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Reno,
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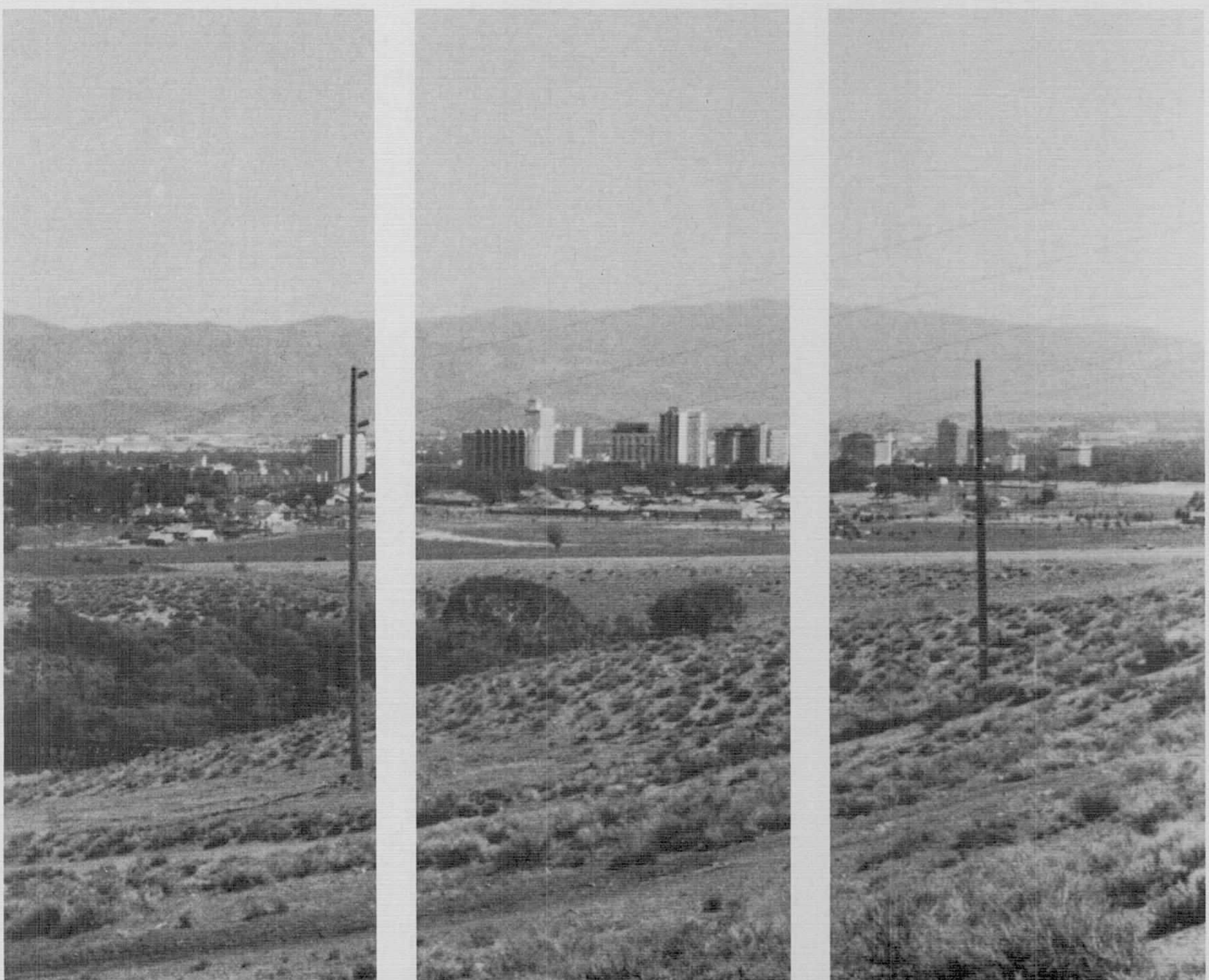
EVANS CREEK WATERSHED

Floodplain Management Study

Washoe County, Nevada



Floodplain Management Study

EVANS CREEK WATERSHED

Washoe County, Nevada

Sponsored by:

Washoe-Storey Conservation District
City of Reno, Nevada

Prepared by:

U.S. Department of Agriculture
Soil Conservation Service
Reno, Nevada
Davis, California

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INTRODUCTION

This report summarizes the results of a floodplain management study for the Evans Creek watershed in Washoe County, Nevada. The study was undertaken at the request of the Washoe-Storey Conservation District (WSCD) and the City of Reno, Nevada.

Study Authority and Purpose: The study was conducted by the Soil Conservation Service (SCS) under the authority of Public Law 83-566, Section 6, Floodplain Management Assistance Program. This program allows SCS to assist state and local governments in appraising water and land resources and formulating management options for their conservation and use.

The purpose of the study was to develop flood data that can be used by community leaders and local officials to reduce flood damage by improved management of the floodplain. Specific objectives include the following:

1. Develop detailed information on floods of various magnitudes, including locations and depths of flooding and the damages that would occur.

2. Identify possible solutions to the flood problem and the costs of the various alternatives.

3. Estimate the damage reduction benefits that would be achieved by each alternative, and identify (approximately) the areas that would still be subject to flooding.

4. Identify the environmental and social concerns and the attitudes of the local residents with respect to alternative flood management plans.

STUDY AREA DESCRIPTION

Location: The Evans Creek Watershed is located in south-western Washoe County in western Nevada extending northerly from the city of Reno (Figure 1). It lies on the eastern slopes of Peavine Mountain and adjacent to the Peavine Mountain Watershed Project which was completed in 1963. U.S. Highway 395, Interstate 80 (I-80), and Southern Pacific and Western Pacific Railroads traverse the watershed. Reno is located 14 miles east of the California state line. Carson City, the Nevada state capitol, lies 30 miles south of Reno on U.S. 395.

The watershed drains southeasterly through an open channel from Raleigh Heights to North Sierra Street a distance of about three and one-half miles. Low flows are intercepted by the city storm drain system. Volumes greater than the storm drain capacity flow through the University of Nevada campus and a portion of north central Reno for one and one-half miles to the Truckee River.

Climate: Average annual precipitation at the Reno Airport, where the Weather Bureau gage is located, is 7.22 inches. Of this amount, an average of 60 percent occurs from November through March in the form of snow, with fairly heavy snowfall occurring at higher elevations during the winter months. Although the majority of rainfall is of low intensity, there is generally at least one convective storm per year which results in moderately heavy runoff. Occasionally there is heavy runoff during the winter when it rains following snowfall.

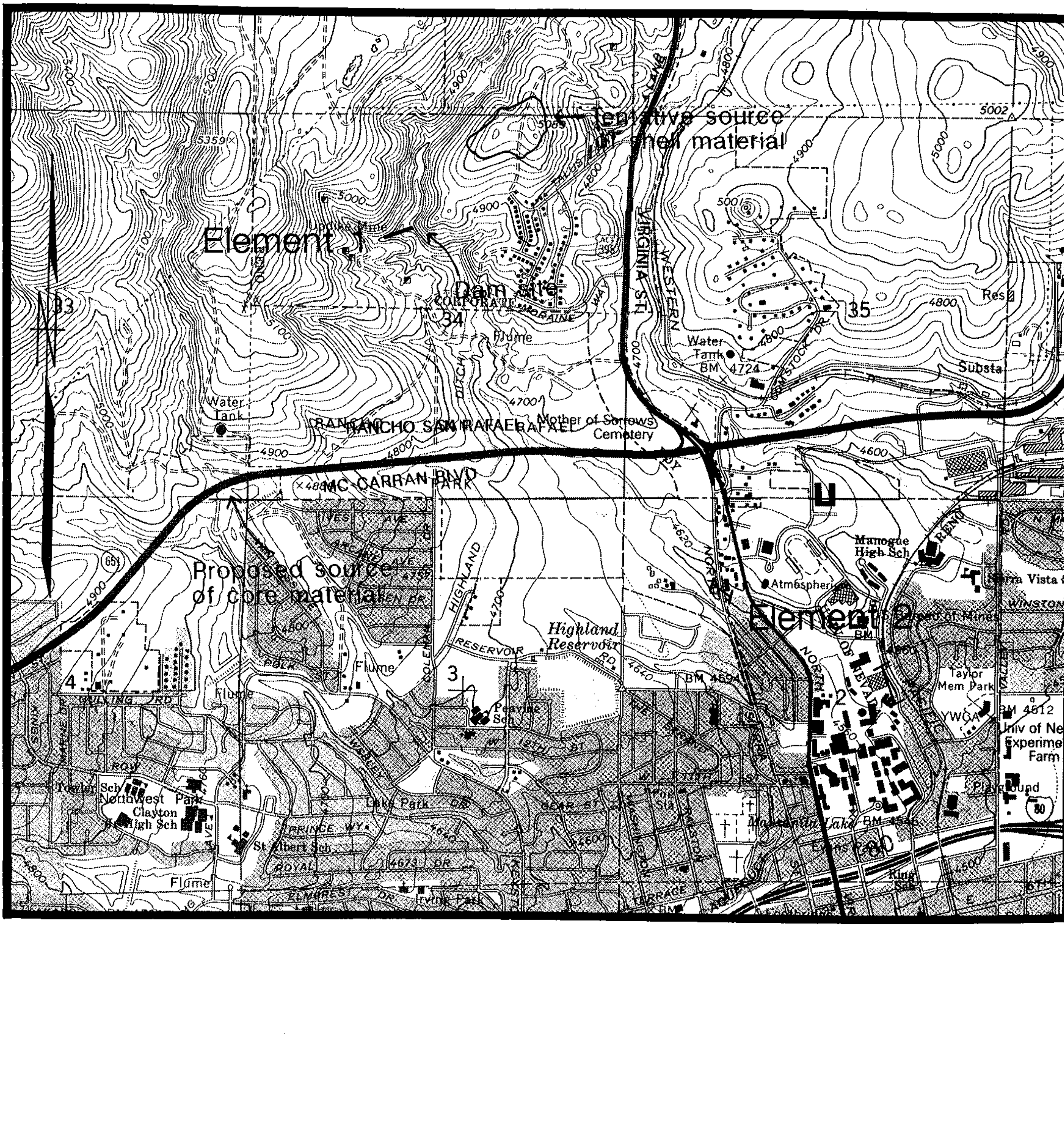
The mean annual temperature for this area is 49.2 degrees Fahrenheit, with July having a monthly average temperature of 69.3 degrees Fahrenheit and January having a monthly average temperature of 31.3 degrees Fahrenheit. Temperature extremes varied from a minimum of -16 degrees Fahrenheit to a maximum of 104 degrees Fahrenheit during the period from 1930 to 1967.

