

OFFSITE DRAINAGE STUDY

For

8220 Sunrise Boulevard – Monarch Senior Assisted Living

JTS Job No. 2006-092

APN: 216-0090-012

City of Citrus Heights, Sacramento County, CA

14 April 2008

Prepared by

JTS Engineering Consultants

1808 'J' STREET

SACRAMENTO, CA 95811

TEL NO. (916) 441-6708

FAX NO. (916) 441-5336

OFFSITE DRAINAGE STUDY

For

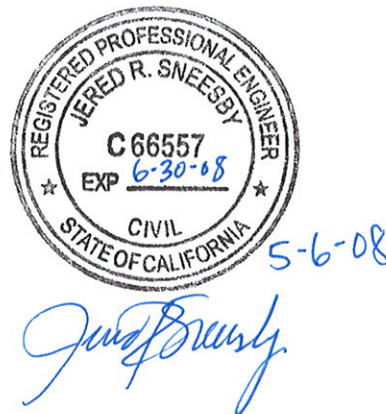
8220 Sunrise Boulevard – Monarch Senior Assisted Living

JTS Job No. 2006-092

APN: 216-0090-012

City of Citrus Heights, Sacramento County, CA

14 April 2008



Prepared by
JTS Engineering Consultants
1808 'J' STREET
SACRAMENTO, CA 95811
TEL NO. (916) 441-6708
FAX NO. (916) 441-5336



OFFSITE DRAINAGE STUDY
8220 SUNRISE BOULEVARD
CITRUS HEIGHTS, CA

Background:

The "Sunrise Branch" of Cripple Creek is a natural drainage channel that flows in a westerly direction along the north boundary of the subject property, before flowing under Sunrise Boulevard and then joining with the main branch of Cripple Creek.

Objective:

Although the 100-yr HGL/floodway is defined for the main channel of Cripple Creek, the Sunrise Branch is not included as a "Special Flood Hazard Area" on FEMA maps. The 10- and 100-yr HGL elevations along the northern boundary are required prior to development. This study will evaluate the hydrology/hydraulics of the Sunrise Branch watershed and provide estimates of water-surface elevations for the 10- and 100-yr design storm just upstream of Sunrise Boulevard.

Analysis:

The extent of the watershed was determined using USGS topographic maps (see Exhibit "A"). The area was initially determined to be slightly over one square mile.

Sacramento County Facility Maps and LIDAR Topography were used to further refine the watershed boundaries (see Exhibit "B"), since existing pipe systems and earthworks have altered drainage flow patterns. The watershed area of Sunrise Branch east of Sunrise Boulevard is approximately 645 Acres.

To determine runoff, Sacramento Method charts were used from the Sacramento City/County Drainage Manual. The primary land use is "low-density residential", or effectively 50% impervious (from Table 5-3)

$$Q_{10} = 465 \text{ cfs (see Exhibit "C")}$$

$$Q_{100} = 640 \text{ cfs (see Exhibit "D")}$$

The FEMA FIRM (see Exhibit "E") and Sacramento County Flood Profiles for Cripple Creek (see Exhibit "F") are included for perspective. The "100 year FEMA with Floodway" HGL downstream of Sunrise Boulevard is 152.5' elevation in Cripple Creek.

Exhibit "G" is a color-banded LIDAR topo exhibit indicating the general topography of the area and the confluence of the Sunrise Branch and Cripple Creeks. The irregularly-shaped parcel at the southwest corner of Sunrise Boulevard and Twin Oaks Avenue was the subject of a 1987 hydraulic study for Sunrise Creek Apartments (Exhibit "H"). The upstream water surface elevations are indicated upstream of the onsite culvert (see Exhibit "I") as:

$$WS_{100} = 152.7$$

$$WS_{10} = 151.6$$

These elevations are to be used as the downstream boundary conditions for this hydraulic study of the creek segment shown in Exhibit "J" and photographed in Exhibit "K". A close-up view of the double-box culvert with dimensions is shown in Exhibit "L"; the roadway above this culvert is at elevation 154.6'.

Normal depth was approximated at three locations for a trapezoidal cross-section, average slope of 0.004 (based on average distance of 2,500 ft. between 10-foot contours along the creek as measured from Exhibit "A"), and Manning's 'n'-value of 0.0375 for "Weeds, Brush, & Bushy Willows." Results are shown in Exhibits "M-1, 2, 3, & 4." Results for Section C were thrown out because the water level calculation yielded a lower result than downstream Section B, as indicated in Exhibit "J".

Due to the non-uniform channel characteristics and the downstream culvert constriction, a HEC-RAS analysis was performed using additional cross-sections to more accurately determine flood levels. Results are shown in Exhibit "N", "O", & "P". Water levels are summarized below:

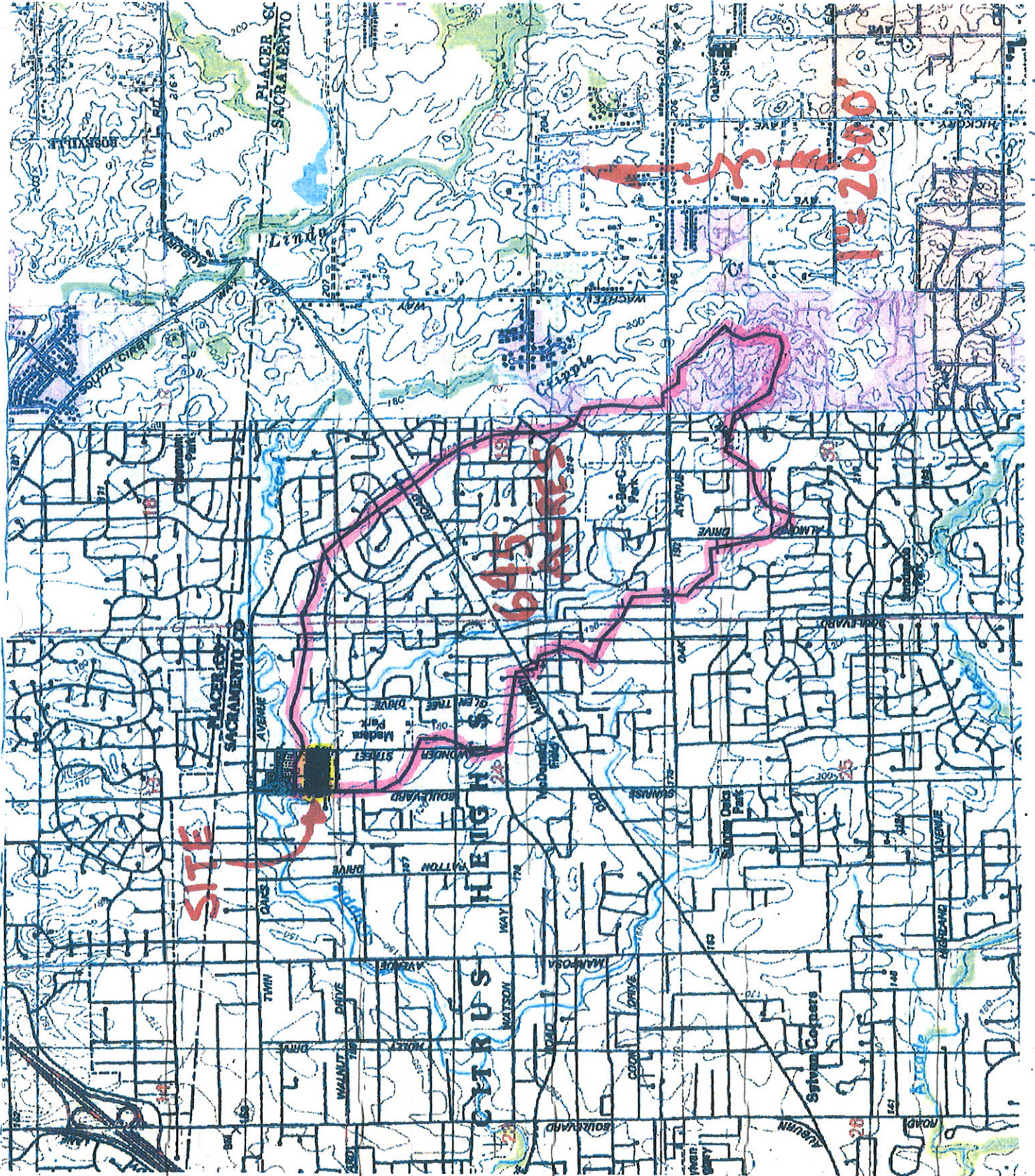
$$\begin{array}{l} \text{Section A:} \\ \text{HGL}_{10} = 152.65 \\ \text{HGL}_{100} = 154.29 \end{array}$$

