PRELIMINARY DRAINAGE STUDY

HYDROLOGIC & HYDRAULIC ANALYSIS

PRELIMINARY DRNSTY-2025-00020

PROJ-2023-00088

APN: 0328-165-16

Prepared for:
Darren Diess
Diess Boat Storage
32864 Hilltop Blvd.
Arrowbear Lake, CA 92382
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Submittal Date: 10/29/2025

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County of San Bernardino
LAND DEVELOPMENT

PRELIMINARY DRAINAGE REPORT **REVIEWED**

FOR CODE COMPLIANCE

THE REVIEW OF THIS REPORT SHALL NOT BE CONSTRUED TO BE A PERMIT FOR ANY VIOLATION OF ANY CODE OR ORDINANCE OF THIS COUNTY

By Chris Chew

Date 10/29/2025

FINAL DRAINAGE REPORT SHALL BE BASED ON THIS PRELIMINARY DRAINAGE REPORT

10/29/2025
Matthew R. Walsh, R.C.E.

WALSH ENGINEERING

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Table of Contents

1. Introduction 4
2. Site Description 5
3. Hydrologic Conditions 5
4. Soils 6
5. FEMA Flood Plain 6
6. Project Description and Proposed Storm Drain 6
7. Proposed Drainage Easement 6
8. Water Quality 7
9. Hydrology 7
   a. Peak Flow Mitigation Requirements 7
   b. Peak Flow Mitigation Results 7
   c. Detention Basin Analysis (Volume Based Mitigation) 9
   d. Culvert and Existing Ditch Analysis 9
10. Detention Basin Design 9
11. Hydraulic calculations 10
   a. Onsite Hydraulic Analysis 10
   b. Existing Drainage Ditch Water Surface Elevation Analysis 10
   c. Proposed Culvert Hydraulic Analysis 11
12. Conclusions 11
13. List of References 12
14. Appendices .....

Appendix A: Hydrology Maps .....
Appendix B: Hydrologic Calculations and Resources .....
Appendix C: Detention Basin Design .....
Appendix D: Hydraulic Calculations and Resources .....
Appendix E: FEMA and DWR Floodplain Maps .....
Appendix F: Infiltration Report .....

1. Introduction

Our client, Darren Diess, is proposing to develop a property located at 32864 Hilltop Blvd., Arrowbear Lake, CA 92382, with an APN of 328-165-16. There are currently three (3) existing permitted buildings within the property, and in addition to this, the client would like to build a new multi-level accessory boat storage. The 328-165-16 APN is divided into two (2) zoning areas: Hilltop/General Commercial - Sign Control Primary (HT/CG-SCP) and Multiple Residential (RM). This project will only develop the HT/CG-SCP part of the property.

The project will utilize its existing terrain as much as possible. It will include all site improvements, including civil and landscape. New concrete paving will be a part of the improvements where needed, along with new concrete driveways, curbs, parking, perimeter PVC fencing, masonry trash enclosures, and all boat storage. Existing buildings are to be considered as accessory buildings and are used for storage. The auxiliary buildings located on the northwestern portion of the site along Highway 18 are planned to be removed. The new boat storage building will be constructed with a pre-engineered metal building with exterior metal panel siding. The southwest corner of the building will have a mountain design with rough-sawn wood columns with stone bases, wood beams, and a standing seam metal roof. The proposed storage 10,974-square-foot (SF) building will store approximately 69 boats. a 1,757-SF existing building to be used as an office. The auxiliary buildings located on the northwestern portion of the site along Highway 18 are planned to be removed.

The proposed building will be used primarily for boat storage only. With this, there will be no repairs, rental, or sales on-site. All stored boats will be shielded from public view by the building walls or privacy screens. The project will be built in compliance with all regulations adopted by the county and its jurisdiction.

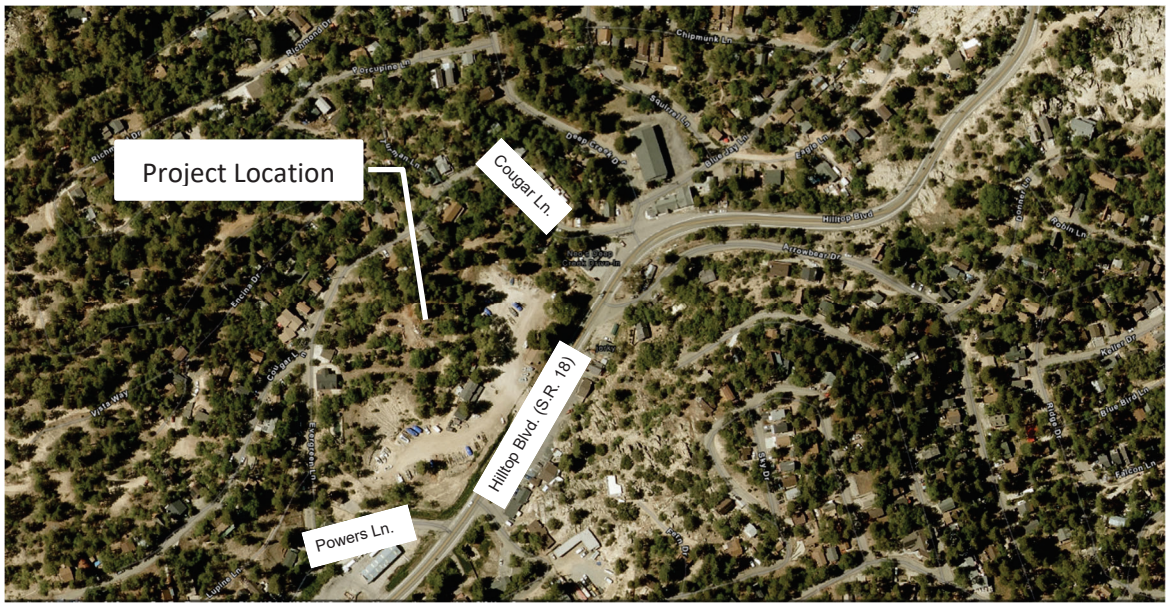


Figure 1: Vicinity Map

2. Site Description

The subject property currently consists of a small office building (1757 Square-feet) with a garage (643 Square-feet) and several auxiliary buildings. The auxiliary buildings are located on the northwestern portion of the site along State Route (S.R.) 18 and are 1,258 and 1,388 square feet respectively. The ground surface consists of woodland and woodland grass area. The surrounding area has a variety of residential homes and commercial properties. The surrounding properties in the immediate vicinity of the project site are:

North: Residences (32871, 32861, 32839 Cougar Lane) and Deep Creek Drive In
East: State Route 18
South: Commercial (32807 Powers Lane)
West: Residences (32794-32825 Cougar Lane)

3. Hydrologic Conditions

A natural ridge intersects the northwesterly section of the property. The portion of the property west of the natural ridge will remain undisturbed with this project. See the Watershed Delineation Exhibit Included in Appendix A for an overview of the Dry Creek Watershed. Historical drainage within the project site area tends to flow downslope from the ridge and then flow in the southwesterly direction until it ultimately discharges to an existing low point at Powers Lane approximately 50 feet west of the intersection of Hilltop Boulevard. Natural slope across the site is approximately 5.8% with a maximum slope of approximately 30%. Water is accelerated by steeper slopes at the northern site boundary and ridge before reaching more moderate slopes where shallow concentrated flows convey water to the southwestern site boundary. An existing ditch located along the property boundary and adjacent to State Highway 18 flows southwest until the intersection of S.R. 18 and Powers Lane where it turns to run west along the north side of Powers Lane. The ditch continues along powers lane until reaching the low point and existing culvert located at Powers Lane. The outlet of the existing culvert is unknown. See the Pre-Development Hydrology Exhibit in appendix A for detailed existing hydrologic conditions. The existing condition of the project site consists of a total area of 2.92 acres with 8% of the site consisting of impervious surfaces.