Topography: The topography of the watershed is varied, characterized by comparatively low, gently sloping bench lands, subdued, rounded hill lands and rough mountainous lands having slopes in excess of 30 percent. Elevations range from 4,500 feet mean sea level (msl) in the lower end of the watershed in the City of Reno to 5,450 feet msl in the mountainous northern section. This mountainous northern section of the watershed comprises approximately 80 percent of the total watershed area. All drainages within the watershed are ephemeral with drainage gradients varying from steep to moderate. These drainages terminate at the Truckee River which is a perennial stream that flows eastward 27 miles then northward into Pyramid Lake located about 30 miles northeast of Reno.

EVANS CREEK WATERSHED

PROJECT MAP

Washoe County, Nevada



SCALE

1   1/2   0   1 mile

SOURCE: U.S. GEOLOGICAL SURVEY TOPOGRAPHIC MAP DENVER, COLORADO 1982

USDA SOIL CONSERVATION SERVICE

Land Use and Status: The watershed contains 2,889 acres (4.51 square miles). State University land within the watershed accounts for 19 acres, public domain lands administered by the Bureau of Land Management accounts for 963 acres, and Rancho San Rafael County Park (Parks) occupies 348 acres. The remaining 1,559 acres are privately owned (Table 1).

TABLE 1. Land Ownership in Evans Creek Watershed

Land Status	Land Use	Acres	Percent of Watershed
Board of Regents University of Nevada System	University Campus	19	.7
Public Domain BLM	Wildlife, Rangeland and Recreation	963	33.3
Washoe County Park	Recreation and Grazing	348	12
Private	Urban, Commercial, Industrial and Agricultural	1559	54
TOTAL WATERSHED AREA		2889	100

Population Characteristics: There are 3650 people living within the two census tracts that encompass the residential areas of the floodplain (1980 US Department of Commerce). Table 2 compares population characteristics in these two census tracts. A review of the race/ethnic data shows that a smaller proportion of the people living within the floodplain are white compared to all of Reno. Census data indicates that much of this difference is due to a larger percentage of black people living in this part of the city.

Additionally, census data indicates that people living in the floodplain are not economically as well off as compared to the overall population in the city. Median household income in the floodplain is $9,600 compared to $17,500 for the entire city. Median home values in the floodplain are also significantly lower. A much higher unemployment rate is also found for people living in the floodplain. Table 2 illustrates a comparison between the floodplain and the city.

TABLE 2. Comparison of Census Information Within Evans Creek Floodplain to City of Reno

Item	Evans Creek Floodplain	City of Reno
Population	3636	100,700
Race		
White	83%	92%
Black	7%	3%
American Indian, Eskimo, and Aleut	2%	1%
Asian and Pacific Islander	5%	2%
Other	3	2%
Persons of Spanish Origins	9%	5%
Median Household Income	$9,600	$17,500
Median Home Value	$58,500	$77,000
Unemployment Rate	7.6%	4.7%

Biology: Upstream of McCarran Boulevard most of the watershed is still rangeland. Vegetation is primarily comprised of sagebrush, saltbush, rabbitbrush, upland desert scrub greasewood, and native grasses. Creek side riparian vegetation is dominated by cottonwood and willow with an understory of spike rushes, sedge, and some cottail.

Wetlands are found along the creek, upstream of McCarran Boulevard in the county park. These wetlands are classified as Type 3 by the National Wetlands Inventory of the U.S. Fish and Wildlife Service. The long-range plan for the park includes nature study trails and an interpretive program in the wetland area. Since the land in this part of the watershed is irrigated, it is classified as unique land.

California quail, magpies, chukar, and black-tailed jackrabbits are among the animals that inhabit the watershed. Mourning doves arrive in the autumn. Hawks, owls, and coyotes are occasional predator visitors. Because Evans Creek is an ephemeral stream game fish and waterfowl are found nearby but not within the watershed.

Between North Sierra Street and McCarran Boulevard, the land is owned by Rancho San Rafael County Park and is used for recreation and agriculture (cattle grazing).

The area downstream of North Sierra Street has been completely urbanized. Except for a 600 foot reach along the edge of a parking lot on the university campus, the creek has been obliterated and replaced by city storm drains.

The US Fish and Wildlife Service has been contacted and they have no record of threatened, endangered or candidate species in the watershed (Appendix D).

The Nevada State Division of Historic Preservation and Archaeology has been contacted and their records indicate some archaeological sites are located within the watershed (Appendix D). During future planning these sites should be evaluated for impacts by the project.

Geology: The Evans Creek watershed is situated in a transitional zone between the Basin and Range and the Sierra Nevada physiographic/geologic provinces. As such, its geology reflects the processes and geologic history characteristic of both regions.

The mountainous areas of the upper watershed are underlain largely by Mesozoic- and Tertiary-age igneous rocks showing varying degrees of alteration. Volcanic andesites and breccias of the Tertiary Alta formation are locally prominent. Widespread intrusive and volcanic activity, east-west-trending folding and faulting, mineralization, and brecciation followed emplacement of the Alta Volcanics. As a result of this deformation, the Alta Formation within the Evans Creek watershed is variously soft and clayey, silicified and resistant, mottled and bleached by acidic products of oxidation, and brecciated. The Alta is generally highly fractured and in areas relatively permeable. Altered, clayey exposures typically erode into angular, one inch fragments and are easily ripped, while silicified exposures commonly erode in angular blocks up to two feet wide, accumulating as talus on steep hill slopes. Local exploration for gold, silver, and mercury ore focused on the silicified and bleached andesites of the Alta Formation. Adits, test pits, and tailings piles remain as evidence of past mining activity, although local production appears to have been minor (Bonham, 1969; Schliebs, 1982).

A more recent phase of normal and strike-slip faulting associated with Basin and Range extension helped shape the area's existing topography. Except for faults which displace Quaternary deposits, all that is known of the age of individual faults in the Reno area is that they are post-Miocene (roughly 12 million years or younger).

South of McCarran Boulevard, the watershed is underlain in part by alluvial fan deposits of Peavine Mountain. These poorly consolidated, poorly-sorted deposits consist of gravelly to sandy and clayey (montmorillonitic) silts. Where Evans Creek enters the Truckee River Valley, sandy boulder to large cobble gravels were deposited as a thick wedge by the Truckee River during the last glacial age.

Soils: Based on the distribution of soil types, the upper watershed can be roughly divided into three subregions.

The northeast third of the upper watershed is characterized by deep sandy loams underlying Panther Valley, bordered to the east and southwest by moderately deep cobbly (or stony) sandy loams, and to the north by shallow stony loams and other clayey soils. Many of the soils in this subregion are montmorillonitic and exhibit shrink-swell phenomena. Runoff is described as medium to rapid, except in the alluvium-filled valley where runoff from these sandy soils is generally low.

The northwest third of the upper watershed consists mostly of shallow gravelly (or stony) loams and shallow to moderately deep, very gravelly sandy loams. Some of the soils in this subregion are montmorillonitic and exhibit shrink-swell. Runoff is described as medium to high.

Hill slopes in the southern third of the upper watershed are characterized by moderately deep cobbly clays, cobbly clay loams and very stony loams. Areas in and around drainages and near the Reno Mizpah and Updike Mines are typically underlain by shallow very stony loams and very gravelly (or stony) sandy loams. Most of the soils in this subregion are montmorillonitic and exhibit shrink-swell. Runoff is described as medium to high.

Erosion and Sedimentation: Sheet and rill erosion contributes most of the sediment that passes through, and is deposited in, the lower reaches of the watershed. Hill slopes of the upper watershed produce sediment at an estimated average annual rate of 0.7 acre-feet per square mile. Locally, sheet and rill erosion is enhanced by steep topography, sparse vegetation, the low permeability, and medium to high runoff characteristic of many of the soils. The high runoff character of the occasional summertime convectional storm events also contributes to the erosion. Fortunately, gully development and therefore the total sediment yield from sheet and rill erosion are mitigated by the numerous exposures of, and the shallow depth to, relatively resistant bedrock. The fractured nature of the bedrock has a tendency to locally increase permeability and reduce runoff.

Channel erosion in the upper watershed is generally of minor importance, although it does occur along some of the steeper reaches. The material underlying the channels is relatively resistant to scour at the velocities of flow encountered. Stream channels transport mostly silt and sand eroded from hill slopes to lower reaches of the watershed.

Hydrology: SCS Technical Release 20 (TR-20) computer program for project formulation-hydrology was used to develop runoff hydrographs for various storm frequencies and project alternatives. Rainfall amounts for 24-hour duration storms were taken from the National Oceanic and Atmospheric Administration (NOAA) Atlas 2, Volume 7 Precipitation-Frequency Atlas of the Western United States for Nevada. The 500-year rainfall amount was obtained by extending the rainfall-frequency plot. Runoff curve numbers were based on the soils, cover and land use existing in the drainage areas. Time of concentration was calculated from channel hydraulics. Peak flow-frequency curves were obtained for five stream gauge stations in Western Nevada. In order to obtain about the same slope for the peak flow-frequency curve generated by TR-20, it was necessary to use the SCS Type I 24-hour storm distribution for the 2, 5, and 10-year frequency events and the SCS Type II 24-hour distribution for the 25, 50, 100 and 500-year events. Peak flows for without project conditions for various return periods for Evans Creek downstream of North Sierra Street are illustrated in Table 3.