$$\begin{array}{l} \text{Section B:} \\ \text{HGL}_{10} = 155.80 \\ \text{HGL}_{100} = 156.73 \end{array}$$

$$\begin{array}{l} \text{Section C:} \\ \text{HGL}_{10} = 157.49 \\ \text{HGL}_{100} = 158.57 \end{array}$$

EXHIBIT "A"

2006-092



Contour interval = 10'

SCALE: 1" = 200'

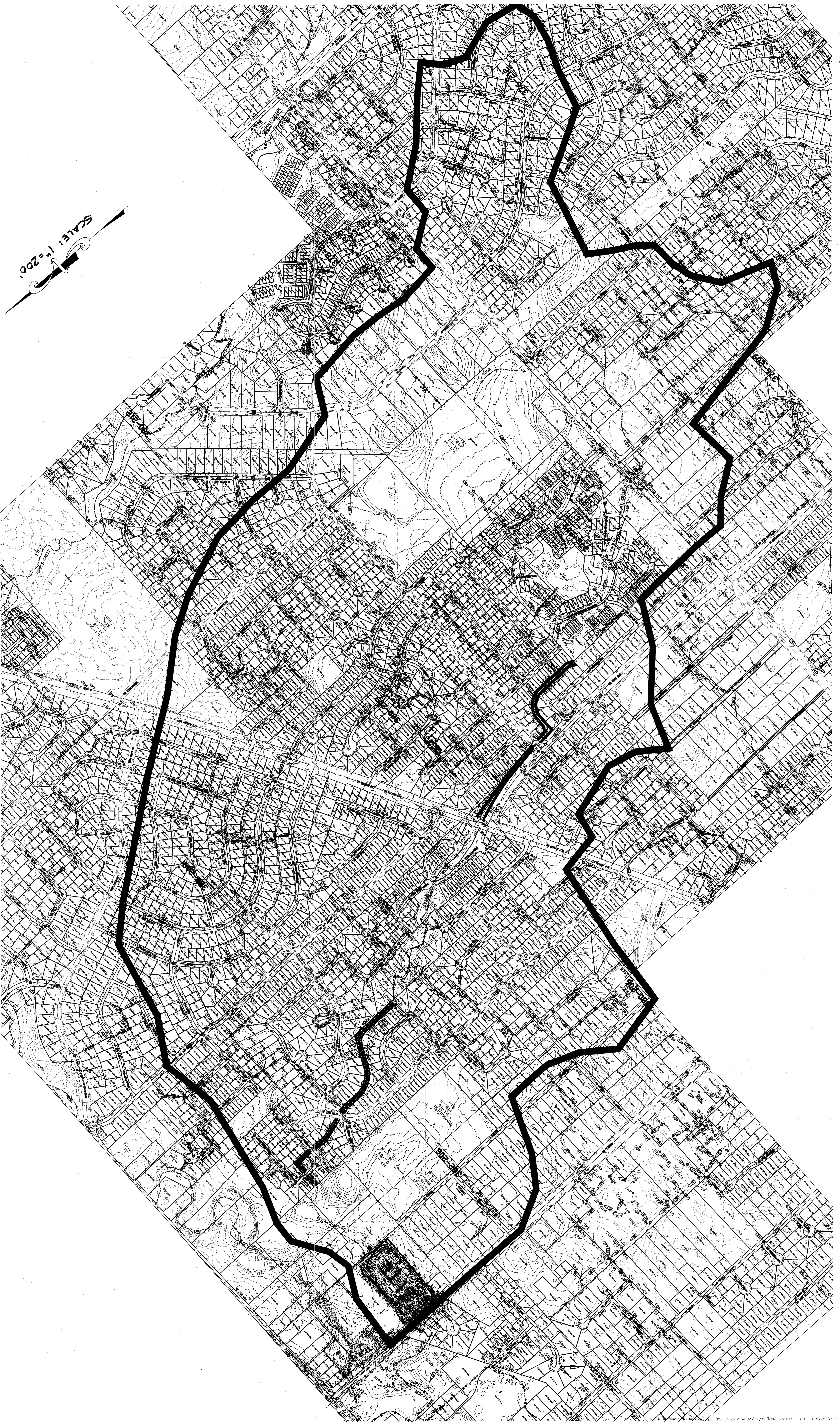
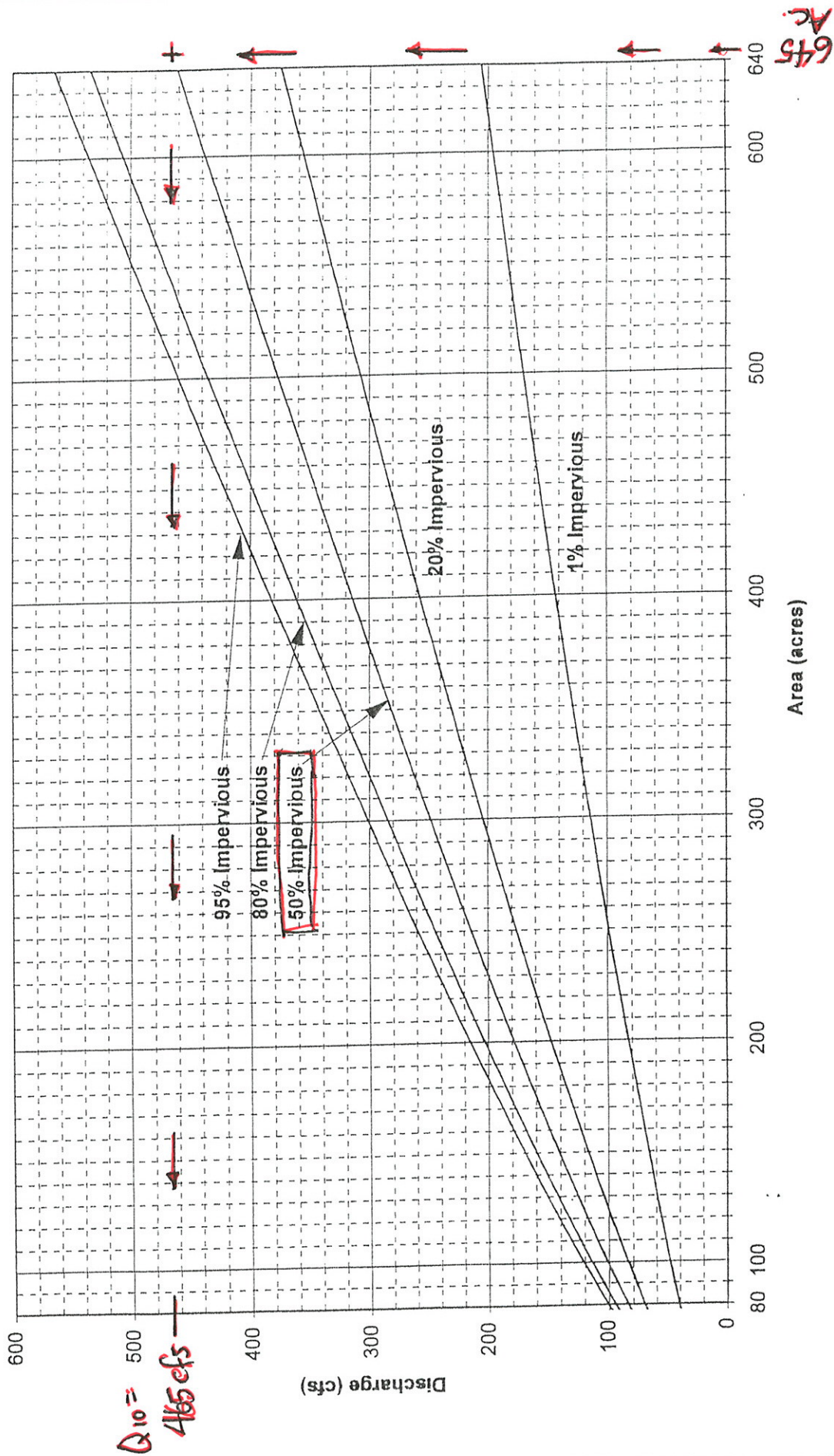


