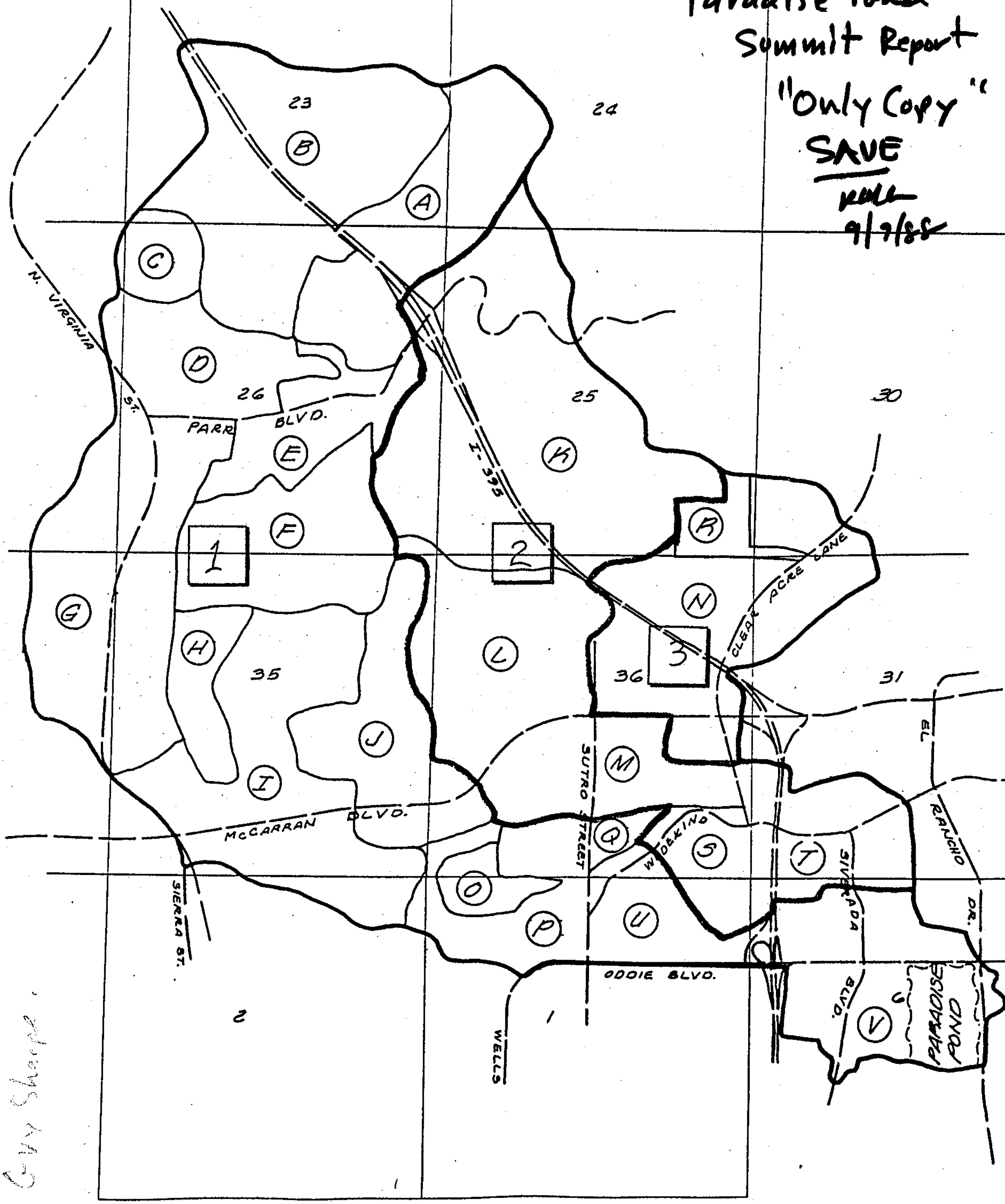
PARADISE POND

SUMMIT REPORT

SEPTEMBER 1988

Paradise Pond
Summit Report
"Only Copy"
SAVE
9/7/88



City Sharpe

Hydrograph Location
23
24
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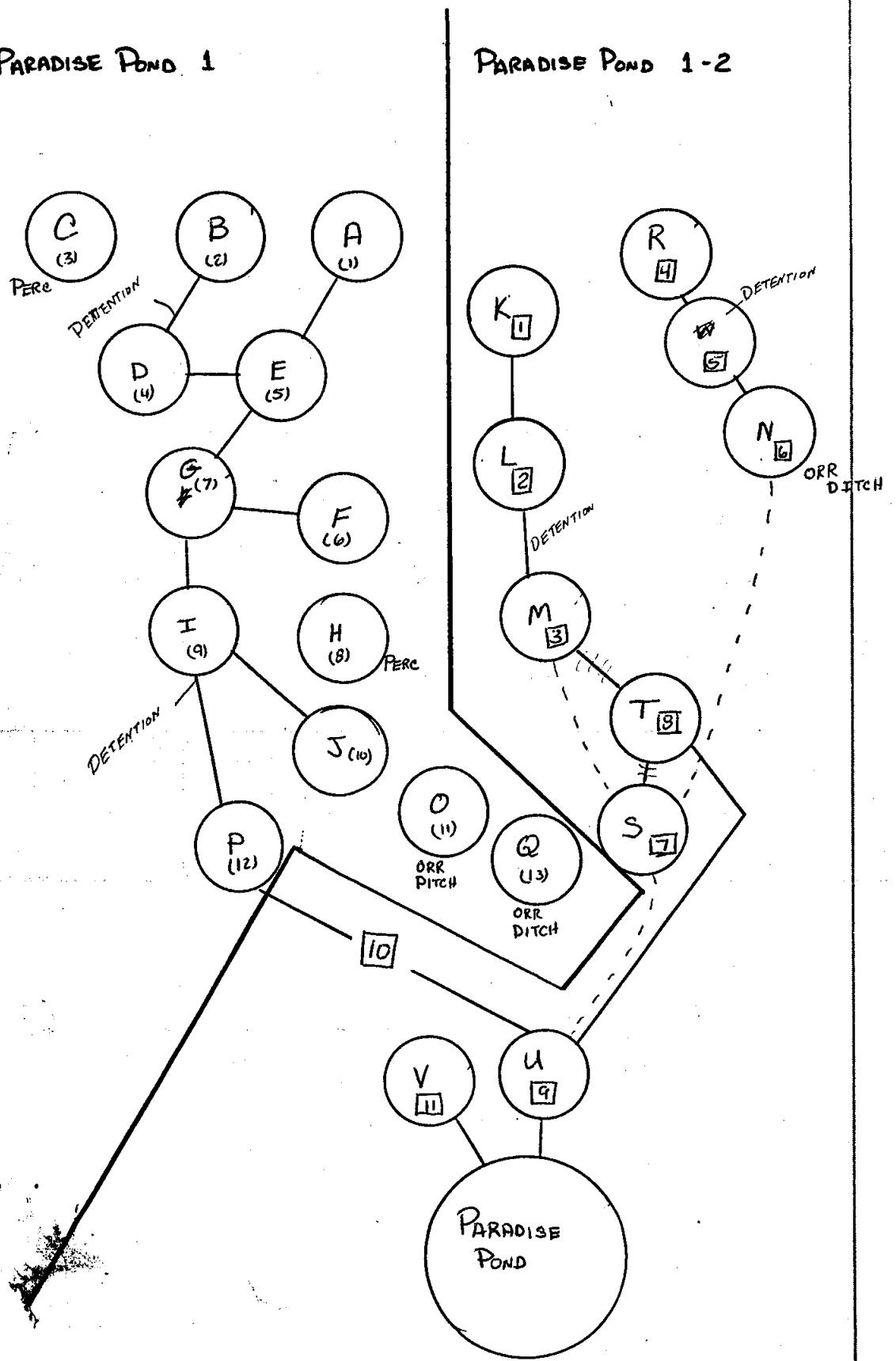
U
V
N. VIRGINIA ST.
PARR BLVD.
I-395
CLEAR ACRE LANE
EL RANCHO DR.
SUTRO STREET
WEDEKIND
SIERRA ST.
McCARRAN BLVD.
SIERRA BLVD.
ODDIE BLVD.
WELLS
PARADISE POND

DW

PARADISE POND



DW

PARADISE POND

Rainfall — From New Winzler And Kelly Report

24 hour Duration				6 hour Duration			
100yr.	= 2.88"	2.70	~~2.88~~ 2.76"	100yr.	= 1.62"	1.70	1.50
50yr.	= 2.62"	2.5	2.40	50yr.	= 1.27	1.50	1.38
25yr.	= 2.11"	2.10	2.11	25yr.	= 1.09"	1.35	1.20
5yr.	= 1.39"	1.50	1.56	5yr.	= 0.78"	0.95	0.84
2yr.	= 1.06"		1.08"	2yr.	= 0.65		0.57
10yr.	= 1.68"		1.80"	10yr.	= ~~0.84~~ 0.90"		1.02

3 hour Duration			
100yr.	= 1.25"	1.45	1.32
50yr.	= 1.04"	1.28	1.12
25yr.	= 0.97"	1.13	0.99
5yr.	= 0.60"	0.79	0.67
2yr.	= 0.48"		0.45
10yr.	= 0.70"		0.82

Red ⇒ NOAA MAPS

Black ⇒ City of Reno charts per Kennedy Report Chart

Calcs of Subareas feeding Paradise pond

Subarea "A" Present Condition

total Area

59.18 ⇒ 15.165
59.15

$$15.165 \frac{(400)^2}{(5280)^2} = 15.165\ (0.0057) = \underline{0.340\ sm}$$

Soil type area

Scs #	Planimeter		Avg. Plan.	* Area (SF)
862	1.17	1.13	1.15	184,452
871	10.61	10.56	10.585	1,697,761
132	4.12	4.18	4.15	665,631
191	1.11	1.14	1.125	180,442
862	1.52	1.46	1.49	238,986
880	0.91	0.87	0.89	142,750
862	2.64	2.59	2.615	419,428
872	3.48	3.47	3.475	557,366
880	0.62	0.61	0.615	98,642
872	2.60	2.57	2.585	414,616
221	7.27	7.27	7.27	1,166,058
880	0.52	0.50	0.51	81,800
880	0.45	0.43	0.44	70,573
880	1.30	1.25	1.275	204,501
870	1.72	1.69	1.705	273,470
880	0.96	0.96	0.96	153,977
871	7.69	7.72	7.705	1,235,829
222	1.20	1.24	1.22	195,680
882	2.03	1.99	2.01	322,390
880	4.39	4.41	4.40	705,730
881	1.92	1.92	1.92	307,955
221	0.25	0.25	0.25	40,098
222	0.65	0.70	0.675	108,265
			59.02	9,466,400

* Area = (Avg. Plan.)(400)²(C_F)

C_F = Correction factor = $\frac{59.165}{59.02} = 1.0025$

Subarea "A" Present Condition Cont

Summary Soil types

SCS #	Area	Hydrologic Group
132	665,631	C
191	180,442	D
221	1,314,421	D
222	303,945	D
862	842,866	D
870	273,470	D
871	2,933,590	D
872	971,982	D
880	1,457,973	D
881	307,955	C
882	322,390	C

C area

665,631
307,955
322,390
1,295,976 ⇒ $\frac{1,295,976}{9,466,400} = 14\%$

∴ D area = 100 − 14 = 86%

Roadway area

total ⇒ 3.10 3.15 ⇒ 3.125 ⇒ $3.125(400)^2 = 500,000$ sf

C ⇒ 1.02 1.03 ⇒ 1.025 ⇒ $1.025(400)^2 = 164,000$ sf

C ⇒ $\frac{164,000}{9,466,400} = 2\%$ D ⇒ $\frac{500,000 - 164,000}{9,466,400} = 3\%$

Jail area

total ⇒ 6.28 6.20 ⇒ 6.24 ⇒ $6.24(400)^2 = 998,400$ sf

C ⇒ 2.65 2.70 ⇒ 2.675 ⇒ $2.675(400)^2 = 428,000$ sf

C ⇒ $\frac{428,000}{9,466,400} = 4.5\%$ D ⇒ $\frac{998,400 - 428,000}{9,466,400} = 10.5\%$

Subarea "A" Present Condition

TR 55

Land Use	Hydrologic Soil Group D %	D CN	D Product	Hydrologic Soil Group C %	C CN	C Product	%	CN	Product
Road w/open Ditchs	3	94	282	2	92	184			
Commerical (Jail)	10.5	95	997.5	4.5	94	423			
	55.7	82	5945	~~63.5~~	76	570			
Open Steep Range (Poor condition)	(12.5)	~~80~~	~~6452.5~~	(7.5)	~~86~~	645			
	16.8	86		4.0	86				
	86%		~~7732~~	14%		1252			
			7224.5			1177.0			
			7291.7			1197.0	(85)	future	

Adjusted CN = $\frac{7224.5 + 1177}{100} = 84$

Weighted CN = $\frac{7732 + 1252}{100} = 90$

Subarea "A" Present Condition

Time of Concentration

Reach	Descrip. of flow	Slope (%)	Length (Ft)	Table 3-1 Velocity	Time (t_c) sec.
A to B	Overland (poor Cond.)	22%	1950'	4.6 Ft/sec.	424
B to C	Overland (poor Cond.)	5%	2320'	2.25 Ft/sec.	1031
C to D	48" Pipe	3%	1270'	① 17.2 Ft/sec	74
					1529 sec.