TABLE 3. Peak Flows for Without Project for Evans Creek Downstream of North Sierra Street

Return Period (years)	Peak Flow Rates (cfs)
2	0
5	125
10	235
25	710
50	885
100	1080
500	1550

The 6-hour local storm and 24-hour general storm probable maximum precipitation (PMP) quantities were calculated using the procedure given in Hydrometeorological Report No. 49. The local storm PMP was more critical and was used in the freeboard routings for the proposed floodwater retarding structure. This is the size of storm that would occur if all meterological conditions were optimum.

EXISTING FLOODPLAIN MANAGEMENT

The existing floodplain management consists of utilizing streets and storm drains to transmit floodwater to the Truckee River (Appendix A). On the University property limited floodproofing of buildings has been installed, and sand-bags are used during flood events. In other areas of the city temporary floodproofing has been undertaken by private landowners by placing sandbags at critical locations.

Downstream of North Sierra Street the channel has been obliterated by buildings and parking areas and low flows are confined to a storm sewer conduit system. The first 350 feet of conduit downstream of North Sierra Street is 36-inch diameter corrugated metal pipe (CMP). It outlets into a 48-inch diameter reinforced concrete pipe (RCP). In addition to having a smaller diameter, the CMP is on flatter grade and has more resistance to flow than the RCP. The result is that the CMP has a capacity of 55 cubic feet per second (cfs) of flood water while the RCP's capacity is 175 cfs.

The 48-inch diameter RCP extends easterly to the eastern side of the University parking lot. At this point it outlets into an earthen channel. The channel is on a flatter grade than the RCP. The channel is shallow, narrow and not uniform in configuration. The capacity of the channel is less than the 48-inch RCP. The channel is about 600 feet long and outlets into a 54-inch diameter RCP. The 54-inch RCP extends 500-feet downstream where it transitions to a 48-inch RCP. The 54 inch RCP has the higher capacity to transmit more water than its trash grate equipped inlet can facilitate.

Downstream of the University the flow is contained in a conduit until it crosses I-80. Downstream of I-80 the conduit has a 60-inch diameter. When conduit capacities are exceeded, flow is overland and crosses I-80 via Evans Avenue overpass. From there to the Truckee River the storm flows are contained in conduits and the streets. Appendix A shows the flow pattern of the flood waters by reach. The 100-year runoff of 1110 cfs is conveyed across I-80 and flows down Evans Avenue. About 760 cfs is diverted to the east by 6th, 5th, and 4th Streets. The diverted flood water travels east and north to I-80 at Wells Avenue and Sutro Street where it enters the storm drain system and is carried to the Truckee River.

FLOOD PROBLEMS

McCarran Boulevard crosses Evans Creek on an embankment which has two hydraulic structures through it. Low flows are carried in a 48-inch diameter CMP which has a capacity of about 100 cfs when water is two feet above the top of the pipe at the inlet. With water at this elevation, about 0.2 acres upstream of McCarran would be inundated. Flows greater than this will flow through a 10 foot by 10 foot concrete box culvert. The two culverts can discharge flows greater than the 500-year event.

At North Sierra Street a 36-inch diameter CMP projects from the roadfill and conveys low flows in Evans Creek under the road and eventually into the City of Reno storm drain system. The inlet capacity of this culvert is about 55 cfs. Flows greater than this inundate the area upstream of North Sierra Street to a depth of 11 feet. This results in the storage of about 10 acre feet with a surface area of about 3 acres. Storms exceeding the 2-year event will cause the ponded floodwater to overtop North Sierra street and flood an apartment complex, UNR buildings, and a small residential area all north of I-80. Floodwaters are then funnelled over the freeway via Evans avenue. Flooding south of I-80 damages both residential neighborhoods and commercial/industrial establishments.

The 500, 100, 50, 25, 10, and 5-year flood events were used to evaluate the potential damages under present land use conditions. No changes are expected in the physical characteristics of the watershed in the foreseeable future that would significantly affect the rate of runoff. Urban development that might occur in the future will be regulated by local government ordinances which will comply with the Federal Flood Insurance Program.

During the 100-year event buildings in the floodplain would be inundated with up to 3.5 feet of water. In general average depths will be less than .5 feet except in reach 2 (Appendix A) where depths will be 2-3 feet. In this 100-year floodplain about 80 buildings will have water in them. Damages to these buildings and contents alone have been calculated to be $3.3 million. The six different storm frequencies mentioned above were evaluated to estimate damages to the buildings and contents (Table 4). Based on this analysis, it is estimated that average annual damages to buildings and contents will be $204,250.

Floodwater and the associated sediment deposition also results in significant cleanup and repair expense to the university grounds and the city streets. An event as small as a 10-year flood causes substantial cleanup cost. For instance, in 1986, flooding caused about $90,000 in cleanup/repair expenses to the city roads and university grounds. The 1986 storm approximated the 10-year event. Average annual cleanup and repair expenses are estimated to be $23,400.

In the event of a large flood, traffic would be severely disrupted. The primary intersections that would be affected are Evans Avenue at 2nd, 4th, and, 6th streets. A flood event equal to or larger than a 25-year would force re-routing of traffic causing time delays and increased operating costs for travelers to arrive at their destinations. Average annual cost are estimated to be $1,550.

Flood damage to automobiles in reach 2 can be a problem. If these vehicles are not removed from the area before floodwaters rise, they will suffer damages. Nuisance damages would begin when floodwaters are around a foot in depth and would increase substantially when the water begins to rise enough to enter vehicles. It is estimates that over a hundred vehicles would not be evacuated and would receive some damage due to flooding during the 100-year event. Average annual damages to these vehicles are estimated to be $950.

The total value of average annual damages evaluated in all categories is estimated to be $230,150. In addition, a major flood would cause many other damages that were not evaluated in this study. Estimates were not made on structural damages that would occur to utilities. Estimates were also not made on revenues that would be lost by businesses in the commercial areas or on the lost wages of employees of these businesses.

TABLE 4 FLOOD DAMAGES AND BUILDINGS BY FLOOD EVENT

	EVENT (years)					
TYPE OF BUILDING UNIT	5	10	25	50	100	500
Residential						
Total Damages ($)	0	18,100	148,200	162,400	179,800	581,900
Number Flooded(#)[1]	0	9	37	41	41	57
Commercial						
Total Damages ($)	0	17,100	308,300	614,000	759,900	927,900
Number Flooded (#)	0	2	17	24	27	31
University						
Total Damages ($)	0	359,100	1,883,500	2,048,300	2,384,900	3,014,500
Number Flooded (#)	0	6	8	9	11	11
Total Damages ($)	0	394,300	2,340,000	2,824,700	3,324,600	4,524,300
Number Flooded (#)	0	17	62	74	79	99

[1] Includes apartments units as well as single family homes.

ALTERNATIVES FOR FLOODPLAIN MANAGEMENT

Two elements of floodplain management were investigated during this phase of planning. The first is a dam in Evans Creek upstream of McCarran Boulevard. The second element consists of increasing the capacity of the upstream portion of the existing storm drain system downstream of North Sierra and within the University of Nevada campus.

Element 1: Earlier floodplain studies proposed a dam sited approximately 2000 feet upstream of McCarran Boulevard (Appendix E). The site was on the San Rafael Ranch which has since been purchased by the Parks. The site is in the wetland area which the Parks is converting into a wetlands education center. There is a high degree of private citizen involvement in this project. Because Parks has preempted this dam site it was deleted from consideration in this study.

A new site was selected in Evans Creek about 3000 feet upstream from the above mentioned site. The site is located in the NE 1/4, SE 1/4, NW 1/4, Section 34, Range 19 East, Township 20 North. A dam was designed to control the 100-year storm. All storms up to and including the 100-year storm would route through the principal spillway (Appendix C). During the 100-year storm, the reservoir will cover nine acres and will require 1.1 days to empty. The emergency spillway was designed to safely pass the freeboard hydrograph. The top of the dam is set so that the PMP hydrograph will not overtop the dam.

During this study, surface and subsurface geology were investigated (Appendix B). The rock in the proposed dam foundation and emergency spillway consisted of a highly fractured volcanic andesite. The proposed design considers these conditions. Also it was discovered that the area may have seismic faults close to the dam site. The age of the faults is not known, but they still need to be considered in designing a structure upstream of a metropolitan area. Laboratory tests were conducted by the SCS Soils Mechanics Laboratory in Lincoln, Nebraska on selected samples from proposed core borrow in West Wash flood control basin. The tests indicated that the clayey material is potentially dispersive. Therefore special precautions must be taken so that the clay particles in the core would not migrate into the shell material.

Based upon the geologic and hydrologic studies and using SCS engineering design standards, the dam was designed as follows (Appendix C): Site preparation includes stripping an average of five feet of alluvial overburden from the foundation area. The spoil may be used later in the shell. The dam will have a top width of 14 feet (see Table 5). It will have a zone fill consisting of an impervious core with a top width of eight feet. It extends to the maximum water surface elevation of the routed emergency spillway hydrograph. The core will be surrounded with a three foot thick filter blanket which is needed to counteract the dispersive nature of the core material. The filter extends to the invert of the cut off trench (see Appendix C) following its downstream side. During final design more tests would have to be conducted and other borrow sites should be investigated. Should the dispersive characteristics not be encountered the filter may be deleted from the design. The filter will be surrounded by a drain to protect it from erosion. The drain will also act as a self healing section as protection from seismic activity. The downstream drain will lead to a horizontal drain blanket which will outlet to the downstream dam toe through a rock blanket. Again, should the dispersive characteristics of the core material not be present, the upstream blanket drain could be eliminated. A rock shell will surround the drain.

Because of the fractured rock it will be necessary to apply dental grout to the foundation surface from the upstream toe of the dam to the downstream side of the cutoff trench invert. It will also be necessary to pave the emergency spillway. The spillway will take the form of a trapezoidal channel and is paved from the upstream end of the level section to a point where the spillway outlet channel grade conforms to natural grade. A cutoff wall is designed at the end of the concrete section. If the spillway ever operates, extensive erosion would occur between the end of the concrete section and the Evans Creek channel bed. However, from a loss standpoint, it was felt that the recurrence interval of this magnitude of flow is so rare that it would be impractical to install a standard chute spillway and energy dissipator. Therefore, the abbreviated design was chosen and should any erosion take place the sponsor would incur fairly significant maintenance costs.