The property receives run-on from the surrounding residential homes to the north of the site and include drainage form the cougar lane and some of the residential properties on the northside of Cougar Lane. The drainage from these DMAs has been identified to historically drain through the proposed project site to the existing drainage ditch along S.R. 18. The proposed developed condition of the site conveys these flows directly to the existing drainage ditch which flow along the project frontage to the southwest corner of the site. Since run-on will be conveyed around the proposed basin the run-on DMA’s are not included in the peak flow mitigation and volume mitigation analyses for basin sizing.

The existing drainage ditch along S.R. 18 collects drainage from the upper reaches of the dry creek watershed from both sides of S.R. 18. The DMAs delineated on the Run-on Hydrology Exhibit represent areas that influence the existing drainage ditch upstream of the proposed culvert. In total the run-on tributary area is 4.60 acres and consists of roughly 29% impervious surfaces. A hydrologic analysis of

onsite and offsite run-on entering the existing drainage ditch above the proposed culvert is included in Section 9.d.

4. Soils

According to the Project's Geotechnical/Geologic Study dated August 14, 2024 by Hilltop Geotechnical and the SGS Websoil Survey data available, the soils on the project site are comprised of the Runnings springs, Cedar pines and Plasket complex unit. The site soil conditions consists of shallow sandy loams with relatively shallow lying bedrock. Slopes range from 15 to 35 percent. The soils are not well drained with high runoff and low hydraulic conductivity. The hydrologic soil group for these soils is D.

Further evaluation of onsite soil conditions was completed during infiltration rate testing. The findings from this testing event are provided in the Infiltration rate testing report provided in Appendix F. The results of the testing identified an infiltration rate of 2.65 in/hr.

5. FEMA Flood Plain

The project site lies within FEMA Zone D per FEMA Flood Insurance Rate Map (FIRM) panel 06071C8000H Dated August 28, 2008. Zone D are areas with possible but undetermined flood hazards. No flood hazard analysis has been conducted.

The project site is not within the 100-year floodplain per DWR Best Available Maps Included in Appendix E. No data is available for the 200-yr or 500-yr floodplains in the area of the site.

6. Project Description and Proposed Storm Drain

The proposed project storm drain system will collect runoff from the building roofs, impervious surfaces and uphill drainage in an on-site storm drainage system. Storm water runoff will be conveyed as surface flow in V gutters to an underground pipe network and directed to the proposed drainage basin. The proposed Storm drain system is included in the Post Development Hydrology Exhibit provided in Appendix A.

The proposed condition of the site includes a proposed earthen swale along the north side of the development that conveys offsite run-on and drainage from the northeast corner of the site to its historical drainage path in the existing drainage ditch. Peak flow within the existing drainage ditch is not anticipated to increase due to the proposed development. A Hydrological analysis of the tributary area above the proposed culvert is discussed in Section 9.d. A hydraulic analysis of the existing drainage ditch and the proposed culvert are provided in Section 11.b and 11.c.

7. Proposed Drainage Easement

A drainage easement has been proposed along the site eastern and southern sides of the site boundary. The Easement accommodates the existing natural drainage course conveying offsite run-on from neighborhoods north of the site along Highway 18 and Powers Lane. The location of the existing natural channel and proposed easement are included on the Post-Development Hydrology Map provided in

Appendix A. A hydrologic analysis of the existing drainage ditch is discussed in Section 11.b. It is anticipated that drainage conveyance functionality of the existing ditch will be preserved as the project is not proposing any grading within the area that would change the course.

8. Water Quality

The proposed project is subject to the County's water quality and NPDES requirements and recommendations provided in the San Bernardino County Stormwater Program "Technical Guidance Document for Water Quality Management Plans," effective date September 19, 2013. A separate Water Quality Management Plan (WQMP) has been prepared for the project. The project will be required to capture and infiltrate 100 percent of the water quality design capture volume (DCV). Calculations for the proposed drainage basin in terms of water quality treatment and hydromodification management are included within the projects Water Quality Management Plan. DCV of 5,900CF was identified for the proposed site condition.

9. Hydrology

a. Peak Flow Mitigation Requirements

The peak flow mitigation requirements for the proposed project are determined as follows:

1. Storm Water Detention – The detention basin will be sized to accept the differential or increase in runoff for a series of design year storms (2, 10, 25 and 100-year storms) between 90 percent of the pre-project development condition and the post-project development condition.

2. Pre-development peak flow rates are calculated in accordance with the County of San Bernardino (COSB) Hydrology Manual with the following exceptions:

a. 2-year peak flow rates are calculated at 90 percent of the pre-development 2-year peak flow rate.

b. 10-year peak flow rates are calculated using 5-year rainfall.

c. 25-year peak flow rates are calculated using 10-year rainfall.

d. 100-year peak flow rates are calculated using 25-year rainfall and antecedent moisture content (AMC) II.

For purposes of preliminary design, only the 25-year predeveloped and 100-year post developed conditions are analyzed herein.

b. Peak Flow Mitigation Results

Hydrologic Conditions on site were modeled using the Rational Method as outlined in Section D of the COSB Hydrology Manual. Peak Flow rates were calculated for 2-year, 10-years, 25-year, 100-year storm frequencies. Curve Numbers were determined based on surface type and the hydrologic Soil group identified in the SGS Soil Survey, see Appendix B. Time of Concentration (Tc) for the initial sub basin was

identified using Figure D-1 from the COSB Hydrology Manual. Downstream Tc values were calculated per Section D.3 of the COSB Hydrology Manual. Atlas 14 rainfall intensities were used and adjusted to match the specific Tc using linear interpolation. The resulting rainfall intensities are provided in the Adjusted Rainfall Intensities Table in Appendix B. Maximum Loss rate was calculated in accordance with COSB hydrology Manual Section C.6.5. Calculation Summary Tables are provided in Appendix B.

Peak Flow Mitigation Summary Table				
	Pre-Development		Post-Development	
Storm Frequency	Peak Flow Rate (cfs)	Time of Concentration (min)	Peak Flow Rate (cfs)	Time of Concentration (min)
2-Year	4.88	11.14	5.10	10.93
10-Year	8.41	11.14	8.65	10.93
25-Year	10.61	11.14	10.88	10.93
100-Year	14.12	11.14	14.41	10.93

Peak Flow Mitigation

The results of the Rational Method hydrologic analysis were used herein to present the anticipated pre and post-development peak flow rate runoff conditions for the proposed project as follows:

100-Year Existing Conditions Peak Flow Rate using 25-yr Rainfall: 10.61 cfs

90 percent 100-Year Existing Conditions Peak Flow Rate using 25-yr Rainfall: 9.55 cfs

100-Year Developed Condition Peak Flow Rate: 14.41 cfs

$Q_{Mitigation} = Q_{100YR} - Q_{90\% \text{ of } 25Yr} = 4.86$ cfs

Adequate Detention of storm water flows will be provided to mitigate the 4.86 cfs as calculated above prior to release offsite to the existing drainage ditch.

Peak flow-based Mitigation Volume

The detention capacity required for peak flow mitigation was calculated using the Small Area Unit Hydrograph procedure discussed in Section J of the COSB Hydrology Manual. The procedure is applicable to watersheds whose time of concentration is less than 25 minutes.

$V_{Peak\ Flow\ Mitigation} = (\Delta Q)(Tc)(60)$

$\Delta Q = Q_{Mitigation} = 4.86$ cfs

Tc = 10.93 min

$V_{Peak\ Flow\ Mitigation} = (4.86)(10.93)(60) =$ **3,187 CF**

c. Detention Basin Analysis (Volume Based Mitigation)

The required detention capacity required for the project is calculated using the Runoff Volume Estimation procedure discussed in Section E.8 of the COSB Hydrology Manual. The 100 year existing condition was compared to the 100 year proposed condition. A summary of the results is provided below. Calculations are provided in Appendix B.

