

FINAL HYDROLOGY STUDY

For:

San Antonio Water
400 E. 20 TH Street
Upland, CA 91784
APN: 1044-091-22-0000

Prepared for:

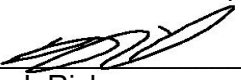
CEDG INC.
Erik Peterson
401 E. Columbia Avenue
Pomona, CA 91767
(909) 625-3916

Prepared by:

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Date Prepared: August 20, 2026

Prepared under the supervision of:



Kevin J. Richer
RCE 43714, Exp. 3/31/27



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Discussion

The purpose of this study is to model the drainage patterns of the pre-developed condition and post-developed condition of the project site during the 10-year, 25-year and 100-year storm events. The study also models the 100-year 24-hour storm event being routed through the proposed underground retention system to show that the storm water volume is mitigated.

The project site is 4.92-acres in size, located at 400 e. 20th street in the city of Upland. In its existing condition, the project site is partially developed with a water tank and equipment pad located towards the west boundary. The site is primarily pervious with dirt and rock cover. The site has no landscape or natural vegetation. There is a small paved turn-around near the entrance to the lot. There is a 3' to 6' high slope along the south boundary of the project adjacent to the freeway right-of-way. The property is bounded to the north by the right-of-way of 20th Street and single family tract homes further to the north, to the west by residential homes, to the south by the 210 Freeway right-of-way, and to the east by an undeveloped lot. It is located in Soil Group A, as shown on the Hydrologic Soils Group Map of the San Bernardino County Hydrology Manual in Appendix A. The project proposes to develop the majority of the site with a office building and maintenance building along with access drives and parking areas. The westerly third of the site will remain undisturbed around the existing water tank and equipment pad. There will be a large landscape area in front of the office building with landscape buffers along the north, east and south boundaries. The site is divided into 2 drainage areas. Area 1 covers the northeasterly quadrant of the site where drainage sheet to a landscaped infiltration basin located to the north of the proposed office building. Area 2 covers the southerly maintenance building and the easterly drive and parking lot. This area sheets towards curbs and gutters that flow westerly toward series of catch basin inlets connected to a proposed storm drain and towards a proposed underground infiltration system located west of the paved area near the south boundary.

	Q _{PRE} (CFS)	T _{C,PRE} (MIN)	Q _{POST "A"} (CFS)	T _{C,POST} (MIN)	Q _{POST} (CFS)	T _{C,POST} (MIN)
10-YR	7.47	14.80	7.67	7.75	4.05	12.12
25-YR	9.43	14.80	9.26	7.70	5.06	12.12
100-YR	13.66	14.80	11.72	7.63	7.22	12.12

Appendix A

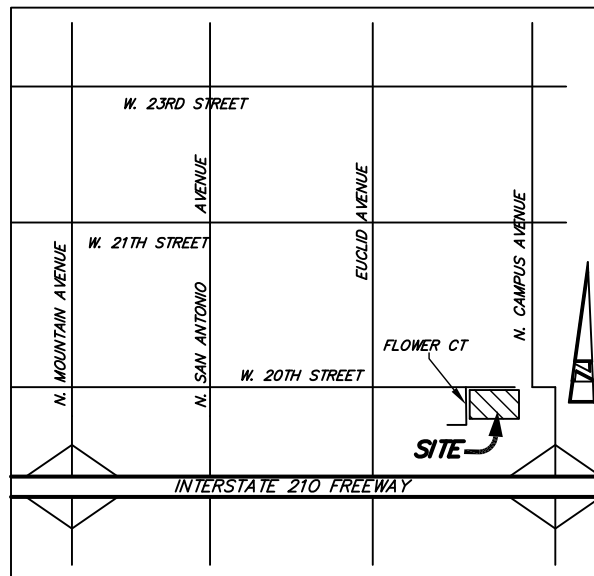
Vicinity Map

Thomas Guide Map

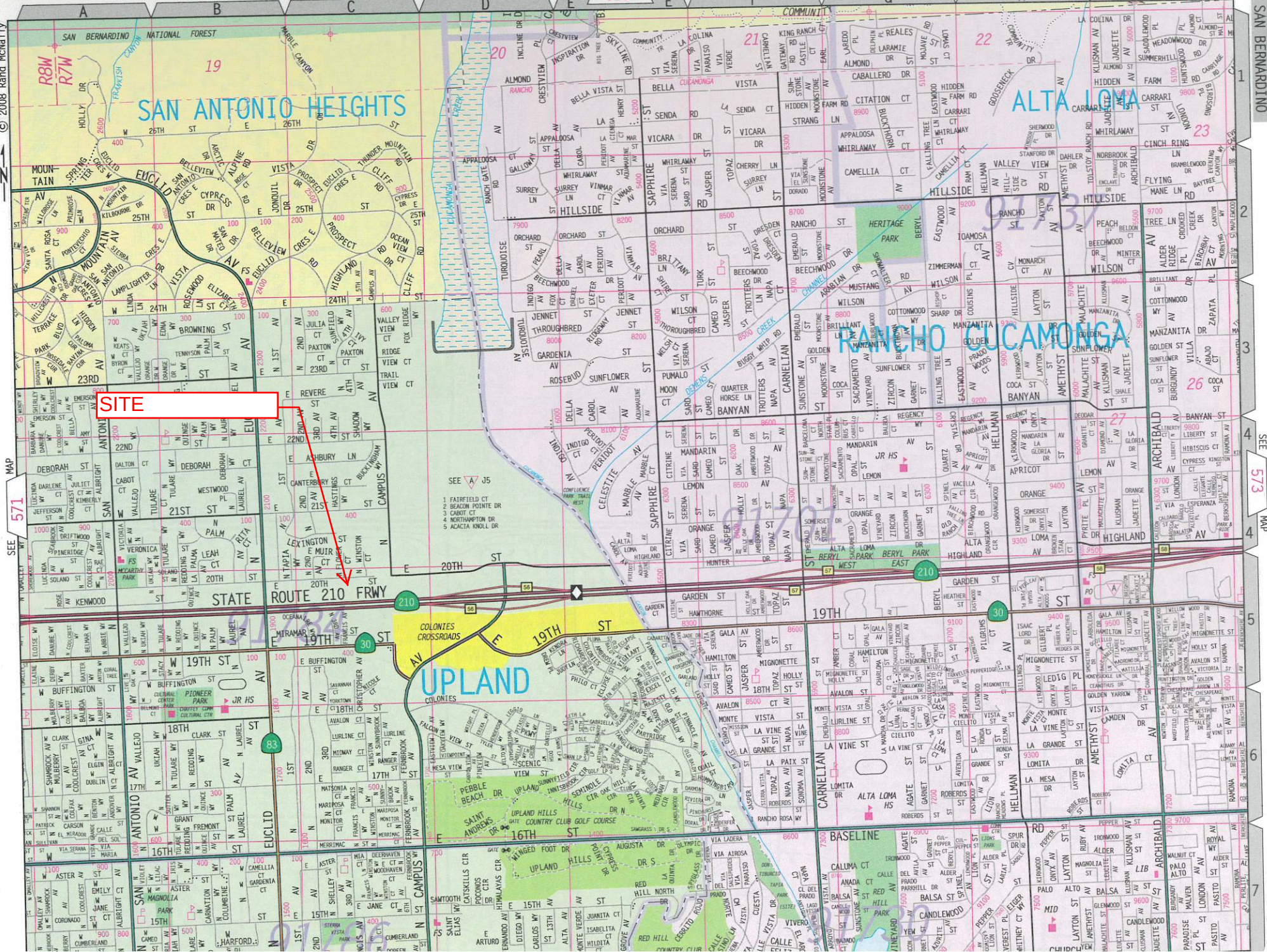
Curve Number Tables

Hydrologic Soils Group

Map Isohyethal Maps



VICINITY MAP
N.T.S.

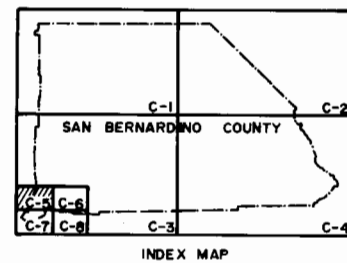
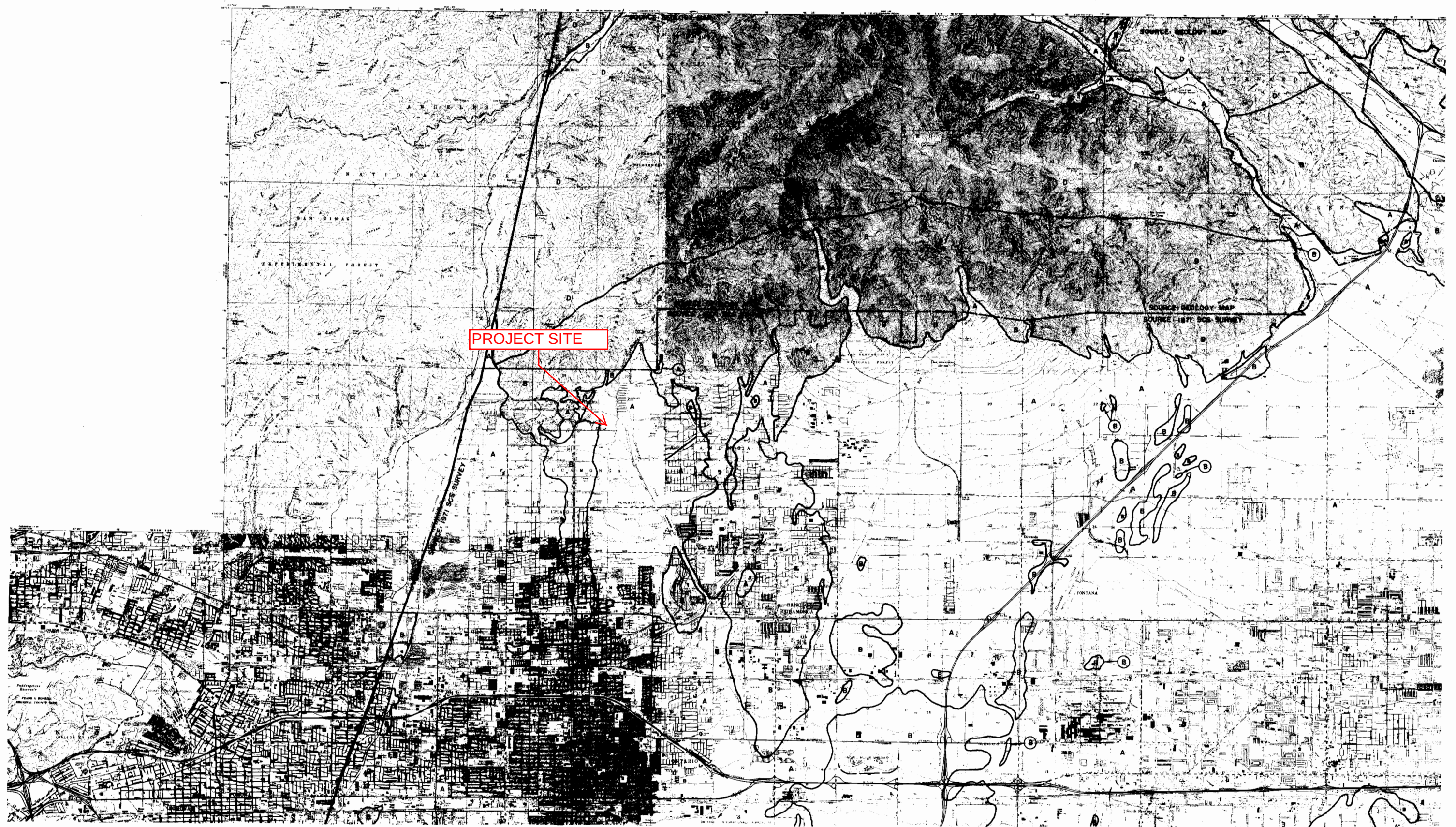


Curve (I) Numbers of Hydrologic Soil-Cover Complexes For Pervious Areas-AMC II

Cover Type (3)	Quality of Cover (2)	Soil Group			
		A	B	C	D
<u>NATURAL COVERS -</u>					
Barren (Rockland, eroded and graded land)		78	86	91	93
Chaparral, Broadleaf (Manzonita, ceanothus and scrub oak)	Poor	53	70	80	85
	Fair	40	63	75	81
	Good	31	57	71	78
Chaparral, Narrowleaf (Chamise and redshank)	Poor	71	82	88	91
	Fair	55	72	81	86
Grass, Annual or Perennial	Poor	67	78	86	89
	Fair	50	69	79	84
	Good	38	61	74	80
Meadows or Cienegas (Areas with seasonally high water table, principal vegetation is sod forming grass)	Poor	63	77	85	88
	Fair	51	70	80	84
	Good	30	58	71	78
Open Brush (Soft wood shrubs - buckwheat, sage, etc.)	Poor	62	76	84	88
	Fair	46	66	77	83
	Good	41	63	75	81
Woodland (Coniferous or broadleaf trees predominate. Canopy density is at least 50 percent.)	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	25	55	70	77
Woodland, Grass (Coniferous or broadleaf trees with canopy density from 20 to 50 percent)	Poor	57	73	82	86
	Fair	44	65	77	82
	Good	33	58	72	79
<u>URBAN COVERS -</u>					
Residential or Commercial Landscaping (Lawn, shrubs, etc.)	Good	32	56	69	75
Turf (Irrigated and mowed grass)	Poor	58	74	83	87
	Fair	44	65	77	82
	Good	33	58	72	79
<u>AGRICULTURAL COVERS -</u>					
Fallow (Land plowed but not tilled or seeded)		77	86	91	94

SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

**CURVE NUMBERS
FOR
PERVIOUS AREAS**



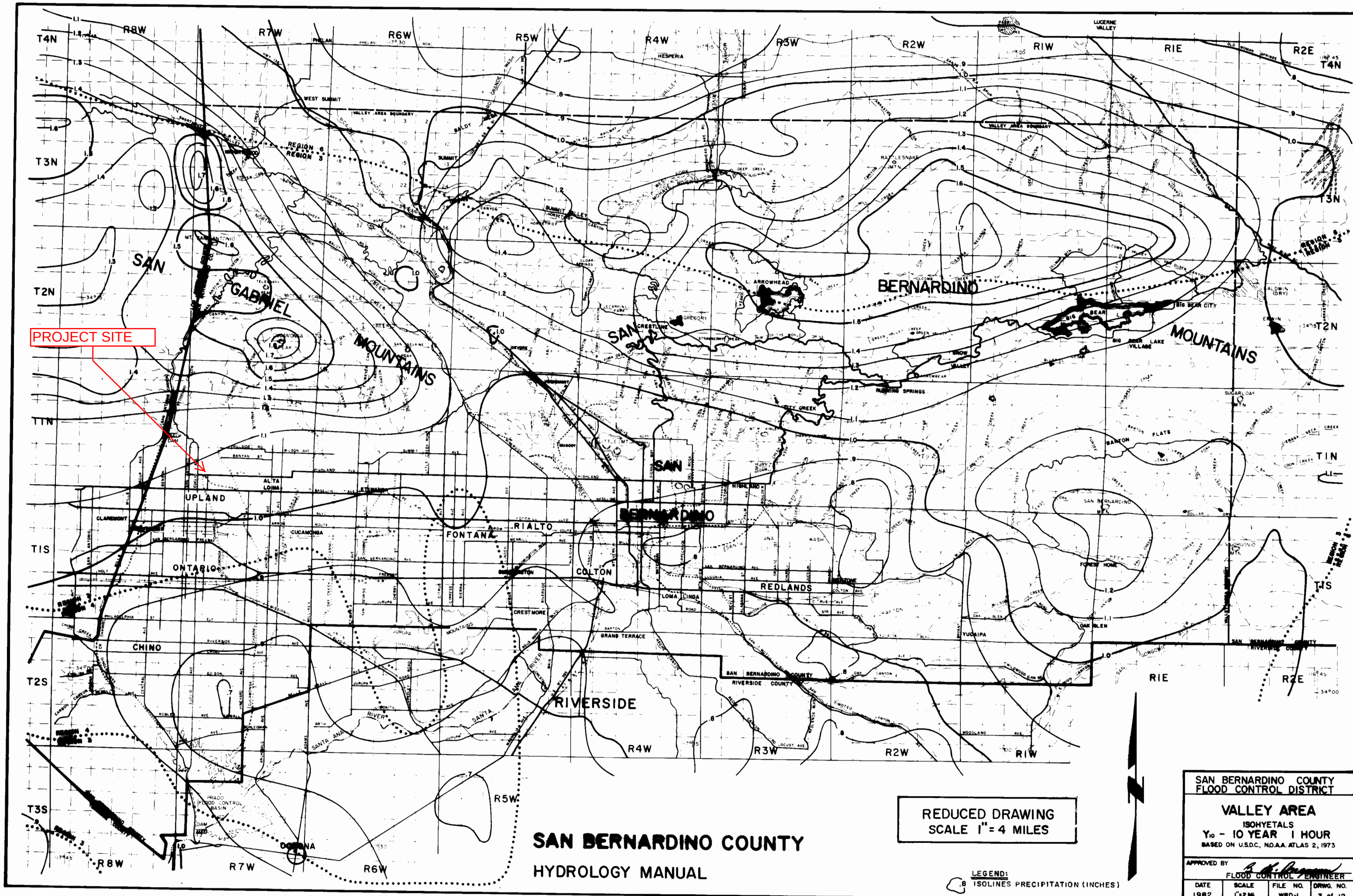
- LEGEND
- SOIL GROUP BOUNDARY
 - A SOIL GROUP DESIGNATION
 - BOUNDARY OF INDICATED SOURCE

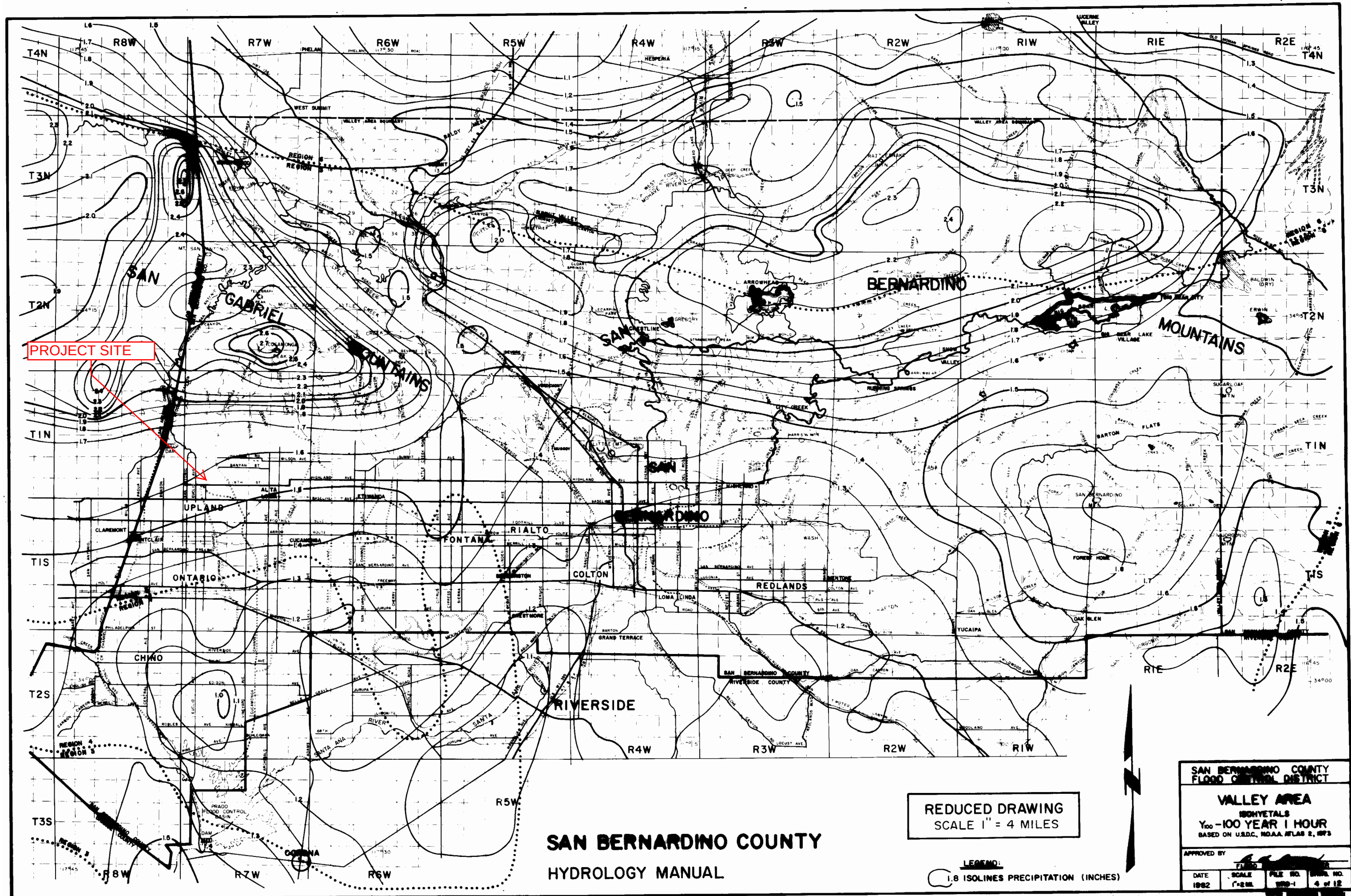


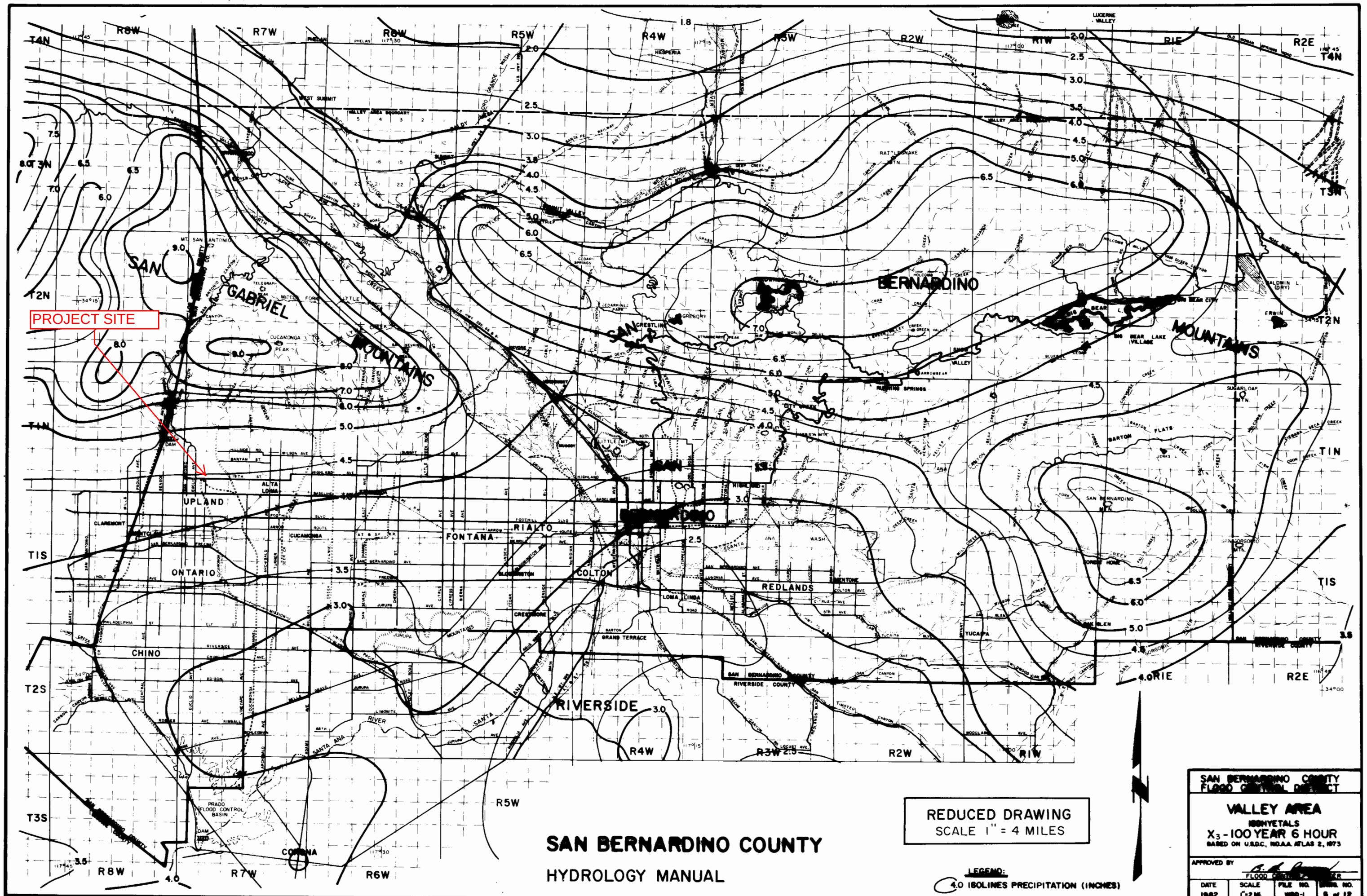
SCALE REDUCED BY 1/2

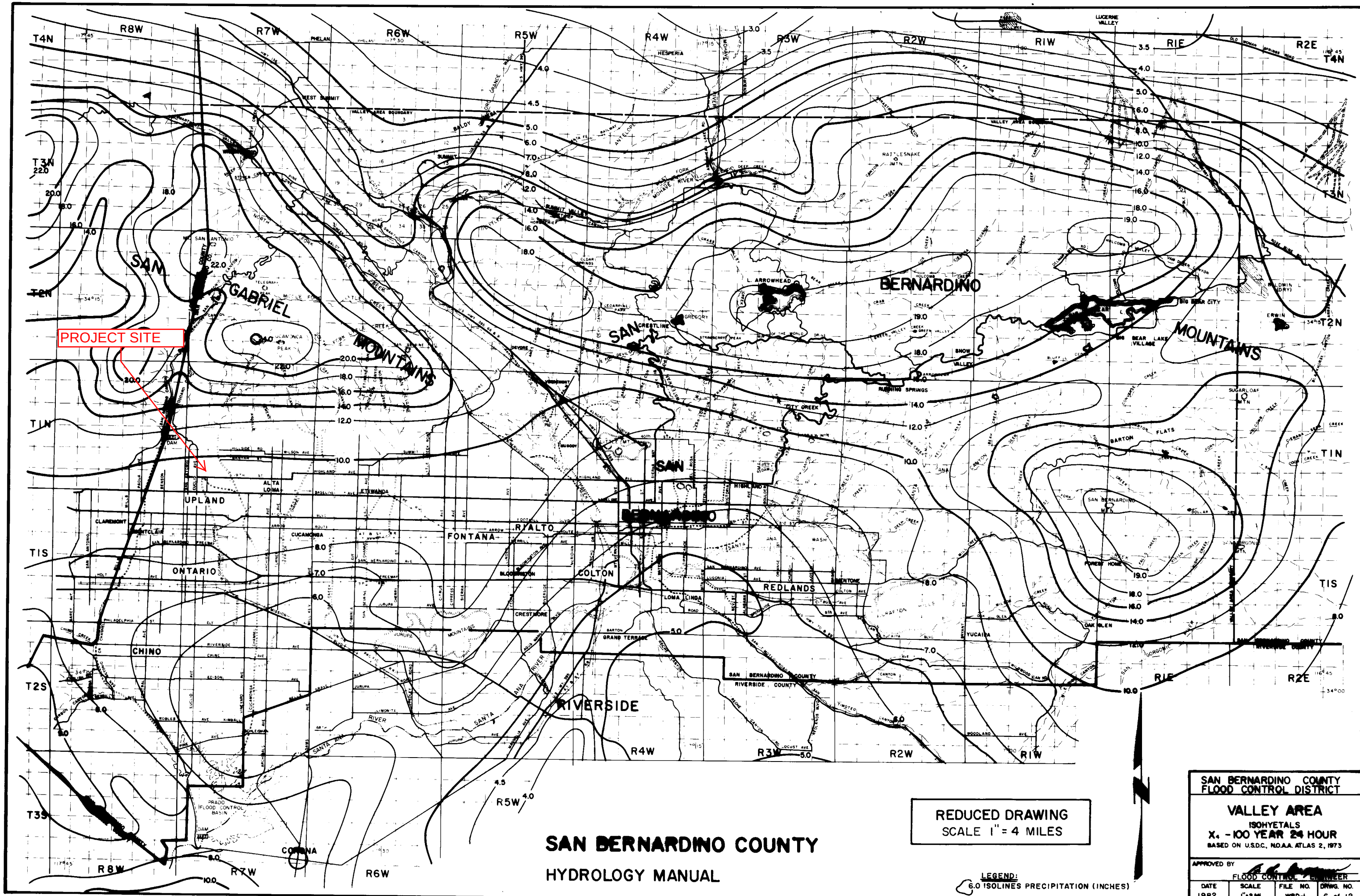
**HYDROLOGIC SOILS GROUP MAP
FOR
SOUTHWEST-A AREA**

**SAN BERNARDINO COUNTY
HYDROLOGY MANUAL**





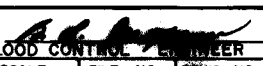




REDUCED DRAWING
SCALE 1" = 4 MILES

SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

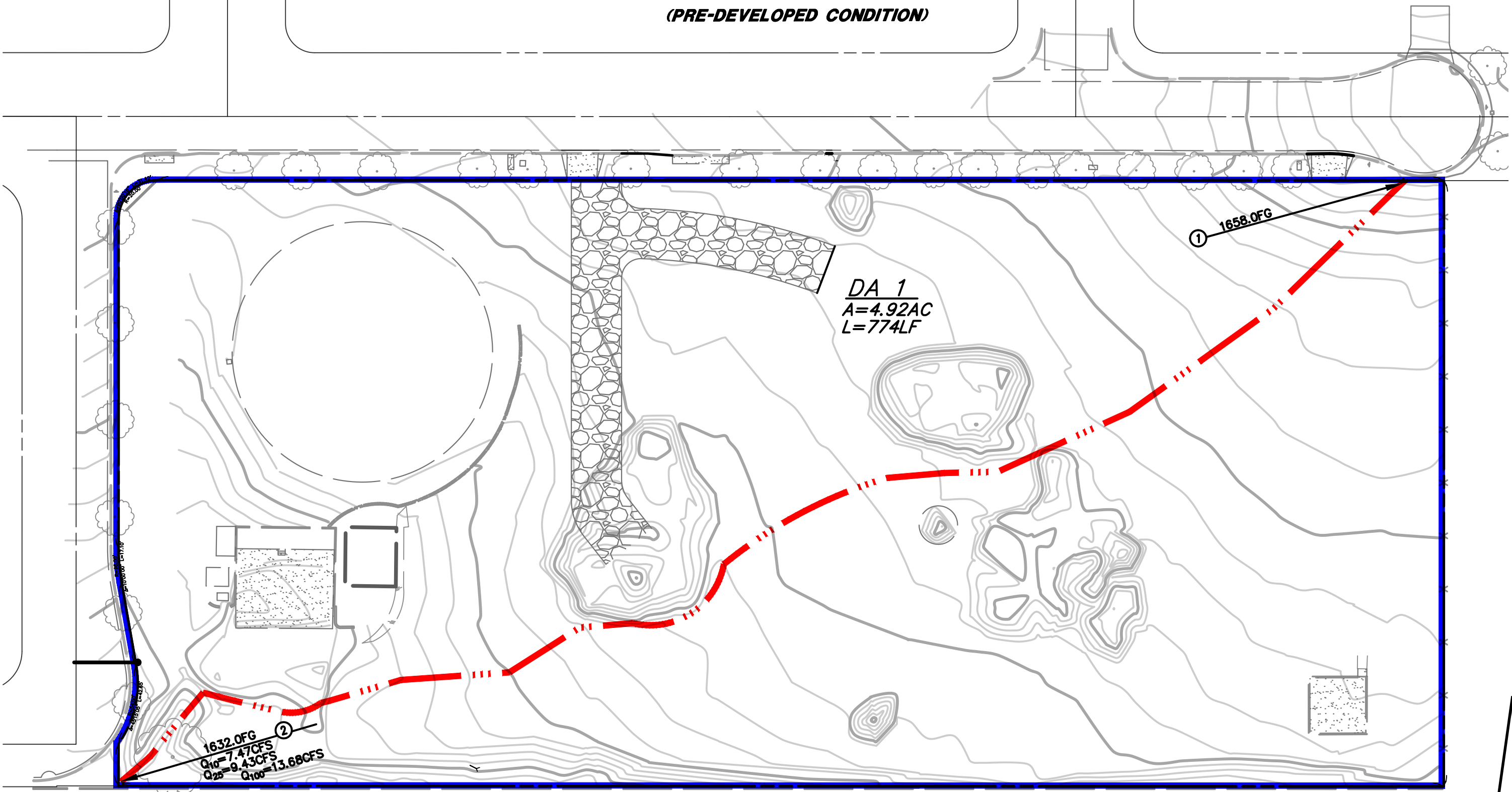
LEGEND:
6.0 ISOLINES PRECIPITATION (INCHES)