$t_c = \frac{1529}{3600} = \underline{0.42 \text{ hrs.}}$

$L = 0.6\,(t_c)$

$L = 0.6\,(0.42) = \underline{0.25 \text{ hrs.}}$

$V = \frac{1.49}{N}\left(\frac{D}{4}\right)^{2/3}(S)^{1/2}$

① $V = \frac{1.49}{0.015}\left(\frac{4}{4}\right)^{2/3}(0.03)^{1/2} = 17.2 \text{ Ft/sec}$

Avg. Slope $= \frac{0.22(1950) + 0.05(2320) + 0.03(1270)}{583.10}$

$= \frac{583.10}{(1950+2320+1270)} = 0.105$

$L = \frac{L^{0.8}(S+1)^{0.7}}{1900\,(y)^{0.5}}$

$L = \frac{(1950+2320+1270)^{0.8}\left[\left(\frac{1000}{90} - 10\right)+1\right]^{0.7}}{1900\,(0.105)^{0.5}}$

$\underline{L = 0.27 \text{ hrs.}}$

Subarea "B" Present Condition

total Area

54.99 55.07 ⇒ 55.04
21.04 20.98 ⇒ 21.01
76.05

76.05 (0.0057) = 0.436 sm

Soil type Area

Scs #	Planimeter		Avg. Plan	Area (SF)
880	0.72	0.71	0.715	114,242
880	0.18	0.20	0.19	30,358
861	14.96	14.92	14.94	2,387,104
221	0.03	0.04	0.035	5,592
880	0.13	0.12	0.125	19,972
222	8.21	8.14	8.175	1,306,197
221	11.34	11.26	11.30	1,805,507
880	0.06	0.08	0.07	11,185
870	1.42	1.37	1.395	222,892
870	1.70	1.69	1.695	270,826
872	11.63	11.59	11.61	1,855,039
862	0.57	0.57	0.57	91,074
871	1.98	1.93	1.955	312,369
190	0.17	0.16	0.165	26,364
683	1.67	1.69	1.68	268,429
110	0.70	0.73	0.715	114,242
870	3.06	2.99	3.025	483,333
812	1.25	1.26	1.255	200,523
312	0.90	0.92	0.91	145,399
862	0.08	0.08	0.08	12,782
862	0.90	0.88	0.89	142,204
880	2.15	2.15	2.15	343,526
882	4.68	4.69	4.685	748,566
221	1.96	1.98	1.97	314,765
110	5.86	5.85	5.855	935,508
			76.155	12,168,000

Subarea "B" Present Condition

Summary Soil type

Scs #	Area	Hydrologic group
110	1,049,750	D
190	26,364	D
221	2,125,864	D
222	1,306,197	D
312	145,399	D
683	268,429	D
812	200,523	B
861	2,387,104	D
862	246,060	D
870	977,051	D
871	312,369	D
872	1,855,039	D
880	519,283	D
882	748,566	C

C area

$\frac{748,566}{12,168,000} = 6\%$

B area

$\frac{200,523}{12,168,000} = 2\%$

$\therefore$ D $\Rightarrow 100 - (6+2) = 92\%$

Res. in C 1/5 acre

$2.18\ \ 2.15 \Rightarrow 2.165 \Rightarrow \frac{2.165\,(400)^2}{748,566\ sf} = 46\% \times 0.06 = 3\%$

Res in D 1/5 acre

$12.59\ \ 12.50 \Rightarrow 12.545 \Rightarrow \frac{12.545(400)^2}{12,168,000} = 16.5\%$

OPEN DITCH W Roadway

$$2.88 \quad 2.90 \Rightarrow 2.89 \Rightarrow \frac{2.89(400)^2}{12,186,000} = 4\%$$

Residential 1 acre

$$1.98 \quad 2.02 \Rightarrow 2.000 \Rightarrow \frac{3.195(400)^2}{12,186,000} \quad 4\%$$

$$1.19 \quad 1.20 \Rightarrow 1.195$$

Subarea "B" Present Condition

TR 55

Land Use	Hydrologic Soil Group D			C			B		
	%	CN	Product	%	CN	Product	%	CN	Product
Residental 1/5 acre	16.5	89	1468.5	3	85	255	2	77	154
Road w/ open Ditches	4	94	376						
Residental 1 acre	4	84	336						
Open Range (Poor Cond)	42 ~~67.5~~	82 ~~89~~	5535 ~~6007.5~~	3	76 ~~86~~	228 ~~258~~			
future ½ acre	25.5	85							
	92		~~8188~~ 7715.5	6		~~513~~ 493	2		154
			7792	(84)	future				

Adjusted CN = $\frac{7715.5+493+154}{100}$ = 94

Weighted CN = $\frac{8188+513+154}{100}$ = 89

Subarea "B" Present Condition Time of Concentration

Reach	Descrip. of flow	Slope (%)	Length (Ft.)	Table 3-1 Velocity	Time sec.
A to B	overland (poor cond.)	18 ~~4.2~~ %	1350	4.25 Ft/sec.	318
B to C	overland (poor cond.)	4%	1580	2 Ft/sec.	790
C to D	Pipe 30"	4%	380	* 14.5 Ft/sec.	26
D to E	overland (short weeds)	3%	1890	1.2 Ft/sec	1575
					2709 sec

$t_c = \frac{2709}{3600} = 0.75$ hrs.

Avg. Slope

$0.18 (1350)$
$0.04 (1580)$
$0.04 (380)$
$0.03 (1890)$
378.10

$= \frac{378.10}{5200}$

$= 7.27\%$

$L = 0.6\, t_c$

$L = 0.45$ hrs.

$$L = \frac{(1350+1580+380+1890)^{0.8}\left[\left(\frac{1000}{89}-10\right)+1\right]^{0.7}}{1900\ (7.27\%)^{0.5}}$$

$L = 0.32$ hrs.

* $V = \frac{1.49}{0.015}\left(\frac{2.5}{4}\right)^{2/3}(0.04)^{1/2} = 14.5$ Ft/sec

Subarea "C" Present Condition

This area is a Possibe Perculation Basin Only now.

Total area

11.77 ⇒ 11.79
11.81

11.79 (0.0057) = 0.0677 s.m.

Soil types

SCS #	Planimeter		Avg. Plan	Area (SF)
862	0.03	0.03	0.03	4812
862	0.20	0.20	0.20	32,082
880	5.44	5.37	5.405	867,006
872	3.44	3.39	3.415	547,794
991	0.51	0.51	0.51	81,808
882	2.18	2.22	2.20	352,898
			11.76	1,886,400

$C_F = 1.0026$

Summary area

Scs #	Area (SF)	Hydrologic group
862	36,894	D
872	547,794	D
880	867,006	D
882	352,898	C
991	81,803	D

Subarea "C" Present Condition Con't

Residential 1/5 acre

$0.67 \quad 0.68 \Rightarrow 0.675 \Rightarrow \frac{0.675(400)^2}{1,886,400} = 6\%$

C area

$\frac{352,898}{1,886,400} = 19\%$ $\quad \therefore D_{area} = 100 - 19 = 81\%$

Subarea "C" present Condition

TR 55

Land Use	Hydrologic Soil Group D %	D CN	D Product	C %	C CN	C Product	%	CN	Product
Residental ½ acre	6	89	534						
Open Range (Poor Cond.)	75	82 ~~89~~	6150 ~~6675~~ ~~19~~	19	76 ~~86~~	1444 ~~1634~~			
	81%		~~7209~~ 6684	19%		~~1634~~ 1444			

Adjusted $CN = \frac{6684 + 1444}{100} = 81$

Weighted $CN = \frac{7209 + 1634}{100} = 88$

Subarea "C" Present Condition Time of Concentration

Reach	Descrip. of flow	Slope (%)	Length (Ft.)	Table 3-1 velocity	Time sec.
A to B	Overland (poor)	20%	1150	4.5 Ft/sec	256
B to C	Overland (poor)	3.3%	300	1.8 Ft/sec.	167
					423 sec.

$t_c = \frac{423}{3600}$ 0.12 hrs.

$L = 0.6\ t_c$

$L = 0.6(0.12) =$ 0.07 hrs.

Avg. Slope

$0.20(1150)$
$0.033(300)$
239.9

$= \frac{239.9}{1450} = 16.5\%$

$$L = \frac{(1150+300)^{0.8}\left[\left(\frac{1000}{88}-10\right)+1\right]^{0.7}}{1900\ (16.5\%)^{0.5}}$$

$L = 0.08$ hrs.

Subarea "D" present Condition

total Area

41.31 ⇒ 41.295 ⇒ 41.295 (0.0057)
41.28

237
= 0.~~24~~ S.M.

Soil types

Scs#	Planimetar		Avg. Plan	Area (SF)
882	3.30	3.30	3.30	528,000
872	0.31	0.33	0.32	51,200
221	1.04	1.03	1.035	165,600
110	6.44	6.44	6.44	1,030,400
871	0.59	0.57	0.58	92,800
991			29.62	4,739,200
			41.295	6,607,200

Summary of Soil types

Scs #	Area (SF)	Hydrologic group
110	1,030,400	D
221	165,600	D
871	92,800	D
872	51,200	D
882	528,000	C
991	4,739,200	N/A

C area

$\frac{528,000}{6,607,200} = 8\%$

D area

$\frac{51,200 + 92,800 + 165,600 + 1,030,400}{6,607,200} = 20\%$

Subarea "D" Present Condition Con't

Commercial Area

18.72 ⇒ 18.72 (400)² = 2,995,200 sF / 6,607,200 = 45%
18.72

* We shall assume that soil type #991 is in the class group D as a worse case dimension.

Industrail Area

0.49 0.48 0.485
2.15 2.16 ⇒ 2.155 ⇒ 2.99 (400)² / 6,607,200 = 7%
0.34 0.36 0.35

Mobile Home Park

1.05 1.04 ⇒ 1.045 (400)² / 6,607,200 = 2.5%

Residental

C ⇒ 0.30 0.30 ⇒ 0.30 (400)² / 6,607,200 1%

D ⇒ 11.00 11.10 ⇒ 11.05 (400)² / 6,607,200 = 27%

Subarea "D" Present Condition

TR 55

Land Use	Hydrologic Soil Group D %	D CN	D Product	C %	C CN	C Product	%	CN	Product
Commercial	45	95	4275						
Industrail 12.5	(7)	93	651						
Mobile Home Park	2.5	92	230	8%					
Residential (1 acre) ~~28~~ 27	(27)	84	2268	(1%)	79	79			
Open range (poor) 47	(10.5)	82 ~~87~~	861 ~~934.5~~	(79%)	76 ~~86~~	532 ~~602~~			
	92		~~8358.5~~ 8285 8347.5	8%		~~681~~ 611 632			
						(90) future			

Adjusted CN = $\frac{8285+611}{100} = 89$

Weighted CN = $\frac{8358.5+681}{100} = 90$

Subarea "D" Present Condition Time of Concentration

Reach	Descrip. of flow	Slope (%)	Length (Ft.)	Table 3-1 Velocity	Time sec.
A to B	overland (poor cond.)	8%	270	2.8 Ft/sec	96
B to C	Asphalt Ditched	4%	850	4.0 Ft/sec.	212
C to D	grass Ditched (bare)	6.5%	650	2.5 Ft/sec	260
D to E	18" Pipe	4%	960	10.3 Ft/sec.	93
E to F	24" Pipe	1.5%	1240	7.7 Ft/sec.	161
F to G	48" Pipe	1.0%	420	9.9 Ft/sec.	42
G to H	Ditched grass	1.0%	190	1.5 Ft/sec.	127
H to I	48" Pipe	2.5%	100	15.7 Ft/sec.	6
			4680		997 Sec.

$V_1 = \frac{1.49}{0.015}\left(\frac{1.5}{4}\right)^{2/3}(0.04)^{1/2} = 10.3$ Ft/sec

$V_2 = \frac{1.49}{0.015}\left(\frac{2}{4}\right)^{2/3}(0.015)^{1/2} = 7.7$ Ft/sec

$V_3 = \frac{1.49}{0.015}\left(\frac{4}{4}\right)^{2/3}(0.01)^{1/2} = 9.9$ Ft/sec

$V_4 = \frac{1.49}{0.015}\left(\frac{4}{4}\right)^{2/3}(0.025)^{1/2} = 15.7$ Ft/sec

$$L = \frac{(4680)^{0.8}\left[\left(\frac{1000}{90} - 10\right)+1\right]^{0.7}}{1900\,(3.5\%)^{0.5}}$$

$= 0.41$ hrs.

$t_c = \frac{997}{3600} = 0.28$ hrs.

$L = 0.6\,t_c$

$L = 0.17$ hrs.

