RETURN WITHIN 2 WEEKS TO:
CITY OF COLORADO SPRINGS
STORM WATER & SUBDIVISION
101 W. COSTILLA, SUITE 113
COLORADO SPRINGS, CO 80903
(719) 385-5979

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NEVADA/TEJON INTERCHANGE
CDOT PROJECT NO. IM0252-309

FINAL HYDRAULICS REPORT

Submitted by:

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November 5, 1999
JF9790

NEVADA/TEJON INTERCHANGE
CDOT PROJECT NO. M0252-309

FINAL HYDRAULICS REPORT

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CDOT PROJECT NO. IM0252-309
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I. INTRODUCTION

The Colorado Department of Transportation - Region 2 contracted with the firm of Felsburg Holt &Ullevig (FHU) for the provision of engineering services for the Nevada/Tejon Interchange Improvement project. The firm of J. F. Sato and Associates (JFSA) signed a sub-consultant agreement with FHU to provide services in the area of hydrology / hydraulic engineering required for this project.

The existing Nevada/Tejon Interchange complex and the proposed improvements are located in the City of Colorado Springs, El Paso County along I-25 in the immediate vicinity of the Fountain Creek / Cheyenne Creek confluence . The project area is partially in Township 14 South, Range 66 West, and partially in T15S, R66W. **Figure 1, Vicinity Map** shows the project area. Fountain Creek flows in a south-easterly direction parallel to I-25 in the project area. Cheyenne Creek flows north along Nevada Avenue. An elevated structure carries I-25 over Cheyenne Creek and Nevada Avenue. Cheyenne Creek joins Fountain Creeks just downstream of I-25.

The proposed improvements to the existing Nevada/Tejon Interchange consist of providing acceleration/deceleration lanes for ramps; providing increased capacity for Nevada Avenue, Tejon Street, and Arvada Street; and other minor modifications to local streets. The project also includes widening of I-25 from four to six lanes within the project limits, and new bridge structures over Nevada Avenue - Cheyenne Creek and Tejon Street. The ultimate widening of I-25 will include eight lanes with two HOV lanes added. The horizontal alignment of I-25 will be slightly moved to the north. The profile of I-25 will be slightly raised near the Nevada/Tejon crossings. The project limits include approximately 1.5 miles of I-25.

A floodplain assessment report was prepared during the project development phase (Reference 1). This report summarizes the hydrologic and hydraulic investigations carried out during the project development phase and preliminary and final design phases. Floodplain / floodway and stream crossing issues are included in Chapter III, and stormwater drainage is discussed in Chapter IV.

II. HYDROLOGY

A. Fountain Creek

Hydrologic analyses for the Fountain Creek basin were carried out by the U. S. Army Corps of Engineers in 1976 for Flood Insurance Studies in El Paso County. The following peak discharge-frequency data for Fountain Creek in the project area were obtained from Reference 2.

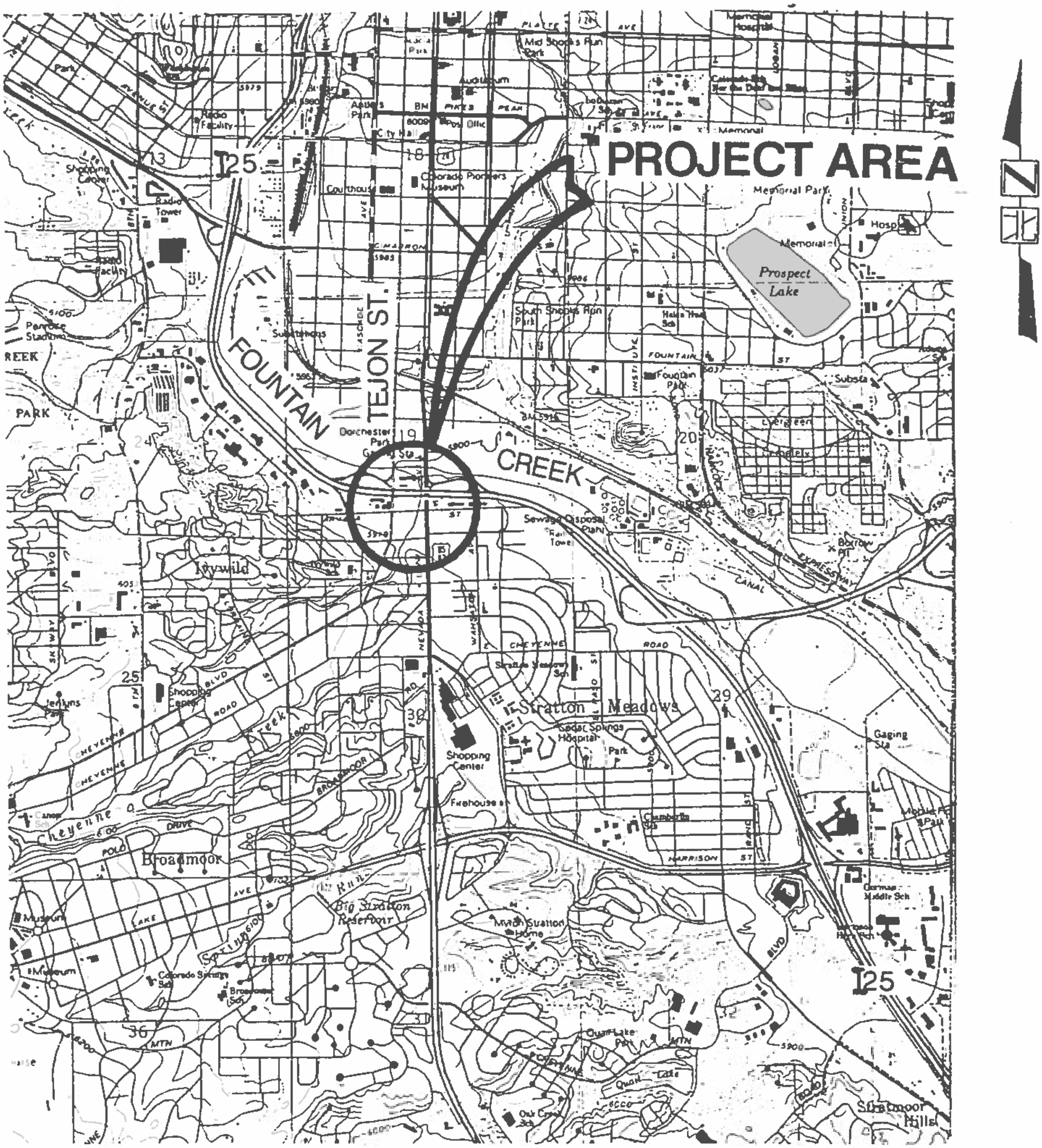


FIGURE 1

VICINITY MAP

Location	Drainage Area Km²/(Square Miles)	Peak Discharge, cms/(cfs)*			
		10-yr	50-yr	100-yr	500-yr
Downstream of confl. W/Monument Creek	927.2 (358.0)	261 (9,200)	807 (28,500)	1,195 (42,200)	2,275 (98,000)
Upstream of confl. W/Monument Creek	310.8 (120.0)	125 (4,400)	396 (14,000)	581 (20,500)	1,331 (47,000)

* cms: cubic meters per second
cfs: cubic feet per second

B. Cheyenne Creek

Peak discharges near the confluence with Fountain Creek obtained from Reference 2 are:

Return Period, years	Q, cms - (cfs)
10	159 - (5,600)
50	300 - (10,600)
100	377 - (13,300)
500	609 - (21,500)

Extrapolation in log-probability paper indicates that the 2-year peak discharge is approximately 43 cms (1,600 cfs) and the 5-year peak discharge is 113 cms (4,000 cfs). A copy of the peak flow - frequency curve is included in the appendix.

III. EXISTING STRUCTURES

A. Storm Drainage Facilities

The alignment of I-25 within the project area runs on the south side of and parallel to Fountain Creek. The topography of the areas south of I-25 slope down in a general north-easterly direction towards Fountain Creek. The roadway embankment of I-25 constitute a major storm drainage feature in the project area.

Storm surface runoff that drains towards Fountain Creek is intercepted and collected by I-25 roadway side channels. Cross drainage culverts under I-25 convey the collected storm runoff to Fountain Creek. There are four major cross drainage culverts west of the Nevada/Tejon interchange and one east. Surface runoff from the I-25 highway pavement and median areas are collected at inlets that discharge into the following cross drainage culverts.

I-25 Station	Size and Type
300 + 760	900 mm (36-in.) RCP
301 + 160	1,200 mm & 600 mm (48-in. & 24-in.) RCPs
301 + 470	900 mm & 2-600 mm (36-in.& 2-24-in.) RCPs
301 + 900	450 mm (18-in.) RCP
302 + 700	1,200 mm (48-in.) RCP

The area immediately south of I-25 and west of Tejon Street includes large paved areas and other light industrial and commercial land use areas. The total area is approximately 14.7 ha (36 ac), of which 7.9 ha (19.5 ac) drain towards the portion of Arvada Street included in the project. A small roadside ditch along Arvada Street intercepts and conveys some surface runoff directly to Cheyenne Creek. Currently, there is no storm sewer on Arvada Street. There is a small storm sewer system along Tejon Street that discharges into Fountain Creek. On Nevada Avenue there are three small drainage systems that include curb and gutter, curb-opening (Type R) inlets, and storm pipes that discharge directly into Cheyenne Creek.

B. Stream Crossing Structures.

The following structures are located in the vicinity of the project area:

Fountain Creek. Nevada Avenue and Tejon Street are carried over Fountain Creek by separate structures. These two bridge structures are outside the project limits.

Cheyenne Creek. The existing I-25 highway crosses Nevada Avenue and Cheyenne Creek on a single elevated structure. Cheyenne Creek runs under this structure in its open natural channel. Downstream of I-25 a single cell concrete box culvert (CBC) carries Cheyenne Creek towards its outfall in Fountain Creek. The inlet of this CBC is approximately 30.5 m (100 feet) downstream of I-25. It has a length of approximately 45.7 m (150 feet). The outlet is about 36.5 m (120 feet) from Fountain Creek.

IV. DESIGN DISCUSSION

A. Floodplains and Floodways

1. Existing Conditions

The assessment report titled "Nevada/Tejon Interchange, Fountain Creek and Cheyenne Creek Floodplain and Floodway Boundaries under Existing Conditions" (Reference 1) was prepared by JFSA in August 1998.

As indicated in Reference 1 the floodplain boundaries shown in the current Flood Insurance Rate Maps are not valid. Roadway projects such as the US 24 bypass project that includes a bridge across Fountain Creek were built after the FIRM panels were developed. The area in the vicinity of the Fountain Creek and Cheyenne Creek confluence do not correctly represent the floodplain limits in the area where I-25 is overtopped by the 100-year peak flow in Fountain Creek. The overbank areas south of I-25 are not effective flow areas. Peak flow in Cheyenne Creek for the 100-year event does not overtop I-25 with or without a median barrier. HEC-2 data file for Fountain Creek is not available in FEMA's archives managed by Michael Baker Engineering Co.

HEC-2 / HEC-RAS model of Fountain Creek was developed using current mapping provided by the City of Colorado Springs and topographic data developed by CDOT for this project. Correct floodplain and floodway boundaries for existing conditions were delineated on updated mapping. (Please see Reference 1.)

2. Proposed Conditions

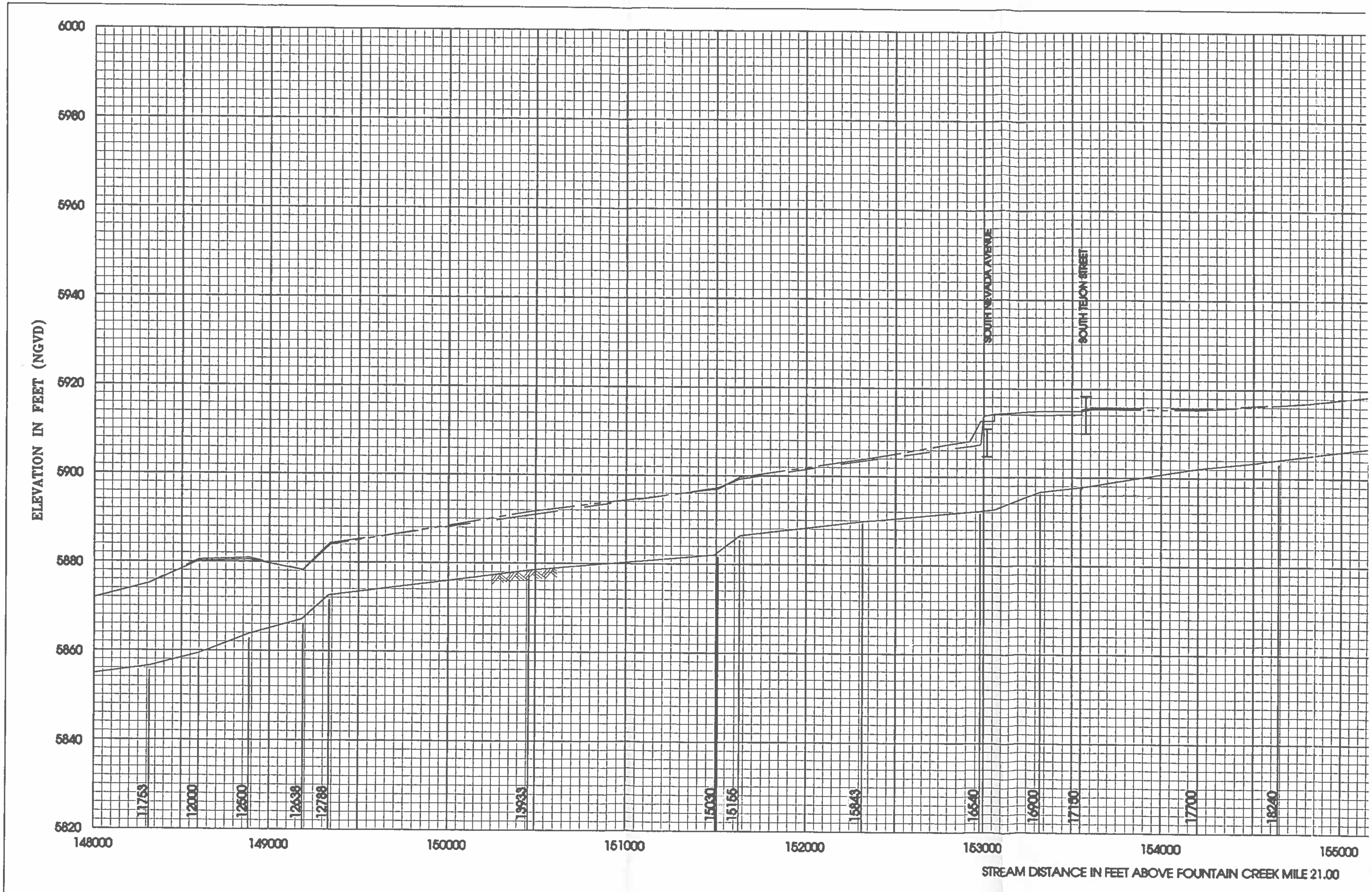
The new cross sections with future widening of I-25 and future retaining wall on the south side of Fountain Creek, new ramps, and other roadway improvements were coded into the HEC-RAS model. The adopted I-25, ramp and wall alignments on the south side of Fountain Creek do not cause any floodplain encroachment . As shown in **Figure 2**, the 100-year water surface profiles for the existing and proposed conditions are substantially the same.

The profiles and other project data were presented to the El Paso County floodplain administrator. After review of the submitted material the Floodplain Administrator of El Paso County concluded that the proposed project will not increase the base flood elevations (BFEs) and the project will comply with current floodplain regulations. He also indicated that the map revision process for updating the current FIRM will be conducted by the County in the near future.

A copy of the letter from the Floodplain Administrator is included in the Appendix. Please see Reference 1 for a detailed discussion of hydraulic modeling of Fountain Creek. **A composite of the current Flood Insurance Rate Maps along Fountain and Cheyenne Creeks in the project area included in Reference 1 is included in the back cover pocket of this report also. It shows the location of the cross sections used in HEC-RAS.**

B. Proposed Storm Drainage Plan

The proposed roadway improvements for the Nevada/Tejon Interchange will neither cause major changes to the predominant drainage patterns in the project area, nor significantly modify the existing drainage system.