TABLE 5. Dam Data

1. 100-year storm routed through principal spillway
2. Dam top elevation -- 4826 msl
3. Emergency spillway crest elevation -- 4813.7 msl
4. Principal spillway crest elevation -- 4789.2 msl
5. Floodwater retarding storage -- 139.5 acre-feet
6. Sediment storage -- 50 acre-feet
7. Life of sediment pool -- 71 years
8. Maximum principal spillway discharge at 100-year storm -- 126 cfs
9. Principal spillway discharge duration at 100-year storm -- 26 hours
10. Maximum height of fill -- 72 feet
11. Top length of fill -- 426 feet
12. Dam top width -- 14 feet
13. Average depth of stripping -- 5 feet
14. Cutoff trench depth -- 10 feet
15. Cutoff trench bottom width -- 12 feet
16. Principal spillway data
    - Pipe -- 30-inch diameter reinforced concrete pipe
    - Inlet -- reinforced concrete tower with trash rack
    - Outlet -- reinforced concrete impact basin
17. Emergency spillway data
    - Bottom width -- 50 feet
    - Concrete lining -- from upstream edge of level section to the downstream cutoff wall with lining to the maximum water surface elevation of the routed free-board hydrograph

    Side slope
    - Lined -- 1.5:1
    - Unlined -- 2:1

    Upstream cutoff wall
    - Depth -- 4 feet

    Downstream cutoff wall
    - Depth -- 26 feet
    - Slope -- 1.5:1
18. Volumes

    Excavation
    - Cutoff trench and emergency spillway -- 13,000 cu. yd.
    - Stripping -- 18,000 cu. yd

    Fill
    - Core and cutoff trench -- 50,500 cu. yd.
    - Filter -- 6,700 cu. yd.
    - Drain -- 8,200 cu. yd.
    - Shell -- 64,000 cu. yd.

    Concrete
    - Reinforced concrete -- 38 cu. yd.
    - Paving concrete -- 550 cu. yd.
    - Dental grout -- 1573 cu. yd.

    30-inch reinforced concrete pipe -- 325 feet
19. Right-of-Way -- 15 acres

Element 2: This element has two parts and should be installed as one unit. Otherwise the problem is merely shifted from upstream to downstream and no real damage reduction is realized.

The first part of this element is located at the intersection of Evans Creek and North Sierra Street (Appendix E). The existing 36-inch CMP culvert is inadequate to allow the 48-inch RCP to run full. Therefore this element proposes to install a 350 feet long 48-inch RCP parallel to the 36-inch CMP. The proposed work also includes installing an appropriate headwall on the upstream side of North Sierra Street.

The second part of this element is to extend the existing 54-inch RCP on the University campus 600 feet northerly (upstream) to join the existing 48-inch RCP. Even though the existing 54-inch RCP transitions to a 48-inch RCP 500 feet downstream, it is considered prudent to use 54-inch RCP for the proposed extension. Appropriate drop inlets to receive water from the parking lot will be included in this element.

Alternatives

There appear to be 2 alternative management plans. Alternative 1 consists of constructing the dam only. Alternative 2 includes both the dam and two storm drain segments. It is important to understand that installing the drain segments without the dam solves only a small part of the problem.

Effects of the Alternatives

Alternative 1: The installation cost of this alternative is $1,947,000. The average annual cost is $175,700 including $2,900 for Operation and Maintenance (O&M). This alternative requires the acquisition of 15 acres of privately owned land.

This alternative would prevent flood damages to new development and reduce damages to existing facilities by 88 percent. Although the majority of the flood problem would be eliminated, some flood damages would still occur with a 25-year and greater flood event. Peak flows for various return periods for Evans Creek downstream of North Sierra Street are shown in Table 6.

Average annual costs and benefits were developed using an interest rate of 8 7/8 percent over a 100-year period. Operation and maintenance cost include a provision for cleaning the reservoir at 71 years after construction and for repair of the outlet of the emergency spillway.

TABLE 6. Peak Flow Rates for Alternative 1 for Evans Creek Downstream of North Sierra Street

Return Period (years)	Peak Flow Rates at North Sierra Street	
	Without Project (cfs)	With Alternative 1 (cfs)
2	0	0
5	125	85
10	235	105
25	710	200
50	885	245
100	1080	285
500	1550	395

In general, damages to university grounds and city streets, traffic disruption, and automobile damage would be minimized. Table 7 illustrates the damage reduction benefits attributable to this alternative. Total damage reduction benefits attributable to this alternative are $203,550.

Comparing the average annual cost of $175,700 to the average annual benefits of $203,550 produces a benefit to cost ratio of 1.2:1.0. This means that for every $1 spent, this alternative would yield $1.20 in benefits.

The environmental effects of this alternative are:

Positive impacts of this alternative should be expected as a result of watershed protection from the ravages of storm runoff. Existing surface water supplies to the wetlands area above McCarran Boulevard will not be impacted by the construction of the dam. It is possible that the ephemeral creek flow may be prolonged due to the dam construction, depending on ponding behind the dam and the timing and nature of storm events in the upper watershed.

Negative impacts will be primarily limited to that associated with temporary disturbance of soil and ground cover at the construction site and along the access road. Disturbed areas will be revegetated with native species. This will reduce the time for the site to return to native vegetation and reduce the amount of invader species. Noise commonly associated with construction activities will also be a temporary factor of disturbance. If construction activities are limited to a time of year other than during the breeding season, there should be minimum impacts on the wildlife species in the wetlands.

TABLE 7 ALTERNATIVE 1 DAMAGES AND BENEFITS
(Average Annual Values)

Damage Catagory	Future without Project Damage	Future with Project Damage	Project Benefits
Residential, Commercial, Industrial, and University Buildings and Contents	$204,250	$24,050	$180,200
City and University grounds Cleanup	$23,400	$2,450	$20,950
Traffic Disruption	$1,550	$100	$1,450
Automobiles	$950	$0	$950
TOTALS	$230,150	$26,600	$203,550

Alternative 2: The installation cost of this alternative is $2,357,200. The average annual cost is $212,800 including $3,600 for Operation and Maintenance (O&M). Right-of way required is the same as in Alternative 1. It is assumed that no additional easements will be required.

This alternative would prevent flood damages to new development and reduce damages to existing facilities by 98 percent. Primarily the residual damages result from storms between the 100 and 500-year frequencies. Peak flows for various return periods for Evans Creek downstream of North Sierra Street are given in Table 8.

TABLE 8. Peak Flows Alternative 2
for Evans Creek Downstream of North Sierra Street

	Peak Flow Rates at North Sierra Street	
Return Period (years)	Without Project (cfs)	With Alternative 2 (cfs)
2	0	0
5	125	0
10	235	0
25	710	70
50	885	115
100	1080	115
500	1550	265

Damages to university grounds and city streets, traffic disruption, and automobiles are nearly eliminated. Table 9 shows the damage reduction benefits from this alternative which are $227,300 in average annual terms. In addition, to the damage reduction benefits, $4750 in annual benefits would accrue as savings in administering the national flood insurance program. Therefore, the total benefits attributable to this alternative are $232,050.

Comparing the average annual costs of $212,800 to the average annual benefits of $232,050 produces a benefit to cost ratio of 1.1:1.0. This means that for every $1 spent this alternative would yield $1.10 in benefits.

The environmental effects of this alternative are:

The positive environmental impacts of this alternative include those of Alternative 1.

The negative impacts of this alternative in addition to those of Alternative 1, include removing 600 feet of existing earth channel adjacent to the parking lot on the UNR campus. The predominant vegetation along this channel are various domestic tree species. These trees are deciduous and receive most of their annual water requirement from irrigation runoff from other areas of the campus. It is not felt that these trees will be disturbed to any great extent during project installation. Any water that may be lost through project installation can be mitigated by installing an irrigation system. During future planning the impacts should be studied in greater detail. Should a mitigation plan be required, it will be developed during that phase of planning.

TABLE 9 ALTERNATIVE 2 DAMAGES AND BENEFITS
(Average Annual Values)

Damage Catagory	Future without Project Damage	Future with Project Damage	Project Benefits
Residential, Commercial, Industrial, and University Buildings and Contents	$204,250	$2,500	$201,750
City and University grounds Cleanup	$23,400	$300	$23,100
Traffic Disruption	$1,550	$50	$1,500
Automobiles	$950	$0	$950
TOTALS	$230,150	$2,850	$227,300

PUBLIC PARTICIPATION

In March of 1987 SCS received a request from the sponsors to provide them a Floodplain Management Study. By July of 1987 a plan of work for the proposed study had been completed and approved by SCS West National Technical Center Portland, Oregon. A joint agreement between the City of Reno and SCS was signed in December of 1987.

On May 31,1988 work on the project began by holding the first steering committee meeting. The steering committee was formed to guide the study. The group was made up of representatives from the following:

> City of Reno, Washoe-Storey Conservation District, Washoe County Parks, University of Nevada, Reno, a homeowners' association, an apartment owner and the SCS.

The committee met five times during this phase of planning.

Should a planning start be authorized (see below), a public meeting will be held at the beginning of the plan development phase, and this Floodplain Management Study will be used as a scoping document.

OPPORTUNITIES FOR IMPLEMENTATION

It appears from this study that flood damages are significant in the watershed and that corrective measures can be developed to economically address them.

Funding to install these corrective measures can come from either local, state or federal sources. All funding avenues should be pursued.

The sponsors of this study specifically asked the SCS to explore potential federal funding under PL-566. The criteria for PL-566 is:

1. Eligible purposes are defined by the Act as any undertaken for (1) preventing damage from erosion, floodwater, and sediment; (2) furthering the conservation, development, utilization, and disposal of water; or (3) conserving and properly using land.

2. Watershed area less than 250,000 acres.

3. Flood water detention structure capacity limited to no more than 12,500 acre-feet or no more than 25,000 acre-feet of total capacity in the plan.

4. The average annual benefit to cost ratio must exceed a value of one.

5. The project must be environmentally acceptable.

6. The project must have strong local support.

RECOMMENDATIONS

This project appears to meet the criteria to be eligible for PL-566 funding, and SCS would accept a formal application for technical and financial assistance under the program should they wish to pursue this option.

