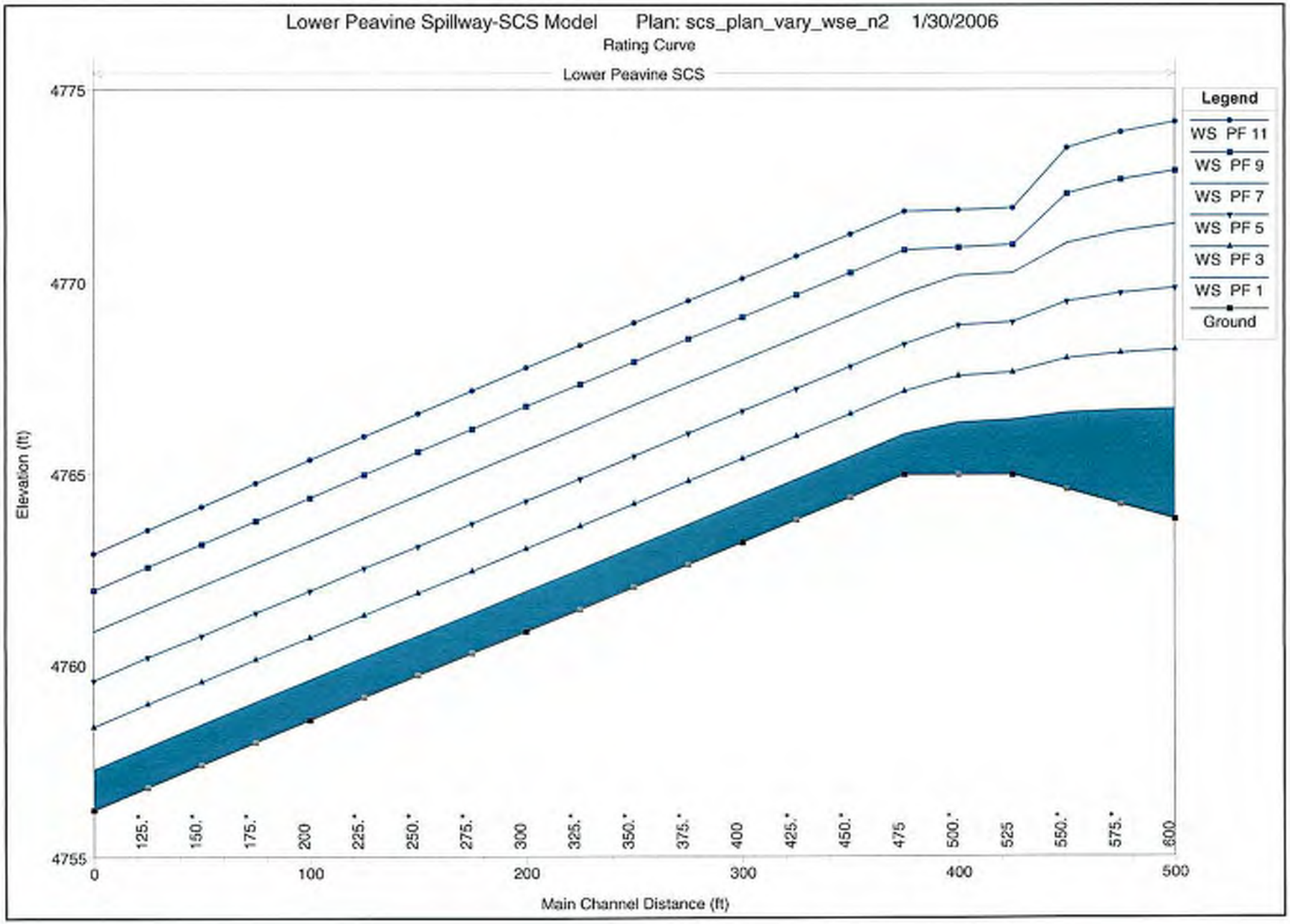


Lower Peavine Creek Detention Dam
Hydrology Model

Discharge (cfs)	Elevation (feet)				
	n=0.04 [2]	n=0.018[2]	n=0.022[2]	n=0.025[2]	NRCS[3]
0	4765.00	4765.00	4765.00	4765.00	4765.0
500	4766.06	4766.06	4766.06	4766.06	4766.5
1000	4766.66	4766.66	4766.66	4766.66	4767.5
1500	4767.17	4767.17	4767.17	4767.17	4768.3
2000	4767.62	4767.62	4767.62	4767.62	4769.0
3000	4768.40	4768.40	4768.40	4768.40	4770.3
4000	4769.09	4769.09	4769.09	4769.09	4771.4
5000	4769.71	4769.71	4769.71	4769.71	4772.2
6000	4770.30	4770.30	4770.30	4770.30	4773.0
7000	4770.85	4770.85	4770.85	4770.85	4773.5
8000	4771.35	4771.35	4771.35	4771.35	4773.8
9000	4771.85	4771.63	4771.85	4771.85	4774.4
10000	4772.30	4772.15	4772.30	4772.30	4774.6

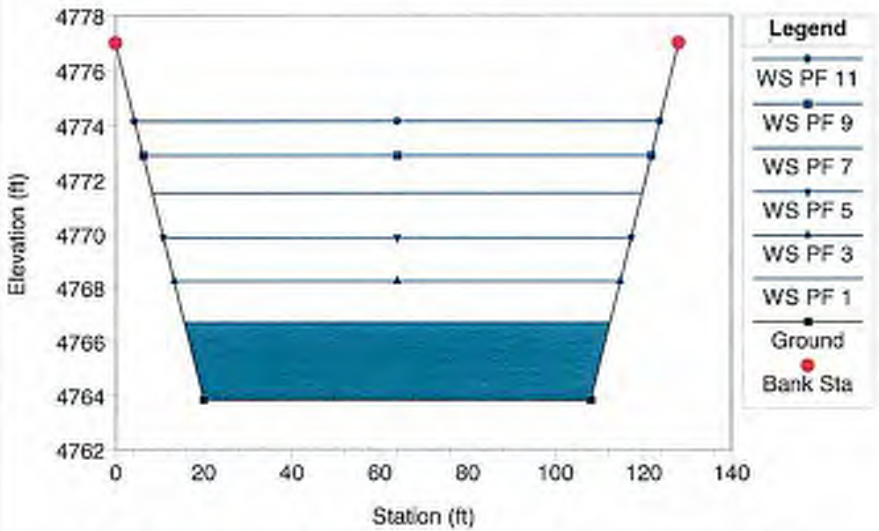
NOTE:

1. Spillway geometry was adopted from the As-Built plans-Lower Peavine Dam, NRCS (1961) and was reproduced in HEC-RAS model
2. Obtained from the reproduced HEC-RAS model results
3. Obtained from the Wateshed work plan, NRCS (1958)


Lower Peavine Spillway-SCS Model Plan: scs_plan_vary_wse_n2 1/30/2006
Rating Curve
Lower Peavine SCS
Legend
WS PF 11
WS PF 9
WS PF 7
WS PF 5
WS PF 3
WS PF 1
Ground
Elevation (ft)
4775
4770
4765
4760
4755
0
100
200
300
400
500
125.*
150.*
175.*
200
225.*
250.*
275.*
300
325.*
350.*
375.*
400
425.*
450.*
475
500.*
525
550.*
575.*
600
Main Channel Distance (ft)

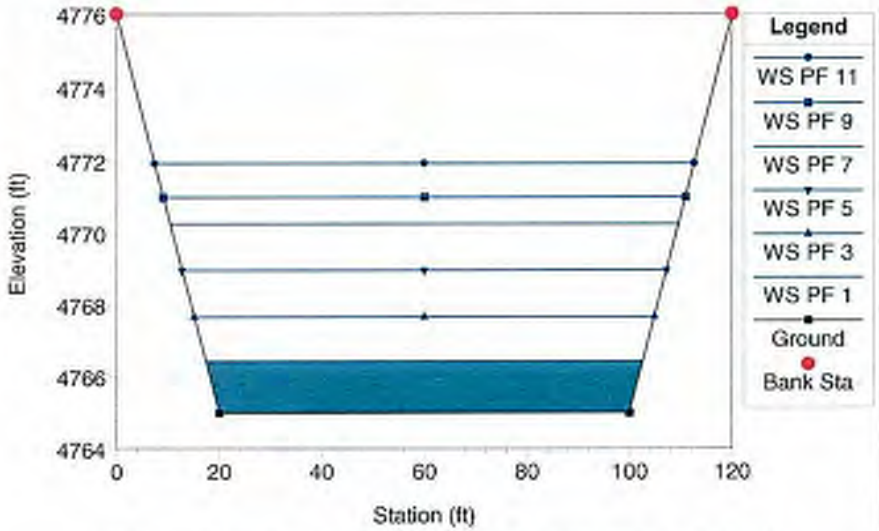
Lower Peavine Spillway-SCS Model Plan: scs_plan_vary_wse_n2 1/30/2006

RS = 600 Rating Curve



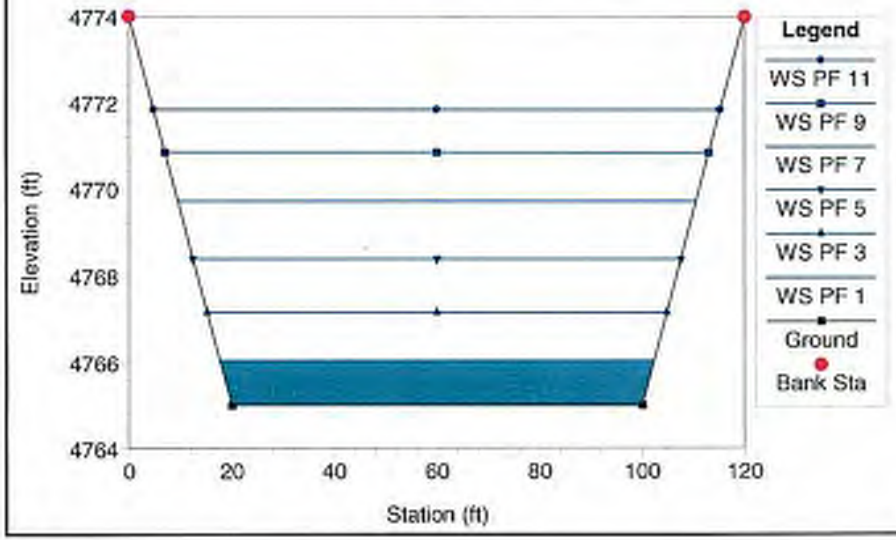
Lower Peavine Spillway-SCS Model Plan: scs_plan_vary_wse_n2 1/30/2006

RS = 525 Rating Curve



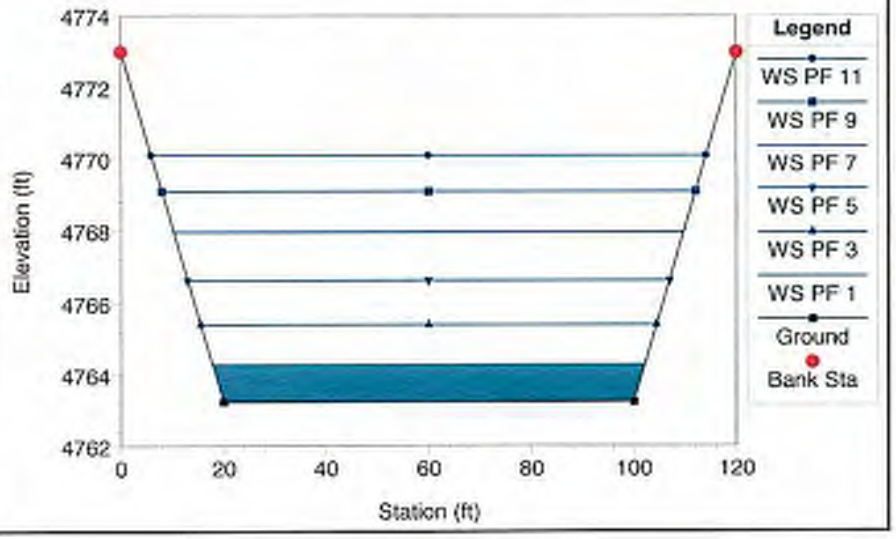
Lower Peavine Spillway-SCS Model Plan: scs_plan_vary_wse_n2 1/30/2006

RS = 475 Rating Curve



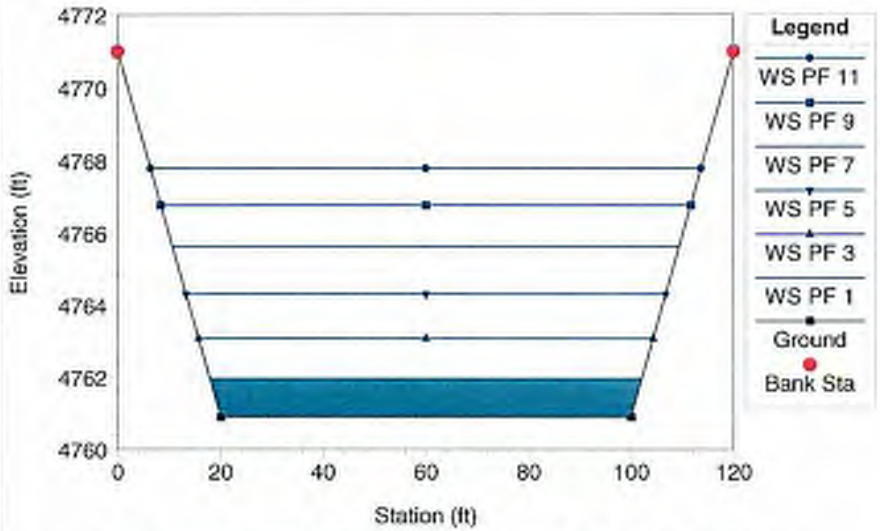
Lower Peavine Spillway-SCS Model Plan: scs_plan_vary_wse_n2 1/30/2006

RS = 400 Rating Curve



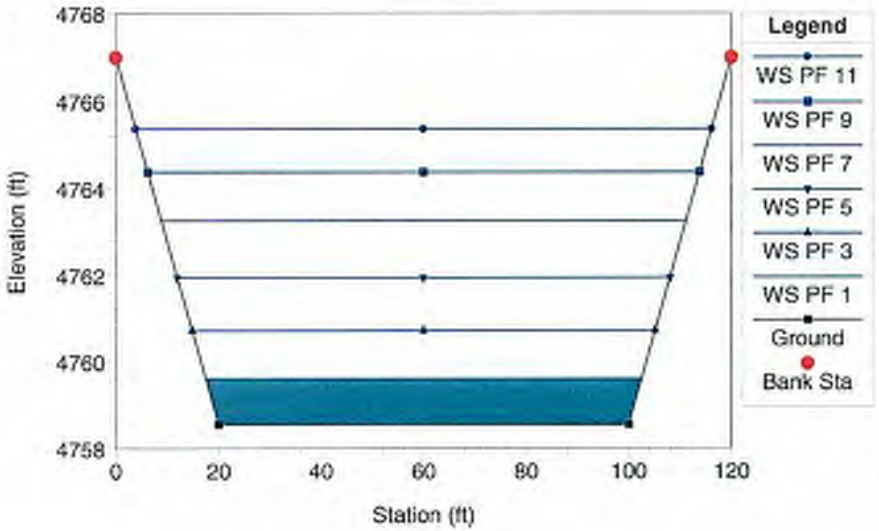
Lower Peavine Spillway-SCS Model Plan: scs_plan_vary_wse_n2 1/30/2006

RS = 300 Rating Curve



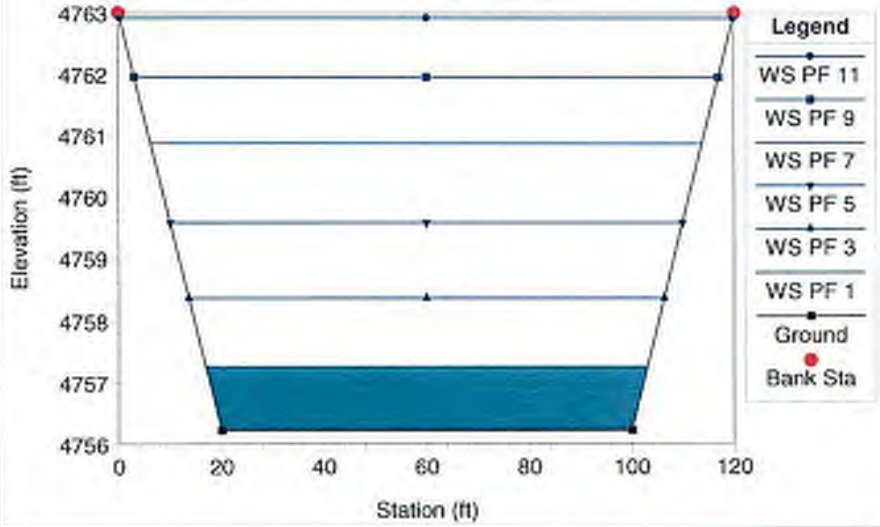
Lower Peavine Spillway-SCS Model Plan: scs_plan_vary_wse_n2 1/30/2006

RS = 200 Rating Curve



Lower Peavine Spillway-SCS Model Plan: scs_plan_vary_wse_n2 1/30/2006

RS = 100 Rating Curve



McCarran Rating Curves
(Upper and Lower Peavine HEC-HMS)

Broad Crested Weir[1]	
Adjusted Elev. (ft)	Discharge (cfs)
4,934.00	0.00
4,936.00	947.52
4,938.00	2,680.00
4,940.00	4,923.47
4,942.00	7,580.18
4,944.00	10,593.63
4,946.00	13,925.69
4,948.00	17,548.37
4,950.00	21,440.00
4,952.00	25,583.12
4,954.00	29,963.31

Culvert[2]	
Adjusted Elev. (ft)	Discharge (cfs)
4894	0
4896.3	25
4897.39	50
4898.34	75
4899.26	100
4900.4	125
4902.05	150
4904	175
4907.64	200
4914.52	225
4922.18	250
4930.63	275
4939.88	300
4949.93	325
4960.79	350
4972.45	375
4984.91	400

Combined[3]		
Adjusted Elev. (ft)	Vol (ac-ft)	Discharge (cfs)
4894	0	0
4896	0.1962415	19.37
4898	0.5598784	65.77
4900	1.1430411	118.02
4902	2.0824235	149.21
4904	3.3607149	174.92
4906	5.0679798	191.4
4908	7.3307385	198.85
4910	10.178692	206.25
4915	20.007053	223.79
4920	34.018936	240.09
4925	55.616917	255.36
4930	120.23865	269.78
4935	264.78842	618.47
4940	444.07336	5220
4945	638.02997	21500.83
4950	846.90228	43217.07

NOTES:

(1) Overtopping of McCarran is modeled as broad-crested weir using Culvertmaster.

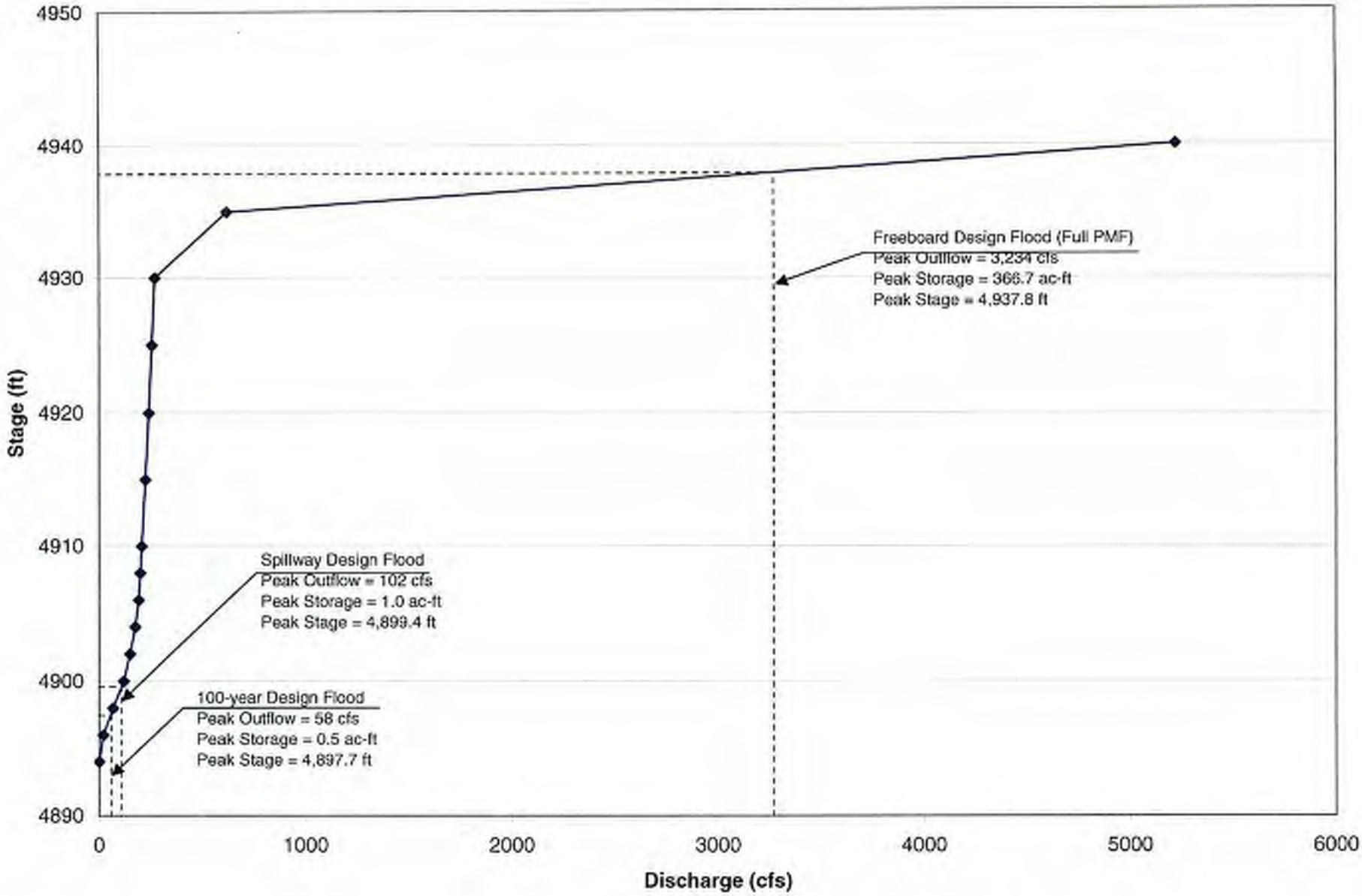
(2) Culvert analysis of 48" CMP underneath McCarran is performed using Culvertmaster. See attached for Culvertmaster analysis.

(3) Combined rating curve is a combination of McCarran rating curve and culvert rating curve and used in HEC-HMS hydrologic modeling of Upper and Lower Peavine.

Job No. 4307-05-0009
Created by: DLT
Checked by: CA

McCarran Rating Curve
(Upper and Lower Peavine HEC-HMS)

Reno EAP Phase II
Client: City of Reno



Culvert Analysis Report
Culvert-1

Culvert Summary					
Computed Headwater Elev:	4,907.64	ft	Discharge	200.00	cfs
Inlet Control HW Elev.	4,906.25	ft	Tailwater Elevation	4,878.00	ft
Outlet Control HW Elev.	4,907.64	ft	Control Type	Outlet Control	
Headwater Depth/Height	3.41				

Grades					
Upstream Invert	4,894.00	ft	Downstream Invert	4,878.00	ft
Length	300.00	ft	Constructed Slope	0.053333	ft/ft

Hydraulic Profile					
Profile	CompositeM2PressureProfile		Depth, Downstream	3.85	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	3.85	ft
Velocity Downstream	16.12	ft/s	Critical Slope	0.057648	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	4.00	ft
Section Size	48 inch		Rise	4.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	4,907.64	ft	Upstream Velocity Head	3.94	ft
Ke	0.50		Entrance Loss	1.97	ft

Inlet Control Properties					
Inlet Control HW Elev.	4,906.25	ft	Flow Control	N/A	
Inlet Type	Headwall		Area Full	12.6	ft²
K	0.00780		HDS 5 Chart	2	
M	2.00000		HDS 5 Scale	1	
C	0.03790		Equation Form	1	
Y	0.69000				

Rating Table Report
Culvert-1

Range Data:				
	Minimum	Maximum	Increment	
Discharge	0.00	400.00	40.00	cfs

Discharge (cfs)	HW Elev. (ft)
0.00	4,894.00
40.00	4,896.98
80.00	4,898.53
120.00	4,900.11
160.00	4,902.80
200.00	4,907.64
240.00	4,919.02
280.00	4,932.41
320.00	4,947.86
360.00	4,965.36
400.00	4,984.91

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Harding ESE
37 Brookside Road Waterbury, CT 06708 USA +1-203-755-1666

Dant Boulevard Detention Dam
Rating Curves

MACTEC HMS Model Output	
Elevation (ft)	Discharge (cfs)
4670	0
4670.2	0
4671	0
4671.1	4.6
4671.5	12.3
4674.8	34.4
4676.5	41.3
4678	46.5
4679	49.7
4680	52.5
4680.1	52.8
4680.9	55.1
4681.7	57.4
4682.5	59.4
4683.2	61.3
4683.9	63.1
4684.4	64.2
4684.6	64.7
4685.2	66.2
4685.9	67.7
4686.5	69.1
4687.1	70.3
4687.7	71.6
4688.2	72.8
4688.7	73.8
4689.2	74.8
4689.4	75.2
4689.7	75.8
4690.1	76.7
4690.5	77.4
4690.8	78.1
4691.2	78.8
4691.5	79.5
4691.9	80.2
4692.2	80.8
4692.5	81.4
4692.8	81.9
4693.1	82.5
4693.3	82.9
4693.4	83.1
4693.7	83.6
4694	84.2
4694.3	84.6
4694.5	85.1
4694.8	85.6
4695.1	86.1
4695.3	86.5

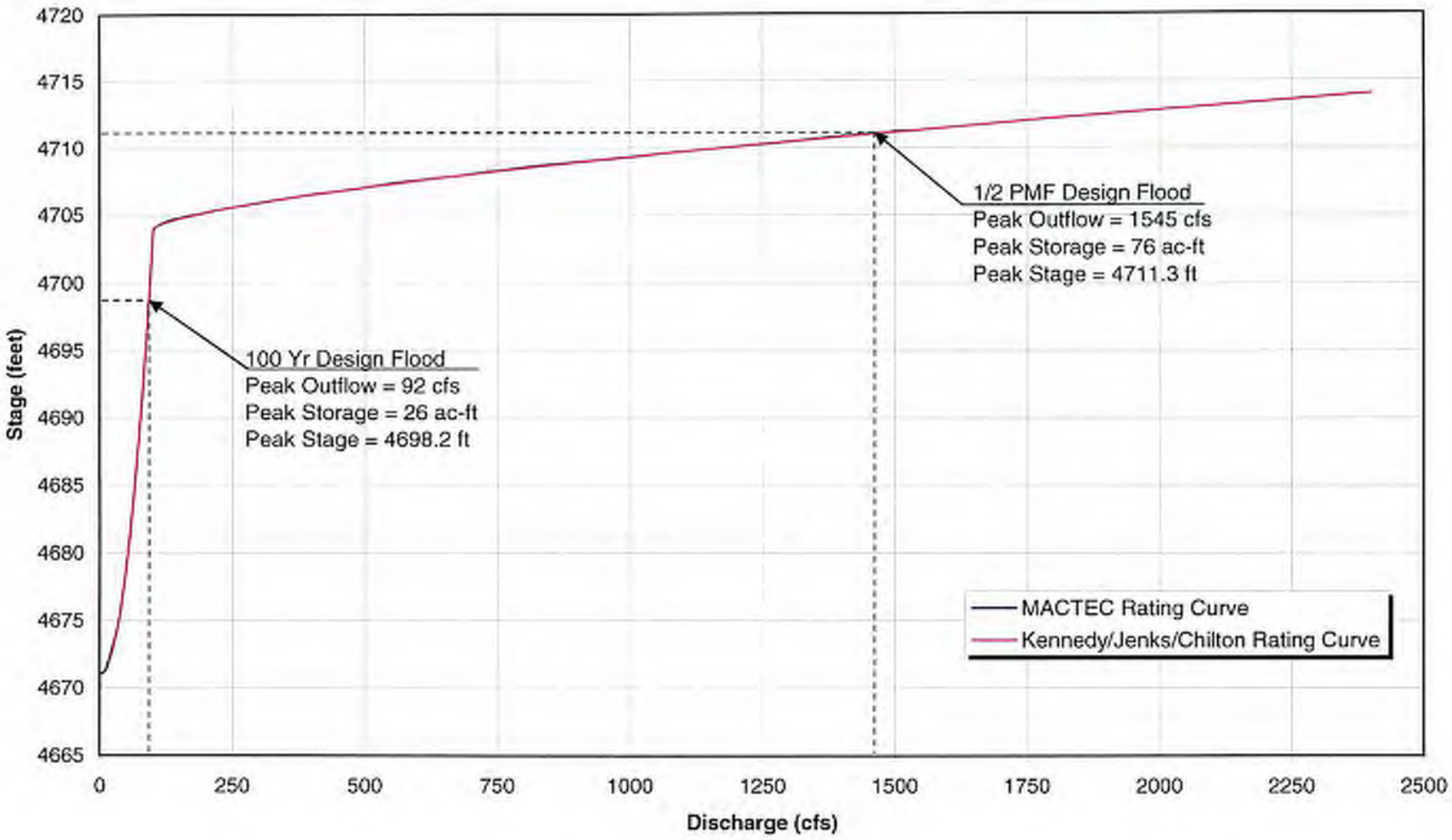
MACTEC HMS Model Output (cont)	
Elevation (ft)	Discharge (cfs)
4695.6	87
4695.9	87.5
4696.1	87.9
4696.3	88.3
4696.6	88.7
4696.8	89.1
4696.9	89.2
4697	89.5
4697.2	89.9
4697.5	90.2
4697.7	90.6
4697.9	91
4698.2	91.4
4698.4	91.8
4698.6	92.2
4698.9	92.6
4699.1	93
4699.3	93.4
4699.6	93.8
4699.8	94.1
4700	94.5
4700.2	94.9
4700.4	95.1
4700.4	95.2
4700.6	95.5
4700.8	95.8
4701.1	96.2
4701.3	96.5
4701.5	96.8
4701.7	97.2
4701.9	97.5
4702.1	97.8
4702.3	98.1
4702.5	98.4
4702.6	98.7
4702.8	99
4703	99.3
4703.2	99.6
4703.4	99.9
4703.5	100
4703.6	100.1
4703.8	100.4
4703.9	100.7
4704.1	103.8
4704.3	112.1
4704.5	124.3
4704.7	140.6

MACTEC HMS Model Output (cont)	
Elevation (ft)	Discharge (cfs)
4704.9	161.7
4705.1	188.8
4705.4	223.7
4705.7	268.6
4706.1	324.9
4706.1	324.3
4706.5	389.1
4706.9	470.5
4707.5	573.2
4708	687.9
4708.1	701.8
4708.8	859.6
4709.4	1020.8
4709.5	1042.8
4710.2	1229.8
4710.3	1262.4
4710.8	1387.3
4710.9	1413.9
4711.2	1503.8
4711.2	1496.9
4711.3	1544.4
4711.3	1544.7

Kennedy/Jenks HEC-1 Model Output	
Elevation (ft)	Discharge (cfs)
4672.0	17.5
4672.2	19.3
4672.5	21.5
4672.9	24.2
4673.5	27.7
4674.0	30.4
4674.4	32.4
4675.9	39.0
4676.0	39.2
4678.0	46.4
4678.8	49.0
4680.0	52.6
4682.0	58.2
4684.0	63.2
4685.1	66.0
4686.0	67.9
4688.0	72.3
4690.0	76.4
4692.0	80.4
4694.0	84.1
4696.0	87.7
4700.0	94.4
4702.0	97.7
4704.0	100.8
4704.1	103.5
4704.4	120.7
4704.9	165.8
4705.6	252.3
4706.0	308.1
4706.5	393.9
4707.6	603.9
4708.9	896.0
4710.0	1171.1
4710.4	1283.4
4712.0	1746.7
4712.1	1780.0
4714.0	2399.1

NOTE:
(1) HEC-HMS model is a direct coversion from HEC-1 model of Dant Blvd Dentention Dam performed by Kenendy\Jenks/Chilton (1988)

Dant Boulevard Detention Dam
Rating Curves



Created by : DLT 11/28/05
Checked by :

Job No. 4367-05-0009

Culvert Analysis Report

Weir (EAST WASH SPILLWAY DIKE)

Hydraulic Component(s): Roadway					
Discharge	3,000.00	cfs	Allowable HW Elevation	4,860.81	ft
Roadway Width	12.00	ft	Overtopping Coefficient	2.96	US
Low Point	4,857.15	ft	Headwater Elevation	4,860.81	ft
Discharge Coefficient (Cr)	2.95		Submergence Factor (Kt)	1.00	
Tailwater Elevation	-9,999.00	ft			

Sta (ft)	Elev. (ft)
0.00	4,858.54
50.91	4,858.76
103.36	4,858.94
157.09	4,859.21
203.69	4,859.16
221.42	4,858.91
230.12	4,858.99
237.24	4,859.06
285.47	4,858.61
303.40	4,858.21
322.35	4,857.15
357.76	4,860.40

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Harding ESE
37 Brookside Road Waterbury, CT 06708 USA +1-203-755-1666

Created by: DLT 11-28-05
Checked by :

Job No. 4307-05-0009

Rating Table Report
Overtopping (EAST WASH SPILLWAY DIKE)

Range Data:			
	Minimum	Maximum	Increment
Allowable HW E	4,857.15	4,867.15	0.25 ft

HW Elev. (ft)	Discharge (cfs)
4,857.15	0.00
4,857.40	0.80
4,857.65	4.54
4,857.90	12.55
4,858.15	25.85
4,858.40	47.47
4,858.65	80.41
4,858.90	146.81
4,859.15	281.75
4,859.40	514.57
4,859.65	827.08
4,859.90	1,203.37
4,860.15	1,635.84
4,860.40	2,118.87
4,860.65	2,641.20
4,860.90	3,213.12
4,861.15	3,841.05
4,861.40	4,513.97
4,861.65	5,219.62
4,861.90	5,948.38
4,862.15	6,697.87
4,862.40	7,478.26
4,862.65	8,307.40
4,862.90	9,131.04
4,863.15	9,960.41
4,863.40	10,854.74
4,863.65	11,753.33
4,863.90	12,675.54
4,864.15	13,620.79
4,864.40	14,588.51
4,864.65	15,578.21
4,864.90	16,589.39
4,865.15	17,621.61
4,865.40	18,674.45
4,865.65	19,747.52
4,865.90	20,840.43
4,866.15	21,952.84
4,866.40	23,084.40
4,866.65	24,234.79
4,866.90	25,403.72
4,867.15	26,590.80

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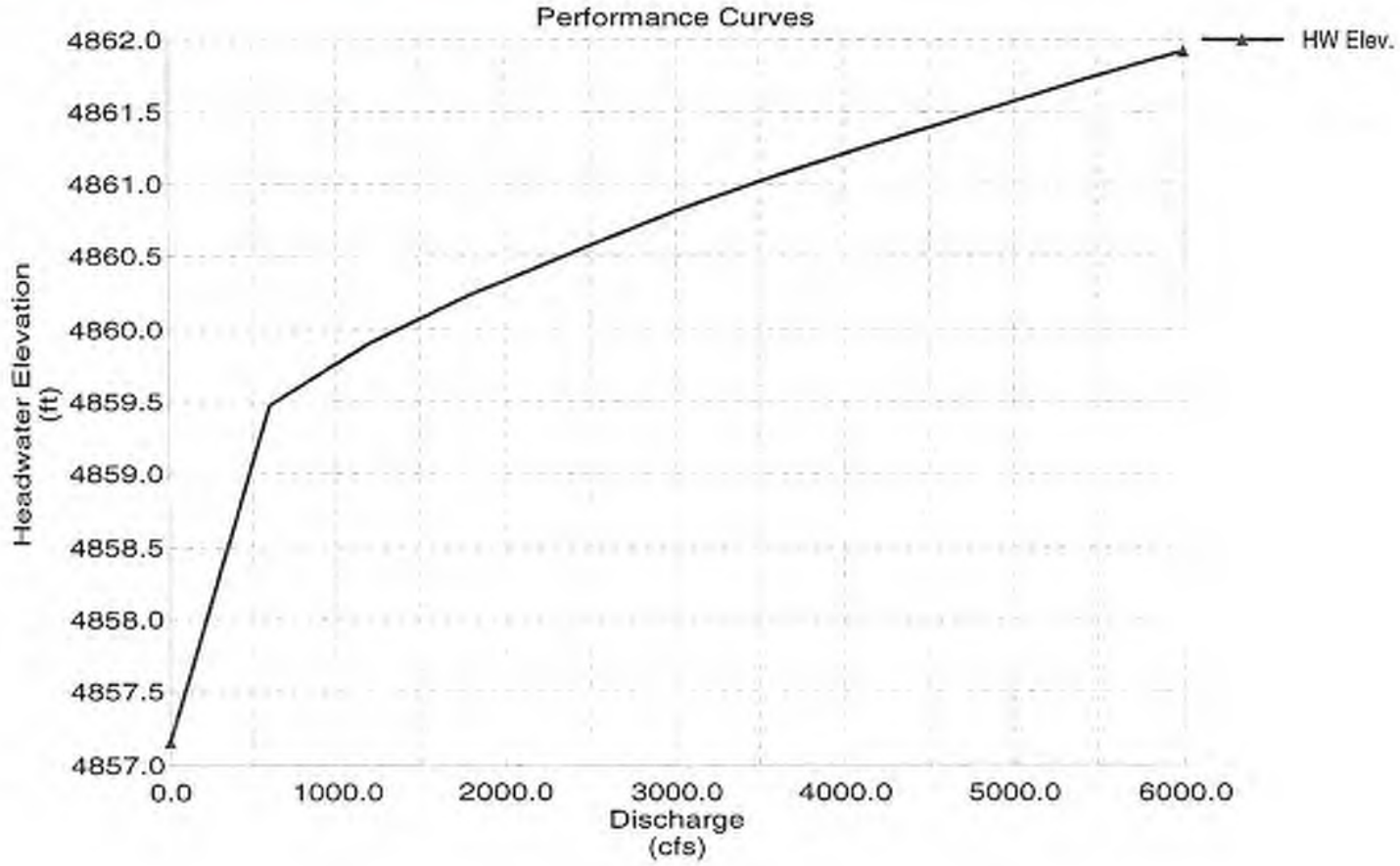
Performance Curves Report
East Wash Spillway Dike

Range Data:				
	Minimum	Maximum	Increment	
Discharge	0.00	6,000.00	600.00	cfs



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Rating Table Report
Overtopping

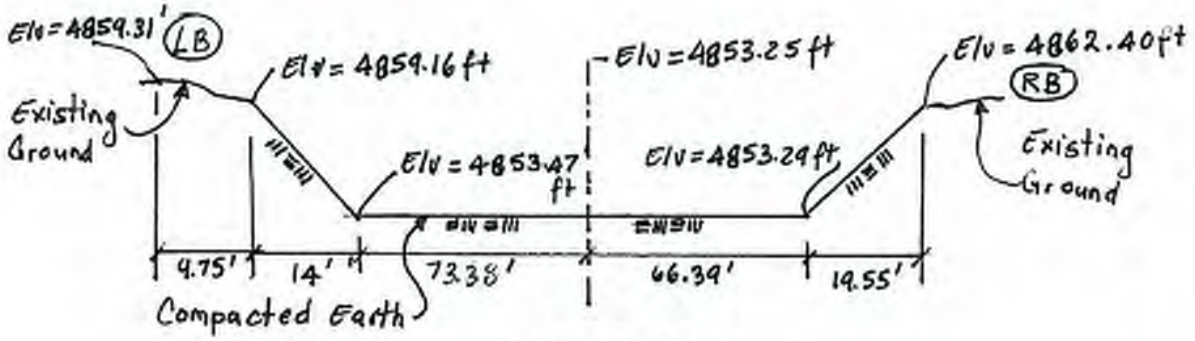
Range Data:				
	Minimum	Maximum	Increment	
Discharge	0.00	15,000.00	1,500.00	cfs

Discharge (cfs)	HW Elev. (ft)
0.00	4,853.25
1,500.00	4,855.71
3,000.00	4,856.98
4,500.00	4,858.03
6,000.00	4,858.96
7,500.00	4,859.93
9,000.00	4,860.67
10,500.00	4,861.35
12,000.00	4,861.99
13,500.00	4,862.60
15,000.00	4,863.20

From HMS analysis, local 6-hr PMF generated 7,625 cfs @ spillway.

=> WSEL = 4,860.25 ft

=> LB is overtopped by 0.94 ft



CROSS-SECTION

LOOKING UPSTREAM

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WEST WASH DAM

Culvert Analysis Report

Weir → USED FOR ADJUSTED RATING CURVE

Hydraulic Component(s): Roadway					
Discharge	500.00	cfs	Allowable HW Elevation	4,785.29	ft
Roadway Width	14.00	ft	Overtopping Coefficient	2.97	US
Low Point	4,783.08	ft	Headwater Elevation	4,785.28	ft
Discharge Coefficient (Cr)	2.97		Submergence Factor (Kt)	1.00	
Tailwater Elevation	-9,999.00	ft			

Sta (ft)	Elev. (ft)
0.00	4,793.14
32.00	4,793.14
54.00	4,793.14
83.00	4,793.30
133.00	4,793.43
233.00	4,793.60
283.00	4,793.42
333.00	4,793.50
383.00	4,793.65
433.00	4,793.69
483.00	4,793.56
533.00	4,793.41
583.00	4,793.42
633.00	4,793.61
683.00	4,792.88
767.00	4,783.09
811.00	4,783.08
835.00	4,801.51
858.00	4,802.83

CHECKED: CA

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Project Engineer: Dien Ta

Rating Table Report
Overtopping

Range Data:			
	Minimum	Maximum	Increment
Allowable HW E	4,793.14	4,803.14	0.25 ft

HW Elev. (ft)	Discharge (cfs)
4,793.14	7,700.11
4,793.39	8,146.43
4,793.64	8,725.71
4,793.89	9,554.04
4,794.14	10,547.77
4,794.39	11,672.23
4,794.64	13,066.80
4,794.89	14,442.06
4,795.14	15,609.65
4,795.39	17,464.55
4,795.64	19,102.70
4,795.89	20,820.34
4,796.14	22,613.33
4,796.39	24,476.61
4,796.64	26,380.43
4,796.89	28,342.53
4,797.14	30,365.06
4,797.39	32,446.13
4,797.64	34,584.00
4,797.89	36,777.11
4,798.14	39,024.00
4,798.39	41,323.37
4,798.64	43,673.99
4,798.89	46,074.71
4,799.14	48,524.49
4,799.39	51,022.33
4,799.64	53,567.31
4,799.89	56,158.57
4,800.14	58,795.27
4,800.39	61,476.64
4,800.64	64,201.95
4,800.89	66,970.52
4,801.14	69,781.66
4,801.39	72,634.77
4,801.64	75,536.62
4,801.89	78,487.22
4,802.14	81,480.45
4,802.39	84,516.59
4,802.64	87,595.74
4,802.89	90,718.82
4,803.14	93,886.64

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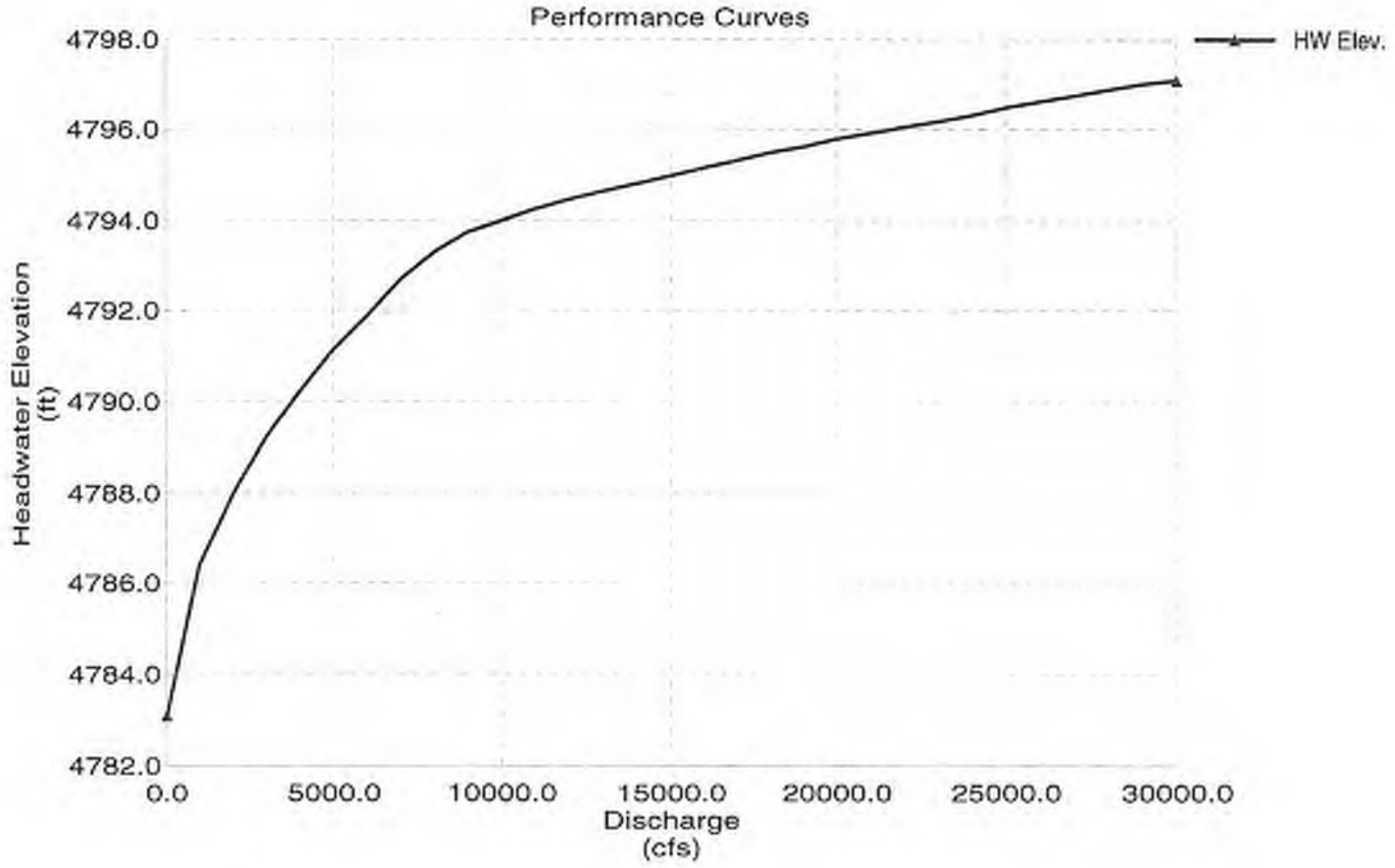
Performance Curves Report
West Wash Dam with Spillway

Range Data:				
	Minimum	Maximum	Increment	
Discharge	0.00	30,000.00	1,000.00	cfs



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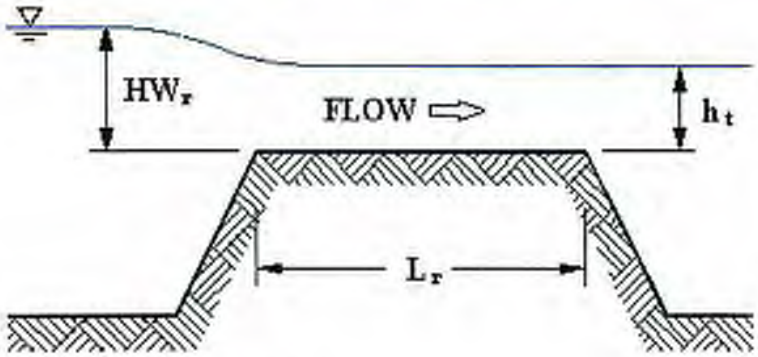
Roadway Overtopping

Whenever the culvert headwater begins to rise above the minimum elevation of the roadway, overtopping will occur. Overtopping flow is modeled as a special type of weir flow expressed by the general broad-crested weir equation. Overtopping flow is one component of the total culvert system.



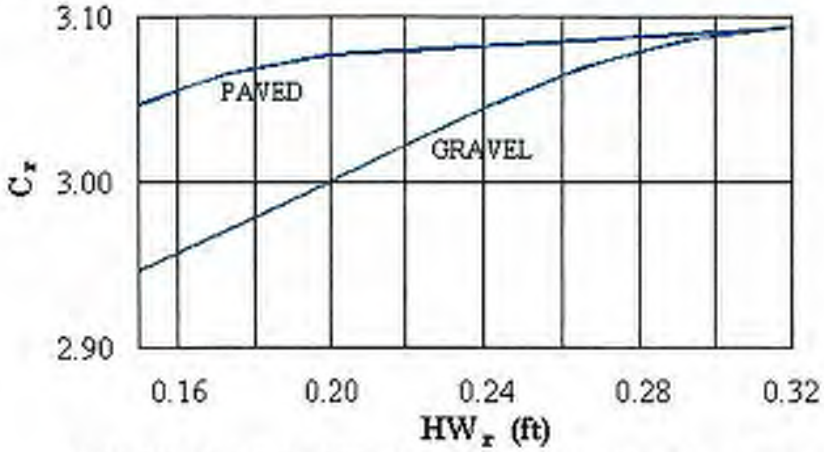
$$Q_o = C_d \times L \times HW_r^{1.5}$$

Q_o is the overtopping flow rate in ft^3/s (m^3/s)
C_d is the overtopping discharge coefficient
L is the length of the roadway crest, ft (m)
HW_r is the overtopping depth

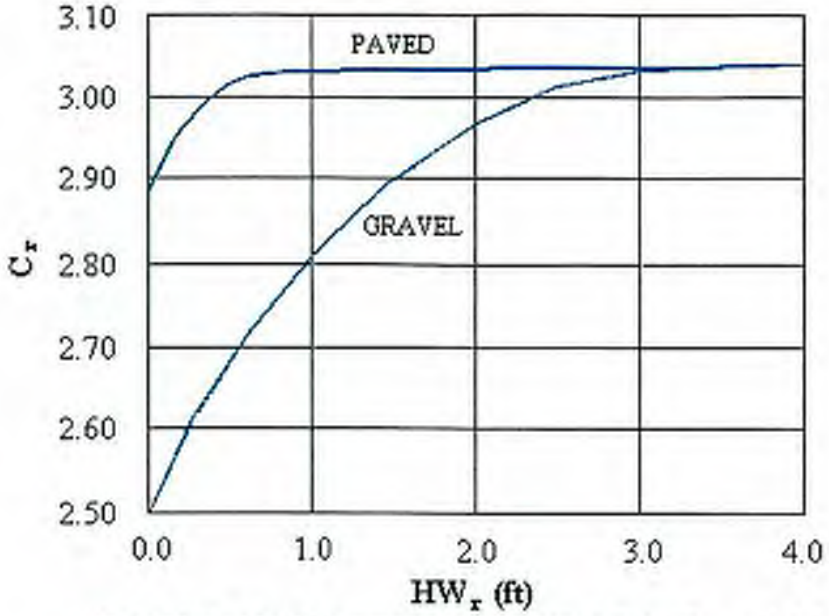
The overtopping discharge coefficient is a function of submergence using the equation:

$$C_d = k_t C_r$$

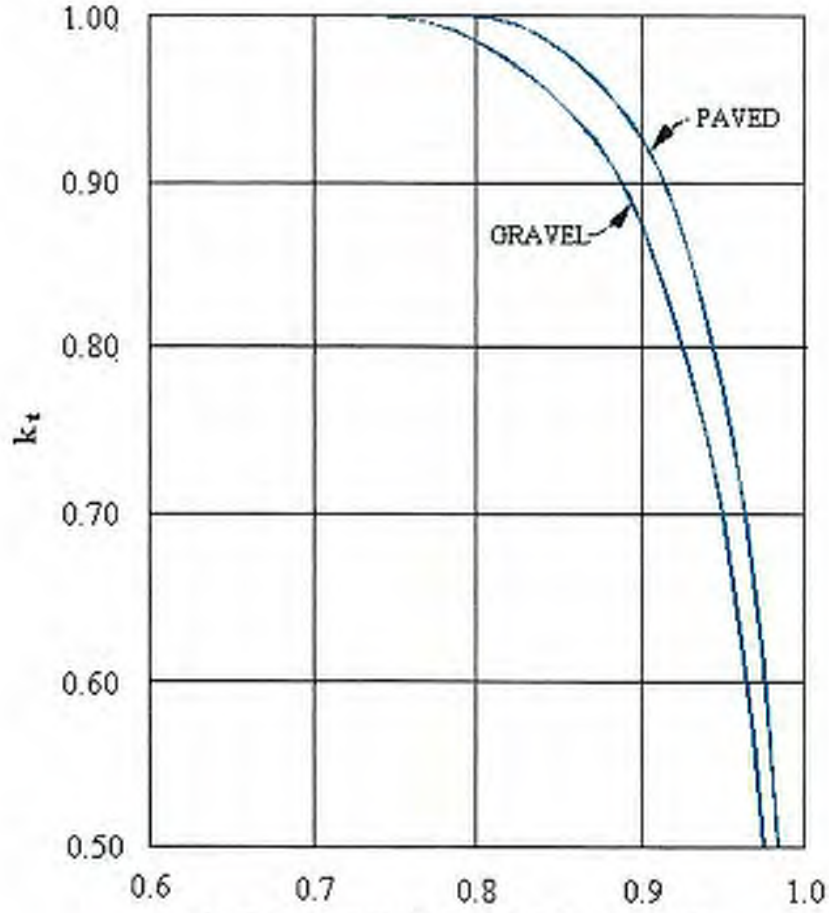
along with the figures below. The first two figures are used to derive the base weir coefficient resulting from deep and shallow overtopping, respectively. The submergence correction is determined implicitly using the final figure and applied against the base coefficient.



DISCHARGE COEFFICIENT FOR $HW_r / L_r > 0.15$



DISCHARGE COEFFICIENT FOR $HW_r / L_r \leq 0.15$



APPENDIX F

HEC-HMS Results and Comparisons

Upper and Lower Peavine Hydrology Summary and Comparison

	Upper Peavine Dam	Lower Peavine Dam	McCarran
Top of Principal Spillway Elevation (ft)*	5011.55	4757.95	Top of Roadway = 4934 ft
Original Emergency Spillway Crest elevation (ft)*	5025.70	4768.20	
Current Emergency Spillway Crest elevation (ft)*	5025.44	4768.50	
Original Design Top of Dam Elevation (ft)*	5033.20	4777.20	
Current Top of Dam (ft)*	varies 5032.93 to 5034.3	varies 4777.36 to 4778.40	

Upper Peavine Dam

Structure and Storm Frequency	Storm Duration (hrs)	Precipitation (in)	Maximum Water Surface Elevation (ft)*	Emergency Spillway Discharge (cfs)	Comments
100-yr - Watershed Work Plan[1]	2	3.00	5017.6	0	
100-yr 24-hr - NRCS Reevaluated[2]	24	2.70	5013.40	0	
100-yr 24-hr - MACTEC HEC-HMS Model	24	varies (2.69-3.24)	5012.00	0	The 100-yr, 24-hour design flood does not overtop the dam. The WSEL is also below the emergency spillway crest elevation.
Spillway Design Flood - Watershed Work Plan[1]	2	7.50	5029.30	2300	
Spillway Design Flood (100yr & PMF) - NRCS Reevaluated[2] [4]	6	4.80	5026.30	75	
Spillway Design Flood (100yr & PMF) - MACTEC HEC-HMS Model [5]	6	4.57	5021.40	0	The spillway design flood does not overtop the dam. The WSEL is also the emergency spillway crest elevation.
Freeboard Design Flood (PMF) - NRCS Reevaluated [2]	6	13.44	5031.30	4700	
Freeboard Design Flood (PMF) - USCOE Investigation[7]	6	13.44	5031.20	5030	
Freeboard Design Flood (PMF) - MACTEC HEC-HMS Model [5] [6]	6	11.60	5032.60	6678	The full 6hr Local PMF does not overtop the dam but the WSEL is only 0.6 ft below top of dam.

* All elevations reported in NAVD 1988 (+3.2 feet from NAVD 1929)

Upper and Lower Peavine Hydrology Summary and Comparison

McCarran

Structure and Storm Frequency	Storm Duration (hrs)	Precipitation (in)	Maximum Water Surface Elevation (ft)	Emergency Spillway Discharge (cfs)	Comments
100-yr 24-hr - MACTEC HEC-HMS Model	24	varies (2.69-3.24)	4897.70	n/a	The 100-yr, 24-hr design flood does not overtop the roadway.
Spillway Design Flood (100yr & PMF) - NRCS Reevaluated	6	4.57	4899.40	n/a	The flood does not overtop the roadway.
Freeboard Design Flood (PMF) - MACTEC HEC-HMS Model [5] [6]	6	11.60	4937.80	n/a	The flood overtops the roadway by 3.8 ft.

Lower Peavine Dam

Structure and Storm Frequency	Storm Duration (hrs)	Precipitation (in)	Maximum Water Surface Elevation (ft)*	Emergency Spillway Discharge (cfs)	Comments
100-yr - Watershed Work Plan[1]	2	3	4761.4	0	
100-yr 24-hr - NRCS Reevaluated[2]	24	2.70	4759	0	
100-yr 24-hr - MACTEC HEC-HMS Model	24	varies (2.69-3.24)	4757.30	0	The 100-yr, 24-hour design flood does not overtop the dam. The WSEL is also below the emergency spillway crest elevation.
Spillway Design Flood - Watershed Work Plan[1]	2	7.50	4773.00	2725	
Spillway Design Flood (100yr & PMF) - NRCS Reevaluated[2] [4]	6	4.8	4768.50	70	
Spillway Design Flood (100yr & PMF) - MACTEC HEC-HMS Model [5]	6	4.57	4768.30	618	The spillway design flood does not overtop the dam. The WSEL is 0.1 ft above the emergency spillway crest.
Freeboard Design Flood (PMF) - NRCS Reevaluated [2]	6	13.44	4776.40	5950	
Freeboard Design Flood (PMF) - USCOE Investigation[7]	6	13.44	4776.40	6039	
Freeboard Design Flood (PMF) - MACTEC HEC-HMS Model [5] [6]	6	11.60	4773.80	3333	The full 6hr Local PMF does not overtop the dam. The WSEL is 3.4 ft below the top of dam.

* All elevations reported in NAVD 1988 (+3.2 feet from NAVD 1929)

[1] Peavine Watershed Work Plan, NRCS, March 1958.

[2] Peavine Watershed Project - Project Reevaluation, NRCS October 1976.

[3] Differs from (2) in emergency spillway rating curve only.

[4] Rigid Boundary assumed for emergency spillway dike overflow.

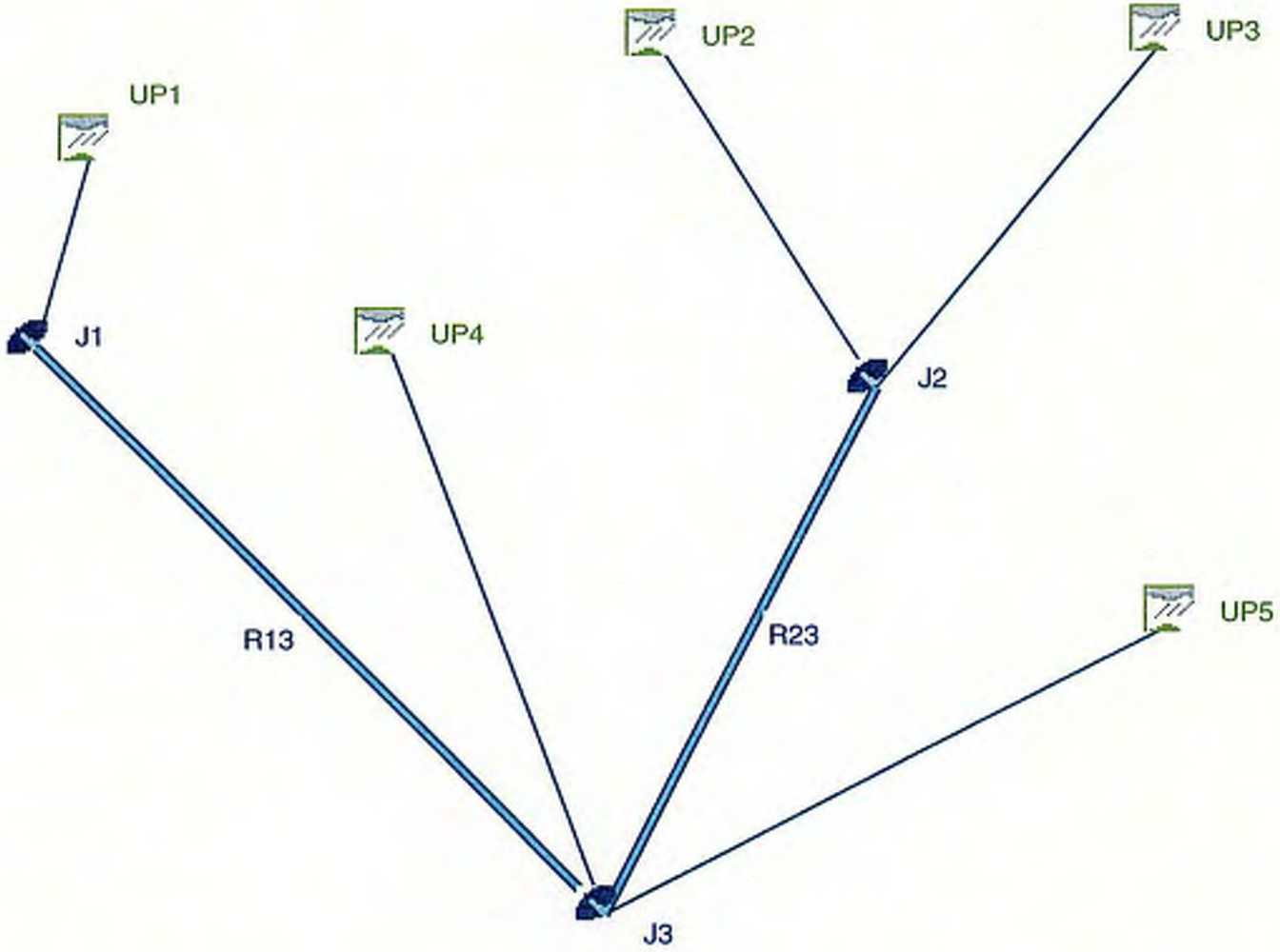
[5] This study, MACTEC, 2006

[6] Precipitation depth is a local PMF of 6-hour duration.

[7] USCOE National Dam Inspection, 1978

100 YEAR – 24 HOUR ANALYSIS

SUB BASINS GROUP 1



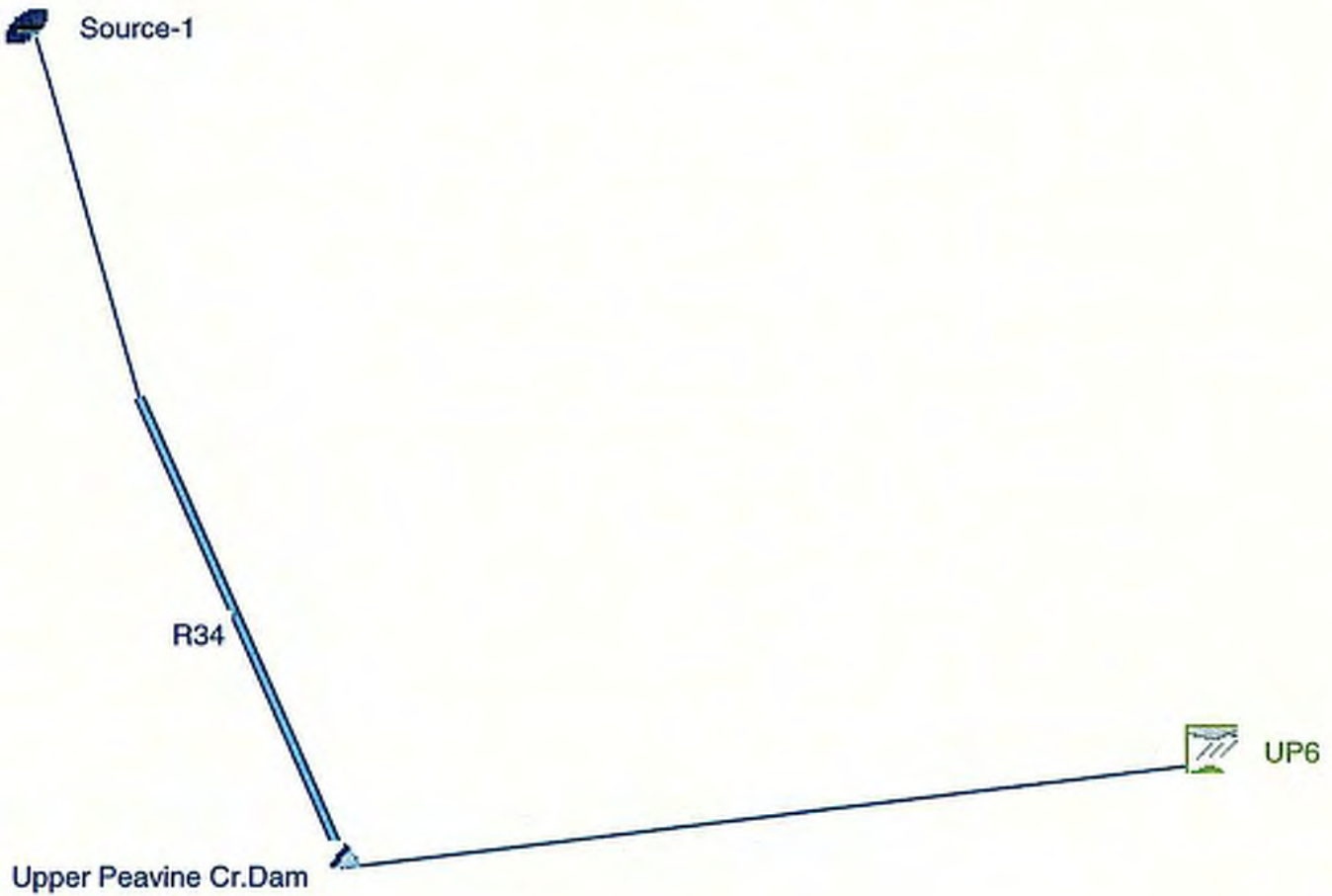
HMS * Summary of Results

Project : UL_PeavineWatershed Run Name : 100year_111005-1

Start of Run : 05Jul05 0000 Basin Model : No_Outlets_111005-1
End of Run : 06Jul05 1200 Met. Model : 100Yr_24HR_Mod1
Execution Time : 10Nov05 1701 Control Specs : Scenario1

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
UP1	189.03	05 Jul 05 1225	20.000	0.327
J1	189.03	05 Jul 05 1225	20.000	0.327
R13	188.83	05 Jul 05 1230	20.021	0.327
UP2	103.71	05 Jul 05 1230	12.908	0.286
UP3	300.61	05 Jul 05 1235	42.890	0.579
J2	401.85	05 Jul 05 1235	55.798	0.865
R23	399.14	05 Jul 05 1240	55.813	0.865
UP4	117.31	05 Jul 05 1250	21.303	0.472
UP5	152.56	05 Jul 05 1230	18.655	0.390
J3	814.04	05 Jul 05 1235	115.79	2.054

SUB BASINS GROUP 2



HMS * Summary of Results

Project : UL_PeavineWatershed Run Name : 100yr-111005-2

Start of Run : 05Jul05 0000 Basin Model : No_Outlets_111005-2
End of Run : 06Jul05 1200 Met. Model : 100Yr_24HR_Mod2
Execution Time : 10Nov05 1700 Control Specs : Scenario1

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
Source-1	814.04	05 Jul 05 1235	115.79	2.054
R34	806.69	05 Jul 05 1240	115.76	2.054
UP6	49.293	05 Jul 05 1220	5.2354	0.085
Upper Peavine Cr.Dam	36.203	05 Jul 05 2245	44.765	2.139

HMS * Summary of Results for Upper Peavine Cr.Dam

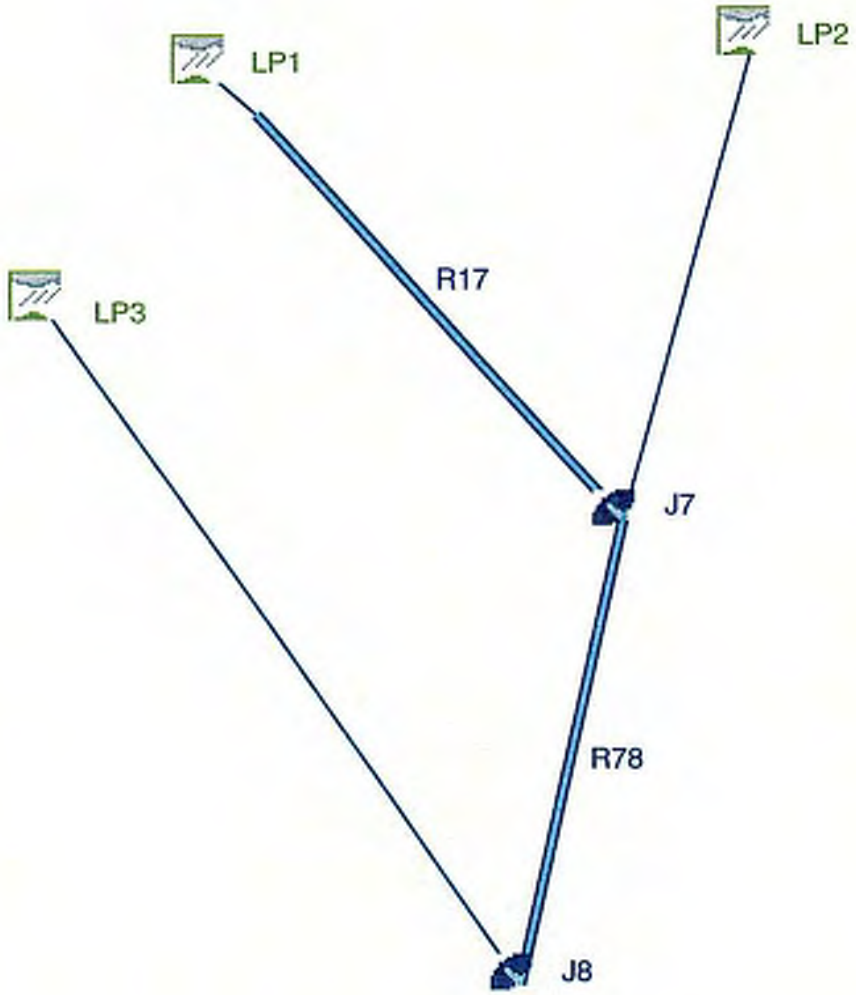
Project : UL_PeavineWatershed Run Name : 100yr-111005-2

Start of Run	: 05Jul05 0000	Basin Model	: No_Outlets_111005-2
End of Run	: 06Jul05 1200	Met. Model	: 100Yr_24HR_Mod2
Execution Time	: 10Nov05 1700	Control Specs	: Scenario1

Computed Results

Peak Inflow	: 835.55 (cfs)	Date/Time of Peak Inflow	: 05 Jul 05 1240
Peak Outflow	: 36.203 (cfs)	Date/Time of Peak Outflow	: 05 Jul 05 2245
Total Inflow	: 1.06 (in)	Peak Storage	: 95.359(ac-ft)
Total Outflow	: 0.39 (in)	Peak Elevation	: 5012.0(ft)

SUB BASINS GROUP 3



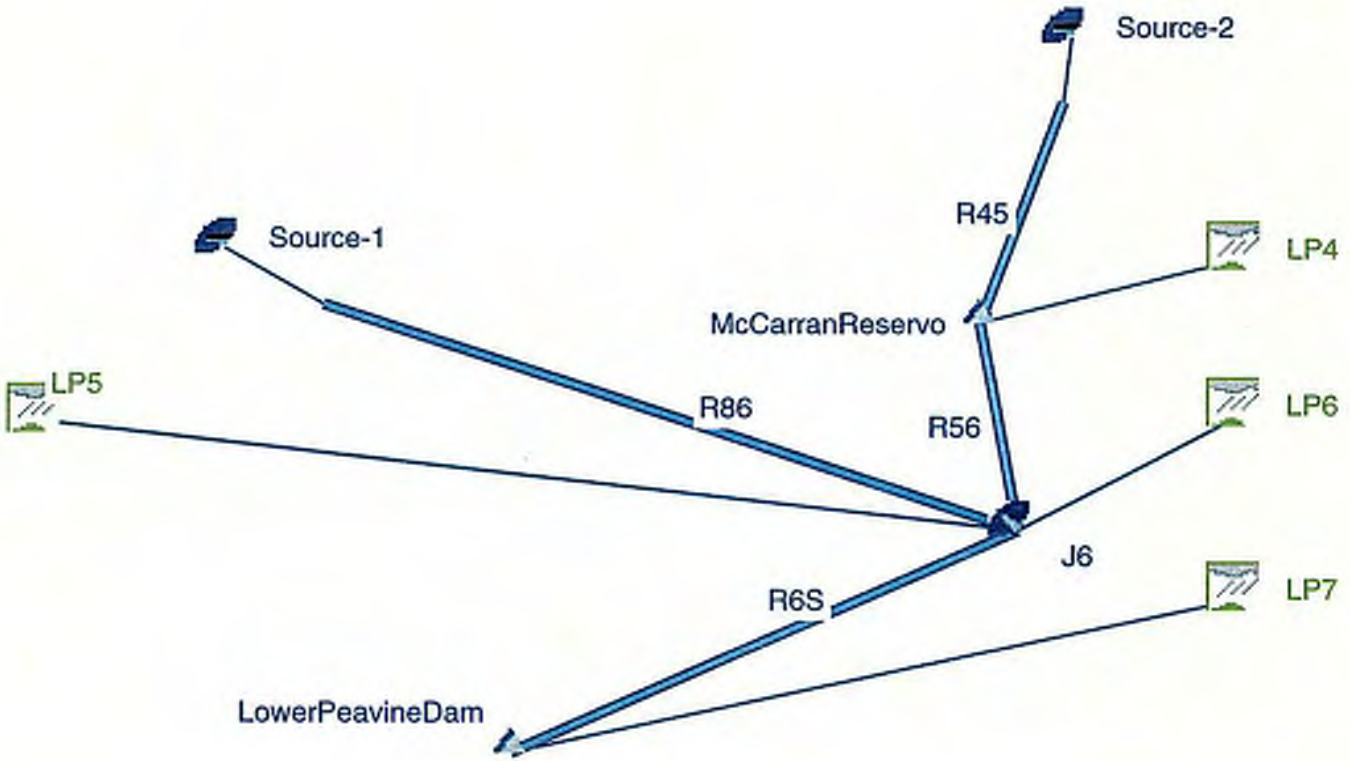
HMS * Summary of Results

Project : UL_PeavineWatershed Run Name : 100yr_111005-3

Start of Run : 05Jul05 0000 Basin Model : No_Outlets_111005-3
End of Run : 06Jul05 1200 Met. Model : 100Yr_24HR_Mod3
Execution Time : 10Nov05 1700 Control Specs : Scenario1

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
LP1	86.633	05 Jul 05 1230	11.094	0.189
R17	85.829	05 Jul 05 1240	11.103	0.189
LP2	124.83	05 Jul 05 1230	15.372	0.223
J7	200.70	05 Jul 05 1230	26.474	0.412
R78	200.13	05 Jul 05 1235	26.479	0.412
LP3	70.886	05 Jul 05 1220	6.7307	0.092
J8	244.41	05 Jul 05 1230	33.210	0.504

SUB BASINS GROUP 4



HMS * Summary of Results

Project : UL_PeavineWatershed Run Name : 100yr_111005-4

Start of Run : 05Jul05 0000 Basin Model : No_Outlets111005-4
End of Run : 06Jul05 1200 Met. Model : 100Yr_24HR_Mod4
Execution Time : 10Nov05 1659 Control Specs : Scenario1

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
Source-1	244.41	05 Jul 05 1230	33.210	0.504
R86	240.68	05 Jul 05 1230	33.222	0.504
Source-2	56.404	05 Jul 05 1840	72.653	2.139
R45	56.405	05 Jul 05 1845	72.571	2.139
LP4	41.888	05 Jul 05 1215	3.4168	0.067
McCarranReservo	57.703	05 Jul 05 1850	75.865	2.206
R56	57.703	05 Jul 05 1850	75.772	2.206
LP5	17.496	05 Jul 05 1210	1.2674	0.023
LP6	52.820	05 Jul 05 1220	4.9336	0.070
J6	315.40	05 Jul 05 1230	115.20	2.803
R6S	311.69	05 Jul 05 1230	115.13	2.803
LP7	76.452	05 Jul 05 1225	8.4484	0.112
LowerPeavineDam	75.518	05 Jul 05 1850	111.86	2.915

HMS * Summary of Results for McCarranReservo

Project : UL_PeavineWatershed Run Name : 100yr_111005-4

Start of Run : 05Jul05 0000 Basin Model : No_Outlets111005-4

End of Run : 06Jul05 1200 Met. Model : 100Yr_24HR_Mod4

Execution Time : 10Nov05 1659 Control Specs : Scenario1

Computed Results

Peak Inflow	: 57.713 (cfs)	Date/Time of Peak Inflow	: 05 Jul 05 1840
Peak Outflow	: 57.703 (cfs)	Date/Time of Peak Outflow	: 05 Jul 05 1850
Total Inflow	: 0.65 (in)	Peak Storage	: 0.50030(ac-ft)
Total Outflow	: 0.64 (in)	Peak Elevation	: 4897.7(ft)

HMS * Summary of Results for LowerPeavineDam

Project : UL_PeavineWatershed Run Name : 100yr_111005-4

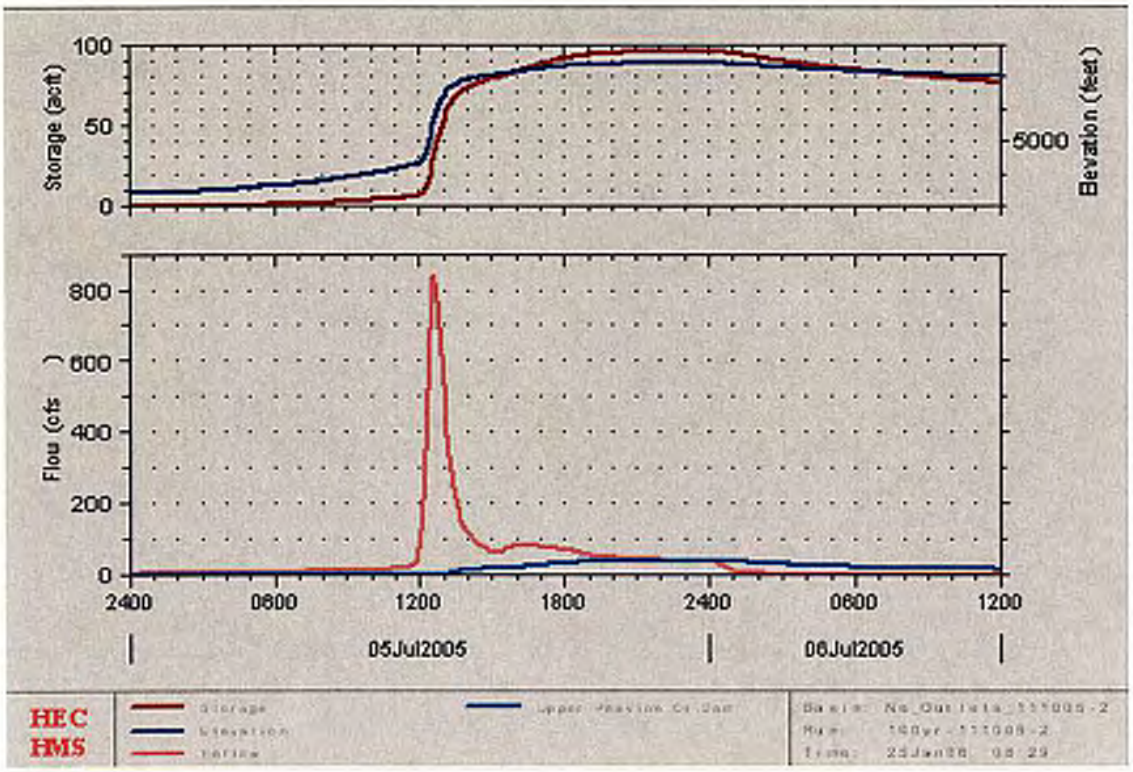
Start of Run : 05Jul05 0000 Basin Model : No_Outlets111005-4

End of Run : 06Jul05 1200 Met. Model : 100Yr_24HR_Mod4

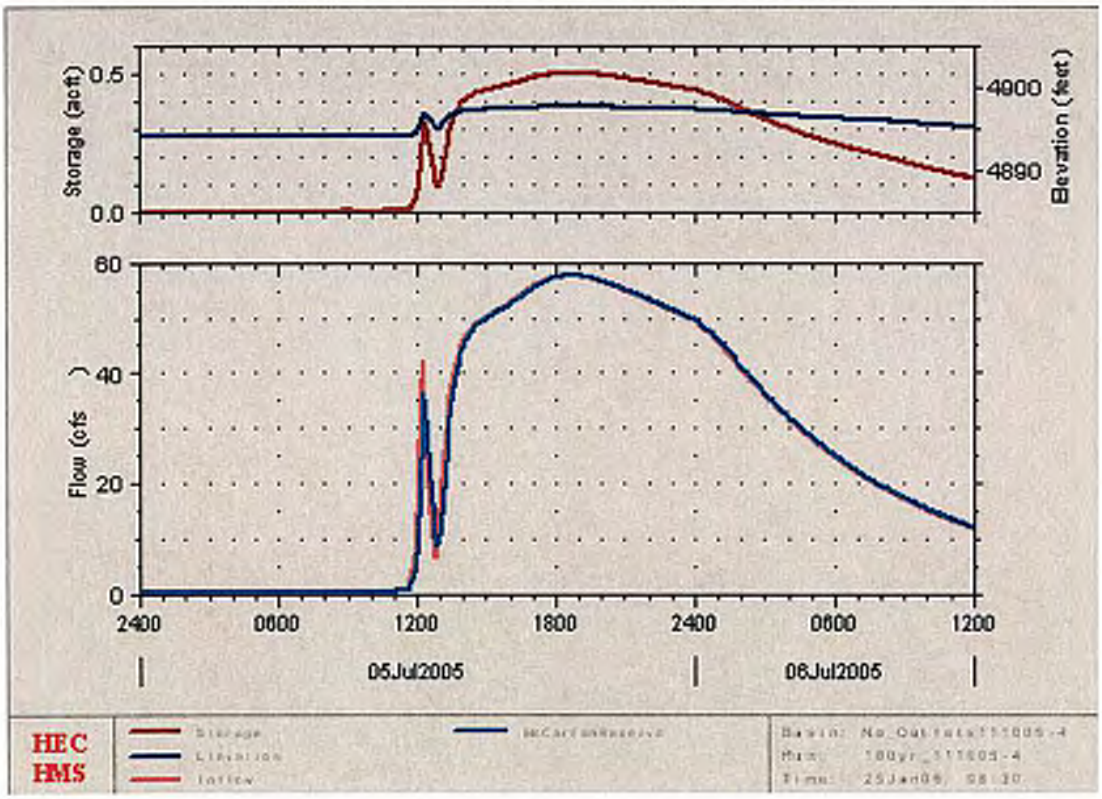
Execution Time : 10Nov05 1659 Control Specs : Scenario1

Computed Results

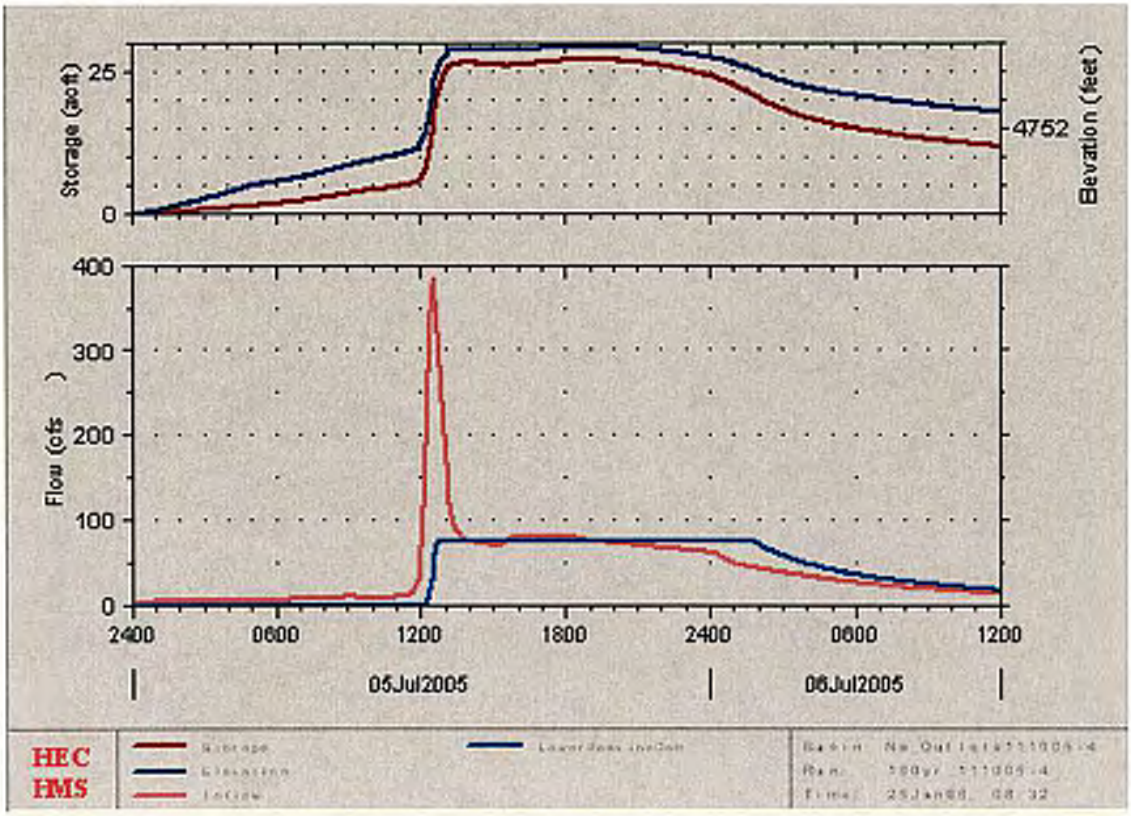
Peak Inflow	: 382.56 (cfs)	Date/Time of Peak Inflow	: 05 Jul 05 1230
Peak Outflow	: 75.518 (cfs)	Date/Time of Peak Outflow	: 05 Jul 05 1850
Total Inflow	: 0.79 (in)	Peak Storage	: 26.998(ac-ft)
Total Outflow	: 0.72 (in)	Peak Elevation	: 4757.7(ft)



100 Year 24 hour Hydrograph at Upper Peavine Detention Dam

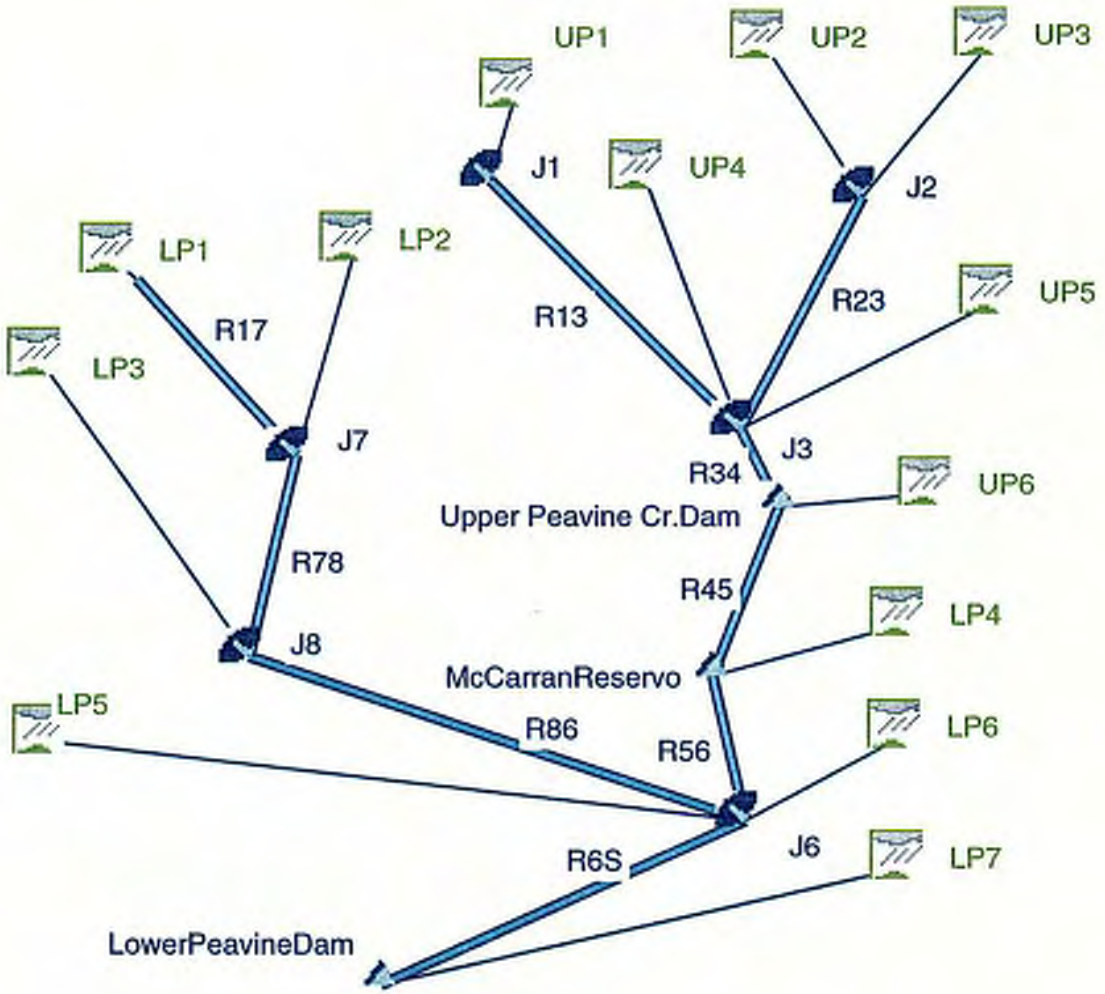


100 Year 24 hour Hydrograph at McCarran Boulevard



100 Year 24 hour Hydrograph at Lower Peavine Detention Dam

EMERGENCY SPILLWAY ANALYSIS



HMS * Summary of Results

Project : UL_PeavineWatershed Run Name : Spillway_110905

Start of Run : 05Jul05 0000 Basin Model : No_Outlets_110905
End of Run : 06Jul05 1200 Met. Model : Emergency Spillway
Execution Time : 10Nov05 1629 Control Specs : Scenario1

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
LP1	257.06	05 Jul 05 0335	24.135	0.189
R17	255.62	05 Jul 05 0340	24.152	0.189
LP2	333.64	05 Jul 05 0330	31.128	0.223
J7	579.16	05 Jul 05 0335	55.280	0.412
R78	576.50	05 Jul 05 0340	55.290	0.412
LP3	158.47	05 Jul 05 0325	13.324	0.092
J8	712.79	05 Jul 05 0335	68.614	0.504
R86	708.50	05 Jul 05 0335	68.620	0.504
UP1	393.86	05 Jul 05 0330	34.445	0.327
J1	393.86	05 Jul 05 0330	34.445	0.327
R13	391.99	05 Jul 05 0335	34.470	0.327
UP2	296.53	05 Jul 05 0340	25.893	0.286
UP3	692.73	05 Jul 05 0340	71.966	0.579
J2	989.25	05 Jul 05 0340	97.859	0.865
R23	985.42	05 Jul 05 0345	97.873	0.865
UP4	384.23	05 Jul 05 0400	42.733	0.472
UP5	420.28	05 Jul 05 0340	36.831	0.390
J3	2095.2	05 Jul 05 0345	211.91	2.054
R34	2092.4	05 Jul 05 0345	211.91	2.054
UP6	129.36	05 Jul 05 0330	11.085	0.085
Upper Peavine Cr.Dam	72.368	05 Jul 05 0530	143.94	2.139
R45	72.367	05 Jul 05 0535	143.84	2.139
LP4	109.09	05 Jul 05 0320	8.2988	0.067
McCarranReservo	101.87	05 Jul 05 0330	151.98	2.206
R56	101.73	05 Jul 05 0330	151.88	2.206
LP5	39.929	05 Jul 05 0320	2.9694	0.023
LP6	126.98	05 Jul 05 0320	10.564	0.070
J6	944.77	05 Jul 05 0335	234.03	2.803
R6S	941.96	05 Jul 05 0335	233.95	2.803
LP7	196.10	05 Jul 05 0330	17.670	0.112
LowerPeavineDam	211.31	05 Jul 05 0440	234.75	2.915

HMS * Summary of Results for Upper Peavine Cr.Dam

Project : UL_PeavineWatershed Run Name : Spillway_110905

Start of Run : 05Jul05 0000 Basin Model : No_Outlets_110905

End of Run : 06Jul05 1200 Met. Model : Emergency Spillway

Execution Time : 10Nov05 1629 Control Specs : Scenario1

Computed Results

Peak Inflow	: 2193.2 (cfs)	Date/Time of Peak Inflow	: 05 Jul 05 0345
Peak Outflow	: 72.368 (cfs)	Date/Time of Peak Outflow	: 05 Jul 05 0530
Total Inflow	: 1.95 (in)	Peak Storage	: 210.35(ac-ft)
Total Outflow	: 1.26 (in)	Peak Elevation	: 5021.4(ft)

HMS * Summary of Results for McCarranReservo

Project : UL_PeavineWatershed Run Name : Spillway_110905

Start of Run : 05Jul05 0000 Basin Model : No_Outlets_110905

End of Run : 06Jul05 1200 Met. Model : Emergency Spillway

Execution Time : 10Nov05 1629 Control Specs : Scenario1

Computed Results

Peak Inflow	: 109.09 (cfs)	Date/Time of Peak Inflow	: 05 Jul 05 0320
Peak Outflow	: 101.87 (cfs)	Date/Time of Peak Outflow	: 05 Jul 05 0330
Total Inflow	: 1.29 (in)	Peak Storage	: 0.95800(ac-ft)
Total Outflow	: 1.29 (in)	Peak Elevation	: 4899.4(ft)

HMS * Summary of Results for LowerPeavineDam

Project : UL_PeavineWatershed Run Name : Spillway_110905

Start of Run : 05Jul05 0000 Basin Model : No_Outlets_110905

End of Run : 06Jul05 1200 Met. Model : Emergency Spillway

Execution Time : 10Nov05 1725 Control Specs : Scenario1

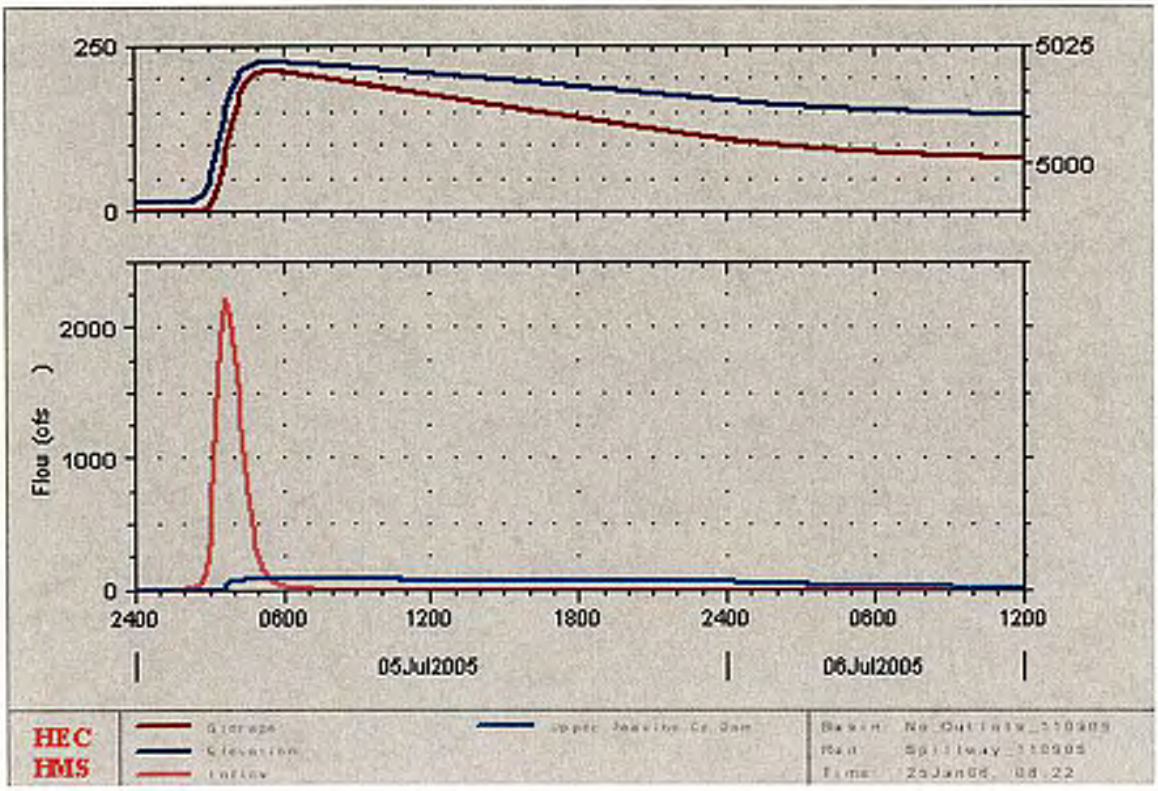
Computed Results

Peak Inflow : 1130.7 (cfs) Date/Time of Peak Inflow : 05 Jul 05 0335

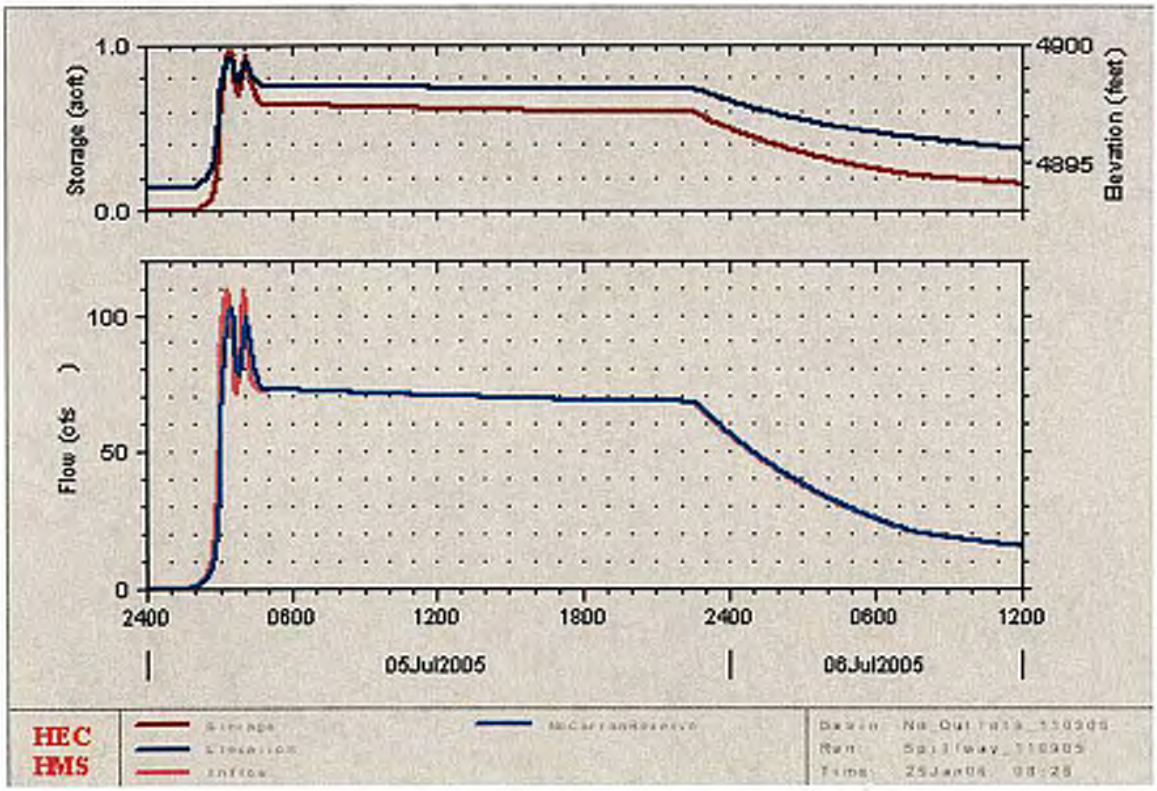
Peak Outflow : 211.31 (cfs) Date/Time of Peak Outflow : 05 Jul 05 0440

Total Inflow : 1.62 (in) Peak Storage : 95.648(ac-ft)

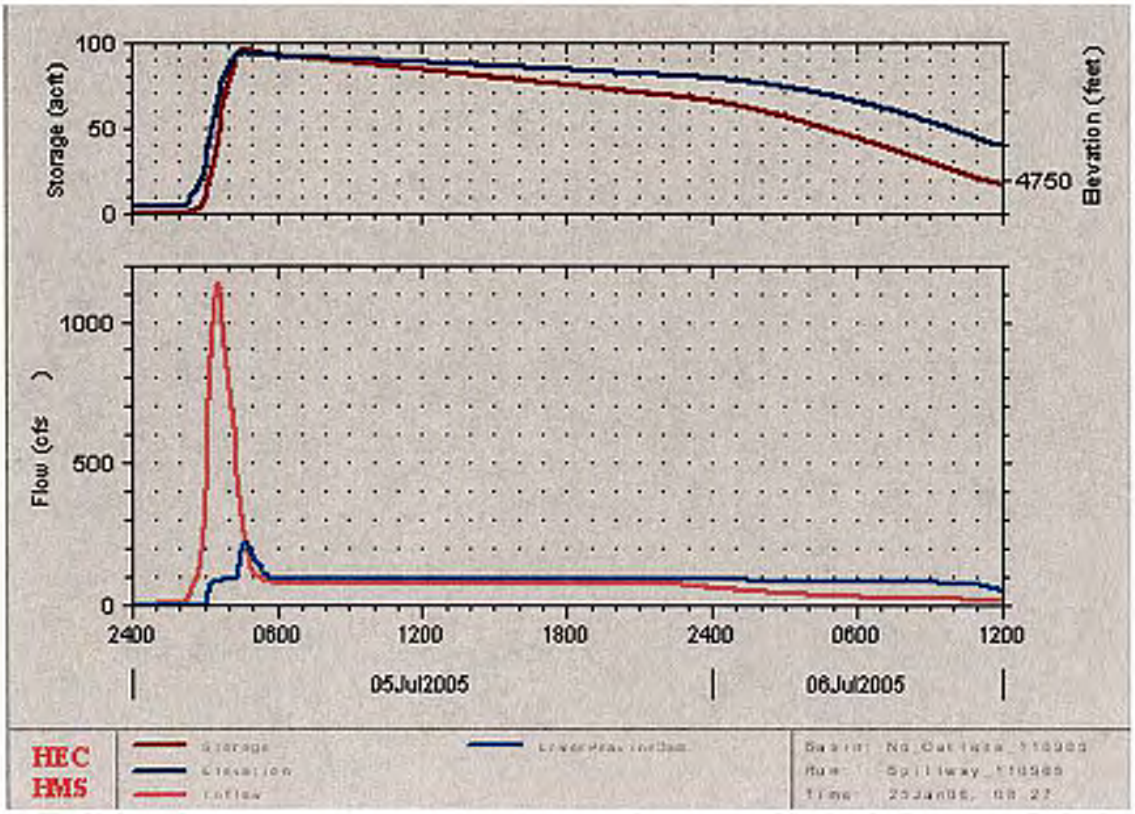
Total Outflow : 1.51 (in) Peak Elevation : 4768.3(ft)



Emergency Spillway Hydrograph at Upper Peavine Detention Dam

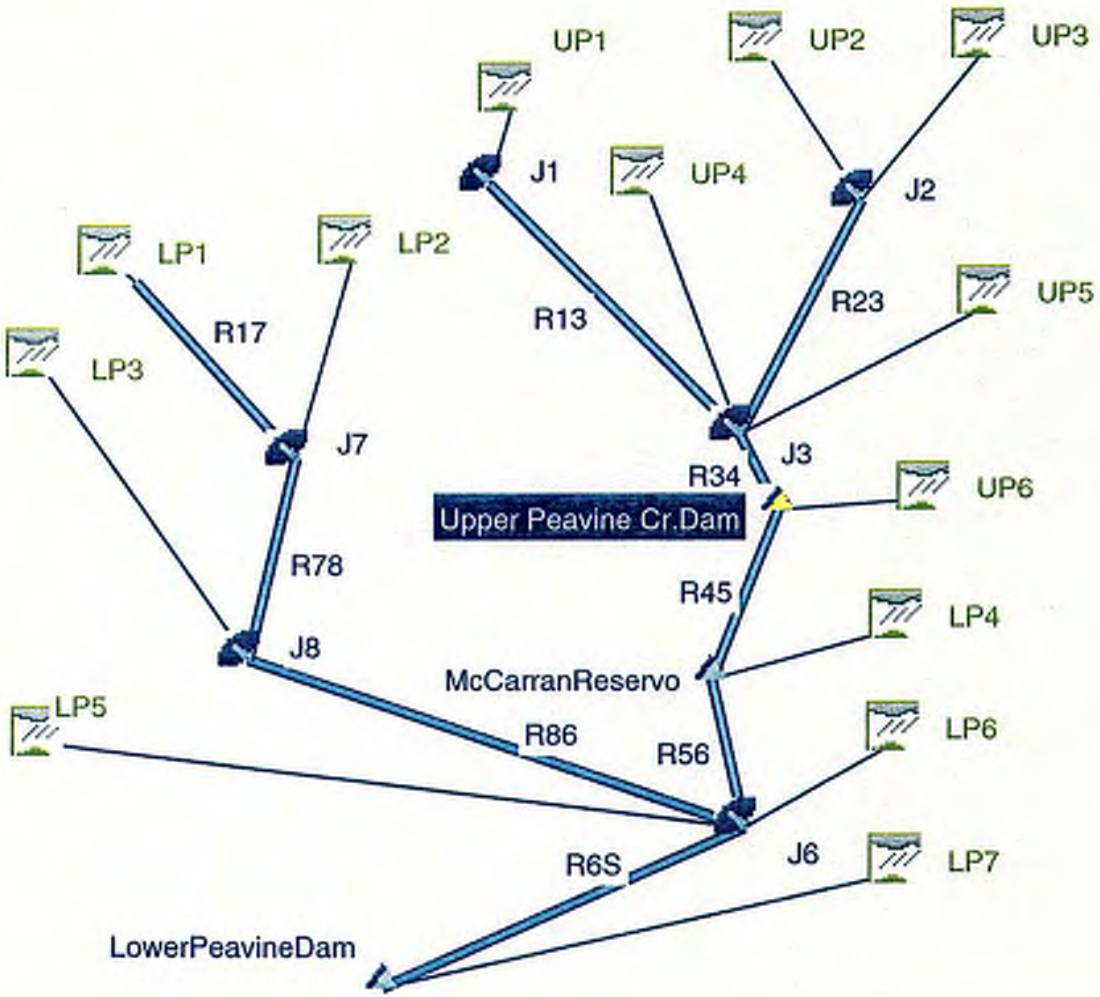


Emergency Spillway Hydrograph at McCarran Boulevard



Emergency Spillway Hydrograph at Lower Peavine Detention Dam

PROBABLE MAXIMUM PRECIPITATION (PMP) ANALYSIS



HMS * Summary of Results

Project : UL_PeavineWatershed Run Name : freeboard_110905

Start of Run : 05Jul05 0000 Basin Model : No_Outlets_110905
End of Run : 06Jul05 1200 Met. Model : Freeboard
Execution Time : 10Nov05 1610 Control Specs : Scenario1

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
LP1	918.91	05 Jul 05 0335	88.065	0.189
R17	919.29	05 Jul 05 0335	88.096	0.189
LP2	1147.5	05 Jul 05 0330	107.03	0.223
J7	2036.0	05 Jul 05 0335	195.12	0.412
R78	2035.8	05 Jul 05 0335	195.16	0.412
LP3	531.00	05 Jul 05 0320	44.786	0.092
J8	2503.8	05 Jul 05 0330	239.95	0.504
R86	2488.3	05 Jul 05 0330	240.00	0.504
UP1	1507.5	05 Jul 05 0325	132.88	0.327
J1	1507.5	05 Jul 05 0325	132.88	0.327
R13	1501.6	05 Jul 05 0330	132.90	0.327
UP2	1275.8	05 Jul 05 0330	115.84	0.286
UP3	2480.8	05 Jul 05 0340	258.92	0.579
J2	3720.0	05 Jul 05 0335	374.76	0.865
R23	3710.5	05 Jul 05 0340	374.76	0.865
UP4	1666.1	05 Jul 05 0350	191.18	0.472
UP5	1769.8	05 Jul 05 0330	160.89	0.390
J3	8333.7	05 Jul 05 0340	859.73	2.054
R34	8325.0	05 Jul 05 0340	859.88	2.054
UP6	458.64	05 Jul 05 0325	39.775	0.085
Upper Peavine Cr.Dam	6768.5	05 Jul 05 0400	807.99	2.139
R45	6714.3	05 Jul 05 0400	808.21	2.139
LP4	384.36	05 Jul 05 0320	30.777	0.067
McCarranReservo	3233.6	05 Jul 05 0445	838.70	2.206
R56	3226.7	05 Jul 05 0445	838.69	2.206
LP5	135.97	05 Jul 05 0310	10.723	0.023
LP6	413.30	05 Jul 05 0320	34.893	0.070
J6	3518.7	05 Jul 05 0440	1124.3	2.803
R6S	3501.1	05 Jul 05 0440	1124.3	2.803
LP7	627.14	05 Jul 05 0325	56.929	0.112
LowerPeavineDam	3453.5	05 Jul 05 0450	1123.5	2.915

HMS * Summary of Results for Upper Peavine Cr.Dam

Project : UL_PeavineWatershed Run Name : freeboard_110905

Start of Run	: 05Jul05 0000	Basin Model	: No_Outlets_110905
End of Run	: 06Jul05 1200	Met. Model	: Freeboard
Execution Time	: 10Nov05 1610	Control Specs	: Scenario1

Computed Results

Peak Inflow	: 8698.9 (cfs)	Date/Time of Peak Inflow	: 05 Jul 05 0340
Peak Outflow	: 6768.5 (cfs)	Date/Time of Peak Outflow	: 05 Jul 05 0400
Total Inflow	: 7.89 (in)	Peak Storage	: 424.50(ac-ft)
Total Outflow	: 7.08 (in)	Peak Elevation	: 5032.6(ft)

HMS * Summary of Results for McCarranReservo

Project : UL_PeavineWatershed Run Name : freeboard_110905

Start of Run : 05Jul05 0000 Basin Model : No_Outlets_110905

End of Run : 06Jul05 1200 Met. Model : Freeboard

Execution Time : 10Nov05 1610 Control Specs : Scenario1

Computed Results

Peak Inflow	: 6833.7 (cfs)	Date/Time of Peak Inflow	: 05 Jul 05 0400
Peak Outflow	: 3233.6 (cfs)	Date/Time of Peak Outflow	: 05 Jul 05 0445
Total Inflow	: 7.13 (in)	Peak Storage	: 366.68(ac-ft)
Total Outflow	: 7.13 (in)	Peak Elevation	: 4937.8(ft)

HMS * Summary of Results for LowerPeavineDam

Project : UL_PeavineWatershed Run Name : freeboard_110905

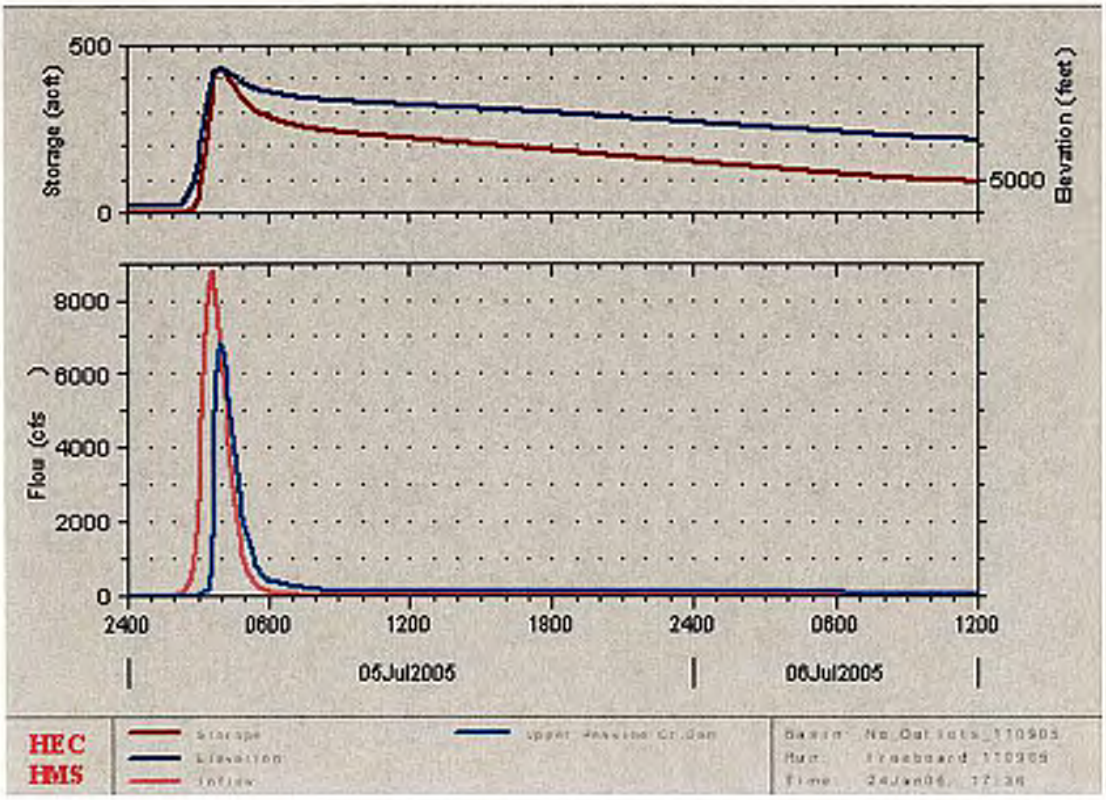
Start of Run : 05Jul05 0000 Basin Model : No_Outlets_110905

End of Run : 06Jul05 1200 Met. Model : Freeboard

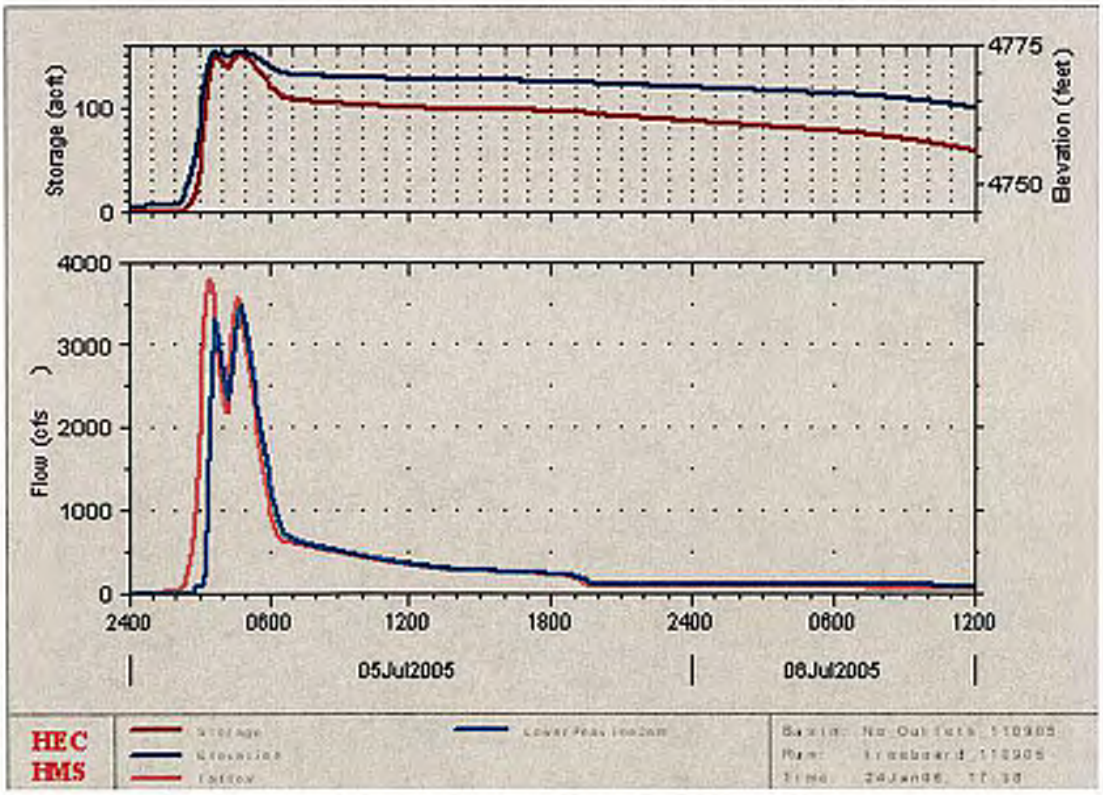
Execution Time : 10Nov05 1610 Control Specs : Scenario1

Computed Results

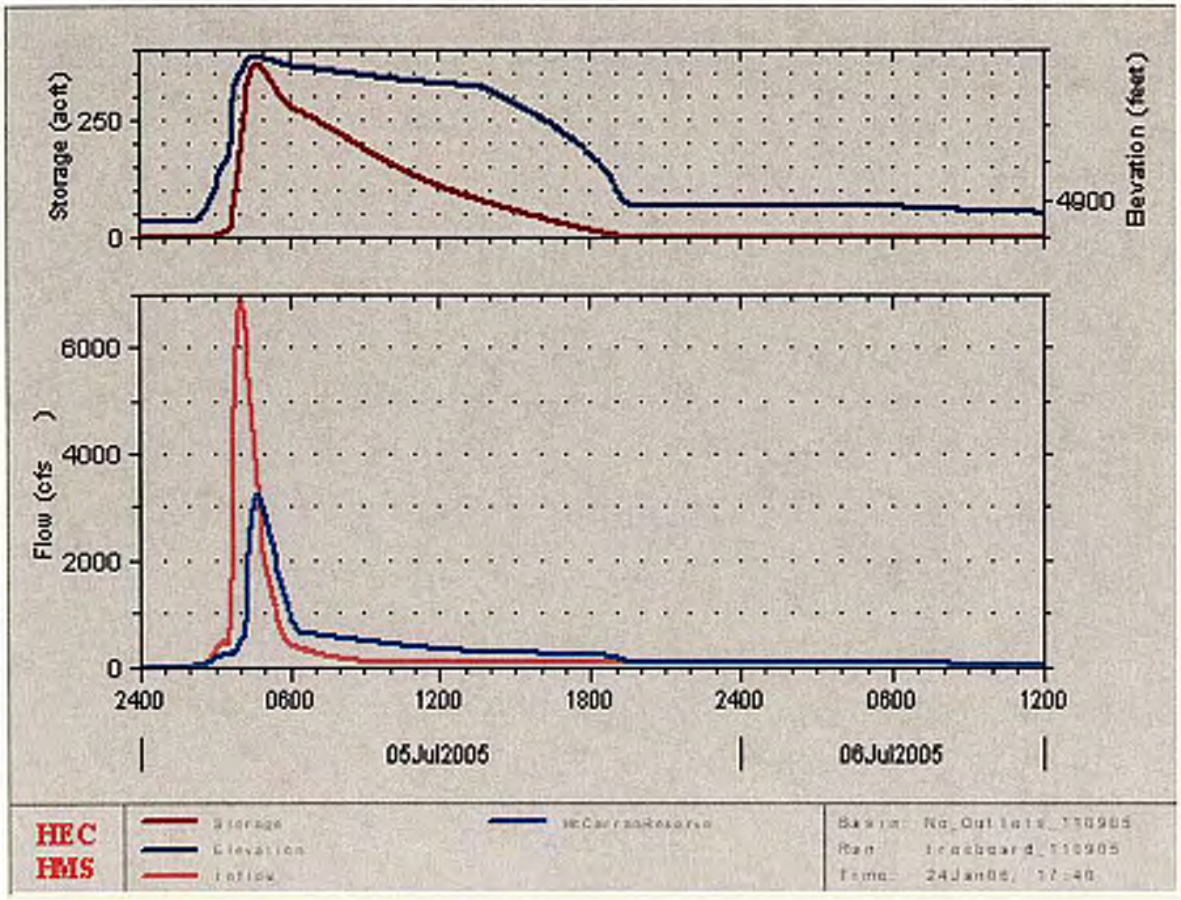
Peak Inflow	: 3768.0 (cfs)	Date/Time of Peak Inflow	: 05 Jul 05 0330
Peak Outflow	: 3453.5 (cfs)	Date/Time of Peak Outflow	: 05 Jul 05 0450
Total Inflow	: 7.60 (in)	Peak Storage	: 149.83(ac-ft)
Total Outflow	: 7.23 (in)	Peak Elevation	: 4773.8(ft)



PMF Hydrograph at Upper Peavine Detention Dam



PMF Hydrograph at Lower Peavine Detention Dam



PMF Hydrograph at McCarran Boulevard Reservoir

East and West Wash Hydrology Summary and Comparison

	Eastwash Dam	Westwash Dam
Top of Principal Spillway Elevation (ft)*	4853.15	4760
Original Emergency Spillway Dike elevation (ft)*	4858.2	n/a
Current Emergency Spillway Dike elevation (ft)*	4857.15 (7)	n/a
Original Emergency Spillway Crest elevation (ft)*	4853.20	4784.00
Current Emergency Spillway Crest elevation (ft)*	4853.20	4782.20
Original Design Top of Dam Elevation (ft)*	4861.20	4791.70
Current Top of Dam (ft)*	4862.00	4793.15

East Wash Dam

Structure and Storm Frequency	Storm Duration (hrs)	Precipitation (in)	Maximum Water Surface Elevation (ft)*	Emergency Spillway Discharge (cfs)	Comments
100-yr - Watershed Work Plan(1)	2	3.00	4855.40	1000	
100-yr 24-hr - NRCS Reevaluated(2)	24	2.70	4854.75	600	Assume sediment pool drains are plugged.
100-yr 24-hr - MACTEC HEC-HMS Model	24	varies (2.75 to 3.22)	4855.30	674	The 100-year, 24-hour design flood does not overtop the dam. The WSEL is 2 ft above the emergency spillway crest elevation.
Spillway Design Flood - Watershed Work Plan(1)	2	7.50	4859.35	3970	
Spillway Design Flood (100yr & PMF) - NRCS Reevaluated(2) (4)	6	4.80	4856.35	1510	
Spillway Design Flood (100yr & PMF) - MACTEC HEC-HMS Model (5)	6	4.52	4857.90	2601	The spillway design flood does not overtop the dam. The WSEL is 4.7 ft above the emergency spillway crest elevation.
Freeboard Design Flood (PMF) - NRCS Reevaluated (2)	6	13.44	4861.20	5990	
Freeboard Design Flood (PMF) - USCOE Investigation (3) (4) (8)	6	13.44	4860.00	6000	
Freeboard Design Flood (PMF) - MACTEC HEC-HMS Model (5) (6)	6	11.60	4860.40	9564	The full 6hr Local PMF (freeboard design flood) does not overtop the dam and the available freeboard is 1.6 ft which is higher than the minimum freeboard of 1.5 ft recommended by the USCOE.

* All elevations reported in NAVD 1988 (+3.2 feet from NAVD 1929)

East and West Wash Hydrology Summary and Comparison

West Wash Dam

Structure and Storm Frequency	Storm Duration (hrs)	Precipitation (in)	Maximum Water Surface Elevation (ft)*	Emergency Spillway Discharge (cfs)	Comments
100-yr - Watershed Work Plan[1]	2	3.00	4779.40	0	
100-yr 24-hr - NRCS Reevaluated[2]	24	2.70	4773.05	0	
100-yr 24-hr - MACTEC HEC-HMS Model	24	varies (2.75 to 3.22)	4774.20	0	The 100-yr, 24-hour design flood does not overtop the dam. The WSEL is also below the emergency spillway crest elevation.
Spillway Design Flood - Watershed Work Plan[1]	2	7.50	4789.30	5000	
Spillway Design Flood (100yr & PMF) - NRCS Revaluated[2] [4]	6	4.80	4784.4 [4]	1145	
Spillway Design Flood (100yr & PMF) - MACTEC HEC-HMS Model [5]	6	4.52	4786.20	1592	The spillway design flood does not overtop the dam. The WSEL is 2.2 ft above the emergency spillway crest elevation.
Freeboard Design Flood (PMF) - NRCS Reevaluated [2]	6	13.44	4792.50	8530	Dam is overtopped.
Freeboard Design Flood (PMF) - MACTEC HEC-HMS Model [5] [6]	6	11.60	4794.80	14162	The full 6hr Local PMF overtops the dam by 1.6 ft for a period of ~40 minuts.

* All elevations reported in NAVD 1988 (+3.2 feet from NAVD 1929)

[1] Peavine Watershed Work Plan, NRCS, March 1958.

[2] Peavine Watershed Project - Project Reevaluation, NRCS October 1976.

[3] Differs from (2) in emergency spillway rating curve only.

[4] Rigid Boundary assumed for emergency spillway dike overflow.

[5] This study. MACTEC, 2006

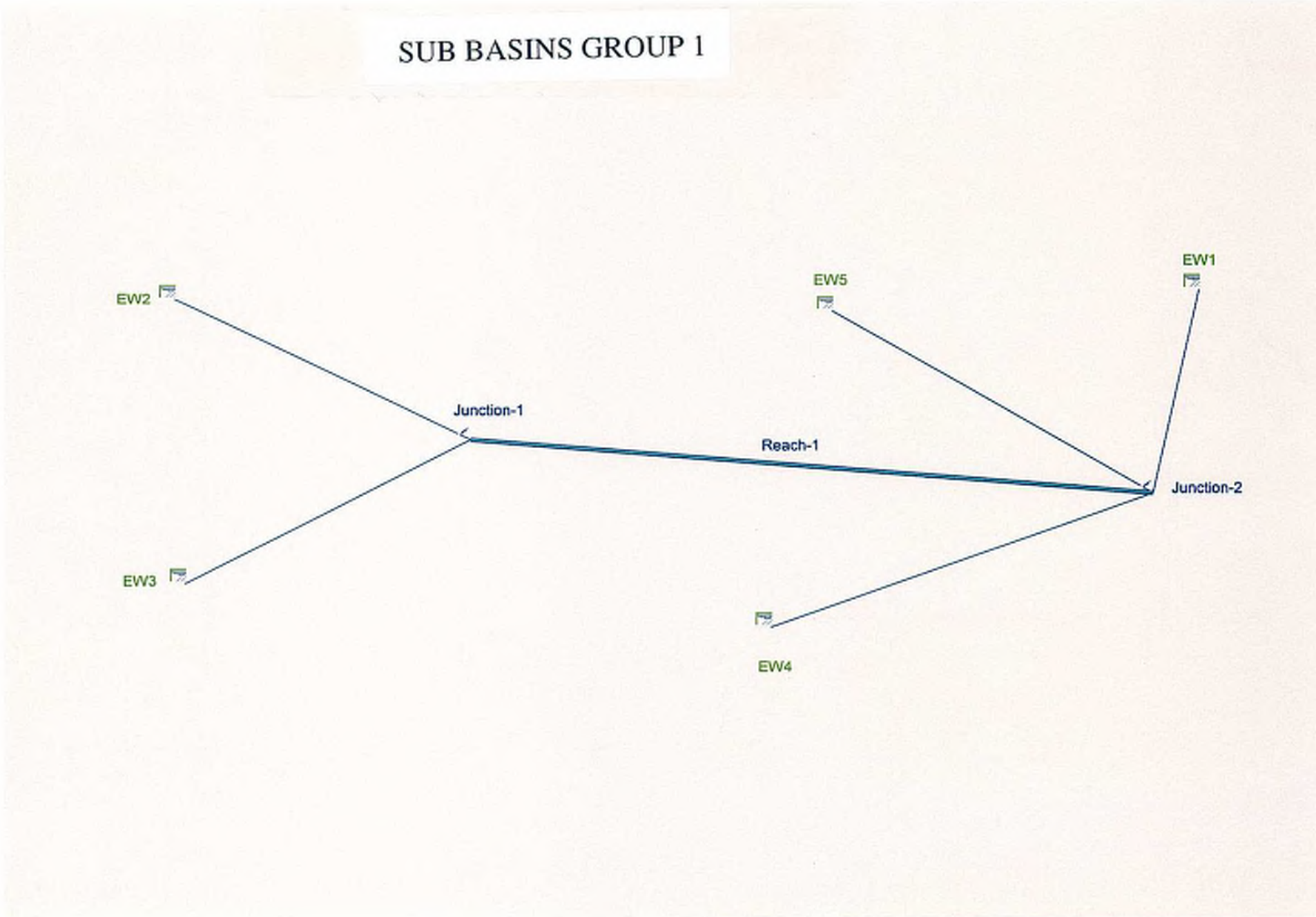
[6] Precipitation depth is a local PMF of 6-hour duration.

[7] This is the low spot in the dike adjacent to the east wall of the emergency spillway.

[8] USCOE National Dam Inspection, 1978

100 YEAR – 24 HOUR ANALYSIS

SUB BASINS GROUP 1



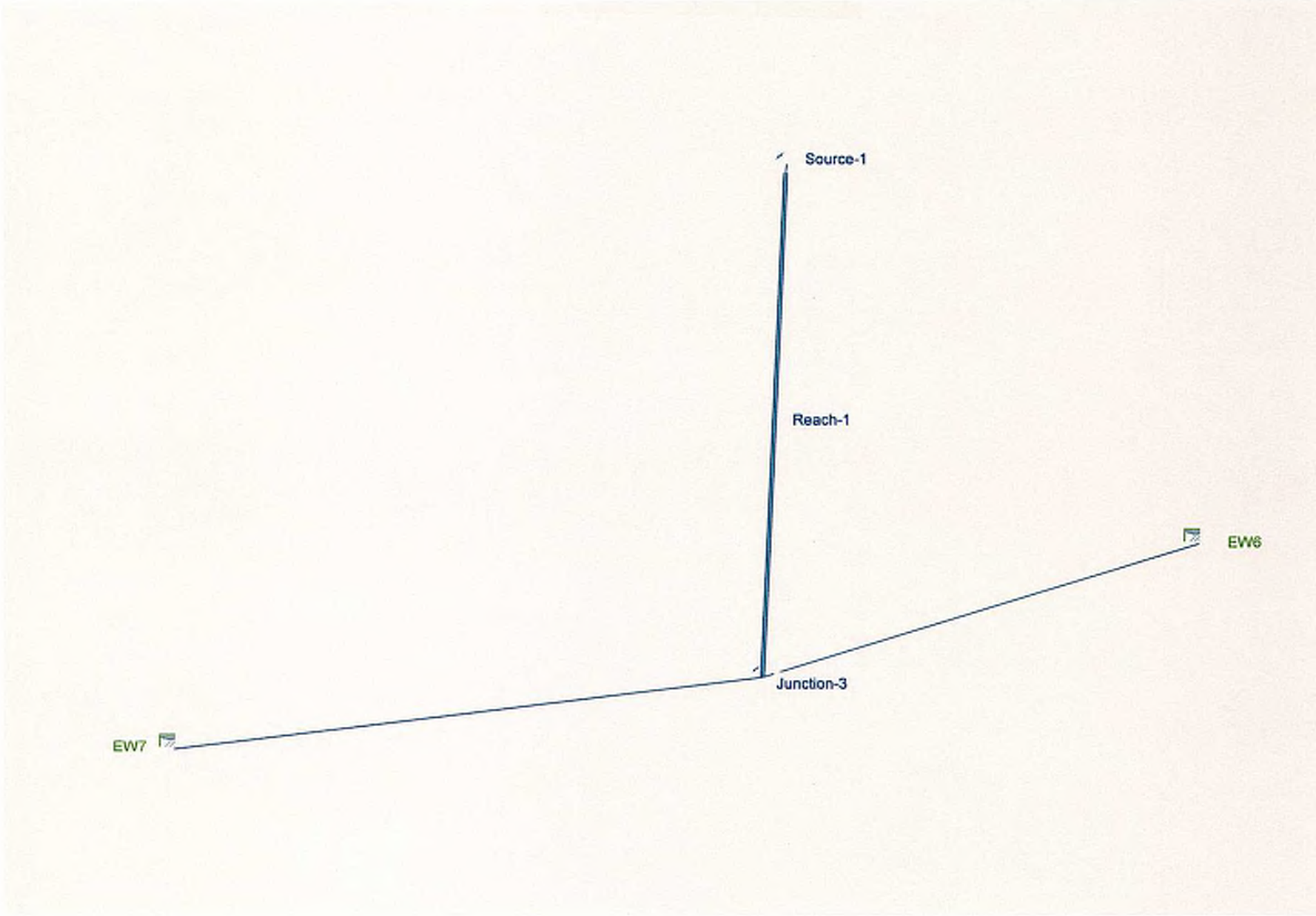
HMS * Summary of Results

Project : eastwestwash Run Name : Modifed Group 1

Start of Run : 17Aug05 2400 Basin Model : Basin Group 1_120305
End of Run : 19Aug05 1200 Met. Model : 100yr-24hr-1
Execution Time : 03Dec05 1600 Control Specs : Control 2

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
EW2	144.66	18 Aug 05 1220	15.292	0.209
EW3	206.44	18 Aug 05 1230	27.071	0.370
Junction-1	338.29	18 Aug 05 1225	42.363	0.579
Reach-1	332.55	18 Aug 05 1225	42.371	0.579
EW4	57.715	18 Aug 05 1220	5.9264	0.081
EW5	23.786	18 Aug 05 1215	2.0486	0.028
EW1	239.27	18 Aug 05 1225	28.974	0.396
Junction-2	641.46	18 Aug 05 1225	79.320	1.084

SUB BASINS GROUP 2



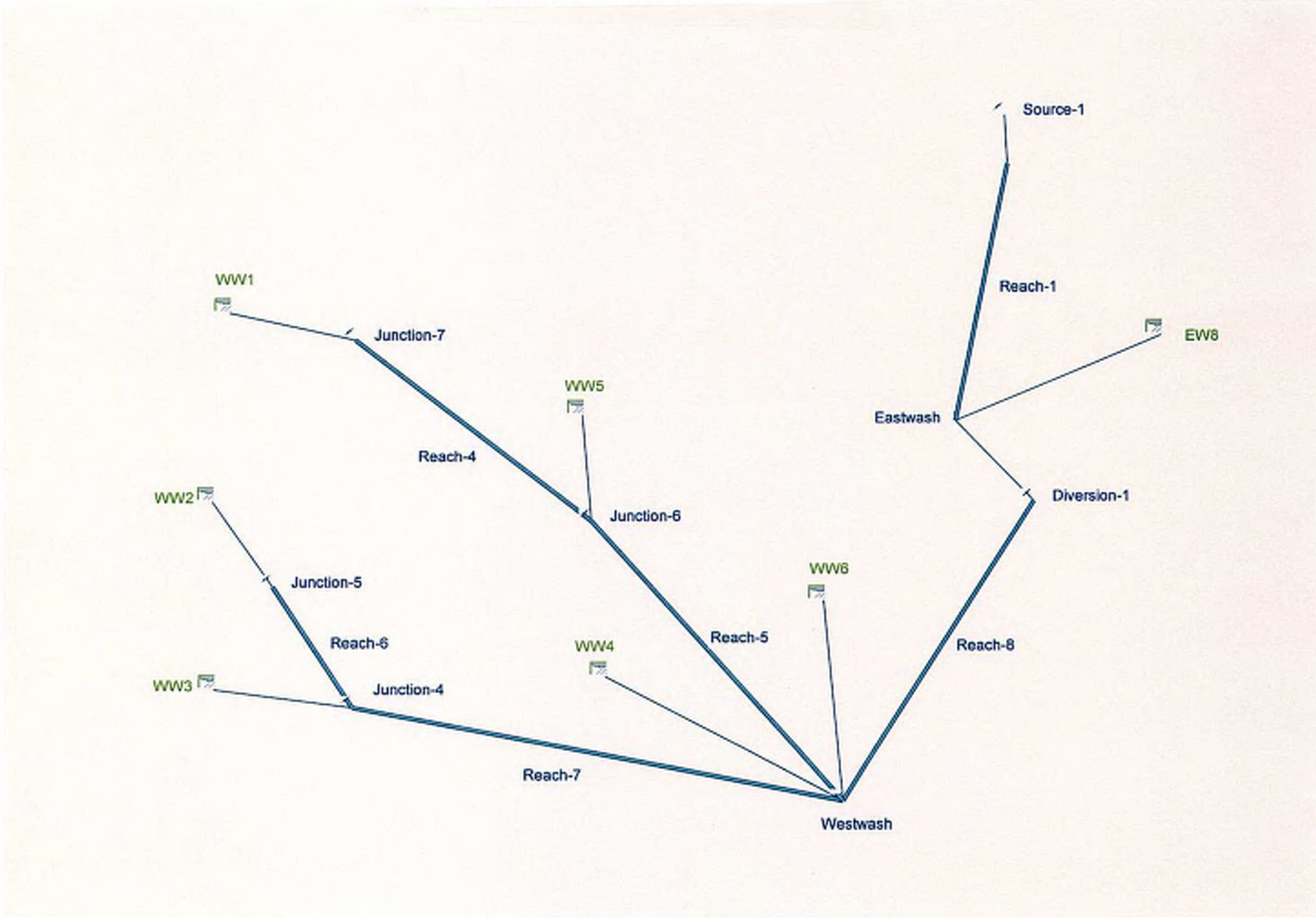
HMS * Summary of Results

Project : eastwestwash Run Name : Modified Group 2

Start of Run : 17Aug05 2400 Basin Model : Basin Group 2_120305
End of Run : 19Aug05 1200 Met. Model : 100yr-24hr-2
Execution Time : 03Dec05 1602 Control Specs : Control 2

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
Source-1	465.57	18 Aug 05 1240	79.317	3.241
Reach-1	461.26	18 Aug 05 1245	79.339	3.241
EW7	164.03	18 Aug 05 1215	14.751	0.238
EW6	231.90	18 Aug 05 1245	36.933	0.488
Junction-3	740.07	18 Aug 05 1245	131.02	3.967

SUB BASINS GROUP 3



HMS * Summary of Results

Project : eastwestwash Run Name : Modified Group 3

Start of Run : 17Aug05 2400 Basin Model : Basin Group 3_120305
End of Run : 19Aug05 1200 Met. Model : 100yr-24hr-3
Execution Time : 03Dec05 1605 Control Specs : Control 2

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
WW2	99.402	18 Aug 05 1210	6.1504	0.099
Junction-5	99.402	18 Aug 05 1210	6.1504	0.099
Reach-6	95.008	18 Aug 05 1210	6.1580	0.099
WW3	289.52	18 Aug 05 1225	33.437	0.493
Junction-4	328.01	18 Aug 05 1225	39.595	0.592
Reach-7	325.18	18 Aug 05 1230	39.602	0.592
WW1	103.31	18 Aug 05 1220	9.2754	0.183
Junction-7	103.31	18 Aug 05 1220	9.2754	0.183
Reach-4	103.46	18 Aug 05 1220	9.2793	0.183
WW5	142.06	18 Aug 05 1230	16.451	0.222
Junction-6	239.99	18 Aug 05 1225	25.730	0.405
Reach-5	236.35	18 Aug 05 1230	25.748	0.405
Source-1	665.75	18 Aug 05 1245	131.02	3.314
Reach-1	665.48	18 Aug 05 1250	131.03	3.314
EW8	161.50	18 Aug 05 1225	17.644	0.284
Eastwash	674.30	18 Aug 05 1300	133.46	3.598
Diversion-1	650.99	18 Aug 05 1300	112.73	3.598
Reach-8	646.31	18 Aug 05 1305	112.75	3.598
WW4	88.446	18 Aug 05 1215	6.9333	0.145
WW6	109.75	18 Aug 05 1215	8.7725	0.105
Westwash	67.798	18 Aug 05 2045	135.11	4.845

HMS * Summary of Results for Eastwash

Project : eastwestwash Run Name : Modified Group 3

Start of Run	: 17Aug05 2400	Basin Model	: Basin Group 3_120305
End of Run	: 19Aug05 1200	Met. Model	: 100yr-24hr-3
Execution Time	: 03Dec05 1605	Control Specs	: Control 2

Computed Results

Peak Inflow	: 745.23 (cfs)	Date/Time of Peak Inflow	: 18 Aug 05 1245
Peak Outflow	: 674.30 (cfs)	Date/Time of Peak Outflow	: 18 Aug 05 1300
Total Inflow	: 0.77 (in)	Peak Storage	: 57.101(ac-ft)
Total Outflow	: 0.70 (in)	Peak Elevation	: 4855.3(ft)

HMS * Summary of Results for Westwash

Project : eastwestwash Run Name : Modified Group 3

Start of Run : 17Aug05 2400 Basin Model : Basin Group 3_120305

End of Run : 19Aug05 1200 Met. Model : 100yr-24hr-3

Execution Time : 03Dec05 1605 Control Specs : Control 2

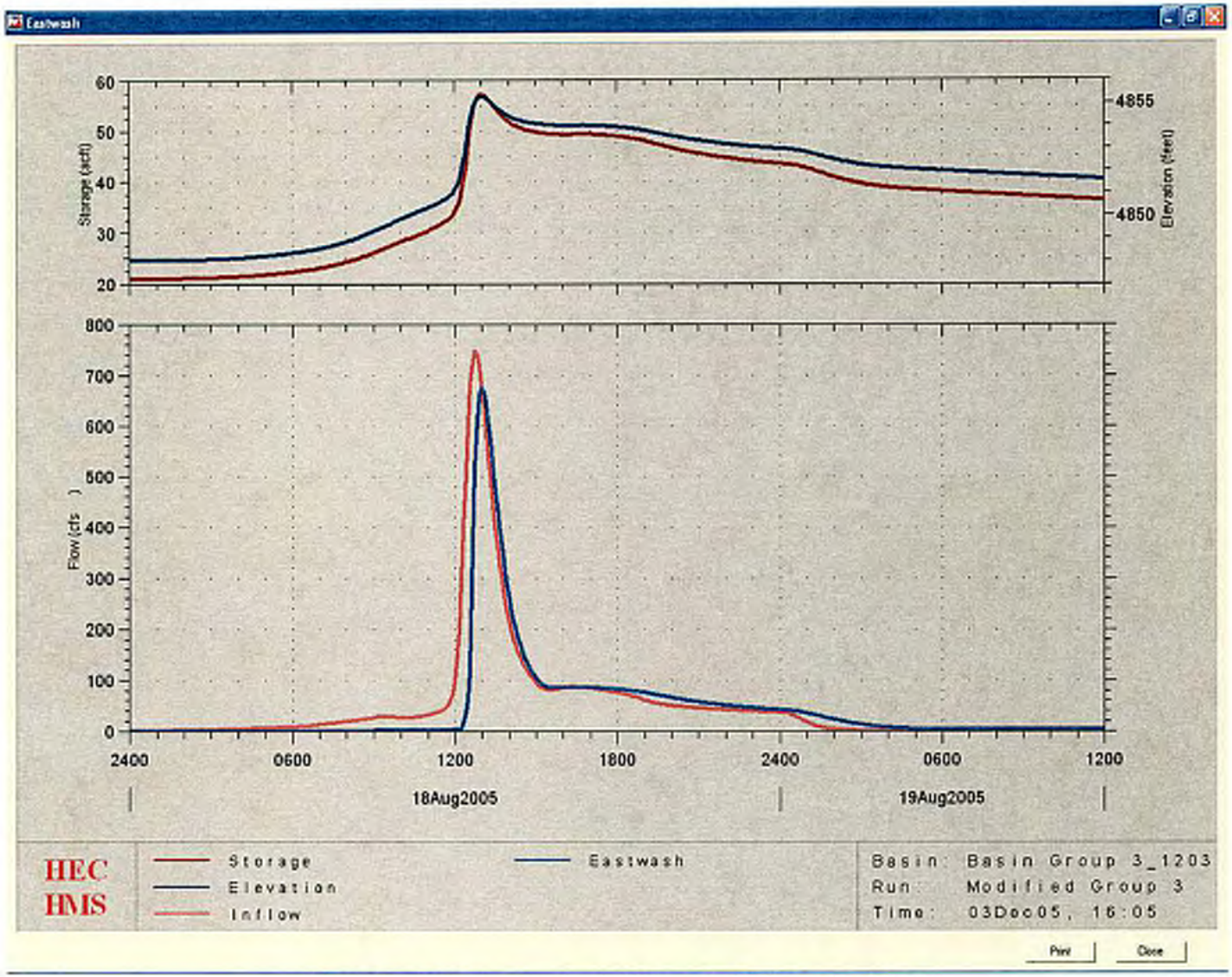
Computed Results

Peak Inflow : 922.30 (cfs) Date/Time of Peak Inflow : 18 Aug 05 1250

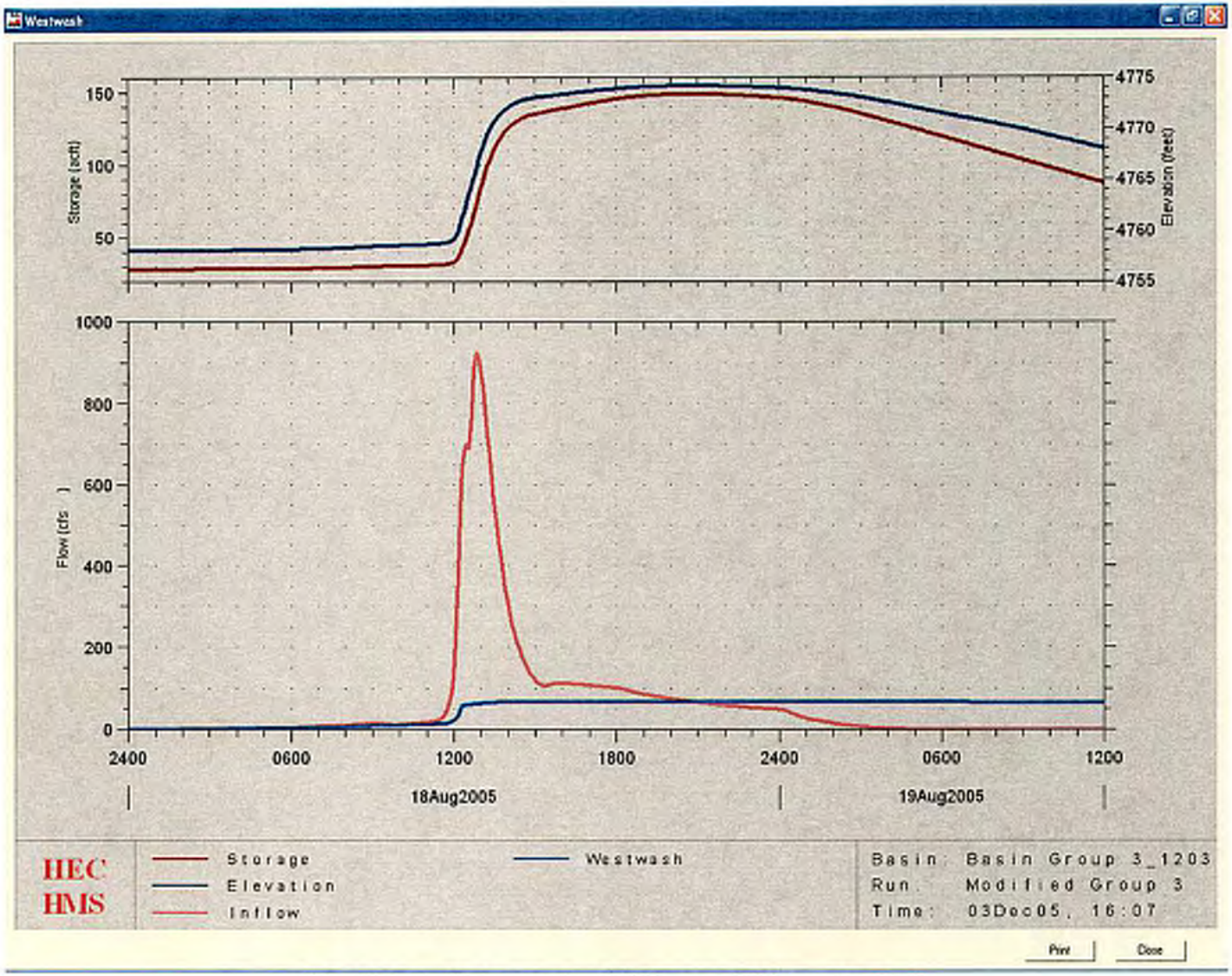
Peak Outflow : 67.798 (cfs) Date/Time of Peak Outflow : 18 Aug 05 2045

Total Inflow : 0.75 (in) Peak Storage : 148.84(ac-ft)

Total Outflow : 0.52 (in) Peak Elevation : 4774.2(ft)

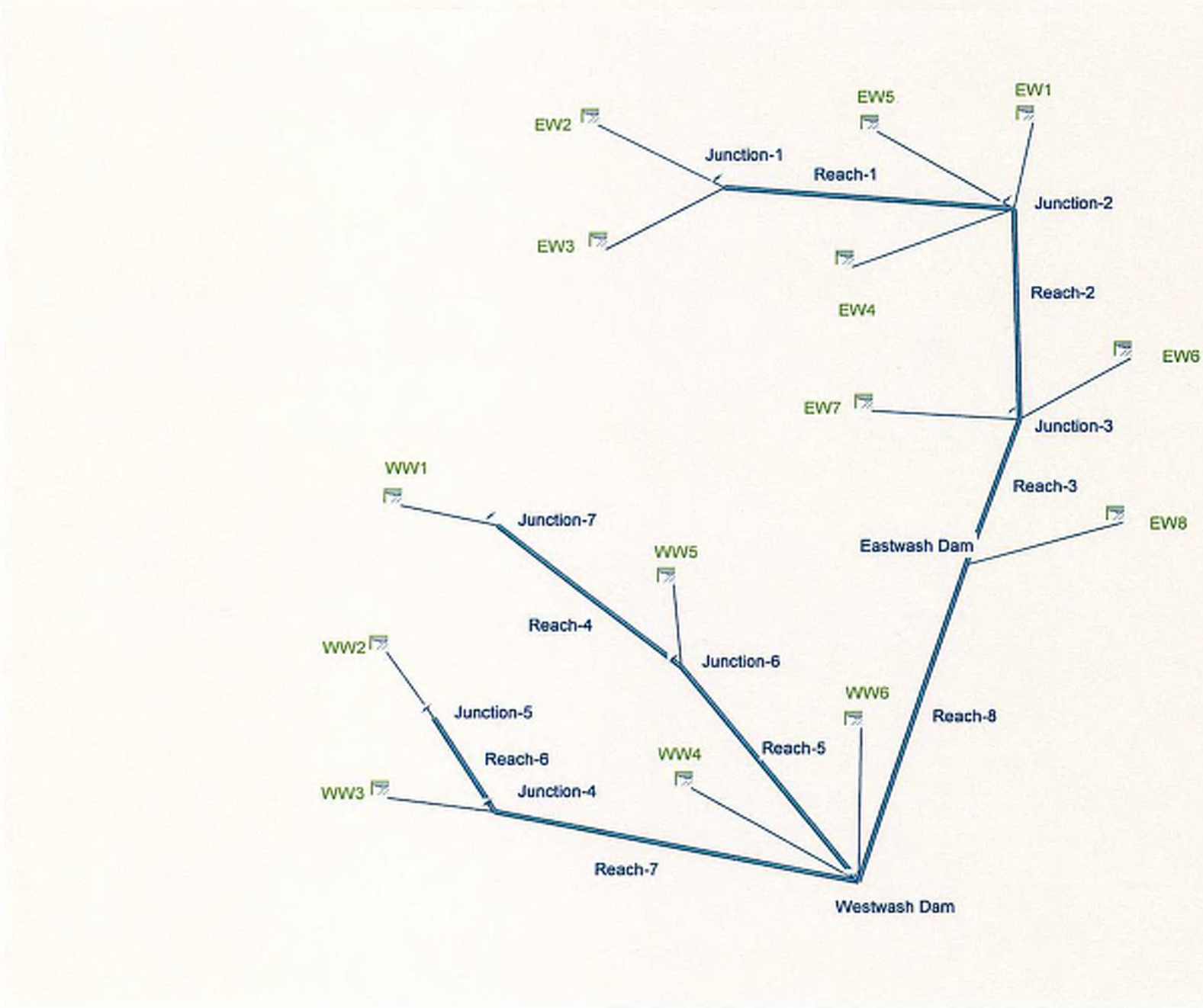


East Wash Hydrograph of 100-year, 24-hour Analysis



West Wash Hydrograph of 100-year, 24-hour Analysis

EMERGENCY SPILLWAY ANALYSIS



HMS * Summary of Results

Project : eastwestwash Run Name : Modified Spillway

Start of Run : 17Aug05 2400 Basin Model : No_Outlets_120305
End of Run : 19Aug05 1200 Met. Model : Emergency Spillway
Execution Time : 03Dec05 1516 Control Specs : Control 2

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
WW2	168.76	18 Aug 05 0320	12.967	0.099
Junction-5	168.76	18 Aug 05 0320	12.967	0.099
Reach-6	168.63	18 Aug 05 0320	12.975	0.099
WW3	745.01	18 Aug 05 0330	69.145	0.493
Junction-4	874.27	18 Aug 05 0330	82.120	0.592
Reach-7	867.54	18 Aug 05 0335	82.159	0.592
WW1	247.91	18 Aug 05 0325	20.355	0.183
Junction-7	247.91	18 Aug 05 0325	20.355	0.183
Reach-4	246.50	18 Aug 05 0325	20.354	0.183
WW5	356.67	18 Aug 05 0330	33.315	0.222
Junction-6	599.29	18 Aug 05 0330	53.669	0.405
Reach-5	595.67	18 Aug 05 0335	53.716	0.405
EW2	298.51	18 Aug 05 0325	25.543	0.209
EW3	476.75	18 Aug 05 0335	45.219	0.370
Junction-1	762.43	18 Aug 05 0330	70.762	0.579
Reach-1	757.52	18 Aug 05 0335	70.779	0.579
EW4	117.06	18 Aug 05 0325	9.8993	0.081
EW5	42.936	18 Aug 05 0320	3.4220	0.028
EW1	532.06	18 Aug 05 0330	48.397	0.396
Junction-2	1441.3	18 Aug 05 0330	132.50	1.084
Reach-2	1434.1	18 Aug 05 0335	132.59	1.084
EW7	353.07	18 Aug 05 0325	29.087	0.238
EW6	622.16	18 Aug 05 0350	70.010	0.488
Junction-3	2301.3	18 Aug 05 0335	231.68	1.810
Reach-3	2293.6	18 Aug 05 0340	231.67	1.810
EW8	412.41	18 Aug 05 0330	37.199	0.284
Eastwash Dam	2601.1	18 Aug 05 0345	257.59	2.094
Reach-8	2588.7	18 Aug 05 0345	257.68	2.094
WW4	194.99	18 Aug 05 0320	15.373	0.145
WW6	211.20	18 Aug 05 0320	17.229	0.105
Westwash Dam	1592.4	18 Aug 05 0430	353.35	3.341

HMS * Summary of Results for Eastwash Dam

Project : eastwestwash Run Name : Modified Spillway

Start of Run : 17Aug05 2400 Basin Model : No_Outlets_120305
End of Run : 19Aug05 1200 Met. Model : Emergency Spillway
Execution Time : 03Dec05 1516 Control Specs : Control 2

Computed Results

Peak Inflow : 2676.2 (cfs) Date/Time of Peak Inflow : 18 Aug 05 0340
Peak Outflow : 2601.1 (cfs) Date/Time of Peak Outflow : 18 Aug 05 0345
Total Inflow : 2.41 (in) Peak Storage : 75.004(ac-ft)
Total Outflow : 2.31 (in) Peak Elevation : 4857.9(ft)

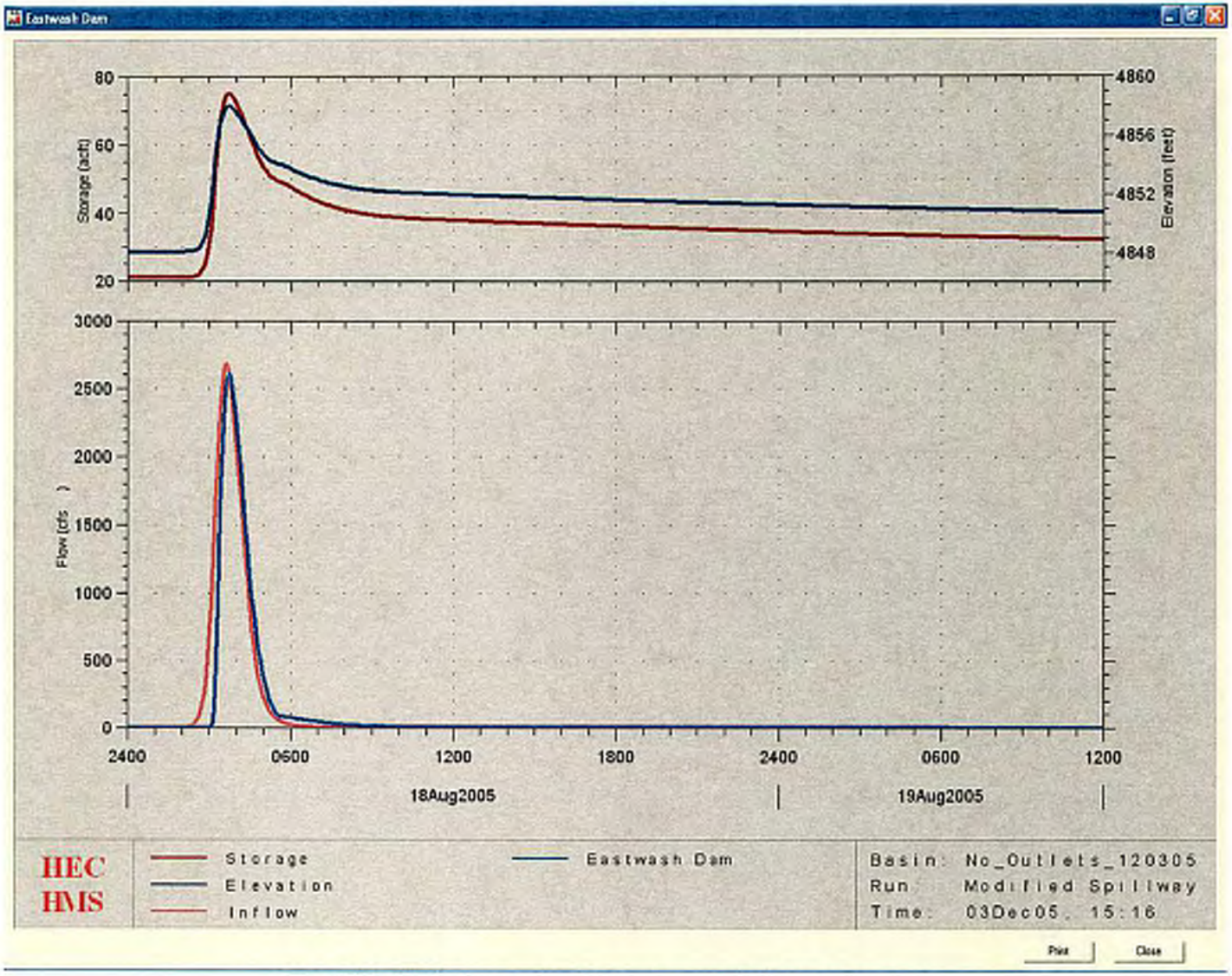
HMS * Summary of Results for Westwash Dam

Project : eastwestwash Run Name : Modified Spillway

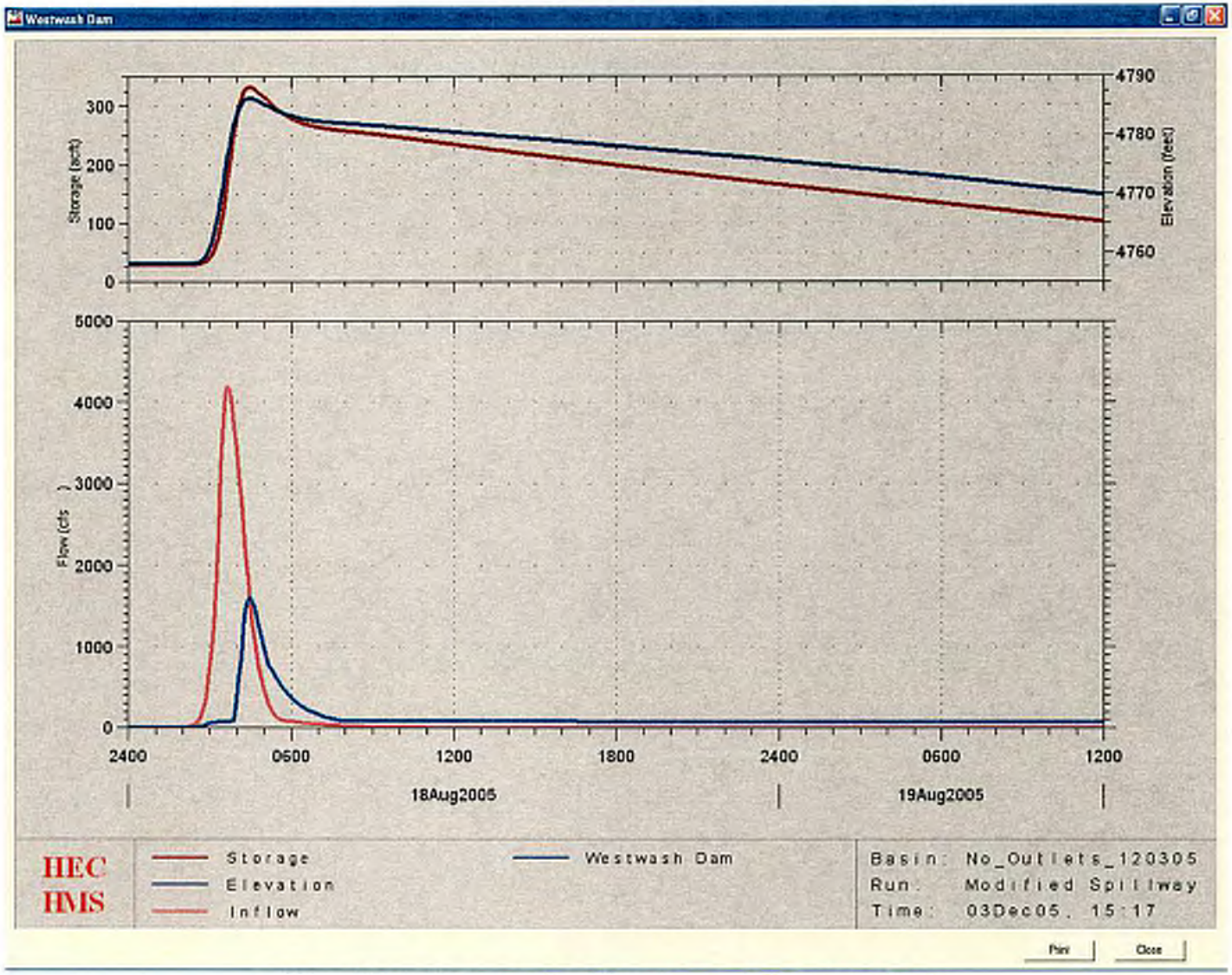
Start of Run : 17Aug05 2400 Basin Model : No_Outlets_120305
End of Run : 19Aug05 1200 Met. Model : Emergency Spillway
Execution Time : 03Dec05 1516 Control Specs : Control 2

Computed Results

Peak Inflow : 4190.1 (cfs) Date/Time of Peak Inflow : 18 Aug 05 0340
Peak Outflow : 1592.4 (cfs) Date/Time of Peak Outflow : 18 Aug 05 0430
Total Inflow : 2.39 (in) Peak Storage : 332.20(ac-ft)
Total Outflow : 1.98 (in) Peak Elevation : 4786.2(ft)

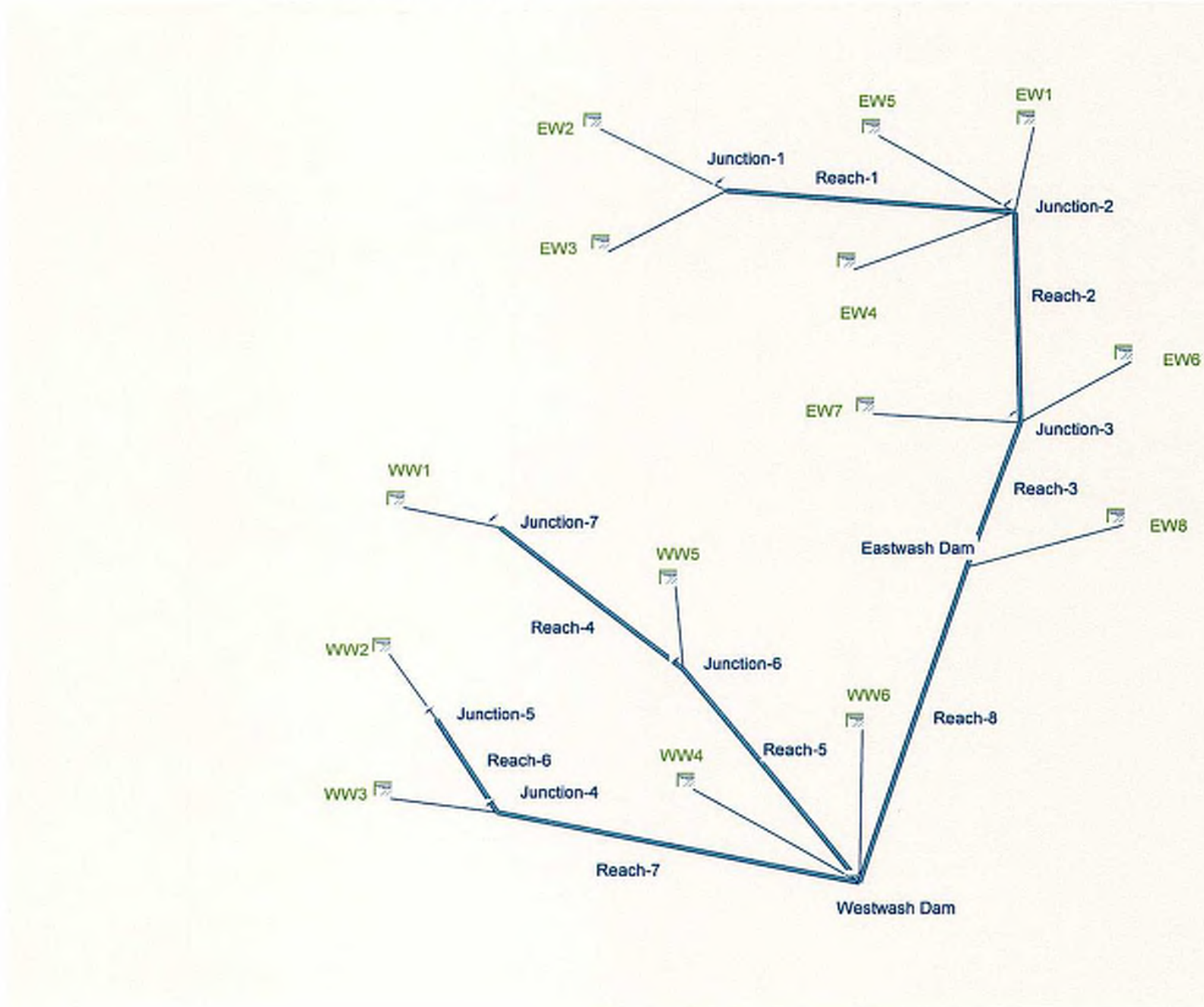


East Wash Hydrograph of Emergency Spillway Analysis



West Wash Hydrograph of Emergency Spillway Analysis

PROBABLE MAXIMUM PRECIPITATION (PMP) ANALYSIS



HMS * Summary of Results

Project : eastwestwash Run Name : ModifiedFreeboard

Start of Run : 17Aug05 2400 Basin Model : No_Outlets_120305
End of Run : 19Aug05 1200 Met. Model : Freeboard
Execution Time : 03Dec05 1431 Control Specs : Control 2

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
WW2	595.58	18 Aug 05 0305	45.962	0.099
Junction-5	595.58	18 Aug 05 0305	45.962	0.099
Reach-6	590.44	18 Aug 05 0305	45.979	0.099
WW3	2527.3	18 Aug 05 0330	237.32	0.493
Junction-4	2969.4	18 Aug 05 0325	283.30	0.592
Reach-7	2955.4	18 Aug 05 0330	283.41	0.592
WW1	932.46	18 Aug 05 0320	77.548	0.183
Junction-7	932.46	18 Aug 05 0320	77.548	0.183
Reach-4	922.69	18 Aug 05 0325	77.563	0.183
WW5	1167.8	18 Aug 05 0330	110.64	0.222
Junction-6	2073.5	18 Aug 05 0325	188.20	0.405
Reach-5	2063.4	18 Aug 05 0330	188.32	0.405
EW2	1077.1	18 Aug 05 0325	93.422	0.209
EW3	1722.0	18 Aug 05 0330	165.39	0.370
Junction-1	2761.6	18 Aug 05 0330	258.81	0.579
Reach-1	2756.3	18 Aug 05 0330	258.88	0.579
EW4	420.23	18 Aug 05 0325	36.207	0.081
EW5	153.12	18 Aug 05 0320	12.516	0.028
EW1	1925.7	18 Aug 05 0330	177.01	0.396
Junction-2	5216.2	18 Aug 05 0330	484.61	1.084
Reach-2	5181.0	18 Aug 05 0330	484.78	1.084
EW7	1274.3	18 Aug 05 0320	106.38	0.238
EW6	2095.1	18 Aug 05 0345	237.68	0.488
Junction-3	8177.0	18 Aug 05 0335	828.85	1.810
Reach-3	8168.2	18 Aug 05 0335	828.92	1.810
EW8	1436.1	18 Aug 05 0330	131.85	0.284
Eastwash Dam	9564.1	18 Aug 05 0335	949.43	2.094
Reach-8	9528.0	18 Aug 05 0335	949.74	2.094
WW4	742.15	18 Aug 05 0320	59.747	0.145
WW6	647.03	18 Aug 05 0315	54.684	0.105
Westwash Dam	14162	18 Aug 05 0345	1460.8	3.341

HMS * Summary of Results for Eastwash Dam

Project : eastwestwash Run Name : ModifiedFreeboard

Start of Run : 17Aug05 2400 Basin Model : No_Outlets_120305

End of Run : 19Aug05 1200 Met. Model : Freeboard

Execution Time : 03Dec05 1431 Control Specs : Control 2

Computed Results

Peak Inflow : 9548.6 (cfs) Date/Time of Peak Inflow : 18 Aug 05 0335

Peak Outflow : 9564.1 (cfs) Date/Time of Peak Outflow : 18 Aug 05 0335

Total Inflow : 8.60 (in) Peak Storage : 94.556(ac-ft)

Total Outflow : 8.50 (in) Peak Elevation : 4860.4(ft)

HMS * Summary of Results for Westwash Dam

Project : eastwestwash Run Name : ModifiedFreeboard

Start of Run : 17Aug05 2400 Basin Model : No_Outlets_120305

End of Run : 19Aug05 1200 Met. Model : Freeboard

Execution Time : 03Dec05 1431 Control Specs : Control 2

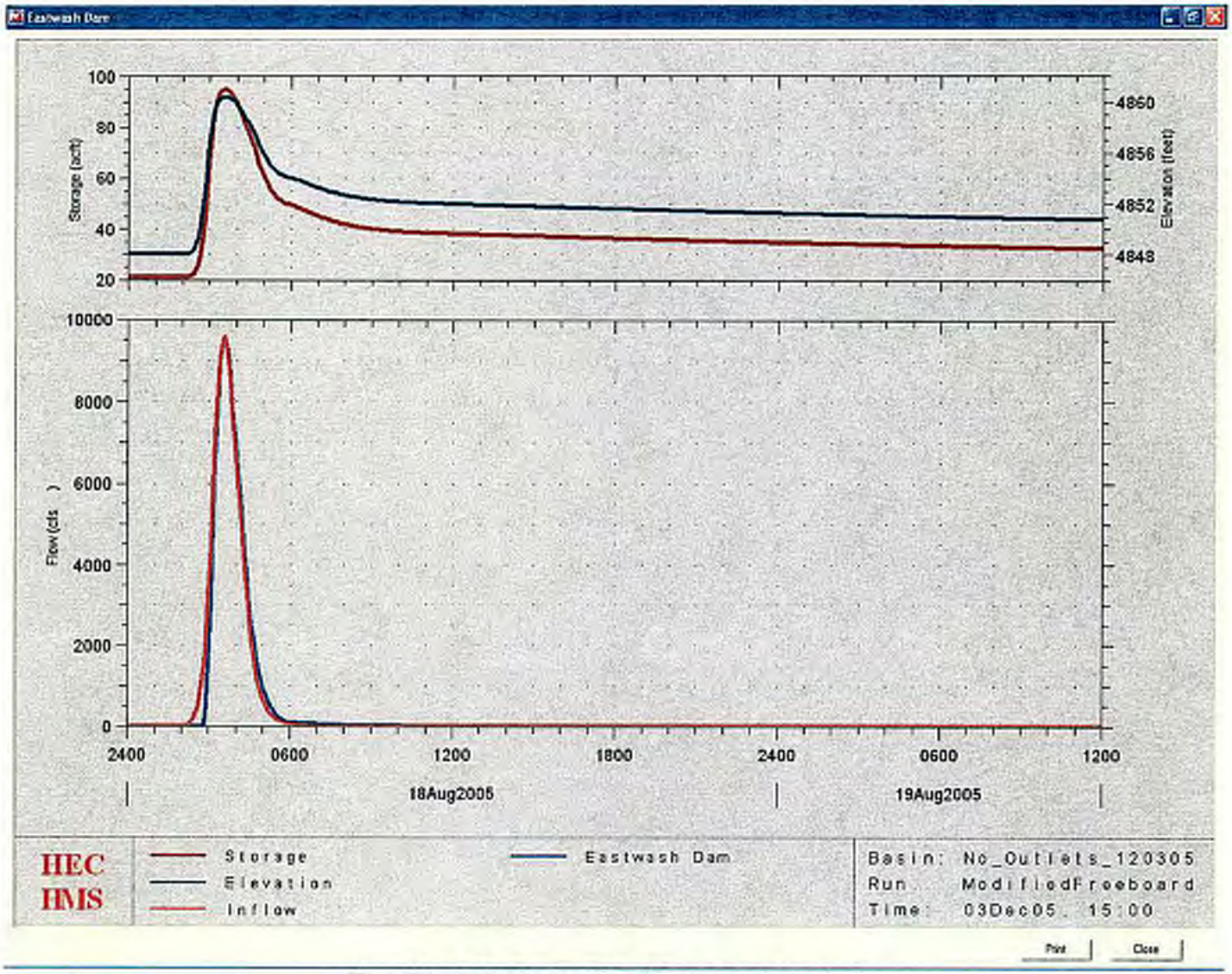
Computed Results

Peak Inflow : 15497 (cfs) Date/Time of Peak Inflow : 18 Aug 05 0330

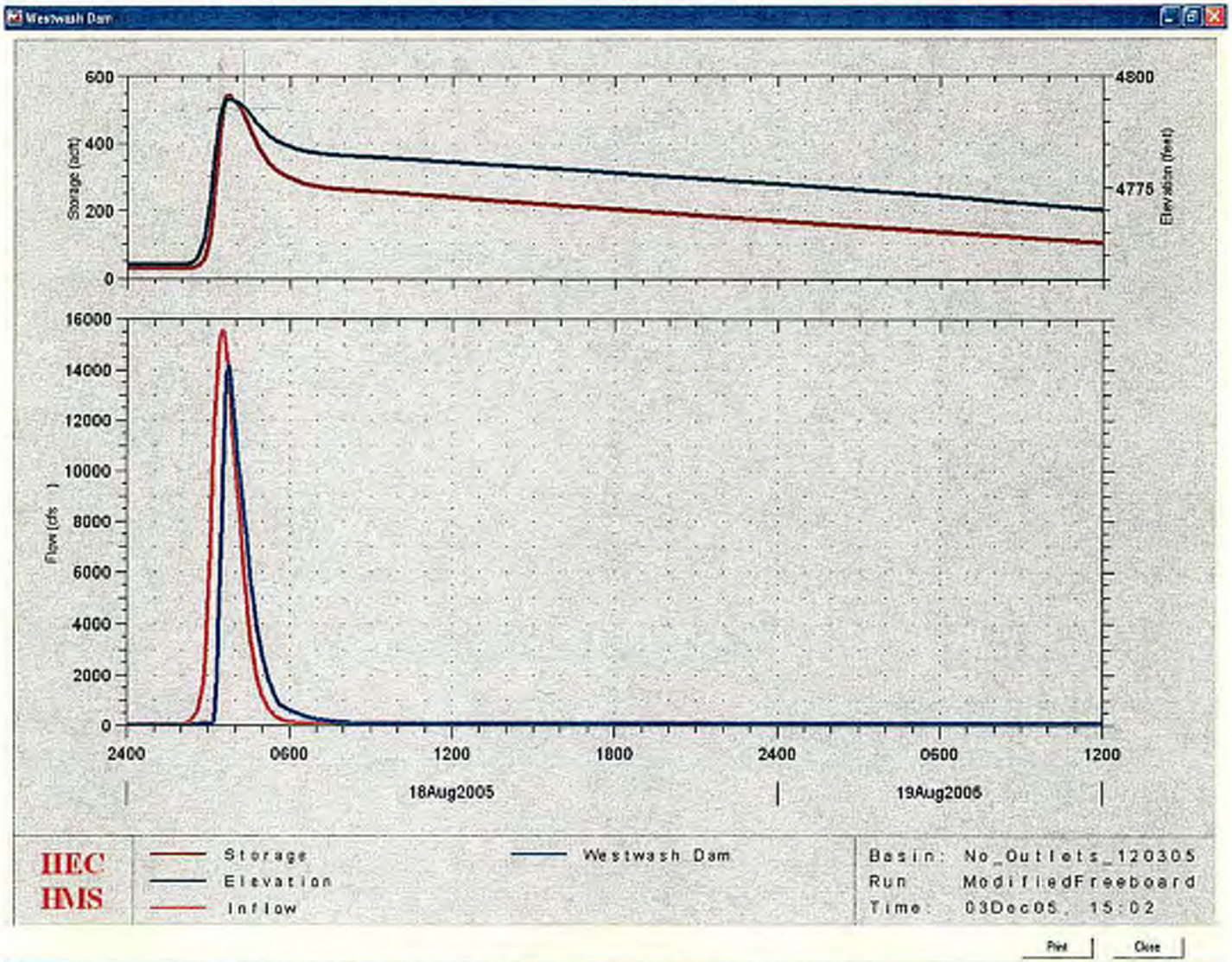
Peak Outflow : 14162 (cfs) Date/Time of Peak Outflow : 18 Aug 05 0345

Total Inflow : 8.62 (in) Peak Storage : 540.69(ac-ft)

Total Outflow : 8.20 (in) Peak Elevation : 4794.8(ft)



East Wash Hydrograph of Freeboard Analysis



West Wash Hydrograph of Freeboard Analysis

Dant Hydrology Summary and Comparison

	McCarran	Dam
Top of Road Elevation (ft)*	5009 +/-	
Emergency Spillway Crest Elevation (ft)*		4703.50
Top of Dam Elevation (ft)*		4714.00

McCarran

Structure and Storm Frequency	Storm Duration (hrs)	Precipitation (in)	Maximum Water Surface Elevation (ft)	Emergency Spillway Discharge (cfs)	Comments
100 yr- 24 hr - Original [2]	24	2.70	n/a	n/a	
100 yr - 24 hr - MACTEC HEC-HMS Model (3)	24	varies (2.95-3.22)	4945.30	n/a	
Spillway Design Flood (1/2 PMF) - Original [2]	n/a	n/a	n/a	n/a	
Spillway Design Flood (1/2 PMF) - MACTEC HEC-HMS Model [3]	6	5.59 [4]	4967.70	n/a	

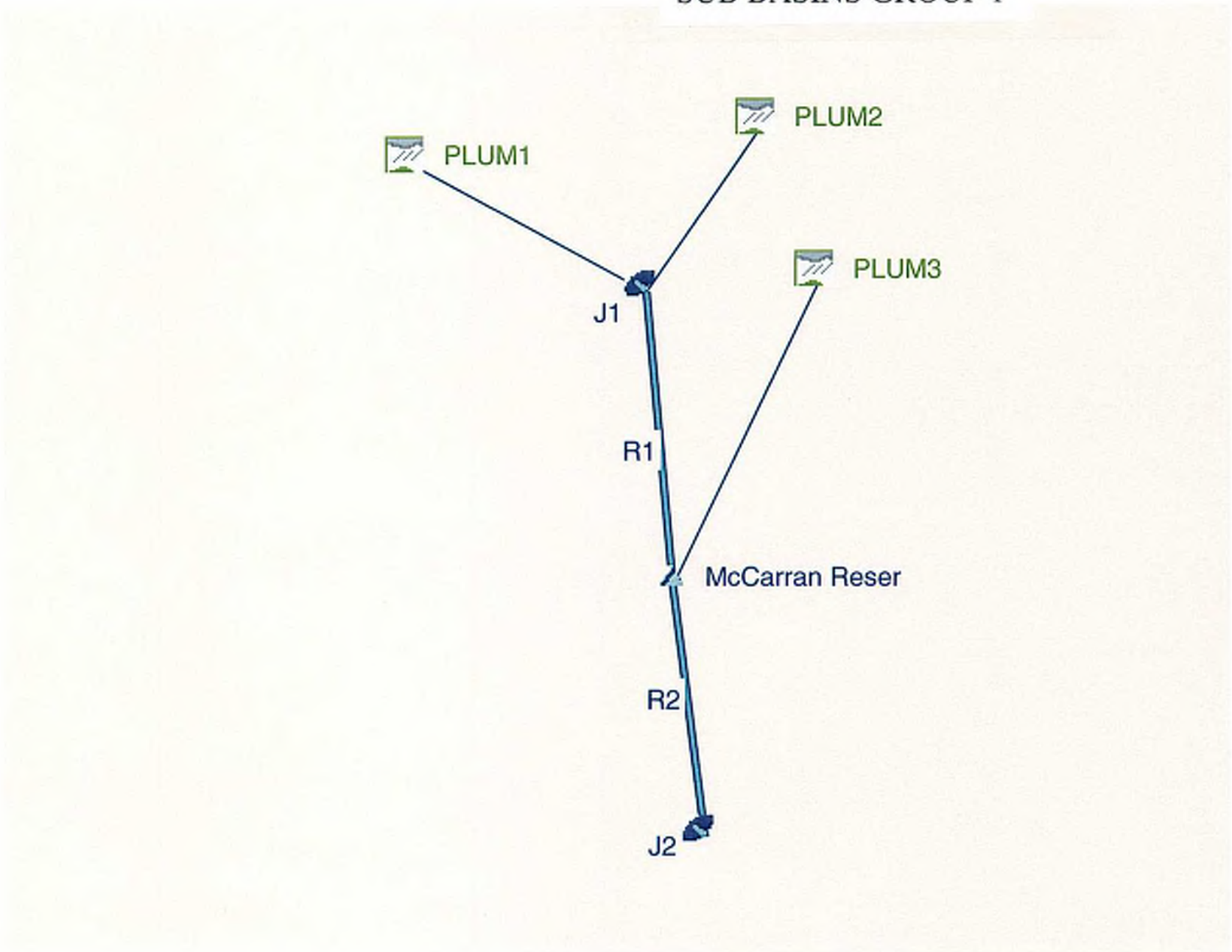
Dam

Structure and Storm Frequency	Storm Duration (hrs)	Precipitation (in)	Maximum Water Surface Elevation (ft)	Emergency Spillway Discharge (cfs)	Comments
100 yr- 24hr - Original [2]	24	2.7	4702	0	
100 yr - 24 hr - MACTEC HEC-HMS Model [3]	24	varies (2.95-3.22)	4698.20	0	The spillway design flood does not overtop the dam. The WSEL is 5.8 ft below emergency crest elevation.
Spillway Design Flood (1/2 PMF) - Original [2]	6	5.80	4710.94	1438	
Spillway Design Flood (1/2 PMF) - MACTEC HEC-HMS Model [3]	6	5.59 [4]	4711.30	1544.7	The spillway design flood does not overtop the dam. The WSEL is 2.7 ft below dam crest elevation.

[1] All elevations reported in NAVD 1988 (+4.0 feet from NAVD 1929)
[2] Design Report, Dant Boulevard Stormwater Detention Dam, Kennedy/JenksChilton, Nov 1988.
[3] This study. MACTEC, 2006
[4] Reported precipitation depth is the effective rainfall required to produce one half of full PMF produced peak water surface elevation at the dam.
[4] Reported precipitation depth is the effective rainfall required to produce one half of the peak water surface elevation at the dam resulting from a full PMF event.

100 YEAR – 24 HOUR ANALYSIS

SUB BASINS GROUP 1



HMS * Summary of Results

Project : DANTBLVD_Modified Run Name : Gr1_Latest

Start of Run : 20Jul05 0000 Basin Model : DANTMOD_010306-1

End of Run : 21Jul05 1200 Met. Model : Washoe 100 Yr-G1

Execution Time : 04Jan06 1019 Control Specs : Control 1

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	e (ac ft)	Drainage Area (sq mi)
PLUM1	200.99	20 Jul 05 1225	21.718	0.350
PLUM2	120.70	20 Jul 05 1220	11.877	0.182
J1	317.25	20 Jul 05 1220	33.594	0.532
R1	315.55	20 Jul 05 1225	33.609	0.532
PLUM3	184.87	20 Jul 05 1225	19.838	0.304
McCarran Reser	481.69	20 Jul 05 1225	53.443	0.836
R2	479.72	20 Jul 05 1230	53.474	0.836
J2	479.72	20 Jul 05 1230	53.474	0.836

01/04/06.

HMS * Summary of Results for McCarran Reser

Project : DANTBLVD_Modified Run Name : Grl_Latest

Start of Run : 20Jul05 0000 Basin Model : DANTMOD_010306-1

End of Run : 21Jul05 1200 Met. Model : Washoe 100 Yr-G1

Execution Time : 04Jan06 1019 Control Specs : Control 1

Computed Results

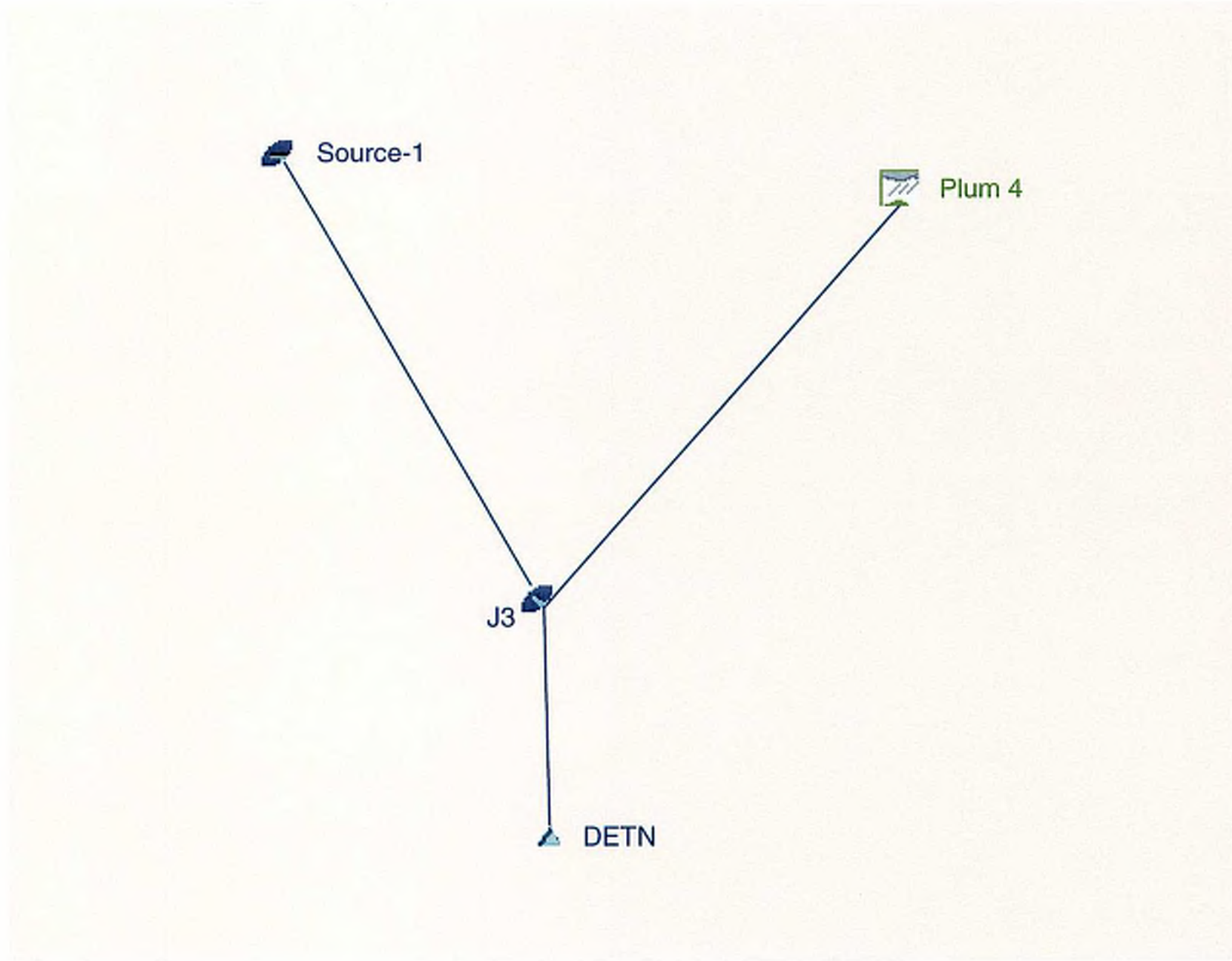
Peak Inflow : 500.42 (cfs) Date/Time of Peak Inflow : 20 Jul 05 1225

Peak Outflow : 481.69 (cfs) Date/Time of Peak Outflow : 20 Jul 05 1225

Total Inflow : 53.447 (ac-ft) Peak Storage : 2.2458(ac-ft)

Total Outflow : 53.443 (ac-ft) Peak Elevation : 4945.3(ft)

SUB BASINS GROUP 2



HMS * Summary of Results

Project : DANTBLVD_Modified Run Name : Gr3_Latest

Start of Run : 20Jul05 0000 Basin Model : DANTMOD_010306-3

End of Run : 21Jul05 1200 Met. Model : Washoe 100 Yr-G2

Execution Time : 04Jan06 1154 Control Specs : Control 1

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	e (ac ft)	Drainage Area (sq mi)
Source-1	479.72	20 Jul 05 1230	53.474	0.836
Plum 4	102.99	20 Jul 05 1235	13.968	0.299
J3	577.01	20 Jul 05 1230	67.442	1.135
DETN	91.521	20 Jul 05 1325	67.506	1.135

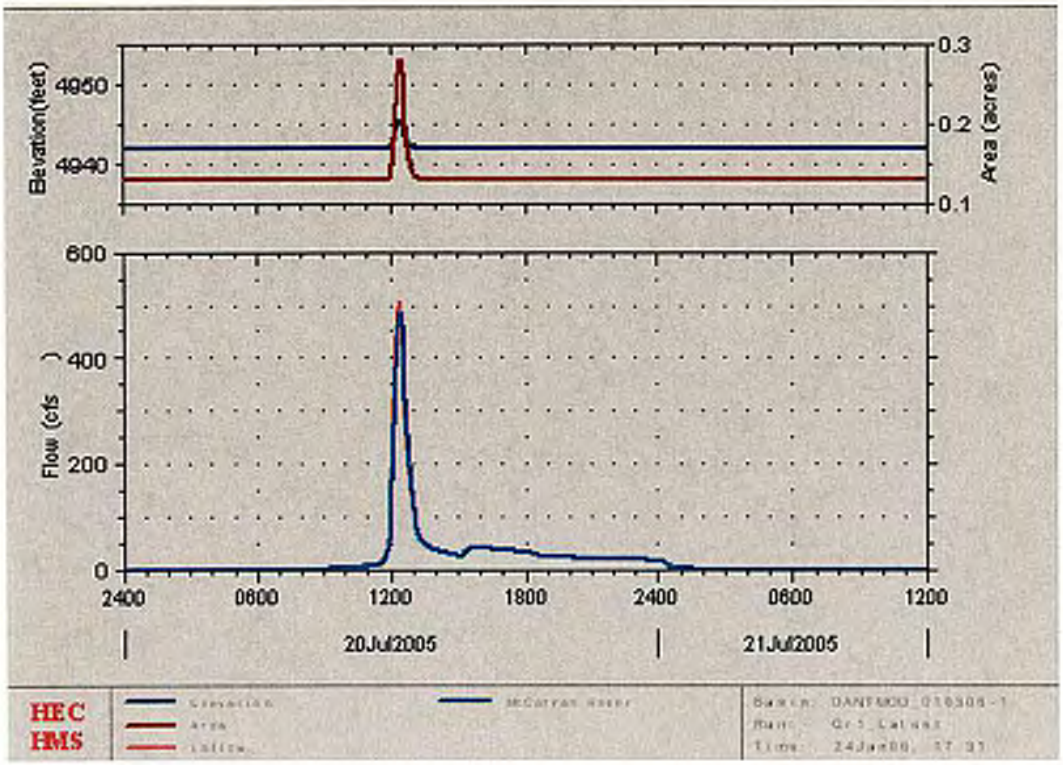
HMS * Summary of Results for DETN

Project : DANTBLVD_Modified Run Name : Gr3_Latest

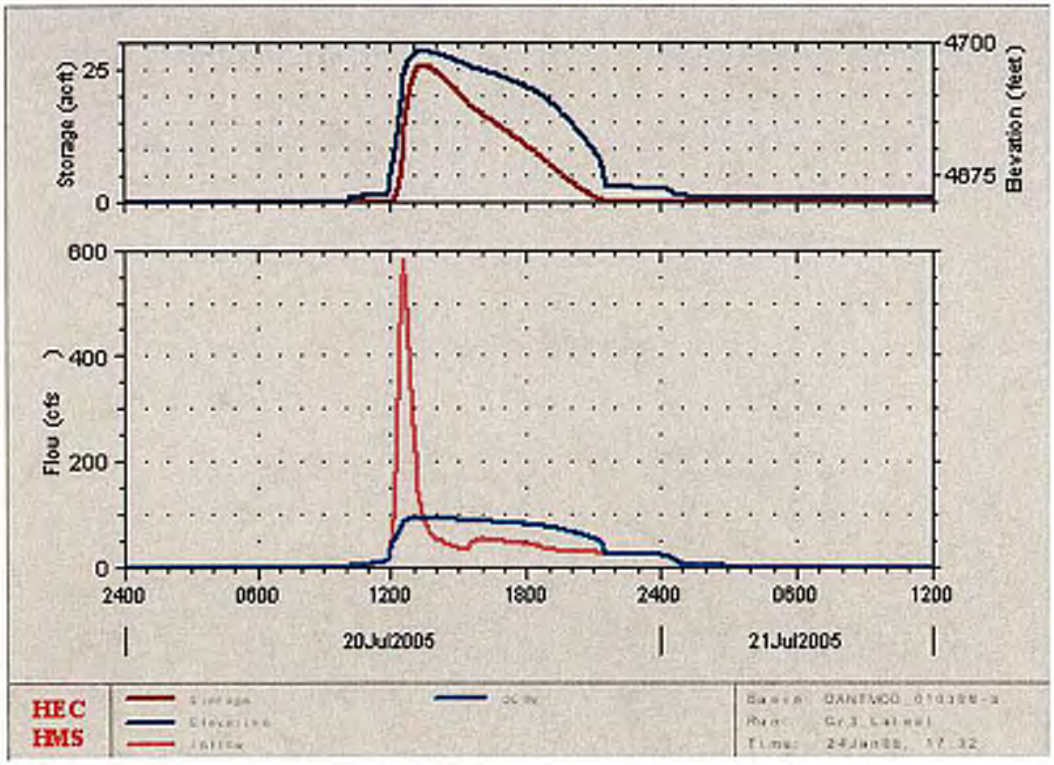
Start of Run	: 20Jul05 0000	Basin Model	: DANTMOD_010306-3
End of Run	: 21Jul05 1200	Met. Model	: Washoe 100 Yr-G2
Execution Time	: 04Jan06 1154	Control Specs	: Control 1

Computed Results

Peak Inflow	: 577.01 (cfs)	Date/Time of Peak Inflow	: 20 Jul 05 1230
Peak Outflow	: 91.521 (cfs)	Date/Time of Peak Outflow	: 20 Jul 05 1325
Total Inflow	: 67.442 (ac-ft)	Peak Storage	: 25.479(ac-ft)
Total Outflow	: 67.506 (ac-ft)	Peak Elevation	: 4698.2(ft)

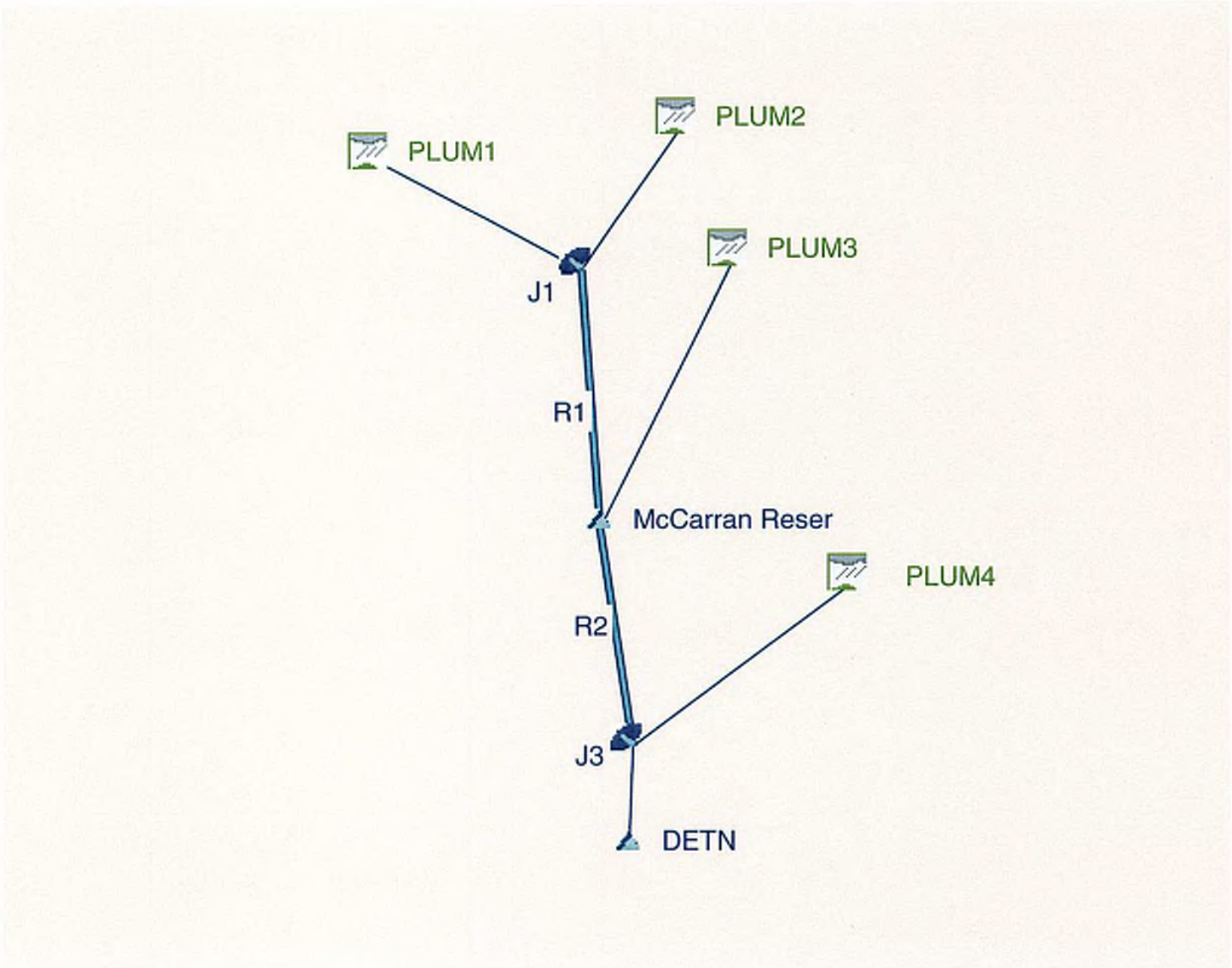


100 Year 24 Hour Hydrograph at McCarran Boulevard Reservoir



100 Year 24 Hour Hydrograph at Dant Boulevard Detention Dam

EMERGENCY SPILLWAY ANALYSIS



HMS * Summary of Results

Project : DANTBLVD_Modified Run Name : Final_Emergency

Start of Run : 20Jul05 0000 Basin Model : DANTMOD_010306

End of Run : 21Jul05 1200 Met. Model : Emergency Spillway

Execution Time : 24Jan06 1715 Control Specs : Control 1

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	e (ac ft)	Drainage Area (sq mi)
PLUM1	487.99	20 Jul 05 0330	39.251	0.350
PLUM2	272.16	20 Jul 05 0325	21.205	0.182
J1	757.09	20 Jul 05 0330	60.456	0.532
R1	755.02	20 Jul 05 0330	60.483	0.532
PLUM3	438.78	20 Jul 05 0330	35.401	0.304
McCarran Reser	1130.3	20 Jul 05 0335	95.878	0.836
R2	1128.9	20 Jul 05 0340	95.902	0.836
PLUM4	329.43	20 Jul 05 0340	31.043	0.299
J3	1458.4	20 Jul 05 0340	126.95	1.135
DETN	987.18	20 Jul 05 0405	126.90	1.135

HMS * Summary of Results for McCarran

Reser

Project : DANTBLVD_Modified Run Name :

Final_Emergency

Start of Run : 20Jul05 0000 Basin Model : DANTMOD_010306

End of Run : 21Jul05 1200 Met. Model : Emergency Spillway

Execution Time : 24Jan06 1715 Control Specs : Control 1

Computed Results

Peak Inflow	: 1193.8 (cfs)	Date/Time of Peak Inflow	: 20 Jul 05 0330
Peak Outflow	: 1130.3 (cfs)	Date/Time of Peak Outflow	: 20 Jul 05 0335
Total Inflow	: 95.884 (ac-ft)	Peak Storage	: 7.6474(ac-ft)
Total Outflow	: 95.878 (ac-ft)	Peak Elevation	: 4960.8(ft)

HMS * Summary of Results for DETN

Project : DANTBLVD_Modified Run Name : Final_Emergency

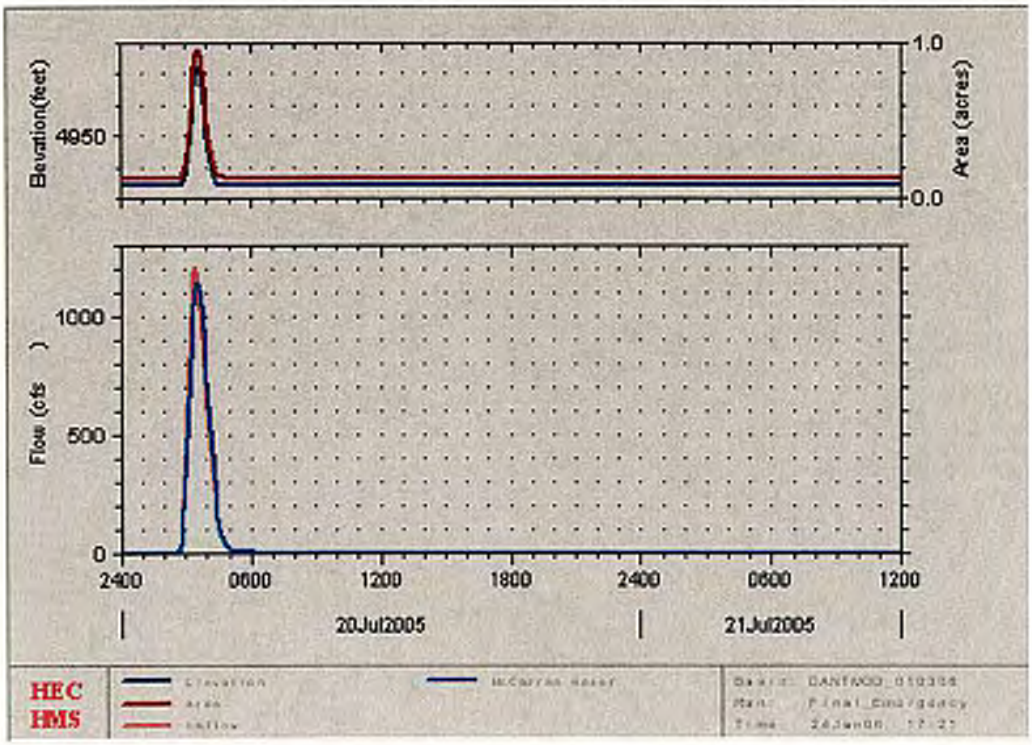
Start of Run : 20Jul05 0000 Basin Model : DANTMOD_010306

End of Run : 21Jul05 1200 Met. Model : Emergency Spillway

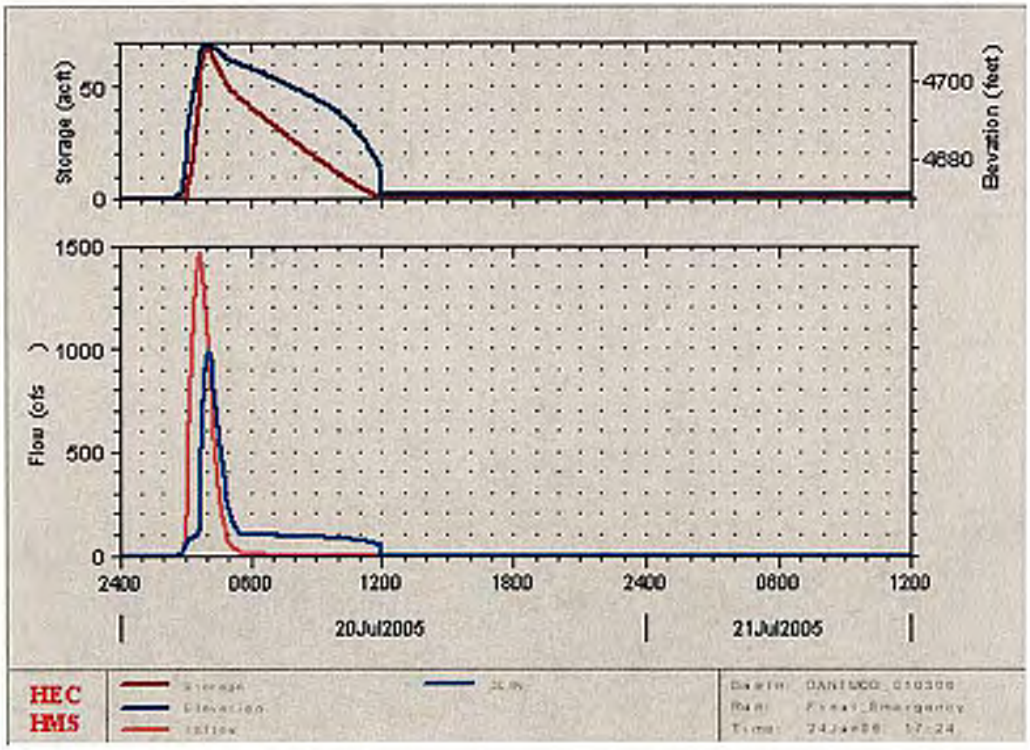
Execution Time : 24Jan06 1715 Control Specs : Control 1

Computed Results

Peak Inflow	: 1458.4 (cfs)	Date/Time of Peak Inflow	: 20 Jul 05 0340
Peak Outflow	: 987.18 (cfs)	Date/Time of Peak Outflow	: 20 Jul 05 0405
Total Inflow	: 126.95 (ac-ft)	Peak Storage	: 66.494(ac-ft)
Total Outflow	: 126.90 (ac-ft)	Peak Elevation	: 4709.3(ft)

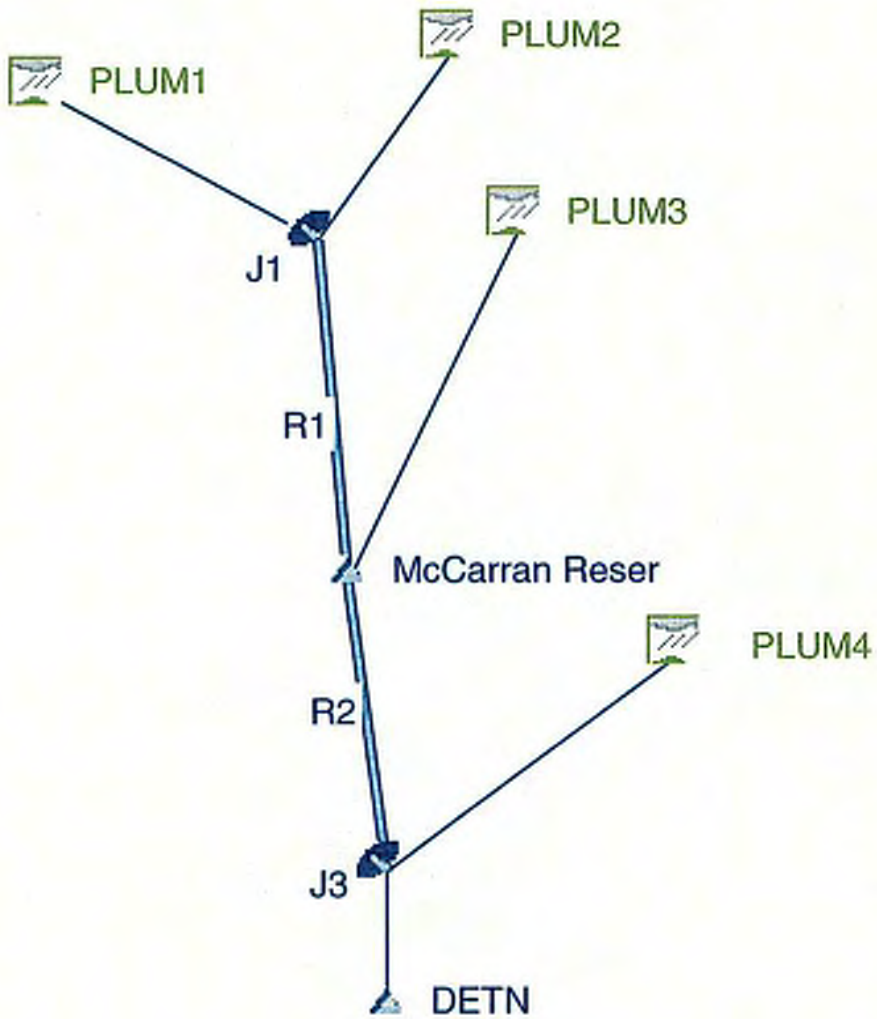


Emergency Spillway Hydrographs at McCarran Reservoir



Emergency Spillway Hydrograph at Dant Boulevard Detention Dam

½ PROBABLE MAXIMUM PRECIPITATION (1/2 PMP) ANALYSIS



11/29/05.

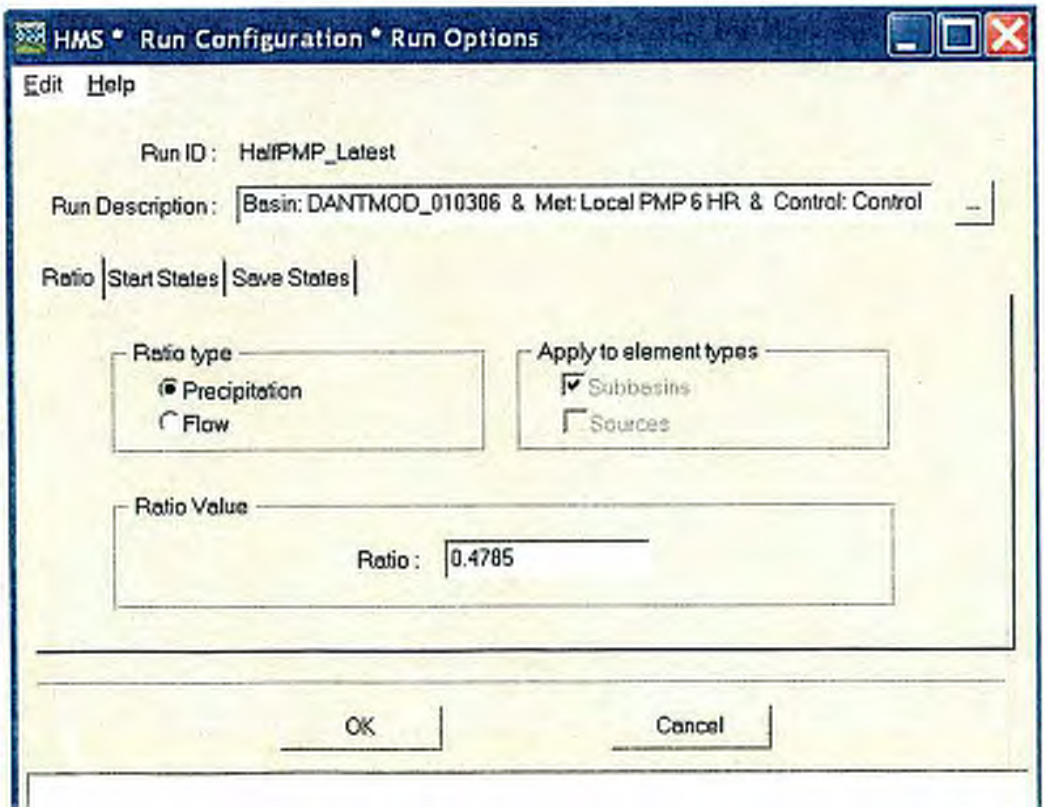
HMS * Summary of Results

Project : DANTBLVD_Modified Run Name : HalfPMP_Latest

Start of Run : 20Jul05 0000 Basin Model : DANTMOD_010306
End of Run : 21Jul05 1200 Met. Model : Local PMP 6 HR
Execution Time : 04Jan06 1347 Control Specs : Control 1

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	e (ac ft)	Drainage Area (sq mi)
PLUM1	679.18	20 Jul 05 0330	55.671	0.350
PLUM2	377.12	20 Jul 05 0325	29.860	0.182
J1	1050.6	20 Jul 05 0325	85.531	0.532
R1	1048.6	20 Jul 05 0330	85.593	0.532
PLUM3	606.17	20 Jul 05 0330	49.876	0.304
McCarran Reser	1313.9	20 Jul 05 0345	135.47	0.836
R2	1311.5	20 Jul 05 0350	135.44	0.836
PLUM4	469.43	20 Jul 05 0340	44.614	0.299
J3	1774.6	20 Jul 05 0345	180.05	1.135
DETN	1544.7	20 Jul 05 0410	180.14	1.135

PRECIPITATION RATIO USED TO GET HALF PMF FLOW.



01/04/06

HMS * Summary of Results for McCarran Reser

Project : DANTBLVD_Modified Run Name : HalfPMP_Latest

Start of Run	: 20Jul05 0000	Basin Model	: DANTMOD_010306
End of Run	: 21Jul05 1200	Met. Model	: Local PMP 6 HR
Execution Time	: 04Jan06 1347	Control Specs	: Control 1

Computed Results

Peak Inflow	: 1654.8 (cfs)	Date/Time of Peak Inflow	: 20 Jul 05 0330
Peak Outflow	: 1313.9 (cfs)	Date/Time of Peak Outflow	: 20 Jul 05 0345
Total Inflow	: 135.47 (ac-ft)	Peak Storage	: 18.621(ac-ft)
Total Outflow	: 135.47 (ac-ft)	Peak Elevation	: 4967.5(ft)

HMS * Summary of Results for DETN

Project : DANTBLVD_Modified Run Name : HalfPMP_Latest

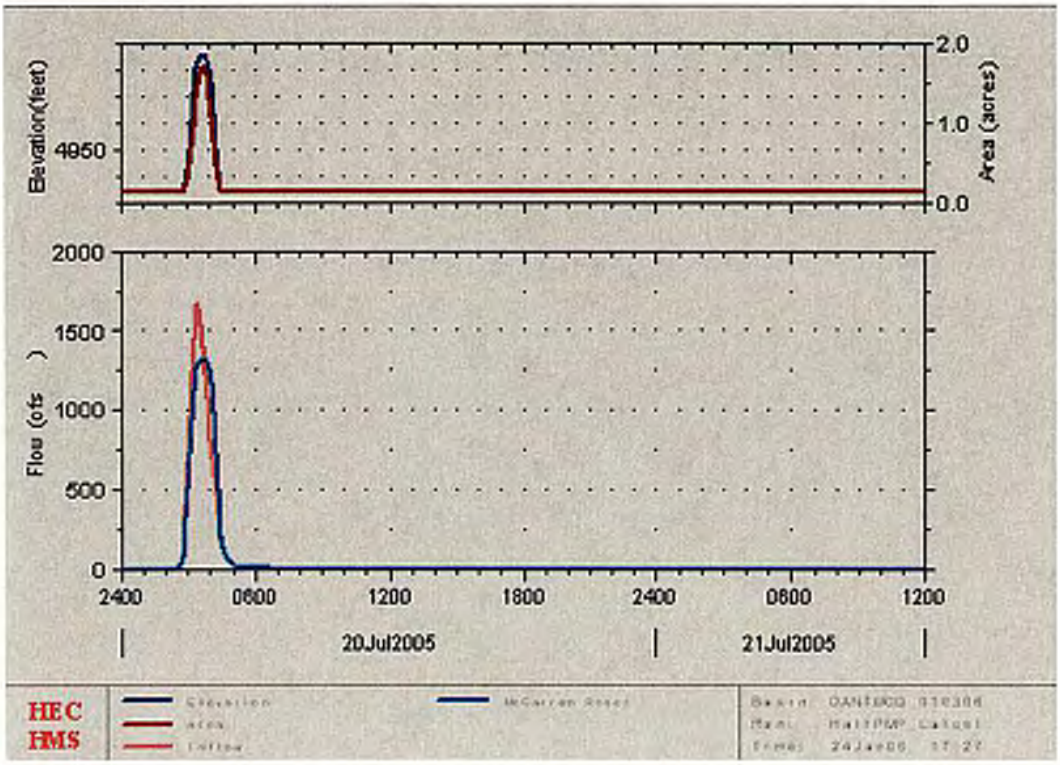
Start of Run : 20Jul05 0000 Basin Model : DANTMOD_010306

End of Run : 21Jul05 1200 Met. Model : Local PMP 6 HR

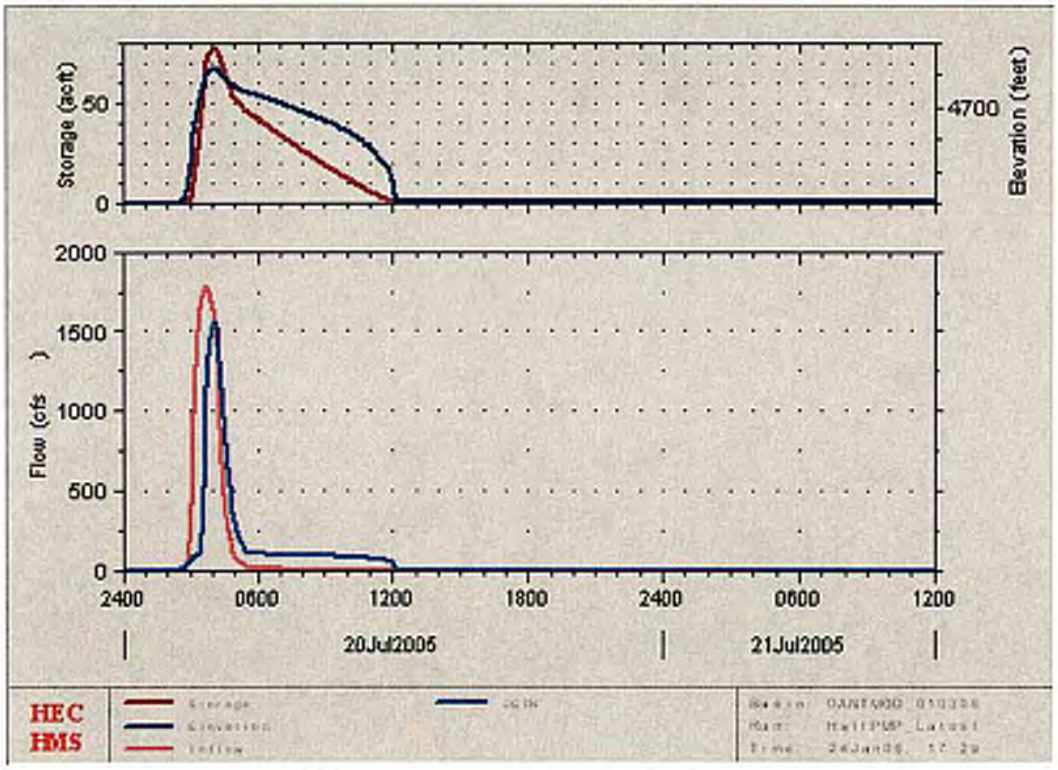
Execution Time : 04Jan06 1347 Control Specs : Control 1

Computed Results

Peak Inflow	: 1774.6 (cfs)	Date/Time of Peak Inflow	: 20 Jul 05 0345
Peak Outflow	: 1544.7 (cfs)	Date/Time of Peak Outflow	: 20 Jul 05 0410
Total Inflow	: 180.05 (ac-ft)	Peak Storage	: 76.394(ac-ft)
Total Outflow	: 180.14 (ac-ft)	Peak Elevation	: 4711.3(ft)



½ PMF Hydrograph at McCarran Boulevard Reservoir



½ PMF Hydrograph at Dant Boulevard Detention Dam

Appendix C Sensitive Species Supporting Information

NEVADA
DIVISION OF
NATURAL HERITAGE

STATE OF NEVADA
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
Division of Natural Heritage

Steve Sisolak
Governor

Bradley Crowell
Director

Kristin Szabo
Administrator

25 March 2021

Vicki Thill
EM Strategies, Inc.
1651 Meadow Wood Lane
Reno, NV 89502

RE: Data request received 23 March 2021

Dear Ms. Thill:

We are pleased to provide the information you requested on endangered, threatened, candidate, and/or At Risk plant and animal taxa recorded within or near the West Wash Dam Project area in Washoe County. We searched our database and maps for the following, a 2-kilometer radius around shapefiles provided, including:

Township 19N	Range 19E	Sections 03 and 04
Township 20N	Range 19E	Sections 33 and 34

There are no at-risk taxa recorded within the given area. However, habitat may be available for: the Golden Eagle, *Aquila chrysaetos*, a Nevada Bureau of Land Management (BLM) Sensitive Species; the northern rubber boa, *Charina bottae*, a Nevada BLM Sensitive Species; and the spotted bat, *Euderma maculatum*, a Nevada BLM Sensitive Species. The Nevada Department of Wildlife (NDOW) manages, protects, and restores Nevada's wildlife resources and associated habitat. Please contact Jinna Larkin, NDOW GIS Coordinator (775) 688-1580 to obtain further information regarding wildlife resources within and near your area of interest. Removal or destruction of state protected flora species requires a special permit from Nevada Division of Forestry (NRS 527.270).

Please note that our data are dependent on the research and observations of many individuals and organizations and in most cases are not the result of comprehensive or site-specific field surveys. Natural Heritage reports should never be regarded as final statements on the taxa or areas being considered, nor should they be substituted for on-site surveys required for environmental assessments.

Thank you for checking with our program. Please contact us for additional information or further assistance.

Sincerely,

Eric S. Miskow
Biologist/Data Manager

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Reno Fish And Wildlife Office
1340 Financial Boulevard, Suite 234
Reno, NV 89502-7147
Phone: (775) 861-6300 Fax: (775) 861-6301
http://www.fws.gov/reno/

In Reply Refer To:
Consultation Code: 08ENVD00-2021-SLI-0241
Event Code: 08ENVD00-2021-E-00791
Project Name: West Wash Dam

April 12, 2021

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The attached species list indicates threatened, endangered, proposed, and candidate species and designated or proposed critical habitat that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act of 1973, as amended (ESA, 16 U.S.C. 1531 *et seq*.), for projects that are authorized, funded, or carried out by a Federal agency. Candidate species have no protection under the ESA but are included for consideration because they could be listed prior to the completion of your project. Consideration of these species during project planning may assist species conservation efforts and may prevent the need for future listing actions. For additional information regarding species that may be found in the proposed project area, visit http://www.fws.gov/nevada/es/ipac.html.

The purpose of the ESA is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the ESA and its implementing regulations (50 CFR 402 *et seq*.), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2) (c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or

designated or proposed critical habitat. Guidelines for preparing a Biological Assessment can be found at: http://www.fws.gov/midwest/endangered/section7/ba_guide.html.

If a Federal action agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species, and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at: http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF.

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this species list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally listed, proposed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the ESA, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally, as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation, for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the attached list.

The Nevada Fish and Wildlife Office (NFWO) no longer provides species of concern lists. Most of these species for which we have concern are also on the Animal and Plant At-Risk Tracking List for Nevada (At-Risk list) maintained by the State of Nevada’s Natural Heritage Program (Heritage). Instead of maintaining our own list, we adopted Heritage's At-Risk list and are partnering with them to provide distribution data and information on the conservation needs for at-risk species to agencies or project proponents. The mission of Heritage is to continually evaluate the conservation priorities of native plants, animals, and their habitats, particularly those most vulnerable to extinction or in serious decline. In addition, in order to avoid future conflicts, we ask that you consider these at-risk species early in your project planning and explore management alternatives that provide for their long-term conservation.

For a list of at-risk species by county, visit Heritage's website (http://heritage.nv.gov). For a specific list of at-risk species that may occur in the project area, you can obtain a data request form from the website (http://heritage.nv.gov/get_data) or by contacting the Administrator of Heritage at 901 South Stewart Street, Suite 5002, Carson City, Nevada 89701-5245, (775) 684-2900. Please indicate on the form that your request is being obtained as part of your coordination with the Service under the ESA. During your project analysis, if you obtain new information or data for any Nevada sensitive species, we request that you provide the information to Heritage at the above address.

Furthermore, certain species of fish and wildlife are classified as protected by the State of Nevada (http://www.leg.state.nv.us/NAC/NAC-503.html). You must first obtain the appropriate license, permit, or written authorization from the Nevada Department of Wildlife (NDOW) to

take, or possess any parts of protected fish and wildlife species. Please visit http://www.ndow.org or contact NDOW in northern Nevada (775) 688-1500, in southern Nevada (702) 486-5127, or in eastern Nevada (775) 777-2300.

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq*.), and projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/eagle_guidance.html). Additionally, wind energy projects should follow the Service's wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

The Service's Pacific Southwest Region developed the *Interim Guidelines for the Development of a Project Specific Avian and Bat Protection Plan for Wind Energy Facilities* (Interim Guidelines). This document provides energy facility developers with a tool for assessing the risk of potential impacts to wildlife resources and delineates how best to design and operate a bird- and bat-friendly wind facility. These Interim Guidelines are available upon request from the NFWO. The intent of a Bird and Bat Conservation Strategy is to conserve wildlife resources while supporting project developers through: (1) establishing project development in an adaptive management framework; (2) identifying proper siting and project design strategies; (3) designing and implementing pre-construction surveys; (4) implementing appropriate conservation measures for each development phase; (5) designing and implementing appropriate post-construction monitoring strategies; (6) using post-construction studies to better understand the dynamics of mortality reduction (*e.g.*, changes in blade cut-in speed, assessments of blade "feathering" success, and studies on the effects of visual and acoustic deterrents) including efforts tied into Before-After/Control-Impact analysis; and (7) conducting a thorough risk assessment and validation leading to adjustments in management and mitigation actions.

The template and recommendations set forth in the Interim Guidelines were based upon the Avian Powerline Interaction Committee's Avian Protection Plan template (http://www.aplic.org/) developed for electric utilities and modified accordingly to address the unique concerns of wind energy facilities. These recommendations are also consistent with the Service's wind energy guidelines. We recommend contacting us as early as possible in the planning process to discuss the need and process for developing a site-specific Bird and Bat Conservation Strategy.

The Service has also developed guidance regarding wind power development in relation to prairie grouse leks (sage-grouse are included in this). This document can be found at: http://www.fws.gov/southwest/es/Oklahoma/documents/te_species/wind%20power/prairie%20grouse%20lek%205%20mile%20public.pdf.

Migratory Birds are a Service Trust Resource. Based on the Service's conservation responsibilities and management authority for migratory birds under the Migratory Bird Treaty Act of 1918, as amended (MBTA; 16 U.S.C. 703 *et seq*.), we recommend that any land clearing or other surface disturbance associated with proposed actions within the project area be timed to avoid potential destruction of bird nests or young, or birds that breed in the area. Such destruction may be in violation of the MBTA. Under the MBTA, nests with eggs or young of migratory birds may not be harmed, nor may migratory birds be killed. Therefore, we recommend land clearing be conducted outside the avian breeding season. If this is not feasible,

we recommend a qualified biologist survey the area prior to land clearing. If nests are located, or if other evidence of nesting (*i.e.*, mated pairs, territorial defense, carrying nesting material, transporting food) is observed, a protective buffer (the size depending on the habitat requirements of the species) should be delineated and the entire area avoided to prevent destruction or disturbance to nests until they are no longer active.

Guidance for minimizing impacts to migratory birds for projects involving communications towers (*e.g.*, cellular, digital television, radio, and emergency broadcast) can be found at: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm; http://www.towerkill.com; and http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html.

If wetlands, springs, or streams are are known to occur in the project area or are present in the vicinity of the project area, we ask that you be aware of potential impacts project activities may have on these habitats. Discharge of fill material into wetlands or waters of the United States is regulated by the U.S. Army Corps of Engineers (ACOE) pursuant to section 404 of the Clean Water Act of 1972, as amended. We recommend you contact the ACOE's Regulatory Section regarding the possible need for a permit. For projects located in northern Nevada (Carson City, Churchill, Douglas, Elko, Esmeralda, Eureka, Humboldt, Lander, Lyon, Mineral, Pershing, Storey, and Washoe Counties) contact the Reno Regulatory Office at 300 Booth Street, Room 3060, Reno, Nevada 89509, (775) 784-5304; in southern Nevada (Clark, Lincoln, Nye, and White Pine Counties) contact the St. George Regulatory Office at 321 North Mall Drive, Suite L-101, St. George, Utah 84790-7314, (435) 986-3979; or in California along the eastern Sierra contact the Sacramento Regulatory Office at 650 Capitol Mall, Suite 5-200, Sacramento, California 95814, (916) 557-5250.

We appreciate your concern for threatened and endangered species. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

The table below outlines lead FWS field offices by county and land ownership/project type. Please refer to this table when you are ready to coordinate (including requests for section 7 consultation) with the field office corresponding to your project, and send any documentation regarding your project to that corresponding office. Therefore, the lead FWS field office may not be the office listed above in the letterhead.

Lead FWS offices by County and Ownership/Program

County	Ownership/Program	Species	Office Lead*
Alameda	Tidal wetlands/marsh adjacent to Bays	Salt marsh species, delta smelt	BDFWO
Alameda	All ownerships but tidal/estuarine	All	SFWO
Alpine	Humboldt Toiyabe National Forest	All	RFWO

Alpine	Lake Tahoe Basin Management Unit	All	RFWO
Alpine	Stanislaus National Forest	All	SFWO
Alpine	El Dorado National Forest	All	SFWO
Colusa	Mendocino National Forest	All	AFWO
Colusa	Other	All	By jurisdiction (see map)
Contra Costa	Legal Delta (Excluding ECCHCP)	All	BDFWO
Contra Costa	Antioch Dunes NWR	All	BDFWO
Contra Costa	Tidal wetlands/marsh adjacent to Bays	Salt marsh species, delta smelt	BDFWO
Contra Costa	All ownerships but tidal/estuarine	All	SFWO
Del Norte	All	All	AFWO
El Dorado	El Dorado National Forest	All	SFWO
El Dorado	LakeTahoe Basin Management Unit		RFWO
Glenn	Mendocino National Forest	All	AFWO
Glenn	Other	All	By jurisdiction (see map)
Humboldt	All except Shasta Trinity National Forest	All	AFWO
Humboldt	Shasta Trinity National Forest	All	YFWO
Lake	Mendocino National Forest	All	AFWO
Lake	Other	All	By jurisdiction (see map)
Lassen	Modoc National Forest	All	KFWO
Lassen	Lassen National Forest	All	SFWO
Lassen	Toiyabe National Forest	All	RFWO
Lassen	BLM Surprise and Eagle Lake Resource Areas	All	RFWO

Lassen	BLM Alturas Resource Area	All	KFWO
Lassen	Lassen Volcanic National Park	All (includes Eagle Lake trout on all ownerships)	SFWO
Lassen	All other ownerships	All	By jurisdiction (see map)
Marin	Tidal wetlands/marsh adjacent to Bays	Salt marsh species, delta smelt	BDFWO
Marin	All ownerships but tidal/estuarine	All	SFWO
Mendocino	Russian River watershed	All	SFWO
Mendocino	All except Russian River watershed	All	AFWO
Modoc	Modoc National Forest	All	KFWO
Modoc	BLM Alturas Resource Area	All	KFWO
Modoc	Klamath Basin National Wildlife Refuge Complex	All	KFWO
Modoc	BLM Surprise and Eagle Lake Resource Areas	All	RFWO
Modoc	All other ownerships	All	By jurisdiction (See map)
Mono	Inyo National Forest	All	RFWO
Mono	Humboldt Toiyabe National Forest	All	RFWO
	All ownerships but tidal/estuarine	All	SFWO
Napa			
Napa	Tidal wetlands/marsh adjacent to San Pablo Bay	Salt marsh species, delta smelt	BDFWO
Nevada	Humboldt Toiyabe National Forest	All	RFWO
Nevada	All other ownerships	All	By jurisdiction (See map)

Placer	Lake Tahoe Basin Management Unit	All	RFWO
Placer	All other ownerships	All	SFWO
Sacramento	Legal Delta	Delta Smelt	BDFWO
Sacramento	Other	All	By jurisdiction (see map)
San Francisco	Tidal wetlands/marsh adjacent to San Francisco Bay	Salt marsh species, delta smelt	BDFWO
San Francisco	All ownerships but tidal/estuarine	All	SFWO
San Mateo	Tidal wetlands/marsh adjacent to San Francisco Bay	Salt marsh species, delta smelt	BDFWO
San Mateo	All ownerships but tidal/estuarine	All	SFWO
San Joaquin	Legal Delta excluding San Joaquin HCP	All	BDFWO
San Joaquin	Other	All	SFWO
Santa Clara	Tidal wetlands/marsh adjacent to San Francisco Bay	Salt marsh species, delta smelt	BDFWO
Santa Clara	All ownerships but tidal/estuarine	All	SFWO
Shasta	Shasta Trinity National Forest except Hat Creek Ranger District (administered by Lassen National Forest)	All	YFWO
Shasta	Hat Creek Ranger District	All	SFWO
Shasta	Bureau of Reclamation (Central Valley Project)	All	BDFWO
Shasta	Whiskeytown National Recreation Area	All	YFWO

Shasta	BLM Alturas Resource Area	All	KFWO
Shasta	Caltrans	By jurisdiction	SFWO/AFWO
Shasta	Ahjumawi Lava Springs State Park	Shasta crayfish	SFWO
Shasta	All other ownerships	All	By jurisdiction (see map)
Shasta	Natural Resource Damage Assessment, all lands	All	SFWO/BDFWO
Sierra	Humboldt Toiyabe National Forest	All	RFWO
Sierra	All other ownerships	All	SFWO
Siskiyou	Klamath National Forest (except Ukonom District)	All	YFWO
Siskiyou	Six Rivers National Forest and Ukonom District	All	AFWO
Siskiyou	Shasta Trinity National Forest	All	YFWO
Siskiyou	Lassen National Forest	All	SFWO
Siskiyou	Modoc National Forest	All	KFWO
Siskiyou	Lava Beds National Volcanic Monument	All	KFWO
Siskiyou	BLM Alturas Resource Area	All	KFWO
Siskiyou	Klamath Basin National Wildlife Refuge Complex	All	KFWO
Siskiyou	All other ownerships	All	By jurisdiction (see map)
Solano	Suisun Marsh	All	BDFWO
Solano	Tidal wetlands/marsh adjacent to San Pablo Bay	Salt marsh species, delta smelt	BDFWO
Solano	All ownerships but tidal/estuarine	All	SFWO
Solano	Other	All	By jurisdiction (see map)

Sonoma	Tidal wetlands/marsh adjacent to San Pablo Bay	Salt marsh species, delta smelt	BDFWO
Sonoma	All ownerships but tidal/estuarine	All	SFWO
Tehama	Mendocino National Forest	All	AFWO
Tehama	Shasta Trinity National Forest except Hat Creek Ranger District (administered by Lassen National Forest)	All	YFWO
Tehama	All other ownerships	All	By jurisdiction (see map)
Trinity	BLM	All	AFWO
Trinity	Six Rivers National Forest	All	AFWO
Trinity	Shasta Trinity National Forest	All	YFWO
Trinity	Mendocino National Forest	All	AFWO
Trinity	BIA (Tribal Trust Lands)	All	AFWO
Trinity	County Government	All	AFWO
Trinity	All other ownerships	All	By jurisdiction (See map)
Yolo	Yolo Bypass	All	BDFWO
Yolo	Other	All	By jurisdiction (see map)
All	FERC-ESA	All	By jurisdiction (see map)
All	FERC-ESA	Shasta crayfish	SFWO
All	FERC-Relicensing (non-ESA)	All	BDFWO

***Office Leads:**

AFWO=Arcata Fish and Wildlife Office

BDFWO=Bay Delta Fish and Wildlife Office

KFWO=Klamath Falls Fish and Wildlife Office

RFWO=Reno Fish and Wildlife Office

YFWO=Yreka Fish and Wildlife Office

Attachment(s):

- Official Species List
- USFWS National Wildlife Refuges and Fish Hatcheries
- Migratory Birds
- Wetlands

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

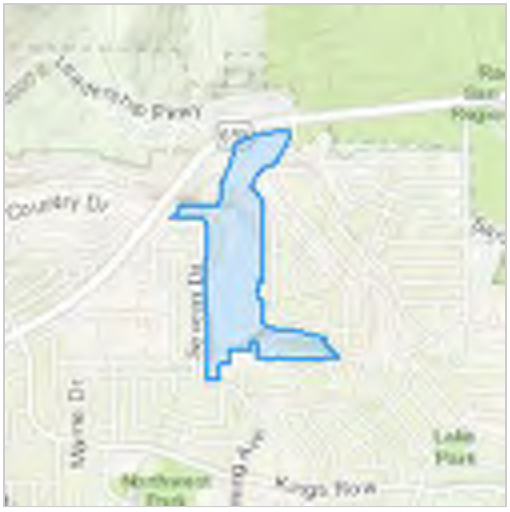
This species list is provided by:

Reno Fish And Wildlife Office
1340 Financial Boulevard, Suite 234
Reno, NV 89502-7147
(775) 861-6300

Project Summary

Consultation Code: 08ENVD00-2021-SLI-0241
Event Code: 08ENVD00-2021-E-00791
Project Name: West Wash Dam
Project Type: DAM
Project Description: West Wash Dam environmental evaluation in Reno, NV
Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@39.54504145,-119.84642972256998,14z



Counties: Washoe County, Nevada

Endangered Species Act Species

There is a total of 5 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Amphibians

NAME	STATUS
Sierra Nevada Yellow-legged Frog *Rana sierrae* There is **final** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/9529	Endangered

Fishes

NAME	STATUS
Cui-ui *Chasmistes cujus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/456	Endangered
Lahontan Cutthroat Trout *Oncorhynchus clarkii henshawi* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/3964	Threatened

Insects

NAME	STATUS
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate

Flowering Plants

NAME	STATUS
Webber's Ivesia *Ivesia webberi*	Threatened

There is **final** critical habitat for this species. The location of the critical habitat is not available.
Species profile: https://ecos.fws.gov/ecp/species/4682

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

USFWS National Wildlife Refuge Lands And Fish Hatcheries

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS OR FISH HATCHERIES WITHIN YOUR PROJECT AREA.

Migratory Birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

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1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

The birds listed below are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ below. This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the E-bird data mapping tool (Tip: enter your location, desired date range and a species on your list). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found below.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
Bald Eagle *Haliaeetus leucocephalus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Dec 1 to Aug 31
Brewer's Sparrow *Spizella breweri* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/9291	Breeds May 15 to Aug 10

NAME	BREEDING SEASON
Golden Eagle *Aquila chrysaetos* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/1680	Breeds Dec 1 to Aug 31
Green-tailed Towhee *Pipilo chlorurus* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/9444	Breeds May 1 to Aug 10
Lewis's Woodpecker *Melanerpes lewis* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9408	Breeds Apr 20 to Sep 30
Olive-sided Flycatcher *Contopus cooperi* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3914	Breeds May 20 to Aug 31
Pinyon Jay *Gymnorhinus cyanocephalus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9420	Breeds Feb 15 to Jul 15
Williamson's Sapsucker *Sphyrapicus thyroideus* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/8832	Breeds May 1 to Jul 31
Willow Flycatcher *Empidonax traillii* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/3482	Breeds May 20 to Aug 31

Probability Of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read and understand the FAQ "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see

below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

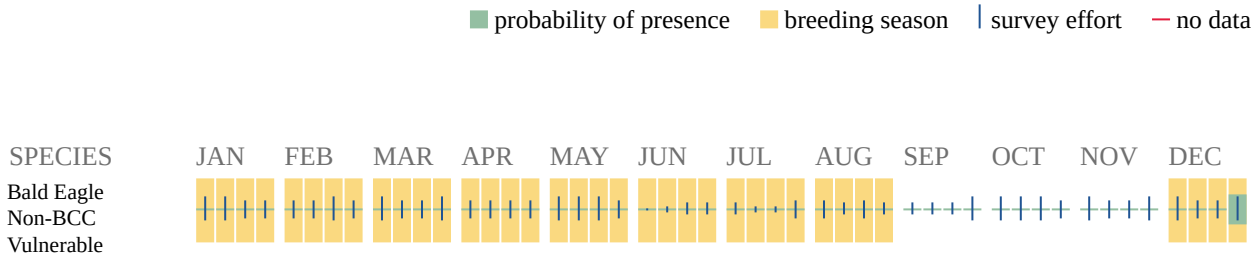
1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

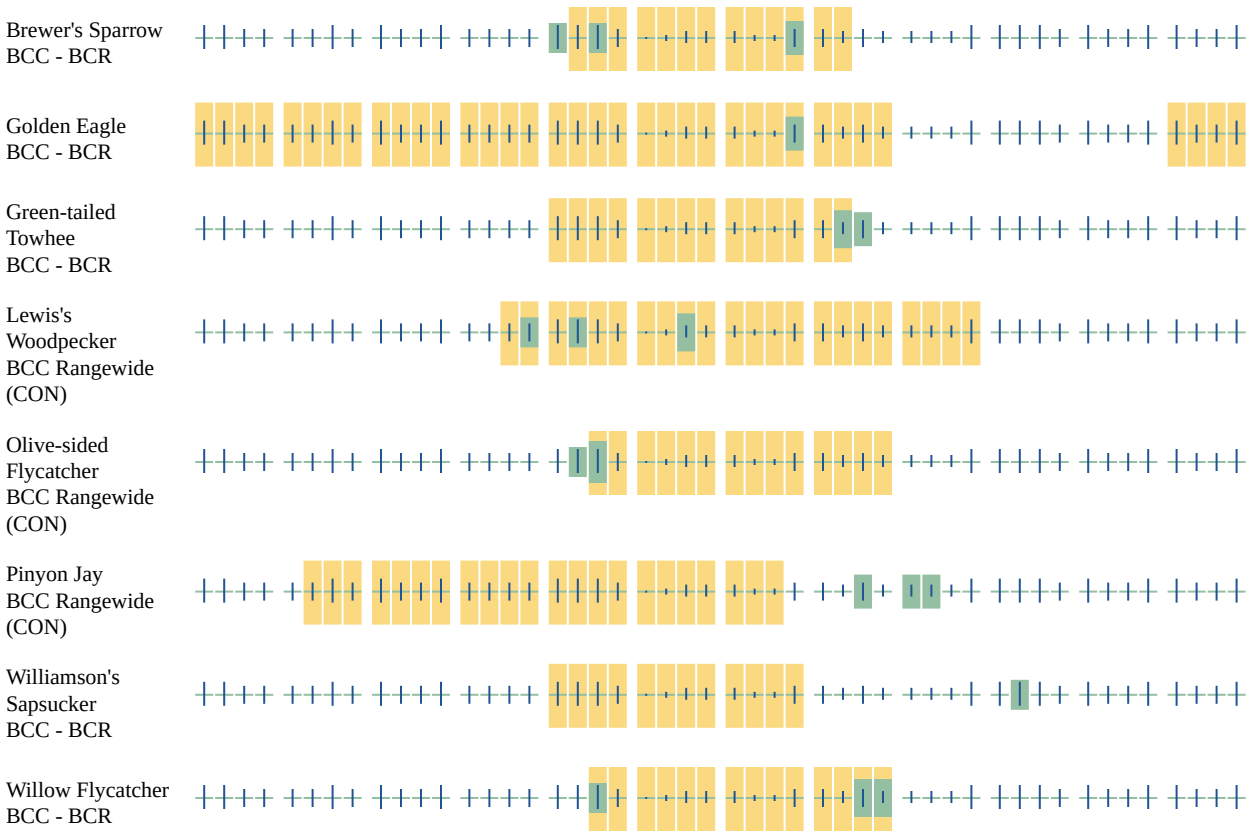
Breeding Season (■)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.





Additional information can be found using the following links:

- Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Measures for avoiding and minimizing impacts to birds http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php
- Nationwide conservation measures for birds http://www.fws.gov/migratorybirds/pdf/management/nationwidestandardconservationmeasures.pdf

Migratory Birds FAQ

Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures or permits

may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?
The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the AKN Phenology Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?
The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets .

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?
To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: The Cornell Lab of Ornithology All About Birds Bird Guide, or (if you are unsuccessful in locating the bird of interest there), the Cornell Lab of Ornithology Neotropical Birds guide. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?
Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);

2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities,

should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

Wetlands

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

FRESHWATER EMERGENT WETLAND

- PEM1C

FRESHWATER FORESTED/SHRUB WETLAND

- PSSB
- PSSC
- PSSCh

FRESHWATER POND

- PUBFh

RIVERINE

- R3UBHx
- R4SBC
- R4SBJ
- R5UBFx

STEVE SISOLAK
Governor

STATE OF NEVADA

DEPARTMENT OF WILDLIFE

6980 Sierra Center Parkway, Suite 120
Reno, Nevada 89511
Phone (775) 688-1500 • Fax (775) 688-1595

TONY WASLEY
Director

BONNIE LONG
Deputy Director

JACK ROBB
Deputy Director

Vicki Thill
Biologist
EM Strategies
1650 Meadow Wood Lane
Reno, Nevada 89502

March 25, 2021

Re: WestWashDam

Dear Vicki Thill:

I am responding to your request for information from the Nevada Department of Wildlife (NDOW) on the known or potential occurrence of wildlife resources in the vicinity of the WestWashDam located in Washoe County, Nevada. In order to fulfill your request, an analysis was performed using the best available data from the NDOW's wildlife occurrences, raptor nest sites and ranges, greater sage-grouse leks and habitat, and big game distributions databases. No warranty is made by the NDOW as to the accuracy, reliability, or completeness of the data for individual use or aggregate use with other data. These data should be considered **sensitive** and may contain information regarding the location of sensitive wildlife species or resources. All appropriate measures should be taken to ensure that the use of this data is strictly limited to serve the needs of the project described on your GIS Data Request Form. Abuse of this information has the potential to adversely affect the existing ecological status of Nevada's wildlife resources and could be cause for the denial of future data requests.

To adequately provide wildlife resource information in the vicinity of the proposed project the NDOW delineated an area of interest that included a four-mile buffer around the project area provided by you on Tuesday, March 23, 2021. Wildlife resource data was queried from the NDOW databases based on this area of interest. The results of this analysis are summarized below.

Big Game - Occupied mule deer distribution exists outside of the project area within portions of the four-mile buffer area. No known occupied bighorn sheep, elk, or pronghorn antelope distributions exist in the vicinity of the project area. Please refer to the attached maps for details regarding big game distributions relative to the proposed project area.

Greater Sage-Grouse - There is no known greater sage-grouse habitat in the vicinity of the project area. Greater sage-grouse activity in the vicinity of the project area has been documented by 209 tracking locations generated by at least three radio-marked birds in the vicinity of the project area. There are no known greater sage-grouse lek sites in the vicinity of the project area.

Lahontan Cutthroat Trout - are known to exist in the vicinity of the project area in the City of Reno-Truckee River watershed.

Raptors - Various species of raptors, which use diverse habitat types, may reside in the vicinity of the project area. American kestrel, bald eagle, barn owl, burrowing owl, Cooper's hawk, ferruginous hawk, flammulated owl, golden eagle, great horned owl, long-eared owl, merlin, northern goshawk, northern harrier, northern saw-whet owl, osprey, peregrine falcon, red-tailed hawk, rough-legged hawk, sharp-shinned hawk, short-eared owl, Swainson's hawk, turkey vulture, and western screech owl have distribution ranges that include the project area and four-mile buffer area. Furthermore, the following raptor species have been directly observed in the vicinity of the project area:

American kestrel	great horned owl	prairie falcon
bald eagle	merlin	red-tailed hawk
barn owl	northern goshawk	rough-legged hawk
burrowing owl	osprey	sharp-shinned hawk
Cooper's hawk	peregrine falcon	snowy owl
golden eagle		

Raptor species are protected by State and Federal laws. In addition, bald eagle, burrowing owl, California spotted owl, ferruginous hawk, flammulated owl, golden eagle, northern goshawk, peregrine falcon, prairie falcon, and short-eared owl are NDOW species of special concern and are target species for conservation as outlined by the Nevada Wildlife Action Plan. Per the *Interim Golden Eagle Technical Guidance: Inventory and Monitoring Protocols; and Other Recommendations in Support of Golden Eagle Management and Permit Issuance* (United States Fish and Wildlife Service 2010) we have queried our raptor nest database to include raptor nest sites within ten miles of the proposed project area. There are five known raptor nest sites within ten miles of the project area:

Probable Use	Last Check	Last Active	Township/Range/Section
Burrowing Owl	7/29/1977	7/29/1977	21 0190N 0200E 020
Buteo	3/2/1978	3/2/1978	21 0200N 0200E 029
Eagle	5/26/1979	5/26/1979	21 0190N 0200E 013
Eagle	6/22/2012		21 0190N 0180E 029
Northern Goshawk	1/1/1980	1/1/1980	21 0200N 0180E 019

Other Wildlife Resources

There are no water developments in the vicinity of the project area. Additional species have also been observed in the vicinity of the project area. Please refer to the appendix for details regarding these species.

The proposed project area may also be in the vicinity of abandoned mine workings, which often provide habitat for state and federally protected wildlife, especially bat species, many of which are protected under NAC 503.030. To request data regarding known abandoned mine workings in the vicinity of the project area please contact the Nevada Division of Minerals (http://minerals.state.nv.us/).

The above information is based on data stored at our Reno Headquarters Office and does not necessarily incorporate the most up to date wildlife resource information collected in the field. Please contact the Habitat Division Supervising Biologist at our Western Region Reno Office (775.688.1500) to discuss the current environmental conditions for your project area and the interpretation of our analysis. Furthermore, it should be noted that the information detailed above is preliminary in nature and not necessarily an identification of every wildlife resource concern associated with the proposed project. Consultation with the Supervising Habitat biologist will facilitate the development of appropriate survey protocols and avoidance or mitigation measures that may be required to address potential impacts to wildlife resources.

Mark Freese - Western Region Supervising Habitat Biologist (775.688.1145)

Federally listed Threatened and Endangered species are also under the jurisdiction of the United States Fish and Wildlife Service. Please contact them for more information regarding these species.

If you have any questions regarding the results or methodology of this analysis, please do not hesitate to contact Jinna Larkin at (775) 688-1580.

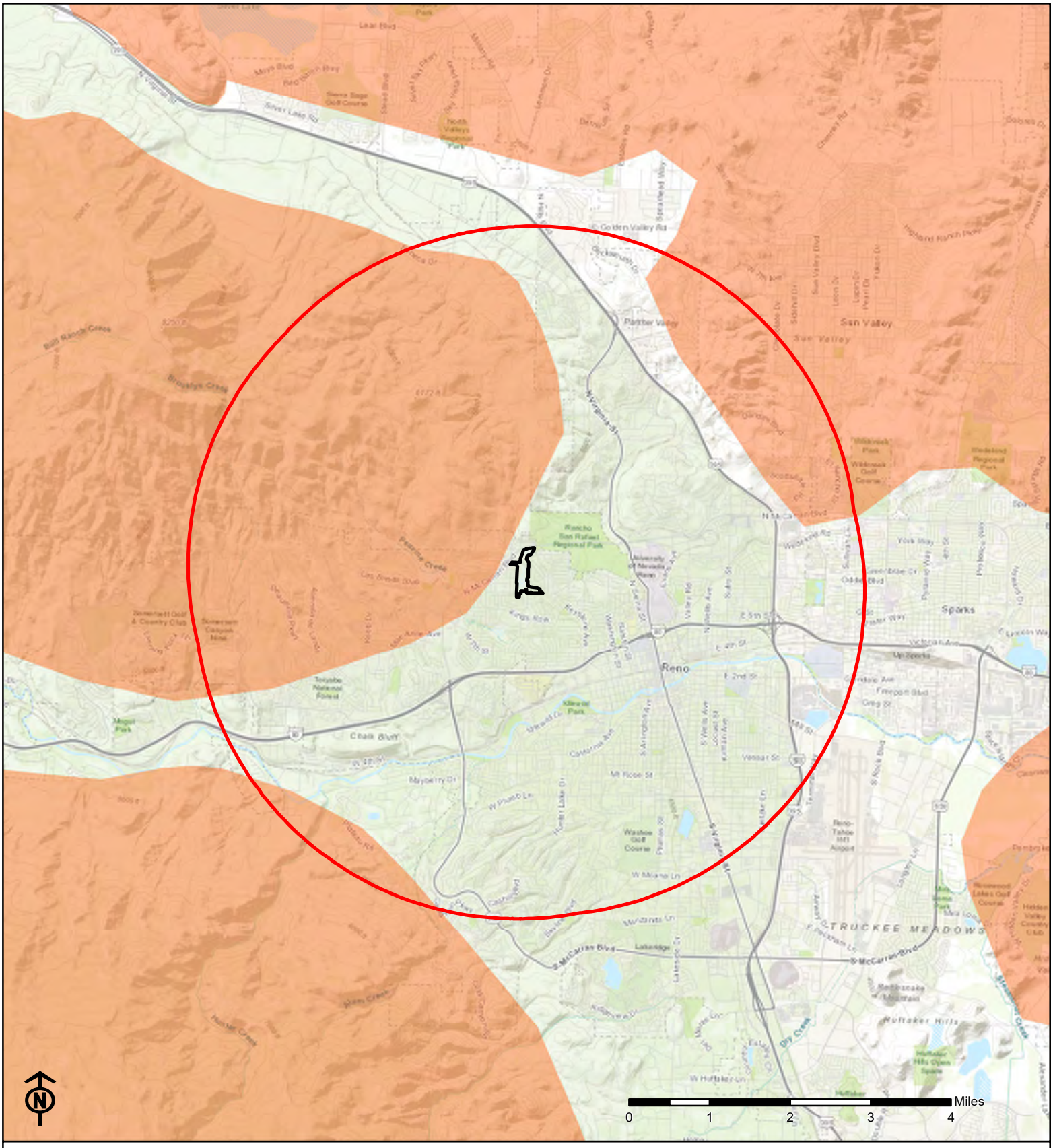
Appendix: Other Wildlife Species Table

Common Name	ESA	State	SWAP SoCP
American beaver		Furbearer	
American black bear			
American crow			
American goldfinch		Protected	
American mink		Furbearer	
American robin		Protected	
Anna's hummingbird		Protected	
Barrow's goldeneye			
black-chinned hummingbird		Protected	
black-headed grosbeak		Protected	
black bullhead			
bluegill			
Brazilian (Mexican) free-tailed bat		Protected	Yes
Brewer's blackbird		Protected	
brook trout			
brown-headed cowbird		Protected	
brown creeper		Protected	
brown trout			
bullfrog			
bullhead (unknown)			
California ground squirrel			
California quail			
California toad			Yes
Canada goose			
Cassin's finch		Protected	Yes
cedar waxwing		Protected	
chisel-toothed kangaroo rat			
common carp			
common kingsnake			
common muskrat		Furbearer	
common raven		Protected	
coyote		Unprotected	
cutbow trout			
dark-eyed junco		Protected	
desert tortoise	Threatened	Threatened	Yes
desert woodrat			
eastern kingbird		Protected	
Eurasian wigeon			
European starling		Unprotected	
evening grosbeak		Protected	
falcon (unknown)			
fathead minnow			
flycatcher (unknown)			
glaucous-winged gull		Protected	
glaucous gull		Protected	

golden-mantled ground squirrel			
Great Basin collared lizard			Yes
Great Basin fence lizard			
Great Basin gophersnake			
Great Basin pocket mouse			
greater scaup			
green heron		Protected	
green sunfish			
hawk (unknown)			
hermit thrush		Protected	
house finch		Protected	
house mouse			
house sparrow		Unprotected	
house wren		Protected	
Lahontan cutthroat trout	Threatened		Yes
Lahontan redside			
Lahontan speckled dace			
largemouth bass			
lesser goldfinch		Protected	
long-nosed leopard lizard			Yes
mallard			
mew gull		Protected	
montane vole			
mountain chickadee		Protected	
mountain lion			
mountain sucker			
mountain whitefish			Yes
mourning dove			
nighthawk (unknown)			
North American deermouse			
North American porcupine			
North American river otter		Furbearer	Yes
northern flicker		Protected	
northern mockingbird		Protected	
northern pike		Injurious	
northern rubber boa			Yes
Ord's kangaroo rat			
Oregon junco		Protected	
Pacific chorus frog			
Paiute sculpin			
pine siskin		Protected	
quail (unknown)			
raccoon			
rainbow trout			
red-breasted sapsucker		Protected	
redside shiner			
rock dove			
roof rat			

ruddy duck		
rufous hummingbird	Protected	Yes
Sacramento perch		
skunk (unknown)		
sora		
speckled dace		
spotted bass		
spotted bat	Threatened	Yes
spotted towhee	Protected	
sucker (unknown)		
Tahoe sucker		
terrestrial gartersnake		
Thayer's gull	Protected	
toad (unknown)		
Toquerville pyrg		
Townsend's solitaire	Protected	
trout (unknown)		
tui chub		
turtle (unknown)		
vermilion flycatcher	Protected	
Virginia rail		
western fence lizard		
western harvest mouse		
western kingbird	Protected	
western pond turtle		Yes
western rattlesnake		
western scrub-jay		
western tanager	Protected	
western toad		Yes
western yellow-bellied racer		
white-crowned sparrow	Protected	
white-headed woodpecker	Protected	Yes
white-tailed antelope squirrel		
Williamson's sapsucker	Protected	
Wilson's warbler	Protected	
Woodhouse's toad		
yellow-bellied marmot		
yellow-rumped warbler	Protected	
yellow bullhead		

ESA: Endangered Species Act Status
State: State of Nevada Special Status
SWAP SoCP: Nevada State Wildlife Action Plan (2012) Species of Conservation Priority



Project Area

Four Mile Buffer Area Boundary

Mule Deer Distribution

WestWashDam
Mule Deer Distribution

March 25, 2021

Projection: UTM Zone 11 North, NAD83

No warranty is made by the Nevada Department of Wildlife as to the accuracy, reliability, or completeness of the data for individual use or aggregate use with other data.

V:\ActiveProjects\DataRequests\Template\Data Request - Response Template.mxd

Appendix D Archaeological Inventory Report Summary

FINAL – Cultural Resources Inventory Report for the West Wash Dam Supplemental Watershed Plan Project, Reno, Nevada

Prepared by
Sarah Branch, Project Archaeologist
Lauren Culleton, Project Archaeologist

With Contributions by
Jeramie Memmott

Broadbent & Associates, Inc.
5450 Louie Lane #101
Reno, Nevada 89511

For
Farr West Engineering
5510 Longley Lane
Reno, Nevada 89511

Submitted to
Charles Armitage
State Archaeologist
National Resources Conservation Service
Nevada State Office
1365 Corporate Boulevard
Reno, Nevada 89502

Broadbent Project No. 21-02-102

December 2021

The City of Reno (City) has entered into an agreement with the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) to rehabilitate the West Wash Dam and East Wash Dam in northwest Reno, Nevada to meet current NRCS, City, and State of Nevada Division of Water Resources (DWR) dam safety criteria and performance standards. Farr West Engineering (FWE) has been retained to assist the City in meeting the requirements of the NRCS Watershed Program, which include the development of a Supplemental Watershed Plan and Environmental Assessment (Plan/EA). FWE has been tasked with developing design alternatives for the project and preparing the Plan/EA in accordance with PL-83-566, the National Environmental Policy Act (NEPA), the Principles and Requirements for Federal Investments in Water Resources (PR&G), the NRCS National Watershed Program Manual (NWPM), the National Watershed Program Handbook (NWPH), and all other applicable laws, regulations, and policies. The rehabilitation measures that are to be proposed in the Plan/EA will be considered with public input and prioritized through the City and NRCS.

Because the West Wash Dam Supplemental Watershed Plan Project (Project) is considered a federal undertaking, it must comply with Section 106 of the National Historic Preservation Act of 1966 (NHPA), as amended (54 U.S.C. § 300101 et seq.), and its implementing regulations (36 CFR Part 800.4[b]). In May 2021, FWE contracted with Broadbent & Associates Inc. (Broadbent) to conduct an intensive cultural resource inventory for the Project, which is in northwest Reno, Nevada, at the intersection of Wyoming Avenue and Putnam Drive immediately south of McCarran Boulevard. The Area of Potential Effects (APE) for direct physical effects comprises 53.23 acres and the APE for indirect effects is 133.49 acres, which includes the footprint of the direct effects APE and an additional 80.26 acres surrounding the direct effects APE.

Prior to beginning fieldwork, Broadbent conducted a records search through the Nevada Cultural Resources Information System (NVCRIS) for a one-mile radius surrounding the direct effects APE. The review of records available on NVCRIS indicated that 23 cultural resources inventories, surveys, and projects have been completed within one mile of the APE. These include a mix of reports completed for Section 106 and research completed as part of coursework at the University of Nevada, Reno or on behalf of the Nevada SHPO. Three of the reports are within the APE, two of which are broad overviews of specific resources within Reno (a survey of structures made from river rock and a revision of the Nevada State Historic Preservation Plan DeLongchamps Study Unit). The third report was prepared as part of the original construction of the East and West Wash Dams.

Per NVCRIS, 16 archaeological sites and 139 architectural resources have been previously identified within one mile of the Direct Effects APE; there are no NRHP-listed historic properties within one mile of the Direct Effects APE. According to the list maintained by Nevada SHPO, there are also no resources that have been listed on the Nevada State Register of Historic Places (NVSRHP) within one mile of the APE. The archaeological sites within one mile of the APE include 12 prehistoric sites (eight lithic scatters, a possible camp site, a rock art site with talus pits, a possible quarry, and a site with no additional information near Rancho San Rafael Park), two historic sites (a rock and mortar foundation and a refuse pit), and two multi-component sites (a prehistoric camp with a historic isolate and a historic refuse deposit/prehistoric lithic scatter). None of these sites are located within the direct effects APE; one site (26WA1697) is located

within the indirect effects APE. The 139 architectural resources within one mile of the direct effects APE include one structure (S95 – the Highland Reservoir) and 138 buildings, most of which are residential; none are located within the direct effects APE. The indirect effects APE encompasses 141 parcels, most of which contain residences constructed between 1964 and 2015; 46 of the parcels contain structures that are historic in age (at least 50 years old). All the structures within the indirect effects APE were constructed after the West Wash and East Wash Dams were completed.

On June 10, 2021, Broadbent archaeologists conducted the intensive pedestrian Cultural Resources Inventory of the 53.23-acre APE. The inventory was completed according to the standards and guidelines provided by NRCS and the Nevada State Historic Preservation Office (SHPO). All fieldwork was completed under direct supervision of Broadbent permitted archaeologist Ms. Margo Memmott and was conducted according to the terms of Broadbent's State of Nevada Antiquities Permit No. 618. Ms. Lauren Culleton served as the Architectural Historian for the Project.

The intensive pedestrian cultural resources survey resulted in the identification and recordation of three historic structures and a historic district. The historic structures include the East Wash Dam (S2872), the West Wash Dam (S2873), and a segment of the previously recorded Highland Ditch (S808). Because the East and West Wash Dams function as a unit, they were also included in the East and West Wash Dam Historic District (D390). No archaeological sites or isolated cultural resources were identified during the intensive cultural resources inventory. An attempt was made to relocate previously recorded prehistoric archaeological site 26WA1697, but it is presumed destroyed in its entirety by the construction of McCarran Boulevard and continuing modern development of the area.

Broadbent recommends that the segment of the Highland Ditch (S808) recorded for the Project be considered a non-contributing segment to the NRHP-eligibility of the whole resource and not individually eligible for NRHP inclusion. Broadbent recommends that the East Wash Dam (S2872) and West Wash Dam (S2873) are eligible for NRHP inclusion. Broadbent also recommends that the East and West Wash Dam Historic District (D390) is eligible for NRHP inclusion. Structures S2872 and S2873 are recommended as contributing resources to Historic District D390; Structure S808 is recommended as non-contributing to the historic district.

A total of 46 parcels within the indirect effects APE contain structures that are at least 50 years old. Most are single-family residences, with the oldest constructed in 1964, three years after the completion of the East Wash Dam; all remain unevaluated for NRHP inclusion.

If Design Alternative 1 is chosen, no changes will be made to any of the historic structures identified during the survey, and Broadbent would recommend a finding of No Historic Properties Affected for the Project.

Design Alternative 2 includes modifying property and infrastructure to improve flood conveyance downstream of West Wash Dam (S2873), but does not include modifications to the historic structures identified during the survey. Because the potential modifications proposed in Alternative 2 extend beyond the current APE, selection of Alternative 2 would require additional Section 106 review to analyze the

potential effects of the new design elements. As such, a determination of project effect for Alternative 2 can only be made once the expanded APE has been established and the identification of historic properties within the expanded APE has been completed.

Design Alternative 3 (Alternative 3a in previous documents related to the Project) includes modifications to both East Wash Dam (S2872) and West Wash Dam (S2873). Per the information presented at the West Wash Dam Rehabilitation Project Public Scoping Meeting held on October 19, 2021, the current plan for Alternative 3 includes increasing the capacity of the East Wash Dam by excavating material from the existing basin and reseeding it with native vegetation, restoring the west embankment upstream of the spillway to its original height, improve the grading of the spillway, and armor the west embankment and the spillway to reduce erosion. For the West Wash Dam, Alternative 3 includes raising the dam crest and adding will to the southeast side of the dam, and restoring the spillway to its original design before armoring it. Armoring could include rip rap or other similar methods, to be decided during the design process. If the final design elements included in Alternative 3 repair and rehabilitate the dams using the same materials and with the same design as the original structures (i.e., maintain and repair the structure with like materials), Broadbent recommends a finding of No Adverse Effect. If the final design of Alternative 3 would substantially alter the design of the East and West Wash Dams and their accessory structures, or would involve the use or addition of materials that are not in keeping with the original materials used in the construction of these structures, Broadbent recommends that a Historic Properties Treatment Plan (HPTP) be developed to resolve the adverse effect to these historic properties through mitigation. Appropriate mitigation methods should involve public interpretation, such as the production of a brochure or other publications, web-based and published articles, public presentations, museum exhibits, or historic markers. As the significance of S2872, S2873, and D390 is based on their association with the theme of Land Usage (specifically the subtheme of Townsite Development/City Planning) and their ability to convey that significance, mitigation through excavation or similar data recovery and reporting methods would not be considered appropriate.

Design Alternatives 4 and 5 (Alternatives 5a and 6a in previous documents related to the Project) involve removing both East Wash Dam (S2872) and West Wash Dam (S2873) and returning the area to a natural drainage landscape. In addition to removing the dams, Alternative 5 would include the flood proofing measures described in Alternative 2. If either of these alternatives are selected, Broadbent recommends that a HPTP be developed to resolve the adverse effects to these historic properties through mitigation as described above.

The 46 unevaluated properties of historic age that are within the indirect APE have experienced loss of integrity of association, setting, and feeling due to ongoing landscape-scale alterations outside of their historic period. Further, they are elevated above the level of the West Wash and East Wash Dams, and either face away from the dams or have the view of the dams obscured by the neighboring houses. As such, implementation of any of the five Design Alternatives would not constitute an adverse effect to the unevaluated properties located within the indirect effects APE.

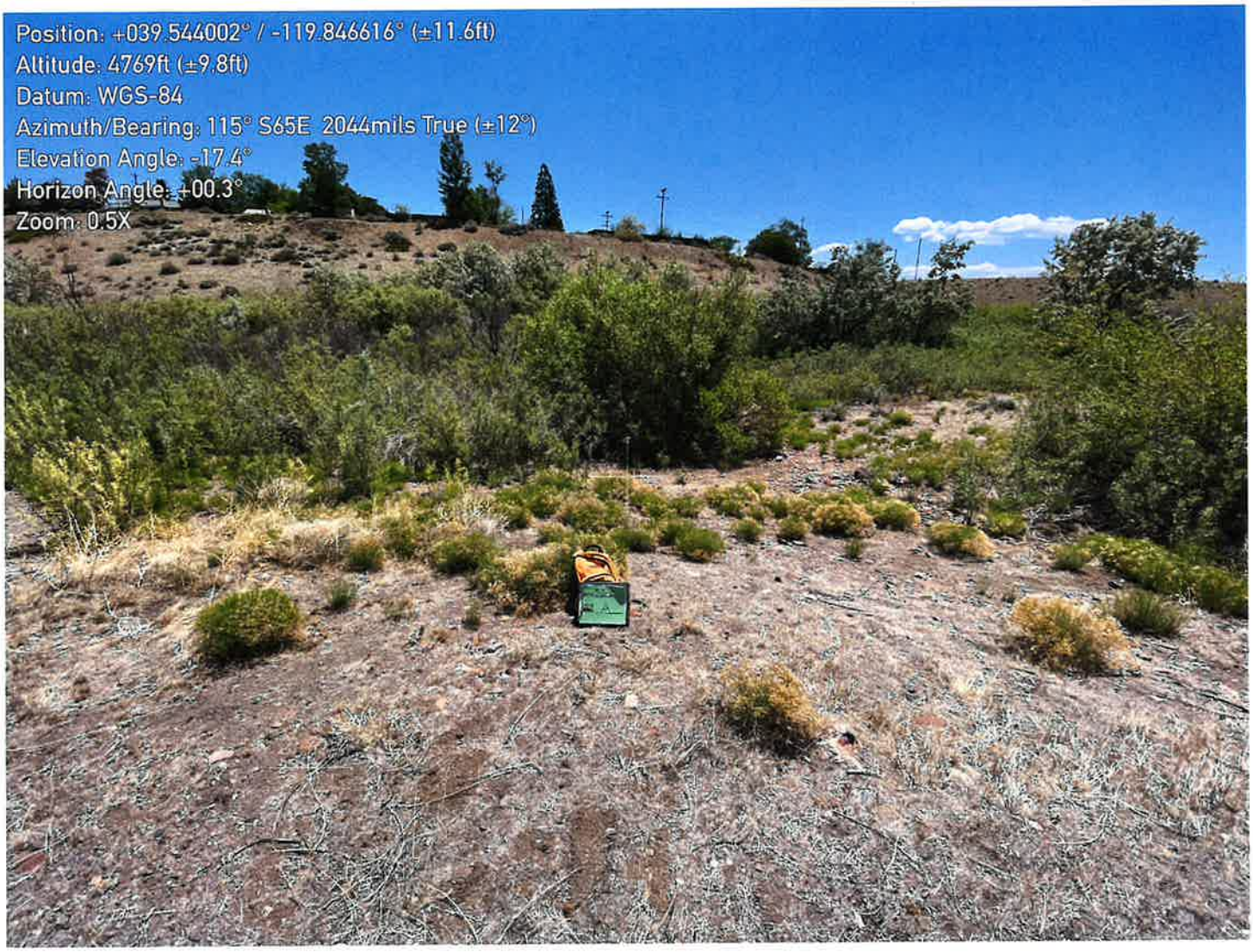
Appendix E Arid West Ephemeral and Intermittent Streams OHWM Datasheets, Beta Streamflow Duration Assessment Method – Arid West Data Forms, Arid West Wetland Determination Data Forms

Overview – Area 2 - View southwest/downstream of the West Wash Dam

Overview – Area 1 - View northeast/upstream of the West Wash Dam

Overview – Area 1 below the "leaky Ditch"

Investigation Location A



WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: W. Wash Dam City/County: Reno/Washoe Sampling Date: 6/3/21
Applicant/Owner: City of Reno State: NV Sampling Point: A (A)
Investigator(s): L. BURNSIDE Section, Township, Range: 3+4, T19N R19E
Landform (hillslope, terrace, etc.): Depression Local relief (concave, convex, none): Concave Slope (%): 10%
Subregion (LRR): W Range + Irrigated Region Lat: 39.54402 Long: -119.846616 Datum: NA-1983
Soil Map Unit Name: 1050 Wadsworth 15-30% slopes NWI classification: Upland
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ____ (If no, explain in Remarks.)
Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No ____
Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓	No ____	**Is the Sampled Area within a Wetland?** Yes ____ No ✓
Hydric Soil Present?	Yes ____	No ✓	
Wetland Hydrology Present?	Yes ____	No ✓	

Remarks: Manmade channel w/ veg supported by nuisance flow from upstream development

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 3m²)	Absolute % Cover	Dominant Species?	Indicator Status
1. Salix exigua	40	✓	FACW
2. Populus balsamifera	10		FAC
3. Shepherdia argentea	10		FACU
4.			
	60	= Total Cover	

Sapling/Shrub Stratum (Plot size: ____)			
1. Encelia nauseosus	15	✓	NA
2. Artemisia tridentata	15	✓	NA
3.			
4.			
5.			
	30	= Total Cover	

Herb Stratum (Plot size: ____)			
1. Juncus balticus	2		FACW
2. Distichlis spicata	4	✓	FAC
3. Agropyron cristatum	4	✓	NA
4.			
5.			
6.			
7.			
8.			
	10	= Total Cover	

Woody Vine Stratum (Plot size: ____)			
1.			
2.			
	100	= Total Cover	

% Bare Ground in Herb Stratum 30 % Cover of Biotic Crust ____

Dominance Test worksheet:
Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)
Total Number of Dominant Species Across All Strata: 5 (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: 40% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	2	x 2 =	4
FAC species	2	x 3 =	6
FACU species	1	x 4 =	4
UPL species	3	x 5 =	15
Column Totals:	8 (A)		29 (B)

Prevalence Index = B/A = 3.6

Hydrophytic Vegetation Indicators:
___ Dominance Test is >50%
___ Prevalence Index is ≤3.0[1]
___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ____ No ✓

Remarks:

SOIL

Sampling Point: _____

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-17	10YR 4/3	100					Clay	
17-20	Lt Gray	100					Weathered Tuff	
20+	Gray	100					BR	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: Bedrock

Depth (inches): 20

Hydric Soil Present? Yes _____ No X

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Potential for subsurface flow of nuisance flow through weathered bedrock

A

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: W. Dam Rehabilitation **Date:** 6/3/21 **Time:**
Project Number: 3167Code **Town:** Reno **State:** NV
Stream: **Photo begin file#:** **Photo end file#:**
Investigator(s): L. BURNSIDE

Y ☒ / N ☐ Do normal circumstances exist on the site?

Y ☐ / N ☒ Is the site significantly disturbed?