ELEVATION IN FEET (NGVD)
6000
5980
5960
5940
5920
5900
5880
5860
5840
5820
SOUTH NEVADA AVENUE
SOUTH TEJON STREET
11753
12000
12500
12638
12788
13933
15030
15156
15843
16540
16900
17180
17700
18240
148000
149000
150000
151000
152000
153000
154000
155000
STREAM DISTANCE IN FEET ABOVE FOUNTAIN CREEK MILE 21.00

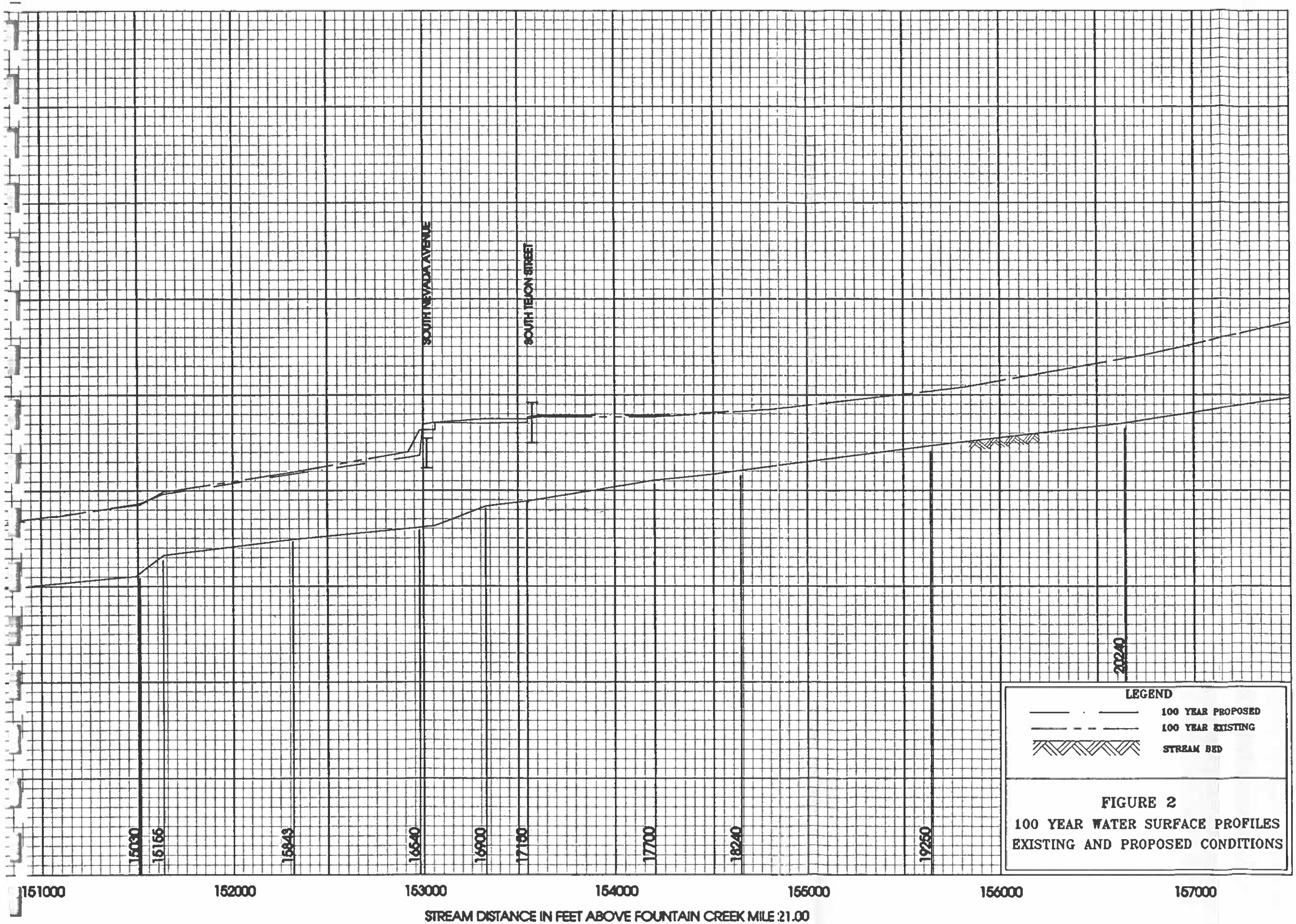


FIGURE 2
100 YEAR WATER SURFACE PROFILES
EXISTING AND PROPOSED CONDITIONS

FLOOD PROFILES

FOUNTAIN CREEK

JF SATO AND ASSOCIATES

EL PASO COUNTY, CO
AND INCORPORATED AREAS
CITY OF COLORADO SPRINGS

1. Methodology and Design Criteria

The design frequency and other design criteria were obtained from CDOT's Drainage Design Manual (Reference 3) and the City of Colorado Springs and El Paso County Drainage Criteria Manual (Reference 4). The Rational Method was used to estimate the peak rates of runoff at adopted design points. The more conservative criteria from the referenced manuals were selected for design of proposed drainage facilities. The following design frequencies were adopted.

Storm drains, major system: (all culverts across I-25)	100-year
Storm drains, minor system: (includes inlets)	10-year
Parallel Drainage: (side drains/roadside ditches, no overflow onto highway)	100-year

Peak flow rates for the 10-year and 100-year frequencies at designated design points were calculated using the Rational Method as prescribed by the City of Colorado Springs' Drainage Criteria Manual for drainage areas up to 100 acres (Reference 4). Rainfall intensity-frequency curves and runoff coefficients given in Reference 4 were used (Copies are included in the Appendix). Drainage basin boundaries, design points, and directions of flow were defined using FIMS mapping and 2-foot contour interval topographic maps provided by CDOT. The drainage basins are shown in **Exhibit 1** located in the back cover pocket of this report. Electronic data files or hard copy of FIMS topographic mapping used to delineate basin boundaries can be provided upon request.

2. Considered Storm Drainage Plan Alternatives

Two storm drainage plans for future developed conditions were considered. Future developed conditions include ultimate widening of I-25 to eight lanes with two HOV lanes added. Plan A with storm drain (sewer) systems and a detention pond on the south side of I-25, and plan B with storm drain systems only. All proposed storm drainage facilities were sized for the adopted design frequencies and were verified for the major storm event, namely the 100-year flood.

The detention pond of Plan A is located in Basin A10 to store runoff from basins A5, A6, A7, and A10 with releases to the existing 250 mm (18-in.) RCP that discharges in Fountain Creek (Please see Exhibit 1). The detention pond is located in CDOT's right of way near CDOT Region 2 office on Arvada Street.

Plan B includes storm drain systems on Nevada Avenue and Tejon Street with a single outfall to Cheyenne Creek.

The preliminary layout of plan A was discussed in the progress meeting of June 1999. Appraisal of Plan A was discontinued per CDOT's recommendation as CDOT land availability for a detention pond was not certain. Evaluation of Plan B continued to final design level. Estimates of 10-year and 100-year peak flow rates for proposed Plan B conditions are shown in **Table 1** and **Table 2**, respectively.

Considering that storm runoff for existing conditions is substantially unmodified, no peak flow rates for existing conditions were calculated. The I-25 roadway stations shown in these tables refer to the metric stationing adopted by CDOT for this project. The project limits along I-25 are located at approximately Sta. 300 + 700 and Sta.303 + 000 on the north and south limits, respectively. A set of preliminary design drawings have been submitted to CDOT under separate cover.

C. Stream Crossing Structures

The Fountain Creek bridge structures that carry Nevada Avenue and Tejon Street will remain unmodified. The following Cheyenne Creek crossings structures are included in the project.

Interchange Structures. Two new crossing structures on Cheyenne Creek are included in the improved interchange. Theses structures carry the proposed roadways that link Nevada Avenue and Tejon Street on the north and south side of I-25 (North Connector and South Connector Roads, see Exhibit 2, page 14).

Arvada Street. The existing bridge across Cheyenne Creek will be replaced.

As indicated in Reference 1, the HEC-2 data file for Cheyenne Creek was available in FEMA's archives and a copy was provided by Michael Baker. The base flood elevations and floodway data obtained from this model do match the Floodway Data Table for Cheyenne Creek in the FIS dated March 1997 (Reference 4). The HEC-2 model was converted to a HEC-RAS model to analyze the proposed crossing structures. The Cheyenne Creek flood profiles drawing of Reference 4 is included in this report as **Figure 3**.

Figure 3 shows that the 50-, 100-, and 500-year flood water surface profiles coincide from just upstream of I-25 to the Navajo Street bridge, a stream distance of approximately 460 m (1,500 feet). The water level at elevation 5915 ft under the I-25 crossing is the same for 50-, 100-, and 500-year floods but is approximately 3 feet lower for the 10-year event. This indicates that the water level on Fountain Creek backs up the water level on Cheyenne Creek for major floods but not for the 10-year or more frequent events.

TABLE 1
NEVADA AVENUE / TEJON STREET / I-25 INTERCHANGE
10-yr Peak Runoff Flow Rates - Proposed Conditions

Station at Design Point	Upstream Design Point	Local ributar Basin ID	BASIN DATA A M^2	C	CA M^2	Computation of Time of Concentration: Overland Flow Sx %	Lx M	Tx MIN	Channel Flow So %	Lo M	To MIN	Compute Tc MIN	Regiona Tc(2) MIN	Upstream Tc	USED Tc MIN	Storm Duration Min	Intensity I10 Inch/hour	Peak Q10 cfs	Peak Q10 cms	Proposed Drainage Facility
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
300+760		A2	25198.0	0.81	20410.4	3.00	100.0	6.58	3.00	230.0	4.84	11.42	16.01		11.42	11.42	4.38	22.10	0.63	Roadside Ditch/I-25 cross drainage Culvert
301+000		A1a	11200.0	0.90	10080.0	2.00	15.0	2.01	3.00	650.0	10.26	12.27	22.12		12.27	12.27	4.26	10.60	0.30	Drop Inlet on I-25
301+160		A3	45693.0	0.81	37011.3	3.00	100.0	6.58	3.00	400.0	8.42	15.00	19.11		15.00	15.00	3.90	35.63	1.01	Roadside Ditch
		A1b	345.0	0.90	310.5	2.00	23.0	2.49	3.00	400.0	6.31	8.80	17.71		8.80	8.80	4.84	0.37	0.01	I-25 Gutter/Inlet
	A3+A1b		46038.0	0.81	37321.8									15.00	15.00	15.00	3.90	35.93	1.02	I-25 cross drainage Culvert
301+465		A4	28680.0	0.81	23230.8	3.00	100.0	6.58	3.00	300.0	6.31	12.89	17.29		12.89	12.89	4.17	23.91	0.68	Roadside Ditch
		A13	6900.0	0.90	6210.0	2.00	23.0	2.49	3.00	300.0	4.73	7.22	15.89		7.22	7.22	5.17	7.93	0.22	I-25 Gutter/inlet
		A9	8352.0	0.90	7516.8	2.00	23.0	2.49	2.00	340.0	8.76	11.25	16.61		11.25	11.25	4.41	8.19	0.23	I-25 Gutter/inlet
	A4+A13+A9		43932.0	0.84	36957.6									12.89	12.89	12.89	4.17	38.04	1.08	I-25 cross drainage Culvert
301+650		A6	13882.0	0.85	11799.7	3.00	100.0	5.67	3.00	270.0	5.68	11.35	16.74		11.35	11.35	4.39	12.80	0.36	
		A5	35212.0	0.82	28873.8	3.00	100.0	6.35	1.00	220.0	8.02	14.37	15.83		14.37	14.37	3.97	28.34	0.80	
	A6+A5		49094.0	0.83	40673.5									14.37		14.37	3.97	39.92	1.13	Channel to Low Point
301+900		A10	19736.0	0.65	12828.4	3.00	100.0	10.21	3.00	250.0	5.26	15.47	16.38		15.47	15.47	3.84	12.18	0.35	
	A6+A5+A10		68830.0	0.78	53501.9									14.37	15.47	15.47	3.84	50.78	1.44	Inlet/Sewer
301+650		A7	40278.0	0.74	29805.7	3.00	100.0	8.17	1.00	270.0	7.38	15.55	16.74		15.55	15.55	3.83	28.22	0.80	Gutter/Inlet
		A11	38303.0	0.72	27578.2	3.00	100.0	8.62	3.00	240.0	3.79	12.41	16.20		12.41	12.41	4.24	28.85	0.82	Gutter/Inlet
	A7+A11		78581.0	0.73	57383.9									15.55	15.55	15.55	3.83	54.34	1.54	Inlet/Sewer
		T1	7190.0	0.89	6399.1	2.00	50.0	3.85	1.00	450.0	12.30	16.15	19.11		16.15	16.15	3.77	5.95	0.17	Inlet/Sewer
		T2	2962.0	0.89	2636.2	2.00	50.0	3.85	1.00	450.0	12.30	16.15	19.11		16.15	16.15	3.77	2.45	0.07	Inlet/Sewer
301+900	A7+11+T1+T2		88733.0	0.75	66419.2									16.15	16.15	16.15	3.77	61.78	1.75	Inlet/Sewer
	A7+11+T1+T2+5+6+10		157563.0	0.76	119921.1									16.15	16.15	16.15	3.77	111.55	3.16	Inlet/Sewer
301+900		A12	13387.0	0.72	9638.6	3.00	100.0	8.62	3.00	350.0	7.36	15.99	18.20		15.99	15.99	3.78	9.01	0.26	I-25 Gutter/Inlet
	A7+11+T1+T2+5+6+10+12		170950.0	0.76	129559.7										16.15	16.15	3.77	120.52	3.42	I-25 Gutter/Inlet
		A8	5882.0	0.84	4940.9	3.00	40.0	3.73	3.00	100.0	2.10	5.83	12.55		5.83	5.83	5.51	6.73	0.19	Inlet
	A7+11+T1+T2+5+6+10+12+8		176832.0	0.76	134500.6									16.15	16.15	16.15	3.77	125.11	3.55	Sewer System (Tejon to Fountain Ck)
302+090		A22	12957.0	0.73	9458.6	3.00	100.0	8.39	2.00	130.0	3.35	11.74	14.19		11.74	11.74	4.33	10.12	0.29	Ditch/Inlet to Cheyenne CK
		A21	8421.0	0.76	6400.0	3.00	70.0	6.45	1.00	130.0	3.55	10.01	13.64		10.01	10.01	4.62	7.30	0.21	Ditch/Inlet to Cheyenne CK
		A20	11250.0	0.71	7987.5	2.00	100.0	10.11	1.00	130.0	4.74	14.85	14.19		14.19	14.19	4.00	7.88	0.22	Gutter/Inlet to Cheyenne CK
302+200		A27	9316.0	0.78	7266.5	2.00	50.0	5.87	1.00	190.0	6.92	12.79	14.37		12.79	12.79	4.18	7.50	0.21	Drop Inlet
302+100		A24	5310.0	0.89	4725.9	2.00	40.0	3.44	1.00	500.0	18.22	21.67	19.84		19.84	19.84	3.41	3.98	0.11	Gutter/Inlet (Nevada to Cheyenne CK)
	A27+A24		14626.0	0.78	11992.4										19.84	19.84	3.41	10.09	0.29	
302+100		A23	4780.0	0.89	4254.2	2.00	40.0	3.44	1.00	500.0	18.22	21.67	19.84		19.84	19.84	3.41	3.58	0.10	Gutter/Inlet (Nevada to Cheyenne CK)
	A24+27+23		19406.0	0.84	16246.6									0.00	0.00	0.00	0.00	0.00	0.00	Gutter/Inlet (Nevada to Cheyenne CK)
302+200		A29	12592.0	0.78	9821.8	5.00	100.0	6.13	3.00	220.0	4.63	10.76	15.83		10.76	10.76	4.49	10.89	0.31	Inlet/Culvert (RampD to Fountain CK)
302+700		A28	4207.0	0.78	3281.5	2.00	20.0	3.71	5.00	140.0	1.71	5.42	12.92		5.42	5.42	5.63	4.56	0.13	Inlet/Ditch/Culvert
		A26	28631.0	0.20	5726.2	2.00	50.0	16.50	5.00	510.0	6.23	22.74	20.20		20.20	20.20	3.38	4.77	0.14	Ditch
		A25	26739.0	0.76	20321.6	3.00	100.0	7.71	3.00	510.0	10.73	18.44	21.12		18.44	18.44	3.53	17.73	0.50	Gutter
	A28+A26+A25		59577.0	0.49	29329.3									20.20	20.20	20.20	3.38	24.45	0.69	Inlet/Ditch
		A30	23020.0	0.90	20718.0	5.00	40.0	2.42	5.00	510.0	8.31	10.74	20.02		10.74	10.74	4.49	22.99	0.65	Drop Inlet on I-25
	A28+26+25+30		82597.0	0.61	50047.3									20.20	20.20	20.20	3.38	41.73	1.18	Drop Inlet/Culvert to Fountain CK
303+000		A31	29469.0	0.85	25048.7	2.00	50.0	4.58	3.00	300.0	6.31	10.90	16.38		10.90	10.90	4.47	27.63	0.78	Drop Inlet/Culvert to Fountain CK

TABLE 1

TABLE 2
NEVADA AVENUE / TEJON STREET / I-25 INTERCHANGE
100-yr Peak Runoff Flow Rates - Proposed Conditions

