

**Thienes Engineering, Inc.**

CIVIL ENGINEERING • LAND SURVEYING

**PRELIMINARY HYDROLOGY  
CALCULATIONS**

FOR

CAJON LOGISTIC CENTER  
CAJON BOULEVARD  
SAN BERNARDINO, CALIFORNIA

PREPARED FOR

ALERE PROPERTY GROUP, LLC  
100 BAYVIEW CIRCLE, SUITE 310  
NEWPORT BEACH, CALIFORNIA 92660  
PH. (949) 509-5000  
FAX. (949) 509-5001

OCTOBER 2, 2017

JOB NO. 3560

PREPARED BY

THIENES ENGINEERING  
14349 FIRESTONE BOULEVARD  
LA MIRADA, CALIFORNIA 90638  
P. (714) 521-4811  
FAX. (714) 521-4173

**PRELIMINARY HYDROLOGY  
CALCULATIONS**

**FOR**

**CAJON LOGISTIC CENTER**

**PREPARED BY BRIAN WEIL  
UNDER THE SUPERVISION OF**

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**REINHARD STENZEL      DATE:**  
**R.C.E. 56155**  
**EXP. 12/31/18**

## INTRODUCTION

### A: PROJECT LOCATION

The project site is located on the easterly side of Cajon Boulevard northwest of Little League Drive, between Kendall Drive and Cajon Boulevard in the City of San Bernardino. Please see Figure 1 for vicinity map.

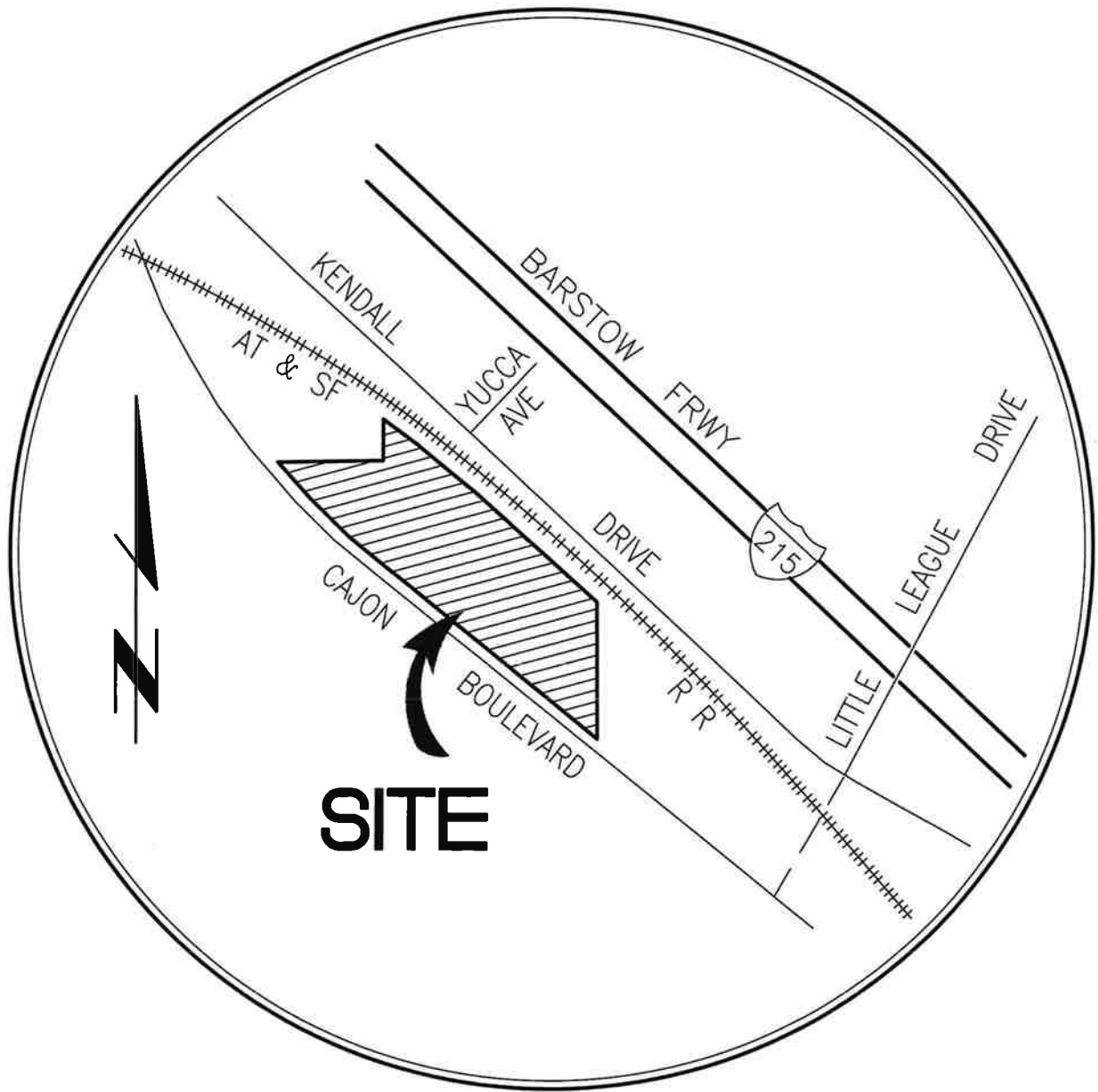
### B: STUDY PURPOSE

The purpose of this study is to determine the proposed condition 100-year peak flow rate from the site that will ultimately drain to a proposed Master Planned storm drain in Cajon Boulevard per City of San Bernardino Vulcan Materials Company Master Plan Line E20 and E21 drawing number 12982.

### C: PROJECT STAFF:

Thienes Engineering staff involved in this study include:

Reinhard Stenzel  
Brian Weil  
Eduardo Toledanes



VICINITY MAP

N.T.S.

## DISCUSSION

The project site is approximately 20 acres. Proposed improvements to the site include a single story (321,800 square feet) warehouse type building. Truck docks are located on the northerly side of the Building, paved vehicle parking areas on the easterly and westerly side of the site and a proposed water quality basin at the southeasterly corner of the project site. The remaining areas will be landscaped.

### Existing Conditions

The site is currently an undeveloped dirt lot and being utilized as a storage and parking area. Runoff from the site generally drains southeasterly to Cajon Boulevard. An existing storm drain system (per City of San Bernardino Vulcan Materials Company Master Plan Line E20 and E21 drawing number 12982) in Cajon Boulevard was designed to convey 100-year commercial runoff from the project site. The existing 100-year peak flow rate from the site tributary to the existing Cajon Storm drain system is approximately 67.6 cfs (41.0 cfs. + 256.6 cfs.).

Please see Appendix "A" for reference materials, Existing Hydrology calculations and Hydrology map for the existing Master Planned Storm Drain Lines E20 and E21.

### Proposed Condition

Runoff from the site at proposed condition was tabled to the Master Planned storm drain in Cajon Boulevard (Line E-21). Drainage from the project site will maintain its drainage pattern at existing condition. See Appendix "A" for portions of the Master Drainage Plan.

Under proposed condition, runoff from the site drains to catch basins and conveyed to a proposed water quality basin (southeast of the building) via a proposed storm drain system and ultimately discharged to an existing 30" R.C.P. lateral downstream (see nodes 100-106). The total 100-year peak flow rate tributary to the existing 30" R.C.P. lateral (at Node 106) is approximately 58.3 cfs. which is less than the existing condition of 67.6 cfs.

Runoff from a southerly portion of the landscaped areas (0.5 acres) from the site including a portion of the Southern Sierra's Power Company easement area (0.4 acres) will drain to Cajon Boulevard.

Please see Appendix "B" for proposed condition hydrology calculations and Appendix "D" for hydrology map.

### Detention Basin and Retention Chambers

The proposed basin east of the site including the underground chambers north and east of the proposed building will be utilized only for water quality purposes. Runoff from the site will drain to catch basins and conveyed to the underground chambers and into the proposed basin. Here, initial runoff from the site will be treated for water quality and allowed to infiltrate. Runoff that exceeds the BMP volume including the peak flow will be conveyed to Line "C" and ultimately discharged to the existing 30" R.C.P. downstream.

### Methodology

San Bernardino County Rational Method program (AES Software) was used for the hydrology calculations. The site is composed of soil type "A" per the San Bernardino County Hydrology Manual (see reference in Appendix "A").

**APPENDIX**

**DESCRIPTION**

**A**

**REFERENCE MATERIALS**

**B**

**HYDROLOGY CALCULATIONS**

**C**

**HYDRAULIC CALCULATIONS**

**D**

**HYDROLOGY MAP**

# **APPENDIX A**

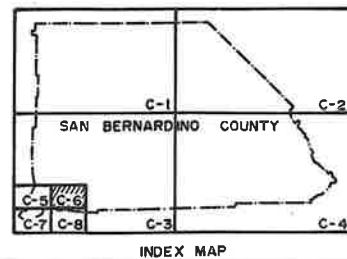
## **REFERENCE MATERIALS**





SOURCE: GEOLOGY MAP

SOURCE: GEOLOGY MAP  
SOURCE: 1971 SCS SURVEY

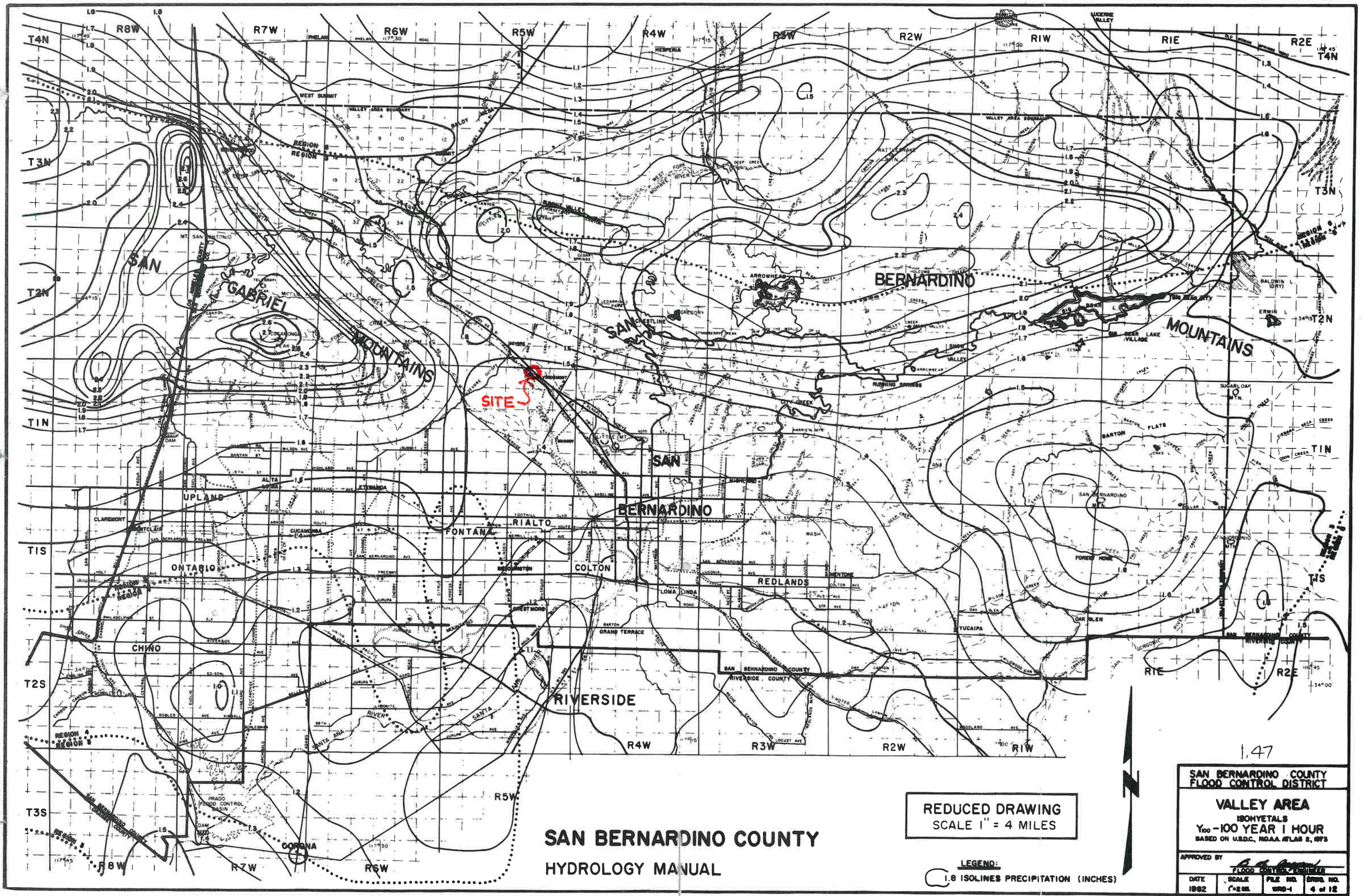


- LEGEND
- SOIL GROUP BOUNDARY
  - A SOIL GROUP DESIGNATION
  - - - BOUNDARY OF INDICATED SOURCE

SCALE REDUCED BY 1/2

SOIL "A"  
HYDROLOGIC SOILS GROUP MAP  
FOR  
SOUTHWEST-B AREA





**SAN BERNARDINO COUNTY  
HYDROLOGY MANUAL**

**REDUCED DRAWING  
SCALE 1" = 4 MILES**

**LEGEND:**  
1.8 ISOLINES PRECIPITATION (INCHES)

1.47

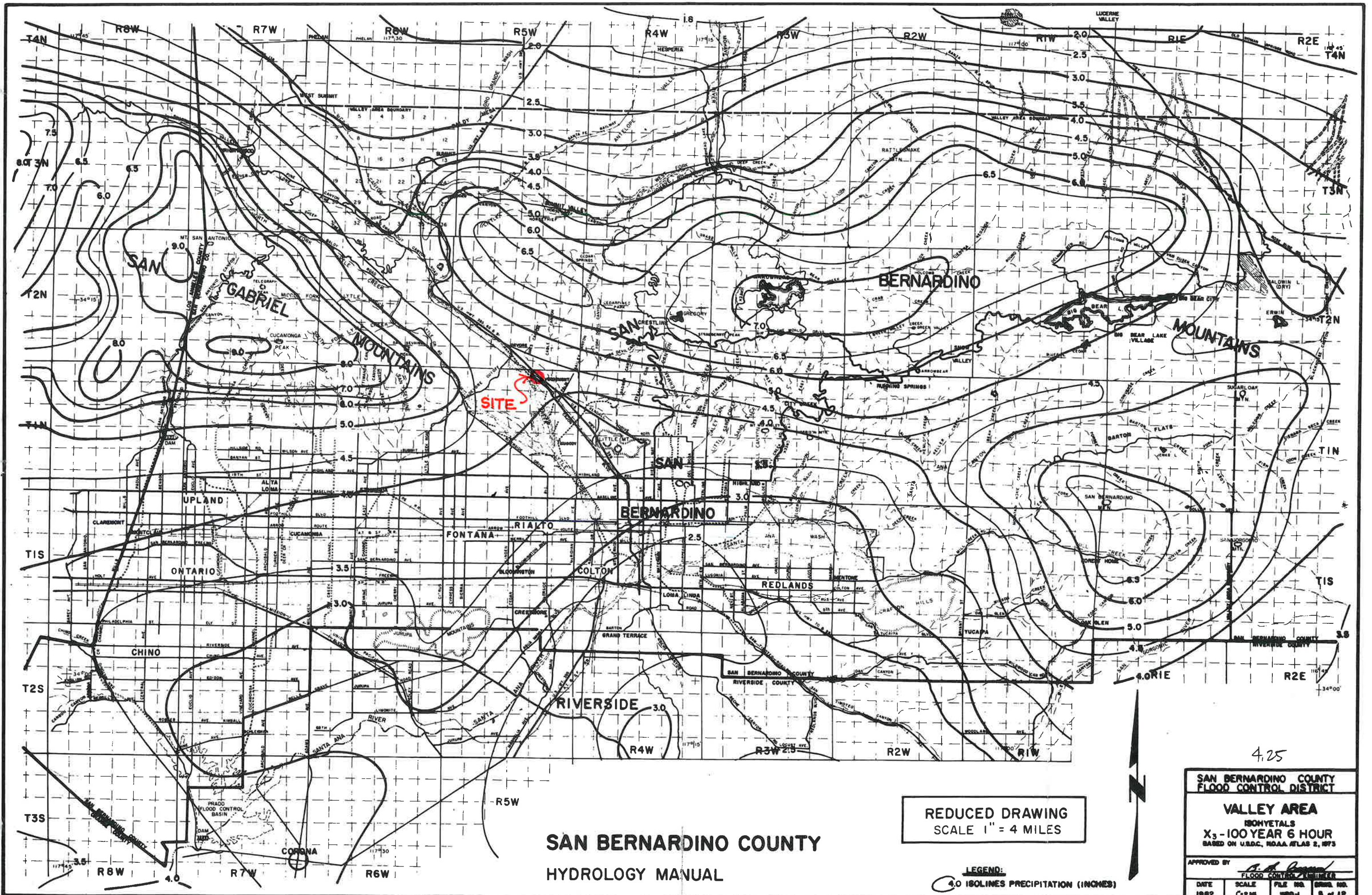
**SAN BERNARDINO COUNTY  
FLOOD CONTROL DISTRICT**

**VALLEY AREA**  
180 HOURS  
Y<sub>100</sub> - 100 YEAR 1 HOUR  
BASED ON U.S.D.C. NOAA ATLAS 2, 1973

APPROVED BY: *[Signature]*

DATE	SCALE	FILE NO.	DWG. NO.
1982	1" = 4 M.	WRD-1	4 of 12





**SAN BERNARDINO COUNTY  
HYDROLOGY MANUAL**

**REDUCED DRAWING  
SCALE 1" = 4 MILES**

**LEGEND:**  
4.0 ISOLINES PRECIPITATION (INCHES)

4.25

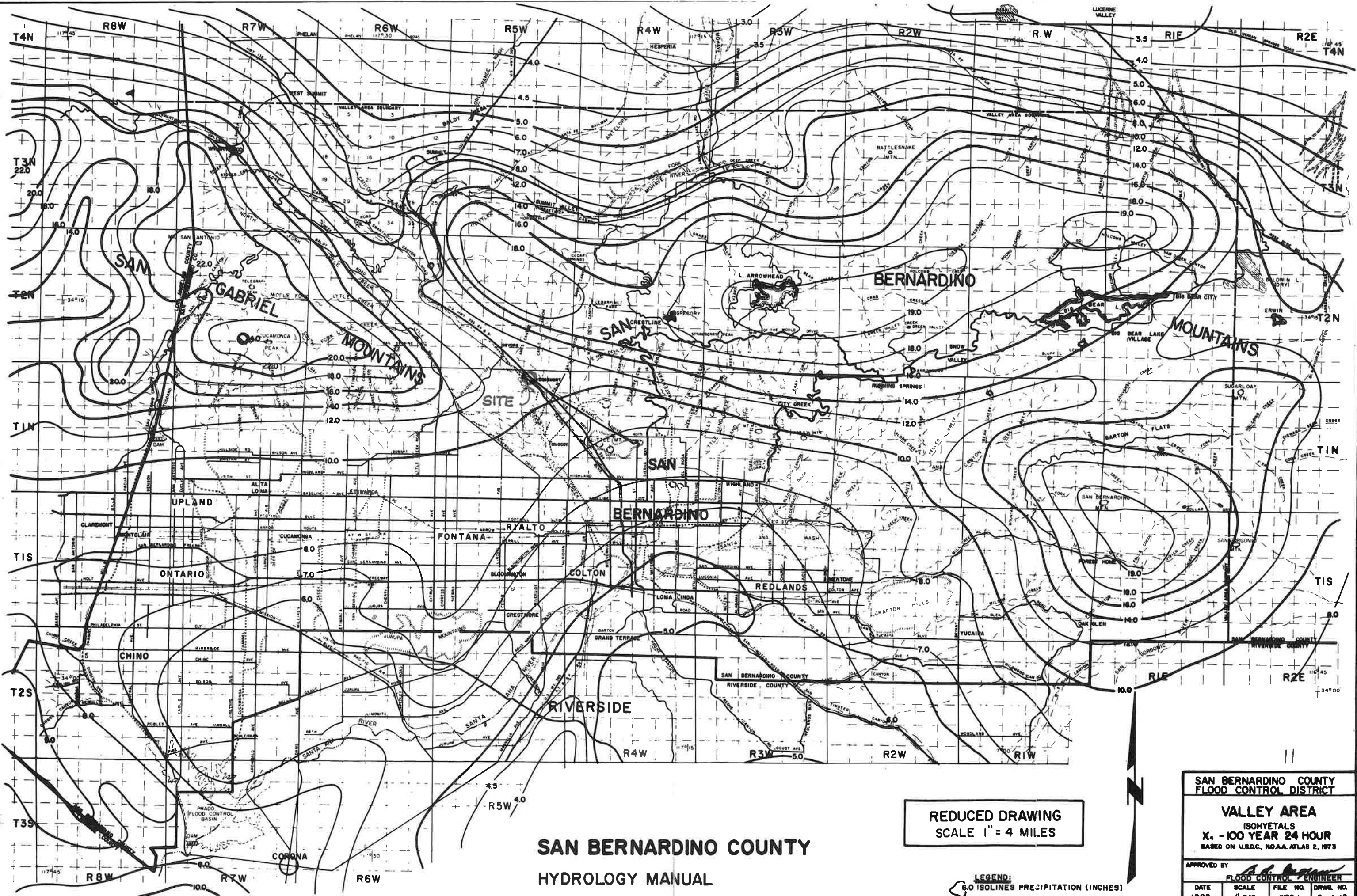
**SAN BERNARDINO COUNTY  
FLOOD CONTROL DISTRICT**