Volume Based Mitigation Summary Table		
	Existing Condition	Proposed Condition
Tributary Area (Acre)	2.9251	2.9209
$P_{100yr\ 24\text{-}hr}$	16.2	16.2
Runoff Yield, Y	0.82	0.87
Volume (CF)	140,872	149,407

$V_{Mitigation} = V_{Proposed\ 100yr} - V_{Existing\ 100yr}$

$V_{Mitigation}$ = 140,872 CF – 149,407 CF = **8,535 CF**

d. Culvert and Existing Ditch Analysis

Hydrologic analysis was completed to evaluate peak flow rates generated from onsite and offsite run-on entering the existing drainage ditch and passing through the proposed culvert located under the driveway. Peak flow rates for the 10-year and 100-year storm frequencies were calculated using the rational method as stated in Section D of the COSB Hydrology Manual. A summary of the results are provided in the table below. Detailed hydrologic calculations are provided in Appendix B.

Culvert Hydrology Summary Table			
Sub Basin	Area (Acre)	Peak flow (cfs)	Time of Concentration (min)
10-year			
DMA 1-2	3.96	8.55	13.36
DMA 3	0.64	1.68	13.50
Total	4.6	**11.97**	--
100-year			
DMA 1-2	3.96	17.29	13.36
DMA 3	0.64	2.8	13.50
Total	4.6	**20.16**	--

10.Detention Basin Design

The proposed bioretention basin was designed based on the San Bernadino County Drainage Basin Design Criteria Mannal and has maximum design capacity of 9,390 CF. The Infiltration section of the basin consists of 1.5’ of amended soil over 1’ of gravel over undisturbed native material. The basin has been designed with 1’ of freeboard above the emergency spillway located at elevation 6023.5 resulting

in a maximum ponding depth of 2'. A summary of basin design and storage capacity is included below. The proposed bioretention basin design meets the requirements for water quality treatment, hydromodification, and detention as a comprehensive drainage facility. Additional basin design details are provided in Appendix A, the Post Development Hydrology Exhibit, and Appendix C, WQMP Form 4.3-5.

Drawdown time was calculated using an infiltration rate of 2.65 in/hr identified during infiltration testing and a basin surface area of 3,181 SF. The drawdown time for the basin's maximum storage capacity of 9,390 CF was calculated to be 13.7 hrs. An outflow rate of .19 cfs was calculated based on the surface area and infiltration rate provided above.

Below is a summary of basin storage capacity based on water depth.

Detention Basin Information Table				
Water Surface Elevation	Depth (ft)	Storage Volume (CF)	Outflow (cfs)	Notes
6019	0	0	0.19	Bottom of basin
6019.5	0.5	636	0.19	
6020	1	1272	0.19	Top of Gravel
6020.5	1.5	1272	0.19	
6021	2	1272	0.19	
6021.5	2.5	1272	0.19	Top of Amended Soil
6022	3	2967	0.19	
6022.5	3.5	4881	0.19	
6023	4	7029	0.19	
6023.5	4.5	9390	0.19	Spillway Invert
6024	Freeboard			
6024.5	Freeboard			

11.Hydraulic calculations

a. Onsite Hydraulic Analysis

Proposed onsite storm drainage facilities will be prepared with the final storm drain design and specifications. The preliminary storm drain design was based on peak flow rates developed using the COSB Hydrology Manual. Preliminary design specifications are presented on the Post Development Hydrology map included in Appendix A.

b. Existing Drainage Ditch Water Surface Elevation Analysis

The water surface elevation in the existing culvert was evaluated for the 10-year and 100-year for storm events. Stream geometry was identified form a cross-section of the existing drainage ditch approximately 30' upstream of the proposed culvert. The existing drainage ditch cross section and

dimensions are provided in Appendix D. The peak flowrates identified in section 9.d. were used to calculate the Water Surface Elevation (WSEL). Hydraflow Express was used to model conditions within the existing drainage ditch and identify WSEL. Below is the Water Surface Elevation Summary table which presents model inputs and results. The ditch cross-section and Hydraflow model used in the evaluation of the WSEL are provided in Appendix D.

Water Surface Elevation Summary Table				
Channel Slope	.051			
Mannings	0.03	Natural Channel		
10 -Yr Peak Flow	11.97	cfs		
100-Yr Peak Flow	20.16	cfs		
	Flowline	**Top of Bank**	**10-Yr WSEL**	**100-Yr WSEL**
Height	-	1.50	0.99	1.20
Elevation	6031.5	6033	6,032.49	6,032.70

c. Proposed Culvert Hydraulic Analysis

Hydraulic calculations for the proposed culvert conveying off site run-on under the proposed driveway were completed using the COSB Hydrology Manual and Hydraflow Express. A simulation was completed to confirm that the designed culvert would convey the 10-year storm event without causing the headwater elevation to rise above the inlet top of the culvert. Additionally, the 100-year event was analyzed to confirm headwaters did not rise above an elevation that would cause objectionable backwater depths or outlet velocities. Based on the Hydrologic analysis provided in section 9.d. the proposed circular pipe culvert should have a minimum diameter of 24 inches and be installed at a minimum slope of 1.25%. Model inputs and results from the simulation are provided in Appendix D.

12.Conclusions

The proposed development will mitigate drainage impacts based on the hydrologic study above by detaining stormwater collected onsite in a new bioretention basin for water quality treatment and flood control before discharging any flows exceeding the required design storm events via a proposed basin spillway leading to the historical drainage path. The bioretention basin design was engineered to mitigate the peak flow of 4.86 cfs, detain the design flood control volume of 8,535 CF and treat the design capture volume of 5,900 CF. The resulting detention basin has a maximum capacity of 9,390 CF.

A hydrologic and hydraulic analysis was completed to evaluate water surface elevation within the existing drainage ditch and sizing for the proposed culvert. Calculations included in section 9.d. identified the Peak flow rate for the 10-year and 100-year storm event produced by offsite run-on at the entrance to the proposed culvert. The preliminary recommended design for the proposed culvert is provided in section 11.c. A drainage easement to protect the existing natural drainage course is proposed along the eastern and southern edges of the site. The proposed easement is delineated in the Post-development Hydrologic Map in Appendix A. additional analysis of the drainage course will be provided upon the Final submittal of this document.

13. List of References

1: County of San Bernardino Hydrology Manual

2: County of San Bernardino Hydrology Manual Addendum 1

3: San Bernardino County Detention Basin Design Criteria

3: Mojave River Watershed Technical Guidance Document for Water Quality Management Plans