Station at Design Point	Incoming Design Point	Local Tributary Basin ID	BASIN DATA A M^2	C	CA M^2	Computation of Time of Concentration: Overland Flow Sx %	Lx M	Tx MIN	Channel Flow So %	Lo M	To MIN	Computed Tc MIN	Regional Tc(2) MIN	Upstream Tc	USED Tc MIN	Storm Duration Min	Intensity I100 Inch/hour	Peak Q100 cfs	Peak Q100 cms	Proposed Drainage Facility
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
300+760		A2	25198.0	0.85	21418.3	3.00	100.0	5.67	3.00	230.0	4.84	10.51	16.01		10.51	10.51	6.85	36.21	1.03	Roadside Ditch/I-25 cross drainage Culvert
301+000		A1a	11200.0	0.93	10416.0	2.00	15.0	1.71	3.00	650.0	10.26	11.97	22.12		11.97	11.97	6.50	16.72	0.47	Drop Inlet on I-25
301+160		A3	45693.0	0.85	38839.1	3.00	100.0	5.67	3.00	400.0	8.42	14.09	19.11		14.09	14.09	6.06	58.11	1.65	Roadside Ditch
		A1b	345.0	0.93	320.9	2.00	23.0	2.11	3.00	400.0	6.31	8.43	17.71		8.43	8.43	7.43	0.59	0.02	I-25 Gutter/Inlet
	A3+A1b		46038.0	0.85	39159.9									14.09	14.09	14.09	6.06	58.59	1.66	I-25 cross drainage Culvert
301+465		A4	28680.0	0.85	24378.0	3.00	100.0	5.67	3.00	300.0	6.31	11.98	17.29		11.98	11.98	6.49	39.10	1.11	Roadside Ditch
		A13	6900.0	0.93	6417.0	2.00	23.0	2.11	3.00	300.0	4.73	6.85	15.89		6.85	6.85	7.95	12.60	0.36	I-25 Gutter/Inlet
		A9	8352.0	0.93	7767.4	2.00	23.0	2.11	2.00	340.0	8.76	10.88	16.61		10.88	10.88	6.75	12.96	0.37	I-25 Gutter/Inlet
	A4+A13+A9		43932.0	0.88	38562.4									11.98	11.98	11.98	6.49	61.85	1.75	I-25 cross drainage Culvert
301+650		A6	13882.0	0.89	12355.0	3.00	100.0	4.76	3.00	270.0	5.68	10.45	16.74		10.45	10.45	6.86	20.94	0.59	
		A5	35212.0	0.87	30634.4	3.00	100.0	5.22	1.00	220.0	8.02	13.24	15.83		13.24	13.24	6.23	47.11	1.33	
	A6+A5		49094.0	0.88	42989.4									13.24		13.24	6.23	66.11	1.87	Channel to Low Point
301+900		A10	19736.0	0.88	17367.7	3.00	100.0	4.99	3.00	250.0	5.26	10.25	16.38		10.25	10.25	6.91	29.65	0.84	
	A6+A5+A10		68830.0	0.88	60357.1									13.24	10.25	10.25	6.91	103.04	2.92	Inlet/Sewer
301+650		A7	40278.0	0.80	32222.4	3.00	100.0	6.81	1.00	270.0	7.38	14.19	16.74		14.19	14.19	4.00	31.81	0.90	Gutter/Inlet
		A11	38303.0	0.79	30259.4	3.00	100.0	7.03	3.00	240.0	3.79	10.82	16.20		10.82	10.82	4.48	33.47	0.95	Gutter/Inlet
	A7+A11		78581.0	0.80	62481.8									14.19	14.19	14.19	4.00	61.68	1.75	Inlet/Sewer
		T1	7190.0	0.93	6686.7	2.00	50.0	3.12	1.00	450.0	12.30	15.42	19.11		15.42	15.42	3.85	6.36	0.18	Inlet/Sewer
		T2	2962.0	0.93	2754.7	2.00	50.0	3.12	1.00	450.0	12.30	15.42	19.11		15.42	15.42	3.85	2.62	0.07	Inlet/Sewer
301+900	A7+11+T1+T2		88733.0	0.81	71923.1									15.42	15.42	15.42	3.85	68.37	1.94	Inlet/Sewer
	A7+11+T1+T2+5+6+10		157563.0	0.84	132280.2									15.42	15.42	15.42	3.85	125.74	3.56	Inlet/Sewer
301+900		A12	13387.0	0.79	10575.7	3.00	100.0	7.03	3.00	350.0	7.36	14.40	18.20		14.40	14.40	3.97	10.37	0.29	I-25 Gutter/Inlet
	A7+11+T1+T2+5+6+10+12		170950.0	0.84	142856.0										15.42	15.42	3.85	135.79	3.85	I-25 Gutter/Inlet
		A8	5882.0	0.88	5176.2	3.00	40.0	3.16	3.00	100.0	2.10	5.26	12.55		5.26	5.26	5.67	7.25	0.21	Inlet
	A7+11+T1+T2+5+6+10+12+8		176832.0	0.84	148032.1									15.42	15.42	15.42	3.85	140.71	3.99	Sewer System (Tejon to Fountain Ck)
302+090		A22	12957.0	0.80	10365.6	3.00	100.0	6.81	2.00	130.0	3.35	10.16	14.19		10.16	10.16	6.94	17.76	0.50	Ditch/Inlet to Cheyenne CK
		A21	8421.0	0.82	6905.2	3.00	70.0	5.31	1.00	130.0	3.55	8.87	13.64		8.87	8.87	7.29	12.44	0.35	Ditch/Inlet to Cheyenne CK
		A20	11250.0	0.78	8775.0	2.00	100.0	8.30	1.00	130.0	4.74	13.04	14.19		13.04	13.04	6.27	13.58	0.38	Gutter/Inlet to Cheyenne CK
302+200		A27	9316.0	0.84	7825.4	2.00	50.0	4.77	1.00	190.0	6.92	11.69	14.37		11.69	11.69	4.34	8.39	0.24	Drop Inlet
302+100		A24	5310.0	0.92	4885.2	2.00	40.0	2.95	1.00	500.0	18.22	21.17	19.84		19.84	19.84	3.41	4.11	0.12	Gutter/Inlet (Nevada to Cheyenne CK)
	A27+A24		14626.0	0.87	12710.6										19.84	19.84	3.41	10.70	0.30	
302+100		A23	4780.0	0.92	4397.6	2.00	40.0	2.95	1.00	500.0	18.22	21.17	19.84		19.84	19.84	3.41	3.70	0.10	Gutter/Inlet (Nevada to Cheyenne CK)
	A24+27+23		19406.0	0.88	17108.2									19.84	19.84	19.84	3.41	14.40	0.41	Gutter/Inlet (Nevada to Cheyenne CK)
302+200		A29	12592.0	0.83	10451.4	5.00	100.0	5.18	3.00	220.0	4.63	9.80	15.83		9.80	9.80	4.65	12.01	0.34	Inlet/Culvert (RampD to Fountain CK)
302+700		A28	4207.0	0.83	3491.8	2.00	20.0	3.13	5.00	140.0	1.71	4.84	12.92		4.84	5.00	5.75	4.96	0.14	Inlet/Ditch/Culvert
		A26	28631.0	0.76	21759.6	2.00	50.0	6.23	5.00	510.0	6.23	12.47	20.20		12.47	12.47	4.23	22.72	0.64	Ditch
		A25	26739.0	0.76	20321.6	3.00	100.0	7.71	3.00	510.0	10.73	18.44	21.12		18.44	18.44	3.53	17.73	0.50	Gutter
	A28+A26+A25		59577.0	0.76	45573.0									18.44	18.44	18.44	3.53	39.77	1.13	Inlet/Ditch
		A30	23020.0	0.93	21408.6	5.00	40.0	2.06	5.00	510.0	8.31	10.37	20.02		10.37	10.37	4.55	24.08	0.68	Drop Inlet on I-25
	A28+26+25+30		82597.0	0.81	66981.6									18.44	18.44	18.44	3.53	58.45	1.66	Drop Inlet/Culvert to Fountain CK
303+000		A31	29469.0	0.88	25932.7	2.00	50.0	4.03	3.00	300.0	6.31	10.35	16.38		10.35	10.35	4.56	29.19	0.83	Drop Inlet/Culvert to Fountain CK

TABLE 2

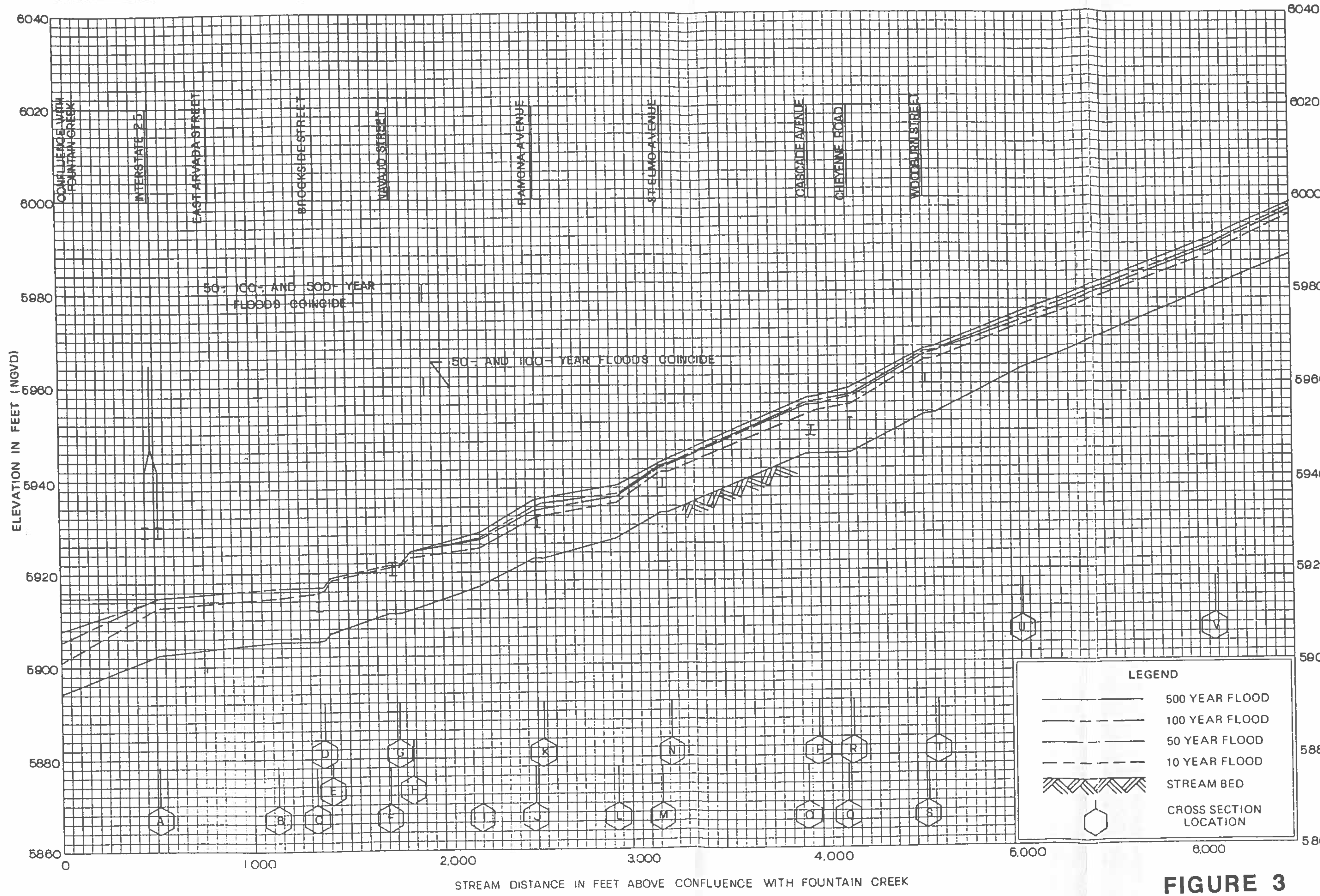


FIGURE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

EL PASO COUNTY, CO
AND INCORPORATED AREAS

FLOOD PROFILES

CHEYENNE CREEK

18P

The design frequency for the Cheyenne Creek crossing structures near the confluence with Fountain Creek was selected to avoid overtopping by events more frequent than the 10-year flood. By trial-and-error runs of HEC-RAS it was determined that the 2-year flood with a peak discharge of 45 cms (1,600 cfs) is the adequate design flood for the Cheyenne Creek crossing structures on the north and south connector roads, and replacement of the Arvada Street bridge.

Adequate alternative structures that will not be overtopped by the 2-year event are triple 4.6 m x 1.8 m (span x rise) (15' x 6') concrete box culvert, double 4.6 m x 2.1 m (15' x 7') RCP, or 12.2 m (40') single span bridge. HEC-RAS output plots of profile and cross sections and tables are included in the Appendix.

V. RECOMMENDED DESIGN

A. I-25 Cross Drainage Culverts - The existing cross drainage culverts under I-25 will be extended to accommodate the proposed interchange improvements.

Location (Sta)	Existing RCP Culvert	Q10 cms (cfs)	Q100 cms (cfs)	Remarks
300 + 760	900 mm (36-in.)	0.63 (22.1)	1.03 (36.2)	I-25 not widened at this location. Existing culvert with adequate capacity.
301 + 160	1200 mm & 600 mm (48-in. & 24-in)	1.02 (35.9)	1.66 (58.6)	Extend existing culvert. Adequate capacity.
301 + 470	900 mm & 2-600 mm (36-in & 2-24-in)	1.08 (38.0)	1.75 (61.9)	Extend existing 900 mm. RCP. Replace 2-600 mm with 900 mm RCP.
301 + 900	450 mm (18-in.)	N/A	N/A	Existing storm runoff drainage pipe that starts in parking lot of CDOT's office on Arvada Street, runs under I-25 and discharges in Fountain Creek. To be abandoned and replaced by Tejon/Arvada storm drainage system.
302 + 700	1200 mm (48-in)	1.18 (41.7)	1.66 (58.5)	Extend existing culvert. Adequate capacity.

The capacity of the existing cross drainage culverts were verified using CDOT criteria. Hydraulic calculations spread sheets are included in the Appendix.

I-25 Pavement Drainage

Drop (grate) inlets were selected to intercept drainage of I-25 pavement surfaces. The inlets were sized and placed for the design 10-year event and water spread verified for the 100-year event. Inlets were placed approximately every 100 m (300 ft.) and connected to 450 mm (18-in.) discharge pipes.

B. Tejon / Arvada Storm Drain System.

Storm runoff from areas south of I-25/west of Tejon Street and from portions of Tejon Street, South Connector Road, and Arvada Street will be collected and discharged into an underground storm sewer system that will outfall into Cheyenne Creek. The runoff peak flow rates for this system are shown in Tables 1 and 2. The main features of this system are:

Storm Sewer Line	Required Diameter, mm - (inch)	Approx. Length, m - (ft)	Remarks
Tejon St.	450 - (18) 1200 - (48) 1200 - (48) 1350 - (54)	26.8 - (88) 25.3 - (83) 35.0 - (115) 16.9 - (55) 96.3 - (316)	Approximate lengths between inlet and manhole, between MHs, and between MH and outlet
Arvada St.	900 - (36) 1050 - (42)	241.5- (792) 18.8 - (62) 240.3 - (789)	Total distance between MHs
Ramp A- S. Connector Rd.	525 - (21)* 1350 - (54)	41.2 - (135) 154.0 - (505) 195.2 - (640)	Distance from inlet to MH Outfall to Cheyenne Creek - distance between MHs

* Required size can be changed to 600 - (24) size if adequate cover is available

A grass-lined roadside channel with very flat slope from approximately Sta. 301 + 700 to Tejon Street will provide some water quality improvement to the runoff flows originating on the area just south of I-25.

C. Nevada Avenue Storm Drain System

Runoff from an area south of I-25/East of Nevada Avenue and from portions of Nevada Avenue and S. Connector road will be conveyed to Cheyenne Creek by a storm sewer system. The main features of this small system are:

Storm Sewer Line	Required Diameter mm - (inch)	Approx. Length m - (ft)	Remarks
Nevada Ave.	450 - (18)	80.9 - (265)	Line includes pipe along Nevada Ave. and lateral lines from Type R inlets near Arvada St.
Ramp C - Outfall to Cheyenne Creek	530 - (21)* 675 - (27)	74.2 - (343) 24.8 - (80) 99.0 - (423)	Total distance between Ramp C inlet and MH3. Distance between inlet in Nevada Ave. and outlet.

* Required size can be changed to 600 - (24) size if adequate cover is available

A general layout of these storm drainage systems is shown in **Exhibit 2.**

Hydraulic calculations for the proposed storm drain systems were done using the program UDSEWER. The design peak discharges were obtained from Table 1, 10-year Peak Runoff Flow Rates. A schematic layout of the proposed storm drain systems shown in Exhibit 2, and a table showing the design peak flows are included in the Appendix. Sizing of curb opening in a sump condition for Type R inlets was done using the chart and graph included in the Appendix.

D. Cheyenne Creek Crossing Structures

After the FIR presentation and discussion with CDOT project staff, it was decided to use the bridge alternative for all the structures on Cheyenne Creek. The three structures are single span bridges:

	Length of Single Span
North Connector Road	12.2 m (40 ft)
South Connector Road	12.2 m (40 ft)
Arvada Street	11.5 m (37.7 ft)

These structures can accommodate the 2-year flood with no overtopping.

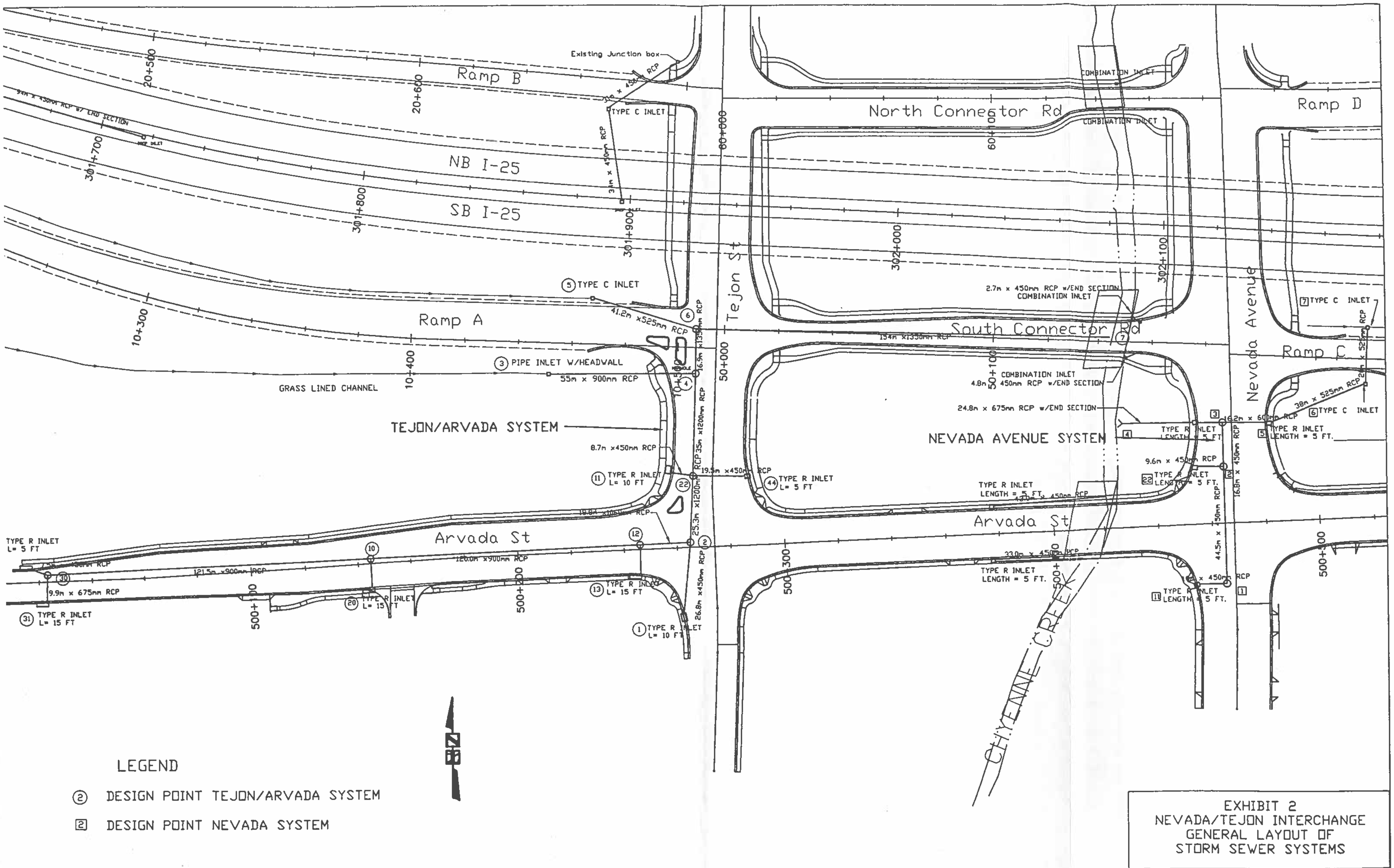


EXHIBIT 2
NEVADA/TEJON INTERCHANGE
GENERAL LAYOUT OF
STORM SEWER SYSTEMS

Estimates of potential contraction scour at these three bridges were estimated using flow distribution and hydraulic parameters calculated with HEC-RAS:

	Total Potential Scour, ft		
Frequency	N. Connector	South Connector	Arvada
2-year	0.0	0.0	2.5
100-year	4.0	7.4	6.6
500-year	5.5	9.8	7.5

No local nor degradation scour is anticipated. Similar depths of potential scour at the north and south connector roadway culverts can be used for design of these structures.