Avg. Slope

0.08	270
0.04	850
0.065	650
0.04	960
0.015	1240
0.01	420
0.01	190
0.025	100

$163.45 \div 4680 = 3.52$

Routing subarea "B" through subarea "D"

1.) 18" pipe

$L = 930'$
$S = 2.5\%$

$$V = \frac{1.49}{0.015}\left(\frac{1.5}{4}\right)^{2/3}(0.025)^{1/2} = 8.2 \text{ Ft/sec}$$

$$t = {}^{930}/_{8.2} = 113 \text{ sec.}$$

2) Open channel

$L = 40'$
$S = 2.5\%$

$V = 0.75 \text{ Ft/sec}$

$$t = {}^{40}/_{0.75} = 53 \text{ sec.}$$

3.) 24" pipe

$L = 390'$
$S = 3.5\%$

$$V = \frac{1.49}{0.015}\left(\frac{2}{4}\right)^{2/3}(0.035)^{1/2} = 11.7 \text{ Ft/sec}$$

$$t = {}^{390}/_{11.7} = 33 \text{ sec.}$$

4.) Open Channel

$L = 10'$
$S = 10\%$

$V = 1.5 \text{ Ft/sec}$

$$t = {}^{10}/_{1.5} = 7 \text{ sec.}$$

Routing "B" through "D"

5.) 48" PIPE

$L = 420'$ /
$S = 1.0\%$

$$V = \frac{1.49}{0.015}\left(\frac{4}{4}\right)^{2/3}(0.01)^{1/2} = 9.9 \text{ FT/sec}$$

$$t = {}^{420}/_{9.9} = 42 \text{ sec.}$$

6.) Open channel

$L = 190'$
$S = 1.0\%$

$V = 1.5$ FT/sec.

$$t = {}^{190}/_{1.5} = 127 \text{ sec.}$$

7.) 48" Pipe

$L = 100'$
$S = 2.5\%$

$$V = \frac{1.49}{0.015}\left(\frac{4}{4}\right)^{2/3}(0.015)^{1/2} = 15.7 \text{ FT/sec}$$

$$t = {}^{100}/_{15.7} = 6 \text{ sec.}$$

time total (K)

$113 + 53 + 33 + 7 + 42 + 127 + 6 = 381$ sec.

$$\frac{381}{3600} = 0.11 \text{ hrs.} = K$$

$x = 0.30$ try

Subarea "E" Present Condition

Total Area

28.46 28.34 ⇒ 28.40

28.40 (0.0057) = 0.163 sm

Soil type areas

Scs #	Planimeter		Avg. Plan	Area (SF)
	12.70	12.77		
991	~~14.14~~	~~14.21~~	12.735	2,047,694
~~991~~	~~0.75~~	~~0.69~~		
991	0.65	0.55	0.60	96,476
871	0.42	0.40	0.41	65,925
132	0.10	0.14	0.12	19,295
132	0.65	0.64	0.645	103,711
191	0.78	0.77	0.775	124,614
862	2.08	2.10	2.09	336,057
190	2.58	2.61	2.595	417,257
192	0.08	0.08	0.08	12,863
871	0.33	0.31	0.32	51,454
190	3.48	3.51	3.495	561,970
871	1.44	1.44	1.44	231,541
880	0.08	0.08	0.08	12,863
872	0.54	0.53	0.535	86,024
880	0.16	0.16	0.16	25,727
861	2.19	2.17	2.18	350,528
			28.26	4,544,000

$$C_f = \frac{28.40}{28.26} = 1.0050$$

Subarea "E" Present Condition

Summary Soil types

Scs #	Area (SF)	Hydrologic group
132	123,006	C
190	979,227	D
191	124,614	D
192	12,863	D
861	350,528	D
862	336,057	D
871	348,920	D
872	86,024	D
880	38,590	C
991	2,144,170	N/A

C area

$\frac{38590 + 123,006}{4,544,000} = 3.5\%$ ∴ D area = 100 − 3.5 = 96.5%

Assuming the N/A area is considered as Hydrologic group D.

Commercial

C ⇒ 0.65 0.63 ⇒ $\frac{0.64(400)^2}{4,544,000} = 2\%$

D ⇒ 0.66 0.70 ⇒ 0.68 ⇒ $\frac{7.82(400)^2}{4,544,000} = 27.5\%$
1.14 1.14 ⇒ 1.14

Roadway w/ open Ditch

0.42 0.50 ⇒ $\frac{0.46(400)^2}{4,544,000} = 1.5\%$

Asphalt

2.21 2.31 ⇒ $\frac{2.26(400)^2}{4,544,000} = 8\%$

Subarea "E" Present Condition Con't

Industrial

7.10 7.15 ⇒ $\frac{7.125(400)^2}{4,544,000} = 25\%$

Residental less than 1/8

1.66 1.50 ⇒ $\frac{1.58(400)^2}{4,544,000} = 5.5\%$

D ⇒

C ⇒ 0.17 0.18 ⇒ $\frac{0.175(400)^2}{4544,000} = 0.5$

Residental 1 acre

1.09 1.00 ⇒ $\frac{1.045(400)^2}{4,544,000}$ 4%

Subarea "E" Present Condition

TR 55

Land Use	Hydrologic Soil Group D %	D CN	D Product	C %	C CN	C Product	%	CN	Product
Commercial 45.5	27.5	95	2612.5	~~1.5~~ 2	94	188			
Roadway w/ open Ditch	1.5	94	141						
Asphalt	8	98	784						
Industrial	25	93	2325						
Residental < 1/8 acre	5.5	92	506	0.5	90	45			
Residental 1 acre	4	84	336		76				
Open Space (poor)	25	82 ~~89~~	2050 ~~2225~~	1	86 ~~89~~	76 ~~89~~			
	96.5		~~8929.5~~ 8754.5 8988.5	3.5		~~319~~ 309			

Adjusted CN = $\frac{8754.5 + 309}{100} = 91$ (93)

Weighted CN = $\frac{8929.5 + 319}{100} = 92$

Subarea "E" Present Condition Time of Concentration

Reach	Descrip. of flow	Slope (%)	Length (Ft.)	Table 3-1 Velocity	Time sec.
A to B	Open Ditch (Bare)	1	1450	1 Ft/sec	1450
B to C	36" Pipe	1	280	8.2 Ft/sec	34
C to D	Open Ditch (Bare)	1	980	1 Ft/sec	980
D to E	24" Pipe	2	130	8.8 Ft/sec.	15
E to F	Open Ditch	1.5	650	1.2 Ft/sec	542
F to G	36" Pipe	5	~~50~~ 120	18.3 Ft/sec	7
G to H	Open Ditch	1.5	700	1.2 Ft/sec	583
H to I	36" Pipe	1.5	60	10.0 Ft/sec. ~~8.8 Ft~~	6
I to J	Open Ditch	10	300	3.2 Ft/sec.	94
			4670		3711 sec

$t_c = \frac{3711}{3600} = 1.03$ hrs.

$L = 0.6\, t_c$

$L = 0.6(1.03) = 0.62$ hrs.

$V_1 = \frac{1.49}{0.015}\left(\frac{3}{4}\right)^{2/3}(0.01)^{1/2} = 8.2$ Ft/sec

$V_2 = \frac{1.49}{0.015}\left(\frac{2}{4}\right)^{2/3}(0.02)^{1/2} = 8.8$ Ft/sec

$V_3 = \frac{1.49}{0.015}\left(\frac{3}{4}\right)^{2/3}(0.05)^{1/2} = 18.3$ Ft/sec

$V_4 = \frac{1.49}{0.015}\left(\frac{3}{4}\right)^{2/3}(0.015)^{1/2} = 10.0$ Ft/sec

Avg. Slope

0.01 (1450)
0.01 (280)
0.01 (980)
0.02 (130)
0.015 (650)
0.05 (120)
0.015 (700)
0.015 (60)
0.10 (300)

86.85

$\frac{86.85}{4670} = 1.86\%$

$L = \frac{(4670)^{0.8}\left[\left(\frac{1000}{92} - 10\right)\right]+1)^{0.7}}{1900\,(1.86)^{0.5}}$

$L = 0.52$ hrs.

DJ | PARADISE POND

Routing Subarea "A" through Subarea "E"

1.) 24"x30" square culvert

$L = 50'$
$S = 2\%$

$$V = \frac{1.49}{0.015}\left(\frac{2(2.5)}{2+2+2.5+2.5}\right)^{2/3}(0.02)^{1/2} = 9.5\ FT/sec.$$

$$t = 50/9.5 = 5\ sec.$$

~~2.)~~

2.) OPEN DITCH

$L = 20'$
$S = 402$
~~1.49~~
$V = 6.5\ FT/sec.$

$$t = 20/6.5 = 3\ sec.$$

3.) 36" pipe

$L = 50'$
$S = 2\%$

$$V = \frac{1.49}{0.015}\left(\frac{3}{4}\right)^{2/3}(0.02)^{1/2} = 11.6\ FT/sec.$$

$$t = 50/11.6 = 4\ sec.$$

4.) OPEN DITCH

$L = 580'$
$S = 1\%$

$V = 1\ FT/sec$

$$t = 580/1 = 580\ sec.$$

Routing "A" through "E" Con't

5.) see time of Concentration for Subarea "E"

~~D to E~~ B to C	34
C to D	980
D to E	15
E to F	542
F to G	7
G to H	583
H to I	6
I to J	94
	2261 sec total

total time (K)

5+3+4+580+2261 = 2853 sec.

$\frac{2853}{3600}$ = 0.79 hrs. = K

X = 0.30 try

Routing Subareas "B" & "D" through Subarea "E"

1.) 48" PIPE

$L = 850'$
$S = 1.5\%$

$$V = \frac{1.49}{0.015}\left(\frac{4}{4}\right)^{2/3}(0.025)^{1/2} = 15.7 \text{ FT/sec.}$$

$$t = {}^{850}/_{15.7} = 54 \text{ sec.}$$

total time (K)

$$K = \frac{54}{3600} = 0.015 \text{ hrs.}$$

$x = 0.30$ try

DW | PARADISE POND

Subarea "F" Present Condition

total Area

~~57.11~~ 56.67
56.66 ⇒ 56.665 (0.0057) = 0.325 sm

Soil types

Scs #	Planimeter		Avg. Plan	Area (SF)
190	0.04	0.07	0.055	8826
871	5.01	5.00	5.005	803,210
190	2.39	2.38	2.385	382,748
280	3.54	3.53	3.535	567,302
871	3.29	3.36	3.325	533,601
191	10.10	10.10	10.10	1,620,863
310	4.66	4.57	4.515	724,574
311	0.06	0.07	0.065	10,431
871	0.30	0.26	0.28	44,935
190	15.92	15.82	15.87	2,546,941
1050	6.62	6.71	6.665	1,069,609
311	4.67	4.72	4.695	753,460
			56.495	9,066,400 sf

$C_F = \frac{56.665}{56.495} = 1.0030$

Summary of Soil types

Scs #	Area	Hydrologic group
190	2,938,415	D
191	1,620,863	D
280	567,302	D
310	724,574	D
311	763,891	D
871	1,381,746	D
1050	1,069,609	D

Subarea "F" Present Condition Con't

Asphalt

0.42 0.48 ⇒ $\frac{0.45\,(400)^2}{9,066,400}$ = 1%

Road w/ c&g

0.13 0.16 ⇒ $\frac{0.145\,(400)^2}{9,066,400}$ = .5%

Residential 1/3 acre

9.91 9.85 ⇒ $\frac{9.88\,(400)^2}{9,066,400}$ = 17.5%

Residential 1/3 acre

8.19 8.14 ⇒ $\frac{8.165\,(400)^2}{9,066,400}$ = 14.5%

Residential 1 acre

3.19 3.24 ⇒ $\frac{3.20\,(400)^2}{9,066,400}$ = 5.5%

TR 55

Subarea "F" Present Condition

LAND USE	Hydrologic Soil Group D %	D CN	D Product	%	CN	Product	%	CN	Product
Asphalt	1	98	98						
Roads w/ Curb & Gutter	.5	98	49						
Residential (1/8 acre)	17.5	92	1610						
Residential (1/3 acre) 56.5	(14.5)	86	1247						
Residential (1 acre)	5.5	84	462						
Open Range land (poor) 19	(61)	92 89	5002 ~~5491~~						
	100		~~8895~~ 8468						
			(86)						

Adjusted CN = $\frac{8468}{100} = 85$

Weighted CN = $\frac{8895}{100} = 89$

Subarea "F" Present Cond. Time of Concentration

Reach	Descrip. of flow	Slope (%)	Length (Ft.)	Table 3-1 velocity	Time sec.
A to B	Curb & Gutter flow	2.5	500	3.2 Ft/sec.	156
B to C	12" PIPE	6.5	500	10.0 Ft/sec.	50
C to D	18" PIPE	5.0	1060	11.5 Ft/sec	92
D to E	24" PIPE	6.0	2070	15.3 Ft/sec	135
			4130		433 sec

$t_c = \frac{433}{3600} = 0.12$ hrs.

$L = 0.6\, t_c$

$L = 0.6(0.12) = 0.07$ hrs.

Avg. Slope

$0.025\,(500)$
$0.065\,(500)$
$0.05\,(1060)$
$0.06\,(2070)$
222.2

$\frac{222.2}{4130} = 5.4\%$

$V_1 = \frac{1.49}{0.015}\left(\frac{1}{4}\right)^{2/3}(0.065)^{1/2} = 10.0$ Ft/sec

$V_2 = \frac{1.49}{0.015}\left(\frac{1.5}{4}\right)^{2/3}(0.05)^{1/2} = 11.5$ Ft/sec

$V_3 = \frac{1.49}{0.015}\left(\frac{2}{4}\right)^{2/3}(0.06)^{1/2} = 15.3$ Ft/sec

$$L = \frac{(4130)^{0.8}\left[\left(\frac{1000}{99} - 10\right) + 1\right]^{0.7}}{1900\,(5.4)^{0.5}}$$

$L = 0.31$ hrs.