14. Appendices

A: Hydrology Maps

B: Hydrologic Calculations and Resources

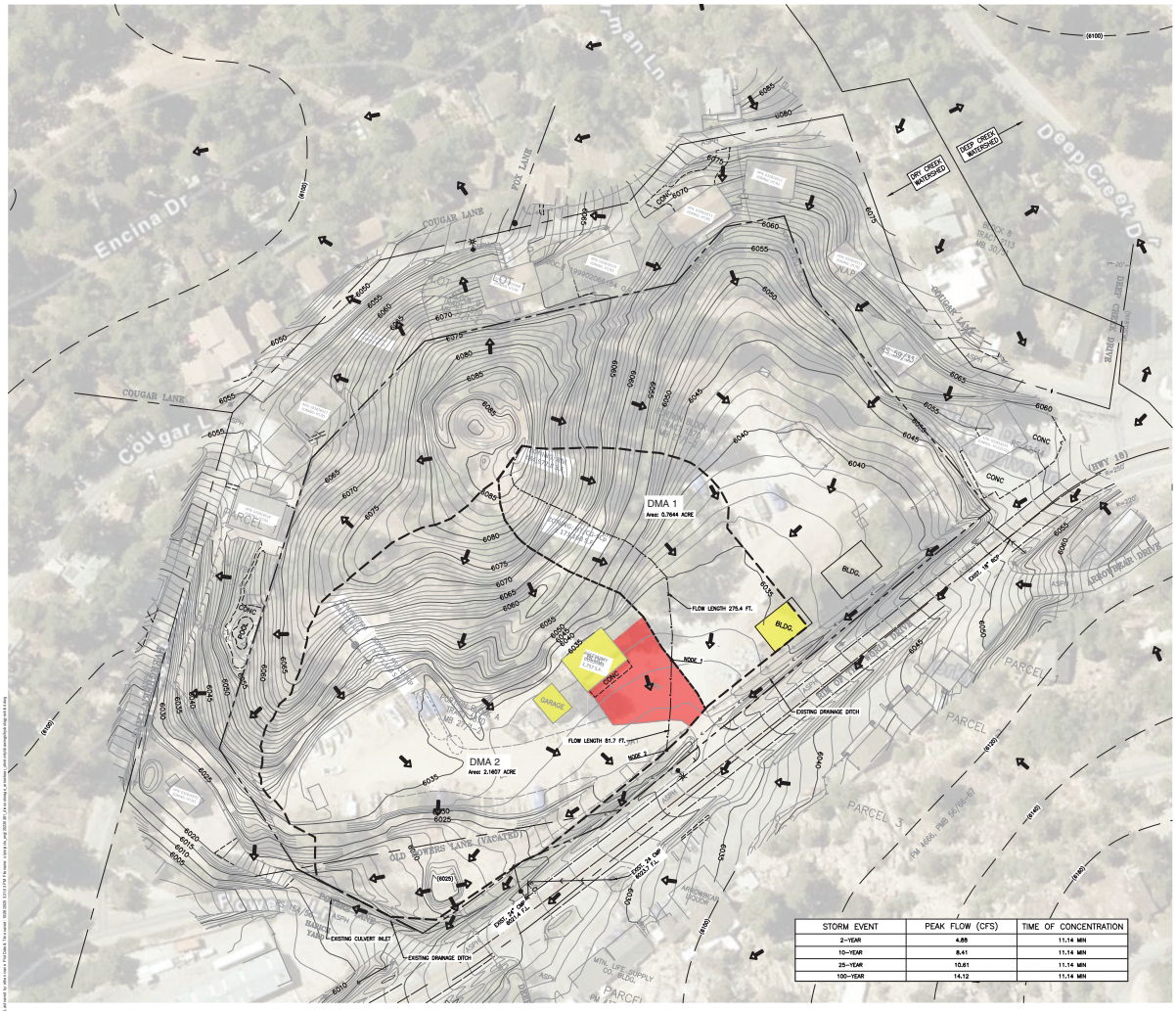
C: Detention Basin Design

D: Hydraulic Calculations and Resources

E: FEMA and DWR Floodplain Maps

F: Infiltration Report

Appendix A: Hydrology Maps



GENERAL LEGEND

- PROPERTY LINE
- LIMIT OF TRIBUTARY AREA
- TIME OF CONCENTRATION
- USGS 20FT CONTOURS
- WATERSHED BOUNDARY
- BIORETENTION BASIN
- BUILDING
- PAVEMENT
- HARDSCAPE
- DIRECTION OF SURFACE FLOW

PRE DEVELOPMENT		
	AREA (ACRE)	% IMP
DMA 1	0.7644	3%
DMA 2	2.1607	10%
TOTAL	2.9251	

STORM EVENT	PEAK FLOW (CFS)	TIME OF CONCENTRATION
2-YEAR	4.88	11.14 MIN
10-YEAR	8.41	11.14 MIN
25-YEAR	10.61	11.14 MIN
100-YEAR	14.12	11.14 MIN

WALSH ENGINEERING
WALSHENGINEERING.NET (805) 319-4948
1909 GARDEN STREET, SUITE 202-204 SAN LUIS OBISPO, CA 93401

PRELIMINARY NOT FOR CONSTRUCTION
10-17-2025

NO.	DATE	REVISIONS
1	10/17/25	PER HOUSE TO COMMENTS

SCALE: 1" = 40'

Know what's below. Call811 before you dig.

NOTE: UTILITIES SHOWN BOPE PLOTTED FROM OBSERVED EVIDENCE AND PLANS OBTAINED FROM UTILITY PROVIDERS. EXACT LOCATIONS MUST BE DETERMINED BY THE CONTRACTOR. SHALL CALL 811 FOR UTILITY LOCATIONS BEFORE FINISH IS EXCAVATION. IT IS THE CONTRACTOR'S RESPONSIBILITY TO PROTECT EXISTING UTILITIES. ANY DAMAGE TO EXISTING UTILITIES WILL BE THE SOLE RESPONSIBILITY OF THE CONTRACTOR.

ON THE MOUNTAIN BOAT & THE BOAT YARD

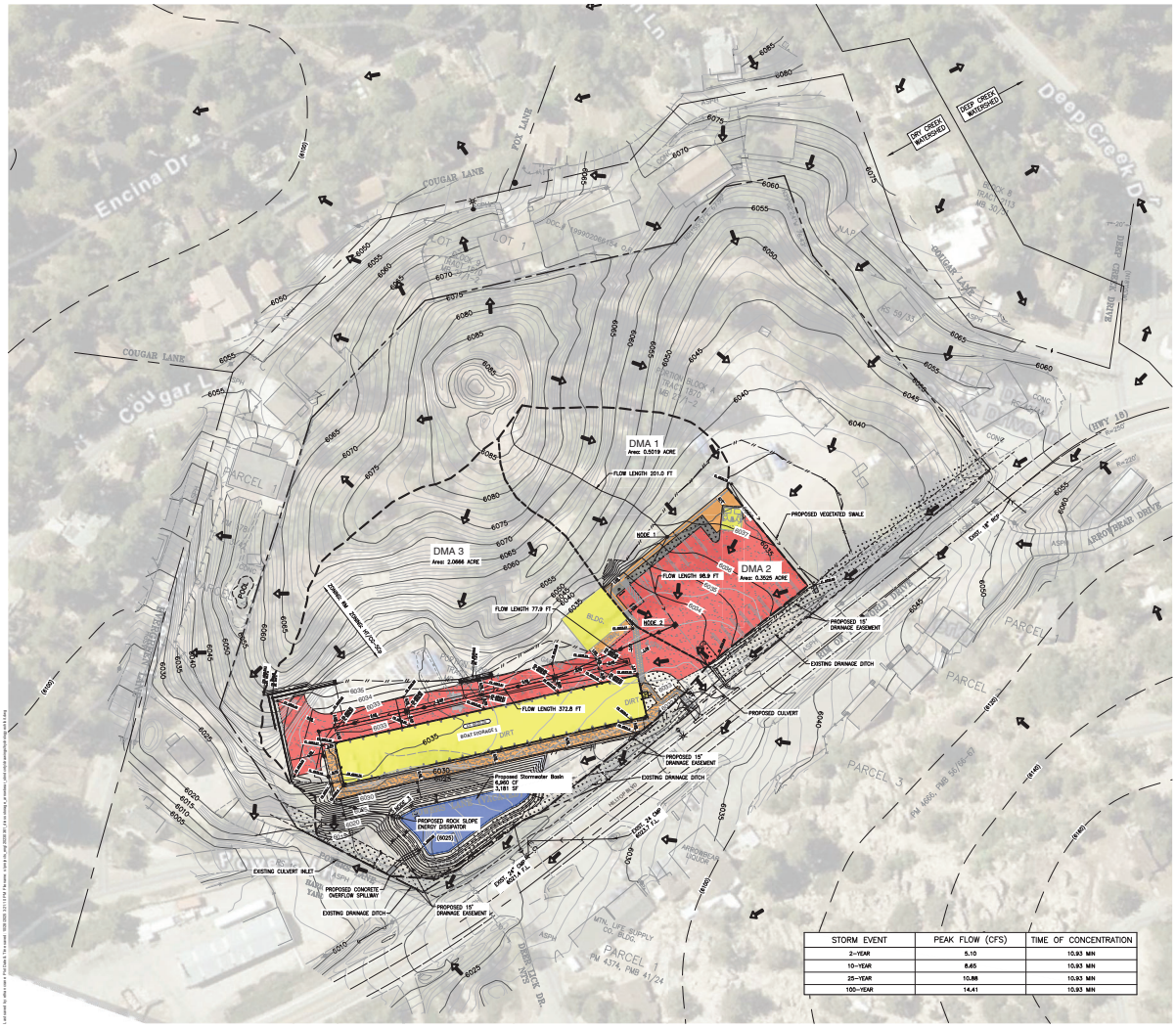
2884 HILLTOP BLVD
ARROYO GRANDE, CA 93214