The recommended highway improvements will not cause an increase in the 100-year water surface elevation on either Fountain Creek or Cheyenne Creek. The proposed project is in compliance with current floodplain development regulations in El Paso County.

The proposed widening of I-25 from four lanes to eight lanes will result in some increase of peak runoff flows in the existing cross drainage culverts. The existing culverts have capacity to safely pass the design peak flows. Some modifications to the existing cross drainage system will be required.

The storm drainage systems for Tejon/Arvada streets and Nevada Avenue include storm drains to convey the runoff flows to Cheyenne Creek. Roadway drainage facilities have been provided on all proposed ramps and connector roadways.

VI. REFERENCES

1. J. F. Sato and Associates, Nevada/Tejon Interchange -Assessment Report- Fountain Creek and Cheyenne Creek Floodplain Boundaries under Existing Conditions, August 1998

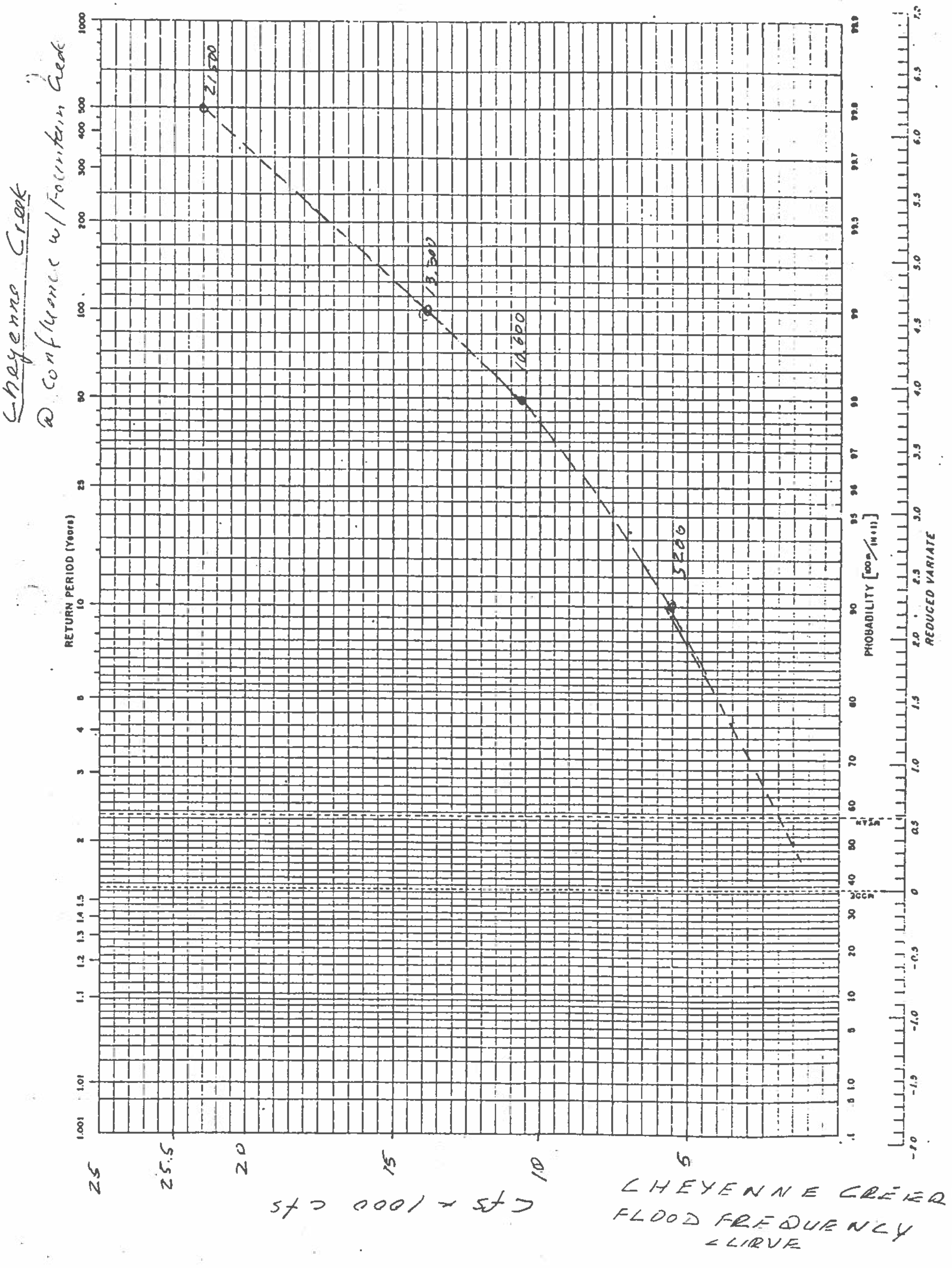
2. Federal Emergency Management Agency - Flood Insurance Study, El Paso County, Colorado and Incorporated Areas, March 17 1997

3. Colorado Department of Transportation - Drainage Design Manual, July 1995.

4. City of Colorado Springs and El Paso County - Drainage Criteria Manual, July 1996.

APPENDIX

- Cheyenne Creek Flood Frequency Curve
- Copy of Regional Floodplain Administrator's Letter
- Rainfall-Intensity-Frequency Curves - El Paso County, and Recommended Average Runoff Coefficients
- HEC-RAS Output and Scour Calculations, Cheyenne Creek
- Culvert Capacity Calculations
- Storm Sewer Profile Calculations, Inlet Sizing Chart



Cheyenne Creek
@ Confluence w/ Fountain Creek
21,500
13,300
10,600
5200
RETURN PERIOD (Years)
PROBABILITY
REDUCED VARIATE
25
25.5
20
15
10
5
cfs x 1000 cfs
CHEYENNE CREEK
FLOOD FREQUENCY
CURVE

PIKES PEAK REGIONAL BUILDING DEPARTMENT
101 WEST COSTILLA
COLORADO SPRINGS COLORADO 80903-3879

February 22, 1999

James Flohr, P.E.
Colorado Department of Transportation
16 East Arvada Street
Colorado Springs, CO 80906

Re: Nevada Avenue/Tejon Street Interchange

Dear James Flohr:

I have reviewed the hydraulic analysis for this project, as prepared by J.F. Sato. That analysis indicated that the proposed improvements would not cause an increase in the 100 year water surface elevation, therefore the project would comply with the current floodplain development requirements. Based on this information, a floodplain development permit could be issued for construction of the proposed interchange.

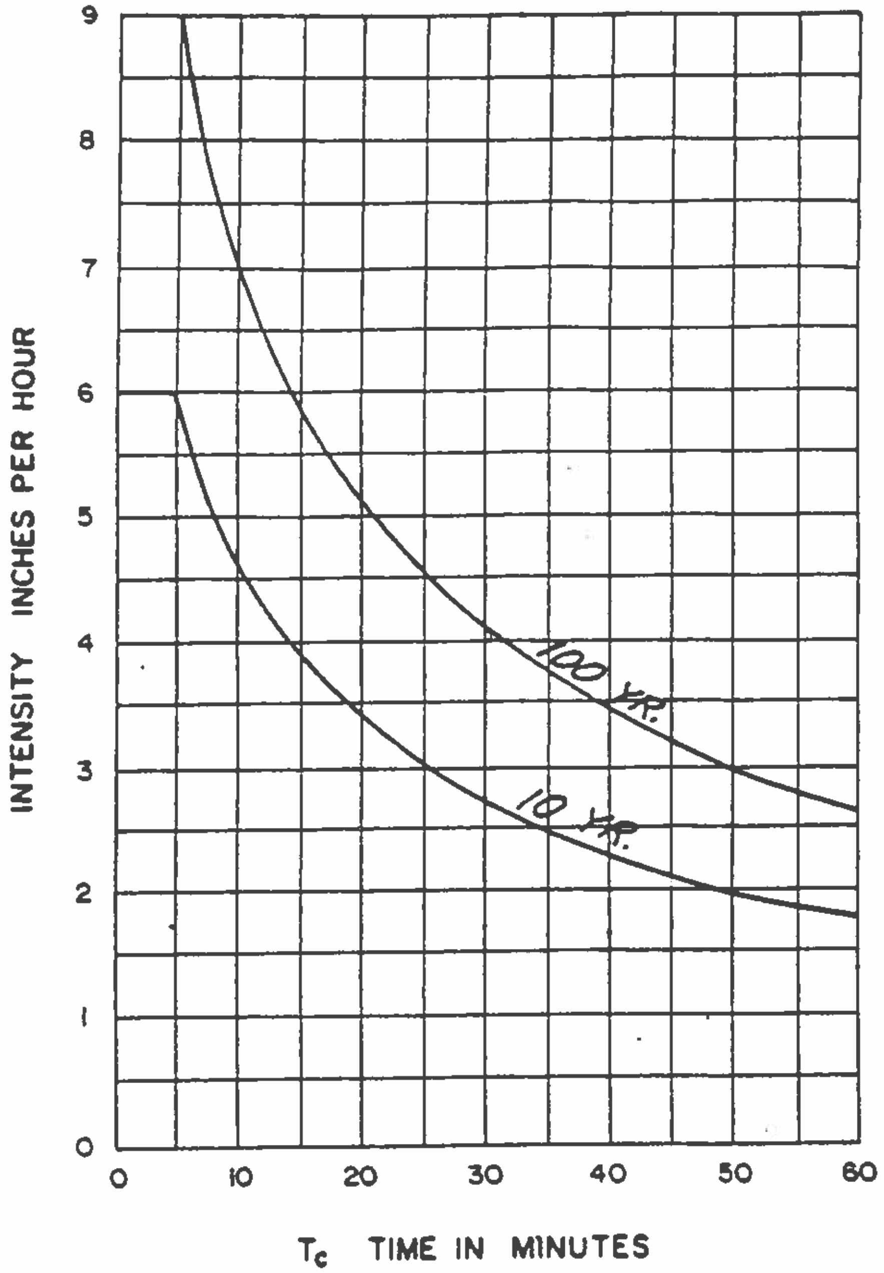
A separate application for a floodplain development permit will be needed prior to construction.

If I can provide any additional information or assistance, please give me a call, 719-327-2906 or fax 719-327-2953.

Sincerely,

Dan Bunting, P.E.
Regional Floodplain Administrator

Hunt
FHU
Sato



RE: Based upon Pikes Peak area council of governments/ areawide urban runoff control manual.

HDR Infrastructure, Inc.
A Centerra Company

The City of Colorado Springs / El Paso County
Drainage Criteria Manual

Storm Rainfall
Time Intensity-Frequency Curves

Date
OCT. 1987

Figure
5 - 1

TABLE 5-1

RECOMMENDED AVERAGE RUNOFF COEFFICIENTS AND PERCENT IMPERVIOUS

LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	"C" FREQUENCY 10 A&B*	10 C&D*	100 A&B*	100 C&D*
Business					
Commercial Areas	95	0.90	0.90	0.90	0.90
Neighborhood Areas	70	0.75	0.75	0.80	0.80
Residential					
1/8 Acre or less	65	0.60	0.70	0.70	0.80
1/4 Acre	40	0.50	0.60	0.60	0.70
1/3 Acre	30	0.40	0.50	0.55	0.60
1/2 Acre	25	0.35	0.45	0.45	0.55
1 Acre	20	0.30	0.40	0.40	0.50
Industrial					
Light Areas	80	0.70	0.70	0.80	0.80
Heavy Areas	90	0.80	0.80	0.90	0.90
Parks and Cemeteries	7	0.30	0.35	0.55	0.60
Playgrounds	13	0.30	0.35	0.60	0.65
Railroad Yard Areas	40	0.50	0.55	0.60	0.65
Undeveloped Areas					
Historic Flow Analysis- Greenbelts, Agricultural	2	0.15	0.25	0.20	0.30
Pasture/Meadow	0	0.25	0.30	0.35	0.45
Forest	0	0.10	0.15	0.15	0.20
Exposed Rock	100	0.90	0.90	0.95	0.95
Offsite Flow Analysis (when land use not defined)	45	0.55	0.60	0.65	0.70
Streets					
Paved	100	0.90	0.90	0.95	0.95
Gravel	80	0.80	0.80	0.85	0.85
Drive and Walks	100	0.90	0.90	0.95	0.95
Roofs	90	0.90	0.90	0.95	0.95
Lawns	0	0.25	0.30	0.35	0.45

* Hydrologic Soil Group

- HEC-RAS Output and Scour Calculations, Cheyenne Creek

HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	2040	1600.00	5911.90	5918.02		5919.67	0.007047	10.82	188.92	46.66	0.82
Reach-1	2040	13300.00	5911.90	5925.07	5925.07	5926.43	0.004647	15.33	3532.25	1093.56	0.77
Reach-1	2040	21500.00	5911.90	5926.29	5926.29	5927.70	0.005302	17.42	4929.73	1187.60	0.83
Reach-1	2036	1600.00	5911.10	5918.42	5917.39	5918.67	0.005835	6.24	547.97	258.92	0.57
Reach-1	2036	13300.00	5911.10	5922.95	5921.47	5923.23	0.005041	8.51	4035.65	1172.48	0.59
Reach-1	2036	21500.00	5911.10	5924.08	5922.25	5924.45	0.005522	9.91	5412.65	1249.15	0.63
Reach-1	2035.5	Bridge									
Reach-1	2035	1600.00	5911.10	5918.40		5918.66	0.005896	6.27	545.19	257.57	0.58
Reach-1	2035	13300.00	5911.10	5922.11		5922.64	0.011096	11.52	3088.17	1097.87	0.85
Reach-1	2035	21500.00	5911.10	5923.23		5923.83	0.010391	12.57	4374.78	1193.97	0.85
Reach-1	2032	1600.00	5907.00	5913.24	5913.24	5915.40	0.012749	11.77	136.04	32.80	1.01
Reach-1	2032	13300.00	5907.00	5919.31	5919.31	5920.32	0.005304	13.30	3820.17	1495.83	0.74
Reach-1	2032	21500.00	5907.00	5920.10	5920.10	5921.26	0.006638	15.66	5018.72	1521.81	0.84
Reach-1	2031	1600.00	5905.50	5913.15	5910.80	5914.44	0.005999	9.09	176.04	23.00	0.58
Reach-1	2031	13300.00	5905.50	5918.29	5917.28	5918.70	0.003376	9.42	3745.59	1378.46	0.46
Reach-1	2031	21500.00	5905.50	5919.36	5918.03	5919.85	0.004092	10.94	5390.35	1669.55	0.52
Reach-1	2030.5	Bridge									
Reach-1	2030	1600.00	5905.30	5912.60		5914.01	0.006843	9.53	167.97	23.00	0.62
Reach-1	2030	13300.00	5905.30	5917.08	5917.08	5918.09	0.007997	13.73	2615.79	1020.19	0.70
Reach-1	2030	21500.00	5905.30	5917.83	5917.83	5919.13	0.010668	16.53	3429.67	1138.93	0.82
Reach-1	2024	1600.00	5905.30	5912.28	5912.28	5912.66	0.002209	6.04	595.56	857.74	0.45
Reach-1	2024	13300.00	5905.30	5914.18	5914.18	5914.95	0.006318	12.39	2521.80	1234.44	0.79
Reach-1	2024	21500.00	5905.30	5916.48		5916.77	0.001553	7.33	5372.83	1240.20	0.41

HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach-1	6	1600.00	5904.01	5909.16	5908.40	5909.28	0.001510	3.80	679.97	381.78	0.35
Reach-1	6	13300.00	5904.01	5914.18	5911.11	5914.29	0.000503	3.75	5398.96	1150.00	0.23
Reach-1	6	21500.00	5904.01	5916.51	5911.88	5916.63	0.000366	3.78	8078.55	1150.00	0.20
Reach-1	5.5	Bridge									
Reach-1	5	1600.00	5902.00	5908.06	5908.06	5908.61	0.005048	7.29	393.59	344.69	0.62
Reach-1	5	13300.00	5902.00	5913.90		5914.12	0.000913	5.51	4063.31	1050.00	0.31
Reach-1	5	21500.00	5902.00	5916.35		5916.54	0.000575	5.05	6636.02	1050.00	0.25
Reach-1	4	1600.00	5900.00	5906.23	5904.10	5906.61	0.002043	4.99	353.32	243.61	0.42
Reach-1	4	13300.00	5900.00	5913.37	5909.87	5913.92	0.001169	7.26	2425.88	303.23	0.38
Reach-1	4	21500.00	5900.00	5915.45	5911.44	5916.33	0.001481	9.13	3056.47	303.23	0.44
Reach-1	3.5	Bridge									
Reach-1	3	1600.00	5900.00	5905.59	5904.29	5906.29	0.004097	6.71	238.53	59.47	0.59
Reach-1	3	13300.00	5900.00	5911.76	5911.03	5913.47	0.004211	12.55	1454.17	240.18	0.70
Reach-1	3	21500.00	5900.00	5912.81	5912.81	5915.92	0.006846	17.09	1705.26	240.18	0.90
Reach-1	2	1600.00	5898.01	5904.45	5903.19	5905.48	0.005655	8.13	196.82	45.07	0.69
Reach-1	2	13300.00	5898.01	5911.86	5911.13	5912.65	0.002630	9.50	2471.09	751.68	0.54
Reach-1	2	21500.00	5898.01	5913.06	5912.28	5914.02	0.002987	10.94	3397.75	778.32	0.58
Reach-1	1.75	Bridge									
Reach-1	1.5	1600.00	5897.51	5902.69	5902.69	5904.59	0.012821	11.08	144.42	38.39	1.01
Reach-1	1.5	13300.00	5897.51	5910.63	5910.63	5911.99	0.004618	11.94	1947.24	674.02	0.70
Reach-1	1.5	21500.00	5897.51	5911.78	5911.78	5913.33	0.005074	13.56	2788.96	769.52	0.75

HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 (Continued)

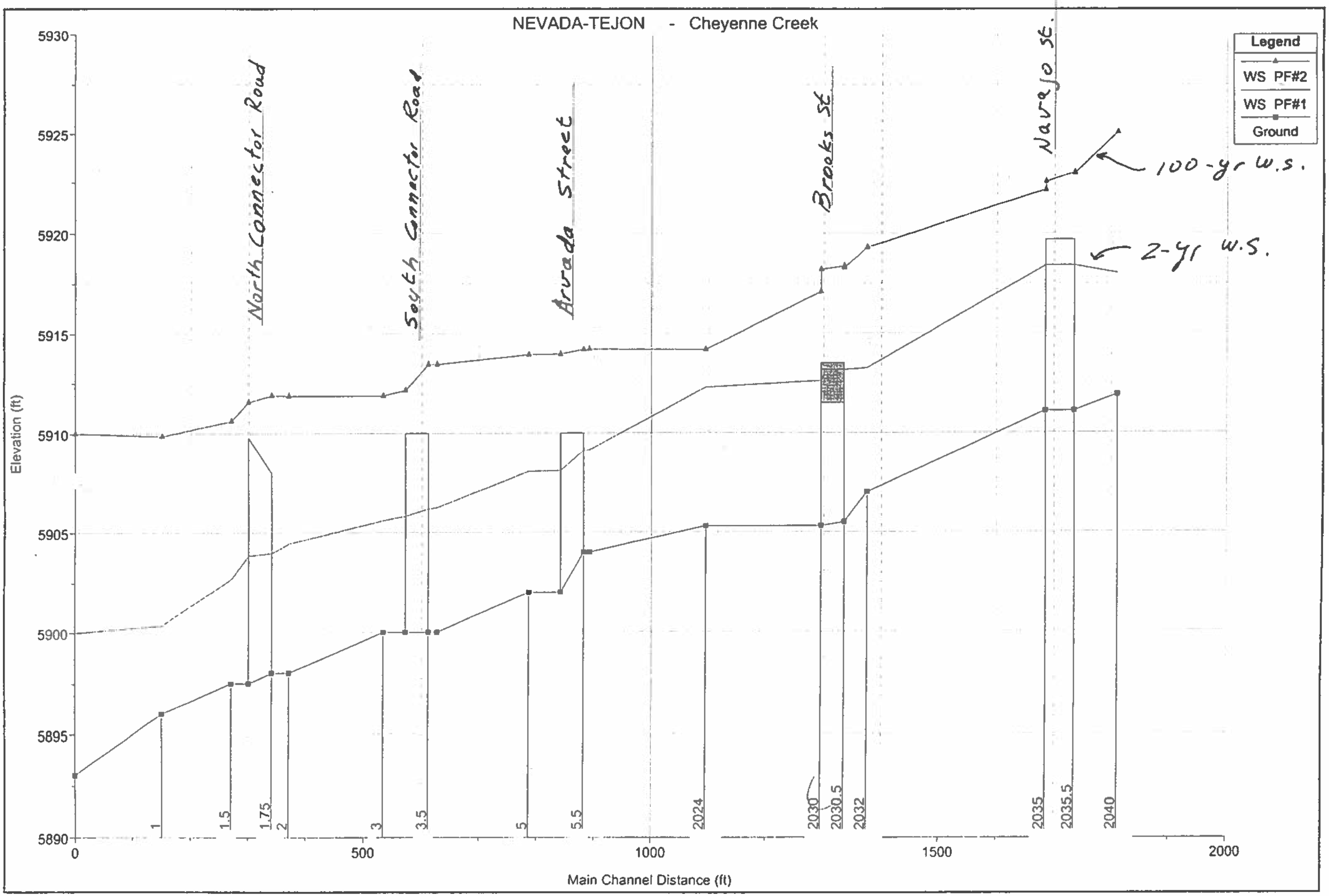
Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	1	1600.00	5896.00	5900.34	5900.34	5901.13	0.015996	7.14	224.03	145.30	1.01
Reach-1	1	13300.00	5896.00	5909.85		5910.60	0.001316	6.97	1967.34	250.13	0.39
Reach-1	1	21500.00	5896.00	5909.53		5911.63	0.003840	11.68	1887.54	241.38	0.67
Reach-1	0.5	1600.00	5893.00	5900.00	5897.35	5900.10	0.000572	2.48	644.50	167.11	0.22
Reach-1	0.5	13300.00	5893.00	5910.00	5902.00	5910.38	0.000488	5.05	2881.08	311.51	0.25
Reach-1	0.5	21500.00	5893.00	5910.00	5904.18	5910.99	0.001275	8.16	2881.08	311.51	0.40

HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1

Reach	River Sta	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
		(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Reach-1	2040	5919.67	5918.02	1.65	0.44	0.56	17.72	1434.53	147.75	46.66
Reach-1	2040	5926.43	5925.07	1.36	0.31	0.43	532.54	4679.10	8088.36	1093.56
Reach-1	2040	5927.70	5926.29	1.41	0.34	0.42	1166.02	5836.89	14497.09	1187.60
Reach-1	2036	5918.67	5918.42	0.25				521.11	1078.89	258.92
Reach-1	2036	5923.23	5922.95	0.28	0.00	0.06	28.92	1846.50	11424.58	1172.48
Reach-1	2036	5924.45	5924.08	0.37	0.00	0.07	171.30	2527.11	18801.58	1249.15
Reach-1	2035.5	Bridge								
Reach-1	2035	5918.66	5918.40	0.26	2.51	0.76		521.80	1078.20	257.57
Reach-1	2035	5922.64	5922.11	0.53	2.13	0.19	1.29	2179.34	11119.37	1097.87
Reach-1	2035	5923.83	5923.23	0.60	2.34	0.22	74.59	2848.94	18576.47	1193.97
Reach-1	2032	5915.40	5913.24	2.15	0.34	0.35		1599.95	0.05	32.80
Reach-1	2032	5920.32	5919.31	1.01	0.17	0.24	800.87	4581.54	7917.59	1495.83
Reach-1	2032	5921.26	5920.10	1.16	0.21	0.27	1801.30	5828.58	13870.11	1521.81
Reach-1	2031	5914.44	5913.15	1.28				1600.00		23.00
Reach-1	2031	5918.70	5918.29	0.41	0.00	0.12	6915.56	2772.53	3611.90	1378.46
Reach-1	2031	5919.85	5919.36	0.49	0.00	0.13	11552.83	3488.76	6458.41	1669.55
Reach-1	2030.5	Bridge								
Reach-1	2030	5914.01	5912.60	1.41	0.74	0.61		1600.00		23.00
Reach-1	2030	5918.09	5917.08	1.01	1.61	0.14	6580.57	3720.20	2999.23	1020.19
Reach-1	2030	5919.13	5917.83	1.29	0.74	0.60	10981.31	4764.80	5753.89	1138.93
Reach-1	2024	5912.66	5912.28	0.39	0.35	0.08	391.07	1063.34	145.59	857.74
Reach-1	2024	5914.95	5914.18	0.77	0.18	0.20	8794.17	2905.87	1599.95	1234.44

HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 (Continued)

Reach	River Sta	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
		(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Reach-1	2024	5916.77	5916.48	0.29	0.09	0.05	15774.85	2241.13	3484.02	1240.20
Reach-1	6	5909.28	5909.16	0.12	0.02	0.00	0.24	585.38	1014.38	381.78
Reach-1	6	5914.29	5914.18	0.11	0.01	0.00	4597.72	1460.99	7241.29	1150.00
Reach-1	6	5916.63	5916.51	0.12	0.00	0.00	9061.78	1886.13	10552.09	1150.00
Reach-1	5.5	Bridge								
Reach-1	5	5908.61	5908.06	0.55	0.49	0.05	0.00	1014.15	585.85	344.69
Reach-1	5	5914.12	5913.90	0.23	0.17	0.03	2988.98	1815.24	8495.77	1050.00
Reach-1	5	5916.54	5916.35	0.19	0.14	0.07	8022.29	2069.18	11408.52	1050.00
Reach-1	4	5906.61	5906.23	0.38	0.03	0.00	0.03	1576.92	23.05	243.61
Reach-1	4	5913.92	5913.37	0.55			271.41	6101.80	6926.80	303.23
Reach-1	4	5916.33	5915.45	0.88			501.09	9069.08	11929.83	303.23
Reach-1	3.5	Bridge								
Reach-1	3	5906.29	5905.59	0.70	0.78	0.03		1600.00		59.47
Reach-1	3	5913.47	5911.76	1.71	0.54	0.27	93.87	7700.56	5505.57	240.18
Reach-1	3	5915.92	5912.81	3.12	0.71	0.65	166.26	11571.98	9761.75	240.18
Reach-1	2	5905.48	5904.45	1.03	0.19	0.03		1600.00		45.07
Reach-1	2	5912.65	5911.86	0.79	0.12	0.06	760.38	6253.31	6286.31	751.68
Reach-1	2	5914.02	5913.06	0.96	0.12	0.06	2292.01	8096.26	11111.74	778.32
Reach-1	1.75	Bridge								
Reach-1	1.5	5904.59	5902.69	1.91	1.71	0.33		1600.00		38.39
Reach-1	1.5	5911.99	5910.63	1.36	0.27	0.18	473.85	7267.47	5558.69	674.02


NEVADA-TEJON - Cheyenne Creek
Legend
WS PF#2
WS PF#1
Ground
North Connector Road
South Connector Road
Arvada Street
Brooks St
Navajo St.
100-yr W.S.
2-yr W.S.
Elevation (ft)
Main Channel Distance (ft)
5930
5925
5920
5915
5910
5905
5900
5895
5890
0
500
1000
1500
2000
1
1.5
1.75
2
3
3.5
5
5.5
2024
2030
2030.5
2032
2035
2035.5
2040

J.F. SATO AND ASSOCIATES
Consulting Engineers
Project Managers & Planners

Project Nevada / Tejon / I-25 Reference ______ JFSA Job No. 9790
Subject Bridge scour Designed ______ Date ______
Item Cheyenne Creek Checked ______ Date ______

$Q_2 = 1{,}600$ cfs $Q_{100} = 13{,}300$ cfs $Q_{500} = 21{,}500$ cfs

D_{50} : 2 mm = 0.0066 ft (Assume)

Shear Vel., $V_{*c} = (g y_1 S_1)^{0.5}$

Fall Velocity, w = 0.9 fps

$$\frac{y_2}{y_1} = \left(\frac{Q_{mc2}}{Q_{mc1}}\right)^{6/7} \left(\frac{W_{c1}}{W_{c2}}\right)^{k_1} \left(\frac{n_2}{n_1}\right)^{k_2}$$

(1) : Main channel
(2) : Contracted channel

		Bridge	
	N. Conn. (1.75)	S. Conn. (3.5)	Arvada (5.5)
100-yr:			
y_1, ft	17.18	15.55	11.92
Q_{mc2}	13,300	13,300	13,300
Q_{mc1}	9519	7702	7274
$S \times 10^{-4}$	3.6	5.7	1.84
V_{*c}	0.50	0.59	0.30
k_1	0.64	0.64	0.59
k_2	0.21	0.21	0.066
n_1	0.035	0.035	0.035
n_2	0.024	0.024	0.024
W_{c1}/W_{c2}	1	1	1
y_2/y_1	1.231	1.476	1.55
y_s	4.0	7.4	6.6

J.F. SATO AND ASSOCIATES
Consulting Engineers
Project Managers & Planners

Sheet 2/2

Project ______ Reference ______ JFSA Job No. ______
Subject ______ Designed ______ Date ______
Item ______ Checked ______ Date ______

		(1.75) NC	(3.5) SC	(5.5) Arvada
500-yr	y_1	17.49	15.91	12.8
	Q_{mc2}	21,500	21,500	21,500
	Q_{mc1}	15,600	12,267	12,500
	y_2/y_1	1.317	1.618	1.592
	y_s	5.5	9.8	7.5
2-yr	y_1	6.44	6.23	5.15
	Q_{mc2}	1600	1,600	1600
	Q_{mc1}	1600	1576	1013
	y_2/y_1	1	1.013	1.48
	y_s	0.0	0.08	2.5

- Culvert Hydraulic Calculations

PRELIMINARY CULVERT DESIGN WITH CONSIDERATION OF INLET/OUTLET CONTROL

Project: Tejon/Nevada Interchange at 300+760
Date: April 1, 1999

I. Culvert Hydraulics

Culvert ID	Culvert Hydraulic Control	Design Flow cfs	Length ft	Slope ft/ft	Conduit Shape	Dia or Rise ft	Dia or Span ft	Number of Cell	Flow per Cell	Flow per ft cfs/f	Hw/D Ratio	Manning's N	Hydr. Radius ft	Flow Area sq ft	Flow Vel. fps	Vel. Head ft	Friction Slope ft/ft	Entrance Loss ft	Exit Loss ft	Friction Losses ft	Invert Drop ft	HW
300+760	Inlet	36.21	175.00	0.0100	R	3.50	3.50	1.00	36.21	10.35	0.78										1.75	2.73
	Outlet	36.21	175.00	0.0100	R	3.50	3.50	1.00	36.21	10.35		0.0130	0.88	9.62	3.76	0.22	0.00129	0.0660	0.0440	0.2255	1.75	2.09
	Control				R	3.50	3.50	1.00	36.21	10.35											1.75	2.73
300+760	Inlet	36.21	175.00	0.0100	R	3.00	3.00	1.00	36.21	12.07	1.00										1.75	3.00
	Outlet	36.21	175.00	0.0100	R	3.00	3.00	1.00	36.21	12.07		0.0130	0.75	7.07	5.12	0.41	0.00293	0.1222	0.0815	0.5130	1.75	2.47
	Control				R	3.00	3.00	1.00	36.21	12.07											1.75	3.00
300+760	Inlet	36.21	175.00	0.0100	R	2.00	2.00	2.00	18.11	9.05	1.35										1.75	2.70
	Outlet	36.21	175.00	0.0100	R	2.00	2.00	2.00	18.11	9.05		0.0130	0.50	3.14	5.76	0.52	0.00637	0.1547	0.1031	1.1149	1.75	3.12
	Control				R	2.00	2.00	2.00	18.11	9.05											1.75	3.12

PRELIMINARY CULVERT DESIGN WITH CONSIDERATION OF INLET/OUTLET CONTROL

Project: Tejon/Nevada Interchange at 301+650
Date: April 1, 1999

I. Culvert Hydraulics

Culvert ID	Culvert Hydraulic Control	Design Flow cfs	Length ft	Slope ft/ft	Conduit Shape R or B	Dia or Rise ft	Dia or Span ft	Number of Cell	Flow per Cell	Flow per ft cfs/f	Hw/D Ratio	Manning's N	Hydr. Radius ft	Flow Area sq ft	Flow Vel. fps	Vel. Head ft	Friction Slope ft/ft	Entrance Loss ft	Exit Loss ft	Friction Losses ft	Invert Drop ft	HW
301+650	Inlet	112.19	135.00	0.0100	R	3.50	3.50	2.00	56.10	16.03	1.10										1.35	3.85
	Outlet	112.19	135.00	0.0100	R	3.50	3.50	2.00	56.10	16.03		0.0130	0.88	9.62	5.83	0.53	0.00309	0.1584	0.1056	0.4174	1.35	2.03
	Control				R	3.50	3.50	2.00	56.10	16.03											1.35	3.85
301+650	Inlet	112.19	135.00	0.0100	R	3.00	3.00	2.00	56.10	18.70	1.60										1.35	4.80
	Outlet	112.19	135.00	0.0100	R	3.00	3.00	2.00	56.10	18.70		0.0130	0.75	7.07	7.94	0.98	0.00704	0.2934	0.1956	0.9498	1.35	2.79
	Control				R	3.00	3.00	2.00	56.10	18.70											1.35	4.80