Location Details: A-lower manmade drainage

Projection: NAD1983 11N **Datum:** NA 1983

Coordinates: 39.544002 -119.846616

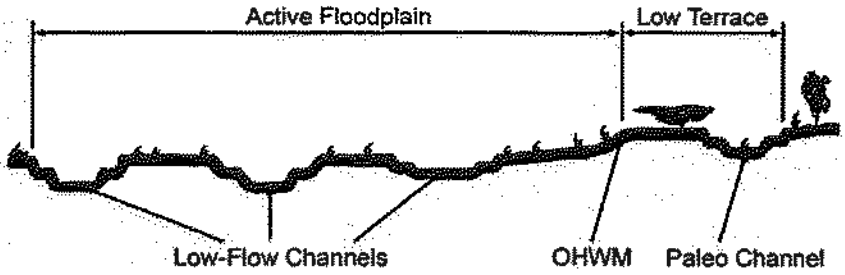
Potential anthropogenic influences on the channel system:
Manmade flood water conveyance channel to dam and standpipe

Brief site description:
W. Wash Dam - Emergency flood control facility

Checklist of resources (if available):

- ☒ Aerial photography
  - Dates:
- ☒ Topographic maps
- ☐ Geologic maps
- ☐ Vegetation maps
- ☒ Soils maps
- ☐ Rainfall/precipitation maps
- ☐ Existing delineation(s) for site
- ☒ Global positioning system (GPS)
- ☐ Other studies
- ☐ Stream gage data
  - Gage number:
  - Period of record:
  - ☐ History of recent effective discharges
  - ☐ Results of flood frequency analysis
  - ☐ Most recent shift-adjusted rating
  - ☐ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

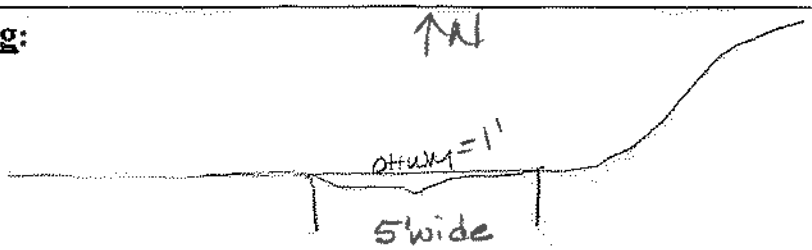


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - ☒ Mapping on aerial photograph
   - ☐ Digitized on computer
   - ☒ GPS
   - ☐ Other:

Project ID: **Cross section ID:** **Date:** **Time:**

Cross section drawing:



OHWM

GPS point: 39.544002, -119.846616

Indicators:

- ☐ Change in average sediment texture
- ☐ Change in vegetation species
- ☐ Change in vegetation cover
- ☒ Break in bank slope
- ☐ Other: _____
- ☐ Other: _____

Comments:
√ shallow conveyance under flood conditions over tops and fills the basin wide area

Floodplain unit: ☐ Low-Flow Channel ☒ Active Floodplain ☐ Low Terrace

GPS point: 39.544002, -119.846616

Characteristics of the floodplain unit:

Average sediment texture: Sandy clay

Total veg cover: 100 % Tree: 60 % Shrub: 30 % Herb: 10 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☒ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☒ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

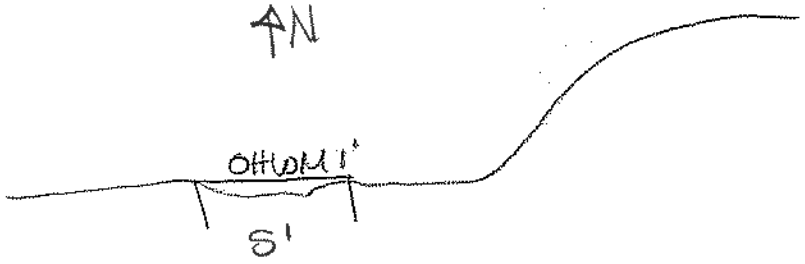
A

Beta Arid West Streamflow Duration Assessment Method

General site information

Project name or number: W. Wash Dam		
Site code or identifier: A	Assessor(s): L. BURNSIDE	
Waterway name: W. Wash		Visit date: 6/3/21
Current weather conditions (check one) ☐ Storm/heavy rain ☐ Steady rain ☐ Intermittent rain ☐ Snowing ☐ Cloudy (___ % cover) ☒ Clear/Sunny	Notes on current or recent weather conditions (e.g., precipitation in previous week):	Coordinates at downstream end (decimal degrees): Lat (N): 39.544002 Long (W): -119.846616 Datum: N.A. 1983
Surrounding land-use within 100 m (check one or two): ☒ Urban/industrial/residential ☐ Agricultural (farmland, crops, vineyards, pasture) ☐ Developed open-space (e.g., golf course) ☐ Forested ☐ Other natural ☒ Other: Flood Control Facility	Describe reach boundaries: Channel is consistent throughout	
Mean channel width (m): 5'	Reach length (m): 40x width; min 40 m; max 200 m. Entire 1006 LF	Enter photo ID, or check if completed Top down: _____ Mid down: _____ Mid up: _____ Bottom up: _____ Investigation Location
Disturbed or difficult conditions (check all that apply): ☐ Recent flood or debris flow ☐ Stream modifications (e.g., channelization) ☐ Diversions ☐ Discharges ☐ Drought ☐ Vegetation removal/limitations ☐ Other (explain in notes) ☑ None	Notes on disturbances or difficult site conditions:	
Observed hydrology: 0 % of reach with surface flow 0 % of reach with sub-surface or surface flow 0 # of isolated pools	Comments on observed hydrology:	

Site sketch:



1. Hydrophytic plant species

Record up to 5 hydrophytic plant species (FACW or OBL in the **Arid West** regional wetland plant list) within the assessment area: **within the channel or up to one half-channel width**. Explain in notes if species has an odd distribution (e.g., covers less than 2% of assessment area, long-lived species solely represented by seedlings, or long-lived species solely represented by specimens in decline), or if there is uncertainty about the identification. Enter photo ID, or check if photo is taken.

Check if applicable: ☐ No vegetation in assessment area ☐ No hydrophytes in assessment area

Species	Odd distribution?	Notes	Photo ID
Salix exigua.		Location A	
Populus fremontii		"	
Shepherdia argentea		"	
Juncus balticus		"	
Distichlis spicata		"	
Agropyron cristatum		"	

Notes on hydrophytic vegetation:

2 and 3. Aquatic invertebrates

2. How many aquatic invertebrates are quantified in a 15-minute search?

Number of individuals quantified:
- ☒ None
- ☐ 1 to 19
- ☐ 20 +

(Do not count mosquitos)

Photo ID:_____

3. Is there evidence of aquatic stages of EPT (Ephemeroptera, Plecoptera and Trichoptera)?

Yes / No

Ephemeroptera larva
Image credit: Dieter Tracey

Plecoptera larva
Tracey Saxby

Trichoptera larva
Tracey Saxby

Notes on aquatic invertebrates:

4. Algal Cover

Are algae found on the streambed?		Notes on algae cover:	Photo ID:
☐ Check if *all* observed algae appear to be deposited from an upstream source.	☒ Not detected ☐ Yes, < 10% cover ☐ Yes, ≥ 10% (check Yes in single indicator below)		

5. Are single indicators observed?

Indicator	Present	Notes	Photo ID
Fish	☐ Yes ☒ No, no fish ☐ No, only non-native mosquitofish		
Algae cover ≥ 10%	☐ Yes ☒ No		

Supplemental information E.g., aquatic or semi-aquatic amphibians, snakes, or turtles; iron-oxidizing bacteria and fungi; etc.

None detected

Photo log

Indicate if any other photos taken during the assessment

Photo ID	Description
Location A	

Additional notes about the assessment:

Classification: Ephemeral

1. Hydrophytic plant species	2. Aquatic invertebrates	3. EPT taxa	4. Algae	5. Single indicators • fish present • algae cover ≥ 10%	Classification
None	None	Absent	Absent	Absent	**Ephemeral**
				Present	**At least intermittent**
			Present	Absent	**Need more information**
				Present	**At least intermittent**
	Few (1-19)	Absent	Absent	Absent	**Need more information**
				Present	**At least intermittent**
			Present	Absent	**Need more information**
				Present	**At least intermittent**
		Present			**At least intermittent**
	Many (20+)	Absent	Absent	Absent	**Need more information**
				Present	**At least intermittent**
			Present	Absent	**Need more information**
				Present	**At least intermittent**
		Present			**At least intermittent**
Few (1-2) Supported by nuisance flow from up slope development	None	Absent	Absent	Absent	**Need more information**
				Present	**At least intermittent**
			Present		**At least intermittent**
	Few (1-19)	Absent	Absent		**Intermittent**
			Present		**At least intermittent**
		Present			**At least intermittent**
	Many (20+)	Absent	Absent		**Intermittent**
			Present		**At least intermittent**
		Present	Absent		**At least intermittent**
			Present		**Intermittent**
Many (3+)	None	Absent	Absent	Absent	**Need more information**
				Present	**At least intermittent**
			Present		**At least intermittent**
	Few (1-19)	Absent			**At least intermittent**
		Present			**Perennial**
	Many (20+)	Absent			**At least intermittent**
		Present			**Perennial**

Shading provided to enhance readability by increasing the contrast between neighboring cells; empty cells indicate the classification will not change with additional information however it is recommended that all five indicators be measured and recorded during every assessment.

Investigation Location B

B

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: W. Dam Rehabilitation
Project Number: 36T7006
Stream:
Investigator(s): L. BURNSIDE

Date: 6/3/21
Town: Reno
Photo begin file#:

Time:
State: NV
Photo end file#:

Y ☒ / N ☐ Do normal circumstances exist on the site?

Y ☐ / N ☒ Is the site significantly disturbed?

Location Details: B Mid Manmade Channel

Projection: NAD 1983 11N **Datum:** NA 1983
Coordinates: 39.545250, -119.846088

Potential anthropogenic influences on the channel system:
Manmade flood conveyance channel to dam and standpipe

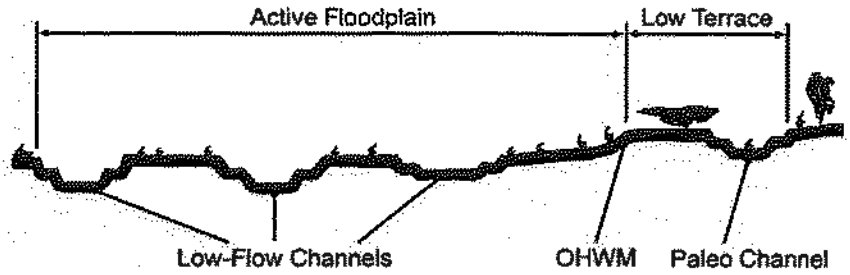
Brief site description:
W. Wash Dam - Emergency flood control facility

Checklist of resources (if available):

- ☒ Aerial photography
  Dates:
- ☒ Topographic maps
- ☐ Geologic maps
- ☐ Vegetation maps
- ☒ Soils maps
- ☐ Rainfall/precipitation maps
- ☐ Existing delineation(s) for site
- ☒ Global positioning system (GPS)
- ☐ Other studies

- ☐ Stream gage data
  Gage number:
  Period of record:
  - ☐ History of recent effective discharges
  - ☐ Results of flood frequency analysis
  - ☐ Most recent shift-adjusted rating
  - ☐ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

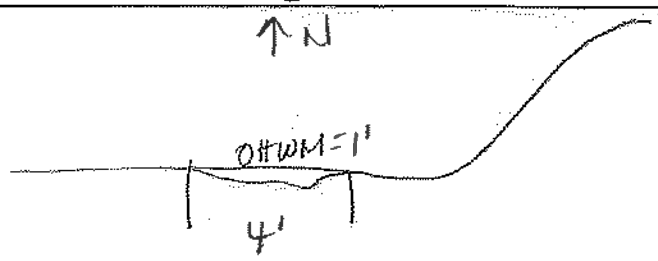


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - ☒ Mapping on aerial photograph
   - ☐ Digitized on computer
   - ☒ GPS
   - ☐ Other:

Project ID: **Cross section ID:** B **Date:** **Time:**

Cross section drawing:



OHWM

GPS point: 39.545250, -119.846088

Indicators:

- ☐ Change in average sediment texture
- ☐ Change in vegetation species
- ☐ Change in vegetation cover
- ☒ Break in bank slope
- ☐ Other: _____
- ☐ Other: _____

Comments:
√ shallow conveyance. under flood conditions sheet flows across the basinwide area.

Floodplain unit: ☐ Low-Flow Channel ☒ Active Floodplain ☐ Low Terrace

GPS point: 39.545250, -119.846088

Characteristics of the floodplain unit:

Average sediment texture: Sandy Clay

Total veg cover: 100 % Tree: 100 % Shrub: 30 % Herb: 10 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☒ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☒ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

 B

Beta Arid West Streamflow Duration Assessment Method

General site information

Project name or number: W. Wash Dam

Site code or identifier: B

Assessor(s): L. BURNSIDE

Waterway name: W. Wash

Visit date: 6/3/21

Current weather conditions (check one)
- ☐ Storm/heavy rain
- ☐ Steady rain
- ☐ Intermittent rain
- ☐ Snowing
- ☐ Cloudy (___ % cover)
- ☒ Clear/Sunny

Notes on current or recent weather conditions (e.g., precipitation in previous week):

Coordinates at downstream end (decimal degrees):
Lat (N): 39.545250
Long (W): -119.846088
Datum: NA 1983

Surrounding land-use within 100 m (check one or two):
- ☒ Urban/industrial/residential
- ☐ Agricultural (farmland, crops, vineyards, pasture)
- ☐ Developed open-space (e.g., golf course)
- ☐ Forested
- ☐ Other natural
- ☒ Other: Flood Control Facility

Describe reach boundaries: channel is consistent throughout

Mean channel width (m): 4'

Reach length (m): 40x width; min 40 m; max 200 m. Entire POOL LF

Enter photo ID, or check if completed
Top down: _____ Mid down: _____
Mid up: _____ Bottom up: _____
Investigation Location

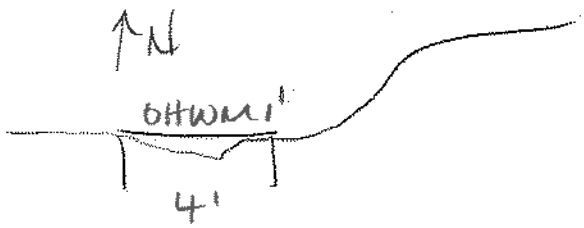
Disturbed or difficult conditions (check all that apply):
- ☐ Recent flood or debris flow
- ☐ Stream modifications (e.g., channelization)
- ☐ Diversions
- ☐ Discharges
- ☐ Drought
- ☐ Vegetation removal/limitations
- ☐ Other (explain in notes)
- ☒ None

Notes on disturbances or difficult site conditions:

Observed hydrology:
- 0 % of reach with surface flow
- 0 % of reach with sub-surface or surface flow
- 0 # of isolated pools

Comments on observed hydrology:

Site sketch:



1. Hydrophytic plant species

Record up to 5 hydrophytic plant species (FACW or OBL in the **Arid West** regional wetland plant list) within the assessment area: **within the channel or up to one half-channel width.** Explain in notes if species has an odd distribution (e.g., covers less than 2% of assessment area, long-lived species solely represented by seedlings, or long-lived species solely represented by specimens in decline), or if there is uncertainty about the identification. Enter photo ID, or check if photo is taken.

Check if applicable: ☐ No vegetation in assessment area ☐ No hydrophytes in assessment area

Species	Odd distribution?	Notes	Photo ID
Salix exigua		Location B	
Populus fremontii		"	
Shepherdia argentea		"	
Juncus balticus		"	
Distichlis spicata		"	
Agropyron cristatum		"	

Notes on hydrophytic vegetation:

2 and 3. Aquatic invertebrates

2. How many aquatic invertebrates are quantified in a 15-minute search?

Number of individuals quantified:
☒ None
☐ 1 to 19
☐ 20 +

(Do not count mosquitos)

Photo ID: _____

3. Is there evidence of aquatic stages of EPT (Ephemeroptera, Plecoptera and Trichoptera)?

Yes / No

Ephemeroptera larva
Image credit: Dieter Tracey

Plecoptera larva
Tracey Saxby

Trichoptera larva
Tracey Saxby

Notes on aquatic invertebrates:

4. Algal Cover

Are algae found on the streambed? ☐ Check if *all* observed algae appear to be deposited from an upstream source.	☒ Not detected ☐ Yes, < 10% cover ☐ Yes, ≥ 10% (check Yes in single indicator below)	Notes on algae cover:	Photo ID:

5. Are single indicators observed?

Indicator	Present	Notes	Photo ID
Fish	☐ Yes ☒ No, no fish ☐ No, only non-native mosquitofish		
Algae cover ≥ 10%	☐ Yes ☒ No		

Supplemental information E.g., aquatic or semi-aquatic amphibians, snakes, or turtles; iron-oxidizing bacteria and fungi; etc.

None detected

Photo log

Indicate if any other photos taken during the assessment

Photo ID	Description
location B	

Additional notes about the assessment:

Classification: Ephemeral

1. Hydrophytic plant species	2. Aquatic invertebrates	3. EPT taxa	4. Algae	5. Single indicators • fish present • algae cover ≥ 10%	Classification
None	None	Absent	Absent	Absent	**Ephemeral**
				Present	**At least intermittent**
			Present	Absent	**Need more information**
				Present	**At least intermittent**
		Present	Absent	Absent	**Need more information**
				Present	**At least intermittent**
	Few (1-19)		Present	Absent	**Need more information**
				Present	**At least intermittent**
		Present			**At least intermittent**
	Many (20+)	Absent	Absent	Absent	**Need more information**
				Present	**At least intermittent**
			Present	Absent	**Need more information**
				Present	**At least intermittent**
		Present			**At least intermittent**
	None	Absent	Absent	Absent	**Need more information**
				Present	**At least intermittent**
			Present		**At least intermittent**
	Few (1-19)	Absent	Absent		**Intermittent**
			Present		**At least intermittent**
		Present			**At least intermittent**
	Many (20+)	Absent	Absent		**Intermittent**
			Present		**At least intermittent**
		Present	Absent		**At least intermittent**
			Present		**Intermittent**
Few (1-2)	None	Absent	Absent	Absent	**Need more information**
				Present	**At least intermittent**
			Present		**At least intermittent**
	Few (1-19)	Absent	Absent		**Intermittent**
			Present		**At least intermittent**
		Present			**At least intermittent**
	Many (20+)	Absent	Absent		**Intermittent**
			Present		**At least intermittent**
		Present	Absent		**At least intermittent**
			Present		**Intermittent**
Many (3+)	None	Absent	Absent	Absent	**Need more information**
				Present	**At least intermittent**
			Present		**At least intermittent**
	Few (1-19)	Absent			**At least intermittent**
		Present			**Perennial**
	Many (20+)	Absent			**At least intermittent**
		Present			**Perennial**

Supported by subsurface (deep) nuisance flow from up slope developments

Shading provided to enhance readability by increasing the contrast between neighboring cells; empty cells indicate the classification will not change with additional information however it is recommended that all five indicators be measured and recorded during every assessment.

Investigation Location C

C

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: W. Dam Rehabilitation
Project Number: 36TM006
Stream:
Investigator(s): L. BURNSIDE

Date: 4/3/21
Town: Reno
Photo begin file#:

Time:
State: NV
Photo end file#:

Y [X] / N [ ] Do normal circumstances exist on the site?

Y [ ] / N [X] Is the site significantly disturbed?

Location Details: C Upper Manmade Channel
Projection: NAD1983 UN **Datum:** NA-1983
Coordinates: 39.546570, -119.843779

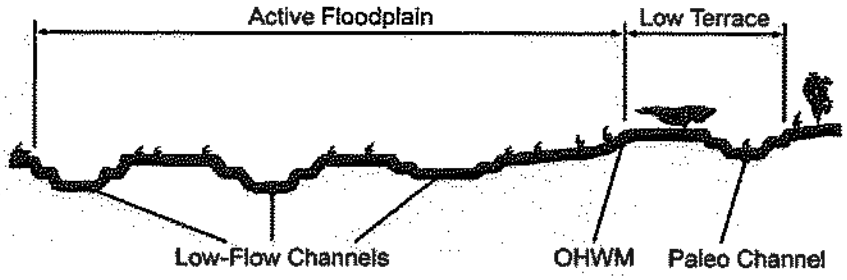
Potential anthropogenic influences on the channel system:
Manmade flood conveyance channel to dam and stand pipe

Brief site description:
W. Wash Dam - Emergency flood control facility

Checklist of resources (if available):

- [X] Aerial photography
  Dates:
- [X] Topographic maps
- [ ] Geologic maps
- [ ] Vegetation maps
- [ ] Soils maps
- [ ] Rainfall/precipitation maps
- [ ] Existing delineation(s) for site
- [X] Global positioning system (GPS)
- [ ] Other studies
- [ ] Stream gage data
  Gage number:
  Period of record:
  - [ ] History of recent effective discharges
  - [ ] Results of flood frequency analysis
  - [ ] Most recent shift-adjusted rating
  - [ ] Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

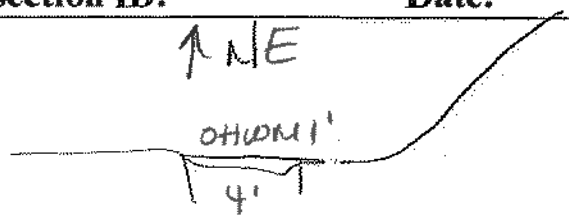


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - [X] Mapping on aerial photograph
   - [ ] Digitized on computer
   - [X] GPS
   - [ ] Other:

Project ID: **Cross section ID:** **Date:** **Time:**

Cross section drawing:



OHWM

GPS point: 39.545250, -119.846088

Indicators:

- ☐ Change in average sediment texture
- ☐ Change in vegetation species
- ☐ Change in vegetation cover
- ☒ Break in bank slope
- ☐ Other: _____
- ☐ Other: _____

Comments:
√ shallow conveyance under flood conditions sheet flows across the basinwide area

Floodplain unit: ☐ Low-Flow Channel ☒ Active Floodplain ☐ Low Terrace

GPS point: 39.545250, -119.846088

Characteristics of the floodplain unit:

Average sediment texture: Sandy clay

Total veg cover: 100 % Tree: 60 % Shrub: 30 % Herb: 10 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☒ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☒ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

C

Beta Arid West Streamflow Duration Assessment Method

General site information

Project name or number: W. Wash Dam

Site code or identifier: C

Assessor(s): L. BURNSIDE

Waterway name: W. Wash

Visit date: 6/3/21

Current weather conditions (check one)
- ☐ Storm/heavy rain
- ☐ Steady rain
- ☐ Intermittent rain
- ☐ Snowing
- ☐ Cloudy (___ % cover)
- ☒ Clear/Sunny

Notes on current or recent weather conditions (e.g., precipitation in previous week):

Coordinates at downstream end (decimal degrees):
Lat (N): 39.546570
Long (W): -119.848779
Datum: NA 1983

Surrounding land-use within 100 m (check one or two):
- ☒ Urban/industrial/residential
- ☐ Agricultural (farmland, crops, vineyards, pasture)
- ☐ Developed open-space (e.g., golf course)
- ☐ Forested
- ☐ Other natural
- ☒ Other: Flood Control Facility

Describe reach boundaries: channel is consistent throughout

Mean channel width (m): 4'

Reach length[1] (m): 40x width; min 40 m; max 200 m. Entire 1006 LF

Enter photo ID, or check if completed
Top down: _____ Mid down: _____
Mid up: _____ Bottom up: _____
Investigation Location

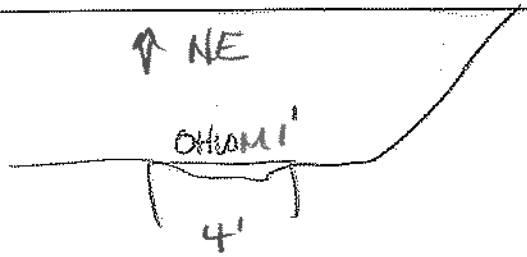
Disturbed or difficult conditions (check all that apply):
- ☐ Recent flood or debris flow
- ☐ Stream modifications (e.g., channelization)
- ☐ Diversions
- ☐ Discharges
- ☐ Drought
- ☐ Vegetation removal/limitations
- ☐ Other (explain in notes)
- ☒ None

Notes on disturbances or difficult site conditions:

Observed hydrology:
- 0 % of reach with surface flow
- 0 % of reach with sub-surface or surface flow
- 0 # of isolated pools

Comments on observed hydrology:

Site sketch:



1. Hydrophytic plant species

Record up to 5 hydrophytic plant species (FACW or OBL in the **Arid West** regional wetland plant list) within the assessment area: **within the channel or up to one half-channel width**. Explain in notes if species has an odd distribution (e.g., covers less than 2% of assessment area, long-lived species solely represented by seedlings, or long-lived species solely represented by specimens in decline), or if there is uncertainty about the identification. Enter photo ID, or check if photo is taken.

Check if applicable: ☐ No vegetation in assessment area ☐ No hydrophytes in assessment area

Species	Odd distribution?	Notes	Photo ID
Salix Exigua		Location C	
Populus fremontii		"	
Shepherdia argentea		"	
Juncus balticus		"	
Distichlis spicata		"	
Agropyron cristatum		"	

Notes on hydrophytic vegetation:

2 and 3. Aquatic invertebrates

2. How many aquatic invertebrates are quantified in a 15-minute search?

Number of individuals quantified:
☒ None
☐ 1 to 19
☐ 20 +

(Do not count mosquitos)

Photo ID:_____

3. Is there evidence of aquatic stages of EPT (Ephemeroptera, Plecoptera and Trichoptera)?

Yes / No

Ephemeroptera larva
Image credit: Dieter Tracey

Plecoptera larva
Tracey Saxby

Trichoptera larva
Tracey Saxby

Notes on aquatic invertebrates:

4. Algal Cover

Are algae found on the streambed? ☐ Check if *all* observed algae appear to be deposited from an upstream source.	☒ Not detected ☐ Yes, < 10% cover ☐ Yes, ≥ 10% (check Yes in single indicator below)	Notes on algae cover:	Photo ID:

5. Are single indicators observed?

Indicator	Present	Notes	Photo ID
Fish	☐ Yes ☒ No, no fish ☐ No, only non-native mosquitofish		
Algae cover ≥ 10%	☐ Yes ☒ No		

Supplemental information E.g., aquatic or semi-aquatic amphibians, snakes, or turtles; iron-oxidizing bacteria and fungi; etc.

None detected

Photo log

Indicate if any other photos taken during the assessment

Photo ID	Description
	location B

Additional notes about the assessment:

Classification: Ephemeral

1. Hydrophytic plant species	2. Aquatic invertebrates	3. EPT taxa	4. Algae	5. Single indicators • fish present • algae cover ≥ 10%	Classification
None	None	Absent	Absent	Absent	**Ephemeral**
				Present	**At least intermittent**
			Present	Absent	**Need more information**
				Present	**At least intermittent**
		Present			**At least intermittent**
	Few (1-19)	Absent	Absent	Absent	**Need more information**
				Present	**At least intermittent**
			Present	Absent	**Need more information**
				Present	**At least intermittent**
		Present			**At least intermittent**
	Many (20+)	Absent	Absent	Absent	**Need more information**
				Present	**At least intermittent**
			Present	Absent	**Need more information**
				Present	**At least intermittent**
		Present			**At least intermittent**
Few (1-2)	None	Absent	Absent	Absent	**Need more information**
				Present	**At least intermittent**
			Present		**At least intermittent**
	Few (1-19)	Absent	Absent		**Intermittent**
			Present		**At least intermittent**
		Present			**At least intermittent**
	Many (20+)	Absent	Absent		**Intermittent**
			Present		**At least intermittent**
		Present	Absent		**At least intermittent**
			Present		**Intermittent**
Many (3+)	None	Absent	Absent	Absent	**Need more information**
				Present	**At least intermittent**
			Present		**At least intermittent**
	Few (1-19)	Absent			**At least intermittent**
		Present			**Perennial**
	Many (20+)	Absent			**At least intermittent**
		Present			**Perennial**

Supported by subsurface (deep) flow from upslope development

Shading provided to enhance readability by increasing the contrast between neighboring cells; empty cells indicate the classification will not change with additional information however it is recommended that all five indicators be measured and recorded during every assessment.

Investigation Location D

Highland Ditch – Concrete Lined

D

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: W. Dam Rehabilitation
Project Number: 36T7006
Stream:
Investigator(s): L. BURNSIDE

Date: 6/3/21
Town: Reno
Photo begin file#:

Time:
State: NV
Photo end file#:

Y ☒ / N ☐ Do normal circumstances exist on the site?

Y ☐ / N ☒ Is the site significantly disturbed?

Location Details: D Highland Ditch

Projection: NAD 1983 11N **Datum:** NA 1983
Coordinates: 39.541904, -119.842900

Potential anthropogenic influences on the channel system:
Man made concrete lined ditch

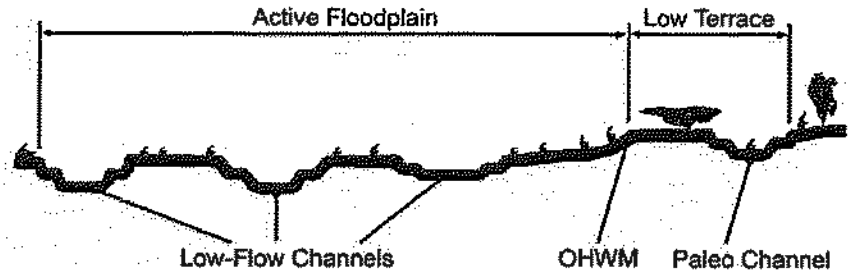
Brief site description:
Convey Truckee water flow

Checklist of resources (if available):

- ☒ Aerial photography
  Dates:
- ☒ Topographic maps
- ☐ Geologic maps
- ☐ Vegetation maps
- ☒ Soils maps
- ☐ Rainfall/precipitation maps
- ☐ Existing delineation(s) for site
- ☒ Global positioning system (GPS)
- ☐ Other studies

- ☐ Stream gage data
  Gage number:
  Period of record:
  - ☐ History of recent effective discharges
  - ☐ Results of flood frequency analysis
  - ☐ Most recent shift-adjusted rating
  - ☐ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units



Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - ☒ Mapping on aerial photograph
   - ☐ Digitized on computer
   - ☒ GPS
   - ☐ Other:

Project ID: **Cross section ID:** **Date:** **Time:**

Cross section drawing:

Concrete ditch

OHWM

GPS point: _____

Indicators:

- ☐ Change in average sediment texture
- ☐ Change in vegetation species
- ☐ Change in vegetation cover
- ☐ Break in bank slope
- ☐ Other: _____
- ☐ Other: _____

Comments:

Concrete ditch

Floodplain unit:

☐ Low-Flow Channel ☐ Active Floodplain ☐ Low Terrace

GPS point: _____

No Floodplain

Characteristics of the floodplain unit:

Average sediment texture: _____

Total veg cover: _____% Tree: _____% Shrub: _____% Herb: _____%

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

D

Beta Arid West Streamflow Duration Assessment Method

General site information

Project name or number: 10 Wash Dam		
Site code or identifier: D	Assessor(s): L. Burnside	
Waterway name: High land Ditch		Visit date: 6/3/21
Current weather conditions (check one) ☐ Storm/heavy rain ☐ Steady rain ☐ Intermittent rain ☐ Snowing ☐ Cloudy (___ % cover) ☒ Clear/Sunny	Notes on current or recent weather conditions (e.g., precipitation in previous week):	Coordinates at downstream end (decimal degrees): Lat (N): 39.541904 Long (W): -119.842900 Datum: NA 1983
Surrounding land-use within 100 m (check one or two): ☒ Urban/industrial/residential ☐ Agricultural (farmland, crops, vineyards, pasture) ☐ Developed open-space (e.g., golf course) ☐ Forested ☐ Other natural ☐ Other:	Describe reach boundaries: Concrete Ditch	
Mean channel width (m) 10'	Reach length (m): 40x width; min 40 m; max 200 m. 100 LF	Enter photo ID, or check if completed Top down: _____ Mid down: _____ Mid up: _____ Bottom up: _____ Investigation Location
Disturbed or difficult conditions (check all that apply): ☐ Recent flood or debris flow ☐ Stream modifications (e.g., channelization) ☐ Diversions ☐ Discharges ☐ Drought ☐ Vegetation removal/limitations ☐ Other (explain in notes) ☐ None	Notes on disturbances or difficult site conditions: Concrete Ditch	
Observed hydrology: 100 % of reach with surface flow 100 % of reach with sub-surface or surface flow / # of isolated pools	Comments on observed hydrology:	

Site sketch:

1. Hydrophytic plant species

Record up to 5 hydrophytic plant species (FACW or OBL in the **Arid West** regional wetland plant list) within the assessment area: **within the channel or up to one half-channel width**. Explain in notes if species has an odd distribution (e.g., covers less than 2% of assessment area, long-lived species solely represented by seedlings, or long-lived species solely represented by specimens in decline), or if there is uncertainty about the identification. Enter photo ID, or check if photo is taken.

Check if applicable: ☒ No vegetation in assessment area ☐ No hydrophytes in assessment area

Species	Odd distribution?	Notes	Photo ID

Notes on hydrophytic vegetation:

2 and 3. Aquatic invertebrates

2. How many aquatic invertebrates are quantified in a 15-minute search?

Number of individuals quantified:
- ☒ None
- ☐ 1 to 19
- ☐ 20 +

(Do not count mosquitos)

Photo ID:_____

3. Is there evidence of aquatic stages of EPT (Ephemeroptera, Plecoptera and Trichoptera)?

Yes / No

Ephemeroptera larva
Image credit: Dieter Tracey

Plecoptera larva
Tracey Saxby

Trichoptera larva
Tracey Saxby

Notes on aquatic invertebrates:

4. Algal Cover

Are algae found on the streambed?		Notes on algae cover:	Photo ID:
☐ Check if *all* observed algae appear to be deposited from an upstream source.	☒ Not detected ☐ Yes, < 10% cover ☐ Yes, ≥ 10% (check Yes in single indicator below)		

5. Are single indicators observed?

Indicator	Present	Notes	Photo ID
Fish	☐ Yes ☒ No, no fish ☐ No, only non-native mosquitofish		
Algae cover ≥ 10%	☐ Yes ☒ No		

Supplemental information E.g., aquatic or semi-aquatic amphibians, snakes, or turtles; iron-oxidizing bacteria and fungi; etc.

None detected

Photo log

Indicate if any other photos taken during the assessment

Photo ID	Description
	location 1

Additional notes about the assessment:

Manmade irrigation ditch

Classification: Intermittent / Controlled Flow to a TNW

1. Hydrophytic plant species	2. Aquatic invertebrates	3. EPT taxa	4. Algae	5. Single indicators • fish present • algae cover ≥ 10%	Classification
None	None	Absent	Absent	Absent	**Ephemeral**
				Present	**At least intermittent**
			Present	Absent	**Need more information**
				Present	**At least intermittent**
	Few (1-19)	Absent	Absent	Absent	**Need more information**
				Present	**At least intermittent**
			Present	Absent	**Need more information**
				Present	**At least intermittent**
		Present			**At least intermittent**
	Many (20+)	Absent	Absent	Absent	**Need more information**
				Present	**At least intermittent**
			Present	Absent	**Need more information**
				Present	**At least intermittent**
		Present			**At least intermittent**
Few (1-2)	None	Absent	Absent	Absent	**Need more information**
				Present	**At least intermittent**
			Present		**At least intermittent**
	Few (1-19)	Absent	Absent		**Intermittent**
			Present		**At least intermittent**
		Present			**At least intermittent**
	Many (20+)	Absent	Absent		**Intermittent**
			Present		**At least intermittent**
		Present	Absent		**At least intermittent**
			Present		**Intermittent**
Many (3+)	None	Absent	Absent	Absent	**Need more information**
				Present	**At least intermittent**
			Present		**At least intermittent**
	Few (1-19)	Absent			**At least intermittent**
		Present			**Perennial**
	Many (20+)	Absent			**At least intermittent**
		Present			**Perennial**

Shading provided to enhance readability by increasing the contrast between neighboring cells; empty cells indicate the classification will not change with additional information however it is recommended that all five indicators be measured and recorded during every assessment.

Investigation Location D

Highland Ditch – Dam Discharge Culvert

Investigation Location D

Highland Ditch – Leaky Flume Section

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: W. Wash Dam City/County: Reno/Washoe Sampling Date:
Applicant/Owner: City of Reno State: NV Sampling Point: D1
Investigator(s): L. Burkhalter Section, Township, Range: 3 and 4, T19N, R19E
Landform (hillslope, terrace, etc.): Depression Local relief (concave, convex, none): Concave Slope (%): 0-2
Subregion (LRR): D Range & Irrigated Region Lat: 39.541909 Long: -119.844551 Datum: NA1983
Soil Map Unit Name: Wasco clay 15-30% Slopes - 1050 NWI classification: Upland
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ____ (If no, explain in Remarks.)
Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No ____
Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ✓ No ____
Hydric Soil Present? Yes ____ No ✓
Wetland Hydrology Present? Yes ✓ No ____
Is the Sampled Area within a Wetland? Yes ____ No X

Remarks: The corrugated metal flume has significant splits resulting insignificant leaks

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status
1. Salix exigua	90	✓	FACW
2. Shepherdia argentea	10		FACU
3.			
4.			
	100 = Total Cover		

Sapling/Shrub Stratum (Plot size: ____)			
1.			
2.			
3.			
4.			
5.			
	= Total Cover		

Herb Stratum (Plot size: ____)			
1. Typha angustifolia	100	✓	OBL
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	100 = Total Cover		

Woody Vine Stratum (Plot size: ____)			
1.			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum 40 % Cover of Biotic Crust ____

Dominance Test worksheet:
Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)
Total Number of Dominant Species Across All Strata: 2 (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: 10% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	1	x 1 =	1
FACW species	1	x 2 =	1
FAC species	0	x 3 =	0
FACU species	1	x 4 =	4
UPL species	0	x 5 =	0
Column Totals:	3 (A)		6 (B)

Prevalence Index = B/A = 2

Hydrophytic Vegetation Indicators:
___ Dominance Test is >50%
✓ Prevalence Index is ≤3.0[1]
___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
✓ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No ____

Remarks: Veg is supported by severe ditch leak in corrugated flume

SOIL

Sampling Point: _____

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
							Engineered fill and rock	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes _____ No X

Remarks:

Engineered fill and rock

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ✓ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ✓ No ___ Depth (inches): 3

Water Table Present? Yes ___ No ✓ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ___ No ✓ Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Leaky ditch wetland

Appendix F Regulatory Branch Memorandum 2004-03 – “Leaky Ditch Wetlands”

CESPK-CO-R (1145) 13 Feb 2004

REGULATORY BRANCH MEMORANDUM 2004-03

SUBJECT: "Leaky Ditch" Wetlands

1. Purpose. To establish policy for "leaky ditch" wetlands.

2. Applicability. This applies to all actions in the Sacramento District.

3. References.

a. Federal Register, Vol. 51, No. 219, dated 13 November 1986, page 41217.

b. Regulatory Branch Office Memorandum 2003-04, "Irrigated" Wetlands, dated 31 Oct 2003.

c. 33 CFR 328: Definition of Waters of the United States.

4. Definition. A "leaky ditch" wetland is an area down slope from an irrigation ditch that meets the definition of wetlands in accordance with the Corps' Wetland Delineation Manual where the hydrology is due solely to leakage from the ditch.

5. Background. Reference 3a states that artificially irrigated areas, which would revert to upland if the irrigation ceased, and irrigation ditches excavated on dry land are generally not considered to be waters of the United States. Reference 3b identifies the procedures to be used in differentiating between natural and artificially irrigated wetlands. Some leaky ditch wetlands have been considered "waters of the United States" in the past since they did not meet a strict interpretation as irrigated. This has resulted in confusion and an appearance of inconsistency.

6. Policy. Wetlands created solely by leakage from irrigation ditches will be considered "artificially irrigated wetlands." Accordingly, such wetlands will not be considered waters of the U.S. Where there is uncertainty regarding the source of hydrology for the

wetland, we will assume that the wetland is supported, at least partially, by natural hydrology unless clearly demonstrated otherwise. In such cases the wetland would be jurisdictional until shown to be due solely to a leaky ditch.

ANDREW J. ROSENAU
Chief, Regulatory Branch

Appendix G Signed Statement from Property Owner Allowing Access

TEMPORARY LICENSE TO ENTER UPON PROPERTY

This Temporary License to Enter Upon Property entered into this _____ day of _____ 2022, by **CITY OF RENO, a municipal corporation**, ("CITY"), gives permission to United States Army Corps of Engineers ("USACE") and its agents and contractors to enter upon various parcels owned by CITY ("PROPERTY"), further described in Exhibit "A" and located in Reno, Nevada for a period of time commencing January 31, 2022 and terminating on or before February 28, 2023 for the purpose of allowing the evaluation of water resources which may be jurisdictional resources of the United States Army Corps of Engineers.

RECITALS

WHEREAS, the CITY is owner of the attached various Assessor Parcel Numbers described in Exhibit "A", located adjacent at the intersection of Keystone Avenue and North McCarran Boulevard, Reno, Nevada at the intersection of Township 20 North, Range 19 East, Sections 33 and 34 with Township 19 North, Range 19 East, Sections 3 and 4.

WHEREAS, USACE desires to enter upon the various City owned properties for the purpose of the evaluation of water resources which may be jurisdictional resources of the United States Army Corps of Engineers described in Exhibit "A".

WHEREAS, the CITY desires to give permission to USACE to enter upon the various City owned properties for the purpose and reasons stated above.

NOW, THEREFORE, in consideration with respect to the above recitals, the CITY gives permission to USACE to enter upon the various City owned properties described in Exhibit "A" for the purpose of having access to the PROPERTY for the period commencing on January 31, 2022 and terminating on February 28, 2023 for the purpose the evaluation of water resources which may be jurisdictional resources of the United States Army Corps of Engineers.

1. This License is to be governed by and construed in accordance with the laws of the State of Nevada.

2. Both CITY and USACE represent they have the authority to sign this License and has had sufficient opportunity to have an attorney of their choice review this License.

3. USACE will pay for any and all damages sustained to the above described property as a result of their activities and the activities of its agents and contractors.

4. USACE for the duration of this Temporary License to Enter Upon Property, will indemnify, hold harmless and defend CITY from and against liability for loss, damage or liability CITY may suffer or sustain by reasons arising from the performance of the activity identified above by USACE, its agents and contractors. Liability includes all claims, actions, damages, losses, judgments, injuries, costs and expenses including, but not limited to, reasonable attorney's fees and costs.

5. USACE acknowledges and agrees that it is entering and using the Premises in its "as is" condition and all activities of License, its agents and contractors are performed at its own risk.

6. USACE, its agents and contractors shall maintain, for a two year period of time after termination or revocation of this License, comprehensive general liability insurance for limits of not less than two million dollars ($2,000,000) for bodily injury and property damage, per occurrence. As evidence of liability insurance coverage, the City will accept certification of insurance issued by an authorized representative of the insurance carrier. Each certificate shall contain a 30-day written notice of cancellation to the certificate holder and shall name the City as an additional insured for any reason other than non-payment of premium. For non-payment of premium at least 10-day written notice of cancellation for non-payment of premium.

7. No legal title or leasehold interest in the Property is created or vested in USACE by the grant of this License. Use of the Property shall be limited to the scope of this License.

8. This License and rights conveyed herein are subordinate to the City's rights and abilities to determine, in its sole discretion, what is in the best interest of the public with respect to use and maintenance of the subject property, as such all or a portion of the rights conveyed by this License could be superseded and replaced for other public uses.

9. USACE, its agents and contractors shall not use the Property which will in any way conflict with any law, statute, ordinance or governmental rule or regulation now in force or which may hereafter be enacted or promulgated.

10. City may revoke this License at will by having a written revocation notice delivered to the other party prior to the termination date specified in the notice.

11. City will not waive and intends to assert available defenses and limitations contained in Chapter 41 of the Nevada Revised Statutes.

12. Any and all notices, requests, demands or other communications to or upon a party in connection with this License shall be in writing and shall be personally delivered or sent by telecopy or other electronic facsimile transmission, or by certified mail postage prepaid, to the respective designated representative and at the following address or an address for each party as designated from time to time:

CITY: City of Reno
Attn: Lori Miles, Property Agent
P.O. Box 1900
Reno, Nevada 89505

USACE: Jennifer C. Thomason, Senior Project Manager
300 Booth Street, Room 3050
Reno, NV 89509-1361

13. No right hereunder may be assigned, divided, transferred, encumbered or granted by USACE.

14. This License is terminated on February 28, 2023.

CITY OF RENO

By: _____
John Flansberg
Director of Public Works

APPROVED AS TO FORM:

By:_____
Susan Ball Rothe
Deputy City Attorney

United States Army Corps of Engineers

By: _____
Jennifer C. Thomason, Senior Project Manager

EXHIBIT "A"

CITY OF RENO OWNED WEST WASH DAM AND EAST WASH DIVERSION DAM ACCESS PARCELS
Available for Use for Evaluation of Water Resources which may be Jurisdictional Resources of the United States Army Corps of Engineers by
UNITED STATES ARMY CORPS OF ENGINEERS

Parcel Number	Description of Parcel
001-190-16	Southwest corner Keystone Avenue and North McCarran Boulevard
001-101-07	Northwest of Wyoming Avenue and Putnam Drive
001-111-10	Northwest of Wyoming Avenue and Putnam Drive
002-201-01	North of Putnam Drive and Wyoming Avenue intersection
002-202-01	Northeast of Putnam Drive and Wyoming Avenue intersection

Appendix H ORM Upload Sheet

Waters_Name	State	Cowardin_Code	HGM_Code	Meas_Type	Amount	Units	Waters_Type	Latitude	Longitude	Local_Waterway
Highland Ditch	NEVADA	U	RIVERINE	Linear		FOOT	RPW			Truckee River
Unnamed Drainage 1	NEVADA	R6	MINSOILFLT	Linear		FOOT	UPLAND			
Unnamed Drainage 2	NEVADA	R6	MINSOILFLT	Linear		FOOT	UPLAND			

City of Reno

Technical Memorandum #4

Detailed Alternatives
West Wash Dam Rehabilitation

Peavine Mountain Watershed Plan-EA

September 2022

OWNER:
City of Reno
1 East First Street
Reno, NV 89501

LEAD FEDERAL AGENCY:
USDA-NRCS
1365 Corporate Blvd
Reno, NV 89502

ENGINEER:

Farr West Engineering
5510 Longley Lane
Reno, NV 89511
(775) 851-4788
(775) 851-0766 Fax

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1.0 INTRODUCTION

West Wash Dam, in the Peavine Mountain Watershed of Washoe County, Nevada, is included in a United States Department of Agriculture-Natural Resources Conservation Service (USDA-NRCS) funded rehabilitation partnership project. The dam provides protection against flooding to about 30,000 Nevadans who live and work downstream. Additionally, the dam protects downstream city roads, one state highway, and an interstate highway. Among other critical infrastructure, the dam also protects power lines and railroad tracks.

West Wash Dam was constructed in 1961 under the direction and authority of Watershed Protection and Flood Prevention Act (Public Law 83-566). East Wash diversion Dam, constructed in 1960 under the same program, contributes storm water flow from Peavine Mountain Watershed into West Wash Dam, thereby creating a linked storm water control system. The original watershed plans for these dams used an evaluated life of 50 years. Having reached over 50 years in age, the dams are eligible for rehabilitation through the NRCS Watershed and Flood Prevention Operations Program. The goals of the program include prevention of erosion, floodwater, and sediment damage; to further the conservation, use, and disposal of water; and to further the conservation and proper use of land in authorized watersheds (United States Department of Agriculture Natural Resources Conservation Service, n.d.)

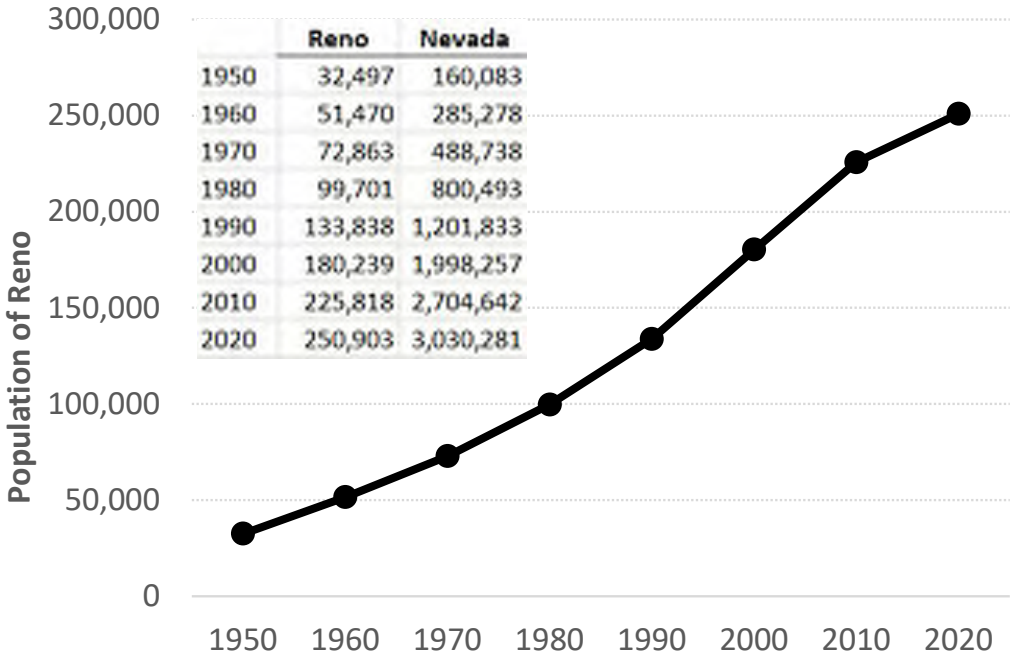
Both the West Wash and East Wash dams are currently classified as High Hazard Dams by the Nevada Division of Water Resources (NDWR) and do not meet the requirements for dam safety by the State of Nevada, or NRCS. Previous studies indicate that hydrologic/hydraulic inadequacies have been identified primarily with the West Wash Dam (MACTEC Engineering and Consulting, Inc., 2006).

West Wash Detention Dam is located at the intersection of Wyoming and Gulling Streets at the intersection of Township 19 North, Range 19 East, Sections 3 and 4. Inflow to the West Wash Dam comes from approximately 3.34 square miles of watershed, which includes roughly 2.09 square miles of East Wash Dam's watershed. (City of Reno, 2006) The East Wash Diversion Dam is located at the intersection of Keystone Avenue and North McCarran Boulevard at the intersection of Township 20 North, Range 19 East, Sections 33 and 34 with Township 19 North, Range 19 East, Sections 3 and 4. Inflow to the East Wash Dam comes from 2.09 square miles of watershed on the southeast flank of Peavine Mountain.

The City of Reno entered into an agreement with the USDA – NRCS to rehabilitate the West Wash Dam to meet current NRCS, City of Reno and State of Nevada Division of Water Resources (DWR) dam safety criteria and performance standards. Farr West Engineering (FWE) will assist the City of Reno (The City or COR) to meet the requirements of the NRCS Watershed Program including the development of a physically, environmentally, socially, and economically sound improvement plan known as the Supplemental Watershed Plan and Environmental Assessment (Plan/EA).

The original Peavine Mountain Watershed Plan noted damaging floods impacting residential areas of Reno, which was solved by constructing the East and West Wash Dams (City of Reno, 1958). Since that time Reno has grown significantly and dense residential areas are immediately adjacent to and downstream of both dams. Today, residential, business and transportation infrastructure are built within the historical path of storm drainage from Peavine Mountain (Hansford Economic Consulting LLC, 2022). The City of Reno is a thriving economic hub with a growing population. Figure 1 illustrates the population growth in the City of Reno and State of Nevada since 1950, the last decennial Census before the West Wash Dam was constructed. The City of Reno has sustained an average annual population growth of 3.0% since 1950, while the State of Nevada has seen average annual population growth of 4.3% during the same period.

Figure 1: City of Reno Historical Population Growth*



	Reno	Nevada
1950	32,497	160,083
1960	51,470	285,278
1970	72,863	488,738
1980	99,701	800,493
1990	133,838	1,201,833
2000	180,239	1,998,257
2010	225,818	2,704,642
2020	250,903	3,030,281

*Courtesy of Economic Appendix (Hansford Economic Consulting LLC, 2022)

Flooding from storm events due to stormwater runoff have continued to occur and impact the City of Reno. Maintaining the East and West Wash Dams will protect homes, businesses, and infrastructure downstream of the dams from floodwater, sediment, and erosion damage (City of Reno, 1958).

NRCS requested evaluation of East Wash Dam be included in modeling and alternatives development for this project due to the interconnected functionality of the dams. An in-depth discussion about the hydraulics/hydrology associated with the East and West Wash Dams is presented Technical Memoranda produced by Farr West Engineering (Farr West Engineering, 2022). Modeling shows the East Wash Dam will not pass the Probable Maximum Flood (PMF) without excessive damage to the spillway and the West Wash Dam will not pass the PMF without overtopping. Addressing these deficiencies is the purpose of the development of the alternatives discussed in this report.

The West Wash Dam Rehabilitation project is needed to address current safety and regulatory deficiencies at the West Wash and East Wash Dams and bring both dams into compliance with current National Soil Conservation Service (NRCS) and the Nevada Division of Water Resources (NDWR) safety regulations, engineering standards, and performance criteria. The West Wash Dam Rehabilitation project is also needed to ensure that the dam is properly maintained to minimize the risk to lives and property in the surrounding and downstream urban area within the City of Reno.

The purposes of the West Wash Dam Rehabilitation project are to:

i. Preserve the flood protection function of the West Wash Dam to meet High Hazard Dam safety requirements under NRCS TR-60 and NDWR Nevada Administrative Code (NAC)
ii. To protect lives and property in the surrounding urban area, and
iii. To comply with current performance and safety standards in a cost effective and environmentally acceptable manner

1.1 NRCS OBJECTIVES

The NRCS Watershed and Flood Prevention Operations Program goals include preventing erosion, floodwater, and sediment damage; furthering the conservation, development, utilization, and disposal of water; and furthering the conservation and proper use of land in authorized watersheds (USDA NRCS, n.d.).

1.1.1 Guiding Principles

The guiding principles of NRCS include promoting healthy and resilient ecosystems, sustainable economic development, wise use of floodplains, increasing public safety and ensuring environmental justice by using a watershed approach to analysis and decision making though Federal investments in water resources (Congressional Research Service, 2015)**.**

On a local level, the City of Reno's Master Plan offers guidance on how the NRCS objectives align with the City's stated objectives and purpose and need for the project (City of Reno, 2017). Selected sections of the City's plan relevant to this project are listed below.

- Major Drainageways
    - It is the City's policy to preserve and improve major drainageways as open and recreational space for current and future generations and to ensure that, when practicable, facilities and improvements that address stormwater discharge and floodplain management are designed to serve other regional objectives such as recreation, open space preservation, and enhancement of water quality.
    - Development projects in major drainageways should require additional review and protection in order to implement the following objectives:
        - To ensure the safety of people and property by providing for drainage of stormwater and maintaining natural attenuation of peak flows;
        - To maintain, preserve, or enhance the quality of the water in both the Truckee River and Stead basins, and to promote continued natural infiltration of stormwater runoff;
        - To maintain or improve wildlife habitats, native vegetation, and natural terrain;
        - To reduce the need for the expenditure of public funds to remedy or avoid flood hazards, erosion, or other situations caused by inappropriate alteration of natural watercourses;
        - To provide open space and land easements for conservation or access, especially in environmentally sensitive areas where development requires new approaches and attention to open space needs;
        - To improve or enhance wildlife corridors in urban areas to maintain the quality of life and the ecological balance of the community;
        - To ensure that major drainageways are used for public access and recreational facilities, where appropriate;
        - To reduce major drainageway erosion;
        - To prevent sediments (man-caused or occurring naturally) from reaching the Truckee River;
        - To provide for open fencing adjacent to major drainageways to maintain aesthetic continuity, encourage community pride, and encourage self-policing; and

        - To identify critical drainage areas in the City of Reno and its sphere of influence (SO') and present strategies for their care, enhancement, protection, and treatment, both for function and appearance.
    - The design approach to any channel improvements should be appropriate to the site and based on maintaining a natural channel, overall aesthetics, and the quality of the natural environment. Therefore, stripping the channel of vegetation or creating steep, barren side slopes should be prohibited.
- Flood Management
    - Encourage the use of non-structural solutions for flood control and highly discourage the use of fill for development in floodplains and drainageways. If fill for development in floodplains and drainageways occurs in hydrographic basins (i.e. those that drain to the Truckee River and closed drainage basins), it should only be allowed when it is demonstrated that:
        - Flood elevations will not be increased;
        - Hazards to other properties in the basin will not result or will be mitigated; and
        - Fill or associated modifications to drainage patterns will not negatively impact wetlands.
    - Periodically adopt updated flood mapping in coordination with FEMA to reflect potential changes to the city's flood hazard boundaries over time and ensure hydrology studies address closed drainage basin systems.
- Resiliency of Infrastructure and Facilities
    - Develop mitigation strategies, redundancies, and back-up systems, or consider relocation of city infrastructure and facilities located in high-hazard areas. Where relocation and redundancies are not feasible, seek to upgrade existing and build new infrastructure and facilities designed to withstand a greater degree of stress or damage. Work with regional service and utility providers to ensure their infrastructure and facilities are protected as well.

2.0 PROJECT ALTERNATIVES

2.1 PURPOSE AND NEED

When formulating an alternative, it was first determined whether the alternative met the project purpose and need. The project purpose and need are summarized below:

- Project Purpose:
  - Preserve the flood protection function of the West Wash Dam, a High Hazard Dam and meet the requirements of NRCS and Nevada Division of Water Resources (NDWR) Division of Dam safety
  - Protect lives and property in the surrounding urban area
  - Comply with current performance and safety standards in a cost effective and environmentally acceptable manner
- Project Need:
  - Address current deficiencies at West Wash and East Wash Dams to bring both dams into compliance with current dam safety regulations, engineering standards and performance criteria for High Hazard Dams under NRCS TR-60 for PMP events and NDWR Division of Dams NAC 535.240 for minimum freeboard requirements.
  - Ensure the watershed structure is properly maintained to minimize the risk to lives and property in the surrounding and downstream area which has been developed into a thriving, urban residential and commercial center since the original construction of the dams.

2.2 FORMULATION PROCESS

The formulation of alternatives followed the Council on Environmental Quality's (CEQ) regulations for implementing NEPA and numerous USDA-NRCS watershed planning policies (USDA NRCS, n.d.). A virtual public scoping meeting was held via the City of Reno's Zoom platform on Tuesday, October 19, 2021, 6pm – 8pm. A link to pre-register for the meeting was included on the project website. Participants were invited to submit comments to the City of Reno prior to the meeting by emailing, mailing, or calling project manager Steve Gamilis. A total of thirty-nine (39) individual comments were received for the project during the scoping process. Twenty (20) public comments were received September 21, 2021 through December 19, 2021. Nineteen (19) comments were received during the scoping meeting by members of the public who attended the meeting. Written comments were replied to individually by the City of Reno. Comments submitted virtually were answered during the scoping meeting. Scoping comments were incorporated into the formulation process of alternatives. Many alternatives were initially considered.

Alternative formulation also included identification of the problems and challenges with the current state of the structures, the upstream watershed, and the urban development downstream. Meeting existing safety requirements for high hazard dams and providing protection for the City of Reno, including its increase in urbanization, were identified as the major project challenges and opportunities.

Compliance with current NDWR and NRCS Safety of Dams regulations, engineering standards, and performance criteria is necessary to ensure the protection of lives and property surrounding and downstream of the dams. The following challenges were identified:

- Repairs and necessary maintenance identified in yearly dam inspection reports
- Hydraulic inadequacy of current dam design
- High hazard dam classification
- Possible sediment accumulation that reduces runoff volume stored by the dams

Since 1958, when the original Peavine Mountain Watershed Plan was written, Reno has experienced significant development. Today, the City of Reno has a population of over 180,000 (City of Reno, 2017). Reno is expected to grow by more than 62,000 residents between 2015 and 2036, reaching a population of over 301,000 in 2036 (City of Reno, 2017). The East and West Wash Dams are estimated to provide protection against flooding to about 30,000 Nevadans who live and work downstream of the dams. Additionally, the dams protect downstream city roads, one state highway (Highway 395), and Interstate 80. The health and safety of the residents and infrastructure of Reno is critical to this project. Challenges related to the City's urbanization are summarized below.

- Change to urban land use around and below the dam area since project inception in 1958
- Continuing growth in the City of Reno
- Reliance on the project area as an informal recreation area
- Infrastructure encroachment across facility features

This project presents opportunities for NRCS and the City to not only meet safety standards but to provide flood protection for the City into the future. Opportunities that the West Wash Dam Rehabilitation Project provides include:

- Maintain downstream flood protection and reduce risk of loss of life and damage to property
- Reduce possibility of dam failure and protect downstream communities, real estate, and infrastructure
- Full compliance with NDWR and NRCS criteria
- Removing possible sediment accumulation with East and West Wash Dams

Initial Preliminary Alternatives were formulated based on the requirements of NRCS National Watershed Program Manual; results of the Data Collection and Analysis Report; the Hydrology, Hydraulics, and Sediment Analysis (HH&S) Technical Memoranda; preliminary modeling; and existing reports.

Preliminary alternatives were refined and further developed through the Preliminary Alternatives Workshop held August 12, 2021. Some of the initial preliminary alternatives presented in the workshop were not selected for further evaluation. Due to the ongoing COVID-19 pandemic this workshop was held virtually. Workshop attendees included various staff from the United States Department of Agriculture – Natural Resources Conservation Service (USDA – NRCS) and administrative, management, and maintenance staff from the City of Reno. The USDA – NRCS is the Lead Federal Agency, and the City of Reno is the project Sponsor. Nevada Division of Environmental Protection (NDEP) declined the role as a cooperating agency but instead has continued as a participating agency in a collaborative role. The Environmental Protection Agency (EPA) Region 9 accepted the invitation to a cooperating role and provided comments during the preliminary alternatives workshop related to the project scope.

During the course of the Preliminary Alternatives Workshop, five (5) Alternatives were selected for further detailed analysis. NRCS requires consideration and analysis of certain project alternatives, including no action (also referred to as future without project, or FWOP), removal of the dams, and flood proofing measures. These alternatives, and others, were analyzed by the team under four criteria: completeness; effectiveness; efficiency; and acceptability (U.S. Water Resources Counsel, 1983) (USDA, 2017).

Completeness is the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects, including any necessary actions by others. This may require relating the plan to other types of public or private plans if the other plans are crucial to realization of the contributions of the objective. Completeness does not automatically mean that alternative actions need to be large in scope or scale (U.S. Water Resources Counsel, 1983). Completeness of project alternatives is measured by the alternative's ability to meet safety requirements for High Hazard Dams as stated by the Nevada Division of Dams and NRCS. An alternative's completeness is also based on its integration into and alignment with other City of Reno plans, zoning, and policies. Some existing

plans considered are the City of Reno Master Plan, the Emergency Action Plan for East and West Wash Dams, and existing development plans for the area.

Effectiveness is the extent to which an alternative plan alleviates the specified problems and achieves the specified opportunities (U.S. Water Resources Counsel, 1983). Effectiveness is measured by whether the alternative would meet safety requirements for High Hazard Dams as stated by the Nevada Division of Dams and NRCS and whether the alternative meets the purpose and need for the project.

Efficiency is the extent to which an alternative plan is the most cost-effective means of alleviating the specified problems and realizing the specified opportunities, consistent with protecting the Nation's environment (U.S. Water Resources Counsel, 1983). Efficiency is measured primarily by conducting the Benefit Cost Analysis for alternatives and identifying the National Economic Development (NED) plan alternative.

Acceptability is the workability and viability of the alternative plan with respect to acceptance by State and local entities and the public, as well as the compatibility with existing laws, regulations, and public policies (U.S. Water Resources Counsel, 1983). Acceptability of an alternative is measured by its adherence to NRCS high hazard dam requirements (TR-60), and State of Nevada Dam Safety Regulations specified in the Nevada Administrative Code Sections (NAC 535.240(5) NAC 535.240 (1.a) and NAC 535.240(2.a.1). The acceptability of an alternative plan is also contingent on compatibility with City of Reno regulations and policies as well as acceptance by the local community surrounding and downstream of the dams.

2.3 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

Twelve (12) alternatives were considered in the preliminary alternative analysis. Seven (7) of the preliminary alternatives considered did not meet the formulation criteria, were eliminated from further analysis, and were not analyzed in detail as viable alternatives. Alternatives that did not address the purpose and need for action, did not achieve the Federal Objective and Guiding Principles, or became unreasonable due to cost, logistics, existing technology, or environmental reasons were eliminated (USDA NRCS, n.d.). Alternatives determined not feasible due to the potential for unacceptable environmental impacts, necessary changes in zoning, land use or property ownership, environmental justice concerns, or redundancy were removed from subsequent more detailed evaluations (USDA, 2017).

A list of the alternatives considered but eliminated from detailed study is shown below. A summary of the alternatives eliminated and reasons for elimination can be found in the Preliminary Alternatives Memo completed by Farr West Engineering.

Preliminary Alternative	**Rationale for eliminating alternative from detailed study**
Remediate only East Wash Dam	Does not provide flood protection function of the West Wash Dam. Objectives of the NRCS Watershed and Flood Prevention Operations Program would not be met because preventing erosion, floodwater, and sediment damage would not be achieved for the West Wash Dam.
Remediate only East Wash Dam with downstream improvements from West Wash Dam	This alternative was eliminated from further consideration because it became redundant after a slight alteration to other alternatives.
Remediate only West Wash Dam	Does not address the identified dam safety deficiencies at East Wash Dam, and therefore does not meet the Purpose and Need for the project to improve dam safety for future events.
Upstream Solution	Eliminated from further consideration as unreasonable due to the high cost of the project, and the expansion of environmental impacts onto federal lands

Remove only East Wash Dam	This Alternative does not meet the requirements of PL 566 to protect the downstream properties from flood flow up to the 1% flood. In addition, this alternative exposes additional properties to damage from flow up to the 1% flood, and thus does not meet the Purpose and Need of the project to preserve the flood protection function of the West Wash Dam in order to protect lives and property in the surrounding urban area, as well as to comply with current performance and safety standards. This Alternative does not meet the objectives of the NRCS to prevent flooding, erosion, and sediment damage, and does not meet the federal Guiding Principles to increase the public safety or to use a watershed approach.
Remove only West Wash Dam	This Alternative does not meet the requirements of PL 566 to protect the downstream properties from flood flow up to the 1% flood and exposes additional properties to damage from flow up to the 1% flood (United States Congress, 1954). Therefore, it does not protect lives and property in the surrounding urban area and also does not comply with current performance and safety standards of NRCS and NDWR. This Alternative does not meet the objectives of the NRCS to prevent flooding, erosion, and sediment damage, and does not meet the federal guiding principles to increase the public safety or to use a watershed approach.
Remove East Wash Dam with downstream improvements from East Wash Dam	This alternative does not meet the Federal Guiding Principles of increasing public safety and ensuring environmental justice using a watershed approach to analysis and decision making. This Alternative would effectively sacrifice one neighborhood to benefit another.
Remove West Wash Dam with downstream improvements from West Wash Dam	This alternative does not meet the Federal Guiding Principles of increasing public safety and ensuring environmental justice using a watershed approach to analysis and decision making. This Alternative would effectively sacrifice one property to benefit others.

2.4 ALTERNATIVES IDENTIFIED FOR DETAILED ANALYSIS

Five (5) alternatives, including the No Action alternative, were identified as reasonable alternatives and were carried forward from the Preliminary Alternatives Workshop for detailed analysis and discussion. Some alternatives may require NRCS funding agreement modification or additional funding to complete, if selected. If an alternative is selected that exceeds the current NRCS authorization for funding, then a request to modify or amend the agreement may be necessary.

The following five alternatives were discussed during the Detailed Alternatives Workshop held on April 29, 2022:

1. No Action Alternative or Future Without Project
2. Downstream Flood Improvements (Floodproofing)
3. Remediate Both East Wash and West Wash Dams
4. Remove Both Dams (Decommissioning)
5. Remove Both Dams (Decommissioning) with Flood Improvements downstream of both dams

The Detailed Alternatives Workshop was held virtually and was attended by NRCS, City of Reno, NDWR Division of Dam Safety, NDEP, and Farr West project staff and consultants. The workshop began with a presentation of the five (5) alternatives including discussion of the capital costs, preliminary environmental impacts, and storm event modeling scenarios. An overview and summary of the preliminary economic

analysis was also presented during the workshop including identification of the National Economic Development (NED) alternative. Materials from the Detailed Alternatives workshop are included in Appendix A of this report.

Workshop discussion of the alternatives included the challenges raised by differing storm events, potential downstream impacts of alternatives, proposed dam rehabilitation actions, and viability and reasonableness of the alternatives. Existing Emergency Action Plans and procedures in place for the East and West Dams were also discussed.

A non-economic evaluation scoring matrix was developed to assist in the identification of a selected alternative. The matrix is a tool used to identify the best alternative relative to the competing alternatives based on direct comparison. During the Detailed Alternatives Workshop, a preliminary matrix was presented that included suggested criteria, sub-criteria, and weights. The decision criteria for the scoring matrix were presented in six primary categories, each with subcategories, all of which are listed below.

- Operations and Maintenance
    - Level of effort to maintain
    - Need for additional resources
- Engineering
    - Constructability
    - Design
    - Delay/Risk
    - Impact to Ex. Public Facilities
- Public/Regional Impacts
    - Potential for Opposition
- Environmental
    - Land Use
    - Water Resources
    - Floodplains
    - Biological Resources
    - Cultural & Historic Resources
    - Environmental Justice
    - Noise
    - Health/Human Safety
    - Aesthetics
    - GHG/Climate Change
    - Cumulative Impacts
- Right-of-Way Requirements
    - Permanent Acquisitions
    - Project Delay/Risk
- Level of Flood Protection
    - 100-year Storm
    - 200-year Storm
    - 500-year Storm
    - PMF Event

During the Detailed Alternatives Workshop, a blank matrix was provided for each entity and a completed sample matrix was provided by Farr West Engineering to assist in discussion and development of the decision matrix. Additional meetings were held with NRCS and the City of Reno to reach consensus on the weighting for criteria and sub-criteria. Changes to the original weights were made based on discussion and

justification provided by NRCS and the City of Reno. The City of Reno, NRCS, and Farr West Engineering then ranked the alternatives in their respective matrices to determine final scores for each alternative. It's important to note that while each organization's rank and overall score for each alternative may differ, all the weights for the criteria and sub-criteria were consistent across matrices. A full explanation of the criteria, sub-criteria, and weights, as well as final matrices with scores from Farr West Engineering, NRCS, and the City of Reno are provided in Appendix B of this report.

3.0 DETAILED ANALYSIS

This memo provides the analysis for each of the five (5) alternatives and includes a narrative description, drawings, cost estimates, economic analysis, environmental effects, flooding impacts, and an identification of risks and uncertainties for each of the five alternatives. Flood modeling parameters and criteria and impacts of flooding impacts are addressed in Technical Memoranda produced by Farr West Engineering (Farr West Engineering, 2022) and are summarized for each alternative. Additional information on storm modeling and flood impacts can be found in those technical memoranda.

3.1 CAPITAL COST ESTIMATES

For this report, each alternative includes a preliminary capital cost estimate for the purposes of comparing the magnitude of different options. At this level, estimates are limited in their accuracy, but do provide a method of comparing costs. Bid items were determined collaboratively as the project team defined the alternatives, which were analyzed up to approximately a 10% design. The cost estimates provided follow AACE Class 4 estimate classification guidelines. Detailed calculations, quantities, and methodology are discussed in the Basis of Estimate, which can be found in Appendix C of this report.

Dimensions and quantities of existing infrastructure, such as intake structures, piping, and a Portland cement concrete (PCC) diversion chute, were primarily determined based on record documents, adapted from "USDA SCS, 1959 Plans for Construction of West Wash Dam" and "Plans for Construction of East Wash Diversion Dam, Prepared by the U.S. Department of Agriculture, 1960". Other quantities such as site grading and channel design were acquired from using AutoCAD and various hydraulic modeling software packages. Production rate for work, such as earthwork and best management practices (BMPs), were retrieved from the Federal Highway Administration (FHWA) Production Rates spreadsheet, latest revision date of November 8, 2016, which can be found in the Appendix of the Basis of Estimate. Inflation was accounted for when incorporating past bid results by using the Engineering News-Record (ENR) Construction Cost Index (CCI), which can be found in the Appendix of the Basis of Estimate. Other construction unit costs were derived from "Heavy Construction Costs with RSMeans data", 2019, 33rd Edition. Each capital cost will be included in the corresponding alternative section of this Report.

All unit costs are provided in 2022 values. If a unit cost was taken from a job prior to 2022, it was adjusted to 2022 values based on the Engineering News Record. The 10-year moving average based on the Engineering News Record is approximately 3% each year for an effective inflation rate of 9.3%, rounded up to 10%, from 2022 to 2025. This inflation rate has been added to the end of each estimate to provide estimates in 2025 values, which is the estimated year that construction would start

Since these alternatives are loosely defined and a Class 4 estimate is being used, the "MROUND" and "ROUNDUP" functions were used in Excel. Using this function may change the total cost of a bid item and total as it rounds to the defined interval of either the hundreds or thousands. This function was used to avoid an inaccurate level of perceived accuracy in the cost estimate but does not alter the level of magnitude of any line item.

A 30% contingency was used for all cost estimates at the AACE Class 4 level. Engineering costs were estimated at 10% of the base bid. Likewise, Construction Management was also estimated at 10% of the base bid. Potential items of cost which a might be associated with an alternative, but for which no costs have been included in the estimate, are:

- Removal of hazardous wastes,
- Financing costs,
- Licensing costs.

3.2 BENEFIT COST ANALYSIS

The Benefit-Cost Analysis (BCA) was completed by a professional economist using the Economic and Environmental Principles and Guidelines (P&G) for Water and Related Land Resource Implementation Studies (Executive Order 11747) Chapter 1, Section II as the guiding document for the economic analysis. The purpose of the economic analysis is to identify, among the reasonable alternatives both required and selected, the alternative that best meets the Federal Objective. The Federal Objective of water and related land resources planning is to contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements.

The National Economic Development (NED) Plan is defined as "a plan that reasonably maximizes net national economic development benefits, consistent with the Federal objective. This plan is to be identified as the National Economic Development plan" (U.S. Water Resources Counsel, 1983). The NED Plan consistent with protecting the Nation's environment must be selected for funding to be provided through the USDA Watershed and Flood Prevention Operations Program unless the Secretary of a department or head of an independent agency grants an exception when there is some overriding reason for selecting another plan, based upon other Federal, State, local, and international concerns. The West Wash Dam Economic Appendix included a Benefit-Cost Analysis (BCA) for all reasonable and required alternatives and identified the NED plan.

A Benefit-Cost-Ratio (BCR) greater than 1 means the project is expected to deliver a positive net present value. It is a worthwhile investment. A negative BCA ratio means that the project is expected to generate greater disbenefits than actual benefits – making conditions worse rather than better. A positive BCA ratio that is less than 1 means the project's costs outweigh the benefits and it should not be considered; however, an overarching concern associated with dam rehabilitation analyses is the intent of the program to minimize threat to human life. Agency policy allows for use of the Other Social and Economic (OSE) consideration account to make the case for rehabilitating any given floodwater detention structure, even if the associated benefit-cost ratio is less than 1:1. This is due to a priority placed on protecting lives. Also, trying to monetize the value of life, or in the case of dams, avoidance of loss of life, is fraught with subjective value judgements. Threat to human life can therefore be used to supersede purely economic considerations when deemed appropriate.

The Economic Appendix is included in Appendix D of this report.

3.3 ENVIRONMENTAL EFFECTS

All reasonably foreseeable environmental effects including direct, indirect, and cumulative impacts are identified and discussed for each alternative. Direct impacts are caused by the action and occur at the same time and place, or in the short term. The potential direct effects of this proposed project include disturbance or changes to the existing dam area. Impacts to soil, vegetation, biological resources, and cultural and historic resources at the dam area are assessed under direct effects.

Indirect impacts are those impacts caused by the alternative and occur later in time or some distance away but are still reasonably foreseeable. Indirect impacts include downstream effects, viewshed impacts, or impacts that occur over time, or long term. Potential indirect impacts of the project alternatives include downstream impacts like flooding from various storm events, inundation from dam failures, breaches or capacity limits, and damage to residences, businesses, and property.

Cumulative impacts are those that result from all past, present, and reasonably foreseeable future actions. These can result from individually minor, but collectively significant actions taking place over a period of time. Cumulative impacts identified in this alternatives analysis for this project include long term impacts related to climate change, health and human safety, and environmental justice.

Environmental reports identifying baseline conditions were completed at the project site. Baseline reports allow for the determination of effects on existing resources of the proposed alternatives. A Biological Assessment, Cultural Resources Inventory, and Aquatic Resources Delineation were completed for the proposed project. The environmental effects description in the Future Without Project Alternative include baseline resource descriptions for the project area. Results of these surveys were presented during the detailed alternatives analysis workshop, have been submitted to NRCS and will be detailed in the Environmental Assessment.

4.0 ALTERNATIVES CONSIDERED FOR DETAILED ANALYSIS

4.1 ALTERNATIVE 1: FUTURE WITHOUT PROJECT (NO ACTION)

4.1.1 Description

East Wash and West Wash Dams provide stormwater retention and attenuation for the Peavine Watershed. The two dams work in conjunction to protect downstream developments and convey storm flows into the City of Reno storm drain system. Stormwater is routed from the north into the East Wash Dam through a culvert under N McCarran Boulevard. The East Wash principal spillway has two separate diversion paths for flows. The first stage of principal flow is conveyed from the upstream toe of East Wash Dam into the City storm drain system by direct connection under Keystone Avenue. The second stage of flow is diverted into the West Wash Dam basin by an open concrete channel located to the west of East Wash Dam. The auxiliary spillway of the East Wash Dam consists of an earthen berm that is located to the west of East Wash Dam's open concrete channel. Once the water surface elevation reaches 4,858 feet, the west berm will overtop and push flows into the West Wash basin (Farr West Engineering, 2022).

The West Wash Dam receives storm runoff from a culvert under N McCarran Boulevard, from several storm drain outfalls from the adjacent neighborhoods, and from flows diverted from East Wash Dam in larger storm events. The West Wash Dam has a small sediment drain for extremely low flows that is connected to the principal spillway. The principal spillway outfalls to an open drainage ditch just below the Highland Ditch. The downstream end of the ditch has a storm drain inlet connected to the city storm drain system. The West Wash Auxiliary Spillway is an open channel that diverts flows around the western edge of the dam and onto the adjacent streets when the water surface elevation reaches 4,784.9 feet (Farr West Engineering, 2022).

If the No Federal Action alternative is selected, substantial rehabilitation of West Wash Dam would not occur. The City would continue on-going general maintenance of the structures and rely on the existing Emergency Action Plan (EAP) as the source for public safety. If a Probable Maximum Flood (PMF) event were predicted, the City would evacuate the residences that would be impacted by a dam breach. The EAP uses a Yellow Alert and Red Alert. Yellow alert provides warning up to 5 days in advance of the anticipated flood event, and Red Alert evacuation approximately 24 to 48 hours in advance (2018 Washoe County Regional Flood Response Action).

The City of Reno would work to improve the condition of the dams and conduct maintenance as funding allows. Actions identified in NDWR's annual dam inspections would be prioritized. However, repairs would not improve the dam to retain the Probable Maximum Precipitation (PMP),

Under the No Action alternative, operation and maintenance activities would continue and include:

- Sediment removal
- Vegetation removal on dam structures
- Erosion restoration

4.1.2 Drawings

An exhibit for Alternative 1, that shows the general layout and lists key components of the East and West Wash Dam in their existing conditions, can be found in Appendix E. Important features of how the dams currently operate include the overtopping of the East Wash Dam Auxiliary Spillway during a 100-year storm event, the activation of the West Wash Dam Auxiliary Spillway during a 200-year storm event, and the overtopping of the West Wash Dam during the ¾ Local PMP storm event.

4.1.3 Cost Estimate

Alternative 1 does not include any capital expenses, since no construction is being proposed. Operation and maintenance efforts will continue as they currently are, adjusting year-over-year for inflation. Currently, the City of Reno estimate that operation and maintenance efforts cost approximately $20,000 annually (Hansford Economic Consulting LLC, 2022).

4.1.4 Economic Analysis

Alternative 1 has the largest cost for total damages occurring from a single-year event out of all five alternatives. Total damages occurring from a single-year event are calculated to be the greatest under Alternative 1 for the Local PMP event, at $192,527,004. There are no damage costs associated with the 100-year event for Alternative 1 since there is no anticipated flooding for that storm event.

Since there isn't a project under Alternative 1, the only costs associated with this alternative are the annual maintenance costs. The net benefits for all storm events (benefits minus costs) are negative and the benefit-cost ratio is zero.

For more information on the economic analysis or how anything discussed in this section was calculated, see the Economic Appendix in Appendix D.

4.1.5 Environmental Effects

This section includes brief baseline resource descriptions for the project area and a summary of the effects of the Future Without Project, or No Action, alternative.

4.1.5.1 Land Use

The West Wash and East wash Dams are bounded by N McCarran Blvd. and residential development. The Dams are located on five City of Reno owned parcels zoned for Parks, Greenways, Open Space (PGOS), and Single Family Residential (SFR8) in the areas surrounding the dam. The residential growth in northwest Reno over the last 50 years has fully surrounded both Dams. The Dams see very little flow except during precipitation events and are used as open space and walking paths for the nearby residents. No official recreational facilities exist within the Dam area.

Land uses surrounding the project area include single and multi-family residential, commercial, and retail. An example of current nearby development in the area is located immediately adjacent to the East Wash Dam. The property, which sits directly west of the East Wash Dam, is a 6.05-acre parcel (APN #001-190-12) located south of N McCarren Blvd. and approximately 900 feet west of the intersection of Keystone Ave. and McCarren Blvd. The development, approved by the City of Reno Planning Commission is a mixed retail/office and residential (Rubicon Design Group, LLC, 2019).

The Truckee Meadows Water Authority (TMWA) owns several infrastructure locations near the dam area including a building to the south of West Wash Dam and a water storage tank which can be seen north of the project area. Above ground utility lines also cross the project area. South of the dam flows the Highland Ditch which winds through Reno, carrying irrigation water from the Truckee River. The irrigation flume lies just south of, and outside of, the direct project area.

North of the project area, and outside the area of direct effect, are undeveloped lands owned by the Federal Government and Washoe County. These lands make up the open space of Peavine Mountain and contain the subbasins which flow into the East and West Wash Dams. Federal Lands are owned by the US Forest Service and are managed for multiple uses and are subject to extractive (e.g. mining or logging) or OHV use (EPA, 2022).

The proposed project location includes an area of potential impact surrounding the existing dams. There are no unique lands, forest lands, national natural landmarks, wilderness areas, national monuments, or

national parks or trails located within the proposed project area, or area of interest. There are no wild and scenic rivers in Nevada. Because the proposed project is not within the immediate vicinity of any National/State Parks, monuments, wild and scenic rivers, etc.; formally classified lands were not considered further.

Under the no action alternative very few direct effects are anticipated for land uses. No ground disturbance and no temporary construction effects would occur in the project area under this alternative. No impacts or changes to current land uses would occur under this alternative, therefore no direct impacts will occur to land use, formally classified lands, and important farmland. However, flooding risk and impacts to downstream residents and property remains, which is discussed in further detail in the flooding impacts section.

4.1.5.2 Water Resources

The East and West Wash Dams are generally dry dams. Water resources in the area include stormwater, drinking water and irrigation infrastructure.

Analysis of the City of Reno storm drain system was performed as part of Farr West's HH&S technical memorandum (Farr West Engineering, 2022). A stormwater culvert runs under N McCarran Boulevard and carries storm water into the drainage. This is located on a parcel owned by a private developer, and currently planned for mixed use development. Storm waters from the surrounding developed residential neighborhood enter the project area through City of Reno stormwater drainage structures. The East Wash Primary Spillway is directly connected to the storm drain system, and the West Wash Primary Spillway directs flows to a downstream open channel that is connected to the storm drain system. The storm drain system downstream of East and West Wash Dams consist of individual catch basins that feed lateral pipes. The lateral pipes then feed into the storm drain mains. The mains flow in a southeasterly fashion until they reach their ultimate outfall at the Truckee River (Farr West Engineering, 2022).

An Aquatic Resources Delineation (ARD) was completed for the project area in June 2021, in accordance with the Corps of Engineers Wetlands Delineation Manual and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region (Version 2), and A Field Guide to Identification of the Ordinary High-Water Mark in the Arid Region of the Western United States. As part of this report a Wetlands Specialist completed a routine onsite investigation to determine the location and extent of resources that may have potential to be under the regulatory jurisdiction of the U.S. Army Corps of Engineers in accordance with Section 404 of the Clean Water Act for the City of Reno, West Wash Dam Rehabilitation Project. The ARD and its proposed findings were prepared in accordance with current Corps' guidance (September 3, 2021) (Wood Rodgers, 2022).

The 53-acre survey area is located in Sections 3 and 4, Township 19 North and Range 19 East in a 3.34 square mile watershed that includes 2.09 square miles of the East Wash watershed. Flood flows to the West Wash Dam come through the East Wash Dam with very little attenuation. The project area has no identified streams, rivers, or ponds located within it. The ARD identified and evaluated two reaches of improved ephemeral channels. The channels were evaluated to determine the streamflow duration using the Streamflow Duration Assessment Method for the Arid West (SDAM AW) and in accordance with A Field Guide to Identification of the Ordinary High-Water Mark in the Arid Region of the Western United States. Although the improved ephemeral channels have no evidence of consistent annual flow providing a surface water connection to a traditional navigable water, these drainages and other vegetated areas may be under the regulatory jurisdiction of the USACE.

These two unnamed channels are both primarily supported by upslope development nuisance water and stormwater discharge, neither of which meet the criteria of consistent/annual flow. Both channels largely support vegetation that meet the criteria for hydrophytic vegetation, however soils do not meet the criteria for hydridic soils and wetland hydrology is not present. Therefore, vegetated potential wetlands appear to not fulfill the required 3-parameter approach criteria to meet the definition of jurisdictional wetlands. The

wetland located under the flume portion of the Highland Ditch is supported by severe leaks in the flume and thus is a "leaky ditch wetland". Given that one of the wetlands has primarily developed and is sustained by the leaky ditch, it is likely that this wetland may not be regulated by the USACE pursuant to CESPK-CO-R Regulatory Branch Memorandum 2004-03 "Leaky Ditch" Wetlands (Wood Rodgers, 2022).

Under the no action alternative, no jurisdictional waters of the US, or other water resources would be affected and therefore there would be no impacts to the direct project area. Water resources downstream of the dam may be impacted during certain flooding events. Flooding impacts are discussed in the flood impacts section for this alternative.

4.1.5.3 Floodplains

The Federal Emergency Management Agency (FEMA) provides flood insurance rate mapping (FIRM) for most areas of the County including Washoe County. FIRM Panel 32031C3036G includes the majority of the East and West Wash Dam areas. The southeastern corner of the project area can be seen on FIRM panel 32031C3037G. This panel has not been printed by FMEA and is not available as a FIRM map. FEMA's National Flood Hazard Layer was accessed to view this part of the project area (Federal Emergency Management Agency, 2022). The portion of the project area is within the project APE, but outside of potential construction disturbance within the dam area identified in the project alternatives.

The entire project area including both the East and West Wash Dams is in a low hazard flood zone as identified by FEMA and lies within FEMA flood Zone X, which is defined on the FIRM as area of minimal flood hazard, which are the areas outside any Special Flood Hazard Area and higher than the elevation of the 0.2-percent-annual-chance (or 500 year) flood. FIRMette's were created for the project area using the National Flood Hazard Layer and are included in Appendix F.

For reference, the following FEMA flood hazard zone designations are provided:

- **Zones A and V**: Zones in the A and Z category are the flood insurance rate zones corresponding to the 100-year floodplains, determined by detailed methods in the Flood Insurance Study. In most instances, base flood elevations derived from the detailed hydraulic analysis are shown at selected intervals within this zone. Mandatory flood insurance purchase requirements apply.
- **Zones B, C, and X**: Zones B, C, and X are the flood insurance rate zones that correspond to areas outside the 100-year floodplains. Areas of 100-year sheet flow flooding where average depths are less than 1 foot, areas of 100-year stream flooding where the contributing drainage area is less than 1 square mile, or areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.
- **Zone D**: Zone D are the flood insurance areas that also correspond to areas outside the 100-year floodplains. Areas in Zone D include areas in which flood hazards are undetermined, but possible.

The project area is not identified as being within a flood zone, a flood plain or in a flood hazard area. However, the function of the East and West Wash Dams is to detain and direct storm water flows that may lead to flooding. FEMA's Flood Insurance Study for Washoe County (Federal Emergency Management Agency, June 18, 2013 Reprinted with corrections July 9, 2021) notes the following:

Summer thunderstorms occur from July through October. Thunderstorm floods are characterized by high peak, short-duration, very high velocity flows and can carry and deposit large volumes of boulders, rocks, sand, silt, and other flood detritus. They possess great destructive force and create extremely high hazards. These are local phenomena that affect only small, isolated areas at a time, such as single canyons, and cause flash floods, such as those that occurred in the Peavine Creek area in northwest Reno in July 1956 (Federal Emergency Management Agency, June 18, 2013 Reprinted with corrections July 9, 2021).

The entire project area consisting of the East and West Wash lies within FEMA FIRM Zone X, which is defined as "areas of 0.2% annual chance of flood; areas of 1% annual chance flood with average depths of

less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood" (Federal Emergency Management Agency, 2009). The dams help regulate flooding downstream due to stormwater and snowmelt run-off events.

Under the no action alternative, the dams will continue to provide stormwater and snowmelt flow regulation at average levels. However, the High Hazard Dam will not meet safety requirements of NRCS or the State of Nevada and will continue to provide inadequate flood protection for storm events that exceed 0.5% annual chance.

Indirect impacts under the no action alternative include damage to property and risk of lives related to flooding events at a High Hazard Dam. Impacts of downstream flooding are discussed in Section 4.1.6. Cumulative impacts related to increased flooding events or unpredictability of future storm events due to climate change are addressed in the cumulative impacts section.

4.1.5.4 Vegetation

Desktop and field surveys were conducted to document baseline biological conditions for the West Wash Dam Rehabilitation Project (Project). The Project encompasses 53.2 acres on land owned by the City of Reno. The Project is in portions of Sections 33 and 34, Township 20 North, Range 19 East (T20N, R19E), and Sections 3 and 4, T19N, R19E, Mount Diablo Base and Meridian, Washoe County, Nevada (Project Area). The Project is in the City of Reno, south of N McCarran Boulevard and west of Keystone Avenue. (EM Strategies , 2021)

Existing literature, United States Geological Survey (USGS) topographic maps, aerial imagery, NRCS soils data, NRCS ecological site data, and USGS Southwest Regional Gap Analysis Project (SWReGAP) vegetation community data were used to determine the vegetation communities, wildlife associations, and soils that are expected to occur within the Project Area. Portions of the Project Area were largely unvegetated and moderately disturbed due to several walking trails in the area and use by the public, as well as construction activities and the earthen dams.

Field verification identified two vegetation communities within the Project Area, the Inter-Mountain Basins Big Sagebrush Shrubland and the Great Basin Lowland Riparian vegetation community. The Inter-Mountain Basins Big Sagebrush Shrubland vegetation community makes up the majority of the Project Area, covering 45.2 acres. The shrub layer consists of several co-dominant species including fourwing saltbush (Atriplex canescens), rubber rabbitbrush (Ericameria nauseosa), basin big sagebrush (Artemisia tridentata ssp. tridentata), and broom snakeweed (Gutierrezia sarothrae). The herbaceous layer in this vegetation community was sparse, with large areas nearly devoid of vegetation (EM Strategies , 2021).

The Great Basin Lowland Riparian vegetation community occurs along the flowing stream in the central portion of the Project Area, covering eight acres. Vegetation in this riparian area is dominated by narrowleaf willow (Salix exigua). A few large trees occur within this area, namely Fremont cottonwood (Populus freemontii), Russian olive (Elaeagnus angustifolia), and mature willow trees. The narrowleaf willow stands are very dense, preventing the development of any significant herbaceous layer. In more open areas, dominant forb species included annual rabbitsfoot grass (Polypogon monspeliensis), Arctic rush (Juncus arcticus), Kentucky bluegrass (Poa pratensis), and cattail (Typha sp.).

A sub-type within this community is a wetland lacking a mature tree canopy located in the southeastern corner of the Project Area. This area is dominated almost exclusively by a dense stand of narrowleaf willow with some cattail and Arctic rush along the edges. A small stand of tree of heaven (Ailanthus altissima) occurs on the north side of the wetland.

No protected plant species were observed or recorded during the survey (EM Strategies , 2021).

A noxious weed is a plant that has been defined as a pest by law or regulation. Nevada Department of Agriculture's (NDOA) policy regarding noxious weed abatement is that if a plant is found likely to be

"detrimental or destructive and difficult to control or eradicate" (Nevada Revised Statute § 555.005, 2021), the NDOA, with approval of the Board of Agriculture, will designate the plant as a noxious weed.

It is the NDOA's policy to use the "Noxious Weed Tier System" to determine what action is to be taken consistent with existing statutes which include authority for: the promulgation of quarantine, abatement for eradication and/or control; holding and inspecting; establishing weed control districts; and for other regulatory activities. At the time, the NDOA lists a species, it will also give a rating of A, B, or C. These ratings reflect the NDOA's view of the statewide importance of the noxious weed, the likelihood that eradication or control efforts would be successful, and the present distribution of noxious weeds within the state. These lists will be in the Nevada Administrative Code (Nevada Administrative Code § 555.010, 2018).

The following defines the NDOA weed ratings:

- "A" Weeds normally limited in distribution throughout the state; actively excluded from the state and actively eradicated wherever found; actively eradicated from nursery stock dealer premises; control required by the state.
- "B" Weeds more widespread throughout the state; actively excluded where possible, actively eradicated from nursery stock dealer premises; control required by the state in areas where populations are not well established or previously unknown to occur.
- "C" Weeds generally widespread throughout the state; actively eradicated from nursery stock dealer premises; abatement at the discretion of the state quarantine officer.

Noxious weed species were distributed throughout the Project Area, with heavier concentrations in the northern disturbed area and along the streambanks. Noxious weeds can threaten native plant species and may be established as a result of ground disturbing activities. Five noxious weed species were observed and mapped within the Project Area during the noxious weed survey:

1. Perennial pepperweed (Lepidium latifolium);
2. Nodding thistle (Carduus nutans);
3. Hoary cress (Cardaria draba);
4. Medusahead grass (Taeniatherum caput-medusae); and
5. Jointed goat grass (Aegilops cylindrica).

Under the No Action, or FWOP alternative, there would be no change to the Dams. The City of Reno would continue minimal mitigation actions including routine maintenance to continue operation of the dams.

4.1.5.5 Fish and Aquatic Resources

U.S. Fish and Wildlife Section 7 Consultation identified four threatened, endangered, or candidate species listed in the project area (EM Strategies , 2021). The U.S. Fish and Wildlife Service (FWS) Information for Planning and Consultation (IPaC), a project planning tool that streamlines the FWS environmental review process for compliance with the Endangered Species Act was queried. A Formal Species List (Consultation Code 08ENVD00-2021-E-00791) (EM Strategies , 2021) was obtained for the project area. The Formal Species List indicated that there is Final critical habitat for Sierra Nevada yellow-legged frog and Webber's Ivesia, however the location of the critical habitat is unknown. In proximity to the survey area there is potential habitat for Cui-ui and Lahontan cutthroat trout, assumed to be the Truckee River, Table 1 lists the protected fish and aquatic species that may be near the Project Area.

Table 1: Threatened and Endangered Species In Close Proximity to the Project Area

Type of Animal	Species	Status	Critical Habitat w/in project Area
Amphibians	Sierra Nevada Yellow-legged Frog	Endangered	No
Fish	Cui-ui	Endangered	No
Fish	Lohontan Cutthroat Trout	Threatened	No

The Sierra Nevada yellow-legged frog (SNYLF) is found at high elevations in wet mountain meadows of the Sierra Nevada mountains. The SNYLF is considered highly aquatic and requires water of sufficient depth or flow to avoid freezing. Cui-ui are found only in Pyramid Lake and the mouth of the Truckee River; historically this species was also present in Winnemucca Lake, which is now dry. Therefore, the proposed Project will have no effect on the SNYLF or cui-ui (EM Strategies , 2021).

Lahontan Cutthroat Trout (LCT) is listed as threatened under the ESA. This native fish historically inhabited the Truckee River drainage from Lake Tahoe to Pyramid Lake but was extirpated from the Tahoe Basin by the early to mid-1900s. Restocking efforts by NDOW and other agencies (i.e., California Department of Fish and Wildlife) have reintroduced LCT into Lake Tahoe and the headwaters of the Truckee River. Now a popular game fish, LCT were historically a valuable food source for the Pyramid Lake Paiute Tribe, the Washoe Tribe, and early explorers (EM Strategies , 2021).

LCT require specific habitat for spawning, characterized mainly by cool water, pools with nearby cover, stream banks that are stable and well vegetated, and riffle-run areas with rocky substrate. Outside of spawning season, LCT occupies both lakes and streams (EM Strategies , 2021).

Non-native salmonid fish are generally considered to be the greatest threat to LCT populations. These non-native salmonids threaten LCT persistence through hybridization and by increasing competition for habitat and resources. LCT are also threatened by altered watersheds that may have increased turbidity and high flows, which reduce the spawning habitat quality. Warmer water temperatures and drought can affect the survival rate of young LCT (EM Strategies , 2021).

LCT are documented in the Truckee River, including within the Reno city limits. The ephemeral drainages in the Project Area do not represent suitable habitat as described by USFWS and do not have connectivity with suitable habitat for LCT (i.e., as a tributary or perennial stream). Movement of LCT into the Project Area is also impeded by multiple physical barriers (i.e., embankment dam, cement canals). Given that there is no possibility of occurrence in the Project Area, the proposed Project will have no effect on LCT. (EM Strategies , 2021)

Under the No Action alternative, because there is no possibility of occurrence within the Project Area, no direct effects to LHT or other threaten or endangered species will occur.

Indirect impacts may occur under the No Action alternative if future flooding impacts would affect the turbidity and temperatures of the Truckee River, if and when storm flows reach the river in unexpected and unpredictable manners. These same actions may contribute to cumulative impacts under the no action alternative and are discussed as related to climate change uncertainly in the cumulative impacts section of this report.

4.1.5.6 Wildlife

Baseline biological desktop and field surveys were conducted for this project (EM Strategies , 2021). A total of fifteen bird, three mammal, and one reptile species were directly observed or detected by sign (e.g., tracks, burrows, scat, skeletal remains) in the Project Area. Nesting habitat for raptors is present in the riparian corridor of the Project Area and on the power poles that border the Project Area. No raptor nests

were recorded in the Project Area. Fifteen (15) avian species protected by the MBTA were observed in the Project Area. Day-roosting habitat for bats is present in the Project Area in the mature trees of the riparian corridor. There is potential habitat for monarch butterfly in proximity to the survey area, however no critical habitat has been designated.

The monarch butterfly is a distinctively colored orange, black, and white butterfly. Monarch butterflies in Nevada lay eggs during spring and summer. Larvae feed on plants in the subfamily Asclepiadoidae which contain toxins that monarch butterflies can sequester as an anti-predation defense. Adult monarch butterflies utilize a wide variety of plant species for nectar (EM Strategies , 2021).

The main threat to monarch butterflies is disturbance (i.e., logging, land conversion) to their overwintering sites. Monarch butterfly populations breeding in Nevada are likely to overwinter on the Pacific coast of California. No known overwintering sites occur in Nevada. Additional threats include the use of herbicides (i.e., glyphosates) in agricultural areas and effects of climate change (e.g., extreme weather conditions) (EM Strategies , 2021).

The potential for occurrence of Monarch butterflies is relatively high because they are assumed to use the Project Area for breeding due to the presence of milkweed. Citizen science records exist for monarch butterflies in the vicinity of the Project Area. The timeframe for monarch butterflies to arrive and breed in Reno is likely to extend from May through August (EM Strategies , 2021).

Analysis of the migratory birds with potential to occur in the Project Area are grouped by focal habitats found in the Project Area as defined by the Nevada Bird Conservation Plan. This does not consider the small size of the Project Area or the heavily developed urban surroundings (EM Strategies , 2021).

Under the No Action Alternative, no disturbance to existing milkweed stands will occur, and therefore no impacts to the Monarch are anticipated under the no action alternative. Where possible, milkweed stands should not be removed during the summer breeding period (May through August) to prevent impacts to breeding monarch butterflies. Plants that will be disturbed should be salvaged and replanted in appropriate habitat when practical.

No disturbance to migratory birds is anticipated under the No action alternative. However, migratory bird clearance survey requirements during migratory bird breeding season (April 1 through July 31). If ground disturbance must occur within this time, a migratory bird nesting clearance survey would be conducted within a three-day period prior to the disturbance followed by a 14-day period to complete the disturbance. If a nest is found, a species-appropriate no-disturbance buffer would be placed around the nest until the young have fledged, or until the nest fails.

4.1.5.7 Wetlands and Riparian Areas

A riparian corridor is present in the Project Area which enters from the west and then curves south to the West Wash embankment dam. There was a small rivulet of running water which was surrounded by thick, mature mixed willows, along with cottonwood trees. The non-jurisdictional wetland adjacent to Highland Ditch also possesses mature willows, cottonwood trees, and tree of heaven. These willows and trees provide potential nesting habitat for migratory birds. Additional nesting habitat is present in the form of powerlines and other tall artificial structures within the Project Area. Adjacent homes with landscaped backyards provide attractive foraging habitat for many migratory birds (EM Strategies , 2021).

The Great Basin Lowland Riparian vegetation community occurs along the flowing stream in the central portion of the Project Area, covering eight acres. A sub-type within this community is a wetland lacking a mature tree canopy located in the southeastern corner of the Project. This area is dominated almost exclusively by a dense stand of narrowleaf willow with some cattail and Arctic rush along the edges. A small stand of tree of heaven (Ailanthus altissima) occurs on the north side of the wetland (EM Strategies , 2021).

Although these areas appear to be wetlands or contain riparian type vegetative communities, they do not contain hydric soils and do not meet their definition of wetland for USACE jurisdictional purposes (Wood Rodgers, 2022). As used in the Aquatic Resource Delineation, the term "wetlands" has a regulatory definition as defined in Chapter 33, Part 328, Section 7(b) of the Code of Federal Regulations. The term "wetlands" means "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marches, bogs, and similar areas." The frequency and duration of saturation may vary by geographical region and is largely dependent upon local climatic conditions.

Because no wetland or riparian areas would be disturbed under the No Action Alternative, there would be no direct impacts to those resources. If regular O&M activities for the dams conducted under the No Action alternative would potentially impact those areas, it is recommended avoidance fencing or flagging be used to protect existing resources and wildlife habitat.

4.1.5.8 Air Quality

The Clean Air Act requires the EPA to establish National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. There are two types of NAAQS standards: primary and secondary. Primary standards set limits to protect public health, especially that of sensitive populations such as asthmatics, children, and seniors. Secondary standards set limits to protect public welfare, including protections against decreased visibility, damage to animals, crops, and buildings. The EPA has set NAAQS for seven principal pollutants, which are called "criteria" pollutants (Code of Federal Regulations).

The Washoe County Air Quality Management Division (AQMD) implements clean air solutions that protect the quality of life for the citizens of Reno, Sparks, and Washoe County including air monitoring, permitting and compliance, planning, and public education. AQMD is required by federal and state law to monitor ambient air quality data in Washoe County for pollutants deemed harmful by the U.S. Environmental Protection Agency (EPA). Data is monitored and collected to determine compliance with the NAAQS. The AQMD began monitoring ambient air quality in Washoe County in the 1960's, and the monitoring network has grown and evolved since that time. Ambient air monitoring sites in Washoe County operated and maintained by the AQMD between 2012 and 2021 measure O_3, $PM_{2.5}$, PM_{10}, CO, NO_2, and SO_2. There is no Pb monitoring in Washoe County (Washoe County Health Disrict , 2022).

The AQMD operated seven (7) ambient air monitoring sites in 2021. The Project Area is within Hydrographic Area 87 (HA 87) as defined by the State of Nevada Division of Water Resources. This area was designated as "serious" non-attainment for the 24-hour PM_{10} NAAQS until it was redesignated to "Attainment/Maintenance" effective January 7, 2016. Washoe County is classified as "attainment" or "unclassifiable/attainment" for all other pollutants and averaging times (Washoe County Health District , 2022).

Particulate matter, also known as particle pollution or PM, is a complex mixture of extremely small particles and liquid droplets. Particle pollution is made up of several components, including acids (such as nitrates and sulfates), organic chemicals, metals, and soil or dust particles. The size of particles is directly linked to their potential for causing health problems. Of concern are particles that are 10 micrometers in diameter or smaller because those are the particles that generally pass through the throat and nose and enter the lungs. Once inhaled, these particles can affect the heart and lungs and cause serious health effects. EPA groups particle pollution into two categories:

- "Inhalable coarse particles" (PM_{10} and PM coarse), such as those found near roadways and dusty industries, are between 2.5 and 10 micrometers in diameter.

- "Fine particles" ($PM_{2.5}$), such as those found in smoke and haze, are 2.5 micrometers in diameter and smaller. These particles can be directly emitted from sources such as forest fires, or they can form when gases emitted from power plants, industries, and automobiles react in the air.

Particle pollution, especially fine particles, contain microscopic solids or liquid droplets that are so small that they can get deep into the lungs and cause serious health problems. Numerous scientific studies have linked particle pollution exposure to a variety of problems, including irritation of the airways, coughing, difficulty breathing, decreased lung function, aggravated asthma, development of chronic bronchitis, irregular heartbeat, nonfatal heart attacks, and premature death in people with heart or lung disease. People with heart or lung diseases, children, and older adults are the most likely to be affected by particle pollution exposure. However, even healthy people may experience temporary symptoms from exposure to elevated levels of particle pollution (Washoe County Health Disrict , 2022).

State Implementation Plans (SIPs) are plans developed by local jurisdictions to obtain clean air standards. Areas not meeting National Ambient Air Quality Standards are required to prepare, submit, and implement SIPs demonstrating attainment and maintenance of these standards. The last Washoe County SIP for PM_{10} was a request to redesignate the area as maintenance for PM_{10}, which was approved by EPA in 2016 (Federal Register, 2015).

Washoe County is currently in maintenance or attainment status for PM_{10}. SIP requirements related to PM_{10} maintenance for this project are dust control for construction activities and non-road vehicle emissions standards (Washoe County Health District Air Quality Management District , 2014).

The No Action Alternative would not cause dust or PM10 to be released into the air and would not contribute to PM_{10} in the area. Therefore, the No Action Alternative will have no effect on air quality in the Project Area.

4.1.5.9 Cultural Resources

In consultation with the Nevada State Historic Preservation Office (SHPO), NRCS, and the City of Reno, an area of direct and indirect effects, Area of Potential Effect (APE), of 133.49 acres was determined for the West Wash Dam Rehabilitation project area. The APE includes the 53.23-acre footprint of the direct effects APE and an additional 80.26 acres surrounding the direct effects APE. A Cultural Resource Inventory (CRI) was completed for the project APE under the supervision of a state certified archeologist (Broadbent and Associates , 2021).

A literature review was conducted and summarized existing surveys near the Project APE. The CRI noted that 16 archaeological sites and 139 architectural resources have been previously identified within one mile of the direct effects APE. None of these sites are located within the direct effects APE; only one is located within the indirect effects APE. The 139 architectural resources within one mile of the direct effects APE include structures and buildings, none of which are located within the direct effects APE.

Based on the NVCRIS search results, there are no NRHP-listed historic properties within one mile of the APE. According to the list maintained by Nevada SHPO, there are also no resources that have been listed on the Nevada State Register of Historic Places (NVSRHP) within one mile of the APE. The indirect effects APE encompasses 141 parcels, most of which contain residences constructed between 1964 and 2015; 46 of the parcels contain structures that are historic in age (at least 50 years old). All the structures within the indirect effects APE were constructed after the West Wash and East Wash Dams were completed. The historic aged resources within the APE have not been evaluated for their eligibility for inclusion in the NRHP.

The survey of the direct effects APE resulted in the identification of three architectural resources of historic age including the West Wash Dam and associated structures, the East Wash Dam and associated structures, and a segment of the Highland Ditch. The East and West Wash Dams were recorded as individual structures

and as elements of the East and West Wash Dam Historic District. No archaeological resources were identified. The East and West Wash Dams were identified as eligible for NRHP listing, both separately and together as a historic district. The SHPO has concurred with this determination of eligibility.

The Peavine Creek Watershed Flood Control Project, including the construction for the East and Wash Dams, is significant in that it was the first to be undertaken in Nevada using the federal funding offered through the Watershed Protection and Flood Prevention Act of 1954 and was the first in the nation to be undertaken by the SCS to exclusively protect a city. Because the construction of these dams substantially decreased the flood risk to northwest Reno, the Veterans Administration and Federal Housing Authority were able to back loans and loan guarantees for home construction in the area, allowing for the continued expansion and development of the city (Broadbent and Associates , 2021).

The West Wash Dam (S2873) structure is an earthen embankment dam constructed from local materials across West Wash in northwestern Reno. The dam is oriented northeast-southwest (60-240°), with the northeastern end near the intersection of Polk Street and O'Farrell Street; the southwestern end terminates at the eastern end of Gulling Road. The dam is approximately 780 feet long, with the crest approximately 12 feet wide; the embankment is at least 70 feet tall. It is partially vegetated on both the north and south slopes.

The proposed East and West Wash Dam Historic District (D390) is defined primarily by the edges of the City-owned parcels that contain the East and West Wash Dams and a portion of West Wash below West Wash Dam, but also include some private property at the southern end. The boundaries include the extant features that were constructed as part of the Peavine Creek Watershed Flood Control Project along with the remaining course of West Wash above and below the dams. The historic district encompasses a flood control system that was constructed between 1960 and 1961 as part of the Peavine Creek Watershed Flood Control Project. This project was designed in 1958 under the auspices of the newly adopted Watershed Protection and Flood Prevention Act, and included dams on East Wash, West Wash, Upper Peavine Creek, and Lower Peavine Creek (HDR, 2011). The East and West Wash Dams are located northwest of downtown Reno and work in conjunction with each other, with the East Wash Dam diverting water through a spillway into the reservoir of the West Wash Dam. The Upper and Lower Peavine Creek Dams are located to the west of the East and West Wash Dams and work in tandem; they are located outside of the boundaries of the proposed historic district.

The indirect effects APE surrounding the dams encompasses 141 parcels, most of which contain residences constructed between 1964 and 2015; 46 of the parcels contain structures that are at least 50 years old. The earliest of these 46 residences were constructed in 1964, four years after construction of the West Wash Dam, and three years after the East Wash Dam was completed. The structures within the indirect effects APE have not been recorded as part of this project and remain unevaluated for NRHP inclusion. Broadbent recommends that the segment of the Highland Ditch (S808) recorded for this project in not eligible for NRHP inclusion and should be considered a non-contributing segment to the NRHP-eligibility of the whole resource.

Under the No Action Alternative, no changes will be made to any of the historic structures identified during the survey, and there would be no impact to the existing historic structures.

4.1.5.10 Environmental Justice and Socioeconomics

Data from the 2015 five-year American Community Survey was used to analyze socioeconomic information for the Project Area. The Affected Area encompasses six census tracts; 13, 14, and 24.01 located north of Interstate 80 (I-80), and 1.03, 1.04, and 1.06 located south of I-80. The direct project area of the dams is almost entirely within Census tract 24.01. A small section of the south end of the project area is within Census Tract 13. Additional tracts are included in the inundation maps and are considered in the impacts calculated by the BCA. Table 2 shows the Census Tracts in the direct, indirect, and downstream project areas. The Census Tract Figure is included in Appendix G of this report.

Table 2: Project Census Tracts

Tract Number	Project Location
24.01	Direct and indirect project area
13	Direct and indirect project area and downstream area
14	Downstream area
1.03	Downstream area
1.06	Downstream area
1.04	Downstream area

The direct project area is mainly limited to the area of the dams and the disturbance and construction work that would take place therein. Census Tract 24 includes the area around the dams and has a population of approximately 4,190 with a median age of 32.2 years. The median household income is 122% of the State median household income. However, 9% of the population in this area is below the poverty level and 11% are disabled. The residences surrounding the direct area, and included in the indirect project area, are mostly single-family homes built in the late 1960's, 1970's, or later. The area is 32% minority.

The No Action alternative would not change the current flooding impacts related to the dams. There would be no construction impacts for the residents within the direct or indirect project area, and no changes to FEMA flood maps or insurance rates would occur.

The following summary of downstream impacts was provided in the BCA

Table 3: Acreage Potentially Flooded (Future without Project) *

Land Use	Acres	Percentage of Area
Single Family Residential	123	34%
General Commercial [1]	84	23%
Vacant	68	19%
Entertainment (casinos, hotels, resorts) [2]	40	11%
Public Parks	6	2%
Apartments & Townhomes	12	3%
Office & Professional Uses	11	3%
Common Area	13	3%
Industrial & Warehouse	4	1%
Public Utility	3	1%
Total	**364**	**100%**

Source: Farr West Engineering and Washoe County Assessor, March 2022.

[1] Includes retail, restaurants, fast food, churches, convenience stores, a railroad passenger terminal, and St. Marys Hospital.

[2] Includes the bowling center and convention center owned by the City of Reno.

*Courtesy of Economic Appendix (Hansford Economic Consulting LLC, 2022)

The following is an excerpt from the BCA population and housing discussion of the project area.

> About a third of the total land area that is estimated to be inundated during a local PMP event is used for single family (attached and detached) housing. The majority of the single-family housing is located north of I-80. General commercial uses are found both north and south of I-80, with the greatest concentration being along Keystone Avenue. General commercial encompasses a wide variety of uses including retail, restaurants, fast food, churches, and convenience stores, as well as some specialty uses including a railroad passenger terminal, and St. Mary's Hospital. Office and professional uses are scattered around the downtown core, with many of the buildings having been converted from residential to office use.
>
> There are about 16,200 residents (6% of Reno's total population) living in the area impacted by a potential flooding event at the West wash and East Wash dams (Affected Area). The median age of residents in Reno is 38.5 years, about the same as in the US and the State; in the Affected Area, the median age is much greater in three of the census tracts (48.6 years, 49.4 years, and 56.2 years). These three census tracts lie south of I-80 and are Tracts 1.03, 1.04 and 1.06.
>
> Compared with the City of Reno, the State, and the US, there is a much larger percentage of persons living below the poverty level in three of the census tracts, including two of the

tracts south of I-80, and census tract 14. There is also a much higher proportion of people living with a disability in two of the census tracts south of I-80 (32% and 26% compared with 12% in Reno, the State, and the US). Median household income (MHI) varies widely between the census tracts; from 53% of the City's MHI to 122% of the City's MHI. Generally, household income is higher in the mostly residential areas north of I-80. Conversely, there is a high proportion of residents receiving food stamps/SNAP benefits in Downtown Reno.

The unemployment rate is similar to the State and the US in most of the census tracts (5% to 7%), but it is much higher in Downtown Reno (at least 15%). The percentage of households without a vehicle is much greater in Downtown Reno (18% to 45%) compared with the State and the US (8%); the same as the City of Reno in census tract 14, and lower than the State average of 7% in census tract 13 (5%) and census tract 24.01 (2%).

There is a total of 7,900 housing units in the Affected Area (7% of the City's housing stock). Most of the housing units are north of I-80; however, there is also a relatively large number of homes located in census tract 1.04, which is south of I-80. Note that the vast majority of the homes in this census tract lie outside of the flooded portion of the census tract. A large share of the housing units are studio and 1-bedroom units south of I-80. In the City, 21% of units have 1-bedroom or less; in the tracts south of I-80, 86% of units are this size in census tract 1.03, 61% in census tract 1.04, and 95% in census tract 1.06. A third of the housing units in census tract 14 are studio or 1-bedroom units. These statistics indicate a very transitory population living in the Affected Area, particularly in the area south of I-80, which is Downtown Reno.

With the exception of census tract 24.01, the housing stock is generally older than for the City of Reno, and much older than the State, reflecting the rapid growth in other parts of the State in the past 50 years. Occupancy is similar to that of the City, State, and the US in most of the census tracts, but it is lower in census tract 1.03, where many older homes have been repurposed from residential to commercial uses. The percentage of units that are occupied by owners is significantly low south of I-80. Only 4% of units are occupied by owners in some parts of Downtown Reno. This is much lower than the City's average of 48%, the State's average of 57%, and the US average of 64%. Two of the census tracts north of I-80 have much higher owner occupancy than the City, State, and US.

As expected with the high proportion of studio and one-bedroom units south of I-80, in and around downtown Reno, household sizes are smaller in and around Downtown Reno. The socioeconomic variables point to a generally older, more transitory, lower-income, and disabled population south of I-80, and a more typical residential population (meaning more similar to the City, State, and the US) living in the Affected Area north of I-80. (Hansford Economic Consulting LLC, 2022)

4.1.5.11 Noise

The project area is surrounded by residential and commercial development, and bounded by McCarran Boulevard, a major four-lane throughfare circumventing the City of Reno. The current traffic levels are anticipated to remain unchanged throughout the project. Normal street and traffic noise is ongoing.

Noise impacts related to project construction will be limited to OSHA construction standards levels for human health and are limited in duration to normal daytime working hours under the City of Reno codes and contract requirements.

The No Action Alternative will have no additional construction noise, and therefore no impacts to noise, or the auditory landscape are anticipated under that alternative.

4.1.5.12 Health and Human Safety

The West Wash Detention Dam and East Wash Diversion Dam protect tens of thousands of citizens and billions of dollars of property in the City of Reno, including nearby residents and large scale downtown development. The City of Reno has Emergency Action Plans (EAP) in place for both dams to protect citizens and property in the event of flooding. The EAPs include flood modeling, mitigation actions, flood maps, and evacuation plans. Emergency Action Plans are tools for city personnel and public safety agencies to maximize public safety while minimizing property damage in the unlikely event of an emergency spillway discharge or failure of the Dams. The EAPs recommend emergency actions which may become necessary at or downstream from the facility. The plans are intended to serve as an appendix to and supplement agency responsibilities and actions set forth in the City of Reno Emergency Operations Plan and meets State of Nevada requirements (NAC 535.320). The plan identifies actions to be taken in case of a dam breach or dam failure and includes classification as either a Red Alert Condition or a Yellow Alert Condition (City of Reno , 2006).

While these plans are in place to guide emergency response personnel, the plans do not include actions to improve the dams to meet current NRCS and State of Nevada dam safety requirements for High Hazard Dams. Under the No action Alternative, these two High Hazard Dams would not be rehabilitated. The risk of dam failure and/or flooding due to changes in precipitation patterns would remain. Routine maintenance would be performed. Risk of flooding to downstream residents, businesses and infrastructure is discussed in the flooding impacts section.

4.1.5.13 Climate Change and Greenhouse Gas Emissions

Increases in greenhouse gas (GHG) concentrations in the Earth's atmosphere are thought to be the main cause of human induced climate change. GHGs naturally trap heat by impeding the exit of solar radiation that reaches the Earth and is reflected into space. Some GHGs occur naturally and are necessary for keeping the Earth's surface inhabitable. However, increases in the concentrations of these gases in the atmosphere during the last hundred years have decreased the amount of solar radiation reflected into space, intensifying the natural greenhouse effect, and resulting in an increase of average global temperature.

Principal GHGs of concern are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), perfluorocarbons (PFC), and hydrofluorocarbons (HFC). Each of the principal GHGs has a long atmospheric lifetime (one year to several thousand years). In addition, the potential heat trapping ability of each of these gases varies significantly. CH_4 is 23 times as potent as CO_2, while SF_6 is 22,200 times more potent than CO_2. Conventionally, GHGs have been reported as CO_2 equivalents (CO_2e). CO_2e takes into account the relative potency of non-CO_2 GHGs and converts their quantities to an equivalent amount of CO_2 so that all emissions can be reported as a single quantity. The primary human-made processes that release these gases include burning of fossil fuels for transportation, heating, and electricity generation; agricultural practices that release CH_4 such as livestock grazing and crop residue decomposition; and industrial processes that release smaller amounts of high global warming potential gases such as SF_6, PFCs, and HFCs. Deforestation and land cover conversion have also been identified as contributing to global warming by reducing the Earth's capacity to remove CO_2 from the air and altering the Earth's albedo or surface reflectance, allowing more solar radiation to be absorbed. Climate change is a global problem, and GHGs are global pollutants, unlike criteria air pollutants (such as ozone precursors) and toxic air contaminants (TACs), which are pollutants of regional and local concern.

The primary GHG in Nevada is CO_2, which accounted for more than 85% of gross GHG emissions in 2019 (NDEP, 2021). The 2019 greenhouse gas (GHG) emissions inventory prepared by the Nevada Division of Environmental Protection (NDEP) under NRS 445B.380 provides an informative assessment of current statewide GHG emissions and identifies major sectors expected to drive future GHG emissions in Nevada. (State of Nevada, 2022) Reno's 2017–2036 master plan, Reimagine Reno, incorporates by reference the goal from its 2019–2035 Sustainability and Climate Action Plan to complete GHG inventories on a three-

year cycle (City of Reno, 2017). The most recent GHG inventory was completed for Washoe County in 2011. The 2011 periodic Emissions Inventory is a comprehensive accounting of all sources of air pollutant emissions. Washoe County has two distinct air pollution seasons: Ozone is a pollutant of concern in summertime, and both particulate matter (PM) and CO are pollutants of concern in wintertime. Summer and winter EI's were developed to evaluate air pollutant emission contributions during these seasons. Because these pollutants are of regional and local concern, and not global GHG pollutants, they are addressed in the air quality section of this report.

The City's Action Plan states "Reno is growing hotter more quickly than any city in the United States. Our average annual temperature rose more than 7 degrees Fahrenheit over the past 50 years. The ten hottest summers on record have occurred over the past 15 years. Climate change already is blamed for larger, more frequent wildfires — and the smoke they pour into the skies hundreds of miles away. Climate researchers predict smaller snowpacks, droughts that last for multiple years, and dramatic increases in flooding" (City of Reno, 2019).

Goals and Priorities of the City's action plan related to the West Wash Dam Rehabilitation Project include:

- Priority 1-Lead by Example-Sustainable city operations: 1.13 Consider climate impacts and integrate climate resilience into city planning, services, projects, and investments, and report resilience projects annually.
- Priority 8- Safeguard Water Resources: 8.3 Promote LID, green infrastructure and sustainable site development that replicate natural hydrology to manage significant storm events.

Policies throughout Reno's Master Plan are intended to make Reno a more sustainable and resilient community. These policies underscore the need to focus not just on today's conditions, or the conditions of the past, but to recognize the dynamic nature of our natural environment and the need to anticipate and plan for a less predictable future (City of Reno, 2017).

Climate change impacts to storm frequency and intensity are unknown but estimated by NOAA data to be mild for the area because of its location within the Sierra rain shadow. However, if the dams fail, the risk of a significant amount of damage to property and risk to lives of those who live and work in the dams' flow path remain in place, and may increase over time as the condition of the dams continues to degrade. Storm flows continue to enter the Truckee River although existing storm drain infrastructure cannot effectively convey local PMP events.

The project is not in conflict with established climate actions plans for Washoe County and the City of Reno and State of Nevada. Rehabilitation of the West and East wash dams will be in furtherance of the City's goals of planning for climate resilience by improving management of storm flows during significant storm events

The No Action Alternative will have no construction emissions and therefore will have no direct impacts on GHG emissions. However, the No Action Alternative would fail to improve the storm management capabilities of the dams and the dams would remain a risk to the public for future unpredictable storm events.

4.1.5.14 Visual Aesthetic Resources

The Project area is in the northwest Truckee Meadows, which is bound to the east by the Virginia Range, to the south by the Huffaker Hills and Steamboat Hills, to the west by the Carson Range, and to the north by Peavine Mountain. The Project is located near the base of Peavine Mountain, which is an open space and recreation area, mostly owned and managed by the Bureau of Land management.

The natural topography and vegetation of the project area have been altered by the construction of the East and West Wash Dams. The topography within the project area ranges in elevation from 4,560 to 4,640 feet

above mean sea level. The contributing watersheds for the dams extend north underneath McCarran Boulevard into the south slopes of Peavine Mountain (Broadbent and Associates , 2021).

East Wash Dam and West Wash Dam have been maintained to ensure continued functionality since their construction in 1960-1961 and the location, design, materials, and workmanship of the flood management system have not been substantially altered since. When the dams were first constructed, they were largely outside the incorporated limits of the City of Reno; however, within five years of construction, several neighborhoods of residential houses were constructed to the east and south of the dams. McCarran Boulevard was constructed immediately north of East Wash Dam between 1978 and 1979 and additional residential neighborhoods were added from the 1970s through the 1990s. Although the area surrounding the dams has changed dramatically since their construction, these changes reflect the significance of the resource and the residential development of Reno (Broadbent and Associates , 2021).

Most of the landscape within and surrounding the project area has been disturbed by construction and development or has been burned by wildfire (Broadbent and Associates , 2021). The biological survey conducted for the project area included the observation that: “The outer edges of the Project Area are extremely disturbed, with heavily utilized walking trails present. Trash and debris were commonly found along the fence lines that border the Project Area and near the culvert located at the extreme northwest corner of the Project Area (EM Strategies , 2021).

Under the No Action alternative, no changes would be made to the existing visual landscape or regular dam operations. Maintenance would continue and the structures would not be altered significantly from their current design.

4.1.5.15 Cumulative Impacts

The NEPA definition of a cumulative impact comes from the Council on Environmental Quality (CEQ), which defines a cumulative impact as:

> …the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (Code of Federal Regulations).

National Environmental Compliance Handbook defines Cumulative Effects as the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other action (NRCS, 2016).

Cumulative impacts can result from individually minor but collectively significant projects taking place over a period of time or in geographic distance. Temporal changes that may contribute to cumulative impacts if this project may be related to additional development in the City of Reno upstream and downstream over time, which may reduce permeable surfaces and increasing the reliance on storm drain infrastructure over time. Similarly, and geographically, additional development in the City of Reno upstream and downstream, increasing the risks from flooding events and dam failure to a larger geographic area of the City than currently modeled.

Plans for development in the area and the City of Reno continue. The City and the Truckee Meadows region have created development goals for long term planning which include protection of the natural environment and resources and mitigating the impacts of development on these resources (City of Reno, 2017) (Truckee Meadows Regional Planning Agency, 2019).

Temporal and geographic changes related to this project may have a disparate impact on minority populations including low income, disabled, transient, or elderly. The project could have a cumulative

impact on the existence of cultural and historic resources. Future storm events or certain alternative could destroy the dams as they currently exist, and without mitigation these irreplaceable historic resources would be lost. These same storm events and/or alternatives could impact biological diversity including threatened and endangered species if not mitigated.

Table 3 is a summary of the impacts discussed in this section. Alternatives 2-5 will include a summary of impacts in similar table form.

Table 4: Alternative 1 Impacts Summary

Resource	Direct Impacts	Indirect Impacts
Land Use	Maintenance: brush removal	Downstream flooding WW: breach w/local PMP and, 200-year storm AS flow and. EW: no breach no flow
Water Resources	No changes to the resources within the dam areas and no impacts	Flooding of Highland Ditch during a dam breach event.
Floodplains	There are no floodplains within the project area.	No additional impacts
Vegetation	Maintenance: brush removal. No other impacts in the dam area	No additional impacts
Fish and Aquatic Resources	No changes to the resources within the dam areas and no impacts	No additional impacts
Wildlife	No changes to the resources within the dam areas and no impacts	No additional impacts
Wetlands/Riparian Areas	No changes to the resources within the dam areas and no impacts. None of the alternatives include making changes to the contributing watersheds above the dam area. No development is planned in the water shed areas, and the area is owned by the federal government under the BLM.	Inadvertent Impacts to Highland Ditch and surrounding wildlife habitat during flood flows.
Air Quality	No changes to the structures, no construction disturbance or emissions and no impacts	No additional impacts
Cultural Resources	No changes to the historic structures and no impact	No additional impacts
Environmental Justice	Impacts disadvantaged groups and downstream residents related to flooding impacts.	Massive flooding impacts during a dam breach event.
Noise	No construction disturbance or noise and no impacts	No additional impacts
Health and Safety	These High Hazard Dams would not be rehabilitated. The risk of dam failure and or/ flooding due to changes in precipitation patterns would remain. Routine maintenance would be performed. Risk of flooding to downstream residents, businesses and infrastructure	No additional impacts
Visual and Aesthetic resources	No changes to aesthetics	No additional impacts
Climate Change and GHG emissions	No emissions. No improvement resilience flooding events.	Loss of species habitat and resulting lack of biodiversity.

4.1.6 Flooding Impacts

Under Alternative 1, all the runoff from a 100-year storm would be contained within the East and West Wash Dams and would not activate West Wash Dam's auxiliary spillway. Therefore, there are no anticipated damages or flooding downstream of either dam during the 100-year storm event.

The worst-case scenario for Alternative 1 is a Local PMP event, which would cause an overtop of the West Wash Dam and likely cause a breach. If the West Wash Dam were to breach, it is estimated that the breach would last approximately 36 minutes and reach a maximum depth of approximately 40 feet, which would occur immediately downstream of the dam. The flood wave would follow residential roads until it reached Interstate 80, where most of it would be contained and stop at the low point near the N Virginia St. overpass. Existing storm drains within the freeway would then drain the water into the storm drain system. Some overflow from Interstate 80 would flood downtown, albeit at a much shallower depth, until the water reaches the railroad to the north of 2nd Street. Since the railroad is lower than the surrounding streets, the flood water would collect and pool there and not go any further south (Farr West Engineering, 2022). The total area flooded for a breach event caused by the Local PMP is approximately 271 acres. An inundation map for the Local PMP breach event for Alternative 1 can be found in Appendix H.

The BCA estimates no costs associated with damages for a 100-year storm event and $192,527,004 of damages with a breach caused by a Local PMP event under the no action alternative. Under the no action alternative, no structures would be damaged in a 100-year event and 1,218 structures would be damaged in a breach event (Hansford Economic Consulting LLC, 2022).

4.1.7 Strengths, Weaknesses, Opportunities, and Constraints (Risk and Uncertainty)

Risk and uncertainty in these alternatives include upstream development contributing to storm water runoff, climate change, and flooding impacts downstream of the dam including downtown Reno and the Truckee River. These specific attributes related to these uncertainties is discussed under each alternative.

Storm water models were created using lidar from the City of Reno, the NOAA Atlas 14, and the Probable Maximum Precipitation event developed using the HMR-49 (NOAA, National Weather Service, 1984). Since the HMR-49 report was most recently updated in 1984, a PMP study of the area would refine modeling results. That being said, any refining is anticipated to reduce the PMP precipitation value and the PMP value used for modeling purposes is believed to be conservative.

Climate change impacts to storm frequency and intensity are unknown but estimated by NOAA data to be mild for the area because of the dams' locations within the Sierra rain shadow. However, if the dams fail, the risk of significant property damage and danger to those who live and work in the dams' flow path remain and may increase over time as the condition of the dams continue to degrade. Storm flows that will continue to enter the Truckee River through existing storm drain infrastructure cannot effectively convey local PMP events. The uncertainties related to climate change can be addressed by ensuring design options that allow the City of Reno to be resilient in the face of potential events.

The strengths of the no action alternative in cost savings and disturbance avoidance come at the expense of a failure to plan for long-term resilience to flooding events for the City of Reno, impacts to flooding events for surrounding residents, and health and safety risks that would remain at these High Hazard Dams.

4.1.8 Summary

This alternative does not meet the purpose and need for the project and would leave both High Hazards Dams lacking required safety measures to protect citizens and infrastructure of the City of Reno. Therefore, the No Action Alternative is not reasonable and is an unacceptable solution. Analysis of the No Action alternative will be carried forward only as a reference for impacts of the proposed project, not as a viable project alternative.

4.2 ALTERNATIVE 2: DOWNSTREAM FLOOD IMPROVEMENTS

4.2.1 Description

Alternative 2 consists of only making improvements downstream of East and West Wash Dams and not doing any improvements to the dams themselves, nor the dam impoundment areas. Downstream improvements would involve purchasing all APNs that have over one foot of water on them during the Local PMP/breach event, demolishing any structures on the property, and reverting the land back to its original habitat. There are 664 properties with greater than one foot of inundation. APNs with less than one foot of water at the Local PMP/breach event would not be purchased and demolished and would need repairs if a breach were to occur. The purpose of this alternative is to clear the flood path to minimize the risk to human health and life, while not altering the existing East and West Wash Dam structures. No changes to the existing storm drain system would be made under this alternative. Demolition of APNs in the flood area will include removal of existing utilities and other infrastructure, such as roadways. Rezoning of the acquired APNs will be necessary to avoid any attempts of future development in this area.

4.2.2 Drawings

Two exhibits for Alternative 2, that show the general layout and illustrate which APNs will have greater than one foot of water and will need to be purchased and demolished, can be found in Appendix E. The first exhibit shows the general layout of the existing East and West Wash Dams in their current conditions and that no improvements will be made to the dams or within the dam impoundment areas. The second exhibit illustrates the flood area under Alternative 2 for the Local PMP/breach event and which APNs within the flood area have greater than or less than one foot of water on the property. APNs with a foot of water or more on the property will be purchased, demolished, and reverted to their original landscape under this alternative.

4.2.3 Cost Estimate

The AACE Level 4 cost estimate for Alternative 2 is shown in Table 4. Detailed discussion on how quantities and unit costs were developed can be found in the Basis of Estimate in Appendix C. The total estimated cost for Alternative 2, including property acquisition, is $2,012,174,467.

This cost estimate does not include the approximately $100,000 estimated for Federal and local permitting including zoning changes, and new FEMA flood mapping. City administrative costs are also not included in the above estimate but are assumed to be 25% of engineering costs for preliminary cost sharing estimating purposes.

Based on preliminary cost sharing estimates, the City or Reno would be responsible for approximately $1,639,817,700.00, which is primarily property acquisition under a cost sharing agreement with PL-566 funds. This cost is not economically feasible for the City of Reno.

Table 5: Alternative 2 Capital Cost Estimate

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization	1	LS	$ 11,110,000	$11,110,000
2	Temporary Erosion and Sediment Control	1,615	DY	$ 1,000	$1,620,000
3	Temporary Traffic Control	1,615	DY	$ 1,000	$1,620,000
4	Geotechnical Testing and Inspection Services	167	DY	$ 1,750	$300,000
5	Structures Demolition	4,497,331	SF	$ 10	$ 44,980,000
6	Material Disposal	18,888,790	CY	$ 9	$ 170,000,000
7	Revegetation	182	AC	$ 5,500	$ 1,010,000
8	Site Grading	836	EA	$3,000	$2,508,000
				Construction Subtotal	**$233,148,000**
				Engineering	$23,314,800
				Construction Management	$23,314,800
				Effective Inflation	$23,314,800
				Contingency	$69,944,400
				Based Bid Total	$373,036,800
				Property Acquisition	$1,639,137,66
				Total	**$2,012,174,46**

4.2.4 Economic Analysis

Alternative 2 would have the least damages from a single-year event at $36,764,306, occurring from a Local PMP event, because all properties expected to have flooding greater than one foot on the property would be acquired. There are no damage costs associated with the 100-year event for Alternative 2 since there is no anticipated flooding for that storm event.

The net benefits for Alternative 2 increase with increased storm severity, but all net benefits are negative, and all benefit-cost ratios are zero. The Net Benefit in the NED Account for Alternative 2 is -$42,712 for the 100-year storm event and -$42,563 for the Local PMP event.

In addition to the NED, there are impacts that can be measured in the RED account for Alternative 2 because under this alternative there is substantial property acquisition. The RED account considers people displaced, visitors lost, and jobs lost because of the necessary property acquisitions. The calculations are based on the census tract. The estimated number of permanent residents displaced is 1,990 under Alternative 2. The number of visitors lost from Downtown Reno is estimated at 18,150 per year under Alternative 2. Using estimates of occupancy and building square feet per employee, it is calculated that about 2,466 jobs would be lost under Alternative 2. Using the Assessor's database, the amount of property taxes that would be lost in fiscal year 2022/23 were also considered. The loss of property taxes increases with the number of properties acquired (over ten years under Alternative 2). RED impacts are estimated to be -$69,718,659 under Alternative 2 and would result in severe losses of revenues to the City of Reno and State of Nevada. Annual property tax losses were discounted and amortized to determine average annual equivalent losses.

For more information on the economic analysis or how anything discussed in this section was calculated, see the Economic Appendix in Appendix D.

4.2.5 Environmental Effects

Identified environmental impacts are presented in chart form for this Alternative 2 (see Table 5). Impacts were identified using the existing dam area and the disturbance within the dam area. Because this alternative was eliminated from further detailed consideration, the downstream area impacted during various flooding scenarios was not evaluated. This project would involve 270.56 acres of floodway created and the removal of 664 homes in the area. An expanded APE would need to be established and evaluation of resources within the 270.56 acres and any indirect impacts area. The proposed floodway would remove residential structures and creation of the floodway would be designed with native and wetland plants. Direct impacts to environmental resources were identified, and indirect and cumulative impacts were considered. This impact to the community is significant enough to eliminate this alternative from further consideration as unreasonable. The relocation of residents that would take place under this alternative is addressed under cumulative impacts as related to existing long term planning documents developed by the City of Reno and the Truckee Meadows Regional Planning Agency (City of Reno, 2017) (Truckee Meadows Regional Planning Agency, 2019).

Table 6: Alternative 2 Impacts Summary

Resource	Direct Impacts	Indirect Impacts
Land Use	No ground disturbance and no temporary construction effects would occur in the dam area under this alternative. No impacts or changes to current land uses would occur under this alternative. Displacement and relocation of residents of 1,346 homes. Major land use changes where downstream properties are purchased/relocated, and floodway area is designed and constructed.	An expanded APE must be established to include the downstream effects and evaluation of resources within the expanded APE must be completed.
Water Resources	No changes to the resources within the dam areas. Therefore, no direct impacts. NDEP permitting and a SWPPP would be needed.	Truckee River irrigation ditches, and storm water infrastructure downstream of the dam. Creation of floodway, infiltration and ground water/surface water interactions, water quality would need analysis
Floodplains	There are no floodplains within the project area.	Changes to existing FEMA mapping would likely be required. A special flood way or other regulatory changes under FEMA may occur. When modeled, the flooding does not impact identified existing flood zones.
Vegetation	No changes within the dam area	Expanded APE must be established and evaluation of resources within the expanded APE completed. The floodway would remove residential structures and creation of the floodway would be designed with native and wetland plants.

Fish and Aquatic Resources	No changes to the resources within the dam areas. Modeled Flood flows would not reach the Truckee River.	No additional impacts
Wildlife	Where possible, milkweed stands should not be removed during the summer breeding period (May through August) to prevent impacts to breeding monarch butterflies. Plants that will be disturbed should be salvaged and replanted in appropriate habitat when practical.	No additional impacts
Wetlands/Riparian Areas	No changes to the riparian resources within the dam areas and no impacts to wetland identified within the dam areas.	Inadvertent Impacts to Highland Ditch and surrounding wildlife habitat during flood flows.
Air Quality	No construction disturbance or emissions within the dam area. Expanded APE including inundated properties must be established and construction of floodway or demolition or relocation of buildings and infrastructure must be analyzed. construction days and equipment and construction dust from excavation disturbance and other mitigation measures related to PM10. NDEP permit necessary.	No additional impacts
Cultural Resources	Demolition of homes over 50 years in age which potentially historic significance. Additional Section 106 review to analyze the potential effects of the new design elements. Expanded APE must be established and the identification of historic properties within the expanded APE completed.	Additional Section 106 review to analyze the potential effects of the new design elements would be needed. Expanded APE must be established and the identification of historic properties within the expanded APE completed.
Environmental Justice	Purchasing properties is a large impact on one area for the benefit of other downstream residents and property owners. Alternative 2 displaces about 2,000 permanent residents, causes an estimated almost 2,500 jobs to be lost, and reduces annual visitation to Reno's Downtown by about 18,000 people per year. shows there is a high proportion of minorities living in Downtown Reno compared with the City of Reno, as well as a lower income, more transitory and older population with a higher proportion of the population having a disability, and living in poverty than in the City of Reno, the State, and the US. These disadvantaged persons would be severely	Changing of the make-up and feel of the existing neighborhood and community.

	impacted as much of Downtown Reno becomes a flood plain under alternatives 2, 4, and 5.	
Noise	Temporary construction noise in demolition of 1346 of homes and infrastructure and creation of floodway. No additional noise from traffic is expected.	Reduction in traffic noise within the neighborhood where the new floodway is created.
Health and Safety	The dams would not be rehabilitated, and the risk of downstream flooding remains the same as in alt 1 however, all properties subject to over 1 foot of inundation during the local PMP storm would be purchased to create a floodway. See flooding impacts for further description.	The floodway may pose risk to residents and citizens if not properly secured. Access to the floodway during storm and potential flood events would pose a risk of injury and even drowning. In addition, the waters may be unhealthy for residents and the watershed due to residential and commercial run off contaminants in the area.
Visual and Aesthetic resources	Changes to create floodway from primarily residential area.	No additional impacts
Climate Change- and GHG emissions	GHG emissions from construction equipment. Approximately 1,077 days of ground disturbance and active construction.	A flood way may allow the City to manage unpredictable storm flows in the future, up to the local PMP event. The floodway may allow for additional vegetation which may sequester greenhouse gasses and provide additional filtration of storm water, and therefore improved water quality.

4.2.5.1 Cumulative Impacts

In the past, development in the area was dependent on the existence of the East and West Wash Dam structures for storm flow and flood protection. Entire neighborhoods were approved for development by HUD in the 1960's based on the existence of these storm water conveyance structures.

Construction of housing development plans that were City reviewed and approved were built based on the existence and assumed flood protection of the East and West Wash Dam structures. The surrounding development caused an increase in impermeable surfaces in the watershed from roads and housing areas, which must be included in storm flow calculations now and in the future to provide appropriate stormwater conveyance and drainage. Creation of a floodway would increase permeability of floodwaters for the area and may allow for groundwater seepage of storm and flood waters back into the ground or to the Truckee River.

Depending on the functionality of the floodway water quality may be improved or diminished based on infiltration of constituents in the storm water runoff from the surrounding developed areas. The impact of relocating housing for 646 properties and homes to other moderate density single family homes or like properties would be severe in an area with already difficult to access housing. Housing demand is on the rise in Reno and in the region and relocating these residents would be in opposition to planning goals and

development scenarios. This alternative is in direct conflict with the goals of the City of Reno Master Plan for the retention of existing housing stock, to target infill development consistent with land use plans and design principles for neighborhoods, maintaining facilities in existing neighborhoods to address changing needs over time, improving safety of existing infrastructure, and to support and aid in the upkeep and maintenance of lower income households and seniors (City of Reno, 2017).

Historic Resources, including the historic District identified during baseline work for this project, would be fully removed and the land returned to pre-development grade. Additional Section 106 review would be needed to analyze the potential effects of the new design elements. An expanded APE would be established and the identification of historic properties within the expanded APE completed.

Impacts to human health and safety remain in place and are discussed further in the flooding impacts section below.

4.2.6 Flooding Impacts

Under Alternative 2, all of the runoff from a 100-year storm would be contained within the East and West Wash Dams and would not activate West Wash Dam's auxiliary spillway. Therefore, there are no anticipated damages or flooding downstream of either dam during the 100-year storm event (Farr West Engineering, 2022).

The worst-case scenario for Alternative 2 is a Local PMP event, which would cause an overtop of the West Wash Dam and likely cause a breach. If the West Wash Dam were to breach, it is estimated that the breach would last approximately 36 minutes and reach a maximum depth of approximately 40 feet, which would occur immediately downstream of the dam (Farr West Engineering, 2022). The total area flooded for a breach event caused by the Local PMP is approximately 271 acres. An inundation map for the Local PMP breach event for Alternative 2 can be found in Appendix H.

Under Alternative 2, all houses and roads within the flood area that would be inundated with over one foot of water because of a dam breach would be acquired and demolished to prevent devastating damage from the main flood wave. However, houses with less than one foot of water would remain and still incur minor water damage. The flood wave would follow the remaining residential roads and still reach Interstate 80, where most of it would be contained and stop at the low point near the N Virginia St. overpass. Existing storm drains within the freeway would then drain the water into the storm drain system. Some overflow from Interstate 80 would flood downtown, albeit at a much shallower depth, until the water reaches the railroad to the north of 2nd Street. Since the railroad is lower than the surrounding streets, the flood water would collect and pool there and no go any further south.

The BCA estimates no costs associated with damages from a 100-year storm event and $36,764,306 of damages from a breach caused by a Local PMP event under Alternative 2. There would be no structures damaged during a 100-year event and 593 structures would be damaged during a breach event (Hansford Economic Consulting LLC, 2022).

4.2.7 Strengths, Weaknesses, Opportunities, and Constraints (Risk and Uncertainty)

Alternative 2 uses a method of addressing flooding in the affected urban area using a designed flood plain instead of upgrading the existing dam structures and storm drain infrastructure. The constraints on this project by the infrastructure that has been planned and built with reliance on the dams for flood protection since the 1960s is significant.

Alternative 2 has the potential to provide groundwater infiltration, possibilities for LID development, green infrastructure, and may provide additional habitat for wildlife and incidental recreation opportunities for citizens and visitors.

This is not a reasonable alternative because it does not meet the objectives of the NRCS watershed plan or the purpose and need identified for the project. This alternative does not meet the stated needs of the project

to address current deficiencies at West Wash and East Wash Dams to bring both dams into compliance with current dam safety regulations, engineering standards, and performance criteria for High Hazard Dams. This alternative also does not ensure the watershed structure is properly maintained to minimize the risk to lives and property in the surrounding and downstream urban area. The stated purpose of the project is to preserve the flood protection function of the West Wash Dam, protect lives and property in the surrounding urban area, and comply with current performance and safety standards in a cost effective and environmentally acceptable manner. This alternative would leave residents and property at risk during the extensive planning period, fails to preserve the flood protection function of the existing dams, and would be an exorbitant cost to the City of Reno and NRCS.

4.2.8 Summary

This alternative does not meet the purpose and need for the project and would leave these High Hazards Dams lacking required safety measures to protect citizens and infrastructure of the City of Reno. Downstream flood improvements, or flood proofing, is not a viable alternative for this developed, urban residential and commercial area. This alternative includes displacing hundreds of residents at a cost of billions of dollars and over a span of several years, or even decades, spent in property acquisition alone. In the meantime, the dams would still not be rehabilitated to meet NDWR and NRCS dam safety requirements, and residents and businesses would remain at risk during extreme flooding events. In addition, the cost of purchasing residential properties, relocating residents, and building a floodway are not feasible.

For these reasons this alternative is eliminated from further detailed analysis. Information herein is being provided to assist with comparison of the remaining viable and reasonable alternatives. Therefore, Alternative 2 is not reasonable, is unacceptable and further analysis of the alternative will not be carried forward.

4.3 ALTERNATIVE 3: REMEDIATE BOTH EAST WASH AND WEST WASH DAMS

4.3.1 Description

This alternative includes remediation of both dams to meet the safety requirements of the NRCS and the NDWR Division of Dams. East Wash Dam is classified as a diversion dam while West Wash Dam is classified as a detention dam. Both Dams have been identified as High Hazard Dams by the Division of Dams.

Currently, the East Wash Dam meets NRCS criteria for Earthen Dams with the exception of excessive damage to the spillway in a PMF event (USDA NRCS, 2019). Storm event modeling confirms East Wash dam will fail through the spillway during a large storm event (greater than 100-year event) and cause excessive damage to the auxiliary spillway and concrete chute principal spillway due to erosion and head cutting. Modeling shows foundation erosion at the concrete spillway during large storm events. Activation of the auxiliary spillway will result in loss of the west berm in a large storm and head cutting of the approach channel. During any single event this will not impact water impoundment, but afterwards, repair of the channel and replacement of the berm to maintain functionality of the dam for a subsequent large storm event will be needed. When head cutting occurs a significant increase in debris and sediment loading occurs which may cause additional flow issues in receiving channels and structures and will require cleaning out once the event is passed. Additionally, the removed material and scarp in the spillway formed by the head cutting activity will need to be addressed via repair or replacement of lost material. It is important to note that repair of the headcut within the spillway is not optional as future flow will pick up the progression of the headcut upstream and may cause an unsafe condition or total loss of any impounded water (the reservoir). In other words, the spillway may not be unsafe with respect to headcutting for one extreme event, however, left unattended, it will become unsafe thereafter, due to the damage incurred. Extended flow and extreme storm events will cause damage and should be avoided. Endeavoring to keep the concrete chute

principal spillway of East Wash intact by including armoring will improve the overall flood protection function of the dams.

Requiring major repairs such as remediation of a headcut is an unacceptable condition as resources following an extreme event may cause significant delays in such activity. Therefore, it is essential that the spillway be able to accommodate the design flood flow with minimal, if any, damage. Armoring of the auxiliary spillway is recommended to be a part of the design phase during which a value engineering approach will be utilized to arrive at an effective and cost-efficient method of preventing excessive damage.

The West Wash Dam does not meet NRCS criteria and modeling has shown it would overtop in a PMF event (USDA NRCS, 2019) (Farr West Engineering, 2022). However, neither the original United States Army Corps of Engineers Phase I calculations performed, nor the original parameters utilized are available for review. Due to data gaps and potential advances in the knowledge of seismic activity in the area, seismic stability will be investigated as a part of the final design of this project.

Remediation of both dams will be confined to the already disturbed areas of the structures. East Wash Dam will have the west dike of the principal spillway approach restored to the original design elevation as a maintenance item. Armoring of the auxiliary spillway of the East Wash dam will occur to avoid future damage to the East Wash Dam structure due to head cutting and degradation.

The West Wash Dam embankment will be raised five feet to a new elevation of 4798 feet, the auxiliary spillway widened to the original design width of 80 feet and lowered to a crest elevation of 4782.5 feet, the impoundment area to the west of the existing flow line will be regraded to allow for more water storage, and a 2-foot-tall parapet wall will be built on the east corner of the dam. The parapet wall is intended to provide 3’ of freeboard and meet the DWR requirements under NAC 535.240. The final height of the wall will be determined during final design. Re-grading the impoundment area of West Wash Dam will consist of steepening the western slope to a 2:1 slope and the total cut and fill associated with the grading will be approximately 421,683 yd^3 and 28,588 yd^3, respectively.

With these proposed changes, the West Wash Dam auxiliary spillway will not be activated until the 500-year storm event (currently it activates during a 200-year storm event). The improvements to the West Wash Dam will supply three feet of freeboard during the Local PMP event, and the dam will no longer overtop or be in jeopardy of breaching. This alternative exceeds the current NRCS authorization for funding for this project. If this alternative is selected, then a request to modify or amend the agreement may be necessary.

Other minor improvements that will be made under this alternative include:

- Stripping of vegetation, debris, and weathered fill from crest and downstream face of West Wash Dam
- Stripping of vegetation, debris, and weathered fill from crest and both faces of East Wash Dam’s Auxiliary spillway
- Cleaning out Principal Spillway and sediment drain conduits
- Replacement of sediment drain trash rack
- Corrosion resistant coating of sediment drain riser (and potentially interior of conduit to outfall in Principal Spillway riser)
- Repair of principal spillway riser concrete spalls and damage (both East and West Wash Dams).
- Daylighting of West Wash Dam Principal Spillway downstream invert
- Excavation along Principal Spillway conduit for installation of seep intercept system
- Backfill for repair of right spillway guide “wall” at crossing of Gulling Dr.

Every year both the East and West Wash dams are inspected by the Division of Water Resources at the State of Nevada's Department of Conversation and Natural Resources. The list of improvements above will address many of the items flagged for repair or maintenance by NDWR during the yearly inspections. All yearly inspection reports are provided in the Preliminary Alternatives Memo completed by Farr West Engineering.

4.3.2 Drawings

An exhibit for Alternative 3, that shows the general layout and lists key components of the remediation of East and West Wash Dams, can be found in Appendix E.

4.3.3 Cost Estimate

The AACE Level 4 cost estimate for Alternative 3 is shown in Table 6. Detailed discussion on how quantities and unit costs were developed can be found in the Basis of Estimate in Appendix C. The total estimated cost for Alternative 3 is $23,008,000.

This cost estimate does not include City administrative costs which are assumed to be 25% of engineering costs for preliminary cost sharing estimating purposes. Based on preliminary cost sharing estimates, the City or Reno would be responsible for approximately $7,058,800.00 under a cost sharing agreement with PL-566 funds.

Table 7: Alternative 3 Capital Cost Estimate

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization	1	LS	$690,000	$690,000
2	Temporary Erosion and Sediment Control	1,000	DY	$1,000	$1,000,000
3	Protection or Replacement of "NW Reno Flood Basin Labyrinth"	1	LS	$6,000	$6,000
4	Geotechnical Testing and Inspection Services	133	DY	$1,750	$233,000
5	Clearing, Grubbing, and Stripping	22	AC	$13,000	$286,000
6	Revegetation and Seeding	22	AC	$5,500	$121,000
7	Excavation and Disposal	1	LS	$5,665,000	$5,665,000
8	On-Site Cut/Fill	1	LS	$350,000	$350,000
9	Slope Stabilization	233,351	SF	$10	$2,334,000
10	Geosynthetic Stabilization	122,418	SF	$25	$3,070,000
11	Existing Utilities	1	LS	$525,000	$525,000
12	Miscellaneous Improvements	1	LS	$100,000	$100,000
13	On-Site Cut/Fill	1	LS	$690,000	$690,000
				Construction Subtotal	**$14,380,000**
				Engineering	$1,438,000
				Construction Management	$1,438,000
				Effective Inflation	$1,438,000
				Contingency	$4,314,000
				Total	**$23,008,000**

4.3.4 Economic Analysis

Alternative 3 would have the second highest damages from a single-year event of $190,321,707, which is associated with the Local PMP event. There are no damage costs associated with the 100-year event for Alternative 3 since there is no anticipated flooding for that storm event.

Under Alternative 3 the benefits are maximized in the local PMP flood event. Annual costs are much lower than under Alternative 2, but the net benefit is still negative. The Net Benefit in the NED Account for Alternative 3 is -$598 for the 100-year storm event and -$505 for the Local PMP event. The benefit-cost ratio for the 100-year storm event was zero. There is a positive benefit-cost ratio of 0.16 to 1 for the Local PMP event, meaning there is a sixteen-cent return for every dollar spent on the project. This result is typical for dam rehabilitation projects because there isn't any cost associated with the comparison alternative (future without the project) and the project is being driven by dam safety that impacts threat to human lives.

For more information on the economic analysis or how anything discussed in this section was calculated, see the Economic Appendix in Appendix D.

4.3.5 Environmental Effects

Environmental effects of Alternative 3 are focused on the direct area of potential impact, which includes the area of the existing dams, and area of indirect impacts, which includes possible downstream effects. Direct impacts are primarily related to ground disturbance and construction activities within the existing area of the dams and the residents directly adjacent and within 1,000 feet of the project area. Indirect effects include impacts of flooding due to storm events of differing recurrence intervals of varying intensity and duration. Impacts from a 100-year recurrence event would be limited to the direct area of the dams because the entire storm water event would be contained by the dams and City of Reno storm water infrastructure. A PMP event, however, would see indirect downstream flooding impacts due to controlled primary and auxiliary spillway activation. These impacts are discussed under the indirect impacts discussion. Direct impacts under Alternative 3 include: land use, vegetation, wildlife, wetlands/riparian areas, air quality, cultural resources, noise, and aesthetics. Table 7 is a summary of environmental impacts anticipated for Alternative 3.

Table 8: Alternative 3 Impacts Summary Table

Resource	Direct Impacts	Indirect Impacts	Potential Mitigation
Land Use	• Removal of vegetation, soil disturbance, disturbance of existing drainage patterns. • Total soil disturbance within the dam area is 421,683 cubic yards. This work would also impact the existing City of Reno Storm drain inlets. 2 of the inlets are within the excavation area for alternative 3. • Additional armoring of spillways and adding a low wall. Some easements may be	Potential inadvertent erosion and runoff impacts downstream during construction	• Storm Water Pollution Prevention Plan (SWPPP). • Construction BMPs to prevent erosion and run off. • Surface Area disturbance Permit and accompanying BMPs

	needed from neighboring properties.		
Water Resources	No changes to the resources within the dam areas- no impacts	No additional impacts	None
Floodplains	There are no floodplains within the project area.	Downstream impacts from flooding may occur. When modeled the flooding does not impact identified floodzones.	None
Vegetation	Vegetation identified within the dam area would be excavated. The Inter-Mountain Basins Big Sagebrush Shrubland and The Great Basin Lowland Riparian vegetation communities including wetland vegetation would be disturbed.	Accidental Loss of Inter-Mountain Basins Big Sagebrush Shrubland and The Great Basin Lowland Riparian vegetation communities.	Avoidance fencing, relocation and replanting of vegetation types.
Fish and Aquatic Resources	No aquatic species identified within the direct project area. No impacts.	Modeled Flood flows would not reach the Truckee River. And therefore, would have no effect on fish and aquatic species. No additional impacts.	None
Wildlife	Excavation to remediate the dams under Alt 3 would disturb wildlife habitat including habitat for monarch butterflies.	Accidental removal of wildlife habitat. Possible accidental take of wildlife. Possible reduction in wildlife biodiversity with accidental take. Migratory Birds nay be impacted. Construction activities are limited to the ground and existing roads and road shoulders. No disturbance to migratory birds is	• Where possible, milkweed stands should not be removed during the summer breeding period (May through August) to prevent impacts to breeding monarch butterflies. Plants that will be disturbed should be salvaged and replanted in appropriate habitat when practical. • Mitigation practices to adhere to the

		anticipated under alternative 3. A migratory bird clearance survey may be necessary.	Migratory Bird Treaty may be necessary. if ground disturbance during migratory bird breeding season (April 1 through July 31), a migratory bird nesting clearance survey would be conducted within a three-day period prior to the disturbance followed by a 14-day period to complete the disturbance. If a nest is found, a species-appropriate no-disturbance buffer would be placed around the nest until the young have fledged, or until the nest fails.
Wetlands/Riparian Areas	Disturbance of riparian corridor present in the Project Area which enters from the west and then curves south to the West Wash embankment dam including a thick, mature mixed willows, along with cottonwood trees. The non-jurisdictional wetland adjacent to Highland Ditch also possesses mature willows, cottonwood trees, and tree of heaven. These willows and trees provide potential nesting habitat for migratory birds.	Inadvertent Impacts to Highland Ditch and surrounding wildlife habitat during flood flows.	Avoidance plans and fencing: excavation plans show the areas to be partially avoided because the regarding activities are focused on the west side of the west wash impoundment area.
Air Quality	Temporary construction impacts to air quality to include construction emissions and soil disturbance. Total soil disturbance within the dam area is 421,683 cubic yards.	No impact: below identified emissions thresholds in PM10 SIP	Fugitive Dust suppression would be necessary and other mitigation measures related to PM10.

	Construction equipment emissions will have temporary effect.		
Cultural Resources	• If the final design elements included in Alternative 3 repair and rehabilitate the dams using the same materials and with the same design as the original structures (i.e., maintain and repair the structure with like materials), recommends a finding of No Adverse Effect. • If the final design of Alternative 3 would substantially alter the design of the East and West Wash Dams and their accessory structures, or would involve the use or addition of materials that are not in keeping with the original materials used in the construction of these structures, recommends mitigation	Inadvertent loss of unidentified cultural or historical resources	Historic Properties Treatment Plan (HPTP) developed to resolve the adverse effect to these historic properties through mitigation Appropriate mitigation methods should involve public interpretation, such as the production of a brochure or other publications, web-based and published articles, public presentations, museum exhibits, or historic markers.
Environmental Justice	Controlled release (auxiliary spillway activation) that would occur under alt 3 would affect different residences than under alt 1 or 2. (see inundation maps) More impacts to residences directly downstream from AS and south of Severn drive under Alt 3.	Less overall flooding in flooded areas (25 ft max, instead of 40 ft max inundation in areas)	Updated Emergency Action Plans.
Noise	Temporary construction noise.	Increased ambient noise levels during construction period.	Construction noise mitigation actions such as limited hours (7-7pm)

Health and Safety	Both Dams would be rehabilitated to meet federal, state and community design and safety standards for high hazard dams. Risk of flooding still remains for extreme flooding events at the local PMP event when a controlled release would occur through the auxiliary spillway. However, the dam would not breach. Risks to life and safety would be lessened due to anticipated activation of auxiliary spillway and less total inundation depths downstream.	Downstream Flooding	Downstream flooding still a possibility, Dam EAPs would be revised for new flooding events and warning times.
Visual and Aesthetic Resources	Minor aesthetic changes: Raise WW dam 5-feet, add a 2-foot-tall parapet wall on eastern berm near dam, regrade western slope of impoundment area to hold more water, widen Auxiliary Spillway to 80', and lower Auxiliary Spillway crest height by 2.4-feet.	No additional impacts	None
Climate Change-GHG Emissions	GHG emissions from construction equipment. Approximately 614 days of ground disturbance and active construction activity.	No additional impacts	Construction equipment and emission BMPs and City Standards.

4.3.5.1 Cumulative Impacts

Development which has occurred upstream and in the area surrounding the dams has caused an increase in impermeable surfaces in the watershed. Maintaining existing development and infrastructure and allowing plans to process as developed would be possible only through this alternative.

While flooding impacts are still possible, Alternative 3 provides the most protection for residents and property in the City of Reno during a PMP event without significant acquisition and allows the City to manage unpredictable storm flows that may arise in the future.

In the event of a dam breach additional impacts would occur downstream, however, Alternative 3 is designed so that the West Wash Dam will not breach during a PMP event. Impacts would be due to a controlled release of the spillways, which is discussed in the flooding impacts section below.

4.3.6 Flooding Impacts

Under Alternative 3, all of the runoff from a 100-year storm would be contained within the East and West Wash Dams and would not activate West Wash Dam's auxiliary spillway. Therefore, there are no anticipated damages or flooding downstream of either dam during the 100-year storm event (Farr West Engineering, 2022).

The worst-case scenario for Alternative 3 is a Local PMP event. Since this alternative would involve raising the dam and expanding the runoff capacity of the dam impoundment, the Local PMP will only cause auxiliary spillway activation and will not overtop or breach the dam. It is estimated that a Local PMP event would cause discharge through the auxiliary spillway for 5.5 hours and reach a maximum downstream flood depth of approximately 25 feet (Farr West Engineering, 2022). The total area flooded for a breach event caused by the Local PMP is approximately 218 acres. An inundation map for the Local PMP breach event for Alternative 3 can be found in Appendix H.

Under Alternative 3, discharge from the auxiliary spillway would flow immediately onto Severn Dr. and then follow residential roads until it reached Interstate 80, where most of it would be contained and stop at the low point near the N Virginia St. overpass. Existing storm drains within the freeway would then drain the water into the storm drain system. Some overflow from Interstate 80 would flood downtown, albeit at a much shallower depth, until the water reaches the railroad to the north of 2nd St. Most of the water south of Interstate 80 will pool in the recessed railway, but a small amount of flow will reach E 2nd St. between the N Sierra St. and Evans Ave. intersections.

The BCA estimates no costs associated with damages from a 100-year storm event and $109,321,707 of damages from a Local PMP event under Alternative 3. There would be no structures damaged from a 100-year event and 1,086 structures damaged in a Local PMP event (Hansford Economic Consulting LLC, 2022).

4.3.7 Strengths, Weaknesses, Opportunities, and Constraints (Risk and Uncertainty)

Alternative 3's strengths are its minimal impacts to environmental resources within the dam area, particularly when mitigation is incorporated to maximize avoidance of sensitive resources. In addition, this alternative provides the most protection of property and lives downstream of the dam and allows the City the potential to manage extreme events that may occur but are unpredictable due to climate change uncertainty. This alternative also provides additional flood protection for more severe storm events than other alternatives, provides storm flow capacity for potential additional development upstream, and minimizes encroachment into the dam area by neighboring uses. The alternative provides opportunities to meet the project challenges including maintaining downstream flood protection and reducing risk of loss of life and damage to property, reducing the possibility of dam failure and obtaining full compliance with NDWR and NRCS dam safety criteria. Alternative 3 meets the purpose and need for the project.

The primary weakness of this alternative is its costs. Although capital costs, maintenance costs, and additional planning costs have been determined using a basis of cost estimate, inflation and other economic uncertainty can still affect the project cost in unanticipated ways. The Economic Appendix has worked to account for future uncertainty and has identified this alternative as the NED plan.

4.3.8 Summary

Alternative 3 meets the purpose and need for the project, has been identified as the NED alternative, and was identified as the best ranking alternative by City of Reno using the decision matrix tool. This alternative will be carried forward in the environmental assessment.

4.4 ALTERNATIVE 4: REMOVE BOTH DAMS (DECOMMISSIONING)

4.4.1 Description

Under Alternative 4, the existing East Wash and West Wash Dam embankments would be completely removed, including primary and auxiliary spillways, and the area would be returned to pre-development conditions. Earth derived from the removal process would be either disposed of on-site or transported to an off-site disposal area. No flood protection would be afforded to properties downstream from the dam sites under this preliminary alternative, however some properties in the immediate vicinity of the existing auxiliary spillways would no longer be threatened by their activation. This alternative would include analysis of existing storm water conveyance downstream from the dams and preparation of flood maps for inclusion in the FEMA FIRM program. This alternative exceeds the current NRCS authorization for funding for this project. If this alternative is selected, then a request to modify or amend the agreement may be necessary.

4.4.2 Drawings

An exhibit for Alternative 4, that shows the East and West Wash Dams returned to pre-development conditions, can be found in Appendix E. Approximate cut and fill quantities required to grade the area are also listed in the exhibit.

4.4.3 Cost Estimate

The AACE Level 4 cost estimate for Alternative 4 is shown in Table 8. Detailed discussion on how quantities and unit costs were developed can be found in the Basis of Estimate in Appendix C. The total estimated cost for Alternative 4 $5,540,000.

This cost estimate does not include City administrative costs which are assumed to be 25% of engineering costs for preliminary cost sharing estimating purposes. Based on preliminary cost sharing estimates, the City or Reno would be responsible for approximately $1,696,600.00 under a cost sharing agreement with PL-566 funds.

Table 9: Alternative 4 Capital Cost Estimate

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization (not to exceed 5% of base bid)	1	LS	$200,000	$200,000
2	Temporary Erosion and Sediment Control	340	DY	$1,000	$340,000
3	Protection or Replacement of "NW Reno Flood Basin Labyrinth"	1	LS	$6,000	$6,000
4	Geotechnical Testing and Inspection Services	36	DY	$1,750	$65,000
5	Revegetation and Seeding	12	AC	$5,500	$66,000
6	Excavation and Disposal	1	LS	$2,160,000	$2,160,000
7	On-Site Cut/Fill	1	LS	$520,000	$520,000
8	East Wash Dam 4'x3'x28' Intake Structure Removal	1	LS	$10,000	$10,000
9	West Wash Dam Principal Spillway Inlet Removal	1	LS	$10,000	$10,000
10	West Wash Dam Sediment Pool Drain Removal	1	LS	$2,000	$2,000
11	West Wash Dam Spillway Energy Dissipator Outlet Removal	1	LS	$5,000	$5,000
12	PCC Chute Removal	1	LS	$40,000	$40,000
13	East Wash Dam 36" RC Pipe Abandonment in Place	173	LF	$75	$15,000
14	West Wash Dam 24" RC Pipe Abandon in Place	300	LF	$50	$15,000
15	West Wash Dam 18" RC Pipe Abandon in Place	60	LF	$40	$2,400
				Construction Subtotal	**$3,456,400**
				Engineering	$345,640
				Construction Management	$345,640
				Effective Inflation	$345,640
				Contingency	$1,036,920
				Total	**$5,540,000**

4.4.4 Economic Analysis

Alternative 4 would have the third highest damages from a single-year event of $67,988,719, which is associated with the 100-year event. Since there are no dams in place under this alternative, the Local PMP was not considered as that storm even only requires analysis for dam structures.

Alternative 4 is modeled under the 10-year, 25-year, 50-year, and 100-year flood events since both dams are removed. Under these storm events the future without project incurs no damages so the analysis yields negative benefits. The Net Benefit in the NED Account for Alternative 4 is -$13,566 for the 100-year storm event. Costs are lowest for Alternative 4, but the benefit-cost ratio is negative for all storm events. The benefit-cost ratio is -96.30 for the 100-year storm. A negative BCA ratio means that the project is expected to generate greater disbenefits than actual benefits – making conditions worse rather than better.

For more information on the economic analysis or how anything discussed in this section was calculated, see the Economic Appendix in Appendix D.

4.4.5 Environmental Effects

Identified environmental impacts for Alternative 4 are presented in Table 9. Impacts were identified using the existing dam area and the disturbance within the dam area. Because this alternative was eliminated from further detailed consideration, the downstream area impacted during various flooding scenarios were not evaluated. Direct impacts of Alternative 4 include effects on land use, vegetation, wildlife, cultural resources, socioeconomic or environmental justice concerns, health and safety, and aesthetic resources. Direct impacts include impacts of ground disturbance and construction activity in the area of the dams and the existing residences. Additional potential indirect impacts include floodplains, vegetation, and wildlife.

Table 10: Alternative 4 Impacts Summary

Resource	Direct Impacts	Indirect Impacts
Land Use	Total soil disturbance within the dam area is 130,485 cubic yards.	No Additional Impacts
Water Resources	No changes to the resources within the dam areas and no impacts	No Additional Impacts
Floodplains	There are no floodplains within the project area. Downstream impacts from flooding may occur- see flooding impacts section.	When modeled the flooding does not impact identified flood zones. This alternative would include analysis of existing storm water conveyance downstream from the dams and preparation of flood maps for inclusion in the FEMA FIRM program.
Vegetation	Vegetation identified within the dam area would be excavated. The Inter-Mountain Basins Big Sagebrush Shrubland and The Great Basin Lowland Riparian vegetation communities including wetland vegetation would be disturbed.	Loss of vegetative communities which support biological and wildlife diversity. Diminished wildlife diversity.
Fish and Aquatic Resources	Impacts to habitat identified within the dam area would be minimal. Habitats identified were generally along the riparian corridor, and not on the dam structures. Under this alternative Only the dam structures would be removed and the dam structure area re-graded. No aquatic or fish species were identified within the project area, and therefore no impact.	No additional impacts
Wildlife	Excavation to remove the dams may disturb wildlife habitat including habitat for monarch butterflies.	Disturbance and loss of wildlife habitat. Decrease in wildlife and biodiversity

Wetland and Riparian Areas	No direct impacts to identified wetlands or riparian areas	Inadvertent Impacts to Highland Ditch and surrounding wildlife habitat during flood flows.
Air Quality	Temporary construction impacts to air quality to include construction emissions and soil disturbance. Total soil disturbance within the dam area is 130,485 cubic yards. Dust suppression would be necessary and other mitigation measures related to PM10.	No additional impacts
Cultural Resources	Design involves removing both East Wash Dam (S2872) and West Wash Dam (S2873) which are historic resources and returning the area to a natural drainage landscape. This would be an impact requiring mitigation.	No additional impacts
Environmental Justice	Home and businesses previously not in a floodway may be identified as being within a floodway and become subject to FEMA Flood requirements including possible flood insurance. Under this alternative, at the 100-year flood event, both neighborhoods below the FORMER dam areas would flood via the existing City of Reno Storm Drain outlets. The major flood paths are modeled to run south down Kings Row and Keystone Avenue to I-80, where floodwaters would be contained until it drain through storm drain infrastructure. There is a high proportion of minorities living in Downtown Reno compared with the City of Reno, as well as a lower income, more transitory and older population with a higher proportion of the population having a disability, and living in poverty than in the City of Reno, the State, and the US. These disadvantaged persons would be severely impacted as much of Downtown Reno becomes a flood plain under alternatives 2, 4, and 5	No additional impacts
Noise	Temporary construction noise.	No additional impacts
Health and Safety	Because there would be no dams under this alternative, the safety standard that would be met is the community safety standard of the 100-year storm flood protections and requirements. Home and businesses previously not in a floodway may be identified as being within a floodway and become subject to FEMA Flood requirements including possible	No additional impacts

	flood insurance. Under this alternative, at the 100-year flood event, both neighborhoods below the former dam areas would flood via the existing City of Reno Storm Drain outlets. The major flood paths are modeled to run south down Kings Row and Keystone Avenue to I-80, where floodwaters would be contained until it drains through storm drain infrastructure.	
Visual and Aesthetic Resources	Aesthetic changes to the area to restore it to natural contours. Loss of historic resources and feeling of area.	No additional impacts
Climate Change-GHG Emissions	GHG emissions from construction equipment. Approximately 229 days of ground disturbance and active construction activity.	No additional impacts

4.4.5.1 Cumulative Impacts

Cumulative impacts of Alternative 4 include socioeconomic or environmental justice concerns, land use and climate change, impacts to historic resources and health and safety of the residents of Reno. Alternative 4 may cause changes in property values or costs of flood insurance for some downstream residents, and improvements for others. The City of Reno would be unable to manage the unpredictable storm events that may be caused by climate change because this alternative does not provide any protection from stormwater runoff. Even in a 100-year event, over 455 parcels would be flooded. Loss of historic resources would occur if the dams were removed without mitigation of those impacts. The health and safety of Reno residents would not improve under this alternative, all houses downstream of the two dams would flood during 10-, 25-, 50- and 100-year storm events. The City of Reno would incur costs of clean up and flood impacts. New FEMA flood mapping would likely be necessary.

4.4.6 Flooding Impacts

A PMP event is only taken into consideration when a dam is impounding water, to ensure that the dam will either pass or contain the PMP and limit flooding potential caused by a breach downstream of the dam. When there are no dams along a drainage, the applicable design criteria changes, as dictated by local storm water ordinances. For this reason, flood damages were only considered up to the 100-year event in the BCA for Alternative 4.

Under Alternative 4 (removing East and West Wash Dams), runoff from a 100-year storm would flow unrestricted through the previous impoundment areas for the removed East and West Wash dams and into residential neighborhoods. No infrastructure would be constructed under this alternative to route storm water around existing structures or roads. Storm runoff would flow down residential streets from the previous location of the dams to Interstate 80. The flood water would then be contained within the freeway and stop at the low point near N Virginia St. Existing storm drains within the freeway would then drain the water into the storm drain system. It is estimated that a 100-year storm event would cause runoff downstream of the East and West Wash drainage for 7 hours and reach a maximum downstream flood depth of approximately 20 feet (Farr West Engineering, 2022). The total area flooded for during a 100-year storm event is approximately 100 acres. An inundation map for the Local PMP breach event for Alternative 4 can be found in Appendix H.

The BCA estimates damages of $67,988,719 for a 100-year storm event, damaging an estimated 556 houses (Hansford Economic Consulting LLC, 2022). Again, the Local PMP was not evaluated under the BCA for Alternative 4 since there are no dams in place under this alternative.

4.4.7 Strengths, Weaknesses, Opportunities, and Constraints (Risk and Uncertainty)

This alternative would provide the opportunity to perform an analysis of existing storm water conveyance downstream from the dams and preparation of flood maps for inclusion in the FEMA FIRM program.

Alternative 4's weakness and constraints include its failure to provide 100-year storm flood protection for the City's residents and property downstream of a dam, which development was predicated upon. This is not a viable alternative because the project would not meet the objectives of the NRCS watershed plan or the purpose and need for the project. This alternative does not meet the project needs to ensure the watershed structure is properly maintained to minimize the risk to lives and property in the surrounding and downstream urban area. The stated purpose of the project is to preserve the flood protection function of the West Wash Dam, protect lives and property in the surrounding urban area, and comply with current performance and safety standards in a cost effective and environmentally acceptable manner.

4.4.8 Summary

Under this alternative, no flood protection for a 100 -year storm event would be afforded to residents or property. The alternative does not meet the purpose and need for the project. For these reasons Alternative 4 is deemed unreasonable and is eliminated from further detailed analysis. Information herein is being provided to assist with comparison of the remaining viable and reasonable alternatives, further analysis of Alternative 4 will not be carried forward.

4.5 ALTERNATIVE 5: REMOVE BOTH DAMS WITH DOWNSTREAM FLOOD IMPROVEMENTS

4.5.1 Description

The dams would be removed as described above under Alternative 4. In addition to the removal of both dams, trapezoidal concrete channels would be constructed to relay stormwater runoff up to the 100-year storm event. The channels would start at the location of the removed dams, combine into a single channel at the intersection of Keystone Ave. and Kings Row, and discharge all storm runoff into the Truckee River.

In order to construct this alternative, houses along the channel alignment would need to be purchased and demolished. Additionally, culvert crossings would need to be constructed at all road and other transportation crossings, including Interstate 80 and the railroad in downtown Reno. Since both dams are removed, flood protection would only be required up to the 100-year storm event. This alternative exceeds the current NRCS authorization for funding for this project. If this alternative is selected, then a request to modify or amend the agreement may be necessary.

4.5.2 Drawings

An exhibit for Alternative 5, which shows the alignment for the channel and calls out all culvert crossings, can be found in Appendix E. Additionally, a basic detail showing a cross section of the trapezoidal channel, as well as a plan and cross section view of a general road culvert crossing can be found in Appendix E.

4.5.3 Cost Estimate

The AACE Level 4 cost estimate for Alternative 5 is shown in Table 10. Detailed discussion on how quantities and unit costs were developed can be found in the Basis of Estimate in Appendix C. The total estimated cost for Alternative 5 $172,210,890.

This cost estimate does not include the approximately $100,000 estimated for Federal and local permitting including zoning changes, and US Army Corps of Engineers Permitting. The cost estimate does not include City administrative costs which are assumed to be 25% of engineering costs for preliminary cost sharing estimating purposes. Based on preliminary cost sharing estimates, the City or Reno would be responsible for approximately $112,581,400.00 under a cost sharing agreement with PL-566 funds.

Table 11: Alternative 5 Capital Cost Estimate

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization	1	LS	$1,800,000	$1,800,000
2	Temporary Erosion and Sediment Control	983	DY	$1,000	$983,000
3	Temporary Traffic Control	1	LS	$1,490,000	$1,490,000
4	Protection or Replacement of "NW Reno Flood Basin Labyrinth"	1	LS	$6,000	$6,000
5	Geotechnical Testing and Inspection Services	36	DY	$1,750	$65,000
6	Revegetation and Seeding	12	AC	$5,500	$66,000
7	Excavation and Disposal	1	LS	$2,160,000	$2,160,000
8	On-Site Cut/Fill	1	LS	$520,000	$520,000
9	East Wash Dam 4'x3'x28' Intake Structure Removal	1	LS	$10,000	$10,000
10	West Wash Dam Principal Spillway Inlet Removal	1	LS	$10,000	$10,000
11	West Wash Dam Sediment Pool Drain Removal	1	LS	$2,000	$2,000
12	West Wash Dam Spillway Energy Dissipator Outlet Removal	1	LS	$5,000	$5,000
13	PCC Chute Removal	1	LS	$40,000	$40,000
14	East Wash Dam 36" RC Pipe Abandonment in Place	173	LF	$75	$15,000
15	West Wash Dam 24" RC Pipe Abandon in Place	300	LF	$50	$15,000
16	West Wash Dam 18" RC Pipe Abandon in Place	60	LF	$40	$2,400
17	West Wash Trapezoidal Channel	5,159	LF	$350	$1,810,000
18	East Wash Trapezoidal Channel	6,071	LF	$366	$2,230,000
19	Combined Trapezoidal Channel	5,550	LF	$466	$2,590,000
20	10'x8' Box Culvert Crossing on Local Roads	10	EA	$351,453	$3,520,000
21	12'x9' Box Culvert Crossing on Local Roads	4	EA	$678,464	$2,720,000
22	Culvert Crossing on Collector Roads	5	EA	$995,545	$4,980,000
23	Culvert Crossing on Arterial Roads	3	EA	$1,659,091	$4,980,000
24	Culvert Crossing on Railroad	1	EA	$1,226,755	$1,230,000

25	Culvert Crossing on I-80 Highway	1	EA	$4,325,330	$4,330,000
26	Property Demolition	41.5	AC	$43,560	$1,810,000
				Construction Subtotal	**$37,389,400**
				Engineering	$3,738,940
				Construction Management	$3,738,940
				Effective Inflation	$3,738,940
				Contingency	$11,216,820
				Base Bid Total	**$59,823,040**
				Property Acquisition	$112,387,850
				Total with Property Acquisition	**$172,210,890**

4.5.4 Economic Analysis

There are no damages sustained under any of the storm events for Alternative 5 because the channel contains storm runoff up to, and including, the 100-year storm event. Since there are no dams in place under this alternative, the Local PMP was not considered.

Alternative 5 is modeled under the 10-year, 25-year, 50-year, and 100-year flood events since both dams are removed. Alternative 5 protects the Affected Area to the same level as the Future without Project by purchasing all the properties that would be damaged during the modeled storm events. Like Alternative 2, estimated net benefit is negative, and the benefit-cost ratio for all storm events is zero. The Net Benefit in the NED Account for Alternative 5 is -$4,130 for the 100-year storm event.

In addition to the NED, there are impacts that can be measured in the RED account for Alternative 5 because under this alternative there is substantial property acquisition. The RED account considers people displaced, visitors lost, and jobs lost because of necessary property acquisitions. The calculations are based on the census tract data. The estimated number of permanent residents displaced is 325 under Alternative 5. No hotel/motel units are acquired under Alternative 5. Using estimates of occupancy and building square feet per employee, it is calculated that about 170 jobs would be lost under Alternative 5. No casino/recreation buildings would be acquired under Alternative 5. Using the Assessor's database, the amount of property taxes that would be lost in fiscal year 2022/23 was also considered. The loss of property taxes increases with the number of properties acquired (over five years under Alternative 5). Annual property tax losses were discounted and amortized to determine average annual equivalent losses.

For more information on the economic analysis or how anything discussed in this section was calculated, see Economic Appendix in Appendix D.

4.5.5 Environmental Effects

Alternative 5 is the only alternative that involves modeled flood flows impacting the Truckee River. Impacts to the Truckee River from storm flows would be temporary and delivered through a channel system. Storm flow impacts to the Truckee River would include increased turbidity, and changes to flows which may affect fish and aquatic resources including the Lahontan Cutthroat Trout. Table 11 includes a summary of environmental impacts and potential mitigation actions. Other direct impacts of Alternative 5 include effects on land use, water resources, flood zones, vegetation, fish and aquatic species, wildlife resources air quality, cultural resources, noise, health and safety, and climate change. Potential indirect impacts include effects to water resources, flood plains, vegetation, fish and aquatic resources, wildlife, noise and health and safety and climate change.

Table 12: Alternative 5 Impacts Summary

Resource	Direct Impacts	Indirect Impacts	Potential Mitigation
Land Use	Total soil disturbance within the dam area is 421,683 cubic yards. Additional disturbance to construct 18,245 ft of culvert channelization to convey storm flows. The channel would be constructed on current residential properties and would require the acquisition and demolition of 160 residential homes and properties.	Change in neighborhood composition and land uses therein. Property values and or flood insurance rates may change.	None
Water Resources	Storm flows draining directly into the Truckee River during storm events.	Additional permitting and environmental requirements including impacts a Water of the US and endangered aquatic species and critical habitat.	Likely require USACE/CTWCD permitting and or/impact assessment. NDEP permitting will be needed. May require coordination with Truckee Meadows Stormwater Permit Coordinating Committee (The Truckee Meadows SWPCC is responsible for implementing the Truckee Meadows Stormwater Quality Management Program to protect the water quality of the region's waterways, streams and the overall Truckee River Watershed
Floodplains	Flood zones north of and including the Truckee River would be impacted by storm flows draining to the Truckee river.	Impacts to existing flood zones downstream of downtown Reno	Changes to existing FEMA mapping would likely be required. A special flood way or other regulatory changes under FEMA may occur. When modeled, the flooding does not impact identified existing flood zones.

Vegetation	Vegetation identified within the dam area would be excavated. The Inter-Mountain Basins Big Sagebrush Shrubland and The Great Basin Lowland Riparian vegetation communities including wetland vegetation would be disturbed.	Loss of wildlife and biodiversity.	Avoidance fencing or removal and replacement of vegetation.
Fish and Aquatic Resources	Direct flows into the Truckee River. These changes in flows and turbidity could impact fish and aquatic life in the Truckee River including LCT, which is an endangered species. LCT are also threatened by altered watersheds that may have increased turbidity and high flows, which reduce the spawning habitat quality. Warmer water temperatures and drought can affect the survival rate of young LCT (USFWS 1995).	No additional impacts	Discharge plan, turbidity requirements, water quality monitoring, NPDES permit and associated requiremetns.
Wildlife Resources	Excavation to remove the dams would disturb wildlife habitat including habitat for monarch butterflies.	Loss of wildlife and biodiversity. Accidental take of threatened or endangered species.	Avoidance fencing to limit disturbance of sensitive populations during excavation activities.
Air Quality	Temporary construction impacts to air quality include construction emissions and soil disturbance. Total soil disturbance within the dam area is 130, 485 cubic yards. Additional disturbance for construction of 18,245 ft of culvert channelization to convey storm flows.	No additional impacts	Dust suppression would be necessary and other mitigation measures related to PM10. Surface area disturbance.
Cultural Resources	Design involve removing both East Wash Dam (S2872) and West Wash	Unintentional loss of historic resources.	Historic Properties Treatment Plan (HPTP) developed to resolve the

	Dam (S2873) which are historic resources, and returning the area to a natural drainage landscape.		adverse effect to these historic properties through mitigation Appropriate mitigation methods should involve public interpretation, such as the production of a brochure or other publications, web-based and published articles, public presentations, museum exhibits, or historic markers.
Environmental Justice	There is a high proportion of minorities living in Downtown Reno compared with the City of Reno, as well as a lower income, more transitory and older population with a higher proportion of the population having a disability, and living in poverty than in the City of Reno, the State, and the US. These disadvantaged persons would be severely impacted as much of Downtown Reno becomes a flood plain under alternatives 2, 4, and 5. The estimated number of permanent residents displaced is 325 under Alternative 5. 170 jobs would be lost under Alternative 5.	Communities downstream of Reno could be impacted by flows into the Truckee River during a major storm event.	None
Noise	Temporary construction noise. construction of channel to Truckee river and demolition of 160 homes.	Increased ambient noise during construction.	Construction noise mitigation actions such as limited hours (7-7pm)
Health and Safety	Because there would be no dams under this alternative, the safety standard that would be met is the community safety standard of the 100 year storm flood protections and requirements. A channel	Contribute to flooding risks in the downtown Reno area depending on the flows in the Truckee River at the time of peak discharge. Impacts in downtown Reno could include damage to the	New Emergency Action Plans or protocol for channel safety.

	system would be constructed to convey the entire 100 year storm flows from the former east and west wash dam areas directly to the Truckee River at river side drive in downtown Reno	flood walls through downtown, and the surrounding businesses and infrastructure, impacts to kayak park and other recreational amenities. The flood walls are USACE structures, and impacts to those structures may require additional USACE consultation.	
Visual and Aesthetic Resources	Aesthetic changes to the area to restore it to natural contours. Changes to the neighborhoods due to demolition of homes and construction of an open, channelized flood flow system.	No additional impacts	None
Climate Change/ GHG Emissions	GHG emissions from construction equipment. Approximately 829 days of ground disturbance and active construction activity.	Decreased vegetation and water infiltration. No additional ability to convey or manage storm flows over the 100 year storm event. Inability to managing unpredictable storm flows in the future.	Construction equipment and emission BMPs and City Standards.

4.5.5.1 Cumulative Impacts

Alternative 5 is in conflict with the existing City's Master Plan regarding sustainable development due to channelization of drainage (City of Reno, 2017). Changes to wetlands and wildlife habitat within the existing dam areas would occur. Large storm flows into the Truckee River could impact Truckee River wildlife as well as increase the risk of flooding related hazards in downtown Reno. Channelization is designed to contain the 100-year storm event flows and is not designed to allow for excess storm flow. Therefore, the City would not be equipped to manage unpredictable storm flows that may occur due to climate change. Changes to the visual and aesthetic nature of the area would occur by removing residences and a naturally contoured drainage and installing channelized drainage, which is also counter to the policies of the City's Master Plan. (City of Reno, 2017)

4.5.6 Flooding Impacts

PMP event is only taken into consideration when a dam is impounding water, to ensure that the dam will either pass of contain the PMP and limit flooding potential caused by a breach downstream of the dam. When there are no dams along a drainage, the applicable design criteria changes, as dictated by local storm water ordinances. For this reason, flood damages were only considered up to the 100-year event in the BCA for Alternative 5.

Under Alternative 5, runoff from a 100-year storm would flow through the previous impoundment areas for the removed East and West Wash dams and into concrete channels that would route the flow through residential neighborhoods, under Interstate 80 and the railroad, and through downtown to the Truckee River.

Flow would enter two separate channels and the location of the removed East and West Wash Dams, which would join to become one channel at the intersection of Keystone Ave. and Kings Row. The channel was designed to fully contain storms up to and including the 100-year storm, so there is no anticipated flooding under this alternative for the evaluated storm events. Anticipated peak flows and total runoff volumes that would reach the Truckee River for the East Wash Channel, West Wash Channel, and Combined Channel are listed in Table 12. It is estimated that a 100-year storm event would cause runoff to flow through the concrete channels for approximately 7 hours (Farr West Engineering, 2022).

The BCA had no costs associated with damage and no structure damage under Alternative 5. (Hansford Economic Consulting LLC, 2022). Again, the Local PMP was not evaluated under the BCA for Alternative 5 since there are no dams in place under this alternative.

Table 13: Peak Flows and Total Volumes Channeled to Truckee River under Alternative 5

Channel	Peak Flow Rate to Truckee River (cfs)	Total Runoff Volume to Truckee River (ft^3)
West Wash	1,482	7,705,428
East Wash	1,904	12,769,747
Combined	3,386	20,475,175

4.5.7 Strengths, Weaknesses, Opportunities, and Constraints (Risk and Uncertainty)

The strengths of this alternative include the elimination of dam maintenance and risk of dam failure. Under this alternative the dams are removed, so no dam breach or spillway activation would occur, and those flood impacts are removed. However, the risk of flooding is contained only up to a 100-year exceedance storm event. A larger event, such as 500-year or PMP event would not be contained by the flood channels.

Alternative 5 has high costs and time to acquire land, move residents, and construct a storm conveyance channel. The channelized drainage may cause adverse impacts to the Truckee River due to increased flows during storm events which could in turn impact endangered and sensitive species and downstream development.

4.5.8 Summary

Alternative 5 is in conflict with the City's existing Master Plan regarding sustainable development due to channelization of drainage (City of Reno, 2017). Large storm flows into the Truckee River could impact Truckee River endangered wildlife including the Lahontan Cutthroat Trout as well as increase the risk of flooding related hazards in downtown Reno. Under this alternative, the City would not be equipped to manage unpredictable storm flows that may occur in the future due to storm events larger than the 100-year storm, or due to climate change. This alternative was not found to be the NED Plan through the Benefit Cost Analysis, nor was it found to be the selected alternative though the decision matrix tool.

This alternative includes displacing hundreds of residents while, in the meantime, residents and businesses would remain at risk during extreme flooding events. For these reasons, this alternative is not the preferred alternative.

5.0 SUMMARY AND COMPARISON OF ALL ALTERNATIVES

This section includes summary tables for the detailed alternatives analysis. Table 13 includes a qualitative summary of environmental resource impacts. Table 14 is a summary of flooding impacts for 100-year and Local PMP storm events per alternative identified in Technical Memoranda (Farr West Engineering, 2022). Table 15 is a summary of the economic analysis results.

Table 14: Qualitative Summary of Environmental Resources Impacts per Alternative

Resource	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Land Use		X	X	X	X
Water Resources		X		X	X
Floodplain		X		X	X
Vegetation	X	X	X	X	X
Fish/Aquatic Resources				X	X
Wildlife Resources		X	X		
Wetlands/ Riparian Areas		X	X	X	X
Air Quality		X	X	X	X
Cultural Resources		X	X	X	X
Environmental Justice	X	X	X	X	
Noise		X	X	X	X
Health and Safety	X	X	X	X	X
Aesthetics		X	X	X	X
GHG/Climate Change	X	X	X	X	X
Cumulative Impacts	X	X	X	X	X

Table 15: Flooding Impacts for 100-year and Local PMP Storm Events per Alternative

Storm Event	Alternative 1 DS Flood Area	Alternative 2 DS Flood Area	Alternative 3 DS Flood Area	Alternative 4 DS Flood Area	Alternative 5 DS Flood Area
	No Action	**DS Flood Improvements**	**Remediate WW**	**Remove both dams**	**Remove dams w/channel to Truckee**
100-Year	No AS activation, no breach. No DS flood area	No AS activation, no breach. No DS flood area	No AS activation, no breach. No DS flood area	Flooding DS of both dams	All runoff conveyed in channel, no flooding
Area (acres)	0	0	0	99.6	0
PMP	Breach with AS flow	Breach with AS flow	Only AS Flow	Flooding DS of both dams	Flooding DS of both dams
Area (acres)	270.56	270.56	217.53	264.62	264.62

Table 16: Summary of Equivalent Annual Net Benefit and BCR by Alternative*

Alternative		Equivalent Annual Net Benefit *	Benefit-Cost Ratio
		In $1,000s	
Alt. 1	Future Without Project [1], [2]	N/A	N/A
Alt. 2	Downstream Flood Improvements [1]	($42,570)	0.00:1
Alt. 3	**Remediate West Wash Dam to contain PMP**	**($510)**	**0.16:1**
Alt. 4	Remove both Dams	($13,570)	-96.3:1
Alt. 5	Remove Dams - Flood Conveyance to Truckee River	($4,130)	0.00:1

** Rounded up to the nearest ten thousand dollars.*
The Alternative 3 net benefit is negative $510,000, for example.

[1] Under both of these alternatives, the West Wash Dam Auxiliary Spillway breaches during the PMP.

[2] Pursuant to the National Watershed Program Manual Section 502.2, existing dams not meeting current safety and performance standards cannot be identified as the NED alternative, but will continue to be included to allow a valid comparison of the alternatives.

*Courtesy of the Economic Appendix (Hansford Economic Consulting LLC, 2022)

6.0 PREFERRED ALTERNATIVE

The National Economic Development (NED) Alternative is the alternative or combination of alternatives that reasonably maximizes the net economic benefit of the project consistent with protecting the nation's environment. The net economic benefit is the benefit minus the cost. According to the NWPM Sections 502.2 and 505.35.B(1)(iv), when human life is potentially at risk, the NED alternative is defined as the federally assisted alternative with the greatest net economic benefits.

Under the Economic analysis, Alternative 3 is the NED Plan. Alternative 3 has the greatest net benefit, even though the benefit is negative. Under Alternative 3, all existing properties are protected as they are currently in the 100-year flood event, and better in the 200-year, 500-year, and Local PMP events. Furthermore, in a local PMP event, Alternative 3 would allow a controlled release through the auxiliary spillway instead of overtopping the dam with a potential breach, resulting in less property damage compared to the future without a project, or no action alternative. Additionally, both East and Wash dams would be in compliance with NDWR high hazard dam safety requirements. OSE and RED accounts further decrease the net benefits of Alternatives 2 and 5 and reaffirm that Alternative 3 is the most appropriate project alternative (Hansford Economic Consulting LLC, 2022). See the Economic Appendix in Appendix D for a detailed discussion of the analysis and NED.

The City of Reno evaluated the detailed alternatives throughout the Detailed Alternatives Workshop, follow up meetings and discussions and through completion and refinement of the decision matrix. Through project discussions and the results of the decision matrix the City's preferred alternative is identified as Alternative 3. Copies of the decision matrix criteria, sub criteria and rankings are included in Appendix B.

Both the City of Reno and the NRCS have identified Alternative 3 as their preferred alternative. Therefore, Alternative 3 will be carried forward into the Preliminary Supplemental Watershed Plan and Environmental Assessment and undergo an impacts analysis available for public review and comment. This alternative exceeds the current NRCS authorization for funding for this project and a request to modify or amend the agreement may be necessary.

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APPENDIX A: DETAILED ALTERNATIVES WORKSHOP MATERIAL

Supplemental Watershed Plan and Environmental Document for the Peavine Mountain Watershed and West Wash Dam Rehabilitation
Alternative Selection Workshop
Friday, April 29, 2022
City of Reno
April 29, 2022

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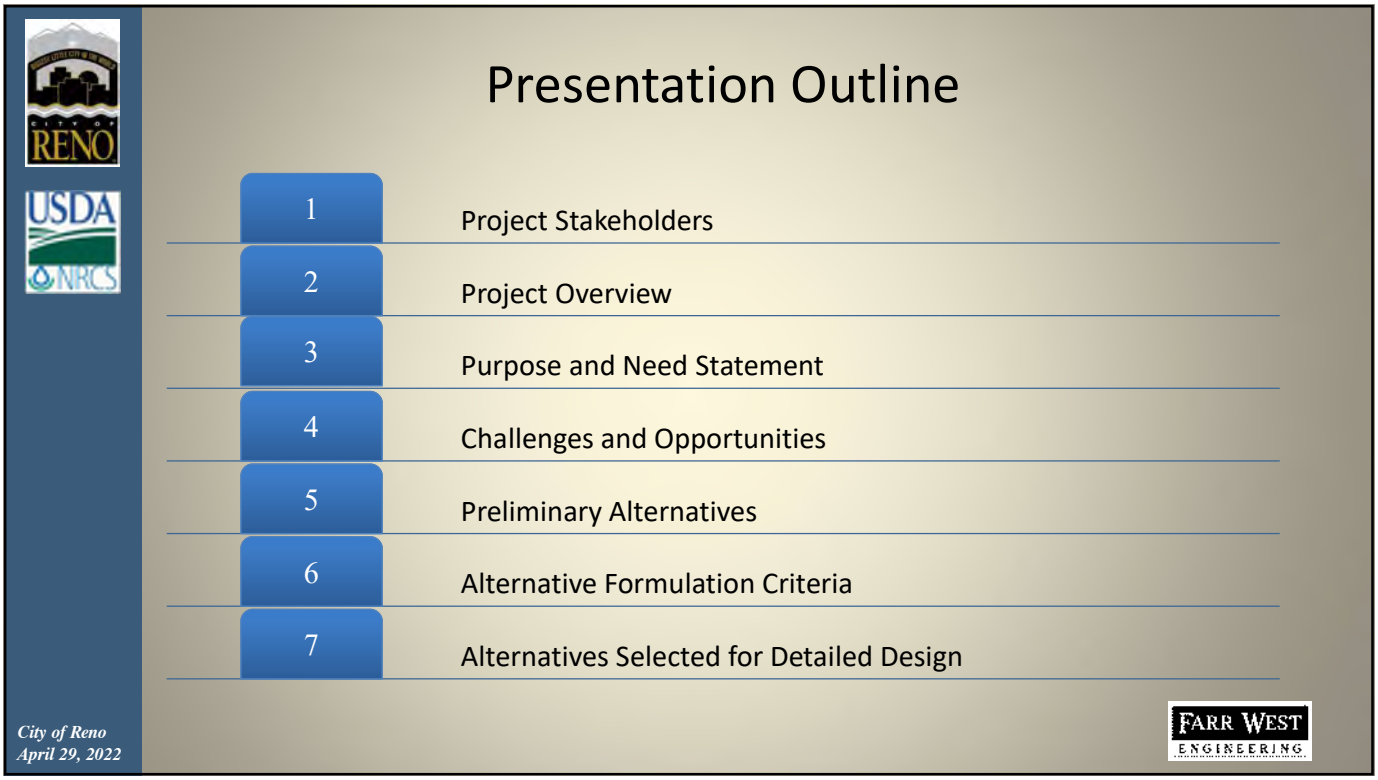
Presentation Outline
1 Project Stakeholders
2 Project Overview
3 Purpose and Need Statement
4 Challenges and Opportunities
5 Preliminary Alternatives
6 Alternative Formulation Criteria
7 Alternatives Selected for Detailed Design
City of Reno
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Presentation Outline

8	Alternative 1 – Future Without Project
9	Alternative 2 – Downstream Flood Improvements
10	Alternative 3 – Remediate West Wash Dam and East Wash AS
11	Alternative 4 – Remove Both Dams
12	Alternative 5 – Remove Both Dams with Downstream Flood Channel
13	Alternative Analysis Discussion
14	Closing Statements and Open discussion

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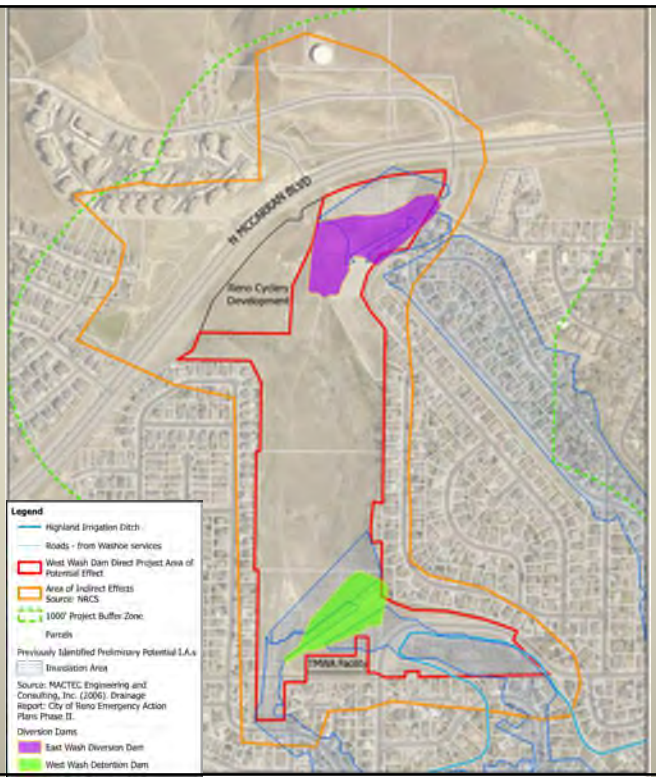
OWNER:
City of Reno
1 East First Street
Reno, NV 89501

LEAD FEDERAL AGENCY:
USDA-NRCS
1365 Corporate Blvd
Reno, NV 89502

ENGINEER:
Farr West Engineering
5510 Longley Lane
Reno, NV 89511
(775) 851-4788
(775) 851-0766 Fax

4



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Purpose and Need Statement

The purpose of this project is to preserve the flood protection function of the West Wash Dam, to protect lives and property in the surrounding urban area, and to comply with current performance and safety standards in a cost effective and environmentally acceptable manner. The project needs include addressing current deficiencies at West Wash and East Wash Dams to bring both dams into compliance with current dam safety regulations, engineering standards and performance criteria, and ensure the watershed structure is properly maintained to minimize the risk to lives and property in the surrounding and downstream urban area. West Wash and East Wash Dams work together as an integrated system and must be analyzed and evaluated as such.

Purpose:

1. Preserve the flood protection function of the West Wash Dam
2. To protect lives and property in the surrounding urban area
3. Comply with current performance and safety standards in a cost effective and environmentally acceptable manner

Needs:

1. Addressing current deficiencies at West Wash and East Wash Dams to bring both dams into compliance with current dam safety regulations, engineering standards and performance criteria
2. Ensure the watershed structure is properly maintained to minimize the risk to lives and property in the surrounding and downstream urban area.

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Challenges

Dam Criteria- High Hazard Dam

Compliance with current Nevada safety of dams regulations, engineering standards and performance criteria is necessary to ensure the protection of lives and property surrounding and downstream of the dam.

When compared to current design and performance standards, the following deficiencies were identified:

1. Repairs and maintenance identified in dam inspection reports
2. Hydraulic inadequacy of current dam design
3. High hazard dam rehabilitation
4. Sediment damage identification and possible reduction

City of Reno Growth and Increased Urbanization

Since 1958, when the original Peavine Mountain Watershed Plan was written, Reno has experienced significant development. Today, the City of Reno has a population of over 180,000 (City of Reno, 2017). The City is expected to grow by more than 62,000 residents between 2015 and 2036, reaching a population of over 301,000 in 2036 (City of Reno, 2017). The dam is estimated to provide protection against flooding to about 30,000 Nevadans who live and work downstream. Additionally, the dam protects downstream city roads, one state highway (395), and Interstate 80.

- Change to urban land use around and below the dam area since project inception in 1958
- Continuing growth in the City of Reno
- Reliance on the project area as an informal recreation area
- Infrastructure encroachment across facility features

Opportunities

Watershed and Resource Opportunities

1. Maintain downstream flood protection and reduce risk of loss of life and damage to property
2. Reduce possibility of dam failure and protect downstream communities, real estate and infrastructure
3. Full compliance with NDWR and NRCS criteria
4. Sediment damage identification and possible reduction

Preliminary Alternatives

- Alternative 1: No action
- Alternative 2: Improve flood conveyance downstream of West Wash Dam
- Alternative 3A: Improve both dams
- Alternative 3B: Improve only East Wash Dam
- Alternative 3C: Improve only East Wash Dam with improved flood conveyance downstream of West Wash Dam
- Alternative 3D: Improve only West Wash Dam
- Alternative 4: Upstream solution
- Alternative 5A: Remove both dams
- Alternative 5B: Remove only East Wash Dam
- Alternative 5C: Remove only West Wash Dam
- Alternative 6A: Remove both dams with improved flood conveyance downstream of both dams
- Alternative 6B: Remove only East Wash Dam with improved flood conveyance downstream of East Wash Dam
- Alternative 6C: Remove only West Wash Dam with improved flood conveyance downstream of West Wash Dam

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Alternatives Formulation Criteria

Does the alternative meet the project purpose and need?

Does the alternative meet the goals and policies of NRCS Watershed and Flood Prevention Operations Program?

The alternatives were also analyzed under four criteria: (U.S. Water Resources Counsel , 1983) (DM9500-013)

1. **Completeness** is the extent to which a given alternative plan provides and accounts for all necessary investments or other actions, to ensure the realization of the planned effects, including any necessary actions by others. This may require relating the plan to other types of public or private plans if the other plans are crucial to realization of the contributions of the objective. Completeness does not automatically mean that alternative actions need to be large in scope or scale.
2. **Effectiveness** is the extent to which an alternative plan alleviates the specified problems and achieves the specified opportunities.
3. **Efficiency** is the extent to which an alternative plan is the most cost-effective means of alleviating the specified problems and realizing the specified opportunities, consistent with protecting the Nation's environment.
4. **Acceptability** is the workability and viability of the alternative plan with respect to acceptance by State and local entities and the public and compatibility with existing laws, regulations and public policies.

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Alternatives Selected for Detailed Analysis

Alternative	Description	Proposed Project
1	Future Without Project	City continues O&M for current dams. No work done on improving existing dams.
2	Downstream Flood Improvements	Purchase all homes within the WW Local PMP breach inundation areas that will have over a foot of water on property and repair damages for houses that will have under a foot of water on property. No work done on improving existing dams.
3	Remediate West Wash Dam and East Wash Auxiliary Spillway	West Wash Dam will be remediated to allow containment of local PMP storm runoff. Raise WW dam 5-feet, add a 2-foot-tall parapet wall on eastern berm near dam, regrade western slope of impoundment area to hold more water, widen Auxiliary Spillway (AS) to 80', and lower AS crest height by 2.4-feet. East Wash Dam Auxiliary Spillway crest will be regraded to elevation 4858.0'
4	Remove Both Dams	Remove both dams and regrade impoundment areas to reflect near pre-development conditions.
5	Remove Both Dams with Downstream Flood Channel	Remove both dams and construct a channel that will convey 100-year flood flows to Truckee River. Purchase and demo all houses in proposed channel alignment and construct box culvert crossings under all perpendicular roads.

PMP = Probable Maximum Precipitation
WW = West Wash

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Cost Estimating

Estimating Methods:

- Historical Bid Results
- *Heavy Construction Costs with RSMeans Data*, 2019, 33rd Annual Edition

Construction costs:

- Mobilization/Demobilization
- Traffic and Erosion Control
- Materials and labor
- 10% Engineering
- 10% Construction Management
- 10% Effective Inflation
- 30% Contingency

Inflation Adjustments:

- Engineering News-Record
- Projected effective inflation rates
- Assumed construction or right-of-way acquisition start date of 2025

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Alternative 1: Future Without Project

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Alternative 1 - Preliminary Environmental Impacts

- **Land Use**: brush removal during maintenance, downstream flooding w/local PMP (homes and infrastructure) and AS flow w/200 yr storm flow.
- Water Resources: no changes, no impacts
- Floodplains: no floodplain within the dam area
- **Vegetation**: brush removal
- Fish/Aquatic Resources: no changes, no impacts to LCT
- Wildlife Resources: no impacts to butterflies, migratory birds
- Wetlands/Riparian Areas: no changes to riparian area identified
- Air Quality: no construction, no disturbance
- Cultural Resources: establishment of historic district, no impacts
- **Environmental Justice**: flooding of particular neighborhoods. Participation and notice to disadvantaged groups and all downstream residents.
- Noise: no construction no noise

Note: Headings that are bolded signify the resources under each alternative that are the most impacted by that alternative

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Alternative 1 - Preliminary Environmental Impacts

- **Health and Safety**: massive impacts to safety of downstream residents, infrastructure. These High Hazard Dams would not be rehabilitated. The risk of dam failure and/or flooding due to changes in precipitation patterns would remain. Routine maintenance would be performed. Risk of flooding to downstream residents, businesses and infrastructure as shown in BCA and on inundation figure and alt 1/2 local MP breech figure.
- Aesthetics: no changes
- **GHG/Climate Change**: Not complete. Cumulative: Managing unpredictable storm flows in the future
- **Cumulative Impacts**: flooding impacts, impacts to habitat and wildlife during flooding. climate change impacts on storm frequency and intensity are unknown but estimated by NOAA data to be mild for the area within the Sierra rain shadow. However, if the dams fail, the risk of a significant amount of damage to property and risk to lives of those who live and work in the dams flow path remain, and may increase over time as the condition of the dams continues to degrade. Storm flows continue to enter the Truckee River although existing storm drain infrastructure which cannot effectively convey local PMP events.

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Note: Headings that are bolded signify the resources under each alternative that are the most impacted by that alternative

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Alternative 1: Future Without Project

Cost

- No Capital Cost

Construction Duration

- Not Applicable

Challenges

- Does not address the deficiencies of the dams

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Alternative 1: Future Without Project
Storm Event Scenarios

Alternative 1 – Future Without Project		
Storm Event	Containment Category	# of Parcels Flooded*
100 Year	Contained	0
200 Year	Spillway Activated	109
500 Year	Spillway Activated	215
PMP	Overtopping of West Wash dam, potential breach	664
*Flooded = Over one foot of water		

West Wash Dam will overtop between ½ and ¾ of the local PMP (7,200 to 11,700 cfs)

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Alternative 2: Downstream Flood Improvements

- Purchase all properties within the West Wash Local PMP breach inundation areas that will have over one foot of water on property and repair damages for properties that will have under one foot of water on the property.
- No work done on improving existing dams.

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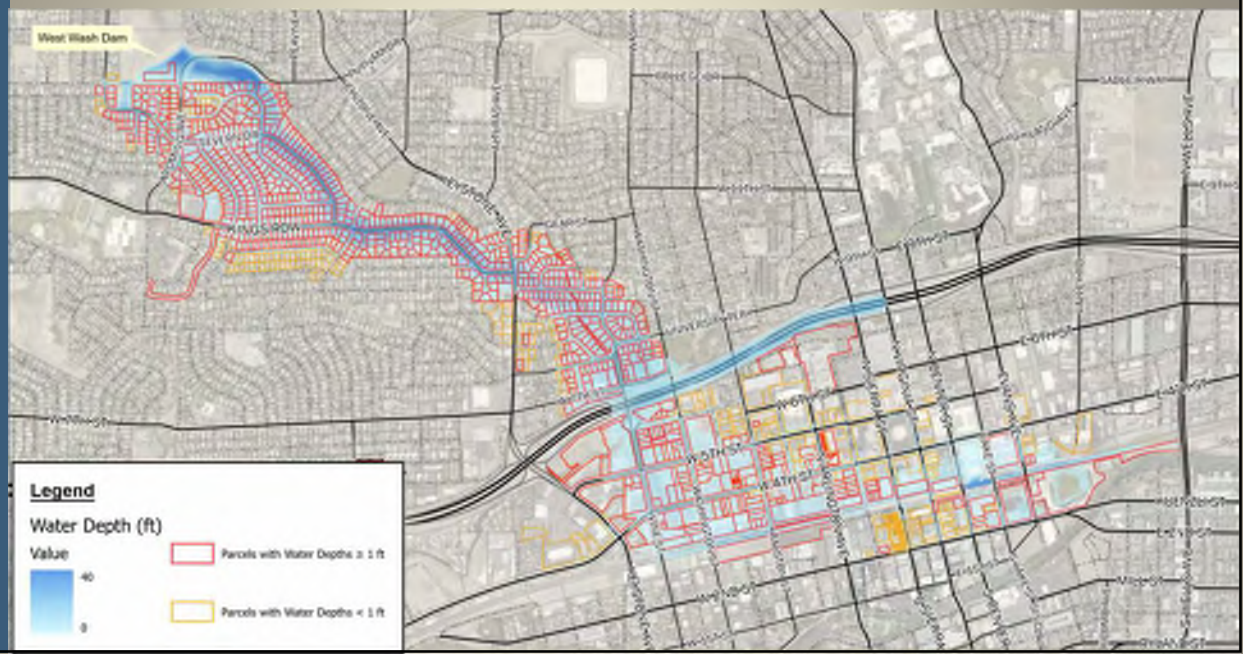
Alternative 2: Downstream Flood Improvements



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Alternative 2: Downstream Flood Improvements
Preliminary Environmental Impacts

- **Land Use**: major land use changes where downstream properties are purchased/relocated, and floodway area is designed and constructed.
- **Water Resources**: no changes to identified resources. There are water resources including Truckee River irrigation ditches, and storm water infrastructure downstream of the dam. Creation of floodway, infiltration and ground water/surface water interactions, water quality would need analysis. NDEP permitting and a SWPP would be needed.
- **Floodplain**: Downstream impacts from flooding may occur. A floodplain would be created by this alternative. New FEMA mapping would be required. When modeled the flooding does not impact identified existing flood zones.
- **Vegetation**: Expanded APE must be established and evaluation of resources within the expanded APE completed. The floodway would remove residential structures and creation of the floodway would be designed with native and wetland plants.
- Fish/Aquatic Resources: no changes to the resources within the dam areas. Modeled Flood flows would not reach the Truckee River.
- **Wildlife Resources**: Where possible, milkweed stands should not be removed during the summer breeding period (May through August) to prevent impacts to breeding monarch butterflies. Plants that will be disturbed should be salvaged and replanted in appropriate habitat when practical.
- Wetlands/Riparian Areas: no changes to the riparian resources within the dam areas and no impacts to wetland identified within the dam areas. A wetland may be created with construction of the floodway.
- **Air Quality**: Expanded APE including inundated properties must be established and construction of floodway or demolition or relocation of buildings and infrastructure must be analyzed. construction days and equipment and construction dust from excavation disturbance and other mitigation measures related to PM10. An NDEP permit for air quality would be necessary.
- **Cultural Resources**: additional Section 106 review to analyze the potential effects of the new design elements. Expanded APE must be established and the identification of historic properties within the expanded APE completed.

Note: Headings that are bolded signify the resources under each alternative that are the most impacted by that alternative

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Alternative 2: Downstream Flood Improvements Preliminary Environmental Impacts

- **Environmental Justice**: purchasing properties is a large impact on one area for the benefit of other downstream residents and property owners.
- **Noise**: temporary construction noise in demolition of 664 properties and infrastructure and creation of floodway may last 5-10 years.
- **Health and Safety**: The dams would not be rehabilitated, and the risk of downstream flooding remains the same as in Alt 1. However, all properties subject to over 1 foot of inundation during the local PMP storm would be purchased to create a floodway. The floodway may pose risk to residents and citizens if not properly secured. Access to the floodway during storm and potential flood events would pose a risk of injury and even drowning. In addition, the waters may be unhealthy for residents and the watershed due to residential and commercial run off contaminants in the area.
- **Aesthetics**: changes to create floodway from primarily residential area.
- **GHG/Climate Change**: Direct; construction days and equipment and construction dust from excavation disturbance. Indirect: vegetation changes, altering stream flows, ground filtration of storm water in floodway.
- **Cumulative Impacts**: creation of a floodway would increase permeability of floodwaters for the area and may allow for groundwater seepage of storm and flood waters back into the ground or to the Truckee River. Depending on the functionality of the floodway water quality may be improved or diminished based on infiltration of constituents in the storm water run off from the surrounding developed areas. The impact of relocating housing for 664 properties and homes to other moderate density single family homes or like properties, in an area with already difficult to access housing. Housing demand is on the rise in Reno and in the region. Relocating these residents would be in opposition to planning goals and development scenarios.

Note: Headings that are bolded signify the resources under each alternative that are the most impacted by that alternative

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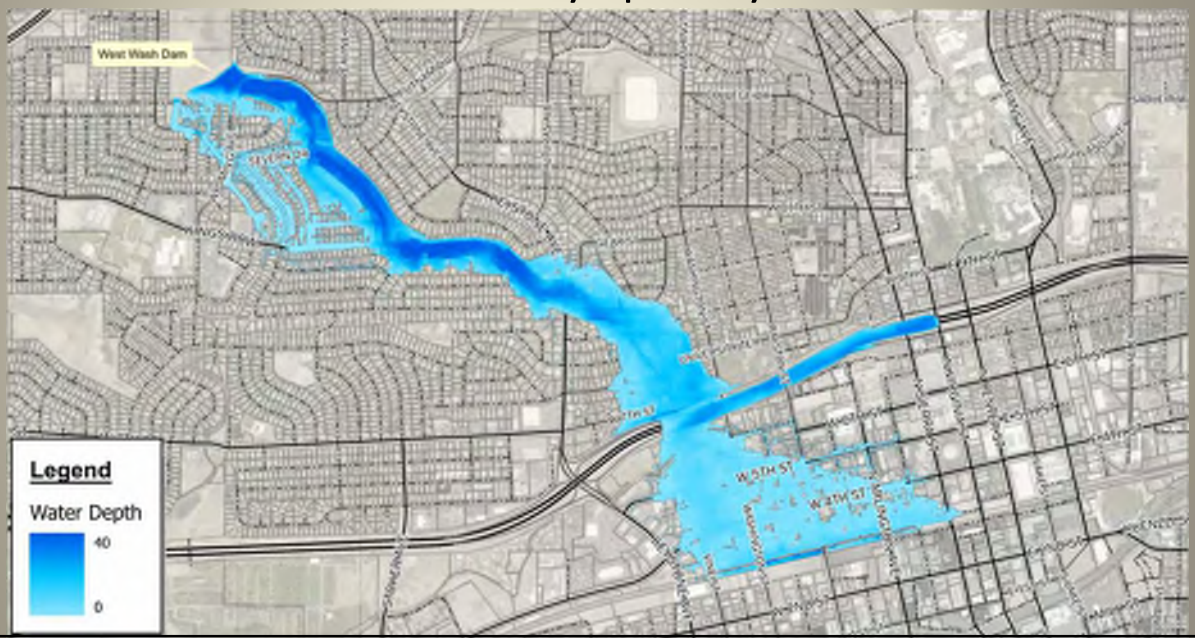
Alt 1 and 2: Inundation Area for Local PMP Dam Breach with Auxiliary Spillway Activation



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Alternative 2: Downstream Flood Improvements

Cost

- $1.91 Billion Total
  - $1.53 Billion Attributed to Property Acquisition

Construction Duration

- 5-10 years

Challenges

- Property Acquisition
  - 664 Properties (greater than 1 foot of inundation)
  - Demolition of homes during housing crisis
  - High likelihood of political pressures and lawsuits, leading to substantial delays
  - Still damage to properties with less than 1 foot of inundation

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Alternative 2: Downstream Flood Improvements Storm Event Scenarios

Alternative 2 - Flood Proofing		
Storm Event	Containment Category	# of Parcels Flooded*
100 Year	Contained	0
200 Year	Spillway Activated	0
500 Year	Spillway Activated	0
PMP	Overtopping of dams, potential breach. No homes flooded since homes are demolished.	0
*Flooded = Over one foot of water		

West Wash Dam will overtop between ½ and ¾ of the local PMP (7,200 to 11,700 cfs)

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Alternative 3: Remediate West Wash Dam and East Wash Auxiliary Spillway

- Improve West Wash Dam to contain Local Probable Maximum Precipitation (PMP)
  - Raise West Wash dam 5-feet
  - Add a 2-foot-tall parapet wall on eastern berm near dam
  - Expand basin capacity and regrade western slope of impoundment area to hold more water
  - Widen Auxiliary Spillway to 80’
  - Lower Auxiliary Spillway crest height by 2.4-feet
  - Original design elevation restoration and armoring at East Wash Dam auxiliary spillway

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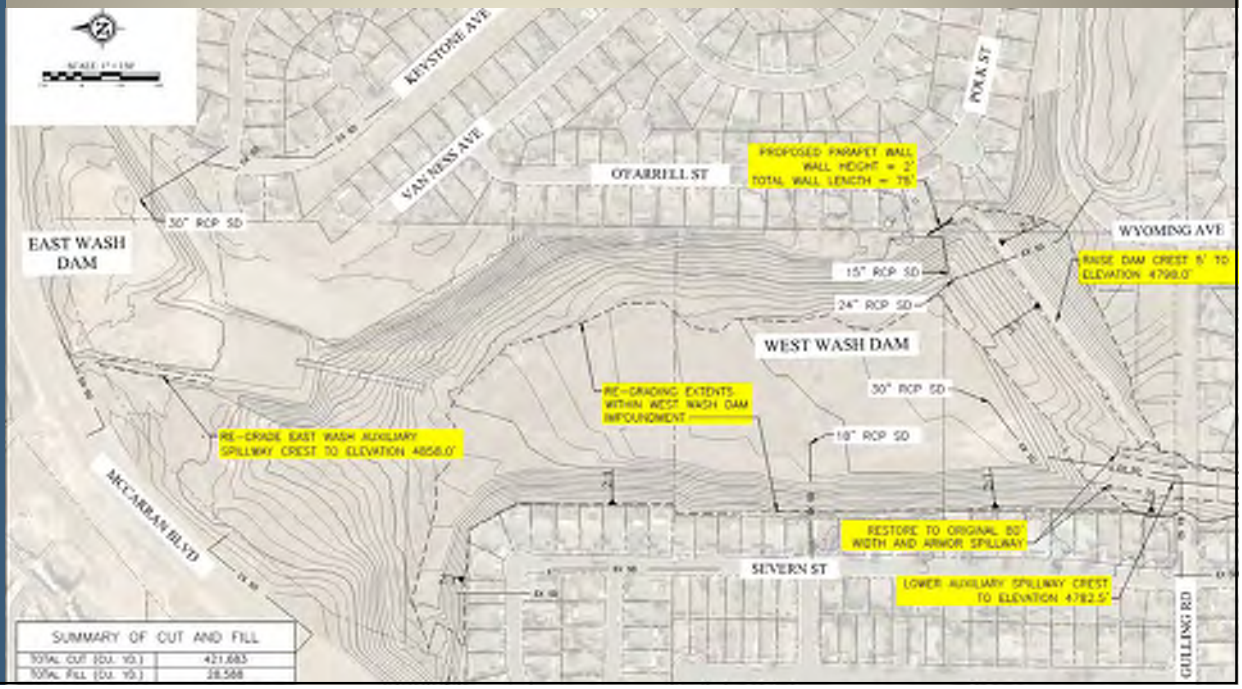
Alternative 3: Remediate West Wash Dam and East Wash AS



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Alternative 3: Remediate West Wash Dam and East Wash AS Preliminary Environmental Impacts

- **Land Use**: Direct impacts to the dam area include removal of vegetation, soil disturbance, disturbance of existing drainage patterns. Total soil disturbance within the dam area is 421,683 cubic yards. This work would also impact the existing City of Reno Storm drain inlets. Two (2) of the inlets are within the excavation area for alternative 3.
- Water Resources: no changes to the resources within the dam areas and no impacts
- Floodplains: Downstream impacts from flooding may occur. When modeled the flooding does not impact identified flood zones.
- **Vegetation**: Vegetation identified within the dam area would be excavated. The Inter-Mountain Basins Big Sagebrush Shrubland and The Great Basin Lowland Riparian vegetation communities including wetland vegetation would be disturbed. Mitigation would be necessary.
- Fish/Aquatic Resources: Modeled Flood flows would not reach the Truckee River. And therefore, would have no effect on fish and aquatic species.
- **Wildlife Resources**: Excavation to remediate the dams under Alt 3 would disturb wildlife habitat including habitat for monarch butterflies. Where possible, milkweed stands should not be removed during the summer breeding period (May through August) to prevent impacts to breeding monarch butterflies. Plants that will be disturbed should be salvaged and replanted in appropriate habitat when practical.
- **Wetlands/Riparian Areas**: A riparian corridor is present in the Project Area which enters from the west and then curves south to the West Wash embankment dam including a thick, mature mixed willows, along with cottonwood trees. The non-jurisdictional wetland adjacent to Highland Ditch also possesses mature willows, cottonwood trees, and tree of heaven. These willows and trees provide potential nesting habitat for migratory birds. Additional nesting habitat is present in the form of powerlines and other tall artificial structures within the Project Area. These would be disturbed under this alternative. However, excavation plans show the areas to be partially avoided because the regrading activities are focused on the west side of the west wash impoundment area. Other mitigation would likely be necessary.
- **Air Quality**: Temporary construction impacts to air quality to include construction emissions and soil disturbance. Total soil disturbance within the dam area is 421,683 cubic yards. Dust suppression and other mitigation measures related to PM10 would be necessary. An NDEP permit for air quality would be necessary.

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Note: Headings that are bolded signify the resources under each alternative that are the most impacted by that alternative

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Alternative 3: Remediate West Wash Dam and East Wash AS Preliminary Environmental Impacts

- **Cultural Resources**: If the final design elements included in Alternative 3 repair and rehabilitate the dams using the same materials and with the same design as the original structures (i.e., maintain and repair the structure with like materials), a finding of No Adverse Effect is likely. If the final design of Alternative 3 would substantially alter the design of the East and West Wash Dams and their accessory structures or would involve the use or addition of materials that are not in keeping with the original materials used in the construction of these structures, it is recommended that a Historic Properties Treatment Plan (HPTP) be developed to resolve any adverse effect to these historic properties through mitigation.
- **Environmental Justice**: Controlled release (auxiliary spillway activation) that would occur under alt 3 would affect different residences than under alt 1 or 2. More impacts occur to residences directly downstream from AS and south of Severn drive under Alt 3. Less depth of flooding (25 ft max, instead of 40 ft max inundation in areas)
- **Noise**: Temporary construction noise for duration of proejct, 2-3 years. Limited to 7a-7pm, (during dry season?)
- **Health and Safety**: both Dams would be rehabilitated to meet federal, state and community design and safety standards for high hazard dams. Risk of flooding still remains for extreme flooding events at the local PMP event. Controlled release would occur through the auxiliary spillway. However, the dam would not breach. Risks to life and safety would be lessened due to warnings for anticipated activation of auxiliary spillway and less total inundation depths downstream
- **Aesthetics**: minor aesthetic changes: Raise WW dam 5-feet, add a 2-foot-tall parapet wall on eastern berm near dam, regrade western slope of impoundment area to hold more water, widen AS to 80', and lower AS crest height by 2.4-feet
- **GHG/Climate Change**: Direct; construction days and equipment and construction dust from excavation disturbance. Indirect: changes in vegetation
- **Cumulative Impacts**: flooding impacts at 500-year storm (see inundation mapping). No Dam breach, no flooding in any lesser storm events.

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Note: Headings that are bolded signify the resources under each alternative that are the most impacted by that alternative

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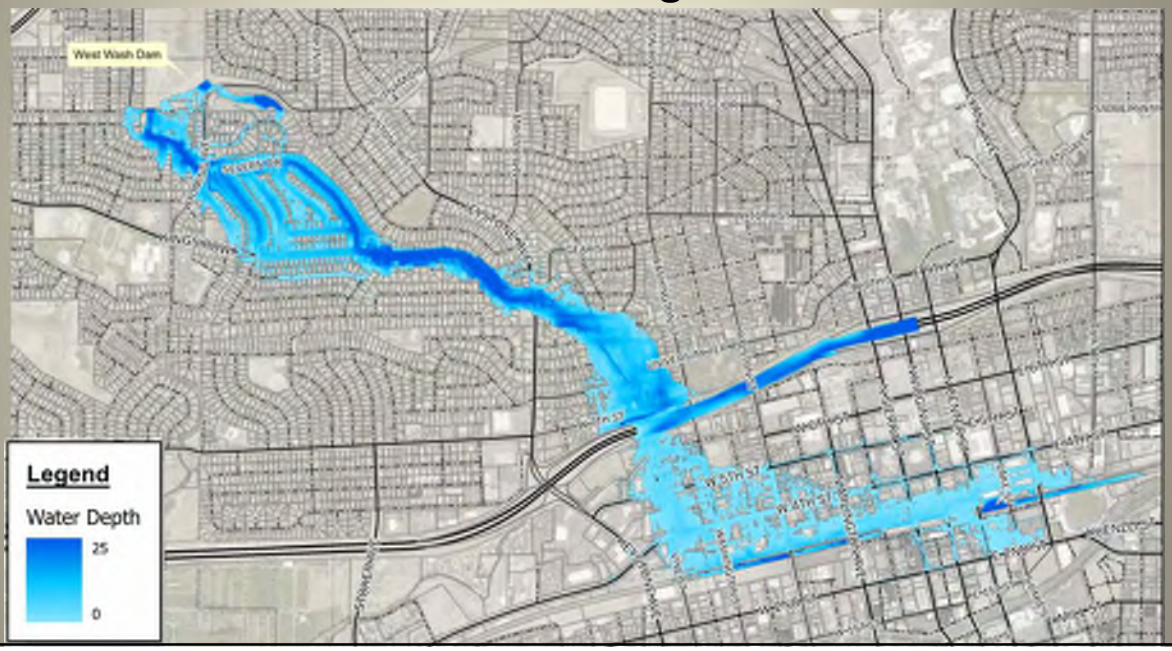
Alternative 3: Inundation Area for Auxiliary Spillway Activation during PMP



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Alternative 3: Remediate West Wash Dam and East Wash Auxiliary Spillway

Cost

- $23 Million

Construction Duration

- 2-3 years

Challenges

- Extensive excavation
  - ➢ Will be limited to geotechnical conditions
- Utilities relocations (water, power, communications, storm drain)
- Disposal of excess material and hauling routes

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Alternative 3: Remediate West Wash Dam and East Wash Auxiliary Spillway Storm Event Scenarios

Alternative 3 - Improve East and West Wash Dams		
Storm Event	Containment Category	# of Parcels Flooded*
100 Year	Contained	0
200 Year	Contained	0
500 Year	Spillway Activated	196
PMP	Spillway Activated, 3 ft of freeboard remaining in West Wash Dam	625
*Flooded = Over one foot of water		

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Alternative 4: Remove Both Dams

- Remove both dams
  - Existing dams would either be breached or completely removed
  - Collection structures would be constructed to direct flow to the existing storm water conveyance facilities downstream.
  - No flood protection would be afforded to properties downstream from the dam sites under this alternative
  - Regrade impoundment areas to reflect near pre-development conditions

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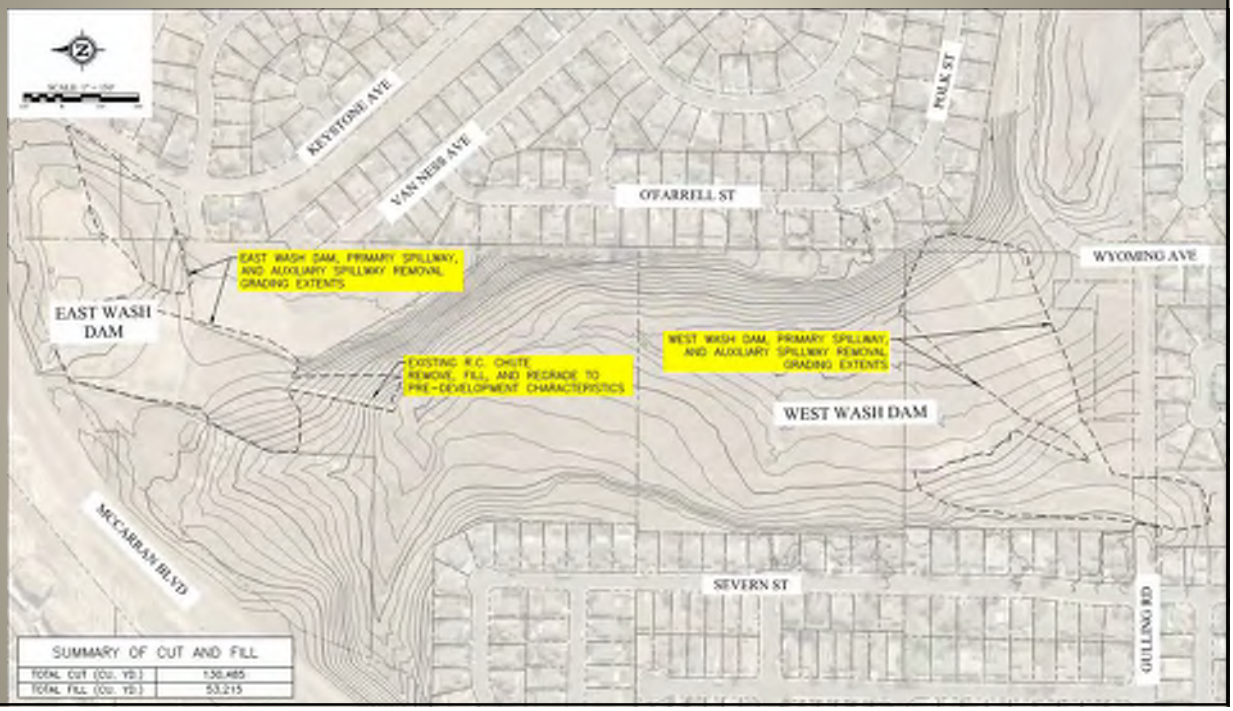
Alternative 4 : Remove Both Dams



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Alternative 4: Remove Both Dams
Preliminary Environmental Impacts

- **Land Use**: Total soil disturbance within the dam area is 130,485 cubic yards. What would the area become? (Open space, park, etc.)
- **Water Resources**: no changes to the resources within the dam areas. A SWPP and NDEP permitting will be needed.
- **Floodplains**: This alternative would include analysis of existing storm water conveyance downstream from the dams and preparation of flood maps for inclusion in the FEMA FIRM program.
- **Vegetation**: Vegetation identified within the dam area would be excavated. The Inter-Mountain Basins Big Sagebrush Shrubland and The Great Basin Lowland Riparian vegetation communities including wetland vegetation would be disturbed.
- **Fish/Aquatic Resources**: impacts to habitat identified within the dam area would be minimal. Habitats identified were generally along the riparian corridor, and not on the dam structures. Some disturbance impacts due to construction activity may occur, but mitigation fencing would be placed around identified habitats for protection. No aquatic or fish species were identified within the project area.
- Wildlife Resources: Excavation to remove the dams may disturb wildlife habitat including habitat for monarch butterflies. However, excavation plans show the wetlands are and wildlife habitat area being largely avoided during dam removal actives.
- **Wetlands/Riparian Areas**: A riparian corridor is present in the Project Area which enters from the west and then curves south to the West Wash embankment dam including a thick, mature mixed willows, along with cottonwood trees. The non-jurisdictional wetland adjacent to Highland Ditch also possesses mature willows, cottonwood trees, and tree of heaven. These willows and trees provide potential nesting habitat for migratory birds. Additional nesting habitat is present in the form of powerlines and other tall artificial structures within the Project Area. These would be disturbed under this alternative. However, excavation plans show the areas to be partially avoided because the regrading activities are focused on the west side of the west wash impoundment area. Mitigation would likely be necessary.
- **Air Quality**: Temporary construction impacts to air quality to include construction emissions and soil disturbance. Total soil disturbance within the dam area is 130, 485 cubic yards. Dust suppression and other mitigation measures related to PM10 would be necessary. An NDEP permit for air quality would be necessary.

Note: Headings that are bolded signify the resources under each alternative that are the most impacted by that alternative

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Alternative 4: Remove Both Dams
Preliminary Environmental Impacts

- **Cultural Resources**: HPTP be developed to resolve the adverse effects to these historic properties through mitigation as described above in Alternative 3.
- **Environmental Justice**: Home and businesses previously not in a floodway may be identified as being within a floodway and become subject to FEMA Flood requirements including possible flood insurance. Under this alternative, at the 100-year flood event, both neighborhoods below the FORMER dam areas would flood via the existing City of Reno Storm Drain outlets. The major flood paths are modeled to run south down Kings Row and Keystone avenue to I-80, where floodwaters would be contained until it drain through storm drain infrastructure.
- **Noise**: Temporary construction noise for duration of construction: approximately 1 year, limited to 7-7pm, (during dry season?)
- **Health and Safety**: Because there would be no dams under this alternative, the safety standard that would be met is the community safety standard of the 100-year storm flood protections and requirements. Home and businesses previously not in a floodway may be identified as being within a floodway and become subject to FEMA Flood requirements including possible flood insurance. Under this alternative, at the 100-year flood event, both neighborhoods below the FORMER dam areas would flood via the existing City of Reno Storm Drain outlets. The major flood paths are modeled to run south down Kings Row and Keystone avenue to I-80, where floodwaters would be contained until it drain through storm drain infrastructure.
- **Aesthetics**: aesthetic changes to the area to restore it to natural contours.
- **GHG/Climate Change**: Direct; construction days and equipment and construction dust from excavation disturbance. Indirect: vegetation changes, stream flow changes, and uncertainty of future storm patterns.
- **Cumulative Impacts**: all houses downstream of the two dams would flood during 10-, 25-, 50- and 100-year storm events. COR would incur costs of clean up and flood impacts. New FEMA flood mapping would likely be necessary. Property values or costs of flood insurance would impact only some residents for the benefit of all.

Note: Headings that are bolded signify the resources under each alternative that are the most impacted by that alternative

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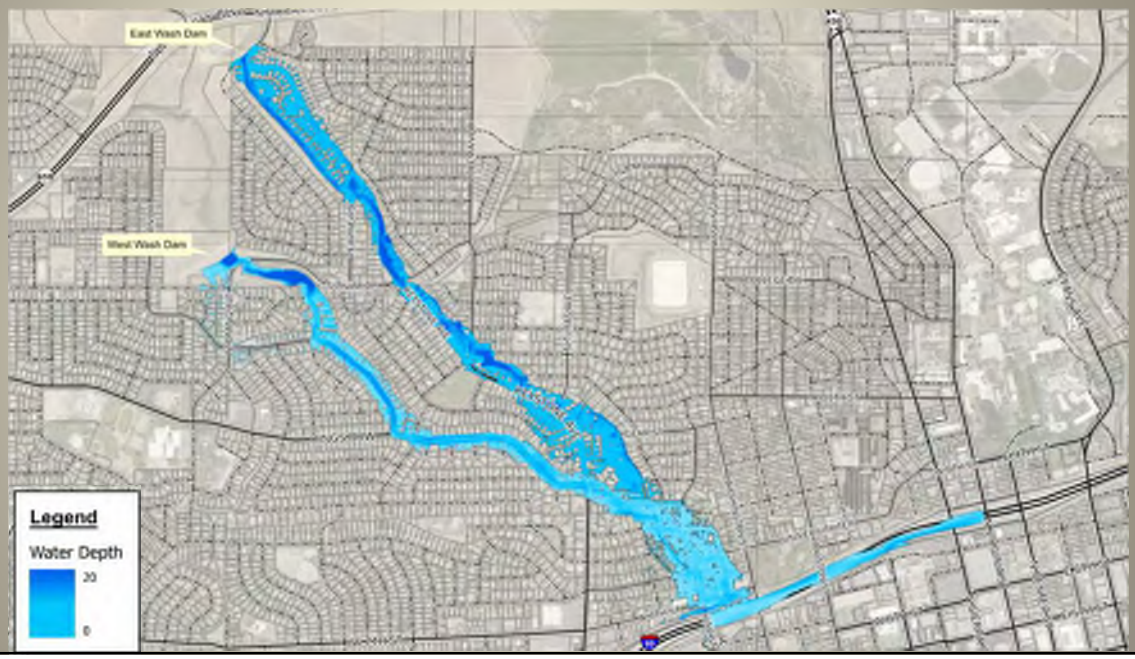
Alternative 4: Inundation Area for 100-year Flood Event



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Alternative 4: Remove Both Dams

Cost

- $5.54 Million

Construction Duration

- 1 year

Challenges

- Disposal of material
- Hauling routes

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Alternative 4: Remove Both Dams
Storm Event Scenarios

Alternative 4 - Remove East and West Wash Dams		
Storm Event	Containment Category	# of Parcels Flooded*
10 Year	Variable flooding during all storm events	368
25 Year		412
50 Year		444
100 Year		455
*Flooded = Over one foot of water		

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Alternative 5: Remove Both Dams with Downstream Flood Channel

- Remove both dams and construct a channel to convey 100- year flood flows downstream of both dams
  - Both dams would be removed as described in *Alternative 4 – Remove Both Dams*
  - Establish flood corridor with channeling structures from both East Wash and West Wash Dams to the receiving waters of the Truckee River
  - Will require acquisition of homes and commercial properties and/or will have severe impacts to existing homes and commercial properties

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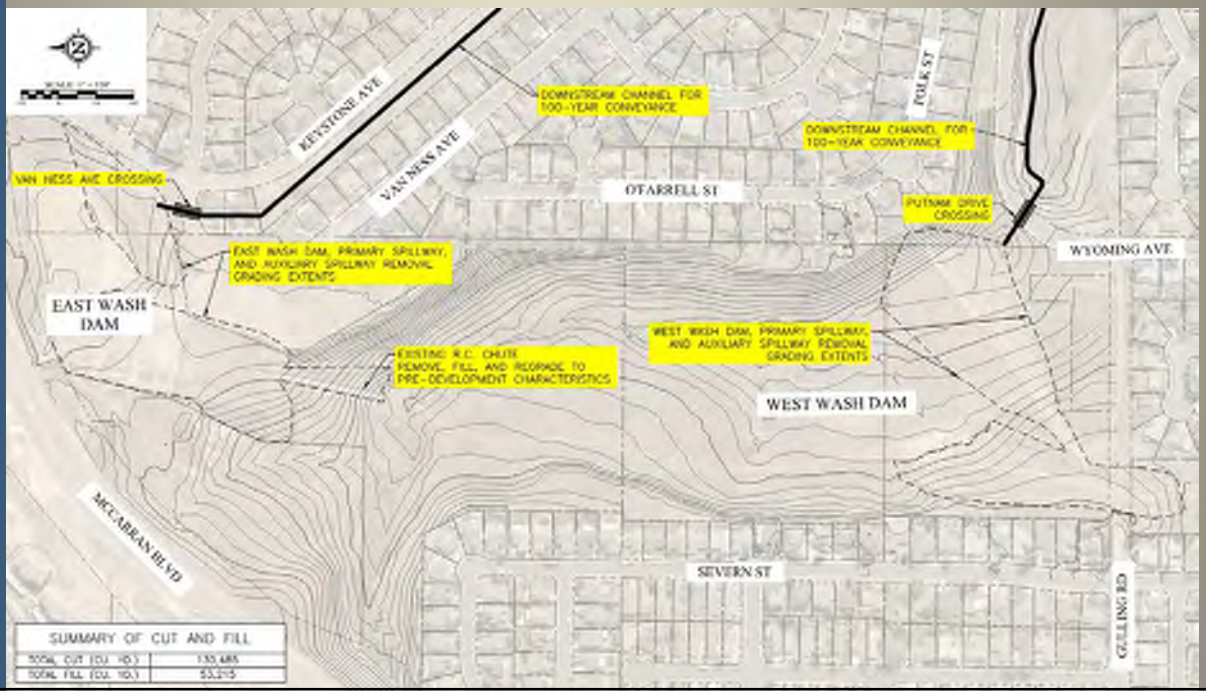
Alternative 5: Remove Both Dams with Downstream Flood Channel



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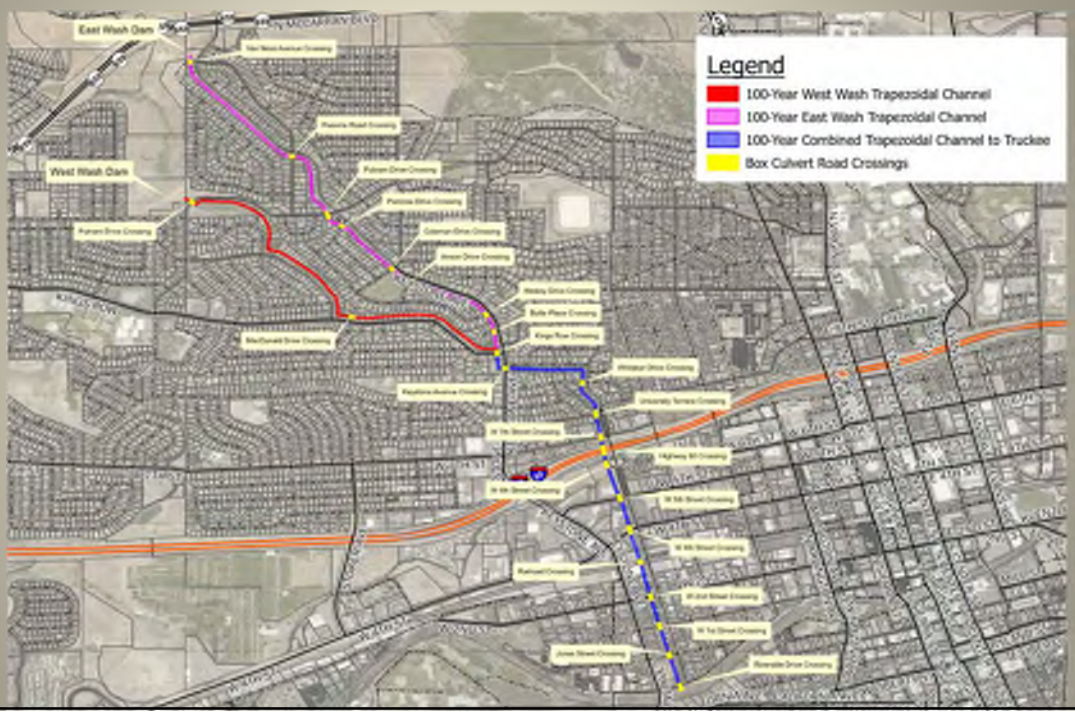
Alternative 5: Remove Both Dams with Downstream Flood Channel



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Alternative 5: Remove Both Dams with Downstream Flood Channel
Preliminary Environmental Impacts

- **Land Use**: construction of pipeline through residential and commercial areas. Total soil disturbance within the dam area is 421,683 cubic yards. Additional disturbance to construct 18,245 ft of culvert channelization to convey storm flows. The channel would be constructed on current residential properties and would require the acquisition and demolition of 161 residences and properties. (Against policies of COR to channelize (see pg. 73 of Reno master Plan)
- **Water Resources**: storm flows into the Truckee river flows in large storm events. (see graph and totals in next column.) Likely require USACE/CTWCD permitting and or/impact assessment. A SWPP and NDEP permitting will be needed. May require coordination with Truckee Meadows Stormwater Permit Coordinating Committee. The Truckee Meadows SWPCC is responsible for implementing the Truckee Meadows Stormwater Quality Management Program to protect the water quality of the region's waterways, streams and the overall Truckee River Watershed.
- **Floodplains**: Flood zones north of and including the Truckee River would be impacted by storm flows draining in the Truckee river. Max Expanded APE must be established and evaluation of resources within the expanded APE has been completed.
  - West Wash Peak Flow (cfs) = 1,482
  - West Wash Total Volume (ft^3) = 7,705,428
  - East Wash Peak Flow (cfs) = 1,904
  - East Wash Total Volume (ft^3) = 12,769,747
  - Combined Peak Flow (cfs) = 3,386
  - Combined Total Volume (ft^3) = 20,475,175
- **Vegetation**: Vegetation identified within the dam area would be excavated. The Inter-Mountain Basins Big Sagebrush Shrubland and The Great Basin Lowland Riparian vegetation communities including wetland vegetation would be disturbed. Expanded APE must be established to include the culvert alignment.

Note: Headings that are bolded signify the resources under each alternative that are the most impacted by that alternative

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Alternative 5: Remove Both Dams with Downstream Flood Channel
Preliminary Environmental Impacts

- **Fish/Aquatic Resources**: Expanded APE must be established and evaluation of resources within the expanded APE has been completed. This is the only alternative that involves direct flows into the Truckee River. These changes in flows and turbidity could impact fish and aquatic life in the Truckee River including LCT, which is an endangered species. LCT are also threatened by altering watersheds that may have increased turbidity and high flows, thereby reducing spawning habitat quality. Warmer water temperatures and drought can affect the survival rate of young LCT.
- Wildlife Resources: Excavation to remove the dams would disturb wildlife habitat including habitat for monarch butterflies. However, excavation plans show the wetlands are and wildlife habitat area being largely avoided during dam removal activities.
- **Wetlands/Riparian Areas**: A riparian corridor is present in the Project Area which enters from the west and then curves south to the West Wash embankment dam including a thick, mature mixed willows, along with cottonwood trees. The non-jurisdictional wetland adjacent to Highland Ditch also possesses mature willows, cottonwood trees, and tree of heaven. These willows and trees provide potential nesting habitat for migratory birds. Additional nesting habitat is present in the form of powerlines and other tall artificial structures within the Project Area. These would be disturbed under this alternative and mitigation would be necessary.
- **Air Quality**: Temporary construction impacts to air quality include construction emissions and soil disturbance. Total soil disturbance within the dam area is 130, 485 cubic yards. Additional disturbance for construction of 18,245 ft of culvert channelization to convey storm flows. An NDEP permit for air quality would be necessary. Dust suppression would be necessary and other mitigation measures related to PM10.
- **Cultural Resources**: HPTP be developed to resolve the adverse effects to these historic properties through mitigation as described above.

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Note: Headings that are bolded signify the resources under each alternative that are the most impacted by that alternative

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Alternative 5: Remove Both Dams with Downstream Flood Channel
Preliminary Environmental Impacts

- Environmental Justice: the potential effects of flooding on residents would be removed. However, its is possible that downstream communities would be impacted by flows into the Truckee River during a major storm event.
- **Noise**: Temporary construction noise for duration of 3-5 years, limited to 7-7pm, (during dry season?) construction of channel to Truckee river and demolition of 161 homes.
- **Health and Safety**: Because there would be no dams under this alternative, the safety standard that would be met is the community safety standard of the 100-year storm flood protections and requirements. A channel system would be constructed to convey the entire 100-year storm flows from the FORMER east and west wash dam areas directly to the Truckee River at river side drive in downtown Reno. This flow may contribute to flooding risks in the downtown reno area depending on the flows in the Truckee River at the time of peak discharge. Impacts in downtown reno could include damage to the flood walls through downtown, and the surrounding businesses and infrastructure, impacts to kayak park and other recreational amenities. The flood walls are USACE structures, and impacts to those structures may require additional USACE consultation.
- **Aesthetics**: aesthetic changes to the area to restore it to natural contours. Changes to the neighborhoods due to demolition of 161 homes and construction of an open, channelized flood flow system.
- **GHG/Climate Change**: Direct; construction days and equipment and construction dust from excavation disturbance. Indirect: vegetation changes, altering stream flows, limiting ground filtration of water with concrete channel.
- **Cumulative Impacts**: channelization of drainage, changing wetlands, wildfire habitat of existing dam areas. Large storm flows into the Truckee river could impact Truckee river wildlife as well as increase the risk of flooding related hazards in downtown Reno. Changes to the visual and esthetic nature of the area by installing channelized drainage, which is also counter to the policies of the COR Master plan.

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Note: Headings that are bolded signify the resources under each alternative that are the most impacted by that alternative

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Alternative 5: Remove Both Dams with Downstream Flood Channel

Cost

- $165 Million
  - ➢$105.2 Million Attributed to Property Acquisition

Construction Duration

- 3-5 years

Construction Challenges

- Property Acquisition
  - ➢161 Properties
  - ➢Demolition of homes during housing crisis
  - ➢Demolition of existing businesses
  - ➢High likelihood of political pressures and lawsuits, leading to substantial delays
- Tunneling under railroad and I-80
- Disposal of material and hauling routes
- Commerce disruption during construction

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Alternative 5: Remove Both Dams with Downstream Flood Channel
Storm Event Scenarios

Alternative 5 - Remove Dams with Downstream Improvements		
Storm Event	Containment Category	# of Parcels Flooded*
10 Year	Contained within Channel	0
25 Year	Contained within Channel	0
50 Year	Contained within Channel	0
100 Year	Contained within Channel	0
*Flooded = Over one foot of water		

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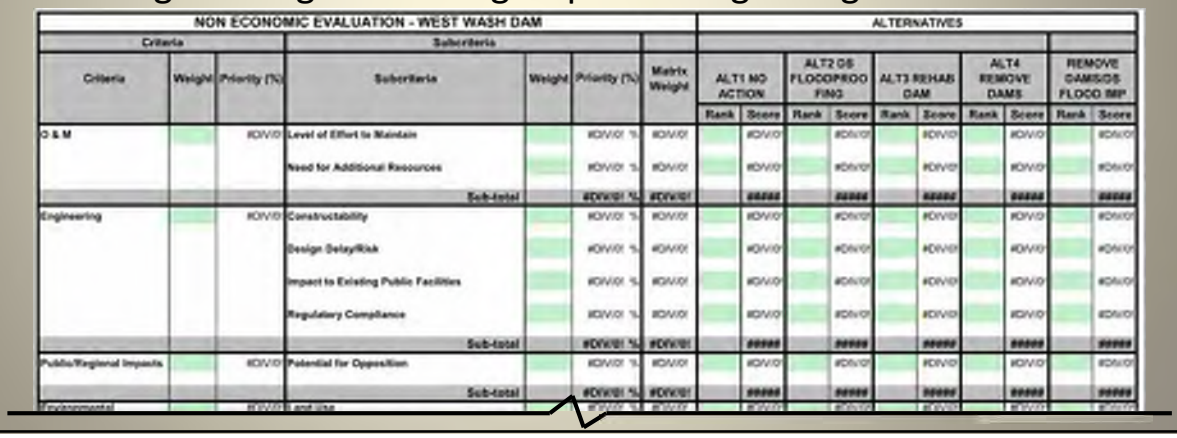
Non-Economic Evaluation – Scoring Matrix

- A blank matrix was provided prior to the workshop to self-complete
- We will go through this as a group and assign weights and ranks



NON ECONOMIC EVALUATION - WEST WASH DAM

Criteria	Weight	Priority (%)	Subcriteria	Weight	Priority (%)	Matrix Weight	ALTERNATIVES: ALT1 NO ACTION Rank	ALT1 NO ACTION Score	ALT2 GS FLOODPROO FING Rank	ALT2 GS FLOODPROO FING Score	ALT3 REHAB DAM Rank	ALT3 REHAB DAM Score	ALT4 REMOVE DAMS Rank	ALT4 REMOVE DAMS Score	REMOVE DAMS/GS FLOOD IMP Rank	REMOVE DAMS/GS FLOOD IMP Score
O & M		#DIV/0!	Level of Effort to Maintain		#DIV/0! %	#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
			Need for Additional Resources		#DIV/0! %	#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
			Sub-total		#DIV/0! %	#DIV/0!		#####		#####		#####		#####		#####
Engineering		#DIV/0!	Constructability		#DIV/0! %	#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
			Design Delay/Risk		#DIV/0! %	#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
			Impact to Existing Public Facilities		#DIV/0! %	#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
			Regulatory Compliance		#DIV/0! %	#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
			Sub-total		#DIV/0! %	#DIV/0!		#####		#####		#####		#####		#####
Public/Regional Impacts		#DIV/0!	Potential for Opposition		#DIV/0! %	#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
			Sub-total		#DIV/0! %	#DIV/0!		#####		#####		#####		#####		#####
Environmental		#DIV/0!	Land use		#DIV/0! %	#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!

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Non-Economic Evaluation – Scoring Matrix

- Criteria and sub-criteria weighting scale

Verbal Scale	Numeric Scale
Critical	10
Very Important	7.5
Important	5
Less Important	2.5
Least Important	0

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Non-Economic Evaluation – Scoring Matrix

- Assign weights to each criteria
  - Operations and maintenance
  - Engineering
  - Public/Regional Impacts
  - Environmental
  - ROW Requirements
  - Level of Flood Protection

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Non-Economic Evaluation – Scoring Matrix

- Assign weights to each sub-criteria

O&M	Engineering	Public/Regional Impacts	Environmental	ROW Requirements	Level of Flood Protection
• Level of effort to maintain • Need for additional resources	• Constructability • Design Delay/Risk • Impact to Ex. Public Facilities	• Potential for Opposition	• Land Use • Water Resources • Floodplains • Biological Resources • Cultural & Historic Resources • Environmental Justice • Noise • Health/Human Safety • Aesthetics • GHG/Climate Change • Cumulative Impacts	• Permanent Acquisitions • Project Delay/Risk	• 100-year Storm • 200-year Storm • 500-year Storm • PMF Event

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Non-Economic Evaluation – Scoring Matrix

- Rank each alternative for each sub-criteria
  - Best possible score: 5
  - Worst possible score: 1
  - If there are any ties, all alternatives will be given higher rank
    - Ex: Two alternatives are tied for lowest scoring, both alternatives would be assigned a rank of 2

Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Future Without Project	Downstream Flood Improvements	Remediate West Wash Dam	Remove Both Dams	Remove Both Dams with Downstream Flood Channel

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Non-Economic Evaluation – Scoring Matrix

- A preliminary scoring matrix was completed by Farr West Engineering
  - Matrix is shown on next two slides

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NON ECONOMIC EVALUATION - WEST WASH DAM							ALTERNATIVES									
Criteria			Subcriteria				ALT1 NO ACTION		ALT2 DS FLOODPROOFING		ALT3 REHAB DAM		ALT4 REMOVE DAMS		REMOVE DAMS/DS FLOOD IMP	
Criteria	Weight	Priority (%)	Subcriteria	Weight	Priority (%)	Matrix Weight	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score
O & M	2.5	6.7%	Level of Effort to Maintain	10	57.1 %	3.8	5	3.8	2	1.5	5	3.8	5	3.8	1	0.8
			Need for Additional Resources	7.5	42.9 %	2.9	4	2.3	3	1.7	5	2.9	3	1.7	1	0.6
			Sub-total	17.5	100.0 %	6.7		6.1		3.2		6.7		5.5		1.3
Engineering	5	13.3%	Constructability	10	26.7 %	3.6	5	3.6	2	1.4	4	2.6	4	2.5	2	1.4
			Design Delay/Risk	10	26.7 %	3.6	5	3.6	1	0.7	4	2.6	3	2.1	2	1.4
			Impact to Existing Public Facilities	7.5	20.0 %	2.7	5	2.7	1	0.5	4	2.1	3	1.6	2	1.1
			Regulatory Compliance	10	26.7 %	3.6	1	0.7	5	3.6	5	3.6	5	3.6	5	3.6
			Sub-total	37.5	100.0 %	13.3		10.5		6.2		11.4		10.1		7.5
Public/Regional Impacts	7.5	20.0%	Potential for Opposition	10	100.0 %	20.0	5	20.0	1	4.0	4	16.0	3	12.0	2	8.0
			Sub-total	10	100.0 %	20.0		20.0		4.0		16.0		12.0		8.0
Environmental	5	13.3%	Land Use	10	10.5 %	1.4	5	1.4	2	0.6	5	1.4	3	0.8	1	0.3
			Water Resources	10	10.5 %	1.4	5	1.4	5	1.4	5	1.4	5	1.4	1	0.3
			Floodplains	7.5	7.9 %	1.1	5	1.1	1	0.2	5	1.1	5	1.1	2	0.4
			Biological Resources	10	10.5 %	1.4	5	1.4	4	1.1	3	0.8	3	0.8	2	0.6
			Cultural and Historic Resources	10	10.5 %	1.4	5	1.4	4	1.1	3	0.8	3	0.8	3	0.8
			Environmental Justice	10	10.5 %	1.4	5	1.4	1	0.3	4	1.1	3	0.8	2	0.6
			Noise	7.5	7.9 %	1.1	5	1.1	1	0.2	3	0.6	4	0.8	2	0.4
			Health/Human Safety	7.5	7.9 %	1.1	1	0.2	4	0.8	5	1.1	3	0.6	2	0.4
			Aesthetics	7.5	7.9 %	1.1	5	1.1	1	0.2	4	0.8	3	0.6	3	0.6
			GHG/Climate Change	7.5	7.9 %	1.1	5	1.1	1	0.2	3	0.6	4	0.8	2	0.4
			Cumulative Impacts	7.5	7.9 %	1.1	1	0.2	4	0.8	5	1.1	3	0.6	2	0.4
			Sub-total	95	100.0 %	13.3		11.8		7.0		10.3		9.4		5.3

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Non-Economic Evaluation – Scoring Matrix

NON ECONOMIC EVALUATION - WEST WASH DAM							ALTERNATIVES									
Criteria			Subcriteria				ALT1 NO ACTION		ALT2 DS FLOODPROOFING		ALT3 REHAB DAM		ALT4 REMOVE DAMS		REMOVE DAMS/DS FLOOD IMP	
Criteria	Weight	Priority (%)	Subcriteria	Weight	Priority (%)	Matrix Weight	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score
ROW Requirements	7.5	20.0%	Permanent Acquisitions	10	57.1 %	11.4	5	11.4	1	2.3	4	9.1	5	11.4	2	4.6
			Project Delay/Risk	7.5	42.9 %	8.6	5	8.6	2	3.4	4	6.9	5	8.6	2	3.4
			Sub-total	17.5	100.0 %	20.0		20.0		5.7		16.0		20.0		8.0
Level of Flood Protection	10	26.7%	100-yr Storm	10	28.6 %	7.6	5	7.6	5	7.6	5	7.6	1	1.5	5	7.6
			200-yr Storm	7.5	21.4 %	5.7	2	2.3	5	5.7	5	5.7	1	1.1	5	5.7
			500-yr Storm	7.5	21.4 %	5.7	2	2.3	5	5.7	5	5.7	1	1.1	5	5.7
			PMF Event	10	28.6 %	7.6	1	1.5	5	7.6	5	7.6	2	3.0	5	7.6
			Sub-total	35	100.0 %	26.7		13.7		26.7		26.7		6.9		26.7
Total	37.5	100%				Total		81.9		52.9		87.6		63.9		56.7

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Economic Analysis

- Four Economic Accounts
  - NED: National Economic Development
  - EQ: Environmental Quality
  - RED: Regional Economic Development
  - OSE: Other Social Effects

NED is the only required account.

Once a benefit cost ratio greater than 1 is established the analysis may stop, provided stopping does not distort the comparison of alternatives.

The alternative with the greatest benefit MUST be selected unless there are overriding economic or non-economic reasons to select a different alternative. Exemption can be granted by the Chief of NRCS.

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Economic Considerations

- Monetized Values (on next slide)

	Includes	Excludes
NED	Structural & Contents Damages $	Vehicle Damages, Cost of Traffic (Vehicle & Rail) Delays, Emergency Costs, Clean-up Costs
RED	Loss of Property Taxes from Acquisitions (Alts 2 & 5)	Loss of Consolidated Taxes & Redevelopment Tax Increment; Room Tax, Tourism Surcharges; Indirect & Induced Effects (Alts 2 & 5)

- Non-Monetized Considerations

	INCLUDES (numbers are for Alt. 2 PMP Breach Event)
OSE	Displacement of Low-Income Families - 60 Reno Housing Authority Units removed; total about 1,960 persons displaced with land acquisition
RED	Number of Jobs Lost about 2,600 – Direct effects only (excl. indirect & induced impacts) with land acquisition

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NED Results & RED Property Tax Losses

Positive Benefit Cost Ratio in Alternatives 2 & 3

Alternative 2 NED Results Problematic – seek an Exemption

Based on 2022 Dollars, Discount Rate of 2.25%, 56 Years	Alternative 2 Downstream Flood Improvements 100-YR	200-YR	500-YR	WW Local PMP Breach	Alternative 3 Remediate West Wash Dam to contain PMP 100-YR	200-YR	500-YR	Auxiliary Spillway Activation (PMP)
	Thousands of Dollars				Thousands of Dollars			
Benefit Cost Ratio	0.0	0.2	0.4	2.9	0.0	35.1	-0.1	-4.0
NED - Net Benefits	**($44,166)**	**($34,644)**	**($24,381)**	**$83,617**	**($653)**	**$22,289**	**($713)**	**($3,242)**
RED - Property Tax Loss	$0	($3,550)	($6,723)	($69,719)	$0	$0	$0	$0

Based on 2022 Dollars, Discount Rate of 2.25%, 56 Years	Alternative 4 Remove both Dams 10-YR	25-YR	50-YR	100-YR	Alternative 5 Remove both Dams - Flood Conveyance to Truckee River 10-YR	25-YR	50-YR	100-YR
	Thousands of Dollars				Thousands of Dollars			
Benefit Cost Ratio	-300	-330	-383	-406	0	0	0	0
NED - Net Benefits	**($46,039)**	**($50,589)**	**($58,717)**	**($62,253)**	**($4,352)**	**($4,352)**	**($4,352)**	**($4,352)**
RED - Property Tax Loss	$0	$0	$0	$0	($6,705)	($6,705)	($6,705)	($6,705)

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Conclusion – Engineering, Non-Economic, and Economic Analysis

Evaluation Parameter	Alternative 1 No Project	Alternative 2 DS Flood Improvements	Alternative 3 Remediate WW Dam	Alternative 4 Remove Both Dams	Alternative 5 Remove Both Dams w/DS Flood Channel
Approximate Estimated Capital Cost	$0	$1.91 Billion	$23 Million	$5.5 Million	$165 Million
Non-Economic Evaluation Score (FWE's initial scores)	81.9	52.9	87.0	63.9	56.7
Estimated Construction Duration (years)	N/A	5-10	2-3	1	3-5

- Benefit Cost Analysis
  - Positive Benefit Cost Ratio in Alternatives 2 & 3
  - Alternative 2 NED Results Problematic – seek an Exemption

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Conclusion – Environmental Analysis

- Environmental resource categories marked with an "X" under each alternative signify the resources that are the most impacted by that alternative
- This summary is qualitative and not an indication of the significance of the impact

Environmental Resource	Alternative 1 No Project	Alternative 2 DS Flood Improvements	Alternative 3 Remediate WW Dam	Alternative 4 Remove Both Dams	Alternative 5 Remove Both Dams w/DS Flood Channel
Land Use	X	X	X	X	X
Water Resources		X		X	X
Floodplain		X		X	X
Vegetation	X	X	X	X	X
Fish/Acquatic Resources				X	X
Wildlife Resources		X	X		
Wetlands/ Riparian Areas			X	X	X
Air Quality		X	X	X	X
Cultural Resources		X	X	X	X
Environmental Justice	X	X	X	X	
Noise		X	X	X	X
Health and Safety	X	X	X	X	X
Aesthetics		X	X	X	X
GHG/Climate Change	X	X	X	X	X
Cumulative Impacts	X	X	X	X	X

Next Milestones

- Tech Memo 4: Selected Alternative
  - Draft submittal: May 27, 2022
  - Final submittal: July 22, 2022
- Public meeting for draft Environmental Document Comments
  - Planned for October 2022
- Watershed Plan and Environmental Document
  - First submittal of Preliminary Supplemental Draft Plan/ED: July 2022
  - Final submittal of Supplemental Plan/ED & FONSI: March 24, 2023

APPENDIX B: NON-ECONOMIC EVALUATION MATERIAL

CRITERIA AND SUB-CRITERIA WEIGHTS AND PRIORITIES

Alternatives 1-5 were evaluated using a matrix comparison. The matrix is a tool used to identify the best alternative relative to the competing alternatives based on direct comparison. This section includes a brief description of the methodology used, including descriptions of the various criteria and the specific weighting assigned to each criterion.

Each alternative under consideration was scored based on specific criteria. The relative value assigned to each criteria determined its weight compared to the other criteria used in the evaluation. The weight was based on the importance to the project, with a maximum of ten (10) representing critical importance, and a minimum of zero (0) representing least importance. Table 1 presents the scale used in the weighting of criteria.

Table 1: Criteria/Sub-Criteria Weighting Scale

Verbal Scale	Numeric Scale
Critical	10
Very Important	7.5
Important	5
Less Important	2.5
Least Important	0

The criteria and sub-criteria used for the non-economic evaluation were developed by carefully considering the goals of the project and the needs of the City of Reno. Scoring will be reviewed with the City of Reno, NRCS, and Farr West Engineering during a workshop on April 29, 2022. The six main evaluation criteria that were used to compare the West Wash Dam Rehabilitation alternatives are:

1. Operations and Maintenance
2. Engineering
3. Public/Regional Impacts
4. Environmental
5. ROW Requirements
6. Level of Flood Protection

Table 2 applies the weighting scale in Table 1 to each of the three evaluation criteria listed above based on each criteria's relative importance. The "Priority" column in Table 2 represents a normalization of the weighting, which reflects the relative contribution that a particular criterion has on the overall ranking relative to the other criteria. This priority is expressed as a percentage of the sum of all criterion weights. In this case there are six criteria categories that were weighted separately. These priorities reflect the total criteria scoring, equaling 100 percent.

Table 2: West Wash Dam Rehabilitation Criteria Weights and Priorities

Criteria	Weight	Priority
Operations and Maintenance	2.5	6.3%
Engineering	5	12.5%
Public/Regional Impacts	7.5	18.8%
Environmental	10	25.0%
ROW Requirements	5	12.5%
Level of Flood Protection	10	25.0%
Total	**40.0**	**100%**

The six main criteria listed above were broken down into a total of twenty-four (24) sub-criteria, which are specific characteristics used to compare how well each alternative meets each of the main criteria. Similar to the criteria (as described above), each sub-criterion was assigned a weight, which was then used to calculate a priority. Finally, a matrix weight was calculated for each sub-criterion. The matrix weight for each criterion is equal to that criteria's priority multiplied by 100, which brings the weight from a percentage to a whole number that was used for scoring purposes. The criteria's matrix weight is then multiplied by each sub-criteria's priority to determine the highest possible score that each sub-criterion could be worth. The summation of the matrix weights for all the sub-criteria within a criterion will always equal the criterion's priority multiplied by 100 and the summation of all sub-criteria within the entire matrix will always equal 100. The chosen sub-criteria, weights, priorities, and matrix weights used for the non-economic analysis of the West Wash Dam Rehabilitation alternatives is summarized in Table 3. An example of matrix weights is described below:

- The matrix weight of the criterion "Operations and Maintenance" is 6.3
    - 6.3% priority, as listed in Table 2, multiplied by 100
- The matrix weight for the "Level of Effort to Maintain" sub-criterion is 3.15
    - 50.0% sub-criterion's priority, as listed in Table 3, multiplied by 6.3, the criterion's matrix weight

After the criteria and sub-criteria were established and weighted, each alternative was ranked within each sub-criterion and a resulting score was calculated. For example, there are five alternatives, so for each alternative was ranked relatively from one (1) to five (5) for each sub-criteria, with five representing the highest, and most desirable, rank. The score was then calculated by dividing the rank by the number of alternatives (5) and then multiplying it by the sub-criteria's matrix weight. If two alternatives are tied for a given sub-criteria, each alternative will be ranked as the same higher rank. For example, if two alternatives are tied as the lowest rank for a sub-criterion, both of the alternatives would be given a rank of 2. Similarly, if three alternatives were tied for the middle, each alternative would be given a score of 4 (the highest and lowest ranked alternatives in this example would still be given a 5 and 1, respectively). The scores for each sub-criteria were then summed for each alternative, and the highest overall scoring alternative is considered the most desirable. The highest possible score for any alternative is 100.

Table 3: West Wash Dam Rehabilitation Sub-Criteria Weights, Priorities, and Matrix Weights

Sub-Criteria	Weight	Priority	Matrix Weight
Operation & Maintenance Weight = 2.5, Priority = 6.3%			
Level of Effort to Maintain	5	50.0%	3.15
Need for Additional Resources	5	50.0%	3.15
Subtotal	10	100.0%	6.3
Engineering Weight = 5, Priority = 12.5%			
Constructability	7.5	30.0%	3.8
Design Delay/Risk	2.5	10.0%	1.3
Impact to Existing Facilities	5	20.0%	2.5
Regulatory Compliance	10	40.0%	5.0
Subtotal	25	100.0%	12.5
Public/Regional Impacts Weight = 7.5, Priority = 18.8%			
Potential for Opposition	10	100.0%	18.8
Subtotal	10	100.0%	18.8
Environmental Weight = 10, Priority = 25.0%			
Land Use	10	10.3%	2.6
Water Resources	10	10.3%	2.6
Floodplains	7.5	7.7%	1.9
Biological Resources	10	10.3%	2.6
Cultural and Historic Resources	10	10.3%	2.6
Environmental Justice	10	10.3%	2.6
Noise	7.5	7.7%	1.9
Health/Human Safety	10	10.3%	2.6
Aesthetics	7.5	7.7%	1.9
GHG/Climate Change	7.5	7.7%	1.9
Cumulative Impacts	7.5	7.7%	1.9
Subtotal	97.5	100.0%	25.0
ROW Requirements Weight = 5, Priority = 12.5%			
Permanent Acquisitions/Legal Challenges	10	100.0%	12.5
Subtotal	10	100.0%	12.5
Level of Flood Protection Weight = 10, Priority = 25.0%			
100-Year Storm	2.5	10.0%	2.5
200-Year Storm	5	20.0%	5.0
500-Year Storm	7.5	30.0%	7.5
PMF Event	10	40.0%	10.0
Subtotal	25	100.0%	25.0

CRITERIA AND SUB-CRITERIA DESCRIPTIONS

The criteria and sub-criteria used for the non-economic evaluation were introduced in Table 2 and Table 3, respectively. Detailed descriptions of what each criterion and sub-criterion represents, as well as the reasoning for the weight that Farr West Engineering assigned to each, are discussed in the following sections.

OPERATIONS & MAINTENANCE

The operation and maintenance of a dam and other flood protection infrastructure would be long-term commitment for the City of Reno that would require personnel and potentially equipment. The sub-criteria under the Operations and Maintenance criterion attempts to evaluate the degree of maintenance, operation, and how well each alternative accommodates long term accessibility for maintenance purposes. This criterion was considered "Less Important" compared to impacts from other criteria and was evaluated using two sub-criteria.

1. Level of Effort to Maintain: The level of effort to maintain the proposed infrastructure, both in the short- and long-term, will vary depending on the overall area of the flood protection infrastructure, as well as with how complex that infrastructure may become. Maintenance activities may include fixing degrading spillway pipes, keeping the primary spillways free of garbage, cleaning out and maintaining concrete channels, unclogging any pipes or culverts associated with flood prevention after storms, etc. The level of effort to maintain will increase as the scale of infrastructure to maintain increases. Therefore, this sub-criterion was considered "Important" within the *Operations and Maintenance* criterion. Alternatives with newer and less infrastructure were given higher scores.
2. Need for Additional Resources: Maintaining any sort of infrastructure requires certain assets, such as personnel and equipment (e.g., trucks, backhoes, bulldozers, etc.). The larger the maintenance area or more numerous the infrastructure, the more personnel and equipment the City of Reno will need. Therefore, this sub-criterion was considered "Important" within the *Operations and Maintenance* criterion. Alternatives requiring less personnel and equipment to maintain the infrastructure were given higher scores.

ENGINEERING

The design and constructability of an alternative was considered an "Important" criterion when selecting a project, since construction challenges have the potential to cause a significant increase in project costs and/or delay in schedule and could impact the feasibility of constructing the project. The engineering criterion considers the potential ease of design and construction and is evaluated by the following three sub-criteria.

1. Constructability: Ease of construction was considered "Very Important" within the *Engineering* criterion. As construction methods or needs become more complex, project duration and cost can drastically increase. Some construction complications considered were things like tunneling under freeways or railroad tracks, construction in areas with a large amount of existing utilities, demolition of large amounts of existing infrastructure, large amounts of grading that would require intensive geotechnical investigation beforehand, etc. Alternatives that had complex design and construction aspects were given lower scores.
2. Design Delay/Risk: The design process is where any investigation occurs that is needed prior to construction to develop a constructable plan set and limit risk during construction. Since the existing dam area and everything downstream has been previously disturbed, this sub-criterion was considered "Less Important" within the *Engineering* criterion. Alternatives with complex designs or a large amount of anticipated investigation were given lower scores.

3. Impact to Existing Public Facilities: Construction of new infrastructure has the possibility to impact existing public facilities (e.g., modifying existing roads, relocating existing underground or overhead utilities, modifying or removing existing public buildings, etc.) This sub-criterion was considered "Important" within the *Engineering* criterion. Alternatives with larger impacts to existing public facilities were given lower scores.
4. Regulatory Compliance: This sub-criterion takes into consideration whether or not the dam functions according to local, state, and federal regulation. This sub-criterion was considered "Critical".

PUBLIC/REGIONAL IMPACTS

With any construction project, there will be impacts to the general population. This criterion was considered "Very Important" and was evaluated using one sub-criteria.

1. Potential for Opposition: Any construction project has the potential for opposition, either by the public or a regulating agency. The larger the construction area or impacts, the more likely there is to be opposition. Therefore, this sub-criterion was considered "Critical" within the *Public/Regional Impacts* criterion. Alternatives with more potential opposition due to anticipated impacts were given lower scores.

ENVIRONMENTAL

Any construction project can have a possible impact to the surrounding environment in many ways. Those impacts can be permanent or temporary and can vary based on the size and location of a project. This criterion was considered "Critical" and was evaluated using eleven sub-criteria.

1. Land Use: If any property acquisition is required for the construction of an alternative, it may necessitate changing existing land use zoning. This is especially true if a residential or commercial property is purchased for public facility purposes. Alternatives that have a greater potential impact on changing existing land use zones were given lower scores. This sub-criterion was considered "Critical".
2. Water Resources: This sub-criterion includes potential impacts to Waters of the US (e.g., the Truckee River) and wetlands/riparian areas. Alternatives that have a greater potential impact to Waters of the US, wetlands, or riparian areas were given lower scores. This sub-criterion was considered "Critical".
3. Floodplains: This sub-criterion includes an alternative's potential impact to existing floodplains, possibly creating new floodplains that would require FEMA mapping, or the existence of existing floodplains within the project area. Any alternatives that may potentially impact existing floodplains or create new floodplains (and require FEMA mapping) were given lower scores. This sub-criterion was considered "Very Important".
4. Biological Resources: This sub-criterion includes potential impacts to fish/aquatic resources, wildlife resources, and vegetation., either within the project area or as a direct impact from construction. Any alternative that has any potential negative impacts to any of biological resources were given lower scores. This sub-criterion was considered "Critical".
5. Cultural and Historic Resources: This sub-criterion includes potential impacts to any artifacts, structures, or other historically significant items identified, which could possibly include historical viewsheds. Alternatives that have a greater possibility of negatively impacting any cultural or historic resources were given lower scores. This sub-criterion was considered "Critical".