PRE-DEVELOPMENT HYDROLOGY EXHIBIT

design by: EJC
drawn by: EJC
checked by: MRW

10/28/2025

project #: 20230360



STORM EVENT	PEAK FLOW (CFS)	TIME OF CONCENTRATION
2-YEAR	5.10	10.93 MIN
10-YEAR	8.65	10.93 MIN
25-YEAR	10.88	10.93 MIN
100-YEAR	14.41	10.93 MIN

GENERAL LEGEND

- PROPERTY LINE
- LIMIT OF TRIBUTARY AREA
- TIME OF CONCENTRATION
- USGS 20FT CONTOURS
- WATERSHED BOUNDARY
- BIORETENTION BASIN
- BUILDING
- PAVEMENT
- HARDSCAPE
- DIRECTION OF SURFACE FLOW
- DIRECTION OF PIPE FLOW

POST DEVELOPMENT		
	AREA (ACRE)	% IMP
DMA 1	0.5019	0%
DMA 2	0.3525	94%
DMA 3	2.0666	32%
TOTAL	2.9209	

NOTE: UTILITIES SHOWN BOPE PLOTTED FROM OBSERVED EVIDENCE AND PLANS OBTAINED FROM UTILITY PROVIDERS. EXACT LOCATIONS OF UTILITIES SHALL BE VERIFIED BY THE CONTRACTOR SHALL CALL 811 FOR UTILITY AND LINE MARKING PRIOR TO EXCAVATION. THE CONTRACTOR SHALL POTHOLE ALL EXISTING UTILITIES. ANY DAMAGE TO EXISTING UTILITIES WILL BE THE SOLE RESPONSIBILITY OF THE CONTRACTOR.

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PAGE
2 OF 3

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PRELIMINARY NOT FOR CONSTRUCTION

10-17-2025

NO.	DATE	DESCRIPTION
1	10.17.25	PER CITY COMMENTS
2	10.27.25	PER CITY COMMENTS

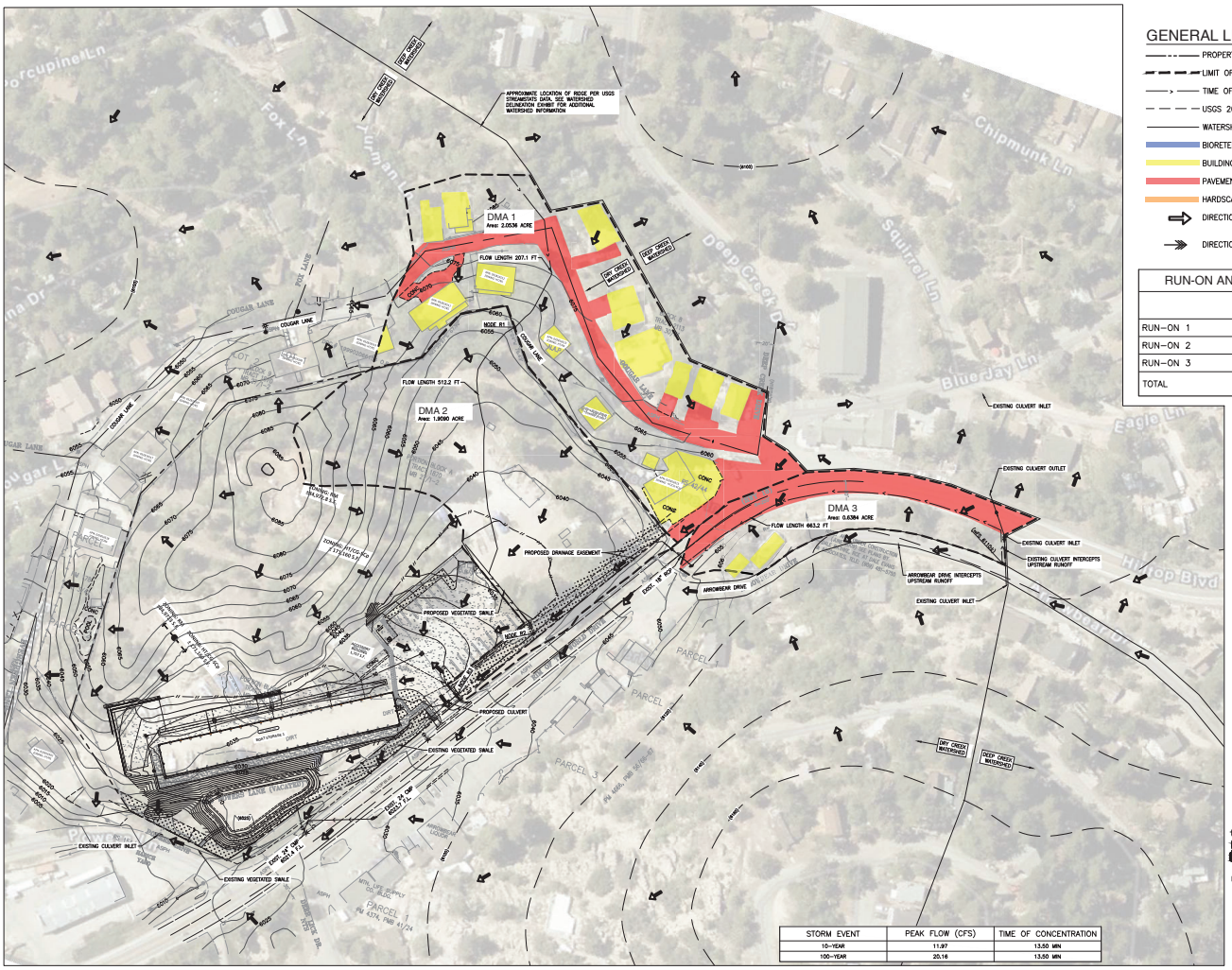
ON THE MOUNTAIN BOAT & THE BOAT YARD
2884 HILLTOP BLVD
ARROWHEAD LAKE, CA 92314

POST-DEVELOPMENT HYDROLOGY EXHIBIT

design by: E.JC
drawn by: E.JC
checked by: MRW

10/28/2025

project #: 20230360



GENERAL LEGEND

- PROPERTY LINE
- LIMIT OF TRIBUTARY AREA
- TIME OF CONCENTRATION
- USGS 20FT CONTOURS
- WATERSHED BOUNDARY
- BIORETENTION BASIN
- BUILDING
- PAVEMENT
- HARDSCAPE
- DIRECTION OF SURFACE FLOW
- DIRECTION OF PIPE FLOW

RUN-ON ANALYSIS		
	AREA (ACRE)	% IMP
RUN-ON 1	2.0536	50%
RUN-ON 2	1.9090	0%
RUN-ON 3	0.6351	46%
TOTAL	4.5977	

STORM EVENT	PEAK FLOW (CFS)	TIME OF CONCENTRATION
10-YEAR	11.97	13.50 MIN
100-YEAR	20.16	13.50 MIN

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PRELIMINARY NOT FOR CONSTRUCTION
10-17-2025

NO.	DATE	REVISIONS
1	10/17/25	RESPONSE TO COMMENTS

NOTE: UTILITIES SHOWN WERE PLOTTED FROM OBSERVED EVIDENCE AND PLANS OBTAINED FROM UTILITY PROVIDERS. EXACT LOCATIONS MAY VARY. BEFORE ANY EXCAVATION CONTRACTOR SHALL CALL 811 FOR UTILITY LOCATING SERVICES PRIOR TO EXCAVATION AND SHALL HAND EXCAVATE AROUND EXPOSING UTILITIES. ANY DAMAGE TO EXISTING UTILITIES WILL BE THE SOLE RESPONSIBILITY OF THE CONTRACTOR.