EXHIBIT 'C'



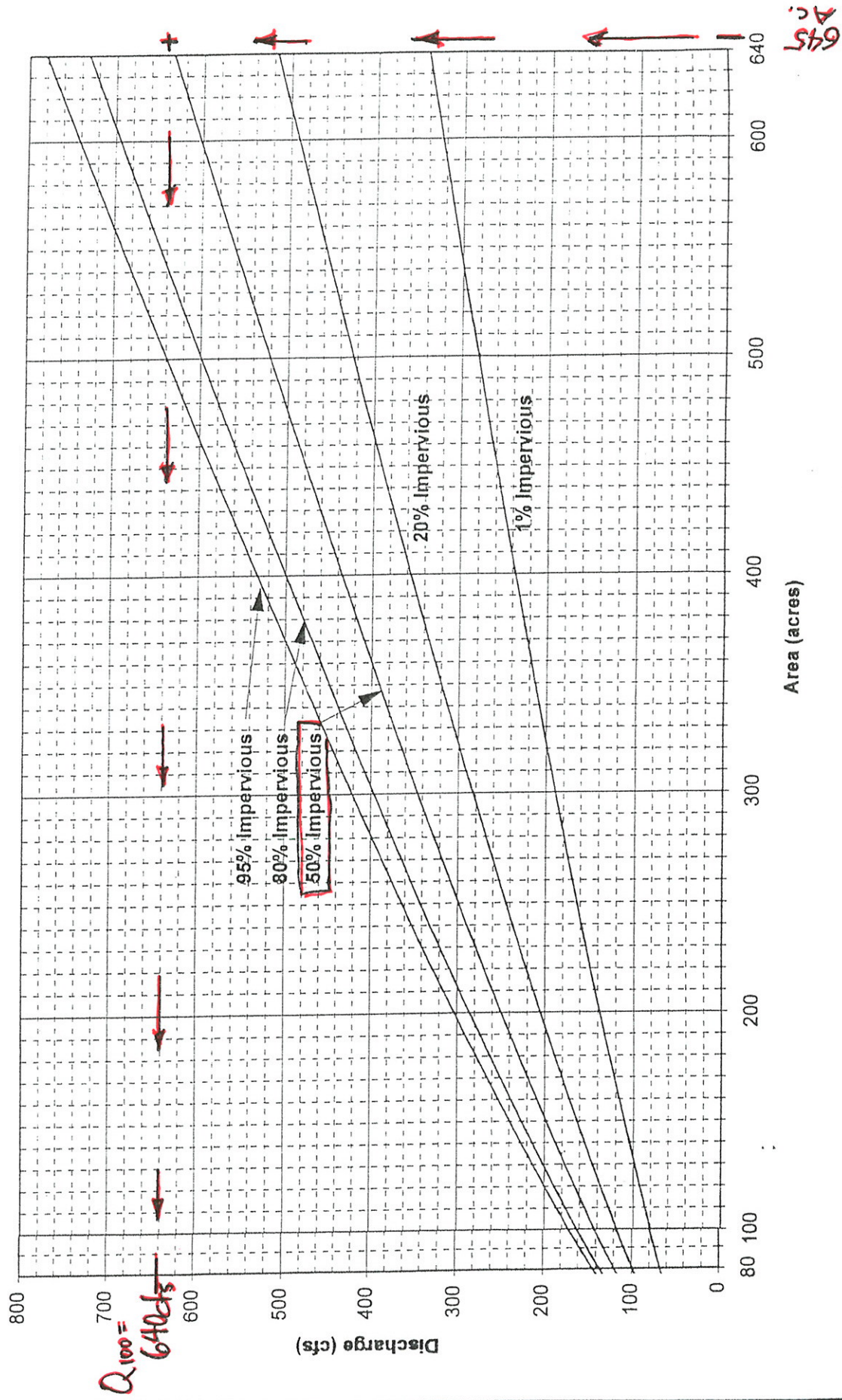
Note: Refer to accompanying disk for assumptions made in deriving this figure.

10-Year Peak Flow
Sacramento Method
Rainfall Zone 3, 80-640 Acres

Date: December 1996

Figure: 2-17

EXHIBIT 'D'



Note: Refer to accompanying disk for assumptions made in deriving this figure.

