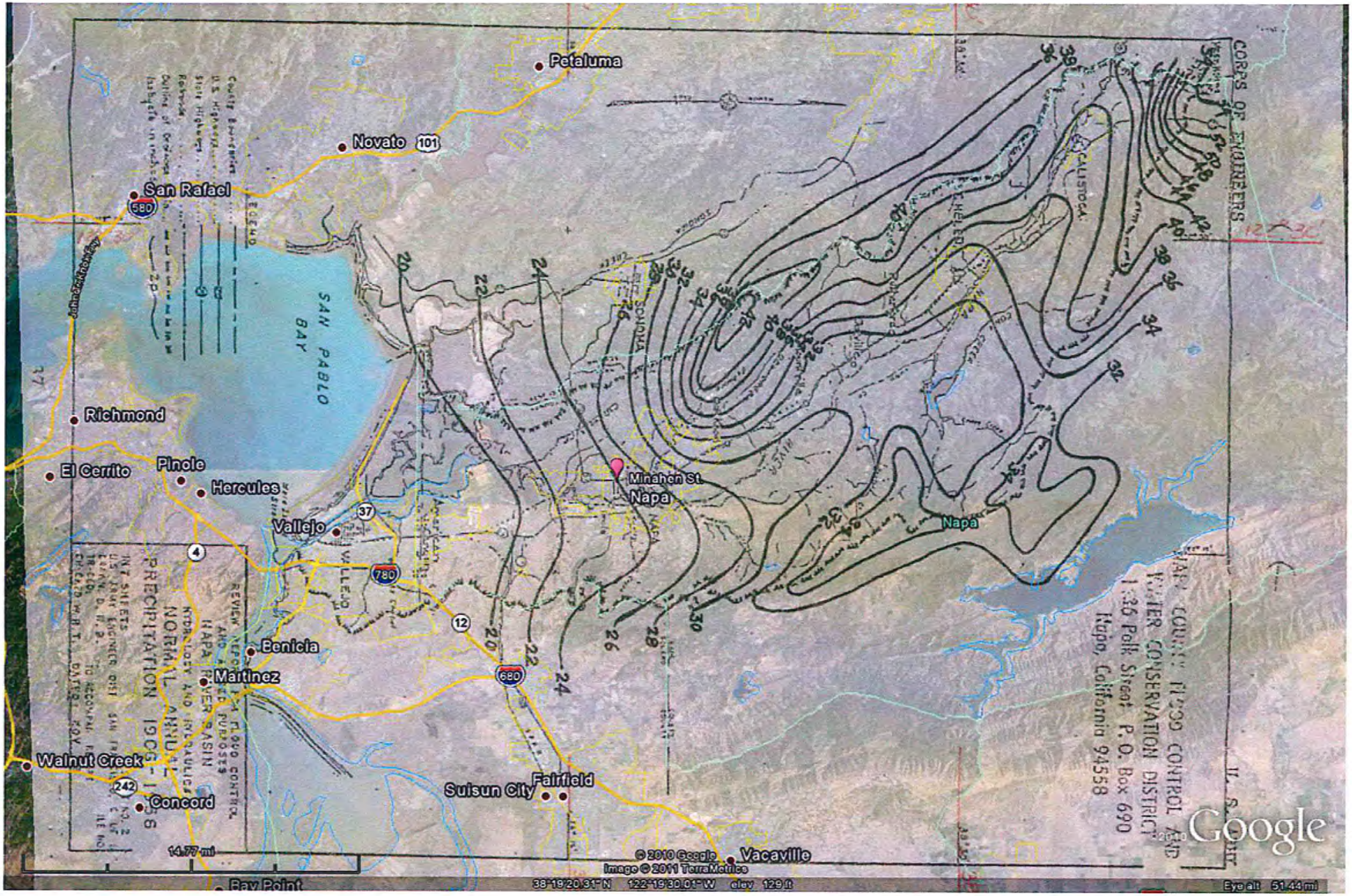
Attachment 1

Napa River Basin Normal Annual Precipitation


Petaluma
Novato
San Rafael
Richmond
El Cerrito
Pinole
Hercules
Vallejo
Benicia
Martinez
Walnut Creek
Concord
Bay Point
Suisun City
Fairfield
Vacaville
Napa
Minahen St
SAN PABLO BAY
CORPS OF ENGINEERS
NORMAL ANNUAL PRECIPITATION 1906-1958
NAPA RIVER BASIN
HYDROLOGY AND HYDRAULICS
REVIEW REPORT FLOOD CONTROL AND RELATED PURPOSES
MAP COURTESY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
1:36 Polk Street P. O. Box 690
Napa, California 94558
14.77 mi
© 2010 Google
Image © 2011 TerraMetrics
38°19'20.31" N 122°19'30.01" W elev 129 ft
Eye alt 51.44 mi
Google

Attachment 2

IDF
Time of Concentration Worksheet
Table 1: Scenario Comparison
Hydraflow Storm Sewer Calculations for Existing, Preferred, Alt's 1, 2, & 3

Hydraflow IDF Report

Return Period (Yrs)	Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	--------
2	48.5010	21.0000	1.0112	--------
3	0.0000	0.0000	0.0000	--------
5	138.9221	29.3001	1.1481	--------
10	105.8091	23.9001	1.0593	--------
25	218.3138	28.6001	1.1680	--------
50	341.7882	33.8001	1.2270	--------
100	354.9776	32.5001	1.2165	--------

S:\BE Engineering\Storm Sewer 2005 IDF Data\09-24 City of Napa (2).IDF

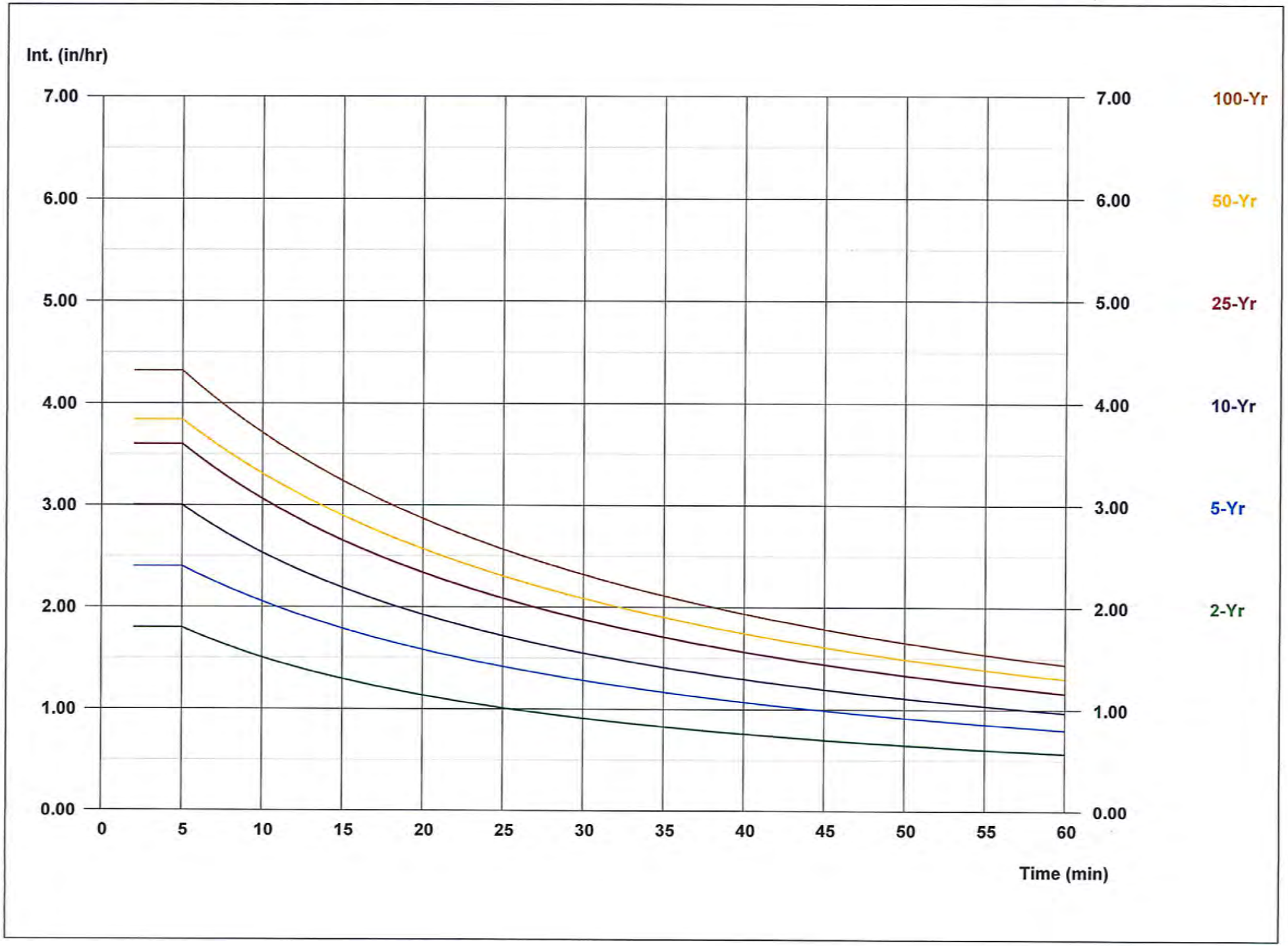
Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	1.80	1.51	1.29	1.13	1.01	0.91	0.83	0.76	0.70	0.65	0.61	0.57
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	2.40	2.05	1.79	1.58	1.42	1.28	1.17	1.07	0.99	0.92	0.85	0.80
10	3.00	2.53	2.19	1.93	1.72	1.55	1.41	1.29	1.20	1.11	1.04	0.97
25	3.60	3.06	2.66	2.34	2.09	1.88	1.71	1.56	1.44	1.33	1.24	1.16
50	3.84	3.31	2.90	2.57	2.31	2.09	1.90	1.74	1.61	1.49	1.39	1.30
100	4.32	3.71	3.24	2.87	2.57	2.32	2.11	1.94	1.79	1.66	1.54	1.44

Tc = time in minutes. Min Tc = 5

Storm Sewer IDF Curves

IDF file: 09-24 City of Napa (2).IDF



December 2011
Job# 09-24

Time of Concentration (Tc) Worksheet

$$T_c = T_o + T_g + T_p + T_{ch}$$

T_c= Time of Concentration (min)

T_o= overland flow travel time, 10 minutes minimum

T_g= gutter flow travel time

T_p= pipe flow travel time

T_{ch}= channel flow travel time

$$T_O = \frac{0.66 \times L^{0.5} \times n^{0.52}}{S^{0.31} \times i^{0.38}}$$

To= overland flow time of concentration, minutes
L= overland flow length, ft
n= roughness coefficient for overland flow
S= average slope of flow path, ft/ft assumed average of 0.0075 ft/ft or 0.75%
i= intensity of precipitation, in/hr

Area ID	Area Size (Ac)	T_o Overland Flow (min)	Length (ft)	Gutter Velocity (ft/s)	T_g Time (min)	T_c (min)	i Intensity 10-yr (in/hr)	25-yr (in/hr)	100-yr (in/hr)	Q Flow Rate 10-yr (cfs)	25-yr (cfs)	100-yr (cfs)
A	6.8	10	540	3.63	2.48	12.48	2.35	2.85	3.46	10.47	12.69	15.43
B	1.4	10	488	2.43	3.35	13.35	2.29	2.78	3.38	2.10	2.55	3.10
C	2.8	10	648	2.88	3.75	13.75	2.27	2.75	3.35	4.16	5.04	6.14
D	9.3	10	1230	3.85	5.32	15.32	2.17	2.63	3.21	13.23	16.05	19.58
E	3.3	10	697	3	3.87	13.87	2.26	2.74	3.34	4.88	5.92	7.21
F	2.5	10	764	2.79	4.56	14.56	2.22	2.69	3.28	3.63	4.40	5.37
G	2.3	10	786	2.73	4.80	14.80	2.20	2.67	3.26	3.32	4.02	4.91
H	3.0	10	684	2.93	3.89	13.89	2.26	2.74	3.33	4.44	5.38	6.56
I	1.6	10	665	2.49	4.45	14.45	2.22	2.70	3.29	2.33	2.83	3.45
J	1.6	10	635	2.5	4.23	14.23	2.24	2.71	3.30	2.34	2.84	3.47
K	4.6	10	1056	3.23	5.45	15.45	2.16	2.62	3.20	6.52	7.91	9.66
L	2.7	10	643	2.86	3.75	13.75	2.27	2.75	3.35	4.01	4.86	5.92

Table 1: Comparison Between Existing and Proposed
Minahen Street and Locust Street
Closed Conduit Storm Drain System

Line No.	Scenario				
	Existing	Preferred	Alternative 1	Alternative 2	Alternative 3
	Size (inches) and Material				
17	36″ – 42″ CMP	Abandoned	Abandoned	36″ RCP	24″ RCP
16	18″ PVC	18″ PVC (Ex)	18″ PVC (Ex)	18″ PVC (Ex)	18″ PVC (Ex)
15	42″ CMP	30″ RCP	30″ RCP	42″ RCP	30″ RCP
14	18″ RCP	15″ RCP	15″ RCP	15″ RCP	15″ RCP
13	42″ CMP	30″ RCP	30″ RCP	42″ RCP	30″ RCP
12	48″ CMP	30″ RCP	30″ RCP	42″ RCP	42″ RCP
11	12″ unknown material	24″ RCP	24″ RCP	30″ RCP	30″ RCP
10	8″ PVC	15″ RCP	15″ RCP	15″ RCP	15″ RCP
9	48″ CMP	36″ RCP	36″ RCP	60″x42″ BC	60″x42″ BC
8	24″ CMP	Abandoned	24″ RCP	Abandoned	18″ RCP
7	12″ unknown material	18″ RCP	18″ RCP	18″ RCP	18″ RCP
6	24″ CMP	18″ RCP	30″ RCP	18″ RCP	30″ RCP
5	60″x36″ CMP	50″x36″ BC	60″x40″ BC	60″x42″ BC	60″x42″ BC
4	12″ RCP	15″ RCP	15″ RCP	15″ RCP	15″ RCP
3	8″ PVC	18″ RCP	18″ RCP	15″ RCP	15″ RCP
2	8″ PVC	15″ RCP	15″ RCP	15″ RCP	15″ RCP
1	65″x40″ CMP	60″x36″ BC	60″x40″ BC	60″x42″ BC	60″x42″ BC

BC: Precast Concrete Box Culvert
CMP: Corrugated Metal Pipe
PVC: Polyvinyl Chloride
RCP: Reinforced Concrete Pipe