SAN BERNARDINO COUNTY FLOOD CONTROL DISTRICT			
VALLEY AREA			
ISOHYETALS			
X ₄ - 100 YEAR 24 HOUR			
BASED ON U.S.D.C. NO. AA. ATLAS 2, 1973			
APPROVED BY: 			
DATE	SCALE	FILE NO.	DRWG. NO.
1982	1" = 2 MI.	WRD-1	6 of 12

Appendix B

Hydrology Map (Pre-Developed)
Rational Method Output (Pre-Developed)

HYDROLOGY MAP
(PRE-DEVELOPED CONDITION)



LEGEND

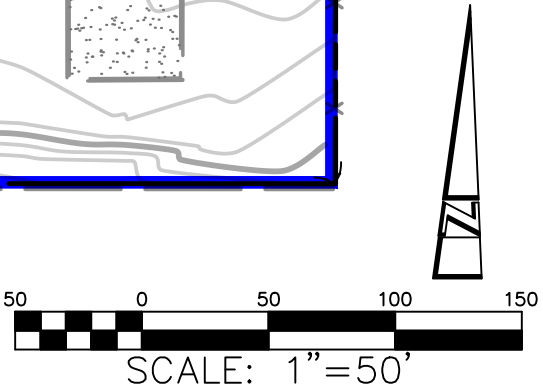
- ON-SITE WATER SHED BOUNDARY
- WATER COURSE
- DIRECTION OF FLOW
- NODE NUMBER

SITE:

SAN ANTONIO WATER
400 E. 20TH STREET
UPLAND, CA 91784

PREPARED FOR:

CEDG INC.
ERIK PETERSON
401 E. COLUMBIA AVE.
POMONA, CA 91767
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San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
 Rational Hydrology Study Date: 11/26/25

 JN 6773 RAIONAL STUDY
 UNDEVELOPED
 10 YEAR STORM

Program License Serial Number 5016

***** Hydrology Study Control Information *****

Rational hydrology study storm event year is 10.0
 Computed rainfall intensity:
 Storm year = 10.00 1 hour rainfall = 0.978 (In.)
 Slope used for rainfall intensity curve b = 0.6000
 Soil antecedent moisture condition (AMC) = 2
 ++++++
 Process from Point/Station 1.000 to Point/Station 2.000
 **** INITIAL AREA EVALUATION ****

 UNDEVELOPED (poor cover) subarea
 Decimal fraction soil group A = 1.000
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 SCS curve number for soil(AMC 2) = 67.00
 Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.578(In/Hr)
 Initial subarea data:
 Initial area flow distance = 774.000(Ft.)
 Top (of initial area) elevation = 1658.000(Ft.)
 Bottom (of initial area) elevation = 1632.000(Ft.)
 Difference in elevation = 26.000(Ft.)
 Slope = 0.03359 s(%)= 3.36
 $TC = k(0.525)*[(length^3)/(elevation\ change)]^{0.2}$
 Initial area time of concentration = 14.805 min.
 Rainfall intensity = 2.265(In/Hr) for a 10.0 year storm
 Effective runoff coefficient used for area (Q=KCIA) is C = 0.670
 Subarea runoff = 7.467(CFS)
 Total initial stream area = 4.920(Ac.)
 Pervious area fraction = 1.000
 Initial area Fm value = 0.578(In/Hr)
 End of computations, Total Study Area = 4.92 (Ac.)
 The following figures may
 be used for a unit hydrograph study of the same area.
 Note: These figures do not consider reduced effective area
 effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
 Area averaged SCS curve number = 67.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
 Rational Hydrology Study Date: 11/26/25

 JN 6773 RAIONAL STUDY
 UNDEVELOPED
 25 YEAR STORM

Program License Serial Number 5016

***** Hydrology Study Control Information *****

Rational hydrology study storm event year is 25.0
 10 Year storm 1 hour rainfall = 0.978(In.)
 100 Year storm 1 hour rainfall = 1.460(In.)
 Computed rainfall intensity:
 Storm year = 25.00 1 hour rainfall = 1.170 (In.)
 Slope used for rainfall intensity curve b = 0.6000
 Soil antecedent moisture condition (AMC) = 2
 ++++++
 Process from Point/Station 1.000 to Point/Station 2.000
 **** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
 Decimal fraction soil group A = 1.000
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 SCS curve number for soil(AMC 2) = 67.00
 Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.578(In/Hr)
 Initial subarea data:
 Initial area flow distance = 774.000(Ft.)
 Top (of initial area) elevation = 1658.000(Ft.)
 Bottom (of initial area) elevation = 1632.000(Ft.)
 Difference in elevation = 26.000(Ft.)
 Slope = 0.03359 s(%)= 3.36
 $TC = k(0.525)*[(length^3)/(elevation\ change)]^{0.2}$
 Initial area time of concentration = 14.805 min.
 Rainfall intensity = 2.709(In/Hr) for a 25.0 year storm
 Effective runoff coefficient used for area (Q=KCIA) is C = 0.708
 Subarea runoff = 9.433(CFS)
 Total initial stream area = 4.920(Ac.)
 Pervious area fraction = 1.000
 Initial area Fm value = 0.578(In/Hr)
 End of computations, Total Study Area = 4.92 (Ac.)
 The following figures may
 be used for a unit hydrograph study of the same area.
 Note: These figures do not consider reduced effective area
 effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
 Area averaged SCS curve number = 67.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
 Rational Hydrology Study Date: 11/26/25

 JN 6773 RAIONAL STUDY
 UNDEVELOPED
 100 YEAR STORM

Program License Serial Number 5016

***** Hydrology Study Control Information *****

Rational hydrology study storm event year is 100.0
 10 Year storm 1 hour rainfall = 0.978(In.)
 100 Year storm 1 hour rainfall = 1.460(In.)
 Computed rainfall intensity:
 Storm year = 100.00 1 hour rainfall = 1.460 (In.)
 Slope used for rainfall intensity curve b = 0.6000
 Soil antecedent moisture condition (AMC) = 3
 ++++++
 Process from Point/Station 1.000 to Point/Station 2.000
 **** INITIAL AREA EVALUATION ****

 UNDEVELOPED (poor cover) subarea
 Decimal fraction soil group A = 1.000
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 SCS curve number for soil(AMC 2) = 67.00
 Adjusted SCS curve number for AMC 3 = 84.60
 Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.290(In/Hr)
 Initial subarea data:
 Initial area flow distance = 774.000(Ft.)
 Top (of initial area) elevation = 1658.000(Ft.)
 Bottom (of initial area) elevation = 1632.000(Ft.)
 Difference in elevation = 26.000(Ft.)
 Slope = 0.03359 s(%)= 3.36
 $TC = k(0.525)*[(length^3)/(elevation\ change)]^{0.2}$
 Initial area time of concentration = 14.805 min.
 Rainfall intensity = 3.381(In/Hr) for a 100.0 year storm
 Effective runoff coefficient used for area (Q=KCIA) is C = 0.823
 Subarea runoff = 13.685(CFS)
 Total initial stream area = 4.920(Ac.)
 Pervious area fraction = 1.000
 Initial area Fm value = 0.290(In/Hr)
 End of computations, Total Study Area = 4.92 (Ac.)
 The following figures may
 be used for a unit hydrograph study of the same area.
 Note: These figures do not consider reduced effective area
 effects caused by confluences in the rational equation.

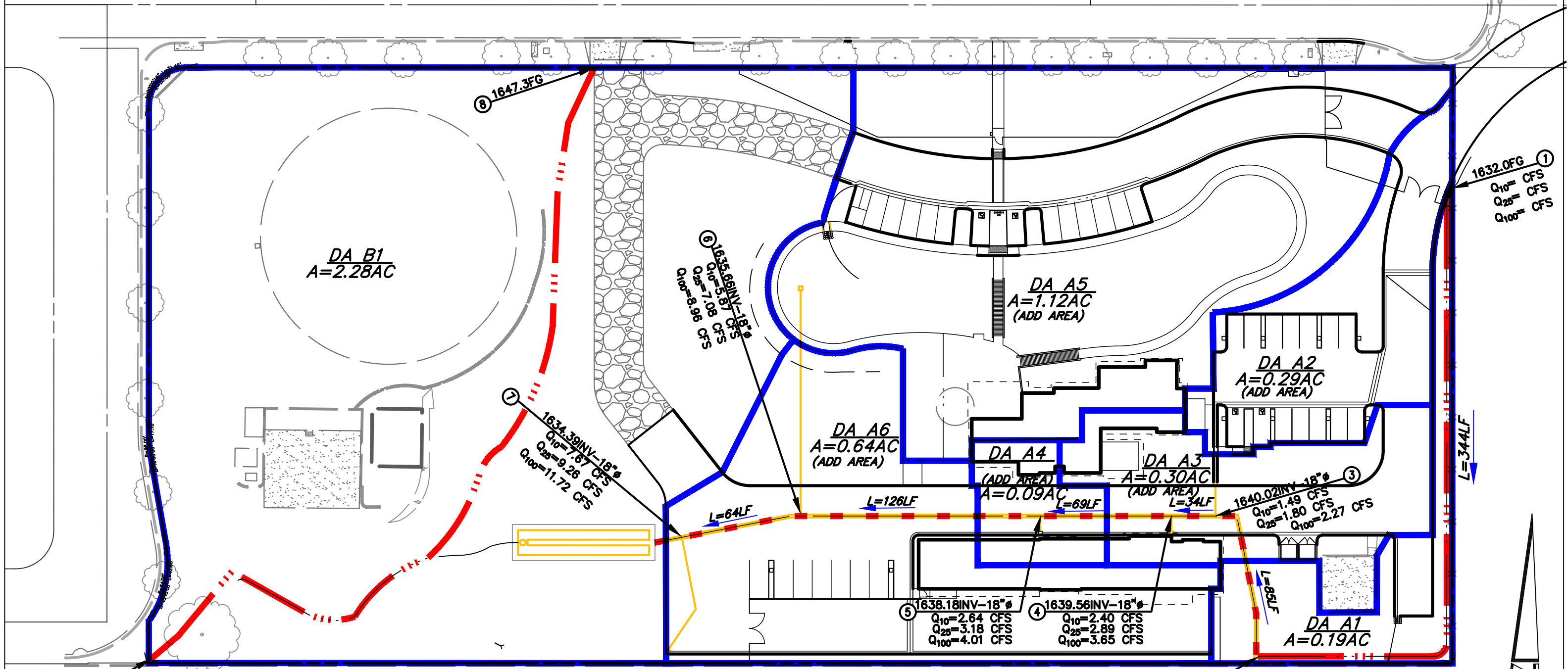
Area averaged pervious area fraction(Ap) = 1.000
 Area averaged SCS curve number = 67.0

Appendix C

Hydrology Map (Post-Developed)
Rational Method Output (Post-Developed)

HYDROLOGY MAP

(POST-DEVELOPED CONDITION)



LEGEND

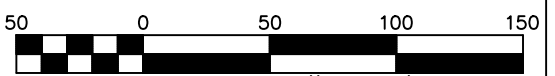
- ON-SITE WATER SHED BOUNDARY
- WATER COURSE
- PIPE COURSE
- DIRECTION OF FLOW
- NODE NUMBER

SITE:

SAN ANTONIO WATER
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PREPARED FOR:

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SCALE: 1"=50'

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
 Rational Hydrology Study Date: 11/26/25

 6773 RATIONAL STUDY
 POST DEVELOPED AREA A
 10 YEAR STORM

Program License Serial Number 5016

***** Hydrology Study Control Information *****

Rational hydrology study storm event year is 10.0
 Computed rainfall intensity:
 Storm year = 10.00 1 hour rainfall = 0.978 (In.)
 Slope used for rainfall intensity curve b = 0.6000
 Soil antecedent moisture condition (AMC) = 2
 ++++++
 Process from Point/Station 1.000 to Point/Station 2.000
 **** INITIAL AREA EVALUATION ****

 COMMERCIAL subarea type
 Decimal fraction soil group A = 1.000
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 SCS curve number for soil(AMC 2) = 32.00
 Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.098(In/Hr)
 Initial subarea data:
 Initial area flow distance = 344.000(Ft.)
 Top (of initial area) elevation = 1652.800(Ft.)
 Bottom (of initial area) elevation = 1644.600(Ft.)
 Difference in elevation = 8.200(Ft.)
 Slope = 0.02384 s(%)= 2.38
 $TC = k(0.304)*[(length^3)/(elevation\ change)]^{0.2}$
 Initial area time of concentration = 6.638 min.
 Rainfall intensity = 3.664(In/Hr) for a 10.0 year storm
 Effective runoff coefficient used for area (Q=KCIA) is C = 0.876
 Subarea runoff = 0.610(CFS)
 Total initial stream area = 0.190(Ac.)
 Pervious area fraction = 0.100
 Initial area Fm value = 0.098(In/Hr)
 ++++++
 Process from Point/Station 2.000 to Point/Station 3.000
 **** PIPEFLOW TRAVEL TIME (User specified size) ****

 Upstream point/station elevation = 1641.730(Ft.)
 Downstream point/station elevation = 1640.020(Ft.)
 Pipe length = 85.00(Ft.) Manning's N = 0.013
 No. of pipes = 1 Required pipe flow = 0.610(CFS)
 Given pipe size = 18.00(In.)
 Calculated individual pipe flow = 0.610(CFS)
 Normal flow depth in pipe = 2.48(In.)
 Flow top width inside pipe = 12.41(In.)
 Critical depth could not be calculated.
 Pipe flow velocity = 4.14(Ft/s)
 Travel time through pipe = 0.34 min.
 Time of concentration (TC) = 6.98 min.
 ++++++
 Process from Point/Station 2.000 to Point/Station 3.000
 **** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type

Decimal fraction soil group A = 1.000
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 SCS curve number for soil(AMC 2) = 32.00
 Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.098(In/Hr)
 Time of concentration = 6.98 min.
 Rainfall intensity = 3.555(In/Hr) for a 10.0 year storm
 Effective runoff coefficient used for area,(total area with modified
 rational method)(Q=KCIA) is C = 0.875
 Subarea runoff = 0.884(CFS) for 0.290(Ac.)
 Total runoff = 1.494(CFS)
 Effective area this stream = 0.48(Ac.)
 Total Study Area (Main Stream No. 1) = 0.48(Ac.)
 Area averaged Fm value = 0.098(In/Hr)
 ++++++
 Process from Point/Station 3.000 to Point/Station 4.000
 **** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 1640.020(Ft.)
 Downstream point/station elevation = 1639.560(Ft.)
 Pipe length = 34.00(Ft.) Manning's N = 0.013
 No. of pipes = 1 Required pipe flow = 1.494(CFS)
 Given pipe size = 18.00(In.)
 Calculated individual pipe flow = 1.494(CFS)
 Normal flow depth in pipe = 4.25(In.)
 Flow top width inside pipe = 15.29(In.)
 Critical Depth = 5.50(In.)
 Pipe flow velocity = 4.69(Ft/s)
 Travel time through pipe = 0.12 min.
 Time of concentration (TC) = 7.10 min.
 ++++++
 Process from Point/Station 3.000 to Point/Station 4.000
 **** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type

Decimal fraction soil group A = 1.000
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 SCS curve number for soil(AMC 2) = 32.00
 Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.098(In/Hr)
 Time of concentration = 7.10 min.
 Rainfall intensity = 3.519(In/Hr) for a 10.0 year storm
 Effective runoff coefficient used for area,(total area with modified
 rational method)(Q=KCIA) is C = 0.875
 Subarea runoff = 0.908(CFS) for 0.300(Ac.)
 Total runoff = 2.402(CFS)
 Effective area this stream = 0.78(Ac.)
 Total Study Area (Main Stream No. 1) = 0.78(Ac.)
 Area averaged Fm value = 0.098(In/Hr)
 ++++++
 Process from Point/Station 4.000 to Point/Station 5.000
 **** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 1639.560(Ft.)
 Downstream point/station elevation = 1638.180(Ft.)
 Pipe length = 69.00(Ft.) Manning's N = 0.013
 No. of pipes = 1 Required pipe flow = 2.402(CFS)
 Given pipe size = 18.00(In.)
 Calculated individual pipe flow = 2.402(CFS)
 Normal flow depth in pipe = 4.89(In.)
 Flow top width inside pipe = 16.02(In.)
 Critical Depth = 7.03(In.)
 Pipe flow velocity = 6.18(Ft/s)

Travel time through pipe = 0.19 min.
 Time of concentration (TC) = 7.29 min.
 ++++++
 Process from Point/Station 4.000 to Point/Station 5.000
 **** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
 Decimal fraction soil group A = 1.000
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 SCS curve number for soil(AMC 2) = 32.00
 Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.098(In/Hr)
 Time of concentration = 7.29 min.
 Rainfall intensity = 3.465(In/Hr) for a 10.0 year storm
 Effective runoff coefficient used for area,(total area with modified
 rational method)(Q=KCIA) is C = 0.875
 Subarea runoff = 0.235(CFS) for 0.090(Ac.)
 Total runoff = 2.636(CFS)
 Effective area this stream = 0.87(Ac.)
 Total Study Area (Main Stream No. 1) = 0.87(Ac.)
 Area averaged Fm value = 0.098(In/Hr)
 ++++++
 Process from Point/Station 5.000 to Point/Station 6.000
 **** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 1638.180(Ft.)
 Downstream point/station elevation = 1635.660(Ft.)
 Pipe length = 126.00(Ft.) Manning's N = 0.013
 No. of pipes = 1 Required pipe flow = 2.636(CFS)
 Given pipe size = 18.00(In.)
 Calculated individual pipe flow = 2.636(CFS)
 Normal flow depth in pipe = 5.13(In.)
 Flow top width inside pipe = 16.25(In.)
 Critical Depth = 7.38(In.)
 Pipe flow velocity = 6.34(Ft/s)
 Travel time through pipe = 0.33 min.
 Time of concentration (TC) = 7.62 min.
 ++++++
 Process from Point/Station 5.000 to Point/Station 6.000
 **** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
 Decimal fraction soil group A = 1.000
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 SCS curve number for soil(AMC 2) = 32.00
 Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.098(In/Hr)
 Time of concentration = 7.62 min.
 Rainfall intensity = 3.374(In/Hr) for a 10.0 year storm
 Effective runoff coefficient used for area,(total area with modified
 rational method)(Q=KCIA) is C = 0.874
 Subarea runoff = 3.231(CFS) for 1.120(Ac.)
 Total runoff = 5.867(CFS)
 Effective area this stream = 1.99(Ac.)
 Total Study Area (Main Stream No. 1) = 1.99(Ac.)
 Area averaged Fm value = 0.098(In/Hr)
 ++++++
 Process from Point/Station 6.000 to Point/Station 7.000
 **** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 1635.660(Ft.)
 Downstream point/station elevation = 1634.390(Ft.)
 Pipe length = 64.00(Ft.) Manning's N = 0.013
 No. of pipes = 1 Required pipe flow = 5.867(CFS)

Given pipe size = 18.00(In.)
 Calculated individual pipe flow = 5.867(CFS)
 Normal flow depth in pipe = 7.88(In.)
 Flow top width inside pipe = 17.86(In.)
 Critical Depth = 11.22(In.)
 Pipe flow velocity = 7.89(Ft/s)
 Travel time through pipe = 0.14 min.
 Time of concentration (TC) = 7.75 min.
 ++++++
 Process from Point/Station 6.000 to Point/Station 7.000
 **** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type

Decimal fraction soil group A = 1.000
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 SCS curve number for soil(AMC 2) = 32.00
 Pervious ratio(A_p) = 0.1000 Max loss rate(F_m) = 0.098(In/Hr)
 Time of concentration = 7.75 min.
 Rainfall intensity = 3.338(In/Hr) for a 10.0 year storm
 Effective runoff coefficient used for area, (total area with modified
 rational method)($Q=KCIA$) is $C = 0.874$
 Subarea runoff = 1.803(CFS) for 0.640(Ac.)
 Total runoff = 7.670(CFS)
 Effective area this stream = 2.63(Ac.)
 Total Study Area (Main Stream No. 1) = 2.63(Ac.)
 Area averaged F_m value = 0.098(In/Hr)
 End of computations, Total Study Area = 2.63 (Ac.)
 The following figures may
 be used for a unit hydrograph study of the same area.
 Note: These figures do not consider reduced effective area
 effects caused by confluences in the rational equation.

Area averaged pervious area fraction(A_p) = 0.100
 Area averaged SCS curve number = 32.0

San Bernardino County Rational Hydrology Program

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 6773 RATIONAL STUDY
 POST DEVELOPED AREA B
 10 YEAR STORM

Program License Serial Number 5016

***** Hydrology Study Control Information *****

Rational hydrology study storm event year is 10.0
 Computed rainfall intensity:
 Storm year = 10.00 1 hour rainfall = 0.978 (In.)
 Slope used for rainfall intensity curve b = 0.6000
 Soil antecedent moisture condition (AMC) = 2
 ++++++
 Process from Point/Station 8.000 to Point/Station 9.000
 **** INITIAL AREA EVALUATION ****

 UNDEVELOPED (poor cover) subarea
 Decimal fraction soil group A = 1.000
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 SCS curve number for soil(AMC 2) = 67.00
 Pervious ratio(A_p) = 1.0000 Max loss rate(F_m) = 0.578(In/Hr)
 Initial subarea data:
 Initial area flow distance = 465.000(Ft.)
 Top (of initial area) elevation = 1647.300(Ft.)
 Bottom (of initial area) elevation = 1632.000(Ft.)
 Difference in elevation = 15.300(Ft.)
 Slope = 0.03290 s(%) = 3.29
 $TC = k(0.525)*[(length^3)/(elevation\ change)]^{0.2}$
 Initial area time of concentration = 12.125 min.
 Rainfall intensity = 2.553(In/Hr) for a 10.0 year storm
 Effective runoff coefficient used for area ($Q=KCIA$) is $C = 0.696$
 Subarea runoff = 4.052(CFS)
 Total initial stream area = 2.280(Ac.)
 Pervious area fraction = 1.000
 Initial area F_m value = 0.578(In/Hr)
 End of computations, Total Study Area = 2.28 (Ac.)
 The following figures may
 be used for a unit hydrograph study of the same area.
 Note: These figures do not consider reduced effective area
 effects caused by confluences in the rational equation.

Area averaged pervious area fraction(A_p) = 1.000
 Area averaged SCS curve number = 67.0

San Bernardino County Rational Hydrology Program

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 Rational Hydrology Study Date: 11/26/25

 6773 RATIONAL STUDY
 POST DEVELOPED AREA A
 25 YEAR STORM

Program License Serial Number 5016

***** Hydrology Study Control Information *****

Rational hydrology study storm event year is 25.0
 10 Year storm 1 hour rainfall = 0.978(In.)
 100 Year storm 1 hour rainfall = 1.460(In.)
 Computed rainfall intensity:
 Storm year = 25.00 1 hour rainfall = 1.170 (In.)
 Slope used for rainfall intensity curve b = 0.6000
 Soil antecedent moisture condition (AMC) = 2
 ++++++
 Process from Point/Station 1.000 to Point/Station 2.000
 **** INITIAL AREA EVALUATION ****

 COMMERCIAL subarea type
 Decimal fraction soil group A = 1.000
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 SCS curve number for soil(AMC 2) = 32.00
 Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.098(In/Hr)
 Initial subarea data:
 Initial area flow distance = 344.000(Ft.)
 Top (of initial area) elevation = 1652.800(Ft.)
 Bottom (of initial area) elevation = 1644.600(Ft.)
 Difference in elevation = 8.200(Ft.)
 Slope = 0.02384 s(%)= 2.38
 $TC = k(0.304)*[(length^3)/(elevation\ change)]^{0.2}$
 Initial area time of concentration = 6.638 min.
 Rainfall intensity = 4.383(In/Hr) for a 25.0 year storm
 Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
 Subarea runoff = 0.733(CFS)
 Total initial stream area = 0.190(Ac.)
 Pervious area fraction = 0.100
 Initial area Fm value = 0.098(In/Hr)
 ++++++
 Process from Point/Station 2.000 to Point/Station 3.000
 **** PIPEFLOW TRAVEL TIME (User specified size) ****

 Upstream point/station elevation = 1641.730(Ft.)
 Downstream point/station elevation = 1640.020(Ft.)
 Pipe length = 85.00(Ft.) Manning's N = 0.013
 No. of pipes = 1 Required pipe flow = 0.733(CFS)
 Given pipe size = 18.00(In.)
 Calculated individual pipe flow = 0.733(CFS)
 Normal flow depth in pipe = 2.71(In.)
 Flow top width inside pipe = 12.88(In.)
 Critical Depth = 3.81(In.)
 Pipe flow velocity = 4.37(Ft/s)
 Travel time through pipe = 0.32 min.
 Time of concentration (TC) = 6.96 min.
 ++++++
 Process from Point/Station 2.000 to Point/Station 3.000

**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type

Decimal fraction soil group A = 1.000
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 SCS curve number for soil(AMC 2) = 32.00
 Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.098(In/Hr)
 Time of concentration = 6.96 min.
 Rainfall intensity = 4.259(In/Hr) for a 25.0 year storm
 Effective runoff coefficient used for area,(total area with modified
 rational method)(Q=KCIA) is C = 0.879
 Subarea runoff = 1.065(CFS) for 0.290(Ac.)
 Total runoff = 1.798(CFS)
 Effective area this stream = 0.48(Ac.)
 Total Study Area (Main Stream No. 1) = 0.48(Ac.)
 Area averaged Fm value = 0.098(In/Hr)
 ++++++
 Process from Point/Station 3.000 to Point/Station 4.000
 **** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 1640.020(Ft.)
 Downstream point/station elevation = 1639.560(Ft.)
 Pipe length = 34.00(Ft.) Manning's N = 0.013
 No. of pipes = 1 Required pipe flow = 1.798(CFS)
 Given pipe size = 18.00(In.)
 Calculated individual pipe flow = 1.798(CFS)
 Normal flow depth in pipe = 4.66(In.)
 Flow top width inside pipe = 15.77(In.)
 Critical Depth = 6.05(In.)
 Pipe flow velocity = 4.94(Ft/s)
 Travel time through pipe = 0.11 min.
 Time of concentration (TC) = 7.08 min.
 ++++++
 Process from Point/Station 3.000 to Point/Station 4.000
 **** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type

Decimal fraction soil group A = 1.000
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 SCS curve number for soil(AMC 2) = 32.00
 Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.098(In/Hr)
 Time of concentration = 7.08 min.
 Rainfall intensity = 4.218(In/Hr) for a 25.0 year storm
 Effective runoff coefficient used for area,(total area with modified
 rational method)(Q=KCIA) is C = 0.879
 Subarea runoff = 1.095(CFS) for 0.300(Ac.)
 Total runoff = 2.892(CFS)
 Effective area this stream = 0.78(Ac.)
 Total Study Area (Main Stream No. 1) = 0.78(Ac.)
 Area averaged Fm value = 0.098(In/Hr)
 ++++++
 Process from Point/Station 4.000 to Point/Station 5.000
 **** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 1639.560(Ft.)
 Downstream point/station elevation = 1638.180(Ft.)
 Pipe length = 69.00(Ft.) Manning's N = 0.013
 No. of pipes = 1 Required pipe flow = 2.892(CFS)
 Given pipe size = 18.00(In.)
 Calculated individual pipe flow = 2.892(CFS)
 Normal flow depth in pipe = 5.38(In.)
 Flow top width inside pipe = 16.48(In.)

Critical Depth = 7.75(In.)
 Pipe flow velocity = 6.51(Ft/s)
 Travel time through pipe = 0.18 min.
 Time of concentration (TC) = 7.25 min.
 ++++++
 Process from Point/Station 4.000 to Point/Station 5.000
 **** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
 Decimal fraction soil group A = 1.000
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 SCS curve number for soil(AMC 2) = 32.00
 Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.098(In/Hr)
 Time of concentration = 7.25 min.
 Rainfall intensity = 4.156(In/Hr) for a 25.0 year storm
 Effective runoff coefficient used for area,(total area with modified
 rational method)(Q=KCIA) is C = 0.879
 Subarea runoff = 0.285(CFS) for 0.090(Ac.)
 Total runoff = 3.178(CFS)
 Effective area this stream = 0.87(Ac.)
 Total Study Area (Main Stream No. 1) = 0.87(Ac.)
 Area averaged Fm value = 0.098(In/Hr)
 ++++++
 Process from Point/Station 5.000 to Point/Station 6.000
 **** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 1638.180(Ft.)
 Downstream point/station elevation = 1635.660(Ft.)
 Pipe length = 126.00(Ft.) Manning's N = 0.013
 No. of pipes = 1 Required pipe flow = 3.178(CFS)
 Given pipe size = 18.00(In.)
 Calculated individual pipe flow = 3.178(CFS)
 Normal flow depth in pipe = 5.65(In.)
 Flow top width inside pipe = 16.71(In.)
 Critical Depth = 8.14(In.)
 Pipe flow velocity = 6.69(Ft/s)
 Travel time through pipe = 0.31 min.
 Time of concentration (TC) = 7.57 min.
 ++++++
 Process from Point/Station 5.000 to Point/Station 6.000
 **** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
 Decimal fraction soil group A = 1.000
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 SCS curve number for soil(AMC 2) = 32.00
 Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.098(In/Hr)
 Time of concentration = 7.57 min.
 Rainfall intensity = 4.052(In/Hr) for a 25.0 year storm
 Effective runoff coefficient used for area,(total area with modified
 rational method)(Q=KCIA) is C = 0.878
 Subarea runoff = 3.904(CFS) for 1.120(Ac.)
 Total runoff = 7.082(CFS)
 Effective area this stream = 1.99(Ac.)
 Total Study Area (Main Stream No. 1) = 1.99(Ac.)
 Area averaged Fm value = 0.098(In/Hr)
 ++++++
 Process from Point/Station 6.000 to Point/Station 7.000
 **** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 1635.660(Ft.)
 Downstream point/station elevation = 1634.390(Ft.)