**VALLEY AREA**  
ISOHYETALS  
X<sub>3</sub> - 100 YEAR 6 HOUR  
BASED ON U.S.D.C. NOAA ATLAS 2, 1973

APPROVED BY *[Signature]*  
FLOOD CONTROL ENGINEER

DATE 1982	SCALE 1"=4M	FILE NO. WB-1	SHEET NO. 8 of 12
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**SAN BERNARDINO COUNTY  
HYDROLOGY MANUAL**

**REDUCED DRAWING  
SCALE 1" = 4 MILES**

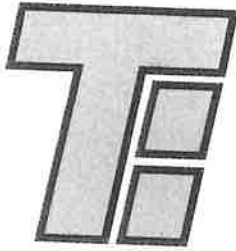
**LEGEND:**  
6.0 ISOLINES PRECIPITATION (INCHES)

**SAN BERNARDINO COUNTY  
FLOOD CONTROL DISTRICT**

**VALLEY AREA  
ISOHYETALS  
X<sub>1</sub> - 100 YEAR 24 HOUR  
BASED ON U.S.D.C. NOAA ATLAS 2, 1973**

APPROVED BY *[Signature]*  
FLOOD CONTROL ENGINEER

DATE	SCALE	FILE NO.	DRWG. NO.
1982	1"=2 MI.	WRD-1	6 of 12



# **Thienes Engineering, Inc.**

CIVIL ENGINEERING • LAND SURVEYING

## **HYDROLOGY & HYDRAULIC CALCULATIONS**

FOR

CAJON BOULEVARD MASTER PLAN  
STORM DRAIN (LINES E-20 AND E-21)  
SAN BERNARDINO, CALIFORNIA

PREPARED FOR

CALMAT LAND CO. C/O VULCAN MATERIAL CO.  
3200 SAN FERNANDO ROAD  
LOS ANGELES, CALIFORNIA 90065  
PH. (323) 258-2777  
FAX. (323) 258-1583

MARCH 15, 2012  
REVISED JUNE 27, 2012  
REVISED AUGUST 29, 2012  
REVISED OCTOBER 8, 2012  
REVISED NOVEMBER 28, 2012  
REVISED AUGUST 6, 2013 (DELTA 1 REVISION)  
REVISED SEPTEMBER 16, 2013 (DELTA 2 REVISION)  
REVISED OCTOBER 31, 2014 (DELTA 5 REVISION)

JOB NO. 3073C

PREPARED BY

THIENES ENGINEERING  
14349 FIRESTONE BOULEVARD  
LA MIRADA, CALIFORNIA 90638  
P. (714) 521-4811  
FAX. (714) 521-4173



SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.10  
 SUBAREA AREA (ACRES) = 3.30 SUBAREA RUNOFF (CFS) = 9.31  
 EFFECTIVE AREA (ACRES) = 75.08 AREA-AVERAGED Fm (INCH/HR) = 0.10  
 AREA-AVERAGED Fp (INCH/HR) = 0.80 AREA-AVERAGED Ap = 0.12  
 TOTAL AREA (ACRES) = 104.65 PEAK FLOW RATE (CFS) = 245.82  
 NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 132.00 TO NODE 132.00 IS CODE = 1

>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<

=====

TOTAL NUMBER OF STREAMS = 2  
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 1 ARE:  
 TIME OF CONCENTRATION (MIN.) = 15.92  
 RAINFALL INTENSITY (INCH/HR) = 3.21  
 AREA-AVERAGED Fm (INCH/HR) = 0.10  
 AREA-AVERAGED Fp (INCH/HR) = 0.80  
 AREA-AVERAGED Ap = 0.12  
 EFFECTIVE STREAM AREA (ACRES) = 75.08  
 TOTAL STREAM AREA (ACRES) = 104.65  
 PEAK FLOW RATE (CFS) AT CONFLUENCE = 245.82

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 130.00 TO NODE 131.00 IS CODE = 21

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<  
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<

=====

INITIAL SUBAREA FLOW-LENGTH (FEET) = 1190.00  
 ELEVATION DATA: UPSTREAM (FEET) = 1844.00 DOWNSTREAM (FEET) = 1822.00

Tc = K \* [(LENGTH\*\* 3.00) / (ELEVATION CHANGE)] \*\* 0.20  
 SUBAREA ANALYSIS USED MINIMUM Tc (MIN.) = 11.474  
 \* 100 YEAR RAINFALL INTENSITY (INCH/HR) = 3.912  
 SUBAREA Tc AND LOSS RATE DATA (AMC III):

DEVELOPMENT TYPE/ LAND USE	SCS SOIL GROUP	AREA (ACRES)	Fp (INCH/HR)	Ap (DECIMAL)	SCS CN	Tc (MIN.)
COMMERCIAL	A	12.30	0.80	0.10	52	11.47

SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp (INCH/HR) = 0.80  
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.10  
 SUBAREA RUNOFF (CFS) = 42.43  
 TOTAL AREA (ACRES) = 12.30 PEAK FLOW RATE (CFS) = 42.43

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 131.00 TO NODE 132.00 IS CODE = 31

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<  
 >>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

=====

ELEVATION DATA: UPSTREAM (FEET) = 1810.00 DOWNSTREAM (FEET) = 1807.80  
 FLOW LENGTH (FEET) = 80.00 MANNING'S N = 0.013  
 DEPTH OF FLOW IN 27.0 INCH PIPE IS 19.1 INCHES  
 PIPE-FLOW VELOCITY (FEET/SEC.) = 14.13  
 ESTIMATED PIPE DIAMETER (INCH) = 27.00 NUMBER OF PIPES = 1  
 PIPE-FLOW (CFS) = 42.43  
 PIPE TRAVEL TIME (MIN.) = 0.09 Tc (MIN.) = 11.57  
 LONGEST FLOWPATH FROM NODE 130.00 TO NODE 132.00 = 1270.00 FEET.

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 132.00 TO NODE 132.00 IS CODE = 1

>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<  
 >>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<

=====

TOTAL NUMBER OF STREAMS = 2  
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:  
 TIME OF CONCENTRATION (MIN.) = 11.57  
 RAINFALL INTENSITY (INCH/HR) = 3.89  
 AREA-AVERAGED Fm (INCH/HR) = 0.08  
 AREA-AVERAGED Fp (INCH/HR) = 0.80  
 AREA-AVERAGED Ap = 0.10  
 EFFECTIVE STREAM AREA (ACRES) = 12.30  
 TOTAL STREAM AREA (ACRES) = 12.30  
 PEAK FLOW RATE (CFS) AT CONFLUENCE = 42.43

\*\* CONFLUENCE DATA \*\*

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp (Fm) (INCH/HR)	Ap (ACRES)	Ae (ACRES)	HEADWATER NODE
1	234.33	11.09	3.993	0.80 (0.10)	0.12	58.0	110.00

1	239.05	11.88	3.831	0.80( 0.10)	0.12	61.7	120.00
1	245.82	15.92	3.214	0.80( 0.10)	0.12	75.1	100.00
1	226.77	33.60	2.053	0.80( 0.11)	0.14	104.7	554.00
1	242.33	12.67	3.686	0.80( 0.10)	0.12	64.9	123.00
2	42.43	11.57	3.893	0.80( 0.08)	0.10	12.3	130.00

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO  
CONFLUENCE FORMULA USED FOR 2 STREAMS.

\*\* PEAK FLOW RATE TABLE \*\*

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap (ACRES)	Ae (ACRES)	HEADWATER NODE
1	276.07	11.09	3.993	0.80( 0.09)	0.12	69.8	110.00
2	280.79	11.88	3.831	0.80( 0.09)	0.12	74.0	120.00
3	282.45	12.67	3.686	0.80( 0.09)	0.12	77.2	123.00
4	280.69	15.92	3.214	0.80( 0.10)	0.12	87.4	100.00
5	248.73	33.60	2.053	0.80( 0.11)	0.13	117.0	554.00
6	279.61	11.57	3.893	0.80( 0.09)	0.12	72.5	130.00

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:

PEAK FLOW RATE(CFS) = 282.45 Tc(MIN.) = 12.67  
EFFECTIVE AREA(ACRES) = 77.24 AREA-AVERAGED Fm(INCH/HR) = 0.09  
AREA-AVERAGED Fp(INCH/HR) = 0.80 AREA-AVERAGED Ap = 0.12  
TOTAL AREA(ACRES) = 116.95  
LONGEST FLOWPATH FROM NODE 100.00 TO NODE 132.00 = 4194.00 FEET.

\*\*\*\*\*  
FLOW PROCESS FROM NODE 132.00 TO NODE 142.00 IS CODE = 31

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<  
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

ELEVATION DATA: UPSTREAM(FEET) = 1806.30 DOWNSTREAM(FEET) = 1785.70  
FLOW LENGTH(FEET) = 929.00 MANNING'S N = 0.013  
DEPTH OF FLOW IN 54.0 INCH PIPE IS 43.8 INCHES  
PIPE-FLOW VELOCITY(FEET/SEC.) = 20.46  
ESTIMATED PIPE DIAMETER(INCH) = 54.00 NUMBER OF PIPES = 1  
PIPE-FLOW(CFS) = 282.45  
PIPE TRAVEL TIME(MIN.) = 0.76 Tc(MIN.) = 13.43  
LONGEST FLOWPATH FROM NODE 100.00 TO NODE 142.00 = 5123.00 FEET.

\*\*\*\*\*  
FLOW PROCESS FROM NODE 142.00 TO NODE 142.00 IS CODE = 81

>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

MAINLINE Tc(MIN) = 13.43  
\* 100 YEAR RAINFALL INTENSITY(INCH/HR) = 3.560  
SUBAREA LOSS RATE DATA(AMC III):  
DEVELOPMENT TYPE/ SCS SOIL AREA Fp Ap SCS  
LAND USE GROUP (ACRES) (INCH/HR) (DECIMAL) CN  
COMMERCIAL A 2.20 0.80 0.10 52  
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.80  
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.10  
SUBAREA AREA(ACRES) = 2.20 SUBAREA RUNOFF(CFS) = 6.89  
EFFECTIVE AREA(ACRES) = 79.44 AREA-AVERAGED Fm(INCH/HR) = 0.09  
AREA-AVERAGED Fp(INCH/HR) = 0.80 AREA-AVERAGED Ap = 0.12  
TOTAL AREA(ACRES) = 119.15 PEAK FLOW RATE(CFS) = 282.45  
NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

\*\*\*\*\*  
FLOW PROCESS FROM NODE 142.00 TO NODE 142.00 IS CODE = 1

>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<

TOTAL NUMBER OF STREAMS = 2  
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 1 ARE:  
TIME OF CONCENTRATION(MIN.) = 13.43  
RAINFALL INTENSITY(INCH/HR) = 3.56  
AREA-AVERAGED Fm(INCH/HR) = 0.09  
AREA-AVERAGED Fp(INCH/HR) = 0.80  
AREA-AVERAGED Ap = 0.12  
EFFECTIVE STREAM AREA(ACRES) = 79.44  
TOTAL STREAM AREA(ACRES) = 119.15  
PEAK FLOW RATE(CFS) AT CONFLUENCE = 282.45

\*\*\*\*\*  
FLOW PROCESS FROM NODE 140.00 TO NODE 141.00 IS CODE = 21

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<

>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<

INITIAL SUBAREA FLOW-LENGTH(FEET) = 1420.00  
ELEVATION DATA: UPSTREAM(FEET) = 1836.00 DOWNSTREAM(FEET) = 1803.00

Tc = K \* [(LENGTH\*\* 3.00) / (ELEVATION CHANGE)] \*\* 0.20  
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 11.764  
\* 100 YEAR RAINFALL INTENSITY(INCH/HR) = 3.854

SUBAREA Tc AND LOSS RATE DATA(AMC III):

DEVELOPMENT TYPE/ LAND USE	SCS SOIL GROUP	AREA (ACRES)	Fp (INCH/HR)	Ap (DECIMAL)	SCS CN	Tc (MIN.)
COMMERCIAL	A	12.20	0.80	0.10	52	11.76

SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.80  
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.10  
SUBAREA RUNOFF(CFS) = 41.44  
TOTAL AREA(ACRES) = 12.20 PEAK FLOW RATE(CFS) = 41.44

\*\*\*\*\*  
FLOW PROCESS FROM NODE 141.00 TO NODE 142.00 IS CODE = 31

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<  
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

ELEVATION DATA: UPSTREAM(FEET) = 1793.00 DOWNSTREAM(FEET) = 1786.70  
FLOW LENGTH(FEET) = 80.00 MANNING'S N = 0.013  
DEPTH OF FLOW IN 21.0 INCH PIPE IS 16.4 INCHES  
PIPE-FLOW VELOCITY(FEET/SEC.) = 20.52  
ESTIMATED PIPE DIAMETER(INCH) = 21.00 NUMBER OF PIPES = 1  
PIPE-FLOW(CFS) = 41.44  
PIPE TRAVEL TIME(MIN.) = 0.06 Tc(MIN.) = 11.83  
LONGEST FLOWPATH FROM NODE 140.00 TO NODE 142.00 = 1500.00 FEET.

\*\*\*\*\*  
FLOW PROCESS FROM NODE 142.00 TO NODE 142.00 IS CODE = 1

>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<  
>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<

TOTAL NUMBER OF STREAMS = 2  
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:  
TIME OF CONCENTRATION(MIN.) = 11.83  
RAINFALL INTENSITY(INCH/HR) = 3.84  
AREA-AVERAGED Fm(INCH/HR) = 0.08  
AREA-AVERAGED Fp(INCH/HR) = 0.80  
AREA-AVERAGED Ap = 0.10  
EFFECTIVE STREAM AREA(ACRES) = 12.20  
TOTAL STREAM AREA(ACRES) = 12.20  
PEAK FLOW RATE(CFS) AT CONFLUENCE = 41.44

\*\* CONFLUENCE DATA \*\*

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	276.07	11.85	3.838	0.80( 0.09)	0.12	72.0	110.00
1	280.79	12.64	3.692	0.80( 0.09)	0.12	76.2	120.00
1	282.45	13.43	3.560	0.80( 0.09)	0.12	79.4	123.00
1	280.69	16.68	3.126	0.80( 0.09)	0.12	89.6	100.00
1	248.73	34.36	2.026	0.80( 0.10)	0.13	119.2	554.00
1	279.61	12.33	3.748	0.80( 0.09)	0.12	74.7	130.00
2	41.44	11.83	3.841	0.80( 0.08)	0.10	12.2	140.00

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO  
CONFLUENCE FORMULA USED FOR 2 STREAMS.

\*\* PEAK FLOW RATE TABLE \*\*

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	317.47	11.85	3.838	0.80( 0.09)	0.11	84.2	110.00
2	320.02	12.33	3.748	0.80( 0.09)	0.11	86.9	130.00
3	320.59	12.64	3.692	0.80( 0.09)	0.11	88.4	120.00
4	320.80	13.43	3.560	0.80( 0.09)	0.11	91.6	123.00
5	314.25	16.68	3.126	0.80( 0.09)	0.12	101.8	100.00
6	270.17	34.36	2.026	0.80( 0.10)	0.13	131.4	554.00
7	317.35	11.83	3.841	0.80( 0.09)	0.11	84.1	140.00

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:  
PEAK FLOW RATE(CFS) = 320.80 Tc(MIN.) = 13.43  
EFFECTIVE AREA(ACRES) = 91.64 AREA-AVERAGED Fm(INCH/HR) = 0.09  
AREA-AVERAGED Fp(INCH/HR) = 0.80 AREA-AVERAGED Ap = 0.11  
TOTAL AREA(ACRES) = 131.35  
LONGEST FLOWPATH FROM NODE 100.00 TO NODE 142.00 = 5123.00 FEET.



\*\*\*\*\*

FLOW PROCESS FROM NODE 142.00 TO NODE 157.00 IS CODE = 31

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

ELEVATION DATA: UPSTREAM(FEET) = 1785.60 DOWNSTREAM(FEET) = 1776.70
FLOW LENGTH(FEET) = 406.00 MANNING'S N = 0.013
DEPTH OF FLOW IN 57.0 INCH PIPE IS 45.7 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 21.08
ESTIMATED PIPE DIAMETER(INCH) = 57.00 NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 320.80
PIPE TRAVEL TIME(MIN.) = 0.32 Tc(MIN.) = 13.75
LONGEST FLOWPATH FROM NODE 100.00 TO NODE 157.00 = 5529.00 FEET.

\*\*\*\*\*

FLOW PROCESS FROM NODE 157.00 TO NODE 157.00 IS CODE = 1

>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<

TOTAL NUMBER OF STREAMS = 2
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 1 ARE:
TIME OF CONCENTRATION(MIN.) = 13.75
RAINFALL INTENSITY(INCH/HR) = 3.51
AREA-AVERAGED Fm(INCH/HR) = 0.09
AREA-AVERAGED Fp(INCH/HR) = 0.80
AREA-AVERAGED Ap = 0.11
EFFECTIVE STREAM AREA(ACRES) = 91.64
TOTAL STREAM AREA(ACRES) = 131.35
PEAK FLOW RATE(CFS) AT CONFLUENCE = 320.80

\*\*\*\*\*

FLOW PROCESS FROM NODE 152.00 TO NODE 153.00 IS CODE = 21

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<

INITIAL SUBAREA FLOW-LENGTH(FEET) = 1000.00
ELEVATION DATA: UPSTREAM(FEET) = 1825.00 DOWNSTREAM(FEET) = 1810.00

Tc = K \* [(LENGTH\*\* 3.00) / (ELEVATION CHANGE)] \*\* 0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 11.160
\* 100 YEAR RAINFALL INTENSITY(INCH/HR) = 3.978
SUBAREA Tc AND LOSS RATE DATA(AMC III):
DEVELOPMENT TYPE/ SCS SOIL AREA Fp Ap SCS Tc
LAND USE GROUP (ACRES) (INCH/HR) (DECIMAL) CN (MIN.)
COMMERCIAL A 10.50 0.80 0.10 52 11.16
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.80
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.10
SUBAREA RUNOFF(CFS) = 36.84
TOTAL AREA(ACRES) = 10.50 PEAK FLOW RATE(CFS) = 36.84

\*\*\*\*\*

FLOW PROCESS FROM NODE 153.00 TO NODE 154.00 IS CODE = 31

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

ELEVATION DATA: UPSTREAM(FEET) = 1796.80 DOWNSTREAM(FEET) = 1790.00
FLOW LENGTH(FEET) = 620.00 MANNING'S N = 0.012
DEPTH OF FLOW IN 30.0 INCH PIPE IS 20.5 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 10.29
ESTIMATED PIPE DIAMETER(INCH) = 30.00 NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 36.84
PIPE TRAVEL TIME(MIN.) = 1.00 Tc(MIN.) = 12.16
LONGEST FLOWPATH FROM NODE 152.00 TO NODE 154.00 = 1620.00 FEET.