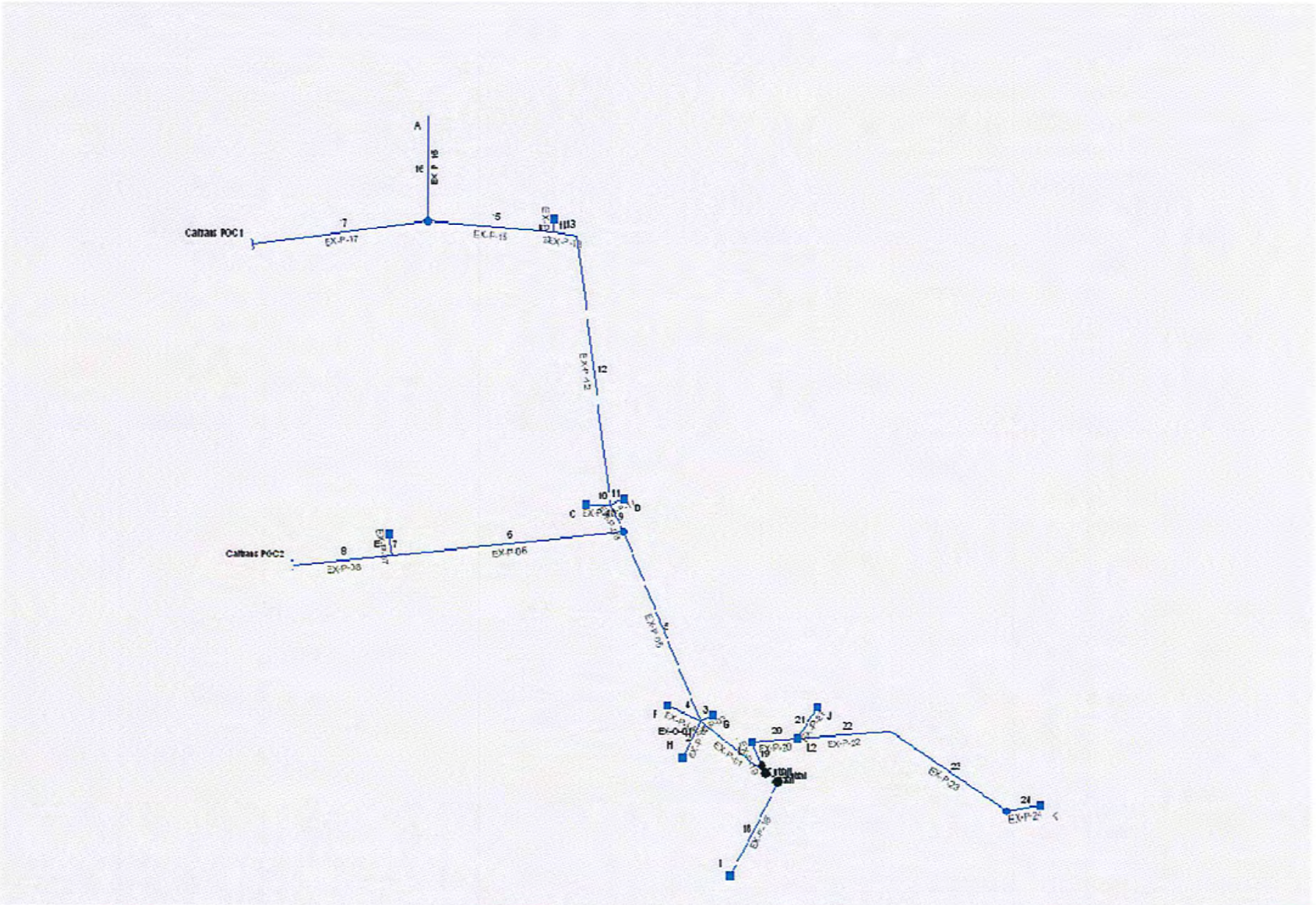
Ex: Existing to Remain

Storm Drain Infrastructure Study

Existing

Hydraflow Plan View

09-24 SD Inf Study - Existing

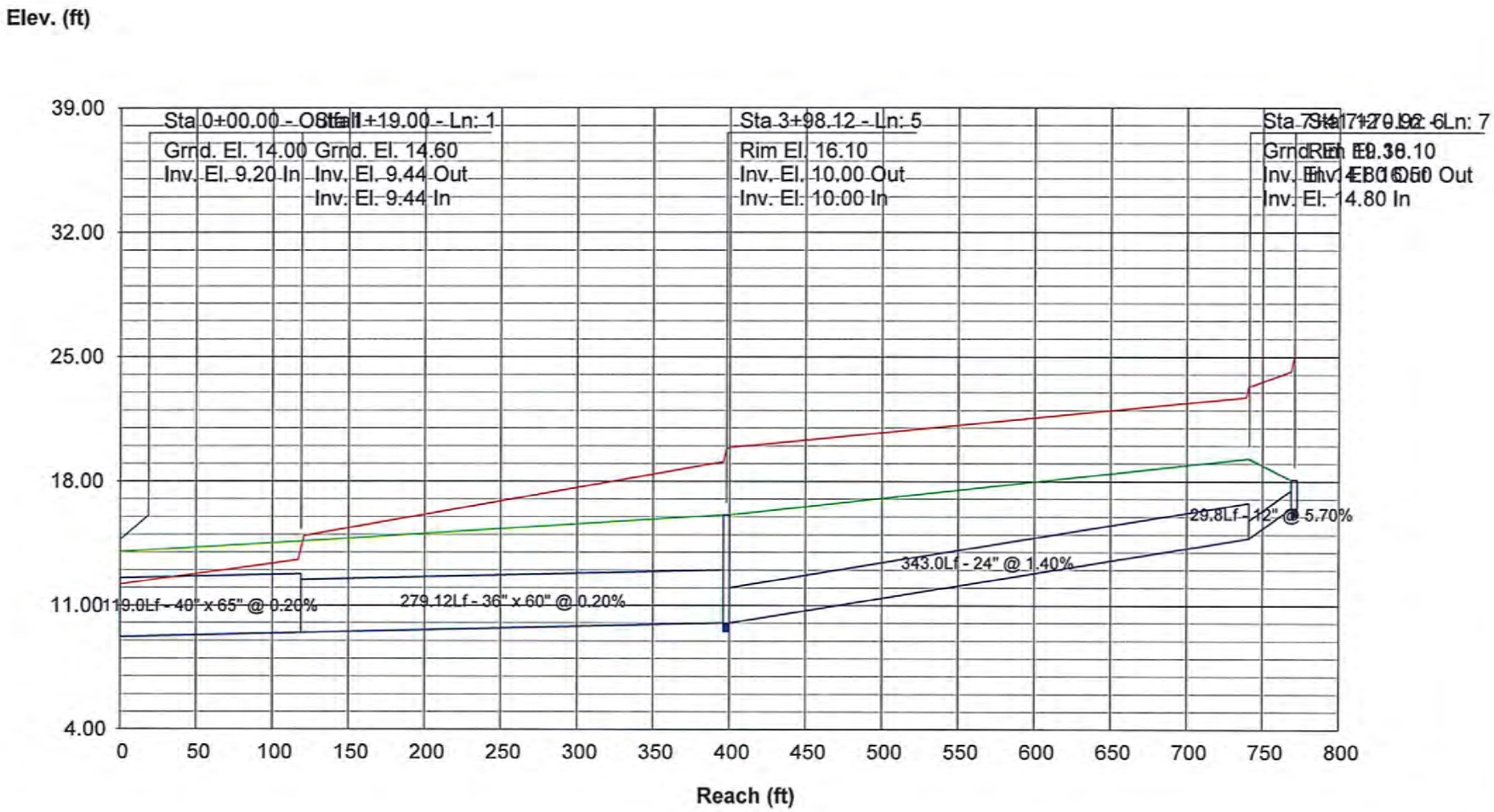


09-24 SD Inf Study - Existing	No. Lines: 24	12-12-2011

Hydraflow Storm Sewers 2005

Storm Sewer Profile

Proj. file: 09-24_Napa-SD-Ex_v1.0.stm

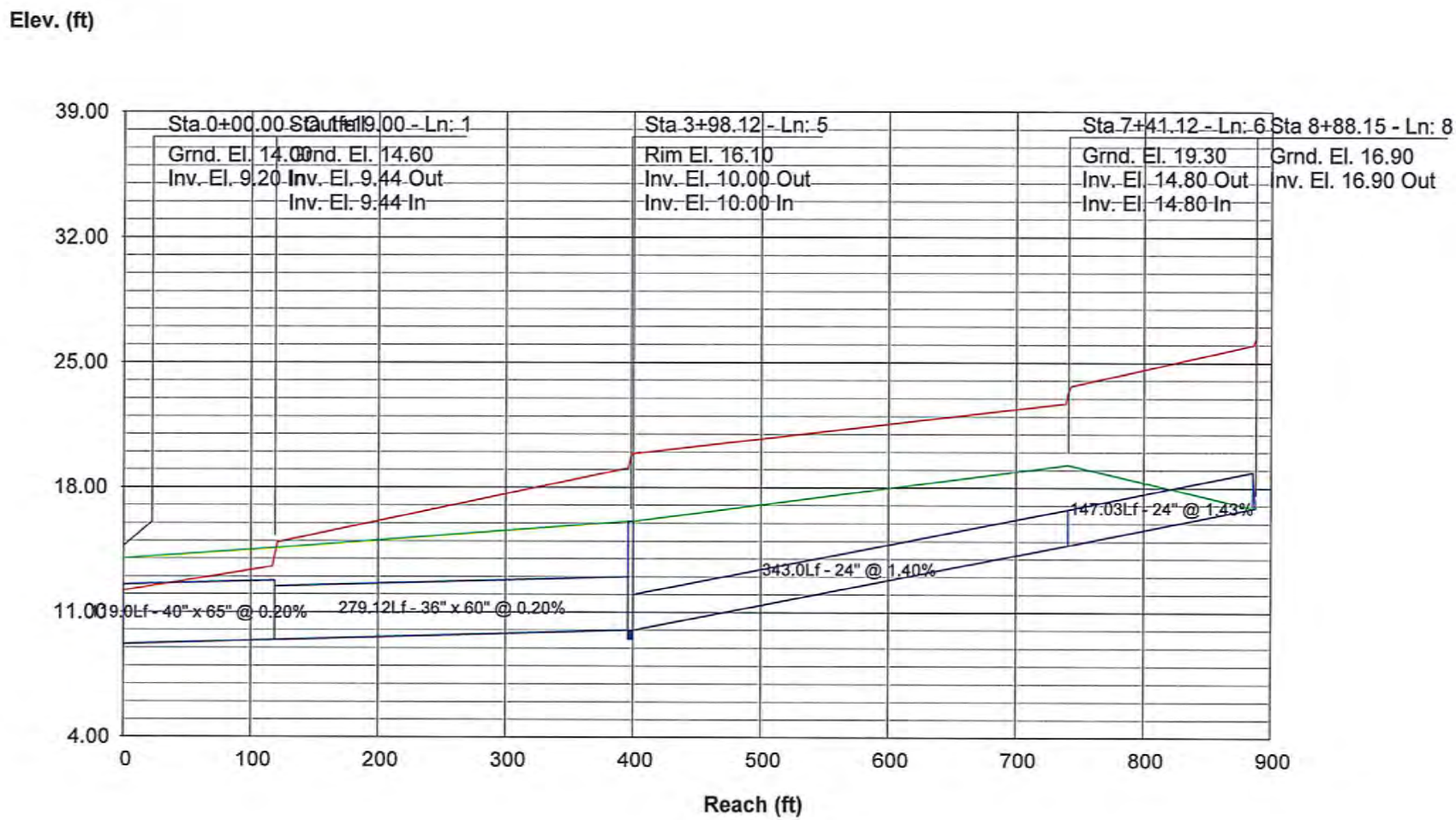


LEPHART TO DHE

Hydraflow Storm Sewers 2005

Storm Sewer Profile

Proj. file: 09-24_Napa-SD-Ex_v1.0.stm

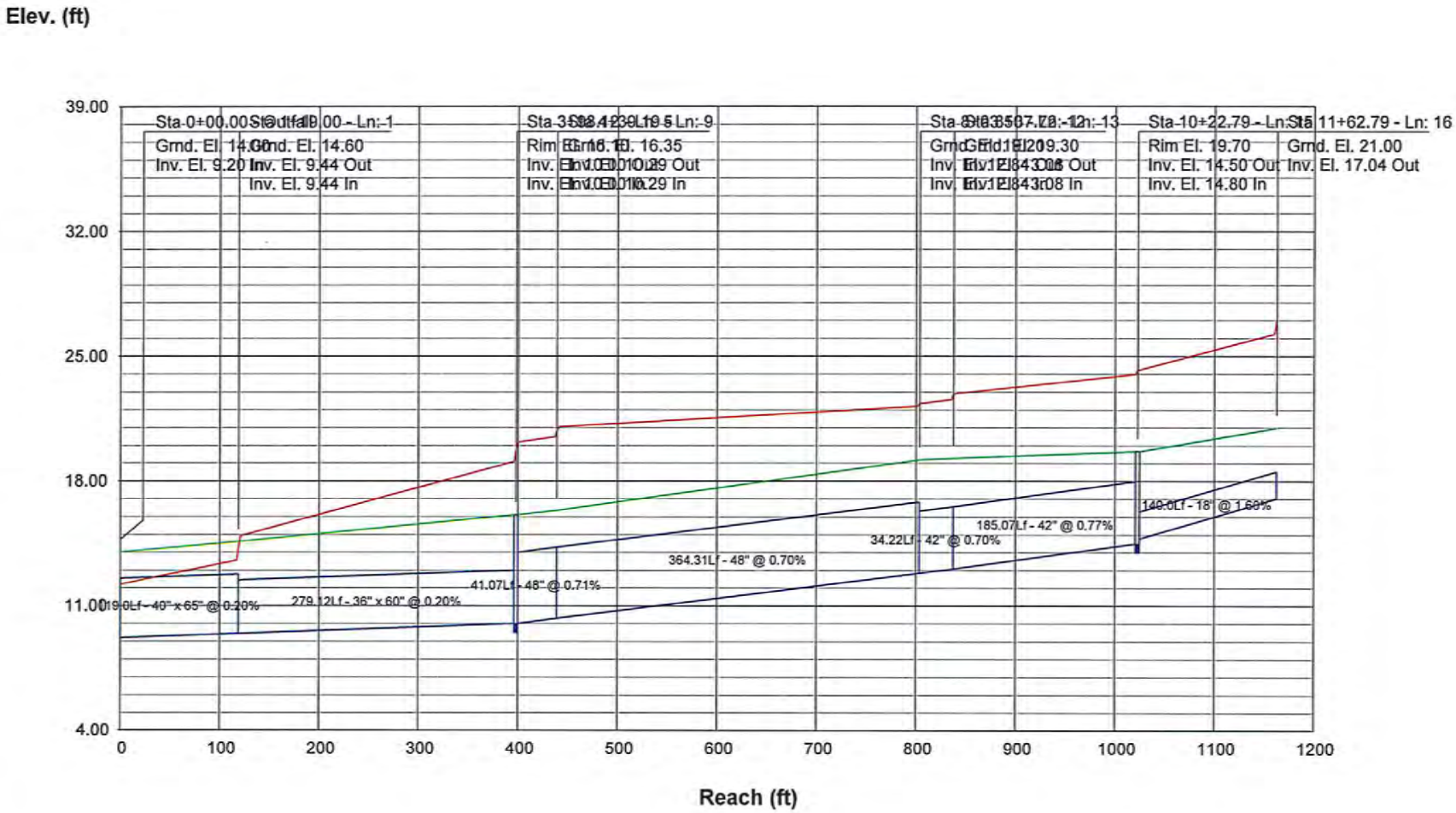


LERHARE TO CHANNEL

Hydraflow Storm Sewers 2005

Storm Sewer Profile

Proj. file: 09-24_Napa-SD-Ex_v1.0.stm

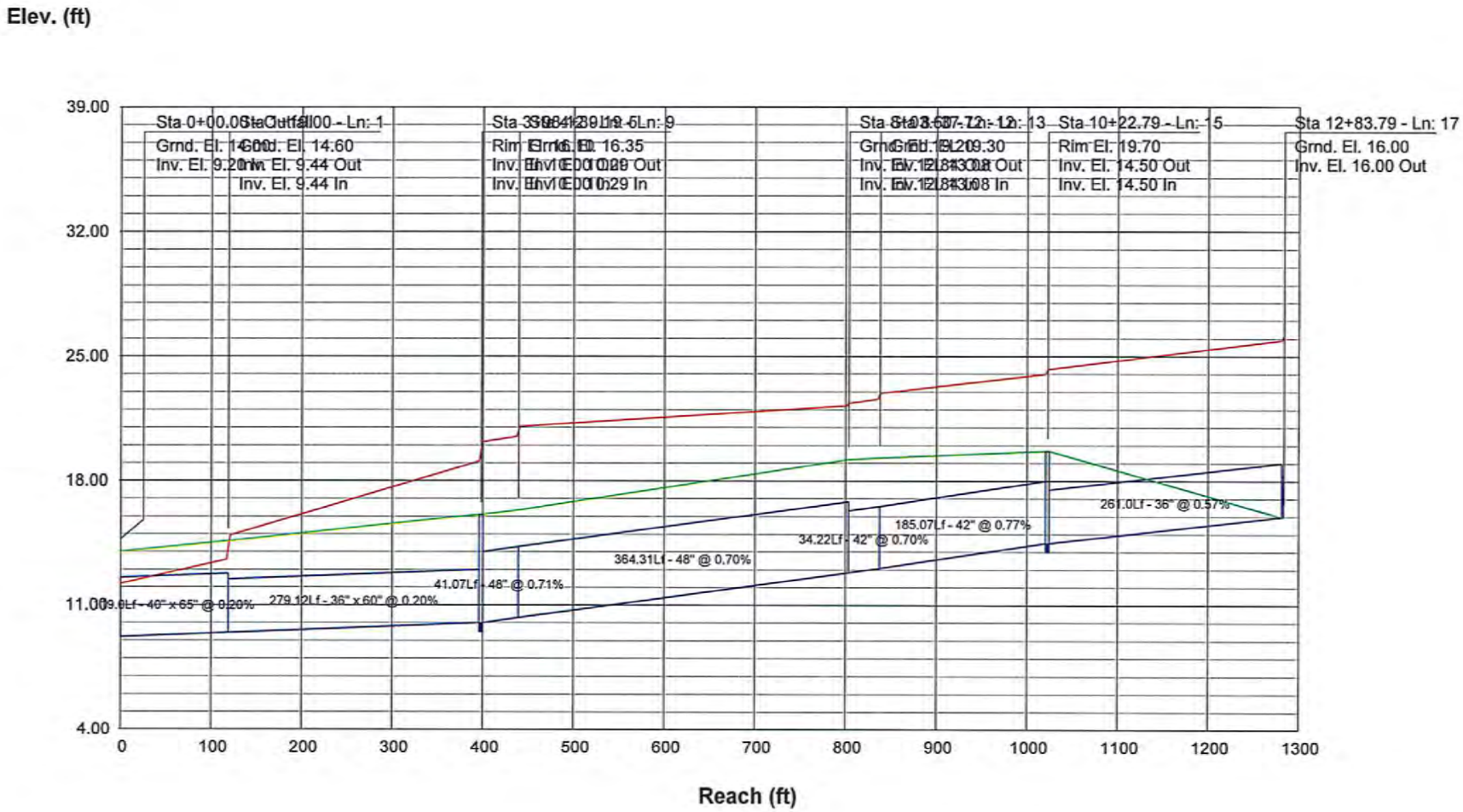


LERNHART → DIHA

Hydraflow Storm Sewers 2005

Storm Sewer Profile

Proj. file: 09-24_Napa-SD-Ex_v1.0.stm



LERNHART -> CHANNEL NORTH

Hydraflow Storm Sewers 2005

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr line No.	Line length (ft)	Defl angle (deg)	Junc type	Known Q (cfs)	Drng area (ac)	Runoff coeff (C)	Inlet time (min)	Invert El Dn (ft)	Line slope (%)	Invert El Up (ft)	Line size (in)	Line type	N value (n)	J-loss coeff (K)	Inlet/ Rim El (ft)	
1	End	119.0	-144.1	None	0.00	0.00	0.00	0.0	9.20	0.20	9.44	40 65	Ellip	0.025	1.00	14.60	EX-P-01
2	1	54.8	-97.5	Curb	0.00	2.97	0.65	13.9	9.44	4.67	12.00	8	Cir	0.013	1.00	13.80	EX-P-02
3	1	20.6	117.9	Curb	0.00	2.26	0.65	14.8	9.44	6.11	10.70	8	Cir	0.013	1.00	13.10	EX-P-03
4	1	54.0	-12.4	Curb	0.00	2.43	0.65	14.6	9.44	3.63	11.40	12	Cir	0.013	1.00	14.30	EX-P-04
5	1	279.1	29.9	MH	0.00	0.00	0.00	0.0	9.44	0.20	10.00	36 60	Ellip	0.025	0.96	16.10	EX-P-05
6	5	343.0	-71.3	None	0.00	0.00	0.00	0.0	10.00	1.40	14.80	24	Cir	0.013	1.00	19.30	EX-P-06
7	6	29.8	85.7	Curb	0.00	3.28	0.65	13.9	14.80	5.70	16.50	12	Cir	0.013	1.00	18.10	EX-P-07
8	6	147.0	0.5	Hdwl	14.65	0.00	0.00	0.0	14.80	1.43	16.90	24	Cir	0.025	1.00	16.90	EX-P-08
9	5	41.1	-5.2	None	0.00	0.00	0.00	0.0	10.00	0.71	10.29	48	Cir	0.025	1.00	16.35	EX-P-09
10	9	35.5	-59.9	DrGrt	0.00	2.84	0.65	13.8	10.29	11.01	14.20	8	Cir	0.013	1.00	15.60	EX-P-10
11	9	21.9	95.2	Curb	0.00	9.26	0.65	15.3	10.29	14.67	13.50	12	Cir	0.013	1.00	15.20	EX-P-11
12	9	364.3	21.3	None	0.00	0.00	0.00	0.0	10.29	0.70	12.84	48	Cir	0.025	0.97	19.20	EX-P-12
13	12	34.2	-75.4	None	0.00	0.00	0.00	0.0	12.84	0.70	13.08	42	Cir	0.025	0.99	19.30	EX-P-13
14	13	19.0	81.7	Curb	0.00	1.40	0.65	13.4	13.08	13.26	15.60	18	Cir	0.013	1.00	18.40	EX-P-14
15	13	185.1	-2.0	MH	0.00	0.00	0.00	0.0	13.08	0.77	14.50	42	Cir	0.025	1.00	19.70	EX-P-15
16	15	140.0	85.5	None	0.00	6.80	0.65	12.5	14.80	1.60	17.04	18	Cir	0.013	1.00	21.00	EX-P-16
17	15	261.0	-11.2	Hdwl	27.27	0.00	0.00	0.0	14.50	0.57	16.00	36	Cir	0.025	1.00	16.00	EX-P-17
18	End	145.8	118.5	Curb	0.00	1.60	0.65	14.5	10.80	1.44	12.90	6	Cir	0.013	1.00	14.30	EX-P-18
19	End	36.0	-114.7	Curb	0.00	2.70	0.65	13.8	9.30	0.56	9.50	24	Cir	0.013	1.50	13.10	EX-P-19
20	19	67.2	110.7	DrGrt	0.00	0.00	0.00	0.0	9.80	4.93	13.11	16	Cir	0.025	1.22	0.00	EX-P-20

09-24 SD Inf Study - Existing | Number of lines: 24 | Date: 12-12-2011

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr line No.	Line length (ft)	Defl angle (deg)	Junc type	Known Q (cfs)	Drng area (ac)	Runoff coeff (C)	Inlet time (min)	Invert El Dn (ft)	Line slope (%)	Invert El Up (ft)	Line size (in)	Line type	N value (n)	J-loss coeff (K)	Inlet/ Rim El (ft)	
21	20	51.6	-51.2	DrGrt	0.00	1.60	0.66	14.2	13.44	2.01	14.48	12	Cir	0.025	1.00	0.00	EX-P-21
22	20	138.4	-0.1	None	0.00	0.00	0.00	0.0	12.94	1.46	14.96	18	Cir	0.025	0.64	0.00	EX-P-22
23	22	202.3	36.1	MH	0.00	0.00	0.00	0.0	14.96	1.54	18.08	18	Cir	0.025	0.70	0.00	EX-P-23
24	23	51.0	-41.0	Curb	0.00	4.60	0.63	15.5	18.08	1.57	18.88	18	Cir	0.025	1.00	0.00	EX-P-24

09-24 SD Inf Study - Existing | Number of lines: 24 | Date: 12-12-2011

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	EX-P-01	93.98	40 x 65 e	119.0	9.20	9.44	0.202	12.20*	13.57*	0.68	14.25	End
2	EX-P-02	5.28	8 c	54.8	9.44	12.00	4.671	14.25*	24.74*	3.56	28.31	1
3	EX-P-03	3.92	8 c	20.6	9.44	10.70	6.108	14.25*	16.43*	1.96	18.39	1
4	EX-P-04	4.24	12 c	54.0	9.44	11.40	3.632	14.48*	15.25*	0.45	15.70	1
5	EX-P-05	81.91	36 x 60 e	279.1	9.44	10.00	0.201	14.93*	19.10*	0.72	19.82	1
6	EX-P-06	20.48	24 c	343.0	10.00	14.80	1.399	19.91*	22.72*	0.66	23.38	5
7	EX-P-07	5.84	12 c	29.8	14.80	16.50	5.705	23.38*	24.18*	0.86	25.04	6
8	EX-P-08	14.65	24 c	147.0	14.80	16.90	1.428	23.70*	25.99*	0.34	26.32	6
9	EX-P-09	61.83	48 c	41.1	10.00	10.29	0.706	20.19*	20.48*	0.38	20.85	5
10	EX-P-10	5.07	8 c	35.5	10.29	14.20	11.011	20.85*	27.12*	3.28	30.40	9
11	EX-P-11	15.85	12 c	21.9	10.29	13.50	14.671	20.85*	25.19*	6.33	31.52	9
12	EX-P-12	41.93	48 c	364.3	10.29	12.84	0.700	21.06*	22.20*	0.17	22.37	9
13	EX-P-13	41.99	42 c	34.2	12.84	13.08	0.701	22.37*	22.59*	0.29	22.89	12
14	EX-P-14	2.53	18 c	19.0	13.08	15.60	13.263	23.15*	23.16*	0.03	23.19	13
15	EX-P-15	39.74	42 c	185.1	13.08	14.50	0.767	22.92*	23.98*	0.27	24.25	13
16	EX-P-16	12.58	18 c	140.0	14.80	17.04	1.600	24.25*	26.26*	0.79	27.05	15
17	EX-P-17	27.27	36 c	261.0	14.50	16.00	0.575	24.28*	25.90*	0.23	26.13	15
18	EX-P-18	2.80	6 c	145.8	10.80	12.90	1.441	11.30*	47.73*	3.17	50.90	End
19	EX-P-19	14.33	24 c	36.0	9.30	9.50	0.556	10.76	10.92	0.84	11.76	End
20	EX-P-20	9.97	16 c	67.2	9.80	13.11	4.929	11.76*	15.96*	0.97	16.92	19
21	EX-P-21	2.86	12 c	51.6	13.44	14.48	2.014	17.51*	18.74*	0.21	18.95	20
22	EX-P-22	7.41	18 c	138.4	12.94	14.96	1.460	17.44*	19.99*	0.17	20.17	20
23	EX-P-23	7.56	18 c	202.3	14.96	18.08	1.542	20.17*	24.05*	0.20	24.25	22
24	EX-P-24	7.60	18 c	51.0	18.08	18.88	1.569	24.25*	25.24*	0.29	25.53	23

09-24 SD Inf Study - Existing | Number of lines: 24 | Run Date: 12-12-2011

NOTES: c = cir; e = ellip; b = box; Return period = 25 Yrs. ; *Surcharged (HGL above crown).

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	
1	End	119.0	0.00	31.24	0.00	0.00	20.31	0.0	16.3	2.6	93.98	38.65	6.82	40 65 e	0.20	9.44	9.20	13.57	12.20	14.60	14.00	EX-P-01
2	1	54.8	2.97	2.97	0.65	1.93	1.93	13.9	13.9	2.7	5.28	2.61	15.14	8	4.67	12.00	9.44	24.74	14.25	13.80	14.60	EX-P-02
3	1	20.6	2.26	2.26	0.65	1.47	1.47	14.8	14.8	2.7	3.92	2.98	11.24	8	6.11	10.70	9.44	16.43	14.25	13.10	14.60	EX-P-03
4	1	54.0	2.43	2.43	0.65	1.58	1.58	14.6	14.6	2.7	4.24	6.79	5.40	12	3.63	11.40	9.44	15.25	14.48	14.30	14.60	EX-P-04
5	1	279.1	0.00	23.58	0.00	0.00	15.33	0.0	15.7	2.6	81.91	30.04	6.95	36 60 e	0.20	10.00	9.44	19.10	14.93	16.10	14.60	EX-P-05
6	5	343.0	0.00	3.28	0.00	0.00	2.13	0.0	13.9	2.7	20.48	26.76	6.52	24	1.40	14.80	10.00	22.72	19.91	19.30	16.10	EX-P-06
7	6	29.8	3.28	3.28	0.65	2.13	2.13	13.9	13.9	2.7	5.84	8.51	7.43	12	5.70	16.50	14.80	24.18	23.38	18.10	19.30	EX-P-07
8	6	147.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	14.65	14.06	4.66	24	1.43	16.90	14.80	25.99	23.70	16.90	19.30	EX-P-08
9	5	41.1	0.00	20.30	0.00	0.00	13.20	0.0	15.5	2.6	61.83	62.77	4.92	48	0.71	10.29	10.00	20.48	20.19	16.35	16.10	EX-P-09
10	9	35.5	2.84	2.84	0.65	1.85	1.85	13.8	13.8	2.7	5.07	4.01	14.53	8	11.01	14.20	10.29	27.12	20.85	15.60	16.35	EX-P-10
11	9	21.9	9.26	9.26	0.65	6.02	6.02	15.3	15.3	2.6	15.85	13.64	20.18	12	14.67	13.50	10.29	25.19	20.85	15.20	16.35	EX-P-11
12	9	364.3	0.00	8.20	0.00	0.00	5.33	0.0	13.7	2.8	41.93	62.49	3.34	48	0.70	12.84	10.29	22.20	21.06	19.20	16.35	EX-P-12
13	12	34.2	0.00	8.20	0.00	0.00	5.33	0.0	13.6	2.8	41.99	43.81	4.36	42	0.70	13.08	12.84	22.59	22.37	19.30	19.20	EX-P-13
14	13	19.0	1.40	1.40	0.65	0.91	0.91	13.4	13.4	2.8	2.53	38.24	1.43	18	13.26	15.60	13.08	23.16	23.15	18.40	19.30	EX-P-14
15	13	185.1	0.00	6.80	0.00	0.00	4.42	0.0	12.8	2.8	39.74	45.83	4.13	42	0.77	14.50	13.08	23.98	22.92	19.70	19.30	EX-P-15
16	15	140.0	6.80	6.80	0.65	4.42	4.42	12.5	12.5	2.8	12.58	13.28	7.12	18	1.60	17.04	14.80	26.26	24.25	21.00	19.70	EX-P-16
17	15	261.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	27.27	26.29	3.86	36	0.57	16.00	14.50	25.90	24.28	16.00	19.70	EX-P-17
18	End	145.8	1.60	1.60	0.65	1.04	1.04	14.5	14.5	2.7	2.80	0.67	14.28	6	1.44	12.90	10.80	47.73	11.30	14.30	0.00	EX-P-18
19	End	36.0	2.70	8.90	0.65	1.76	5.71	13.8	17.1	2.5	14.33	16.86	5.92	24	0.56	9.50	9.30	10.92	10.76	13.10	0.00	EX-P-19
20	19	67.2	0.00	6.20	0.00	0.00	3.95	0.0	17.0	2.5	9.97	8.85	7.14	16	4.93	13.11	9.80	15.96	11.76	0.00	13.10	EX-P-20

09-24 SD Inf Study - Existing | Number of lines: 24 | Run Date: 12-12-2011

NOTES: Intensity = 218.31 / (Inlet time + 28.60) ^ 1.17; Return period = 25 Yrs.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	
21	20	51.6	1.60	1.60	0.66	1.06	1.06	14.2	14.2	2.7	2.86	2.63	3.65	12	2.01	14.48	13.44	18.74	17.51	0.00	0.00	EX-P-21
22	20	138.4	0.00	4.60	0.00	0.00	2.90	0.0	16.4	2.6	7.41	6.60	4.19	18	1.46	14.96	12.94	19.99	17.44	0.00	0.00	EX-P-22
23	22	202.3	0.00	4.60	0.00	0.00	2.90	0.0	15.6	2.6	7.56	6.78	4.28	18	1.54	18.08	14.96	24.05	20.17	0.00	0.00	EX-P-23
24	23	51.0	4.60	4.60	0.63	2.90	2.90	15.5	15.5	2.6	7.60	6.84	4.30	18	1.57	18.88	18.08	25.24	24.25	0.00	0.00	EX-P-24

09-24 SD Inf Study - Existing | Number of lines: 24 | Run Date: 12-12-2011

NOTES: Intensity = 218.31 / (Inlet time + 28.60) ^ 1.17; Return period = 25 Yrs.