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Pipe length = 64.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 7.082(CFS)
Given pipe size = 18.00(In.)
Calculated individual pipe flow = 7.082(CFS)
Normal flow depth in pipe = 8.77(In.)
Flow top width inside pipe = 17.99(In.)
Critical Depth = 12.36(In.)
Pipe flow velocity = 8.28(Ft/s)
Travel time through pipe = 0.13 min.
Time of concentration (TC) = 7.70 min.
+++++
Process from Point/Station 6.000 to Point/Station 7.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type

Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Pervious ratio(A_p) = 0.1000 Max loss rate(F_m) = 0.098(In/Hr)
Time of concentration = 7.70 min.
Rainfall intensity = 4.011(In/Hr) for a 25.0 year storm
Effective runoff coefficient used for area, (total area with modified rational method)($Q=KCIA$) is $C = 0.878$
Subarea runoff = 2.181(CFS) for 0.640(Ac.)
Total runoff = 9.262(CFS)
Effective area this stream = 2.63(Ac.)
Total Study Area (Main Stream No. 1) = 2.63(Ac.)
Area averaged F_m value = 0.098(In/Hr)
End of computations, Total Study Area = 2.63 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(A_p) = 0.100
Area averaged SCS curve number = 32.0

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 6773 RATIONAL STUDY
 POST DEVELOPED AREA B
 25 YEAR STORM

Program License Serial Number 5016

***** Hydrology Study Control Information *****

Rational hydrology study storm event year is 25.0
 10 Year storm 1 hour rainfall = 0.978(In.)
 100 Year storm 1 hour rainfall = 1.460(In.)
 Computed rainfall intensity:
 Storm year = 25.00 1 hour rainfall = 1.170 (In.)
 Slope used for rainfall intensity curve b = 0.6000
 Soil antecedent moisture condition (AMC) = 2
 ++++++
 Process from Point/Station 8.000 to Point/Station 9.000
 **** INITIAL AREA EVALUATION ****

 UNDEVELOPED (poor cover) subarea
 Decimal fraction soil group A = 1.000
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 SCS curve number for soil(AMC 2) = 67.00
 Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.578(In/Hr)
 Initial subarea data:
 Initial area flow distance = 465.000(Ft.)
 Top (of initial area) elevation = 1647.300(Ft.)
 Bottom (of initial area) elevation = 1632.000(Ft.)
 Difference in elevation = 15.300(Ft.)
 Slope = 0.03290 s(%)= 3.29
 $TC = k(0.525)*[(length^3)/(elevation\ change)]^{0.2}$
 Initial area time of concentration = 12.125 min.
 Rainfall intensity = 3.053(In/Hr) for a 25.0 year storm
 Effective runoff coefficient used for area (Q=KCIA) is C = 0.730
 Subarea runoff = 5.079(CFS)
 Total initial stream area = 2.280(Ac.)
 Pervious area fraction = 1.000
 Initial area Fm value = 0.578(In/Hr)
 End of computations, Total Study Area = 2.28 (Ac.)
 The following figures may
 be used for a unit hydrograph study of the same area.
 Note: These figures do not consider reduced effective area
 effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
 Area averaged SCS curve number = 67.0

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 6773 RATIONAL STUDY
 POST DEVELOPED AREA A
 100 YEAR STORM

Program License Serial Number 5016

***** Hydrology Study Control Information *****

Rational hydrology study storm event year is 100.0
 10 Year storm 1 hour rainfall = 0.978(In.)
 100 Year storm 1 hour rainfall = 1.460(In.)
 Computed rainfall intensity:
 Storm year = 100.00 1 hour rainfall = 1.460 (In.)
 Slope used for rainfall intensity curve b = 0.6000
 Soil antecedent moisture condition (AMC) = 3
 ++++++
 Process from Point/Station 1.000 to Point/Station 2.000
 **** INITIAL AREA EVALUATION ****

 COMMERCIAL subarea type
 Decimal fraction soil group A = 1.000
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 SCS curve number for soil(AMC 2) = 32.00
 Adjusted SCS curve number for AMC 3 = 52.00
 Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
 Initial subarea data:
 Initial area flow distance = 344.000(Ft.)
 Top (of initial area) elevation = 1652.800(Ft.)
 Bottom (of initial area) elevation = 1644.600(Ft.)
 Difference in elevation = 8.200(Ft.)
 Slope = 0.02384 s(%)= 2.38
 $TC = k(0.304)*[(length^3)/(elevation\ change)]^{0.2}$
 Initial area time of concentration = 6.638 min.
 Rainfall intensity = 5.470(In/Hr) for a 100.0 year storm
 Effective runoff coefficient used for area (Q=KCIA) is C = 0.887
 Subarea runoff = 0.922(CFS)
 Total initial stream area = 0.190(Ac.)
 Pervious area fraction = 0.100
 Initial area Fm value = 0.079(In/Hr)
 ++++++
 Process from Point/Station 2.000 to Point/Station 3.000
 **** PIPEFLOW TRAVEL TIME (User specified size) ****

 Upstream point/station elevation = 1641.730(Ft.)
 Downstream point/station elevation = 1640.020(Ft.)
 Pipe length = 85.00(Ft.) Manning's N = 0.013
 No. of pipes = 1 Required pipe flow = 0.922(CFS)
 Given pipe size = 18.00(In.)
 Calculated individual pipe flow = 0.922(CFS)
 Normal flow depth in pipe = 3.04(In.)
 Flow top width inside pipe = 13.48(In.)
 Critical Depth = 4.29(In.)
 Pipe flow velocity = 4.68(Ft/s)
 Travel time through pipe = 0.30 min.
 Time of concentration (TC) = 6.94 min.
 ++++++

Process from Point/Station 2.000 to Point/Station 3.000
 **** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type

Decimal fraction soil group A = 1.000
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 SCS curve number for soil(AMC 2) = 32.00
 Adjusted SCS curve number for AMC 3 = 52.00
 Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
 Time of concentration = 6.94 min.
 Rainfall intensity = 5.326(In/Hr) for a 100.0 year storm
 Effective runoff coefficient used for area,(total area with modified
 rational method)(Q=KCIA) is C = 0.887
 Subarea runoff = 1.345(CFS) for 0.290(Ac.)
 Total runoff = 2.267(CFS)
 Effective area this stream = 0.48(Ac.)
 Total Study Area (Main Stream No. 1) = 0.48(Ac.)
 Area averaged Fm value = 0.079(In/Hr)
 ++++++
 Process from Point/Station 3.000 to Point/Station 4.000
 **** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 1640.020(Ft.)
 Downstream point/station elevation = 1639.560(Ft.)
 Pipe length = 34.00(Ft.) Manning's N = 0.013
 No. of pipes = 1 Required pipe flow = 2.267(CFS)
 Given pipe size = 18.00(In.)
 Calculated individual pipe flow = 2.267(CFS)
 Normal flow depth in pipe = 5.25(In.)
 Flow top width inside pipe = 16.36(In.)
 Critical Depth = 6.82(In.)
 Pipe flow velocity = 5.28(Ft/s)
 Travel time through pipe = 0.11 min.
 Time of concentration (TC) = 7.05 min.
 ++++++
 Process from Point/Station 3.000 to Point/Station 4.000
 **** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type

Decimal fraction soil group A = 1.000
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 SCS curve number for soil(AMC 2) = 32.00
 Adjusted SCS curve number for AMC 3 = 52.00
 Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
 Time of concentration = 7.05 min.
 Rainfall intensity = 5.277(In/Hr) for a 100.0 year storm
 Effective runoff coefficient used for area,(total area with modified
 rational method)(Q=KCIA) is C = 0.887
 Subarea runoff = 1.383(CFS) for 0.300(Ac.)
 Total runoff = 3.649(CFS)
 Effective area this stream = 0.78(Ac.)
 Total Study Area (Main Stream No. 1) = 0.78(Ac.)
 Area averaged Fm value = 0.079(In/Hr)
 ++++++
 Process from Point/Station 4.000 to Point/Station 5.000
 **** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 1639.560(Ft.)
 Downstream point/station elevation = 1638.180(Ft.)
 Pipe length = 69.00(Ft.) Manning's N = 0.013
 No. of pipes = 1 Required pipe flow = 3.649(CFS)
 Given pipe size = 18.00(In.)

Calculated individual pipe flow = 3.649(CFS)
 Normal flow depth in pipe = 6.08(In.)
 Flow top width inside pipe = 17.02(In.)
 Critical Depth = 8.76(In.)
 Pipe flow velocity = 6.95(Ft/s)
 Travel time through pipe = 0.17 min.
 Time of concentration (TC) = 7.21 min.
 ++++++
 Process from Point/Station 4.000 to Point/Station 5.000
 **** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type

Decimal fraction soil group A = 1.000
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 SCS curve number for soil(AMC 2) = 32.00
 Adjusted SCS curve number for AMC 3 = 52.00
 Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
 Time of concentration = 7.21 min.
 Rainfall intensity = 5.204(In/Hr) for a 100.0 year storm
 Effective runoff coefficient used for area,(total area with modified
 rational method)(Q=KCIA) is C = 0.886
 Subarea runoff = 0.364(CFS) for 0.090(Ac.)
 Total runoff = 4.013(CFS)
 Effective area this stream = 0.87(Ac.)
 Total Study Area (Main Stream No. 1) = 0.87(Ac.)
 Area averaged Fm value = 0.079(In/Hr)
 ++++++
 Process from Point/Station 5.000 to Point/Station 6.000
 **** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 1638.180(Ft.)
 Downstream point/station elevation = 1635.660(Ft.)
 Pipe length = 126.00(Ft.) Manning's N = 0.013
 No. of pipes = 1 Required pipe flow = 4.013(CFS)
 Given pipe size = 18.00(In.)
 Calculated individual pipe flow = 4.013(CFS)
 Normal flow depth in pipe = 6.39(In.)
 Flow top width inside pipe = 17.23(In.)
 Critical Depth = 9.20(In.)
 Pipe flow velocity = 7.14(Ft/s)
 Travel time through pipe = 0.29 min.
 Time of concentration (TC) = 7.51 min.
 ++++++
 Process from Point/Station 5.000 to Point/Station 6.000
 **** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type

Decimal fraction soil group A = 1.000
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 SCS curve number for soil(AMC 2) = 32.00
 Adjusted SCS curve number for AMC 3 = 52.00
 Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
 Time of concentration = 7.51 min.
 Rainfall intensity = 5.081(In/Hr) for a 100.0 year storm
 Effective runoff coefficient used for area,(total area with modified
 rational method)(Q=KCIA) is C = 0.886
 Subarea runoff = 4.946(CFS) for 1.120(Ac.)
 Total runoff = 8.959(CFS)
 Effective area this stream = 1.99(Ac.)
 Total Study Area (Main Stream No. 1) = 1.99(Ac.)
 Area averaged Fm value = 0.079(In/Hr)
 ++++++

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Process from Point/Station 6.000 to Point/Station 7.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 1635.660(Ft.)
Downstream point/station elevation = 1634.390(Ft.)
Pipe length = 64.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 8.959(CFS)
Given pipe size = 18.00(In.)
Calculated individual pipe flow = 8.959(CFS)
Normal flow depth in pipe = 10.10(In.)
Flow top width inside pipe = 17.86(In.)
Critical Depth = 13.89(In.)
Pipe flow velocity = 8.77(Ft/s)
Travel time through pipe = 0.12 min.
Time of concentration (TC) = 7.63 min.
+++++
Process from Point/Station 6.000 to Point/Station 7.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(A_p) = 0.1000 Max loss rate(F_m) = 0.079(In/Hr)
Time of concentration = 7.63 min.
Rainfall intensity = 5.032(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area, (total area with modified
rational method)($Q=KCIA$) is $C = 0.886$
Subarea runoff = 2.766(CFS) for 0.640(Ac.)
Total runoff = 11.725(CFS)
Effective area this stream = 2.63(Ac.)
Total Study Area (Main Stream No. 1) = 2.63(Ac.)
Area averaged F_m value = 0.079(In/Hr)
End of computations, Total Study Area = 2.63 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(A_p) = 0.100
Area averaged SCS curve number = 32.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
 Rational Hydrology Study Date: 11/26/25

 6773 RATIONAL STUDY
 POST DEVELOPED AREA B
 100 YEAR STORM

Program License Serial Number 5016

***** Hydrology Study Control Information *****

Rational hydrology study storm event year is 100.0
 10 Year storm 1 hour rainfall = 0.978(In.)
 100 Year storm 1 hour rainfall = 1.460(In.)
 Computed rainfall intensity:
 Storm year = 100.00 1 hour rainfall = 1.460 (In.)
 Slope used for rainfall intensity curve b = 0.6000
 Soil antecedent moisture condition (AMC) = 3
 ++++++
 Process from Point/Station 8.000 to Point/Station 9.000
 **** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
 Decimal fraction soil group A = 1.000
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 SCS curve number for soil(AMC 2) = 67.00
 Adjusted SCS curve number for AMC 3 = 84.60
 Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.290(In/Hr)
 Initial subarea data:
 Initial area flow distance = 465.000(Ft.)
 Top (of initial area) elevation = 1647.300(Ft.)
 Bottom (of initial area) elevation = 1632.000(Ft.)
 Difference in elevation = 15.300(Ft.)
 Slope = 0.03290 s(%)= 3.29
 $TC = k(0.525)*[(length^3)/(elevation\ change)]^{0.2}$
 Initial area time of concentration = 12.125 min.
 Rainfall intensity = 3.811(In/Hr) for a 100.0 year storm
 Effective runoff coefficient used for area (Q=KCIA) is C = 0.832
 Subarea runoff = 7.225(CFS)
 Total initial stream area = 2.280(Ac.)
 Pervious area fraction = 1.000
 Initial area Fm value = 0.290(In/Hr)
 End of computations, Total Study Area = 2.28 (Ac.)
 The following figures may
 be used for a unit hydrograph study of the same area.
 Note: These figures do not consider reduced effective area
 effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
 Area averaged SCS curve number = 67.0

Appendix D

Unit Hydrograph (Pre-Developed)
Unit Hydrograph (Post-Developed)

Unit Hydrograph Analysis

Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2004, Version 7.0

Study date 11/26/25

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San Bernardino County Synthetic Unit Hydrology Method

Manual date - August 1986

Program License Serial Number 5016

UNIT HYDROGRAPH

PRE DEVELOPED

100 YEAR 24 HOUR STORM

Storm Event Year = 100

Antecedent Moisture Condition = 3

English (in-lb) Input Units Used

English Rainfall Data (Inches) Input Values Used

English Units used in output format

Area averaged rainfall intensity isohyetal data:

Sub-Area (Ac.)	Duration (hours)	Isohyetal (In)
Rainfall data for year 100		
4.92	1	1.46

Rainfall data for year 100

4.92	6	3.91
------	---	------

Rainfall data for year 100

4.92	24	8.57
------	----	------

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***** Area-averaged max loss rate, Fm *****

SCS curve No.(AMCII)	SCS curve NO.(AMC 3)	Area (Ac.)	Area Fraction	Fp(Fig C6) (In/Hr)	Ap (dec.)	Fm (In/Hr)
67.0	84.6	4.92	1.000	0.290	0.880	0.255

Area-averaged adjusted loss rate Fm (In/Hr) = 0.255

***** Area-Averaged low loss rate fraction, Yb *****

Area (Ac.)	Area Fract	SCS CN (AMC2)	SCS CN (AMC3)	S	Pervious Yield Fr
4.33	0.880	67.0	84.6	1.82	0.784
0.59	0.120	98.0	98.0	0.20	0.972

Area-averaged catchment yield fraction, Y = 0.806

Area-averaged low loss fraction, Yb = 0.194

User entry of time of concentration = 0.247 (hours)

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Watershed area = 4.92(Ac.)

Catchment Lag time = 0.197 hours

Unit interval = 5.000 minutes

Unit interval percentage of lag time = 42.2155

Hydrograph baseflow = 0.00(CFS)

Average maximum watershed loss rate(Fm) = 0.255(In/Hr)

Average low loss rate fraction (Yb) = 0.194 (decimal)

VALLEY DEVELOPED S-Graph proportion = 0.120

VALLEY UNDEVELOPED S-Graph proportion = 0.880

FOOTHILL S-Graph proportion = 0.000

MOUNTAIN S-Graph proportion = 0.000

DESERT S-Graph proportion = 0.000

Computed peak 5-minute rainfall = 0.540(In)

Computed peak 30-minute rainfall = 1.106(In)
 Specified peak 1-hour rainfall = 1.460(In)
 Computed peak 3-hour rainfall = 2.671(In)
 Specified peak 6-hour rainfall = 3.910(In)
 Specified peak 24-hour rainfall = 8.570(In)

Rainfall depth area reduction factors:

Using a total area of 4.92(Ac.) (Ref: fig. E-4)

5-minute factor = 1.000	Adjusted rainfall = 0.540(In)
30-minute factor = 1.000	Adjusted rainfall = 1.106(In)
1-hour factor = 1.000	Adjusted rainfall = 1.460(In)
3-hour factor = 1.000	Adjusted rainfall = 2.671(In)
6-hour factor = 1.000	Adjusted rainfall = 3.910(In)
24-hour factor = 1.000	Adjusted rainfall = 8.570(In)

Unit Hydrograph

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Interval Number	'S' Graph Mean values	Unit Hydrograph ((CFS))
--------------------	--------------------------	----------------------------

(K = 59.50 (CFS))

1	4.560	2.713
2	24.058	11.601
3	52.441	16.889
4	70.058	10.482
5	78.443	4.989
6	83.574	3.053
7	87.148	2.127
8	89.815	1.587
9	91.957	1.275
10	93.555	0.951
11	94.790	0.735
12	95.917	0.671
13	96.840	0.549
14	97.587	0.445
15	98.210	0.371
16	98.706	0.295
17	99.090	0.228
18	99.461	0.221
19	100.000	0.111

Total soil rain loss = 1.56(In)

Total effective rainfall = 7.01(In)

Peak flow rate in flood hydrograph = 12.68(CFS)

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24 - HOUR STORM Runoff Hydrograph

Hydrograph in 5 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	5.0	10.0	15.0	20.0
0+ 5	0.0003	0.04	Q				
0+10	0.0016	0.19	Q				
0+15	0.0045	0.42	Q				
0+20	0.0084	0.57	VQ				
0+25	0.0128	0.64	VQ				
0+30	0.0175	0.68	VQ				
0+35	0.0224	0.71	VQ				
0+40	0.0274	0.73	VQ				
0+45	0.0326	0.75	VQ				
0+50	0.0379	0.77	VQ				

0+55	0.0433	0.78	VQ
1+ 0	0.0487	0.79	VQ
1+ 5	0.0542	0.80	VQ
1+10	0.0598	0.81	VQ
1+15	0.0654	0.81	VQ
1+20	0.0710	0.82	VQ
1+25	0.0767	0.83	Q
1+30	0.0824	0.83	Q
1+35	0.0882	0.83	Q
1+40	0.0939	0.84	Q
1+45	0.0997	0.84	Q
1+50	0.1055	0.84	Q
1+55	0.1113	0.84	Q
2+ 0	0.1171	0.84	Q
2+ 5	0.1229	0.85	Q
2+10	0.1288	0.85	Q
2+15	0.1346	0.85	Q
2+20	0.1405	0.85	Q
2+25	0.1464	0.86	QV
2+30	0.1523	0.86	QV
2+35	0.1582	0.86	QV
2+40	0.1642	0.86	QV
2+45	0.1701	0.86	QV
2+50	0.1761	0.87	QV
2+55	0.1821	0.87	QV
3+ 0	0.1881	0.87	QV
3+ 5	0.1941	0.87	QV
3+10	0.2001	0.88	QV
3+15	0.2062	0.88	QV
3+20	0.2122	0.88	QV
3+25	0.2183	0.88	Q V
3+30	0.2244	0.89	Q V
3+35	0.2305	0.89	Q V
3+40	0.2367	0.89	Q V
3+45	0.2428	0.89	Q V
3+50	0.2490	0.90	Q V
3+55	0.2552	0.90	Q V
4+ 0	0.2614	0.90	Q V
4+ 5	0.2676	0.90	Q V
4+10	0.2738	0.91	Q V
4+15	0.2801	0.91	Q V
4+20	0.2864	0.91	Q V
4+25	0.2927	0.91	Q V
4+30	0.2990	0.92	Q V
4+35	0.3053	0.92	Q V
4+40	0.3117	0.92	Q V
4+45	0.3181	0.93	Q V
4+50	0.3245	0.93	Q V
4+55	0.3309	0.93	Q V
5+ 0	0.3373	0.93	Q V
5+ 5	0.3438	0.94	Q V
5+10	0.3503	0.94	Q V
5+15	0.3568	0.94	Q V
5+20	0.3633	0.95	Q V
5+25	0.3698	0.95	Q V
5+30	0.3764	0.95	Q V
5+35	0.3830	0.96	Q V
5+40	0.3896	0.96	Q V
5+45	0.3962	0.96	Q V
5+50	0.4029	0.97	Q V
5+55	0.4095	0.97	Q V
6+ 0	0.4162	0.97	Q V
6+ 5	0.4230	0.98	Q V
6+10	0.4297	0.98	Q V
6+15	0.4365	0.98	Q V
6+20	0.4433	0.99	Q V

6+25	0.4501	0.99	Q	V				
6+30	0.4569	0.99	Q	V				
6+35	0.4638	1.00	Q	V				
6+40	0.4707	1.00	Q	V				
6+45	0.4776	1.01	Q	V				
6+50	0.4846	1.01	Q	V				
6+55	0.4916	1.01	Q	V				
7+ 0	0.4986	1.02	Q	V				
7+ 5	0.5056	1.02	Q	V				
7+10	0.5127	1.02	Q	V				
7+15	0.5197	1.03	Q	V				
7+20	0.5269	1.03	Q	V				
7+25	0.5340	1.04	Q	V				
7+30	0.5412	1.04	Q	V				
7+35	0.5484	1.05	Q	V				
7+40	0.5556	1.05	Q	V				
7+45	0.5629	1.05	Q	V				
7+50	0.5702	1.06	Q	V				
7+55	0.5775	1.06	Q	V				
8+ 0	0.5848	1.07	Q	V				
8+ 5	0.5922	1.07	Q	V				
8+10	0.5996	1.08	Q	V				
8+15	0.6071	1.08	Q	V				
8+20	0.6146	1.09	Q	V				
8+25	0.6221	1.09	Q	V				
8+30	0.6297	1.10	Q	V				
8+35	0.6372	1.10	Q	V				
8+40	0.6449	1.11	Q	V				
8+45	0.6525	1.11	Q	V				
8+50	0.6602	1.12	Q	V				
8+55	0.6680	1.12	Q	V				
9+ 0	0.6757	1.13	Q	V				
9+ 5	0.6836	1.13	Q	V				
9+10	0.6914	1.14	Q	V				
9+15	0.6993	1.15	Q	V				
9+20	0.7072	1.15	Q	V				
9+25	0.7152	1.16	Q	V				
9+30	0.7232	1.16	Q	V				
9+35	0.7313	1.17	Q	V				
9+40	0.7394	1.18	Q	V				
9+45	0.7475	1.18	Q	V				
9+50	0.7557	1.19	Q	V				
9+55	0.7640	1.20	Q	V				
10+ 0	0.7723	1.20	Q	V				
10+ 5	0.7806	1.21	Q	V				
10+10	0.7890	1.22	Q	V				
10+15	0.7974	1.22	Q	V				
10+20	0.8059	1.23	Q	V				
10+25	0.8144	1.24	Q	V				
10+30	0.8230	1.25	Q	V				
10+35	0.8316	1.25	Q	V				
10+40	0.8403	1.26	Q	V				
10+45	0.8491	1.27	Q	V				
10+50	0.8579	1.28	Q	V				
10+55	0.8668	1.29	Q	V				
11+ 0	0.8757	1.30	Q	V				
11+ 5	0.8847	1.30	Q	V				
11+10	0.8937	1.31	Q	V				
11+15	0.9028	1.32	Q	V				
11+20	0.9120	1.33	Q	V				
11+25	0.9213	1.34	Q	V				
11+30	0.9306	1.35	Q	V				
11+35	0.9400	1.36	Q	V				
11+40	0.9494	1.37	Q	V				
11+45	0.9589	1.38	Q	V				
11+50	0.9686	1.40	Q	V				

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11+55	0.9782	1.41	Q		V		
12+ 0	0.9880	1.42	Q		V		
12+ 5	0.9978	1.43	Q		V		
12+10	1.0077	1.43	Q		V		
12+15	1.0176	1.43	Q		V		
12+20	1.0275	1.44	Q		V		
12+25	1.0375	1.45	Q		V		
12+30	1.0475	1.46	Q		V		
12+35	1.0577	1.47	Q		V		
12+40	1.0679	1.49	Q		V		
12+45	1.0783	1.50	Q		V		
12+50	1.0887	1.52	Q		V		
12+55	1.0993	1.53	Q		V		
13+ 0	1.1099	1.55	Q		V		
13+ 5	1.1207	1.57	Q		V		
13+10	1.1317	1.59	Q		V		
13+15	1.1427	1.60	Q		V		
13+20	1.1539	1.62	Q		V		
13+25	1.1652	1.64	Q		V		
13+30	1.1767	1.67	Q		V		
13+35	1.1883	1.69	Q		V		
13+40	1.2001	1.71	Q		V		
13+45	1.2121	1.74	Q		V		
13+50	1.2242	1.76	Q		V		
13+55	1.2366	1.79	Q		V		
14+ 0	1.2491	1.82	Q		V		
14+ 5	1.2618	1.85	Q		V		
14+10	1.2748	1.88	Q		V		
14+15	1.2880	1.92	Q		V		
14+20	1.3014	1.95	Q		V		
14+25	1.3151	1.99	Q		V		
14+30	1.3291	2.03	Q		V		
14+35	1.3434	2.07	Q		V		
14+40	1.3580	2.12	Q		V		
14+45	1.3729	2.17	Q		V		
14+50	1.3883	2.23	Q		V		
14+55	1.4040	2.28	Q		V		
15+ 0	1.4202	2.35	Q		V		
15+ 5	1.4368	2.42	Q		V		
15+10	1.4541	2.50	Q		V		
15+15	1.4719	2.59	Q		V		
15+20	1.4904	2.69	Q		V		
15+25	1.5094	2.76	Q		V		
15+30	1.5281	2.72	Q		V		
15+35	1.5462	2.62	Q		V		
15+40	1.5644	2.65	Q		V		
15+45	1.5838	2.81	Q		V		
15+50	1.6050	3.08	Q	Q	V		
15+55	1.6291	3.50	Q	Q	V		
16+ 0	1.6588	4.30	Q	Q	V		
16+ 5	1.7040	6.57			Q	V	
16+10	1.7790	10.89				Q	V
16+15	1.8663	12.68					QV
16+20	1.9297	9.21			Q		V
16+25	1.9722	6.17		Q			V
16+30	2.0060	4.91		Q			V
16+35	2.0357	4.31		Q			V
16+40	2.0624	3.88		Q			V
16+45	2.0868	3.54		Q			V
16+50	2.1089	3.21		Q			V
16+55	2.1293	2.96	Q				V
17+ 0	2.1485	2.79	Q				V
17+ 5	2.1665	2.61	Q				V
17+10	2.1835	2.46	Q				V
17+15	2.1994	2.32	Q				V
17+20	2.2145	2.19	Q				V

17+25	2.2289	2.08	Q		V
17+30	2.2426	1.99	Q		V
17+35	2.2555	1.87	Q		V
17+40	2.2676	1.76	Q		V
17+45	2.2794	1.71	Q		V
17+50	2.2908	1.66	Q		V
17+55	2.3019	1.62	Q		V
18+ 0	2.3128	1.58	Q		V
18+ 5	2.3234	1.54	Q		V
18+10	2.3338	1.52	Q		V
18+15	2.3441	1.50	Q		V
18+20	2.3543	1.47	Q		V
18+25	2.3643	1.45	Q		V
18+30	2.3741	1.43	Q		V
18+35	2.3838	1.40	Q		V
18+40	2.3933	1.38	Q		V
18+45	2.4027	1.36	Q		V
18+50	2.4119	1.34	Q		V
18+55	2.4210	1.32	Q		V
19+ 0	2.4300	1.30	Q		V
19+ 5	2.4389	1.29	Q		V
19+10	2.4476	1.27	Q		V
19+15	2.4562	1.25	Q		V
19+20	2.4648	1.24	Q		V
19+25	2.4732	1.22	Q		V
19+30	2.4815	1.21	Q		V
19+35	2.4898	1.20	Q		V
19+40	2.4979	1.18	Q		V
19+45	2.5060	1.17	Q		V
19+50	2.5140	1.16	Q		V
19+55	2.5218	1.15	Q		V
20+ 0	2.5297	1.13	Q		V
20+ 5	2.5374	1.12	Q		V
20+10	2.5450	1.11	Q		V
20+15	2.5526	1.10	Q		V
20+20	2.5602	1.09	Q		V
20+25	2.5676	1.08	Q		V
20+30	2.5750	1.07	Q		V
20+35	2.5823	1.06	Q		V
20+40	2.5896	1.05	Q		V
20+45	2.5968	1.05	Q		V
20+50	2.6039	1.04	Q		V
20+55	2.6110	1.03	Q		V
21+ 0	2.6180	1.02	Q		V
21+ 5	2.6250	1.01	Q		V
21+10	2.6319	1.00	Q		V
21+15	2.6388	1.00	Q		V
21+20	2.6456	0.99	Q		V
21+25	2.6524	0.98	Q		V
21+30	2.6591	0.98	Q		V
21+35	2.6658	0.97	Q		V
21+40	2.6724	0.96	Q		V
21+45	2.6790	0.96	Q		V
21+50	2.6855	0.95	Q		V
21+55	2.6920	0.94	Q		V
22+ 0	2.6985	0.94	Q		V
22+ 5	2.7049	0.93	Q		V
22+10	2.7112	0.93	Q		V
22+15	2.7176	0.92	Q		V
22+20	2.7239	0.91	Q		V
22+25	2.7301	0.91	Q		V
22+30	2.7363	0.90	Q		V
22+35	2.7425	0.90	Q		V
22+40	2.7487	0.89	Q		V
22+45	2.7548	0.89	Q		V
22+50	2.7609	0.88	Q		V

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22+55	2.7669	0.88	Q				V
23+ 0	2.7729	0.87	Q				V
23+ 5	2.7789	0.87	Q				V
23+10	2.7849	0.86	Q				V
23+15	2.7908	0.86	Q				V
23+20	2.7967	0.85	Q				V
23+25	2.8025	0.85	Q				V
23+30	2.8083	0.85	Q				V
23+35	2.8141	0.84	Q				V
23+40	2.8199	0.84	Q				V
23+45	2.8256	0.83	Q				V
23+50	2.8314	0.83	Q				V
23+55	2.8370	0.83	Q				V
24+ 0	2.8427	0.82	Q				V
24+ 5	2.8481	0.78	Q				V
24+10	2.8523	0.62	Q				V
24+15	2.8550	0.39	Q				V
24+20	2.8567	0.24	Q				V
24+25	2.8579	0.17	Q				V
24+30	2.8588	0.13	Q				V
24+35	2.8595	0.10	Q				V
24+40	2.8601	0.08	Q				V
24+45	2.8605	0.06	Q				V
24+50	2.8609	0.05	Q				V
24+55	2.8611	0.04	Q				V
25+ 0	2.8613	0.03	Q				V
25+ 5	2.8615	0.02	Q				V
25+10	2.8616	0.02	Q				V
25+15	2.8617	0.01	Q				V
25+20	2.8617	0.01	Q				V
25+25	2.8618	0.00	Q				V
25+30	2.8618	0.00	Q				V

Unit Hydrograph Analysis

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Study date 11/26/25

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San Bernardino County Synthetic Unit Hydrology Method
Manual date - August 1986

Program License Serial Number 5016

6773 UNIT HYDROGRAPH
POST-DEVELOPED AREA A
100 YEAR 24 HOUR STORM

Storm Event Year = 100

Antecedent Moisture Condition = 3

English (in-lb) Input Units Used

English Rainfall Data (Inches) Input Values Used

English Units used in output format

Area averaged rainfall intensity isohyetal data:

Sub-Area (Ac.)	Duration (hours)	Isohyetal (In)
Rainfall data for year 100		
2.64	1	1.46

Rainfall data for year 100		
2.64	6	3.91

Rainfall data for year 100		
2.64	24	8.57

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***** Area-averaged max loss rate, Fm *****