LIST OF PREPARERS

Soil Conservation Service:

California Watershed Planning Staff
- William Brooks, Resource Conservationist
- David DeTullio, Staff Leader
- Lester Hansen, Planning Engineer
- Julia Knight, Geologist
- Tim Kuhn, Economist
- Rachel Lopez, Secretary
- Rick Moore, Civil Engineering Technician
- Walt Sykes, Planning Specialist
- Michele Tuvell, Community Planning Technician
- Bill Won, Civil Engineering Technician

California State Engineering Staff
- Tom Smith, State Soil Mechanics Engineer
- Lyle Steffen, State Geologist
- Norman Evenstad, Geologist Trainee

Nevada
- John Capurro, District Conservationist
- Loren Spencer, State Conservation Engineer
- Mark Twyeffort, Hydraulic Engineer

Washoe-Storey Conservation District:

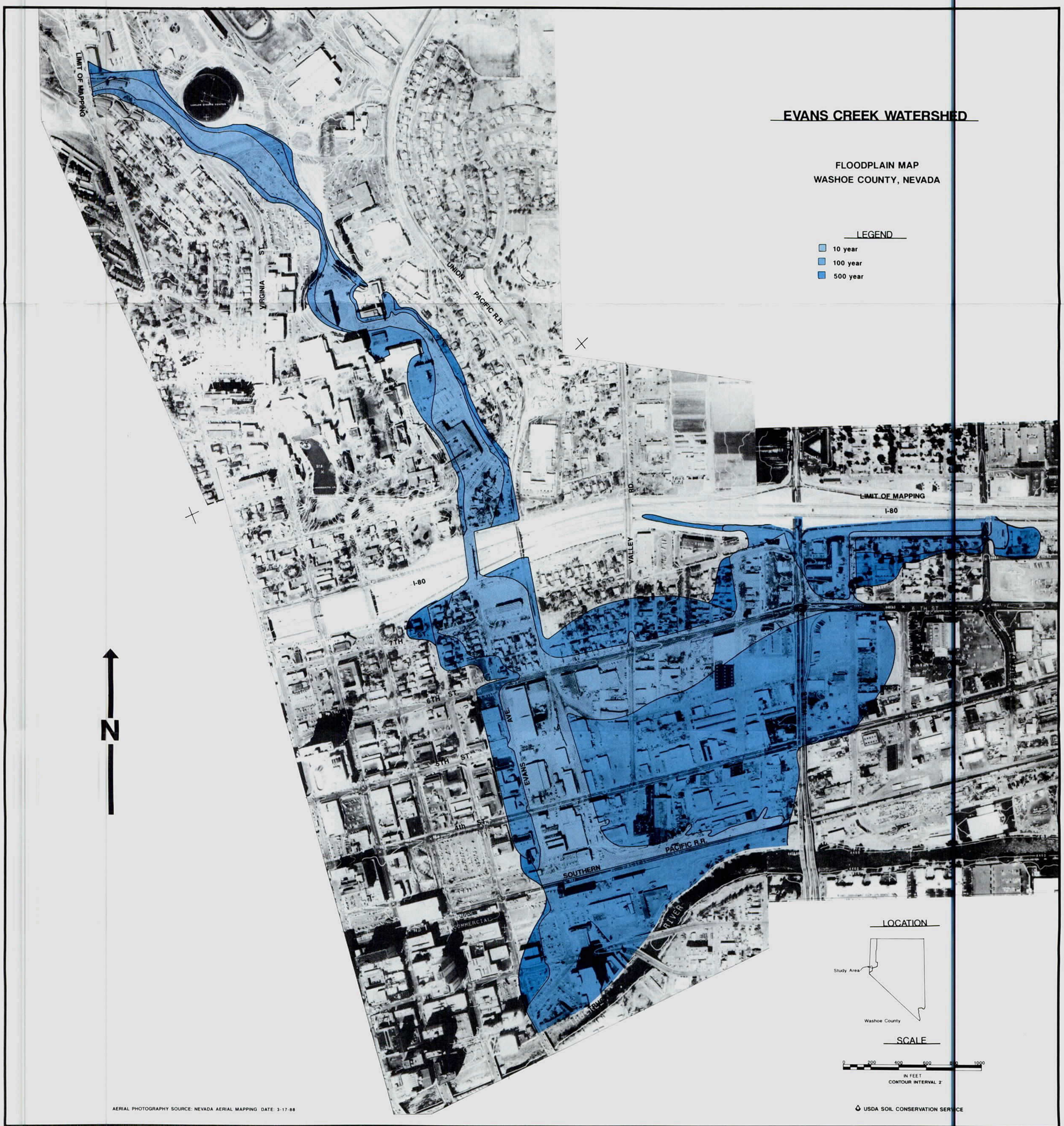
Ray Huxtable

City of Reno:

Bill Vann, Civil Engineer

APPENDIX A

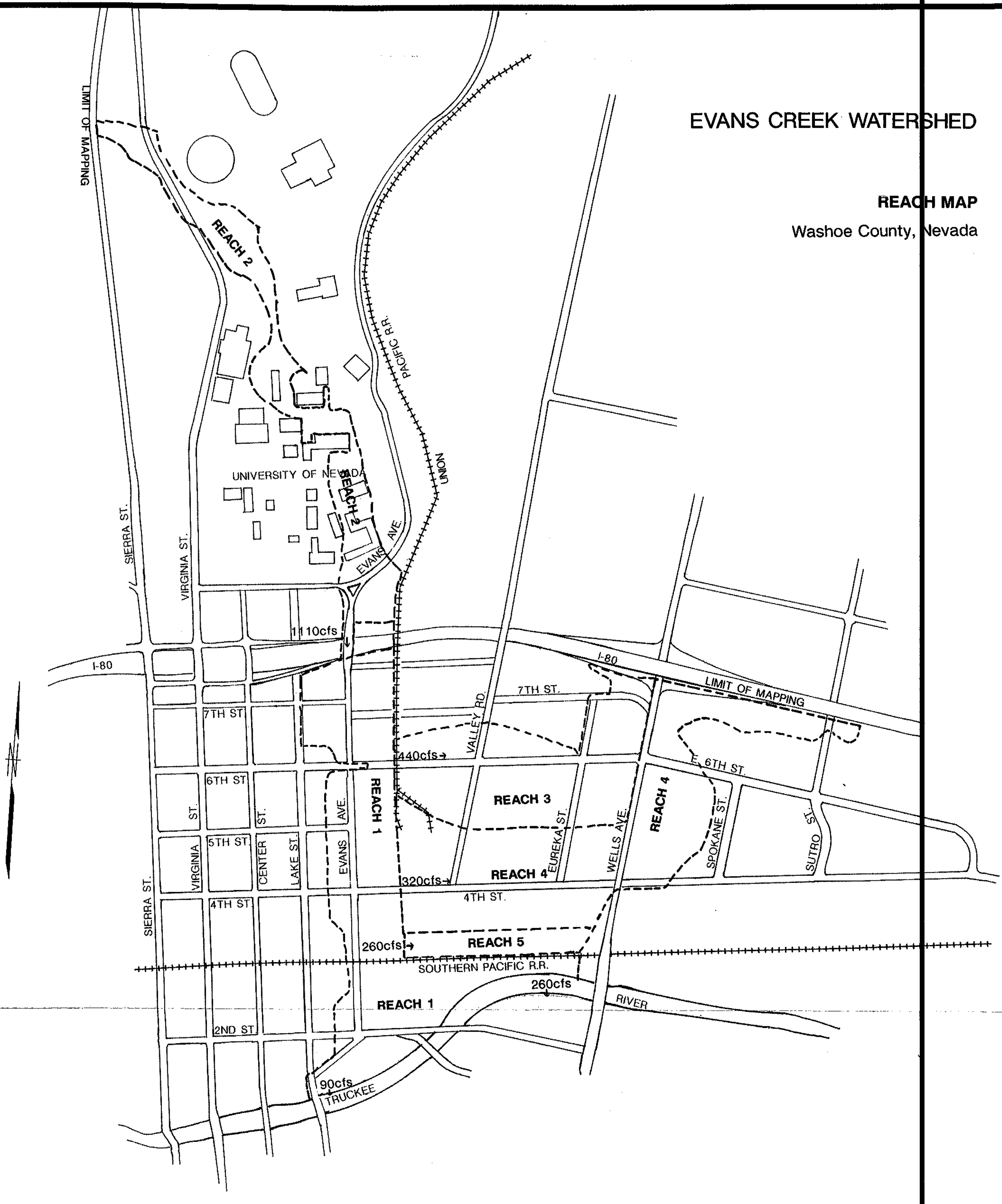
FLOODPLAIN MAPS


EVANS CREEK WATERSHED
FLOODPLAIN MAP
WASHOE COUNTY, NEVADA
LEGEND
10 year
100 year
500 year
LIMIT OF MAPPING
VIRGINIA ST
UNION PACIFIC R.R.
I-80
LIMIT OF MAPPING
I-80
VALLEY RD
7TH
6TH ST
5TH ST
4th ST
EVANS AVE
SOUTHERN PACIFIC R.R.
COMMERCIAL
TRUCKEE RIVER
N
LOCATION
Study Area
Washoe County
SCALE
0 200 400 600 800 1000
IN FEET
CONTOUR INTERVAL 2'
AERIAL PHOTOGRAPHY SOURCE: NEVADA AERIAL MAPPING DATE: 3-17-88
USDA SOIL CONSERVATION SERVICE