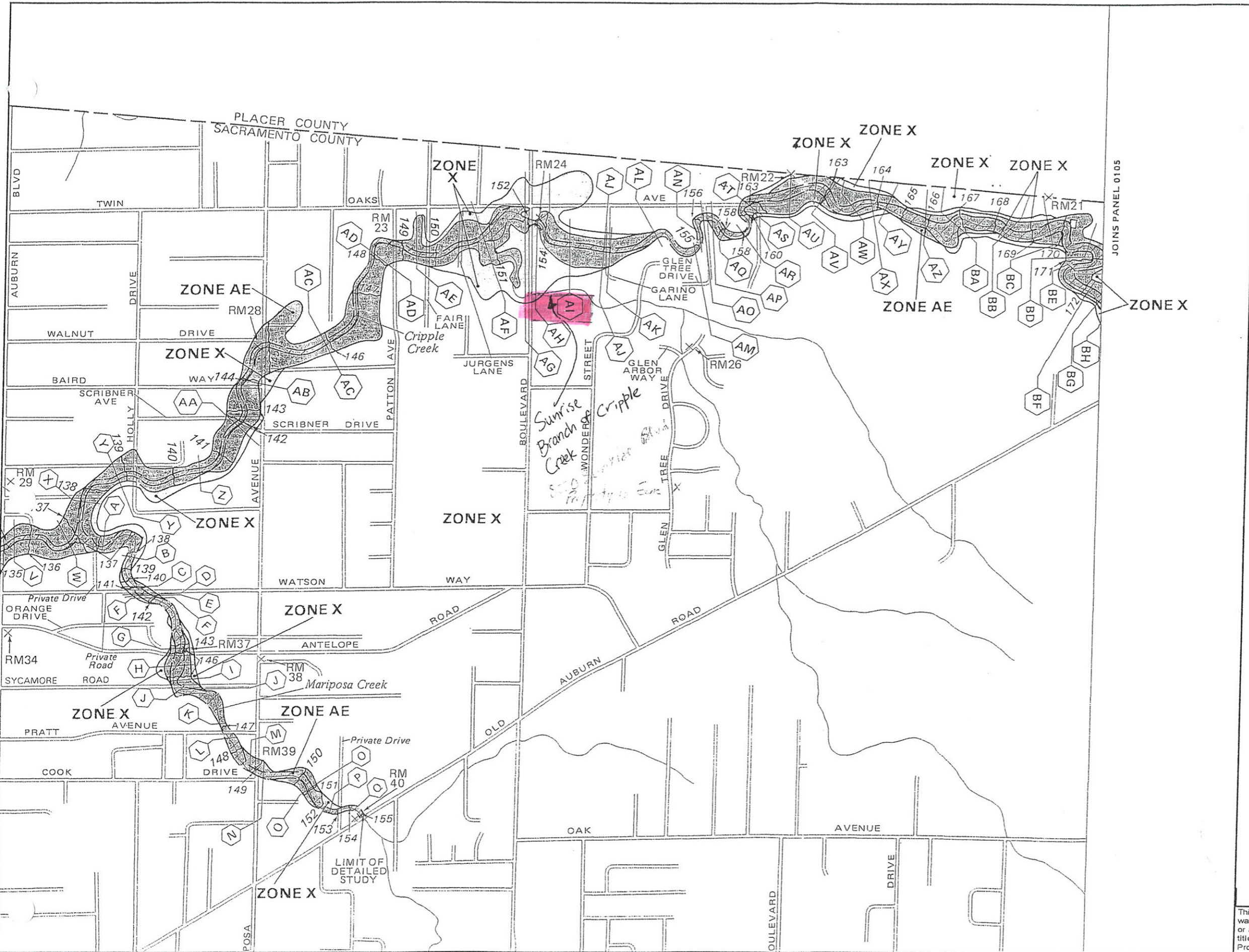
100-Year Peak Flow Sacramento Method Rainfall Zone 3, 80-640 Acres

Date: December 1996

Figure 2-23



APPROXIMATE SCALE IN FEET
1000 0 1000

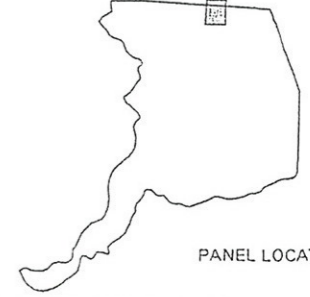


NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

SACRAMENTO COUNTY, CALIFORNIA
(UNINCORPORATED AREAS)

PANEL 85 OF 705
(SEE MAP INDEX FOR PANELS NOT PRINTED)



PANEL LOCATION

COMMUNITY-PANEL NUMBER
060262 0085 E
MAP REVISED:
JULY 6, 1998

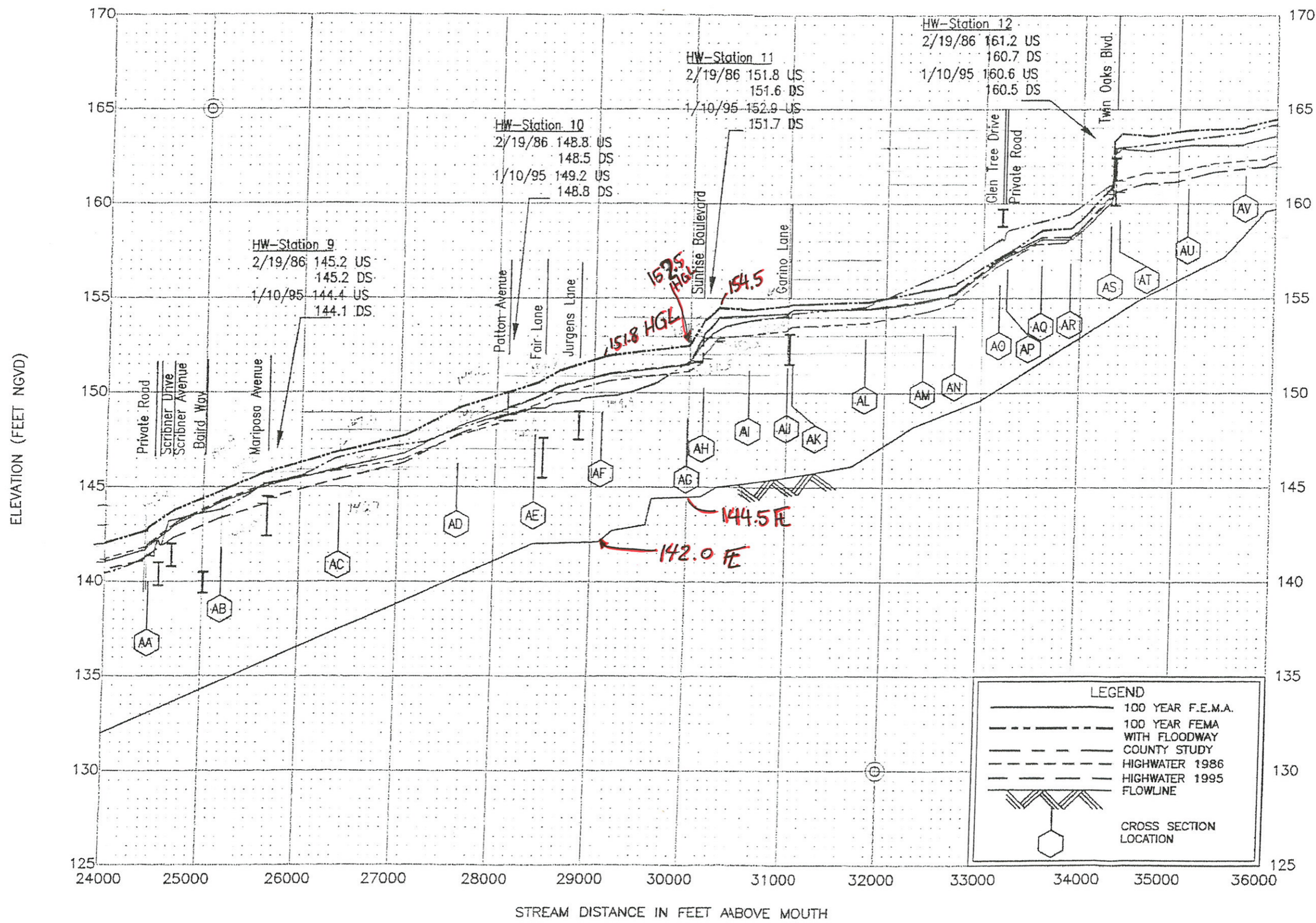


Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

8220 Sunrise Blvd.

2006-092



Plot File Location: F:\Shared Folders\
 Dredger\Couner Flood Profile\Cripple Creek\
 Cripple Creek Master.dwg
 Data File Location: F:\Shared Folders\
 Dredger\Couner Flood Profile\Cripple Creek\
 Cripple Creek Analysis.dwg
 Date: 3/12/2001