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q byp (cfs)	Junc type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp line No
							Ht (in)	L (ft)	area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
1	EX-O-01	0.00	0.00	0.00	0.00	None	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
2	H	5.28	0.00	5.28	0.00	Curb	6.0	3.00	0.00	0.00	0.00	Sag	2.00	0.080	0.050	0.013	0.55	9.86	0.66	9.86	2.00	Off
3	G	3.92	0.00	3.92	0.00	Curb	6.0	3.00	0.00	0.00	0.00	Sag	2.00	0.080	0.050	0.013	0.46	8.08	0.57	8.08	2.00	Off
4	F	4.24	0.00	4.24	0.00	Curb	6.0	3.00	0.00	0.00	0.00	Sag	2.00	0.080	0.050	0.013	0.49	8.52	0.59	8.52	2.00	Off
5		0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
6		0.00	0.00	0.00	0.00	None	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
7	E	5.84	0.00	5.84	0.00	Curb	6.0	3.00	0.00	0.00	0.00	Sag	2.00	0.080	0.050	0.013	0.59	10.54	0.69	10.54	2.00	Off
8	Caltrans POC2	14.65*	0.00	14.65	0.00	Hdwl	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
9		0.00	0.00	0.00	0.00	None	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
10	C	5.07	0.00	5.07	0.00	DrGrt	0.0	0.00	2.00	4.00	2.00	Sag	2.00	0.050	0.050	0.013	0.35	16.18	0.35	16.18	0.00	Off
11	D	15.85	0.00	15.85	0.00	Curb	6.0	3.00	0.00	0.00	0.00	Sag	2.00	0.080	0.050	0.013	2.40	46.82	2.51	46.82	2.00	Off
12		0.00	0.00	0.00	0.00	None	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
13		0.00	0.00	0.00	0.00	None	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
14	B	2.53	0.00	2.53	0.00	Curb	6.0	3.00	0.00	0.00	0.00	Sag	2.00	0.080	0.050	0.013	0.36	6.02	0.47	6.02	2.00	Off
15		0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
16	A	12.58	0.00	0.00	12.58	None	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
17	Caltrans POC1	27.27*	0.00	27.27	0.00	Hdwl	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
18	I	2.80	0.00	2.80	0.00	Curb	6.0	3.00	0.00	0.00	0.00	Sag	2.00	0.080	0.050	0.013	0.38	6.45	0.49	6.45	2.00	Off
19	L	4.82	0.00	4.82	0.00	Curb	6.0	3.00	0.00	0.00	0.00	Sag	2.00	0.080	0.050	0.013	0.52	9.27	0.63	9.27	2.00	Off
20	L2	0.00	0.00	0.00	0.00	DrGrt	0.0	0.00	2.00	4.00	2.00	Sag	2.00	0.050	0.050	0.000	0.00	2.00	0.00	2.00	0.00	Off
21	J	2.86	0.00	2.86	0.00	DrGrt	0.0	0.00	4.00	2.00	2.00	Sag	2.00	0.050	0.050	0.013	0.29	13.74	0.29	13.74	0.00	Off
22		0.00	0.00	0.00	0.00	None	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off

09-24 SD Inf Study - Existing | Number of lines: 24 | Run Date: 12-12-2011

NOTES: Inlet N-Values = 0.016 ; Intensity = 218.31 / (Inlet time + 28.60) ^ 1.17; Return period = 25 Yrs. ; * Indicates Known Q added

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q byp (cfs)	Junc type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp line No
							Ht (in)	L (ft)	area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
23		0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
24	K	7.60	0.00	7.60	0.00	Curb	6.0	3.00	0.00	0.00	0.00	Sag	2.00	0.080	0.050	0.013	0.73	13.35	0.83	13.35	2.00	Off

09-24 SD Inf Study - Existing | Number of lines: 24 | Run Date: 12-12-2011

NOTES: Inlet N-Values = 0.016 ; Intensity = 218.31 / (Inlet time + 28.60) ^ 1.17; Return period = 25 Yrs. ; * Indicates Known Q added

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
1	40 65 e	93.98	9.20	12.20	3.00	13.42	7.01	0.76	12.96	0.974	119	9.44	13.57	3.33	14.18	6.63	0.68	14.25	1.192	1.083	1.289	1.00	0.68
2	8	5.28	9.44	14.25	0.67	0.35	15.14	3.56	17.81	19.144	54.8	12.00	24.74	0.67**	0.35	15.14	3.56	28.31	19.137	19.141	10.49	1.00	3.56
3	8	3.92	9.44	14.25	0.67	0.35	11.24	1.96	16.22	10.550	20.6	10.70	16.43	0.67**	0.35	11.24	1.96	18.39	10.546	10.548	2.176	1.00	1.96
4	12	4.24	9.44	14.48	1.00	0.79	5.41	0.45	14.93	1.421	54.0	11.40	15.25	1.00	0.79	5.40	0.45	15.70	1.420	1.421	0.767	1.00	0.45
5	36 60 e	81.91	9.44	14.93	3.00	11.78	6.95	0.75	15.69	1.491	279	10.00	19.10	3.00	11.78	6.95	0.75	19.85	1.491	1.491	4.163	0.96	0.72
6	24	20.48	10.00	19.91	2.00	3.14	6.52	0.66	20.57	0.820	343	14.80	22.72	2.00	3.14	6.52	0.66	23.38	0.820	0.820	2.812	1.00	0.66
7	12	5.84	14.80	23.38	1.00	0.79	7.43	0.86	24.24	2.688	29.8	16.50	24.18	1.00	0.79	7.43	0.86	25.04	2.687	2.688	0.801	1.00	0.86
8	24	14.65	14.80	23.70	2.00	3.14	4.66	0.34	24.04	1.552	147	16.90	25.99	2.00	3.14	4.66	0.34	26.32	1.552	1.552	2.282	1.00	0.34
9	48	61.83	10.00	20.19	4.00	12.56	4.92	0.38	20.57	0.685	41.1	10.29	20.48	4.00	12.57	4.92	0.38	20.85	0.685	0.685	0.281	1.00	0.38
10	8	5.07	10.29	20.85	0.67	0.35	14.53	3.28	24.13	17.641	35.5	14.20	27.12	0.67**	0.35	14.53	3.28	30.40	17.634	17.637	6.263	1.00	3.28
11	12	15.85	10.29	20.85	1.00	0.79	20.18	6.33	27.18	19.811	21.9	13.50	25.19	1.00**	0.79	20.18	6.33	31.52	19.803	19.807	4.334	1.00	6.33
12	48	41.93	10.29	21.06	4.00	12.56	3.34	0.17	21.23	0.315	364	12.84	22.20	4.00	12.57	3.34	0.17	22.38	0.315	0.315	1.148	0.97	0.17
13	42	41.99	12.84	22.37	3.50	9.62	4.36	0.30	22.67	0.644	34.2	13.08	22.59	3.50	9.62	4.36	0.30	22.89	0.644	0.644	0.220	0.99	0.29
14	18	2.53	13.08	23.15	1.50	1.77	1.43	0.03	23.18	0.058	19.0	15.60	23.16	1.50	1.77	1.43	0.03	23.19	0.058	0.058	0.011	1.00	0.03
15	42	39.74	13.08	22.92	3.50	9.62	4.13	0.27	23.18	0.577	185	14.50	23.98	3.50	9.62	4.13	0.27	24.25	0.577	0.577	1.068	1.00	0.27
16	18	12.58	14.80	24.25	1.50	1.77	7.12	0.79	25.04	1.436	140	17.04	26.26	1.50	1.77	7.12	0.79	27.05	1.436	1.436	2.010	1.00	0.79
17	36	27.27	14.50	24.28	3.00	7.07	3.86	0.23	24.51	0.619	261	16.00	25.90	3.00	7.07	3.86	0.23	26.13	0.618	0.618	1.614	1.00	0.23
18	6	2.80	10.80	11.30	0.50*	0.20	14.28	3.17	14.47	24.998	146	12.90	47.73	0.50**	0.20	14.28	3.17	50.90	24.989	24.993	36.43	1.00	3.17
19	24	14.33	9.30	10.76	1.46	2.46	5.83	0.53	11.29	0.515	36.0	9.50	10.92	1.42	2.38	6.01	0.56	11.48	0.553	0.534	0.192	1.50	0.84
20	16	9.97	9.80	11.76	1.33	1.40	7.14	0.79	12.55	6.248	67.2	13.11	15.96	1.33	1.40	7.14	0.79	16.75	6.246	6.247	4.195	1.22	0.97

09-24 SD Inf Study - Existing | Number of lines: 24 | Run Date: 12-12-2011

Notes: * Normal depth assumed.; ** Critical depth.

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
21	12	2.86	13.44	17.51	1.00	0.79	3.65	0.21	17.72	2.391	51.6	14.48	18.74	1.00	0.79	3.65	0.21	18.95	2.391	2.391	1.234	1.00	0.21
22	18	7.41	12.94	17.44	1.50	1.77	4.19	0.27	17.72	1.842	138	14.96	19.99	1.50	1.77	4.19	0.27	20.27	1.841	1.842	2.548	0.64	0.17
23	18	7.56	14.96	20.17	1.50	1.77	4.28	0.28	20.45	1.920	202	18.08	24.05	1.50	1.77	4.28	0.28	24.33	1.919	1.919	3.882	0.70	0.20
24	18	7.60	18.08	24.25	1.50	1.77	4.30	0.29	24.54	1.940	51.0	18.88	25.24	1.50	1.77	4.30	0.29	25.53	1.939	1.939	0.989	1.00	0.29

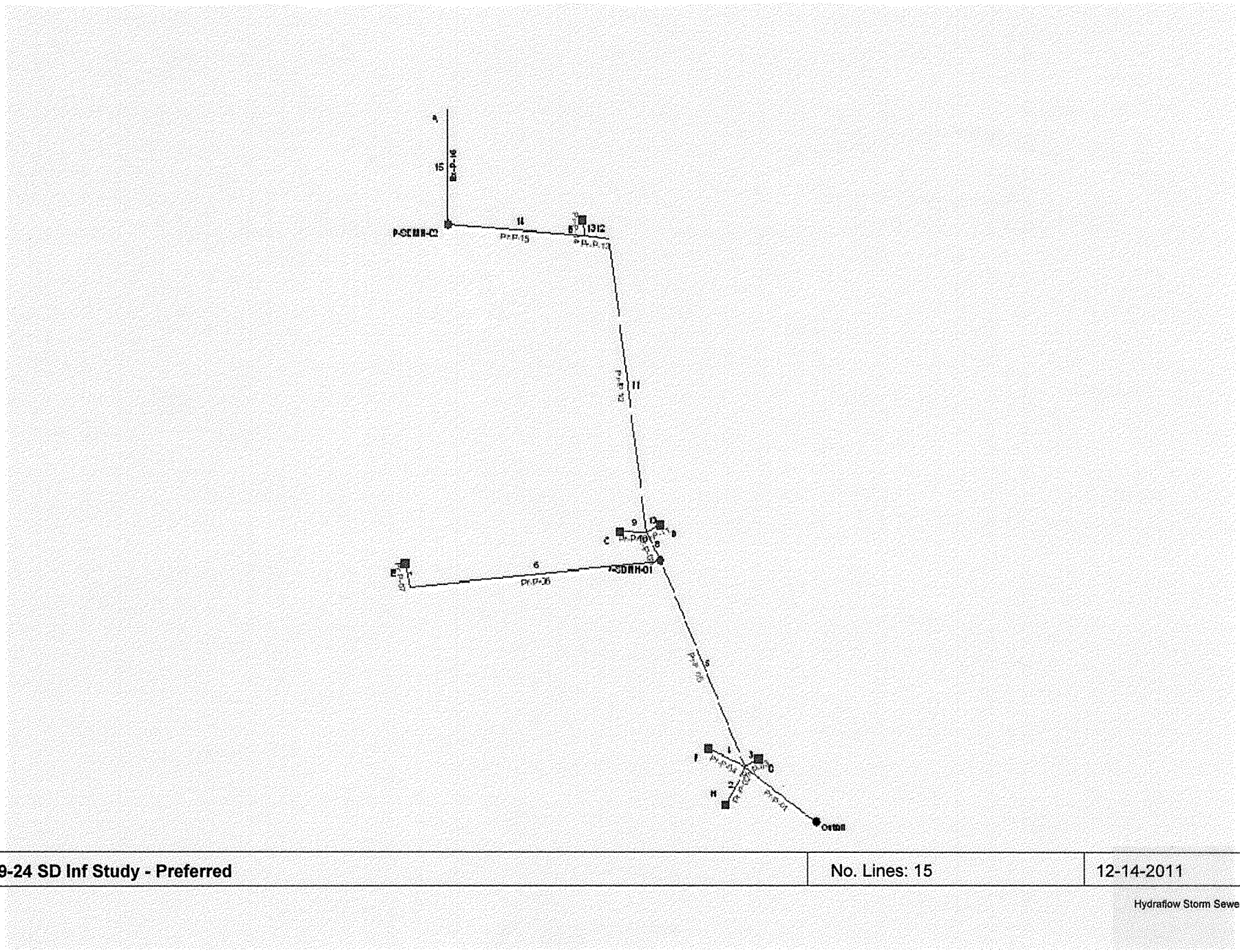
09-24 SD Inf Study - Existing | Number of lines: 24 | Run Date: 12-12-2011

Notes: * Normal depth assumed.; ** Critical depth.

Storm Drain Infrastructure Study

Preferred

Hydraflow Plan View

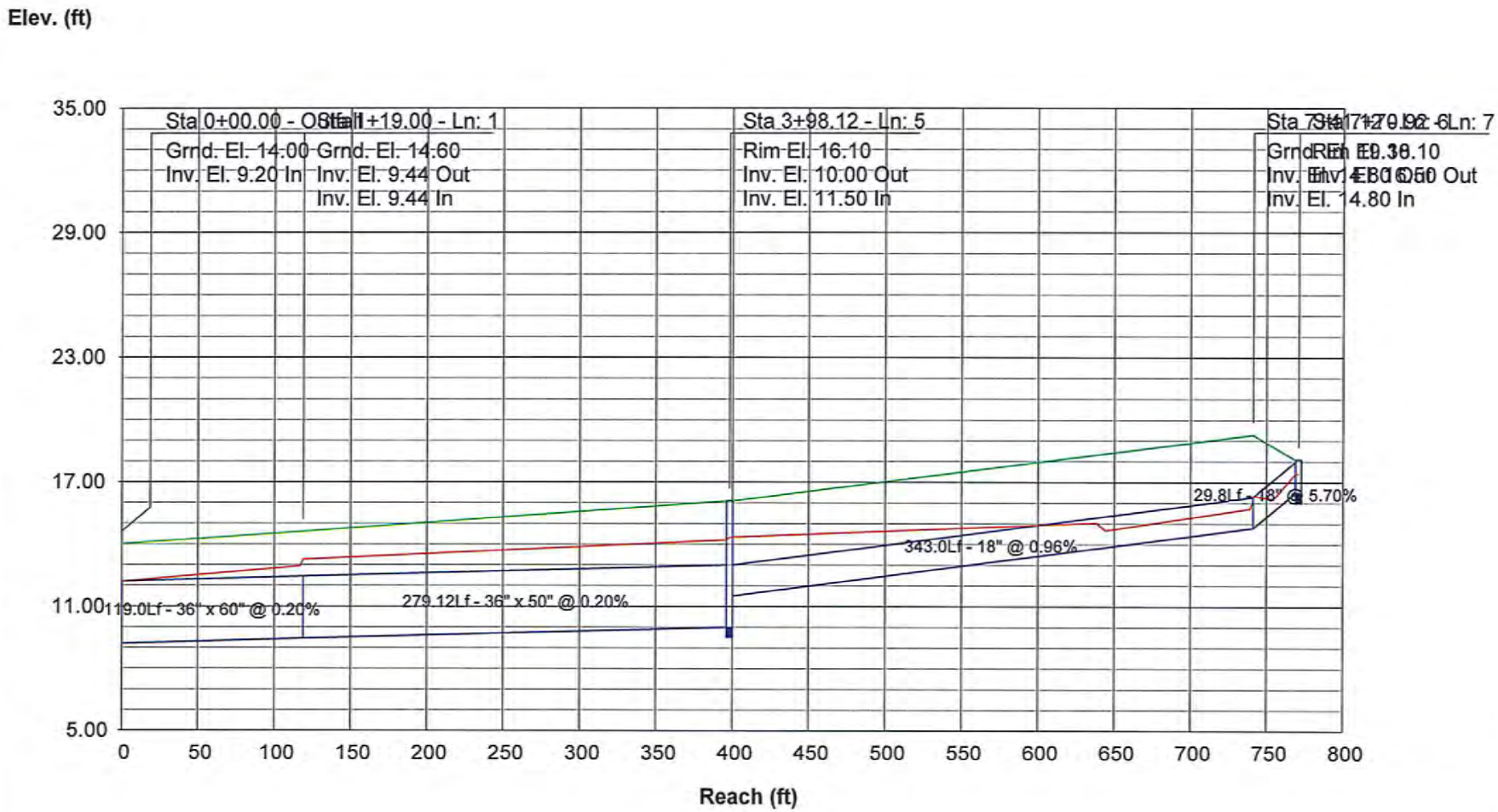


09-24 SD Inf Study - Preferred	No. Lines: 15	12-14-2011

Hydraflow Storm Sewers 2005

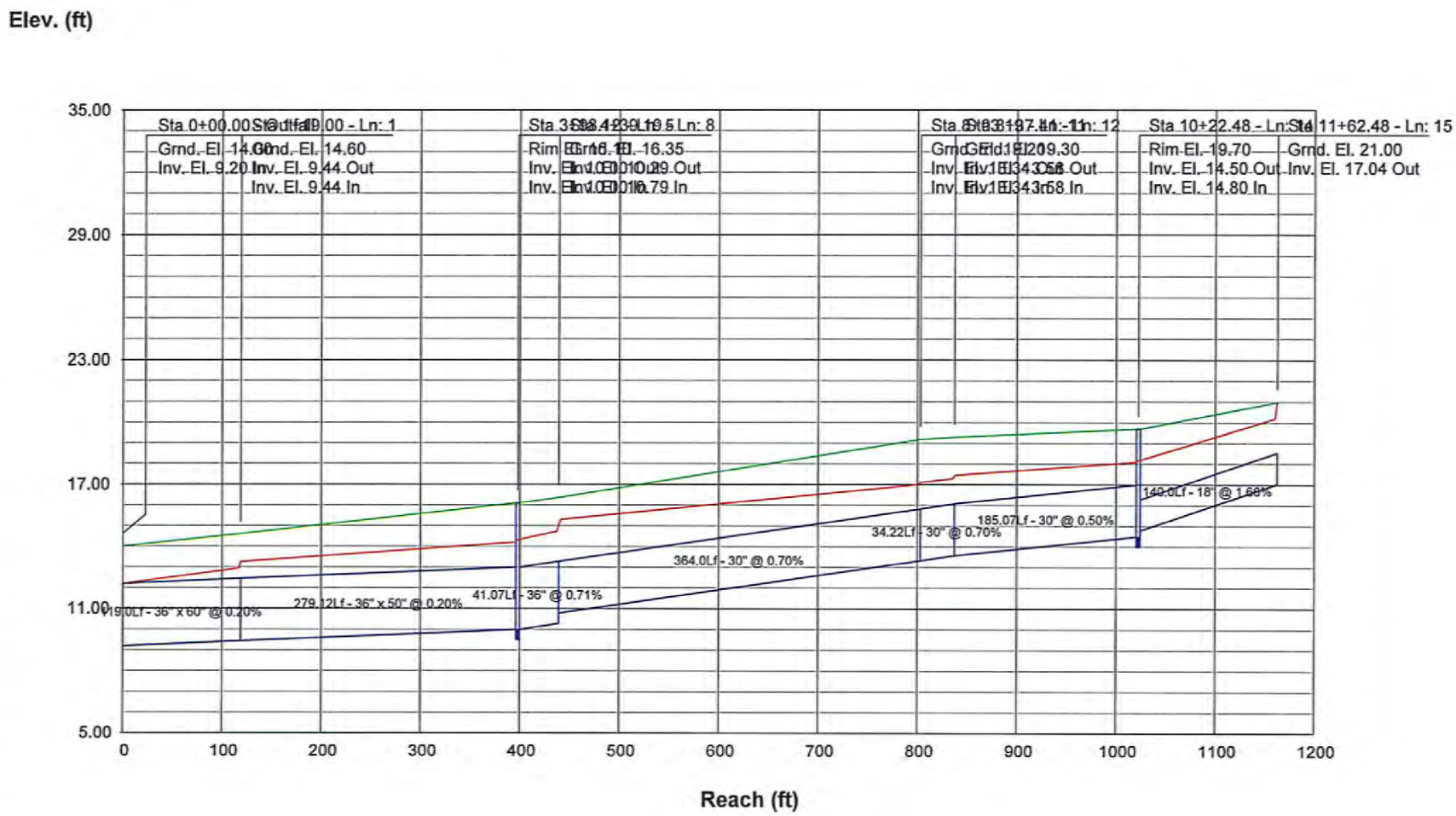
Storm Sewer Profile

Proj. file: 09-24_Napa-SD-Prop-Pref_v1.0.stm



Storm Sewer Profile

Proj. file: 09-24_Napa-SD-Prop-Pref_v1.0.stm



Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr line No.	Line length (ft)	Defl angle (deg)	Junc type	Known Q (cfs)	Drng area (ac)	Runoff coeff (C)	Inlet time (min)	Invert El Dn (ft)	Line slope (%)	Invert El Up (ft)	Line size (in)	Line type	N value (n)	J-loss coeff (K)	Inlet/ Rim El (ft)	
1	End	119.0	-144.1	None	17.34	0.00	0.00	0.0	9.20	0.20	9.44	36 60	Box	0.025	1.00	14.60	Pr-P-01
2	1	54.8	-97.5	Curb	0.00	2.97	0.65	13.9	11.19	0.66	11.55	15	Cir	0.013	1.00	13.80	Pr-P-02
3	1	20.6	117.9	Curb	0.00	2.26	0.65	14.8	10.94	0.20	10.98	18	Cir	0.013	1.00	13.10	Pr-P-03
4	1	54.0	-12.4	Curb	0.00	2.43	0.65	14.6	11.19	0.43	11.42	15	Cir	0.013	1.00	14.30	Pr-P-04
5	1	279.1	29.9	MH	0.00	0.00	0.00	0.0	9.44	0.20	10.00	36 50	Box	0.025	0.96	16.10	Pr-P-05
6	5	343.0	-71.3	None	0.00	0.00	0.00	0.0	11.50	0.96	14.80	18	Cir	0.013	1.00	19.30	Pr-P-06
7	6	29.8	85.7	Curb	0.00	3.28	0.65	13.9	14.80	5.70	16.50	18	Cir	0.013	1.00	18.10	Pr-P-07
8	5	41.1	-5.2	None	0.00	0.00	0.00	0.0	10.00	0.71	10.29	36	Cir	0.025	1.00	16.35	Pr-P-09
9	8	35.5	-59.9	DrGrt	0.00	2.84	0.65	13.8	12.04	0.62	12.26	15	Cir	0.013	1.00	15.60	Pr-P-10
10	8	21.9	95.2	Curb	0.00	9.26	0.65	15.3	11.29	0.49	11.40	24	Cir	0.013	1.00	15.20	Pr-P-11
11	8	364.0	21.3	None	0.00	0.00	0.00	0.0	10.79	0.70	13.34	30	Cir	0.025	0.97	19.20	Pr-P-12
12	11	34.2	-75.4	None	0.00	0.00	0.00	0.0	13.34	0.70	13.58	30	Cir	0.025	0.99	19.30	Pr-P-13
13	12	19.0	81.7	Curb	0.00	1.40	0.65	13.4	14.83	0.21	14.87	15	Cir	0.013	1.00	18.40	Pr-P-14
14	12	185.1	-2.0	MH	0.00	0.00	0.00	0.0	13.58	0.50	14.50	30	Cir	0.025	1.00	19.70	Pr-P-15
15	14	140.0	85.5	None	0.00	6.80	0.65	12.5	14.80	1.60	17.04	18	Cir	0.013	1.00	21.00	Ex-P-16