EVANS CREEK WATERSHED

REACH MAP

Washoe County, Nevada



--- Boundary of 100 year floodplain

SCALE
(in feet)
0 500 1000 2000

Aerial photography provided by Nevada Aerial Mapping 3-17-88

USDA SOIL CONSERVATION SERVICE

FLOODPLAIN HYDRAULICS

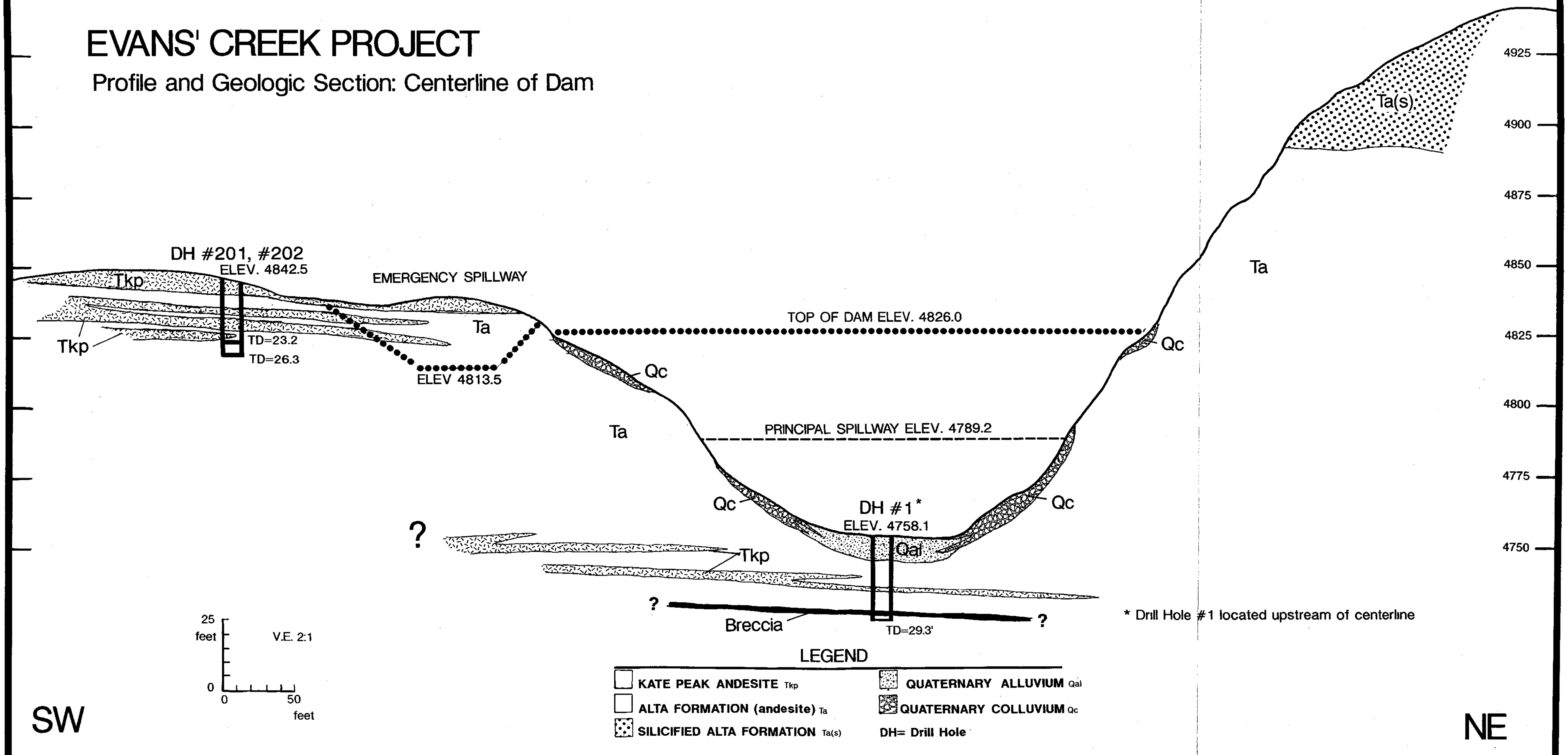
The floodplain was divided into two reaches for depth and extent of flooding determinations. The first reach extends from North Sierra Street southeasterly to I-80. This area includes the Virginian Apartment complex and the UNR campus. This reach was analyzed using detailed cross sections and the Corps of Engineers' HEC-2 Water Surface Profile computer program. The channel and floodplain are steep in this area and profiles were calculated going downstream with supercritical flow. Water surface profiles were computed for the 10, 25, 50, 100 and 500-year floods. Flood flows are funnelled to the Evans Avenue overpass which conveys them over I-80 towards downtown Reno and the Truckee River. At the south end of Evans Avenue overpass, flows begin to spread to the west and east. Floods are confined on the east by the Union Pacific Railroad tracks to 6th Street. The flows are influenced by streets and buildings rather than a confined flow area. A portion of the flood flows continue down Evans Avenue to the intersection with the Southern Pacific Railroad tracks. Part of the flow is diverted east along the railroad tracks and overflows the tracks west of Wells Avenue and then flows into the Truckee River. Routings in this reach were based on flow capacities and slope of streets. Aerial photography with two foot contour lines at a scale of 1-inch equal 200 feet were used in the floodplain analysis.

APPENDIX B

DAM SITE GEOLOGY

EVANS' CREEK PROJECT

Profile and Geologic Section: Centerline of Dam



* Drill Hole #1 located upstream of centerline

LEGEND

- KATE PEAK ANDESITE Tkp
- ALTA FORMATION (andesite) Ta
- SILICIFIED ALTA FORMATION Ta(s)
- QUATERNARY ALLUVIUM Qal
- QUATERNARY COLLUVIUM Qc
- DH= Drill Hole

The geologic investigation entailed compiling surface and subsurface geologic information of the proposed dam site area, collecting and analyzing samples from the proposed borrow site, estimating erosion and reservoir sedimentation rates, and noting possible concerns and making recommendations for further phases of study.

Geology of the Dam Site Area: The area immediately surrounding the proposed dam site is geologically complex, and details remain poorly understood. Most of the area is underlain by volcanics of the Early to Middle Miocene-aged Alta Formation. Fine-grained to finely-porphyritic andesites of the Alta have been altered to varying degrees, resulting in a mosaic of subunits that are variously soft and clayey, silicified and resistant, mottled and bleached by acidic products of oxidation, and brecciated. Porphyritic andesites of the younger Kate Peak Formation are also exposed locally. Kate Peak intrusives have a more distinctively porphyritic texture than Alta volcanics and are slightly softer and not as intensely fractured.

The bedrock underlying the proposed emergency spillway and west abutment consists of alternating layers of Alta and Kate Peak Andesites. This interpretation is based on surface observations plus subsurface information derived from two shallow drill holes. No pressure testing was done, but water loss was extremely high during drilling. Particularly in the Alta Formation, fracturing and alteration are interpreted to continue with depth and render the strata highly permeable, moderately soft, and intermittently clayey. With at least two prominent fracture sets and fracture spacing on the order of one inch, these formations behave somewhat as a well-graded, highly erodible, coarse gravel. The primary fracture set dips steeply downstream, south to southeast although there is some local variation. While not strictly applicable to this bedrock setting, emergency spillway design should treat these units as Class "E" or easily eroded soils.

Underlying up to 8 to 10 feet of poorly-sorted, cobbly (?) alluvial material, the foundation for the proposed structure consists primarily of highly fractured Alta Andesite, with some minor, thin sills of Kate Peak porphyritic Andesite. The degree of alteration ranges from slight to severe, with very soft, extremely clayey material occurring as 0.5 to 1-foot thick zones. This interpretation is based on subsurface information derived from a shallow (30-foot) drill hole located just upstream of the principal spillway. No pressure testing was done, but water loss was extremely high during drilling; at one point during the investigation, drilling fluids surfaced upstream, revealing a particularly weak, permeable breccia (fault?) zone dipping downstream to the southeast - roughly parallel to the prominent fracture direction expressed locally on the surface. The east abutment is a particularly steep, rugged hill slope. Underlying a veneer of talus are outcrops of Alta Andesite that are again highly fractured and altered. No subsurface investigation of the east abutment was undertaken, although it is thought that the altered Alta exposed at the surface extends with depth and may or may not include breccia zones or minor sills of Kate Peak Andesite. The prominent fracture set dips to the southeast, roughly parallel to but less variable than those underlying the west abutment. Above the elevation of the proposed structure are resistant ridges of silicified, fractured Alta Andesite that provide the angular blocks of talus that accumulate downslope.

The presence of high-angle, normal (?) faults roughly 500 to 1000 feet downstream of the proposed dam site are proposed here to explain the isolated exposure of metavolcanics of the Mesozoic Peavine Formation and of Early Tertiary-aged tuffs. If indeed present, these faults would be post-Miocene, roughly 12 million years or younger. As an alternative explanation, local outcrops of these older formations may reflect some complex combination of faulting and the presence of marked paleorelief prior to the extrusion of the Alta volcanics. Whatever the exact locations and ages of local faults, project design should assume that seismic activity is at least a remote possibility. However, because the proposed site is located in a relatively stable bedrock area, the impact of any such activity would be restricted to minor rock falls and landslide activity (Bingler, 1974).

Further phases of study should include a more extensive subsurface geologic investigation. In particular, the previous qualities of the fractured bedrock need to be quantified, potentially troublesome breccia zones identified, and the stratigraphy of the east abutment investigated. Because of the fractured nature of the bedrock, any planned drilling program should anticipate difficulties in obtaining core and pressure testing and may require special equipment or techniques. The potential for shrink-swell in soil and altered bedrock at the proposed dam site and its impact on structure design will also need to be investigated.

<u>Borrow Investigation</u>: A potential source of material for the impervious core of the proposed structure is found behind West Wash dam, located in the NE 1/4 of Section 4, T.19 N., R.19 E., approximately two miles southwest of the site. West Wash Dam was completed in 1963 as part of the Peavine Mountain Watershed project, and is nestled in a residential area south of McCarran Boulevard. The proposed material is a shallow layer of clayey subsoil 1 to 6 feet thick that is reportedly fairly uniform throughout the Peavine Mountain watershed. The principal borrow for the Peavine Mountain structures probably included this clay, as well as underlying clayey gravels and bedded lake sediments.