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ON THE MOUNTAIN BOAT & THE BOAT YARD

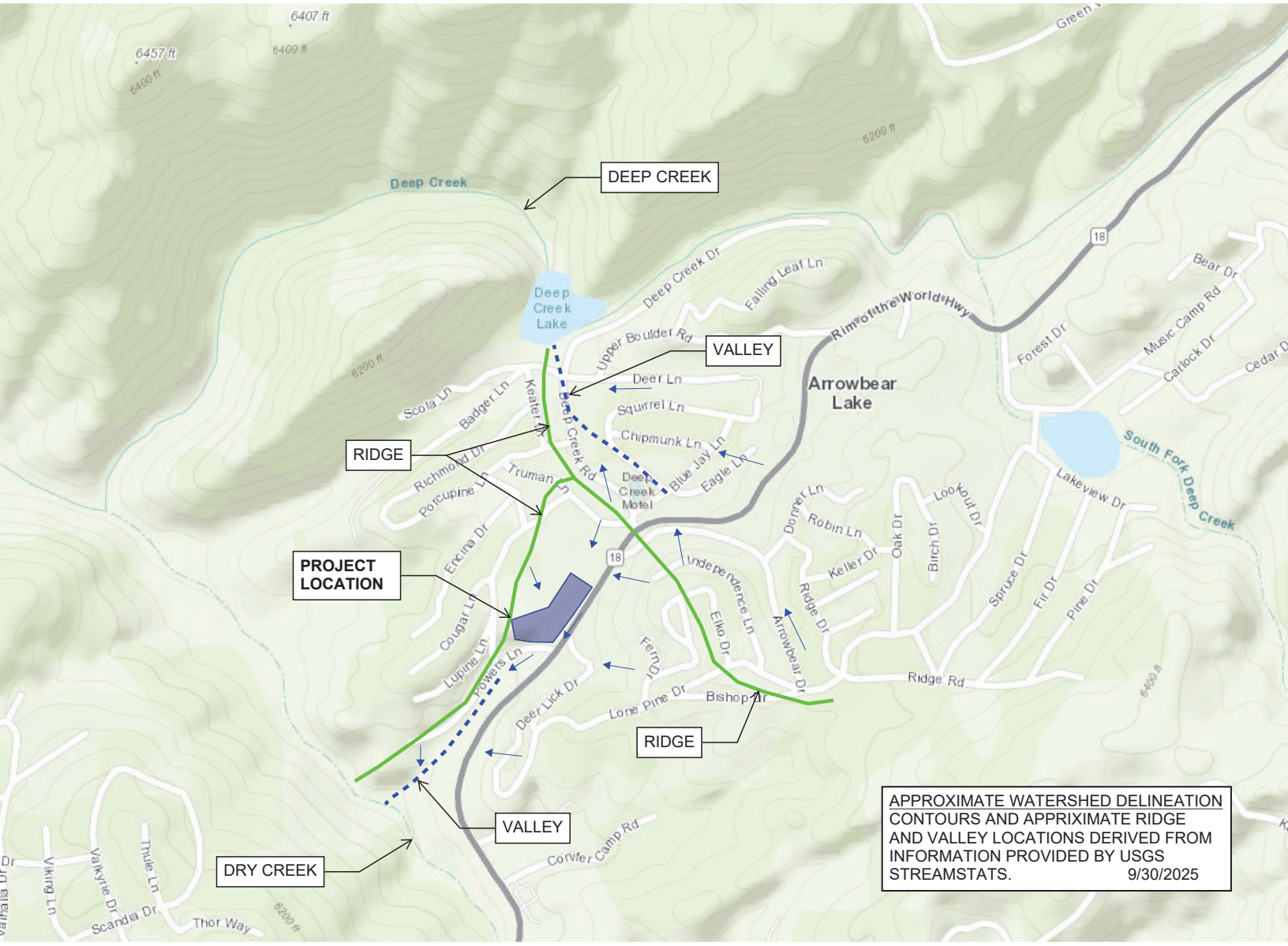
2884 HILLTOP BLVD
ARROWBEAR LAKE, CA 92314

CULVERT ANALYSIS
HYDROLOGY EXHIBIT

design by: E.JC
drawn by: E.JC
checked by: MRW

10/28/2025

project #: 20230360



APPROXIMATE WATERSHED DELINEATION CONTOURS AND APPRIXIMATE RIDGE AND VALLEY LOCATIONS DERIVED FROM INFORMATION PROVIDED BY USGS STREAMSTATS. 9/30/2025

Appendix B: Hydrologic Calculations and Resources

NOAA Atlas 14, Volume 6, Version 2
Location name: Running Springs, California, USA*
Latitude: 34.2099°, Longitude: -117.0867°
Elevation: 6043 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	2.16 (1.79-2.63)	2.96 (2.45-3.61)	4.03 (3.32-4.92)	4.91 (4.02-6.05)	6.13 (4.86-7.82)	7.09 (5.50-9.24)	8.09 (6.12-10.8)	9.12 (6.71-12.5)	10.5 (7.44-15.1)	11.7 (7.96-17.3)
10-min	1.55 (1.28-1.88)	2.12 (1.76-2.59)	2.89 (2.38-3.53)	3.52 (2.89-4.34)	4.40 (3.48-5.60)	5.08 (3.94-6.62)	5.79 (4.39-7.73)	6.53 (4.81-8.98)	7.56 (5.33-10.8)	8.38 (5.71-12.4)
15-min	1.25 (1.04-1.52)	1.71 (1.42-2.08)	2.33 (1.92-2.84)	2.84 (2.32-3.50)	3.54 (2.81-4.52)	4.10 (3.18-5.34)	4.67 (3.54-6.23)	5.27 (3.88-7.24)	6.10 (4.30-8.73)	6.75 (4.60-10.0)
30-min	0.874 (0.726-1.07)	1.20 (0.992-1.46)	1.63 (1.35-1.99)	1.99 (1.63-2.45)	2.48 (1.97-3.17)	2.87 (2.23-3.74)	3.27 (2.48-4.37)	3.69 (2.72-5.07)	4.27 (3.01-6.11)	4.73 (3.22-7.01)
60-min	0.616 (0.511-0.750)	0.844 (0.699-1.03)	1.15 (0.949-1.40)	1.40 (1.15-1.73)	1.75 (1.38-2.23)	2.02 (1.57-2.63)	2.30 (1.74-3.08)	2.60 (1.91-3.57)	3.01 (2.12-4.31)	3.33 (2.27-4.94)
2-hr	0.468 (0.388-0.570)	0.636 (0.527-0.776)	0.864 (0.714-1.06)	1.06 (0.865-1.30)	1.32 (1.05-1.69)	1.54 (1.19-2.00)	1.76 (1.33-2.35)	2.00 (1.47-2.75)	2.33 (1.65-3.34)	2.60 (1.77-3.86)
3-hr	0.404 (0.335-0.492)	0.550 (0.455-0.670)	0.748 (0.618-0.914)	0.915 (0.749-1.13)	1.15 (0.911-1.47)	1.34 (1.04-1.74)	1.54 (1.16-2.05)	1.75 (1.28-2.40)	2.04 (1.44-2.92)	2.28 (1.55-3.38)
6-hr	0.312 (0.259-0.380)	0.429 (0.355-0.523)	0.588 (0.486-0.719)	0.721 (0.591-0.889)	0.909 (0.720-1.16)	1.06 (0.820-1.38)	1.21 (0.918-1.62)	1.38 (1.02-1.89)	1.61 (1.14-2.31)	1.80 (1.22-2.67)
12-hr	0.223 (0.185-0.271)	0.316 (0.262-0.385)	0.439 (0.363-0.537)	0.540 (0.443-0.666)	0.679 (0.538-0.866)	0.787 (0.611-1.02)	0.898 (0.680-1.20)	1.01 (0.746-1.39)	1.17 (0.827-1.68)	1.30 (0.883-1.92)
24-hr	0.160 (0.142-0.184)	0.234 (0.207-0.270)	0.330 (0.291-0.382)	0.408 (0.357-0.475)	0.513 (0.435-0.618)	0.594 (0.493-0.730)	0.676 (0.548-0.851)	0.760 (0.599-0.984)	0.874 (0.661-1.18)	0.961 (0.703-1.34)
2-day	0.099 (0.088-0.114)	0.147 (0.130-0.169)	0.209 (0.185-0.242)	0.260 (0.228-0.304)	0.331 (0.280-0.398)	0.385 (0.319-0.473)	0.440 (0.357-0.554)	0.498 (0.392-0.644)	0.576 (0.436-0.777)	0.637 (0.466-0.889)
3-day	0.073 (0.064-0.084)	0.108 (0.095-0.124)	0.155 (0.136-0.179)	0.193 (0.169-0.225)	0.247 (0.209-0.297)	0.289 (0.240-0.355)	0.332 (0.269-0.418)	0.377 (0.297-0.489)	0.440 (0.333-0.594)	0.489 (0.358-0.683)
4-day	0.059 (0.052-0.067)	0.087 (0.077-0.100)	0.125 (0.110-0.145)	0.157 (0.137-0.183)	0.201 (0.170-0.242)	0.236 (0.196-0.291)	0.273 (0.221-0.344)	0.312 (0.246-0.404)	0.366 (0.277-0.494)	0.409 (0.299-0.571)
7-day	0.039 (0.034-0.045)	0.057 (0.050-0.066)	0.082 (0.073-0.095)	0.104 (0.091-0.121)	0.136 (0.115-0.163)	0.161 (0.134-0.198)	0.189 (0.153-0.238)	0.218 (0.172-0.283)	0.261 (0.197-0.352)	0.296 (0.217-0.414)
10-day	0.029 (0.026-0.034)	0.042 (0.037-0.049)	0.061 (0.054-0.071)	0.078 (0.068-0.091)	0.102 (0.086-0.123)	0.122 (0.101-0.150)	0.143 (0.116-0.181)	0.167 (0.132-0.217)	0.202 (0.153-0.273)	0.231 (0.169-0.323)
20-day	0.018 (0.016-0.021)	0.026 (0.023-0.030)	0.037 (0.033-0.043)	0.047 (0.041-0.055)	0.061 (0.052-0.074)	0.074 (0.061-0.091)	0.087 (0.070-0.110)	0.102 (0.080-0.132)	0.124 (0.093-0.167)	0.142 (0.104-0.199)
30-day	0.014 (0.012-0.016)	0.020 (0.018-0.023)	0.028 (0.025-0.033)	0.036 (0.031-0.042)	0.047 (0.040-0.057)	0.056 (0.047-0.069)	0.066 (0.054-0.084)	0.078 (0.061-0.100)	0.094 (0.071-0.127)	0.108 (0.079-0.151)
45-day	0.011 (0.010-0.013)	0.016 (0.014-0.018)	0.023 (0.020-0.026)	0.028 (0.025-0.033)	0.037 (0.031-0.044)	0.044 (0.036-0.054)	0.051 (0.041-0.065)	0.059 (0.047-0.077)	0.072 (0.054-0.097)	0.082 (0.060-0.114)
60-day	0.010 (0.009-0.011)	0.014 (0.012-0.016)	0.020 (0.017-0.023)	0.024 (0.021-0.029)	0.031 (0.027-0.038)	0.037 (0.031-0.046)	0.043 (0.035-0.055)	0.050 (0.039-0.065)	0.060 (0.045-0.081)	0.068 (0.049-0.094)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