SCS curve No.(AMCII)	SCS curve NO.(AMC 3)	Area (Ac.)	Area Fraction	Fp(Fig C6) (In/Hr)	Ap (dec.)	Fm (In/Hr)
32.0	52.0	2.64	1.000	0.785	0.600	0.471

Area-averaged adjusted loss rate Fm (In/Hr) = 0.471

***** Area-Averaged low loss rate fraction, Yb *****

Area (Ac.)	Area Fract	SCS CN (AMC2)	SCS CN (AMC3)	S	Pervious Yield Fr
1.58	0.600	32.0	52.0	9.23	0.331
1.06	0.400	98.0	98.0	0.20	0.972

Area-averaged catchment yield fraction, $Y = 0.587$
 Area-averaged low loss fraction, $Y_b = 0.413$
 User entry of time of concentration = 0.127 (hours)
 ++++++
 Watershed area = 2.64(Ac.)
 Catchment Lag time = 0.102 hours
 Unit interval = 5.000 minutes
 Unit interval percentage of lag time = 82.0210
 Hydrograph baseflow = 0.00(CFS)
 Average maximum watershed loss rate(F_m) = 0.471(In/Hr)
 Average low loss rate fraction (Y_b) = 0.413 (decimal)
 VALLEY DEVELOPED S-Graph Selected
 Computed peak 5-minute rainfall = 0.540(In)
 Computed peak 30-minute rainfall = 1.106(In)
 Specified peak 1-hour rainfall = 1.460(In)
 Computed peak 3-hour rainfall = 2.671(In)
 Specified peak 6-hour rainfall = 3.910(In)
 Specified peak 24-hour rainfall = 8.570(In)

Rainfall depth area reduction factors:
 Using a total area of 2.64(Ac.) (Ref: fig. E-4)

5-minute factor = 1.000	Adjusted rainfall = 0.540(In)
30-minute factor = 1.000	Adjusted rainfall = 1.106(In)
1-hour factor = 1.000	Adjusted rainfall = 1.460(In)
3-hour factor = 1.000	Adjusted rainfall = 2.671(In)
6-hour factor = 1.000	Adjusted rainfall = 3.910(In)
24-hour factor = 1.000	Adjusted rainfall = 8.570(In)

U n i t H y d r o g r a p h

+++++

Interval Number	'S' Graph Mean values	Unit Hydrograph ((CFS))

	(K = 31.93 (CFS))	
1	11.850	3.783
2	65.711	17.197
3	94.581	9.217
4	98.967	1.401
5	100.000	0.330

Total soil rain loss = 3.31(In)
 Total effective rainfall = 5.26(In)
 Peak flow rate in flood hydrograph = 10.22(CFS)

+++++

24 - H O U R S T O R M
 R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	5.0	10.0	15.0	20.0
0+ 5	0.0003	0.04	Q				
0+10	0.0017	0.21	Q				

0+15	0.0037	0.30	Q
0+20	0.0059	0.31	Q
0+25	0.0081	0.32	Q
0+30	0.0103	0.32	Q
0+35	0.0125	0.32	Q
0+40	0.0147	0.32	Q
0+45	0.0169	0.32	Q
0+50	0.0191	0.32	Q
0+55	0.0213	0.32	Q
1+ 0	0.0236	0.32	Q
1+ 5	0.0258	0.32	Q
1+10	0.0280	0.32	Q
1+15	0.0303	0.33	QV
1+20	0.0325	0.33	QV
1+25	0.0348	0.33	QV
1+30	0.0370	0.33	QV
1+35	0.0393	0.33	QV
1+40	0.0416	0.33	QV
1+45	0.0438	0.33	QV
1+50	0.0461	0.33	QV
1+55	0.0484	0.33	QV
2+ 0	0.0507	0.33	QV
2+ 5	0.0530	0.33	QV
2+10	0.0553	0.33	QV
2+15	0.0576	0.34	QV
2+20	0.0599	0.34	Q V
2+25	0.0622	0.34	Q V
2+30	0.0646	0.34	Q V
2+35	0.0669	0.34	Q V
2+40	0.0693	0.34	Q V
2+45	0.0716	0.34	Q V
2+50	0.0740	0.34	Q V
2+55	0.0763	0.34	Q V
3+ 0	0.0787	0.34	Q V
3+ 5	0.0810	0.34	Q V
3+10	0.0834	0.35	Q V
3+15	0.0858	0.35	Q V
3+20	0.0882	0.35	Q V
3+25	0.0906	0.35	Q V
3+30	0.0930	0.35	Q V
3+35	0.0954	0.35	Q V
3+40	0.0978	0.35	Q V
3+45	0.1003	0.35	Q V
3+50	0.1027	0.35	Q V
3+55	0.1051	0.35	Q V
4+ 0	0.1076	0.36	Q V
4+ 5	0.1101	0.36	Q V
4+10	0.1125	0.36	Q V
4+15	0.1150	0.36	Q V
4+20	0.1175	0.36	Q V
4+25	0.1199	0.36	Q V
4+30	0.1224	0.36	Q V
4+35	0.1249	0.36	Q V
4+40	0.1275	0.36	Q V
4+45	0.1300	0.37	Q V
4+50	0.1325	0.37	Q V
4+55	0.1350	0.37	Q V
5+ 0	0.1376	0.37	Q V
5+ 5	0.1401	0.37	Q V
5+10	0.1427	0.37	Q V
5+15	0.1452	0.37	Q V
5+20	0.1478	0.37	Q V
5+25	0.1504	0.38	Q V
5+30	0.1530	0.38	Q V
5+35	0.1556	0.38	Q V
5+40	0.1582	0.38	Q V

5+45	0.1608	0.38	Q	V				
5+50	0.1635	0.38	Q	V				
5+55	0.1661	0.38	Q	V				
6+ 0	0.1687	0.38	Q	V				
6+ 5	0.1714	0.39	Q	V				
6+10	0.1741	0.39	Q	V				
6+15	0.1767	0.39	Q	V				
6+20	0.1794	0.39	Q	V				
6+25	0.1821	0.39	Q	V				
6+30	0.1848	0.39	Q	V				
6+35	0.1875	0.39	Q	V				
6+40	0.1903	0.40	Q	V				
6+45	0.1930	0.40	Q	V				
6+50	0.1957	0.40	Q	V				
6+55	0.1985	0.40	Q	V				
7+ 0	0.2013	0.40	Q	V				
7+ 5	0.2040	0.40	Q	V				
7+10	0.2068	0.41	Q	V				
7+15	0.2096	0.41	Q	V				
7+20	0.2125	0.41	Q	V				
7+25	0.2153	0.41	Q	V				
7+30	0.2181	0.41	Q	V				
7+35	0.2210	0.41	Q	V				
7+40	0.2238	0.42	Q	V				
7+45	0.2267	0.42	Q	V				
7+50	0.2296	0.42	Q	V				
7+55	0.2325	0.42	Q	V				
8+ 0	0.2354	0.42	Q	V				
8+ 5	0.2383	0.42	Q	V				
8+10	0.2412	0.43	Q	V				
8+15	0.2442	0.43	Q	V				
8+20	0.2472	0.43	Q	V				
8+25	0.2501	0.43	Q	V				
8+30	0.2531	0.43	Q	V				
8+35	0.2561	0.44	Q	V				
8+40	0.2592	0.44	Q	V				
8+45	0.2622	0.44	Q	V				
8+50	0.2652	0.44	Q	V				
8+55	0.2683	0.44	Q	V				
9+ 0	0.2714	0.45	Q	V				
9+ 5	0.2745	0.45	Q	V				
9+10	0.2776	0.45	Q	V				
9+15	0.2807	0.45	Q	V				
9+20	0.2839	0.46	Q	V				
9+25	0.2870	0.46	Q	V				
9+30	0.2902	0.46	Q	V				
9+35	0.2934	0.46	Q	V				
9+40	0.2966	0.47	Q	V				
9+45	0.2998	0.47	Q	V				
9+50	0.3031	0.47	Q	V				
9+55	0.3064	0.47	Q	V				
10+ 0	0.3096	0.48	Q	V				
10+ 5	0.3129	0.48	Q	V				
10+10	0.3163	0.48	Q	V				
10+15	0.3196	0.49	Q	V				
10+20	0.3230	0.49	Q	V				
10+25	0.3264	0.49	Q	V				
10+30	0.3298	0.50	Q	V				
10+35	0.3332	0.50	Q	V				
10+40	0.3367	0.50	Q	V				
10+45	0.3401	0.50	Q	V				
10+50	0.3436	0.51	Q	V				
10+55	0.3472	0.51	Q	V				
11+ 0	0.3507	0.52	Q	V				
11+ 5	0.3543	0.52	Q	V				
11+10	0.3579	0.52	Q	V				

11+15	0.3615	0.53	Q	V			
11+20	0.3652	0.53	Q	V			
11+25	0.3689	0.53	Q	V			
11+30	0.3726	0.54	Q	V			
11+35	0.3763	0.54	Q	V			
11+40	0.3801	0.55	Q	V			
11+45	0.3839	0.55	Q	V			
11+50	0.3877	0.56	Q	V			
11+55	0.3916	0.56	Q	V			
12+ 0	0.3955	0.57	Q	V			
12+ 5	0.3994	0.57	Q	V			
12+10	0.4033	0.56	Q	V			
12+15	0.4072	0.57	Q	V			
12+20	0.4111	0.57	Q	V			
12+25	0.4150	0.58	Q	V			
12+30	0.4191	0.58	Q	V			
12+35	0.4231	0.59	Q	V			
12+40	0.4272	0.59	Q	V			
12+45	0.4313	0.60	Q	V			
12+50	0.4355	0.61	Q	V			
12+55	0.4397	0.61	Q	V			
13+ 0	0.4440	0.62	Q	V			
13+ 5	0.4483	0.63	Q	V			
13+10	0.4527	0.64	Q	V			
13+15	0.4571	0.64	Q	V			
13+20	0.4616	0.65	Q	V			
13+25	0.4662	0.66	Q	V			
13+30	0.4708	0.67	Q	V			
13+35	0.4755	0.68	Q	V			
13+40	0.4803	0.69	Q	V			
13+45	0.4851	0.70	Q	V			
13+50	0.4900	0.71	Q	V			
13+55	0.4950	0.72	Q	V			
14+ 0	0.5001	0.74	Q	V			
14+ 5	0.5052	0.75	Q	V			
14+10	0.5105	0.76	Q	V			
14+15	0.5158	0.78	Q	V			
14+20	0.5213	0.79	Q	V			
14+25	0.5269	0.81	Q	V			
14+30	0.5326	0.83	Q	V			
14+35	0.5384	0.85	Q	V			
14+40	0.5444	0.87	Q	V			
14+45	0.5505	0.89	Q	V			
14+50	0.5569	0.92	Q	V			
14+55	0.5633	0.94	Q	V			
15+ 0	0.5700	0.97	Q	V			
15+ 5	0.5770	1.00	Q	V			
15+10	0.5841	1.04	Q	V			
15+15	0.5916	1.08	Q	V			
15+20	0.5994	1.13	Q	V			
15+25	0.6073	1.14	Q	V			
15+30	0.6143	1.03	Q	V			
15+35	0.6212	1.00	Q	V			
15+40	0.6287	1.09	Q	V			
15+45	0.6370	1.20	Q	V			
15+50	0.6465	1.39	Q	V			
15+55	0.6582	1.70	Q	V			
16+ 0	0.6757	2.54	Q	V			
16+ 5	0.7107	5.07	Q	V			
16+10	0.7811	10.22	Q	V			
16+15	0.8229	6.07	Q	V			
16+20	0.8378	2.16	Q	V			
16+25	0.8470	1.35	Q	V			
16+30	0.8551	1.18	Q	V			
16+35	0.8630	1.14	Q	V			
16+40	0.8703	1.06	Q	V			

16+45	0.8771	0.99	Q		V
16+50	0.8835	0.93	Q		V
16+55	0.8895	0.88	Q		V
17+ 0	0.8953	0.84	Q		V
17+ 5	0.9008	0.80	Q		V
17+10	0.9061	0.77	Q		V
17+15	0.9112	0.74	Q		V
17+20	0.9161	0.72	Q		V
17+25	0.9209	0.69	Q		V
17+30	0.9256	0.67	Q		V
17+35	0.9301	0.66	Q		V
17+40	0.9345	0.64	Q		V
17+45	0.9388	0.62	Q		V
17+50	0.9430	0.61	Q		V
17+55	0.9471	0.60	Q		V
18+ 0	0.9511	0.58	Q		V
18+ 5	0.9551	0.57	Q		V
18+10	0.9590	0.57	Q		V
18+15	0.9629	0.57	Q		V
18+20	0.9668	0.56	Q		V
18+25	0.9705	0.55	Q		V
18+30	0.9743	0.54	Q		V
18+35	0.9779	0.53	Q		V
18+40	0.9815	0.52	Q		V
18+45	0.9851	0.52	Q		V
18+50	0.9886	0.51	Q		V
18+55	0.9921	0.50	Q		V
19+ 0	0.9955	0.50	Q		V
19+ 5	0.9989	0.49	Q		V
19+10	1.0022	0.48	Q		V
19+15	1.0055	0.48	Q		V
19+20	1.0087	0.47	Q		V
19+25	1.0120	0.47	Q		V
19+30	1.0151	0.46	Q		V
19+35	1.0183	0.46	Q		V
19+40	1.0214	0.45	Q		V
19+45	1.0245	0.45	Q		V
19+50	1.0276	0.44	Q		V
19+55	1.0306	0.44	Q		V
20+ 0	1.0336	0.44	Q		V
20+ 5	1.0365	0.43	Q		V
20+10	1.0395	0.43	Q		V
20+15	1.0424	0.42	Q		V
20+20	1.0453	0.42	Q		V
20+25	1.0482	0.42	Q		V
20+30	1.0510	0.41	Q		V
20+35	1.0538	0.41	Q		V
20+40	1.0566	0.41	Q		V
20+45	1.0594	0.40	Q		V
20+50	1.0621	0.40	Q		V
20+55	1.0649	0.40	Q		V
21+ 0	1.0676	0.39	Q		V
21+ 5	1.0703	0.39	Q		V
21+10	1.0729	0.39	Q		V
21+15	1.0756	0.38	Q		V
21+20	1.0782	0.38	Q		V
21+25	1.0808	0.38	Q		V
21+30	1.0834	0.38	Q		V
21+35	1.0860	0.37	Q		V
21+40	1.0886	0.37	Q		V
21+45	1.0911	0.37	Q		V
21+50	1.0936	0.37	Q		V
21+55	1.0961	0.36	Q		V
22+ 0	1.0986	0.36	Q		V
22+ 5	1.1011	0.36	Q		V
22+10	1.1036	0.36	Q		V

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22+15	1.1060	0.36	Q			V
22+20	1.1085	0.35	Q			V
22+25	1.1109	0.35	Q			V
22+30	1.1133	0.35	Q			V
22+35	1.1157	0.35	Q			V
22+40	1.1181	0.35	Q			V
22+45	1.1204	0.34	Q			V
22+50	1.1228	0.34	Q			V
22+55	1.1251	0.34	Q			V
23+ 0	1.1275	0.34	Q			V
23+ 5	1.1298	0.34	Q			V
23+10	1.1321	0.33	Q			V
23+15	1.1344	0.33	Q			V
23+20	1.1367	0.33	Q			V
23+25	1.1389	0.33	Q			V
23+30	1.1412	0.33	Q			V
23+35	1.1435	0.33	Q			V
23+40	1.1457	0.32	Q			V
23+45	1.1479	0.32	Q			V
23+50	1.1501	0.32	Q			V
23+55	1.1523	0.32	Q			V
24+ 0	1.1545	0.32	Q			V
24+ 5	1.1565	0.28	Q			V
24+10	1.1572	0.11	Q			V
24+15	1.1573	0.02	Q			V
24+20	1.1574	0.00	Q			V

Unit Hydrograph Analysis

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Study date 11/26/25

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San Bernardino County Synthetic Unit Hydrology Method
Manual date - August 1986

Program License Serial Number 5016

UNIT HYDROGRAPH
POST DEVELOPED AREA B
100 YEAR 24 HOUR STORM

Storm Event Year = 100

Antecedent Moisture Condition = 3

English (in-lb) Input Units Used

English Rainfall Data (Inches) Input Values Used

English Units used in output format

Area averaged rainfall intensity isohyetal data:

Sub-Area (Ac.)	Duration (hours)	Isohyetal (In)
Rainfall data for year 100		
2.28	1	1.46

Rainfall data for year 100		
2.28	6	3.91

Rainfall data for year 100		
2.28	24	8.57

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***** Area-averaged max loss rate, Fm *****

SCS curve No.(AMCII)	SCS curve NO.(AMC 3)	Area (Ac.)	Area Fraction	Fp(Fig C6) (In/Hr)	Ap (dec.)	Fm (In/Hr)
67.0	84.6	2.28	1.000	0.290	0.480	0.139

Area-averaged adjusted loss rate Fm (In/Hr) = 0.139

***** Area-Averaged low loss rate fraction, Yb *****

Area (Ac.)	Area Fract	SCS CN (AMC2)	SCS CN (AMC3)	S	Pervious Yield Fr
1.09	0.480	67.0	84.6	1.82	0.784
1.19	0.520	98.0	98.0	0.20	0.972

Area-averaged catchment yield fraction, $Y = 0.882$
 Area-averaged low loss fraction, $Y_b = 0.118$
 User entry of time of concentration = 0.202 (hours)
 ++++++
 Watershed area = 2.28(Ac.)
 Catchment Lag time = 0.162 hours
 Unit interval = 5.000 minutes
 Unit interval percentage of lag time = 51.5677
 Hydrograph baseflow = 0.00(CFS)
 Average maximum watershed loss rate(F_m) = 0.139(In/Hr)
 Average low loss rate fraction (Y_b) = 0.145 (decimal)
 Note: user entry of the Y_b value
 VALLEY DEVELOPED S-Graph proportion = 0.520
 VALLEY UNDEVELOPED S-Graph proportion = 0.480
 FOOTHILL S-Graph proportion = 0.000
 MOUNTAIN S-Graph proportion = 0.000
 DESERT S-Graph proportion = 0.000

 Computed peak 5-minute rainfall = 0.540(In)
 Computed peak 30-minute rainfall = 1.106(In)
 Specified peak 1-hour rainfall = 1.460(In)
 Computed peak 3-hour rainfall = 2.671(In)
 Specified peak 6-hour rainfall = 3.910(In)
 Specified peak 24-hour rainfall = 8.570(In)

Rainfall depth area reduction factors:
 Using a total area of 2.28(Ac.) (Ref: fig. E-4)

5-minute factor = 1.000	Adjusted rainfall = 0.540(In)
30-minute factor = 1.000	Adjusted rainfall = 1.106(In)
1-hour factor = 1.000	Adjusted rainfall = 1.460(In)
3-hour factor = 1.000	Adjusted rainfall = 2.671(In)
6-hour factor = 1.000	Adjusted rainfall = 3.910(In)
24-hour factor = 1.000	Adjusted rainfall = 8.570(In)

U n i t H y d r o g r a p h		
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Interval	'S' Graph	Unit Hydrograph
Number	Mean values	((CFS))

	(K =	27.57 (CFS))
1	5.609	1.547
2	32.696	7.469
3	67.061	9.476
4	83.388	4.502
5	89.853	1.783
6	92.838	0.823
7	95.004	0.597
8	96.208	0.332
9	97.083	0.241
10	97.829	0.206
11	98.416	0.162
12	98.877	0.127
13	99.236	0.099
14	99.502	0.073
15	99.749	0.068
16	100.000	0.034

Total soil rain loss = 1.15(In)
 Total effective rainfall = 7.42(In)

Peak flow rate in flood hydrograph = 6.88(CFS)

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24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	2.5	5.0	7.5	10.0
0+ 5	0.0002	0.02	Q				
0+10	0.0010	0.13	Q				
0+15	0.0029	0.27	VQ				
0+20	0.0052	0.33	VQ				
0+25	0.0076	0.36	VQ				
0+30	0.0102	0.37	VQ				
0+35	0.0128	0.38	VQ				
0+40	0.0155	0.39	VQ				
0+45	0.0182	0.39	VQ				
0+50	0.0209	0.39	VQ				
0+55	0.0236	0.40	VQ				
1+ 0	0.0264	0.40	VQ				
1+ 5	0.0292	0.40	VQ				
1+10	0.0320	0.41	VQ				
1+15	0.0348	0.41	VQ				
1+20	0.0376	0.41	Q				
1+25	0.0404	0.41	Q				
1+30	0.0432	0.41	Q				
1+35	0.0461	0.41	Q				
1+40	0.0489	0.41	Q				
1+45	0.0518	0.41	Q				
1+50	0.0546	0.41	Q				
1+55	0.0575	0.42	Q				
2+ 0	0.0604	0.42	Q				
2+ 5	0.0632	0.42	Q				
2+10	0.0661	0.42	Q				
2+15	0.0690	0.42	Q				
2+20	0.0719	0.42	QV				
2+25	0.0748	0.42	QV				
2+30	0.0777	0.42	QV				
2+35	0.0807	0.42	QV				
2+40	0.0836	0.43	QV				
2+45	0.0865	0.43	QV				
2+50	0.0895	0.43	QV				
2+55	0.0924	0.43	QV				
3+ 0	0.0954	0.43	QV				
3+ 5	0.0984	0.43	QV				
3+10	0.1014	0.43	QV				
3+15	0.1043	0.43	QV				
3+20	0.1073	0.44	Q V				
3+25	0.1103	0.44	Q V				
3+30	0.1134	0.44	Q V				
3+35	0.1164	0.44	Q V				
3+40	0.1194	0.44	Q V				
3+45	0.1224	0.44	Q V				
3+50	0.1255	0.44	Q V				
3+55	0.1285	0.44	Q V				
4+ 0	0.1316	0.45	Q V				
4+ 5	0.1347	0.45	Q V				
4+10	0.1378	0.45	Q V				
4+15	0.1409	0.45	Q V				
4+20	0.1440	0.45	Q V				
4+25	0.1471	0.45	Q V				
4+30	0.1502	0.45	Q V				
4+35	0.1533	0.45	Q V				

4+40	0.1565	0.46	Q	V				
4+45	0.1596	0.46	Q	V				
4+50	0.1628	0.46	Q	V				
4+55	0.1660	0.46	Q	V				
5+ 0	0.1691	0.46	Q	V				
5+ 5	0.1723	0.46	Q	V				
5+10	0.1755	0.46	Q	V				
5+15	0.1787	0.47	Q	V				
5+20	0.1820	0.47	Q	V				
5+25	0.1852	0.47	Q	V				
5+30	0.1884	0.47	Q	V				
5+35	0.1917	0.47	Q	V				
5+40	0.1950	0.47	Q	V				
5+45	0.1982	0.48	Q	V				
5+50	0.2015	0.48	Q	V				
5+55	0.2048	0.48	Q	V				
6+ 0	0.2081	0.48	Q	V				
6+ 5	0.2115	0.48	Q	V				
6+10	0.2148	0.48	Q	V				
6+15	0.2181	0.49	Q	V				
6+20	0.2215	0.49	Q	V				
6+25	0.2249	0.49	Q	V				
6+30	0.2283	0.49	Q	V				
6+35	0.2317	0.49	Q	V				
6+40	0.2351	0.50	Q	V				
6+45	0.2385	0.50	Q	V				
6+50	0.2419	0.50	Q	V				
6+55	0.2454	0.50	Q	V				
7+ 0	0.2488	0.50	Q	V				
7+ 5	0.2523	0.50	Q	V				
7+10	0.2558	0.51	Q	V				
7+15	0.2593	0.51	Q	V				
7+20	0.2628	0.51	Q	V				
7+25	0.2664	0.51	Q	V				
7+30	0.2699	0.51	Q	V				
7+35	0.2735	0.52	Q	V				
7+40	0.2770	0.52	Q	V				
7+45	0.2806	0.52	Q	V				
7+50	0.2842	0.52	Q	V				
7+55	0.2879	0.53	Q	V				
8+ 0	0.2915	0.53	Q	V				
8+ 5	0.2951	0.53	Q	V				
8+10	0.2988	0.53	Q	V				
8+15	0.3025	0.54	Q	V				
8+20	0.3062	0.54	Q	V				
8+25	0.3099	0.54	Q	V				
8+30	0.3137	0.54	Q	V				
8+35	0.3174	0.55	Q	V				
8+40	0.3212	0.55	Q	V				
8+45	0.3250	0.55	Q	V				
8+50	0.3288	0.55	Q	V				
8+55	0.3326	0.56	Q	V				
9+ 0	0.3365	0.56	Q	V				
9+ 5	0.3403	0.56	Q	V				
9+10	0.3442	0.56	Q	V				
9+15	0.3481	0.57	Q	V				
9+20	0.3521	0.57	Q	V				
9+25	0.3560	0.57	Q	V				
9+30	0.3600	0.58	Q	V				
9+35	0.3640	0.58	Q	V				
9+40	0.3680	0.58	Q	V				
9+45	0.3720	0.59	Q	V				
9+50	0.3761	0.59	Q	V				
9+55	0.3801	0.59	Q	V				
10+ 0	0.3842	0.60	Q	V				
10+ 5	0.3884	0.60	Q	V				

10+10	0.3925	0.60	Q	V			
10+15	0.3967	0.61	Q	V			
10+20	0.4009	0.61	Q	V			
10+25	0.4051	0.61	Q	V			
10+30	0.4094	0.62	Q	V			
10+35	0.4137	0.62	Q	V			
10+40	0.4180	0.63	Q	V			
10+45	0.4223	0.63	Q	V			
10+50	0.4267	0.63	Q	V			
10+55	0.4311	0.64	Q	V			
11+ 0	0.4355	0.64	Q	V			
11+ 5	0.4399	0.65	Q	V			
11+10	0.4444	0.65	Q	V			
11+15	0.4489	0.66	Q	V			
11+20	0.4535	0.66	Q	V			
11+25	0.4581	0.67	Q	V			
11+30	0.4627	0.67	Q	V			
11+35	0.4674	0.68	Q	V			
11+40	0.4720	0.68	Q	V			
11+45	0.4768	0.69	Q	V			
11+50	0.4815	0.69	Q	V			
11+55	0.4864	0.70	Q	V			
12+ 0	0.4912	0.70	Q	V			
12+ 5	0.4961	0.71	Q	V			
12+10	0.5010	0.71	Q	V			
12+15	0.5058	0.71	Q	V			
12+20	0.5107	0.71	Q	V			
12+25	0.5157	0.72	Q	V			
12+30	0.5207	0.72	Q	V			
12+35	0.5257	0.73	Q	V			
12+40	0.5308	0.74	Q	V			
12+45	0.5359	0.75	Q	V			
12+50	0.5411	0.75	Q	V			
12+55	0.5464	0.76	Q	V			
13+ 0	0.5517	0.77	Q	V			
13+ 5	0.5570	0.78	Q	V			
13+10	0.5625	0.79	Q	V			
13+15	0.5680	0.80	Q	V			
13+20	0.5735	0.81	Q	V			
13+25	0.5792	0.82	Q	V			
13+30	0.5849	0.83	Q	V			
13+35	0.5907	0.84	Q	V			
13+40	0.5966	0.85	Q	V			
13+45	0.6025	0.87	Q	V			
13+50	0.6086	0.88	Q	V			
13+55	0.6147	0.89	Q	V			
14+ 0	0.6210	0.91	Q	V			
14+ 5	0.6274	0.92	Q	V			
14+10	0.6338	0.94	Q	V			
14+15	0.6404	0.96	Q	V			
14+20	0.6472	0.98	Q	V			
14+25	0.6540	1.00	Q	V			
14+30	0.6610	1.02	Q	V			
14+35	0.6682	1.04	Q	V			
14+40	0.6755	1.06	Q	V			
14+45	0.6830	1.09	Q	V			
14+50	0.6907	1.12	Q	V			
14+55	0.6986	1.15	Q	V			
15+ 0	0.7068	1.18	Q	V			
15+ 5	0.7152	1.22	Q	V			
15+10	0.7239	1.26	Q	V			
15+15	0.7329	1.31	Q	V			
15+20	0.7423	1.36	Q	V			
15+25	0.7519	1.40	Q	V			
15+30	0.7612	1.35	Q	V			
15+35	0.7701	1.29	Q	V			

15+40	0.7791	1.32	Q		V	
15+45	0.7889	1.42	Q		V	
15+50	0.7998	1.58	Q		V	
15+55	0.8125	1.85	Q		V	
16+ 0	0.8287	2.35	Q		V	
16+ 5	0.8542	3.70		Q	V	
16+10	0.8984	6.42			Q	
16+15	0.9457	6.88			VQ	
16+20	0.9751	4.26		Q	V	
16+25	0.9933	2.65			V	
16+30	1.0072	2.01	Q		V	
16+35	1.0198	1.83	Q		V	
16+40	1.0309	1.62	Q		V	
16+45	1.0411	1.48	Q		V	
16+50	1.0506	1.37	Q		V	
16+55	1.0594	1.28	Q		V	
17+ 0	1.0677	1.20	Q		V	
17+ 5	1.0755	1.13	Q		V	
17+10	1.0828	1.07	Q		V	
17+15	1.0898	1.02	Q		V	
17+20	1.0965	0.97	Q		V	
17+25	1.1028	0.92	Q		V	
17+30	1.1089	0.88	Q		V	
17+35	1.1148	0.86	Q		V	
17+40	1.1205	0.83	Q		V	
17+45	1.1261	0.81	Q		V	
17+50	1.1316	0.79	Q		V	
17+55	1.1369	0.77	Q		V	
18+ 0	1.1421	0.75	Q		V	
18+ 5	1.1472	0.74	Q		V	
18+10	1.1522	0.73	Q		V	
18+15	1.1572	0.72	Q		V	
18+20	1.1621	0.71	Q		V	
18+25	1.1670	0.70	Q		V	
18+30	1.1717	0.69	Q		V	
18+35	1.1764	0.68	Q		V	
18+40	1.1810	0.67	Q		V	
18+45	1.1856	0.66	Q		V	
18+50	1.1901	0.65	Q		V	
18+55	1.1945	0.64	Q		V	
19+ 0	1.1988	0.63	Q		V	
19+ 5	1.2031	0.63	Q		V	
19+10	1.2074	0.62	Q		V	
19+15	1.2116	0.61	Q		V	
19+20	1.2158	0.60	Q		V	
19+25	1.2199	0.60	Q		V	
19+30	1.2239	0.59	Q		V	
19+35	1.2279	0.58	Q		V	
19+40	1.2319	0.58	Q		V	
19+45	1.2358	0.57	Q		V	
19+50	1.2397	0.56	Q		V	
19+55	1.2436	0.56	Q		V	
20+ 0	1.2474	0.55	Q		V	
20+ 5	1.2511	0.55	Q		V	
20+10	1.2549	0.54	Q		V	
20+15	1.2586	0.54	Q		V	
20+20	1.2622	0.53	Q		V	
20+25	1.2659	0.53	Q		V	
20+30	1.2695	0.52	Q		V	
20+35	1.2731	0.52	Q		V	
20+40	1.2766	0.51	Q		V	
20+45	1.2801	0.51	Q		V	
20+50	1.2836	0.51	Q		V	
20+55	1.2871	0.50	Q		V	
21+ 0	1.2905	0.50	Q		V	
21+ 5	1.2939	0.49	Q		V	

21+10	1.2973	0.49	Q				V
21+15	1.3007	0.49	Q				V
21+20	1.3040	0.48	Q				V
21+25	1.3073	0.48	Q				V
21+30	1.3106	0.48	Q				V
21+35	1.3139	0.47	Q				V
21+40	1.3171	0.47	Q				V
21+45	1.3203	0.47	Q				V
21+50	1.3235	0.46	Q				V
21+55	1.3267	0.46	Q				V
22+ 0	1.3299	0.46	Q				V
22+ 5	1.3330	0.46	Q				V
22+10	1.3361	0.45	Q				V
22+15	1.3392	0.45	Q				V
22+20	1.3423	0.45	Q				V
22+25	1.3454	0.45	Q				V
22+30	1.3484	0.44	Q				V
22+35	1.3514	0.44	Q				V
22+40	1.3545	0.44	Q				V
22+45	1.3575	0.43	Q				V
22+50	1.3604	0.43	Q				V
22+55	1.3634	0.43	Q				V
23+ 0	1.3663	0.43	Q				V
23+ 5	1.3693	0.43	Q				V
23+10	1.3722	0.42	Q				V
23+15	1.3751	0.42	Q				V
23+20	1.3780	0.42	Q				V
23+25	1.3808	0.42	Q				V
23+30	1.3837	0.41	Q				V
23+35	1.3865	0.41	Q				V
23+40	1.3894	0.41	Q				V
23+45	1.3922	0.41	Q				V
23+50	1.3950	0.41	Q				V
23+55	1.3978	0.40	Q				V
24+ 0	1.4005	0.40	Q				V
24+ 5	1.4032	0.38	Q				V
24+10	1.4050	0.27	Q				V
24+15	1.4059	0.13	Q				V
24+20	1.4064	0.07	Q				V
24+25	1.4067	0.04	Q				V
24+30	1.4069	0.03	Q				V
24+35	1.4070	0.02	Q				V
24+40	1.4071	0.01	Q				V
24+45	1.4072	0.01	Q				V
24+50	1.4072	0.01	Q				V
24+55	1.4073	0.01	Q				V
25+ 0	1.4073	0.00	Q				V
25+ 5	1.4073	0.00	Q				V
25+10	1.4073	0.00	Q				V
25+15	1.4073	0.00	Q				V

Appendix E

**Storage vs Outflow
Factor of Safety Calcsheet
Soils/Infiltration Report
Routing Hydrograph (Post-Developed)**

Worksheet H: Factor of Safety and Design Infiltration Rate Worksheet

Factor Category		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) $p = w \times v$
A	Suitability Assessment	Soil assessment methods	0.25	3	0.75
		Predominant soil texture	0.25	1	0.25
		Site soil variability	0.25	1	0.25
		Depth to groundwater / impervious layer	0.25	1	0.25
		Suitability Assessment Safety Factor, $S_A = \Sigma p$			
B	Design	Tributary area size	0.25	1	0.25
		Level of pretreatment/ expected sediment loads	0.25	1	0.25
		Redundancy	0.25	2	0.50
		Compaction during construction	0.25	1	0.25
		Design Safety Factor, $S_B = \Sigma p$			
Combined Safety Factor, $S_{TOT} = S_A \times S_B$				1.9 use 2.0 Min	
Measured Infiltration Rate, inch/hr, K_M (corrected for test-specific bias)				6	
Design Infiltration Rate, in/hr, $K_{DESIGN} = S_{TOT} / K_M$				3	
Supporting Data					
Briefly describe infiltration test and provide reference to test forms:					



SOILS SOUTHWEST, INC.