\*\*\*\*\*

FLOW PROCESS FROM NODE 153.00 TO NODE 154.00 IS CODE = 81

>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

MAINLINE Tc(MIN) = 12.16
\* 100 YEAR RAINFALL INTENSITY(INCH/HR) = 3.778
SUBAREA LOSS RATE DATA(AMC III):
DEVELOPMENT TYPE/ SCS SOIL AREA Fp Ap SCS
LAND USE GROUP (ACRES) (INCH/HR) (DECIMAL) CN
COMMERCIAL A 15.10 0.80 0.10 52
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.80

SUBAREA AVERAGE PERVIOUS AREA FRACTION,  $A_p = 0.10$   
 SUBAREA AREA (ACRES) = 15.10 SUBAREA RUNOFF (CFS) = 50.26  
 EFFECTIVE AREA (ACRES) = 25.60 AREA-AVERAGED  $F_m$  (INCH/HR) = 0.08  
 AREA-AVERAGED  $F_p$  (INCH/HR) = 0.80 AREA-AVERAGED  $A_p = 0.10$   
 TOTAL AREA (ACRES) = 25.60 PEAK FLOW RATE (CFS) = 85.20

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 154.00 TO NODE 155.00 IS CODE = 31

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<  
 >>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

=====

ELEVATION DATA: UPSTREAM (FEET) = 1790.00 DOWNSTREAM (FEET) = 1787.70  
 FLOW LENGTH (FEET) = 450.00 MANNING'S N = 0.012  
 DEPTH OF FLOW IN 45.0 INCH PIPE IS 34.4 INCHES  
 PIPE-FLOW VELOCITY (FEET/SEC.) = 9.39  
 ESTIMATED PIPE DIAMETER (INCH) = 45.00 NUMBER OF PIPES = 1  
 PIPE-FLOW (CFS) = 85.20  
 PIPE TRAVEL TIME (MIN.) = 0.80  $T_c$  (MIN.) = 12.96  
 LONGEST FLOWPATH FROM NODE 152.00 TO NODE 155.00 = 2070.00 FEET.

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 154.00 TO NODE 155.00 IS CODE = 81

>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

=====

MAINLINE  $T_c$  (MIN) = 12.96  
 \* 100 YEAR RAINFALL INTENSITY (INCH/HR) = 3.636  
 SUBAREA LOSS RATE DATA (AMC III):

DEVELOPMENT TYPE/ LAND USE	SCS SOIL GROUP	AREA (ACRES)	$F_p$ (INCH/HR)	$A_p$ (DECIMAL)	SCS CN
COMMERCIAL	A	10.00	0.80	0.10	52

SUBAREA AVERAGE PERVIOUS LOSS RATE,  $F_p$  (INCH/HR) = 0.80  
 SUBAREA AVERAGE PERVIOUS AREA FRACTION,  $A_p = 0.10$   
 SUBAREA AREA (ACRES) = 10.00 SUBAREA RUNOFF (CFS) = 32.01  
 EFFECTIVE AREA (ACRES) = 35.60 AREA-AVERAGED  $F_m$  (INCH/HR) = 0.08  
 AREA-AVERAGED  $F_p$  (INCH/HR) = 0.80 AREA-AVERAGED  $A_p = 0.10$   
 TOTAL AREA (ACRES) = 35.60 PEAK FLOW RATE (CFS) = 113.95

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 155.00 TO NODE 156.00 IS CODE = 31

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<  
 >>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

=====

ELEVATION DATA: UPSTREAM (FEET) = 1787.70 DOWNSTREAM (FEET) = 1781.60  
 FLOW LENGTH (FEET) = 1080.00 MANNING'S N = 0.012  
 DEPTH OF FLOW IN 48.0 INCH PIPE IS 39.3 INCHES  
 PIPE-FLOW VELOCITY (FEET/SEC.) = 10.34  
 ESTIMATED PIPE DIAMETER (INCH) = 48.00 NUMBER OF PIPES = 1  
 PIPE-FLOW (CFS) = 113.95  
 PIPE TRAVEL TIME (MIN.) = 1.74  $T_c$  (MIN.) = 14.70  
 LONGEST FLOWPATH FROM NODE 152.00 TO NODE 156.00 = 3150.00 FEET.

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 155.00 TO NODE 156.00 IS CODE = 81

>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

=====

MAINLINE  $T_c$  (MIN) = 14.70  
 \* 100 YEAR RAINFALL INTENSITY (INCH/HR) = 3.371  
 SUBAREA LOSS RATE DATA (AMC III):

DEVELOPMENT TYPE/ LAND USE	SCS SOIL GROUP	AREA (ACRES)	$F_p$ (INCH/HR)	$A_p$ (DECIMAL)	SCS CN
COMMERCIAL	A	13.40	0.80	0.10	52

SUBAREA AVERAGE PERVIOUS LOSS RATE,  $F_p$  (INCH/HR) = 0.80  
 SUBAREA AVERAGE PERVIOUS AREA FRACTION,  $A_p = 0.10$   
 SUBAREA AREA (ACRES) = 13.40 SUBAREA RUNOFF (CFS) = 39.70  
 EFFECTIVE AREA (ACRES) = 49.00 AREA-AVERAGED  $F_m$  (INCH/HR) = 0.08  
 AREA-AVERAGED  $F_p$  (INCH/HR) = 0.80 AREA-AVERAGED  $A_p = 0.10$   
 TOTAL AREA (ACRES) = 49.00 PEAK FLOW RATE (CFS) = 145.17

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 156.00 TO NODE 157.00 IS CODE = 31

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<  
 >>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

=====

ELEVATION DATA: UPSTREAM (FEET) = 1781.60 DOWNSTREAM (FEET) = 1777.00  
 FLOW LENGTH (FEET) = 70.00 MANNING'S N = 0.013

DEPTH OF FLOW IN 36.0 INCH PIPE IS 26.0 INCHES  
 PIPE-FLOW VELOCITY(FEET/SEC.) = 26.56  
 ESTIMATED PIPE DIAMETER(INCH) = 36.00 NUMBER OF PIPES = 1  
 PIPE-FLOW(CFS) = 145.17  
 PIPE TRAVEL TIME(MIN.) = 0.04 Tc(MIN.) = 14.75  
 LONGEST FLOWPATH FROM NODE 152.00 TO NODE 157.00 = 3220.00 FEET.

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 157.00 TO NODE 157.00 IS CODE = 1

>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<  
 >>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<

-----  
 TOTAL NUMBER OF STREAMS = 2  
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:  
 TIME OF CONCENTRATION(MIN.) = 14.75  
 RAINFALL INTENSITY(INCH/HR) = 3.37  
 AREA-AVERAGED Fm(INCH/HR) = 0.08  
 AREA-AVERAGED Fp(INCH/HR) = 0.80  
 AREA-AVERAGED Ap = 0.10  
 EFFECTIVE STREAM AREA(ACRES) = 49.00  
 TOTAL STREAM AREA(ACRES) = 49.00  
 PEAK FLOW RATE(CFS) AT CONFLUENCE = 145.17

\*\* CONFLUENCE DATA \*\*

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	317.47	12.17	3.777	0.80( 0.09)	0.11	84.2	110.00
1	320.02	12.65	3.690	0.80( 0.09)	0.11	86.9	130.00
1	320.59	12.96	3.637	0.80( 0.09)	0.11	88.4	120.00
1	320.80	13.75	3.510	0.80( 0.09)	0.11	91.6	123.00
1	314.25	17.00	3.090	0.80( 0.09)	0.12	101.8	100.00
1	270.17	34.69	2.014	0.80( 0.10)	0.13	131.4	554.00
1	317.35	12.15	3.780	0.80( 0.09)	0.11	84.1	140.00
2	145.17	14.75	3.365	0.80( 0.08)	0.10	49.0	152.00

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO  
 CONFLUENCE FORMULA USED FOR 2 STREAMS.

\*\* PEAK FLOW RATE TABLE \*\*

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	452.05	12.15	3.780	0.80( 0.09)	0.11	124.4	140.00
2	452.25	12.17	3.777	0.80( 0.09)	0.11	124.6	110.00
3	456.83	12.65	3.690	0.80( 0.09)	0.11	128.9	130.00
4	458.69	12.96	3.637	0.80( 0.09)	0.11	131.4	120.00
5	462.10	13.75	3.510	0.80( 0.09)	0.11	137.3	123.00
6	447.26	17.00	3.090	0.80( 0.09)	0.11	150.8	100.00
7	355.65	34.69	2.014	0.80( 0.10)	0.12	180.4	554.00
8	463.96	14.75	3.365	0.80( 0.09)	0.11	143.7	152.00

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:  
 PEAK FLOW RATE(CFS) = 463.96 Tc(MIN.) = 14.75  
 EFFECTIVE AREA(ACRES) = 143.75 AREA-AVERAGED Fm(INCH/HR) = 0.09  
 AREA-AVERAGED Fp(INCH/HR) = 0.80 AREA-AVERAGED Ap = 0.11  
 TOTAL AREA(ACRES) = 180.35  
 LONGEST FLOWPATH FROM NODE 100.00 TO NODE 157.00 = 5529.00 FEET.

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 157.00 TO NODE 162.00 IS CODE = 31

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<  
 >>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

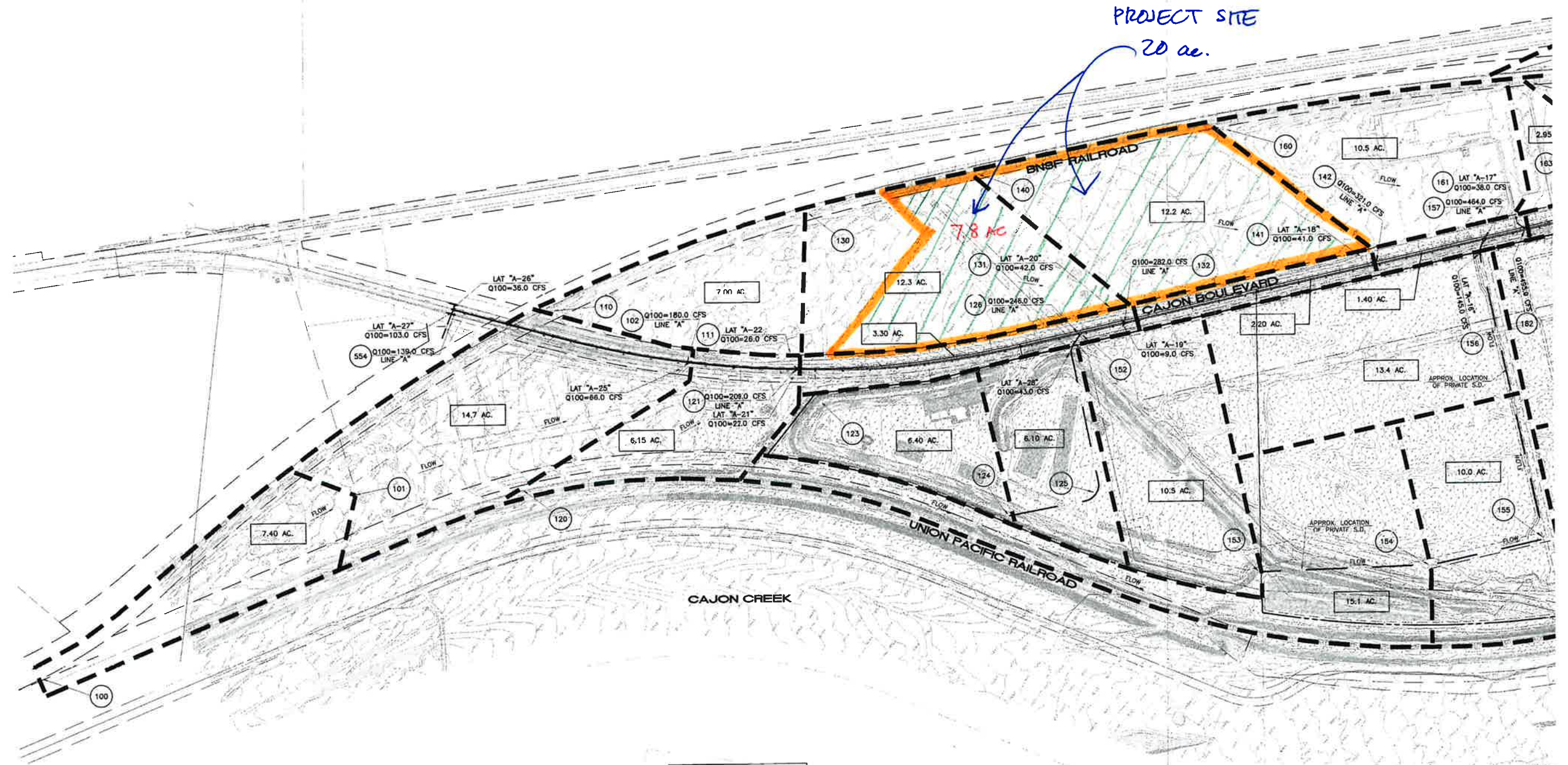
-----  
 ELEVATION DATA: UPSTREAM(FEET) = 1775.61 DOWNSTREAM(FEET) = 1772.40  
 FLOW LENGTH(FEET) = 151.00 MANNING'S N = 0.013  
 DEPTH OF FLOW IN 66.0 INCH PIPE IS 52.5 INCHES  
 PIPE-FLOW VELOCITY(FEET/SEC.) = 22.89  
 ESTIMATED PIPE DIAMETER(INCH) = 66.00 NUMBER OF PIPES = 1  
 PIPE-FLOW(CFS) = 463.96  
 PIPE TRAVEL TIME(MIN.) = 0.11 Tc(MIN.) = 14.86  
 LONGEST FLOWPATH FROM NODE 100.00 TO NODE 162.00 = 5680.00 FEET.

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 157.00 TO NODE 162.00 IS CODE = 81

>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

-----  
 MAINLINE Tc(MIN) = 14.86  
 \* 100 YEAR RAINFALL INTENSITY(INCH/HR) = 3.350





PROJECT SITE

20 ac.

7.8 ac

$20 \text{ ac.} - 12.2 \text{ ac.} = 7.8 \text{ ac.}$

$\frac{42 \text{ cfs}}{12.3 \text{ ac.}} = \frac{x}{7.8 \text{ ac.}}$

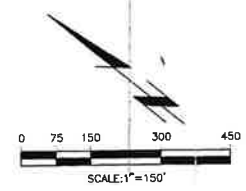
$x = 26.6 \text{ cfs. @ NODE (131)}$

$\text{RUNOFF @ (141)} = 41.0 + 26.6 = 67.6 \text{ cfs. (TOTAL RUNOFF FROM THE SITE)}$

$\text{EXIST. RUNOFF FROM THE SITE @ NODE 141} = 67.6 \text{ cfs.}$

LEGEND

- SUBAREA BOUNDARY
- 1.00 AC. SUBAREA AREA
- (100) NODE NUMBER
- DRAINAGE FLOW



City of San Bernardino  
 PUBLIC WORKS DEPARTMENT  
**PROPOSED CONDITION  
 HYDROLOGY MAP**  
 CAJON BOULEVARD  
 MASTER PLANNED STORM DRAIN  
 LINES E-20 AND E-21

PREPARED FOR:  
 CALMAT LAND CO.  
 C/O VULCAN MATERIAL COMPANY  
 3200 SAN FERNANDO ROAD  
 LOS ANGELES, CA 90065  
 PHONE: (323) 258-2777  
 FAX: (323) 258-1583

**TEI** Thienes Engineering, Inc.  
 CIVIL ENGINEERING & LAND SURVEYING  
 24348 FIRESTONE BOULEVARD  
 VAN NUYS, CALIFORNIA 91411  
 PHONE: (818) 709-1111 FAX: (818) 709-1112

Designed by _____	Approved by _____	Date _____
Checked by _____	Public Works Director	R.C.E. 2012B
Designed by _____		
Checked by _____		
Date _____	Sheet 1 of 2	Sheets



**GENERAL NOTES**

- All work shall be in accordance with the Standard Specifications for Public Works Construction (Green Book) latest edition and all supplements.
- Approval of this plan by the City of San Bernardino does not constitute a representation as to the accuracy of the location or of the existence or non-existence of any underground utility pipe or structure within the limits of this project. The Contractor shall assume full responsibility for the protection of all utilities within the limits of the project.
- Inspection shall be by the City of San Bernardino, Department of Public Works. All requests for inspection shall be made at least 24 hours in advance of the proposed construction.
- During the period of construction, the Contractor shall furnish, erect and maintain such warnings, signs, stop signs, barricades and other safety measures as directed by the City of San Bernardino, Department of Public Works with reference to The California Manual of Uniform Traffic Control Devices.
- Contractor shall not open more trench than can be properly constructed and filled in a day's operation. Any trench unavoidably left open during the hours of darkness or over a weekend shall be fenced with 6 foot chain link fencing and properly lighted.
- Contractor shall reinstall pavement markings and striping that has been disturbed by his operations.
- OSHA permit required for trenches over 3 feet in depth.
- Contractor shall contact Underground Service Alert prior to beginning work.

**Additional Notes:**

- The Contractor shall provide safe and continuous passage for local pedestrian and vehicular traffic at all times.
- Should any of the existing utilities or any other facilities conflict with the proposed storm drain line, the Contractor shall notify the Engineer and await the relocation and/or alternate design.
- The Contractor shall so conduct his operations as to offer the least possible obstruction and inconvenience to the public, and he shall have under construction no greater length or amount of work than he can prosecute properly with due regard to the rights of the public.
- Convenient access to driveways, houses, and buildings along the line of work shall be maintained, and temporary crossings shall be provided and maintained in good condition. Not more than one crossing or intersecting street or road shall be closed at any one time without the approval of the Engineer.
- The Contractor shall provide and maintain such fences, barriers, directional signs, lights, and flagmen as are necessary to give adequate warning to the public at all times of any dangerous conditions to be encountered as a result of the construction work and to give directions to the public.
- The Contractor shall exercise due care to avoid injury to existing improvements or facilities, utility facilities, adjacent property, and trees and shrubbery that are not to be removed. Contractor shall notify USA prior to entering project site.
- In accordance with generally accepted construction practices, the Contractor shall be solely and completely responsible for conditions of the job site, including safety of all persons and property during performance of the work, and the Contractor shall fully comply with all state and federal laws, rules, regulations, and orders relating to safety to the public and workmen.
- Street cut permits must be obtained from the Public Works Department along with Community Development and work for conditions of the job site, including safety of all persons and property during performance of the work, and the Contractor shall fully comply with all state and federal laws, rules, regulations, and orders relating to safety to the public and workmen.
- All removals in paved areas shall be saw cut on a neat, straight line parallel to the pipe line. The cut edge shall be protected from crushing and all broken edges shall be recut prior to paving operations.
- Dust shall be controlled at all times by approved methods.
- Public streets shall be kept clean and free from dirt and/or debris. The Contractor shall be responsible for all costs incurred in street cleaning necessitated by his operation.
- Full street closure will not be permitted unless prior written approval is obtained from the Director of Public Works/City Engineer. Two weeks notice will be required to the City and affected property owners prior to any closure.
- Compaction of earth within two feet of any concrete structures shall be at 95% of maximum density as determined by ASTM D-1557; other compaction shall be to a minimum of 90% with exception to city standards.
- All concrete shall conform to Section 201-1 of the Standard Specification for Public Works Construction, latest edition, except that all structural concrete shall be 4000 psi with "A" gradation in all inverts and 4000 psi with "B" gradation for all walls.