6. Environmental Justice: This sub-criterion includes any social impacts that could possibly result from an alternative, especially to disadvantaged groups. Alternatives that had a greater possibility of having a negative effect on environmental justice were given lower scores. This sub-criterion was considered "Critical".
7. Noise: This sub-criterion includes potential impacts to residential homes, businesses, and any other inhabited building as a result of noise due to construction. No long-term noise impacts are anticipated as a result of the implementation of any of the alternatives. Alternatives that have possible noise impacts to a larger amount of surrounding buildings were given lower scores. This sub-criterion was considered "Very Important".
8. Health/Human Safety: This sub-criteria includes any potential impacts to the health and safety of any person as a result of the implementation of an alternative. For example, flooding poses a risk to the health and safety of all downstream persons within the inundation area. Alternatives that have a greater potential to negatively health and human safety were given lower scores. This sub-criterion was considered "Critical".
9. Aesthetics: This sub-criterion includes any potential impacts to the aesthetics of the existing area that could possibly be changed under any of the alternatives. Alternatives that have a greater potential for negatively impacting the aesthetics of an area were given lower scores. This sub-criterion was considered "Very Important".
10. GHG/Climate Change: This sub-criterion includes the greenhouse gases, climate change, and air quality impacts that an alternative may have. This includes both impacts during construction (e.g., equipment emissions, dust, etc.) and long-term impacts as a result of an alternative (e.g., a larger potential for dust due to less vegetation). Alternatives that have a greater possibility of negative impacts associated with GHG/climate change were given lower scores. This sub-criterion was considered "Very Important".
11. Cumulative Impacts: This sub-criterion includes the potential impact on the environment which results from the incremental actions of the past, present, and reasonably foreseeable future. Cumulative impacts include actions that are minor individually but significant collectively over a period of time. Alternatives that have a greater possibility of negative cumulative impacts over a period of time were given lower scores. This sub-criterion was considered "Very Important".

ROW REQUIREMENTS

Public construction projects may need to acquire parcels, easements, or rights-of-way for the success of the project. Depending on the scale of the acquisitions needed, project delays (permanent or temporary) may result. Therefore, this criterion was considered "Important" and evaluated using two sub-criteria.

1. Permanent Acquisitions/Legal Challenges: This sub-criterion includes any easements, rights-of-way, or complete parcel acquisitions necessary for the construction of any alternative. This sub-criterion considers both the level-of-effort of acquisition and potential legal challenges based on amount parcels/rights-of-way/easements acquired. and was considered "Critical" within the *ROW Requirements* criterion. Alternatives with a greater number of permanent acquisitions were given lower scores.

LEVEL OF FLOOD PROTECTION

The purpose of any dam is to prevent uncontrolled downstream flooding that could have negative impacts on life and property. Since this objective is paramount to the functioning of a dam, this criterion was considered "Critical" and was evaluated based four sub-criteria: Each sub-criterion was analyzed on the basis of the potential for damages and loss of life.

1. 100-Year Storm: A 100-year storm (storm event with a 1% possibility of occurring at a given location within a given year) has the least possibility for damage and potential loss of life and thus was considered "Less Important" within the *Level of Flood Protection* criterion. Alternatives that have more flooding and a higher potential for loss of life as a result of the 100-year storm were given lower scores.
2. 200-Year Storm: A 200-year storm (storm event with a 0.5% possibility of occurring at a given location within a given year) was considered "Important" within the *Level of Flood Protection* criterion. Alternatives that have more flooding and a higher potential for loss of life as a result of the 200-year storm were given lower scores.
3. 500-Year Storm: A 500-year storm (storm event with a 0.2% possibility of occurring at a given location within a given year) was considered "Very Important" within the *Level of Flood Protection* criterion. Alternatives that have more flooding and a higher potential for loss of life as a result of the 500-year storm were given lower scores.
4. PMF Event: A PMF event (probable maximum flood event) estimates the most water an area can experience as a result of a storm. When constructing or evaluating a dam (or system of dams), it is imperative to consider the effects of a PMF and to either contain the estimated volume of runoff or release it in a controlled manner through an auxiliary/emergency spillway. There is no recurrence interval or percent of possibility of this storm happening per year. Given the amount of water associated with a PMF event, this type of event has the highest possibility of flooding and loss of life. Therefore, this sub-criterion was considered "Critical" within the *Level of Flood Protection* criterion. Alternatives that have a greater potential for downstream flooding due to an uncontrolled release of water/dam breach as a result of the PMF Event were given lower scores.

SCORING MATRIX

After each criterion and sub-criterion were determined for the non-economic analysis and a weight was assigned to each criterion and sub-criterion, as discussed in the previous sections, each alternative was ranked within each criterion and sub-criterion in a scoring matrix.

Farr West Engineering, NCRS, and COR ranked the alternatives individually. A matrix from each entity is shown below. It is important to note that all weights for the criteria and sub-criteria were agreed upon and the only difference between the three matrices is the ranking for each alternative per sub-criteria.

FARR WEST ENGINEERING NON ECONOMIC EVALUATION - WEST WASH DAM							ALTERNATIVES									
Criteria			Subcriteria													
Criteria	Weight	Priority (%)	Subcriteria	Weight	Priority (%)	Matrix Weight	ALT1 NO ACTION		ALT2 DS FLOODPROOFING		ALT3 REHAB DAM		ALT4 REMOVE DAMS		REMOVE DAMS/DS FLOOD IMP	
							Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score
O & M	2.5	6.3%	Level of Effort to Maintain	5	50.0 %	3.1	4	2.5	2	1.3	5	3.1	3	1.9	2	1.3
			Need for Additional Resources	5	50.0 %	3.1	5	3.1	2	1.3	5	3.1	3	1.9	2	1.3
			Sub-total	**10**	**100.0 %**	**6.3**		**5.6**		**2.5**		**6.3**		**3.8**		**2.5**
Engineering	5	12.5%	Constructability	7.5	30.0 %	3.8	5	3.8	2	1.5	3	2.3	4	3.0	1	0.8
			Design Delay/Risk	2.5	10.0 %	1.3	5	1.3	1	0.3	4	1.0	3	0.8	2	0.5
			Impact to Existing Public Facilities	5	20.0 %	2.5	5	2.5	1	0.5	4	2.0	3	1.5	2	1.0
			Regulatory Compliance	10	40.0 %	5.0	2	2.0	5	5.0	5	5.0	1	1.0	5	5.0
			Sub-total	**25**	**100.0 %**	**12.5**		**9.5**		**7.3**		**10.3**		**6.3**		**7.3**
Public/Regional Impacts	7.5	18.8%	Potential for Opposition	10	100.0 %	18.8	5	18.8	1	3.8	4	15.0	3	11.3	2	7.5
			Sub-total	**10**	**100.0 %**	**18.8**		**18.8**		**3.8**		**15.0**		**11.3**		**7.5**
Environmental	10	25.0%	Land Use	10	10.3 %	2.6	5	2.6	2	1.0	5	2.6	3	1.5	1	0.5
			Water Resources	10	10.3 %	2.6	5	2.6	5	2.6	5	2.6	5	2.6	1	0.5
			Floodplains	7.5	7.7 %	1.9	5	1.9	1	0.4	5	1.9	5	1.9	2	0.8
			Biological Resources	10	10.3 %	2.6	5	2.6	4	2.1	1	0.5	3	1.5	2	1.0
			Cultural and Historic Resources	10	10.3 %	2.6	5	2.6	4	2.1	3	1.5	3	1.5	3	1.5
			Environmental Justice	10	10.3 %	2.6	5	2.6	1	0.5	4	2.1	3	1.5	2	1.0
			Noise	7.5	7.7 %	1.9	5	1.9	1	0.4	3	1.2	4	1.5	2	0.8
			Health/Human Safety	10	10.3 %	2.6	1	0.5	4	2.1	5	2.6	3	1.5	2	1.0
			Aesthetics	7.5	7.7 %	1.9	5	1.9	1	0.4	4	1.5	3	1.2	3	1.2
			GHG/Climate Change	7.5	7.7 %	1.9	5	1.9	1	0.4	3	1.2	4	1.5	2	0.8
			Cumulative Impacts	7.5	7.7 %	1.9	1	0.4	4	1.5	5	1.9	3	1.2	2	0.8
			Sub-total	**97.5**	**100.0 %**	**25.0**		**21.4**		**13.3**		**19.5**		**17.6**		**9.9**
ROW Requirements	5	12.5%	Permanent Acquisitions/Legal Challenges	10	100.0 %	12.5	5	12.5	1	2.5	3	7.5	5	12.5	2	5.0
			Sub-total	**10**	**100.0 %**	**12.5**		**12.5**		**2.5**		**7.5**		**12.5**		**5.0**
Level of Flood Protection	10	25.0%	100-yr Storm	2.5	10.0 %	2.5	5	2.5	5	2.5	5	2.5	1	0.5	5	2.5
			200-yr Storm	5	20.0 %	5.0	2	2.0	5	5.0	5	5.0	1	1.0	3	3.0
			500-yr Storm	7.5	30.0 %	7.5	2	3.0	5	7.5	4	6.0	1	1.5	4	6.0
			PMF Event	10	40.0 %	10.0	1	2.0	5	10.0	4	8.0	2	4.0	4	8.0
			Sub-total	**25**	**100.0 %**	**25.0**		**9.5**		**25.0**		**21.5**		**7.0**		**19.5**
Total	**40**	**100%**				**Total**		**77.3**		**54.3**		**80.0**		**58.3**		**51.6**

NRCS NON ECONOMIC EVALUATION - WEST WASH DAM							ALTERNATIVES									
Criteria			Subcriteria													
Criteria	Weight	Priority (%)	Subcriteria	Weight	Priority (%)	Matrix Weight	ALT1 NO ACTION		ALT2 DS FLOODPROOFING		ALT3 REHAB DAM		ALT4 REMOVE DAMS		REMOVE DAMS/DS FLOOD IMP	
							Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score
O & M	2.5	6.3%	Level of Effort to Maintain	5	50.0 %	3.1	3	1.9	2	1.3	4	2.5	5	3.1	3	1.9
			Need for Additional Resources	5	50.0 %	3.1	5	3.1	2	1.3	5	3.1	3	1.9	2	1.3
			Sub-total	**10**	**100.0 %**	**6.3**		**5.0**		**2.5**		**5.6**		**5.0**		**3.1**
Engineering	5	12.5%	Constructability	7.5	30.0 %	3.8	5	3.8	2	1.5	3	2.3	4	3.0	1	0.8
			Design Delay/Risk	2.5	10.0 %	1.3	5	1.3	1	0.3	3	0.8	4	1.0	2	0.5
			Impact to Existing Public Facilities	5	20.0 %	2.5	5	2.5	1	0.5	4	2.0	3	1.5	2	1.0
			Regulatory Compliance	10	40.0 %	5.0	3	3.0	3	3.0	5	5.0	3	3.0	5	5.0
			Sub-total	**25**	**100.0 %**	**12.5**		**10.5**		**5.3**		**10.0**		**8.5**		**7.3**
Public/Regional Impacts	7.5	18.8%	Potential for Opposition	10	100.0 %	18.8	5	18.8	1	3.8	4	15.0	3	11.3	2	7.5
			Sub-total	**10**	**100.0 %**	**18.8**		**18.8**		**3.8**		**15.0**		**11.3**		**7.5**
Environmental	10	25.0%	Land Use	10	10.3 %	2.6	5	2.6	2	1.0	5	2.6	3	1.5	1	0.5
			Water Resources	10	10.3 %	2.6	4	2.1	4	2.1	5	2.6	1	0.5	2	1.0
			Floodplains	7.5	7.7 %	1.9	5	1.9	1	0.4	5	1.9	5	1.9	2	0.8
			Biological Resources	10	10.3 %	2.6	5	2.6	4	2.1	1	0.5	3	1.5	2	1.0
			Cultural and Historic Resources	10	10.3 %	2.6	5	2.6	3	1.5	4	2.1	2	1.0	1	0.5
			Environmental Justice	10	10.3 %	2.6	5	2.6	2	1.0	4	2.1	2	1.0	3	1.5
			Noise	7.5	7.7 %	1.9	5	1.9	1	0.4	3	1.2	4	1.5	2	0.8
			Health/Human Safety	10	10.3 %	2.6	3	1.5	5	2.6	4	2.1	1	0.5	2	1.0
			Aesthetics	7.5	7.7 %	1.9	5	1.9	1	0.4	4	1.5	3	1.2	3	1.2
			GHG/Climate Change	7.5	7.7 %	1.9	3	1.2	5	1.9	5	1.9	1	0.4	2	0.8
			Cumulative Impacts	7.5	7.7 %	1.9	3	1.2	4	1.5	5	1.9	1	0.4	2	0.8
			Sub-total	**97.5**	**100.0 %**	**25.0**		**21.9**		**14.9**		**20.3**		**11.5**		**9.9**
ROW Requirements	5	12.5%	Permanent Acquisitions/Legal Challenges	10	100.0 %	12.5	5	12.5	1	2.5	3	7.5	5	12.5	2	5.0
			Sub-total	**10**	**100.0 %**	**12.5**		**12.5**		**2.5**		**7.5**		**12.5**		**5.0**
Level of Flood Protection	10	25.0%	100-yr Storm	2.5	10.0 %	2.5	5	2.5	5	2.5	5	2.5	1	0.5	5	2.5
			200-yr Storm	5	20.0 %	5.0	3	3.0	5	5.0	5	5.0	1	1.0	2	2.0
			500-yr Storm	7.5	30.0 %	7.5	3	4.5	5	7.5	4	6.0	1	1.5	2	3.0
			PMF Event	10	40.0 %	10.0	1	2.0	5	10.0	4	8.0	2	4.0	3	6.0
			Sub-total	**25**	**100.0 %**	**25.0**		**12.0**		**25.0**		**21.5**		**7.0**		**13.5**
Total	**40**	**100%**				**Total**		**80.7**		**53.9**		**79.9**		**55.8**		**46.2**

CITY OF RENO NON ECONOMIC EVALUATION - WEST WASH DAM							ALTERNATIVES									
Criteria			Subcriteria													
Criteria	Weight	Priority (%)	Subcriteria	Weight	Priority (%)	Matrix Weight	ALT1 NO ACTION		ALT2 DS FLOODPROOFING		ALT3 REHAB DAM		ALT4 REMOVE DAMS		REMOVE DAMS/DS FLOOD IMP	
							Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score
O & M	2.5	6.3%	Level of Effort to Maintain	5	50.0 %	3.1	4	2.5	2	1.3	5	3.1	3	1.9	2	1.3
			Need for Additional Resources	5	50.0 %	3.1	5	3.1	2	1.3	5	3.1	3	1.9	2	1.3
			Sub-total	**10**	**100.0 %**	**6.3**		**5.6**		**2.5**		**6.3**		**3.8**		**2.5**
Engineering	5	12.5%	Constructability	7.5	30.0 %	3.8	5	3.8	2	1.5	3	2.3	4	3.0	1	0.8
			Design Delay/Risk	2.5	10.0 %	1.3	5	1.3	1	0.3	4	1.0	3	0.8	2	0.5
			Impact to Existing Public Facilities	5	20.0 %	2.5	5	2.5	1	0.5	4	2.0	3	1.5	2	1.0
			Regulatory Compliance	10	40.0 %	5.0	2	2.0	5	5.0	5	5.0	1	1.0	5	5.0
			Sub-total	**25**	**100.0 %**	**12.5**		**9.5**		**7.3**		**10.3**		**6.3**		**7.3**
Public/Regional Impacts	7.5	18.8%	Potential for Opposition	10	100.0 %	18.8	5	18.8	1	3.8	4	15.0	3	11.3	2	7.5
			Sub-total	**10**	**100.0 %**	**18.8**		**18.8**		**3.8**		**15.0**		**11.3**		**7.5**
Environmental	10	25.0%	Land Use	10	10.3 %	2.6	5	2.6	2	1.0	5	2.6	3	1.5	1	0.5
			Water Resources	10	10.3 %	2.6	5	2.6	5	2.6	5	2.6	5	2.6	1	0.5
			Floodplains	7.5	7.7 %	1.9	5	1.9	1	0.4	5	1.9	5	1.9	2	0.8
			Biological Resources	10	10.3 %	2.6	5	2.6	4	2.1	1	0.5	3	1.5	2	1.0
			Cultural and Historic Resources	10	10.3 %	2.6	5	2.6	4	2.1	3	1.5	3	1.5	3	1.5
			Environmental Justice	10	10.3 %	2.6	5	2.6	1	0.5	4	2.1	3	1.5	2	1.0
			Noise	7.5	7.7 %	1.9	5	1.9	1	0.4	3	1.2	4	1.5	2	0.8
			Health/Human Safety	10	10.3 %	2.6	3	1.5	4	2.1	5	2.6	1	0.5	2	1.0
			Aesthetics	7.5	7.7 %	1.9	5	1.9	1	0.4	4	1.5	3	1.2	3	1.2
			GHG/Climate Change	7.5	7.7 %	1.9	5	1.9	1	0.4	3	1.2	4	1.5	2	0.8
			Cumulative Impacts	7.5	7.7 %	1.9	1	0.4	4	1.5	5	1.9	3	1.2	2	0.8
			Sub-total	**97.5**	**100.0 %**	**25.0**		**22.4**		**13.3**		**19.5**		**16.5**		**9.9**
ROW Requirements	5	12.5%	Permanent Acquisitions/Legal Challenges	10	100.0 %	12.5	5	12.5	1	2.5	3	7.5	5	12.5	2	5.0
			Sub-total	**10**	**100.0 %**	**12.5**		**12.5**		**2.5**		**7.5**		**12.5**		**5.0**
Level of Flood Protection	10	25.0%	100-yr Storm	2.5	10.0 %	2.5	5	2.5	5	2.5	5	2.5	1	0.5	5	2.5
			200-yr Storm	5	20.0 %	5.0	2	2.0	5	5.0	5	5.0	1	1.0	3	3.0
			500-yr Storm	7.5	30.0 %	7.5	2	3.0	5	7.5	4	6.0	1	1.5	4	6.0
			PMF Event	10	40.0 %	10.0	1	2.0	5	10.0	4	8.0	2	4.0	4	8.0
			Sub-total	**25**	**100.0 %**	**25.0**		**9.5**		**25.0**		**21.5**		**7.0**		**19.5**
Total	**40**	**100%**				**Total**		**78.3**		**54.3**		**80.0**		**57.3**		**51.6**

NEVADA NRCS – RENO STATE OFFICE
May 13, 2022

West Wash Dam
Preferred Alternatives Scoring Matrix Review and Suggestions

This letters summarizes the review comments and suggestions from the NV NRCS Watershed Team for the West Wash Dam project Evaluation Matrix Explanation and Calculations documents provided after the Preferred Alternatives Workshop held on Friday May 9th.

Evaluation Matrix Explanation

1. Criteria Weights:
    a. NRCS would like to see the weight to the Environmental criteria be increased to 10. One of the main goals of this planning process is to select an alternative that has the least impact on the environment, among other criteria, it does not seem appropriate to weigh it second to last compared to all other criteria.
    b. It is recommended the weights for Engineering and ROW Requirements criteria are lowered to 5. Although important criteria to consider when it comes to feasibility of the projects, the planning process we are following tends to put less emphasize on those types of impacts when determining an alternative.
2. Sub-Criteria Weights, NRCS would like to see the weight for Health/Human Safety sub-criteria be increased to 10. It would seem to us that, from a dam safety perspective, we would like the protection of life and property to be weighed as high as possible.

Evaluation Matrix Calcs

As we worked through the spreadsheetwe noticed that interpretation of the sub-criteria could change how an alternative is ranked, this we will include our interpretations of the criteria when appropriate.

Level of Effort to Maintain

	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
Farr West	4	2	5	3	2
NRCS	3	2	4	5	3

- Alt 4 would leave the least amount of infrastructure in place to be maintained

Design Delay/Risk

	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
Farr West	5	1	4	3	2
NRCS	5	1	3	4	2

- Investigations at the design phase for Alt 4 is likely less than Alt 3

Regulatory Compliance

	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
Farr West	2	5	5	1	5
NRCS	3	3	5	3	5

Natural Resources Conservation Service
1365 Corporate Blvd., Reno, NV 89502
Phone: (775) 857-8500 Toll Free Fax: (855) 816-0893
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- Alt 2 would still have a dam that does not meet NRCS or State Standards so would be out of compliance

Water Resources

	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
Farr West	5	5	5	5	1
NRCS	4	4	5	1	2

- This is one of those criteria's where there was discussion on how to interpret the sub-criteria. Are we concerned with discharging water to the Truckee that is poor quality due to sediment and/or overland flow over the city? Or are we looking at the potential to increase to water quantity to the Truckee which could have a positive effect on riparian areas? The ranking shown is just where we landed before we decided we likely need further conversation on this sub-criteria.

Cultural and Historic Properties

	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
Farr West	5	4	3	3	3
NRCS	5	3	4	2	1

- The State Cultural Specialist disagrees with the last three all being ranked at three as there are degrees of impact and two is not a higher ranking because of the potential impact to other historic properties in a very large area downstream.
- Alternative 1-No impacts-best for Resource=5
- Alternative 2-Dams not impacted-but potential historic properties in a larger area of historic properties downstream impacted=3
- Alternative 3-Dams slightly impacted and no adverse effects if in kind material is used=4
- Alternative 4-Dams removed-no impact below dam (This may be removed?)=2
- Alternative 5-Dams removed and larger area downstream historic properties potentially impacted=1

Environmental Justice

	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
Farr West	5	1	4	3	2
NRCS	5	2	4	2	3

- Alt 4 should be lower ranking as there would be increased flooding downstream that affects different communities and potential need for flood insurance that would have economic impacts

Health/Human Safety

	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
Farr West	1	4	5	3	2
NRCS	3	5	4	1	2

Alt 4 would have the most impact since it would provide no flood protection and Alt 2 would provide have the least impact as all property downstream would purchased.

GHG/Climate Change

	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5

Farr West	5	1	3	4	2
NRCS	3	5	5	1	2

- It seemed like Farr West focused more on the air quality aspect of this item to rank the alternatives, however for NRCS we tend to focus more on the "robustness" of alternatives to account for climate change. We ranked thinking about if there was increase in more extreme events whichalternatives would best handle that.

Cumulative Impacts

	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
Farr West	1	4	5	3	2
NRCS	3	4	5	1	2

- On this one we were not sure what cumulative effect they were considering for the ranking. We ranked thinking about the cumulative effects of continued flooding and ranked those that would reduce recurring flooding higher.

200-yr Storm

	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
Farr West	2	5	5	1	3
NRCS	3	5	5	1	2

- Alt 5 would be designed to handle the 100-yr storm however it looks like Alt 1 would handle a storm somewhere between a 100-yr and 200-yr thus it should likely rank better because it handles more of the 200-yr storm.

500-yr Storm

	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
Farr West	2	5	4	1	4
NRCS	3	5	4	1	2

- Similar to above it is our thought that since Alt 1 would handle more of the 500 yr flood it should likely rank better

PMF Event

	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
Farr West	1	5	4	2	4
NRCS	1	5	4	2	3

- Don't believe Alt 3 and Alt 5 should rank similarly as Alt 3 would be able to handle more of the PMF than Alt 5

Sincerely,

JOSE ROSADO, P.E.
State Conservation Engineer

Attachments

APPENDIX C: BASIS OF ESTIMATE

FARR WEST
ENGINEERING

BASIS OF ESTIMATE
CITY OF RENO
WEST WASH DAM REHABILITATION

Prepared For:	City of Reno
Prepared By:	Savannah Hughes, E.I., Eric Kao, P.E.
Reviewed By:	Keith Karpstein, P.E. Alex Stodtmeister, P.E.
Date:	March 2022
Subject:	Basis of Estimate for West Wash Dam Rehabilitation

1.0 PURPOSE

The City of Reno has entered into an agreement with the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). This agreement has the intention of rehabilitating West Wash Dam to meet dam safety criteria and performance standards set forth by NRCS, the City of Reno, and State of Nevada Division of Water Resources (DWR). Meeting the requirements of the NRCS Watershed Program will include the development of a physically, environmentally, socially, and economically sound improvement plan – the Supplemental Watershed Plan and Environmental Document (Plan/ED).

In a collaborative effort between the City of Reno, community members and stakeholders, NRCS, and Farr West Engineering, five project alternatives have been selected. These alternatives will undergo further development and consideration, with the intent of selecting the solution that best satisfies the NRCS requirements. This memorandum provides a Basis of Estimate for each alternative, detailing how the total costs were estimated, and provides a means of assessing these alternatives under the economic metric.

This Basis of Estimate provides a Class 4 cost estimate for five project alternatives [*AACE International Recommended Practice No. 17R-97*, 2019]. These alternatives include:

- Alternative 1 – No Action
- Alternative 2 – Flood Proofing
- Alternative 3 – Improvements to East and West Wash Dam
- Alternative 4 – Removal of East and West Wash Dam
- Alternative 5 – Removal of East and West Wash Dams for Downstream Improvements

A Class 4 cost estimate is a high-level estimate, primarily used for concept studies and feasibility analysis. Typical accuracy ranges for this level of cost estimating can range between +50/-30%. Recent supply chain shortages, inflation, and market uncertainty have been considered when assessing each estimate. The estimated construction start date of 2025 have been considered when assessing each alternative. Unit and lump sum costs are provided in 2022 values, ultimately adjusted with an effective interest rate for 2025 as described in Section 5.1 – Interest and Cost Indexing.

2.0 ESTIMATE PARAMETERS

2.1 PROJECT SCOPE DESCRIPTION

The City of Reno is the owner of the East Wash Diversion and West Wash Dam which were constructed in 1960 and 1961, respectively. Both dams are located within the Peavine Mountain Watershed project area and were originally constructed as high hazard dams using technical and financial assistance provided under the authority of the Watershed Protection and Flood Prevention Act (Public Law 83-566). The original watershed plans for these dams used an evaluated life of 50 years.

West Wash Dam in the Peavine Mountain Watershed of Washoe County, Nevada, is included in a USDA-funded rehabilitation partnership project. The dam provides protection against flooding to about 30,000 Nevadans who live and work downstream. Additionally, the dam protects downstream city roads, one state highway, and an interstate highway. Among other critical infrastructure, the dam also protects power lines and railroad tracks.

City of Reno's Drainage report provides additional background: The East Wash Diversion Dam is located at the intersection of Keystone Avenue and North McCarran Boulevard at the intersection of Township 20 North, Range 19 East, Sections 33 and 34 with Township 19 North, Range 19 East, Sections 3 and 4. Inflow to the East Wash Dam comes from 2.09 square miles of watershed on the southeast flank of Peavine Mountain. West Wash Detention Dam is located at the intersection of Wyoming and Gulling Streets at the intersection of Township 19 North, Range 19 East, Sections 3 and 4. Inflow to the West Wash Dam comes from 3.34 square miles of watershed, which includes 2.09 square miles of East Wash Dam's watershed.

The East Wash Dam has a very small detention basin and is designed to divert major flow to West Wash without significant attenuation. The watershed is primarily undeveloped Forest Service land with moderate to relatively steep slopes, abundant rock outcrops and some bare soil patches. Soils exhibit very slow infiltration rates, and ground cover consists of moderate to sparse sage brush, shrubs, and grasses. Relatively low permeability soils and rock outcrops result in high runoff.

2.2 METHODOLOGY

This estimate is built upon a previous preliminary estimate done within Farr West in September 2021. Bid items were determined collaboratively as the project team defined the alternatives. Dimensions and quantities to existing infrastructures, such as intake structures, piping, and PCC diversion chute, were primarily determined based on record documents, adapted from "USDA SCS, 1959 Plans for Construction of West Wash Dam" and "Plans for Construction of East Wash Diversion Dam, Prepared by the U.S. Department of Agriculture, 1960." Other quantities such as site grading and channel design were acquired from using AutoCAD and various H&H modeling software packages. Production rate for work, such as earthwork and BMPs, were retrieved from the Federal Highway Administration (FHWA) Production Rates spreadsheet, latest revision date of November 8, 2016, see Appendix C. Account for inflation when incorporating past bid results were factored in by using the Engineering News-Record (ENR) Construction Cost Index (CCI), see Appendix D. Other construction unit costs were derived from "Heavy Construction Costs with RSMeans data", 2019, 33rd Edition.

2.3 ESTIMATE CLASSIFICATION

This AACE Estimate classification is a Class 4.

3.0 BASIS OF ESTIMATE

3.1 DESIGN BASIS

This project is currently undergoing alternatives analysis and each alternative has been developed to approximately 10% design. A 10% design or "predesign" is typical of design efforts for the purpose of

developing design criteria, alternatives analysis, identifying potential risks, and developing a planning/conceptual level cost estimate.

Several different design and modeling software were used. AutoCAD Civil 3D was used to determine stage-storage curves, site grading, and determine areas and lengths for construction materials such as riprap and chute removals. SITES was used to model the way runoff would move through the dam system with the different alternatives. HEC-RAS was used to model the downstream impacts during a local probable maximum precipitation (PMP) event.

3.2 PLANNING BASIS

Alternate 1: No Action Taken.

- This alternative does not involve capital expenses relating to rehabilitation of the dams. Maintenance and operating expenses will remain consistent with previous years or increase at rates consistent with previous trends and market fluctuations.

Alternate 2: Flood Proofing

- This alternative involves actions related to the minimization of collateral damage resulting from a flood event. Structures that would experience over a foot of water within the inundation area, will be acquired and demolished. Structures that would experience less than a foot of water will be allocated restoration funding in the event that a flood event does occur.

Alternate 3: Improve East and West Dams.

- This alternative involves improvements to the existing dam infrastructure to increase hydraulic retention during a storm event. The solution will include mass excavation and re-sloping of the west bank of the West Wash Dam, raising the dam berm, and restoring and armoring the auxiliary spillway to design conditions.

Alternate 4: Remove East and West Wash Dams

- This alternative explores removing both dams, removing the inlet/outlet structures and piping, removing the PCC chute, backfilling the spillways and removed PCC chute, and returning the channel to pre-construction conditions.

Alternate 5: Remove East and West Wash Dams with Downstream Improvements

- This alternative explores removing both dams, removing the inlet/outlet structures and piping, removing the PCC chute, backfilling the spillways and removed PCC chute, and constructing downstream improvements. The downstream improvements consists of constructing two separate trapezoidal channels, each conveying the flows coming from the two dams, and undergoes multiple roadway crossings by use of culvert boxes. Roadway crossings include residential, collector, and arterial roads, federal highway, and railroad alignment. Eventually the two channels will converge and ultimately discharge into the Truckee River. This alternate consists of over one hundred homes and businesses to be acquired and demolished for the construction of the channels.

4.0 ACRONYMS

AC – Acre(s)

BCY – Bank Cubic Yard

CY – Cubic Yard

LCY – Loose Cubic Yard

PMP – Probable Maximum Precipitation

SF – Square Foot

SY – Square Yard

4.1 COST BASIS

4.1.1 Alternative 1

Alternative 1 maintains the status quo and therefore does not have an associated capital cost.

4.1.2 Alternative 2

Bid Item 1 - Mobilization and Demobilization - $11,110,00

Mobilization and Demobilization encapsulates the expenses associated with the contractor(s) mobilizing and demobilizing equipment, personnel, and materials to and from the project location.

- Not to exceed (NTE) 5% of the base bid;
- Contractors are often located in Reno, resulting in minimal costs;
- City of Reno jobs have historically been set to NTE of 5% for this bid item.

Due to the high cost of parcel acquisition, which is unrelated to the construction costs, Bid Item Five had been excluded from the "base bid" amount.

Bid Item 2 – Temporary Erosion and Sediment Control - $1,620,000

Temporary Erosion and Sediment Control includes best management practices (BMPs). This may include, but is not limited to, a Stormwater Pollution Prevention Plan, silt fencing, dust control, inlet protection, street sweeping, temporary construction entrances, etc.

- High bidder unit cost for 2021 Reno Consolidated Sewer Rehabilitation Phase 3 was $250/Day, equivalent to $260/Day in 2022.
- BMPs will likely require:
    - Water truck(s)
    - Silt fencing
    - Construction entrances
- Estimate $1000/Day for additional project area and earthwork because it is in a flood zone, acreage is much higher, and the project is primarily earthwork related;
- Construction Schedule Estimate, assuming five crews:
    - 430 working days of demolition, based on 3 days/house/crew
    - 440 working days of seeding, based on 2.5 AC/crew/day [FHWA, 2016]
    - 167 working days of grading, based on 1 parcel/day/crew
    - 20 days for mobilization [FHWA, 2016], 20 days for demobilization, 50 weather days, 55 holidays;
    - Total calendar days of 1,615 or 4.42 years
- Total cost of $1,613,360, rounded to $1,620,000

Bid Item 3 – Temporary Traffic Control - $1,620,000

- Estimate $1000/Day due to the large project area and potential for several blocks of construction efforts
- Construction Schedule Estimate, assuming five crews:

  - 430 working days of demolition, based on 3 days/house/crew
  - 440 working days of seeding, based on 2.5 AC/crew/day [FHWA, 2016]
  - 167 working days of grading, based on 1 parcel/day/crew
  - 20 days for mobilization [FHWA, 2016], 20 days for demobilization, 50 weather days, 55 holidays
  - Total calendar days of 1,615 or 4.42 years
- Total cost of $1,613,360, rounded to $1,620,000

Bid Item 4 – Geotechnical Testing and Inspection Services - $300,000

Geotechnical Testing and Inspection Services will be performed by a third-party sub-contractor. These efforts may include, but are not limited to, soils sampling and analysis, compaction testing, observation for SWPPP compliance, and final compliance testing.

- Assume geotechnical testing on-site for grading activities;
- Grading equal to approximately 167 working days
- Unit cost of $1,750/day based on 2022 CME rate schedule
- Total cost of $292,600 rounded to $300,000

Bid Item 5 – Parcel Acquisition - $1,534,774,000

Property acquisition involves the purchasing the properties that will realize one foot or greater of water during the local PMP breach event. The property values and purchase prices have been determined by a third-party economist.

- Single-Family Residential Parcels: 830,936 SF at $335/SF
- Multi-Family Residential Parcels: 42,019 SF at $530/SF
- Non-Residential Parcel: 33,371 SF at $225/SF
- Mixed Use Parcel: 3,198,510 SF at $370/SF
- Buildable Land: 1,478,939 SF at $15/SF

Total cost of $1,514,776,026, rounded to $1,514,780,000 provided as a lump sum.

Bid Item 6 – Structures Demolition - $44,980,000

Structures demolition and pad leveling involves demolition of the structures that would experience over one foot of water during a flood event.

- Unit price of $10/SF retrieved from Home Guide, “Cost to Demolish a House”, [Website], Retrieved from: https://homeguide.com/costs/cost-to-demolish-a-house for the Reno, Nevada area
- Total area of building for demolition of 4,497,331 SF

Total cost of $44,973,310, rounded to $44,980,000.

Bid Item 7 – Material Disposal – $25,190,000

Material disposal includes the removal of all material related to the structures being demolished.

Buildings assume:

- 4,497,331 SF of buildings for demolition

- 14-foot-tall buildings
- 30% of building spatial volume is material
- Total volume of 18,888,790 CY

Disposal assumes:

  - Based on unit costs from RSMeans Heavy Construction Costs, 33rd Annual Edition,;
  - Assumes:
    - Volume: 699,585
    - 18 CY haul truck, 15 min. wait/ld./uld., 35 MPH, cycle 20 miles – $8.30/LCY
    - Reno cost index of 91.5
  - 2019 unit cost: $7.60/LCY, adjusted to 2022 rates, unit cost: $8.50/LCY, rounded to $9.00/LCY

- Total disposal, lump sum of $169,999,110 rounded to $170,000,000.

Bid Item 8 – Revegetation – $1,010,000

Revegetation and Seeding will include materials and labor associated with revegetating disturbed project areas.

- 22 acres, based on area of disturbance from berm removal and site grading;
- $5,000/acre was the high bid for TRI Center Effluent Reservoir in 2020;
- Adjusted for inflation using ENR, the 2022 unit cost is provided at $5,500/acre
- 182 acres
- Total cost of $1,003,374, rounded to $1,010,000.

Bid Item 9 – Site Grading – $2,508,000

Site grading involves regrading of parcels that are acquired.

- 836 parcels
- Assume parcels average 5,100 – 8,000 SF
- Based on unit costs from RSMeans Heavy Construction Costs, 33rd Annual Edition,;
  - $2,800/Parcel
  - Reno cost index of 91.5
  - Adjusted for inflation using ENR, provides a unit cost of $2,880/parcel, round to $3,000
- Total cost of $2,508,000

4.1.3 Alternative 3

Bid Item 1 - Mobilization and Demobilization - $690,000

Mobilization and Demobilization encapsulates the expenses associated with the contractor(s) mobilizing and demobilizing equipment, personnel, and materials to and from the project location.

- Not to exceed (NTE) 5% of the base bid;
- Contractors are often located in Reno, resulting in minimal costs;
- City of Reno jobs have historically been set to NTE of 5% for this bid item.

Lump sum cost of $684,500, rounded to $690,000.

Bid Item 2 – Temporary Erosion and Sediment Control - $1,000,000

Temporary Erosion and Sediment Control includes best management practices (BMPs). This may include, but is not limited to, a Stormwater Pollution Prevention Plan, silt fencing, dust control, temporary construction entrances, etc.

- High bidder unit cost for 2021 Reno Consolidated Sewer Rehabilitation Phase 3 was $250/Day, equivalent to $260/Day in 2022.
- BMPs will likely require:
    - Water truck(s)
    - Silt fencing
    - Construction entrances
- Estimate $1000/Day for additional project area and earthwork because it is in a flood zone, acreage is much higher, and the project is primarily earthwork related;
- Construction Schedule Estimate:
    - Clearing and grubbing equal to 3 acres per day, approximately 8 days [FHWA, 2016].
    - Stripping equal to 700 CY/crew/day, assuming three crews for 228 days [FHWA, 2016].
    - Seeding equal to 2.5 AC/day for 9 days [FHWA, 2016]
    - Excavation and Disposal, equal to 1,200 CY/crew/day, assuming three crews for 109 days [FHWA, 2016]. Likewise for On-site cut/fill, for 24 days.
    - Slope stabilization equal to 20 SY/crew/day, assuming three crews for 194 days [FHWA, 2016].
    - Geosynthetic stabilization equal to 1 acre per day, for 2 days [FHWA, 2016].
    - Remove and replace existing utilities, 20 days.
    - Miscellaneous improvements, 20 days.
    - Before stated days are working days, convert to calendar days for 914 days.
    - 20 days for mobilization [FHWA, 2016], 20 days for demobilization, 35 weather days, 25 holidays;
    - Total calendar days equal to 998, rounded to 1,000 days.

Bid Item 3 – Protection or Replacement of "NW Reno Flood Basin Labyrinth" - $6,000

The NW Reno Basin Labyrinth is an 11-circuit Chartres-mirror labyrinth. During construction, the contractor will be responsible for the protection and preservation or replacement of the Labyrinth. Rip rap calculator and cost is estimated from Cornerstone Landscape Supply.

- Lump Sum amount: $6,000
- Materials: Approximately 40 tons of 4"-8" Rip Rap - $50/ton or $2,000
- Labor: Four laborers and a foreman - $1,000/hour
- Time: 4 hours

Bid Item 4 – Geotechnical Testing and Inspection Services - $233,000

Geotechnical Testing and Inspection Services will be performed by a third-party sub-contractor. These efforts may include, but are not limited to, soils sampling and analysis, compaction testing, observation for SWPPP compliance, and final compliance testing.

- Assume geotechnical testing on-site for grading activities;
- Excavation and grading at 1,200 CY/day [FHWA, 2016]
- Unit cost of $1,750/day based on 2022 CME rate schedule

Bid Item 5 – Clearing, Grubbing, Stripping - $286,000

Clearing involves the removal and disposal of vegetative material, including trees, shrubs, brush, limbs, etc. Grubbing involves the removal and disposal of wood or rot matter including stumps, trunks, roots, etc. Stripping involves the removal and disposal of all organic sod, topsoil, grass, and grass roots after clearing and grubbing. This item also involves the protection of trees, shrubs, and other vegetative growth and fencing which are not designated for removal.

- Disturbed area: 22 Acres
- Based on unit costs from RSMeans Heavy Construction Costs, 33rd Annual Edition
- Clearing and Grubbing land assumes the following:
    - Cut and chip light trees to 6" diameter - $5,025/AC
- Topsoil Stripping and Stockpiling assumes the following:
    - Loam or topsoil, remove and stockpile on site, 6" deep, 500' haul - $1.76/SY or $6,758/AC.
    - Assumes organic topsoil, loam, and vegetative chipping will be mixed onsite and used for revegetation (not hauled offsite for disposal)
- Total unit cost of $11,783/AC, round to $12,000/AC;
- Reno cost index of 91.5, $10,980/AC
- Adjusted for inflation using ENR, the 2022 unit cost is provided at $12,338.75. To account for cost of mixing soil for revegetation, round to $13,000/AC.
- Total cost of $286,000

Bid Item 6 – Revegetation and Seeding - $121,000

Revegetation and Seeding will include materials and labor associated with revegetating disturbed project areas.

- 22 acres, based on area of disturbance from berm removal and site grading;
- $5,000/acre was the high bid for TRI Center Effluent Reservoir in 2020;
- Adjusted for inflation using ENR, the 2022 unit cost is provided at $5,500/acre

Bid Item 7 – Excavation and Disposal- $5,665,000

- Includes the excavation and offsite disposal of cut material, not used onsite;
- Total cut to be disposed of equivalent to 393,095 BCY;
- Preliminary volume;
- Based on unit costs from RSMeans Heavy Construction Costs, 33rd Annual Edition
- Excavation of material assumes:
    - 4.5 CY bucket, 90% fill factor -$1.08/BCY (393,095 BCY)
    - Ripping, medium hard, 300 HP dozer, adverse conditions - $3.14/BCY
    - Reno cost index of 91.5
    - Adjusted for 2022 values with ENR, unit cost of $4.32/BCY for excavation, add 15% for loading onto truck, unit cost of $5.00/BCY
- Disposal of material assumes:
    - Following excavation, any material not used for fill onsite will be disposed of offsite.
    - Preliminary volume – includes a swell factor of 20%. Conservative assumption; not based on geotechnical data.
    - Based on unit costs from RSMeans Heavy Construction Costs, 33rd Annual Edition,;
    - Assumes:
        - Embankment volume: 393,095 BCY
        - Swell Volume: 471,714 LCY
        - 18 CY, 15 min. wait/ld./uld., 35 MPH, cycle 20 miles – $8.30/LCY

        - Reno cost index of 91.5
    - 2019 unit cost: $7.60/LCY, adjusted to 2022 rates, unit cost: $8.50/LCY
    - Accounting for potential dumping fee, assume $12.00/LCY
- Total excavation and disposal, lump sum of $5,660,568, rounded to $5,665,000

Bid Item 8 – On-Site Cut/Fill- $350,000

- Includes excavation of material used for fill, transport to fill location, and compaction.
- Preliminary volume – assumes material will be compacted equal to existing conditions, includes a swell factor of 20% for transport purposes;
- 28,560 BCY, 34,280 LCY;
- Based on unit costs from RSMeans Heavy Construction Costs, 33rd Annual Edition,;
- Excavation assumes:
    - 4.5 CY bucket, 90% fill factor -$1.08/BCY (43,000 BCY)
    - Ripping, medium hard, 300 HP dozer, adverse conditions - $3.14/BCY
    - Reno cost index of 91.5
    - Adjusted for 2022 values with ENR, unit cost of $4.32/BCY for excavation, add 15% for loading onto truck, unit cost of $5.00/BCY
- General fill assumes:
    - Spread fill, from stockpile with 2-1/2 C.Y. F.E. Loader with dozer 300 HP, 300' Haul, 2019 unit cost of $4.88/LCY, with Reno adjustment, $4.47/LCY
    - Adjusted for 2022 values with ENR, unit cost of $4.83/LCY
- Compaction assumes:
    - Sheepsfoot or wobbly wheel roller, 6" lifts, 2 passes, $.99/CY
    - Adjusted for 2022 values with ENR, unit cost of $1.01/CY
- Total lump sum amount equal to $343,428, round to $350,000.

Bid Item 9 – Slope Stabilization - $2,334,000

Slope Stabilization involves the materials and construction methods of slope stabilization. This could include rip rapping the slopes that are steeper than a 3:1 slope.

- Unit cost of $10/SF
- Area of 223,351 SF

Total cost of $2,333,510, rounded to $2,334,000.

Bid Item 10 – Geosynthetic Stabilization - $3,070,000

Geosynthetic Stabilization involves the materials and construction methods of surface stabilization. This will include lining the West Wash auxiliary spillway and East Wash spillway.

- Unit cost of $25/SF
- Area of 122,418 SF

Total cost of $3,060,450, rounded to $3,070,000.

Bid Item 11 – Existing Utilities - $525,000

- Power Pole Adjustment – $25,000 lump sum
- Remove and replace fiber - $100,000 lump sum

- Remove and replace 50 of 18" RCP, 250 LF of 10" VCP, and 800 LF of 30" RCP storm drain and storm structures, $350,000
- Deepen 200 LF of 12" ductile iron waterline - $50,000

Bid Item 12 - Miscellaneous Improvements - $100,000

Miscellaneous Improvements include those that do not constitute a large capital expense, but will be included in the overall improvements made for this project alternative. These include, but are not limited to:

- Sediment drain repairs:
    - Corrosion resistant coating
    - Replacement of sediment drain trash rack
- Relocating existing drain at toe of west wash dam
- Repairing principal spillway riser
- Daylighting West Wash Dam Principal Spillway downstream

Lump sum cost of $100,000.

4.1.4 Alternative 4

Bid Item 1 - Mobilization and Demobilization - $200,000

Mobilization and Demobilization encapsulates the expenses associated with the contractor(s) mobilizing and demobilizing equipment, personnel, and materials to and from the project location.

- Not to exceed (NTE) 5% of the base bid;
- Contractors are often located in Reno, resulting in minimal costs;
- City of Reno jobs have historically been set to NTE of 5% for this bid item.

Bid Item 2 – Temporary Erosion and Sediment Control - $340,000

Temporary Erosion and Sediment Control includes best management practices (BMPs). This may include, but is not limited to, a Stormwater Pollution Prevention Plan, silt fencing, dust control, temporary construction entrances, etc.

- High bidder unit cost for 2021 Reno Consolidated Sewer Rehabilitation Phase 3 was $250/Day, equivalent to $260/Day in 2022.
- BMPs will likely require:
    - Water truck(s)
    - Silt fencing
    - Construction entrances
- Estimate $1000/Day for additional project area and earthwork because it is in a flood zone, acreage is much higher, and the project is primarily earthwork related;
- Construction Schedule Estimate:
    - Typical "low" production rate for project's with more than 50,000 CY is 1,200 CY/Day [FHWA, 2016];
    - Gross earthwork is equivalent to 197,000 BCY (excavation and grading)
    - Earthwork equal to 164 working days (5 working days per week);
    - Seeding equal to 2.5 AC/day [FHWA, 2016]
    - Structure removal equal to 10 working days;

- Auxiliary efforts equal to 10 working days;
- 20 days for mobilization [FHWA, 2016], 20 days for demobilization, 10 weather days, 10 holidays;
- Total days equal to 340

Bid Item 3 – Protection or Replacement of "NW Reno Flood Basin Labyrinth" - $6,000

The NW Reno Basin Labyrinth is an 11-circuit Chartres-mirror labyrinth. During construction, the contractor will be responsible for the protection and preservation or replacement of the Labyrinth. Rip rap calculator and cost is estimated from Cornerstone Landscape Supply.

- Lump Sum amount: $6,000
- Materials: Approximately 40 tons of 4"-8" Rip Rap - $50/ton or $2,000
- Labor: Four laborers and a foreman - $1,000/hour
- Time: 4 hours

Bid Item 4 – Geotechnical Testing and Inspection Services - $65,000

Geotechnical Testing and Inspection Services will be performed by a third-party sub-contractor. These efforts may include, but are not limited to, soils sampling and analysis, compaction testing, observation for SWPPP compliance, and final compliance testing.

- Assume geotechnical testing on-site for grading activities;
- Grading equal to 43,000 CY at 1,200 CY/day;
- Unit cost of $1,750/day based on 2022 subcontractor rate schedule for TRIC Reservoir Pumping Facility construction

Bid Item 5 – Revegetation and Seeding - $66,000

Revegetation and Seeding will include materials and labor associated with revegetating disturbed project areas.

- 12 acres, based on area of disturbance from berm removal and site grading;
- $5,000/acre was the high bid for TRI Center Effluent Reservoir in 2020;
- Adjusted for inflation using ENR, the 2022 unit cost is provided at $5,500/acre

Bid Item 6 – Excavation and Disposal- $2,160,000

- Includes the excavation and offsite disposal of cut material, not used onsite;
- Total cut to be disposed of equivalent to 111,000 BCY;
- Preliminary volume;
- Based on unit costs from RSMeans Heavy Construction Costs, 33rd Annual Edition
    - Excavation of material assumes:
        - 4.5 CY bucket, 90% fill factor -$1.08/BCY (111,000 BCY)
        - Ripping, medium hard, 300 HP dozer, adverse conditions - $3.14/BCY
        - Reno cost index of 91.5
        - Adjusted for 2022 values with ENR, unit cost of $4.32/BCY for excavation, add 15% for loading onto truck, unit cost of $5.00/BCY
- Disposal of material assumes:
    - Following excavation, any material not used for fill onsite will be disposed of offsite.

  - Preliminary volume – includes a swell factor of 20%. Conservative assumption; not based on geotechnical data.
  - Based on unit costs from RSMeans Heavy Construction Costs, 33rd Annual Edition,;
  - Assumes:
    - Embankment volume: 111,000 BCY
    - Swell Volume: 133,200 LCY
    - 18 CY, 15 min. wait/ld./uld., 35 MPH, cycle 20 miles – $8.30/LCY
    - Reno cost index of 91.5
  - 2019 unit cost: $7.60/LCY, adjusted to 2022 rates, unit cost: $8.50/LCY
  - Accounting for potential dumping fee, assume $12.00/LCY
- Total excavation and disposal, lump sum of $2,153,400, rounded to $2,160,000

Bid Item 7 – On-Site Cut/Fill- $520,000

- Includes excavation of material used for fill, transport to fill location, and compaction.
- Preliminary volume – assumes material will be compacted equal to existing conditions, includes a swell factor of 20% for transport purposes;
- 43,000 BCY, 51,600 LCY;
- Based on unit costs from RSMeans Heavy Construction Costs, 33rd Annual Edition,;
- Excavation assumes:
  - 4.5 CY bucket, 90% fill factor -$1.08/BCY (43,000 BCY)
  - Ripping, medium hard, 300 HP dozer, adverse conditions - $3.14/BCY
  - Reno cost index of 91.5
  - Adjusted for 2022 values with ENR, unit cost of $4.32/BCY for excavation, add 15% for loading onto truck, unit cost of $5.00/BCY
- General fill assumes:
  - Spread fill, from stockpile with 2-1/2 C.Y. F.E. Loader with dozer 300 HP, 300’ Haul, 2019 unit cost of $4.88/LCY, with Reno adjustment, $4.47/LCY
  - Adjusted for 2022 values with ENR, unit cost of $4.83/LCY
- Compaction assumes:
  - Sheepsfoot or wobbly wheel roller, 6” lifts, 2 passes, $.99/CY
  - Adjusted for 2022 values with ENR, unit cost of $1.01/CY
- Total lump sum amount equal to $516,344, round to $520,000

Bid Item 8 – East Wash Dam 4’x3’x28’ Intake Structure Removal - $10,000

Removal of the East Wash Dam Intake Structure will include demolition and waste disposal.

- Dimensions obtained from Plans for Construction of East Wash Diversion Dam, Prepared by the U.S. Department of Agriculture, 1960
- Assume the following:
  - Four-man crew with one foreman at $1,000/hour;
  - 5 hours of work;
  - One 18 CY haul truck for disposal and one excavator;

Bid Item 9 - West Wash Dam Principal Spillway Inlet Removal - $10,000

Removal of the West Wash Dam Principal Spillway Inlet will include demolition and waste disposal.

- Dimensions obtained from USDA SCS, 1959 Plans for Construction of West Wash Dam
- Assume the following:

  - Four-man crew with one foreman at $1,000/hour;
  - 5 hours of work;
  - Two haul trucks for disposal and one excavator;

Bid Item 10 - West Wash Dam Sediment Pool Drain Removal - $2,000

Removal of the West Wash Dam Sediment Pool Drain will include both demolition and waste disposal.

- Dimensions obtained from USDA SCS, 1959 Plans for Construction of West Wash Dam
- Assume the following:
  - Four-man crew with one foreman at $1,000/hour;
  - 1 hour of work;
  - Disposal is minimal due to size

Bid Item 11 - West Wash Dam Spillway Energy Dissipator Outlet Removal - $5,000

Removal of the West Wash Dam Spillway Energy Dissipator Outlet will include both demolition and waste disposal.

- Dimensions obtained from USDA SCS, 1959 Plans for Construction of West Wash Dam
- Assume the following:
  - Four-man crew with one foreman at $1,000/hour;
  - 3 hours of work;
  - 1 haul truck and 1 excavator;

Bid Item 12 - PCC Chute Removal - $40,000

Removal of the East Wash PCC Chute will include demolition, loading haul trucks, and hauling for disposal.

- Dimensions obtained from Plans for Construction of East Wash Diversion Dam, Prepared by the U.S. Department of Agriculture, 1960
- Based on unit costs from RSMeans Heavy Construction Costs, 33rd Annual Edition;
- Assume the following for demolition:
  - 330 feet long, 15 feet wide, max 18 foot walls, 8” mesh reinforced concrete;
  - Total area of concrete approximately 1870 SY
  - Unit cost of 6” mesh reinforced concrete from RSMeans (thickest available) is $17.55/SY
  - Reno cost index of 91.5
  - 2019 unit cost: $16.05/SY, adjusted to 2022 rates with ENR, unit cost: $18.00/SY for demolition
- Assume the following for loading:
  - 4.5 CY bucket, 90% fill factor -$1.08/CY (630 CY)
  - Excavator dumps bucket into haul truck to dispose of offsite
  - Reno cost index of 91.5
  - 2019 unit cost of $1.00/CY, adjusted to 2022 rates with the ENR, unit cost: $1.12/CY for loading
- Assume the following for hauling:
  - 18 CY, 15 min. wait/ld./uld., 35 MPH, cycle 20 miles – $8.30/CY
  - Reno cost index of 91.5

  - 2019 unit cost of $7.60/CY, adjusted to 2022 rates with the ENR, unit cost: $8.50/CY for loading
- Total lump sum amount of $39,720, rounded to $40,000

Bid Item 13 - East Wash Dam 36" RC Pipe Abandonment in Place - $15,000

- Dimensions obtained from Plans for Construction of East Wash Diversion Dam, Prepared by the U.S. Department of Agriculture, 1960
- Approximately 173 feet;
- Unit cost based on TRI Effluent Reservoir 2020 high bidder of $30/LF for 16" pipe
- Increase by factor of 2.25 for 36" pipe, $67.50/LF
- Unit cost of $74.30 when adjusted to 2022 rated with ENR – round to $75/LF

Bid Item 14 - West Wash Dam 24" RC Pipe Abandon in Place - $15,000

- Dimensions obtained from USDA SCS, 1959 Plans for Construction of West Wash Dam;
- Approximately 300 feet;
- Unit cost based on TRI Effluent Reservoir 2020 high bidder of $30/LF for 16" pipe
- Increase by factor of 1.5 for 24" pipe, $45/LF
- Unit cost of $49.53 when adjusted to 2022 rated with ENR – round to $50/LF

Bid Item 15 - West Wash Dam 18" RC Pipe Abandon in Place - $2,400

- Dimensions obtained from USDA SCS, 1959 Plans for Construction of West Wash Dam;
- Approximately 60 feet;
- Unit cost based on TRI Effluent Reservoir 2020 high bidder of $30/LF for 16" pipe
- Increase by factor of 1.125 for 18" pipe, $33.75/LF
- Unit cost of $37.15 when adjusted to 2022 rated with ENR – round to $40/LF

4.1.5 Alternative 5

Alternative 5 includes the removal of the two dams, as well as downstream improvements. Bid items 3 through 15 for Alternative 4 are the same bid items 4 through 16 in Alternative 5. Subsequent bid items are unique to Alternative 5, relating to downstream improvements.

Bid Item 1 – Mobilization and Demobilization - $1,800,000

Mobilization and Demobilization encapsulates the expenses associated with the contractor(s) mobilizing and demobilizing equipment, personnel, and materials to and from the project location.

- Not to exceed (NTE) 5% of base bid;
- Contractors are often located in Reno, resulting in minimal costs;
- City of Reno jobs have historically been set to NTE of 5% for this bid item.
- Total cost of $1,750,962 rounded to $1,800,000

Bid Item 2 – Temporary Erosion and Sediment Control - $983,000

Temporary Erosion and Sediment Control includes best management practices (BMPs). This may include, but is not limited to, a Stormwater Pollution Prevention Plan, silt fencing, dust control, inlet protection, street sweeping, temporary construction entrances, etc.

- BMPs will likely require:
    - Water trucks
    - Graveling of storage and staging areas
    - Dust palliatives
    - Street sweeping
    - Sediment-concrete washout exit station
    - Coir log
    - Silt fencing
    - Temporary construction entrances
- Estimated $1000/Day because it is in a flood zone for Alternative 4 area, property demolition in residential neighborhood, and the project is primarily earthwork related;
- Construction schedule estimate based on Production Rates spreadsheet retrieved from FHWA [FHWA, 2016], see Appendix C:
    - Clearing and grubbing equal to 3 acres per day, 8 days
    - Stripping equal to 700 CY/crew/day, assuming three crews for 228 days
    - Seeding equal to 2.5 AC/day for 9 days
    - Excavation & disposal, equal to 1,200 CY/crew/day, assuming three crews for 186 days
        - Refer to Alternative 4 Bid Item 2 for excavation and disposal of 109 days
        - Downstream improvement excavation and disposal, 77 days
            - Gross earthwork was 92,186 BCY
                - Determined volume of excavation based on channel length and cross-sectional area (include assumed 4" thickness to cement-lining)
                - Determined volume of excavation based on culvert length and cross-sectional area (including assumed 12" thickness to perimeter of boxes)
    - On-site cut and fill, equal to 1,200 CY/crew/day, assuming three crews for 24 days
    - Slope stabilization equal to 20 SY/crew/day, assuming three crews for 194 days
    - Geosynthetic stabilization equal to 1 acre per day, for two days
    - Remove and replace existing utilities, 20 days
    - Miscellaneous improvements, 20 days
    - Property demolition, 158 days
        - 158 parcels for demolition
        - 1 day per parcel
    - Mobilization, 20 days
        - Major Earthwork – High Production Rate of 20 days
    - Demobilization, 20 days
        - Match with Mobilization
    - Survey and Staking, 23 days
        - Slope, reference and clearing stakes – Average Production Rate of 800 LF/Day
        - Total length of channel alignments (including culvert), 18,245 LF
        - Total days equal to 22.8 days, rounded up to 23 days
    - Erosion Control, 11 days
        - Silt fence/Wattles – High Production Rate of 1,700 LF/Day
        - Total length of channel alignments (including culvert), 18,245 LF
        - Total days equal to 10.3 days, rounded up to 11 days
    - Weather days, 35 days
    - Holidays, 25 days
    - Total working days equal to 983

Bid Item 3 – Temporary Traffic Control - $1,490,000

- Based on City of Reno's 2021 Sewer and Street Rehabilitation Project, average bid price to traffic control was 4.92% of the base bid
- This item applies subtotal of downstream improvements, i.e. items not in conjunction with Alternative 4, due to this portion of work affecting residential, collector, and arterial roadways
- Total cost was $1,485,840, rounded up to $1,490,000

Bid Items 4 – 16

Refer to Alternative 4 Bid Items 3 – 15.

Bid Item 17 – West Wash Trapezoidal Channel - $1,810,000

- Earthwork unit price was $36/LF
    - Earthwork unit price was $12/CY
        - See Alternative 4 Bid Item 6 for excavation and disposal cost
    - Cross-sectional area was 81.00 SF
        - Assumed 4" cement-lining thickness
        - Bottom width: 5'
        - Total depth: 5.04'
        - Side slope of 2:1 (H:V)
        - Top Width: 25.16'
    - Determined price per linear foot by multiplying earthwork unit price ($/CY) with cross-sectional area (SF)

- Concrete lining unit price was $314/LF
    - 2022 price per area was $11.41/SF
        - 2018 Lyon County Cardelli Drainage Ditch Modifications (Project #1426)
        - Average bid unit price was $765/CY
        - 4" cement-lining thickness design
        - 2018 price per area was $10/SF
        - Compounding inflation from 2018 to 2022: 14.1%
            - From ENR CCI spreadsheet, Appendix D
            - '18-'19: 3.0%, '19-'20: 1.7%, '20-'21: 2.1%, '21-'22: 7.3%
    - Channel width was 27.54'
        - Bottom width: 5'
        - Side wall width: 11.27' (per side)
    - Determined price per linear foot by multiplying 2022 price per area with channel width
- Total channel unit price was $350/LF
    - Summed earthwork unit price with concrete lining unit price
- Total channel price was $1,806,435, rounded up to $1,810,000

Bid Item 18 – East Wash Trapezoidal Channel - $2,230,000

- Earthwork unit price was $39/LF
    - Earthwork unit price was $12/CY
        - See Bid Item 6 for excavation and disposal cost
    - Cross-sectional area was 87.76 SF

        - Assumed 4" cement-lining thickness
        - Bottom width: 5'
        - Total depth: 5.30'
        - Side slope of 2:1 (H:V)
        - Top Width: 26.18'
    - Determined price per linear foot by multiplying earthwork unit price ($/CY) with cross-sectional area (SF)
- Concrete lining unit price was $327/LF
    - 2022 price per area was $11.41/SF
        - See Bid Item 17 on 2018 Lyon County project
    - Channel Width was 28.68'
        - Bottom width: 5'
        - Side wall width: 11.84' (per side)
    - Determined price per linear foot by multiplying 2022 price per area with channel width
- Total channel unit price was $366/LF
    - Summed earthwork unit price with concrete lining unit price
- Total channel price was $2,223,607, rounded up to $2,230,000

Bid Item 19 – Combined Trapezoidal Channel - $2,590,000

- Earthwork unit price was $60/LF
    - Earthwork unit price was $12/CY
        - See Bid Item 6 for excavation and disposal cost
    - Cross-sectional area was 134.32 SF
        - Assumed 4" cement-lining thickness
        - Bottom width: 5'
        - Total depth: 6.85'
        - Side slope of 2:1 (H:V)
        - Top Width: 32.40'
    - Determined price per linear foot by multiplying earthwork unit price ($/CY) with cross-sectional area (SF)
- Concrete lining unit price was $406/LF
    - 2022 price per area was $11.41/SF
        - See Bid Item 17 on 2018 Lyon County project
    - Channel width was 35.63'
        - Bottom width: 5'
        - Side wall width: 15.32' (per side)
    - Determined price per linear foot by multiplying 2022 price per area with channel width
- Total channel unit price was $466/LF
    - Summed earthwork unit price with concrete lining unit price
- Total channel price was $2,587,761, rounded up to $2,590,000

Bid Item 20 – 10'x8' Box Culvert Crossing on Local Roads - $3,520,000

- The level of estimate to determine the cost for each individual culvert crossings was not necessary due to the project's maturity, therefore grouping the crossings based on the general road hierarchy and road widths deemed the most suitable type of categorization:
    - Local road width was 40'

        - Any culvert crossings with road widths between 30'-50'
        - Average road width for local road crossings was 43.5'
        - Median road width for local road crossings was 40'
        - 10'x8' culvert crossings on local road
            - West Wash Crossings
                - Putnam Drive (40-foot road width)
                - McDonald Drive (50-foot road width)
            - East Wash Crossings
                - Van Ness Avenue (50-foot road width)
                - Peavine Road (50-foot road width)
                - Putnam Drive (50-foot road width)
                - Penrose Drive (40-foot road width)
                - Coleman Drive (40-foot road width)
                - Anson Drive (30-foot road width)
                - Wesley Drive (40-foot road width)
                - Butte Place (40-foot road width)
        - 12'x9' culvert crossings on local road
            - Combined Crossings
                - Whitaker Drive (50-foot road width)
                - University Terrace (60-foot road width)
                - Jones Street (40-foot road width)
                - Riverside Drive (30-foot road width)
    - Collector road width was 60'
        - Any culvert crossings with road widths between 50'-80'
        - Average road width for collector road crossings was 58'
        - Median road width for collector road crossings was 60'
        - 12'x9' culvert crossings on collector road
            - Kings Row (60-foot road width)
            - Keystone Avenue (60-foot road width)
            - West 7th Street (50-foot road width)
            - West 2nd Street (60-foot road width)
            - West 1st Street (60-foot road width)
    - Arterial road width was 100'
        - Any culvert crossings with road widths between 80'-120'
        - Average road width for arterial road crossings was 100'
        - Median road width for arterial road crossings was 100'
        - 12'x9' culvert crossings on arterial road
            - West 6th Street (100-foot road width)
            - West 5th Street (80-foot road width)
            - West 4th Street (120-foot road width)

- 10'x8' Culvert unit price was $304,754/EA
    - Culvert material price was $2,073/LF
        - 2019 M CON Products Price List Catalog, see Appendix E
            - $6,120/m/row for 10'x8' culvert box
        - Compounding inflation from 2019 to 2022: 11.1%
            - From ENR Costs data
            - '19-'20: 1.7%, '20-'21: 2.1%, '21-'22: 7.3%
        - Converted from unit meter to unit linear feet, and then applied compounding inflation rate to culvert price

  - O&P cost was $467/LF
    - From RSMeans Cost Data
    - O&P cost was $510/LF
    - Reno cost index was 91.5
    - Applied cost index to O&P cost
  - H&H modeled for 3 rows of culverts
  - Determined unit price per each crossing by adding the culvert material price with O&P cost, multiplying by number of rows, and respective road width
- Earthwork unit price was $6,400/EA
  - Earthwork unit price was $12/CY
    - See Alternative 4 Bid Item 6 for excavation and disposal cost
  - Cross-sectional area was 120 SF
    - Assumed 12" perimeter thickness
    - Outer dimension was 12'x10'
  - H&H modeled for 3 rows of culverts
  - Determined price per each crossing by multiplying earthwork unit price ($/CY) with cross-sectional area (SF) and number of rows, and multiplying with respective road width
- Pavement unit price was $30,709/EA
  - Pavement price was $28.43/SF
    - From 2021 City of Reno Sewer and Road Rehabilitation Project (#1792)
      - Average pavement bid unit price for 4" thick pavement was $26.50/SF
    - Inflation from 2021 to 2022: 7.3%
      - From ENR Cost Data
      - '21-'22: 7.3%
    - Applied inflation rate to pavement price
  - Pavement width for local street classification was 30'
    - From City of Reno Standard Details R-101A & R-101B, see Appendix F
      - Half street width for local street classification was 17.5'
      - Removed 2.5' from half street width to exclude the curb & gutter and isolate lane width
    - Determined pavement width by multiplying lane width of 15' by 2 to account for the two lanes of a local street
  - Pavement length was 36'
    - Added the outer widths to the row of the three 10'x8' culvert boxes
  - Determined price per each crossing by multiplying the pavement price to the pavement's width and length

- Sidewalk unit price was $3,631/EA
  - Sidewalk price was $12.61/SF
    - From 2021 City of Reno Sewer and Road Rehabilitation Project (#1792)
      - Average sidewalk bid unit price was $11.75/SF
    - Inflation from 2021 to 2022: 7.3%
      - From ENR Cost Data
      - '21-'22: 7.3%
    - Applied inflation rate to sidewalk price
  - Sidewalk width was 4'
    - From City of Reno Standard Details R-104A, see Appendix F
      - 4' minimum for residential streets

  - Sidewalk length was 36'
    - Added outer widths to the row of the three 10'x8' culvert boxes
  - Determined price per each crossing by multiplying the sidewalk price to the sidewalk's width and length and lastly multiplying by 2 for sidewalks located on both sides of the road

- Curb & gutter unit price was $3,863/EA
  - Curb & gutter price was $53.65/LF
    - From 2021 City of Reno Sewer and Road Rehabilitation Project (#1792)
      - Average curb & gutter bid unit price was $50.00/SF
    - Inflation from 2021 to 2022: 7.3%
      - From ENR Cost Data
      - '21-'22: 7.3%
    - Applied inflation rate to curb & gutter price
  - Curb & gutter length was 36'
    - Added outer widths to the row of the three 10'x8' culvert boxes
  - Determined price per each crossing by multiplying the curb & gutter price to the curb & gutter's length and lastly multiplying by 2 for curb & gutter located on both sides of the road

- Guardrail unit price was $2,096/EA
  - Guardrail was $29.11/LF
    - From 2016 Town of Weston Guardrail Overview Report
      - Cost for cable guardrail described a range between $24 to $28 per LF
      - Choose $24/LF due to the report's location in Massachusetts
    - Compounding inflation from 2016 to 2022: 21.3%
      - From ENR Cost Data
      - '16-'17: 4.0%, '17-'18: 3.2%, '18-'19: 3.0%, '19-'20: 1.7%, '20-'21: 2.1%, '21-'22: 7.3%
    - Applied inflation rate to guardrail price
  - Guardrail length was 36'
    - Added outer widths to the row of the three 10'x8' culvert boxes
  - Determined price per each crossing by multiplying the guardrail price to the guardrail's length and lastly multiplying by 2 for guardrails located on both sides of the road

- 10'x8' Box Culvert Crossing on Local Roads unit price was $351,453/EA
  - Determined price per each crossing by adding the aforementioned components:
    - Culvert unit price
    - Earthwork unit price
    - Pavement unit price
    - Sidewalk unit price
    - Curb & gutter unit price
    - Guardrail unit price

- Total culvert price was $3,514,528, rounded up to $3,520,000

Bid Item 21 – 12'x9' Box Culvert Crossing on Local Roads - $2,720,000

- 12'x9' Culvert unit price was $604,825/EA
  - Culvert material price was $3,012/LF
    - Extrapolated from 2019 M CON Products Price List Catalog
      - Percent difference of 38.5% with matching height from catalog
        - $5,539/m/row for 10'x6' culvert box
        - $3,750/m/row for 8'x6' culvert box
      - Percent difference of 5.0% with matching width from catalog
        - $6,120/m/row for 10'x8' culvert box
        - $5,828/m/row for 10'x7' culvert box
      - Extrapolated 10'x8' culvert into 10'x9' for $6,418
        - Multiplied $6,120 by 5.0%
      - Extrapolated 10'x9' culvert into 12'x9' for $8,891
        - Multiplied $6,418 by 38.5%
    - Compounding inflation from 2019 to 2022: 11.1%
      - From ENR Costs data
      - '19-'20: 1.7%, '20-'21: 2.1%, '21-'22: 7.3%
    - Converted from unit meter to unit linear feet, and applied Compounding inflation rate to culvert material price
  - O&P cost was $769/LF
    - From RSMeans Cost Data
    - O&P cost was $840/LF
    - Reno cost index was 91.5
    - Applied cost index to O&P cost
  - H&H modeled for 4 rows of culverts
  - Determined unit price per each crossing by adding the culvert material price with O&P cost, multiplying by number of rows and respective road width

- Earthwork unit price was $10,951/EA
  - Earthwork unit price was $12/CY
    - See Bid Item 6 for excavation and disposal cost
  - Cross-sectional area was 154 SF
    - Assumed 12" perimeter thickness
    - Outer dimension was 14'x11'
  - H&H modeled for 4 rows of culverts
  - Determined price per each crossing by multiplying earthwork unit price ($/CY) with cross-sectional area (SF) and number of rows, and multiplying with respective road width

- Pavement unit price was $47,770/EA
  - Pavement price was $28.43/SF
    - From 2021 City of Reno Sewer and Road Rehabilitation Project (#1792)
      - Average pavement bid unit price for 4" thick pavement was $26.50/SF
    - Inflation from 2021 to 2022: 7.3%
      - From ENR Cost Data
      - '21-'22: 7.3%
    - Applied inflation rate to pavement price
  - Pavement width for local street classification was 30'

        - From City of Reno Standard Details R-101A & R-101B
            - Half street width for local street classification was 17.5'
            - Removed 2.5' from half street width to exclude the curb & gutter and isolate lane width
        - Determined pavement width by multiplying lane width of 15' by 2 to account for the two lanes of a local street
    - Pavement length was 56'
        - Added the outer widths to the row of the four 12'x9' culvert boxes
    - Determined price per each crossing by multiplying the pavement price to the pavement's width and length

- Sidewalk unit price was $5,648/EA
    - Sidewalk price was $12.61/SF
        - From 2021 City of Reno Sewer and Road Rehabilitation Project (#1792)
            - Average sidewalk bid unit price was $11.75/SF
        - Inflation from 2021 to 2022: 7.3%
            - From ENR Cost Data
            - '21-'22: 7.3%
        - Applied inflation rate to sidewalk price
    - Sidewalk width was 4'
        - From City of Reno Standard Details R-104A
            - 4' minimum for residential streets
    - Sidewalk length was 56'
        - Added outer widths to the row of the four 12'x9' culvert boxes
    - Determined price per each crossing by multiplying the sidewalk price to the sidewalk's width and length and lastly multiplying by 2 for sidewalks located on both sides of the road

- Curb & gutter unit price was $6,009/EA
    - Curb & gutter price was $53.65/LF
        - From 2021 City of Reno Sewer and Road Rehabilitation Project (#1792)
            - Average curb & gutter bid unit price was $50.00/SF
        - Inflation from 2021 to 2022: 7.3%
            - From ENR Cost Data
            - '21-'22: 7.3%
        - Applied inflation rate to curb & gutter price
    - Curb & gutter length was 56'
        - Added outer widths to the row of the four 12'x9' culvert boxes
    - Determined price per each crossing by multiplying the curb & gutter price to the curb & gutter's length and lastly multiplying by 2 for curb & gutter located on both sides of the road

- Guardrail unit price was $3,260/EA
    - Guardrail was $29.11/LF
        - From 2016 Town of Weston Guardrail Overview Report
            - Cost for cable guardrail described a range between $24 to $28 per LF
            - Choose $24/LF due to the report's location in Massachusetts
        - Compounding inflation from 2016 to 2022: 21.3%
            - From ENR Cost Data

- ’16-’17: 4.0%, ’17-’18: 3.2%, ’18-’19: 3.0%, ’19-’20: 1.7%, ’20-’21: 2.1%, ’21-’22: 7.3%
- Applied inflation rate to guardrail price
- Guardrail length was 56’
  - Added outer widths to the row of the four 12’x9’ culvert boxes
- Determined price per each crossing by multiplying the guardrail price to the guardrail’s length and lastly multiplying by 2 for guardrails located on both sides of the road

- 12’x9’ Box Culvert Crossing on Local Roads unit price was $678,463/EA
  - Determined price per each crossing by adding the aforementioned components:
    - Culvert unit price
    - Earthwork unit price
    - Pavement unit price
    - Sidewalk unit price
    - Curb & gutter unit price
    - Guardrail unit price

- Total culvert price was $2,713,854, rounded up to $2,720,000

<u>Bid Item 22 – Culvert Crossing on Collector Roads - $4,980,000</u>

- 12’x9’ Culvert unit price was $907,237/EA
  - Culvert material price was $3,012/LF
    - Extrapolated from 2019 M CON Products Price List Catalog
      - Percent difference of 38.5% with matching height
        - $5,539/m/row for 10’x6’ culvert box
        - $3,750/m/row for 8’x6’ culvert box
      - Percent difference of 5.0% with matching width
        - $6,120/m/row for 10’x8’ culvert box
        - $5,828/m/row for 10’x7’ culvert box
      - Extrapolated 10’x8’ culvert into 10’x9’ for $6,418
        - Multiplied $6,120 by 5.0%
      - Extrapolated 10’x9’ culvert into 12’x9’ for $8,891
        - Multiplied $6,418 by 38.5%
    - Compounding inflation from 2019 to 2022: 11.1%
      - From ENR Costs data
      - ’19-’20: 1.7%, ’20-’21: 2.1%, ’21-’22: 7.3%
    - Converted from unit meter to unit linear feet, and applied compounding inflation rate to culvert price
  - O&P cost was $769/LF
    - From RSMeans Cost Data
    - O&P cost was $840/LF
    - Reno cost index was 91.5
    - Applied cost index to O&P cost
  - H&H modeled for 4 rows of culverts
  - Determined unit price per each crossing by adding the culvert material price with O&P cost, multiplying by number of rows and respective road width

- Earthwork unit price was $16,427/EA

  - Earthwork unit price was $12/CY
    - See Alternative 4 Bid Item 6 for excavation and disposal cost
  - Cross-sectional area was 154 SF
    - Assumed 12" perimeter thickness
    - Outer dimension was 14'x11'
  - H&H modeled for 4 rows of culverts
  - Determined price per each crossing by multiplying earthwork unit price ($/CY) with cross-sectional area (SF) and number of rows, and multiplying with respective road width

- Pavement unit price was $54,139/EA
  - Pavement price was $28.43/SF
    - From 2021 City of Reno Sewer and Road Rehabilitation Project (#1792)
      - Average pavement bid unit price for 4" thick pavement was $26.50/SF
    - Inflation from 2021 to 2022: 7.3%
      - From ENR Cost Data
      - '21-'22: 7.3%
    - Applied inflation rate to pavement price
  - Pavement width for collector street classification was 34'
    - From City of Reno Standard Details R-101A & R-101B
      - Half street width for collector street classification was 19.5'
      - Removed 2.5' from half street width to exclude the curb & gutter and isolate lane width
    - Determined pavement width by multiplying lane width of 17' by 2 to account for the other side of the collector street
  - Pavement length was 56'
    - Added the outer widths to the row of the four 12'x9' culvert boxes
  - Determined price per each crossing by multiplying the pavement price to the pavement's width and length

- Sidewalk unit price was $8,472/EA
  - Sidewalk price was $12.61/SF
    - From 2021 City of Reno Sewer and Road Rehabilitation Project (#1792)
      - Average sidewalk bid unit price was $11.75/SF
    - Inflation from 2021 to 2022: 7.3%
      - From ENR Cost Data
      - '21-'22: 7.3%
    - Applied inflation rate to sidewalk price
  - Sidewalk width was 6'
    - From City of Reno Standard Details R-104A
      - 6' minimum for collector and arterial streets
  - Sidewalk length was 56'
    - Added outer widths to the row of the four 12'x9' culvert boxes
  - Determined price per each crossing by multiplying the sidewalk price to the sidewalk's width and length and lastly multiplying by 2 for sidewalks located on both sides of the road

- Curb & gutter unit price was $6,009/EA
  - Curb & gutter price was $53.65/LF

        - From 2021 City of Reno Sewer and Road Rehabilitation Project (#1792)
            - Average curb & gutter bid unit price was $50.00/SF
        - Inflation from 2021 to 2022: 7.3%
            - From ENR Cost Data
            - '21-'22: 7.3%
        - Applied inflation rate to curb & gutter price
    - Curb & gutter length was 56'
        - Added outer widths to the row of the four 12'x9' culvert boxes
    - Determined price per each crossing by multiplying the curb & gutter price to the curb & gutter's length and lastly multiplying by 2 for curb & gutter located on both sides of the road

- Guardrail unit price was $3,260/EA
    - Guardrail was $29.11/LF
        - From 2016 Town of Weston Guardrail Overview Report
            - Cost for cable guardrail described a range between $24 to $28 per LF
            - Choose $24/LF due to the report's location in Massachusetts
        - Compounding inflation from 2016 to 2022: 21.3%
            - From ENR Cost Data
            - '16-'17: 4.0%, '17-'18: 3.2%, '18-'19: 3.0%, '19-'20: 1.7%, '20-'21: 2.1%, '21-'22: 7.3%
        - Applied inflation rate to guardrail price
    - Guardrail length was 56'
        - Added outer widths to the row of the four 12'x9' culvert boxes
    - Determined price per each crossing by multiplying the guardrail price to the guardrail's length and lastly multiplying by 2 for guardrails located on both sides of the road

- Culvert Crossing on Collector Roads unit price was $995,545/EA
    - Determined price per each crossing by adding the aforementioned components:
        - Culvert unit price
        - Earthwork unit price
        - Pavement unit price
        - Sidewalk unit price
        - Curb & gutter unit price
        - Guardrail unit price

- Total culvert price was $4,977,725, rounded up to $4,980,000

<u>Bid Item 23 – Culvert Crossing on Arterial Roads - $4,980,000</u>

- 12'x9' Culvert unit price was $1,512,062/EA
    - Culvert material price was $3,012/LF
        - Extrapolated from 2019 M CON Products Price List Catalog
            - Percent difference of 38.5% with matching height
                - $5,539/m/row for 10'x6' culvert box
                - $3,750/m/row for 8'x6' culvert box
            - Percent difference of 5.0% with matching width
                - $6,120/m/row for 10'x8' culvert box

        - $5,828/m/row for 10'x7' culvert box
      - Extrapolated 10'x8' culvert into 10'x9' for $6,418
        - Multiplied $6,120 by 5.0%
      - Extrapolated 10'x9' culvert into 12'x9' for $8,891
        - Multiplied $6,418 by 38.5%
    - Compounding inflation from 2019 to 2022: 11.1%
      - From ENR Costs data
      - '19-'20: 1.7%, '20-'21: 2.1%, '21-'22: 7.3%
    - Converted from unit meter to unit linear feet, and applied compounding inflation rate to culvert price
  - O&P cost was $769/LF
    - From RSMeans Cost Data
    - O&P cost was $840/LF
    - Reno cost index was 91.5
    - Applied cost index to O&P cost
  - H&H modeled for 4 rows of culverts
  - Determined unit price per each crossing by adding the culvert material price with O&P cost, multiplying by number of rows and respective road width

- Earthwork unit price was $27,378/EA
  - Earthwork unit price was $12/CY
    - See Alternative 4 Bid Item 6 for excavation and disposal cost
  - Cross-sectional area was 154 SF
    - Assumed 12" perimeter thickness
    - Outer dimension was 14'x11'
  - H&H modeled for 4 rows of culverts
  - Determined price per each crossing by multiplying earthwork unit price ($/CY) with cross-sectional area (SF) and number of rows, and multiplying with respective road width

- Pavement unit price was $101,909/EA
  - Pavement price was $28.43/SF
    - From 2021 City of Reno Sewer and Road Rehabilitation Project (#1792)
      - Average pavement bid unit price for 4" thick pavement was $26.50/SF
    - Inflation from 2021 to 2022: 7.3%
      - From ENR Cost Data
      - '21-'22: 7.3%
    - Applied inflation rate to pavement price
  - Pavement width for arterial street classification was 64'
    - From City of Reno Standard Details R-101A & R-101B
      - Half street width for collector street classification was 34.5'
      - Removed 2.5' from half street width to exclude the curb & gutter and isolate lane width
    - Determined pavement width by multiplying lane width of 32' by 2 to account for the other side of the arterial street
  - Pavement length was 56'
    - Added the outer widths to the row of the four 12'x9' culvert boxes
  - Determined price per each crossing by multiplying the pavement price to the pavement's width and length

- Sidewalk unit price was $8,472/EA
  - Sidewalk price was $12.61/SF
    - From 2021 City of Reno Sewer and Road Rehabilitation Project (#1792)
      - Average sidewalk bid unit price was $11.75/SF
    - Inflation from 2021 to 2022: 7.3%
      - From ENR Cost Data
      - ’21-’22: 7.3%
    - Applied inflation rate to sidewalk price
  - Sidewalk width was 6’
    - From City of Reno Standard Details R-104A
      - 6’ minimum for collector and arterial streets
  - Sidewalk length was 56’
    - Added outer widths to the row of the four 12’x9’ culvert boxes
  - Determined price per each crossing by multiplying the sidewalk price to the sidewalk’s width and length and lastly multiplying by 2 for sidewalks located on both sides of the road

- Curb & gutter unit price was $6,009/EA
  - Curb & gutter price was $53.65/LF
    - From 2021 City of Reno Sewer and Road Rehabilitation Project (#1792)
      - Average curb & gutter bid unit price was $50.00/SF
    - Inflation from 2021 to 2022: 7.3%
      - From ENR Cost Data
      - ’21-’22: 7.3%
    - Applied inflation rate to curb & gutter price
  - Curb & gutter length was 56’
    - Added outer widths to the row of the four 12’x9’ culvert boxes
  - Determined price per each crossing by multiplying the curb & gutter price to the curb & gutter’s length and lastly multiplying by 2 for curb & gutter located on both sides of the road

- Guardrail unit price was $3,260/EA
  - Guardrail was $29.11/LF
    - From 2016 Town of Weston Guardrail Overview Report
      - Cost for cable guardrail described a range between $24 to $28 per LF
      - Choose $24/LF due to the report’s location in Massachusetts
    - Compounding inflation from 2016 to 2022: 21.3%
      - From ENR Cost Data
      - ’16-’17: 4.0%, ’17-’18: 3.2%, ’18-’19: 3.0%, ’19-’20: 1.7%, ’20-’21: 2.1%, ’21-’22: 7.3%
    - Applied inflation rate to guardrail price
  - Guardrail length was 56’
    - Added outer widths to the row of the four 12’x9’ culvert boxes
  - Determined price per each crossing by multiplying the guardrail price to the guardrail’s length and lastly multiplying by 2 for guardrails located on both sides of the road

- Culvert Crossing on Collector Roads unit price was $1,659,901/EA

  - Determined price per each crossing by adding the aforementioned components:
    - Culvert unit price
    - Earthwork unit price
    - Pavement unit price
    - Sidewalk unit price
    - Curb & gutter unit price
    - Guardrail unit price

- Total culvert price was $4,977,273, rounded up to $4,980,000

Bid Item 24 – Culvert Crossing on Railroad - $1,230,000

- Railroad road width was approximately 56’
- 12’x9’ Culvert unit price was $846,755/EA
  - Culvert material price was $3,012/LF
    - Extrapolated from 2019 M CON Products Price List Catalog
      - Percent difference of 38.5% with matching height
        - $5,539/m/row for 10’x6’ culvert box
        - $3,750/m/row for 8’x6’ culvert box
      - Percent difference of 5.0% with matching width
        - $6,120/m/row for 10’x8’ culvert box
        - $5,828/m/row for 10’x7’ culvert box
      - Extrapolated 10’x8’ culvert into 10’x9’ for $6,418
        - Multiplied $6,120 by 5.0%
      - Extrapolated 10’x9’ culvert into 12’x9’ for $8,891
        - Multiplied $6,418 by 38.5%
    - Compounding inflation from 2019 to 2022: 11.1%
      - From ENR Costs data
      - ’19-’20: 1.7%, ’20-’21: 2.1%, ’21-’22: 7.3%
    - Converted from unit meter to unit linear feet, and applied compounding inflation rate to culvert price
  - O&P cost was $769/LF
    - From RSMeans Cost Data
    - O&P cost was $840/LF
    - Reno cost index was 91.5
    - Applied cost index to O&P cost
  - H&H modeled for 4 rows of culverts
  - Determined unit price per each crossing by adding the culvert material price with O&P cost, multiplying by number of rows and respective road width

- Box Culvert Jacking was $380,000/EA
  - Similar to jack and bore with round pipes, but with segmental unit of culvert boxes hydraulically jacked into the tunnel for culvert crossing
    - More information on box culvert jacking can be viewed on https://www.tenbusch.com/underground_equipment/box_culvert_jacking.html
    - Brochure from Tenbusch in Appendix G
  - Contacted representative from Tenbusch
    - Al Tenbusch noted box culvert jacking is the highly recommended method to install box culverts. He can provide pricing if we give him more

information on the project such as setup of boring pit, depth to dig underneath freeway, soil condition, etc. Al also recommended getting Peavine Construction involved to further discuss this portion of the project

- Jack and bore past projects
  - 2020 TRI LLC TMWRF Effluent Water Main Project (#1512, rebid)
    - Lump sum average of $487,500 for 200 LF of 24" round pipe using jack and bore
    - Jack and bore unit price was about $2,437/LF by dividing the lump sum price by length
  - 2018 City of Reno Central & South Reno Interceptor Capacity Project Phase 1 (#1364)
    - Lump sum average of $806,654 for 334 LF of 24" round pipe with 36" steel casing using jack and bore
    - Jack and bore unit price was about $2,412/LF by dividing the lump sum price by length
  - Due to lack of pricing data for box culvert jacking, jack and bore past project bids was taken and assumed twice the price for box culvert jacking, and thus rounded up to $5,000/LF
- Determined box culvert jacking unit price by multiplying the $5,000/LF to the railroad's road width plus 20' for boring pit setup, as specified in #1364 project
- Determined culvert crossing on railroad by adding the 12'x9' culvert unit price with the box culvert jacking unit price

- Total culvert price was $1,226,755, rounded up to $1,230,000

<u>Bid Item 25 – Culvert Crossing on I-80 Highway - $4,330,000</u>

- Highway road width was approximately 210'
- 12'x9' Culvert unit price was $3,175,330/EA
  - Culvert material price was $3,012/LF
    - Extrapolated from 2019 M CON Products Price List Catalog
      - Percent difference of 38.5% with matching height
        - $5,539/m/row for 10'x6' culvert box
        - $3,750/m/row for 8'x6' culvert box
      - Percent difference of 5.0% with matching width
        - $6,120/m/row for 10'x8' culvert box
        - $5,828/m/row for 10'x7' culvert box
      - Extrapolated 10'x8' culvert into 10'x9' for $6,418
        - Multiplied $6,120 by 5.0%
      - Extrapolated 10'x9' culvert into 12'x9' for $8,891
        - Multiplied $6,418 by 38.5%
    - Compounding inflation from 2019 to 2022: 11.1%
      - From ENR Costs data
      - '19-'20: 1.7%, '20-'21: 2.1%, '21-'22: 7.3%
    - Converted from unit meter to unit linear feet, and applied compounding inflation rate to culvert price
  - O&P cost was $769/LF
    - From RSMeans Cost Data

        - O&P cost was $840/LF
        - Reno cost index was 91.5
        - Applied cost index to O&P cost
    - H&H modeled for 4 rows of culverts
    - Determined unit price per each crossing by adding the culvert material price with O&P cost, multiplying by number of rows and respective road width

- Box Culvert Jacking was $1,150,000/EA
        - See Bid Item 24 on Culvert Crossing on Railroad
        - Due to lack of pricing data for box culvert jacking, jack and bore past project bids was taken and assumed twice the price for box culvert jacking, and thus rounded up to $5,000/LF
    - Determined box culvert jacking unit price by multiplying the $5,000/LF to the highway's road width plus 20' for boring pit setup, as specified in #1364 project
    - Determined culvert crossing on railroad by adding the 12'x9' culvert unit price with the box culvert jacking unit price

- Total culvert price was $4,325,330, rounded up to $4,330,000

Bid Item 26 – Property Demolition - $1,810,000

- Property demolition unit price was $43,560/AC
    - Unit price of $10/SF retrieved from https://homeguide.com/costs/cost-to-demolish-a-house for the Reno, Nevada area
    - Converted from unit square footage to unit acreage
- Property demolition area was 41.5 acres
    - Collected 161 property data from Washoe County Assessor's website affected by installation of downstream improvements
    - Area accounted for the entire property area, not only the building area
    - Excluded 10 properties owned by the City of Reno, as those were empty lots
- Determined property demolition by multiplying the unit price with the area
- Total demolition price was $1,807,740, rounded up to $1,810,000

Property Acquisition - $103,889,861

Property acquisition involves purchasing existing properties that will develop into trapezoidal flood channels for conveying excess storm runoff into the Truckee River. The property values and purchase prices have been determined by a third-party economist.

- Total cost for single-family residential parcel was $66,458,305
    - 135 units with cumulative building area of 198,383 SF
    - Unit cost of $335/SF
- Total cost for non-residential parcel was $1,963,500
    - 1 unit with building area of 7,700 SF
    - Unit cost of $225/SF
- Total cost for mixed-use parcel was $30,207,540
    - 20 units with cumulative building area of 81,642 SF
    - Unit cost of $370/SF
- Total cost for buildable land was $5,270,516
    - 5 units with cumulative building area of 351,368 SF
    - Unit cost of $15/SF

5.0 ADDITIONAL FACTORS OF ESTIMATE

5.1 INTEREST AND COST INDEXING

All unit costs are provided in 2022 values. If a unit cost was taken from a job prior to 2022, it was adjusted to 2022 values based on the Engineering News Record. The 10-year moving average based on the Engineering News Record is approximately 3% each year for an effective inflation rate of 9.3%, rounded up to 10%, from 2022 to 2025. This inflation rate has been added to the end of each estimate.

5.2 ROUNDING

Because these alternatives are loosely defined and a Class 4 estimate is being used, the "MROUND" and "ROUNDUP" functions were used in Excel. Using this function may change the total cost of a bid item and total as it rounds to the defined interval of either the hundreds or thousands. This function was used to avoid an inaccurate level of perceived accuracy in the cost estimate but does not alter the level of magnitude of any line item.

5.3 EXCLUSIONS

Potential items of cost which a reviewer might associate with the project, but for which no costs have been included in the estimate.

- Removal of hazardous wastes,
- Financing costs,
- Licensing costs

Individual areas not considered in this level of estimate.

5.4 CONTINGENCIES

A 30% contingency was considered for this estimate level.

5.5 ENGINEERING

- 10% of base bid
- City of Reno jobs are typically ~10% for engineering related services and fees.

5.6 CONSTRUCTION MANAGEMENT

- 10% of base bid
- City of Reno jobs are typically ~10% for construction management.

6.0 ESTIMATE QUALITY ASSURANCE

Table 1: Summary of Estimates

Date of Estimate	Prepared By	Reviewed By	QA/QC Reviewer
September 2021	Christina Brennan, PE	Keith Karpstein, PE	
February 2022	Eric Kao, PE Savannah Hughes, EI	Alex Stodtmeister, PE	
March 2022	Eric Kao, PE Savannah Hughes, EI	Keith Karpstein, PE Alex Stodtmeister, PE	

7.0 ATTACHMENTS

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APPENDIX A – COST ESTIMATES

FARR WEST
ENGINEERING

City of Reno - West Wash Drainage Improvements
Alternate 2 - Flood Proofing Downstream
Engineer's Opinion of Probable Construction Costs (Preliminary)

Estimate by:	Savannah Hughes, E.I.
Project No.	1930
QC Check by:	Keith Karpstein, P.E.
Date:	03/03/22

BID SCHEDULE - BASE BID

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization (not to exceed 5% of base bid)	1	LS	$ 11,110,000	$ 11,110,000
2	Temporary Erosion and Sediment Control	1615	DY	$ 1,000	$ 1,620,000
3	Temporary Traffic Control	1615	DY	$ 1,000	$ 1,620,000
4	Geotechnical Testing and Inspection Services	167	DY	$ 1,750	$ 300,000
5	Structures Demolition	4497331	SF	$ 10	$ 44,980,000
6	Material Disposal	18888790	CY	$ 9	$ 170,000,000
7	Revegetation	182	AC	$ 5,500	$ 1,010,000
8	Site Grading	836	EA	$ 3,000	$ 2,508,000

Construction Subtotal:	**$**	**233,148,000**
10% Engineering:	**$**	**23,314,800**
10% Construction Management:	**$**	**23,314,800**
10% Effective Inflation	**$**	**23,314,800**
30% Contingency:	**$**	**69,944,400**
Base Bid Total:	**$**	**373,036,800**
Property Acquisition:	**$**	**1,639,137,667**
Grand Total:	**$**	**2,012,174,467**

FARR WEST
ENGINEERING

City of Reno - West Wash Drainage Improvements
Alternate 3 - Remediate East and West Wash Dams
Engineer's Opinion of Probable Construction Costs (Preliminary)

Estimate by:	Savannah Hughes, E.I.
Project No.	1930
QC Check by:	Keith Karpstein, P.E.
Date:	01/24/22

BID SCHEDULE - BASE BID

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization (not to exceed 5% of base bid)	1	LS	$690,000	$690,000
2	Temporary Erosion and Sediment Control	1000	DY	$1,000	$1,000,000
3	Protection or Replacement of "NW Reno Flood Basin Labyrinth"	1	LS	$6,000	$6,000
4	Geotechnical Testing and Inspection Services	133	DY	$1,750	$233,000
5	Clearing, Grubbing, and Stripping	22	AC	$13,000	$286,000
6	Revegetation and Seeding	22	AC	$5,500	$121,000
7	Excavation and Disposal	1	LS	$5,665,000	$5,665,000
8	On-Site Cut/Fill	1	LS	$350,000	$350,000
9	Slope Stabilization	233351	SF	$10	$2,334,000
10	Geosynthetic Stabilization	122418	SF	$25	$3,070,000
12	Existing Utilities	1	LS	$525,000	$525,000
13	Miscellaneous Improvements	1	LS	$100,000	$100,000

Construction Subtotal:	**$**	**14,380,000**
10% Engineering:	**$**	**1,438,000**
10% Construction Management:	**$**	**1,438,000**
10% Effective Inflation	**$**	**1,438,000**
30% Contingency:	**$**	**4,314,000**
Base Bid Total:	**$**	**23,008,000**

FARR WEST
ENGINEERING

City of Reno - West Wash Drainage Improvements
Alternate 4 - Remove East and West Wash Dams
Engineer's Opinion of Probable Construction Costs (Preliminary)

Estimate by:	Savannah Hughes, E.I.
Project No.	1930
QC Check by:	Alex Stodtmeister, P.E.
Date:	02/17/22

BID SCHEDULE - BASE BID

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization (not to exceed 5% of base bid)	1	LS	$ 200,000	$ 200,000
2	Temporary Erosion and Sediment Control	340	DY	$ 1,000	$ 340,000
3	Protection or Replacement of "NW Reno Flood Basin Labyrinth"	1	LS	$ 6,000	$ 6,000
4	Geotechnical Testing and Inspection Services	36	DY	$ 1,750	$ 65,000
5	Revegetation and Seeding	12	AC	$ 5,500	$ 66,000
6	Excavation and Disposal	1	LS	$ 2,160,000	$ 2,160,000
7	On-Site Cut/Fill	1	LS	$ 520,000	$ 520,000
8	East Wash Dam 4'x3'x28' Intake Structure Removal	1	LS	$ 10,000	$ 10,000
9	West Wash Dam Principal Spillway Inlet Removal	1	LS	$ 10,000	$ 10,000
10	West Wash Dam Sediment Pool Drain Removal	1	LS	$ 2,000	$ 2,000
11	West Wash Dam Spillway Energy Dissipator Outlet Removal	1	LS	$ 5,000	$ 5,000
12	PCC Chute Removal	1	LS	$ 40,000	$ 40,000
13	East Wash Dam 36" RC Pipe Abandonment in Place	173	LF	$ 75	$ 15,000
14	West Wash Dam 24" RC Pipe Abandon in Place	300	LF	$ 50	$ 15,000
15	West Wash Dam 18" RC Pipe Abandon in Place	60	LF	$ 40	$ 2,400

Construction Subtotal:	**$**	**3,456,400**
10% Engineering:	**$**	**345,640**
10% Construction Management:	**$**	**345,640**
10% Effective Inflation	**$**	**345,640**
30% Contingency:	**$**	**1,036,920**
Base Bid Total:	**$**	**5,540,000**

FARR WEST
ENGINEERING

City of Reno - West Wash Drainage Improvements
Alternate 5 - Remove East and West Wash Dams with Downstream Improvements
Engineer's Opinion of Probable Construction Costs (Preliminary)

Estimate by:	Eric Kao
Project No.	1930
QC Check by:	Alex Stodtmeister
Date:	02/18/22

BID SCHEDULE - BASE BID

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization	1	LS	$1,800,000	$1,800,000
2	Temporary Erosion and Sediment Control	983	DY	$1,000	$983,000
3	Temporary Traffic Control	1	LS	$1,490,000	$1,490,000
4	Protection or Replacement of "NW Reno Flood Basin Labyrinth"	1	LS	$6,000	$6,000
5	Geotechnical Testing and Inspection Services	36	DY	$1,750	$65,000
6	Revegetation and Seeding	12	AC	$5,500	$66,000
7	Excavation and Disposal	1	LS	$2,160,000	$2,160,000
8	On-Site Cut/Fill	1	LS	$520,000	$520,000
9	East Wash Dam 4'x3'x28' Intake Structure Removal	1	LS	$10,000	$10,000
10	West Wash Dam Principal Spillway Inlet Removal	1	LS	$10,000	$10,000
11	West Wash Dam Sediment Pool Drain Removal	1	LS	$2,000	$2,000
12	West Wash Dam Spillway Energy Dissipator Outlet Removal	1	LS	$5,000	$5,000
13	PCC Chute Removal	1	LS	$40,000	$40,000
14	East Wash Dam 36" RC Pipe Abandonment in Place	173	LF	$75	$15,000
15	West Wash Dam 24" RC Pipe Abandon in Place	300	LF	$50	$15,000
16	West Wash Dam 18" RC Pipe Abandon in Place	60	LF	$40	$2,400
17	West Wash Trapezoidal Channel	5,159	LF	$350	$1,810,000
18	East Wash Trapezoidal Channel	6,071	LF	$366	$2,230,000
19	Combined Trapezoidal Channel	5,550	LF	$466	$2,590,000
20	10'x8' Box Culvert Crossing on Local Roads	10	EA	$351,453	$3,520,000
21	12'x9' Box Culvert Crossing on Local Roads	4	EA	$678,464	$2,720,000
22	Culvert Crossing on Collector Roads	5	EA	$995,545	$4,980,000
23	Culvert Crossing on Arterial Roads	3	EA	$1,659,091	$4,980,000
24	Culvert Crossing on Railroad	1	EA	$1,226,755	$1,230,000
25	Culvert Crossing on I-80 Highway	1	EA	$4,325,330	$4,330,000
26	Property Demolition	41.5	AC	$43,560	$1,810,000

Construction Subtotal:	**$37,389,400**
10% Engineering:	**$3,738,940**
10% Construction Management:	**$3,738,940**
10% Effective Inflation:	**$3,738,940**
30% Contingency:	**$11,216,820**
Base Bid Total:	**$59,823,040**
Property Acquisition:	**$ 112,387,852**

APPENDIX B – DESIGN FIGURES

SCALE: 1" = 100'

100' 0 100' 200'

KEYSTONE AVE

VAN NESS AVE

O'FARRELL ST

POLK ST

WYOMING AVE

EAST WASH DAM

WEST WASH DAM

EXISTING FLOWLINE

EXISTING R.C. CHUTE

OVERTOPPING OF WEST BERM WILL OCCUR DURING THE 100-YEAR EVENT

OVERTOPPING OF WEST WASH DAM WILL OCCUR DURING THE 3/4 LOCAL PMP EVENT

EXISTING SPILLWAY, WILL BE ACTIVATED DURING 200-YEAR EVENT

MCCARRAN BLVD

SEVERN ST

GULLING RD

DATE: 8/4/2021
SCALE:
DESIGNED: MA
DRAWN: SHH
CHECKED: CC

FARR WEST ENGINEERING
5510 LONGLEY LANE
RENO, NEVADA 89511
PHONE: (775) 851-4788
FAX: (775) 851-0766

CITY OF RENO

SUPPLEMENTAL WATERSHED PLAN AND ENVIRONMENTAL DOCUMENT FOR THE PEAVINE MOUNTAIN WATERSHED

ALTERNATIVE 1 - FUTURE WITHOUT PROJECT (NO ACTION)

WASHOE COUNTY NEVADA

1

SCALE: 1" = 150'

150' 0 150' 300'

KEYSTONE AVE

VAN NESS AVE

O'FARRELL ST

POLK ST

EAST WASH DAM

WEST WASH INUNDATION AREA

WYOMING AVE

WEST WASH DAM

IMPROVE NATURAL CONVEYANCE 2.2 MI TO TRUCKEE RIVER

MCCARRAN BLVD

SEVERN ST

GULLING RD

DATE:

SCALE:

DESIGNED:

DRAWN: SHH

CHECKED:

FARR WEST ENGINEERING
5510 LONGLEY LANE
RENO, NEVADA 89511
PHONE: (775) 851-4788
FAX: (775) 851-0766

CITY OF RENO

SUPPLEMENTAL WATERSHED PLAN AND ENVIRONMENTAL DOCUMENT FOR THE PEAVINE MOUNTAIN WATERSHED

ALTERNATIVE 2 - FLOOD PROOFING DOWNSTREAM FROM WEST WASH

WASHOE COUNTY NEVADA

2

East Wash Dam

West Wash Dam

659

659

430

PEAVINE RD

COLEMAN DR

PUTNAM DR

PUTNAM DR

WASHINGTON ST

COLLEGE DR

ALTURAS AVE

KEYSTONE AVE

KEYSTONE AVE

WYOMING AVE

SEVERN DR

KINGS ROW

GEAR ST

W 11TH ST

SADLEIR WAY

HIGHLAND AVE

N WELLS AVE

E 9TH ST

W 9TH ST

E 9TH ST

WASHINGTON ST

UNIVERSITY TER

VALLEY RD

E 6TH ST

W 7TH ST

W 6TH ST

N SIERRA ST

N VIRGINIA ST

N CENTER ST

EVANS AVE

E 4TH ST

W 7TH ST

W 5TH ST

W 4TH ST

LAKE ST

N ARLINGTON AVE

KUENZLI ST

E 2ND ST

VINE ST

WASHINGTON ST

RALSTON ST

STOKER AVE

KEYSTONE AVE

W 2ND ST

E 1ST ST

S SIERRA ST

S CENTER ST

S LAKE ST

SINCLAIR ST

MILL ST

HOLCOMB AVE

S WELLS AVE

LOU ST

W 1ST ST

RYLAND ST

Legend

Water Depth (ft)

Value

40

0

Parcels with Water Depths ≥ 1 ft

Parcels with Water Depths < 1 ft

P:\Client Projects\Reno, City of 1461\1930 West Wash Dam\3.0 Studies_Reports\3.12 BCA\Figures\1930_BCA Figs\1930_BCA Figs_Alternatives.aprx, Editor: djones, Printed: 3/7/2022

20 Years!
FARR WEST ENGINEERING

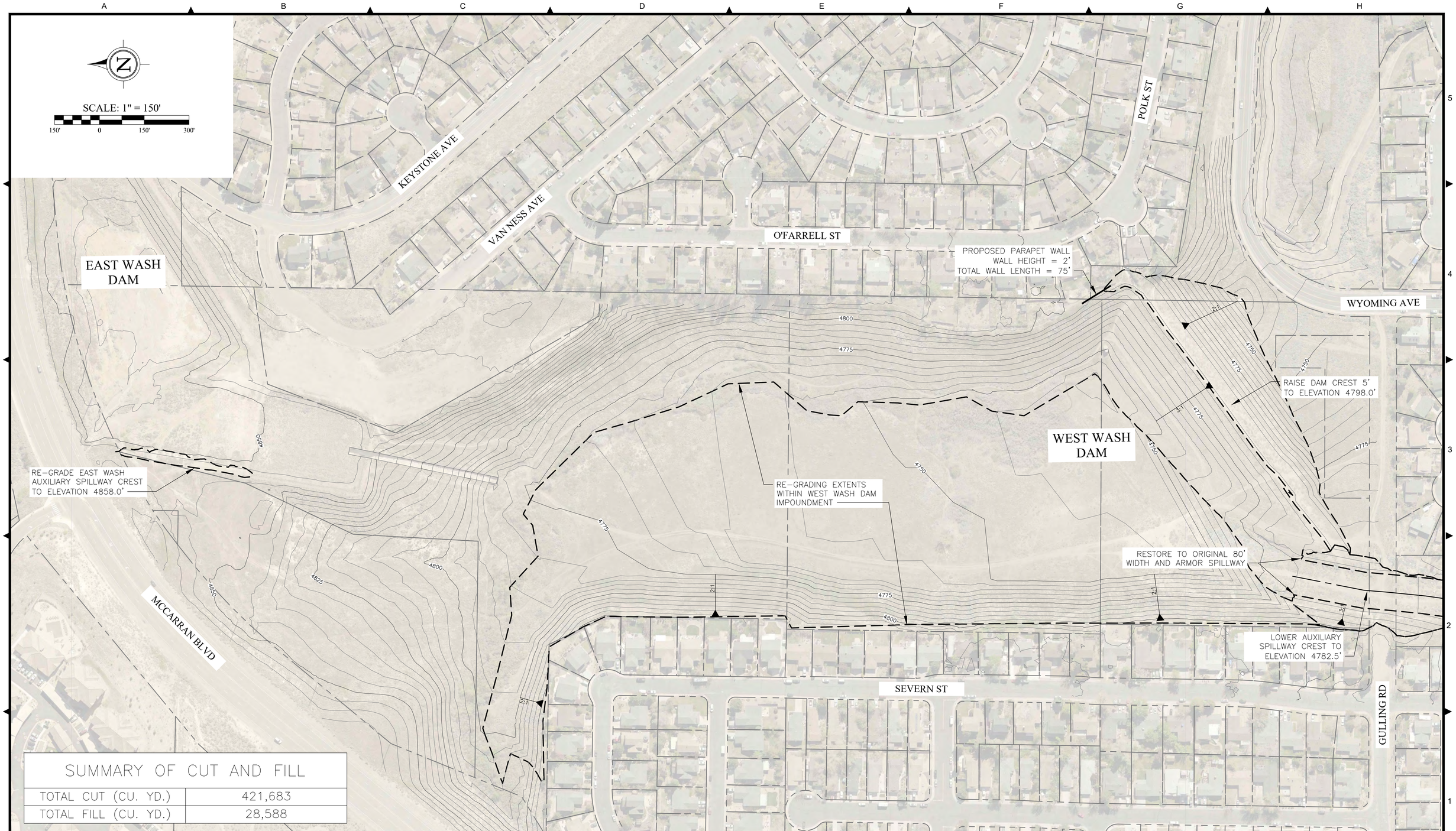
5510 Longley Lane
Reno, NV 89511
(775) 851-4788
www.farrwestengineering.com

Supplemental Watershed Plan and Environmental Document for the Peavine Mountain Watershed
Alternative 2 - Downstream Flood Improvements
Parcels with Flood Damage from West Wash Dam Breach at Local PMP

N

1:12,000

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.



SUMMARY OF CUT AND FILL	
TOTAL CUT (CU. YD.)	421,683
TOTAL FILL (CU. YD.)	28,588

DATE:
SCALE:
DESIGNED:
DRAWN: SHH
CHECKED:

FARR WEST ENGINEERING
5510 LONGLEY LANE
RENO, NEVADA 89511
PHONE: (775) 851-4788
FAX: (775) 851-0766

CITY OF RENO

SUPPLEMENTAL WATERSHED PLAN AND ENVIRONMENTAL DOCUMENT FOR THE PEAVINE MOUNTAIN WATERSHED

ALTERNATIVE 3 - REMEDIATE EAST AND WEST WASH DAMS

WASHOE COUNTY NEVADA

3

SCALE: 1" = 150'

150' 0 150' 300'

KEYSTONE AVE

VAN NESS AVE

O'FARRELL ST

POLK ST

WYOMING AVE

EAST WASH DAM, PRIMARY SPILLWAY, AND AUXILIARY SPILLWAY REMOVAL GRADING EXTENTS

WEST WASH DAM, PRIMARY SPILLWAY, AND AUXILIARY SPILLWAY REMOVAL GRADING EXTENTS

MCCARRAN BLVD

SEVERN ST

GULLING RD

4725 4750 4775 4800 4825 4850

SUMMARY OF CUT AND FILL	
TOTAL CUT (CU. YD.)	130,485
TOTAL FILL (CU. YD.)	53,215

DATE:
SCALE:
DESIGNED:
DRAWN: SHH
CHECKED:

FARR WEST ENGINEERING
5510 LONGLEY LANE
RENO, NEVADA 89511
PHONE: (775) 851-4788
FAX: (775) 851-0766

CITY OF RENO

SUPPLEMENTAL WATERSHED PLAN AND ENVIRONMENTAL DOCUMENT FOR THE PEAVINE MOUNTAIN WATERSHED

ALTERNATIVE 4 & 5 - REMOVE EAST AND WEST WASH DAMS

WASHOE COUNTY NEVADA

East Wash Dam

West Wash Dam

Van Ness Avenue Crossing

Peavine Road Crossing

Putnam Drive Crossing

Penrose Drive Crossing

Coleman Drive Crossing

Anson Drive Crossing

Wesley Drive Crossing

Butte Place Crossing

Kings Row Crossing

Whitaker Drive Crossing

University Terrace Crossing

W 7th Street Crossing

Highway 80 Crossing

W 6th Street Crossing

W 5th Street Crossing

W 4th Street Crossing

Railroad Crossing

W 2nd Street Crossing

W 1st Street Crossing

Riverside Drive Crossing

Jones Street Crossing

Keystone Avenue Crossing

MacDonald Drive Crossing

Putnam Drive Crossing

Legend

- 100-Year West Wash Trapezoidal Channel
- 100-Year East Wash Trapezoidal Channel
- 100-Year Combined Trapezoidal Channel to Truckee
- Box Culvert Road Crossings

N MCCARRAN BLVD

N SIERRA ST

N VIRGINIA ST

KEYSTONE AVE

KINGS ROW

W 7TH ST

W 6TH ST

W 5TH ST

W 4TH ST

W 2ND ST

E 9TH ST

E 6TH ST

E 5TH ST

E 4TH ST

E 2ND ST

EVANS AVE

N CENTER ST

S CENTER ST

N ARLINGTON AVE

S ARLINGTON AVE

STOKER AVE

KUENZLI ST

MILL ST

RYLAND ST

E LIBERTY ST

W LIBERTY ST

CALIFORNIA AVE

PLUMAS ST

Supplemental Watershed Plan and Environmental Document for the Peavine Mountain Watershed
Alternative 5 - Remove Both Dams with Flood Conveyance to Truckee
100-Year Flood Channel Alignment with Road Crossings

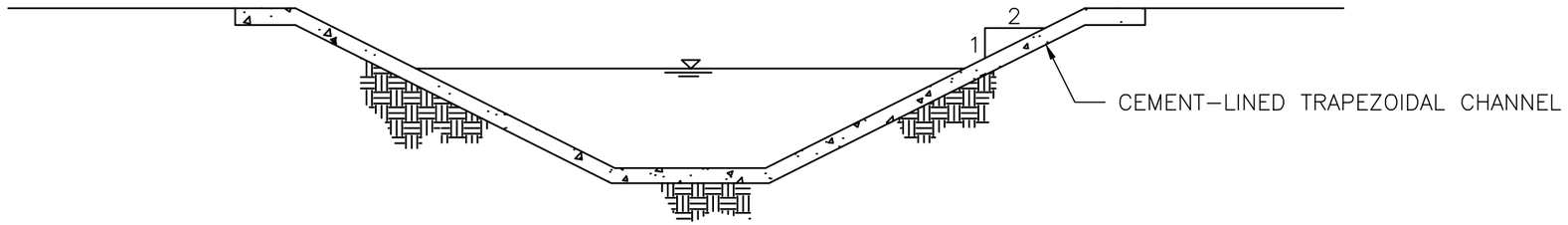
N

1" = 1,200'

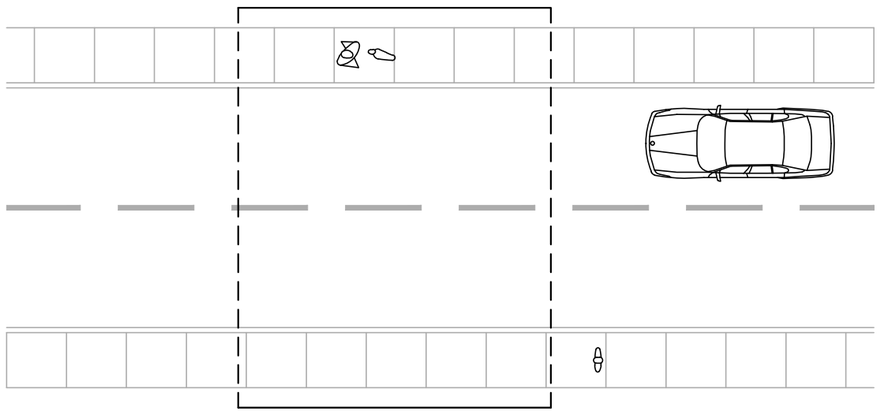
FARR WEST ENGINEERING
5510 Longley Lane
Reno, NV 89511
(775) 851-4788
www.farrwestengineering.com

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

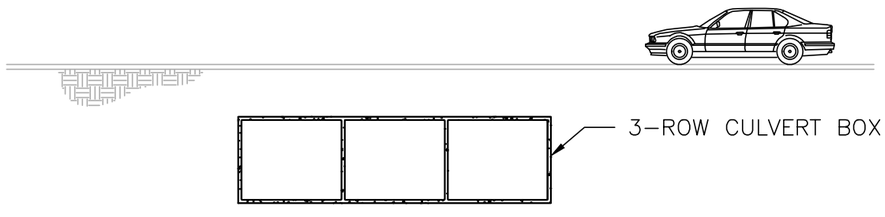
P:\Client Projects\Reno, City of 1461\1930 West Wash Dam\3.0 Studies_Reports\3.12 BCA\Channel Design\Channel Design\Channel Design.aprx, Layout: Channel Overview. Editor: ccluff. Printed: 2/16/2022



CHANNEL DESIGN PROFILE



CULVERT DESIGN PLAN



CULVERT DESIGN PROFILE

JOB NO.: 1930
DESIGN: SHH
DRAWN: SHH
CHECKED: AS
DATE: FEBRUARY 2022

FARR WEST
ENGINEERING
5510 LONGLEY LANE
RENO, NEVADA 89511
PHONE: (775) 851–4788
FAX: (775) 851–0766

WEST WASH DAM REHABILITATION
CHANNEL AND CULVERT BOX DESIGN EXHIBIT

CITY OF RENO

NEVADA

APPENDIX C – FHWA PRODUCTION RATES SPREADSHEET

Last Revised: Nov 8, 2016

PRODUCTION RATES - ENGLISH

Activity	Unit	Typical Production Rate			Notes for Production Rates
		Low	Average	High	
MOBILIZATION					
Projects less than $1 million	Day		3		
Major bridge project	Day	14	26	28	
Paving only project	Day	2	3	5	
Grading only / Minor Earthwork	Day	4	10	20	
Grading and paving / Major Earthwork	Day	7	12	20	
Grading, paving and bridge project	Day	12	17	22	
SURVEY AND STAKING					
Verify FHWA control	Day	1	2	3	
Stake centerline	LF	1,600	3,200	4,800	Use lower rates for smaller projects
Slope, Reference and Clearing Stakes	LF	600	800	1,600	Use higher rates for flat, lightly/non-vegetated terrain
Grade finishing stakes	LF	800	1,600	2,400	Use lower rates for smaller projects; rates represent one course of aggregate (ie: red tops, blue tops, etc); include time for survey of each aggregate course; use higher rates where Machine Guidance is anticipated (ie: large linear projects)
Stake drainage structure/device	EA	4	8	16	Rate will depend on size and type of structure/device, project topography, and proximity of each structure to eachother (ie: will the surveyor have to relocate base station multiple times?)
EROSION CONTROL					
Silt fence / Wattles	LF	200	1,000	1,700	Use lower rates for excessive boulders and heavy trees, steep terrain.
Matting	SY	600	1,800	2,800	Use lower rates for isolated small areas, oddly shaped, etc.
CLEARING & GRUBBING					
Projects with a lot of large trees, rugged terrain, or heavy brush	AC	0.3	1.3	2.7	
Projects with fewer large trees, flatter terrain, or less heavy brush	AC	1	3	6	
EARTHWORK					
Strip and stockpile topsoil	CY	300	700	1,200	Use lower rates for excessive boulders and steep terrain, smaller projects, and long haul to stockpile location.
Subexcavation (no shoring or dewatering needed)					Use 14 days when cofferdam required, minimum.
1' to 5' deep	CY	125	325	500	Rates from RS Means.
5' to 10' deep	CY	225	600	1,000	Rates from RS Means.
Roadway Excavation					
Projects with less than 50,000 CY of earthwork or haul distance of 5 miles or more	CY	400	1,600	2,500	**Note 2.** Also consider number of sites (ie: will multiple sites be in production at once?)
Projects with more than 50,000 CY of earthwork	CY	1,200	2,800	4,500	**Note 2.** Also consider number of sites (ie: will multiple sites be in production at once?)
Rock excavation by hammer	CY	80	240	640	Rates from RS Means. Use on jobs with minor rock cuts or where blasting is not
Rock excavated by ripping	CY	300	900	1,500	Use lower rates for harder, yet rippable, rock. Use higher rates for softer rock.
Rock excavated by blasting	CY	150	250	400	Use lower rates for difficult access and harder rock; these prod. Rates include pioneering, drilling, blasting, loading and haul away activities but do not include scaling
Structure Excavation (most soils)	CY	60	120	180	Rates from RS Means

Activity	Unit	Typical Production Rate			Notes for Production Rates
		Low	Average	High	
Structure Excavation (sand/gravel)	**CY**	**100**	**160**	**220**	Rates from RS Means
Embankment Construction	**CY**	**250**	**1,100**	**2,600**	**Note 2**

Activity	Unit	Typical Production Rate			Notes for Production Rates
		Low	Average	High	
REMOVALS					
PCC pavement	SY	500	1,000	2,500	Reduce rates for lower quantity and increased pavement depth.
Asphalt pavement	SY	500	3,500	8,000	Reduce rates for lower quantity and increased pavement depth; rates are based on
Roadway Obliteration	SY	80	400	1,500	Rates will vary depending on how much work is required to return it to the original condition. Large areas with simple horizontal and veritcal geometry will have a production rate up to 1500 SY/day. Areas that require additional fill or projects with multiple small obliteration sites will have lower production rates.
Concrete curb & gutter	LF	200	360	1,100	Rate will vary based on quantity, dimensions, and condition of curb/gutter to be
Sidewalk	SY	100	600	1,200	site conditions must be considered: rate will increase significantly if material can be
Guardrail	LF	310	600	870	
Pipe <36" diameter	LF	120	240	360	
Pipe >36" diameter	LF	95	150	270	
Pavement Cutting (AC)	LF	800	1,600	2,400	As depth increases, reduce rates.
Pavement Cutting (PCC)	LF	800	1,600	2,400	As depth increases, reduce rates.
Structures, minor	DAY	5	10	20	
Structures, major	DAY	1	3	5	
DRAINAGE					
Box culvert, Cast-in-place	LF	2	10	16	Prod. Rates include forming, tieing, casting and stripping but do not include excavation or backfill. Site specific conditions (box size, traffic requirements, existing structure removal, foundation, dewatering, etc…) should also be considered.
Box culvert, Precast	LF	40	70	140	Prod. Rates include placement only. Excavation, and backfill/compaction, off-site production times and transportation should be considered as well. Site specific conditions (box size, traffic requirements, existing structure removal, foundation,
Inlets and manholes, new or adjust	EA	1	2	3	As Total in a Line increases, increase production. Pre cast, use higher rate.
Pipe culvert, 24" and smaller	LF	40	80	120	Redue rates for sliver fills, deep fills, rocky soil, smaller projects. Consider traffic volume. Under average conditions, assume 1 installation per day per crew.
Pipe culvert, 30" to 42"	LF	30	70	100	Reduce rates for sliver fills, deep fills, rocky soil, smaller projects. Consider traffic volume. Under average conditions, assume 1 installation per day per crew.
Pipe culvert, 48" and larger	LF	20	55	80	Reduce rates for sliver fills, deep fills, rocky soil, smaller projects. Consider traffic volume. Under average conditions, assume 1 installation per day per crew.
Riprap, aprons	CY	20	40	60	Reduce rates for rocky soil, steep sliver fills, smaller projects.
Riprap lined ditches	LF	100	200	300	Reduce rates for rocky soil, steep sliver fills, smaller projects.
Underdrain	LF	200	400	800	Reduce rates for rocky soil, smaller projects, and large trenches dimensions.
Wingwall/Headwall	SF	14	35	90	Unit is for exposed face sqft; rates are for minor drainage structures; as wall area increases, increase production rates; add 7 days for cure and backfill.
SUBGRADE AND BASE					
Subgrade stabilization, lime	SY	900	4,000	6,000	Rates includes scarification and compaction efforts; As application area increases, increase production rate.
Subgrade stabilization, cement	SY	900	4,000	5,000	Rates includes scarification and compaction efforts; As application area increases,
Subgrade stabilization, asphalt	SY	900	3,000		Limited data available; Rates includes scarification and compaction efforts
Recycling, Cold In Place	SY		12,000	15,000	Limited data available
Asphalt Pavement Milling	SY	2,000	3,000	6,500	
Pulverizing	SY	2,000	4,000	12,500	reduce rates if pulverizing deeper than 3"
Aggregate Base	TONS	400	1,000	1,800	rates include lay down but do not include final grading operations; consider project specific conditions; these activities may be combined with smaller quantities
Aggregate Shoulder	CY	100	350	500	
Cement Treated Base	SY	1,940	4,050	5,920	As quantity increases, increase production rate. Allow for sequencing of one lane at a time and curing.

Activity	Unit	Typical Production Rate			Notes for Production Rates
		Low	Average	High	
Finishing Subgrade/Base Course/Surface Course	**LF**	**500**	**1,000**	**2,000**	Rates are for two lanes; rates do not include survey time; rates represent one course (ie: red tops, blue tops, etc); decrease rates for rocky subgrade; increase rates if it is anticipated that AMG will be used (larger projects);
PAVING					
Asphalt paving (HACP)	**TONS**	**550**	**1,000**	**1,700**	**Note 2**
Asphalt surface treatment (fog seal)	**TONS**	**3**	**20**	**58**	Project specific restrictions should be closely considered; increase rates as quantity increases, and where traffic passage can be limited/elliminated
Prime coat	**SY**	**3,900**	**10,000**	**20,000**	Production rate will typically be controlled by Asphalt paving production rate
Tack coat	**TONS**	**1**	**3**	**8**	Production rate will typically be controlled by Asphalt paving production rate
Paved Ditch	**SY**	**250**	**500**	**750**	Rates dependent upon difficulty of paving, based on accessibility, ditch dimensions and continuous ditch length. Longer ditches will generally have higher production rates.
Portland Cement Concrete Pavement (slip forming)	**SY**	**460**	**2,500**	**5,000**	***Slip forming*** , increase production rates with increase in paving length; production rate varies significatly based on pavement depth.
Portland Cement Concrete Pavement (conventional forming)	**SY**	**20**	**300**	**600**	***Conventional forming;*** sharp curves and angles decrease production; note: slip form concrete paving will have significantly higher production rates; use RS Means if slip form paving is anticipated (ie: for vary large concrete paving projects).
Chip Seal	**SY**	**2,500**	**13,500**	**21,000**	Add one day to complete brooming
Approach roads, minor HACP	**TONS**	**80**	**250**	**350**	
Full Depth Patch	**SY**	**60**	**160**	**400**	Project specific conditions should be considered; Larger sites will yeild higher rates;

Activity	Unit	Typical Production Rate			Notes for Production Rates
		Low	Average	High	
CURBS, GUTTERS, AND SIDEWALK					
Curb & Gutter, Concrete	**LF**	**160**	**480**	**900**	Reduce rates for hand mixed/placed
Curb, Concrete	**LF**	**160**	**480**	**900**	Reduce rates for hand mixed/placed.
Curb, Bituminous	**LF**	**650**	**1,200**	**1,850**	
Curb, Stone	**LF**	**50**	**100**	**150**	Limited data available
Sidewalks, Concrete	**SY**	**80**	**160**	**280**	
GUARDRAIL AND GUARDWALL					
W-beam or box beam guardrail	**LF**	**250**	**500**	**1,000**	Use lower rates for stiff/rocky soils.
Steel Backed Timber guardrail	**LF**		**600**		Limited data available
Cable guardrail	**LF**		**800**		Limited data available
BRIDGES AND STRUCTURES					
Cofferdams	**SY**	**100**	**200**	**300**	Limited Data available; increase rate for higher quantities and sandy soil; decrease rates for rocky, or cobbly soil
Column/Pier Cap/Abutment Construction	**CY**	**2**	**4**	**8**	Rates include forming, tieing, pouring; Add cure time and time for stripping forms; Recommend breaking down into individual work activities (ie: survey, form, tie rebar, pour concrete, cure, strip forms);
Deck Construction	**SF**	**100**	**250**	**400**	Rates include forming, tieing, pouring; Add cure time and time for stripping forms; Recommend breaking down into individual work activities (ie: survey, form, tie rebar, pour concrete, cure, strip forms)**;** Reduce production rate for decks with complicated geometry. Add 14 days for curing for all rates.
Drilled Shafts	**LF**	**10**	**112**	**280**	**Note 1**; Increase rate for shaft clusters, good accessibility and drilling space; soil type is primary controling factor; reduce rate slightly for cobbly soil, bore diameter and lower quantities; reduce rate significatly for harder rock
Membrane Waterproofing	**SF**		**1,500**		Limited data available
Piles, Driving Concrete	**LF**	**100**	**250**	**500**	Allow time for relaxation/testing/redriving; reduce rate for larger diameter/sectional area
Piles, Driving Steel	**LF**	**100**	**250**	**500**	Allow time for relaxation/testing/redriving; reduce rate for larger diameter/sectional area
Prestressed girders (fabrication)	**DAYS**	**10**	**13**	**20**	Includes tieing, prestressing, casting, curing and transportation for one set of girders (ie:for one casting of girders); NOTE: assume 3 girders (typical) per set/casting; tieing/prestressing and casting times (approximately 3-4 days) will overlap cure times for each previous set
Prestressed girders (setting)	**EA**	**3**	**6**	**12**	Rates are for ***placement,*** not fabrication. Use lower rate for poor access, and longer beams. Add fabrication, curing and transportation time (below)
Reinforcement (Substructure)	**Lbs**	**3,000**	**4,000**	**5,000**	Rates include tieing rebar only
Reinforcement (Superstructure)	**Lbs**	**3,000**	**4,400**	**5,800**	Typical = 3 days/span; rates include tieing rebar only
Structural Concrete	**CY**	**20**	**110**	**200**	Production rate will be primarily controlled by size of pour; increase rates for larger structural sections/quantities; reduce rates for poor accessibility to pour site
Structural steel beams (setting)	**EA**	**3**	**6**	**12**	
Structure Steel, Erecting	**Lbs**		**25,000**		Limited data available
Sidewalks and parapets	**DAYS**		**5/span**		Limited data available; recommend conducting project-specific cost based UPA
Wall, MSE	**SF**	**40**	**150**	**220**	Limited data available. Rates include excavation and backfill. Recommend site/project-specific requirements are considered. Increase rate as quantity increases.
Wall, gabion	**SF**	**40**	**300**	**600**	Limited data available; rates do not include excavation
Wall, Stone masonry	**SF**	**35**	**50**	**100**	Limited data available; rates include excavation and are based on exposed face area
Retaining Wall, Reinforced Concrete	**SF**	**10**	**22**	**60**	Limited data available; reduce rates for form liner or stone masonry facing
RIPRAP, ROCKERIES, ROCK EMBANKMENTS					

Activity	Unit	Typical Production Rate			Notes for Production Rates
		Low	Average	High	
Class 2 and smaller	CY	10	80	200	Site specific requirements should be closely considered. Reduce rates for multiple small sites, and large amounts of excavation; Increase rates are for larger qtys
Class 3 & 4	CY	20	80	150	Site specific requirements should be closely considered. Reduce rates for multiple small sites, and large amounts of excavation; Increase rates are for larger qtys
Class 5 & 6	CY	40	100	150	Site specific requirements should be closely considered. Reduce rates for multiple small sites, and large amounts of excavation; Increase rates are for larger qtys
Class 7 and larger	CY	20	100	200	Site specific requirements should be closely considered. Reduce rates for multiple small sites, and large amounts of excavation; Increase rates are for larger qtys
Riprap Grouting	CY	100	150	200	Rates are for grouting of already placed riprap, apply to quantity of grout to be placed, and do not include placement of riprap; Site specific conditions should be closely considered, including concrete/grout haul distance, assumed grout coverage, riprap size, site access, etc…
Special Rock Embankment	CY	75	180	280	Site specific requirements should be closely considered. Reduce rates for multiple small sites, and large amounts of excavation; Increase rates are for larger qtys
Rock Buttress	CY	25	55	92	Site specific requirements should be closely considered. Reduce rates for multiple small sites, and large amounts of excavation; Increase rates are for larger qtys
Rockery	SY	4	20	40	Site specific requirements should be closely considered. Reduce rates for multiple small sites, and large amounts of excavation; Increase rates are for larger qtys
SIGNING AND STRIPING					
Pavement Marking, Paint	LF	20,000	50,000	85,000	
Pavement Marking, Thermoplastic	LF	3,100	5,600	10,000	Limited data avail
Pavement Marking, Symbol	EA	5	10	18	
Delineators	EA	35	50	100	Use lower rates for stiff/rocky soil.
Signs	EA	10	20	30	Use lower rates for stiff/rocky soil.
REVEGETATION					
Mulching, Hydraulic Method	AC	2.5	8	11	
Seeding, Hydraulic Method	AC	2.5	8	11	
Place conserved topsoil	CY	200	800	1,200	Includes shaping/compacting.

Activity	Unit	Typical Production Rate			Notes for Production Rates
		Low	Average	High	
MISCELLANEOUS					
Concrete barrier, pre-cast	**LF**	**100**	**200**	**300**	
Curb ramp, concrete	**SY**	**12**	**22**	**30**	reduce rate for mulitple smaller ramps; increase rate for larger, longer ramps
Ditch checks structures (Riprap)	**EA**	**4**	**15**	**25**	rates are for riprap ditch check structures
Ditch check structures (Wattles)	**EA**	**20**	**50**	**100**	rates are for wattle check structures; reduce rates for rocky soil
Final clean up	**STA**	**10**	**30**	**50**	rates will vary based on project size and scope
Finishing, aggregate base	**STA**	**10**	**25**	**50**	rates include staking, final grading and QC verification of red tops
Finishing, subgrade	**STA**	**5**	**12**	**25**	rates include staking, final grading and QC verification of bue tops; reduce rates in rocky
Geotextiles, stabilization	**SY**	**500**	**1,000**	**2,000**	rate will depend on lift dimensions and geotextile frequency; closer geotextile layers will
Geotextiles, underdrain	**SY**	**100**	**140**	**350**	rate will depend on lift dimensions, understrain length and frequency; larger, more
Sheet piling	**SY**	**55**	**82**	**110**	limited data available; reduce rate by half if removal is required.
Temp bridge	**DAY**	**7**	**14**	**21**	Includes erecting and dismantling; rates will vary based on site-specific conditions
Temp detours	**DAY**	**2**	**5**	**7**	Use lower rates for simpler detours, minor earthwork and surfacing.

Studies find significant correlation between production rates and the following influences:

Activity:	Influence:
Bridge deck	Curved or staight
Drilled Shafts	Total length, clustered shafts, accessibility **Note 1 below**
Excavation	Work Area Quantity
Embankment	Work Area Quantity, Work Zone Congestion
Lime Treated Subgrade	Work Area Quantity, Length of Work Area
Flexible Base	Work Area Quantity, Length of Work Area
Cement Treated Base	Work Area Quantity, Length of Work Area
Hot Mix Pavement	Work Area Quantity, Course Type (Bottom or Final Mat)
Conc Pavement-Slip Form	Work Area Quantity, Length of Work Area
Conc Pavement-Conventional Forming	Work Area Quantity, Configuration (Curves, angles)
MSE Walls	Size of wall (If a wall has different components, see above rates)
Pre Cast Box Culvert	Length, Soil Type, Clay Content of Soil
Cast in place Box Culvert	Length
RCP	Length, Orientation to Road
Inlets and Manholes	Quantity in a line, CIP vs Pre Cast
Wingwall/Headwall	Wall Surface Area
Note 1	No difference was found between cased and uncased shafts. Clusters = areas where multiple shafts can be installed with no major relocation of the drill rig. Locations with good accessibility would be w/in 30' of a current operational road; locations with good room for drill rig and other equipment to maneuver would be over 2500 SQFT per hole
Note 2 Complexity is technical difficulty or unusual project conditions	**Base Rate Adjustment Factors** **Factors** — **Adjustment for Noted Conditions** Location — Rural = 1.0 Small City = 0.85 Big city = .75 Traffic conditions — Light = 1.0 Moderate = .88 High = .70 Complexity — Low = 1.0 Medium = .85 High = .70 Soil conditions — Good = 1.0 Fair = .85 Poor = .65 Quantity of work — Large = 1.0 Medium = .88 Small = .75 **DO NOT USE MORE THAN 2 FACTORS FOR AN ITEM OF WORK**

APPENDIX D – ENR CCI SPREADSHEET

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg.	Percent Change	5-Year moving Average	10-Year moving Average
2022	12555.55	12683.97											12620	1.6%		
2021	11627.94	11698.8	11749.8	11849.3	11989.9	12112.05	12237	12463	12464	12464	12467	12481	12134	7.3%		
2020	11392	11396	11397	11412	11418	11436	11439	11455	11499	11539	11579	11626	11466	2.1%	3.1%	
2019	11206	11213	11228	11228	11230	11268	11293	11311	11311	11326	11381	11381	11281	1.7%	3.5%	
2018	10878	10889	10959	10971	11013	11069	11116	11124	11170	11183	11184	11186	11062	3.0%	2.8%	
2017	10542	10559	10667	10678	10692	10703	10789	10826	10823	10817	10870	10873	10737	3.2%	2.7%	3.0%
2016	10132	10181	10242	10279	10315	10337	10379	10385	10403	10434	10442	10530	10338	4.0%	3.0%	3.1%
2015	9972	9962	9972	9992	9975	10039	10037	10039	10065	10128	10092	10152	10035	1.6%	2.9%	2.7%
2014	9664	9681	9702	9750	9796	9800	9835	9846	9870	9886	9912	9936	9806	3.2%	2.8%	2.8%
2013	9437	9453	9456	9484	9516	9542	9552	9545	9552	9689	9666	9668	9547	2.4%	2.5%	2.7%
2012	9176	9198	9268	9273	9290	9291	9324	9351	9341	9376	9398	9412	9308	2.8%	2.9%	3.0%
2011	8938	8998	9011	9027	9035	9053	9080	9088	9116	9147	9173	9172	9070	2.7%	2.5%	3.0%
2010	8660	8672	8671	8677	8761	8805	8844	8837	8836	8921	8951	8952	8799	3.2%	3.1%	2.8%
2009	8549	8533	8534	8528	8574	8578	8566	8564	8586	8596	8592	8641	8570	1.3%	3.1%	3.2%
2008	8090	8094	8109	8112	8141	8185	8293	8362	8557	8623	8602	8551	8310	5.7%	3.1%	3.6%
2007	7880	7880	7856	7865	7942	7939	7959	8007	8050	8045	8092	8089	7966	2.7%	3.5%	3.7%
2006	7660	7689	7692	7695	7691	7700	7721	7722	7763	7883	7911	7888	7751	2.9%	4.6%	3.6%
2005	7297	7298	7309	7355	7398	7415	7422	7479	7540	7563	7630	7647	7446	5.0%	4.2%	3.6%
2004	6825	6862	6957	7017	7065	7109	7126	7188	7298	7314	7312	7308	7115	6.9%	4.1%	3.5%
2003	6581	6640	6627	6635	6642	6694	6695	6733	6741	6771	6794	6782	6694	3.7%	4.1%	3.6%
2002	6462	6462	6502	6480	6512	6532	6605	6592	6589	6579	6578	6563	6538	1.8%	3.6%	3.3%
2001	6281	6272	6279	6286	6288	6318	6404	6389	6391	6397	6410	6390	6343	2.9%	2.6%	3.2%
2000	6130	6160	6202	6201	6233	6238	6225	6233	6224	6259	6266	6283	6221	2.5%	2.4%	3.3%
1999	6000	5992	5986	6008	6006	6039	6076	6091	6128	6134	6127	6127	6059	2.2%	2.3%	3.0%
1998	5852	5874	5875	5883	5881	5895	5921	5929	5963	5986	5995	5991	5920	2.5%	2.6%	2.5%
1997	5765	5769	5759	5799	5837	5860	5863	5854	5851	5848	5838	5858	5826	1.5%	2.4%	2.6%
1996	5523	5532	5537	5550	5572	5597	5617	5652	5683	5719	5740	5744	5620	4.4%	2.4%	2.8%
1995	5443	5444	5435	5432	5433	5432	5484	5506	5491	5511	5519	5524	5471	1.5%	2.9%	2.8%
1994	5336	5371	5381	5405	5405	5408	5409	5424	5437	5437	5439	5439	5408	2.0%	3.4%	2.7%
1993	5071	5070	5106	5167	5262	5260	5252	5230	5255	5264	5278	5310	5210	5.2%	3.0%	2.8%
1992	4888	4884	4927	4946	4965	4973	4992	5032	5042	5052	5058	5059	4985	3.7%	3.1%	2.7%
1991	4777	4773	4772	4766	4801	4818	4854	4892	4891	4892	4896	4889	4835	2.3%	3.2%	2.8%
1990	4680	4685	4691	4693	4707	4732	4734	4752	4774	4771	4787	4777	4732	2.1%	2.6%	2.7%

APPENDIX E – 2019 M CON PRODUCTS PRICE LIST CATALOG

Precast Concrete Products

2019 PRICE LIST

M CON
PRODUCTS INC

2150 Richardson Side Road.
Carp, Ontario, Canada K0A 1L0
tf. +1 800 267 5515
e. sales@mconproducts.com

www.mconproducts.com

M CON PRODUCTS INC

M CON Products Inc.
2150 Richardson Side Road.
Carp, Ontario, Canada K0A 1L0
tf. +1 800 267 5515
e. sales@mconproducts.com

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M CON Products Inc.
2150 Richardson Side Road.
Carp, Ontario, Canada K0A 1L0
tf. +1 800 267 5515
e. sales@mconproducts.com

REINFORCED CONCRETE PIPE

Price per Metre				
INSIDE DIMENSION (MM)	**50-D**	**65-D**	**100-D**	**140-D**
300	$92.30	$92.30	$92.30	$92.30
375	$113.90	$113.90	$113.90	$113.90
450	$117.30	$117.30	$117.30	$146.70
525	$128.00	$128.00	$149.40	$176.50
600	$172.20	$172.20	$197.80	$232.60
675	$263.90	$263.90	$300.50	$352.00
750	$347.90	$347.90	$397.60	$464.80
825	$403.60	$403.60	$513.20	$539.30
900	$484.20	$484.20	$553.80	$646.50
975	$531.20	$559.20	$636.30	$744.70
1050	$608.30	$638.80	$731.50	$852.00
1200	$762.40	$800.90	$916.20	$1,067.60
1350	$980.50	$1,029.40	$1,177.70	$1,371.50
1500	$1,199.20	$1,258.60	$1,438.90	$1,678.80
1650	$1,436.10	$1,509.00	$1,724.70	$2,010.80
1800	$1,735.30	$1,824.50	$2,082.90	$2,430.60
1950	$2,012.50	$2,115.40	$2,414.50	$2,818.50
2100	$2,309.30	$2,422.40	$2,770.40	$3,231.20
2250	$2,624.50	$2,756.90	$3,149.80	$3,675.20
2400	$3,071.80	$3,222.60	$3,683.60	$4,297.90
2550	$3,459.80	$3,629.70	$4,149.70	$4,842.00
2700	$3,839.90	$4,031.20	$4,607.70	$5,375.70
3000	$4,701.90	$4,939.40	$5,645.20	$6,585.50

Prices include a pre-lubricated rubber gasket.
Jacking Pipe - Add 10% to the above price per metre for 1200mm diameter and larger.
For smaller tunneling pipe, please contact our estimating department.
For Special Design Pipe, please contact our engineering department.

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REINFORCED CONCRETE PIPE DIMENSIONS

INSIDE DIA.	OUTSIDE DIA.	WALL DIM.	LAY LENGTH	MASS PER PIECE	TRUCKLOAD LOTS
(mm)	(mm)	(mm)	(m)	(kg)	(pcs)
300	445	70	2.29	486	65
375	533	76	2.29	648	50
450	622	83	2.44	878	40
525	711	89	2.29	1016	34
600	800	95	2.29	1232	28
675	889	102	2.29	1458	22
750	978	108	2.29	1716	19
825	1067	114	2.29	1874	17
900	1156	121	2.29	2253	17
975	1245	127	2.29	2567	12
1050	1334	133	2.29	2919	11
1200	1511	146	2.29	3661	9
1350	1689	159	2.29	4429	8
1500	1867	171	2.44	5734	6
1650	2045	184	2.44	6719	5
1800	2223	197	2.44	7846	4
1950	2362	190	2.44	8390	4
2100	2540	203	2.44	9562	4
2250	2717	215	2.44	10726	3
2400	2895	228	2.44	12214	2
2550	3073	241	2.44	13776	2
2700	3251	254	2.44	15139	2
3000	3606	279	2.44	18786	1

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PIPE TEE (90°) AND WYE (45°) BRANCHES

	Main Pipe Size (mm)					
	300-525	600-825	900-1200	1350-1800	1950-2400	2550-3000 AND BOXES
Branch Size (mm)						
100	$149.80	$157.50	$200.90	$272.50	$326.30	$377.90
125	$164.70	$172.50	$220.60	$298.50	$358.30	$414.20
150	$181.40	$190.70	$242.90	$329.50	$394.70	$457.10
200	$241.90	$254.20	$324.20	$439.30	$526.90	$609.30
250	$271.10	$284.30	$362.70	$491.90	$589.90	$682.20
300	$368.90	$522.40	$677.90	$960.50	$1,243.10	$1,694.80
375	$446.30	$597.50	$804.70	$1,127.20	$1,483.00	$1,824.40
450	$545.50	$675.40	$884.70	$1,207.30	$1,563.50	$1,904.30
525	$589.20	$696.50	$906.80	$1,229.40	$1,585.00	$1,926.20
600		$871.50	$1,086.60	$1,409.20	$1,764.70	$2,106.10
675		$1,240.50	$1,407.20	$1,730.10	$2,085.80	$2,427.10
750		$1,602.10	$1,746.80	$2,069.10	$2,425.10	$2,766.00
825		$1,832.60	$1,954.90	$2,277.90	$2,633.80	$2,974.90
900			$2,273.40	$2,596.20	$2,951.80	$3,292.60
975			$2,588.40	$2,884.80	$3,240.90	$3,581.90
1050			$2,939.90	$3,206.80	$3,562.20	$3,903.30
1200			$3,627.80	$3,850.20	$4,206.40	$4,547.20
1350				$4,801.00	$5,129.30	$5,532.90
1500				$5,798.00	$6,124.90	$6,483.10

To calculate the price of a TEE or WYE branch, multiply the price per metre of the main pipe by its length and add the corresponding price for the required branch as listed above.

NOTES:
Special angle branches can be manufactured upon request.
Maintenance hole TEES are calculated the same as pipe TEES.
Scribed holes - Up to 1350mm $107.70 1500mm and over $215.30 each.
Branches 375mm and larger are for concrete pipe only.
Branches 300mm and smaller are for concrete or smooth wall PVC pipe.
Maximum branch size for 45 degree wye is 1050mm

REDUCERS & INCREASERS
PRICE PER PIECE
300 to 3000 mm reinforced pipe REDUCER or INCREASER
• Multiply the PRICE per metre of the larger pipe x 6.5

M CON Products Inc.
2150 Richardson Side Road.
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tf. +1 800 267 5515
e. sales@mconproducts.com

CONCRETE PIPE PLUGS AND CAPS

INSIDE DIA.	PLUG MASS (KG)	CAP MASS (KG)	PRICE PER PIECE
300	26	122	$92.30
375	39	167	$113.90
450	53	221	$146.70
525	69	270	$176.50
600	86	325	$232.60
675	106	384	$352.00
750	130	472	$464.80
825	154	527	$539.30
900	180	618	$646.60
975	865	720	$744.70
1050	989	765	$852.00
1200	1266	986	$1,067.60
1350	1572	1239	$1,371.50
1500	1908	1440	$1,678.80
1650	2284	1676	$2,010.80
1800	2702	1983	$2,430.60
1950	3097	2192	$2,818.50
2100	3585	2531	$3,231.20
2250	4109	2894	$3,675.20
2400	4667	3279	$4,297.90
2550	5262	3690	$4,842.00
2700	5893	4127	$5,375.70
3000	7095	5892	$6,585.50

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REINFORCED CONCRETE PIPE BENDS

Price Per Piece				
INSIDE DIA.	**50-D**	**65-D**	**100-D**	**140-D**
300	$497.10	$497.10	$497.10	$497.10
375	$615.70	$615.70	$615.70	$615.70
450	$634.40	$634.40	$634.40	$792.50
525	$691.00	$691.00	$807.90	$951.50
600	$878.20	$878.20	$1,008.50	$1,186.60
675	$1,320.10	$1,320.10	$1,503.20	$1,760.00
750	$1,740.10	$1,740.10	$1,989.30	$2,324.10
825	$2,017.60	$2,017.60	$2,565.80	$2,696.90
900	$2,418.70	$2,418.70	$2,767.40	$3,230.20
975	$2,656.00	$2,797.10	$3,181.90	$3,721.60
1050	$3,041.20	$3,194.60	$3,656.90	$4,260.50
1200	$3,810.80	$4,003.90	$4,581.20	$5,338.70
1350	$4,904.00	$5,146.70	$5,888.10	$6,857.70
1500	$5,995.30	$6,291.50	$7,194.50	$8,393.50
1650	$7,181.20	$7,544.80	$8,622.30	$10,050.30
1800	$8,676.20	$9,121.10	$10,415.00	$12,152.20
1950	$10,063.40	$10,575.90	$12,071.70	$14,092.40
2100	$11,546.20	$12,112.00	$13,850.90	$16,153.80
2250	$13,122.80	$13,782.50	$15,749.00	$18,376.70
2400	$15,358.80	$16,113.50	$18,416.80	$21,489.00
2550	$17,298.50	$18,147.50	$20,747.80	$24,210.40
2700	$19,198.60	$20,155.40	$23,038.50	$26,877.70
3000	$23,509.60	$24,695.50	$28,225.40	$32,926.80

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2150 Richardson Side Road.
Carp, Ontario, Canada K0A 1L0
tf. +1 800 267 5515
e. sales@mconproducts.com

REINFORCED ELLIPTICAL CONCRETE PIPE

				Price per Metre			
EQUIVALENT	RISE X SPAN	MASS PER PIECE	WALL DIM.	PIPE CLASS			
DIAM. (MM)	(MM)	(KG)	(MM)	HE I	HE II	HE III	HE IV
900	730 x 1150	2283	114	$701.60	$740.90	$822.50	$943.60
1050	855 x 1345	2928	127	$858.80	$898.40	$1,013.10	$1,161.30
1200	975 x 1535	3665	140	$1,055.40	$1,103.60	$1,239.80	$1,430.20
1350	1090 x 1730	4518	152	$1,324.60	$1,394.50	$1,563.80	$1,799.60
1500	1220 x 1920	5421	165	$1,578.90	$1,660.70	$1,869.10	$2,147.00
1650	1340 x 2110	6401	178	$1,872.20	$1,968.90	$2,207.70	$2,543.40
1800	1465 x 2305	7464	191	$2,253.20	$2,362.10	$2,652.00	$3,054.80

NOTES:
1) Prices include buytl rubber gaskets.
2) Unit length is 2.44m
3) Bends- multiply the price per metre of the elliptical pipe x 5.0.
4) Reducers & Increasers - multiply the price per metre of the larger elliptical pipe x 6.0.
5) Plugs & Caps - multiply the price per metre of the elliptical HE IV pipe x 1.0.
6) Tee and Wye Junctions - multiply the price per metre of the elliptical pipe x 2.44 and then add the corresponding pipe branch price from page 4 (for elliptical branch, use the equivalent diameter).
7) Maintenance Hole Tee - Multiply the price per metre of the elliptical pipe x 2.44 and add $4,342.00 for the 1200mm riser stub.
8) Manufactured to ASTM C507M.

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2150 Richardson Side Road.
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tf. +1 800 267 5515
e. sales@mconproducts.com

REINFORCED CONCRETE BOX CULVERTS - OPSS1821

SPAN X RISE (MM)	LAY LENGTH (M)	MASS PER PIECE (KG)	DESIGN EARTH COVER (M)	PRICE PER METRE
1800 x 900	2.50	8449	0.6 to 5.5	$1,984.00
1800 x 1200	2.50	9227	0.6 to 5.5	$2,165.50
2400 x 1200	2.50	10787	0.6 to 3.6	$2,763.20
2400 x 1500	2.50	11559	0.6 to 3.6	$2,960.10
2400 x 1800	2.50	12347	0.6 to 3.6	$3,158.00
3000 x 1500	2.50	16848	0.6 to 3.6	$4,323.00
3000 x 1800	2.50	17809	0.6 to 3.6	$4,571.10
3000 x 2100	2.50	18770	0.6 to 3.6	$4,816.70
3000 x 2400	2.50	19731	0.6 to 3.6	$5,061.70

REINFORCED CONCRETE BOX CULVERTS - CHBDC

SPAN X RISE (MM)	LAY LENGTH (M)	MASS PER PIECE (KG)	DESIGN EARTH COVER (M)	PRICE PER METRE
1800 x 900	200	8449	0.0 to 0.6 & 5.5 to 8.0	$2,496.50
1800 x 1200	200	9227	0.0 to 0.6 & 5.5 to 8.0	$2,716.00
2400 x 1200	200	10787	0.0 to 0.6 & 3.6 to 6.0	$3,473.50
2400 x 1500	200	11559	0.0 to 0.6 & 3.6 to 5.0	$3,750.50
2400 x 1800	200	12347	0.0 to 0.6 & 3.6 to 5.0	$3,952.20
3000 x 1500	250	16848	0.0 to 0.6 & 3.6 to 5.0	$5,316.80
3000 x 1800	250	17809	0.0 to 0.6 & 3.6 to 5.0	$5,539.60
3000 x 2100	250	18770	0.0 to 0.6 & 3.6 to 5.0	$5,828.40
3000 x 2400 10'x8'	250	19731	0.0 to 0.6 & 3.6 to 5.0	$6,120.00

probably typo for 2.50 m

NOTES:
1) Box Lay Length - 2.50 m
2) Jointing Material - add 5% to above price per metre.
3) Delivery - Please allow 4-6 weeks from date of order for delivery.
4) Specials - Please contact our Sales or Engineering Departments for prices of special design box units.
5) Tee & Wye Junctions (Box Culvert Branch) - Multiply the price per metre of the main box unit by 6.0.
6) Tee & Wye Junctions (Pipe Branch) - Multiply the price per metre of the main box unit by 2.5 and add the branch price from pg. 4.
(For elliptical branches, use the equivalent diameter)
7) Bends & Elbows - 5.0 x price per metre of box unit = Total price per piece of Bend or Elbow.
8) Reducers & Increasers - 6.0 x price per metre of the larger box = Total price per piece of Reducers and Increasers.
9) Plugs & Caps - Price per metre of box unit = Total price per piece of Plug or Cap
10) Radius Box Unit - 1.15 x price per metre of straight box.
11) Beveled or Skewed End - 1.2 x price per metre of straight box, and then multiply by length of beveled or skewed unit.
12) Flush Ends - $775.10 per unit.
13) 15M Dowels & Inserts - $85.50 each.
14) Scribed Holes - $226.00 each.
15) Hole for 686 mm Access Opening $ 1,291.80 (includes steps.)
16) Maintenance Hole Tee - 1200 mm dia. - $4,774.60 (includes steps.)

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REINFORCED NON-STANDARD CONCRETE BOX CULVERTS

SPAN X RISE (MM)	WALL THICKNESS (MM)	LAY LENGTH (M)	MASS PER PIECE (KG)	DESIGN EARTH COVER (M)	PRICE PER METRE	DESIGN EARTH COVER (M)	PRICE PER METRE
1200 x 900	200	2.50	6535	0.6 to 3.6	$1,602.10	0.0 to 0.6	P.O.R.
1200 x 1200	200	2.50	7260	0.6 to 3.6	$1,735.60	0.0 to 0.6	P.O.R.
1500 x 1200	200	2.50	7985	0.6 to 3.6	$1,910.40	0.0 to 0.6	P.O.R.
1500 x 1500	200	2.50	8249	0.6 to 3.6	$2,083.90	0.0 to 0.6	P.O.R.
1800 x 1500	200	2.50	9474	0.6 to 3.6	$2,257.00	0.0 to 0.6	P.O.R.
1800 x 1800	200	2.50	10204	0.6 to 3.6	$2,531.30	0.0 to 0.6	P.O.R.
2400 x 900	200	2.50	9474	0.6 to 3.6	$2,561.80	0.0 to 0.6	P.O.R.
2400 x 2100	200	2.50	12460	0.6 to 3.6	$3,353.50	0.0 to 0.6	P.O.R.
2400 x 2400	200	2.50	13191	0.6 to 3.6	$3,553.50	0.0 to 0.6	P.O.R.
3000 x 900	250	2.50	14125	0.6 to 3.6	$3,827.50	0.0 to 0.6	P.O.R.
3000 x 1200	250	2.50	15039	0.6 to 3.6	$4,079.40	0.0 to 0.6	P.O.R.
3000 x 2700	As required	As required		0.6 to 3.6	$6,185.50	0.0 to 0.6	P.O.R.
3000 x 3000	As required	As required		0.6 to 3.6	$6,872.60	0.0 to 0.6	P.O.R.
3600 x 1500	As required	As required		0.6 to 3.6	$5,475.70	0.0 to 0.6	P.O.R.
3600 x 1800	As required	As required		0.6 to 3.6	$6,570.70	0.0 to 0.6	P.O.R.
3600 x 2100	As required	As required		0.6 to 3.6	$7,666.00	0.0 to 0.6	P.O.R.
3600 x 2400	As required	As required		0.6 to 3.6	$8,760.90	0.0 to 0.6	P.O.R.
3600 x 2700	As required	As required		0.6 to 3.6	$9,856.20	0.0 to 0.6	P.O.R.
3600 x 3000	As required	As required		0.6 to 3.6	$10,951.30	0.0 to 0.6	P.O.R.
4200 x 1500	As required	As required		0.6 to 3.6	$7,177.00	0.0 to 0.6	P.O.R.
4200 x 1800	As required	As required		0.6 to 3.6	$8,612.30	0.0 to 0.6	P.O.R.
4200 x 2100	As required	As required		0.6 to 3.6	$10,047.60	0.0 to 0.6	P.O.R.
4200 x 2400	As required	As required		0.6 to 3.6	$11,482.90	0.0 to 0.6	P.O.R.
4200 x 2700	As required	As required		0.6 to 3.6	$12,929.70	0.0 to 0.6	P.O.R.
4200 x 3000	As required	As required		0.6 to 3.6	$14,353.80	0.0 to 0.6	P.O.R.
4800 x 1500	As required	As required		0.6 to 3.6	$8,202.20	0.0 to 0.6	P.O.R.
4800 x 1800	As required	As required		0.6 to 3.6	$9,842.60	0.0 to 0.6	P.O.R.
4800 x 2100	As required	As required		0.6 to 3.6	$11,482.90	0.0 to 0.6	P.O.R.
4800 x 2400	As required	As required		0.6 to 3.6	$13,123.60	0.0 to 0.6	P.O.R.
4800 x 2700	As required	As required		0.6 to 3.6	$14,764.00	0.0 to 0.6	P.O.R.
4800 x 3000	As required	As required		0.6 to 3.6	$16,404.40	0.0 to 0.6	P.O.R.

M CON PRODUCTS INC

M CON Products Inc.
2150 Richardson Side Road.
Carp, Ontario, Canada K0A 1L0
tf. +1 800 267 5515
e. sales@mconproducts.com

MAINTENANCE HOLES

MAINTENANCE HOLE ESTIMATING TABLE

1200MM			1500MM			1800MM			2400MM		
Depth (m)			Depth (m)			Depth (m)			Depth (m)		
FROM	TO	PRICE	FROM	TO	PRICE	FROM	TO	PRICE	FROM	TO	PRICE
0.86	1.00	$1,639	1.25	1.39	$3,456	1.82	1.97	$5,765	1.46	1.75	$10,447
1.01	1.15	$1,755	1.40	1.54	$3,642	1.98	2.12	$6,013	1.76	2.06	$10,919
1.16	1.30	$1,871	1.55	1.69	$3,817	2.13	2.27	$6,262	2.07	2.36	$11,805
1.31	1.46	$1,988	1.70	1.84	$3,959	2.28	2.42	$6,510	2.37	2.67	$12,691
1.47	1.61	$2,102	1.85	1.99	$4,178	2.43	2.58	$6,759	2.68	2.87	$13,164
1.62	1.76	$2,222	2.00	2.14	$4,353	2.59	2.63	$6,759	2.88	3.18	$13,607
1.77	1.91	$2,339	2.15	2.30	$4,527	2.64	2.78	$7,024	3.19	3.48	$14,438
1.92	2.07	$2,454	2.31	2.45	$4,702	2.79	2.93	$7,101	3.49	3.79	$14,677
2.08	2.22	$2,569	2.46	2.65	$4,702	2.94	3.08	$7,350	3.80	4.09	$14,907
2.23	2.32	$2,692	2.66	2.80	$5,128	3.09	3.24	$7,332	4.10	4.20	$14,907
2.33	2.47	$2,442	2.81	2.96	$5,303	3.25	3.39	$7,580	4.21	4.50	$15,138
2.48	2.62	$2,556	2.97	3.11	$5,367	3.40	3.54	$7,562	4.51	4.80	$15,376
2.63	2.78	$2,676	3.12	3.26	$5,541	3.55	3.64	$7,562	4.81	5.00	$15,614
2.79	2.93	$2,793	3.27	3.41	$9,276	3.65	3.79	$7,811	5.01	5.11	$16,842
2.94	3.08	$2,908	3.42	3.57	$5,772	3.80	3.95	$7,801	5.12	5.41	$17,285
3.09	3.23	$3,023	3.58	3.67	$5,947	3.96	4.10	$8,049	5.42	5.72	$17,516
3.24	3.39	$3,145	3.68	3.82	$5,582	4.11	4.25	$8,039	5.73	6.02	$17,639
3.40	3.54	$3,261	3.83	3.97	$5,757	4.26	4.40	$8,287	6.03	6.33	$17,754
3.55	3.69	$3,377	3.98	4.12	$5,821	4.41	4.56	$8,269	6.34	6.63	$17,992
3.70	3.84	$3,492	4.13	4.28	$5,995	4.57	4.71	$8,518	6.64	6.93	$18,231
3.85	4.00	$3,607	4.29	4.43	$6,051	4.72	4.86	$8,500	6.94	7.24	$18,469
4.01	4.15	$3,723	4.44	4.58	$6,226	4.87	5.00	$8,748	7.25	7.54	$18,707
4.16	4.30	$3,852	4.59	4.73	$6,282	5.01	5.17	$10,179	7.55	7.84	$18,945
4.31	4.45	$3,969	4.74	4.89	$6,456	5.18	5.32	$10,427			
4.46	4.61	$4,084	4.90	5.00	$6,520	5.33	5.47	$10,417			
4.62	4.76	$4,207	5.01	5.19	$8,135	5.48	5.63	$10,665			
4.77	4.91	$4,322	5.20	5.34	$8,199	5.64	5.78	$10,655			
4.92	5.00	$4,437	5.35	5.50	$8,373	5.79	5.93	$10,904			
5.01	5.06	$5,878	5.51	5.65	$8,429	5.94	6.08	$10,893			
5.07	5.22	$5,993	5.66	5.80	$8,604	6.09	6.24	$11,142			
5.23	5.37	$6,108	5.81	5.95	$8,660	6.25	6.39	$11,132			
5.38	5.52	$6,224	5.96	6.11	$8,834	6.40	6.54	$11,380			
5.53	5.67	$6,347	6.12	6.26	$8,898	6.55	6.69	$11,370			
5.68	5.82	$6,462	6.27	6.41	$9,073	6.70	6.85	$11,618			
5.83	5.98	$6,577	6.42	6.56	$9,136	6.86	7.00	$11,608			
5.99	6.13	$6,700	6.57	6.72	$9,311	7.01	7.15	$11,857			
6.14	6.28	$6,823	6.73	6.87	$9,374	7.16	7.30	$11,846			
6.29	6.44	$6,938	6.88	7.03	$9,549						
6.45	6.59	$7,061									
6.60	6.74	$7,177									

NOTES:
1. Depth represents the difference between finished grade and the lowest invert elevation.
2. Prices are rounded to the nearest dollar.
3. The Estimating Table transitions to 1200mm dia. components as follows:
a) 1200mm - Flat Top to tapered top (cone section)
b) 1500mm - After 1.80m of headroom
c) 1800mm - After 1.80m of headroom
d) 2400mm - After 2.40m of headroom
4. Prices are calculated based on the most common applications and will vary with site conditions.
5. Prices include: standard precast concrete components c/w steps, pipe openings and joint gaskets.
6. 1200mm Safety Landings are included at 5.0m and deeper.
7. Prices do NOT include: castings, grade adjustment rings, flexible connectors, pre-benching, precast drops and other accessories.

M CON PRODUCTS INC

M CON Products Inc.
2150 Richardson Side Road.
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tf. +1 800 267 5515
e. sales@mconproducts.com

MAINTENANCE HOLES

CODE NO.	DETAILS		HT. (M)	MASS (KG)	PRICE
		1200mm Ø MAINTENANCE HOLE - OPSD 701.010			
2120001	Base Slab		0.20	759	$601.00
2121091	Monolithic Base		0.91	1741	$1,269.90
2120011	Benching				$692.90
2122030	Risers	(Available in .30, .61, .91, 1.22, 1.53, 1.83m)		1340/m	$768.60/m
2124000	Taper Top		1.32	1975	$1,054.80
2123300	Flat Cap		0.30	742	$601.00
	Transition Riser for 2400 mm & 3000 mm Flat Tops		0.20	308	$230.60
9091200	Safety Landing	(OPSD 404.020)			$1,440.30
		1500mm Ø MAINTENANCE HOLE - OPSD 701.011			
2150001	Base Slab		0.30	1786	$1,197.50
2151183	Monolithic Base		1.83	4779	$3,329.45
2152030	Risers	(Available in .30, .61, .91, 1.22, 1.53, 1.83,2.13 & 2.44m)		2007/m	$1,165.00/m
2153450	Flat Cap		0.43	1879	$1,197.50
2153454	Tapered Transition Section c/w steps		0.61	1633	$1,197.50
9091500	Safety Landing	(OPSD 404.020)			$2,028.10
		1800mm Ø MAINTENANCE HOLE - OPSD 701.012			
2180001	Base Slab		0.30	2540	$1,614.90
2181213	Monolithic Base		2.13	7917	$5,143.46
2182030	Risers	(Available in .30, .61, .91, 1.22, 1.53, 1.83, 2.13 & 2.44m)		2846/m	$1,656.60/m
2183380	Flat Cap		0.43	2704	$1,614.90
2183384	Tapered Transition Section c/w steps		0.61	2570	$1,614.90
9091800	Safety Landing	(OPSD 404.020)			$2,631.50
		2400mm Ø MAINTENANCE HOLE - OPSD 701.013			
2240001	Base Slab		0.30	4480	$3,200.00
2242030	Risers	(Available in .61, .91, 1.22, 1.53, 1.83, 2.13 & 2.44m)		4866/m	$2,953.40/m
2243300	Flat Cap		0.43	4930	$3,200.00
2243304	Transition Slab		0.43	4265	$3,200.00
9092400	Safety Landing	(OPSD 404.020)			$4,115.00
		3000mm Ø MAINTENANCE HOLE - OPSD 701.014			
2300001	Base Slab		0.30	6944	$5,389.00
2302030	Risers	(Available in .61, .91, 1.22, 1.53, 1.83, 2.13 & 2.44m)		7400/m	$4,620.30/m
2303300	Flat Cap		0.45	7945	$5,389.00
2303304	Transition Slab		0.45	7261	$5,389.00
9093000	Safety Landing				Price on request
		3600mm Ø MAINTENANCE HOLE			
2360001	Base Slab		0.30	10140	$9,516.20
2362122	Risers	(Available in .61, .91, 1.22, 1.53, 1.83, 2.13 & 2.44m)		10808/m	$10,069.20/m
2363304	Flat Cap		0.45	10500	$9,516.20
9093600	Transition Slab		0.45	11529	$9,516.20
	Safety Landing				Price on request

NOTES:
Price includes rubber gasket.
Other Monolithic Base heights available. Please contact our sales or engineering department for pricing
Prices on product manufactured to OPSD 700 series and OPSD 1000 series.
Standard steps conform to OPSD 405.010.
Solid aluminum steps available upon request.

M CON PRODUCTS INC

M CON Products Inc.
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tf. +1 800 267 5515
e. sales@mconproducts.com

MAINTENANCE HOLES

CODE NO.			MASS (KG)	PRICE
	BOX MH SIZE	BOX MH NAME		
3033999	900mm x 900mm	M3.3	1968/m	$1,738.20/m
3033001	900mm x 900mm (separate top slab)	M3.3	689	$841.30
	900mm x 900mm Mono Base or Mono Top Premium			$337.00
3040999	1200mm x 1200mm	M4	3968/m	$2,278.60/m
3040001	1200mm x 1200mm (separate top slab)	M4	1590	$1,349.60
	1200mm x 1200mm Mono Base or Mono Top Premium			$597.50
3050999	1500mm x 1800mm	M5	5537/m	$2,822.00/m
3050001	1500mm x 1800mm (separate top slab)	M5	2631	$2,050.80
	1500mm x 1800mm Mono Base or Mono Top Premium			$1,119.40
3055999	1800mm x 1800mm	M5.5	6107/m	$3,874.90/m
3055001	1800mm x 1800mm (separate top slab)	M5.5	3049	$2,622.30
	1800mm x 1800mm Mono Base or Mono Top Premium			$1,343.60
3065999	1800mm x 2400mm	M6.5	6820/m	$3,252.60/m
3065001	1800mm x 2400mm (separate top slab)	M6.5	3884	$2,864.10
	1800mm x 2400mm Mono Base or Mono Top Premium			$1,790.70
3075999	1800mm x 3000mm	M7.5	7858/m	$5,369.70/m
3075001	1800mm x 3000mm (separate top slab)	M7.5	4720	$4,010.90
	1800 mm x 3000mm Mono Base or Mono Top Premium			$2,238.90
3080999	2400mm x 2400mm	M8	8151/m	$5,369.70/m
3080001	2400mm x 2400mm (separate top slab)	M8	5431	$4,010.90
	2400mm x 2400mm Mono Base or Mono Top Premium			$2,238.90
3090999	2400mm x 3000mm	M9	9342/m	$5,224.70/m
3090001	2400mm x 3000mm (separate top slab)	M9	6590	$5,052.60
	2400mm x 3000mm Mono Base or Mono Top Premium			$3,171.90
3095999	3000mm x 3000mm	M9.5	10714/m	$8,103.70/m
3095001	3000mm x 3000mm (separate top slab)	M9.5	8013	$6,882.10
	3000mm x 3000mm Mono Base or Mono Top Premium			$3,964.80
3100999	2400mm x 3800mm	M10	11059/m	$8,453.00/m
3100001	2400mm x 3800mm (separate top slab)	M10	8204	$7,064.00
	2400mm x 3800mm Mono Base or Mono Top Premium			$4,018.00
3110999	3000mm x 3800mm	M11	12544/m	$10,892.00/m
3110001	3000mm x 3800mm (separate top slab)	M11	9927	$8,943.20
	3000mm x 3800mm Mono Base or Mono Top Premium			$5,022.20
3120999	3800mm x 3800mm	M12	14570/m	$14,050.90/m
3120001	3800mm x 3800mm (separate top slab)	M12	12284	$11,419.50
	3800mm x 3800mm Mono Base or Mono Top Premium			$6,361.20
3130999	2400mm x 4200mm	M13	12024/m	$10,083.20/m
3130001	2400mm x 4200mm (separate top slab)	M13	9094	$8,070.20
	2400mm x 4200mm Mono Base or Mono Top Premium			$4,440.50
3140999	3000mm x 4200mm	M14	13550/m	$12,599.10/m
3140001	3000mm x 4200mm (separate top slab)	M14	12771	$10,590.40
	3000mm x 4200mm Mono Base or Mono Top Premium			$5,550.70
3150999	3800mm x 4200mm	M15	15600/m	$15,600.00/m
3150001	3800mm x 4200mm (separate top slab)	M15	14400	$12,676.00
	3800mm x 4200mm Mono Base or Mono Top Premium			$7,061.00

A minimum charge of 2 metres will apply to all box maintenance holes. Box Maintenance prices are designed to maximum depth of 7 metres.
Butyl tape or hydrophilic gasket and waterproofing membrane are required for all box structures (refer to the Sealants section in our price list)
Special Safety Landings, Hatches and Specialty Hardware available for all box maintenance holes.

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CATCH BASINS AND SPECIALTY PRODUCTS

CODE NO.	DETAILS	MASS (KG)	PRICE
	CATCH BASINS / DITCH INLETS		
1201030	600mm x 600mm Catch Basin (OPSD 705.010)	942kg/m	$503.40/m
1301030	600mm x 600mm Ditch Inlet (OPSD 705.030)	1267kg/m	$752.00/m
1241030	600mm x 1450mm Twin Inlet (OPSD 705.020)	1567kg/m	$976.90/m
1341030	600mm x 1200mm Ditch Inlet (OPSD 705.040A/B)	1830kg/m	$1,167.40/m
1361030	1200mm x 1200mm Ditch Inlet (OPSD 702.040/050)	3968kg/m	$2,312.00/m
9012099	Goss Trap (PVC)		$703.00
NOTE: Minimum charge of 1 metre will apply to all box catch basins and ditch inlets. Price of Ditch Inlet includes one pair of Ditch Inlet fasteners			
	DITCH INLET GRATES		
9090010	762mm x 768mm Ditch Inlet Grate - Type A (403.010A)		$599.00
9090020	768mm x 1338mm Ditch Inlet Grate - Type B (403.010B)		$881.70
9090030	768mm x 1465mm Ditch Inlet Grate - Type C (403.010C)		$968.00
	ACCESSORIES		
99100	20mm Hollow Aluminum Maintenance Hole Step 405.010 (supplied only)		$27.30
99105	20mm Solid Aluminum Maintenance Hole Step 405.020 (supplied only)		$39.30
99111	20mm Galvanized Maintenance Hole Step (supplied only)		$75.20
99125	Aluminum Ladder c/w hardware		P.O.R.
99150	Aluminum Hatch		P.O.R.
99901	4 ton Lifting device		$416.10
99902	8 ton Lifting device		$783.10
	SEALANTS FOR BOX STRUCTURES		
99010	Butyl Tape - 25mm x 25mm (Box Manhole Sealant)		$235.00
99030	Expanded Bentonite Tape - 25mm x 19mm (Hydrophilic Waterstop)		$693.00
99035	Paraprimer for Hydrophilic Waterstop (1 gallon container)		$175.00
99060	Mel-Rol Waterproofing Membrane (300mm wide x 18m roll)		$235.00
99065	Mel-Prime Primer (3.78 liter container)		$175.00
99090	Pail of Hydraulic Cement		$125.00

M CON Products Inc.
2150 Richardson Side Road.
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tf. +1 800 267 5515
e. sales@mconproducts.com

PIPE TO STRUCTURE FLEXIBLE CONNECTORS

CODE	CONNECTOR TYPE	PVC PIPE	CORE HOLE DIA. (MM)	PRICE EACH
9200150	CAST-IN	150		$211.70
9220150	BOOT	150	250/300	$211.70
9200200	CAST-IN	200		$211.70
9220200	BOOT	200	300	$211.70
9200250	CAST-IN	250		$276.40
9220250	BOOT	250	350	$276.40
9200300	CAST-IN	300		$276.40
9220300	BOOT	300	400	$276.40
9220375	BOOT	375	500	$361.40
9220450	BOOT	450	560	$434.50
9220525	BOOT	525	660	$549.60
9220600	BOOT	600	711	$614.80
9220675	BOOT	675	813	$648.90

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2150 Richardson Side Road.
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tf. +1 800 267 5515
e. sales@mconproducts.com

CITY OF OTTAWA VALVE CHAMBERS

CODE NO.	DETAILS	HEIGHT	MASS (KG)	PRICE
4150002	Circular Base Set (2 pieces/set) 1780mm x 790mm	.40m	1232	$785.30
4151122	1520mm Ø Bottom	1.22m	2543	$1,421.30
4153450	1520mm Ø Flat Cap	0.43m	1818	$1,197.50
2072015	760mm Ø Risers (Available in .15, .23, .30, .45, .61 & .76m)		667kg/m	$685.50/m
4154015	760mm Ø Top Section	0.15m	95	$165.10
4154030	760mm Ø Top Section	0.30m	197	$209.20
4154045	760mm Ø Top Section	0.45m	299	$313.20
3050999	1500mm x 1800mm (Park VC W31.1)		5537/m	$2,822.00/m
3050001	1500mm x 1800mm (separate top slab)		2631	$2,050.80
	1500mm x 1800mm Mono Base or Mono Top Premium			$1,119.40
3055999	1800mm x 1800mm (Park VC)		6197/m	$3,874.90/m
3055001	1800mm x 1800mm (separate top slab)		3049	$2,622.30
	1800mm x 1800mm Mono Base or Mono Top Premium			$1,343.60
4060999	1800mm x 2400mm (W10, Type R-1)		6820/m	$3,252.60
4060001	1800mm x 2400mm (separate top slab)		3884	$2,864.10
	1800mm x 2400mm Mono Base or Mono Top Premium			$1,790.70
4070999	1800mm x 3000mm (W10, Type R-2)		7858/m	$5,369.70
4070001	1800mm x 3000mm (separate top slab)		4720	$4,010.90
	1800mm x 3000mm Mono Base or Mono Top Premium			$2,238.90
4090999	2400mm x 3000mm (W11, Type R-3)		9342/m	$5,224.70
4090001	2400mm x 3000mm (separate top slab)		6590	$5,052.60
	2400mm x 3000mm Mono Base or Mono Top Premium			$3,171.90
4110999	3000mm x 3800mm (W11, Type R-4)		12544/m	$10,892.00
4110001	3000mm x 3800mm (separate top slab)		9927	$8,943.20
	3000mm x 3800mm Mono Base or Mono Top Premium			$5,022.20
4090999	2400mm x 3000mm (W12, Type R-3)		9342/m	$5,224.70
4090001	2400mm x 3000mm (separate top slab)		6590	$5,052.60
	2400mm x 3000mm Mono Base or Mono Top Premium			$3,171.90
4110999	3000mm x 3800mm (W12, Type R-4)		12544/m	$10,892.00
4110001	3000mm x 3800mm (separate top slab)		9927	$8,943.20
	3000mm x 3800mm Mono Base or Mono Top Premium			$5,022.20
4110999	3000mm x 3800mm (W13, Type R-4)		12544/m	$10,892.00
4110001	3000mm x 3800mm (separate top slab)		9927	$8,943.20
	3000mm x 3800mm Mono Base or Mono Top Premium			$5,022.20

NOTES:
Monolithic base & top are included in the price per vertical metre of Box Valve Chambers.
Additional sizes are available, please contact our sales department.
There is a premium for TVS Chambers, add 25% to the cost of the box portion of a standard box valve chambers.
Hydrophilic gasket and waterproofing membrane are required for all valve chambers (refer to the Sealants section in our price list)

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HEADWALLS AND WINGWALLS

CODE NO.	DETAILS	MASS (KG)	PRICE PER PIECE
	HEADWALLS - MODIFIED OPSD 804.030		
6020300	Headwall for 300 dia. pipe	5052	$3,211.40
6020375	Headwall for 375 dia. pipe	4978	$3,211.40
6020450	Headwall for 450 dia. pipe	4890	$3,904.10
6020525	Headwall for 525 dia. pipe	7217	$3,904.10
6020600	Headwall for 600 dia. pipe	7183	$4,985.60
6020675	Headwall for 675 dia. pipe	7068	$4,985.60
6020750	Headwall for 750 dia. pipe	9998	$6,088.80
6020825	Headwall for 825 dia. pipe	9841	$6,088.80
6020900	Headwall for 900 dia. pipe	9669	$7,202.40
	WINGWALLS - MODIFIED OPSD 804.040		
6040675	Wingwall for 675 dia. Pipe	15088	$15,669.40
6040750	Wingwall for 750 dia. Pipe	14988	$15,669.40
6040825	Wingwall for 825 dia. Pipe	14886	$15,669.40
6040900	Wingwall for 900 dia. Pipe	22279	$17,550.80
6041050	Wingwall for 1050 dia. Pipe	22021	$17,550.80
6041200	Wingwall for 1200 dia. Pipe	21730	$17,550.80
6041350	Wingwall for 1350 dia. Pipe	27745	$21,212.80
6041500	Wingwall for 1500 dia. Pipe	27363	$21,212.80
6041650	Wingwall for 1650 dia. Pipe	26994	$21,212.80
6041800	Wingwall for 1800 dia. Pipe	26471	$21,212.80
	SEGMENTAL WINGWALL 1900 - 2250 dia Pipe		$26,000.00
	SEGMENTAL WINGWALL 2400 - 3000 dia Pipe		$30,160.00
	HEADWALL GRATES - OPSD 804.050		
6010375	Headwall grate for 300 dia. pipe		$789.50
6010375	Headwall grate for 375 dia. pipe		$789.50
6010450	Headwall grate for 450 dia. pipe		$868.80
6010525	Headwall grate for 525 dia. pipe		$868.80
6010600	Headwall grate for 600 dia. pipe		$933.00
6010675	Headwall grate for 675 dia. pipe		$933.00
6010750	Headwall grate for 750 dia. pipe		$1,105.70
6010825	Headwall grate for 825 dia. pipe		$1,105.70
6010900	Headwall grate for 900 dia. pipe		$1,162.20
6010975	Headwall grate for 975 dia. pipe		$1,231.50
6011050	Headwall grate for 1050 dia. pipe		$1,401.20
6011200	Headwall grate for 1200 dia. pipe		$1,602.80
6011350	Headwall grate for 1350 dia. pipe		$1,705.60
6011500	Headwall grate for 1500 dia. pipe		$1,850.20
6011650	Headwall grate for 1650 dia. pipe		$2,215.50
6011800	Headwall grate for 1800 dia. pipe		$2,553.60

NOTE:
Precast alternatives to OPSD 804.020 are available, as as well as other sizes.
Specialty headwall grates are also available, please contact our sales department.
MINIMUM DELIVERY CHARGE - $100.00. E.&O.E.

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GRADE ADJUSTMENT RINGS

CODE NO.	DETAILS	HEIGHT(MM)	MASS (KG)	PRICE
		710mm Ø MAINTENANCE HOLE		
2125005	Adjuster 710mm Ø x 159mm wide	50	55	$46.60
2125007	Adjuster 710mm Ø x 159mm wide	75	82	$49.40
2125010	Adjuster 710mm Ø x 159mm wide	100	109	$52.90
2125015	Adjuster 710mm Ø x 159mm wide	150	164	$57.80
2125030	Adjuster 710mm Ø x 159mm wide c/w step	300	325	$219.20
		760mm Ø MAINTENANCE HOLE / VALVE CHAMBER		
4155005	Adjuster 760mm Ø	50	37	$46.60
4155007	Adjuster 760mm Ø	75	36	$49.40
4155010	Adjuster 760mm Ø	100	74	$52.90
4155015	Adjuster 760mm Ø	150	112	$66.80
		600mm x 600mm SQUARE CATCH BASIN		
1205005	Adjuster 600mm x 600mm	50	40	$45.50
1205007	Adjuster 600mm x 600mm	75	61	$49.20
1205010	Adjuster 600mm x 600mm	100	81	$53.50
1205015	Adjuster 600mm x 600mm	150	121	$68.80
		330mm x 480mm RECTANGULAR OLD STYLE CATCH BASIN		
1005005	Adjuster 330mm x 480mm	50	19	$48.10
1005007	Adjuster 330mm x 480mm	75	28	$49.20
1005015	Adjuster 330mm x 480mm	150	56	$72.50
	SEALANT FOR ADJUSTMENT RINGS			
99020	Box of 1/4" dia. Butyl Tape (26 rolls/box)			$439.10
99021	Roll of 1/4" dia. Butyl Tape (20' long)			$16.90
		PACKAGING FORMAT FOR ALL ADJUSTMENT RINGS		
Thickness (mm)	Thickness (inches)	Quantity per Bundle		
50	2	12 pcs		
75	3	8 pcs		
100	4	6 pcs		
150	6	4 pcs		
MINIMUM DELIVERY CHARGE - $100.00. E.&O.E.				

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MUNICIPAL CASTINGS

CODE	SPEC	DETAILS	PRICE
		ONTARIO PROVINCIAL STANDARD	
9012000	400.020	150mm high x 610mm x 610mm CB Frame & Grate - Flat	$440.00
9012010	400.010	150mm high x 610mm x 610mm CB Frame & Grate - Dished	$440.00
9012020	400.030	150mm high x 610mm x 610mm CB Frame & Grate - V Type	$635.00
9012060	400.100	150mm high x 610mm x 610mm CB Frame & Grate - Slotted Openings	$610.00
9020030	401.010B	150mm high x 625 Ø MH Square Frame & Open Grate	$400.00
9020040	401.010A	150mm high x 625 Ø MH Square Frame & Closed Cover	$400.00
9020050	401.030	150mm high x 625 Ø MH Square Frame & Cover - Watertight	$775.00
9020060	401.020	130mm high x 760 Ø MH Frame & Cover	$637.00
9020070	400.070	150mm high x 625 Ø MH Raised Frame & Herringbone Grate	$554.00
9040020	402.010	150mm high x 625 Ø VC Frame & Cover	$620.00
9040030	402.030	VC Frame & Cover for Meter Chamber - 3 pc unit	$3,816.80
		CITY OF OTTAWA	
9010020	S20/S21	75mm high x 390mm x 550mm CB Frame & Grate	$300.00
9012030	S22/S23	230mm high x 610mm x 610mm CB Frame & Cover - Curb Inlet	$589.00
9012050	S25/S28	230mm high x 610mm x 610mm CB Frame & Cover - Curb Inlet CBMH	$928.00
9020000		760 Ø MH Adjustable Frame & Cover c/w guide frame	$1,000.00
9020010	S24.1/S25	130mm high x 760 Ø MH Frame & Cover - Fish Logo	$560.00
9020020	S24/S25	130mm high x 760 Ø MH Frame & Cover - Toilet Logo	$560.00
9020023	S24.2/S25	130mm high x 760 Ø MH Frame & Stabiloc Cover	$950.00
9020025		130mm high x 760 Ø MH Frame & Cover - Watertight	$975.00
9020073	S19	150mm high x 625 Ø MH Raised Frame & Fish Grate	$440.00
9020073S	S19/S23	150mm high x 625 Ø MH Raised Frame & Solid Fish Grate	$440.00
9040010	W15/W16	130mm high x 760 Ø VC Frame & Cover	$570.00
9040000		760 Ø VC Adjustable Frame & Cover c/w guide frame	$1,015.00
		MISCELLANEOUS	
9012004		100mm high x 610mm x 610mm CB Frame & Grate - Flat - Low Profile	$525.00
9020080		625 Ø MH Adjustable Frame & Cover c/w guide frame (Ontario Std)	$995.40

NOTE:
Specialty castings and/or inscriptions are available on special order.

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TERMS AND CONDITIONS 2019

1 ALL PRICES ARE SUBJECT TO CHANGE WITHOUT NOTICE. Estimates are open for acceptance for 30 days.
2 Acceptance of all pricing shall not obligate the seller until the Purchaser's credit is approved by our Credit Department. Orders must be placed by means of a signed purchase order, signed letter or signed M-Con estimate sheet.
3 PAYMENT TERMS: Net 30 days. A 3% cash discount will be allowed as incentive for prompt payment, providing no amount is overdue and full payment is made by the 25th of the month following. Note that H.S.T. is not subject to the discount. Interest at a rate of 2% per month (24% per annum) will be charged on overdue accounts.
4 Federal and Provincial Taxes are extra. Any changes in tax regulation will be charged or credited accordingly.
5 The prices contained in this Price List are based on the use of Normal Portland Cement, with rubber gaskets complying with CSA A257.3 and ATSM C443. A premium will be added for any other type of Cement or Gasket.
6 Prices include delivery for truckload quantities within a 250 kilometre travel distance from our closest plant. Deliveries which exceed the set limit will be subject to a flat delivery charge. A truckload consists of a minimum of 32,000 kg and any order less than the minimum will be priced F.O.B. from our closest plant with delivery charges extra.
7 To ensure adequate service, no less than 24 hours notice should be given to enable proper scheduling of deliveries.
8 When delivery F.O.B. truck at jobsite is included in the price quoted, delivery shall be construed to mean motor truck delivery, as close to jobsite, designated storage area or to line of trench as is practical for loaded motor trucks and trailers operating under their own power without risk of accident, injury or undue delay. The Purchaser shall provide and maintain suitable access roads to project site for delivery of goods.
Delivery beyond a point accessible to loaded trucks shall be at the risk of the purchaser.
9 The seller reserves the right to make an extra charge for unreasonable delay in unloading or releasing his vehicles. The seller shall not be responsible for any damages due to delays caused by the failure of transportation facilities, strikes, fire, labour difficulties, government regulations, war, flood, accident, material procurement difficulties or any caused beyond its control.
10 Prices are based on deliveries being made in normal daylight working hours.
11 Estimates are made on the condition that full delivery will be taken within six months from acceptance of order. Any goods delivered after that period will be subject to any increase in prices shown in our regular published price list in effect at the time of each delivery.
12 The purchaser will inspect all products for deficiencies. In order to avoid unnecessary costs and delays, special attention should be given to specialty or custom pieces. Defects or inaccuracies should be reported to the Seller immediately. The Seller will deliver new goods to the Purchaser at the site of the work. It is a condition of sale that this will be the limit of the Seller's liability and he will not be liable for any labour costs or other consequential damages.
13 SPECIAL PRECAST CONCRETE PRODUCTS ORDERED ARE NOT SUBJECT TO CANCELLATION. Stock items returned for credit will be subject to 25% handling charges or a minimum of $25.00 charge. The items must meet the acceptance of the Seller and any damaged products will not be credited. Material pick up for credit will be subject to freight charges.
14 The Purchaser is reminded to verify all quantities, calculations, specifications etc. and the Seller assumes no liability in that regard.
15 No warranties, representations, conditions or agreements exist which are not set out in this price list.
16 If the financial responsibility of the Purchaser becomes unsatisfactory to the Seller, the Seller reserves the right to demand payment in advance or other security and if in default to cancel the unfilled portion of the contract.
17 Waiver of any one or more of the Terms and Conditions herein by the Seller shall not constitute a general waiver of Terms and Conditions and the Seller reserves the right to enforce any and all conditions not so waived. Any such waiver must be in writing.

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Storm Water Management: Echelon Systems

Retaining Wall blocks: Stone Strong Systems

M CON IS PART OF THE PRECAST GROUP. COLLECTIVELY WE ARE THE MOST DIVERSE SUPPLIER OF PRECAST PRODUCTS IN ONTARIO. IF OTHER PRECAST PRODUCTS ARE REQUIRED, PLEASE DO NOT HESITATE TO CONTACT ONE OF OUR AFFILIATED COMPANIES.

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Fax (613) 225-5318

Website www.centralprecast.com
Email info@centralprecast.com

PRODUCT LINE

Landscape Products	Distributors of interlocking stones, retaining walls, slabs and curbing
Architectural Precast	Manufacturers of architectural precast for buildings such as big box stores and condo buildings
Masonry Furnishings	Manufacturers of masonry furnishings that include sills, lintels, coping and caps.
Site Furnishings	Manufacturers of planters, steps, garbage receptacles, benches, ashtrays, etc.
Fencing	Manufacturers of various precast concrete fencing systems
Columns & Signs	Manufacturers of custom columns and signs to your specifications
Shelters	Manufacturers of a variety of standard shelters

UTILITY STRUCTURES INC

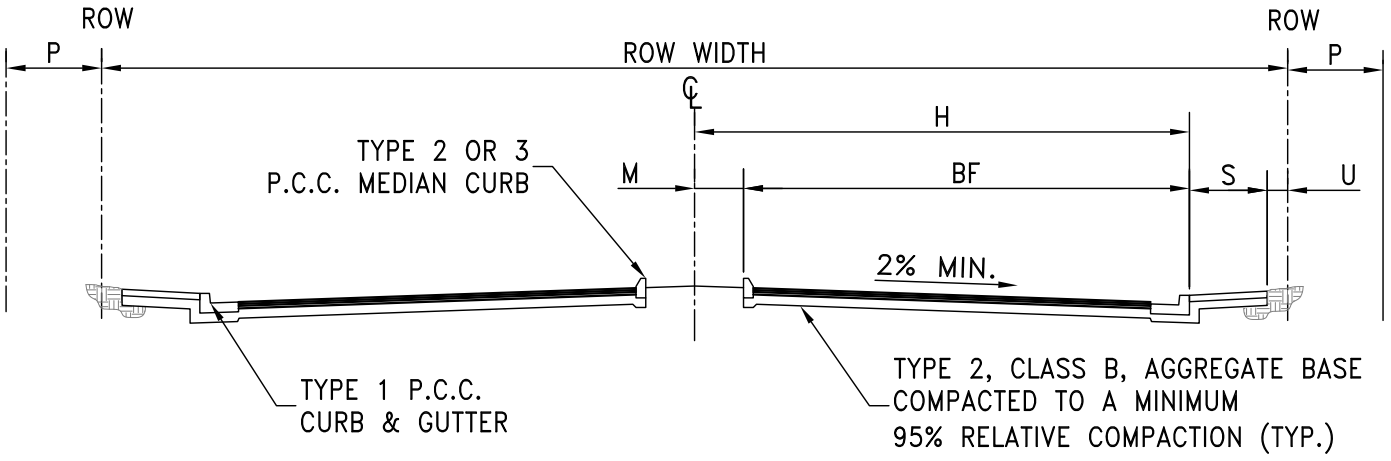
61 Bongard Avenue
Nepean, Ontario K2E 6V2
Tel (613) 225-6398 Toll Free (800) 267-5515
Fax (613) 225-1681

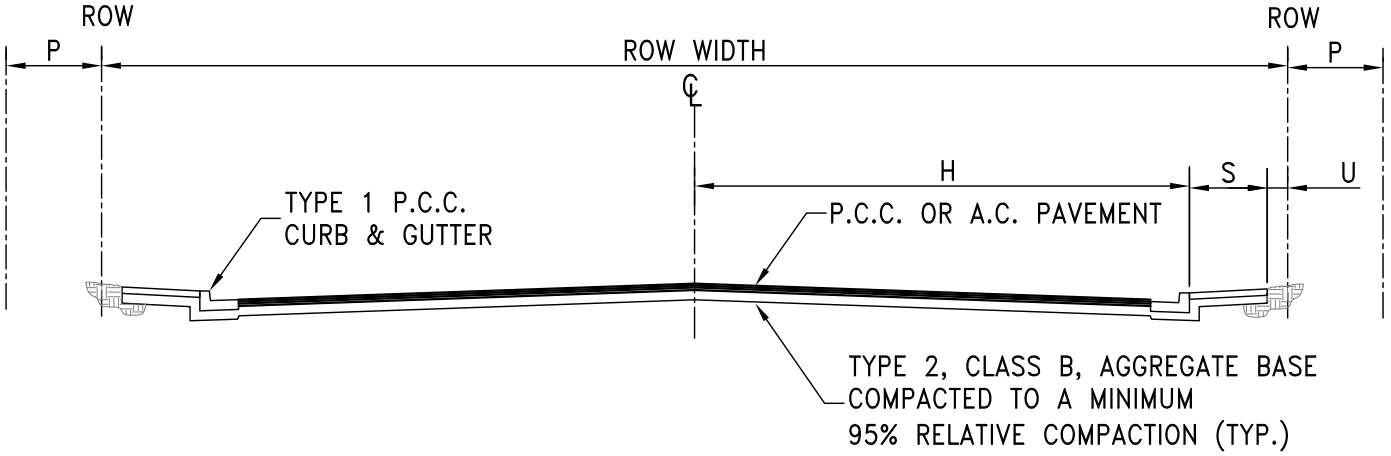
Website www.utilitystructures.com
Email info@utilitystructures.com

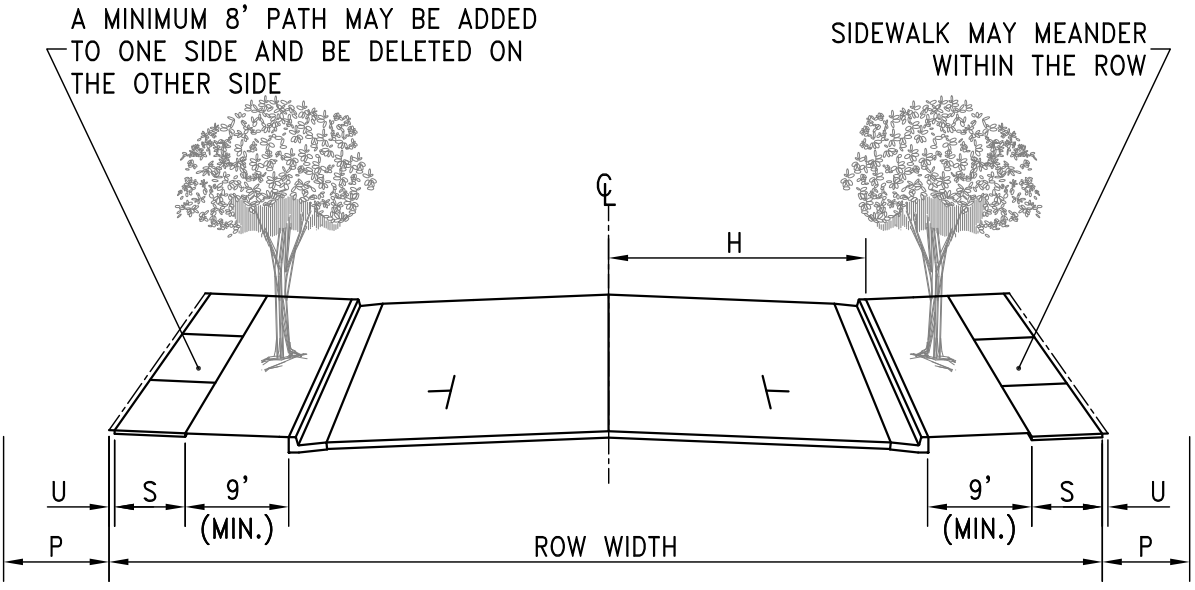
PRODUCT LINE

Concrete Poles	Manufacturers of concrete poles for hydro distribution, street lighting
Utility Structures	Manufacturers of utility vaults, distribution chambers and other electrical structures
Highway Barriers	Manufacturers of standard OPSD concrete barriers
Specialty Items	Bollards, Aluminum Pole bases

APPENDIX F – CITY OF RENO CONSTRUCTION STANDARD DETAILS







WITH PARKWAY

(RESIDENTIAL COLLECTOR AND LOCAL STREETS ONLY)

	STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION	DRAWING No.
RENO	ROADWAY SECTIONS	R-101A
		APPROVED BY: JF / DATE: 1/2013

STREET CLASSIFICATION	ROW WIDTH	P (8)	H	BF	M	S	U	A.D.T. (MAX.)
ARTERIAL–MAJOR	102 (4)	7.5	44.5	37	7.5	6	0.5	----
ARTERIAL–MINOR	82 (4)	7.5	34.5	--	--	6	0.5	30,000
COLLECTOR–COMMERCIAL	64	7.5	25.5	--	--	6	0.5	15,000
COLLECTOR–RESIDENTIAL (WITHOUT PARKWAY)	50	7.5	20.5	--	--	4	0.5	8,000 (6.)
COLLECTOR–RESIDENTIAL (WITH PARKWAY)	68	7.5	19.5	--	--	4	0.5	8,000 (6.)
LOCAL (WITHOUT PARKWAY)	46	7.5	17.5	--	--	4	0.5	1,000
LOCAL (WITH PARKWAY)	64	7.5	17.5	--	--	4	0.5	1,000

ALL UNITS IN TABLE ARE IN FEET UNLESS OTHERWISE NOTED.

ABBREVIATIONS:

A.D.T AVERAGE DAILY TRAFFIC
ROW RIGHT OF WAY WIDTH
℄ CENTERLINE OF ROW
P PRIVATE UTILITY EASEMENT WIDTH
H HALF STREET WIDTH (BACK FACE OF CURB TO CENTERLINE OF ROW)
M MEDIAN ISLAND WIDTH
BF HALF STREET WIDTH WITH MEDIAN ISLAND (BACK FACE OF CURB TO BACK FACE OF CURB)
S SIDEWALK WIDTH
U DISTANCE FROM BACK OF SIDEWALK TO ROW

NOTES:

1. BF AND H ARE MEASURED TO THE BACK FACE OF CURB.

2. CURB & GUTTER SECTIONS SHALL BE POURED SEPARATELY FROM SIDEWALK SECTIONS.

3. STRUCTURAL SECTION TO BE DETERMINED BY ENGINEERING DESIGN BASED ON RESILIENT MODULUS TESTING, BUT IN NO CASE SHALL THE A.C. BE LESS THAN 4" OVER 6" BASE.

(4.) ADDITIONAL ROW MAY BE REQUIRED ON ARTERIAL STREETS AND AT INTERSECTIONS.

5. WIDER SIDEWALKS ARE TO BE PROVIDED WHEN REQUIRED BY THE CITY ENGINEER.

(6.) RESIDENTIAL DRIVEWAY ACCESS SHALL NOT BE ALLOWED ON ANY STREET WHERE THE A.D.T. IS GREATER THAN 4,000.

7. REFER TO ADDITIONAL INFORMATION ON WIDTHS AND REQUIREMENTS FOR RESIDENTIAL COLLECTORS, LOCAL STREETS, ALLEYS, PERMANENT EMERGENCY ACCESS AND SHARED DRIVEWAYS AS CONTAINED IN THE CITY OF RENO'S DESIGN MANUAL.

(8.) ADDITIONAL EASEMENTS MAY BE REQUIRED FOR CITY CONDUIT.

RENO

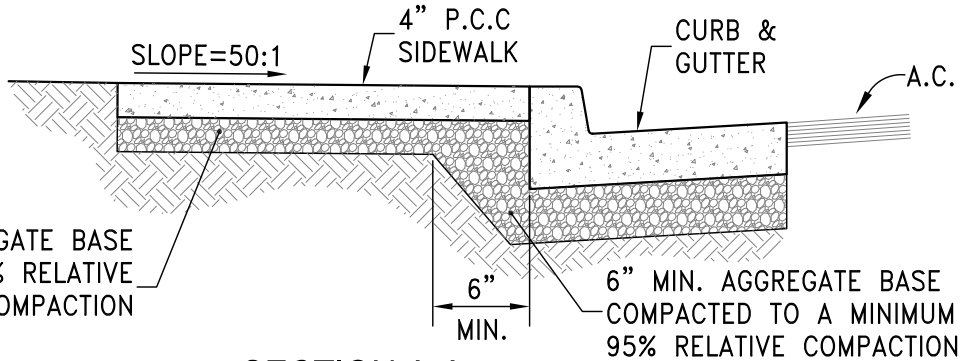
STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION

NOTES - ROADWAY SECTIONS

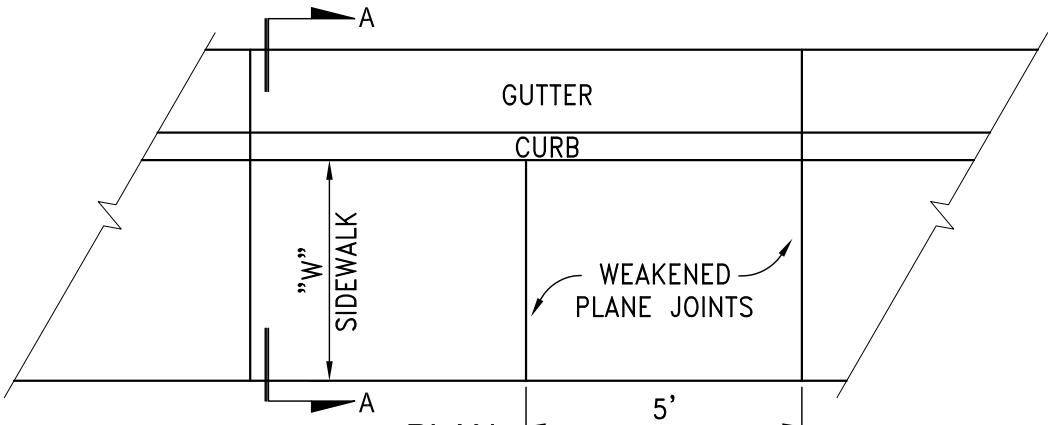
DRAWING No.

R-101B

APPROVED BY: JF | DATE: 1/2013



SECTION A-A



PLAN

NOTES:

1. FIBER-REINFORCED PORTLAND CEMENT CONCRETE (P.C.C.) SHALL HAVE THE FOLLOWING CHARACTERISTICS: 4000 PSI MIN. COMPRESSIVE STRENGTH AT 28 DAYS, MIN. 6 SACKS OF CEMENT PER CUBIC YARD WITH MAX. WATER-CEMENT RATIO OF 0.45, AIR ENTRAINMENT 6% ±1.5%, SLUMP AT 1 TO 4 INCHES. MIX DESIGN SHALL CONFORM TO THE REQUIREMENTS OF SECTION 337 OF STANDARD SPECIFICATIONS OF PUBLIC WORKS CONSTRUCTION (SSPWC). CEMENT SHALL BE TYPE II. ALL CEMENT CONCRETE SHALL HAVE A COARSE AGGREGATE GRADATION CONFORMING TO SIZE No. 67. POLYPROPYLENE OR CELLULOSE FIBERS SHALL BE ADDED TO THE P.C.C. AT 1.5 LBS. PER CUBIC YARD. ALL MATERIALS SHALL CONFORM TO SSPWC.

2. AGGREGATE BASE MATERIAL UNDER SIDEWALKS SHALL BE TYPE 2, CLASS B CRUSHED AGGREGATE BASE. MATERIALS SHALL CONFORM TO SSPWC SECTION 200.

3. SIDEWALK WIDTH "W" SHALL BE 4 FT MIN. ON RESIDENTIAL STREETS AND 6 FT MIN. ON COLLECTOR AND ARTERIAL STREETS.

4. WEAKENED PLANE JOINTS SHALL BE CONSTRUCTED AT 5 FT INTERVALS AND ACCORDANCE WITH SECTION 312 OF THE SSPWC.

5. ALL ADJACENT CONCRETE REMOVAL SHALL BE TO NEAT SAW CUT LINES AT RIGHT ANGLES TO NEW SIDEWALK. DOWEL INTO EXISTING ADJACENT CONCRETE SIDEWALK WITH A MINIMUM OF TWO (2) No. 4 REINFORCEMENT BARS EQUALLY SPACED ACROSS WIDTH "W". DOWELS SHALL PENETRATE A MINIMUM OF 4" INTO EXISTING CONCRETE.

6. SIDEWALKS SHALL NOT BE POURED MONOLITHICALLY WITH CURBS.

7. COLORED CONCRETE AND PAVERS ARE NOT ALLOWED.

8. TUNNELING AND/OR BORING IS NOT ALLOWED.

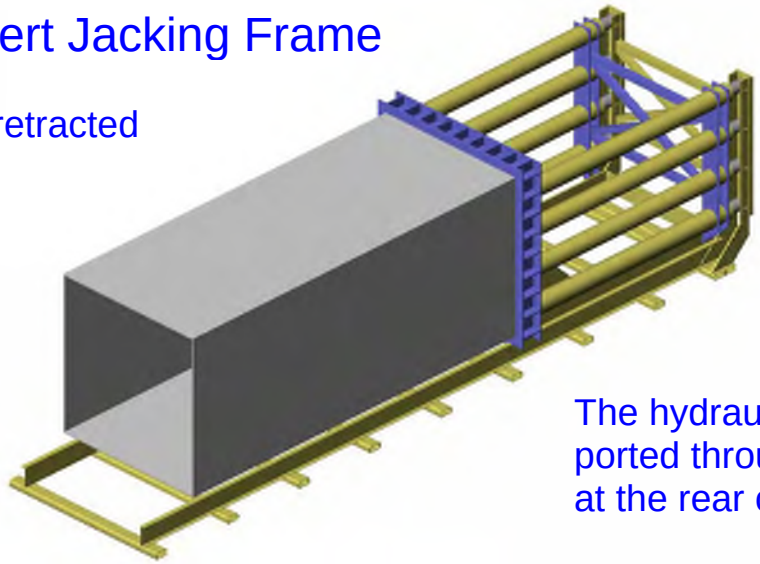
	STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION	DRAWING No.
RENO	SIDEWALK DETAIL	R-104A
		APPROVED BY: JF / DATE: 1/2013

APPENDIX G – TENBUSCH BOX CULVERT JACKING FRAME BROCHURE

TENBUSCH

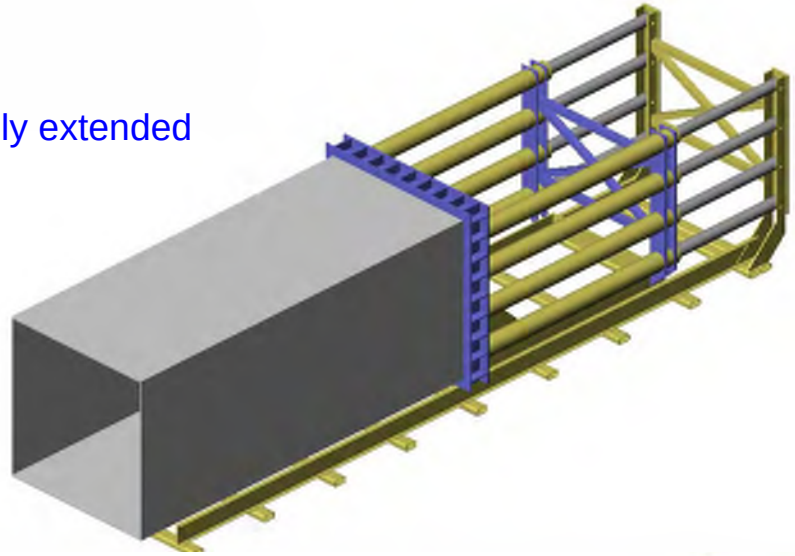
Box Culvert Jacking Frame

Fully retracted

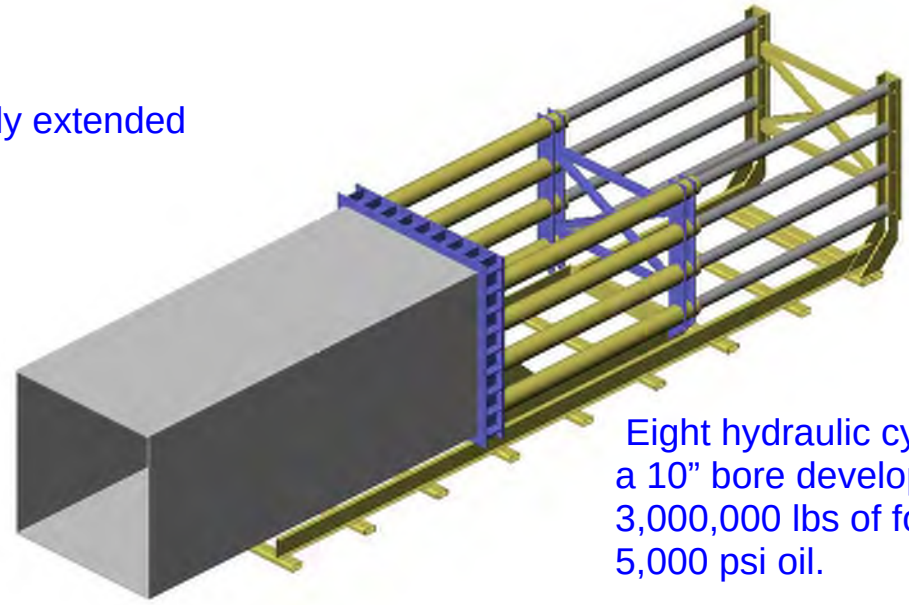


The hydraulic cylinders are ported through the rod end at the rear of the pit.

Partially extended



Fully extended



Eight hydraulic cylinders with a 10” bore develop over 3,000,000 lbs of force using 5,000 psi oil.

APPENDIX D: ECONOMIC APPENDIX

HANSFORD ECONOMIC CONSULTING LLC

Peavine Mountain Watershed - West Wash Dam Rehabilitation

Economic Appendix

USDA United States Department of Agriculture

Natural Resources Conservation Service

BIGGEST LITTLE CITY IN THE WORLD

CITY OF RENO

September 27, 2022

HEC No. 200333

DRAFT

This Economic Appendix to the Peavine Mountain Watershed – West Wash Dam Rehabilitation was prepared by Hansford Economic Consulting LLC.

The analyses and findings contained within this report are based on primary and secondary data available as of the date of this report and the methodologies used to conduct the work, which were provided by the United States Department of Agriculture, Natural Resources Conservation Science, and the United States Army Corps of Engineers. Updates to information used in this report could change or invalidate the findings contained herein. While it is believed that the primary and secondary sources of information are accurate, this is not guaranteed.

Every reasonable effort has been made in order that the data contained in this study reflect the most accurate and timely information possible. No responsibility is assumed for inaccuracies in reporting by the client, its consultants and representatives, or any other data source used in the preparation of this study. No warranty or representation is made that any projected values or results contained in this report would actually be achieved. Changes in economic and social conditions that may impact the findings of this report include, but are not limited to, national and local economic recessions, climate change, major environmental problems and natural disasters.

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Section 1: INTRODUCTION AND FINDINGS

1.1 INTRODUCTION

This document presents the economic analysis prepared as input to the Peavine Mountain Watershed – West Wash Dam Rehabilitation Project (Project), sponsored by the City of Reno (City or Reno) and the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS).

The West Wash Dam was built in 1960 under the direction and authority of the Watershed Protection and Flood Prevention Act (Public Law 83-566). The East Wash diversion dam was built in the same year under the same program to move storm water flow from the Peavine Mountain watershed into the West Wash Dam. Both the East and West Wash dams are eligible for rehabilitation through the USDA Watershed and Flood Prevention Operations Program. Both dams are currently classified as High Hazard dams by the Nevada Division of Water Resources and do not meet requirements for dam safety as prescribed by either the State of Nevada or the NRCS.

While flooding does occur in the City of Reno (predominantly in the Truckee River corridor), there haven't been any damages resulting from flood waters at the West Wash Dam since the impoundment was constructed in 1960. In the event that a local Probable Maximum Precipitation Event (PMP) were to occur in the Peavine Watershed, the City would deploy its Emergency Action Plan (EAP). The EAP uses a Yellow Alert and Red Alert. Yellow alert provides warning up to 5 days in advance of the anticipated flood event, and Red Alert evacuation approximately 24 to 48 hours in advance (2018 Washoe County Regional Flood Response Action).

1.2 PURPOSE OF THE ECONOMIC ANALYSIS

The Economic and Environmental Principles and Guidelines (P&G) for Water and Related Land Resource Implementation Studies (Executive Order 11747) Chapter 1, Section II is the guiding document used for the enclosed economic analysis[1]. Other key documents used in the development of the economic analysis are listed in Section 6.

The purpose of the economic analysis is to identify, among the reasonable alternatives both required and selected, the alternative that best meets the Federal Objective.

The Federal Objective.

> The Federal objective of water and related land resources planning is to contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements.

The National Economic Development (NED) Plan is further defined in P&G § 1.6.3:

[1] The plan follows the P&G rather than the Principles, Requirements and Guidelines (PR&G) because the project was initially funded prior to June 1, 2018, after which date PR&G would be required.

"A plan that reasonably maximizes net national economic development benefits, consistent with the Federal objective, is to be formulated. This plan is to be identified as the national economic development plan."

The NED Plan consistent with protecting the Nation's environment must be selected for funding to be provided through the USDA Watershed and Flood Prevention Operations Program unless the Secretary of a department or head of an independent agency grants an exception when there is some overriding reason for selecting another plan, based upon other Federal, State, local, and international concerns.

The following only applies to the Watershed Rehabilitation Program: National Watershed Program Handbook Section 502.2, states, "In cases where human life is at risk in the event of catastrophic failure of an existing dam that does not meet current safety and performance standards, an overriding reason for an exception to the NED plan requirement exists.

(1) To avoid seeking individual exceptions in such cases, the NED plan is defined as the federally assisted alternative with the greatest net economic benefits. ***Thus, for rehabilitation projects, the no-action alternative may not be identified as the NED alternative, but will continue to be included to allow a valid comparison of the reasonable alternatives.***

(2) Rehabilitation alternatives, required by legislation and policy to be evaluated, include no action, decommissioning, rehabilitation, and, where applicable, relocation of at-risk dwellings, as well as additional alternatives, as appropriate.

(3) If all reasonable alternatives result in the same benefits, use a least-cost analysis to evaluate alternatives and select the NED plan. ***If benefits of all alternatives are not the same, a benefit-cost analysis will be completed for all reasonable alternatives***. A project-specific exception would be required if the policy-identified NED plan is not selected."

The West Wash Dam economic analysis, presented in this appendix, conducts a Benefit-Cost Analysis (BCA) for all reasonable and required alternatives, and identifies the NED plan.

1.3 PROJECT ALTERNATIVES

Through a series of public workshops and consultation between the project sponsors and the consulting engineer for the project, Farr West Engineering, four reasonable and required project alternatives have been identified. **Table 1-1** provides a summary of the project alternatives.

Alternatives 1 through 3 keep or rehabilitate the West Wash Dam. Flooding under the 100-year, 200-year, 500-year, and local PMP events were simulated for these alternatives. Alternatives 4 and 5 remove the dams; flooding under the 10-year, 25-year, 50-year, and 100-year events were simulated for these alternatives.

Table 1-1
Summary of the Project Alternatives

Alternatives	Flood Event	The Project	Conditions
1 **Future Without Project**	100-YR, 200-YR, 500-YR, Local PMP	City continues maintenance of existing dams. No improvements. **Does not meet State dam standards for the PMP.**	Existing dam does not release any water over the AS until the 200-yr storm. EW will not breach during a PMP event. **WW will breach during a PMP event.**
2 **Downstream Flood Improvements**	100-YR, 200-YR, 500-YR, Local PMP	**No improvements to existing dams; flood-proof downstream.** Purchase all structures within the WW Local PMP breach inundation areas that will have over a foot of water on property and repair damages to structures that will have under a foot of water on property. **Does not meet State dam standards for the PMP.**	Existing dam does not release any water over the AS until the 200-yr storm. EW will not breach during a PMP event. **WW will breach during a PMP event.**
3 **Remediate West Wash Dam to contain PMP**	100-YR, 200-YR, 500-YR, Local PMP	**Improve existing WW dam**. Raise WW dam 5 feet, add 2 foot parapet wall on eastern berm near dam, regrade western slope of impoundment area to hold more water, widen AS to 80 feet, lower AS crest height by 2.4 feet.	AS will not activate until 500-year storm. Local PMP will have 3ft of freeboard and there will be **no breach of dam.**
4 **Remove both Dams**	10-YR, 25-YR, 50-YR, 100-YR	**Remove both dams** and regrade impoundment areas to reflect pre-development conditions.	**All storm events will flood structures downstream of both dams.**
5 **Remove both Dams - Flood Conveyance to Truckee River**	10-YR, 25-YR, 50-YR, 100-YR	**Remove both dams**; **construct a channel that will convey 100-year flood flows to the Truckee River**. Purchase and demo all structures in proposed channel alignment and construct box culvert crossings under all perpendicular roads and RR.	**Channel will not flood in any instances**; will hold 100-yr storm with freeboard.

Notes: EW = East Wash, WW= West Wash, AS = Auxiliary Spillway, RR= Railroad.

Alternatives 2 and 5 include significant land acquisitions as part of the project. Only the acquisition costs are included in the economic analysis; however, moving and relocation expenses could be a significant factor in selecting the alternative project. It is here noted that the requirements of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646), as amended, include real property acquisition relocation payments to a displaced person, business, or farm operation. Such payments include moving and related expenses for a displaced person, business, or farm operation; financial assistance for replacement housing for a displaced person who qualifies and whose dwelling is acquired because of the project; and termination payments for dislocated businesses whose owners choose to close out. In addition, replacement dwellings must be decent, safe, and sanitary. If a displaced homeowner's current dwelling does not meet these minimum requirements, then it requires a betterment by replacing the dwelling with a structure that meets the minimum requirement. If the replacement dwelling is above decent, safe,

and sanitary conditions then those costs above the minimum requirement are the sole responsibility of the non-federal cost-share partner(s).

1.4 Methodology Overview

The BCA is performed in a series of steps that are described here:

BCA	Step	Table(s) in Report	Description
Background and	1	Maps 3-1, 3-2, and 3-3	Identify the Affected Area (performed by Farr West Engineering).
Engineering	2		Identify the properties and assets in the Affected Area (performed by Farr West Engineering).
	3		Determine flood depth, velocity and duration of flooding (performed by Farr West Engineering).
	4	Table 3-1	Determine the useful life of the project, period of the BCA analysis, and the discount factor.
	5		Create a database of parcels with depth of flooding on each parcel for each flood event under each alternative (completed by Farr West Engineering).
Benefits Analysis	6	Tables 3-2 through 3-4	Categorize properties to perform damages analysis and refine database for queries. Inventory damages from single flood events.
	7	Tables 3-5 through 3-10	Determine the depth-damage curves for physical property damages (structures and contents).
	8	Table 3-11	Calculate damage costs for each event under each alternative.
	9	Tables 4-1 and 4-2	Determine the damage-frequency (probability of the event) and Expected Annual Damage (EAD) for each alternative.
	10	Tables 4-3 through 4-6	Calculate the average annual equivalent benefits for each alternative.
Costs Analysis	11	Tables 4-7 and 4-8	Estimate installation project costs at base year - 2025 dollars – (completed by Farr West Engineering).
	12	Tables 4-9 and 4-10	Estimate project maintenance costs (completed by the City of Reno).
	13	Tables 4-11 and 4-12	Calculate the average annual equivalent project installation and maintenance costs.
Results	14	Tables 5-1 through 5-4	Compute Net Benefits and Benefit-Cost Ratios
	15	Table 5-5	Display Results and the NED Alternative

The BCA does not include all potential benefits and costs that could be monetized in the NED account. **Table 1-2** summarizes the economic impacts included and excluded from the analysis.

Table 1-2
Economic Impacts Included and Excluded in the NED

Benefits	Costs
Included in the BCA Damages to buildings/structures & contents	**Included in the BCA** Design & other soft costs, project construction, land/property purchases, maintenance costs for life of project
Excluded from the BCA Erosion, recreation loss, income loss (wages & profits), relocation costs, emergency costs & post-flood clean-up costs, vehicle damages, time lost due to detours (road & rail); damage to special and unique facilities	**Excluded from the BCA** Existing structure demolition costs, flood-proofing of existing structures costs, permanent relocation costs, land restoration costs, long-term environmental control costs

Given the scope and budget of the economic analysis for the Peavine Mountain Watershed - West Wash Dam Rehabilitation Project, damages analysis was limited to structural damages. In review of other recently completed flood control project economic analyses, structural (including contents) damages comprise the vast majority of total damages identified and monetized. In the Saint Vrain Creek, Longmont, Colorado economic analysis (completed in 2020), which conducted a thorough analysis of different measurable damages, 87% of total damages monetized in the NED were structural.

Although additional damages and costs could be monetized, their addition is not anticipated to change the results of the economic analysis for these reasons:

- There is little recreation value from the current project. The only recreation is for activities such as dog-walking and riding bicycles. These activities have been a by-product of building the West Wash Dam, they were not an intended recreational use of the facilities.

- The EAP Red Alert gives approximately 24 to 48 hours advance notice to evacuate. This is sufficient time for most residents to remove vehicles from the premises, as well as key items of value and sentiment. Economic Guidance Memorandum (EGM) 09-04 provides that only 12% of respondents to a survey would not move at least one vehicle to higher ground with warning time greater than 12 hours.

- Even a local PMP event would result in traffic re-routing of no more than 12 hours (City of Reno estimate based on prior floods in the City). Delays to railroad activities could be more significant; however, these were not included in the analysis due to budgetary constraints.

- Due to the short duration of even the worst possible flood event, temporary relocation costs are not anticipated to be significant compared to the cost of the structural and content damages.

- Income loss was excluded from the benefits analysis due to the short duration of the potential worst flood. Income loss would be greater under some alternatives than other alternatives.

- Local share of clean-up costs from flooding is a cost item that the City budgets for. The most recent floods, from the Truckee River, cost the City $2.13 million (in 2005) and $3.92 million (in 2017), with the local cost share approximately 4%, and 96% of costs reimbursed by the Federal Emergency Management Agency (FEMA). It is anticipated that there would be emergency and clean-up costs incurred under all alternatives except alternative 5. This item was not included in the analysis due to time and budgetary constraints.

- Existing structure demolition costs were excluded from the analysis given the high-level of planning at this stage of the project. Flood-proofing of existing structures would only be required for Alternative 2, which is already the most expensive project (addition of such costs would not change the outcome of the analysis). Land restoration and long-term environmental control costs are not monetized but are discussed in the Environmental Assessment.

1.5 FINDINGS

Results of the NED account analysis are shown in **Table 1-3**. The table displays the differences between the forecasted conditions with the projects (alternatives 2 through 5) and forecasted conditions without a project (Alternative 1).

The NED Plan is Alternative 3 because it has the greatest net benefit, even though the benefit is negative. Under Alternative 3, all existing properties are protected as they are currently in the 100-year flood event, and better in the 200-year, 500-year, and local PMP events. Further, in a local PMP event, Alternative 3 would allow a controlled release through the auxiliary spillway; fewer properties in total would be damaged than in the future without a project, and both East and Wash dams would be in compliance with State dam requirements. OSE and RED accounts further decrease the net benefits of alternatives 2 and 5, and reaffirm that Alternative 3 is the best project alternative.

The RED account monetizes the property tax loss from property acquisitions under alternatives 2 and 5, as this information is readily available in the data from the Washoe County Assessor (Assessor) used to conduct the economic analysis. Property taxes (which are allocated among the State of Nevada (State), and local service providers) would be reduced by $69.7 million per year under Alternative 2 and $6.7 million per year under Alternative 5. Other municipal revenue losses were not monetized but would increase the negative benefits in the RED account.

Table 1-3
NED Results

Alternative		Equivalent Annual Net Benefit *	Benefit-Cost Ratio
		In $1,000s	
Alt. 1	Future Without Project [1], [2]	N/A	N/A
Alt. 2	Downstream Flood Improvements [1]	($42,570)	0.00:1
Alt. 3	**Remediate West Wash Dam to contain PMP**	**($510)**	**0.16:1**
Alt. 4	Remove both Dams	($13,570)	-96.3:1
Alt. 5	Remove Dams - Flood Conveyance to Truckee River	($4,130)	0.00:1

** Rounded up to the nearest ten thousand dollars.*
The Alternative 3 net benefit is negative $510,000, for example.

[1] Under both of these alternatives, the West Wash Dam Auxiliary Spillway breaches during the PMP.

[2] Pursuant to the National Watershed Program Manual Section 502.2, existing dams not meeting current safety and performance standards cannot be identified as the NED alternative, but will continue to be included to allow a valid comparison of the alternatives.

The OSE account measures some of the social and other impacts that would occur under alternatives 2 and 5. Alternative 2 displaces about 2,000 permanent residents, causes an estimated almost 2,500 jobs to be lost, and reduces annual visitation to Reno's Downtown by about 18,000 people per year.

Alternatives 2, 4, and 5 fundamentally alter the economic fabric and character of the City of Reno. Downtown Reno is the historical heart of the "Biggest Little City". In addition, the socioeconomic description of the Affected Area (see Section 2) shows there is a high proportion of minorities living in Downtown Reno compared with the City of Reno, as well as a lower income, more transitory and older population with a higher proportion of the population having a disability, and living in poverty than in the City of Reno, the State, and the US. These disadvantaged persons would be severely impacted as much of Downtown Reno becomes a flood plain under alternatives 2, 4, and 5; they would not be impacted under alternative 3.

Given the results of the NED account analysis, and the findings of the RED and OSE accounts, as well as description of the socioeconomic characteristics of the Affected Area, Alternative 3 is the recommended alternative.

Section 2: STUDY AREA

2.1 LOCATION AND LAND USE

West Wash Dam lies within northwest Reno, as shown in **Map 1**. The City of Reno has a population of 250,900, and is itself part of the Reno-Sparks Metropolitan Area, which has a population of 468,300[2]. The area protected by the West Wash Dam is urban, containing mostly residential and non-residential uses, some governmental and quasi-governmental uses, and two public parks.

Map 1
West Wash Dam Location

Photo from Google Earth.

The "Affected Area", which is the area in the City of Reno containing properties that could potentially be damaged by a flooding event in the local area of the West Wash Dam, is displayed in **Map 2**. Land uses of the properties shown in blue (flooded in the local PMP event) in Map 2 are summarized in **Table 2-1**. In total, 364 acres could be flooded.

The Affected Area encompasses six census tracts; 13, 14, and 24.01 located north of Interstate 80 (I-80), and 1.03, 1.04, and 1.06 located south of I-80. Other census tracts shown on **Map 2** are not included in the following description of the Affected Area.

[2] Table DP05, US Census Bureau – 2020 American Community Survey 5-year estimates.

Map 2
Map of the Affected Area

Table 2-1
Acreage Potentially Flooded (Future without Project)

Land Use	Acres	Percentage of Area
Single Family Residential	123	34%
General Commercial [1]	84	23%
Vacant	68	19%
Entertainment (casinos, hotels, resorts) [2]	40	11%
Public Parks	6	2%
Apartments & Townhomes	12	3%
Office & Professional Uses	11	3%
Common Area	13	3%
Industrial & Warehouse	4	1%
Public Utility	3	1%
Total	**364**	**100%**

Source: Farr West Engineering and Washoe County Assessor, March 2022.

[1] Includes retail, restaurants, fast food, churches, convenience stores, a railroad passenger terminal, and St. Marys Hospital.

[2] Includes the bowling center and convention center owned by the City of Reno.

About a third of the total land area that is estimated to be inundated during a local PMP event is used for single family (attached and detached) housing. The majority of the single-family housing is located north of I-80. General commercial uses are found both north and south of I-80, with the greatest concentration being along Keystone Avenue. General commercial encompasses a wide variety of uses including retail, restaurants, fast food, churches, and convenience stores, as well as some specialty uses including a railroad passenger terminal, and St. Mary's Hospital. Office and professional uses are scattered around the downtown core, with many of the buildings having been converted from residential to office use.

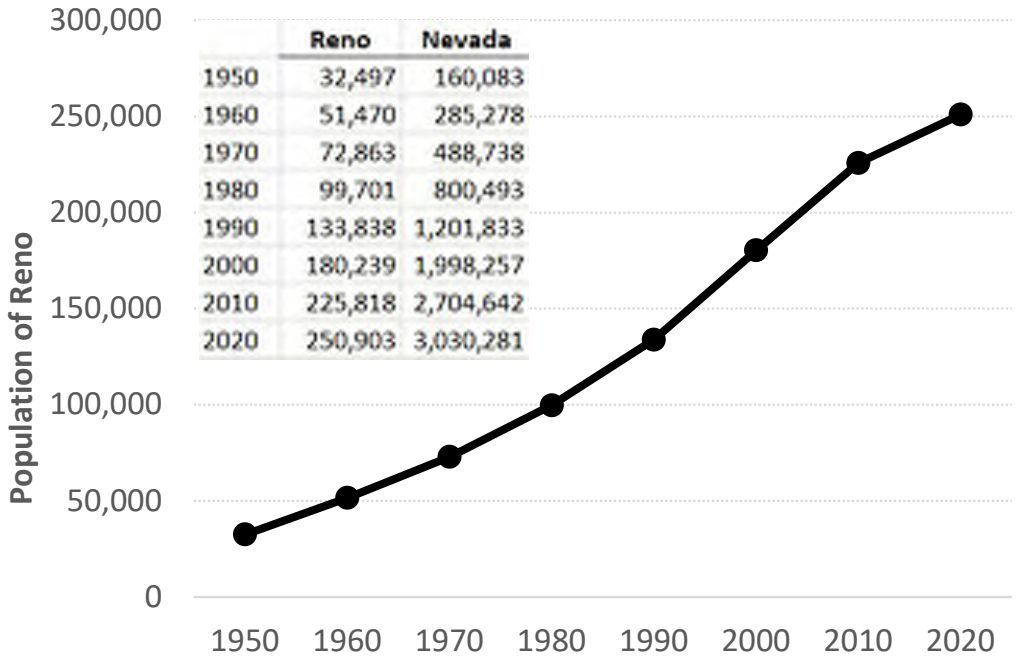
There are several other specialty uses of land in Downtown Reno. Casinos, once the primary source of municipal revenues to Northern Nevada, still line Virginia Street, interspersed with some large and moderate-sized hotels. The National Bowling Stadium and the Convention Center, both owned by the City of Reno, lie in the flood inundation area, as well as Greater Nevada Field, home of the Reno Aces (triple-A baseball team). The Union Pacific Railroad track, which reached Reno 154 years ago, runs through the heart of downtown.

2.2 POPULATION AND HOUSING

The City of Reno is a thriving economic hub with a growing population. **Figure 1** shows population growth in the City of Reno and State of Nevada since 1950, the last decennial Census before the West Wash Dam was constructed.

The City of Reno has sustained an average annual population growth of 3.0% since 1950, while the State of Nevada has seen average annual population growth of 4.3% during the same period.

Figure 1
City of Reno Historical Population Growth



	Reno	Nevada
1950	32,497	160,083
1960	51,470	285,278
1970	72,863	488,738
1980	99,701	800,493
1990	133,838	1,201,833
2000	180,239	1,998,257
2010	225,818	2,704,642
2020	250,903	3,030,281

Source: US Census Bureau.

Table 2-2 compares socioeconomic variables that describe the Affected Area with the City of Reno, the State of Nevada (State), and the United States (US).

Population. There are about 16,200 residents (6% of Reno's total population) living in the Affected Area, although not all of the homes would sustain damage in the event of a local PMP event and subsequent expected breach of the West Wash Dam auxiliary spillway. The median age of residents in Reno is 38.5 years, about the same as in the US and the State; in the Affected Area, the median age is much greater in three of the census tracts (48.6 years, 49.4 years, and 56.2 years). These three census tracts lie south of I-80.

Compared with the City of Reno, the State, and the US, there is a much larger percentage of persons living below the poverty level in three of the census tracts, including two of the tracts south of I-80, and census tract 14. There is also a much higher proportion of people living with a disability in two of the census tracts south of I-80 (32% and 26% compared with 12% in Reno, the State, and the US). Median household income (MHI) varies widely between the census tracts; from 53% of the City's MHI to 122% of the City's MHI. Generally, household income is higher in the mostly residential areas north of I-80. Conversely, there is a high proportion of residents receiving food stamps/SNAP benefits in Downtown Reno.

The unemployment rate is similar to the State and the US in most of the census tracts (5% to 7%), but it is much higher in Downtown Reno (at least 15%). The percentage of households without a vehicle is much greater in Downtown Reno (18% to 45%) compared with the State and the US (8%); the same as the City of Reno in census tract 14, and lower than the State average of 7% in census tract 13 (5%) and census tract 24.01 (2%).

Housing. There is a total of 7,900 housing units in the Affected Area (7% of the City's housing stock). Most of the housing units are north of I-80; however, there is also a relatively large number of homes located in census tract 1.04, which is south of I-80. Note that the vast majority of the homes in this census tract lie outside of the flooded portion of the census tract.

A large share of the housing units are studio and 1-bedroom units south of I-80. In the City, 21% of units have 1-bedroom or less; in the tracts south of I-80, 86% of units are this size in census tract 1.03, 61% in census tract 1.04, and 95% in census tract 1.06. A third of the housing units in census tract 14 are studio or 1-bedroom units. These statistics indicate a very transitory population living in the Affected Area, particularly in the area south of I-80, which is Downtown Reno.

With the exception of census tract 24.01, the housing stock is generally older than for the City of Reno, and much older than the State, reflecting the rapid growth in other parts of the State in the past 50 years. Occupancy is similar to that of the City, State, and the US in most of the census tracts, but it is lower in census tract 1.03, where many older homes have been repurposed from residential to commercial uses. The percentage of units that are occupied by owners is significantly low south of I-80. Only 4% of units are occupied by owners in some parts of Downtown Reno. This is much lower than the City's average of 48%, the State's average of 57%, and the US average of 64%. Two of the census tracts north of I-80 have much higher owner occupancy than the City, State, and US.

As expected with the high proportion of studio and one-bedroom units south of I-80, in and around downtown Reno, household sizes are smaller in and around Downtown Reno.

The socioeconomic variables point to a generally older, more transitory, lower-income, and disabled population south of I-80, and a more typical residential population (meaning more similar to the City, State, and the US) living in the Affected Area north of I-80.

Table 2-2
Socioeconomic Characteristics

Variable	United States	State of Nevada	City of Reno	Census Tract (South of I-80) 1.03	1.04	1.06	Census Tract (North of I-80) 13	14	24.01
Population	**326,569,308**	**3,030,281**	**250,903**	**963**	**2,922**	**1,175**	**3,465**	**3,439**	**4,190**
Median Age	**38.1**	**38.0**	**38.5**	**48.6**	**49.4**	**56.2**	**38.0**	**22.5**	**32.2**
Persons below the Poverty Level	40,910,326	381,695	31,049	280	455	566	477	1,139	360
Percent below the Poverty Level	*13%*	*13%*	*12%*	*29%*	*16%*	*48%*	*14%*	*33%*	*9%*
Population with a Disability	40,786,461	375,254	29,390	308	485	307	555	197	449
Percent with a Disability	*12%*	*12%*	*12%*	*32%*	*17%*	*26%*	*16%*	*6%*	*11%*
Median Household Income	**$64,994**	**$62,043**	**$58,790**	**$30,906**	**$49,754**	**n.a.**	**$70,464**	**$38,884**	**$71,912**
Percent of State MHI				*53%*	*85%*	*n.a.*	*120%*	*66%*	*122%*
Households receiving Food Stamp/SNAP Benefits	11%	12%	11%	18%	12%	42%	11%	5%	4%
Total Housing Units	**138,432,751**	**1,268,533**	**112,516**	**904**	**1,819**	**600**	**1,459**	**1,593**	**1,582**
Occupied	122,354,219	1,130,011	105,321	699	1,749	511	1,347	1,383	1,530
Vacant	16,078,532	138,522	686	205	70	89	112	210	52
Occupancy	*88%*	*89%*	*94%*	*77%*	*96%*	*85%*	*92%*	*87%*	*97%*
Owner-Occupied	78,801,376	644,864	50,244	30	618	22	953	295	1,023
Percent occupied by Owners	*64%*	*57%*	*48%*	*4%*	*35%*	*4%*	*71%*	*21%*	*67%*
Studio / 1-bdrm Units	18,545,872	172,138	23,267	774	1,101	569	107	532	181
2+ Bedroom Units	119,886,879	1,096,395	89,249	130	718	31	1,352	1,061	1,401
Percent of Units less than 2 Bedrooms	*13%*	*14%*	*21%*	*86%*	*61%*	*95%*	*7%*	*33%*	*11%*
Built since 1970	85,996,081	1,131,168	88,029	590	829	405	645	639	1,345
Older than 50 Years	52,436,670	137,365	24,487	314	990	195	814	954	237
Percent of Units older than 50 Years	*38%*	*11%*	*22%*	*35%*	*54%*	*33%*	*56%*	*60%*	*15%*
Persons per Household	**2.67**	**2.68**	**2.38**	**1.38**	**1.67**	**2.30**	**2.57**	**2.49**	**2.74**
Civilian Labor Force	**164,759,496**	**1,525,262**	**138,697**	**620**	**1,969**	**518**	**1,726**	**2,451**	**2,655**
Employed	155,888,980	1,425,040	131,317	528	1,867	367	1,662	2,265	2,419
Unemployment Rate	*5%*	*7%*	*5%*	*15%*	*5%*	*29%*	*4%*	*8%*	*9%*
Average Travel Time to Work (minutes)	27	25	21	21	23	21	20	20	26
Households with Vehicles									
No Vehicle	10,344,521	82,002	9,243	188	318	228	71	131	34
At least 1 Vehicle	112,009,698	1,048,009	96,078	511	1,431	283	1,276	1,252	1,496
Percentage Households without a Vehicle	8%	7%	9%	27%	18%	45%	5%	9%	2%

Source: 2020 American Community Survey 5-year estimates, US Census Bureau.

Table 2-3 shows that there is a high proportion of minorities living in Downtown Reno compared with the City of Reno. North of I-80, minorities are a smaller percentage of the total population. Latino and Asian minorities represent the largest number of minorities.

Table 2-3
Race and Ethnicity

Race and Ethnicity	City of Reno	Census Tract (South of I-80) 1.03	1.04	1.06	Census Tract (North of I-80) 13	14	24.01
Minorities							
Black	7,967	23	60	327	10	64	196
American Indian and Alaska Native	2,778	59	33	38	8	112	0
Asian	18,057	121	494	57	320	316	711
Native Hawaiian and Pacific Islander	1,975	0	0	8	1	26	0
Latino Ethnicity (any race)	60,270	107	873	105	368	685	441
Total Minorities	**91,047**	**310**	**1,460**	**535**	**707**	**1,203**	**1,348**
Total Population	**250,903**	**963**	**2,922**	**1,175**	**3,465**	**3,439**	**4,190**
Minorities as Percentage of Total	**36%**	**32%**	**50%**	**46%**	**20%**	**35%**	**32%**

Source: 2020 American Community Survey 5-year estimates, US Census Bureau.

2.3 EMPLOYMENT

Reno's labor force primarily works in educational services, health care, social assistance, arts, entertainment, recreation, accommodation and food services, and retail trade. **Table 2-4** shows that the primary employment industry for residents in the Affected Area is arts, entertainment, and recreation, and accommodation and food services. In the census tracts north of I-80, a high proportion of residents are employed in educational services, and health care and social assistance. The labor force in the Affected Area works in industries that reflect the overall City employment.

The percentage of workers working from home is similar in the Affected Area as in the City. For those who travel to work, driving alone is the main form of transportation in all census tracts, except 1.06. Only 40% of workers drive alone in census tract 1.06 (downtown), 59% of workers drive alone in census tract 1.04 (downtown), and 60% drive alone in census tract 14 (close to downtown but north of I-80 and connected by bridges). In two of these census tracts, a high proportion (20%-25%) of workers walk to work. In the area south of I-80, a much higher proportion of workers use public transit than in the City.

The employment figures also point to a lower-income, more transitory population living in or near the downtown core working in lower-paying service industry jobs (at the casinos, hotels, and restaurants for example).

Table 2-4
Employment by Industry Sector and Means of Travel to Work

Occupation	City of Reno	Census Tract (South of I-80) 1.03	1.04	1.06	Census Tract (North of I-80) 13	14	24.01
Industry							
Agriculture, forestry, fishing & hunting, and mining	1%	0%	1%	0%	0%	2%	1%
Construction	7%	0%	4%	3%	6%	4%	7%
Manufacturing	7%	15%	7%	7%	4%	3%	4%
Wholesale trade	3%	3%	3%	0%	2%	6%	2%
Retail trade	12%	15%	11%	2%	17%	8%	14%
Transportation & warehousing, and utilities	6%	16%	5%	13%	5%	2%	6%
Information	2%	0%	0%	0%	2%	0%	1%
Finance & insurance, and real estate & rental and leasing	5%	8%	7%	4%	6%	1%	11%
Professional, scientific, & management, and administrative & waste management services	11%	13%	14%	17%	12%	15%	8%
Educational services, and health care & social assistance	20%	8%	13%	10%	17%	28%	22%
Arts, entertainment, & recreation, and accommodation & food services	18%	16%	26%	44%	20%	26%	14%
Other services, except public administration	4%	0%	2%	1%	5%	2%	3%
Public administration	4%	6%	6%	0%	4%	3%	7%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Percentage of the Labor Force							
Working from Home	4%	0%	10%	7%	6%	6%	2%
Working Elsewhere	96%	100%	90%	93%	94%	94%	98%
Means of Transportation to Work							
Driving Alone	79%	73%	59%	40%	79%	60%	79%
Carpooling	13%	10%	5%	20%	10%	13%	14%
Using Public Transportation	2%	11%	20%	12%	6%	1%	1%
Walking to Work	4%	6%	9%	23%	2%	21%	1%
Other Means	2%	0%	7%	6%	2%	5%	4%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Source: 2020 American Community Survey 5-year estimates, US Census Bureau.

Section 3: ECONOMIC ANALYSIS COMPONENTS

The Economic and Environmental Principles and Guidelines (P&G) for Water and Related Land Resource Implementation Studies (Executive Order 11747) provides four accounts in which to record information that may be relevant to decision makers. These include:

a) National economic development (NED) - shows effects on the national economy,

b) Environmental quality (EQ) - shows effects on ecological, cultural, and aesthetic attributes of significant natural and cultural resources that cannot be measured in monetary terms,

c) Regional economic development (RED) - shows the regional incidence of NED effects, income transfers, and employment effects, and

d) Other social effects (OSE) - shows urban and community impacts and effects on life, health and safety.

The NED account (P&G § 1.7.2) is the only required account. Other information that is required by law or that will have a material bearing on the decision-making process should be included in the other accounts (EQ, RED, and OSE) or in some other appropriate format used to organize information on effects. Effects in the NED account must be expressed in monetary units. EQ effects can be expressed in appropriate numeric units or non-numeric terms. RED and OSE effects can be expressed in monetary units, other numeric units, or non-numeric terms. Monetary values must be expressed in average annual equivalents by appropriate discounting and annualizing techniques using the applicable discount rate.

3.1 NED ACCOUNT

The NED analysis used the following general methodologies:

- The BCA is conducted for a 56-year period to include six years of planning and construction and the estimated useful life of the project (50 years). A sensitivity analysis was run with a 100-year evaluation period, the maximum allowable evaluation period; it did not change the results of the analysis. While each of the alternatives have different planning and construction timeframes, the schedule for Alternative 3 (Dam Remediation) is used for all of the alternatives. Per P&G § 1.4.12 (a) The period of analysis is to be the same for each alternative plan.

- Benefits and costs for this study are computed at the March 2022 price level.

- The analysis uses the current Federal Water Projects discount rate of 2.25 percent, which is applicable until September 30, 2022. The discount rate is used to discount benefits and costs projected to be realized. The discount rate can be commonly thought of as the cost of money, or the interest rate. **Table 3-1** provides the discount factor used in the analysis.

Table 3-1
Period of Analysis and Discount Factor

Calendar Year	Project Year [1]	Discount Factor [2]
	56 years	**2.25%**
2022	Planning	0.978
2023	Planning	0.956
2024	Planning	0.935
2025	Planning	0.915
2026	Construction	0.895
2027	Construction	0.875
2028	1	0.856
2029	2	0.837
2030	3	0.819
2031	4	0.801
2032	5	0.783
2033	6	0.766
2034	7	0.749
2035	8	0.732
2036	9	0.716
2037	10	0.700
2038	11	0.685
2039	12	0.670
2040	13	0.655
2041	14	0.641
2042	15	0.627
2043	16	0.613
2044	17	0.599
2045	18	0.586
2046	19	0.573
2047	20	0.561
2048	21	0.548
2049	22	0.536
2050	23	0.525
2051	24	0.513

[1] Uses Alternative 3 implementation phase and useful life of rehabilitated West Wash dam (50 years).
[2] Discount factor for Federal Water Projects until 9/30/22.

Due to table size, only the first 30 years of the analysis is shown*

- The analysis estimates the annualized damages the community can expect to suffer over the 56-year period for each alternative. The calculated damages for each alternative are based on the probability of exceedance of each of the flood events modeled. The annualized damages represent the average of different sized storm events. During many years there will be no damages while, in others, damages may be much greater than the estimated annualized damages.

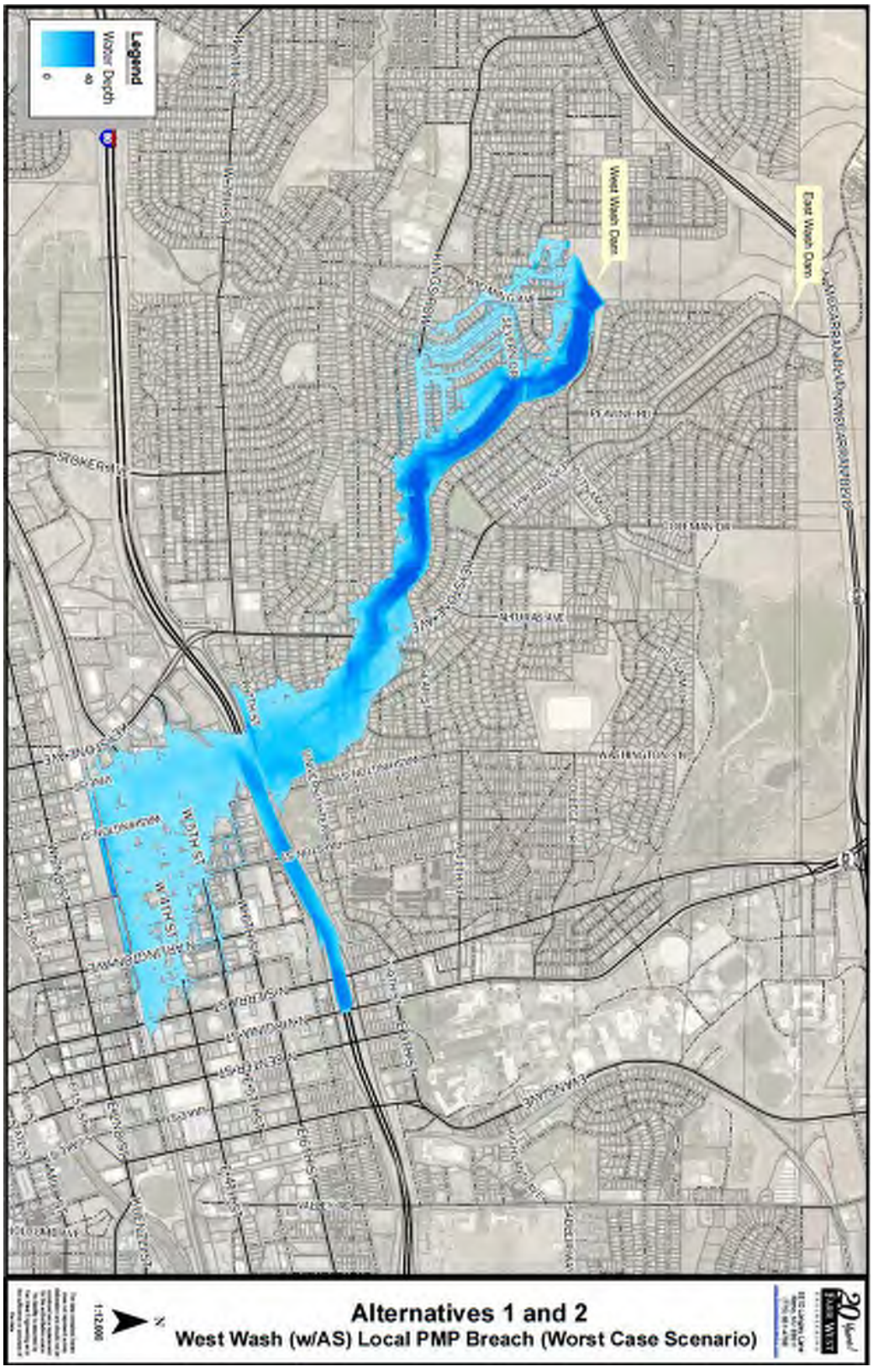
3.2 Structures and Depth-Damage Relationships

Farr West Engineering provided the maps and databases for each flood event modeled under each alternative. Inundation of properties is illustrated in **Map 3-1** for the local PMP event under alternatives 1 and 2, **Map 3-2** for the local PMP event under Alterative 3, and **Map 3-3** for the 100-year flood event under alternatives 4 and 5. A flood depth for every Assessor parcel was provided under each storm event. To conduct the damage calculations, every developed parcel (a building exists on the parcel) was assigned to a Structural Depth Damage Function Category (SDDF Category). **Table 3-2** provides the list of land use and building types provided by Washoe County, and the SDDF Category assigned for the analysis. There are some building uses that are not described well by the Assessor for purposes of the BCA. Google Earth and the Assessor's online maps were used to conduct a survey of the non-residential buildings to assign the parcel to the best SDDF Category.

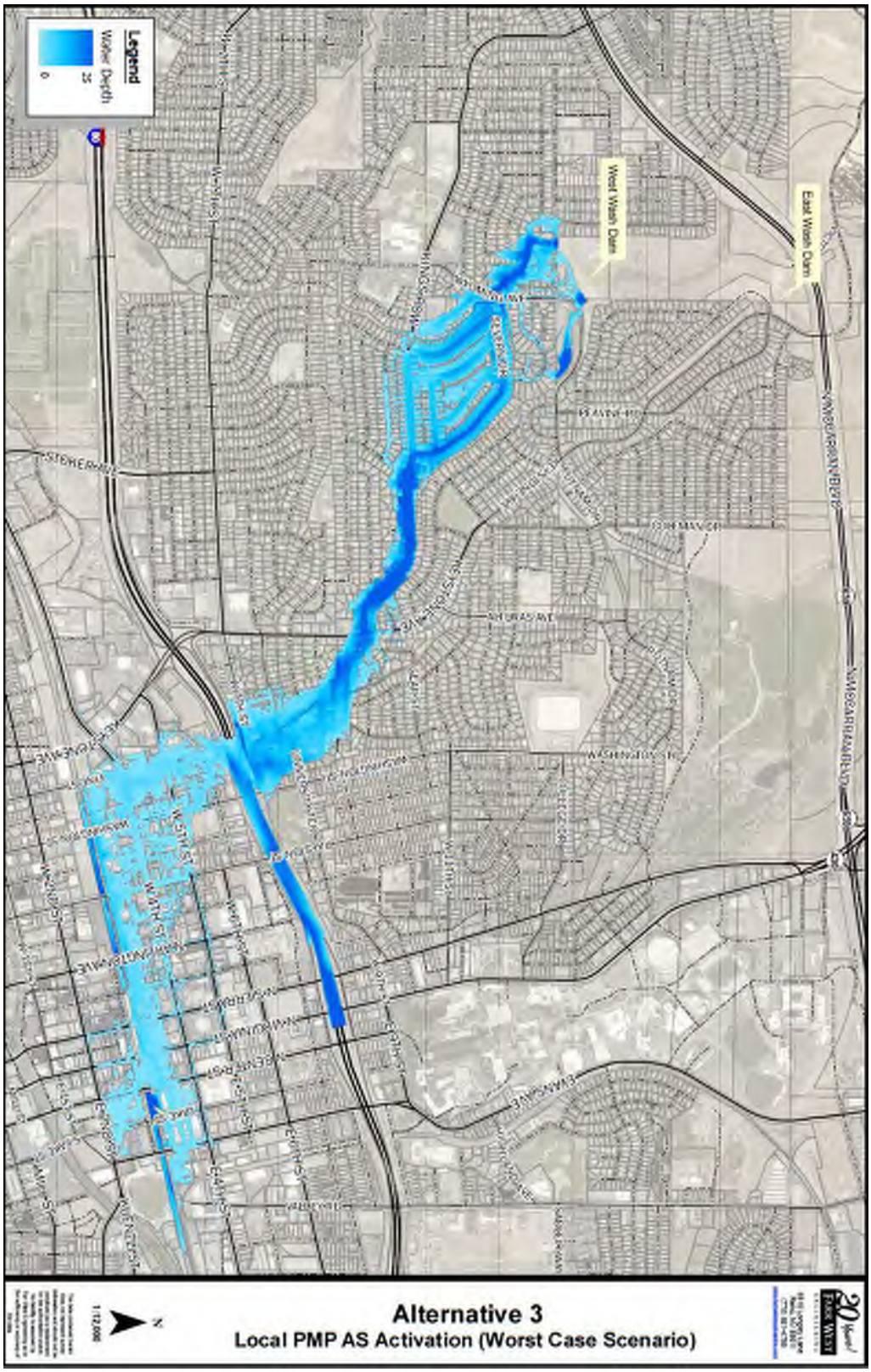
The greatest number of buildings are damaged under the Future without Project (Alternative 1) local PMP event. **Table 3-3** shows the number of parcels with structural damage by SDDF Category. Single Family Residential has been further categorized according to building layout. This information is provided in the Assessor's records. Of the 676 single family residences, almost 70% are one-story (the majority of which without a basement), 14% are two-story, and 17% are split level. Most homes do not have a basement; 17% do have a basement. The majority of the non-residential parcels (62%) have been developed as apartments. Retail clothing and hotel uses occupy the next largest number of parcels.

The number of parcels with damaged structures by alternative is shown in **Table 3-4**. While alternatives 4 and 5 can only be compared with alternatives 1, 2, and 3 for the 100-year storm, the increased protection under alternatives 2 and 3 compared with alternative 1 is evident, particularly the protection under the 200-year storm.

Map 3-1
Alternatives 1 and 2 Inundation Map



Map 3-2
Alternative 3 Inundation Map



Map 3-3
Alternative 4 Inundation Map

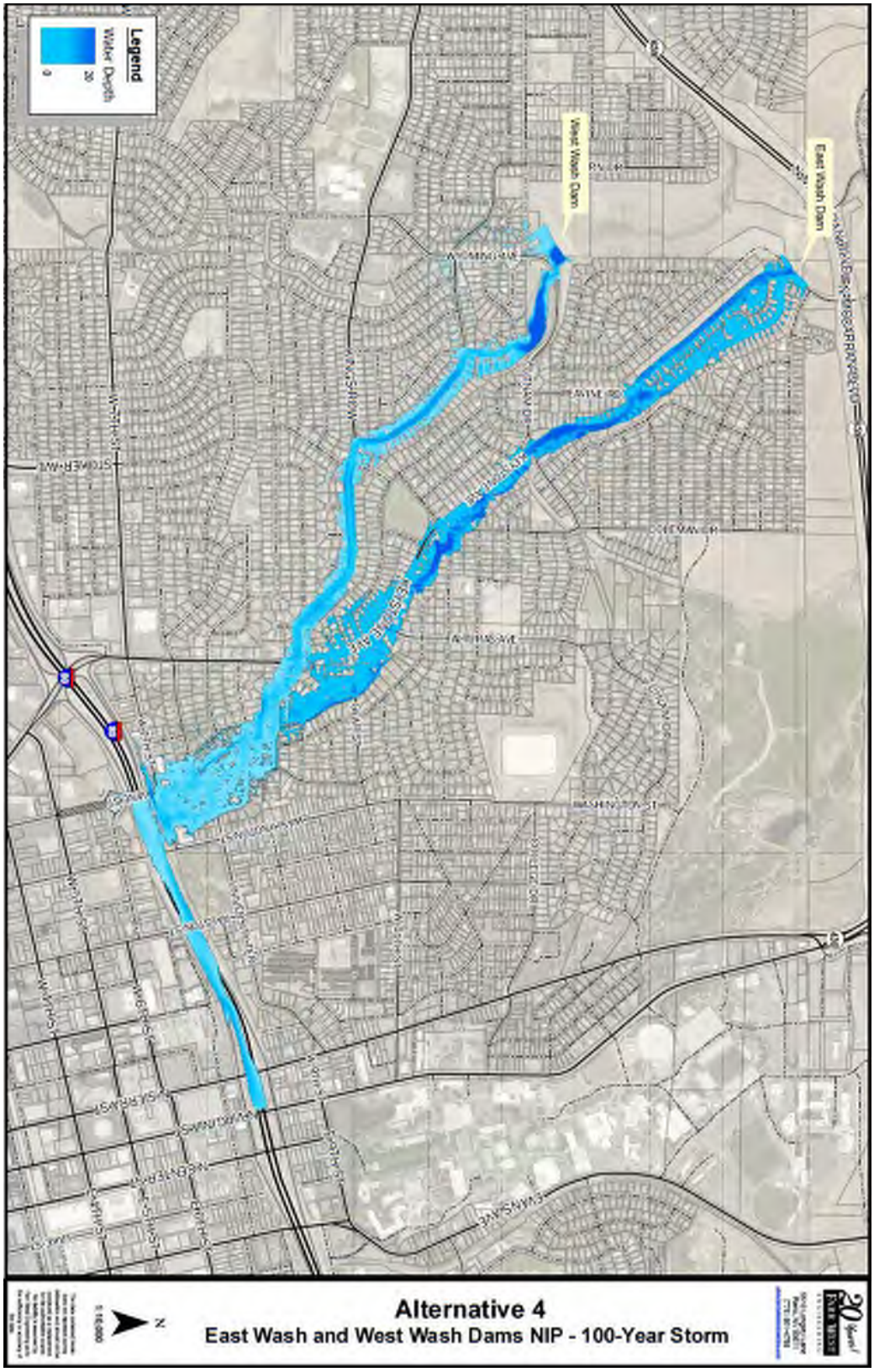


Table 3-2
SDDF Land Use Categories in the NED

Land Use & Bldg Type	SDDF Category	Land Use & Bldg Type	SDDF Category
200Single Family Residence	SF	400Neighborhood Shopping Ctr	Supermarket
210Luxury Apartment	Apartment	400Office Building	Office
210Parking Level	Apartment	400Parking Structure	Apartment
210Retail Store	Apartment	400Passenger Terminal	Warehouse, Refrigerated
250Condo/Townhouse	Apartment	400Restaurant	Non-Fast Food
300Conversion	SF	400Retail Store	Retail - Clothing
300Duplex	SF	400Rooming House	Apartment
310Single Family Residence	SF	400Shell, Neigh. Shop. Ctr.	Retail - Furniture
320Conversion	SF	400Single Family Residence	Retail - Clothing
320Multiple Res (Low Rise)	SF	410Conversion	Office
320Single Family Residence	SF	410Day Care Center	Schools
330Conversion	Apartment	410Dental Office/Clinic	Medical Office
340Apartment	Apartment	410Medical Office	Medical Office
340Conversion	Apartment	410Office Building	Office
340Multiple Res (Low Rise)	Apartment	410Restaurant	Non-Fast Food
400Bar/Tavern	Non-Fast Food	420Casino	Hotel
400Cocktail Lounge	Non-Fast Food	420Hotel, Full Service	Hotel
400Community Service Building	Religious Facilities	420Parking Structure	Hotel
400Convention Center	Retail - Furniture	420Restroom Building	Hotel
400Conversion	Retail - Clothing	420Storage Warehouse	Hotel
400Church	Religious Facilities	420Theater - Live Stage	Hotel
400Discount Store	Retail - Electronic	430Hotel, Full Service	Hotel
400Discount Warehouse Store	Retail - Furniture	430Motel	Hotel
400Fast Food Restaurant	Fast Food	430Restaurant	Hotel
400General Commercial	Retail - Clothing	430Retail Store	Hotel
400Hospital	Hospital	440Bowling Center	Recreation
400Industrials, Heavy Mftg.	Protective Services	440Convention Center	Recreation
400Medical Office	Medical Office	440Industrial Flex Building	Recreation
400Mini-Lube Garage	Automotive Repair	500Convenience Market	Convenience Store
400Mini-Mart Convenience Store	Convenience Store	500Service Repair Garage	Automotive Repair
400Multiple Res (Low Rise)	Apartment	500Storage Warehouse	Warehouse, Non-Refrig.
		710Utility	Protective Services

Table 3-3
Future Without Project Parcels with Damage

SDDF Category	# Parcels with Structural Damage	Percentage of Subtotals
Single Family Residential		
One-Story	373	55%
One-Story, with Basement	94	14%
Two-Story	88	13%
Two-Story, with Basement	6	1%
Split Level	101	15%
Split Level with Basement	14	2%
Subtotal SF Residential	**676**	**100%**
Non-Residential (includes Apartments)		
Apartment	334	62%
Convenience Store	2	0%
Fast Food	9	2%
Hospital [1]	1	0%
Hotel [2]	57	11%
Medical Office	7	1%
Non-Fast Food	11	2%
Office	20	4%
Protective Services	3	1%
Recreation [3]	3	1%
Religious Facilities	4	1%
Retail - Clothing	78	14%
Retail - Furniture	3	1%
Schools	1	0%
Warehouse, Non-Refrig.	4	1%
Warehouse, Refrigerated	2	0%
Supermarket	2	0%
Automotive Repair	1	0%
Subtotal Non-Residential	**542**	**100%**
TOTAL	**1,218**	

[1] St. Mary's Hospital.

[2] Includes hotel casinos such as Circus Circus, El Dorado, Silver Legacy, Sands, and Gold Dust West, as well as some large hotels including Whitney Peak, and numerous boutique hotels.

[3] Includes the National Bowling Stadium, the Convention Center, and a large flex-use building; all owned by the City of Reno.

Table 3-4
Number of Parcels with Damaged Structures

Flood Event	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
	Number of Parcels with Damaged Structures				
10-YR	0	0	0	493	0
25-YR	0	0	0	520	0
50-YR	0	0	0	539	0
100-YR	0	0	0	556	0
200-YR	304	0	0	n.a.	n.a.
500-YR	364	6	361	n.a.	n.a.
PMP	1,218	593	1,086	n.a.	n.a.

Source: Farr West Engineering and HEC, April 2022.

Depth-Damage Relationships. Residential inundation damage employs the generic depth-damage relationships specified in EGM 04-01 dated December 4, 2000 which are summarized in **Table 3-5.** Depth-damage functions (DDFs) for non-residential structures were taken from the URS draft report "*Solicitation of Expert Opinion Depth-Damage Function Calculations for the Benefit-Cost Analysis Tool*" (2008). The DDFs are different for non-residential buildings depending on whether the structures are pre-engineered or engineered. Pre-engineered structures may be of stock design and easily replicated in different locations and they are more easily combustible. Engineered structures are primarily built of non-combustible materials, and they require greater design effort prior to construction. The structures are defined as follows:

Pre-engineered Structures – the shell of the structure may be Class D (Wood or Steel framed exterior walls), Class P (Wood and Metal Walls, pole frame), or Class S (Metal Frame and Walls).

Engineered Structures – the shell of the structure may be Class A (Fireproof Structural Steel Frame), Class B (Reinforced Concrete Frame), Class C (Masonry Bearing Walls), or Class M (Mill Type Construction).

The Washoe County Assessor data includes class of structure for all non-residential buildings. Table **3-6** provides the pre-engineered DDFs at the mean, and **Table 3-7** provides the engineered DDFs at the mean.

3.3 STRUCTURE AND CONTENT VALUATION

Structure Valuation. For every building, the DDFs (for the correlating flood depth on the property) are multiplied by the structure replacement value to determine the estimate of damage in monetary units. Structure replacement values for every property are determined using Assessor data. The State of Nevada uses Marshall & Swift cost data to determine structure values; however, the taxable value of structures reported by the Assessor includes a 1.5% per year depreciation allowance for up to 50 years. The appropriate depreciation factor had to be applied to every

property to ensure that the structure replacement value used in the analysis does not include the statutory applied depreciation. The structure valuations represent the estimated cost to rebuild the structures in 2022.

Table 3-5
DDF for Residential Structure Damage Value

Depth in Feet		Single Family with Basement			Single Family NO Basement		
		SF1	SF2	SFSplit	SF1B	SF2B	SFSplitB
		Mean of Structure Damage			Mean of Structure Damage		
0.5	[1]	25.5%	17.9%	18.5%	13.4%	9.3%	7.2%
1		32.0%	22.3%	23.2%	23.3%	15.2%	9.4%
1.5	[2]	38.7%	27.0%	28.2%	32.1%	20.9%	12.9%
2		38.7%	27.0%	28.2%	32.1%	20.9%	12.9%
3		45.5%	31.9%	33.4%	40.1%	26.3%	17.4%
4		52.2%	36.9%	38.6%	47.1%	31.4%	22.8%
5		58.6%	41.9%	43.8%	53.2%	36.2%	28.9%
6		64.5%	46.9%	48.8%	58.6%	40.7%	35.5%
7		69.8%	51.8%	53.5%	63.2%	44.9%	42.3%
8		74.2%	56.4%	57.8%	67.2%	48.8%	49.2%
9		77.7%	60.8%	61.6%	70.5%	52.4%	56.1%
10		80.1%	64.8%	64.8%	73.2%	55.7%	62.6%
11		81.1%	68.4%	67.2%	75.4%	58.7%	68.6%
12		81.1%	71.4%	68.8%	77.2%	61.4%	73.9%
13		81.1%	73.7%	69.3%	78.5%	63.8%	78.4%
14		81.1%	75.4%	69.3%	79.5%	65.9%	81.7%
15		81.1%	76.4%	69.3%	80.2%	67.7%	83.8%
16		81.1%	76.4%	69.3%	80.7%	69.2%	84.4%

Source: EGM 04-01.

[1] Uses the 0.5ft values for inundations zero to 0.5 feet.

[2] Uses the 2ft values for inundations 1.01 to 2.0 feet; no DDF values for 1.5ft depth in EGM 04-01.

Table 3-6
DDF for Non-Residential Structure Damage Value (Pre-Engineered Structures)

	Pre-Engineered (One-Story)									
Depth (feet)	Apartment	Hotel	Recreation	Non-Fast Food	Religious Facilities	Retail - Clothing	Fast Food	Hospital [1]	Protective Services	Convenience Store
					Mean of Damage					
0.5	8.5%	8.2%	8.8%	14.8%	10.2%	9.1%	11.1%	9.0%	7.1%	11.1%
1	12.5%	11.7%	13.5%	19.4%	16.4%	13.2%	15.9%	14.1%	10.5%	16.0%
1.5	16.1%	15.1%	18.2%	25.3%	22.1%	16.9%	22.5%	18.2%	14.0%	21.6%
2	20.4%	18.1%	23.6%	32.4%	28.3%	20.5%	28.7%	24.7%	17.3%	25.3%
3	25.9%	23.9%	31.3%	41.0%	35.9%	26.6%	37.4%	34.5%	22.3%	34.1%
4	31.7%	29.1%	38.6%	49.6%	42.9%	33.3%	47.3%	44.6%	28.2%	41.9%
5	33.5%	31.8%	42.1%	56.3%	48.4%	36.4%	52.1%	51.4%	32.1%	45.4%
6	37.5%	35.3%	47.6%	63.9%	54.2%	41.0%	58.3%	61.7%	35.5%	51.4%
7	39.4%	38.1%	50.3%	67.2%	58.1%	43.9%	63.5%	67.8%	38.9%	57.0%
8	42.2%	40.8%	54.2%	71.3%	62.1%	47.7%	67.0%	75.5%	42.7%	60.6%
9	45.1%	44.4%	57.5%	72.7%	65.3%	51.3%	70.9%	79.6%	45.7%	62.8%
10	46.6%	45.7%	59.1%	73.5%	66.1%	52.4%	72.2%	81.3%	47.1%	63.6%
11	46.6%	45.7%	59.1%	73.5%	66.1%	52.4%	72.2%	81.3%	47.1%	63.6%
12	46.6%	45.7%	59.1%	73.5%	66.1%	52.4%	72.2%	81.3%	47.1%	63.6%
13	46.6%	45.7%	59.1%	73.5%	66.1%	52.4%	72.2%	81.3%	47.1%	63.6%
14	46.6%	45.7%	59.1%	73.5%	66.1%	52.4%	72.2%	81.3%	47.1%	63.6%
15	46.6%	45.7%	59.1%	73.5%	66.1%	52.4%	72.2%	81.3%	47.1%	63.6%
16	46.6%	45.7%	59.1%	73.5%	66.1%	52.4%	72.2%	81.3%	47.1%	63.6%

Depth (feet)	Retail - Furniture	Retail - Electronic	Automotive Repair	Supermarket	Warehouse, Refrig.	Office	Medical Office	Schools	Warehouse, Non-Refrig.
0.5	7.9%	8.7%	7.5%	7.6%	8.2%	9.9%	8.4%	9.9%	7.6%
1	11.8%	12.9%	11.1%	11.6%	13.0%	13.5%	12.8%	14.2%	11.8%
1.5	15.1%	16.8%	15.0%	15.7%	16.9%	16.8%	16.3%	18.1%	16.1%
2	18.7%	20.4%	18.1%	19.5%	21.5%	19.4%	21.0%	23.9%	19.9%
3	25.2%	26.8%	23.5%	25.9%	29.1%	25.4%	27.9%	30.2%	25.4%
4	32.1%	33.2%	29.5%	32.9%	36.7%	30.5%	37.2%	36.9%	31.4%
5	35.0%	36.5%	31.9%	35.3%	40.2%	33.5%	40.9%	39.4%	34.2%
6	39.5%	40.3%	36.8%	41.1%	46.2%	38.6%	51.9%	43.9%	39.0%
7	42.7%	43.9%	40.9%	44.6%	49.9%	45.7%	56.6%	45.8%	41.8%
8	47.1%	48.3%	45.1%	48.1%	54.3%	51.1%	61.7%	48.4%	45.7%
9	51.3%	51.5%	48.3%	51.4%	58.9%	55.0%	66.0%	51.1%	50.4%
10	52.5%	52.6%	49.7%	52.9%	60.9%	59.1%	67.8%	52.8%	51.7%
11	52.5%	52.6%	49.7%	52.9%	60.9%	59.1%	67.8%	52.8%	51.7%
12	52.5%	52.6%	49.7%	52.9%	60.9%	59.1%	67.8%	52.8%	51.7%
13	52.5%	52.6%	49.7%	52.9%	60.9%	59.1%	67.8%	52.8%	51.7%
14	52.5%	52.6%	49.7%	52.9%	60.9%	59.1%	67.8%	52.8%	51.7%
15	52.5%	52.6%	49.7%	52.9%	60.9%	59.1%	67.8%	52.8%	51.7%
16	52.5%	52.6%	49.7%	52.9%	60.9%	59.1%	67.8%	52.8%	51.7%

Source: URS 2008 Solicitation of Expert Opinion Depth-Damage Function Calculations for the Benefit-Cost Analysis Tool.

[1] Hospital is the only prototype modeled with two stories.

Table 3-7
DDF for Non-Residential Structure Damage Value (Engineered Structures)

	Engineered (One-Story)									
Depth (feet)	Apartment	Hotel	Recreation	Non-Fast Food	Religious Facilities	Retail - Clothing	Fast Food	Hospital [1]	Protective Services	Convenience Store
					Mean of Damage					
0.5	7.9%	7.6%	8.1%	13.7%	9.5%	8.3%	10.4%	8.7%	6.7%	10.2%
1	11.0%	10.2%	11.9%	17.7%	14.7%	11.4%	14.4%	13.3%	9.2%	14.1%
1.5	13.6%	12.5%	15.4%	22.7%	19.3%	13.9%	19.9%	16.9%	11.5%	18.5%
2	17.4%	15.3%	20.2%	29.1%	24.8%	17.2%	25.6%	23.0%	14.5%	21.9%
3	21.3%	19.2%	26.0%	36.4%	30.9%	21.4%	32.8%	31.8%	17.7%	28.7%
4	26.2%	23.6%	32.2%	44.1%	37.0%	26.9%	41.6%	41.2%	22.6%	35.5%
5	29.6%	27.8%	26.8%	51.2%	43.2%	31.5%	47.1%	48.3%	27.9%	40.0%
6	32.1%	29.8%	40.7%	57.5%	47.6%	34.3%	52.0%	57.4%	29.7%	44.4%
7	34.1%	32.5%	43.4%	60.7%	51.3%	37.2%	56.9%	63.2%	32.9%	49.5%
8	37.2%	35.6%	47.4%	64.9%	55.4%	41.2%	60.5%	70.7%	36.8%	53.3%
9	38.9%	37.7%	49.4%	65.7%	57.5%	43.2%	63.4%	74.1%	38.4%	54.5%
10	41.1%	39.8%	51.6%	67.0%	59.0%	45.0%	65.1%	76.1%	40.5%	56.0%
11	41.1%	39.8%	51.6%	67.0%	59.0%	45.0%	65.1%	76.1%	40.5%	56.0%
12	41.1%	39.8%	51.6%	67.0%	59.0%	45.0%	65.1%	76.1%	40.5%	56.0%
13	41.1%	39.8%	51.6%	67.0%	59.0%	45.0%	65.1%	76.1%	40.5%	56.0%
14	41.1%	39.8%	51.6%	67.0%	59.0%	45.0%	65.1%	76.1%	40.5%	56.0%
15	41.1%	39.8%	51.6%	67.0%	59.0%	45.0%	65.1%	76.1%	40.5%	56.0%
16	41.1%	39.8%	51.6%	67.0%	59.0%	45.0%	65.1%	76.1%	40.5%	56.0%

Depth (feet)	Retail - Furniture	Retail - Electronic	Automotive Repair	Supermarket	Warehouse, Refrig.	Office	Medical Office	Schools	Warehouse, Non-Refrig.
0.5	7.3%	8.0%	7.0%	7.1%	7.7%	9.3%	8.0%	9.3%	7.1%
1	10.3%	11.2%	9.7%	10.1%	44.5%	12.3%	11.7%	13.0%	10.2%
1.5	12.5%	13.9%	12.4%	13.0%	14.5%	14.9%	14.5%	16.2%	13.3%
2	15.7%	17.1%	15.3%	16.4%	18.6%	17.5%	18.9%	21.5%	16.7%
3	20.3%	21.6%	18.9%	20.8%	24.3%	22.2%	24.4%	26.7%	20.4%
4	26.0%	26.9%	24.0%	26.7%	30.9%	26.8%	32.7%	32.7%	25.5%
5	30.4%	31.6%	27.9%	30.6%	35.5%	30.7%	37.2%	36.2%	29.7%
6	33.1%	33.8%	31.0%	34.4%	39.8%	34.7%	46.3%	39.7%	32.8%
7	36.2%	37.1%	34.8%	37.8%	43.3%	41.2%	50.7%	41.6%	35.5%
8	40.7%	41.7%	39.1%	41.5%	47.8%	46.5%	55.8%	44.5%	39.6%
9	13.2%	43.4%	40.8%	43.3%	50.9%	49.4%	58.9%	46.4%	42.5%
10	43.2%	45.3%	43.0%	45.5%	53.4%	53.6%	61.2%	48.5%	44.5%
11	43.2%	45.3%	43.0%	45.5%	53.4%	53.6%	61.2%	48.5%	44.5%
12	43.2%	45.3%	43.0%	45.5%	53.4%	53.6%	61.2%	48.5%	44.5%
13	43.2%	45.3%	43.0%	45.5%	53.4%	53.6%	61.2%	48.5%	44.5%
14	43.2%	45.3%	43.0%	45.5%	53.4%	53.6%	61.2%	48.5%	44.5%
15	43.2%	45.3%	43.0%	45.5%	53.4%	53.6%	61.2%	48.5%	44.5%
16	43.2%	45.3%	43.0%	45.5%	53.4%	53.6%	61.2%	48.5%	44.5%

Source: URS 2008 Solicitation of Expert Opinion Depth-Damage Function Calculations for the Benefit-Cost Analysis Tool.