SOILS, MATERIALS AND ENVIRONMENTAL ENGINEERING CONSULTANTS

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**Report of Geotechnical Evaluations and
Soils Infiltration Testing for WQMP-BMP Stormwater Disposal Design**

Planned New San Antonio Water District Headquarters Office and Maintenance Facility
400 E. 20th Street
Upland, CA
APN: 1044-091-22

Project No. 24036-F/BMP

August 28, 2024

Prepared for:

CEDG, Inc.
c/o Mr. Erik Peterson
401 E. Columbia Avenue
Pomona, CA 91767

soilssouthwest@aol.com
Established 1984



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August 28, 2024

Project No.24001-F/BMP

CEDG, Inc.
401 E. Columbia Avenue
Pomona, CA 91767

Attention: Mr. Erik Peterson

Subject: Report of Geotechnical Evaluations and
Soils Infiltration Rates for WQMP-BMP Stormwater Disposal Design
Planned New San Antonio Water District Headquarters Office and Maintenance Facility
400 E. 20th Street
Upland, CA
APN: 1044-091-22

Reference: Preliminary Site Plan Provided by Addressee

Dear Mr. Peterson,

Presented herewith is the report of (i) Geotechnical Evaluations and (ii) Soils Infiltration Rates for WQMP-BMP Stormwater Disposal Design proposed for the planned new administrative office and maintenance structures, parking, along with shallow depth basin and underground infiltration disposal systems to be located 400 East 20th Street, Upland, California. In absence of detailed development plans review, the opinions and recommendations included should be considered as "preliminary". Revised and/or updated recommendations may be warranted following precise grading and development plans review.

Based on the referenced site plan, it is understood that the subject development will primarily include two new near grade structures including one maintenance shop and one administrative office structure. Construction of wood and stucco, concrete tilt-up or concrete framed, or concrete block construction with concrete slabs-on-grade is assumed. Supplemental construction is to include on-site driveways and parking and paving for auto/heavy-duty truck traffic, along with the installation of a couple WQMP-BMP stormwater disposal systems to complete the project. Moderate site preparations and grading should be expected. For estimation purposes, the anticipated structural loadings of 80 kips and 8 klf are assumed for isolated column and conventional wall spread foundations, respectively.

Based on the test explorations and laboratory testing completed at this time, it is our opinion that the soils encountered primarily consist of upper 3 feet of variegating layers of gravels and silty fine to medium coarse gravel sand mixtures with high concentrations of rocks, cobbles, and occasional small boulders to the refusal depth of 3 feet explored. Descriptions of the soils encountered are provided in the attached Log of Borings.

No shallow-depth groundwater or impermeable layers were encountered. Historical and shallow-depth groundwater is reported at approximately 267 feet below grade as measured at the nearest water well, 01N07W28N002S. Based on such, and as described in the Special Publication SP117, published by the State of California Department of Conservation, Division of Mines and Geology, it is our opinion that the site is considered non-susceptible to seismically induced soils liquefaction thereby requiring no special geotechnical design recommendations other than those as recommended herein.

Based on review of the available USGS (California Geologic Survey) publication, it is understood that the site is not situated within an A-P Special Studies Zone where a known seismic fault passes through the site or its adjacent. Supplemental information is provided in Appendix C.

Following review of the online FEMA National Flood Hazard Layer Mapping, it is understood that the project site is classified as a Zone X, Area of Minimal Flood Hazard.

Based on the evaluations completed at this time, it is our opinion that from a geotechnical viewpoint, the site should be considered suitable for the proposed development provided that the recommendations and opinions included are considered in design and construction.

Final grading and detailed development plan review is suggested to verify the applicability of the certain assumptions as used in preparing this report.

This report has been substantiated by subsurface explorations and mathematical analysis made in accordance with the generally accepted engineering principles, including those field and laboratory testing considered necessary in the circumstances.

We offer no other warranty, expressed or implied.

Respectfully submitted,
Soils Southwest, Inc.

Malay Gupta, RCE 31708



John Flippin
Project Coordinator

1.0 Introduction

1.1 Purpose and Scope of Work

This report presents the results of (i) Geotechnical Evaluations and (ii) Soils Infiltration Testing for WQMP-BMP Stormwater Disposal System Design for the new administrative office and maintenance structures, parking, along with shallow depth and underground infiltration design systems to be located 400 East 20th Street, Upland, California. In absence of precise grading and/or detailed development plans, the recommendations and opinions included may require updating and revisions recommendations following detailed development plans review.

The soils encountered as described herein are based on visual observations made during test explorations, supplemented by the necessary laboratory testing completed at this time. Being beyond scope of work, no geologic investigations or Phase I Environmental Site Assessment (ESA) are included. Reports of such will be supplied upon request.

The recommendations contained reflect our best estimate of the soils' conditions as encountered during field explorations as conducted for the site. It is not to be considered as a warranty of the soils' conditions for other areas or for the depth beyond the explorations advanced at this time.

The recommendations supplied should be considered valid and applicable following review of the final grading and development plans when supplied and when the following conditions are observed:

- i. Pre-grade meeting with the contractor, public agency, and the geotechnical engineer,
- ii. Excavated bottom inspections and verifications by the geotechnical engineer prior to backfill placement,
- iii. Continuous observations and testing during site preparation and structural fill soils placement,
- iv. Observation and inspection of footing trenching prior to steel and concrete placement,
- v. Plumbing trenches backfill placement prior to concrete slab-on-grade placement,
- vi. On and off-site utility trenches backfill testing and verifications, and
- vii. Consultations as required during construction or upon your request.

1.2 Site Description

The rectangular shaped subject parcel of 4.92 acres is currently a water district yard facility in operation. In general, the site is bounded by East 20th Street to the north, by Interstate 210 Freeway on the south, by vacant undeveloped property on the east, and by Flower Court on the west. Following review of the available site drawings, overall vertical relief within the property is unknown, however, based on site reconnaissance, sheet flow from incidental rainfall is estimated to flow towards the south and southwest. Other than an existing reservoir tank, pump station, and numerous soil, rock, and asphalt debris stockpiles in the center portion of the property, along with a satellite tower at the southeast corner, presence of no other significant features were noted.

1.3 Proposed Development

No precise grading and/or detailed development plans are available for review; however, it is understood that the subject development will primarily include two (2) structures near existing grade to accommodate, among others, a maintenance building and an administrative office. Use of wood and stucco framed, concrete block, or metal framed construction with concrete slabs-on-grade is assumed. Supplemental construction is anticipated to include on-site driveways, parking and paving, along with the installation of two (2) WQMP-BMP stormwater disposal systems. Considering existing offsite paving, curb-gutter, and drive approaches, off-site street improvements is not anticipated at this time.

Moderate site preparations and grading are anticipated as described in the following sections.

1.4 Subsurface Investigation

The geotechnical evaluations include subsurface explorations, soil sampling, necessary laboratory testing, engineering analyses, and preparation of this report. Being beyond scope of work, no geologic investigations or Phase I Environmental Site Assessments are included. Reports on such will be supplied on request.

In general, our scope of work included the following: review of the referenced site plan supplied along with three (6) test borings (B-1 to B-6) explored by using a Hollow-Stem Auger (HSA) drill rig advanced to the refusal depth of 3 feet below grade along with four (4) infiltration test borings to maximum depths between 3 and 8 feet (P-1 and P-4) as requested for WQMP-BMP Stormwater Disposal Design. During explorations, the soils encountered were continuously logged, bulked, and undisturbed samples were procured and recorded. Collected samples were subsequently transferred to our laboratory for necessary geotechnical testing.

Descriptions of the soils encountered are provided on the attached Log of Borings. Approximate test locations are shown on the attached Plate A.

- Laboratory testing conducted on the selected bulk and undisturbed samples were programmed according to the project requirements. The laboratory testing included determinations of:
 - Moisture Density Determination (ASTM D2216),
 - Maximum Dry Density and Optimum Moisture Content (ASTM D1557),
 - Soils' Peak and Residual Shear Strengths (ASTM D3080),
 - Soils' Consolidation Characteristics (ASTM D2435),
 - Soils' Sieve Analyses (ASTM D422),
 - Soils' R-value (ASTM D2844), and
 - Soils' Sand Equivalent, SE (ASTM D2419).
- Based on the field investigation and laboratory testing completed the necessary engineering analyses and evaluations were made on which to base our preliminary recommendations for foundation design, slab-on-grade, site preparations and grading, utility trenches backfill, and
- Preparation of this report for initial use by the project design professionals.

The recommendations supplied should be considered "tentative" and may require revisions and/or upgrading following final grading and detailed development plans review.

2.0 Geotechnical Evaluations

2.1 Site Soils Description

The soils encountered primarily consist of upper 3 feet of variegating layers of gravels and silty fine to medium coarse gravel sand mixtures with high concentrations of rocks, cobbles, and occasional small boulders to the refusal depth of 3 feet explored. Descriptions of the soils encountered are provided in the attached Log of Borings.

Based on review of the USDA Natural Resources Conservation Service: Web Soil Survey for the subject area, it is our understanding that the soil classification within the structural pad areas is identified as being SpC-Soboba stony loamy sand, 2 to 9 percent slopes with the upper 60 inches consisting of stony loamy sand and very stony sands below existing grade, whereas the soils within the planned underground infiltration disposal system at the southwest portion of the property being classified as HaC-Hanford coarse sandy loam, 2 to 9 percent slopes consisting of sandy loam and fine sandy loam up to five (5) feet below existing grade. Following review of the Geological Map of the Mount Baldy Quadrangle (2002), the project site is designated as consisting of Qg alluvial gravel and sand of stream channels.

Based on review of the available USGS (California Geologic Survey) publications, it is understood that the site is not situated within an A-P Special Studies Zone where seismic fault passes through the site or its adjacent.

No groundwater or impermeable soils were encountered within the refusal depth of 3 feet explored. According to California Department of Water Resources, the historical groundwater level is at a depth of approximately 267 feet which is in excess of 50 feet below grade as measured at the nearest water well (01N07W28N002S). Based on such and as described in the Special Publication SP117, published by the State of California Department of Conservation, Division of Mines and Geology, it is our opinion that the site is considered non-susceptible to seismically induced soils liquefaction.

Laboratory shear tests conducted on the upper soils remolded to 90% indicate "moderate" shear strengths under increased moisture conditions. Results of the laboratory shear tests are provided on Plate B.

Consolidation tests conducted on remolded samples indicate "slight" potential for compressibility along with slight to moderate hydro-collapse potential under anticipated static structural loadings with potential for "tolerable" settlements to footings and concrete slabs-on-grade. Areas of slight to moderate compressibility and/or hydro collapsible potential may require further excavation and/or compaction effort. Results of the laboratory determined soils consolidation potential are shown in Appendix B.

Fine to medium coarse to coarse sands with traces of silts along with rocks and cobbles encountered are considered "low" in expansion potential requiring no special construction requirements other than those as recommended herein. Supplemental soil expansion testing, however, is recommended following mass grading completion to provide supplemental/revised foundation recommendations, if warranted.

2.2 Subsurface Variations

During site preparations and grading, buried irrigation, debris, organic and others may be encountered. In addition, variations in soil strata, their continuity and orientations may be expected. Due to the deposition characteristics of the soils encountered, care should be exercised in interpolating or extrapolating the subsurface soils conditions existing in between and beyond the test explorations conducted.

2.3 Excavability

It is our opinion that the grading required for the project may be accomplished by using conventional heavy-duty construction equipment. No blasting or jackhammering should be warranted. However, considering the presence of high concentration of cobbles and boulders, it is suggested to use rocks no greater than 6-8 inches in compacted fills, but directly beneath footings and slabs should be avoided.

2.4 Soil Corrosivity

Reference Soil Sample B-1 @ 0-3 feet below grade

1. Chloride concentration equal to 29 mg/Kg does not exceed 10,000 ppm is non-corrosive to ferrous metals,
2. pH equal to 7.93 units exceeding 4.0 units is non-corrosive to buried metals,
3. Sulfate concentration equal to 82 mg/Kg does not exceed 2000 ppm is non-corrosive to concrete, and
4. Resistivity equal to 3,640 ohms/cm is "moderately" corrosive to buried metals.

Soil chemical test results are included in Appendix B.

It is suggested that following mass grading completions, soils corrosivity potential evaluations should be made to determine, at a minimum, concentrations of pH, sulfate, chloride, and resistivity. Further corrective recommendations should be provided by Corrosion Engineer.

2.5 Groundwater

No groundwater or bedrock was encountered within the refusal depth of 3 feet explored. However, following review of the available recorded groundwater well data as shown in the table below, historical groundwater was measured at approximately 267 feet below the existing well grade. The following table describes the historical and the current groundwater level as recorded in the nearest well as listed by the local reporting agency.

GROUNDWATER TABLE	
Reporting Agency	California Department of Water Resources Marcelo Montagna 2008 Maps http://wdl.water.ca.gov/waterdatalibrary/
Well Number	01N/07W-28N002S Cucamonga-1000547
Well Monitoring Agency	Chino Basin
Well Location: Township/Range/Section	T01N-R07W-Section 28
Well Elevation:	1675
Current Depth to Water (Measured in feet)	469
Current Date Water was Measured	March 26, 2024
Depth to Water (Measured in feet) (Shallowest)	267
Date Water was Measured (Shallowest)	December 15, 1983

Fluctuations in groundwater levels, however, can occur due to seasonal variations in the amount of rainfall, runoff, altered natural drainage paths, and other factors not evident at the time the test borings completed. Accordingly, for the planned development, it is our opinion that provisions should be maintained to dispose incidental surface runoff away from the individual structural pads, once constructed.

3.0 Faulting and Seismicity

3.1 Faulting and Seismicity

Based on the information published by the USGS (currently known as California Geologic Survey) Department of Conservation, State of California, it is understood that the site is not situated within an A-P Special Study Zone where earthquake fault(s) runs through or adjacent to the subject site. In the absence of shallow (less than 50 feet) depth groundwater, the site is considered non-susceptible to soils liquefaction in the event of a strong motion earthquake. However, the site being within Southern California where potentials for seismically induced structural hazards could not be ignored, it is our opinion that implementation of the current CBC seismic design parameters in structural design as described herein may reduce the potential for seismically induced structural distress to some "acceptable" tolerable limits.

Seismically induced site-specific potential hazards are discussed in the following sections.

3.2 Direct or Primary Seismic Hazards

Surface ground rupture along with active fault zones and ground shaking represent primary or direct seismic hazards to structures. There are no known active or potentially active faults that pass through or towards the subject site and the site is not situated within an A-P Special Studies Zone. According to the current 2022 CBC, the site is considered situated within Seismic Zone 4. As a result, it is likely that during the life expectancy of the structures built, moderate to severe ground shaking may have some adverse effects to the structures built.

3.3 Induced or Secondary Seismic Hazards

In addition to ground shaking, effects of seismic activity may include surface rupture, flooding, landsliding, lateral spreading, settlements, and subsidence. Potential effects of such are as described below.

3.3.1 Liquefaction

Liquefaction is caused by build-up of excess hydrostatic pressure in saturated cohesionless soils due to cyclic stress generated by ground shaking during an earthquake. The significant factors on which liquefaction potential of a soil deposit depends, among others include, soil type, relative soil density, intensity of earthquake, duration of ground shaking, and depth of ground water.

No groundwater was encountered within the refusal depth of 3 feet explored. In absence of historically reported groundwater within 50 feet below grade, and based on review the Special Publication SP117, published by the State of California Department of Conservation, Division of Mines and Geology, it is our opinion that the site is considered non-susceptible to seismically induced soils liquefaction thereby requiring no special geotechnical design recommendations other than those as recommended herein.

3.3.2 Shallow Depth Ground Rupture

The site is not situated within an A-P Special Studies Zone. Based on review of the existing geologic information, no major fault is noted to cross through or extend towards the site. The potential for surface rupture resulting from nearby fault movement is not known for certainty; however, in our opinion it is considered "remote" due to the distance of the site to the recorded nearby earthquake fault.

3.3.3 Flooding

Flooding hazards include tsunamis (seismic sea waves), Seiches, or failure of manmade reservoirs, tanks, and aqueducts. The potential for these hazards is considered "remote" considering the inland site location and in absence of nearby known bodies of water. Based on review of the FEMA National Flood Hazard Layer FIRMette map, it is our understanding that the subject area is delineated as Zone X, Area of Minimal Flood Hazard on its eastern half while the western half is delineated as being in an area with "Reduced Flood Risk due to Levee as shown in the attached Appendix C.

3.3.4 Landslides

Seismically induced landslides and other slope failures are common occurrences during or soon after an earthquake. Considering the site and its adjacent being relatively flat, it is our opinion that potential for seismically induced landslides should be considered "remote".

3.3.5 Lateral Spreading

Seismically induced lateral spreading involves lateral movement of soils due to ground shaking. Lateral spreading is demonstrated by near vertical cracks with predominantly horizontal movement of the soil mass involved. The topography of the site being near level, it is our opinion that the potential for seismically induced lateral spreading should be considered "remote".

3.3.6 Seismically Induced Settlement

Considering the proximity of the earthquake fault as described, it is our opinion that potential for some total and differential settlements due to ground shaking may be anticipated as described herein.

3.4 Seismic Design Parameters

The design spectrum was developed based on the 2022 CBC. Site Coordinates of 34.135692°N, -117.645040°W were used to establish the seismic parameters presented below.

3.4.1 Seismic Design Coefficients

The site is situated at approximately 1.3 miles from the Cucamonga Fault capable of generating an earthquake magnitude, M of 6.7 and Peak Horizontal Ground Acceleration, PGA of 0.753g at 10% probability of exceedance in 50-year return period.

For foundation and structural design use of the following seismic parameters are suggested as based on the current 2022 CBC:

Recommended values are based upon the online review of ASCE 7-22 Hazard Tool coefficient parameters. The following presents the seismic design parameters evaluated based on the available publications published by California Geological Survey (CGS), 2022 CBC, and ASCE Standard 7-16.

TABLE 3.4.1 A1: Seismic Design Parameters

Seismic Source Type

Based on California Geological Survey-Probabilistic Seismic Hazard Assessment Peak Horizontal Ground Acceleration (PGA) having a 10% probability of exceedance in a 50-year period is described as below:

Seismic Source Type / Appendix C	
Nearest Maximum Fault Magnitude	$M \geq 6.7$
Peak Horizontal Ground Acceleration (PGA)	0.753g

In design, vertical acceleration may be assumed to about 1/3 to 2/3 of the estimated horizontal ground accelerations (PGA) described.

It should be noted that lateral force requirement in design should be intended to resist total structural collapse due to the described PGA of 0.753g or greater. However, during the lifetime use of the structure built, it is our opinion that some structural damage may be anticipated requiring structural repairs and/or replacement. Use of flexible lifeline connections are suggested.

TABLE 3.4.1 A2: Seismic Design Coefficients

CBC Chapter 16	2022 ASCE 7-16 Standard Seismic Design Parameters	Recommended Values
1613A.5.2	Site Class	D
1613.5.1	The mapped spectral accelerations at short period	S_s
1613.5.1	The mapped spectral accelerations at 1.0-second period	S_1
1613A5.3(1)	Seismic Coefficient, S_s	1.766g
1613A5.3(2)	Seismic Coefficient, S_1	0.658g
1613A5.3(1)	Site Class D / Seismic Coefficient, F_a	1g
1613A5.3(2)	Site Class D / Seismic Coefficient, F_v	n/a
16A-37 Equation	Spectral Response Accelerations, $S_{Ms} = F_a S_s$	1.766g
16A-38 Equation	Spectral Response Accelerations, $S_{M1} = F_v S_1$	n/a
16A-39 Equation	Design Spectral Response Accelerations, $S_{Ds} = 2/3 \times S_{Ms}$	1.177g
16A-40 Equation	Design Spectral Response Accelerations, $S_{D1} = 2/3 \times S_{Ms}$	n/a

4.0 Evaluations and Recommendations

4.1 General Evaluations

Based on field explorations, laboratory testing, and subsequent engineering analyses, the following tentative conclusions and recommendations are presented for initial study:

- (I) From a geotechnical viewpoint, the site is considered grossly stable for the proposed development, provided that the recommendations supplied herein are incorporated in design and construction. Foundation design should reflect considerations of the seismically induced PGA as described.
- (II) Based on the dry, silty, gravelly, variable consistency nature of the upper soils existing as encountered, it is our opinion that for structural support the load bearing soils should be reworked in the form of subexcavations, followed by scarification, moisturization, and their replacement as engineered fills compacted to minimum 90%. In the event that new fill soils are required over the current grade surface such should be placed on the original grades when prepared as described.
- (III) The subexcavation depths during mass grading as described in the following section should be considered as "minimum". During grading, localized deeper subexcavations may be required within areas underlain by buried debris, utilities, localized fills or soft soils and others. It will be the responsibility of the grading contractor to inform the project geotechnical engineer of the presence of such prior to further site preparations and grading.
- (IV) In order to minimize potential for differential settlements, it is recommended that structural footings should be established exclusively into engineered fills of local soils compacted to the minimum as recommended in this report. Construction of footings and slabs straddling over cut and fill transition conditions shall be avoided.
- (V) Structural design consideration should include probability for "moderate" peak ground acceleration from relatively active nearby earthquake faults. Implementing the seismic design parameters and procedures as outlined in the current CBC and as described earlier, however, may minimize the adverse effects for the structures proposed.
- (VI) Although no groundwater was encountered, provisions should be maintained during construction to divert incidental rainfall away from the structural pads constructed.
- (VII) It is our opinion that, if site preparations and grading are performed as recommended and as per the generally accepted construction practices and current CBC, the proposed development will not adversely affect the stability of the site or its adjacent.

4.1.1 Recommendations for Site Preparations and Grading for Structural Support

In absence of detailed development plans review, the planned structural pad grades are assumed at/or near the existing grade surface. For adequate structural support, it is our opinion that moderate site preparations and grading should be included in the form of subexcavations of the near grade dry, silty, gravelly, variable consistency soils and their replacement as engineered fills compacted to minimum 90%.

In general, site preparations and grading should include subexcavations of the near surface soils to about:

- (i) minimum 5 feet below the current grade surface or
- (ii) to the depth as required to expose the underlying moist and dense natural subgrades or
- (iii) to the depth as required to maintain a 24-inch-thick compacted fill mat blanket below foundation bottoms, whichever is greater.

The site preparations and grading described should encompass, at a minimum, the proposed structural footprint areas and minimum 5 feet beyond or as suggested by the geotechnical engineer during grading. No cut and fill transition conditions should be allowed.

Within areas requiring fill soils, if any, such may be placed following sufficient subexcavations to expose the underlying dense subgrades as approved by the project geotechnical engineer. During grading, the engineered fills placed should be compacted to near Optimum Moisture and with minimum 90% compaction of soils' Maximum Dry Density as determined by ASTM D1557.

The subexcavation depths described should be considered as "preliminary". Localized additional subexcavations may be required within areas underlain by undocumented old fills, buried utilities and abandoned sewer and/or buried septic systems. It is recommended that the excavated subgrades should be verified and approved by the geotechnical engineer prior to structural fill soil placement. Supplemental recommendations may be warranted following detailed development plans review.

Mass grading required for the project is recommended to encompass, at a minimum, the entire individual structural pads and beyond.

For reference, supplemental general mass grading recommendations are included Section 5 of this report.

4.2 Structural Fill Material Requirements

The local and/or imported fills, if required, should be gravelly sand, free of organics, roots, debris, and rocks larger than 6 to 8-inch in diameter.

Although no significant variations in soil conditions are anticipated, actual soils conditions may vary during grading. It will be the contractor's responsibility to notify Soils Southwest, Inc. about such variations for revised/updated geotechnical recommendations.

Non-expansive in nature, the on-site soils free of organic, debris, and rocks larger than 8-inch in load bearing structural backfills placed should be compacted to minimum 90% of the soils' Maximum Dry Density as determined by ASTM D1557 test method. Import soils, if required, should be non-expansive, gravelly sand and meeting the following criteria:

Liquid Limit	<35
Plasticity Index	<15
Expansion Index	<20

4.2.1 Structural Fill Soils Placement

Within the areas of structural loadings, it is our opinion that the near grade soils should be subexcavated to minimum 5 feet depth. For adequate structural bearing, it is our opinion that the excavated soils may be placed in 6 to 8-inch lifts with near Optimum Moisture Conditions compacted to minimum 90%. No structural fills should be placed during unfavorable weather conditions.

4.2.2 Cut and Fill Transition Conditions Pad Preparations (if applicable)

Use of cut and fill transition conditions should be avoided to minimize potential for differential settlements to footings and concrete slabs-on-grade. Within cut and fill transition areas, if it becomes essential, it is suggested that following the necessary cut, the entire structural pad should be prepared so as to establish a uniform bearing compacted fill mat prepared in conformance to the general guidelines as described below.

Pad Preparation Guidelines for Cut and Fill Transition Condition Areas

Fill Depth Required for Finish Grade (Within low-lying areas)	Overexcavation Depth below Finish Grade (Within cut areas)
Up to 5 feet	Equal Depth
5 to 10 feet	5 feet
Greater than 10 feet	One-half the maximum thickness of fills placed on the "fill" portion (20 feet maximum)

Cut portions should be overexcavated beyond the structural perimeter lines for a horizontal distance equal to the depth of overexcavation or to a minimum distance of 5 feet, whichever is greater. Actual subexcavation depths should be determined by the geotechnical engineer during grading.

4.3 Structural Foundation Design Parameters

In the absence of detailed development plans review, it is assumed that for load bearing support conventional continuous wall foundations and isolated spread footings will be used bearing directly on the engineered graded fills placed as described earlier in this report.

It is assumed that the subject development will include concrete tilt-up or concrete framed, concrete block construction with concrete slabs-on-grade and concrete footings in the form of isolated pier foundations or continuous wall foundations. Use of load bearing concrete wall and/or isolated spread footings are assumed to be used underlain by at least 30-inch-thick engineered fill mat of local soils compacted to minimum 90% as recommended earlier.

Structural foundations, in the form of exterior load bearing wall foundations and isolated pier foundations, may be considered in design based on the following equations:

$$\begin{aligned} \text{Continuous Wall Footing:} \quad q_{\text{allowable}} &= 2000 + 350d + 250b \\ \text{Isolated Square Footing:} \quad q_{\text{allowable}} &= 2400 + 350d + 100b, \text{ where} \end{aligned}$$

$q_{\text{allowable}}$ = allowable soil vertical bearing capacity, in psf
 d = footing depth, minimum 30-inch,
 b = footing width, minimum 24-inch.

The above soil bearing capacities may be increased for each additional depth in footing and width in excess of the minimum recommended. Under static loading conditions, with a Factor of Safety, $FS = 3.0$, the total maximum vertical bearing capacity is recommended not to exceed 3500 psf for continuous wall footings and isolated square footings. If normal code requirements are applied, the above capacities may further be increased by an additional 1/3 for short duration of loading which includes the effect of wind and seismic forces. The load bearing footings should be reinforced with minimum 2-#5 near the top and 2-#5 rebar near bottom of continuous wall footings. For isolated foundations reinforcing requirements shall be determined by the project structural engineer. Actual foundation dimensions (b & d) and reinforcement requirements should be provided by the project structural engineer based on anticipated structural dead loadings, soil bearing capacity, and Peak Ground Acceleration (PGA) described.

The footing depths described should be measured vertically from the lowest adjacent outside grade and not from the finished pad grade or from finished floor surface. Footing depths and dimensions shall be verified by the geotechnical engineer prior to footing-forming, rebar, and concrete placement. It will be the contractor's responsibility to arrange such verifications by the geotechnical engineer.

Based on the laboratory determined soils' consolidation characteristics, settlements to properly designed and constructed foundations supported exclusively into engineered fills of site soils or its equivalent or better, and carrying maximum assumed structural loadings, are expected to be within "tolerable" limits.

Under static loading conditions, over a 40-foot-span, the estimated total and differential settlements should be about 1 and 1/2-inch, respectively, provided the foundations being supported by engineered fills of local soils compacted to minimum 90% as described. Most of the elastic deformations, however, are expected to occur during construction.

4.4 Concrete Slabs-on-Grade

No concrete slabs, sidewalks and flatworks should be placed bearing directly on the surface soils currently existing. The prepared subgrades to receive footings should be adequate for concrete slab-on-grade placement. The following is provided for reference only.

Building Pad Warehouse/ Truck Traffic:

1. Suggested 5-inch-thick (net) slab thickness,
2. 2500 psi concrete with water/cement ratio of 0.64 maximum,
3. #4 rebar @ 18-inch o/c using chairs or as required by the project structural engineer,
4. Within moisture sensitive areas, it is suggested to use 10-mil-thick commercially available StegoWrap, Visqueen or other approved coverings,
5. Two (2) inches of sand with SE>30 over the installed Stego Wrap System,
6. Saw cuts requirements shall be as per the structural engineer.