PRELIMINARY CULVERT DESIGN WITH CONSIDERATION OF INLET/OUTLET CONTROL

Project: Tejon/Nevada Interchange at 301+465
Date: April 1, 1999

I. Culvert Hydraulics

Culvert ID	Culvert Hydraulic Control	Design Flow Q10 cfs	Length ft	Slope ft/ft	Conduit Shape R or B	Dia or Rise ft	Dia or Span ft	Number of Cell	Flow per Cell	Flow per ft cfs/f	Hw/D Ratio	Manning's N	Hydr. Radius ft	Flow Area sq ft	Flow Vel. fps	Vel. Head ft	Friction Slope ft/ft	Entrance Loss ft	Exit Loss ft	Friction Losses ft	Invert Drop ft	HW
301+465	Inlet	61.85	95.00	0.0050	R	4.00	4.00	1.00	61.85	15.46	0.94										0.48	3.76
	Outlet	61.85	95.00	0.0050	R	4.00	4.00	1.00	61.85	15.46		0.0130	1.00	12.57	4.92	0.38	0.00184	0.1128	0.0752	0.1752	0.48	0.84
	Control				R	4.00	4.00	1.00	61.85	15.46											0.48	3.76
301+465	Inlet	61.85	95.00	0.0050	R	3.50	3.00	2.00	30.93	10.31	0.90										0.48	3.15
	Outlet	61.85	95.00	0.0050	R	3.50	3.00	2.00	30.93	10.31		0.0130	0.88	9.62	3.21	0.16	0.00094	0.0481	0.0321	0.0893	0.48	0.64
	Control				R	3.50	3.00	2.00	30.93	10.31											0.48	3.15

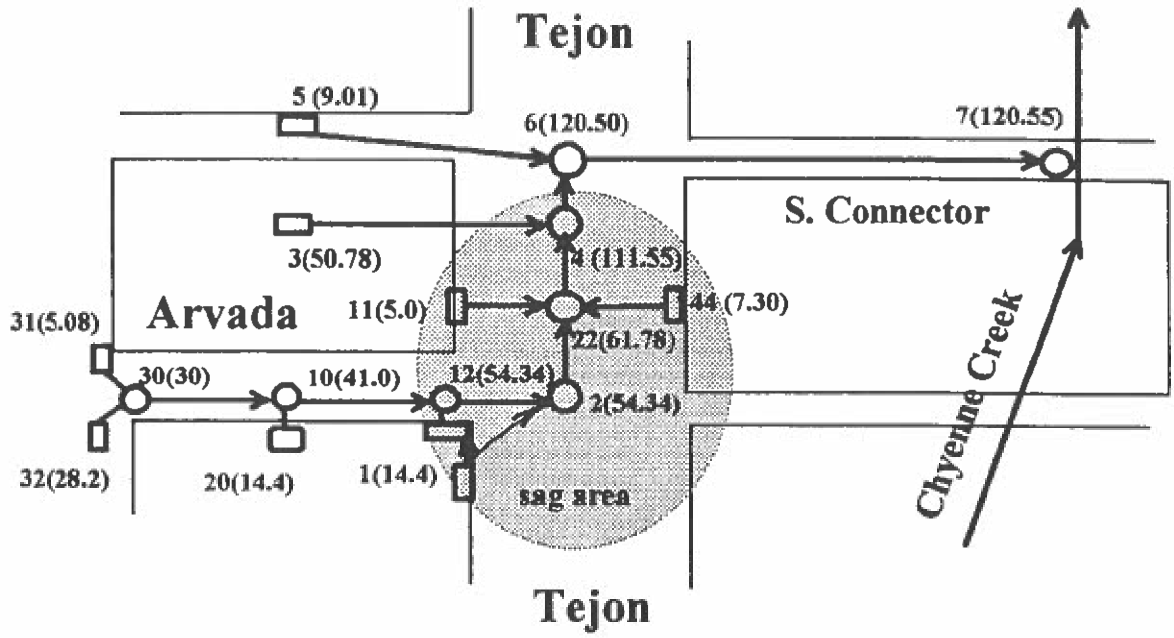
PRELIMINARY CULVERT DESIGN WITH CONSIDERATION OF INLET/OUTLET CONTROL

Project: Tejon/Nevada Interchange at 310+160
Date: April 1, 1999

I. Culvert Hydraulics

Culvert ID	Culvert Hydraulic Control	Design Flow (cfs)	Length (ft)	Slope (ft/ft)	Conduit Shape	Dia or Rise (ft)	Dia or Span (ft)	Number of Cell	Flow per Cell	Flow per ft (cfs/f)	Hw/D Ratio	Manning's N	Hydr. Radius (ft)	Flow Area (sq ft)	Flow Vel. (fps)	Vel. Head (ft)	Friction Slope (ft/ft)	Entrance Loss (ft)	Exit Loss (ft)	Friction Losses (ft)	Invert Drop (ft)	HW
310+160	Inlet	58.59	215.00	0.0100	R	4.00	4.00	1.00	58.59	14.65	0.88										2.15	3.52
	Outlet	58.59	215.00	0.0100	R	4.00	4.00	1.00	58.59	14.65		0.0130	1.00	12.57	4.66	0.34	0.00165	0.1013	0.0675	0.3558	2.15	2.67
	Control				R	4.00	4.00	1.00	58.59	14.65											2.15	3.52
310+160	Inlet	58.59	215.00	0.0100	R	3.50	3.50	1.00	58.59	16.74	1.10										2.15	3.85
	Outlet	58.59	215.00	0.0100	R	3.50	3.50	1.00	58.59	16.74		0.0130	0.88	9.62	6.09	0.58	0.00337	0.1728	0.1152	0.7253	2.15	3.16
	Control				R	3.50	3.50	1.00	58.59	16.74											2.15	3.85
310+160	Inlet	58.59	215.00	0.0100	R	2.00	3.00	2.00	29.30	9.77	0.90										2.15	1.80
	Outlet	58.59	215.00	0.0100	R	2.00	3.00	2.00	29.30	9.77		0.0130	0.50	3.14	9.32	1.35	0.01668	0.4051	0.2700	3.5862	2.15	6.41
	Control				R	2.00	3.00	2.00	29.30	9.77											2.15	6.41

- Storm Sewer Profile Calculations & Inlet Size Chart



Note: 2(54.34) = manhole ID (flowrate in cfs)

Sewer ID id defined as

NEVADA AVENUE / TEJON STREET / I-25 INTERCHANGE

10-yr Peak Runoff Flow Rates - Proposed Conditions

Station at Design Point	Upstream Design Point	Local Tributary Basin ID	BASIN DATA A M^2	C	CA M^2	Overland Flow Sx %	Lx M	Tx MIN	Channel Flow So %	Lo M	To MIN	Computed Tc MIN	Regional Tc(2) MIN	Upstream Tc	USED Tc MIN	Storm Duration Min	Intensity I10 Inch/hour	Peak Q10 cfs	Peak Q10 cms	Proposed Drainage Facility	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
300+760		A2	25198.0	0.81	20410.4	3.00	100.0	6.58	3.00	230.0	4.84	11.42	16.01		11.42	11.42	4.38	22.10	0.63	Roadside Ditch/I-25 cross drainage Culvert	
301+000		A1a	11200.0	0.90	10080.0	2.00	15.0	2.01	3.00	650.0	10.26	12.27	22.12		12.27	12.27	4.28	10.80	0.30	Drop Inlet on I-25	
301+160		A3	45693.0	0.81	37011.3	3.00	100.0	6.58	3.00	400.0	8.42	15.00	19.11		15.00	15.00	3.90	36.63	1.01	Roadside Ditch	
		A1b	345.0	0.90	310.5	2.00	23.0	2.49	3.00	400.0	6.31	8.80	17.71		8.80	8.80	4.84	0.37	0.01	I-25 Gutter/Inlet	
	A3+A1b		46038.0	0.81	37321.8									15.00	15.00	15.00	3.90	35.93	1.02	I-25 cross drainage Culvert	
301+485		A4	28680.0	0.81	23230.8	3.00	100.0	6.58	3.00	300.0	6.31	12.89	17.29		12.89	12.89	4.17	23.91	0.68	Roadside Ditch	
		A13	6900.0	0.90	6210.0	2.00	23.0	2.49	3.00	300.0	4.73	7.22	15.89		7.22	7.22	5.17	7.93	0.22	I-25 Gutter/Inlet	
		A9	8352.0	0.90	7516.8	2.00	23.0	2.49	2.00	340.0	8.76	11.25	16.61		11.25	11.25	4.41	8.19	0.23	I-25 Gutter/Inlet	
	A4+A13+A9		43932.0	0.84	36957.6									12.89	12.89	12.89	4.17	38.04	1.08	I-25 cross drainage Culvert	
301+650		A6	13882.0	0.85	11799.7	3.00	100.0	5.67	3.00	270.0	5.68	11.35	16.74		11.35	11.35	4.39	12.80	0.36		
		A5	35212.0	0.82	28873.8	3.00	100.0	6.35	1.00	220.0	8.02	14.37	15.83		14.37	14.37	3.97	28.34	0.80		
	A6+A5		49094.0	0.83	40673.5									14.37		14.37	3.97	39.92	1.13	Channel to Low Point	
301+900		A10	19736.0	0.65	12828.4	3.00	100.0	10.21	3.00	250.0	5.26	15.47	16.38		15.47	15.47	3.84	12.18	0.35		M20
	A6+A5+A10		68830.0	0.78	53501.9									14.37	15.47	15.47	3.84	50.78	1.44	Inlet/Sewer	M3
301+650		A7	40278.0	0.74	29805.7	3.00	100.0	8.17	1.00	270.0	7.38	15.55	16.74		15.55	15.55	3.83	28.22	0.80	Gutter/Inlet	
		A11	38303.0	0.72	27578.2	3.00	100.0	8.62	3.00	240.0	3.79	12.41	16.20		12.41	12.41	4.24	28.85	0.82	Gutter/Inlet	M30
	A7+A11		78581.0	0.73	57383.9									15.55	15.55	15.55	3.83	54.34	1.54	Inlet/Sewer	M1 and M2
		T1	7190.0	0.89	6399.1	2.00	50.0	3.85	1.00	450.0	12.30	16.15	19.11		16.15	16.15	3.77	5.95	0.17	Inlet/Sewer	
		T2	2962.0	0.89	2636.2	2.00	50.0	3.85	1.00	450.0	12.30	16.15	19.11		16.15	16.15	3.77	2.45	0.07	Inlet/Sewer	
301+900	A7+11+T1+T2		88733.0	0.75	66419.2									16.15	16.15	16.15	3.77	61.78	1.75	Inlet/Sewer	M22
	A7+11+T1+T2+5+6+10		157563.0	0.76	119921.1									16.15	16.15	16.15	3.77	111.55	3.16	Inlet/Sewer	M4
301+900		A12	13387.0	0.72	9638.6	3.00	100.0	8.62	3.00	350.0	7.36	15.99	18.20		15.99	15.99	3.78	9.01	0.26	I-25 Gutter/Inlet	M5
	A7+11+T1+T2+5+6+10+12		170950.0	0.76	129559.7										16.15	16.15	3.77	120.52	3.42	I-25 Gutter/Inlet	M6
		A8	5882.0	0.84	4940.9	3.00	40.0	3.73	3.00	100.0	2.10	5.83	12.55		5.83	5.83	5.51	6.73	0.19	Inlet	
	A7+11+T1+T2+5+6+10+12+8		176832.0	0.76	134500.6									16.15	16.15	16.15	3.77	125.11	3.55	Sewer System (Tejon to Fountain Ck)	
302+090		A22	12957.0	0.73	9458.6	3.00	100.0	8.39	2.00	130.0	3.35	11.74	14.19		11.74	11.74	4.33	10.12	0.29	Ditch/Inlet to Cheyenne CK	
		A21	8421.0	0.76	6400.0	3.00	70.0	6.45	1.00	130.0	3.55	10.01	13.64		10.01	10.01	4.62	7.30	0.21	Ditch/Inlet to Cheyenne CK	M11+M44 ↑ Tejon
		A20	11250.0	0.71	7987.5	2.00	100.0	10.11	1.00	130.0	4.74	14.85	14.19		14.19	14.19	4.00	7.88	0.22	Gutter/Inlet to Cheyenne CK	
302+200		A27	9316.0	0.78	7266.5	2.00	50.0	5.87	1.00	190.0	6.92	12.79	14.37		12.79	12.79	4.18	7.50	0.21	Drop Inlet	M7 ↓
302+100		A24	5310.0	0.89	4725.9	2.00	40.0	3.44	1.00	500.0	18.22	21.67	19.84		19.84	19.84	3.41	3.98	0.11	Gutter/Inlet (Nevada to Cheyenne CK)	
	A27+A24		14626.0	0.78	11992.4										19.84	19.84	3.41	10.09	0.29		M5
302+100		A23	4780.0	0.89	4254.2	2.00	40.0	3.44	1.00	500.0	18.22	21.67	19.84		19.84	19.84	3.41	3.58	0.10	Gutter/Inlet (Nevada to Cheyenne CK)	M11, M1, M2, M22 Nevada
	A24+27+23		19406.0	0.84	16246.6									0.00	0.00	0.00	0.00	0.00	0.00	Gutter/Inlet (Nevada to Cheyenne CK)	
302+200		A29	12592.0	0.78	9821.8	5.00	100.0	6.13	3.00	220.0	4.63	10.76	15.83		10.76	10.76	4.49	10.89	0.31	Inlet/Culvert (RampD to Fountain CK)	
302+700		A28	4207.0	0.78	3281.5	2.00	20.0	3.71	5.00	140.0	1.71	5.42	12.92		5.42	5.42	5.63	4.56	0.13	Inlet/Ditch/Culvert	
		A26	28631.0	0.20	5726.2	2.00	50.0	16.50	5.00	510.0	6.23	22.74	20.20		20.20	20.20	3.38	4.77	0.14	Ditch	
		A25	26739.0	0.76	20321.6	3.00	100.0	7.71	3.00	510.0	10.73	18.44	21.12		18.44	18.44	3.53	17.73	0.50	Gutter	
	A28+A26+A25		59577.0	0.49	29329.3									20.20	20.20	20.20	3.38	24.45	0.69	Inlet/Ditch	
		A30	23020.0	0.90	20718.0	5.00	40.0	2.42	5.00	510.0	8.31	10.74	20.02		10.74	10.74	4.49	22.99	0.65	Drop Inlet on I-25	
	A28+26+25+30		82597.0	0.61	50047.3									20.20	20.20	20.20	3.38	41.73	1.18	Drop Inlet/Culvert to Fountain CK	
303+000		A31	29469.0	0.85	25048.7	2.00	50.0	4.58	3.00	300.0	6.31	10.90	16.38		10.90	10.90	4.47	27.63	0.78	Drop Inlet/Culvert to Fountain CK	

TABLE 1

STORM SEWER SYSTEM DESIGN USING UDSEWER MODEL
Developed by Dr. James Guo, Civil Eng. Dept, U. of Colorado at Denver
Metro Denver Cities/Counties & UDFCD Pool Fund Study

USER:J F Sato and Associates...
ON DATA 11-04-1999 AT TIME 14:16:58 VERSION=07-15-1995

*** PROJECT TITLE :Tejon/Nevada Interchange

*** RETURN PERIOD OF FLOOD IS 10 YEARS
*** SUMMARY OF HYDRAULICS AT MANHOLES

MANHOLE ID NUMBER	DESIGN PEAK FLOW CFS	GROUND ELEVATION FEET	WATER ELEVATION FEET	COMMENTS
1.00	3.58	5910.20	5906.67	OK
2.00	7.04	5908.90	5906.34	OK
3.00	13.67	5908.90	5905.95	OK
4.00	13.48	5911.20	5906.00	OK
6.00	7.50	5907.82	5906.46	OK
5.00	10.09	5909.60	5906.22	OK
11.00	3.58	5910.23	5906.74	OK
7.00	7.50	5907.28	5906.66	OK
22.00	3.58	5910.23	5906.59	OK

OK MEANS WATER ELEVATION IS LOWER THAN GROUND ELEVATION

*** SUMMARY OF SEWER HYDRAULICS

NOTE: THE GIVEN FLOW DEPTH-TO-SEWER SIZE RATIO= 1

SEWER ID NUMBER	MANHOLE NUMBER UPSTREAM ID NO.	MANHOLE NUMBER DNSTREAM ID NO.	SEWER SHAPE	REQUIRED DIA(RISE) (IN) (FT)	SUGGESTED DIA(RISE) (IN) (FT)	EXISTING DIA(RISE) (IN) (FT)	EXISTING WIDTH (FT)
12.00	1.00	2.00	ROUND	13.29	18.00	18.00	0.00
23.00	2.00	3.00	ROUND	17.12	18.00	18.00	0.00
34.00	3.00	4.00	ROUND	25.01	27.00	27.00	0.00
53.00	5.00	3.00	ROUND	22.32	24.00	24.00	0.00
65.00	6.00	5.00	ROUND	19.97	21.00	21.00	0.00
111.00	11.00	1.00	ROUND	13.29	18.00	18.00	0.00
76.00	7.00	6.00	ROUND	19.97	21.00	21.00	0.00
222.00	22.00	2.00	ROUND	13.29	18.00	18.00	0.00

DIMENSION UNITS FOR ROUND AND ARCH SEWER ARE IN INCHES
DIMENSION UNITS FOR BOX SEWER ARE IN FEET
REQUIRED DIAMETER WAS DETERMINED BY SEWER HYDRAULIC CAPACITY.
SUGGESTED DIAMETER WAS DETERMINED BY COMMERCIALLY AVAILABLE SIZE.
FOR A NEW SEWER, FLOW WAS ANALYZED BY THE SUGGESTED SEWER SIZE; OTHERWISE,
EXISITNG SIZE WAS USED