[1] Hospital is the only prototype modeled with two stories.

Content Valuation. To determine content damage valuation for single family residential, the structure replacement value is multiplied by the contents DDF shown in **Table 3-8**. Residential contents are valued at about 50% of the residential structure values.

Table 3-8
DDF for Residential Contents Damage Value

Depth in Feet		Single Family with Basement			Single Family NO Basement		
		SF1	SF2	SFSplit	SF1B	SF2B	SFSplitB
		Mean of Contents Damage			Mean of Contents Damage		
0.5	[1]	16.0%	11.9%	11.6%	8.1%	5.0%	2.9%
1		18.9%	13.8%	13.8%	13.3%	8.7%	4.7%
1.5	[2]	21.8%	15.7%	16.1%	17.9%	12.2%	7.5%
2		21.8%	15.7%	16.1%	17.9%	12.2%	7.5%
3		24.7%	17.7%	18.2%	22.0%	15.5%	11.1%
4		27.4%	19.8%	20.2%	25.7%	18.5%	15.3%
5		30.0%	22.0%	22.1%	28.8%	21.3%	20.1%
6		32.4%	24.3%	23.6%	31.5%	23.9%	25.2%
7		34.5%	26.7%	24.9%	33.8%	26.3%	30.5%
8		36.3%	29.1%	25.8%	35.7%	28.4%	35.7%
9		37.7%	31.7%	26.3%	37.2%	30.3%	40.9%
10		38.6%	34.4%	26.3%	38.4%	32.0%	45.8%
11		39.1%	37.2%	26.3%	39.2%	33.4%	50.2%
12		39.1%	40.0%	26.3%	39.7%	34.7%	54.1%
13		39.1%	43.0%	26.3%	40.0%	35.6%	57.2%
14		39.1%	46.1%	26.3%	40.0%	36.4%	59.4%
15		39.1%	49.3%	26.3%	40.0%	36.9%	60.5%
16		39.1%	52.6%	26.3%	40.0%	37.2%	60.5%

Source: EGM 04-01.

[1] Uses the 0.5ft values for inundations zero to 0.5 feet.

[2] Uses the 2ft values for inundations 1.01 to 2.0 feet; no DDF values for 1.5ft depth in EGM 04-01.

For non-residential structures there is an additional computation. First, content valuation is expressed as a percentage of structure replacement valuation, as shown in **Table 3-9**. Second, the content value is multiplied by the content DDFs shown in **Table 3-10**.

Table 3-9
Content Value to Structure Ratio for Non-Residential SDDF Categories

Assessor Building Occupancy		SDDF Use Category	Content Value to Structure Ratio	
			Pre-Engineered	Engineered
Multi-Family Residential		*Source: USB 2008 Study*		
Luxury Apartment		Apartment	12%	10%
Condo/Townhouse		Apartment	12%	10%
Multi-Family 5-9 Units		Apartment	12%	10%
Multi-Family / Apartments 10+ Units		Apartment	12%	10%
Resort / Entertainment				
Casino & Hotel Casino		Hotel	19%	15%
Hotel / Motel		Hotel	19%	15%
Bowling / Convention Center		Recreation	30%	25%
Commercial				
Bar/Tavern		Non-Fast Food	26%	23%
Cocktail Lounge		Non-Fast Food	26%	23%
Community Service Building		Religious Facilities	8%	7%
Convention Center		Retail - Furniture	18%	14%
Conversion	[1]	Retail - Clothing	36%	29%
General Commercial		Retail - Clothing	36%	29%
Discount Store		Retail - Electronic	81%	65%
Discount Warehouse Store		Retail - Furniture	18%	14%
Fast Food Restaurant		Fast Food	17%	15%
Hospital		Hospital	30%	28%
Industrials, Heavy Mftg	[2]	Protective Services	88%	69%
Mini-Lube Garage		Automotive Repair	83%	66%
Mini-Mart Convenience Store		Convenience Store	62%	52%
Neighborhood Shopping Ctr		Supermarket	106%	85%
Rooming House		Apartment	12%	10%
Passenger Terminal		Warehouse, Refrigerated	43%	36%
Restaurant		Non-Fast Food	26%	23%
Retail Store		Retail - Clothing	36%	29%
Shell, Neigh. Shop. Ctr		Retail - Furniture	18%	14%
Offices				
Conversion		Office	14%	12%
Restaurant		Non-Fast Food	26%	23%
Medical Office		Medical Office	15%	13%
Office Building		Office	14%	12%
Day Care Center		Schools	7%	6%
Dental Office/Clinic		Medical Office	15%	13%
Industrial				
Service Repair Garage		Automotive Repair	83%	66%
Convenience Market		Convenience Store	62%	52%
Storage Warehouse		Warehouse, Non-Refrig.	47%	37%
Religious & Other				
Church		Religious Facilities	8%	7%
Utility		Protective Services	88%	69%
Parking Structure			0%	0%

Source: USB 2008 Study, Washoe County Assessor, and HEC April 2022.

[1] Use is currently changing.

[2] Building exclusive use is power units / generators for casinos.

Table 3-10
DDF for Non-Residential Contents Damage Value

	All Building Types (One-Story)									
Depth (feet)	Apartment	Hotel	Recreation	Non-Fast Food	Religious Facilities	Retail - Clothing	Fast Food	Hospital [1]	Protective Services	Convenience Store
					Mean of Damage					
0.5	14.3%	11.8%	16.9%	17.1%	19.7%	12.3%	10.6%	10.3%	5.0%	11.6%
1	21.7%	16.1%	25.7%	27.7%	29.3%	29.0%	21.3%	14.6%	15.0%	23.1%
1.5	26.6%	18.6%	31.4%	35.9%	41.3%	38.4%	29.4%	18.4%	20.0%	32.1%
2	30.4%	26.3%	43.7%	48.9%	48.4%	46.3%	38.6%	27.0%	25.0%	39.9%
3	39.0%	34.1%	62.7%	57.3%	60.0%	55.4%	52.7%	37.0%	40.0%	52.9%
4	45.0%	39.7%	72.9%	71.9%	69.3%	70.0%	62.6%	53.4%	50.0%	70.7%
5	47.9%	48.7%	80.0%	79.7%	76.4%	79.0%	73.0%	70.0%	58.0%	79.3%
6	51.9%	52.4%	84.0%	84.9%	81.4%	89.0%	79.3%	79.1%	65.0%	88.0%
7	55.7%	58.4%	91.1%	92.9%	88.4%	95.7%	88.3%	85.6%	78.0%	94.1%
8	59.3%	61.3%	95.0%	93.4%	94.3%	97.9%	94.9%	92.5%	90.0%	95.7%
9	60.6%	63.1%	95.0%	94.3%	97.1%	97.9%	98.6%	95.6%	90.0%	97.1%
10	63.4%	64.9%	95.0%	94.3%	97.1%	99.3%	98.6%	96.3%	92.0%	98.6%
11	63.4%	64.9%	95.0%	94.3%	97.1%	99.3%	98.6%	96.3%	92.0%	98.6%
12	63.4%	64.9%	95.0%	94.3%	97.1%	99.3%	98.6%	96.3%	92.0%	98.6%
13	63.4%	64.9%	95.0%	94.3%	97.1%	99.3%	98.6%	96.3%	92.0%	98.6%
14	63.4%	64.9%	95.0%	94.3%	97.1%	99.3%	98.6%	96.3%	92.0%	98.6%
15	63.4%	64.9%	95.0%	94.3%	97.1%	99.3%	98.6%	96.3%	92.0%	98.6%
16	63.4%	64.9%	95.0%	94.3%	97.1%	99.3%	98.6%	96.3%	92.0%	98.6%

Depth (feet)	Retail - Furniture	Retail - Electronic	Automotive Repair	Supermarket	Warehouse , Refrig.	Office	Medical Office	Schools	Warehouse, Non-Refrig.
0.5	39.9%	10.9%	11.7%	24.0%	20.7%	14.3%	9.0%	14.3%	13.4%
1	46.9%	23.0%	16.4%	30.7%	29.7%	10.0%	14.3%	21.7%	20.7%
1.5	53.3%	28.7%	21.9%	36.8%	37.6%	26.0%	18.4%	26.6%	27.6%
2	61.9%	34.1%	28.9%	40.9%	48.0%	34.3%	26.9%	30.4%	33.7%
3	68.1%	44.3%	40.9%	52.9%	59.1%	45.4%	40.4%	39.0%	47.4%
4	79.1%	67.0%	57.7%	64.0%	65.7%	55.0%	57.1%	45.0%	56.9%
5	85.7%	77.7%	63.3%	75.4%	74.3%	63.9%	67.3%	47.9%	65.6%
6	90.7%	86.7%	70.7%	87.3%	79.7%	73.3%	75.4%	51.9%	73.6%
7	97.1%	95.4%	79.3%	98.9%	84.0%	76.4%	82.3%	55.7%	81.3%
8	99.3%	97.4%	84.3%	100.0%	89.9%	83.4%	91.3%	59.3%	88.4%
9	99.3%	98.6%	87.1%	100.0%	93.6%	89.3%	96.3%	60.6%	91.6%
10	99.3%	98.6%	87.1%	100.0%	93.6%	91.4%	96.9%	63.4%	93.6%
11	99.3%	98.6%	87.1%	100.0%	93.6%	91.4%	96.9%	63.4%	93.6%
12	99.3%	98.6%	87.1%	100.0%	93.6%	91.4%	96.9%	63.4%	93.6%
13	99.3%	98.6%	87.1%	100.0%	93.6%	91.4%	96.9%	63.4%	93.6%
14	99.3%	98.6%	87.1%	100.0%	93.6%	91.4%	96.9%	63.4%	93.6%
	99.3%	98.6%	87.1%	100.0%	93.6%	91.4%	96.9%	63.4%	93.6%
	99.3%	98.6%	87.1%	100.0%	93.6%	91.4%	96.9%	63.4%	93.6%

Source: URS 2008 Solicitation of Expert Opinion Depth-Damage Function Calculations for the Benefit-Cost Analysis Tool.

[1] Hospital is the only prototype modeled with two stories.

3.4 STRUCTURE AND CONTENT DAMAGES BY ALTERNATIVE

Valuation of structures and contents is provided in **Table 3-11** for the worst flood events by alternative. Alternative 5 is not included because by purchasing all the properties that would be damaged in the 100-year event there would not be any damage to properties. The greatest estimated damage from a single flood event is under Alternative 1 (local PMP event); however, the damages under Alternative 3 (local PMP event) are very similar because although fewer parcels are damaged, flood depths would be greater at some high value non-residential properties; in particular, the hospital, some non-fast food eating establishments, and some large and medium-sized stores that would not be flooded under Alternative 1.

Table 3-11
Estimate of Structures and Contents Values by SDDF Category

	Alt. 1 (PMP Event)		Alt. 2 (PMP Event)		Alt. 3 (PMP Event)		Alt. 4 (100-YR Event)	
SDDF Category	Structures	Contents	Structures	Contents	Structures	Contents	Structures	Contents
Single Family Residential								
One-Story	$34,180,858	$18,082,977	$4,925,542	$2,994,827	$32,163,299	$16,930,145	$22,973,811	$12,614,713
One-Story, with Basement	$7,204,230	$3,958,759	$1,013,961	$595,165	$6,082,114	$3,315,197	$5,255,694	$2,897,840
Two-Story	$8,568,221	$4,604,825	$630,727	$398,507	$7,702,685	$4,146,801	$4,801,680	$2,681,430
Two-Story, with Basement	$599,213	$348,825	$70,098	$39,299	$520,395	$305,034	$414,501	$239,259
Split Level	$9,558,425	$4,726,243	$691,010	$415,196	$8,864,219	$4,445,484	$5,750,839	$3,173,000
Split Level with Basement	$712,415	$448,088	$161,922	$68,902	$600,901	$402,498	$415,370	$258,890
Subtotal SF Residential	**$60,823,362**	**$32,169,716**	**$7,493,260**	**$4,511,896**	**$55,933,611**	**$29,545,159**	**$39,611,895**	**$21,865,131**
Non-Residential (includes Apartments)								
Apartment	$9,529,988	$1,752,650	$2,439,667	$484,835	$8,096,082	$1,473,101	$428,078	$81,083
Convenience Store	$262,460	$227,621	$262,460	$227,621	$262,460	$227,621	$0	$0
Fast Food	$569,386	$109,083	$521,972	$98,575	$527,091	$92,112	$0	$0
Hospital	$14,788,319	$6,041,920	$0	$0	$17,751,738	$6,827,370	$2,589,394	$889,025
Hotel	$10,474,711	$2,757,694	$5,817,169	$1,529,540	$9,525,699	$2,534,798	$0	$0
Medical Office	$2,929,916	$573,169	$966,895	$154,774	$1,963,021	$418,395	$957,829	$192,366
Non-Fast Food	$2,322,346	$815,511	$933,833	$304,592	$4,464,287	$1,611,763	$0	$0
Office	$5,070,358	$982,939	$1,601,919	$209,910	$4,578,934	$933,182	$34,472	$6,361
Protective Services	$100,647	$142,734	$0	$0	$100,647	$142,734	$21,942	$26,216
Recreation	$15,335,813	$7,738,856	$3,657,117	$2,106,998	$15,188,397	$7,653,925	$0	$0
Religious Facilities	$1,625,767	$218,813	$86,513	$13,367	$1,539,254	$205,446	$0	$0
Retail - Clothing	$2,136,781	$1,381,702	$1,445,838	$852,555	$2,049,292	$1,339,765	$38,193	$18,585
Retail - Furniture	$3,096,687	$2,020,972	$199,883	$180,446	$3,096,687	$2,020,972	$0	$0
Schools	$167,509	$14,915	$0	$0	$167,509	$14,915	$0	$0
Warehouse, Non-Refrig.	$232,911	$197,543	$139,261	$115,404	$450,516	$370,741	$0	$0
Warehouse, Refrigerated	$1,950,047	$1,522,569	$0	$0	$1,950,047	$1,522,569	$0	$0
Retail - Electronic	$0	$0	$0	$0	$1,109,094	$1,569,136	$0	$0
Supermarket	$690,813	$1,750,776	$107,219	$300,787	$690,813	$1,750,776	$282,504	$945,645
Automotive Repair	$0	$0	$0	$0	$279,408	$342,640	$0	$0
Subtotal Non-Residential	**$71,284,460**	**$28,249,466**	**$18,179,747**	**$6,579,404**	**$73,790,976**	**$31,051,960**	**$4,352,413**	**$2,159,281**
TOTAL	**$132,107,823**	**$60,419,181**	**$25,673,006**	**$11,091,300**	**$129,724,587**	**$60,597,120**	**$43,964,307**	**$24,024,412**
Residential	46%	53%	29%	41%	43%	49%	90%	91%
Non-Residential	54%	47%	71%	59%	57%	51%	10%	9%

3.5 RED AND OSE ACCOUNTS

As described earlier, the RED and OSE accounts may or may not be monetized, and should be included whenever impacts are considerable and may influence selection of the project alternative, potentially overriding the NED plan.

OSE Account. Other social and economic considerations for this project are accounted for by measuring the loss in permanent residents, the loss in jobs, and loss in annual visitation to Downtown Reno.

RED Account. The regional economic development account impacts may include direct, indirect, and induced impacts. For this project, only the direct impact of property acquisition in the form of lost annual property taxes was estimated and annualized.

The OSE and RED account impacts are estimated in Section 5 of the report.

Section 4: PROJECT ALTERNATIVES BENEFITS AND COSTS

Alternative 1, the Future without Project condition, represents expected conditions over the next 56 years if there is no change to the current flood protection infrastructure and management measures. The relative benefits of flood risk management alternatives can be gauged by comparison to this baseline condition.

4.1 EXPECTED ANNUAL DAMAGES

This section describes the calculations to determine Expected Annual Damages (EAD) under each alternative. The estimated damages resulting from a single-year event occurring are summarized in **Table 4-1**. The damages are estimated in 2022 dollars because the structure replacement values are for fiscal year 2022/23 which runs July 1, 2022 through June 30, 2023.

Total damages occurring from a single event are calculated to be greatest under Alternative 1 (local PMP event), followed by Alternative 3 (local PMP event), then by Alternative 4 (100-year event). Alternative 2 would have the least damage from a single event occurring because all properties expected to have flooding greater than one foot on the property would be acquired. No damages would be sustained under Alternative 5 because all the properties that could be damaged would be acquired.

Table 4-1
Summary of Damages as a Result of a Single-Year Event Occurring

	Alternative 1				Alternative 2			
	100-YR	200-YR	500-YR	PMP	100-YR	200-YR	500-YR	PMP
Parcels Damaged [1]	***0***	***304***	***364***	***1,218***	***0***	***0***	***6***	***593***
Damages	*2022 $ damages from a single event*				*2022 $ damages from a single event*			
Structural	$0	$17,730,273	$23,719,121	$132,107,823	$0	$0	$287,760	$25,673,006
Contents	$0	$10,092,775	$13,187,792	$60,419,181	$0	$0	$174,210	$11,091,300
Total Damages	**$0**	**$27,823,048**	**$36,906,913**	**$192,527,004**	**$0**	**$0**	**$461,970**	**$36,764,306**

	Alternative 3				Alternative 4			
	100-YR	200-YR	500-YR	PMP	10-YR	25-YR	50-YR	100-YR
Parcels Damaged [1]	***0***	***0***	***361***	***1,086***	***493***	***520***	***539***	***556***
Damages	*2022 $ damages from a single event*				*2022 $ damages from a single event*			
Structural	$0	$0	$23,447,507	$129,724,587	$32,806,909	$36,299,123	$41,464,815	$43,964,307
Contents	$0	$0	$13,498,939	$60,597,120	$18,109,824	$19,867,751	$22,000,189	$24,024,412
Total Damages	**$0**	**$0**	**$36,946,446**	**$190,321,707**	**$50,916,733**	**$56,166,874**	**$63,465,004**	**$67,988,719**

Source: HEC May 2022.

[1] Number of parcels with structures; excludes vacant parcels (as a result, does not match Farr West reported parcels affected by alternative).

The damage-frequency relationship for each event is expressed in **Table 4-2.** The EAD is the cumulative damages calculated at the exceedance probability for each flood event. Note that the local PMP does not have a specified probability of occurrence. Sensitivity analysis was run with the PMP at different interval periods. It was found that any time interval greater than 5,000 years had negligible impact on the result.

Table 4-2
Expected Average Annual Damages by Alternative

Alternative	Return Period (years)	Damage-Frequency Relationship: Exceedance Probability	Estimated Damages [1]	Mean Damage	Probability Interval	Interval Damages	Estimated Cumulative Damages
Alt. 1							
100-YR	100	0.01000	$0				**annual**
				$13,911,524	0.005	$69,558	$69,558
200-YR	200	0.00500	$27,823,048				
				$32,364,981	0.003	$97,095	$166,653
500-YR	500	0.00200	$36,906,913				
				$114,716,959	0.002	$223,698	$390,351
PMP [2]	20,000	0.00005	$192,527,004				
			EXPECTED ANNUAL DAMAGES (EAD) - Alt. 1				**$390,351**
Alt. 2							
100-YR	100	0.01000	$0				**annual**
				$0	0.005	$0	$0
200-YR	200	0.00500	$0				
				$230,985	0.003	$693	$693
500-YR	500	0.00200	$461,970				
				$18,613,138	0.002	$36,296	$36,989
PMP [2]	20,000	0.00005	$36,764,306				
			ESTIMATED TOTAL ANNUAL DAMAGES (EAD) - Alt. 2				**$36,989**
Alt. 3							
100-YR	100	0.01000	$0				**annual**
				$0	0.005	$0	$0
200-YR	200	0.00500	$0				
				$18,473,223	0.003	$55,420	$55,420
500-YR	500	0.00200	$36,946,446				
				$113,634,077	0.002	$221,586	$277,006
PMP [2]	20,000	0.00005	$190,321,707				
			ESTIMATED TOTAL ANNUAL DAMAGES (EAD) - Alt. 3				**$277,006**
Alt. 4							
2-YR	2	0.50000	$0				**annual**
				$25,458,367	0.400	$10,183,347	$10,183,347
10-YR	10	0.10000	$50,916,733				
				$53,541,804	0.060	$3,212,508	$13,395,855
25-YR	25	0.04000	$56,166,874				
				$59,815,939	0.020	$1,196,319	$14,592,174
50-YR	50	0.02000	$63,465,004				
				$65,726,862	0.010	$657,269	$15,249,442
100-YR	100	0.01000	$67,988,719				
			ESTIMATED TOTAL ANNUAL DAMAGES (EAD) - Alt. 4				**$15,249,442**

Source: Farr West Engineering, Hydrometeorological Report No. 49, NOAA, 1984 (PMP recurrence), and Part 611 Water Resources Handbook for Economics, 1998, USDA-NRCS.

[1] Includes structural and content damages.

[2] The PMP return period and therefore the probability of exceedence is not known; the analysis uses 20,000 years for the computations. Any period greater than 5,000 years results in negligble change to the EAD.

4.2 AVERAGE ANNUAL EQUIVALENT BENEFITS

P&G § 2.1.3 future discusses the procedure to properly calculate monetized (Average Annual Equivalent terms) data in order to allow proper comparison:

> Net NED benefits of the plan are calculated in average annual equivalent terms. To perform this calculation, discount the benefit stream, deferred installation costs, and operation, maintenance and Replacement (OM&R) costs to the beginning of the period of analysis using the applicable project discount rate. Installation expenditures are brought forward to the end of the period of installation by charging compound interest at the project discount rate from the date the costs are incurred. Use the project discount rate to convert the present worth values to average annual equivalent terms.

Average annual equivalents account for the difference in timing between when the cost of a project component begins and when the component's benefits begin. The EAD values are shown in **Table 4-3** for the Future without Project. The EAD is the same every year because there is no project. The discounted and amortized values are calculated to determine average annual equivalent damages for Alternative 1.

The same calculations are provided in **Table 4-4** for Alternative 2. The reduced damages (benefits of) the project would not be realized until 2049 when the project is estimated to be completed. Alternative 3 average annual equivalent damages are calculated in **Table 4-5**. Benefits of the project are realized in 2028 upon completion of improvements. Alternative 4 average annual equivalent damages are calculated in **Table 4-6**. Improvements would be completed and benefits realized in 2026.

Table 4-3
Present Value and Average Annual Equivalent Damages – Alternative 1

Calendar Year	Project Year [1]	Estimated DAMAGES in 2022 $s				Present Value of Estimated DAMAGES [2]			
		100-YR	200-YR	500-YR	PMP (Breach)	100-YR	200-YR	500-YR	PMP (Breach)
2022	Planning	$0	$69,558	$166,653	$390,351	$0	$68,027	$162,985	$381,761
2023	Planning	$0	$69,558	$166,653	$390,351	$0	$66,530	$159,399	$373,360
2024	Planning	$0	$69,558	$166,653	$390,351	$0	$65,066	$155,891	$365,145
2025	Planning	$0	$69,558	$166,653	$390,351	$0	$63,634	$152,461	$357,110
2026	Construction	$0	$69,558	$166,653	$390,351	$0	$62,234	$149,106	$349,252
2027	Construction	$0	$69,558	$166,653	$390,351	$0	$60,865	$145,825	$341,566
2028	1	$0	$69,558	$166,653	$390,351	$0	$59,525	$142,616	$334,050
2029	2	$0	$69,558	$166,653	$390,351	$0	$58,215	$139,478	$326,699
2030	3	$0	$69,558	$166,653	$390,351	$0	$56,934	$136,409	$319,510
2031	4	$0	$69,558	$166,653	$390,351	$0	$55,682	$133,407	$312,480
2032	5	$0	$69,558	$166,653	$390,351	$0	$54,456	$130,471	$305,604
2033	6	$0	$69,558	$166,653	$390,351	$0	$53,258	$127,600	$298,879
2034	7	$0	$69,558	$166,653	$390,351	$0	$52,086	$124,793	$292,302
2035	8	$0	$69,558	$166,653	$390,351	$0	$50,940	$122,047	$285,870
2036	9	$0	$69,558	$166,653	$390,351	$0	$49,819	$119,361	$279,579
2037	10	$0	$69,558	$166,653	$390,351	$0	$48,723	$116,734	$273,427
2038	11	$0	$69,558	$166,653	$390,351	$0	$47,651	$114,166	$267,411
2039	12	$0	$69,558	$166,653	$390,351	$0	$46,602	$111,653	$261,526
2040	13	$0	$69,558	$166,653	$390,351	$0	$45,577	$109,197	$255,771
2041	14	$0	$69,558	$166,653	$390,351	$0	$44,574	$106,794	$250,143
2042	15	$0	$69,558	$166,653	$390,351	$0	$43,593	$104,444	$244,639
2043	16	$0	$69,558	$166,653	$390,351	$0	$42,634	$102,145	$239,255
2044	17	$0	$69,558	$166,653	$390,351	$0	$41,695	$99,898	$233,991
2045	18	$0	$69,558	$166,653	$390,351	$0	$40,778	$97,700	$228,842
2046	19	$0	$69,558	$166,653	$390,351	$0	$39,881	$95,550	$223,806
2047	20	$0	$69,558	$166,653	$390,351	$0	$39,003	$93,447	$218,881
2048	21	$0	$69,558	$166,653	$390,351	$0	$38,145	$91,391	$214,065
2049	22	$0	$69,558	$166,653	$390,351	$0	$37,305	$89,380	$209,354
2050	23	$0	$69,558	$166,653	$390,351	$0	$36,485	$87,413	$204,748
2051	24	$0	$69,558	$166,653	$390,351	$0	$35,682	$85,489	$200,242
TOTAL		**$0**	**$3,895,227**	**$9,332,543**	**$21,859,635**	**$0**	**$2,202,215**	**$5,276,270**	**$12,358,617**
Average Annual Equivalent Damages [2]						**$0**	**$69,558**	**$166,653**	**$390,351**

Discount Rate: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/econ/prices/?cid=nrcs143_009685

[1] Uses Alternative 3 implementation phase and useful life of [2] Discount Rate 2.25% 56 years

******Due to table size, only the first 30 years of the analysis is shown**

Table 4-4
Present Value and Average Annual Equivalent Damages – Alternative 2

Calendar Year	Project Year [1]	Estimated DAMAGES in 2022 $s				Present Value of Estimated DAMAGES [2]			
		100-YR	200-YR	500-YR	PMP (Breach)	100-YR	200-YR	500-YR	PMP (Breach)
2022	Planning	$0	$69,558	$166,653	$390,351	$0	$68,027	$162,985	$381,761
2023	Planning	$0	$69,558	$166,653	$390,351	$0	$66,530	$159,399	$373,360
2024	Planning	$0	$69,558	$166,653	$390,351	$0	$65,066	$155,891	$365,145
2025	Planning	$0	$69,558	$166,653	$390,351	$0	$63,634	$152,461	$357,110
2026	Construction	$0	$69,558	$166,653	$390,351	$0	$62,234	$149,106	$349,252
2027	Construction	$0	$69,558	$166,653	$390,351	$0	$60,865	$145,825	$341,566
2028	1	$0	$69,558	$166,653	$390,351	$0	$59,525	$142,616	$334,050
2029	2	$0	$69,558	$166,653	$390,351	$0	$58,215	$139,478	$326,699
2030	3	$0	$69,558	$166,653	$390,351	$0	$56,934	$136,409	$319,510
2031	4	$0	$69,558	$166,653	$390,351	$0	$55,682	$133,407	$312,480
2032	5	$0	$69,558	$166,653	$390,351	$0	$54,456	$130,471	$305,604
2033	6	$0	$69,558	$166,653	$390,351	$0	$53,258	$127,600	$298,879
2034	7	$0	$69,558	$166,653	$390,351	$0	$52,086	$124,793	$292,302
2035	8	$0	$69,558	$166,653	$390,351	$0	$50,940	$122,047	$285,870
2036	9	$0	$69,558	$166,653	$390,351	$0	$49,819	$119,361	$279,579
2037	10	$0	$69,558	$166,653	$390,351	$0	$48,723	$116,734	$273,427
2038	11	$0	$69,558	$166,653	$390,351	$0	$47,651	$114,166	$267,411
2039	12	$0	$69,558	$166,653	$390,351	$0	$46,602	$111,653	$261,526
2040	13	$0	$69,558	$166,653	$390,351	$0	$45,577	$109,197	$255,771
2041	14	$0	$69,558	$166,653	$390,351	$0	$44,574	$106,794	$250,143
2042	15	$0	$69,558	$166,653	$390,351	$0	$43,593	$104,444	$244,639
2043	16	$0	$69,558	$166,653	$390,351	$0	$42,634	$102,145	$239,255
2044	17	$0	$69,558	$166,653	$390,351	$0	$41,695	$99,898	$233,991
2045	18	$0	$69,558	$166,653	$390,351	$0	$40,778	$97,700	$228,842
2046	19	$0	$69,558	$166,653	$390,351	$0	$39,881	$95,550	$223,806
2047	20	$0	$69,558	$166,653	$390,351	$0	$39,003	$93,447	$218,881
2048	21	$0	$69,558	$166,653	$390,351	$0	$38,145	$91,391	$214,065
2049	22	$0	$0	$693	$36,989	$0	$0	$372	$19,838
2050	23	$0	$0	$693	$36,989	$0	$0	$363	$19,401
2051	24	$0	$0	$693	$36,989	$0	$0	$355	$18,974
TOTAL		**$0**	**$1,878,056**	**$5,463,401**	**$11,612,136**	**$0**	**$1,396,126**	**$3,716,497**	**$8,263,577**
Average Annual Equivalent Damages [2]						**$0**	**$44,097**	**$117,387**	**$261,008**

Discount Rate: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/econ/prices/?cid=nrcs143_009685

[1] Uses Alternative 3 implementation phase and useful life of [2] Discount Rate 2.25% 56 years

*****_Due to table size, only the first 30 years of the analysis is shown_*****

Table 4-5
Present Value and Average Annual Equivalent Damages – Alternative 3

Calendar Year	Project Year [1]	Estimated DAMAGES in 2022 $s				Present Value of Estimated DAMAGES [2]			
		100-YR	200-YR	500-YR	PMP	100-YR	200-YR	500-YR	PMP
2022	Planning	$0	$69,558	$166,653	$390,351	$0	$68,027	$162,985	$381,761
2023	Planning	$0	$69,558	$166,653	$390,351	$0	$66,530	$159,399	$373,360
2024	Planning	$0	$69,558	$166,653	$390,351	$0	$65,066	$155,891	$365,145
2025	Planning	$0	$69,558	$166,653	$390,351	$0	$63,634	$152,461	$357,110
2026	Construction	$0	$69,558	$166,653	$390,351	$0	$62,234	$149,106	$349,252
2027	Construction	$0	$69,558	$166,653	$390,351	$0	$60,865	$145,825	$341,566
2028	1	$0	$0	$55,420	$277,006	$0	$0	$47,426	$237,053
2029	2	$0	$0	$55,420	$277,006	$0	$0	$46,383	$231,837
2030	3	$0	$0	$55,420	$277,006	$0	$0	$45,362	$226,735
2031	4	$0	$0	$55,420	$277,006	$0	$0	$44,364	$221,746
2032	5	$0	$0	$55,420	$277,006	$0	$0	$43,388	$216,867
2033	6	$0	$0	$55,420	$277,006	$0	$0	$42,433	$212,095
2034	7	$0	$0	$55,420	$277,006	$0	$0	$41,499	$207,427
2035	8	$0	$0	$55,420	$277,006	$0	$0	$40,586	$202,863
2036	9	$0	$0	$55,420	$277,006	$0	$0	$39,693	$198,399
2037	10	$0	$0	$55,420	$277,006	$0	$0	$38,820	$194,033
2038	11	$0	$0	$55,420	$277,006	$0	$0	$37,965	$189,764
2039	12	$0	$0	$55,420	$277,006	$0	$0	$37,130	$185,588
2040	13	$0	$0	$55,420	$277,006	$0	$0	$36,313	$181,504
2041	14	$0	$0	$55,420	$277,006	$0	$0	$35,514	$177,510
2042	15	$0	$0	$55,420	$277,006	$0	$0	$34,732	$173,604
2043	16	$0	$0	$55,420	$277,006	$0	$0	$33,968	$169,784
2044	17	$0	$0	$55,420	$277,006	$0	$0	$33,221	$166,048
2045	18	$0	$0	$55,420	$277,006	$0	$0	$32,490	$162,394
2046	19	$0	$0	$55,420	$277,006	$0	$0	$31,775	$158,820
2047	20	$0	$0	$55,420	$277,006	$0	$0	$31,075	$155,326
2048	21	$0	$0	$55,420	$277,006	$0	$0	$30,392	$151,908
2049	22	$0	$0	$55,420	$277,006	$0	$0	$29,723	$148,565
2050	23	$0	$0	$55,420	$277,006	$0	$0	$29,069	$145,296
2051	24	$0	$0	$55,420	$277,006	$0	$0	$28,429	$142,099
TOTAL		**$0**	**$417,346**	**$3,770,899**	**$16,192,410**	**$0**	**$386,356**	**$2,372,444**	**$9,399,666**
Average Annual Equivalent Damages [2]						**$0**	**$12,203**	**$74,934**	**$296,891**

Discount Rate: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/econ/prices/?cid=nrcs143_009685

[1] Uses Alternative 3 implementation phase and useful life of [2] Discount Rate 2.25% 56 years

*****_Due to table size, only the first 30 years of the analysis is shown_*****

Table 4-6
Present Value and Average Annual Equivalent Damages – Alternative 4

Calendar Year	Project Year [1]	Estimated DAMAGES in 2022 $s				Present Value of Estimated DAMAGES [2]			
		10-YR	25-YR	50-YR	100-YR	10-YR	25-YR	50-YR	100-YR
2022	Planning	$0	$0	$0	$0	$0	$0	$0	$0
2023	Planning	$0	$0	$0	$0	$0	$0	$0	$0
2024	Planning	$0	$0	$0	$0	$0	$0	$0	$0
2025	Planning	$0	$0	$0	$0	$0	$0	$0	$0
2026	Construction	$10,183,347	$13,395,855	$14,592,174	$15,249,442	$9,111,166	$11,985,436	$13,055,797	$13,643,864
2027	Construction	$10,183,347	$13,395,855	$14,592,174	$15,249,442	$8,910,675	$11,721,698	$12,768,506	$13,343,632
2028	1	$10,183,347	$13,395,855	$14,592,174	$15,249,442	$8,714,597	$11,463,763	$12,487,537	$13,050,007
2029	2	$10,183,347	$13,395,855	$14,592,174	$15,249,442	$8,522,833	$11,211,505	$12,212,750	$12,762,843
2030	3	$10,183,347	$13,395,855	$14,592,174	$15,249,442	$8,335,289	$10,964,797	$11,944,009	$12,481,998
2031	4	$10,183,347	$13,395,855	$14,592,174	$15,249,442	$8,151,872	$10,723,518	$11,681,183	$12,207,333
2032	5	$10,183,347	$13,395,855	$14,592,174	$15,249,442	$7,972,491	$10,487,548	$11,424,140	$11,938,712
2033	6	$10,183,347	$13,395,855	$14,592,174	$15,249,442	$7,797,057	$10,256,770	$11,172,753	$11,676,002
2034	7	$10,183,347	$13,395,855	$14,592,174	$15,249,442	$7,625,484	$10,031,071	$10,926,898	$11,419,073
2035	8	$10,183,347	$13,395,855	$14,592,174	$15,249,442	$7,457,686	$9,810,339	$10,686,452	$11,167,797
2036	9	$10,183,347	$13,395,855	$14,592,174	$15,249,442	$7,293,580	$9,594,463	$10,451,298	$10,922,051
2037	10	$10,183,347	$13,395,855	$14,592,174	$15,249,442	$7,133,086	$9,383,338	$10,221,318	$10,681,713
2038	11	$10,183,347	$13,395,855	$14,592,174	$15,249,442	$6,976,123	$9,176,859	$9,996,399	$10,446,663
2039	12	$10,183,347	$13,395,855	$14,592,174	$15,249,442	$6,822,614	$8,974,923	$9,776,430	$10,216,785
2040	13	$10,183,347	$13,395,855	$14,592,174	$15,249,442	$6,672,484	$8,777,431	$9,561,301	$9,991,966
2041	14	$10,183,347	$13,395,855	$14,592,174	$15,249,442	$6,525,656	$8,584,284	$9,350,905	$9,772,094
2042	15	$10,183,347	$13,395,855	$14,592,174	$15,249,442	$6,382,060	$8,395,388	$9,145,140	$9,557,060
2043	16	$10,183,347	$13,395,855	$14,592,174	$15,249,442	$6,241,623	$8,210,649	$8,943,902	$9,346,758
2044	17	$10,183,347	$13,395,855	$14,592,174	$15,249,442	$6,104,277	$8,029,974	$8,747,092	$9,141,083
2045	18	$10,183,347	$13,395,855	$14,592,174	$15,249,442	$5,969,953	$7,853,275	$8,554,613	$8,939,935
2046	19	$10,183,347	$13,395,855	$14,592,174	$15,249,442	$5,838,585	$7,680,465	$8,366,370	$8,743,213
2047	20	$10,183,347	$13,395,855	$14,592,174	$15,249,442	$5,710,108	$7,511,457	$8,182,269	$8,550,819
2048	21	$10,183,347	$13,395,855	$14,592,174	$15,249,442	$5,584,457	$7,346,168	$8,002,219	$8,362,659
2049	22	$10,183,347	$13,395,855	$14,592,174	$15,249,442	$5,461,572	$7,184,517	$7,826,131	$8,178,640
2050	23	$10,183,347	$13,395,855	$14,592,174	$15,249,442	$5,341,391	$7,026,422	$7,653,918	$7,998,670
2051	24	$10,183,347	$13,395,855	$14,592,174	$15,249,442	$5,223,854	$6,871,807	$7,485,494	$7,822,660
TOTAL		**$529,534,023**	**$696,584,450**	**$758,793,027**	**$792,970,995**	**$283,866,463**	**$373,416,921**	**$406,764,973**	**$425,086,703**
Average Annual Equivalent Damages [2]						**$8,966,007**	**$11,794,485**	**$12,847,794**	**$13,426,491**

Discount Rate: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/econ/prices/?cid=nrcs143_009685

[1] Uses Alternative 3 implementation phase and useful life of [2] Discount Rate 2.25% 56 years

******Due to table size, only the first 30 years of the analysis is shown**

4.3 ESTIMATED COSTS

Project Installation Costs. Project installation costs for each of the alternatives were estimated by Farr West Engineering. The construction costs include the planning "soft" costs associated with each of the projects, management during construction, 30% cost contingency since these estimates are early in the planning process, and 10% effective inflation to bring the total estimated construction cost for each project alternative to base year (2025) cost estimates.

Added to the estimated construction cost is an estimate of property acquisition cost under alternatives 2 and 5. The property acquisition costs are based on market prices of real estate in northwest Reno, spring 2022, inflated to 2025 dollars based on historical real estate property value increases from 2010 to 2020 in the City of Reno. Real property is described in National Watershed Program Manual (NPWM) Section 506.50 K (11&12). Real property includes all costs associated with

the purchase of real property, which may include planning, design, administrative, etc. This includes purchases of land, buildings, changes to utilities, roads, etc. Real property is a cost-shareable item in rehabilitation; however, only up to the point where NRCS pays 100% of construction costs. Any real property purchased is owned by the sponsor as NRCS cannot own land.

The cost estimates are summarized in **Table 4-7**. Alternative 2 is estimated to cost more than $2.0 billion, with $1.6 billion of the total cost attributed to property acquisition. Alternative 5 has a cost estimate of $172.2 million. Alternative 3 is estimated to cost $23.0 million, and Alternative 4 has a cost estimate of $5.5 million.

Table 4-7
Estimated Total Project Costs

Project Item	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
	All figures in 2025 $s (estimates rounded up to nearest $1,000)				
Estimated Construction Cost	**N.A.**	**$233,148,000**	**$14,380,000**	**$3,457,000**	**$37,390,000**
10% Engineering		$23,315,000	$1,438,000	$346,000	$3,739,000
10% Construction Management		$23,315,000	$1,438,000	$346,000	$3,739,000
10% Effective Inflation		$23,315,000	$1,438,000	$346,000	$3,739,000
30% Contingency		$69,945,000	$4,314,000	$1,038,000	$11,217,000
Base Bid Total	**N.A.**	**$373,038,000**	**$23,008,000**	**$5,533,000**	**$59,824,000**
Property Acquisition Estimate	**N.A.**	**$1,639,138,000**	**N.A.**	**N.A.**	**$112,388,000**
Grand Total Cost Estimate	**N.A.**	**$2,012,176,000**	**$23,008,000**	**$5,533,000**	**$172,212,000**

Source: Farr West Engineering April, 2022, and HEC May, 2022.

The project installation costs occur over different time periods for each alternative. **Table 4-8** provides an estimated schedule for each project to be completed. Alternative 4, which removes both dams, would likely be completed soonest, by the end of 2025. It is estimated that Alternative 3 (rehabilitation) would likely be completed by the end of 2027. Alternatives 2 and 5 are expected to take much longer to complete due to the number of property acquisitions that would be necessary. Alternative 2 would likely not be complete until the end of 2048, and alternative 5 by the end of 2034.

Table 4-8
Alternative Projects Installation Costs in 2025$

Calendar Year	Alt. 1	Alternative 2 Project Phase [1]	Alternative 2 Estimated Cost 2025 $s	Alternative 3 Project Phase [1]	Alternative 3 Estimated Cost 2025 $s	Alternative 4 Project Phase [1]	Alternative 4 Estimated Cost 2025 $s	Alternative 5 Project Phase [1]	Alternative 5 Estimated Cost 2025 $s
		All estimated costs rounded to nearest $1,000 - totals may not exactly match engineer's estimates due to rounding							
2022	$0	Planning	$0	Planning	$0	Planning	$0	Planning	$0
2023	$0	Planning	$0	Planning	$0	Planning	$0	Planning	$0
2024	$0	Planning	$4,663,000	Planning	$719,000	Planning	$346,000	Planning	$1,869,000
2025	$0	Planning	$4,663,000	Planning	$719,000	Construction	$5,187,000	Planning	$1,869,000
2026	$0	Planning	$4,663,000	Construction	$10,785,000		$0	ROW	$22,478,000
2027	$0	Planning	$4,663,000	Construction	$10,785,000		$0	ROW	$22,478,000
2028	$0	Planning	$4,663,000		$0		$0	ROW	$22,478,000
2029	$0	ROW	$163,914,000		$0		$0	ROW	$22,478,000
2030	$0	ROW	$163,914,000		$0		$0	ROW	$22,478,000
2031	$0	ROW	$163,914,000		$0		$0	Construction	$14,021,000
2032	$0	ROW	$163,914,000		$0		$0	Construction	$14,021,000
2033	$0	ROW	$163,914,000		$0		$0	Construction	$14,021,000
2034	$0	ROW	$163,914,000		$0		$0	Construction	$14,021,000
2035	$0	ROW	$163,914,000		$0		$0		$0
2036	$0	ROW	$163,914,000		$0		$0		$0
2037	$0	ROW	$163,914,000		$0		$0		$0
2038	$0	ROW	$163,914,000		$0		$0		$0
2039	$0	Construction	$34,973,000		$0		$0		$0
2040	$0	Construction	$34,973,000		$0		$0		$0
2041	$0	Construction	$34,973,000		$0		$0		$0
2042	$0	Construction	$34,973,000		$0		$0		$0
2043	$0	Construction	$34,973,000		$0		$0		$0
2044	$0	Construction	$34,973,000		$0		$0		$0
2045	$0	Construction	$34,973,000		$0		$0		$0
2046	$0	Construction	$34,973,000		$0		$0		$0
2047	$0	Construction	$34,973,000		$0		$0		$0
2048	$0	Construction	$34,973,000		$0		$0		$0
TOTAL	**$0**		**$2,012,185,000**		**$23,008,000**		**$5,533,000**		**$172,212,000**

Source: Farr West Engineering April 26, 2022.

[1] ROW = Property acquisitions.

Maintenance Costs. Annual maintenance costs at the East and West Wash Dams, and downstream of the current dams under alternatives 4 and 5, were estimated by the City of Reno using known current maintenance costs. As represented by Alternative 1, the City currently spends about $20,000 per year, on average, to maintain the dams site area. Under Alternative 2, the estimated annual maintenance cost is greater because of the maintenance associated with downstream improvements. Alternative 3 would incur greater costs than the current costs. Under alternatives 4 and 5, the annual maintenance costs are estimated to be lower; however, these costs do not account for clean-up after storm events. Since alternatives 4 and 5 model the 10-year, 25-year, 50-year, and 100-year events, it is anticipated that clean-up costs would add a much greater cost burden to the City than shown in **Table 4-9**.

Table 4-9
Estimated Maintenance Costs

Cost Item	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
City of Reno Estimate of Annual Maintenance Costs [1]	All Figures in 2022 $s				
	$20,000	**$59,000**	**$30,000**	**$12,000**	**$11,000**

Source: City of Reno April 27, 2022.

[1] City cost estimates rounded up to the nearest thousand dollars.

Annual maintenance costs are projected **in Table 4-10**. The costs remain at $20,000 each year under each alternative until the project is complete.

Table 4-10
Alternative Projects Maintenance Costs in 2022 $s

Calendar Year	Project Phase [1]	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
2022	Planning	$20,000	$20,000	$20,000	$20,000	$20,000
2023	Planning	$20,000	$20,000	$20,000	$20,000	$20,000
2024	Planning	$20,000	$20,000	$20,000	$20,000	$20,000
2025	Planning	$20,000	$20,000	$20,000	$20,000	$20,000
2026	Construction	$20,000	$20,000	$20,000	**$12,000**	$20,000
2027	Construction	$20,000	$20,000	$20,000	$12,000	$20,000
2028	**1**	$20,000	$20,000	**$30,000**	$12,000	$20,000
2029	2	$20,000	$20,000	$30,000	$12,000	$20,000
2030	3	$20,000	$20,000	$30,000	$12,000	$20,000
2031	4	$20,000	$20,000	$30,000	$12,000	$20,000
2032	5	$20,000	$20,000	$30,000	$12,000	$20,000
2033	6	$20,000	$20,000	$30,000	$12,000	$20,000
2034	7	$20,000	$20,000	$30,000	$12,000	$20,000
2035	8	$20,000	$20,000	$30,000	$12,000	**$11,000**
2036	9	$20,000	$20,000	$30,000	$12,000	$11,000
2037	10	$20,000	$20,000	$30,000	$12,000	$11,000
2038	11	$20,000	$20,000	$30,000	$12,000	$11,000
2039	12	$20,000	$20,000	$30,000	$12,000	$11,000
2040	13	$20,000	$20,000	$30,000	$12,000	$11,000
2041	14	$20,000	$20,000	$30,000	$12,000	$11,000
2042	15	$20,000	$20,000	$30,000	$12,000	$11,000
2043	16	$20,000	$20,000	$30,000	$12,000	$11,000
2044	17	$20,000	$20,000	$30,000	$12,000	$11,000
2045	18	$20,000	$20,000	$30,000	$12,000	$11,000
2046	19	$20,000	$20,000	$30,000	$12,000	$11,000
2047	20	$20,000	$20,000	$30,000	$12,000	$11,000
2048	21	$20,000	$20,000	$30,000	$12,000	$11,000
2049	22	$20,000	**$59,000**	$30,000	$12,000	$11,000
2050	23	$20,000	$59,000	$30,000	$12,000	$11,000
2051	24	$20,000	$59,000	$30,000	$12,000	$11,000
TOTAL		**$1,120,000**	**$2,251,000**	**$1,620,000**	**$704,000**	**$733,000**

Source: City of Reno and Farr West Engineering, May 2022.

[1] Uses Alternative 3 implementation phase and useful life of rehabilitated West Wash dam (50 years). Timing of projects for alternatives 2, 4, and 5 shown in Table 4-8.

*****_Due to table size, only the first 30 years of the analysis is shown*_

4.4 AVERAGE ANNUAL EQUIVALENT COSTS

Average annual equivalent project installation costs are calculated in **Table 4-11.** Project costs were provided in 2025 dollars, indexed back to 2022 dollars, then discounted and amortized. The calculated average annual equivalent installation cost is greatest under Alternative 2, and smallest under Alternative 4. Calculated average annual equivalent project maintenance cost, shown in **Table 4-12**, is also greatest under Alternative 2 and smallest under Alternative 4.

Table 4-11
Present Value and Average Annual Equivalent Project Installation Costs

Calendar Year	Project Year [1]	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
	Index [2] 1.093			*Present Values [3]*		
2022	Planning	$0	$0	$0	$0	$0
2023	Planning	$0	$0	$0	$0	$0
2024	Planning	$0	$3,990,453	$615,298	$296,096	$1,599,433
2025	Planning	$0	$3,902,644	$601,759	$4,341,199	$1,564,238
2026	Construction	$0	$3,816,766	$8,827,756	$0	$18,398,729
2027	Construction	$0	$3,732,779	$8,633,502	$0	$17,993,867
2028	1	$0	$3,650,639	$0	$0	$17,597,914
2029	2	$0	$125,503,619	$0	$0	$17,210,674
2030	3	$0	$122,741,925	$0	$0	$16,831,955
2031	4	$0	$120,041,003	$0	$0	$10,268,158
2032	5	$0	$117,399,514	$0	$0	$10,042,209
2033	6	$0	$114,816,150	$0	$0	$9,821,231
2034	7	$0	$112,289,634	$0	$0	$9,605,116
2035	8	$0	$109,818,713	$0	$0	$0
2036	9	$0	$107,402,164	$0	$0	$0
2037	10	$0	$105,038,791	$0	$0	$0
2038	11	$0	$102,727,424	$0	$0	$0
2039	12	$0	$21,435,811	$0	$0	$0
2040	13	$0	$20,964,118	$0	$0	$0
2041	14	$0	$20,502,805	$0	$0	$0
2042	15	$0	$20,051,643	$0	$0	$0
2043	16	$0	$19,610,409	$0	$0	$0
2044	17	$0	$19,178,884	$0	$0	$0
2045	18	$0	$18,756,855	$0	$0	$0
2046	19	$0	$18,344,112	$0	$0	$0
2047	20	$0	$17,940,452	$0	$0	$0
2048	21	$0	$17,545,675	$0	$0	$0
2049	22	$0	$0	$0	$0	$0
2050	23	$0	$0	$0	$0	$0
2051	24	$0	$0	$0	$0	$0
Total [1]		**$0**	**$1,351,202,983**	**$18,678,314**	**$4,637,295**	**$130,933,522**
Average Annual Equivalent Cost			**$42,678,152**	**$589,960**	**$146,470**	**$4,135,575**

Source: Farr West Engineering March 18, 2022, and the NRCS Discount Rate for Federal Water Projects through Sep 30, 2022.

[1] Uses Alternative 3 implementation phase and useful life of rehabilitated West Wash dam (50 years).

[2] Project costs provided in 2025 were first indexed back to 2022 dollars.

[3] Discount Rate 2.25% 56 years

******Due to table size, only the first 30 years of the analysis is shown**

Table 4-12
Present Value and Average Annual Equivalent Maintenance Costs

Calendar Year	Project Year [1]	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
				Present Values [2]		
2022	Planning	$19,560	$19,560	$19,560	$19,560	$19,560
2023	Planning	$19,129	$19,129	$19,129	$19,129	$19,129
2024	Planning	$18,709	$18,709	$18,709	$18,709	$18,709
2025	Planning	$18,297	$18,297	$18,297	$18,297	$18,297
2026	Construction	$17,894	$17,894	$17,894	$10,737	$17,894
2027	Construction	$17,500	$17,500	$17,500	$10,500	$17,500
2028	1	$17,115	$17,115	$25,673	$10,269	$17,115
2029	2	$16,739	$16,739	$25,108	$10,043	$16,739
2030	3	$16,370	$16,370	$24,556	$9,822	$16,370
2031	4	$16,010	$16,010	$24,015	$9,606	$16,010
2032	5	$15,658	$15,658	$23,487	$9,395	$15,658
2033	6	$15,313	$15,313	$22,970	$9,188	$15,313
2034	7	$14,976	$14,976	$22,465	$8,986	$14,976
2035	8	$14,647	$14,647	$21,970	$8,788	$8,056
2036	9	$14,325	$14,325	$21,487	$8,595	$7,878
2037	10	$14,009	$14,009	$21,014	$8,406	$7,705
2038	11	$13,701	$13,701	$20,552	$8,221	$7,536
2039	12	$13,400	$13,400	$20,099	$8,040	$7,370
2040	13	$13,105	$13,105	$19,657	$7,863	$7,208
2041	14	$12,816	$12,816	$19,224	$7,690	$7,049
2042	15	$12,534	$12,534	$18,801	$7,521	$6,894
2043	16	$12,258	$12,258	$18,388	$7,355	$6,742
2044	17	$11,989	$11,989	$17,983	$7,193	$6,594
2045	18	$11,725	$11,725	$17,587	$7,035	$6,449
2046	19	$11,467	$11,467	$17,200	$6,880	$6,307
2047	20	$11,215	$11,215	$16,822	$6,729	$6,168
2048	21	$10,968	$10,968	$16,452	$6,581	$6,032
2049	22	$10,726	$31,643	$16,090	$6,436	$5,900
2050	23	$10,490	$30,947	$15,736	$6,294	$5,770
2051	24	$10,260	$30,266	$15,389	$6,156	$5,643
Total		**$633,206**	**$1,085,169**	**$894,264**	**$410,201**	**$448,736**
Avg. Annual Equivalent Cost [2]		**$20,000**	**$34,275**	**$28,246**	**$12,956**	**$14,173**

Source: City of Reno & Farr West Engineering, May 2022; NRCS Discount Rate for Federal Water Projects.

[1] Uses Alternative 3 implementation phase and useful life of rehabilitated West Wash dam (50 years).

[2] Discount Rate 2.25% 56 years

Due to table size, only the first 30 years of the analysis is shown*

Section 5: COMPARISON OF ALTERNATIVES AND CONCLUSIONS

Benefits and costs for each of the alternatives in the NED account is compared in this section and OSE and RED account impacts are determined.

5.1 NED COMPARISON OF ALTERNATIVES BENEFITS AND COSTS

The net benefit by flood event under Alternative 2 is provided in **Table 5-1.** Benefits increase with increased storm severity. Since there isn't a project under Alternative 1 (shown as Future Without Project), the only costs associated with this alternative are the annual maintenance costs. Benefits minus costs are negative. The benefit-cost ratio is zero.

Table 5-1
Alternative 2 Net Benefit by Flood Event

National Economic Development		100-YR	200-YR	500-YR	PMP (Breach)
Estimated Annual Equivalent Damages [1]			*Present Values*		
Future Without Project	a	$0	$69,558	$166,653	$390,351
Downstream Flood Improvements	b	$0	$44,097	$117,387	$261,008
Net Annual Equivalent Damages	**c = a-b**	**$0**	**$25,461**	**$49,266**	**$129,343**
Estimated Annual Equivalent Cost [2]					
Downstream Flood Improvements	d	$42,712,427	$42,712,427	$42,712,427	$42,712,427
Future Without Project	e	$20,000	$20,000	$20,000	$20,000
Net Annual Equivalent Costs	**f = d-e**	**$42,692,427**	**$42,692,427**	**$42,692,427**	**$42,692,427**
Estimated Net Benefit	**g = c-f**	**($42,712,427)**	**($42,666,966)**	**($42,643,161)**	**($42,563,084)**
Benefit-Cost Ratio	h = c/f	0.00	0.00	0.00	0.00

[1] Includes structures and contents damages.

[2] Includes project installation and annual maintenance costs.

Under Alternative 3 the benefits are maximized in the local PMP flood event. Annual costs are much lower than under Alternative 2 but the net benefit is still negative. There is a positive benefit-cost ratio of 0.16 to 1 meaning there is a sixteen-cent return for every dollar spent on the project. This result is typical for dam rehabilitation projects because there isn't any cost associated with the comparison alternative (future without the project) and the project is being driven by dam safety that impacts threat to human lives. Net benefits for Alternative 3 and 4 are shown in **Tables 5-2** and **5-3**, respectively.

Table 5-2
Alternative 3 Net Benefit by Flood Event

National Economic Development		100-YR	200-YR	500-YR	PMP [3]
Estimated Annual Equivalent Damages [1]			*Present Values*		
Future Without Project	a	$0	$69,558	$166,653	$390,351
Remediate West Wash Dam to contain PMP	b	$0	$12,203	$74,934	$296,891
Net Annual Equivalent Damages	**c = a-b**	**$0**	**$57,354**	**$91,718**	**$93,459**
Estimated Annual Equivalent Cost [2]					
Remediate West Wash Dam to contain PMP		$618,206	$618,206	$618,206	$618,206
Future Without Project		$20,000	$20,000	$20,000	$20,000
Net Annual Equivalent Costs		**$598,206**	**$598,206**	**$598,206**	**$598,206**
Estimated Net Benefit	**g = c-f**	**($598,206)**	**($540,851)**	**($506,488)**	**($504,746)**
Benefit-Cost Ratio	h = c/f	0.00	0.10	0.15	0.16

[1] Includes structures and contents damages.

[2] Includes project installation and annual maintenance costs.

[3] Controlled release from the West Wash Dam Auxiliary Spillway.

Alternatives 4 and 5 are modeled under the 10-year, 25-year, 50-year, and 100-year flood events since both dams are removed. Under these storm events the future without project incurs no damages so the analysis yields negative benefits. Costs are lowest for Alternative 4 but the benefit-cost ratio is negative.

Table 5-3
Alternative 4 Net Benefit by Flood Event

National Economic Development		10-YR	25-YR	50-YR	100-YR
Estimated Annual Equivalent Damages [1]			*Present Values*		
Future Without Project	a	$0	$0	$0	$0
Remove both Dams	b	$8,966,007	$11,794,485	$12,847,794	$13,426,491
Net Annual Equivalent Damages	**c = a-b**	**($8,966,007)**	**($11,794,485)**	**($12,847,794)**	**($13,426,491)**
Estimated Annual Equivalent Cost [2]					
Remove both Dams	d	$159,427	$159,427	$159,427	$159,427
Future Without Project	e	$20,000	$20,000	$20,000	$20,000
Net Annual Equivalent Costs	**f = d-e**	**$139,427**	**$139,427**	**$139,427**	**$139,427**
Estimated Net Benefit	**g = c-f**	**($9,105,434)**	**($11,933,912)**	**($12,987,220)**	**($13,565,918)**
Benefit-Cost Ratio	h = c/f	-64.31	-84.59	-92.15	-96.30

[1] Includes structures and contents damages.

[2] Includes project installation and annual maintenance costs.

Alternative 5 protects the Affected Area to the same level as the Future without Project by purchasing all the properties that would be damaged during the modeled storm events. Similar to Alternative 2, estimated net benefit is negative, and the benefit-cost ratio is zero. The calculation of net benefits for Alternative 5 is shown in **Table 5-4**.

Table 5-4
Alternative 5 Net Benefit by Flood Event

National Economic Development		**10-YR**	**25-YR**	**50-YR**	**100-YR**
Estimated Annual Equivalent Damages [1]			*Present Values*		
Future Without Project	a	$0	$0	$0	$0
Remove both Dams - Flood Conveyance to Truckee River	b	$0	$0	$0	$0
Net Annual Equivalent Damages	**c = a-b**	**$0**	**$0**	**$0**	**$0**
Estimated Annual Equivalent Cost [2]					
Remove both Dams - Flood Conveyance to Truckee River	d	**$4,149,748**	**$4,149,748**	**$4,149,748**	**$4,149,748**
Future Without Project	e	$20,000	$20,000	$20,000	$20,000
Net Annual Equivalent Costs	**f = d-e**	**$4,129,748**	**$4,129,748**	**$4,129,748**	**$4,129,748**
Estimated Net Benefit	**g = c-f**	**($4,129,748)**	**($4,129,748)**	**($4,129,748)**	**($4,129,748)**
Benefit-Cost Ratio	h = c/f	0.00	0.00	0.00	0.00

[1] Includes structures and contents damages.

[2] Includes project installation and annual maintenance costs.

A summary of net benefits and the benefit-cost ratio under each event for each alternative is provided in **Table 5-5.**

Table 5-5
Comparison of Net Benefit and BCR in the NED Account

2022 Dollars, Discount Rate of 2.25%, 56 Years	**Alternative 2**				**Alternative 3**			
	Downstream Flood Improvements				**Remediate West Wash Dam to contain PMP**			
	100-YR	200-YR	500-YR	PMP (Breach)	100-YR	200-YR	500-YR	PMP (Controlled)
	Thousands of Dollars				*Thousands of Dollars*			
Benefit Cost Ratio	0.00	0.00	0.00	0.00	0.00	0.10	0.15	0.16
NED - Net Benefits	**($42,712)**	**($42,667)**	**($42,643)**	**($42,563)**	**($598)**	**($541)**	**($506)**	**($505)**

2022 Dollars, Discount Rate of 2.25%, 56 Years	**Alternative 4**				**Alternative 5**			
	Remove both Dams				**Remove Dams - Flood Conveyance to Truckee River**			
	10-YR	25-YR	50-YR	100-YR	10-YR	25-YR	50-YR	100-YR
	Thousands of Dollars				*Thousands of Dollars*			
Benefit Cost Ratio	-64.31	-84.59	-92.15	-96.30	0.00	0.00	0.00	0.00
NED - Net Benefits	**($9,105)**	**($11,934)**	**($12,987)**	**($13,566)**	**($4,130)**	**($4,130)**	**($4,130)**	**($4,130)**

5.2 RED AND OSE ACCOUNTS

In addition to the NED, there are impacts that can be measured in the RED and OSE accounts for alternatives 2 and 5 because under these two alternatives there is substantial property acquisition. **Table 5-6** calculates an estimate of persons displaced, visitors lost, and jobs lost as a result of the necessary property acquisitions. The calculations are based on the census tract data provided in Table 2-1. The estimated number of permanent residents displaced is 1,990 under Alternative 2 and 325 under Alternative 5. The number of visitors staying at hotel/motel units that are lost from Downtown Reno is estimated at 18,150 per year under Alternative 2[3]. No hotel/motel units are acquired under Alternative 5. Using estimates of occupancy and building square feet per employee, it is calculated that about 2,466 jobs would be lost under Alternative 2, and 170 jobs would be lost under Alternative 5. No casino/recreation buildings would be acquired under Alternative 5.

Using the Assessor's database, the amount of property taxes that would be lost in fiscal year 2022/23 is shown in **Table 5-7**. The loss of property taxes increases with the number of properties acquired (over ten years under Alternative 2 and five years under Alternative 5). The annual property tax losses are discounted and amortized to determine average annual equivalent losses in **Table 5-8**.

RED and OSE impacts are summarized in **Table 5-9**. Alternative 2 would result in severe losses of revenues to the City of Reno and State of Nevada.

Table 5-9
RED and OSE Accounts Impacts under Alternatives 2 and 5

	Alt. 2	Alt. 5
	Downstream Flood Improvements	Remove both Dams - Flood Conveyance to Truckee River
Regional Economic Development (RED)		
Avg. Annual Equivalent Loss of Property Taxes	($69,718,659)	($6,704,781)
Other Social Effects (OSE)		
Persons Displaced	1,990	325
Jobs Lost	2,466	170
Annual Number of Visitors Lost	18,150	0

[3] It is assumed that these accommodation units are not replaced elsewhere in Reno.

Table 5-6
Jobs Lost, Persons Displaced, and Visitors Lost from Property Acquisitions

Land Use	**Alternative 2** Downstream Flood Improvements	**Alternative 5** Remove Dams - Flood Conveyance to Truckee River
Single Family Homes		
Number of Units	527	155
Est. Persons per Unit	2.24	2.24
Occupancy	91%	91%
Total Est. Displaced Persons	**1,070**	**315**
Apartments		
Number of Units	453	5
Est. Persons per Unit	2.24	2.24
Occupancy	91%	91%
Total Est. Displaced Persons	**920**	**10**
Est. Permanent Residents Displaced	**1,990**	**325**
Hotels/Motels		
Number of Units	153	0
Avg. No. Visitors per Unit per Day	2.0	2.0
Annual Max. Visitor Days	111,690	0
Est. Occupancy	65%	65%
Est. Visitor Stay (Days)	4	4
Est. Annual Visitors Lost	**18,150**	**0**
Casinos / Entertainment		
First Floor Building Square Feet	86,778	0
Estimated Occupancy	100%	100%
Est. Employees per Bldg. Sq. Ft.	200	200
Total Est. Jobs Lost	**434**	**0**
Commercial		
Building Square Feet	660,889	49,551
Estimated Occupancy	90%	90%
Est. Employees per Bldg. Sq. Ft.	300	300
Total Est. Jobs Lost	**1,983**	**149**
Industrial		
Building Square Feet	24,888	10,880
Estimated Occupancy	90%	90%
Est. Employees per Bldg. Sq. Ft.	450	450
Total Est. Jobs Lost	**50**	**22**
Est. Total Jobs Lost	**2,466**	**170**

Source: Washoe County Assessor, Farr West Engineering, and HEC May 2022.

Table 5-7
Estimated Loss of Property Taxes from Property Acquisitions

Calendar Year	Project Year [1]	Alternative 2	Alternative 5
		Figures in 2022 $s	
2022	Planning	$0	$0
2023	Planning	$0	$0
2024	Planning	$0	$0
2025	Planning	$0	$0
2026	Construction	$0	$1,625,070
2027	Construction	$0	$3,250,140
2028	1	$0	$4,875,209
2029	2	$10,173,574	$6,500,279
2030	3	$20,347,148	$8,125,349
2031	4	$30,520,721	$8,125,349
2032	5	$40,694,295	$8,125,349
2033	6	$50,867,869	$8,125,349
2034	7	$61,041,443	$8,125,349
2035	8	$71,215,017	$8,125,349
2036	9	$81,388,590	$8,125,349
2037	10	$91,562,164	$8,125,349
2038	11	$101,735,738	$8,125,349
2039	12	$101,735,738	$8,125,349
2040	13	$101,735,738	$8,125,349
2041	14	$101,735,738	$8,125,349
2042	15	$101,735,738	$8,125,349
2043	16	$101,735,738	$8,125,349
2044	17	$101,735,738	$8,125,349
2045	18	$101,735,738	$8,125,349
2046	19	$101,735,738	$8,125,349
2047	20	$101,735,738	$8,125,349
2048	21	$101,735,738	$8,125,349
2049	22	$101,735,738	$8,125,349
2050	23	$101,735,738	$8,125,349
2051	24	$101,735,738	$8,125,349

Source: Washoe County Assessor, Farr West Engineering, and HEC May 2022.

[1] Uses Alternative 3 implementation phase and useful life of rehabilitated West Wash dam (50 years).

Due to table size, only the first 30 years of the analysis is shown*

Table 5-8 ***Due to table size, only the first 30 years of the analysis is shown****

Present Value and Average Annual Equivalent Annual Loss of Property Taxes

Calendar Year	Project Year [1]	Alternative 2	Alternative 5
		Present Values [2]	
2022	Planning	$0	$0
2023	Planning	$0	$0
2024	Planning	$0	$0
2025	Planning	$0	$0
2026	Construction	$0	$1,453,970
2027	Construction	$0	$2,843,951
2028	1	$0	$4,172,055
2029	2	$8,514,654	$5,440,333
2030	3	$16,654,580	$6,650,774
2031	4	$24,432,147	$6,504,424
2032	5	$31,859,360	$6,361,295
2033	6	$38,947,873	$6,221,315
2034	7	$45,708,995	$6,084,416
2035	8	$52,153,703	$5,950,529
2036	9	$58,292,647	$5,819,588
2037	10	$64,136,164	$5,691,529
2038	11	$69,694,283	$5,566,288
2039	12	$68,160,668	$5,443,802
2040	13	$66,660,800	$5,324,012
2041	14	$65,193,937	$5,206,857
2042	15	$63,759,351	$5,092,281
2043	16	$62,356,334	$4,980,226
2044	17	$60,984,189	$4,870,637
2045	18	$59,642,239	$4,763,459
2046	19	$58,329,818	$4,658,640
2047	20	$57,046,277	$4,556,127
2048	21	$55,790,980	$4,455,870
2049	22	$54,563,306	$4,357,819
2050	23	$53,362,646	$4,261,925
2051	24	$52,188,407	$4,168,142
Total		**$2,207,313,501**	**$212,275,373**
Avg. Annual Equivalent Loss [2]		**$69,718,659**	**$6,704,781**

Source: Washoe County Assessor, Farr West Engineering, and HEC May 2022.

[1] Uses Alternative 3 implementation phase and useful life of rehabilitated West Wash dam (50 years).

[2] Discount Rate 2.25% 56 years

5.3 CONCLUSIONS

A BCR greater than 1 means the project is expected to deliver a positive net present value. It is a worthwhile investment. A negative BCA ratio means that the project is expected to generate greater disbenefits than actual benefits – making conditions worse rather than better. A positive BCA ratio that is less than 1 means the project's costs outweigh the benefits and it should not be considered; however, an overarching concern associated with dam rehabilitation analyses is the intent of the program to minimize threat to human life. Agency policy allows for use of the OSE account to make the case for rehabilitating any given floodwater detention structure, even if the associated benefit-cost ratio is less than 1:1. This is due to a priority placed on protecting lives. Also, trying to monetize the value of life, or in the case of dams, avoidance of loss of life, is fraught with subjective value judgements. Threat to human life can therefore be used to supersede purely economic considerations when deemed appropriate.

Alternative 3 is the NED Plan. Alternative 3 has the greatest net benefit, even though the benefit is negative. Under alternative 3, all existing properties are protected as they are currently in the 100-year flood event, and better in the 200-year, 500-year, and local PMP events. Further, in a local PMP event, Alternative 3 would allow a controlled release through the auxiliary spillway; fewer properties in total would be damaged than in the future without a project, and both East and Wash dams would be in compliance with State dam requirements. OSE and RED accounts further decrease the net benefits of alternatives 2 and 5, and reaffirm that alternative 3 is the best project alternative.

The RED account monetizes the property tax loss from property acquisitions under alternatives 2 and 5, as this information is readily available in the data from the Assessor used to conduct the economic analysis. Property taxes (which are allocated among the State and local service providers) would be reduced by $69.7 million per year under Alternative 2 and $6.7 million per year under Alternative 5. Other municipal revenue losses (property taxes, sales taxes, consolidated taxes, and hotel room taxes, for example) were not monetized but would increase the negative benefits in the RED account.

The OSE account measures some of the social and other impacts that would occur under alternatives 2 and 5. Alternative 2 displaces about 2,000 permanent residents, causes an estimated almost 2,500 jobs to be lost, and reduces annual visitation to Reno's Downtown by about 18,000 people per year.

Alternatives 2, 4, and 5 fundamentally alter the economic fabric and character of the City of Reno. Downtown Reno is the historical heart of the "Biggest Little City". In addition, the socioeconomic description of the Affected Area (see Section 2) shows there is a high proportion of minorities living in Downtown Reno compared with the City of Reno, as well as a lower income, more transitory and older population with a higher proportion of the population having a disability, and living in poverty than in the City of Reno, the State, and the US. These disadvantaged persons would be severely impacted as much of Downtown Reno becomes a flood plain under alternatives 2, 4, and 5; they would not be impacted under Alternative 3.

Given the results of the NED account analysis shown in **Table 5-10,** and the findings of the RED and OSE accounts, as well as description of the socioeconomic characteristics of the Affected Area, Alternative 3 is the recommended alternative.

Table 5-10
Summary of Equivalent Annual Net Benefit and BCR by Alternative

Alternative		Equivalent Annual Net Benefit *	Benefit-Cost Ratio
		In $1,000s	
Alt. 1	Future Without Project [1], [2]	N/A	N/A
Alt. 2	Downstream Flood Improvements [1]	($42,570)	0.00:1
Alt. 3	**Remediate West Wash Dam to contain PMP**	**($510)**	**0.16:1**
Alt. 4	Remove both Dams	($13,570)	-96.3:1
Alt. 5	Remove Dams - Flood Conveyance to Truckee River	($4,130)	0.00:1

** Rounded up to the nearest ten thousand dollars.*
The Alternative 3 net benefit is negative $510,000, for example.

[1] Under both of these alternatives, the West Wash Dam Auxiliary Spillway breaches during the PMP.

[2] Pursuant to the National Watershed Program Manual Section 502.2, existing dams not meeting current safety and performance standards cannot be identified as the NED alternative, but will continue to be included to allow a valid comparison of the alternatives.

Section 6: REFERENCES

Code of Federal Regulations, Title 49, Part 24, Uniform Relocation Assistance and Real Property Acquisition for Federal and Federally-Assisted Programs.

Nevada Department of Taxation, Nevada Property Tax: Elements and Application, updated March, 2021.

Saint Vrain Creek, Flood Risk Management Study Continuing Authorities Program Section 205 Longmont, Colorado, U.S. Army Corps of Engineers Omaha District Economic Appendix, July 2020.

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United States Department of Agriculture, Natural Conservation Science, Title 390 - National Watershed Program Manual (NWPM).

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United States Department of Agriculture, Natural Resources Conservation Science, Watershed Rehabilitation Planning Series Webinar 8 – Economics, Issues and Procedures in Watershed Rehabilitation Economic Analysis, February 2017.

URS Group Inc, Solicitation of Expert Opinion Depth-Damage Function Calculations for the Benefit-Cost Analysis Tool, 2008.

United States Army Corps of Engineers, Economic Guidance Memorandum (EGM) 04-01.

United States Army Corps of Engineers, Economic Guidance Memorandum (EGM) 09-04.

United States Army Corps of Engineers, Expected Annual Flood Damage Computation, User's Manual, March 1989.

Watershed Rules 7 Code of Federal Regulations Part 622 (Projects funded under Public Law 83-566).

APPENDIX E: ALTERNATIVE DRAWINGS

SCALE: 1" = 100'

100' 0 100' 200'

KEYSTONE AVE

VAN NESS AVE

O'FARRELL ST

POLK ST

WYOMING AVE

EAST WASH DAM

WEST WASH DAM

EXISTING FLOWLINE

EXISTING R.C. CHUTE

OVERTOPPING OF WEST BERM WILL OCCUR DURING THE 100-YEAR EVENT

OVERTOPPING OF WEST WASH DAM WILL OCCUR DURING THE 3/4 LOCAL PMP EVENT

EXISTING SPILLWAY, WILL BE ACTIVATED DURING 200-YEAR EVENT

MCCARRAN BLVD

SEVERN ST

GULLING RD

DATE: 8/4/2021
SCALE:
DESIGNED: MA
DRAWN: SHH
CHECKED: CC

FARR WEST ENGINEERING
5510 LONGLEY LANE
RENO, NEVADA 89511
PHONE: (775) 851-4788
FAX: (775) 851-0766

CITY OF RENO

SUPPLEMENTAL WATERSHED PLAN AND ENVIRONMENTAL DOCUMENT FOR THE PEAVINE MOUNTAIN WATERSHED

ALTERNATIVE 1 - FUTURE WITHOUT PROJECT (NO ACTION)

WASHOE COUNTY NEVADA

1

SCALE: 1" = 150'

150' 0 150' 300'

KEYSTONE AVE

VAN NESS AVE

O'FARRELL ST

POLK ST

EAST WASH DAM

WEST WASH INUNDATION AREA

WYOMING AVE

WEST WASH DAM

IMPROVE NATURAL CONVEYANCE 2.2 MI TO TRUCKEE RIVER

MCCARRAN BLVD

SEVERN ST

GULLING RD

DATE:

SCALE:

DESIGNED:

DRAWN: SHH

CHECKED:

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5510 LONGLEY LANE
RENO, NEVADA 89511
PHONE: (775) 851-4788
FAX: (775) 851-0766

CITY OF RENO

SUPPLEMENTAL WATERSHED PLAN AND ENVIRONMENTAL DOCUMENT FOR THE PEAVINE MOUNTAIN WATERSHED

ALTERNATIVE 2 - FLOOD PROOFING DOWNSTREAM FROM WEST WASH

WASHOE COUNTY NEVADA

2

East Wash Dam

West Wash Dam

659

659

430

PEAVINE RD

COLEMAN DR

PUTNAM DR

PUTNAM DR

WASHINGTON ST

COLLEGE DR

ALTURAS AVE

KEYSTONE AVE

KEYSTONE AVE

WYOMING AVE

SEVERN DR

KINGS ROW

GEAR ST

W 11TH ST

SADLEIR WAY

HIGHLAND AVE

N WELLS AVE

E 9TH ST

W 9TH ST

E 9TH ST

WASHINGTON ST

UNIVERSITY TER

VALLEY RD

E 6TH ST

W 7TH ST

W 6TH ST

N SIERRA ST

N VIRGINIA ST

N CENTER ST

EVANS AVE

E 4TH ST

W 7TH ST

W 5TH ST

W 4TH ST

LAKE ST

N ARLINGTON AVE

KUENZLI ST

E 2ND ST

VINE ST

WASHINGTON ST

RALSTON ST

STOKER AVE

KEYSTONE AVE

W 2ND ST

E 1ST ST

S SIERRA ST

S CENTER ST

S LAKE ST

SINCLAIR ST

MILL ST

HOLCOMB AVE

S WELLS AVE

LOU ST

W 1ST ST

RYLAND ST

Legend

Water Depth (ft)

Value

40

0

Parcels with Water Depths ≥ 1 ft

Parcels with Water Depths < 1 ft

P:\Client Projects\Reno, City of 1461\1930 West Wash Dam\3.0 Studies_Reports\3.12 BCA\Figures\1930_BCA Figs\1930_BCA Figs_Alternatives.aprx, Editor: djones, Printed: 3/7/2022

20 Years!
FARR WEST ENGINEERING

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Reno, NV 89511
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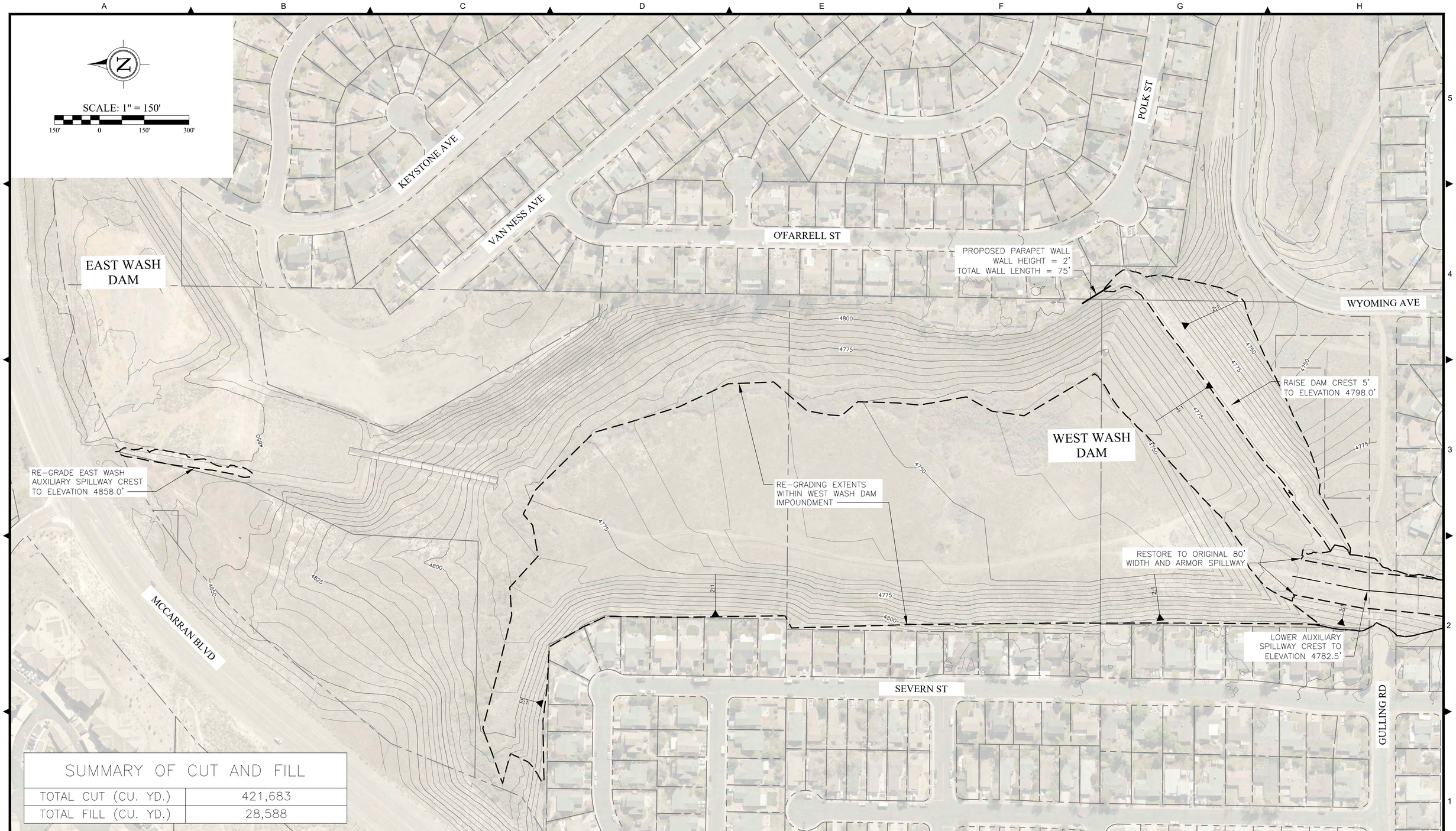
www.farrwestengineering.com

Supplemental Watershed Plan and Environmental Document for the Peavine Mountain Watershed
Alternative 2 - Downstream Flood Improvements
Parcels with Flood Damage from West Wash Dam Breach at Local PMP

N

1:12,000

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.



SUMMARY OF CUT AND FILL	
TOTAL CUT (CU. YD.)	421,683
TOTAL FILL (CU. YD.)	28,588

DATE:
SCALE:
DESIGNED:
DRAWN: SHH
CHECKED:

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5510 LONGLEY LANE
RENO, NEVADA 89511
PHONE: (775) 851-4788
FAX: (775) 851-0766

CITY OF RENO

SUPPLEMENTAL WATERSHED PLAN AND ENVIRONMENTAL DOCUMENT FOR THE PEAVINE MOUNTAIN WATERSHED

ALTERNATIVE 3 - REMEDIATE EAST AND WEST WASH DAMS

WASHOE COUNTY NEVADA

3

SCALE: 1" = 150'

150' 0 150' 300'

KEYSTONE AVE

VAN NESS AVE

O'FARRELL ST

POLK ST

WYOMING AVE

EAST WASH DAM, PRIMARY SPILLWAY, AND AUXILIARY SPILLWAY REMOVAL GRADING EXTENTS

WEST WASH DAM, PRIMARY SPILLWAY, AND AUXILIARY SPILLWAY REMOVAL GRADING EXTENTS

MCCARRAN BLVD

SEVERN ST

GULLING RD

4725 4750 4775 4800 4825 4850

SUMMARY OF CUT AND FILL	
TOTAL CUT (CU. YD.)	130,485
TOTAL FILL (CU. YD.)	53,215

DATE:
SCALE:
DESIGNED:
DRAWN: SHH
CHECKED:

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5510 LONGLEY LANE
RENO, NEVADA 89511
PHONE: (775) 851-4788
FAX: (775) 851-0766

CITY OF RENO

SUPPLEMENTAL WATERSHED PLAN AND ENVIRONMENTAL DOCUMENT FOR THE PEAVINE MOUNTAIN WATERSHED

ALTERNATIVE 4 & 5 - REMOVE EAST AND WEST WASH DAMS

WASHOE COUNTY NEVADA

East Wash Dam

West Wash Dam

Van Ness Avenue Crossing

Peavine Road Crossing

Putnam Drive Crossing

Penrose Drive Crossing

Coleman Drive Crossing

Anson Drive Crossing

Wesley Drive Crossing

Butte Place Crossing

Kings Row Crossing

Whitaker Drive Crossing

University Terrace Crossing

W 7th Street Crossing

Highway 80 Crossing

W 6th Street Crossing

W 5th Street Crossing

W 4th Street Crossing

Railroad Crossing

W 2nd Street Crossing

W 1st Street Crossing

Riverside Drive Crossing

Jones Street Crossing

Keystone Avenue Crossing

MacDonald Drive Crossing

Putnam Drive Crossing

Legend

- 100-Year West Wash Trapezoidal Channel
- 100-Year East Wash Trapezoidal Channel
- 100-Year Combined Trapezoidal Channel to Truckee
- Box Culvert Road Crossings

N MCCARRAN BLVD

N SIERRA ST

N VIRGINIA ST

KEYSTONE AVE

KINGS ROW

W 7TH ST

W 6TH ST

W 5TH ST

W 4TH ST

W 2ND ST

E 9TH ST

E 6TH ST

E 5TH ST

E 4TH ST

E 2ND ST

EVANS AVE

N CENTER ST

S CENTER ST

N ARLINGTON AVE

S ARLINGTON AVE

STOKER AVE

KUENZLI ST

MILL ST

RYLAND ST

E LIBERTY ST

W LIBERTY ST

CALIFORNIA AVE

PLUMAS ST

Supplemental Watershed Plan and Environmental Document for the Peavine Mountain Watershed
Alternative 5 - Remove Both Dams with Flood Conveyance to Truckee
100-Year Flood Channel Alignment with Road Crossings

N

1" = 1,200'

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Reno, NV 89511
(775) 851-4788
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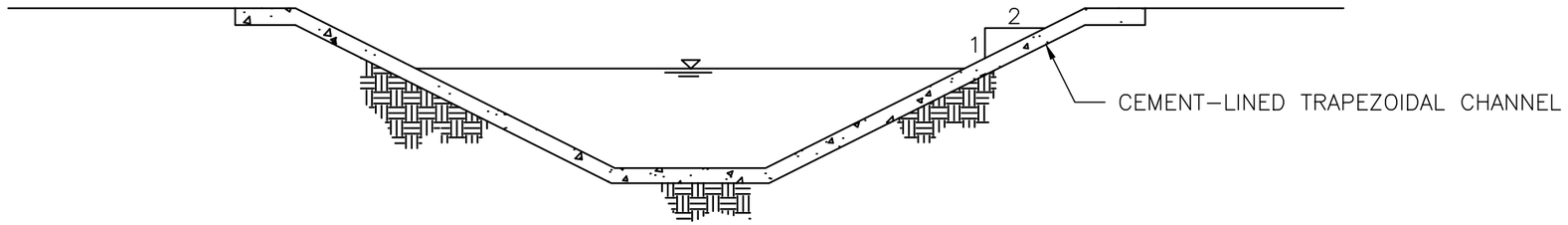
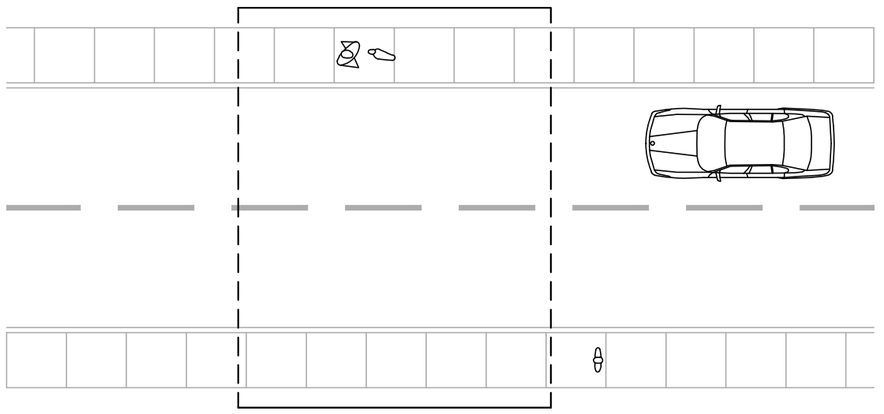
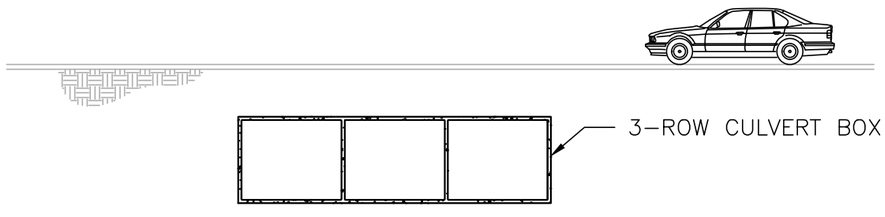
P:\Client Projects\Reno, City of 1461\1930 West Wash Dam\3.0 Studies_Reports\3.12 BCA\Channel Design\Channel Design\Channel Design.aprx, Layout: Channel Overview. Editor: ccluff. Printed: 2/16/2022



CHANNEL DESIGN PROFILE



CULVERT DESIGN PLAN



CULVERT DESIGN PROFILE

JOB NO.: 1930
DESIGN: SHH
DRAWN: SHH
CHECKED: AS
DATE: FEBRUARY 2022

FARR WEST
ENGINEERING
5510 LONGLEY LANE
RENO, NEVADA 89511
PHONE: (775) 851–4788
FAX: (775) 851–0766

WEST WASH DAM REHABILITATION
CHANNEL AND CULVERT BOX DESIGN EXHIBIT

CITY OF RENO

NEVADA

APPENDIX F: FEMA FIRMETTE MAPS

National Flood Hazard Layer FIRMette

FEMA

119°51'6"W 39°33'7"N

119°50'28"W 39°32'39"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 3/21/2022 at 6:17 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

National Flood Hazard Layer FIRMette

FEMA

119°51'6"W 39°32'55"N

119°50'29"W 39°32'27"N

Feet 1:6,000

0 250 500 1,000 1,500 2,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

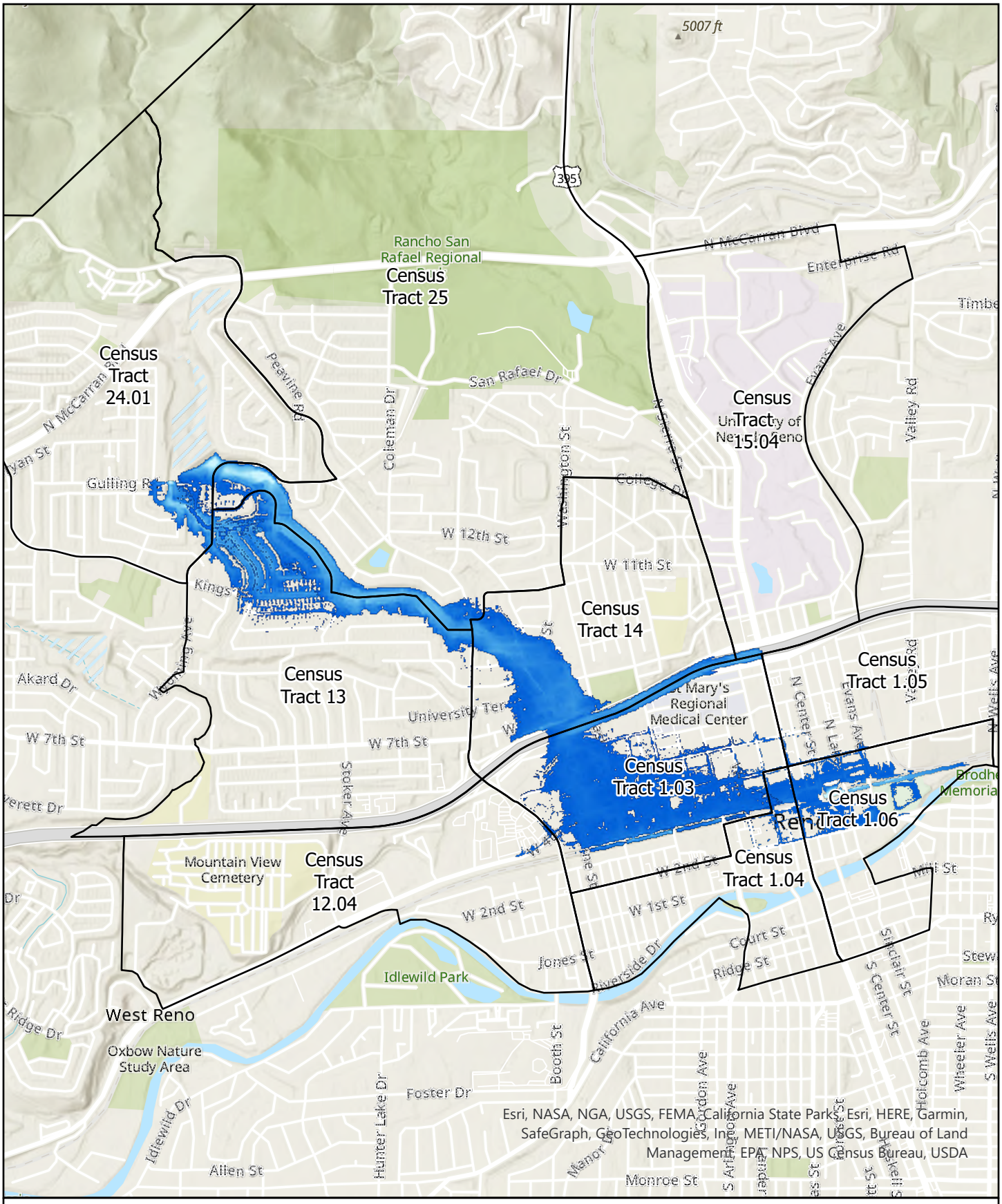
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 3/21/2022 at 6:14 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

APPENDIX G: CENSUS TRACT FIGURES



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Reno, NV 89511
(775) 851-4788
www.farrwestengineering.com

N

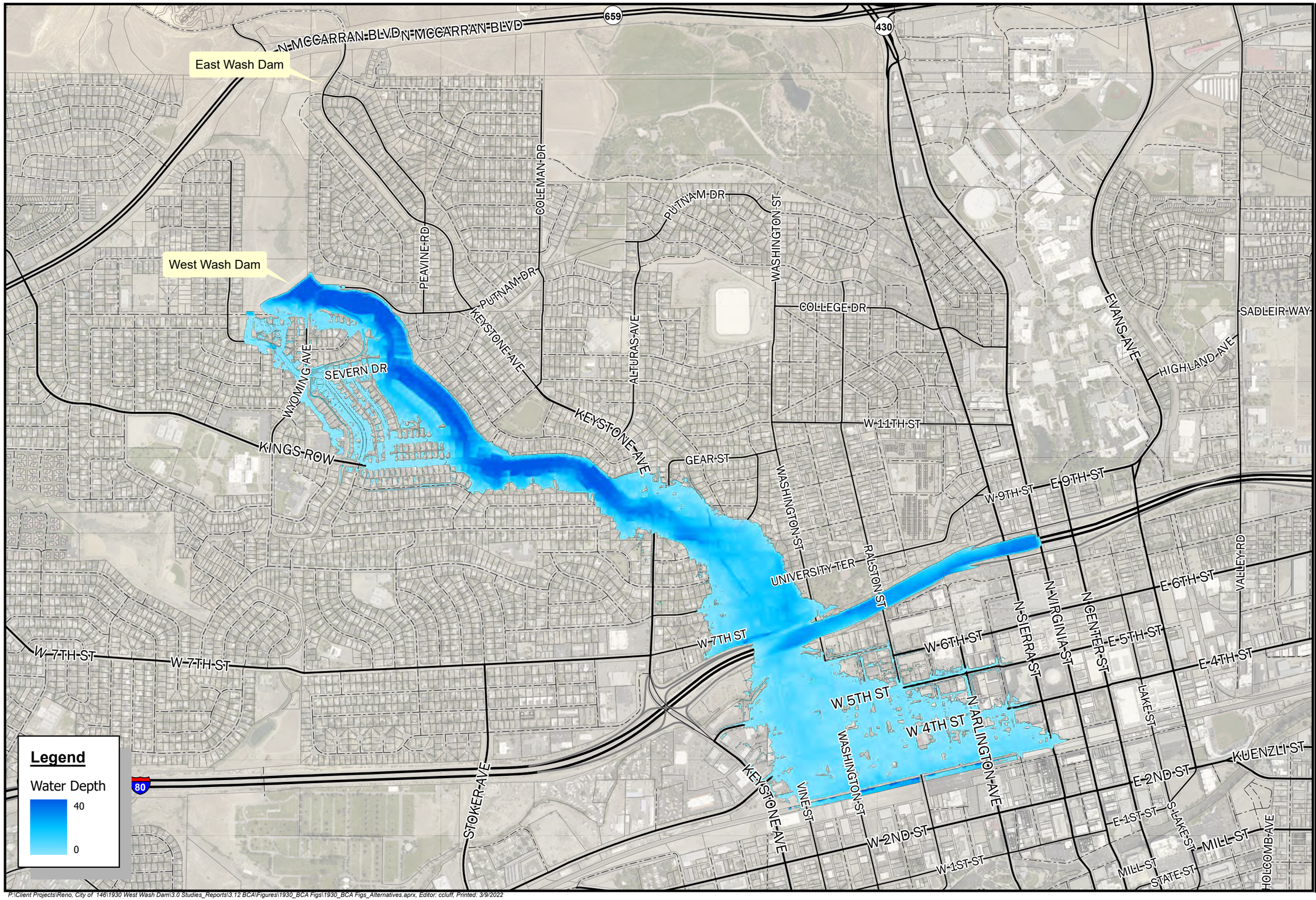
1" = 2,000'

City of Reno West Wash Dam Rehabilitation Project Census Tracts

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

Q:\client\Reno\Projects\CoR-WestWashDam-1930\WestWashDam-ProProject\CoR-WestWashDam.aprx, Layout: City of Reno West Wash Dam Rehabilitation Project Census Tracts. Editor: tbaker. Printed: 3/11/2022

APPENDIX H: INUNDATION MAPS



20 Years!
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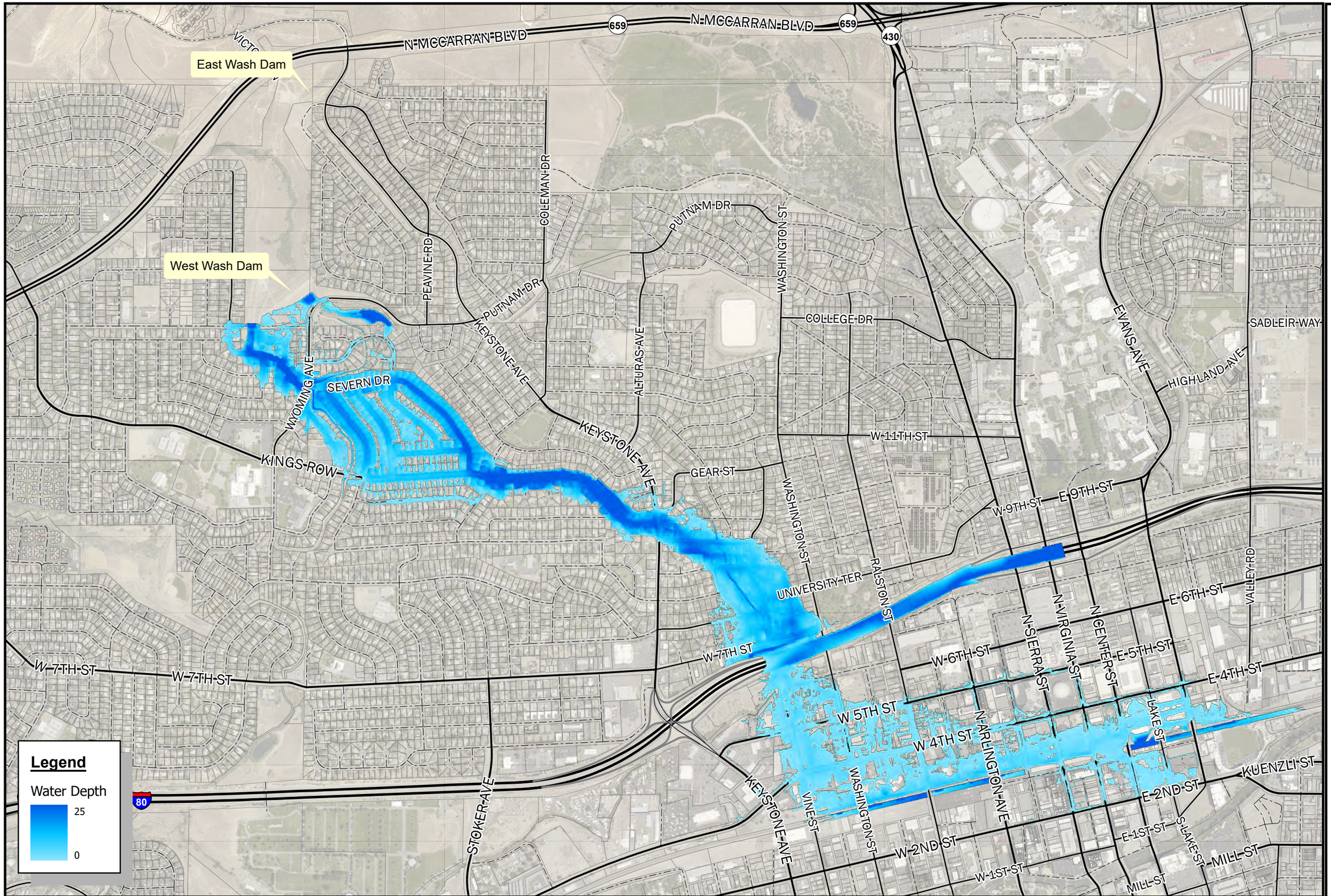
Alternatives 1 and 2
West Wash (w/AS) Local PMP Breach (Worst Case Scenario)

N

1:12,000

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.12 BCA\Figures\1930_BCA Figs\1930_BCA Figs_Alternatives.aprx, Editor: ccluff, Printed: 3/9/2022



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Alternative 3
Local PMP AS Activation (Worst Case Scenario)

N

1:12,000

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.12 BCA\Figures\1930_BCA Figs\1930_BCA Figs_Alternatives.aprx, Editor: ccluff, Printed: 3/9/2022

20 Years!
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Alternative 4
East Wash and West Wash Dams NIP - 100-Year Storm

N

1:10,000

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.12 BCA\Figures\1930_BCA Figs\1930_BCA Figs_Alternatives.aprx, Editor: ccluff, Printed: 1/7/2022

FARR WEST
ENGINEERING

TECHNICAL MEMORANDUM

CITY OF RENO

SUPPLEMENTAL WATERSHED PLAN AND ENVIRONMENTAL DOCUMENT FOR THE PEAVINE MOUNTAIN WATERSHED AND WEST WASH DAM REHABILITATION

Prepared For:	City of Reno
Prepared By:	Michael Anderson, P.E.; Jessica Dugan, J.D, M.S.; Chelsea Cluff, E.I.
Reviewed By:	Keith Karpstein, P.E.
Date:	March 18, 2022
Subject:	Preliminary Alternatives Analysis for West Wash Dam Rehabilitation

1.0 SUMMARY OF PRELIMINARY ALTERNATIVES

The Preliminary Alternatives are classified in general terms as:

1) Future Without Project (No Action)
2) Downstream Improvements of West Wash
3) Structural Solution - dam remediation
    a. Remediate both dams
    b. Remediate only East Wash Dam
    c. Remediate only East Wash Dam with downstream improvements of West Wash Dam
    d. Remediate only West Wash Dam
4) Upstream Solutions
5) Structural Solution - dam removal
    a. Remove both dams
    b. Remove only East Wash Dam
    c. Remove only West Wash Dam
6) Structural Solution - dam removal with downstream improvements
    a. Remove both dams with downstream improvements from both dams
    b. Remove East Wash Dam with downstream improvements from East Wash Dam
    c. Remove West Wash Dam with downstream improvements fromWest Wash Dam.

2.0 PRELIMINARY ALTERNATIVES FORMULATION

Initial Preliminary Alternatives were formulated based on the requirements of NRCS National Watershed Program Manual; results of the Data Collection and Analysis Report; the Hydrology, Hydraulics, and Sediment Analysis (HH&S) Technical Memoranda; preliminary modeling and existing reports. Preliminary alternatives were refined and further developed through the Preliminary Alternatives Workshop that was held on August 12, 2021. Due to the ongoing COVID-19 pandemic this workshop was held virtually.

Workshop attendees included various staff from the United States Department of Agriculture – Natural Resources Conservation Service (USDA – NRCS), the lead Federal Agency, and administrative, management and maintenance staff from the City of Reno, the project Sponsor. Staff from Farr West Engineering, Consultant for the Sponsor, was also present. NRCS extended invitations to other agencies potentially interested in the project to participate in the workshop. These agencies were also invited to become cooperating agencies in the NEPA process. A representative of the Nevada Department of Environmental Protection (NDEP) attended as a stakeholder. However, NDEP declined to become a cooperating agency in the project.

Workshop materials are included in Appendix A.

3.0 DESCRIPTION AND DISCUSSION OF PRELIMINARY ALTERNATIVES

This Section includes descriptions of all preliminary alternatives identified including preliminary engineering figures and costs. The preliminary workshop materials included a discussion of each of the preliminary alternatives, as shown in Appendix A.

PRELIMINARY ALTERNATIVE 1: NO ACTION

The Future Without Project (FWOP), no action, or "do nothing" alternative will maintain the status quo for this portion of the Peavine Mountain Watershed Management Project. For runoff less than the 1% chance of exceedance in one year (100-year or 1% flood) storm event, East Wash and West Wash Dams will continue to collect and release runoff flow with no damage to either structure or downstream properties.

At East Wash Dam, runoff flow approaching the 1% flood will prematurely activate the auxiliary spillway (western dike of the East Wash Dam principal spillway approach), potentially causing damage to the adjacent commercial property to the west.

At West Wash Dam, runoff flow approaching the 0.5% (200-year) flood will activate the auxiliary spillway, and runoff flow from approximately ¾ of the Local PMP event will initiate overtopping of the dam embankment, potentially leading to a dam breach event and exposing additional downstream properties to additional damage.

For a pictorial representation of Alternative 1, see Exhibit 1 in Appendix A.

Costs

No money will be spent on modification or rehabilitation of the two dams from the current Project funding allocation. Costs of maintenance will continue to be borne by the City of Reno for the foreseeable future with modest increases for inflation or periodic larger efforts to address specific deficiencies.

Discussion

Flood protection and dam deficiencies differ between East Wash and West Wash Dams in the event of a smaller probability (less frequent and larger) storm approaching and including the Probable Maximum Flood (PMF), which is defined as runoff from a Probable Maximum Precipitation (PMP) event (approximately 13" of precipitation in one storm for this area).

East Wash Dam will continue to pass the Local and General PMF by diverting nearly all of the inflow to West Wash above West Wash Dam. Flood rates approaching the 1% flood will activate East Wash Dam's auxiliary spillway by overtopping the west and south dikes of the principal spillway approach, as designed. Activation of the auxiliary spillway may adversely affect that private property identified as Washoe County APN 001-190-12. At flood rates approaching the 1% flood, North McCarran Boulevard is likely to be

overtopped to the north of East Wash Dam for a short period of time due to limited culvert capacity. This overtopping will result in closure of the road for some period of time and necessitate subsequent repairs. Overtopping of North McCarran Boulevard may occur under any of the preliminary alternatives. However, neither raising North McCarran Boulevard nor increasing the capacity of any of the culverts beneath it are within the scope of this project.

West Wash Dam will accommodate and pass the inflow from West Wash and the flow diverted from East Wash up to approximately ¾ of the Local PMF. Flood rates approaching ¾ of the Local PMF will be passed through both the principal and auxiliary spillways of West Wash Dam with nearly all the auxiliary flow discharged onto Severn Drive, at which point it will travel generally east and south to the historic West Wash alignment through Reno. As West Wash Dam auxiliary spillway flow increases, the discharged water is likely to be "lost" from the spillway at both the right (west) and left (east) sides allowing water to potentially flood properties along Gulling Road. The "lost" flow to the east has the potential to damage the toe of the dam embankment as it makes its way to the historic West Wash near its crossing at Highland Ditch and Wyoming Avenue. Additionally, models predict that as inflow exceeds ¾ of the Local PMF rates, the West Wash Dam embankment itself will overtop, significantly increasing flow below the dam. Overtopping flow will damage the embankment, possibly severely. Any overtopping event of an earth embankment such as West Wash Dam may lead to a breach of the embankment, which would quickly release the impounded water with instantaneous flow in West Wash well in excess of the projected PMF, causing damage to downstream properties.

PRELIMINARY ALTERNATIVE 2: DOWNSTREAM IMPROVEMENTS FROM WEST WASH

Downstream improvements include efforts to allow potential auxiliary spillway flow and overtopping flow of the West Wash Dam embankment to pass through the downstream community to the receiving waters of the Truckee River with minimal damage. To reduce the probability of a breach of West Wash Dam embankment, the crest and downstream face would be armored. In addition, the west embankment of East Wash Dam principal spillway approach channel would be brought back to the design elevation. Since the construction of East Wash Dam there has been a lowering of the west training dike crest of the principal spillway approach through erosion and human activity.

Implementation of this alternative would involve establishment of a flood corridor from West Wash Dam down to the receiving waters of the Truckee River. This preliminary alternative, alone, would be predicated on minor modification of East Wash and West Wash Dams. At-risk properties would be surveyed for individual solutions ranging from property acquisition and removal to construction of conveyance structures adequate to accommodate discharge up to the potential overtopping flow.

For a pictorial representation of Alternative 2, see Exhibit 2 in Appendix A.

Costs

Costs of maintenance of East Wash and West Wash Dams will continue to be borne by the City of Reno with the addition of maintenance of the new flood corridor for the foreseeable future with modest increases for inflation or periodic larger efforts to address specific deficiencies. Extensive expenditures on land acquisition and storm drain improvements related to the flood corridor would be needed. The total estimated cost is $396 million. A detailed breakdown of the preliminary cost estimate is located in Appendix B.

Discussion

Development along the potential flood corridors congruent with the historic wash alignment is already dense, therefore innovative measures would be necessary to accomplish this alternative. Potential means

could include acquisition of potentially inundated properties along an identified flood corridor, acquisition of select properties most vulnerable, zoning restrictions, construction of an open channel, improvement of existing storm water system or some combination of strategies.

The number of developed properties along all potential paths to the Truckee River is quite high (hundreds of individual parcels). Additionally, Interstate Highway 80 and the Union Pacific Railroad east-west mainline lie between the dams and river. This alternative may include the construction of large conveyance structures under neath the existing essential transportation lines.

Sudden introduction of large quantities of stormwater to the Truckee River may also require additional solutions downstream of the confluence of the flood corridor and the Truckee River. Coordination and consultation with the Truckee Meadows Stormwater Permit Coordinating Committee (SWPCC) would be necessary. SWPCC is responsible for implementing the Truckee Meadows Storm Water Quality Management Program to protect the water quality of the region's waterways, streams and the Truckee River Watershed.

Improvement of flood conveyance downstream would involve establishment of a flood corridor with channeling structures from West Wash Dam down to the receiving waters of the Truckee River. This preliminary alternative, alone, would be predicated on minor modifications to both East Wash and West Wash Dams. Conveyance structures adequate to accommodate discharge flow up to the potential overtopping or breach flow would be built from West Wash Dam to the Truckee River through Reno. Extensive storm drain system modeling would be necessary.

PRELIMINARY ALTERNATIVE 3A: REMEDIATE EAST WASH AND WEST WASH DAMS

This alternative includes remediation of both dams to meet the safety requirements of the NRCS and the State of Nevada Division of Dams. East Wash Dam is classified as a diversion dam while West Wash Dam is classified as a detention dam. Both Dams have been identified as High Hazard Dams by the Division of Dams. Currently, the East Wash Dam meets NRCS criteria for Earthen Dams (TR-60) with the exception of excessive damage to the spillway in a PMF event. The West Wash Dam does not meet NRCS criteria and would overtop in a PMF event (USDA NRCS, 2019). The United States Army Corps of Engineers Phase I inspection report indicates that the existing structures meet applicable seismic safety requirements. However, neither the original calculations performed nor the original parameters utilized are available for review. Due to data gaps and potential advances in the knowledge of seismic activity in the area, seismic stability will be investigated as a part of this project.

Remediation of both dams will be confined to the already disturbed areas of the structures. East Wash Dam will have the west dike of the principal spillway approach restored to the original design elevation and overall dam capacity will be increased by excavating material from within the dam impoundment area. West Wash Dam will have the embankment raised, the auxiliary spillway widened to at least the design width, and the auxiliary spillway walls repaired. More specific engineering details will be developed in a detailed alternatives analysis.

Every year both the East and West Wash dams are inspected by the Division of Water Resources at the State of Nevada's Department of Conversation and Natural Resources. Based on previous years' inspections for the East and West Wash dams, there are many items that need repairs or maintenance. A comprehensive list of necessary repairs is included in the Data Collection and Analysis Report completed by Farr West Engineering. Recent actions recommended for the East Wash Dam include monitoring vegetation, erosion control, monitoring cracks in the spillway and repairing as needed. Recent actions recommended at the West Wash Dam include remove stored material in spillway, evaluate altered grading

of spillway and provide report, repair right wing of the spillway wall, remove accumulated debris from sediment drain riser, analyze impact of unauthorized encroachment into spillway, repair loss of crest width and uneven elevation, consider more robust exclusion measures, remove vegetation on and within 25 feet of embankments, and repair erosion gullies and consider riprap. It should be noted that a potential seep was identified in the report. The potential seepage will be investigated further prior to completing design efforts. However, it appears that the moisture is due to meteoric water collection and not necessarily seepage.

For a pictorial representation of Alternative 3A, see Exhibit 3A in Appendix A.

Cost

Costs for Alternative 3A will include the grading and armoring necessary to remediate both dams. For East Wash Dam, grading will be required to reestablish the design elevation of the west dike of the spillway. For West Wash Dam, grading will be required for raising the embankment, widening the auxiliary spillway, and repairing the spillway walls. Costs for geotechnical evaluations of seismic hazard potential, excavation, removal of soils, and armoring from within the impoundment area of both dams to increase dam capacity will also be considered. The total estimated cost is $22 million. A detailed breakdown of the preliminary cost estimate is located in Appendix B.

Discussion

Remediation of East Wash Dam would reestablish the crest elevation of the principal spillway's guide dike to at least original design elevation. This would return auxiliary spillway activation to original design intervals and reduce the incidence of potentially damaging flow impacting the neighboring property to the west and minimize potential damage to the spillway. Slightly reconfiguring and armoring the auxiliary spillway to either side of the existing concrete chute principal spillway would reduce damage to the cast in place concrete in the event of auxiliary spillway activation. Reconfiguring and armoring can be accomplished in such a manner that the visual effect is largely unnoticeable.

Remediation of West Wash Dam would eliminate the potential for a breaching failure of the dam due to overtopping and reduce the number of properties exposed to inundation to those that were "at risk" from spillway flow under the initial design and that have been built within the floodway since original construction. Raising the embankment up to six feet (6') may impede a portion of viewscapes from surrounding properties. However, the overall visual aspect of the dam will remain unchanged. The auxiliary spillway may be slightly reconfigured to allow for a higher peak flow rate, which may allow for a higher chance of activating the spillway. At a minimum, the auxiliary spillway will be returned to the as-designed configuration and armored against erosion. Some, or all, of the material needed to raise the embankment may be derived from the impoundment area. Removal of material in the impoundment area will affect the walking labyrinth and will require its removal and, possibly, replacement.

In summary, remediation of both dams will maximize the number of properties protected for all inflow design floods while minimizing the disruption of private property holdings. All improvements will be confined to the already disturbed area. Improvement of East Wash Dam will reestablish the west training dike grading to the as-built elevation and increase overall dam capacity by excavating material within the dam impoundment area. The primary and auxiliary spillway that discharges to the West Wash Dam will also be improved. Improvement of West Wash Dam will eliminate the potential for overtopping of the dam for storms approaching the PMP and reduce the number of properties exposed to inundation from activation of the auxiliary spillway.

PRELIMINARY ALTERNATIVE 3B: REMEDIATE ONLY EAST WASH DAM

Remediation of East Wash Dam will include reestablishing the design elevation of the west dike of the principal spillway approach and an overall increase of impoundment capacity by excavating material from within the impoundment area. Improvements to East Wash Dam will be confined to the already disturbed area. Under this alternative the threat of damage to the neighboring parcel west of East Wash Dam from flow up to, and including, the 1% flood is eliminated. Under current conditions, flow into West Wash intercepted by West Wash Dam is attenuated up to and including the 1% flood with no overtopping or discharge from the auxiliary spillway. Therefore, threat to downstream properties of West Wash Dam will remain the same as in Alternative 1.

For a pictorial representation of Alternative 3B, see Exhibit 3B in Appendix A.

Cost

Costs for Alternative 3B will include the grading and armoring necessary to reestablish the design elevation of the west dike of the spillway approach on East Wash Dam. Costs for excavation, removal of soils from within the impoundment area to increase dam capacity, and armoring will also be considered. The total estimated cost is $3 million. A detailed breakdown of the preliminary cost estimate is located in Appendix B.

Discussion

This alternative would protect one at-risk property from damage due to premature activation of the auxiliary spillway in a 1% flood event and reduce potential damage to the principal spillway. Raising the guide dike embankments of the approach channel up to as-built elevation and reconfiguration and armoring of the auxiliary spillway will have a minimal effect on viewscapes and will occur entirely within already disturbed land. Flood flows below the 1% flood will continue to be routed through the principal spillway drain structure and into existing stormwater conveyance systems downstream. Flood flows at, and above, the 1% flood will continue to be diverted into West Wash and intercepted by West Wash Detention Dam. West Wash Detention Dam will not be modified under this preliminary alternative so flood events at and above ¾ of the Local PMF will continue to overtop the West Wash Dam embankment with the possibility of breaching it.

PRELIMINARY ALTERNATIVE 3C: REMEDIATE ONLY EAST WASH DAM AND FLOOD PROOF DOWNSTREAM OF WEST WASH DAM

This alternative is a combination of Alternatives 3B and 2 as discussed above. The result will be the addition of the parcel west of East Wash Dam to those protected up to the 1% flood, as described in Alternative 2.

For a pictorial representation of Alternative 3C, see Exhibit 3C in Appendix A.

Cost

Costs for Alternative 3C will include the grading and armoring necessary to reestablish the design elevation of the west dike of the spillway approach on East Wash Dam. Costs for excavation, removal of soils from within the impoundment area to increase dam capacity, and armoring will also be considered. Costs of maintenance of East and West Wash Dam will continue to be borne by the City of Reno with the addition of maintenance of the new flood corridor for the foreseeable future with modest increases for inflation or periodic larger efforts to address specific deficiencies. Extensive expenditures on land acquisition and storm drain improvements related to the flood corridor would be needed. The total estimated cost is $1.9 billion. A detailed breakdown of the preliminary cost estimate is located in Appendix B.

Discussion

Remediation of East Wash Dam would reestablish the west training dike grading to the as-built elevation and increase overall dam capacity by excavating material within the dam impoundment area. The primary and auxiliary spillway that discharge to the West Wash Dam will also be improved. Improvements to East Wash Dam will be confined to the already disturbed area. Improvements to the downstream flood conveyance is considered an element of this preliminary alternative in a manner similar to Preliminary Alternative 2: Flood Proofing.

PRELIMINARY ALTERNATIVE 3D: REMEDIATE ONLY WEST WASH DAM

Remediation of West Wash Dam would include raising the embankment, widening the auxiliary spillway to at least the design width, and repairing the auxiliary spillway walls. Improvements to West Wash Dam will be confined to the already disturbed area. Under this alternative, the potential for overtopping of the dam for local PMP storms will be eliminated and the number of developed properties exposed to inundation from activation of the auxiliary spillway will be reduced. Threat to downstream property west of East Wash Dam will remain the same as in Preliminary Alternative 1: No Action.

For a pictorial representation of Alternative 3D, see Exhibit 3D in Appendix A.

Cost

Costs for Alternative 3D will include the grading required for raising the embankment, armoring, widening the auxiliary spillway, and repairing the spillway walls of West Wash Dam. Costs for excavation and removal of soils from within the impoundment area to increase dam capacity will also be considered. The total estimated cost is $19 million. A detailed breakdown of the preliminary cost estimate is located in Appendix B.

Discussion

This preliminary alternative would protect all properties that were at risk from being inundated with water from a dam breach by supplying the necessary freeboard to ensure there is no overtopping of West Wash Dam. There would still be some inundation of houses within the flow path of West Wash's auxiliary spillway (which would only activate at a 200-year storm event or above). The property directly to the west of the East Wash auxiliary spillway would be damaged by a 100-year storm event and above.. Flood flows equal to or greater than the 100-year flood event will activate East Wash Dam’s auxiliary spillway as designed and cause varying degrees of damage to the adjacent property to the west.

PRELIMINARY ALTERNATIVE 4: UPSTREAM SOLUTION

Prior public participation questioned the potential for upstream solutions. An upstream solution could reduce or eliminate the necessity of large, or potentially any, improvements at East or West Wash Dams. Upstream solutions include land treatment to reduce runoff, diversion of runoff to adjacent drainages, additional detention structure(s) or some combination of activities. All upstream solutions would expand the area of impact of the project beyond the current area of disturbance and include additional impacts to wildlife habitat, cultural resources, and public lands.

For a pictorial representation of Alternative 4, see Exhibit 4 in Appendix A.

Cost

The cost of this alternative, in addition to earthwork and drainage structures, would include geotechnical studies and dam design which may include seismic studies. Dam design may need to include seismic related engineering considerations related to construction. A Right of Way, permanent easement or purchase of public lands would also need to occur under this alternative. The total estimated cost is $5.5 million. A detailed breakdown of the preliminary cost estimate is located in Appendix B.

Discussion

Land treatment is not likely to reduce runoff significantly due to the arid nature of the environment and relatively thin layer of soil above the bedrock of Peavine Mountain. Mechanical treatments will increase infiltration of high frequency storms at the expense of greater sediment loading during larger, less frequent, storms. Vegetative treatments are unlikely to reduce runoff, with the exception of planting Great Basin specific species after a fire in the basin which will return runoff and sediment volumes to pre-fire levels. Vegetation is at about the highest level of seral progression to be expected for the environment.

Diversion of flow from the tributary areas of East and West Washes was explored in the initial Watershed Management Plan (WMP) and was found to adversely impact other areas of development in nearby watersheds. Since the 1960's urbanization in all surrounding watersheds has increased the density of development so it is unreasonable to believe that the impacts would be any less than those identified in the initial WMP. Diversion of stormwater flow was eliminated from further consideration for a lack of receiving drainages available within a reasonable distance.

A potential additional dam site was identified in the East Wash, north of North McCarran Boulevard. The site is identified as a portion of Washoe County Assessor's parcel number 082-430-22 and is federal land administered by the U.S.D.I. Bureau of Land Management. Construction of a dam in upper East Wash will impact public land access and viewscapes in the general area of the dam. Construction of a dam may also impact the usability of existing high traffic trails. Since East Wash canyon is deeply incised, a relatively large structure will remain mostly invisible until within approximately 1,000' of the structure. Wildlife and vegetative habitat will be impacted over a several acre area that will lie beneath the dam and impoundment limits.

PRELIMINARY ALTERNATIVE 5A: REMOVE BOTH DAMS

The existing embankments would either be breached or completely removed. Earth derived from the removal process would be either disposed of on-site or transported to an off-site disposal area. Collection structures would be constructed to direct flow to the existing storm water conveyance facilities. The existing detention basins and embankment areas would be contoured to a natural-appearing wash finish and armored to a degree to minimize erosion under most circumstances and return the areas to an approximation of pre-development condition. No flood protection would be afforded to properties downstream from the dam sites under this preliminary alternative, however some properties in the immediate vicinity of the existing auxiliary spillways would no longer be threatened by their activation. This alternative would include analysis of existing storm water conveyance downstream from the dams and preparation of flood maps for inclusion in the FEMA FIRM program.

For a pictorial representation of Alternative 5A, see Exhibit 5A in Appendix A.

Cost

Costs for Alternative 5A will include the excavation and removal of soils from both East and West Wash Dams, as well as any grading and revegetation necessary to return the area into a natural drainage. The total estimated cost is $5 million. A detailed breakdown of the preliminary cost estimate is located in Appendix B.

Discussion

Removal of both dams will eliminate all hazards from diverted flow onto developed properties and the potential of a catastrophic failure of West Wash Dam. The property neighboring East Wash Dam auxiliary spillway to the west would no longer be threatened in the event of premature auxiliary spillway activation. Similarly, those properties on Severn Drive and Gulling Road to the west of Wyoming Avenue and adjacent to the spillway of West Wash Dam would no longer be threatened by flow through the spillway in the event of a large inflow (low probability) flood. Properties downstream of the dam locations through the approximate historic East and West Washes and on to the Truckee River will no longer benefit from

protection from the 1% flood event. The conveyance capacity of the existing stormwater system is known but the relative recurrence interval for that capacity has not been determined. It is assumed that the capacity is significantly less than the 1% flood flow. All impacted properties will be subject to periodic flooding and many will be required to gain insurance against flooding. Original project analysis indicated that a significant number of properties could suffer damage from floods as common as the 10-year storm event (10% chance of exceedance).

PRELIMINARY ALTERNATIVE 5B: REMOVE ONLY EAST WASH DAM

East Wash Dam would be removed as described under Preliminary Alternative 5A with West Wash Dam treated as in Preliminary Alternative 1, above. No flood protection would be afforded to properties downstream from East Wash Dam under this preliminary alternative. Those properties downstream from West Wash Dam to the confluence with East Wash would be protected from the majority of floods.

For a pictorial representation of Alternative 5B, see Exhibit 5B in Appendix A.

Cost

Costs for Alternative 5B will include the excavation and removal of soils from East Wash Dam, as well as any grading and revegetation necessary to return the area into a natural drainage. The total estimated cost is $780,000. A detailed breakdown of the preliminary cost estimate is located in Appendix B.

Discussion

Flood hazards from flow in East Wash being diverted to West Wash would be largely eliminated, which would eliminate threat of flood to the property immediately adjacent to the auxiliary spillway at East Wash Dam and all the properties downstream of West Wash Dam to the confluence with East Wash The potential for overtopping West Wash Dam would also be largely eliminated. All properties from East Wash Dam downstream to the Truckee River would be subject to conditions as stated under Alternative 5A.

PRELIMINARY ALTERNATIVE 5C: REMOVE ONLY WEST WASH DAM

West Wash Detention Dam would be removed as described under Preliminary Alternative 5A with East Wash Dam treated as in Preliminary Alternative 1, above. No flood protection would be afforded to properties downstream from West Wash Dam under this preliminary alternative. Those properties downstream from East Wash Dam to the confluence with West Wash would still be protected from all floods.

For a pictorial representation of Alternative 5C, see Exhibit 5C in Appendix A.

Cost

Costs for Alternative 5C will include the excavation and removal of soils from West Wash Dam, as well as any grading and revegetation necessary to return the area into a natural drainage. The total estimated cost is $4 million. A detailed breakdown of the preliminary cost estimate is located in Appendix B.

Discussion

Removal of only West Wash Dam would maintain the diversion of flow from East Wash into West Wash. The hazard to the property immediately adjacent to the East Wash Dam auxiliary spillway would remain and the properties downstream of East Wash Dam would continue to be protected from flooding as described under Preliminary Alternative 1. The properties impacted by activation of the auxiliary spillway at West Wash Dam would no longer be subject to flooding in extreme events that activate the auxiliary spillway. However, all properties downstream of West Wash Dam to the Truckee River would be subject to periodic flood damage as described under Preliminary Alternative 5A.

PRELIMINARY ALTERNATIVE 6A: REMOVE BOTH DAMS WITH FLOOD CONVEYANCE IMPROVEMENTS DOWNSTREAM OF BOTH DAMS

The dams would be removed as described above under Preliminary Alternative 5A. Flood proofing would be implemented downstream to eliminate hazards to remaining properties downstream in a manner similar to Alternative 2. However, the scope of the flood proofing would be for only the 1% flood, not potential overtopping flows from West Wash Dam. The flood proofing would also include the portion of East Wash between the current East Wash Dam location and the confluence of East Wash and West Wash, downstream.

For a pictorial representation of Alternative 6A, see Exhibit 6A in Appendix A

Cost

Costs for Alternative 6A will include the excavation and removal of soils from both East Wash and West Wash Dams, as well as any grading and revegetation necessary to return the area into a natural drainage. City of Reno will be responsible for the addition of maintenance of the new flood corridor for the foreseeable future with modest increases for inflation or periodic larger efforts to address specific deficiencies. Extensive expenditures on land acquisition and storm drain improvements related to the flood corridor would be needed. The total estimated cost is $164 million. A detailed breakdown of the preliminary cost estimate is located in Appendix B.

Discussion

Since the flood proofing recurrence interval is considerably shorter under this alternative than Alternative 2, the effort will be less to provide the anticipated relief from flooding. However, numerous developed parcels are still within the range of potential flood corridors including Interstate Highway 80 and Union Pacific Railroad right of way.

Downstream development along potential corridors is already dense, therefore innovative measures would be necessary to accomplish improving flood conveyance downstream of both dams. Potential means could include acquisition of all potentially inundated properties along the historic East and West Wash alignment or acquisition of select properties to allow construction of an open channel.

Modification to the pre-development conditions that the removed dams were returned to would be necessary to introduce flood flow to the constructed conveyance facilities unless all of the potentially inundated land was vacated between the dams and the Truckee River.

Sudden introduction of large quantities of stormwater to the Truckee River may also require additional solutions downstream of the confluence in the Truckee River and adjacent properties

PRELIMINARY ALTERNATIVE 6B: REMOVE EAST WASH DAM WITH FLOOD CONVEYANCE IMPROVEMENTS DOWNSTREAM OF EAST WASH DAM

The East Wash Dam would be removed as described above under Preliminary Alternative 5B. Flood proofing would be implemented downstream to eliminate hazards to remaining properties downstream in a manner similar to Alternative 2. However, the scope of the flood proofing would be for only the 1% flood and span from East Wash Dam site to the Truckee River.

For a pictorial representation of Alternative 6B, see Exhibit 6B in Appendix A.

Cost

Costs for Alternative 6B will include the excavation and removal of soils from East Wash Dam, as well as any grading and revegetation necessary to return the area into a natural drainage. Costs of maintenance of

West Wash Dam will continue to be borne by the City of Reno with the addition of maintenance of the new flood corridor for the foreseeable future with modest increases for inflation or periodic larger efforts to address specific deficiencies. Extensive expenditures on land acquisition and storm drain improvements related to the flood corridor would be needed. The total estimated cost is $121 million. A detailed breakdown of the preliminary cost estimate is located in Appendix B.

Discussion

This alternative would meet the criteria of PL 566 by eliminating the dam safety deficiencies at both dams and is effectively a slightly less expensive version of Alternative 6A (United States Congress, 1954). This is due to the East Wash diversion flow being diverted away from West Wash Dam.

Downstream development along the potential corridor is already dense, therefore innovative measures would be necessary to accomplish improving flood conveyance downstream of East Wash Dam. Potential means could include acquisition of all potentially inundated properties along the historic East Wash alignment or acquisition of select properties to allow construction of an open channel.

Modification to the pre-development conditions that the East Wash Dam was returned to would still be necessary to introduce flood flow to the constructed conveyance facilities unless all the potentially inundated land was vacated between the dam and the Truckee River.

Sudden introduction of large quantities of stormwater to the Truckee River may also require additional solutions downstream of the confluence of the flood corridor and the Truckee River. Coordination and consultation with the Truckee Meadows Stormwater Permit Coordinating Committee (SWPCC) would be necessary. SWPCC is responsible for implementing the Truckee Meadows Storm Water Quality Management Program to protect the water quality of the region's waterways, streams and the Truckee River Watershed

PRELIMINARY ALTERNATIVE 6C: REMOVE WEST WASH DAM WITH FLOOD CONVEYANCE IMPROVEMENTS DOWNSTREAM OF WEST WASH DAM

The West Wash Dam would be removed as described above under Preliminary Alternative 5C. Flood proofing would be implemented downstream to eliminate hazards to remaining properties downstream in a manner similar to Alternative 2. However, the scope of the flood proofing would be for only the 1% flood, not potential overtopping flows from West Wash Dam. Conveyance structures adequate to accommodate discharge flow up to the 1% flood would be built from West Wash Dam to the Truckee River through Reno.

For a pictorial representation of Alternative 6C, see Exhibit 6C in Appendix A.

Cost

Costs for Alternative 6C will include the excavation and removal of soils from West Wash Dam, as well as any grading and revegetation necessary to return the area into a natural drainage. Costs of maintenance of East Wash Dam will continue to be borne by the City of Reno with the addition of maintenance of the new flood corridor for the foreseeable future with modest increases for inflation or periodic larger efforts to address specific deficiencies. Extensive expenditures on land acquisition and storm drain improvements related to the flood corridor would be needed. The total estimated cost is $131 million. A detailed breakdown of the preliminary cost estimate is located in Appendix B.

Discussion

This alternative would meet the criteria of PL 566 and eliminate the dam safety deficiencies at both dams and is effectively a slightly less expensive version of Alternative 6A (United States Congress, 1954).

Downstream development along the potential corridor is already dense, therefore innovative measures would be necessary to accomplish improving flood conveyance downstream of West Wash Dam. Potential

means could include acquisition of all potentially inundated properties along the historic West Wash alignment or acquisition of select properties to allow construction of an open channel.

Modification to the pre-development conditions that the West Wash Dam was returned to would still be necessary to introduce flood flow to the constructed conveyance facilities unless all the potentially inundated land was vacated between the dam and the Truckee River.

Sudden introduction of large quantities of stormwater to the Truckee River may also require additional solutions downstream of the confluence of the flood corridor and the Truckee River. Coordination and consultation with the Truckee Meadows Stormwater Permit Coordinating Committee (SWPCC) would be necessary. SWPCC is responsible for implementing the Truckee Meadows Storm Water Quality Management Program to protect the water quality of the region's waterways, streams and the Truckee River Watershed

4.0 PRELIMINARY ALTERNATIVES ELIMINATED FROM DETAILED ANALYSIS

The Alternatives eliminated from detailed study and the associated reasoning is discussed in this section. Alternatives that do not address the purpose and need for action; do not achieve the NRCS's objectives or Guiding Principles; or become unreasonable because of cost, logistics, existing technology, or environmental reasons were removed from further consideration (USDA NRCS, 2009, p. 501.37)

The Purpose and Need for Action

The purpose of this project is to preserve the flood protection function of the West Wash Dam, to protect lives and property in the surrounding urban area and to comply with current performance and safety standards in a cost effective and environmentally acceptable manner.

The project needs include addressing current deficiencies at West Wash and East Wash Dams to bring both dams into compliance with current NRCS and the Nevada Division of Dams safety regulations, engineering standards and performance criteria. The project also needs to ensure the watershed structure is properly maintained to minimize the risk to lives and property in the surrounding and downstream urban area.

The original Watershed Plan noted damaging floods impacting residential areas of Reno. Since that time Reno has grown significantly and dense residential areas surround the area of both dams. Today, residential, business and transportation infrastructure have built up and follow the historical path of storm drainage from Peavine Mountain. Flooding due to stormwater runoff events have continued to occur and impact the City of Reno. Maintaining the East and West Wash Dams will provide essential flood prevention services for the Reno areas protecting homes business and infrastructure form floodwater, sediment and erosion damage (City of Reno, 1958).

NRCS Objectives

THE NRCS Watershed and Flood Prevention Operations Program goals include preventing erosion; floodwater, and sediment damage; furthering the conservation development, use, and disposal of water; and furthering the conservation and proper use of land in authorized watersheds (USDA NRCS, n.d.).

Guiding Principles

Guiding Principles the Federal Government seeks to promote though Federal investments in water resources include promoting Healthy and Resilient Ecosystems, Sustainable Economic Development, wise use of Floodplains, increasing public safety and ensuring environmental justice using a watershed approach to analysis and decision making (Congressional Research Service, 2015)**.**

Preliminary alternatives eliminated from detailed analysis are listed below and reasoning is provided in this section:

- Preliminary Alternative 3B: Remediate only East Wash Dam

- Preliminary Alternative 3C: Remediate only East Wash Dam with downstream improvements from West Wash Dam
- Preliminary Alternative 3D: Remediate only West Wash Dam
- Preliminary Alternative 4: Upstream Solution
- Preliminary Alternative 5B: Remove only East Wash Dam
- Preliminary Alternative 5C: Remove only West Wash Dam
- Preliminary Alternative 6B - Remove East Wash Dam with downstream improvements from East Wash Dam
- Preliminary Alternative 6C: Remove West Wash Dam with downstream improvements fromWest Wash Dam

PRELIMINARY ALTERNATIVE 3B: REMEDIATE ONLY EAST WASH DAM

Remediation of East Wash Dam will include reestablishing the design elevation of the west dike of the principal spillway approach and an overall increase of impoundment capacity by excavating material from within the impoundment area. Improvements to East Wash Dam will be confined to the already disturbed area. Under this alternative the threat of damage to the neighboring parcel west of East Wash Dam from flow up to and including the 1% flood is eliminated. Similarly, flow into West Wash intercepted by West Wash Dam is attenuated up to and including the 1% flood. Threat to downstream properties of West Wash Dam will remain the same as in Alternative 1.

This alternative was eliminated from further consideration due to the fact that it does not address the identified dam safety deficiencies at West Wash Dam, and therefore does not meet the Purpose and Need for the project . Mainly, the flood protection function of the West Wash Dam would not be preserved under this alternative. Objectives of the NRCS Watershed and Flood Prevention Operations Program would not be met because preventing erosion; floodwater, and sediment damage would not be achieved for the West Wash Dam.

PRELIMINARY ALTERNATIVE 3C: REMEDIATE ONLY EAST WASH DAM WITH DOWNSTREAM IMPROVEMENTS FROM WEST WASH DAM

This alternative is a combination of Alternatives 3B and 2 as discussed above. The result will be the addition of the parcel west of East Wash Dam to those protected up to the 1% flood, as similarly described in Alternative 2.

This alternative was eliminated from further consideration because it became redundant after a slight alteration to Alternative 2. Alternative 2 incorporates all Flood Proofing actions into one alternative.

PRELIMINARY ALTERNATIVE 3D: REMEDIATE ONLY WEST WASH DAM

Remediation of West Wash Dam will include raising the embankment, widening the auxiliary spillway to at least the design width, repairing the auxiliary spillway walls, and increasing overall dam capacity by excavating material from within the dam impoundment area. Improvements to West Wash Dam will be confined to the already disturbed area. Under this alternative the potential for overtopping of the dam for local PMP storms will be eliminated and the number of developed properties exposed to inundation from activation of the auxiliary spillway will be reduced. Threat to downstream property west of East Wash Dam will remain the same as in Preliminary Alternative 1 No Action.

This alternative was eliminated from further consideration due to the fact that it does not address the identified dam safety deficiencies at East Wash Dam, and therefore does not meet the Purpose and Need for the project. The Guiding Principles of federal investments in water resources include using a watershed approach to analysis and decision making (Congressional Research Service, 2015). By remediating only one of the two dams in the system this principal is not met.

PRELIMINARY ALTERNATIVE 4: UPSTREAM SOLUTION

Prior public participation raised the question of the potential for upstream solutions. An upstream solution could reduce or eliminate the necessity of large, or potentially any, improvements at East or West Wash Dams. Upstream solutions include land treatment to reduce runoff, diversion of runoff to adjacent drainages, additional detention structure(s) or some combination of activities. All upstream solutions will spread the area of impact beyond the current area of disturbance and include wildlife habitat, cultural resources, and access to public lands.

Land treatment is not likely to reduce runoff significantly due to the arid nature of the environment and relatively thin layer of soil above the bedrock of Peavine Mountain. Mechanical treatments will increase infiltration of high frequency storms at the expense of greater sediment loading during larger, less frequent, storms. Vegetative treatments are unlikely to reduce runoff, with the exception of planting great basin specific species after a fire in the basin which will return runoff and sediment volumes to pre-fire levels. Vegetation is at about the highest level of seral progression to be expected for the environment.

Land treatment was eliminated from further consideration due to the ineffectiveness of all known methods for this particular watershed.

Diversion of flow from the tributary areas of East and West Washes was explored in the initial Watershed Management Plan and was found to adversely impact other areas of development in nearby watersheds. Since the 1960s urbanization in all surrounding watersheds has increased the density of development so it is unreasonable to believe that the impacts would be any less than those identified in the initial WMP. Diversion of storm water flow was eliminated from further consideration for a lack of receiving drainages available within a reasonable distance.

A potential additional dam site was identified in the East Wash north of North McCarran Boulevard. The site is identified as a portion of Washoe County Assessor's parcel number 082-430-22 and is federal land administered by the U.S.D.I. Bureau of Land Management. Construction of a dam in upper East Wash will impact public land access and viewscapes in the general area of the dam. Construction of a dam may also impact the usability of existing high traffic trails. Since East Wash canyon is deeply incised, a relatively large structure will remain mostly invisible until within approximately 1,000' of the structure. Wildlife and vegetative habitat will be impacted over a several acre area that will lie beneath the dam and impoundment limits.

The upstream solutions alternative, including building an additional dam, was eliminated from further consideration because it is unreasonable due to the cost of the project, the expansion of environmental impacts on federal lands, and the added risk of a new structure within a seismically active region. The high cost and environmental impacts of Alternative 4 do not meet the Purpose and Need for the project to comply with current performance and safety standards in a cost effective and environmentally acceptable manner.

PRELIMINARY ALTERNATIVE 5B: REMOVE ONLY EAST WASH DAM

East Wash Dam would be removed as described under Alternative 5A with West Wash Dam treated as in Alternative 1, above. No flood protection would be afforded to properties downstream from East Wash Dam under this alternative. Flood hazards from flow in East Wash being diverted to West Wash would be largely eliminated, including the property immediately adjacent to the auxiliary spillway at East Wash Dam as well as all the properties downstream of West Wash Dam to the confluence with East Wash. The potential for overtopping West Wash Dam would also be largely eliminated. All properties from East Wash Dam downstream to the Truckee River would be subject to conditions as stated under Alternative 5A.

This project alternative was eliminated from further consideration since Alternative 5B does not meet the requirements of PL 566 to protect the downstream properties from flood flow up to the 1% flood (United States Congress, 1954). In addition, Alternative 5B exposes additional properties to damage from flow up to the 1% flood, and thus does not meet the Purpose and Need of the project to preserve the flood protection

function of the West Wash Dam in order to protect lives and property in the surrounding urban area, as well as to comply with current performance and safety standards This Alternative does not meet the objectives of the NRCS to prevent flooding, erosion, and sediment damage, and does not meet the federal Guiding Principles to increase the public safety or to use a watershed approach.

PRELIMINARY ALTERNATIVE 5C: REMOVE ONLY WEST WASH DAM

West Wash Detention Dam would be removed as described under Alternative 5A with East Wash Dam treated as in Alternative 1, above. No flood protection would be afforded to properties downstream of West Wash Dam under this alternative. Those properties downstream of East Wash Dam to the confluence with West Wash would still be protected from all floods since the diversion of flow from East Wash into West Wash would be maintained. However, the hazard to the property immediately adjacent to the East Wash Dam auxiliary spillway would remain. The properties impacted by activation of the auxiliary spillway at West Wash Dam would no longer be subject to flooding in extreme events that activate the auxiliary spillway. However, all properties downstream of West Wash Dam to the Truckee River would be subject to periodic flood damage as described under Alternative 5A.

This alternative was eliminated from further consideration. Alternative 5C does not meet the requirements of PL 566 to protect the downstream properties from flood flow up to the 1% flood and also exposes additional properties to damage from flow up to the 1% flood (United States Congress, 1954). Therefore, Alternative 5C does not meet the Purpose and Need of the project to preserve the flood protection function of the West Wash Dam to protect lives and property in the surrounding urban area and also does not comply with current performance and safety standards. This Alternative does not meet the objectives of the NRCS to prevent flooding, erosion, and sediment damage, and does not meet the federal guiding principles to increase the public safety or to use a watershed approach

PRELIMINARY ALTERNATIVE 6B: REMOVE ONLY EAST WASH DAM WITH DOWNSTREAM IMPROVEMENTS FROM EAST WASH DAM

The East Wash Dam would be removed as described above under Alternative 5B. Flood proofing would be put in place for flow up to the 1% flood, similar to that described under Alternative 2, from East Wash Dam site to the Truckee River. This alternative would meet the criteria of PL 566 and eliminate the dam safety deficiencies at both dams and is effectively a slightly less expensive version of Alternative 6A (United States Congress, 1954).

This alternative was eliminated from further consideration because it does not meet the Federal Guiding Principles of increasing public safety and ensuring environmental justice using a watershed approach to analysis and decision making. Alternative 6B would effectively sacrifice one neighborhood to benefit another.

PRELIMINARY ALTERNATIVE 6C: REMOVE ONLY WEST WASH DAM WITH DOWNSTREAM IMPROVEMENTS FROM WEST WASH DAM

The West Wash Dam would be removed as described above under Alternative 5C. Flood proofing would be put in place for flow up to the 1% flood, similar to that described under Alternative 2, from West Wash Dam site to the Truckee River. This alternative would meet the criteria of PL 566 and eliminate the dam safety deficiencies at both dams and is effectively a slightly less expensive version of Alternative 6A (United States Congress, 1954).

This alternative was eliminated from further consideration because it does not meet the Federal Guiding Principles of increasing public safety and ensuring environmental justice using a watershed approach to analysis and decision making. Alternative 6C would effectively sacrifice one property to benefit others.

5.0 ALTERNATIVES SELECTED FOR DETAILED ANALYSIS

During the course of the Preliminary Alternatives Workshop five (5) Alternatives were selected for further detailed analysis. NRCS requires consideration and analysis of certain project alternatives, including no action, or future without project (FWOP); removal of both dams; and flood proofing. Preliminary alternatives selected for detailed analysis pursuant to NEPA and the National Watershed Project Manual will include preliminary engineering design, environmental impact analysis, cost benefit analysis, and opportunities for public participation and comment. The Alternatives selected for further consideration are listed below:

- **Alternative 1: Future Without Project (No Action)**
- **Alternative 2: Downstream Improvements of West Wash Dam**
- **Alternative 3a: Remediate Both Dams**
- **Alternative 5a: Remove Both Dams**
- **Alternative 6a: Remove Both Dams with Downstream Improvements from Both Dams**

6.0 REFERENCES

City of Reno. (1958). *Peavine Mountain Watershed: Watershed Work Plan.* US Department of Agriculture Soil Conservation Service.

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United States Congress. (1954). Public Law 83-566. *Watershed Protection and Flood Prevention Act*.

USDA NRCS. (2009). *National Watershed Program Manual, Third Edition.* Washington, DC.

USDA NRCS. (2019). *Technical Release 210-60: Earth Dams and Reservoirs.*

USDA NRCS. (n.d.). *Watershed and Flood Prevention Operations Program*. Retrieved from NRCS Website: https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/wfpo/

APPENDIX A: PRELIMINARY ALTERNATIVE WORKSHOP MATERIALS

EXHIBITS

LEGEND

SCALE: 1" = 300'

300' 0 600' 1200'

- EARTH/FILL
- ARMORING MATERIAL
- NATURAL INUNDATION ZONE
- DRAINAGE/FLOWLINE
- MATCHLINE
- BOUNDARY

N

ALTERNATIVE 4

ALTERNATIVES 1, 2, 3A, 5A, 6A

ALTERNATIVE 3B, 3C, 5B, 6B

ALTERNATIVE 3D, 5C, 6C

EAST WASH DAM

WEST WASH DAM

MCCARRAN BLVD

DATE: 8/4/2021
SCALE:
DESIGNED: MA
DRAWN: SHH
CHECKED: CC

FARR WEST ENGINEERING
5510 LONGLEY LANE
RENO, NEVADA 89511
PHONE: (775) 851-4788
FAX: (775) 851-0766

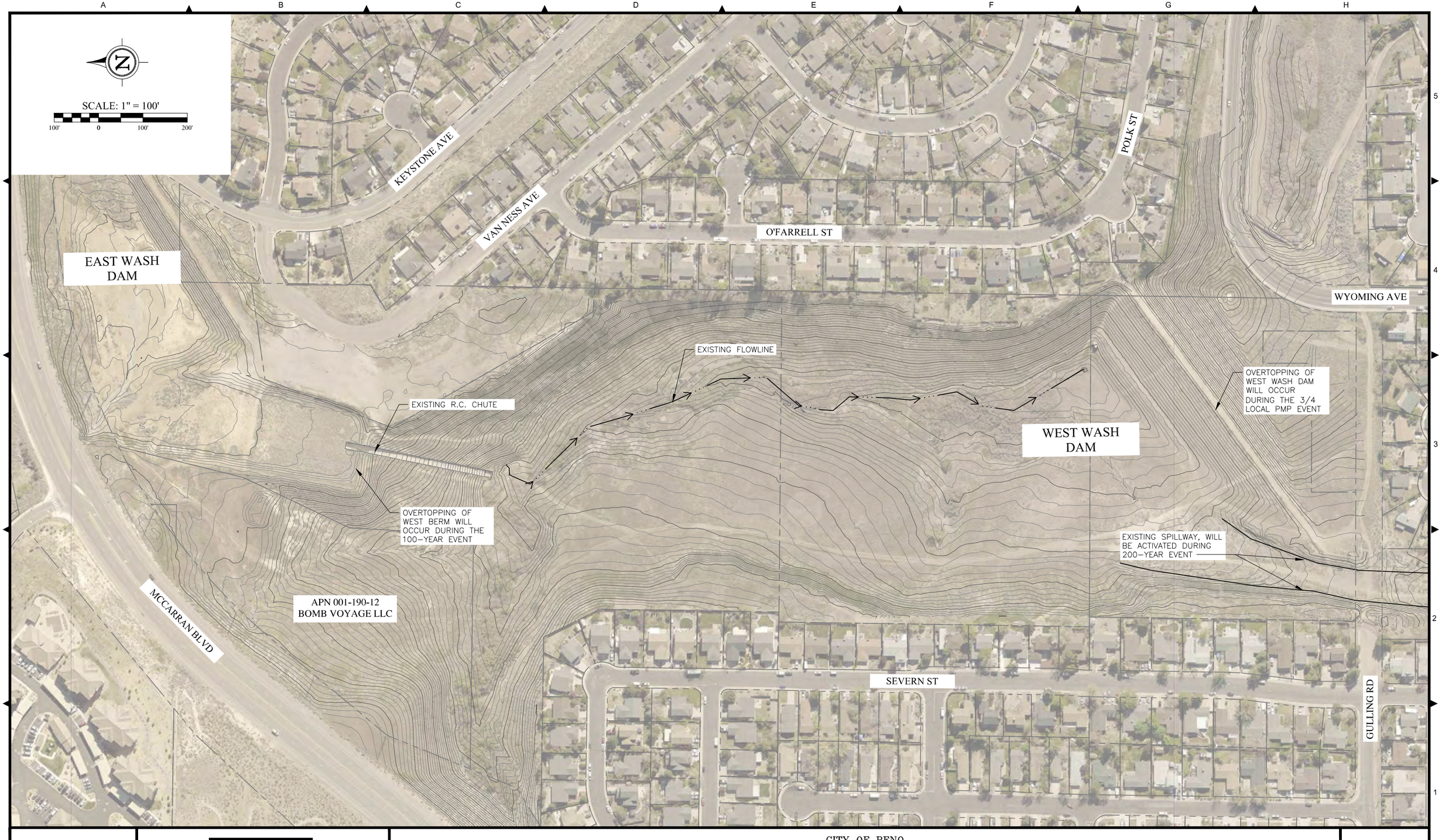
CITY OF RENO

SUPPLEMENTAL WATERSHED PLAN AND ENVIRONMENTAL DOCUMENT FOR THE PEAVINE MOUNTAIN WATERSHED

LEGEND

WASHOE COUNTY NEVADA

L



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PHONE: (775) 851-4788
FAX: (775) 851-0766

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PRELIMINARY ALTERNATIVE 1 - NO ACTION

WASHOE COUNTY NEVADA

1

SCALE: 1" = 150'

150' 0 150' 300'

KEYSTONE AVE

VAN NESS AVE

O'FARRELL ST

POLK ST

WEST WASH
INUNDATION AREA

WYOMING AVE

EAST WASH
DAM

WEST WASH
DAM

IMPROVE NATURAL CONVEYANCE
2.2 MI TO TRUCKEE RIVER

MCCARRAN BLVD

SEVERN ST

GULLING RD

DATE: _____

SCALE: _____

DESIGNED: _____

DRAWN: SHH

CHECKED: _____

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FAX: (775) 851-0766

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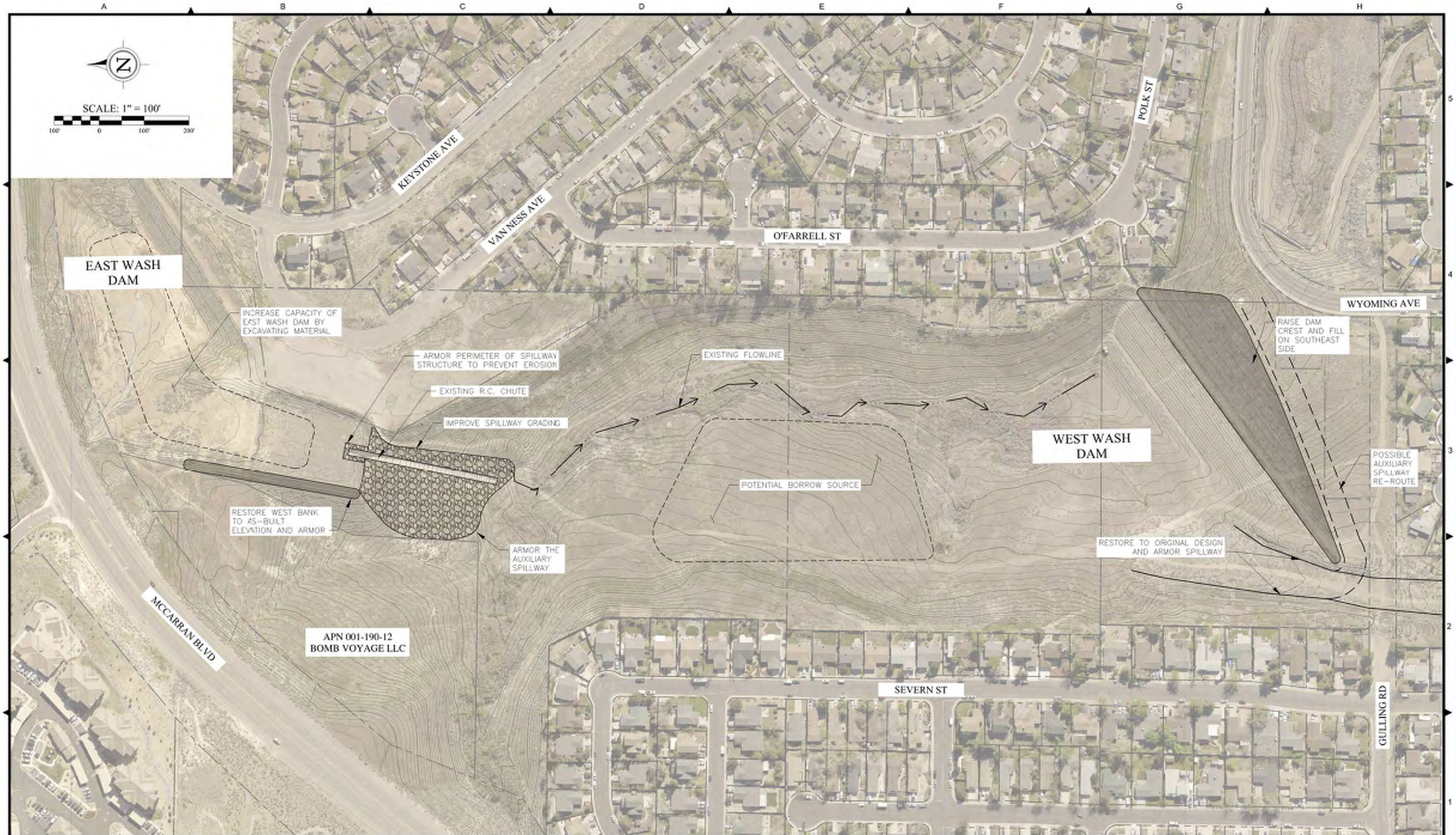
PRELIMINARY ALTERNATIVE 2 - FLOOD PROOFING DOWNSTREAM FROM WEST WASH

WASHOE COUNTY NEVADA

2



DATE: 8/4/2021
SCALE:
DESIGNED: MA
DRAWN: SHH
CHECKED: CC

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RENO, NEVADA 89511
PHONE: (775) 851-4788
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PRELIMINARY ALTERNATIVE 3A - IMPROVE EAST AND WEST WASH DAMS

WASHOE COUNTY NEVADA

3A

SCALE: 1" = 60'

60' 0 60' 120'

KEYSTONE AVE

VAN NESS AVE

O'FARRELL ST

EAST WASH DAM

INCREASE CAPACITY OF EAST WASH DAM BY EXCAVATING MATERIAL

ARMOR PERIMETER OF SPILLWAY STRUCTURE TO PREVENT EROSION

IMPROVE SPILLWAY GRADING

EXISTING R.C. CHUTE

EXISTING FLOWLINE

POTENTIAL BORROW SOURCE

RESTORE WEST BANK TO AS-BUILT ELEVATION

ARMOR THE SPILLWAYS BELOW EAST WASH DAM TO PREVENT EROSION DURING EVENT

MCCARRAN BLVD

APN 001-190-12
BOMB VOYAGE LLC

DATE: 8/4/2021
SCALE:
DESIGNED: MA
DRAWN: SHH
CHECKED: CC

FARR WEST ENGINEERING
5510 LONGLEY LANE
RENO, NEVADA 89511
PHONE: (775) 851-4788
FAX: (775) 851-0766

CITY OF RENO

SUPPLEMENTAL WATERSHED PLAN AND ENVIRONMENTAL DOCUMENT FOR THE PEAVINE MOUNTAIN WATERSHED

PRELIMINARY ALTERNATIVE 3B - IMPROVE EAST WASH DAM

WASHOE COUNTY NEVADA

3B

SCALE: 1" = 100'

100' 0 100' 200'

KEYSTONE AVE

VAN NESS AVE

O'FARRELL ST

POLK ST

IMPROVE NATURAL CONVEYANCE 2.2 MILES TO TRUCKEE RIVER

WEST WASH INUNDATION AREA

WYOMING AVE

EAST WASH DAM

INCREASE CAPACITY OF EAST WASH DAM BY EXCAVATING MATERIAL

ARMOR PERIMETER OF SPILLWAY STRUCTURE TO PREVENT EROSION

EXISTING R.C. CHUTE

IMPROVE SPILLWAY GRADING

EXISTING FLOWLINE

WEST WASH DAM

POSSIBLE AUXILIARY SPILLWAY RE-ROUTE

RESTORE WEST BERM TO AS-BUILT ELEVATION AND ARMOR

ARMOR THE SPILLWAYS BELOW EAST WASH DAM TO PREVENT EROSION

MCCARRAN BLVD

APN 001-190-12
BOMB VOYAGE LLC

SEVERN ST

GULLING RD

DATE: 8/4/2021
SCALE:
DESIGNED: MA
DRAWN: SHH
CHECKED: CC

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5510 LONGLEY LANE
RENO, NEVADA 89511
PHONE: (775) 851-4788
FAX: (775) 851-0766

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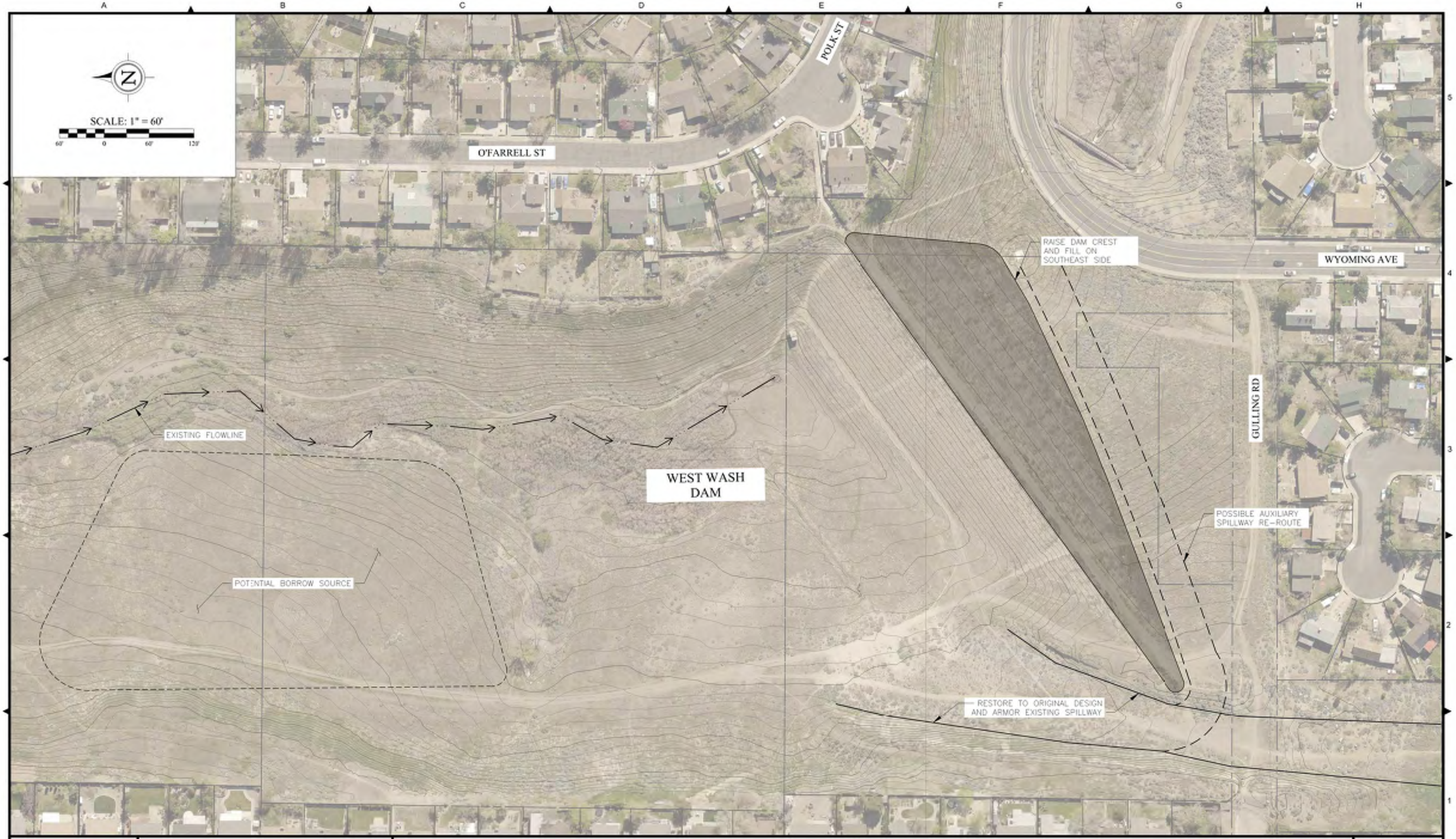
PRELIMINARY ALTERNATIVE 3C - IMPROVE EAST WASH DAM WITH DOWNSTREAM IMPROVEMENTS

WASHOE COUNTY NEVADA

3C



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CHECKED: CC

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5510 LONGLEY LANE
RENO, NEVADA 89511
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PRELIMINARY ALTERNATIVE 3D - IMPROVE WEST WASH DAM

WASHOE COUNTY NEVADA

3D

SCALE: 1" = 50'

50' 0 50' 100'

WATER WILL NATURALLY COLLECT ON THE NORTHERN END OF THE DAM AS WATER DRAINS FROM THE WATERSHED

CONSTRUCT DAM AS PRIMARY RETENTION FOR EAST WASH

OUTLET STRUCUTRE

DAM CREST

DATE: 8/4/2021
SCALE:
DESIGNED: MA
DRAWN: SHH
CHECKED: CC

FARR WEST ENGINEERING
5510 LONGLEY LANE
RENO, NEVADA 89511
PHONE: (775) 851-4788
FAX: (775) 851-0766

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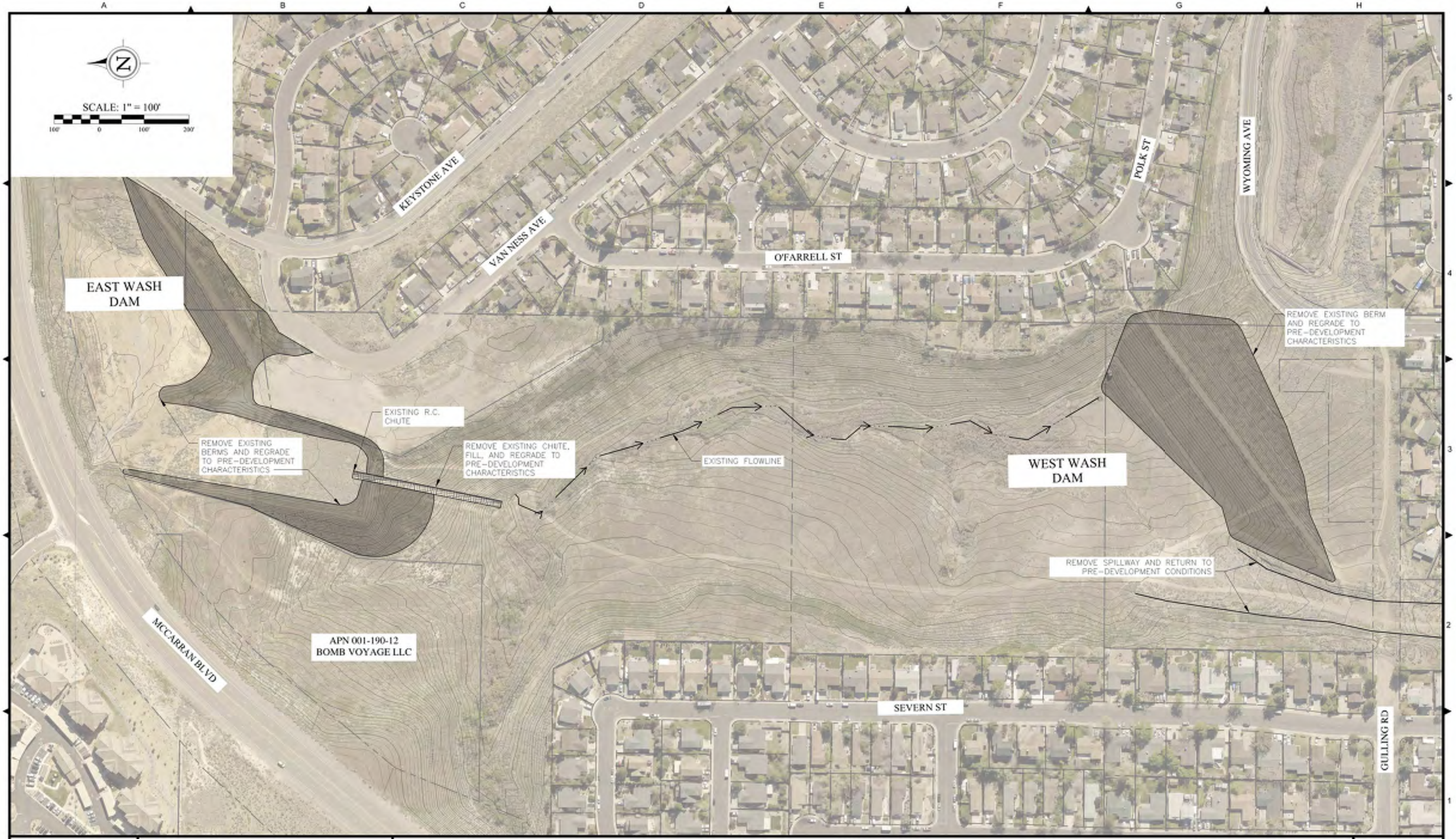
SUPPLEMENTAL WATERSHED PLAN AND ENVIRONMENTAL DOCUMENT FOR THE PEAVINE MOUNTAIN WATERSHED

PRELIMINARY ALTERNATIVE 4 - UPSTREAM SOLUTION (DETENTION STRUCTURE)

WASHOE COUNTY NEVADA



DATE: 8/4/2021
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5510 LONGLEY LANE
RENO, NEVADA 89511
PHONE: (775) 851-4788
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SUPPLEMENTAL WATERSHED PLAN AND ENVIRONMENTAL DOCUMENT FOR THE PEAVINE MOUNTAIN WATERSHED

PRELIMINARY ALTERNATIVE 5A - REMOVE EAST AND WEST WASH DAMS

WASHOE COUNTY NEVADA

5A

SCALE: 1" = 60'

60' 0 60' 120'

KEYSTONE AVE

VAN NESS AVE

O'FARRELL ST

EAST WASH DAM

MCCARRAN BLVD

REMOVE EXISTING BERMS AND REGRADE TO PRE-DEVELOPMENT CHARACTERISTICS

REMOVE EXISTING SPILLWAY, FILL, AND REGRADE TO PRE-DEVELOPMENT CHARACTERISTICS

EXISTING R.C. CHUTE

EXISTING FLOWLINE

APN 001-190-12
BOMB VOYAGE LLC

DATE: 8/4/2021
SCALE:
DESIGNED: MA
DRAWN: SHH
CHECKED: CC

FARR WEST ENGINEERING
5510 LONGLEY LANE
RENO, NEVADA 89511
PHONE: (775) 851-4788
FAX: (775) 851-0766

CITY OF RENO

SUPPLEMENTAL WATERSHED PLAN AND ENVIRONMENTAL DOCUMENT FOR THE PEAVINE MOUNTAIN WATERSHED

PRELIMINARY ALTERNATIVE 5B - REMOVE EAST WASH DAM

WASHOE COUNTY NEVADA

5B

SCALE: 1" = 60'

60' 0 60' 120'

O'FARRELL ST

WYOMING AVE

GULLING RD

WEST WASH DAM

EXISTING FLOWLINE

REMOVE EXISTING BERM AND REGRADE TO PRE-DEVELOPMENT CHARACTERISTICS

REMOVE SPILLWAY AND RETURN TO PRE-DEVELOPMENT CONDITIONS

DATE: 8/4/2021
SCALE:
DESIGNED: MA
DRAWN: SHH
CHECKED: DC

FARR WEST ENGINEERING
5510 LONGLEY LANE
RENO, NEVADA 89511
PHONE: (775) 851-4788
FAX: (775) 851-0766

CITY OF RENO

SUPPLEMENTAL WATERSHED PLAN AND ENVIRONMENTAL DOCUMENT FOR THE PEAVINE MOUNTAIN WATERSHED

PRELIMINARY ALTERNATIVE 5C - REMOVE WEST WASH DAM

WASHOE COUNTY NEVADA

5C

SCALE: 1" = 100'

100' 0 100' 200'

EAST WASH INUNDATION AREA

KEYSTONE AVE

VAN NESS AVE

IMPROVE NATURAL CONVEYANCE 2.3 MILES TO TRUCKEE RIVER

O'FARRELL ST

POLK ST

IMPROVE NATURAL CONVEYANCE 2.2 MILES TO TRUCKEE RIVER

WEST WASH INUNDATION AREA

WYOMING AVE

EAST WASH DAM

REMOVE EXISTING BERM AND REGRADE TO PRE-DEVELOPMENT CHARACTERISTICS

EXISTING R.C. CHUTE

REMOVE EXSTING BERMS AND REGRADE TO PRE-DEVELOPMENT CHARACTERISTICS

REMOVE EXISTING CHUTE, FILL, AND REGRADE TO PRE-DEVELOPMENT CHARACTERISTICS

EXISTING FLOWLINE

WEST WASH DAM

REMOVE SPILLWAY AND RETURN TO PRE-DEVELOPMENT CONDITIONS

MCCARRAN BLVD

APN 001-190-12
BOMB VOYAGE LLC

SEVERN ST

GULLING RD

DATE: 8/4/2021
SCALE:
DESIGNED: MA
DRAWN: SHH
CHECKED: CC

FARR WEST ENGINEERING
5510 LONGLEY LANE
RENO, NEVADA 89511
PHONE: (775) 851-4788
FAX: (775) 851-0766

CITY OF RENO

SUPPLEMENTAL WATERSHED PLAN AND ENVIRONMENTAL DOCUMENT FOR THE PEAVINE MOUNTAIN WATERSHED

PRELIMINARY ALTERNATIVE 6A - REMOVE EAST AND WEST WASH DAMS WITH DOWNSTREAM IMPROVEMENTS

WASHOE COUNTY NEVADA

6A

DATE: 8/4/2021
SCALE:
DESIGNED: MA
DRAWN: SHH
CHECKED: CC

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ENGINEERING
5510 LONGLEY LANE
RENO, NEVADA 89511
PHONE: (775) 851-4788
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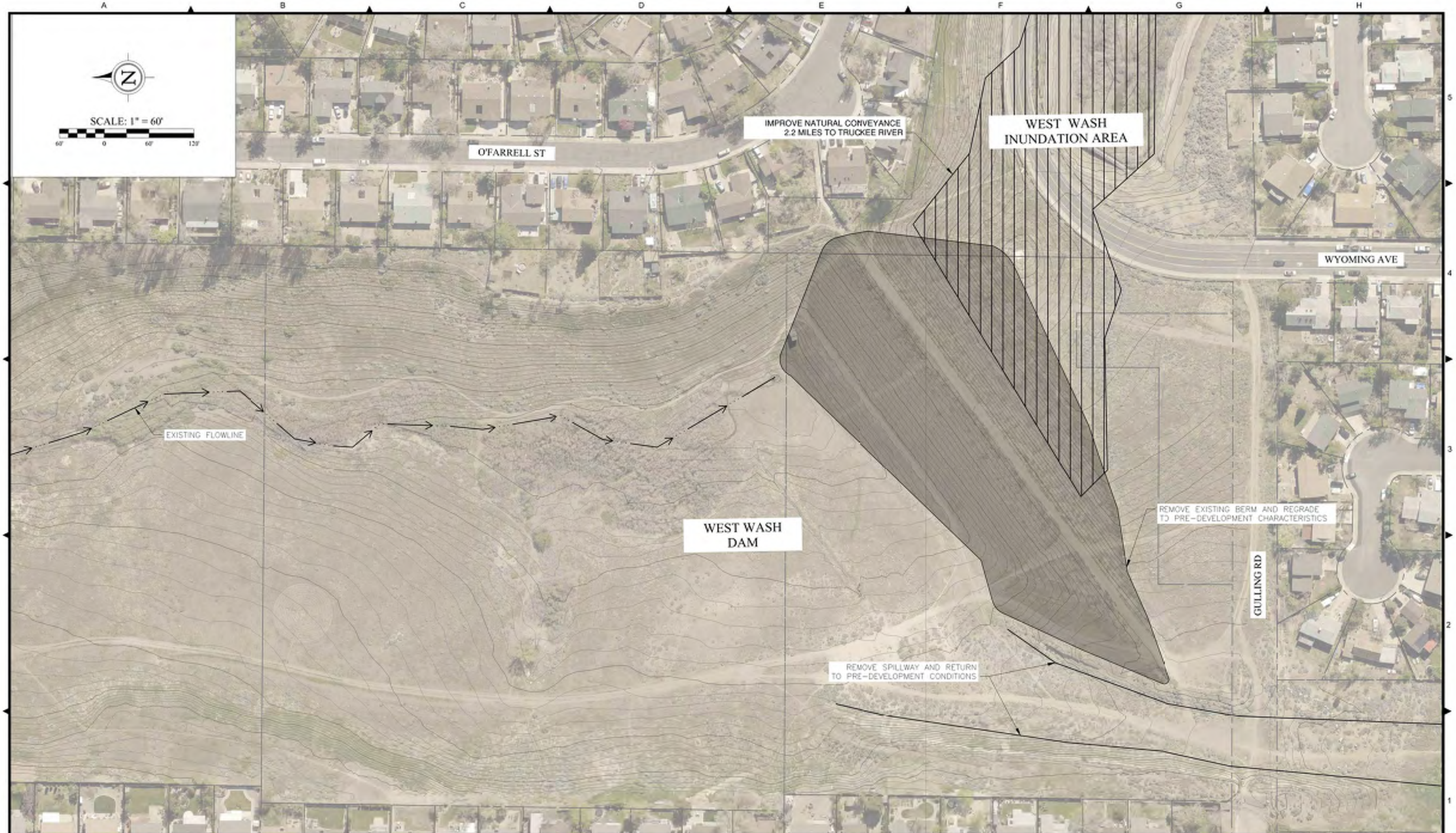
CITY OF RENO

SUPPLEMENTAL WATERSHED PLAN AND ENVIRONMENTAL DOCUMENT FOR THE PEAVINE MOUNTAIN WATERSHED

PRELIMINARY ALTERNATIVE 6B - REMOVE EAST WASH DAM WITH DOWNSTREAM IMPROVEMENTS

WASHOE COUNTY NEVADA

6B



DATE: 8/4/2021
SCALE:
DESIGNED: MA
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FARR WEST
ENGINEERING
5510 LONGLEY LANE
RENO, NEVADA 89511
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FAX: (775) 851-0766

CITY OF RENO

SUPPLEMENTAL WATERSHED PLAN AND ENVIRONMENTAL DOCUMENT FOR THE PEAVINE MOUNTAIN WATERSHED

PRELIMINARY ALTERNATIVE 6C - REMOVE WEST WASH DAM WITH DOWNSTREAM IMPROVEMENTS

WASHOE COUNTY NEVADA

6C

MEMO

FARR WEST
ENGINEERING

TECHNICAL MEMORANDUM

CITY OF RENO

SUPPLEMENTAL WATERSHED PLAN AND ENVIRONMENTAL DOCUMENT FOR THE PEAVINE MOUNTAIN WATERSHED AND WEST WASH DAM REHABILITATION

Prepared For:	Preliminary Alternatives Workshop
Prepared By:	Michael Anderson, P.E.
Reviewed By:	Keith Karpstein, P.E.
Date:	August 5, 2021
Subject:	Preliminary Alternatives for West Wash Dam Rehabilitation

1.0 SUMMARY OF PRELIMINARY ALTERNATIVES

The Preliminary Alternatives are classified in general terms as:

1. No action
2. Improve flood conveyance downstream of West Wash Dam
3. Dam improvements
    a. Improve both dams
    b. Improve only East Wash Dam
    c. Improve only East Wash Dam with improved flood conveyance downstream of West Wash
    d. Improve only West Wash Dam
4. Upstream solution
5. Dam removal
    a. Remove both dams
    b. Remove only East Wash Dam
    c. Remove only West Wash Dam
6. Dam removal with improvements to flood conveyance downstream
    a. Remove both dams with flood conveyance improvements downstream of both dams
    b. Remove East Wash Dam with flood conveyance improvements downstream of East Wash Dam
    c. Remove West Wash Dam with flood conveyance improvements downstream of West Wash Dam

Several preliminary alternatives will be selected from the above list of thirteen (13), one of which must be Alternative 1. The selected alternatives will then undergo detailed studies.

2.0 DESCRIPTION OF PRELIMINARY ALTERNATIVES

PRELIMINARY ALTERNATIVE 1: NO ACTION

The no action or "do nothing" preliminary alternative will maintain the status quo for this portion of the Peavine Mountain Watershed Management Project. Below the 100-year storm event (1% chance of exceedance), the East Wash and West Wash Dams will continue to flow with no damage to the structures or downstream properties, with exception of the proposed facility west of the East Wash Dam. For 100-year storm events, the western dike of the East Wash Dam will overtop, potentially causing damage to the proposed bike facility to the west. The West Wash Dam will activate the auxiliary spillway during the 200-year event and overtop the main embankment during the ¾ Local PMP event. No money will be spent on modification or rehabilitation of the two dams from the current Project award. Costs of maintenance will continue to be borne by the City of Reno for the foreseeable future with modest increases for inflation or periodic larger efforts to address specific deficiencies.

PRELIMINARY ALTERNATIVE 2: IMPROVE FLOOD CONVEYANCE DOWNSTREAM OF WEST WASH DAM

Improvement of flood conveyance downstream would involve establishment of a flood corridor with channeling structures from West Wash Dam down to the receiving waters of the Truckee River. This preliminary alternative, alone, would be predicated on non-modification of East Wash and West Wash Dams as described above under Preliminary Alternative 1, no action. Conveyance structures adequate to accommodate discharge flow up to the potential overtopping or breach flow would be built from West Wash Dam to the Truckee River through Reno.

PRELIMINARY ALTERNATIVE 3A: IMPROVE BOTH DAMS

Improvement of both dams will maximize the number of properties protected for all inflow design floods while minimizing the disruption of private property holdings. All improvements will be confined to the already disturbed area. Improvement of East Wash Dam will reestablish the west training dike grading to the as-built elevation and increase overall dam capacity by excavating material within the dam impoundment area. The primary and auxiliary spillway that discharge to the West Wash Dam will also be improved. Improvement of West Wash Dam will eliminate the potential for overtopping of the dam for storms approaching the PMP and reduce the number of properties exposed to inundation from activation of the auxiliary spillway.

PRELIMINARY ALTERNATIVE 3B: IMPROVE ONLY EAST WASH DAM

Improvement of East Wash Dam will reestablish the west training dike grading to the as-built elevation and increase overall dam capacity by excavating material within the dam impoundment area. The primary and auxiliary spillway that discharge to the West Wash Dam will also be improved. Improvements to East Wash Dam will be confined to the already disturbed area. Threat to downstream properties of West Wash Dam will remain the same as in Preliminary Alternative (1), No Action.

PRELIMINARY ALTERNATIVE 3C: IMPROVE ONLY EAST WASH DAM AND IMPROVE FLOOD CONVEYANCE DOWNSTREAM OF WEST WASH DAM

Improvement of East Wash Dam will reestablish the west training dike grading to the as-built elevation and increase overall dam capacity by excavating material within the dam impoundment area. The primary and auxiliary spillway that discharge to the West Wash Dam will also be improved. Improvements to East Wash Dam will be confined to the already disturbed area. Improvements to the downstream flood conveyance is considered an element of this preliminary alternative in a manner similar to Preliminary Alternative 2, *Improve Flood Conveyance Downstream of West Wash Dam*.

PRELIMINARY ALTERNATIVE 3D: IMPROVE ONLY WEST WASH DAM

Improvement of West Wash Dam will eliminate the potential for overtopping of the dam for ¾ of the Local PMP storms and reduce the number of properties exposed to inundation from activation of the auxiliary spillway. Improvements to West Wash Dam will be confined to the already disturbed area. Threat to downstream property west of East Wash Dam will remain the same as in Preliminary Alternative 1, No Action.

PRELIMINARY ALTERNATIVE 4: UPSTREAM SOLUTION

Prior public participation questioned the potential for upstream solutions. An upstream solution could reduce or eliminate the necessity of large, or potentially any, improvements at East or West Wash Dams. Upstream solutions include land treatment to reduce runoff, diversion of runoff to adjacent drainages, additional detention structure(s) or some combination of activities and will be considered upon selection of this preliminary alternative for further development.

PRELIMINARY ALTERNATIVE 5A: REMOVE BOTH DAMS

The existing embankments would either be breached or completely removed. Earth derived from the removal process would be either disposed of on-site or transported to an off-site disposal area. Collection structures would be constructed to direct flow to the existing storm water conveyance facilities. The existing detention basins and embankment areas would be contoured to a natural-appearing wash finish and armored to a degree to minimize erosion under most circumstances and return the areas to an approximation of pre-development condition. No flood protection would be afforded to properties downstream from the dam sites under this preliminary alternative, however some properties in the immediate vicinity of the existing auxiliary spillways would no longer be threatened by their activation.

PRELIMINARY ALTERNATIVE 5B: REMOVE ONLY EAST WASH DAM

East Wash Dam would be removed as described under Preliminary Alternative 5 with West Wash Dam treated as in Preliminary Alternative 1, above. No flood protection would be afforded to properties downstream from East Wash Dam under this preliminary alternative. Those properties downstream from West Wash Dam to the confluence with East Wash would be protected from the majority of floods.

PRELIMINARY ALTERNATIVE 5C: REMOVE ONLY WEST WASH DAM

West Wash Detention Dam would be removed as described under Preliminary Alternative 5 with East Wash Dam treated as in Preliminary Alternative 1, above. No flood protection would be afforded to properties downstream from West Wash Dam under this preliminary alternative. Those properties downstream from East Wash Dam to the confluence with West Wash would still be protected from all floods.

PRELIMINARY ALTERNATIVE 6A: REMOVE BOTH DAMS WITH FLOOD CONVEYANCE IMPROVEMENTS DOWNSTREAM OF BOTH DAMS

The dams would be removed as described above under Preliminary Alternative 5a. Improvement of flood conveyance downstream would involve establishment of a flood corridor with channeling structures from West Wash Dam and East Wash Dam down to the receiving waters of the Truckee River. Conveyance structures adequate to accommodate discharge flow up to the PMF event would be built from both dams to the Truckee River through Reno.

PRELIMINARY ALTERNATIVE 6B: REMOVE EAST WASH DAM WITH FLOOD CONVEYANCE IMPROVEMENTS DOWNSTREAM OF EAST WASH DAM)

The East Wash Dam would be removed as described above under Preliminary Alternative 5b. Improvement of flood conveyance downstream would involve establishment of a flood corridor with channeling

structures from East Wash Dam down to the receiving waters of the Truckee River. Conveyance structures adequate to accommodate discharge flow up to the PMF event would be built from East Wash Dam to the Truckee River through Reno.

PRELIMINARY ALTERNATIVE 6C: REMOVE WEST WASH DAM WITH FLOOD CONVEYANCE IMPROVEMENTS DOWNSTREAM OF WEST WASH DAM

The West Wash Dam would be removed as described above under Preliminary Alternative 5c. Improvement of flood conveyance downstream would involve establishment of a flood corridor with channeling structures from West Wash Dam down to the receiving waters of the Truckee River. Conveyance structures adequate to accommodate discharge flow up to the PMF event would be built from West Wash Dam to the Truckee River through Reno.

3.0 DISCUSSION OF PRELIMINARY ALTERNATIVES

PRELIMINARY ALTERNATIVE 1: NO ACTION

Safety differs between East Wash and West Wash Dam in the event of a smaller probability (less frequent and larger) storm approaching and including the Probable Maximum Flood (PMF) which is defined as that runoff from a Probable Maximum Precipitation event (approaching a foot of precipitation in one storm).

East Wash Dam will continue to pass the PMF by diverting nearly all of the inflow to West Wash above West Wash Dam. Flood rates that match the 100-year storm event (1% chance of exceedance) will activate the auxiliary spillway by overtopping the west and south dikes of the principal spillway approach, as designed. Activation of the auxiliary spillway may adversely affect that private property identified as Washoe County APN 001-190-12. At flood rates approaching the PMF North McCarran Boulevard may be overtopped above East Wash Dam for a short period of time due to limited culvert capacity and resulting in closure of the road and subsequent repairs. This consequence may occur under all of the preliminary alternatives with the exception of Preliminary Alternatives 5a, 5b, 6a, 6b and possibly Preliminary Alternative 4 . Neither raising North McCarran Boulevard nor increasing the capacity of the culverts beneath it are being considered as a part of this project.

West Wash Dam will accommodate and pass the inflow from West Wash and the flow diverted from East Wash nearly up to the PMF. Flood rates above the 200-year storm event and approaching a significant portion of the PMF will be passed through the spillways with nearly all the flow discharged onto Severn Drive at which point it will flow generally east and south to the historic West Wash alignment through Reno. As spillway flow increases, the discharged water is likely to be “lost” from the spillway at both the right (west) and left (east) sides allowing water to potentially flood properties along Gulling Road. The latter flow has the potential to also damage the toe of the dam embankment as it makes its way to the historic West Wash near its crossing at Highland Ditch and Wyoming Avenue. Additionally, models predict that as inflow reaches ¾ of the Local PMF rates, the dam embankment itself will overtop which will significantly increase flow through West Wash below the dam and will damage the embankment, possibly severely. Any overtopping event of an embankment may lead to a breach of the embankment, which would be devastating to properties downstream.

PRELIMINARY ALTERNATIVE 2: IMPROVE FLOOD CONVEYANCE DOWNSTREAM OF WEST WASH DAM

Development along potential corridors is already dense, therefore innovative measures would be necessary to accomplish this preliminary alternative. Potential means could include acquisition of all potentially inundated properties along the historic West Wash alignment or acquisition of select properties to allow construction of an open channel.

Modification to the West Wash Dams would still be necessary to introduce flood flow to the constructed conveyance facilities unless all of the potentially inundated land was vacated between the dam and the Truckee River.

Sudden introduction of large quantities of stormwater to the Truckee River may also require additional solutions downstream of the confluence in the Truckee River and adjacent properties.

PRELIMINARY ALTERNATIVE 3A: IMPROVE BOTH DAMS

Improvement of East Wash Detention Dam would reestablish principal spillway guide dike crest elevation to as-built levels. This would return auxiliary spillway activation to as-designed intervals and reduce the incidence of potentially damaging flow impacting the neighboring property to the west and minimize potential damage to the spillway. Raising the guide dike embankments of the approach channel up to as-built elevation will have a minimal effect on viewscapes and will occur entirely within already disturbed land. Slightly reconfiguring and armoring the auxiliary spillway to either side of the existing concrete chute principal spillway will reduce damage to the cast in place concrete in the event of auxiliary spillway activation. This can be accomplished in such a manner that the visual effect is largely unnoticeable.

Improvement of West Wash Dam will eliminate the potential for a breaching failure of the dam by overtopping and reduce the number of properties exposed to inundation to those that were "at risk" from spillway flow under the initial design and built within the floodway since construction. An embankment raise of up to six feet (6') may impede a portion of viewscapes from surrounding properties. However, the overall visual aspect of the dam will remain unchanged. The auxiliary spillway may be slightly reconfigured to allow a higher peak flow rate and there may be a higher chance of activating the spillway. At a minimum, the auxiliary spillway will be returned to the as-designed configuration and armored against erosion. Some or all of the material needed to raise the embankment may be derived from the impoundment area which will affect the walking labyrinth and require its removal and, possibly, replacement.

PRELIMINARY ALTERNATIVE 3B: IMPROVE ONLY EAST WASH DAM

Selection of this preliminary alternative will choose to protect one at-risk property from damage due to premature activation of the auxiliary spillway in a 100-year flood event and reduce potential damage to the principal spillway. Raising the guide dike embankments of the approach channel up to as-built elevation and reconfiguration and armoring of the auxiliary spillway will have a minimal effect on viewscapes and will occur entirely within already disturbed land. Flood flows below the 100-year event will continue to be routed through the principal spillway drain structure and into existing storm water conveyance systems downstream. Flood flows at and above the 100-year event will continue to be diverted into West Wash and intercepted by West Wash Detention Dam. West Wash Detention Dam will not be modified under this preliminary alternative so flood events at and above ¾ of the Local PMF will continue to overtop the West Wash Dam embankment with the possibility of breaching it.

PRELIMINARY ALTERNATIVE 3C: IMPROVE ONLY EAST WASH DAM AND IMPROVE FLOOD CONVEYANCE DOWNSTREAM OF WEST WASH DAM

This preliminary alternative would be a combination of Preliminary Alternative 3b with Preliminary Alternative 2 as discussed above.

PRELIMINARY ALTERNATIVE 3D: IMPROVE ONLY WEST WASH DAM

Selection of this preliminary alternative will choose to protect all at risk properties, except the parcel west of East Wash Dam, from damage for all but very low probability flood events as described above under Preliminary Alternative 3a. Flood flows equal to or greater than the 100-year flood event will activate East Wash Dam's auxiliary spillway as designed and cause varying degrees of damage to the neighboring property to the west.

PRELIMINARY ALTERNATIVE 4: UPSTREAM SOLUTION

All upstream solutions would spread the area of impact. Direct impacts would go beyond the current area of disturbance and include wildlife habitat, cultural resources, and access to public lands.

Land treatment is not likely to reduce runoff significantly due to the arid nature of the environment and relatively thin layer of soil above the bedrock of Peavine Mountain. Mechanical treatments will increase infiltration of high frequency storms at the expense of greater sediment loading during larger, less frequent, storms. Vegetative treatments are unlikely to reduce runoff, with the exception of planting great basin specific species after a fire in the basin. Vegetation is at about the highest level of seral progression to be expected for the environment.

Diversion of flow from the tributary areas of East and West Washes will adversely impact other areas of development in nearby watersheds. No nearby watercourses or dry washes have been identified that are capable of conveying additional flow through the Reno urban area. Diverting flow to a neighboring hydrographic basin was not considered.

An additional dam site has been identified in the East Wash north of North McCarran Boulevard. The site is identified as a portion of Washoe County Assessor's parcel number 082-430-22 and is Federal Land. If this preliminary alternative is selected for further consideration, further analysis will be performed to determine the viability of an additional structure and the size necessary to alleviate or significantly reduce the inadequacies of East and West Wash Dams. Construction of a dam in upper East Wash will impact public land access and viewscapes in the general area of the dam. Construction of a dam may also impact the usability of existing high traffic trails. Since East Wash canyon is deeply incised, a relatively large structure will remain mostly invisible until within approximately 1,000' of the structure. Wildlife and vegetative habitat will be impacted over a several acre area that will lie beneath the dam and impoundment limits.

PRELIMINARY ALTERNATIVE 5A: REMOVE BOTH DAMS

Removal of both dams will eliminate all hazards from diverted flow onto private properties and the potential of a catastrophic failure of West Wash Dam. The property neighboring East Wash Dam spillway would no longer be threatened in the event of premature auxiliary spillway activation. Similarly, those properties on Severn Drive to the west of Wyoming Avenue and adjacent to the spillway of West Wash Dam would no longer be threatened by flow through the spillway in the event of a large inflow (low probability) flood.

Properties downstream of the dam locations through the approximate historic East and West Washes and on to the Truckee River will no longer benefit from protection from the 100-year storm event. The conveyance capacity of the existing stormwater system is known but the relative recurrence interval for that capacity has not been determined. Selection of this preliminary alternative will include analysis of existing storm water conveyance downstream from the dams and preparation of flood maps for inclusion in the FEMA FIRM program. All impacted properties will be subject to periodic flooding and many will be required to gain insurance against flooding. Original project analysis indicated that a significant number of properties could suffer damage from floods as common as the 10-year storm event (10% chance of exceedance).

PRELIMINARY ALTERNATIVE 5B: REMOVE ONLY EAST WASH DAM

Removal of only East Wash Dam would eliminate flood hazards from flow in East Wash being diverted to West Wash including the property immediately adjacent to the auxiliary spillway at East Wash Dam and all those properties downstream of West Wash Dam to the confluence with East Wash. All properties from East Wash Dam downstream to the Truckee River would be subject to conditions as stated under Preliminary Alternative 5a.

PRELIMINARY ALTERNATIVE 5C: REMOVE ONLY WEST WASH DAM

Removal of only West Wash Dam would maintain the diversion of flow from East Wash into West Wash. The hazard to the property immediately adjacent to the East Wash Dam auxiliary spillway would remain and the properties downstream of East Wash Dam would continue to be protected from flooding as described under Preliminary Alternative 1. The properties impacted by activation of the auxiliary spillway at West Wash Dam would no longer be subject to flooding in extreme events that activate the auxiliary spillway. However, all properties downstream of West Wash Dam to the Truckee River would be subject to periodic flood damage as described under Preliminary Alternative 5a.

PRELIMINARY ALTERNATIVE 6A: REMOVE BOTH DAMS WITH FLOOD CONVEYANCE IMPROVEMENTS DOWNSTREAM OF BOTH DAMS

The removal of both dams would adhere to the description in Preliminary Alternative 5a.

Downstream development along potential corridors is already dense, therefore innovative measures would be necessary to accomplish improving flood conveyance downstream of both dams. Potential means could include acquisition of all potentially inundated properties along the historic East and West Wash alignment or acquisition of select properties to allow construction of an open channel.

Modification to the pre-development conditions that the removed dams were returned to would still be necessary to introduce flood flow to the constructed conveyance facilities unless all of the potentially inundated land was vacated between the dams and the Truckee River.

Sudden introduction of large quantities of stormwater to the Truckee River may also require additional solutions downstream of the confluence in the Truckee River and adjacent properties.

PRELIMINARY ALTERNATIVE 6B: REMOVE EAST WASH DAM WITH FLOOD CONVEYANCE IMPROVEMENTS DOWNSTREAM OF EAST WASH DAM

The removal of East Wash Dam would adhere to the description in Preliminary Alternative 5b.

Downstream development along the potential corridor is already dense, therefore innovative measures would be necessary to accomplish improving flood conveyance downstream of East Wash Dam. Potential means could include acquisition of all potentially inundated properties along the historic East Wash alignment or acquisition of select properties to allow construction of an open channel.

Modification to the pre-development conditions that the East Wash Dam was returned to would still be necessary to introduce flood flow to the constructed conveyance facilities unless all of the potentially inundated land was vacated between the dam and the Truckee River.

Sudden introduction of large quantities of stormwater to the Truckee River may also require additional solutions downstream of the confluence in the Truckee River and adjacent properties.

PRELIMINARY ALTERNATIVE 6C: REMOVE WEST WASH DAM WITH FLOOD CONVEYANCE IMPROVEMENTS DOWNSTREAM OF WEST WASH DAM

The combination of the Preliminary Alternative 5c with Preliminary Alternative 2 would maintain the objective of the flood mitigation program. The washes would be restored to a condition similar to the pre-project state and the balance of the effects would be similar to those discussed above under Preliminary Alternative 2.

POWERPOINT PRESENTATION

1

OWNER:
City of Reno
1 East First Street
Reno, NV 89501

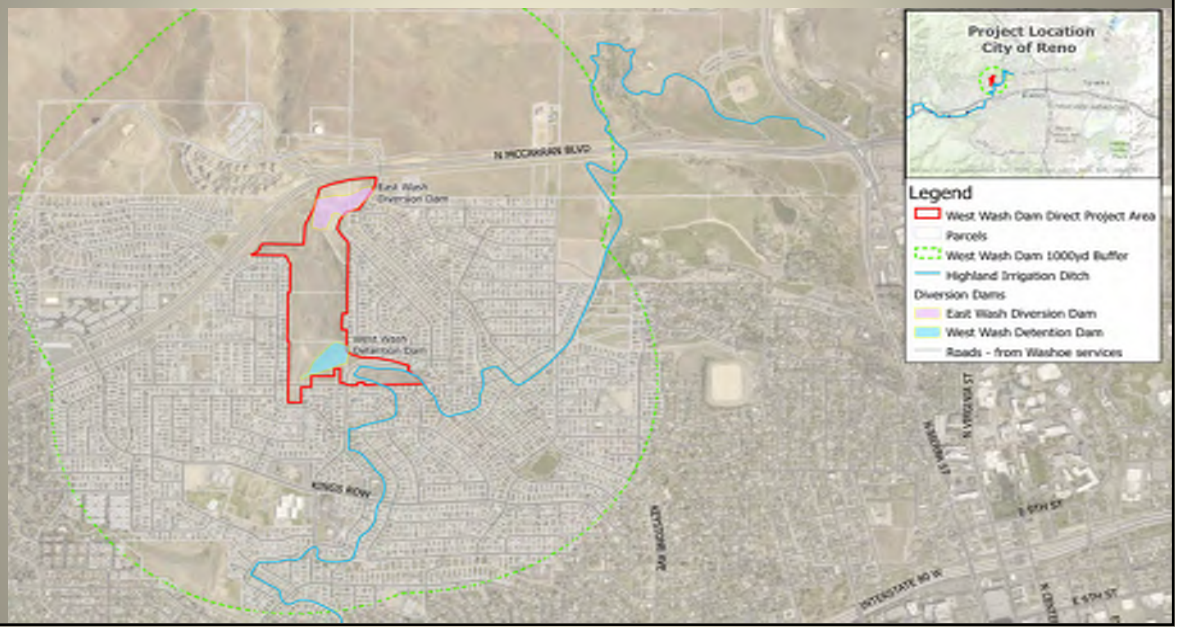
LEAD FEDERAL AGENCY:
USDA-NRCS
1365 Corporate Blvd
Reno, NV 89502

ENGINEER:
Farr West Engineering
5510 Longley Lane
Reno, NV 89511
(775) 851-4788
(775) 851-0766 Fax

City of Reno
August 12, 2021

2

Project Location



City of Reno
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Project Background

- The City of Reno is the owner of the East and West Wash Dams
  - Constructed in 1960 (West Wash Dam) and 1961 (East Wash Dam)
  - Located within the Peavine Mountain Watershed
  - Original watershed plans for these dams used an evaluated life of 50 years

20 Years! FARR WEST ENGINEERING

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Problem Statement

- Both dams are currently classified as High Hazard Dams by the Nevada Division of Water Resources (NDWR)
  - East and West Wash Dams do not meet the requirements for dam safety by the State of Nevada and NRCS
- Increased urbanization adjacent to dams increases the risk to lives and property in a stormwater flooding event
  - Rehabilitation of dams necessary to meet current safety standards and minimize the risk to lives and property in the surrounding urban area

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Purpose and Need Statement

- Purpose:
  - Preserve the flood protection function of the West Wash Dam
  - Protect lives and property in the surrounding urban area
  - Comply with current performance and safety standards in a cost effective and environmentally acceptable manner
- Needs:
  - Dams are not compliant with current dam safety regulations, engineering standards and performance criteria

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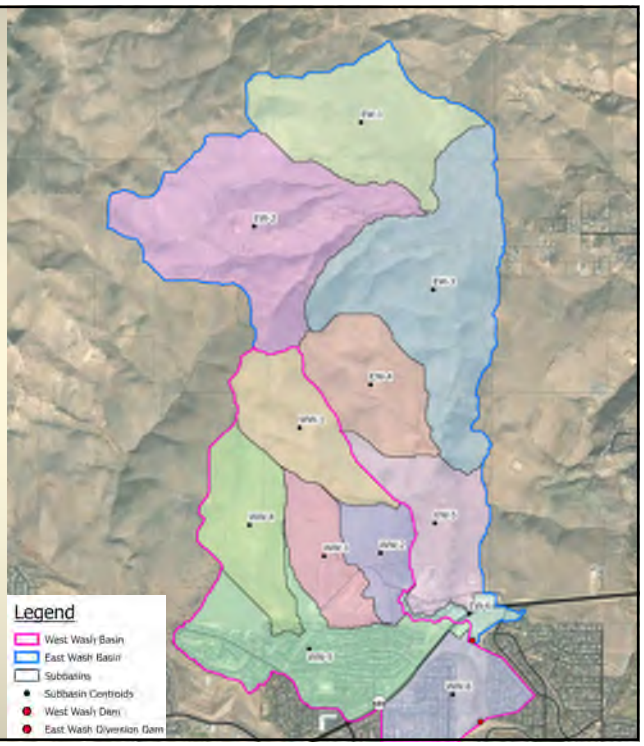
Watershed Area

- West Wash Basin Area
  - 845 acres (1.4 mi^2)
- East Wash Basin Area
  - 1,369 acres (2.1 mi^2)
- Total Watershed Area
  - 2,214 acres (3.5 mi^2)



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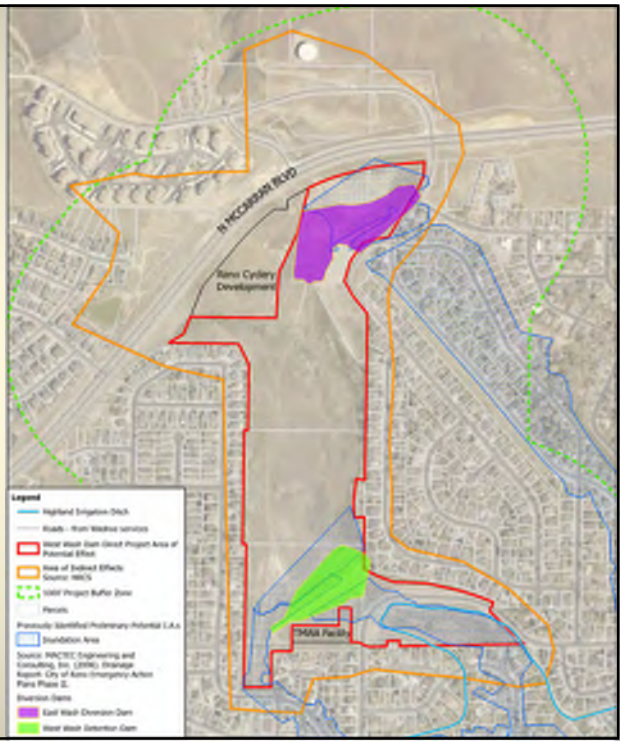
Area of Concern

- Defines the area of impact that may result from a proposed undertaking
- May change if additional alternatives outside the area are identified
- Potential downstream inundation areas will be identified and evaluated during detailed analysis

- Direct Effects (red outline)
  - existing area of dams is current area of direct effects
  - environmental resources existing within the area are evaluated for potential impacts of proposed undertaking
- Indirect Effects (orange outline)
  - visual, auditory, and/or atmospheric impacts that may result from a proposed undertaking (e.g., visual intrusions, noise, vibration, smell, dust, etc.)
  - permanent or temporary in nature



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August 12, 2021

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Summary of Alternatives

- Alternative 1
  - No action
- Alternative 2
  - Improve flood conveyance downstream of West Wash Dam
- Alternative 3A
  - Improve both dams
- Alternative 3B
  - Improve only East Wash Dam
- Alternative 3C
  - Improve only East Wash Dam with improved flood conveyance downstream of West Wash Dam
- Alternative 3D
  - Improve only West Wash Dam

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August 12, 2021

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Summary of Alternatives

- Alternative 4
  - Upstream solution
- Alternative 5A
  - Remove both dams
- Alternative 5B
  - Remove only East Wash Dam
- Alternative 5C
  - Remove only West Wash Dam
- Alternative 6A
  - Remove both dams with improved flood conveyance downstream of both dams
- Alternative 6B
  - Remove only East Wash Dam with improved flood conveyance downstream of East Wash Dam
- Alternative 6C
  - Remove only West Wash Dam with improved flood conveyance downstream of West Wash Dam

City of Reno
August 12, 2021

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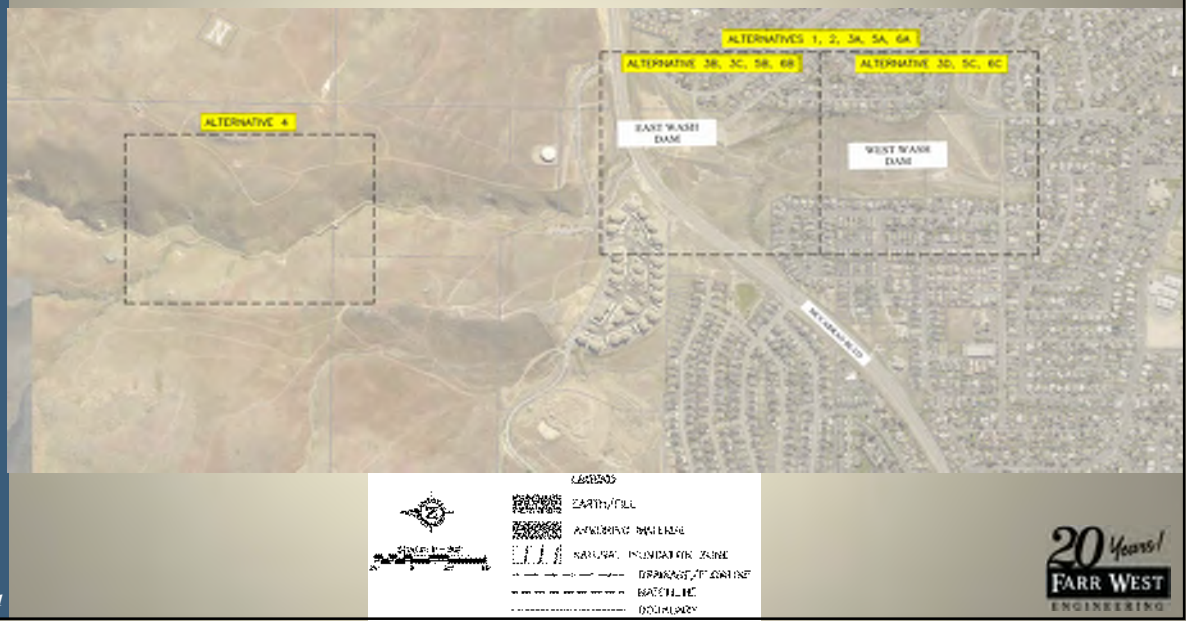
Preliminary Alternatives Legend



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Preliminary Alternative 1

- No action
  - No money will be spent on modification or rehabilitation of the two dams
  - City of Reno will continue to pay for costs of maintenance
    - Costs increase for inflation or to address growing deficiencies
  - The flow rate that initiates overtopping of both dams will be calculated and an approximate equivalent recurrence interval will be determined
  - No immediate cost

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Preliminary Alternative 1

No action

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Preliminary Alternative 2

- Improve flood conveyance downstream of West Wash Dam
  - Establish flood corridor (approx. 2.2 miles) with channeling structures from West Wash Dam to the receiving waters of the Truckee River
    - Conveyance structures adequate to accommodate the potential overtopping or breach flow
    - Approximately 426 homes will be impacted by acquisition of substantial improvements
  - High cost

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20 Years! FARR WEST ENGINEERING

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Preliminary Alternative 2

Improve flood conveyance downstream of West Wash Dam

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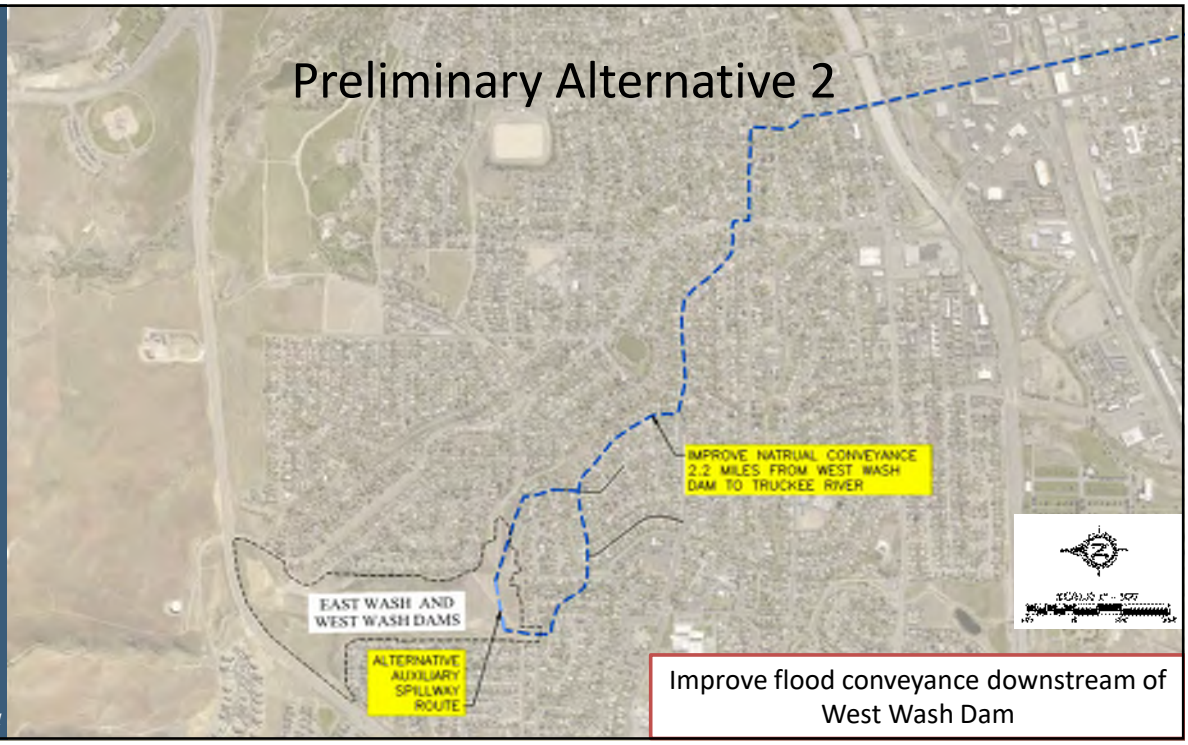
Preliminary Alternative 2



Improve flood conveyance downstream of West Wash Dam

City of Reno
August 12, 2021

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Preliminary Alternative 3A

- Improve both dams
  - Maximize the properties protected for all design floods while minimizing the disruption of private property
    - Improvement of dams will eliminate threat of overtopping and threat to neighboring properties
    - Improvement of dams will minimize potential spillway damage
  - All improvements will be confined already disturbed area
  - Medium-low cost

City of Reno
August 12, 2021

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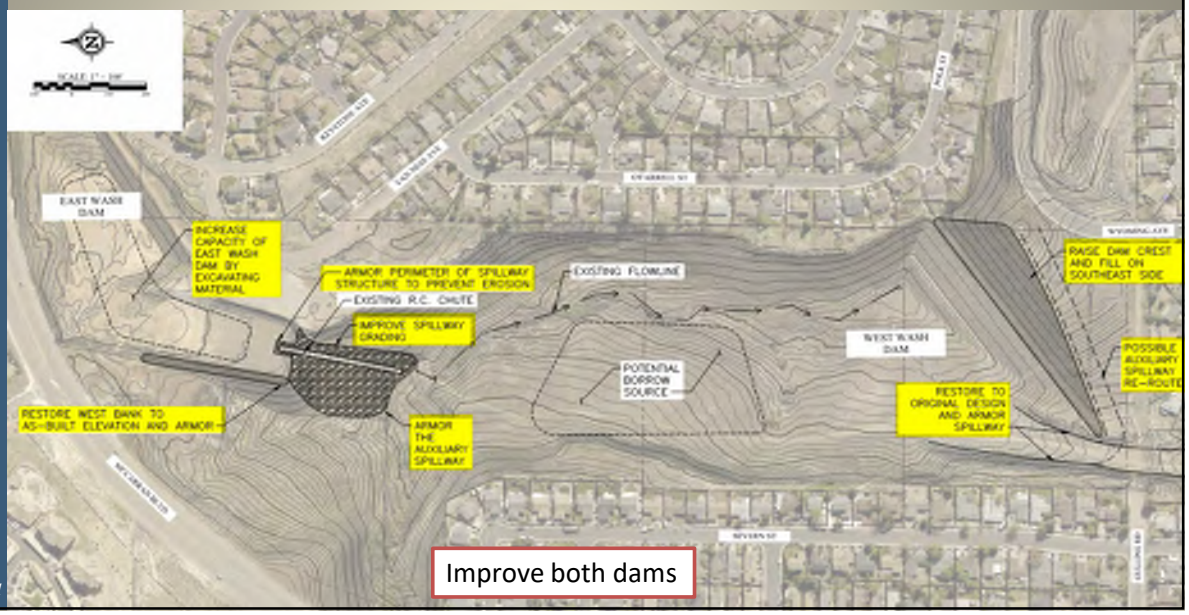
Preliminary Alternative 3A



City of Reno
August 12, 2021

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Preliminary Alternative 3B

- Improve only East Wash Dam
  - Eliminate threat to neighboring property to the west
  - minimize potential damage to the R.C. chute spillway for storms approaching the Probable Maximum Precipitation event
  - Improvements will be confined to already disturbed area
  - Threat to downstream properties of West Wash Dam will remain the same as *Preliminary Alternative 1 - No Action*
  - Low cost

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Preliminary Alternative 3B

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Preliminary Alternative 3C

- Improve only East Wash Dam with improved flood conveyance downstream of West Wash Dam
  - Eliminate the threat to the neighboring property to the west
  - Minimize potential damage to the R.C. chute spillway for storms approaching the Probable Maximum Precipitation event
  - Downstream conveyance would be improved as described in *Preliminary Alternative 2 – Improve Flood Conveyance Downstream*
  - High cost

City of Reno
August 12, 2021

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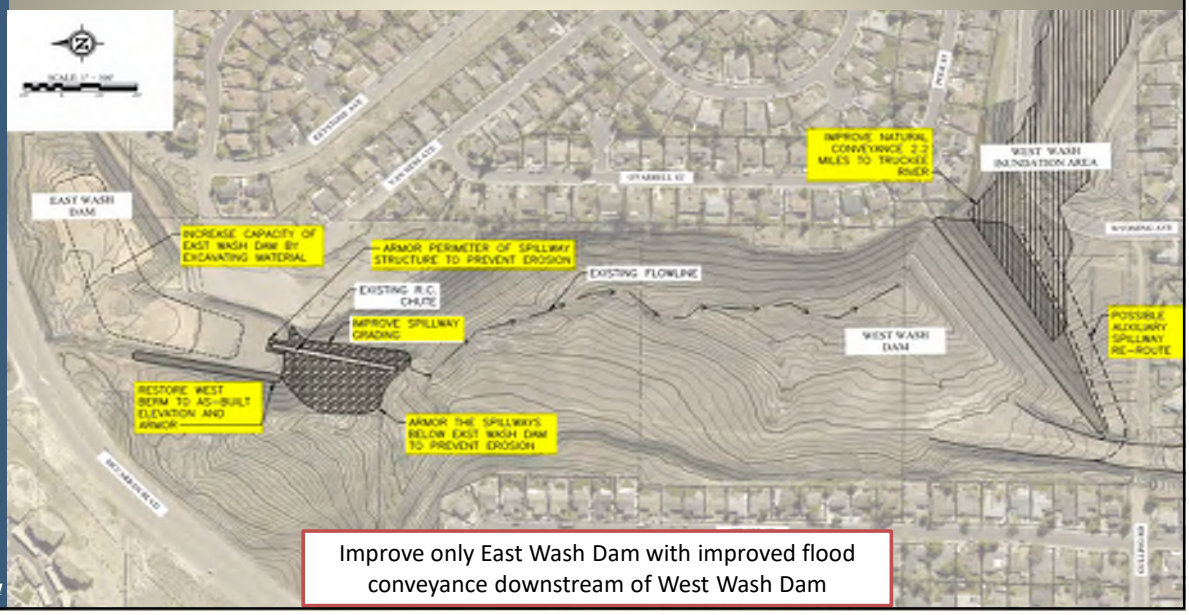
Preliminary Alternative 3C



Improve only East Wash Dam with improved flood conveyance downstream of West Wash Dam

City of Reno
August 12, 2021

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Preliminary Alternative 3D

- Improve only West Wash Dam
  - Eliminate the potential for overtopping of the dam for storms approaching the Probable Maximum Precipitation event
  - Improve auxiliary spillway to meet current design standards
  - Improvements confined to the already disturbed area
  - Threat to downstream property west of East Wash Dam will remain the same as in *Preliminary Alternative 1 - No Action*
  - Low cost

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Preliminary Alternative 3D

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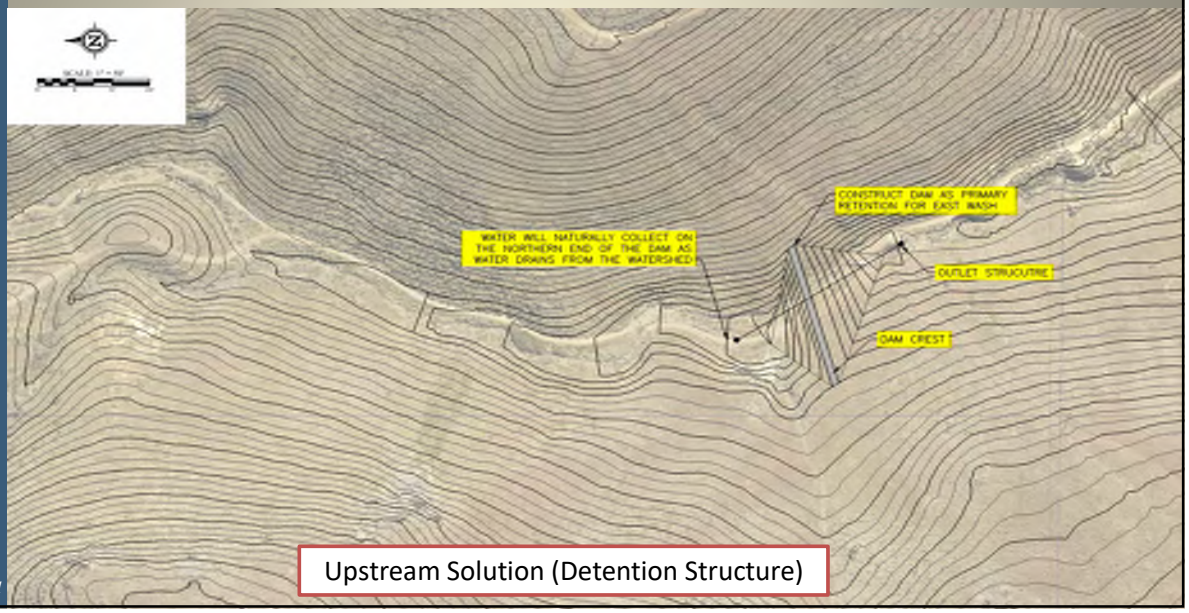
Preliminary Alternative 4

- Upstream solution
  - Prior public participation questioned the potential for upstream solutions
  - An upstream solution could reduce or eliminate the necessity of potentially any improvements at East or West Wash Dams
  - Options include
    - land treatment to reduce runoff
    - diversion of runoff to adjacent drainages
    - additional detention structure(s)
    - some combination of the above
  - Medium cost

Preliminary Alternative 4



Upstream Solution (Detention Structure)

Preliminary Alternative 5A

- Remove both dams
  - Existing dams would either be breached or completely removed
  - Collection structures would be constructed to direct flow to the existing storm water conveyance facilities downstream.
  - No flood protection would be afforded to properties downstream from the dam sites under this alternative
  - Medium-high cost

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Preliminary Alternative 5A

Remove both dams

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Preliminary Alternative 5B

- Remove only East Wash Dam
  - East Wash Dam would be removed as described in *Preliminary Alternative 5A – Remove Both Dams*
  - West Wash Dam treated as in *Preliminary Alternative 1 – No Action*
  - No flood protection to properties downstream from East Wash Dam
  - Medium cost

Preliminary Alternative 5B

Remove only East Wash Dam

Preliminary Alternative 5C

- Remove only West Wash Dam
  - West Wash Dam would be removed as described in *Preliminary Alternative 5A – Remove Both Dams*
  - West Wash Dam treated as in *Preliminary Alternative 1 – No Action*
  - No flood protection to properties downstream from West Wash Dam
  - Medium cost

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August 12, 2021

20 Years! FARR WEST ENGINEERING

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Preliminary Alternative 5C

Remove only West Wash Dam

City of Reno
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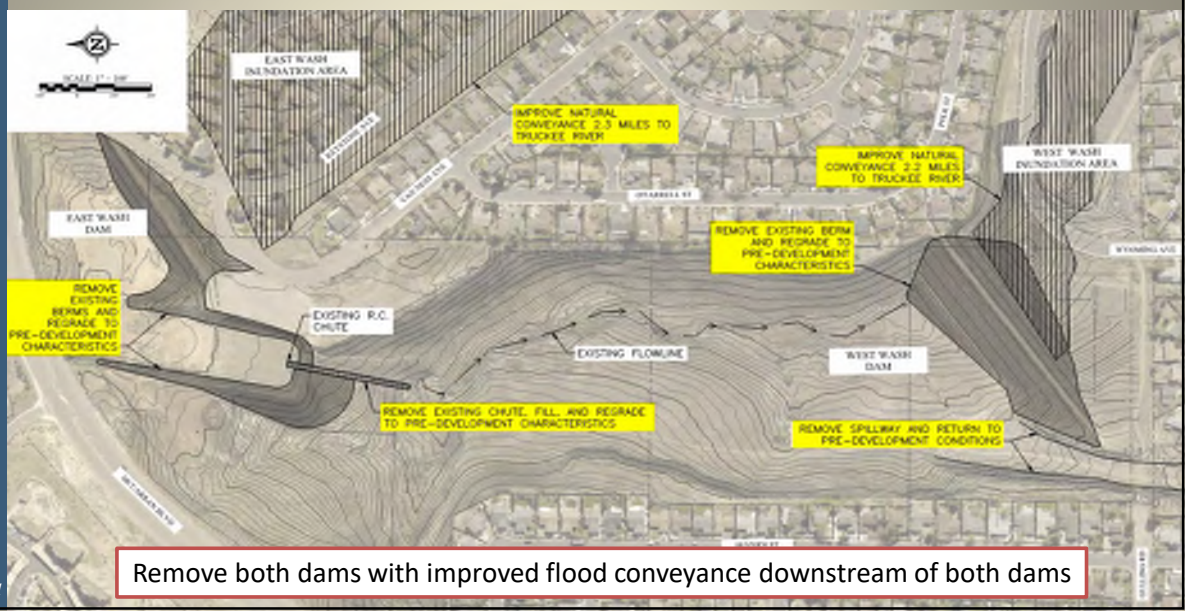
Preliminary Alternative 6A

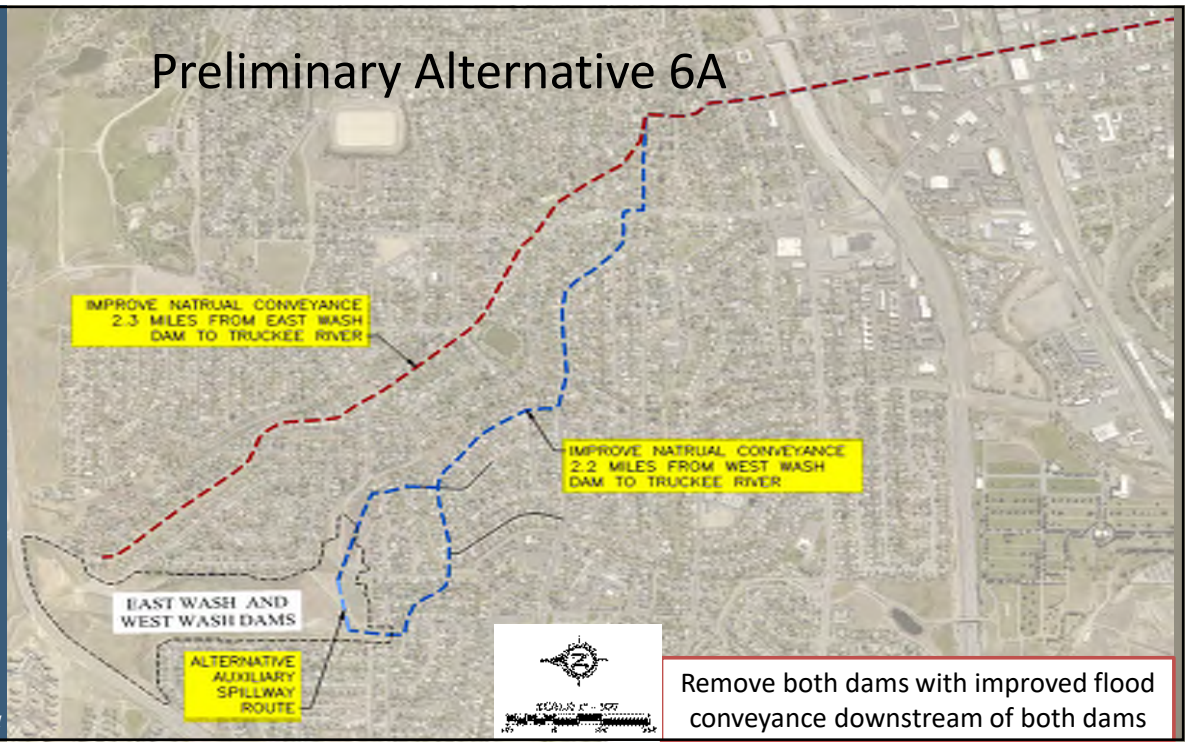
- Remove both dams with improved flood conveyance downstream of both dams
  - Both dams would be removed as described in *Preliminary Alternative 5A – Remove Both Dams*
  - Establish flood corridor with channeling structures from both East Wash and West Wash Dams to the receiving waters of the Truckee River
  - Will require acquisition of homes and/or will have severe impacts to existing homes
  - High cost

Preliminary Alternative 6A



Remove both dams with improved flood conveyance downstream of both dams

Preliminary Alternative 6A



Remove both dams with improved flood conveyance downstream of both dams

City of Reno
August 12, 2021

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Preliminary Alternative 6B

- Remove East Wash Dam with improved flood conveyance downstream of East Wash Dam
  - East Wash Dam would be removed as described in *Preliminary Alternative 5A – Remove Both Dams*
  - Establish flood corridor with channeling structures from East Wash and Dam to the receiving waters of the Truckee River
    - Will require acquisition of homes and/or will have severe impacts to existing homes
  - High cost

City of Reno
August 12, 2021

20 Years! FARR WEST ENGINEERING

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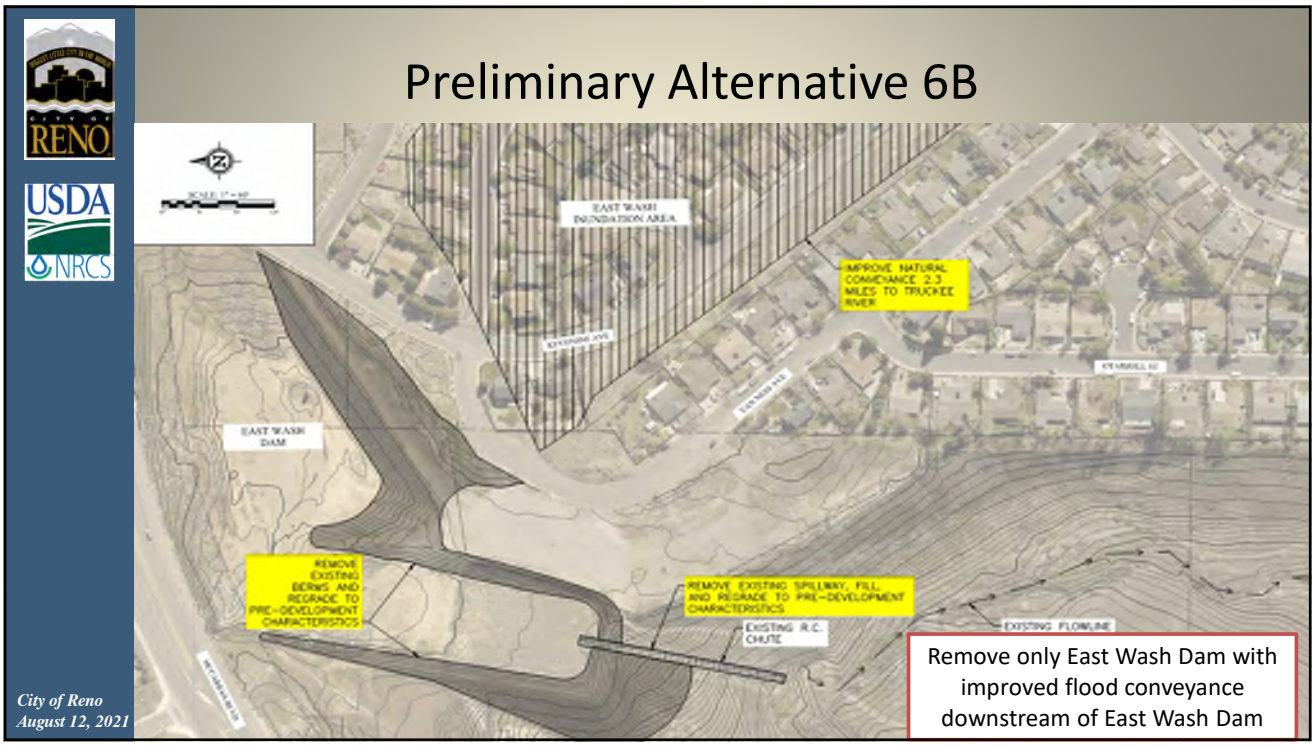
Preliminary Alternative 6B
EAST WASH INUNDATION AREA
IMPROVE NATURAL CONVEYANCE 2.3 MILES TO TRUCKEE RIVER
EAST WASH DAM
REMOVE EXISTING BERMS AND REGRADE TO PRE-DEVELOPMENT CHARACTERISTICS
REMOVE EXISTING SPILLWAY, FILL AND REGRADE TO PRE-DEVELOPMENT CHARACTERISTICS
EXISTING R.C. CHUTE
EXISTING FLOWLINE
Remove only East Wash Dam with improved flood conveyance downstream of East Wash Dam
City of Reno
August 12, 2021

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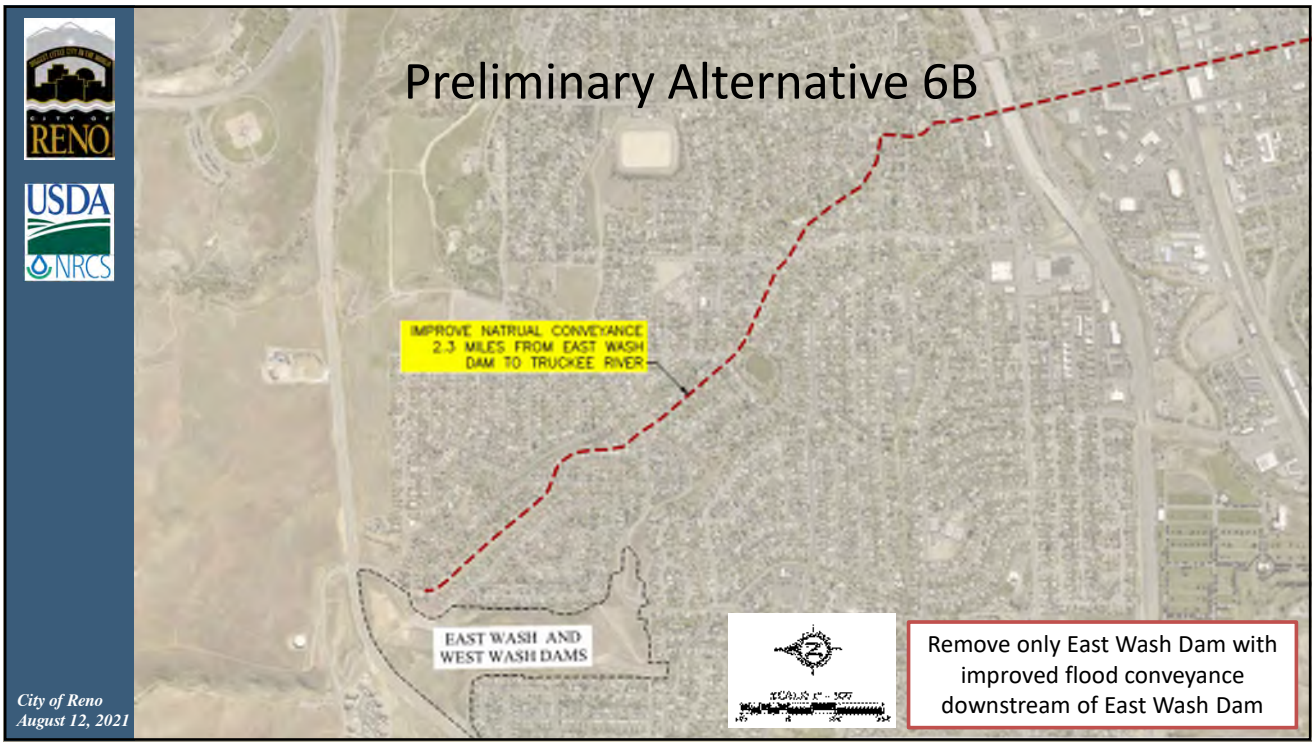
Preliminary Alternative 6B
IMPROVE NATRUAL CONVEYANCE 2.3 MILES FROM EAST WASH DAM TO TRUCKEE RIVER
EAST WASH AND WEST WASH DAMS
Remove only East Wash Dam with improved flood conveyance downstream of East Wash Dam
City of Reno
August 12, 2021

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Preliminary Alternative 6C

- Remove West Wash Dam with improved flood conveyance downstream of West Wash Dam
  - West Wash Dam would be removed as described in *Preliminary Alternative 5A – Remove Both Dams*
  - Establish flood corridor with channeling structures from West Wash Dam to the receiving waters of the Truckee River
  - Will require acquisition of homes and/or will have severe impacts to existing homes
  - High cost

City of Reno
August 12, 2021

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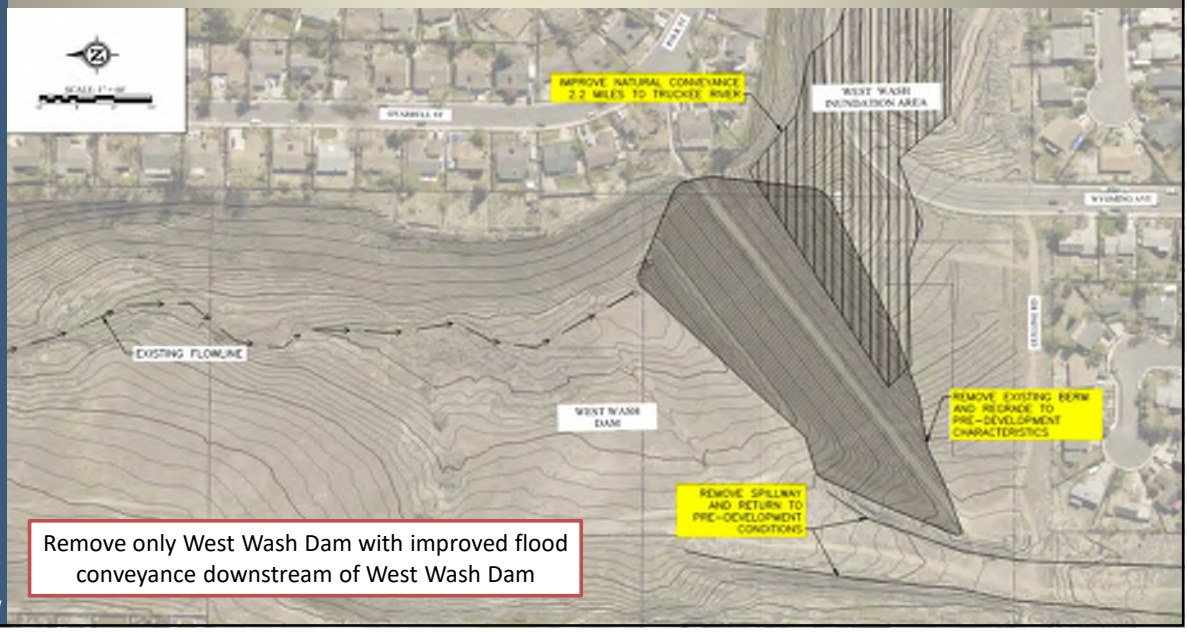
Preliminary Alternative 6C



Remove only West Wash Dam with improved flood conveyance downstream of West Wash Dam

City of Reno
August 12, 2021

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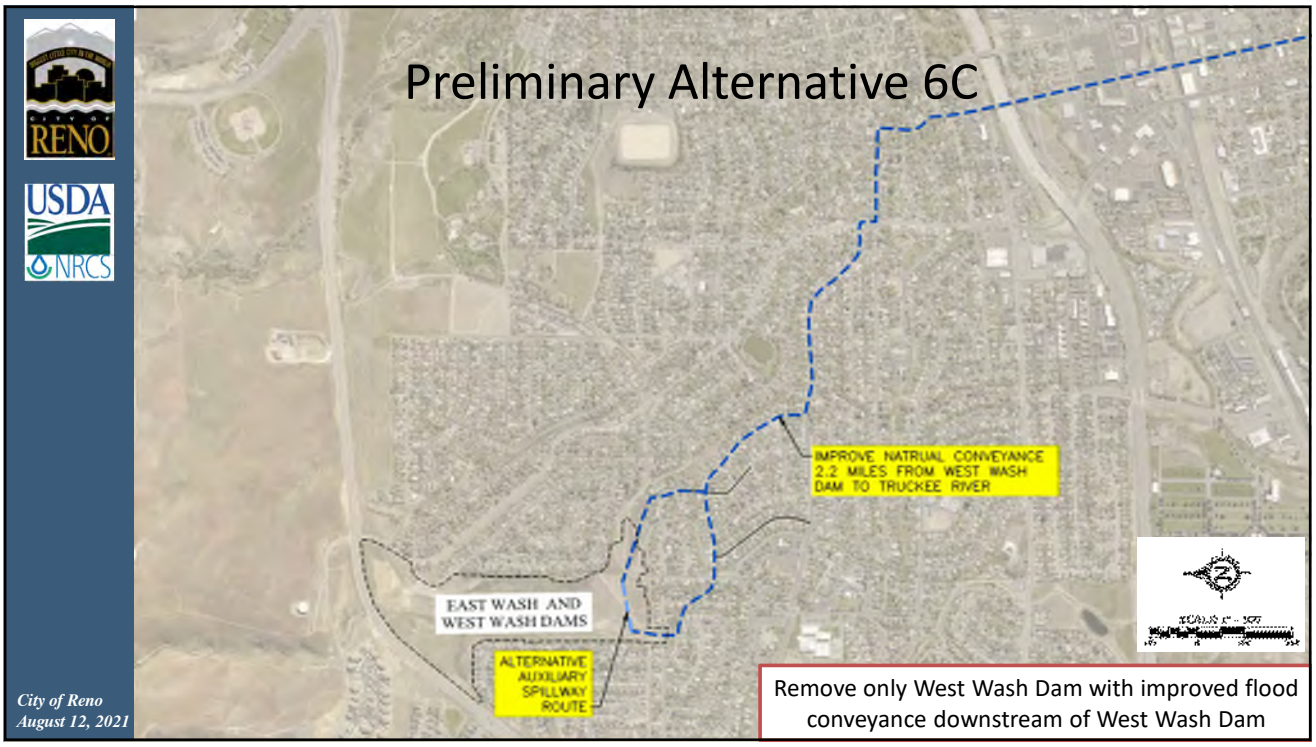
Preliminary Alternative 6C
IMPROVE NATRUAL CONVEYANCE 2.2 MILES FROM WEST WASH DAM TO TRUCKEE RIVER
EAST WASH AND WEST WASH DAMS
ALTERNATIVE AUXILIARY SPILLWAY ROUTE
Remove only West Wash Dam with improved flood conveyance downstream of West Wash Dam
City of Reno
August 12, 2021

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APPENDIX B: PRELIMINARY COST ESTIMATES

FARR WEST
ENGINEERING

City of Reno - West Wash Drainage Improvements
Alternate 2 - Downstream Improvements from West Wash
Engineer's Opinion of Probable Construction Costs (Preliminary)

Estimate by:	Savannah Hughes, E.I.
Project No.	1930
QC Check by:	Keith Karpstein, P.E.
Date:	03/17/22

BID SCHEDULE - BASE BID

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization (not to exceed 5% of base bid)	1	LS	$ 11,790,000	$ 11,790,000
2	Temporary Erosion and Sediment Control	1	LS	$ 5,735,345	$ 5,735,345
3	Temporary Traffic Control	1	LS	$ 5,735,345	$ 5,735,345
4	Geotechnical Testing and Inspection Services	1	LS	$ 5,735,345	$ 5,735,345
5	Structures Demolition	4,497,331	SF	$ 10	$ 44,973,310
6	Material Disposal	18,888,790	CY	$ 9	$ 169,999,110
7	Revegetation	182	AC	$ 5,500	$ 1,003,375
8	Site Grading	836	EA	$ 3,000	$ 2,508,000

Construction Subtotal:	**$**	**247,479,829**
10% Engineering:	**$**	**24,747,983**
10% Construction Management:	**$**	**24,747,983**
10% Effective Inflation	**$**	**24,747,983**
30% Contingency:	**$**	**74,243,949**
Base Bid Total:	**$**	**395,967,727**
Property Acquisition	**$**	**1,514,780,000**
Grand Total	**$**	**1,910,747,727**

FARR WEST
ENGINEERING

City of Reno - West Wash Drainage Improvements
Alternate 3B - Remediate Only East Wash Dam
Engineer's Opinion of Probable Construction Costs (Preliminary)

Estimate by:	Kristi Thompson
Project No.	1930
QC Check by:	Keith Karpstein, P.E.
Date:	03/17/22

BID SCHEDULE - BASE BID

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization (not to exceed 5% of base bid)	1	LS	$ 100,000.00	$ 100,000
2	Temporary Erosion and Sediment Control	1	LS	$ 46,821	$ 46,821
3	Geotechnical Testing and Inspection Services	1	LS	$ 46,821	$ 46,821
4	Clearing, Grubbing, and Stripping	0.2	AC	$ 13,000	$ 1,957
5	Revegetation and Seeding	0.2	AC	$ 5,500	$ 1,308
6	On-Site Cut/Fill	1	LS	$ 5,000	$ 5,000
7	Geosynthetic Stabilization	70,984	SF	$ 25	$ 1,774,594

Construction Subtotal:	**$**	**1,976,502**
10% Engineering:	**$**	**197,650**
10% Construction Management:	**$**	**197,650**
10% Effective Inflation	**$**	**197,650**
30% Contingency:	**$**	**592,951**
Base Bid Total:	**$**	**3,162,403**

FARR WEST ENGINEERING

City of Reno - West Wash Drainage Improvements
Alternate 3C - Remediate Only East Wash Dam with Flood Proofing Downstream of West Wash Dam
Engineer's Opinion of Probable Construction Costs (Preliminary)

Estimate by:	Savannah Hughes, E.I.
Project No.	1930
QC Check by:	Keith Karpstein, P.E.
Date:	03/17/22

BID SCHEDULE - BASE BID

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization (not to exceed 5% of base bid)	1	LS	$ 11,120,000.00	$ 11,120,000
2	Temporary Erosion and Sediment Control	4	DY	$ 1,000.00	$ 3,505
3	Temporary Traffic Control	1,615	DY	$ 1,000.00	$ 1,620,000
4	Geotechnical Testing and Inspection Services	1	DY	$ 1,750	$ 2,000
5	Clearing, Grubbing, and Stripping	0.2	AC	$ 13,000	$ 2,000
6	Revegetation and Seeding	0.2	AC	$ 5,500	$ 2,000
8	On-Site Cut/Fill	1	LS	$ 5,000	$ 5,000
10	Geosynthetic Stabilization	70,984	SF	$ 25	$ 1,780,000
12	Geotechnical Testing and Inspection Services	167	DY	$ 1,750	$ 300,000
13	Structures Demolition	4,497,331	SF	$ 10	$ 44,980,000
14	Material Disposal	18,888,790	CY	$ 9	$ 170,000,000
15	Revegetation	182	AC	$ 5,500	$ 1,010,000
16	Site Grading	836	EA	$ 3,000	$ 2,508,000

Construction Subtotal:	**$**	**233,332,505**
10% Engineering:	**$**	**23,333,251**
10% Construction Management:	**$**	**23,333,251**
10% Effective Inflation	**$**	**23,333,251**
30% Contingency:	**$**	**69,999,752**
Base Bid Total:	**$**	**373,332,009**
Parcels Acquisition:	**$**	**1,514,780,000**
Grand Total:	**$**	**1,888,112,009**

FARR WEST
ENGINEERING

City of Reno - West Wash Drainage Improvements
Alternate 3D - Remediate Only West Wash Dam
Engineer's Opinion of Probable Construction Costs (Preliminary)

Estimate by:	Savannah Hughes, E.I.
Project No.	1930
QC Check by:	Keith Karpstein, P.E.
Date:	03/17/22

BID SCHEDULE - BASE BID

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization (not to exceed 5% of base bid)	1	LS	$ 570,000	$ 570,000
2	Temporary Erosion and Sediment Control	1	LS	$ 280,029	$ 280,029
3	Protection or Replacement of "NW Reno Flood Basin Labyrinth"	1	LS	$ 6,000	$ 6,000
4	Geotechnical Testing and Inspection Services	1	LS	$ 280,029	$ 280,029
5	Clearing, Grubbing, and Stripping	21	AC	$ 13,000	$ 277,092
6	Revegetation and Seeding	22	AC	$ 5,500	$ 118,711
7	Excavation and Disposal	1	LS	$ 5,665,000	$ 5,665,000
8	On-Site Cut/Fill	1	LS	$ 350,000	$ 350,000
9	Slope Stabilization	233,351	SF	$ 10	$ 2,333,510
10	Geosynthetic Stabilization	51,434	SF	$ 25	$ 1,285,856
12	Existing Utilities	1	LS	$ 525,000	$ 525,000
13	Miscellaneous Improvements	1	LS	$ 100,000	$ 100,000

Construction Subtotal:	**$**	**11,791,227**
10% Engineering:	**$**	**1,179,123**
10% Construction Management:	**$**	**1,179,123**
10% Effective Inflation	**$**	**1,179,123**
30% Contingency:	**$**	**3,537,368**
Base Bid Total:	**$**	**18,865,963**

FARR WEST
ENGINEERING

City of Reno - West Wash Drainage Improvements
Alternate 3D - Remediate Only West Wash Dam
Engineer's Opinion of Probable Construction Costs (Preliminary)

Estimate by:	Kristi Thompson
Project No.	1930
QC Check by:	Keith Karpstein, P.E.
Date:	03/17/22

BID SCHEDULE - BASE BID

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization (not to exceed 5% of base bid)	1	LS	$ 600,000.00	$ 600,000
2	Temporary Erosion and Sediment Control	1000	DY	$ 1,000.00	$ 1,000,000
3	Protection or Replacement of "NW Reno Flood Basin Labyrinth"	1	LS	$ 6,000	$ 6,000
4	Geotechnical Testing and Inspection Services	133	DY	$ 1,750	$ 233,000
5	Clearing, Grubbing, and Stripping	21	AC	$ 13,000	$ 277,092
6	Revegetation and Seeding	22	AC	$ 5,500	$ 118,711
7	Excavation and Disposal	1	LS	$ 5,665,000	$ 5,665,000
8	On-Site Cut/Fill	1	LS	$ 350,000	$ 350,000
9	Slope Stabilization	233,351	SF	$ 10	$ 2,334,000
10	Geosynthetic Stabilization	51,434	SF	$ 25	$ 1,290,000
12	Existing Utilities	1	LS	$ 525,000	$ 525,000
13	Miscellaneous Improvements	1	LS	$ 100,000	$ 100,000

Construction Subtotal:	**$**	**12,498,802**
10% Engineering:	**$**	**1,249,880**
10% Construction Management:	**$**	**1,249,880**
10% Effective Inflation	**$**	**1,249,880**
30% Contingency:	**$**	**3,749,641**
Base Bid Total:	**$**	**19,998,084**

FARR WEST
ENGINEERING

City of Reno - West Wash Drainage Improvements
Alternate 4- Upstream Solutions
Engineer's Opinion of Probable Construction Costs (Preliminary)

Estimate by:	Kristi Thompson
Project No.	1930
QC Check by:	Keith Karpstein, P.E.
Date:	03/17/22

BID SCHEDULE - BASE BID

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization (not to exceed 5% of base bid)	1	LS	$ 60,000	$ 60,000
2	Temporary Erosion and Sediment Control	1	LS	$ 36,739	$ 36,739
3	Geotechnical Testing and Inspection Services	1	LS	$ 36,739	$ 36,739
4	Outlet Pipe	325	LF	$ 1,000	$ 325,000
5	Outlet Structure	2	EA	$ 15,000	$ 30,000
6	Revegetation	1.45	AC	$ 5,500	$ 7,968
7	Site Grading	41863	CY	$ 25	$ 1,046,586

Construction Subtotal:	**$**	**1,543,032**
25% Engineering Design and Permitting:	**$**	**385,758**
15% Construction Management:	**$**	**231,455**
10% Effective Inflation	**$**	**154,303**
50% Contingency:	**$**	**771,516**
Base Bid Total:	**$**	**3,086,064**
Property Acquisition:	**$**	**2,418,825**
Grand Total:	**$**	**5,504,889**

FARR WEST
ENGINEERING

City of Reno - West Wash Drainage Improvements
Alternate 5A - Remove East and West Wash Dams
Engineer's Opinion of Probable Construction Costs (Preliminary)

Estimate by:	Savannah Hughes, E.I.
Project No.	1930
QC Check by:	Keith Karpstein, P.E.
Date:	02/17/22

BID SCHEDULE - BASE BID

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization (not to exceed 5% of base bid)	1	LS	$ 200,000	$ 200,000
2	Temporary Erosion and Sediment Control	340	DY	$ 1,000	$ 340,000
3	Protection or Replacement of "NW Reno Flood Basin Labyrinth"	1	LS	$ 6,000	$ 6,000
4	Geotechnical Testing and Inspection Services	36	DY	$ 1,750	$ 63,000
5	Revegetation and Seeding	12	AC	$ 5,500	$ 66,000
6	Excavation and Disposal	1	LS	$ 2,160,000	$ 2,160,000
7	On-Site Cut/Fill	1	LS	$ 520,000	$ 520,000
8	East Wash Dam 4'x3'x28' Intake Structure Removal	1	LS	$ 10,000	$ 10,000
9	West Wash Dam Principal Spillway Inlet Removal	1	LS	$ 10,000	$ 10,000
10	West Wash Dam Sediment Pool Drain Removal	1	LS	$ 2,000	$ 2,000
11	West Wash Dam Spillway Energy Dissipator Outlet Removal	1	LS	$ 5,000	$ 5,000
12	PCC Chute Removal	1	LS	$ 40,000	$ 40,000
13	East Wash Dam 36" RC Pipe Abandonment in Place	173	LF	$ 75	$ 12,975
14	West Wash Dam 24" RC Pipe Abandon in Place	300	LF	$ 50	$ 15,000
15	West Wash Dam 18" RC Pipe Abandon in Place	60	LF	$ 40	$ 2,400

Construction Subtotal:	**$**	**3,452,375**
10% Engineering:	**$**	**345,238**
10% Construction Management:	**$**	**345,238**
10% Effective Inflation	**$**	**345,238**
30% Contingency:	**$**	**1,035,713**
Base Bid Total:	**$**	**5,530,000**

FARR WEST
ENGINEERING

City of Reno - West Wash Drainage Improvements
Alternate 5B - Remove only East Wash Dam
Engineer's Opinion of Probable Construction Costs (Preliminary)

Estimate by:	Kristi Thompson
Project No.	1930
QC Check by:	Keith Karpstein, P.E.
Date:	02/17/22

BID SCHEDULE - BASE BID

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization (not to exceed 5% of base bid)	1	LS	$ 100,000	$ 100,000
2	Temporary Erosion and Sediment Control	1	LS	$ 9,189	$ 9,189
3	Geotechnical Testing and Inspection Services	1	LS	$ 9,189	$ 10,000
4	Revegetation and Seeding	5	AC	$ 5,500	$ 27,516
5	Excavation and Disposal	1	LS	$ 160,915	$ 160,915
6	On-Site Cut/Fill	1	LS	$ 111,354	$ 111,354
7	East Wash Dam 4'x3'x28' Intake Structure Removal	1	LS	$ 10,000	$ 10,000
8	PCC Chute Removal	1	LS	$ 40,000	$ 40,000
9	East Wash Dam 36" RC Pipe Abandonment in Place	173	LF	$ 75	$ 12,975

Construction Subtotal:	**$**	**481,949**
10% Engineering:	**$**	**48,195**
10% Construction Management:	**$**	**48,195**
10% Effective Inflation	**$**	**48,195**
30% Contingency:	**$**	**144,585**
Base Bid Total:	**$**	**780,000**

FARR WEST
ENGINEERING

City of Reno - West Wash Drainage Improvements
Alternate 5C - Remove Only West Wash Dam
Engineer's Opinion of Probable Construction Costs (Preliminary)

Estimate by:	Kristi Thompson
Project No.	1930
QC Check by:	Keith Karpstein, P.E.
Date:	02/17/22

BID SCHEDULE - BASE BID

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization (not to exceed 5% of base bid)	1	LS	$ 200,000	$ 200,000
2	Temporary Erosion and Sediment Control	1	LS	$ 69,571	$ 69,571
3	Protection or Replacement of "NW Reno Flood Basin Labyrinth"	1	LS	$ 6,000	$ 6,000
4	Geotechnical Testing and Inspection Services	1	LS	$ 69,571	$ 69,571
5	Revegetation and Seeding	7	AC	$ 5,500	$ 38,436
6	Excavation and Disposal	1	LS	$ 1,999,481	$ 1,999,481
7	On-Site Cut/Fill	1	LS	$ 408,550	$ 408,550
8	West Wash Dam Principal Spillway Inlet Removal	1	LS	$ 10,000	$ 10,000
9	West Wash Dam Sediment Pool Drain Removal	1	LS	$ 2,000	$ 2,000
10	West Wash Dam Spillway Energy Dissipator Outlet Removal	1	LS	$ 5,000	$ 5,000
11	West Wash Dam 24" RC Pipe Abandon in Place	300	LF	$ 50	$ 15,000
12	West Wash Dam 18" RC Pipe Abandon in Place	60	LF	$ 40	$ 2,400

Construction Subtotal:	**$**	**2,826,010**
10% Engineering:	**$**	**282,601**
10% Construction Management:	**$**	**282,601**
10% Effective Inflation	**$**	**282,601**
30% Contingency:	**$**	**847,803**
Base Bid Total:	**$**	**4,530,000**

FARR WEST
ENGINEERING

City of Reno - West Wash Drainage Improvements
Alternate 6A - Remove East and West Wash Dams with Downstream Improvements
Engineer's Opinion of Probable Construction Costs (Preliminary)

Estimate by:	Eric Kao
Project No.	1930
QC Check by:	Keith Karpstein, P.E.
Date:	03/17/22

BID SCHEDULE - BASE BID

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization	1	LS	$1,800,000	$1,800,000
2	Temporary Erosion and Sediment Control	1	LS	$870,410	$870,410
3	Temporary Traffic Control	1	LS	$870,410	$870,410
4	Protection or Replacement of "NW Reno Flood Basin Labyrinth"	1	LS	$6,000	$6,000
5	Geotechnical Testing and Inspection Services	1	LS	$870,410	$870,410
6	Revegetation and Seeding	12	AC	$5,500	$66,000
7	Excavation and Disposal	1	LS	$2,160,000	$2,160,000
8	On-Site Cut/Fill	1	LS	$520,000	$520,000
9	East Wash Dam 4'x3'x28' Intake Structure Removal	1	LS	$10,000	$10,000
10	West Wash Dam Principal Spillway Inlet Removal	1	LS	$10,000	$10,000
11	West Wash Dam Sediment Pool Drain Removal	1	LS	$2,000	$2,000
12	West Wash Dam Spillway Energy Dissipator Outlet Removal	1	LS	$5,000	$5,000
13	PCC Chute Removal	1	LS	$40,000	$40,000
14	East Wash Dam 36" RC Pipe Abandonment in Place	173	LF	$75	$12,975
15	West Wash Dam 24" RC Pipe Abandon in Place	300	LF	$50	$15,000
16	West Wash Dam 18" RC Pipe Abandon in Place	60	LF	$40	$2,400
17	West Wash Trapezoidal Channel	5,159	LF	$350	$1,806,435
18	East Wash Trapezoidal Channel	6,071	LF	$366	$2,223,607
19	Combined Trapezoidal Channel	5,550	LF	$466	$2,587,761
20	10'x8' Box Culvert Crossing on Local Roads	10	EA	$351,453	$3,514,528
21	12'x9' Box Culvert Crossing on Local Roads	4	EA	$678,464	$2,713,854
22	Culvert Crossing on Collector Roads	5	EA	$995,545	$4,977,725
23	Culvert Crossing on Arterial Roads	3	EA	$1,659,091	$4,977,273
24	Culvert Crossing on Railroad	1	EA	$1,226,755	$1,226,755
25	Culvert Crossing on I-80 Highway	1	EA	$4,325,330	$4,325,330
26	Property Demolition	41.5	AC	$43,560	$1,807,740

Construction Subtotal:		**$37,421,612**
10% Engineering:		**$3,742,161**
10% Construction Management:		**$3,742,161**
10% Effective Inflation:		**$3,742,161**
30% Contingency:		**$11,226,484**
Base Bid Total:		**$59,874,579**
Property Acquisition:	**$**	**103,899,861**
Grand Total:	**$**	**163,774,440**

FARR WEST
ENGINEERING

City of Reno - West Wash Drainage Improvements
Alternate 6B - Remove East Wash Dams with Downstream Improvements from East Wash Dam
Engineer's Opinion of Probable Construction Costs (Preliminary)

Estimate by:	Kristi Thompson
Project No.	1930
QC Check by:	Keith Karpstein, P.E.
Date:	03/17/22

BID SCHEDULE - BASE BID

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization	1	LS	$1,500,000	$1,500,000
2	Temporary Erosion and Sediment Control	1	LS	$721,546	$721,546
3	Temporary Traffic Control	1	LS	$721,546	$721,546
4	Geotechnical Testing and Inspection Services	1	LS	$721,546	$721,546
5	Revegetation and Seeding	5	AC	$5,500	$27,516
6	Excavation and Disposal	1	LS	$160,915	$160,915
7	On-Site Cut/Fill	1	LS	$111,354	$111,354
8	East Wash Dam 4'x3'x28' Intake Structure Removal	1	LS	$10,000	$10,000
9	PCC Chute Removal	1	LS	$40,000	$40,000
10	East Wash Dam 36" RC Pipe Abandonment in Place	173	LF	$75	$12,975
11	East Wash Trapezoidal Channel	6,071	LF	$366	$2,223,607
12	Combined Trapezoidal Channel	5,550	LF	$466	$2,587,761
13	10'x8' Box Culvert Crossing on Local Roads	8	EA	$351,453	$2,811,622
14	12'x9' Box Culvert Crossing on Local Roads	4	EA	$678,464	$2,713,854
15	Culvert Crossing on Collector Roads	5	EA	$995,545	$4,977,725
16	Culvert Crossing on Arterial Roads	3	EA	$1,659,091	$4,977,273
17	Culvert Crossing on Railroad	1	EA	$1,226,755	$1,226,755
18	Culvert Crossing on I-80 Highway	1	EA	$4,325,330	$4,325,330
19	Property Demolition	31.0	AC	$43,560	$1,350,360

Construction Subtotal:		**$31,221,684**
10% Engineering:		**$3,122,168**
10% Construction Management:		**$3,122,168**
10% Effective Inflation:		**$3,122,168**
30% Contingency:		**$9,366,505**
Base Bid Total:		**$49,954,695**
Property Acquisition:	**$**	**71,116,426**
Grand Total:	**$**	**121,071,120**

FARR WEST
ENGINEERING

City of Reno - West Wash Drainage Improvements
Alternate 6C - Remove West Wash Dam with Downstream Improvements from West Wash Dam
Engineer's Opinion of Probable Construction Costs (Preliminary)

Estimate by:	Kristi Thompson
Project No.	1930
QC Check by:	Keith Karpstein, P.E.
Date:	03/17/22

BID SCHEDULE - BASE BID

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization	1	LS	$1,500,000	$1,500,000
2	Temporary Erosion and Sediment Control	1	LS	$712,783	$712,783
3	Temporary Traffic Control	1	LS	$712,783	$712,783
4	Protection or Replacement of "NW Reno Flood Basin Labyrinth"	1	LS	$6,000	$6,000
5	Geotechnical Testing and Inspection Services	1	LS	$712,783	$712,783
6	Revegetation and Seeding	7	AC	$5,500	$38,436
7	Excavation and Disposal	1	LS	$1,999,481	$1,999,481
8	On-Site Cut/Fill	1	LS	$408,550	$408,550
9	West Wash Dam Principal Spillway Inlet Removal	1	LS	$10,000	$10,000
10	West Wash Dam Sediment Pool Drain Removal	1	LS	$2,000	$2,000
11	West Wash Dam Spillway Energy Dissipator Outlet Removal	1	LS	$5,000	$5,000
12	West Wash Dam 24" RC Pipe Abandon in Place	300	LF	$50	$15,000
13	West Wash Dam 18" RC Pipe Abandon in Place	60	LF	$40	$2,400
14	West Wash Trapezoidal Channel	5,159	LF	$350	$1,806,435
15	Combined Trapezoidal Channel	5,550	LF	$466	$2,587,761
16	10'x8' Box Culvert Crossing on Local Roads	2	EA	$351,453	$702,906
17	12'x9' Box Culvert Crossing on Local Roads	4	EA	$678,464	$2,713,854
18	Culvert Crossing on Collector Roads	5	EA	$995,545	$4,977,725
19	Culvert Crossing on Arterial Roads	3	EA	$1,659,091	$4,977,273
20	Culvert Crossing on Railroad	1	EA	$1,226,755	$1,226,755
21	Culvert Crossing on I-80 Highway	1	EA	$4,325,330	$4,325,330
22	Property Demolition	27.8	AC	$43,560	$1,210,968

Construction Subtotal:		**$30,654,223**
10% Engineering:		**$3,065,422**
10% Construction Management:		**$3,065,422**
10% Effective Inflation:		**$3,065,422**
30% Contingency:		**$9,196,267**
Base Bid Total:		**$49,046,757**
Property Acquisition:	**$**	**81,954,011**
Grand Total:	**$**	**131,000,768**

City of Reno

Technical Memorandum #2

Watershed Plan-ED
Peavine Mountain Watershed
West Wash Dam Rehabilitation

March 2022

OWNER:
City of Reno
1 East First Street
Reno, NV 89501

LEAD FEDERAL AGENCY:
USDA-NRCS
1365 Corporate Blvd
Reno, NV 89502

ENGINEER:

Farr West Engineering
5510 Longley Lane
Reno, NV 89511
(775) 851-4788
(775) 851-0766 Fax

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1.0 INTRODUCTION

This is the second of two technical memoranda (TM) that discuss the hydrology, hydraulics, and sediment (HH&S) analysis associated with the Peavine Mountain Watershed East Wash Diversion and West Wash Dam analysis. The first TM focused on data collection and the selection of key boundary conditions for the HH&S analysis, as well as discussing dam design criteria governed by local, state, and federal ordinances. This TM will discuss the full HH&S analysis. The efforts described include modeling the dams using the NRCS SITES program, performing a sediment analysis, creating inundation maps for potential dam breaches and activation of auxiliary spillways, and analyzing the effects of retained water on existing storm drain infrastructure. Note that all elevations referenced in this TM utilize the North American Vertical Datum of 1988 (NAVD 88).

2.0 EXISTING INFRASTRUCTURE

The East Wash and West Wash Dams provide stormwater retention and attenuation for the Peavine Watershed. The two dams work in conjunction to protect downstream developments and convey storm flows into the City of Reno storm drain system. Stormwater is routed from the north into the East Wash Dam through a culvert under N McCarran Boulevard. The East Wash principal spillway has two separate diversion paths for flows. The first stage of principal flow is conveyed from the upstream toe of East Wash Dam into the City storm drain system by direct connection under Keystone Avenue. The second stage of flow is diverted into the West Wash Dam basin by an open concrete channel located to the west of East Wash Dam. The auxiliary spillway of the East Wash Dam consists of an earthen berm that is located to the west East Wash Dam. Once the water surface elevation reaches 4,858 ft., the west berm will overtop and push flows into the West Wash basin.

The West Wash Dam receives storm flows from a culvert to the north under N McCarran Boulevard, from several storm drain outfalls from the adjoining neighborhoods, and from flows diverted from East Wash Dam in larger storm events. The West Wash Dam has a small sediment drain for extremely low flows that is connected to the principal spillway. The principal spillway outfalls to an open drainage ditch just below the Highland Ditch. The downstream end of the ditch has a storm drain inlet connected to the City storm drain system. The West Wash Auxiliary Spillway is an open channel that diverts flows around the western edge of the dam and onto the adjacent streets when the water surface elevation reaches 4,784.9 ft. The existing infrastructure of East Wash and West Wash Dams is illustrated in Figure 1, where all relevant elevations and topographic contours are shown.

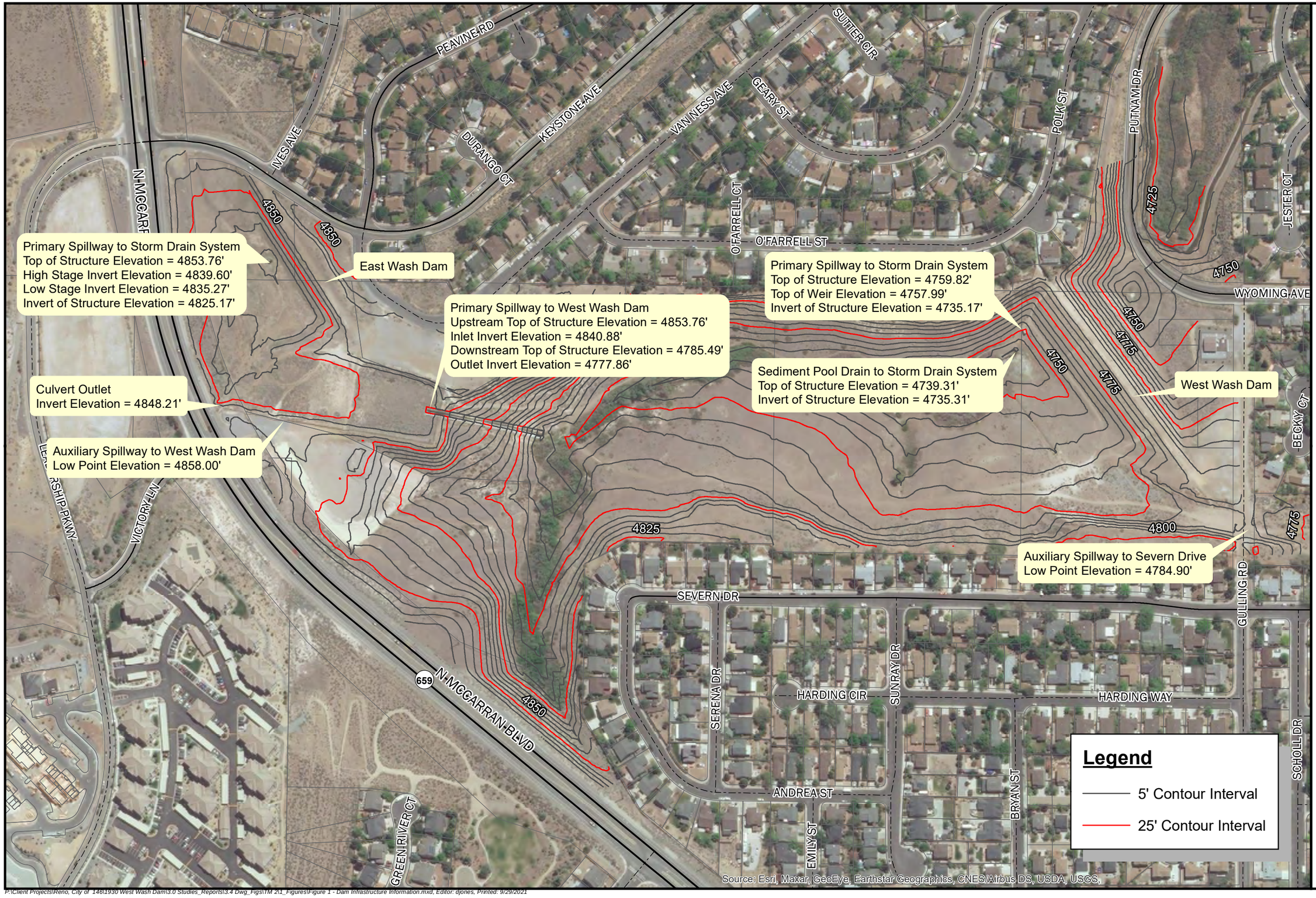

Figure 1: Existing Infrastructure within East Wash and West Wash Dams

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Reno, NV 89511
(775) 851-4788
www.farrwestengineering.com

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

P:\Client Projects\Reno, City of 1461\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\1_Figures\Figure 1 - Dam Infrastructure Information.mxd, Editor: djones, Printed: 9/29/2021

3.0 SEDIMENTATION

Sediment deposition was analyzed in both the East Wash and West Wash dams. However, a full geological/geotechnical investigation into the area was not performed. Rather, the stage-storage curves for the respective dams were determined and then compared to the original design stage-storage curves. Records of historical sediment removal projects were also brought into the analysis to determine the full volume of sediment deposited over the lifetime of the two dams. From this analysis, a historic sediment yield rate was determined, as well as a future sediment yield. A Sediment Storage Rationale was chosen, and future sediment projections made.

The drainage basins into the East Wash and West Wash dams are made up of almost entirely residential neighborhoods and public use lands. There is very limited to no commercial use in these basins, and zero industrial land usage. The public use lands reside on Peavine Mountain and see regular use through recreational trails. All residences within the basins are connected to the City of Reno sanitary sewer system and do not use septic tanks. Because of the land makeup of the basins, there is a low potential for sediment contamination, and it is not recommended to perform chemical testing on the sediment.

Stage-storage curves for the existing dams were calculated using digital surfaces created by the survey effort described in TM 1. The surfaces were created in AutoCAD Civil 3D and are a combination of on-site survey, which has an overall accuracy within one tenth of a foot, and Lidar data with a resolution of two feet. A "Stage Storage Report" was created for each dam. The original design stage-storage curves were created by digitizing the original design drawings for both dams in Civil 3D and a "Stage Storage Report" was created for each original dam design. The curves for each dam were plotted, and volumes compared to determine sediment deposition over the lifetime of the dams. The East Wash curves can be seen in Figure 2 and the West Wash curves can be seen in Figure 3. To provide a more accurate comparison between the design curve and the existing curve, the East Wash original site design had to be modified to account for the construction of N McCarran Blvd during the 1970's. The portion of the original design basin that covered the area traversed by N McCarran Blvd was removed and the stage-storage re-calculated. The modified stage-storage curve can also be found in Figure 2.

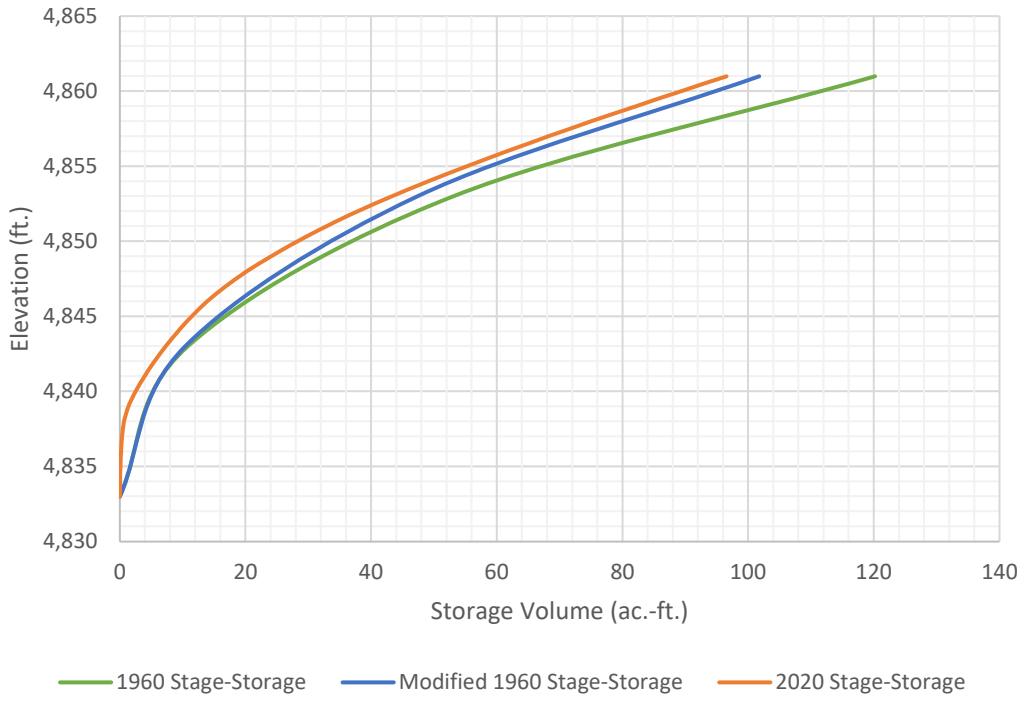

Figure 2: East Wash Dam Stage-Storage Curve Comparison

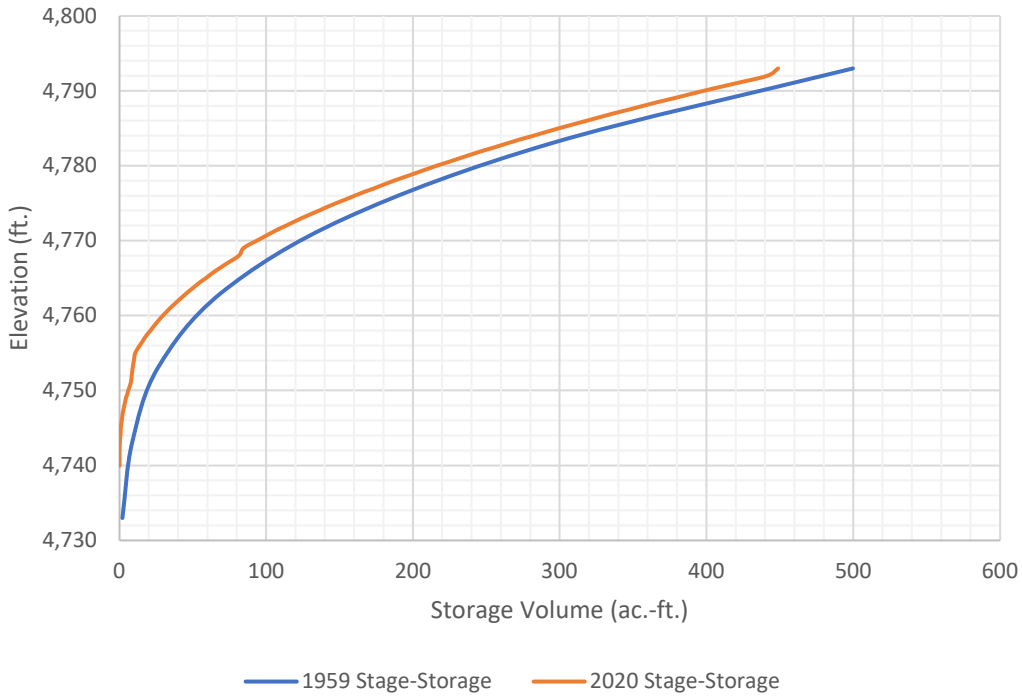

Figure 3: West Wash Dam Stage-Storage Curve Comparison

Historic sediment yields for East Wash and West Wash were difficult to determine because no sediment studies, suspended-load records, or measured sediment accumulation records were provided for this study. Similarly, measured sediment yield rates of nearby watersheds could not be found. A more rudimentary approach was taken to gain a better understanding of the historic sediment yield for both dams. For this process, the calculated stage-storage curves were compared, and the total volume difference was divided by the lifetime of the dam thus far (60 years for East Wash, and 61 years for West Wash). This result was then modified for the East Wash basin due to a single record of sediment removal in 2017, which was provided by the City of Reno. The figure provided shows that 1,150 cubic yards (0.71 acre-feet) of sediment was removed, as shown in Appendix A. This method allows us to calculate the bedload portion of the sediment yield, but completely ignores all pass-through sediment. The East Wash Dam saw an average sediment deposition rate of 0.098 acre-feet per year, with West Wash at 0.836 acre-feet per year. These values were compared back to the sediment yields calculated in the Watershed Work Plan – Peavine Mountain Watershed from 1958 for reasonableness (City of Reno, 1958). This document acts as the basis of design for both dams and calculated sediment yields of 1.5- and 0.1-acre feet per year for East Wash and West Wash respectively (City of Reno, 1958). The sediment yield for West Wash shown in the Watershed Work Plan did not take into account any sediment passed through the East Wash diversion dam, which explains the large difference in sediment deposition rates calculated.