Driveways:

1. 6-inch-thick net slab,
2. 2500 psi concrete with water/cement ratio of 0.64 maximum,
3. Over native grade compacted to a maximum of 95%.

Flatwork:

1. 3 1/2-inch-thick net concrete,
2. 2500 psi concrete with water/cement ratio of 0.64 maximum,
3. Over native grade compacted to a minimum 90%,
4. Tooled joints per the structural engineer.

It is recommended that, prior to concrete pours, utility trenches underlying concrete slabs and driveways should be thoroughly backfilled with sandy gravelly soils, mechanically compacted to the minimum compaction requirements as described.

Within moisture sensitive areas, concrete slabs should be underlain by 2-inch of compacted clean sands, followed by 10-mil-thick vapor barrier, such as commercially available StegoWrap, Visqueen or other approved coverings, overlying an additional 2-inch-thick layer of sands. Sands used should have a Sand Equivalent, SE of 30 or greater.

Subgrades to receive concrete foundations and slab-on-grade should be "dampened" as would be expected in any such concrete placement. Use of low-slump concrete is recommended. In addition, it is recommended that utility trenches underlying concrete slabs and driveways should be thoroughly backfilled with gravelly sandy soils mechanically compacted to minimum 90%. Concrete construction joint requirements should be determined by the project structural engineer.

No concrete should be placed during extreme weather conditions, such as during high outside temperature and/or during high Santa Ana wind conditions. Use of excess water on finished grade is not recommended to prevent post-placement concrete "warping".

4.4.1 Concrete Curing and Crack Control

The recommendations presented in this report are intended to reduce potentials for cracking of concrete slabs-on-grade due to concrete curing or settlement. However, even when the following recommendations have been implemented, foundations, stucco walls and concrete slabs-on-grade may display some minor cracking due to minor soil movement and/or concrete shrinkage.

The occurrence of concrete cracking may also be reduced and/or controlled by limiting the slump of the concrete used, proper concrete placement, and curing along with using crack control joints at reasonable intervals where re-entrant slab corners occur. For standard crack control, maximum expansion/construction joint spacing is recommended not to exceed 24 to 30 x the concrete thickness. Shorter distance between joint spacing would provide greater crack control. Joints at curves and angle points are suggested as determined by the project structural engineer.

To minimize potentials for "warping", subgrades to receive concrete shall be free of excess water. Concrete placements during adverse weather conditions should not be allowed.

4.5 Resistance to Lateral Loads

Resistance to foundation lateral displacement can be achieved by friction acting at the base of foundation and by passive earth pressures. A coefficient friction of 0.40 may be assumed with normal dead load forces for footing established on engineered compacted fills of local soils.

An allowable passive lateral earth resistance of 300 psf per foot of depth may be assumed for the sides of foundations poured against compacted fills. The maximum lateral passive earth pressure is recommended not to exceed 3000 lbs.

For design, active lateral pressures from local soils when used as backfills may be estimated from the following equivalent fluid density:

CONDITIONS	EQUIVALENT FLUID DENSITY, pcf	
	Level Backfill	2:1 Backfill Sloping Upwards
Active	40	55
At Rest	55	70
Seismic	75% of active earth pressures	75% of active earth pressures

4.6 Shrinkage and Subsidence

It is our opinion that during grading the upper soils may be subjected to a volume change. Assuming a 90% relative compaction for structural fills and assuming an overexcavation and recompaction depth as described earlier, such volume change due to shrinkage may be on the order of 7% to 10%. Further volume change may be expected due to supplemental shrinkage during preparation of subgrade soils. For estimation purpose, such may be approximated to about 2-inch when conventional construction equipment is used.

4.7 Construction Considerations

4.7.1 Unsupported Excavation

Gravelly sandy site soils encountered are considered highly susceptible to caving. Temporary excavations up to 4 feet in depth may be made without rigorous lateral support. Excavated surface should be "wetted" during construction to minimize potential surface soil raveling. No surcharge loading should be allowed within an imaginary 1:1 line drawn upward from the toe of the temporary excavations.

4.7.2 Supported Excavations

If vertical excavations exceeding 4 feet in depth become warranted, such should be achieved using shoring to support sidewalls.

4.8 Soil Caving

Considering the gravelly sandy site soils encountered as described, it is our opinion that some caving may be expected during deep excavations. Temporary excavations in excess of 5 feet should be made at a slope ratio of 2 to 1 (h:v) or flatter, or as per the construction guidelines as provided by Cal-Osha.

4.9 Site Preparations for Driveways/Parking/Paving

Assuming concrete paving for use by conventional traffic, it is suggested that prior to concrete placement, the subgrades to receive paving should be subexcavated to minimum 18 inches, followed by the local excavated soils replacement in 6 to 8-inch-thick lifts, compacted to minimum 95%. Use of vibratory sheepsfoot roller is suggested during grading.

4.10 Pavement Thickness Design

Alternative I - Rigid Concrete Paving

Rigid paving, if selected, should be at least 6-inch-thick concrete placed directly over the local sandy gravelly soils compacted to minimum 95%. Alternatively, 5-inch thick concrete can be considered over 4-inch class II base material compacted to 95%. Actual paving thickness and reinforcement requirements should be supplied by the project structural engineer using soils' Subgrade Reaction Modulus, kcf of 350.

Rigid concrete driveways should have thickened edges to prevent potential for lateral sliding under auto and truck traffic loading.

Alternative II - Asphalt Paving

Flexural asphalt paving, if selected, based on the estimated Traffic Indices (TIs) as described and a laboratory determined soils' R-value of 75 and laboratory determined soils' Sand Equivalent, SE of 46.76, the following flexible (a.c.) pavement sections are provided for initial use:

Service Vehicle	Traffic Index, TIs	Pavement Type	Paving Thickness (inch)
Auto/ Truck Traffic	7	a.c. over Class II base or CMB	3.0 over 3.0 5.0 over native
	10	"	5.0 over 3.0

Within paving areas, subgrade soils should be subexcavated to minimum 18 inches, moisture conditioned to near Optimum Moisture Content, followed by the excavated soils replacement as engineered fills compacted to at least 95% of the soils' maximum Dry Density as determined by the method ASTM D1557. Class II base or CMB used to receive asphalt concretes should be placed directly over the prepared subgrades and compacted to minimum 95%. Use of thicker/deepened paving edges are recommended to minimize potential for edge movement and paving distress.

The pavement evaluations are based on estimated Traffic Index (TI) as shown and on the soils' R-value as described. It is recommended that following mass grading completion, representative site soils should be laboratory tested to determine soils' R-value and to provide updated paving thickness.

4.11 Retaining Wall (if planned)

It is unknown if any retaining structure will be associated with development proposed. It is our opinion that retaining foundations should be designed based on a soils vertical bearing capacity of 1800 psf, along with the lateral active pressures as described below:

Slope of Retained Material (h:v)	Equivalent Fluid Density, pcf	
	Clean Sand	Local Soil
level	30	35
2:1	42	55

During a local Magnitude 6.7 earthquake along the Cucamonga fault zone, additional lateral pressures will occur along the back of the retaining walls. The seismic-induced lateral soil pressure may be computed using a triangular pressure distribution with the maximum value at the top of the wall. The maximum lateral pressure of (20 pcf) H where H is the height of the retained soils above the wall footing should be used in the final design of retaining wall.

Sliding resistance value and passive fluid pressure values may be increased by 1/3 during short-term wind and seismic loading conditions.

Any applicable short-term construction surcharges and seismic forces should be added to the above lateral pressure values. All walls shall be waterproofed and protected from hydrostatic pressure by a reliable permanent subdrain system.

The design parameters do not include any hydrostatic pressure build-up. Consequently, installation of "French-drain" behind retaining walls is recommended to minimize water pressure build-up behind retaining walls. Use of impervious material is preferred within upper the 18 inches of the backfills placed.

Backfills behind retaining wall should be compacted to a minimum 90% of the soils' Maximum Dry Density as determined by the ASTM D15571 test method. Flooding and/or jetting behind wall should not be permitted.

Walls adjacent to traffic areas should be designed to resist a uniform lateral pressure of 100 psf, which is a result of an assumed 300 psf surcharge behind the walls due to normal traffic. If the traffic is kept back 10 feet from the wall, the traffic surcharge may be neglected.

4.12 Utility Trenches Backfill

Utility trenches backfills at depth in excess of 2 feet should be placed in thin lifts and compacted to the minimum requirements described. As an alternative, clean granular sand may be used having Sand Equivalent, SE of minimum 30. Jetting is not recommended in lieu of mechanical compaction. Trench excavations should conform to the requirements and safety as specified by Cal-Osha.

4.13 Seasonal Limitations

No fill shall be placed, spread or rolled during unfavorable weather conditions. Where the work is interrupted by heavy rains, fill operations shall not be resumed until moisture conditions are considered favorable by the geotechnical engineer.

4.14 Planters

To minimize potential differential settlement to foundations, planters requiring heavy irrigation should be restricted from using adjacent to footings. In the event that such becomes unavoidable, planter boxes with sealed bottoms should be considered.

4.15 Landscape Maintenance

Only the amount of irrigation necessary to sustain plant life should be provided. Pad drainage should be directed towards streets and to other approved areas away from foundations. Slope areas should be planted with draught resistant vegetation. Over watering landscape areas could adversely affect the proposed site development during its lifetime use.

4.16 Observations and Testing During Site Preparations and Grading

Recommendations provided assume that structural footings and slabs-on-grade be established exclusively into compacted fills. Excavated footings should be inspected, verified, and certified by the geotechnical engineer prior to steel and concrete placement to ensure their sufficient embedment and proper bearing as recommended. Structural backfills discussed should be placed under direct observation and testing by Soils Southwest, Inc. Excess soils generated from footing excavations should be removed from pad areas.

In general, geotechnical inspections should include, at a minimum, the following:

- Subexcavation depth during grading,
- Fill compaction testing,
- Retaining wall backfill compaction (if planned),
- Excavated foundation depth,
- Paving subgrade verification, and
- Utility trenches backfill compaction.

4.17 Plan Review

No precise grading or detailed development plans are prepared and none such are available for review. Prior to the actual mass grading, grading and foundation plans should be available to ensure applicability of the assumptions made in preparing this report. If during construction, conditions are observed different from those as presented, revised and/or supplemental recommendations will be required.

4.18 Pre-Construction Meeting

It is recommended that no clearing of the site or any grading operations be performed without the presence of a representative of this office. An on-site pre-grading meeting should be arranged between the geotechnical engineer and the grading contractor prior to the start of construction. Two days' advance notice for such meeting is required.

5.0 Earth Work/General Grading Recommendations

It is our opinion that the soils encountered primarily consist upper 3 feet of variegating layers of gravels and gravel silty fine to medium coarse sand mixtures with concentrations of rocks, cobbles, and occasional small boulders to the refusal depth of 3 feet explored. Descriptions of the soils encountered are provided in the attached Log of Borings.

Prior to grading commencement, it is suggested that all debris and loose stockpiles should be cleared and disposed off-site to the satisfaction of the geotechnical engineer. In general, site preparations and grading for the project should include, at a minimum, the following:

Structural Backfill

Local soils free of organics, debris, and rocks smaller than 6-inch in overall diameter should be considered suitable for reuse as structural backfill. Loose soils, formwork, and debris should be removed prior to backfilling retaining walls. Local soils backfill should be placed and compacted in accordance with the recommendations provided below. Where space limitations do not allow conventional backfilling operations, special backfill materials, and procedures may be required. Pea gravel or other select backfill can be used within limited space areas. Additional recommendations on such will be provided during construction.

Percentage Compaction During Mass Grading

With the presence of fine to coarse gravelly sandy soils with trace silts, isolated cobbles and rocks existing as described and assuming moderately high dead loads and seismic peak ground acceleration described, it is our opinion that structural fills placed should be compacted to the minimum 90% compaction requirements described. During grading, use of vibratory sheepsfoot roller is recommended.

Site Drainage

Adequate positive drainage should be maintained away from the structural pad in order to prevent water from ponding and to reduce potential percolation into backfill. A desirable slope for surface drainage is 2% in landscape areas and 1% in paved areas. Planters and landscaped areas adjacent to building perimeter should be adequately designed to minimize water filtration into subsoils. Considerations should be given to the use of closed planter bottoms, concrete slabs, and perimeter subdrains where applicable.

Utility Trenches

Buried utility conduits should be bedded and backfilled around the conduit in accordance with the project specifications. Buried utilities in excess of 2 feet should be backfilled with local gravelly sandy soils and compacted to at least 90%. Remaining near surface backfills should be compacted to 95%.

General Grading Recommendations:

Recommended general specifications for surface preparation to receive compacted engineered fills for structural support and utility trench backfill and others are presented below:

1. Areas to be graded, backfilled or paved, shall be grubbed, stripped, and cleaned of all buried and undetected debris, structures, concrete, vegetation and other deleterious materials prior to grading.
2. During grading, the estimated subexcavation depths within building pad areas and 5 feet beyond should be minimum 5 feet below the current grade surface.
3. Where compacted fill is used to provide vertical support for foundations, all loose, soft, and other incompetent soils should be removed to full depth as approved by the geotechnical engineer.
4. Compaction for structural fills shall be determined relative to the Maximum Dry Density as determined by ASTM D1557 compaction methods. All in-situ field density of compacted fill shall be determined by the ASTM D1556 standard methods or by other approved procedures.
5. All new imported soils, if required, shall be clean, granular, and non-expansive material requiring prior approval by the geotechnical engineer.
6. During grading, fill soils shall be placed as thin layers, thickness of which following compaction shall not exceed 6 inches.
7. In accordance with the CBC: rock sizes greater than 12 inches (305 mm) and up to 24 inches (610 mm) in maximum dimension shall be three feet (914 mm) or more below grade, measured vertically. Rock sizes greater than 24 inches (610 mm) in maximum dimension shall be 10 feet (3048 mm) or more below grade, measured vertically.
8. No jetting and/or water tampering be considered for backfill compaction for utility trenches without prior approval of the geotechnical engineer. For such backfill, hand tampering with fill layers of 8 to 12 inches in thickness or as approved by the geotechnical engineer is recommended.
9. Any and all utility trenches at depth as well as cesspool and abandoned septic tank within building pad area and beyond, should either be completely excavated and removed from the site or should be backfilled with gravel, slurry or by other material, as approved by the geotechnical engineer.
10. Any and all import soils if required during grading should be equivalent to the site soils or better. The geotechnical engineer prior to their use should approve such.
11. Any and all grading required for pavement, sidewalks or other facilities to be used by general public, should be constructed under direct observation of the geotechnical engineer or as required by the local public agencies.
12. A site meeting should be held between the grading contractor and the geotechnical engineer prior to actual site preparations and grading. Two days advance notice will be required for such meeting.

6.0 WQMP-BMP Infiltration Rates Using Porchet Method for Stormwater Disposal Design

In general, four (4) infiltration tests were planned at the depth and locations as suggested by the project design engineer. Considering the excessively gravelly sands and concentrations of rocks, cobbles, and occasional small boulders, infiltration testing was limited to the depths of 3 and 5 feet below existing surface grade (BSG) at the southwest where 8-foot testing was planned. Planned testing (P-3 and P-4) at depths 3 to 4 feet within the area of the planned basin/swale could not be performed due to resistance at 1 and 1.5 feet due to concentrations of rocks, cobbles, and small boulders. The tests were performed using the standardized "falling-head" test converted using the Porchet method. Test locations and test data are shown in the attached Appendix D.

Method of infiltration rate as per the guidelines in accordance with Table 1, Infiltration Basin Option 2 of Appendix A of the Riverside County-Low Impact Development (LID) BMP Design Handbook as well as per the Appendices Section VII.3.8.2, Appendix VII: Infiltration Rate Evaluation Protocol and Factor of Safety Recommendations of the San Bernardino County Technical Guidance Document for Water Quality Management Plans Handbook.

Approximate test locations are shown on the attached Plate 1. The test results should be considered tentative given the potential for changes to site finish grades or changes in soil conditions as exposed during site preparations and grading.

The soils encountered within the proposed chamber consist, in general, of dry gravels and fine to medium coarse poorly graded silty sands overlying variegating layers of gravels and silty fine to medium coarse sands with rocks and cobbles to the depth explored of 3 and 5 feet as described (test borings P-1 to P-2). Descriptions of the soils encountered are provided in the attached Log of Borings.

Based on the field infiltration testing completed, it is our opinion that for the infiltration system design proposed at about 3 and 5 feet below grade, the observed soils infiltration rates are 19.79 inches/hour and 15.62 inches/hour for test locations P-1 and P-2, respectively.

For design, it is suggested that use of an appropriate factor of safety as determined by the design engineer should be considered to the observed rate to account for long-term saturation, inconsistencies in subsoil conditions, potential for silting, and lack of maintenance. The observed soils' percolation rates are provided in Section 6.3 of this report.

6.1 METHODOLOGY AND TEST PROCEDURES

EQUIPMENT SET-UP (POST EXCAVATION) PROCEDURES:

Following test boring completion, each of the test holes were fitted with perforated PVC pipes backfilled with 2-inch-thick crushed rock at the bottom to minimize potentials for scouring and caving. For testing, each test hole was initially filled using water supplied by water jugs.

Prior to actual testing, to determine test intervals, as per the Section 2.3 for deep percolation testing of the referenced handbook guideline, two consecutive readings were performed to determine if 6 or more inches of water seeped in 25 minutes. Since 6 inches or more of water seeped away in less than 25 minutes for all test locations, P-1 and P-2, subsequent percolation testing was performed at 10-minute time intervals for at least minimum one hour or until the rates were uniform. Testing included water placement at about and 3 feet below existing grade surface (inlet depth of 24 inches above infiltration system bottom).

The final 10-minute recorded percolation test rates were converted into an Infiltration Rate (I_t) for inches per hour using the "Porchet Method" equation as described in the Reference 2, Riverside County Low Impact Development BMP Design Handbook, as well as per the Appendices Section VII.3.8.2, Appendix

VII: Infiltration Rate Evaluation Protocol and Factor of Safety Recommendations on the San Bernardino County Technical Guidance Document for Water Quality Management Plans Handbook.

6.2 INFILTRATION TEST RESULTS

Based on the soils infiltration testing completed at the test locations and at the test depth as described, the observed soils' percolation rates are 19.79 inches/hour and 15.62 inches/hour for test locations P-1 and P-2, respectively.

Calculations to convert the percolation test rate to infiltration test rates in accordance with Section 2.3 of the County Handbook are presented in Table I and II below. For design, it is suggested that an appropriate Factor of Safety as selected by the design engineer should be considered to the observed field percolation rate described.

6.2.1 SUMMARY & CONVERSION CALCULATIONS

TABLE I

For WQMP-BMP design, based on the soils infiltration testing completed and, on the calculations as described, the following infiltration rates may be considered. Actual field test data are attached.

Observed Infiltration Rate for Design

Test Location (8-9-24)	Test Depth Below Grade, feet	Porchet Method Observed Rate, inch/hour
P-1	3	19.79
P-2	5	15.62
P-3	n/a	n/a
P-4	n/a	n/a

Note: n/a: due to shallow boring resistance to near surface concentrations of rocks, cobbles, and small boulders, infiltration tests could not be performed at the required depths.

TABLE II

Conversion Table (Porchet Method)

Test No.	Depth Test Hole, inches	Time Interval, minutes	Initial Depth, inches	Final Depth, inches	Initial Water Height, inches	Final Water Height, inches	Change in Height/ Time	Average Head Height/Time
	D _t	Δ _T	D _o	D _f	H _o =D _t -D _o	H _f =D _t -D _f	ΔH= H _f -H _o	H _{avg} = (H _o +H _f)/2
P-1	36	10	12	35.5	24.0	0.5	23.50	12.25
P-2	60	10	36	56.5	24.0	3.5	20.50	13.75

Test No.	Infiltration Rate (I_t)=ΔH60r/Δt(r+2H _{avg})		
	A	B	C
	ΔH60r	Δt(r+2H _{avg})	A/B=in/hr
P-1	5640	285	19.79
P-2	4920	315	15.62

Use of a safety factor should be considered to account for long-term saturation, inconsistencies in subsoil conditions along with the potential for silting of percolating soils.

The infiltration rate described is based on the in-situ testing completed at the locations as suggested by the project civil engineer. In the event that the final chamber location and depth vary considerably from those described herein, supplemental soils infiltration testing may be warranted.

It should be noted that over prolonged use and lack of maintenance the detention/infiltration basins or deep chambers constructed based on the suggested design rate may experience much lower infiltration rate due to the accumulation of silts, fines, soils, and others. Regular maintenance of the chambers in the form of removal of debris, oil, and fines are strongly recommended. A maintenance record of such is suggested for future use.

Suggested Requirements for Standard Stormwater BMP installation (where applicable)

The invert of stormwater infiltration should be set at least 10 feet above the groundwater elevation and should not be placed on steep slopes to create conditions for slopes instability.

When adequately installed, it is our opinion that the Stormwater infiltration systems installed should not increase the potential for static or seismic settlement of structures.

Stormwater infiltration installed should not place an increased surcharge on structures or foundations on or its adjacent. The pore water pressure should not increase the soils retained by retaining structures.

The invert of stormwater infiltration should be set back at least 15 feet and outside a 1:1 plan drawn up from the bottom of adjacent foundations.

Stormwater infiltration should not be located near utility lines where the introduction of stormwater could cause damage to utilities or settlement of trench backfill.

Stormwater infiltration systems should not be allowed within 100 feet of any potable groundwater production well.

Once installed, regular maintenance of the detention systems is recommended.

7.0 Closure

The conclusions and recommendations presented are based upon the findings and observations as made during subsurface test excavations and subsequent laboratory testing and engineering evaluations as currently used in the Geotechnical industry. The recommendations supplied should be considered "preliminary" since they are based on soil samples only. If during construction, the subsoil conditions appear different from those as disclosed during field investigation this office should be notified to consider any possible need for modification by the geotechnical recommendations as provided in this report.

Recommendations provided are based on the assumptions that structural footings will be established exclusively into compacted fill. No footings and/or slabs should be allowed straddling over cut and fill transition interface.

Site grading observations and testing must be performed by a representative of this office. Further, it is recommended that excavated footings should be verified and approved by geotechnical engineer prior to steel and concrete placement to ensure that foundations are founded into satisfactory soils and excavations are free of loose and disturbed materials.

A pre-grading meeting between grading contractor and geotechnical engineer is recommended prior to construction preferably at the site, to discuss the grading procedures to be implemented and other requirements described in this report to be fulfilled.

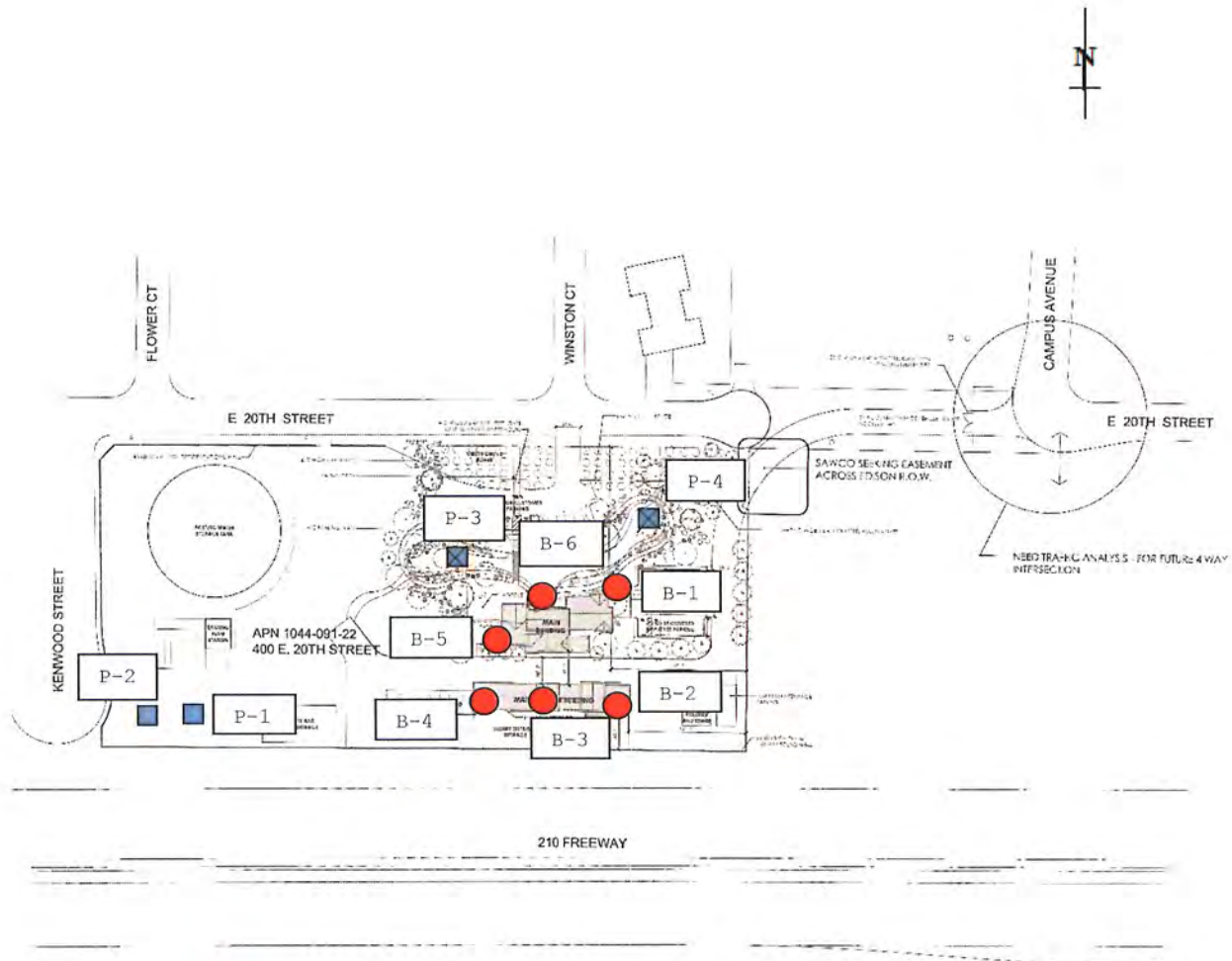
This report has been prepared exclusively for the use of the addressee for the project referenced in the context. It shall not be transferred or be used by other parties without written consent by Soils Southwest, Inc.

Should the project be delayed beyond one year after the date of this report, the recommendations presented shall be reviewed to consider any possible change in site conditions.

The recommendations presented are on the assumption that the necessary geotechnical observations and testing during construction will be performed by a representative of this office. The field observations are considered a continuation of the geotechnical investigation performed.

If another firm is retained for geotechnical observations and testing, our professional liability and responsibility shall be limited to the extent that Soils Southwest, Inc. would not be the geotechnical engineer of record. Use of the geotechnical recommendations by others will relieve Soils Southwest, Inc. of any liability that may arise during the lifetime use of the structure constructed.

PLOT PLAN AND TEST LOCATIONS
400 E. 20th Street, Upland
APN: 1044-091-22
Not to Scale



Legend:

- B-1 Approximate Location of Test Borings for Geotechnical Evaluations
- P-1 Approximate Location of Test Pit for BMP Soils' Infiltration
- P-3 Approximate location of Test Pit for BMP Soils Infiltration that could not be performed as planned due to surface concentrations of rocks, cobbles, and small boulders.

List of Appendices

Appendix A - Log of Borings

Appendix B - Laboratory Test Results

Table I: In-Situ Moisture-Density (ASTM D2216 and D2937)

Table II: Max. Density/Optimum Moisture Content (ASTM D1557)

Table III: Direct Shear (ASTM D3080)

Table IV: Consolidation (ASTM D2435)

Table V: Sand Equivalent, SE (ASTM D2419)

Table VI: Sieve Analysis (ASTM D422)

Table VII: Soils' Chemical Analyses Test Results

Table VIII: Soils' Density Correlation to SPT Blow Counts

APPENDIX C – Supplemental Seismic Design Parameters & FEMA National Flood Hazard Layer Map

APPENDIX D - Field Infiltration Test Data Porchet Method Calculation Summary

LOG OF BORINGS



Soils Southwest, Inc.
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Colton, CA 92324
(909) 370-0474 Fax (909) 370-3156

LOG OF BORING B-1

Project: San Antonio Water District Headquarters			Job No.: 24036-F/BMP
Logged By: John F.	Boring Diam.: 8" HSA	Date: August 9, 2024	

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
					GP			disturbed surface soils, gravels, scattered debris
					GM-SM			GRAVELS consisting of rocks and cobbles - (Max Dry Density = 133 pcf @ 8.0 %
							5	GRAVEL/SAND mixture-tannish light brown, silty, fine to medium coarse, pebbles, rock fragments, rocks, cobbles, dry
								- Abandoned at +/- 3.0 ft. due to resistance (concentrations of rocks and cobbles) - no bedrock - no groundwater
							10	
							15	
							20	
							25	
							30	

Groundwater: n/a Approx. Depth of Bedrock: n/a Datum: n/a Elevation: n/a	Site Location Planned Headquarter Facility 400 East 20th Street Upland, California	Plate #
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Soils Southwest, Inc.
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Colton, CA 92324
(909) 370-0474 Fax (909) 370-3156

LOG OF BORING B-2

Project: San Antonio Water District Headquarters		Job No.: 24036-F/BMP
Logged By: John F.	Boring Diam.: 8" HSA	Date: August 9, 2024

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
					GP			gravels
								GRAVEL- rocks cobbles, small boulders, with very little yellow tan silty dry sand
								- Abandoned test boring @ 1.5 feet due to resistance (concentrations of rocks and cobbles
							5	- no bedrock
								- no groundwater
							10	
							15	
							20	
							25	
							30	

Groundwater: n/a Approx. Depth of Bedrock: n/a Datum: n/a Elevation: n/a	Site Location Planned Headquarter Facility 400 East 20th Street Upland, California	Plate #
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Soils Southwest, Inc.
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Colton, CA 92324

(909) 370-0474 Fax (909) 370-3156

LOG OF BORING B-3

Project: San Antonio Water District Headquarters

Job No.: 24036-F/BMP

Logged By: John F.

Boring Diam.: 8" HSA

Date: August 9, 2024

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
					GM-SM			gravels, scattered weeds and debris
								GRAVEL/SAND mixture-with gravelly and slightly silty, fine to medium coarse, rock fragments, rocks, and cobbles, dry
							5	- Abandoned Test boring @ 2.0 ft. due to resistance (concentrations of rocks and cobbles)
								- no bedrock
								- no groundwater
							10	
							15	
							20	
							25	
							30	

Groundwater: n/a

Approx. Depth of Bedrock: n/a

Datum: n/a

Elevation: n/a

Site Location

Planned Headquarter Facility
400 East 20th Street
Upland, California

Plate



Soils Southwest, Inc.
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(909) 370-0474 Fax (909) 370-3156

LOG OF BORING B-4

Project: San Antonio Water District Headquarters

Job No.: 24036-F/BMP

Logged By: John F.

Boring Diam.: 8" HSA

Date: August 9, 2024

[illegible]

Groundwater: n/a

Approx. Depth of Bedrock: n/a

Datum: n/a

Elevation: n/a

Site Location

Planned Headquarter Facility
400 East 20th Street
Upland, California

Plate



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LOG OF BORING B-5

Project: San Antonio Water District Headquarters

Job No.: 24036-F/BMP

Logged By: John F.

Boring Diam.: 8" HSA

Date: August 9, 2024

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
					GM-SM			disturbed surface gravels and soils with rocks and cobbles
								GRAVEL/SAND mixture-tan to light brown, slightly silty, fine to medium coarse, rock fragments, rocks, and cobbles, dry
							5	- Abandoned test boring @ +/- 1.5 feet due to resistance (concentrations of rocks and cobbles) - no bedrock - no groundwater
							10	
							15	
							20	
							25	
							30	

Groundwater: n/a

Approx. Depth of Bedrock: n/a

Datum: n/a

Elevation: n/a

Site Location

Planned Headquarter Facility
400 East 20th Street
Upland, California

Plate



Soils Southwest, Inc.
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Colton, CA 92324
(909) 370-0474 Fax (909) 370-3156

LOG OF BORING B-6

Project: San Antonio Water District Headquarters

Job No.: 24036-F/BMP

Logged By: John F.