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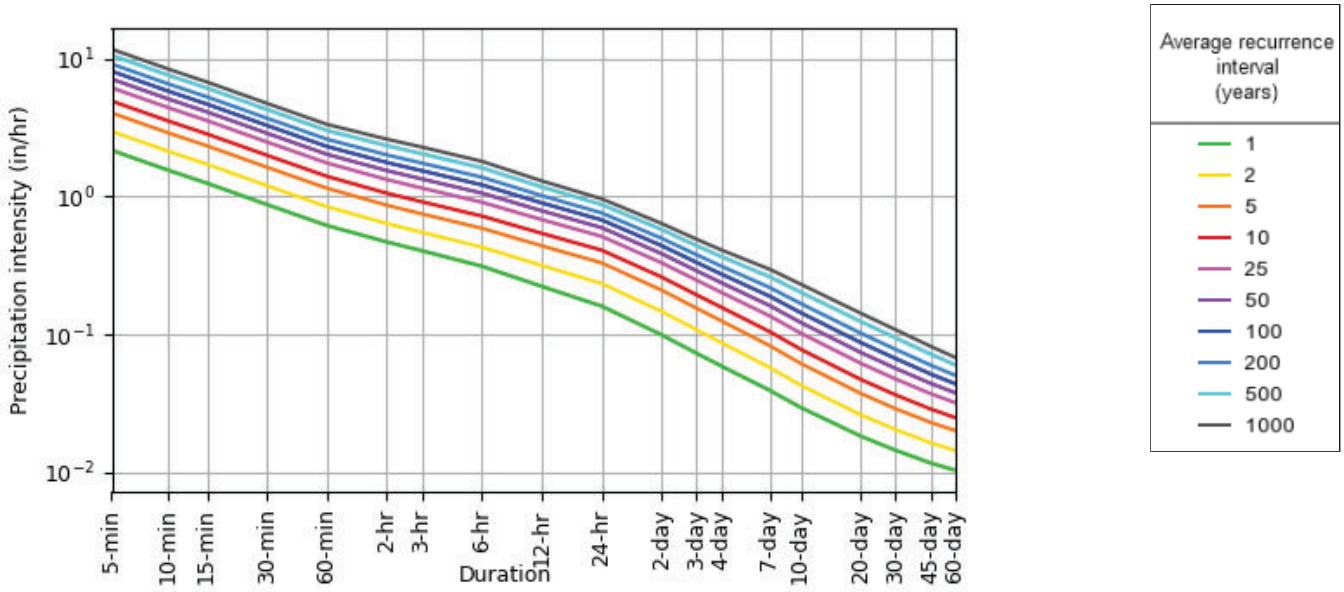
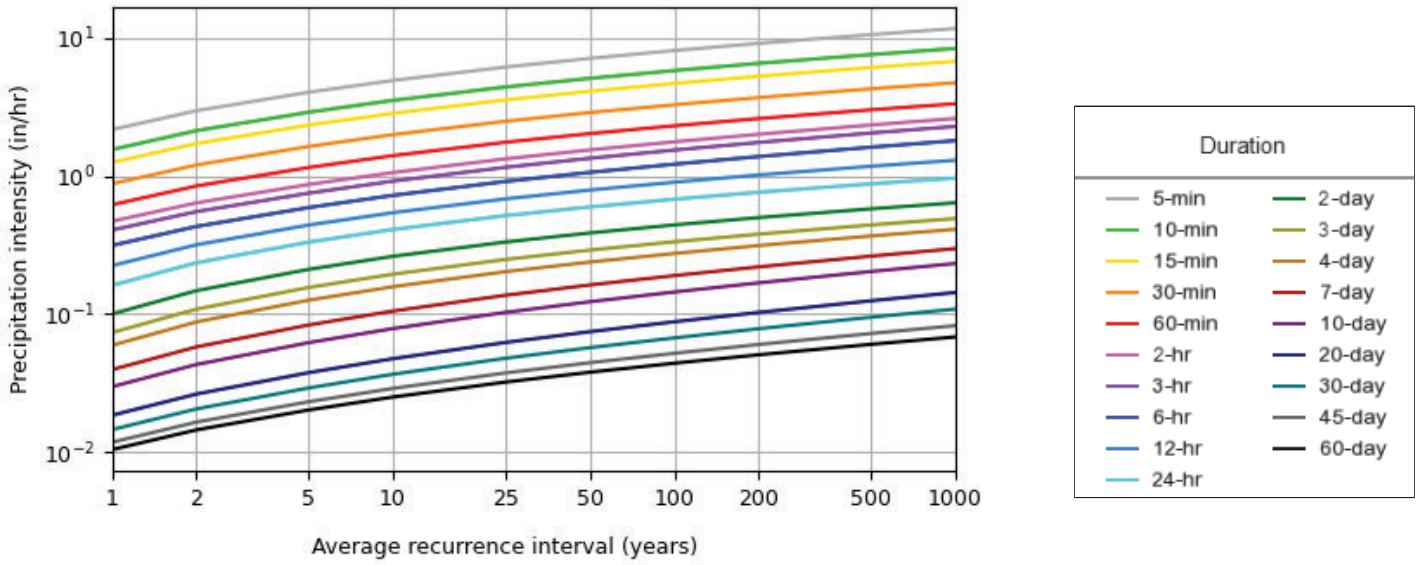
Back to Top