**METROPOLITAN WATER DISTRICT NOTES**

- THE PROCEDURES AND THE SPECIFICATIONS OF ALL CONSTRUCTION EQUIPMENT TO BE USED FOR THE REMOVAL, PLACEMENT AND COMPACTION OF SOIL AND PLACEMENT OF THE RIPRAP IN THE AREAS OF METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA PIPELINE MUST BE SUBMITTED FOR METROPOLITAN'S REVIEW AND WRITTEN APPROVAL AT LEAST 30 DAYS PRIOR TO THEIR USE. PROCEDURES MUST BE SUCH THAT EXCESSIVE UNBALANCED LOADS ARE NOT IMPOSED ON METROPOLITAN WATER DISTRICT PIPELINE. PROCEDURES THAT COULD SUBJECT METROPOLITAN WATER DISTRICT PIPELINE TO EXCESSIVE IMPACTS OR VIBRATORY LOADS ARE NOT ALLOWED.
- NO VIBRATORY COMPACTION EQUIPMENT IN VIBRATORY MODE MAY BE USED WITHIN THE 25 FEET OF THE CENTERLINE OF METROPOLITAN WATER DISTRICT PIPELINE.
- VEHICLES OF VARIABLE WHEEL CONFIGURATION, SUCH AS READY-MIX CONCRETE TRUCKS WITH LIFTABLE AUDIOMAT AXLES, MUST BE OPERATED IN THEIR HIGHWAY LEGAL CONFIGURATION WHEN THEY ARE WITHIN 25 FEET OF THE CENTERLINE OF METROPOLITAN WATER DISTRICT PIPELINE.
- DURING CONSTRUCTION, IF THE COVER OVER METROPOLITAN WATER DISTRICT PIPE IS A MINIMUM OF 4 FEET, VEHICLES IMPOSING LOADS NO GREATER THAN THAT OF A CAT 633C SCRAPPER MAY OPERATE OVER THE PIPELINE IF THE COVER IS BETWEEN 3 AND 4 FEET. EQUIPMENT MUST BE RESTRICTED TO THAT WHICH IMPOSES LOADS NO GREATER THAN 4000 LBS PER LINEAL FOOT. IF COVER IS BETWEEN 2 AND 3 FEET, EQUIPMENT MUST BE RESTRICTED TO THAT WHICH IMPOSES LOADS NO GREATER THAN THAT OF A TRACK-TYPE TRACTOR WEIGHING A MAXIMUM OF 12,000 POUNDS, AND IF COVER IS LESS THAN 2 FEET, ONLY HAND EQUIPMENT MAY BE USED.
- FACILITIES CONSTRUCTED WITHIN METROPOLITAN WATER DISTRICT EASEMENT/ FEE PROPERTY SHALL BE SUBJECT TO THE PARAMOUNT RIGHT OF METROPOLITAN TO USE THE EASEMENT/ FEE PROPERTY FOR THE PURPOSE FOR WHICH IT WAS ACQUIRED. IF AT ANY TIME METROPOLITAN OR ITS ASSIGNS SHOULD, IN THE EXERCISE OF THEIR RIGHTS, FIND IT NECESSARY TO REMOVE ANY OF THE FACILITIES FROM THE EASEMENT/ FEE PROPERTY, SUCH REMOVAL AND REPLACEMENT SHALL BE AT THE EXPENSE OF THE OWNER OF THE FACILITY.
- THE LINER SHALL BE INSTALLED AT THE SLOPE OF THE CHANNEL TO HAVE POSITIVE DRAINAGE AND PREVENT ANY BUILDUP OF HYDROSTATIC PRESSURE BEHIND OR UNDERNEATH THE GROUDED RIPRAP.
- METROPOLITAN WATER DISTRICT WILL BEAR NO RESPONSIBILITY FOR MAINTENANCE OR IMPROVEMENT OF THE PROPOSED CHANNEL WITHIN THE LIMITS OF THEIR EASEMENT/ FEE PROPERTY.

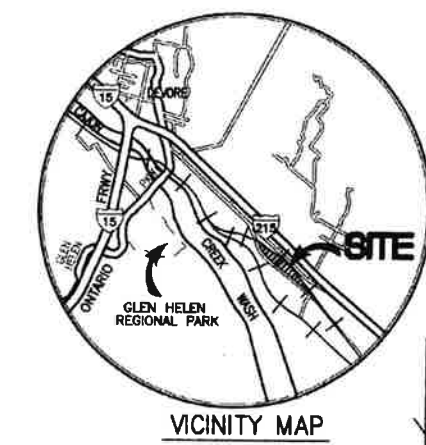
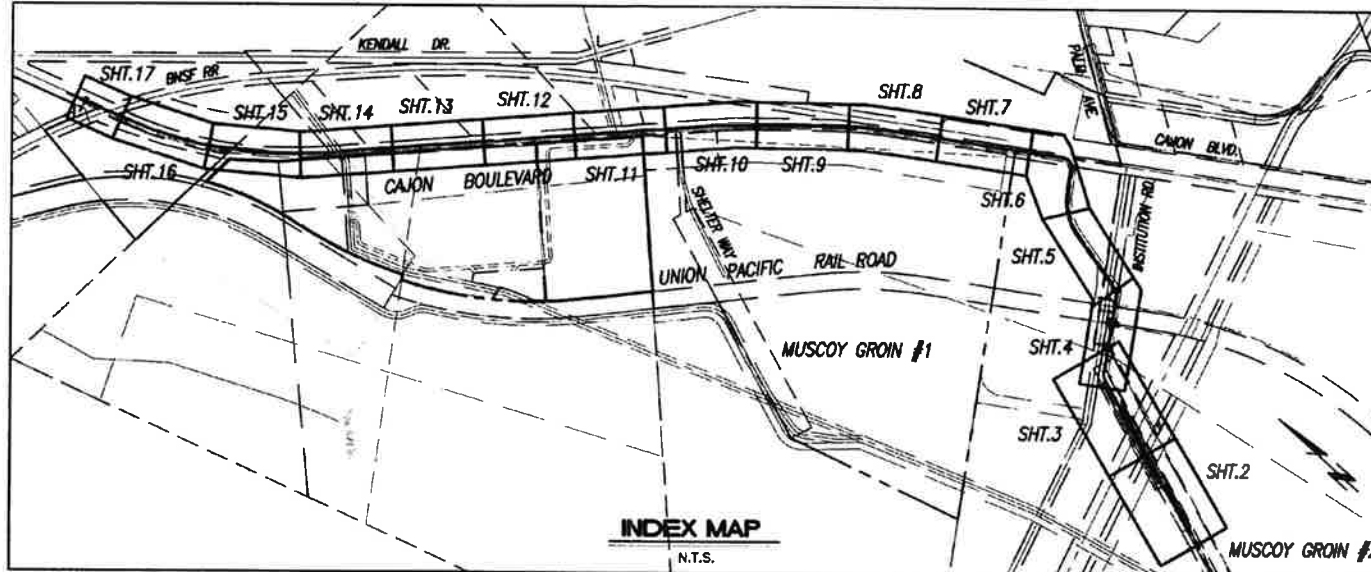
**HOLD HARMLESS INDEMNIFICATION CLAUSE:**

THE CONTRACTOR AGREES THAT HE SHALL ASSUME SOLE AND COMPLETE RESPONSIBILITY FOR JOB SITE CONDITIONS DURING THE COURSE OF CONSTRUCTION OF THE PROJECT INCLUDING SAFETY OF ALL PERSONS AND PROPERTY; THAT THIS REQUIREMENT SHALL APPLY CONTINUOUSLY AND NOT BE LIMITED TO NORMAL WORKING HOURS; AND THAT THE CONTRACTOR SHALL DEFEND, INDEMNIFY, AND HOLD THE CITY OF SAN BERNARDINO, THE OWNER, AND THE PRIVATE ENGINEERS HARMLESS FOR ANY AND ALL LIABILITY, REAL OR ALLEGED, IN CONNECTION WITH PERFORMANCE OF WORK ON THIS PROJECT, EXCEPTING FOR LIABILITY ARISING FROM THE SOLE NEGLIGENCE OF THE OWNER OR ENGINEER.

**EXISTING UNDERGROUND STRUCTURES:**

ALL UNDERGROUND UTILITIES OR STRUCTURE, REPORTED OR FOUND ON PUBLIC RECORDS, ARE INDICATED WITH THEIR APPROXIMATE LOCATION AND EXTENT. THE OWNER, BY ACCEPTING THESE PLANS OR PROCEEDING WITH THE IMPROVEMENTS HEREON, AGREES TO ASSUME LIABILITY AND TO HOLD THE ENGINEER HARMLESS FOR ANY DAMAGES RESULTING FROM THE EXISTENCE OF UNDERGROUND UTILITIES OR STRUCTURES NOT REPORTED OR INDICATED ON PUBLIC RECORDS, OR THOSE CONSTRUCTED AT VARIANCE WITH REPORTED ARE RECORD LOCATIONS. THE CONTRACTOR IS REQUIRED TO TAKE DUE PRECAUTIONARY MEASURES TO PROTECT THE UTILITIES OR STRUCTURES SHOWN AND ANY OTHERS FOUND AT THE SITE. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO NOTIFY THE OWNERS OF ALL UTILITIES STRUCTURES CONCERNED BEFORE STARTING WORK.

# STORM DRAIN IMPROVEMENT PLANS FOR CAJON BOULEVARD CITY OF SAN BERNARDINO



**LIABILITY FOR UNDERGROUND STRUCTURES**

ALL UNDERGROUND UTILITIES SHOWN ON THE PLANS WERE OBTAINED FROM A REVIEW OF AVAILABLE RECORD DATA WHILE DUE CARE WAS TAKEN IN PREPARATION OF THIS INFORMATION THE ENGINEER CANNOT AND DOES NOT GUARANTEE THE ACCURACY OR COMPLETENESS OF THE INFORMATION. IT SHALL BE THE RESPONSIBILITY AND LIABILITY OF THE CONTRACTOR TO DETERMINE THE EXISTENCE OR NON-EXISTENCE OF SUCH UTILITIES AND TO PROTECT THEM IN PLACE. THE REPRESENTATIVES OF THE VARIOUS UTILITY COMPANIES WILL COOPERATE WITH THE CONTRACTOR IN LOCATING EXISTING UTILITIES. IN THE EVENT UNKNOWN UTILITIES OR UNKNOWN STRUCTURES ARE FOUND, OR KNOWN FACILITIES ARE FOUND DURING CONSTRUCTION AT UNEXPECTED ELEVATIONS OR LOCATIONS, THE ENGINEER IS TO BE NOTIFIED OF SUCH CONDITIONS AT ONCE. THE ENGINEER WILL MAKE ANY REQUIRED DESIGN CHANGES AND THE CONTRACTOR AGREES TO COMPLETE ANY EXTRA WORK INCLUDING REPAIRS REQUIRED IN AN EXPEDITIOUS MANNER. REIMBURSEMENT FOR THIS EXTRA WORK WILL BE EQUAL TO THE CONTRACTOR'S COST PLUS 20%. THE CONTRACTOR FURTHER AGREES TO DILIGENTLY PURSUE THE COMPLETION OF SAID EXTRA WORK. THE CONTRACTOR AGREES THAT HE SHALL ASSUME SOLE AND COMPLETE RESPONSIBILITY FOR JOB SITE CONDITIONS DURING THE COURSE OF CONSTRUCTION OF THIS PROJECT INCLUDING SAFETY OF ALL PERSONS AND PROPERTY; THAT THIS REQUIREMENT SHALL APPLY CONTINUOUSLY AND NOT BE LIMITED TO NORMAL WORKING HOURS; AND THAT THE CONTRACTOR SHALL DEFEND, INDEMNIFY AND HOLD THE ENGINEER HARMLESS FROM ANY AND ALL LIABILITY, REAL OR ALLEGED, IN CONNECTION WITH THE PERFORMANCE OF WORK ON THIS PROJECT, EXCEPTING FOR LIABILITY ARISING FROM THE SOLE NEGLIGENCE OF THE OWNER OR THE ENGINEER.

**NOTICE TO CONTRACTOR**

CONTRACTOR SHALL VERIFY ALL CONDITIONS AND DIMENSIONS AND SHALL REPORT DISCREPANCIES TO THE ENGINEER PRIOR TO THE COMMENCEMENT OF WORK.

**DATUM STATEMENT:**

COORDINATES SHOWN ARE BASED ON THE CALIFORNIA STATE PLANE COORDINATE SYSTEM (SPCS), ZONE 5, NORTH AMERICAN DATUM 1983, (2011.00 EPOCH). ALL BEARINGS SHOWN HEREON ARE GRID BEARINGS, ALL DISTANCES SHOWN HEREON ARE GROUND DISTANCES, UNLESS OTHERWISE NOTED. GRID DISTANCES MAY BE OBTAINED BY MULTIPLYING GROUND DISTANCES BY A CONVERSION SCALE FACTOR OF 0.999911526. THE CONVERGENCE ANGLE AT STATION "COCO" IS -00°07'13", THE CONVERGENCE ANGLE AT STATION "P606" IS 00°30'19", AND THE CONVERGENCE ANGLE AT THE PROPERTY SHOWN HEREON IS 00°21'18".

**UNAUTHORIZED CHANGES AND USES**

**CAUTION:** THE ENGINEER PREPARING THESE PLANS WILL NOT BE RESPONSIBLE FOR, NOR LIABLE FOR, UNAUTHORIZED CHANGES TO OR USES OF THESE PLANS. ALL CHANGES TO THE PLANS MUST BE IN WRITING AND MUST BE APPROVED BY THE PREPARER OF THESE PLANS.

**INDEX TO SHEETS**

SHEET NO.	TITLE
1	TITLE SHEET
2-3	TRAPEZOIDAL OPEN CHANNEL PLAN AND PROFILE
4-18	STORM DRAIN PLAN AND PROFILE
19	SECTIONS AND DETAILS
20	DETAILS
21	DRAINAGE AREA MAP

**STORM DRAIN CONSTRUCTION NOTES**

- CONSTRUCT CONCRETE HEADWALL WITH TYPE "B" WINDOW WALL PER CALTRANS STD. PLAN 0888 WITH 6.8 FT. CUT-OFF WALL AND PROTECTION BARRIER PER S.B.C.F.C.D. DWG. S.P. 101-1, 2-3. SEE DETAILS ON SHEET 19. PROVIDE CABLE RAILING AT TOP OF HEADWALL PER CALTRANS STD. PLAN 811-47. SEE DETAIL ON SHEET 20.
- CONSTRUCT ACCESS ROAD WITH 3" THICK CLASS 2 AGGREGATE BASE.
- CONSTRUCT STORM DRAIN MANHOLE PER S.P.P.W.C. STD. PLAN NO. 320-2 WITH 36" MANHOLE SHAFT, FRAME AND COVER.
- CONSTRUCT JUNCTION STRUCTURE PIPE TO PIPE PER S.P.P.W.C. STD. PLAN NO. 331-3.
- SAW CUT, REMOVE AND REPLACE A.C. PAVEMENT PER L.A.C.D.P.W. STD. PLAN 3061-1. SEE DETAIL ON SHT. NO. 20.
- CONSTRUCT CONCRETE COLLAR PER S.P.P.W.C. STD. PLAN NO. 380-4.
- CONSTRUCT STORM DRAIN MANHOLE PER S.P.P.W.C. STD. PLAN NO. 322-2 WITH 36" MANHOLE SHAFT, FRAME AND COVER.
- CONSTRUCT TRANSITION STRUCTURE PER S.P.P.W.C. STD. PLAN NO. 340-2.
- CONSTRUCT CMP RISER PER DETAIL ON SHEET 18, SIZE OF RISER PER PLAN.
- CONSTRUCT CONCRETE BULKHEAD PER S.B.C.F.C.D. DWG. NO. S.P. 176.
- CONSTRUCT 108" R.C.P. D-LOAD PER PROFILE, BEDDING PER L.A.C.D.P.W. STD. PLAN 3080-2, CASE 3. SEE DETAIL ON SHT. NO. 20.
- CONSTRUCT ~181' LONG JACKING SLEEVE 12 FT. DIA., 1" MIN. THK. PER UPRR RAILROAD STD.
- CONSTRUCT 78" R.C.P. D-LOAD PER PROFILE, BEDDING PER L.A.C.D.P.W. STD. PLAN 3080-2, CASE 3. SEE DETAIL ON SHT. NO. 20.
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- CONSTRUCT 30" R.C.P. D-LOAD PER PROFILE, BEDDING PER L.A.C.D.P.W. STD. PLAN 3080-2, CASE 3. SEE DETAIL ON SHT. NO. 20.

- CONSTRUCT 24" R.C.P. D-LOAD PER PROFILE, BEDDING PER L.A.C.D.P.W. STD. PLAN 3080-2, CASE 3. SEE DETAIL ON SHT. NO. 20.
- CONSTRUCT 18" R.C.P. D-LOAD PER PROFILE, BEDDING PER L.A.C.D.P.W. STD. PLAN 3080-2, CASE 3. SEE DETAIL ON SHT. NO. 20.
- PROTECT EXISTING UTILITY LINE IN PLACE.
- CONSTRUCT 6" THICK CONCRETE SPILLWAY PER DETAIL ON SHT. 20.
- CONSTRUCT 12" THICK (UNLESS OTHERWISE SPECIFIED) 6 FT. DEEP (MIN.) CONCRETE CUTOFF WALL PER DETAIL ON SHT. 19.
- CONSTRUCT JUNCTION STRUCTURE PIPE TO PIPE CASE 1 PER S.P.P.W.C. STD. PLAN NO. 332-2.
- PROTECT EXISTING C.M.P. STORM DRAIN LINE IN PLACE, SIZE OF PIPE PER PLAN.
- REMOVE EXISTING CONCRETE HEADWALL, WINDOW WALL, CONC. SLABS AND BOLLERS. SAWCUT AND REMOVE APPROXIMATELY 1 LF. OF EXISTING CMP PRIOR TO NEW S.D. CONNECTION. CONSTRUCT CHAIN LINK FENCE AND GATE PER S.B.C.F.C.D. SPEC. DWG. 4, H=6' MAX.
- CONSTRUCT TRAPEZOIDAL OPEN CHANNEL WITH ROCK SLOPE PROTECTION PER DETAILS ON SHT. NO. 18.
- CONSTRUCT QUARRY STONE APRON TO MATCH EXISTING. SEE DETAIL ON SHEET NO. 18.
- CONSTRUCT 6" THICK CONCRETE ACCESS ROAD DETAILS ON SHEET NO. 19.
- INSTALL IMPERMEABLE LINER, MODEL PRR-24 BY ETL LINER, INC HEAT WELDED TOGETHER TO CREATE A CONTINUOUS IMPERMEABLE SEAM OR EQUIVALENT TO BE APPROVED BY WMO. PROCEDURE FOR THE INSTALLATION OF THE LINER MUST BE SUBMITTED TO WMO FOR REVIEW AND APPROVAL PRIOR TO INSTALLATION.
- PROTECT EXISTING RAILROAD STRUCTURES AND TRACKS IN PLACE.
- CONSTRUCT TRAPEZOIDAL OPEN CHANNEL WITH ROCK SLOPE PROTECTION PER PER DETAILS ON SHT. NO. 18.
- REMOVE AND RELOCATE EXISTING POWER POLE AND GUY ANCHORS.
- PROTECT EXISTING POWER POLE IN PLACE.
- CONSTRUCT CURB OPENING CATCH BASIN WITH GRATING PER S.P.P.W.C. STD. PLAN NO. 302-3, NO. OF GRATES PER PLAN.
- REMOVE EXISTING GRATE INLET AND APPURTENANCES.
- CONSTRUCT LOCAL DEPRESSION PER S.P.P.W.C. STD. PLAN NO. 313-3, CASE F.
- CONSTRUCT 3"x3" CONCRETE SEWER EASEMENT, LENGTH PER PLAN.
- CONSTRUCT 15" THICK MINIMUM GROUDED RIPRAP WITH 6" THICK MIN. FILTER BLANKET.
- CONSTRUCT CONCRETE CURB PER DETAIL ON SHT. 20, CF. PER PLAN (12" MAX.)
- CONSTRUCT PIPE GATE PER S.B.C.F.C.D. STD. S.P. 209, LENGTH=16'. SEE DETAIL ON SHT. NO. 20.

**CONTACTS**

COMPANY	PHONE NO.
BNF RAILWAY	(909)384-6079
CITY OF SAN BERNARDINO	(909)384-5140
CITY OF SAN BERNARDINO (INSPECTION)	(909)384-5111
CITY OF SAN BERNARDINO MUNICIPAL WATER DEPT.	(909)384-5381
KINDER MORGAN	(714)580-4400
MCI WORLDWOM	(972)728-6016
METROPOLITAN WATER DISTRICT	(213)217-8679
SAN GABRIEL VALLEY MUNICIPAL WATER DISTRICT	(909)387-7895
SOUTHERN CALIFORNIA EDISON	(626)968-7911
SOUTHERN CALIFORNIA GAS COMPANY-REDLANDS	(714)796-8920
UNION PACIFIC RAILROAD	(909)536-7725
US SPRINT	(402)544-8536
VERIZON-REDLANDS	(909)748-6640

**COUNTY OF SAN BERNARDINO  
DEPARTMENT OF PUBLIC WORKS**

RECOMMENDED BY: \_\_\_\_\_ DATE: \_\_\_\_\_

APPROVED BY: \_\_\_\_\_ DATE: \_\_\_\_\_

TRAFFIC DIVISION \_\_\_\_\_ OPERATIONS SUPPORT DIVISION \_\_\_\_\_

**Underground Service Alert**

Call: TOLL FREE  
1-800-227-2600

TWO WORKING DAYS BEFORE YOU DIG

**BASIS OF BEARING:**  
THE BEARINGS SHOWN HEREON ARE BASED ON THE CENTERLINE OF CAJON BLVD. BEING N 47°49'25" W AS PER RECORD OF SURVEY R.S.43, PAGES 17-18, IN THE CITY OF SAN BERNARDINO, RECORDS OF COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA.