FLOOD PROFILES
 CRIPPLE CREEK



COUNTY OF SACRAMENTO
 PUBLIC WORKS AGENCY
 DEPARTMENT OF WATER RESOURCES

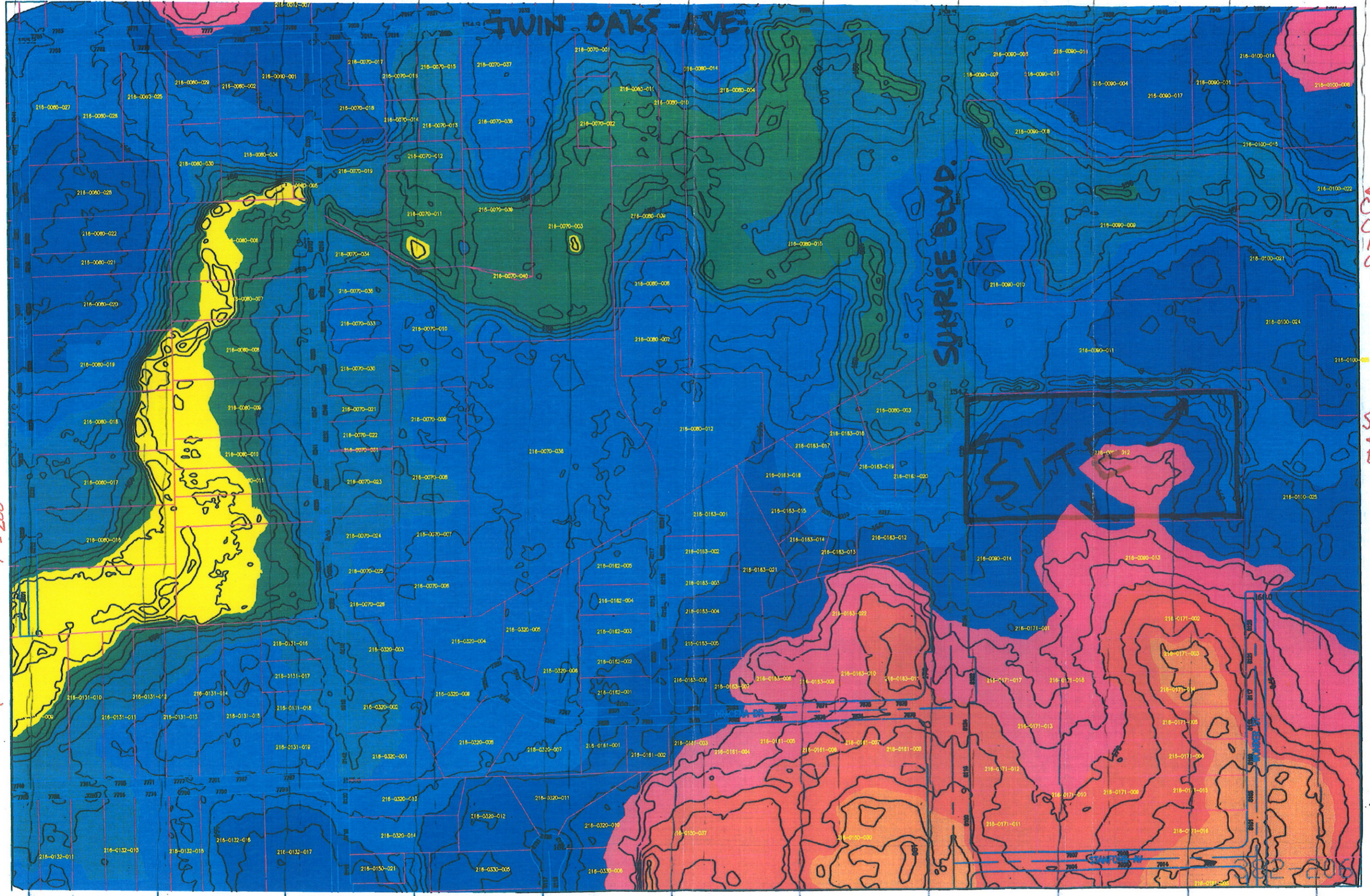
LEGEND

- 100 YEAR F.E.M.A.
- - - 100 YEAR FEMA WITH FLOODWAY COUNTY STUDY
- - - - HIGHWATER 1986
- - - - HIGHWATER 1995
- FLOWLINE
- ⬢ CROSS SECTION LOCATION

S:\2006-092\dwg\2006-092-SHEDMAP.dwg, 4/11/2006 7:03:51 PM, JTS Engineering Consultants Inc.

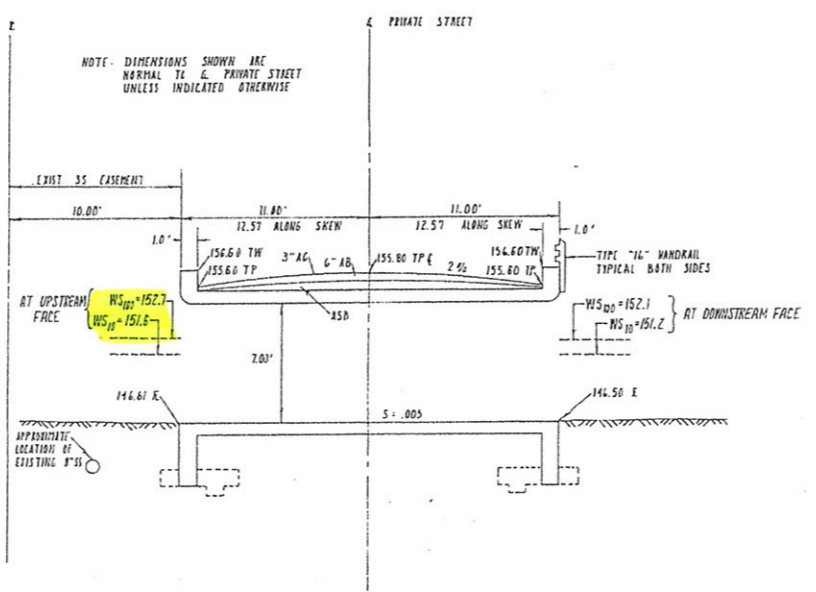
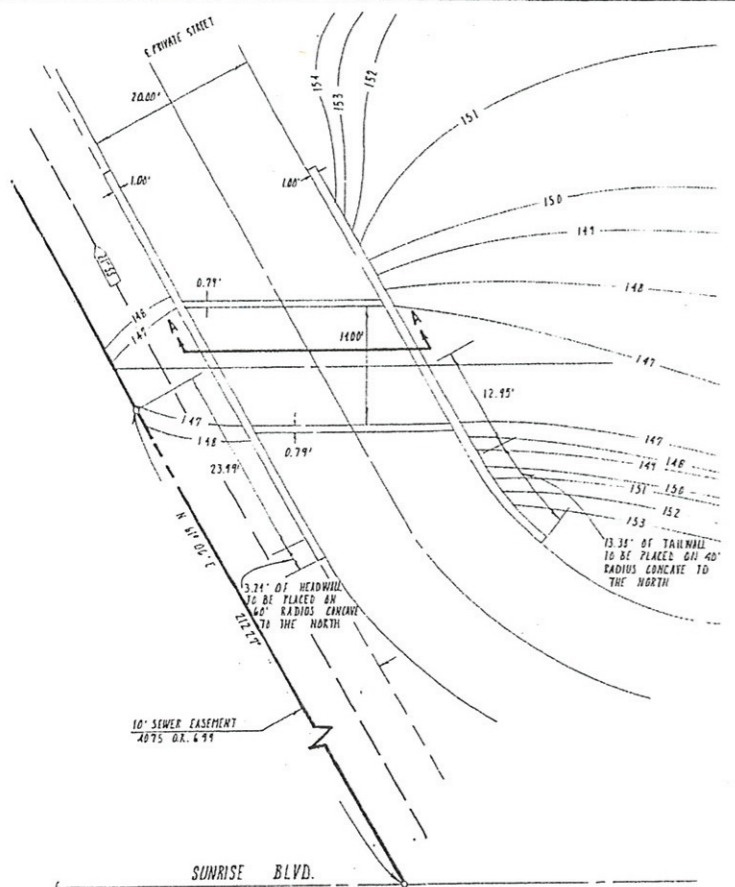
1" = 200'