More data is required to create a more complete sediment yield value for both dams. It is recommended that a Sediment Storage Rationale of 50 years be selected in accordance with NWPM 505.35C and NWPH 605.35D (USDA NRCS, 2009) (USDA NRCS, 2014a). The minimum lifespan is recommended with the idea that sediment deposition, accumulation, and suspended sediment loads can be closely monitored over a short period of time and a more accurate sediment yield calculated.

With this lifespan recommended, stage-storage curves for both dams were projected for the year 2071 using the historic sediment deposition rates calculated. The projected curves can be found in Figure 4 and Figure 5 below.

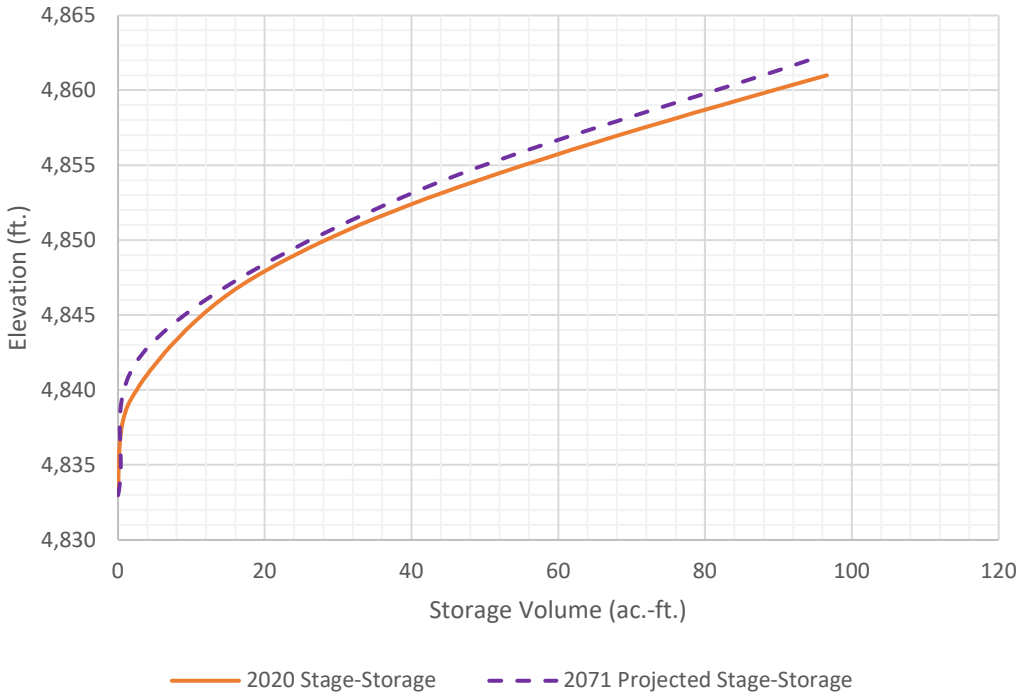

Figure 4: East Wash Dam Projected Stage Storage Curve

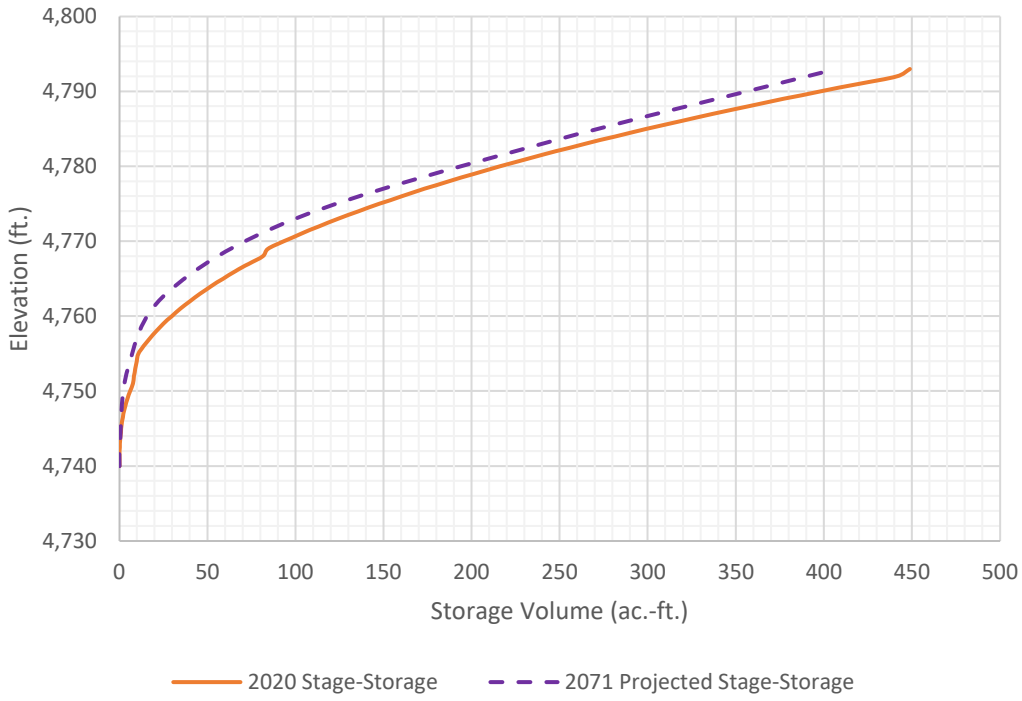

Figure 5: West Wash Dam Projected Stage Storage Curve

4.0 SITES MODELING

The East Wash and West Wash dams were analyzed using SITES, a dam analysis software developed by NRCS. Using boundary conditions discussed in TM 1, a series of models were setup to determine the capacities of the primary and auxiliary spillways, create primary spillway and freeboard design hydrographs, and determine inflow and outflow hydrographs for each storm event discussed in TM 1. A preliminary condition assessment of the West Wash primary spillway was also performed by reviewing CCTV footage of the spillway provided by City of Reno.

4.1 MODEL SETUP

Parameters developed and discussed in TM 1 were included as input in the SITES model, including storm event rainfall totals, rainfall distributions, and the Stage-Storage and Stage-Discharge rating curves for the culvert at the north side of East Wash. The Stage-Storage and Stage-Discharge rating curves for the north culvert were taken into account for flow coming into the East Wash Dam impoundment area in the relevant SITES models.

Curve numbers were developed for each subbasin in the East Wash and West Wash drainage basins. Land cover data from the USDA NRCS Geospatial Data Gateway was used to determine land cover type and soil composition of each subbasin (USDA NRCS, 2021). Curve numbers for each land cover and soil type were then determined using Table 702 of the Truckee Meadows Regional Drainage Manual (TMRDM) (City of Reno; City of Sparks; Washoe County, 2009). If a subbasin contained two or more soil types that had different curve numbers, a weighted composite curve number was calculated. For urbanized areas within the East and Wash drainage basins, a composite curve number was calculated by taking the pervious curve number and determining the percent impervious area of the subbasin, then using Figure 702 of the TMRDM to determine the curve number that takes into account impervious area (City of Reno; City of Sparks; Washoe County, 2009).

Lag time was then calculated for each of the subbasins within the East and West Wash drainage basins. Since the project watershed total area was greater than 100 acres, the SCS Unit Hydrograph Method was utilized to determine storm runoff, per Section 304 of the TMRDM (City of Reno; City of Sparks; Washoe County, 2009). The SCS Unit Hydrograph Method is described in detail in Section 705 of the TMRDM (City of Reno; City of Sparks; Washoe County, 2009). Lag time was calculated using Equations 709 and 710 of the TMRDM (City of Reno; City of Sparks; Washoe County, 2009). Equation 709 was used for small subbasins, defined as having less than one square mile of area and a basin slope of less than ten percent (City of Reno; City of Sparks; Washoe County, 2009). Equation 710 was used for large subbasins, defined as having greater than one square mile of area and a basin slope greater than or equal to ten percent (City of Reno; City of Sparks; Washoe County, 2009). Two-foot resolution lidar data flown in 2017 by USGS of the East and West Wash drainage basins was uploaded to the Aquaveo WMS software, which runs off of a HEC-HMS based engine, for analysis of each subbasin (Aquaveo, 2020). Aquaveo WMS accurately calculated specific equation inputs, such as average slopes and distances of each subbasin (Aquaveo, 2020). Figure 6 illustrates all East Wash and West Wash subbasins within the main drainage basins, along with the curve number, time of concentration, and lag time for each subbasin.

After subbasin characteristics were determined, the SITES model was built (USDA NRCS, 2014b). Five separate models were built with 13 rainfall events within each model. The five models include East Wash only (due to the fact that some flow is diverted to West Wash, but the rest goes into the storm drain system), West Wash only (using the East Wash hydrographs from the East Wash only model), West Wash Dam non-existent (using hydrographs from East Wash developed in the East Wash only model), East Wash Dam non-existent, and West Wash Dam non-existent with no flow from East Wash. The 13 rainfall events include the following storm events: 10-year, 25-year, 50-year, 100-year, 200-year, 500-year, 1000-year, ½ of General PMP, ¾ of General PMP, General PMP, ½ of Local PMP, ¾ of Local PMP, Local PMP. Watershed properties for each drainage area were then added to the model, including the total

drainage area, time of concentration, the curve number for each subbasin, total storm rainfall amounts in inches, and the appropriate rainfall distributions (developed in TM 1). For this report, the rainfall distributions discussed in TM 1 were plotted as graphs. An example of the 1000-year rainfall distribution curve used in the SITES model is shown in Figure 7. All rainfall distribution curves used in the SITES model for each sub-basin can be found in Appendix B.

The East Wash Dam drainage area contains six subbasins, five of which first flow into a smaller storage area to the north of N McCarran Blvd before flowing through a culvert underneath N McCarran Blvd into East Wash, and one of which contributes directly to the East Wash Dam impoundment. The stage-storage curve for the East Wash Dam impoundment was calculated using topographic survey points in conjunction with a stage-storage tool in the 2020 version of AutoCAD Civil 3D (Autodesk, 2021).

The West Wash Dam drainage area contains six subbasins, five of which contribute overland and storm drain flow into the West Wash Dam impoundment area, and one of which directly contributes to the West Wash Dam impoundment area. Flows from the East Wash Dam also contribute to the West Wash Dam via the concrete chute spillway at the north end of the West Wash Dam impoundment area. The stage-storage curve for the West Wash Dam impoundment was calculated using topographic survey points in conjunction with a stage-storage tool in the 2020 version of AutoCAD Civil 3D (Autodesk, 2021).

Figure 6: Delineated Subbasins

20 Years!
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Subbasin ID	CN	TOC (hr)	T_{lag} (hr)
EW-1	84.8	0.402	0.70
EW-2	85.0	0.586	0.35
EW-3	85.0	0.837	0.50
EW-4	85.0	0.261	0.58
EW-5	85.0	0.351	0.67
EW-6	85.0	0.299	0.18
WW-1	85.0	0.353	0.69
WW-2	85.0	0.231	0.50
WW-3	85.0	0.284	0.61
WW-4	85.0	0.341	0.67
WW-5	92.0	0.645	0.39
WW-6	92.0	0.281	0.17

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS,

N

1 " = 1,500 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\1_Figures\Figure 5 - Delineated Subbasins.mxd, Editor: djones, Printed: 9/29/2021

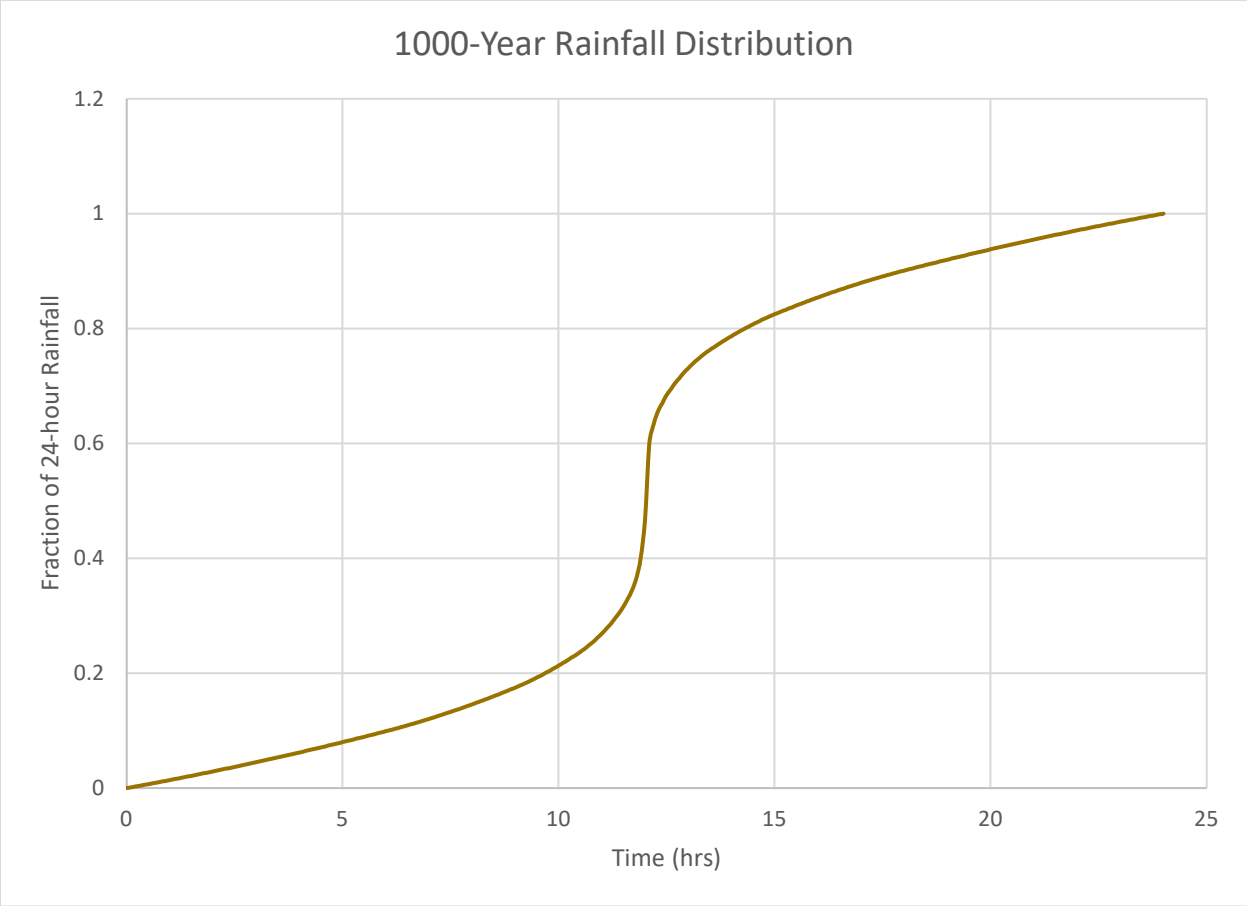

Figure 7: Example Storm Distribution Curve

4.1.1 Model 1: East Wash Dam Standalone

In Model 1, hydrographs were only developed for East Wash Dam. In SITES, results can only be generated for the most downstream element in the model. Since West Wash Dam is downstream of East Wash Dam, East Wash had to be modeled in a standalone scenario so that outflow hydrographs could be obtained for East Wash Dam. Therefore, West Wash Dam was not considered as a part of this model.

Model 1 was created to calculate inflow hydrographs into the East Wash Dam and then calculate outflow hydrographs for the Primary Spillway and Auxiliary Spillway of East Wash Dam. Primary spillway hydrographs, stability design hydrographs, and freeboard hydrographs were also generated. The primary spillway was modeled as a combined stage-discharge rating table that accounted for both the piped spillway and concrete channel spillway. Initially the model was setup with the piped outlet as the primary spillway and the concrete channel outlet as the auxiliary spillway to obtain separate rating tables. Inputs for both spillways included initial elevations, weir lengths, and channel properties that were obtained from topographical survey and as-built drawings. Once the rating tables were developed in SITES for the piped outlet and concrete channel outlet separately, the rating tables were pulled into Excel and a trendline was computed for each rating table. A combined stage-discharge rating table was then estimated that accounted for both Primary Spillways. Rating tables for the piped outlet, concrete channel outlet, and the combined rating tables can be found in Appendix C.

The final iteration of Model 1 calculated hydrographs based on the two Primary Spillways that were represented by one stage-discharge curve and Auxiliary Spillway as the west berm that overflows into West Wash.

4.1.2 Model 2: West Wash Dam Standalone

In Model 2, inflows to the West Wash Dam impoundment area were accounted for from the East Wash Primary Spillway concrete channel, the East Wash Auxiliary Spillway and West Wash's drainage basin. Outflow hydrographs from the East Wash Dam Primary Spillway concrete channel and Auxiliary Spillway calculated in Model 1 were imported and routed into West Wash using a time-discharge table. Inflow hydrographs from the West Wash drainage basin and outflow hydrographs for the Primary Spillway and Auxiliary Spillway of West Wash Dam were then calculated in SITES. Primary spillway hydrographs, stability design hydrographs, and freeboard hydrographs were also generated. The Primary Spillway of West Wash Dam was modeled as a single stage inlet with a circular conduit. Inputs, such as the elevations and weir lengths, were obtained from topographical survey and as-built drawings. The Auxiliary Spillway for West Wash Dam was modeled as the earthen overflow bank on the west side of the dam that routes water onto Severn Drive.

4.1.3 Model 3: West Wash Dam Non-existent

In Model 3, inflows to West Wash were accounted for from the East Wash Primary Spillway concrete channel, the East Wash Auxiliary Spillway and West Wash's drainage basin. Outflow hydrographs from the East Wash Dam Primary Spillway concrete channel and Auxiliary Spillway calculated by Model 1 were imported and routed into West Wash using a time-discharge table. Inflow hydrographs from the West Wash drainage basin were calculated and routed through West Wash to calculate the outflow hydrographs as if West Wash Dam did not exist. Since there was no dam in place to hinder flow for this model, the outflow hydrograph was equivalent to the summation of the East Wash Primary and Auxiliary Spillway and West Wash drainage basin inflow hydrographs.

4.1.4 Model 4: East Wash Dam Non-existent

In Model 4, inflow and outflow hydrographs were calculated for East Wash assuming that the dam was non-existent. Since there was no dam in place to hinder flow for this model, the inflow and outflow hydrographs were the same. It was assumed that all inflow to East Wash would be routed through the historic East Wash alignment and that no flows would be diverted into West Wash.

4.1.5 Model 5: West Wash Dam Non-existent Standalone

In Model 5, inflow and outflow hydrographs were calculated for West Wash assuming that the dam was non-existent. Since there was no dam in place to hinder flow for this model, the inflow and outflow hydrographs were the same. This model assumes that East Wash was also non-existent, and since it was assumed that all flows into East Wash were routed down the historic East Wash alignment in Model 4, no flows from East Wash into West Wash were considered in Model 5.

4.1.6 Models Summary

Due to the way that SITES operates, the three typical scenarios considered in this report (East Wash and West Wash Dams In-Place, West Wash Dam Non-Existent and East Wash In-Place, and East Wash and West Wash Dams Non-Existent) were broken up into five models within SITES (listed in Sections 4.1.1-4.1.5) to obtain the necessary information. However, it is important to note that Models 1 and 2 represent the East Wash and West Wash Dams In-Place scenario, Models 1 and 3 represent the West Wash Dam Non-Existent and East Wash In-Place scenario, and Models 4 and 5 represent the East Wash and West Wash Dams Non-Existent scenario. Inflow and outflow hydrographs will be explained based on the three main scenarios, instead of how it was modeled in SITES (having five distinct models).

4.2 INFLOW AND OUTFLOW HYDROGRAPHS

Hydrographs for inflow and outflow into the East Wash and West Wash dams were created using SITES across the listed storm events for the three different scenarios. The scenarios include the East Wash and West Wash Dams In-Place, West Wash Dam Non-Existent and East Wash Dam In-Place, and East Wash and West Wash Dams Non-Existent. The following sections summarize the results for each scenario. Once peak flows were established in SITES, they were compared to peak flows calculated using the USGS Peak-Flow Regression Equations.

Currently, both dams operate as designed; retaining stormwater and conveying flows through a primary spillway attached to the City of Reno storm drain system. However, the East Wash Dam basin also diverts flow into the West Wash Dam basin via a concrete channel on the southwest side of the dam. This channel, in addition to the primary connection to the storm drain system along Keystone Ave, is also considered a part of the primary spillway. The western berm of the East Wash dam is considered the auxiliary spillway, as any overtopping will simply flow into the West Wash basin. The West Wash dam has a primary spillway that conveys flow to an open channel that feeds the storm drain system along King Edward Dr and an auxiliary spillway that diverts flows around the western edge of the structure and onto the adjacent streets.

4.2.1 East Wash and West Wash Dams In-Place

Peak inflows and outflows, maximum water surface elevations, and available freeboard results for the existing structures can be found below in Table 1 and Table 2. The East Wash Dam was able to contain all the design storms modeled, with auxiliary spillway flows appearing during the 100-year storm event and above. The auxiliary spillway conveys flows over the west berm of the East Wash Dam impoundment area, through the neighboring property, and into the West Wash Dam basin.

The auxiliary spillway of the West Wash Dam was activated during the 200-year storm event and the dam itself was overtopped during the 3/4 Local PMP and Full Local PMP events (represented as negative values in the Freeboard column of the table). Full hydrographs for the modeled storm events in this configuration can be found in Appendix D.

Table 1: East Wash Peak Flows for East Wash and West Wash Dam In-Place

Storm Event	Peak Inflow (cfs)	Peak PS Outflow (cfs)	Peak AS Outflow (cfs)	Max WSE (ft)	Freeboard (ft)
10-year	764	211	-	4,855.22	6.8
25-year	1,129	379	-	4,857.13	4.9
50-year	1,481	525	-	4,857.92	4.1
100-year	1,904	606	734	4,858.48	3.5
200-year	2,423	647	1,489	4,858.78	3.2
500-year	3,281	693	2,511	4,859.10	2.9
1,000-year	3,423	702	2,683	4,859.16	2.8
½ PMP (General)	1,612	547	52	4,858.05	3.9
¾ PMP (General)	2,884	673	2,084	4,858.97	3.0
Full PMP (General)	4,171	730	3,426	4,859.34	2.7
½ PMP (Local)	4,521	743	3,771	4,859.42	2.6
¾ PMP (Local)	7,272	840	6,426	4,860.04	2.0
Full PMP (Local)	10,004	933	9,062	4,860.55	1.4

Table 2: West Wash Peak Flows for East Wash and West Wash Dam In-Place

Storm Event	Peak Inflow (cfs)	Peak PS Outflow (cfs)	Peak AS Outflow (cfs)	Max WSE (ft)	Freeboard (ft)
10-year	597	75	-	4,768.07	24.9
25-year	873	80	-	4,774.90	18.1
50-year	1,139	83	-	4,778.90	14.1
100-year	1,716	86	-	4,782.97	10.0
200-year	2,872	88	97	4,785.60	7.4
500-year	4,585	89	400	4,786.63	6.4
1,000-year	4,946	89	495	4,786.85	6.1
½ PMP (General)	1,367	83	-	4,779.51	13.5
¾ PMP (General)	3,888	88	319	4,786.45	6.6
Full PMP (General)	6,405	90	1,673	4,789.20	3.8
½ PMP (Local)	7,258	92	3,766	4,791.90	1.1
¾ PMP (Local)	11,691	96	9,594	4,798.35	-5.4
Full PMP (Local)	16,090	99	14,433	4,803.70	-10.7

4.2.2 West Wash Dam Non-Existent and East Wash Dam In-Place

This scenario modeled the removal of just the West Wash Dam, while keeping the East Wash Dam in-place. In this configuration, the East Wash Dam continues to perform as designed, by diverting water into the West Wash Dam basin. Resulting flows through the West Wash Dam basin are not retained due to the

dam being non-existent for this scenario. Table 3 below summarizes key flow and water surface elevation information for the East Wash Dam. It should be noted that primary spillway flows represent flow diverted to West Wash, as well as those conveyed to the storm drain system. Table 4 lists the peak storm flow through the channel created by the theoretical removal of West Wash Dam. The inflow and outflow hydrographs for East Wash Dam, as well as the hydrographs for the storm flows through West Wash can be found in Appendix E.

Table 3: East Wash Peak Flows for West Wash Dam Non-Existent and East Wash In-Place

Storm Event	Peak Inflow (cfs)	Peak PS Outflow (cfs)	Peak AS Outflow (cfs)	Max WSE (ft)	Freeboard (ft)
10-year	764	211	-	4,855.22	6.8
25-year	1,129	379	-	4,857.13	4.9
50-year	1,481	525	-	4,857.92	4.1
100-year	1,904	606	734	4,858.48	3.5
200-year	2,423	647	1,489	4,858.78	3.2
500-year	3,281	693	2,511	4,859.10	2.9
1,000-year	3,423	702	2,683	4,859.16	2.8
½ PMP (General)	1,612	547	52	4,858.05	3.9
¾ PMP (General)	2,884	673	2,084	4,858.97	3.0
Full PMP (General)	4,171	730	3,426	4,859.34	2.7
½ PMP (Local)	4,521	743	3,771	4,859.42	2.6
¾ PMP (Local)	7,272	840	6,426	4,860.04	2.0
Full PMP (Local)	10,004	933	9,062	4,860.55	1.4

Table 4: West Wash Peak Flows for West Wash Dam Non-Existent and East Wash In-Place

Storm Event	Peak Storm Flow (cfs)
10-year	597
25-year	873
50-year	1,139
100-year	1,716
200-year	2,872
500-year	4,585
1,000-year	4,946
½ PMP (General)	1,367
¾ PMP (General)	3,888
Full PMP (General)	6,405
½ PMP (Local)	7,258
¾ PMP (Local)	11,691
Full PMP (Local)	16,090

4.2.3 East Wash and West Wash Dams Non-Existent

For the scenario where both dams have been removed, the East Wash drainage basin and West Wash drainage basin were modeled separately. This assumes that the removal of the East Wash dam would result in stormwater flowing down Keystone Avenue (the path of the primary spillway) and would not convey any storm flows into the West Wash basin. Table 5 and Table 6 list the peak storm flows through the original dam locations. Full hydrographs for both basins are presented in Appendix F.

Table 5: East Wash Peak Flows for East Wash and West Wash Dam Non-Existent

Storm Event	Peak Storm Flow (cfs)
10-year	764
25-year	1,129
50-year	1,481
100-year	1,904
200-year	2,423
500-year	3,281
1,000-year	3,423
½ PMP (General)	1,612
¾ PMP (General)	2,884
Full PMP (General)	4,171
½ PMP (Local)	4,521
¾ PMP (Local)	7,272
Full PMP (Local)	10,004

Table 6: West Wash Peak Flows for East Wash and West Wash Dam Non-Existent

Storm Event	Peak Storm Flow (cfs)
10-year	613
25-year	893
50-year	1,160
100-year	1,482
200-year	1,875
500-year	2,528
1,000-year	2,460
½ PMP (General)	1,392
¾ PMP (General)	2,378
Full PMP (General)	3,366
½ PMP (Local)	3,080
¾ PMP (Local)	4,817
Full PMP (Local)	6,538

4.2.4 USGS Regression Equations

The peak inflow and outflow results for the East Wash and West Wash Dams In-Place scenario were compared to another peak flow determination method in order to determine the reasonableness of the hydrologic assumptions made of the contributing drainage basins (e.g., lag time, curve number, etc.). As no stream gages exist in either dam, historical data was unavailable. The regression equations in Methods for Estimating Magnitude and Frequency of Floods in the Southwestern United States published by the USGS were used to create an estimated comparison (USGS, 1997).

The methodology for USGS regression equations requires that the project site be located within one of several defined regions (USGS, 1997). Reno, Nevada borders the Eastern Sierras Region 5 and Northern Great Basin Region 6 (USGS, 1997). Due to the project area bordering two distinct regions, results were computed using equations for each region, and then compared. Table 7 and Table 8 compare the results of the USGS regression equations to the SITES results for the East Wash and West Wash, respectively.

Table 7: East Wash USGS Regression Flows Comparison

Recurrence Interval (years)	Region 5 USGS Peak Flow (cfs)	Region 6 USGS Peak Flow (cfs)	NRCS SITES Peak Flow (cfs)
2	11	0	n/a
5	45	19	n/a
10	97	63	764
25	227	145	1,129
50	385	244	1,481
100	608	594	1,904

Table 8: West Wash USGS Regression Flows Comparison

Recurrence Interval (years)	Region 5 USGS Peak Flow (cfs)	Region 6 USGS Peak Flow (cfs)	NRCS SITES Peak Flow (cfs)
2	6	0	n/a
5	29	13	n/a
10	65	50	488
25	162	120	717
50	286	199	935
100	466	522	1,223

As shown in Table 7 and Table 8, there is a vast difference in peak flows between the SITES results and the USGS results. This prompted a literature review of past hydrologic analyses performed and a comparison of hydrologic parameters selected. The most recent analysis from 2006 was compared to the current modeling effort and found that curve numbers, soil groups, lag time, and time of concentration for both efforts were in line with one another (MACTEC Engineering and Consulting, Inc., 2006c). However, when comparing the 2006 report to the USGS results shown above, they were reasonably in-line with one another (MACTEC Engineering and Consulting, Inc., 2006c). Calculation methodology was also compared, which revealed that the 2006 report utilized HEC-HMS, while this analysis used SITES (MACTEC Engineering and Consulting, Inc., 2006c). However, the difference in programs did not account for the large gap in results. When comparing storm event rainfall totals used for the 2006 analysis with the current analysis, significant differences were found. The analysis performed in this report utilized

data from the most recent NOAA Atlas 14, while previous reports merely estimated rainfall totals (MACTEC Engineering and Consulting, Inc., 2006c). The recent NOAA data was as much as 2-inches greater than previous rainfall totals used for specific rain events. The larger volume of rainfall used as an input into the SITES model accounts for the large differences in peak flow between the 2006 analysis and the current analysis.

In addition, while reviewing the USGS report, a better understanding of the limitations of these regression equations was found. Due to the small number of stream gages sampled in creating the regression equations, the standard error for the equations is quite high. In addition, as stated within the "Additional Data and Study Needs" section on page 110, "*A better understanding of flood characteristics is needed for flood frequency studies in the southwestern United States. Because streamflow is extremely variable, data obtained from the sparse areal distribution of gaging stations and the short records at many stations commonly result in samples that do not represent the populations of floods that occur in the area*" (USGS, 1997). Due to the factors listed in this section, the hydrologic assumptions that were made and input into SITES for this analysis were reasonable. The peak flows calculated in SITES being so much higher than what was calculated with the USGS regression equations also highlights the lack of available data within this area to compare to the model. Future analysis of the dams may produce different results as methodologies, technologies, and available data advance.

4.3 SPILLWAY EVALUATIONS

Evaluation of the primary and auxiliary spillways of the East Wash and West Wash Dams were performed using hydraulic calculation methods to determine if the existing structures meet minimum auxiliary spillway and top of dam elevations. Utilizing SITES, primary spillway, stability design, and auxiliary spillway hydrographs for each dam were calculated per NRCS TR-60 (USDA NRCS, 2019). In addition to the hydraulic evaluation of the primary and auxiliary spillways of the structures, frequency-stage-discharge plots for the auxiliary spillways of each structure were created and the return period for spillway activation was interpolated. A preliminary condition assessment for the primary spillway of the West Wash Dam was performed by reviewing CCTV footage of the spillway provided by City of Reno. No other condition assessments were performed.

4.3.1 East Wash

Utilizing the SITES model results described in Section 4.2.1, the auxiliary spillway flows and maximum water surface elevations for the East Wash Dam were plotted against their respective storm return periods. Comparing these plots with the crest elevation of the auxiliary spillway (4,858 ft) a return period for auxiliary spillway activation can be interpolated. Per the plot in Figure 8, an expected return period for the East Wash auxiliary spillway is approximately 55 years.

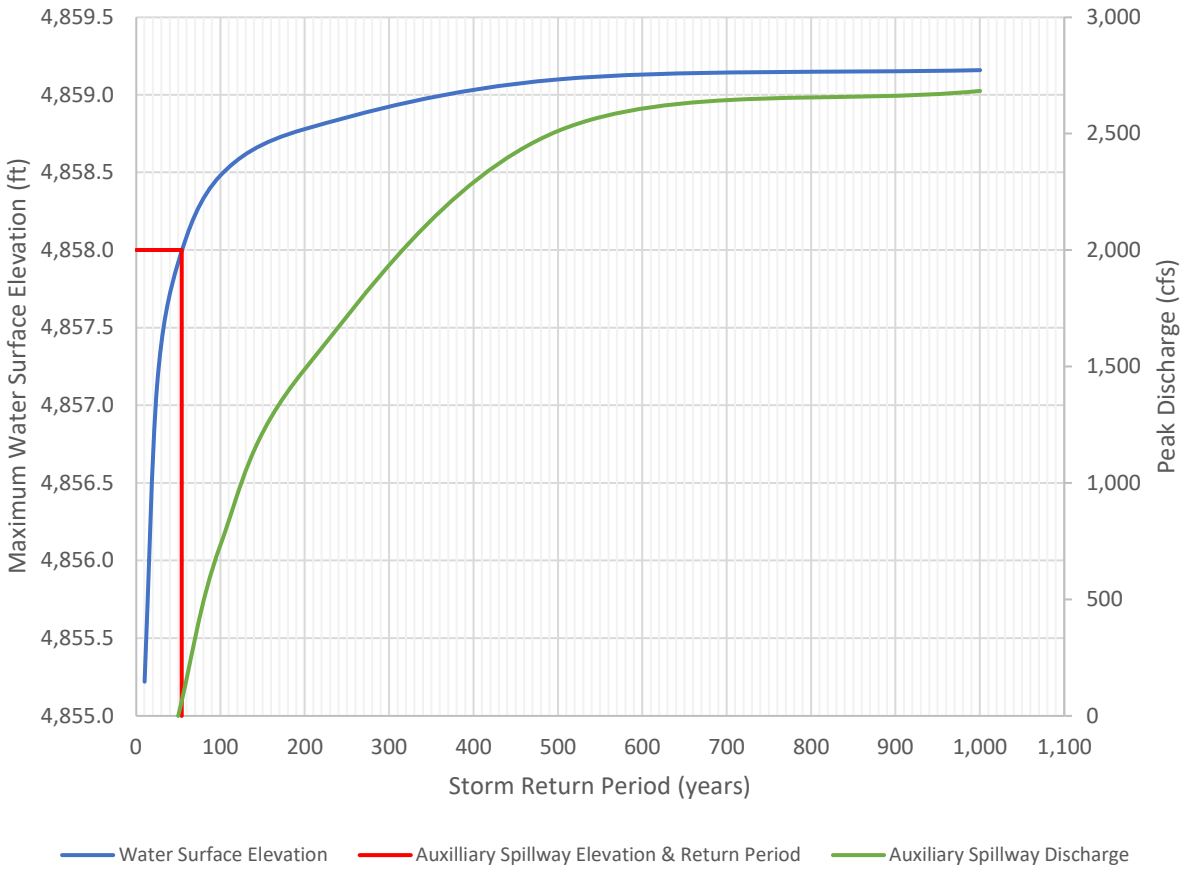

Figure 8: East Wash Frequency-Stage-Discharge Curve

The principal spillway hydrograph, freeboard hydrograph, and stability design hydrograph were calculated in SITES for the East Wash Dam. Stability design and auxiliary spillway hydrographs require both the 100-year storm event (with a 10-day duration) and the PMP to be combined in an equation to generate a hybrid storm that is then used to calculate the appropriate minimum elevations of the auxiliary spillway and top of dam (USDA NRCS, 2019). Two different sets of hydrographs were created using either the General PMP or the Local PMP to determine which PMP storm creates the highest minimum elevations. Table 9 below gives the results for the hydrograph analysis performed for the East Wash Dam and lists both the General and Local PMP results. Based on the existing elevations of the auxiliary spillway crest (4,858 ft.) and top of dam (4,862 ft.), the principal spillway, freeboard, and stability design hydrographs indicate that the East Wash dam has sufficient freeboard to pass the General and Local PMP without overtopping.

Table 9: East Wash Hydrograph Analysis Results

PMP Event	Min. Aux. Spillway Crest (ft)	Top of Dam Elevation (ft)
General	4,857.35	4,861.00
Local	4,857.35	4,861.00

The auxiliary spillway was also evaluated for headcut development and advancement during passage of the freeboard storm event. Soil characteristics for the auxiliary spillway were taken from the USDA Web

Soil Survey. During the passage of the freeboard storm hydrograph, the headcut breached the spillway crest at approximately 2.4 hours. The final height of the headcut was 83.1 ft. The auxiliary spillway will require armoring to ensure that headcut will not advance beyond the upstream edge of the level crest during the freeboard storm.

4.3.2 West Wash

The frequency-stage-discharge plot for the West Wash Dam was created in the same manner as described in Section 4.3.1 for the East Wash. With an auxiliary spillway crest elevation of 4,784.9 ft., the interpolated return period for auxiliary spillway activation is approximately 150 years, as shown by Figure 9.

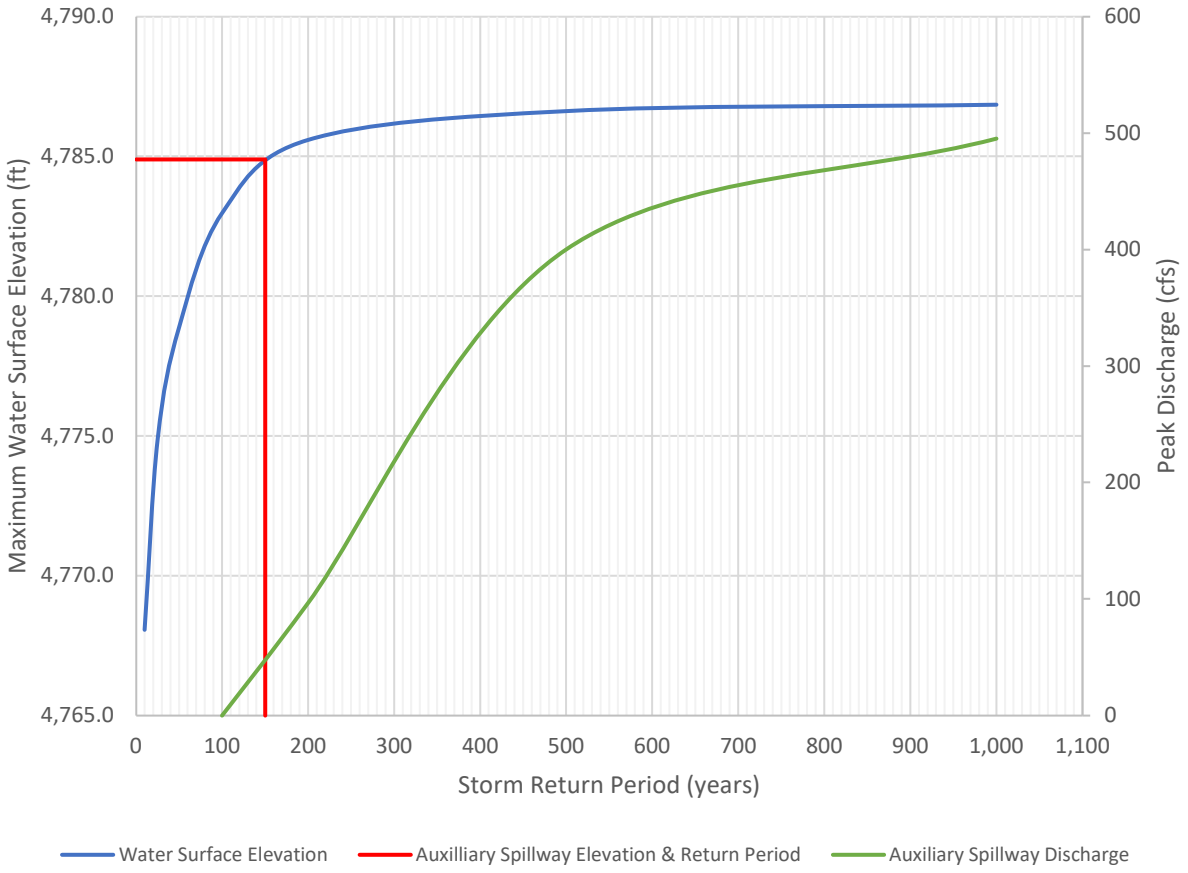

Figure 9: West Wash Frequency-Stage-Discharge Curve

The principal spillway hydrograph, freeboard hydrograph, and stability design hydrograph were calculated in SITES for the West Wash Dam. Stability design and auxiliary spillway hydrographs require both the 100-year storm event (with a 10-day duration) and the PMP to be combined in an equation to generate a hybrid storm that is then used to calculate the appropriate minimum elevations of the auxiliary spillway and top of dam (USDA NRCS, 2019). Two different sets of hydrographs were created using either the General PMP or the Local PMP to determine which PMP storm creates the highest minimum elevations. Table 10 lists the results for the hydrograph analysis performed for the West Wash Dam and lists both the General and Local PMP results. Since West Wash Dam is currently constructed with an auxiliary spillway crest elevation of 4,784.9 ft and top of dam elevation of 4,793 ft, the dam already

exceeds the minimum elevations required in both the General and Local PMP to conform with TR-60 requirements (USDA NRCS, 2019).

Table 10: West Wash Hydrograph Analysis Results

PMP Event	Min. Aux. Spillway Crest (ft)	Top of Dam Elevation (ft)
General	4,774.91	4,787.90
Local	4,774.91	4,792.68

The auxiliary spillway was also evaluated for headcut development and advancement during passage of the freeboard storm event. Soil characteristics for the auxiliary spillway were taken from the USDA Web Soil Survey. During the passage of the freeboard storm hydrograph, the headcut did not breach the spillway crest. The final height of the headcut was 7.6 ft. However, the auxiliary spillway may require armoring as part of future rehabilitation.

On September 15, 2021, the City of Reno recorded footage of the inside of the Primary Spillway of West Wash Dam from the spillway structure to the catch basin at the toe of the dam. The video was reviewed by Farr West Engineering and the overall condition of the Primary Spillway of West Wash Dam was evaluated.

Overall, considering that the primary spillway pipe is over 50 years old, it is in fair to good condition. The erosion level of the concrete pipe at the invert is difficult to assess due to the presence of water, but since there were no obvious holes, pop-outs, rebar exposure, joint misalignment, or other abnormalities, it is apparent that the basic construction and materials were of high quality. The pipe segments are still linear and circular in cross-section with no longitudinal cracks that would be indicative of poor backfill control and settlement issues, nor were there any continuous circumferential cracks that would be indicative of differential settlement. However, the existence of infiltration along the entire length of the pipe at all points of the compass is indicative of saturation of the backfill around the pipe with enough pressure to force water through small imperfections in the pipe. The areas of calcification indicate that the water infiltration has been a long-term issue. There were no sustained drips, or “fountains”, into the pipe that would be indicative of heavy concrete erosion or structural damage to the pipe. Overall, visual inspection of the primary spillway revealed no clear defects or wear indicating the potential lifespan of the spillway has been substantially reduced.

At this time, it is not necessary to line or replace the primary spillway pipe of West Wash Dam. However, it is recommended to inspect the pipe annually via CCTV to document any significant erosion or structural damage in the future as the pipe continues to degrade.

Moving forward, modifications to West Wash Dam may require modifications to the primary spillway. If the dam is raised, a seep intercept, filter, and drain will need to be constructed to control the additional water the dam embankment could hold, if there were ever a significant impoundment of water.

5.0 INUNDATION ROUTINGS

Inundation routings were performed using the hydrographs developed in Section 4.2. The hydrographs developed for East Wash and West Wash Dams In-Place, West Wash Dam Non-Existent and East Wash In-Place, and East Wash and West Wash Dams Non-Existent scenarios were routed downstream of the appropriate dam in a 2D HEC-RAS model to identify the downstream inundation boundary for each storm value determined in TM 1.

5.1 MODEL SETUP

HEC-RAS Version 6.0.0 was used, which was released May 28, 2021 and developed by the U.S. Army Corps of Engineers (US Army Corps of Engineers, 2021b). The downstream inundation area was

developed as a 2D model, where the program read topography and elevations off an imported surface. The surface that was used to develop the model was imported Lidar data flown in 2017 by USGS. The horizontal and vertical projection used were NAD83, Nevada State Plane, West Zone, US Foot and NAVD88, US Foot, respectively. Once the surface was imported, a 2D mesh was created so that HEC-RAS could read the surface. The average cell size of the 2D mesh was set to 30'x30' and break lines were added along all roads and significant slopes to align cells in such a way that would most accurately represent the surface. The extents of the 2D mesh are roughly from Exeter Way (west) to El Rancho Drive (east) and from the East Wash Dam on the north end of Keystone Avenue (north) to 2nd St (south). Figure 10 illustrates the extents of the 2D mesh and break lines used in the 2D HEC-RAS model.

Once the underlying surface was built, land cover data was imported from the 2019 USGS National Land Cover Database (NLCD) (Multi-Resolution Land Characteristics Consortium, 2019). The land cover data consisted of 100'x100' cells that delineated land use areas within the mesh area (Multi-Resolution Land Characteristics Consortium, 2019). Due to the large cell area, several areas within the 2D mesh were refined where it was deemed necessary, such as areas of shrub, open water, road (I-80 corridor only), and developed open space (parks). Manning's *n* values were then associated with the different land cover categories so that the model could account for varying areas of friction while routing the flood waves. Manning's n values were based on *Table 2-1: Example Manning's n values for various NLCD Land Cover Types* in the HEC-RAS 2D User's Manual Version 6.0 (US Army Corps of Engineers, 2021a). Values from the ranges listed in *Table 2-1* were selected at the lowest end of the range to be conservative (US Army Corps of Engineers, 2021a). A list of the Land Cover Types and associated Manning's n values used in the 2D HEC-RAS model can be found in Table 11.

20 Years!
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5510 Longley Lane
Reno, NV 89511
(775) 851-4788
www.farwestengineering.com

Figure 10: Extents of 2D Mesh with Breaklines

East Wash Dam

West Wash Dam

N MCCARRAN BLVD
659
N MCCARRAN BLVD
430
443
395
CLEAR ACRE LN
EL RANCHO DR
N SIERRA ST
N WELLS AVE
SUTRO ST
ODDIE BLVD
ODDIE BLVD
KEYSTONE AVE
KINGS ROW
E 9TH ST
E 6TH ST
E 4TH ST
580
647
W 7TH ST
W 6TH ST
W 5TH ST
W 4TH ST
N VIRGINIA ST
N CENTER ST
EVANS AVE
KIETZKE LN
667
BATTLE BORN WAY
GALLETTI WAY
KUENZLI ST
E 2ND ST
648
80
STOKER AVE
W 2ND ST
RYLAND ST
S SIERRA ST
S CENTER ST
S VIRGINIA ST
S WELLS AVE
KIRMAN AVE
CALIFORNIA AVE

Legend

- Truckee River
- Geometry Breaklines
- 2D Mesh Extents
- 100-yr Truckee River Floodplain

N

1 " = 1,500 '

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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P:\Client Projects\Reno, City of 1461\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\1_Figures\Figure 10 - Extents of 2D Mesh w Breaklines.mxd, Editor: djones, Printed: 9/29/2021

Table 11: Land Cover Types and Associated Manning's n Values used in HEC-RAS 2D Model

Land Cover Types	Manning's n
Developed, Open Space	0.03
Developed, Low Intensity	0.06
Developed, Medium Intensity	0.08
Developed, High Intensity	0.12
Road	0.016
Deciduous Forest	0.08
Evergreen Forest	0.08
Shrub/Scrub	0.07
Grassland/Herbaceous	0.025
Pasture/Hay	0.025
Woody Wetlands	0.045
Emergent Herbaceous Wetlands	0.05
Open Water	0.025

Once the surface and all relevant surface definitions were set up, boundary condition lines were drawn at the appropriate location for each scenario. Boundary condition lines occur where the flow from the hydrograph is introduced into the 2D mesh, which is distributed along the length of the line. For the East Wash and West Wash Dams In-Place scenario, the boundary condition line was drawn along the toe of each dam to and across the crest of West Wash Dam's auxiliary spillway. For the No Dam Failure scenarios (which includes the West Wash Dam Non-Existent and East Wash Dam In-Place and the East Wash and West Wash Dams Non-Existent), the boundary condition lines were drawn slightly downstream of the toe of slope at approximately the same width of either dam to fully capture the natural topography if the dams were non-existent. Each boundary condition line had an associated energy grade slope for distributing flow along the boundary condition line, which was calculated individually for each scenario.

Run times for each model varied depending on the length of the hydrograph. The duration of each dam breach routing matched the duration of the breach hydrograph, which ranged from approximately 30 min to 4 hours. The duration of each West Wash Dam Auxiliary Spillway activation (in the No Dam Failure scenario) routing matched the duration of time where water was actively flowing through the spillway, which ranged from approximately 7 to 13 hours. For the models where the dams were non-existent in the No Dam Failure scenarios, the outflow hydrographs for East Wash and West Wash matched the storm duration of 24-hours. Due to the amount of time it took for HEC-RAS to calculate each run, all No Dam Failure hydrographs were limited in duration. The hydrographs entered into HEC-RAS started and stopped at a point where the flows were significantly below the peak flow, while also capturing the build to/taper from the peak flow. The time range of the hydrographs for scenarios where the dams were non-existent ranged from approximately 4 to 6 hours. All hydrographs used for the HEC-RAS 2D model were obtained from the completed SITES model (see Section 4.0 for a more in-depth analysis on how the hydrographs were developed).

The 2D routings performed in HEC-RAS depict how a certain flow rate of water moves through the existing topography and does not account for any storm drain infrastructure along the routed path. The exact number of storm drain inlets located within each inundation area will be discussed further in

Sections 5.2 and 5.3. Additionally, the HEC-RAS model does not account for any kind of surface infiltration. Given the lack of storm drain and infiltration data within the model, the water from each routed scenario will continue to move its way across the surface in search of lower elevations indefinitely and a reasonable limit to the downstream area had to be determined. It is reasonable to assume, given the existing storm drain system and lack of infiltration, that the inundation areas mapped out by HEC-RAS are overly conservative and are strictly to be used for planning purposes to understand the general path and tendency of any given flood wave. Previous inundation maps for both East Wash and West Wash Dam breaches created by MACTEC show that the maximum flood extents from a breach to the south were about 800 feet south of where Vine St passes under I-80 and approximately a mile to the east of where the flow enters I-80 near the Valley Rd overpass (MACTEC Engineering and Consulting, Inc, 2006a) (MACTEC Engineering and Consulting, Inc, 2006b). Given these previous extents, it was reasonable to assume that the 2D mesh extents would cover enough area if extended 2500 feet to the south of the I-80 corridor and just to the east of the I-80/US 395 interchange. Since the edge of the 2D mesh extended a relatively constant 2500 feet to the south of the I-80 corridor, part of the Truckee River 100-year flood plain was not included within the modeled surface. Some routings performed in HEC-RAS (particularly with the Local PMP) reached the extents of the 2D mesh and show inaccurate pooling around these edges. For the reasons explained previously, these pooling depths should be ignored.

Although it was stated previously that the HEC-RAS 2D mesh routes water through the existing topography, certain limitations of Lidar data are worth mentioning here. Certain topographic features were not included in the 2D model, most notably the center divider and all bridge piers along the I-80 corridor, due to the accuracy limitations and methodology of Lidar. It was determined that obtaining detailed information for the divider and bridges would be difficult and omitting them from the model for this planning-level document would not cause significant accuracy problems in the model. Additionally, the Lidar surface mapped the N Virginia St./N Center St. bridge as a berm within the I-80 corridor, causing pooling that was unrepresentative of actual conditions. To fix this, the surface was edited within the HEC-RAS 2D RAS mapper to remove the bridge so that the flow could continue down the corridor. As a result, the inundation map boundaries are not shown in this area.

For each routing performed in HEC-RAS, the computation interval ranged from 0.1-0.2 seconds depending on the stability of the model run. Courant's number was calculated for each scenario based on the flood wave velocity, average cell size, and computational time step to ensure that it was less than or equal to 1. Courant's number less than one ensures model stability and accuracy, according to the HEC-RAS 2D User's Manual (US Army Corps of Engineers, 2021a). The Shallow Water Equations, Eulerian-Langrangian Method were used as the basis of calculation for all model runs. The Shallow Water Equations are the most appropriate equations to use when there are highly dynamic flood waves, abrupt contractions and expansions, and mixed flow regimes (US Army Corps of Engineers, 2021a).

The following scenarios were routed in the HEC-RAS 2D model:

- Breaches
    - East Wash Dam Breach with Water Surface Elevation at Auxiliary Spillway
    - East Wash Dam Breach with Water Surface Elevation at PMP
    - West Wash Dam Breach with Water Surface Elevation at Auxiliary Spillway
    - West Wash Dam Breach with Water Surface Elevation at PMP
- No Dam Failures
    - West Wash Dam Auxiliary Spillway Activations (East Wash and West Wash Dams In-Place)
        - 200-year, 500-year, 1000-year, ¾ of General PMP, General PMP, ½ of Local PMP, ¾ of Local PMP, Local PMP storm event

- West Wash Dam Non-Existent and East Wash Dam In-Place
  - 10-year, 25-year, 50-year, 100-year, 200-year, 500-year, 1000-year, ½ of General PMP, ¾ of General PMP, General PMP, ½ of Local PMP, ¾ of Local PMP, Local PMP storm events routed downstream of only West Wash
- East Wash and East Wash Dams Non-Existent
  - 10-year, 25-year, 50-year, 100-year, 200-year, 500-year, 1000-year, ½ of General PMP, ¾ of General PMP, General PMP, ½ of Local PMP, ¾ of Local PMP, Local PMP storm events routed downstream of East Wash and West Wash

In total, there were 51 scenarios ran in HEC-RAS. Exhibits illustrating the results of the Dam Failure Routing Maps – East Wash and West Wash Dam In-Place, No Dam Failure Routing Maps – East Wash and West Wash Dam In-Place, No Dam Failure Routing Maps – West Wash Dam Non-Existent, and No Dam Failure Routing Maps – East Wash and West Wash Dam Non-Existent for the HEC-RAS 2D routing can be found in Appendix G, Appendix H, Appendix I, Appendix J, respectively. For the West Wash and East Wash Dams Non-Existent scenarios, the hydrograph for each wash was routed downstream independently. Therefore, in Appendix J, each wash's inundation area is shown on its own map.

5.2 BREACH INUNDATION ROUTINGS

The dam breach hydrographs used for the breach inundation routings were developed using the NRCS Dam Breach Hydrograph Spreadsheet that is based on the TR-60 and TR-66 dam breach principles (USDA NRCS, 2018). The inputs to the equations were based on existing dimensions of both dams and the water surface elevation at the time of breach. A PDF of each NRCS Dam Breach Hydrograph Spreadsheet can be found in

The inundation boundaries for East Wash Dam Breach with Water Surface Elevation at Auxiliary Spillway, East Wash Dam Breach with Water Surface Elevation at PMP, West Wash Dam Breach with Water Surface Elevation at Auxiliary Spillway, West Wash Dam Breach with Water Surface Elevation at PMP are illustrated in Figure 11, Figure 12, Figure 13, and Figure 14, respectively. Based on the GIS data obtained from the City of Reno, there are between 118 and 253 storm drain inlets within the inundation areas. It is important to note that the storm drain GIS data provided does not go beyond Evans Ave to the east, so the storm drain inlet count given is highly conservative.

5.3 NO DAM-FAILURE ROUTINGS

The minimum and maximum inundation areas for West Wash Dam Auxiliary Spillway activation, West Wash Dam Non-Existent and East Wash Dam In-Place, and East Wash and West Wash Dams Non-Existent are illustrated in Figure 15, Figure 16, Figure 17, respectively. Each map compares the smallest storm with flow (200-year storm for the Auxiliary Spillway and 10-year storm for all dam removal scenarios) as the minimum and the Local PMP as the maximum so a general sense of how minor or how extreme flooding during these events can be. The number of storm drain inlets was not included on the maps in this section for the sake of clarity. Again, it is important to note that the storm drain GIS data provided does not go beyond Evans Ave to the east, so the storm drain inlet count given is highly conservative. For the West Wash Dam Auxiliary Spillway activation scenarios there were 150 storm drain inlets within the 200-year storm event inundation area and 373 storm drain inlets within the Local PMP inundation area. For the West Wash Dam Non-Existent and East Wash Dam In-Place scenarios there were 128 storm drain inlets within the 10-year storm event inundation area and 359 storm drain inlets within the Local PMP inundation area. Lastly, for the East Wash and West Wash Dams Non-Existent scenarios, there were 191 storm drain inlets within the 10-year storm event inundation area and 370 storm drain inlets within the Local PMP inundation area.

East Wash Dam

West Wash Dam

N-MCCARRAN-BLVD

659

KINGS-ROW

W-7TH-ST

80

80

STOKER-AVE

KEYSTONE-AV

W-2ND-ST

N-SIERRA-ST

E-9TH-ST

E-6TH-ST

W-6TH-ST

W-5TH-ST

W-4TH-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

KUENZ

RYLAN

N

Legend

- Storm Drain Inlet (113 within Inundation Boundary)
- Truckee River
- 100-yr Truckee River Floodplain

Water Depth (ft)

High : 19

Low : 0

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Figure 11: East Wash Dam Breach with Water Surface Elevation at Auxiliary Spillway

N

1 " = 1,000 '

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P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\1_Figures\Figure 11 - EW Dam Breach at AS with SD.mxd, Editor: djones, Printed: 12/17/2021

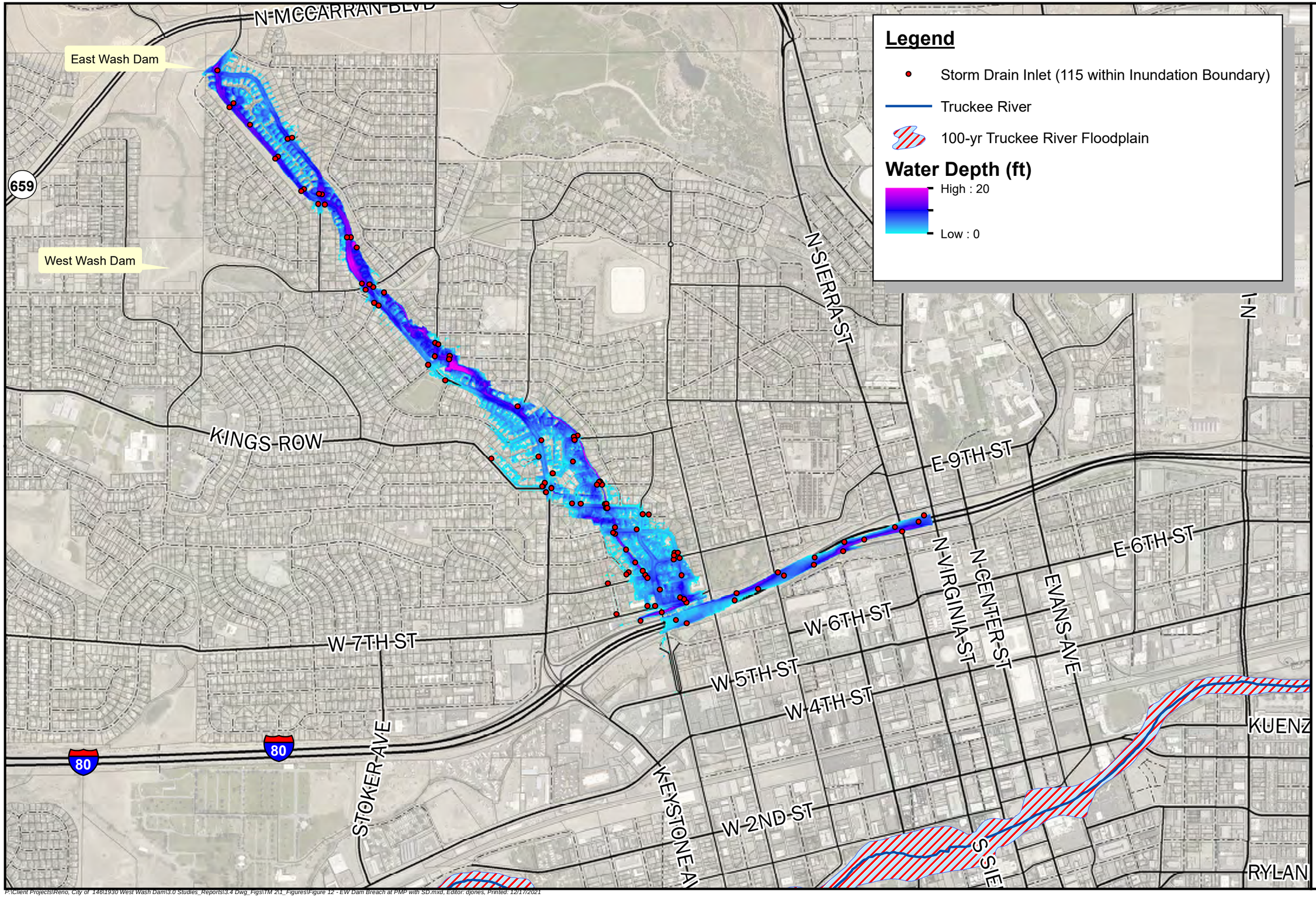

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Figure 12: East Wash Dam Breach with Water Surface Elevation at the PMP

N

1 " = 1,000 '

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East Wash Dam

West Wash Dam

N-MCCARRAN BLVD

659

KINGS-ROW

W-7TH-ST

80

80

STOKER-AVE

KEYSTONE-AVE

W-2ND-ST

N-SIERRA-ST

E-9TH-ST

E-6TH-ST

W-6TH-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

KUENZ

RYLAN

Legend

- Storm Drain Inlet (201 within Inundation Boundary)
- Truckee River
- 100-yr Truckee River Floodplain

Water Depth (ft)

Value

High : 34

Low : 0

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Figure 13: West Wash Dam Breach with Water Surface Elevation at Auxiliary Spillway

N

1 " = 1,000 '

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P:\Client Projects\Reno, City of 1461\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\1_Figures\Figure 13 - WW Dam Breach at AS with SD.mxd, Editor: djones, Printed: 12/17/2021

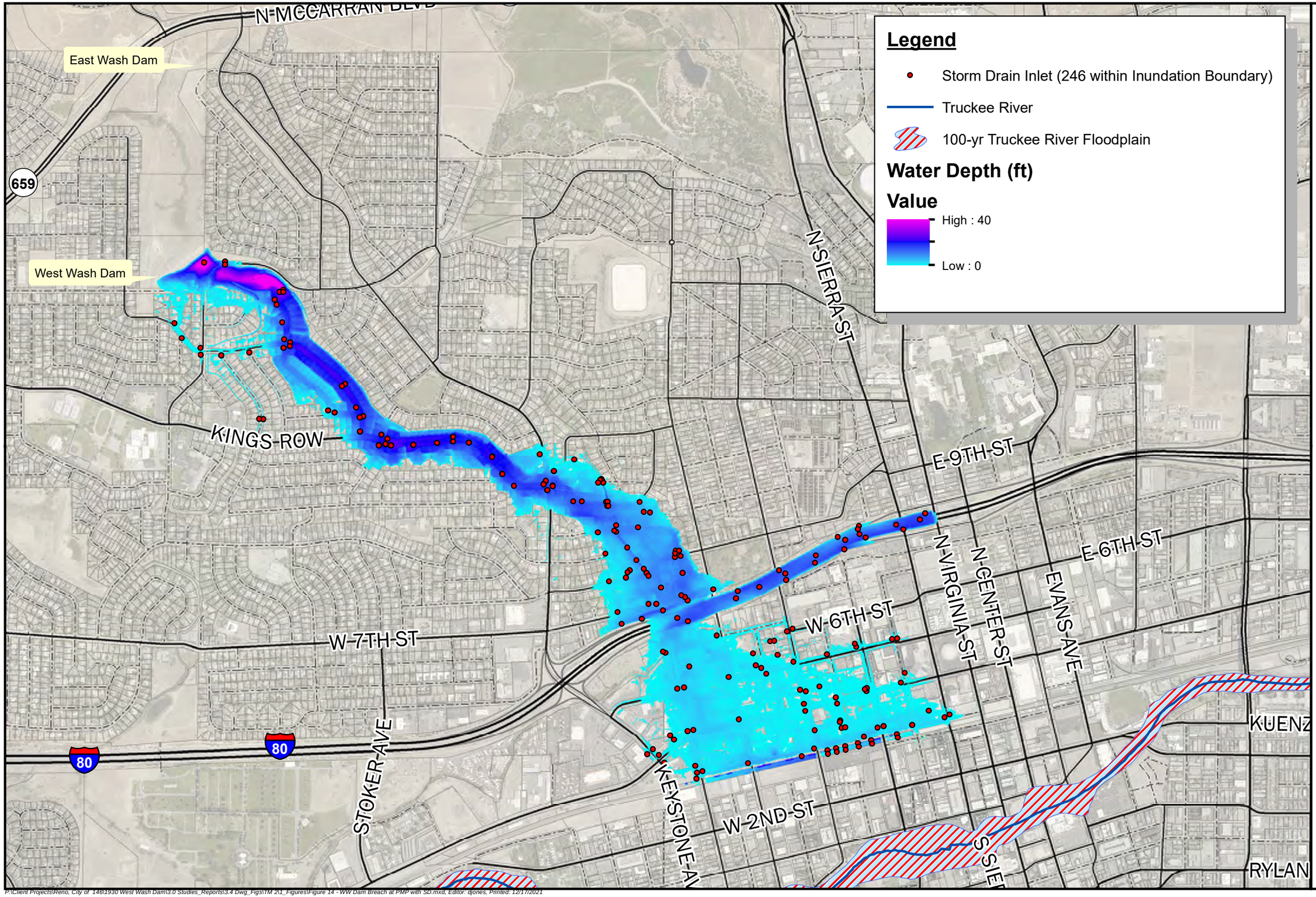

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Figure 14: West Wash Dam Breach with Water Surface Elevation at the PMP

N

1 " = 1,000 '

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P:\Client Projects\Reno, City of 1461\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\1_Figures\Figure 14 - WW Dam Breach at PMP with SD.mxd, Editor: djones, Printed: 12/17/2021

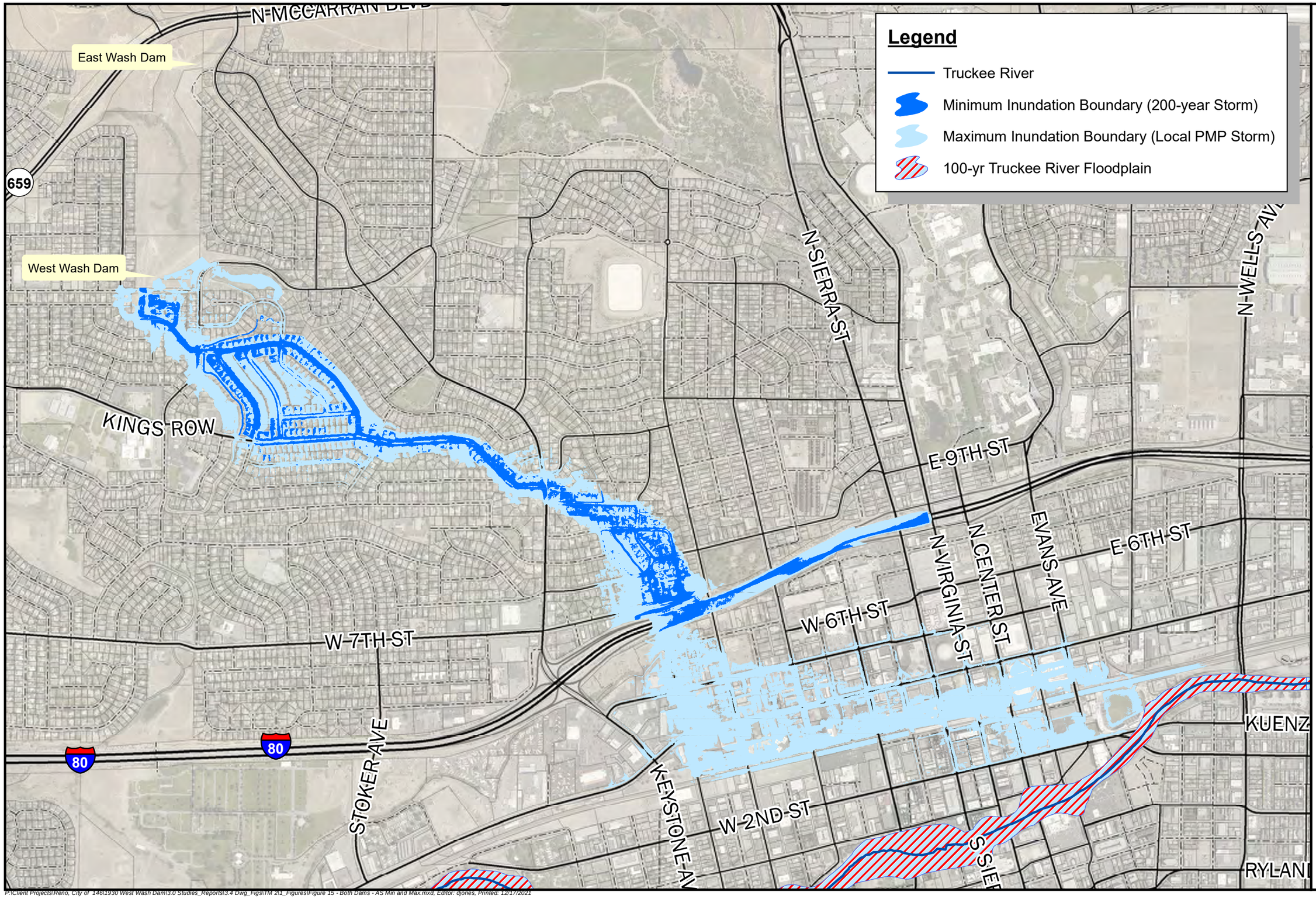

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Figure 15: Both Dams in Place - Auxiliary Spillway Activation Min/Max Inundation

N

1 " = 1,000 '

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P:\Client Projects\Reno, City of 1461\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\1_Figures\Figure 15 - Both Dams - AS Min and Max.mxd, Editor: djones, Printed: 12/17/2021

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Figure 16: West Wash Dam Non-Existent and East Wash Dam In-Place Min/Max Inundation

N

1 " = 1,000 '

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P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\1_Figures\Figure 16 - No WW - AS Min and Max.mxd, Editor: djones, Printed: 12/17/2021

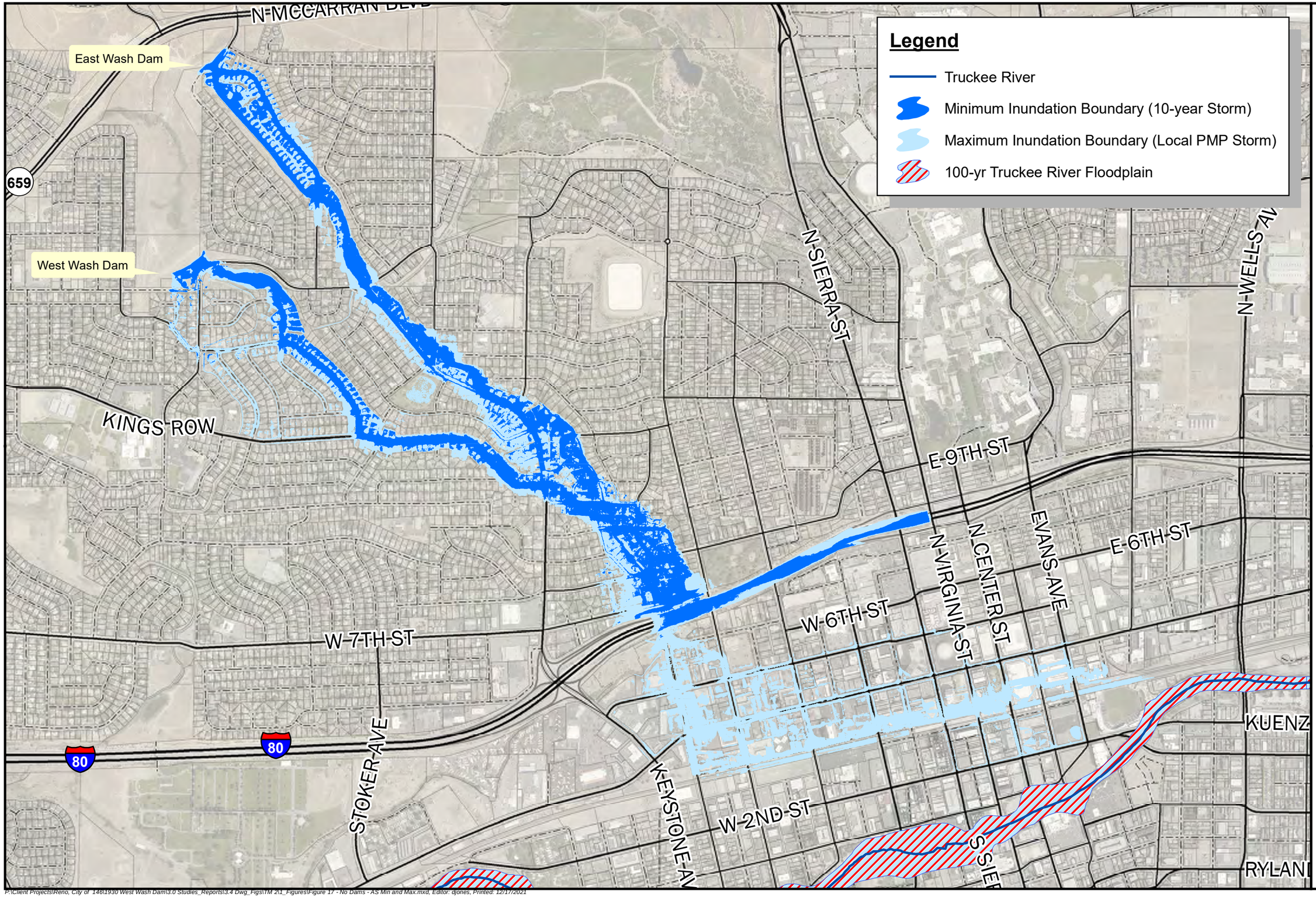

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Figure 17: West Wash and East Wash Dams Non-existent Min/Max Inundation

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P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\1_Figures\Figure 17 - No Dams - AS Min and Max.mxd, Editor: djones, Printed: 12/17/2021

6.0 CITY OF RENO STORM DRAIN SYSTEM ANALYSIS

Analysis of the City of Reno storm drain system was performed since the East Wash Primary Spillway is directly connected to the system, and the West Wash Primary Spillway directs flows to a downstream open channel that is connected to the storm drain system. The storm drain system downstream of East and West Wash Dams consist of individual catch basins that feed lateral pipes. The lateral pipes then feed into the storm drain mains. The mains flow in a southeasterly fashion until it reaches its ultimate outfall at the Truckee River. Results were obtained by creating a storm drain model from the dams to the outfall. The analysis gave insight into system manholes that may surcharge during storm events and cause flooding as a result of the stormwater retained in the dam basins. A surcharged manhole is defined as a manhole in which the rate of water entering is greater than the capacity of the outlet under gravity flow conditions, causing the water level within the manhole to exceed the rim elevation and leave the storm drain system.

6.1 MODEL SETUP

The InfoSWMM program was used to perform the storm drain analysis (Innovyze, 2019). Data to build the model in InfoSWMM was obtained through as-builts, topographic data, and GIS data provided by the City of Reno. Elevations that were not provided in the GIS data or as-builts were interpolated using the straight-line method based on surrounding invert information. Inspection reports were reviewed for each manhole structure in the model and updates were made to the GIS data to ensure accuracy. A schematic of the storm drain system from East Wash and West Wash Dams to the Truckee River is shown in Figure 18.

Three models were developed in InfoSWMM: East Wash and West Wash Dams In-Place, West Wash Dam Non-Existent with East Wash Dam In-Place, and East Wash and West Wash Dams Non-Existent. Within each model 13 rainfall events were simulated. These rainfall events include the 10-year, 25-year, 50-year, 100-year, 200-year, 500-year, 1000-year, ½ of General PMP, ¾ of General PMP, General PMP, ½ of Local PMP, ¾ of Local PMP, Local PMP storm events.

6.2 EAST WASH AND WEST WASH DAMS IN-PLACE

The East Wash and West Wash Dams In-Place model was set up with two storage areas, representing East Wash and West Wash, at the most upstream end of the model. The East Wash and West Wash Dams were developed within the model with the same stage-storage curves used in the SITES model (see Section 4.1 for a more in-depth conversation on the development of the dam stage-storage curves). An initial depth was set within the East Wash and West Wash Dam storage areas in InfoSWMM, where the initial depth was set equal to the maximum reservoir depth that was calculated in the SITES model. For both the East and West Wash Dams, the maximum reservoir depth was caused by the Local PMP storm event. Both storage areas in InfoSWMM were connected to the primary spillway outlets through orifices. The orifice properties were set up to match existing condition as close as possible, given the complex nature of both intake structures. Both storage areas were then connected to the downstream storm drain system in InfoSWMM.

Results from the InfoSWMM model show that six manholes are flooded in this scenario, all between East Wash Dam and the junction where East Wash and West Wash storm drains meet. The location of each manhole, as well as the minimum and maximum volume that floods out of the manhole can be found in Figure 19.

A comparison of the peak primary spillway discharge between the SITES model and the InfoSWMM model was performed to check for consistency. For the East Wash Primary Spillway, flows between the SITES and InfoSWMM models differed by 15-30%, which was caused by how each model handled downstream conditions. In SITES, the rating table assumed free-flow conditions at the primary spillway and did not take into account the miles of downstream pipe that makes up the East Wash storm drain system. For the West Wash Primary Spillway, the flows between the SITES and InfoSWMM models

differed by 0-3%. Like the SITES model, the flow coming out of West Wash discharges directly into a large open channel where downstream conditions do not affect the discharge as much as the East Wash Primary Spillway.

6.3 WEST WASH DAM NON-EXISTENT AND EAST WASH DAM IN-PLACE

The model for the West Wash Dam Non-Existent and East Wash Dam In-Place scenario was set up with one storage area, that represents East Wash, at the most upstream end of the model. East Wash Dam was developed within the model with the same stage-storage curves used in the SITES model (see Section 4.1 for a more in-depth conversation on the development of the dam stage-storage curves). The West Wash Dam and West Wash Primary Spillway were deleted within this model, so the flow out of West Wash began at the open channel located to the southeast of Wyoming Ave and Putnam Dr.

Results from the InfoSWMM model show that seven manholes are flooded in this scenario, five between East Wash Dam and the junction where East Wash and West Wash storm drains meet and two between West Wash Dam and the junction where East Wash and West Wash storm drains meet. The location of each manhole, as well as the minimum and maximum volume that floods out of the manhole can be found in Figure 20.

A comparison of the peak primary spillway discharge between the SITES model and the InfoSWMM model was performed to check for consistency. For the East Wash Primary Spillway, flows between SITES and InfoSWMM models differed by 15-30%, which was caused by how each model handled downstream conditions. In SITES, the rating table assumed free-flow conditions at the primary spillway and did not take into account the miles of downstream pipe that makes up the East Wash storm drain system. For the flows coming out of West Wash, the SITES and InfoSWMM models differed by 0%. Like the SITES model, the flow coming out of West Wash without the dam in place, discharges directly into a large open channel where downstream conditions do not affect the discharge as much as was seen in the East Wash Primary Spillway.

6.4 EAST WASH AND WEST WASH DAMS NON-EXISTENT

The East Wash and West Wash Dam Non-Existent model was set up with no storage areas since both dams were modeled as non-existent. The East Wash Dam, East Wash Primary Spillway, East Wash storm drain system, West Wash Dam, and West Wash Primary Spillway were deleted in this model. The flow out of West Wash began at the open channel located to the southeast of Wyoming Ave and Putnam Dr. No flow out of East Wash was analyzed for the storm drain system since there was no single inlet the flow would be routed to, as with West Wash. Instead, inundation areas were mapped for flows coming out of East Wash (see Section 5.3).

Results from the InfoSWMM model show that one manhole is flooded in this scenario between West Wash Dam and the junction where East Wash and West Wash storm drains meet. The location of each manhole, as well as the minimum and maximum volume that floods out of the manhole can be found in Figure 21.

A comparison of the peak primary spillway discharge between the SITES model and the InfoSWMM model was performed to check for consistency. Since the East Wash storm drain system was not modeled, there was no comparison to perform. For the West Wash storm drain system, the flows between SITES and InfoSWMM models differed by 0%. Like the SITES model, the flow coming out of West Wash, without the dam in place, discharges directly into a large open channel where downstream conditions do not affect the discharge.

Figure 18: Storm Drain System

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East Wash Dam Primary Spillway

West Wash Dam Primary Spillway

Outlet to Truckee River

N MCCARRAN BLVD
659
KINGS ROW
W 7TH ST
80
STOKER AVE
KEYSTONE AVE
N SIERRA ST
N WELLS AVE
E 9TH ST
E 6TH ST
N VIRGINIA ST
N CENTER ST
EVANS AVE
W 6TH ST
W 5TH ST
W 4TH ST

Legend

- Storm Drain Manhole
- Storm Drain Inlet
- Storm Drain Pipe
- Open Channel
- Truckee River

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

P:\Client Projects\Reno, City of 1461\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\1_Figures\Figure 18 - SD System Schematic.mxd, Editor: djones, Printed: 9/29/2021

East Wash Dam

Range of Flood Volumes (MG):
10-year = 0.0
Local PMP = 0.5

Range of Flood Volumes (MG):
10-year = 0.1
Local PMP = 0.8

Range of Flood Volumes (MG):
10-year = 0.0
Local PMP = 0.001

Range of Flood Volumes (MG)
10-year = 2.7
Local PMP = 5.0

West Wash Dam

Range of Flood Volumes (MG)
10-year = 2.0
Local PMP = 3.7

Range of Flood Volumes (MG)
10-year = 1.0
Local PMP = 1.7

COLLEGE-DR
PUTNAM-DR
WASHINGTON-ST
PEAVINE-RD
EVANS-AVE
ERN-DR
PUTNAM-DR
KEYSTONE-AVE
WYOMING-AVE
W-11TH-ST
E-9TH-ST
W-9TH-ST
GEAR-ST
KINGS-ROW
KEYSTONE-AVE
WASHINGTON-ST
UNIVERSITY-TER
RALSTON-ST
N-VIRGINIA-ST
N-GENTER-ST
E-6TH-ST
N-SIERRA-ST
E-5TH-ST
W-6TH-ST
E-4TH-ST
W-7TH-ST
W-5TH-ST
W-4TH-ST
N-ARLINGTON-AVE
STOKER-AVE
KEYSTONE-AVE
VINE-ST
WASHINGTON-ST
W-2ND-ST
W-1ST-ST
Outfall
80
80

Legend

- No Flooding
- Flooded Manholes
- Outfall
- Storm Drain Pipe/Drainage Channels

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User

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Figure 19: Surcharged Manholes - Both Dams In Place

N

1 " = 800 '

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East Wash Dam

Range of Flood Volumes (MG)
10-year = 0.0
Local PMP = 0.5

Range of Flood Volumes (MG)
10-year = 0.1
Local PMP = 0.8

Range of Flood Volumes (MG)
10-year = 2.7
Local PMP = 5.0

Range of Flood Volumes (MG)
10-year = 2.0
Local PMP = 3.7

Range of Flood Volumes (MG)
10-year = 1.0
Local PMP = 1.7

West Wash Dam

Range of Flood Volumes (MG)
10-year = 0.0
Local PMP = 135.9

Range of Flood Volumes (MG)
10-year = 8.9
Local PMP = 518.0

COL-EMAN-DR
PEAVINE-RD
PUTNAM-DR
KEYSTONE-AVE
KINGS-ROW
GEAR-ST
WASHINGTON-ST
COLLEGE-DR
EVANS-AVE
W-11TH-ST
E-9TH-ST
W-9TH-ST
UNIVERSITY-TER
RALSTON-ST
N-VIRGINIA-ST
N-GENTER-ST
E-6TH-ST
N-SIERRA-ST
E-5TH-ST
W-6TH-ST
E-4TH-ST
W-7TH-ST
W-5TH-ST
W-4TH-ST
N-ARLINGTON-AVE
VINE-ST
W-2ND-ST
W-1ST-ST
STOKER-AVE
80

Outfall

Legend

- No Flooding
- Flooded Manholes
- Outfall
- Storm Drain Pipe/Drainage Channels

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User

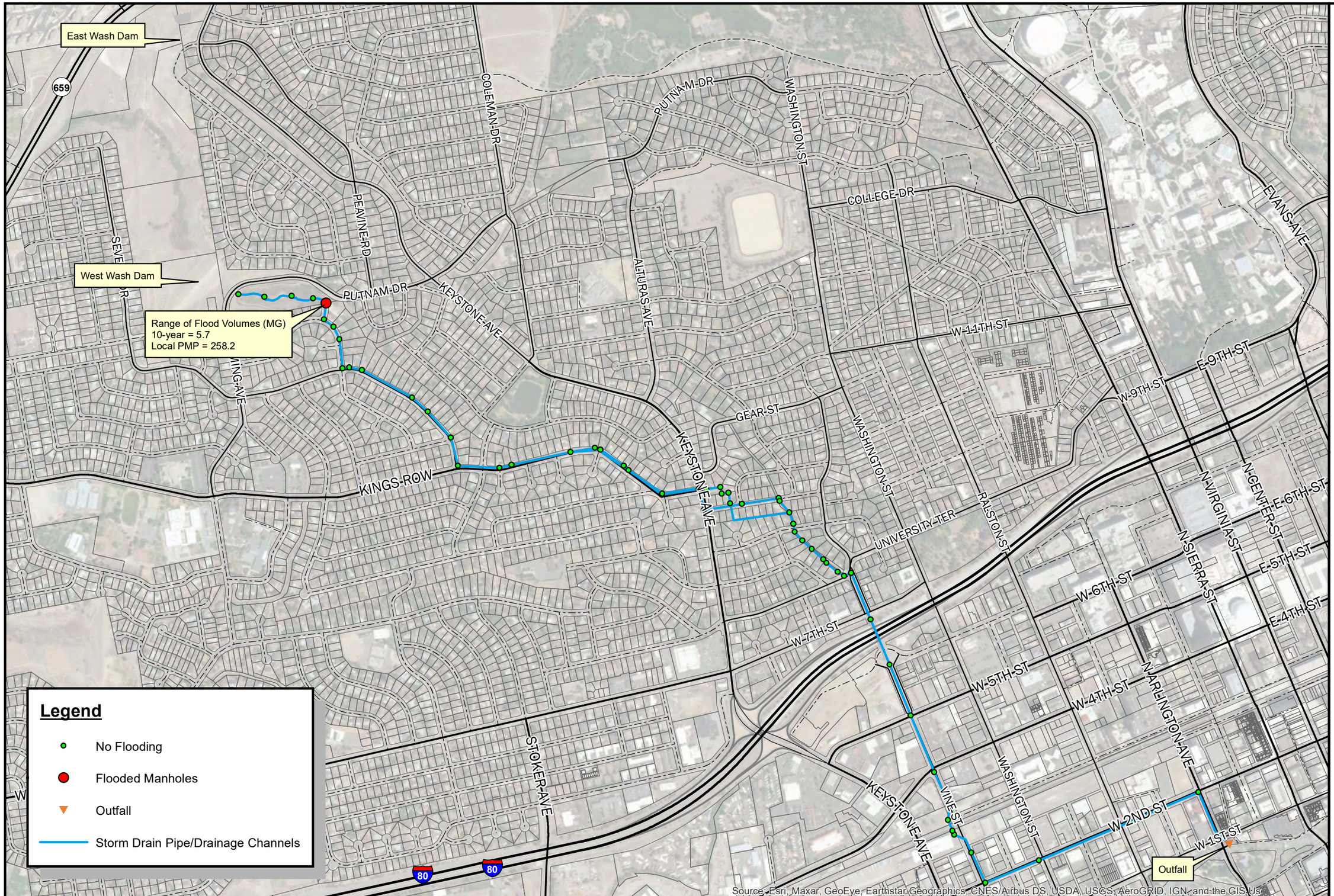
20 Years!
FARR WEST ENGINEERING
5510 Longley Lane
Reno, NV 89511
(775) 851-4788
www.farrwestengineering.com

Figure 20: Surcharged Manholes - West Wash Non-Existent

N

1 " = 800 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.



20 Years!
FARR WEST ENGINEERING
5510 Longley Lane
Reno, NV 89511
(775) 851-4788
www.farrwestengineering.com

Figure 21: Surcharged Manholes - Both Dams Non-Existent

N

1 " = 800 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

7.0 SUMMARY OF WORK

Overall, the HH&S analysis of the East and West Wash Dams predicted the downstream effects of storms from the 10-year storm event up to the Local PMP for three main scenarios: East Wash and West Wash Dams In-Place, West Wash Dam Non-Existent and East Wash Dam In-Place, East Wash and West Wash Dams Non-Existent. A sedimentation analysis was also performed to determine future storage reduction for each dam. Inflow and outflow hydrographs were calculated through the SITES software for the three scenarios considered, then those hydrographs were taken and modeled in HEC-RAS 2D software and InfoSWMM software to determine the effects to the downstream flow area and storm drain system, respectively. The information from the HH&S analysis can be used in future reports to determine an appropriate course of action to bring the East and West Wash Dams into federal, state, and local compliance. The results from this report will be further analyzed in the detailed alternatives analysis report, where recommendations will then be made.

7.1 SEDIMENTATION ANALYSIS

Projected Stage-Storage Curves for East and West Wash Dam were developed using historic sediment deposition rates and comparing the original grading with the current topography for each dam. Since detailed records of sediment accumulation and removal were not found during this analysis, more data is required to create a more complete sediment yield value for both dams. It is recommended that a Sediment Storage Rationale of 50 years be selected in accordance with NWPM 505.35C and NWPH 605.35D (USDA NRCS, 2009) (USDA NRCS, 2014a). The minimum lifespan is recommended with the idea that sediment deposition, accumulation, and suspended sediment loads can be closely monitored over a short period of time and a more accurate sediment yield calculated. Given the 50-year life-span, it was determined that by 2071 East Wash Dam would lose about 5 ac-ft of total storage volume and West Wash Dam would lose about 50 ac-ft of total storage volume due to sediment accumulation.

7.2 SPILLWAY ANALYSIS

Spillway evaluations were performed for the primary and auxiliary spillways of both the East and West Wash Dams. Based on the analysis performed in Section 4.3, dam crest height and auxiliary spillway crest height of both dams already exceeds the minimum elevations required for both the General and Local PMP to conform with TR-60 requirements (USDA NRCS, 2019). The return period for auxiliary spillway activation was determined by developing a frequency-stage-discharge curve for both dams. The East Wash Dam Auxiliary Spillway was determined to have a return period of 55 years, while the West Wash Dam Auxiliary Spillway was determined to have a return period of 150 years. The existing primary spillway of West Wash Dam was inspected via CCTV and analyzed by Farr West Engineering. An overview of the existing condition and recommendations based on the evaluation can be found in Section 0.

7.3 EAST WASH AND WEST WASH DAMS IN-PLACE

The SITES modeling for the East and West Wash Dams In-Place scenario determined that East Wash Dam had freeboard for all storm events and the auxiliary spillway was activated at the 100-year storm event and above. West Wash Dam overtopped for the ¾ Local PMP and full Local PMP, and the auxiliary spillway activated at the 200-year storm and above (excluding the ½ General PMP storm event).

The inundation routings for this scenario were modeled for the West Wash Dam Auxiliary Spillway activations and for each dam breaching at the both the auxiliary spillway elevation and the dam crest elevation. The auxiliary spillway inundation areas had between 150 and 373 storm drain inlets, while the breach inundation areas had between 118 and 253 storm drain inlets within the flow boundaries. The storm drain system was not accounted for in the HEC-RAS 2D model and could alter flow extents. It is also important to note that storm drain inlet information was unknown to the east of Evans St. The breach

inundation boundaries mainly flooded along Kings Row and Keystone Ave neighborhoods to the I-80 freeway corridor, down the I-80 corridor to Valley Rd, then pooled in areas to the north and south of the freeway. For the West Wash Dam breach, there was also some flow pooling to the south of the freeway at the Vine St underpass. None of the inundation areas for the breaches reached the Truckee River 100-year floodplain. The West Wash Dam Auxiliary Spillway inundation area mainly flooded the same areas that the breaches did, with more flooded areas to the south of the freeway and to the east around the I-80/I-580 interchange. The maximum inundation area for the auxiliary spillway reached the Truckee River in several places.

The storm drain modeling for this scenario determined that six manholes are surcharged; all between East Wash Dam and the junction where East Wash and West Wash storm drain systems meet. There are no surcharged manholes downstream of the East Wash/West Wash storm drain junction.

7.4 WEST WASH DAM NON-EXISTENT AND EAST WASH DAM IN-PLACE

The SITES modeling for the West Wash Dam Non-Existent and East Wash Dam In-Place scenario determined that the peak flow out of West Wash was approximately 16,000 cfs during the full Local PMP.

The inundation routings for this scenario were modeled from West Wash only and contained between 128 and 359 storm drain inlets within the flow boundaries. The storm drain system was not accounted for in the HEC-RAS 2D model and could alter flow extents. It is also important to note that storm drain inlet information was unknown to the east of Evans St. The breach inundation boundaries mainly flooded along Kings Row and Keystone Ave neighborhoods to the I-80 freeway corridor, to the south of I-80 at the intersection of Vine St, down the I-80 corridor to Valley Rd, and in areas to the north and south of the freeway from Valley Road to the east of the I-80/I-580 interchange. The maximum inundation area for the auxiliary spillway reached the Truckee River in several places.

The storm drain modeling for this scenario determined that seven manholes are surcharged; five between East Wash Dam and the junction where East Wash and West Wash storm drain systems meet and two between West Wash Dam and the junction where East Wash and West Wash storm drain systems meet. There are no surcharged manholes downstream of the East Wash/West Wash storm drain junction.

7.5 EAST WASH AND WEST WASH DAMS NON-EXISTENT

The SITES modeling for the East and West Wash Dams Non-Existent scenario determined that peak flows out of East and West Wash were approximately 10,000 cfs and 6,500 cfs, respectively. Both peak flows occurred during the full Local PMP storm event.

The inundation routings for this scenario were modeled from East and West Wash only and contained between 191 and 370 storm drain inlets within the flow boundaries. The storm drain system was not accounted for in the HEC-RAS 2D model and could alter flow extents. It is also important to note that storm drain inlet information was unknown to the east of Evans St. The breach inundation boundaries mainly flooded along Kings Row and Keystone Ave neighborhoods to the I-80 freeway corridor, to the south of I-80 at the intersection of Vine St, down the I-80 corridor to Valley Rd, and in areas to the north and south of the freeway from Valley Road to the east of the I-80/I-580 interchange. The maximum inundation area for the auxiliary spillway reached the Truckee River in several places.

The storm drain modeling for this scenario determined that one manhole is surcharged between West Wash Dam and the junction where East Wash and West Wash storm drain systems meet. There are no surcharged manholes downstream of the East Wash/West Wash storm drain junction.

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APPENDIX A: EAST WASH DAM SEDIMENT REMOVAL RECORDS

SHEET NOTES:

(2) APPROXIMATE LIMITS OF SEDIMENT AND DEBRIS REMOVAL AND DISPOSAL. ACTUAL LIMITS TO BE DETERMINED IN THE FIELD BY THE ENGINEER. BID ITEM 300A.

LEGEND

ITEM	
	SEDIMENT AND DEBRIS REMOVAL.
BID ITEM# : QUANTITY (XX)	

EAST WASH DAM

N

SCALE IN FEET

80' 0' 80' 160'

CITY OF RENO
DEPARTMENT OF PUBLIC WORKS
CAPITAL PROJECTS
ONE EAST FIRST STREET, 8TH FLOOR
PO BOX 1900
RENO, NV 89505
PHONE: (775) 334-2548

CITY OF RENO DAMS

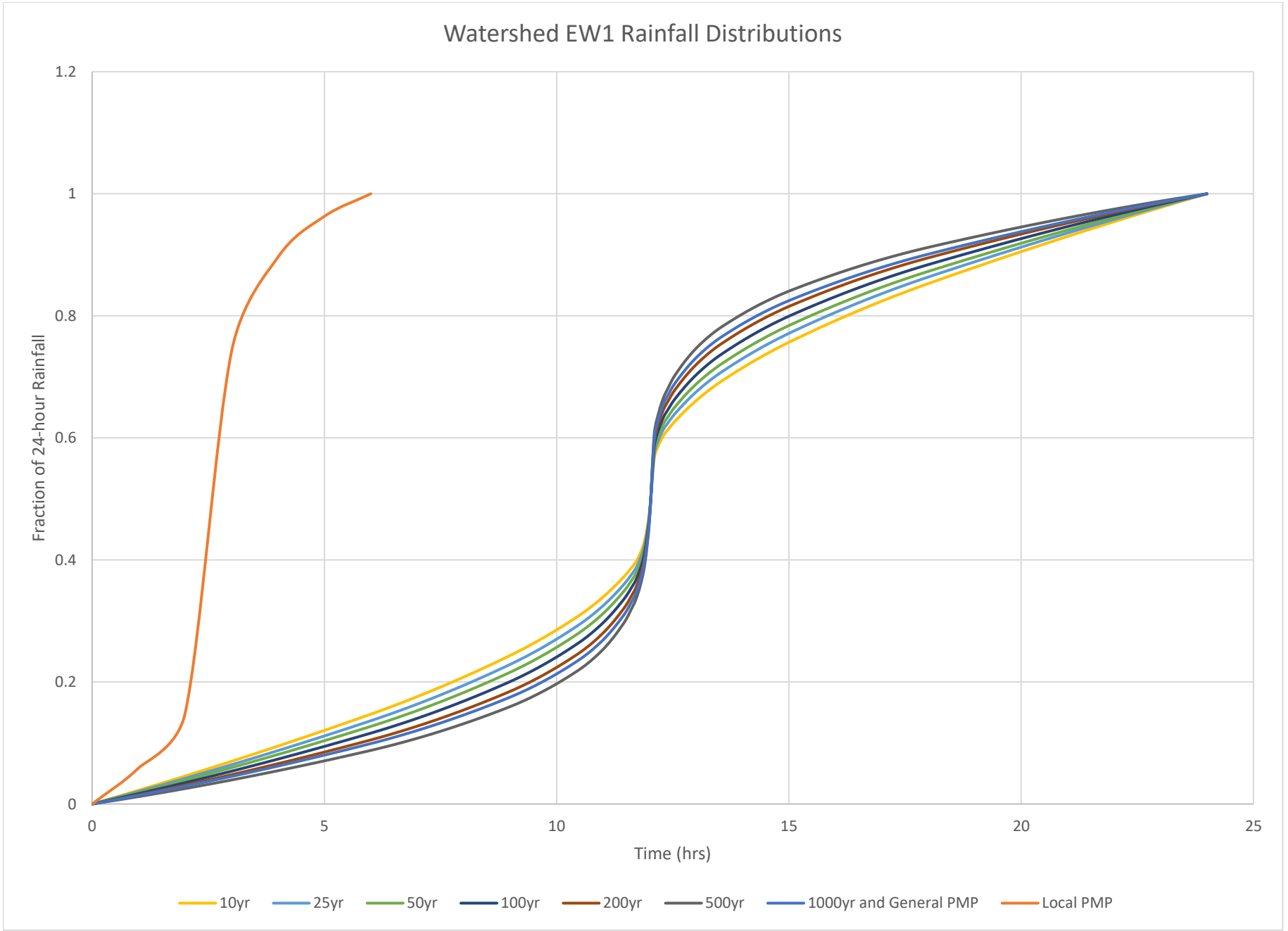
SEDIMENT AND DEBRIS REMOVAL AND FLOOD REPAIRS

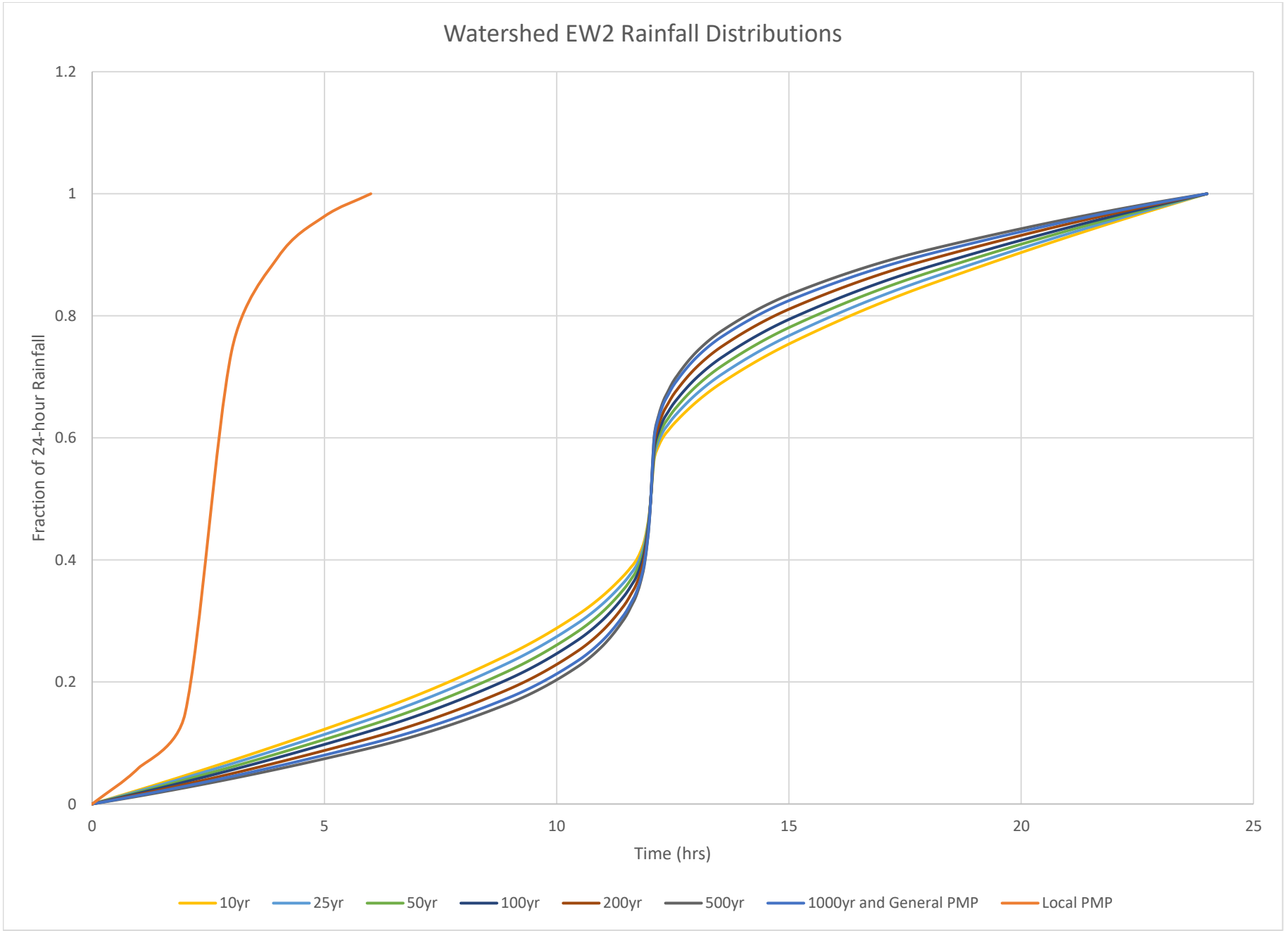
PROJ. No.:	
DESIGN BY:	DV/KA
DRAWN BY:	DV
CHECK BY:	KA
SCALE:	HORZ: AS SHOWN
	VERT: AS SHOWN

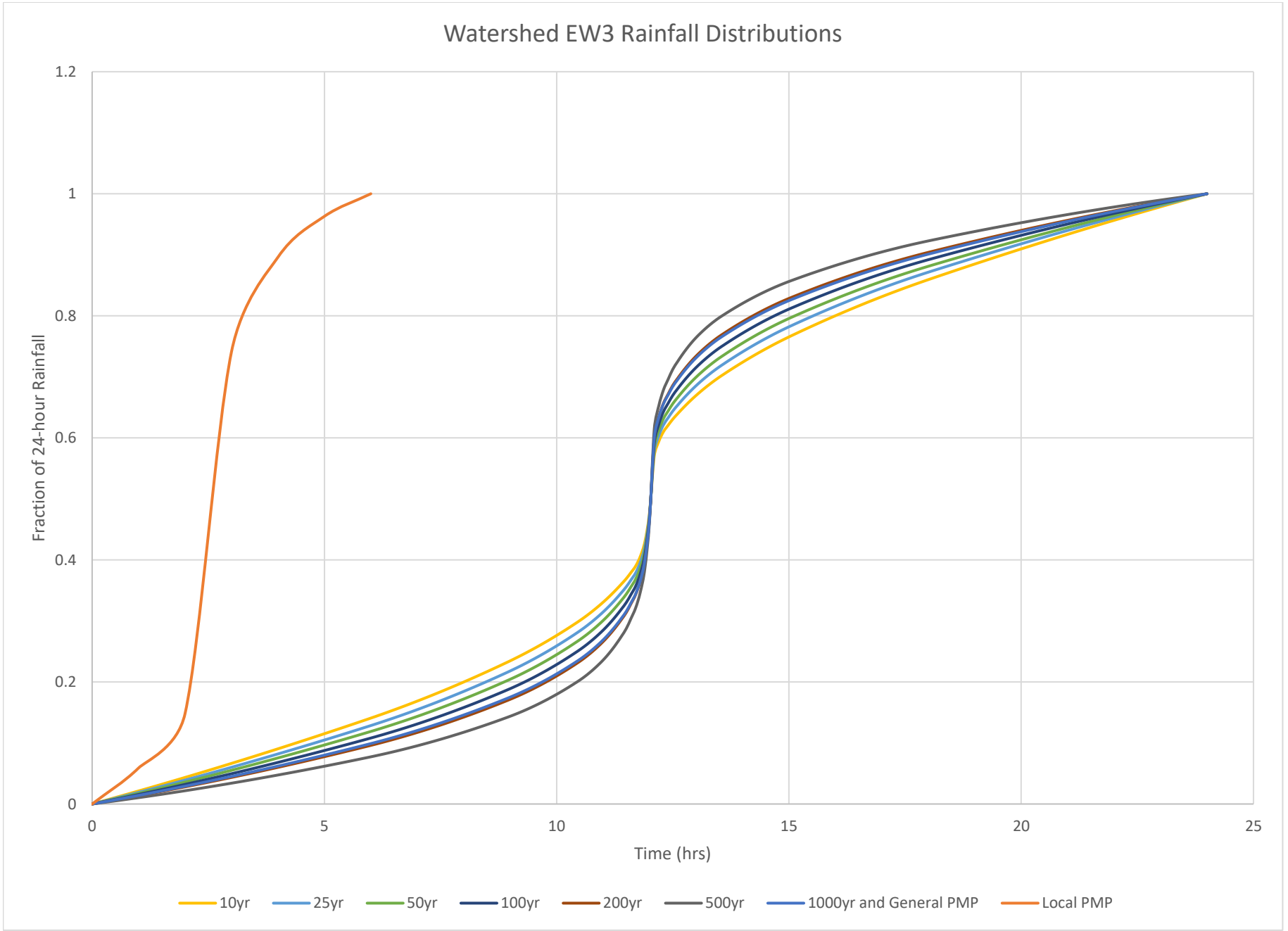
SHEET 4

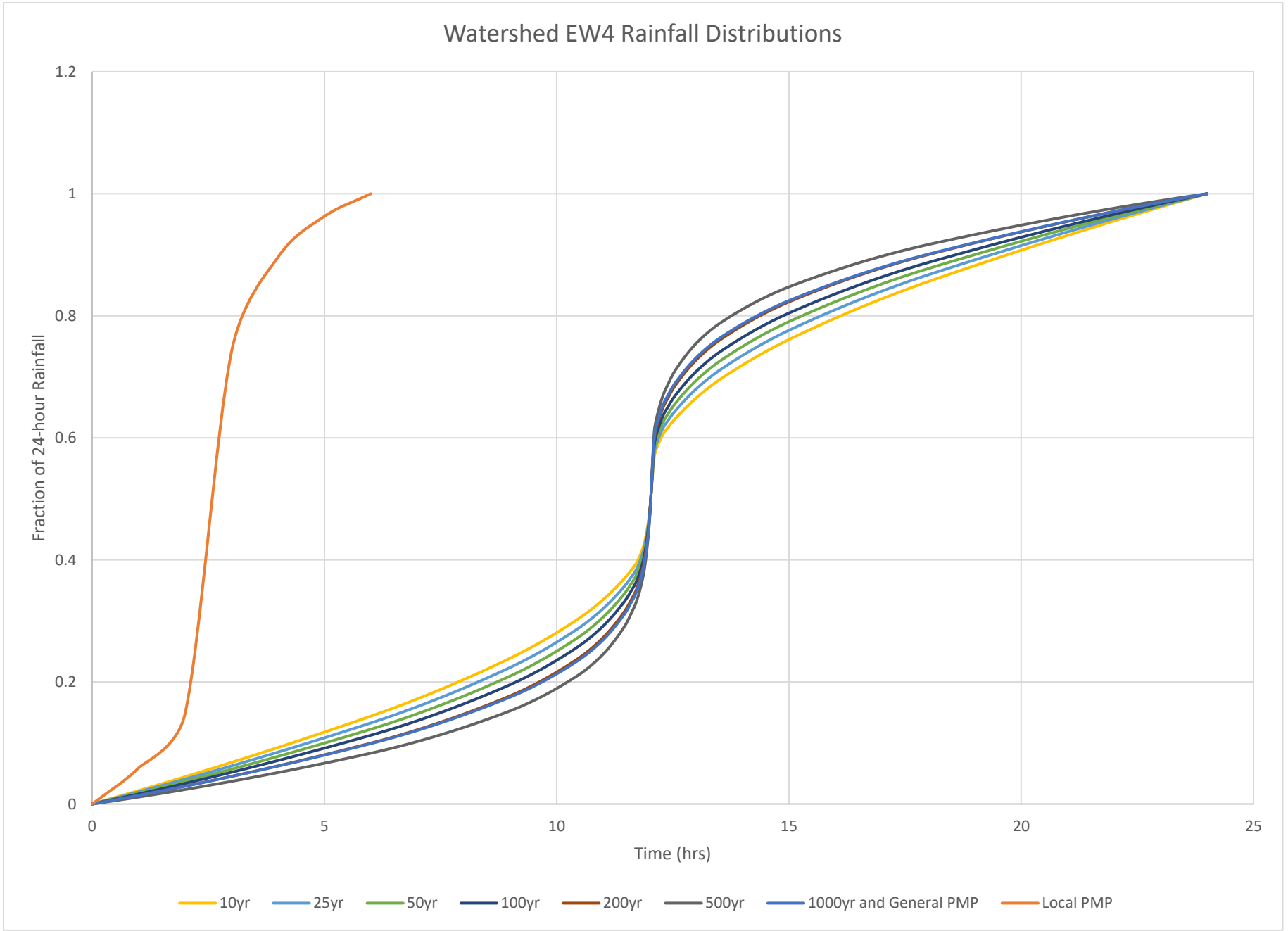
OF 4

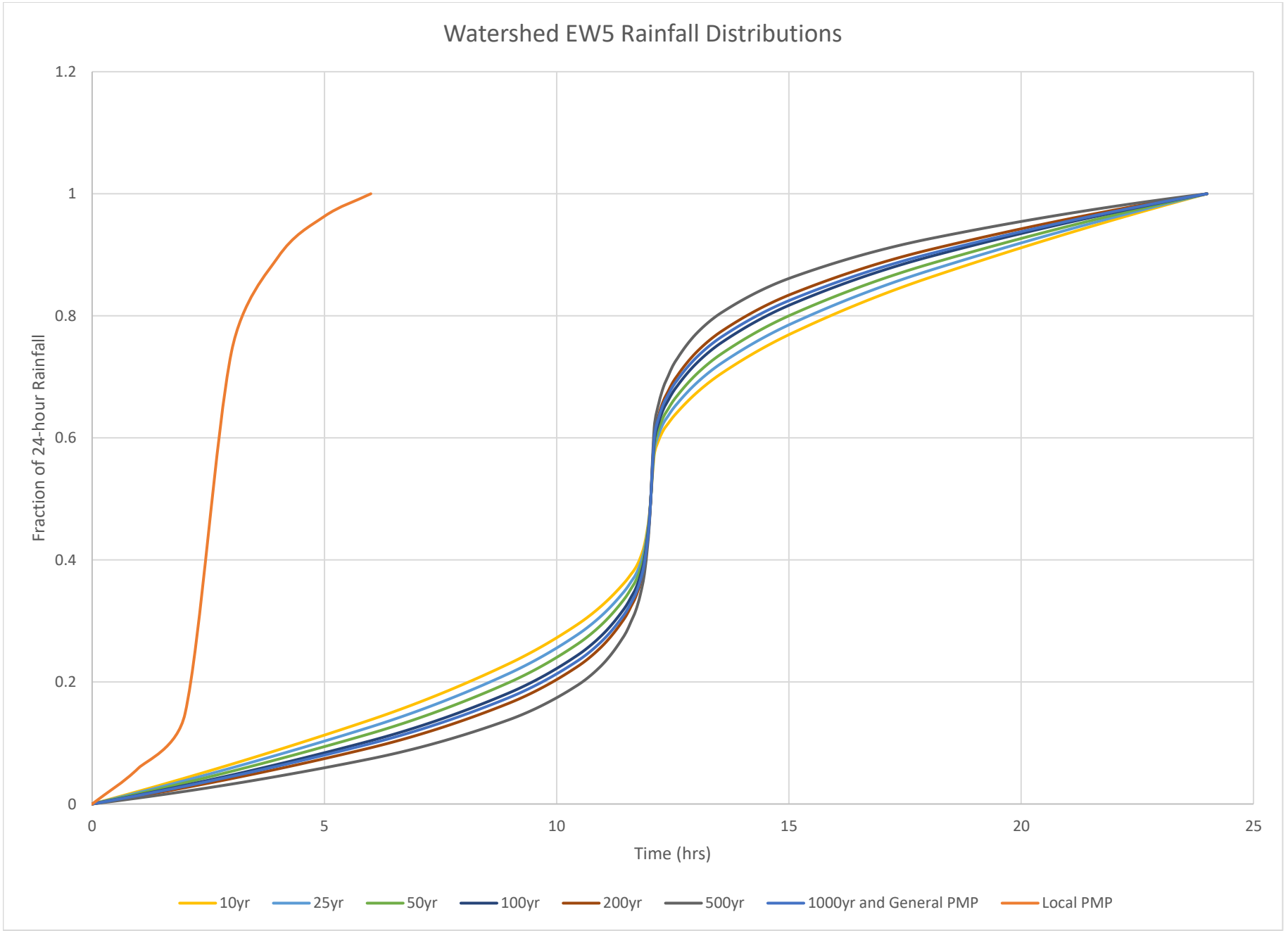
APPENDIX B: STORM DISTRIBUTION CURVES

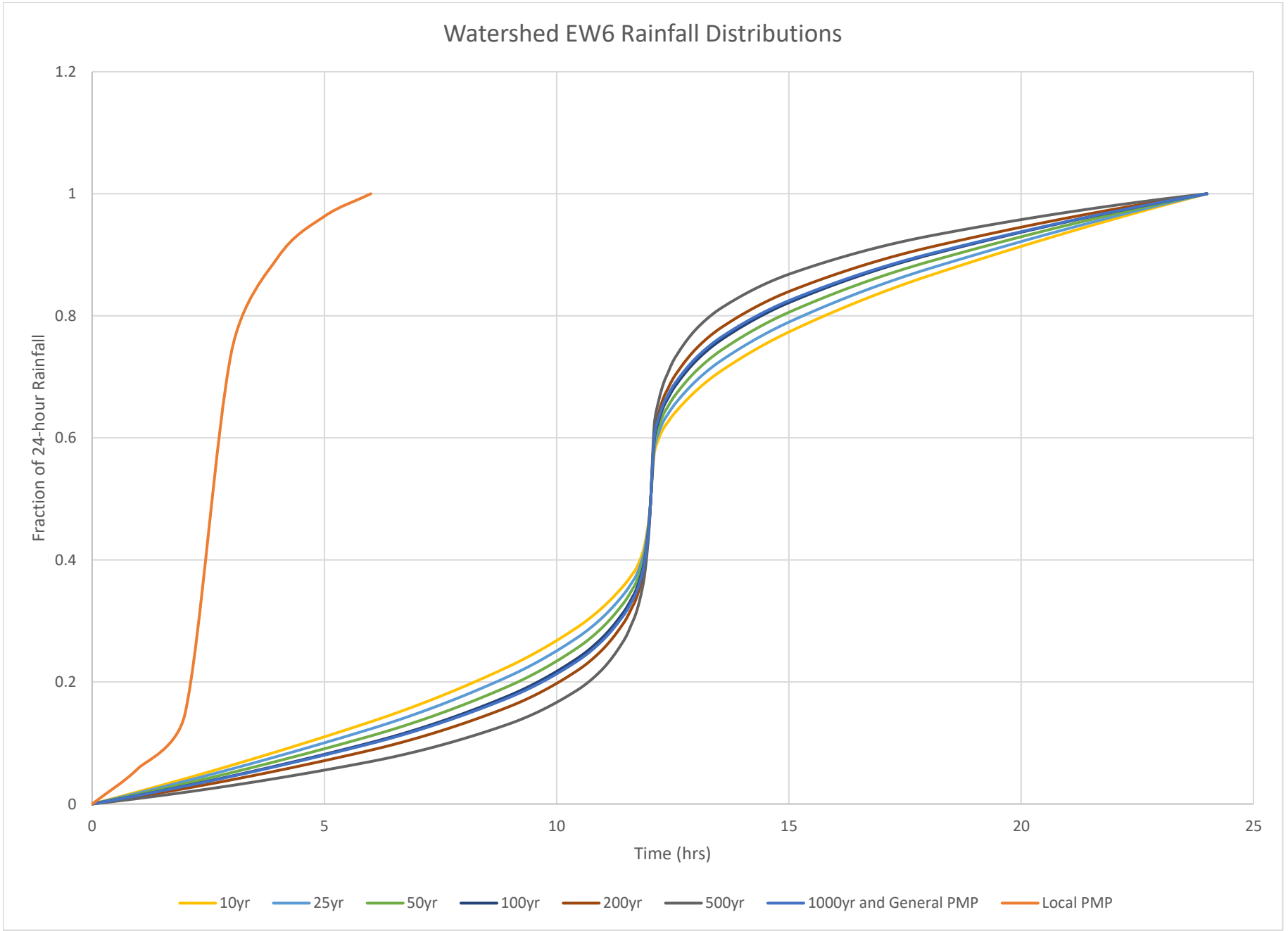

Watershed EW1 Rainfall Distributions
Fraction of 24-hour Rainfall
1.2
1
0.8
0.6
0.4
0.2
0
0
5
10
15
20
25
Time (hrs)
10yr
25yr
50yr
100yr
200yr
500yr
1000yr and General PMP
Local PMP

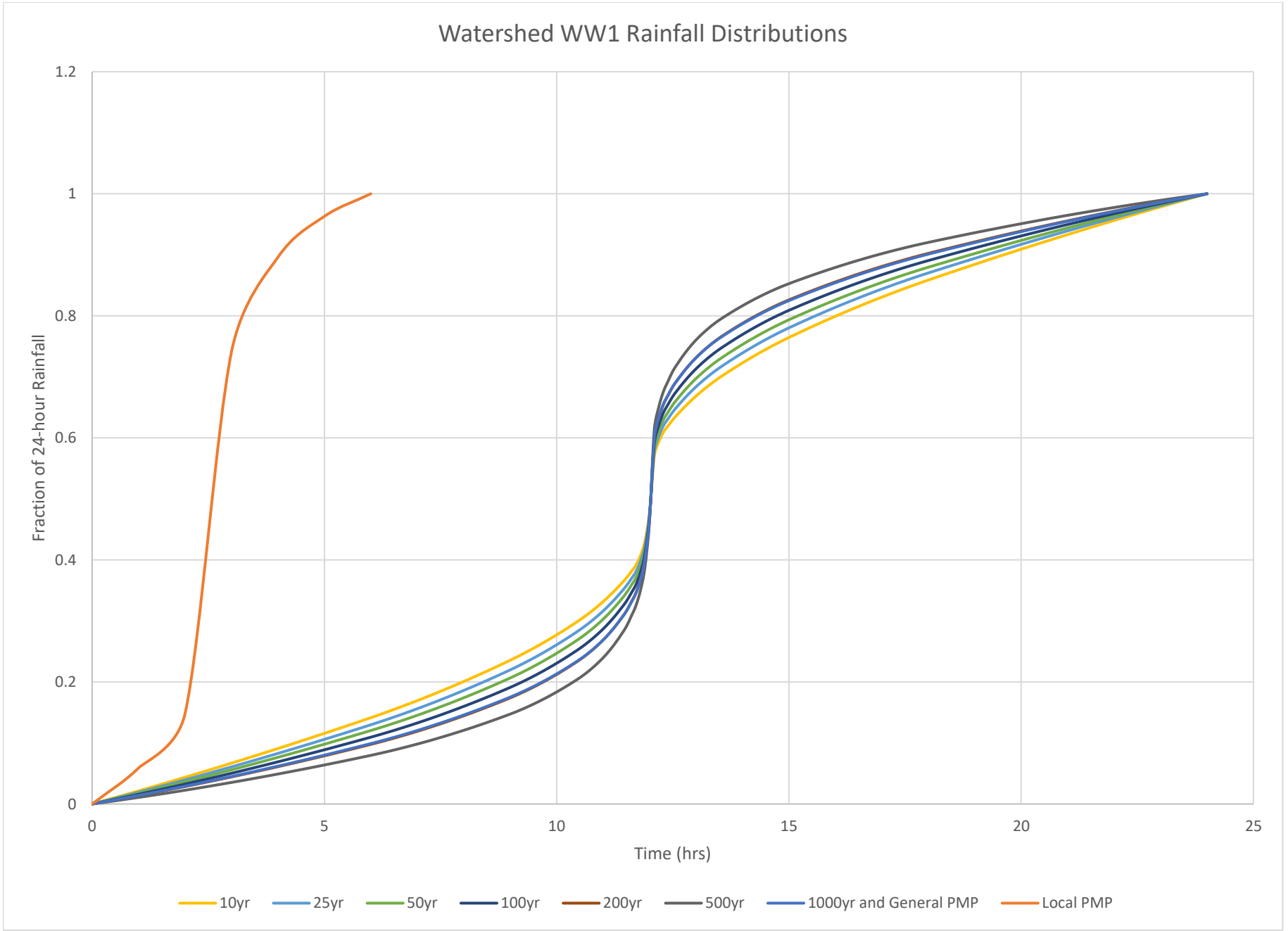

Watershed EW2 Rainfall Distributions
Fraction of 24-hour Rainfall
1.2
1
0.8
0.6
0.4
0.2
0
0
5
10
15
20
25
Time (hrs)
10yr
25yr
50yr
100yr
200yr
500yr
1000yr and General PMP
Local PMP

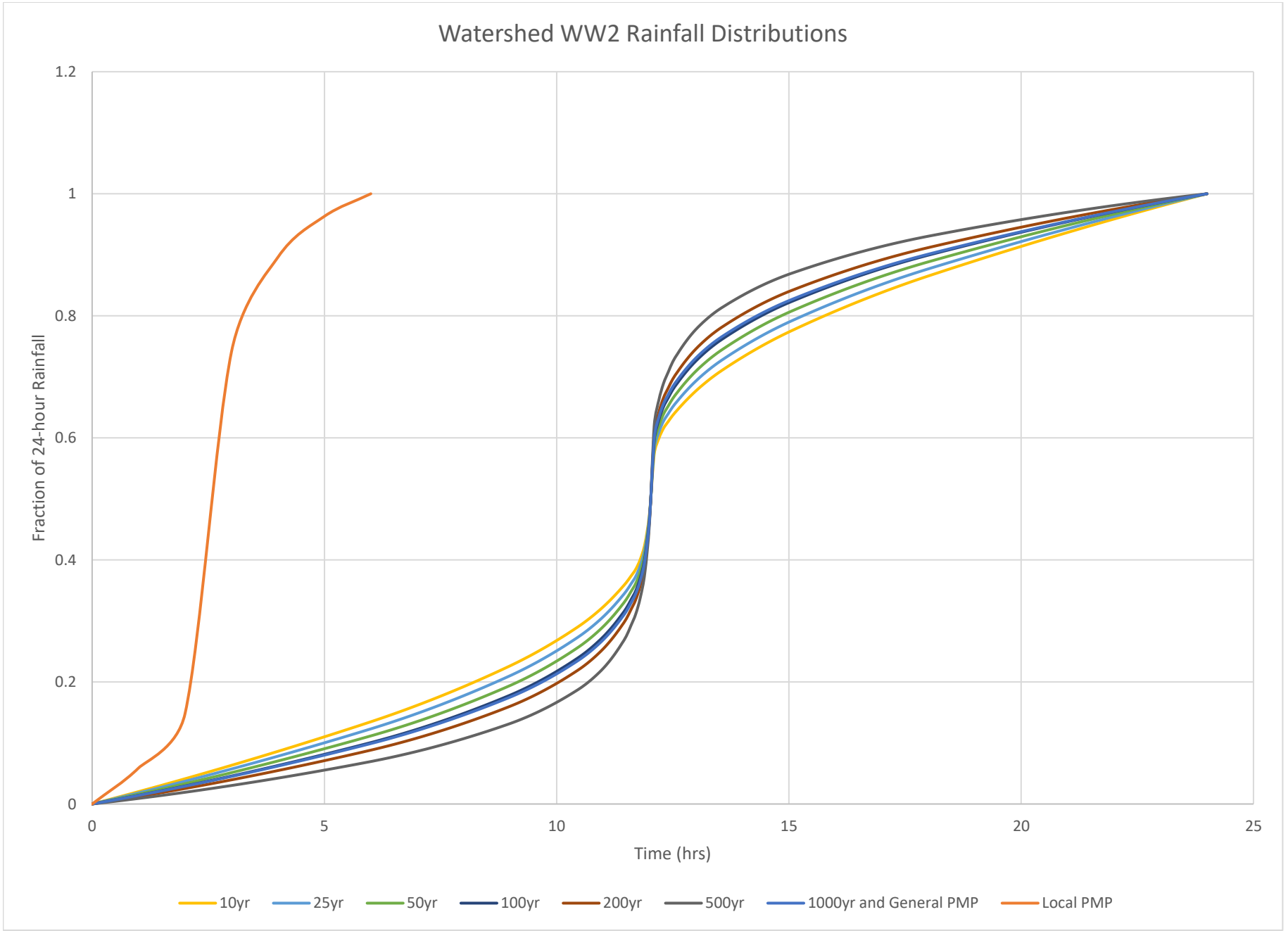

Watershed EW3 Rainfall Distributions
Fraction of 24-hour Rainfall
1.2
1
0.8
0.6
0.4
0.2
0
0
5
10
15
20
25
Time (hrs)
10yr
25yr
50yr
100yr
200yr
500yr
1000yr and General PMP
Local PMP

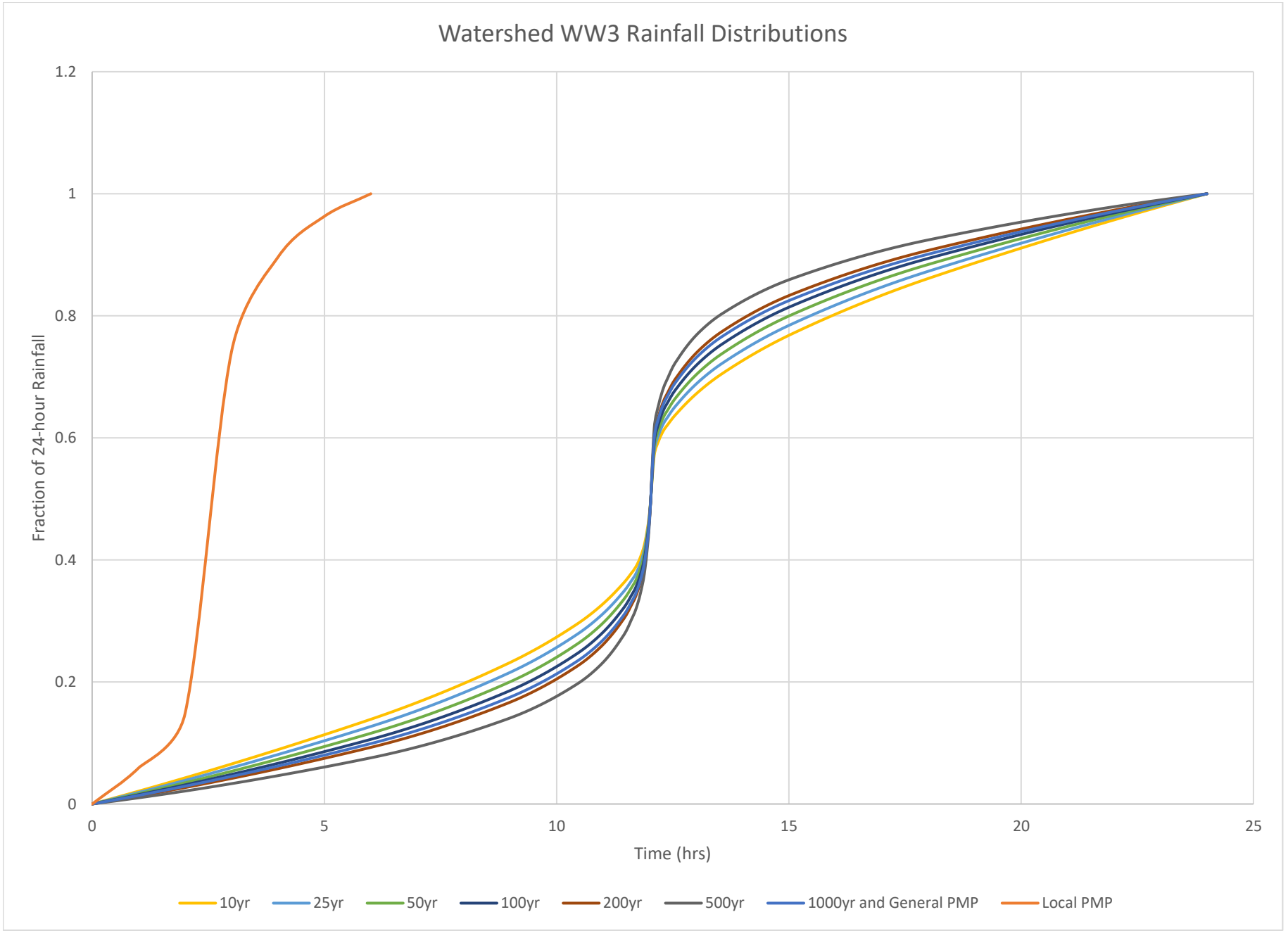

Watershed EW4 Rainfall Distributions
Fraction of 24-hour Rainfall
1.2
1
0.8
0.6
0.4
0.2
0
0
5
10
15
20
25
Time (hrs)
10yr
25yr
50yr
100yr
200yr
500yr
1000yr and General PMP
Local PMP


Watershed EW5 Rainfall Distributions
Fraction of 24-hour Rainfall
1.2
1
0.8
0.6
0.4
0.2
0
0
5
10
15
20
25
Time (hrs)
10yr
25yr
50yr
100yr
200yr
500yr
1000yr and General PMP
Local PMP


Watershed EW6 Rainfall Distributions
Fraction of 24-hour Rainfall
1.2
1
0.8
0.6
0.4
0.2
0
0
5
10
15
20
25
Time (hrs)
10yr
25yr
50yr
100yr
200yr
500yr
1000yr and General PMP
Local PMP


Watershed WW1 Rainfall Distributions
Fraction of 24-hour Rainfall
1.2
1
0.8
0.6
0.4
0.2
0
0
5
10
15
20
25
Time (hrs)
10yr
25yr
50yr
100yr
200yr
500yr
1000yr and General PMP
Local PMP


Watershed WW2 Rainfall Distributions
Fraction of 24-hour Rainfall
1.2
1
0.8
0.6
0.4
0.2
0
0
5
10
15
20
25
Time (hrs)
10yr
25yr
50yr
100yr
200yr
500yr
1000yr and General PMP
Local PMP


Watershed WW3 Rainfall Distributions
Fraction of 24-hour Rainfall
1.2
1
0.8
0.6
0.4
0.2
0
0
5
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Time (hrs)
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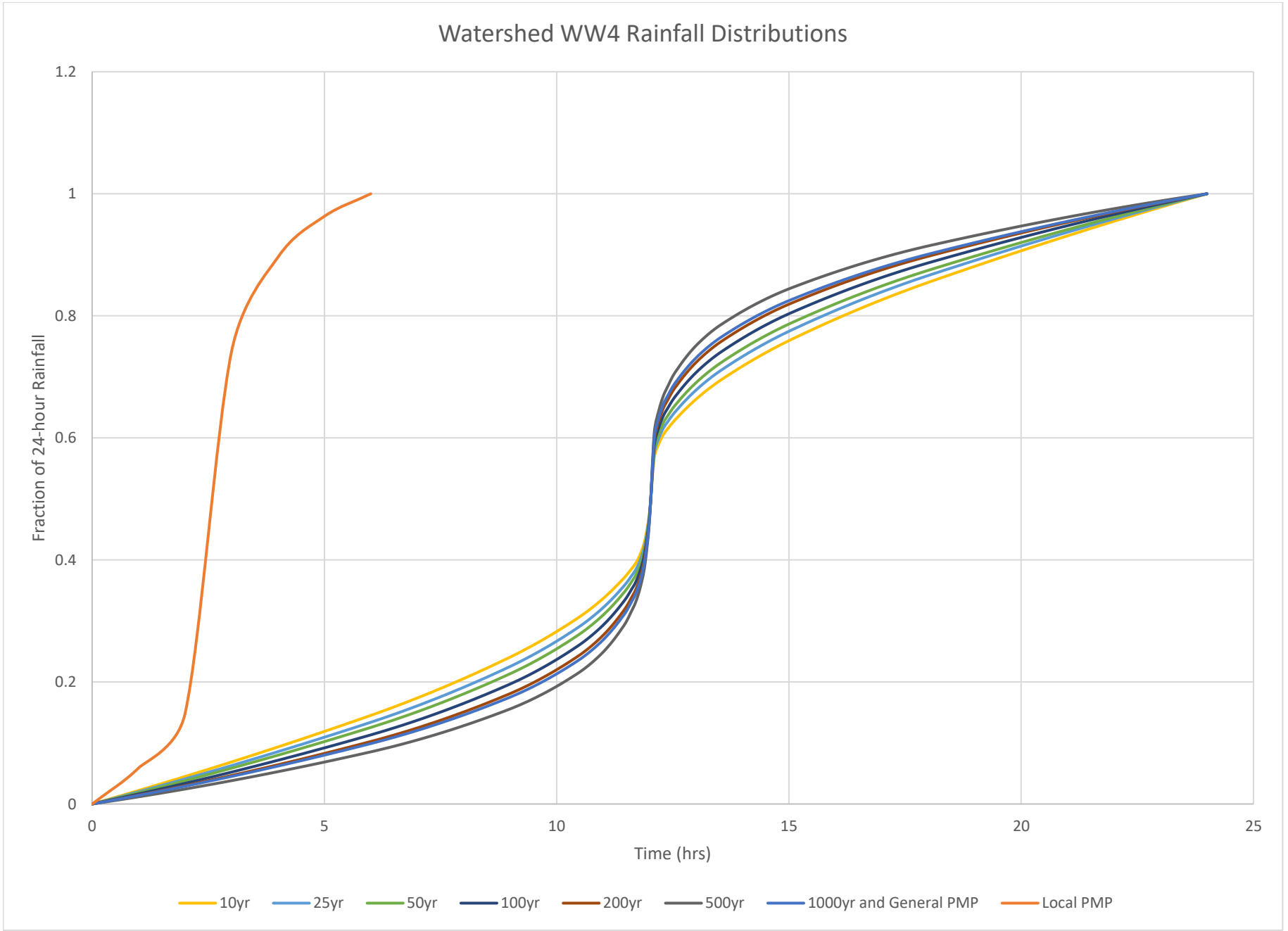
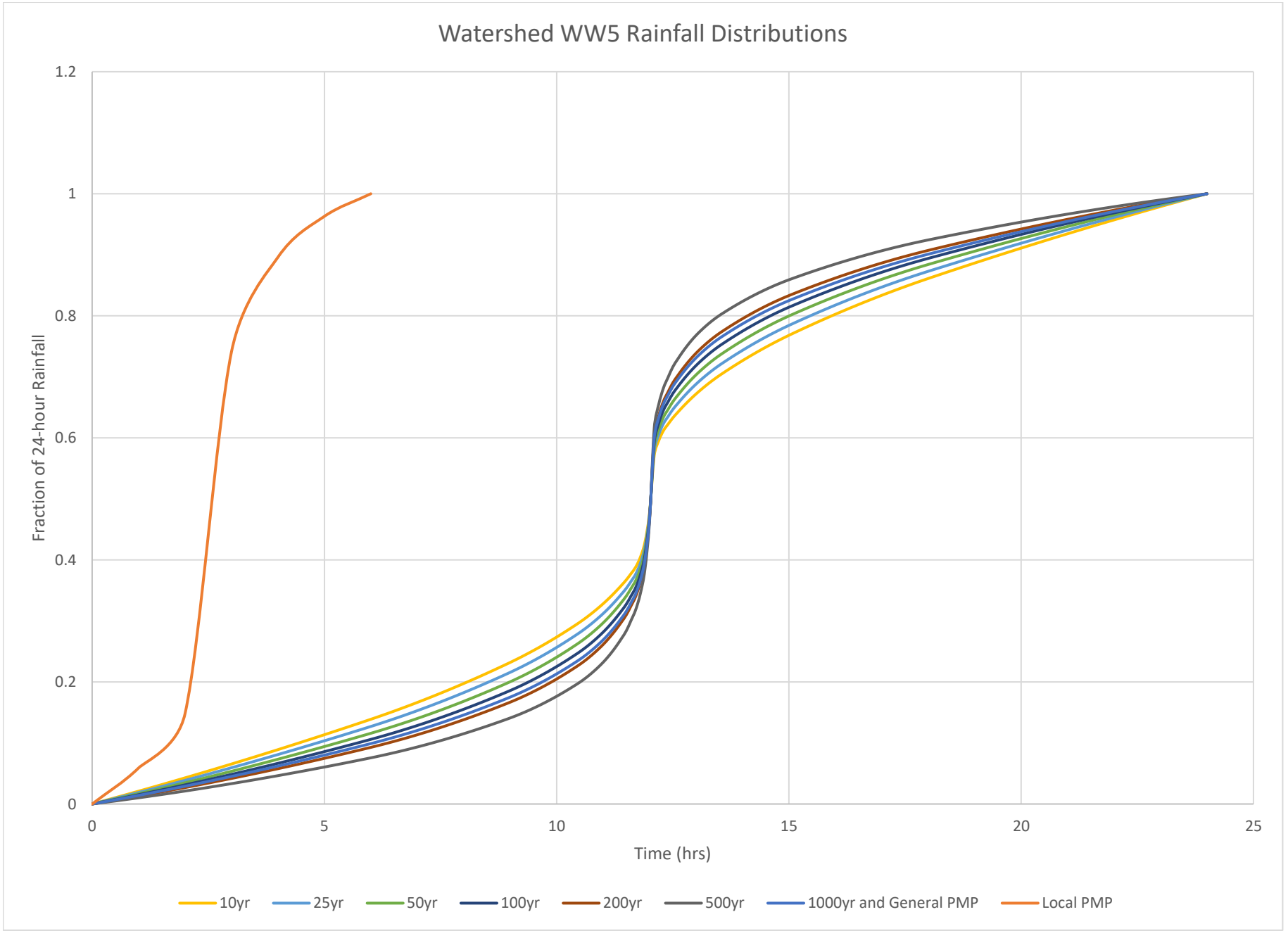
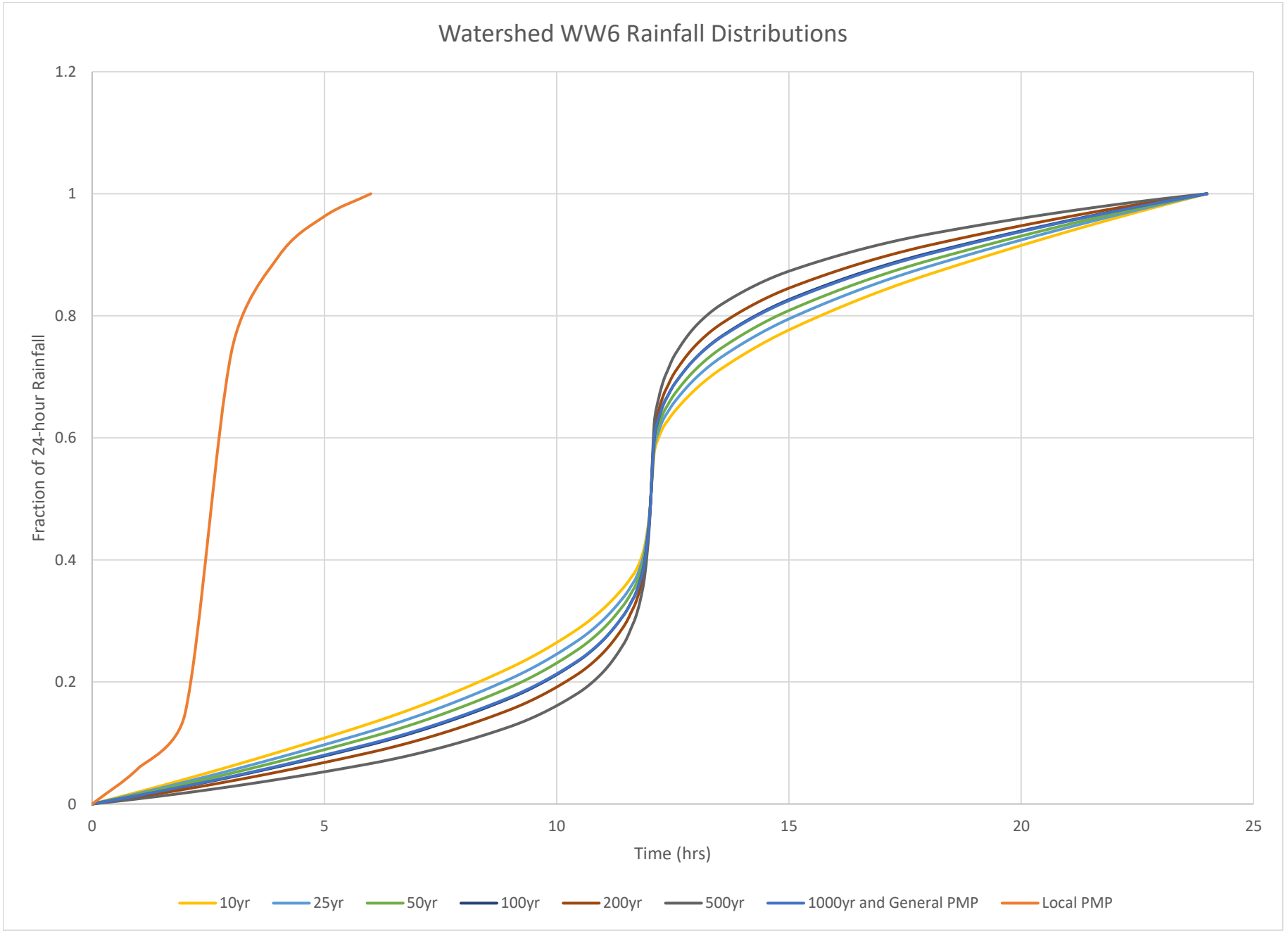
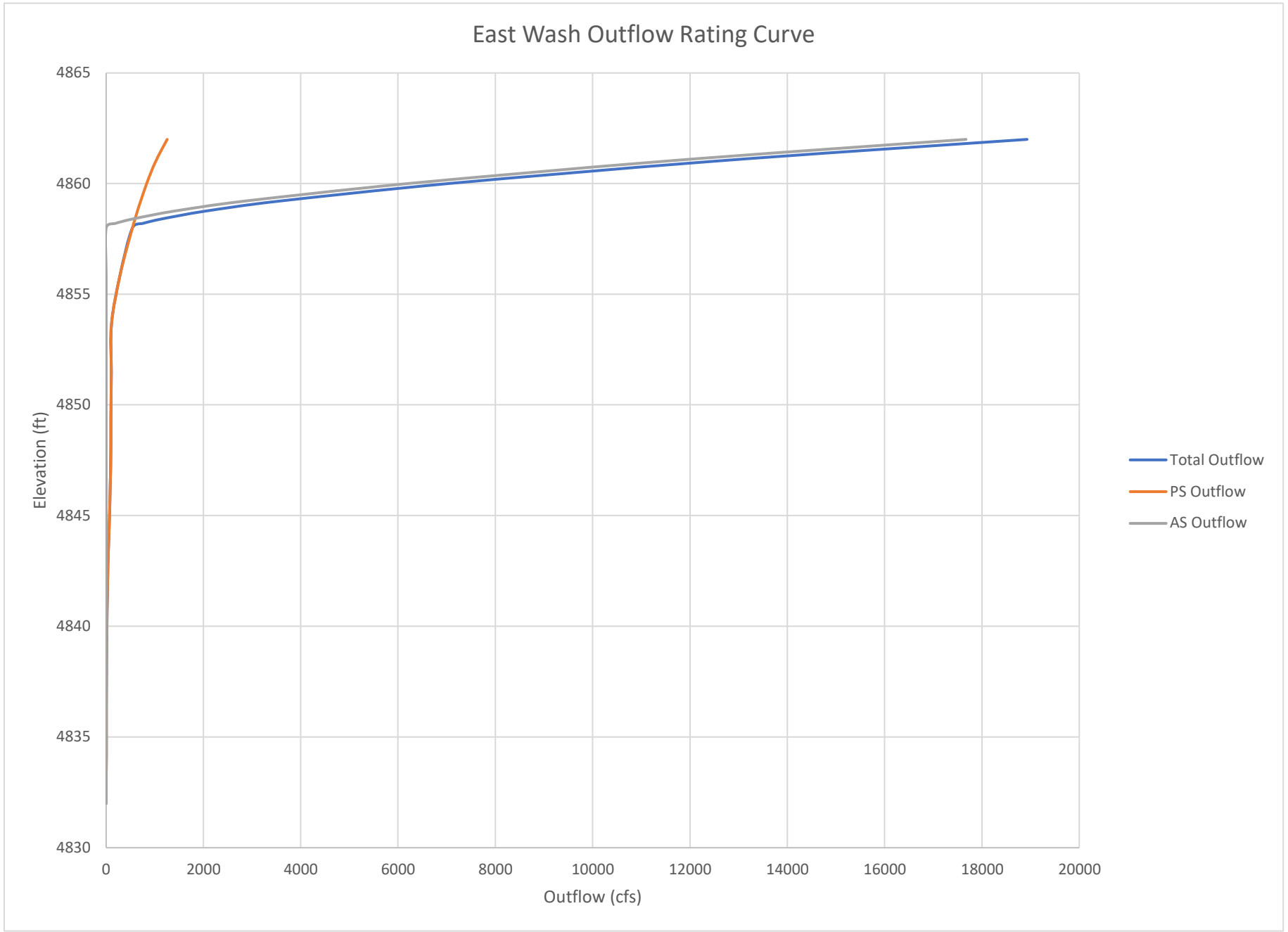
200yr
500yr
1000yr and General PMP
Local PMP

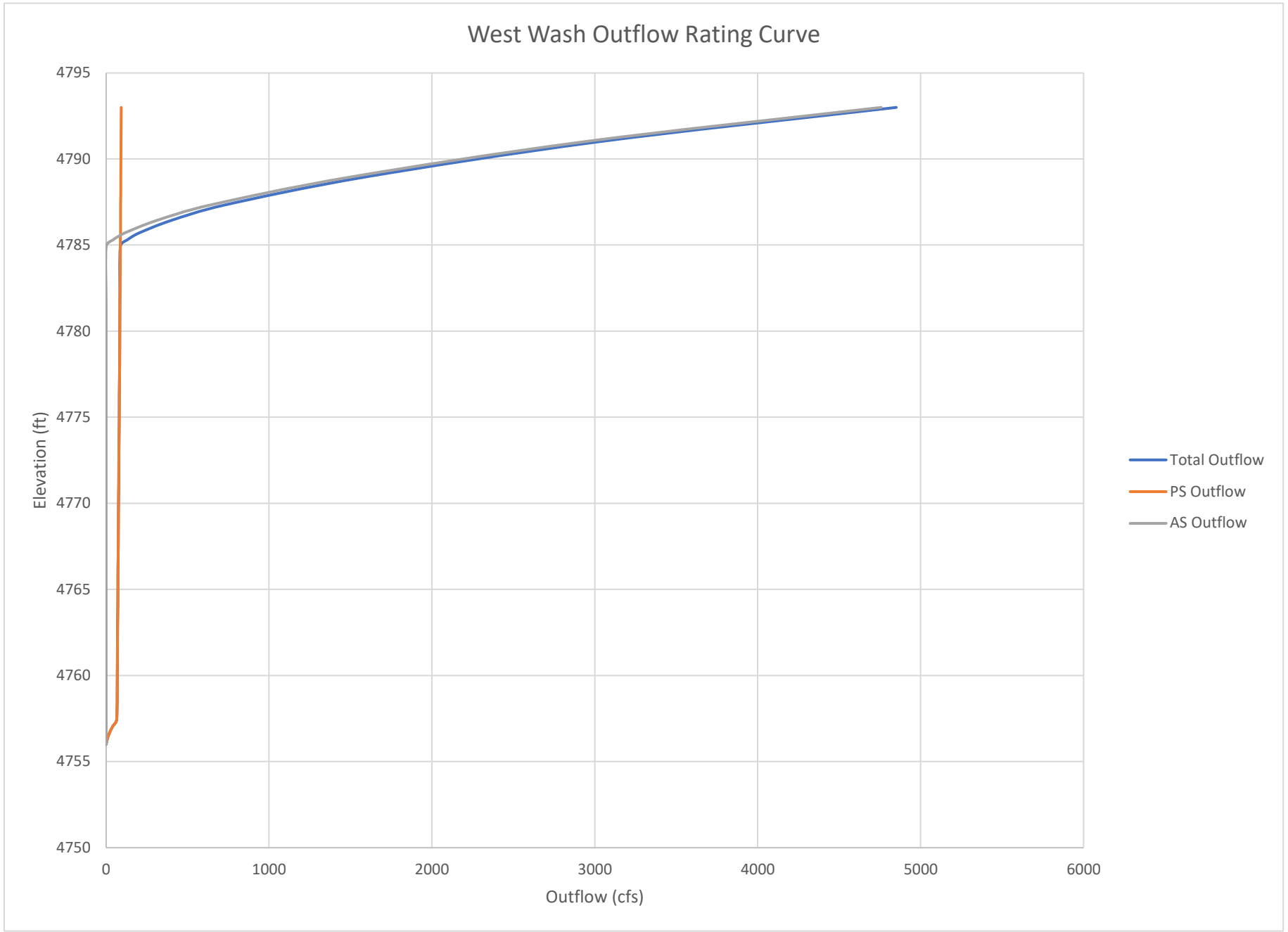

Watershed WW4 Rainfall Distributions
Fraction of 24-hour Rainfall
1.2
1
0.8
0.6
0.4
0.2
0
0
5
10
15
20
25
Time (hrs)
10yr
25yr
50yr
100yr
200yr
500yr
1000yr and General PMP
Local PMP


Watershed WW5 Rainfall Distributions
Fraction of 24-hour Rainfall
1.2
1
0.8
0.6
0.4
0.2
0
0
5
10
15
20
25
Time (hrs)
10yr
25yr
50yr
100yr
200yr
500yr
1000yr and General PMP
Local PMP

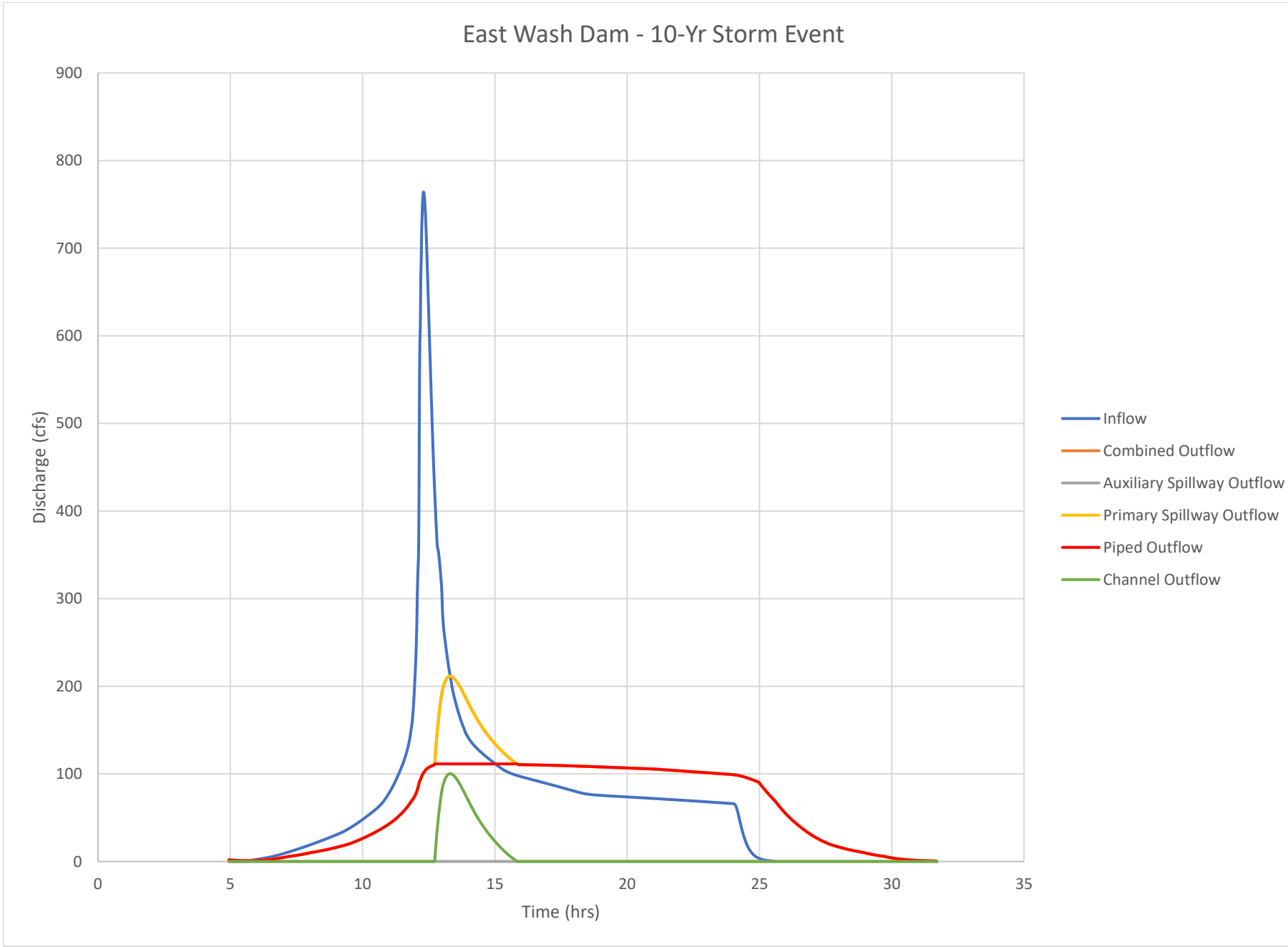

Watershed WW6 Rainfall Distributions
Fraction of 24-hour Rainfall
1.2
1
0.8
0.6
0.4
0.2
0
0
5
10
15
20
25
Time (hrs)
10yr
25yr
50yr
100yr
200yr
500yr
1000yr and General PMP
Local PMP

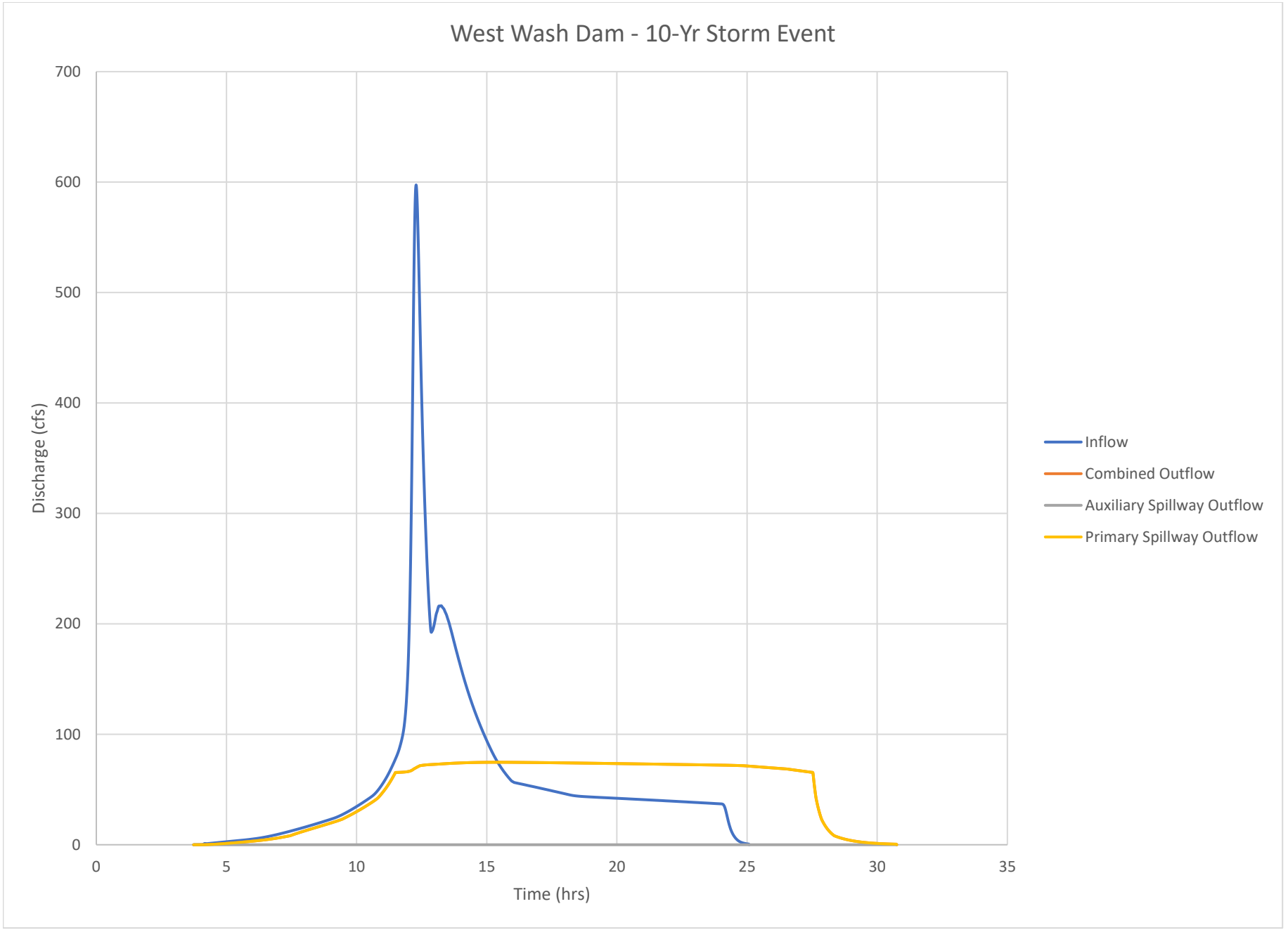
APPENDIX C: RATING CURVES FOR EAST WASH AND WEST WASH

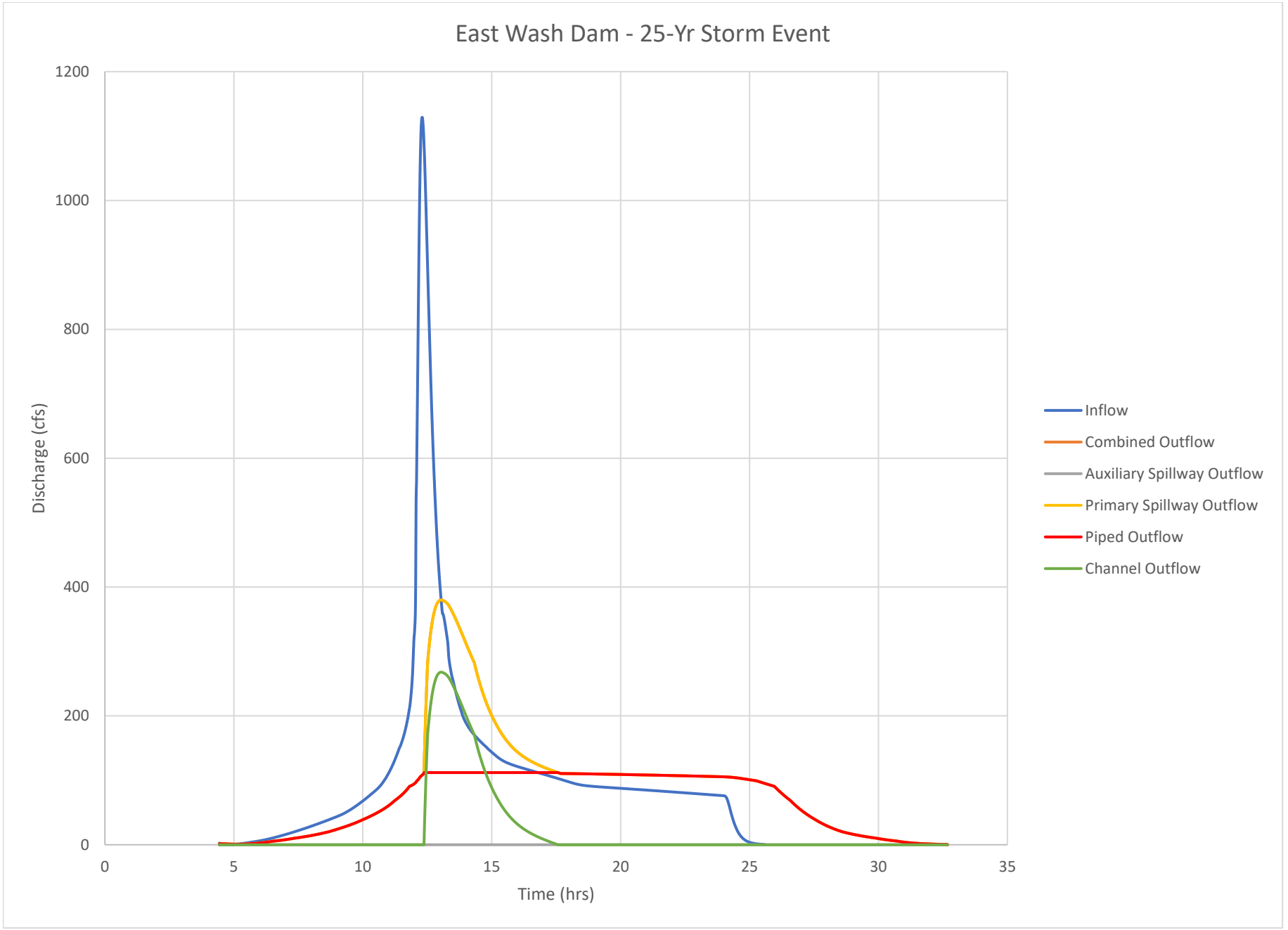

East Wash Outflow Rating Curve
Elevation (ft)
4865
4860
4855
4850
4845
4840
4835
4830
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
Outflow (cfs)
Total Outflow
PS Outflow
AS Outflow

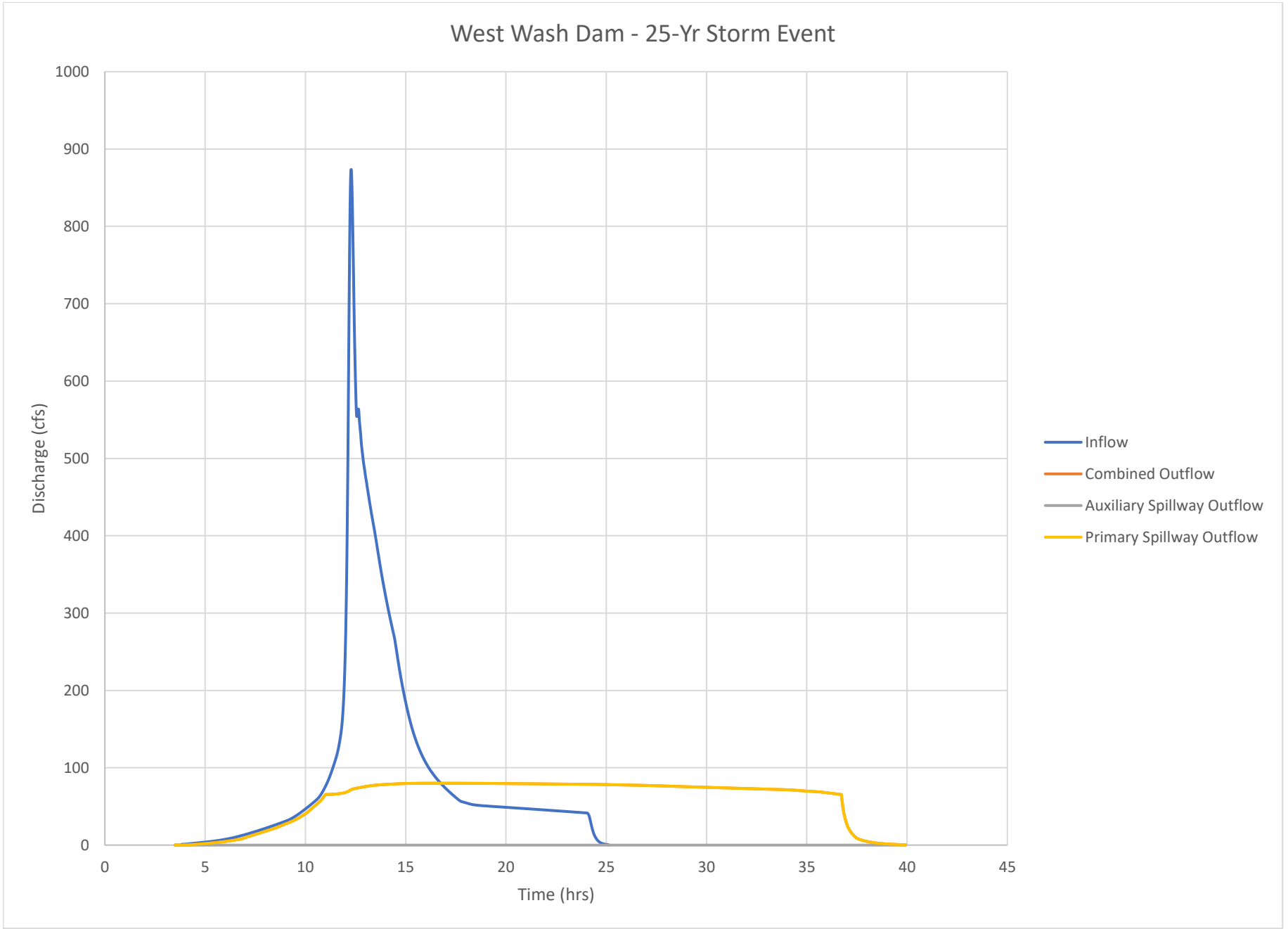

West Wash Outflow Rating Curve
4795
4790
4785
4780
4775
4770
4765
4760
4755
4750
Elevation (ft)
0
1000
2000
3000
4000
5000
6000
Outflow (cfs)
Total Outflow
PS Outflow
AS Outflow

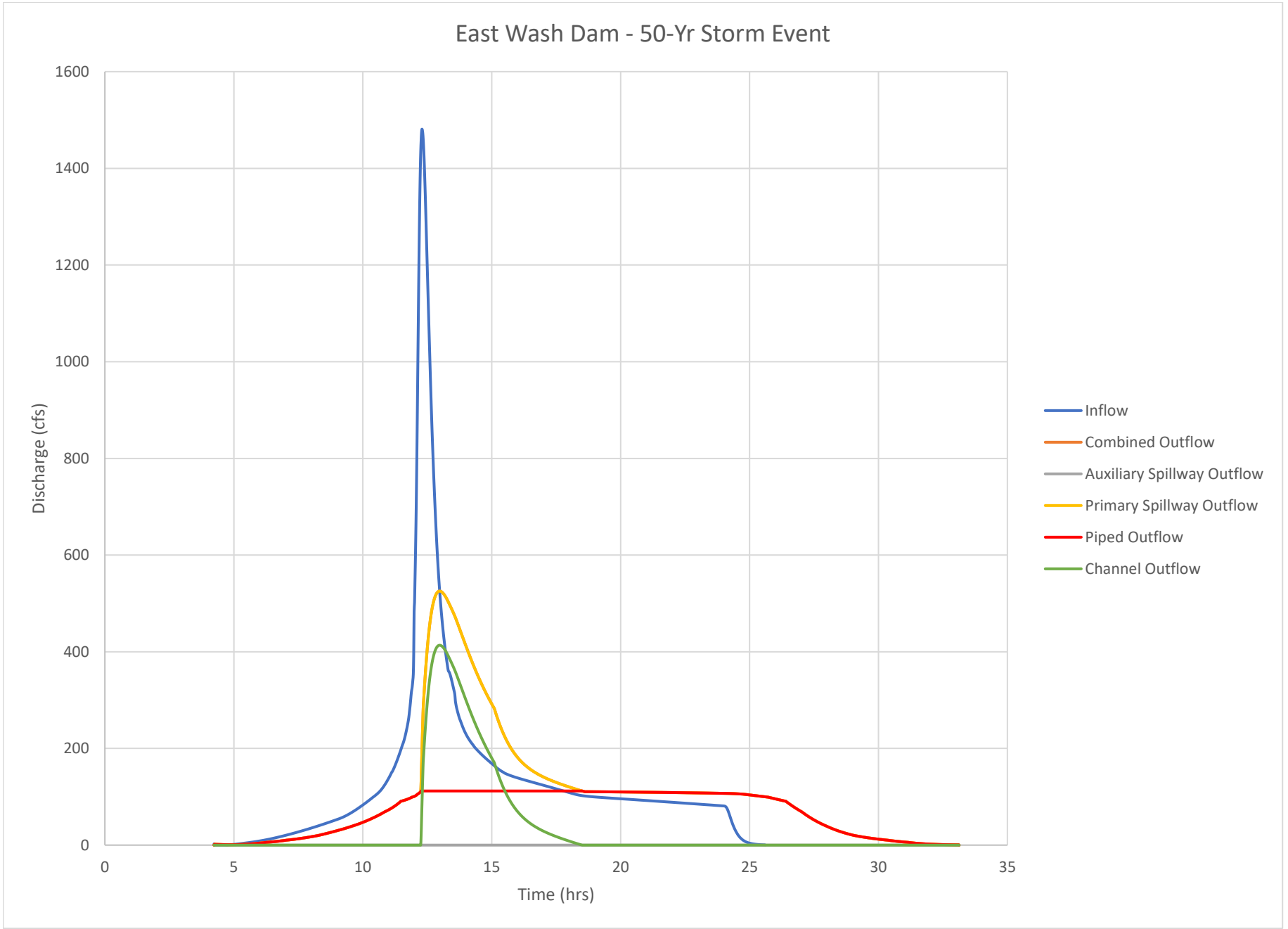
APPENDIX D: INFLOW/OUTFLOW HYDROGRAPHS – EAST WASH AND WEST WASH DAMS IN-PLACE

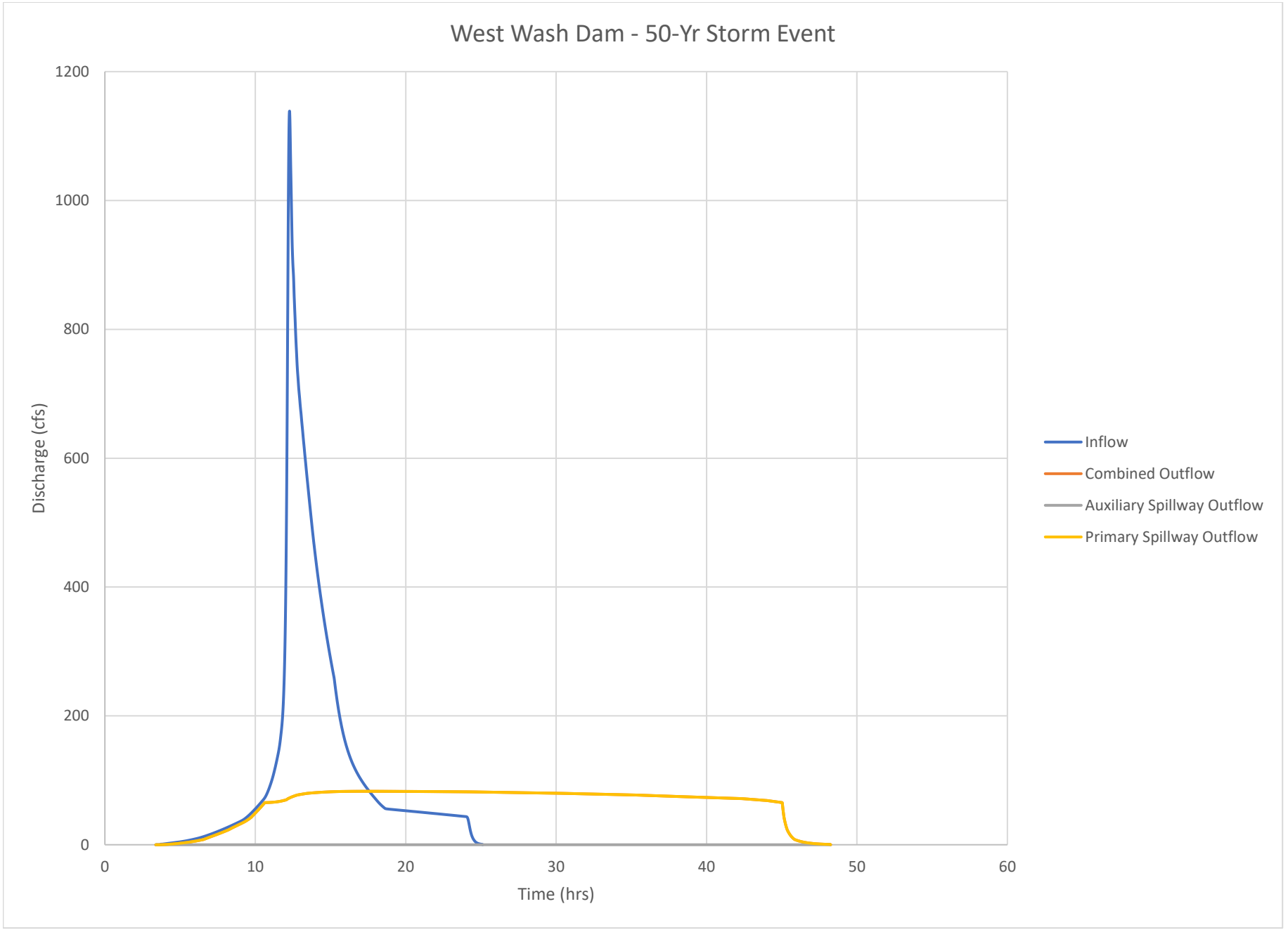

East Wash Dam - 10-Yr Storm Event
Discharge (cfs)
900
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
35
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow
Piped Outflow
Channel Outflow

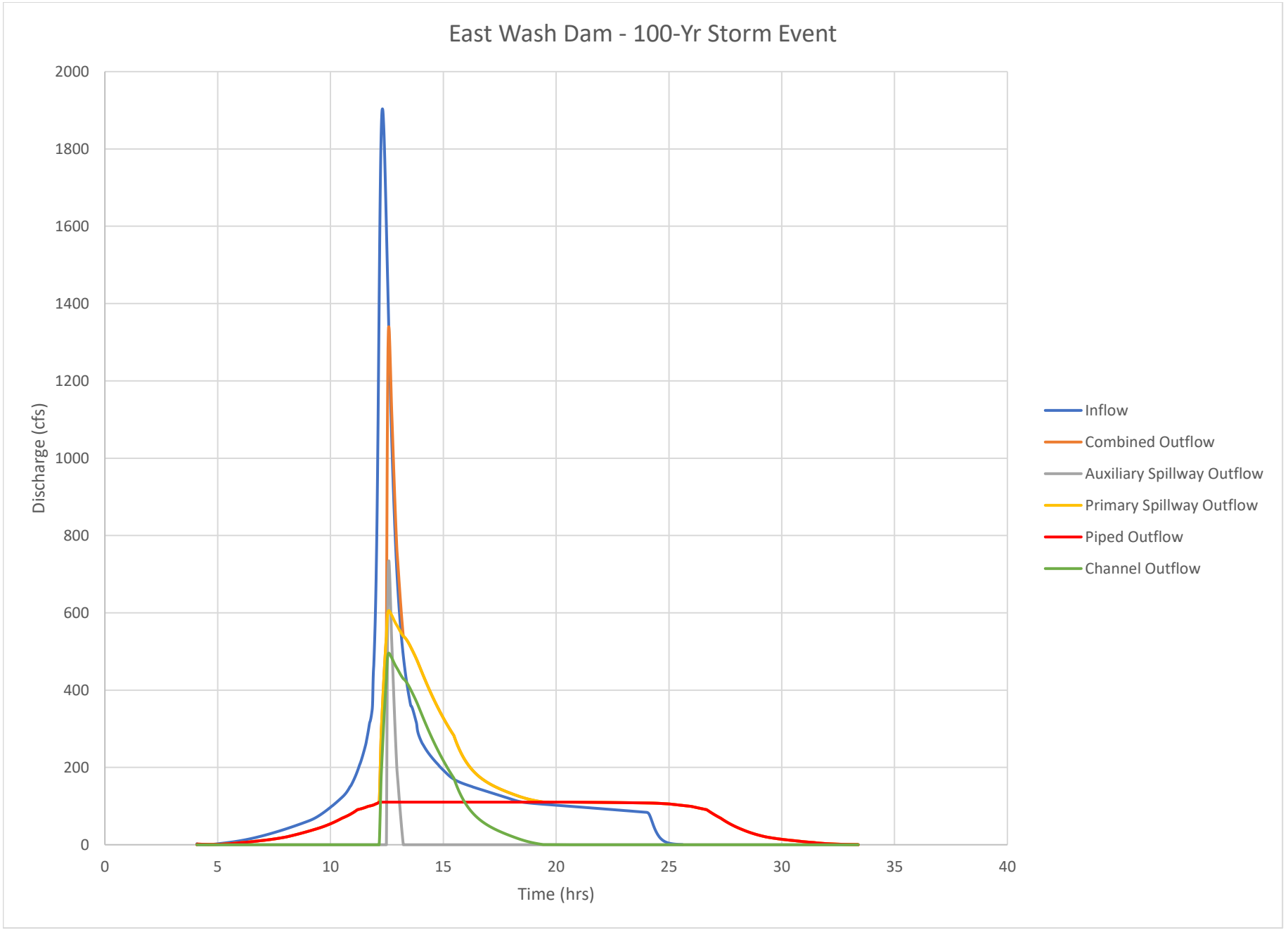

West Wash Dam - 10-Yr Storm Event
Discharge (cfs)
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
35
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow

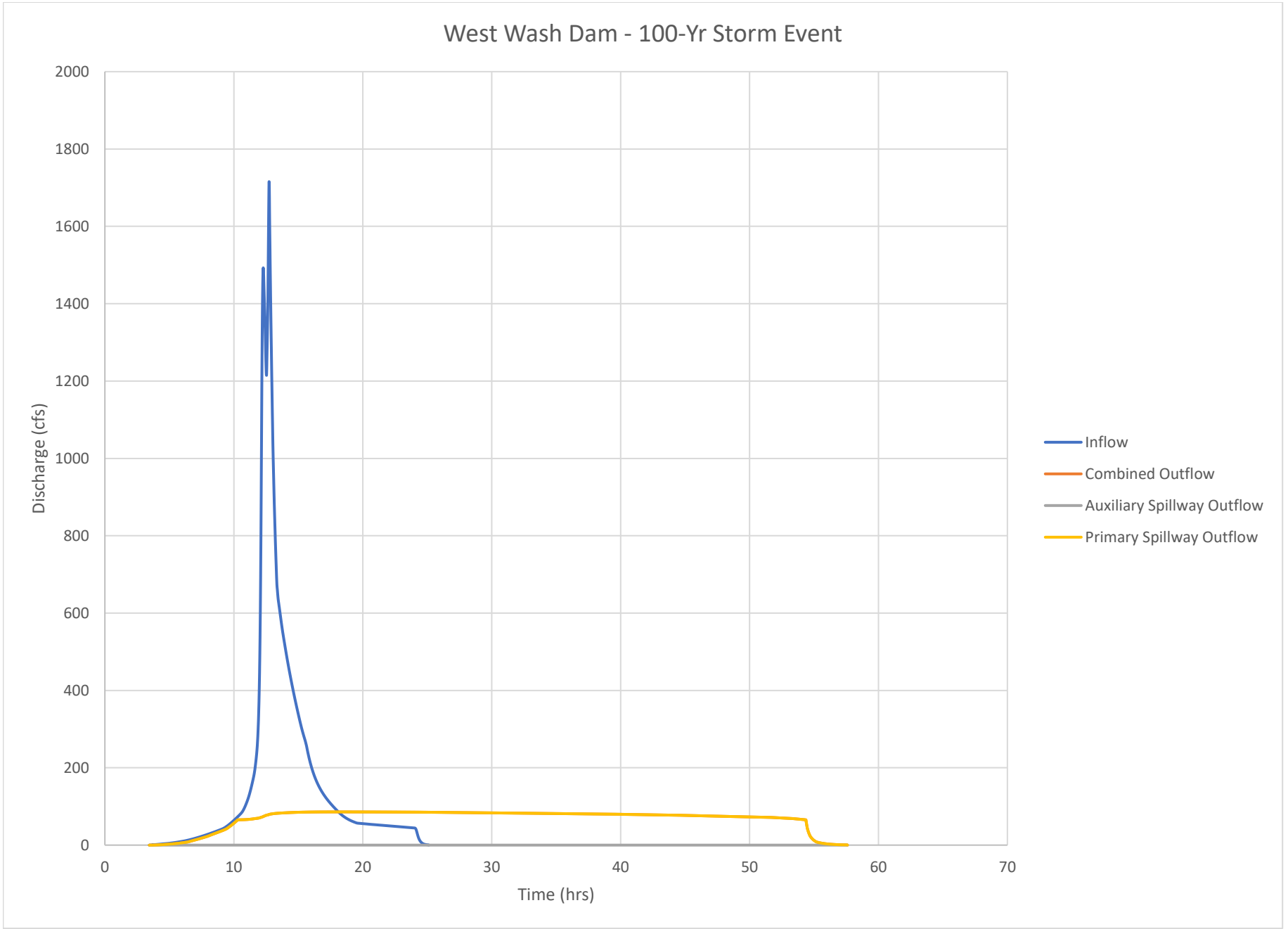

East Wash Dam - 25-Yr Storm Event
Discharge (cfs)
1200
1000
800
600
400
200
0
0
5
10
15
20
25
30
35
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow
Piped Outflow
Channel Outflow

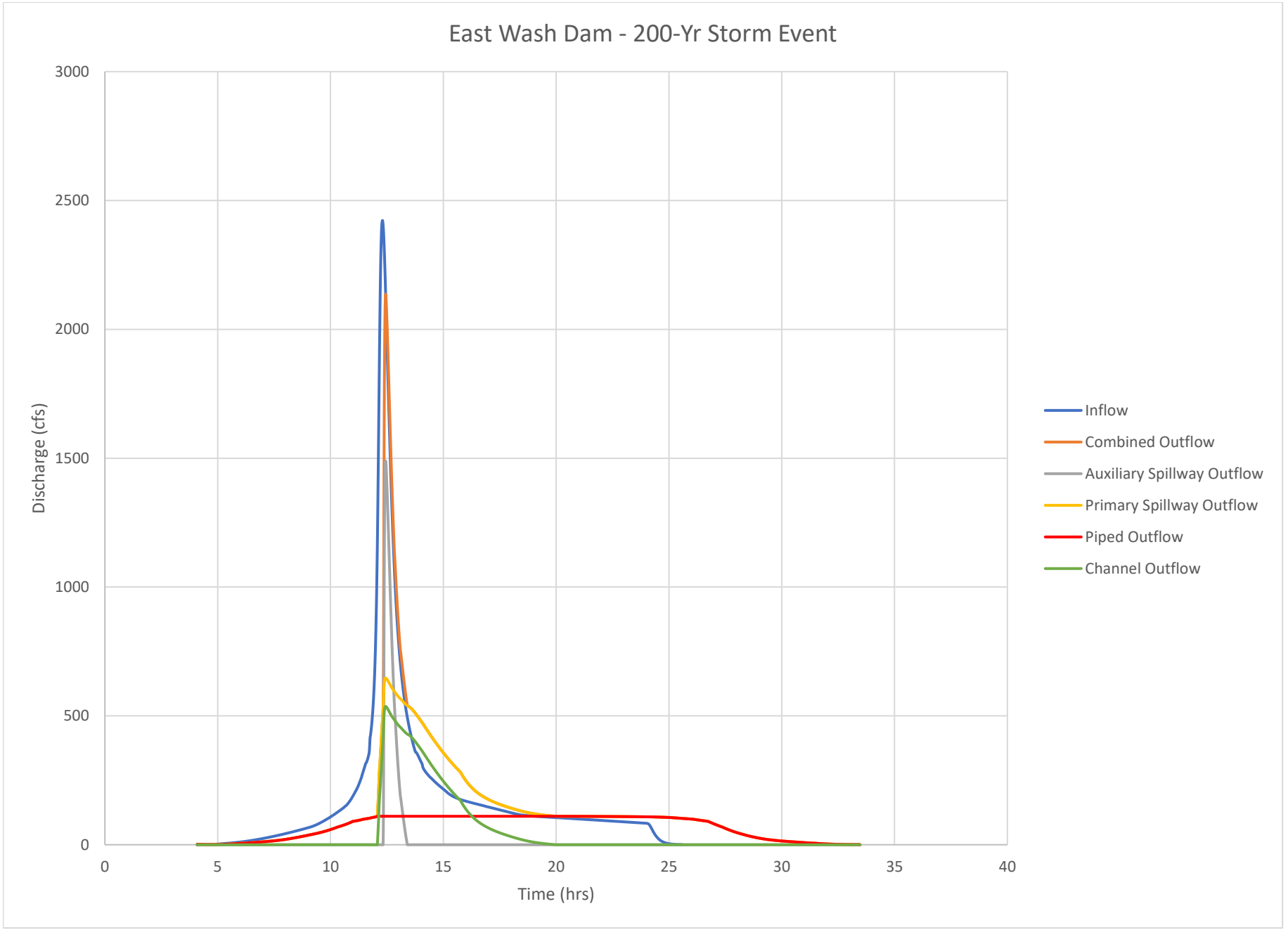

West Wash Dam - 25-Yr Storm Event
Discharge (cfs)
1000
900
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
35
40
45
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow

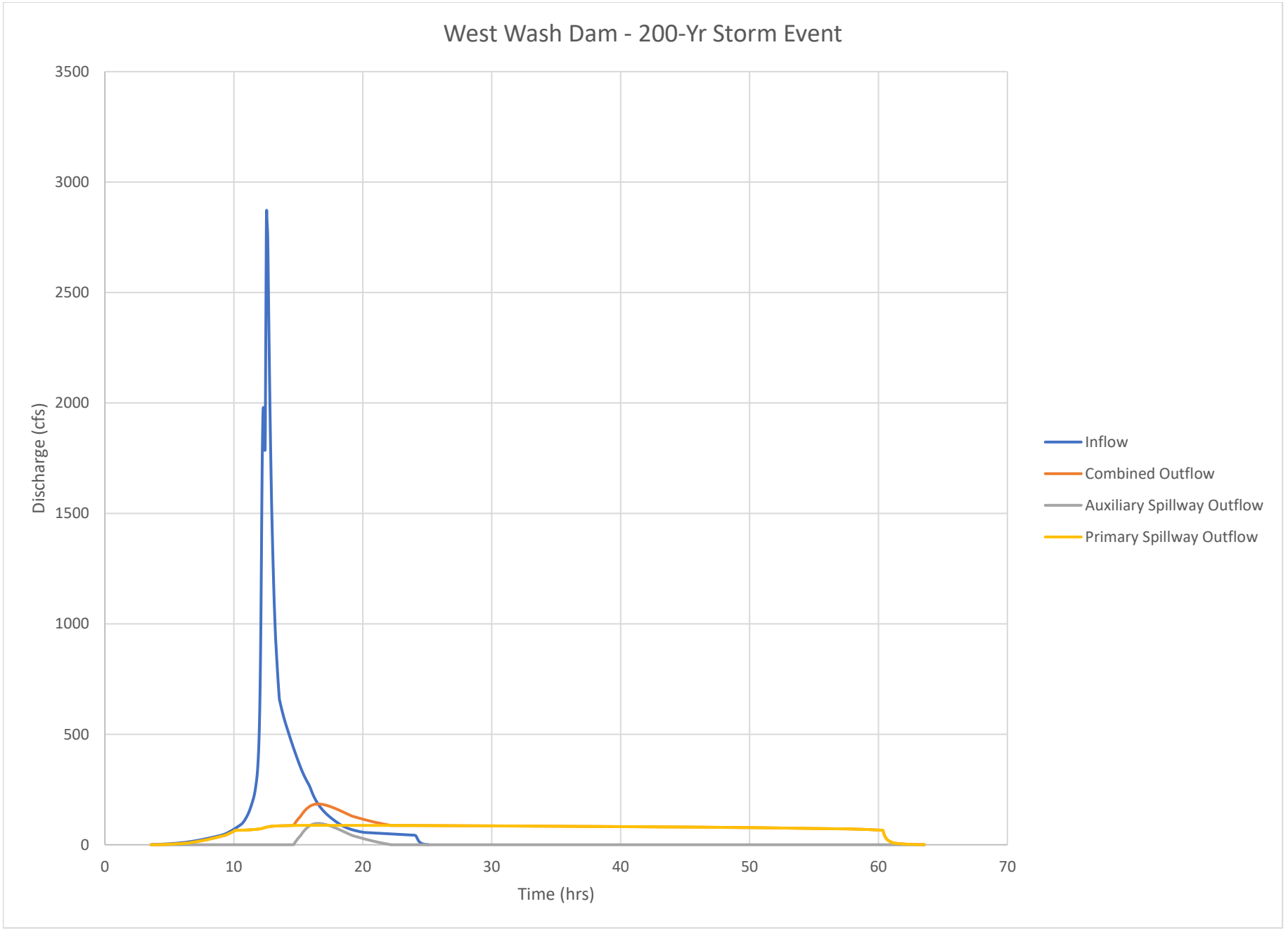

East Wash Dam - 50-Yr Storm Event
Discharge (cfs)
1600
1400
1200
1000
800
600
400
200
0
0
5
10
15
20
25
30
35
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow
Piped Outflow
Channel Outflow

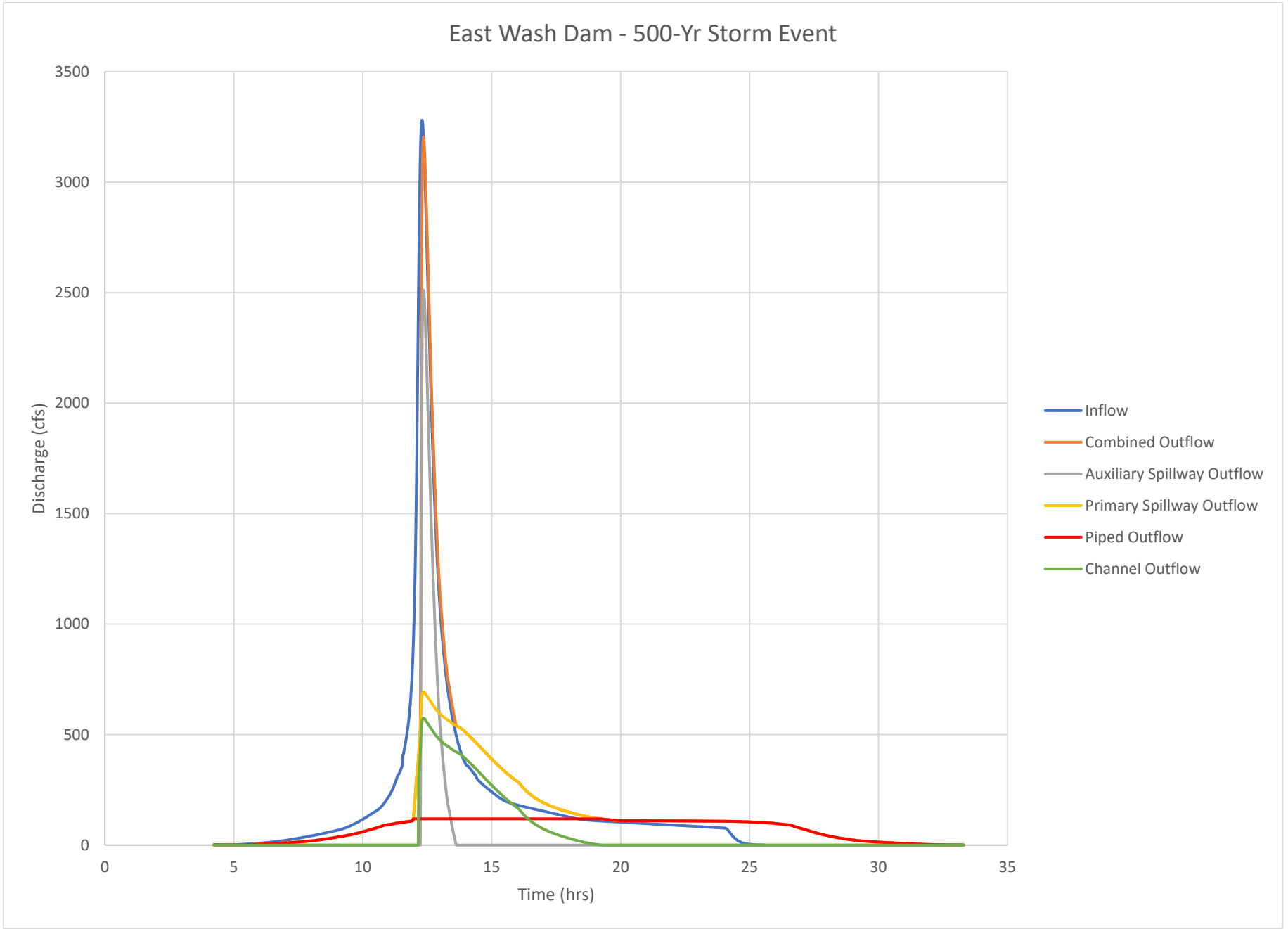

West Wash Dam - 50-Yr Storm Event
Discharge (cfs)
1200
1000
800
600
400
200
0
0
10
20
30
40
50
60
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow

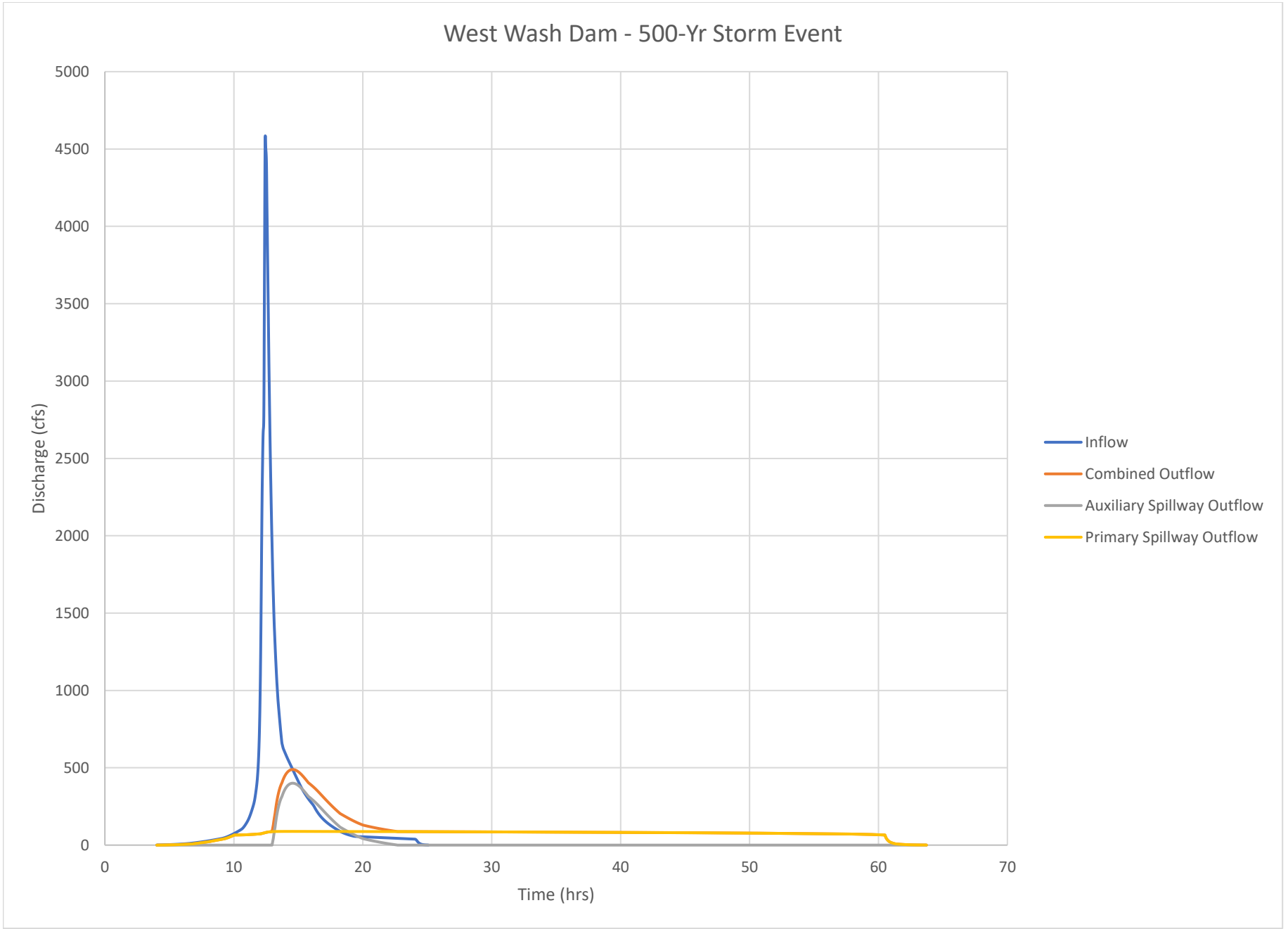

East Wash Dam - 100-Yr Storm Event
Discharge (cfs)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
0
5
10
15
20
25
30
35
40
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow
Piped Outflow
Channel Outflow

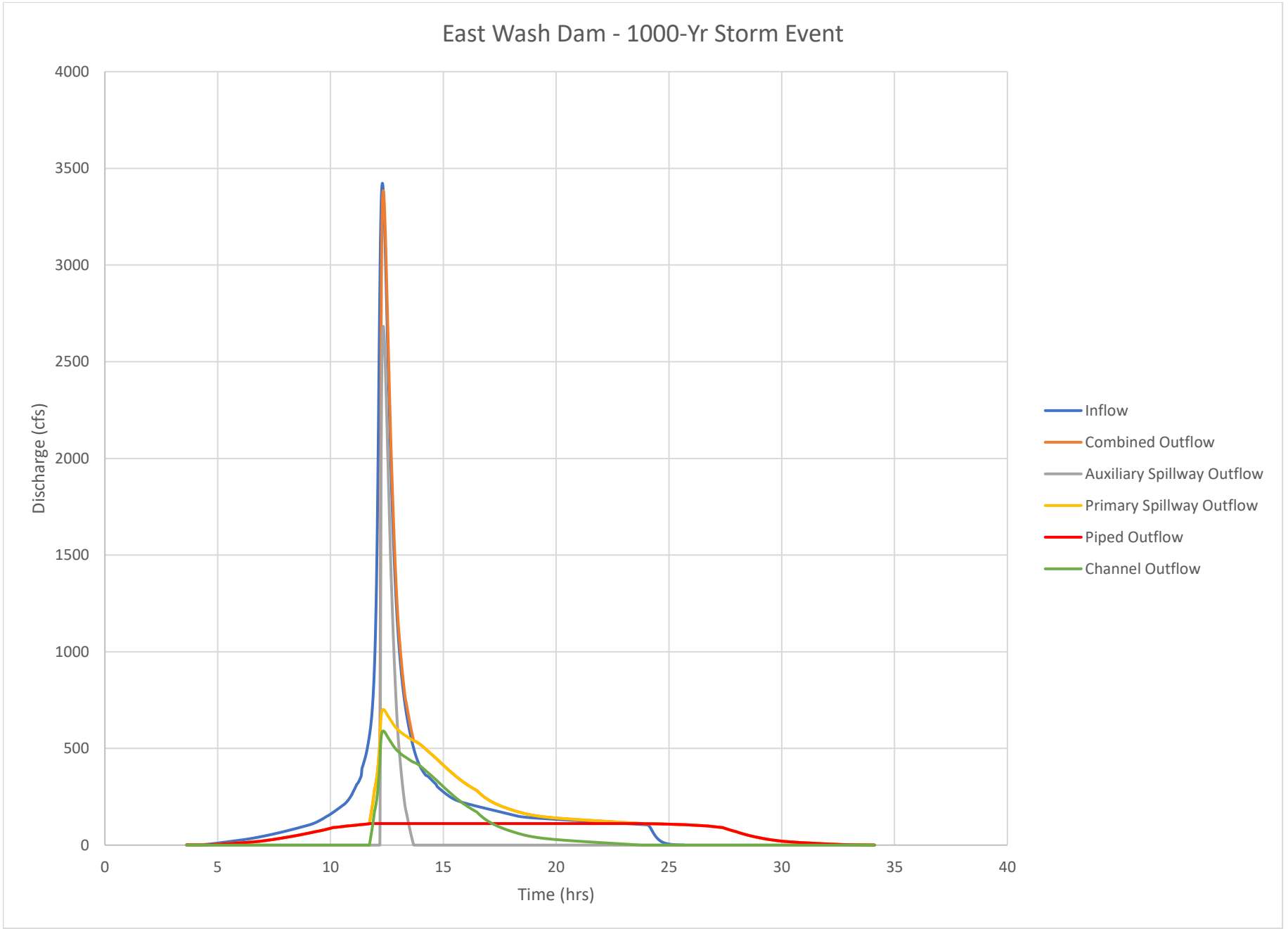

West Wash Dam - 100-Yr Storm Event
Discharge (cfs)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
0
10
20
30
40
50
60
70
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow

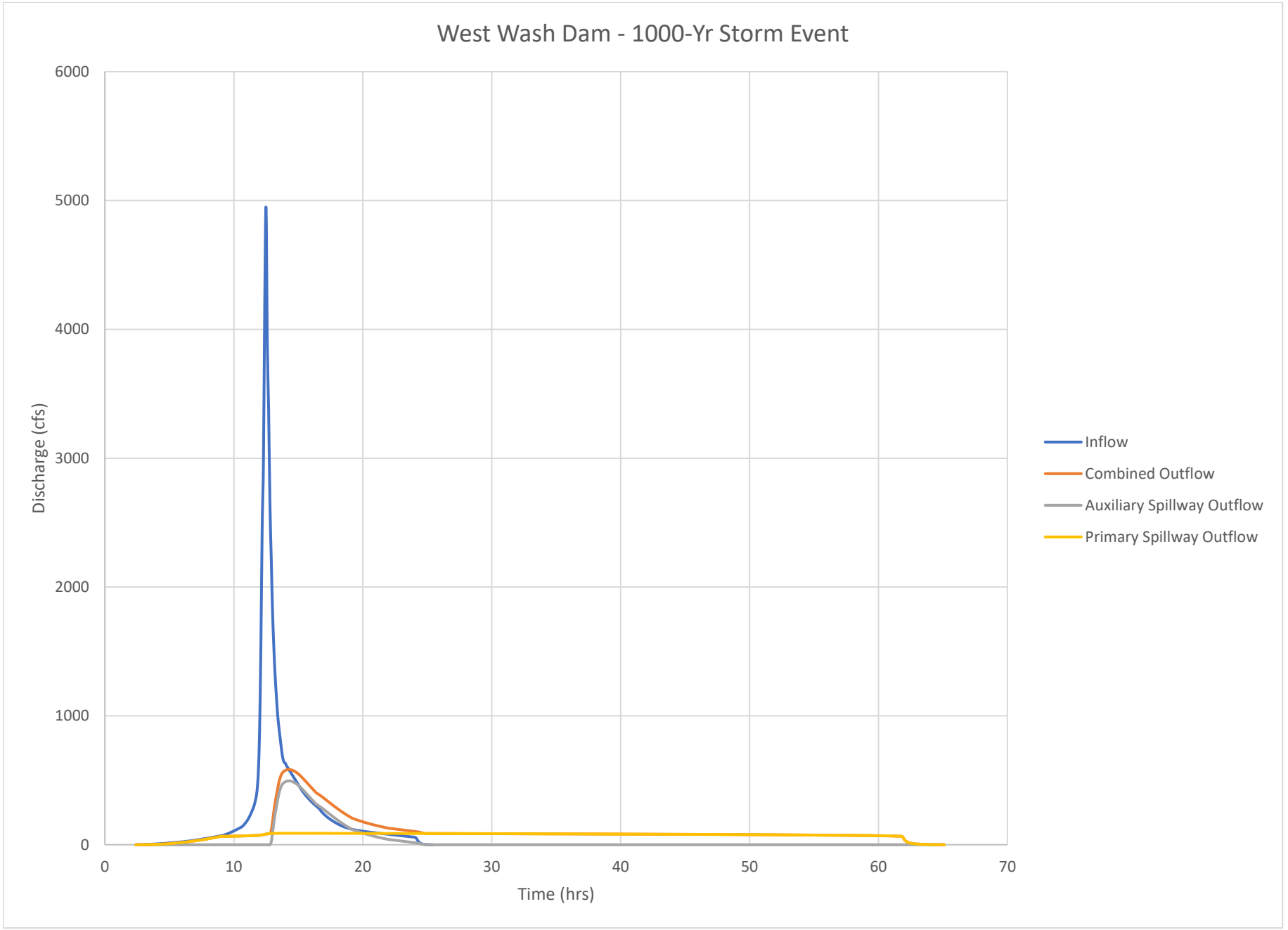

East Wash Dam - 200-Yr Storm Event
Discharge (cfs)
3000
2500
2000
1500
1000
500
0
0
5
10
15
20
25
30
35
40
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow
Piped Outflow
Channel Outflow

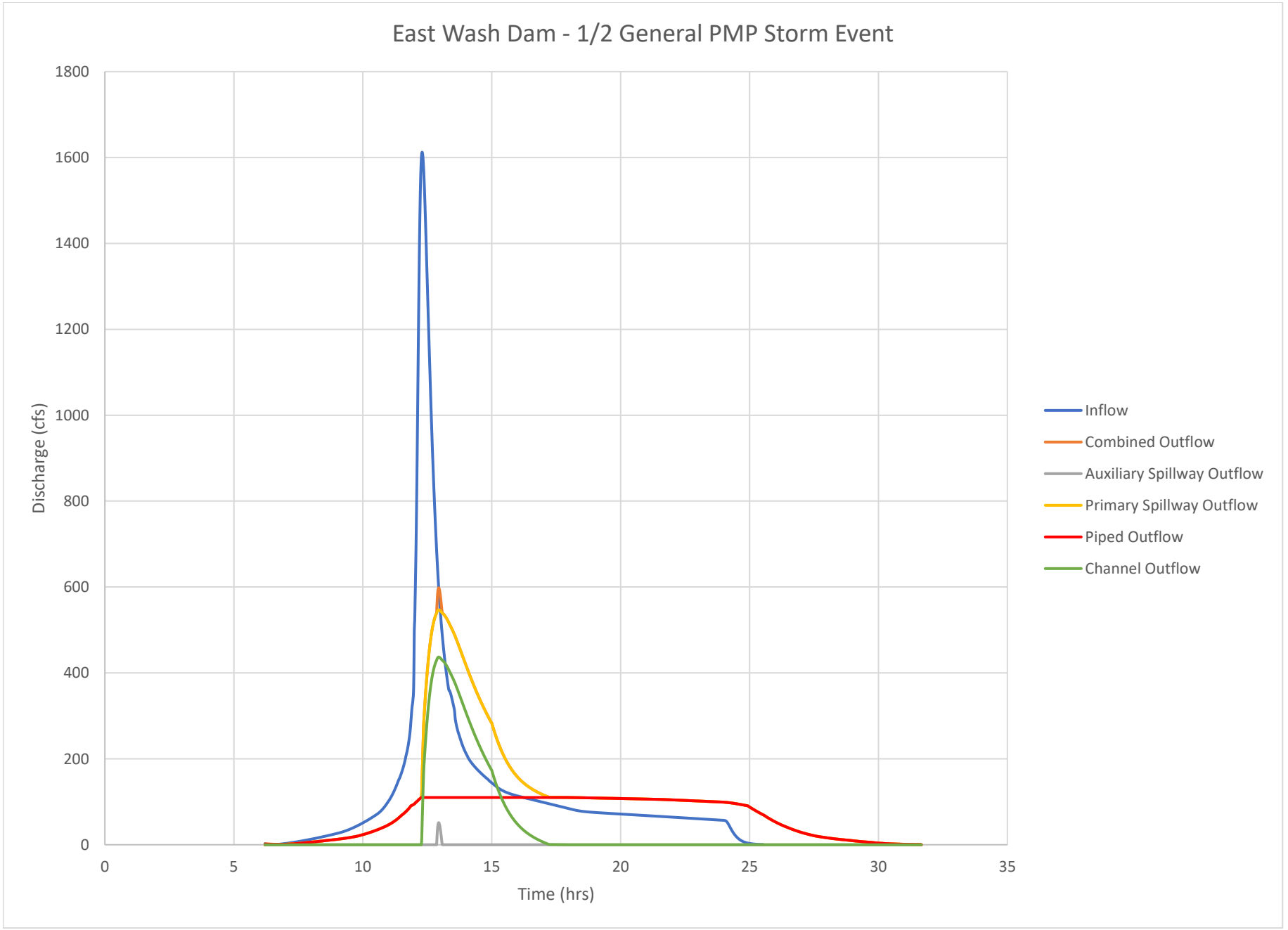

West Wash Dam - 200-Yr Storm Event
Discharge (cfs)
3500
3000
2500
2000
1500
1000
500
0
0
10
20
30
40
50
60
70
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow

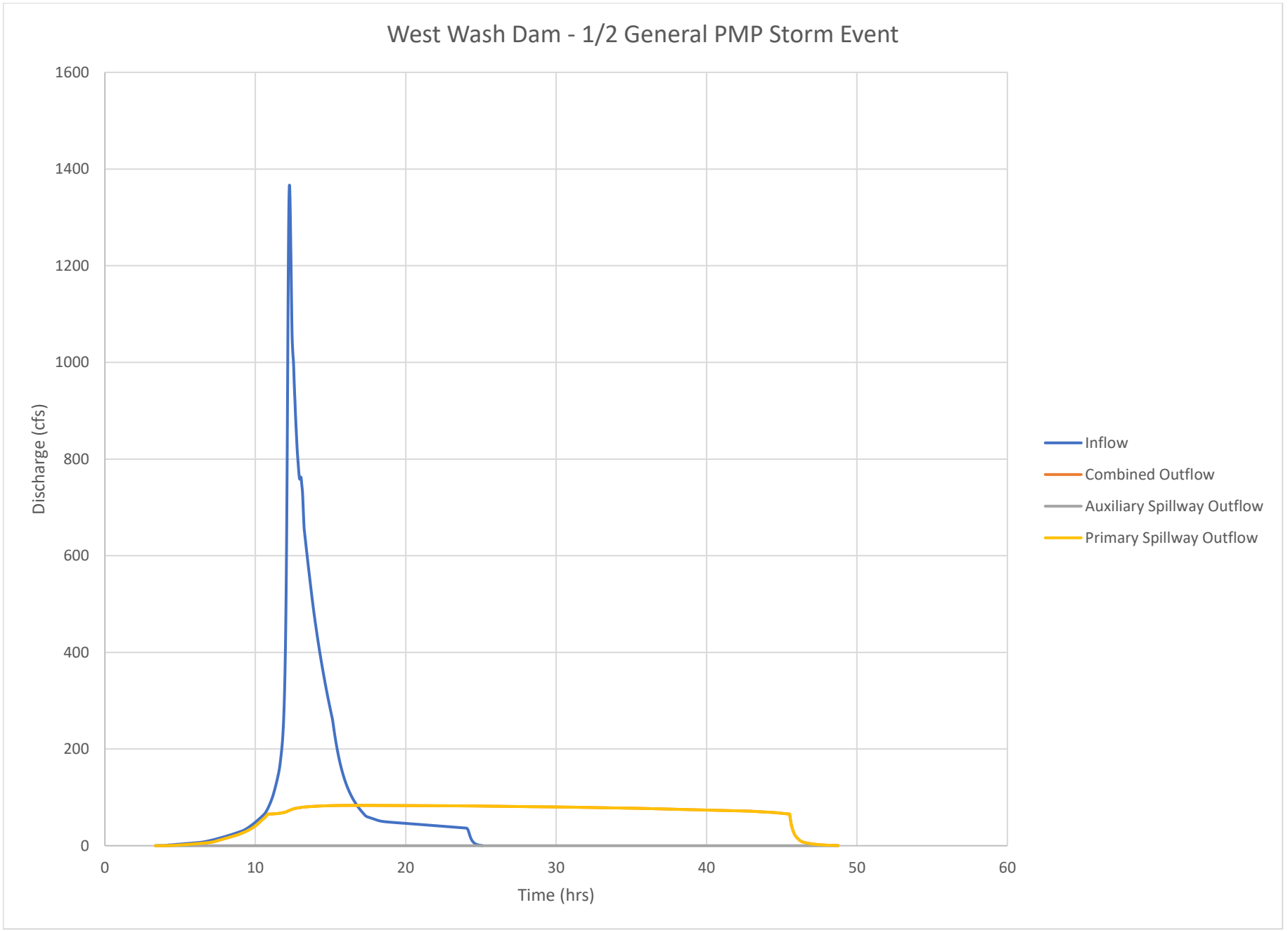

East Wash Dam - 500-Yr Storm Event
Discharge (cfs)
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20
25
30
35
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow
Piped Outflow
Channel Outflow

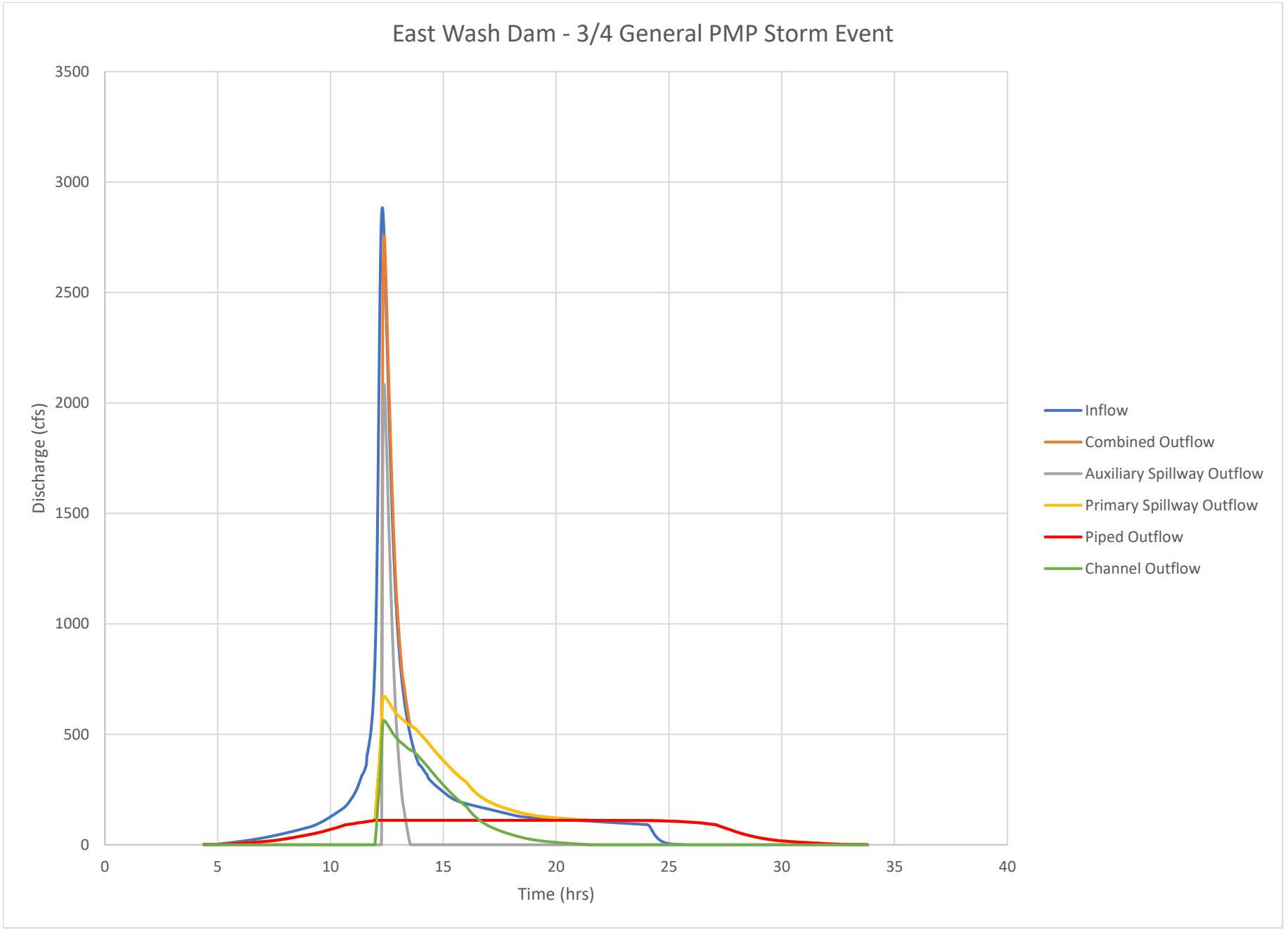

West Wash Dam - 500-Yr Storm Event
Discharge (cfs)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
10
20
30
40
50
60
70
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow

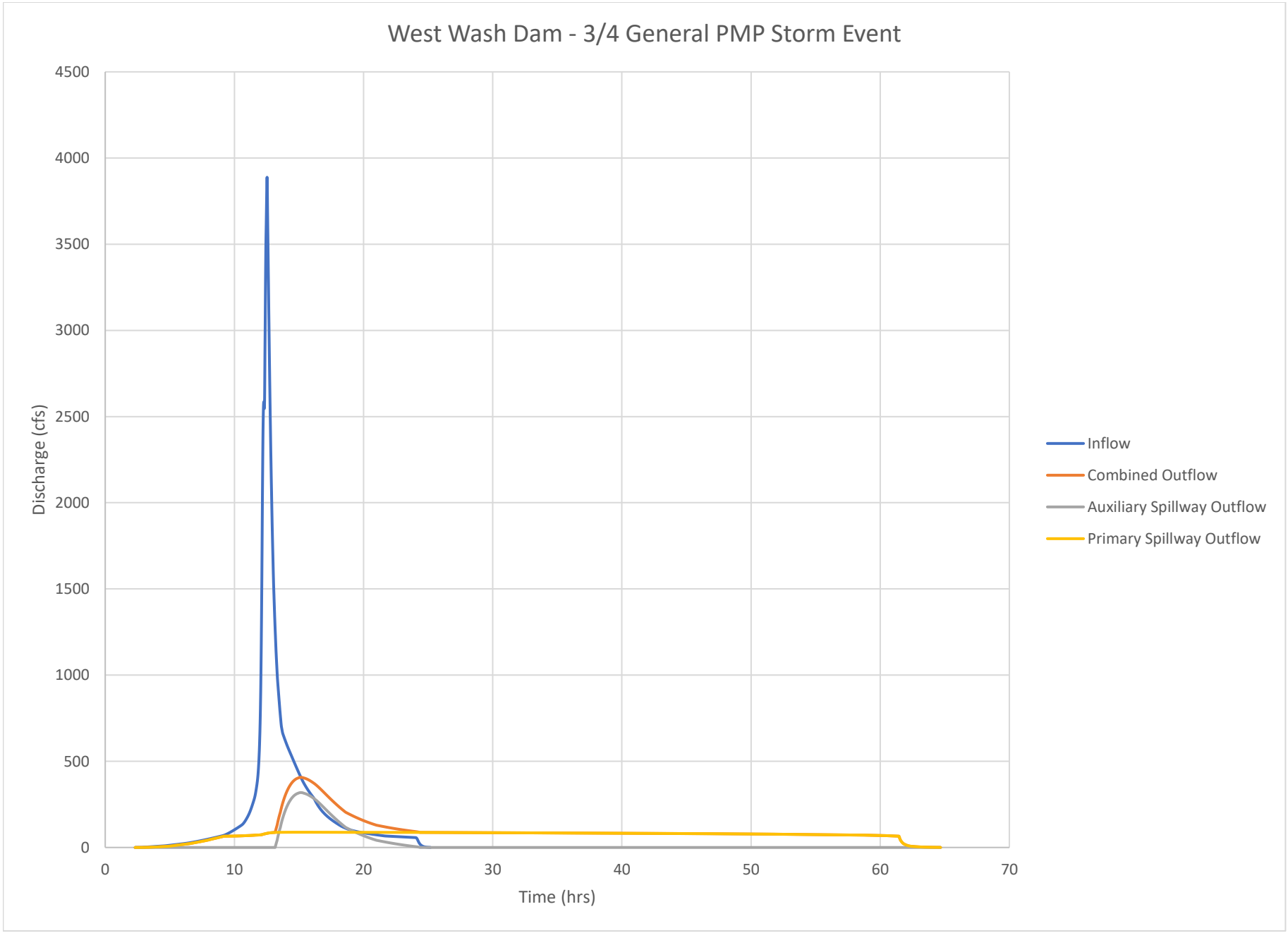

East Wash Dam - 1000-Yr Storm Event
Discharge (cfs)
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20
25
30
35
40
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow
Piped Outflow
Channel Outflow

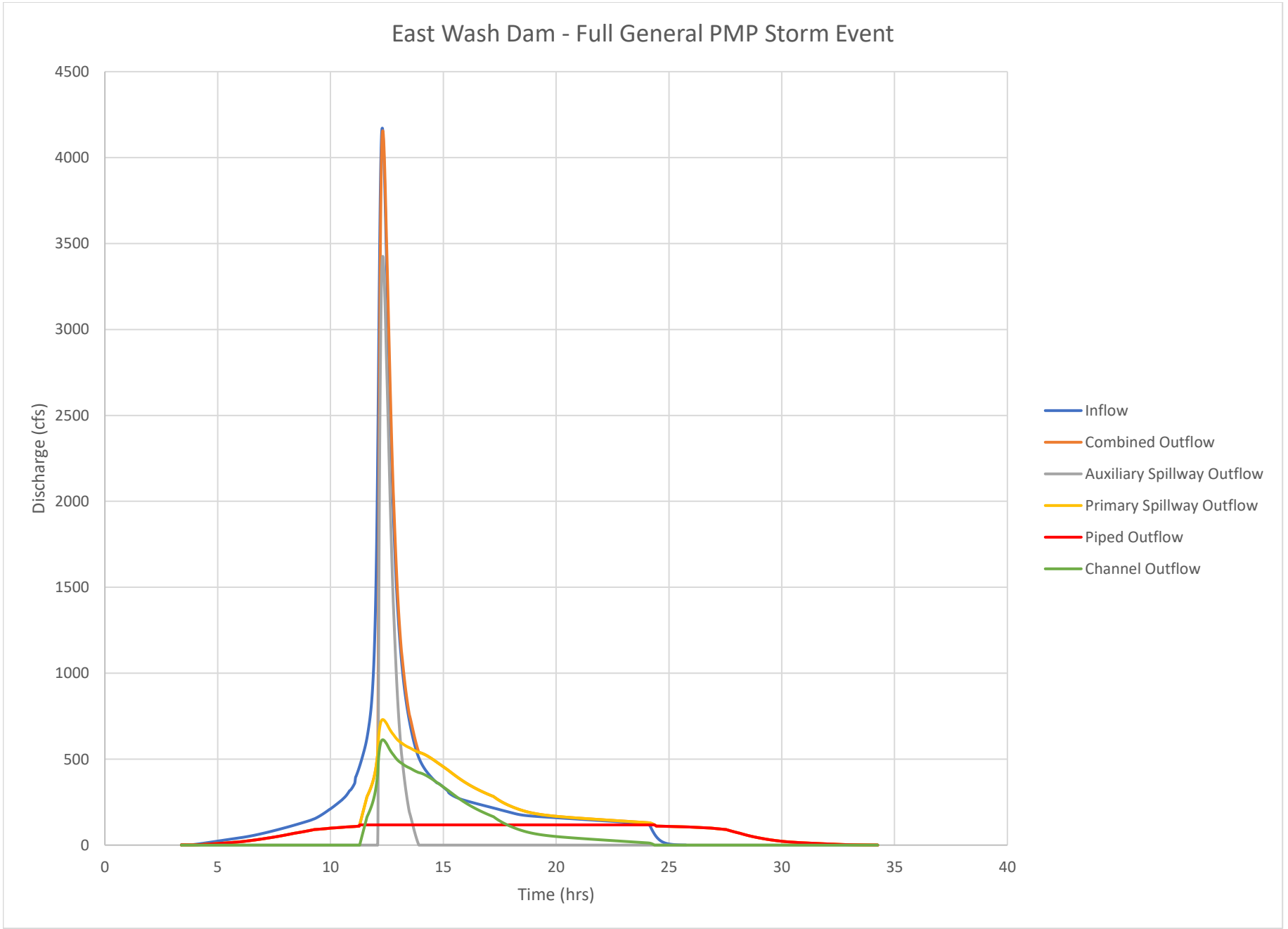

West Wash Dam - 1000-Yr Storm Event
6000
5000
4000
3000
2000
1000
0
Discharge (cfs)
0
10
20
30
40
50
60
70
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow

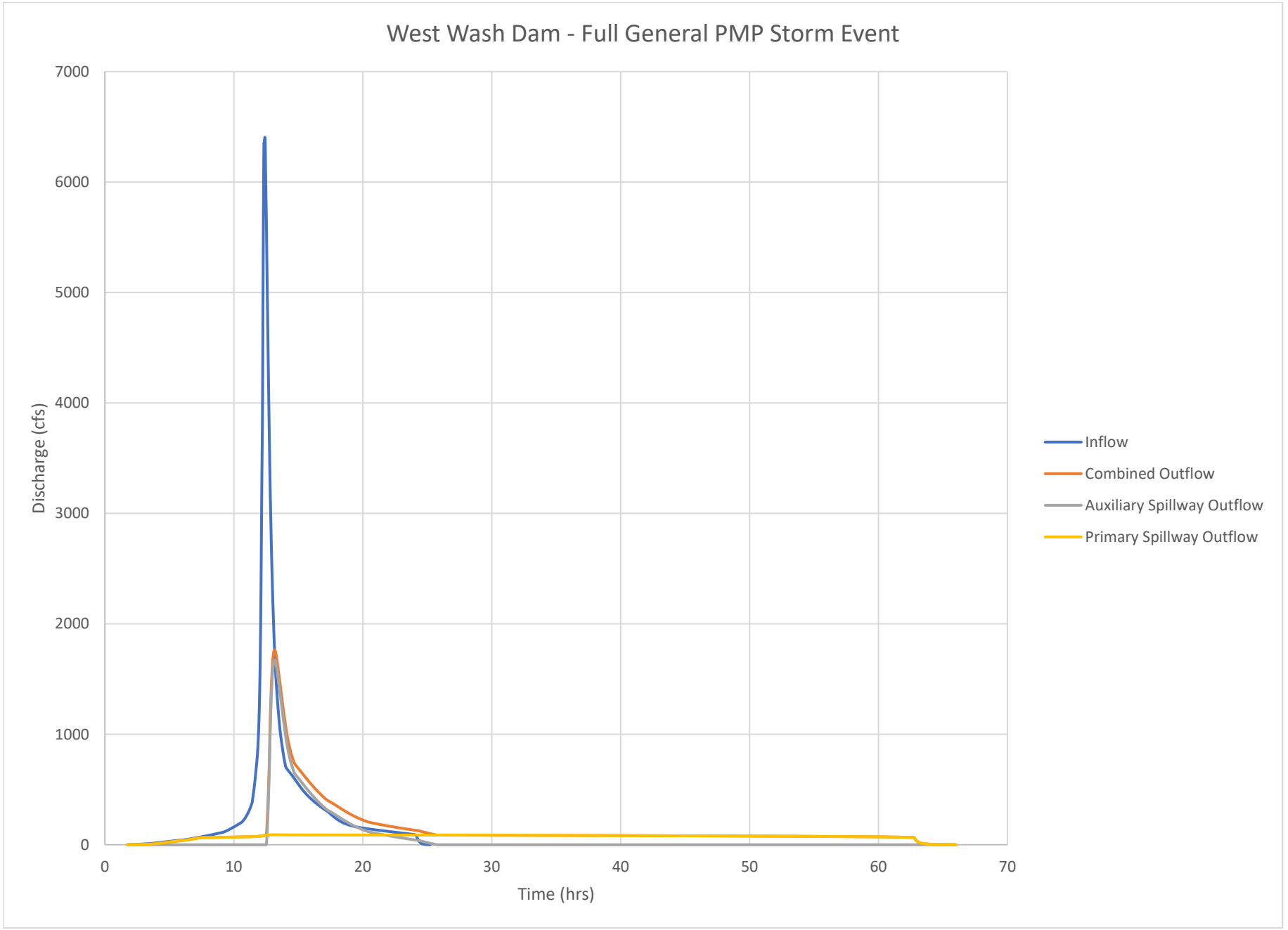

East Wash Dam - 1/2 General PMP Storm Event
Discharge (cfs)
1800
1600
1400
1200
1000
800
600
400
200
0
0
5
10
15
20
25
30
35
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow
Piped Outflow
Channel Outflow

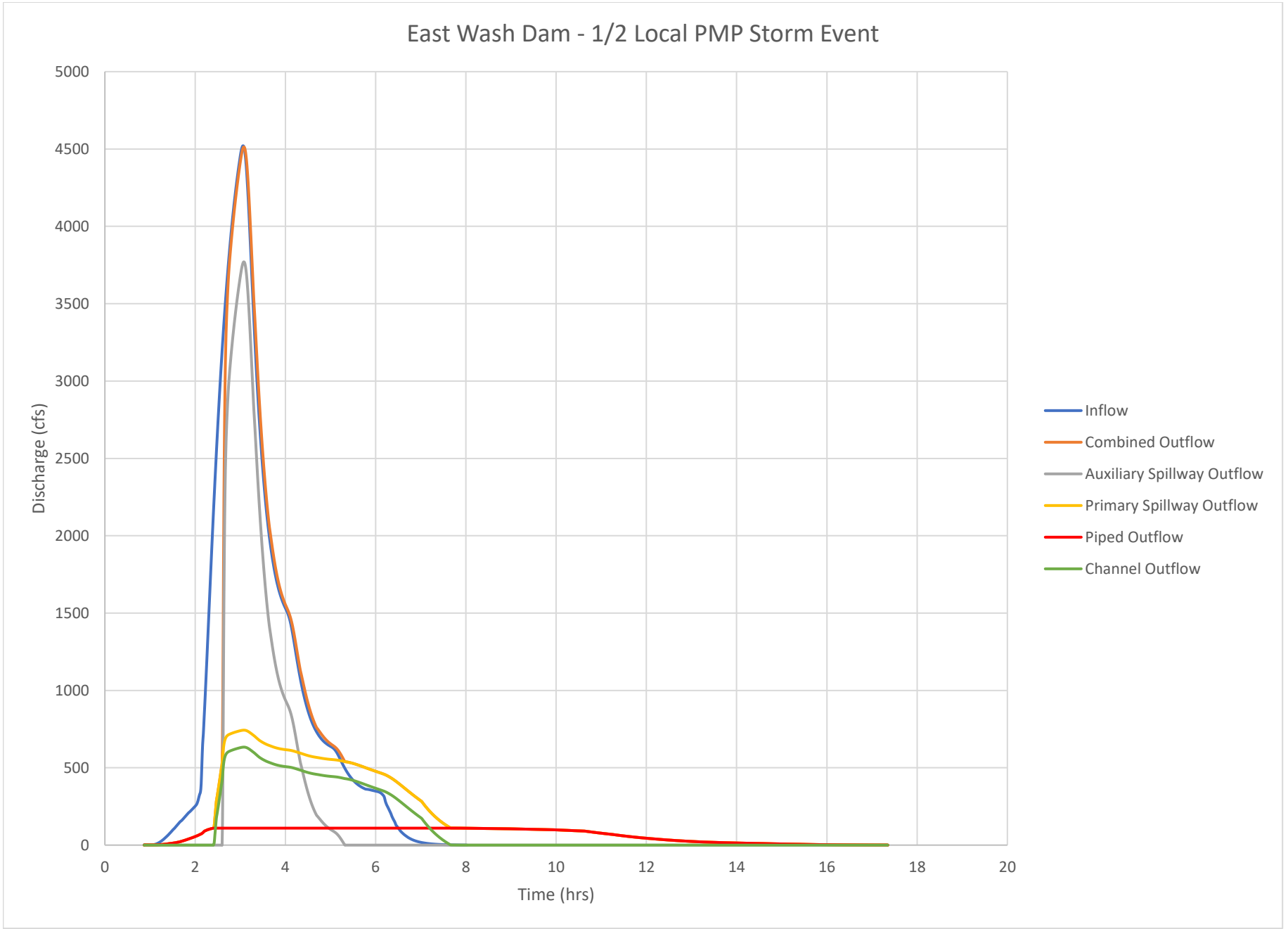

West Wash Dam - 1/2 General PMP Storm Event
Discharge (cfs)
1600
1400
1200
1000
800
600
400
200
0
0
10
20
30
40
50
60
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow

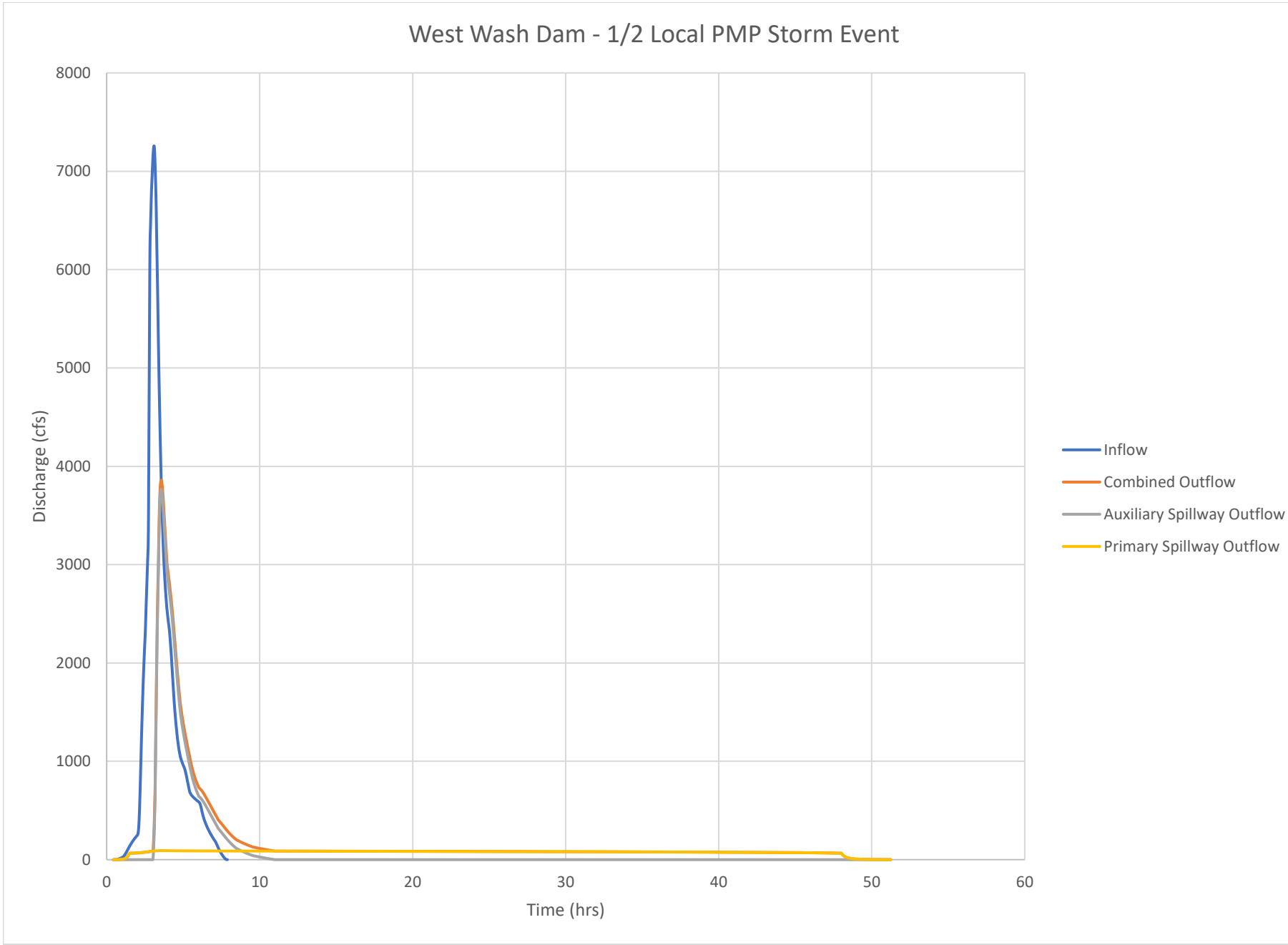

East Wash Dam - 3/4 General PMP Storm Event
Discharge (cfs)
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20
25
30
35
40
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow
Piped Outflow
Channel Outflow

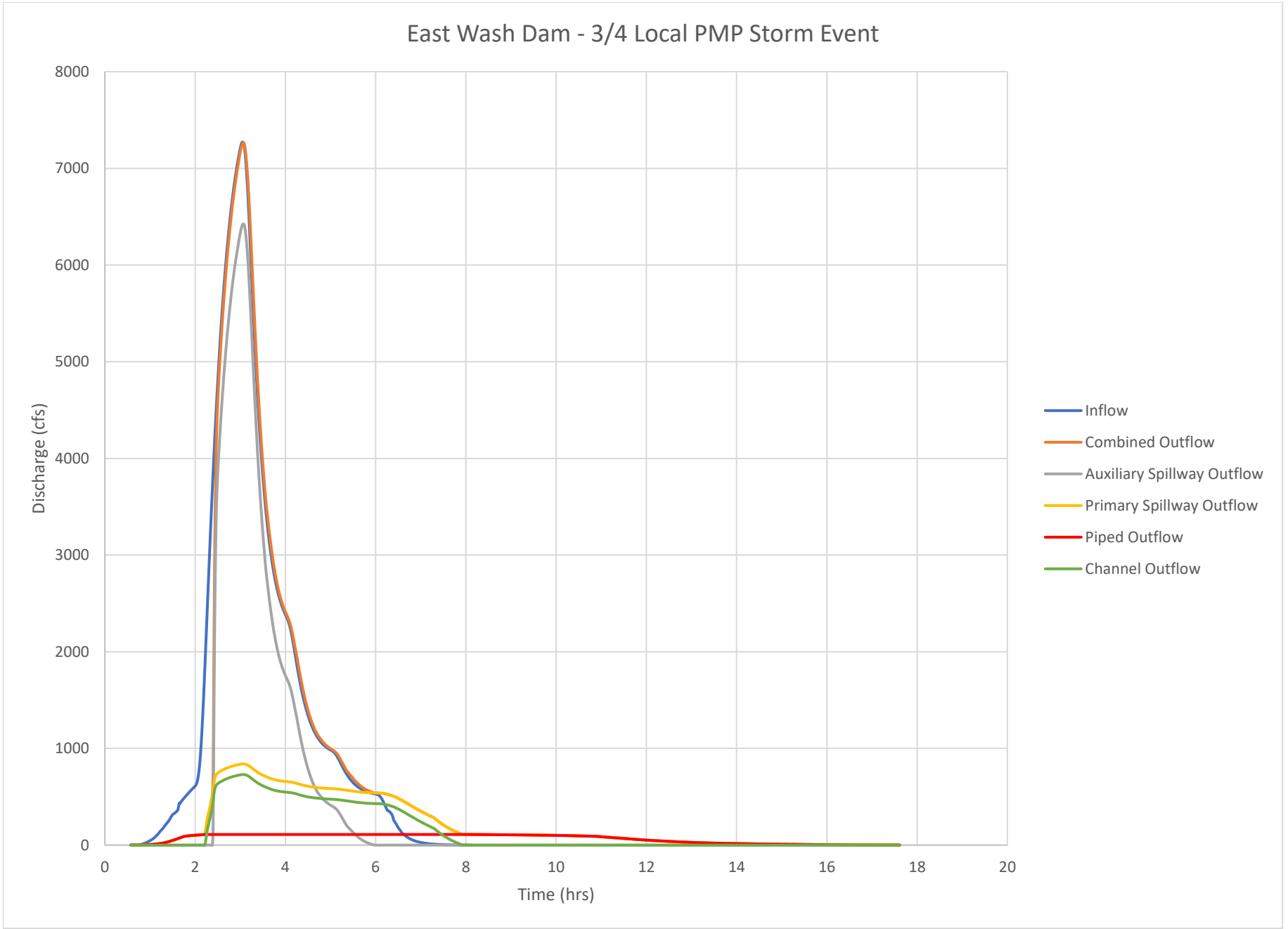

West Wash Dam - 3/4 General PMP Storm Event
Discharge (cfs)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
10
20
30
40
50
60
70
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow

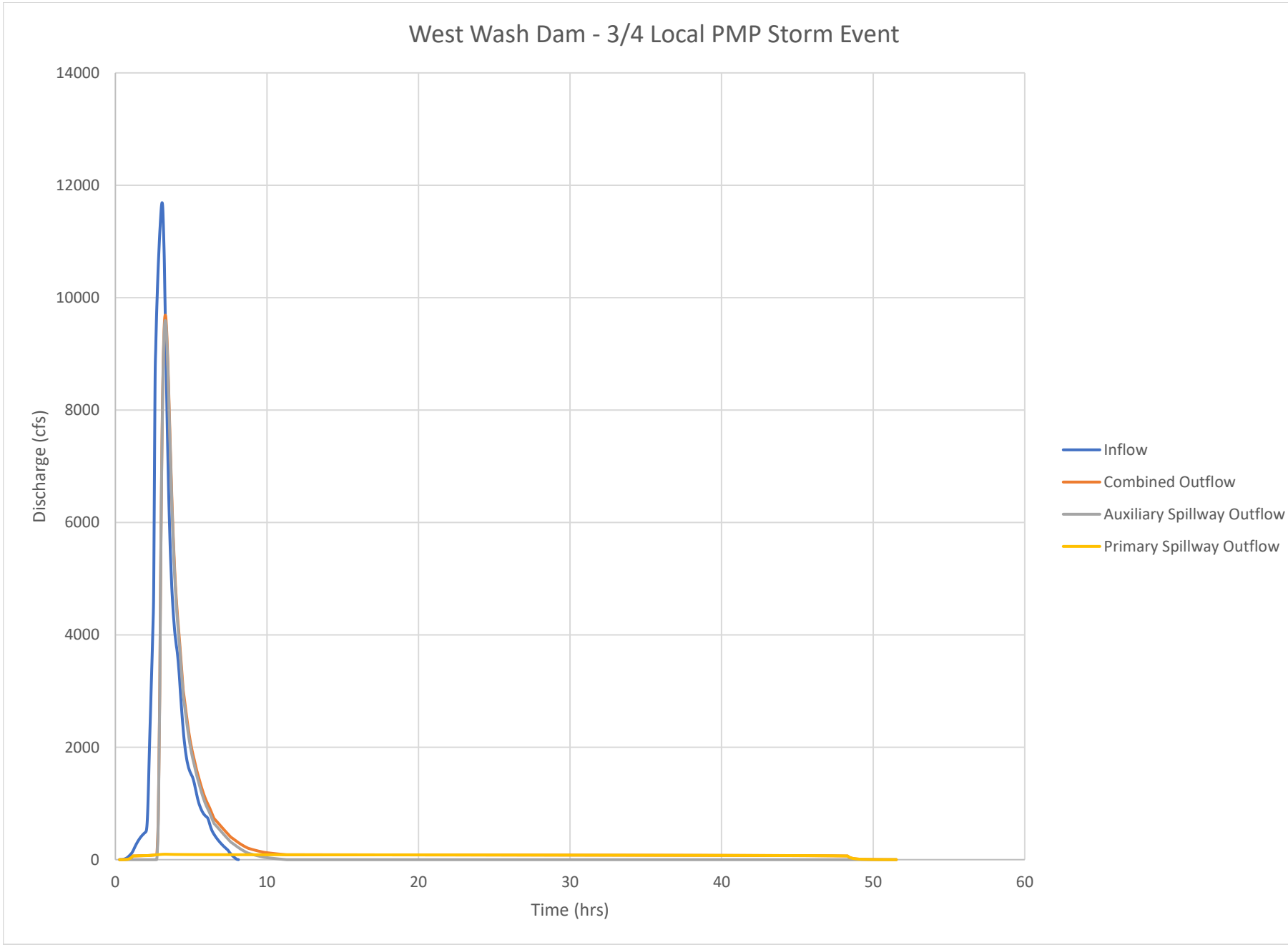

East Wash Dam - Full General PMP Storm Event
Discharge (cfs)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20
25
30
35
40
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow
Piped Outflow
Channel Outflow

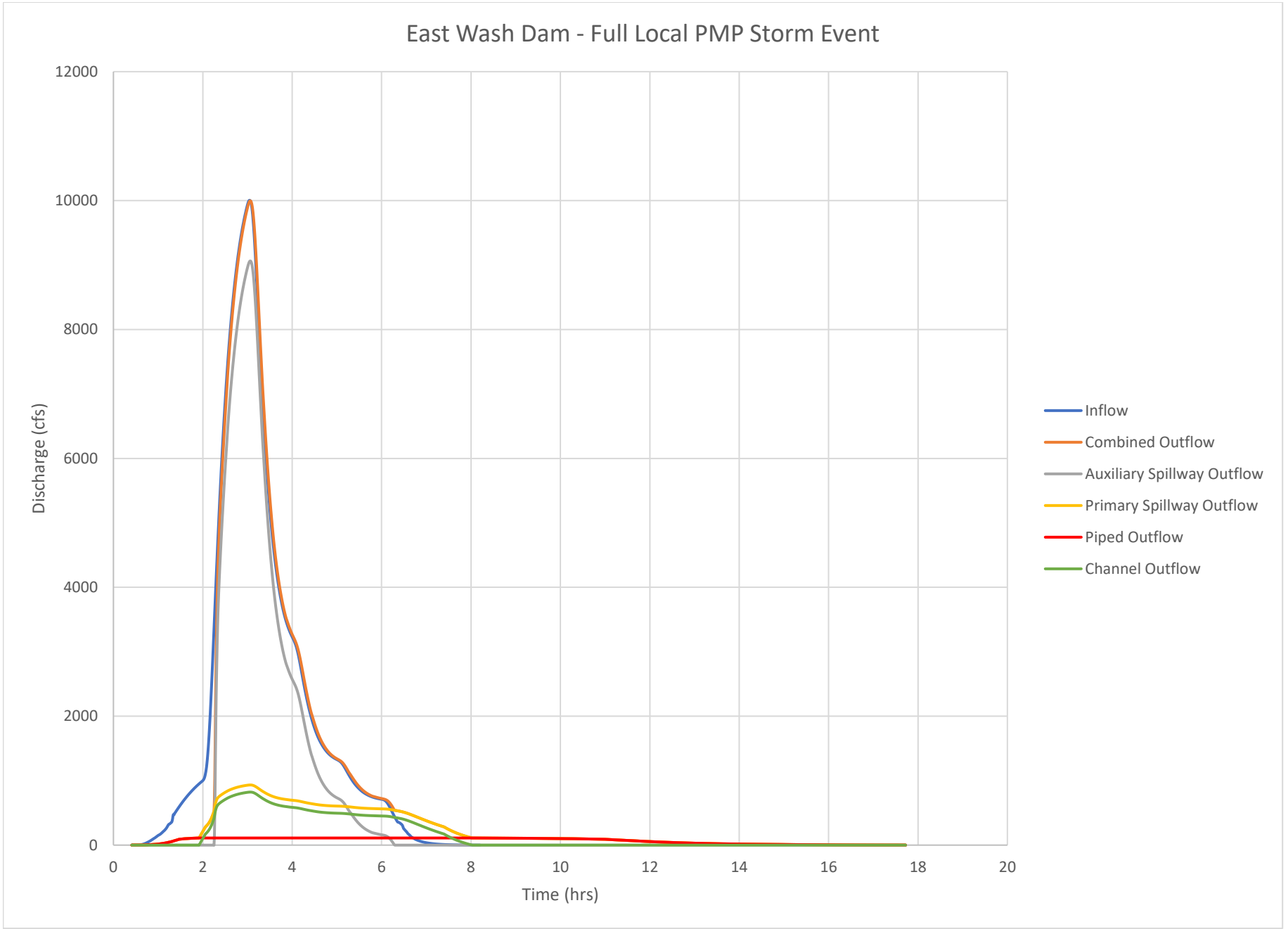

West Wash Dam - Full General PMP Storm Event
Discharge (cfs)
7000
6000
5000
4000
3000
2000
1000
0
0
10
20
30
40
50
60
70
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow

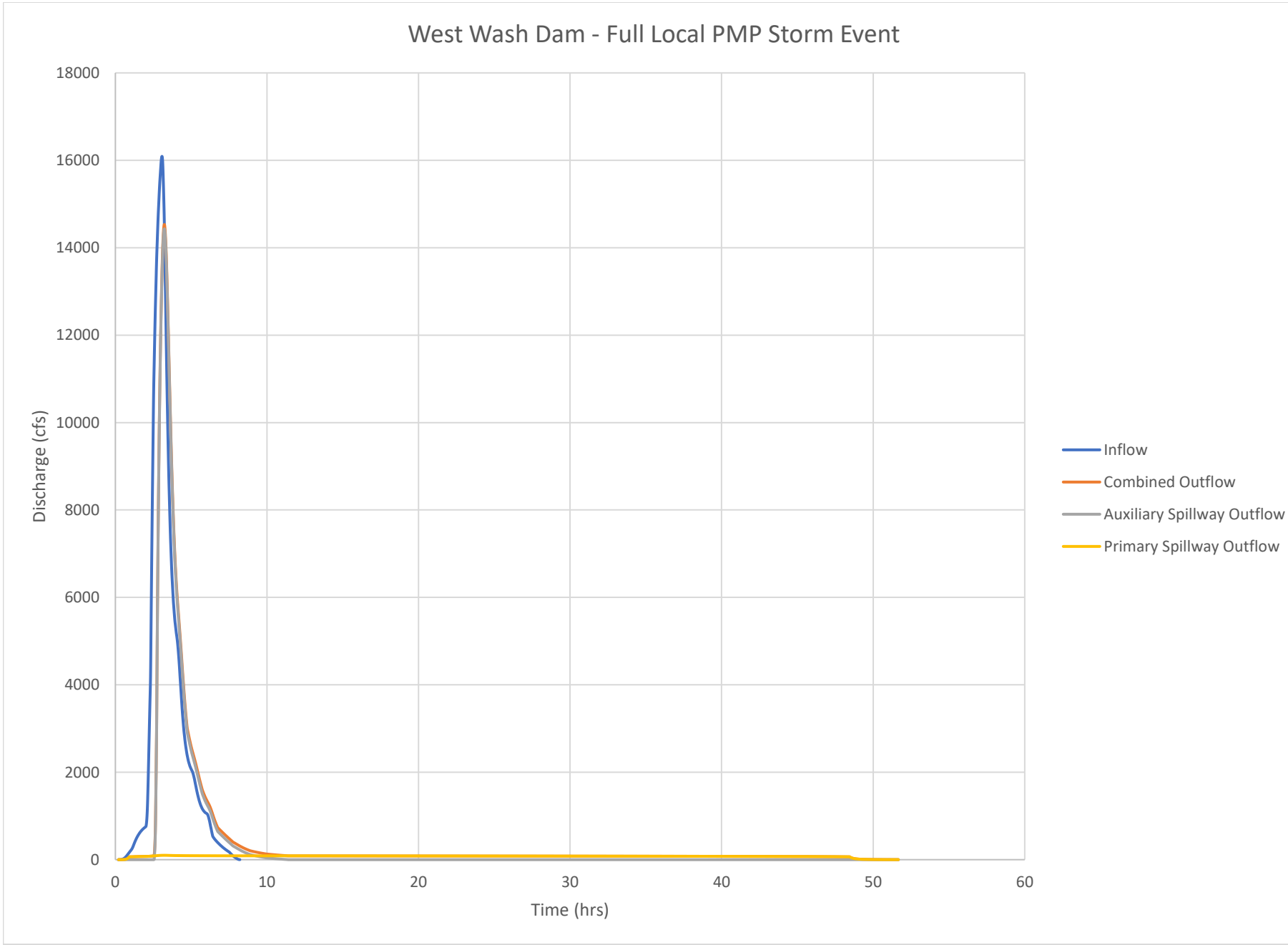

East Wash Dam - 1/2 Local PMP Storm Event
Discharge (cfs)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
2
4
6
8
10
12
14
16
18
20
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow
Piped Outflow
Channel Outflow


West Wash Dam - 1/2 Local PMP Storm Event
Discharge (cfs)
8000
7000
6000
5000
4000
3000
2000
1000
0
0
10
20
30
40
50
60
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow

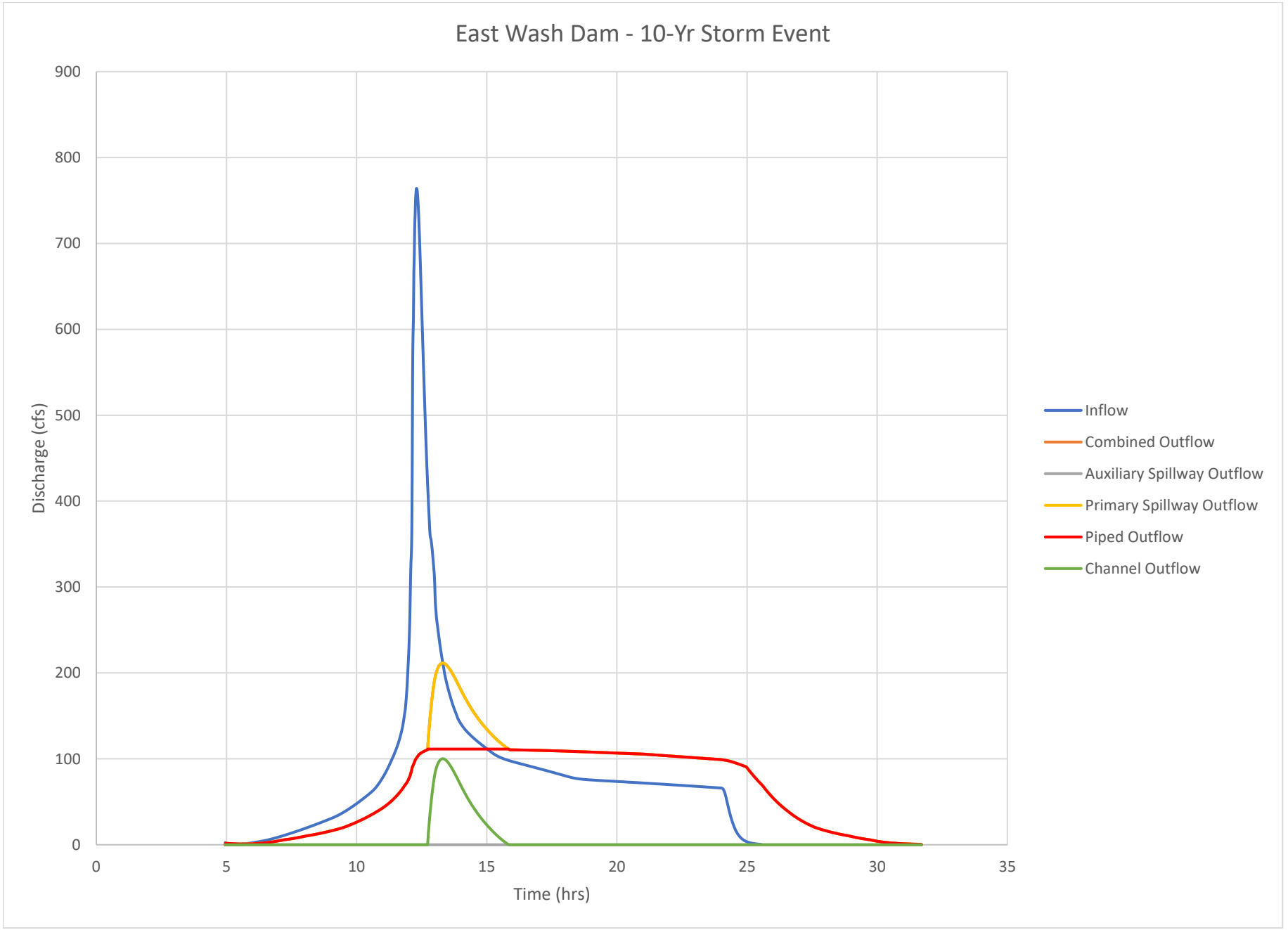

East Wash Dam - 3/4 Local PMP Storm Event
Discharge (cfs)
8000
7000
6000
5000
4000
3000
2000
1000
0
0
2
4
6
8
10
12
14
16
18
20
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow
Piped Outflow
Channel Outflow

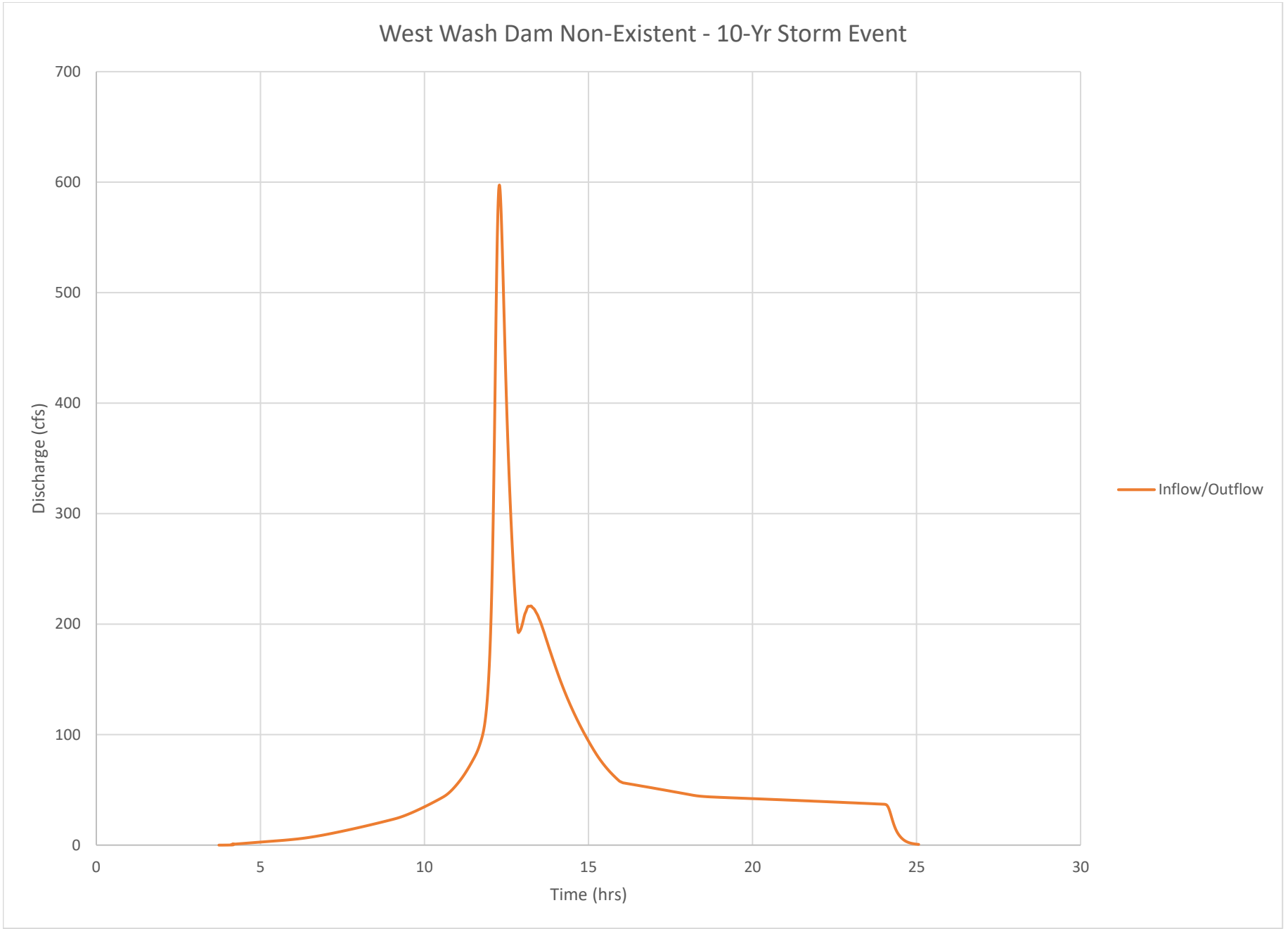

West Wash Dam - 3/4 Local PMP Storm Event
Discharge (cfs)
14000
12000
10000
8000
6000
4000
2000
0
0
10
20
30
40
50
60
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow

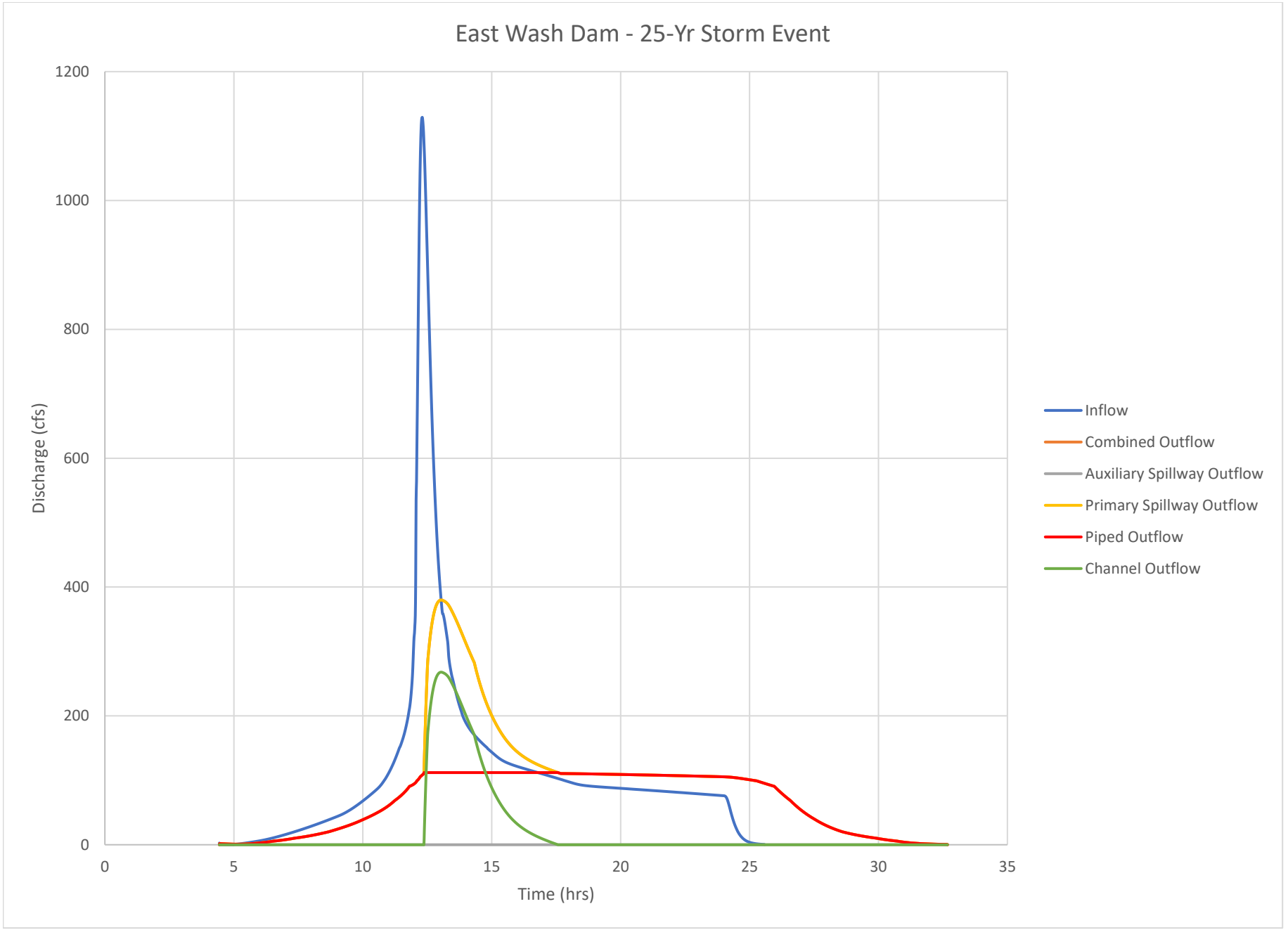

East Wash Dam - Full Local PMP Storm Event
Discharge (cfs)
12000
10000
8000
6000
4000
2000
0
0
2
4
6
8
10
12
14
16
18
20
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow
Piped Outflow
Channel Outflow

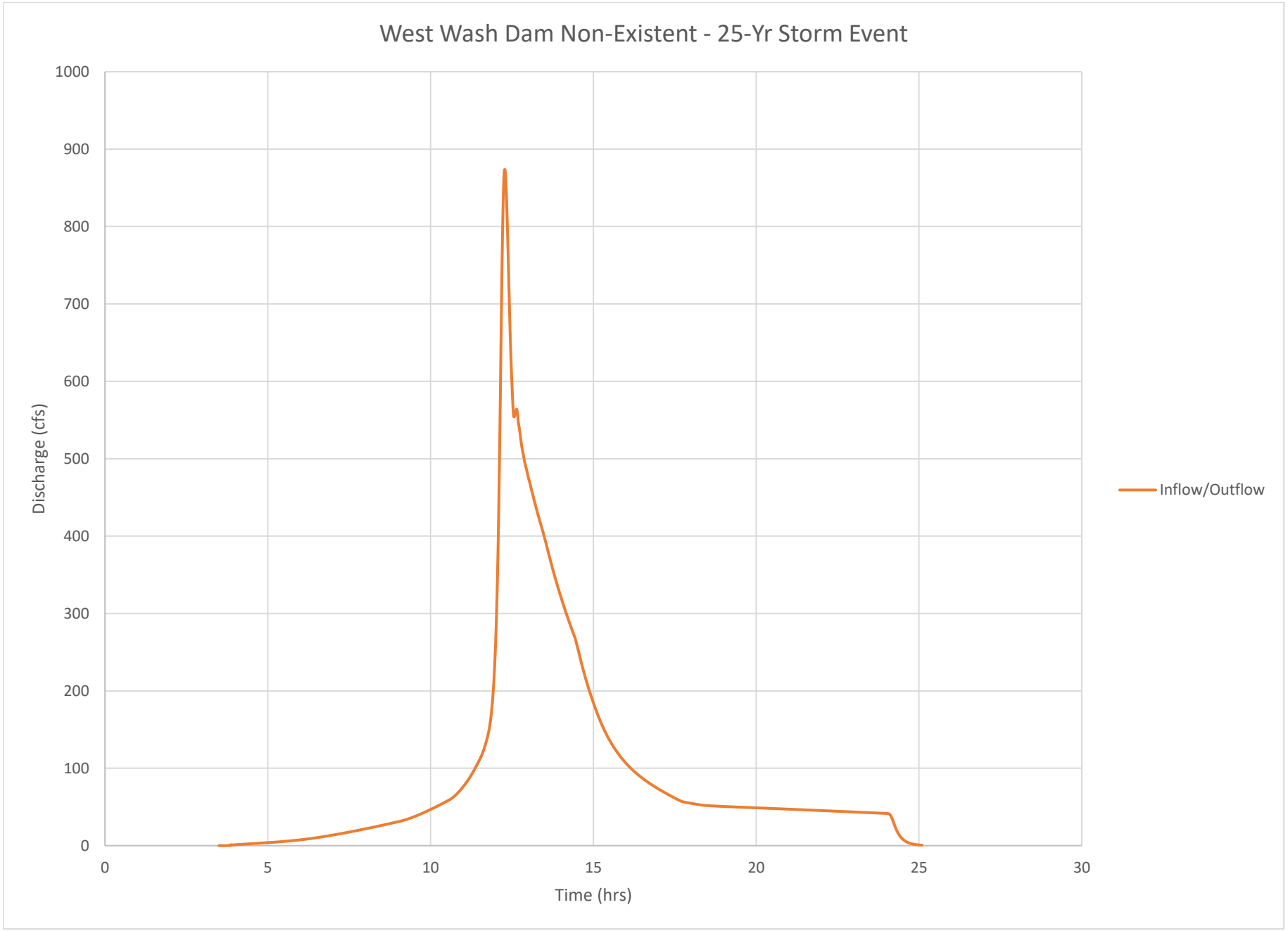

West Wash Dam - Full Local PMP Storm Event
Discharge (cfs)
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
0
10
20
30
40
50
60
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow

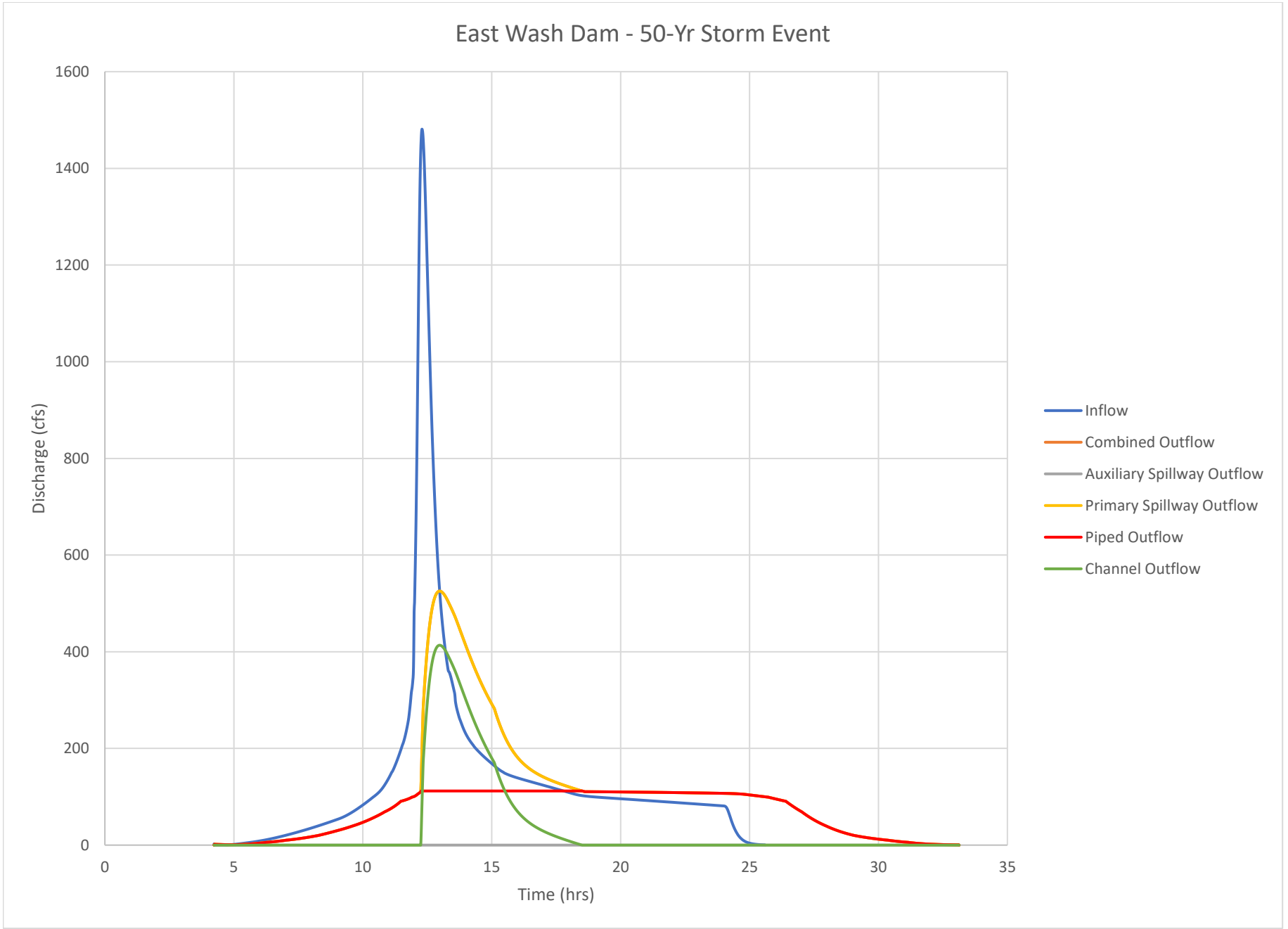
APPENDIX E: INFLOW/OUTFLOW HYDROGRAPHS – WEST WASH DAM NON-EXISTENT

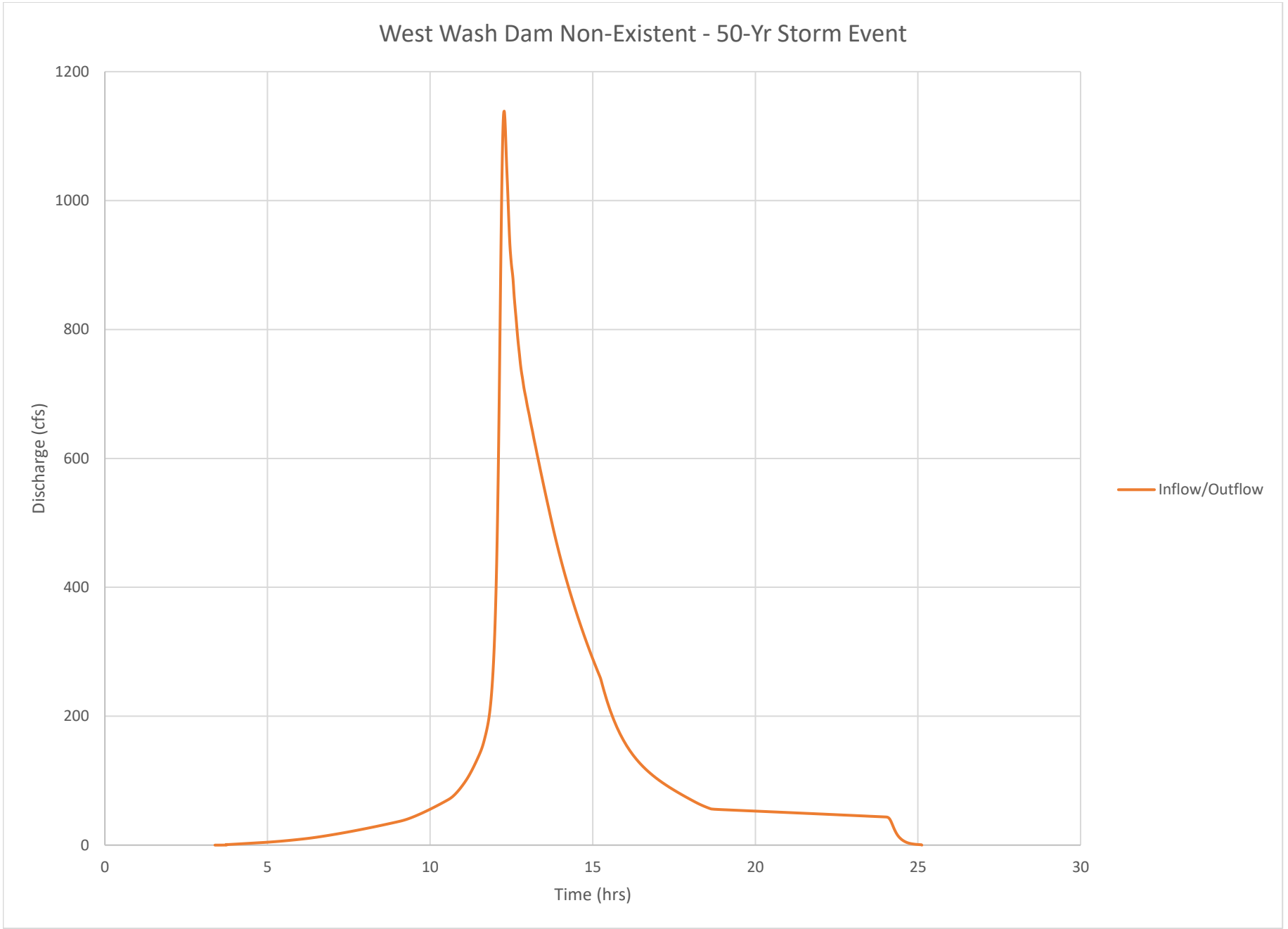

East Wash Dam - 10-Yr Storm Event
Discharge (cfs)
900
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
35
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow
Piped Outflow
Channel Outflow