SEWER ID NUMBER	DESIGN FLOW Q CFS	FLOW FULL Q CFS	NORMAL DEPTH FEET	NORAML VLCITY FPS	CRITIC DEPTH FEET	CRITIC VLCITY FPS	FULL VLCITY FPS	FROUDE NO.	COMMENT
12.0	3.6	8.1	0.70	4.43	0.75	4.08	2.03	1.06	V-OK
23.0	7.0	8.1	1.08	5.15	1.03	5.46	3.98	0.90	V-OK
34.0	13.7	16.8	1.54	4.71	1.28	5.83	3.44	0.71	V-OK
53.0	10.1	12.3	1.38	4.37	1.14	5.47	3.21	0.69	V-OK
65.0	7.5	8.6	1.26	4.03	1.01	5.20	3.12	0.65	V-OK
111.0	3.6	8.1	0.70	4.43	0.75	4.08	2.03	1.06	V-OK
76.0	7.5	8.6	1.26	4.03	1.01	5.20	3.12	0.65	V-OK
222.0	3.6	8.1	0.70	4.43	0.75	4.08	2.03	1.06	V-OK

FROUDE NUMBER=0 INDICATES THAT A PRESSURED FLOW OCCURS

SEWER ID NUMBER	SLOPE %	INVERT ELEVATION UPSTREAM (FT)	INVERT ELEVATION DNSTREAM (FT)	BURIED DEPTH UPSTREAM (FT)	BURIED DEPTH DNSTREAM (FT)	COMMENTS
12.00	0.50	5904.37	5903.64	4.33	3.76	OK
23.00	0.50	5903.44	5903.16	3.96	4.24	OK
34.00	0.25	5903.03	5902.83	3.62	6.12	OK
53.00	0.25	5903.34	5903.21	4.26	3.69	OK
65.00	0.25	5903.63	5903.32	2.44	4.53	OK
111.00	0.50	5904.73	5904.57	4.00	4.13	OK
76.00	0.25	5903.77	5903.61	2.01	2.71	OK
222.00	0.50	5904.37	5904.21	4.36	3.19	OK

OK MEANS BURIED DEPTH IS GREATER THAN REQUIRED SOIL COVER OF 2 FEET

*** SUMMARY OF HYDRAULIC GRADIENT LINE ALONG SEWERS

SEWER ID NUMBER	SEWER LENGTH FEET	SURCHARGED LENGTH FEET	CROWN ELEVATION UPSTREAM FEET	CROWN ELEVATION DNSTREAM FEET	WATER ELEVATION UPSTREAM FEET	WATER ELEVATION DNSTREAM FEET	FLOW CONDITION
12.00	145.96	145.96	5905.87	5905.14	5906.67	5906.34	PRSS'ED
23.00	55.10	55.10	5904.94	5904.66	5906.34	5905.95	PRSS'ED
34.00	81.34	81.34	5905.28	5905.08	5905.95	5906.00	PRSS'ED
53.00	53.14	53.14	5905.34	5905.21	5906.22	5905.95	PRSS'ED
65.00	124.64	124.64	5905.38	5905.07	5906.46	5906.22	PRSS'ED
111.00	32.80	32.80	5906.23	5906.07	5906.74	5906.67	PRSS'ED
76.00	65.60	65.60	5905.52	5905.36	5906.66	5906.46	PRSS'ED
222.00	32.00	32.00	5905.87	5905.71	5906.59	5906.34	PRSS'ED

PRSS'ED=PRESSURED FLOW; JUMP=POSSIBLE HYDRAULIC JUMP; SUBCR=SUBCRITICAL FLOW

*** SUMMARY OF ENERGY GRADIENT LINE ALONG SEWERS

SEWER ID NO	UPST MANHOLE ID NO.	MANHOLE ENERGY ELEV FT	SEWER FRCTION FT	BEND K COEF	JUNCTURE LOSSES BEND LOSS FT	LATERAL K COEF	LATERAL LOSS FT	DOWNST MANHOLE ID	MANHOLE ENERGY FT
12.0	1.00	5906.74	0.14	0.05	0.00	0.00	0.00	2.00	5906.59
23.0	2.00	5906.59	0.21	1.00	0.25	0.00	0.00	3.00	5906.13
34.0	3.00	5906.13	0.13	0.05	0.00	0.00	0.00	4.00	5906.00
53.0	5.00	5906.38	0.09	0.05	0.01	0.25	0.14	3.00	5906.13
65.0	6.00	5906.61	0.24	0.00	0.00	0.00	0.00	5.00	5906.38
111.0	11.00	5906.80	0.03	0.50	0.03	0.00	0.00	1.00	5906.74
76.0	7.00	5906.81	0.12	0.50	0.08	0.00	0.00	6.00	5906.61
222.0	22.00	5906.65	0.03	0.50	0.03	0.00	0.00	2.00	5906.59

BEND LOSS =BEND K* FLOWING FULL VHEAD IN SEWER.
LATERAL LOSS= OUTFLOW FULL VHEAD-JCT LOSS K*INFLOW FULL VHEAD
FRICTION LOSS=0 MEANS IT IS NEGLIGIBLE OR POSSIBLE ERROR DUE TO JUMP.
FRICTION LOSS INCLUDES SEWER INVERT DROP AT MANHOLE
NOTICE: VHEAD DENOTES THE VELOCITY HEAD OF FULL FLOW CONDITION.
A MINIMUM JUCTION LOSS OF 0.05 FT WOULD BE INTRODUCED UNLESS LATERAL K=0.
FRICTION LOSS WAS ESTIMATED BY BACKWATER CURVE COMPUTATIONS.

*** SUMMARY OF EARTH EXCAVATION VOLUME FOR COST ESTIMATE.

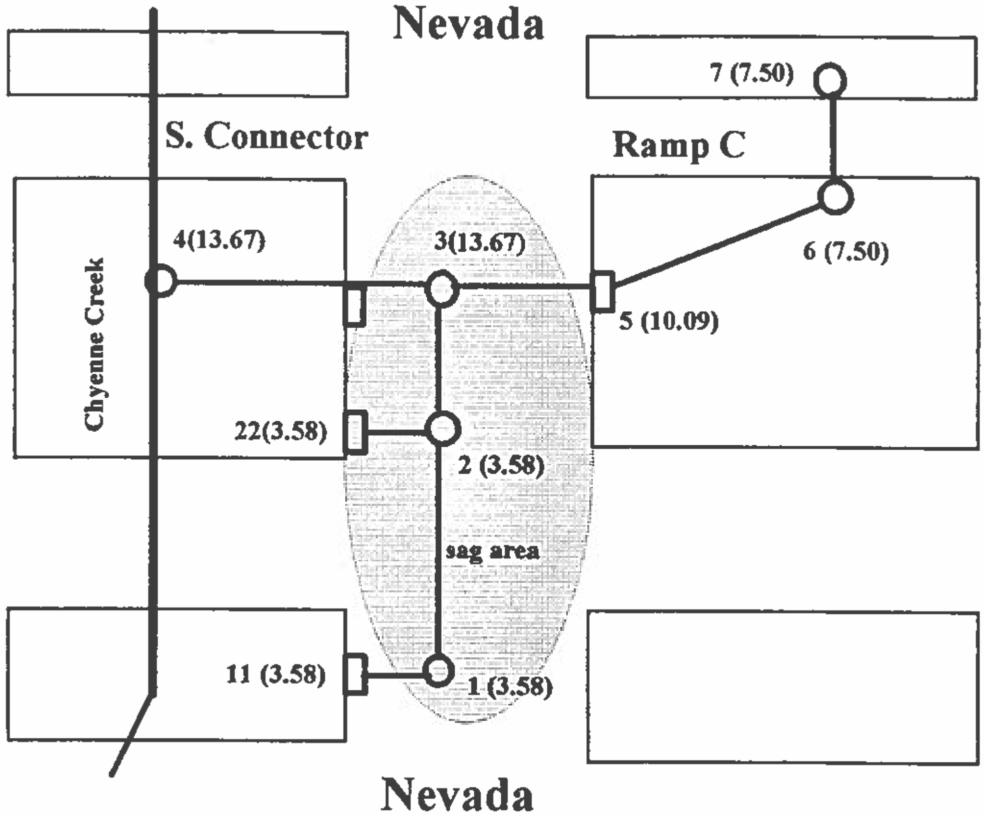
THE TRENCH SIDE SLOPE = 1

MANHOLE ID NUMBER	GROUND ELEVATION FT	INVERT ELEVATION FT	MANHOLE HEIGHT FT
1.00	5910.20	5904.37	5.83
2.00	5908.90	5903.44	5.46
3.00	5908.90	5903.03	5.87
4.00	5911.20	5902.83	8.37
6.00	5907.82	5903.61	4.21
5.00	5909.60	5903.32	6.28
11.00	5910.23	5904.73	5.50
7.00	5907.28	5903.77	3.51
22.00	5910.23	5904.37	5.86

SEWER ID NUMBER	UPST TRENCH WIDTH ON GROUND FT	UPST TRENCH WIDTH AT INVERT FT	DNST TRENCH WIDTH ON GROUND FT	DNST TRENCH WIDTH AT INVERT FT	TRENCH LENGTH FT	WALL THICKNESS INCHES	EARTH VOLUME CUBIC YD
12.00	11.74	3.92	10.60	3.92	145.96	2.50	210.2
23.00	11.00	3.92	11.55	3.92	55.10	2.50	80.4
34.00	10.95	4.79	15.96	4.79	81.34	3.25	178.4
53.00	12.02	4.50	10.89	4.50	53.14	3.00	85.7
65.00	8.17	4.21	12.36	4.21	124.64	2.75	168.5
111.00	11.08	3.92	11.35	3.92	32.80	2.50	47.4
76.00	6.81	4.21	8.22	4.21	65.60	2.75	56.7
222.00	11.80	3.92	9.46	3.92	32.00	2.50	42.9

TOTAL EARTH VOLUME FOR SEWER TRENCHES = 870.2893 CUBIC YARDS
EARTH VOLUME WAS ESTIMATED TO HAVE
BOTTOM WIDTH=DIAMETER OR WIDTH OF SEWER + 2 * B
B=ONE FEET WHEN DIAMETER OR WIDTH <=48 INCHES
B=TWO FEET WHEN DIAMETER OR WIDTH >48 INCHES
IF BOTTOM WIDTH <MINIMUM WIDTH, 2 FT, THE MINIMUM WIDTH WAS USED.

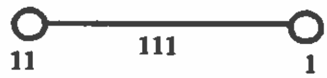
BACKFILL DEPTH UNDER SEWER WAS ASSUMED TO BE ONE FOOT
SEWER WALL THICKNESS=EQIVLNT DIAMATER IN INCH/12 +1 IN INCHES
ED.
BACKFILL DEPTH UNDER SEWER WAS ASSUMED TO BE ONE



Note: 1(3.58) = manhole ID (flowrate in cfs)

Inlets for Manholes 1, 2. and 3 are placed at low points for the same design capacity.

Sewer ID number is defined as



STORM SEWER SYSTEM DESIGN USING UDSEWER MODEL
Developed by Dr. James Guo, Civil Eng. Dept, U. of Colorado at Denver
Metro Denver Cities/Counties & UDFCD Pool Fund Study

USER:J F Sato and Associates...
ON DATA 11-04-1999 AT TIME 11:51:49 VERSION=07-15-1995

*** PROJECT TITLE :Sewer System for Tejon/Arvada 10 flood

*** SUMMARY OF HYDRAULICS AT MANHOLES

MANHOLE ID NUMBER	DESIGN PEAK FLOW CFS	GROUND ELEVATION FEET	WATER ELEVATION FEET	COMMENTS
7.00	120.50	5908.80	5906.00	OK
6.00	120.50	5914.80	5907.69	OK
4.00	111.56	5914.20	5910.09	OK
22.00	61.89	5912.30	5911.35	OK
2.00	54.34	5912.30	5911.86	OK
1.00	5.35	5912.30	5912.27	OK
5.00	9.01	5912.20	5909.30	OK
3.00	50.78	5913.80	5911.42	OK
11.00	10.00	5912.50	5911.95	OK
44.00	7.30	5912.50	5911.86	OK
10.00	41.00	5914.20	5913.09	OK
20.00	14.40	5914.20	5913.57	OK
30.00	30.00	5914.90	5914.02	OK
12.00	54.30	5912.80	5912.05	OK
13.00	11.70	5912.90	5912.62	OK
31.00	28.20	5914.90	5914.14	OK
32.00	5.00	5914.90	5914.22	OK

OK MEANS WATER ELEVATION IS LOWER THAN GROUND ELEVATION

*** SUMMARY OF SEWER HYDRAULICS

NOTE: THE GIVEN FLOW DEPTH-TO-SEWER SIZE RATIO= 1

SEWER ID NUMBER	MANHOLE NUMBER UPSTREAM ID NO.	DNSTREAM ID NO.	SEWER SHAPE	REQUIRED DIA(RISE) (IN) (FT)	SUGGESTED DIA(RISE) (IN) (FT)	EXISTING DIA(RISE) (IN) (FT)	WIDTH (FT)
67.00	6.00	7.00	ROUND	50.66	54.00	54.00	0.00
46.00	4.00	6.00	ROUND	50.32	54.00	54.00	0.00
224.00	22.00	4.00	ROUND	40.34	42.00	48.00	0.00
222.00	2.00	22.00	ROUND	38.42	42.00	48.00	0.00
12.00	1.00	2.00	ROUND	15.45	18.00	18.00	0.00
56.00	5.00	6.00	ROUND	18.78	21.00	24.00	0.00
34.00	3.00	4.00	ROUND	31.54	33.00	36.00	0.00
1122.00	11.00	22.00	ROUND	17.15	18.00	18.00	0.00
4422.00	44.00	22.00	ROUND	15.24	18.00	18.00	0.00
2010.00	20.00	10.00	ROUND	19.66	21.00	24.00	0.00
3010.00	30.00	10.00	ROUND	35.02	36.00	36.00	0.00
1012.00	10.00	12.00	ROUND	32.57	33.00	36.00	0.00
122.00	12.00	2.00	ROUND	38.41	42.00	42.00	0.00
1312.00	13.00	12.00	ROUND	18.19	21.00	24.00	0.00
3130.00	31.00	30.00	ROUND	25.30	27.00	27.00	0.00
3230.00	32.00	30.00	ROUND	15.06	18.00	18.00	0.00

DIMENSION UNITS FOR ROUND AND ARCH SEWER ARE IN INCHES
DIMENSION UNITS FOR BOX SEWER ARE IN FEET
REQUIRED DIAMETER WAS DETERMINED BY SEWER HYDRAULIC CAPACITY.
SUGGESTED DIAMETER WAS DETERMINED BY COMMERCIALLY AVAILABLE SIZE.
FOR A NEW SEWER, FLOW WAS ANALYZED BY THE SUGGESTED SEWER SIZE; OTHERWISE,
EXISITNG SIZE WAS USED

SEWER ID NUMBER	DESIGN FLOW Q CFS	FLOW FULL Q CFS	NORMAL DEPTH FEET	NORAML VLCITY FPS	CRITIC DEPTH FEET	CRITIC VLCITY FPS	FULL VLCITY FPS	FROUDE NO.	COMMENT
67.0	120.5	143.3	3.16	10.10	3.19	10.01	7.58	1.05	V-OK
46.0	111.6	135.1	3.12	9.49	3.19	9.27	7.01	0.99	V-OK
224.0	61.9	98.7	2.30	8.30	2.37	8.00	4.93	1.06	V-OK
222.0	54.3	98.7	2.12	8.05	2.22	7.59	4.32	1.09	V-OK
12.0	5.3	8.1	0.89	4.88	0.89	4.91	3.03	1.00	V-OK
56.0	9.0	17.4	1.02	5.58	1.08	5.22	2.87	1.10	V-OK
34.0	50.8	72.5	1.85	11.10	2.32	8.66	7.18	1.56	V-OK
1122.0	10.0	11.4	1.09	7.28	1.22	6.52	5.66	1.27	V-OK
4422.0	7.3	11.4	0.87	6.85	1.06	5.46	4.13	1.42	V-OK
2010.0	14.4	24.6	1.10	8.13	1.37	6.30	4.58	1.52	V-OK
3010.0	30.0	32.4	2.28	5.20	1.77	6.91	4.24	0.61	V-OK

1012.0	41.0	53.7	1.96	8.37	2.12	7.66	5.80	1.13 V-OK
122.0	54.3	69.1	2.34	7.96	2.30	8.10	5.64	0.97 V-OK
1312.0	11.7	24.6	0.97	7.72	1.22	5.81	3.72	1.56 V-OK
3130.0	28.2	33.6	1.58	9.48	1.84	8.10	7.09	1.39 V-OK
3230.0	5.0	8.1	0.85	4.81	0.86	4.77	2.83	1.01 V-OK

FROUDE NUMBER=0 INDICATES THAT A PRESSURED FLOW OCCURS

SEWER ID NUMBER	SLOPE %	INVERT ELEVATION UPSTREAM (FT)	INVERT ELEVATION DNSTREAM (FT)	BURIED DEPTH UPSTREAM (FT)	BURIED DEPTH DNSTREAM (FT)	COMMENTS
67.00	0.45	5904.50	5902.23	5.80	2.07	OK
46.00	0.40	5904.90	5904.68	4.80	5.62	OK
224.00	0.40	5905.54	5905.08	2.76	5.12	OK
222.00	0.40	5906.00	5905.67	2.30	2.63	OK
12.00	0.50	5908.80	5908.36	2.00	2.44	OK
56.00	0.50	5905.40	5904.72	4.80	8.08	OK
34.00	1.00	5906.00	5904.85	4.80	6.35	OK
1122.00	1.00	5906.40	5906.11	4.60	4.69	OK
4422.00	1.00	5906.20	5905.56	4.80	5.24	OK
2010.00	1.00	5908.40	5908.07	3.80	4.13	OK
3010.00	0.20	5909.20	5908.40	2.70	2.80	OK
1012.00	0.55	5908.00	5906.16	3.20	3.64	OK
122.00	0.40	5906.50	5906.25	2.80	2.55	OK
1312.00	1.00	5906.90	5906.57	4.00	4.23	OK
3130.00	1.00	5909.65	5909.32	3.00	3.33	OK
3230.00	0.50	5909.70	5909.58	3.70	3.82	OK