**OWNER:**  
CALMAT LAND CO.  
C/O VULCAN MATERIALS COMPANY  
3200 SAN FERNANDO ROAD  
LOS ANGELES, CA 90065  
PHONE: (323) 258-2777  
FAX: (323) 258-1583

REGISTERED PROFESSIONAL ENGINEER  
REINHARD STENZEL  
R.C.E. NO. 58155  
Exp. 12-31-14  
STATE OF CALIFORNIA

PLANS PREPARED BY:  
**Thienes Engineering, Inc.**  
CIVIL ENGINEERING - LAND SURVEYING  
14349 FIRESTONE BOULEVARD  
LA MIRADA, CALIFORNIA 90638  
PH: (714)321-4811 FAX: (714)321-4733

REINHARD STENZEL  
R.C.E. 58155 - EXP. 12/31/14

MARK \_\_\_\_\_ REVISIONS \_\_\_\_\_ BY \_\_\_\_\_ APPR. \_\_\_\_\_ DATE \_\_\_\_\_

BENCH MARK:  
SAN BERNARDINO COUNTY SURVEYOR, SPSM# 00485  
2" BRASS DISC. NO. 6-17 S.B. CO. SURVEY, SET 1970, LOCATED AT DEVORE AND GLEN HELEN ROADS, AT THE ENTRANCE TO THE GLEN HELEN REGIONAL PARK, AT THE N/W CORNER OF A GATE HOUSE, 120 FT. EAST OF DEVORE ROAD, 0.8 FT. ABOVE ASPHALT, SET FLUSH WITH TOP OF CURB.  
ELEVATION = 2,006.12 FT. (NGVD '29 / DEVORE QUAD.)

APPROVED *JAN 24, 2013*

CITY ENGINEER: ROBERT G. EISENBERG  
RCE NO. C54931 EXP. 6-30-14

DRAWN BY: E.D.T.

CHECKED BY: B. THIENES

RECOMMENDED BY: R. STENZEL

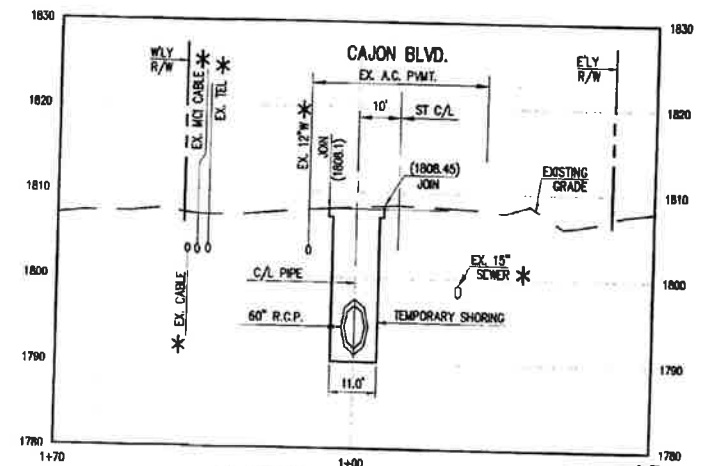
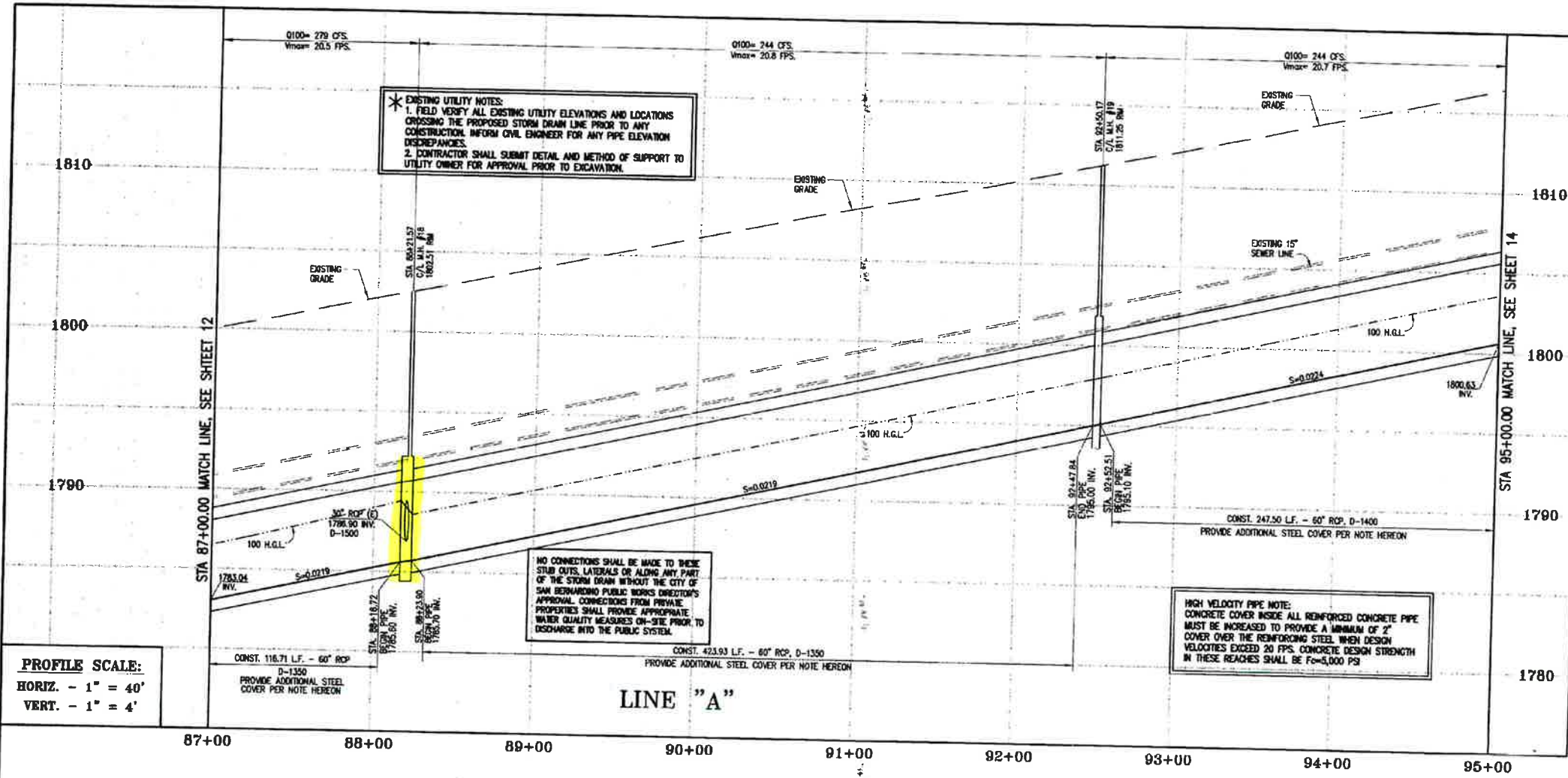
**CITY OF SAN BERNARDINO**  
DEVELOPMENT SERVICES - PUBLIC WORKS/ENGINEERING

**TITLE SHEET**  
FOR  
**VULCAN MATERIALS CO.**  
MASTER PLAN LINE E20 AND E21  
SAN BERNARDINO, CALIFORNIA

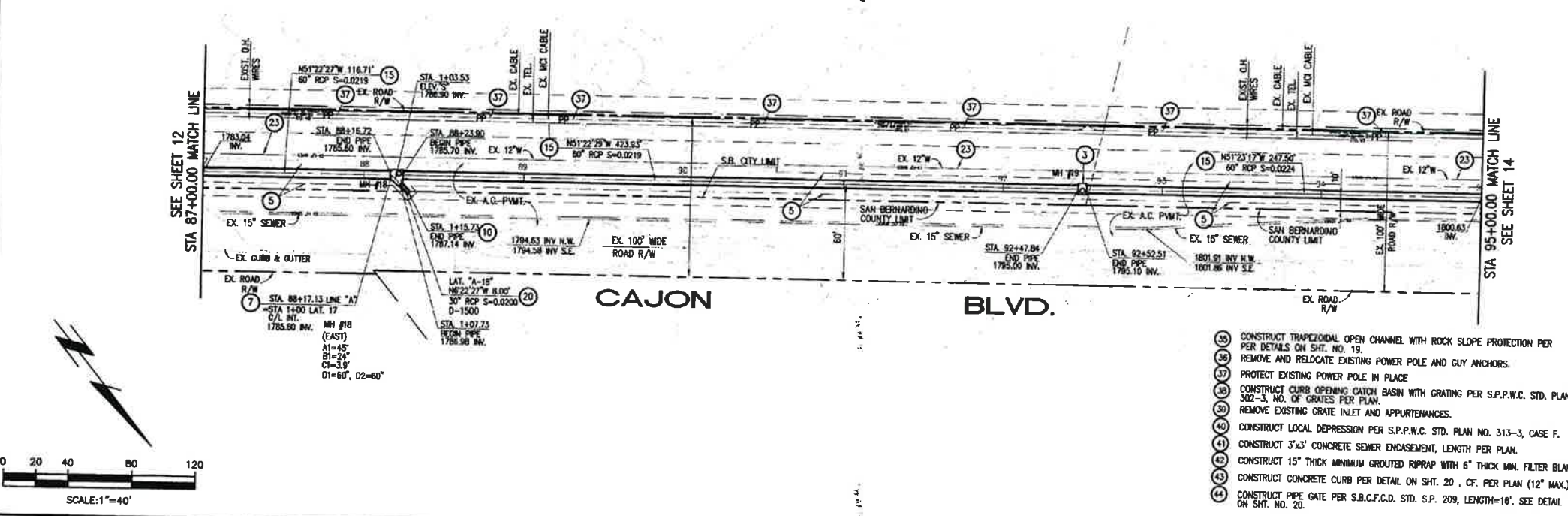
DRAWING NO. 12982  
SHEET 1 OF 21 SHEETS

FOR CITY USE ONLY: FILE NO. \_\_\_\_\_ W.O. NO. \_\_\_\_\_





- STORM DRAIN CONSTRUCTION NOTES**
- CONSTRUCT CONCRETE HEADWALL WITH TYPE "B" WINDOW PER CALTRANS STD. PLAN DB68 WITH 6.8 FT. CUT-OFF WALL AND PROTECTION BARRIER PER S.B.C.F.C.D. DWG. S.P. 101-1,-2,-3. SEE DETAILS ON SHEET 19. PROVIDE CABLE RAILING AT TOP OF HEADWALL PER CALTRANS STD. PLAN B11-47. SEE DETAIL ON SHEET 20.
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  - CONSTRUCT TRANSITION STRUCTURE PER S.P.P.W.C. STD. PLAN No. 340-2
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  - CONSTRUCT CONCRETE BULKHEAD PER S.B.C.F.C.D. DWG. NO. SP. 176.
  - CONSTRUCT 100" R.C.P. D-LOAD PER PROFILE, BEDDING PER L.A.C.D.P.W. STD. PLAN 3080-2, CASE 3. SEE DETAIL ON SHT. NO. 20.
  - CONSTRUCT ~18' LONG JACKING SLEEVE 12 FT. DIA., 1" MIN. THK PER UPRR RAILROAD STD.
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  - CONSTRUCT CHAIN LINK FENCE AND GATE PER S.B.C.F.C.D. SPEC. DWG. II, H=6' MAX.
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**COUNTY OF SAN BERNARDINO  
 DEPARTMENT OF PUBLIC WORKS**

**Underground Service Alert**

Call: TOLL FREE  
 1-800-227-2600

THAT WORKING DAYS BEFORE YOU DIG

**BASIS OF BEARING:**  
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**OWNER:**  
 CALMAT LAND CO.  
 C/O VULCAN MATERIAL COMPANY  
 3200 SAN FERNANDO ROAD  
 LOS ANGELES, CA 90065  
 PHONE: (323) 258-2777  
 FAX: (323) 258-1583

**REGISTERED PROFESSIONAL ENGINEER**  
 RETIRED  
 R.C.E. NO. 9818  
 Exp. 12-31-14  
 CIVIL  
 STATE OF CALIFORNIA

**PLANS PREPARED BY:**  
**Thienes Engineering, Inc.**  
 CIVIL ENGINEERING • LAND SURVEYING  
 14340 FIRESTONE BOULEVARD  
 LA MIRADA, CALIFORNIA 90638  
 PH: (714) 521-4911 FAX: (714) 521-4123

*Reinhold Stenzel*  
 REINHOLD STENZEL  
 R.C.E.: 56155 - EXP. 12/31/14

MARK	REVISIONS	BY	APPR.	DATE

**BENCH MARK:**  
 SAN BERNARDINO COUNTY SURVEYOR, SP5N# 00495  
 2" BRASS DISC, NO. 6-17 S.B. CO. SURVEY, SET 1970, LOCATED AT DEVORE AND GLEN HELEN ROADS, AT THE ENTRANCE TO THE GLEN HELEN REGIONAL PARK, AT THE N/W CORNER OF A GATE HOUSE, 120 FT. EAST OF DEVORE ROAD, 0.6 FT. ABOVE ASPHALT, SET FLUSH WITH TOP OF CURB.  
 ELEVATION = 2,006.12 FT. (NGVD '29 / DEVORE QUAD.)

**APPROVED** JAN. 24, 2013

**QTY ENGINEER** ROBERT G. EISENBERG  
 R.C.E. NO. C54931 EXP. 6-30-14

**DRAWN BY:** E.D.T.

**CHECKED BY:** B. THIENES

**RECOMMENDED BY:** R. STENZEL

**CITY OF SAN BERNARDINO**  
 DEVELOPMENT SERVICES - PUBLIC WORKS/ENGINEERING

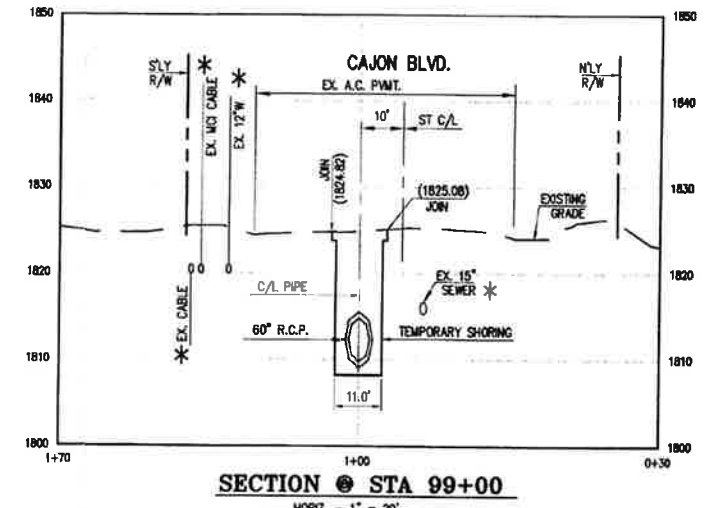
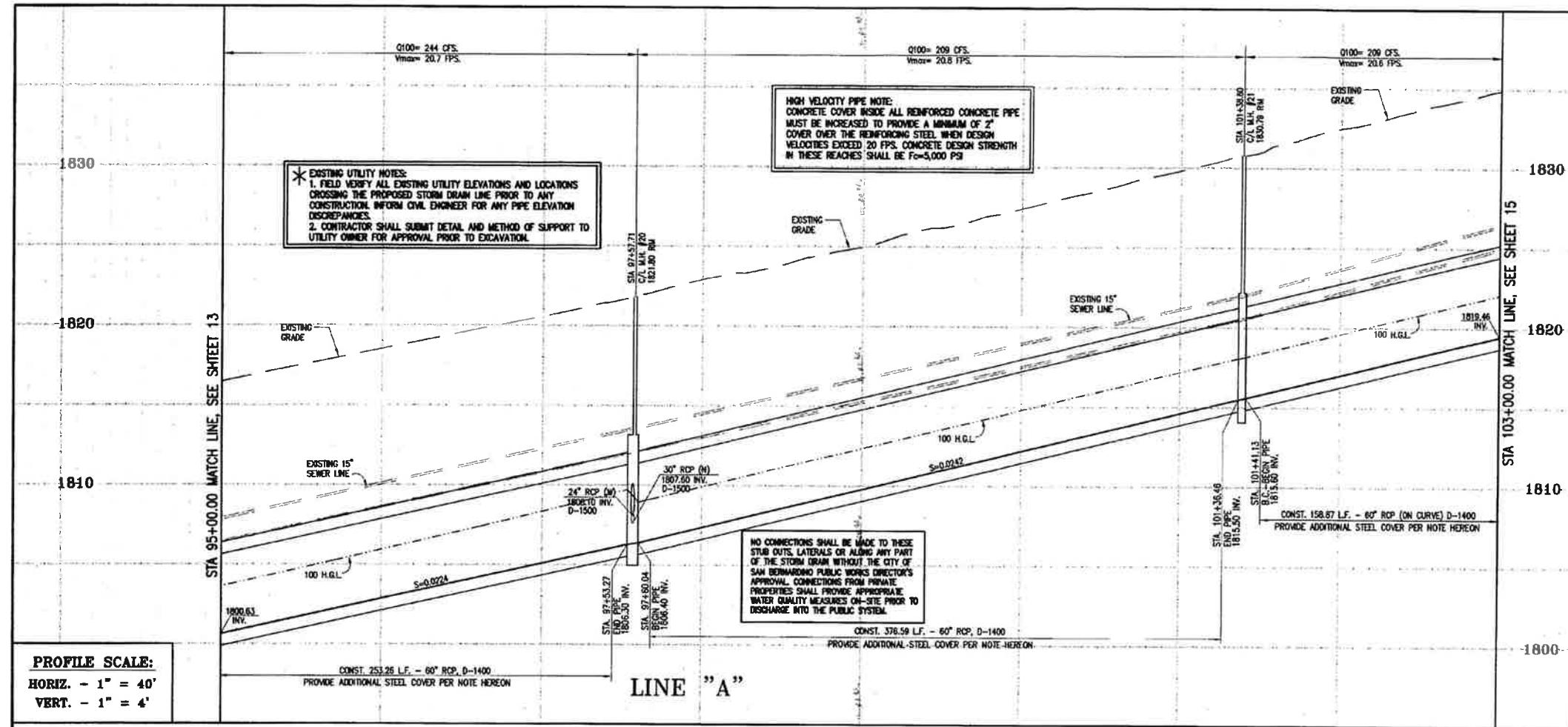
**CAJON STORM DRAIN PLAN & PROFILE**  
 FOR  
**VULCAN MATERIALS CO.**  
 MASTER PLAN LINE E20 AND E21  
 SAN BERNARDINO, CALIFORNIA

FOR CITY USE ONLY: FILE NO. \_\_\_\_\_ W.O. NO. \_\_\_\_\_

**DRAWING NO.**  
 12982

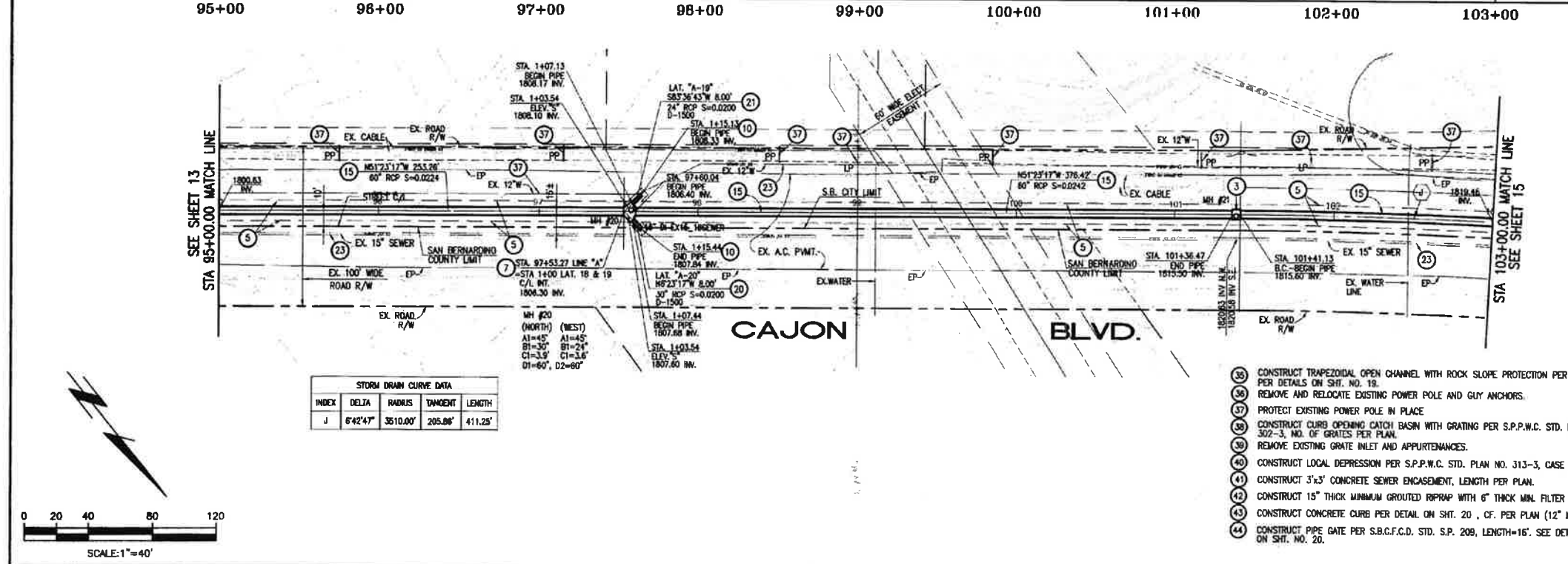
**SHEET 13 OF 21 SHEETS**





**STORM DRAIN CONSTRUCTION NOTES**

- CONSTRUCT CONCRETE HEADWALL WITH TYPE 75" MANHOLE PER CALTRANS STD. PLAN DB88 WITH 6.8 FT. CUT-OFF WALL AND PROTECTION BARRIER PER S.B.C.F.C.D. DWG. S.P. 101-1,-2,-3. SEE DETAILS ON SHEET 19. PROVIDE CABLE RAILING AT TOP OF HEADWALL PER CALTRANS STD. PLAN B11-47. SEE DETAIL ON SHEET 20.
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- REMOVE EXISTING GRATE INLET AND APPURTENANCES.
- CONSTRUCT LOCAL DEPRESSION PER S.P.P.W.C. STD. PLAN No. 313-3, CASE F.
- CONSTRUCT 3"x3" CONCRETE SEWER ENCASUREMENT, LENGTH PER PLAN.
- CONSTRUCT 15" THICK MINIMUM GROUTED RIPRAP WITH 6" THICK MIN. FILTER BLANKET.
- CONSTRUCT CONCRETE CURB PER DETAIL ON SHT. 20, C.F. PER PLAN (12" MAX.)
- CONSTRUCT PIPE GATE PER S.B.C.F.C.D. STD. S.P. 209, LENGTH=16'. SEE DETAIL ON SHT. NO. 20.