Subarea "G" Present Condition

total Area

~~66.95~~
59.54
59.54 ⇒ 59.54 (0.0057) = 0.342 sm

Soil types

Scs #	Planimeter		Avg. Plan	Area (SF)
872.	0.31	0.30	~~0~~ 0.305	48,714
861.	0.20	0.20	0.20	31,944
880.	16.58	16.48	16.53	2,640,144
881.	0.27	0.26	0.265	42,325
281.	1.23	1.25	1.24	198,051
190.	0.08	0.09	0.085	13,576
280.	1.56	1.54	1.55	247,563
191.	0.29	0.31	0.30	47,916
1050	2.15	2.10	2.125	339,401
350.	0.20	0.22	0.21	33,541
350.	0.10	0.15	0.125	19,965
683.	0.05	0.06	0.055	8,785
872.	2.49	2.50	2.495	398,497
312.	0.16	0.15	0.155	24,756
280.	8.42	8.45	8.435	1,347,224
281.	7.60	7.55	7.575	1,209,866
991	17.97	18.02	17.995	2,874,131
			59.645	9,526,400

$C_F = \frac{59.54}{59.645} = 0.9982$

Subarea "G" Present Condition Cont

Summary of Soil types

Scs #	Area	Hydrologic Group
190	13,576	D
191	47,916	D
	1,594,787	
280	~~247,563~~	D
281	~~1,209,866~~	D
	1,407,917	
312	24,756	D
350	53,506	D
683	8785	D
861	31,944	D
872	447,211	D
880	2,640,144	D
881	42,325	C
991	2,874,131	N/A
1050	339,401	D

Carea

$$\frac{42,325}{9,526,400} = 0.5\% \qquad \therefore \text{Darea} = 99.5\%$$

Residential 1/8 acre

2.95 2.98 $\Rightarrow \frac{2.965\,(400)^2}{9,526,400} = 5\%$

Residential 1/4 acre

8.08 8.09 $\Rightarrow \frac{8.085\,(400)^2}{9,526,400} = 13.5\%$

Subarea "G" Present Condition Cont

Roadway (C & G)

$$\begin{matrix} 0.27 & 0.27 \\ 0.30 & 0.34 \end{matrix} \Rightarrow \begin{matrix} 0.27 \\ 0.32 \end{matrix} \Rightarrow \frac{0.59\,(400)^2}{9,526,400} = 1\%$$

Roadway w/ Ditch

$$2.83 \quad 2.75 \Rightarrow \frac{2.79\,(400)^2}{9,526,400} = 5\%$$

Subarea "G" Present Condition

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Land Use	Hydrologic Soil Group D			C					
	%	CN	Product	%	CN	Product	%	CN	Product
Residental (1/8 acre)	5	92	460						
Residental (1/4 acre)	13.5	87	1174.5						
Roadway w/ C&G	1	98	98						
Roadway w/open ditches	5	94	470						
Open land (poor) 72.5	(75)	82	6150		76	38			
		~~89~~	~~6675~~	0.5	~~86~~	~~43~~			
	99.5		~~8877.5~~			~~43~~			
Comm. 2.5		93	8352.5	0.5		38			
			8418	(84)					

Adjusted CN = $\frac{8352.5+38}{100} = 84$

Weighted CN = $\frac{8877.5+43}{100} = 89$

Subarea "G" Present Cond. Time of Concentration

Reach	Descrip. of flow	Slope (%)	Length (Ft)	Table 3-1 velocity	Time sec.
A to B	Open land	12.5%	1420	3.5 Ft/sec	406
B to C	30" PIPE	3%	120	12.6 Ft/sec	10
C to D	Open channel	7%	450	2.6 Ft/sec.	173
D to E	Open channel	1.5%	4480	0.85 Ft/sec	5271
			6470		5860

$t_c = \frac{5860}{3600} = 1.63$ hrs.

$L = 0.6\, t_c$

$L = 0.6(1.63) = 0.98$ hrs.

Avg. Slope

$0.125(1420)$
$0.03(120)$
$0.07(450)$
$0.015(4480)$
279.80

$\frac{279.80}{6470} = 4.3\%$

$L = \frac{(6470)^{0.8}\left(\left(\frac{1000}{89}-10\right)+1\right)^{0.7}}{1900\ (4.3)^{0.5}}$

$L = 0.50$ hrs.

$V_1 = \frac{1.49}{0.015}\left(\frac{2.5}{4}\right)^{2/3}(0.03)^{1/2} = 12.6$ Ft/sec

Routing Subarea "F" through Subarea "G"

1.) 24" PIPE

$L = 320'$
$S = 13\%$

$V = \frac{1.49}{0.015}\left(\frac{2}{4}\right)^{0.666}(0.13)^{0.5} = 22.6\ ^{FT}/_{sec}$

$t = 14$ sec

2.) Open channel

$L = 4410'$
$S = 1.5\%$

$V = 0.85\ ^{FT}/_{sec}$

$t = 5188$ sec.

total time (K)

$K = \frac{5188 + 14}{3600} = 1.45$ hrs.

$x = 0.30$ try

Routing Subareas "B", "D", "E" "A" through Subarea "G"

1.) Open channel

$L = 1120'$
$S = 2\%$

$V = 1$ Ft/sec.

$t = 1120$ sec.

2.) Open Channel

$L = 4480'$
$S = 1.5\%$

$V = 0.85$ Ft/sec.

$t = 5271$ sec

Total time (K)

$$K = \frac{5271 + 1120}{3600} = 1.78 \text{ hrs.}$$

$X = 0.30$ try

Subarea "H" Present Condition

This area has no outlet under the R.R., just percolation

total Area

13.76 ⇒ 13.79 (0.0057) = 0.079 s/m.
13.82

Soil types

Scs #	Planimeter		Avg. Plan	Area (SF)
~~331~~ 311	4.62	4.62	4.62	740,542
1050	1.76	1.72	1.74	278,906
350	2.91	2.94	2.925	468,850
310	1.61	1.62	1.615	258,869
191	1.79	1.81	1.80	288,523
991	1.06	1.07	1.065	170,709
			13.765	2,206,400

$C_F = \frac{13.79}{13.765} = 1.0018$

Summary of Soil types

Scs #	Area	Hydrologic Group
191	288,523	D
310	258,869	D
311	740,542	D
350	468,850	D
991	170,709	N/A
1050	278,906	D

Subarea "H" Present Condition Con't

Residental 1 acre

$$1.04 \quad 1.02 \Rightarrow \frac{1.03\ (400)^2}{2,206,400} = 7.5\%$$

Water tank gravel

$$0.49 \quad 0.51 \Rightarrow \frac{0.50\ (400)^2}{2,206,400} = 3.5\%$$

TR 55

Subarea "H" Present Condition

LAND USE	Hydrologic Soil Group D								
	%	CN	Product	%	CN	Product	%	CN	Product
Residential 1 acre	7.5	84	630						
Water tank area (gravel)	3.5	91	318.5						
Open area (poor)	89	~~89~~ 82	~~7921~~ 7298						
	100		~~8869.5~~ 8246.5						

Adjusted CN = $\frac{8246.5}{100} = 82$

Weighted CN = $\frac{8869.5}{100} = 89$

Subarea "H" Present Condition Time of Concentration

Reach	Descrip. of flow	Slope (%)	Length (Ft.)	Table 3-1 velocity	Time sec.
A to B	over land	16%	1530'	4 Ft/sec.	383

$t_c = \frac{383}{3600} = 0.11$ hrs.

$L = 0.6\, t_c = 0.6\,(0.11)$

$(L = 0.06$ hrs.$)$

$$L = \frac{(1530)^{0.8}\left[\left(\frac{1000}{89} - 10\right) + 1\right]^{0.7}}{1900\ (16)^{0.5}}$$

$L = 0.08$ hrs.

Subarea "I" Present Condition

Total Area

63.38 63.35 ⇒ 63.365 ⇒ 75.505
12.16 12.12 12.14

75.505 (0.0057) = 0.433 sm

Soil types

Scs #	Planimeter		Avg. Plan	Area (SF)
	5.91	5.90		
991	~~7.01~~	~~6.99~~	5.905	945,113
631	0.26	0.26	0.26	41,614
630	3.06	3.08	3.07	491,363
350	0.36	0.34	0.35	56,019
683	4.53	4.49	4.51	721,839
1050	7.32	7.35	7.335	1,173,989
688	2.89	2.87	2.88	460,953
191	29.40	29.31	29.355	4,698,356
871	0.86	0.88	0.87	139,246
191	0.21	0.22	0.215	34,411
190	0.81	0.76	0.785	125,642
871	7.40	7.34	7.37	1,179,591
190	2.85	2.84	2.845	455,351
311	2.72	2.78	2.75	440,146
310	6.67	6.63	6.65	1,064,362
191	0.34	0.32	0.33	52,817
			75.48	12,080,800

$C_F = \frac{75.505}{75.48} = 1.0003$

Subarea "I" Present Condition Con't

Summary of Soil types

SCS #	Area	Hydrologic group
190	580,993	D
191	4,785,584	D
310	1,064,352	D
311	440,146	D
350	56,019	D
630	491,363	D
631	41,614	D
683	721,839	D
683 ~~688~~	460,953	D
871	1,318,837	D
991	945,113	N/A
1050	1,173,989	D

Grass area

3.97 3.96 ⇒ $\frac{3.965 (400)^2}{12,080,800} = 5\%$

Residential 1 acre

4.93 4.87 ⇒ $\frac{4.90 (400)^2}{12,080,800} = 6.5\%$

Roadway w/open Ditch

2.44 2.50 ⇒ $\frac{2.47 (400)^2}{12,080,800} = 3\%$

Residential 1/8 acre

7.76 7.71 ⇒ $\frac{7.735 (400)^2}{12,080,800} = 10\%$

Subarea "I" Present Condition Con't

Residential 1/3 acre

30.54 30.64 ⇒ $\frac{30.59\,(400)^2}{12,080,800} = 40.5\%$

Industrial areas

0.69 0.62 = 0.655
1.02 0.98 = 1.00
⇒ $\frac{1.655\,(400)^2}{12,080,800} = 2\%$

Residential 1/2 acre

1.11 1.15 ⇒ $\frac{1.13\,(400)^2}{12,080,800} = 1.5\%$

Schools

1.71 1.74 ⇒ 1.725
2.02 2.12 2.07
= $\frac{3.795\,(400)^2}{12,080,800} = 5\%$

Roadway w/ C&G

0.45 0.52 ⇒ $\frac{0.485\,(400)^2}{12,080,800} = 0.5\%$

TR 55

Subarea "I" Present Condition

Land Use	Hydrologic Soil Group D								
	%	CN	Product	%	CN	Product	%	CN	Product
Grass area (Cem.)	5	80	400						
Roadway w/open Ditch	3	94	282						
Residental 1 acre	6.5	84	546						
Residental 1/8 acre	10.0	92	920						
Residental 1/3 acre	40.5	86	3483						
Residental 1/2 acre	1.5	85	127.5						
Industrial	2	93	186						
School Site	5	~~98~~ 93	465						
Roadway w/ C&G	0.5	98	49						
Open Space	26	~~99~~ 82	~~2574~~ 2132						
	100		~~8772.5~~ 8590.5						

Adjusted CN = $\frac{9590.5}{100} = 86$

Weighted CN = $\frac{8772.5}{100} = 88$

Subarea "I" Present Condition Time of Concentration

Reach	Descrip. of flow	Slope (%)	Length (Ft.)	Table 3-1 Velocity	Time sec.
A to B	Sheet flow	5%	880	4.5 Ft/sec.	196
B to C	12" PIPE	6.0	820	9.6	85
C to D	15" PIPE	7.0	610	12.1	50
D to E	24" PIPE	8.5%	1550	18.2	85
E to F	Overland	10.0	610	3.2 Ft/sec	191
F to G	36" PIPE	2.0	220	12.2	18
G to H	Open channel	1%	40'	1 Ft/sec.	40
H to I	24" PIPE	2.0	30'	8.8	3
I to J	Overland Channel	5%	400'	2.3 Ft/sec.	174
J to K	30" PIPE	4.0	50'	8.9	6
K to L	Overland Channel	1.5%	1400'	1.2 Ft/sec.	1167
~~L to M~~					
			6610		2015 sec

$t_c = \frac{2015}{3600} = 0.56$ hrs.

$L = 0.6\,(0.56) = 0.34$ hrs.

$V_1 = \frac{1.49}{0.015}\left(\frac{1}{4}\right)^{2/3}(0.06)^{1/2} = 9.6$

$V_2 = \frac{1.49}{0.015}\left(\frac{1.25}{4}\right)^{2/3}(0.07)^{1/2} = 12.1$

$V_3 = \frac{1.49}{0.015}\left(\frac{2}{4}\right)^{2/3}(0.085)^{1/2} = 18.2$

$V_4 = \frac{1.49}{0.015}\left(\frac{3}{4}\right)^{2/3}(0.02)^{1/2} = 12.2$

$V_5 = \frac{1.49}{0.015}\left(\frac{2}{4}\right)^{2/3}(0.02)^{1/2} = 8.8$

$V_6 = \frac{1.49}{0.015}\left(\frac{2.5}{4}\right)^{2/3}(0.015)^{1/2} = 8.9$

Avg. Slope

0.05 (880)
0.06 (820)
0.07 (610)
0.085 (1550)
0.10 (610)
0.02 (220)
0.01 (40)
0.02 (30)
0.05 (400)
0.04 (50)
0.015 (1400)

377.05

$\frac{377.05}{6610} = 5.7\%$

$L = \dfrac{(6610)^{0.8}\left[\left(\frac{1000}{88} - 10\right) + 1\right]^{0.7}}{1900\,(5.7)^{0.5}}$

$L = 0.46$ hrs.