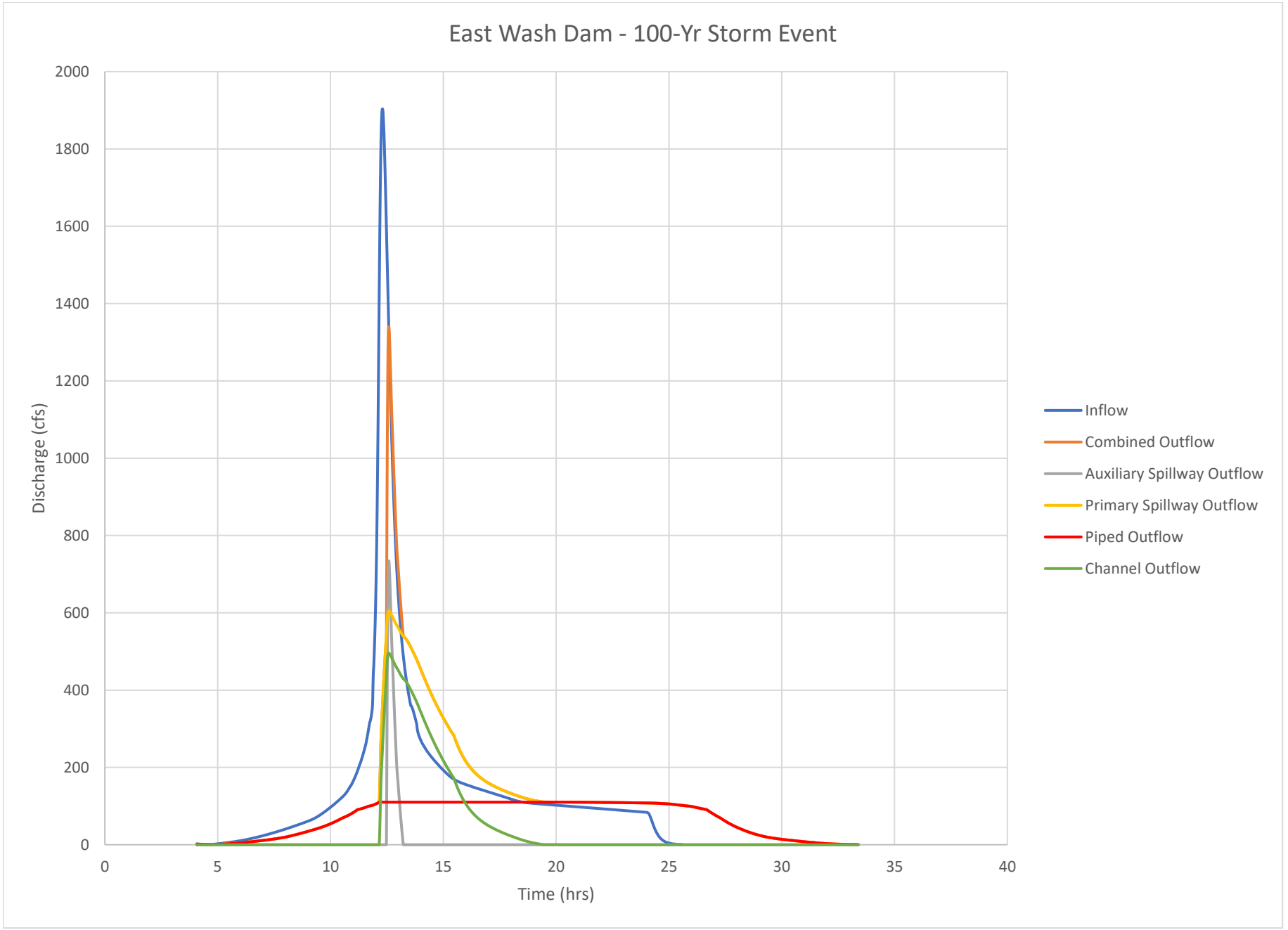

West Wash Dam Non-Existent - 10-Yr Storm Event
Discharge (cfs)
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
Time (hrs)
Inflow/Outflow

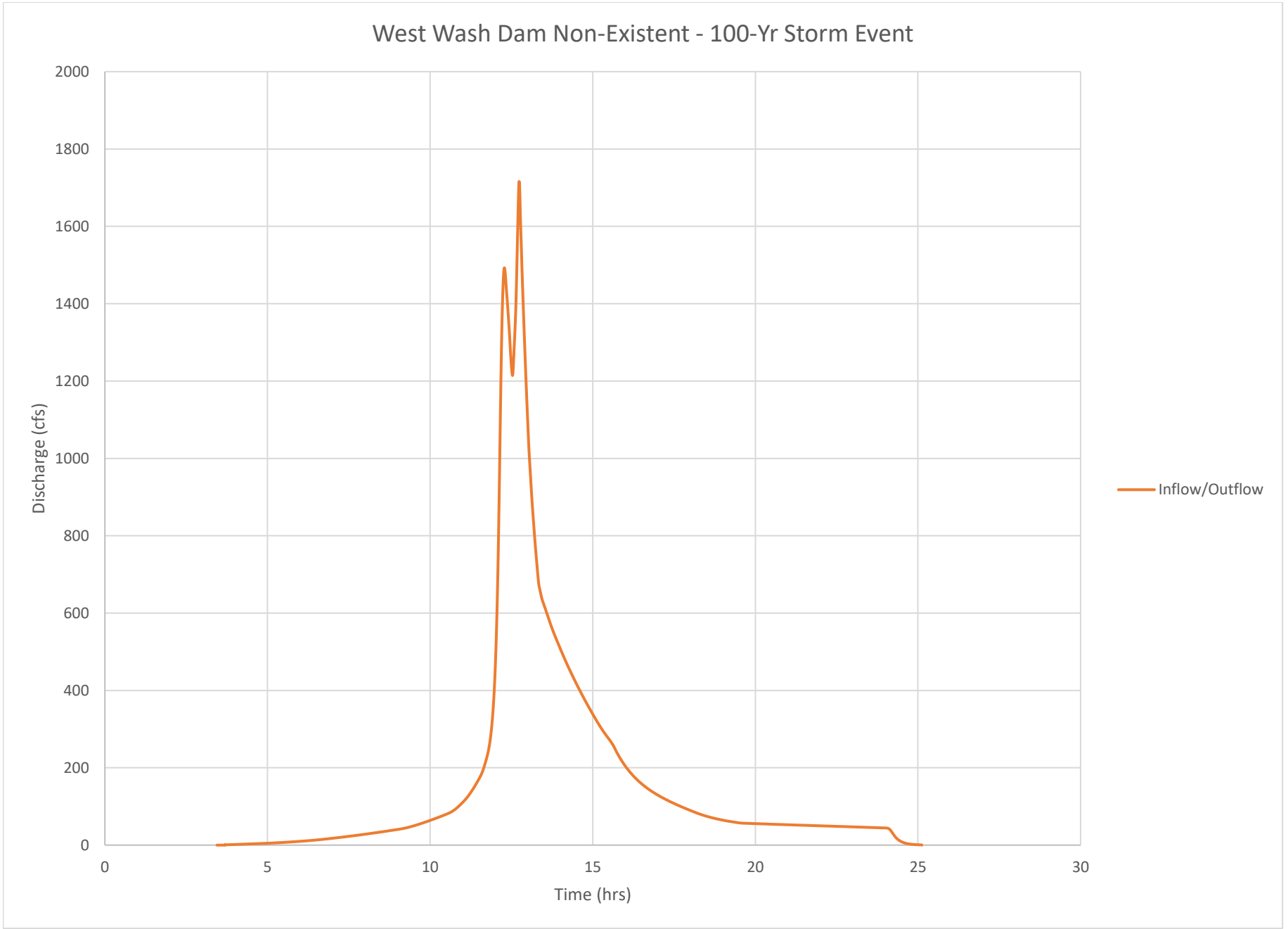

East Wash Dam - 25-Yr Storm Event
Discharge (cfs)
1200
1000
800
600
400
200
0
0
5
10
15
20
25
30
35
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow
Piped Outflow
Channel Outflow

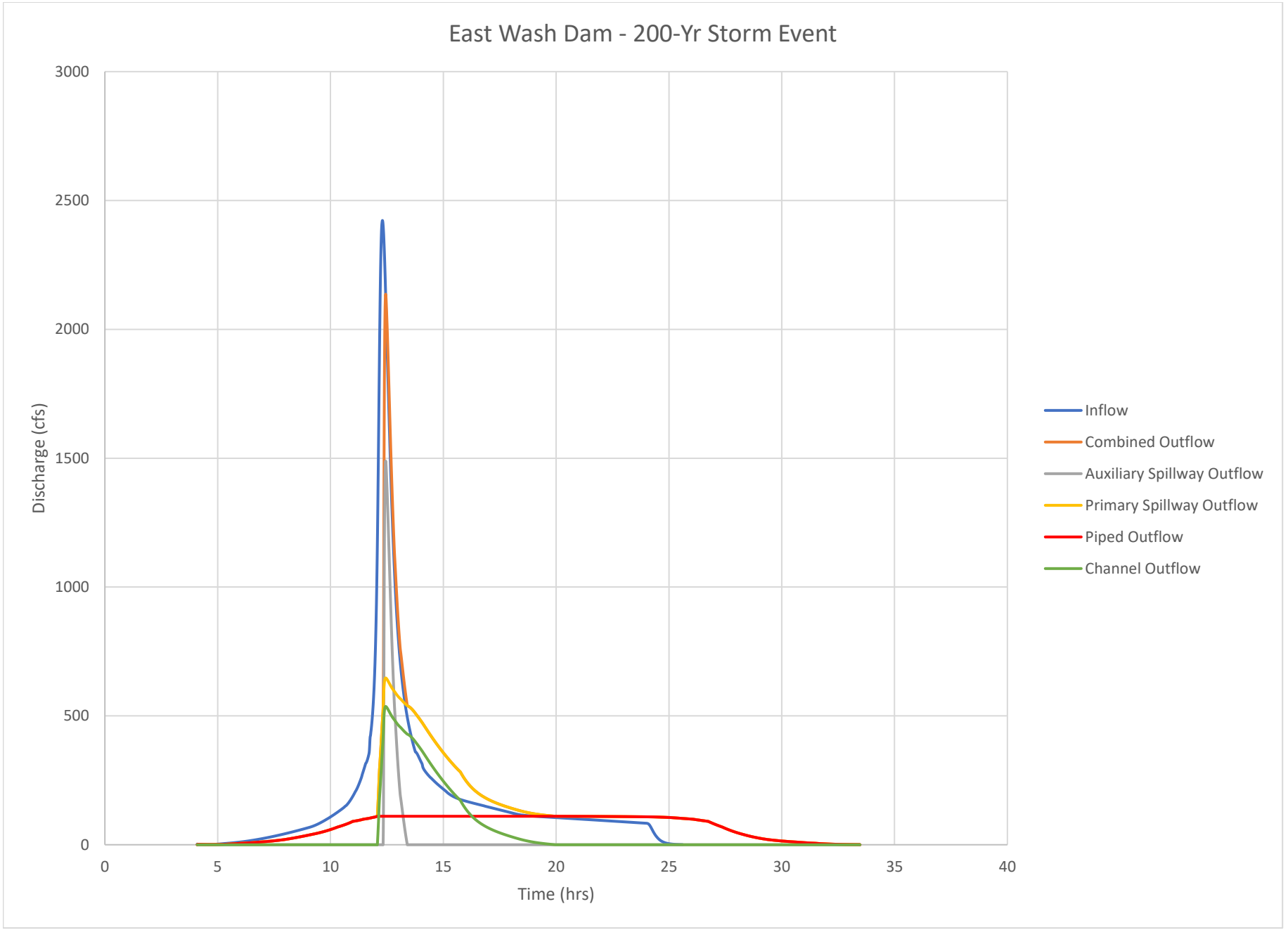

West Wash Dam Non-Existent - 25-Yr Storm Event
Discharge (cfs)
1000
900
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
Time (hrs)
Inflow/Outflow

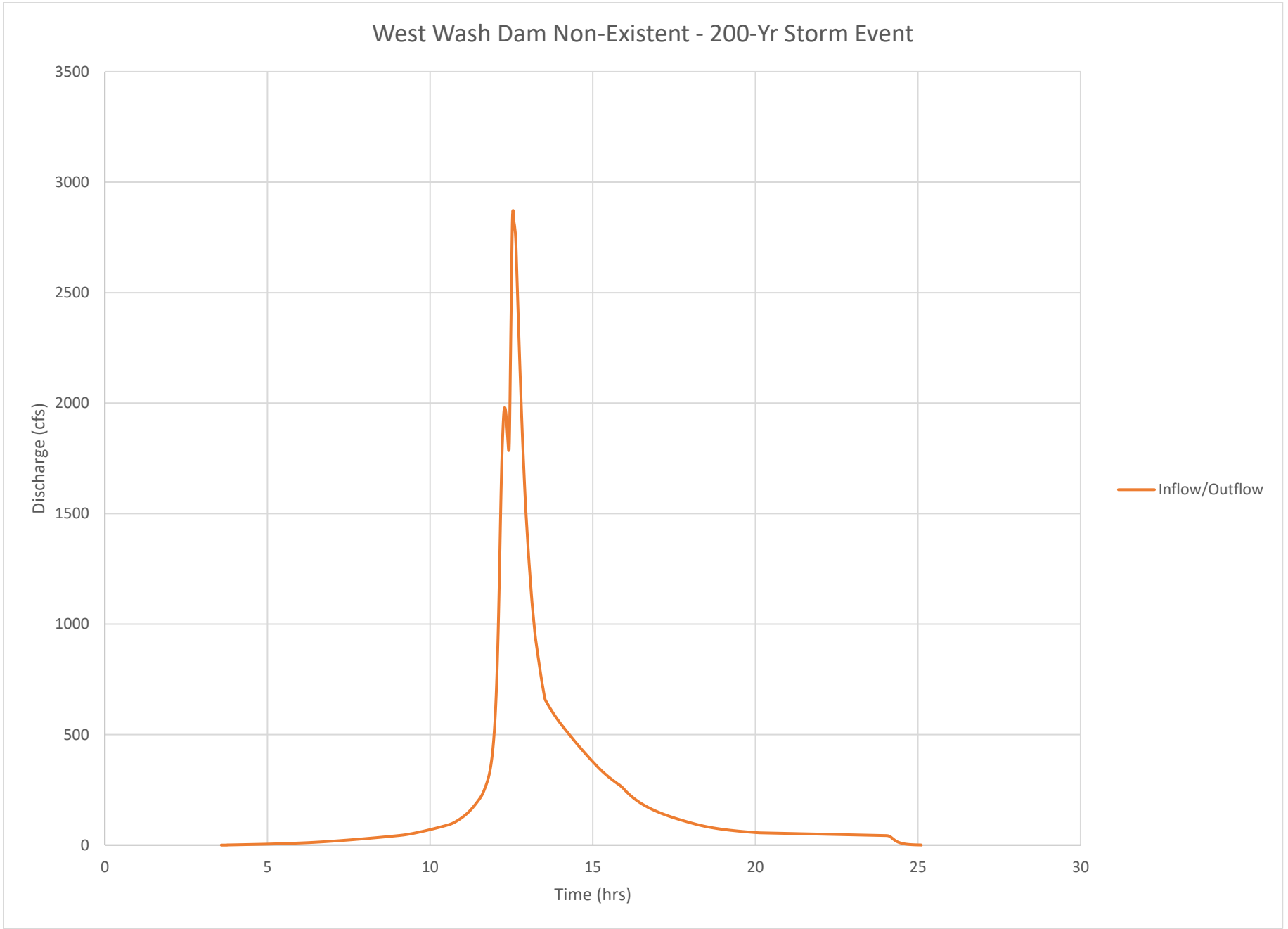

East Wash Dam - 50-Yr Storm Event
Discharge (cfs)
1600
1400
1200
1000
800
600
400
200
0
0
5
10
15
20
25
30
35
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow
Piped Outflow
Channel Outflow

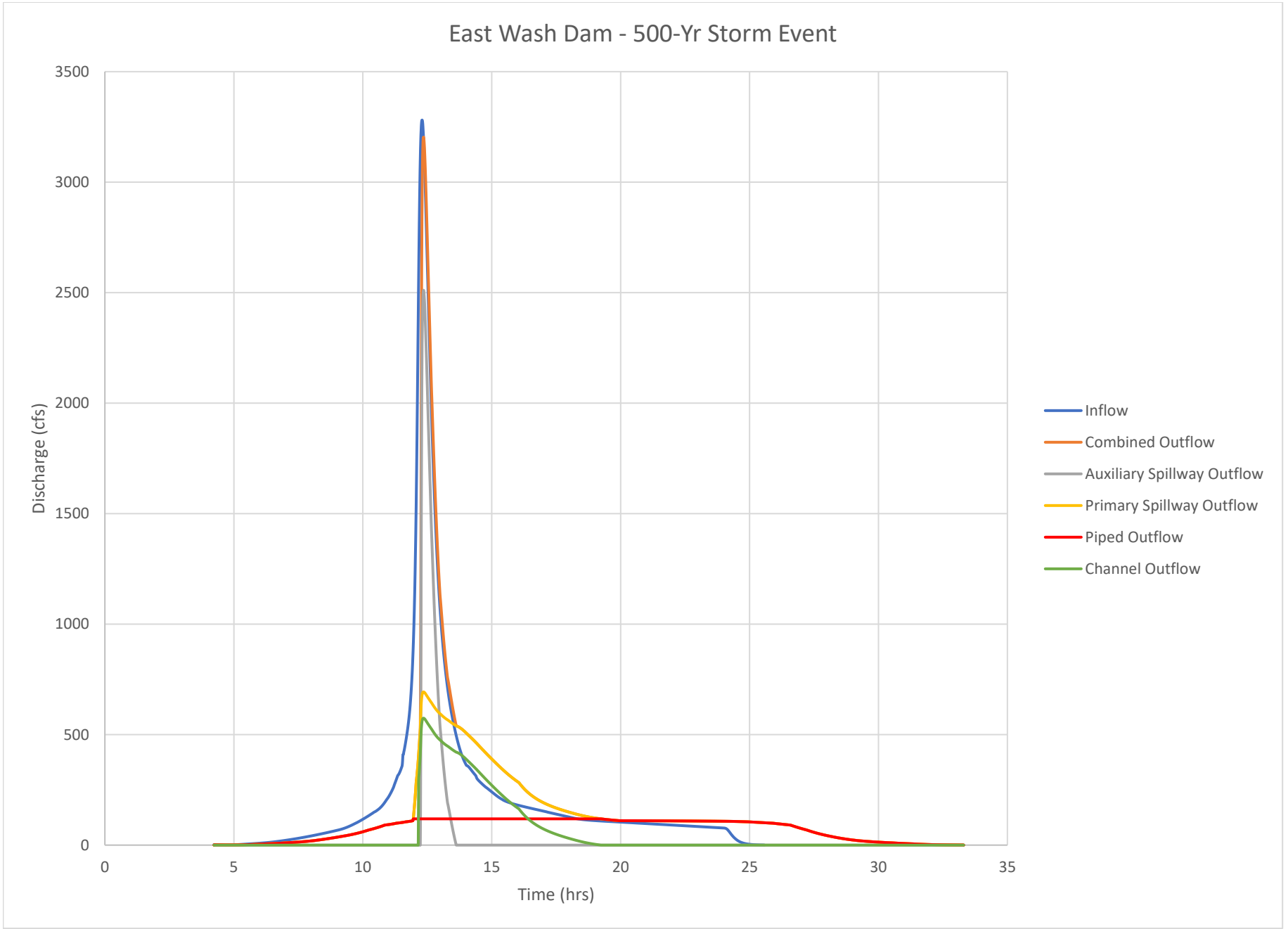

West Wash Dam Non-Existent - 50-Yr Storm Event
1200
1000
800
600
400
200
0
Discharge (cfs)
0
5
10
15
20
25
30
Time (hrs)
Inflow/Outflow

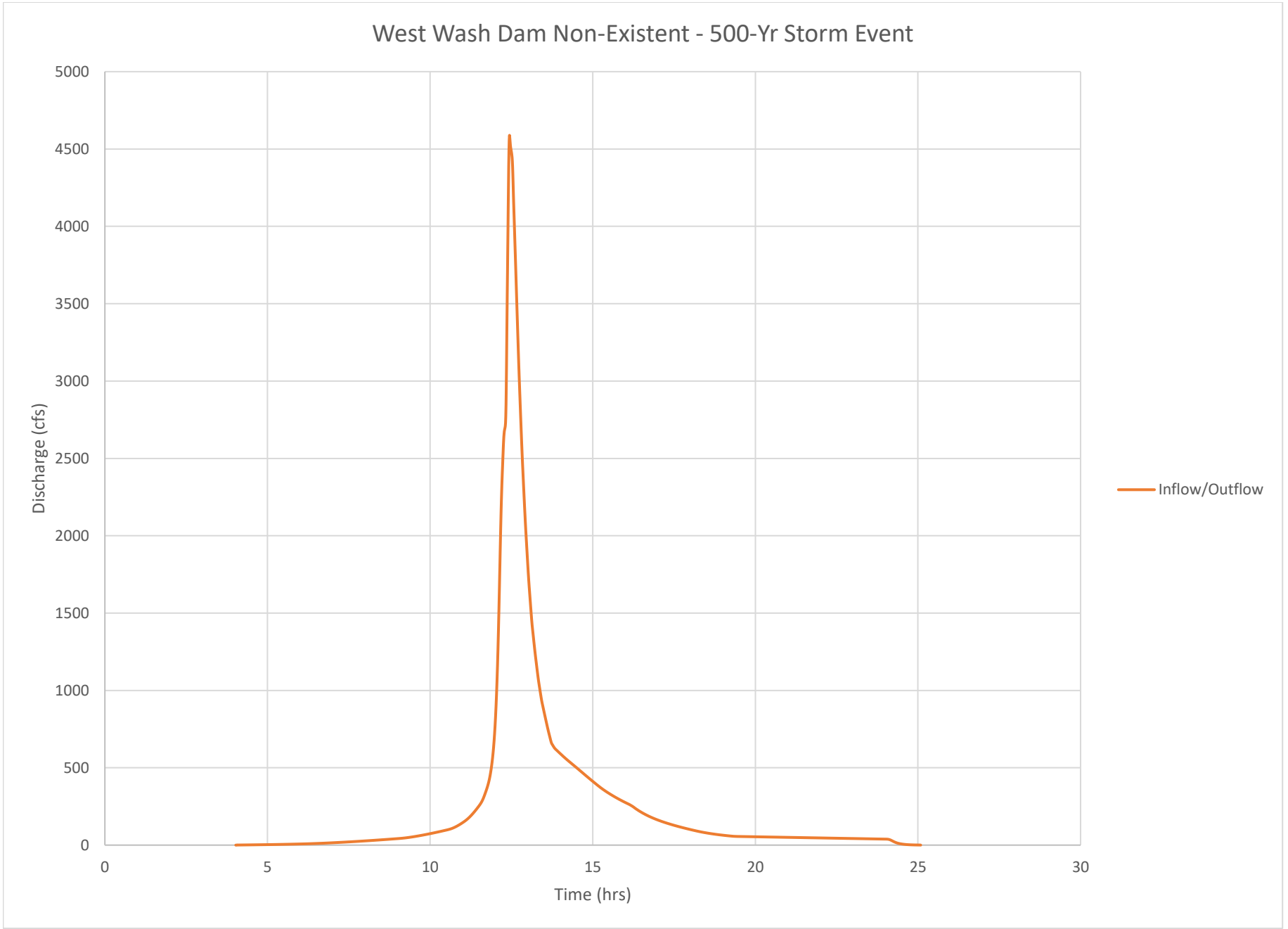

East Wash Dam - 100-Yr Storm Event
Discharge (cfs)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
0
5
10
15
20
25
30
35
40
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow
Piped Outflow
Channel Outflow

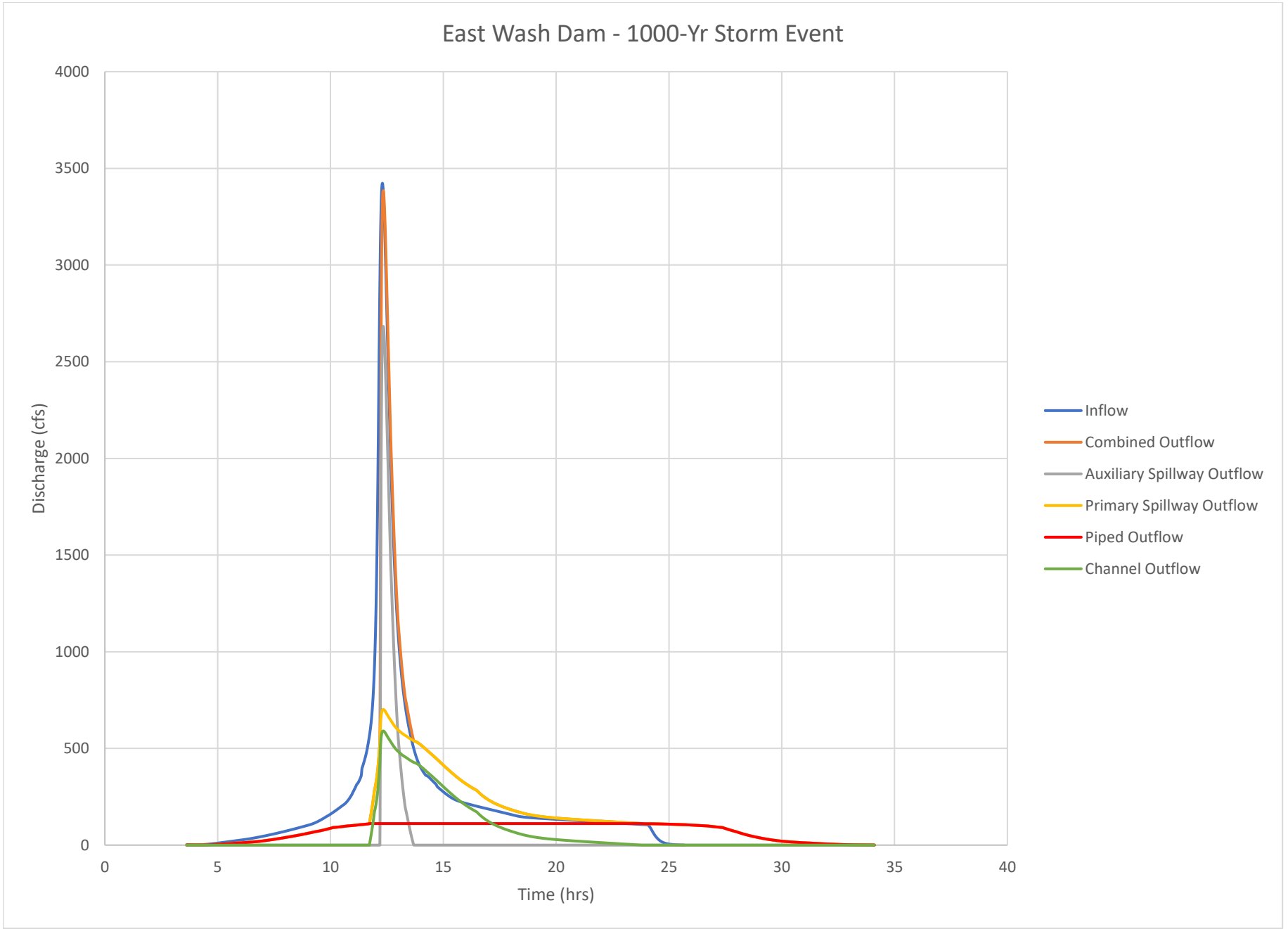

West Wash Dam Non-Existent - 100-Yr Storm Event
Discharge (cfs)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
0
5
10
15
20
25
30
Time (hrs)
Inflow/Outflow

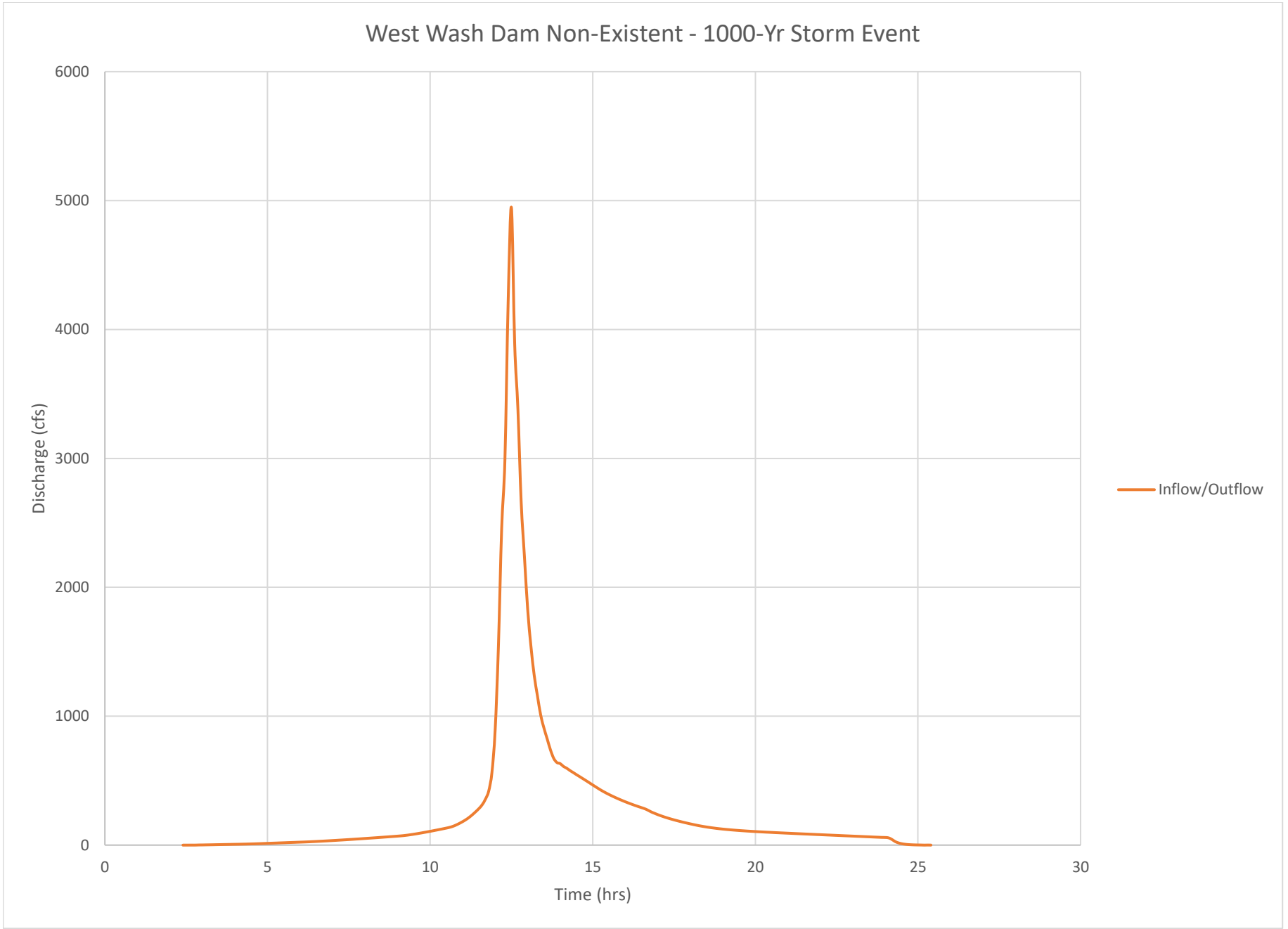

East Wash Dam - 200-Yr Storm Event
Discharge (cfs)
3000
2500
2000
1500
1000
500
0
0
5
10
15
20
25
30
35
40
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow
Piped Outflow
Channel Outflow

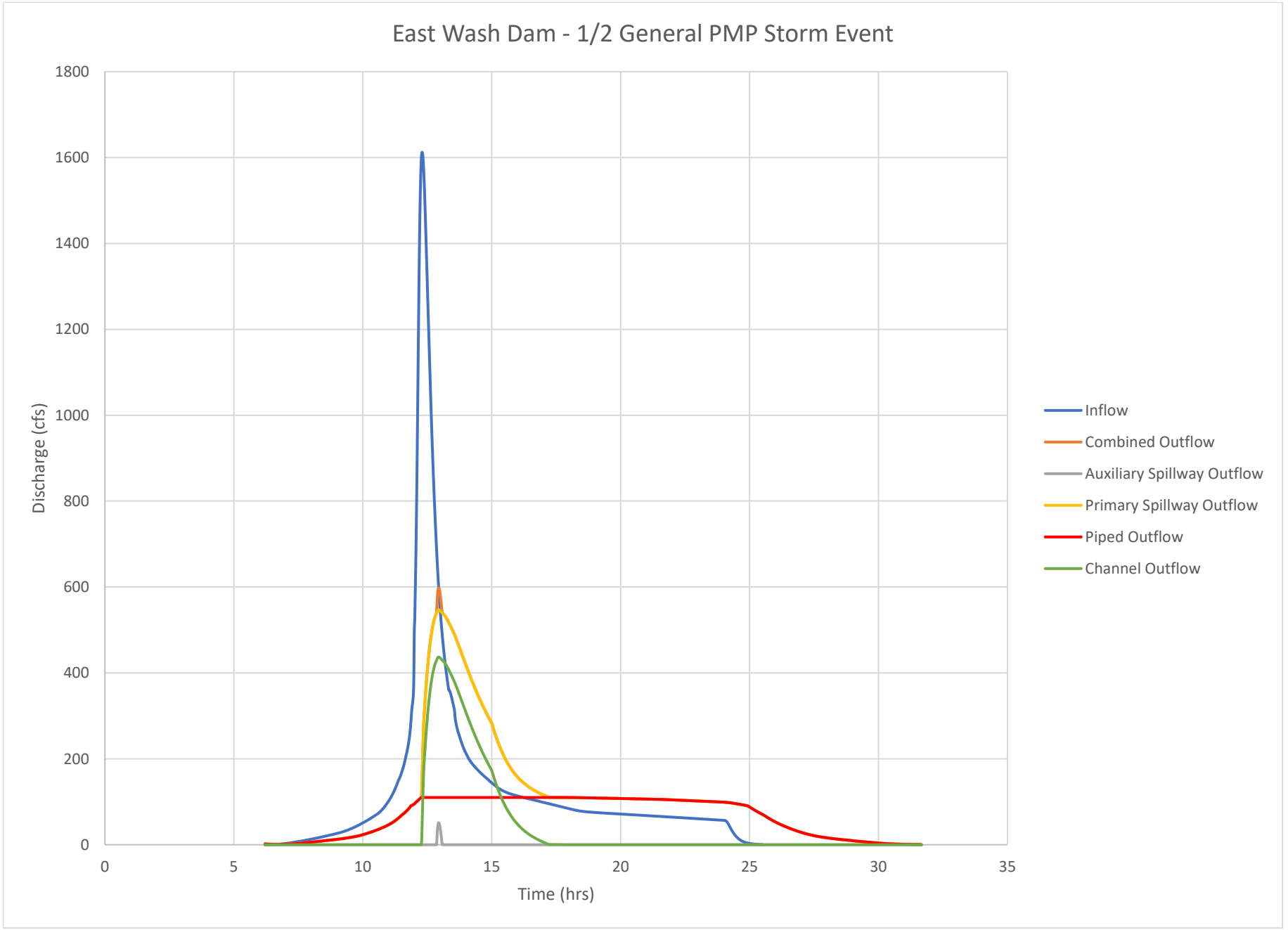

West Wash Dam Non-Existent - 200-Yr Storm Event
Discharge (cfs)
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20
25
30
Time (hrs)
Inflow/Outflow

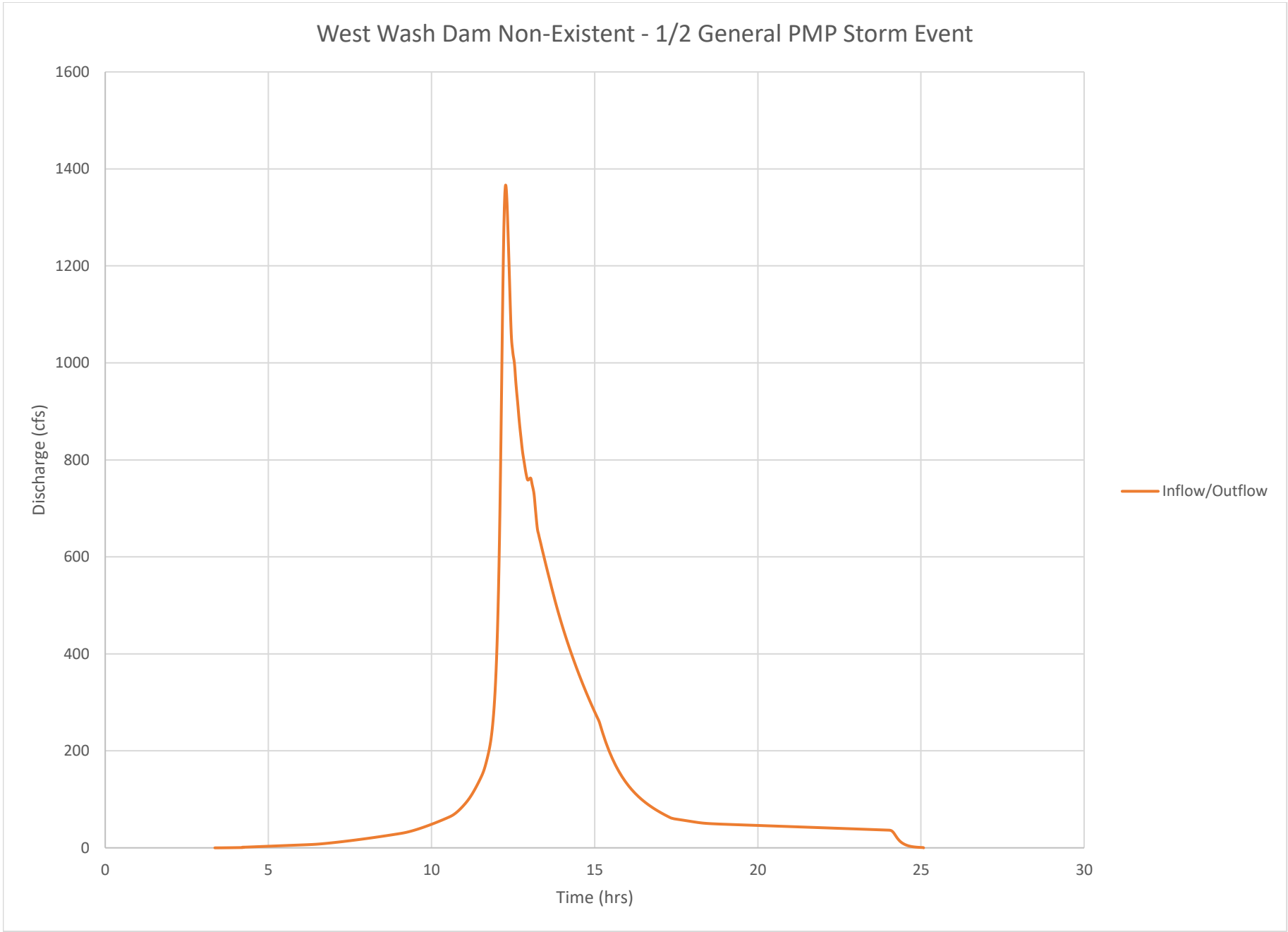

East Wash Dam - 500-Yr Storm Event
Discharge (cfs)
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20
25
30
35
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow
Piped Outflow
Channel Outflow

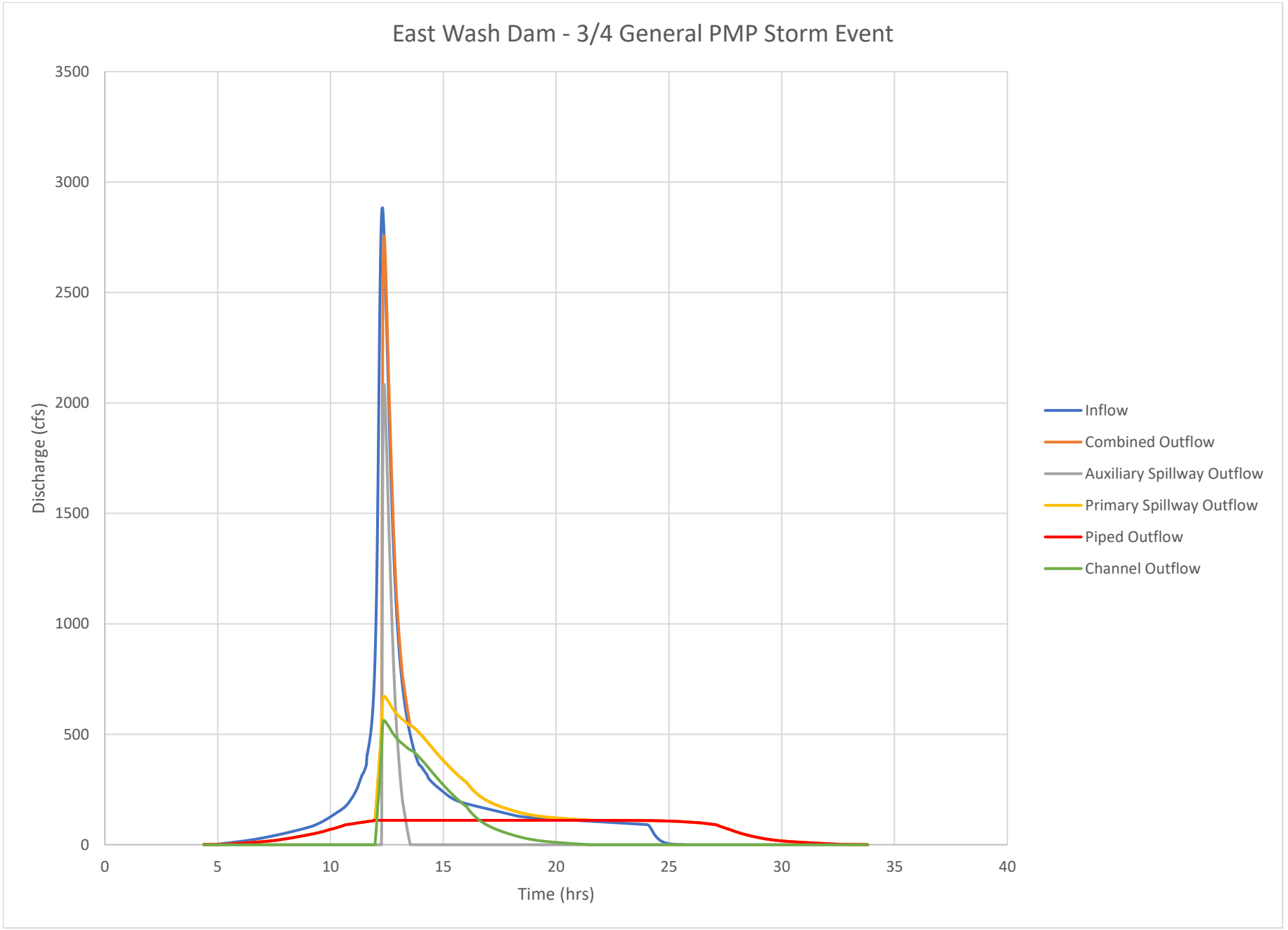

West Wash Dam Non-Existent - 500-Yr Storm Event
Discharge (cfs)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20
25
30
Time (hrs)
Inflow/Outflow

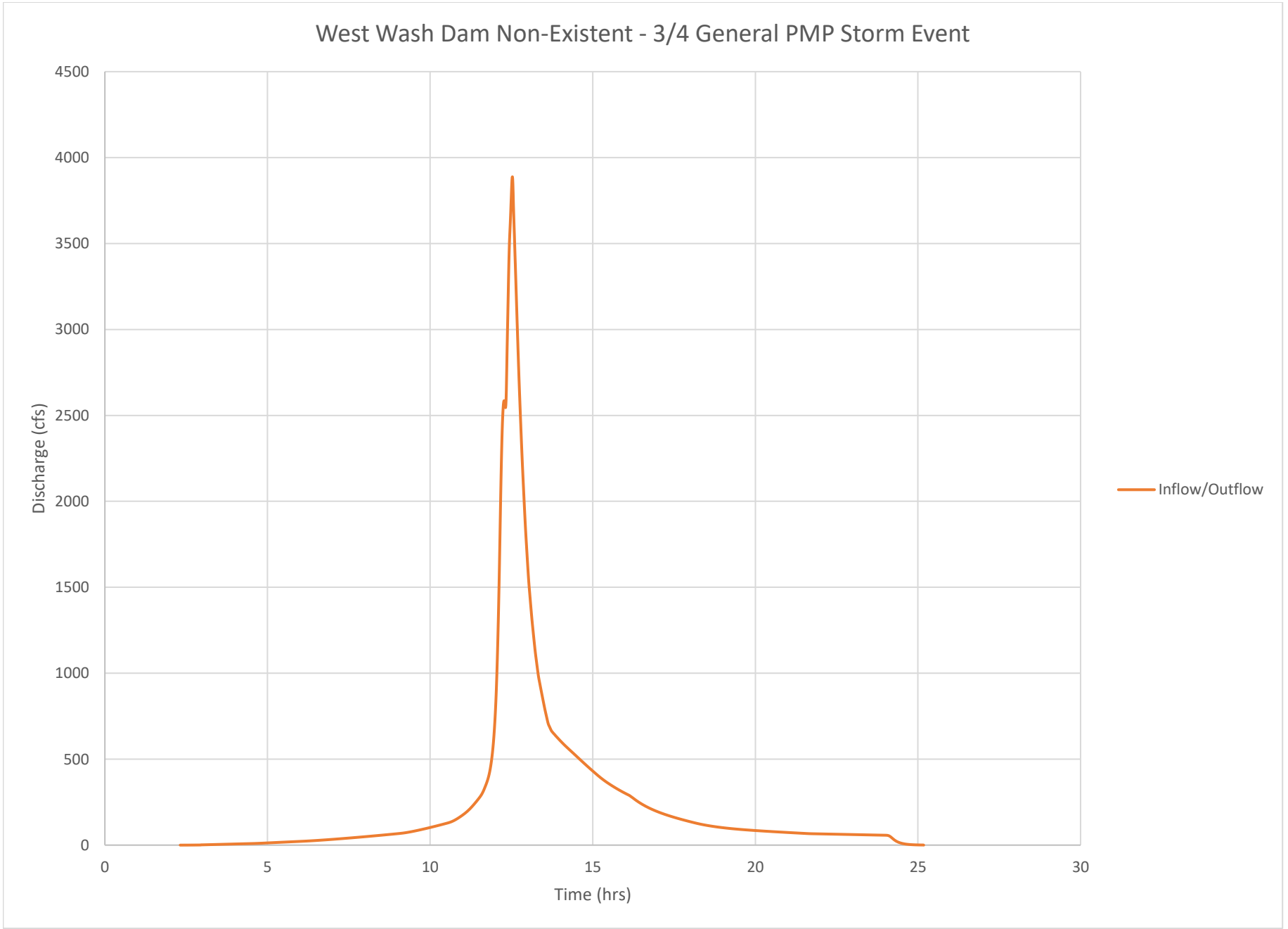

East Wash Dam - 1000-Yr Storm Event
Discharge (cfs)
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20
25
30
35
40
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow
Piped Outflow
Channel Outflow

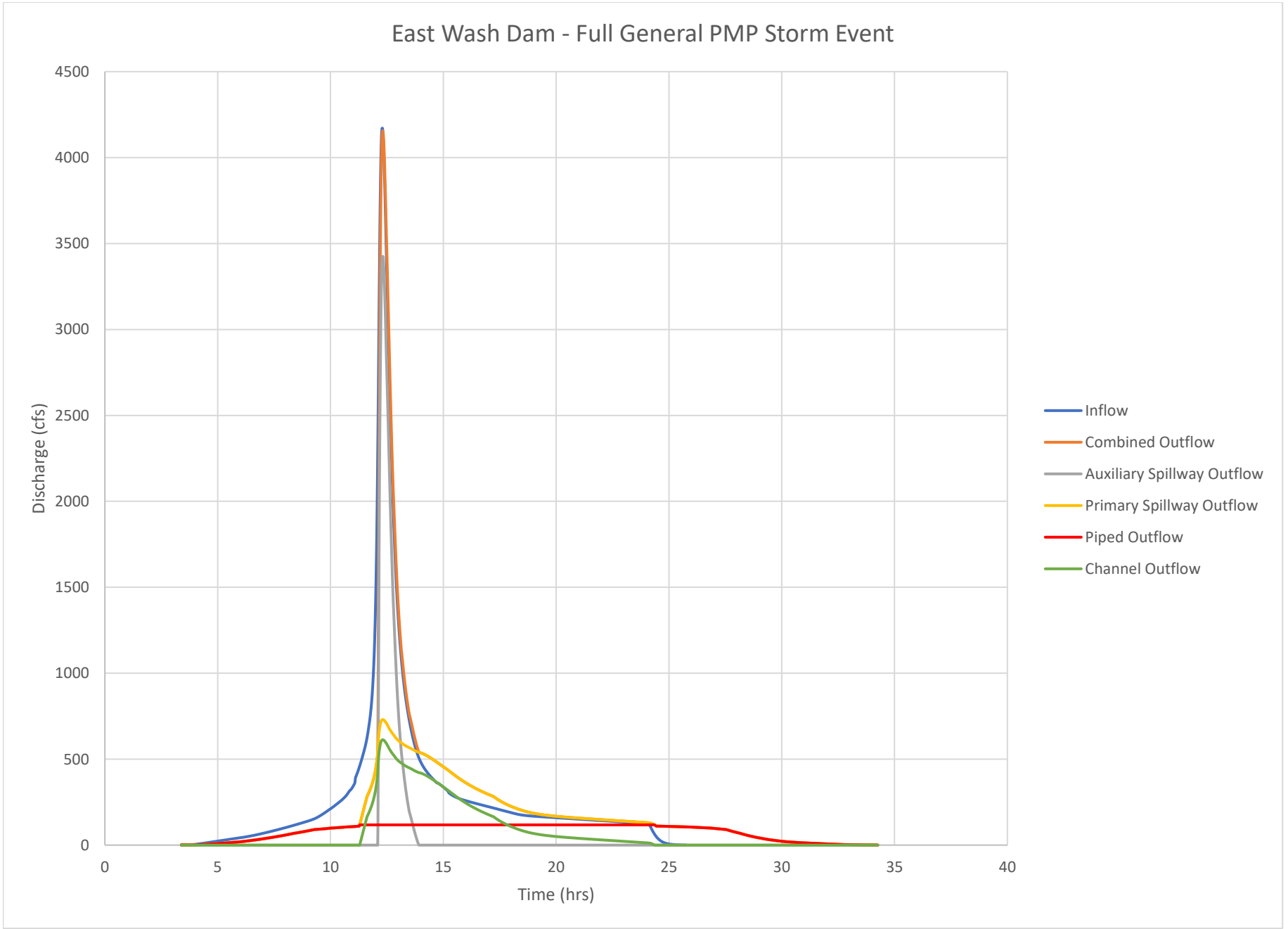

West Wash Dam Non-Existent - 1000-Yr Storm Event
6000
5000
4000
3000
2000
1000
0
Discharge (cfs)
0
5
10
15
20
25
30
Time (hrs)
Inflow/Outflow

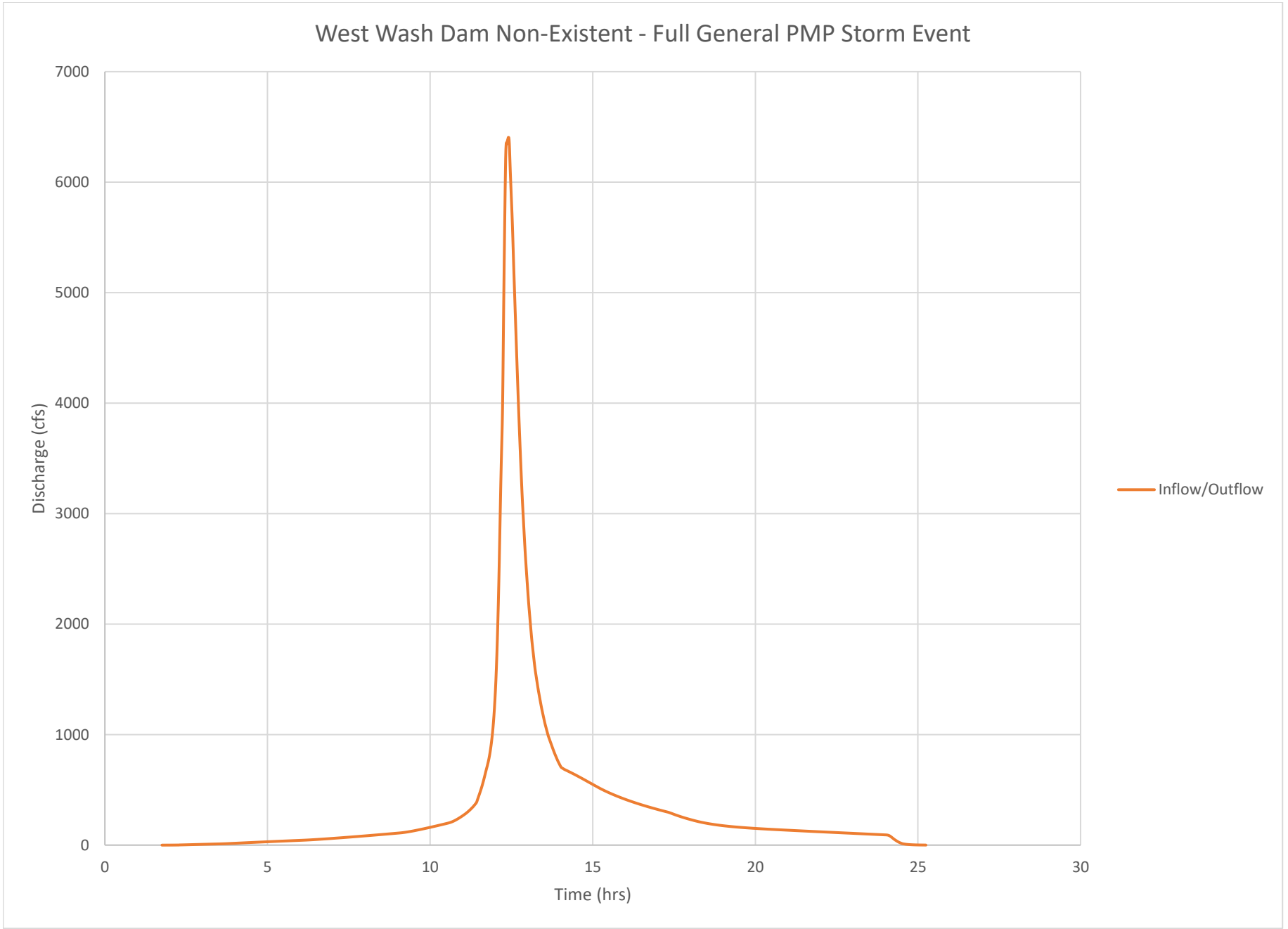

East Wash Dam - 1/2 General PMP Storm Event
Discharge (cfs)
1800
1600
1400
1200
1000
800
600
400
200
0
0
5
10
15
20
25
30
35
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow
Piped Outflow
Channel Outflow

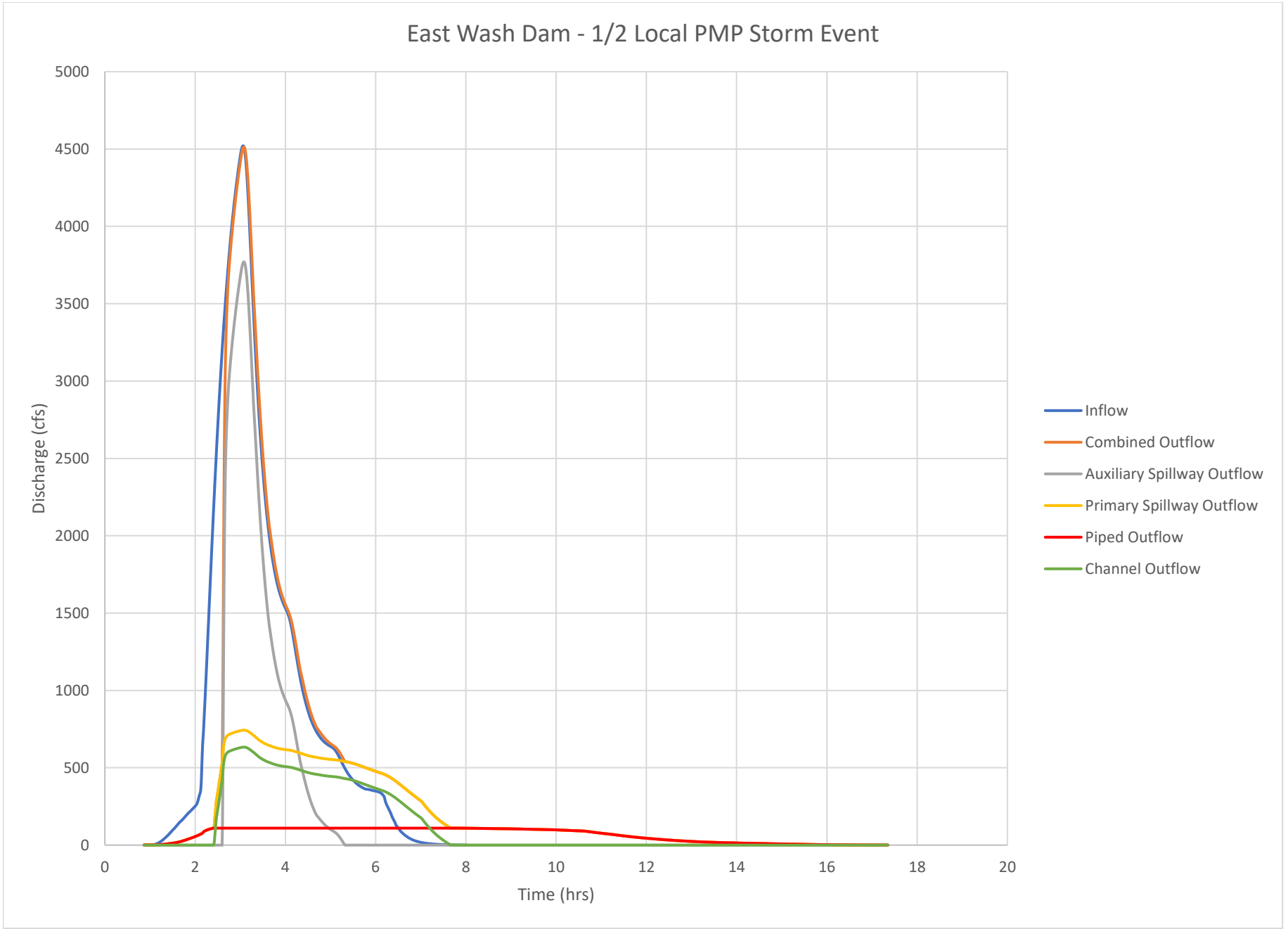

West Wash Dam Non-Existent - 1/2 General PMP Storm Event
1600
1400
1200
1000
800
600
400
200
0
Discharge (cfs)
0
5
10
15
20
25
30
Time (hrs)
Inflow/Outflow

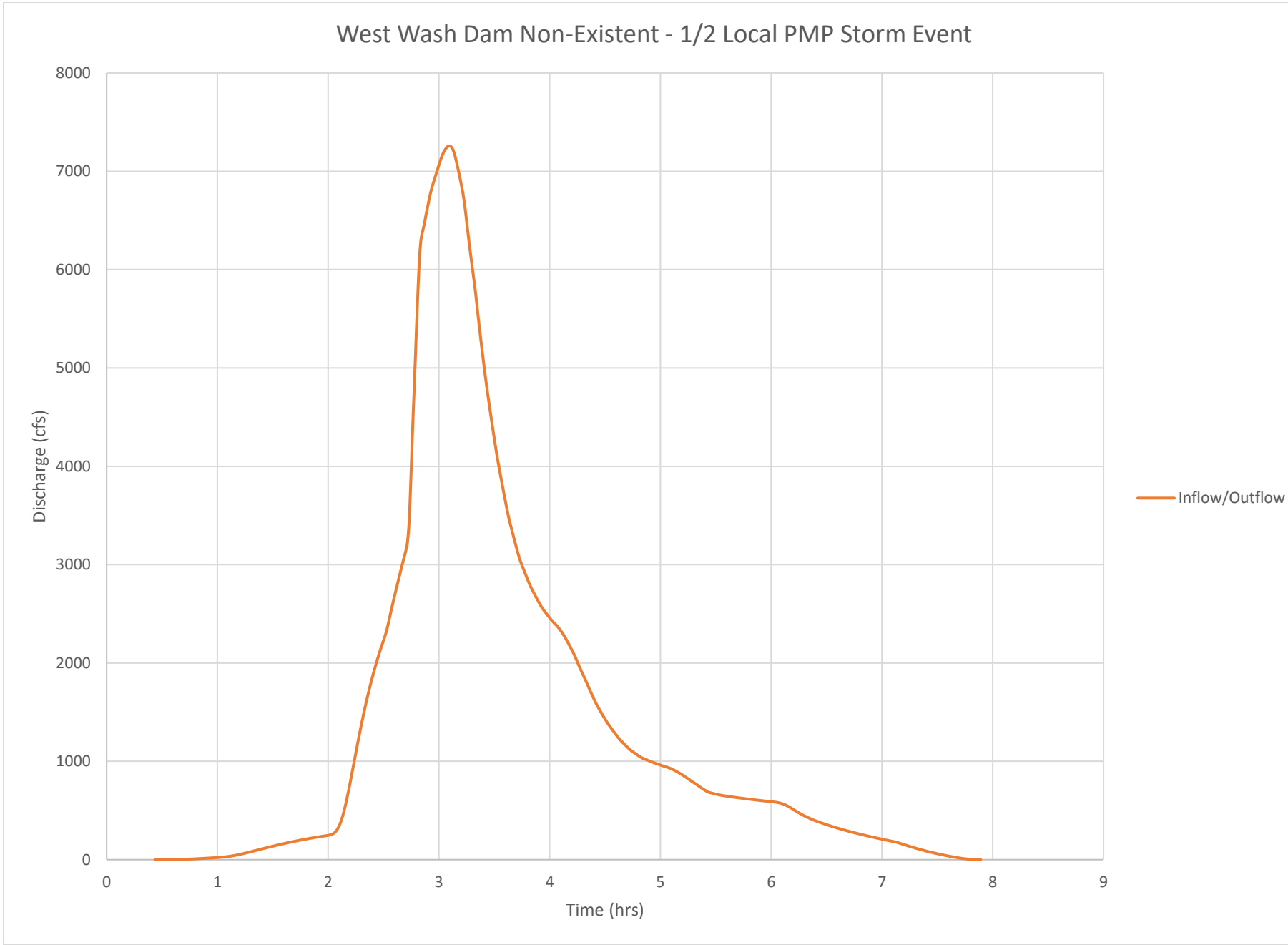

East Wash Dam - 3/4 General PMP Storm Event
Discharge (cfs)
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20
25
30
35
40
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow
Piped Outflow
Channel Outflow

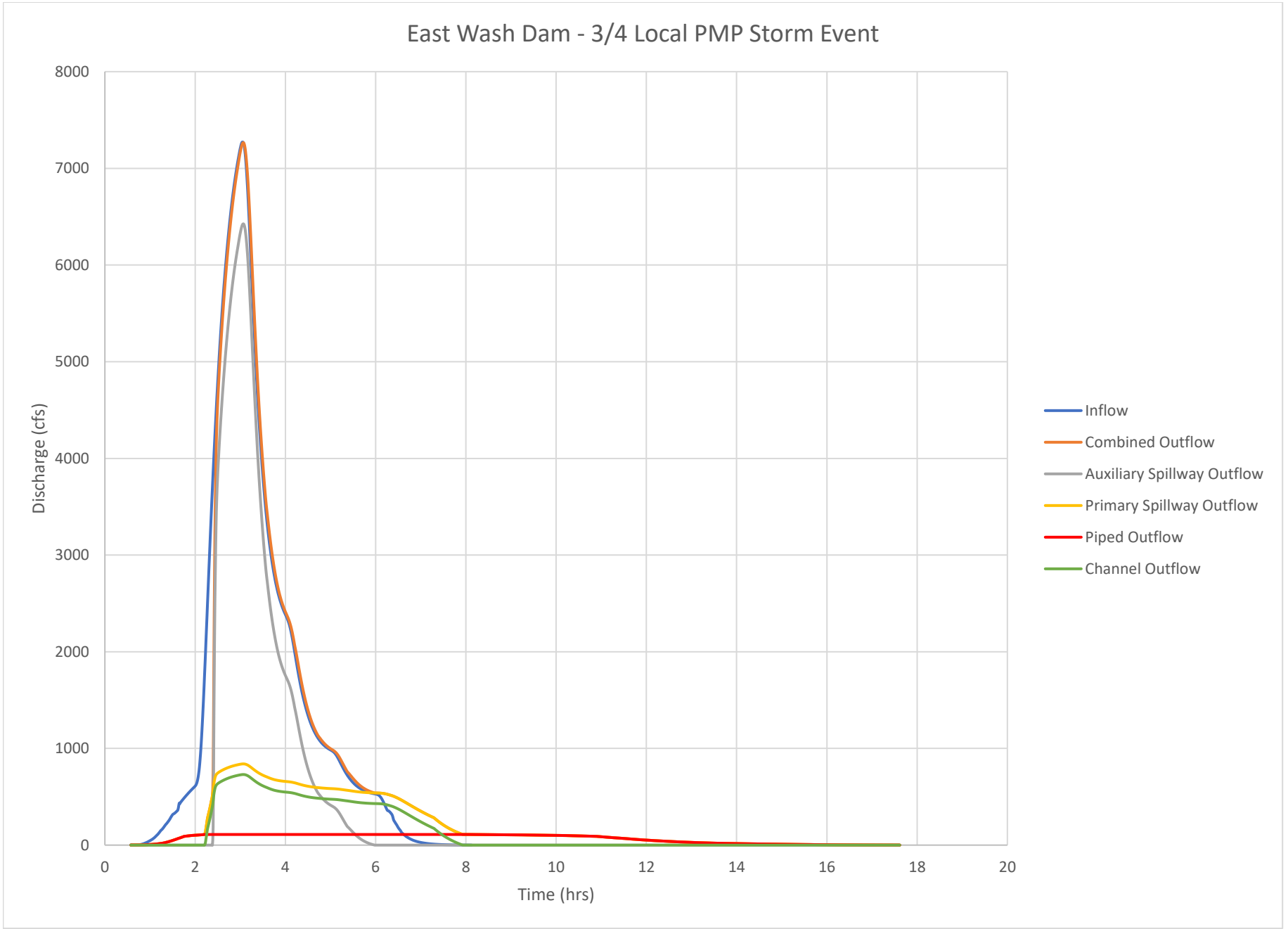

West Wash Dam Non-Existent - 3/4 General PMP Storm Event
Discharge (cfs)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20
25
30
Time (hrs)
Inflow/Outflow

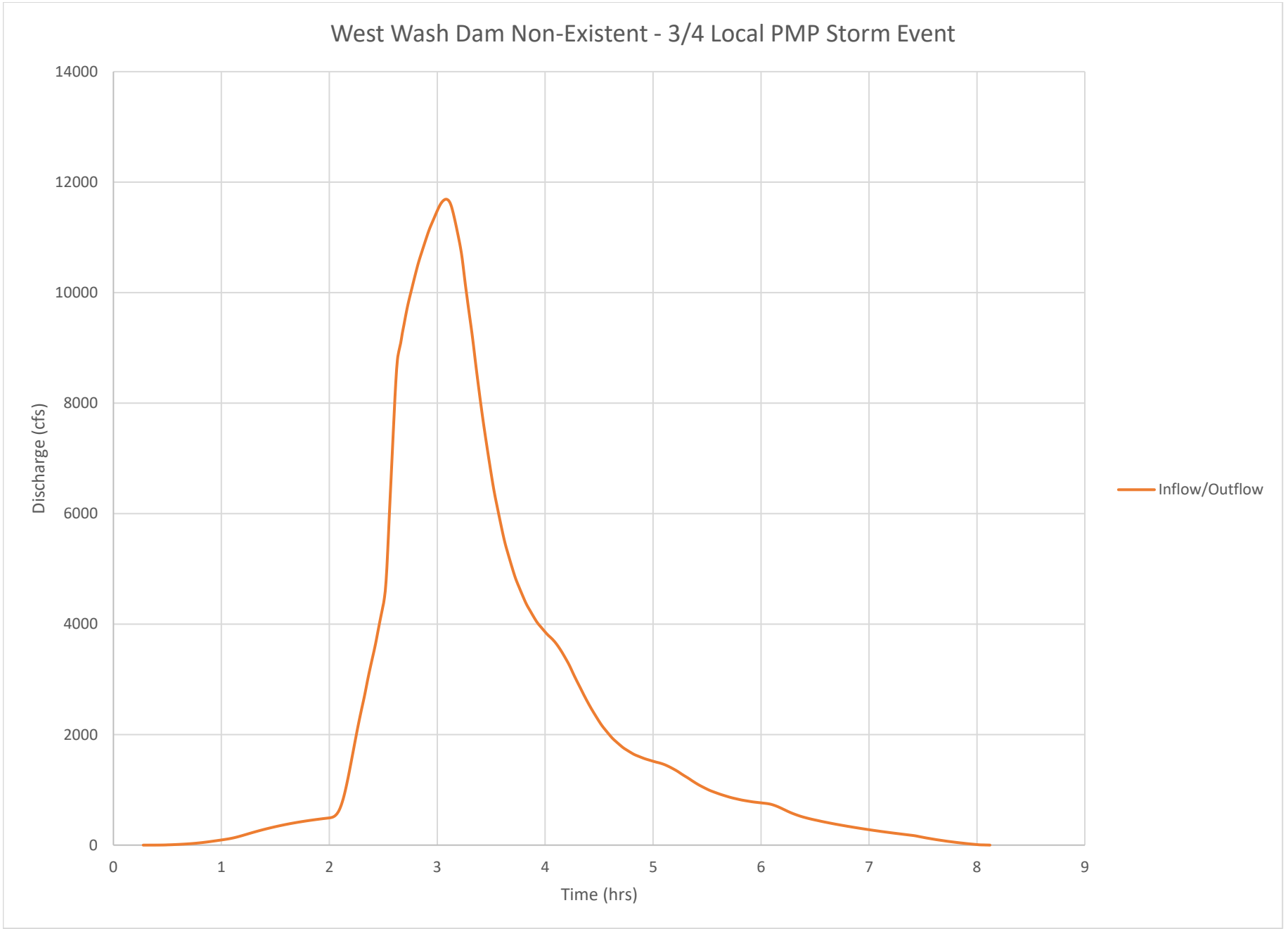

East Wash Dam - Full General PMP Storm Event
Discharge (cfs)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20
25
30
35
40
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow
Piped Outflow
Channel Outflow

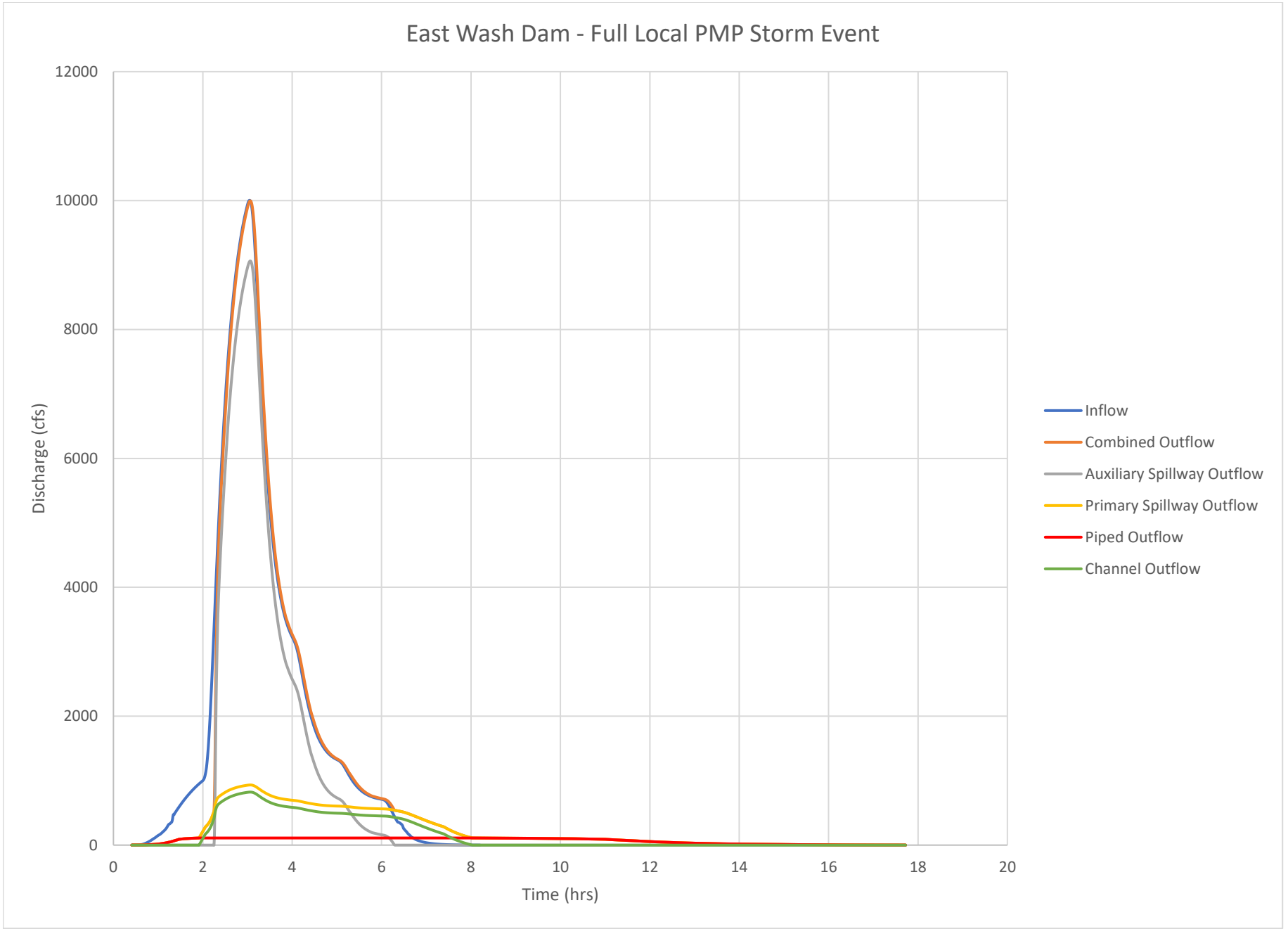

West Wash Dam Non-Existent - Full General PMP Storm Event
7000
6000
5000
4000
3000
2000
1000
0
Discharge (cfs)
0
5
10
15
20
25
30
Time (hrs)
Inflow/Outflow

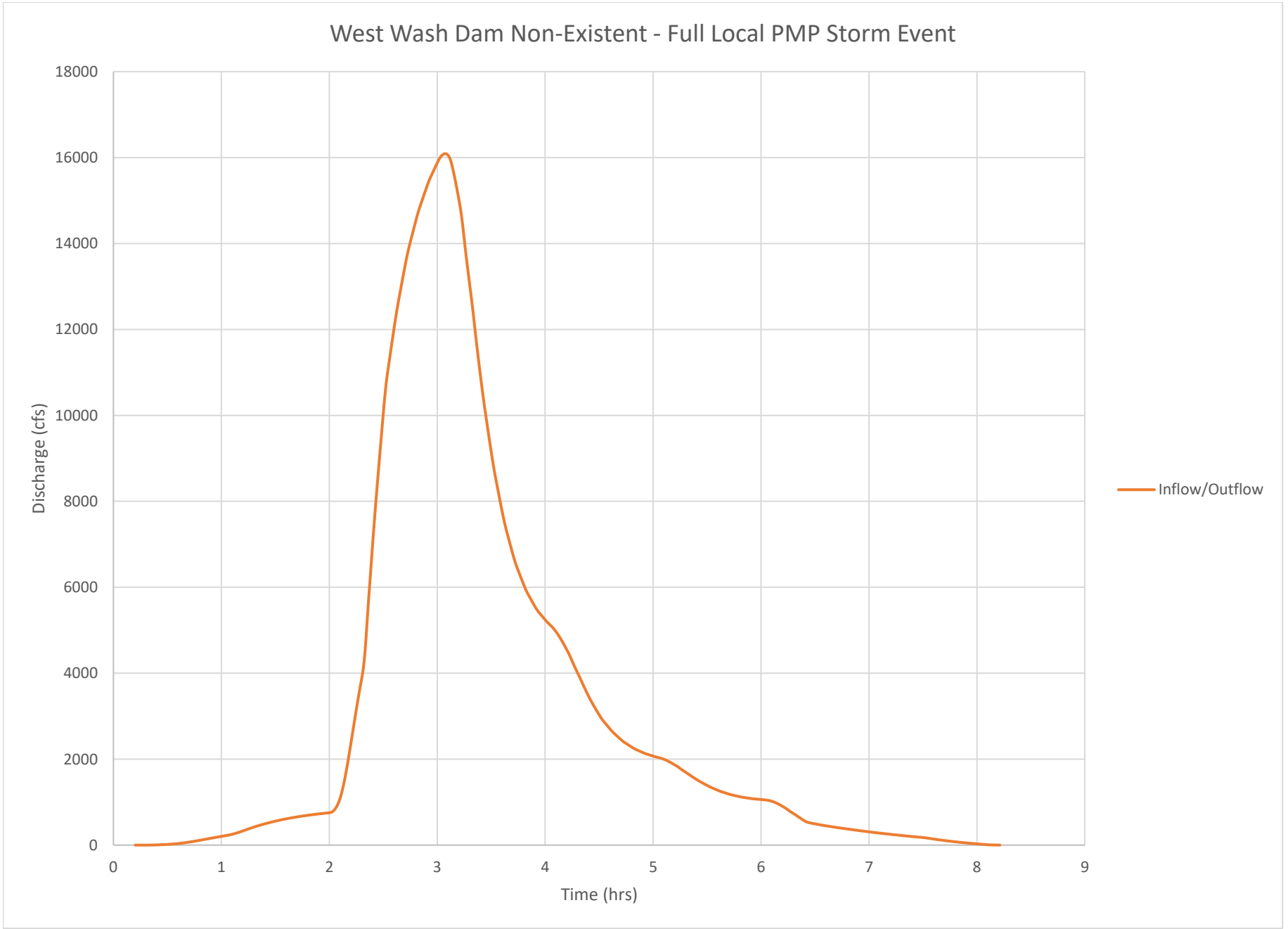

East Wash Dam - 1/2 Local PMP Storm Event
Discharge (cfs)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
2
4
6
8
10
12
14
16
18
20
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow
Piped Outflow
Channel Outflow


West Wash Dam Non-Existent - 1/2 Local PMP Storm Event
Discharge (cfs)
8000
7000
6000
5000
4000
3000
2000
1000
0
0
1
2
3
4
5
6
7
8
9
Time (hrs)
Inflow/Outflow

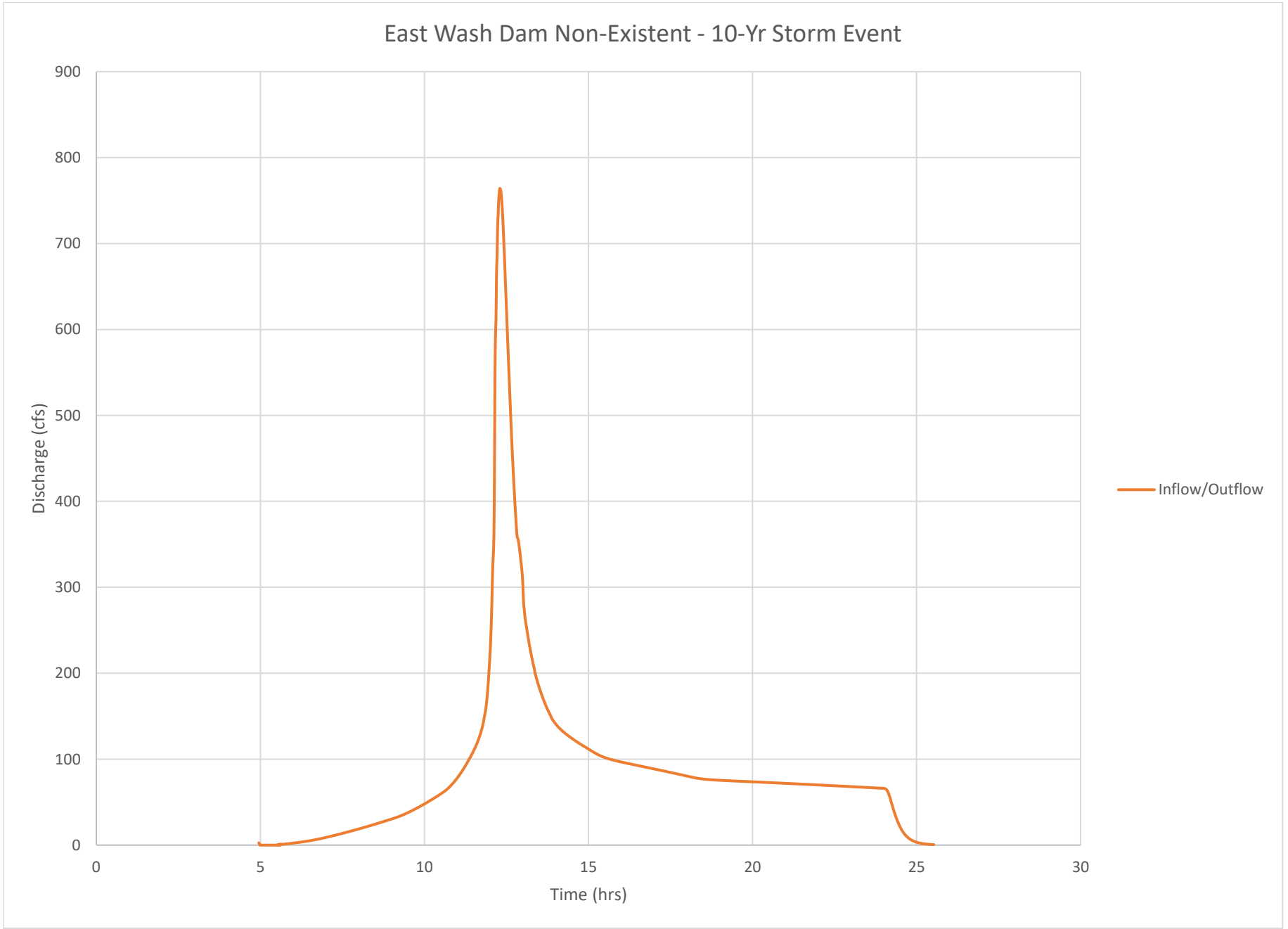

East Wash Dam - 3/4 Local PMP Storm Event
Discharge (cfs)
8000
7000
6000
5000
4000
3000
2000
1000
0
0
2
4
6
8
10
12
14
16
18
20
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow
Piped Outflow
Channel Outflow

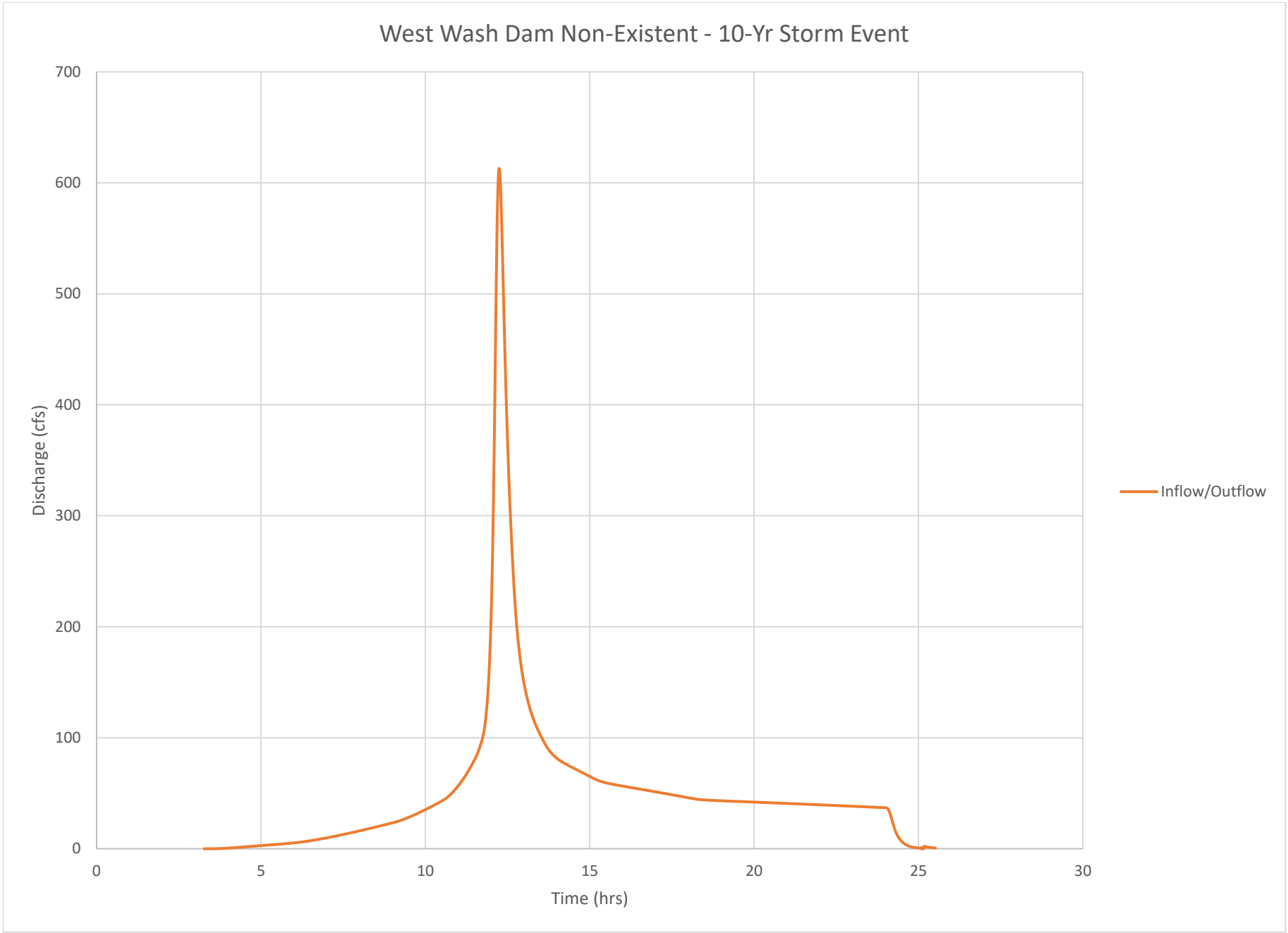

West Wash Dam Non-Existent - 3/4 Local PMP Storm Event
14000
12000
10000
8000
6000
4000
2000
0
Discharge (cfs)
0
1
2
3
4
5
6
7
8
9
Time (hrs)
Inflow/Outflow

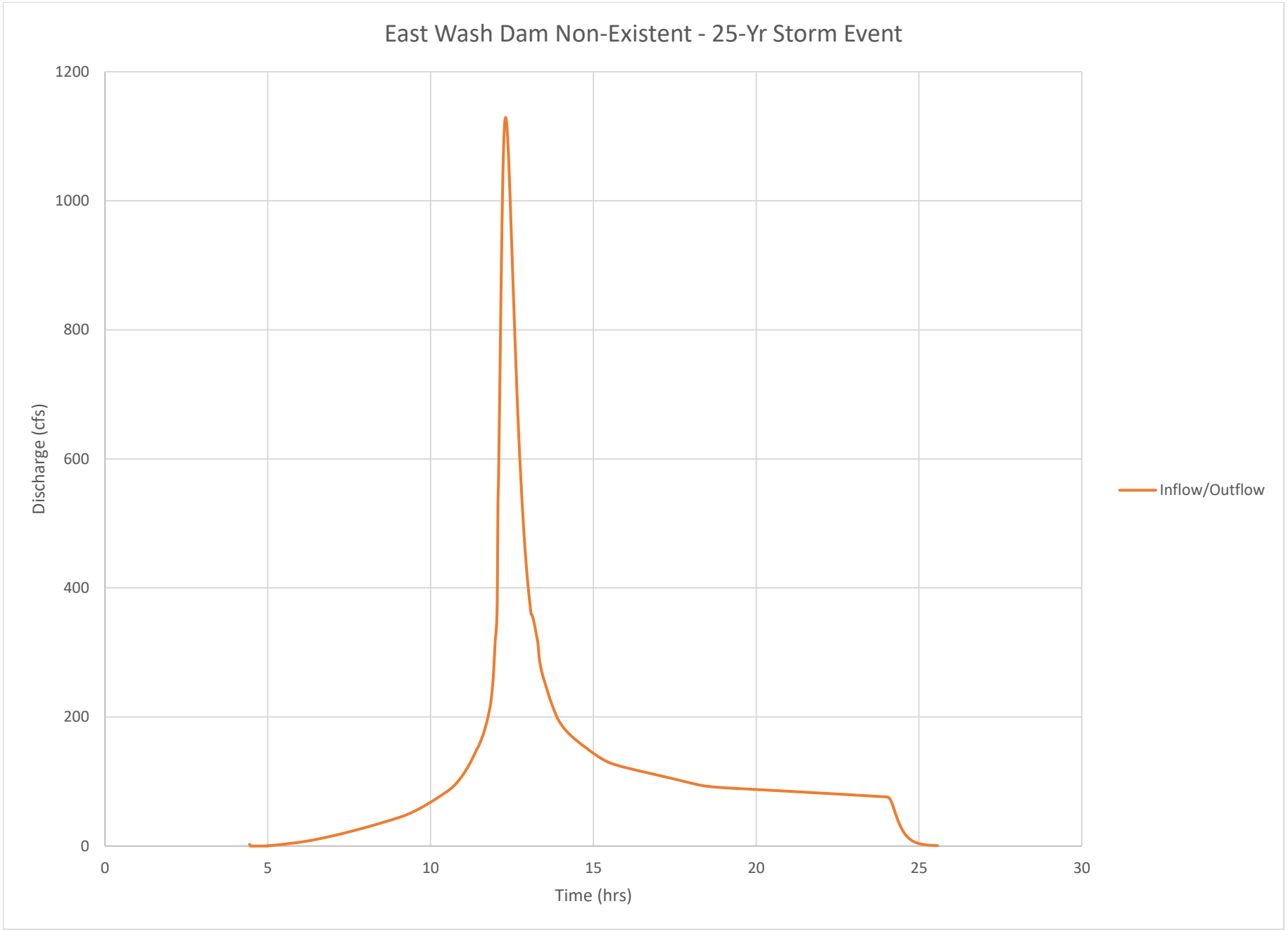

East Wash Dam - Full Local PMP Storm Event
Discharge (cfs)
12000
10000
8000
6000
4000
2000
0
0
2
4
6
8
10
12
14
16
18
20
Time (hrs)
Inflow
Combined Outflow
Auxiliary Spillway Outflow
Primary Spillway Outflow
Piped Outflow
Channel Outflow

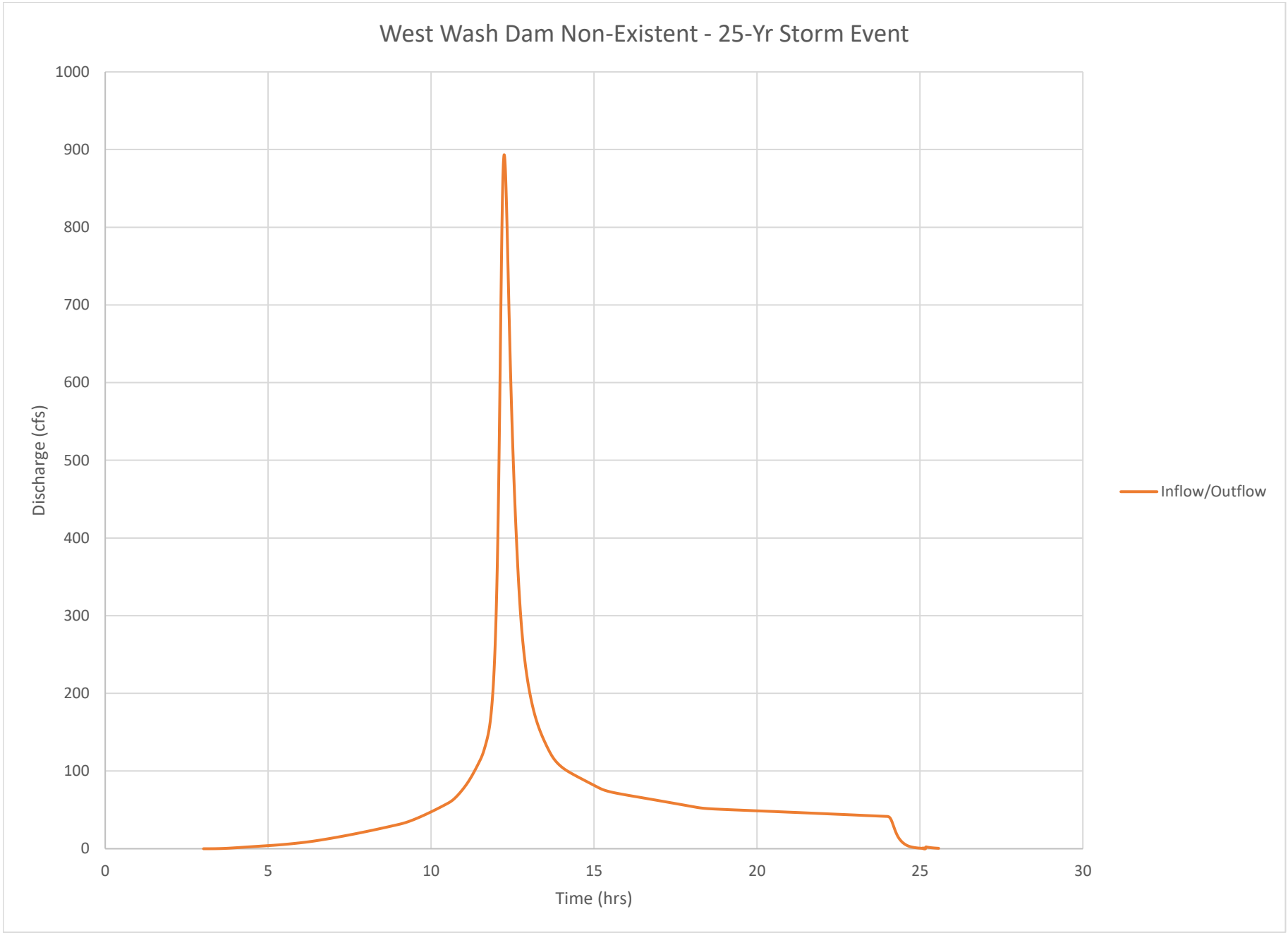

West Wash Dam Non-Existent - Full Local PMP Storm Event
Discharge (cfs)
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
0
1
2
3
4
5
6
7
8
9
Time (hrs)
Inflow/Outflow

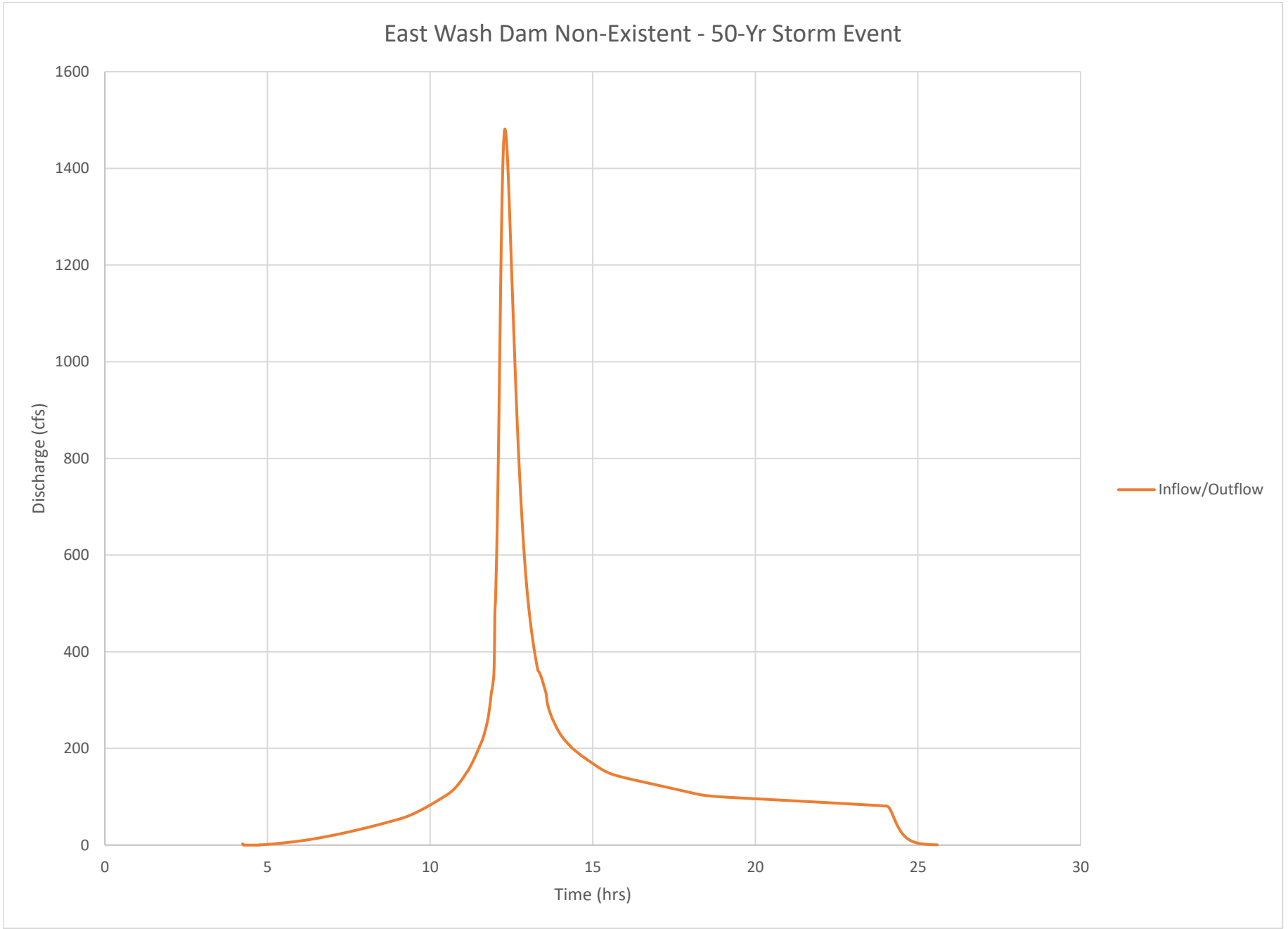
APPENDIX F: INFLOW/OUTFLOW HYDROGRAPHS – EAST WASH AND WEST WASH DAMS NON-EXISTENT

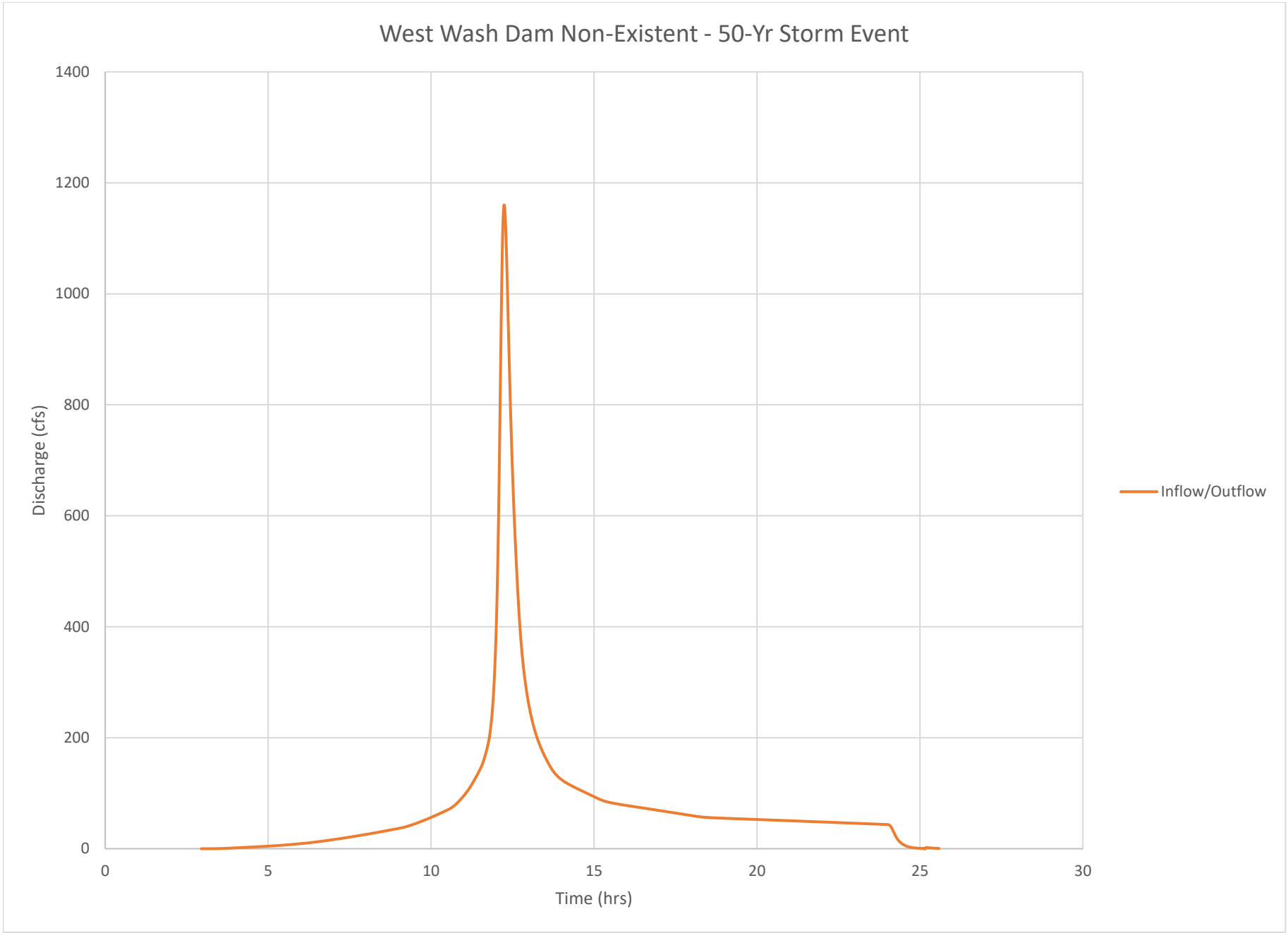

East Wash Dam Non-Existent - 10-Yr Storm Event
900
800
700
600
500
400
300
200
100
0
Discharge (cfs)
0
5
10
15
20
25
30
Time (hrs)
Inflow/Outflow

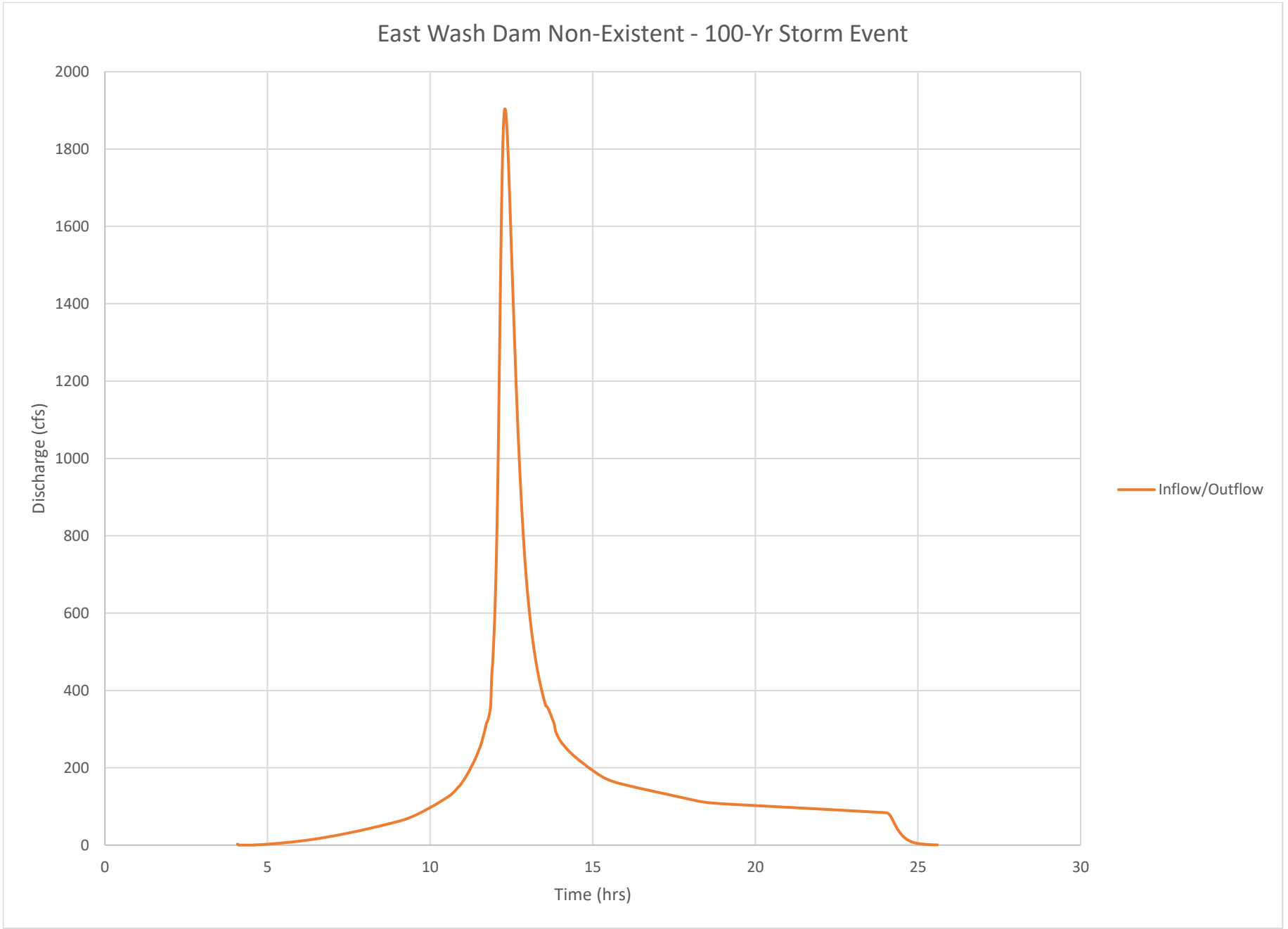

West Wash Dam Non-Existent - 10-Yr Storm Event
Discharge (cfs)
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
Time (hrs)
Inflow/Outflow

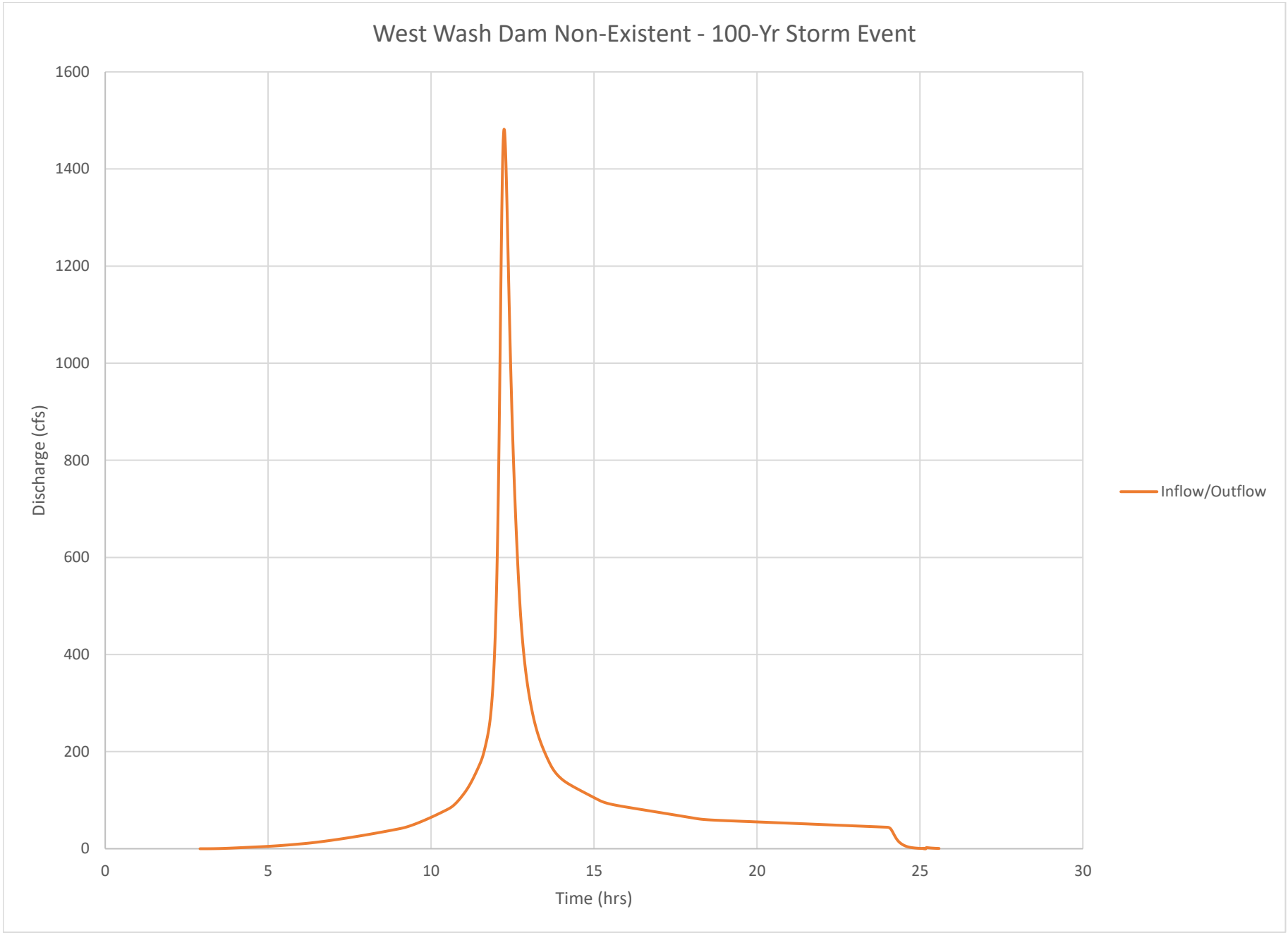

East Wash Dam Non-Existent - 25-Yr Storm Event
1200
1000
800
600
400
200
0
Discharge (cfs)
0
5
10
15
20
25
30
Time (hrs)
Inflow/Outflow

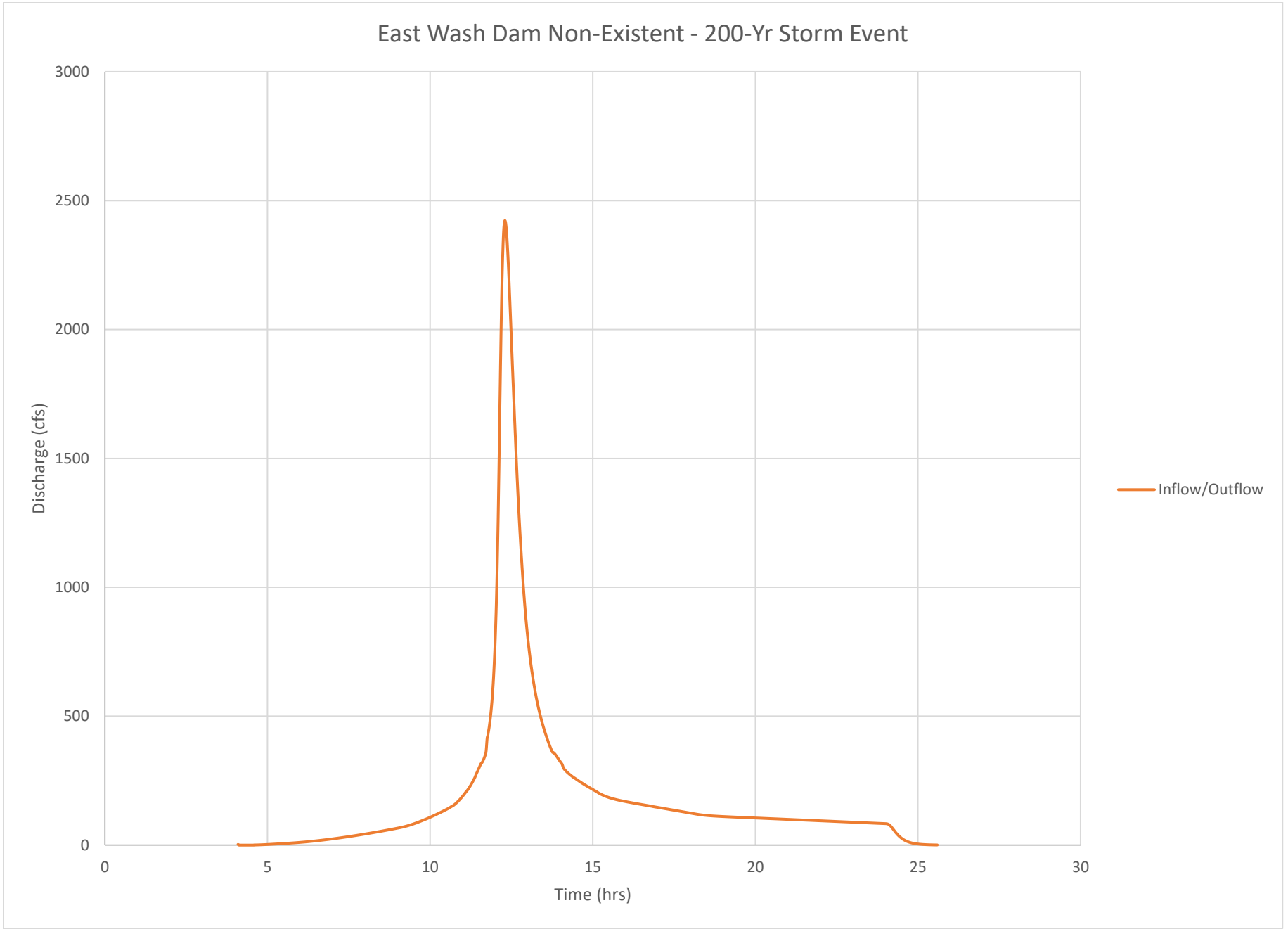

West Wash Dam Non-Existent - 25-Yr Storm Event
Discharge (cfs)
1000
900
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
Time (hrs)
Inflow/Outflow

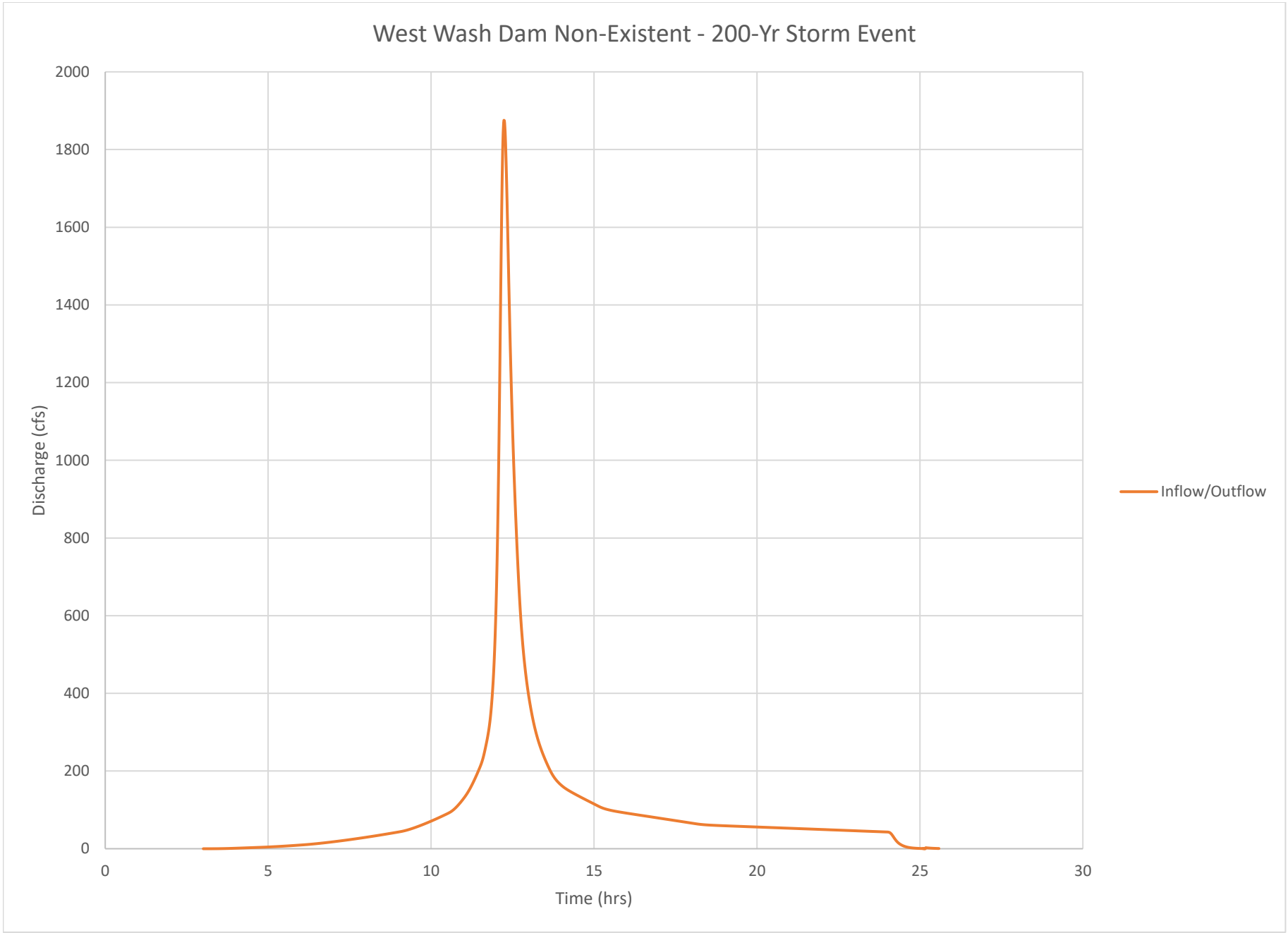

East Wash Dam Non-Existent - 50-Yr Storm Event
1600
1400
1200
1000
800
600
400
200
0
Discharge (cfs)
0
5
10
15
20
25
30
Time (hrs)
Inflow/Outflow

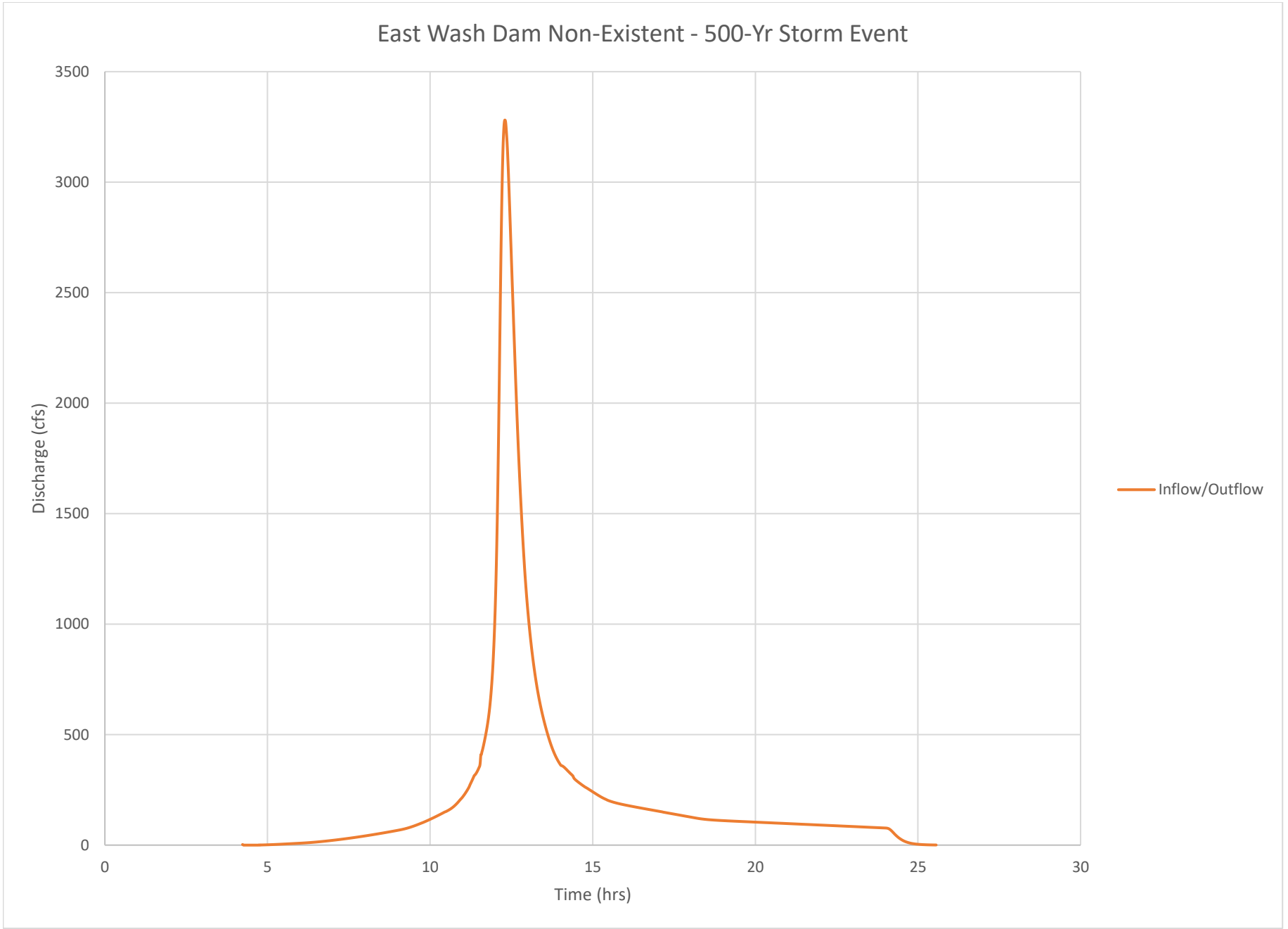

West Wash Dam Non-Existent - 50-Yr Storm Event
1400
1200
1000
800
600
400
200
0
Discharge (cfs)
0
5
10
15
20
25
30
Time (hrs)
Inflow/Outflow

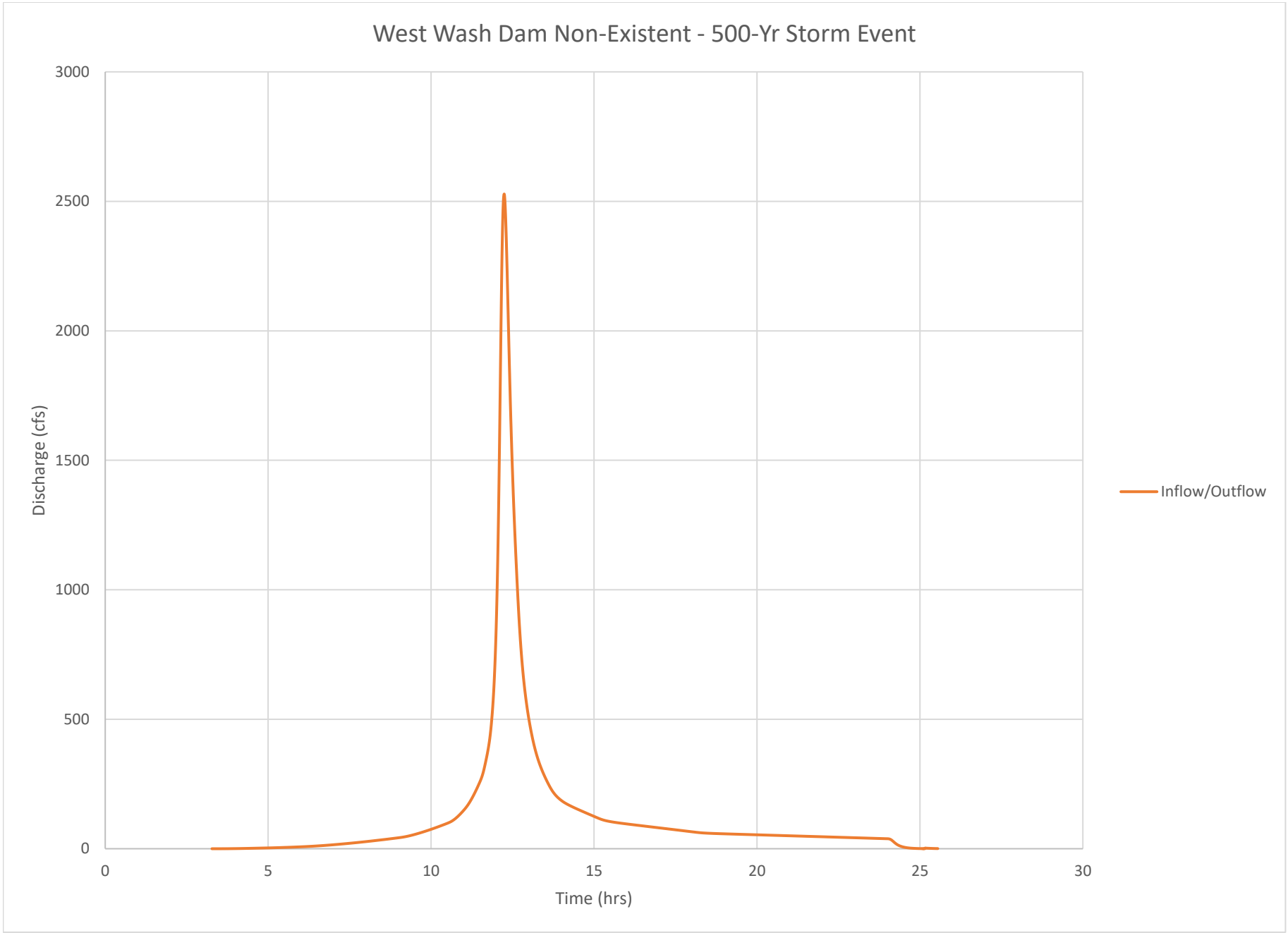

East Wash Dam Non-Existent - 100-Yr Storm Event
Discharge (cfs)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
0
5
10
15
20
25
30
Time (hrs)
Inflow/Outflow

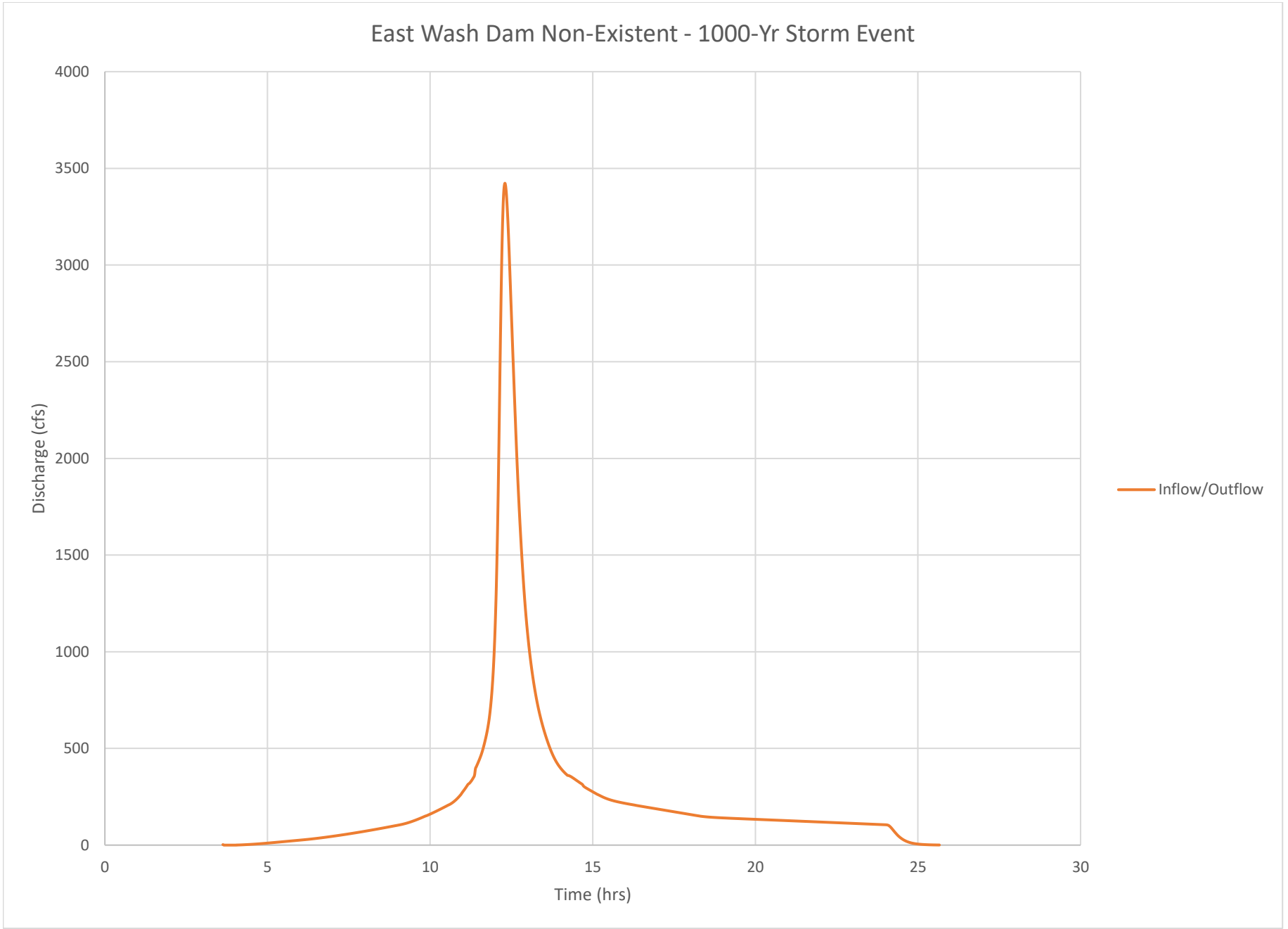

West Wash Dam Non-Existent - 100-Yr Storm Event
1600
1400
1200
1000
800
600
400
200
0
Discharge (cfs)
0
5
10
15
20
25
30
Time (hrs)
Inflow/Outflow

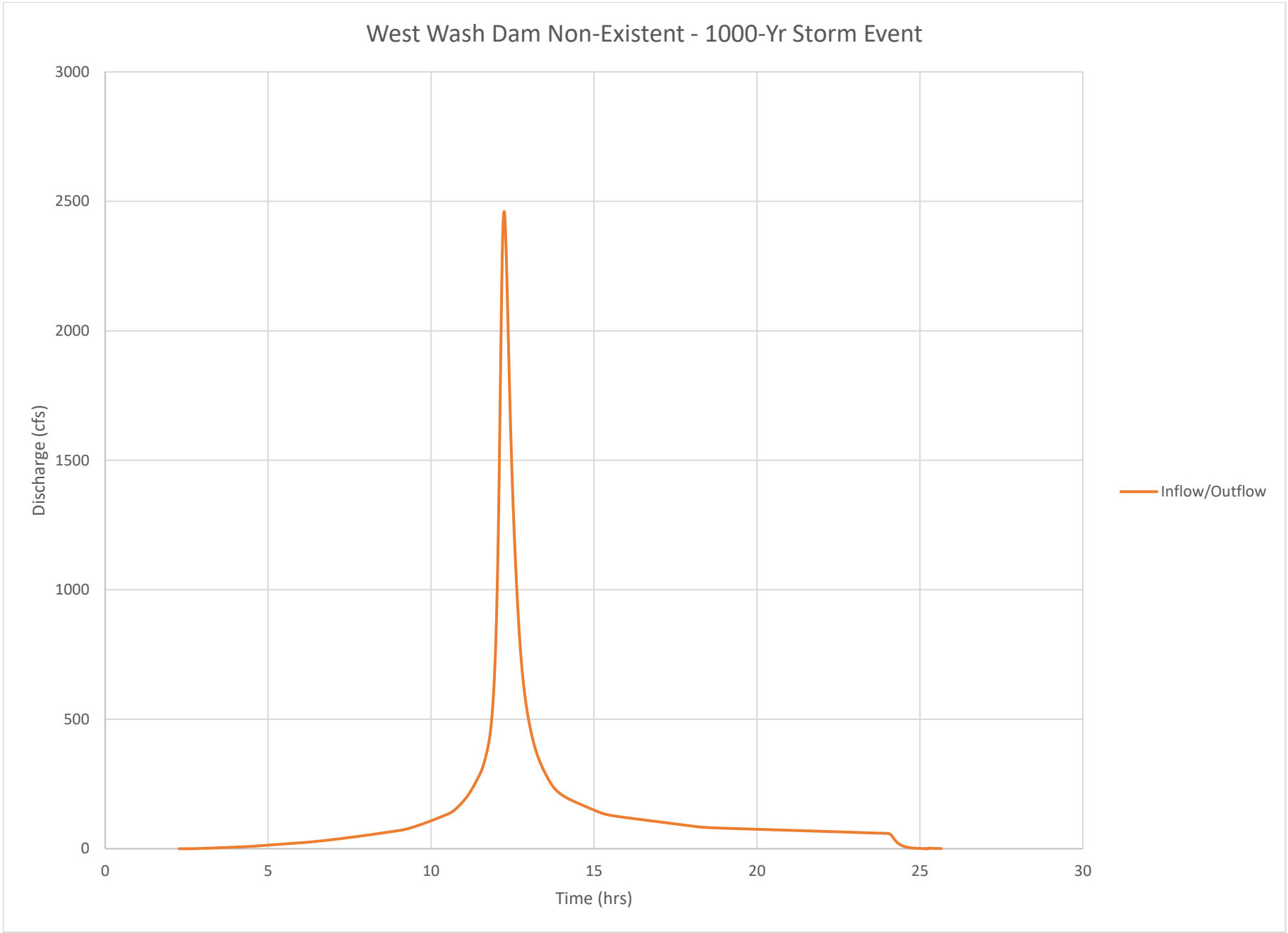

East Wash Dam Non-Existent - 200-Yr Storm Event
Discharge (cfs)
3000
2500
2000
1500
1000
500
0
0
5
10
15
20
25
30
Time (hrs)
Inflow/Outflow

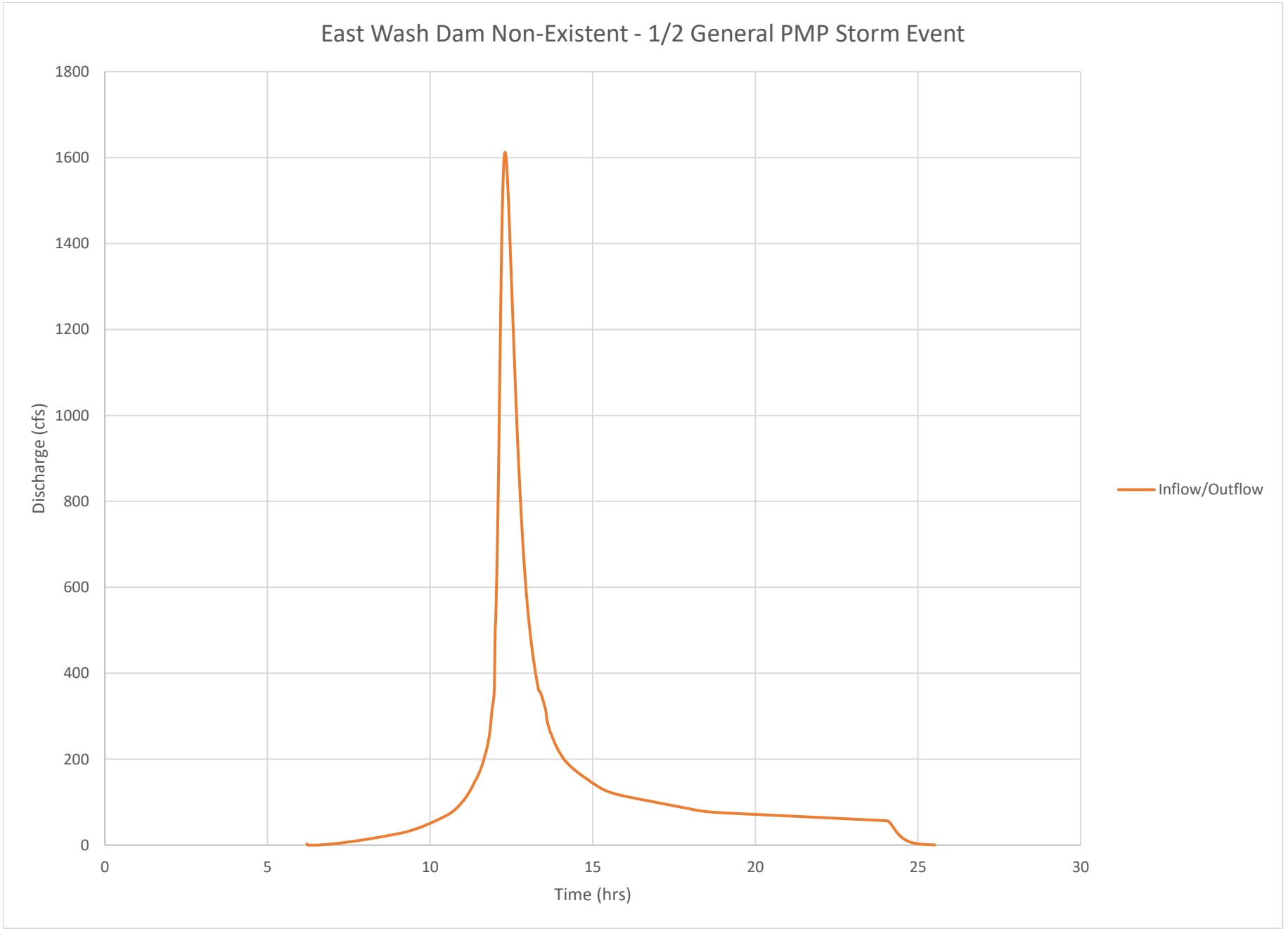

West Wash Dam Non-Existent - 200-Yr Storm Event
Discharge (cfs)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
0
5
10
15
20
25
30
Time (hrs)
Inflow/Outflow

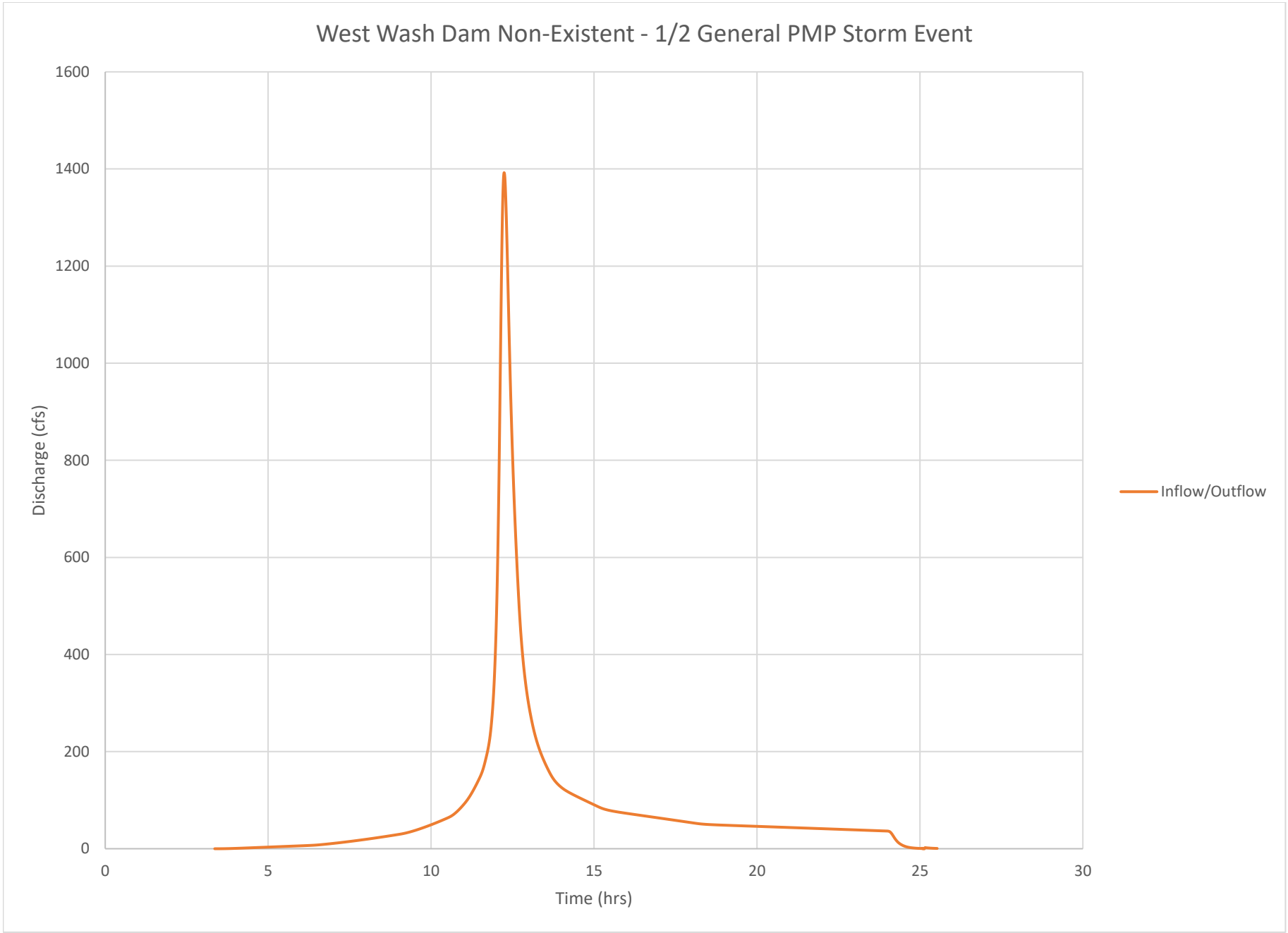

East Wash Dam Non-Existent - 500-Yr Storm Event
Discharge (cfs)
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20
25
30
Time (hrs)
Inflow/Outflow

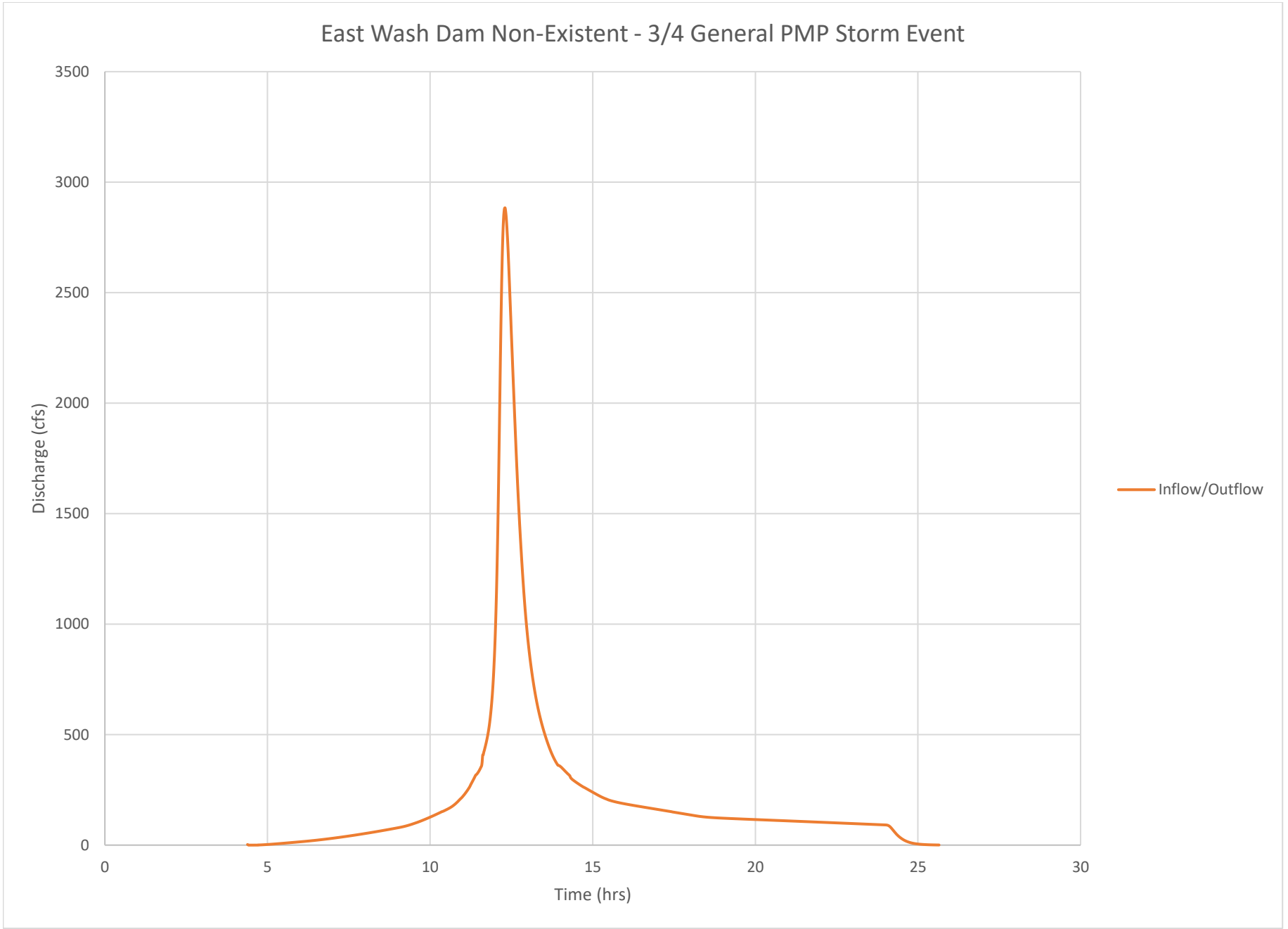

West Wash Dam Non-Existent - 500-Yr Storm Event
3000
2500
2000
1500
1000
500
0
Discharge (cfs)
0
5
10
15
20
25
30
Time (hrs)
Inflow/Outflow

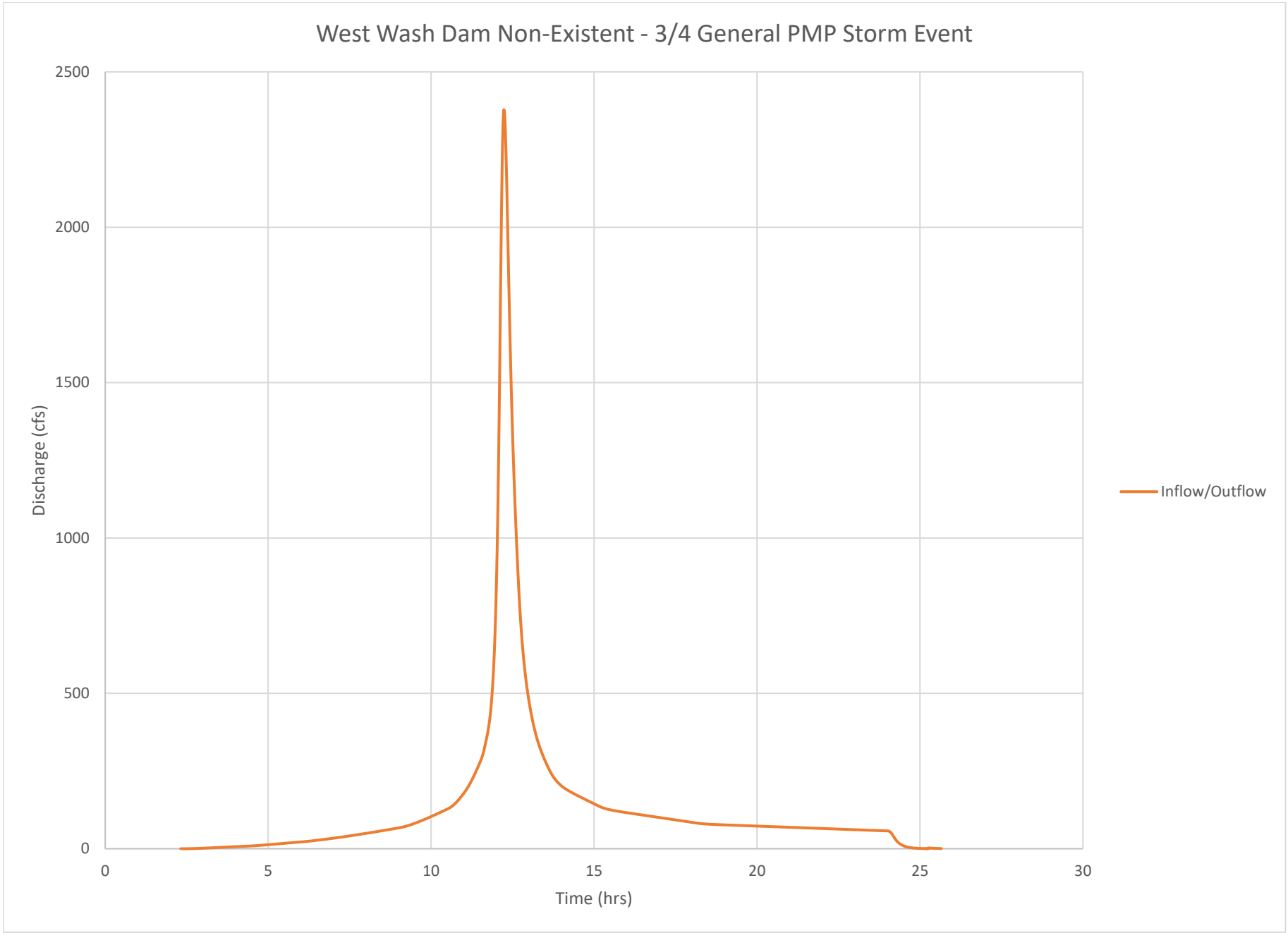

East Wash Dam Non-Existent - 1000-Yr Storm Event
Discharge (cfs)
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20
25
30
Time (hrs)
Inflow/Outflow

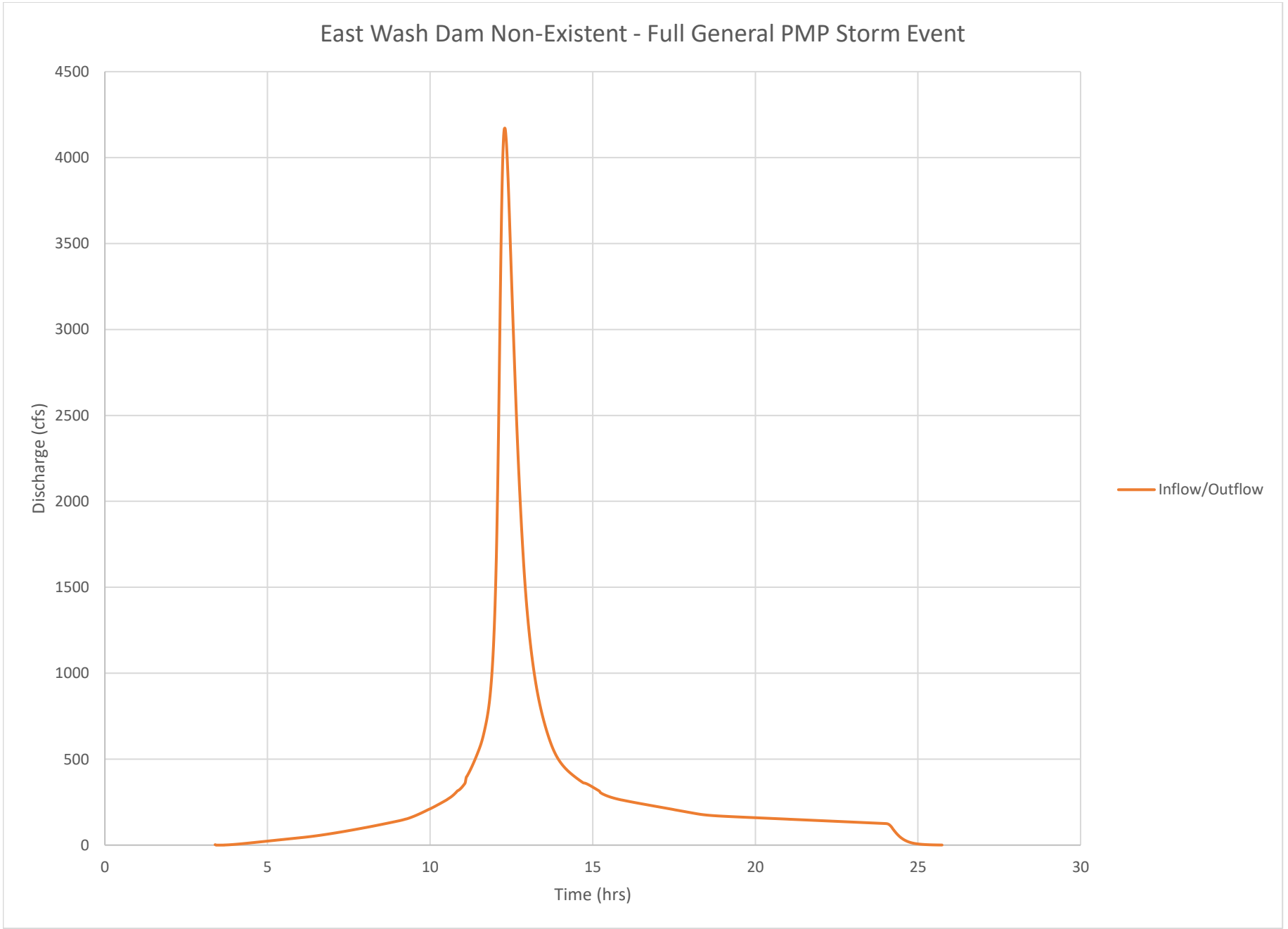

West Wash Dam Non-Existent - 1000-Yr Storm Event
3000
2500
2000
1500
1000
500
0
Discharge (cfs)
0
5
10
15
20
25
30
Time (hrs)
Inflow/Outflow

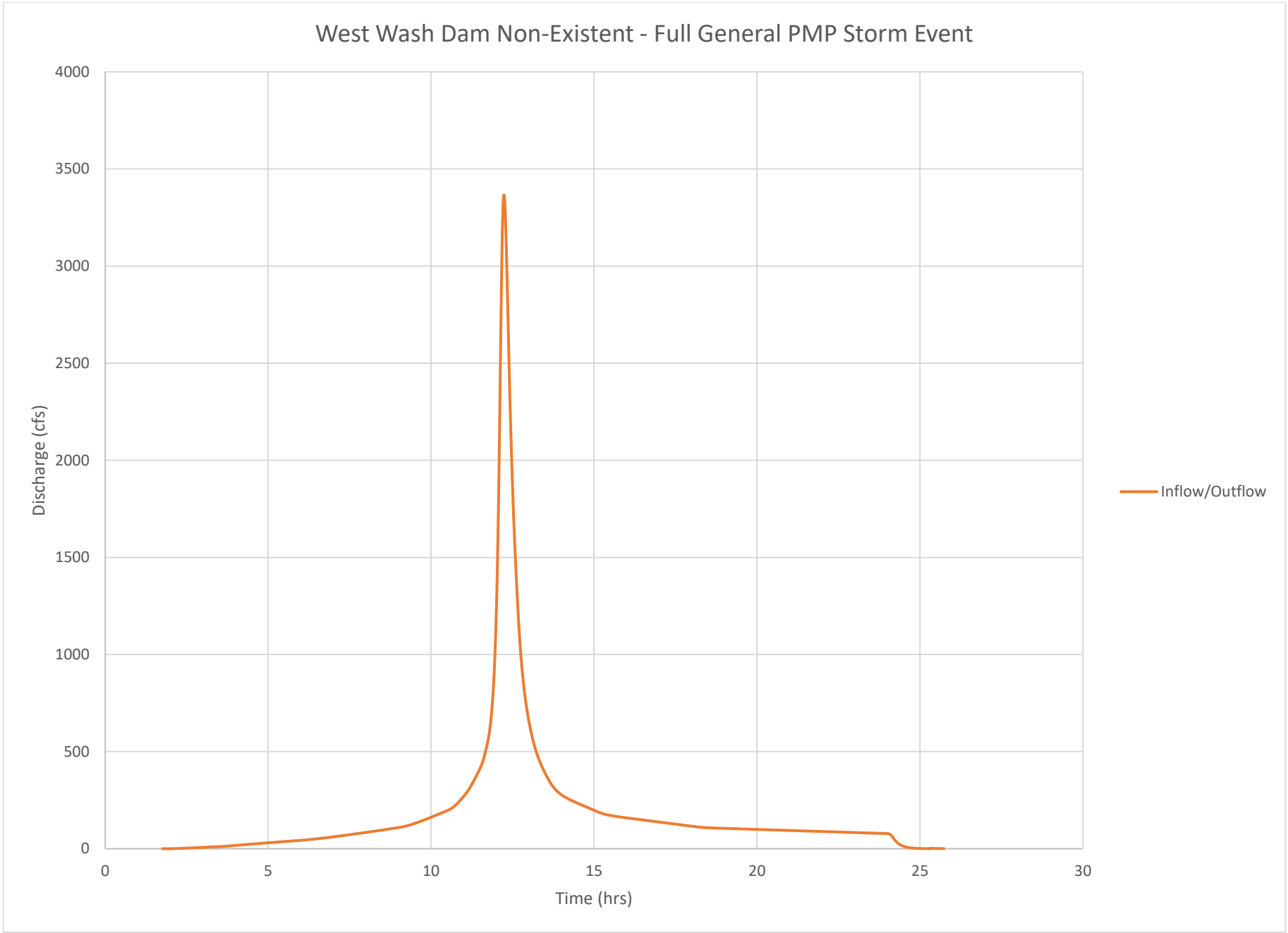

East Wash Dam Non-Existent - 1/2 General PMP Storm Event
Discharge (cfs)
1800
1600
1400
1200
1000
800
600
400
200
0
0
5
10
15
20
25
30
Time (hrs)
Inflow/Outflow

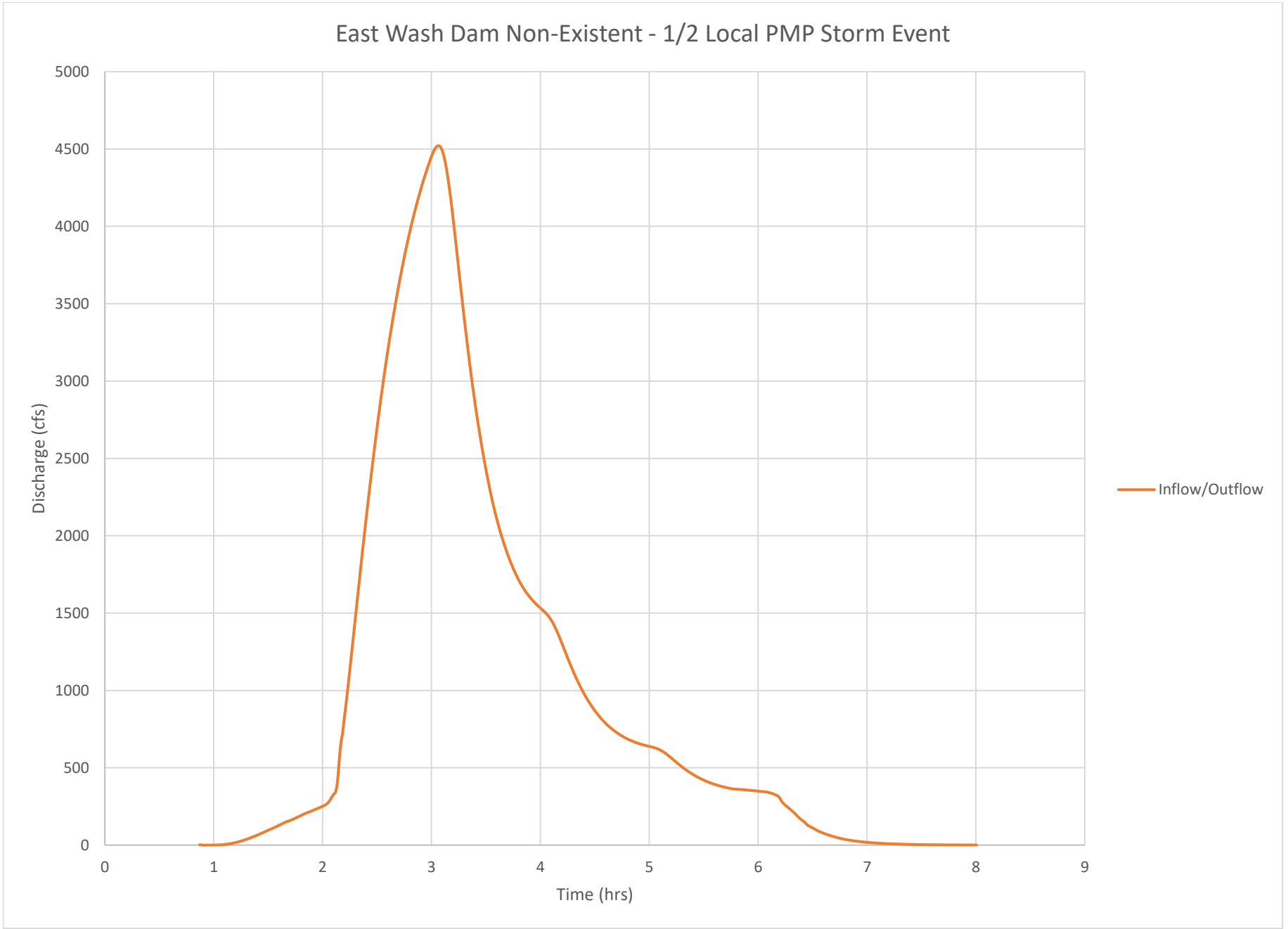

West Wash Dam Non-Existent - 1/2 General PMP Storm Event
1600
1400
1200
1000
800
600
400
200
0
Discharge (cfs)
0
5
10
15
20
25
30
Time (hrs)
Inflow/Outflow

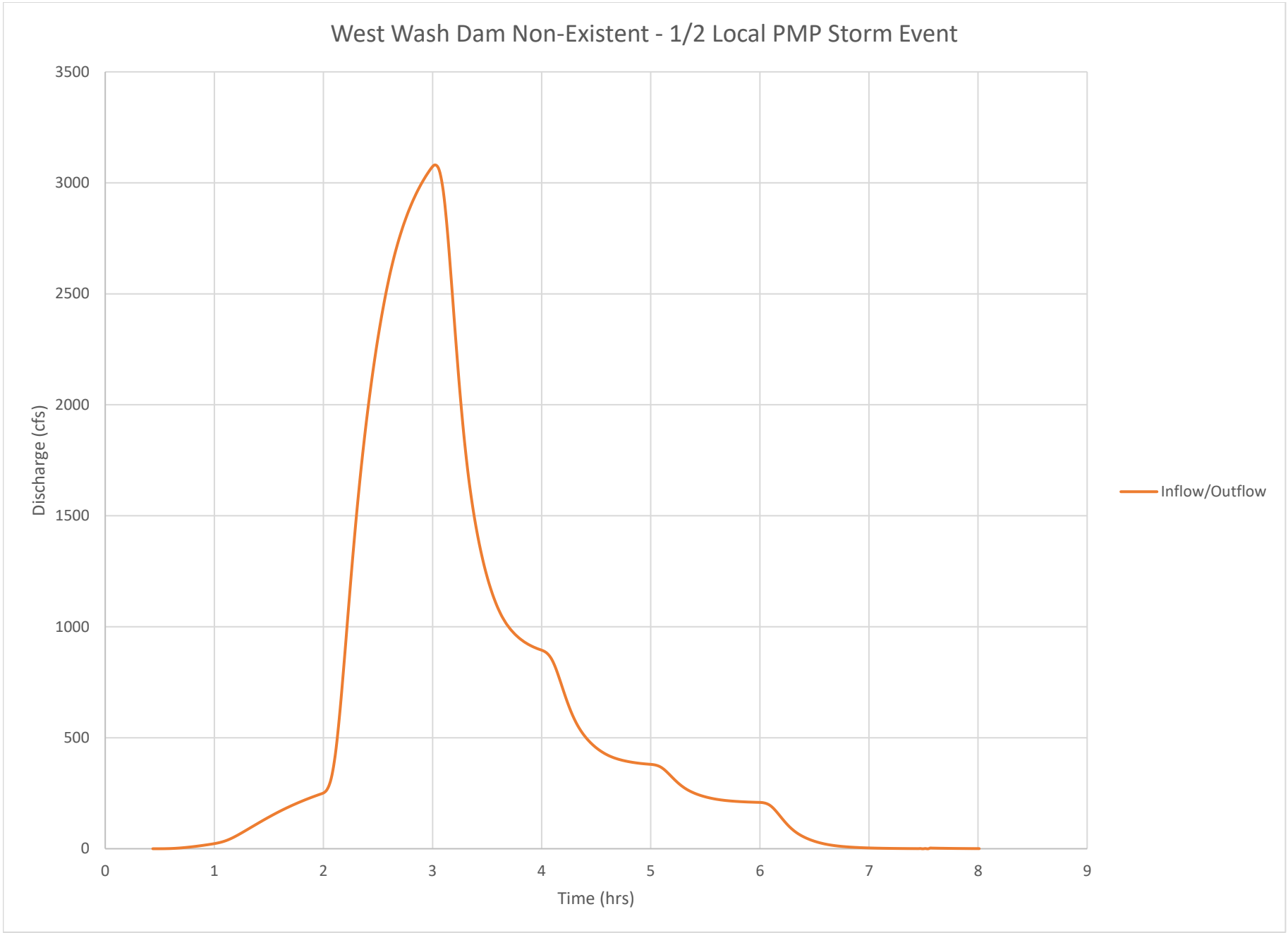

East Wash Dam Non-Existent - 3/4 General PMP Storm Event
Discharge (cfs)
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20
25
30
Time (hrs)
Inflow/Outflow

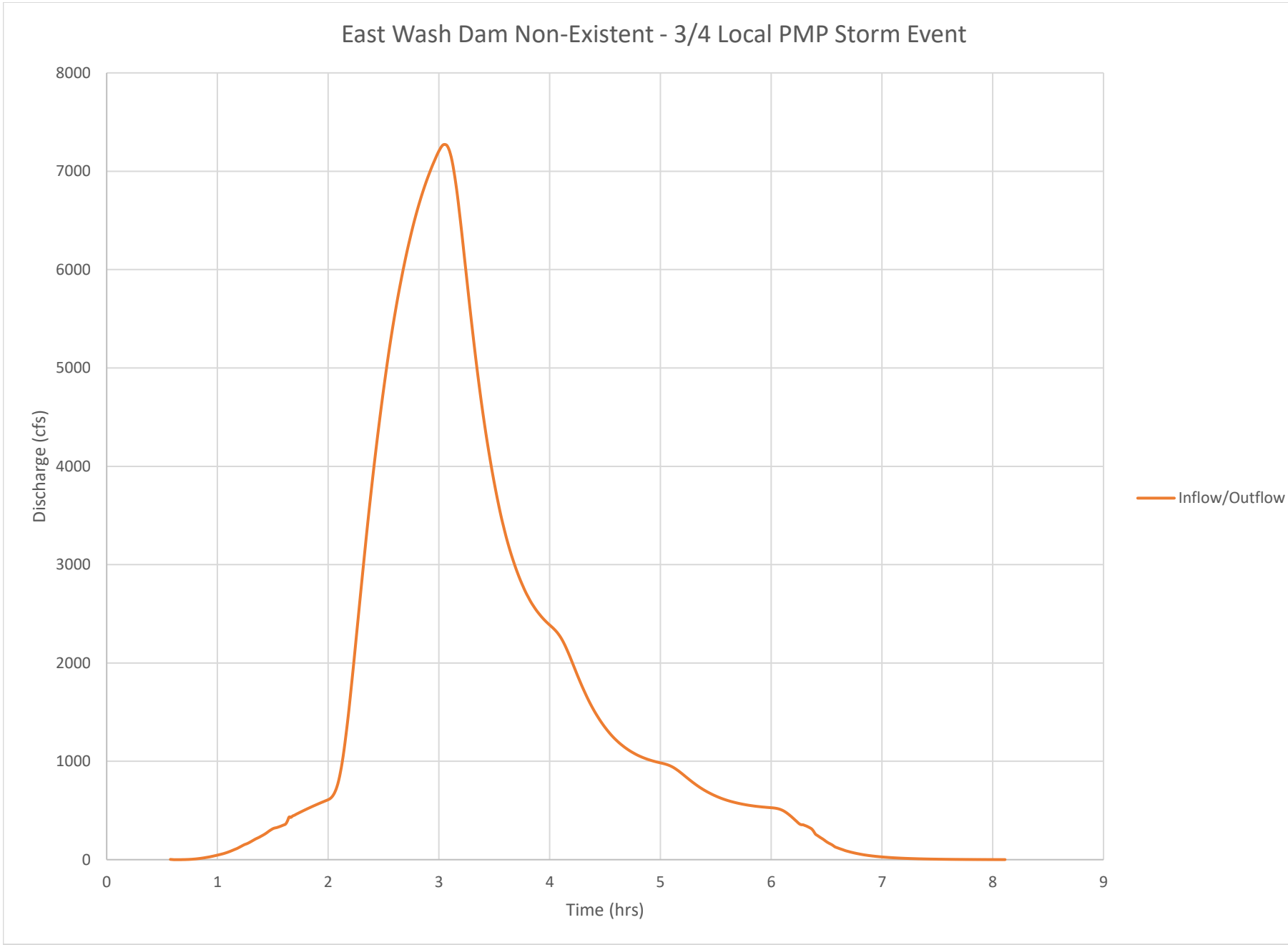

West Wash Dam Non-Existent - 3/4 General PMP Storm Event
2500
2000
1500
1000
500
0
Discharge (cfs)
0
5
10
15
20
25
30
Time (hrs)
Inflow/Outflow

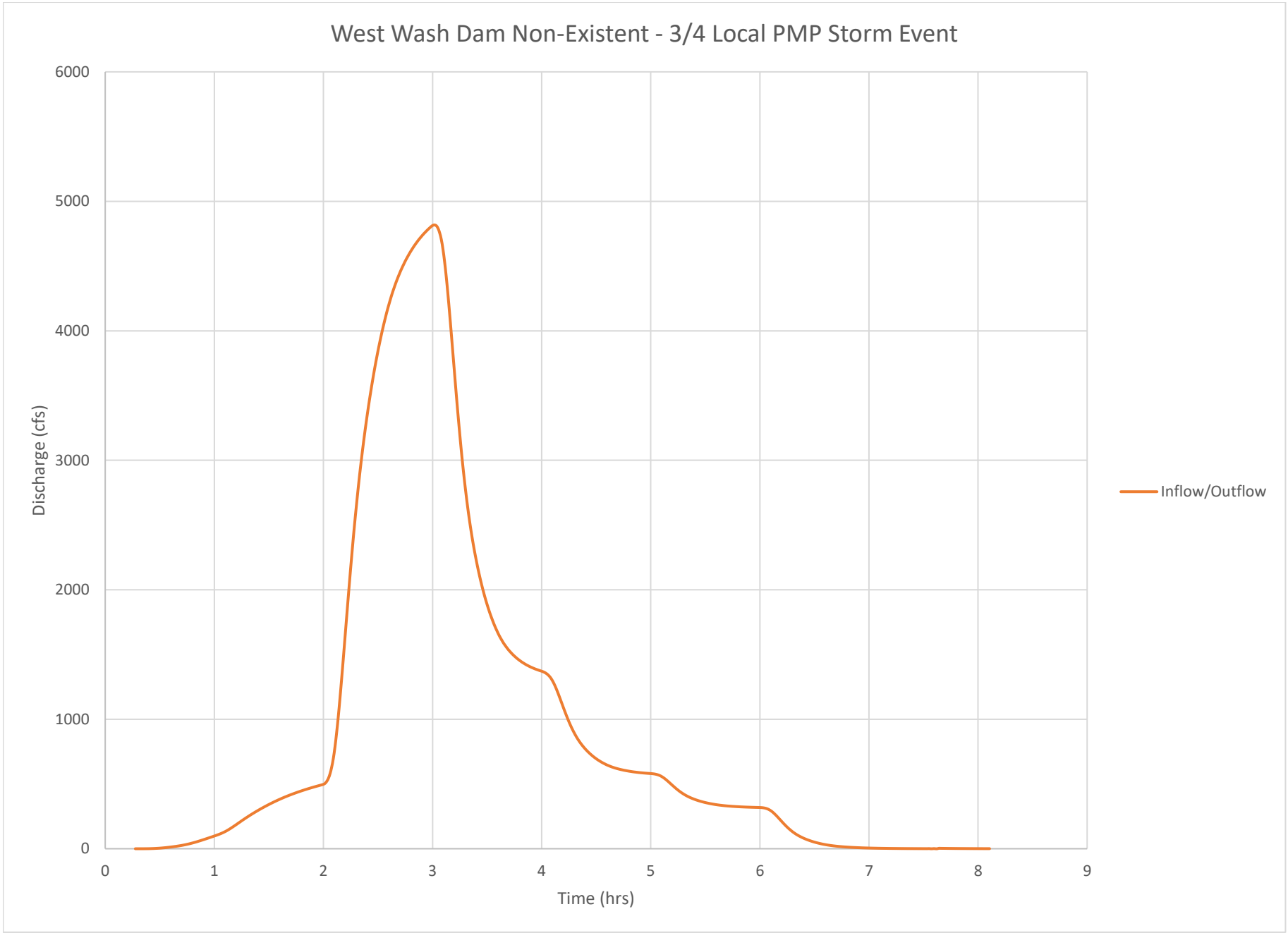

East Wash Dam Non-Existent - Full General PMP Storm Event
Discharge (cfs)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20
25
30
Time (hrs)
Inflow/Outflow

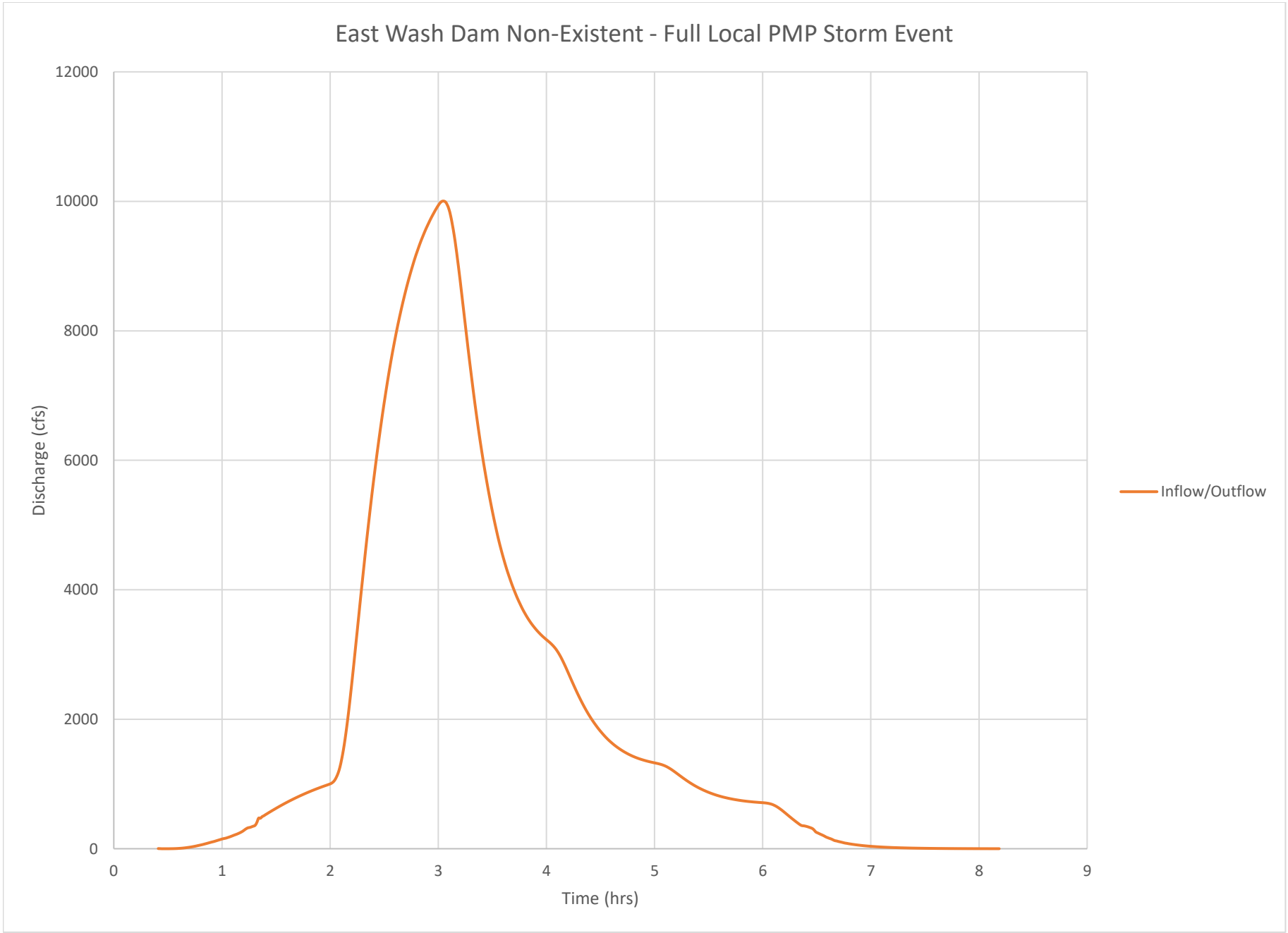

West Wash Dam Non-Existent - Full General PMP Storm Event
Discharge (cfs)
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20
25
30
Time (hrs)
Inflow/Outflow

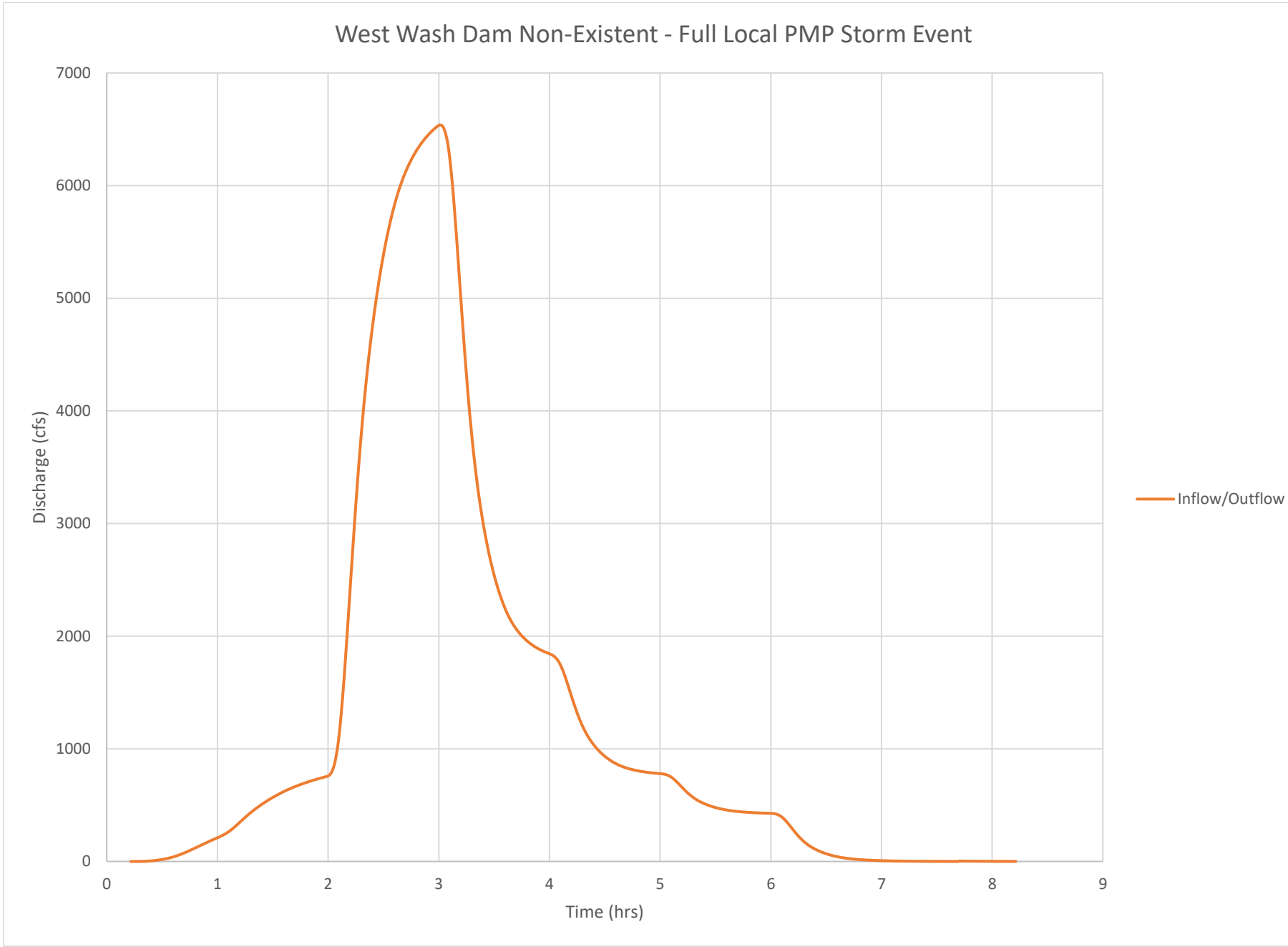

East Wash Dam Non-Existent - 1/2 Local PMP Storm Event
Discharge (cfs)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
1
2
3
4
5
6
7
8
9
Time (hrs)
Inflow/Outflow


West Wash Dam Non-Existent - 1/2 Local PMP Storm Event
Discharge (cfs)
3500
3000
2500
2000
1500
1000
500
0
0
1
2
3
4
5
6
7
8
9
Time (hrs)
Inflow/Outflow

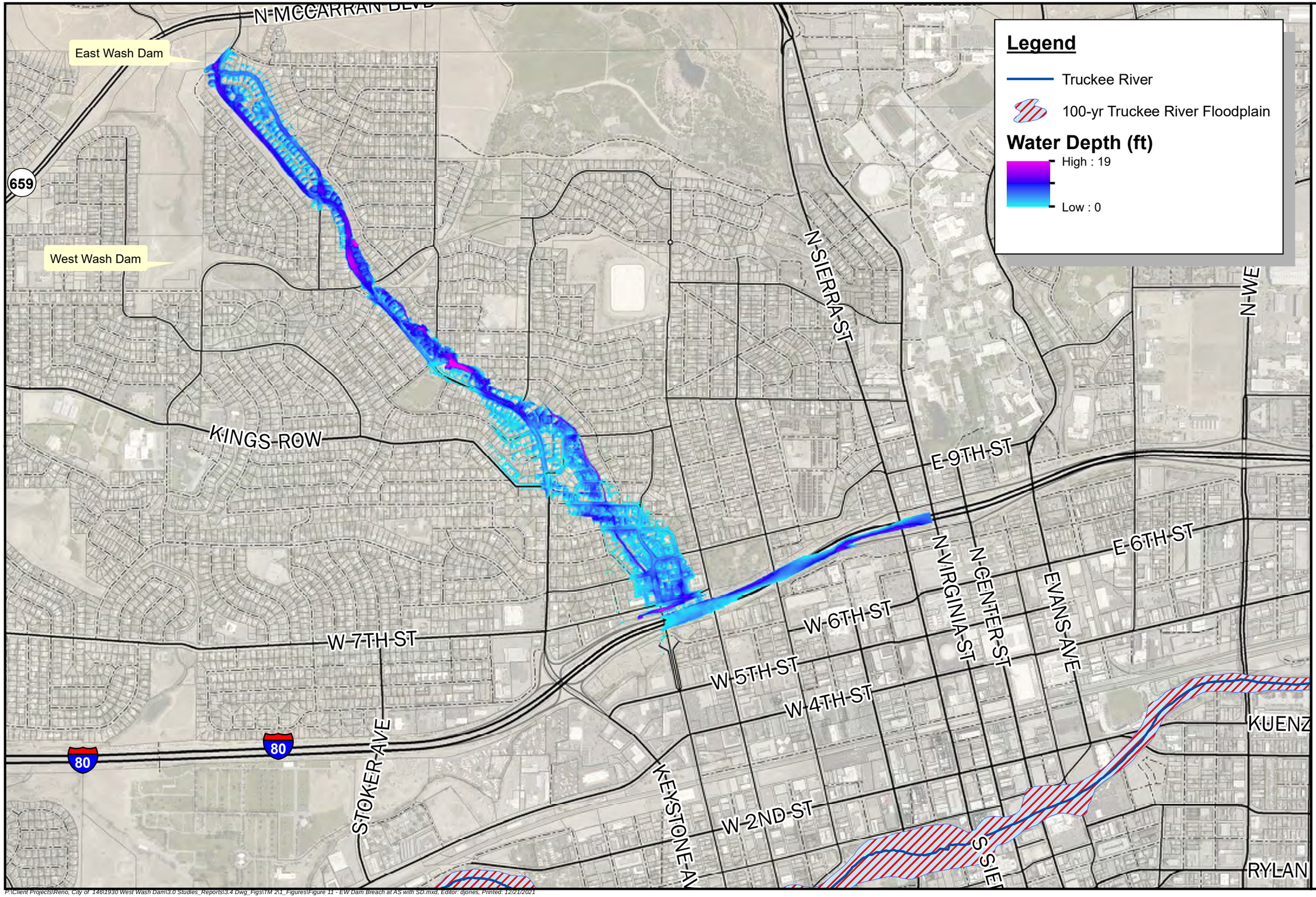

East Wash Dam Non-Existent - 3/4 Local PMP Storm Event
Discharge (cfs)
8000
7000
6000
5000
4000
3000
2000
1000
0
0
1
2
3
4
5
6
7
8
9
Time (hrs)
Inflow/Outflow


West Wash Dam Non-Existent - 3/4 Local PMP Storm Event
6000
5000
4000
3000
2000
1000
0
Discharge (cfs)
0
1
2
3
4
5
6
7
8
9
Time (hrs)
Inflow/Outflow


East Wash Dam Non-Existent - Full Local PMP Storm Event
12000
10000
8000
6000
4000
2000
0
Discharge (cfs)
0
1
2
3
4
5
6
7
8
9
Time (hrs)
Inflow/Outflow


West Wash Dam Non-Existent - Full Local PMP Storm Event
7000
6000
5000
4000
3000
2000
1000
0
Discharge (cfs)
0
1
2
3
4
5
6
7
8
9
Time (hrs)
Inflow/Outflow

APPENDIX G: DAM FAILURE ROUTING MAPS – EAST WASH AND WEST WASH DAMS IN-PLACE



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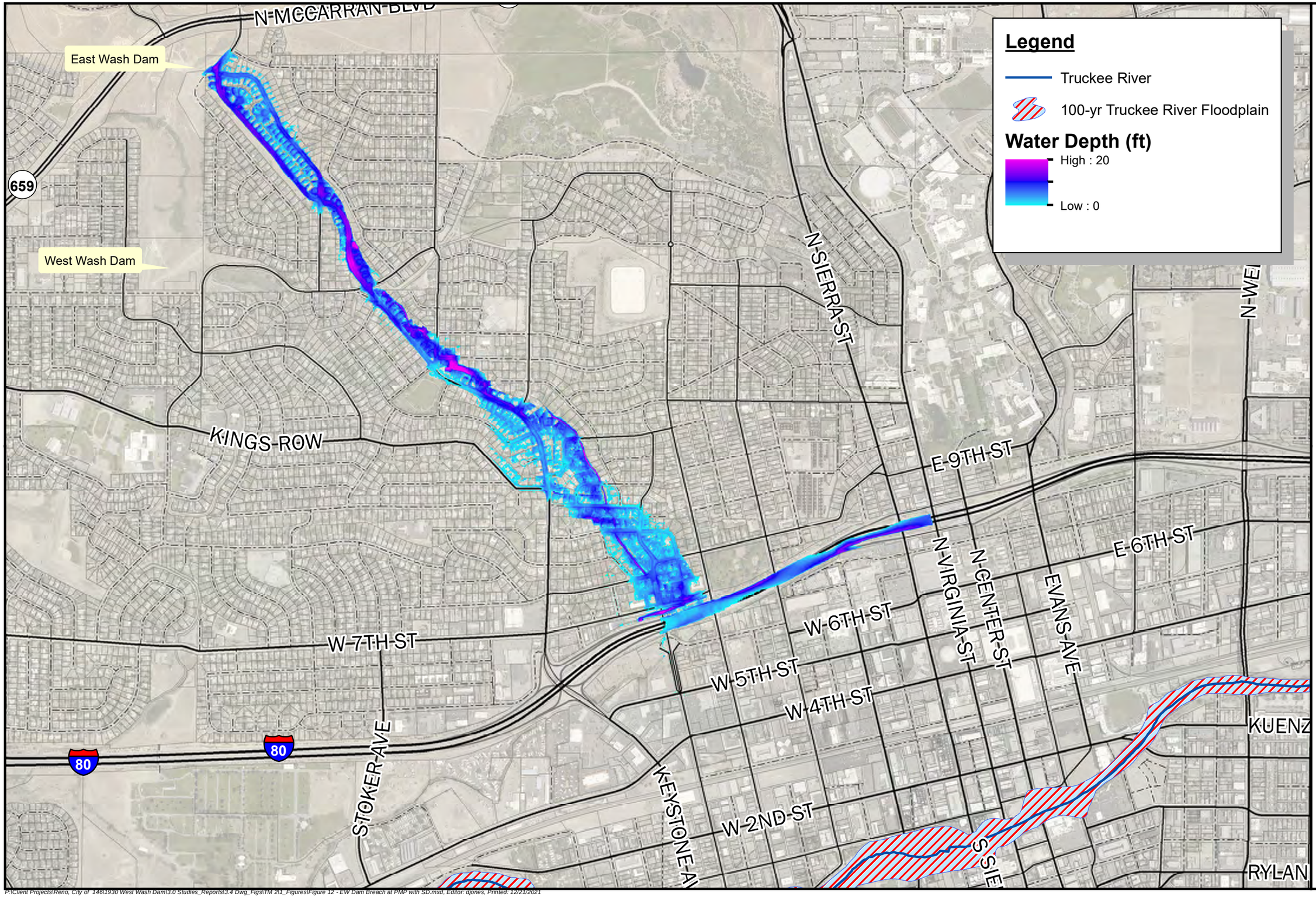
East Wash Dam Breach with Water Surface Elevation at Auxiliary Spillway

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\1_Figures\Figure 11 - EW Dam Breach at AS with SD.mxd, Editor: djones, Printed: 12/21/2021



East Wash Dam Breach with Water Surface Elevation at the PMP

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N

1 " = 1,000 '

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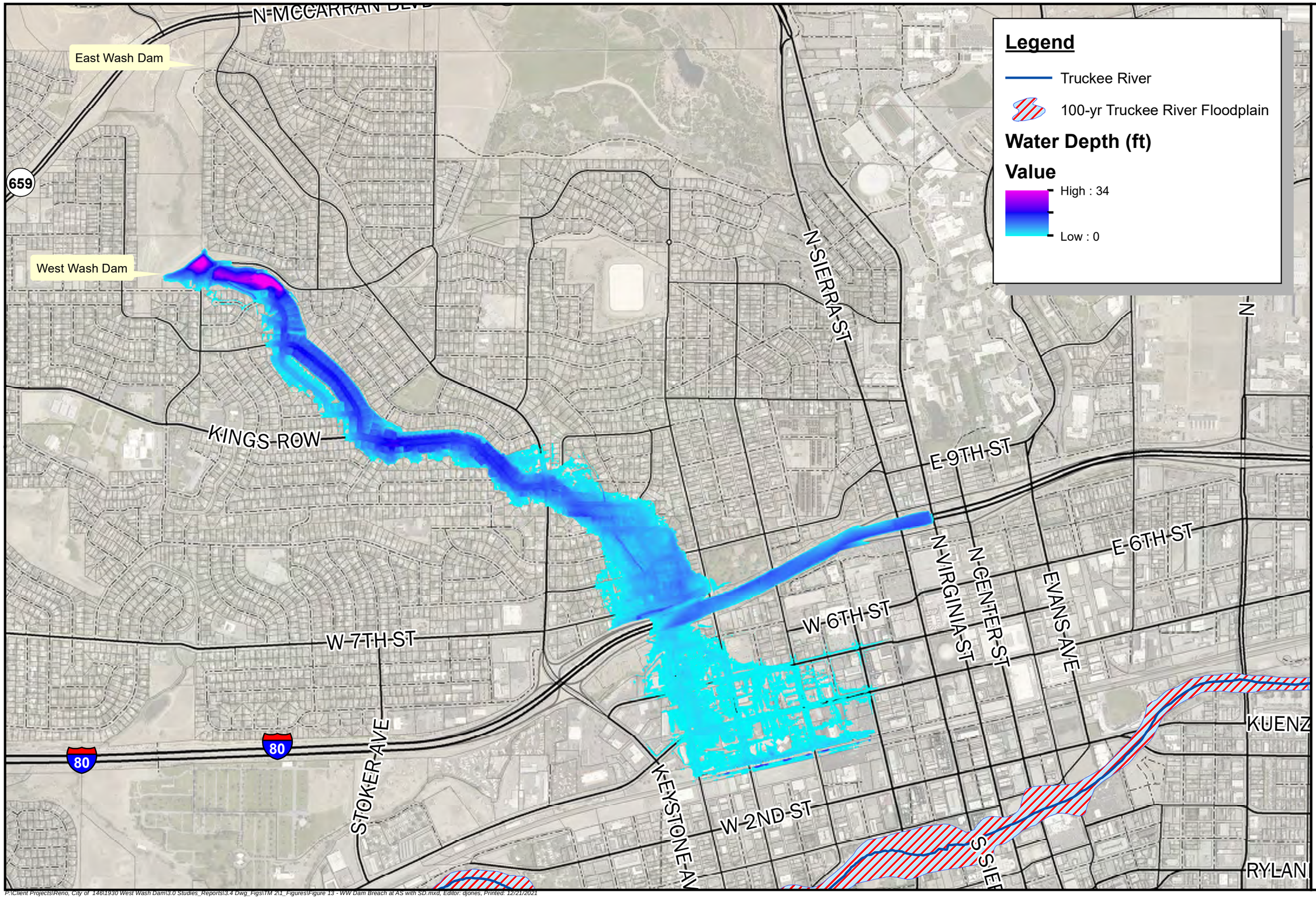
P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\1_Figures\Figure 12 - EW Dam Breach at PMP with SD.mxd, Editor: djones, Printed: 12/21/2021



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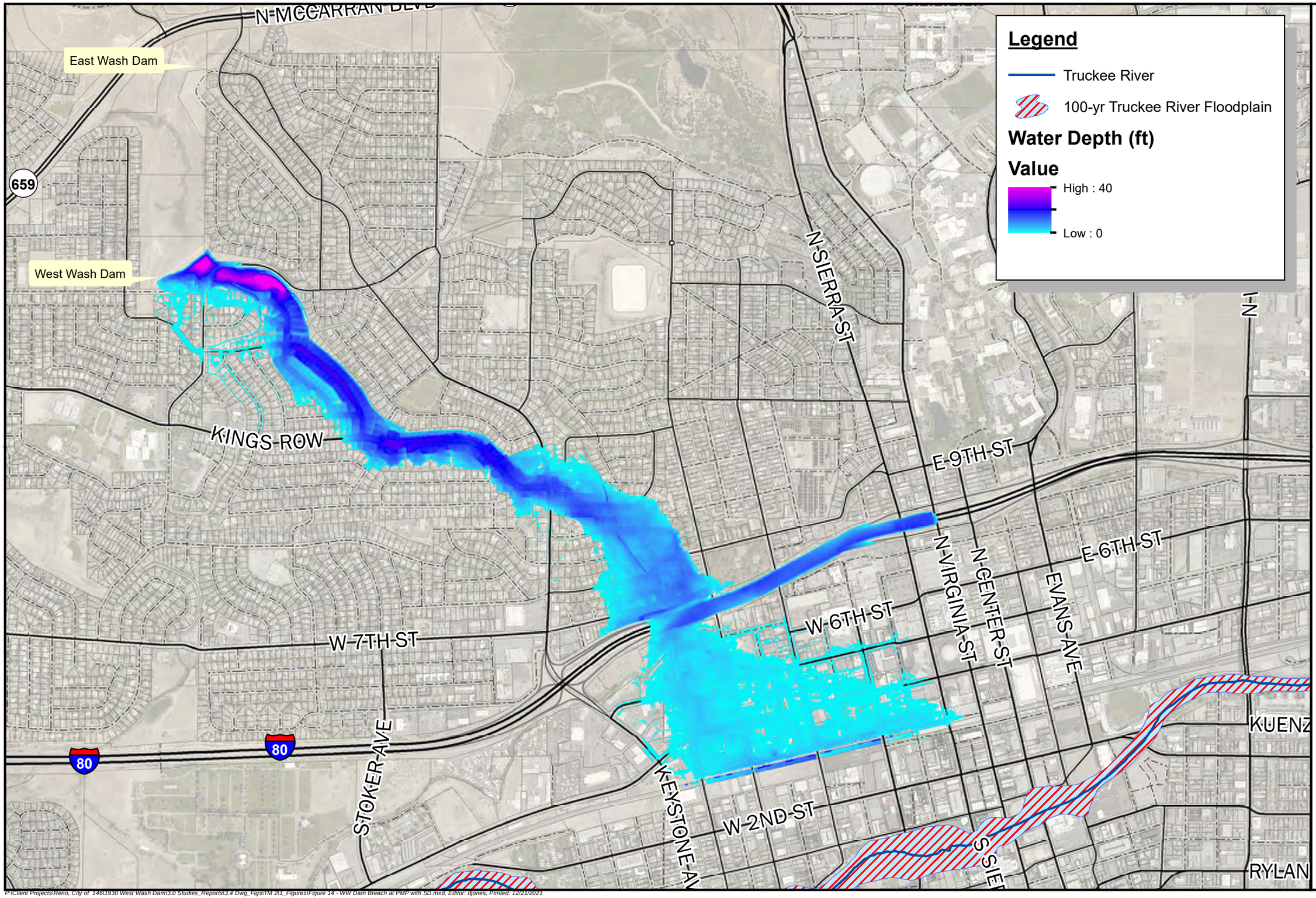
West Wash Dam Breach with Water Surface Elevation at Auxiliary Spillway

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\1_Figures\Figure 13 - WW Dam Breach at AS with SD.mxd, Editor: djones, Printed: 12/21/2021



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West Wash Dam Breach with Water Surface Elevation at the PMP

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\1_Figures\Figure 14 - WW Dam Breach at PMP with SD.mxd, Editor: djones, Printed: 12/21/2021

APPENDIX H: NO DAM FAILURE ROUTING MAPS – EAST WASH AND WEST WASH DAMS IN-PLACE

East Wash Dam

West Wash Dam

659

80

80

N-MCCARRAN BL

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-6TH-ST

W-7TH-ST

W-5TH-ST

W-4TH-ST

W-2ND-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

S-SIER

KUENZ

RYLAN

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 6

Low : 0

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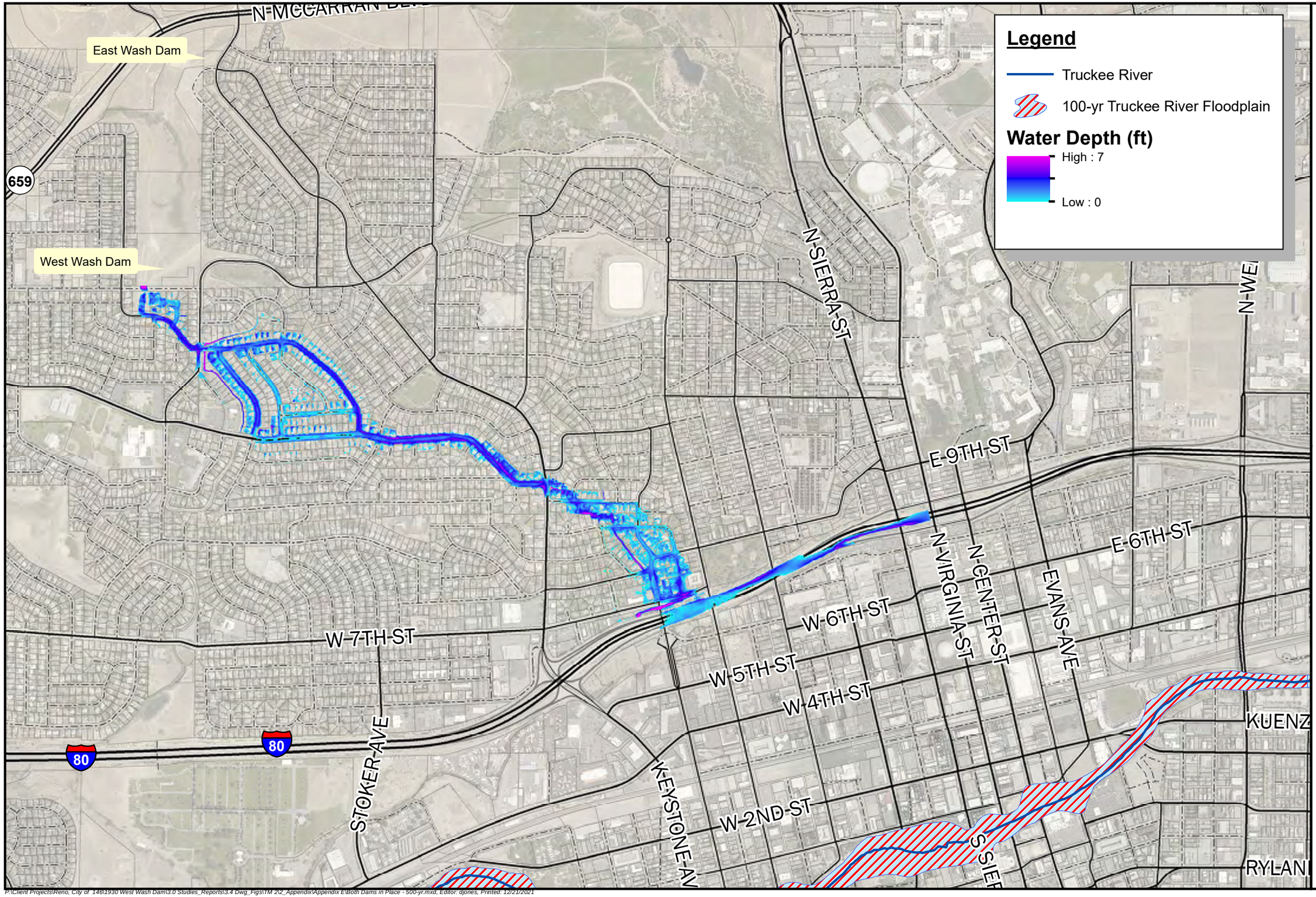
Both Dams In Place: Auxiliary Spillway Activation - 200-Year Storm Inundation

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\2_Appendix\Appendix E\Both Dams In Place - 200-yr.mxd, Editor: djones, Printed: 12/21/2021



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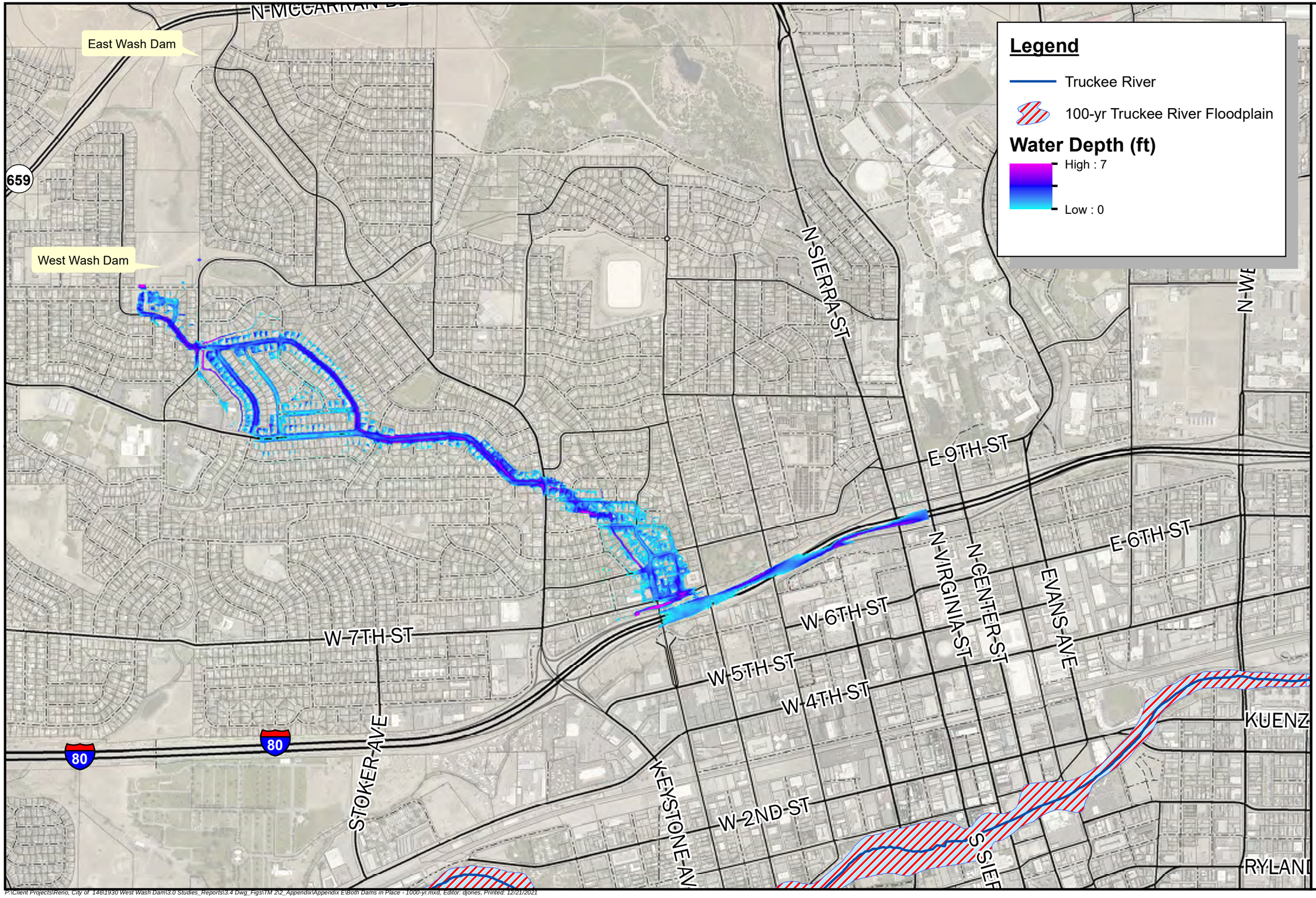
Both Dams In Place: Auxiliary Spillway Activation - 500-Year Storm Inundation

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\2_Appendix\Appendix E\Both Dams in Place - 500-yr.mxd, Editor: djones, Printed: 12/21/2021



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Both Dams In Place: Auxiliary Spillway Activation - 1000-Year Storm Inundation

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\2_Appendix\Appendix E\Both Dams in Place - 1000-yr.mxd, Editor: djones, Printed: 12/21/2021

East Wash Dam

West Wash Dam

N-MCCARRAN-BLVD

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-7TH-ST

W-6TH-ST

W-5TH-ST

W-4TH-ST

W-2ND-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

S-SIER

KUENZ

RYLAND

80

80

659

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 7

Low : 0

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Both Dams In Place: Auxiliary Spillway Activation - 3/4 of General PMP Inundation

N

1 " = 1,000 '

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P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\2_Appendix\Appendix E\Both Dams in Place - 0.75 Gen PMP.mxd, Editor: djones, Printed: 12/21/2021

Both Dams In Place: Auxiliary Spillway Activation - General PMP Inundation

East Wash Dam

West Wash Dam

659

80

80

N-MCCARRAN BLVD

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-7TH-ST

W-6TH-ST

W-5TH-ST

W-4TH-ST

W-2ND-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

S-SIER

KUENZ

RYLAN

Legend

- Truckee River
- 100-yr Truckee River Floodplain

Water Depth (ft)

High : 8

Low : 0

N

1 " = 1,000 '

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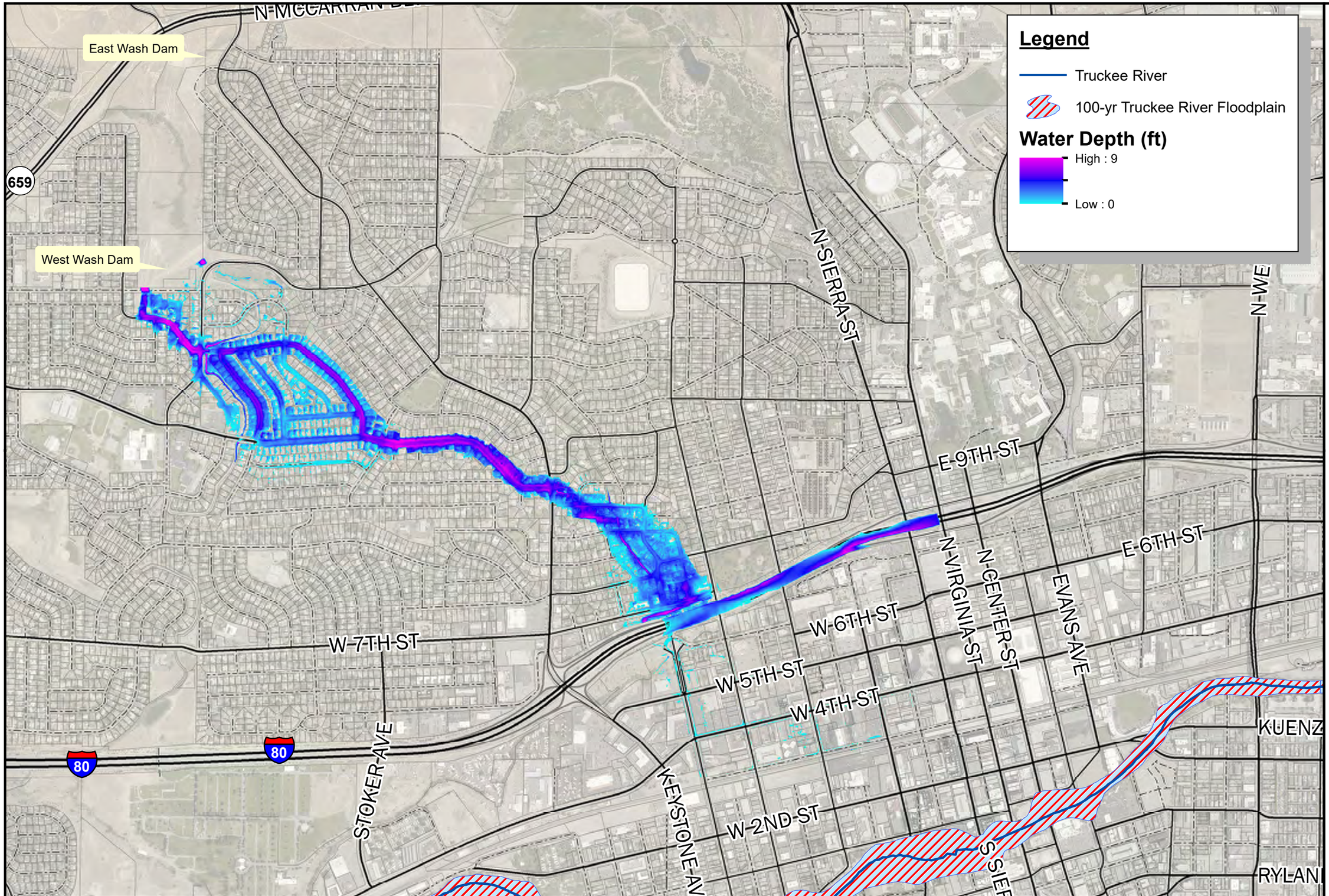
The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\2_Appendix\Appendix E\Both Dams in Place - Full Gen PMP.mxd, Editor: djones, Printed: 12/21/2021



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Both Dams In Place: Auxiliary Spillway Activation - 1/2 of Local PMP Inundation

N

1 " = 1,000 '

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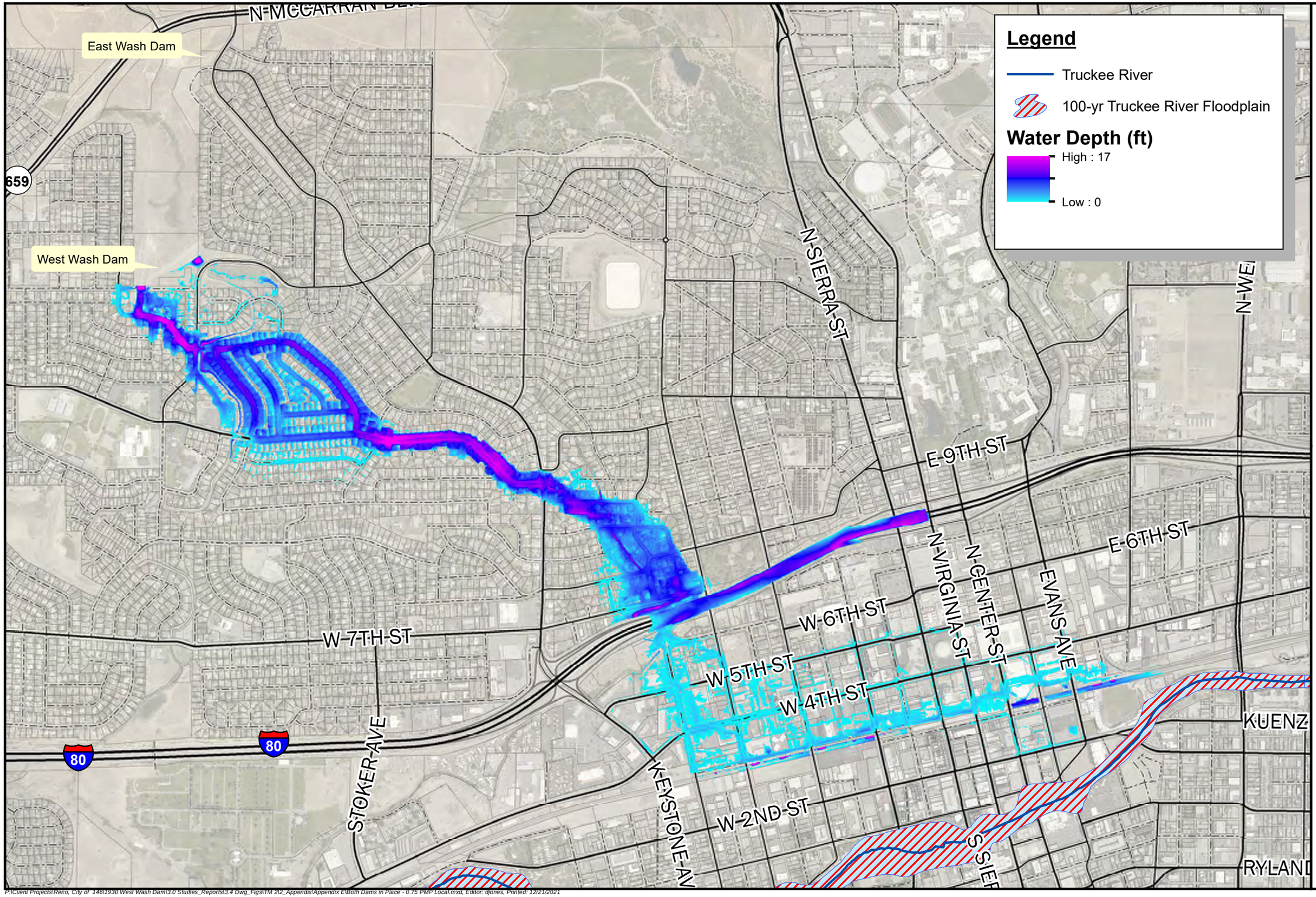
P:\Client Projects\Reno, City of 1461\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\2_Appendix\Appendix E\Both Dams In Place - 0.5 PMP Local.mxd, Editor: djones, Printed: 12/21/2021



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Both Dams In Place: Auxiliary Spillway Activation - 3/4 of Local PMP Inundation

N

1 " = 1,000 '

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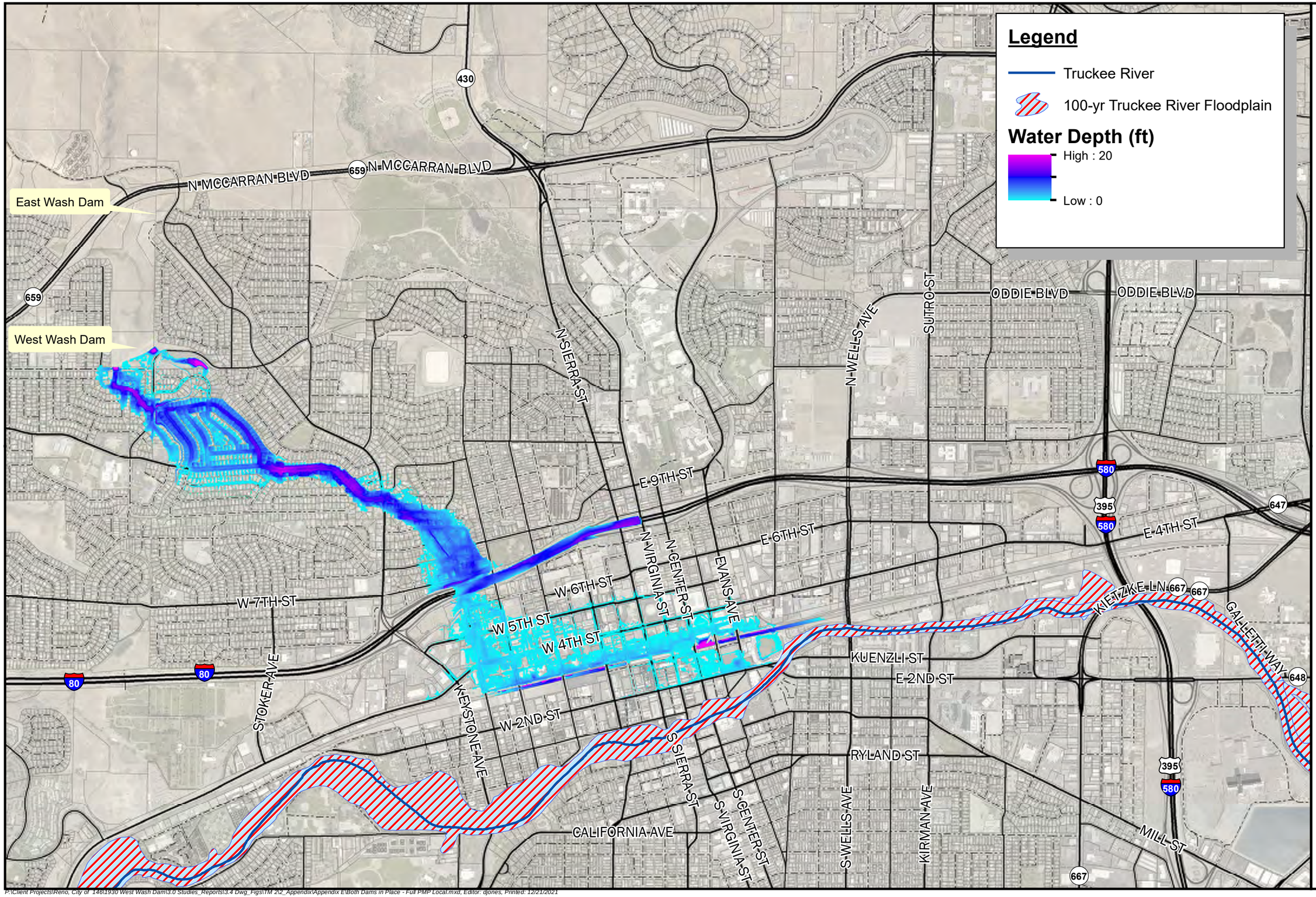
P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\2_Appendix\Appendix E\Both Dams in Place - 0.75 PMP Local.mxd, Editor: djones, Printed: 12/21/2021



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Both Dams In Place: Auxiliary Spillway Activation - Local PMP Inundation

N

1 " = 1,500 '

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APPENDIX I: NO DAM FAILURE ROUTING MAPS – WEST WASH DAM NON-EXISTENT

East Wash Dam

West Wash Dam

659

80

80

N-MCCARRAN-BL

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-7TH-ST

W-6TH-ST

W-5TH-ST

W-4TH-ST

W-2ND-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

S-SIER

KUENZ

RYLAN

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 17

Low : 0

20 Years!
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West Wash Dam Non-Existent & East Wash Dam In-Place - 10-Year Storm Inundation

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\2_Appendix\Appendix F\WW Non-existent - 10yr.mxd, Editor: djones, Printed: 12/21/2021

East Wash Dam

West Wash Dam

659

80

80

N-MCCARRAN

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-7TH-ST

W-6TH-ST

W-5TH-ST

W-4TH-ST

W-2ND-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

S-SIER

KUENZ

RYLAN

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 18

Low : 0

West Wash Dam Non-Existent & East Wash Dam In-Place - 25-Year Storm Inundation

20 Years! FARR WEST ENGINEERING

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N

1 " = 1,000 '

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P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\2_Appendix\Appendix F\WW Non-existent - 25yr.mxd, Editor: djones, Printed: 12/21/2021

East Wash Dam

West Wash Dam

659

80

80

N-MCCARRAN-BL

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-7TH-ST

W-6TH-ST

W-5TH-ST

W-4TH-ST

W-2ND-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

S-SIER

KUENZ

RYLAN

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 18

Low : 0

20 Years!
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West Wash Dam Non-Existent & East Wash Dam In-Place - 50-Year Storm Inundation

N

1 " = 1,000 '

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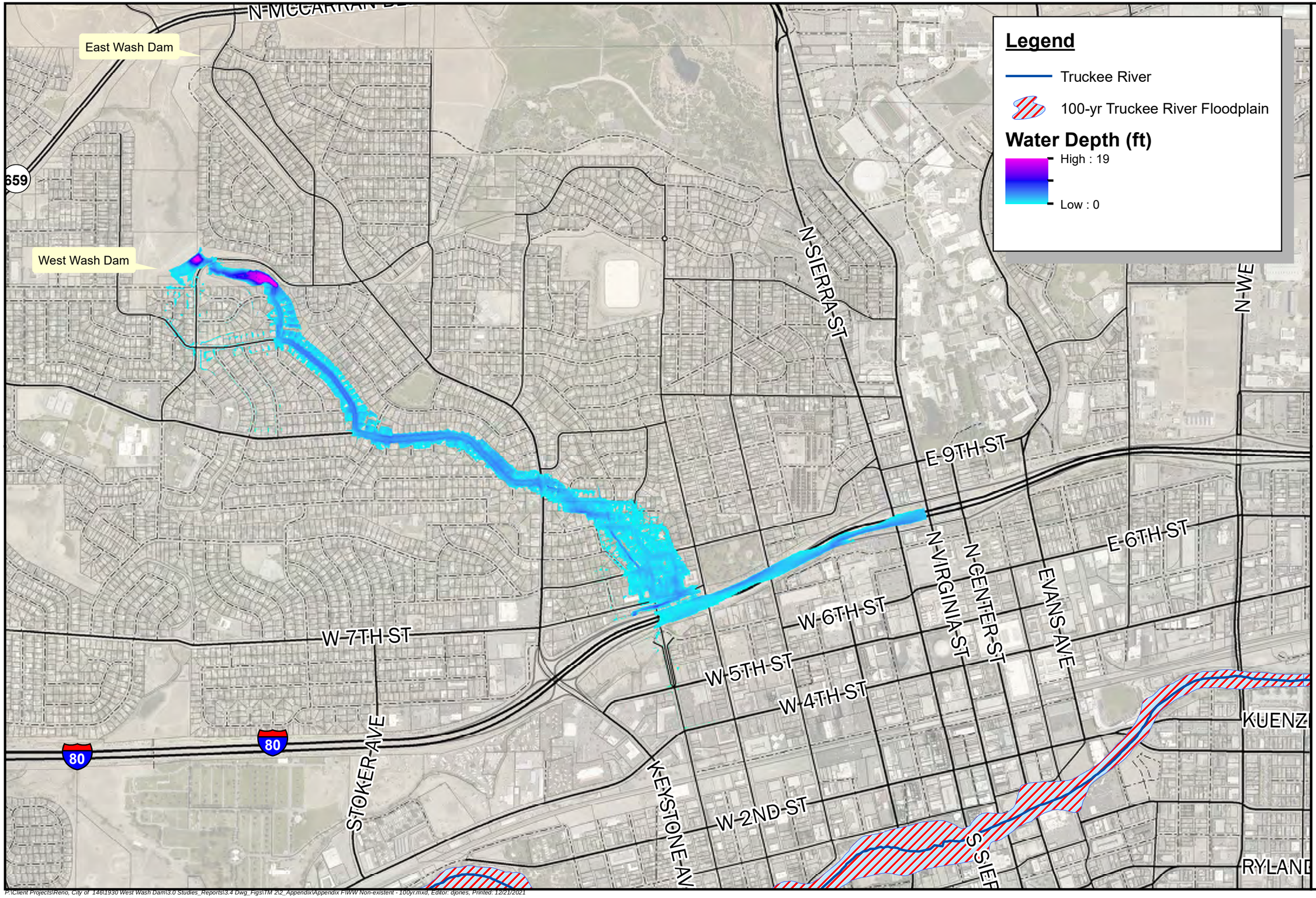
P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\2_Appendix\Appendix F\WW Non-existent - 50yr.mxd, Editor: djones, Printed: 12/21/2021



20 Years!
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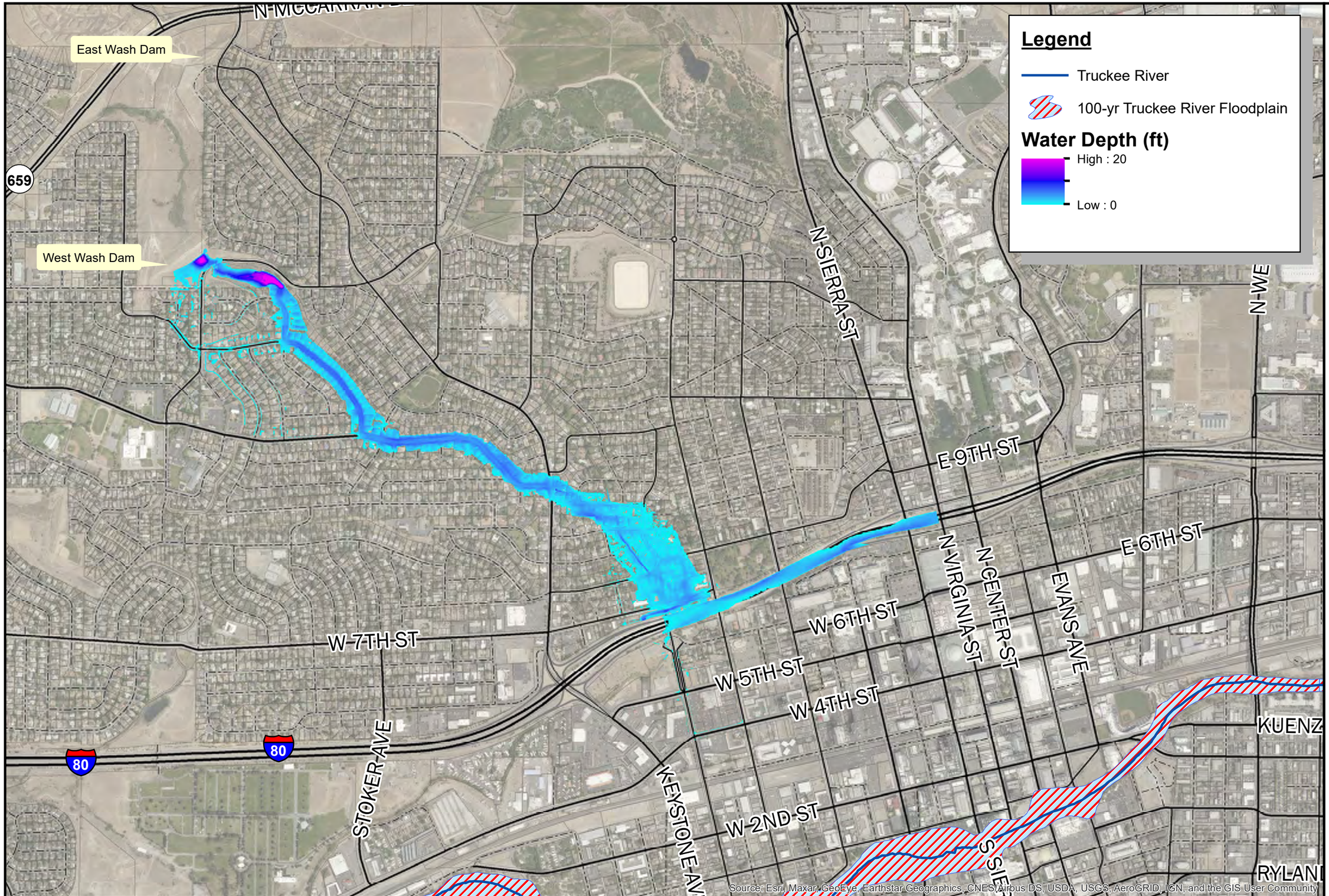
West Wash Dam Non-Existent & East Wash Dam In-Place - 100-Year Storm Inundation

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.



20 Years!
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West Wash Dam Non-Existent & East Wash Dam In-Place - 200-Year Storm Inundation

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

East Wash Dam

West Wash Dam

659

80

80

N-MCCARRAN-BLVD

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-7TH-ST

W-6TH-ST

W-5TH-ST

W-4TH-ST

W-2ND-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

S-SIER

KUENZ

RYLAN

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 21

Low : 0

20 Years! FARR WEST ENGINEERING

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West Wash Dam Non-Existent & East Wash Dam In-Place - 500-Year Storm Inundation

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

P:\Client Projects\Reno, City of 1461\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\2_Appendix\Appendix F\WW Non-existent - 500yr.mxd, Editor: djones, Printed: 12/21/2021

East Wash Dam

West Wash Dam

659

80

80

N-MCCARRAN-BLVD

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-6TH-ST

W-7TH-ST

W-5TH-ST

W-4TH-ST

W-2ND-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

S-SIER

KUENZ

RYLAN

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 21

Low : 0

20 Years! FARR WEST ENGINEERING

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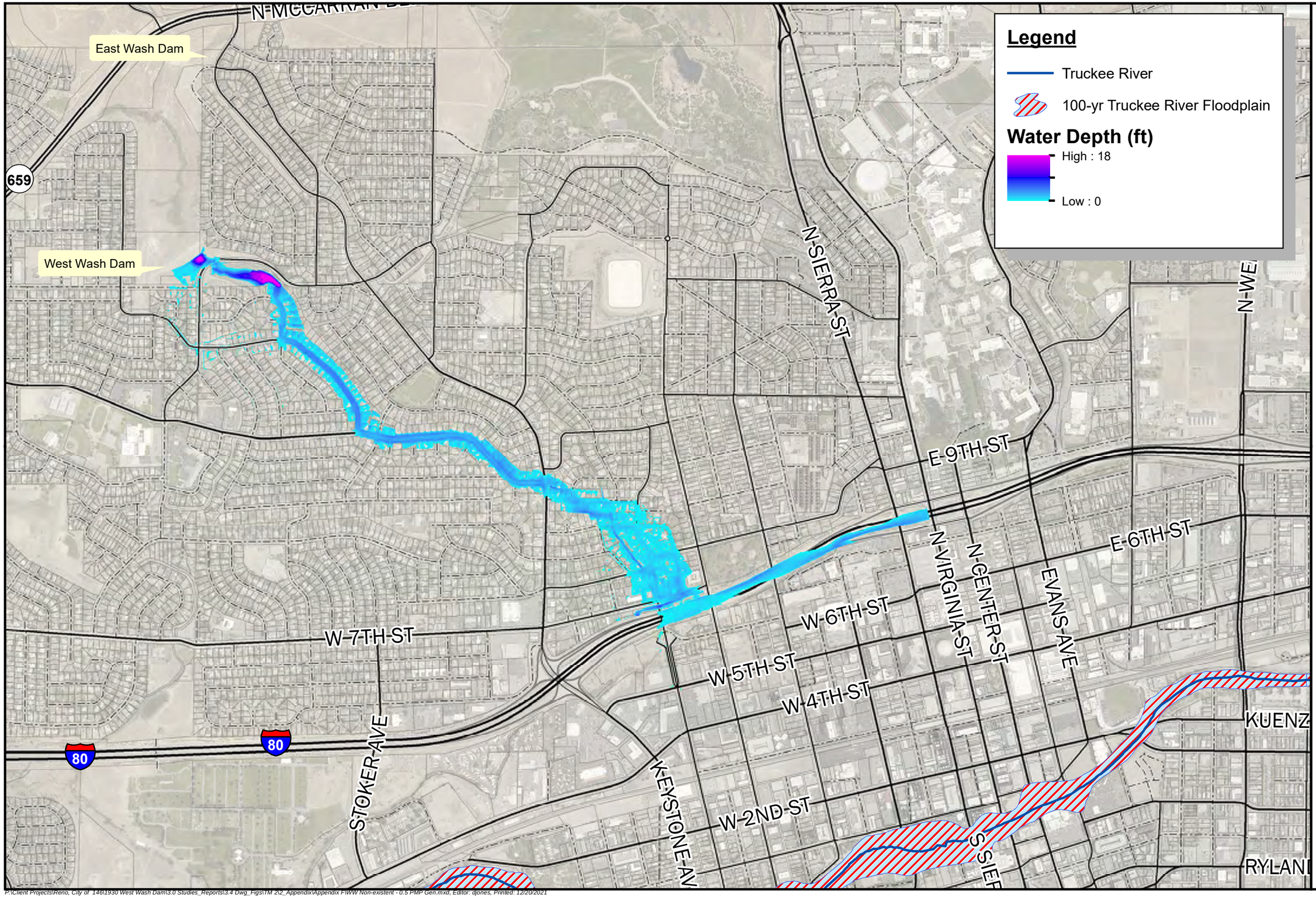
West Wash Dam Non-Existent & East Wash Dam In-Place - 1000-Year Storm Inundation

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.



20 Years!
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West Wash Dam Non-Existent & East Wash Dam In-Place - 1/2 of General PMP Inundation

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

P:\Client Projects\Reno, City of 1461\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\2_Appendix\Appendix F\WW Non-existent - 0.5 PMP Gen.mxd, Editor: djones, Printed: 12/20/2021

East Wash Dam

West Wash Dam

659

80

80

N-MCCARRAN

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-7TH-ST

W-6TH-ST

W-5TH-ST

W-4TH-ST

W-2ND-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

S-SIER

KUENZ

RYLAN

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 21

Low : 0

20 Years!
FARR WEST ENGINEERING
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Reno, NV 89511
(775) 851-4788
www.farrwestengineering.com

West Wash Dam Non-Existent & East Wash Dam In-Place - 3/4 of General PMP Inundation

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

P:\Client Projects\Reno, City of 1461930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\2_Appendix\Appendix F\WW Non-existent - 0.75 PMP Gen.mxd, Editor: djones, Printed: 12/20/2021

East Wash Dam

West Wash Dam

659

80

80

N-MCCARRAN-B

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-6TH-ST

W-7TH-ST

W-5TH-ST

W-4TH-ST

W-2ND-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

S-SIER

KUENZ

RYLAN

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 22

Low : 0

20 Years! FARR WEST ENGINEERING

5510 Longley Lane
Reno, NV 89511
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www.farwestengineering.com

West Wash Dam Non-Existent & East Wash Dam In-Place - General PMP Inundation

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

East Wash Dam

West Wash Dam

659

80

80

N-MCCARRAN

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-7TH-ST

W-6TH-ST

W-5TH-ST

W-4TH-ST

W-2ND-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

S-TOKER-AVE

K-EYSTONE-AVE

S-SIER

KUENZ

RY-LAN

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 23

Low : 0

West Wash Dam Non-Existent & East Wash Dam In-Place - 1/2 of Local PMP Inundation

20 Years! FARR WEST ENGINEERING

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N

1 " = 1,000 '

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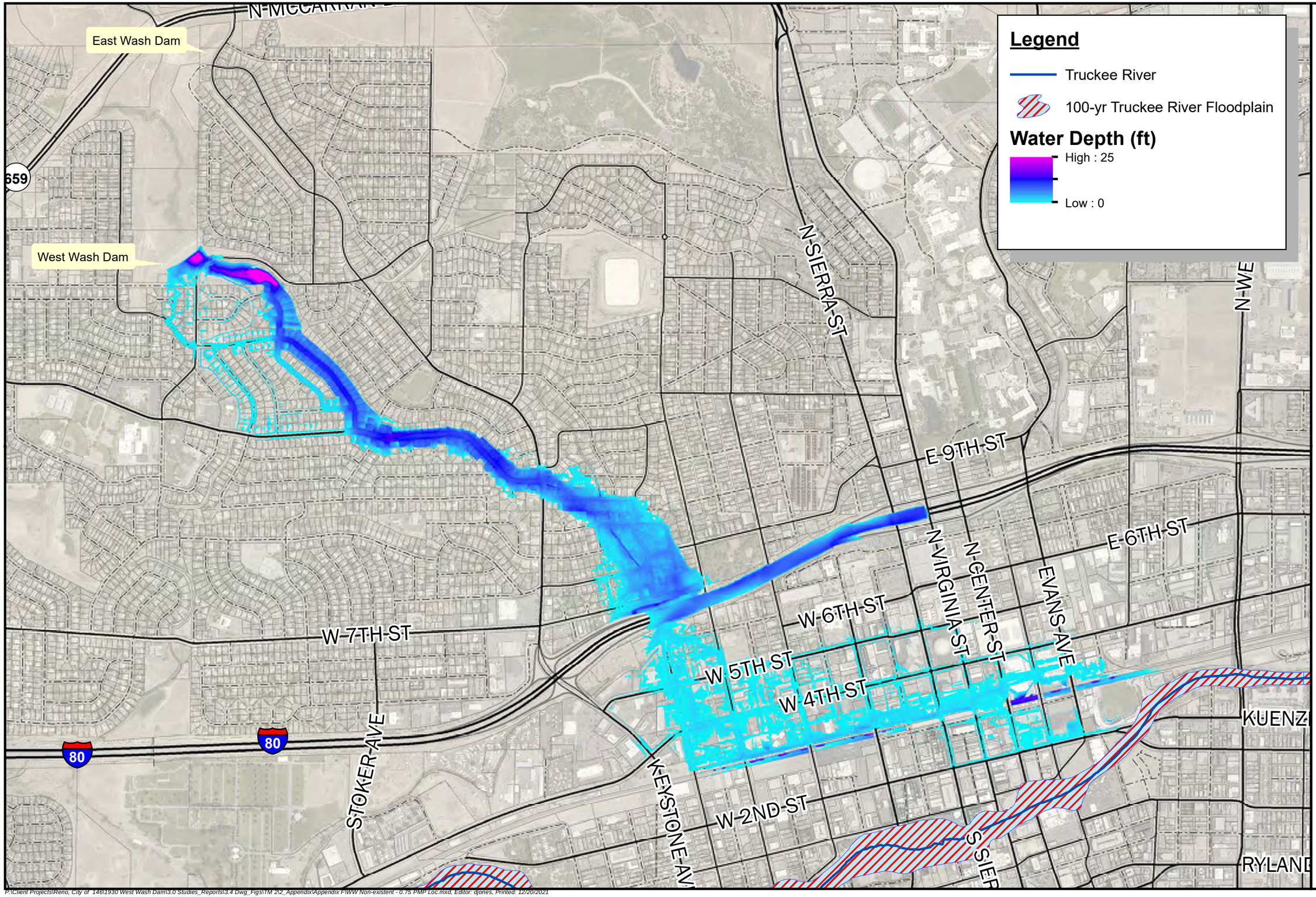

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West Wash Dam Non-Existent & East Wash Dam In-Place - 3/4 of Local PMP Inundation

N

1 " = 1,000 '

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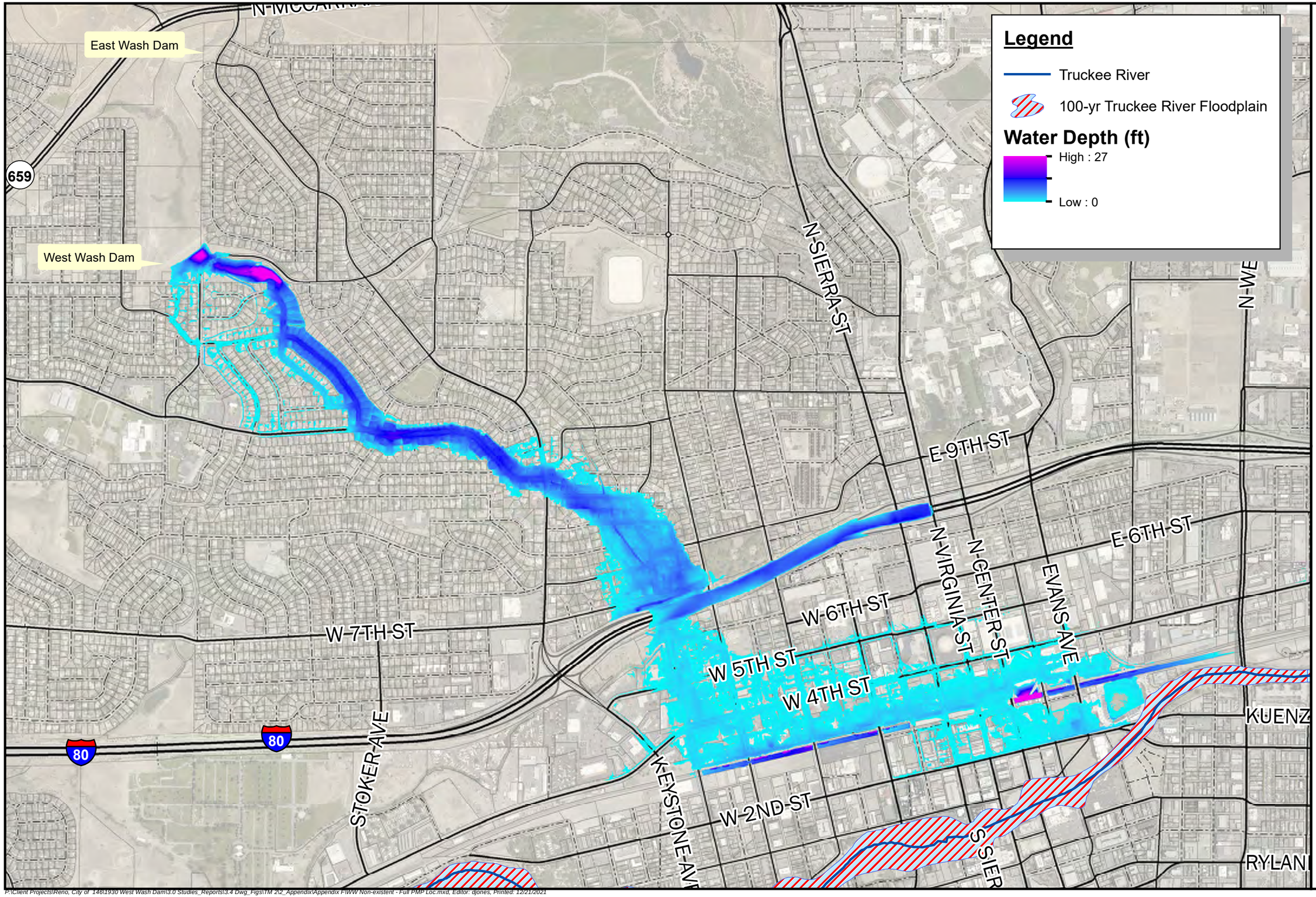

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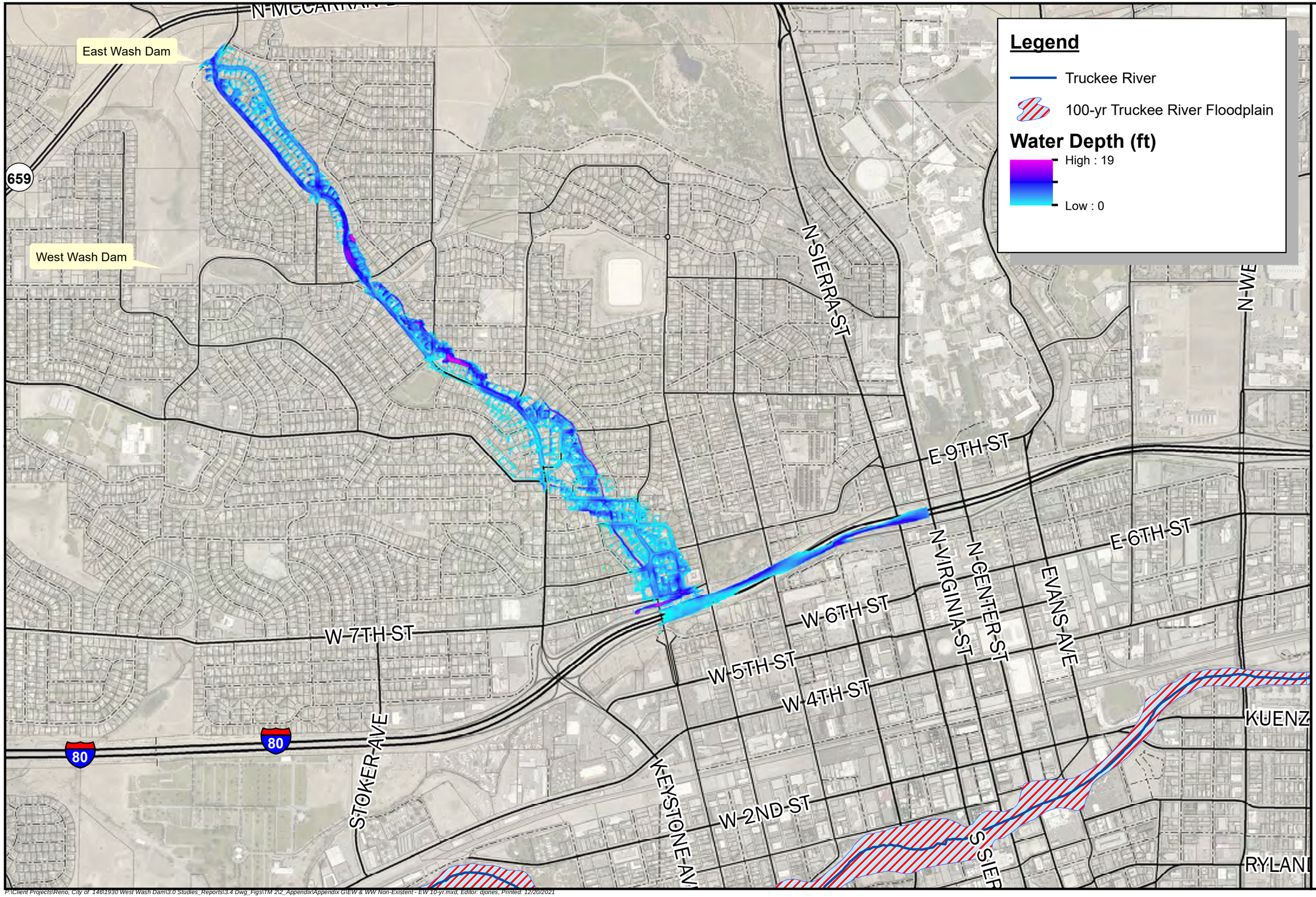
West Wash Dam Non-Existent & East Wash Dam In-Place - Local PMP Inundation

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

APPENDIX J: NO DAM FAILURE ROUTING MAPS – EAST WASH AND WEST WASH DAMS NON-EXISTENT



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West Wash & East Wash Dams Non-Existent - East Wash 10-Year Storm Inundation

N

1 " = 1,000 '

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East Wash Dam

West Wash Dam

659

N-MCCARRAN-BL

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-6TH-ST

W-7TH-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

W-2ND-ST

S-SIERRA-ST

KUENZ

RYLAN

80

80

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 17

Low : 0

20 Years! FARR WEST ENGINEERING

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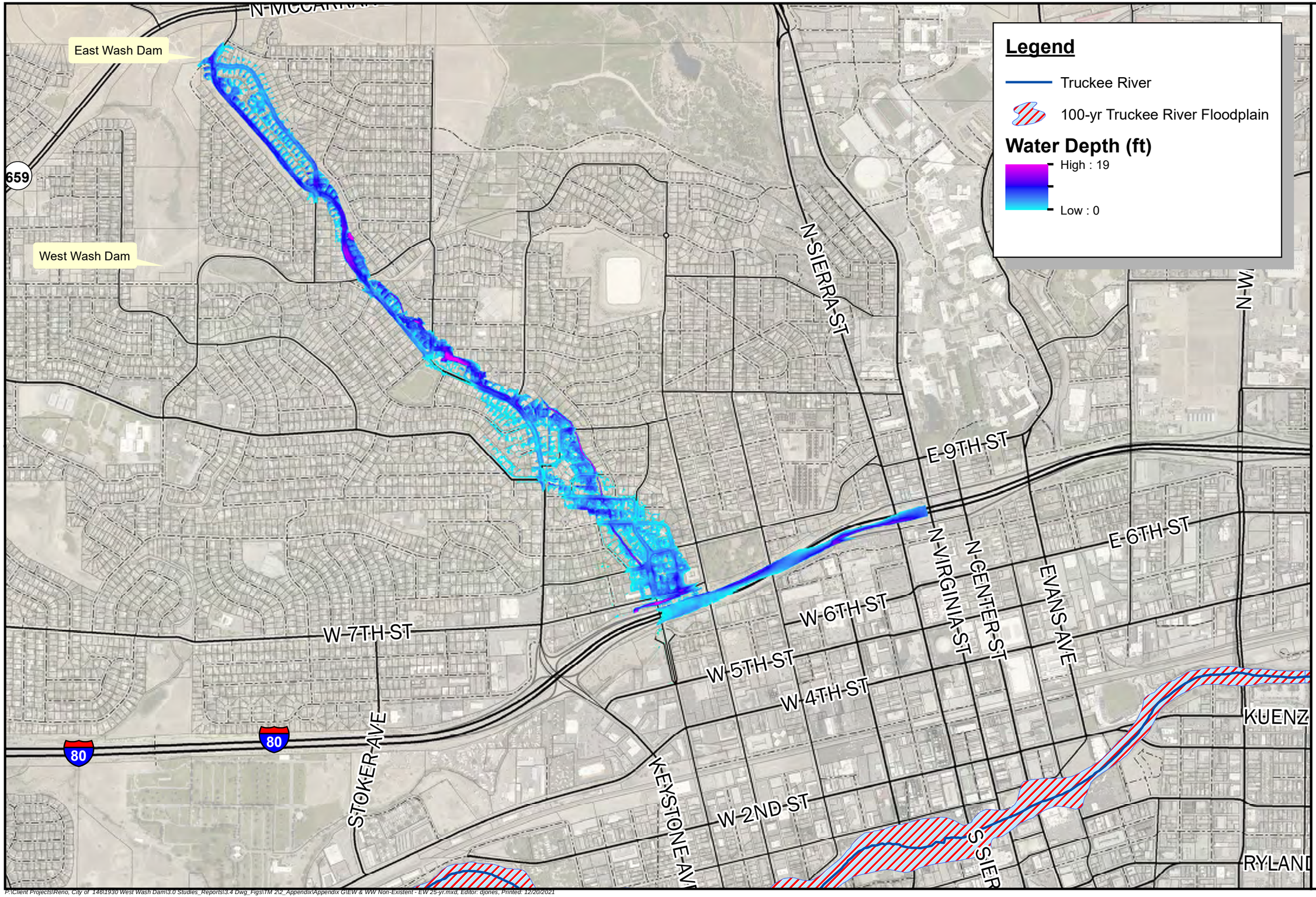
West Wash & East Wash Dams Non-Existent - West Wash 10-Year Storm Inundation

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



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West Wash & East Wash Dams Non-Existent - East Wash 25-Year Storm Inundation

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

East Wash Dam

West Wash Dam

N-MCCARRAN-BL

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-6TH-ST

W-7TH-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

W-2ND-ST

S-SIER

KUENZ

RYLAN

659

80

80

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 18

Low : 0

20 Years! FARR WEST ENGINEERING

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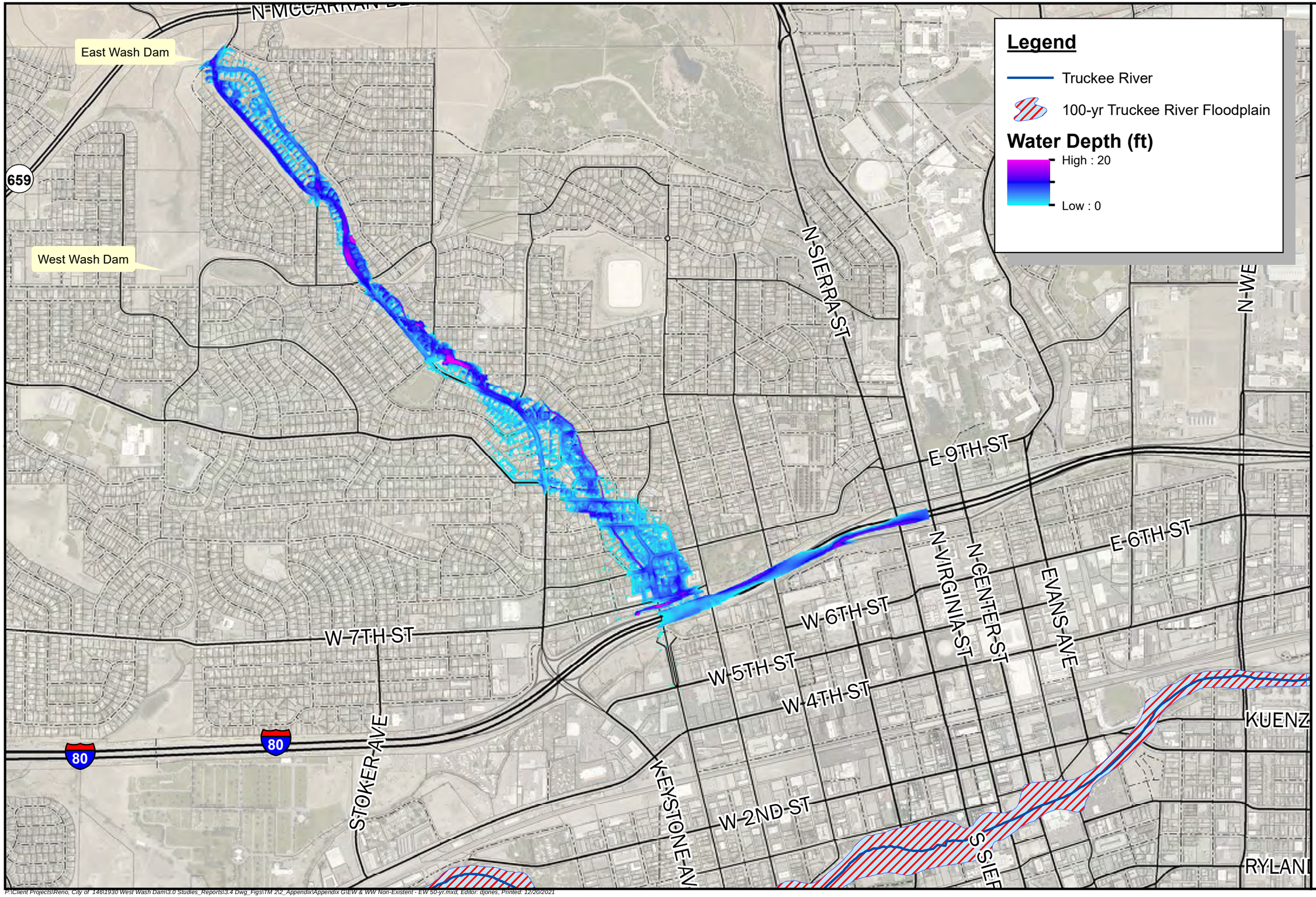
West Wash & East Wash Dams Non-Existent - West Wash 25-Year Storm Inundation

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.



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West Wash & East Wash Dams Non-Existent - East Wash 50-Year Storm Inundation

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

East Wash Dam

West Wash Dam

659

80

80

N-MCCARRAN

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-6TH-ST

W-7TH-ST

W-2ND-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AVE

S-SIER

KUENZ

RYLAN

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 18

Low : 0

20 Years! FARR WEST ENGINEERING

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West Wash & East Wash Dams Non-Existent - West Wash 50-Year Storm Inundation

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

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East Wash Dam

West Wash Dam

659

80

80

N-SIERRA-ST

E-9TH-ST

E-6TH-ST

W-7TH-ST

W-6TH-ST

W-5TH-ST

W-4TH-ST

W-2ND-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

KUENZ

RYLAN

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 20

Low : 0

20 Years!
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Reno, NV 89511
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West Wash & East Wash Dams Non-Existent - East Wash 100-Year Storm Inundation

N

1 " = 1,000 '

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East Wash Dam

West Wash Dam

N-MCCARRAN-B

659

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-6TH-ST

W-7TH-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

W-2ND-ST

S-SIER

KUENZ

RYLAN

80

80

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 18

Low : 0

20 Years! FARR WEST ENGINEERING

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West Wash & East Wash Dams Non-Existent - West Wash 100-Year Storm Inundation

N

1 " = 1,000 '

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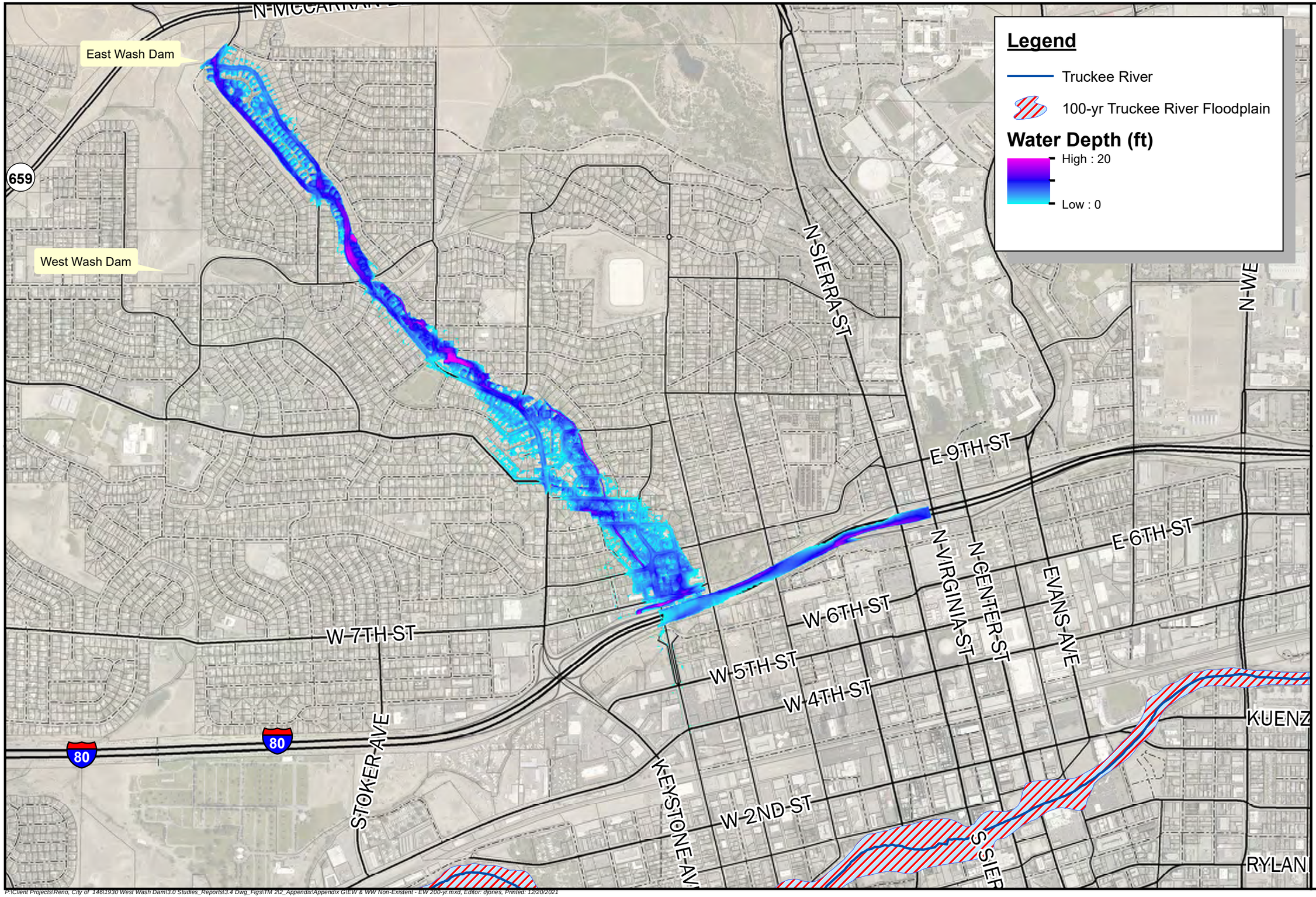
P:\Client Projects\Reno, City of 1461\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\2_Appendix\Appendix G\EW & WW Non-Existent - WW 100-yr.mxd, Editor: djones, Printed: 12/20/2021



20 Years! FARR WEST ENGINEERING

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West Wash & East Wash Dams Non-Existent - East Wash 200-Year Storm Inundation

N

1 " = 1,000 '

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East Wash Dam

West Wash Dam

659

N-MCCARRAN-B

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-6TH-ST

W-7TH-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

W-2ND-ST

S-SIER

KUENZ

RYLAN

80

80

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 19

Low : 0

20 Years!
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West Wash & East Wash Dams Non-Existent - West Wash 200-Year Storm Inundation

N

1 " = 1,000 '

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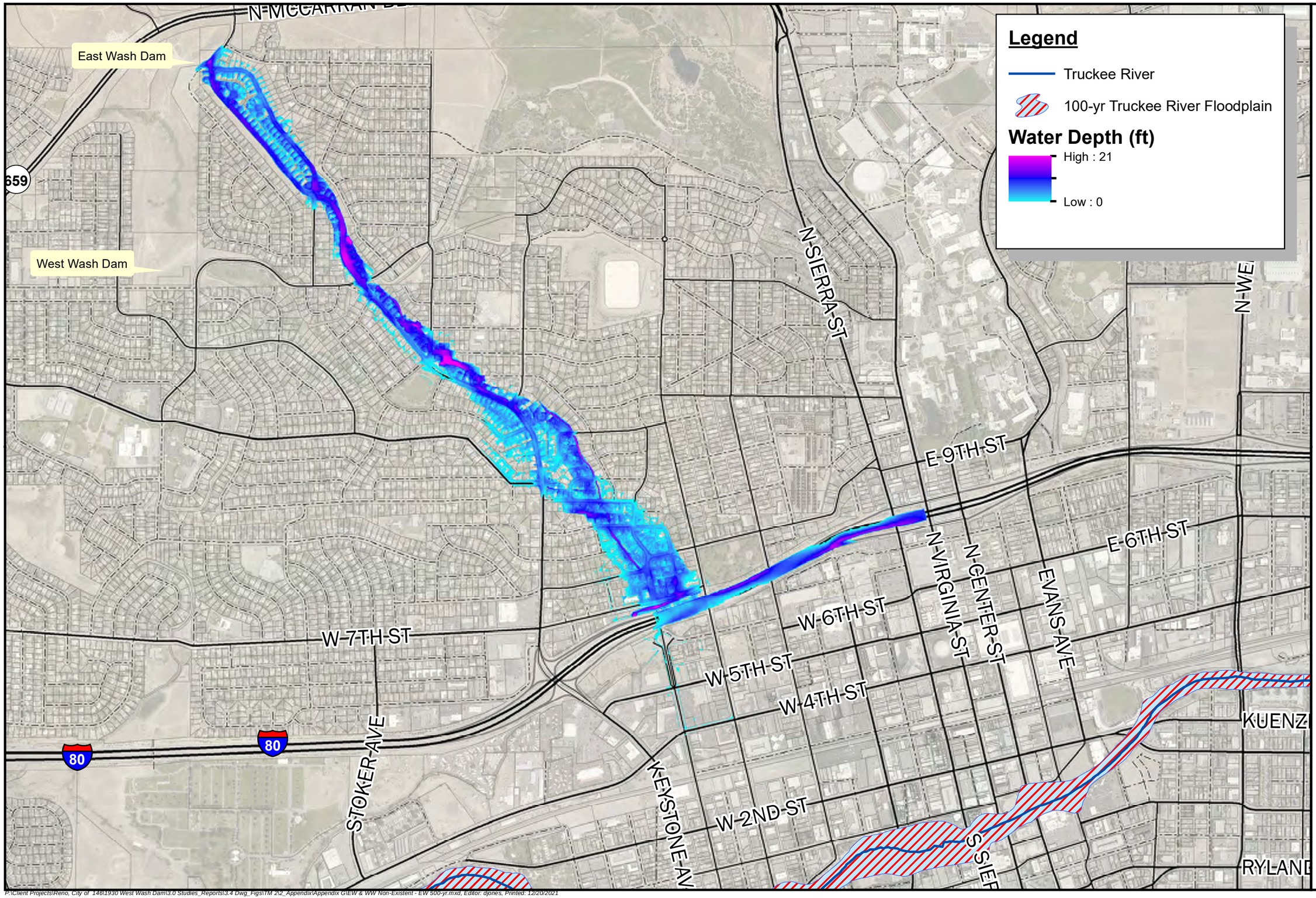

20 Years!
FARR WEST ENGINEERING
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www.farrwestengineering.com

West Wash & East Wash Dams Non-Existent - East Wash 500-Year Storm Inundation

N

1 " = 1,000 '

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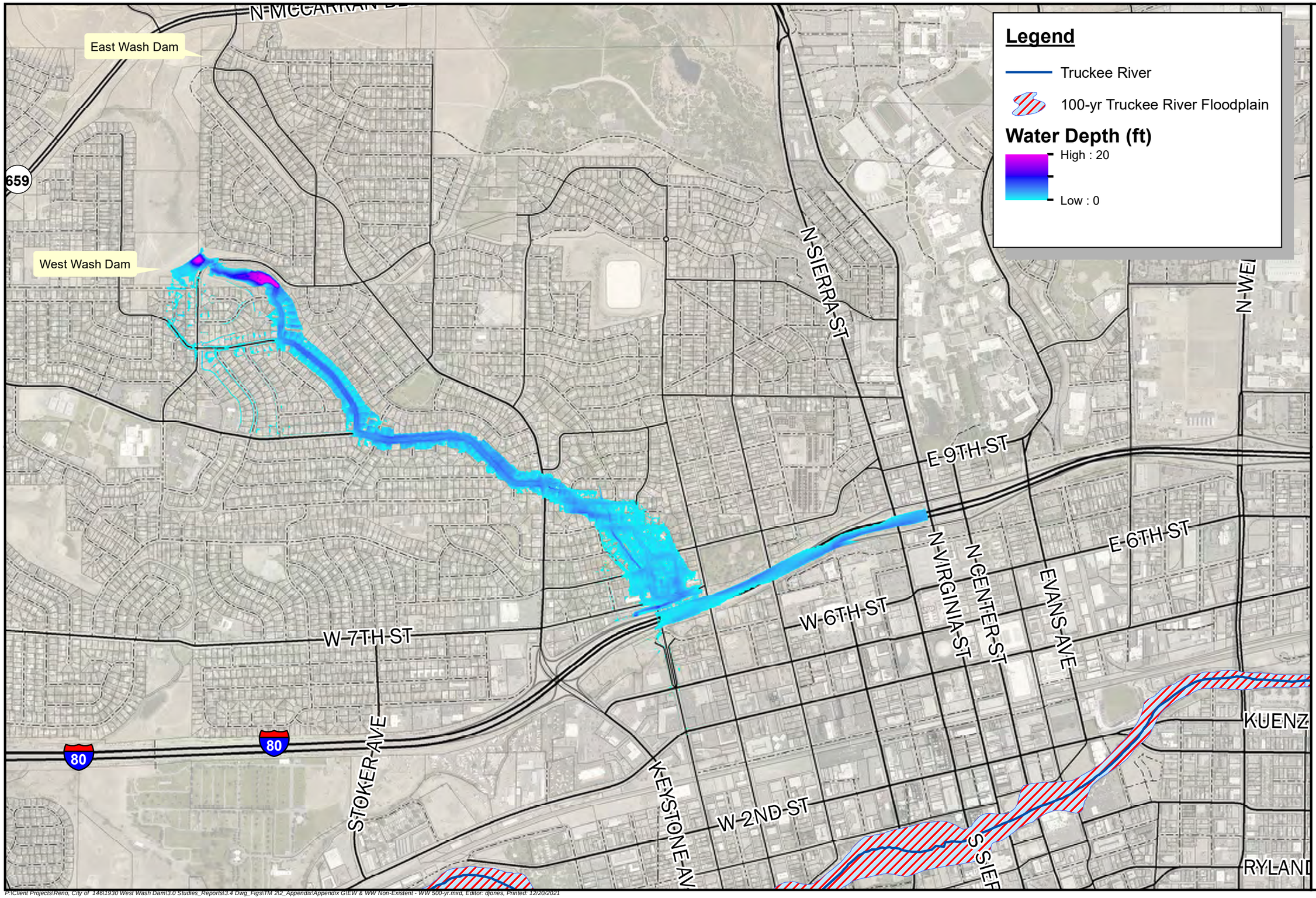

20 Years!
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West Wash & East Wash Dams Non-Existent - West Wash 500-Year Storm Inundation

N

1 " = 1,000 '

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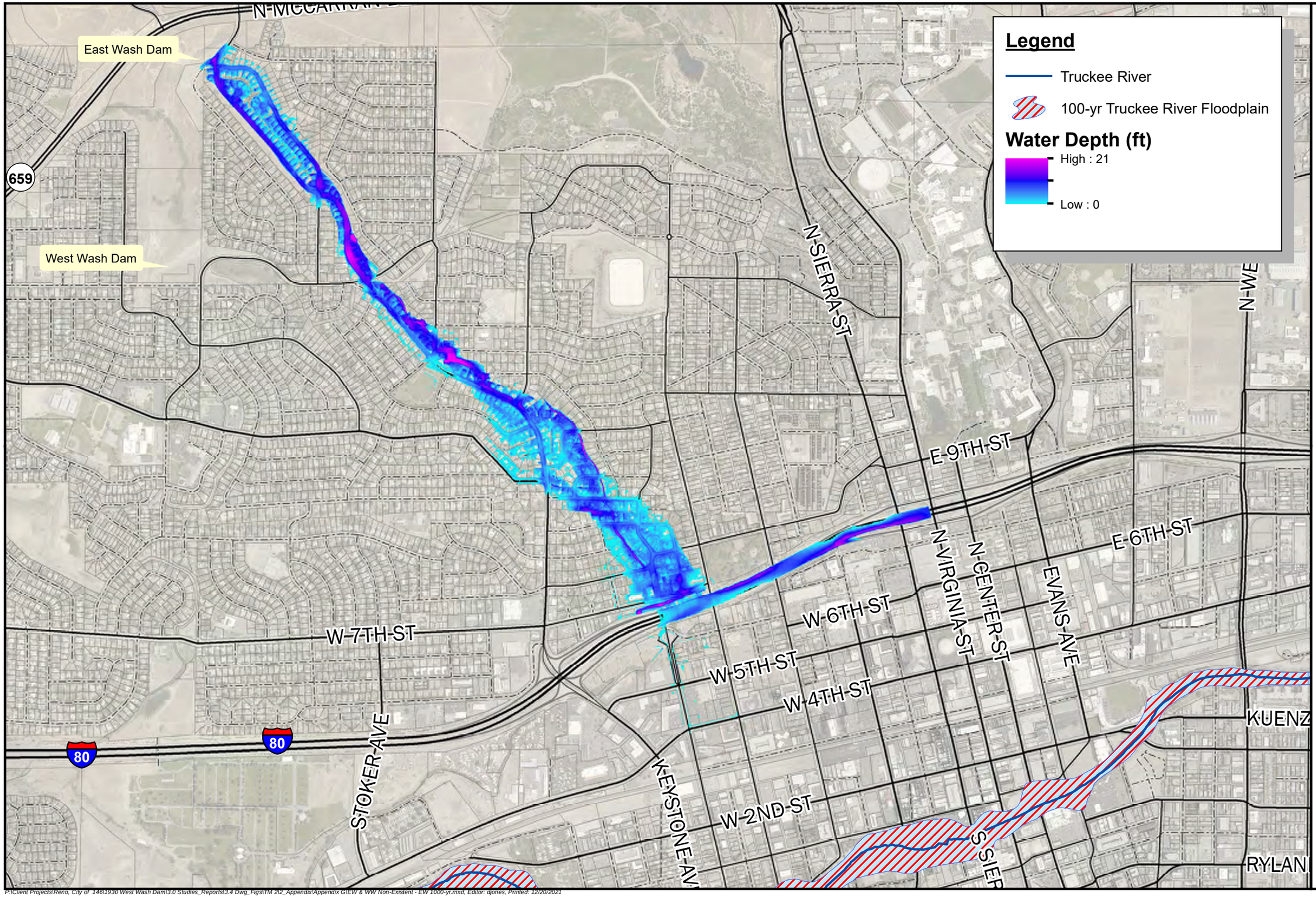

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(775) 851-4788
www.farrwestengineering.com

West Wash & East Wash Dams Non-Existent - East Wash 1000-Year Storm Inundation

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

East Wash Dam

West Wash Dam

659

N-MCCARRAN-BL

N-SIERRA-ST

N-WEI

E-9TH-ST

E-6TH-ST

W-6TH-ST

W-7TH-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

W-2ND-ST

S-SIER

KUENZ

RYLAN

80

80

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 20

Low : 0

20 Years! FARR WEST ENGINEERING

5510 Longley Lane
Reno, NV 89511
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West Wash & East Wash Dams Non-Existent - West Wash 1000-Year Storm Inundation

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

West Wash & East Wash Dams Non-Existent - East Wash 1/2 of General PMP Inundation

East Wash Dam

West Wash Dam

N-MCCARRAN-BL

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-7TH-ST

W-6TH-ST

W-5TH-ST

W-4TH-ST

W-2ND-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

S-SIER

KUENZ

RYLAND

659

80

80

Legend

- Truckee River
- 100-yr Truckee River Floodplain

Water Depth (ft)

High : 20

Low : 0

N

1 " = 1,000 '

20 Years!
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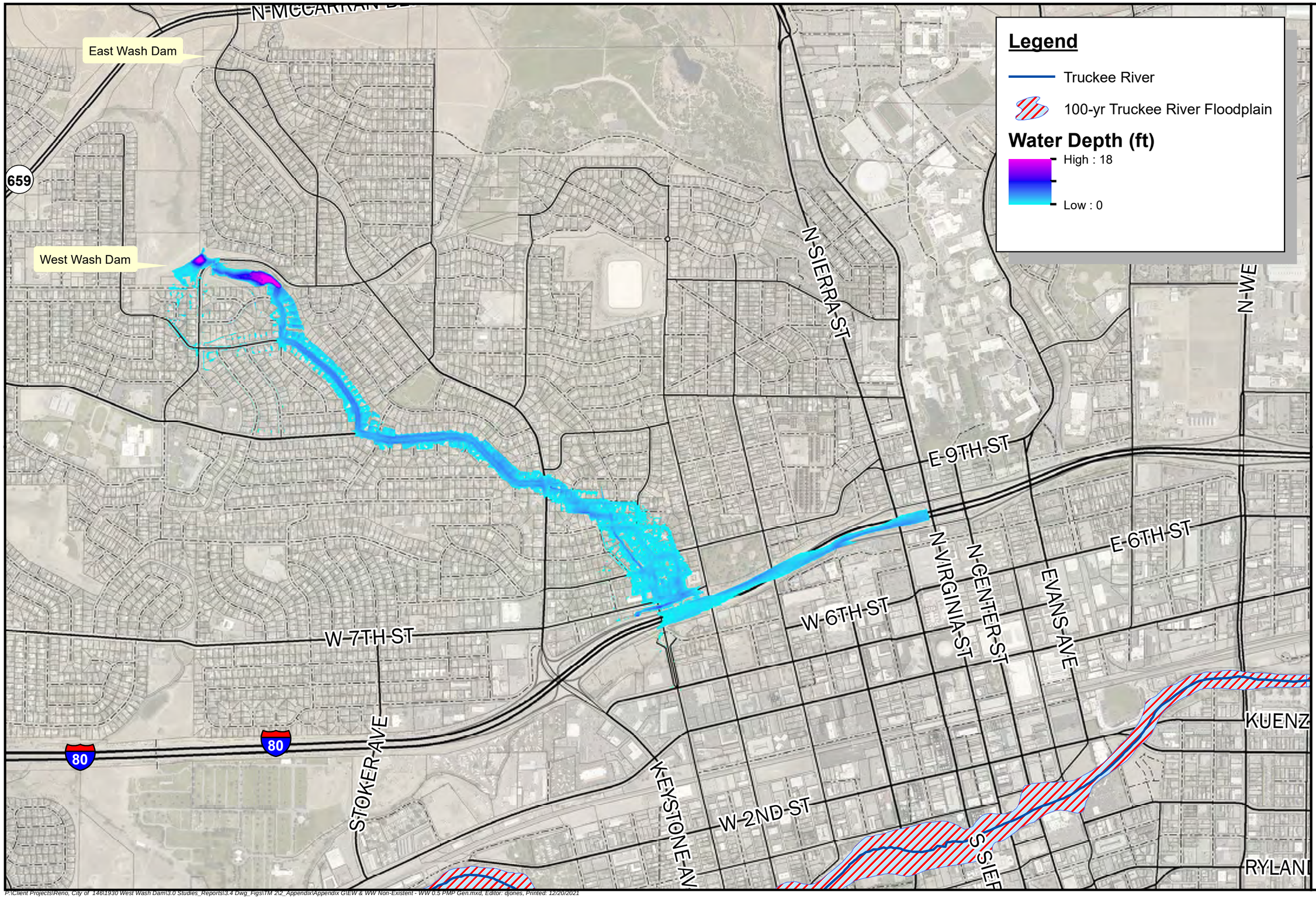

20 Years!
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West Wash & East Wash Dams Non-Existent - West Wash 1/2 of General PMP Inundation

N

1 " = 1,000 '

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East Wash Dam

West Wash Dam

659

80

80

N-MCCARRAN

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-6TH-ST

W-7TH-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

S-TOKER-AVE

K-EYSTONE-AV

W-2ND-ST

S-SIER

KUENZ

RYLAN

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 22

Low : 0

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West Wash & East Wash Dams Non-Existent - East Wash 1/2 of Local PMP Inundation

N

1 " = 1,000 '

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East Wash Dam

West Wash Dam

659

80

80

N-MCCARRAN-B

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-6TH-ST

W-7TH-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

N-KEYSTONE-AV

W-2ND-ST

S-SIER

KUENZ

RYLAN

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 20

Low : 0

20 Years! FARR WEST ENGINEERING

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West Wash & East Wash Dams Non-Existent - West Wash 1/2 of Local PMP Inundation

N

1 " = 1,000 '

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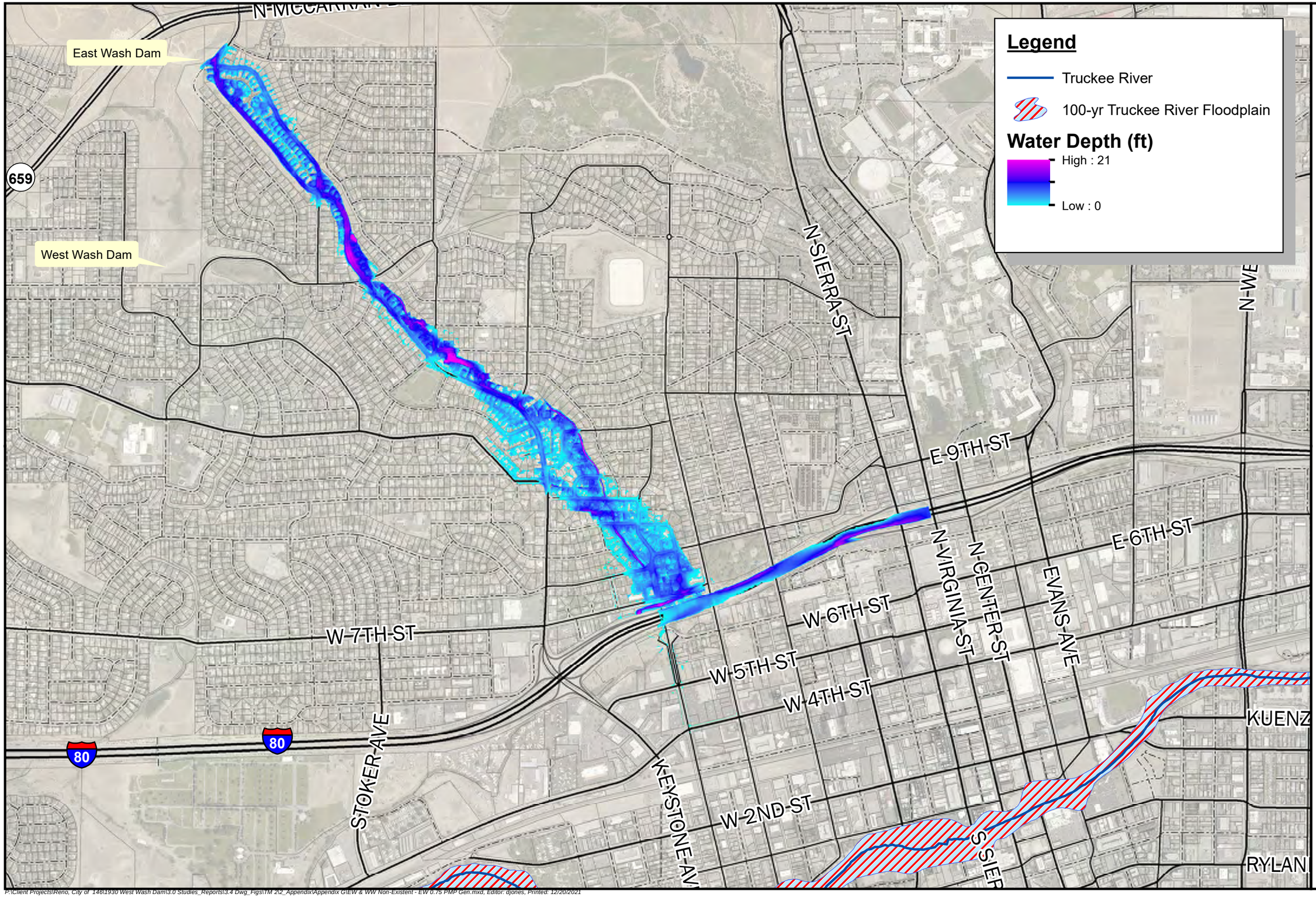

20 Years!
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Reno, NV 89511
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West Wash & East Wash Dams Non-Existent - East Wash 3/4 of General PMP Inundation

N

1 " = 1,000 '

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East Wash Dam

West Wash Dam

659

80

80

N-MCCARRAN

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-6TH-ST

W-7TH-ST

W-2ND-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

S-SIER

KUENZ

RYLAN

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 19

Low : 0

20 Years!
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Reno, NV 89511
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www.farrwestengineering.com

West Wash & East Wash Dams Non-Existent - West Wash 3/4 of General PMP Inundation

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

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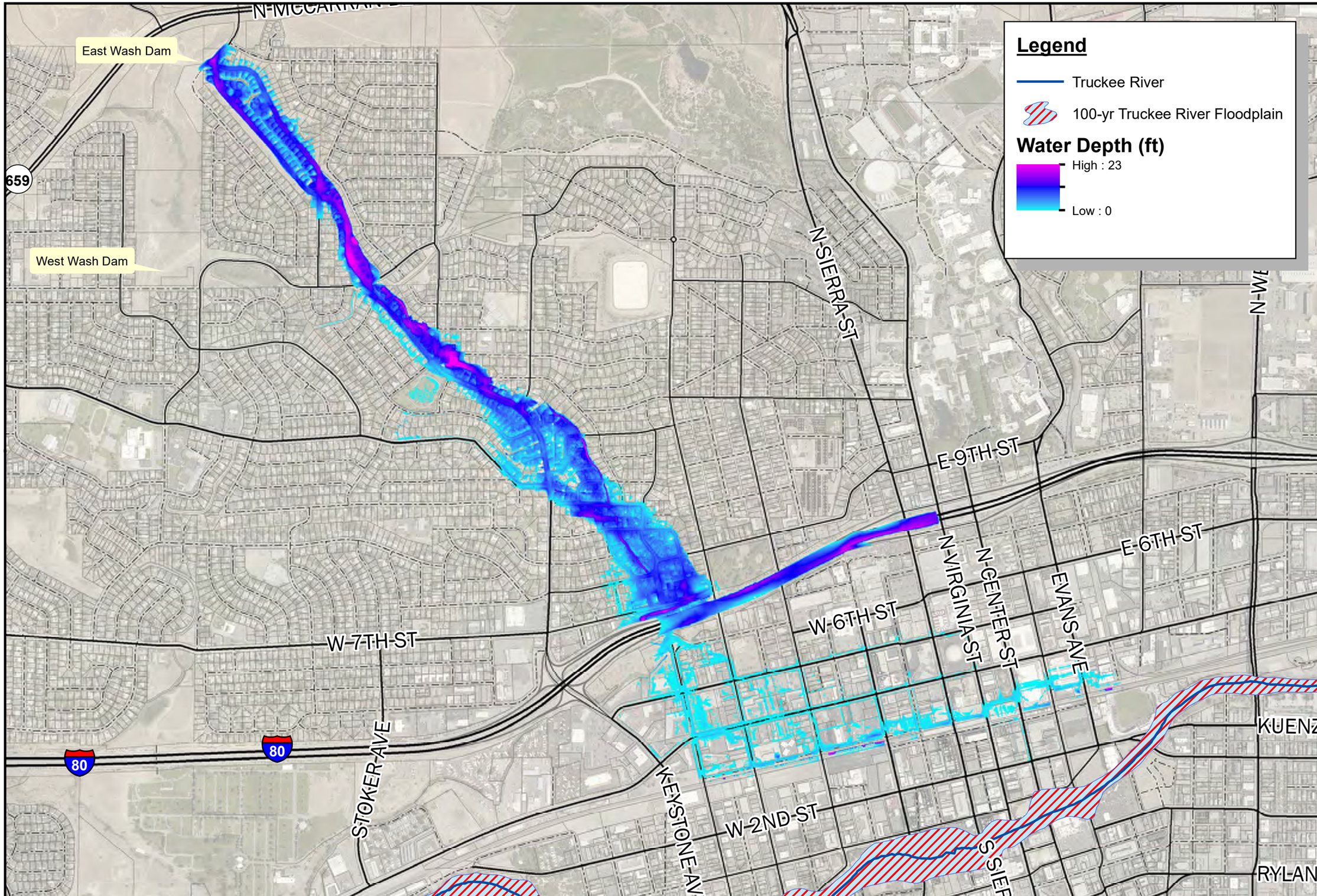

20 Years!
FARR WEST ENGINEERING

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Reno, NV 89511
(775) 851-4788
www.farrwestengineering.com

West Wash & East Wash Dams Non-Existent - East Wash 3/4 of Local PMP Inundation

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.4 Dwg_Figs\TM 2\2_Appendix\Appendix G\EW & WW Non-Existent - EW 0.75 PMP Loc.mxd, Editor: djones, Printed: 12/20/2021

East Wash Dam

West Wash Dam

N-MCCARRAN-BLVD

659

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-6TH-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

W-7TH-ST

80

80

STOKER-AVE

KEYSTONE-AV

W-2ND-ST

S-SIER

KUENZ

RYLAN

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 21

Low : 0

20 Years! FARR WEST ENGINEERING

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West Wash & East Wash Dams Non-Existent - West Wash 3/4 of Local PMP Inundation

N

1 " = 1,000 '

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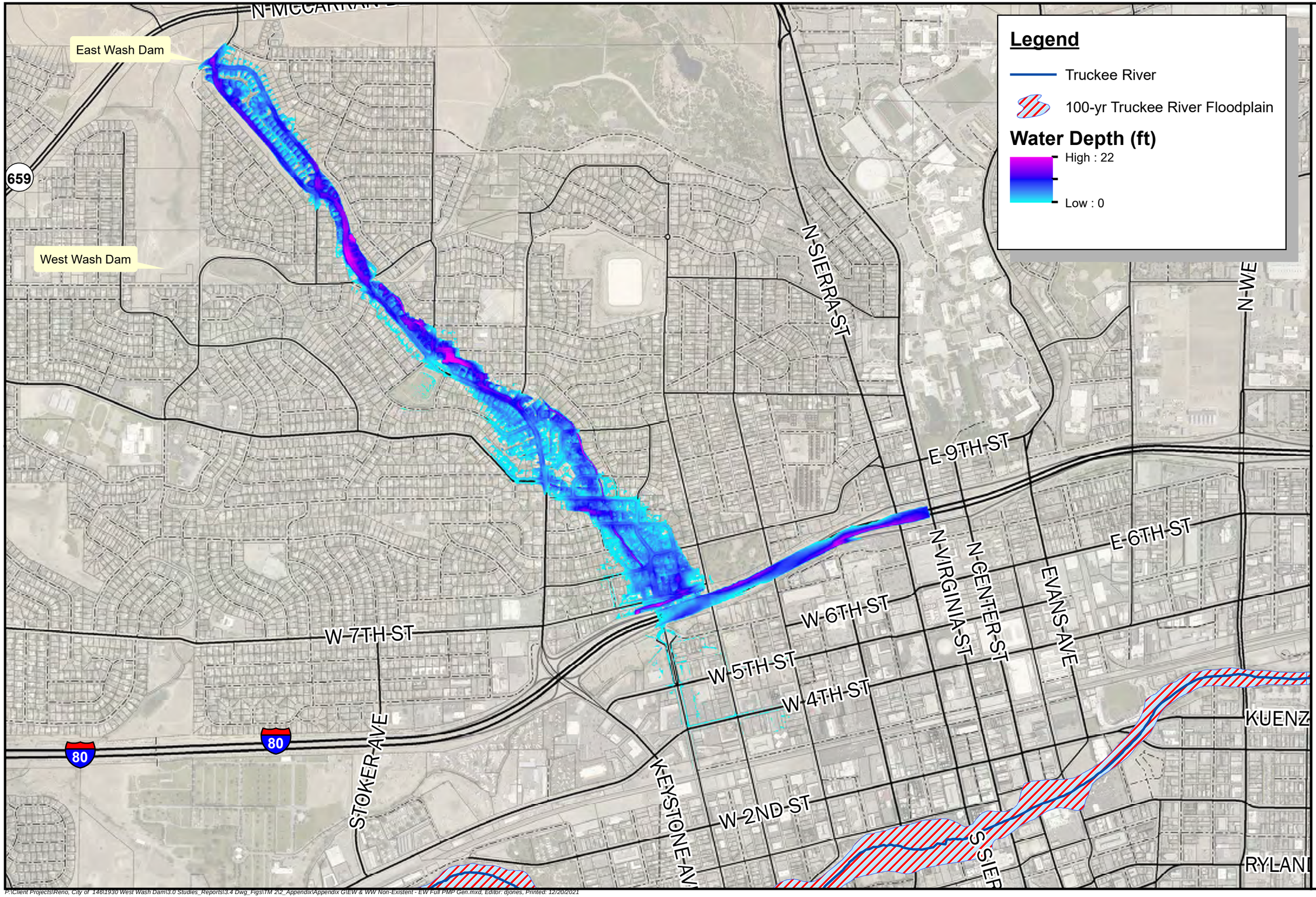

20 Years! FARR WEST ENGINEERING

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West Wash & East Wash Dams Non-Existent - East Wash General PMP Inundation

N

1 " = 1,000 '

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East Wash Dam

West Wash Dam

659

N-MCCARRAN-BL

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-6TH-ST

W-7TH-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

W-2ND-ST

S-SIER

KUENZ

RYLAN

80

80

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 20

Low : 0

20 Years!
FARR WEST ENGINEERING
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Reno, NV 89511
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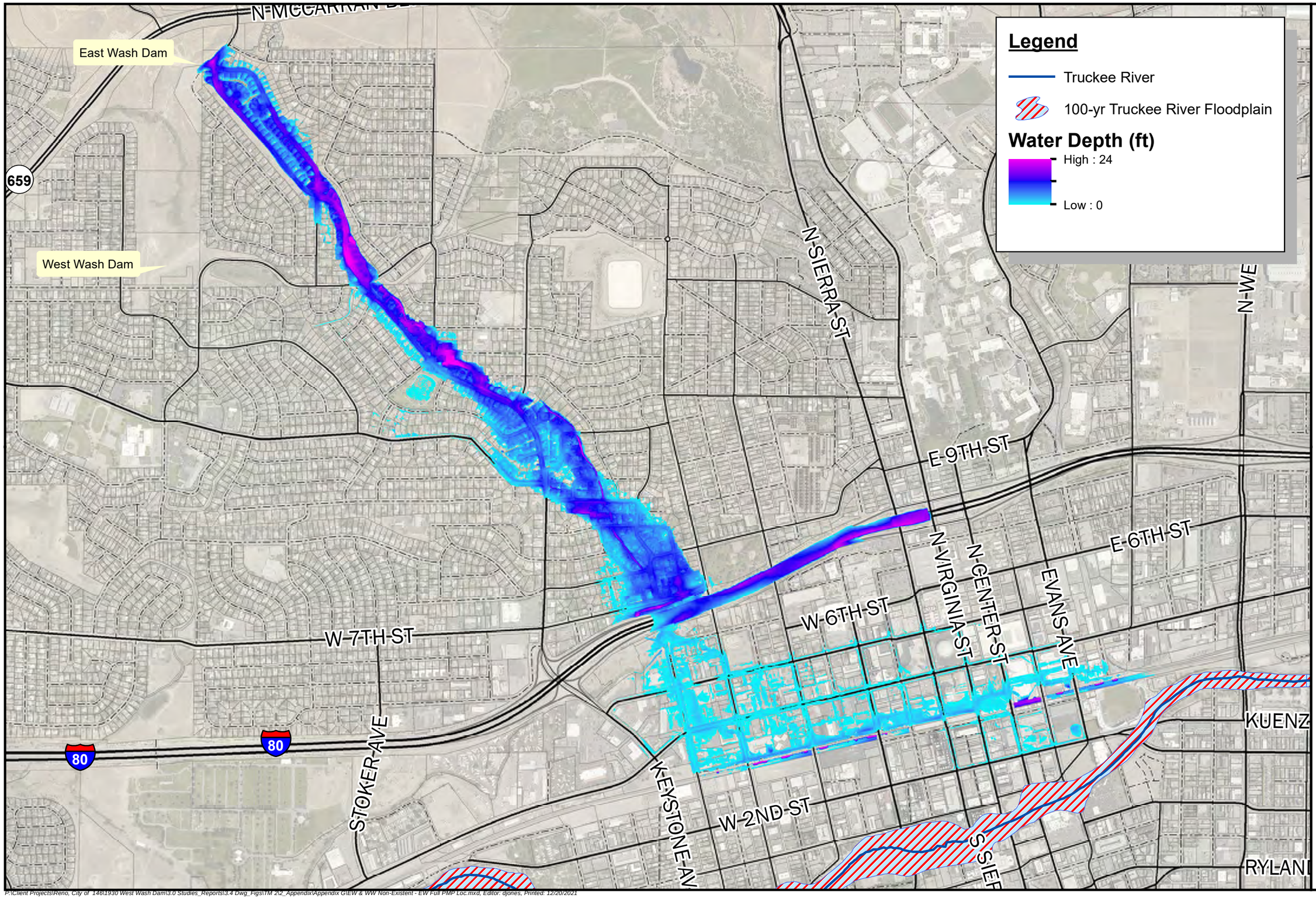
www.farrwestengineering.com

West Wash & East Wash Dams Non-Existent - West Wash General PMP Inundation

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.