Six test pits ranging from 5.3 to 9 feet deep were dug in West Wash reservoir using a small back hoe. Disturbed samples of the shallowest clay layer and of some of the underlying layers were collected for analysis. Sieve and hydrometer analyses, Atterberg limit determinations, and specific gravity tests were run on all samples. In addition, triaxial shear tests at 95 percent compaction, soluble salt determinations, and pinhole tests for dispersion were run on samples collected from the clay layer. Results of these analyses reveal that the clay layer consists mostly of highly plastic inorganic clay (CH) with some elastic silt (MH). Soluble salts are present only in trace amounts. Pockets of dispersive material may be present in this layer, although the sample that tested highly dispersive was collected close to, and may have included, impervious blanket material emplaced as part of the project.

The core of the proposed structure will require approximately 50,000 cubic yards of material. It is estimated that about 49,000 cubic yards of CH/MH material are available for borrow from West Wash reservoir. This estimate does not include material from areas within or near the impervious blanket, which covers the area of the reservoir below 4745 feet elevation. Gravel and cobble-sized fragments in the CH/MH layer will necessitate on-site processing and has further reduced the volume of available material. It is therefore recommended that another potential borrow site be located and investigated. Other possible sources of borrow include: 1) a 1 to 6-foot layer of gravelly clay (GC) that underlies the CH/MH material in the southern part of West Wash reservoir, 2) shallow layer(s) of fine-grained material underlying East Wash reservoir, and 3) fine-grained material in Upper Peavine reservoir and/or the reservoir's borrow site located nearby. Preliminary observations suggest that material underlying East Wash reservoir is less plastic and sandier than that found in West Wash reservoir, and that the amount of material available is limited. Upper Peavine reservoir and its borrow area were not studied.

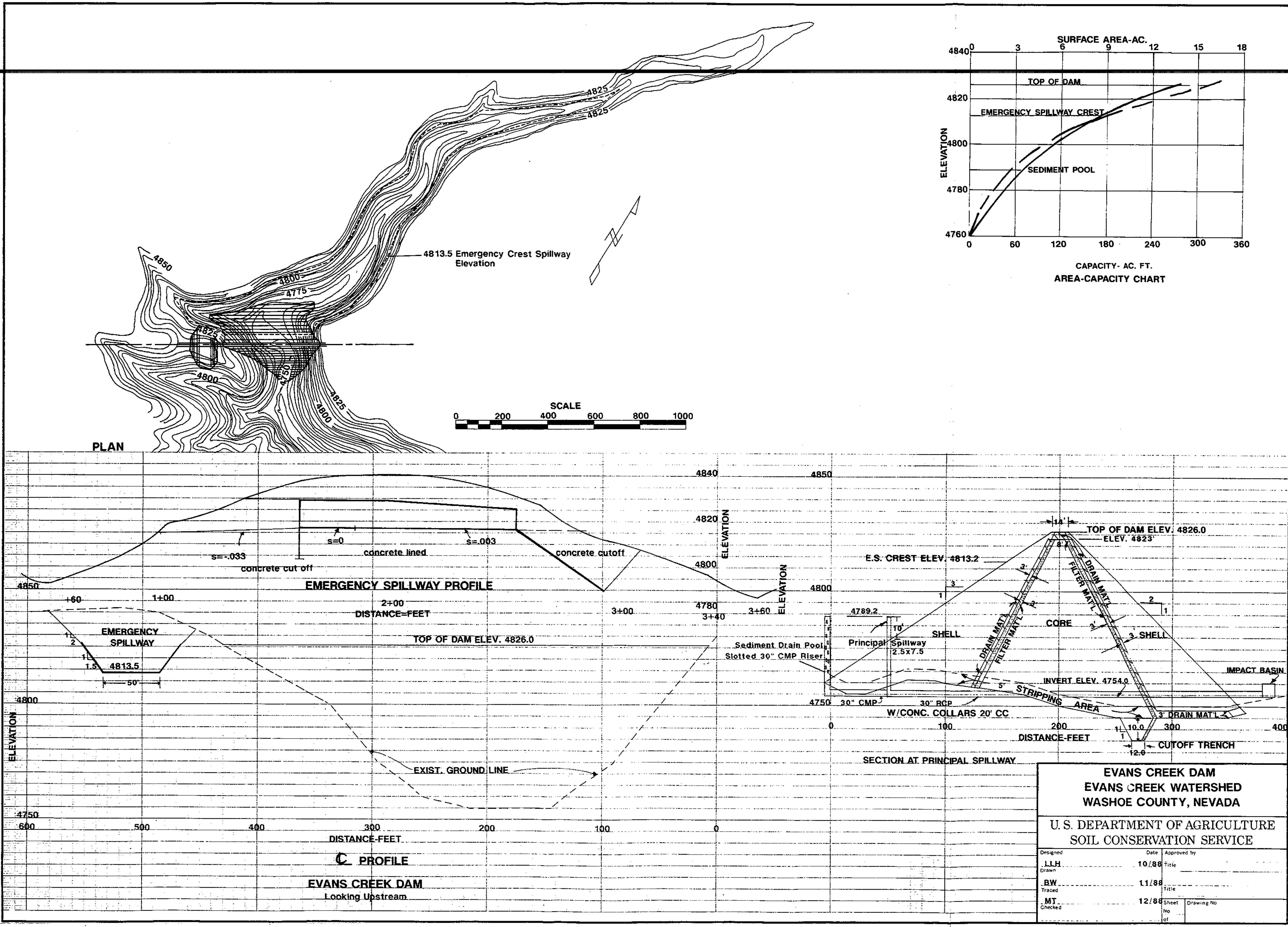
A potential source of material for the rocky outer shell of the proposed structure is a hilltop exposure of resistant bedrock, located within a half-mile of the site to the northeast. This material consists of silicified and bleached andesite that is extremely hard and brittle. Blasting would probably be required to excavate the fracture-bound, angular fragments. The hill overlooks a residential area, and further development is planned that includes the borrow site. Further consideration of this site would require coordination between project designers, developers, and local residents.

Upland Erosion and Reservoir Sedimentation Rates: A brief survey of the upper watershed following a moderately intense summertime rainstorm left no doubt that the steep, sparsely vegetated hillslopes contribute most of the sediment that passes through, and is deposited in, lower reaches of the watershed. The PSIAC (1968) procedure was used to estimate the average annual sediment yield from sheet and rill erosion in the upper watershed. Our estimate of 0.7 acre-feet per square mile (2.4 acre-feet from the 3.39 square mile area) exceeds the original estimate made in 1970 of 0.1 to 0.6 acre-feet per square mile, which was reportedly based on soil mapping units, range condition classes, and field measurements. For comparison, the Peavine Mountain Watershed Work Plan estimated that the average annual sediment yields from the 2.62 square mile East Wash and the 0.94 square mile West Wash subwatersheds are approximately 0.6 acre-feet per square mile and 0.1 acre-feet per square mile respectively.

Published soil survey data formed the basis for estimating reservoir sediment storage requirements. Following a procedure recommended by Steffen (1983), mapped soil units of the upper watershed were grouped into 6 classes based on texture. For each class, the average percentages of gravel, sand, and fines were calculated and the relative area occupied by each class grossly estimated. From this data, a weighted grain size distribution of sediment eroded from upland hillslopes was estimated: 25 percent gravel, 37 percent sand, and 38 percent fines. Sediment delivery ratios and reservoir trap efficiencies for each grain size range were then estimated (professional judgement), from which an estimated average of 0.7 acre-feet of sediment accumulating in the reservoir annually was derived. Hence, over the 100-year life of the project roughly 70 acre-feet of mostly sands would be deposited in the reservoir. As proposed, only 50 acre-feet of the reservoir is designated for sediment storage. Sediment would therefore need to be removed from the reservoir as a part of project maintenance.

APPENDIX C

DAM DRAWINGS



EVANS CREEK DAM
EVANS CREEK WATERSHED
WASHOE COUNTY, NEVADA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date	Approved by
Designed	LLH	10/88	Title
Drawn	BW	11/88	Title
Traced / Checked	MT	12/88	Sheet No of / Drawing No

APPENDIX D

ENVIRONMENTAL AGENCY LETTERS

United States Department of Agriculture
Soil Conservation Service

2121-C 2nd St., Suite 102
Davis, CA 95616-5475
(916) 449-2848

December 12, 1988

Great Basin Complex Manager
USFWS
Endangered Species Office
4600 Kietzke Lane, Bldg. C
Reno, NV 89502

Dear Sir/Madam:

The USDA Soil Conservation Service is providing technical assistance in the development of a PL-566 project in Washoe County. The purpose of the project is to develop a floodplain management plan for the Evans Creek Watershed.

In accordance with Section 7 of the Endangered Species Act, I am requesting a list of threatened and/or endangered species that may occur within the watershed. A map is enclosed to help you locate the project area.

Thank you.

Original Signed

EUGENE E. ANDREUCCETTI
State Conservationist

United States Department of the Interior

FISH AND WILDLIFE SERVICE

RENO FIELD STATION
4600 Kietzke Lane, Building C
Reno, Nevada 89502

January 4, 1989
File No. 1-5-89-SP-28

Mr. Eugene E. Andreuccetti
Soil Conservation Service
2121-C 2nd Street, Suite 102
Davis, CA 95616-5475

Dear Mr. Andreuccetti:

This is in response to your request, received in our office on December 16, 1988, for information on listed and proposed endangered and threatened species which are present or may be present within the area of the proposed floodplain management for the Evans Creek Watershed, Washoe County, Nevada. Your request and this response are made pursuant to Section 7(c) of the Endangered Species Act of 1973, as amended.

To the best of our knowledge, there are no listed, proposed or candidate species present within the area of the subject project. Should a species become officially listed or proposed for listing before the you complete your project, the Soil Conservation Service should reevaluate its responsibilities under the Act.

We appreciate your concern for endangered species and look forward to continued coordination.

Sincerely,

Richard J. Navarre
Field Supervisor

cc: Assistant Regional Director (AFWE), Portland, OR

United States Department of Agriculture
Soil Conservation Service

2121-C 2nd St., Suite 102
Davis, CA 95616-5475
(916) 449-2873

December 12, 1988

Ms. Alice M. Becker
Staff Archaeologist
Department of Conservation and Natural Resources
Division of Historic Preservation and Archaelogy
201 S. Fall Street
Capitol Complex
Carson City, Nevada 89710

Dear Ms. Becker:

We are presently preparing a floodplain management plan for the Evans Creek Watershed which is in southwestern Washoe County. The plan will address floodplain related problems on private and public land.