DW | PARADISE POND

Routing above subareas through Subarea "I"

1.) 36" Pipe

$L = 910'$
$S = 1.7\%$

$V = \frac{1.49}{0.015}\left(\frac{3}{4}\right)^{2/3}(0.017)^{1/2} = 10.7\ Ft/sec.$

$t = {}^{910}/_{10.7} = 85\ sec.$

2.) Open channel

$L = 30'$
$S = 2\%$

$V = 1.4\ Ft/sec.$

$t = {}^{30}/_{1.4} = 21\ sec.$

3.) 48" PIPE

$L = 100'$
$S = 2\%$

$V = \frac{1.49}{0.015}\left(\frac{4}{4}\right)^{2/3}(0.02)^{1/2} = 14.0\ Ft/sec.$

$t = {}^{100}/_{14} = 7\ sec.$

4.) Open Channel

$L = 310'$
$S = 3\%$

$V = 0.8\ Ft/sec$

$t = {}^{310}/_{0.8} = 388\ sec.$

Routeing subareas through Subarea "I" Con't

5.) 78" Pipe

$L = 300'$
$S = 6.5\%$

$V = \frac{1.49}{0.015}\left(\frac{6.5}{4}\right)^{2/3}(0.065)^{1/2} = 35.0\ ^{Ft}/_{sec}$

$t = {}^{300}/_{35} = 9\ sec.$

6.) Open Channel

$L = 960'$
$S = 3\%$

$V = 1.2\ ^{Ft}/_{sec.}$

$t = {}^{960}/_{1.2} = 800\ sec.$

7.) 96" Pipe

$L = 100'$
$S = 10\%$

$V = \frac{1.49}{0.015}\left(\frac{8}{4}\right)^{2/3}(0.10)^{1/2} = 49.9\ ^{Ft}/_{sec.}$

$t = {}^{100}/_{49.9} = 2\ sec.$

8.) Open channel

$L = 2100'$
$S = 2\%$

$V = 1.4\ ^{Ft}/_{sec.}$

$t = {}^{2100}/_{1.4} = 1500\ sec$

total time (K)

$K = \frac{85+21+7+388+9+800+2+1500}{3600} = 0.78\ hrs.$

$\chi = 0.30$ try

Subarea "J" Present Condition

Total Area

43.30 ⇒ 43.25 ⇒ 43.25 (0.0057)
43.20

= 0.248 s.m.

Soil types

Scs #	Planimeter	Avg. Plan	Areas (SF)
310			
311			
190			
191	All are Hydrologic group D		
871			
683			
312			
			6,920,000

Residental 1/3 acre

22.68 22.69 ⇒ $\frac{22.685\ (400)^2}{6,920,000}$ 52.5%

Residental 1/8 acre

4.55 4.53 ⇒ $\frac{4.54\ (400)^2}{6,920,000}$ = 10.5%

Industrial

3.00 3.02 ⇒ 3.01 ⇒ $\frac{4.24\ (400)^2}{6,920,000}$ 10%
1.27 1.19 1.23

Subarea "J" Present Condition Con't

Roadway w/ open Ditch

$$1.50 \quad 1.54 \Rightarrow \frac{1.52\,(400)^2}{6,920,000} = 3.5\%$$

Roadway w/ C & G

$$0.37 \quad 0.31 \Rightarrow \frac{0.34\,(400)^2}{6,920,000} = 1\%$$

Subarea "J" Present Condition

TR 55

LAND USE	Hydrologic Soil Group D								
	%	CN	Product	%	CN	Product	%	CN	Product
Residental 1/3 acre	52.5	86	4515						
Residental 1/8 acre	10.5	92	966						
Industrial	10.0	93	930						
Roadway w/open Ditch	3.5	94	329						
Roadway w/ Gorb & Gutter	1.0	98	98						
Open Rangle (open space)	22.5	~~89~~ 82	~~2005~~ 1845						
			~~8840.5~~ 8693						

Adjusted CN = $\frac{8693}{100} = 87$

Weighted CN = $\frac{8840.5}{100} = 88$

Subarea "J" Present Condition Time of Concentration

Reach	Descrip. of flow	Slope (%)	Length (Ft.)	Table 3-1 velocity	Time sec.
A to B	Asphalt	7.0%	300	5.3 Ft/sec	57
B to C	12" Pipe	6.3%	2470	9.9 Ft/sec	250
C to D	18" Pipe	9.8%	1180	16.2 Ft/sec.	73
D to E	21" Pipe	10.5	170	18.5 Ft/sec	9
E to F	24" Pipe	9.2%	400	19.0 Ft/sec	21
F to G	30" Pipe	8.0%	180	20.5 Ft/sec	9
G to H	Open Ditch	1.5%	320'	1.2 Ft/sec	267
H to I	36" Pipe	1%	900'	8.2 Ft/sec	110
			5920		796 sec

$t_c = \frac{796}{3600} = 0.22$ hrs.

$L = 0.6(0.22)$

$= 0.13$ hrs.

$V_1 = \frac{1.49}{0.015}\left(\frac{1}{4}\right)^{2/3}(0.063)^{1/2} = 9.9$ Ft/sec

$V_2 = \frac{1.49}{0.015}\left(\frac{1.5}{4}\right)^{2/3}(0.098)^{1/2} = 16.2$

$V_3 = \frac{1.49}{0.015}\left(\frac{1.75}{4}\right)^{2/3}(0.105)^{1/2} = 18.5$

$V_4 = \frac{1.49}{0.015}\left(\frac{2}{4}\right)^{2/3}(0.092)^{1/2} = 19.0$

$V_5 = \frac{1.49}{0.015}\left(\frac{2.5}{4}\right)^{2/3}(0.08)^{1/2} = 20.5$

$V_6 = \frac{1.49}{0.015}\left(\frac{3}{4}\right)^{2/3}(0.01)^{1/2} = 8.2$

Avg. Slope

0.07 (300)
0.063 (2470)
0.098 (1180)
0.105 (170)
0.092 (400)
0.08 (180)
0.015 (320)
0.01 (900)
375.10

$\frac{375.10}{5920} = 6.34\%$

$L = \frac{(5920)^{0.8}\left[\left(\frac{1000}{88} - 10\right) + 1\right]^{0.7}}{1900\ (6.34)^{0.5}}$

$L = 0.40$ hrs.

Routing Subarea "J" through Subarea "H" — I

1.) Rip-Rap Ditch

$L = 450'$
$S = 14\%$

$V = 5.7$ FT/sec

$t = 450/5.7 = 79$ sec.

2.) Open Ditch

$L = 610'$
$S = 2\%$

$V = 1.4$ FT/sec.

$t = 610/1.4 = 436$ sec.

total time (K)

$K = \frac{436+79}{3600} = 0.14$ hrs.

$x = 0.30$ try

Subarea "K" Present Condition

Total Area

59.81 59.73 ⇒ 59.77
48.25 48.24 ⇒ 48.245 ⇒ 125.89 (0.0057)
17.87 17.88 ⇒ 17.875

$= 0.723 \text{ sm.} - \frac{1.65(400)^2}{5280^2} = 0.714 \text{ sm}$

Soil types

Hydrologic group	Scs #	Planimeter		Avg. Plan	Area (SF)
D	870				
D	880				
C	881	3.87	3.91	3.89	622,400
D	872				
D	191				
D	862				
D	873				
D	190				
D	192				
D	871				
D	192				
D	310				
D	313				
D	311				
D	312				

All others areas are in Hydrologic group D

~~20,142,480~~
19,892,083

Carea

$\frac{622,400}{\cancel{20,142,480}\ 19,892,083} = 3\%$

∴ D area = 97%

Subarea "K" presen + Condition

Industrail

0.66 0.67 ⇒ $\frac{0.665\,(6/00)^2}{19,892,083} = 0.5\%$

Roadway w/open Ditch

5.15 5.39 ⇒ 5.27 = $\frac{8.28\,(400)^2}{19,892,083} = 6.5\%$
3.01 3.01 3.01

Subarea "K" Present Condition

TR 55

LAND USE	Hydrologic Soil Group D			C					
	%	CN	Product	%	CN	Product	%	CN	Product
Industrial Area	0.5	93	46.5						
Open Space 18	(90)	82 ~~89~~	7390 ~~8010~~	3	76 ~~86~~	228 ~~258~~			
Roadway w/open Ditch	6.5	94	611						
Residental 12	97	86	~~8667.5~~ 9037.5	3		~~258~~ 228			
			9313.5						
			(93)						

Adjusted CN = $\frac{9037.5+228}{100} = 93$

Weighted CN = $\frac{8667.5+258}{100} = 89$

Subarea "K" Present Condition Time of Concentration

Reach	Descrip. of flow	Slope (%)	Length (Ft.)	Table 3-1 velocity	Time sec.
A to B	Overland Ditch	17%	2050'	4.1 Ft/sec.	500
B to C	30" Pipe	6.5%	150'	18.5 Ft/sec.	8
C to D	Overland Ditch	5.5%	1390'	2.3 Ft/sec.	604
D to E	48" PIPE	5.5%	800'	23.3 Ft/sec.	34
E to F	Overland Ditch	3%	2930	1.7 Ft/sec.	1724
F to G	72" PIPE	2%	290'	18.4 Ft/sec.	16
			7610'		2886 sec.

$t_c = \frac{2886}{3600} = 0.80$ hrs.

$L = 0.6(0.80) = 0.48$ hrs.

Avg. Slope

0.17(2050)
0.065(150)
0.055(1390)
0.055(800)
0.03(2930)
0.02(290)
572.4

$\frac{572.4}{7610} = 7.5\%$

$V_1 = \frac{1.49}{0.015}\left(\frac{2.5}{4}\right)^{2/3}(0.065)^{1/2} = 18.5$

$V_2 = \frac{1.49}{0.015}\left(\frac{4}{4}\right)^{2/3}(0.055)^{1/2} = 23.3$

$V_3 = \frac{1.49}{0.015}\left(\frac{6}{4}\right)^{2/3}(0.02)^{1/2} = 18.4$

$L = \frac{(7610)^{0.8}\left[\left(\frac{1000}{89} - 10\right) + 1\right]^{0.7}}{1900 \quad (7.5)^{0.5}}$

$L = 0.43$ hrs.

Subarea "L" Present Condition

Total Area

48.79 48.79 ⇒ 48.79(0.0057)

= 0.280 sm.

Soil types

Hydrologic Group	Scs#	Planimeter	Avg. Plan	Area.
D	871			
D	310			
D	311			
D (N/A)	991	All areas all Hydrologic Group D		
D	312			
				7,806,400

Industrial

7.40 7.36 ⇒ 7.38
0.59 0.63 ⇒ 0.61

⇒ $\frac{7.99(400)^2}{7,806,400} = 16.5\%$

Residental 1/8 acre

20.90 20.86 ⇒ $\frac{20.88(400)^2}{7,806,400} = 43\%$

Open Area

Subarea 'L' Present Condition

TR 55

LAND USE	Hydrologic Soil Group D								
	%	CN	Product	%	CN	Product	%	CN	Product
Industrial	16.5	93	1534.5						
Residental 1/8 acre	43	92	3956						
Open Area. 38.5	40.5	~~89~~ 92	~~3604.5~~ 3321						
1/3 Acre Resd. 2	100	86	~~9095~~ 8811.5						
			8819.5						
			(88)						

Adjusted CN = $\frac{8811.5}{100} = 88$

Weighted CN = $\frac{9095}{100} = 91$

Subarea "L" Present Condition Time of Concentration

Reach	Descrip. of flow	Slope (%)	Length (Ft.)	Table 3-1 Velocity	Time sec.
A to B	Overland flow	9.7%	2620'	3.1 Ft/sec.	845
B to C	36" Pipe	9.5%	370'	25.3 Ft/sec	15
C to D	24" Pipe	1.5%	330'	7.7 Ft/sec	43
D to E	Overland flow	7%	1070'	2.6 Ft/sec.	412
			4390'		1315 sec.

$t_c = \frac{1315}{3600} = 0.37$ hrs.

$L = 0.6(0.37) = 0.22$ hrs.)

$$L = \frac{(4390)^{0.8}\left[\left(\frac{1000}{91} - 10\right)+1\right]^{0.7}}{1900\,(8.41)^{0.5}}$$

$= 0.24$ Hrs.

$V_1 = \frac{1.49}{0.015}\left(\frac{3}{4}\right)^{2/3}(0.095)^{1/2} = 25.3$

$V_2 = \frac{1.49}{0.015}\left(\frac{2}{4}\right)^{2/3}(0.015)^{1/2} = 7.7$

Avg Slope

0.097(2620)
0.095(370)
0.015(330)
0.07(1070)

369.14 ÷ 4390 =

= 8.41%

Routing Subarea "K" through Subarea "L"

1.) Open Channel

$L = 2430'$

$S = 0.015$

$V = 1.2$ Ft/sec

$t = 2430/1.2 = 2025$ sec.

total time (K)

$K = \frac{2025}{3600} = 0.56$ hrs.

$x = 0.30$ try

Subarea "M" Present Condition

Total Area

27.83 27.92 ⇒ 27.875 (0.005)

= 0.160 sm.