Boring Diam.: 8" HSA

Date: August 9, 2024

[illegible]

Groundwater: n/a

Approx. Depth of Bedrock: n/a

Datum: n/a

Elevation: n/a

Site Location

Planned Headquarter Facility
400 East 20th Street
Upland, California

Plate



Soils Southwest, Inc.
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Colton, CA 92324
(909) 370-0474 Fax (909) 370-3156

LOG OF BORING P-1

Project: San Antonio Water District Headquarters

Job No.: 24036-F/BMP

Logged By: John F.

Boring Diam.: 8" HSA

Date: August 9, 2024

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
					GM-SM			- disturbed surface gravels and soils
					SM			GRAVELS/SAND mixture -light yellow tan,silty fine, dry with rocks and cobbles
					GP			SAND - gray-brown, silty, fine to medium coarse, pebbles, rock fragments, rocks, cobbles, dry
							5	GRAVELS with little to no sand,rocks,cobbles
								- Abandoned infiltration test boring @3.0 ft due to resistance (concentrations of rock and cobbles) - no bedrock
								- no groundwater
							10	
							15	
							20	
							25	
							30	

Groundwater: n/a

Approx. Depth of Bedrock: n/a

Datum: n/a

Elevation: n/a

Site Location

Planned Headquarter Facility
400 East 20th Street
Upland, California

Plate



Soils Southwest, Inc.
897 Via Lata, Suite N
Colton, CA 92324

(909) 370-0474 Fax (909) 370-3156

LOG OF BORING P-2

Project: San Antonio Water District Headquarters

Job No.: 24036-F/BMP

Logged By: John F.

Boring Diam.: 8" HSA

Date: August 9, 2024

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
					SM			disturbed gravels and soils
								SAND - yellowish tannish brown, silty, fine to medium coarse, pebbles, rock fragments, rocks, dry
								- with rocks and cobbles
					GP		5	GRAVELS
								- Abandoned infiltration test boring @5.0ft. due to resistance (concentrations of rocks and cobbles)
								- no bedrock
								- no groundwater
							10	
							15	
							20	
							25	
							30	

Groundwater: n/a

Approx. Depth of Bedrock: n/a

Datum: n/a

Elevation: n/a

Site Location

Planned Headquarter Facility
400 East 20th Street
Upland, California

Plate



Soils Southwest, Inc.
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LOG OF BORING P-3

Project: San Antonio Water District Headquarters

Job No.: 24036-F/BMP

Logged By: John F.

Boring Diam.: 8" HSA

Date: August 9, 2024

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
					GM-SM			gravels, rocks, and cobbles
								GRAVEL/SAND mixture- light yellow gray tan, silty, fine, rock fragments, rocks, cobbles scattered small boulders, dry
							5	SAND (fill) - color change to light brown, silty, fine to medium coarse, pebbles, rock fragments, rocks, cobbles, scattered debris, dry
							10	- Abandoned infiltration test boring @ 1.5ft due to resistance (concentrations of rock and cobbles) - no bedrock - no groundwater
							15	
							20	
							25	
							30	

Groundwater: n/a

Approx. Depth of Bedrock: n/a

Datum: n/a

Elevation: n/a

Site Location

Planned Headquarter Facility
400 East 20th Street
Upland, California

Plate



Soils Southwest, Inc.
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LOG OF BORING P-4

Project: San Antonio Water District Headquarters

Job No.: 24036-F/BMP

Logged By: John F.

Boring Diam.: 8" HSA

Date: August 9, 2024

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
					GP			disturbed surface gravels and soils GRAVEL with little sand, rocks, cobbles, and occasional small boulders, dry - Abandoned infiltration test boring @ 1.0ft due to resistance (concentration of rocks cobbles) - no bedrock - no groundwater
							5	
							10	
							15	
							20	
							25	
							30	

Groundwater: n/a

Approx. Depth of Bedrock: n/a

Datum: n/a

Elevation: n/a

Site Location

Planned Headquarter Facility
400 East 20th Street
Upland, California

Plate

KEY TO SYMBOLS

Symbol Description

Strata symbols



Poorly graded gravel



Silty sand and gravel



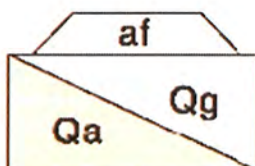
Silty sand

Notes:

1. Exploratory borings were drilled on August 9, 2024 using a 4-inch diameter continuous flight power auger.
2. No free water was encountered at the time of drilling or when re-checked the following day.
3. Boring locations were taped from existing features and elevations extrapolated from the final design schematic plan.
4. These logs are subject to the limitations, conclusions, and recommendations in this report.
5. Results of tests conducted on samples recovered are reported on the logs.



LEGEND

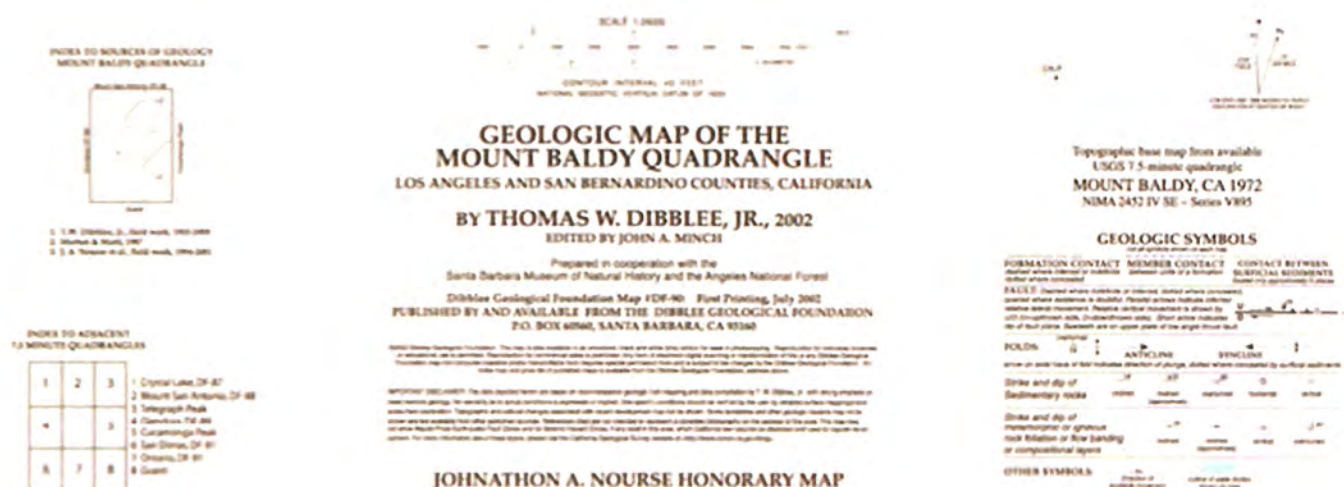


SURFICIAL SEDIMENTS

af artificial fill

Qg alluvial gravel and sand of stream channels

Qa alluvial gravel and sand of valley areas



Search			
Map Unit Legend			
San Bernardino County Southwestern Part, California (CA677)			
San Bernardino County Southwestern Part, California (CA677)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
HaC	Hanford coarse sandy loam, 2 to 9 percent slopes	11.8	17.2%
RmC	Ramona sandy loam, 2 to 9 percent slopes, MLRA 19	5.7	8.3%
SoC	Soboba gravelly loamy sand, 0 to 9 percent slopes	9.9	14.5%
SpC	Soboba stony loamy sand, 2 to 9 percent slopes	41.2	60.0%
Totals for Area of Interest		68.7	100.0%



San Bernardino County Southwestern Part, California

SpC—Soboba stony loamy sand, 2 to 9 percent slopes

Map Unit Setting

National map unit symbol: hckv
Elevation: 960 to 3,690 feet
Mean annual precipitation: 12 to 39 inches
Mean annual air temperature: 60 to 65 degrees F
Frost-free period: 260 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Soboba and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Soboba

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

Ap - 0 to 10 inches: stony loamy sand
C1 - 10 to 24 inches: very stony loamy sand
C2 - 24 to 60 inches: very stony sand

Properties and qualities

Slope: 2 to 9 percent
Surface area covered with cobbles, stones or boulders: 0.1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 19.99 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: R019XG912CA - Sandy Fan

Hydric soil rating: No

Minor Components

Hanford

Percent of map unit: 5 percent

Landform: Alluvial fans

Landform position (two-dimensional): Toeslope

Landform position (three-dimensional): Tread

Down-slope shape: Linear

Across-slope shape: Linear

Hydric soil rating: No

Ramona

Percent of map unit: 5 percent

Landform: Fan remnants

Landform position (three-dimensional): Tread

Down-slope shape: Linear

Across-slope shape: Linear

Hydric soil rating: No

Tujunga, gravelly loamy sand

Percent of map unit: 5 percent

Landform: Alluvial fans

Landform position (two-dimensional): Footslope

Landform position (three-dimensional): Tread

Down-slope shape: Linear

Across-slope shape: Linear

Hydric soil rating: No

Data Source Information

Soil Survey Area: San Bernardino County Southwestern Part, California

Survey Area Data: Version 15, Aug 30, 2023

San Bernardino County Southwestern Part, California

SoC—Soboba gravelly loamy sand, 0 to 9 percent slopes

Map Unit Setting

National map unit symbol: hckt
Elevation: 30 to 4,200 feet
Mean annual precipitation: 10 to 20 inches
Mean annual air temperature: 61 to 63 degrees F
Frost-free period: 175 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Soboba and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Soboba

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

H1 - 0 to 12 inches: gravelly loamy sand
H2 - 12 to 36 inches: very gravelly loamy sand
H3 - 36 to 60 inches: very stony sand

Properties and qualities

Slope: 0 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.2 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: R019XG912CA - Sandy Fan
Hydric soil rating: No

Minor Components

Unnamed

Percent of map unit: 5 percent

Hydric soil rating: No

Delhi, fine sand

Percent of map unit: 5 percent

Hydric soil rating: No

Tujunga, gravelly loam

Percent of map unit: 3 percent

Hydric soil rating: No

Unnamed

Percent of map unit: 2 percent

Landform: Drainageways

Hydric soil rating: Yes

Data Source Information

Soil Survey Area: San Bernardino County Southwestern Part, California

Survey Area Data: Version 15, Aug 30, 2023

San Bernardino County Southwestern Part, California

HaC—Hanford coarse sandy loam, 2 to 9 percent slopes

Map Unit Setting

National map unit symbol: 2y8tl
Elevation: 890 to 2,860 feet
Mean annual precipitation: 11 to 22 inches
Mean annual air temperature: 64 to 65 degrees F
Frost-free period: 320 to 365 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Hanford and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hanford

Setting

Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

A - 0 to 12 inches: sandy loam
C - 12 to 60 inches: fine sandy loam

Properties and qualities

Slope: 2 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High
(1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: A
Ecological site: R019XG911CA - Loamy Fan
Hydric soil rating: No

Minor Components

Greenfield, sandy loam

Percent of map unit: 10 percent

Landform: Alluvial fans

Landform position (three-dimensional): Tread

Down-slope shape: Linear

Across-slope shape: Linear

Hydric soil rating: No

Tujunga, loamy sand

Percent of map unit: 5 percent

Landform: Alluvial fans

Landform position (three-dimensional): Tread

Down-slope shape: Linear

Across-slope shape: Linear

Hydric soil rating: No

Data Source Information

Soil Survey Area: San Bernardino County Southwestern Part, California

Survey Area Data: Version 15, Aug 30, 2023

APPENDIX B

Laboratory Test Programs

Laboratory tests were conducted on representative soils for the purpose of classification and for the determination of the physical properties and engineering characteristics. The number and selection of the types of testing for a given study are based on the geotechnical conditions of the site. A summary of the various laboratory tests performed for the project is presented below.

Moisture Content and Dry Density (D2937):

Data obtained from these tests, performed on undisturbed samples are used to aid in the classification and correlation of the soils and to provide qualitative information regarding soil strength and compressibility.

Direct Shear (D3080):

Data obtained from this test performed at increased and field moisture conditions on relatively remolded soil sample is used to evaluate soil shear strengths. Samples contained in brass sampler rings, placed directly on test apparatus are sheared at a constant strain rate of 0.002 inch per minute under saturated conditions and under varying loads appropriate to represent anticipated structural loadings. Shearing deformations are recorded to failure. Peak and/or residual shear strengths are obtained from the measured shearing load versus deflection curve. Test results, plotted on graphical form, are presented on Plate B-1 of this section.

Consolidation (D2835):

Drive-tube samples are tested at their field moisture contents and at increased moisture conditions since the soils may become saturated during lifetime use of the planned structure.

Data obtained from this test performed on relatively undisturbed and/or remolded samples, were used to evaluate the consolidation characteristics of foundation soils under anticipated foundation loadings. Preparation for this test involved trimming the sample, placing it in a one-inch-high brass ring, and loading it into the test apparatus which contained porous stones to accommodate drainage during testing. Normal axial loads are applied at a load increment ratio, successive loads being generally twice the preceding.

Soil samples are usually under light normal load conditions to accommodate seating of the apparatus. Samples were tested at the field moisture conditions at a predetermined normal load. Potentially moisture sensitive soil typically demonstrated significant volume change with the introduction of free water. The results of the consolidation tests are presented in graphical forms on Plate B-2.

Laboratory Test Results

Table I: Max. Density/Optimum Moisture Content (ASTM D1557)

Sample Location @ Depth, feet	Max. Dry Density, pcf	Optimum Moisture Content, %
B-1 @ 0-3 SAND – GP-SP Tannish light brown, gravel sand mixture, fine to coarse with trace silts, rock fragments, rocks, and cobbles	133	8.0

Table III: Direct Shear (ASTM D3080)

Test Boring No. @ Sample Depth, feet	Test Condition	Cohesion, psf	Friction, degrees
B-1 @ 0-3	Remolded to 90%	640	39

Table IV: Consolidation (ASTM D2435)

Boring No., B	Depth, feet	Consolidation prior to saturation, % @ 2 kips	Hydro Collapse, % @ 2 kips	Total Consolidation, % @ 8 kips (saturated)
1 (remolded)	0-3	0.5	0.1	1.8

Table V: Sand Equivalent, SE (ASTM D2419)

Sample Location @ depth, feet	Sand Equivalent Average, SE
B-3 @ 0-3.0	55.9
B-6 @ 0-3.0	46.7

Table VI: Sieve Analysis (ASTM D422)

SAMPLE: B-6 @ 0-3 feet

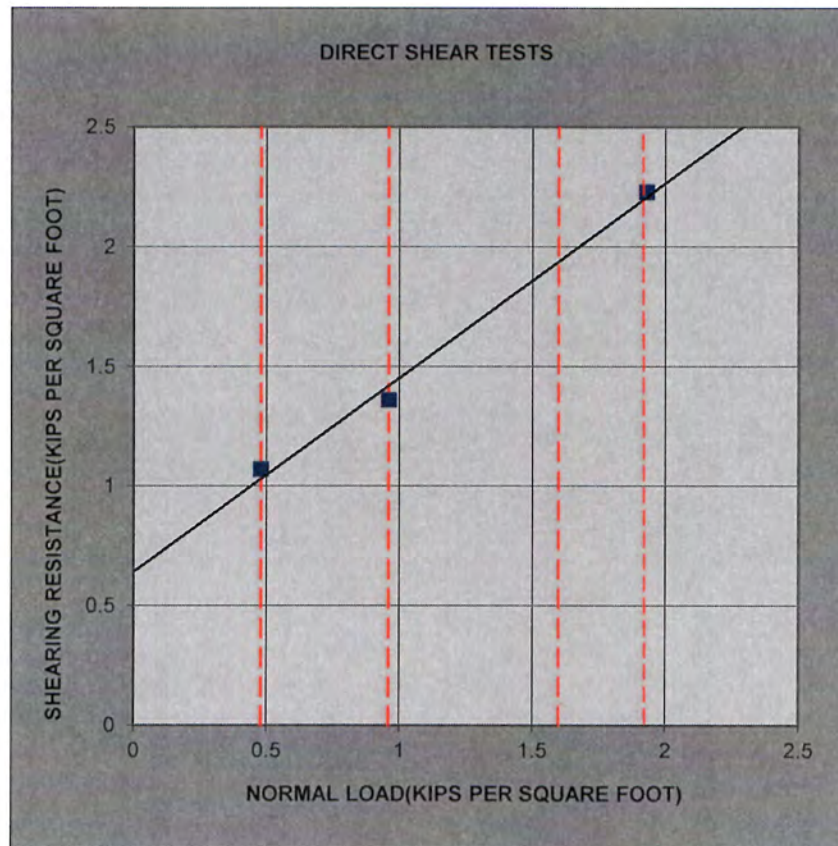
Grain Size	% Retained
Gravels	33
Medium to Coarse	37
Fines	18
Silts	12

Table VII: Soils' Chemical Test Results at Sample Location B-1 @ 0-3 feet

Sample	Method	Result	Units	Remarks
pH	EPA 9040 B	7.93	units	Not corrosive
Resistivity	SM 2510B	3,640	ohms-cm	Moderately corrosive
Chloride	EPA 300.0	29	mg/kg	Not corrosive
Sulfate	EPA 300.0	82	mg/kg	Not corrosive

Table VIII: Soils' Density Correlation to SPT Blow Counts

Density/Consistency		1" Soil Tube -- Blows Per Foot			Standard Penetration Blows Per Foot
Granular	Cohesive	Sand and Gravel	Silt	Clay	
Very Loose	Very Soft	0-50	0-50	0-60	0-5
Loose	Soft	50-100	50-180	60-250	5-10
Slightly Compact	Stiff	100-350	180-1000	250-1000	10-20
Compact	Very Stiff	350-525	1000-2000	1000-4000	20-35
Dense	Hard	525-1500	2000-5000	4000-5000	35-70
Very Dense	Very Hard	1500+	5000+	5000+	70+

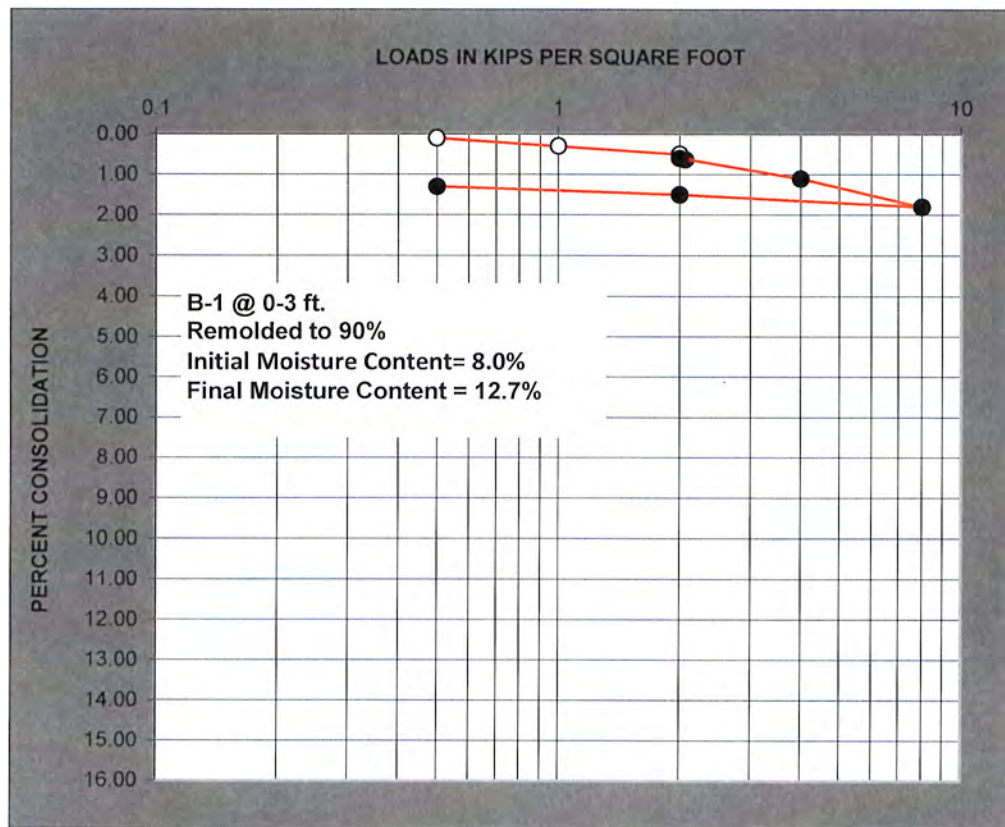


SYMBOL	LOCATION	DEPTH (FT)	TEST CONDITION	COHESION (psf)	FRICTION (degree)
■	B-1	0 to 3	Remolded to 90%	640.10	39.08
Proposed Administrative Office and Maintenance Structures 400 E. 20th Street Upland, California				PROJECT NO.	24036-F
				PLATE	B-1



SOILS SOUTHWEST, INC.
Consulting Foundation Engineers

CONSOLIDATION TESTS



- WATER PERMITTED TO CONTACT SAMPLE



PROJECT

Proposed Adminstrative Office and Maintenance Structures
400 E. 20th Street

PROJECT NO.

24036-F

PLATE

B-2

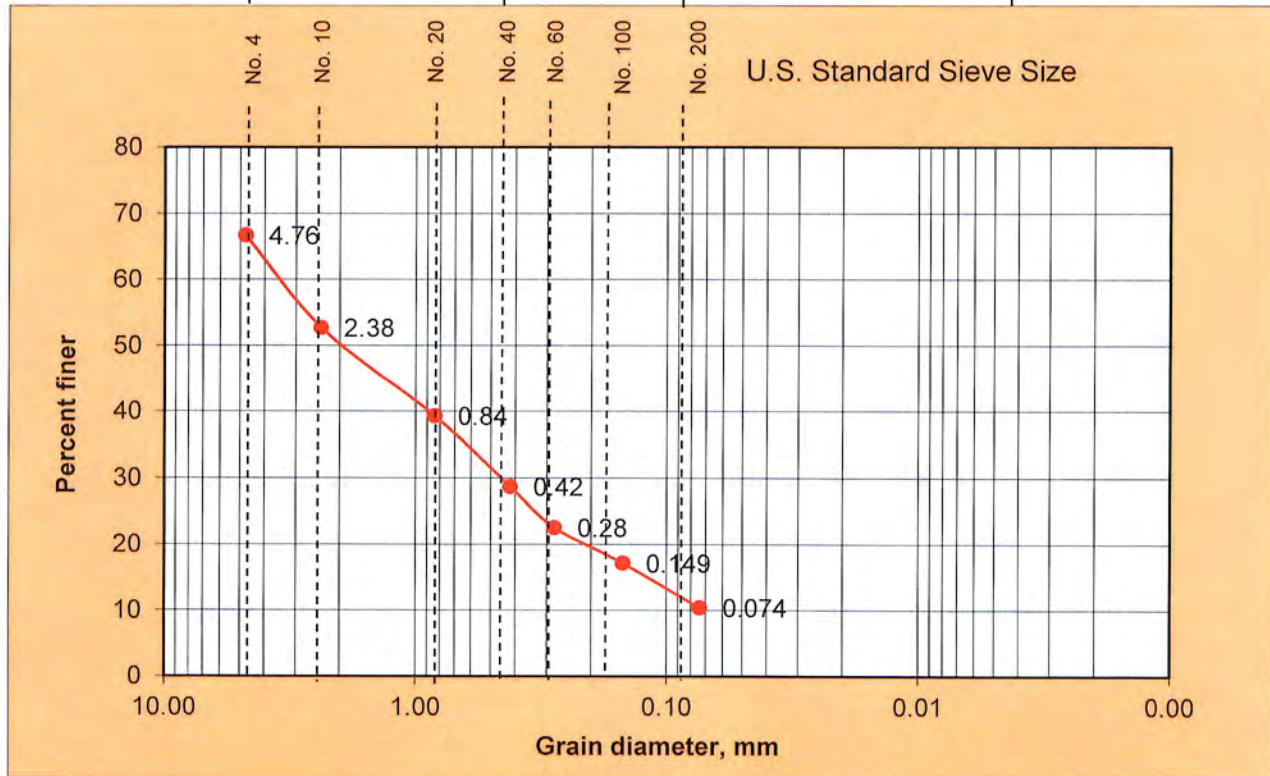
SOILS SOUTHWEST INC.
Consulting Foundation Engineers

GRAIN SIZE DISTRIBUTION

Project: San Antonio Water District HDQ	Job # 24036-F	
Location: 400 E. 20th Street, Upland	Boring No: <u>B-6/P2@0-3'</u>	Sample No: 1
Description of Soil: GP-SP		
Date of Sample: 8/9/2024	Date of Testing: 8/16/2024	
Tested By: JG		

Sieve No.	Sieve Openings in mm	Percent Finer	Grain Size	% Retained
4	4.76	66.74	Gravel	33
10	2.38	52.74	Med. to Crs	37
20	0.84	39.34	Fines	18
40	0.42	28.74	Silts	12
60	0.28	22.54		
100	0.149	17.20		
200	0.074	10.44		

Gravel	Sand			
	Coarse to Medium	Fine	Silt	Clay



Visual Soil Description : GRAVEL/SAND mixture with trace silts, fine to coarse with rock fragments, rocks, and cobbles

Soil Classification: GP-SP

System: USC

SOILS SOUTHWEST INC.
Consulting Foundation Engineers

SAND EQUIVALENT TEST

Test Date: August 16,2024

Project No.: 24036-F/PV

Job Name: San Antonio Water District Headquarters
400 E. 20th Street
Upland

Sample Location: B-6/PV-2 @ 0-3ft

Sample by: JF Tested by: JG

LABORATORY DATA

SAMPLE NO.	1	2	3	4
TIME START	6:13	6:18	6:23	
TIME SOAK (10 min.)	6:23	6:28	6:33	
TIME AT LEVEL 15ML	6:25	6:30	6:35	
TIME of READING (20-min)	6:45	6:50	6:55	
FINE, ML	5.8	5.6	5.7	
COARSE, ML	2.8	2.6	2.6	
SE = 100x (coarse/fine)	48.27	46.42	45.61	
SE Average	46.76			

SAND EQUIVALENT TEST

Test Date: August 15, 2024

Project No.: 24036-F/PV

Job Name: San Antonio Water District Headquarters
400 E. 20th Street
Upland

Sample Location: B-3/PV-1 @ 0-3ft

Sample by: JF Tested by: JG

LABORATORY DATA

SAMPLE NO.	1	2	3	4
TIME START	1:52	1:57	2:02	
TIME SOAK (10 min.)	2:02	2:07	2:12	
TIME AT LEVEL 15ML	2:04	2:09	2:14	
TIME of READING (20-min)	2:24	2:29	2:34	
FINE, ML	6.0	5.8	5.7	
COARSE, ML	3.6	3.0	3.2	
SE = 100x (coarse/fine)	60	51.7	56.1	
SE Average	55.9			



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FOOD · COSMETICS · WATER · SOIL · SOIL VAPOR · WASTES

CASE NARRATIVE

Authorized Signature Name / Title (print)	Ken Zheng, President
Signature / Date	<i>Ken Zheng</i> Ken Zheng, President 08/19/2024 18:03:02
Laboratory Job No. (Certificate of Analysis No.)	2408-00123
Project Name / No.	24036-F SAN ANTONIO WTR DIST. / 400 E. 20th ST., UPLAND
Dates Sampled (from/to)	08/14/24 To 08/14/24
Dates Received (from/to)	08/15/24 To 08/15/24
Dates Reported (from/to)	08/19/24 To 8/19/2024
Chains of Custody Received	Yes
Comments:	
Subcontracting Inorganic Analyses No analyses sub-contracted Other Analyses No analyses sub-contracted	
Sample Condition(s) All samples intact	
Positive Results (Organic Compounds) None	



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CERTIFICATE OF ANALYSIS

2408-00123

SOILS SOUTHWEST INC
 MOLOY GUPTA
 897 VIA LATA SUITE N
 COLTON, CA 92324

Date Reported 08/19/24
 Date Received 08/15/24
 Invoice No. 2349
 Cust # S192
 Permit Number
 Customer P.O.

Project: 24036-F SAN ANTONIO WTR DIST. / 400 E. 20th ST., UPLAND

Analysis	Result	Qual	Units	Method	DF	RL	Date	Tech
Sample: 001 B-1@0-3ft							Date & Time Sampled: 08/14/24 @ 10:00	
Sample Matrix: Soil								
pH@25C-as Dissolved in Wtr	7.93		units	EPA 9040 B	1.0	0	08/15/24	DV
Resistivity	3640		ohms/cm	SM 2510B	1.0	1.0	08/15/24	DV
Chloride	29		mg/Kg	EPA 300.0 (1993 Rev 2.)	1.0	5.0	08/18/24	TLB
Sulfate	82		mg/Kg	EPA 300.0 (1993 Rev 2.)	1.0	5.0	08/18/24	TLB

Respectfully Submitted:

Ken Zheng

Ken Zheng - Lab Director

QUALIFIERS

B = Detected in the associated Method Blank at a concentration above the routine RL.
 B1 = BOD dilution water is over specifications. The reported result may be biased high.
 D = Surrogate recoveries are not calculated due to sample dilution.
 E = Estimated value; Value exceeds calibration level of instrument.
 H = Analyte was prepared and/or analyzed outside of the analytical method holding time
 I = Matrix Interference.
 J = Analyte concentration detected between RL and MDL.
 Q = One or more quality control criteria did not meet specifications. See Comments for further explanation.
 S = Customer provided specification limit exceeded.

ABBREVIATIONS

DF = Dilution Factor
 RL = Reporting Limit, Adjusted by DF
 MDL = Method Detection Limit, Adjusted by DF
 Qual = Qualifier
 Tech = Technician

CHAIN OF CUSTODY

[illegible]



Sample Acceptance Checklist

CLIENT: Soils Southwest

WORK ORDER NUMBER: 2408-123

Temperature: (Criteria: 0.0°C-6.0°C)

Sample Temp. (°C) 5.6c ID#: 22-0030

- ☐ Sample(s) outside temperature criteria: PM contacted by :
☐ Sample(s) outside temperature criteria, but received on ice/chilled on same day of sampling.
☐ Sample(s) received at ambient temperature; placed on ice for transport by courier.

CUSTODY SEAL:

Cooler ☐ Present and Intact ☐ Present and Not Intact ☒ Not Present
Sample(s) ☐ Present and Intact ☐ Present and Not Intact ☒ Not Present

Sample Condition:

	Yes	No	N/A
Was a COC received	☒		
Were sample IDs present?	☒		
Were sampling dates & times present?	☒		
Was a relinquished signature present?	☒		
Were the tests required clearly indicated?	☒		
Were all samples sealed in plastic bags?		☒	<u>to all</u>
Did all bottle labels agree with COC? (ID, dates and times)	☒		
Were correct containers used for the tests required?	☒		
Was a sufficient amount of samples sent for tests indicated?	☒		
Was there headspace in VOA vials?			☒
Were the containers labeled with correct preservatives?			☒

Explanations/Comments:

Notification:

For discrepancies, how was the Project Manager notified?