20 Years! FARR WEST ENGINEERING

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West Wash & East Wash Dams Non-Existent - East Wash Local PMP Inundation

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

East Wash Dam

West Wash Dam

659

N-MCCARRAN-BL

N-SIERRA-ST

N-WE

E-9TH-ST

E-6TH-ST

W-6TH-ST

W-7TH-ST

N-VIRGINIA-ST

N-CENTER-ST

EVANS-AVE

STOKER-AVE

KEYSTONE-AV

W-2ND-ST

S-SIER

KUENZ

RYLAN

80

80

Legend

Truckee River

100-yr Truckee River Floodplain

Water Depth (ft)

High : 23

Low : 0

20 Years!
FARR WEST ENGINEERING
5510 Longley Lane
Reno, NV 89511
(775) 851-4788
www.farrwestengineering.com

West Wash & East Wash Dams Non-Existent - West Wash Local PMP Inundation

N

1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

APPENDIX K: NRCS DAM BREACH HYDROGRAPH SPREADSHEETS

Dambreach Hydrographs via TRs 60 & 66 NRCS guidance

version 3, July 2018

Input data required:

data	variable	explanation
4863	crestEL	dam crest elevation
4858	wsEL	w.s. elev at time of breach
14	TW	dam top width (feet)
2.5	SSup	dam side slope (upstream, SSup:1)
2	SSdn	dam side slope (downstream, SSdn:1)
4845	floorEL	valley floor elev (see note)
75.058	Vs	resv vol at time of breach (acre-feet)
480	L	valley width at dam axis & w.s. elev (feet)
	ELwave	top of wave berm elevation
	Wwave	width of top of wave berm feet
	SSwave	wave berm side slope (SSwave:1)
	ELstab	top of stability berm elevation
	Wstab	width of top of stability berm (feet)
	SSstab	stability berm side slope (SSstab:1)
1	ts	timestep (minutes) for breach hydrograph

output variable	results
T	383
(L < T)?	N
H_w	13
Q_1	7477
(H_w < 103)?	Y
Awave	0
Astab	0
A	981
Br	1
Q_2	1092
Q_{min}	1950
(Q_2 < Q_{min})?	Y
(Q_2 > Q_1)?	N
(Q_1 < Q_{min})?	N
Q_{max}	**1950**

breach hydrograph time (min)	Q (cfs)
0	0
1	**1950**
2	1815
3	1751
4	1690
5	1630
6	1573
7	1518
8	1464
9	1413
10	1363
11	1315
12	1269
13	1225
14	1182
15	1140
16	1100
17	1061
18	1024
19	988
20	953
21	920
22	887
23	856
24	826
25	797
26	769
27	742
28	716
29	691
30	666
31	643
32	620
33	599
34	578
35	557
36	538
37	519
38	501
39	483
40	466
41	450
42	434
43	419
44	404
45	390
46	376
47	363
48	350
49	338
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51	314
52	303
53	293
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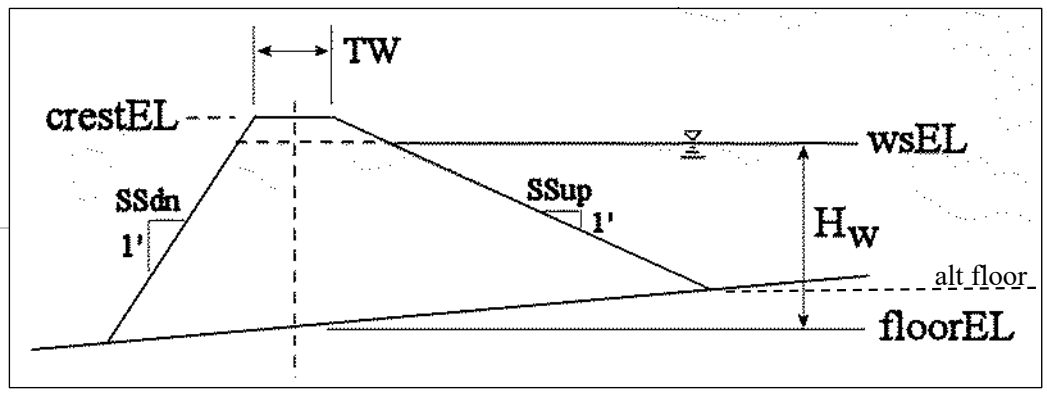
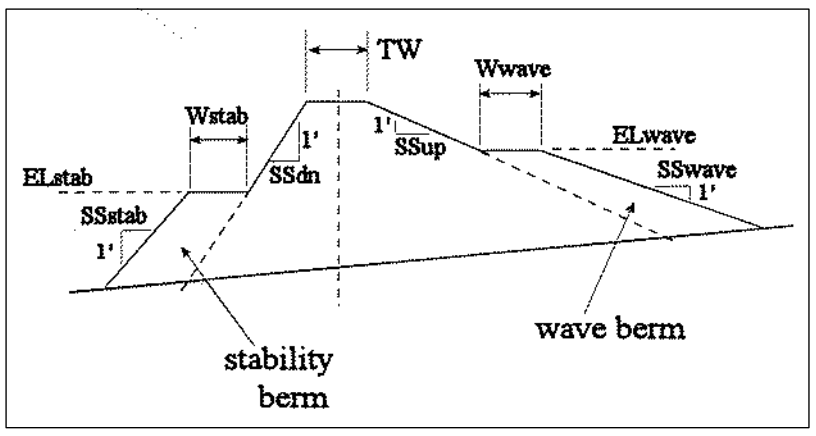
64	197
65	190





auto-scale hydrograph

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602	0

Dambreach Hydrographs via TRs 60 & 66 NRCS guidance

version 3, July 2018

Input data required:

data	variable	explanation
4863	crestEL	dam crest elevation
4860.55	wsEL	w.s. elev at time of breach
14	TW	dam top width (feet)
2.5	SSup	dam side slope (upstream, SSup:1)
2	SSdn	dam side slope (downstream, SSdn:1)
4845	floorEL	valley floor elev (see note)
92.91	Vs	resv vol at time of breach (acre-feet)
480	L	valley width at dam axis & w.s. elev (feet)
	ELwave	top of wave berm elevation
	Wwave	width of top of wave berm feet
	SSwave	wave berm side slope (SSwave:1)
	ELstab	top of stability berm elevation
	Wstab	width of top of stability berm (feet)
	SSstab	stability berm side slope (SSstab:1)
1	ts	timestep (minutes) for breach hydrograph

output variable	results
T	408
(L < T)?	N
H_w	15.55
Q_1	10414
(H_w < 103)?	Y
Awave	0
Astab	0
A	981
Br	1
Q_2	1855
Q_{min}	3051
(Q_2 < Q_{min})?	Y
(Q_2 > Q_1)?	N
(Q_1 < Q_{min})?	N
Q_{max}	**3051**

breach hydrograph time (min)	Q (cfs)
0	0
1	**3051**
2	2787
3	2664
4	2546
5	2434
6	2326
7	2223
8	2125
9	2031
10	1941
11	1855
12	1773
13	1695
14	1620
15	1548
16	1480
17	1414
18	1352
19	1292
20	1235
21	1180
22	1128
23	1078
24	1030
25	985
26	941
27	900
28	860
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30	785
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32	718
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39	523
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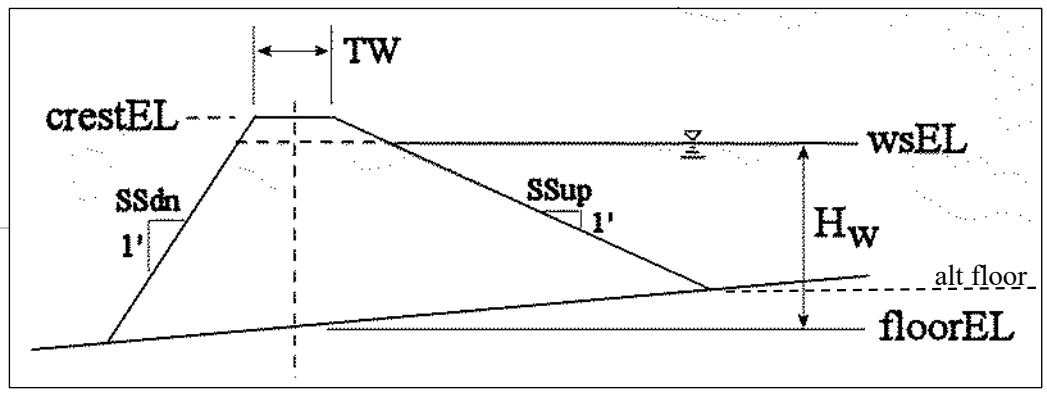

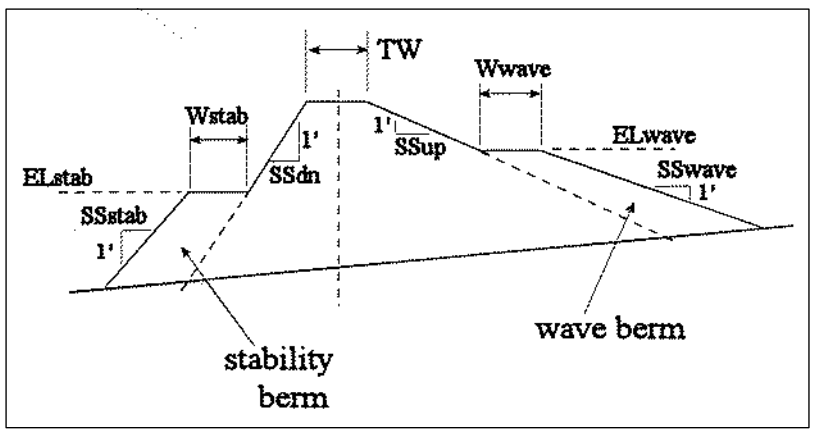

auto-scale hydrograph

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Dambreach Hydrographs via TRs 60 & 66 NRCS guidance

version 3, July 2018

Input data required:

data	variable	explanation
4793	crestEL	dam crest elevation
4784.9	wsEL	w.s. elev at time of breach
14	TW	dam top width (feet)
3	SSup	dam side slope (upstream, SSup:1)
2	SSdn	dam side slope (downstream, SSdn:1)
4733	floorEL	valley floor elev (see note)
299.36	Vs	resv vol at time of breach (acre-feet)
670	L	valley width at dam axis & w.s. elev (feet)
4763	ELwave	top of wave berm elevation
10	Wwave	width of top of wave berm feet
3	SSwave	wave berm side slope (SSwave:1)
4776	ELstab	top of stability berm elevation
10	Wstab	width of top of stability berm (feet)
2	SSstab	stability berm side slope (SSstab:1)
1	ts	timestep (minutes) for breach hydrograph

output variable	results
T	622
(L < T)?	N
H_w	51.9
Q_1	96822
(H_w < 103)?	Y
Awave	300
Astab	430
A	10570
Br	1
Q_2	1850
Q_{min}	62097
(Q_2 < Q_{min})?	Y
(Q_2 > Q_1)?	N
(Q_1 < Q_{min})?	N
Q_{max}	**62097**

breach hydrograph time (min)	Q (cfs)
0	0
1	**62097**
2	35067
3	26352
4	19803
5	14881
6	11183
7	8404
8	6315
9	4746
10	3566
11	2680
12	2014
13	1513
14	1137
15	855
16	642
17	483
18	363
19	273
20	205
21	154
22	116
23	87
24	65
25	49
26	37
27	28
28	21
29	16
30	12
31	9
32	7
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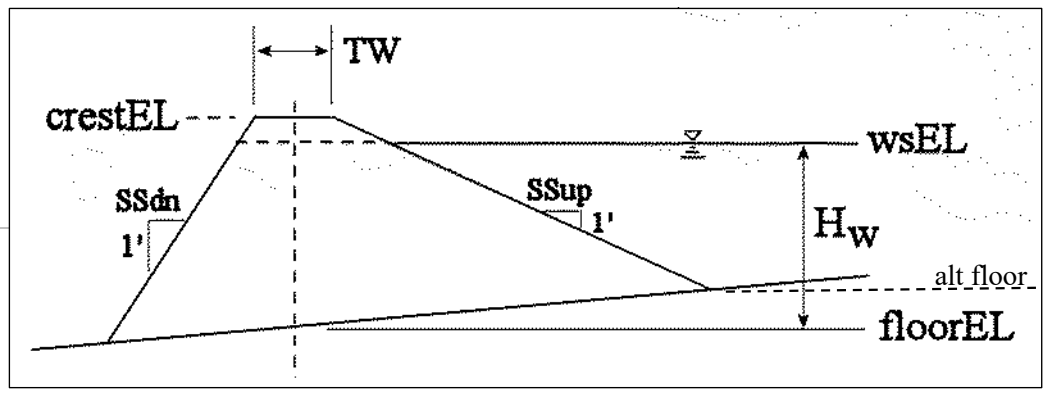
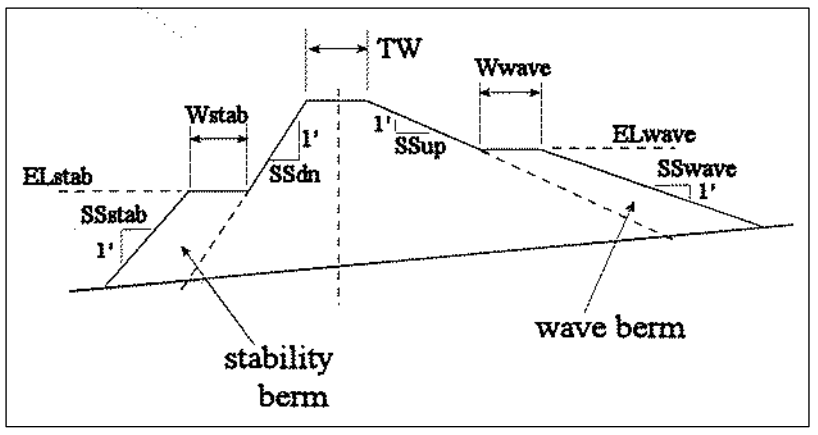
auto-scale hydrograph





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Dambreach Hydrographs via TRs 60 & 66 NRCS guidance

version 3, July 2018

Input data required:

data	variable	explanation
4793	crestEL	dam crest elevation
4798	wsEL	w.s. elev at time of breach
14	TW	dam top width (feet)
3	SSup	dam side slope (upstream, SSup:1)
2	SSdn	dam side slope (downstream, SSdn:1)
4733	floorEL	valley floor elev (see note)
448.83	Vs	resv vol at time of breach (acre-feet)
670	L	valley width at dam axis & w.s. elev (feet)
4763	ELwave	top of wave berm elevation
10	Wwave	width of top of wave berm feet
3	SSwave	wave berm side slope (SSwave:1)
4776	ELstab	top of stability berm elevation
10	Wstab	width of top of stability berm (feet)
2	SSstab	stability berm side slope (SSstab:1)
1	ts	timestep (minutes) for breach hydrograph

output variable	results
T	674
(L < T)?	Y
H_w	65
Q_1	146062
(H_w < 103)?	Y
Awave	300
Astab	430
A	10570
Br	3
Q_2	4331
Q_{min}	109002
(Q_2 < Q_{min})?	Y
(Q_2 > Q_1)?	N
(Q_1 < Q_{min})?	N
Q_{max}	**109002**

breach hydrograph

time (min)	Q (cfs)
0	0
1	**109002**
2	55831
3	39958
4	28597
5	20467
6	14648
7	10483
8	7503
9	5369
10	3843
11	2750
12	1968
13	1409
14	1008
15	722
16	516
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19	189
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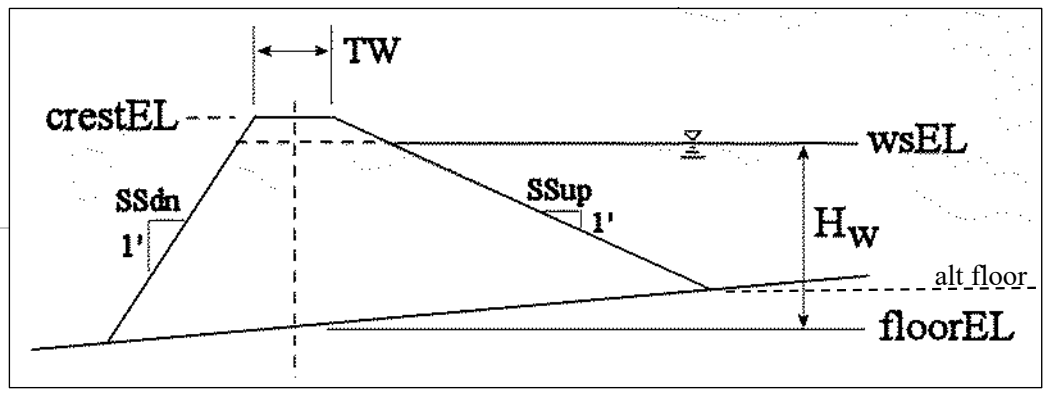

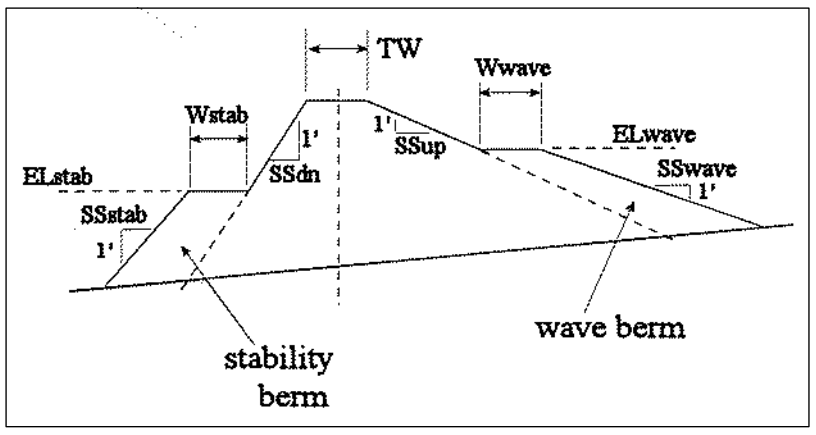

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APPENDIX L: STORM DRAIN SURCHARGED MANHOLES EXHIBITS – EAST WASH AND WEST WASH DAMS IN-PLACE

Both Dams In Place: 10-Year

East Wash Dam

Flood Volume (MG) = 0.1

Flood Volume (MG) = 2.7

West Wash Dam

Flood Volume (MG) = 2.0

Flood Volume (MG) = 1.0

Flood Volume (MG) = 0.01

659

COLEMAN DR

PUTNAM DR

WASHINGTON ST

COLLEGE DR

EVANS AVE

PEAVINE RD

SEVERN DR

PUTNAM DR

KEYSTONE AVE

WYOMING AVE

W 11TH ST

E 9TH ST

W 9TH ST

GEAR ST

KINGS ROW

KEYSTONE AVE

UNIVERSITY TER

RALSTON ST

N VIRGINIA ST

N CENTER ST

E 6TH ST

N SIERRA ST

E 5TH ST

W 6TH ST

E 4TH ST

W 7TH ST

W 5TH ST

W 4TH ST

N ARLINGTON AVE

STOKER AVE

KEYSTONE AVE

VINE ST

WASHINGTON ST

W 2ND ST

W 1ST ST

Outfall

80

80

Legend

Storm Drain Manhole

- No Flooding
- Flooded Manholes
- Outfall
- Storm Drain Pipe/Drainage Channels

N

1 " = 800 '

20 Years!
FARR WEST ENGINEERING
5510 Longley Lane
Reno, NV 89511
(775) 851-4788
www.farrwestengineering.com

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P:\Client Projects\Reno, City of 1461\1930 West Wash Dam\3.0 Studies_Reports\3.8 StormSewerModel\3.8.1 Model\Reno_WestWashDam_Storm.mxd, Editor: djones, Printed: 8/30/2021

Both Dams In Place: 25-Year

East Wash Dam

Flood Volume (MG) = 0.2

Flood Volume (MG) = 3.4

West Wash Dam

Flood Volume (MG) = 2.5

Flood Volume (MG) = 1.2

Flood Volume (MG) = 1.1

659

COLEMAN DR

PUTNAM DR

WASHINGTON ST

COLLEGE DR

EVANS AVE

PEAVINE RD

SEVERN DR

PUTNAM DR

KEYSTONE AVE

ALTA ST

W 11TH ST

E 9TH ST

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WYOMING AVE

GEAR ST

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KEYSTONE AVE

WASHINGTON ST

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RALSTON ST

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W 4TH ST

N ARLINGTON AVE

STOKER AVE

KEYSTONE AVE

VINE ST

WASHINGTON ST

W 2ND ST

W 1ST ST

Outfall

80

80

Legend

Storm Drain Manhole

- No Flooding
- Flooded Manholes
- Outfall
- Storm Drain Pipe/Drainage Channels

N

1 " = 800 '

20 Years!
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Reno, NV 89511
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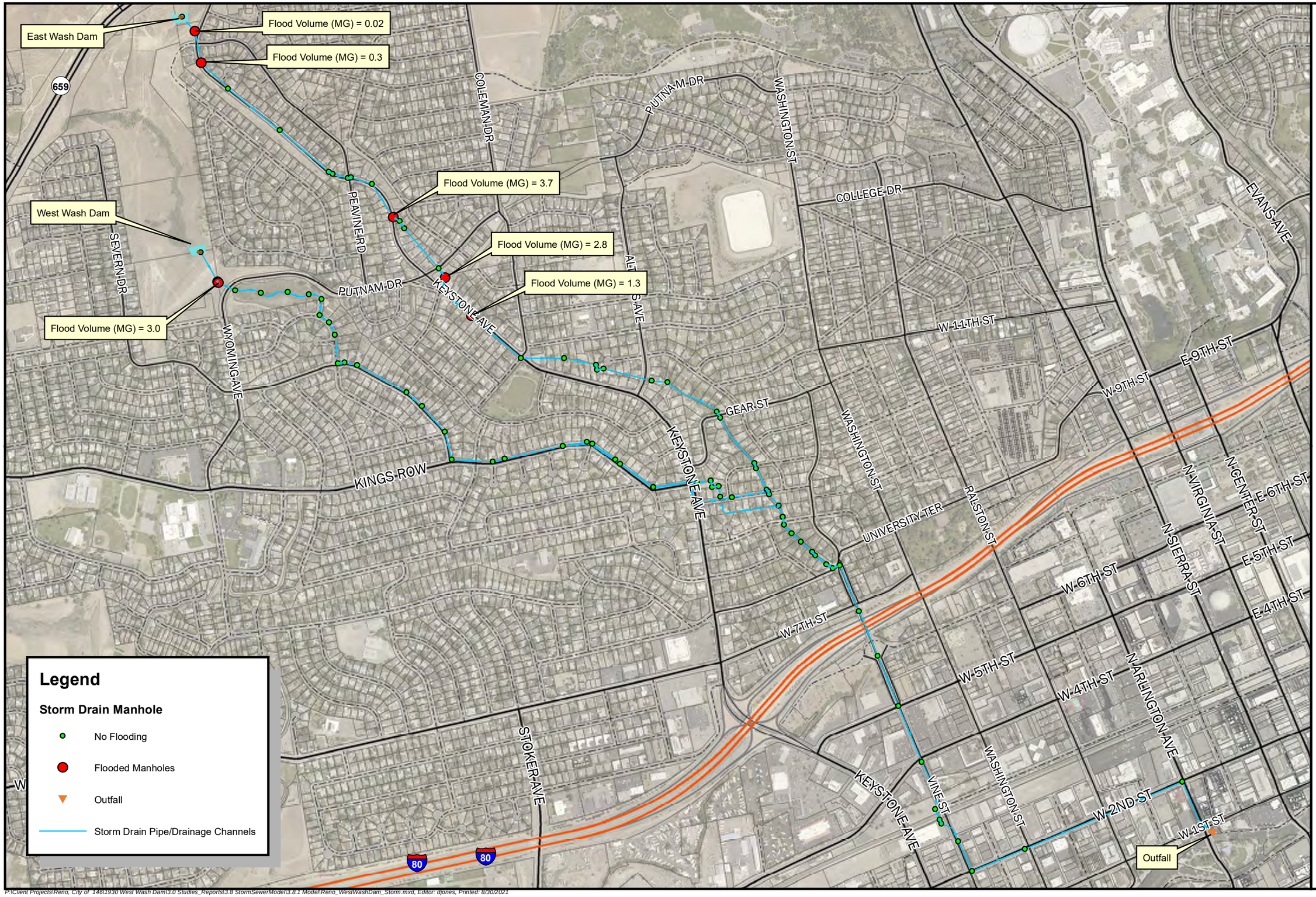
P:\Client Projects\Reno, City of 1461\1930 West Wash Dam\3.0 Studies_Reports\3.8 StormSewerModel\3.8.1 Model\Reno_WestWashDam_Storm.mxd, Editor: djones, Printed: 8/30/2021



Legend

Storm Drain Manhole

- No Flooding
- Flooded Manholes
- Outfall
- Storm Drain Pipe/Drainage Channels

Both Dams In Place: 50-Year

20 Years!
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N

1 " = 800 '

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P:\Client Projects\Reno, City of 1461\1930 West Wash Dam\3.0 Studies_Reports\3.8 StormSewerModel\3.8.1 Model\Reno_WestWashDam_Storm.mxd, Editor: djones, Printed: 8/30/2021

East Wash Dam

Flood Volume (MG) = 0.1

Flood Volume (MG) = 0.4

Flood Volume (MG) = 4.0

West Wash Dam

Flood Volume (MG) = 2.9

Flood Volume (MG) = 1.4

Flood Volume (MG) = 5.9

Outfall

659

COLEMAN DR

PUTNAM DR

WASHINGTON ST

COLLEGE DR

EVANS AVE

PEAVINE RD

SEVERN DR

PUTNAM DR

KEYSTONE AVE

WYOMING AVE

W 11TH ST

E 9TH ST

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GEAR ST

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N ARLINGTON AVE

STOKER AVE

KEYSTONE AVE

VINE ST

WASHINGTON ST

W 2ND ST

W 1ST ST

80

80

Legend

Storm Drain Manhole

- No Flooding
- Flooded Manholes
- Outfall
- Storm Drain Pipe/Drainage Channels

Both Dams In Place: 100-Year

20 Years!
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N

1 " = 800 '

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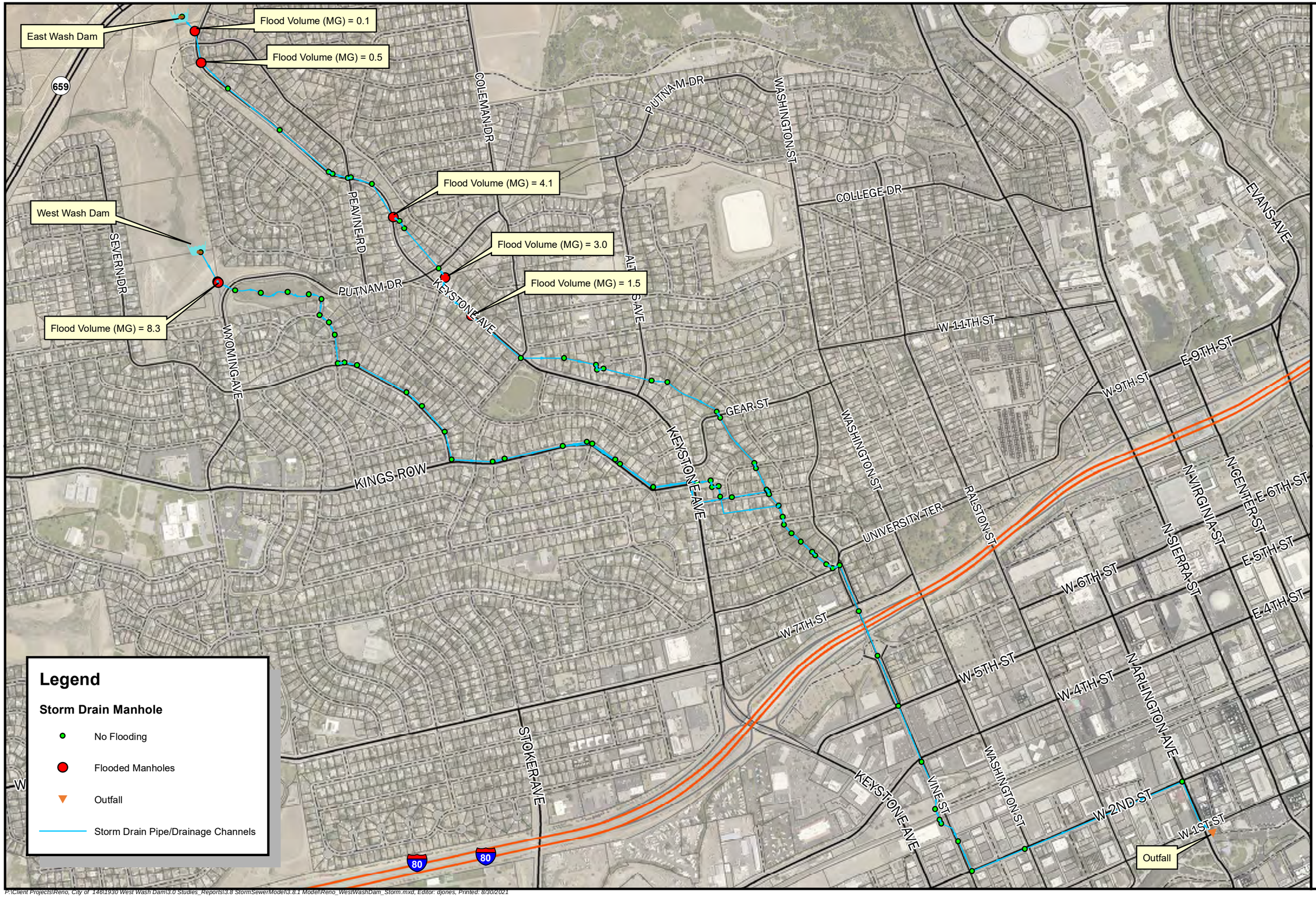
P:\Client Projects\Reno, City of 1461\1930 West Wash Dam\3.0 Studies_Reports\3.8 StormSewerModel\3.8.1 Model\Reno_WestWashDam_Storm.mxd, Editor: djones, Printed: 8/30/2021



20 Years!
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Both Dams In Place: 200-Year

N

1 " = 800 '

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P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.8 StormSewerModel\3.8.1 Model\Reno_WestWashDam_Storm.mxd, Editor: djones, Printed: 8/30/2021

East Wash Dam

Flood Volume (MG) = 0.2

Flood Volume (MG) = 0.5

Flood Volume (MG) = 4.3

West Wash Dam

Flood Volume (MG) = 3.2

Flood Volume (MG) = 1.5

Flood Volume (MG) = 9.5

Outfall

659

COLEMAN DR

PUTNAM DR

WASHINGTON ST

COLLEGE DR

EVANS AVE

PEAVINE RD

SEVERN DR

PUTNAM DR

KEYSTONE AVE

ALTA ST

W 11TH ST

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KEYSTONE AVE

VINE ST

WASHINGTON ST

W 2ND ST

W 1ST ST

80

80

Legend

Storm Drain Manhole

- No Flooding
- Flooded Manholes
- Outfall
- Storm Drain Pipe/Drainage Channels

Both Dams In Place: 500-Year

20 Years!
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N

1 " = 800 '

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P:\Client Projects\Reno, City of 1461\1930 West Wash Dam\3.0 Studies_Reports\3.8 StormSewerModel\3.8.1 Model\Reno_WestWashDam_Storm.mxd, Editor: djones, Printed: 8/30/2021

East Wash Dam

Flood Volume (MG) = 0.2

Flood Volume (MG) = 0.5

Flood Volume (MG) = 4.3

West Wash Dam

Flood Volume (MG) = 3.2

Flood Volume (MG) = 1.5

Flood Volume (MG) = 9.7

659

COLEMAN DR

PUTNAM DR

WASHINGTON ST

COLLEGE DR

EVANS AVE

PEAVINE RD

SEVERN DR

PUTNAM DR

KEYSTONE AVE

WYOMING AVE

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STOKER AVE

KEYSTONE AVE

VINE ST

WASHINGTON ST

W 2ND ST

W 1ST ST

Outfall

80

80

Legend

Storm Drain Manhole

- No Flooding
- Flooded Manholes
- Outfall
- Storm Drain Pipe/Drainage Channels

Both Dams In Place: 1000-Year

20 Years!
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1 " = 800 '

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P:\Client Projects\Reno, City of 1461\1930 West Wash Dam\3.0 Studies_Reports\3.3 Appendix\TM2\MH Surcharge Maps\Dams in place\1000-year.mxd, Editor: djones, Printed: 8/31/2021

Both Dams In Place: 1/2 General PMP

East Wash Dam

Flood Volume (MG) = 0.03

Flood Volume (MG) = 0.4

Flood Volume (MG) = 3.8

West Wash Dam

Flood Volume (MG) = 2.8

Flood Volume (MG) = 1.3

Flood Volume (MG) = 3.4

Outfall

659

COLEMAN DR

PUTNAM DR

WASHINGTON ST

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Legend

Storm Drain Manhole

- No Flooding
- Flooded Manholes
- Outfall
- Storm Drain Pipe/Drainage Channels

20 Years!
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1 " = 800 '

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Both Dams In Place: 3/4 General PMP

East Wash Dam

Flood Volume (MG) = 0.1

Flood Volume (MG) = 0.5

Flood Volume (MG) = 4.2

West Wash Dam

Flood Volume (MG) = 3.1

Flood Volume (MG) = 1.5

Flood Volume (MG) = 9.3

Outfall

659

COLEMAN DR

PUTNAM DR

WASHINGTON ST

COLLEGE DR

EVANS AVE

PEAVINE RD

SEVERN DR

PUTNAM DR

KEYSTONE AVE

WYOMING AVE

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N ARLINGTON AVE

STOKER AVE

KEYSTONE AVE

VINE ST

WASHINGTON ST

W 2ND ST

W 1ST ST

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80

Legend

Storm Drain Manhole

- No Flooding
- Flooded Manholes
- Outfall
- Storm Drain Pipe/Drainage Channels

20 Years! FARR WEST ENGINEERING

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N

1 " = 800 '

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Both Dams In Place: Full General PMP

East Wash Dam

Flood Volume (MG) = 0.2

Flood Volume (MG) = 0.6

West Wash Dam

Flood Volume (MG) = 4.4

Flood Volume (MG) = 3.2

Flood Volume (MG) = 1.5

Flood Volume (MG) = 12.7

Outfall

659

COLEMAN DR

PUTNAM DR

WASHINGTON ST

COLLEGE DR

EVANS AVE

PEAVINE RD

SEVERN DR

PUTNAM DR

KEYSTONE AVE

WYOMING AVE

W 11TH ST

E 9TH ST

W 9TH ST

GEAR ST

KINGS ROW

KEYSTONE AVE

UNIVERSITY TER

RALSTON ST

N VIRGINIA ST

N CENTER ST

E 6TH ST

N SIERRA ST

E 5TH ST

W 6TH ST

E 4TH ST

W 7TH ST

W 5TH ST

W 4TH ST

N ARLINGTON AVE

STOKER AVE

KEYSTONE AVE

VINE ST

WASHINGTON ST

W 2ND ST

W 1ST ST

80

80

Legend

Storm Drain Manhole

- No Flooding
- Flooded Manholes
- Outfall
- Storm Drain Pipe/Drainage Channels

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1 " = 800 '

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Both Dams In Place: 1/2 Local PMP

N

1 " = 800 '

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P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.8 StormSewerModel\3.8.1 Model\Reno_WestWashDam_Storm.mxd, Editor: djones, Printed: 8/31/2021

Both Dams In Place: 3/4 Local PMP

East Wash Dam

Flood Volume (MG) = 0.4

Flood Volume (MG) = 0.7

Flood Volume (MG) = 4.7

West Wash Dam

Flood Volume (MG) = 3.5

Flood Volume (MG) = 1.7

Flood Volume (MG) = 18.1

Outfall

659

COLEMAN DR

PUTNAM DR

WASHINGTON ST

COLLEGE DR

EVANS AVE

PEAVINE RD

SEVERN DR

PUTNAM DR

KEYSTONE AVE

ALTA VISTA AVE

W 11TH ST

E 9TH ST

W 9TH ST

WYOMING AVE

GEAR ST

KINGS ROW

KEYSTONE AVE

WASHINGTON ST

UNIVERSITY TER

RALSTON ST

N VIRGINIA ST

N CENTER ST

E 6TH ST

N SIERRA ST

W 6TH ST

E 5TH ST

W 7TH ST

E 4TH ST

W 5TH ST

W 4TH ST

N ARLINGTON AVE

STOKER AVE

KEYSTONE AVE

VINE ST

WASHINGTON ST

W 2ND ST

W 1ST ST

80

80

Legend

Storm Drain Manhole

- No Flooding
- Flooded Manhole
- Outfall
- Storm Drain Pipe/Drainage Channels

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N

1 " = 800 '

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P:\Client Projects\Reno, City of 1461\1930 West Wash Dam\3.0 Studies_Reports\3.8 StormSewerModel\3.8.1 Model\Reno_WestWashDam_Storm.mxd, Editor: djones, Printed: 8/31/2021

Both Dams In Place: Full Local PMP

East Wash Dam

West Wash Dam

Flood Volume (MG) = 0.5

Flood Volume (MG) = 0.8

Flood Volume (MG) = 0.001

Flood Volume (MG) = 5.0

Flood Volume (MG) = 3.7

Flood Volume (MG) = 1.7

Flood Volume (MG) = 20.4

Outfall

659

PEAVINE RD

SEVERN DR

WYOMING AVE

PUTNAM DR

KEYSTONE AVE

KINGS ROW

GEAR ST

COLLEGE DR

WASHINGTON ST

UNIVERSITY TER

RALSTON ST

EVANS AVE

W 11TH ST

E 9TH ST

W 9TH ST

N VIRGINIA ST

N CENTER ST

E 6TH ST

N SIERRA ST

E 5TH ST

W 6TH ST

E 4TH ST

W 7TH ST

W 5TH ST

W 4TH ST

N ARLINGTON AVE

STOKER AVE

VINE ST

W 2ND ST

W 1ST ST

80

Legend

Storm Drain Manhole

- No Flooding
- Flooded Manholes
- Outfall
- Storm Drain Pipe/Drainage Channels

20 Years! FARR WEST ENGINEERING

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N

1 " = 800 '

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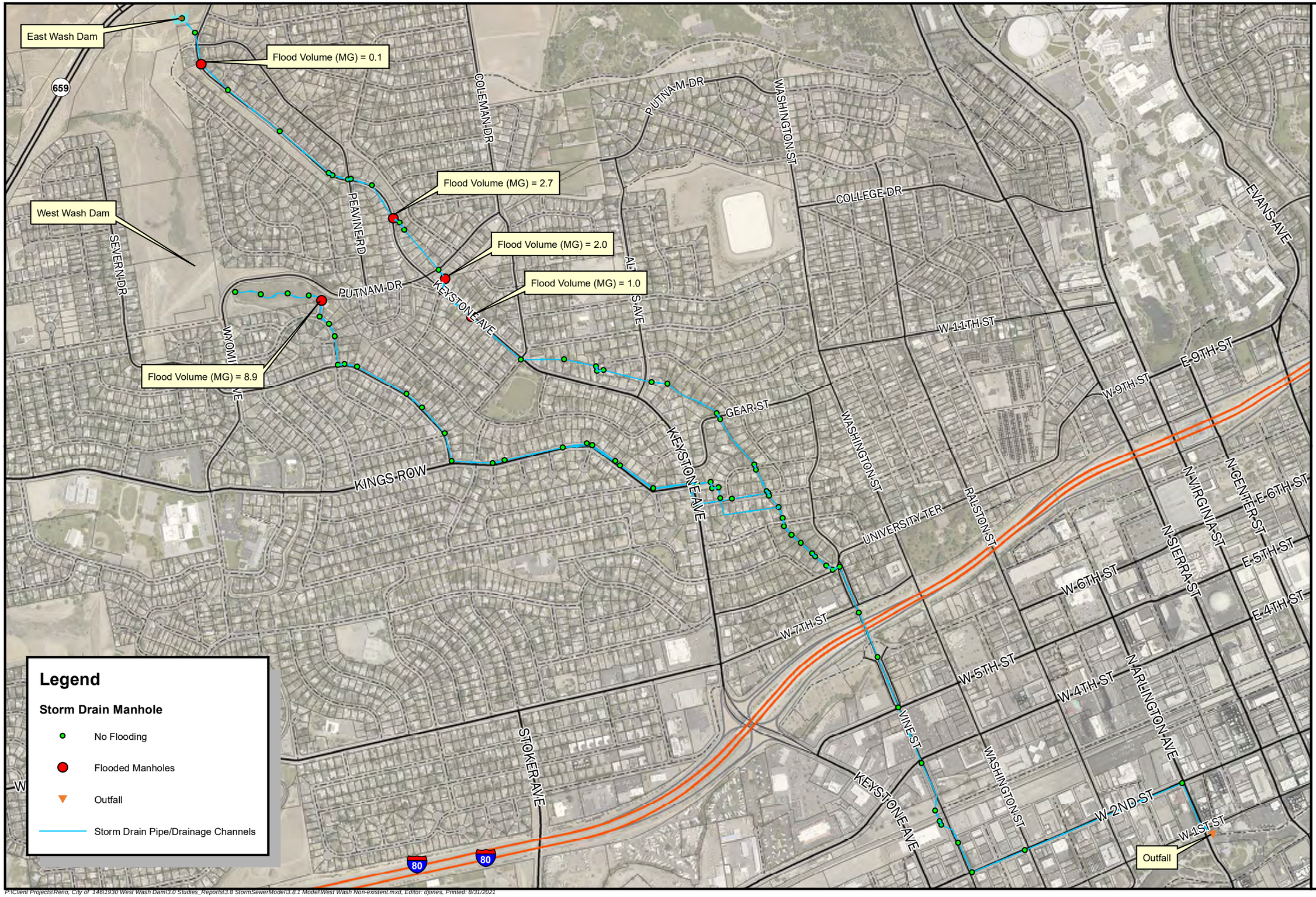
APPENDIX M: STORM DRAIN SURCHARGED MANHOLES EXHIBITS – WEST WASH DAM NON-EXISTENT



20 Years!
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West Wash Non-Existent: 10-Year

N

1 " = 800 '

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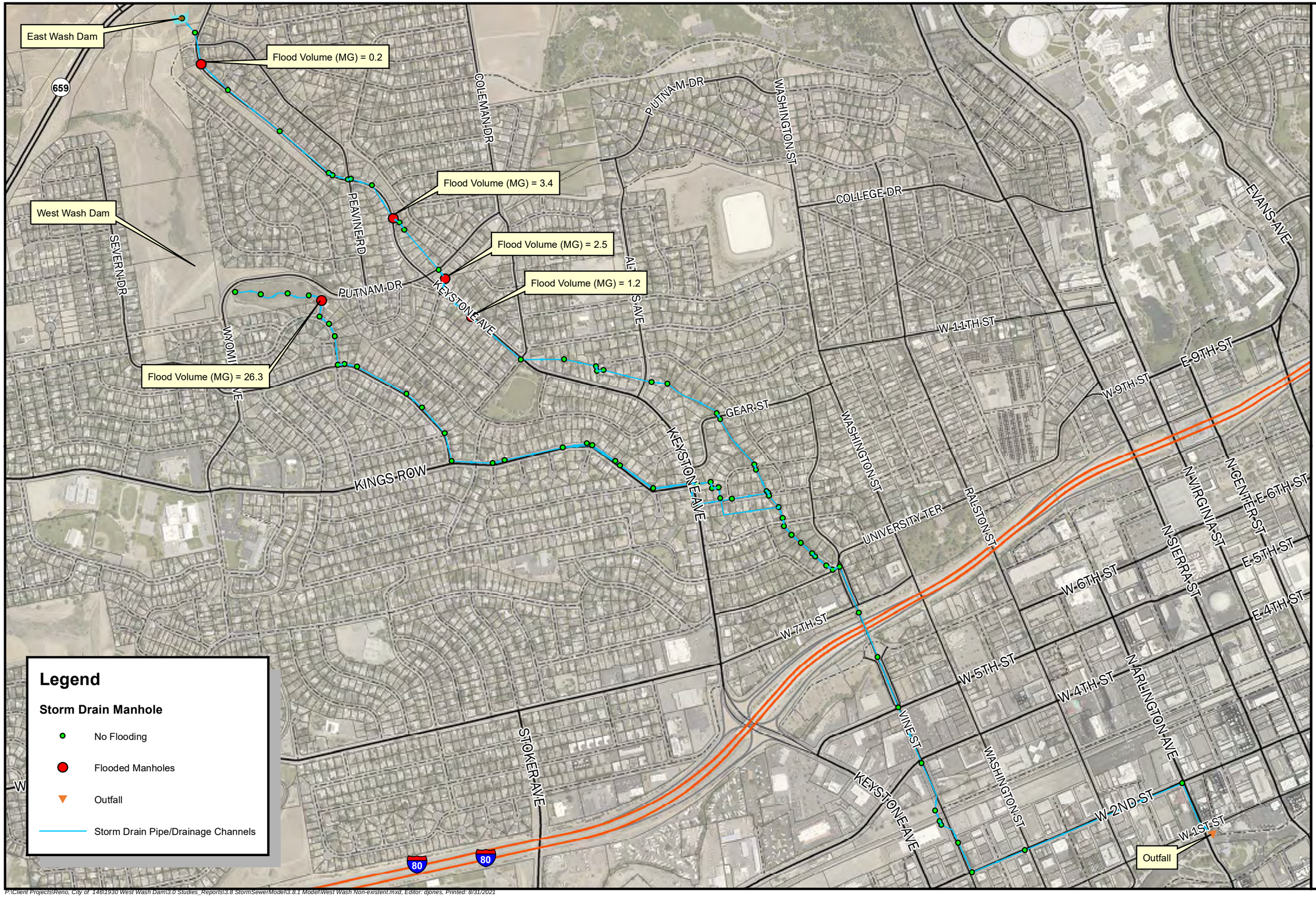
P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.8 StormSewerModel\3.8.1 Model\West Wash Non-existent.mxd, Editor: djones, Printed: 8/31/2021



Legend

Storm Drain Manhole

- No Flooding
- Flooded Manholes
- Outfall
- Storm Drain Pipe/Drainage Channels

West Wash Non-Existent: 25-Year

20 Years! FARR WEST ENGINEERING
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N

1 " = 800 '

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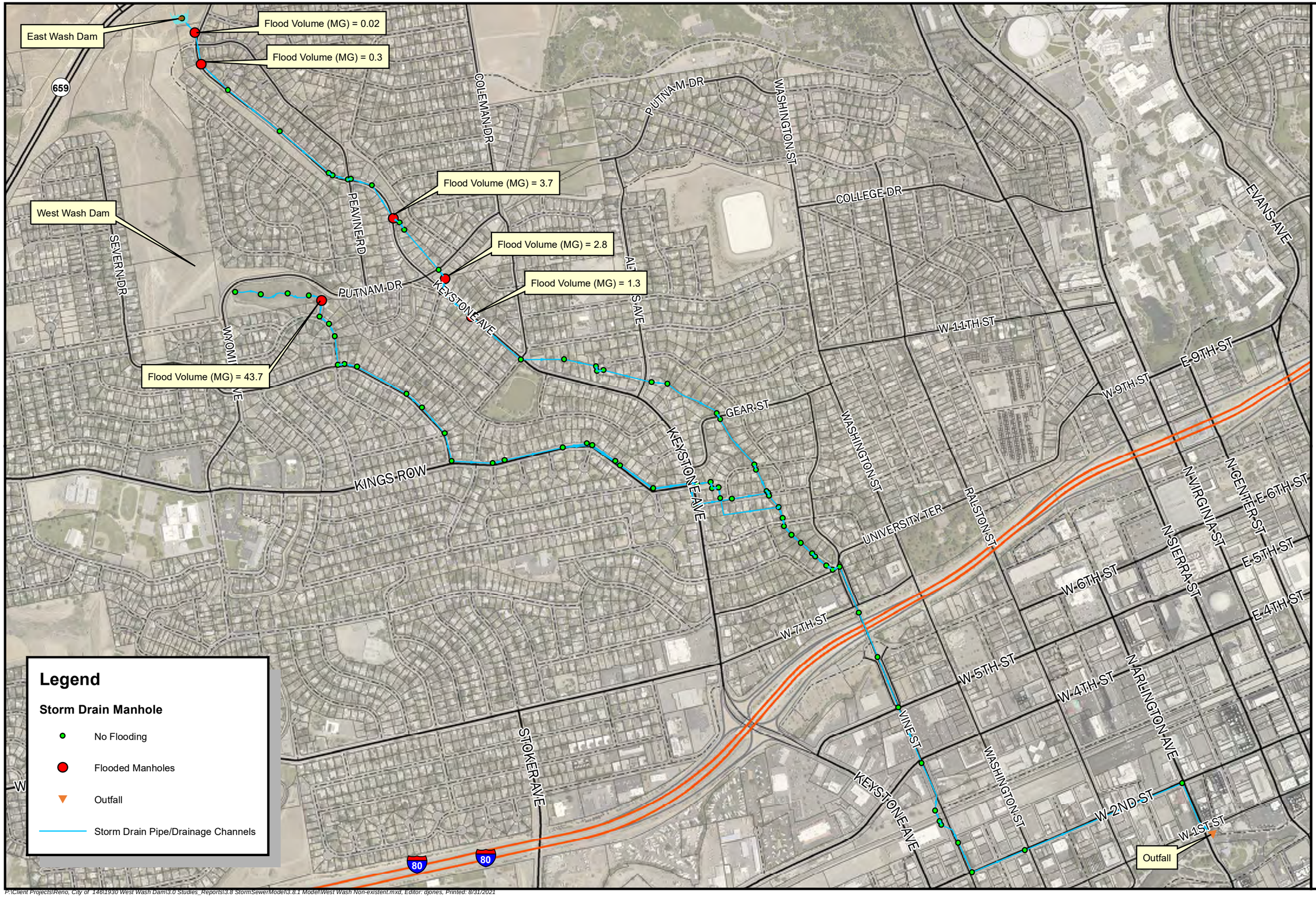
P:\Client Projects\Reno, City of 1461\1930 West Wash Dam\3.0 Studies_Reports\3.8 StormSewerModel\3.8.1 Model\West Wash Non-existent.mxd, Editor: djones, Printed: 8/31/2021



West Wash Non-Existent: 50-Year

20 Years!
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N

1 " = 800 '

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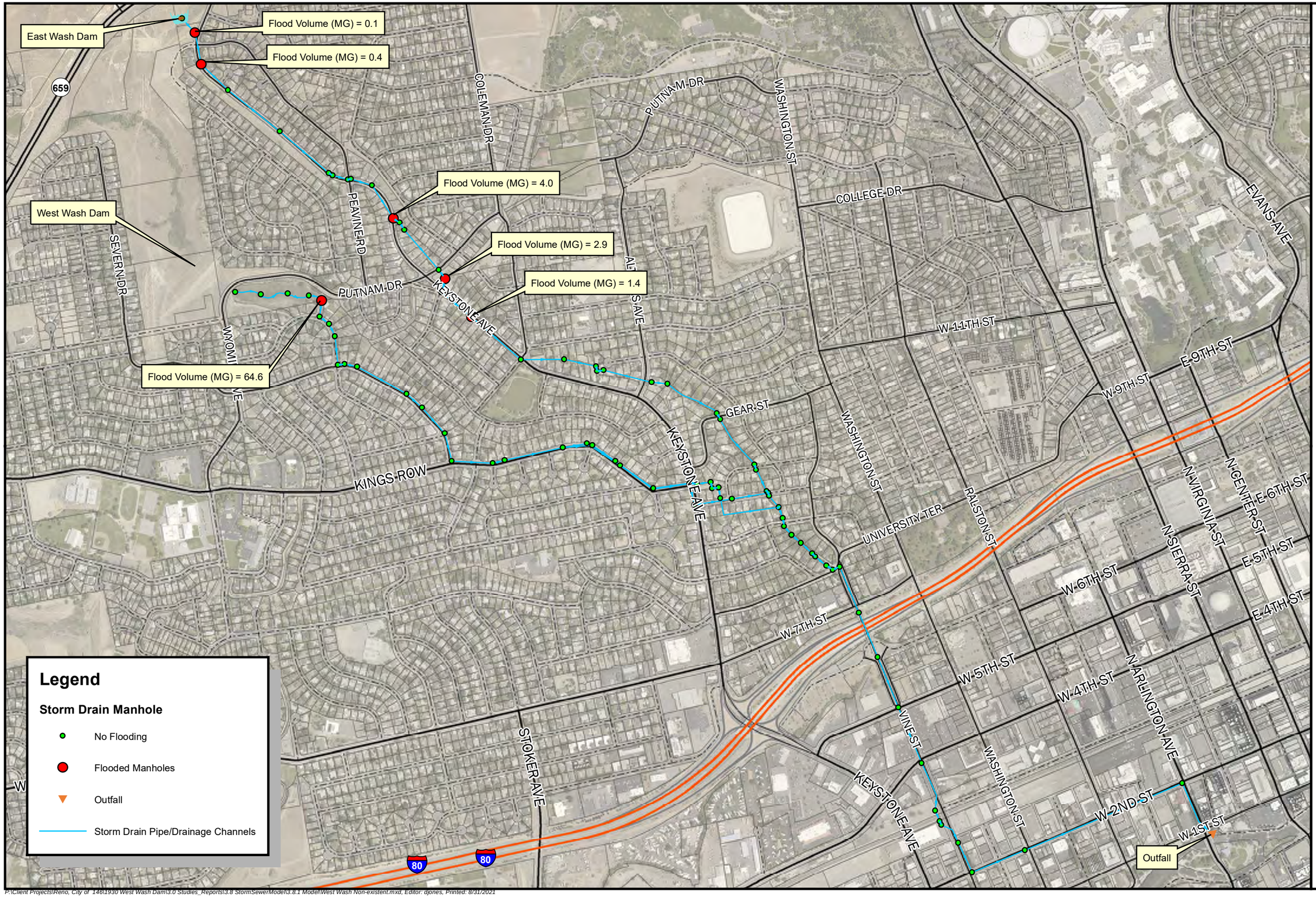
P:\Client Projects\Reno, City of 1461\1930 West Wash Dam\3.0 Studies_Reports\3.8 StormSewerModel\3.8.1 Model\West Wash Non-existent.mxd, Editor: djones, Printed: 8/31/2021



West Wash Non-Existent: 100-Year

20 Years!
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N

1 " = 800 '

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20 Years!
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West Wash Non-Existent: 200-Year

N

1 " = 800 '

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20 Years!
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West Wash Non-Existent: 500-Year

N

1 " = 800 '

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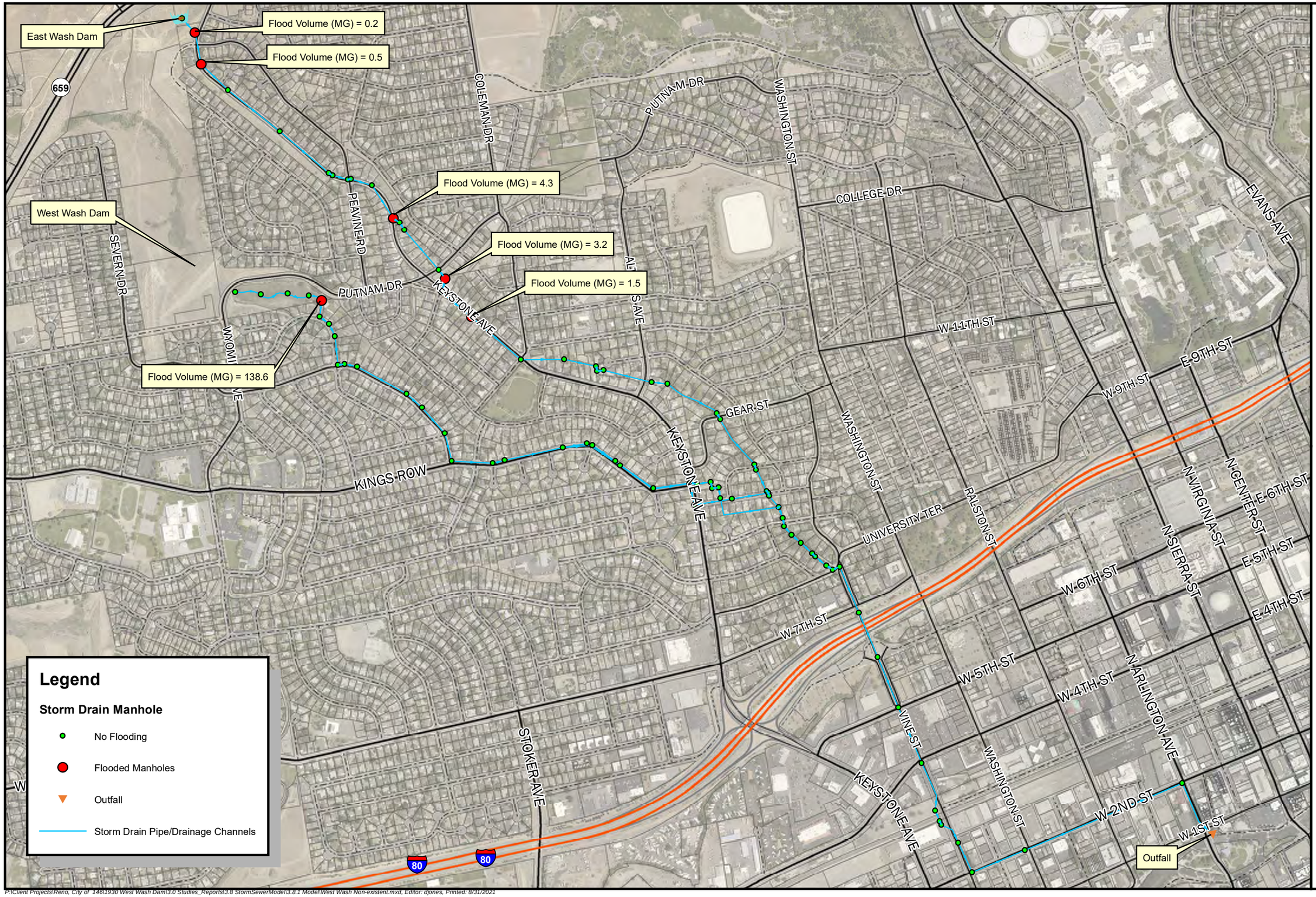

West Wash Non-Existent: 1000-Year

20 Years!
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N

1 " = 800 '

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20 Years!
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West Wash Non-Existent: 1/2 General PMP

N

1 " = 800 '

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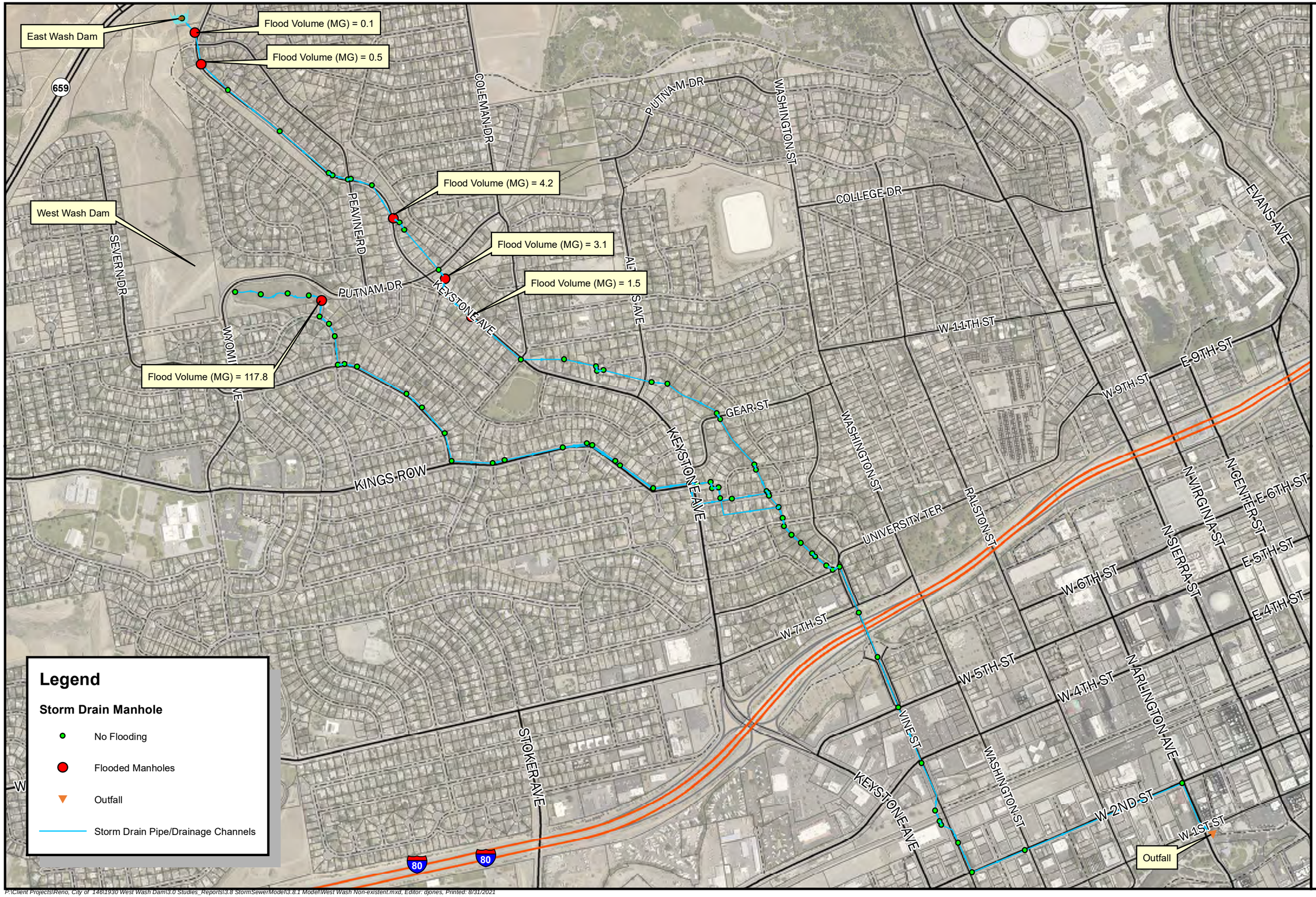

West Wash Non-Existent: 3/4 General PMP

20 Years! FARR WEST ENGINEERING
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N

1 " = 800 '

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20 Years!
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West Wash Non-Existent: Full General PMP

N

1 " = 800 '

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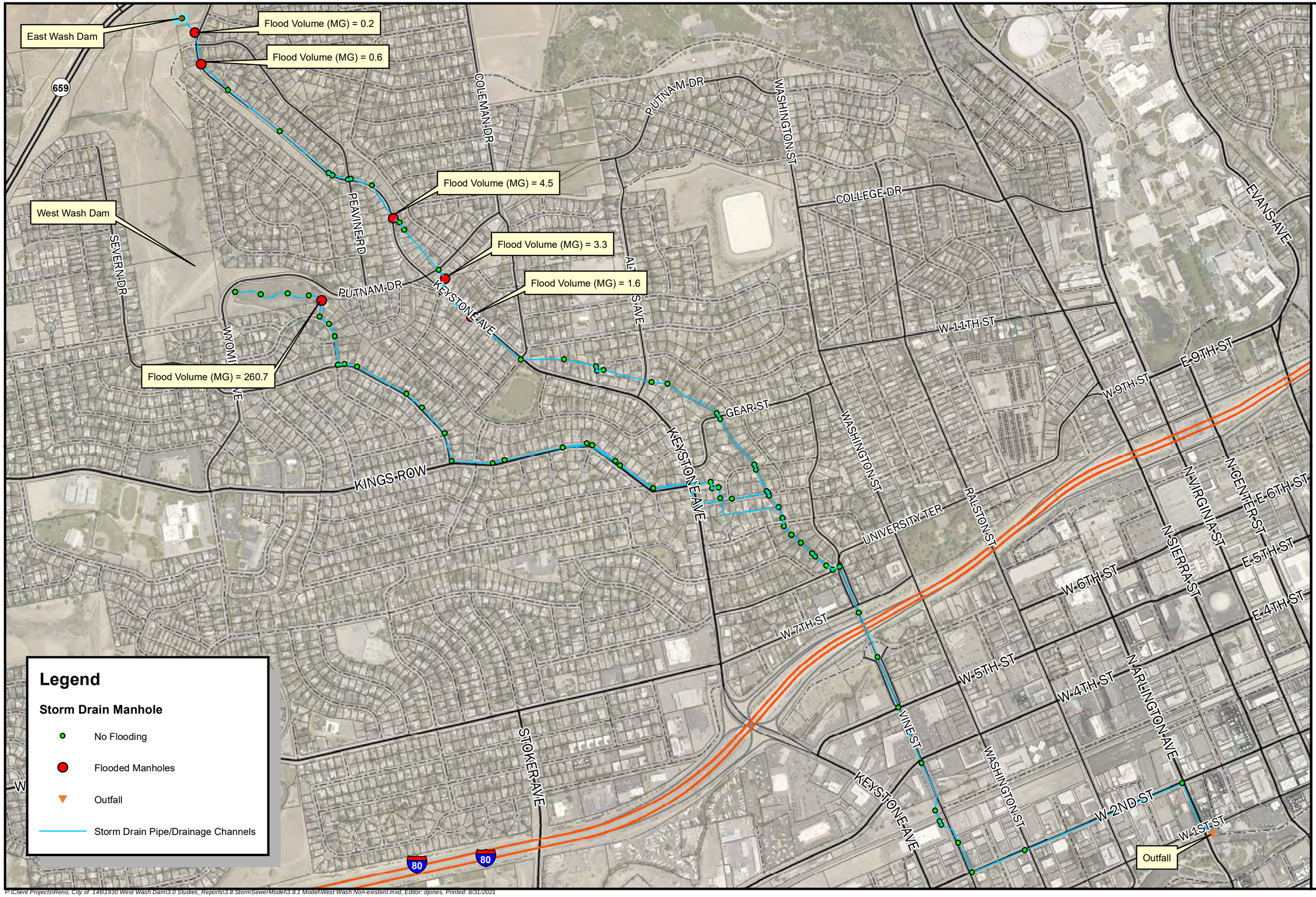

West Wash Non-Existent: 1/2 Local PMP

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N

1 " = 800 '

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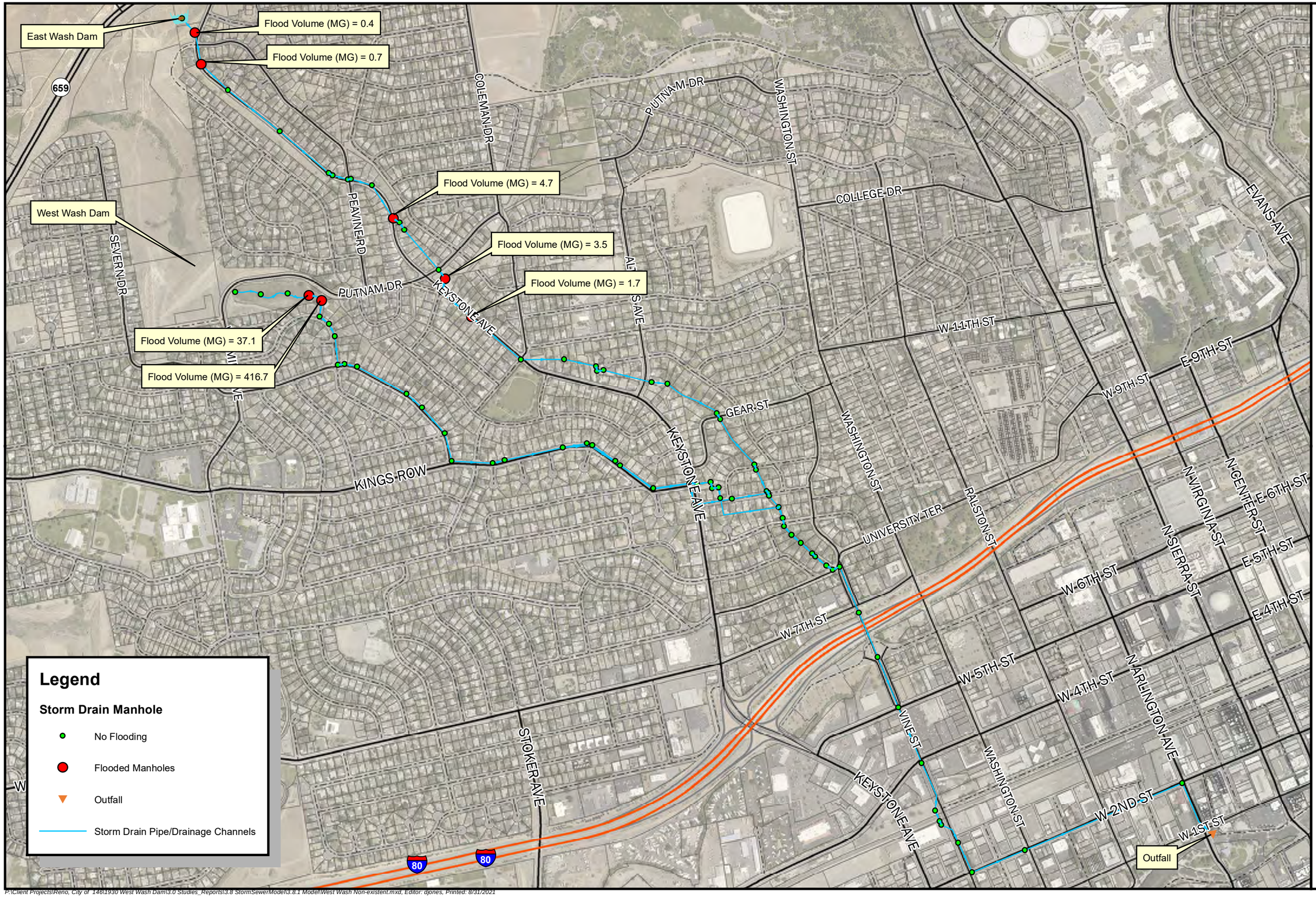

20 Years!
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West Wash Non-Existent: 3/4 Local PMP

N

1 " = 800 '

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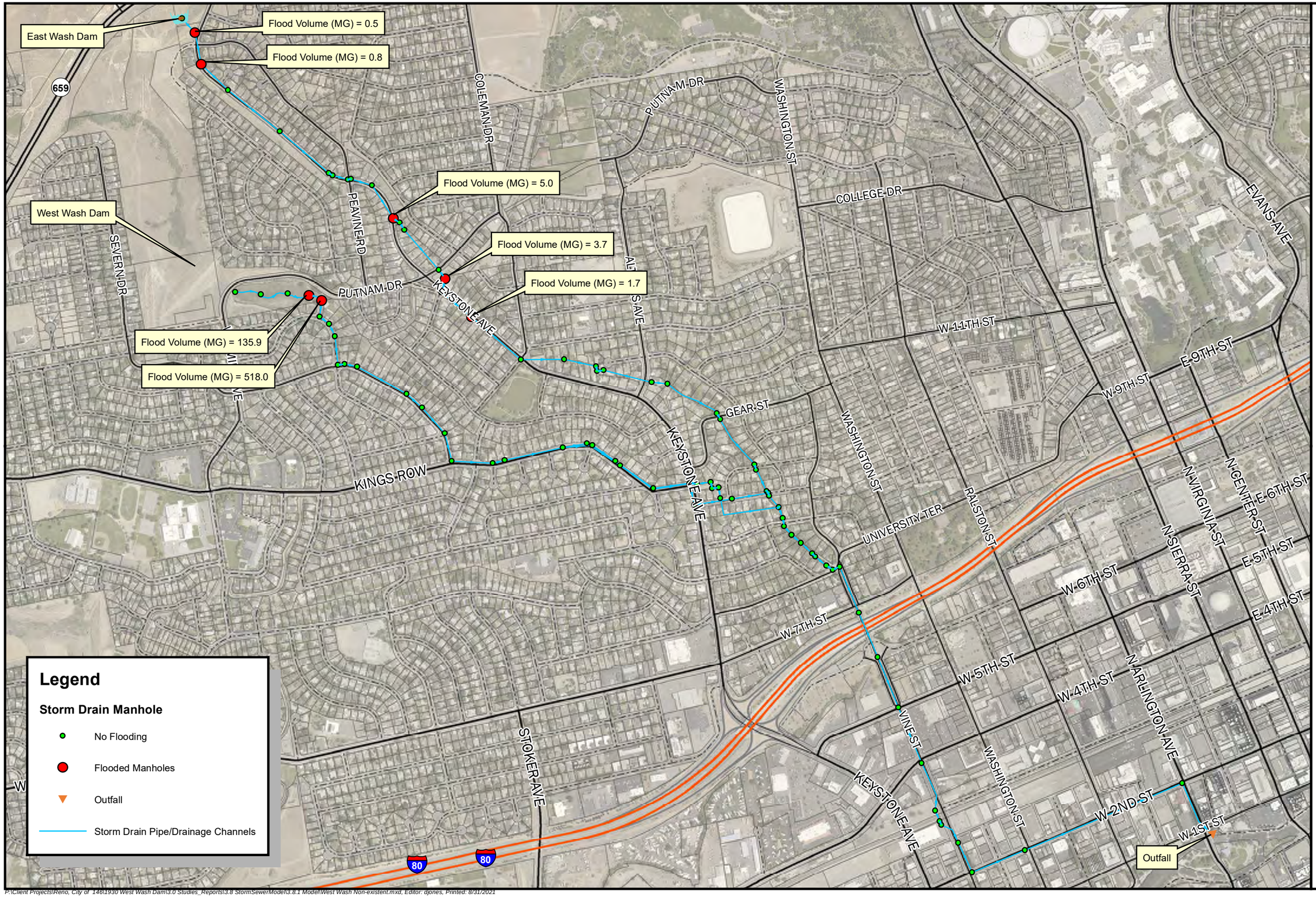

West Wash Non-Existent: Full Local PMP

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N

1 " = 800 '

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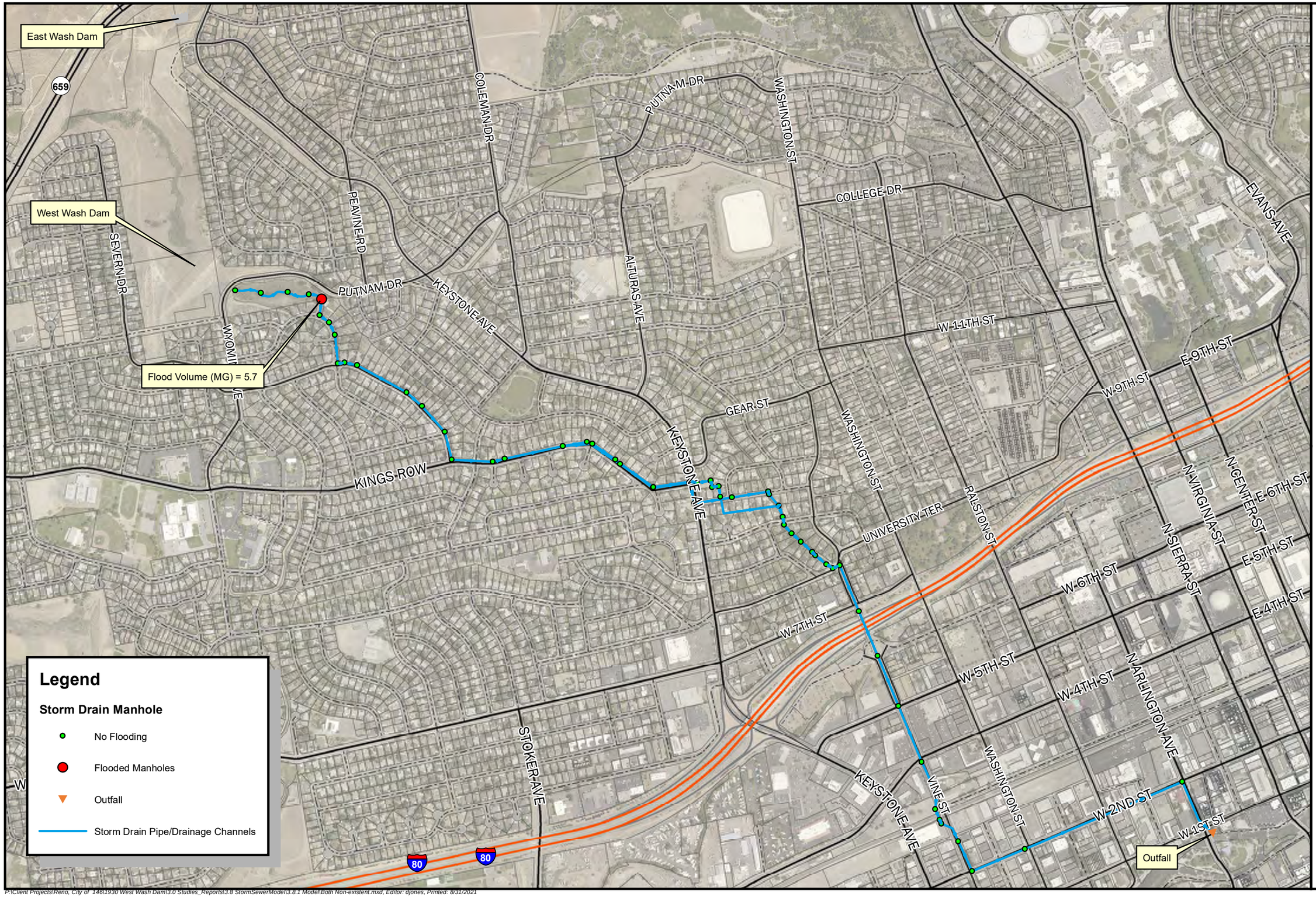
APPENDIX N: STORM DRAIN SURCHARGED MANHOLES EXHIBITS – EAST WASH AND WEST WASH DAMS NON-EXISTENT



Both Dams Non-Existent: 10-Year

20 Years!
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N

1 " = 800 '

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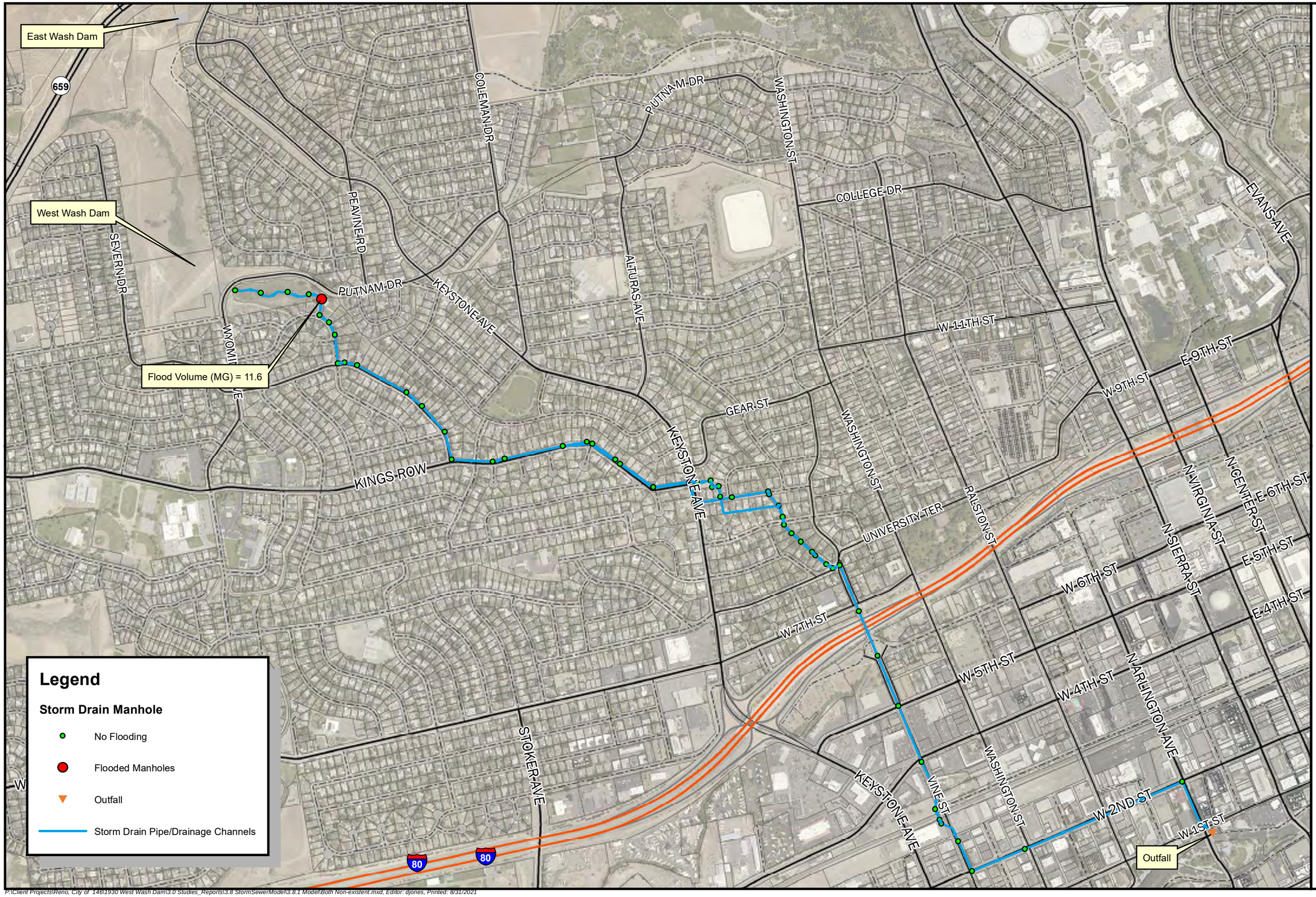
P:\Client Projects\Reno, City of 1461\1930 West Wash Dam\3.0 Studies_Reports\3.8 StormSewerModel\3.8.1 Model\Both Non-existent.mxd, Editor: djones, Printed: 8/31/2021



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Both Dams Non-Existent: 25-Year

N

1 " = 800 '

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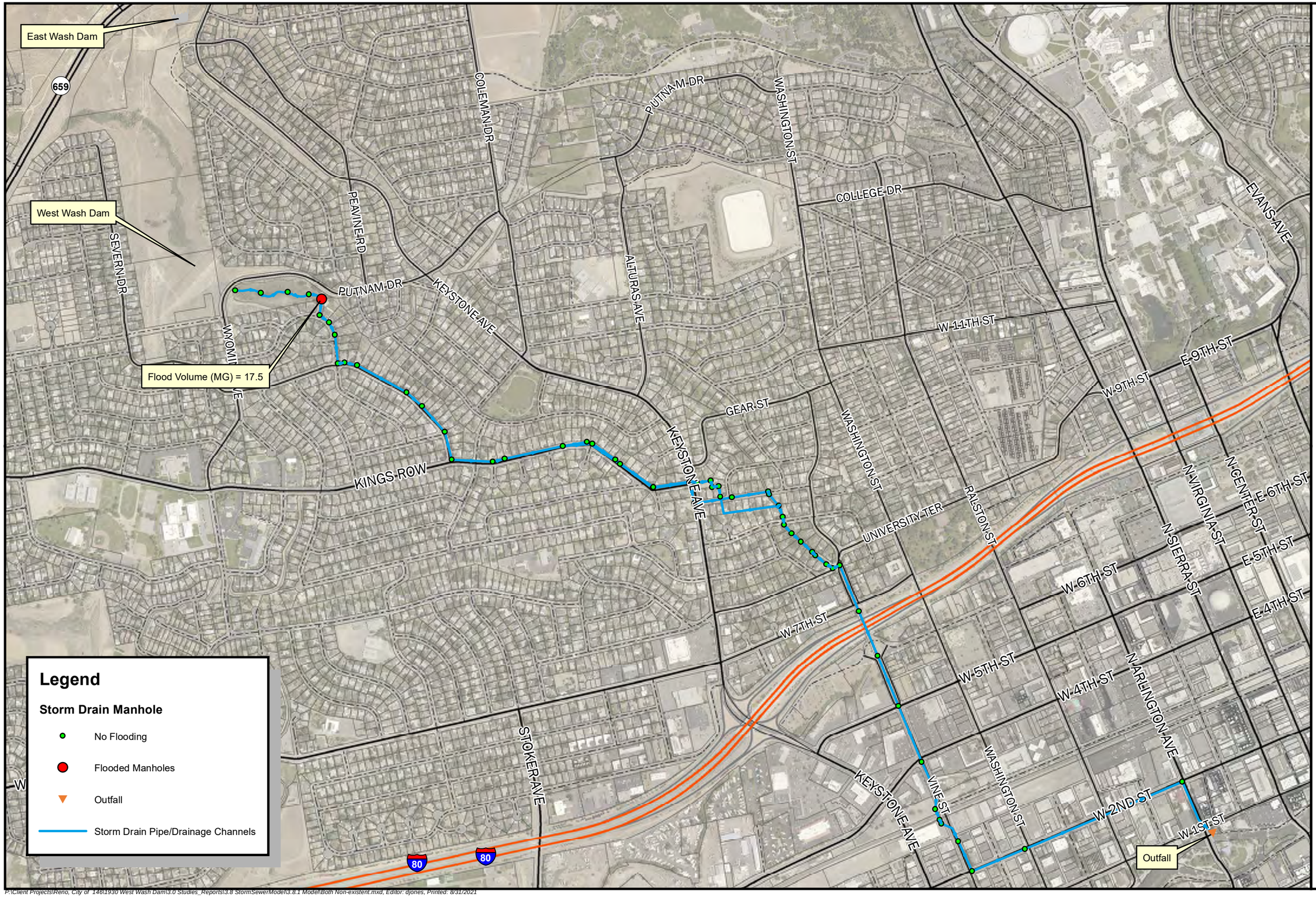
P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.8 StormSewerModel\3.8.1 Model\Both Non-existent.mxd, Editor: djones, Printed: 8/31/2021



20 Years! FARR WEST ENGINEERING

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Both Dams Non-Existent: 50-Year

N

1 " = 800 '

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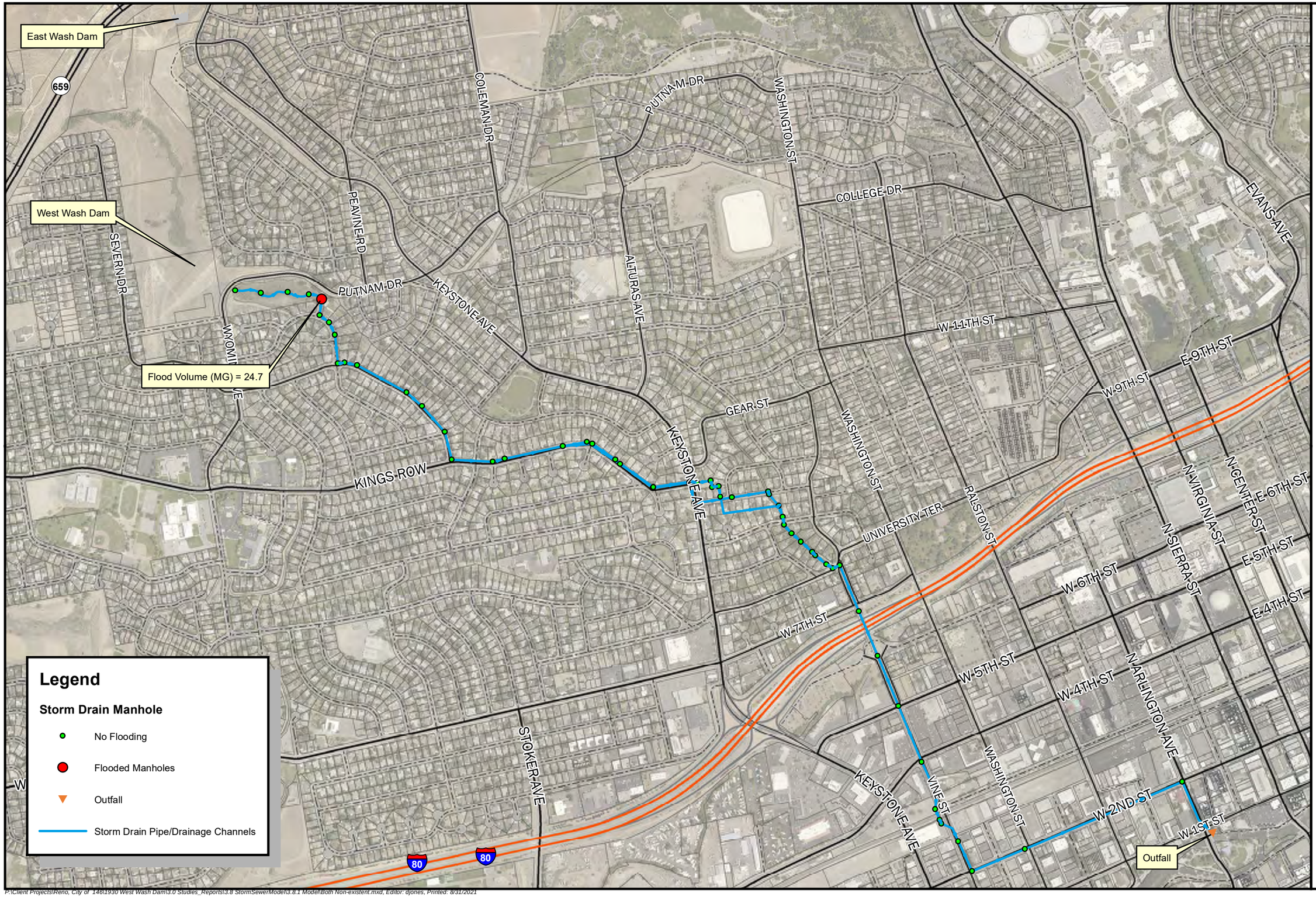
P:\Client Projects\Reno, City of 1461\1930 West Wash Dam\3.0 Studies_Reports\3.8 StormSewerModel\3.8.1 Model\Both Non-existent.mxd, Editor: djones, Printed: 8/31/2021



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Both Dams Non-Existent: 100-Year

N

1 " = 800 '

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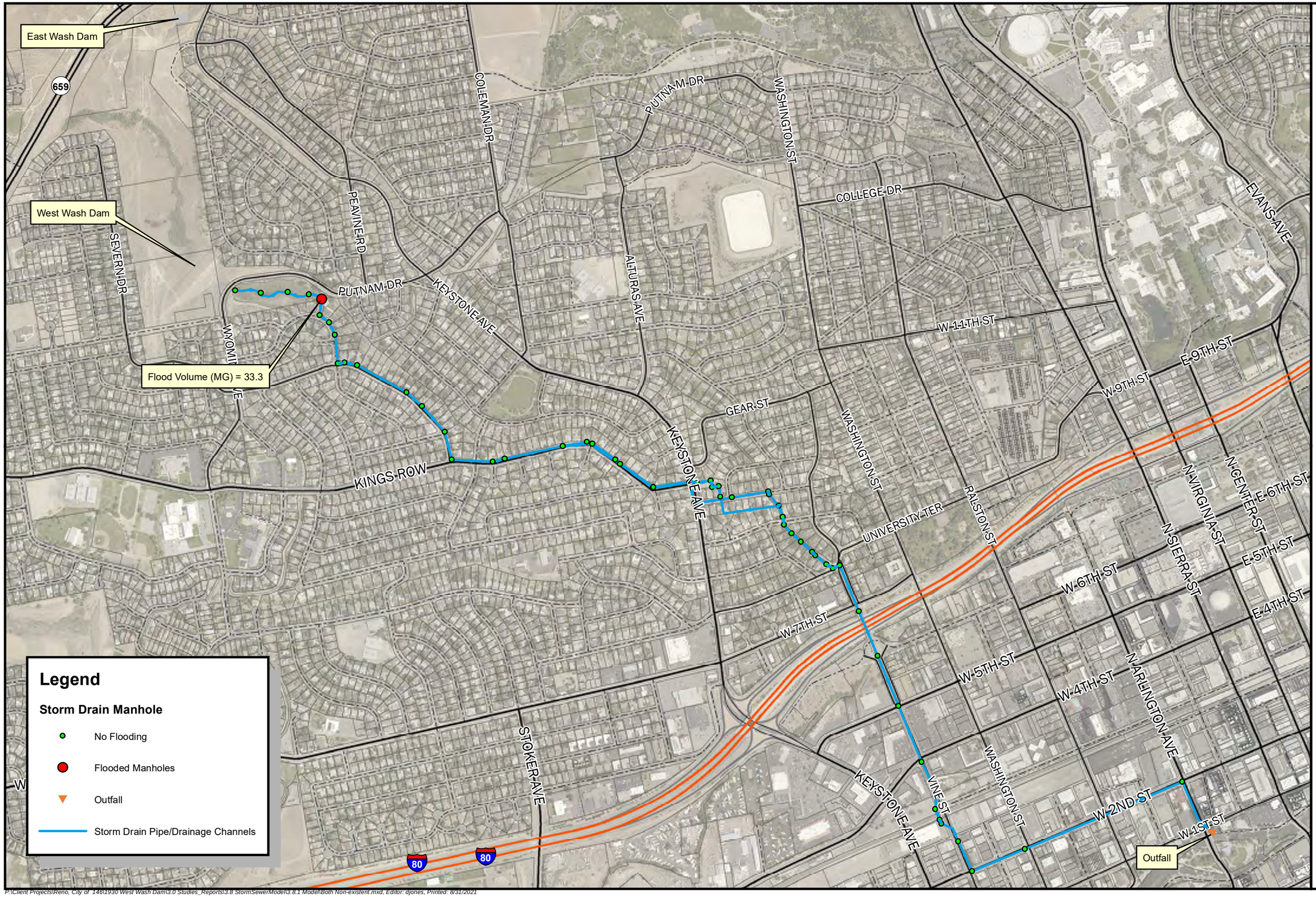
P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.8 StormSewerModel\3.8.1 Model\Both Non-existent.mxd, Editor: djones, Printed: 8/31/2021



20 Years!
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Both Dams Non-Existent: 200-Year

N

1 " = 800 '

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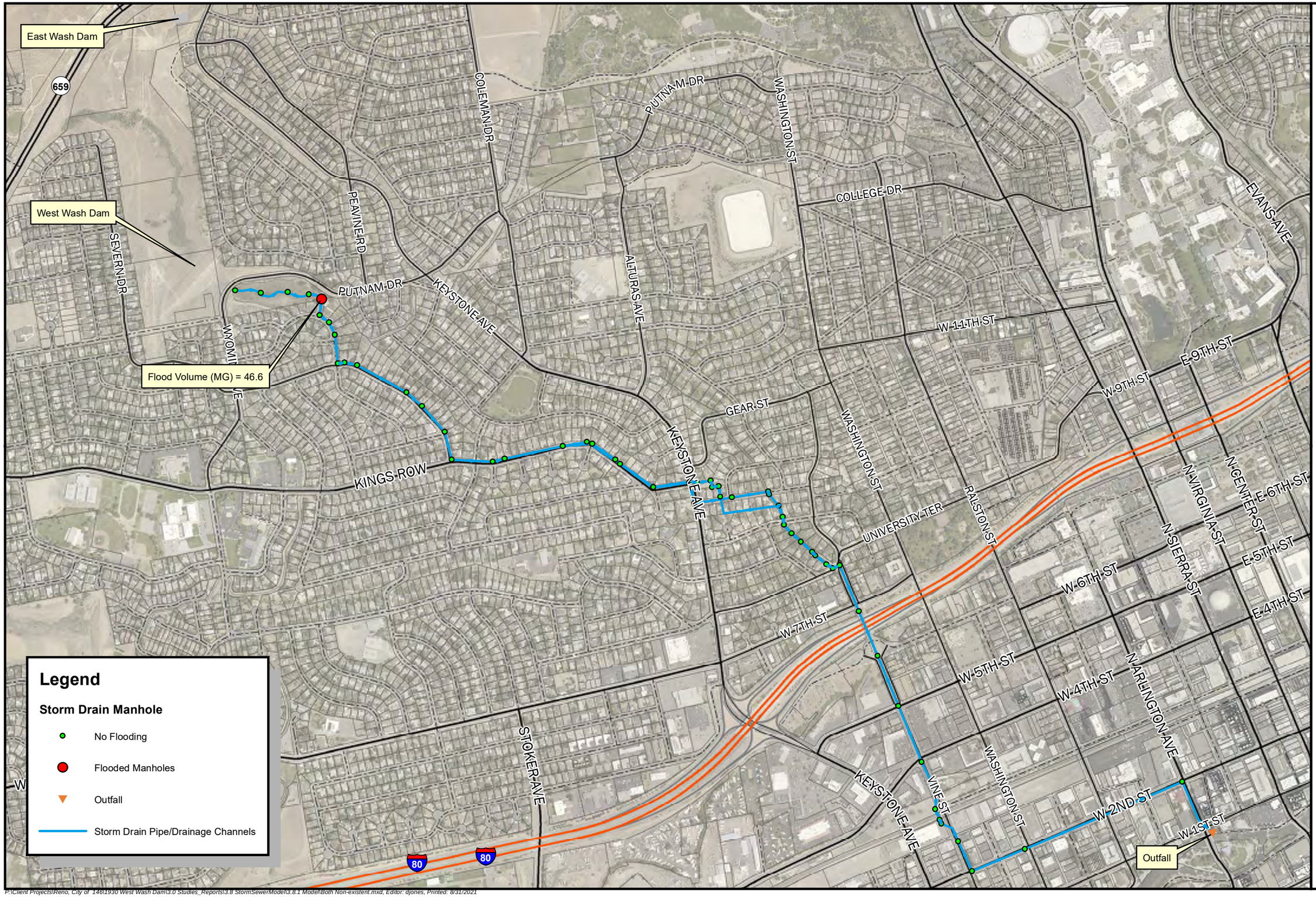
P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.8 StormSewerModel\3.8.1 Model\Both Non-existent.mxd, Editor: djones, Printed: 8/31/2021



20 Years!
FARR WEST ENGINEERING

5510 Longley Lane
Reno, NV 89511
(775) 851-4788
www.farrwestengineering.com

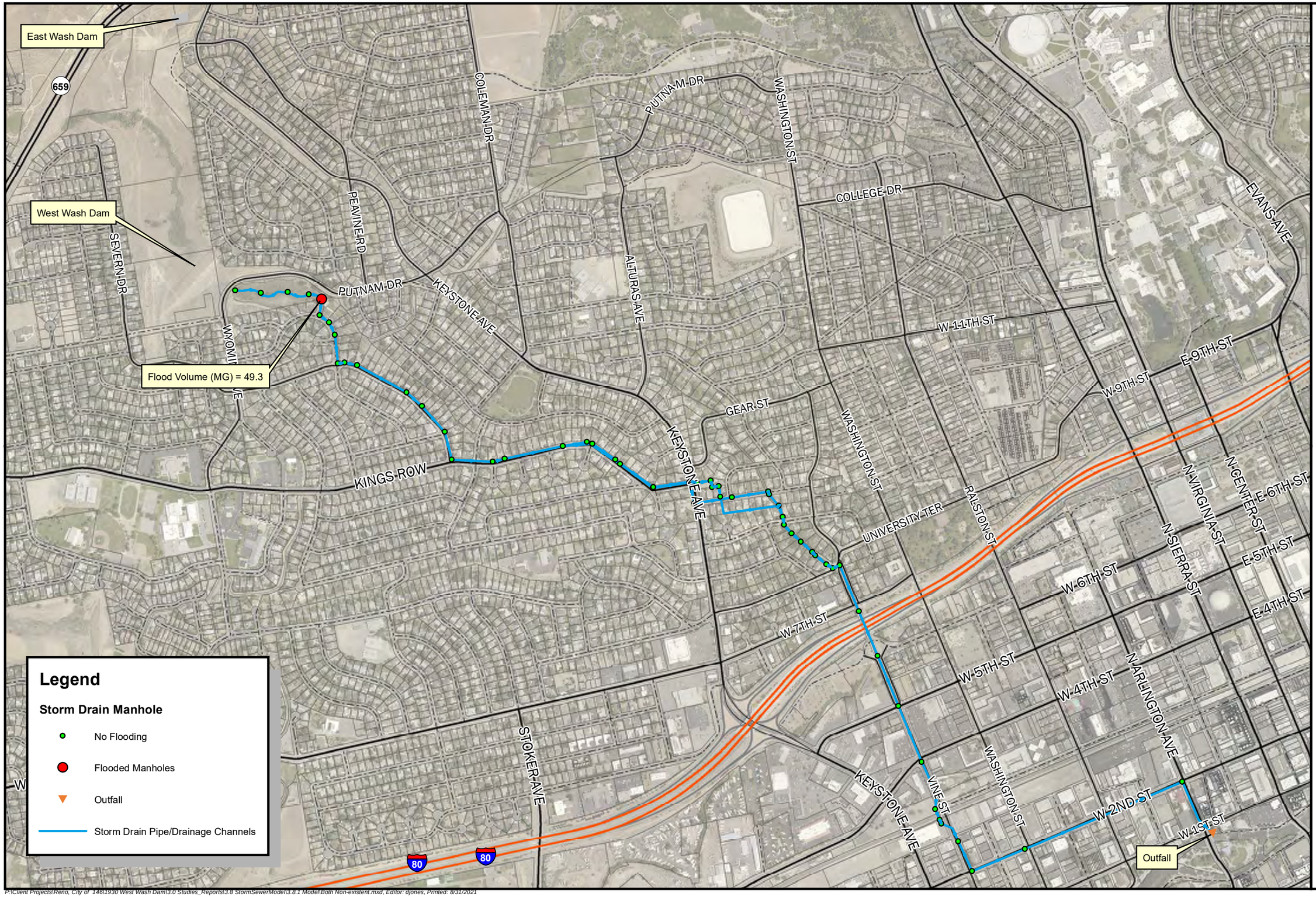
Both Dams Non-Existent: 500-Year

N

1 " = 800 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.8 StormSewerModel\3.8.1 Model\Both Non-existent.mxd, Editor: djones, Printed: 8/31/2021



20 Years!
FARR WEST ENGINEERING

5510 Longley Lane
Reno, NV 89511
(775) 851-4788
www.farrwestengineering.com

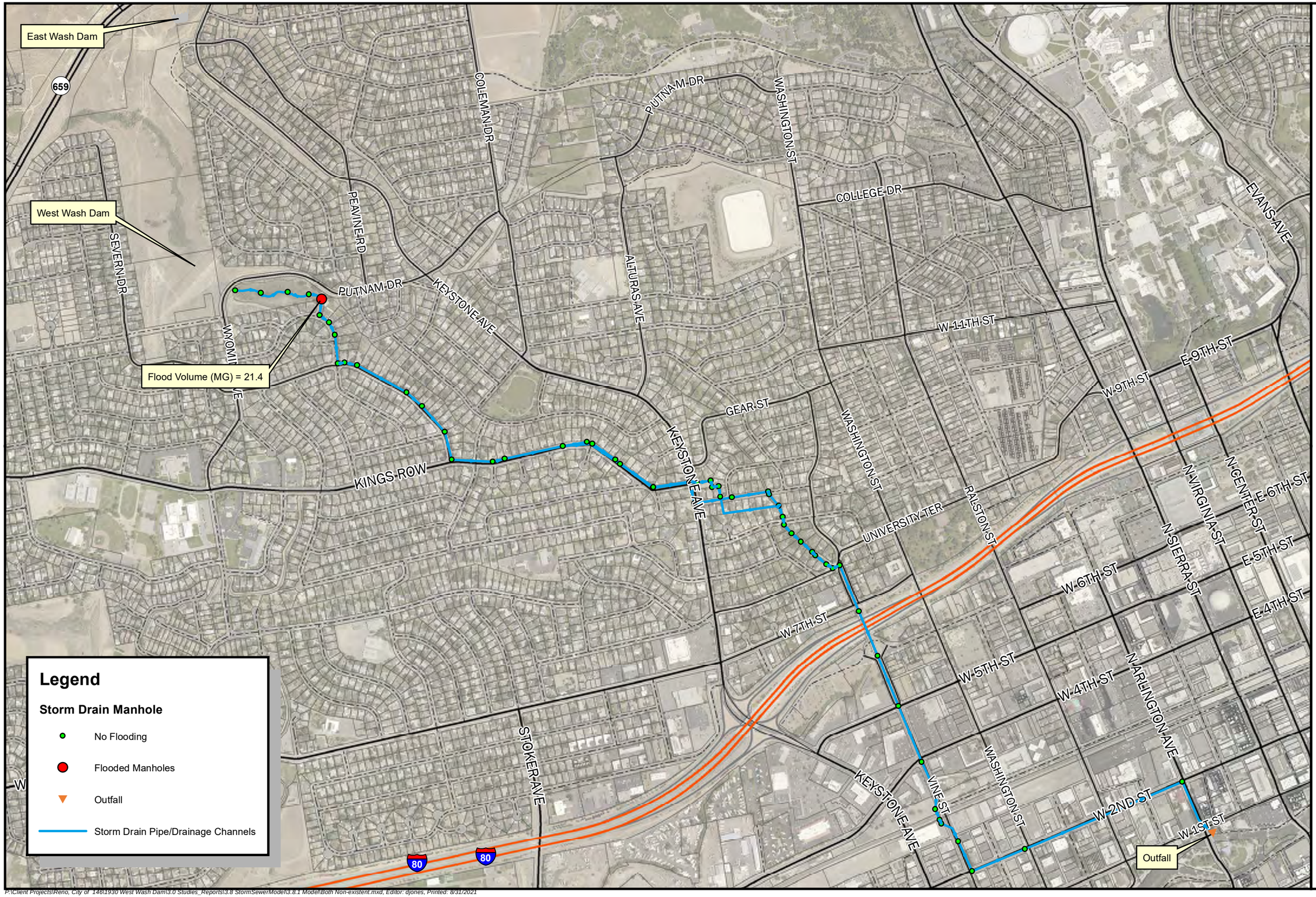
Both Dams Non-Existent: 1000-Year

N

1 " = 800 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.8 StormSewerModel\3.8.1 Model\Both Non-existent.mxd, Editor: djones, Printed: 8/31/2021



20 Years!
FARR WEST ENGINEERING
5510 Longley Lane
Reno, NV 89511
(775) 851-4788
www.farrwestengineering.com

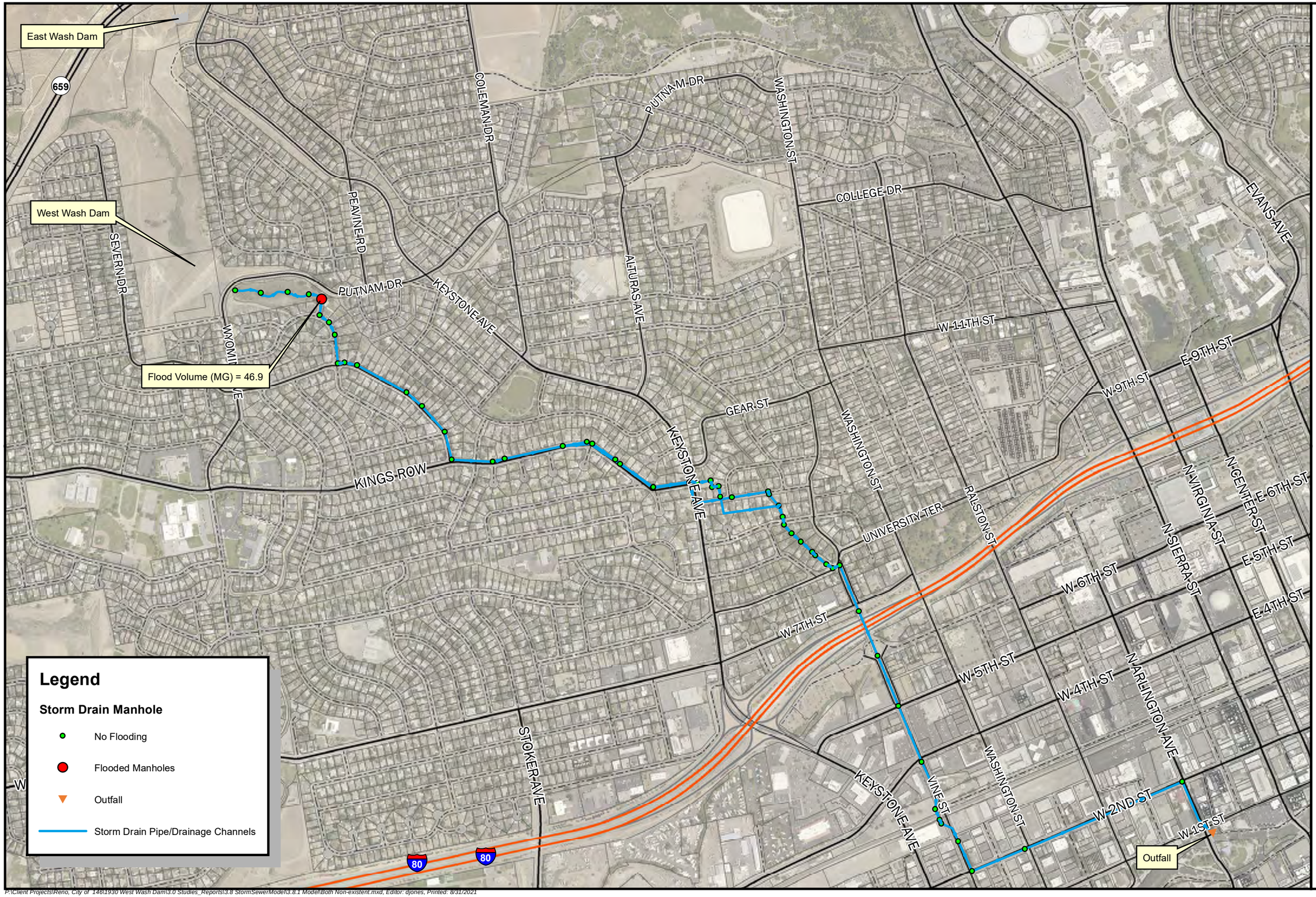
Both Dams Non-Existent: 1/2 General PMP

N

1 " = 800 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.8 StormSewerModel\3.8.1 Model\Both Non-existent.mxd, Editor: djones, Printed: 8/31/2021



20 Years!
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5510 Longley Lane
Reno, NV 89511
(775) 851-4788
www.farrwestengineering.com

Both Dams Non-Existent: 3/4 General PMP

N

1 " = 800 '

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P:\Client Projects\Reno, City of 146\1930 West Wash Dam\3.0 Studies_Reports\3.8 StormSewerModel\3.8.1 Model\Both Non-existent.mxd, Editor: djones, Printed: 8/31/2021

East Wash Dam

West Wash Dam

Flood Volume (MG) = 77.1

659

COLEMAN DR

PUTNAM DR

WASHINGTON ST

COLLEGE DR

EVANS AVE

PEAVINE RD

SEVERN DR

ALTURAS AVE

KEYSTONE AVE

W 11TH ST

E 9TH ST

W 9TH ST

GEAR ST

KINGS ROW

UNIVERSITY TER

RALSTON ST

N VIRGINIA ST

N CENTER ST

E 6TH ST

N SIERRA ST

E 5TH ST

W 6TH ST

E 4TH ST

W 7TH ST

W 5TH ST

W 4TH ST

N ARLINGTON AVE

STOKER AVE

VINE ST

W 2ND ST

W 1ST ST

Outfall

80

80

Legend

Storm Drain Manhole

- No Flooding
- Flooded Manholes
- Outfall
- Storm Drain Pipe/Drainage Channels

Both Dams Non-Existent: Full General PMP

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N

1 " = 800 '

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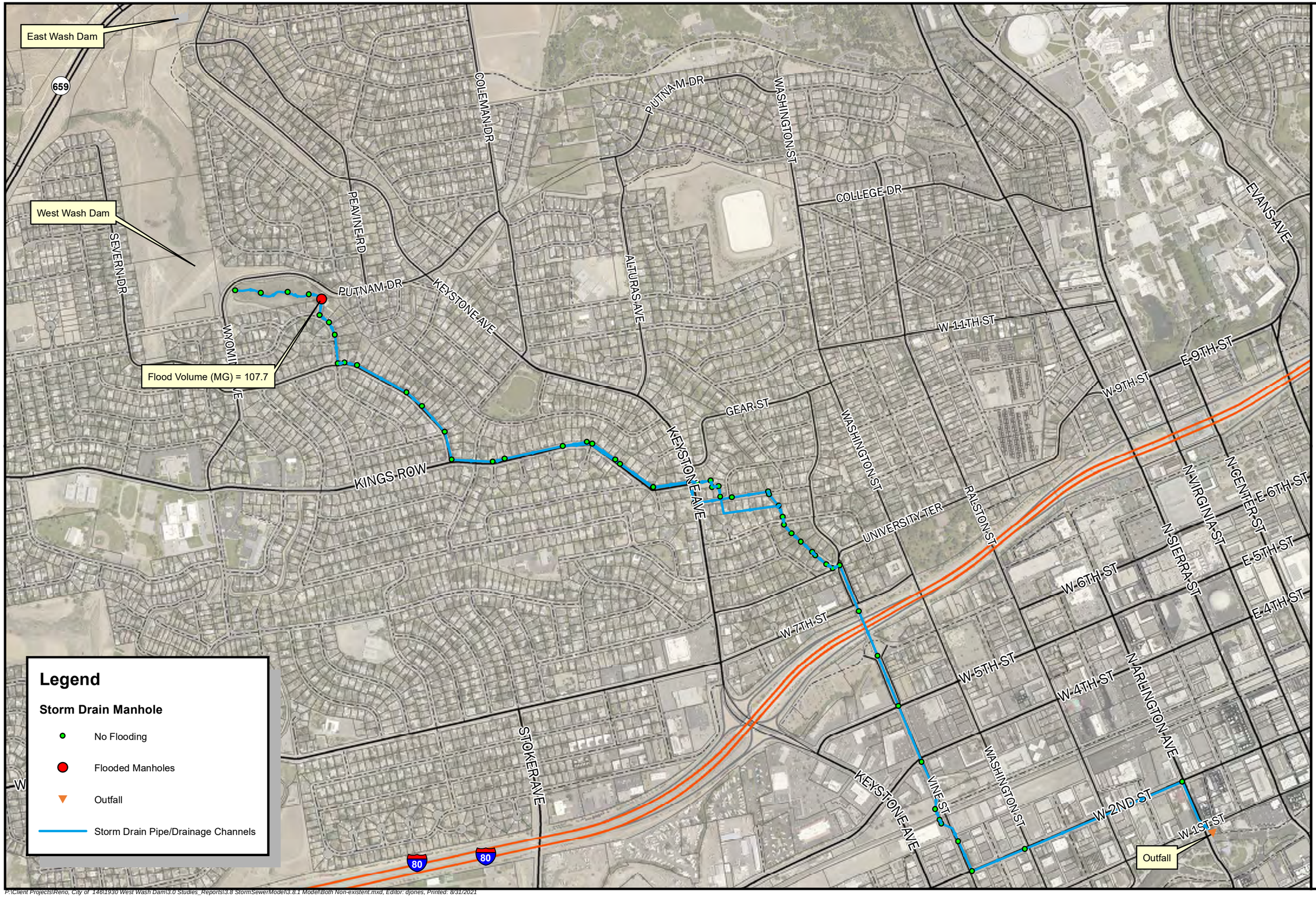

Both Dams Non-Existent: 1/2 Local PMP

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N

1 " = 800 '

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P:\Client Projects\Reno, City of 1461\1930 West Wash Dam\3.0 Studies_Reports\3.8 StormSewerModel\3.8.1 Model\Both Non-existent.mxd, Editor: djones, Printed: 8/31/2021

Both Dams Non-Existent: 3/4 Local PMP

East Wash Dam

West Wash Dam

Flood Volume (MG) = 182.3

Outfall

659

COLEMAN DR
PEAVINE RD
SEVERN DR
PUTNAM DR
WASHINGTON ST
COLLEGE DR
EVANS AVE
ALTURAS AVE
KEYSTONE AVE
W 11TH ST
E 9TH ST
W 9TH ST
GEAR ST
KINGS ROW
UNIVERSITY TER
RALSTON ST
N VIRGINIA ST
N CENTER ST
E 6TH ST
N SIERRA ST
E 5TH ST
W 6TH ST
E 4TH ST
W 7TH ST
W 5TH ST
W 4TH ST
N ARLINGTON AVE
STOKER AVE
VINE ST
W 2ND ST
W 1ST ST
80

Legend

Storm Drain Manhole

- No Flooding
- Flooded Manhole
- Outfall
- Storm Drain Pipe/Drainage Channels

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N

1 " = 800 '

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P:\Client Projects\Reno, City of 1461\1930 West Wash Dam\3.0 Studies_Reports\3.8 StormSewerModel\3.8.1 Model\Both Non-existent.mxd, Editor: djones, Printed: 8/31/2021

Both Dams Non-Existent: Full Local PMP

East Wash Dam

West Wash Dam

659

Flood Volume (MG) = 258.2

COLEMAN DR
PEAVINE RD
SEVERN DR
PUTNAM DR
KEYSTONE AVE
ALTURAS AVE
WASHINGTON ST
COLLEGE DR
EVANS AVE
W 11TH ST
E 9TH ST
W 9TH ST
GEAR ST
KINGS ROW
UNIVERSITY TER
RALSTON ST
N VIRGINIA ST
N CENTER ST
E 6TH ST
N SIERRA ST
E 5TH ST
W 6TH ST
E 4TH ST
W 7TH ST
W 5TH ST
W 4TH ST
N ARLINGTON AVE
STOKER AVE
VINE ST
W 2ND ST
W 1ST ST
Outfall
80

Legend

Storm Drain Manhole

- No Flooding
- Flooded Manholes
- Outfall
- Storm Drain Pipe/Drainage Channels

N

1 " = 800 '

20 Years!
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United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Washoe County, Nevada, South Part

West and East Wash Dams-Direct AOI

June 7, 2021

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:5,780 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 250 500 1000 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Washoe County, Nevada, South Part
Survey Area Data: Version 17, Aug 26, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 1, 2018—Oct 1, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
312	Risley cobbly loam, 15 to 30 percent slopes	0.0	0.0%
650	Chalco very stony clay loam, 15 to 30 percent slopes	0.8	1.5%
683	Reno stony sandy loam, 2 to 8 percent slopes	1.9	3.5%
991	Xeric Torriorthents-Urban land complex	11.5	21.5%
1050	Waspo clay, 15 to 30 percent slopes	38.3	72.0%
1054	Waspo gravelly clay, 2 to 8 percent slopes	0.8	1.4%
Totals for Area of Interest		**53.2**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it

was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Washoe County, Nevada, South Part

312—Risley cobbly loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: hxhy
Elevation: 4,500 to 6,000 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 47 to 49 degrees F
Frost-free period: 100 to 110 days
Farmland classification: Not prime farmland

Map Unit Composition

Risley and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Risley

Setting

Landform: Hills
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Residuum and colluvium derived from altered volcanic rocks

Typical profile

H1 - 0 to 6 inches: cobbly loam
H2 - 6 to 28 inches: clay
Cr - 28 to 60 inches: bedrock

Properties and qualities

Slope: 15 to 30 percent
Surface area covered with cobbles, stones or boulders: 1.0 percent
Depth to restrictive feature: 20 to 39 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Available water capacity: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: R026XY017NV - LOAMY HILL 10-12 P.Z.
Hydric soil rating: No

Minor Components

Rock outcrop

Percent of map unit: 4 percent
Landform: Peaks

Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Mizel

Percent of map unit: 4 percent
Landform: Hills
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R026XY029NV - ERODED SLOPE 10-12 P.Z.
Hydric soil rating: No

Old camp

Percent of map unit: 4 percent
Landform: Hills
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R026XY022NV - STONY SLOPE 8-10 P.Z.
Hydric soil rating: No

Indiano

Percent of map unit: 3 percent
Landform: Hills
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R026XY010NV - LOAMY 10-12 P.Z.
Other vegetative classification: LOAMY 10-12 P.Z. (023XY020NV_1)
Hydric soil rating: No

650—Chalco very stony clay loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: hxlj
Elevation: 4,900 to 5,400 feet
Mean annual precipitation: 8 to 10 inches
Mean annual air temperature: 47 to 49 degrees F
Frost-free period: 90 to 100 days
Farmland classification: Not prime farmland

Map Unit Composition

Chalco and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chalco

Setting

Landform: Pediments
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum and colluvium derived from lake-laid tuff

Typical profile

H1 - 0 to 3 inches: stony clay loam
H2 - 3 to 15 inches: clay
Cr - 15 to 60 inches: bedrock

Properties and qualities

Slope: 15 to 30 percent
Surface area covered with cobbles, stones or boulders: 11.0 percent
Depth to restrictive feature: 10 to 20 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: R026XY015NV - SHALLOW LOAM 10-12 P.Z.
Hydric soil rating: No

Minor Components

Badland

Percent of map unit: 5 percent
Landform: Pediments
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Stodick

Percent of map unit: 5 percent
Landform: Pediments
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R026XY015NV - SHALLOW LOAM 10-12 P.Z.
Hydric soil rating: No

Reno

Percent of map unit: 5 percent
Landform: Fan remnants
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R026XY023NV - CLAYPAN 10-12 P.Z.
Hydric soil rating: No

683—Reno stony sandy loam, 2 to 8 percent slopes

Map Unit Setting

National map unit symbol: hxm3
Elevation: 4,800 to 5,300 feet
Mean annual precipitation: 8 to 10 inches
Mean annual air temperature: 49 to 50 degrees F
Frost-free period: 90 to 100 days
Farmland classification: Not prime farmland

Map Unit Composition

Reno and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Reno

Setting

Landform: Fan remnants
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Mixed alluvium

Typical profile

H1 - 0 to 4 inches: stony sandy loam
H2 - 4 to 24 inches: clay
H3 - 24 to 47 inches: cemented material
Cr - 47 to 60 inches: bedrock

Properties and qualities

Slope: 2 to 8 percent
Surface area covered with cobbles, stones or boulders: 2.0 percent
Depth to restrictive feature: 20 to 39 inches to duripan; 39 to 59 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: R026XY023NV - CLAYPAN 10-12 P.Z.
Hydric soil rating: No

Minor Components

Barnard

Percent of map unit: 5 percent
Landform: Fan remnants
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R026XY017NV - LOAMY HILL 10-12 P.Z.
Hydric soil rating: No

Northmore

Percent of map unit: 5 percent
Landform: Fan remnants
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R026XY010NV - LOAMY 10-12 P.Z.
Hydric soil rating: No

Leviathan

Percent of map unit: 5 percent
Landform: Fan remnants
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R026XY010NV - LOAMY 10-12 P.Z.
Hydric soil rating: No

991—Xeric Torriorthents-Urban land complex

Map Unit Setting

National map unit symbol: hxp2
Elevation: 4,250 to 5,590 feet
Mean annual precipitation: 9 to 12 inches
Mean annual air temperature: 50 to 52 degrees F
Frost-free period: 165 to 175 days
Farmland classification: Not prime farmland

Map Unit Composition

Xeric torriorthents and similar soils: 50 percent
Urban land: 40 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Xeric Torriorthents

Setting

Landform: Fan piedmonts
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Mixed alluvium

Typical profile

H1 - 0 to 60 inches: variable

Properties and qualities

Slope: 0 to 30 percent
Surface area covered with cobbles, stones or boulders: 10.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to very high (0.06 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydrologic Soil Group: A
Hydric soil rating: No

Description of Urban Land

Setting

Landform: Fan piedmonts
Down-slope shape: Convex
Across-slope shape: Convex

Typical profile

H1 - 0 to 60 inches: variable

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydric soil rating: No

Minor Components

Dumps

Percent of map unit: 10 percent
Landform: Fan piedmonts
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

1050—Waspo clay, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: hxc5
Elevation: 4,800 to 5,200 feet

Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 49 to 50 degrees F
Frost-free period: 100 to 110 days
Farmland classification: Not prime farmland

Map Unit Composition

Waspo and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Waspo

Setting

Landform: Pediments
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum and colluvium derived from lacustrine tuff

Typical profile

H1 - 0 to 7 inches: clay
H2 - 7 to 24 inches: clay
Cr - 24 to 60 inches: bedrock

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: 20 to 39 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Ecological site: R026XY019NV - CHURNING CLAY 10-12 P.Z.
Hydric soil rating: No

Minor Components

Chalco

Percent of map unit: 6 percent
Landform: Pediments
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R026XY029NV - ERODED SLOPE 10-12 P.Z.
Hydric soil rating: No

Reno

Percent of map unit: 5 percent
Landform: Fan remnants
Down-slope shape: Linear
Across-slope shape: Convex

Ecological site: R026XY023NV - CLAYPAN 10-12 P.Z.
Hydric soil rating: No

Manogue

Percent of map unit: 4 percent
Landform: Hills
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R026XY027NV - CHURNING CLAY 8-10 P.Z.
Hydric soil rating: No

1054—Waspo gravelly clay, 2 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2w4cb
Elevation: 4,430 to 5,900 feet
Mean annual precipitation: 10 to 13 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 90 to 110 days
Farmland classification: Not prime farmland

Map Unit Composition

Waspo and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Waspo

Setting

Landform: Pediments
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Pedisediment derived from tuff and/or residuum weathered from tuff

Typical profile

A1 - 0 to 7 inches: gravelly clay
A2 - 7 to 24 inches: clay
Cr - 24 to 60 inches: bedrock

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: 20 to 39 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None

Frequency of ponding: None
Calcium carbonate, maximum content: 3 percent
Maximum salinity: Nonsaline to moderately saline (0.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum: 5.0
Available water capacity: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: R026XY019NV - CHURNING CLAY 10-12 P.Z.
Hydric soil rating: No

Minor Components

Chalco

Percent of map unit: 3 percent
Landform: Pediments
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Nose slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R026XY025NV - CLAYPAN 8-10 P.Z.
Hydric soil rating: No

Tunnison

Percent of map unit: 3 percent
Landform: Plateaus
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Mountaintop, crest
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R026XY027NV - CHURNING CLAY 8-10 P.Z.
Hydric soil rating: No

Manogue

Percent of map unit: 3 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Head slope
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: R026XY027NV - CHURNING CLAY 8-10 P.Z.
Hydric soil rating: No

Boondock

Percent of map unit: 3 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R026XY029NV - ERODED SLOPE 10-12 P.Z.
Hydric soil rating: No

Reno

Percent of map unit: 3 percent

Landform: Fan remnants
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R026XY023NV - CLAYPAN 10-12 P.Z.
Hydric soil rating: No

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CITY OF RENO

Public Participation Summary

Scoping

Watershed Plan Update-ED
Peavine Mountain Watershed
West Wash Dam Rehabilitation Project

May 2022

OWNER:
City of Reno
1 East First Street
Reno, NV 89501

LEAD FEDERAL AGENCY:
USDA-NRCS
1365 Corporate Blvd
Reno, NV 89502

ENGINEER:

Farr West Engineering
5510 Longley Lane
Reno, NV 89511
(775) 851-4788
(775) 851-0766 Fax

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1.0 INTRODUCTION

1.1 PURPOSE OF SCOPING UNDER NEPA

Scoping is an early and open process used to identify the range of actions, issues, alternatives, and impacts to be evaluated for a proposed project. (US Code of Federal Regulations) Scoping is an iterative process that occurs throughout the development of a National Environmental Policy Act (NEPA) document and identifies the laws, rules, and regulations, including State, Tribal, and local agency requirements, that must be addressed during project planning and evaluation. The scoping process contributes to the NEPA process by focusing the analysis on the issues of concern which need more in-depth analysis.

Scoping is an important process under the National Environmental Policy Act (NEPA). The scoping process continues throughout planning and early stages of preparation of an environmental document. Scoping is required for an environmental impact statement; scoping may be helpful during preparation of an environmental assessment, but is not required (see paragraph 46.305(a) Public involvement in the environmental assessment process). Scoping is an opportunity to introduce and explain NEPA's interdisciplinary approach and solicit information as to additional disciplines that should be included. Scoping provides an opportunity to bring agencies and applicants together to lay the groundwork for setting time limits, expediting reviews where possible, integrating other environmental reviews, and identifying any major obstacles that could delay the process. (US Code of Federal Regulations)

Ideally, this process results in a draft plan and environmental analysis that is thorough and balanced, and helps avoid the delays that may occur with inadequate planning or analysis. Scoping is often the first contact between project planners and the public. The public learns how the planners have identified the challenges, how they will investigate and evaluate them, and what the proposed solutions are.

The purpose of this report is to document and summarize the scoping process and public participation during scoping of the West Wash Dam Rehabilitation Project. Scoping for this project occurred in several stages. Agencies were invited to participate in a preliminary alternatives workshop and were invited to become cooperating agencies. Section 3 of this document includes a list of agencies invited to cooperate in this project. A notice of public scoping was provided to stakeholders, residents near the project area, the public, public representatives, state and federal agencies and community groups. These individuals and groups were invited to attend the scoping meeting and/or submit comments. Copies of agency, representative and community and residential mailing lists are included in Appendix B.

Due to the Covid-19 pandemic, and resulting emergency directives (State of Nevada, Office of the Governor) issued by the Governor of Nevada and adhered to by the City of Reno, the requirement of in person meetings was suspended. Meetings that occur electronically are required to have a method for the public to participate. Public outreach during scoping was expanded to include digital formats in order to reach as many residents as possible, including those in isolation or quarantine due to Covid-19. For these reasons, the Scoping meeting was held virtually and the public comment period following the meeting was extended. Electronic notices of the meeting were posted on community websites in addition to more formal channels. Notices are discussed in the scoping section of this document.

The purpose of the scoping meeting was to inform the public about the planning effort underway to rehabilitate the West Wash Dam and to scope issues to be considered during development of the Supplemental Plan and Environmental Document. The public was welcomed to participate in this project to learn about soil and water conservation issues, express views, and to participate throughout the decision-making process related to proposed actions for the West Wash Dam rehabilitation project. The virtual scoping meeting was held on October 19, 2021.

1.2 PROJECT BACKGROUND

West Wash Dam, in the Peavine Mountain Watershed of Washoe County, Nevada, is included in a United States Department of Agriculture-Natural Resources Conservation Service (USDA-NRCS) funded rehabilitation partnership project. The dam provides protection against flooding to about 30,000 Nevadans who live and work downstream.

West Wash Dam was constructed in 1960 under the direction and authority of Watershed Protection and Flood Prevention Act (Public Law 83-566). The original watershed plans for these dams used an evaluated life of 50 years. Having reached over 50 years in age, the dams are eligible for rehabilitation through the Natural Resources Conservation Service's Watershed and Flood Prevention Operations Program. The goals of the program include prevention of erosion, floodwater and sediment damage; to further the conservation, use and disposal of water; and to further the conservation and proper use of land in authorized watersheds. The USDA-NRCS's involvement in funding the project constitutes a major federal action under the National Environmental Policy Act (NEPA). USDA- NRCS is the lead federal agency working with the City of Reno who is the sponsoring local agency (SLO).

1.3 PROJECT LOCATION

The East Wash Diversion Dam is located at the intersection of Keystone Avenue and North McCarran Boulevard at the intersection of Township 20 North, Range 19 East, Sections 33 and 34 with Township 19 North, Range 19 East, Sections 3 and 4. Inflow to the East Wash Dam comes from 2.64 square miles of watershed on the southeast flank of Peavine Mountain. West Wash Detention Dam is located at the intersection of Wyoming and Gulling Streets at the intersection of Township 19 North, Range 19 East, Sections 3 and 4. Inflow to the West Wash Dam comes from approximately 3.56 square miles of watershed, which includes roughly 2.64 square miles of East Wash Dam's watershed. The Dams are located on five (5) City of Reno owned parcels listed in Table 1. These parcels encompass the existing East and West Wash Dam areas.

Table 1 Land location and Ownership

Washoe County APN #	Owner of Record	Zoning
001-190-16	City of Reno	Parks, Greenways, and Open Space
001-101-07	City of Reno	Parks, Greenways, and Open Space
001-111-10	City of Reno	Parks, Greenways, and Open Space
002-201-01	City of Reno	Parks, Greenways, and Open Space
002-202-01*	City of Reno	Single-Family Residential (8 units/ acre)

*location of Highland Ditch

1.4 DESCRIPTION OF PROPOSED ALTERNATIVES

Preliminary alternatives were identified during the preliminary alternatives virtual workshop held on August 12, 2021. The workshop was open to agencies invited to become cooperating agencies, COR, NRCS staff and Farr West staff. A preliminary alternatives summary memo was drafted by FWE on behalf of COR and submitted to NRCS. During the course of the Preliminary Alternatives Workshop five (5) Alternatives were selected for further detailed analysis. NRCS requires consideration and analysis of certain project alternatives, including no action, or future without project (FWOP); removal of both dams; and flood proofing alternatives. (U.S. Water Resources Counsel, 1983) Preliminary alternatives selected for detailed analysis pursuant to NEPA and the National Watershed Program Manual will include preliminary

engineering design, environmental impact analysis, cost benefit analysis, and opportunities for public participation and comment. The project alternatives selected for further consideration are listed below. Additional information on preliminary project alternatives is included in Appendix C.

1.4.1 Alternative 1: Future Without Project (No Action)

This alternative includes no improvements to the dam. This option is required to be considered by NRCS and under NEPA. This option is also called the “Future Without Project” (FWOP) alternative. The without plans condition is synonymous with "No Action” as used in NEPA and the CEQ NEPA regulations (40 CFR 1502.14(d)).) This alternative includes standard maintenance and operation of the dams including meeting current dam safety inspection requirements. No federal money will be spent on modification or rehabilitation of the two dams from the current Project funding allocation. Costs of maintenance will continue to be borne by the City of Reno for the foreseeable future with modest increases for inflation or periodic larger efforts to address specific deficiencies.

1.4.2 Alternative 2: Downstream Improvements (Flood Proofing)

This alternative includes increasing storm drain infrastructure capacity downstream of the dams. Options for creating a floodway are part of this preliminary alternative and include purchasing property and converting it to floodway and open space. Flood proofing actions are required to be considered as an alternative by NRCS policy (U.S. Water Resources Counsel, 1983). Implementation of this alternative would involve establishment of a flood corridor from West Wash Dam down to the receiving waters of the Truckee River. This preliminary alternative, alone, would be predicated on minor modification of East Wash and West Wash Dams. At-risk properties would be surveyed for individual solutions ranging from property acquisition and removal to construction of conveyance structures adequate to accommodate discharge up to the potential overtopping breach flow.

1.4.3 Alternative 3: Remediate Both Dams

This alternative includes projects to remediate both East and West Wash Dams to meet the safety requirements of the NRCS and the State of Nevada Division of Dams. East Wash Dam is classified as a diversion dam while West Wash Dam is classified as a detention dam. Both Dams have been identified as High Hazard Dams by the Division of Dams. Currently, the East Wash Dam meets NRCS criteria for Earthen Dams (TR-60) with the exception of excessive damage to the spillway in a PMF event.

The East Wash Dam remediation options include reestablishing the crest elevation of the principal spillways and auxiliary spillway improvements. Remediations to the West Wash Dam include raising the dam embankment, increasing storage capacity, and auxiliary spillway improvements. Remediation of both dams will be confined to the already disturbed areas of the structures. East Wash Dam would have the west dike of the principal spillway approach restored to the original design elevation and armoring of the spillways. West Wash Dam would have the embankment raised, storage capacity increased, the auxiliary spillway widened to at least the design width, and the auxiliary spillway walls repaired

1.4.4 Alternative 4: Removal of Both Dams

This alternative includes returning the area to a natural drainage landscape. This alternative is required to be considered by NRCS policy. (U.S. Water Resources Counsel, 1983) The existing embankments would either be breached or completely removed. Earth derived from the removal process would be either disposed of on-site or transported to an off-site disposal area. Collection structures would be constructed to direct flow to the existing storm water conveyance facilities. The existing detention basins and embankment areas would be contoured to a natural-appearing wash finish and armored to a degree to minimize erosion under most circumstances and return the areas to an approximation of pre-development condition.

1.4.5 Alternative 5: Removal of Both Dams with downstream improvements

This alternative includes returning the area to a natural drainage landscape, increasing storm drain infrastructure capacity downstream and creating a floodway. The dams would be removed as described above under Alternative 4. Flood proofing would be implemented downstream to eliminate hazards to remaining properties downstream in a manner similar to Alternative 2. However, the scope of the flood proofing would be for only the 1% flood, not potential overtopping flows from West Wash Dam. The flood proofing would also include the portion of East Wash between the current East Wash Dam location and the confluence of East Wash and West Wash, downstream.

2.0 PROJECT SCOPING

2.1 SCOPING NOTIFICATIONS

Public participation is an integral part of planning and decision making which provides opportunities for the public to be involved in the project. Various methods used to notify the public about the scoping effort are included in this section.

2.1.1 Press Release

The City of Reno issued a press release to the general public providing notice and inviting the public to participate in the scoping meeting. A copy of the press release is included in Appendix A.

2.1.2 Project Website

The project website was created and hosted by the City of Reno (Reno.gov/WestWashDamRehabilitationProject). For the Public Scoping meeting the website provided the project schedule, a posting notice, a project map, a copy of the notice letter sent to residents and a copy of the presentation given at the public scoping meeting held October 19, 2021. The project website also included background, project location and a link to submit written comments to the City of Reno regarding the project scoping. A printout of the website information is included in Appendix C.

2.1.3 Newspaper

The notice of Scoping meeting was published in the Reno Gazette Journal on September 22, 2021. The Reno Gazette Journal is the main daily newspaper for Reno, Nevada. It is owned and operated by the Gannett Company. It began being published when the Nevada State Journal and the Reno Evening Gazette were combined on October 7, 1983. Notice of the meeting was also published online by the Nevada Press Association. (Gazette, 2021)

The Reno Gazette Journal (RGJ) also published a news story about the project and included information on the public scoping period. A copy of the RGJ Proof of Publication and article is included in Appendix A.

2.1.4 Project Location Signs

Notification of the scoping meeting for the West Wash Dam Rehabilitation Project was posted at several locations at the project site where pedestrians often enter the area. A copy of the posting is included in Appendix A.

2.1.5 State of Nevada Clearing House

Information regarding the project scoping meeting was provided to the Nevada State Clearinghouse which published the informational record (E2022-104) on their website on September 22, 2021. A copy of the Clearinghouse letter is included in Appendix A.

2.1.6 Electronic and Social Media Notices

Notices of the public scoping meeting for the West Wash Dam Rehabilitation Project were posted on the City of Reno's social media accounts including Facebook and Nextdoor websites on October 14th and October 19th. The City of Reno posted a press release on the City's news webpage on October 14, 2021. Copies and screenshots of these postings are included in Appendix A.

2.1.7 Resident Notification Letters

Notice of the scoping meeting was sent to the mailing address for all residences within 1,000 ft of the project area boundary. A copy of the residential scoping notice letter and mailing list is included in Appendix A.

2.1.8 Letters To Agencies, Stakeholders, Community Groups And Elected Officials

Scoping meeting notice letters were sent to a list of stakeholders and agencies developed by the City of Reno and NRCS. Recipients included State and Federal Agencies, local government offices and planning agencies, elected representatives for the City of Reno, the State of Nevada Congressmen and Senators, as well as community organizations. The full mailing list for the notice of scoping is included in Appendix B.

2.2 SCOPING MEETING

The public scoping meeting for the West Wash Dam Rehabilitation Project was held virtually due to the ongoing public health and safety concerns associated with the Covid-19 pandemic. The State of Nevada Emergency Directive 003 for Covid-19 limited public gatherings. Federal requirements for the protection of employees also included having virtual meetings when possible. The virtual meeting was held via the City of Reno's Zoom platform on Tuesday, October 19, 2021, 6pm – 8pm.

A link to pre-register for the meeting was included on the project website. Participants were invited to submit comments to the City of Reno prior to the meeting by emailing, mailing or calling project manager Steve Gamilis at the contact information below.

City of Reno- Utilities Services Department

Attn: Steve Gamilis

1 East 1st street, 7th Floor

PO Box 1900

Reno, NV 89505

Email: gamiliss@reno.gov

The scoping meeting included a power point presentation and live discussion covering the project background, project location, project purpose and need, preliminary project alternatives, schedule, and website and contact information for submitting comments. Copies of all meeting materials are available in Appendix C.

Due to the ongoing Covid-19 pandemic and the difficulties of public gatherings, the public comment period was extended from 30 to 60 days to allow the public to become aware of the project and submit comments. Scoping comments were invited to be submitted to the City of Reno through December 19, 2021 and are summarized in Section 4 of this Report.

3.0 COOPERATING AGENCIES

In accordance with the Council on Environmental Quality regulations implementing the National Environmental Policy Act (NEPA) (40 CFR Section 1501.6) United States Department of Agriculture – Natural Resources Conservation Service (NRCS) formally requested agencies to become cooperating agencies in the planning and development of the West Wash Dam Rehabilitation Project Supplemental Watershed Plan and Environmental Document. Agencies identified as having expertise or jurisdiction by law related to this project, were contacted. NRCS sent letters seeking input and inviting cooperation to the agencies listed below. NRCS also reached out to local tribes by contacting the Reno-Sparks Indian Colony representatives.

- City of Reno Community Services Department Planning and Development
- Environmental Protection Agency Region 9
- Nevada Division of Environmental Protection
- Nevada Division of Wildlife
- Nevada Division of Water Resources
- State Historic Preservation Office
- Truckee River Flood Management Authority
- Truckee Meadows Storm Water Permit Coordinating Committee
- US Army Corps of Engineers
- US Fish and Wildlife Service
- Washoe County Emergency Management

NDEP declined the role as a cooperating agency but expressed interest in coordinating as a participating agency in a collaborative role. NDEP contact information is below:

Donette Baretto

Bureau of Water Pollution Control

Nevada Division of Environmental Protection

dbaretto@ndep.nv.gov

The only agency to accept a cooperating role in the project is EPA Region 9. Scoping comments were received from EPA are included in the compiled list of scoping comments. EPA Region 9 contact information is below:

Hugo Hoffman *(he/him)*

NEPA Reviewer

Environmental Review Branch

Tribal, Intergovernmental & Policy Division

U.S. Environmental Protection Agency, Region 9

(415) 972-3929 | hoffman.hugo@epa.gov

4.0 SCOPING COMMENTS TO BE ADDRESSED IN DRAFT PLAN/ED

The comment period was open for 60 days to provide additional opportunities for the public to participate in project scoping. Comments were submitted and responded to by the City of Reno. Copies of the comment log and Agency comments are included in Appendix D.

4.1 AGENCY COMMENTS

One agency comment was received from EPA Region 9 which was largely a listing of procedural requirements pursuant to NEPA, CEQ regulations (CFR Parts 1500-1508) and Section 309 of the Clean Air Act. The EPA accepted NRCS's invitation to serve as a Cooperating Agency for the subject Environmental Document on September 3, 2021. EPA offered comments for consideration in preparing the Environmental Document. Comments were provided with the assumption that the NRCS is preparing an Environmental Assessment for the proposed project and the EPA may have additional scoping comments if NRCS decides to prepare an Environmental Impact Statement. Comments were related to the project purpose and need, the alternatives analysis, water resources, drainage and floodplains, dam safety, air quality, biological resources, climate change and greenhouse gases, environmental justice, tribal consultation, monitoring and mitigation, and cumulative impacts. See Appendix D for a copy of the comments.

4.2 PUBLIC COMMENTS

A total of thirty-nine (39) individual comments were received for the project during the scoping process. Twenty (20) public comments were received September 21, 2021 through December 19, 2021. Comments were received following posting notice of the West Wash Dam Rehabilitation Project scoping meeting in September and were collected through the comment period following the scoping meeting. Nineteen (19) comments were received during the scoping meeting by members of the public who attended the meeting. Written comments were replied to individually by the City of Reno. Comments submitted virtually were answered during the scoping meeting.

All Comments were reviewed and categorized by topics. Topic categories were based on requirements of NEPA and NRCS. Some comments included more than one topic, so comments by topic was a totaled forty-three (43). Thirteen (13) of the forty-three (43) public comments were focused on requests for more information and IT assistance to access the virtual meeting. Other topics with more than 2 comments in the category were enhancements to the project area, land use (open space/zoning/public access), questions about the alternatives analysis, and biological resources related to plants: native habitats, weed abatement, herbicide use. A summary of comments is below in Tables 1 and 2. A copy of written comments submitted are included in Appendix D.

4.3 CATEGORIZATION OF COMMENTS

Table 2 Number of Comments by Commenter Type

Type of Commenter	Number of Comments
Public Comments	39
Agency Comments	1
Other Stakeholder Comments	0
Total Comments	40

Table 3 Number of Comments by Category

Categories of Comments	Number of Type of Comments
Contact/access to virtual meeting or webpage	7
Enhancements to the project area	4
Land use (open space/zoning/public access)	4
Request for additional information	6
Alternatives Analysis	3
Mitigation for dust and noise	2
Plants: Native habitats, weed abatement, herbicide use	3
Dam Removal Alternative	2
Climate Change	1
Wildfires	2
Flooding	2
Public notice	2
Existing development	2
Current dam safety (human safety)	2
Cumulative impacts	1

5.0 FUTURE OPPORTUNITIES FOR PUBLIC PARTICIPATION

The next phase of the NEPA planning process is to develop detailed draft project alternatives based on the issues presented in this Scoping Report, detailed technical studies and analysis, and a workshop. Alternatives will be developed to meet the goals and objectives of the USDA-NRCS and City of Reno for the proposed project and to address planning and environmental issues identified during the scoping process. The alternatives will be formulated in compliance with NEPA, CEQ regulations, and the NRCS NEPA guidance. The USDA-NRCS and City of Reno will meet with cooperating and contributing agencies, interested tribes, and other members of the public to identify a preferred alternative.

The assessment of alternatives developed for the West Wash Dam Rehabilitation project will be documented in a Selected Alternatives Memo and the Draft PLAN-Environmental document. At this time the environmental document is assumed to be an Environmental Assessment. If an EIS is needed, additional opportunities for public participation will occur and a Notice of Intent will be published. Although the USDA-NRCS and City of Reno welcomes public input at any time during the NEPA planning process, the next official public comment period will begin when the Draft PLAN-EA is published. The Draft PLAN-EA is expected to be published in 2023. At that time, the Draft PLAN-EA will be released for a 30-day public review period. The Draft PLAN-EA will be available on the project website and from the City of Reno. It will also be distributed to elected officials, regulatory agencies, and members of the public and notice will be published through the Nevada State Clearinghouse. One public meeting will be held during the next public review period.

6.0 REFERENCES

Gazette, T. R. (2021, October 22). Nevada Public Notice. Reno, NV, USA.

State of Nevada, Office of the Governor. (n.d.). *, Emergency Directive dated March 22, 2020 Governor Directives and Declarations | Nevada Health Response (nv.gov).*

U.S. Water Resources Counsel. (1983, March 10). Principles and Guidelines. *Economic and Environmental Principles and Guidelines for Water and Realted Land Resources*.

US Code oF Federal Regulations. (n.d.). 40 CFR Section 1501.9.

US Code of Federal Regulations. (n.d.). *42 CFR Sec. 46.235 NEPA Scoping Process.*

APPENDIX A – NOTICE OF SCOPING MEETING

1. Press release
2. Newspaper publication and article
3. Project location field posting
4. State of Nevada Clearinghouse
5. Social media postings
6. Residential notice letter

City of Reno looking for feedback on West Wash Dam Rehabilitation Project

Post Date: 10/14/2021 9:34 AM

The City of Reno is currently seeking public input and participation in the planning process for the West Wash Dam Rehabilitation Project in northwest Reno.

The City invites residents to attend a virtual public meeting on October 19, 2021 from 6-8 p.m. Community members must register for the virtual meeting. The purpose of the meeting is to inform the public about the planning effort and to scope issues to be considered during development of the Supplemental Plan and Environmental Document.

The public is welcome to participate in this project to learn about soil and water conservation issues, express views, and to participate throughout the decision-making process related to proposed actions in the West Wash Dam Rehabilitation Project.

There are two additional ways to submit written questions and comments.

By mail:
City of Reno - Utility Services Department
Attn: Steve Gamilis
1 East 1st Street, 7th Floor
PO Box 1900
Reno, NV 89505

By email:
gamiliss@reno.gov
Please include “West Wash Dam Rehabilitation Project” in the subject line.

Project Description

West Wash Dam, in the Peavine Mountain Watershed of Washoe County, is included in a United States Department of Agriculture Natural Resources Conservation Service (USDA NRCS) funded rehabilitation partnership project. The dam provides protection against flooding to about 30,000 Nevadans who live and work downstream.

Additionally, the dam protects downstream city roads, one state highway, and an interstate highway. Among other critical infrastructure, the dam also protects power lines and railroad

We're Online. How can we help?

West Wash Dam was constructed in 1960 under the direction and authority of the Watershed Protection and Flood Prevention Act. East Wash Diversion Dam, constructed in 1961 under the same program, contributes storm water flow from Peavine Mountain Watershed into West Wash Dam. The original watershed plans for these dams used an evaluated life of 50 years.

Having reached more than 50 years in age, the dams are eligible for rehabilitation through the NRCS's Watershed and Flood Prevention Operations Program. The goals of the program include prevention of erosion, floodwater and sediment damage; to further the conservation, use and disposal of water; and to further the conservation and proper use of land in authorized watersheds.

Project Location

The East Wash Diversion Dam is located near the intersection of Keystone Avenue and North McCarran Boulevard. Inflow to the East Wash Dam comes from 2.64 square miles of watershed on the southeast flank of Peavine Mountain.

West Wash Detention Dam is located near the intersection of Wyoming and Gulling Streets. Inflow to the West Wash Dam comes from approximately 3.56 square miles of watershed, which includes East Wash Dam's watershed.

For more information, visit Reno.gov/WestWashDamRehabilitationProject.

Return to full list >>

We're Online. How can we help?

RGJ media

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OCT 07 2021
CITY OF RENO
Public Works Department

PROOF OF PUBLICATION

STATE OF WISCONSIN SS.
COUNTY OF BROWN

CITY OF RENO - LEGALS
1 E 1ST ST FL 2

RENO NV 89501

Being first duly sworn, deposes and says: That as the legal clerk of the Reno Gazette-Journal, a daily newspaper of general circulation published in Reno, Washoe County, State of Nevada, that the notice referenced below has published in each regular and entire issue of said newspaper issue dated between: 09/22/2021 - 09/22/2021, for exact publication dates please see last line of Proof of Publication below.

PRESS RELEASE
Notice of Scoping Meeting: West Wash Dam Rehabilitation Project

West Wash Dam, in the Peavine Mountain Watershed of Washoe County, Nevada, is included in a United States Department of Agriculture Natural Resources Conservation Service (USDA NRCS) funded rehabilitation partnership project. The dam provides protection against flooding to about 30,000 Nevadans who live and work downstream.

West Wash Dam was constructed in 1960 under the direction and authority of the Watershed Protection and Flood Prevention Act (Public Law 83-566). The original watershed plans for these dams used an evaluated life of 50 years. Having reached over 50 years in age, the dams are eligible for rehabilitation through the NRCS's Watershed and Flood Prevention Operations Program.

The public is welcome to participate in this project to learn about soil and water conservation issues, express views, and to participate throughout the decision-making process related to proposed actions in the West Wash Dam rehabilitation project.

A public scoping meeting will take place on **October 19, 2021 from 6-8 p.m.** Due to the ongoing challenges and restrictions from COVID-19, this meeting will be held virtually. The meeting will take place via Zoom and can be joined by registering using the following link: https://zoom.us/webinar/register/WN_b2vEBhrTQMinsAJibBbPw

For additional project information go to: **Reno.gov/WestWashDamRehabilitationProject.**

No 4922516 September 22, 2021

09/22/2021

Legal Clerk

Subscribed and sworn before me this
22nd of September 2021.

NOTARY PUBLIC RESIDING
AT STATE OF WISCONSIN
COUNTY OF BROWN

Notary Expires: 9-25-23

SHELLY HORA
Notary Public
State of Wisconsin

Ad#:0004922516
P O : Public Mtg

# of Affidavits 1

This is not an invoice

reno gazette journal

NEWS

Two of Reno's 'high hazard' earthen dams could be replaced. Here's why

Amy Alonzo Reno Gazette Journal

Published 10:00 a.m. PT Nov. 6, 2021

An outdated earthen dam in the heart of Reno that safeguards roughly 30,000 residents and workers is up for repair or possible removal, and an adjacent aging dam might also see some work through the project.

Western Wash Dam, built in 1960, was constructed for watershed protection and flood prevention. Western Wash, along with connecting Eastern Wash Dam, built in 1961, has exceeded its life expectancy of 50 years.

The dams are not showing any signs of failure, but about 30,000 Northern Nevadans who live and work downstream of the dams could be impacted if either of them ever breached.

In addition to age, upstream development has affected the way the washes take in water and vegetation has overgrown portions of the dams.

Both dams are classified as “high hazard” by the state and do not meet modern safety requirements.

The Natural Resources Conservation Service of Nevada defines "high hazard" dams as those that would likely see a loss of life if they failed as well as disruption of critical facilities. It is not a reflection of their structural integrity.

Reno’s other eight dams within city limits are also classified as “high hazard,” but the city does not have any others slated for rehabilitation. The city said the other dams don't warrant replacement right now after their latest inspection and that there is very little it can do to get dams out of the "high-hazard" classification given the number of residences in the vicinity of the dams.

Dams rarely fail suddenly, and when dams such as the West and East wash are stressed, the city stays on top of it, according to according to the Natural Resources Conservation Service.

"This is a good thing for the people living downstream," said Keith Conrad, chief of dam safety at Nevada Division of Water Resources.

Western Wash Dam is located south of North McCarran Boulevard, between Severn Drive, O'Farrell Street and Wyoming Avenue. Eastern and Western Wash dams collect water from the Peavine Mountain Watershed and release excess water to existing stormwater systems.

They also protect city roads, Interstate 80, power lines, railroad tracks and Fourth Street.

"Most of these dams don't look like what you'd expect, like the Hoover Dam – they're just a big, big embankment and there might be a small concrete spillway," said Kelly Petersdorf, supervisor for Reno's sewer and stormwater division.

The dams are inspected regularly and are structurally sound, according to Kerri Lanza, engineering manager for the city's Utility Services Department. But due to their age and designation, "clearly they warrant our attention."

The dams are owned by the city, and Reno has partnered with the NRCS to bring them up to code. With the proximity between Western Wash and Eastern Wash, any work to Western Wash would likely impact Eastern Wash as well, according to city officials.

If either of the dams breached, it wouldn't be the first time area residents had to take precautions against an earthen dam failing.

In June 2018, an earthen dam south of Washoe Lake threatened to fail, threatening about 100 residents between Interstate 580 and U.S. 395 south of Pleasant Valley.

The 150-year-old dam threatened to send flood water into Steamboat Creek and Steamboat Ditch.

The 1863 dam constructed of boulders ultimately did not fail and was patched with dirt and rocks.

And while Northern Nevada receives little rainfall each year, the city is no stranger to flooding.

Damaging floods were documented in 1861, 1862, 1867, 1886, 1890, 1900, 1907, 1909, 1928, 1937, 1950, 1955, 1963, 1986, 1997, 2005 and 2017.

In 1997, Reno and Sparks sustained $700 million in flood damage when the Truckee River crested into the city.

Residents have until mid-December to offer input on the Western Wash Dam project. Input can be submitted on the city's website.

Amy Alonzo covers the outdoors, recreation and environment for Nevada and Lake Tahoe. Reach her at aalonzo@gannett.com. Here's how you can support ongoing coverage and local journalism.

The Associated Press contributed to this story.

UTILITY SERVICES DEPARTMENT
1 East 1st Street, 7th Floor
PO Box 1900
Reno, NV 89505

September 17, 2021

West Wash Dam Rehabilitation Project

Notice of Public Scoping Meeting

Dear Representative,

You are invited to participate in the planning process for the West Wash Dam Rehabilitation Project in Northwest Reno. This notice is for a public scoping meeting on **October 19, 2021 from 6-8pm**. Due to the ongoing challenges and restrictions of COVID-19, this meeting will be held virtually. The meeting will take place via Zoom and can be joined by registering using the following link:
https://zoom.us/webinar/register/WN_b2vEBhrTQMingA3ib8BbPw

The purpose of the meeting is to inform the public about the planning effort and to scope issues to be considered during development of the Supplemental Plan and Environmental Document.

Project Description
West Wash Dam, in the Peavine Mountain Watershed of Washoe County, Nevada, is included in a United States Department of Agriculture Natural Resources Conservation Service (USDA NRCS) funded rehabilitation partnership project. The dam provides protection against flooding to about 30,000 Nevadans who live and work downstream. Additionally, the dam protects downstream city roads, one state highway, and an interstate highway. Among other critical infrastructure, the dam also protects power lines and railroad tracks.

West Wash Dam was constructed in 1960 under the direction and authority of the Watershed Protection and Flood Prevention Act (Public Law 83-566). East Wash Diversion Dam, constructed in 1961 under the same program, contributes storm water flow from Peavine Mountain Watershed into West Wash Dam. The original watershed plans for these dams used an evaluated life of 50 years. Having reached over 50 years in age, the dams are eligible for rehabilitation through the NRCS's Watershed and Flood Prevention Operations Program. The goals of the program include prevention of erosion, floodwater and sediment damage; to further the conservation, use and disposal of water; and to further the conservation and proper use of land in authorized watersheds.

22 SEP '21 AM9:17

Project Location
The East Wash Diversion Dam is located at the intersection of Keystone Avenue and North McCarran Boulevard at the intersection of Township 20 North, Range 19 East, Sections 33 and 34 with Township 19 North, Range 19 East, Sections 3 and 4. Inflow to the East Wash Dam comes from 2.64 square miles of watershed on the southeast flank of Peavine Mountain. West Wash Detention Dam is located at the intersection of Wyoming and Gulling Streets at the intersection of Township 19 North, Range 19 East, Sections 3 and 4. Inflow to the West Wash Dam comes from approximately 3.56 square miles of watershed, which includes roughly 2.64 square miles of East Wash Dam's watershed.

For additional project information please go to:
Reno.gov/WestWashDamRehabilitationProject.

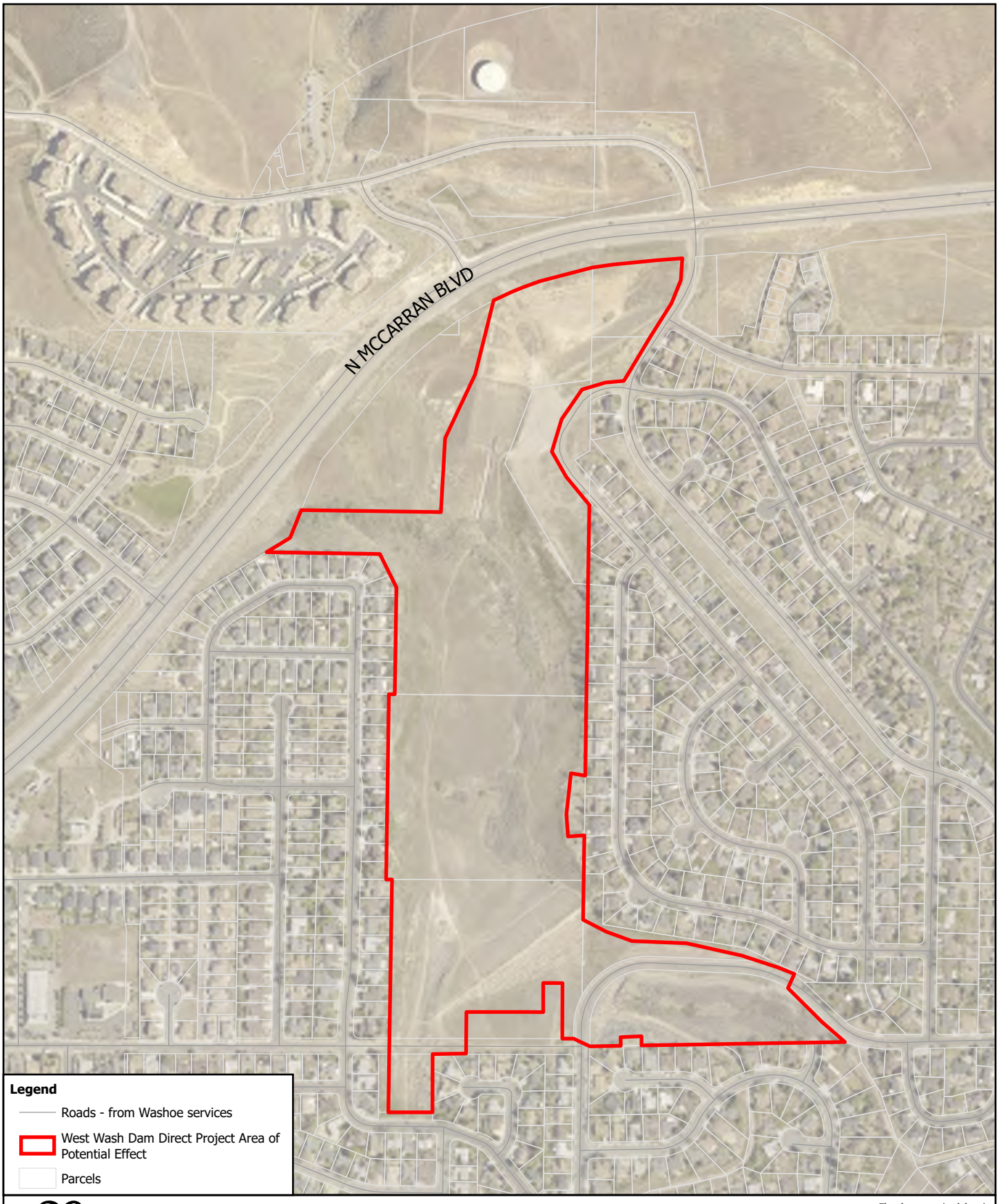
The public is welcome to participate in this project to learn about soil and water conservation issues, express views, and to participate throughout the decision-making process related to proposed actions in the West Wash Dam Rehabilitation Project. Written questions and comments may be submitted by mail or email to City of Reno Project lead, Steve Gamilis. The subject line should include "**West Wash Dam Rehabilitation Project**."

Steve Gamilis
Project Coordinator
City of Reno
Utility Services Department
PO Box 1900
Reno, NV 89505
Email: gamiliss@reno.gov
Office (775) 334-2461

Sincerely,

Steve Gamilis

Steve Gamilis
Project Coordinator
City of Reno
Utility Services Department



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(775) 851-4788
www.farrwestengineering.com

N

1" = 500'

Scoping:
Project Location Figure

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

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West Wash Dam Rehabilitation Project Schedule

Event	Date	Description
Public Scoping meeting	October 19, 2021	Project Scoping to identify all reasonable alternatives and collect public comment
Public Comment ends	December 19, 2021	Invitation and Acceptance of public comments and questions regarding scoping
Draft Environmental Document available for review	July 2022	Notice of Availability of this draft document will be published for the public and sent to interested parties
Public comment	July 2022-September 2022	Collection of all public comments and questions, which will be incorporated in the final environmental document.
Publish Final Environmental Document	October 2022	Availability of this document will be provided to the public
Record of Decision or FONSI issued by NRCS	November 2022	Will be noticed to the public
Project Design	2023-2024	Tentative schedule, actual timing depends on selected project alternative.
Construction Start	2025	Tentative schedule, actual timing depends on selected project alternative, and construction variables.

UTILITY SERVICES DEPARTMENT
1 East 1st Street, 7th Floor
PO Box 1900
Reno, NV 89505

September 17, 2021

West Wash Dam Rehabilitation Project

Notice of Public Scoping Meeting

Dear Resident,

You are invited to participate in the planning process for the West Wash Dam Rehabilitation project in Northwest Reno. This notice is for a public scoping meeting on **October 19, 2021 from 6-8pm**. Due to the ongoing challenges and restrictions of COVID-19, this meeting will be held virtually. The meeting will take place via Zoom and can be joined by registering using the following link: https://zoom.us/webinar/register/WN_b2vEBhrTQMingA3ib8BbPw

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For additional project information please go to:
Reno.gov/WestWashDamRehabilitationProject.

The public is welcome to participate in this project to learn about soil and water conservation issues, express views, and to participate throughout the decision-making process related to proposed actions in the West Wash Dam rehabilitation project. Written questions and comments may be submitted by mail or email to City of Reno Project lead, Steve Gamilis. The subject line should include "**West Wash Dam Rehabilitation Project**."

Steve Gamilis
Project Coordinator
City of Reno
Utility Services Department
PO Box 1900
Reno, NV 89505
Email: gamiliss@reno.gov
Office (775) 334-2461

Sincerely,

Steve Gamilis
Project Coordinator
City of Reno
Utility Services Department

APPENDIX B - SCOPING NOTICE OF DISTRIBUTION LIST

1. Agency, representative and community mailing list
2. Residential mailing list

COR West Wash Dam: cooperation, coordination and public participation list				
Agency	**Contact Name**	**Email**	**Address**	**Additional address**
State and Federal Agencies				
US Fish and Wildlife	Joanna Gilkeson	joanna_gilkeson@fws.gov	U.S. Fish and Wildlife Service Reno Fish & Wildlife Office 1340 Financial Blvd., Suite 234 Reno, Nevada 89502 (775) 861-6300	
EPA- Region 9		Email: r9.info@epa.gov	US EPA Pacific Southwest, Region 9 75 Hawthorne St. San Francisco, CA 94105 Phone: (415) 947-8000 (866) EPA-WEST) Fax: (415) 947-3553	
Bureau of Indian Affairs- Western Region			Western Regional Office 2600 N. Central Avenue, 4th Floor Mailroom Phoenix, AZ 85001 Telephone: (602) 379-6600 Telefax: (602) 379-4139	
Nevada Division of Wildlife	Julie Meadows - Special Licenses and Permits and/or Alan Jenne - Habitat Division Chief	jmeadows@ndow.org ajenne@ndow.org	Regional Office: 1100 Valley Rd. Reno, NV 89512 Phone: (775) 688-1506 Fax: (775) 688-1595	Headquarters: 6980 Sierra Center Pkwy #120 Reno, NV 89511 Phone: (775) 688-1500 Fax: (775) 688-1495 Email: ndowinfo@ndow.org

USACE- Reno Field Office	Jennifer Thomason	Jennifer.C.Thomason@usace.army.mil	Jennifer C. Thomason Senior Project Manager US Army Corps of Engineers, Sacramento District Reno Regulatory Field Office 300 Booth Street, Room 3050 Reno, NV 89509-1361 Office: (775) 784-5304 Mobile: (775) 525-0384	
NV SHPO	Robin Reed, Deputy Director	rreed@shpo.nv.gov	Nevada State Historic Preservation Office Department of Conservation and Natural Resources 901 South Stewart Street, Suite 5004 Carson City, NV 89701 (O): 775-684-3437 I (F) 775-684-3442 rreed@shpo.nv.gov	
NDSL- Nevada State Clearinghouse	Scott Carey	nevadaclearinghouse@lands.nv.gov	NDSL Nevada State Cleaeringhouse 901 South Stewart Street, Suite 5003 Carson City, NV 89701	
Nevada Division of Water Resources (NDWR)- Safety of Dams Section	Chris Thorson, P.E.	cthorson@water.nv.gov	Nevada Division of Water Resources 901 South Stewart Street, Suite 2002 Carson City, NV 89701 (O): 775 -684-2803	

NDEP- BWPC (may also include permitting and compliance divisions) and NDEP-BSDW	Andrew Dixon- stormwater	andrew.dixon@ndep.nv.gov	901 S. Stewart Street, Suite 4001 Carson City, Nevada 89701 Phone: 775-687-4670	
Nevada National Heritage Program	Kristin Szabo	kszabo@heritage.nv.gov	Nevada Natural Heritage Program 901 S. Stewart St., Suite 5002 Carson City, NV 89701-5245 Main Phone Number: (775) 684-2900 Fax Number: (775) 684-2909	
Nevada Department of Transportation (NDOT) - Stormwater	No contacts listed on site, only questions or comments for for email	https://www.nevadadot.com/doing-business/about-ndot/ndot-divisions/stormwater/questions-or-comments	(O): (775) 888-7771	
Northern Neavada Water Policy Commission (NNWPC)	Jim Smitherman (Water Resources Program Manager)	jsmitherman@washoecounty.us	1001 East Ninth St. Reno, NV 89512 (O): (775) 954-4657	
Western Regional Water Commission (WRWC)	Jim Smitherman (Water Resources Program Manager)	jsmitherman@washoecounty.us	1001 East Ninth St. Reno, NV 89512 (O): (775) 954-4657	

Local Government				
Washoe County	Dave Solaro (Community Services Department Director)	dsolaro@washoecounty.us	Community Services Department Planning and Development 1001 E. Ninth Street Reno, NV 89512 (O): (775) 328-3600	
Truckee River Flood Management Authority (TRFMA)	George Robison	grobison@washoecounty.us	TRFMA, 9635 Gateway Drive, Suite A, Reno, NV 89521	
Washoe County Emergency Management	Dr. Aaron Kenneston	akenneston@washoecounty.us	Washoe County Emergency Management 1001 East Ninth Street, Building A Reno, NV 89512	
Truckee Meadows Storm Water Permit Coordinating Committee	Theresa Jones (SWPCC Coordinator)	jonest@reno.gov	1 E. 1st Street Reno, NV 89501 (775) 334-3311	
Washoe Co. Central Truckee Meadows Remediation District (CTMRD)	Chris Benedict (Program Manager)	cbenedict@washoecounty.us	1001 E. Ninth Street, Building C Reno, NV 89512 (775) 954-4642	
Trucke Meadows Regional Planning Agency (TMRPA)	Dr. Jeremy Smith (Director of Regional Planning)	jsmith@tmrpa.org	1105 Terminal Way #316 Reno, NV 89502 (O): (775) 321-8385 (Direct): (775) 321-8390	

Washoe Storey Conservation District	Bret Tyler (WSCD Chairman)	brettyler2@gmail.com washoestoreycd@gmail.com	1365 Corporate Drive Sparks, NV 89431 (O): (775) 722-6302	
Truckee Meadows Water Authority	Scott Estes (Director of System Planning & Engineering)	sestes@tmwa.com	1355 Capital Blvd Reno, NV 89502	Mailing address: P.O. Box 30013 Reno, NV 89520-3013
Elected Officials				
City of Reno Mayor	Hillary Schieve	mayor@reno.gov	City of Reno 1 E. First Street PO Box 1900 Reno, NV 89505 phone: 775-334-2001	
City of Reno Neighborhood Advisory Board Ward 1	Jenny Brekhus (Council Member)	brekhusj@reno.gov	City of Reno 1 E. First Street PO Box 1900 Reno, NV 89505 Phone: 775-334-2011	
City of Reno Neighborhood Advisory Board Ward 2	Naomi Duerr (Council Member)	duerrn@reno.gov	City of Reno 1 E. First Street PO Box 1900 Reno, NV 89505 Phone: 775-334-2017	
City of Reno Neighborhood Advisory Board Ward 3	Oscar Delgado (Coucil Member)	delgadoo@reno.gov	City of Reno 1 E. First Street PO Box 1900 Reno, NV 89505 Phone: 775-334-2021	

City of Reno Neighborhood Advisory Board Ward 4	Bonnie Weber (Coucil Member)	weberb@reno.gov	City of Reno 1 E. First Street PO Box 1900 Reno, NV 89505 Phone: 775-334-2015	
City of Reno Neighborhood Advisory Board Ward 5	Neoma Jardon (Council Member)	jardon@reno.gov	City of Reno 1 E. First Street PO Box 1900 Reno, NV 89505	
Reno City Counsel Memebr at Large	Devon Reese City Counsel at Large	reesed@reno.gov	City of Reno 1 E. First Street PO Box 1900 Reno, NV 89505 Phone: 775-334-2014	
Washoe County Commissioners District 1	Alexis Hill	AHILL@WASHOECOUNTY.US	1001 E 9th St. Reno, NV 89512 Phone: (775) 328-2005	
State Representative 2nd district	Mark Amodei (U.S. Congressman)	https://amodei.house.gov/	5310 Kietzke Lane, Suite 103 Reno, NV 89511 Phone: (775) 686-5760 Fax: (775) 686-5711	
Senior Senator	Catherine Cortez Masto	https://www.cortezmasto.senate.gov/	400 South Virginia Street Suite 902 Reno, NV 89501 P: (775) 686-5750 F: (775) 686-5757	313 Hart Senate Office Building Washington, DC 20510 P: (202) 224-3542
Junior Senator	Jacky Rosen	https://www.rosen.senate.gov/	Bruce Thompson Federal Building 400 S. Virginia Street, Suite 738 Reno, NV 89501 Phone 775-337-0110	144 Russell Senate Office Building Washington, DC 20510 Phone: 202-224-6244

Community Organizations				
Agency	**Contact Name**	**Email**	**Address**	**Additional address**
Reno Sparks Neighborhoods (**West University Neighborhood**)		community@renosparks.org	3983 S McCarran Blvd. #191 Reno, NV 89502 (775) 391-4005	
Nextdoor Neighborhood	Old Northwest and N McCarren communities	Unable to find any way to contact people within these neighborhoods without being a part of that community on the website		
One Truckee River (OTR) (Nevada Land Trust)		https://nevadalandtrust.org/contact-us/	2601 Plumas St. Reno, NV 89509 (O): (775) 851-5180 (F): (775) 851-5182	Mailing address: Nevada Land Trust P.O. Box 20288 Reno, NV 89515
Keep Truckee Meadows Beautiful (KTMB)		staff@ktmb.org	2601 Plumas St. Reno, NV 89510 (O): (775) 851-5185	Mailing address: P.O. Box 7412 Reno, NV 89510
The Nature Conservancy (TNC)		nevada@tnc.org	1 East First St., Suite 1007 Reno, NV 89501 (O): (775) 322-4990	
Sierra Nevada Journeys (SNJ)	Eaton Dunkelberger (CEO)	https://www.sierranevadajourneys.org/contact-us	190 East Liberty St. Reno, NV 89501 (O): (775) 355-1688	
Reno Cyclery	Jared Fisher (owner of Bomb Voyage, LLC)		10575 Discovery Drive Las Vegas, NV 89135 (702) 274-3862	

Local Tribes (NRCS will consult)				
Tribal Nation	**Contact Name**	**Email**	**Address**	**Additional address**
Reno-Sparks Indian Colony	Bethany B. Sam (PR/Community Information Officer) and Chairman Arlan Melendez	bsam@rsic.org	34 Reservation Road Reno, NV 89502 (O): (775) 329-2936 (F): (775) 329-8710	
Fallon Paiute	Chairwoman Cathi Williams-Tuni		565 Rio Vista Drive Fallon, Nevada 89406	
Pyramid Lake Paiute Tribe	Donna Noel	Donna Noel <DNoel@plpt.nsn.us>	P.O. Box 256 Nixon, NV 89424	
Pyramid Lake Paiute Tribe	Chairwoman Janet Davis		P.O. Box 256 Nixon, NV 89425	
Summit Lake Paiute Tribe	Mr. James Simmons		2255 Green Vista Dr. #402 Sparks, NV 89431	
Washoe Tribe of Nevada and California	Chairman Serrell Smoey		919 Highway 395 South Gardnerville, NV 89410	
Residents w/in 1,000 ft of direct project area				
Agency	**Contact Name**	**Email**	**Address**	**Additional address**

Residents near the area (w/in 1,000 ft)	See **Area Residents** tab			
Residents w/in downstream inundation area	See **Downstream Residents** Tab			

Residents w/in 1,000 ft of direct project area										
APN	STREETNUM	STREET	CITY	ZIP	FIRST NAME	LAST NAME	MAILING1	MAILCITY	MAILSTATE	MAILZIP
104104	3405	GULLING RD	RENO	89503		TEMPLE SINAI	3405 GULLING RD	RENO	NV	89503
104143	2940	BRYAN ST	RENO	89503	DIEGO A	LOZADA et al	2940 BRYAN ST	RENO	NV	89503
104147	2705	GULLING CT	RENO	89503	RANDALL R	LAMAY TRUST	2705 GULLING CT	RENO	NV	89503
104148	2715	GULLING CT	RENO	89503	TONG T & BONNIE R N	LE	3093 CREEKSIDE LN	SPARKS	NV	89431
104149	2725	GULLING CT	RENO	89503	JATINDER & KANWALJEET	CHANA	3004 MELINA DR	EL DORADO HILLS	CA	95762
104150	2735	GULLING CT	RENO	89503	JOSE P	LOPEZ-MEDINA	PO BOX 20601	RENO	NV	89515
104151	2730	GULLING CT	RENO	89503	TIEMING	HE et al	1225 MORRISON CANYON RD	FREMONT	CA	94536
104152	2720	GULLING CT	RENO	89503	PAMELA L & JOHN	UMEK	2720 GULLING CT	RENO	NV	89503
104153	2710	GULLING CT	RENO	89503	JOEL	JAYME LIVING TRUST	6401 ADOBE SPRINGS CT	SPARKS	NV	89436
104154	2700	GULLING CT	RENO	89503	MERIAM	BURBANK LIVING TRUST	2700 GULLING CT	RENO	NV	89503
104156	2890	BRYAN ST	RENO	89503	JOSE	SEGURA	2890 BRYAN ST	RENO	NV	89503
104157	2880	BRYAN ST	RENO	89503	RANDOLPH & KIMBERLY	BRANDT LIVING TRUST	5635 ELDER CIR	LIVERMORE	CA	94550
104158	2870	BRYAN ST	RENO	89503	DENNIS B & JOCELYN	HOUSTON	2870 BRYAN ST	RENO	NV	89503
104159	2860	BRYAN ST	RENO	89503	STEVEN D	HILL	2860 BRYAN ST	RENO	NV	89503
104162	2930	BRYAN ST	RENO	89503		PICONE FAMILY TRUST	1340 TAPADERO TRL	RENO	NV	89521
104164	2928	BRYAN ST	RENO	89503	JOHANNES & SWENJA	ZIEGLER	10378 SUGAR PINE RD	TRUCKEE	CA	96161
104165	2924	BRYAN ST	RENO	89503	LOREN T	NELSON	9001 TIMOTHY DR	RENO	NV	89511
104166	2920	BRYAN ST	RENO	89503	PINAK S	LONKAR et al	2920 BRYAN ST	RENO	NV	89503
104167	2916	BRYAN ST	RENO	89503	MAX & MEGAN	CONELLY	2916 BRYAN ST	RENO	NV	89503
104168	2912	BRYAN ST	RENO	89503	STEVEN Z	HELLER	2912 BRYAN ST	RENO	NV	89503
104169	2908	BRYAN ST	RENO	89503	JOHN C	HANCOCK TRUST	2908 BRYAN ST	RENO	NV	89503
104170	2904	BRYAN ST	RENO	89503	GENEVIEVE M	CASTILLO	6888 W SERENERA WAY APT 386	WEST JORDAN	UT	84081
104171	2900	BRYAN ST	RENO	89503	GERARDO & BRENDA G	CASALLAS	2900 BRYAN ST	RENO	NV	89503
104173	3343	GULLING RD	RENO	89503	JUWHAN	EOM et al	3343 GULLING RD	RENO	NV	89503
104174	3353	GULLING RD	RENO	89503	DANIEL F & KELLY L	COONS	PO BOX 1460	DAYTON	NV	89403
104175	3345	GULLING RD	RENO	89503	GARRETT D	PETERSON et al	3345 GULLING RD	RENO	NV	89503
104176	3347	GULLING RD	RENO	89503	THOMAS E JR & ALISA D	BLACK 2016 TRUST	600 YELLOW PINE RD	RENO	NV	89511
104177	3349	GULLING RD	RENO	89503	WILLIAM B	KICE	3349 GULLING RD	RENO	NV	89503
104178	3351	GULLING RD	RENO	89503	WILLIAM J & HEATHER N	EATON	3351 GULLING RD	RENO	NV	89503
105112	2700	HACIENDA WAY	RENO	89503		HIGHLAND CONG JEHOVAHS WITNESS	PO BOX 33537	RENO	NV	89533
105206	2650	SUNRAY DR	RENO	89503		CHAUCER LIVING TRUST	PO BOX 5782	RENO	NV	89513-5782
105216	2985	ANDREA ST	RENO	89503	MATTHEW & TAUNI	LIEDTKE	2985 ANDREA ST	RENO	NV	89503
105217	2615	EMILY ST	RENO	89503	SHIRLEY L	ROMAN TRUST	1070 MILL CREEK RD	INCLINE VILLAGE	NV	89451
105218	2625	EMILY ST	RENO	89503	SUSAN K	SUPANCHECK TRUST	2625 EMILY ST	RENO	NV	89503
105219	2635	EMILY ST	RENO	89503	JOHN L & CAROLYN L	CORSTORPHINE	15850 ROCKY VISTA RD	RENO	NV	89521
105220	2630	EMILY ST	RENO	89503	LECIA C	MOJICA	2630 EMILY ST	RENO	NV	89503
105221	2620	EMILY ST	RENO	89503	PHILIP R	BUTLER	2620 EMILY ST	RENO	NV	89503
105222	2610	EMILY ST	RENO	89503		MUNCY LIVING TRUST et al	4984 SIERRA PINE DR	RENO	NV	89519
105223	2937	ANDREA ST	RENO	89503		WEISSGERBER FAMILY TRUST	213 SADDLE CT	FOLSOM	CA	95630
105224	2905	ANDREA ST	RENO	89503	MARK D & CHARLOTTE R	STOCK	561 KEYSTONE AVE # 411	RENO	NV	89503
105231	2617	SUNRAY DR	RENO	89503		BUI FAMILY TRUST	2508 HART AVE	SANTA CLARA	CA	95050
105232	2637	SUNRAY DR	RENO	89503	JEFFREY K	WHITE	2637 SUNRAY DR	RENO	NV	89503
105233	2627	SUNRAY DR	RENO	89503		LUMMUS FAMILY 2020 TRUST	1212 BROKEN FEATHER CT	RENO	NV	89511
105245	2945	BRYAN ST	RENO	89503	PETER & SHARON K	CHAMBERLIN	2945 BRYAN ST	RENO	NV	89503
105246	2935	BRYAN ST	RENO	89503	KYLE P	MORRIS	2935 BRYAN ST	RENO	NV	89503
105251	2640	EMILY ST	RENO	89503	JAMES V	SHEEHAN	2640 EMILY ST	RENO	NV	89503
105252	0	EMILY ST	RENO	89503		RENEW RENOVATIONS LLC	PO BOX 17267	RENO	NV	89511
105253	0	EMILY ST	RENO	89503		RENEW RENOVATIONS LLC	PO BOX 17267	RENO	NV	89511
105255	0	EMILY ST	RENO	89503		RENEW RENOVATIONS LLC	PO BOX 17267	RENO	NV	89511
105256	0	EMILY ST	RENO	89503		RENEW RENOVATIONS LLC	PO BOX 17267	RENO	NV	89511
105257	0	EMILY ST	RENO	89503		RENEW RENOVATIONS LLC	PO BOX 17267	RENO	NV	89511
105258	0	EMILY ST	RENO	89503		RENEW RENOVATIONS LLC	PO BOX 17267	RENO	NV	89511
105261	2905	BRYAN ST	RENO	89503	JUAN O	DELANEY	2905 BRYAN ST	RENO	NV	89503
105262	2895	BRYAN ST	RENO	89503	MELISSANORA C	FLORES	1640 SILVERTHREAD DR	RENO	NV	89521
105263	2630	SUNRAY DR	RENO	89503	RONALDO & MYLENE	LERON	5441 S ELK RIVER RD	RENO	NV	89511
105264	2620	SUNRAY DR	RENO	89503	MARK V & SHEILA M	CAMPBELL	3360 QUILICI LN	RENO	NV	89511
105265	2610	SUNRAY DR	RENO	89503	BRIAN	GRAHAM	2610 SUNRAY DR	RENO	NV	89503
105266	2606	SUNRAY DR	RENO	89503	JEFFREY M	HARDCASTLE	2606 SUNRAY DR	RENO	NV	89503
105267	2875	BRYAN ST	RENO	89503	RAYMUNDO C & GINA M	ENRIQUEZ	2875 BRYAN ST	RENO	NV	89503
105268	2855	BRYAN ST	RENO	89503	JESSICA R B & MARK D	NOLAN	2855 BRYAN ST	RENO	NV	89503

105270	2644	SUNRAY DR	RENO	89503	CLIFFORD & NUANANONG	HOWARD	1115 LOS PADRES ST SE	ALBUQUERQUE	NM	87123
105271	2640	SUNRAY DR	RENO	89503	DONALD L & SHELBY K	LUNDQUIST	2640 SUNRAY DR	RENO	NV	89503
105272	2925	BRYAN ST	RENO	89503	SEAN	OSTERHAGEN et al	2925 BRYAN ST	RENO	NV	89503
105273	2915	BRYAN ST	RENO	89503	OLIVIA M	RODRIGUES LIVING TRUST	5712 BRETT DR	SACRAMENTO	CA	95842
105275	11000	MCCARRAN BLVD	RENO	89503	ANGELA	HEREDIA-BONNET et al	PO BOX 33714	RENO	NV	89533
110101	2800	SEVERN DR	RENO	89503	ANTHONY R & PATRICIA A	DULDULAO	PO BOX 4002	MANTECA	CA	95337
110102	2810	SEVERN DR	RENO	89503	SCOTT R	LAKE et al	2810 SEVERN DR	RENO	NV	89503
110103	2820	SEVERN DR	RENO	89503	VALON	BISHOP	PO BOX 50041	RENO	NV	89513
110104	2840	SEVERN DR	RENO	89503	DUSTIN & JESSICA	DUNBAR	2840 SEVERN DR	RENO	NV	89503
110105	2860	SEVERN DR	RENO	89503		CHARTSIRI TRUST	2860 SEVERN DR	RENO	NV	89503
110107	0	UNSPECIFIED	RENO	89503		RENO CITY OF	PO BOX 1900	RENO	NV	89505
110108	2890	SEVERN DR	RENO	89503		MORRIS FAMILY TRUST	PO BOX 5172	TAHOE CITY	CA	96145
110109	2910	SEVERN DR	RENO	89503	STEVEN & DEBORAH L	KATERS	2910 SEVERN DR	RENO	NV	89503
110110	2930	SEVERN DR	RENO	89503	GLEN V	WEATHERSON	2930 SEVERN DR	RENO	NV	89503
110111	2950	SEVERN DR	RENO	89503	LINDA A	SEALOCK TRUST	2950 SEVERN DR	RENO	NV	89503
110116	2970	SEVERN DR	RENO	89503	KIM	ARNOTT	2970 SEVERN DR	RENO	NV	89503
110119	2990	SEVERN DR	RENO	89503	HUGH J	GALLAGHER	PO BOX 492	VIRGINIA CITY	NV	89440
110203	2965	SEVERN DR	RENO	89503	JOSE W & EUGENIA M	HERRERA	2965 SEVERN DR	RENO	NV	89503
110204	2945	SEVERN DR	RENO	89503	JOSHUA M & SARA N	SKROCH	1481 WASHINGTON ST	RENO	NV	89503
110205	2935	SEVERN DR	RENO	89503		JENSEN FAMILY TRUST	PO BOX 253	VERDI	NV	89439
110206	2915	SEVERN DR	RENO	89503	JAMES K & KAY M	WILSON TRUST	2689 HIGHLAND DR	BISHOP	CA	93514
110207	2485	SUNRAY DR	RENO	89503	TRAVIS	TEBBE	2485 SUNRAY DR	RENO	NV	89503
110208	2495	SUNRAY DR	RENO	89503	JEFFREY G	ACTON LIVING TRUST et al	932 KINGS CANYON CT	SCOTTS VALLEY	CA	95066
110209	2910	HARDING CIR	RENO	89503	NICKOLE	SEABORG	2910 HARDING CIR	RENO	NV	89503
110210	2920	HARDING CIR	RENO	89503	TOBY G	ROSS LIVING TRUST et al	PO BOX 8030	RENO	NV	89507
110211	2930	HARDING CIR	RENO	89503	KYLE N	SCHELLER	5535 DAYBREAK DR	RENO	NV	89523
110212	2940	HARDING CIR	RENO	89503	GAGE L	KABISCH	2940 HARDING CIR	RENO	NV	89503
110213	2950	HARDING CIR	RENO	89503	BRENT & RACHEL	OLIVEIRA	1246 LOMA VERDE CT	SPARKS	NV	89436
110214	2960	HARDING CIR	RENO	89503	JEFFREY S	ATEN	2960 HARDING CIR	RENO	NV	89503
110215	2995	SEVERN DR	RENO	89503	HEATHER D	BEDFORD	2995 SEVERN DR	RENO	NV	89503
110216	2975	SEVERN DR	RENO	89503	CRYSTAL P & ROBERT H	ZEYER	2975 SEVERN DR	RENO	NV	89503
110301	2965	HARDING CIR	RENO	89503	DANA N	BOSLEY	2965 HARDING CIR	RENO	NV	89503
110302	2955	HARDING CIR	RENO	89503		O'BRIEN LIVING TRUST	2955 HARDING CIR	RENO	NV	89503
110303	2945	HARDING CIR	RENO	89503	LINDA	FELDMAN TRUST	4541 FELTON ST # 7	SAN DIEGO	CA	92116
110304	2935	HARDING CIR	RENO	89503	CHARLES P & CHERIE D	ADAMS	2935 HARDING CIR	RENO	NV	89503
110305	2925	HARDING CIR	RENO	89503	ERIKA & MATTHEW A	SHAUL	2544 E 125TH WAY	THORNTON	CO	80241
110306	2915	HARDING CIR	RENO	89503	MICHAEL P & SIERRA M	ARONSON	2915 HARDING CIR	RENO	NV	89503
110307	2505	SUNRAY DR	RENO	89503		WAHL FAMILY TRUST	PO BOX 8012	MAMMOTH LAKES	CA	93546
110308	2515	SUNRAY DR	RENO	89503	MARIA J	RAMOS et al	2515 SUNRAY DR	RENO	NV	89503
110309	2915	ANDREA ST	RENO	89503	J'NEAL	HACHQUET et al	2915 ANDREA ST	RENO	NV	89503
110310	2935	ANDREA ST	RENO	89503	HAMILTON H & NATALEE R	KIZER	2935 ANDREA ST	RENO	NV	89503
110311	2945	ANDREA ST	RENO	89503		SILVER BRIDGE LLC ANDREA SERIES	PO BOX 17414	RENO	NV	89511
110312	2965	ANDREA ST	RENO	89503	SHEILA A	FITZPATRICK	2965 ANDREA ST	RENO	NV	89503
110313	2975	ANDREA ST	RENO	89503	CRISTINA	RUSU	2975 ANDREA ST	RENO	NV	89503
110314	2995	ANDREA ST	RENO	89503	BRET T	PECORARO	2995 ANDREA ST	RENO	NV	89503
110401	2510	SUNRAY DR	RENO	89503	ALLISON C	PODNAR	2510 SUNRAY DR	RENO	NV	89503
110402	2865	HARDING WAY	RENO	89503	HUGH D	FONDER	2865 HARDING WAY	RENO	NV	89503
110403	2845	HARDING WAY	RENO	89503		DISCOVERY COVE TRUST	3445 SAN MATEO AVE	RENO	NV	89509
110404	2825	HARDING WAY	RENO	89503	THOR E & TRISCA G	ARVIDSON	2825 HARDING WAY	RENO	NV	89503
110405	2815	HARDING WAY	RENO	89503	TERRY W	FITCH et al	2815 HARDING WAY	RENO	NV	89503
110406	2505	BRYAN ST	RENO	89503		GEXIN WANG & MIN YANG LIVING TRUST	495 SYSONBY CT	RENO	NV	89521
110501	2800	HARDING WAY	RENO	89503	SHARLYN K	MAYEDA	2800 HARDING WAY	RENO	NV	89503
110502	2810	HARDING WAY	RENO	89503	ALEX W & ELIZABETH H	PIERSON	2810 HARDING WAY	RENO	NV	89503
110503	2820	HARDING WAY	RENO	89503	CAMERON	INDA	474 KUEHNIS DR	CAMPBELL	CA	95008
110504	2830	HARDING WAY	RENO	89503	ELIZABETH A	HARDING	2830 HARDING WAY	RENO	NV	89503
110505	2840	HARDING WAY	RENO	89503	ALBERT	TOBIASSON	3708 LAKESIDE DR STE 202	RENO	NV	89509
110506	2860	HARDING WAY	RENO	89503	PAUL	RIPLEY et al	1220 COLUSA DR	RENO	NV	89503
110507	2490	SUNRAY DR	RENO	89503	KEVIN E & JESSICA S	QUINN TRUST	PO BOX 1610	CORDOVA	AK	99574
110508	2865	SEVERN DR	RENO	89503		WOO FAMILY TRUST	15065 NAPOLEON DR	RENO	NV	89511
110509	2845	SEVERN DR	RENO	89503	MARY L	HAWKS LIVING TRUST	2845 SEVERN DR	RENO	NV	89503
110510	2825	SEVERN DR	RENO	89503		ATTINGER-SNARR LIVING TRUST	10415 W LYNX TRL	COEUR D ALENE	ID	83814
110511	2815	SEVERN DR	RENO	89503		DIEFENBACHER FAMILY TRUST	PO BOX 33561	RENO	NV	89533
110512	2805	SEVERN DR	RENO	89503		MEAD FAMILY TRUST	PO BOX 5554	RENO	NV	89513

111101	2700	SEVERN DR	RENO	89503	CYNTHIA R	FERRIS et al	2700 SEVERN DR	RENO	NV	89503
111102	2710	SEVERN DR	RENO	89503	IRENE M	SEELYE	2710 SEVERN DR	RENO	NV	89503
111103	2720	SEVERN DR	RENO	89503	TABITHA V	MAHER	2720 SEVERN DR	RENO	NV	89503
111104	2730	SEVERN DR	RENO	89503		NIEHAUS FAMILY 2015 TRUST	2730 SEVERN DR	RENO	NV	89503
111105	2740	SEVERN DR	RENO	89503		SIMS FAMILY TRUST	2740 SEVERN DR	RENO	NV	89503
111106	2750	SEVERN DR	RENO	89503	PETER	KOSTAN et al	2750 SEVERN DR	RENO	NV	89503
111107	2760	SEVERN DR	RENO	89503		PILCHER LIVING TRUST	2760 SEVERN DR	RENO	NV	89503
111108	2780	SEVERN DR	RENO	89503	JOHN J	RIGDON	2780 SEVERN DR	RENO	NV	89503
111109	2790	SEVERN DR	RENO	89503	JELANI T SR	SMITH et al	2790 SEVERN DR	RENO	NV	89503
111110	0	GULLING RD	RENO	89503		RENO CITY OF	PO BOX 1900	RENO	NV	89505
111111	3215	GULLING RD	RENO	89503		TRUCKEE MEADOWS WATER AUTHORITY	PO BOX 30013	RENO	NV	89520
111201	2785	SEVERN DR	RENO	89503	RANDALL C & SARA L	HALL	4163 FLORIDA CT	LIVERMORE	CA	94550
111202	2775	SEVERN DR	RENO	89503	BRADLEY F	ROMINE	2775 SEVERN DR	RENO	NV	89503
111203	2765	SEVERN DR	RENO	89503	GEORGE & STEPHANIE	WILKINSON et al	1275 OLD FOOTHILL RD S	GARDNERVILLE	NV	89460
111204	2755	SEVERN DR	RENO	89503	JOEY D	BINARD	2755 SEVERN DR	RENO	NV	89503
111205	2745	SEVERN DR	RENO	89503	IAN	SANTA CRUZ	308 CARENTAN RD	SEASIDE	CA	93955
111206	2735	SEVERN DR	RENO	89503	GARY W	SMITH	2735 SEVERN DR	RENO	NV	89503
111207	2725	SEVERN DR	RENO	89503	ALAN & LISA	HESS	2725 SEVERN DR	RENO	NV	89503
111208	2715	SEVERN DR	RENO	89503	ELIZABETH B	PATETA	2715 SEVERN DR	RENO	NV	89503
111209	2705	SEVERN DR	RENO	89503		STICE FAMILY TRUST	980 FERRIS DR	MINDEN	NV	89423
111210	2702	HARDING WAY	RENO	89503	JOSEPH I & LESLIE K	MOYA	749 PUTNAM DR	RENO	NV	89503
111211	2710	HARDING WAY	RENO	89503	JOSEPH E & STACY M	BARRAGAN	2710 HARDING WAY	RENO	NV	89503
111212	2722	HARDING WAY	RENO	89503	DELIA	RAMILO	560 CRANLEIGH DR	RENO	NV	89512
111213	2732	HARDING WAY	RENO	89503	JOHN	GERTZ	2732 HARDING WAY	RENO	NV	89503
111214	2742	HARDING WAY	RENO	89503	JAMES A	WILLIAMSON	2742 HARDING WAY	RENO	NV	89503
111215	2756	HARDING WAY	RENO	89503	ROBERT J & SUSAN C	CLOBUCKER TRUST	2756 HARDING WAY	RENO	NV	89503
111216	2766	HARDING WAY	RENO	89503		RAMOCIOTTI LIVING TRUST	2766 HARDING WAY	RENO	NV	89503
111217	2776	HARDING WAY	RENO	89503	COLLEEN L	ROGERS	2776 HARDING WAY	RENO	NV	89503
111218	2792	HARDING WAY	RENO	89503	RICHARD G & WENDY A	HUTCHINGS	2792 HARDING WAY	RENO	NV	89503
111304	2791	HARDING WAY	RENO	89503	JOHN B	SWARTZ	2791 HARDING WAY	RENO	NV	89503
111305	2781	HARDING WAY	RENO	89503	KRISTI G	BORACCHIA	1575 GEARY ST	RENO	NV	89503
111306	2771	HARDING WAY	RENO	89503	CHRIS M	CUNNINGHAM	2771 HARDING WAY	RENO	NV	89503
111307	2761	HARDING WAY	RENO	89503	GEORGE & DOREEN	CORTISSE FAMILY TRUST	2761 HARDING WAY	RENO	NV	89503
111308	2751	HARDING WAY	RENO	89503	DIANA	PFULLER	2751 HARDING WAY	RENO	NV	89503
111309	2741	HARDING WAY	RENO	89503	RYAN M	ROBNETT	2741 HARDING WAY	RENO	NV	89503
111310	2731	HARDING WAY	RENO	89503	NGOI D L & EMMANUEL W	QUINAIN	2731 HARDING WAY	RENO	NV	89503
111311	2721	HARDING WAY	RENO	89503	MIGUEL A & MARTA C	MARTIR	2721 HARDING WAY	RENO	NV	89503
111312	2711	HARDING WAY	RENO	89503	FELIX O & BRIDGET A	IGBEKOYI	2711 HARDING WAY	RENO	NV	89503
119012	0	MCCARRAN BLVD	RENO	89503		BOMB VOYAGE LLC	10575 DISCOVERY DR	LAS VEGAS	NV	89135
119014	0	MCCARRAN BLVD	RENO	89503		NEVADA STATE OF	1263 S STEWART ST	CARSON CITY	NV	89701
119015	0	GULLING RD	RENO	89503		RENO CITY OF	PO BOX 1900	RENO	NV	89505
119016	0	GULLING RD	RENO	89503		RENO CITY OF	PO BOX 1900	RENO	NV	89505
124101	2535	GELLERT DR	RENO	89503	KOLLIN S & KENDALL J	GEORGE	2535 GELLERT DR	RENO	NV	89503
124102	2565	GELLERT DR	RENO	89503	JOY C	KING	2565 GELLERT DR	RENO	NV	89503
124103	2595	GELLERT DR	RENO	89503	JANET N	DAVIS	2595 GELLERT DR	RENO	NV	89503
124104	2635	GELLERT DR	RENO	89503	ERIC T & JANELLE C	DYE	2635 GELLERT DR	RENO	NV	89503
124105	2645	GELLERT DR	RENO	89503		CASHELL FAMILY TRUST	1200 FINANCIAL BLVD	RENO	NV	89502
124106	2685	GELLERT DR	RENO	89503	BRIAN & JULIE	MERICA	1985 BLACK SAND DR	RENO	NV	89521
124107	2701	GELLERT DR	RENO	89503	JOHN	BESAW	2701 GELLERT DR	RENO	NV	89503
124108	2715	GELLERT DR	RENO	89503	MATTHEW & JENNIFER	STARK	2715 GELLERT DR	RENO	NV	89503
124109	2725	GELLERT DR	RENO	89503	ROSS	ALBRIGHT et al	4530 MOUNTAINGATE DR	RENO	NV	89519
124110	2745	GELLERT DR	RENO	89503	BRANDON B & JULIE K	SMITH	2745 GELLERT DR	RENO	NV	89503
124111	2755	GELLERT DR	RENO	89503	PATRICK S	TEBBUTT	2755 GELLERT DR	RENO	NV	89503
124112	2765	GELLERT DR	RENO	89503		THOMAS LIVING TRUST	2765 GELLERT DR	RENO	NV	89503
124113	2775	GELLERT DR	RENO	89503	JACKIE M	HAGER	2775 GELLERT DR	RENO	NV	89503
124114	1420	LOCKSLEY WAY	RENO	89503	BRIAN A	SORRELL	1420 LOCKSLEY WAY	RENO	NV	89503
124115	1430	LOCKSLEY WAY	RENO	89503		MEAD FAMILY TRUST	PO BOX 5554	RENO	NV	89513
124201	1435	LOCKSLEY WAY	RENO	89503	SAMARA W	WENTEN	1502 WASHINGTON AVE	BERKELEY	CA	94707
124202	1425	LOCKSLEY WAY	RENO	89503	MARY J	HARDIMAN	200 DESERT ROSE DR	SPARKS	NV	89441
124203	1401	LOCKSLEY WAY	RENO	89503	WILLIAM A JR & KELLEY A	DINKINS	1401 LOCKSLEY WAY	RENO	NV	89503
124204	2798	GELLERT DR	RENO	89503	HELEN E	O'BRIEN 2000 TRUST et al	4415 BRIDLE WAY	RENO	NV	89519
124205	2790	GELLERT DR	RENO	89503	HELEN E	O'BRIEN 2000 TRUST et al	4415 BRIDLE WAY	RENO	NV	89519
124206	2780	GELLERT DR	RENO	89503	MELANIE K	GUMP	2780 GELLERT DR	RENO	NV	89503

124207	2760	GELLERT DR	RENO	89503		AABEL FAMILY TRUST	1402 MARINER WY	ROHNERT PARK	CA	94928
124208	2750	GELLERT DR	RENO	89503	NANCY C	SAULT 2014 TRUST	2750 GELLERT DR	RENO	NV	89503
124209	2740	GELLERT DR	RENO	89503	BARBARA	MADER-SCHERRER	2740 GELLERT DR	RENO	NV	89503
124210	2720	GELLERT DR	RENO	89503	CHRISTINA P	FORD	2720 GELLERT DR	RENO	NV	89503
124211	2710	GELLERT DR	RENO	89503	GAIL M	FULCHER	2710 GELLERT DR	RENO	NV	89503
124212	2701	VAN BUREN DR	RENO	89503	AMANDA	KARVONEN	PO BOX 8963	TRUCKEE	CA	96162
124213	2735	VAN BUREN DR	RENO	89503		PTJ INVESTMENTS LLC	PO BOX 4860	KETCHUM	ID	83340
124214	2765	VAN BUREN DR	RENO	89503	ROBERT R	SEITZLER	2765 VAN BUREN DR	RENO	NV	89503
124215	2775	VAN BUREN DR	RENO	89503	KENNETH N & JANICE M	WISE	2775 VAN BUREN DR	RENO	NV	89503
124216	2801	VAN BUREN DR	RENO	89503	STEVEN F	GIBBONS et al	2801 VAN BUREN DR	RENO	NV	89503
124217	2825	VAN BUREN DR	RENO	89503		NGO-HAI FAMILY TRUST	3150 PLATTE RIVER DR	RENO	NV	89503
124218	2835	VAN BUREN DR	RENO	89503	TAYO	LARRIEU et al	2835 VAN BUREN DR	RENO	NV	89503
124219	2865	VAN BUREN DR	RENO	89503	MATTHEW S	GEYER	2865 VAN BUREN DR	RENO	NV	89503
124220	1410	EXETER WAY	RENO	89503	SHERRY	COOPS	1410 EXETER WAY	RENO	NV	89503
124221	1420	EXETER WAY	RENO	89503	SEAN M	REDMOND	1420 EXETER WAY	RENO	NV	89503
124222	1430	EXETER WAY	RENO	89503	STACEY & TIM	CROWLEY FAMILY TRUST	4265 PALOMINO CIR	RENO	NV	89519
124223	1440	EXETER WAY	RENO	89503	RONALD & PHYLLISS	FAGG TRUST	2005 HUMBOLDT ST	RENO	NV	89509
124224	1450	EXETER WAY	RENO	89503	JOHN P & DONNA M	BERA LIVING TRUST	1450 EXETER WAY	RENO	NV	89503
124225	1454	EXETER WAY	RENO	89503	JAMES R	ARNICH	1454 EXETER WAY	RENO	NV	89503
124226	1470	EXETER WAY	RENO	89503	JERE D & KAY L	MARBLE	106 LINDBERGH CT	DAYTON	NV	89403
124301	1465	EXETER WAY	RENO	89503	GUMERCINDO & REINA C	MALDONADO	1465 EXETER WAY	RENO	NV	89503
124313	2850	VAN BUREN DR	RENO	89503	TITO A	BONILLA-REYES	2850 VAN BUREN DR	RENO	NV	89503
124314	2830	VAN BUREN DR	RENO	89503		HANOVER PROPERTIES LLC SERIES FOUR	10423 ST JAMES PL	TRUCKEE	CA	96161
124315	2790	VAN BUREN DR	RENO	89503		O'NEILL FAMILY 2010 TRUST	1580 SCOTT VALLEY RD	RENO	NV	89523
124316	2780	VAN BUREN DR	RENO	89503	DAVID P	MATTHEWS et al	2780 VAN BUREN DR	RENO	NV	89503
124317	2760	VAN BUREN DR	RENO	89503	HAI VAN & SUE W	QUAN	6145 GREENBROOK DR	RENO	NV	89511
124318	2730	VAN BUREN DR	RENO	89503	NINA N	CAMPANARO	2730 VAN BUREN DR	RENO	NV	89503
124319	2700	VAN BUREN DR	RENO	89503	RONALD D III	COLEMAN et al	2700 VAN BUREN DR	RENO	NV	89503
124320	2701	KINGS ROW	RENO	89503	JERRY W & JULIA R	BUMPS	2701 KINGS ROW	RENO	NV	89503
124321	2735	KINGS ROW	RENO	89503	DEBORAH	NELSON et al	2735 KINGS ROW	RENO	NV	89503
124322	2745	KINGS ROW	RENO	89503		TAH 2018-1 BORROWER LLC	1508 BROOKHOLLOW DR	SANTA ANA	CA	92705
124323	2775	KINGS ROW	RENO	89503	DEBORA A	WRIGHT et al	2775 KINGS ROW	RENO	NV	89503
124324	2785	KINGS ROW	RENO	89503	ANA MARIE	MARQUEZ	2785 KINGS ROW	RENO	NV	89503
124401	1300	POLSON ST	RENO	89503	PETER	SCHUSTER	1300 POLSON ST	RENO	NV	89503
124402	1330	POLSON ST	RENO	89503		PELEAU TRUST	4282 MUIRWOOD CIR	RENO	NV	89509
124403	2690	VAN BUREN DR	RENO	89503	TIMOTHY A & RISHA L	SIMPSON	2690 VAN BUREN DR	RENO	NV	89503
124501	2415	VAN BUREN DR	RENO	89503	MICHAEL D	NELMS	2415 VAN BUREN DR	RENO	NV	89503
124502	2425	VAN BUREN DR	RENO	89503	KALI & JON	ERIKSEN	2425 VAN BUREN DR	RENO	NV	89503
124503	2475	VAN BUREN DR	RENO	89503	MAUREEN L	KELLY LIVING TRUST	2475 VAN BUREN DR	RENO	NV	89503
124504	2495	VAN BUREN DR	RENO	89503		KED PROPERTIES LLC	1805 PALISADE DR	RENO	NV	89509
124505	2535	VAN BUREN DR	RENO	89503	MIKE	GEMME	PO BOX 6612	RENO	NV	89513
124506	2565	VAN BUREN DR	RENO	89503	SOMNUK & AMY	PITAK	4735 HUNTER PEAK CT	ANTIOCH	CA	94531
124507	2601	VAN BUREN DR	RENO	89503	OSCAR H & ROXANA	ORTIZ	2601 VAN BUREN DR	RENO	NV	89503
124508	2635	VAN BUREN DR	RENO	89503	ALICIA M	FERRARO	2635 VAN BUREN DR	RENO	NV	89503
124509	1360	POLSON ST	RENO	89503	PHIL B	GURULE et al	1360 POLSON ST	RENO	NV	89503
124510	1390	POLSON ST	RENO	89503	MARGARITO	HERNANDEZ	517 BRINKBY AVE APT 807	RENO	NV	89509
124511	2640	GELLERT DR	RENO	89503	ANN	MITCHELL et al	2640 GELLERT DR	RENO	NV	89503
124512	2610	GELLERT DR	RENO	89503	KATIE	LINDSTROM	2610 GELLERT DR	RENO	NV	89503
124513	2600	GELLERT DR	RENO	89503	SYDNII	RAY	2600 GELLERT DR	RENO	NV	89503
124514	2570	GELLERT DR	RENO	89503	WILLIAM A JR & FIANNA B	SAXTON	2570 GELLERT DR	RENO	NV	89503
124515	2540	GELLERT DR	RENO	89503	JAMES W	BYRNE	2540 GELLERT DR	RENO	NV	89503
124516	2510	GELLERT DR	RENO	89503	GRETCHEN L	KELLY et al	790 BROOKFIELD DR	RENO	NV	89503
124517	2500	GELLERT DR	RENO	89503	THOMAS C & BARBARA A	RICH	2500 GELLERT DR	RENO	NV	89503
124518	1400	KIRKHAM WAY	RENO	89503	PETER A	TOMAINO TRUST	201 W MOANA LN	RENO	NV	89509
124519	1430	KIRKHAM WAY	RENO	89503		MINTER LLC	5151 KOMATITE CT	SPARKS	NV	89436
124520	1450	KIRKHAM WAY	RENO	89503	KATRINA M	PARISENA	1450 KIRKHAM WAY	RENO	NV	89503
126084	2505	KINGS ROW	RENO	89503		CORP OF PRES BISHOP CHURCH LDS	50 E NORTH TEMPLE	SALT LAKE CITY	UT	84150
137101			RENO	89503		NOT AVAILABLE	NOT SUPPLIED	NOT SUPPLIED	NV	00000
137102	2625	SCHOLL DR	RENO	89503	LEAH M & DANIEL	LEYVA	2625 SCHOLL DR	RENO	NV	89503
137103	2645	SCHOLL DR	RENO	89503	RAYMOND C & WHILMA N	HILLIS	2645 SCHOLL DR	RENO	NV	89503
137104	2665	SCHOLL DR	RENO	89503		BOYNTON FAMILY TRUST	17435 N 58TH ST	SCOTTSDALE	AZ	85254
137105	2695	SCHOLL DR	RENO	89503	SHERYN	LAPLUME LIVING TRUST	2695 SCHOLL DR	RENO	NV	89503
137106	2705	SCHOLL DR	RENO	89503	LEE C	AUSTIN TRUST	2705 SCHOLL DR	RENO	NV	89503

137107	2735	SCHOLL DR	RENO	89503	RICHARD A JR	CAMERON	PO BOX 10732	RENO	NV	89503
137108	2765	SCHOLL DR	RENO	89503	IVAN D	PEREZ	2765 SCHOLL DR	RENO	NV	89503
137201	1450	LOCKSLEY WAY	RENO	89503	CHELSEY M & AUSTIN A	MILLER	1450 LOCKSLEY WAY	RENO	NV	89503
137202	1460	LOCKSLEY WAY	RENO	89503		MDR PROPERTIES LLC	790 WILD HAWK DR	SPARKS	NV	89436
137203	1480	LOCKSLEY WAY	RENO	89503	DANIEL C	ROCOVITS et al	1480 LOCKSLEY WAY	RENO	NV	89503
137204	1490	LOCKSLEY WAY	RENO	89503	PAMELA M	MITCHELL TRUST	1490 LOCKSLEY WAY	RENO	NV	89503
137205	2700	SCHOLL DR	RENO	89503	VIRGINIA F	BEAR TRUST	2001 DIPINTO AVE	HENDERSON	NV	89052
137206	2680	VALMAR PL	RENO	89503	JOHN D	FLEMING LIVING TRUST	2680 VALMAR PL	RENO	NV	89503
137207	2670	VALMAR PL	RENO	89503	KYLE	ANDERSON et al	2670 VALMAR PL	RENO	NV	89503
137208	2650	VALMAR PL	RENO	89503	KATHERINE A	MCCARTHY	2650 VALMAR PL	RENO	NV	89503
137209	2630	VALMAR PL	RENO	89503	JAMES A & SONYA L	VASQUEZ	3793 PROSPECT DR	CARSON CITY	NV	89703
137210	2610	VALMAR PL	RENO	89503	FRANK SR	LAWSON	2610 VALMAR PL	RENO	NV	89503
137211	2600	VALMAR PL	RENO	89503	TIAN-TWU	HSIEH et al	1401 EXETER	RENO	NV	89503
137212	2590	VALMAR PL	RENO	89503	DUNG T & SHUI Y	LEUNG	PO BOX 901	RENO	NV	89504
137213	2580	VALMAR PL	RENO	89503	RODGER & LORA	STONE	2955 OUTLOOK DR	RENO	NV	89509
137214	2560	VALMAR PL	RENO	89503	DAVID L	GEORGE et al	2560 VALMAR PL	RENO	NV	89503
137215	2550	VALMAR PL	RENO	89503	GARY W & PATRICIA G	OEHLERT	885 MEADOW SPRINGS DR	RENO	NV	89509
137216	2540	VALMAR PL	RENO	89503	L & K	KOLBET TRUST	2540 VALMAR PL	RENO	NV	89503
137217	2530	VALMAR PL	RENO	89503	HOWARD L & PEGGY L	TUNE	2530 VALMAR PL	RENO	NV	89503
137218	2520	VALMAR PL	RENO	89503	CHARLENE K	SULLIVAN LIVING TRUST	2520 VALMAR PL	RENO	NV	89503
137219	2500	VALMAR PL	RENO	89503	BRYTON	LEWIS	2500 VALMAR PL	RENO	NV	89503
137301	1460	KIRKHAM WAY	RENO	89503	PHILIP S	BARBER FAMILY TRUST	1460 KIRKHAM WAY	RENO	NV	89503
137302	1470	KIRKHAM WAY	RENO	89503	ERIKA M	NIELSEN et al	1470 KIRKHAM WAY	RENO	NV	89503
137303	1480	KIRKHAM WAY	RENO	89503	TERRY J	PETERSON	1480 KIRKHAM WAY	RENO	NV	89503
137304	1490	KIRKHAM WAY	RENO	89503		MLT INVESTMENTS LLC	316 CALIFORNIA AVE # 17	RENO	NV	89509
137401	2505	VALMAR PL	RENO	89503	JOAN A	MULLER	2505 VALMAR PL	RENO	NV	89503
137402	2515	VALMAR PL	RENO	89503	DAVID M & DARLARAE A	MONROE	2515 VALMAR PL	RENO	NV	89503
137403	2525	VALMAR PL	RENO	89503	SCHOLASTIKA M & CHARLES M	MUTISYA	PO BOX 9244	RENO	NV	89507
137404	2535	VALMAR PL	RENO	89503	LOREN S	STALEY et al	2535 VALMAR PL	RENO	NV	89503
137405	2555	VALMAR PL	RENO	89503	GERALD L & DIANE M	FRANZEN	2555 VALMAR PL	RENO	NV	89503
137406	2575	VALMAR PL	RENO	89503	CURTIS J	RISLEY et al	2575 VALMAR PL	RENO	NV	89503
137407	2595	VALMAR PL	RENO	89503	PAUL & JANELLE	ZAHTILLA FAMILY TRUST	2595 VALMAR PL	RENO	NV	89503
137408	2605	VALMAR PL	RENO	89503	MARILYN I	ARNOLD	6036 CITATION CT	RENO	NV	89523
137409	2615	VALMAR PL	RENO	89503	PEGGY	SCHWEIKERT	2615 VALMAR PL	RENO	NV	89503
137410	2675	VALMAR PL	RENO	89503	ANNA M	OUTLAND TRUST	2675 VALMAR PL	RENO	NV	89503
137411	2685	VALMAR PL	RENO	89503	RANDY S	LUNAK	2685 VALMAR PL	RENO	NV	89503
137412	2630	SCHOLL DR	RENO	89503	HUNTER	NOBLE et al	2630 SCHOLL DR	RENO	NV	89503
137413	2600	SCHOLL DR	RENO	89503	SARA	HUNT et al	2600 SCHOLL DR	RENO	NV	89503
137414	2560	SEVERN DR	RENO	89503		HSU FAMILY TRUST	2851 SAGE RIDGE DR	RENO	NV	89509
137415	2550	SEVERN DR	RENO	89503	UFFE & SHEILA D	NIELSEN	2550 SEVERN DR	RENO	NV	89503
137416	2540	SEVERN DR	RENO	89503	SUSAN M	DIXON	2540 SEVERN DR	RENO	NV	89503
137417	2530	SEVERN DR	RENO	89503		JHM FAMIL TRUST	1885 CALLOWAY CIR	AUBURN	CA	95603
137418	2510	SEVERN DR	RENO	89503	KATHLEEN	FRAZIER	2510 SEVERN DR	RENO	NV	89503
137419	2500	SEVERN DR	RENO	89503	MARY	BARKER	1412 WESSEX CIR	RENO	NV	89503
137501	2670	SEVERN DR	RENO	89503	ANDREA K & JESSE K	NORTHROP	2670 SEVERN DR	RENO	NV	89503
137502	2680	SEVERN DR	RENO	89503	DAVID & PATRICIA	HALTERMAN	775 PORTO MIO WAY	LAS VEGAS	NV	89138
137503	2690	SEVERN DR	RENO	89503	GARY	HAMMERSMITH	2690 SEVERN DR	RENO	NV	89503
137504	0	SEVERN DR	RENO	89503		RENO CITY OF	PO BOX 1900	RENO	NV	89505
138302	1495	EXETER WAY	RENO	89503	MAX H	HATCH	1495 EXETER WAY	RENO	NV	89503
138303	1485	EXETER WAY	RENO	89503	DAVID A	KELLY	1485 EXETER WAY	RENO	NV	89503
138304	1475	EXETER WAY	RENO	89503	JANE	GAMMEL 2017 TRUST	1475 EXETER WAY	RENO	NV	89503
138401	1480	EXETER WAY	RENO	89503	DONALD H & SUSAN E	OLSON	1480 EXETER WAY	RENO	NV	89503
138402	1484	EXETER WAY	RENO	89503	STACEY L	BONZER	1484 EXETER WAY	RENO	NV	89503
138403	1490	EXETER WAY	RENO	89503	CATHERINE J	RAIL	1490 EXETER WAY	RENO	NV	89503
138404	2800	SCHOLL DR	RENO	89503	CHRISTIAN G	BOLANOS et al	2800 SCHOLL DR	RENO	NV	89503
138405	1475	LOCKSLEY WAY	RENO	89503	LOGAN E	FOLEY	1475 LOCKSLEY WAY	RENO	NV	89503
138406	1455	LOCKSLEY WAY	RENO	89503	ROGER A & JACQUELINE K	PORTS	1455 LOCKSLEY WAY	RENO	NV	89503
138407	1445	LOCKSLEY WAY	RENO	89503	BETTE H	HEATH	1445 LOCKSLEY WAY	RENO	NV	89503
138501	2795	SCHOLL DR	RENO	89503	KYLIE	KEENAN et al	2795 SCHOLL DR	RENO	NV	89503
138502	2805	SCHOLL DR	RENO	89503	LEATH M	HAYDEN 2018 TRUST	2805 SCHOLL DR	RENO	NV	89503
138503	2835	SCHOLL DR	RENO	89503	GREGORY R & WILMA J	HOWE	3075 SOCRATES DR	RENO	NV	89512
138504	2865	SCHOLL DR	RENO	89503		FORTUNE RENO PROPERTIES LLC	PO BOX 34541	RENO	NV	89533
138505	2895	SCHOLL DR	RENO	89503	RICHARD & DALE	TAMBELLINI TRUST	1552 MARSEILLE LN	ROSEVILLE	CA	95747

138506	2905	SCHOLL DR	RENO	89503	JEFFREY S & LILA J	SPRINGER	6645 SW NYBERG LN	TUALATIN	OR	97062
139101	1555	WYOMING AVE	RENO	89503	CAROL J	DUSEK	1555 WYOMING AVE	RENO	NV	89503
139102	1535	WYOMING AVE	RENO	89503	ANDREW S & ANNETTE E	ROTHMAN	40 MEMORY CIR	RENO	NV	89509
139103	2401	VAN BUREN DR	RENO	89503	CHARLES B & CARLY	CRONIN	2401 VAN BUREN DR	RENO	NV	89503
139104	2405	VAN BUREN DR	RENO	89503	RICK W & LORRIE K	EDNEY	20 MILLER RIDGE RD	WELLINGTON	NV	89444
139105	2411	VAN BUREN DR	RENO	89503	DAVID & AMBER	RODRIGUEZ	2411 VAN BUREN DR	RENO	NV	89503
139201	2406	VAN BUREN DR	RENO	89503	ISIDRO & CLAUDIA	NAVA	2406 VAN BUREN DR	RENO	NV	89503
139202	1485	WYOMING AVE	RENO	89503	JOSEPH R & GLENNYS A	FEAZEL	1485 WYOMING AVE	RENO	NV	89503
139308	1490	WYOMING AVE	RENO	89503	JENNIFER	EDWARDS	1490 WYOMING AVE	RENO	NV	89503
139314	2385	VAN BUREN CT	RENO	89503	MARVIN L & DEANNA M	SMALL	10635 SUMMER GLEN DR	RENO	NV	89521
139315	1540	WYOMING AVE	RENO	89503	ROBERT J	DOYLE	1540 WYOMING AVE	RENO	NV	89503
139325	1558	WYOMING CT	RENO	89503	DANIEL M	MCKEE	1558 WYOMING CT	RENO	NV	89503
139326	1560	WYOMING CT	RENO	89503	RAYMON D & CINDY	FOOTE	1675 PINECREST CT	RENO	NV	89523
139331	1561	WYOMING CT	RENO	89503	WILLIAM E	BARSTYS TRUST	1561 WYOMING CT	RENO	NV	89503
140101	2450	SEVERN DR	RENO	89503	MELVIN	GOOD	2450 SEVERN DR	RENO	NV	89503
140102	1595	BOYER CT	RENO	89503	JONATHAN D & HILARY M	SHIPMAN	1595 BOYER CT	RENO	NV	89503
140103	1585	BOYER CT	RENO	89503		325 WEST LIBERTY LLC	540 CITADEL WAY	RENO	NV	89503
140104	1575	BOYER CT	RENO	89503	HOWARD J & SHEILA M	MICHAELS	1575 BOYER CT	RENO	NV	89503
140105	1565	BOYER CT	RENO	89503		GOODWIN FAMILY 2011 TRUST	PO BOX 398	CEDARVILLE	CA	96104
140106	1555	BOYER CT	RENO	89503	S	STOPPER LIVING TRUST	1555 BOYER CT	RENO	NV	89503
140107	1545	BOYER CT	RENO	89503		DICKERSON FAMILY TRUST	1545 BOYER CT	RENO	NV	89503
140108	1540	BOYER CT	RENO	89503	JERICA	HARASYMCHUK	1540 BOYER CT	RENO	NV	89503
140109	1550	BOYER CT	RENO	89503	BEVERLY C	JOHNSON	1550 BOYER CT	RENO	NV	89503
140110	1560	BOYER CT	RENO	89503	MATTHEW S	SNYDER	1560 BOYER CT	RENO	NV	89503
140111	1580	BOYER CT	RENO	89503		ET TRUST	538 SANTA MARGUARITA DR	APTOS	CA	95003
140112	1595	WYOMING AVE	RENO	89503	CECELIA A	NICHOLS	1595 WYOMING AVE	RENO	NV	89503
140113	1585	WYOMING AVE	RENO	89503	DAVID M JR	MIDDLETON LIVING TRUST	1585 WYOMING AVE	RENO	NV	89503
140114	1565	WYOMING AVE	RENO	89503	LISA R & JOSEPH D G	METZGAR	1565 WYOMING AVE	RENO	NV	89503
140201	1795	WYOMING AVE	RENO	89503	TORREY B & ROSEMARY W	CARROLL	PO BOX 4196	CRESTED BUTTE	CO	81224
140202	1775	WYOMING AVE	RENO	89503	JESUS D	RIVAS et al	1775 WYOMING AVE	RENO	NV	89503
140203	1765	WYOMING AVE	RENO	89503	MEGAN E	WOOD et al	1765 WYOMING AVE	RENO	NV	89503
140204	1755	WYOMING AVE	RENO	89503	EVGENY & TATIANA	SOKOLOVA	2210 THOMAS JEFFERSON DR	RENO	NV	89509
140205	1725	WYOMING AVE	RENO	89503	THOMAS H	ENGLISH	1725 WYOMING AVE	RENO	NV	89503
140206	1695	WYOMING AVE	RENO	89503		TAH 2018-1 BORROWER LLC	1508 BROOKHOLLOW DR	SANTA ANA	CA	92705
140207	1665	WYOMING AVE	RENO	89503	AMY S	TAYLOR	1665 WYOMING AVE	RENO	NV	89503
140208	1645	WYOMING AVE	RENO	89503	SAMUEL G	DUNER	1645 WYOMING AVE	RENO	NV	89503
140209	1625	WYOMING AVE	RENO	89503		O'BRIEN FAMILY TRUST	PO BOX 662	TAHOE CITY	CA	96145
140210	2405	SEVERN DR	RENO	89503	JOHN M & KATHERINE H	KELLY	PO BOX 5711	RENO	NV	89513
140211	1720	BECKY CT	RENO	89503	MARIANNE I	HODGE FAMILY TRUST	1720 BECKY CT	RENO	NV	89503
140212	1730	BECKY CT	RENO	89503	PATRICK J	FITZGERALD LIVING TRUST	305 W MOANA LN STE C	RENO	NV	89509
140213	1750	BECKY CT	RENO	89503	JACOB J & JANELLE B	WILDSCHUT	1750 BECKY CT	RENO	NV	89503
140214	1780	BECKY CT	RENO	89503	NICK & LINDA	ANDERSON FAMILY TRUST	1780 BECKY CT	RENO	NV	89503
140215	1790	BECKY CT	RENO	89503	PATRICK L	CAMPBELL	1790 BECKY CT	RENO	NV	89503
140216	1815	BECKY CT	RENO	89503	JONAS & JESSICA	BUCHHOLZ	1815 BECKY CT	RENO	NV	89503
140217	1835	BECKY CT	RENO	89503	THOMAS E	HAWKINS	1835 BECKY CT	RENO	NV	89503
140218	1855	BECKY CT	RENO	89503	GEORGE O	KOHL	1855 BECKY CT	RENO	NV	89503
140219	1875	BECKY CT	RENO	89503	VICTOR M	LEONARDI	3778 SPITZE DR	LAS VEGAS	NV	89103
140220	1885	BECKY CT	RENO	89503	BRANDON J	MORALES	1885 BECKY CT	RENO	NV	89503
140221	1895	BECKY CT	RENO	89503	NANCY S	STEVENS	1895 BECKY CT	RENO	NV	89503
140222	1880	BECKY CT	RENO	89503	DARBY	MEYER et al	12550 STILLWATER WAY	RENO	NV	89511
140223	1870	BECKY CT	RENO	89503		WARREN FAMILY TRUST	1870 BECKY CT	RENO	NV	89503
140224	1765	BECKY CT	RENO	89503	RUTH J	EACHUS FAMILY TRUST	1765 BECKY CT	RENO	NV	89503
140225	1745	BECKY CT	RENO	89503		VINCI FAMILY TRUST	1745 BECKY CT	RENO	NV	89503
146101	3001	SKY COUNTRY DR	RENO	89503	DAVID & JANE	ROBERTI LIVING TRUST	PO BOX 917	LOYALTON	CA	96118
146107	3011	SKY COUNTRY DR	RENO	89503	BONIFACIO & SILVERIA	BUSTARDE	3011 SKY COUNTRY DR	RENO	NV	89503
146108	3021	SKY COUNTRY DR	RENO	89503	ALAN	COGHLAN	3021 SKY COUNTRY DR	RENO	NV	89503
146109	3031	SKY COUNTRY DR	RENO	89503	PETER	MIKHALEV et al	6800 CHESTERFIELD LN	RENO	NV	89523
146110	3041	SKY COUNTRY DR	RENO	89503	DOMINGO Y	PINEDA et al	3041 SKY COUNTRY DR	RENO	NV	89503
146201	3305	BIG SKY DR	RENO	89503		CHARDI KALAA CORP	7245 SOUVERAIN LN	RENO	NV	89506
146202	3315	BIG SKY DR	RENO	89503	JESSIE N	YEAGER	PO BOX 625	VERDI	NV	89439
146203	3325	BIG SKY DR	RENO	89503	JASON A	THOMPSON et al	3325 BIG SKY DR	RENO	NV	89503
146204	3335	BIG SKY DR	RENO	89503	CHRISTOPHER J & AMANDA G	LACROIX	3335 BIG SKY DR	RENO	NV	89503
146205	3355	BIG SKY DR	RENO	89503	MAJOR S & RAJINDER K	BOUGHAN	3355 BIG SKY DR	RENO	NV	89503

146306	3350	BIG SKY DR	RENO	89503	JAMLONG	SRIPHONGNGARM et al	3350 BIG SKY DR	RENO	NV	89503
146307	3340	BIG SKY DR	RENO	89503	JOSE S & MARIA J	RODRIGUEZ	3340 BIG SKY DR	RENO	NV	89503
146308	3330	BIG SKY DR	RENO	89503	CHARLES S V B	WAGEMANS	3330 BIG SKY DR	RENO	NV	89503
146309	3320	BIG SKY DR	RENO	89503		SINGH FAMILY TRUST	3320 BIG SKY DR	RENO	NV	89503
146310	3310	BIG SKY DR	RENO	89503	LORENZO	TRIMBLE	3310 BIG SKY DR	RENO	NV	89503
146311	3300	BIG SKY DR	RENO	89503	FRED S	NAVARRO et al	3300 BIG SKY DR	RENO	NV	89503
147102	3020	SEVERN DR	RENO	89503	PAMELA C	FITCH	3020 SEVERN DR	RENO	NV	89503
147103	3030	SEVERN DR	RENO	89503	AARON M	WOOD et al	3030 SEVERN DR	RENO	NV	89503
147104	3040	SEVERN DR	RENO	89503	ELIZABETH K	BRACKETT 1990 TRUST	3380 BELFORD RD	RENO	NV	89509
147105	3050	SEVERN DR	RENO	89503	ANTHONY E	WALKER	3050 SEVERN DR	RENO	NV	89503
147106	3060	SEVERN DR	RENO	89503	GARY L	MAY	3060 SEVERN DR	RENO	NV	89503
147107	3070	SEVERN DR	RENO	89503	CAROL	WRIGHT TRUST	3070 SEVERN DR	RENO	NV	89503
147108	3080	SEVERN DR	RENO	89503	BRANDON A	DREELAN	3080 SEVERN DR	RENO	NV	89503
147109	4045	ANDREA ST	RENO	89503		EMERSON-BOATNER FAMILY TRUST	4045 ANDREA ST	RENO	NV	89503
147110	4035	ANDREA ST	RENO	89503		DOONAN TRUST	4035 ANDREA ST	RENO	NV	89503
147111	4025	ANDREA ST	RENO	89503	PATRICK S	DOLAN et al	4025 ANDREA ST	RENO	NV	89503
147112	4015	ANDREA ST	RENO	89503		CLIFFHOUSE INVESTMENTS LLC	16771 SOUTHVIEW DR	PIONEER	CA	95666
147113	4005	ANDREA ST	RENO	89503	ANTONIO E & MARIA L	DE LA TORRE	4005 ANDREA ST	RENO	NV	89503
147114	3095	ANDREA ST	RENO	89503	JOSHUA	KEMP	3095 ANDREA ST	RENO	NV	89503
147115	3085	ANDREA ST	RENO	89503	SUSAN C	STOTLER	3085 ANDREA ST	RENO	NV	89503
147116	3075	ANDREA ST	RENO	89503	JOANNE C	TYSON FAMILY TRUST	2601 BURR CT	RENO	NV	89509
147117	3065	ANDREA ST	RENO	89503	ADAM M	AUERBACH TRUST	2075 ROCK HAVEN DR	RENO	NV	89511
147118	3055	ANDREA ST	RENO	89503	MARK D	MIDDLETON	5637 ADOBE RD	ROCKLIN	CA	95765
147119	3045	ANDREA ST	RENO	89503	CHERRY A	CASTILLO et al	11360 TORINO WAY	RENO	NV	89521
147120	3035	ANDREA ST	RENO	89503	WARNER W	WHIPPLE	975 5TH ST	ELKO	NV	89801
147121	3025	ANDREA ST	RENO	89503	BRADLEY J & KIMBERLY	WASS	3025 ANDREA ST	RENO	NV	89503
147122	3015	ANDREA ST	RENO	89503	FEDERICO	LIM	PO BOX 6172	RENO	NV	89513
147123	3005	ANDREA ST	RENO	89503	MICHAEL & MICHELLE	MOODY	3005 ANDREA ST	RENO	NV	89503
147125	3010	SEVERN DR	RENO	89503	DAVID F & CHELSEA H	MAYNARD	3010 SEVERN DR	RENO	NV	89503
147301	2490	SERENA DR	RENO	89503	DAVID & CHARLENE	KANAK LIVING TRUST	100 STERLING OAKS DR APT 244	CHICO	CA	95928-9461
147302	2478	SERENA DR	RENO	89503	JEANNIE S	SELIM 2015 LIVING TRUST	2478 SERENA DR	RENO	NV	89503
147303	2466	SERENA DR	RENO	89503	DONALD J & KATHLEEN J	BEATY	12484 STONY CREEK CT	TRUCKEE	CA	96161
147304	2452	SERENA DR	RENO	89503	KATELYNN	MASON	2452 SERENA DR	RENO	NV	89503
147305	2440	SERENA DR	RENO	89503	THOMAS J	GORDON	2440 SERENA DR	RENO	NV	89503
147306	2428	SERENA DR	RENO	89503	ALAN & EUPHEMIA M	WRIGHT	2428 SERENA DR	RENO	NV	89503
147307	2416	SERENA DR	RENO	89503	DANA J	JULIAN	2416 SERENA DR	RENO	NV	89503
147308	2404	SERENA DR	RENO	89503		EMERALD SAGE LLC	2885 SANFORD AVE SW # 20562	GRANDVILLE	MI	49418
147401	2405	SERENA DR	RENO	89503	JASON & SANDY	HAGGERTY	2405 SERENA DR	RENO	NV	89503
147402	2417	SERENA DR	RENO	89503		NOBLE LIVING TRUST	2417 SERENA DR	RENO	NV	89503
147403	2429	SERENA DR	RENO	89503	PHILIP A	SHARP	2429 SERENA DR	RENO	NV	89503
147404	2441	SERENA DR	RENO	89503	ROBERT A & TAYLOR C	SEARS et al	2441 SERENA DR	RENO	NV	89503
147405	2453	SERENA DR	RENO	89503	DAVID R	SPEGAL	2453 SERENA DR	RENO	NV	89503
147406	2467	SERENA DR	RENO	89503		BARAKAT LIVING TRUST	695-825 GOLD RUN RD	SUSANVILLE	CA	96130
147407	2479	SERENA DR	RENO	89503	DUSTIN W	MILLS	2479 SERENA DR	RENO	NV	89503
147408	4010	ANDREA ST	RENO	89503	TERRENCE	SPAMPANATO	2855 SAGITTARIUS DR	RENO	NV	89509
147409	4020	ANDREA ST	RENO	89503		VERBURG-USELMAN FAMILY 2019 TRUST	4020 ANDREA ST	RENO	NV	89503
147410	4030	ANDREA ST	RENO	89503	JUAN & ELVIA	SANCHEZ	4030 ANDREA ST	RENO	NV	89503
147411	4040	ANDREA ST	RENO	89503		SEMPRE INSIEME TRUST	PO BOX 5548	FALLON	NV	89407
148101	3290	SNAKE RIVER DR	RENO	89503		RENO CITY OF	PO BOX 1900	RENO	NV	89505
149101	3101	PLATTE RIVER DR	RENO	89503	IQBAL S	SIDHU	3101 PLATTE RIVER DR	RENO	NV	89503
149201	3100	PLATTE RIVER DR	RENO	89503	KEVIN T	SHOEMAKER	3100 PLATTE RIVER DR	RENO	NV	89503
149202	3071	SKY COUNTRY DR	RENO	89503	SUNNY & TU	NGUYEN	3071 SKY COUNTRY DR	RENO	NV	89503
149203	3081	SKY COUNTRY DR	RENO	89503	VINHSONHAI	LUAN et al	3081 SKY COUNTRY DR	RENO	NV	89503
149301	3303	SNAKE RIVER DR	RENO	89503	VIRGILIO D	VALLO	3303 SNAKE RIVER DR	RENO	NV	89503
149302	3311	SNAKE RIVER DR	RENO	89503	SHAHZAD	AHMAD	6700 KISKADEE DR	SPARKS	NV	89436
149303	3327	SNAKE RIVER DR	RENO	89503	MARK S & JOYCE E	LARSEN	3327 SNAKE RIVER DR	RENO	NV	89503
149406	3326	SNAKE RIVER DR	RENO	89503	MONICA N	SALLIOTTE et al	3326 SNAKE RIVER DR	RENO	NV	89503
149407	3318	SNAKE RIVER DR	RENO	89503	JOSE L & AIDA	ARIAS	3318 SNAKE RIVER DR	RENO	NV	89503
149408	3310	SNAKE RIVER DR	RENO	89503		BENSON LIVING TRUST	3310 SNAKE RIVER DR	RENO	NV	89503
149409	3302	SNAKE RIVER DR	RENO	89503	LAP T	PHAN et al	3302 SNAKE RIVER DR	RENO	NV	89503
150101	3061	GREEN RIVER CT	RENO	89503	DENAE	GRANGER et al	3061 GREEN RIVER CT	RENO	NV	89503
150102	3071	GREEN RIVER CT	RENO	89503	RICHARD J & DE ANNA J	ZUNINO	3071 GREEN RIVER CT	RENO	NV	89503
150103	3081	GREEN RIVER CT	RENO	89503	SYDNEY	SIMAS et al	3081 GREEN RIVER CT	RENO	NV	89503

150104	3091	GREEN RIVER CT	RENO	89503	ALVIN T & MARISSA J	VU	1547 PRINCETON DR	SAN JOSE	CA	95118
150105	3101	GREEN RIVER DR	RENO	89503	BRIAN M & CASEY M	FLEISCHER	3101 GREEN RIVER DR	RENO	NV	89503
150106	3111	GREEN RIVER DR	RENO	89503	ARNOLD C	LEONG TRUST	3111 GREEN RIVER DR	RENO	NV	89503
150107	3121	GREEN RIVER DR	RENO	89503	STEVE	HIGLEY	3121 GREEN RIVER DR	RENO	NV	89503
150108	3131	GREEN RIVER DR	RENO	89503	ROBIN	BUTLER	3131 GREEN RIVER DR	RENO	NV	89503
150204	3140	GREEN RIVER DR	RENO	89503	BRUCE S & BARBARA D	HARPER TRUST	3140 GREEN RIVER DR	RENO	NV	89503
150205	3130	GREEN RIVER DR	RENO	89503	NERIO C & ANICETA D	GALIMA	3130 GREEN RIVER DR	RENO	NV	89503
150206	3120	GREEN RIVER DR	RENO	89503	ENRIQUETA	CORONA-MEDEROS	1344 S WELLS AVE	RENO	NV	89502
150207	3110	GREEN RIVER DR	RENO	89503	ROLAND E	MANABAT et al	3110 GREEN RIVER DR	RENO	NV	89503
150208	3100	GREEN RIVER DR	RENO	89503	BRIAN R & BARBARA J	COLLIER	3100 GREEN RIVER DR	RENO	NV	89503
150209	3111	PLATTE RIVER DR	RENO	89503	JEFFREY S & MARIA T M	SINOCRUZ	3111 PLATTE RIVER DR	RENO	NV	89503
150210	3121	PLATTE RIVER DR	RENO	89503	ADRIENNE R	PETERSEN	3121 PLATTE RIVER DR	RENO	NV	89503
150211	3131	PLATTE RIVER DR	RENO	89503	NOEL L & ELEANOR G	MONZON	3131 PLATTE RIVER DR	RENO	NV	89503
150212	3141	PLATTE RIVER DR	RENO	89503		PURDY TRUST	3141 PLATTE RIVER DR	RENO	NV	89503
150303	3140	PLATTE RIVER DR	RENO	89503		PHILLIPS TRUST	3140 PLATTE RIVER DR	RENO	NV	89503
150304	3130	PLATTE RIVER DR	RENO	89503	DANNY L & DEBRA L	FOSTER	3130 PLATTE RIVER DR	RENO	NV	89503
150305	3120	PLATTE RIVER DR	RENO	89503	CRISTINA	TURCAN	3120 PLATTE RIVER DR	RENO	NV	89503
150306	3110	PLATTE RIVER DR	RENO	89503	RAYMOND L & DEBRA G	POLAK	3110 PLATTE RIVER DR	RENO	NV	89503
150307	3091	SKY COUNTRY DR	RENO	89503	MARSHA H	LEE	3091 SKY COUNTRY DR	RENO	NV	89503
150308	3101	SKY COUNTRY DR	RENO	89503	DAVID G & KATHY W	REID	3101 SKY COUNTRY DR	RENO	NV	89503
150402	3110	SKY COUNTRY DR	RENO	89503	PATRICK & JANET	HAMILL LIVING TRUST	3110 SKY COUNTRY DR	RENO	NV	89503
150501	3080	GREEN RIVER CT	RENO	89503	STEVEN M	GHIGLIERI	880 KIRMAN AVE	RENO	NV	89502
150502	3070	GREEN RIVER CT	RENO	89503	CARINA A	BLACK	3070 GREEN RIVER CT	RENO	NV	89503
150503	3060	GREEN RIVER CT	RENO	89503	JAMES S	DUTHIE	3060 GREEN RIVER CT	RENO	NV	89503
161001										
161002										
161004										
161005										
161301										
202014	0	MCCARRAN BLVD	RENO	89503		CHARDI KALAA CORPORATION	7245 SOUVERAIN LN	RENO	NV	89506
202015	300	MCCARRAN BLVD	WASHOE COUNTY	89503		WASHOE COUNTY	1001 E 9TH ST BLDG A	RENO	NV	89512
202017	0	MCCARRAN BLVD	WASHOE COUNTY	89503		WASHOE COUNTY	1001 E 9TH ST BLDG A	RENO	NV	89512
202019	0	KEYSTONE AVE	RENO	89503		CHARDI KALAA CORPORATION	7245 SOUVERAIN LN	RENO	NV	89506
202020	0	KEYSTONE AVE	RENO	89503		RENO CITY OF	PO BOX 1900	RENO	NV	89505
202021	0	MCCARRAN BLVD	RENO	89503		LEADERSHIP MASTER LLC	11890 DONNER PASS RD # 4	TRUCKEE	CA	96161
202022	0	MCCARRAN BLVD	RENO	89503		LEADERSHIP MASTER LLC	11890 DONNER PASS RD # 4	TRUCKEE	CA	96161
207107	2315	COTTAGE CT	RENO	89503	KEVIN	SAWYER et al	2315 COTTAGE CT	RENO	NV	89503
207108	1720	PEAVINE RD	RENO	89503	LEROY G	DRACE	1720 PEAVINE RD	RENO	NV	89503
207109	1740	PEAVINE RD	RENO	89503	BRANDON	CARLSON	1740 PEAVINE RD	RENO	NV	89503
207110	1750	PEAVINE RD	RENO	89503	GLENN & PATRICIA	MELOSH FAMILY TRUST	2685 SUNRISE AVE	SANTA ROSA	CA	95409
207201	1745	PEAVINE RD	RENO	89503		SLAGLE FAMILY TRUST	1745 PEAVINE RD	RENO	NV	89503
207202	1735	PEAVINE RD	RENO	89503	ROXANNE D	BROWN TRUST et al	PO BOX 6534	RENO	NV	89513
207203	1725	PEAVINE RD	RENO	89503	ANDREW V	HANKS	1725 PEAVINE RD	RENO	NV	89503
207204	1715	PEAVINE RD	RENO	89503		DIGENAN FAMILY TRUST	201 SKYLINE DR	ELKO	NV	89801
207205	1705	PEAVINE RD	RENO	89503	LINDA D	METZGER	11524 DEODAR WAY	RENO	NV	89506
207206	1695	PEAVINE RD	RENO	89503	WALTER JR & CHRISTINA	CAMARENA	13344 RIDGELANE DR NW	SILVERDALE	WA	98383
207207	1685	PEAVINE RD	RENO	89503	ROCKLIN & SHAWNA	DRAFTON	1685 PEAVINE RD	RENO	NV	89503
207208	1675	PEAVINE RD	RENO	89503	BRIAN	DELUCA	1675 PEAVINE RD	RENO	NV	89503
207209	2540	KEYSTONE AVE	RENO	89503	MATTHEW L	LEATHEN	2540 KEYSTONE AVE	RENO	NV	89503
207210	2550	KEYSTONE AVE	RENO	89503	AARON J	MILLER et al	2550 KEYSTONE AVE	RENO	NV	89503
207211	2560	KEYSTONE AVE	RENO	89503		PPMC FAMILY TRUST	PO BOX 278484	SACRAMENTO	CA	95827
207212	2570	KEYSTONE AVE	RENO	89503	RAMONCITO L	REYES	1448 SNOW SUMMIT DR	RENO	NV	89523
207213	2580	KEYSTONE AVE	RENO	89503		SLAGLE FAMILY TRUST	1745 PEAVINE RD	RENO	NV	89503
207214	2590	KEYSTONE AVE	RENO	89503	TRAVIS	BURROUGHS	2590 KEYSTONE AVE	RENO	NV	89503
207215	2600	KEYSTONE AVE	RENO	89503	RODNEY M & GILDA H	KINGSBURY	2600 KEYSTONE AVE	RENO	NV	89503
208207	1605	PEAVINE RD	RENO	89503	ROBIN & MICHAEL P	URSITTI	3939 SILVER LACE LN	REDDING	CA	96001
208208	2470	KEYSTONE AVE	RENO	89503	KENT	WONG et al	PO BOX 22521	CARSON CITY	NV	89721
208209	2480	KEYSTONE AVE	RENO	89503	DAVID J & KELLY J	DUELL et al	2480 KEYSTONE AVE	RENO	NV	89503
208211	2500	KEYSTONE AVE	RENO	89503	ELLEN	CAMPBELL	331 STONEY RIDGE CIR	PRESCOTT	AZ	86303
208212	2510	KEYSTONE AVE	RENO	89503	ALEX T	LOOBY	2510 KEYSTONE AVE	RENO	NV	89503
208213	2520	KEYSTONE AVE	RENO	89503	TODD	BARBER	2520 KEYSTONE AVE	RENO	NV	89503
208214	2530	KEYSTONE AVE	RENO	89503	DARBY M & JOHN D	BRYANT	10180 GOLD MINE DR	RENO	NV	89521
208301	2455	KEYSTONE AVE	RENO	89503	SEAN R & KATHERINE L	MICKEY	2455 KEYSTONE AVE	RENO	NV	89503

209101	2855	KEYSTONE AVE	RENO	89503	EDWARD F & ERLINDA	MONDRAGON	2855 KEYSTONE AVE	RENO	NV	89503
209103	2685	KEYSTONE AVE	RENO	89503	JOHN C & JACQUELYN	DUKE	2685 KEYSTONE AVE	RENO	NV	89503
209201	1995	PEAVINE RD	RENO	89503	TODD A & ROSE C	BELCHER	1995 PEAVINE RD	RENO	NV	89503
209202	1975	PEAVINE RD	RENO	89503		BARKER-HILL 2006 FAMILY TRUST	1975 PEAVINE RD	RENO	NV	89503
209203	1965	PEAVINE RD	RENO	89503	MEAGANROSE K	CASTRO	1965 PEAVINE RD	RENO	NV	89503
209204	1955	PEAVINE RD	RENO	89503	MELISSA A & STEVEN G	BANAS	1955 PEAVINE RD	RENO	NV	89503
209205	1935	PEAVINE RD	RENO	89503	M BUFORD & SHIRLEY	ROBEY	1935 PEAVINE RD	RENO	NV	89503
209206	1915	PEAVINE RD	RENO	89503	JAMES A & SONJA L	COX	1915 PEAVINE RD	RENO	NV	89503
209207	1895	PEAVINE RD	RENO	89503	SIONE S & SELA	MOKOFISI	4151 HUBBLE CT	SPARKS	NV	89436
209208	1865	PEAVINE RD	RENO	89503	RAYMON	FOOTE	1675 PINECREST CT	RENO	NV	89523
209209	1845	PEAVINE RD	RENO	89503	NOAH	GLICK et al	1845 PEAVINE RD	RENO	NV	89503
209210	1835	PEAVINE RD	RENO	89503	GRANT	WELLER	1835 PEAVINE RD	RENO	NV	89503
209211	1795	PEAVINE CT	RENO	89503		SHILES LIVING TRUST	1795 PEAVINE CT	RENO	NV	89503
209212	1785	PEAVINE CT	RENO	89503	PHILIP J & PAULA A	GLOVER FAMILY TRUST	1785 PEAVINE CT	RENO	NV	89503
209213	1775	PEAVINE CT	RENO	89503	MARK W	SINGLETON et al	1775 PEAVINE CT	RENO	NV	89503
209214	1765	PEAVINE CT	RENO	89503	CHRISTOPHER M & JAIMIE A	TRIBBLE	1765 PEAVINE CT	RENO	NV	89503
209215	1755	PEAVINE CT	RENO	89503	DAN A	JENKINS	1755 PEAVINE CT	RENO	NV	89503
209217	2610	KEYSTONE AVE	RENO	89503	QUYEN Q	TRAN et al	2610 KEYSTONE AVE	RENO	NV	89503
209218	2620	KEYSTONE AVE	RENO	89503	ASHLEY R	HENSLEY et al	2620 KEYSTONE AVE	RENO	NV	89503
209219	2630	KEYSTONE AVE	RENO	89503	DEMETRIUS J & LINDSEY A	MCBRIDE	2630 KEYSTONE AVE	RENO	NV	89503
209220	2640	KEYSTONE AVE	RENO	89503	WILLIAM III	ANDERSON	2640 KEYSTONE AVE	RENO	NV	89503
209221	2420	DURANGO CT	RENO	89503	JOHN J & PATRICIA A	MCDONALD	2420 DURANGO CT	RENO	NV	89503
209222	2410	DURANGO CT	RENO	89503	CYNTHIA M	BARTL	2410 DURANGO CT	RENO	NV	89503
209223	2400	DURANGO CT	RENO	89503	JUDITH A	PURSER TRUST	2400 DURANGO CT	RENO	NV	89503
209224	2405	DURANGO CT	RENO	89503	JIMMY L & SARALEE	KWEK	2405 DURANGO CT	RENO	NV	89503
209225	2415	DURANGO CT	RENO	89503	JOHN T & KRISTI M	SARIKAKIS	2415 DURANGO CT	RENO	NV	89503
209226	2660	KEYSTONE AVE	RENO	89503		SORENSON FAMILY 2020 TRUST	100 SHELTER CT	RENO	NV	89521
209227	2680	KEYSTONE AVE	RENO	89503	RUSSELL C & MELISSA	WHIPPLE	2680 KEYSTONE AVE	RENO	NV	89503
209301	1770	PEAVINE RD	RENO	89503	BEVERLY A & JOHN	GEYER	1770 PEAVINE RD	RENO	NV	89503
209302	1790	PEAVINE RD	RENO	89503	SHANON & SCOTT	TAYLOR	1790 PEAVINE RD	RENO	NV	89503
209303	1800	PEAVINE RD	RENO	89503	JOSE L	CUEVAS-VERA et al	1800 PEAVINE RD	RENO	NV	89503
209304	1820	PEAVINE RD	RENO	89503	ALFONSO G & MARTHA L	ARREDONDO	1820 PEAVINE RD	RENO	NV	89503
209305	1830	PEAVINE RD	RENO	89503		RUBINSTEIN FAMILY TRUST	1830 PEAVINE RD	RENO	NV	89503
209306	1850	PEAVINE RD	RENO	89503	FRANCIS E	BURNS	PO BOX 5533	RENO	NV	89513
209307	1870	PEAVINE RD	RENO	89503	DAVID W & ANALISA U	ZIMMERMAN	575 COUNTRY DR	FERNLEY	NV	89408
209308	1890	PEAVINE RD	RENO	89503	JAMES A	CREMEANS	1890 PEAVINE RD	RENO	NV	89503
209309	1900	PEAVINE RD	RENO	89503	ANNE E	WALLACE	1900 PEAVINE RD	RENO	NV	89503
209310	1920	PEAVINE RD	RENO	89503	RICHARD A & JENNIFER R	CHRISTIAN	1920 PEAVINE RD	RENO	NV	89503
209311	1940	PEAVINE RD	RENO	89503	JOAN M	HALLAHAN	1940 PEAVINE RD	RENO	NV	89503
209312	1950	PEAVINE RD	RENO	89503		WELLS FAMILY TRUST	PO BOX 4081	STATELINE	NV	89449
209313	1960	PEAVINE RD	RENO	89503	STEVEN & CHRISTINE	BRANUM	1960 PEAVINE RD	RENO	NV	89503
209314	1990	PEAVINE RD	RENO	89503	LYNNE M	NELSON	1990 PEAVINE RD	RENO	NV	89503
209315	2910	KEYSTONE AVE	RENO	89503		FU LIVING TRUST	1790 KING EDWARD DR	RENO	NV	89503
209316	2920	KEYSTONE AVE	RENO	89503	ANTONIO S & ROSA ELENA G	MIRAMONTES	470 N TRESCOTT AVE SPC A	BATTLE MOUNTAIN	NV	89820-2822
209501	0	UNSPECIFIED	RENO	89503		RENO CITY OF	PO BOX 1900	RENO	NV	89505
209601	1880	VAN NESS AVE	RENO	89503	ANDREW C	BROWN	1880 VAN NESS AVE	RENO	NV	89503
209602	1890	VAN NESS AVE	RENO	89503		DAM PROPERTIES LLC	3565 LONE TREE LN	RENO	NV	89511
209603	1900	VAN NESS AVE	RENO	89503	DONNA R	CAREY	1900 VAN NESS AVE	RENO	NV	89503
209604	1930	VAN NESS AVE	RENO	89503	IRENA & SIGITAS	JAKAITIENE	1930 VAN NESS AVE	RENO	NV	89503
209605	1960	VAN NESS AVE	RENO	89503	JOHN B & PAULA J	CRANDELL	1960 VAN NESS AVE	RENO	NV	89503
209606	1980	VAN NESS AVE	RENO	89503		TRAVELLA FAMILY TRUST	1980 VAN NESS AVE	RENO	NV	89503
209607	1990	VAN NESS AVE	RENO	89503	JAY W & SARA J	LAWRENCE	1990 VAN NESS AVE	RENO	NV	89503
209701	1965	VAN NESS AVE	RENO	89503	DONALD E JR	BUTTERFIELD et al	1965 VAN NESS AVE	RENO	NV	89503
209702	1925	VAN NESS AVE	RENO	89503	WENDY L	BROADHEAD	1925 VAN NESS AVE	RENO	NV	89503
209703	1901	VAN NESS AVE	RENO	89503	JUDY F	EDDY LIVING TRUST	1901 VAN NESS AVE	RENO	NV	89503
211001	2315	IVES CT	RENO	89503		BOARDWALK HEALTH HOLDINGS LLC	PO BOX 128109	NASHVILLE	TN	37212
211002	2325	IVES CT	RENO	89503		BOARDWALK HEALTH HOLDINGS LLC	PO BOX 128109	NASHVILLE	TN	37212
211003	2335	IVES CT	RENO	89503		BOARDWALK HEALTH HOLDINGS LLC	PO BOX 128109	NASHVILLE	TN	37212
211004	2345	IVES CT	RENO	89503		BOARDWALK HEALTH HOLDINGS LLC	PO BOX 128109	NASHVILLE	TN	37212
211005	2355	IVES CT	RENO	89503		BOARDWALK HEALTH HOLDINGS LLC	PO BOX 128109	NASHVILLE	TN	37212
211006	2365	IVES CT	RENO	89503		BOARDWALK HEALTH HOLDINGS LLC	PO BOX 128109	NASHVILLE	TN	37212
211007	2360	IVES CT	RENO	89503		BOARDWALK HEALTH HOLDINGS LLC	PO BOX 128109	NASHVILLE	TN	37212
211008	2350	IVES CT	RENO	89503		BOARDWALK HEALTH HOLDINGS LLC	PO BOX 128109	NASHVILLE	TN	37212