**COUNTY OF SAN BERNARDINO  
DEPARTMENT OF PUBLIC WORKS**

RECOMMENDED BY: \_\_\_\_\_  
 APPROVED BY: \_\_\_\_\_  
 TRAFFIC DIVISION \_\_\_\_\_ DATE \_\_\_\_\_  
 MUHAMMAD ALI, P.E., PLUMB ENGINEER  
 OPERATIONS SUPPORT DIVISION \_\_\_\_\_ DATE \_\_\_\_\_

**Underground Service Alert**  
 Call: TOLL FREE  
 1-800-227-2600  
 TWO WORKING DAYS BEFORE YOU DIG

**BASIS OF BEARING:**  
 THE BEARINGS SHOWN HEREON ARE BASED ON THE CENTERLINE OF CAJON BLVD. BEING N 47°48'25" W AS PER RECORD OF SURVEY R.S.43, PAGES 17-18, IN THE CITY OF SAN BERNARDINO, RECORDS OF COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA.

**OWNER:**  
 CALMAT LAND CO.  
 C/O VULCAN MATERIAL COMPANY  
 3200 SAN FERNANDO ROAD  
 LOS ANGELES, CA 90065  
 PHONE: (323) 258-2777  
 FAX: (323) 258-1983

**REGISTERED PROFESSIONAL ENGINEER**  
 R.C.E. NO. 58155  
 Exp. 12-31-14  
 CIVIL  
 STATE OF CALIFORNIA

**PLANS PREPARED BY:**  
**Thienes Engineering, Inc.**  
 CIVIL ENGINEERING - LAND SURVEYING  
 14348 FIRESTONE BOULEVARD  
 LA MIRADA, CALIFORNIA 90638  
 PH: (714) 521-4311 FAX: (714) 521-4173

REINHARD STENZEL  
 R.C.E. 58155 - EXP. 12/31/14

**MARK REVISIONS BY APPR. DATE**

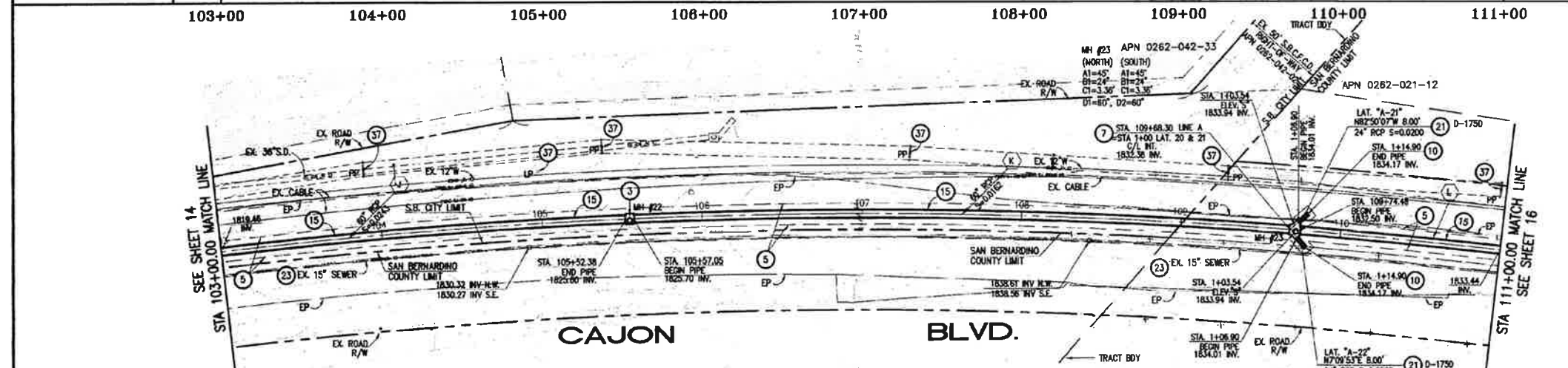
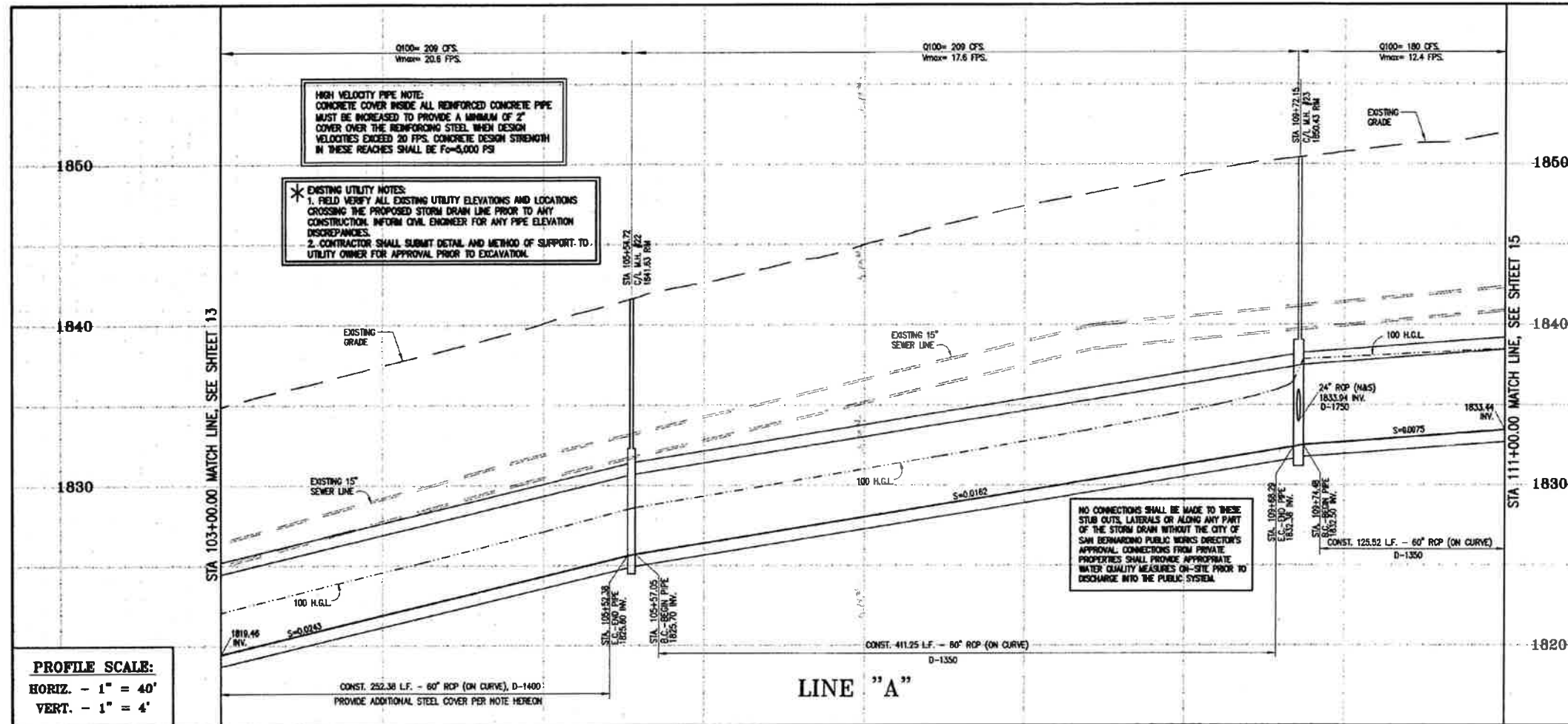
**BENCH MARK:**  
 SAN BERNARDINO COUNTY SURVEYOR SP581 00485  
 2" BRASS DISC, NO. 6-17 S.B. CO. SURVEY, SET 1970, LOCATED AT DEVORE AND GLEN HELEN ROADS, AT THE ENTRANCE TO THE GLEN HELEN REGIONAL PARK, AT THE N/W CORNER OF A GATE HOUSE, 120 FT. EAST OF DEVORE ROAD, 0.6 FT. ABOVE ASPHALT, SET FLUSH WITH TOP OF CURB.  
 ELEVATION = 2,008.12 FT. (NGVD '29 / DEVORE QUAD.)

**APPROVED** JAN. 24, 2013  
 CITY ENGINEER ROBERT G. EISENBERG  
 R.C.E. NO. C54931 EXP. 6-30-14

**DRAWN BY:** E.D.T.  
**CHECKED BY:** B. THIENES  
**RECOMMENDED BY:** R. STENZEL

**CITY OF SAN BERNARDINO**  
 DEVELOPMENT SERVICES - PUBLIC WORKS/ENGINEERING  
**CAJON STORM DRAIN PLAN & PROFILE**  
 FOR  
**VULCAN MATERIALS CO.**  
 MASTER PLAN LINE E20 AND E21  
 SAN BERNARDINO, CALIFORNIA

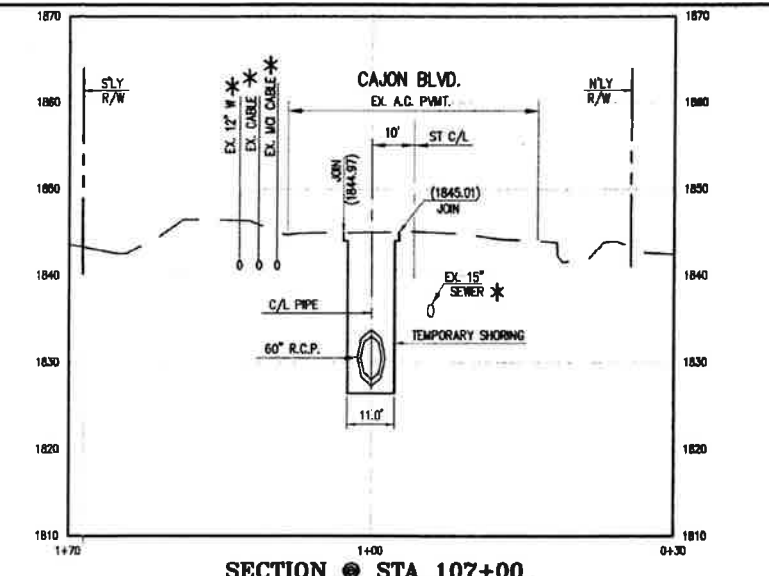
**DRAWING NO. 12982**  
 SHEET 14 OF 21 SHEETS  
 FOR CITY USE ONLY: FILE NO. \_\_\_\_\_ W.Q. NO. \_\_\_\_\_



**STORM DRAIN CURVE DATA**

INDEX	DELTA	RADIUS	TANGENT	LENGTH
J	8°42'47"	3510.00'	205.98'	411.25'
K	8°42'47"	3510.00'	205.98'	411.25'
L	8°28'29"	3510.00'	188.54'	386.85'

35. CONSTRUCT TRAPEZOIDAL OPEN CHANNEL WITH ROCK SLOPE PROTECTION PER DETAILS ON SHT. NO. 19.
36. REMOVE AND RELOCATE EXISTING POWER POLE AND GUY ANCHORS.
37. PROTECT EXISTING POWER POLE IN PLACE.
38. CONSTRUCT CURB OPENING CATCH BASIN WITH GRATING PER S.P.P.W.C. STD. PLAN NO. 302-3, NO. OF GRATES PER PLAN.
39. REMOVE EXISTING GRATE INLET AND APPURTENANCES.
40. CONSTRUCT LOCAL DEPRESSION PER S.P.P.W.C. STD. PLAN NO. 313-3, CASE F.
41. CONSTRUCT 3'x3' CONCRETE SEWER ENCASUREMENT, LENGTH PER PLAN.
42. CONSTRUCT 15" THICK MINIMUM GROUTED RRPPR WITH 6" THICK MIN. FILTER BLANKET.
43. CONSTRUCT CONCRETE CURB PER DETAIL ON SHT. NO. 20, C.F. PER PLAN (12" MAX.)
44. CONSTRUCT PIPE GATE PER S.B.C.F.C.D. STD. S.P. 208, LENGTH=16'. SEE DETAIL ON SHT. NO. 20.



- STORM DRAIN CONSTRUCTION NOTES**
1. CONSTRUCT CONCRETE HEADWALL WITH TYPE "B" MANHOLE PER CALTRANS STD. PLAN 0868 WITH 6.6 FT. CUT-OFF WALL AND PROTECTION BARRIER PER S.B.C.F.C.D. DWG. S.P. 101-1, -2, -3. SEE DETAILS ON SHEET 19. PROVIDE CABLE RAILING AT TOP OF HEADWALL PER CALTRANS STD. PLAN 811-47. SEE DETAIL ON SHEET 20.
  2. CONSTRUCT ACCESS ROAD WITH 3" THICK CLASS 2 AGGREGATE BASE.
  3. CONSTRUCT STORM DRAIN MANHOLE PER S.P.P.W.C. STD. PLAN NO. 320-2 WITH 36" MANHOLE SHAFT, FRAME AND COVER.
  4. CONSTRUCT JUNCTION STRUCTURE PIPE TO PIPE PER S.P.P.W.C. STD. PLAN NO. 331-3.
  5. SAWCUT, REMOVE AND REPLACE A.C. PAVEMENT PER L.A.C.D.P.W. STD. PLAN 3081-1. SEE DETAIL ON SHT. NO. 20.
  6. CONSTRUCT CONCRETE COLLAR PER S.P.P.W.C. STD. PLAN NO. 380-4.
  7. CONSTRUCT STORM DRAIN MANHOLE PER S.P.P.W.C. STD. PLAN NO. 322-2 WITH 36" MANHOLE SHAFT, FRAME AND COVER.
  8. CONSTRUCT TRANSITION STRUCTURE PER S.P.P.W.C. STD. PLAN NO. 340-2.
  9. CONSTRUCT CMP RISER PER DETAIL ON SHEET 19, SIZE OF RISER PER PLAN.
  10. CONSTRUCT CONCRETE BULKHEAD PER S.B.C.F.C.D. DWG. NO S.P. 178.
  11. CONSTRUCT 108" R.C.P. D-LOAD PER PROFILE, BEDDING PER L.A.C.D.P.W. STD. PLAN 3080-2, CASE 3. SEE DETAIL ON SHT. NO. 20.
  12. CONSTRUCT -181" LONG JACKING SLEEVE 12 FT. DIA., 1" MIN. THK. PER UPRR RAILROAD STD.
  13. CONSTRUCT 78" R.C.P. D-LOAD PER PROFILE, BEDDING PER L.A.C.D.P.W. STD. PLAN 3080-2, CASE 3. SEE DETAIL ON SHT. NO. 20.
  14. CONSTRUCT 72" R.C.P. D-LOAD PER PROFILE, BEDDING PER L.A.C.D.P.W. STD. PLAN 3080-2, CASE 3. SEE DETAIL ON SHT. NO. 20.
  15. CONSTRUCT 60" R.C.P. D-LOAD PER PROFILE, BEDDING PER L.A.C.D.P.W. STD. PLAN 3080-2, CASE 3. SEE DETAIL ON SHT. NO. 20.
  16. CONSTRUCT 54" R.C.P. D-LOAD PER PROFILE, BEDDING PER L.A.C.D.P.W. STD. PLAN 3080-2, CASE 3. SEE DETAIL ON SHT. NO. 20.
  17. CONSTRUCT 48" R.C.P. D-LOAD PER PROFILE, BEDDING PER L.A.C.D.P.W. STD. PLAN 3080-2, CASE 3. SEE DETAIL ON SHT. NO. 20.
  18. CONSTRUCT 42" R.C.P. D-LOAD PER PROFILE, BEDDING PER L.A.C.D.P.W. STD. PLAN 3080-2, CASE 3. SEE DETAIL ON SHT. NO. 20.
  19. CONSTRUCT 36" R.C.P. D-LOAD PER PROFILE, BEDDING PER L.A.C.D.P.W. STD. PLAN 3080-2, CASE 3. SEE DETAIL ON SHT. NO. 20.
  20. CONSTRUCT 30" R.C.P. D-LOAD PER PROFILE, BEDDING PER L.A.C.D.P.W. STD. PLAN 3080-2, CASE 3. SEE DETAIL ON SHT. NO. 20.
  21. CONSTRUCT 24" R.C.P. D-LOAD PER PROFILE, BEDDING PER L.A.C.D.P.W. STD. PLAN 3080-2, CASE 3. SEE DETAIL ON SHT. NO. 20.
  22. CONSTRUCT 18" R.C.P. D-LOAD PER PROFILE, BEDDING PER L.A.C.D.P.W. STD. PLAN 3080-2, CASE 3. SEE DETAIL ON SHT. NO. 20.
  23. PROTECT EXISTING UTILITY LINE IN PLACE.
  24. CONSTRUCT 6" THICK CONCRETE SPILLWAY PER DETAIL ON SHT. NO. 20.
  25. CONSTRUCT 12" THICK (UNLESS OTHERWISE SPECIFIED) 5 FT. DEEP (MIN.) CONCRETE CUTOFF WALL PER DETAIL ON SHT. 19.
  26. CONSTRUCT JUNCTION STRUCTURE PIPE TO PIPE CASE 1 PER S.P.P.W.C. STD. PLAN NO. 332-2.
  27. PROTECT EXISTING C.M.P. STORM DRAIN LINE IN PLACE, SIZE OF PIPE PER PLAN.
  28. REMOVE EXISTING CONCRETE HEADWALL, MANHOLE, CONC. SLABS AND BOLLERS. SAWCUT AND REMOVE APPROXIMATELY 1 L.F. OF EXISTING CMP PRIOR TO NEW S.D. CONNECTION. CONSTRUCT CHAIN LINK FENCE AND GATE PER S.B.C.F.C.D. SPEC. DWG. II, H=6" MAX.
  29. CONSTRUCT TRAPEZOIDAL OPEN CHANNEL WITH ROCK SLOPE PROTECTION PER DETAILS ON SHT. NO. 19.
  30. CONSTRUCT QUARRY STONE APRON TO MATCH EXISTING. SEE DETAIL ON SHEET NO. 19.
  31. CONSTRUCT 6" THK. CONCRETE ACCESS ROAD DETAILS ON SHEET NO. 19.
  32. INSTALL IMPERVIOUS LINER, MODEL PPL-24 BY BTL LINER, INC HEAT WELDED TOGETHER TO CREATE A CONTINUOUS IMPERMEABLE SEAM OR EQUIVALENT TO BE APPROVED BY MWD. PROCEDURE FOR THE INSTALLATION OF THE LINER MUST BE SUBMITTED TO MWD FOR REVIEW AND APPROVAL PRIOR TO INSTALLATION.
  33. PROTECT EXISTING RAILROAD STRUCTURES AND TRACKS IN PLACE.