09-24 SD Inf Study - Preferred | Number of lines: 15 | Date: 12-14-2011

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	Pr-P-01	67.30	36 x 60 b	119.0	9.20	9.44	0.202	12.20*	12.94*	0.31	13.25	End
2	Pr-P-02	5.28	15 c	54.8	11.19	11.55	0.657	13.28*	13.64*	0.29	13.93	1
3	Pr-P-03	3.92	18 c	20.6	10.94	10.98	0.200	13.49*	13.52*	0.08	13.59	1
4	Pr-P-04	4.24	15 c	54.0	11.19	11.42	0.426	13.38*	13.61*	0.19	13.80	1
5	Pr-P-05	39.17	36 x 50 b	279.1	9.44	10.00	0.201	13.27*	14.20*	0.15	14.35	1
6	Pr-P-06	5.81	18 c	343.0	11.50	14.80	0.962	14.35	15.72	n/a	16.13 j	5
7	Pr-P-07	5.84	18 c	29.8	14.80	16.50	5.705	16.36	17.42	n/a	17.42 j	6
8	Pr-P-09	33.85	36 c	41.1	10.00	10.29	0.706	14.35*	14.74*	0.36	15.10	5
9	Pr-P-10	5.07	15 c	35.5	12.04	12.26	0.620	15.19*	15.41*	0.27	15.67	8
10	Pr-P-11	15.85	24 c	21.9	11.29	11.40	0.489	15.10*	15.20*	0.40	15.60	8
11	Pr-P-12	14.45	30 c	364.0	10.79	13.34	0.701	15.32*	16.99*	0.13	17.12	8
12	Pr-P-13	14.53	30 c	34.2	13.34	13.58	0.701	17.12*	17.28*	0.13	17.41	11
13	Pr-P-14	2.53	15 c	19.0	14.83	14.87	0.211	17.48*	17.51*	0.07	17.58	12
14	Pr-P-15	12.47	30 c	185.1	13.58	14.50	0.497	17.45*	18.08*	0.10	18.18	12
15	Ex-P-16	12.58	18 c	140.0	14.80	17.04	1.600	18.18*	20.19*	0.79	20.98	14

09-24 SD Inf Study - Preferred | Number of lines: 15 | Run Date: 12-14-2011

NOTES: c = cir; e = ellip; b = box; Return period = 25 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	
1	End	119.0	0.00	31.24	0.00	0.00	20.31	0.0	17.9	2.5	67.30	38.35	4.49	36 60 b	0.20	9.44	9.20	12.94	12.20	14.60	14.00	Pr-P-01
2	1	54.8	2.97	2.97	0.65	1.93	1.93	13.9	13.9	2.7	5.28	5.23	4.31	15	0.66	11.55	11.19	13.64	13.28	13.80	14.60	Pr-P-02
3	1	20.6	2.26	2.26	0.65	1.47	1.47	14.8	14.8	2.7	3.92	4.70	2.22	18	0.20	10.98	10.94	13.52	13.49	13.10	14.60	Pr-P-03
4	1	54.0	2.43	2.43	0.65	1.58	1.58	14.6	14.6	2.7	4.24	4.22	3.46	15	0.43	11.42	11.19	13.61	13.38	14.30	14.60	Pr-P-04
5	1	279.1	0.00	23.58	0.00	0.00	15.33	0.0	16.4	2.6	39.17	30.38	3.13	36 50 b	0.20	10.00	9.44	14.20	13.27	16.10	14.60	Pr-P-05
6	5	343.0	0.00	3.28	0.00	0.00	2.13	0.0	14.0	2.7	5.81	10.30	4.19	18	0.96	14.80	11.50	15.72	14.35	19.30	16.10	Pr-P-06
7	6	29.8	3.28	3.28	0.65	2.13	2.13	13.9	13.9	2.7	5.84	25.08	4.21	18	5.70	16.50	14.80	17.42	16.36	18.10	19.30	Pr-P-07
8	5	41.1	0.00	20.30	0.00	0.00	13.20	0.0	16.3	2.6	33.85	29.14	4.79	36	0.71	10.29	10.00	14.74	14.35	16.35	16.10	Pr-P-09
9	8	35.5	2.84	2.84	0.65	1.85	1.85	13.8	13.8	2.7	5.07	5.08	4.13	15	0.62	12.26	12.04	15.41	15.19	15.60	16.35	Pr-P-10
10	8	21.9	9.26	9.26	0.65	6.02	6.02	15.3	15.3	2.6	15.85	15.81	5.04	24	0.49	11.40	11.29	15.20	15.10	15.20	16.35	Pr-P-11
11	8	364.0	0.00	8.20	0.00	0.00	5.33	0.0	14.2	2.7	14.45	17.85	2.94	30	0.70	13.34	10.79	16.99	15.32	19.20	16.35	Pr-P-12
12	11	34.2	0.00	8.20	0.00	0.00	5.33	0.0	14.0	2.7	14.53	17.86	2.96	30	0.70	13.58	13.34	17.28	17.12	19.30	19.20	Pr-P-13
13	12	19.0	1.40	1.40	0.65	0.91	0.91	13.4	13.4	2.8	2.53	2.96	2.06	15	0.21	14.87	14.83	17.51	17.48	18.40	19.30	Pr-P-14
14	12	185.1	0.00	6.80	0.00	0.00	4.42	0.0	12.8	2.8	12.47	15.04	2.54	30	0.50	14.50	13.58	18.08	17.45	19.70	19.30	Pr-P-15
15	14	140.0	6.80	6.80	0.65	4.42	4.42	12.5	12.5	2.8	12.58	13.28	7.12	18	1.60	17.04	14.80	20.19	18.18	21.00	19.70	Ex-P-16

09-24 SD Inf Study - Preferred | Number of lines: 15 | Run Date: 12-14-2011

NOTES: Intensity = 218.31 / (Inlet time + 28.60) ^ 1.17; Return period = 25 Yrs.

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q byp (cfs)	Junc type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp line No
							Ht (in)	L (ft)	area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
1		17.34*	0.00	0.00	17.34	None	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
2	H	5.28	0.00	5.28	0.00	Curb	6.0	3.00	0.00	0.00	0.00	Sag	2.00	0.080	0.050	0.013	0.55	9.86	0.66	9.86	2.00	Off
3	G	3.92	0.00	3.92	0.00	Curb	6.0	3.00	0.00	0.00	0.00	Sag	2.00	0.080	0.050	0.013	0.46	8.08	0.57	8.08	2.00	Off
4	F	4.24	0.00	4.24	0.00	Curb	6.0	3.00	0.00	0.00	0.00	Sag	2.00	0.080	0.050	0.013	0.49	8.52	0.59	8.52	2.00	Off
5	P-SDMH-01	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
6		0.00	0.00	0.00	0.00	None	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
7	E	5.84	0.00	5.84	0.00	Curb	6.0	3.00	0.00	0.00	0.00	Sag	2.00	0.080	0.050	0.013	0.59	10.54	0.69	10.54	2.00	Off
8		0.00	0.00	0.00	0.00	None	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
9	C	5.07	0.00	5.07	0.00	DrGrt	0.0	0.00	2.00	4.00	2.00	Sag	2.00	0.050	0.050	0.013	0.35	16.18	0.35	16.18	0.00	Off
10	D	15.85	0.00	15.85	0.00	Curb	6.0	3.00	0.00	0.00	0.00	Sag	2.00	0.080	0.050	0.013	2.40	46.82	2.51	46.82	2.00	Off
11		0.00	0.00	0.00	0.00	None	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
12		0.00	0.00	0.00	0.00	None	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
13	B	2.53	0.00	2.53	0.00	Curb	6.0	3.00	0.00	0.00	0.00	Sag	2.00	0.080	0.050	0.013	0.36	6.02	0.47	6.02	2.00	Off
14	P-SDMH-02	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
15	A	12.58	0.00	0.00	12.58	None	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off

09-24 SD Inf Study - Preferred | Number of lines: 15 | Run Date: 12-14-2011

NOTES: Inlet N-Values = 0.016 ; Intensity = 218.31 / (Inlet time + 28.60) ^ 1.17; Return period = 25 Yrs. ; * Indicates Known Q added

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
1	36 60 b	67.30	9.20	12.20	3.00	15.00	4.49	0.31	12.51	0.621	119	9.44	12.94	3.00	15.00	4.49	0.31	13.25	0.621	0.621	0.739	1.00	0.31
2	15	5.28	11.19	13.28	1.25	1.23	4.31	0.29	13.56	0.670	54.8	11.55	13.64	1.25	1.23	4.31	0.29	13.93	0.669	0.670	0.367	1.00	0.29
3	18	3.92	10.94	13.49	1.50	1.77	2.22	0.08	13.56	0.140	20.6	10.98	13.52	1.50	1.77	2.22	0.08	13.59	0.139	0.140	0.029	1.00	0.08
4	15	4.24	11.19	13.38	1.25	1.23	3.46	0.19	13.56	0.432	54.0	11.42	13.61	1.25	1.23	3.46	0.19	13.80	0.432	0.432	0.233	1.00	0.19
5	36 50 b	39.17	9.44	13.27	3.00	12.50	3.13	0.15	13.42	0.334	279	10.00	14.20	3.00	12.50	3.13	0.15	14.35	0.334	0.334	0.931	0.96	0.15
6	18	5.81	11.50	14.35	1.50	1.77	3.29	0.17	14.52	0.307	343	14.80	15.72 j	0.92**	1.14	5.09	0.40	16.13	0.627	0.467	1.601	1.00	0.40
7	18	5.84	14.80	16.36	1.50	1.77	3.30	0.17	16.53	0.309	29.8	16.50	17.42 j	0.92**	1.14	5.12	0.41	17.83	0.636	0.473	0.141	1.00	n/a
8	36	33.85	10.00	14.35	3.00	7.07	4.79	0.36	14.70	0.953	41.1	10.29	14.74	3.00	7.07	4.79	0.36	15.10	0.953	0.953	0.391	1.00	0.36
9	15	5.07	12.04	15.19	1.25	1.23	4.13	0.27	15.45	0.617	35.5	12.26	15.41	1.25	1.23	4.13	0.27	15.67	0.617	0.617	0.219	1.00	0.27
10	24	15.85	11.29	15.10	2.00	3.14	5.05	0.40	15.49	0.491	21.9	11.40	15.20	2.00	3.14	5.04	0.40	15.60	0.491	0.491	0.107	1.00	0.40
11	30	14.45	10.79	15.32	2.50	4.91	2.94	0.13	15.45	0.459	364	13.34	16.99	2.50	4.91	2.94	0.13	17.12	0.459	0.459	1.672	0.97	0.13
12	30	14.53	13.34	17.12	2.50	4.91	2.96	0.14	17.26	0.464	34.2	13.58	17.28	2.50	4.91	2.96	0.14	17.42	0.464	0.464	0.159	0.99	0.13
13	15	2.53	14.83	17.48	1.25	1.23	2.06	0.07	17.55	0.153	19.0	14.87	17.51	1.25	1.23	2.06	0.07	17.58	0.153	0.153	0.029	1.00	0.07
14	30	12.47	13.58	17.45	2.50	4.91	2.54	0.10	17.55	0.342	185	14.50	18.08	2.50	4.91	2.54	0.10	18.18	0.342	0.342	0.633	1.00	0.10
15	18	12.58	14.80	18.18	1.50	1.77	7.12	0.79	18.97	1.436	140	17.04	20.19	1.50	1.77	7.12	0.79	20.98	1.436	1.436	2.010	1.00	0.79

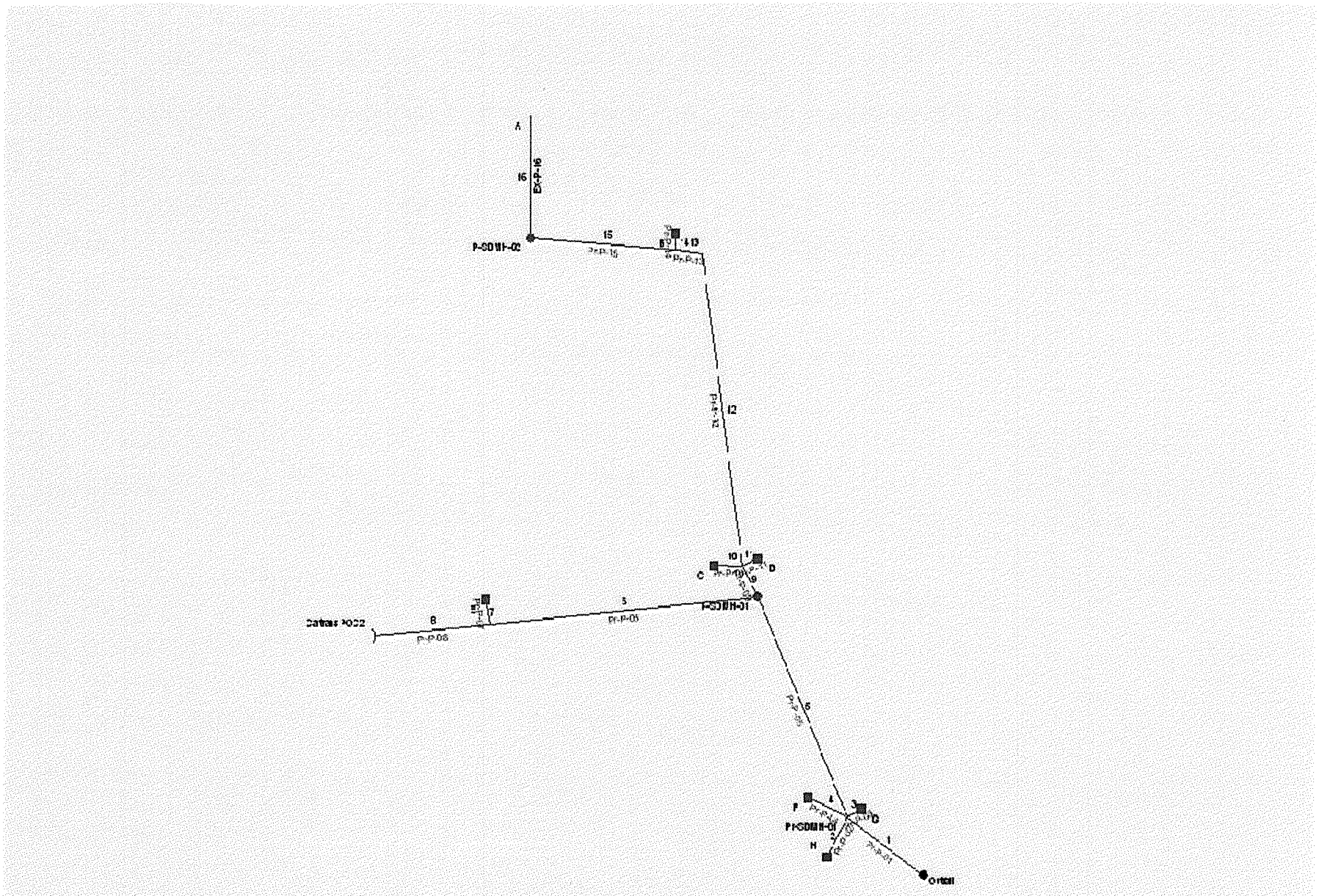
09-24 SD Inf Study - Preferred | Number of lines: 15 | Run Date: 12-14-2011

Notes: ; ** Critical depth.; j-Line contains hyd. jump.