Verbal: PM Initials: _____ Data/Time: _____

Email: Send to: _____ Data/Time: _____

Project Manager's response:

Completed By: [Signature]

Date: 8/15/24

A R Laboratories
1650 S. Grove Ave., Suite C, Ontario, CA 91761
PH: 909-781-6335
Email: office@arlaboratories.com

ANAHEIM TEST LAB, INC

196 Technology Drive, Unit D
Irvine, CA 92618
Phone (949) 336-6544

TO:

SOILS SOUTHWEST, INC.
897 VIA LATA, SUITE N
COLTON, CA. 92324

DATE: 8/26/2024

P.O. NO.: Verbal

LAB NO.: C-8132

SPECIFICATION: CA 301

MATERIAL: Brown, Silty Sand w.
Gravel

Project No.: 24036-F
Project: San Antonio Water District HDQ
400 East 20th St, Upland, CA
Sample ID: B-6/PV-2 @ 0-3'
Sample Date: 8/16/2024

ANALYTICAL REPORT "R" VALUE

BY EXUDATION

BY EXPANSION

75

N/A

RESPECTFULLY SUBMITTED



WES BRIDGER LAB MANAGER

"R" VALUE CA 301

Client: Soils Southwest, Inc.
Client Reference No.: 24036-F
Sample: B-6/PV-2 @ 0-3'

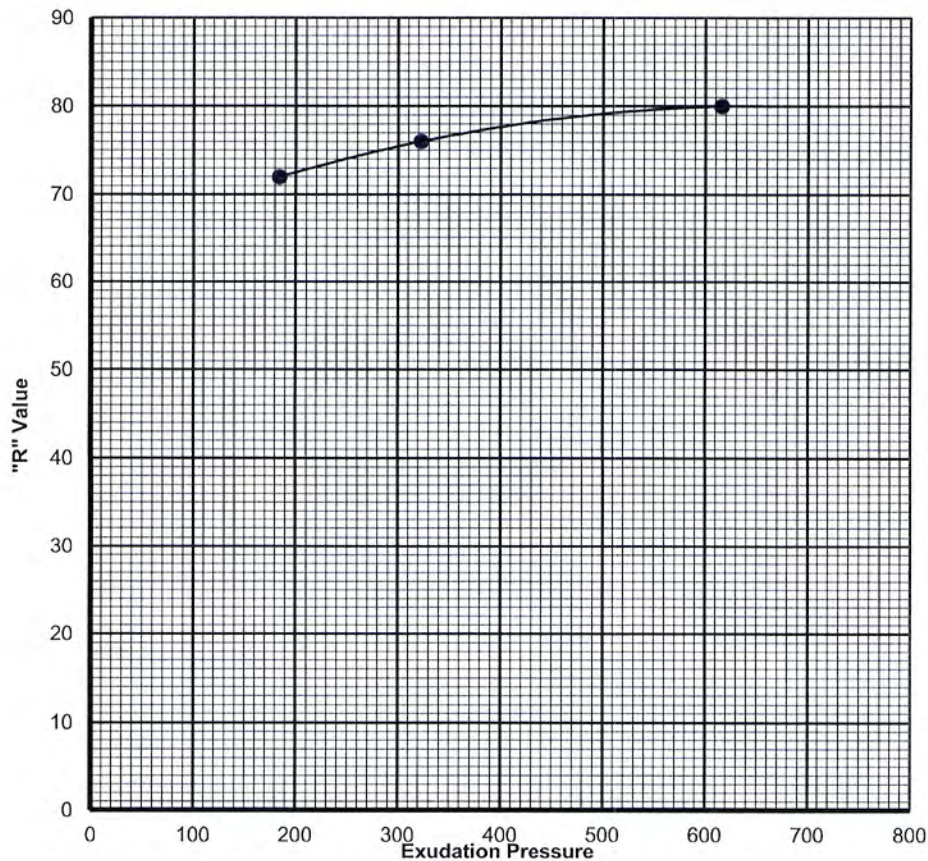
ATL No.: C 8132 Date: 8/26/2024

Soil Type: Brown, Silty Sand w. Gravel

TEST SPECIMEN		A	B	C	D
Compactor Air Pressure	psi	350	350	350	
Initial Moisture Content	%	2.0	2.0	2.0	
Moisture at Compaction	%	7.6	7.1	7.3	
Briquette Height	in.	2.45	2.46	2.49	
Dry Density	pcf	135.5	134.2	134.8	
EXUDATION PRESSURE	psi	184	616	322	
EXPANSION PRESSURE	psf	0	0	0	
Ph at 1000 pounds	psi	20	13	16	
Ph at 2000 pounds	psi	35	22	28	
Displacement	turns	3.45	3.86	3.81	
"R" Value		72	80	76	
CORRECTED "R" VALUE		72	80	76	

Final "R" Value

BY EXUDATION: @ 300 psi	75
BY EXPANSION: TI = 5.0	N/A



APPENDIX C

Supplemental Seismic Design Parameters & FEMA National Flood Hazard Layer Map



California
Department of Conservation

California Department of Conservation

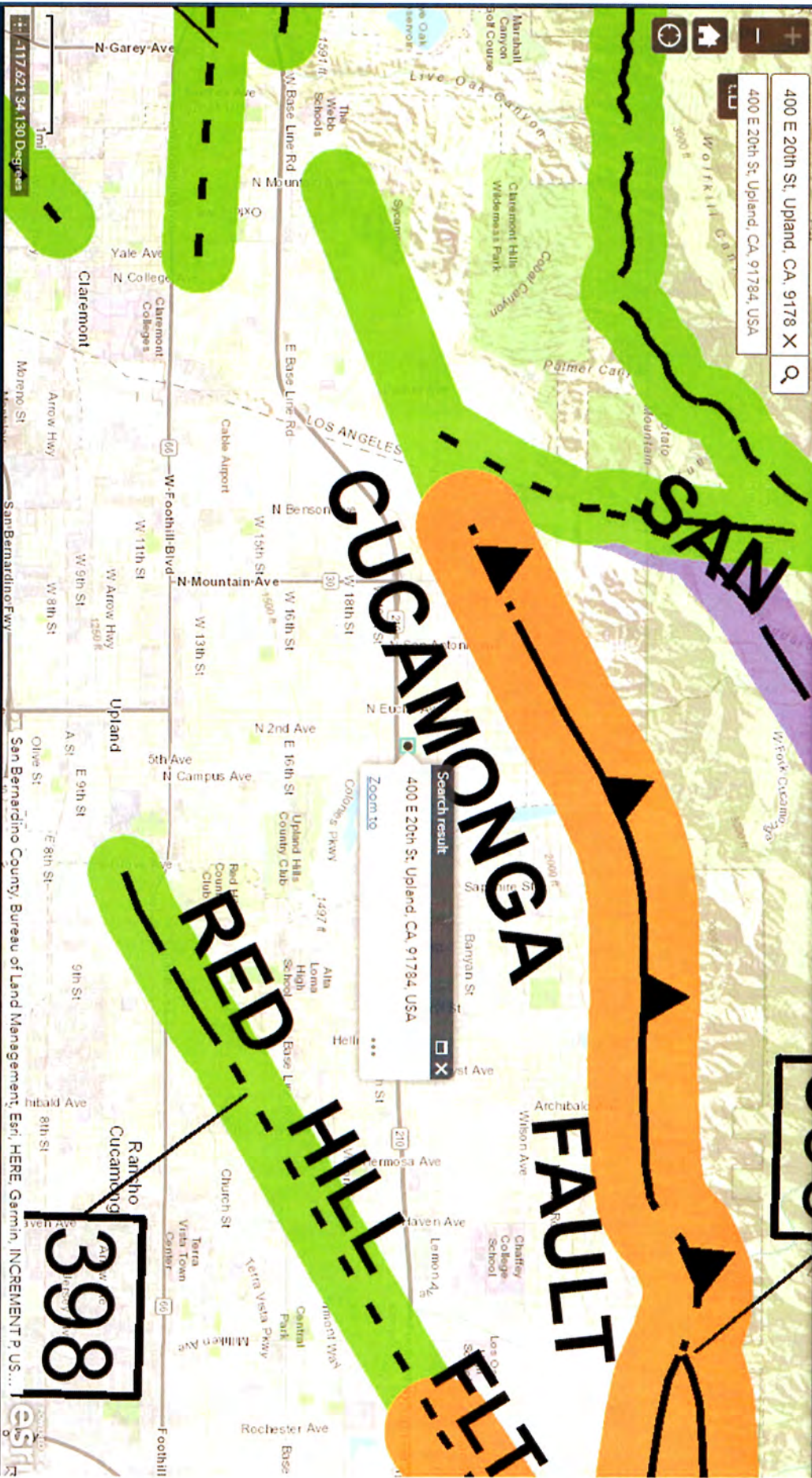
California Geological Survey

Fault Activity Map of California

California Geological Survey

400 E 20th St, Upland, CA, 9178 X

400 E 20th St, Upland, CA, 91784, USA



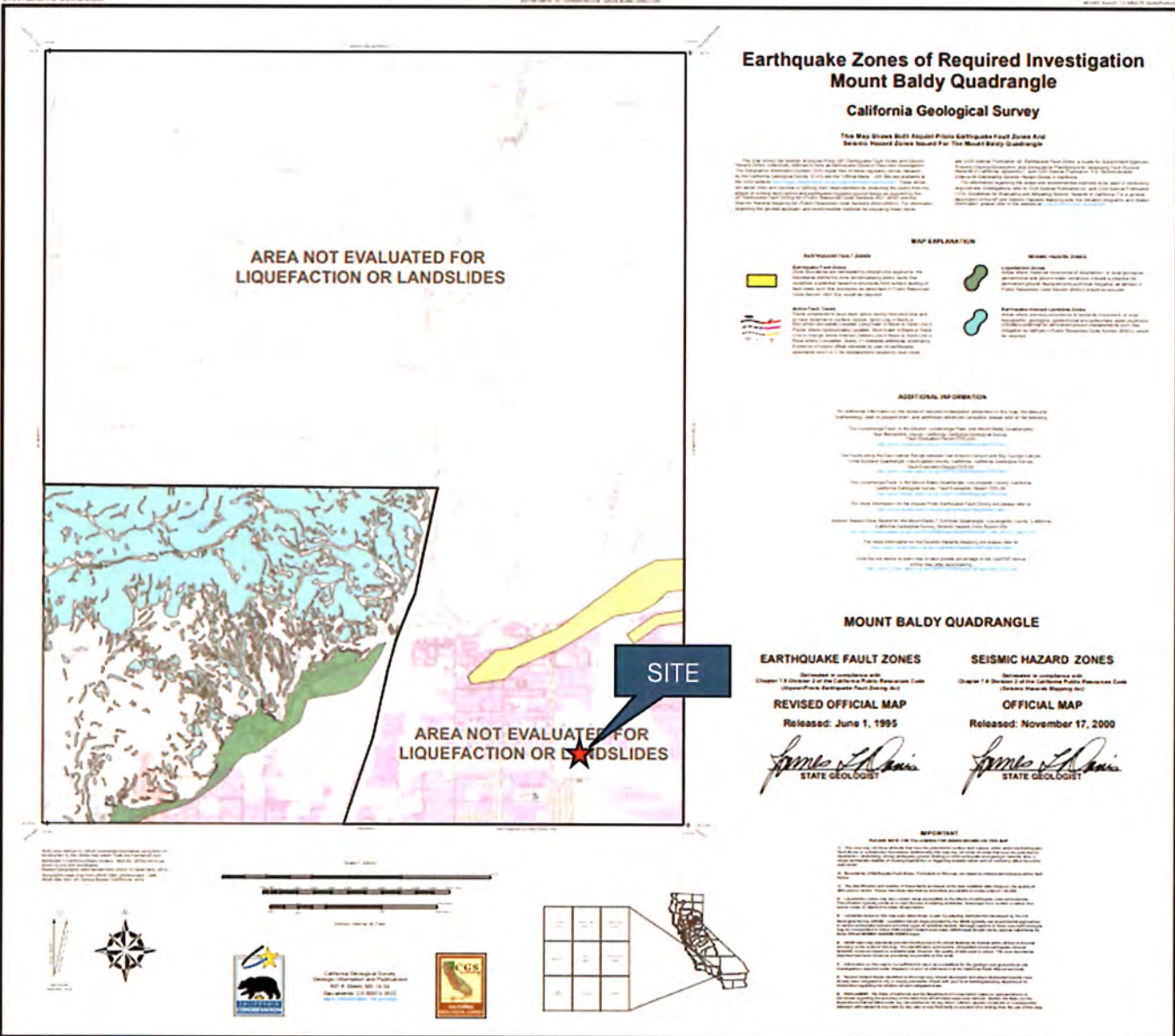
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ASCE Hazards Report

Address:

No Address at This Location

Standard: ASCE/SEI 7-16

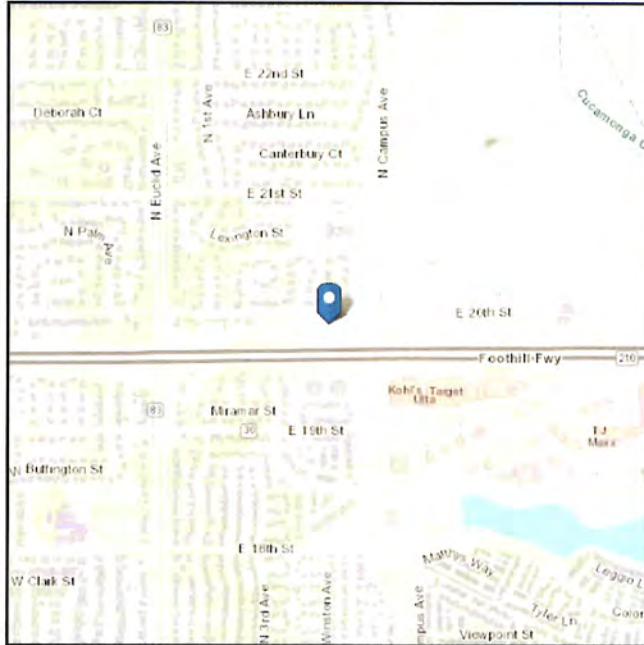
Risk Category: III

Soil Class: D - Stiff Soil

Latitude: 34.135692

Longitude: -117.64504

Elevation: 1649.1604629371752 ft
(NAVD 88)



Seismic

Site Soil Class: D - Stiff Soil

Results:

S_S :	1.766	S_{D1} :	N/A
S_1 :	0.658	T_L :	12
F_a :	1	PGA :	0.753
F_v :	N/A	PGA _M :	0.829
S_{MS} :	1.766	F_{PGA} :	1.1
S_{M1} :	N/A	I_e :	1.25
S_{DS} :	1.177	C_v :	1.453

Ground motion hazard analysis may be required. See ASCE/SEI 7-16 Section 11.4.8.

Data Accessed: Mon Jul 22 2024

Date Source: [USGS Seismic Design Maps](#)

2008 National Seismic Hazard Maps – Source Parameters

[New Search](#)

Distance in Miles	Name	State	Pref Slip Rate (mm/yr)	Dip (degrees)	Dip Dir	Slip Sense	Rupture Top (km)	Rupture Bottom (km)	Length (km)
1.30	Cucamonga	CA	5	45	N	thrust	0	8	28
3.02	San Jose	CA	0.5	74	NW	strike slip	0	15	20
5.56	Sierra Madre	CA	2	53	N	reverse	0	14	57
5.56	Sierra Madre Connected	CA	2	51		reverse	0	14	76
9.14	Chino, alt 2	CA	1	65	SW	strike slip	0	14	29
9.22	Chino, alt 1	CA	1	50	SW	strike slip	0	9	24
11.28	San Jacinto;SBV+SJV+A	CA	n/a	90	V	strike slip	0	16	134
11.28	San Jacinto;SBV+SJV	CA	n/a	90	V	strike slip	0	16	88
11.28	San Jacinto;SBV+SJV+A+C	CA	n/a	90	V	strike slip	0	17	181
11.28	San Jacinto;SBV+SJV+A+CC	CA	n/a	90	V	strike slip	0	16	181
11.28	San Jacinto;SBV	CA	6	90	V	strike slip	0	16	45
11.28	San Jacinto;SBV+SJV+A+CC+B+SM	CA	n/a	90	V	strike slip	0.1	15	241
11.28	San Jacinto;SBV+SJV+A+CC+B	CA	n/a	90	V	strike slip	0.1	15	215
13.53	S. San Andreas;BB+NM+SM+NSB+SSB+BG+CO	CA	n/a	85		strike slip	0.1	13	390
13.53	S. San Andreas;CH+CC+BB+NM+SM+NSB+SSB+BG+CO	CA	n/a	86		strike slip	0.1	13	512
13.53	S. San Andreas;NSB+SSB+BG+CO	CA	n/a	79		strike slip	0.2	12	206
13.53	S. San Andreas;BB+NM+SM+NSB	CA	n/a	90	V	strike slip	0	14	220

2008 National Seismic Hazard Maps – Source Parameters

[New Search](#)

Fault Name	State
Cucamonga	California

GEOMETRY	
Dip (degrees)	45
Dip direction	N
Sense of slip	thrust
Rupture top (km)	0
Rupture bottom (km)	8
Rake (degrees)	90
Length (km)	28

MODEL VALUES		
Slip Rate	5	
Probability of activity	1	
	ELLSWORTH	HANKS
Minimum magnitude	6.5	6.5
Maximum magnitude	6.70	6.50
b-value	0.8	0.8

Fault Model	Deformation Model	Char Rate ¹	GR-a-value ¹	Weight
Stitched	2.1	3.31e-03 / 6.61e-03	2.648 / NA	0.50
UnStitched	2.1	3.31e-03 / 6.61e-03	2.648 / NA	0.50
Stitched	2.4	3.31e-03 / 6.61e-03	2.648 / NA	0.50
UnStitched	2.4	3.31e-03 / 6.61e-03	2.648 / NA	0.50

¹ 1st Value is based on Ellsworth relation and 2nd value is based on Hanks and Bakun relation

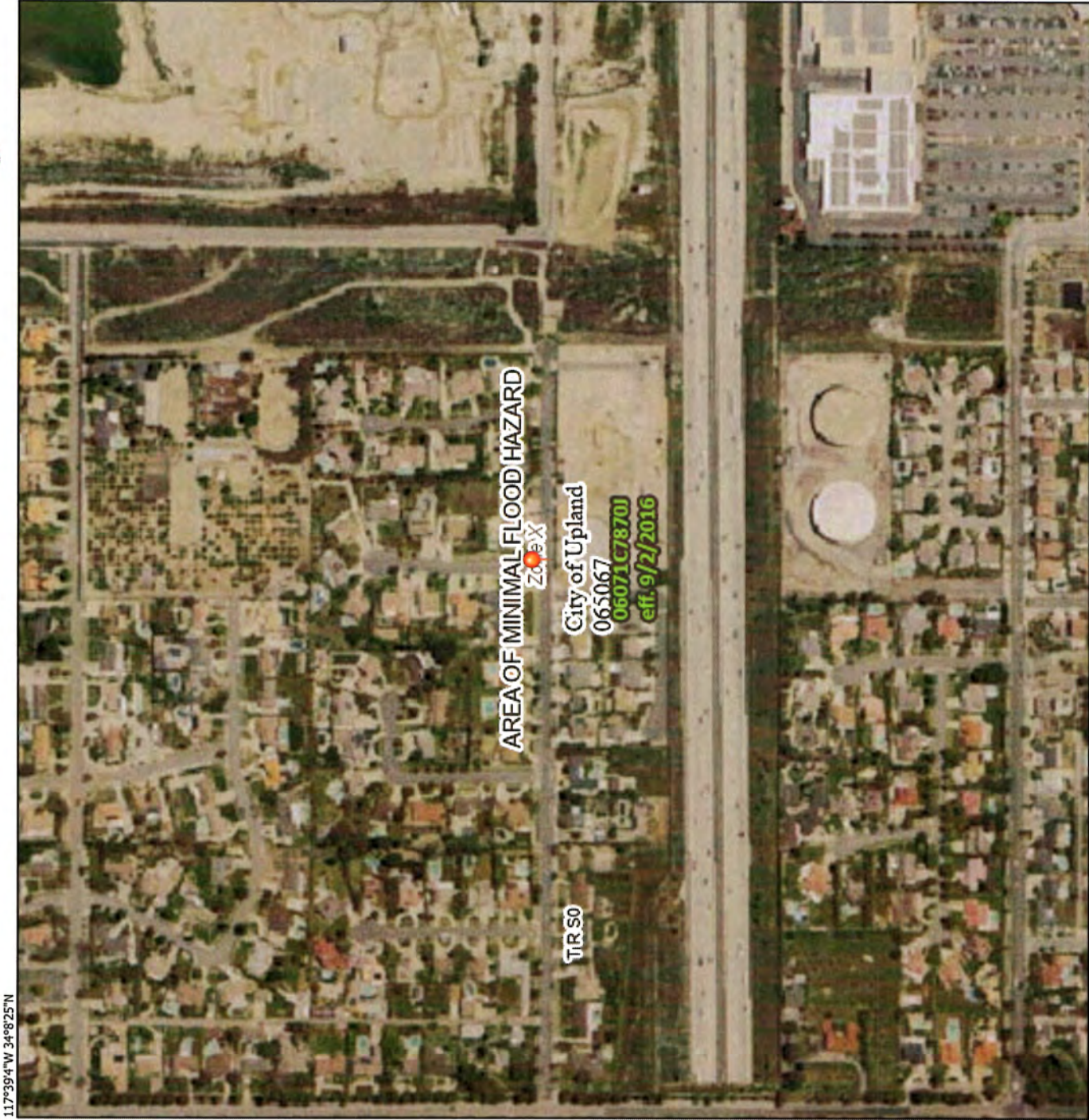
Comments

Slip rate based on cumulative vertical displacement across three strands reported by Morton and Matti (1987, 1991).

National Flood Hazard Layer FIRMette



117°39'4"W 34°8'25"N



117°38'27"W 34°7'55"N



Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

Without Base Flood Elevation (BFE)
Zone A, V, A99

With BFE or Depth
Zone AE, AO, AH, VE, AR

Regulatory Floodway

0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile
Zone X

Future Conditions 1% Annual Chance Flood Hazard
Zone X

Area with Reduced Flood Risk due to Levee. See Notes.
Zone X

Area with Flood Risk due to Levee
Zone D

NO SCREEN

Area of Minimal Flood Hazard
Zone X

Effective LOMRs

Area of Undetermined Flood Hazard
Zone D

Channel, Culvert, or Storm Sewer

Levee, Dike, or Floodwall

Cross Sections with 1% Annual Chance Water Surface Elevation

Coastal Transect

Base Flood Elevation Line (BFE)

Limit of Study

Jurisdiction Boundary

Coastal Transect Baseline

Profile Baseline

Hydrographic Feature

Digital Data Available

No Digital Data Available

Unmapped

MAP PANELS

20.2

17.5

8

4

20.2

17.5

8

4

OTHER AREAS OF FLOOD HAZARD

OTHER AREAS

GENERAL STRUCTURES

OTHER FEATURES

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards.

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 7/22/2024 at 3:06 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

APPENDIX D

Field Infiltration Test Data Porchet Method Calculation Summary

Conversion Table (Porchet Method)
San Antonio Water District Headquarters
400 E. 20th Street, Upland
Project No. 24036-BMP

Test N no.	Test Hole Depth (inches) D_T	Time Interval ΔT	Initial Depth (inches) D_O (in)	Final Depth (inches) D_f (in)	Initial Water Height (inches) $H_O = D_T - D_O$	Final Water Height (inches) $H_f = D_T - D_f$	Change Height/Time $\Delta H / \Delta D = H_O - H_f$	Average Head Height/Time $H_{avg} = (H_O + H_f) / 2$
P-1	36	10	12	35.5	24	0.5	23.5	12.25
P-2	60	10	36	56.5	24	3.5	20.5	13.75
P-3					Test at required depth could not be performed			
P-4					Test at required depth could not be performed			

Observed Infiltration Rate (it) = $\Delta H 60r / \Delta t$ (r+2H _{avg})			
A	B	C	
$\Delta H 60r$	Δt (r+2H _{avg})	A/B= inch/hr	
P-1 5640	285	19.79	
P-2 4920	315	15.62	
P-3			
P-4			

Legend

- $\Delta H / \Delta D$ = Observed Field Rate
 H_O = inches of water filled from bottom
 D_O = initial height of water (inches) from bottom
 D_f = final height of water (inches) from bottom
Columns A-B-C : Porchet Conversion Calculations
Column C: Observed Rate following Porchet Conversion
 D_t = depth of test hole bottom (inches)

Percolation Test Data Sheet

Project: SAN ANTONIO WATER DISTRICT HOOD - UPLAND			Project No. 24036		
Test Hole No: P-1		Tested By: JG		Date: 8-9-24	
Depth of Test Hole, D_T 36		USCS Soil Classification			
Test Hole Dimensions (inches)				Length	Width
Diameter (if round)= 8.0 in.		Sides (if rectangular)=			
Sandy Soil Criteria Test *					

Trial No.	Start Time	Stop Time	Δt Time Interval (min)	D_o Initial Depth to Water (in.)	D_f Final Depth to Water (in.)	ΔD Change in Water Level (in.)	Greater Than or Equal to 6.0 inches??? (Y/N)
1	10:38	10:45	25	12	36	24	Y
2	10:45	10:55	25	12	36	24	Y

* If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Otherwise, pre-soak (fill) overnight. Obtain at least twelve measurements per hole over at least six hours (approximately 30 minute intervals) with a precision of at least 0.25."

Trial No.	Start Time	Stop Time	Δt Time Interval (min)	D_o Initial Depth to Water (in.)	D_f Final Depth to Water (in.)	ΔD Change in Water Level (in.)	$\Delta T / \Delta D$ Percolation Rate (min./in.)
1	10:56	11:06	10	12	36	24	0.42
2	11:07	11:17	10	12	36	24	0.42
3	11:18	11:28	10	12	36	24	0.42
4	11:29	11:39	10	12	36	24	0.42
5	11:40	11:50	10	12	35.5	23.5	0.43
6	11:51	12:01	10	12	35.5	23.5	0.43
7	12:01	12:11	10	12	35.5	23.5	0.43
8							
9							
10							
11							
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13							
14							
15							
16							
17							
18							

Comments

Percolation Test Data Sheet

Project: SAN ANTONIO WATER DISTRICT HOE - UPLAND			Project No. 24036		
Test Hole No:	P-2	Tested By: JG		Date: 8-9-24	
Depth of Test Hole, D _T	60	USCS Soil Classification			
Test Hole Dimensions (inches)			Length	Width	
Diameter (if round)=	8.0 in.	Sides (if rectangular)=			

Sandy Soil Criteria Test *							
Trial No.	Start Time	Stop Time	Δt Time Interval (min)	D _o Initial Depth to Water (in.)	D _f Final Depth to Water (in.)	ΔD Change in Water Level (in.)	Greater Than or Equal to 6.0 inches??? (Y/N)
1	10:49	11:04	25	36	60	24	Y
2	11:05	11:20	25	36	60	24	Y

* If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Otherwise, pre-soak (fill) overnight. Obtain at least twelve measurements per hole over at least six hours (approximately 30 minute intervals) with a precision of at least 0.25."

Trial No.	Start Time	Stop Time	Δt	D _o	D _f	ΔD	ΔT/ΔD
			Time Interval (min)	Initial Depth to Water (in.)	Final Depth to Water (in.)	Change in Water Level (in.)	Percolation Rate (min./in.)
1	11:21	11:31	10	36	57	21	0.48
2	11:32	11:42	10	36	57	21	0.48
3	11:43	11:53	10	36	57	21	0.48
4	11:54	12:04	10	36	57	21	0.48
5	12:07	12:17	10	36	56.5	20.5	0.49
6	12:18	12:28	10	36	56.5	20.5	0.49
7	12:29	12:39	10	36	56.5	20.5	0.49
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							

Comments

Form 4.3-3 Infiltration LID BMP - including underground BMPs (DA 1)

1 Remaining LID DCV not met by site design BMP (ft³):

$V_{unmet} = \text{Form 4.2-1 Item 7} - \text{Form 4.3-2 Item 19}$

BMP Type Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs

DA DMA
BMP Type

DA DMA
BMP Type

DA DMA
BMP Type
(Use additional forms
for more BMPs)

2 Infiltration rate of underlying soils (in/hr) See Section 5.4.2 and Appendix C of the TGD for WQMP for minimum requirements for assessment methods

19.79

15.62

3 Infiltration safety factor See TGD Section 5.4.2 and Appendix D

4 Design percolation rate (in/hr) $P_{design} = \text{Item 2} / \text{Item 3}$

5 Pondered water drawdown time (hr) Copy Item 6 in Form 4.2-1

6 Maximum ponding depth (ft) BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details

7 Ponding Depth (ft) $d_{BMP} = \text{Minimum of } (1/12 * \text{Item 4} * \text{Item 5}) \text{ or Item 6}$

8 Infiltrating surface area, SA_{BMP} (ft²) the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP

9 Amended soil depth, d_{media} (ft) Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details

10 Amended soil porosity

11 Gravel depth, d_{media} (ft) Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details

12 Gravel porosity

13 Duration of storm as basin is filling (hrs) Typical ~ 3hrs

14 Above Ground Retention Volume (ft³) $V_{retention} = \text{Item 8} * [\text{Item 7} + (\text{Item 9} * \text{Item 10}) + (\text{Item 11} * \text{Item 12}) + (\text{Item 13} * (\text{Item 4} / 12))]$

15 Underground Retention Volume (ft³) Volume determined using manufacturer's specifications and calculations

16 Total Retention Volume from LID Infiltration BMPs: (Sum of Items 14 and 15 for all infiltration BMP included in plan)

17 Fraction of DCV achieved with infiltration BMP: % Retention% = Item 16 / Form 4.2-1 Item 7

18 Is full LID DCV retained onsite with combination of hydrologic source control and LID retention/infiltration BMPs? Yes ☐ No ☐
If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.

PROFESSIONAL LIMITATIONS

Our investigation was performed using the degree of care and skill ordinarily exercised, under similar circumstances by other reputable geotechnical engineers practicing in these general or similar localities. No other warranty, expressed or implied, is made as to the conclusions and professional advice included in this report.

The investigations are based on soil samples only, consequently the recommendations provided shall be considered 'preliminary'. The samples taken and used for testing and the observations made are believed representative of site conditions; however, soil and geologic conditions can vary significantly between boring. As in most major projects, conditions revealed by excavations may vary with preliminary findings. If this occurs, the changed conditions must be evaluated by the project geotechnical engineer and designs adjusted as required or alternate design recommended.

The report is issued with the understanding that it is the responsibility of the owner, or of his representative, to ensure that the information and recommendations contained herein are brought to the attention of the project architect and engineers. Appropriate recommendations should be incorporated into structural plans. The necessary steps should be taken to see that out such recommendations in field.

The findings of this report are valid as of this present date. However, changes in the conditions of a property can occur with the passage of time, whether they due to natural process or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur from legislation or broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside of our control. Therefore, this report is subject to review and should be updated after a period of one year.

RECOMMENDED SERVICES

The review of grading plans and specifications, field observations and testing by a geotechnical representative of this office is integral part of the conclusions and recommendations made in this report. If Soils Southwest, Inc. (SSW) is not retained for these services, the Client agrees to assume SSW's responsibility for any potential claims that may arise during and after construction or during the lifetime use of the structure and its appurtenant.

The recommendations supplied should be considered valid and applicable, provided the following conditions, at a minimum, are met:

- i. Pre-grade meeting with the contractor, public agency, and the geotechnical engineer,
- ii. Excavated bottom inspections and verifications by the greotechnical engineer prior to backfill placement,
- iii. Continuous observations and testing during site preparation and structural fill soils placement,
- iv. Observation and inspection of footing trenching prior to steel and concrete placement,
- v. Subgrade verifications including plumbing trench backfills prior to concrete slab-on-grade placement,
- vi. On and off-site utility trench backfill testing and verifications,
- vii. Precise-grading plan review, and
- viii. Consultations as required during construction or upon request.

In the event that the above conditions are not strictly fulfilled, Soils Southwest, Inc. will assume no responsibility for any structural distresses during the lifetime use of the development planned.

Appendix F

Hydraulic Design