**COUNTY OF SAN BERNARDINO  
DEPARTMENT OF PUBLIC WORKS**

RECOMMENDED BY: \_\_\_\_\_

APPROVED BY: \_\_\_\_\_

TRAFFIC DIVISION \_\_\_\_\_ DATE \_\_\_\_\_

MUHAMMAD ALI P.E. PERMIT ENGINEER DATE \_\_\_\_\_  
OPERATIONS SUPPORT DIVISION

**Underground Service Alert**

Call: TOLL FREE  
1-800-227-2600

**BEFORE YOU DIG**  
TWO WORKING DAYS BEFORE YOU DIG

**BASIS OF BEARING:**  
THE BEARINGS SHOWN HEREON ARE BASED ON THE CENTERLINE OF CAJON BLVD. BEING N 47°48'25" W AS PER RECORD OF SURVEY R.S.43, PAGES 17-18, IN THE CITY OF SAN BERNARDINO, RECORDS OF COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA.

**OWNER:**  
CALMAT LAND CO.  
C/O VULCAN MATERIAL COMPANY  
3200 SAN FERNANDO ROAD  
LOS ANGELES, CA 90065  
PHONE: (323) 258-2777  
FAX: (323) 258-1583

**REGISTERED PROFESSIONAL ENGINEER**  
STATE OF CALIFORNIA  
R.C.E. NO. 56155  
Exp. 12-31-14

**PLANS PREPARED BY:**  
**Thienes Engineering, Inc.**  
CIVIL ENGINEERING - LAND SURVEYING  
14349 FIRESTONE BOULEVARD  
LA MIRADA, CALIFORNIA 90638  
PH: (714) 321-4811 FAX: (714) 321-4173

*Renhard Stenzel* 1-21-15  
DATE

RENHARD STENZEL  
R.C.E. 56155 - EXP. 12/31/14

MARK	REVISIONS	BY	APPR.	DATE

**BENCH MARK:**  
SAN BERNARDINO COUNTY SURVEYOR, SP5N# 00495  
2" BRASS DISC, NO. 6-17 S.B. CO. SURVEY, SET 1970. LOCATED AT DEVORE AND GLEN HELEN ROADS, AT THE ENTRANCE TO THE GLEN HELEN REGIONAL PARK, AT THE N/W CORNER OF A GATE HOUSE, 120 FT. EAST OF DEVORE ROAD, 0.8 FT. ABOVE ASPHALT, SET FLUSH WITH TOP OF CURB.  
ELEVATION = 2,008.12 FT. (NGVD '29 / DEVORE QUAD.)

**APPROVED:** JAN. 24, 2013

*[Signature]*

CITY ENGINEER: ROBERT G. EISENBERG  
RICE NO. C54931 EXP. 6-30-14

DRAWN BY: E.D.T.

CHECKED BY: B. THIENES

RECOMMENDED BY: R. STENZEL

**CITY OF SAN BERNARDINO**  
DEVELOPMENT SERVICES - PUBLIC WORKS/ENGINEERING

**CAJON STORM DRAIN PLAN & PROFILE**  
FOR  
**VULCAN MATERIALS CO.**  
MASTER PLAN LINE E20 AND E21  
SAN BERNARDINO, CALIFORNIA

FOR CITY USE ONLY: FILE NO. \_\_\_\_\_ W.O. NO. \_\_\_\_\_

**DRAWING NO. 12982**  
SHEET 15 OF 21 SHEETS



# **APPENDIX B**

## **HYDROLOGY CALCULATIONS**

Analysis prepared by:

THIENES ENGINEERING  
16800 VALLEY VIEW AVENUE  
LA MIRADA CA 90638  
PH: (714) 521-4811 FAX: (714) 521-4173

\*\*\*\*\* DESCRIPTION OF STUDY \*\*\*\*\*  
\* JN 3560 \*  
\* CAJON LOGISTIC CENTER \*  
\* 100-YEAR \*  
\*\*\*\*\*

FILE NAME: C:\XDRIVE\3560\100P.DAT  
TIME/DATE OF STUDY: 18:41 10/02/2017

=====

USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:

=====

--\*TIME-OF-CONCENTRATION MODEL\*--

USER SPECIFIED STORM EVENT (YEAR) = 100.00  
SPECIFIED MINIMUM PIPE SIZE (INCH) = 12.00  
SPECIFIED PERCENT OF GRADIENT'S (DECIMAL) TO USE FOR FRICTION SLOPE = 0.95  
\*USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL\*

SLOPE OF INTENSITY DURATION CURVE (LOG(I; IN/HR) vs. LOG(Tc; MIN)) = 0.6000  
USER SPECIFIED 1-HOUR INTENSITY (INCH/HOUR) = 1.4500

\*ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD\*

\*\*\*\*\*

FLOW PROCESS FROM NODE 100.00 TO NODE 101.00 IS CODE = 21

=====

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<  
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<

=====

INITIAL SUBAREA FLOW-LENGTH (FEET) = 517.00  
ELEVATION DATA: UPSTREAM (FEET) = 1844.90 DOWNSTREAM (FEET) = 1826.53

Tc = K \* [(LENGTH\*\* 3.00) / (ELEVATION CHANGE)] \*\* 0.20  
SUBAREA ANALYSIS USED MINIMUM Tc (MIN.) = 7.214  
\* 100 YEAR RAINFALL INTENSITY (INCH/HR) = 5.169  
SUBAREA Tc AND LOSS RATE DATA (AMC III):

DEVELOPMENT TYPE/ LAND USE	SCS SOIL GROUP	AREA (ACRES)	Fp (INCH/HR)	Ap (DECIMAL)	SCS CN	Tc (MIN.)
COMMERCIAL	A	2.15	0.80	0.10	52	7.21
NATURAL GOOD COVER "OPEN BRUSH"	A	0.75	0.69	1.00	61	22.19

SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp (INCH/HR) = 0.71  
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.33  
SUBAREA RUNOFF (CFS) = 12.87  
TOTAL AREA (ACRES) = 2.90 PEAK FLOW RATE (CFS) = 12.87

\*\*\*\*\*

FLOW PROCESS FROM NODE 101.00 TO NODE 102.00 IS CODE = 9

=====

>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<

=====

UPSTREAM NODE ELEVATION (FEET) = 1826.53  
DOWNSTREAM NODE ELEVATION (FEET) = 1819.60  
CHANNEL LENGTH THRU SUBAREA (FEET) = 595.00  
"V" GUTTER WIDTH (FEET) = 3.00 GUTTER HIKE (FEET) = 0.150  
PAVEMENT LIP (FEET) = 0.030 MANNING'S N = .0150  
PAVEMENT CROSSFALL (DECIMAL NOTATION) = 0.02000  
MAXIMUM DEPTH (FEET) = 1.00  
\* 100 YEAR RAINFALL INTENSITY (INCH/HR) = 4.244  
SUBAREA LOSS RATE DATA (AMC III):

DEVELOPMENT TYPE/ LAND USE	SCS SOIL GROUP	AREA (ACRES)	Fp (INCH/HR)	Ap (DECIMAL)	SCS CN
COMMERCIAL	A	3.05	0.80	0.10	52

SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp (INCH/HR) = 0.80  
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.10  
TRAVEL TIME COMPUTED USING ESTIMATED FLOW (CFS) = 18.60  
TRAVEL TIME THRU SUBAREA BASED ON VELOCITY (FEET/SEC.) = 3.54  
AVERAGE FLOW DEPTH (FEET) = 0.47 FLOOD WIDTH (FEET) = 31.59  
"V" GUTTER FLOW TRAVEL TIME (MIN.) = 2.80 Tc (MIN.) = 10.02  
SUBAREA AREA (ACRES) = 3.05 SUBAREA RUNOFF (CFS) = 11.43  
EFFECTIVE AREA (ACRES) = 5.95 AREA-AVERAGED Fm (INCH/HR) = 0.16  
AREA-AVERAGED Fp (INCH/HR) = 0.73 AREA-AVERAGED Ap = 0.21  
TOTAL AREA (ACRES) = 5.95 PEAK FLOW RATE (CFS) = 21.89

END OF SUBAREA "V" GUTTER HYDRAULICS:  
DEPTH (FEET) = 0.49 FLOOD WIDTH (FEET) = 33.83  
FLOW VELOCITY (FEET/SEC.) = 3.65 DEPTH\*VELOCITY (FT\*FT/SEC) = 1.78  
LONGEST FLOWPATH FROM NODE 100.00 TO NODE 102.00 = 1112.00 FEET.

\*\*\*\*\*

FLOW PROCESS FROM NODE 101.00 TO NODE 102.00 IS CODE = 81

=====

>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

=====

MAINLINE Tc(MIN) = 10.02  
 \* 100 YEAR RAINFALL INTENSITY (INCH/HR) = 4.244  
 SUBAREA LOSS RATE DATA(AMC III):  
 DEVELOPMENT TYPE/ SCS SOIL AREA Fp Ap SCS  
 LAND USE GROUP (ACRES) (INCH/HR) (DECIMAL) CN  
 COMMERCIAL A 0.85 0.80 0.10 52  
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.80  
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.10  
 SUBAREA AREA(ACRES) = 0.85 SUBAREA RUNOFF(CFS) = 3.19  
 EFFECTIVE AREA(ACRES) = 6.80 AREA-AVERAGED Fm(INCH/HR) = 0.15  
 AREA-AVERAGED Fp(INCH/HR) = 0.74 AREA-AVERAGED Ap = 0.20  
 TOTAL AREA(ACRES) = 6.80 PEAK FLOW RATE(CFS) = 25.08

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 101.00 TO NODE 102.00 IS CODE = 81

>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

MAINLINE Tc(MIN) = 10.02  
 \* 100 YEAR RAINFALL INTENSITY (INCH/HR) = 4.244  
 SUBAREA LOSS RATE DATA(AMC III):  
 DEVELOPMENT TYPE/ SCS SOIL AREA Fp Ap SCS  
 LAND USE GROUP (ACRES) (INCH/HR) (DECIMAL) CN  
 NATURAL GOOD COVER  
 "OPEN BRUSH" A 1.50 0.69 1.00 61  
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.69  
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 1.00  
 SUBAREA AREA(ACRES) = 1.50 SUBAREA RUNOFF(CFS) = 4.80  
 EFFECTIVE AREA(ACRES) = 8.30 AREA-AVERAGED Fm(INCH/HR) = 0.24  
 AREA-AVERAGED Fp(INCH/HR) = 0.71 AREA-AVERAGED Ap = 0.34  
 TOTAL AREA(ACRES) = 8.30 PEAK FLOW RATE(CFS) = 29.88

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 101.00 TO NODE 102.00 IS CODE = 81

>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

MAINLINE Tc(MIN) = 10.02  
 \* 100 YEAR RAINFALL INTENSITY (INCH/HR) = 4.244  
 SUBAREA LOSS RATE DATA(AMC III):  
 DEVELOPMENT TYPE/ SCS SOIL AREA Fp Ap SCS  
 LAND USE GROUP (ACRES) (INCH/HR) (DECIMAL) CN  
 NATURAL GOOD COVER  
 "OPEN BRUSH" A 0.15 0.69 1.00 61  
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.69  
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 1.00  
 SUBAREA AREA(ACRES) = 0.15 SUBAREA RUNOFF(CFS) = 0.48  
 EFFECTIVE AREA(ACRES) = 8.45 AREA-AVERAGED Fm(INCH/HR) = 0.25  
 AREA-AVERAGED Fp(INCH/HR) = 0.71 AREA-AVERAGED Ap = 0.36  
 TOTAL AREA(ACRES) = 8.45 PEAK FLOW RATE(CFS) = 30.36

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 102.00 TO NODE 103.00 IS CODE = 9

>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<

UPSTREAM NODE ELEVATION(FEET) = 1819.60  
 DOWNSTREAM NODE ELEVATION(FEET) = 1815.35  
 CHANNEL LENGTH THRU SUBAREA(FEET) = 575.00  
 "V" GUTTER WIDTH(FEET) = 3.00 GUTTER HIKE(FEET) = 0.150  
 PAVEMENT LIP(FEET) = 0.030 MANNING'S N = .0150  
 PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000  
 MAXIMUM DEPTH(FEET) = 1.00  
 \* 100 YEAR RAINFALL INTENSITY (INCH/HR) = 3.668  
 SUBAREA LOSS RATE DATA(AMC III):  
 DEVELOPMENT TYPE/ SCS SOIL AREA Fp Ap SCS  
 LAND USE GROUP (ACRES) (INCH/HR) (DECIMAL) CN  
 COMMERCIAL A 5.90 0.80 0.10 52  
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.80  
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.10  
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) = 39.81  
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) = 3.48  
 AVERAGE FLOW DEPTH(FEET) = 0.62 FLOOD WIDTH(FEET) = 47.28  
 "V" GUTTER FLOW TRAVEL TIME(MIN.) = 2.76 Tc(MIN.) = 12.77  
 SUBAREA AREA(ACRES) = 5.90 SUBAREA RUNOFF(CFS) = 19.06  
 EFFECTIVE AREA(ACRES) = 14.35 AREA-AVERAGED Fm(INCH/HR) = 0.18  
 AREA-AVERAGED Fp(INCH/HR) = 0.72 AREA-AVERAGED Ap = 0.25  
 TOTAL AREA(ACRES) = 14.35 PEAK FLOW RATE(CFS) = 45.04

END OF SUBAREA "V" GUTTER HYDRAULICS:  
 DEPTH(FEET) = 0.65 FLOOD WIDTH(FEET) = 49.69  
 FLOW VELOCITY(FEET/SEC.) = 3.57 DEPTH\*VELOCITY(FT\*FT/SEC) = 2.31  
 LONGEST FLOWPATH FROM NODE 100.00 TO NODE 103.00 = 1687.00 FEET.

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 103.00 TO NODE 104.00 IS CODE = 31

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<  
 >>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

ELEVATION DATA: UPSTREAM(FEET) = 1811.40 DOWNSTREAM(FEET) = 1798.83  
 FLOW LENGTH(FEET) = 496.00 MANNING'S N = 0.012  
 DEPTH OF FLOW IN 27.0 INCH PIPE IS 19.4 INCHES  
 PIPE-FLOW VELOCITY(FEET/SEC.) = 14.74  
 ESTIMATED PIPE DIAMETER(INCH) = 27.00 NUMBER OF PIPES = 1  
 PIPE-FLOW(CFS) = 45.04  
 PIPE TRAVEL TIME(MIN.) = 0.56 Tc(MIN.) = 13.33  
 LONGEST FLOWPATH FROM NODE 100.00 TO NODE 104.00 = 2183.00 FEET.

```

*****
FLOW PROCESS FROM NODE 104.00 TO NODE 104.00 IS CODE = 81
-----
>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<
-----
MAINLINE Tc(MIN) = 13.33
* 100 YEAR RAINFALL INTENSITY(INCH/HR) = 3.575
SUBAREA LOSS RATE DATA(AMC III):
DEVELOPMENT TYPE/   SCS SOIL   AREA   Fp   Ap   SCS
LAND USE            GROUP   (ACRES) (INCH/HR) (DECIMAL) CN
COMMERCIAL          A         1.15   0.80   0.10  52
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.80
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.10
SUBAREA AREA(ACRES) = 1.15   SUBAREA RUNOFF(CFS) = 3.62
EFFECTIVE AREA(ACRES) = 15.50 AREA-AVERAGED Fm(INCH/HR) = 0.17
AREA-AVERAGED Fp(INCH/HR) = 0.72 AREA-AVERAGED Ap = 0.24
TOTAL AREA(ACRES) = 15.50   PEAK FLOW RATE(CFS) = 47.45

```

```

*****
FLOW PROCESS FROM NODE 104.00 TO NODE 104.00 IS CODE = 81
-----
>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<
-----
MAINLINE Tc(MIN) = 13.33
* 100 YEAR RAINFALL INTENSITY(INCH/HR) = 3.575
SUBAREA LOSS RATE DATA(AMC III):
DEVELOPMENT TYPE/   SCS SOIL   AREA   Fp   Ap   SCS
LAND USE            GROUP   (ACRES) (INCH/HR) (DECIMAL) CN
COMMERCIAL          A         3.15   0.80   0.10  52
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.80
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.10
SUBAREA AREA(ACRES) = 3.15   SUBAREA RUNOFF(CFS) = 9.91
EFFECTIVE AREA(ACRES) = 18.65 AREA-AVERAGED Fm(INCH/HR) = 0.16
AREA-AVERAGED Fp(INCH/HR) = 0.73 AREA-AVERAGED Ap = 0.22
TOTAL AREA(ACRES) = 18.65   PEAK FLOW RATE(CFS) = 57.36

```

```

*****
FLOW PROCESS FROM NODE 104.00 TO NODE 104.00 IS CODE = 81
-----
>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<
-----
MAINLINE Tc(MIN) = 13.33
* 100 YEAR RAINFALL INTENSITY(INCH/HR) = 3.575
SUBAREA LOSS RATE DATA(AMC III):
DEVELOPMENT TYPE/   SCS SOIL   AREA   Fp   Ap   SCS
LAND USE            GROUP   (ACRES) (INCH/HR) (DECIMAL) CN
NATURAL GOOD COVER
"OPEN BRUSH"       A         0.15   0.69   1.00  61
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.69
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 1.00
SUBAREA AREA(ACRES) = 0.15   SUBAREA RUNOFF(CFS) = 0.39
EFFECTIVE AREA(ACRES) = 18.80 AREA-AVERAGED Fm(INCH/HR) = 0.16
AREA-AVERAGED Fp(INCH/HR) = 0.73 AREA-AVERAGED Ap = 0.22
TOTAL AREA(ACRES) = 18.80   PEAK FLOW RATE(CFS) = 57.75

```

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*****
FLOW PROCESS FROM NODE 104.00 TO NODE 105.00 IS CODE = 31
-----
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<
-----
ELEVATION DATA: UPSTREAM( FEET) = 1798.83 DOWNSTREAM( FEET) = 1798.10
FLOW LENGTH( FEET) = 21.00 MANNING'S N = 0.012
DEPTH OF FLOW IN 27.0 INCH PIPE IS 21.0 INCHES
PIPE-FLOW VELOCITY( FEET/SEC.) = 17.44
ESTIMATED PIPE DIAMETER( INCH) = 27.00 NUMBER OF PIPES = 1
PIPE-FLOW( CFS) = 57.75
PIPE TRAVEL TIME( MIN.) = 0.02 Tc( MIN.) = 13.35
LONGEST FLOWPATH FROM NODE 100.00 TO NODE 105.00 = 2204.00 FEET.

```

```

*****
FLOW PROCESS FROM NODE 105.00 TO NODE 105.00 IS CODE = 81
-----
>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<
-----
MAINLINE Tc(MIN) = 13.35
* 100 YEAR RAINFALL INTENSITY(INCH/HR) = 3.572
SUBAREA LOSS RATE DATA(AMC III):
DEVELOPMENT TYPE/   SCS SOIL   AREA   Fp   Ap   SCS
LAND USE            GROUP   (ACRES) (INCH/HR) (DECIMAL) CN
NATURAL GOOD COVER
"OPEN BRUSH"       A         0.25   0.69   1.00  61
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.69
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 1.00
SUBAREA AREA(ACRES) = 0.25   SUBAREA RUNOFF(CFS) = 0.65
EFFECTIVE AREA(ACRES) = 19.05 AREA-AVERAGED Fm(INCH/HR) = 0.17
AREA-AVERAGED Fp(INCH/HR) = 0.73 AREA-AVERAGED Ap = 0.23
TOTAL AREA(ACRES) = 19.05   PEAK FLOW RATE(CFS) = 58.34

```