Storm Drain Infrastructure Study

Alternative 1

Hydraflow Plan View

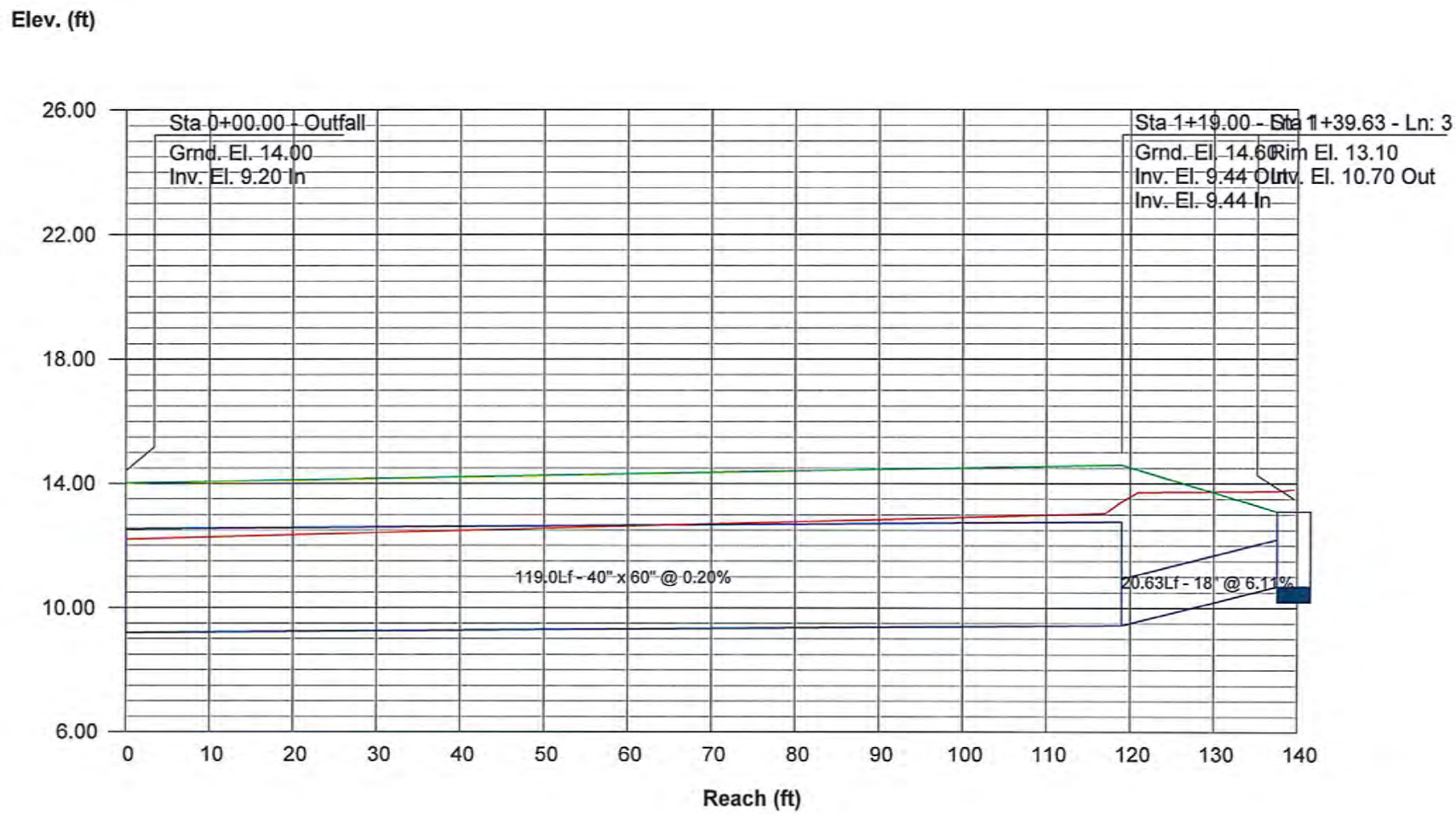


09-24 SD Inf Study - Alt #1	No. Lines: 16	12-14-2011

Hydraflow Storm Sewers 2005

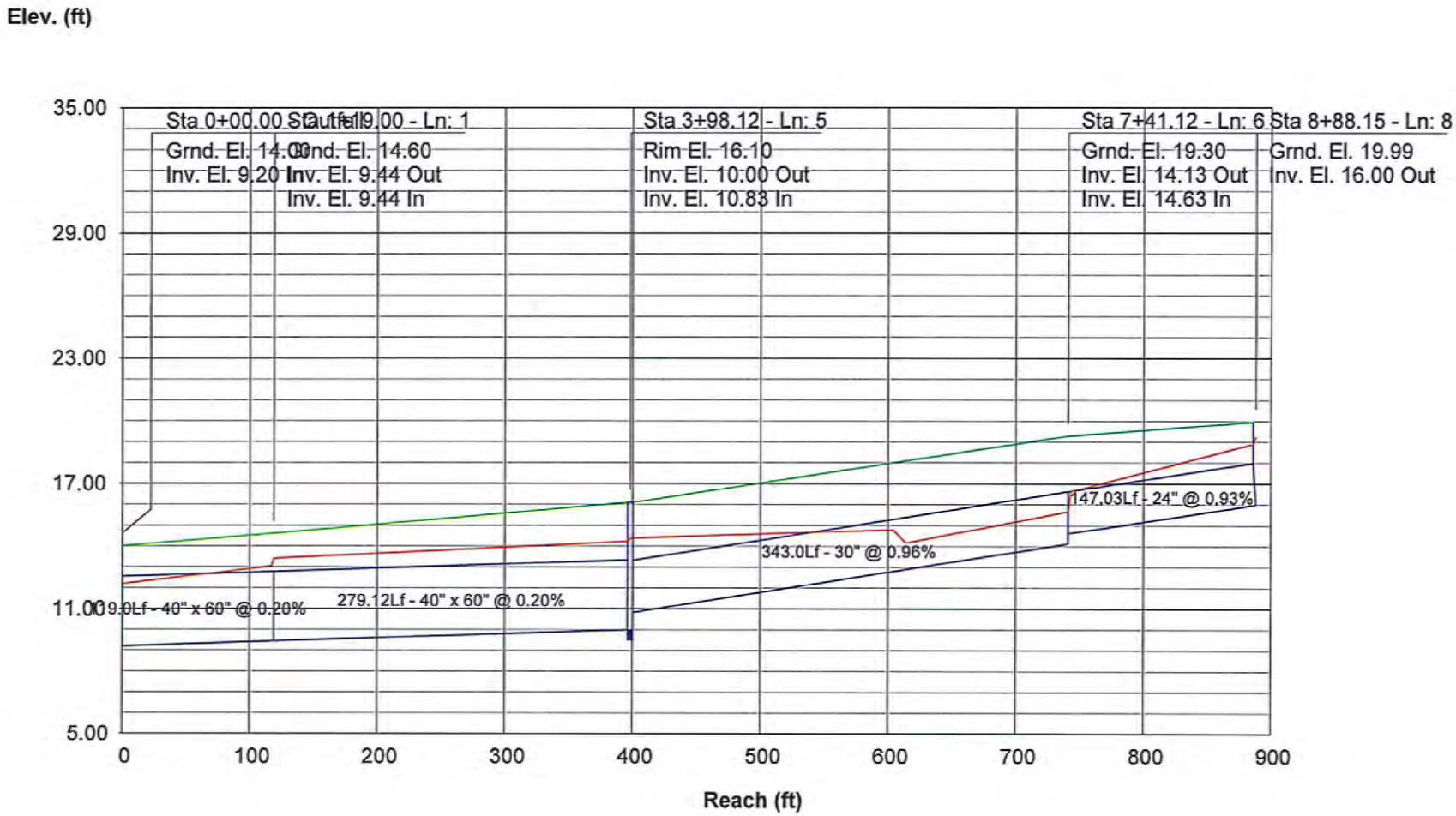
Storm Sewer Profile

Proj. file: 09-24_Napa-SD-Prop-Alt01_v1.0.stm



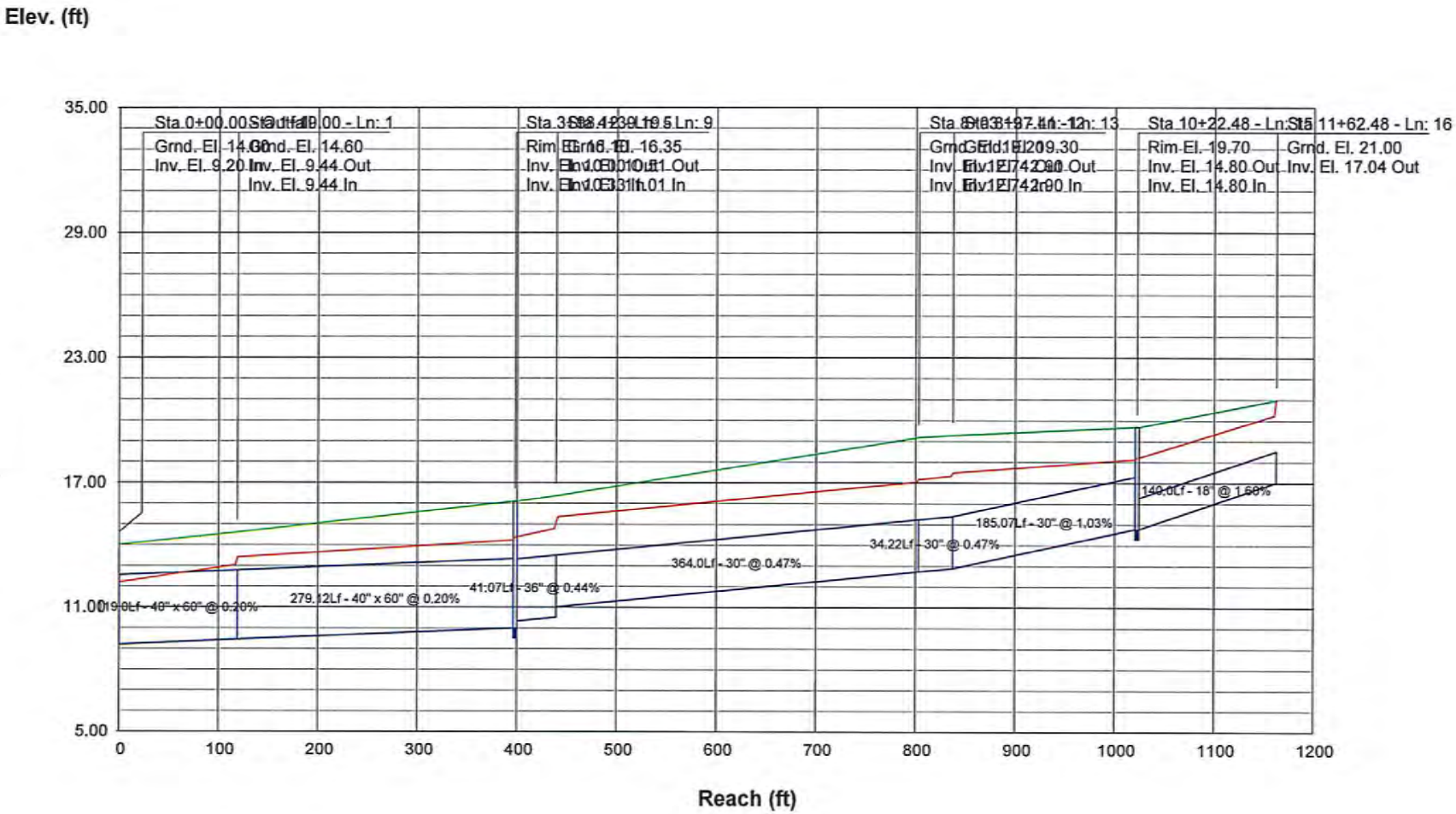
Storm Sewer Profile

Proj. file: 09-24_Napa-SD-Prop-Alt01_v1.0.stm



Storm Sewer Profile

Proj. file: 09-24_Napa-SD-Prop-Alt01_v1.0.stm



Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr line No.	Line length (ft)	Defl angle (deg)	Junc type	Known Q (cfs)	Drng area (ac)	Runoff coeff (C)	Inlet time (min)	Invert El Dn (ft)	Line slope (%)	Invert El Up (ft)	Line size (in)	Line type	N value (n)	J-loss coeff (K)	Inlet/ Rim El (ft)	
1	End	119.0	-144.1	None	17.35	0.00	0.00	0.0	9.20	0.20	9.44	40 60	Box	0.025	1.00	14.60	Pr-P-01
2	1	54.8	-97.5	Curb	0.00	2.97	0.65	13.9	9.44	4.67	12.00	15	Cir	0.013	1.00	13.80	Pr-P-02
3	1	20.6	117.9	Curb	0.00	2.26	0.65	14.8	9.44	6.11	10.70	18	Cir	0.013	1.00	13.10	Pr-P-03
4	1	54.0	-12.4	Curb	0.00	2.43	0.65	14.6	9.44	3.63	11.40	15	Cir	0.013	1.00	14.30	Pr-P-04
5	1	279.1	29.9	MH	0.00	0.00	0.00	0.0	9.44	0.20	10.00	40 60	Box	0.025	0.96	16.10	Pr-P-05
6	5	343.0	-71.3	None	0.00	0.00	0.00	0.0	10.83	0.96	14.13	30	Cir	0.013	1.00	19.30	Pr-P-06
7	6	29.8	85.7	Curb	0.00	3.28	0.65	13.9	15.13	0.30	15.22	18	Cir	0.013	1.00	18.10	Pr-P-07
8	6	147.0	0.5	Hdwl	14.65	0.00	0.00	0.0	14.63	0.93	16.00	24	Cir	0.025	1.00	19.99	Pr-P-08
9	5	41.1	-5.2	None	0.00	0.00	0.00	0.0	10.33	0.44	10.51	36	Cir	0.025	1.00	16.35	Pr-P-09
10	9	35.5	-59.9	DrGrt	0.00	2.84	0.65	13.8	12.26	0.62	12.48	15	Cir	0.013	1.00	15.60	Pr-P-10
11	9	21.9	95.2	Curb	0.00	9.26	0.65	15.3	11.51	0.49	11.62	24	Cir	0.013	1.00	15.20	Pr-P-11
12	9	364.0	21.3	None	0.00	0.00	0.00	0.0	11.01	0.47	12.74	30	Cir	0.025	0.97	19.20	Pr-P-12
13	12	34.2	-75.4	None	0.00	0.00	0.00	0.0	12.74	0.47	12.90	30	Cir	0.025	0.99	19.30	Pr-P-13
14	13	19.0	81.7	Curb	0.00	1.40	0.65	13.4	14.15	0.21	14.19	15	Cir	0.013	1.00	18.40	Pr-P-14
15	13	185.1	-2.0	MH	0.00	0.00	0.00	0.0	12.90	1.03	14.80	30	Cir	0.025	1.00	19.70	Pr-P-15
16	15	140.0	85.5	None	0.00	6.80	0.65	12.5	14.80	1.60	17.04	18	Cir	0.013	1.00	21.00	EX-P-16

09-24 SD Inf Study - Alt #1 | Number of lines: 16 | Date: 12-14-2011

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	Pr-P-01	82.02	40 x 60 b	119.0	9.20	9.44	0.202	12.20*	13.03*	0.38	13.41	End
2	Pr-P-02	5.28	15 c	54.8	9.44	12.00	4.671	13.49*	13.86*	0.29	14.15	1
3	Pr-P-03	3.92	18 c	20.6	9.44	10.70	6.108	13.71*	13.73*	0.08	13.81	1
4	Pr-P-04	4.24	15 c	54.0	9.44	11.40	3.632	13.60*	13.83*	0.19	14.02	1
5	Pr-P-05	53.82	40 x 60 b	279.1	9.44	10.00	0.201	13.42*	14.24*	0.16	14.40	1
6	Pr-P-06	20.46	30 c	343.0	10.83	14.13	0.962	14.40	15.64	n/a	15.64 j	5
7	Pr-P-07	5.84	18 c	29.8	15.13	15.22	0.302	16.38	16.47	0.22	16.68	6
8	Pr-P-08	14.65	24 c	147.0	14.63	16.00	0.932	16.63*	18.91*	0.34	19.25	6
9	Pr-P-09	33.85	36 c	41.1	10.33	10.51	0.438	14.40*	14.79*	0.36	15.14	5
10	Pr-P-10	5.07	15 c	35.5	12.26	12.48	0.620	15.24*	15.46*	0.27	15.72	9
11	Pr-P-11	15.85	24 c	21.9	11.51	11.62	0.489	15.14*	15.25*	0.40	15.65	9
12	Pr-P-12	14.45	30 c	364.0	11.01	12.74	0.474	15.37*	17.04*	0.13	17.17	9
13	Pr-P-13	14.53	30 c	34.2	12.74	12.90	0.468	17.17*	17.33*	0.13	17.46	12
14	Pr-P-14	2.53	15 c	19.0	14.15	14.19	0.211	17.53*	17.56*	0.07	17.63	13
15	Pr-P-15	12.47	30 c	185.1	12.90	14.80	1.027	17.50*	18.13*	0.10	18.23	13
16	EX-P-16	12.58	18 c	140.0	14.80	17.04	1.600	18.23*	20.24*	0.79	21.03	15

09-24 SD Inf Study - Alt #1 | Number of lines: 16 | Run Date: 12-14-2011

NOTES: c = cir; e = ellip; b = box; Return period = 25 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	
1	End	119.0	0.00	31.24	0.00	0.00	20.31	0.0	17.9	2.5	82.02	44.49	5.19	40 60 b	0.20	9.44	9.20	13.03	12.20	14.60	14.00	Pr-P-01
2	1	54.8	2.97	2.97	0.65	1.93	1.93	13.9	13.9	2.7	5.28	13.96	4.31	15	4.67	12.00	9.44	13.86	13.49	13.80	14.60	Pr-P-02
3	1	20.6	2.26	2.26	0.65	1.47	1.47	14.8	14.8	2.7	3.92	25.95	2.22	18	6.11	10.70	9.44	13.73	13.71	13.10	14.60	Pr-P-03
4	1	54.0	2.43	2.43	0.65	1.58	1.58	14.6	14.6	2.7	4.24	12.31	3.46	15	3.63	11.40	9.44	13.83	13.60	14.30	14.60	Pr-P-04
5	1	279.1	0.00	23.58	0.00	0.00	15.33	0.0	16.4	2.6	53.82	44.37	3.23	40 60 b	0.20	10.00	9.44	14.24	13.42	16.10	14.60	Pr-P-05
6	5	343.0	0.00	3.28	0.00	0.00	2.13	0.0	14.0	2.7	20.46	40.23	5.38	30	0.96	14.13	10.83	15.64	14.40	19.30	16.10	Pr-P-06
7	6	29.8	3.28	3.28	0.65	2.13	2.13	13.9	13.9	2.7	5.84	5.77	3.72	18	0.30	15.22	15.13	16.47	16.38	18.10	19.30	Pr-P-07
8	6	147.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	14.65	11.35	4.66	24	0.93	16.00	14.63	18.91	16.63	19.99	19.30	Pr-P-08
9	5	41.1	0.00	20.30	0.00	0.00	13.20	0.0	16.3	2.6	33.85	22.96	4.79	36	0.44	10.51	10.33	14.79	14.40	16.35	16.10	Pr-P-09
10	9	35.5	2.84	2.84	0.65	1.85	1.85	13.8	13.8	2.7	5.07	5.08	4.13	15	0.62	12.48	12.26	15.46	15.24	15.60	16.35	Pr-P-10
11	9	21.9	9.26	9.26	0.65	6.02	6.02	15.3	15.3	2.6	15.85	15.81	5.04	24	0.49	11.62	11.51	15.25	15.14	15.20	16.35	Pr-P-11
12	9	364.0	0.00	8.20	0.00	0.00	5.33	0.0	14.2	2.7	14.45	14.69	2.94	30	0.47	12.74	11.01	17.04	15.37	19.20	16.35	Pr-P-12
13	12	34.2	0.00	8.20	0.00	0.00	5.33	0.0	14.0	2.7	14.53	14.58	2.96	30	0.47	12.90	12.74	17.33	17.17	19.30	19.20	Pr-P-13
14	13	19.0	1.40	1.40	0.65	0.91	0.91	13.4	13.4	2.8	2.53	2.96	2.06	15	0.21	14.19	14.15	17.56	17.53	18.40	19.30	Pr-P-14
15	13	185.1	0.00	6.80	0.00	0.00	4.42	0.0	12.8	2.8	12.47	21.61	2.54	30	1.03	14.80	12.90	18.13	17.50	19.70	19.30	Pr-P-15
16	15	140.0	6.80	6.80	0.65	4.42	4.42	12.5	12.5	2.8	12.58	13.28	7.12	18	1.60	17.04	14.80	20.24	18.23	21.00	19.70	EX-P-16

09-24 SD Inf Study - Alt #1 | Number of lines: 16 | Run Date: 12-14-2011

NOTES: Intensity = 218.31 / (Inlet time + 28.60) ^ 1.17; Return period = 25 Yrs.

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q byp (cfs)	Junc type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp line No
							Ht (in)	L (ft)	area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
1	Pr-SDMH-01	17.35*	0.00	0.00	17.35	None	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
2	H	5.28	0.00	5.28	0.00	Curb	6.0	3.00	0.00	0.00	0.00	Sag	2.00	0.080	0.050	0.013	0.55	9.86	0.66	9.86	2.00	Off
3	G	3.92	0.00	3.92	0.00	Curb	6.0	3.00	0.00	0.00	0.00	Sag	2.00	0.080	0.050	0.013	0.46	8.08	0.57	8.08	2.00	Off
4	F	4.24	0.00	4.24	0.00	Curb	6.0	3.00	0.00	0.00	0.00	Sag	2.00	0.080	0.050	0.013	0.49	8.52	0.59	8.52	2.00	Off
5	P-SDMH-01	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
6		0.00	0.00	0.00	0.00	None	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
7	E	5.84	0.00	5.84	0.00	Curb	6.0	3.00	0.00	0.00	0.00	Sag	2.00	0.080	0.050	0.013	0.59	10.54	0.69	10.54	2.00	Off
8	Caltrans POC2	14.65*	0.00	14.65	0.00	Hdwl	6.0	6.00	2.00	4.00	2.00	Sag	2.00	0.080	0.050	0.013	0.00	0.00	0.00	0.00	0.00	6
9		0.00	0.00	0.00	0.00	None	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
10	C	5.07	0.00	5.07	0.00	DrGrt	0.0	0.00	2.00	4.00	2.00	Sag	2.00	0.050	0.050	0.013	0.35	16.18	0.35	16.18	0.00	Off
11	D	15.85	0.00	15.85	0.00	Curb	6.0	3.00	0.00	0.00	0.00	Sag	2.00	0.080	0.050	0.013	2.40	46.82	2.51	46.82	2.00	Off
12		0.00	0.00	0.00	0.00	None	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
13		0.00	0.00	0.00	0.00	None	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
14	B	2.53	0.00	2.53	0.00	Curb	6.0	3.00	0.00	0.00	0.00	Sag	2.00	0.080	0.050	0.013	0.36	6.02	0.47	6.02	2.00	Off
15	P-SDMH-02	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
16	A	12.58	0.00	0.00	12.58	None	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off

09-24 SD Inf Study - Alt #1 | Number of lines: 16 | Run Date: 12-14-2011

NOTES: Inlet N-Values = 0.016 ; Intensity = 218.31 / (Inlet time + 28.60) ^ 1.17; Return period = 25 Yrs. ; * Indicates Known Q added

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
1	40 60 b	82.02	9.20	12.20	3.00	15.00	5.47	0.46	12.66	0.559	119	9.44	13.03	3.33	16.67	4.92	0.38	13.41	0.685	0.622	0.741	1.00	0.38
2	15	5.28	9.44	13.49	1.25	1.23	4.31	0.29	13.78	0.670	54.8	12.00	13.86	1.25	1.23	4.31	0.29	14.15	0.669	0.670	0.367	1.00	0.29
3	18	3.92	9.44	13.71	1.50	1.77	2.22	0.08	13.78	0.140	20.6	10.70	13.73	1.50	1.77	2.22	0.08	13.81	0.139	0.140	0.029	1.00	0.08
4	15	4.24	9.44	13.60	1.25	1.23	3.46	0.19	13.78	0.432	54.0	11.40	13.83	1.25	1.23	3.46	0.19	14.02	0.432	0.432	0.233	1.00	0.19
5	40 60 b	53.82	9.44	13.42	3.33	16.67	3.23	0.16	13.58	0.295	279	10.00	14.24	3.33	16.67	3.23	0.16	14.40	0.295	0.295	0.824	0.96	0.16
6	30	20.46	10.83	14.40	2.50	4.91	4.17	0.27	14.67	0.249	343	14.13	15.64 j	1.51**	3.10	6.59	0.68	16.32	0.538	0.394	n/a	1.00	n/a
7	18	5.84	15.13	16.38	1.25*	1.57	3.72	0.21	16.59	0.302	29.8	15.22	16.47	1.25	1.57	3.72	0.22	16.68	0.302	0.302	0.090	1.00	0.22
8	24	14.65	14.63	16.63	2.00*	3.14	4.66	0.34	16.97	1.552	147	16.00	18.91	2.00	3.14	4.66	0.34	19.25	1.552	1.552	2.282	1.00	0.34
9	36	33.85	10.33	14.40	3.00	7.07	4.79	0.36	14.75	0.953	41.1	10.51	14.79	3.00	7.07	4.79	0.36	15.14	0.953	0.953	0.391	1.00	0.36
10	15	5.07	12.26	15.24	1.25	1.23	4.13	0.27	15.50	0.617	35.5	12.48	15.46	1.25	1.23	4.13	0.27	15.72	0.617	0.617	0.219	1.00	0.27
11	24	15.85	11.51	15.14	2.00	3.14	5.05	0.40	15.54	0.491	21.9	11.62	15.25	2.00	3.14	5.04	0.40	15.65	0.491	0.491	0.107	1.00	0.40
12	30	14.45	11.01	15.37	2.50	4.91	2.94	0.13	15.50	0.459	364	12.74	17.04	2.50	4.91	2.94	0.13	17.17	0.459	0.459	1.672	0.97	0.13
13	30	14.53	12.74	17.17	2.50	4.91	2.96	0.14	17.31	0.464	34.2	12.90	17.33	2.50	4.91	2.96	0.14	17.46	0.464	0.464	0.159	0.99	0.13
14	15	2.53	14.15	17.53	1.25	1.23	2.06	0.07	17.60	0.153	19.0	14.19	17.56	1.25	1.23	2.06	0.07	17.63	0.153	0.153	0.029	1.00	0.07
15	30	12.47	12.90	17.50	2.50	4.91	2.54	0.10	17.60	0.342	185	14.80	18.13	2.50	4.91	2.54	0.10	18.23	0.342	0.342	0.633	1.00	0.10
16	18	12.58	14.80	18.23	1.50	1.77	7.12	0.79	19.02	1.436	140	17.04	20.24	1.50	1.77	7.12	0.79	21.03	1.436	1.436	2.010	1.00	0.79

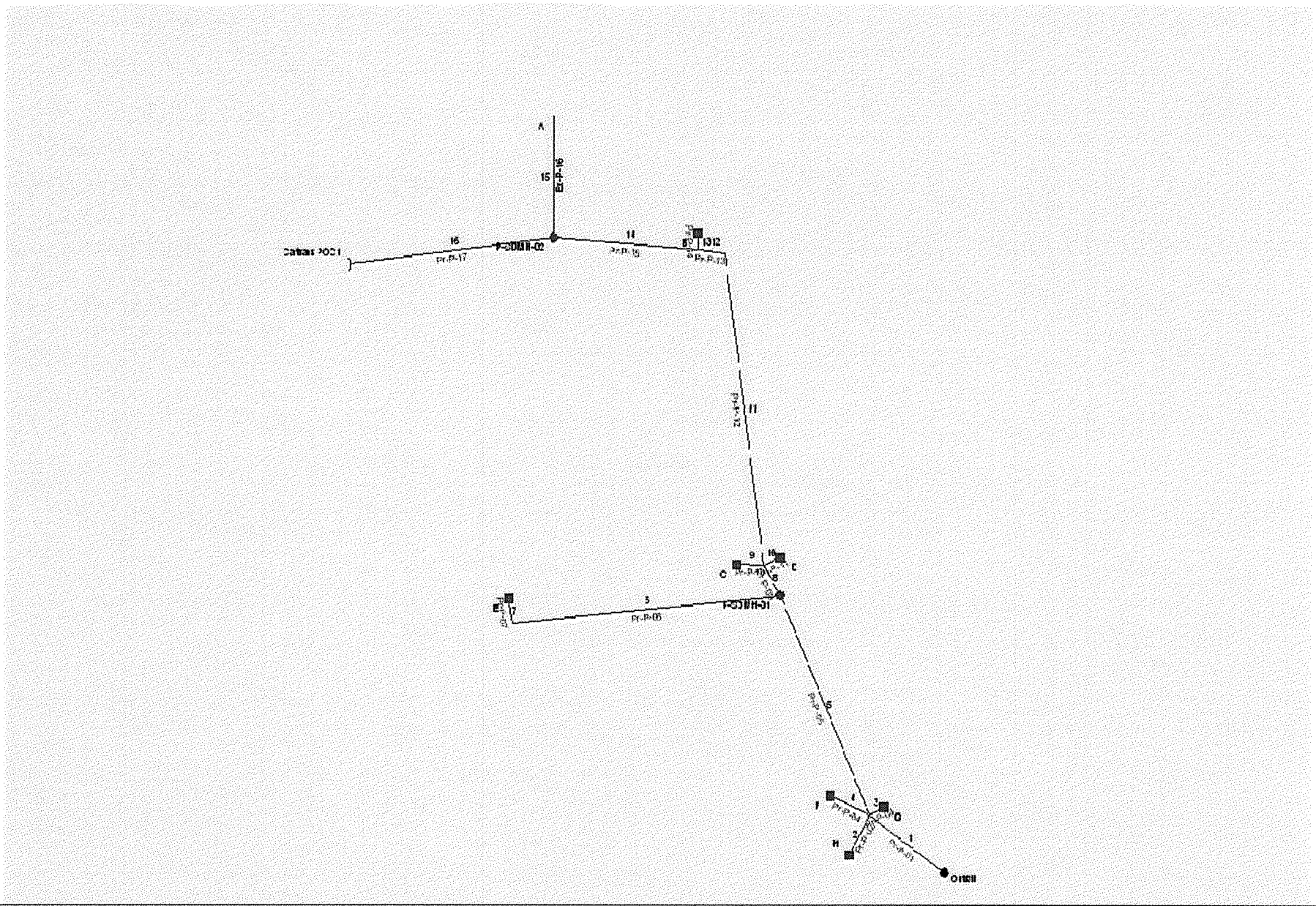
09-24 SD Inf Study - Alt #1 | Number of lines: 16 | Run Date: 12-14-2011

Notes: * Normal depth assumed.; ** Critical depth.; j-Line contains hyd. jump.