I am providing a description of the project along with a location map.

Please provide us with pertinent information relative to known historic and archaeological sites in the project area. We would appreciate having an estimate of any associated costs beforehand.

Thank you.

William H. Brooks

WILLIAM H. BROOKS
Resource Conservationist

RICHARD H. BRYAN
Governor

STATE OF NEVADA

ROLAND D. WESTERGARD
State Historic Preservation Officer

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

DIVISION OF HISTORIC PRESERVATION AND ARCHEOLOGY
201 S. Fall Street
Capitol Complex
Carson City, Nevada 89710
(702) 885-5138

January 18, 1989

William H. Brooks
Resource Conservationist
Soil Conservation Service
2121-C 2nd Street, Suite 102
Davis, CA 95616-5475

Dear Mr. Brooks:

This letter is in response to your request for information on the location of National Register listed and eligible properties within the Evans Creek Watershed. We have checked the National Register, our files and those at the Nevada State Museum. A copy of the current listing of National Register properties in Nevada is enclosed. Please note that a number of properties in Washoe County, are located within the Evans Watershed.

Additionally, several prehistoric sites potentially eligible for inclusion, 26WA1093, -1094, -1402 and -1404, are located along water courses in the foothills. Numerous small sites and isolates also have been discovered. Historic sites may be associated with mining activity on Peavine Mountain and Nevada-California-Oregon Railroad construction and sidings in Panther Valley.

The Evans Creek Watershed contains National Register listed and eligible properties. At this time without knowing the scope of work or exact location of project related activities, effects to historic properties are unknown but impacts could occur. Information is insufficient for consultation as per 36 CFR 800.4.

Therefore, it follows that we have no way of estimating costs as you have requested in your letter. Please consult with us again when your project is better defined as per 36 CFR 800.4. If you have any questions regarding this project or the process please call us.

Sincerely,

Ronald M. James
for Alice M. Becker
Staff Archeologist

AMB:emt

0-343

Name/Address	Type of Entry	Date Entered
WASHOE COUNTY		
**Senator Newlands Mansion 17 Elm Court, Reno	Building	1961
Lake Mansion Adjacent to the Centennial Coliseum, on U.S. 395	Building	06/29/72
Morrill Hall University of Nevada campus	Building	05/01/74
Old Winters Ranch/Winters Mansion North of Carson City	Building	07/30/74
Bowers Mansion 19 miles South of Reno, Off U.S. 395	Building	01/31/76
Mt. Rose Elementary School 915 Lander, Reno	Building	11/25/77
Glendale School South Virginia Street & Kietzke Lane, Reno	Building	01/30/78
Derby Dam 19 miles East of Sparks	Structure	04/26/78
Odd Fellows Building 133 North Sierra Street, Reno	Building	11/27/78
Alamo Ranch House SW of Steamboat at 20205 S. Virginia Street, Steamboat	Building	10/23/79
Hawkins House 549 Court Street, Reno	Building	12/17/79
Rainier Brewing Company Bottling Plant, 310 Spokane Street, Reno	Building	03/26/80
Nevada-California-Oregon Railroad Depot, 325 East 4th Street, Reno	Building	02/08/80
Virginia Street Bridge Spans Truckee River, Reno	Structure	12/10/80
Benson Dillon Billinghurst House 729 Evans Avenue, Reno	Building	11/08/74
1872 California-Nevada State Boundary Marker, NW of Verdi on California/Nevada border	Object	08/27/81

Name/Address	Type of Entry	Date Entered
Gerlach Watertower Main Street, Gerlach	Structure	10/29/81
Mackay School of Mines University of Nevada-Reno Campus	Building	04/01/82
George Wingfield House 219 Court Street, Reno	Building	07/11/82
Riverside Mill Company Flour Mill 345 East 2nd Street, Reno	Building	08/18/82
First United Methodist Church West 1st & West Streets, Reno	Building	02/24/83
Levy House 111-121 California Avenue, Reno	Building	02/24/83
Nortonia Boarding House 150 Ridge Street, Reno	Building	02/24/83
Tyson House 242 West Liberty Street	Building	02/24/83
Graham House 548 California Avenue, Reno	Building	03/07/83
Humphrey House 467 Ralston Street, Reno	Building	03/07/83
Twaddle Mansion 485 West Fifth Street, Reno	Building	03/07/83
Clifford House 339 Ralston Street, Reno	Building	03/07/83
20th Century Club 335 West First Street, Reno	Building	04/21/83
Nevada-California-Oregon Railway Locomotive House & Machine Shop 401 East 4th Street, Reno	Building	05/09/83
Mapes Hotel-Casino 10 North Virginia Street, Reno	Building	05/04/84
Giraud-Hardy House 442 Flint Street, Reno	Building	05/04/84
Burke House 36 Steward Street, Reno	Building	05/31/84

Name/Address	Type of Entry	Date Entered
McCarthy-Platt House 1000 Plumas Street, Reno	Building	05/31/84
El Cortez Hotel 239 West Second Street, Reno	Building	06/13/84
Francovich House 557 Washington Street, Reno	Building	10/26/84
Pincolini Hotel 214 Lake Street, Reno	Building	10/11/84
McKinley Park School Riverside Drive & Keystone Avenue, Reno	Building	09/16/85
*Walter Cliff Ranch 7635 Old Highway 395	Historic District	09/16/85
Washoe County Courthouse 117 South Virginia Street, Reno	Thematic	08/06/86
Reno National Bank 204 North Virginia Street, Reno	Thematic	08/06/86
California Apartments 45 California Avenue, Reno	Thematic	08/06/86
Riverside Hotel 17 South Virginia Street, Reno	Thematic	08/06/86
Bell Telephone Building 100 North Center Street, Reno	Thematic	08/06/86
University of Nevada Reno Historic District UNR Complex, Reno	Historic District	02/25/87
Joseph Gray House 457 Court St. Reno	Building	11/20/87

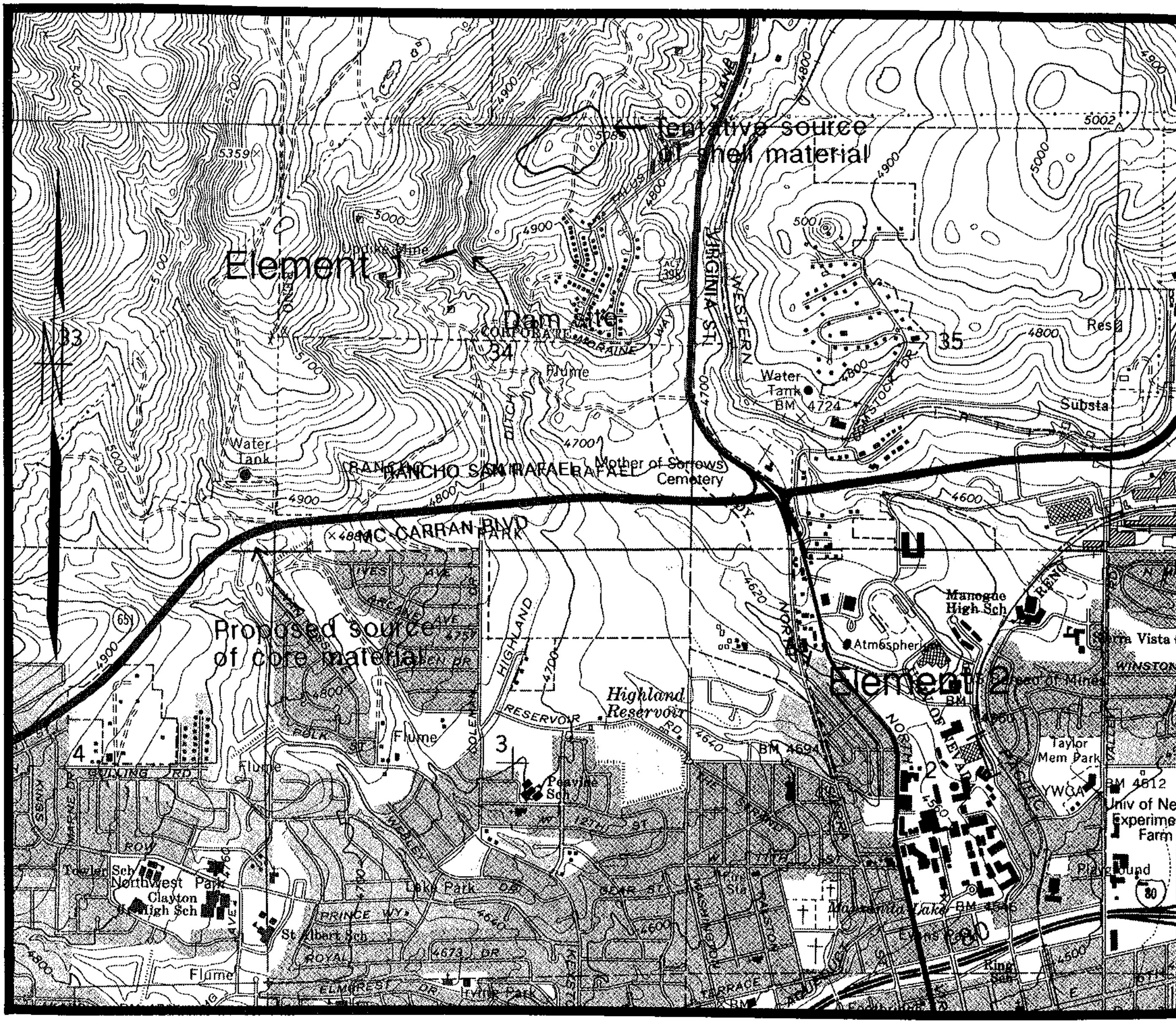
APPENDIX E

PROJECT MAP

EVANS CREEK WATERSHED

PROJECT MAP

Washoe County, Nevada



SCALE

1 1/2 0 1 mile

SOURCE: U.S. GEOLOGICAL SURVEY TOPOGRAPHIC MAP DENVER, COLORADO 1982

USDA SOIL CONSERVATION SERVICE