Soil types

Hydrologic Group	Scs #	Planimeter	Avg. Plan.	Area
D	312			
N/A (D)	991			
D	190	All areas are in Hydrologic Group D		
D	871			

4,460,000

Industrial

1.47 1.41 ⇒ 1.44 = $\frac{9.845(400)^2}{4,460,000}$ = 35.5%

8.41 8.40 ⇒ 8.405

Residential 1/5 acre

10.03 9.94 ⇒ $\frac{9.985(400)^2}{4,460,000}$ = 36%

Apartments

3.12 3.15 ⇒ 3.135 = $\frac{3.555(400)^2}{4,460,000}$ = 13%

0.44 0.40 ⇒ 0.42

Subarea "M" Present Condition Con't

Residental 1 acre

0.54 0.56 $\Rightarrow \frac{0.55\,(400)^2}{4,460,000} = 2\%$

Grass area

2.24 2.19 $\Rightarrow \frac{2.215\,(400)^2}{4,460,000} = 8\%$

Meadow

0.88 0.87 $\Rightarrow \frac{0.875\,(400)^2}{4,460,000} = 3\%$

TR 55

Subarea "M" Present Condition

LAND USE	Hydrologic Soil Group D								
	%	CN	Product	%	CN	Product	%	CN	Product
Industrial	3.5,5	93	3301.5						
Residential 1/3 area	36	92	3312						
Residential 1 acre	2	84	168						
Residential (Apart.)	13	95	1235						
Grass field	8	80	640						
Meadow	3	~~80~~ 94	252						
Open Space	2.5	~~89~~ 82	~~2220~~ 205						
	100		~~9131~~ 9113.5						

Weighted CN = $\frac{9131}{100}$ = 91 ✓

Subarea "M" Present Condition Time of Concentration

Reach	Descrip. of flow	Slope (%)	Length (Ft.)	Table 3-1 velocity	Time sec.
A to B	Overland	2%	200'	1.4 Ft/sec.	143
B to C	18" Pipe	5%	910'	11.6 Ft/sec.	78
C to D	36" Pipe	3.5%	1100'	15.3 Ft/sec	72
D to E	42" Pipe	3%	110'	15.7 Ft/sec.	7
E to F	30" Pipe	3.5%	1770'	13.6 Ft/sec.	130
F to G	Overland	1.5%	630	0.85 Ft/sec.	741
			4720'		1171 sec.

$t_c = \frac{1171}{3600} = 0.325$ hrs.

$L = 0.6\,(0.325) = 0.195$ hrs.

$$V_1 = \frac{1.49}{0.015}\left(\frac{1.5}{4}\right)^{2/3}(0.05)^{1/2} = 11.6$$

$$V_2 = \frac{1.49}{0.015}\left(\frac{3}{4}\right)^{2/3}(0.035)^{1/2} = 15.3$$

$$V_3 = \frac{1.49}{0.015}\left(\frac{3.5}{4}\right)^{2/3}(0.03)^{1/2} = 15.7$$

$$V_4 = \frac{1.49}{0.015}\left(\frac{2.5}{4}\right)^{2/3}(0.035)^{1/2} = 13.6$$

~~$V_5 = \frac{1.49}{0.015}$~~

Avg. Slope

0.02 (200)
0.05 (910)
0.035 (1100)
0.03 (110)
0.035 (1770)
0.015 (630)

162.70 ÷ 4720

= 3.45%

$$L = \frac{(4720)^{0.8}\left[\left(\frac{1000}{91} - 10\right) + 1\right]^{0.7}}{1900\ (3.45)^{0.5}}$$

$L = 0.40$ hrs.

Route subareas K & L through Subarea "M"

1.) 72" Pipe

$L = 190'$

$S = 3.7\%$

$V = \frac{1.49}{0.015}\left(\frac{6}{4}\right)^{2/3}(0.037)^{1/2} = 25.0\ ^{Ft}/_{sec.}$

$t = {}^{190}/_{25} = 8\ sec.$

2.) Rip Rap Flow

$L = 40'$

$S = 37\%$

$V = 9.5\ ^{Ft}/_{sec.}$

$t = {}^{40}/_{9.5} = 4\ sec.$

3.) 36" Pipe

$L = 1170'$

$S = 3.5\%$

$V = 15.3\ ^{Ft}/_{sec}$ see 36" Pipe and below for Subrea "M"

$t = \frac{1170}{15.3} = 76\ sec$

total time (K)

$K = \frac{8+4+76+7+130+741}{3600} = 0.27\ hrs.$

$x = 0.30$ try

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Subarea "O" Present Condition

Area runs into the Orr Ditch.

Total Area

11.84 11.83 ⇒ 11.835 (0.0057)

= 0.068 sm

All Hydrologic groups are D from Scs #688, & 312

Commercial area

2.53 2.54 ⇒ $\frac{2.535\ (400)^2}{1,893,600}$ 21.4%

Residental 1/8 acre

$\frac{1.765\ (400)^2}{1,893,600}$ 15%

Residental 1/4 acre

7.55 7.52 ⇒ $\frac{7.535\ (400)^2}{1,893,600}$ = 64%

Subarea "O" Present Condition

TR 55

LAND USE	Hydrologic Soil Group D								
	%	CN	Product	%	CN	Product	%	CN	Product
~~Commercial / Industrial~~	21	93	1953						
Residential 1/8 acre	15	92	1380						
Residential 1/4 acre	64	97	5568						
	100		8901						

Weighted CN = $\frac{8901}{100} = 89$

Subarea "O" Present Condition Time of Concentration

Reach	Descrip. of flow	Slope (%)	Length (Ft.)	Table 3-1 Velocity	Time sec.
A to B	15" Pipe	3.3%	1360'	8.3 Ft/sec.	164
B to C	Asphalt (sheet)	2%	150	2.8 Ft/sec	54
C to D	Overland	6%	200	2.4 Ft/sec	83
			1710		301 sec.

$t_o = \frac{301}{3600} = 0.08$ hrs.

$L = 0.6(0.08) = 0.05$ hrs.

Avg. Slope

$0.033(1360)$
$0.02\ (150)$
$0.06\ (200)$
$59.88 \div 1710$
$= 0.035$

$V_1 = \frac{1.49}{0.015}\left(\frac{1.25}{4}\right)^{2/3}(0.033)^{1/2} = 8.3$

$$L = \frac{(1710)^{0.8}\left[\left(\frac{1010}{99} - 10\right) + 1\right]^{0.7}}{1900\ (3.5)^{0.5}}$$

$L = 0.19$ hrs.

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Subarea 'P' Present Condition

Total Area

50.72 50.70 ⇒ 50.71 − 11.835 = 38.875 (0.0057)

= 0.223 sm

Again all the Hydrologic groups are D
for Scs # 312, 1050, 991, 631, 683,

Industrial areas

	1.91	1.92 = 1.915		
	1.69	1.75 1.72		
	9.44	9.42 9.43	= 15.03 / 38.875	= 38.5%
school	1.24	1.22 1.23		
	0.74	0.73 0.735		

Residental 1 acre

0.21	0.22 − 0.215	= 0.455 / 38.875	= 1%
0.23	0.25 0.24		

Residental ¼ acre

0.42	0.40	0.41		
0.50	0.53	= 0.515	= 1.435 / 38.875	= 3.5%
0.50	0.52	0.51		

Grass

2.09	2.14	= 2.115	= 14.545 / 38.875	= ~~37.5%~~ 38.0%
12.43		= 12.43		

Subarea "P" Present Condition Co't

Residental 1/8 acre

0.14 0.16 = 0.15
5.14 5.18 5.16 = 5.31 / 38.875 = 13.5

Pavement

0.34 0.35 = 0.345
0.05 0.06 0.055 = 0.705 / 38.875 = 2%
0.32 0.29 0.305

Commercial

1.39 1.40 = 1.395 / 38.875 = 3.5%

Subarea "P" Present Condition

TR 55

LAND USE	Hydrologic Soil Group D								
	%	CN	Product	%	CN	Product	%	CN	Product
Industrial	38.5	93	3580.5						
Grass	38	80	3040						
Residental 1 acre	1	84	84						
Residental 1/4 acre	3.5	87	304.5						
Residental 1/8 acre	13.5	92	1242						
Pavement w/c&G	2	98	196						
Commercial	3.5	95	332.5						
			8779.5						

Weighted CN = $\frac{8779.5}{100} = 88$

Subarea "P" Present Condition

Time of Concentration

Reach	Descrip. of flow	Slope (%)	Length (Ft.)	Table 3-1 velocity	Time sec.
A to B	Overland flow	1	800'	1 Ft/sec.	800
B to C	18" Pipe	3.5%	550'	9.7 Ft/sec	57
	Overland Ditch	5%	50'	2.3 Ft/sec.	22
	18" Pipe	5%	200'	11.6 Ft/sec.	17
	Over Asphalt	7.5	600'	5.5 Ft/sec.	109
	72" Pipe	3%	60'	22.5 Ft/sec	3
	Overland Ditch	5%	160'	1.6 Ft/sec.	100
	30" Pipe	2.5	200'	11.5 Ft/sec	17
	Overland Ditch	1.5%	1300'	0.85 Ft/sec.	1529
	36" Pipe	1.5%	1400'	~~10.0~~ 10.0 Ft/sec	140
			5320'		2794 sec.

$t_c = \frac{2794}{3600} = 0.78$ hrs.

$L = 0.6(0.78) = 0.47$ hrs.

$V_1 = \frac{1.49}{0.015}\left(\frac{1.5}{4}\right)^{2/3}(0.035)^{1/2} = 9.7$

$V_2 = \frac{1.49}{0.015}\left(\frac{1.5}{4}\right)^{2/3}(0.05)^{1/2} = 11.6$

$V_3 = \frac{1.49}{0.015}\left(\frac{6}{4}\right)^{2/3}(0.03)^{1/2} = 22.5$

$V_4 = \frac{1.49}{0.015}\left(\frac{2.5}{4}\right)^{2/3}(0.025)^{1/2} = 11.5$

$V_5 = \frac{1.49}{0.015}\left(\frac{3}{4}\right)^{2/3}(0.015)^{1/2} = 10.0$

Avg. Slope

0.01 (800)
0.035 (550)
0.05 (50)
0.05 (200)
0.075 (600)
0.03 (60)
0.05 (160)
0.025 (200)
0.015 (1300)
0.015 (1400) = 140.05 ÷ 5320 = 2.6%

$L = \frac{(5320)^{0.8}\left[\left(\frac{1000}{89} - 10\right)\right] + 1^{0.7}}{1900\ (2.6)^{0.5}}$

$= 0.57$ hrs.

Routing "I" through "P"

See subarea "P"

for time of 1789 sec.

Add 24"

$L = 850'$
$S = 1.5\%$
$V = \frac{1.49}{0.015}\left(\frac{2}{4}\right)^{2/3}(0.015)^{1/2} = 7.7\ ^{FT}/_{sec.}$
$t = {}^{850}/_{7.7} = 111$ sec.

total time (tc)

$\frac{1789 + 111}{3600} = 0.53$ hrs. $= K$

$X = 0.80$ try

Subarea "Q" Present Condition

This area flow into the Orr Ditch

Total Area

5.42 5.36 ⇒ 5.39 (0.057)

= 0.031 sm.

Soil type = 991

∴ Hydrologic group = D

Residental 1/8 acre or less

0.65	0.65	⇒ 0.65		
0.69	0.70	0.695	= 3.61 / 5.39	= 67%
2.25	2.28	2.265		

Open Space

100 - 67 = 33%

Subarea "Q" Present Condition

TR 55

Land Use	Hydrologic Soil Group D								
	%	CN	Product	%	CN	Product	%	CN	Product
Residential 1/8 acre	67	92	6164						
Open Space	~~33~~ 33	82	2706						
	100		8870						

Weighted CN = $\frac{8870}{100} = 89$

Subarea "Q" Present Condition

Time of Concentration

Reach	Descrip. of flow	Slope (%)	Length (Ft.)	Table 3-1 velocity	Time sec.
A to B	Overland flow	3%	480'	1.7 Ft/sec	282
B to C	Curb & Gutter flow	3%	730'	3.5 Ft/sec.	209
			1210		491 sec.

$$t_c = \frac{491}{3600} = 0.136 \text{ hrs.}$$

$$L = 0.6(0.136)$$

$$= 0.08 \text{ hrs.}$$

Avg. Slope

$$\frac{0.03(480) + 0.03(730)}{0.03}$$

$$L = \frac{(1210)^{0.8}\left[\left(\frac{1000}{99} - 10\right) + 1\right]^{0.7}}{1900\,(3.0)^{0.5}}$$

$L = 0.16$ hrs.

DW Paradise Pond

Subarea "R" Present Condition

Total Area

10.47 10.59 ⇒ 10.525 (0.0057)

= 0.060 sm

All soil types are in Hydrologic group D

& All area is Residental 1/8 acre or less

% Residental 1/8 acre 100% @ CN = 92

CN = 92

Subarea "R" Present Condition Time of Concentration

Reach	Descrip. of flow	Slope (%)	Length (Ft.)	Table 3-1 Velocity	Time sec.
A to B	Over Asphalt.	8	400	5.5 Ft/sec	73
B to C	12" Pipe	6.0	640	9.7 Ft/sec.	66
C to D	15" Pipe	4.5	750	9.7 Ft/sec.	77
D to E	18" Pipe	5.5	1230	12.1 Ft/sec	102
E to F	21" Pipe	6%	570	14.0 Ft/sec.	41
F to G	30" Pipe	1.0	110	7.3 Ft/sec	15
G to H	96" Pipe	0.1	480	5.0 Ft/sec.	96
			4180		470 sec

$t_c = \frac{470}{3600} = 0.13$ hrs.