CRIPPLE CREEK

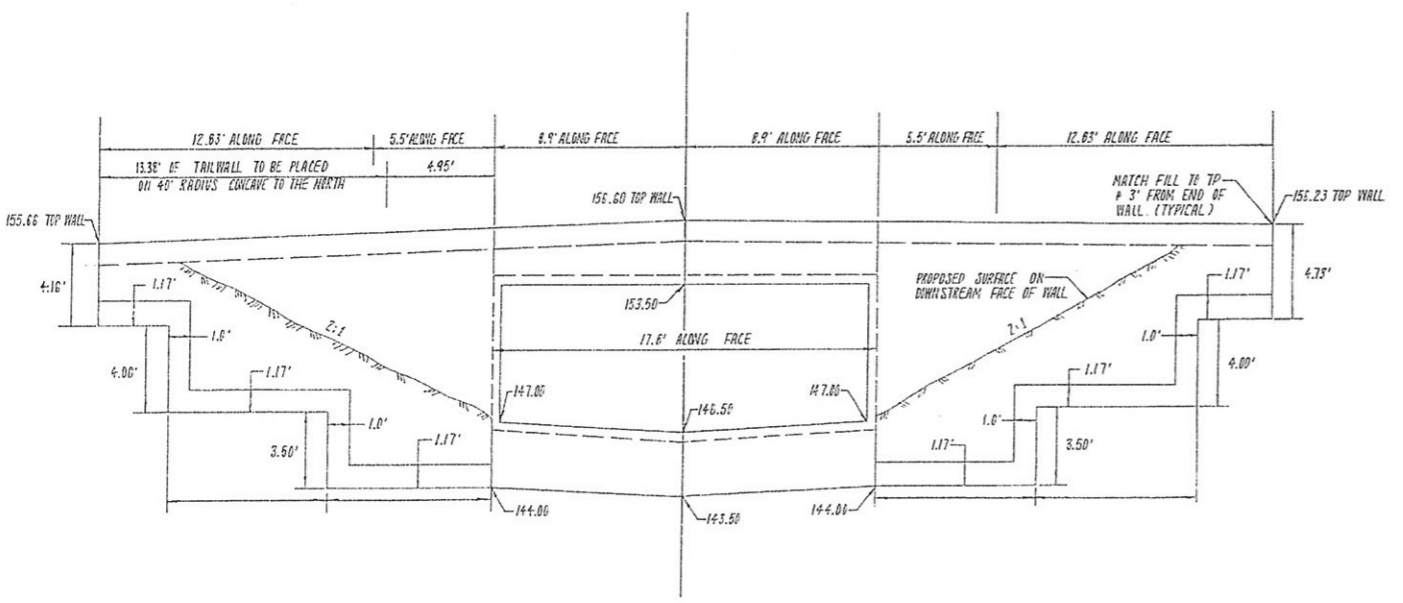


CRIPPLE CREEK MAIN CHANNEL

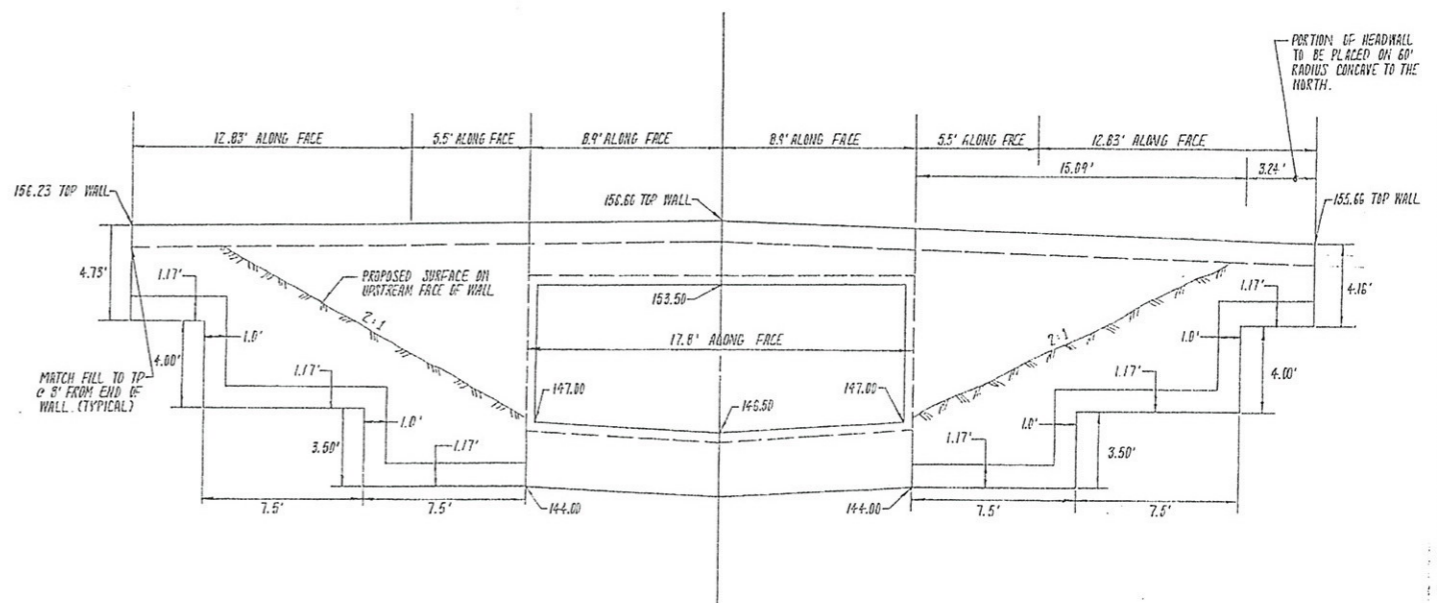
SURRISE BRANCH



SECTION A-A



DOWNSTREAM FACE



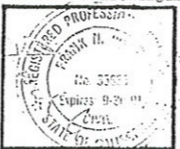
UPSTREAM FACE

BENCHMARK ELEV. _____
 SEE SHEET 1
 FIELD BOOK NO. _____ PG. _____

JTS ENGINEERING CONSULTANTS, INC.
 1808 J STREET
 SACRAMENTO, CALIFORNIA 95814 (916) 441-6708

DESIGNED F. WALKER
 DRAWN _____
 CHECKED F. WALKER
 SUBMITTED _____ RCE

SCALE
 N/A



NO.	DATE	REVISION	COUNTY APPROVAL	BY

BOX CULVERT
 8315 SUNRISE BLVD.
 SUNRISE CREEK APARTMENTS
 COUNTY OF SACRAMENTO A.P.N: 216-080-015 CALIFORNIA

DATE OCT. 1997
 SHEET
8 / 9
 OF

Attachment B: Site Photos



Photo 1. View of the western segment of the unnamed drainage looking upstream.



Photo 2. View of the western segment of the unnamed drainage looking downstream.



Photo 3. View of the eastern segment of the unnamed drainage looking downstream.