```

*****
FLOW PROCESS FROM NODE 105.00 TO NODE 106.00 IS CODE = 51
-----
>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<
>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<
-----
ELEVATION DATA: UPSTREAM( FEET) = 1798.10 DOWNSTREAM( FEET) = 1798.00
CHANNEL LENGTH THRU SUBAREA( FEET) = 81.00 CHANNEL SLOPE = 0.0012
CHANNEL BASE( FEET) = 50.00 "Z" FACTOR = 3.000
MANNING'S FACTOR = 0.030 MAXIMUM DEPTH( FEET) = 3.00

```

CHANNEL FLOW THRU SUBAREA(CFS) = 58.34  
FLOW VELOCITY(FEET/SEC) = 1.43 FLOW DEPTH(FEET) = 0.78  
TRAVEL TIME(MIN.) = 0.95 Tc(MIN.) = 14.30  
LONGEST FLOWPATH FROM NODE 100.00 TO NODE 106.00 = 2285.00 FEET.

=====  
END OF STUDY SUMMARY:  
TOTAL AREA(ACRES) = 19.05 TC(MIN.) = 14.30  
EFFECTIVE AREA(ACRES) = 19.05 AREA-AVERAGED Fm(INCH/HR) = 0.17  
AREA-AVERAGED Fp(INCH/HR) = 0.73 AREA-AVERAGED Ap = 0.23  
PEAK FLOW RATE(CFS) = 58.34  
=====

=====  
END OF RATIONAL METHOD ANALYSIS  
=====

1

# **APPENDIX C**

## **HYDRAULIC CALCULATIONS**

0  
 T1 CAJON LOGISTIC CENTER  
 T2 LINE "A" (PRIVATE)  
 T3 100-YR

SO	1000.001798.10	30			1801.50		
R	1021.291798.83	30	.012				
JX	1025.291798.96	30	18	.012	13.3	1799.40	45.00
R	1060.631800.17	30	.012			22.50	90.00
R	1115.881802.05	30	.012				
R	1146.601803.10	30	.012			45.00	39.00
R	1150.601803.20	30	.012				1
R	1328.041806.88	30	.012				
R	1332.041806.96	30	.012				1
R	1499.181810.43	30	.012				
R	1516.851810.80	30	.012			22.50	45.00
R	1521.731810.90	30	.012				
SH	1521.731810.90	30					
CD	18	4			1.50		
CD	24	4			2.00		
CD	30	4			2.50		
CD	54	4			4.50		
CD	60	4			5.00		

DATE: 10/ 3/2017  
 TIME: 9: 8

F0515P  
 WATER SURFACE PROFILE - CHANNEL DEFINITION LISTING

PAGE 1

CARD CODE	SECT NO	CHN TYPE	NO OF PIERS	AVE WIDTH	PIER WIDTH	HEIGHT 1 DIAMETER	BASE WIDTH	ZL	ZR	INV DROP	Y(1)	Y(2)	Y(3)	Y(4)	Y(5)	Y(6)	Y(7)	Y(8)	Y(9)	Y(10)
CD	18	4				1.50														
CD	24	4				2.00														
CD	30	4				2.50														
CD	54	4				4.50														
CD	60	4				5.00														

F 0 5 1 5 P

PAGE NO 3

WATER SURFACE PROFILE - TITLE CARD LISTING

HEADING LINE NO 1 IS -

CAJON LOGISTIC CENTER

HEADING LINE NO 2 IS -

LINE "A" (PRIVATE)

HEADING LINE NO 3 IS -

100-YR

F 0 5 1 5 P

PAGE NO 2

WATER SURFACE PROFILE - ELEMENT CARD LISTING

ELEMENT NO	IS	A	SYSTEM OUTLET	U/S DATA	STATION	INVERT	SECT	W S ELEV								
1	IS	A	SYSTEM OUTLET	U/S DATA	1000.00	1798.10	30	1801.50								
2	IS	A	REACH	U/S DATA	1021.29	1798.83	30	0.012	N	0.012	RADIUS	ANGLE	ANG PT	MAN H		
3	IS	A	JUNCTION	U/S DATA	1025.29	1798.96	30	0.012	N	0.012	Q3	Q4	INVERT-3	INVERT-4	PHI 3	PHI 4
4	IS	A	REACH	U/S DATA	1060.63	1800.17	30	0.012	N	0.012	RADIUS	ANGLE	ANG PT	MAN H		
5	IS	A	REACH	U/S DATA	1115.88	1802.05	30	0.012	N	0.012	RADIUS	ANGLE	ANG PT	MAN H		
6	IS	A	REACH	U/S DATA	1146.60	1803.10	30	0.012	N	0.012	RADIUS	ANGLE	ANG PT	MAN H		
7	IS	A	REACH	U/S DATA	1150.60	1803.20	30	0.012	N	0.012	RADIUS	ANGLE	ANG PT	MAN H		
8	IS	A	REACH	U/S DATA	1328.04	1806.88	30	0.012	N	0.012	RADIUS	ANGLE	ANG PT	MAN H		
9	IS	A	REACH	U/S DATA	1332.04	1806.96	30	0.012	N	0.012	RADIUS	ANGLE	ANG PT	MAN H		
10	IS	A	REACH	U/S DATA	1499.18	1810.43	30	0.012	N	0.012	RADIUS	ANGLE	ANG PT	MAN H		
11	IS	A	REACH	U/S DATA	1516.85	1810.80	30	0.012	N	0.012	RADIUS	ANGLE	ANG PT	MAN H		
12	IS	A	REACH	U/S DATA	1521.73	1810.90	30	0.012	N	0.012	RADIUS	ANGLE	ANG PT	MAN H		
13	IS	A	SYSTEM HEADWORKS	U/S DATA	1521.73	1810.90	30	0.00			W S ELEV					

F 0 5 1 5 P

PAGE NO 3

WATER SURFACE PROFILE ELEMENT CARD LISTING

NO EDIT ERRORS ENCOUNTERED-COMPUTATION IS NOW BEGINNING

\*\* WARNING NO. 2 \*\* - WATER SURFACE ELEVATION GIVEN IS LESS THAN OR EQUALS INVERT ELEVATION IN HDWKDS, W.S.ELEV = INV + DC

LICENSEE: THIENES ENGINEERING

F0515P

PAGE 1

WATER SURFACE PROFILE LISTING

CAJON LOGISTIC CENTER  
 LINE "A" (PRIVATE)  
 100-YR

STATION	INVERT ELEV	DEPTH OF FLOW	W.S. ELEV	Q	VEL	VEL HEAD	ENERGY GRD.EL.	SUPER ELEV	CRITICAL DEPTH	HGT/DIA	BASE/ID NO.	ZL	NO AVBPR PIER
L/ELEM	SO					SF AVE	HF		NORM DEPTH			ZR	



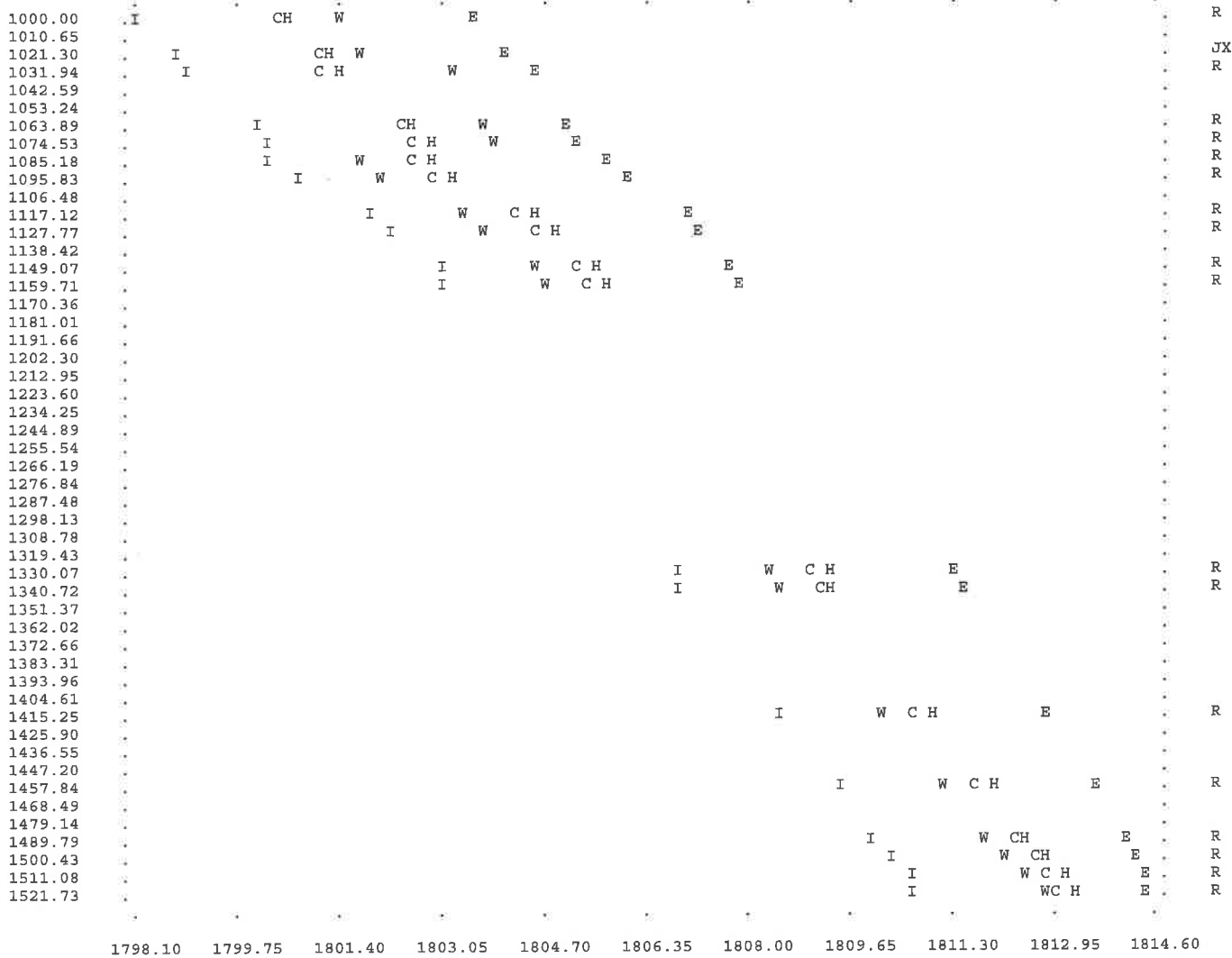
1000.00	1798.10	3.400	1801.500	58.3	11.88	2.190	1803.690	0.00	2.381	2.50	0.00	0.00	0	0.00
21.29	0.03429					.017214	0.37			1.552		0.00		
1021.29	1798.83	3.036	1801.866	58.3	11.88	2.190	1804.056	0.00	2.381	2.50	0.00	0.00	0	0.00
JUNCT STR	0.03250					.013735	0.05					0.00		
1025.29	1798.96	4.284	1803.244	45.0	9.17	1.305	1804.549	0.00	2.226	2.50	0.00	0.00	0	0.00
35.34	0.03424					.010256	0.36			1.320		0.00		
1060.63	1800.17	3.698	1803.868	45.0	9.17	1.305	1805.173	0.00	2.226	2.50	0.00	0.00	0	0.00
6.96	0.03403					.010256	0.07			1.320		0.00		
1067.59	1800.41	3.542	1803.949	45.0	9.17	1.305	1805.254	0.00	2.226	2.50	0.00	0.00	0	0.00
HYDRAULIC JUMP												0.00		
1067.59	1800.41	1.397	1801.804	45.0	15.96	3.954	1805.758	0.00	2.226	2.50	0.00	0.00	0	0.00
10.00	0.03403					.028156	0.28			1.320		0.00		
1077.59	1800.75	1.404	1802.151	45.0	15.84	3.896	1806.047	0.00	2.226	2.50	0.00	0.00	0	0.00
38.29	0.03403					.026262	1.01			1.320		0.00		
1115.88	1802.05	1.461	1803.511	45.0	15.11	3.543	1807.054	0.00	2.226	2.50	0.00	0.00	0	0.00
9.87	0.03418					.024098	0.24			1.320		0.00		
1125.75	1802.39	1.482	1803.869	45.0	14.84	3.420	1807.289	0.00	2.226	2.50	0.00	0.00	0	0.00
20.85	0.03418					.022200	0.46			1.320		0.00		
1146.60	1803.10	1.543	1804.643	45.0	14.15	3.109	1807.752	0.00	2.226	2.50	0.00	0.00	0	0.00
4.00	0.02500					.020778	0.08			1.453		0.00		
1150.60	1803.20	1.547	1804.747	45.0	14.11	3.090	1807.837	0.00	2.226	2.50	0.00	0.00	0	0.00
177.44	0.02074					.020145	3.57			1.544		0.00		
LICENSEE: THIENES ENGINEERING						F0515P								PAGE 2

WATER SURFACE PROFILE LISTING

CAJON LOGISTIC CENTER  
LINE "A" (PRIVATE)  
100-YR

STATION	INVERT ELEV	DEPTH OF FLOW	W.S. ELEV	Q	VEL	VEL HEAD	ENERGY GRD. EL.	SUPER ELEV	CRITICAL DEPTH	HGT/DIA	BASE/ID NO.	ZL	NO PIER	AVBPR
L/ELEM	SO					SF AVE	HF			NORM DEPTH		ZR		
1328.04	1806.88	1.576	1808.456	45.0	13.80	2.959	1811.415	0.00	2.226	2.50	0.00	0.00	0	0.00
4.00	0.02000					.019581	0.08			1.563		0.00		
1332.04	1806.96	1.576	1808.536	45.0	13.80	2.957	1811.493	0.00	2.226	2.50	0.00	0.00	0	0.00
77.50	0.02076					.018715	1.45			1.544		0.00		
1409.54	1808.57	1.627	1810.196	45.0	13.30	2.747	1812.943	0.00	2.226	2.50	0.00	0.00	0	0.00
46.17	0.02076					.016866	0.78			1.544		0.00		
1455.71	1809.53	1.697	1811.225	45.0	12.68	2.498	1813.723	0.00	2.226	2.50	0.00	0.00	0	0.00
26.48	0.02076					.015017	0.40			1.544		0.00		
1482.19	1810.08	1.772	1811.849	45.0	12.09	2.271	1814.120	0.00	2.226	2.50	0.00	0.00	0	0.00
16.99	0.02076					.013413	0.23			1.544		0.00		
1499.18	1810.43	1.854	1812.284	45.0	11.53	2.064	1814.348	0.00	2.226	2.50	0.00	0.00	0	0.00
10.36	0.02094					.012077	0.13			1.540		0.00		
1509.54	1810.65	1.935	1812.582	45.0	11.03	1.891	1814.473	0.00	2.226	2.50	0.00	0.00	0	0.00
7.31	0.02094					.010940	0.08			1.540		0.00		
1516.85	1810.80	2.034	1812.834	45.0	10.52	1.719	1814.553	0.00	2.226	2.50	0.00	0.00	0	0.00
2.91	0.02049					.010119	0.03			1.551		0.00		
1519.76	1810.86	2.099	1812.959	45.0	10.23	1.624	1814.583	0.00	2.226	2.50	0.00	0.00	0	0.00
1.97	0.02049					.009480	0.02			1.551		0.00		
1521.73	1810.90	2.226	1813.126	45.0	9.75	1.475	1814.601	0.00	2.226	2.50	0.00	0.00	0	0.00

CAJON LOGISTIC CENTER  
LINE "A" (PRIVATE)  
100-YR



**N O T E S**

1. GLOSSARY

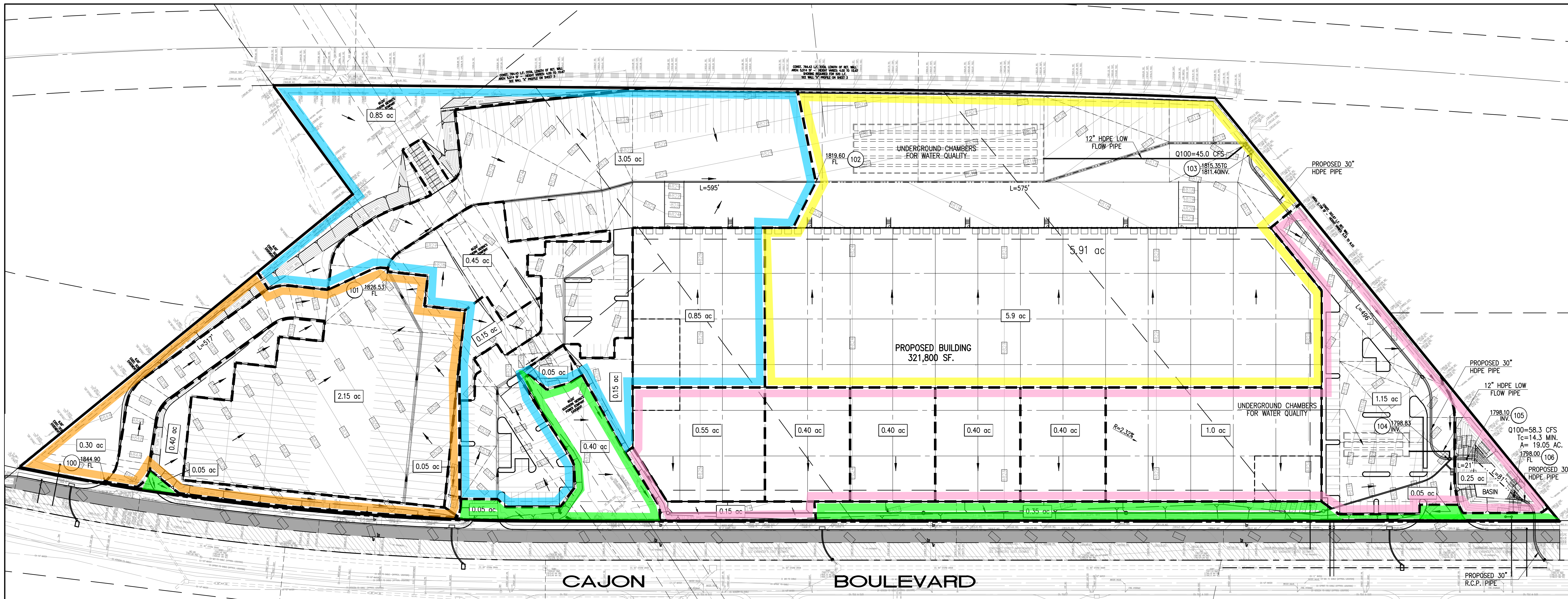
- I = INVERT ELEVATION
- C = CRITICAL DEPTH
- W = WATER SURFACE ELEVATION
- H = HEIGHT OF CHANNEL
- E = ENERGY GRADE LINE
- X = CURVES CROSSING OVER
- B = BRIDGE ENTRANCE OR EXIT
- Y = WALL ENTRANCE OR EXIT

2. STATIONS FOR POINTS AT A JUMP MAY NOT BE PLOTTED EXACTLY

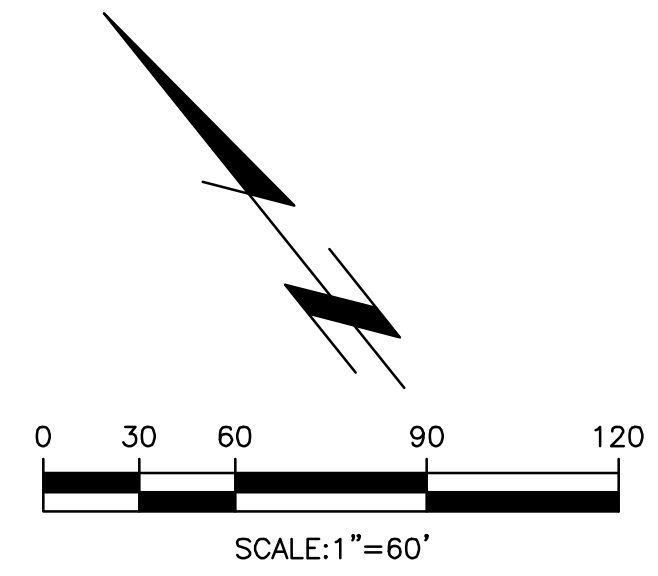
# **APPENDIX D**

## **HYDROLOGY MAP**





LEGEND	
	PROJECT BOUNDARY
	SUBAREA BOUNDARY
	FLOW PATH
	SUBAREA AREA
	NODE NUMBER



CITY OF SAN BERNARDINO  
 PUBLIC WORKS DEPARTMENT  
**PROPOSED CONDITION  
 HYDROLOGY MAP  
 FOR  
 CAJON LOGISTIC CENTER  
 CAJON BOULEVARD  
 SAN BERNARDINO, CA**

**PREPARED FOR:**  
 ALERE PROPERTY GROUP, LLC  
 100 BAYVIEW CIRCLE, SUITE 310  
 NEWPORT BEACH, CA 92660  
 PHONE: (949) 509-5000  
 FAX: (949) 509-5001



Designed by _____	Approved by _____	Date _____
Checked by _____	Public Works Director _____	R.C.E. XXXXXX
Designed by _____		
Checked by _____		
Date _____	Sheet <b>1</b> of <b>1</b> Sheets	

3560 / 1 OF 1 SHEET

Last Update: 9/28/17  
D:\3560-3599\3560\3560HYD.dwg