OK MEANS BURIED DEPTH IS GREATER THAN REQUIRED SOIL COVER OF 2 FEET

*** SUMMARY OF HYDRAULIC GRADIENT LINE ALONG SEWERS

SEWER ID NUMBER	SEWER LENGTH FEET	SURCHARGED LENGTH FEET	CROWN ELEVATION UPSTREAM FEET	CROWN ELEVATION DNSTREAM FEET	WATER ELEVATION UPSTREAM FEET	WATER ELEVATION DNSTREAM FEET	FLOW CONDITION
67.00	505.10	0.00	5909.00	5906.73	5907.69	5906.00	JUMP
46.00	55.40	55.40	5909.40	5909.18	5910.09	5907.69	PRSS'ED
224.00	114.80	114.80	5909.54	5909.08	5911.35	5910.09	PRSS'ED
222.00	83.00	83.00	5910.00	5909.67	5911.86	5911.35	PRSS'ED
12.00	87.90	87.90	5910.30	5909.86	5912.27	5911.86	PRSS'ED
56.00	135.10	135.10	5907.40	5906.72	5909.30	5907.69	PRSS'ED
34.00	114.80	114.80	5909.00	5907.85	5911.42	5910.09	PRSS'ED
1122.00	28.54	28.54	5907.90	5907.61	5911.95	5911.35	PRSS'ED
4422.00	64.00	64.00	5907.70	5907.06	5911.86	5911.35	PRSS'ED
2010.00	32.80	32.80	5910.40	5910.07	5913.57	5913.09	PRSS'ED
3010.00	398.50	398.50	5912.20	5911.40	5914.02	5913.09	PRSS'ED
1012.00	334.50	334.50	5911.00	5909.16	5913.09	5912.05	PRSS'ED
122.00	62.00	62.00	5910.00	5909.75	5912.05	5911.86	PRSS'ED
1312.00	33.00	33.00	5908.90	5908.57	5912.62	5912.05	PRSS'ED
3130.00	32.80	32.80	5911.90	5911.57	5914.14	5914.02	PRSS'ED
3230.00	24.60	24.60	5911.20	5911.08	5914.22	5914.02	PRSS'ED

PRSS'ED=PRESSURED FLOW; JUMP=POSSIBLE HYDRAULIC JUMP; SUBCR=SUBCRITICAL FLOW

*** SUMMARY OF ENERGY GRADIENT LINE ALONG SEWERS

SEWER ID NO	UPST MANHOLE ID NO.	MANHOLE ENERGY ELEV FT	SEWER FRCTION FT	BEND K COEF	BEND LOSS FT	LATERAL K COEF	LATERAL LOSS FT	DOWNST MANHOLE ID	MANHOLE ENERGY FT
67.0	6.00	5909.24	3.24	0.00	0.00	0.00	0.00	7.00	5906.00
46.0	4.00	5910.86	0.15	1.00	0.76	0.25	0.70	6.00	5909.24
224.0	22.00	5911.73	0.18	0.05	0.02	0.25	0.67	4.00	5910.86
222.0	2.00	5912.15	0.10	0.05	0.01	0.25	0.30	22.00	5911.73
12.0	1.00	5912.41	0.19	0.50	0.07	0.00	0.00	2.00	5912.15
56.0	5.00	5909.43	0.18	0.05	0.01	0.00	0.00	6.00	5909.24
34.0	3.00	5912.22	0.56	1.00	0.80	0.00	0.00	4.00	5910.86
1122.0	11.00	5912.44	0.22	1.00	0.50	0.00	0.00	22.00	5911.73
4422.0	44.00	5912.12	0.26	0.50	0.13	0.00	0.00	22.00	5911.73
2010.0	20.00	5913.89	0.11	0.50	0.16	0.00	0.00	10.00	5913.62
3010.0	30.00	5914.30	0.68	0.00	0.00	0.00	0.00	10.00	5913.62
1012.0	10.00	5913.62	1.07	0.00	0.00	0.00	0.00	12.00	5912.55
122.0	12.00	5912.55	0.15	0.50	0.25	0.00	0.00	2.00	5912.15
1312.0	13.00	5912.84	0.07	1.00	0.22	0.00	0.00	12.00	5912.55
3130.0	31.00	5914.92	0.23	0.50	0.39	0.00	0.00	30.00	5914.30
3230.0	32.00	5914.35	0.05	0.00	0.00	0.00	0.00	30.00	5914.30

BEND LOSS =BEND K* FLOWING FULL VHEAD IN SEWER.
LATERAL LOSS= OUTFLOW FULL VHEAD-JCT LOSS K*INFLOW FULL VHEAD

FRICTION LOSS=0 MEANS IT IS NEGLIGIBLE OR POSSIBLE ERROR DUE TO JUMP.
FRICTION LOSS INCLUDES SEWER INVERT DROP AT MANHOLE
NOTICE: VHEAD DENOTES THE VELOCITY HEAD OF FULL FLOW CONDITION.
A MINIMUM JUCTION LOSS OF 0.05 FT WOULD BE INTRODUCED UNLESS LATERAL K=0.
FRICTION LOSS WAS ESTIMATED BY BACKWATER CURVE COMPUTATIONS.

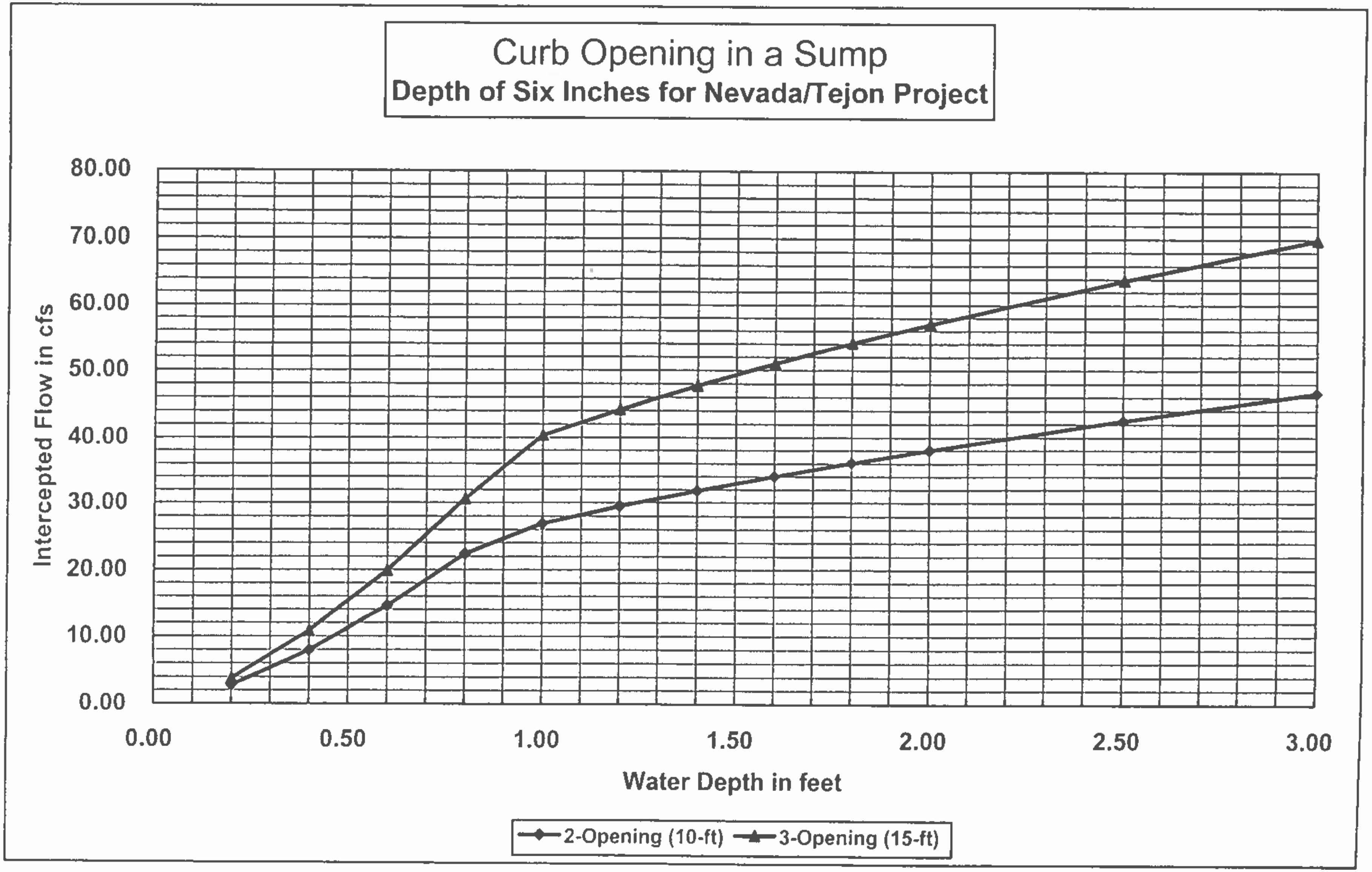
*** SUMMARY OF EARTH EXCAVATION VOLUME FOR COST ESTIMATE.

THE TRENCH SIDE SLOPE = 1

MANHOLE ID NUMBER	GROUND ELEVATION FT	INVERT ELEVATION FT	MANHOLE HEIGHT FT
7.00	5908.80	5902.23	6.57
6.00	5914.80	5904.50	10.30
4.00	5914.20	5904.85	9.35
22.00	5912.30	5905.54	6.76
2.00	5912.30	5906.00	6.30
1.00	5912.30	5908.80	3.50
5.00	5912.20	5905.40	6.80
3.00	5913.80	5906.00	7.80
11.00	5912.50	5906.40	6.10
44.00	5912.50	5906.20	6.30
10.00	5914.20	5908.00	6.20
20.00	5914.20	5908.40	5.80
30.00	5914.90	5909.20	5.70
12.00	5912.80	5906.16	6.64
13.00	5912.90	5906.90	6.00
31.00	5914.90	5909.65	5.25
32.00	5914.90	5909.70	5.20

SEWER ID NUMBER	UPST TRENCH WIDTH ON GROUND FT	AT INVERT FT	DNST TRENCH WIDTH ON GROUND FT	AT INVERT FT	TRENCH LENGTH FT	WALL THICKNESS INCHES	EARTH VOLUME CUBIC YD
67.00	19.18	9.42	11.73	9.42	505.10	5.50	1897.8
46.00	17.18	9.42	18.83	9.42	55.40	5.50	245.1
224.00	10.69	6.83	15.40	6.83	114.80	5.00	306.7
222.00	9.77	6.83	10.43	6.83	83.00	5.00	165.1
12.00	7.08	3.92	7.96	3.92	87.90	2.50	70.9
56.00	13.10	4.50	19.65	4.50	135.10	3.00	402.3
34.00	13.93	5.67	17.03	5.67	114.80	4.00	335.6
1122.00	12.28	3.92	12.45	3.92	28.54	2.50	48.4
4422.00	12.68	3.92	13.56	3.92	64.00	2.50	120.2
2010.00	11.10	4.50	11.76	4.50	32.80	3.00	52.7
3010.00	9.73	5.67	9.93	5.67	398.50	4.00	628.4
1012.00	10.73	5.67	11.61	5.67	334.50	4.00	615.4
122.00	10.35	6.25	9.85	6.25	62.00	4.50	111.5
1312.00	11.50	4.50	11.96	4.50	33.00	3.00	55.1
3130.00	9.71	4.79	10.36	4.79	32.80	3.25	45.7
3230.00	10.48	3.92	10.73	3.92	24.60	2.50	32.5

TOTAL EARTH VOLUME FOR SEWER TRENCHES = 5133.6 CUBIC YARDS
EARTH VOLUME WAS ESTIMATED TO HAVE
BOTTOM WIDTH=DIAMETER OR WIDTH OF SEWER + 2 * B
B=ONE FEET WHEN DIAMETER OR WIDTH <=48 INCHES
B=TWO FEET WHEN DIAMETER OR WIDTH >48 INCHES
IF BOTTOM WIDTH <MINIMUM WIDTH, 2 FT, THE MINIMUM WIDTH WAS USED.
BACKFILL DEPTH UNDER SEWER WAS ASSUMED TO BE ONE FOOT
SEWER WALL THICKNESS=EQIVLNT DIAMATER IN INCH/12 +1 IN INCHES
ED.
BACKFILL DEPTH UNDER SEWER WAS ASSUMED TO BE ONE FOOT
SEWER WALL THICKNESS=EQIVLNT DIAMATER IN INCH/12 +1 IN INCHES


Curb Opening in a Sump
Depth of Six Inches for Nevada/Tejon Project
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Intercepted Flow in cfs
0.00
0.50
1.00
1.50
2.00
2.50
3.00
Water Depth in feet
2-Opening (10-ft)
3-Opening (15-ft)

Curb Opening in a Sump

Curb Opening	L=	5 ft
Curb Height	H=	0.5 ft
Pan Width	W=	2 ft

Weir Q=2.3 (L+1.8*W)Y^1.5
Orifice Q=0.67 HL (64.4Y)^0.5

No of Curb Opening	Net Area sq ft	Perimeter ft
1	2.5	8.6
2	5	13.6
3	7.5	18.6

Water Depth ft	1-opening Q cfs	2-opening Q cfs	3-opening Q cfs
0.20	**1.77**	**2.80**	**3.83**
0.40	**5.00**	**7.91**	**10.82**
0.60	**9.19**	**14.54**	**19.88**
0.80	12.02	**22.38**	**30.61**
1.00	13.44	26.88	40.33
1.20	14.72	29.45	44.17
1.40	15.90	31.81	47.71
1.60	17.00	34.01	51.01
1.80	18.03	36.07	54.10
2.00	19.01	38.02	57.03
2.50	21.25	42.51	63.76
3.00	23.28	46.56	69.85

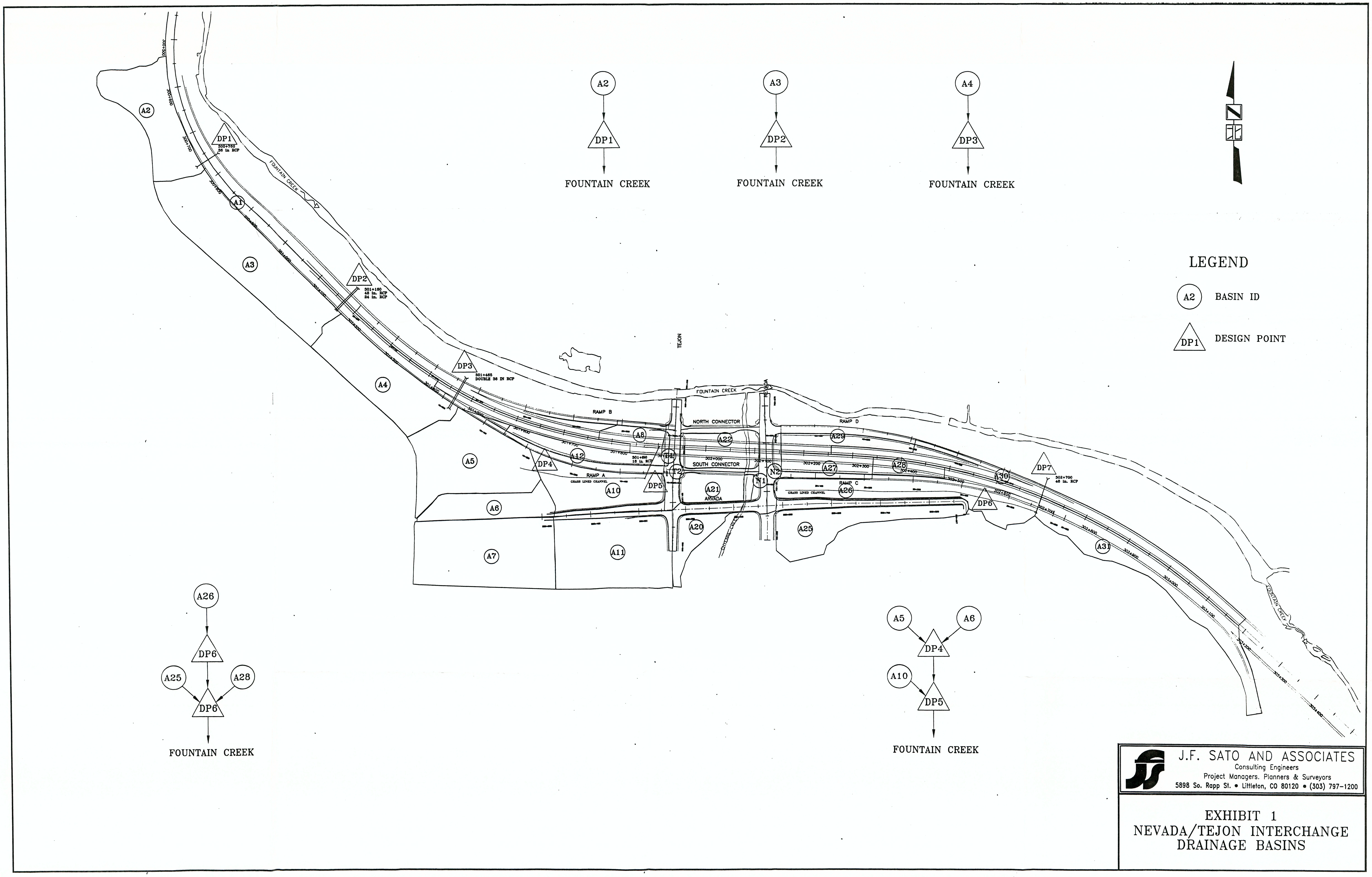


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EXHIBIT 1
NEVADA/TEJON INTERCHANGE
DRAINAGE BASINS

FIGURE 2
FLOODPLAIN / FLOODWAY
FOUNTAIN & CHEYENNE CREEKS