211009	2330	IVES CT	RENO	89503		BOARDWALK HEALTH HOLDINGS LLC	PO BOX 128109	NASHVILLE	TN	37212
211010	2320	IVES CT	RENO	89503		BOARDWALK HEALTH HOLDINGS LLC	PO BOX 128109	NASHVILLE	TN	37212
211011	2305	IVES CT	RENO	89503		BOARDWALK HEALTH HOLDINGS LLC	PO BOX 128109	NASHVILLE	TN	37212
213103	2245	IVES AVE	RENO	89503	LESLIE G & VIRGINIA	MACHEN TRUST	2245 IVES AVE	RENO	NV	89503
213104	2255	IVES AVE	RENO	89503	AMANDA	ROBERTSON	2255 IVES AVE	RENO	NV	89503
213105	2265	IVES AVE	RENO	89503	MARVELL L	KELLEN FAMILY TRUST	2265 IVES AVE	RENO	NV	89503
213106	2275	IVES AVE	RENO	89503	NICKOLAS E	NIEMANN	2275 IVES AVE	RENO	NV	89503
213107	2285	IVES AVE	RENO	89503	STEVEN	ZUVICICH	2285 IVES AVE	RENO	NV	89503
213108	2295	IVES AVE	RENO	89503	JASON L	HANSEN	2295 IVES AVE	RENO	NV	89503
213109	2301	IVES AVE	RENO	89503	SHELLIE	SCHOPPE	2301 IVES AVE	RENO	NV	89503
213110	2325	IVES AVE	RENO	89503	JACOB L & NICOLE L	CHATELLE	2325 IVES AVE	RENO	NV	89503
213111	2355	IVES AVE	RENO	89503	BRIN T & STEPHANIE A	REYNOLDS	2355 IVES AVE	RENO	NV	89503
213201	2295	ARCANE AVE	RENO	89503	BRIAN E & DESIREE A	VALLES	2295 ARCANE AVE	RENO	NV	89503
213202	2270	IVES AVE	RENO	89503		DIMINIO LLC SERIES 13	890 NEPTUNE CT	RENO	NV	89512
213204	2250	IVES AVE	RENO	89503	THOMAS	CALHOUN et al	2565 S GAYLORD ST	DENVER	CO	80210
213205	2240	IVES AVE	RENO	89503	PHILLIP C	LONGBALLA et al	2240 IVES AVE	RENO	NV	89503
213211	2255	WARD PL	RENO	89503	PAUL G	HUBBARD	2255 WARD PL	RENO	NV	89503
213213	2295	WARD PL	RENO	89503		MARTINI FAMILY TRUST	2295 WARD PL	RENO	NV	89503
213214	2285	ARCANE AVE	RENO	89503	GARY D	WALKER	2285 ARCANE AVE	RENO	NV	89503
213215	2275	WARD PL	RENO	89503	KEVIN	HALL	2275 WARD PL	RENO	NV	89503
213216	2260	IVES AVE	RENO	89503	VIDUR	MAHADEVA	2260 IVES AVE	RENO	NV	89503
213302	2290	ARCANE AVE	RENO	89503		SULLIVAN MATTHEWS FAMILY TRUST	2290 ARCANE AVE	RENO	NV	89503
213314	2280	ARCANE AVE	RENO	89503	BILLY F JR & COLLEEN	BAKER	2280 ARCANE AVE	RENO	NV	89503
213315	2260	ARCANE AVE	RENO	89503	GERALD G	STOTLER	2260 ARCANE AVE	RENO	NV	89503
213316	2250	ARCANE AVE	RENO	89503	DANIEL L & TETIANA V	GERBER	2250 ARCANE AVE	RENO	NV	89503
213317	2240	ARCANE AVE	RENO	89503	SUSAN J	MILES	2240 ARCANE AVE	RENO	NV	89503
213318	2230	ARCANE AVE	RENO	89503	KEVIN P	RYAN	4881 RAMCREEK TRL	RENO	NV	89519
213326	2340	IVES AVE	RENO	89503	JAMES E & CAROL L	ARDEN	2340 IVES AVE	RENO	NV	89503
213327	2288	ARCANE AVE	RENO	89503	MARSHA L	JAMISON	2288 ARCANE AVE	RENO	NV	89503
213328	0	IVES AVE	RENO	89503	JAMES E & CAROL L	ARDEN	2340 IVES AVE	RENO	NV	89503
213401	2290	WARD PL	RENO	89503	BOHDAN & HALYNA	KINASH	914 COLUMBIA CT	GARDNERVILLE	NV	89460
219401	1510	PEAVINE RD	RENO	89503		EARDLEY LIVING TRUST	1510 PEAVINE RD	RENO	NV	89503
219402	1530	PEAVINE RD	RENO	89503	GREGORY J	HOFF et al	1530 PEAVINE RD	RENO	NV	89503
219403	1550	PEAVINE RD	RENO	89503	GREGORY	GULLA	1550 PEAVINE RD	RENO	NV	89503
219406	1570	PEAVINE RD	RENO	89503	MARK J & VIRGINIA B	LENZ JOINT LIVING TRUST	1570 PEAVINE RD	RENO	NV	89503
219407	2375	KEYSTONE AVE	RENO	89503	MICHAEL J	LINDBERG et al	2375 KEYSTONE AVE	RENO	NV	89503
219409	2365	KEYSTONE AVE	RENO	89503	HEATHER	SLOANE	2365 KEYSTONE AVE	RENO	NV	89503
219504	1620	PEAVINE RD	RENO	89503	ASHLEY L	SANTTI	1620 PEAVINE RD	RENO	NV	89503
219506	2370	KEYSTONE AVE	RENO	89503		TJ MACH I LLC	450 VERA DR	RENO	NV	89511
219507	2350	KEYSTONE AVE	RENO	89503	CLINTON	FOLTZ	2350 KEYSTONE AVE	RENO	NV	89503
219508	2340	KEYSTONE AVE	RENO	89503	DANIELLE	LECLAIR	4033 STATE ST	BRIDGEPORT	MI	48722
220101	0	UNSPECIFIED	RENO	89503		RENO CITY OF	PO BOX 1900	RENO	NV	89505
220201	0	UNSPECIFIED	RENO	89503		RENO CITY OF	PO BOX 1900	RENO	NV	89505
221106	2250	PUTNAM DR	RENO	89503	SHERYL L & STEVE A	LAGUNA	2250 PUTNAM DR	RENO	NV	89503
221108	2141	COBBLESTONE CT	RENO	89503	SCOTT & NATALIE	FENLEY	2141 COBBLESTONE CT	RENO	NV	89503
221109	2151	COBBLESTONE CT	RENO	89503	MICHAEL L	BELLI et al	450 SUNSHINE LN	RENO	NV	89502
221110	2181	COBBLESTONE CT	RENO	89503		RENO KOREAN PRESBYTERIAN CHURCH	148 RICHARDS WAY	SPARKS	NV	89431
221111	2195	COBBLESTONE CT	RENO	89503	SCHOLASTIKA M & CHARLES M	MUTISYA	PO BOX 9244	RENO	NV	89507
221112	2225	COBBLESTONE CT	RENO	89503	STEPHANIE A	HIX	2225 COBBLESTONE CT	RENO	NV	89503
221113	2245	COBBLESTONE CT	RENO	89503	RICHARD & MONICA	ANDERSON	1701 HANOVER ST	RENO	NV	89523
221114	2261	COBBLESTONE CT	RENO	89503	BRYCE K	POLLOCK	2261 COBBLESTONE CT	RENO	NV	89503
221115	2290	PUTNAM DR	RENO	89503		FERNHOFF RESIDENTIAL PROPERTIES LLC	680 JUNIPER HILL RD	RENO	NV	89519
221201	1345	PEAVINE RD	RENO	89503	NANCY K & RANDALL R	RHEW et al	1285 COMMERCE ST	SPARKS	NV	89431
221202	1385	PEAVINE RD	RENO	89503	MICHAEL W & KELLI A	PILCHER	PO BOX 886	VERDI	NV	89439
221203	1380	VAN NESS AVE	RENO	89503	MAXWELL J	GEORGESON et al	1380 VAN NESS AVE	RENO	NV	89503
221204	2325	PUTNAM DR	RENO	89503	DANIEL L & SANDRA J	GOTTA	2325 PUTNAM DR	RENO	NV	89503
221205	1350	VAN NESS AVE	RENO	89503		CHATELLE FAMILY TRUST	1350 VAN NESS AVE	RENO	NV	89503
221301	2326	PUTNAM DR	RENO	89503	KEVIN	PORTER	2326 PUTNAM DR	RENO	NV	89503
221302	2260	COBBLESTONE CT	RENO	89503		MOJO-001 LLC	4272 DANT BLVD	RENO	NV	89519
221303	2250	COBBLESTONE CT	RENO	89503	DARLEEN	AZIZISEFAT LIVING TRUST	PO BOX 5480	RENO	NV	89513
221304	2240	COBBLESTONE CT	RENO	89503	SHARON M & BRUCE V	FERRIGNO	2240 COBBLESTONE CT	RENO	NV	89503
221305	2230	COBBLESTONE CT	RENO	89503	SEAN P	PATTERSON	540 CITADEL WAY	RENO	NV	89503
221306	2220	COBBLESTONE CT	RENO	89503	JOSE M	TIBADUIZA et al	2220 COBBLESTONE CT	RENO	NV	89503

221307	2210	COBBLESTONE CT	RENO	89503	THOMAS M	ALDRICH et al	2210 COBBLESTONE CT	RENO	NV	89503
221308	2200	COBBLESTONE CT	RENO	89503	JOSE M	TIBADUIZA	2200 COBBLESTONE CT	RENO	NV	89503
221309	2190	COBBLESTONE CT	RENO	89503	DANIEL J	SCHWARTZ	2190 COBBLESTONE CT	RENO	NV	89503
221310	2180	COBBLESTONE CT	RENO	89503	REX A & ALICE M	MAXWELL	2180 COBBLESTONE CT	RENO	NV	89503
221311	2170	COBBLESTONE CT	RENO	89503	NICHOLAS R	POLINKO	6400 SHARLANDS AVE APT J2057	RENO	NV	89523
221312	2160	COBBLESTONE CT	RENO	89503	SANDRA L	CASEY	2160 COBBLESTONE CT	RENO	NV	89503
221313	2150	COBBLESTONE CT	RENO	89503		RICHARD MAZZA & ESTHER ISAAC FAMILY TRUST	5998 N WHITE SANDS RD	RENO	NV	89511
221314	2140	COBBLESTONE CT	RENO	89503	CATHLEEN A	GREEN et al	195 STAGS LEAP CIR	SPARKS	NV	89441
221316	0	PUTNAM DR	RENO	89503		TRUCKEE MEADOWS WATER AUTHORITY	PO BOX 30013	RENO	NV	89520
222245	0	UNSPECIFIED	RENO	89503		HIGH SIERRA CONSTRUCTION	59 DAMONTE RANCH PKWY # B355	RENO	NV	89521-1907
223204	2060	BONNEVILLE AVE	RENO	89503	BERNARD	FLETCHER	2060 BONNEVILLE AVE	RENO	NV	89503
223205	2050	BONNEVILLE AVE	RENO	89503	MAJID L	KAZEMI TRUST	2050 BONNEVILLE AVE	RENO	NV	89503
223206	2040	BONNEVILLE AVE	RENO	89503	DAVID & GWEN	KUBIN	2040 BONNEVILLE AVE	RENO	NV	89503
223207	2030	BONNEVILLE AVE	RENO	89503	MELANIE C	YOUNG	2030 BONNEVILLE AVE	RENO	NV	89503
223208	2020	BONNEVILLE AVE	RENO	89503	JACK B & CAROLYN	LEGGETT TRUST	2020 BONNEVILLE AVE	RENO	NV	89503
223232	2080	BONNEVILLE AVE	RENO	89503	KATHY	MCGARR LIVING TRUST	2080 BONNEVILLE AVE	RENO	NV	89503
223233	2070	BONNEVILLE AVE	RENO	89503	SCOTT A & MONIQUE S	SADY	2070 BONNEVILLE AVE	RENO	NV	89503
223234	2090	BONNEVILLE AVE	RENO	89503	RAYMOND G	ALBRECHT	5015 PLEASANT VIEW DR	SPARKS	NV	89434
223238	1975	PUTNAM DR	RENO	89503		PROULX LIVING TRUST	1975 PUTNAM DR	RENO	NV	89503
223239	2110	KEYSTONE AVE	RENO	89503	JUAN R & PATRICIA	FIGUEROA	2110 KEYSTONE AVE	RENO	NV	89503
223240	2120	KEYSTONE AVE	RENO	89503	ARIELLE	KOSHKIN	2120 KEYSTONE AVE	RENO	NV	89503
223242	2130	KEYSTONE AVE	RENO	89503	STACI J	BONE	2130 KEYSTONE AVE	RENO	NV	89503
223243	2140	KEYSTONE AVE	RENO	89503		PADILLA FAMILY TRUST	280 W HIGHLAND DR	HENDERSON	NV	89015
223244	2150	KEYSTONE AVE	RENO	89503	LEO D	LEIGHTON	2150 KEYSTONE AVE	RENO	NV	89503
223245	2160	KEYSTONE AVE	RENO	89503	R	RANALLO LIVING TRUST	2160 KEYSTONE AVE	RENO	NV	89503
223301	0	PUTNAM DR	RENO	89503		TRUCKEE MEADOWS WATER AUTHORITY	PO BOX 30013	RENO	NV	89520
223403	1500	PEAVINE RD	RENO	89503	CODY M	FAJARDO et al	1500 PEAVINE RD	RENO	NV	89503
223404	1450	PEAVINE RD	RENO	89503	CURT C	MILLER et al	1450 PEAVINE RD	RENO	NV	89503
223405	1430	PEAVINE RD	RENO	89503	KENNETH M & CATHERINE D	EARDLEY	1510 PEAVINE RD	RENO	NV	89503
223406	1400	PEAVINE RD	RENO	89503	YVONNE & ALAN J	DESLONGCHAMP	1400 PEAVINE RD	RENO	NV	89503
223407	1370	PEAVINE RD	RENO	89503	BARRY R	GIBSON et al	1015 FLANDERS RD	RENO	NV	89511
223408	1350	PEAVINE RD	RENO	89503		FLOYD FAMILY TRUST	1350 PEAVINE RD	RENO	NV	89503
223409	2265	PUTNAM DR	RENO	89503	NANCY K	TUN	1501 DIAMOND COUNTRY DR	RENO	NV	89521
223410	2295	PUTNAM DR	RENO	89503		MOLEZZO FAMILY TRUST	3201 PLUMAS ST # 312	RENO	NV	89509
227102	75	PENROSE DR	RENO	89503	MALIA	MITOOKA-FERRANTO et al	75 PENROSE DR	RENO	NV	89503
227103	65	PENROSE DR	RENO	89503	CONRAD V & LUZ D	VALDEZ	65 PENROSE DR	RENO	NV	89503
227104	55	PENROSE DR	RENO	89503	VICTORIA	GRAY TRUST	55 PENROSE DR	RENO	NV	89503
227105	45	PENROSE DR	RENO	89503	KILEY	SAUER et al	45 PENROSE DR	RENO	NV	89503
227106	35	PENROSE DR	RENO	89503	CHARLES E & JOAN	MUELLER TRUST et al	35 PENROSE DR	RENO	NV	89503
227107	25	PENROSE DR	RENO	89503	CHRISTOPHER S & CHRISTINA	SARMAN et al	5530 AMBROSE DR	RENO	NV	89519
227109	1830	WESLEY DR	RENO	89503	REED A	KOBEMIK	1830 WESLEY DR	RENO	NV	89503
227110	15	PENROSE DR	RENO	89503	DIANA J	MARTIN TRUST	15 PENROSE DR	RENO	NV	89503
227111	2125	KEYSTONE AVE	RENO	89503	HUMBERTO & EVAN	VISCARRA	409 STANFORD WAY	SPARKS	NV	89431
227201	2065	KEYSTONE AVE	RENO	89503	RICARDO A	RIVAS-BONILLA	2065 KEYSTONE AVE	RENO	NV	89503
227224	1790	HAROLD DR	RENO	89503	ROBERT L JR	RALSTON	1790 HAROLD DR	RENO	NV	89503
227225	60	PENROSE DR	RENO	89503	MICHAEL C & CASSANDRA K	JOHNSON	60 PENROSE DR	RENO	NV	89503
227301	1785	HAROLD DR	RENO	89503	CHRISTINE M & MARK R	FAULSTICH	1785 HAROLD DR	RENO	NV	89503
227320	1760	WESLEY DR	RENO	89503	ERIC T	HOWSLEY et al	1760 WESLEY DR	RENO	NV	89503
227321	1780	WESLEY DR	RENO	89503	ROBERT M	BRIM	1780 WESLEY DR	RENO	NV	89503
227322	20	PENROSE DR	RENO	89503	DAVID L	BAKKE	20 PENROSE DR	RENO	NV	89503
227401	1845	WESLEY DR	RENO	89503	ZACHARY & ANNA	CHATELLE	1845 WESLEY DR	RENO	NV	89503
227402			RENO	89503		NOT AVAILABLE	NOT SUPPLIED	NOT SUPPLIED	NV	00000
227403	1805	WESLEY DR	RENO	89503	BRANDON R	CARLSON	1805 WESLEY DR	RENO	NV	89503
227404	1795	WESLEY DR	RENO	89503	ROSALIND & BRENDAN	BUCY	1795 WESLEY DR	RENO	NV	89503
227405	1785	WESLEY DR	RENO	89503	KRIST-ANN	PEHRSON	1785 WESLEY DR	RENO	NV	89503
227406	1765	WESLEY DR	RENO	89503	VICTORIA	WEISER	1765 WESLEY DR	RENO	NV	89503
229242	0	KEYSTONE AVE	RENO	89503		RENO CITY OF	PO BOX 1900	RENO	NV	89505
229701	0	UNSPECIFIED	RENO	89503		RENO CITY OF	PO BOX 1900	RENO	NV	89505
242101	1690	VAN NESS AVE	RENO	89503	DONALD & JUDITH	PEITZ FAMILY TRUST	1690 VAN NESS AVE	RENO	NV	89503
242102	1700	VAN NESS AVE	RENO	89503	ALFREDO E & CLEO E	EYZAGUIRRE	1700 VAN NESS AVE	RENO	NV	89503
242103	1730	VAN NESS AVE	RENO	89503	DANIELLE	MOLLET TRUST	2010 MARGOT CIR	RENO	NV	89509
242104	1750	VAN NESS AVE	RENO	89503		LAMONT FAMILY TRUST	2210 ARCANE AVE	RENO	NV	89503
242105	1780	VAN NESS AVE	RENO	89503	TOBIN W & HEATHER G	SMITH	1780 VAN NESS AVE	RENO	NV	89503

242106	1800	VAN NESS AVE	RENO	89503		WELTY FAMILY TRUST	1800 VAN NESS AVE	RENO	NV	89503
242107	1820	VAN NESS AVE	RENO	89503		GIUSTI FAMILY TRUST	1820 VAN NESS AVE	RENO	NV	89503
242108	1830	VAN NESS AVE	RENO	89503	JAMES	PLATT TRUST	1830 VAN NESS AVE	RENO	NV	89503
242109	1840	VAN NESS AVE	RENO	89503	ELAINE W	FIELD et al	1840 VAN NESS AVE	RENO	NV	89503
242110	1850	VAN NESS AVE	RENO	89503		ALLEN FAMILY TRUST	100 W PUEBLO ST	RENO	NV	89509
242111	1860	VAN NESS AVE	RENO	89503	DANIEL G	WAGNER	1860 VAN NESS AVE	RENO	NV	89503
242112	1870	VAN NESS AVE	RENO	89503	ANDREW C	BROWN	1870 VAN NESS AVE	RENO	NV	89503
242204	1865	O'FARRELL ST	RENO	89503	MATTHEW J & MAE D	DILLON	1865 O'FARRELL ST	RENO	NV	89503
242205	1835	O'FARRELL ST	RENO	89503	JOHN	GREEN et al	1835 O'FARRELL ST	RENO	NV	89503
242206	1801	O'FARRELL ST	RENO	89503		PS & SP LLC SERIES L	1510 STAR WAY	RENO	NV	89511
242207	1765	O'FARRELL ST	RENO	89503		BOSSOB LIVING TRUST	9530 OAKLEY LN	RENO	NV	89521
242208	1745	O'FARRELL ST	RENO	89503		LABRANCH FAMILY TRUST	1745 O'FARRELL ST	RENO	NV	89503
242209	1715	O'FARRELL ST	RENO	89503	STEPHEN	LEVITT	1715 O'FARRELL ST	RENO	NV	89503
242210	1685	O'FARRELL ST	RENO	89503		FRAZZETTA FAMILY TRUST	1685 O'FARRELL ST	RENO	NV	89503
242211	1665	O'FARRELL ST	RENO	89503		RABENSTINE FAMILY TRUST	1665 O'FARRELL ST	RENO	NV	89503
242212	1625	O'FARRELL ST	RENO	89503		WASSON DECEDENTS TRUST	204 DANA ST	PETALUMA	CA	94952
242213	1615	O'FARRELL ST	RENO	89503	TAMARA S	WRIGHT-WALDHOR et al	1615 O'FARRELL ST	RENO	NV	89503
242214	1565	O'FARRELL ST	RENO	89503	WALTER D	REXRODE et al	1565 O'FARRELL ST	RENO	NV	89503
242215	1545	O'FARRELL ST	RENO	89503	ELIAS M	VASQUEZ	1545 O'FARRELL ST	RENO	NV	89503
242216	1525	O'FARRELL ST	RENO	89503	SANDRA	DE LA ROSA	1525 O'FARRELL ST	RENO	NV	89503
242301	1520	O'FARRELL ST	RENO	89503	TOM N II & JUDITH G	HASPERIS	1520 O'FARRELL ST	RENO	NV	89503
242302	1540	O'FARRELL ST	RENO	89503	BILLIE R	TOUT	1540 O'FARRELL ST	RENO	NV	89503
242303	1560	O'FARRELL ST	RENO	89503	RONALD W & MARILAN	JOHNSON	1560 O'FARRELL ST	RENO	NV	89503
242304	1600	O'FARRELL ST	RENO	89503	VALARIE Y	CAVALLO	1600 O'FARRELL ST	RENO	NV	89503
242305	1620	O'FARRELL ST	RENO	89503	NELSON & SHEILA	ROJAS FAMILY TRUST	1620 O'FARRELL ST	RENO	NV	89503
242306	1650	O'FARRELL ST	RENO	89503	WILLIAM C	ARNDT	1650 O'FARRELL ST	RENO	NV	89503
242307	1670	O'FARRELL ST	RENO	89503	RITA	TRAUTMAN	1670 O'FARRELL ST	RENO	NV	89503
242308	1700	O'FARRELL ST	RENO	89503		PRITCHETT 2008 FAMILY TRUST	1700 O'FARRELL ST	RENO	NV	89503
242309	1710	O'FARRELL CT	RENO	89503	GARY K & JACQUELINE L	RAY	1710 O'FARRELL CT	RENO	NV	89503
242310	1720	O'FARRELL CT	RENO	89503	RICHARD J & CHRISTINE	HOUK	1720 O'FARRELL CT	RENO	NV	89503
242311	1730	O'FARRELL CT	RENO	89503	DEBRA J	HENDRICKSON TRUST	1730 O'FARRELL CT	RENO	NV	89503
242312	1750	O'FARRELL ST	RENO	89503	SARAH H	VOSS	1750 O'FARRELL ST	RENO	NV	89503
242313	1770	O'FARRELL ST	RENO	89503	CATHERINE A	BERRY FAMILY TRUST	1770 O'FARRELL ST	RENO	NV	89503
242314	1800	O'FARRELL ST	RENO	89503	BRIAN	ALLEN	12428 GREENWOOD DR	TRUCKEE	CA	96161
242315	1830	O'FARRELL ST	RENO	89503	CRYSTAL M & TIMOTHY	FINN	1830 O'FARRELL ST	RENO	NV	89503
242316	1885	VAN NESS AVE	RENO	89503	DAVID W	WEEKS et al	1885 VAN NESS AVE	RENO	NV	89503
242317	1875	VAN NESS AVE	RENO	89503		JACOBS FAMILY TRUST	15511 DE LA CRUZ DR	SLOUGHHOUSE	CA	95683
242318	1865	VAN NESS AVE	RENO	89503		SMB & AME LIVING TRUST	1865 VAN NESS AVE	RENO	NV	89503
242319	1845	VAN NESS AVE	RENO	89503		SMYTH LIVING TRUST	PO BOX 5663	RENO	NV	89513
242320	1835	VAN NESS AVE	RENO	89503		LAMPSON-MALCOLM LIVING TRUST	1835 VAN NESS AVE	RENO	NV	89503
242321	1825	VAN NESS AVE	RENO	89503	KATHERINE & RICHARD J	GODBEY	PO BOX 193	WELLINGTON	NV	89444
242322	1795	GEARY ST	RENO	89503		COLLINS FAMILY TRUST	1795 GEARY ST	RENO	NV	89503
242323	1775	GEARY ST	RENO	89503	CONSTANCE E	HUNING	1775 GEARY ST	RENO	NV	89503
242324	1745	GEARY ST	RENO	89503		TAH MS BORROWER LLC	1508 BROOKHOLLOW DR	SANTA ANA	CA	92705
242325	1725	GEARY ST	RENO	89503	LYNN D & SHELLEY	MINEDEW	1725 GEARY ST	RENO	NV	89503
242326	1701	GEARY ST	RENO	89503	RUSSELL C & JILL S	CARTWRIGHT	1701 GEARY ST	RENO	NV	89503
242327	1685	GEARY ST	RENO	89503	TAYLOR & SHANE	KOCKENMEISTER	1685 GEARY ST	RENO	NV	89503
242328	1675	GEARY ST	RENO	89503	MARY	WHEELER	1675 GEARY ST	RENO	NV	89503
242329	1665	GEARY ST	RENO	89503	TRUDY M	MILLER	1665 GEARY ST	RENO	NV	89503
242330	1655	GEARY ST	RENO	89503		RICE FAMILY TRUST	1655 GEARY ST	RENO	NV	89503
242401	1650	GEARY ST	RENO	89503		MEAD FAMILY TRUST	PO BOX 5554	RENO	NV	89513
242402	1670	GEARY ST	RENO	89503	GUY H & MARY A	RECTOR FAMILY TRUST	1670 GEARY ST	RENO	NV	89503
242403	1700	GEARY ST	RENO	89503	JOSEPH & CAROL	MISCHEL	1700 GEARY ST	RENO	NV	89503
242404	1730	GEARY ST	RENO	89503	CHRISTINE	ANDERSON	1730 GEARY ST	RENO	NV	89503
242406	1770	GEARY ST	RENO	89503	GLENNA E	SMITH	PO BOX 2920	CARSON CITY	NV	89702
242407	1775	VAN NESS AVE	RENO	89503	JASON	BACCIGALUPPI et al	1775 VAN NESS AVE	RENO	NV	89503
242408	1755	VAN NESS AVE	RENO	89503	DOUGLAS D & JANELL L	ADAMS	1641 SATURNO HEIGHTS DR	RENO	NV	89523
242409	1735	VAN NESS AVE	RENO	89503	ROBERT & KAREN	ELLIS et al	1735 VAN NESS AVE	RENO	NV	89503
242410	1701	VAN NESS AVE	RENO	89503	SANDORAT & ERIN R	DURAN	1701 VAN NESS AVE	RENO	NV	89503
242411	2445	SUTTER CIR	RENO	89503	MICHAEL S & ADLETA	MCGUIRE	2445 SUTTER CIR	RENO	NV	89503
242412	2465	SUTTER CIR	RENO	89503	ANTHONY R & AMBER C	SPENCER	2465 SUTTER CIR	RENO	NV	89503
242413	2495	SUTTER CIR	RENO	89503	STEPHAN J	HOLLANDSWORTH	2495 SUTTER CIR	RENO	NV	89503
243101	1401	PEAVINE RD	RENO	89503	PAMELA H	GORMLY-OLSEN et al	1401 PEAVINE RD	RENO	NV	89503

243102	1400	VAN NESS AVE	RENO	89503		WILLSEY FAMILY TRUST	1400 VAN NESS AVE	RENO	NV	89503
243103	1430	VAN NESS AVE	RENO	89503	BAYARD C	CATRON	1430 VAN NESS AVE	RENO	NV	89503
243104	1460	VAN NESS AVE	RENO	89503	THERESA L	CROWLEY	1460 VAN NESS AVE	RENO	NV	89503
243105	1480	VAN NESS AVE	RENO	89503		LARK FAMILY LIVING TRUST	2952 ASPENDALE DR	RENO	NV	89503
243106	1500	VAN NESS AVE	RENO	89503	CHRISTOPHER M	RUSBY	1500 VAN NESS AVE	RENO	NV	89503
243107	1520	VAN NESS AVE	RENO	89503	MARTHA	WILLIAMS	1520 VAN NESS AVE	RENO	NV	89503
243108	1540	VAN NESS AVE	RENO	89503	RONALD A	DEL SOLDATO TRUST	1540 VAN NESS AVE	RENO	NV	89503
243109	1560	VAN NESS AVE	RENO	89503	ROBIN	STODDARD	1560 VAN NESS AVE	RENO	NV	89503
243110	1580	VAN NESS AVE	RENO	89503	THERESA A	MOORE	1580 VAN NESS AVE	RENO	NV	89503
243111	1600	VAN NESS AVE	RENO	89503	DENNIS W & ALAINE L	FLYNN	1600 VAN NESS AVE	RENO	NV	89503
243112	1630	VAN NESS AVE	RENO	89503	MARIO	TRINIDAD	1660 VAN NESS AVE	RENO	NV	89503
243113	1660	VAN NESS AVE	RENO	89503	MARIO R & SUSANA A	TRINIDAD	1660 VAN NESS AVE	RENO	NV	89503
243114	1585	PEAVINE RD	RENO	89503	TAWNA T	GALLI	1585 PEAVINE RD	RENO	NV	89503
243115	1545	PEAVINE RD	RENO	89503	RICHARD J & DEANNA M	NURGE	11780 CAMEL ROCK DR	RENO	NV	89506
243116	1525	PEAVINE RD	RENO	89503	GORDON & ISLEAN	QUONG FAMILY TRUST	1525 PEAVINE RD	RENO	NV	89503
243117	1511	PEAVINE RD	RENO	89503		HARGER FAMILY TRUST	2305 EVA ADAMS DR	RENO	NV	89509
243118	1475	PEAVINE RD	RENO	89503	FRANCES G	MEYER et al	1475 PEAVINE RD	RENO	NV	89503
243119	1455	PEAVINE RD	RENO	89503	CAM	MCFADDIN et al	1516 LOMBARD ST APT 3	SAN FRANCISCO	CA	94123
243120	1435	PEAVINE RD	RENO	89503	GREGORY & DIANE	HOFF	1530 PEAVINE RD	RENO	NV	89503
243201	2490	SUTTER CIR	RENO	89503	CLAIRE M	WHITESIDE et al	2490 SUTTER CIR	RENO	NV	89503
243202	2460	SUTTER CIR	RENO	89503	RALPH	BETTS et al	2460 SUTTER CIR	RENO	NV	89503
243203	2440	SUTTER CIR	RENO	89503	JOHN E	HADDER et al	2440 SUTTER CIR	RENO	NV	89503
243204	1675	VAN NESS AVE	RENO	89503	ELIZABETH L	KRAYK	1675 VAN NESS AVE	RENO	NV	89503
243205	1645	VAN NESS AVE	RENO	89503	LINDA A	ROUSH	1930 MARLA DR	RENO	NV	89509
243206	1625	VAN NESS AVE	RENO	89503	JANICE	ATKIN	6033 CONNESS WAY	RENO	NV	89523
243207	1595	VAN NESS AVE	RENO	89503	JAMES M	MORNING	1595 VAN NESS AVE	RENO	NV	89503
243208	1565	VAN NESS AVE	RENO	89503	KRISTINE M	WILBRECHT	1565 VAN NESS AVE	RENO	NV	89503
243209	1535	VAN NESS AVE	RENO	89503	CHRISTOPHER	BAKER	1535 VAN NESS AVE	RENO	NV	89503
243210	1501	VAN NESS AVE	RENO	89503	DANA L	BUCHHOLZ et al	1501 VAN NESS AVE	RENO	NV	89503
243211	1485	VAN NESS AVE	RENO	89503	MATHEW L & ADRIANNA P	BANOVICH	80 BITTERBRUSH RD	RENO	NV	89523
243212	1465	VAN NESS AVE	RENO	89503	TOBY M	EBENS	1465 VAN NESS AVE	RENO	NV	89503
243213	1435	VAN NESS AVE	RENO	89503	YVONNE R	LEWELLIN	1435 VAN NESS AVE	RENO	NV	89503
243214	1401	VAN NESS AVE	RENO	89503	SHARON	VASQUEZ TRUST	1401 VAN NESS AVE	RENO	NV	89503
243215	2475	POLK ST	RENO	89503	CUAUHTEMOC & LUCY	CASTILLO	2475 POLK ST	RENO	NV	89503
243216	1420	GEARY ST	RENO	89503	BRIAN C	FILIPPINI et al	4953 145TH AVE SE	BELLEVUE	WA	98006
243217	1430	GEARY ST	RENO	89503	STEVEN	ANDERSON	1430 GEARY ST	RENO	NV	89503
243218	1440	GEARY ST	RENO	89503	ASHLEY B	HALL	1440 GEARY ST	RENO	NV	89503
243219	1450	GEARY ST	RENO	89503		MARSHALL LIVING TRUST	1450 GEARY ST	RENO	NV	89503
243220	1460	GEARY ST	RENO	89503	CHRISTOPHER C	PEARSON	1460 GEARY ST	RENO	NV	89503
243221	1470	GEARY ST	RENO	89503	DENNY & KATHIE	WILLIAMS FAMILY TRUST	1470 GEARY ST	RENO	NV	89503
243222	1480	GEARY ST	RENO	89503		SMITH LIVING TRUST	1480 GEARY ST	RENO	NV	89503
243223	1490	GEARY ST	RENO	89503	BRENT A & KATHRYN	MERRITT	1490 GEARY ST	RENO	NV	89503
243224	1530	GEARY ST	RENO	89503	ALAINE F	BARREA	1530 GEARY ST	RENO	NV	89503
243225	1560	GEARY ST	RENO	89503		GONZALES FAMILY LIVING TRUST	1560 GEARY ST	RENO	NV	89503
243226	1590	GEARY ST	RENO	89503	KATHLEEN E	ALBANESE	1590 GEARY ST	RENO	NV	89503
243227	1630	GEARY ST	RENO	89503	LINDA J	CIAMPOLI-HARDDONIERE TRUST	3112 SKYE TER	SPARKS	NV	89431
243301	1625	GEARY ST	RENO	89503	GEORGE A	WALDEN et al	1625 GEARY ST	RENO	NV	89503
243302	1621	GEARY ST	RENO	89503	C JAMES & SHAREN	GEORGESON FAMILY TRUST et al	4280 MUIRWOOD CIR	RENO	NV	89509
243303	1615	GEARY ST	RENO	89503	MEGAN E & MICHAEL B	MACHADO	1615 GEARY ST	RENO	NV	89503
243304	1607	GEARY ST	RENO	89503	RICK	LEWIS	1607 GEARY ST	RENO	NV	89503
243305	1585	GEARY ST	RENO	89503		GAEDTKE LIVING TRUST	1585 GEARY ST	RENO	NV	89503
243306	1575	GEARY ST	RENO	89503	KRISTI G	BORACCHIA	1575 GEARY ST	RENO	NV	89503
243307	1555	GEARY ST	RENO	89503	ZACHARY	LANNOY	1435 O'FARRELL ST	RENO	NV	89503
243308	1525	GEARY ST	RENO	89503	LAUREN J & MARK G	GANDOLFO	2590 THOMAS JEFFERSON DR	RENO	NV	89509
243309	1495	GEARY ST	RENO	89503	LESLIE E	SKINNER	1495 GEARY ST	RENO	NV	89503
243310	1435	GEARY ST	RENO	89503	ANTHONY	DEMARTINO	1435 GEARY ST	RENO	NV	89503
243311	2501	POLK ST	RENO	89503		VERNON FAMILY 2008 TRUST	2501 POLK ST	RENO	NV	89503
243312	2535	POLK ST	RENO	89503	GENE E & CLAIRE E	MOWREY	2535 POLK ST	RENO	NV	89503
243313	2565	POLK ST	RENO	89503	FRANK S & SUSANNE M	HOWELL TRUST	2565 POLK ST	RENO	NV	89503
243314	2595	POLK ST	RENO	89503	KURT	BARNICA	2595 POLK ST	RENO	NV	89503
243315	2625	POLK ST	RENO	89503	JOYCE M	PATTERSON TRUST	2625 POLK ST	RENO	NV	89503
243316	2645	POLK ST	RENO	89503	DOUGLAS J & CHRISTINE M	WILCOX	2645 POLK ST	RENO	NV	89503
243317	2685	POLK ST	RENO	89503		TAH 2018-1 BORROWER LLC	1508 BROOKHOLLOW DR	SANTA ANA	CA	92705

243318	1420	O'FARRELL ST	RENO	89503		ATKINSON FAMILY TRUST	1420 O'FARRELL ST	RENO	NV	89503
243319	1460	O'FARRELL ST	RENO	89503	MEGAN	ALMANSOORI	1460 O'FARRELL ST	RENO	NV	89503
243320	1490	O'FARRELL ST	RENO	89503	DANIEL T & MARY A	ALLEN	3565 LONE TREE LN	RENO	NV	89511
243401	1485	O'FARRELL ST	RENO	89503	ROBERT	STACK	1485 O'FARRELL ST	RENO	NV	89503
243402	1465	O'FARRELL ST	RENO	89503	MICHELLE K	HOCHREIN	1465 O'FARRELL ST	RENO	NV	89503
243403	1435	O'FARRELL ST	RENO	89503	ANN-MARIE	VOLLSTEDT et al	1435 O'FARRELL ST	RENO	NV	89503
243404	1401	O'FARRELL ST	RENO	89503	KAREN E	VARGAS	1401 O'FARRELL ST	RENO	NV	89503
243405	2680	POLK ST	RENO	89503	LUKE E & CORY L	FREY	2680 POLK ST	RENO	NV	89503
243406	2670	POLK ST	RENO	89503		WINCHELL LIVING TRUST	2670 POLK ST	RENO	NV	89503
243407	2660	POLK ST	RENO	89503	TESSA	LANNOY	2660 POLK ST	RENO	NV	89503
243408	2640	POLK ST	RENO	89503	TRAVIS	WILKEY	2640 POLK ST	RENO	NV	89503
243409	2620	POLK ST	RENO	89503	JOHN & PEGGY	EWALD FAMILY TRUST	25 CHINCHILLA LN	RENO	NV	89511
243410	2600	POLK ST	RENO	89503	CRAIG T	REYNOLDS	2600 POLK ST	RENO	NV	89503
243411	2570	POLK ST	RENO	89503	LUCAS	ANDERSON et al	2570 POLK ST	RENO	NV	89503
243412	2540	POLK ST	RENO	89503	THOMAS W	RENNIE	2540 POLK ST	RENO	NV	89503
243413	2520	POLK ST	RENO	89503	JENNIFER D & ANTHONY W	STEVENS	2520 POLK ST	RENO	NV	89503
243414	2500	POLK ST	RENO	89503	KRISTAL E	CURRY LIVING TRUST	2500 POLK ST	RENO	NV	89503
243415	2480	POLK ST	RENO	89503		ANDREATTA FAMILY TRUST	2480 POLK ST	RENO	NV	89503
243416	2450	POLK ST	RENO	89503	BRIAN	DAVIS	1997 PLUMAS ST	RENO	NV	89509
243417	2430	POLK ST	RENO	89503	BRIAN	DAVIS	2430 POLK ST	RENO	NV	89503
243418	2400	POLK ST	RENO	89503		LUKE LIVING TRUST	2400 POLK ST	RENO	NV	89503
243501	1390	VAN NESS AVE	RENO	89503	DEBRA & DONALD	KAMKA	1390 VAN NESS AVE	RENO	NV	89503
243502	2330	POLK ST	RENO	89503	ALLEN	VARNEY	36 WOODCREST AVE	ITHACA	NY	14850
243503	1395	PEAVINE RD	RENO	89503		FRASER TRUST	1395 PEAVINE RD	RENO	NV	89503
249108	1680	SEVERN DR	RENO	89503	MARLYS J	MAYS	1680 SEVERN DR	RENO	NV	89503
250104	1710	SEVERN DR	RENO	89503		AMARO FAMILY TRUST	3387 JORDAN RD	OAKLAND	CA	94602
250105	1750	SEVERN DR	RENO	89503	CHRISTINA L & RICHARD J	AMORE	1750 SEVERN DR	RENO	NV	89503
250106	1780	SEVERN DR	RENO	89503	ROGER B & MARIE D	WIERE	1780 SEVERN DR	RENO	NV	89503
250107	1800	SEVERN DR	RENO	89503	ADAM R	BEESON	1800 SEVERN DR	RENO	NV	89503
250108	1820	SEVERN DR	RENO	89503	LARRY V JR	ROBERTS et al	1820 SEVERN DR	RENO	NV	89503
250109	1860	SEVERN DR	RENO	89503	JEFFREY D	HACKER et al	1860 SEVERN DR	RENO	NV	89503
250110	1890	SEVERN DR	RENO	89503	FARRELL B & JAMIE D	VAUGHN	1890 SEVERN DR	RENO	NV	89503
250202	1885	SEVERN DR	RENO	89503	FABIAN & TINA	REYNOSO	1885 SEVERN DR	RENO	NV	89503
250203	1855	SEVERN DR	RENO	89503	ZACHARY D & HEATHER C	BAUTISTA	7659 MANDOLIN WAY	ROHNERT PARK	CA	94928
250204	1815	SEVERN DR	RENO	89503	THOMAS C & MICHELLE L	BROWN	15560 CHERRYWOOD DR	RENO	NV	89511
250205	1795	SEVERN DR	RENO	89503		TONDA FAMILY TRUST	9760 RIM ROCK CIR	LOOMIS	CA	95650
250206	1765	SEVERN DR	RENO	89503	RYAN M	HIGH	1765 SEVERN DR	RENO	NV	89503
250207	1715	SEVERN DR	RENO	89503	JOSE E & LILIA	RECINOS	1715 SEVERN DR	RENO	NV	89503
250208	1695	SEVERN DR	RENO	89503	LINO	RICO-RIVERA et al	1695 SEVERN DR	RENO	NV	89503
250214	1740	KING EDWARD DR	RENO	89503	DEBRA J	GALLET et al	1740 KING EDWARD DR	RENO	NV	89503
250215	1790	KING EDWARD DR	RENO	89503		FU LIVING TRUST	1790 KING EDWARD DR	RENO	NV	89503
250216	1830	KING EDWARD DR	RENO	89503	RAYMOND K SR	SCOW	1830 KING EDWARD DR	RENO	NV	89503
250217	1850	KING EDWARD DR	RENO	89503	DANIEL W & ASHLEY K	SMITH	1850 KING EDWARD DR	RENO	NV	89503
250218	1880	KING EDWARD DR	RENO	89503		TAH 2018-1 BORROWER LLC	1508 BROOKHOLLOW DR	SANTA ANA	CA	92705
250219	1940	KING EDWARD DR	RENO	89503	FRED K & EVA L	DELLERA	1940 KING EDWARD DR	RENO	NV	89503
250220	1980	KING EDWARD DR	RENO	89503	JOSE & OLGA L	SILVERIO	1980 KING EDWARD DR	RENO	NV	89503
250301	2020	SEVERN DR	RENO	89503	FREDERICK T JR & CAROLE S	PASCUCCI	2020 SEVERN DR	RENO	NV	89503
250303	1935	KING EDWARD DR	RENO	89503	MARIE D	BURNSTEIN LIVING TRUST	PO BOX 1257	KETTLE FALLS	WA	99141
250304	1905	KING EDWARD DR	RENO	89503	JOSHUA P	STECKLINE LIVING TRUST	3045 ROXBURY DR	RENO	NV	89523
250305	1885	KING EDWARD DR	RENO	89503		MCCULLOCH FAMILY TRUST	1885 KING EDWARD DR	RENO	NV	89503
250306	1855	KING EDWARD DR	RENO	89503	JOHN A JR	BAKER et al	1855 KING EDWARD DR	RENO	NV	89503
250307	1835	KING EDWARD DR	RENO	89503	JOHN T & CHRISTINE M	MORAN	1835 KING EDWARD DR	RENO	NV	89503
250312	1600	VAN PETTEN ST	RENO	89503		FINN LIVING TRUST	1600 VAN PETTEN ST	RENO	NV	89503
250313	1620	VAN PETTEN ST	RENO	89503	CHARLOTTE	POINDEXTER	1620 VAN PETTEN ST	RENO	NV	89503
250314	1640	VAN PETTEN ST	RENO	89503	CHARMAANE R	BUEHRLE	1640 VAN PETTEN ST	RENO	NV	89503
250315	1660	VAN PETTEN ST	RENO	89503	JOSE L	RODRIGUEZ et al	1660 VAN PETTEN ST	RENO	NV	89503
250316	1670	VAN PETTEN ST	RENO	89503	MICHAEL R & MARY J	SUDANO	1670 VAN PETTEN ST	RENO	NV	89503
250317	1680	VAN PETTEN ST	RENO	89503	CHRISTOPHER	COLBORN	9890 SILVER DEW ST	LAS VEGAS	NV	89183
250318	2090	SEVERN DR	RENO	89503	LAURIE A	ARAGON et al	2090 SEVERN DR	RENO	NV	89503
250319	2070	SEVERN DR	RENO	89503	MARY K	DIETHRICH	2070 SEVERN DR	RENO	NV	89503
250320	2040	SEVERN DR	RENO	89503	CAM & JODY N	ROBLIN	2040 SEVERN DR	RENO	NV	89503
250401	1699	VAN PETTEN ST	RENO	89503	PAMELA C & BRANDON F	SILAR	1699 VAN PETTEN ST	RENO	NV	89503
250403	1685	VAN PETTEN ST	RENO	89503	SUSAN J	ENGLESBY TRUST #2	16045 PINE VALLEY DR	RENO	NV	89511

250404	1675	VAN PETTEN ST	RENO	89503		TAH 2017-2 BORROWER LLC	1508 BROOKHOLLOW DR	SANTA ANA	CA	92705
250405	1665	VAN PETTEN ST	RENO	89503	GARY & FRANCENE	LINDENSCHMITT 2010 TRUST	8285 ROYALL OAKS DR	GRANITE BAY	CA	95746
250406	1655	VAN PETTEN ST	RENO	89503	FELIPE	CHAVEZ-GONZALEZ et al	1655 VAN PETTEN ST	RENO	NV	89503
250407	1625	VAN PETTEN ST	RENO	89503	JOSEPH & CAMIE J	LOPEZ	1625 VAN PETTEN ST	RENO	NV	89503
250413	1580	CROWN DR	RENO	89503	MICHELLE M	ZITO	1580 CROWN DR	RENO	NV	89503
250414	1600	CROWN DR	RENO	89503	TAMMARA M	CAGNEY	1600 CROWN DR	RENO	NV	89503
250415	1620	CROWN DR	RENO	89503		WEISS FAMILY TRUST	1620 CROWN DR	RENO	NV	89503
250416	1640	CROWN DR	RENO	89503	GARY S & STEPHANIE L	BOCKMAN	1640 CROWN DR	RENO	NV	89503
250417	1670	CROWN DR	RENO	89503		GERHART LIVING TRUST	1670 CROWN DR	RENO	NV	89503
250418	1690	CROWN DR	RENO	89503	TIFFANY	REGALIA	1690 CROWN DR	RENO	NV	89503
250501	1675	CROWN DR	RENO	89503	SHELBY L	GRANA et al	1675 CROWN DR	RENO	NV	89503
250502	1655	CROWN DR	RENO	89503	JORGE M	ARELLANO et al	1655 CROWN DR	RENO	NV	89503
250503	1635	CROWN DR	RENO	89503	WILLIAM J & WENDY E	BUNNEL	1635 CROWN DR	RENO	NV	89503
250504	1605	CROWN DR	RENO	89503	LAURIE J	LARKIN LIVING TRUST	1605 CROWN DR	RENO	NV	89503
251102	1960	SEVERN DR	RENO	89503	MICHAEL A	HAMILTON et al	1960 SEVERN DR	RENO	NV	89503
251103	2010	SEVERN DR	RENO	89503	ROBERT E	BUHLER et al	PO BOX 8256	RENO	NV	89507
251104	2050	KING EDWARD DR	RENO	89503	EILEEN F	CARPENTER	2050 KING EDWARD DR	RENO	NV	89503
251113	2140	KING EDWARD DR	RENO	89503	NOEL C & ELAINE M	MANOUKIAN	2140 KING EDWARD DR	RENO	NV	89503
251115	2130	KING EDWARD DR	RENO	89503	PHILLIP J & PEGGY L	PERT	2130 KING EDWARD DR	RENO	NV	89503
251117	2100	KING EDWARD DR	RENO	89503	KELSIE	HIEBER	2100 KING EDWARD DR	RENO	NV	89503
251119	2080	KING EDWARD DR	RENO	89503	LUIS	ANGUIANO-CERVANTES et al	2080 KING EDWARD DR	RENO	NV	89503
251121	1920	SEVERN DR	RENO	89503	MICHELLE & PAUL	DZIEDZIC	698 TARN WAY	RENO	NV	89503
251122	2150	KING EDWARD DR	RENO	89503	FRED & FLORENCE	PURA	2150 KING EDWARD DR	RENO	NV	89503
251201	2155	KING RICHARD CT	RENO	89503	JANE A	HARRELL	2155 KING RICHARD CT	RENO	NV	89503
251202	2165	KING EDWARD DR	RENO	89503		FOX FAMILY TRUST	2165 KING EDWARD DR	RENO	NV	89503
251203	2175	KING EDWARD DR	RENO	89503	ERIC & LAURA L	RUUD	2175 KING EDWARD DR	RENO	NV	89503
251204	2185	KING EDWARD DR	RENO	89503	THERESA M	SMITH	2185 KING EDWARD DR	RENO	NV	89503
251205	2205	JESTER CT	RENO	89503	BELINDA G	IRVIN	2205 JESTER CT	RENO	NV	89503
251206	2225	JESTER CT	RENO	89503	NENA A	VALERA et al	5815 TAPPAN DR	RENO	NV	89523
251207	2245	JESTER CT	RENO	89503	YOSHIE	KADOWAKI et al	2245 JESTER CT	RENO	NV	89503
251208	2265	JESTER CT	RENO	89503	JESUS C	LANDEROS et al	2100 WINDSOR WAY	RENO	NV	89503
251209	2275	JESTER CT	RENO	89503	LEANNDRA	COPELAND FAMILY TRUST	808 CRAIN ST	CARSON CITY	NV	89703
251210	2285	JESTER CT	RENO	89503	MELISSA L	MORRISON	14460 RIM ROCK DR	RENO	NV	89521
251211	2295	JESTER CT	RENO	89503	PAUL	ADAMS	2295 JESTER CT	RENO	NV	89503
251212	2280	JESTER CT	RENO	89503	BENJAMIN J & DEBORAH A	MCALISTER	2280 JESTER CT	RENO	NV	89503
251213	2270	JESTER CT	RENO	89503	JACQUELINE G	TIBADUIZA TRUST	2270 JESTER CT	RENO	NV	89503
251214	2260	JESTER CT	RENO	89503	WILLIAM H	KELDERMAN et al	2260 JESTER CT	RENO	NV	89503
251215	2240	JESTER CT	RENO	89503	GARY D	MACLEAN	2240 JESTER CT	RENO	NV	89503
251216	2215	KING EDWARD DR	RENO	89503	DAVID E	CARLSON	7610 JASMINE CT	RENO	NV	89506
251217	2235	KING EDWARD DR	RENO	89503	JANET	WITT et al	2235 KING EDWARD DR	RENO	NV	89503
251218	2255	KING EDWARD DR	RENO	89503		MEGLAND LLC	PO BOX 127	BLUE DIAMOND	NV	89004
251219	2275	KING EDWARD DR	RENO	89503	KRISTINE & ANDREW	WISSEL	2275 KING EDWARD DR	RENO	NV	89503
251220	2285	KING EDWARD DR	RENO	89503	CURTIS L & MARY E	FREEMONT	2285 KING EDWARD DR	RENO	NV	89503
251221	2295	KING EDWARD DR	RENO	89503	JESSE R & KATHLEEN S	JENSEN	2295 KING EDWARD DR	RENO	NV	89503
251301	2290	KING EDWARD DR	RENO	89503	JENNIFER L	HINTON	2290 KING EDWARD DR	RENO	NV	89503
251302	2280	KING EDWARD DR	RENO	89503		TAH 2018-1 BORROWER LLC	1508 BROOKHOLLOW DR	SANTA ANA	CA	92705
251303	2270	KING EDWARD DR	RENO	89503	EVAN M	BREWER	2270 KING EDWARD DR	RENO	NV	89503
251304	2250	KING EDWARD DR	RENO	89503	NATHAN	CORONA	2250 KING EDWARD DR	RENO	NV	89503
251305	2240	KING EDWARD DR	RENO	89503	YOUNESS & LAVONNE	GHANAVATI	2240 KING EDWARD DR	RENO	NV	89503
251306	2230	KING EDWARD DR	RENO	89503	SALLY L	MYERS et al	PO BOX 5555	RENO	NV	89513
251307	2220	KING EDWARD DR	RENO	89503	SHARON L	BAIRD	2220 KING EDWARD DR	RENO	NV	89503
251308	2210	KING EDWARD DR	RENO	89503	LYNDSEY	DARROW et al	2210 KING EDWARD DR	RENO	NV	89503
251310	2190	KING EDWARD DR	RENO	89503	BARBARA M	KRAUSE	2190 KING EDWARD DR	RENO	NV	89503
251311	2180	KING EDWARD DR	RENO	89503	THOMAS J	BARRESI	1638 WHEATGRASS DR	RENO	NV	89509
251312	2160	KING EDWARD DR	RENO	89503	DINA	WARREN	2160 KING EDWARD DR	RENO	NV	89503
251313	2145	KING EDWARD DR	RENO	89503	STEPHEN B & TERESA L	ROTHSCHILD	2145 KING EDWARD DR	RENO	NV	89503
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251316	2040	KING EDWARD CT	RENO	89503		HUMMEL & SKELTON FAMILY TRUST	2040 KING EDWARD CT	RENO	NV	89503
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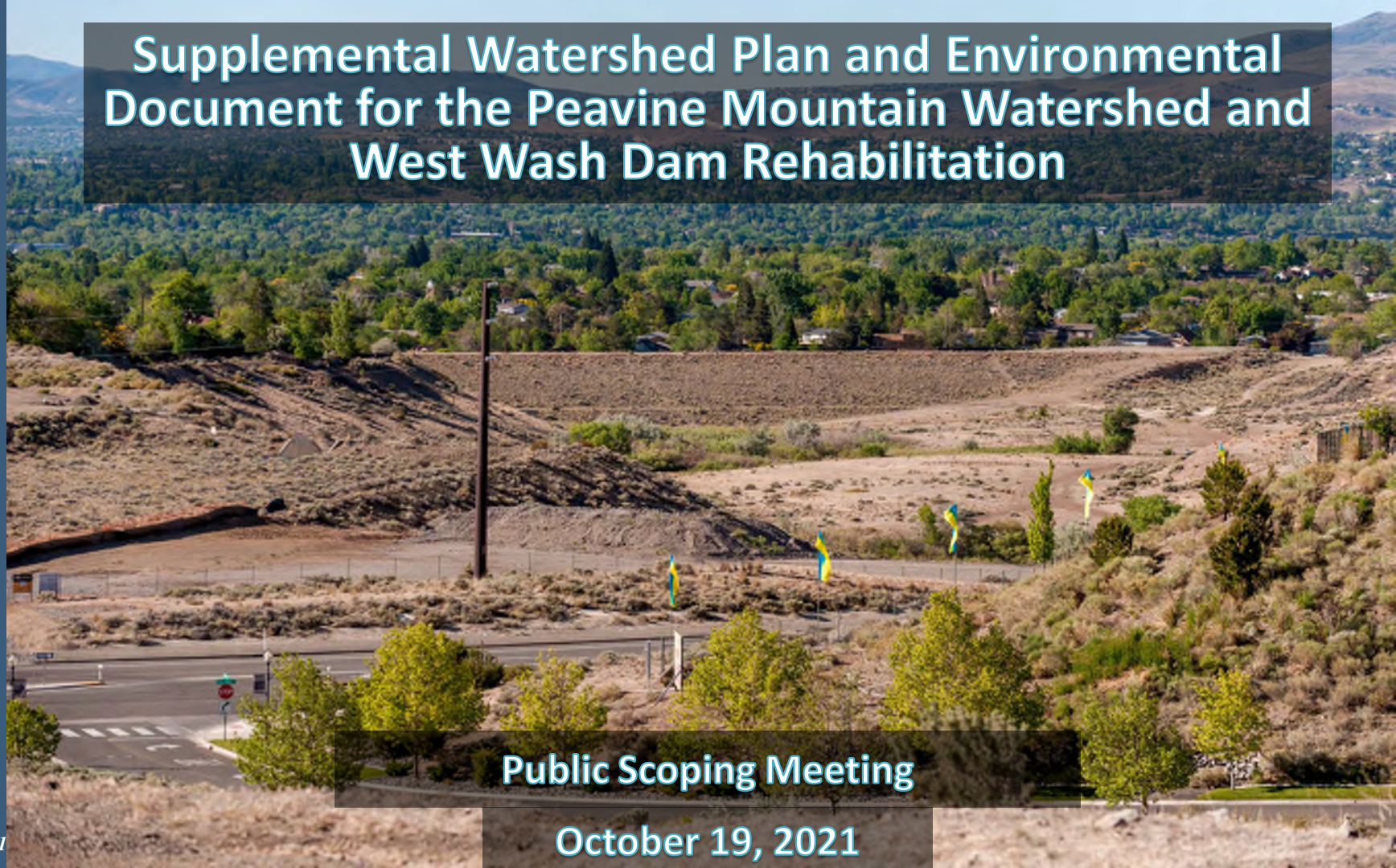
251320	2035	SEVERN DR	RENO	89503		SIBLEY FAMILY TRUST	845 MOUNT ROSE ST	RENO	NV	89509

251321	2055	SEVERN DR	RENO	89503	JAMES G & KAREN A	HUDSON FAMILY TRUST	2055 SEVERN DR	RENO	NV	89503
251322	2075	SEVERN DR	RENO	89503	JODI	WALLACE	2075 SEVERN DR	RENO	NV	89503
251323	2085	SEVERN DR	RENO	89503	RODGER W & LORA A	STONE	2955 OUTLOOK DR	RENO	NV	89509
251324	2105	SEVERN DR	RENO	89503		HAUTE ROUTE RS LLC	2955 OUTLOOK DR	RENO	NV	89509
251325	2125	SEVERN DR	RENO	89503	LOIS & KEVIN	CRAIK	2125 SEVERN DR	RENO	NV	89503
251326	2145	SEVERN DR	RENO	89503	MELANIE	HEILIG et al	2145 SEVERN DR	RENO	NV	89503
251327	2165	SEVERN DR	RENO	89503	THEODOR M	MEEK	2165 SEVERN DR	RENO	NV	89503
251328	2205	SEVERN DR	RENO	89503	FRANK A & DARLENE D	EURONIS	2205 SEVERN DR	RENO	NV	89503
251329	1620	WYOMING AVE	RENO	89503	JOHN L	LASLEY	8825 WINTER PEACE CT	RENO	NV	89523
251401	1695	CROWN DR	RENO	89503	BEVERLY E	TAYLOR	1695 CROWN DR	RENO	NV	89503
251402	1685	CROWN DR	RENO	89503		BRADLEY FAMILY TRUST	2225 KEEVER CT	RENO	NV	89509
253101	2355	KEYSTONE AVE	RENO	89503	MELANIE B & DALLAS T	DUNLOP	8905 ARABIAN FILLY AVE	LAS VEGAS	NV	89143
253102	2345	KEYSTONE AVE	RENO	89503	DEREK A & STEPHANIE L	OLIJAR	2345 KEYSTONE AVE	RENO	NV	89503
253103	2335	KEYSTONE AVE	RENO	89503	DIANA	YORK 2018 FAMILY TRUST	2335 KEYSTONE AVE	RENO	NV	89503
253104	2325	KEYSTONE AVE	RENO	89503	TILDA	ROGNEY	2325 KEYSTONE AVE	RENO	NV	89503
253105	2315	KEYSTONE AVE	RENO	89503		MOON FAMILY TRUST	2315 KEYSTONE AVE	RENO	NV	89503
253106	2305	KEYSTONE AVE	RENO	89503	LEDA	MORA	2305 KEYSTONE AVE	RENO	NV	89503
253113	2255	PUTNAM DR	RENO	89503		SMITH LIVING TRUST	2255 PUTNAM DR	RENO	NV	89503
253115	2295	KEYSTONE AVE	RENO	89503		MOON FAMILY TRUST	2315 KEYSTONE AVE	RENO	NV	89503
253116	2275	KEYSTONE AVE	RENO	89503	SERGIO R & SANDRA H	LOPEZ	2275 KEYSTONE AVE	RENO	NV	89503
253117	2255	KEYSTONE AVE	RENO	89503	STEVEN & SUSAN	SMITH	2255 KEYSTONE AVE	RENO	NV	89503
253118	2235	KEYSTONE AVE	RENO	89503	KOURTNEY L	DAVIS	1601 ROCKY COVE LN	RENO	NV	89521
253119	2225	PUTNAM DR	RENO	89503		WESTRUP FAMILY TRUST	2225 PUTNAM DR	RENO	NV	89503
253120	2235	PUTNAM DR	RENO	89503	JOSEPH D	BRADSHAW	2235 PUTNAM DR	RENO	NV	89503
253121	2201	PUTNAM DR	RENO	89503	ELIZABETH A	BEDARD ESTATE	728 GLEN MEADOW DR	SPARKS	NV	89434
8263104	0	LEADERSHIP PKWY	RENO	89503		TRUCKEE MEADOWS WATER AUTHORITY	PO BOX 30013	RENO	NV	89520
8263105	0	MCCARRAN BLVD	RENO	89503		RENO CITY OF	PO BOX 1900	RENO	NV	89505
8263113	0	MCCARRAN BLVD	WASHOE COUNTY	89503		WASHOE COUNTY	1001 E 9TH ST BLDG A	RENO	NV	89512
8263114	0	LEADERSHIP PKWY	RENO	89503		LEADERSHIP MASTER LLC	11890 DONNER PASS RD # 4	TRUCKEE	CA	96161
8263115	0	LEADERSHIP PKWY	RENO	89503		LEADERSHIP MASTER LLC	11890 DONNER PASS RD # 4	TRUCKEE	CA	96161
8263126	3030	LEADERSHIP PKWY	RENO	89503		KEYSTONE CANYON LLC	11890 DONNER PASS RD STE 4	TRUCKEE	CA	96161
8263127	0	LEADERSHIP PKWY	RENO	89503		LEADERSHIP MASTER LLC	11890 DONNER PASS RD # 4	TRUCKEE	CA	96161

APPENDIX C - SCOPING MEETING MATERIALS

1. Scoping Meeting presentation
2. Project Location Figure
3. Project website with scoping notice

Supplemental Watershed Plan and Environmental Document for the Peavine Mountain Watershed and West Wash Dam Rehabilitation



Public Scoping Meeting

October 19, 2021

City of Reno
October 19, 2021

OWNER:
City of Reno
1 East First Street
Reno, NV 89501

LEAD FEDERAL AGENCY:
USDA-NRCS
1365 Corporate Blvd
Reno, NV 89502

ENGINEER:
Farr West Engineering
5510 Longley Lane
Reno, NV 89511
(775) 851-4788
(775) 851-0766 Fax

Meeting Objectives

- The purpose of this meeting is to inform the public about the planning effort underway for the Peavine Mountain Watershed West Wash Dam Rehabilitation Project.

- This meeting is being held to identify and scope issues to be considered during development of the Supplemental Watershed Plan and Environment Document for the dam rehabilitation project.

20 Years!
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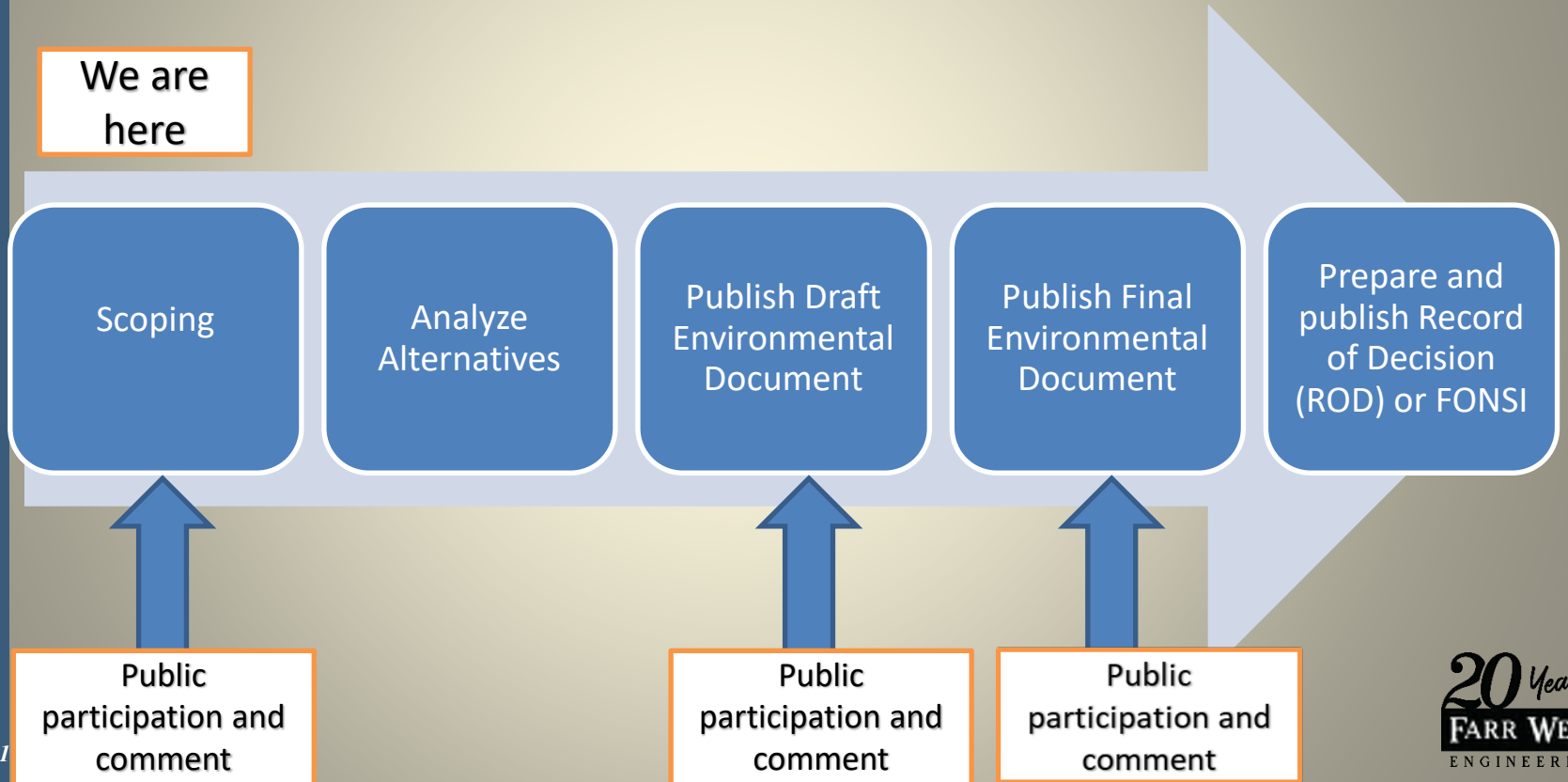
NEPA Process Overview



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Project Description

West Wash Dam, in the Peavine Mountain Watershed of Washoe County, Nevada, is included in a United States Department of Agriculture-Natural Resources Conservation Service (USDA-NRCS) funded rehabilitation partnership project. The City of Reno is the owner of the Dam and the Sponsoring Local Organization.

West Wash Dam was constructed in 1960 and East Wash in 1961 under the direction and authority of the Watershed Protection and Flood Prevention Act (Public Law 83-566). The original watershed plans for these dams used an evaluated life of 50 years

20 Years!
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City of Reno
October 19, 2021

20 Years!
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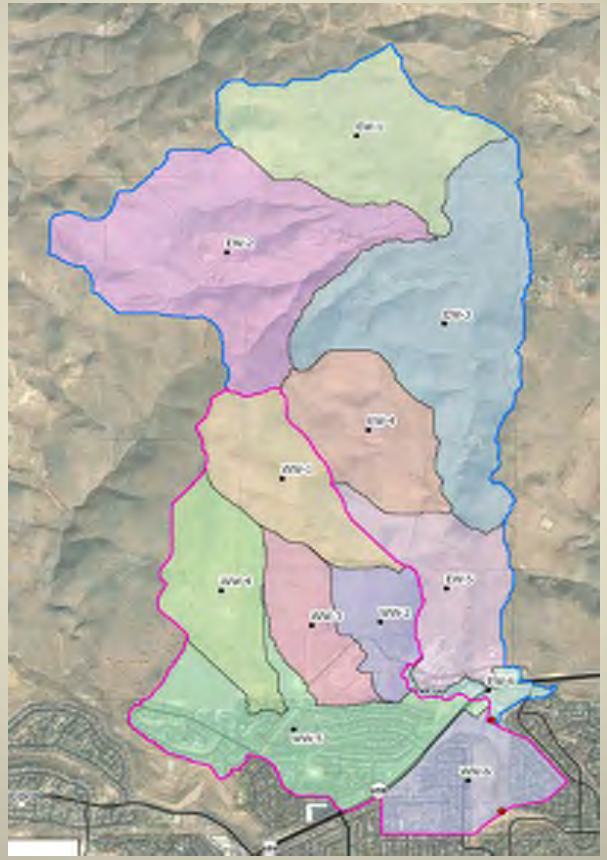
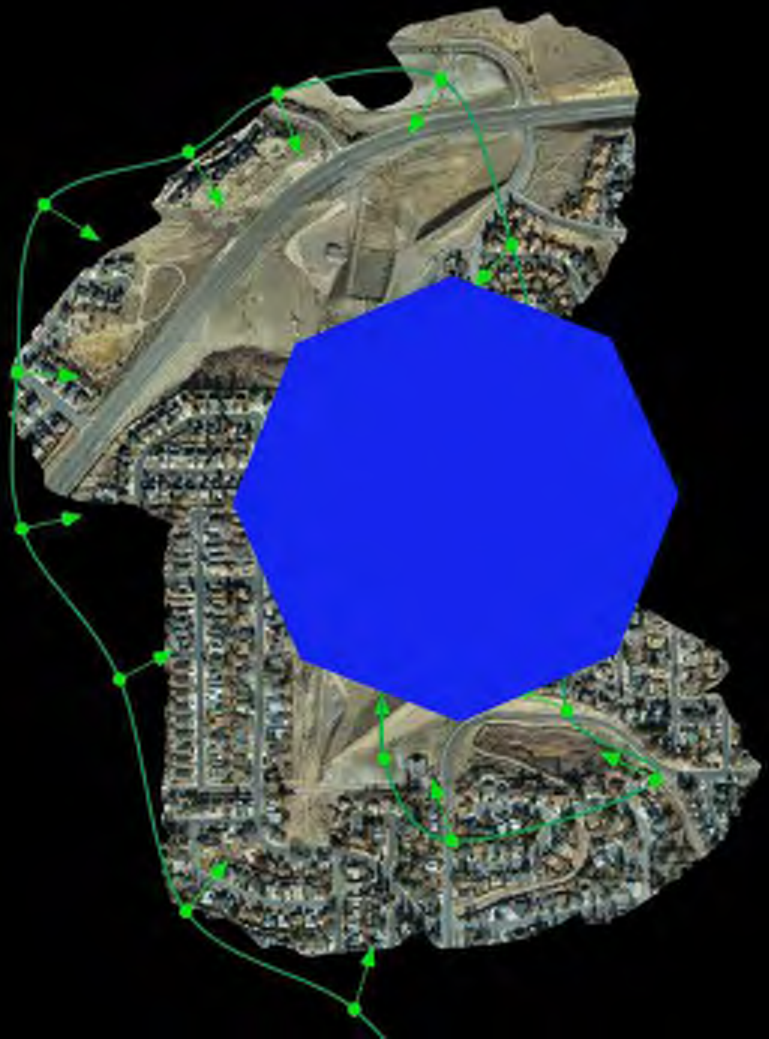
West Wash and East Wash watershed sub-basins





Why are we here?

- 50-year re-evaluation to meet current NRCS, City of Reno and State of Nevada Division of Water Resources dam safety criteria and performance standards.
- Maintain public safety and protection of property from flooding.
- Address previously identified possible deficiencies.
  - Vegetation growth
  - Erosion
  - Upstream development
  - Changes in design methodology
  - Changes in climate patterns

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Current Preliminary Project Alternatives

1. No Action	2. Flood proofing	3. Remediate both Dams	4. Removal of Both Dams	5. Removal of both dams with flood proofing downstream
•No improvements to the Dams •Also called "Future Without Project" •This alternative is required to be considered by NRCS under NEPA	•Increasing storm drain infrastructure capacity downstream of the dams •Creating a flood way (purchasing property and converting it to foodway/open space) •This alternative is required to be considered by NRCS under NEPA	•East Wash •reestablish the crest elevation of the principal spillways •auxiliary spillway improvements •West Wash •Raising the dam embankment •Auxiliary spillway improvements	•Return the area to a natural drainage landscape •This alternative is required to be considered by NRCS under NEPA	•Return the area to a natural drainage landscape •Increasing storm drain infrastructure capacity downstream •Creating a flood way (possible purchase of property)

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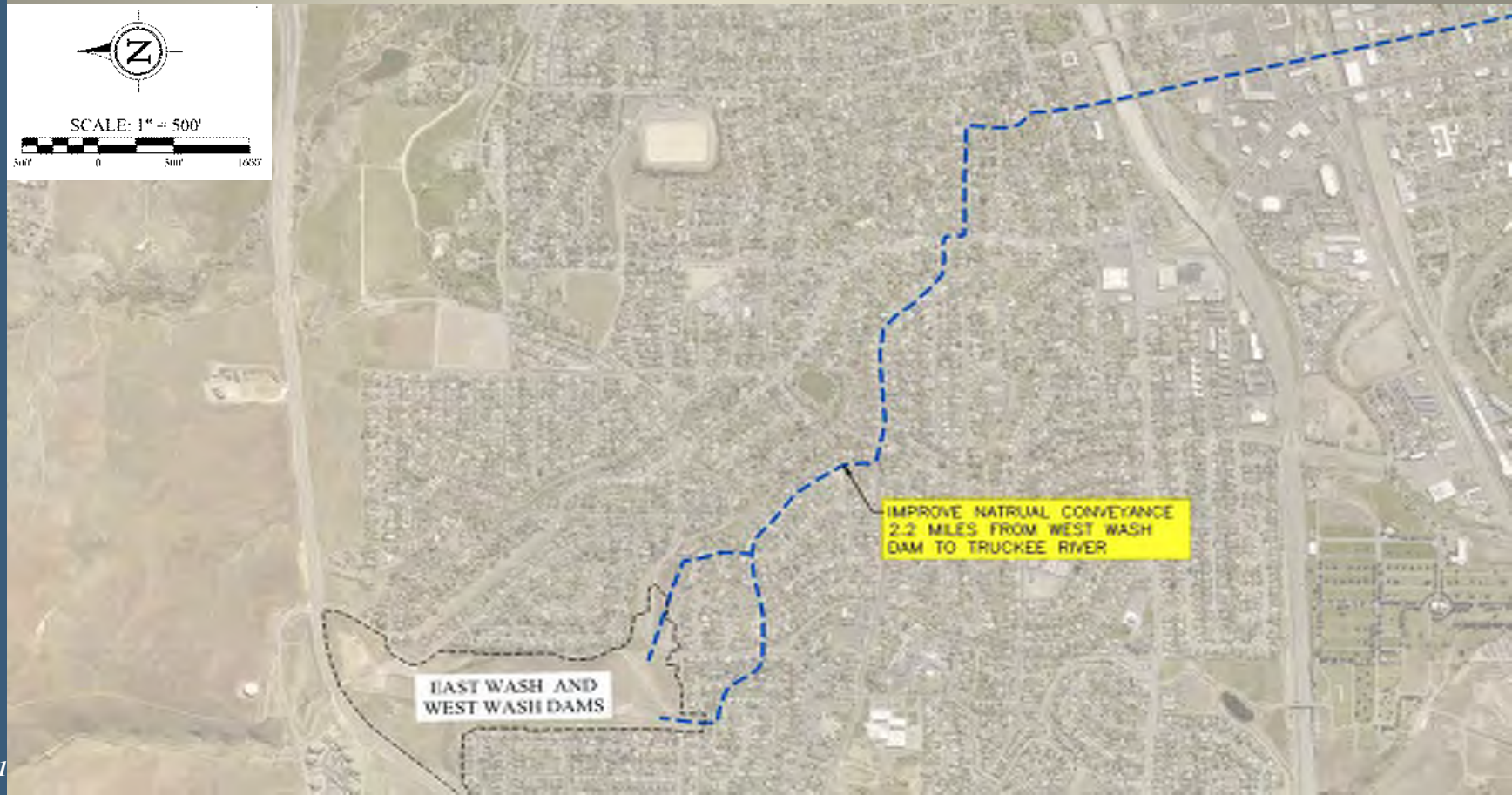
Preliminary Alternative 1: No Action

Preliminary Alternative 2: Floodproofing

Improve flood conveyance downstream of West Wash Dam

Preliminary Alternative 2: Floodproofing



Preliminary Alternative 3: Remediate Both Dams

Preliminary Alternative 4: Removal of Both Dams

Preliminary Alternative 5: Removal of both dams with flood proofing downstream

Remove both dams with improved flood conveyance downstream of both dams

Preliminary Alternative 5

Remove both dams with improved flood conveyance downstream of both dams

Project Schedule

Event	Date	Description
Public Scoping meeting	October 19, 2021	Project Scoping to identify all reasonable alternatives and collect public comment
Public Comment	October 19-December 19, 2021	Invitation and Acceptance of public comments and questions regarding scoping
Draft Environmental Document available for review	July 2022	Notice of availability of this draft document will be published to the public and sent to interested parties
Public comment	July 2022-September 2022	Collection of all public comments and questions which will be incorporated in the final environmental document
Publish Final Environmental Document	October 2022	Availability of this document will be provided to the public
Record of Decision or FONSI issued by NRCS	November 2022	Will be noticed to the public
Project Design	2023-2024	Tentative schedule, actual timing depends on project alternatives.
Construction Begins	2025	Tentative schedule, actual timing depends on project alternatives, and construction variables.

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Public Questions, Comments and Discussion

Written questions and comments may be submitted by mail or email to City of Reno Project lead, Steve Gamilis.

Please include "**West Wash Dam Rehabilitation Project**." in the subject line

Steve Gamilis
Project Coordinator
City of Reno
Utilities Services Department
PO Box 1900
Reno, NV 89505
Email: gamiliss@reno.gov
Office: (775) 334-2461

Comments must be received by **December 19, 2021**.

Additional Information can be found at the project website: West Wash Dam Rehabilitation | City of Reno

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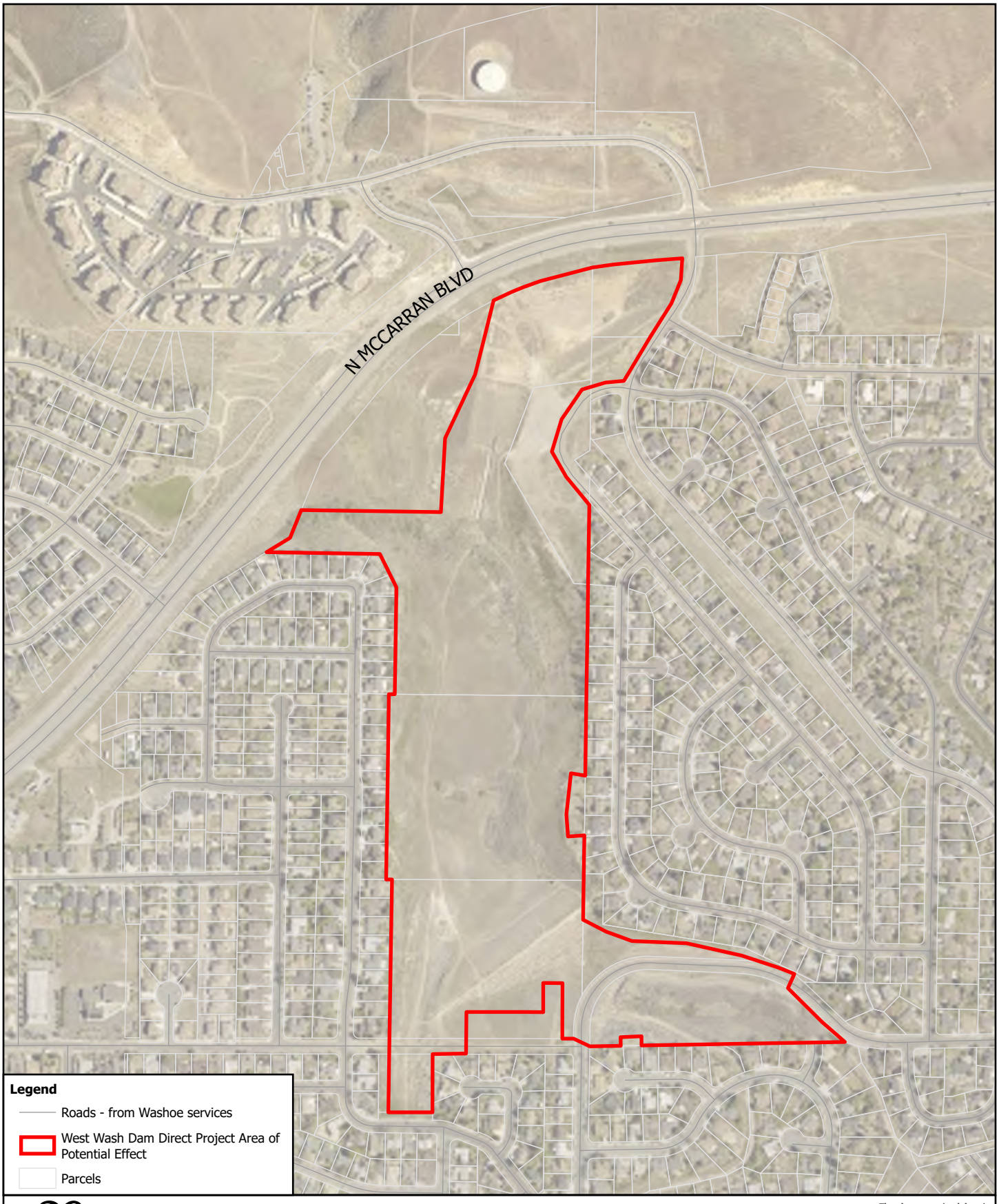

20 Years!
FARR WEST
ENGINEERING
5510 Longley Lane
Reno, NV 89511
(775) 851-4788
www.farrwestengineering.com

N

1" = 500'

Scoping:
Project Location Figure

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

Q:\client\Reno\Projects\CoR-WestWashDam-1930\WestWashDam-ProProject\CoR-WestWashDam.aprx, Layout: Scoping Project Location. Editor: areid. Printed: 9/7/2021

West Wash Dam Rehabilitation

The City of Reno entered into an agreement with the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) to rehabilitate the West Wash Dam to meet current NRCS, City of Reno and State of Nevada Division of Water Resources (DWR) dam safety criteria and performance standards.

Farr West Engineering will assist the City of Reno to meet the requirements of the NRCS Watershed Program including the development of a physically, environmentally, socially, and economically sound improvement plan known as the Supplemental Watershed Plan and Environmental Document (Plan/ED).

West Wash Dam

West Wash Dam, in the Peavine Mountain Watershed of Washoe County, Nevada, is included in a United States Department of Agriculture-Natural Resources Conservation Service (USDA-NRCS) funded rehabilitation partnership project. The dam provides protection against flooding to about 30,000 Nevadans who live and work downstream. Additionally, the dam protects downstream city roads, one state highway, and an interstate highway. Among other critical infrastructure, the dam also protects power lines and railroad tracks.

West Wash Dam was constructed in 1960 under the direction and authority of Watershed Protection and Flood Prevention Act (Public Law 83-566). East Wash diversion Dam, constructed in 1960 under the same program, contributes storm water flow from Peavine Mountain Watershed into West Wash Dam. The original watershed plans for these dams used an evaluated life of 50 years. Having reached over 50 years in age, the dams are eligible for rehabilitation through the Natural Resources Conservation Service's Watershed and Flood Prevention Operations Program. The goals of the program include prevention of erosion, floodwater and sediment damage; to further the conservation, use and disposal of water; and to further the conservation and proper use of land in authorized watersheds.

Both the West Wash and East Wash dams are currently classified as High Hazard Dams by NDWR and do not meet the requirements for dam safety by the State of Nevada or NRCS.

More Information

West Wash Dam Rehabilitation Project - Public Meeting, October 19,

We're Online. How can we help?

- Project Schedule
- Residential Letter
- Posting Notice
- Project Map
- Presentation from October 19, 2021 Public Meeting

For Additional Information

Email: Steve Gamilis

We're Online. How can we help?

APPENDIX D – COMPILED LIST OF SCOPING COMMENTS

Request for Support: Keystone Van Ness Recreation Site Development, submitted October/November 2021

What: 3.7 acre City owned land currently zoned Greenway and Open Space parcel 001-190-15
Where: Near Keystone and North McCarran adjacent to the East and West Wash Dams in Northwest Reno

General Location using Google Earth

Specific Parcel Outline and Zoning using City of Reno GIS map

Request:

Support and prioritize development of a low maintenance recreation facility on City of Reno parcel 001-190-15. Examples may include a trailhead, dog poop station, seating to take in the view of the Sierras, labyrinth, public art, picnic tables, shade structures, and native species plantings to enhance biodiversity.

Why:

1. West and East Wash Dams are scheduled for major Federal rehabilitation work between now and 2025 which presents a unique opportunity to dovetail recreation enhancements in the area. Steve Gamilis in the Utility Services Department at the City of Reno is the Project Coordinator. Email: gamiliss@reno.gov, Office: 775-334-2461. Please see their web page for further details.
2. The City already owns the property!
3. The property is already zoned for Greenways and Open space thanks to efforts from the former West University NAB, citizen efforts, and Council Person Neoma Jardon!
4. It fits with the City of Reno Parks and Recreation priority of creating a healthy community by developing low maintenance open space enhancements. The site is adjacent to several regional trails in the West/East Wash Dam, Keystone Canyon trailhead, and connectors to Rancho San Rafael already heavily used for hiking, mountain biking, running, and dog walking. For a relatively low cost, the City of Reno Recreation and Parks can enhance and preserve an important quality of life resource for our neighborhood.

Public Comment: West Wash Dam Rehabilitation, City of Reno

We live across the street downhill from the East Wash Dam site. We received a letter inviting us to comment and watched the presentation October 19, 2021. The following are comments and questions we would like addressed by the project team.

1. **Protect life and property**. If the dams were removed or nothing done to improve the site, our home of 30+ years and all of our resources are in the direct line of water flow down Keystone Ave. We want the team to create a plan for *maximum protection from extreme water events.*
2. **Prioritize nuisance mitigation during construction**. Wind and dust are common in the area so dust mitigation is a high priority. Please limit construction/noise between 8 am to 5 pm on weekdays only. There is a blind corner at Keystone and Van Ness. Cars speed in the area as they make their way to the North McCarran freeway. Hikers, mountain bikers and dog walkers regularly cross the street as they move from the Open Space over to Rancho San Rafael trails. Please address specifics in your upcoming presentations.
3. **Enhance area for neighborhood use**. The neighborhood uses the site as Open Space for hiking, biking, dog walking, recreating. We want the City to improve and develop the Dam and adjacent 3.7 acre City owned parcel into an official Recreation and Park amenity. The City owned property is Parcel 001-190-15 3.7 acres zoned Greenway and Open Space. A separate request (attached) is submitted to Recreation and Parks but we request your team coordinate an effort with their department.

4. **Enhance biodiversity and resilience**.
    a. Enhance biodiversity. The year round water flow attracts a rich assortment of species to the area. We want improvement and enhancements to protect and build upon naturally occurring biodiversity, in particular natural pollinator species and birds. What plantings and natural features can be repopulated in the area to support this goal?
    b. Eliminate use of biocides for vegetation management. We want the City stop using chemical biocides for vegetation management. In the past, the City has blown biocides in the area with NO PUBLIC NOTICE, blowing these chemicals into our back yards and homes. We exercise and walk our pets in this area and are concerned about the long term effects these chemicals have on biodiversity and our health. Please address these concerns in upcoming public meetings.

Thank you for the opportunity to comment and provide input on the West Wash Dam Rehabilitation Project. Two residents that live near the Keystone Van Ness Intersection.

CITY OF RENO LOG Received for the West Wash Dam Rehabilitation Project

As of 12/15/2021

DATE RECEIVED	NAME	CONTACT INFO	QUESTION / CONCERN
9/21/2021	John Crandell	(775) 742-1843	Went to the website link and received the message "no information found" Where can I get information on this project?
9/23/2021	Sinda Slagle	sindaslagle@gmail.com	I want to register for the zoom call October 19 about the West Wash Dam Rehab. Project, but I'm having trouble. Could you assist me?
9/23/2021	NDSL Nevada State Clearing House	nevadaclearinghouse@lands.nv.gov	email received with the following: When the scoping process begins please feel free to send in the notice to us and we will get it posted and sent out to our distribution list for comment.
9/28/2021	Wendy Broadhead	arthead@sbcglobal.net	I am looking forward to understanding what the West Wash Dam project is. I have found no proposed actions within the City of Reno website, only statements regarding the dam's purpose and regulatory authority of NRCS program. We have, over the decades, had a number of proposed enhancements to the West Wash Dam, including the most recent raising the height of the damn. I would love to comment on this project which backs to my property but I have no idea what is proposed. Is it possible to update the City's website so that the public may be more informed? I see that there are a number of reference studies and reports for flood management. What I don't see are more recent studies regarding this watershed. With the construction of Leadership parkway, which acts as a dam and apartments, which create impermeable surfaces, we don't have actual data corresponding to what our landscape now looks like and what we should be concerned about for future management. These studies and models would be helpful along with models for climate change, which I know FEMA is working on as well. Thank you for helping me be an informed citizen!
9/29/2021	Sue Finn	sue.finn@charter.net	I live in the area affected by the above referenced project and received your letter. I tried to register for the meeting on October 19, 2021. Sadly, the link listed in the letter does not work. I called both numbers listed on the letter and spoke to your assistant, Kara. Please send me the link so that I can register for this important meeting.
10/6/2021	Katherine	775-722-8424	Requested a call back for a question
10/15/2021	Shawn Grady	gradys@reno.gov	Thank you for your work with the West Wash Dam Rehab Project. At the location of the East Wash Diversion Dam has there been any talk about engineering a standing wave feature such as Boise has? I was just on the riverwalk in Boise and bought a surfboard. Their wave attracts eight to ten surfers at a time even during this time of year with lower flows. Could be an awesome way for the city to transform what has been a dangerous low-head dam feature into a great benefit for the community and visitors to the region. I cc'd our Water Entry Team leader, Captain Jason Peters, (also a surfer) on this as well as his knowledge of the river much greater than mine. (October 19 Shawn replied - Thanks for your response. My mistake, I was under the impression the east wash dam was the low head one now visible near Chalk Bluff.)
10/15/2021	Sue Smith	sue@argentnevada.com 775-323-5000	Where do we find out more about this? Will there be a meeting? The FB post says something about Oct 19, but there is no further instructions; so I am contacting you.
10/19/2021	Megan Dettenmaier	megandettenmaier@gmail.com	I'm so pleased that the city is interested in rehabilitating the west wash dam. I have lived here for 2 years and was very disappointed when I started using the west wash to see how many people leave pet waste there without any consideration for the natural landscape. I'd love to attend today's meeting, however I'll be in the middle of another meeting. Thank you so much for taking the time to ask neighbors how they want this natural area converted from the wasteland that it currently is into something better for our community. (November 1 - Thanks for the update. When will decisions be made?)
10/19/2021	Melanie Scott	mel.scott2030@gmail.com	I wasn't able to properly jot down the link for further information and commenting regarding this project. Would you be able to forward that link to me? Thank you for making this meeting possible. I found it very interesting, but I didn't feel I knew enough - even with the excellent overview by the engineering firm - to comment. I hope to continue to learn more about the project. We live very close to the east wash dam.
10/20/2021	Madeline Carpenter	mhcarpenter@sbcglobal.net	Will the recording be available for viewing? I was unable to attend and tried to join at 7PM, said host would start meeting soon.

10/21/2021	Paul Verburg	psjverburg@gmail.com	Unfortunately I was not able to participate in the meeting last Tuesday discussing the West Wash Rehabilitation project but I was curious to find out what was going on on the north end of the wash near McCarran. It was my understanding that it was being developed for retail and housing but some of my neighbors had mentioned that this plan had been nixed. However, there has been some construction going on there and wasn't able to find what was being planned.
10/21/2021	Linda Sealock	sealockl@yahoo.com	I'm so sorry I missed the meeting. I didn't see your confirmation and reminder until too late. I tried to get on from where I signed up and couldn't navigate it.
10/24/2021	Lisa Hill	keystoneneighbor@protonmail.com 775-848-8579	Dear Karina, Please include the following proposal as part of public input for your City of Reno | Parks, Recreation, and Open Space Service Plan. You will be excited to learn we already have City owned land zoned for Open Space and Greenways in the midst of a heavily used trail system that be developed into a low cost recreation site in Northwest Reno near Keystone and North McCarran! The site was preserved thanks to the efforts of the former West University NAB, citizen input, and Council Person Jardon. I am copying Council Person Jardon's office, the Director of Parks and Recreation Jaime Schroeder, and Steve Gamilis the project coordinator for the West Wash Dam Rehabilitation project. I plan on presenting this proposal at an upcoming Parks and Recreation Commission meeting at public comment and hope you will support the idea. Please see the attached document with a summary below. Request for Support: Keystone Van Ness Recreation Site Development, submitted October/November 2021 What: 3.7 acre City owned land currently zoned Greenway and Open Space parcel 001-190-15 Where: Near Keystone and North McCarran adjacent to the East and West Wash Dams in Northwest Reno General Location using Google Earth Keystone Van Ness General location.png Specific Parcel Outline and Zoning using City of Reno GIS map tempsnip.png Request: Support and prioritize development of a low maintenance recreation facility on City of Reno parcel 001-190-15. Examples may include a trailhead, dog poop station, seating to take in the view of the Sierras, labyrinth, public art, picnic tables, shade structures, and native species plantings to enhance biodiversity. Why: 1. West and East Wash Dams are scheduled for major Federal rehabilitation work between now and 2025 which presents a unique opportunity to dovetail recreation enhancements in the area. Steve Gamilis in the Utility Services Department at the City of Reno is the Project Coordinator. Email: gamiliss@reno.gov, Office: 775-334-2461. Please see their web page for further details. 2. The City already owns the property! 3. The property is already zoned for Greenways and Open space thanks to efforts from the former West University NAB, citizen efforts, and Council Person Neoma Jardon! 4. It fits with the City of Reno Park and Recreation priority of creating a healthy community by developing low maintenance open space enhancements. The site is adjacent to several regional trails in the West/East Wash Dam, Keystone Canyon trailhead, and connectors to Rancho San Rafael already heavily used for hiking, mountain biking, running, and dog walking. For a relatively low cost, the City of Reno Recreation and Parks can enhance and preserve an important quality of life resource for our neighborhood. Sincerely, Lisa Hill 775-848-8579

10/24/2021	T Barker Hill and L Hill	keystoneneighbor@protonmail.com	Attached and below, please see our public comments. Regarding developing a recreation site adjacent to the dam site, I simply ask you be aware of our separate request to Parks and Recreation and do whatever you can to coordinate your project with their effort. I included you in an email sent to Parks and Recreation. We look forward to future meetings. With Regard L Hill and T Barker Peavine Road Reno Public Comment: West Wash Dam Rehabilitation, City of Reno We live across the street downhill from the East Wash Dam site. We received a letter inviting us to comment and watched the presentation October 19, 2021. The following are comments and questions we would like addressed by the project team. 1. Protect life and property. If the dams were removed or nothing done to improve the site, our home of 30+ years and all of our resources are in the direct line of water flow down Keystone Ave. We want the team to create a plan for maximum protection from extreme water events. 2. Prioritize nuisance mitigation during construction. Wind and dust are common in the area so dust mitigation is a high priority. Please limit construction/noise between 8 am to 5 pm on weekdays only. There is a blind corner at Keystone and Van Ness. Cars speed in the area as they make their way to the North McCarran freeway. Hikers, mountain bikers and dog walkers regularly cross the street as they move from the Open Space over to Rancho San Rafael trails. Please address specifics in your upcoming presentations. 3. Enhance area for neighborhood use. The neighborhood uses the site as Open Space for hiking, biking, dog walking, recreating. We want the City to improve and develop the Dam and adjacent 3.7 acre City owned parcel into an official Recreation and Park amenity. The City owned property is Parcel 001-190-15 3.7 acres zoned Greenway and Open Space. A separate request (attached) is submitted to Recreation and Parks but we request your team coordinate an effort with their department. tempsnip.png 4. Enhance biodiversity and resilience. a. Enhance biodiversity. The year round water flow attracts a rich assortment of species to the area. We want improvement and enhancements to protect and build upon naturally occurring biodiversity, in particular natural pollinator species and birds. What plantings and natural features can be repopulated in the area to support this goal? b. Eliminate use of biocides for vegetation management. We want the City stop using chemical biocides for vegetation management. In the past, the City has blown biocides in the area with NO PUBLIC NOTICE, blowing these chemicals into our back yards and homes. We exercise and walk our pets in this area and are concerned about the long term effects these chemicals have on biodiversity and our health. Please address these concerns in upcoming public meetings. Thank you for the opportunity to comment and provide input on the West Wash Dam Rehabilitation Project. Two residents that live near the Keystone Van Ness Intersection.
11/1/2021	Jana	janawena@gmail.com	I was unable to attend the zoom meeting regarding the West Wash Dam. Is there is a summary of that meeting available please? Also, I took this picture when we has the rain event on Oct. 24 and thought you might be interested.

11/28/2021	Melanie Scott	mel.scott2030@gmail.com	I am finally able to sit down and provide my thoughts on the West and East WAsh Dam rehab project. My husband, son and I have enjoyed walking down into the open space between the two earthen dams since 2003. There have been wet years, when the stream expanded, the seasonal 'pond' filled up and ducks and other water fowl converged. The willows expanded, and sanctuaries for wild animals both of wing and ground habits increased. Later, we watched motorized vehicles move into the spaces, causing damage to the stream bed and trails. When the City finally blocked off entry to motorized traffic, and designated the area a 'greenway' we were very pleased. We again found this area to provide a small, nearby peaceful place to amble. Since the pandemic, in 2020, this area has seen a huge increase in recreational use. We have seen new bicycle paths cut into the eastside slope, and dog and foot traffic traversing any open area. The stream is but a trickle during the drought, and shrubs, grasses and willows are all challenged to survive. Pathways lead across the stream in many locations, disrupting the meager protections for small wildlife, and the plants that help to anchor the soil. Its rare to see wildlife there now, nor hear much of the songbirds we might once have heard in the morning or evening. That said, it is our hope that the engineering firm tasked with evaluating the safety of the dams, and the prospect of greater flooding events, will decide to maintain/improve/even enlarge the dams now in place. Removal of the dams doesn't make sense to us. In its current state, the area is heavily used and the soil is disrupted. Flooding would likely be heavily sedimented. Flooding of the area would also pick up dog waste, which could also be detrimental, downstream. Weed control through spraying has been a concern to nearby neighbors, who have had wind carried spray, or actual direct application onto their properties. Please address non-chemical ways to manage unwanted plants. Introducing native plants into a managed setting might help, if allowed to establish through certain protections, and controlled irrigation. Given that the City is reevaluating its parks and recreation master plan, would not this area be a great candidate for a City Park? # Established pathways would help to cut down on off-trail traffic; signage and pathways could make it clear when illegal pathway cutting would occur. Native plants could again take root, and help retain soil. # Dog waste could be better handled with poop stations and trash receptacles. # Why not establish a fenced off area for dogs, to allow other areas to remain dog free, to allow for the establishment of native plantings, and sheltering of wildlife. # We have anticipated a bicycle shop and test riding pathways to be constructed just north of the parcel. Perhaps this business would be willing to help fund specially selected trails for bicycling on the parcel # A small parking area on the south end - to the west of the West Wash Dam - and paved pathways to meet ADA standards, and a seating area. # Perhaps there are local businesses that would be interested in donating park benches, or scheduling volunteer days in coordination with KTMB or the Parks Foundation. I will be writing to those in the Parks and Recreation Department as well.
11/29/2021	joy bridgeman	joybridge3@yahoo.com	I live very near the West Wash Dam and am aware of the upcoming work to be done there. I enjoy walking in that area and am hoping that as part of the plan there could be recreational enhancements. This area is a natural wildlife habitat and I often see/hear birds and other wildlife along the little stream that runs through it. The open area has a park like feeling that could be developed nicely. The downer though is the huge amount of dog poop as people walk their dogs and don't pick up. If there were more distinct trails, maybe a few benches and definitely a dog poop station or two I think people would have more respect, and would keep it clean. With ever encroaching building taking our open spaces (like all the apartments across the street) we need to protect and enhance the natural areas we still have left. I hope you will agree and see the potential of this little area
12/1/2021	Jean and Randy Johnson	possegirl@rapiddog.net	We live a block away from the West Wash Dam. I understand there will be some improvements made to the site. I would like to understand what mitigations will be made for noise and dust. And I would like to urge the city to allow this spot to be a recreational area with connector trails. It is well used by the local community at this time for biking and dog walking. If it can be enhanced in any way, we would appreciate it.

12/10/2021	Wendy Broadhead Pondera Ecological Consulting	w.broadhead@att.net	Thank you for the presentation back in October, appreciated the consultants and NRCS information. Based on the powerpoint given during the discussion, I'm trying to figure out the "overtopping" models for the dams, since these were presented without context. The 100-yr events are daily/hourly #s? From what I can see we've had at least two of these, in the past 25 years and really only the East Wash dam gave me concerns, though it never reached the spillway to deliver water to the West Wash retention area. That event also sent a lot of water to the drainage below the West Wash dam, so I assume that was used as storm drainage from somewhere else. The West Wash dam did very well in 1997. Of course this was before the upstream apartment land was conceived, creating acres of impermeable surface (whatever happened to the City's quest for permeable pavement and covering?). Anyway, I look forward the consultants modeling. What I really wanted to comment on is the land within the wash areas. The drainages support native riparian habitat which had done very well until recent declines in native tree species with non-native invasive Russian olive taking over. Adjacent to the riparian tree canopy are now large swaths of perennial pepperweed a Nevada C listed weed. Additionally, some of the upland area has recovered or was not significantly affected by original construction, these areas contain native shrubs and forbs. Areas that have had fairly recent fires have supported invasion of non-native State listed weeds including madusahead, puncture vine, jointed goatgrass, a variety of invasive thistles and ever present cheatgrass. Should earth moving activities occur, say for borrow sites, please place these sites in areas that support non-native species and refrain from disturbing the ever-dwindling native shrub patches. Post construction, a restoration plan with native plant seeding specs., should help reduce the potential for fire by reducing the flammable non-native annual grass species. A weed abatement plan should be developed and followed post construction with certified weed applicators. The drainage within the West Wash dam used to support diverse amphibians. Western toad and Sierran tree frog used to be common here. I realize this is probably a fruitless request but allowing relatively shallow ponding of water before it drains would enhance the re-establishment of these amphibians. Thank you for your time and I look forward to reviewing the draft EA.

RESPONSE	RESPONSE TYPE
The website went live earlier this morning where you can get additional information about the West Wash Dam Rehabilitation Project. Registration for the meeting can be done by using (clicking) the following link: https://zoom.us/webinar/register/WN_b2vEBhrTQMingA3ib8BbPw With this link you will be directed to a registration page requiring you name and email address to register. Please let me know if this works for you or if there are issues.	SG replied via email on 9/22/2021
Thank you for posting the information on your website. It is anticipated that the Draft Environmental document will be sent in July 2022.	SG replied via email on 9/23/2021
The upcoming meeting is for public scoping only and an alternative to rehabilitate the dam has not been selected. Once an alternative is selected, additional information will be provided within the environmental document which will be available to the public for review and comment. This information is anticipated to be available in late summer 2022. Additional information will be available at the scoping meeting and will be posted to the project website after the meeting for public review. All members of the public are welcome to submit questions or comments regarding the dams, the resources present and the goals of the NRCS Watershed and Flood Prevention Operations Program. I appreciate your comments and your concerns will be included in the public scoping record for the project. Thanks for your interest and involvement in the West Wash Dam Rehabilitation Project.	SG replied via email on 9/24/2021
Try using the following link to register to the upcoming meeting: https://zoom.us/webinar/register/WN_b2vEBhrTQMingA3ib8BbPw	SG replied via email on 9/30/2021
SG returned call and Katherine asked about the previous project. SG replied that this is a complet start over with new alternatives.	SG replied via email on 9/29/2021
Thank you for your comment. I will share this concept with the project team. However, since the East Wash Diversion Dam is not on the Truckee River and only receives flow during large storm events, a feature such as this would not serve the purpose as intended.	SG replied via phone on 10/6/2021
Please use the following City link for recent information about the upcoming meeting: https://www.reno.gov/Home/Components/News/News/19864/576 For more information, visit: Reno.gov/WestWashDamRehabilitationProject	SG replied via email on 10/18/2021
Thank you for your comments and interest in the West Wash Dam Rehabilitation Project. There were additional residents that were not available to join the meeting so the recording of the meeting was added to the project's webpage which can be viewed (if interested) with the following link: https://www.reno.gov/government/departments/public-works/west-wash-dam-rehabilitation/ (December 15 - Once an alternative is selected (which I anticipate by April 2022), additional information will be provided within the environmental document which will be available to the public for review and comment. This information is anticipated to be available in late summer 2022. I appreciate your comments and your concerns will be included in the public scoping record for the project)	SG replied via email on 10/18/2021
Thanks for joining the meeting. The following consists of the link: reno.gov/WestWashDamRehabilitationProject In the next few days we will include the presentation and additional information throughout this process.	SG replied via email on 10/28/2021 (SG replied via email on 12/15/2021)
The recording has been added to the project website and can be viewed with the following link: https://www.reno.gov/government/departments/public-works/west-wash-dam-rehabilitation/	SG replied via email on 10/19/2021
	SG replied via email on 10/28/2021

I followed up with Community Development and they gave me the following update for the project adjacent to the West Wash Dam Rehabilitation Project:	
The project is in for a grading permit and the current status is on hold. The project includes retail and housing as initially planned; however, it has been redesigned to reduce grading. There were some non-permitted grading activities going on in the site but CD staff required the contractor to stop all construction activities. We will not issue any permits on the site until the sewer situation is resolved.	SG replied via email on 10/28/2021
Thanks for your interest in the West Wash Dam Rehabilitation Project.	
I apologize for skipping your email which I just saw while double checking my email inbox. The recording from the meeting you missed has been added to the project website and can be viewed with the following link: https://www.reno.gov/government/departments/public-works/west-wash-dam-rehabilitation/	SG replied via email on 12/15/2021
Response from Parks and Recreation: Thank you for providing input on our Parks, Recreation and Open Space Service Plan. Your comments will be incorporated with our public input. If you have any questions, please do not hesitate to contact me.	Parks and Recreation replied via email on 10/25/2021

Thanks for including me in your other email that was sent which my department is researching and gathering information for.	SG replied via email on 12/15/2021
I appreciate your comments and questions for the West Wash Dam Rehabilitation Project and your concerns will be included in the public scoping record for the project.	SG replied via email on 11/03/2021

I appreciate your comments and your concerns will be included in the public scoping record for the project.	SG replied via email on 12/15/2021
We appreciate your comments and your concerns will be included in the public scoping record for the West Wash Dam Rehabilitation Project. Once an alternative is selected, additional information will be provided within the environmental document which will be available to the public for review and comment. This information is anticipated to be available in late summer 2022. Thanks for your interest and involvement in the West Wash Dam Rehabilitation Project.	SG replied via email on 12/15/2021
I appreciate your comments and your concerns will be included in the public scoping record for the project.	SG replied via email on 12/15/2021

Comments are still being accepted and your concerns will be included in the public scoping record for the project. Thanks for your interest and involvement in the West Wash Dam Rehabilitation Project.	SG replied via email on 12/15/2021

West Wash Dam Rehabilitation Public Comments

The following comments were received during the comment period ending December 19, 2021 that are shown as italicized text and responses are in bold text:

- Went to the website link and received the message "no information found" Where can I get information on this project?

The website (https://www.reno.gov/westwashdamrehabilitationproject).

- I want to register for the zoom call October 19 about the West Wash Dam Rehab. Project, but I'm having trouble. Could you assist me?

Registration for the meeting can be done by using (clicking) the following link: https://zoom.us/webinar/register/WN_b2vEBhrTQMingA3ib8BbPw

- I am looking forward to understanding what the West Wash Dam project is. I have found no proposed actions within the City of Reno website, only statements regarding the dam's purpose and regulatory authority of NRCS program. We have, over the decades, had a number of proposed enhancements to the West Wash Dam, including the most recent raising the height of the damn. I would love to comment on this project which backs to my property but I have no idea what is proposed. Is it possible to update the City's website so that the public may be more informed? I see that there are a number of reference studies and reports for flood management. What I don't see are more recent studies regarding this watershed. With the construction of Leadership parkway, which acts as a dam and apartments, which create impermeable surfaces, we don't have actual data corresponding to what our landscape now looks like and what we should be concerned about for future management. These studies and models would be helpful along with models for climate change, which I know FEMA is working on as well. Thank you for helping me be an informed citizen!

The upcoming meeting is for public scoping only and an alternative to rehabilitate the dam has not been selected. Once an alternative is selected, additional information will be provided within the environmental document which will be available to the public for review and comment. This information is anticipated to be available in late summer 2022. Additional information will be available at the scoping meeting and will be posted to the project website after the meeting for public review. All members of the public are welcome to submit questions or comments regarding the dams, the resources present and the goals of the NRCS Watershed and Flood Prevention Operations Program. I appreciate your comments and your concerns will be included in the public scoping record for the project.

- I live in the area affected by the above referenced project and received your letter. I tried to register for the meeting on October 19, 2021. Sadly, the link listed in the letter does not work.

Try using the following link to register to the upcoming meeting: https://zoom.us/webinar/register/WN_b2vEBhrTQMingA3ib8BbPw

- What about the previous project?

This is a complete start over with new alternatives.

- Thank you for your work with the West Wash Dam Rehab Project. At the location of the East Wash Diversion Dam has there been any talk about engineering a standing wave feature such as Boise has? I was just on the riverwalk in Boise and bought a surfboard. Their wave attracts eight to ten surfers at a time even during this time of year with lower flows. Could be an awesome way for the city to transform what has been a dangerous low-head dam feature into a great benefit for the community and visitors to the region.

Since the East Wash Diversion Dam is not on the Truckee River and only receives flow during large storm events, a feature such as this would not serve the purpose as intended.

- Where do we find out more about this? Will there be a meeting? The FB post says something about Oct 19, but there is no further instructions.

Please use the following City link for recent information about the upcoming meeting: https://www.reno.gov/Home/Components/News/News/19864/576
For more information, visit: Reno.gov/WestWashDamRehabilitationProject

- I'm so pleased that the city is interested in rehabilitating the west wash dam. I have lived here for 2 years and was very disappointed when I started using the west wash to see how many people leave pet waste there without any consideration for the natural landscape. I'd love to attend today's meeting, however I'll be in the middle of another meeting. Thank you so much for taking the time to ask neighbors how they want this natural area converted from the wasteland that it currently is into something better for our community. When will decisions be made?

There were additional residents that were not available to join the meeting so the recording of the meeting was added to the project's webpage which can be viewed (if interested) with the following link: https://www.reno.gov/government/departments/public-works/west-wash-dam-rehabilitation. Once an alternative is selected, additional information will be provided within the environmental document which will be available to the public for review and comment. This information is anticipated to be available in late summer 2022.

- I wasn't able to properly jot down the link for further information and commenting regarding this project. Would you be able to forward that link to me? Thank you for making this meeting possible. I found it very interesting, but I didn't feel I knew enough - even with the excellent overview by the engineering firm - to comment. I hope to continue to learn more about the project. We live very close to the east wash dam.

The following consists of the link: reno.gov/WestWashDamRehabilitationProject. In the next few days we will include the presentation and additional information throughout this process.

- Will the recording be available for viewing?

> **The recording has been added to the project website and can be viewed with the following link: https://www.reno.gov/government/departments/public-works/west-wash-dam-rehabilitation/**

- Unfortunately I was not able to participate in the meeting last Tuesday discussing the West Wash Rehabilitation project but I was curious to find out what was going on the north end of the wash near McCarran. It was my understanding that it was being developed for retail and housing but some of my neighbors had mentioned that this plan had been nixed. However, there has been some construction going on there and wasn't able to find what was being planned.

> **The project is in for a grading permit and the current status is on hold. The project includes retail and housing as initially planned; however, it has been redesigned to reduce grading. There were some non-permitted grading activities going on in the site but Building Department staff required the contractor to stop all construction activities.**

- I'm so sorry I missed the meeting. I didn't see your confirmation and reminder until too late. I tried to get on from where I signed up and couldn't navigate it.

> **The recording from the meeting you missed has been added to the project website and can be viewed with the following link: https://www.reno.gov/government/departments/public-works/west-wash-dam-rehabilitation/**

- Attached and below, please see our public comments. Regarding developing a recreation site adjacent to the dam site, I simply ask you be aware of our separate request to Parks and Recreation and do whatever you can to coordinate your project with their effort. I included you in an email sent to Parks and Recreation.
We look forward to future meetings.
Public Comment: West Wash Dam Rehabilitation, City of Reno
We live across the street downhill from the East Wash Dam site. We received a letter inviting us to comment and watched the presentation October 19, 2021. The following are comments and questions we would like addressed by the project team.
1. Protect life and property. If the dams were removed or nothing done to improve the site, our home of 30+ years and all of our resources are in the direct line of water flow down Keystone Ave. We want the team to create a plan for maximum protection from extreme water events.
2. Prioritize nuisance mitigation during construction. Wind and dust are common in the area so dust mitigation is a high priority. Please limit construction/noise between 8 am to 5 pm on weekdays only. There is a blind corner at Keystone and Van Ness. Cars speed in the area as they make their way to the North McCarran freeway. Hikers, mountain bikers and dog walkers regularly cross the street as they move from the Open Space over to Rancho San Rafael trails. Please address specifics in your upcoming presentations.
3. Enhance area for neighborhood use. The neighborhood uses the site as Open Space for hiking, biking, dog walking, recreating. We want the City to improve and develop the Dam and adjacent 3.7 acre City owned parcel into an official Recreation and Park amenity. The City owned property is Parcel 001-190-15 3.7 acres zoned Greenway and Open Space. A separate

request (attached) is submitted to Recreation and Parks but we request your team coordinate an effort with their department.

4. Enhance biodiversity and resilience.

a. Enhance biodiversity. The year round water flow attracts a rich assortment of species to the area. We want improvement and enhancements to protect and build upon naturally occurring biodiversity, in particular natural pollinator species and birds. What plantings and natural features can be repopulated in the area to support this goal?

b. Eliminate use of biocides for vegetation management. We want the City stop using chemical biocides for vegetation management. In the past, the City has blown biocides in the area with NO PUBLIC NOTICE, blowing these chemicals into our back yards and homes. We exercise and walk our pets in this area and are concerned about the long term effects these chemicals have on biodiversity and our health. Please address these concerns in upcoming public meetings.

Thank you for the opportunity to comment and provide input on the West Wash Dam Rehabilitation Project. Two residents that live near the Keystone Van Ness Intersection.

Utility Services Department is researching and gathering information for this.

- Please include the following proposal as part of public input for your City of Reno | Parks, Recreation, and Open Space Service Plan. You will be excited to learn we already have City owned land zoned for Open Space and Greenways in the midst of a heavily used trail system that be developed into a low cost recreation site in Northwest Reno near Keystone and North McCarran! The site was preserved thanks to the efforts of the former West University NAB, citizen input, and Council Person Jardon.

I am copying Council Person Jardon's office, the Director of Parks and Recreation Jaime Schroeder, and Steve Gamilis the project coordinator for the West Wash Dam Rehabilitation project. I plan on presenting this proposal at an upcoming Parks and Recreation Commission meeting at public comment and hope you will support the idea. Please see the attached document with a summary below.

Request for Support: Keystone Van Ness Recreation Site Development, submitted October/November 2021

What: 3.7 acre City owned land currently zoned Greenway and Open Space parcel 001-190-15

Where: Near Keystone and North McCarran adjacent to the East and West Wash Dams in Northwest Reno

General Location using Google Earth

Keystone Van Ness General location.png

Specific Parcel Outline and Zoning using City of Reno GIS map

tempsnip.png

Request: Support and prioritize development of a low maintenance recreation facility on City of Reno parcel 001-190-15. Examples may include a trailhead, dog poop station, seating to take in the view of the Sierras, labyrinth, public art, picnic tables, shade structures, and native species plantings to enhance biodiversity.

Why:

1. West and East Wash Dams are scheduled for major Federal rehabilitation work between now and 2025 which presents a unique opportunity to dovetail recreation enhancements in the area. Steve Gamilis in the Utility Services Department at the City of Reno is the Project Coordinator. Email: gamiliss@reno.gov, Office: 775-334-2461. Please see their web page for further details.

2. The City already owns the property!
3. The property is already zoned for Greenways and Open space thanks to efforts from the former West University NAB, citizen efforts, and Council Person Neoma Jardon!
4. It fits with the City of Reno Park and Recreation priority of creating a healthy community by developing low maintenance open space enhancements. The site is adjacent to several regional trails in the West/East Wash Dam, Keystone Canyon trailhead, and connectors to Rancho San Rafael already heavily used for hiking, mountain biking, running, and dog walking. For a relatively low cost, the City of Reno Recreation and Parks can enhance and preserve an important quality of life resource for our neighborhood.

Thank you for providing input on our Parks, Recreation and Open Space Service Plan. Your comments will be incorporated with our public input.

- I was unable to attend the zoom meeting regarding the West Wash Dam. Is there is a summary of that meeting available please?

Your concerns will be included in the public scoping record for the project.

- I am finally able to sit down and provide my thoughts on the West and East WAsh Dam rehab project.
My husband, son and I have enjoyed walking down into the open space between the two earthen dams since 2003. There have been wet years, when the stream expanded, the seasonal 'pond' filled up and ducks and other water fowl converged. The willows expanded, and sanctuaries for wild animals both of wing and ground habits increased. Later, we watched motorized vehicles move into the spaces, causing damage to the stream bed and trails. When the City finally blocked off entry to motorized traffic, and designated the area a 'greenway' we were very pleased. We again found this area to provide a small, nearby peaceful place to amble.
Since the pandemic, in 2020, this area has seen a huge increase in recreational use. We have seen new bicycle paths cut into the eastside slope, and dog and foot traffic traversing any open area. The stream is but a trickle during the drought, and shrubs, grasses and willows are all challenged to survive. Pathways lead across the stream in many locations, disrupting the meager protections for small wildlife, and the plants that help to anchor the soil. Its rare to see wildlife there now, nor hear much of the songbirds we might once have heard in the morning or evening.
That said, it is our hope that the engineering firm tasked with evaluating the safety of the dams, and the prospect of greater flooding events, will decide to maintain/improve/even enlarge the dams now in place. Removal of the dams doesn't make sense to us. In its current state, the area is heavily used and the soil is disrupted. Flooding would likely be heavily sedimented. Flooding of the area would also pick up dog waste, which could also be detrimental, downstream.
Weed control through spraying has been a concern to nearby neighbors, who have had wind carried spray, or actual direct application onto their properties. Please address non-chemical ways to manage unwanted plants. Introducing native plants into a managed setting might help, if allowed to establish through certain protections, and controlled irrigation.
Given that the City is reevaluating its parks and recreation master plan, would not this area be a great candidate for a City Park?
 # Established pathways would help to cut down on off-trail traffic; signage and pathways could make it clear when illegal pathway cutting would occur. Native plants could again take root, and help retain soil.
 # Dog waste could be better handled with poop stations and trash receptacles.

 # Why not establish a fenced off area for dogs, to allow other areas to remain dog free, to allow for the establishment of native plantings, and sheltering of wildlife.

 # We have anticipated a bicycle shop and test riding pathways to be constructed just north of the parcel. Perhaps this business would be willing to help fund specially selected trails for bicycling on the parcel

 # A small parking area on the south end - to the west of the West Wash Dam - and paved pathways to meet ADA standards, and a seating area.

 # Perhaps there are local businesses that would be interested in donating park benches, or scheduling volunteer days in coordination with KTMB or the Parks Foundation.
I will be writing to those in the Parks and Recreation Department as well.
Thank you for this opportunity to express my thoughts on behalf of my son, and husband.

Your comments and your concerns will be included in the public scoping record for the project.

- I live very near the West Wash Dam and am aware of the upcoming work to be done there. I enjoy walking in that area and am hoping that as part of the plan there could be recreational enhancements. This area is a natural wildlife habitat and I often see/hear birds and other wildlife along the little stream that runs through it. The open area has a park like feeling that could be developed nicely. The downer though is the huge amount of dog poop as people walk their dogs and don't pick up. If there were more distinct trails, maybe a few benches and definitely a dog poop station or two I think people would have more respect, and would keep it clean.
With ever encroaching building taking our open spaces (like all the apartments across the street) we need to protect and enhance the natural areas we still have left. I hope you will agree and see the potential of this little area

Your comments and your concerns will be included in the public scoping record for the West Wash Dam Rehabilitation Project. Once an alternative is selected, additional information will be provided within the environmental document which will be available to the public for review and comment. This information is anticipated to be available in late summer 2022.

- We live a block away from the West Wash Dam. I understand there will be some improvements made to the site. I would like to understand what mitigations will be made for noise and dust. And I would like to urge the city to allow this spot to be a recreational area with connector trails. It is well used by the local community at this time for biking and dog walking. If it can be enhanced in any way, we would appreciate it.

Your comments and your concerns will be included in the public scoping record for the project.

- Thank you for the presentation back in October, appreciated the consultants and NRCS information.
Based on the powerpoint given during the discussion, I'm trying to figure out the "overtopping" models for the dams, since these were presented without context. The 100-yr events are daily/hourly #s? From what I can see we've had at least two of these, in the past 25 years and really only the East Wash dam gave me concerns, though it never reached the spillway to deliver water to the West Wash retention area. That event also sent a lot of water to the drainage below the West Wash dam, so I assume that was used as storm drainage from somewhere else. The West Wash dam did very well in 1997. Of course this was before the

upstream apartment land was conceived, creating acres of impermeable surface (whatever happened to the City's quest for permeable pavement and covering?). Anyway, I look forward the consultants modeling.
What I really wanted to comment on is the land within the wash areas. The drainages support native riparian habitat which had done very well until recent declines in native tree species with non-native invasive Russian olive taking over. Adjacent to the riparian tree canopy are now large swaths of perennial pepperweed a Nevada C listed weed. Additionally, some of the upland area has recovered or was not significantly affected by original construction, these areas contain native shrubs and forbs. Areas that have had fairly recent fires have supported invasion of non-native State listed weeds including madusahead, puncture vine, jointed goatgrass, a variety of invasive thistles and ever present cheatgrass.
Should earth moving activities occur, say for borrow sites, please place these sites in areas that support non-native species and refrain from disturbing the ever-dwindling native shrub patches. Post construction, a restoration plan with native plant seeding specs., should help reduce the potential for fire by reducing the flammable non-native annual grass species. A weed abatement plan should be developed and followed post construction with certified weed applicators.
The drainage within the West Wash dam used to support diverse amphibians. Western toad and Sierran tree frog used to be common here. I realize this is probably a fruitless request but allowing relatively shallow ponding of water before it drains would enhance the re-establishment of these amphibians.
Thank you for your time and I look forward to reviewing the draft EA.

Your concerns will be included in the public scoping record for the project.

CITY OF RENO

Public Participation Plan

Watershed Plan-ED
Peavine Mountain Watershed
West Wash Dam Rehabilitation

March 2021

OWNER:

City of Reno
1 East First Street
Reno, NV 89501

LEAD FEDERAL AGENCY:

USDA-NRCS
1365 Corporate Blvd
Reno, NV 89502

ENGINEER:

Farr West Engineering
5510 Longley Lane
Reno, NV 89511
(775) 851-4788
(775) 851-0766 Fax

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APPENDICES

Appendix A-Draft Cooperating Agency And Scoping Distribution Lists

Appendix B-Draft Scoping Notice

1.0 INTRODUCTION

The City of Reno entered into an agreement with the USDA – NRCS to rehabilitate the West Wash Dam to meet current NRCS, City of Reno and State of Nevada Division of Water Resources (DWR) dam safety criteria and performance standards. Farr West Engineering (FWE) will assist the City of Reno (The City) to meet the requirements of the NRCS Watershed Program including the development of a physically, environmentally, socially, and economically sound improvement plan known as the Supplemental Watershed Plan and Environmental Document (Plan/ED).

Farr West will prepare a Supplemental Plan/ED for the West Wash Dam Rehabilitation Project in accordance with the National Watershed Program Manual (NWPM) Part 501 Subpart D) and National Watershed Program Handbook (NWPH) Part 601 Subpart D. The Supplemental Plan/ED will be prepared in accordance with the Watershed Protection and Flood Protection Act (Public Law 83-566), the National Environmental Policy Act (NEPA), the Principles and Requirements for Federal Investments in Water Resources (PR&G), the NRCS NWPM and NWPH, and all other applicable laws, regulations, and policies.

This Public Participation Plan has been developed for the West Wash Dam Rehabilitation Plan, Peavine Watershed Project Plan/Environmental Document in accordance with Title 400, General Manual, Part 400 of the NRCS General Manual (United States Department of Agriculture Natural Resources Conservation Service, 2014) and NEPA (National Environmental Policy Act, 1969).

1.1 PROJECT DESCRIPTION

West Wash Dam, in the Peavine Mountain Watershed of Washoe County, Nevada, is included in a United States Department of Agriculture-Natural Resources Conservation Service (USDA-NRCS) funded rehabilitation partnership project. The dam provides protection against flooding to about 30,000 Nevadans who live and work downstream. Additionally, the dam protects downstream city roads, one state highway, and an interstate highway. Among other critical infrastructure, the dam also protects power lines and railroad tracks. (City of Reno, 2006)

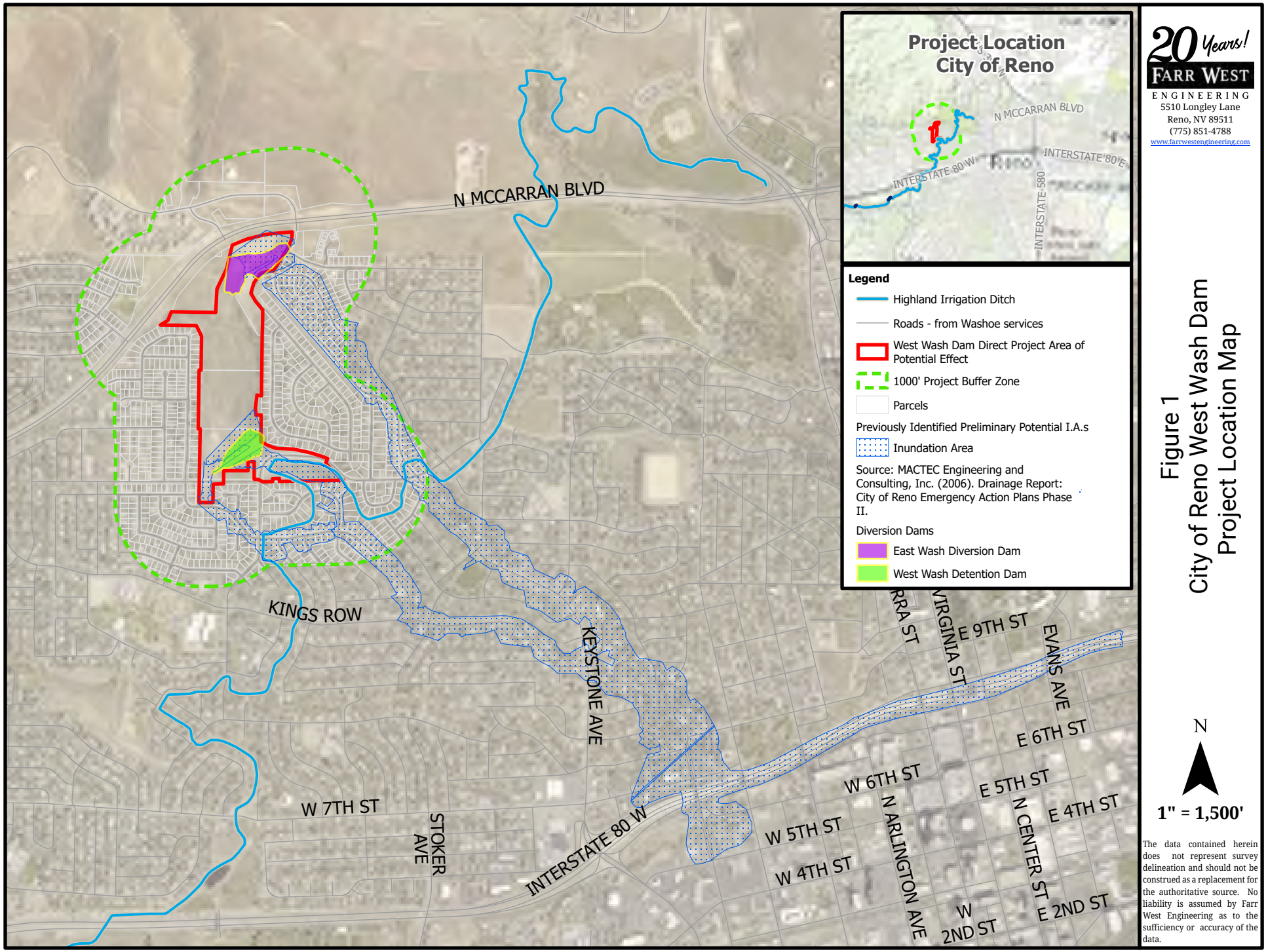
West Wash Dam was constructed in 1961 under the direction and authority of Watershed Protection and Flood Prevention Act (Public Law 83-566). East Wash diversion Dam, constructed in 1960 under the same program, contributes storm water flow from Peavine Mountain Watershed into West Wash Dam. The original watershed plans for these dams used an evaluated life of 50 years. Having reached over 50 years in age, the dams are eligible for rehabilitation through the Natural Resources Conservation Service's Watershed and Flood Prevention Operations Program. The goals of the program include prevention of erosion, floodwater and sediment damage; to further the conservation, use and disposal of water; and to further the conservation and proper use of land in authorized watersheds.

Both the West Wash and East Wash dams are currently classified as High Hazard Dams by NDWR and do not meet the requirements for dam safety by the State of Nevada or NRCS.

1.2 PROJECT LOCATION

The East Wash Diversion Dam is located at the intersection of Keystone Avenue and North McCarran Boulevard at the intersection of Township 20 North, Range 19 East, Sections 33 and 34 with Township 19 North, Range 19 East, Sections 3 and 4. Inflow to the East Wash Dam comes from 2.64 square miles of watershed on the southeast flank of Peavine Mountain. West Wash Detention Dam is located at the intersection of Wyoming and Gulling Streets at the intersection of Township 19 North, Range 19 East, Sections 3 and 4. Inflow to the West Wash Dam comes from approximately 3.56 square miles of watershed, which includes roughly 2.64 square miles of East Wash Dam's watershed. (City of Reno, 2006)

Figures will be included in the public scoping process. Figure 1 shows the project location and Figure 2 shows a close up of the direct project area of potential effects. Figure 3 shows the indirect and direct project area of potential effects.



20 Years!
FARR WEST
ENGINEERING
5510 Longley Lane
Reno, NV 89511
(775) 851-4788
www.farrwestengineering.com

Figure 1
City of Reno West Wash Dam
Project Location Map

N

1" = 1,500'

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

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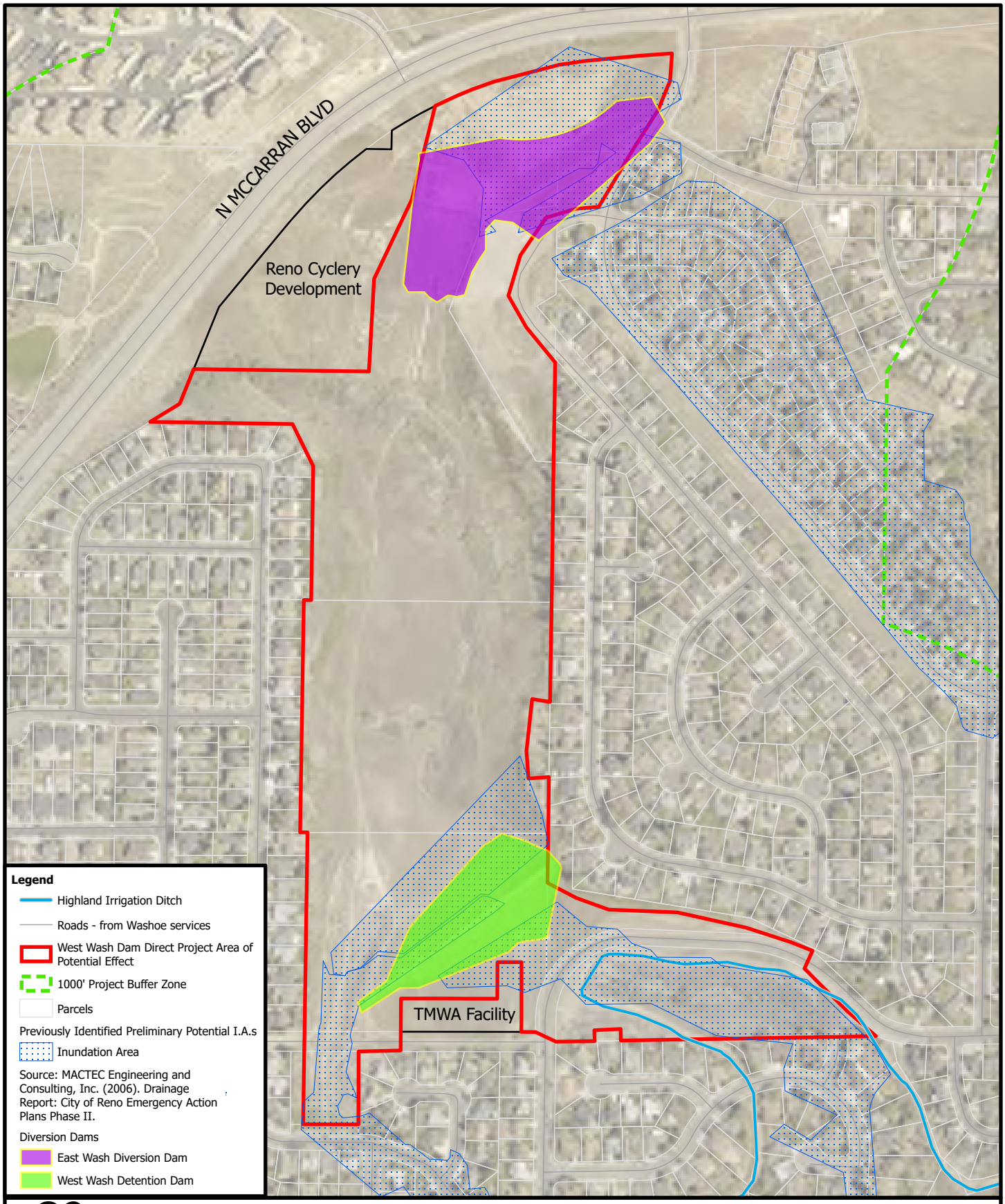


20 Years! FARR WEST ENGINEERING
5510 Longley Lane
Reno, NV 89511
(775) 851-4788
www.farrwestengineering.com

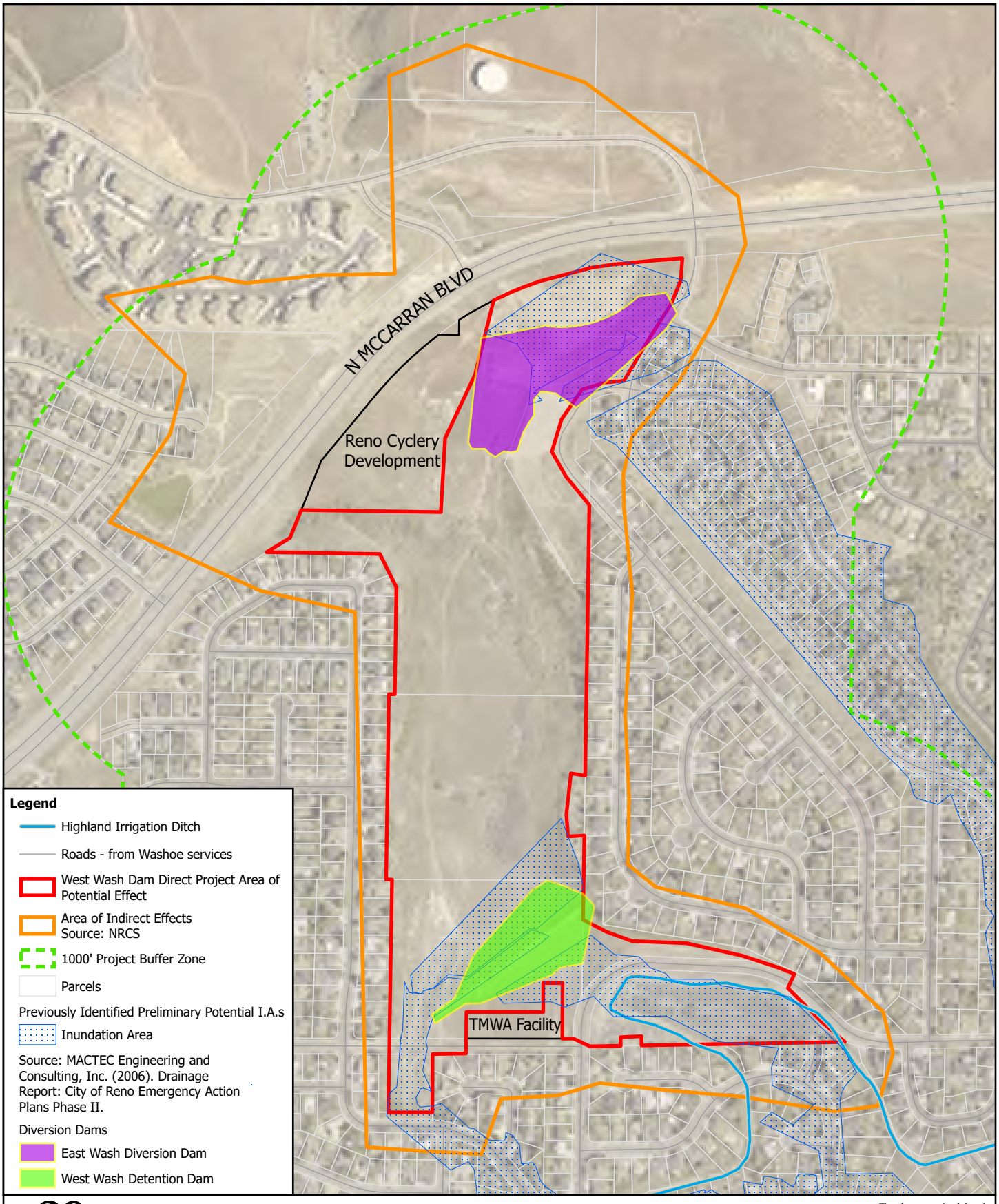
N

1" = 400'

Figure 2
City of Reno West Wash Dam
Direct Project Area of Potential Effects

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

Q:\client\Reno\Projects\CoR-WestWashDam-1930\WestWashDam-ProProject\CoR-WestWashDam.aprx, Layout: Fig 2 Direct Area of Pot. Effects. Editor: areid. Printed: 3/4/2021



20 Years! FARR WEST ENGINEERING
5510 Longley Lane
Reno, NV 89511
(775) 851-4788
www.farrwestengineering.com

N

1" = 500'

Figure 3
Indirect and Direct Project Area of Potential Effects

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

Q:\client\Reno\Projects\CoR-WestWashDam-1930\WestWashDam-ProProject\CoR-WestWashDam.aprx, Layout: Fig 3 Indirect & Direct Area Effects. Editor: areid. Printed: 3/4/2021

2.0 REQUIREMENT OF PUBLIC PARTICIPATION

The USDA-NRCS is the lead federal agency on this project and the City of Reno is the sponsoring local organization. As a major action by a federal agency, USDA-NRCS, public participation is required throughout the project planning process. Public participation is welcomed and diverse opportunities for public participation will be sought at multiple stages of this planning process. Interested or affected individuals, groups, and local governmental agencies will have multiple opportunities to participate in development of the watershed project plan. These opportunities will be announced to the general public through local newspapers and other media.

General requirements for public participation under NEPA include diligent efforts to involve the public, documents written in plain language to maximize project and decision making understanding, and public notice of the proposed action including reasonable efforts to involve the potentially affected communities where the proposed action is expected to have environmental impacts or where the proposed action may have human health or environmental effects in a community. This includes minority, low-income, or federally recognized Indian tribal communities. (NEPA, 1969, 40 CFR Section 6.203) Requirements for public participation specified in the National Environmental Policy Act, OMB Circular A-95 (United States Office of Management and Budget, 1974) Executive Orders (United States, Office of the President., 1954) (United States, Office of the President, 1982), Departmental memoranda, and NRCS rules will be met. (United States Department of Agriculture Natural Resources Conservation Service, 2006)

The public is welcome to participate in this project to learn about soil and water conservation issues, express views, and to participate throughout the decision-making process related to proposed actions in the West Wash Dam rehabilitation project. This public participation plan outlines the planning process and identifies planning stages where the public is invited to participate, and provides draft cooperating agency lists and scoping notice. A tentative schedule for public participation, and entities to be invited to participate are listed herein. This plan is intended to be a reference for project planners including USDA-NRCS, The City, and project consultants.

3.0 AUDIENCE- PUBLIC PARTICIPATION

Public participation is an integral part of a planning or major decision-making process and provides opportunities for the public to be involved in an interchange of data and ideas regarding the West Wash Dam Rehabilitation Project. The public, officials of local, regional, State, and Federal Government, project sponsors and interested agencies and community groups are invited to fully participate in this planning and decision-making process for the West Wash Dam Rehabilitation Project. Entities and groups included in this section apply to all stages of public participation including public meetings and notices.

The Public

Individuals, permanent or ad hoc groups, and officials at all levels of government who have an interest in, or may be affected by, the West Wash Dam Rehabilitation Project are invited to participate. Residents within 1,000 ft of the project area will be mailed notices and invited to participate by direct mail. Residential and businesses located within the potential inundation areas, community groups and stakeholders are invited to participate. A draft distribution list is included in Appendix A.

Tribes

USDA-NRCS, as the lead federal agency for the project, has a non-delegable duty to consult with Tribes that may be interested or affected by the proposed action. A list of Tribes for possible consultation by UDSA-NRCS is included in Appendix A.

Officials

Officials of local, regional, state, and federal government entities are invited to fully participate. People who have governmental decision-making, planning, or administrative responsibilities that relate to the NRCS-assisted activity under consideration. Specific entities may include but are not limited to:

- Washoe County representatives
- City of Reno representatives
- Local representatives

Agencies

Local, regional, state, and federal government agencies are invited to participate. A list of possibly interested agencies to provide notice to is included in Appendix A.

Cooperating Agencies

A cooperating agency is any federal, state or local governmental agency or Native American tribe that enters into a formal agreement with the lead federal agency to help develop the EA. Cooperating agencies and tribes will work with the USDA-NRCS and share knowledge and resources. Collaboration applies throughout the NEPA process and can encompass a wide range of internal and external relationships. Collaboration benefits the environmental assessment by: disclosing relevant information early in the planning process; applying available technical expertise and staff support; avoiding duplication with other federal, state, tribal, and local procedures; and establishing a mechanism for addressing intergovernmental issues. (United States Department of Agriculture Natural Resources Conservation Service, 2006) The USDA-NRCS, as a lead federal agency, is working with the City of Reno, a cooperating and sponsoring local organization. NRCS will work with the City of Reno to identify agencies that will be invited, by letter, to be Cooperating Agencies in the West Wash Dam Rehabilitation Supplemental Plan/EA process.
A list of potential cooperating agencies is included in Appendix A.

Formal Agency Consultation:

Although separate from public participation, agency consultation is an important process that involves identification of public resources and regulations. Some agencies that will be consulted throughout the EA process to ensure that NEPA requirements are met include, but are not limited to:

- U.S. Fish and Wildlife Service
- U.S. Army Corps of Engineers
- Nevada State Historic Preservation Office
- Nevada Division of Environmental Protection, Division of Clean Air
- Nevada Division of Environmental Protection, Bureau of Water Pollution Control
- Nevada Division of Water Resources
- Nevada Natural Heritage Program
- Nevada Dept. of Conservation and Natural Resources, State Engineer
- Nevada Department of Wildlife
- Nevada State Clearing House

4.0 VISION FOR PUBLIC PARTICIPATION

Public participation opportunities for this project will be early, transparent, and robust. Public participation can improve decision-making by ensuring opportunities for the public to express their views and raise issues related to resource conservation, social justice, and other potential impacts of the project.

- Opportunities will be provided for the public to contribute information and express opinions at various stages of the planning and/or decision-making process.
- Efforts will be made to inform the public early and throughout the process.
- All information presented and views expressed through the public participation process will be evaluated and carefully considered.
- Written comments will be acknowledged, and decisions will be reported to the public.

Due to the current Covid-19 pandemic, and resulting emergency directives (State of Nevada, Office of the Governor) issued by the Governor of Nevada and adhered to by the City of Reno, the requirement of in-person meetings has been suspended and meetings that occur electronically must have a method for the public to participate. Farr West will work with the City of Reno's public relations office, to ensure identified avenues of public participation meet Covid-19 directives and NEPA requirements relating to public participation. Challenges raised by Covid-19 and their solutions will be addressed throughout this plan.

Techniques for all public participation are outlined in this section. These techniques apply to public meetings and the Notice of Intent. The scoping notice draft distribution list is included in Appendix B.

Public outreach will be expanded to include digital formats to reach as many residents as possible, including those in isolation or quarantine due to Covid-19.

Digital outreach may include:

- Website Announcements: City of Reno, Washoe County Board of Commissioners, Farr West Engineering, and /or NRCS may post public notices on their websites including project information and contact information for submitting public comment.
- Webpage hosted by COR or COR's contractor, with project information, contact information and directions for submitting public comments. Recordings of public meetings may also be posted on project website
- Digital Scoping or Public Comment Questionnaires made available on-line via a web link and a QR code and distributed via email, web notices and social media related to the project area.

4.1.1 Newspaper Advertisements

Public notices, notice of scoping meeting, notice of Draft EA and record of decision will be published in the local newspaper, the Reno Gazette Journal, giving notice of the event and seeking public comment.

4.1.2 Letters

Letters regarding the planning process will be mailed to city and county representatives inviting participation and comments. Letters will be sent to residences w/in 1000 feet and to all interested agencies and potential cooperating agencies. A cooperating agency list and distribution list are included in Appendix A.

4.1.3 **Press Releases**

The City of Reno is the lead contact for public outreach, information and press releases. The City of Reno's public affairs office will review, approve and distribute public notices and materials.

The City of Reno Office of Communications and Community Engagement and/or Department of Communications and Technology will distribute news releases announcing project scoping and public meetings. Cooperation and assistance from the City of Reno's Public Affairs Department or Communications Department or Information Technology Departments throughout the process is crucial.

City of Reno

Public Affairs Department

1 E. 1st street

PO Box 1900

Reno, NV 89505

NRCS will review and provide feedback in the development of public materials and public scoping to ensure the city is meeting all program requirements. The NRCS state public affairs officer will assist with distribution of notices to any cooperating agencies and the public. NRCS may post a scoping notice and other public notices on their website.

USDA-NRCS

State Public Affairs Officer

Heather Emmons

1365 Corporate Blvd.

Reno, NV 89502

(775) 834-0875

Heather.emmons@usda.gov

4.1.4 **Receipt of Public Comments**

Public comments will be accepted throughout the project process. For any in-person public meetings, comment cards will be provided. Public comments may also be submitted through digital submission through a project webpage or by email. For virtual meetings, an email contact will be provided to receive comments. Comments will also be accepted by mail, telephone call or voicemail.

As a consultant for the city, Farr West Engineering will develop materials for public notice, meeting and information. Questions directed to the Farr West Engineering office will be documented and supplied to the city.

All Public Comments will be directed to City of Reno Project lead, Steve Gamilis.

All avenues seeking public comment will include the following language:

Written comments may be submitted by mail or email to Steve Gamilis City of Reno, Public Works Department, 1 East First St., Reno, Nevada 89501. Email: gamiliss@reno.gov. The subject line should

include “West Wash Dam Rehabilitation Project.” If you have any questions, please contact Steve Gamilis at (775) 334-2461.

Steve Gamilis

Project Coordinator

City of Reno

Public Works Department

1 East First St.

Reno, NV 89501

Office (775) 334-2461

Mobile (775) 399-2859

4.1.5 **Nevada Clearinghouse**

Public notices for scoping and availability of Draft EA and record of decision will be sent to the Nevada State Clearinghouse for publication and distributions. The Nevada Clearinghouse website will post the project scoping notice, and other notices. The State of Nevada Clearinghouse also distributes the notice to all federal, state, and local agencies. The link to the State of Nevada Clearinghouse is: http://clearinghouse.nv.gov.

4.1.6 **Neighborhood Signs**

The project area, a city-owned open space, is frequently accessed by the public from the surrounding neighborhoods. Several signs will be posted at project site access points providing notice of the scoping meeting.

5.0 PLANNING STAGES

The public is invited to participate in all stages of the planning process. Specific opportunities for public participation will be in the scoping meeting, and the notice of Draft EA public meeting. Comments will be accepted by the project lead during designated comment periods in the planning process.

The planning stages are:

- Scoping and comments
- Draft EA and comments
- Notice of availability of draft decision document

For each planning stage identified, this plan includes:

- Specific objectives of the participation activity
- Tentative schedule of information support activities
- Information to be provided
- Assigned partner responsibilities

5.1 SCOPING MEETING

5.1.1 Objective

This meeting shall be held during preliminary planning. The purpose of the meeting is to inform the public about the planning effort and to scope issues to be considered during development of the Supplemental Plan/EA.

Public notice will be circulated following the methods set out in this Plan.

5.1.2 Tentative Schedule

- **September 2021:** send and publish notice of public scoping meeting
- **October 2021:** Virtual scoping meeting (due to Covid-19)
- **October-December2021:** Physical and electronic submission of questions and comments prior to, during and for 2 months after the meeting.

5.1.3 Information to be Provided to the Public

A power point presentation will be created and provided to the public at the scoping meeting and distributed via digital platforms identified in this Plan.

- Objectives
- NEPA process overview
- Project description
- Project location
- Project schedule
- Project Purpose and Need
- Preliminary Alternatives

5.1.4 Responsibilities of Partners

NRCS:

- Review and approve meeting notices and materials and virtual venue to ensure NEPA compliance.
- Participate in responding to public comments, as necessary.

City of Reno:

- Review and approve meeting notices and materials to ensure they meet City guidelines and requirements.
- Send notice of scoping meeting letters to residents within 1,000 feet of project area**.**
- Provide or approve a virtual meeting platform acceptable to the City.
- Participate in scoping meeting and responding to public comments, as necessary.

Consultant (Farr West):

- Prepare draft scoping notices, and coordinate publication of the notice of public meeting.
- Prepare letters to residents within 1,000 feet of project area.
- Prepare meeting materials including a power point presentation.
- Document, compile and evaluate all public comments.
- Include all materials in public participation summary report.

5.2 DRAFT SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT MEETING

5.2.1 Objective

This meeting shall be held following submittal of the Draft Supplemental Plan/EA to NRCS. The purpose of the meeting is to present the alternatives process, the selected alternatives, the preferred alternative and to invite comments.

Public notice will be circulated following the methods set out in this Plan.

5.2.2 Tentative Schedule

- **April 2022:** Notice of Meeting
- **May 2022:** Public meeting: virtual meeting if still necessary due to Covid-19, or City of Reno will identify an appropriate in-person meeting space.
- **May-July 2022:** Physical and electronic submission of questions and comment prior to, during and for 2 months after the meeting.

5.2.3 Information to be Provided to the Public

- Project alternatives and analysis of alternatives
- Selected alternatives
- Preferred Alternative
- Draft EA and FONSI
- Invitation to provide public comment
- Project schedule

5.2.4 Responsibilities of Partners

NRCS:

- Review and approve meeting notices and materials and venue (if virtual) to ensure NEPA compliance.
- Participate in responding to public comments, as necessary.
- If the Environmental Document is an Environmental Assessment: At least thirty (30) calendar days before making the decision on whether, and if so how, to proceed with a proposed action, USDA-NRCS must make an Environmental Assessment and preliminary FONSI available for review and comment to the interested federal agencies, state and local governments, federally-recognized

Indian tribes and the affected public. NRCS must respond to any substantive comments received and finalize the EA and FONSI before making a decision on the proposed action.

- If the Environmental Document prepared for this project is an Environmental Impact Statement (EIS), No decision on the proposed action may be made or published until the later of
    - Thirty days after publication in the Federal Register of a notice of availability (NOA) of a final EIS,
    - Ninety days after publication in the Federal Register of a NOA of a draft EIS.
    - NRCS must allow at least 45 days for comment on a draft EIS.

City of Reno:

- Review and approve meeting notices and materials to ensure they meet City guidelines and requirements.
- Send notice of availability of EA and Draft FONSI meeting, or EIS and NOA publication to the distribution list**.**
- Provide or approve a virtual meeting platform, or in-person meeting location acceptable to the City.
- Participate in public meeting and respond to public comments, as necessary.

Consultant (Farr West):

- Prepare draft Notice of Availability of Draft EA and preliminary FONSI.
- Coordinate publication of the notice of public meeting.
- Prepare letters for delivery to the distribution list.
- Prepare meeting materials including a power point presentation.
- Document, compile and evaluate all public comments.
- Include all materials in public participation summary report.

6.0 DOCUMENTING AND EVALUATING PUBLIC PARTICIPATION

6.1 DOCUMENTATION

Public participation activities will be documented in the reviewable Public Participation Summary Report, showing the nature and extent of public participation activities. The Summary Report will include the following:

1. Meeting agendas and minutes including:
    a. names of those invited to participate
    b. sign-up sheets from meetings and other records of participation
    c. notes and highlights of activity
    d. issues discussed
    e. extent of controversy
    f. views expressed
    g. actions taken
2. Copies of materials and handouts provided in the public presentations
3. Copies of public notices published in newspapers (publications, locations and dates)
4. Copies of news releases
5. Copies of letters to neighboring residents (copy of letter and list of recipients)
6. Copies of letters sent to community groups and stakeholders
7. Comments received and copies of written responses
8. Other relevant materials

6.2 EVALUATION

Public comments made on the West Wash Dam Rehabilitation Project received by email, letters and verbal and/or written public comments collected during the public scoping meeting will be compiled and numbered. Comments will be organized by topic category. Topic will be based on environmental issues generally covered under NEPA that could be affected by the proposed project, and any other topics that emerge. Public comments submitted during the public scoping period will be documented and summarized in the Public Participation Summary Report.

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APPENDIX A-DRAFT COOPERATING AGENCY AND SCOPING DISTRIBUTION LISTS

APPENDIX B-DRAFT SCOPING NOTICE

NOTICE OF PUBLIC SCOPING MEETING

On DATE and TIME, there will be a virtual public scoping meeting conducted by United States Department of Agriculture-Natural Resources Conservation Service (USDA-NRCS) which has funded a rehabilitation project in partnership with the City of Reno for the West Wash Dam. West Wash Dam is located in the Peavine Mountain Watershed of Washoe County, Nevada. The dam provides protection against flooding to about 30,000 Nevadans who live and work downstream. Additionally, the dam protects downstream city roads, one state highway, and an interstate highway. Among other critical infrastructure, the dam also protects power lines and railroad tracks. (City of Reno, 2006)

West Wash Dam was constructed in 1961 under the direction and authority of Watershed Protection and Flood Prevention Act (Public Law 83-566). East Wash diversion Dam, constructed in 1960 under the same program, contributes storm water flow from Peavine Mountain Watershed into West Wash Dam. The original watershed plans for these dams used an evaluated life of 50 years. Having reached over 50 years in age, the dams are eligible for rehabilitation through the Natural Resources Conservation Service's Watershed and Flood Prevention Operations Program. The goals of the program include prevention of erosion and floodwater and sediment damage; to further the conservation, use and disposal of water; and to further the conservation and proper use of land in authorized watersheds.

Both the West Wash and East Wash dams are currently classified as High Hazard Dams by the Nevada Division of Water Resources (NDWR) and do not meet the requirements for dam safety by the State of Nevada or NRCS.

The purpose of this project is to preserve the flood protection function of the West Wash Dam, to protect lives and property in the surrounding urban area and to comply with current performance and safety standards in a cost effective and environmentally acceptable manner. The project needs include addressing current deficiencies at West Wash and East Wash Dams to bring both dams into compliance with current dam safety regulations, engineering standards and performance criteria, and ensure the watershed structure is properly maintained to minimize the risk to lives and property in the surrounding and downstream urban area.

Comments related to project scoping will be accepted through DATE. All comments should be directed to City of Reno Project Lead, Steve Gamilis.

Written comments may be submitted by mail or email to Steve Gamilis City of Reno, Public Works Department, 1 East First St., Reno, Nevada 89501. Email: gamiliss@reno.gov. The subject line should include "West Wash Dam Rehabilitation Project." If you have any questions, please contact Steve Gamilis at (775) 334-2461.

Best Management Practices for the Proposed Project

Erosion and Sedimentation:

- Limit the amount of time between soil disturbance and final stabilization
- Phase the project to limit the amount of soil disturbance per phase
- Stabilize steepened slopes immediately after completion as practicable
- Water or apply dust palliative to denuded areas during construction until permanent revegetation is applied.
- Re-vegetate as soon as possible after any ground disturbance or grading
- Minimize construction and grading during times of inclement weather

Stormwater:

- A stormwater Discharge Permit from NDEP Bureau of Water Pollution Control is necessary for the project.
- A Stormwater Pollution Prevention Plan (SWPPP) is necessary for the project
- Maintain existing drainage and storm drain facilities throughout the duration of construction. Provide necessary erosion control measures to protect from soil erosion due to discharges from existing storm drain facilities.

Air Quality:

- Strict enforcement of idling limits
- Requiring advanced pollution controls and clean fuels for new equipment
- Retrofitting for old equipment
- Using particle traps and other appropriate controls to reduce emissions of DPM and other air pollutions.
- Minimizing construction-related trips of workers and equipment, including trucks and heavy equipment.
- Lease or buy newer, cleaner equipment (1996 or newer model).
- Employ periodic, unscheduled inspections to ensure that construction equipment is properly maintained and does not unnecessarily idle, is tuned to manufacturer's specifications, and is not modified to increase horsepower except in accordance with established specifications.
- In Accordance with NAC 445B.22037 fugitive dust would always be controlled during The Project. This would be accomplished primarily by watering trucks. Dust palliative would be applied to areas left undisturbed for more than 30 days. Areas left undisturbed for more than 90 days would be addressed by hydro-mulching or other methods approved under the permit.
- Pre-wetting.
- Stabilizing with vegetation, gravel, rip rap, or other forms of physical stabilization.
- Limiting, restricting, phasing and/or rerouting motor vehicle access.
- Reducing vehicle speeds and/or number of vehicle trips.
- Limiting use of off-road vehicles on open areas and vacant lots.
- Utilizing work practices and/or structural provisions to prevent wind and water erosion onto paved public roadways.
- Using dust control implements appropriately.
- Installing one (1) or more grizzlies, gravel pads, and/or wash down pads adjacent to the entrance of a paved public roadway to control carry-out and track out.

- Keeping open-bodied haul trucks in good repair, so that spillage may not occur from beds, sidewalls, and tailgates.
- Covering the cargo beds of haul trucks to minimize wind-blown dust emissions and spillage

Noxious Weeds and Invasive Species:

- Using existing roadways or travel paths for access to project sites
- Developing a weed management plan.
- Native vegetation will be planted on disturbed sites
- Ensuring all equipment is cleaned in a contained area prior to mobilization to the site

Natural Areas:

- Plants that will be disturbed should be salvaged and replanted in appropriate habitat when practical

Riparian Areas:

- Avoidance fencing will be used to minimize impacts to the riparian area

Wildlife & Wildlife Habitat:

- Completing restoration activities in a timely manner
- Using existing roadways or travel paths for access to project sites
- Streams, riparian zones, and wetlands will not be used as staging or refueling areas
- Monitoring during project implementation and one year following to ensure restoration activities are functioning as intended
- Ensuring work areas are well-lit to minimize inadvertent impacts to wildlife or wildlife habitat

Special Status Animal Species:

- Monarch Butterfly:
    - To the extent feasible, conduct management activities in monarch migratory and breeding habitat from October 1 to May 31.
    - If native milkweed species occur in the project area, and the project activity is occurring during the breeding season, ensure impacts on milkweed host plants and monarch larvae/pupae are minimized (e.g., buffering and avoiding host plants, establishing alternative access routes).
    - Project personnel should avoid trampling butterfly host plants
    - Where practicable milkweed plants that would be disturbed should be salvaged and replanted in adjacent habitat
- Northwestern Pond Turtle:
    - Determine whether pond turtles are occupying the site prior to project implementation using Visual Encounter Survey protocol (2012 Western Pond Turtle Sampling Techniques, Inventory, and Monitoring).
    - If presence is determined contact NRCS Biologist to establish avoidance measures.
    - Locate temporary work areas, staging areas, and access routes at least 50 m from aquatic habitat.

Migratory Birds, Bald Eagles, and Golden Eagles:

- Migratory Bird Clearance survey requirements will be followed if construction takes place during migratory bird breeding season (April 1 through August 31). If ground disturbance must occur during this period, a migratory bird nesting clearance survey would be conducted within a three-day period prior to disturbance.
- If a nest is found, a species-appropriate no-disturbance buffer would be placed around the nest until the young have fledged, or until the nest fails
- If vegetation removal or disturbance during the nesting season cannot be avoided, protocol-level nesting-bird surveys should be conducted by a qualified biologist within a 3 day period prior to initiating activities followed by a 14 day period to complete disturbance.

Noise:

- Limited construction hours (7am-5pm)
- Ensure that all equipment items have the manufacturers' recommended noise abatement measures, such as mufflers, engine enclosures, and engine vibration isolators, intact and operational
- Noise levels shall not exceed 65 decibels (db) at 50 feet from the operating equipment.
- Noisy portable equipment, such as generators, compressors and/or pumps shall be equipped with sound abatement enclosures and devices and shall be located as far away from sensitive noise receptor areas as practicable. (Sensitive noise receptors are defined as occupied buildings with windows or doors facing the site.)
- Inspect all construction equipment at periodic intervals to ensure proper maintenance and presence of noise control devices
- Strict enforcement of idling limits

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Reno Fish And Wildlife Office
1340 Financial Boulevard, Suite 234
Reno, NV 89502-7147
Phone: (775) 861-6300 Fax: (775) 861-6301

In Reply Refer To: February 10, 2023
Project Code: 2023-0044108
Project Name: Peavine Creek-Truckee River Watershed East Wash and West Wash Dam Rehabilitation Project

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)

(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Migratory Birds: In addition to responsibilities to protect threatened and endangered species under the Endangered Species Act (ESA), there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts see https://www.fws.gov/birds/policies-and-regulations.php.

The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities. It is the responsibility of the project proponent to comply with these Acts by identifying potential impacts to migratory birds and eagles within applicable NEPA documents (when there is a federal nexus) or a Bird/Eagle Conservation Plan (when there is no federal nexus). Proponents should implement conservation measures to avoid or minimize the production of project-related stressors or minimize the exposure of birds and their resources to the project-related stressors. For more information on avian stressors and recommended conservation measures see https://www.fws.gov/birds/bird-enthusiasts/threats-to-birds.php.

In addition to MBTA and BGEPA, Executive Order 13186: *Responsibilities of Federal Agencies to Protect Migratory Birds*, obligates all Federal agencies that engage in or authorize activities that might affect migratory birds, to minimize those effects and encourage conservation measures that will improve bird populations. Executive Order 13186 provides for the protection of both migratory birds and migratory bird habitat. For information regarding the implementation of Executive Order 13186, please visit https://www.fws.gov/birds/policies-and-regulations/executive-orders/e0-13186.php.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Code in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Reno Fish And Wildlife Office
1340 Financial Boulevard, Suite 234
Reno, NV 89502-7147
(775) 861-6300

Project Summary

Project Code: 2023-0044108

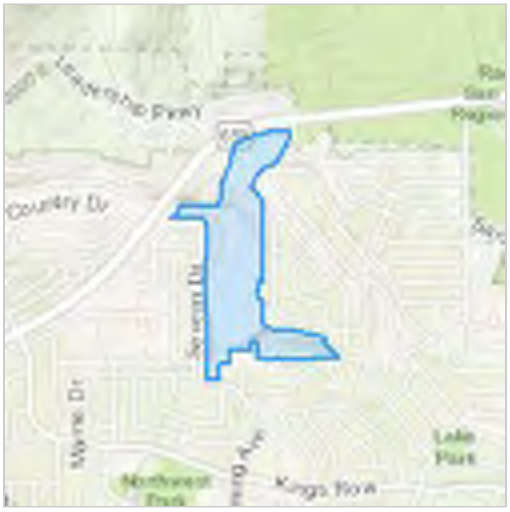
Project Name: Peavine Creek-Truckee River Watershed East Wash and West Wash Dam Rehabilitation Project

Project Type: Dam - Maintenance/Modification

Project Description: The Preferred Alternative would include restoring the East Wash Dam auxiliary spillway to original design elevation. The West Wash Dam embankment would be raised to a new elevation, the auxiliary spillway would be widened to original design width, and the crest elevation would be lowered. The impoundment area west of the existing flow line would be regraded, and a 2-foot-tall parapet wall would be built on the east corner of the dam.

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@39.54504145,-119.84642971565671,14z



Counties: Washoe County, Nevada

Endangered Species Act Species

There is a total of 6 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Amphibians

NAME	STATUS
Sierra Nevada Yellow-legged Frog *Rana sierrae* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/9529	Endangered

Fishes

NAME	STATUS
Cui-ui *Chasmistes cujus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/456	Endangered
Lahontan Cutthroat Trout *Oncorhynchus clarkii henshawi* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/3964	Threatened

Insects

NAME	STATUS
Carson Wandering Skipper *Pseudocopaeodes eunus obscurus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/674	Endangered
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate

Flowering Plants

NAME	STATUS
Webber's Ivesia *Ivesia webberi*	Threatened

There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
Species profile: https://ecos.fws.gov/ecp/species/4682

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

IPaC User Contact Information

Agency: DOWL, LLC
Name: Emily Paris
Address: 5510 Longley Lane
City: Reno
State: NV
Zip: 89511
Email eparis@farrwestengineering.com
Phone: 7753360404

Lead Agency Contact Information

Lead Agency: Natural Resources Conservation Service

Northwestern Pond Turtle Conservation Recommendations

January 2, 2024 – based on recommendations provided by Mark Enders, NDOW

Construction Avoidance/Minimization Measures

1. Determine whether pond turtles are occupying the site prior to project implementation
    a. Visual encounter surveys (Mar-Nov)
        i. Search for basking turtles along both banks of the river.
        ii. Surveys should be done during environmental conditions when turtles are most likely to be basking.
        iii. Minimum four surveys needed to confirm absence.
        iv. NDOW can provide a copy of survey protocol, or it can be found in Chapter 4 (pages 29-35) in Bury, R. B., H. H. Welsh, Jr., D. J. Germano, and D. Ashton (eds.). 2012. Western Pond Turtle: Sampling Techniques, Inventory and Monitoring, Conservation and Management. Northwest Fauna 7. (Book). Society for Northwestern Vertebrate Biology. 128 pp.
        v. If absence is determined, construction activities have low likelihood of impacting adult turtles. Nesting surveys should still be done.
        vi. If presence is determined, construction activities could impact pond turtles, and additional avoidance measures are needed. Nesting surveys should be done.
    b. Nesting surveys (May-Jul)
        i. Search for nests in upland areas with sparse vegetation and southern aspect within 100 m of river
        ii. If turtle nests are encountered, mark with temporary flagging and surround with silt fencing to protect it, then contact NDOW biologist Mark Enders (menders@ndow.org) for assistance.
        iii. All individual nests should remain marked and be avoided for the duration of the nesting and hatchling seasons (combined May 15 – Oct 31), and unnecessary ground-breaking activities should be avoided in potential nesting areas during that time period
        iv. If absence is determined, construction activities have low likelihood of impacting the Truckee River population of pond turtles
2. Continue monitoring for turtle presence and activity during construction, and make construction staff and personnel aware of the possibility of turtle presence.
3. Locate temporary work areas, staging areas, and access routes at least 50 m from the river if possible.

Project Maintenance Avoidance/Minimization Measures

1. All floodplain maintenance activities in future years should be done from April 1 through May 15 to avoid impacts to nesting females, laid eggs, overwintering hatchlings, and emerged hatchlings.
2. Maintenance activities should be implemented to retain suitable turtle nesting habitat as described below.

Habitat features and recommendations

- Enhancing nesting habitat

    - Nesting is the most important part of the pond turtle's life cycle and is what allows populations to persist. NDOW would like to recommend the following features to enhance turtle nesting opportunities in the future
    - South and southwest facing upland areas within 100 m of river should have less than 15% slope to increase probability of turtle nesting
    - Ideal nesting sites have sparse, low-growing vegetation with patchy grasses and forbs, but bare soil is preferable. Herbaceous cover is no more than 40%, total shrub cover no more than 20 %, and tree canopy cover no more than 10%
    - Allow some areas of open canopy, especially on south-facing aspects to allow solar exposure for proper egg development
    - Maintaining soil types of the following percentages facilitates nest digging:
        - Fine Clay 25% or less
        - Loam 25%
        - Sand 25 – 50%
        - Small Aggregate 25% or less
- Basking structures
    - Basking is an essential part of pond turtle biology, and NDOW would like to recommend that basking structures be worked into the project, especially on south-facing aspects.
    - Place logs and root wads in locations that receive full to partial sun exposure, at a variety of angles and water depths. Some can be parallel to the shoreline, but the majority should be perpendicular and extend from the bank into the open water.
    - When placing rip-rap, it would be ideal to prioritize some larger flat-topped rocks between the high and low water marks in order to provide basking rocks for turtles at various flow levels.
    - Basking structures should be anchored if possible
    - Revegetation should be minimal around the best basking structures in order to provide maximum sunlight.

U.S. FISH AND WILDLIFE SERVICE

April 29, 2021

Western Monarch Butterfly Conservation Recommendations:

Purpose: Section 7(a)(1) of the Endangered Species Act of 1973 (ESA), directs federal agencies to use their authorities to further the purpose of the ESA, by conducting conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary activities that an action agency may undertake to avoid and minimize the adverse effects of a proposed action, implement recovery plans, or to develop information that is useful for the conservation of listed species. The purpose of the following conservation recommendations is to encourage federal agencies to incorporate monarch butterflies into their Environmental Assessments and Biological Assessments associated with Section 7 Biological Opinions (BO), when in consultation with the U.S. Fish & Wildlife Service. These recommendations are organized by habitat zone, so that they may be cut/paste, as applicable and contingent upon project location. There is potential utility for these recommendations beyond Section 7, and they are intended to promote benefits for other pollinators as well.

Background: The western monarch butterfly population has declined by more than 99 percent since the 1980s. An estimated 4.5 million monarchs overwintered on the California coast in the 1980s, whereas in 2020, the population estimate for migratory overwintering monarchs was less than 2,000 butterflies. This extreme population decline is due to multiple stressors across the monarch's range, including the loss and degradation of overwintering groves; pesticide use, particularly insecticides; loss of breeding and migratory habitat; climate change; parasites and disease. Historically, the majority of western monarchs spent the winter in forested groves near the coast from Mendocino County, California, south into northern Baja California, Mexico. In recent years, monarchs have not clustered in the southern-most part of their overwintering range, and they are likely year-round residents in some areas of the coast. This resident phenomenon is plausibly due to a combination of climate change, and an abundance of residential-planted non-native, evergreen tropical milkweed that is available for monarchs year-round. Migratory western monarchs leave the overwintering groves in mid-winter to early-spring. Throughout the spring and summer, monarchs breed, lay their eggs on milkweed, and migrate across multiple generations within California and other states west of the Rocky Mountains. In an attempt to reverse the severe population decline of western monarch butterflies, and to protect other pollinators as well, we encourage implementation of the conservation recommendations listed below. Please also see the "Priority Restoration Zones in California for Recovering Western Monarchs" map (Figure 1) for suggested areas to focus conservation actions. Western monarch habitat outside of California is considered Priority level 3, where conservation actions are still important, especially for the larger pollinator community.

Please contact Samantha Marcum (samantha_marcum@fws.gov) or Cat Darst (cat_darst@fws.gov) with questions or suggestions on these recommendations.

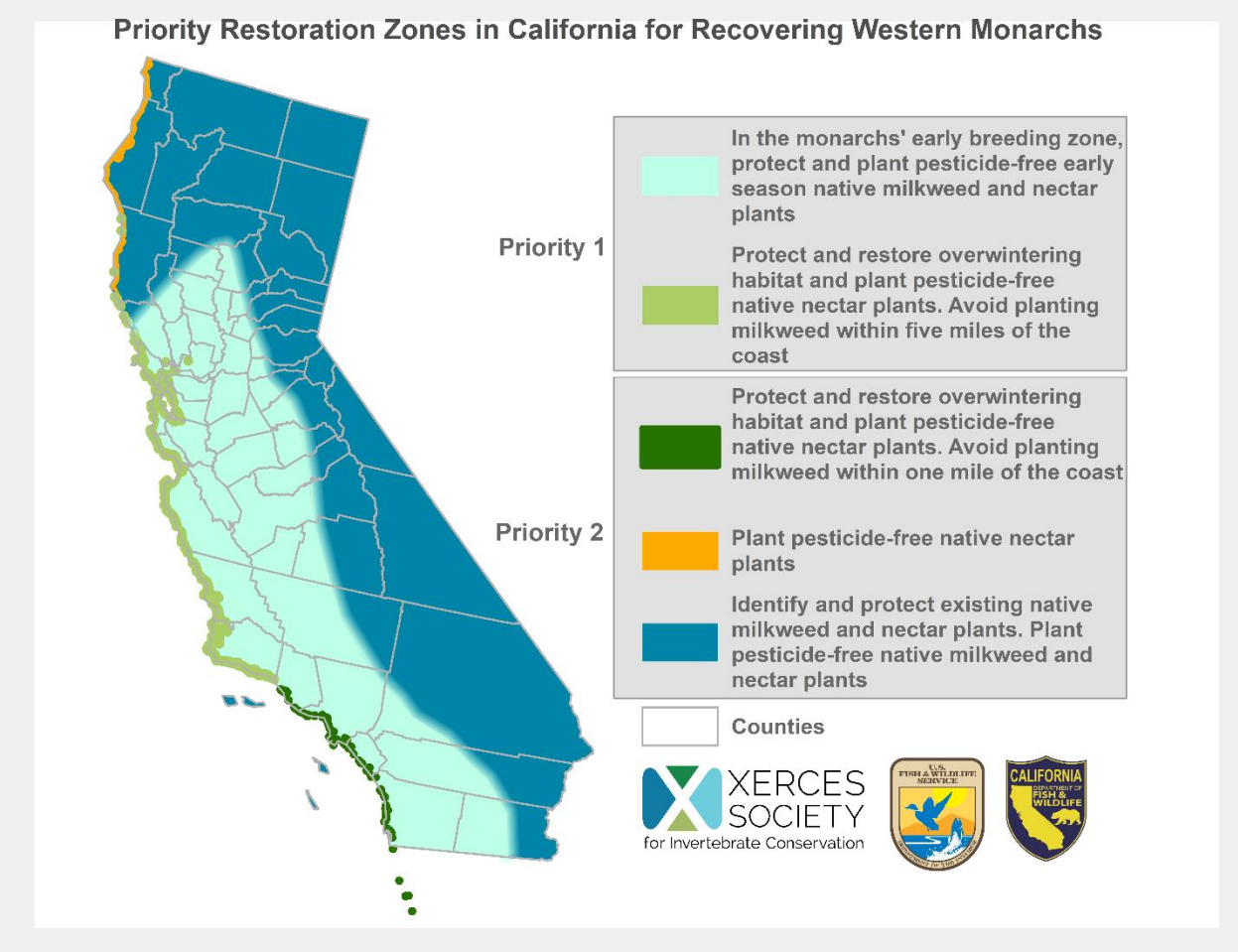

Figure 1. Priority Monarch Habitat Restoration Areas in California.

<u>Coastal California Overwintering Habitat</u>: Western monarchs migrate to the California coast, and cluster in a specific set of forested tree groves during the fall and winter each year. The overwintering groves provide protection from inclement weather, and possess suitable vegetation and microclimate conditions for monarchs (e.g., roosting trees, wind protection, dappled sunlight, nectar sources, water and/or dew for hydration, high humidity, and an absence of freezing temperatures). In the overwintering zone of the coast (i.e., within five miles of the coast from Mendocino County south through Santa Barbara County, and within one mile of the coast from Ventura County south through San Diego County), we recommend the following:

1. Protect, manage, enhance and restore monarch butterfly overwintering groves (Find An Overwintering Site).

Please contact Samantha Marcum (samantha_marcum@fws.gov) or Cat Darst (cat_darst@fws.gov) with questions or suggestions on these recommendations.

2. Conduct overwintering grove habitat assessment(s), and develop and implement long-term grove management plans, as applicable. Management plan actions for groves may include, but are not limited to:

    a. Enhance roosting trees within overwintering groves and within 1/2 mile of groves by planting native insecticide-free trees (e.g., Monterey pine *(Pinus radiata)*, Monterey cypress *(Cupressus macrocarpa)*, Coast redwood *(Sequoia sempervirens)*, coast live oak *(Quercus agrifolia),* Douglas fir *(Pseudotsuga menzesii),* Torrey pine (*Pinus torreyana*), western sycamore *(Platanus racemosa),* bishop pine *(Pinus radiata)* and others, as appropriate for location).

    b. Avoid the removal of trees or shrubs within 1/2 mile of overwintering groves, except for specific grove management purposes, and/or for human health and safety concerns. The maintenance of trees and shrubs within a 1/2 mile of these sites provides a buffer to preserve the microclimate conditions of the winter habitat.

    c. Conduct management activities in groves from March 16-September 14, in coordination with a monarch biologist, such as tree trimming, mowing, burning and grazing in monarch overwintering habitat outside of the estimated timeframe when monarchs are likely present.

    d. Enhance native, insecticide-free nectar sources by planting fall/winter blooming forbs or shrubs within overwintering groves and within one mile of the groves (Nectar Planting Lists).

3. Protect monarchs, other pollinators, and their habitats from pesticides (i.e., insecticides and herbicides).

    a. Avoid the use pesticides within one mile of overwintering groves, particularly when monarchs may be present. If pesticides are used, then conduct applications from March 16-September 14, when possible.

    b. Screen all classes of pesticides for pollinator risk to avoid harmful applications, including biological pesticides such as *Bacillus thuringiensis* (UC Integrated Pest Management).

    c. Avoid the use of neonicotinoids or other systemic insecticides, including coated seeds, any time of the year in monarch habitat due to their ecosystem persistence, systemic nature, and toxicity.

    d. Avoid the use of soil fumigants.

    e. Consider non-chemical weed control techniques, when possible (Cal-IPC Non-chemical BMPs).

Please contact Samantha Marcum (samantha_marcum@fws.gov) or Cat Darst (cat_darst@fws.gov) with questions or suggestions on these recommendations.

BIOLOGICAL RESOURCES REPORT ADDENDUM

For the Peavine Creek-Truckee River Watershed (Washoe County, Nevada) East Wash and West Wash Dam Rehabilitation Project

January 2026

SPONSORING LOCAL ORGANIZATION:

City of Reno

1 East First Street

Reno, NV 89501

(775) 334-2461

PREPARED BY:

USDA-NRCS

1365 Corporate Blvd

Reno, NV 89502

(775) 834-0911

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1.0 INTRODUCTION

The City of Reno (City), in cooperation with the Natural Resources Conservation Service (NRCS) and Nevada Division of Water Resources (NDWR), plan to remediate, remove, or rehabilitate the East and West Wash Dams in Washoe County, Nevada.

DOWL environmental specialists reviewed available information regarding federally listed species and critical habitat in the project vicinity. The purpose of this report is to provide updated information regarding the potential for occurrence in the project area of threatened and endangered species (TES), species that have been proposed for listing under the federal ESA, and species protected by the Migratory Bird Treaty Act (MBTA). Potential project impacts on species and habitat resources are also disclosed, and recommended measures to avoid, minimize, or mitigate impacts to these resources are described.

This Biological Report Addendum includes a brief project description, an ecological overview of the project area, and a screening analysis to determine the potential for TES or critical habitat resources to occur within or near the project area. Potential effects of the project on special-status species or critical habitat resources are also evaluated, and conservation measures to minimize the project effects on these and other natural resources are included in Section 5.0. The scope of work for this Biological Report Addendum included the following three steps:

1. Review of the USFWS Information, Planning, and Conservation System (IPaC) database (Appendix A), which provides information on species and other resources under USFWS jurisdiction that are known or expected to be in or near the project area.
2. Screening analysis to evaluate potential for occurrence and effects on TES and proposed or designated critical habitat.

For the purposes of this document, project area refers to the limits of potential construction; whereas project vicinity refers to a three-mile radius around the project area in which specific biological resources are evaluated.

1.1 PREFERRED ALTERNATIVE

The project's preferred alternative would include the remediation of both the East Wash and West Wash Dams to meet the dam safety requirements of the NRCS and the NDWR Division of Dams. Both Dams have been identified as High Hazard Dams by the NDWR Division of Dams.

Under this alternative, the East Wash Dam would have the west dike of the principal spillway approach restored to the original design elevation. Additionally, armoring of the auxiliary spillway of the East Wash Dam would occur to avoid future damage to the East Wash Dam structure due to head cutting and degradation. Stripping of vegetation, debris, and weathered fill from crest and both faces of the East Wash Dam's auxiliary spillway would also occur. The West Wash Dam would undergo substantial remediation efforts; including but not limited to:

- Raising and extending the embankment crest;
- Lowering and widening the auxiliary spillway crest;
- Lowering the principal spillway crest;
- Removal and replacement of the principal spillway conduit;
- Removal and replacement of the filter drain;
- Construction of a chimney filter/drain; and

- Construction of a seepage cutoff wall.

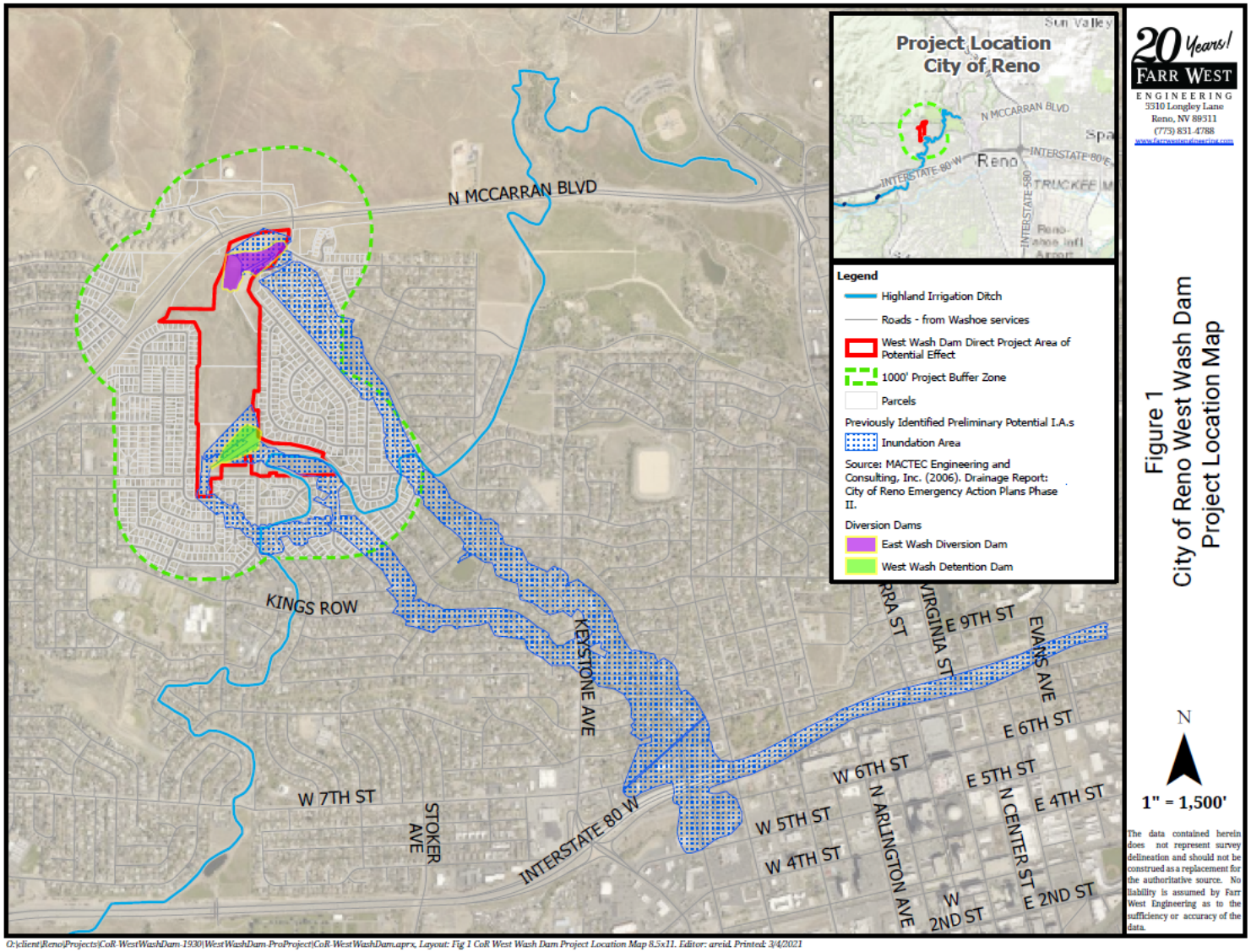
Removal of both the East Wash and West Wash Dams –

Under this alternative, the existing East Wash and West Wash Dam embankments would be completely removed, including primary and auxiliary spillways, and the area would be returned to pre-development conditions. In addition to the removal of both dams, trapezoidal concrete channels would be constructed to relay stormwater runoff up to the 100-year storm event. The channels would start at the location of the removed dams, combine into a single channel at the intersection of Keystone Ave. and Kings Row, and discharge all storm runoff into the Truckee River.

1.2 PROJECT LOCATION

The East Wash and West Wash Dams sit at the base of Peavine Mountain with residential development above, below, and adjacent to the dams. The East Wash Diversion Dam is located at the intersection of Keystone Avenue and North McCarran Boulevard, at the intersection of Township 20 North, Range 19 East, Sections 33 and 34 with Township 19 North, Range 19 East, Sections 3 and 4. The West Wash Dam is located at the intersection of Wyoming Avenue and Putnam Drive at the intersection of Township 19 North, Range 19 East, Sections 3 and 4.

Figure 1: Project Location and Vicinity Map



1.3 SURROUNDING LAND USES AND ECOLOGICAL OVERVIEW

The East Wash and West Wash Dams sit at the base of Peavine Mountain with residential development above, below, and adjacent to the dams. Topography within the project area ranges in elevation from 4,560 to 4,640 feet above mean sea level. The contributing watersheds for the dams extend north underneath McCarran Boulevard into the south slopes of Peavine Mountain (Broadbent and Associates, 2021).

2.0 STUDY METHODS

The potential for TES to occur within the project area is based upon background research to identify species potentially occurring in the region, the natural history of each species, the known range and distribution for each species, and known vegetation and habitat occurring within and near the project area. Once this information is collected, a screening analysis is conducted to identify the potential for any of the listed TES to occur within or near the project area. Critical habitat and other biotic resource components that are important in the life history of TES are also identified through the screening analysis process.

2.1 THREATENED AND ENDANGERED SPECIES RESEARCH

A list of TES for the project area and vicinity was obtained from the USFWS online IPaC database (Appendix A). The USFWS list includes specific TES that may occur within or near the project area. This database also provides information related to each species' habitat requirements and known distribution range in Nevada. Based on the report, a literature search was conducted to review natural history information and identify habitat parameters for investigation during the field reconnaissance portion of the evaluation. A more rigorous literature review and evaluation was conducted for any species that have the potential to occur within or have known ranges in close proximity to the project area.

2.3 SCREENING ANALYSIS

The screening analysis was performed after collecting and reviewing natural history information for each TES listed as potentially occurring in the project area by the USFWS and comparing these requirements to site specific information gathered from background research and field reconnaissance. TES were eliminated from detailed analysis in this Biological Report Addendum if the screening analysis determined that the project was located outside of the known range or distribution of a species, or if required habitat elements for a particular species were not present. In addition, the location of designated or proposed critical habitat was reviewed for each TES in reference to the project area. The standardized criteria used to determine the potential for occurrence of individual species and potential effects on each species are outlined below.

Potential for Occurrence Evaluation – Four occurrence categories that were applied to each TES during the screening analysis are defined as follows:

- *Known to occur* - The species is documented to occur in the project area or vicinity.
- *May occur* – The project area is within the species' currently known range or distribution and vegetation communities, habitat, soils, or other biotic and abiotic indicators resemble those known to support the lifecycle and/or natural history requirements of the species.
- *Unlikely to occur* – The project area is within the species' currently known range or distribution, but vegetation communities, soils, and other biotic and abiotic indicators do not resemble those known to support the lifecycle and/or natural history requirements of the species.

- *Does not occur* - The project area is not within the known range or distribution and other biotic and abiotic indicators do not resemble those known to support the lifecycle and/or natural history requirements of the species.

Potential Effects Evaluation – The effects evaluation conducted for the screening analysis is similar to the effects determination described in the USFWS Endangered Species Act Handbook for Section 7 consultations (USFWS, 1998). The three effects categories used in this BE are defined below:

- *May affect, is likely to adversely affect* - The project is likely to adversely affect a species if: 1) the species is known to occur in the bridge project area; and 2) project activities would disturb areas or habitat elements known to be used by the species or would directly affect an individual.
- *May affect, is not likely to adversely affect* - The project is not likely to adversely affect a species if: 1) the species may occur, but its presence has not been documented; and 2) project activities would not result in disturbance to areas or habitat elements known to be used by the species.
- *No effect* - The project will have no effect on a species if: 1) the species is considered unlikely to occur (range, vegetation, etc., are inappropriate); and 2) the species or its sign was not observed during surveys of the project area.
- *Not likely to jeopardize the continued existence of* – The project is not likely to jeopardize the continued existence of a listed species or to result in the destruction or adverse modification of critical habitat.
- *Likely to jeopardize the continued existence of* – The project would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species.

For proposed or candidate ESA species, the three effects categories used in this report are defined below:

- *Likely to Jeopardize the Continued Existence of* - The project is likely to Jeopardize the Continued Existence of a species if: 1) the species is known to occur in the project area; and 2) project activities would disturb areas or habitat elements known to be used by the species or would directly affect an individual.
- *Not Likely to Jeopardize the Continued Existence of* – The project is not likely to jeopardize the continued existence of a species if: 1) the species may occur, but its presence has not been documented; or 2) project activities would not result in disturbance to areas or habitat elements known to be used by the species.
- *No effect* - The project will have no effect on a species if: 1) the species is considered unlikely to occur (range, vegetation, etc., are inappropriate); and 2) the species or its sign was not observed during surveys of the project area.

3.0 STUDY RESULTS

The following sections describe the results of this Biological Report Addendum and TES screening analysis for the project area. This includes a description of vegetation and habitat resources that were identified, the potential for TES to occur in the project area, and the potential for the project to affect TES or critical habitat resources.

1.4 THREATENED AND ENDANGERED SPECIES

According to the IPaC results for the project area, two Endangered, two Threatened, and two Proposed Threatened species are listed as potentially occurring in the project area (Appendix A). These species include the cui-ui (*Chasmistes cujus*), Carson wandering skipper (*Pseudocopaeodes eunus obscurus*), Lahontan cutthroat trout (*Oncorhynchus clarkii henshawi*), Webber's Ivesia (*Ivesia webberi*), northwestern pond turtle (*Antinemys marmorata*), and monarch butterfly (*Danaus plexippus*) (USFWS, 2026a). No critical habitat was identified within the project vicinity.

The original 2021 Biological Report included a discussion of the cui-ui, Lahontan cutthroat trout, and monarch butterfly. These species were determined to have ***No Effect*** and ***Not Likely to Jeopardize the Continued Existence*** due to lack of habitat and species known range. As the project footprint and/or proposed action have not changed since the 2021 Biological Report, these findings remain valid for the three aforementioned species. As such, the cui-ui, Lahontan cutthroat trout, and monarch butterfly are not discussed in further detail in this Biological Report Addendum. It is important to note that the Carson wandering skipper was briefly mentioned in the 2021 Biological Report; however, no effects determination was provided; therefore, it is analyzed in this report.

1.5 SCREENING ANALYSIS SUMMARY

Screening criteria such as known range and habitat requirements were used to identify whether any TES have the potential to occur in or within the vicinity of the project area. Species with distribution ranges that are known to be far from the project area were eliminated from detailed evaluation. Results of the screening analysis are presented in ***Table 1*****.**

Table 1. **TES Screening Analysis Results for the Project**

Common Name (Species Name)	Status*	Range or Habitat Requirements	Potential for Occurrence in Project Area	Potential Effect
Plants				
Webber's Ivesia (*Ivesia webberi*)	T	Require areas sparsely vegetated, shallow, rocky clay soils with low or no sagebrush. The species prefers elevations between 4,400 and 6,200 feet.	**Unlikely to Occur:** Suitable habitat does not exist in the project area for this species. The project area and vicinity consist of largely developed landscapes. The project area is also at the low end of the species' preferred elevation range. Botanical surveys were completed as part of the 2021 Biological Report and the species was not noted during the survey.	**No Effect**

Common Name (Species Name)	Status*	Range or Habitat Requirements	Potential for Occurrence in Project Area	Potential Effect
Reptiles & Amphibians				
Northwestern Pond Turtle (*Antinemys marmorata*)	PT	Requires aquatic habitats such as streams, ponds, lakes, or permanent/ephemeral wetlands. No individuals have been sited within the project vicinity (USFWS, 2026b)	**Unlikely to Occur:** Suitable habitat does not exist in the project area for this species. The project area and vicinity consist of largely developed landscapes, great basin pinyon-juniper woodland, and inter-mountain basins big sagebrush shrubland. A small amount of riparian habitat occurs within the project area; however, there is no known year-round aquatic habitat to support the species.	**Not Likely to Jeopardize the Continued Existence**
Insects				
Carson Wandering Skipper (*Pseudocopaeodes eunus obscurus)*	E	Requires alkali meadows, which support salt grass, which is their host plant (USFWS, 2026c).	**Unlikely to Occur:** Suitable habitat does not exist in the project area for this species. The project area and vicinity consist of largely developed landscapes, great basin pinyon-juniper woodland, and inter-mountain basins big sagebrush shrubland. No alkali meadows exist within the project area.	**No Effect**

Common Name (Species Name)	Status*	Range or Habitat Requirements	Potential for Occurrence in Project Area	Potential Effect

*USFWS Status Definitions:

T = Threatened. The ESA specifically prohibits the take of a species listed as threatened. Take is defined by the ESA as: to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to engage in any such conduct.

PT = Proposed Threatened. Any species the Service has determined is likely to become endangered within the foreseeable future throughout all or a significant portion of its range and USFWS has proposed a rule to list as threatened. Proposed species are not protected by the take prohibitions of section 9, consistent with any protective regulations finalized under section 4(d) of the ESA, until the rule to list is finalized.

E = Endangered. The ESA specifically prohibits the take of a species listed as endangered. Take is defined by the ESA as: to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to engage in any such conduct.

4.0 MIGRATORY BIRDS

Migratory birds are protected under the Migratory Bird Treaty Act (MBTA [16 U.S.C. 703-711]). The MBTA prohibits the take of any migratory bird, part, nest, egg, or product thereof, with "take" defined as to pursue, hunt, shoot, wound, kill, trap, capture, or collect; or to attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect. The statute does not discriminate between live or dead birds and grants full protection to feathers, eggs, and nests. A take does not include habitat destruction or alteration, as long as there is not a direct taking of birds, nests, eggs, or parts thereof. Birds protected under the act include all common songbirds, waterfowl, shorebirds, hawks, owls, eagles, ravens, crows, native doves and pigeons, swifts, martins, and swallows. Feathers, plumes, nests, and eggs are also protected. A complete list of protected species is found in Code of Federal Regulations Title 50, Part 10.13.

The project area and vicinity contain great basin pinyon-juniper woodland, and inter-mountain basins big sagebrush shrubland that may be used by migratory birds. Construction activities have the potential to impact nesting birds protected under the MBTA if trees and shrubs are removed during the bird breeding season. If vegetation clearing will occur during the migratory bird breeding season (February 1st to September 1st), the contractor shall avoid any active bird nests. During the non-breeding season (September 1st to February 1st) vegetation removal is not subject to this restriction.

1.6 4.1 BALD AND GOLDEN EAGLE PROTECTION ACT

Bald and golden eagles are dually protected under the Bald and Golden Eagle Protection Act of 1940 and the MBTA. According to the Nevada Comprehensive Bird Conservation Plan, most of the majority of bald eagle nesting in Nevada is found near large lakes such as Lake Tahoe and Pyramid Lake, which are over 50 miles away. No known breeding locations exist within the project area (GBBO, 2026).

While the Project would not affect any potential breeding habitat for bald or golden eagles, these raptors may pass through and forage in the area, particularly if carcasses are found along adjacent roadways (i.e., wildlife killed by vehicle collision). Conflicts between eagles and construction equipment could occur if eagles are scavenging along the roadway.

5.0 PROPOSED PROJECT CONSERVATION MEASURES

The following measures are recommended to promote the conservation of the natural habitat, TES, and other wildlife resources that occur in the project area.

- Best management practices to control erosion from the construction site shall be implemented to prevent sediment from leaving the construction site.
- Water shall be applied, as needed, to control dust during all phases of construction.
- To reduce potential impacts to wildlife and vegetation in the project vicinity, boundary limits of construction are to be clearly marked in the field according to the design plans. This would ensure that ground-disturbing activities are limited, which would reduce the amount of potential dust created and reduce the potential for noxious weeds or other undesirable plants to establish.
- The contactor shall not cause injury or death to migratory birds, including eggs and nestlings, and shall avoid any clearing, grubbing, or tree/limb removal during the migratory bird breeding/nesting season (breeding/nesting season is from February 1st to September 1st of any calendar year).
- If active bird nests are identified within the project area, construction activities will avoid disturbing any active nests. After determining appropriate avoidance strategies, avoidance areas, if necessary, will be marked in the field by the Qualified Biologist.
- Remove any carcasses along the roadway and dispose of at an approve location to prevent bald or golden eagles from scavenging along the roadway during construction.
- In compliance with Executive Order 13112 regarding noxious weeds, the contractor shall inspect all earth-moving and hauling equipment at the contractor's equipment storage facility, and all equipment shall be washed prior to entering the construction site to prevent the introduction of noxious weed seed.
- In compliance with Executive Order 13112 regarding invasive and noxious weeds, the contractor shall inspect all construction equipment and remove all attached plant/vegetation and soil/mud debris prior to leaving the construction site.

6.0 SUMMARY AND CONCLUSIONS

Two Endangered, two Threatened, and two Proposed Threatened species were identified as potentially occurring within the project vicinity (USFWS, 2026a). The previous 2021 Biological Report's determinations of ***No Effect*** and ***Not Likely to Jeopardize the Continued Existence*** for the cui-ui, Lahontan cutthroat trout, and monarch butterfly, remain valid. Based on the screening analysis for the remaining three species, the Webber's Ivesia, northwestern pond turtle, and Carson wandering skipper are unlikely to occur within the project area.

Webber's ivesia are listed in Washoe County due to the designation of critical habitat in 2014 in portions of the county between Lake Tahoe and Pyramid Lake. The critical habitat is several miles away from the project area. There is no suitable habitat within the project area, and Webber's ivesia are not anticipated to be located within the area. The Project would not result in any effects (i.e., ***No Effect***) on Webber's ivesia or modify designated critical habitat for this species.

Carson wandering skipper are listed within Washoe County due to the designation of critical habitat in 2004 in portions of the county between Lake Tahoe and Pyramid Lake. The critical habitat is several

miles away from the project area. There is no suitable habitat within the project area. There is potential for some migrating individuals to pass through the project area. However, due to the lack of salt grass which is their host plant the species is not anticipated to roost in the project area. The Project would not result in any effects (i.e., ***No Effect***) on Carson wandering skipper or impede or create barriers to the migration of the species.

The Project is ***not likely to jeopardize the continued existence*** of the northwestern pond turtle. Within the project area, there is minimal suitable aquatic habitat for the species. Long-term impacts to northwestern pond turtles are not anticipated as a result of the Project.

Bald and Golden eagle nesting areas are found within the general vicinity of the Project, and they may use the project area for foraging. Measures to reduce opportunity for foraging along the roadway should be implemented to minimize conflicts during construction. This would include removing any wildlife carcasses within the project area that may encourage eagles and other birds of prey.

7.0 REFERENCES

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APPENDIX A

U.S. FISH AND WILDLIFE SERVICE

INFORMATION, PLANNING, AND CONSERVATION SYSTEM

DATABASE REPORT

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Reno Fish And Wildlife Office
1340 Financial Boulevard, Suite 234
Reno, NV 89502-7147
Phone: (775) 861-6300 Fax: (775) 861-6301

In Reply Refer To: 01/24/2026 00:26:11 UTC
Project Code: 2026-0040549
Project Name: Peavine Creek-Truckee River Watershed East Wash and West Wash Dam Rehab

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed, and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through IPaC by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological

evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at: https://www.fws.gov/sites/default/files/documents/endangered-species-consultation-handbook.pdf

Migratory Birds: In addition to responsibilities to protect threatened and endangered species under the Endangered Species Act (ESA), there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts, see Migratory Bird Permit | What We Do | U.S. Fish & Wildlife Service (fws.gov).

It is the responsibility of the project proponent to comply with these Acts by identifying potential impacts to migratory birds and eagles within applicable NEPA documents (when there is a federal nexus) or a Bird/Eagle Conservation Plan (when there is no federal nexus). Proponents should implement conservation measures to avoid or minimize the production of project-related stressors or minimize the exposure of birds and their resources to the project-related stressors. For more information on avian stressors and recommended conservation measures, see https://www.fws.gov/library/collections/threats-birds.

In addition to MBTA and BGEPA, Executive Order 13186: *Responsibilities of Federal Agencies to Protect Migratory Birds*, obligates all Federal agencies that engage in or authorize activities that might affect migratory birds, to minimize those effects and encourage conservation measures that will improve bird populations. Executive Order 13186 provides for the protection of both migratory birds and migratory bird habitat. For information regarding the implementation of Executive Order 13186, please visit https://www.fws.gov/partner/council-conservation-migratory-birds.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Code in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List
- USFWS National Wildlife Refuges and Fish Hatcheries

- Bald & Golden Eagles
- Migratory Birds
- Wetlands

OFFICIAL SPECIES LIST

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Reno Fish And Wildlife Office
1340 Financial Boulevard, Suite 234
Reno, NV 89502-7147
(775) 861-6300

PROJECT SUMMARY

Project Code: 2026-0040549
Project Name: Peavine Creek-Truckee River Watershed East Wash and West Wash Dam Rehab
Project Type: Dam - Maintenance/Modification
Project Description: Project will rehabilitate the east and west wash dams.
Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@39.54499905,-119.84642977116641,14z

Counties: Washoe County, Nevada

ENDANGERED SPECIES ACT SPECIES

There is a total of 7 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

BIRDS

NAME	STATUS
California Condor *Gymnogyps californianus* Population: Pacific Northwest NEP No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/8193	Experimental Population, Non-Essential

REPTILES

NAME	STATUS
Northwestern Pond Turtle *Actinemys marmorata* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/1111 General project design guidelines: https://ipac.ecosphere.fws.gov/project/4UNUQ4TSJVD3JMVHY4V4LD5H7M/documents/generated/11040.pdf	Proposed Threatened

FISHES

NAME	STATUS
Cui-ui *Chasmistes cujus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/456	Endangered
Lahontan Cutthroat Trout *Oncorhynchus clarkii henshawi* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/3964 General project design guidelines: https://ipac.ecosphere.fws.gov/project/4UNUQ4TSJVD3JMVHY4V4LD5H7M/documents/generated/11040.pdf	Threatened

INSECTS

NAME	STATUS
Carson Wandering Skipper *Pseudocopaeodes eunus obscurus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/674	Endangered
Monarch Butterfly *Danaus plexippus* There is **proposed** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/9743 General project design guidelines: https://ipac.ecosphere.fws.gov/project/4UNUQ4TSJVD3JMVHY4V4LD5H7M/documents/generated/11040.pdf	Proposed Threatened

FLOWERING PLANTS

NAME	STATUS
Webber's Ivesia *Ivesia webberi*	Threatened

There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
Species profile: https://ecos.fws.gov/ecp/species/4682

CRITICAL HABITATS

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

YOU ARE STILL REQUIRED TO DETERMINE IF YOUR PROJECT(S) MAY HAVE EFFECTS ON ALL ABOVE LISTED SPECIES.

USFWS NATIONAL WILDLIFE REFUGE LANDS AND FISH HATCHERIES

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS OR FISH HATCHERIES WITHIN YOUR PROJECT AREA.

BALD & GOLDEN EAGLES

Bald and Golden Eagles are protected under the Bald and Golden Eagle Protection Act [2] and the Migratory Bird Treaty Act (MBTA) [1]. Any person or organization who plans or conducts activities that may result in impacts to Bald or Golden Eagles, or their habitats, should follow appropriate regulations and consider implementing appropriate avoidance and minimization measures, as described in the various links on this page.

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1. The Bald and Golden Eagle Protection Act of 1940.
2. The Migratory Birds Treaty Act of 1918.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

There are Bald Eagles and/or Golden Eagles in your project area.

Measures for Proactively Minimizing Eagle Impacts
For information on how to best avoid and minimize disturbance to nesting bald eagles, please review the National Bald Eagle Management Guidelines. You may employ the timing and activity-specific distance recommendations in this document when designing your project/ activity to avoid and minimize eagle impacts. For bald eagle information specific to Alaska, please refer to Bald Eagle Nesting and Sensitivity to Human Activity.

The FWS does not currently have guidelines for avoiding and minimizing disturbance to nesting Golden Eagles. For site-specific recommendations regarding nesting Golden Eagles, please consult with the appropriate Regional Migratory Bird Office or Ecological Services Field Office.

If disturbance or take of eagles cannot be avoided, an incidental take permit may be available to authorize any take that results from, but is not the purpose of, an otherwise lawful activity. For assistance making this determination for Bald Eagles, visit the Do I Need A Permit Tool. For assistance making this determination for golden eagles, please consult with the appropriate Regional Migratory Bird Office or Ecological Services Field Office.

Ensure Your Eagle List is Accurate and Complete
If your project area is in a poorly surveyed area in IPaC, your list may not be complete and you may need to rely on other resources to determine what species may be present (e.g. your local FWS field office, state surveys, your own surveys). Please review the Supplemental Information on Migratory Birds and Eagles, to help you properly interpret the report for your specified location, including determining if there is sufficient data to ensure your list is accurate.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to bald or golden eagles on your list, see the "Probability of Presence Summary" below to see when these bald or golden eagles are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
Bald Eagle *Haliaeetus leucocephalus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Dec 1 to Aug 31
Golden Eagle *Aquila chrysaetos* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1680	Breeds Jan 1 to Aug 31

PROBABILITY OF PRESENCE SUMMARY

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read "Supplemental Information on Migratory Birds and Eagles", specifically the FAQ section titled "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

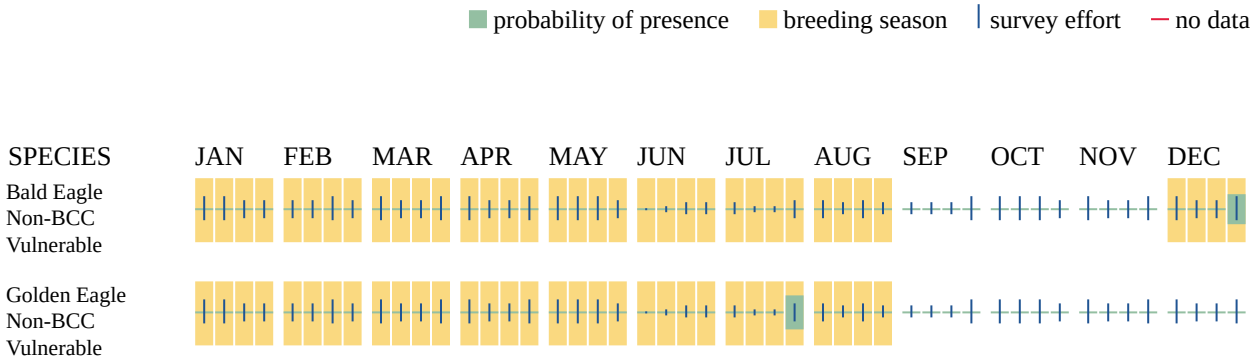
Probability of Presence (■)

Green bars; the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during that week of the year.

Breeding Season (■)
Yellow bars; liberal estimate of the timeframe inside which the bird breeds across its entire range.

Survey Effort (|)
Vertical black lines; the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps.

No Data (–)
A week is marked as having no data if there were no survey events for that week.



Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide avoidance and minimization measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

MIGRATORY BIRDS

The Migratory Bird Treaty Act (MBTA) [1] prohibits the take (including killing, capturing, selling, trading, and transport) of protected migratory bird species without prior authorization by the Department of Interior U.S. Fish and Wildlife Service (Service).

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1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, see the "Probability of Presence Summary" below to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
American Avocet *Recurvirostra americana* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/11927	Breeds Apr 21 to Aug 10
American White Pelican *pelecanus erythrorhynchos* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/6886	Breeds Apr 1 to Aug 31
Bald Eagle *Haliaeetus leucocephalus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Dec 1 to Aug 31
California Gull *Larus californicus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/10955	Breeds Mar 1 to Jul 31
Calliope Hummingbird *Selasphorus calliope* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9526	Breeds May 1 to Aug 15
Cassin's Finch *Haemorhous cassinii* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9462	Breeds May 15 to Jul 15
Clark's Grebe *Aechmophorus clarkii* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/10575	Breeds Jun 1 to Aug 31
Evening Grosbeak *Coccothraustes vespertinus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9465	Breeds May 15 to Aug 10
Flammulated Owl *Psiloscops flammeolus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/7728	Breeds May 10 to Aug 15

NAME	BREEDING SEASON
Golden Eagle *Aquila chrysaetos* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1680	Breeds Jan 1 to Aug 31
Lesser Yellowlegs *Tringa flavipes* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9679	Breeds elsewhere
Lewis's Woodpecker *Melanerpes lewis* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9408	Breeds Apr 20 to Sep 30
Long-eared Owl *asio otus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3631	Breeds Mar 1 to Jul 15
Northern Harrier *Circus hudsonius* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/8350	Breeds Apr 1 to Sep 15
Olive-sided Flycatcher *Contopus cooperi* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3914	Breeds May 20 to Aug 31
Pinyon Jay *Gymnorhinus cyanocephalus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9420	Breeds Feb 15 to Jul 15
Rufous Hummingbird *Selasphorus rufus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/8002	Breeds Apr 15 to Jul 15
Sage Thrasher *Oreoscoptes montanus* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/9433	Breeds Apr 15 to Aug 10
Western Grebe *aechmophorus occidentalis* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/6743	Breeds Jun 1 to Aug 31

PROBABILITY OF PRESENCE SUMMARY

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read "Supplemental Information on Migratory Birds and Eagles", specifically the FAQ section titled "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Green bars; the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during that week of the year.

Breeding Season (■)
Yellow bars; liberal estimate of the timeframe inside which the bird breeds across its entire range.

Survey Effort (|)
Vertical black lines; the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps.

No Data (–)
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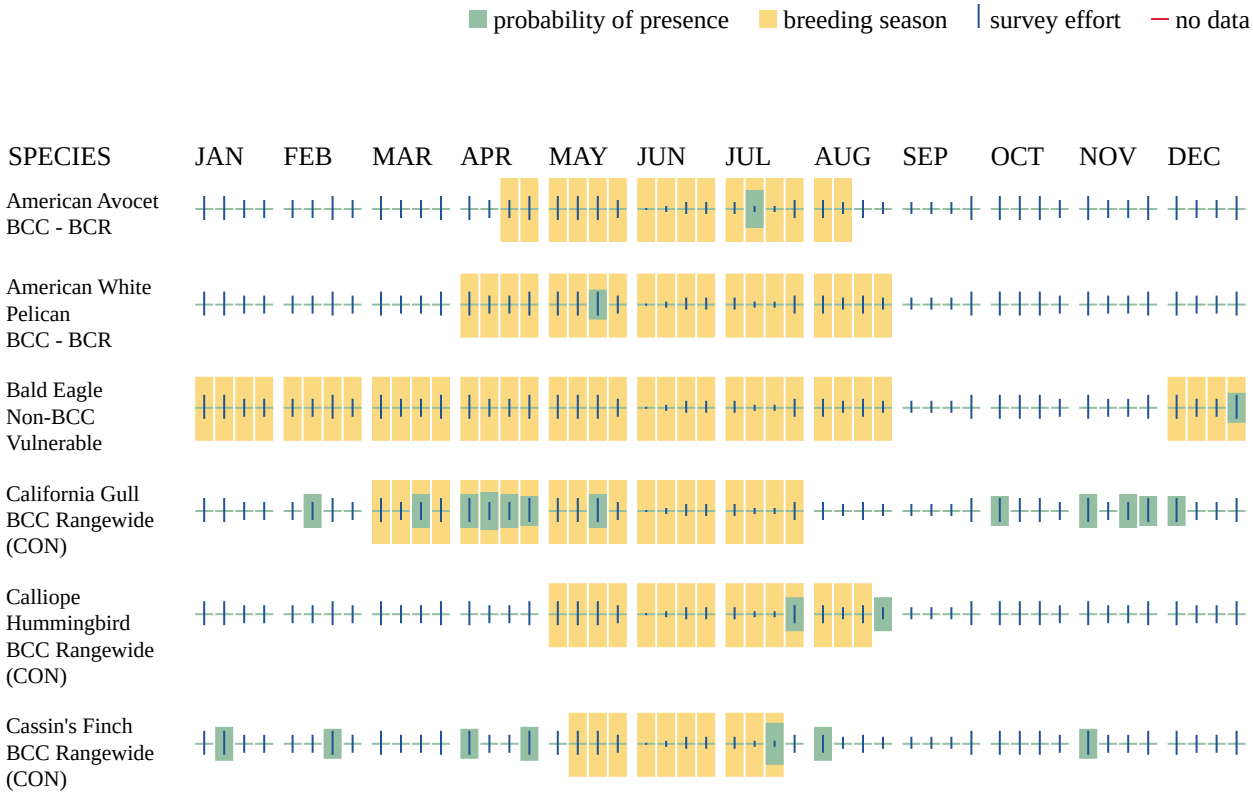

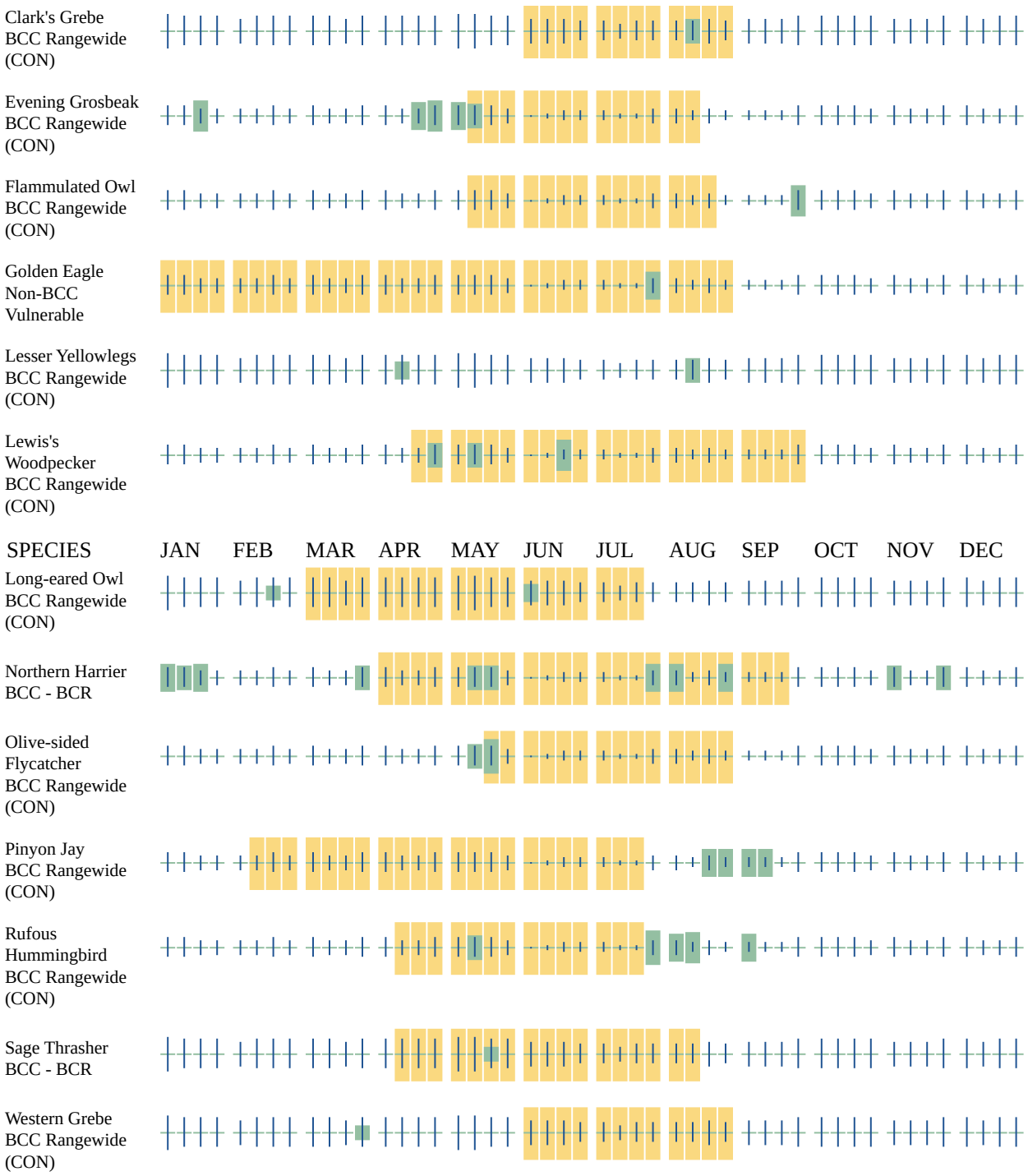

Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds

- Nationwide avoidance and minimization measures for birds
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

WETLANDS

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

WETLAND INFORMATION WAS NOT AVAILABLE WHEN THIS SPECIES LIST WAS GENERATED. PLEASE VISIT HTTPS://WWW.FWS.GOV/WETLANDS/DATA/MAPPER.HTML OR CONTACT THE FIELD OFFICE FOR FURTHER INFORMATION.

Appendix F:
Tables

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Table 1: Number of Comments by Commenter Type (EA Section 4.2.2)

Type of Commenter	Number of Comments
Agency Comments	1
Public Comments	39
Other Stakeholder Comments	0
Total Comments	**40**

Table 2: Number of Comments by Category (EA Section 4.2.2)

Categories of Comments	Number of Type of Comments
Contact/access to virtual meeting or webpage	7
Enhancements to the project area	4
Land use (open space/zoning/public access)	4
Request for additional information	6
Alternatives Analysis	3
Mitigation for dust and noise	2
Plants: Native habitats, weed abatement, herbicide use	3
Dam Removal Alternative	2
Climate Change	1
Wildfires	2
Flooding	2
Public notice	2
Existing development	2
Current dam safety (human safety)	2
Cumulative impacts	1
Total Topic Categories	**43**

Table 3: Resource Concerns Summary (EA Section 4.3)

Resource/Concern	Relevant to The Project		Rationale
	Yes	No	
Soils & Geology			
Geologic Resources and Erosion and Sedimentation	X		Construction activities have the potential to temporarily increase erosion and runoff impacts downstream. Specific ground disturbance impacts to geologic resources are unknown, due the current project design phase; however, there is potential for impacts to geologic resources.
Soils and Prime and Unique Farmland Designation		X	Protection for important farmland is established in the Farmland Protection Policy Act (FPPA), U.S. Department of Agriculture (USDA) regulations implementing the FPPA (7 CFR Part 658), and USDA DR No. 9500-3, Land Use Policy. There are no Prime and Unique Farmlands in the project area ((NRCS, Web Soil Survey)
Land Use			
Land Use	X		The NWP (Public Law 390 Part 501.12) requires consideration of land use measures and potential conversions as part of the alternatives analysis. It is not anticipated that land use classifications would change as a result of the project; however, ecosystem services of land use may be impacted.
Formally Classified Lands		X	The Wilderness Act of 1964 (Pub. L. 88–577), the Wild and Scenic Rivers Act (Pub L. 90-542), along with a number of other federal, state, and local regulations require the protection of formally classified lands, parks, and areas. There are no unique lands, forest lands, national natural landmarks, wilderness areas, national monuments, or national parks or trails located within the project area. There are no wild and scenic rivers in the State.
Water Resources			
Surface and Groundwater Quality and Quantity	X		Section 401 of the Clean Water Act (33 U.S.C. § 1341) requires the protection of surface and ground water within waters of the united states (WOTUS). The Project may result in some temporary impacts to water quality during construction due to runoff.
Clean Water Act / Waters of the U.S., including Wetlands	X		Section 404 of the Clean Water Act (33 U.S.C. § 1344) requires protection and consideration of WOTUS. An aquatic resources delineation was completed and one potential WOTUS, and no wetlands were identified within the project area
Regional Water Management Plan	X		NWP (Pub L. 390 Part 501.4) requires collaboration with local, regional, and state entities. As such, the NWP should be in agreement with the regional water management plan (RWMP). The project agrees with all RWMP.
Floodplain Management	X		There are no Federal Emergency Management Agency (FEMA) regulated floodplains within the project area. Floodplains are managed by FEMA floodplain insurance management program (EO 11988), any work within a FEMA designated floodplain must be properly coordinated with FEMA.
Sole Source Aquifer		X	There are no Sole Source Aquifers, provided with protections under 40 CFR 149, within the project area.
Air Quality			
Clean Air Act / National Ambient Air Quality Standards	X		Construction activities would temporarily cause dust and other regulated particles to be dispersed. Air quality is regulated under the Clean Air Act (42 U.S.C. §7401 et seq.) and National Ambient Air Quality Standards (NAAQS).
Vegetation			
Special Status Plant Species	X		Webber's Ivesia (*Ivesia webberi*) was identified, however no critical habitat exists within the project area. Special status plant species are protected under the Endangered Species Act (ESA) 16 U.S.C. 1531-1544 as well as other applicable state regulations.
Noxious Weeds and Invasive Species	X		Construction has the potential to spread noxious and invasive weeds. USDA upholds the Federal Noxious Weed Program (7 CFR 360) to protect and restrict the spread of noxious weeds.

Natural Areas	X		Vegetation identified within the project area would be excavated. NRCS NEPA guidance requires consideration of natural areas.
Riparian Areas	X		The riparian corridor would be avoided, but disturbance may occur. NRCS NEPA guidance requires consideration of riparian areas.
Wildlife			
Wildlife and Wildlife Habitat & Threatened and Endangered Species	X		Most wildlife habitat exists in the Riparian Corridor and would be largely avoided, however, habitat for Monarch Butterflies, which are protected under ESA (16 U.S.C. 1531-1544) as well as other applicable state regulations. exists throughout the project area and would be disturbed. NRCS NEPA guidance requires consideration of wildlife and wildlife habitat.
Special Status Animal Species	X		Habitat for monarch butterflies exists mainly in the Riparian Corridor but also occurred occasionally throughout the project area. Construction activities would disturb this habitat.
Migratory Birds, Bald Eagles, and Golden Eagles	X		Ground disturbance activities are limited to previously disturbed ground; however, migratory birds use the project area. Impacts to Bald Eagles and Golden Eagles are not anticipated.
Human			
Socioeconomics	X		The project is estimated to provide protection against flooding to about 30,000 Nevadans who live and work downstream, creating the greatest economic benefits out of the alternatives.
Cultural and Historic Resources	X		Alteration to the East and West Wash Dams would occur. Both structures are National Register of Historic Places (NRHP) eligible and would qualify for protection under Section 106 of the National Historic Preservation Act (54 U.S.C. § 306108). Consultation with the State Historic Preservation Office (SHPO), Native Tribes, local governments, and other interested parties is required for compliance with Section 106 of the NRHP.
Public Health and Safety	X		The existing dam prevents flooding of 7,900 housing units. NRCS NEPA guidance requires consideration of public health and safety.
Visual Resources and Scenic Beauty	X		Minor Aesthetic Changes would occur within the area of the dams. NRCS NEPA guidance requires consideration of visual aesthetics.
Parklands and Recreational Uses	X		There are no parklands within the project area, however, temporary impacts to informal recreational uses will occur during construction. Informal recreation will not be prohibited by the City outside of construction areas. NRCS NEPA guidance requires consideration of park and recreational spaces..
Noise	X		There would be temporary, increased ambient noise levels during the construction period. NRCS NEPA guidance requires consideration of noise sensitive resources.
Socioeconomics	X		The project is estimated to provide protection against flooding to about 30,000 Nevadans who live and work downstream, creating the greatest economic benefits out of the alternatives.

Table 4: Applicable General Conformity de minimis Thresholds (EA Section 5.2.4.1)

Pollutant	Type	*De minimis* Threshold (tons/year)	Project Area Attainment Status
PM_{10}	Direct emissions of PM_{10}	100	Maintenance area
CO	Direct emissions of CO	100	Maintenance area

Table 5: ESA vegetation Species Identified by the FWS (EA Section 5.2.5.1)

Type of Vegetation	Species	Scientific Name	Status	Critical Habitat within The Project Area
Flowering Plants	Webber's Ivesia	*Ivesia webberi*	Threatened	No

Table 6: SWReGAP Vegetation Communities in The Project Area (EA Section 5.2.5.1)

Vegetation Community	Nevada Department of Wildlife (NDOW) Wildlife Action Plan (WAP) Habitat	Acres in Project Area	Percent of Project Area
Inter-Mountain Basins Big Sagebrush Shrubland	Sagebrush	26.8	50.4
Developed, Open Space – Low Intensity	Developed Landscapes	19.8	37.2
Developed, Medium – High Intensity		3.2	6.0
Great Basin Pinyon-Juniper Woodland	Lower Montane Woodlands and Chaparral	2.2	4.1
Inter-Mountain Basins Montane Sagebrush Steppe	Sagebrush	1.2	2.3
Total		53.2	100%

Table 7 Field-Verified Vegetation Communities in The Project Area (EA Section 5.2.5.3)

Vegetation Community	NDOW WAP Habitat	Acres in Project Area	Percent of Project Area
Inter-Mountain Basins Big Sagebrush Shrubland	Sagebrush	45.2	85%
Great Basin Lowland Riparian	Intermountain Rivers and Streams	8	15%
Total		53.2	100%

Table 8: ESA Species Identified by the FWS (EA Section 5.2.6.2)

Type of Animal	Species	Scientific Name	Status	Critical Habitat within The Project Area
Amphibians	Sierra Nevada Yellow-legged Frog (SNYLF)	*Rana Sierrae*	Endangered	No
Fish	Cui-ui	*Chasmistes cujus*	Endangered	No
Fish	Lohontan Cutthroat Trout (LCT)	*Oncorhynchus clarkii*	Threatened	No
Insect	Carson Wandering Skipper	*Pseudocopaeodes eunus obscurus*	Endangered	No
Insect	Monarch Butterfly	*Danaus plexippus*	Candidate	No

Table 9: Sensitive Species Within The Project Area (EA Section 5.2.6.2)

Common Name	Scientific Name	Designation	Habitat	Critical Habitat in The Project Area
Reptiles				
Great Basin collared lizard	*Crotaphytus bicintores*	SoCP	Desert, sparsely vegetated, rocky areas on hillsides, rocky plain, and canyons.	No
Long-nosed leopard lizard	*Gambelia wislizenii*	SoCP	Arid and semiarid plains growth.	No
Northern rubber boa	*Charina bottae*	SoCP	Woodlands, forest clearings, patchy chaparral, meadows, and grassy savannas.	No
Western pond turtle	*Clemmys marmorata*	SoCP	Permanent and intermittent water of rivers, creeks, small lakes and ponds, marshes, irrigation ditches and reservoirs.	No
Western toad (including ssp. *Halophilus*)	*Anaxyrus boreas*	SoCP	Desert streams and springs, grasslands, and mountain meadows.	No
Birds				
American goldfinch	*Spinus tristus*	State-Protected and MBTA**	Weedy fields and floodplains	No
American robin	*Turdus migratorius*	State-Protected and MBTA	Woodlands, suburban backyards, parks, and grasslands with shrubs	No
Anna's hummingbird	*Calypte anna*	State-Protected and MBTA	Streamside groves, chaparral, open oak woodland, coastal sage scrub, gardens, city parks	No
Black-chinned hummingbird	*Archilochus alexandri*	State-Protected and MBTA	Lowland deserts and mountainous forests	No
Black-headed grosbeak	*Pheucticus melanocephalus*	State-Protected and MBTA	Deciduous and mixed wooded areas	No
Brewer's blackbird	*Euphagus cyanocephalus*	State-Protected and MBTA	Fields, prairies, farms, parks	No
Brown-headed cowbird	*Molothrus ater*	State-Protected and MBTA	Fields, pastures, meadows, forest edges, and lawns	No
Brown-creeper	*Certhia americana*	State-Protected and MBTA	Mature evergreen or mixed evergreen-deciduous forests	No
Cassin's finch	*Haemorhous cassinii*	State-Protected, SoCP, and MBTA	Evergreen forests in the mountains up to 10,000 feet elevation	No
Cedar waxwing	*Bombycilla cedrorum*	State-Protected and MBTA	Open woodlands, fruiting trees, orchards	No
Common raven	*Corvus corax*	State-Protected and MBTA	Woodlands, usually in coniferous forests and along rocky coastlines	No
Dark-eyed junco (including ssp. *Oreganus*)	*Junco jyemalis*	State-Protected and MBTA	Coniferous or mixed-coniferous forests	No
Eastern kingbird	*Tyrannus tyrannus*	State-Protected and MBTA	Yards, fields, pastures, grasslands, or wetlands	No

Common Name	Scientific Name	Designation	Habitat	Critical Habitat in The Project Area
Evening grosbeak	*Coccothraustes vespertinus*	State-Protected and MBTA	Coniferous and mixed forests	No
Glaucous-winged gull	*Larus glaucescens*	State-Protected and MBTA	Coastlines	No
Glaucus gull	*Larus hyperboreus*	State-Protected and MBTA	Sea cliffs and coastlines	No
Green heron	*Butorides virescens*	State-Protected and MBTA	Lakes, ponds, marshes, swamps, streamside's	No
Hermit thrush	*Catharus guttatus*	State-Protected and MBTA	Low vegetation of conifer trees or shrubs	No
House finch	*Haemorhous mexicanus*	State-Protected and MBTA	Dry desert, desert grassland, chaparral, oak savannah, streamside's, and open coniferous forests at elevations below 6,000 feet	No
House wren	*Troglodytes aedon*	State-Protected and MBTA	Open woods, thickets, towns, and gardens	No
Lesser goldfinch	*Spinus psaltria*	State-Protected and MBTA	Open brushy country, open woods, wooded streams, gardens	No
Mew gull	*Larus canus*	State-Protected and MBTA	Pacific coast	No
Mountain chickadee	*Poecile gambeli*	State-Protected and MBTA	Mountain forests, conifers	No
Northern Flicker	*Colaptes auratus*	State-Protected and MBTA	Woodlands, forest edges, and open fields with scattered trees	No
Northern Mockingbird	*Mimus polyglottos*	State-Protected and MBTA	Forest edges and open areas	No
Pine siskin	*Spinus pinus*	State-Protected and MBTA	Conifers, mixed woods, alders, weedy areas	No
Red-breasted sapsucker	*Sphyrapicus ruber*	State-Protected and MBTA	Coniferous forest, aspen groves.	No
Rufous hummingbird	*Selasphorus rufus*	State-Protected and MBTA	Open or shrubby areas, forest openings, yards, and parks, and sometimes in forests, thickets, swamps, and meadows from sea level to 6,000 feet	No
Spotted towhee	*Pipilo maculatus*	State-Protected and MBTA	Dry upland forests, chaparral, thickets or shrubby areas, parks, and suburban gardens	No
Thayer's (Iceland) gull	*Larus glaucoides*	State-Protected and MBTA	Pacific coast	No
Townsend's solitaire	*Myadestes townsendii*	State-Protected and MBTA	Open pine, fir, and spruce forests in mountainous regions from about 1,100-11,500 feet	No
Vermillion flycatcher	*Pyrocephalus rubinus*	State-Protected and MBTA	Arid scrublands, farmlands, deserts, parks, and canyon mouths	No
Western kingbird	*Tyrannus verticalis*	State-Protected and MBTA	Grasslands, deserts, sagebrush, agricultural fields, and open woodlands	No
Western tanager	*Piranga ludoviciana*	State-Protected and MBTA	Coniferous forests of the north and the high mountains	No
White-crowned sparrow	*Zonotrichia leucophys*	State-Protected and MBTA	Tundra, high alpine meadows, and forest edges	No
White-headed woodpecker	*Dryobates albolarvatus*	State-Protected, SoCP*, and MBTA	Pine forests or mountains of western North America	No
Wouldiamson's sapsucker	*Sphyrapicus Thyroideus*	State-Protected and MBTA	Open coniferous and mixed woodlands in mountains of western North America	No
Wilson's warbler	*Cardellina pusilla*	State-Protected and MBTA	Mountain meadows and thickets near streams	No
Yellow-rumped warbler	*Setophaga coronate*	State-Protected and MBTA	Open evergreen forests and edges	No

Common Name	Scientific Name	Designation	Habitat	Critical Habitat in The Project Area
Amphibians				
SNYLF	*Rana sierrae*	Endangered	High elevations in wet mountain meadows of the Sierra Nevada Mountains.	No
Fish				
Cui-ui	*Chasmistes cujus*	Endangered	Found only in Pyramid Lake and the mouth of the Truckee River.	No
LCT	*Oncorhynchus clarkii henshawi*	Threatened	Spawning: Cool water, pools with nearby cover, stream banks that are stable and well vegetated, and riffle-run areas with rocky substrate.	No
Mountain whitefish	*Prosopium wouldiamsoni*	SoCP	Larger streams in western and northeastern Nevada	No
Insects				
Carson Wandering Skipper	*Pseudocopaeodes eunus obscurus*	Endangered	lowland grassland habitats on alkaline substrates generally at elevation of less than 1,524 meters (5,000 feet)	No
Monarch Butterfly	*Danaus plexippus*	Candidate	Breeding: Milkweed	No
Mammals				
Brazilian free-tailed bat	*Tadarida brasiliensis*	State-Protected and SoCP	Caves, mine tunnels, old wells, hollow trees, human habitations bridges, and other buildings	No
North American River Otter	*Lontra canadensis*	SoCP	Riparian zones in both marine and fresh water	No
Spotted bat	*Euderma maculatum*	State-Protected and SoCP	Arid regions, desert scrub, and open forest in rugged landscapes	No

Table 10: Project Census Tracts (EA Section 5.2.7.1)

Census Tract Number	Project Area Location
24.01	Project Area and Downstream Area
13	Project Area and Downstream Area
14	Downstream Area
1.03	Downstream Area
1.06	Downstream Area
1.04	Downstream Area

Table 11: Socioeconomic variables for Population and Housing* (EA Section 5.2.7.1)

Variable	United States	State of Nevada	City of Reno	Census Tract (South of I-80) 1.03	1.04	1.06	Census Tract (North of I-80) 13	14	24.01
Population	**326,569,308**	**3,030,281**	**250,903**	**963**	**2,922**	**1,175**	**3,465**	**3,439**	**4,190**
Median Age	**38.1**	**38.0**	**38.5**	**48.6**	**49.4**	**56.2**	**38.0**	**22.5**	**32.2**
Persons below the Poverty Level	40,910,326	381,695	31,049	280	455	566	477	1,139	360
Percent below the Poverty Level	*13%*	*13%*	*12%*	*29%*	*16%*	*48%*	*14%*	*33%*	*9%*
Population with a Disability	40,786,461	375,254	29,390	308	485	307	555	197	449
Percent with a Disability	*12%*	*12%*	*12%*	*32%*	*17%*	*26%*	*16%*	*6%*	*11%*
Median Household Income	**$64,994**	**$62,043**	**$58,790**	**$30,906**	**$49,754**	**n.a.**	**$70,464**	**$38,884**	**$71,912**
Percent of State MHI				*53%*	*85%*	*n.a.*	*120%*	*66%*	*122%*
Households receiving Food Stamp/SNAP Benefits	11%	12%	11%	18%	12%	42%	11%	5%	4%
Total Housing Units	**138,432,751**	**1,268,533**	**112,516**	**904**	**1,819**	**600**	**1,459**	**1,593**	**1,582**
Occupied	122,354,219	1,130,011	105,321	699	1,749	511	1,347	1,383	1,530
Vacant	16,078,532	138,522	686	205	70	89	112	210	52
Occupancy	*88%*	*89%*	*94%*	*77%*	*96%*	*85%*	*92%*	*87%*	*97%*
Owner-Occupied	78,801,376	644,864	50,244	30	618	22	953	295	1,023
Percent occupied by Owners	*64%*	*57%*	*48%*	*4%*	*35%*	*4%*	*71%*	*21%*	*67%*
Studio / 1-bdrm Units	18,545,872	172,138	23,267	774	1,101	569	107	532	181
2+ Bedroom Units	119,886,879	1,096,395	89,249	130	718	31	1,352	1,061	1,401
Percent of Units less than 2 Bedrooms	*13%*	*14%*	*21%*	*86%*	*61%*	*95%*	*7%*	*33%*	*11%*
Built since 1970	85,996,081	1,131,168	88,029	590	829	405	645	639	1,345
Older than 50 Years	52,436,670	137,365	24,487	314	990	195	814	954	237
Percent of Units older than 50 Years	*38%*	*11%*	*22%*	*35%*	*54%*	*33%*	*56%*	*60%*	*15%*
Persons per Household	**2.67**	**2.68**	**2.38**	**1.38**	**1.67**	**2.30**	**2.57**	**2.49**	**2.74**
Civilian Labor Force	**164,759,496**	**1,525,262**	**138,697**	**620**	**1,969**	**518**	**1,726**	**2,451**	**2,655**
Employed	155,888,980	1,425,040	131,317	528	1,867	367	1,662	2,265	2,419
Unemployment Rate	*5%*	*7%*	*5%*	*15%*	*5%*	*29%*	*4%*	*8%*	*9%*
Average Travel Time to Work (minutes)	27	25	21	21	23	21	20	20	26
Households with Vehicles									
No Vehicle	10,344,521	82,002	9,243	188	318	228	71	131	34
At least 1 Vehicle	112,009,698	1,048,009	96,078	511	1,431	283	1,276	1,252	1,496
Percentage Households without a Vehicle	8%	7%	9%	27%	18%	45%	5%	9%	2%

Source: 2020 American Community Survey 5-year estimates, US Census Bureau.

*Table reproduced from BCA (Hansford Economic Consulting LLC, 2022)

Table 12: Area Employment and Income Statistics (EA Section 5.2.7.1)

	Tract 1.01	Tract 1.02	Tract 13	Tract 14	Tract 24.01
Percent unemployed	5.5%	11%	2.7%	6.5%	7.1%
Median Household Income	$41,689	$20,753	$57,442	$42,467	$77,336

Table 13: Downstream Properties affected for Different Storm Events (EA Section 5.2.7.3)

<table>
<tr><td rowspan="2">The value 100 is not a frequency unless the auxiliary spillway flows all the time. Likely 1-percent was intended but that seems severely overestimated and perhaps 0.1-percent (1000-yr recurrence) was intended.</td><td colspan="4">The value 100 is not a frequency unless the auxiliary spillway flows all the time. Likely 1-percent was intended but that seems severely overestimated and perhaps 0.1-percent (1000-yr recurrence) was intended.</td></tr>
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<tr><td>The value 100 is not a frequency unless the auxiliary spillway flows all the time. Likely 1-percent was intended but that seems severely overestimated and perhaps 0.1-percent (1000-yr recurrence) was intended.</td><td>The value 100 is not a frequency unless the auxiliary spillway flows all the time. Likely 1-percent was intended but that seems severely overestimated and perhaps 0.1-percent (1000-yr recurrence) was intended.</td><td>The value 100 is not a frequency unless the auxiliary spillway flows all the time. Likely 1-percent was intended but that seems severely overestimated and perhaps 0.1-percent (1000-yr recurrence) was intended.</td><td>AS activation only – 374 properties affected with 215 properties greater than 1 foot inundation</td><td>Breach with AS activation - 1,346 properties affected with 664 properties greater than 1 foot inundation</td></tr>
</table>

Table 14: Qualitative Summary of Environmental Resources Impacts per Alternative (EA Section 6.5)

Resource	Alternative 1	Alternative 3	Alternative 5*
Alternative Identification			
Locally Preferred		X	
Non-structural			X
Environmentally Preferred	X		
Maximum Net Monetized Benefits Plan		X	
Socially Preferred		X	
Preferred Alternative (Maximum Net public benefits identified through tradeoff analysis)		X	
Guiding Principles			
Healthy and Resilient Ecosystems (A primary objective of the analysis is identifying alternatives that will protect and restore the functions of ecosystems.)	Existing conditions would persist. Ecosystems within and surrounding the project area would continue to be at risk of a major flood event should the existing dam(s) fail.	Ecosystems within and adjacent to the project vicinity would be protected from major flood events and/or structural failure.	The project area would be returned to pre-construction conditions including replanting. However, ecosystems would not be immediately restored and the safety and resilience of such ecosystems would not be ensured as flooding over a 100-year event would not be protected against.
Sustainable Economic Development (Alternatives for resolving water resources problems should improve the economic well-being of the Nation for current and future generations.)	Existing conditions would persist. Continued O&M activities would persist. This alternative poses a significant risk to the community in terms of PAR and damages to infrastructure expressed in dollars.	Existing public infrastructure and private residences in the project area would be protected through construction of the project, protect and resolve existing water resources issues, and remain within the approved authorized funding limits provided by NRCS.	Removal of both dams exceeds the authorized funding limits provided by NRCS and may require significant modifications to existing infrastructure which would require additional public funding. In addition, private property along the channel alignment would have to be acquired and demolished which would adversely affect residents and residential values.
Floodplains (Alternatives should avoid investments that adversely affect self-sustaining floodplain function.)	Existing conditions would persist. No adverse effects to floodways would occur outside of normal O&M activities.	The project would ensure that during a flood event no flood zones would be impacted and critical dam infrastructure would remain stable.	The floodplain/floodway would be returned to pre-construction conditions which would result in self-sustaining floodplain up to the 100-year storm event.
Public Safety (Alternatives should reduce risks to people, including life, injury, property, essential public services, and environmental threats to air and water quality.)	Existing conditions, including high risk dam status, would persist. Downtown Reno and communities with or adjacent to the floodway would continue to be at high public safety risk in major flood event should the existing dam(s) fail.	The alternative provides additional flood protection for more severe storm events than other alternatives, provides storm flow capacity for potential additional development upstream and minimizes encroachment into the dam area by neighboring uses.	The floodplain/floodway would be returned to pre-construction conditions, with the removal of both dams construction of concrete channels to provide stormwater runoff protection to an up-to 100-year flood event and ensure public safety. Removal of both dams may result in some temporary air quality and noise impacts; however, these would dissipate following project construction.

Resource	Alternative 1	Alternative 3	Alternative 5*
Environmental Justice (An objective of the watershed project plan evaluation process is the fair treatment of all people, including meaningful involvement in the public comment process.)	Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice in Minority and Low-Income Populations*, which directed federal programs, policies, and activities to avoid disproportionately high and adverse human health and environmental effects on minority and low-income populations, has been rescinded. Therefore, a formal environmental justice analysis, is no longer required, and has not been completed as part of this EA.		
Watershed Approach (A watershed approach recognizes that a water resources activity may have upstream and downstream impacts that are outside the applicable political or administrative boundaries.)	Existing conditions, including high risk dam status, would persist. During a major flood event downstream impacts to the watershed would be major and adverse. This alternative does not support a watershed approach.	A watershed approach would be established by protecting the existing infrastructure within the watershed and taking a variety of upstream and downstream impacts into consideration.	A watershed approach would be established by the project through the reconstruction of the natural floodplain/floodway and removal of infrastructure downstream and within the existing channel alignment to minimize impacts during flood events.
Environmental Resources			
Geologic Resources and Erosion and Sedimentation	No direct or indirect impacts	The likelihood of the reservoir containing water during a seismic event is very low; thus, slope failure is not deemed life-threatening. Seismic deformation of the crest will be on the order of 4 to 12 inches during the maximum design earthquake. Approximately 200,000 yd^3 of cut, which would mostly be used as fill, with an additional approximate 10,000 yd^3 of fill. Soil disturbance of 11 acres. Indirect erosion and runoff impacts downstream during construction would occur.	. The likelihood of the reservoir containing water during a seismic event is very low; thus, slope failure is not deemed life-threatening. Approximately 130,485 yd^3 of cut. Soil Disturbance of 80.87 acres. Indirect erosion and runoff impacts downstream during construction would occur.
Land Use	No direct or indirect impacts	No direct or indirect impacts to Land Use.	Direct impacts to Land Use downstream of the Dams. Acquisition of property and relocation of residents, and 100-year flood channel improvements would be designed and constructed.
Surface and Groundwater Quality and Quantity	Indirect impacts to water quality from flood waters and storm drains downstream of the dams during certain flooding events	No direct or indirect impacts to surface and groundwater quality and quantity.	Indirect impacts to water quality, flow, turbidity, and wildlife in the Truckee River during storm events.

Resource	Alternative 1	Alternative 3	Alternative 5*
Regional Water Management Plan	Moderate direct impacts would occur to compliance with the RWMP.	Meets the goals of the RWMP and therefore no impacts would occur.	Meets the goals of the RWMP and therefore no impacts would occur.
Clean Water Act / Waters of the U.S., including Wetlands	No direct or indirect impacts	No direct or indirect impacts	No direct or indirect impacts within the project Area. Impact analyses would require additional wetland studies on the downstream areas.

Resource	Alternative 1	Alternative 3	Alternative 5*
Floodplain Management	Direct major impacts to floodplain management would occur. Indirect major impacts include damage to property and risk of lives related to flooding events.	Downstream impacts from flooding would occur, however, modeling shows no impacts to identified flood zones.	Flood zones would be impacted by storm flows. Changes to FEMA mapping required due to storm flows draining directly to the Truckee River.
Clean Air Act / National Ambient Air Quality Standards	No direct or indirect impacts	Temporary direct impacts to PM_{10} and CO levels due to construction emissions. Active construction would last approximately 615 days.	Temporary direct impacts to PM_{10} and CO levels due to construction emissions. Active construction would last approximately 829 days.
Special Status Plant Species	No direct or indirect impacts	No direct or indirect impacts	No direct or indirect impacts within the project area.
Natural Areas	No direct or indirect impacts. Routine maintenance of brush removal would continue.	Direct impacts to existing vegetation within the project area.	Direct impacts to existing vegetation within the project area.
Riparian Areas	No direct or indirect impacts	Direct impacts to riparian corridor are not anticipated but may occur.	Direct impacts to riparian corridor would occur.
Wildlife and Wildlife Habitat	Indirect impacts during certain flooding events would affect turbidity and temperatures of the Truckee River.	Direct and Indirect impacts to wildlife habitat would occur during construction.	Direct and Indirect impacts to wildlife habitat would occur during construction. Flows into the Truckee River could cause indirect impacts to fish and aquatic life.
Special Status Animal Species	Indirect impacts during certain flooding events would affect turbidity and temperatures of the Truckee River.	Possible direct impacts to monarch butterfly breeding areas.	Flows into the Truckee River could cause indirect impacts to the LCT. Possible direct impacts to monarch butterfly breeding areas.
Migratory Birds, Bald Eagles, and Golden Eagles	No direct or indirect impacts	No direct or indirect impacts	Possible direct impacts to migratory bird habitat.

Resource	Alternative 1	Alternative 3	Alternative 5*
Socioeconomics	Moderate indirect impacts to socioeconomics would occur during a major flooding event, causing temporary impacts to approximately 2,500 jobs in the downstream area.	No direct or indirect impacts	Indirect impacts to job security. Estimated loss of approximately 170 jobs.
Cultural and Historic Resources	Direct adverse impacts to cultural and historic resources would occur during a major flooding event, as deterioration of the East Wash dam could occur.	Alteration to the East Wash and West Wash Dams which are historic resources. Inadvertent loss of unidentified cultural resources could occur. MOA executed between NRCS and SHPO.	Removal of the East Wash and West Wash dams which are historic resources. Demolition of 325 homes over 50 years in age. Inadvertent loss of unidentified cultural resources could occur.
Public Health and Safety	Moderate direct impacts from risk of dam failure and/or flooding causing damage to property and risk of lives.	Risk of flooding remains for extreme flooding events; however, the dams would not breach. Risks to life and safety would be lessened.	Possible indirect flood impacts by contributing storm flows to Truckee River. Possible indirect impacts to existing flood walls along Truckee River.
Visual Resources and Scenic Beauty	No direct or indirect impacts	Minor direct impacts to visual resources within the project area	Direct impacts to visual resources to restore the area to natural contours and to create downstream channel corridors.
Parklands	No direct or indirect impacts	No direct or indirect impacts to parklands. Temporary loss of informal recreation area during construction, approximately 615 days.	No direct or indirect impacts to parklands. Temporary loss of informal recreation area during construction, approximately 829 days.

Resource	Alternative 1	Alternative 3	Alternative 5*
Noise	No direct or indirect impacts	Direct impacts to noise during construction, approximately 615 days.	Direct impacts to noise during construction, approximately 829 days.

*An Environmental Impact Statement may be required under this alternative

Table 15: Cost Comparison Summary (EA Section 6.5)

	Construction Cost	Design and Construction Engineering Cost	Other Costs (Contingency, escalation, acquisition, etc.)	Total Cost
Alternative 1	N/A	N/A	$20,000/year	$20,000 annually
Alternative 3	$12,000,000	$2,400,000	$4,800,000	$19,200,000
Alternative 5	$37,389,400	$7,477,880	$127,343,612	$172,210,890

Table 16: Summary of Equivalent Annual Net Benefit and BCR by Alternative (EA Section 6.5)

Alternative	Equivalent Annual Net Benefit* *(in $1,000s)*	Annual Costs *(in $1,000s)*	Benefit-Cost Ratio	Benefit-Cost Ratio
Alt. 1 No Action [1], [2]	N/A	N/A	1:1	1
Alt. 3 Rehabilitate Both the East Wash and West Wash Dams to contain PMP	$74	$660	0.11:1	0.1
Alt. 5 Remove Both the East Wash and West Wash Dams – Flood Conveyance to Truckee River	$0	$5,760	0.00:1	0

Rounded up to the nearest ten thousand dollars. Courtesy of the Economic Appendix* **(Hansford Economic Consulting LLC, 2022)

[1] Under this alternative, the West Wash Dam AS breaches during the PMP

[2] Pursuant to the NWPM Section 502.2, existing dams not meeting current safety and performance standards cannot be identified as the NED alternative but would continue to be included to allow a valid comparison of the alternatives.

Table 17: Alternative Non-Monetary Comparison (EA Section 6.5.1)

Alt.	Criteria						Final Score
	O&M	Engineering	Public/Regional Impacts	Environmental	ROW Requirements	Level of Flood Protection	
Alt. 1: No action	5.6	9.5	18.8	22.4	12.5	9.5	**78.3**
Alt. 3: Rehabilitate Dam	6.3	10.3	15.0	19.5	7.5	21.5	**80**
Alt. 5: Remove Dams/DS Floodproofing	2.5	7.3	7.5	9.9	5.0	19.5	**51.6**

Table 18: Alternative 3 Emissions Summary (EA Section 7.2.1.3)

	PM_{10} (tons/yr.)	CO (tons/yr.)
Off-road heavy equipment	29	15
On-road haul trucks and worker commutes	0.047	69
Temporary Stockpiling	0.218	0
Ground Disturbance	50.4	0
Total:	**79.665**	**84**
***De minimis* threshold exceeded?**	**No**	**No**

Table 19: Alternative 3 Air Quality Impacts (EA Section 7.2.1.3)

Active Construction Days	615
Emissions*	0.5 MT CO_2 per year; 1.5 MT CO_2 total project construction
Total Ground Disturbance	421,683 yd^3 (261.37 acre-feet)

* (U.S. EPA, 2022)

Table 20: Potential Effect on Sensitive Species Within The Project Area (EA Section 7.2.1.5)

Common Name	Scientific Name	Effect of The Project on species
Reptiles		
Great Basin collared lizard	*Crotaphytus bicintores*	Possible Indirect effects
Long-nosed leopard lizard	*Gambelia wislizenii*	Possible Indirect effects
Northern rubber boa	*Charina bottae*	Possible Indirect effects
Western pond turtle	*Actimenys marmorata*	Possible Indirect effects
Western toad (including ssp. *Halophilus*)	*Anaxyrus boreas*	Possible Indirect effects

Common Name	Scientific Name	Effect of The Project on species
Birds		
American goldfinch	*Spinus tristus*	Possible Indirect effects
American robin	*Turdus migratorius*	Possible Indirect effects
Anna's hummingbird	*Calypte anna*	Possible Indirect effects
Black-chinned hummingbird	*Archilochus alexandri*	Possible Indirect effects
Black-headed grosbeak	*Pheucticus melanocephalus*	Possible Indirect effects
Brewer's blackbird	*Euphagus cyanocephalus*	Possible Indirect effects
Brown-headed cowbird	*Molothrus ater*	Possible Indirect effects
Brown-creeper	*Certhia americana*	Possible Indirect effects
Cassin's finch	*Haemorhous cassinii*	Possible Indirect effects
Cedar waxwing	*Bombycilla cedrorum*	Possible Indirect effects
Common raven	*Corvus corax*	Possible Indirect effects
Dark-eyed junco (including ssp. *Oreganus*)	*Junco jyemalis*	Possible Indirect effects
Eastern kingbird	*Tyrannus tyrannus*	Possible Indirect effects
Evening grosbeak	*Coccothraustes vespertinus*	Possible Indirect effects
Glaucous-winged gull	*Larus glaucescens*	Possible Indirect effects
Glaucus gull	*Larus hyperboreus*	Possible Indirect effects
Green heron	*Butorides virescens*	Possible Indirect effects
Hermit thrush	*Catharus guttatus*	Possible Indirect effects
House finch	*Haemorhous mexicanus*	Possible Indirect effects
House wren	*Troglodytes aedon*	Possible Indirect effects
Lesser goldfinch	*Spinus psaltria*	Possible Indirect effects
Mew gull	*Larus canus*	Possible Indirect effects
Mountain chickadee	*Poecile gambeli*	Possible Indirect effects
Northern Flicker	*Colaptes auratus*	Possible Indirect effects
Northern Mockingbird	*Mimus polyglottos*	Possible Indirect effects
Pine siskin	*Spinus pinus*	Possible Indirect effects
Red-breasted sapsucker	*Sphyrapicus ruber*	Possible Indirect effects
Rufous hummingbird	*Selasphorus rufus*	Possible Indirect effects
Spotted towhee	*Pipilo maculatus*	Possible Indirect effects
Thayer's (Iceland) gull	*Larus glaucoides*	Possible Indirect effects
Townsend's solitaire	*Myadestes townsendii*	Possible Indirect effects
Vermillion flycatcher	*Pyrocephalus rubinus*	Possible Indirect effects
Western kingbird	*Tyrannus verticalis*	Possible Indirect effects
Western tanager	*Piranga ludoviciana*	Possible Indirect effects
White-crowned sparrow	*Zonotrichia leucophys*	Possible Indirect effects
White-headed woodpecker	*Dryobates albolarvatus*	Possible Indirect effects
Wouldiamson's sapsucker	*Sphyrapicus Thyroideus*	Possible Indirect effects
Wilson's warbler	*Cardellina pusilla*	Possible Indirect effects
Yellow-rumped warbler	*Setophaga coronate*	Possible Indirect effects
Amphibians		
SNYLF	*Rana sierrae*	No direct or indirect effects
Fish		
Cui-ui	*Chasmistes cujus*	No direct or indirect effects

Common Name	Scientific Name	Effect of The Project on species
LCT	*Oncorhynchus clarkii henshawi*	No direct or indirect effects
Mountain whitefish	*Prosopium wouldiamsoni*	No direct or indirect effects
Insects		
Carson Wandering Skipper	*Pseudocopaeodes eunus obscurus*	No direct or indirect effects
Monarch Butterfly	*Danaus plexippus*	Not likely to jeopardize the continued existence of
Mammals		
Brazilian free-tailed bat	*Tadarida brasiliensis*	No direct or indirect effects
North American River Otter	*Lontra canadensis*	No direct or indirect effects
Spotted bat	*Euderma maculatum*	No direct or indirect effects

Table 21: Alternative 3 Environmental Mitigation Summary (EA Section 7.2.5)

Resource	Mitigation
Geologic Resources and Erosion and Sedimentation	Construction BMPs* for soil erosion and sediment control during land disturbing activities. Permanent stabilization of exposed soil areas would be required at the completion of construction. A County dust control permit would be required. Mitigation not determined. Additional study necessary to determine impacts and potential mitigation within proposed excavation area.
Surface and Groundwater Quality and Quantity	National Pollutant Discharge Elimination System (NPDES) permitting and a Stormwater Pollution Prevention Plan (SWPPP) would be required.
Clean Water Act / Waters of the U.S., including Wetlands	No mitigation is anticipated
Floodplain Management	No mitigation is anticipated
Clean Air Act / National Ambient Air Quality Standards	An Air Quality Permit and accompanying BMPs* would be required.
Climate and Greenhouse Gases	Construction equipment and emission BMPs* and City Standards would be followed.
Special Status Plant Species	No mitigation is anticipated.
Noxious Weeds and Invasive Species	BMPs* to prevent the spread of Noxious Weeds would be followed.
Natural Areas	Mitigation includes the usage of avoidance fencing, and relocation and replanting of vegetation types. Plants that would be disturbed should be salvaged and replanted in appropriate habitat when practical.
Riparian Areas	Mitigation includes the usage of avoidance fencing, and relocation and replanting of vegetation types. Excavation plans show the areas to be partially avoided because the regrading activities are focused on the west side of the West Wash impoundment area.
Wildlife & Wildlife Habitat	BMPs* to protect habitat and wildlife during construction would be followed.
Special Status Animal Species	○ Monarch Butterfly ▪ To the extent feasible, conduct management activities in monarch migratory and breeding habitat from October 1 to May 31. ▪ If native milkweed species occur in the project area, and the project activity is occurring during the breeding season, ensure impacts on milkweed host plants and monarch larvae/pupae are minimized (e.g., buffering and avoiding host plants, establishing alternative access routes). ▪ Project personnel should avoid trampling butterfly host plants ▪ Where practicable milkweed plants that would be disturbed should be salvaged and replanted in adjacent habitat ○ Northwestern Pond Turtle ▪ Determine whether pond turtles are occupying the site prior to project implementation using Visual Encounter Survey protocol (2012 Western Pond Turtle Sampling Techniques, Inventory, and Monitoring)

	▪ If presence is determined contact NRCS Biologist to establish avoidance measures ▪ Locate temporary work areas, staging areas, and access routes at least 50 m from aquatic habitat.
Migratory Birds, Bald Eagles, and Golden Eagles	o Project activities should avoid removing, trimming, or disturbing vegetation during the primary avian nesting season April 1 to August 31 o If vegetation removal or disturbance during the nesting season cannot be avoided, protocol-level nesting-bird surveys should be conducted by a qualified biologist within a 3 day period prior to initiating activities followed by a 14 day period to complete disturbance o If a nest is found, a species-appropriate no-disturbance buffer would be placed around the nest until the young have fledged, or until the nest fails
Socioeconomics	No mitigation is anticipated.

Resource	Mitigation
Environmental Justice and Civil Rights	Updated EAPs, with updated inundation maps, would be required.
Cultural and Historic Resources	Mitigation methods include public interpretation, such as the production of a brochure or other publications, web-based and published articles, public presentations, museum exhibits, or historic markers.
Public Health and Safety	Downstream flooding is still a possibility, Dam EAPs would be revised for new flooding events and warning times.
Visual Resources and Scenic Beauty	No mitigation anticipated.
Noise	Construction noise BMPs* would be followed.

Table 22: Alternative 5 Air Quality Impacts (EA Section 7.3.1.4)

Active Construction Days	829
Emissions*	0.5 MT CO_2 per year: 1.75 MT CO_2 for total project construction
Total Ground Disturbance	130,485 yd3 (80.87 Acre-feet)

* (U.S. EPA, 2022)

Table 23: Alternative 5 Peak Flows and Total Volumes Channeled to Truckee River (EA Section 7.3.2)

Channel	Peak Flow Rate to Truckee River (cubic feet per second)	Total Runoff Volume to Truckee River (cubic feet (ft^3))
East Wash	1,904	12,769,747
West Wash	1,482	7,705,428
Combined	3,386	20,475,175

Table 24: Alternative 5 Environmental Mitigation Summary (EA Section 7.3.5)

Resource	Mitigation
Geologic Resources and Erosion and Sedimentation	Construction BMPs* for soil erosion and sediment control during land disturbing activities. Permanent stabilization of exposed soil areas would be required at the completion of construction. A County dust control permit would be required. Mitigation is unknown see above language
Land Use	Relocation and compensation to residents of 160 homes would be required. Comply with the Uniform Relocation Assistance and Real Property Acquisition Policies Act, 42 USC 4601 et. seq., 49 CFR Part 24, if acquisition of land is necessary.

Resource	Mitigation
Surface and Groundwater Quality and Quantity	NPDES permitting and SWPPP would be required.
Clean Water Act / Waters of the U.S., including Wetlands	Additional wetland studies on the downstream areas would be needed for the new stormwater conveyance structures to the Truckee River. This alternative would likely require USACE/Carson Truckee Water Conservation District permitting and or/impact assessments. NDEP permitting would be needed. Coordination with Truckee Meadows Stormwater Permit Coordinating Committee (SWPCC) would be required (the Truckee Meadows SWPCC is responsible for implementing the Truckee Meadows Stormwater Quality Management Program to protect the water quality of the region's waterways, streams and the overall Truckee River Watershed).
Floodplain Management	Additional analysis of downstream area needed. Updated FEMA flood maps and flood insurance would be required.
Clean Air Act / National Ambient Air Quality Standards	An Air Quality Permit and accompanying BMPs* would be required.
Special Status Plant Species	No mitigation is anticipated.
Noxious Weeds and Invasive Species	BMPs* to prevent the spread of Noxious Weeds would be followed.
Natural Areas	Avoidance fencing or removal and replacement of vegetation would likely be required. Further analysis needed for downstream impacts within channel ROW.
Riparian Areas	No mitigation is anticipated. Impact analyses would require additional wetland studies on the downstream areas.
Wildlife & Wildlife Habitat	BMPs* to protect habitat and wildlife during construction would be followed.
Special Status Animal Species	○ Monarch Butterfly ▪ To the extent feasible, conduct management activities in monarch migratory and breeding habitat from October 1 to May 31. ▪ If native milkweed species occur in the project area, and the project activity is occurring during the breeding season, ensure impacts on milkweed host plants and monarch larvae/pupae are minimized (e.g., buffering and avoiding host plants, establishing alternative access routes). ▪ Project personnel should avoid trampling butterfly host plants ▪ Where practicable milkweed plants that would be disturbed should be salvaged and replanted in adjacent habitat ○ Northwestern Pond Turtle ▪ Determine whether pond turtles are occupying the site prior to project implementation using Visual Encounter Survey protocol (2012 Western Pond Turtle Sampling Techniques,

	Inventory, and Monitoring) ▪ If presence is determined contact NRCS Biologist to establish avoidance measures ▪ Locate temporary work areas, staging areas, and access routes at least 50 m from aquatic habitat.
Migratory Birds, Bald Eagles, and Golden Eagles	o Project activities should avoid removing, trimming, or disturbing vegetation during the primary avian nesting season April 1 to August 31 o If vegetation removal or disturbance during the nesting season cannot be avoided, protocol-level nesting-bird surveys should be conducted by a qualified biologist within a 3 day period prior to initiating activities followed by a 14 day period to complete disturbance o If a nest is found, a species-appropriate no-disturbance buffer would be placed around the nest until the young have fledged, or until the nest fails
Socioeconomics	Comply with the Uniform Relocation Assistance and Real Property Acquisition Policies Act, 42 USC 4601 et. seq., 49 CFR Part 24, if acquisition of land is necessary.

Resource	Mitigation
Cultural and Historic Resources	A Memorandum Of Agreement (MOA) developed to resolve the adverse effect to these historic properties through mitigation. Appropriate mitigation methods should involve public interpretation, such as the production of a brochure or other publications, web-based and published articles, public presentations, museum exhibits, or historic markers.
Public Health and Safety	Updated FEMA flood maps and flood insurance would be required. Channels would be constructed to convey flow, up to a 100-year storm event. Fencing should be installed to protect channel from unauthorized access.
Visual Resources and Scenic Beauty	Restoration of the project area to the original preconstruction contours and revegetation with native plant species. Channel improvements and landscape restoration of previous residences that were demolished.
Noise	Construction noise BMPs* would be followed.

Table 25: Cooperating and Participating Agency Contact List (EA Section 8.2)

Agency	Status	Contact Name	Email	Phone number
NDEP Bureau of Water Pollution Control	Participating	Donette Barreto	dbarreto@ndep.nv.gov	(775) 687-9414
NDWR	Participating	Keith Conrad Austin Martin	kconrad@water.nv.gov ajmartin@water.nv.gov	
EPA Region 9	Cooperating	Hugo Hoffman	Hoffman.hugo@epa.gov	(415) 972-3929

Table 26: Summary of Potential Mitigation Measures (EA Section 9.3.1)

Resource	Mitigation
Soils & Geology	Construction BMPs* for soil erosion and sediment control during land disturbing activities. Permanent stabilization of exposed soil areas would be required at the completion of construction. A County dust control permit would be required. Additional study necessary to determine impacts and potential mitigation within proposed excavation area.
Water Resources	NPDES permitting and SWPPP would be required.
Air Quality	An Air Quality Permit and accompanying BMPs* would be required. Construction equipment and emission BMPs* and City Standards would be followed.
Vegetation	Mitigation includes the usage of avoidance fencing, and relocation and replanting of vegetation types for disturbed areas. BMPs* to prevent the spread of Noxious Weeds would be followed.
Wildlife	Where possible, milkweed stands should not be removed during the summer breeding period (May through August) to prevent impacts to breeding monarch butterflies. Plants that would be disturbed should be salvaged and replanted in appropriate habitat when practical. BMPs*, such as avoidance fencing, to protect habitat and wildlife during construction would be followed. Mitigation practices to adhere to the MBTA would be necessary. If ground disturbance is anticipated during migratory bird breeding season (April 1 through July 31), a migratory bird nesting clearance survey would be conducted within a 3-day period prior to the disturbance followed by a 14-day period to complete the disturbance. If a nest is found, a species-appropriate no-disturbance buffer would be placed around the nest until the young have fledged, or until the nest fails. Mitigation for riparian areas includes avoidance plans and fencing. Current plans show the riparian areas to be partially avoided because the excavation activities are focused on the west side of the West Wash impoundment area.
Special Status Animal Species	○ Monarch Butterfly ▪ To the extent feasible, conduct management activities in monarch migratory and breeding habitat from October 1 to May 31. ▪ If native milkweed species occur in the project area, and the project activity is occurring during the breeding season, ensure impacts on milkweed host plants and monarch larvae/pupae are minimized (e.g., buffering and avoiding host plants, establishing alternative access routes). ▪ Project personnel should avoid trampling butterfly host plants ▪ Where practicable milkweed plants that would be disturbed should be salvaged and replanted in adjacent habitat ○ Northwestern Pond Turtle ▪ Determine whether pond turtles are occupying the site prior to project implementation using Visual Encounter Survey protocol (2012 Western Pond Turtle Sampling Techniques, Inventory, and Monitoring) ▪ If presence is determined contact NRCS Biologist to establish avoidance measures ▪ Locate temporary work areas, staging areas, and access routes at least 50 m from aquatic habitat.

Migratory Birds, Bald Eagles, and Golden Eagles	○ Project activities should avoid removing, trimming, or disturbing vegetation during the primary avian nesting season April 1 to August 31 ○ If vegetation removal or disturbance during the nesting season cannot be avoided, protocol-level nesting-bird surveys should be conducted by a qualified biologist within a 3 day period prior to initiating activities followed by a 14 day period to complete disturbance ○ If a nest is found, a species-appropriate no-disturbance buffer would be placed around the nest until the young have fledged, or until the nest fails
Human	MOA developed to resolve the adverse effect to these historic properties through mitigation. Appropriate mitigation methods (according to the MOA) should include providing SHPO with digital copies of archival information pertaining to the 1958 Peavine Mountain Watershed project, placing a Nevada State Historical Marker near the West Wash Dam, and providing SHPO with a brief written narrative of all NRCS cultural resource consultation results for the project. Updated EAPs and evacuation warning times would be required. Construction noise mitigation actions such as limited hours (7am-7pm) would be followed.

Table 27: Project Permits (EA Section 9.4)

Entity	Permit	Duration to obtain	Cost
Local			
The County, District Board of Health Regulations Governing AQMD	Dust Control Permit	4-6 weeks	$1,500
State			
NDEP Bureau of Water Pollution Control	Construction Stormwater General Permit (NVR100000) and SWPPP	4-6 weeks	$300
SHPO	Concurrence of effect needed, and any required mitigation. MOA in place.	Not applicable	N/A
Federal			
USACE	NA: PJD and any required mitigation. A regulatory permit was determined to not be necessary.	9-18 months	Not applicable

Table 28: Project costs (EA Section 9.6)

Item No.	Field Item	Item Cost
001	Demolition	$840,000
002	Dam Reconstruction Earthwork	$10,780,000
003	Structure Construction (Filter, Drain, Cut off, Outlets, Erosion Protection)	$5,040,000
004	Site Restoration	$140,000
	Construction Subtotal	**$16,800,000**
	Admin, Engineering, and Construction Management	$2,400,000
	Total	**$19,200,000**

Table 29: Cost Sharing for the East Wash and West Wash Rehabilitation (EA Section 9.6)

Installation Costs – PL 566 Funds	Construction	$10,920,000
	Engineering	$1,560,000
	Real Property	$0
	Relocation Payments	$0
	Project Admin	$0
	Total Federal Cost	$12,480,000
Installation Costs – Other Funds	Construction	$5,880,000
	Engineering	$840,000
	Real Property	$0
	Relocation Payments	$0
	Required Permits	$0
	Project Admin	$0
	Total Non-Federal Costs	$6,720,000
Total	**Total Installation Costs**	**$19,200,000**

Table 30: Estimated Installation Cost (EA Section 9.7)

Works of Improvement	Unit	Number	Est. Cost - Fed Land	Est. Cost - Non-Fed Land	Est. Cost - Total	PL 83-566 - Fed	PL 83-566 - Non-Fed`	PL 83-566 - Total	Other Funds - Fed	Other Funds - Non-Fed	Other Funds - Total	Total
Land Treatment	N/A	0	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Evaluation Unit	N/A	0	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Technical Assistance	N/A	0	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Preservation Easements	N/A	0	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Flood Proofing	N/A	0	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Land Acquisition	N/A	0	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Flood Warning	N/A	0	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Relocation	N/A	0	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Demolition	lump	1	$0.00	$0	$0	$546,000	$0	$546,000	$0.00	$294,000	$294,000	$840,000
Dam Reconstruction Earthwork	lump	1	$0.00	$0	$0	$7,007,000	$0	$7,007,000	$0.00	$3,773,000	$3,773,000	$10,780,000
Structure Construction	lump	1	$0.00	$0	$0	$3,276,000	$0	$3,276,000	$0.00	$1,764,000	$1,764,000	$5,040,000
Site Restoration	lump	1	$0.00	$0	$0	$91,000	$	$91,000	$0.00	$49,000	$49,000	$140,000
Admin, Engineering	lump	1	$0	$0	$0	$1,560,000	$0	$1,560,000	$0	$840,000	$840,000	$2,400,000
Total Project			$0.00	$0	$0	$12,480,000	$0	$12,480,000	$0.00	$6,720,000	$6,720,000	$19,200,000

Table 31: Estimated Cost Distribution – Water Resource Project Measures (EA Section 9.9)

Works of Improvement	PL566 - Construction	PL566 - Engineering	PL566 - Real Prop Rights	PL566 - Relocation Payments	PL566 - Project Admin	PL566 - Total	Other - Construction	Other - Engineering	Other - Real Prop Rights	Other - Water Rights	Other - Relocation Payments	Other - Project Admin	Other - Total	Installation Costs Total
Floodwater Retarding Structure No.1 - Demolition, Earthwork, Structure, Restoration	$10,920,00 0	$1,560,000	$0.00	$0.00	$0	$12,480,000	$5,880,000	$840,000	$0.00	$0.00	$0.00	$0	$6,720, 000	$19,200,0 00
Multiple Purpose Structure	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Recreational Development and Facilities	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Water Supply – Intake Tower	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Channel Work – Main A 10+00– 40+00 (M)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Channel Work – Lateral A 10+00– 40+00 (O)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Relocation of Properties	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Flood- Proofing	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Floodplain Acquisition	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Flood Warning System	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00

Works of Improvement	PL566 - Construction	PL566 - Engineering	PL5 66 - Real Prop Rights	PL566 - Relocation Payments	PL5 66 - Project Admin	PL566 - Total	Other - Construction	Other - Engineering	Other - Real Prop Rights	Other - Water Rights	Other - Relocation Payments	Other - Project Admin	Other - Total	Installation Costs Total
Land Treatment	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$10,920,00 0	$1,560,000	$0.00	$0.00	$0	$12,480,000	$5,880,000	$840,000	$0.00	$0.00	$0.00	$0	$6,720,000	$19,200,0 00

Table 32: Estimated Average Annual NED Costs (EA Section 9.9)

Works of Improvement	Project Outlays – Amortization of Installation Cost	Operation, Maintenance, and Replacement Cost	Total Annual Cost
Floodwater Retarding Structure No. 1 Demolition - Dam Reconstruction Earthwork - Structure Construction - Site Restoration	$644,000	$20,000.00	$664,000
Land Treatment - Evaluation Unit 1 - Evaluation Unit 2 - Reaches 1 to 6	$0.00	$0.00	$0.00
Multipurpose Channel, Dam, etc. - Reaches 7 and 8	$0.00	$0.00	$0.00
Total	**$644,000**	**$20,000.00**	**$664,000**

[1] 1/ Price base: 2025, amortized over 50 years at a discount rate of 2.25 percent. Prepared: July 2025

[2] 2/ Costs for technical assistance to install measures and financially assisted land treatment in this evaluation unit are included. Costs for installing associated on-farm measures are not included because they have been netted out of the analysis.

[3] 3/ Includes $0.00 for operation, maintenance, and replacement for recreation development.

Table 33: Estimated Average Annual Flood Damage Reduction Benefits (EA Section 9.9)

Item	Without project - Agriculture Related	Without project - Nonagric. related	With project - Agriculture Related	With project - Nonagric. related	Damage Reduction Benefit - Agriculture Related	Damage Reduction Benefit - Nonagric. related
Floodwater - Residential	$0.00	$3,100,000	$0.00	$2,849,000	$0.00	$251,000
Floodwater - Commercial	$0.00	$3,318,000	$0.00	$3,495,000	$0.00	-$177,000
Floodwater - Subtotal	$0.00	$6,418,000	$0.00	$6,344,000	$0.00	$74,000
Sediment - Overbank deposition	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Sediment - Reservoirs	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Sediment - Other	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Sediment - Subtotal	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00

Item	Without project - Agriculture Related	Without project - Nonagric. related	With project - Agriculture Related	With project - Nonagric. related	Damage Reduction Benefit - Agriculture Related	Damage Reduction Benefit - Nonagric. related
Erosion - Floodplain scour	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Erosion - Stream bank	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Erosion - Gullies	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Erosion - Subtotal	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$0.00	$6,418,000	$0.00	$6,344,000	$0.00	$74,000

Table 34: Estimated Average Annual Flood Damage Reduction Benefits (EA Section 9.9)

Works of Improvement	FP	Ir.	Dr.	Res	Com	Other	Rec	M&I Water Supply	Unemployed Labor	Other Econ Effects	Average Annual Benefits	Average Annual Costs	Benefit Cost Ratio
Evaluation unit 1													
Evaluation unit 2													
Reaches 1 to 6													
Multipurpose channel, dam, etc.				$251,000	-$177,000						$74,000	$664,000	0.11
Land treatment													
Reaches 7 & 8													
Multipurpose channel													
Total				**$251,000**	**-$177,000**						**$74,000**	**$664,000**	**0.11**

Table 35: Structural Data for the East Wash and West Wash Dams (EA Section 9.10)

Item	Unit	East Wash	West Wash	Total
Class of Structure		High	High	n/a
Seismic Zone		3	3	3
Uncontrolled drainage area	mi^2	2.14	1.13	3.27
Controlled drainage area	mi^2	0	0.19	0.19
Total drainage area	mi^2	2.14	1.32	3.46
Runoff curve No. (1-day) (AMC II)		85.0	88.0	86.1
Time of concentration	hrs.	2.07	1.51	n/a
Elevation top dam	ft	4,862.00	4,793.00	n/a
Elevation crest AS	ft	4,858.00	4,784.90	n/a
Elevation crest high stage inlet	ft	4,840.88	4,757.99	n/a
Elevation crest low stage inlet	ft	4,835.27	4,735.31	n/a
AS type		Armored	Earth	n/a
AS bottom width	ft	685	50	n/a
AS's exit slope	percent	12%	6%	n/a
Maximum height of dam	ft	24.33	67.57	n/a
Volume of fill	yd^3	n/a	n/a	n/a
Total capacity	acre ft	75.06	299.36	374.42
Sediment submerged	acre ft	Unknown	Unknown	Unknown
Sediment aerated	acre ft	Unknown	Unknown	Unknown
Floodwater retarding	acre ft	71.15	278.49	349.64
Between high and low stage	acre ft	3.79	20.87	24.66
Surface area				
Sediment pool	acres	Unknown	Unknown	n/a
Floodwater retarding pool	acres	6.96	18.20	n/a
Principal spillway design				
Rainfall volume (1-day)	in	4.00	3.72	3.86
Rainfall volume (10-day)	in	9.30	8.44	8.87
Runoff volume (10-day)	in	5.12	7.18	5.9
Capacity of low stage (max.)	ft^3/s	122.52	10.12	n/a
Capacity of high stage (max.)	ft^3/s	555.67	87.28	n/a
Dimensions of conduit	in	36	24	n/a
Type of conduit		CMP	CMP	n/a
Frequency operation-AS	percent chance	1.80%	0.67%	n/a
AS hydrograph				
Rainfall volume	in	4.82	4.79	4.81
Runoff volume	in	3.30	3.55	3.40
Storm duration	hrs.	6	6	6
Velocity of flow	ft/s	6.6	3.4	n/a
Max. reservoir water surface elev.	ft	4,859.05	4,785.34	n/a
Freeboard Hydrograph				

Item	Unit	East Wash	West Wash	Total
Rainfall volume	in	13.5	13.5	13.5
Runoff volume	in	11.01	11.98	11.38
Storm duration	hrs.	6	6	6
Max. reservoir water surface elev.	ft	4,860.55	4,792.68	n/a
Capacity equivalents				
Sediment volume	in	Unknown	Unknown	n/a
Floodwater retarding volume	in	0.62	3.95	1.89
Sediment deposition upstream	acre ft		7.23	7.23