Storm Drain Infrastructure Study

Alternative 2

Hydraflow Plan View

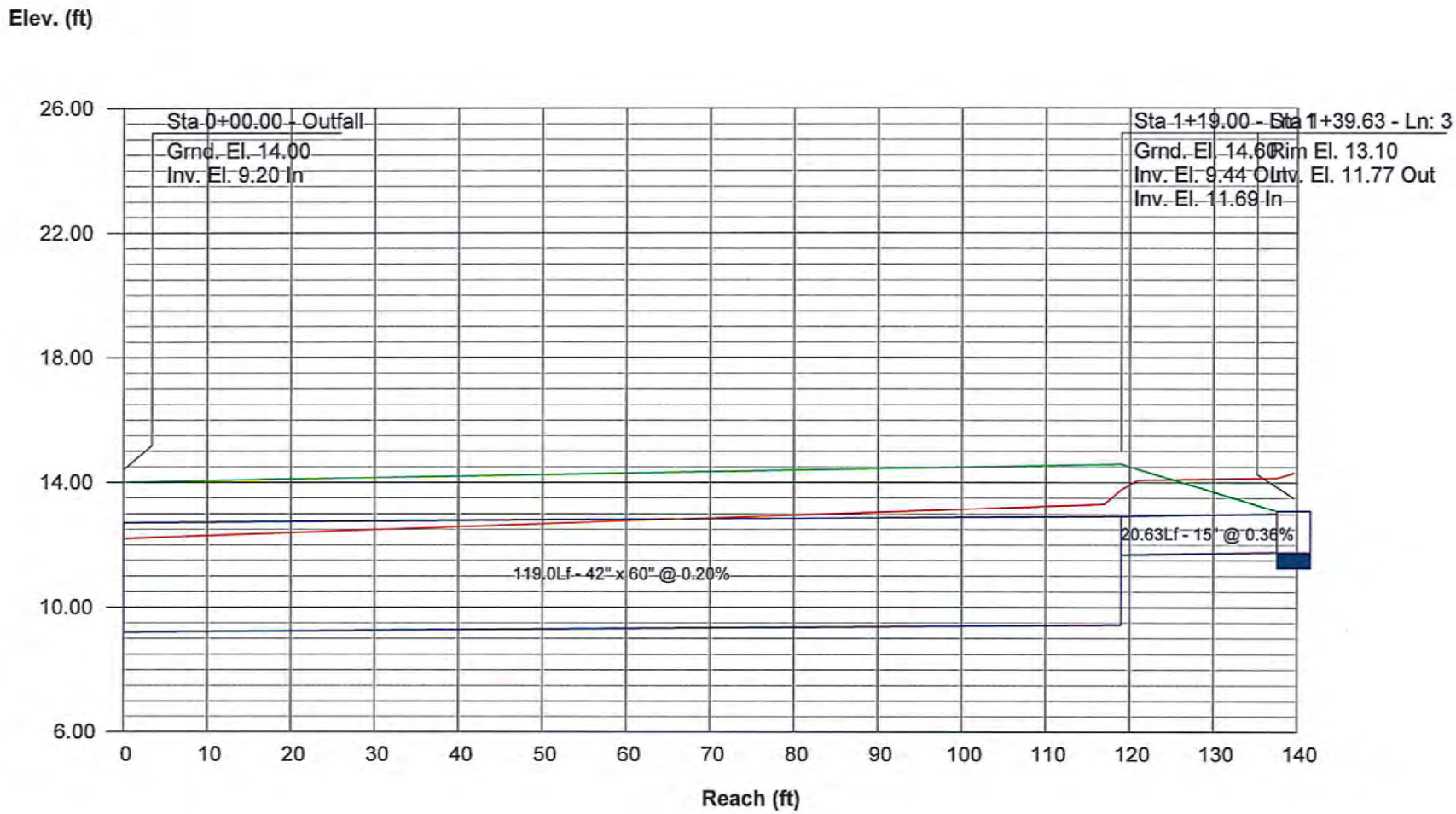


09-24 SD Inf Study - Alt #2	No. Lines: 16	12-14-2011

Hydraflow Storm Sewers 2005

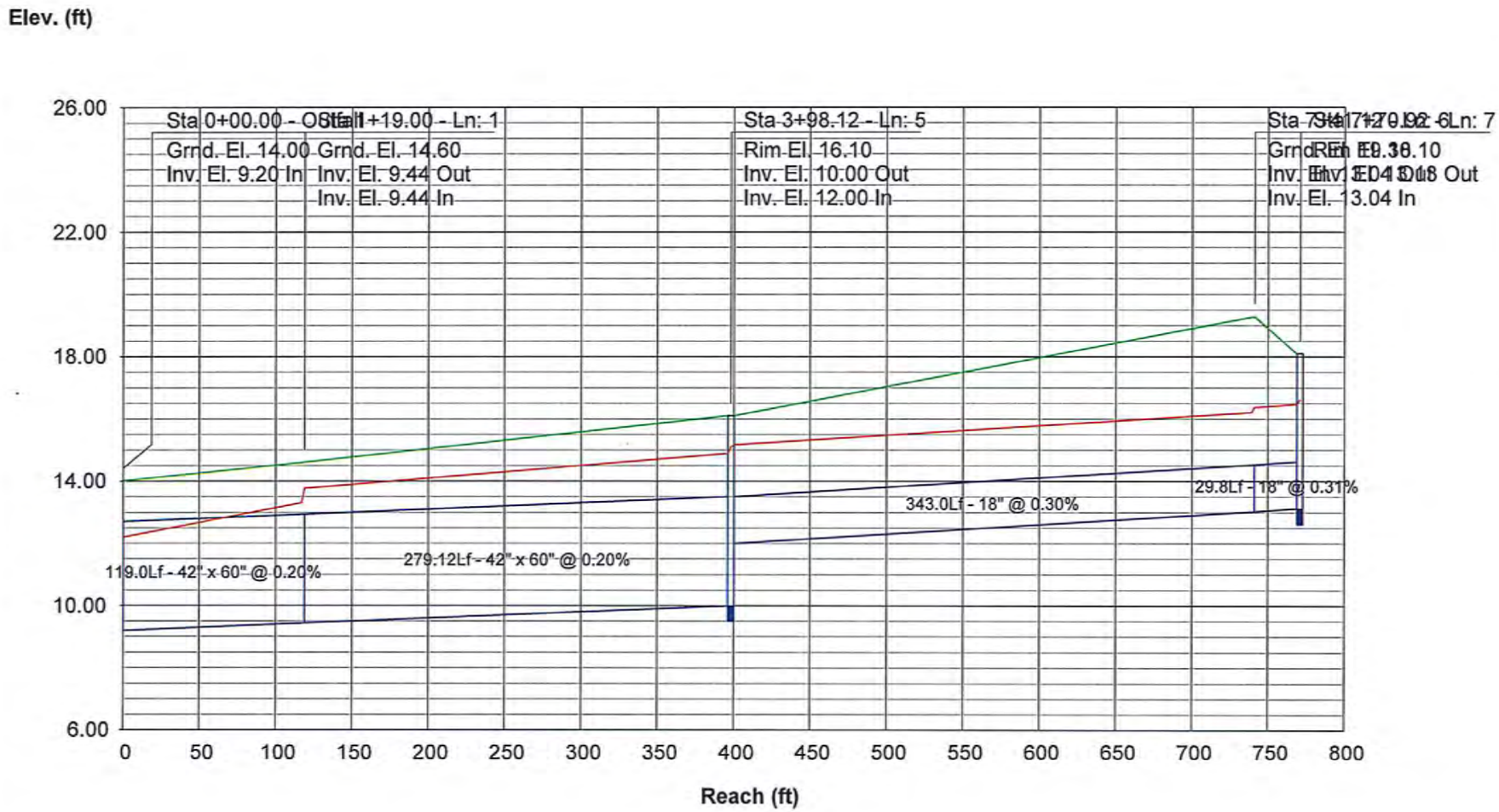
Storm Sewer Profile

Proj. file: 09-24_Napa-SD-Prop-Alt02_v1.0.stm



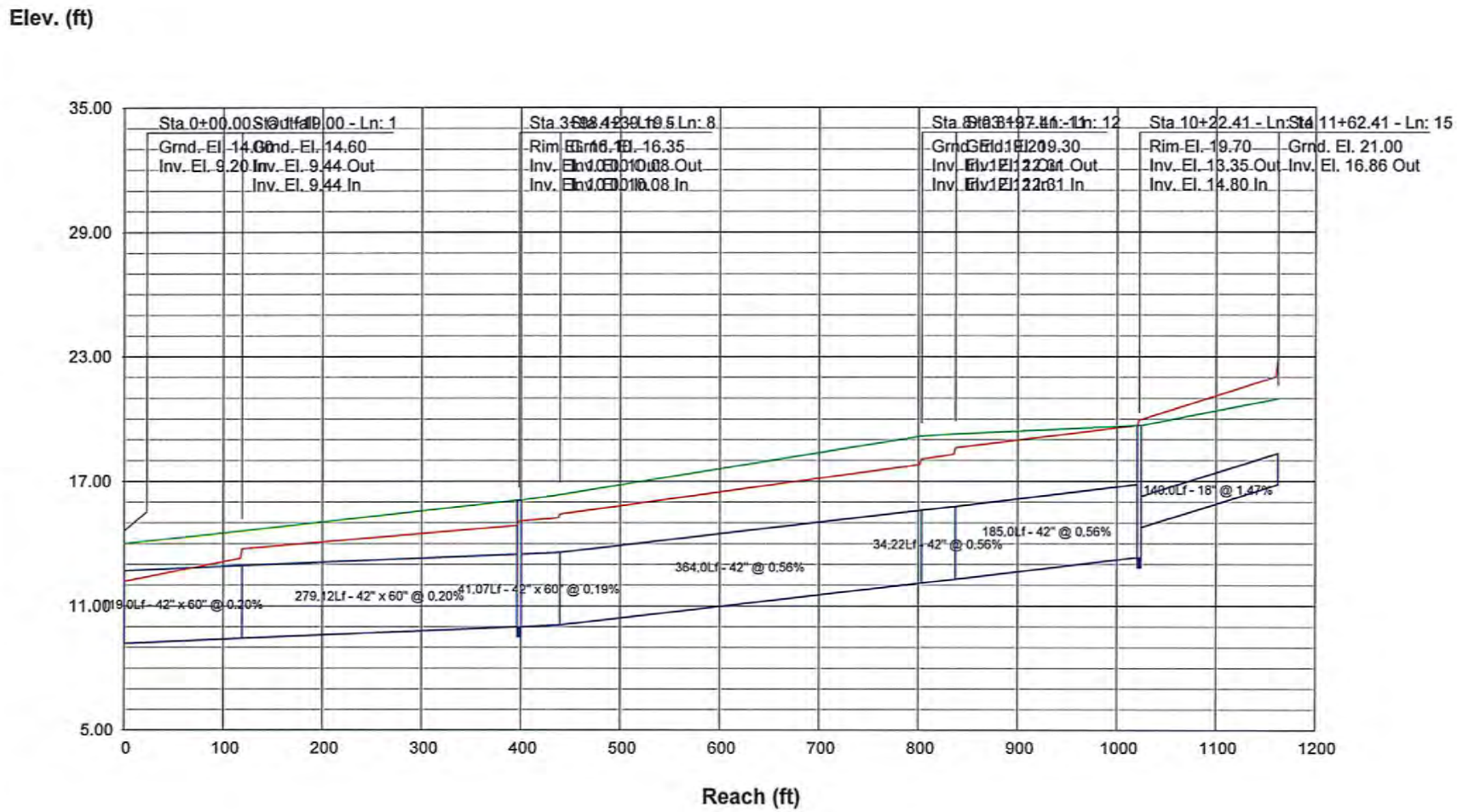
Storm Sewer Profile

Proj. file: 09-24_Napa-SD-Prop-Alt02_v1.0.stm



Storm Sewer Profile

Proj. file: 09-24_Napa-SD-Prop-Alt02_v1.0.stm



Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr line No.	Line length (ft)	Defl angle (deg)	Junc type	Known Q (cfs)	Drng area (ac)	Runoff coeff (C)	Inlet time (min)	Invert El Dn (ft)	Line slope (%)	Invert El Up (ft)	Line size (in)	Line type	N value (n)	J-loss coeff (K)	Inlet/ Rim El (ft)	
1	End	119.0	-144.1	None	17.35	0.00	0.00	0.0	9.20	0.20	9.44	42 60	Box	0.025	1.00	14.60	Pr-P-01
2	1	54.8	-97.5	Curb	0.00	2.97	0.65	14.0	11.69	0.66	12.05	15	Cir	0.013	1.00	13.80	Pr-P-02
3	1	20.6	117.9	Curb	0.00	2.26	0.65	15.0	11.69	0.36	11.77	15	Cir	0.013	1.00	13.10	Pr-P-03
4	1	54.0	-12.4	Curb	0.00	2.43	0.65	15.0	11.69	0.42	11.92	15	Cir	0.013	1.00	14.30	Pr-P-04
5	1	279.1	29.9	MH	0.00	0.00	0.00	0.0	9.44	0.20	10.00	42 60	Box	0.025	0.96	16.10	Pr-P-05
6	5	343.0	-71.3	None	0.00	0.00	0.00	0.0	12.00	0.30	13.04	18	Cir	0.013	1.00	19.30	Pr-P-06
7	6	29.8	85.7	Curb	0.00	3.28	0.65	14.0	13.04	0.31	13.13	18	Cir	0.013	1.00	18.10	Pr-P-07
8	5	41.1	-5.2	None	0.00	0.00	0.00	0.0	10.00	0.19	10.08	42 60	Box	0.025	1.00	16.35	Pr-P-09
9	8	35.5	-59.9	DrGrt	0.00	2.84	0.65	14.0	12.33	0.61	12.55	15	Cir	0.013	1.00	15.60	Pr-P-10
10	8	21.9	95.2	Curb	0.00	9.26	0.65	15.0	11.08	2.79	11.69	30	Cir	0.013	1.00	15.20	Pr-P-11
11	8	364.0	21.3	None	0.00	0.00	0.00	0.0	10.08	0.56	12.12	42	Cir	0.025	0.97	19.20	Pr-P-12
12	11	34.2	-75.4	None	0.00	0.00	0.00	0.0	12.12	0.56	12.31	42	Cir	0.025	0.99	19.30	Pr-P-13
13	12	19.0	81.7	Curb	0.00	1.40	0.65	13.0	14.56	0.20	14.60	15	Cir	0.013	1.00	18.40	Pr-P-14
14	12	185.0	-2.0	MH	0.00	0.00	0.00	0.0	12.31	0.56	13.35	42	Cir	0.025	1.00	19.70	Pr-P-15
15	14	140.0	85.5	None	0.00	6.80	0.65	12.0	14.80	1.47	16.86	18	Cir	0.013	1.00	21.00	Ex-P-16
16	14	261.0	-11.2	Hdwl	27.27	0.00	0.00	0.0	13.85	0.94	16.31	36	Cir	0.025	1.00	16.00	Pr-P-17

09-24 SD Inf Study - Alt #2 | Number of lines: 16 | Date: 12-14-2011

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	Pr-P-01	95.64	42 x 60 b	119.0	9.20	9.44	0.202	12.20*	13.30*	0.46	13.77	End
2	Pr-P-02	5.27	15 c	54.8	11.69	12.05	0.664	13.95*	14.31*	0.29	14.60	1
3	Pr-P-03	3.90	15 c	20.6	11.69	11.77	0.364	14.08*	14.15*	0.16	14.31	1
4	Pr-P-04	4.19	15 c	54.0	11.69	11.92	0.421	14.05*	14.28*	0.18	14.46	1
5	Pr-P-05	67.02	42 x 60 b	279.1	9.44	10.00	0.201	13.77*	14.88*	0.22	15.10	1
6	Pr-P-06	5.79	18 c	343.0	12.00	13.04	0.303	15.16*	16.21*	0.17	16.37	5
7	Pr-P-07	5.82	18 c	29.8	13.04	13.13	0.306	16.37*	16.47*	0.17	16.63	6
8	Pr-P-09	62.20	42 x 60 b	41.1	10.00	10.08	0.195	15.10*	15.24*	0.20	15.44	5
9	Pr-P-10	5.04	15 c	35.5	12.33	12.55	0.608	15.44*	15.66*	0.26	15.92	8
10	Pr-P-11	15.98	30 c	21.9	11.08	11.69	2.788	15.47*	15.50*	0.16	15.67	8
11	Pr-P-12	42.10	42 c	364.0	10.08	12.12	0.560	15.44*	17.80*	0.29	18.09	8
12	Pr-P-13	42.16	42 c	34.2	12.12	12.31	0.555	18.09*	18.31*	0.30	18.60	11
13	Pr-P-14	2.55	15 c	19.0	14.56	14.60	0.200	18.84*	18.87*	0.07	18.93	12
14	Pr-P-15	39.91	42 c	185.0	12.31	13.35	0.562	18.64*	19.71*	0.27	19.98	12
15	Ex-P-16	12.76	18 c	140.0	14.80	16.86	1.471	19.98*	22.05*	0.81	22.86	14
16	Pr-P-17	27.27	36 c	261.0	13.85	16.31	0.943	20.02*	21.63*	0.23	21.86	14

09-24 SD Inf Study - Alt #2 | Number of lines: 16 | Run Date: 12-14-2011

NOTES: c = cir; e = ellip; b = box; Return period = 25 Yrs. ; *Surcharged (HGL above crown).

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	
1	End	119.0	0.00	31.24	0.00	0.00	20.31	0.0	17.1	2.5	95.64	47.63	5.92	42 60 b	0.20	9.44	9.20	13.30	12.20	14.60	14.00	Pr-P-01
2	1	54.8	2.97	2.97	0.65	1.93	1.93	14.0	14.0	2.7	5.27	5.26	4.29	15	0.66	12.05	11.69	14.31	13.95	13.80	14.60	Pr-P-02
3	1	20.6	2.26	2.26	0.65	1.47	1.47	15.0	15.0	2.7	3.90	3.90	3.18	15	0.36	11.77	11.69	14.15	14.08	13.10	14.60	Pr-P-03
4	1	54.0	2.43	2.43	0.65	1.58	1.58	15.0	15.0	2.7	4.19	4.19	3.42	15	0.42	11.92	11.69	14.28	14.05	14.30	14.60	Pr-P-04
5	1	279.1	0.00	23.58	0.00	0.00	15.33	0.0	15.9	2.6	67.02	47.50	3.83	42 60 b	0.20	10.00	9.44	14.88	13.77	16.10	14.60	Pr-P-05
6	5	343.0	0.00	3.28	0.00	0.00	2.13	0.0	14.2	2.7	5.79	5.78	3.28	18	0.30	13.04	12.00	16.21	15.16	19.30	16.10	Pr-P-06
7	6	29.8	3.28	3.28	0.65	2.13	2.13	14.0	14.0	2.7	5.82	5.81	3.29	18	0.31	13.13	13.04	16.47	16.37	18.10	19.30	Pr-P-07
8	5	41.1	0.00	20.30	0.00	0.00	13.20	0.0	15.1	2.6	62.20	46.81	3.55	42 60 b	0.19	10.08	10.00	15.24	15.10	16.35	16.10	Pr-P-09
9	8	35.5	2.84	2.84	0.65	1.85	1.85	14.0	14.0	2.7	5.04	5.03	4.10	15	0.61	12.55	12.33	15.66	15.44	15.60	16.35	Pr-P-10
10	8	21.9	9.26	9.26	0.65	6.02	6.02	15.0	15.0	2.7	15.98	68.48	3.26	30	2.79	11.69	11.08	15.50	15.47	15.20	16.35	Pr-P-11
11	8	364.0	0.00	8.20	0.00	0.00	5.33	0.0	13.3	2.8	42.10	39.17	4.38	42	0.56	12.12	10.08	17.80	15.44	19.20	16.35	Pr-P-12
12	11	34.2	0.00	8.20	0.00	0.00	5.33	0.0	13.2	2.8	42.16	38.98	4.38	42	0.56	12.31	12.12	18.31	18.09	19.30	19.20	Pr-P-13
13	12	19.0	1.40	1.40	0.65	0.91	0.91	13.0	13.0	2.8	2.55	2.89	2.08	15	0.20	14.60	14.56	18.87	18.84	18.40	19.30	Pr-P-14
14	12	185.0	0.00	6.80	0.00	0.00	4.42	0.0	12.3	2.9	39.91	39.23	4.15	42	0.56	13.35	12.31	19.71	18.64	19.70	19.30	Pr-P-15
15	14	140.0	6.80	6.80	0.65	4.42	4.42	12.0	12.0	2.9	12.76	12.74	7.22	18	1.47	16.86	14.80	22.05	19.98	21.00	19.70	Ex-P-16
16	14	261.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	27.27	33.67	3.86	36	0.94	16.31	13.85	21.63	20.02	16.00	19.70	Pr-P-17

09-24 SD Inf Study - Alt #2 | Number of lines: 16 | Run Date: 12-14-2011

NOTES: Intensity = 218.31 / (Inlet time + 28.60) ^ 1.17; Return period = 25 Yrs.

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q byp (cfs)	Junc type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp line No
							Ht (in)	L (ft)	area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
1		17.35*	0.00	0.00	17.35	None	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
2	H	5.27	0.00	5.27	0.00	Curb	6.0	3.00	0.00	0.00	0.00	Sag	2.00	0.080	0.050	0.013	0.55	9.84	0.66	9.84	2.00	Off
3	G	3.90	0.00	3.90	0.00	Curb	6.0	3.00	0.00	0.00	0.00	Sag	2.00	0.080	0.050	0.013	0.46	8.05	0.57	8.05	2.00	Off
4	F	4.19	0.00	4.19	0.00	Curb	6.0	3.00	0.00	0.00	0.00	Sag	2.00	0.080	0.050	0.013	0.48	8.45	0.59	8.45	2.00	Off
5	P-SDMH-01	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
6		0.00	0.00	0.00	0.00	None	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
7	E	5.82	0.00	5.82	0.00	Curb	6.0	3.00	0.00	0.00	0.00	Sag	2.00	0.080	0.050	0.013	0.59	10.52	0.69	10.52	2.00	Off
8		0.00	0.00	0.00	0.00	None	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
9	C	5.04	0.00	5.04	0.00	DrGrt	0.0	0.00	2.00	4.00	2.00	Sag	2.00	0.050	0.050	0.013	0.35	16.12	0.35	16.12	0.00	Off
10	D	15.98	0.00	15.98	0.00	Curb	6.0	3.00	0.00	0.00	0.00	Sag	2.00	0.080	0.050	0.013	2.44	47.57	2.55	47.57	2.00	Off
11		0.00	0.00	0.00	0.00	None	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
12		0.00	0.00	0.00	0.00	None	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
13	B	2.55	0.00	2.55	0.00	Curb	6.0	3.00	0.00	0.00	0.00	Sag	2.00	0.080	0.050	0.013	0.36	6.06	0.47	6.06	2.00	Off
14	P-SDMH-02	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
15	A	12.76	0.00	0.00	12.76	None	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
16	Caltrans POC1	27.27*	0.00	27.27	0.00	Hdwl	6.0	6.00	2.00	4.00	2.00	Sag	2.00	0.080	0.050	0.013	0.00	0.00	0.00	0.00	0.00	14

09-24 SD Inf Study - Alt #2 | Number of lines: 16 | Run Date: 12-14-2011

NOTES: Inlet N-Values = 0.016 ; Intensity = 218.31 / (Inlet time + 28.60) ^ 1.17; Return period = 25 Yrs. ; * Indicates Known Q added

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
1	42 60 b	95.64	9.20	12.20	3.00	15.00	6.38	0.63	12.83	0.761	119	9.44	13.30	3.50	17.50	5.47	0.46	13.77	0.813	0.787	0.937	1.00	0.46
2	15	5.27	11.69	13.95	1.25	1.23	4.29	0.29	14.23	0.666	54.8	12.05	14.31	1.25	1.23	4.29	0.29	14.60	0.665	0.666	0.365	1.00	0.29
3	15	3.90	11.69	14.08	1.25	1.23	3.18	0.16	14.23	0.365	20.6	11.77	14.15	1.25	1.23	3.18	0.16	14.31	0.365	0.365	0.075	1.00	0.16
4	15	4.19	11.69	14.05	1.25	1.23	3.42	0.18	14.23	0.422	54.0	11.92	14.28	1.25	1.23	3.42	0.18	14.46	0.422	0.422	0.228	1.00	0.18
5	42 60 b	67.02	9.44	13.77	3.50	17.50	3.83	0.23	14.00	0.399	279	10.00	14.88	3.50	17.50	3.83	0.23	15.11	0.399	0.399	1.115	0.96	0.22
6	18	5.79	12.00	15.16	1.50	1.77	3.28	0.17	15.33	0.304	343	13.04	16.21	1.50	1.77	3.28	0.17	16.37	0.304	0.304	1.044	1.00	0.17
7	18	5.82	13.04	16.37	1.50	1.77	3.29	0.17	16.54	0.307	29.8	13.13	16.47	1.50	1.77	3.29	0.17	16.63	0.307	0.307	0.091	1.00	0.17
8	42 60 b	62.20	10.00	15.10	3.50	17.50	3.55	0.20	15.30	0.344	41.1	10.08	15.24	3.50	17.50	3.55	0.20	15.44	0.344	0.344	0.141	1.00	0.20
9	15	5.04	12.33	15.44	1.25	1.23	4.11	0.26	15.70	0.609	35.5	12.55	15.66	1.25	1.23	4.10	0.26	15.92	0.608	0.609	0.216	1.00	0.26
10	30	15.98	11.08	15.47	2.50	4.91	3.26	0.16	15.64	0.152	21.9	11.69	15.50	2.50	4.91	3.26	0.16	15.67	0.152	0.152	0.033	1.00	0.16
11	42	42.10	10.08	15.44	3.50	9.62	4.38	0.30	15.74	0.648	364	12.12	17.80	3.50	9.62	4.38	0.30	18.10	0.648	0.648	2.358	0.97	0.29
12	42	42.16	12.12	18.09	3.50	9.62	4.38	0.30	18.39	0.650	34.2	12.31	18.31	3.50	9.62	4.38	0.30	18.61	0.649	0.650	0.222	0.99	0.30
13	15	2.55	14.56	18.84	1.25	1.23	2.08	0.07	18.90	0.156	19.0	14.60	18.87	1.25	1.23	2.08	0.07	18.93	0.156	0.156	0.030	1.00	0.07
14	42	39.91	12.31	18.64	3.50	9.62	4.15	0.27	18.90	0.582	185	13.35	19.71	3.50	9.62	4.15	0.27	19.98	0.582	0.582	1.077	1.00	0.27
15	18	12.76	14.80	19.98	1.50	1.77	7.22	0.81	20.79	1.476	140	16.86	22.05	1.50	1.77	7.22	0.81	22.86	1.476	1.476	2.066	1.00	0.81
16	36	27.27	13.85	20.02	3.00	7.07	3.86	0.23	20.25	0.619	261	16.31	21.63	3.00	7.07	3.86	0.23	21.86	0.618	0.618	1.614	1.00	0.23