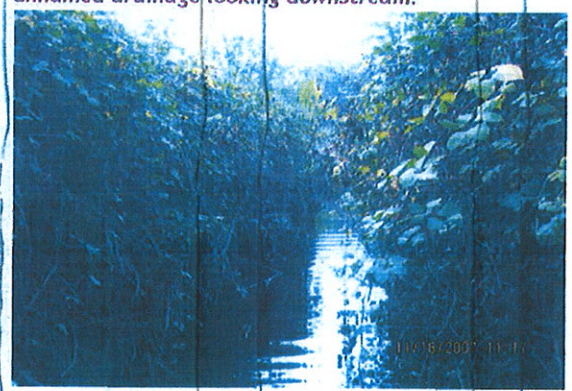


Photo 4. View of the eastern segment of the unnamed drainage looking upstream.

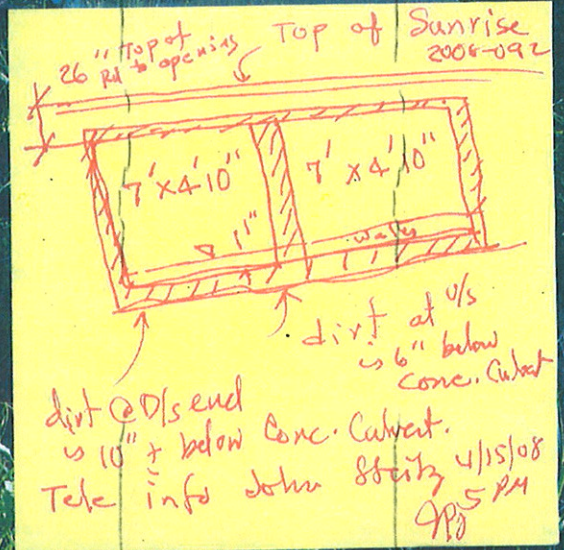


Photo 5. View of the riparian vegetation along the unnamed drainage. Photo was taken from the top of bank looking toward the east.



Photo 6. View of the culvert under Sunrise Blvd through which the unnamed drainage exits the Property.

Exhibit 'L'



SECTION A, 10-yr peak flow

tmp#9.txt

Channel Calculator

Given Input Data:

Shape	Trapezoidal
Solving for	Depth of Flow
Flowrate	465.0000 cfs
Slope	0.0040 ft/ft
Manning's n	0.0375
Height	87.0000 in
Bottom width	90.0000 in
Left slope	0.8333 ft/ft (V/H)
Right slope	0.5556 ft/ft (V/H)

Computed Results:

Depth	65.8310 in = 5.49 ft ;
Velocity	5.3891 fps
Full Flowrate	833.8198 cfs
Flow area	86.2858 ft ²
Flow perimeter	328.3796 in
Hydraulic radius	37.8378 in
Top width	287.4866 in
Area	133.2162 ft ²
Perimeter	405.0346 in
Percent full	75.6678 %

$$HGL_{10} = 146.71' + 5.49' = 152.2'$$

SECTION A, 100yr peak flow

tmp#8.txt

channel calculator

Given Input Data:

Shape	Trapezoidal
Solving for	Depth of Flow
Flowrate	640.0000 cfs
Slope	0.0040 ft/ft
Manning's n	0.0375
Height	87.0000 in
Bottom width	90.0000 in
Left slope	0.8333 ft/ft (V/H)
Right slope	0.5556 ft/ft (V/H)

Computed Results:

Depth	76.7779 in = 6.40 ft;
Velocity	5.8507 fps
Full Flowrate	833.8198 cfs
Flow area	109.3889 ft ²
Flow perimeter	368.0195 in
Hydraulic radius	42.8021 in
Top width	320.3264 in
Area	133.2162 ft ²
Perimeter	405.0346 in
Percent full	88.2505 %

$$HGL_{100} = 146.71' + 6.40' = 153.11'$$

SECTION B, 10-yr peak flow

Exhibit M-3

tmp#10.txt

Channel calculator

Given Input Data:

Shape	Trapezoidal
Solving for	Depth of Flow
Flowrate	465.0000 cfs
Slope	0.0040 ft/ft
Manning's n	0.0375
Height	100.0000 in
Bottom width	58.8000 in
Left slope	1.0000 ft/ft (V/H)
Right slope	0.9090 ft/ft (V/H)

Computed Results:

Depth	82.2624 in = 6.86 ft ;
Velocity	5.6067 fps
Full Flowrate	707.8738 cfs
Flow area	82.9365 ft ²
Flow perimeter	297.4351 in
Hydraulic radius	40.1528 in
Top width	231.5600 in
Area	113.7538 ft ²
Perimeter	348.8902 in
Percent full	82.2624 %

$$HGL_{10} = 150.00' + 6.86' = 156.86'$$

SECTION B, 100 yr peak flow

tmp#11.txt

Channel Calculator

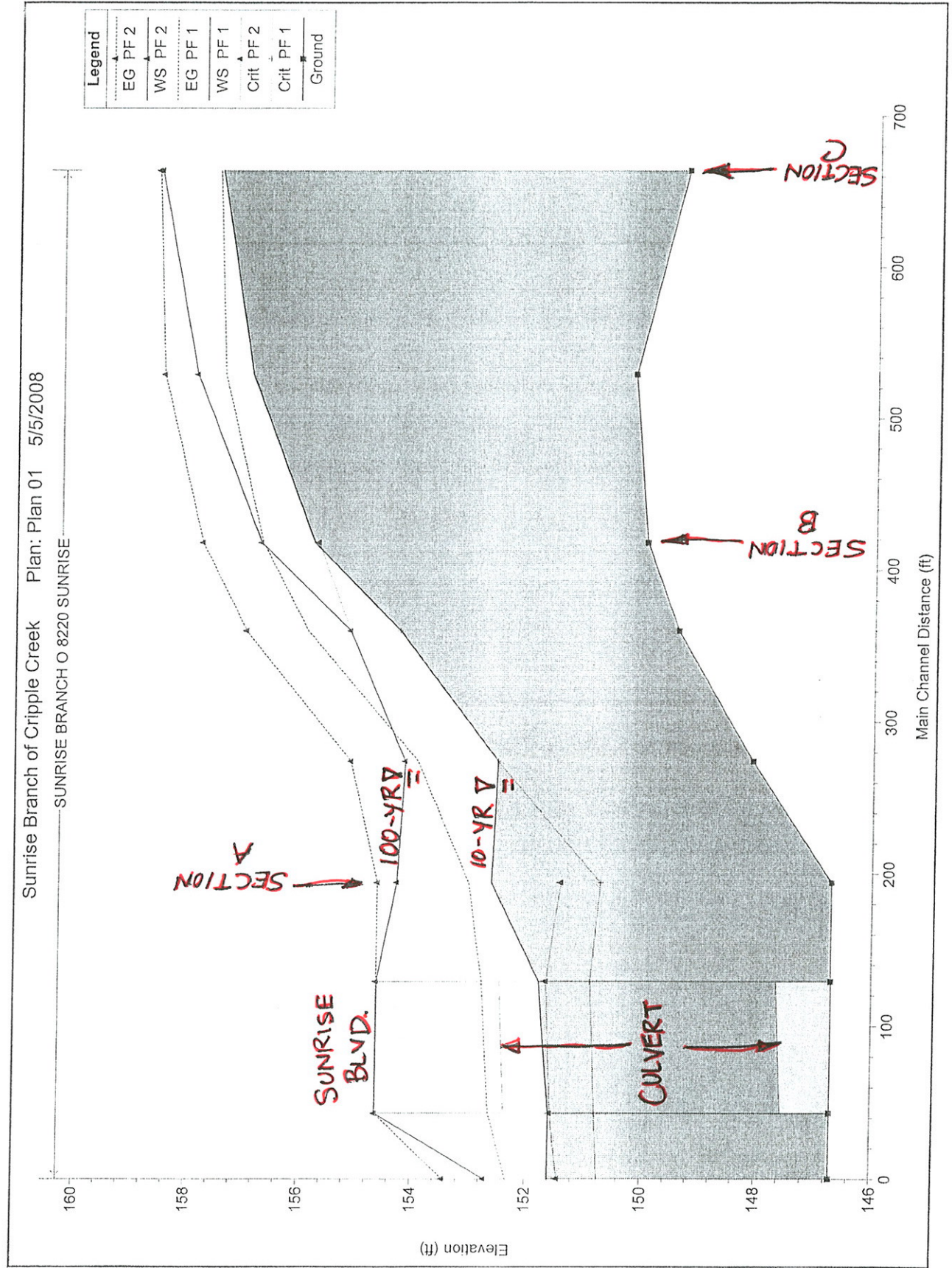
Given Input Data:

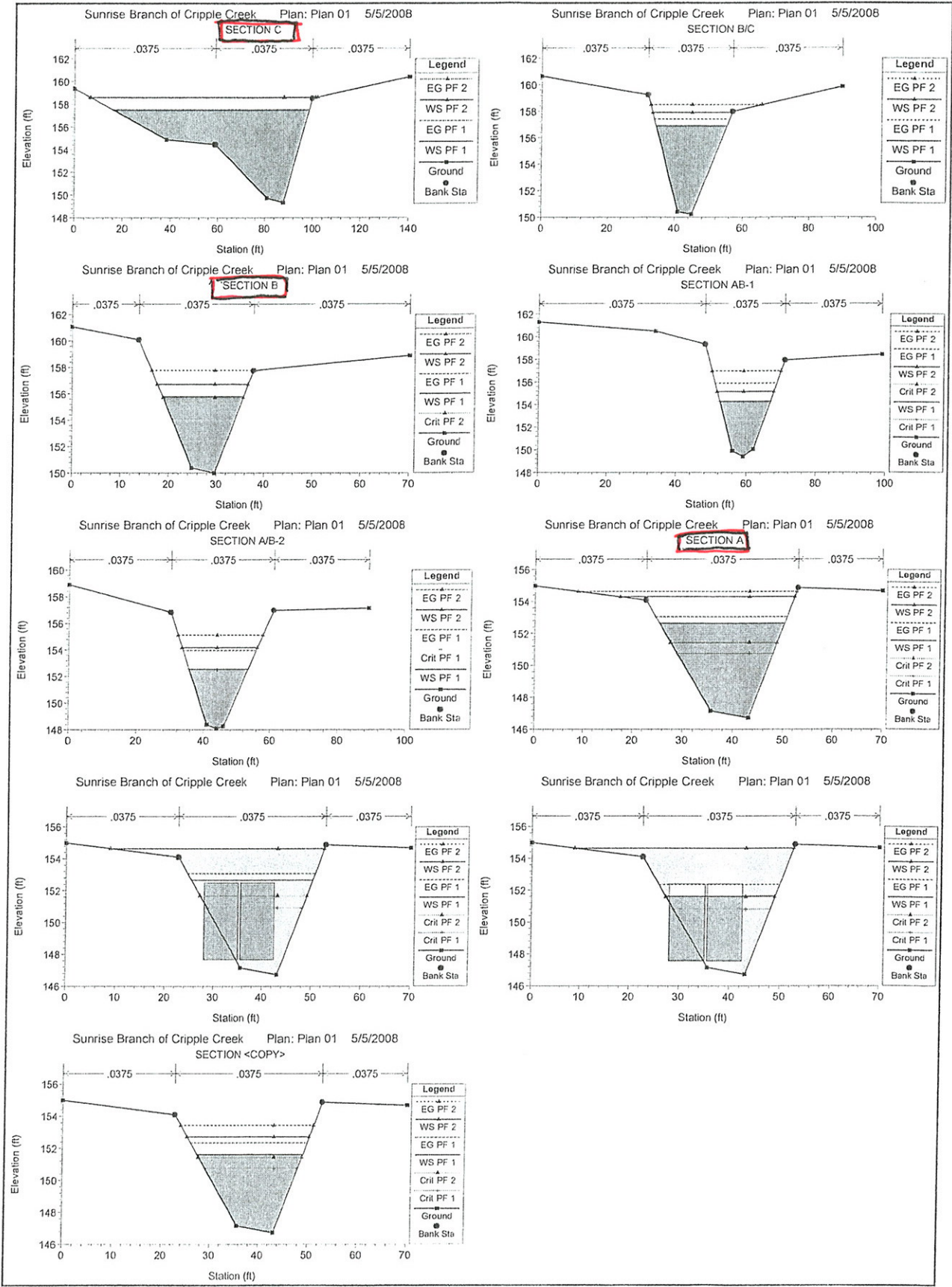
Shape	Trapezoidal
Solving for	Depth of Flow
Flowrate	640.0000 cfs
Slope	0.0040 ft/ft
Manning's n	0.0375
Height	100.0000 in
Bottom width	58.8000 in
Left slope	1.0000 ft/ft (V/H)
Right slope	0.9090 ft/ft (V/H)

Computed Results:

Depth	95.4694 in = 7.96 ft;
Velocity	6.0695 fps
Full Flowrate	707.8738 cfs
Flow area	105.4460 ft ²
Flow perimeter	335.7472 in
Hydraulic radius	45.2251 in
Top width	259.2962 in
Area	113.7538 ft ²
Perimeter	348.8902 in
Percent full	95.4694 %

$HGL_{100} = 150.00' + 7.96' = 157.96'$





HEC-RAS Plan: Plan 01 River: SUNRISE BRANCH O Reach: 8220 SUNRISE

Reach	River Sta	Profile	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
8220 SUNRISE	667.28	PF 1	465.00	149.34	157.49		157.53	0.000225	1.75	304.91	82.33	0.13
8220 SUNRISE	667.28	PF 2	640.00	149.34	158.57		158.62	0.000210	1.87	399.88	94.18	0.13
8220 SUNRISE	535	PF 1	465.00	150.24	156.91		157.41	0.004282	5.65	82.28	20.94	0.50
8220 SUNRISE	535	PF 2	640.00	150.24	157.91		158.49	0.004302	6.13	104.41	23.50	0.51
8220 SUNRISE	420.24	PF 1	465.00	150.00	155.80		156.70	0.009064	7.60	61.22	17.06	0.71
8220 SUNRISE	420.24	PF 2	640.00	150.00	156.73	155.73	157.78	0.009012	8.21	77.96	19.09	0.72
8220 SUNRISE	366	PF 1	465.00	149.42	154.29	154.29	155.89	0.019236	10.15	45.82	14.54	1.01
8220 SUNRISE	366	PF 2	640.00	149.42	155.15	155.15	156.97	0.018461	10.83	59.08	16.25	1.00
8220 SUNRISE	280	PF 1	465.00	148.09	152.56	152.56	153.95	0.017764	9.47	49.11	17.85	1.01
8220 SUNRISE	280	PF 2	640.00	148.09	154.17		155.12	0.008565	7.82	81.89	22.73	0.73
8220 SUNRISE	199.12	PF 1	465.00	146.71	152.65	150.74	153.05	0.003352	5.03	92.42	24.90	0.46
8220 SUNRISE	199.12	PF 2	640.00	146.71	154.29	151.43	154.63	0.002150	4.66	137.93	34.75	0.38
8220 SUNRISE	93.78		Culvert									
8220 SUNRISE	0	PF 1	465.00	146.71	151.60	150.74	152.33	0.007705	6.85	67.91	21.68	0.68
8220 SUNRISE	0	PF 2	640.00	146.71	152.70	151.43	153.43	0.006135	6.84	93.61	25.05	0.62

C

B

A