$L = 0.6(0.13)$

$= 0.08$ hrs.

$V_1 = \frac{1.49}{0.015}\left(\frac{1}{4}\right)^{2/3}(0.06)^{1/2} = 9.7$

$V_2 = \frac{1.49}{0.015}\left(\frac{1.25}{4}\right)^{2/3}(0.045)^{1/2} = 9.7$

$V_3 = \frac{1.49}{0.015}\left(\frac{1.5}{4}\right)^{2/3}(0.055)^{1/2} = 12.1$

$V_4 = \frac{1.49}{0.015}\left(\frac{1.75}{4}\right)^{2/3}(0.06)^{1/2} = 14.0$

$V_5 = \frac{1.49}{0.015}\left(\frac{2.5}{4}\right)^{2/3}(0.01)^{1/2} = 7.3$

$V_6 = \frac{1.49}{0.015}\left(\frac{8}{4}\right)^{2/3}(0.001)^{1/2} = 5.0$

Avg. Slope

0.08 (400)
0.06 (640)
0.045 (750)
0.055 (1230)
0.06 (570)
0.01 (110)
0.001 (480)

207.58 ÷ 4180

= 5%

$L = (4180)^{0.8}\left[\left(\frac{1000}{92} - 10\right) + 1\right]^{0.7}$

$\frac{1900 \quad (5.0)^{0.5}}{}$

$L = 0.$ 9 hrs.

Subarea "N" Present Condition

Total Area

26.26 26.35 ⇒ 26.305
39.49 39.48 ⇒ 39.485 = 67.51 (0.0057)
1.68 1.76 ⇒ 1.72

= 0.3875 sm

All soils are in Hydrologic group D

/

Residental 1/8 acre

15.71	15.76	15.735
0.80	0.72	0.76
0.74	0.76	0.75
1.19	1.20	1.195
2.73	2.71	2.72
10.13	10.06	10.095

$= \frac{31.255}{67.51} = 46.5\%$

Commercial

5.76 5.74 = 5.75.
2.03 2.05 = 2.04
1.46 1.49 = 1.475

$\Rightarrow \frac{9.265}{67.51} = 13.5\%$

Industrial

3.35 3.29 $\Rightarrow \frac{3.32}{67.51} = 5\%$

Subarea "N" Present Condition Cost

Residental 1acre

0.31	0.33	= 0.32	
0.26	0.28	0.27	$= \frac{1.735}{67.51} = 2.5\%$
0.25	0.30	0.275	
0.89	0.85	0.87	

Roadway w/ Open Ditch

1.47	1.41	1.44	$= \frac{3.395}{67.51} = 5\%$
1.99	1.92	1.955	

Roadway w/ C & G

$2.78 \quad 2.71 = \frac{2.745}{67.51} = 4\%$

TR 55

Subarea 'N' Present Condition

LAND USE	Hydrologic Soil Group D								
	%	CN	Product	%	CN	Product	%	CN	Product
Residential 1/8 acre (60%)	46.5	92	4278						
Commercial	13.5	95	1282.5						
Industrial	5	93	465						
Residential 1 acre	2.5	84	210						
Roadway w/ open Ditch	5	94	470						
Roadway w/ C & G	4	98	392						
Open Space (9.5)	23.5	82	1927						
	100		9024.5						
			9164.5						
			(92)						

Weighted CN = $\frac{9024.5}{100} = 90$

Subarea "N" Present Condition Time of Concentration

Reach	Descrip. of flow	Slope (%)	Length (Ft.)	Table 3-1 Velocity	Time sec.
A to B	12" Pipe	3.7%	1360	7.6 Ft/sec.	179
B to C	18" Pipe	5.2%	1770	11.8 Ft/sec.	150
C to D	21" Pipe	3.8%	340'	11.2 Ft/sec	30
D to E	24" Pipe	2.7%	750	10.3 Ft/sec.	73
E to F	30" Pipe	3.4%	1480	13.4 Ft/sec.	110
			5700		542 sec.

$t_c = \frac{542}{3600} = 0.15$ hrs.

$L = 0.6(0.15)$

$= 0.09$ hrs.

$V_1 = \frac{1.49}{0.015}\left(\frac{1}{4}\right)^{2/3}(0.037)^{1/2} = 7.6$

$V_2 = \frac{1.49}{0.015}\left(\frac{1.5}{4}\right)^{2/3}(0.052)^{1/2} = 11.8$

$V_3 = \frac{1.49}{0.015}\left(\frac{1.75}{4}\right)^{2/3}(0.038)^{1/2} = 11.2$

$V_4 = \frac{1.49}{0.015}\left(\frac{2}{4}\right)^{2/3}(0.027)^{1/2} = 10.3$

$V_5 = \frac{1.49}{0.015}\left(\frac{2.5}{4}\right)^{2/3}(0.034)^{1/2} = 13.4$

Avg. Slope

$0.037(1360)$
$0.052(1770)$
$0.038(340)$
$0.027(750)$
$0.034(1480)$

$225.85 \div 5700$

$= 4\%$

$L = (5700)^{0.8}\left[\left(\frac{1000}{90}\right) - 10\right] + 1^{0.7}$

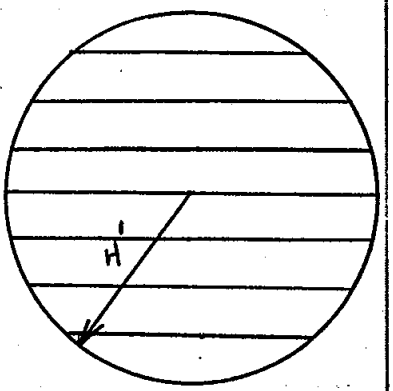
$1900 \quad (4.0)^{0.5}$

$= 0.45$ hrs.

Level Pooling for Route Subarea "R" through Subarea "N"

Storage in 96" ø pipe

Outlet in 12" ø pipe



1" = 4'

HW	HW/D	Q cfs	Plan.	A x 480'	Ac - Ft
12"	1	2.3 2.5	0.28	2150 cf	0.05
24"	2	4.6 5.1	0.68	5222 cf	0.12
36"	3	6.0 6.9	1.17	8986 cf	0.20
48"	4	7.4 8.1	—	12,064	0.28
60"	5	8.5 9.5	—	15,821	0.36
72"	6	9.2 10.5	—	19,277	0.44
84"	7	10.0 11.0	—	21,619	0.50
96"	8	10.5 11.5	—	24,127	0.55

Route "R" through "N" Con't

1.) 12" pipe

$L = 100'$

$S = \cancel{1.0\%}\ 0.5\%$

$V = \frac{1.49}{0.015}\left(\frac{1}{4}\right)^{2/3}(0.005)^{1/2} = 2.8\ FT/sec.$

$t = 100/2.8 = 36\ sec.$

2.) 21" pipe

$L = 400'$

$S = 4.5\%$

$V = \frac{1.49}{0.015}\left(\frac{1.75}{4}\right)^{2/3}(0.045)^{1/2} = 12.1\ FT/sec.$

$t = 400/12.1 = 33\ sec.$

3.) 30" Pipe

$L = 3720'$

$S = 3.5\%$

$V = \frac{1.49}{0.015}\left(\frac{2.5}{4}\right)^{2/3}(0.035)^{1/2} = 13.6$

$t = 3720/13.6 = 274\ sec.$

total time (K)

$K = \frac{274 + 33 + 36}{3600} = 0.095\ hrs.$

$x = 0.30$ try

Subarea "S" Present Condition

Total Area

21.07 21.08 ⇒ 21.075 (0.0057)

= 0.121 sm

Soil types

		Hydrologic Group
Scs #	971	D
	631	D
	630	D
	623	B ⇒ 1.58 1.60 ⇒ $\frac{1.59}{21.075}$ = 7.5%

Residental 1/8 acre or less

3.51 3.52 $\frac{3.515}{21.075}$ = 16.5%

Residental 1 acre

0.55 0.55 $\frac{0.55}{21.075}$ = 2.5%

Roadway w/Ditch

D ⇒ 0.28 0.27 $0.275/21.075$ = 1.5%

B ⇒ 0.05 0.07 $0.06/21.075$ = 0.5%

Residental 1/3 acre

100 − 16.5 − 2.5 − 2 = 79%

B ⇒ 1.50 1.54 $1.52/21.075$ = 7% ∴ D ⇒ 72%

Subarea 'S' Present Condition

TR 55

Land Use	Hydrologic Soil Group D			B					
	%	CN	Product	%	CN	Product	%	CN	Product
Residental 1/8 acre	16.5	92	1518						
Residental 1 acre	2.5	84	210						
Residental 1/3 acre	72	86	6192	7	72	504			
Roadway w/open Ditch	1.5	94	141	0.5	99	44.5			
	92.5		8061	7.5		548.5			

Weighted CN = $\frac{8061 + 548.5}{100} = 86$

Subarea "S" Present Condition Time of Concentration

Reach	Descrip. of flow	Slope (%)	Length (Ft.)	Table 3-1 Velocity	Time sec.
A to B	Over Asphalt	3.5%	600'	3.7 Ft/sec.	162
B to C	12" pipe	12.8%	510	14.1 Ft/sec.	36
C to D	15" pipe	2.3%	350	6.9 Ft/sec.	51
D to E	18" Pipe	1.2%	2340'	5.7 Ft/sec.	411
E to F	48" Pipe	1%	100'	9.9 Ft/sec.	10
			3900'		670 sec.

$t_c = \frac{670}{3600} = 0.186$ hrs.

$L = 0.6(0.186)$

$= 0.11$ hrs.

$V_1 = \frac{1.49}{0.015}\left(\frac{1}{4}\right)^{2/3}(0.128)^{1/2} = 14.1$

$V_2 = \frac{1.49}{0.015}\left(\frac{1.25}{4}\right)^{2/3}(0.023)^{1/2} = 6.9$

$V_3 = \frac{1.49}{0.015}\left(\frac{1.5}{4}\right)^{2/3}(0.012)^{1/2} = 5.7$

$V_4 = \frac{1.49}{0.015}\left(\frac{4}{4}\right)^{2/3}(0.01)^{1/2} = 9.9$

Avg. Slope

0.035(600)
0.128(510)
0.023(350)
0.012(2340)
0.01(100)

123.41 ÷ 3900

= 3.2%

$L = \frac{(3900)^{0.8}\left[\left(\frac{1000}{86} - 10\right) + 1\right]^{0.7}}{1900 \quad (3.2)^{0.5}}$

$= 0.43$ hrs.

Subarea "F" Present Condition

Total Area

27.72 27.66 ⇒ 27.69 (0.0057)

= ~~0.16~~ 0.159 sm

Soil types

	Hydrologic Group
Scs # 190	D
313	D
191	D
871	D
600	D
631	D

All types are in the Hydrologic group D

Roadway w/ open Ditch

0.26 0.26 ⇒ 0.26 = 1.475 / 27.69 = 5.5%
1.20 1.23 1.215

Open Space

0.88 0.89 = 0.885
0.60 0.62 0.61 = 12.2 / 27.69 = 44%
9.61 9.56 9.585
1.12 1.12 1.12

Subarea "T" Present Condition Cont

Residential 1/8 acre

1.69 1.74
0.20 0.21 45.5%
3.73 3.72

Residential 1/2 acre

0.31 0.32 0.315 = $\frac{0.48}{27.69}$ = 1.5%
0.17 0.16 0.165

Industrial

0.55 0.57 $\frac{0.56}{27.69}$ = 2%

Commercial

0.41 0.45 $\frac{0.43}{27.69}$ = 1.5%

Subarea "F" Present Condition

TR 55

Land Use	Hydrologic Soil Group D								
	%	CN	Product	%	CN	Product	%	CN	Product
Roadway w/open Ditch	5.5	94	517.0						
Open Space	44	82	3608						
Residental 1/8 acre	45.5	92	4186						
Residental 1/2 acre	1.5	85	127.5						
Industrial	2	93	186						
Commercial	1.5	95	142.5						
			8767						

Weighted CN = 98 = $\frac{9767}{100}$

TR55

Subarea "T" Present Condition

Time of Concentration

Reach	Descrip. of flow	Slope (%)	Length (Ft.)	Table 3-1 Velocity	Time sec.
A to B	Overland Ditch	4.5%	820	2.2 Ft/sec.	373
B to C	36" Pipe	4.5%	30	17.4 Ft/sec.	2
C to D	Ditch	1.5%	300	1.2 Ft/sec	250
D to E	24" Pipe	1.5%	40	7.7 Ft/sec.	5
E to F	DITCH	1.5%	200	1.2 Ft/sec.	167
F to G	24" Pipe	1.5%	200	7.7 Ft/sec.	26
G to H	Asphalt	5%	1010	4.5 Ft/sec.	224
H to I	24" Pipe	0.5%	640'	4.4 Ft/sec.	145
I to J	DITCH	1%	260'	1 Ft/sec.	260
J to K	18" Pipe	1%	1090'	5.2 Ft/sec.	210
K to L	30" Pipe	1%	40'	7.3 Ft/sec.	5
			4890 4630		1667 sec.

$t_c = \frac{1667}{3600} = 0.46$ hrs.

$L = 0.6\,(0.46) = 0.28$ hrs.