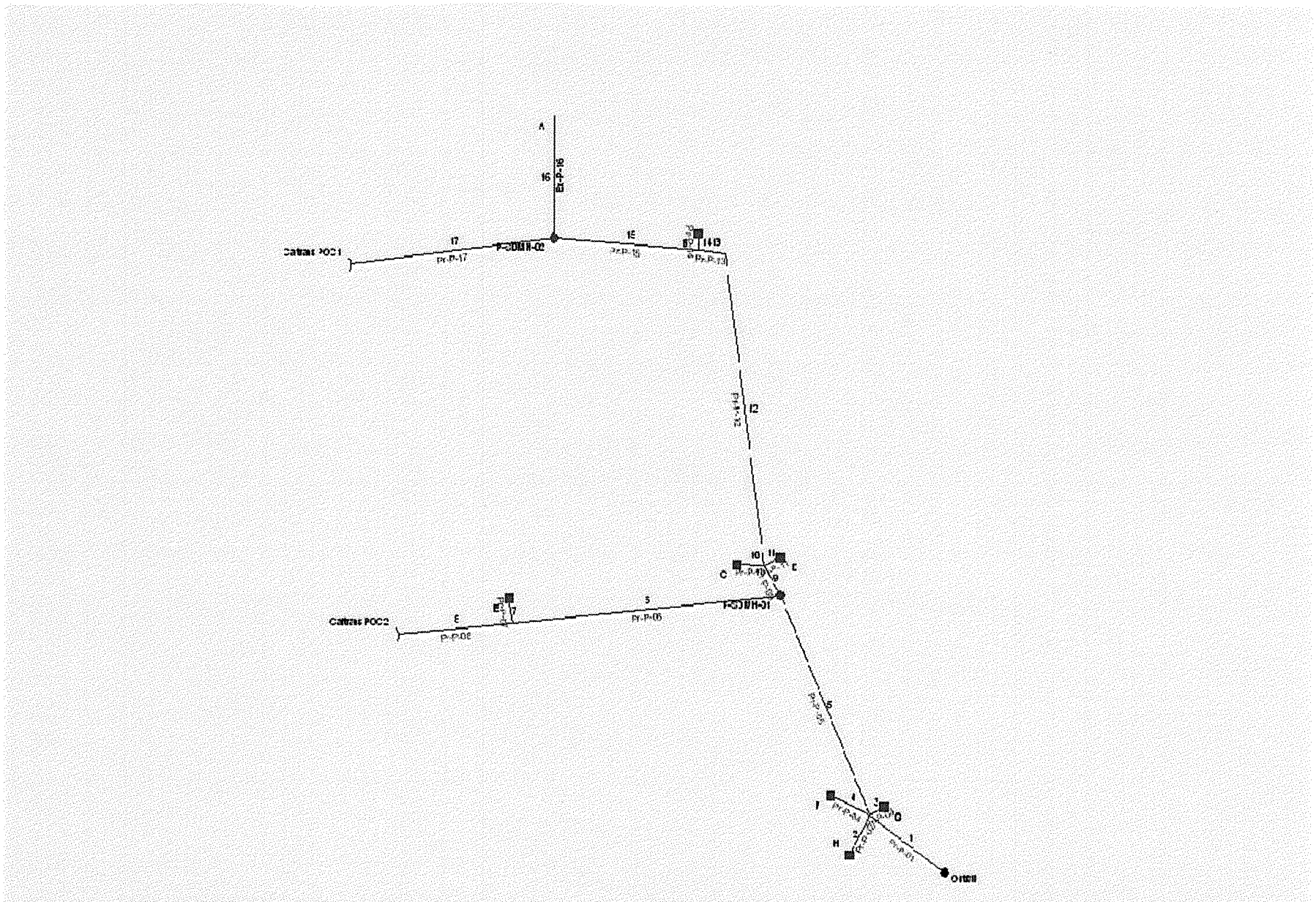
09-24 SD Inf Study - Alt #2 | Number of lines: 16 | Run Date: 12-14-2011

Storm Drain Infrastructure Study

Alternative 3

Hydraflow Plan View

09-24 SD Inf Study - Alt #3

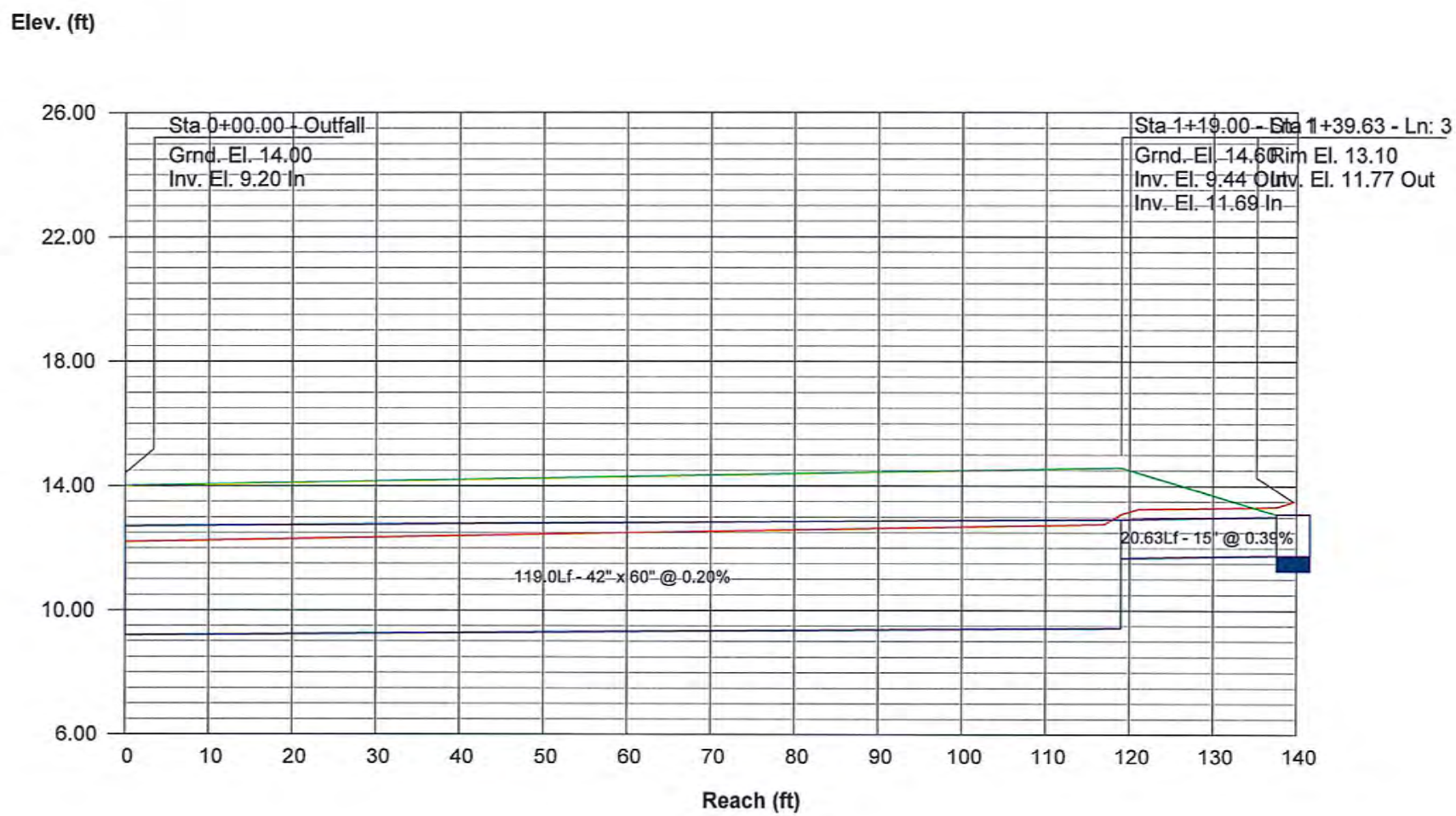


09-24 SD Inf Study - Alt #3	No. Lines: 17	12-13-2011

Hydraflow Storm Sewers 2005

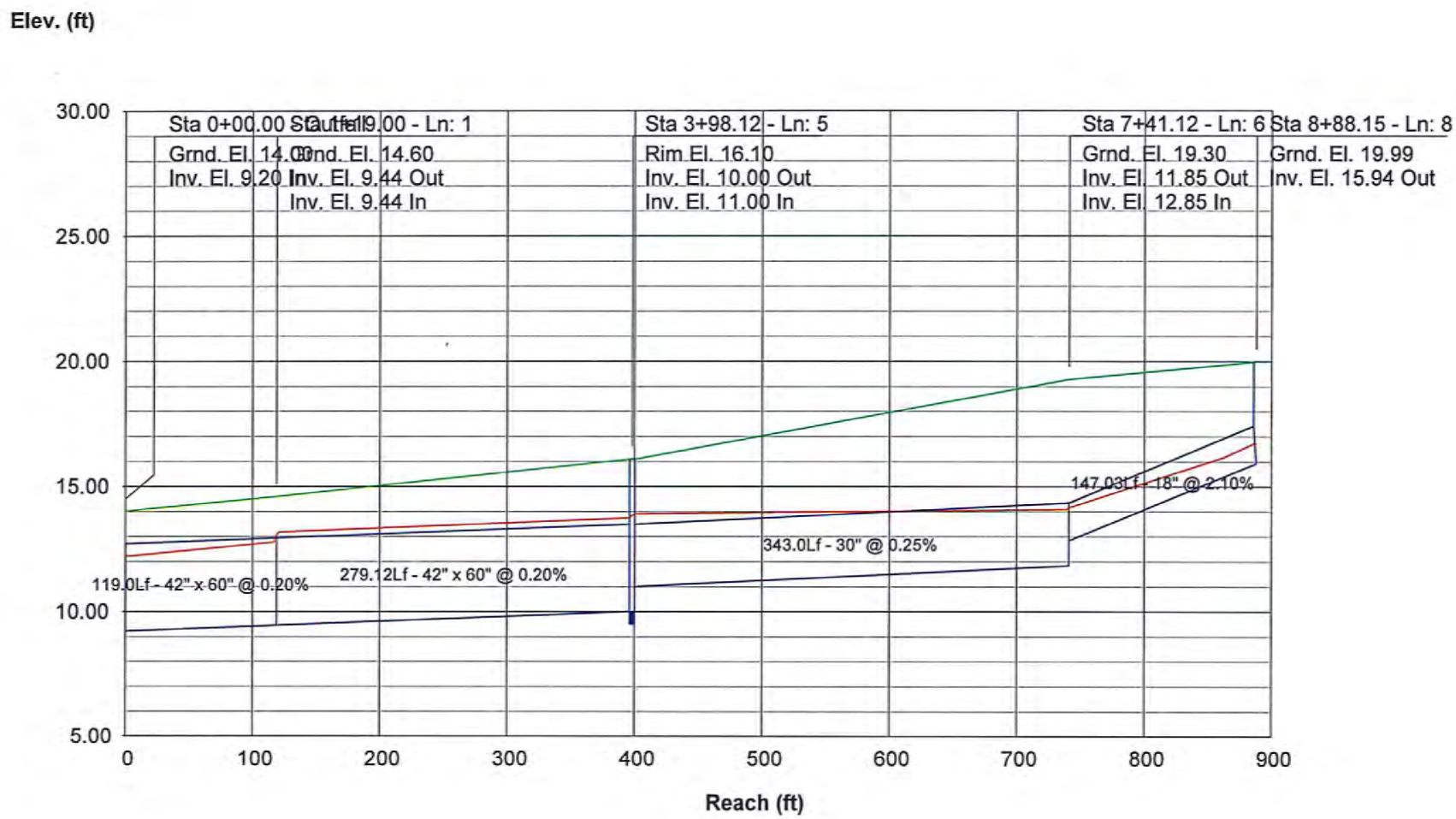
Storm Sewer Profile

Proj. file: 09-24_Napa-SD-Prop-Alt03_v1.0.stm



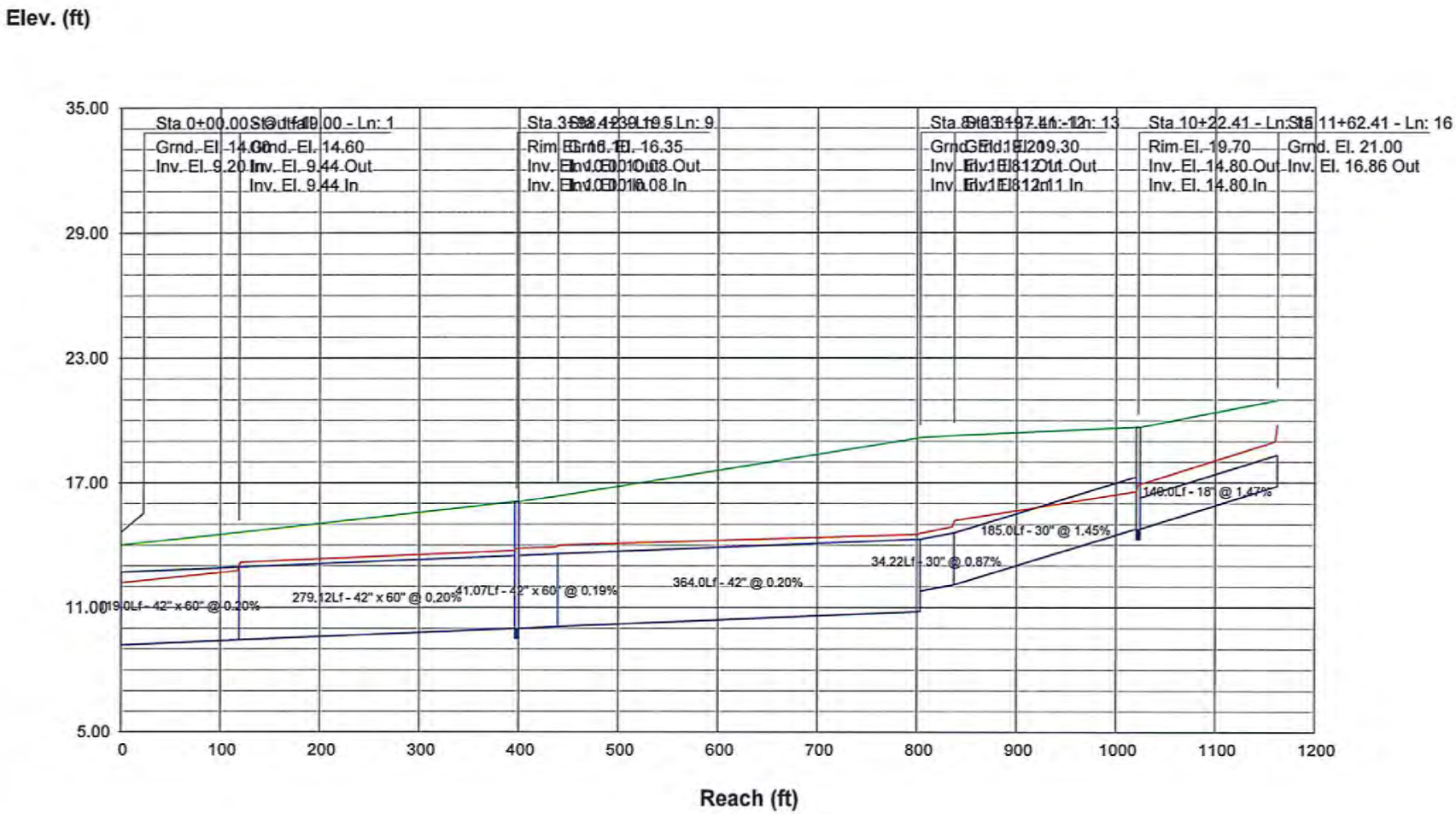
Storm Sewer Profile

Proj. file: 09-24_Napa-SD-Prop-Alt03_v1.0.stm



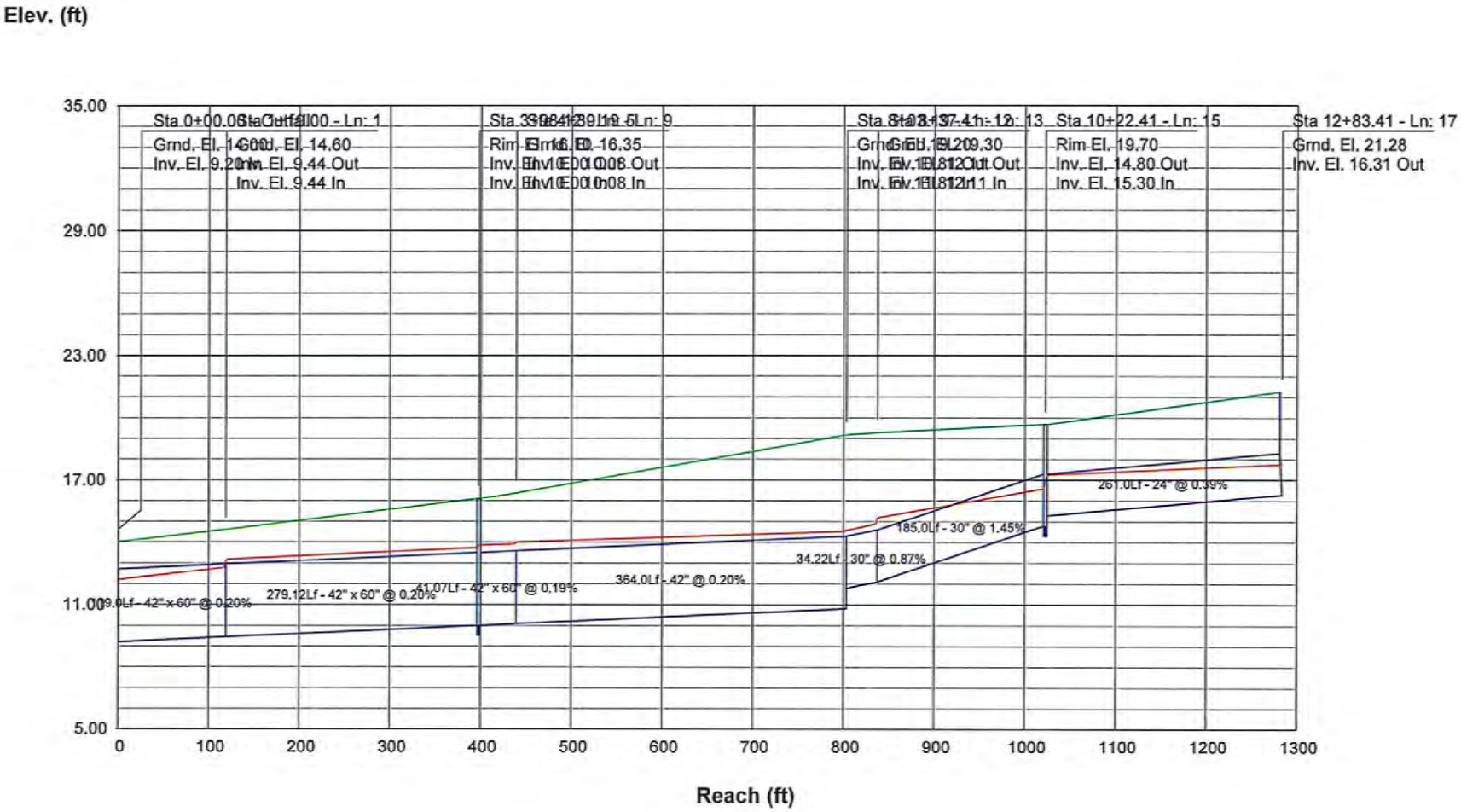
Storm Sewer Profile

Proj. file: 09-24_Napa-SD-Prop-Alt03_v1.0.stm



Storm Sewer Profile

Proj. file: 09-24_Napa-SD-Prop-Alt03_v1.0.stm



Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr line No.	Line length (ft)	Defl angle (deg)	Junc type	Known Q (cfs)	Drng area (ac)	Runoff coeff (C)	Inlet time (min)	Invert El Dn (ft)	Line slope (%)	Invert El Up (ft)	Line size (in)	Line type	N value (n)	J-loss coeff (K)	Inlet/ Rim El (ft)	
1	End	119.0	-144.1	None	17.35	0.00	0.00	0.0	9.20	0.20	9.44	42 60	Box	0.025	1.00	14.60	Pr-P-01
2	1	54.8	-97.5	Curb	0.00	2.97	0.65	14.0	11.69	0.66	12.05	15	Cir	0.013	1.00	13.80	Pr-P-02
3	1	20.6	117.9	Curb	0.00	2.26	0.65	15.0	11.69	0.39	11.77	15	Cir	0.013	1.00	13.10	Pr-P-03
4	1	54.0	-12.4	Curb	0.00	2.43	0.65	15.0	11.69	0.42	11.92	15	Cir	0.013	1.00	14.30	Pr-P-04
5	1	279.1	29.9	MH	0.00	0.00	0.00	0.0	9.44	0.20	10.00	42 60	Box	0.025	0.96	16.10	Pr-P-05
6	5	343.0	-71.3	None	0.00	0.00	0.00	0.0	11.00	0.25	11.85	30	Cir	0.013	1.00	19.30	Pr-P-06
7	6	29.8	85.7	Curb	0.00	3.28	0.65	14.0	12.85	0.31	12.94	18	Cir	0.013	1.00	18.10	Pr-P-07
8	6	147.0	0.5	Hdwl	4.15	0.00	0.00	0.0	12.85	2.10	15.94	18	Cir	0.025	1.00	19.99	Pr-P-08
9	5	41.1	-5.2	None	0.00	0.00	0.00	0.0	10.00	0.19	10.08	42 60	Box	0.025	1.00	16.35	Pr-P-09
10	9	35.5	-59.9	DrGrt	0.00	2.84	0.65	14.0	12.33	0.61	12.55	15	Cir	0.013	1.00	15.60	Pr-P-10
11	9	21.9	95.2	Curb	0.00	9.26	0.65	15.0	11.08	0.20	11.12	30	Cir	0.013	1.00	15.20	Pr-P-11
12	9	364.0	21.3	None	0.00	0.00	0.00	0.0	10.08	0.20	10.81	42	Cir	0.025	0.97	19.20	Pr-P-12
13	12	34.2	-75.4	None	0.00	0.00	0.00	0.0	11.81	0.87	12.11	30	Cir	0.025	0.99	19.30	Pr-P-13
14	13	19.0	81.7	Curb	0.00	1.40	0.65	13.0	13.36	0.20	13.39	15	Cir	0.013	1.00	18.40	Pr-P-14
15	13	185.0	-2.0	MH	0.00	0.00	0.00	0.0	12.11	1.45	14.80	30	Cir	0.025	1.00	19.70	Pr-P-15
16	15	140.0	85.5	None	0.00	6.80	0.65	12.0	14.80	1.47	16.86	18	Cir	0.013	1.00	21.00	Ex-P-16
17	15	261.0	-11.2	Hdwl	5.12	0.00	0.00	0.0	15.30	0.39	16.31	24	Cir	0.025	1.00	21.28	Pr-P-17

09-24 SD Inf Study - Alt #3 | Number of lines: 17 | Date: 12-13-2011

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	Pr-P-01	75.71	42 x 60 b	119.0	9.20	9.44	0.202	12.20	12.77	0.32	13.09	End
2	Pr-P-02	5.27	15 c	54.8	11.69	12.05	0.664	13.13*	13.49*	0.29	13.78	1
3	Pr-P-03	3.90	15 c	20.6	11.69	11.77	0.388	13.26*	13.33*	0.16	13.49	1
4	Pr-P-04	4.19	15 c	54.0	11.69	11.92	0.421	13.23*	13.46*	0.18	13.64	1
5	Pr-P-05	47.92	42 x 60 b	279.1	9.44	10.00	0.201	13.18*	13.75*	0.11	13.86	1
6	Pr-P-06	9.94	30 c	343.0	11.00	11.85	0.248	13.91	14.09	0.07	14.16	5
7	Pr-P-07	5.82	18 c	29.8	12.85	12.94	0.306	14.16	14.24	0.20	14.44	6
8	Pr-P-08	4.15	18 c	147.0	12.85	15.94	2.102	14.16	16.72	n/a	16.72 j	6
9	Pr-P-09	38.98	42 x 60 b	41.1	10.00	10.08	0.195	13.86*	13.91*	0.08	13.99	5
10	Pr-P-10	5.04	15 c	35.5	12.33	12.55	0.608	13.99*	14.21*	0.26	14.47	9
11	Pr-P-11	15.98	30 c	21.9	11.08	11.12	0.200	13.99*	14.02*	0.16	14.19	9
12	Pr-P-12	19.94	42 c	364.0	10.08	10.81	0.200	14.00*	14.53*	0.06	14.59	9
13	Pr-P-13	20.00	30 c	34.2	11.81	12.11	0.868	14.59*	14.89*	0.26	15.15	12
14	Pr-P-14	2.55	15 c	19.0	13.36	13.39	0.200	15.34*	15.37*	0.07	15.44	13
15	Pr-P-15	17.76	30 c	185.0	12.11	14.80	1.454	15.20	16.58	0.35	16.93	13
16	Ex-P-16	12.76	18 c	140.0	14.80	16.86	1.471	16.93*	19.00*	0.81	19.81	15
17	Pr-P-17	5.12	24 c	261.0	15.30	16.31	0.387	17.24	17.75	0.07	17.82	15

09-24 SD Inf Study - Alt #3 | Number of lines: 17 | Run Date: 12-13-2011

NOTES: c = cir; e = ellip; b = box; Return period = 25 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	
1	End	119.0	0.00	31.24	0.00	0.00	20.31	0.0	18.6	2.4	75.71	47.63	4.80	42 60 b	0.20	9.44	9.20	12.77	12.20	14.60	14.00	Pr-P-01
2	1	54.8	2.97	2.97	0.65	1.93	1.93	14.0	14.0	2.7	5.27	5.26	4.29	15	0.66	12.05	11.69	13.49	13.13	13.80	14.60	Pr-P-02
3	1	20.6	2.26	2.26	0.65	1.47	1.47	15.0	15.0	2.7	3.90	4.02	3.18	15	0.39	11.77	11.69	13.33	13.26	13.10	14.60	Pr-P-03
4	1	54.0	2.43	2.43	0.65	1.58	1.58	15.0	15.0	2.7	4.19	4.19	3.42	15	0.42	11.92	11.69	13.46	13.23	14.30	14.60	Pr-P-04
5	1	279.1	0.00	23.58	0.00	0.00	15.33	0.0	17.0	2.5	47.92	47.50	2.74	42 60 b	0.20	10.00	9.44	13.75	13.18	16.10	14.60	Pr-P-05
6	5	343.0	0.00	3.28	0.00	0.00	2.13	0.0	14.2	2.7	9.94	20.42	2.08	30	0.25	11.85	11.00	14.09	13.91	19.30	16.10	Pr-P-06
7	6	29.8	3.28	3.28	0.65	2.13	2.13	14.0	14.0	2.7	5.82	5.81	3.55	18	0.31	12.94	12.85	14.24	14.16	18.10	19.30	Pr-P-07
8	6	147.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	4.15	7.92	3.51	18	2.10	15.94	12.85	16.72	14.16	19.99	19.30	Pr-P-08
9	5	41.1	0.00	20.30	0.00	0.00	13.20	0.0	16.3	2.6	38.98	46.81	2.23	42 60 b	0.19	10.08	10.00	13.91	13.86	16.35	16.10	Pr-P-09
10	9	35.5	2.84	2.84	0.65	1.85	1.85	14.0	14.0	2.7	5.04	5.03	4.10	15	0.61	12.55	12.33	14.21	13.99	15.60	16.35	Pr-P-10
11	9	21.9	9.26	9.26	0.65	6.02	6.02	15.0	15.0	2.7	15.98	18.34	3.26	30	0.20	11.12	11.08	14.02	13.99	15.20	16.35	Pr-P-11
12	9	364.0	0.00	8.20	0.00	0.00	5.33	0.0	13.3	2.8	19.94	23.40	2.07	42	0.20	10.81	10.08	14.53	14.00	19.20	16.35	Pr-P-12
13	12	34.2	0.00	8.20	0.00	0.00	5.33	0.0	13.2	2.8	20.00	19.87	4.07	30	0.87	12.11	11.81	14.89	14.59	19.30	19.20	Pr-P-13
14	13	19.0	1.40	1.40	0.65	0.91	0.91	13.0	13.0	2.8	2.55	2.89	2.08	15	0.20	13.39	13.36	15.37	15.34	18.40	19.30	Pr-P-14
15	13	185.0	0.00	6.80	0.00	0.00	4.42	0.0	12.3	2.9	17.76	25.72	4.19	30	1.45	14.80	12.11	16.58	15.20	19.70	19.30	Pr-P-15
16	15	140.0	6.80	6.80	0.65	4.42	4.42	12.0	12.0	2.9	12.76	12.74	7.22	18	1.47	16.86	14.80	19.00	16.93	21.00	19.70	Ex-P-16
17	15	261.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	5.12	7.32	1.88	24	0.39	16.31	15.30	17.75	17.24	21.28	19.70	Pr-P-17

09-24 SD Inf Study - Alt #3 | Number of lines: 17 | Run Date: 12-13-2011

NOTES: Intensity = 218.31 / (Inlet time + 28.60) ^ 1.17; Return period = 25 Yrs.

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q byp (cfs)	Junc type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp line No
							Ht (in)	L (ft)	area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
1		17.35*	0.00	0.00	17.35	None	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
2	H	5.27	0.00	5.27	0.00	Curb	6.0	3.00	0.00	0.00	0.00	Sag	2.00	0.080	0.050	0.013	0.55	9.84	0.66	9.84	2.00	Off
3	G	3.90	0.00	3.90	0.00	Curb	6.0	3.00	0.00	0.00	0.00	Sag	2.00	0.080	0.050	0.013	0.46	8.05	0.57	8.05	2.00	Off
4	F	4.19	0.00	4.19	0.00	Curb	6.0	3.00	0.00	0.00	0.00	Sag	2.00	0.080	0.050	0.013	0.48	8.45	0.59	8.45	2.00	Off
5	P-SDMH-01	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
6		0.00	0.00	0.00	0.00	None	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
7	E	5.82	0.00	5.82	0.00	Curb	6.0	3.00	0.00	0.00	0.00	Sag	2.00	0.080	0.050	0.013	0.59	10.52	0.69	10.52	2.00	Off
8	Caltrans POC2	4.15*	0.00	4.15	0.00	Hdwl	6.0	6.00	2.00	4.00	2.00	Sag	2.00	0.080	0.050	0.013	0.00	0.00	0.00	0.00	0.00	6
9		0.00	0.00	0.00	0.00	None	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
10	C	5.04	0.00	5.04	0.00	DrGrt	0.0	0.00	2.00	4.00	2.00	Sag	2.00	0.050	0.050	0.013	0.35	16.12	0.35	16.12	0.00	Off
11	D	15.98	0.00	15.98	0.00	Curb	6.0	3.00	0.00	0.00	0.00	Sag	2.00	0.080	0.050	0.013	2.44	47.57	2.55	47.57	2.00	Off
12		0.00	0.00	0.00	0.00	None	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
13		0.00	0.00	0.00	0.00	None	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
14	B	2.55	0.00	2.55	0.00	Curb	6.0	3.00	0.00	0.00	0.00	Sag	2.00	0.080	0.050	0.013	0.36	6.06	0.47	6.06	2.00	Off
15	P-SDMH-02	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
16	A	12.76	0.00	0.00	12.76	None	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.00	Off
17	Caltrans POC1	5.12*	0.00	5.12	0.00	Hdwl	6.0	6.00	2.00	4.00	2.00	Sag	2.00	0.080	0.050	0.013	0.00	0.00	0.00	0.00	0.00	15

09-24 SD Inf Study - Alt #3 | Number of lines: 17 | Run Date: 12-13-2011

NOTES: Inlet N-Values = 0.016 ; Intensity = 218.31 / (Inlet time + 28.60) ^ 1.17; Return period = 25 Yrs. ; * Indicates Known Q added

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
1	42 60 b	75.71	9.20	12.20	3.00	15.00	5.05	0.40	12.60	0.477	119	9.44	12.77	3.33	16.66	4.55	0.32	13.09	0.364	0.420	0.500	1.00	0.32
2	15	5.27	11.69	13.13	1.25	1.23	4.29	0.29	13.41	0.666	54.8	12.05	13.49	1.25	1.23	4.29	0.29	13.78	0.665	0.666	0.365	1.00	0.29
3	15	3.90	11.69	13.26	1.25	1.23	3.18	0.16	13.41	0.365	20.6	11.77	13.33	1.25	1.23	3.18	0.16	13.49	0.365	0.365	0.075	1.00	0.16
4	15	4.19	11.69	13.23	1.25	1.23	3.42	0.18	13.41	0.422	54.0	11.92	13.46	1.25	1.23	3.42	0.18	13.64	0.422	0.422	0.228	1.00	0.18
5	42 60 b	47.92	9.44	13.18	3.50	17.50	2.74	0.12	13.29	0.204	279	10.00	13.75	3.50	17.50	2.74	0.12	13.86	0.204	0.204	0.570	0.96	0.11
6	30	9.94	11.00	13.91	2.50	4.91	2.03	0.06	13.97	0.059	343	11.85	14.09	2.24	4.64	2.14	0.07	14.16	0.052	0.055	0.190	1.00	0.07
7	18	5.82	12.85	14.16	1.32	1.64	3.54	0.19	14.36	0.277	29.8	12.94	14.24	1.31	1.63	3.56	0.20	14.44	0.280	0.278	0.083	1.00	0.20
8	18	4.15	12.85	14.16	1.31	1.64	2.53	0.10	14.26	0.522	147	15.94	16.72 j	0.78**	0.92	4.49	0.31	17.03	2.046	1.284	n/a	1.00	0.31
9	42 60 b	38.98	10.00	13.86	3.50	17.50	2.23	0.08	13.93	0.135	41.1	10.08	13.91	3.50	17.50	2.23	0.08	13.99	0.135	0.135	0.055	1.00	0.08
10	15	5.04	12.33	13.99	1.25	1.23	4.11	0.26	14.25	0.609	35.5	12.55	14.21	1.25	1.23	4.10	0.26	14.47	0.608	0.609	0.216	1.00	0.26
11	30	15.98	11.08	13.99	2.50	4.91	3.26	0.16	14.16	0.152	21.9	11.12	14.02	2.50	4.91	3.26	0.16	14.19	0.152	0.152	0.033	1.00	0.16
12	42	19.94	10.08	14.00	3.50	9.62	2.07	0.07	14.07	0.145	364	10.81	14.53	3.50	9.62	2.07	0.07	14.60	0.145	0.145	0.529	0.97	0.06
13	30	20.00	11.81	14.59	2.50	4.91	4.07	0.26	14.85	0.879	34.2	12.11	14.89	2.50	4.91	4.07	0.26	15.15	0.879	0.879	0.301	0.99	0.26
14	15	2.55	13.36	15.34	1.25	1.23	2.08	0.07	15.41	0.156	19.0	13.39	15.37	1.25	1.23	2.08	0.07	15.44	0.156	0.156	0.030	1.00	0.07
15	30	17.76	12.11	15.20	2.50	4.91	3.62	0.20	15.41	0.694	185	14.80	16.58	1.78	3.74	4.75	0.35	16.93	0.948	0.821	1.519	1.00	0.35
16	18	12.76	14.80	16.93	1.50	1.77	7.22	0.81	17.74	1.476	140	16.86	19.00	1.50	1.77	7.22	0.81	19.81	1.476	1.476	2.066	1.00	0.81
17	24	5.12	15.30	17.24	1.94	3.11	1.64	0.04	17.28	0.167	261	16.31	17.75	1.44	2.43	2.11	0.07	17.82	0.250	0.208	0.544	1.00	0.07

09-24 SD Inf Study - Alt #3 | Number of lines: 17 | Run Date: 12-13-2011

Notes: ; ** Critical depth.; j-Line contains hyd. jump.

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
1	42 60 b	75.71	9.20	12.20	3.00	15.00	5.05	0.40	12.60	0.477	119	9.44	12.77	3.33	16.66	4.55	0.32	13.09	0.364	0.420	0.500	1.00	0.32
2	15	5.27	11.69	13.13	1.25	1.23	4.29	0.29	13.41	0.666	54.8	12.05	13.49	1.25	1.23	4.29	0.29	13.78	0.665	0.666	0.365	1.00	0.29
3	15	3.90	11.69	13.26	1.25	1.23	3.18	0.16	13.41	0.365	20.6	11.77	13.33	1.25	1.23	3.18	0.16	13.49	0.365	0.365	0.075	1.00	0.16
4	15	4.19	11.69	13.23	1.25	1.23	3.42	0.18	13.41	0.422	54.0	11.92	13.46	1.25	1.23	3.42	0.18	13.64	0.422	0.422	0.228	1.00	0.18
5	42 60 b	47.92	9.44	13.18	3.50	17.50	2.74	0.12	13.29	0.204	279	10.00	13.75	3.50	17.50	2.74	0.12	13.86	0.204	0.204	0.570	0.96	0.11
6	30	9.94	11.00	13.91	2.50	4.91	2.03	0.06	13.97	0.059	343	11.85	14.09	2.24	4.64	2.14	0.07	14.16	0.052	0.055	0.190	1.00	0.07
7	18	5.82	12.85	14.16	1.32	1.64	3.54	0.19	14.36	0.277	29.8	12.94	14.24	1.31	1.63	3.56	0.20	14.44	0.280	0.278	0.083	1.00	0.20
8	18	4.15	12.85	14.16	1.31	1.64	2.53	0.10	14.26	0.522	147	15.94	16.72 j	0.78**	0.92	4.49	0.31	17.03	2.046	1.284	n/a	1.00	0.31
9	42 60 b	38.98	10.00	13.86	3.50	17.50	2.23	0.08	13.93	0.135	41.1	10.08	13.91	3.50	17.50	2.23	0.08	13.99	0.135	0.135	0.055	1.00	0.08
10	15	5.04	12.33	13.99	1.25	1.23	4.11	0.26	14.25	0.609	35.5	12.55	14.21	1.25	1.23	4.10	0.26	14.47	0.608	0.609	0.216	1.00	0.26
11	30	15.98	11.08	13.99	2.50	4.91	3.26	0.16	14.16	0.152	21.9	11.12	14.02	2.50	4.91	3.26	0.16	14.19	0.152	0.152	0.033	1.00	0.16
12	42	19.94	10.08	14.00	3.50	9.62	2.07	0.07	14.07	0.145	364	10.81	14.53	3.50	9.62	2.07	0.07	14.60	0.145	0.145	0.529	0.97	0.06
13	30	20.00	11.81	14.59	2.50	4.91	4.07	0.26	14.85	0.879	34.2	12.11	14.89	2.50	4.91	4.07	0.26	15.15	0.879	0.879	0.301	0.99	0.26
14	15	2.55	13.36	15.34	1.25	1.23	2.08	0.07	15.41	0.156	19.0	13.39	15.37	1.25	1.23	2.08	0.07	15.44	0.156	0.156	0.030	1.00	0.07
15	30	17.76	12.11	15.20	2.50	4.91	3.62	0.20	15.41	0.694	185	14.80	16.58	1.78	3.74	4.75	0.35	16.93	0.948	0.821	1.519	1.00	0.35
16	18	12.76	14.80	16.93	1.50	1.77	7.22	0.81	17.74	1.476	140	16.86	19.00	1.50	1.77	7.22	0.81	19.81	1.476	1.476	2.066	1.00	0.81
17	24	5.12	15.30	17.24	1.94	3.11	1.64	0.04	17.28	0.167	261	16.31	17.75	1.44	2.43	2.11	0.07	17.82	0.250	0.208	0.544	1.00	0.07

09-24 SD Inf Study - Alt #3 | Number of lines: 17 | Run Date: 12-13-2011

Notes: ; ** Critical depth.; j-Line contains hyd. jump.

Attachment 3

Open Channel Hydraulics Computations
Lernhart Open Channel (Existing & Proposed) Worksheets
Caltrans Open Channel (Existing & Proposed) HEC-RAS Output

Minahen Project - Lernhart Open Channel

Open Channel Hydraulics Computations

Trapezoidal Cross Section

INPUT:		
Bottom Width (b):		**7.05** Feet
Side Slope (z):	Averaged 'z'	**1.067** :1 (Horizontal:Vertical)
Manning's Coefficient (n)*:		**0.033** Channel: (See Note: 1)
Energy Line Slope (S):		**0.0022** feet per foot
Depth of Flow (y):		**3.00** Feet
OUTPUT:		
Geometric Properties*:		
Cross Sectional Area (A) = (b+z*y)*y		30.75 Square Feet
Wetted Perimeter (P) = $b+2*y*(1+z^2)^{1/2}$		15.82 Feet
Hydraulic Radius (R) = $(b+z*y)*y / (b+2*y*(1+z^2)^{1/2})$		1.94 Feet
Top Width (T) = b+2*z*y		13.45 Feet
Hydraulic Depth (D) = (b+z*y)*y / (b+2*z*y)		2.29 Feet
Section Factor (Z) = $[(b+z*y)*y]^{3/2} / (b+2*z*y)^{1/2}$		46.50 $Feet^{2.5}$
Results:		
Flow Rate (Q) = $(1.49 / n) * R^{2/3} * S^{1/2} * A$		101.43 Cubic Feet per Second
Velocity (V) = Q / A		3.30 Feet per Second

Notes:

1. Excavated or Dredged, with short grass, few weeds.*

References:

*Chow, Ven Te. Open Channel Hydraulics. 1959. McGraw-Hill Book Company, New York
(pages 110 thru 113 Table 5-6 Values of Roughness Coefficient n)
(page 21 Table 2-1 Geometric Elements of Channel Sections)

Assume S is equal to the average channel slope.

Minahen Project - Lernhart Open Channel

Open Channel Hydraulics Computations

Natural Drainage Trapezoidal Cross Section Downstream of Box Culvert

INPUT:		
Bottom Width (b):	**5**	Feet
Side Slope (z):	**3**	:1 (Horizontal:Vertical)
Manning's Coefficient (n)*:	**0.04**	Natural Stream: (See Note: 1)
Energy Line Slope (S):	**0.020**	feet per foot
Depth of Flow (y):	**2.25**	Feet
OUTPUT:		
Geometric Properties*:		
Cross Sectional Area (A) = (b+z*y)*y	26.44	Square Feet
Wetted Perimeter (P) = $b+2*y*(1+z^2)^{1/2}$	19.23	Feet
Hydraulic Radius (R) = $(b+z*y)*y / (b+2*y*(1+z^2)^{1/2})$	1.37	Feet
Top Width (T) = b+2*z*y	18.50	Feet
Hydraulic Depth (D) = (b+z*y)*y / (b+2*z*y)	1.43	Feet
Section Factor (Z) = $[(b+z*y)*y]^{3/2} / (b+2*z*y)^{1/2}$	31.60	$Feet^{2.5}$
Results:		
Flow Rate (Q) = $(1.49 / n) * R^{2/3} * S^{1/2} * A$	172.19	Cubic Feet per Second
Velocity (V) = Q / A	6.51	Feet per Second

Notes:

1. Natural stream course, weedy reaches with timber and underbrush.*

References:

*Chow, Ven Te. Open Channel Hydraulics. 1959. McGraw-Hill Book Company, New York
(pages 110 thru 113 Table 5-6 Values of Roughness Coefficient n)
(page 21 Table 2-1 Geometric Elements of Channel Sections)

Assume S is equal to the average channel slope.

Minahen Project - Caltrans Open Channel

Open Channel Hydraulics Computations (Existing Conditions)

Trapezoidal Cross Section

INPUT:			
Bottom Width (b):		**8.6**	Feet
Side Slope (z):	Averaged 'z'	**1.872**	:1 (Horizontal:Vertical)
Manning's Coefficient (n)*:		**0.05**	Channel: (See Note: 1)
Energy Line Slope (S):		**0.0027**	feet per foot
Depth of Flow (y):		**2.75**	Feet
OUTPUT:			
Geometric Properties*:			
Cross Sectional Area (A) = (b+z*y)*y		37.81	Square Feet
Wetted Perimeter (P) = $b+2*y*(1+z^2)^{1/2}$		20.27	Feet
Hydraulic Radius (R) = $(b+z*y)*y / (b+2*y*(1+z^2)^{1/2})$		1.86	Feet
Top Width (T) = b+2*z*y		18.90	Feet
Hydraulic Depth (D) = (b+z*y)*y / (b+2*z*y)		2.00	Feet
Section Factor (Z) = $[(b+z*y)*y]^{3/2} / (b+2*z*y)^{1/2}$		53.48	$Feet^{2.5}$
Results:			
Flow Rate (Q) = $(1.49 / n) * R^{2/3} * S^{1/2} * A$		88.70	Cubic Feet per Second
Velocity (V) = Q / A		2.35	Feet per Second

Notes:

1. Excavated or Dredged; Channels not maintained, weeds and brush uncut, dense weeds, high as flow depth.*

References:

*Chow, Ven Te. Open Channel Hydraulics. 1959. McGraw-Hill Book Company, New York
(pages 110 thru 113 Table 5-6 Values of Roughness Coefficient n)
(page 21 Table 2-1 Geometric Elements of Channel Sections)

Assume S is equal to the average channel slope.

Minahen Project - Caltrans Open Channel

Open Channel Hydraulics Computations (Proposed Conditions)

Trapezoidal Cross Section

INPUT:			
Bottom Width (b):		**4**	Feet
Side Slope (z):	Averaged 'z'	**1.872**	:1 (Horizontal:Vertical)
Manning's Coefficient (n)*:		**0.033**	Channel: (See Note: 1)
Energy Line Slope (S):		**0.0027**	feet per foot
Depth of Flow (y):		**4.18**	Feet
OUTPUT:			
Geometric Properties*:			
Cross Sectional Area (A) = (b+z*y)*y		49.43	Square Feet
Wetted Perimeter (P) = $b+2*y*(1+z^2)^{1/2}$		21.74	Feet
Hydraulic Radius (R) = $(b+z*y)*y / (b+2*y*(1+z^2)^{1/2})$		2.27	Feet
Top Width (T) = b+2*z*y		19.65	Feet
Hydraulic Depth (D) = (b+z*y)*y / (b+2*z*y)		2.52	Feet
Section Factor (Z) = $[(b+z*y)*y]^{3/2} / (b+2*z*y)^{1/2}$		78.39	$Feet^{2.5}$
Results:			
Flow Rate (Q) = $(1.49 / n) * R^{2/3} * S^{1/2} * A$		200.49	Cubic Feet per Second
Velocity (V) = Q / A		4.06	Feet per Second

Notes:

1. Excavated or Dredged; with short grass, few weeds.*

References:

*Chow, Ven Te. Open Channel Hydraulics. 1959. McGraw-Hill Book Company, New York
(pages 110 thru 113 Table 5-6 Values of Roughness Coefficient n)
(page 21 Table 2-1 Geometric Elements of Channel Sections)

Assume S is equal to the average channel slope.