$V_1 = \frac{1.49}{0.015}\left(\frac{3}{4}\right)^{2/3}(0.045)^{1/2} = 17.4$

$V_2 = \frac{1.49}{0.015}\left(\frac{2}{4}\right)^{2/3}(0.015)^{1/2} = 7.7$

$V_3 = \frac{1.49}{0.015}\left(\frac{2}{4}\right)^{2/3}(0.005)^{1/2} = 4.4$

$V_4 = \frac{1.49}{0.015}\left(\frac{1.5}{4}\right)^{2/3}(0.01)^{1/2} = 5.2$

$V_5 = \frac{1.49}{0.015}\left(\frac{2.5}{4}\right)^{2/3}(0.01)^{1/2} = 7.3$

Avg. Slope

0.045 (850)
0.015 (740)
0.05 (1010)
0.005 (640)
0.01 (1390)

116.95 ÷ 4630 / 4890

= 2.4% → 2.5%

$L = \frac{(4630)^{0.8}\left[\left(\frac{1000}{88} - 10\right) + 1\right]^{0.7}}{1900\,(2.5)^{0.5}}$

$L = 0.52$ hrs

Route Subarea "M" through Subarea "T"

1.) 18" Pipe

$L = 100'$
$S = 1\%$

$V = \frac{1.49}{0.015}\left(\frac{1.5}{4}\right)^{2/3}(0.01)^{1/2} = 5.2$ Ft/sec.

$t = 100/5.2 = 19$ sec.

~~plus~~ 2). Ditch

$L = 180'$
$S = 4.5\%$

$V = 2.2$ Ft/sec

$t = 180/2.2 = 82$ sec.

plus B to L @ Subarea "T" Calcs.

1294 sec.

Total time (tc)

$\frac{1294 + 82 + 19}{3600} = 0.39$ hrs.

$\alpha = 0.30$ try

Route Subarea "S" through Subarea "T"

1.) 48" Pipe

$L = 100'$

$s = 1\%$

$V = \frac{1.49}{0.015}\left(\frac{4}{4}\right)^{2/3}(0.01)^{0.5} = 9.9\ Ft/sec$

$t = 100/9.9 = 10\ sec.$

plus H to L @ Subarea "T" Calcs.

620 sec.

Total Time (K)

$K = \frac{620+10}{3600} = 0.175\ hrs.$

$x = 0.30$ try

Subarea "U" Present Condition

Total Area

46.14 46.19 ⇒ 46.165 (0.005)

= 0.265 sm.

Soil types

Scs #	Hydrologic Group
871	D
991	N/A (D)
630	D
683	D
600	D
623	B
810	B
662	B

⇒ 21.32 21.20 = $\frac{21.26}{46.165}$ = 46%

Open Space

D	0.79	0.77	
D	0.57	0.59	
B	0.57	0.50	
D	0.50	0.47	
B & D	1.40	1.45	-0.81 -0.78 (B)

D ⇒ $\frac{2.475}{46.165}$ 5.5%

B = $\frac{0.795}{46.165}$ = 1.5%

Residential 1/3 acre

D	0.16	0.20
D	0.53	0.53
D	0.25	0.24
D	0.29	0.30
B	4.21	4.23

D ⇒ $\frac{1.25}{46.165}$ 2.5%

B ⇒ $\frac{4.22}{46.165}$ = ~~9%~~ 9.5%

Roadway w/ ~~Open Ditch~~ C & G

D	0.15	0.11

D ⇒ $\frac{0.13}{46.165}$ = 0.5%

Subarea "4" Present Condition Cont

Roadway w/ Open Ditch

D	0.19	0.20
	~~1.20~~	~~1.18~~
B	0.49	0.46
D	0.71	0.72

D ⇒ $\frac{0.91}{46.165}$ = 2%

B = $\frac{0.475}{46.165}$ = 1%

Grass Area

D	0.40	0.34

D ⇒ $\frac{0.37}{46.165}$ = 1%

Residential 1/4 acre

B&D	17.49	17.49
~~D~~ Grass	− 0.40	−0.34
B	− 1.70	−1.68

D ⇒ $\frac{15.43}{46.165}$ = ~~33~~ 34%

B ⇒ $\frac{1.69}{46.165}$ = ~~3.5~~ 4.0%

Interchange

2.56	2.62

B ⇒ $\frac{2.59}{46.165}$ = ~~5~~ 6%

Commercial

B&D	14.52	14.51
D	−3.76	−3.78

B ⇒ $\frac{10.745}{46.165}$ = 24%

D ⇒ $\frac{3.77}{46.165}$ = 8.5%

D = 54%

B = 46%

Subarea "4" Present Condition

TR 55

LAND USE	Hydrologic Soil Group D			B					
	%	CN	Product	%	CN	Product	%	CN	Product
Open Space	55	82	451	1.5	~~75~~ 63	94.5			
Residental 1/8 acre	2.5	92	230	9.5	85	807.5			
Roadway w/C & G	0.5	98	49						
Roadway w/open Ditch	2	94	188	1	89	89			
Grass area	1	80	80						
Residental 1/4 acre	34	87	2958	4	75	300			
Interchange				6	69	414			
Commerical	8.5	95	807.5	24	92	2208			
			4763.5			3913			

Weighted CN = $\frac{4763.5 + 3913}{100} = 8676.5$

$= 87$

TR55

Subarea "A" Present Condition

Time of Concentration

Reach	Descrip. of flow	Slope (%)	Length (Ft.)	Table 3-1 Velocity	Time sec.
A to B	Asphalt flow	6.0	700	5.0 Ft/sec.	140
B to C	Open Ditch	1.0%	880	1.0 Ft/sec.	880
C to D	Asphalt flow	15%	100	8.7 Ft/sec.	12
D to E	18" Pipe	0.5%	360	3.6 Ft/sec.	100
E to F	24" Pipe	0.5	650	4.4 Ft/sec.	148
F to G	30" Pipe	0.5	300	5.1 Ft/sec.	59
G to H	33" Pipe	0.5	400	5.5 Ft/sec.	73
H to I	36" Pipe	0.5	270	5.8 Ft/sec.	47
I to J	48" Pipe	0.5	2280'	7.0 Ft/sec.	326
J to K	54" Pipe	0.5	630'	7.6 Ft/sec.	83
K to L	60" Pipe	0.5%	220'	8.2 Ft/sec.	27
			6790'		1895

Avg. Slope

0.06(700)
0.01(880)
0.15(100)
0.005(5110)
91.35 ÷ 6790
= 1.35%

$t_c = \frac{1895}{3600} = 0.53$ hrs.

$L = 0.6(0.53)$

$= 0.32$ hrs.

$$L = \frac{(6790)^{0.8}\left[\left(\frac{1000}{87} - 10\right) + 1\right]^{0.7}}{1900 \quad (1.35)^{0.5}}$$

~~$L = 0$~~

$L = 1.00$ hrs.

Routing Subarea "T" through Subarea "U"

1.) 30" Pipe

$L = 1400'$

$S = 0.01$

$V = \frac{1.49}{0.015}\left(\frac{2.5}{4}\right)^{2/3}(0.01)^{1/2} = 7.3\ ^{Ft}/_{sec.}$

$t = {}^{1400}/_{7.3} = 192$ sec.

2.) 60" Pipe

$L = 220'$

$S = 0.005$

$V = \frac{1.49}{0.015}\left(\frac{5}{4}\right)^{2/3}(0.005)^{1/2} = 8.2\ ^{Ft}/_{sec.}$

$t = {}^{220}/_{8.2} = 27$ sec.

total time (K)

$K = \frac{192+27}{3600} = .006$ hrs.

$x = 0.30$ try

Route Subarea "P" through Subarea "U"

1.) 42" Pipe

$L = 1030'$

$S = \overset{0.01}{\cancel{0.005}}\%$

$V = \frac{1.49}{0.015}\left(\frac{3.5}{4}\right)^{2/3}(0.01)^{1/2} = 9.1$ Ft/sec.

$t = 1030/9.1 = 113$ sec.

2.) 48" Pipe

$L = 1130'$

$S = 1\%$

$V = \frac{1.49}{0.013}\left(\frac{4}{4}\right)^{2/3}(0.01)^{1/2} = 9.9$ Ft/sec.

$t = 1130/9.9 = 114$ sec.

see Subarea "U" calcs J to L

436 sec.

Total time (K)

$K = \frac{436+114+113}{3600} = 0.18$ hrs.

$X = 0.30$ try

DJ | Paradise Pond

Subarea "V" Present Condition

Total Area

33.92 33.86 ⇒ 33.89 (0.0057)

= 0.195 sq. m.

All soil types are in the Hydrologic Soil group B

Residental 1/8 acre or less

8.29	8.21	8.25	
5.72	5.68	5.70	$= \frac{14.795}{33.89} = 43.5\%$
0.82	0.87	0.845	

Residental 1/4 acre

1.92 1.95 $\frac{1.935}{33.89} = 5.5\%$

Commercial

2.20 2.18 $\frac{2.19}{33.89} = 6.5\%$

Asphalt

1.30	1.38	1.34	
0.27	0.29	0.28	$= \frac{1.875}{33.89} = 5.5\%$
0.26	0.25	0.255	

39% of Water & Grass area.

Water 6.98 6.94 $= \frac{6.96}{33.89} = 20.5\%$

Subarea "V" Present Condition

TR 55

Land Use	Hydrologic Soil Group B								
	%	CN	Product	%	CN	Product	%	CN	Product
Residental 1/8 acre	43.5	85	3697.5						
Residental 1/4 acre	5.5	75	412.5						
Commercial	6.5	92	598						
Asphalt Area	5.5	98	539						
Grass Area	18.5	69	1276.5						
Water Area	20.5	1	20.5						
	100		6544						

Weighted CN = $\frac{6544}{100}$ = 65

Subarea "V" Present Condition

TR55

Time of Concentration

	Reach	Descrip. of flow	Slope (%)	Length (Ft.)	Table 3-1 velocity	Time sec.
	A to B	12" Pipe	0.5	610'	2.8 Ft/sec.	218
	B to C	Asphalt sheet	0.5	1870'	1.4 Ft/sec.	1336
				2480'		1554

$t_c = \frac{1554}{3600} = 0.43$ hrs.

$L = 0.6\,(0.43)$

$= 0.26$ hrs.

$$t = \frac{(2480)^{0.8}\left(\left(\frac{1000}{65} - 10\right) + 1\right)^{0.7}}{1900\,(0.5)^{0.5}}$$

$= 1.42$ hrs.

$V_1 = \frac{1.49}{0.015}\left(\frac{1}{4}\right)^{2/3}(0.005)^{1/2} = 2.8$ Ft/sec.

SEP 8 1988
Engineering Div.

LETTER OF TRANSMITTAL

SUMMIT ENGINEERING CORPORATION ™
5405 MAE ANNE AVENUE • RENO, NEVADA 89523 • (702) 747-8550

DATE	JOB NO.
9/8/88	2056

ATTENTION: Mr. Steve Varela

RE: Paradise Pond
Hydrology Study

To City Of Reno
Post Office Box 1900
Reno, Nevada 89505

GENTLEMEN:

WE ARE SENDING YOU ☒ ATTACHED ☐ UNDER SEPARATE COVER VIA _____ THE FOLLOWING ITEMS:

☐ SHOP DRAWINGS ☐ PRINTS ☐ PLANS ☐ SAMPLES ☐ SPECIFICATIONS

☐ COPY OF LETTER ☐ CHANGE ORDER ☐ _____

COPIES	DATE	NO.	DESCRIPTION
1	9/7/88	1	Data and Calculations
1	9/7/88	2	(Invoice

THESE ARE TRANSMITTED as checked below:

☐ FOR APPROVAL ☐ APPROVED AS SUBMITTED ☐ RESUBMIT _____ COPIES FOR APPROVAL

☐ FOR YOUR USE ☐ APPROVED AS NOTED ☐ SUBMIT _____ COPIES FOR DISTRIBUTION

☒ AS REQUESTED ☐ RETURNED FOR CORRECTIONS ☐ RETURN _____ CORRECTED PRINTS

☐ FOR REVIEW AND COMMENT ☐ _____

☐ FOR BIDS DUE _____ _____ ☐ PRINTS RETURNED AFTER LOAN TO US

REMARKS Here is the data you requested in your April 11, 1988 letter to Mr. Thomas Gallagher. The maps you requested have not been completed yet. When they are, they will be sent to you and the contract finaled out. I have enclosed our August 15, 1988 invoice. We would appreciate a progress payment for this work.

Ok if data ~~again~~ is what we asked for SV

COPY TO _____

SIGNED: James F. Reinstra

IF ENCLOSURES ARE NOT AS NOTED, KINDLY NOTIFY US AT ONCE. James F. Reinstra

City of Reno

POST OFFICE BOX 1900 • RENO, NEVADA 89505

September 2, 1988

Summit Engineering Corporation
5405 Mae Anne Avenue
Reno, Nevada 89523

Gentlemen:

We are returning your invoice dated August 15, 1988, for work on the Paradise Pond Storm Drain Study, unpaid pending delivery of the information requested at our August 9, 1988, meeting.

It has been our intent to obtain the additional data and information, and then final out the contract.

Thank you for your cooperation and we look forward to receiving the information soon.

Sincerely,

STEVE VARELA
CITY ENGINEER

By: Robert M. Gottsacker
Robert M. Gottsacker
Civil Engineer II

SV:RMG:dj
Enclosure

I approve this
9/9/88