PF graphical

PDS-based intensity-duration-frequency (IDF) curves
Latitude: 34.2099°, Longitude: -117.0867°





NOAA Atlas 14, Volume 6, Version 2

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Back to Top

Maps & aerials

Small scale terrain

NOAA Atlas 14, Volume 6, Version 2
Location name: Running Springs, California, USA*
Latitude: 34.2099°, Longitude: -117.0867°
Elevation: 6043 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.180 (0.149-0.219)	0.247 (0.204-0.301)	0.336 (0.277-0.410)	0.409 (0.335-0.504)	0.511 (0.405-0.652)	0.591 (0.458-0.770)	0.674 (0.510-0.899)	0.760 (0.559-1.04)	0.879 (0.620-1.26)	0.974 (0.663-1.44)
10-min	0.258 (0.214-0.314)	0.354 (0.293-0.431)	0.481 (0.397-0.588)	0.587 (0.481-0.723)	0.733 (0.580-0.934)	0.847 (0.657-1.10)	0.965 (0.731-1.29)	1.09 (0.801-1.50)	1.26 (0.889-1.80)	1.40 (0.951-2.07)
15-min	0.312 (0.259-0.380)	0.428 (0.354-0.521)	0.582 (0.481-0.711)	0.709 (0.581-0.874)	0.886 (0.702-1.13)	1.02 (0.795-1.33)	1.17 (0.884-1.56)	1.32 (0.969-1.81)	1.52 (1.08-2.18)	1.69 (1.15-2.50)
30-min	0.437 (0.363-0.533)	0.599 (0.496-0.730)	0.815 (0.673-0.996)	0.994 (0.814-1.22)	1.24 (0.984-1.58)	1.44 (1.11-1.87)	1.64 (1.24-2.18)	1.85 (1.36-2.53)	2.14 (1.51-3.06)	2.36 (1.61-3.51)
60-min	0.616 (0.511-0.750)	0.844 (0.699-1.03)	1.15 (0.949-1.40)	1.40 (1.15-1.73)	1.75 (1.38-2.23)	2.02 (1.57-2.63)	2.30 (1.74-3.08)	2.60 (1.91-3.57)	3.01 (2.12-4.31)	3.33 (2.27-4.94)
2-hr	0.936 (0.777-1.14)	1.27 (1.06-1.55)	1.73 (1.43-2.11)	2.11 (1.73-2.60)	2.65 (2.10-3.38)	3.08 (2.39-4.01)	3.53 (2.67-4.71)	4.00 (2.94-5.50)	4.67 (3.29-6.68)	5.20 (3.55-7.72)
3-hr	1.21 (1.01-1.48)	1.65 (1.37-2.01)	2.25 (1.86-2.75)	2.75 (2.25-3.39)	3.46 (2.74-4.41)	4.02 (3.12-5.24)	4.61 (3.49-6.16)	5.24 (3.86-7.20)	6.13 (4.33-8.78)	6.85 (4.67-10.2)
6-hr	1.87 (1.55-2.28)	2.57 (2.13-3.14)	3.52 (2.91-4.31)	4.32 (3.54-5.33)	5.44 (4.31-6.94)	6.34 (4.92-8.25)	7.27 (5.50-9.70)	8.26 (6.08-11.3)	9.65 (6.81-13.8)	10.8 (7.34-16.0)
12-hr	2.69 (2.23-3.28)	3.81 (3.16-4.64)	5.29 (4.37-6.47)	6.51 (5.34-8.03)	8.19 (6.49-10.4)	9.49 (7.36-12.4)	10.8 (8.20-14.5)	12.2 (8.99-16.8)	14.1 (9.97-20.2)	15.6 (10.6-23.2)
24-hr	3.85 (3.41-4.44)	5.62 (4.97-6.48)	7.93 (7.00-9.17)	9.80 (8.58-11.4)	12.3 (10.4-14.8)	14.3 (11.8-17.5)	16.2 (13.2-20.4)	18.2 (14.4-23.6)	21.0 (15.9-28.3)	23.1 (16.9-32.2)
2-day	4.78 (4.23-5.50)	7.06 (6.25-8.14)	10.1 (8.88-11.6)	12.5 (11.0-14.6)	15.9 (13.5-19.1)	18.5 (15.4-22.7)	21.2 (17.1-26.6)	23.9 (18.8-31.0)	27.7 (20.9-37.3)	30.6 (22.4-42.7)
3-day	5.26 (4.66-6.05)	7.79 (6.89-8.98)	11.2 (9.85-12.9)	14.0 (12.2-16.3)	17.8 (15.1-21.4)	20.8 (17.3-25.6)	24.0 (19.4-30.2)	27.2 (21.5-35.2)	31.7 (24.0-42.8)	35.3 (25.8-49.2)
4-day	5.66 (5.02-6.52)	8.38 (7.42-9.66)	12.0 (10.6-13.9)	15.1 (13.2-17.6)	19.4 (16.4-23.3)	22.7 (18.9-28.0)	26.3 (21.3-33.1)	30.0 (23.6-38.8)	35.2 (26.6-47.4)	39.3 (28.8-54.8)
7-day	6.61 (5.86-7.61)	9.67 (8.55-11.1)	13.9 (12.3-16.1)	17.6 (15.4-20.5)	22.9 (19.4-27.5)	27.2 (22.6-33.4)	31.8 (25.7-40.0)	36.8 (29.0-47.6)	44.0 (33.3-59.3)	49.9 (36.5-69.6)
10-day	7.10 (6.29-8.18)	10.3 (9.11-11.9)	14.8 (13.1-17.1)	18.8 (16.4-21.9)	24.5 (20.8-29.6)	29.3 (24.3-36.1)	34.5 (28.0-43.5)	40.2 (31.7-52.1)	48.6 (36.8-65.5)	55.6 (40.6-77.5)
20-day	8.82 (7.81-10.2)	12.6 (11.1-14.5)	18.0 (15.9-20.8)	22.7 (19.9-26.5)	29.7 (25.2-35.8)	35.6 (29.5-43.8)	42.0 (34.0-52.9)	49.1 (38.7-63.6)	59.6 (45.1-80.4)	68.5 (50.1-95.6)
30-day	10.4 (9.23-12.0)	14.7 (13.0-17.0)	20.9 (18.4-24.1)	26.3 (23.0-30.6)	34.3 (29.0-41.3)	40.9 (34.0-50.3)	48.2 (39.0-60.7)	56.2 (44.3-72.8)	68.0 (51.5-91.7)	78.0 (57.0-109)
45-day	12.7 (11.2-14.6)	17.7 (15.7-20.4)	24.9 (22.0-28.8)	31.1 (27.2-36.3)	40.2 (34.1-48.4)	47.7 (39.6-58.7)	55.9 (45.3-70.3)	64.8 (51.1-83.8)	77.8 (58.8-105)	88.6 (64.8-124)
60-day	14.9 (13.2-17.2)	20.8 (18.4-23.9)	28.9 (25.5-33.4)	35.9 (31.4-41.9)	46.0 (39.0-55.4)	54.3 (45.1-66.8)	63.1 (51.2-79.5)	72.7 (57.3-94.1)	86.5 (65.5-117)	97.9 (71.6-137)

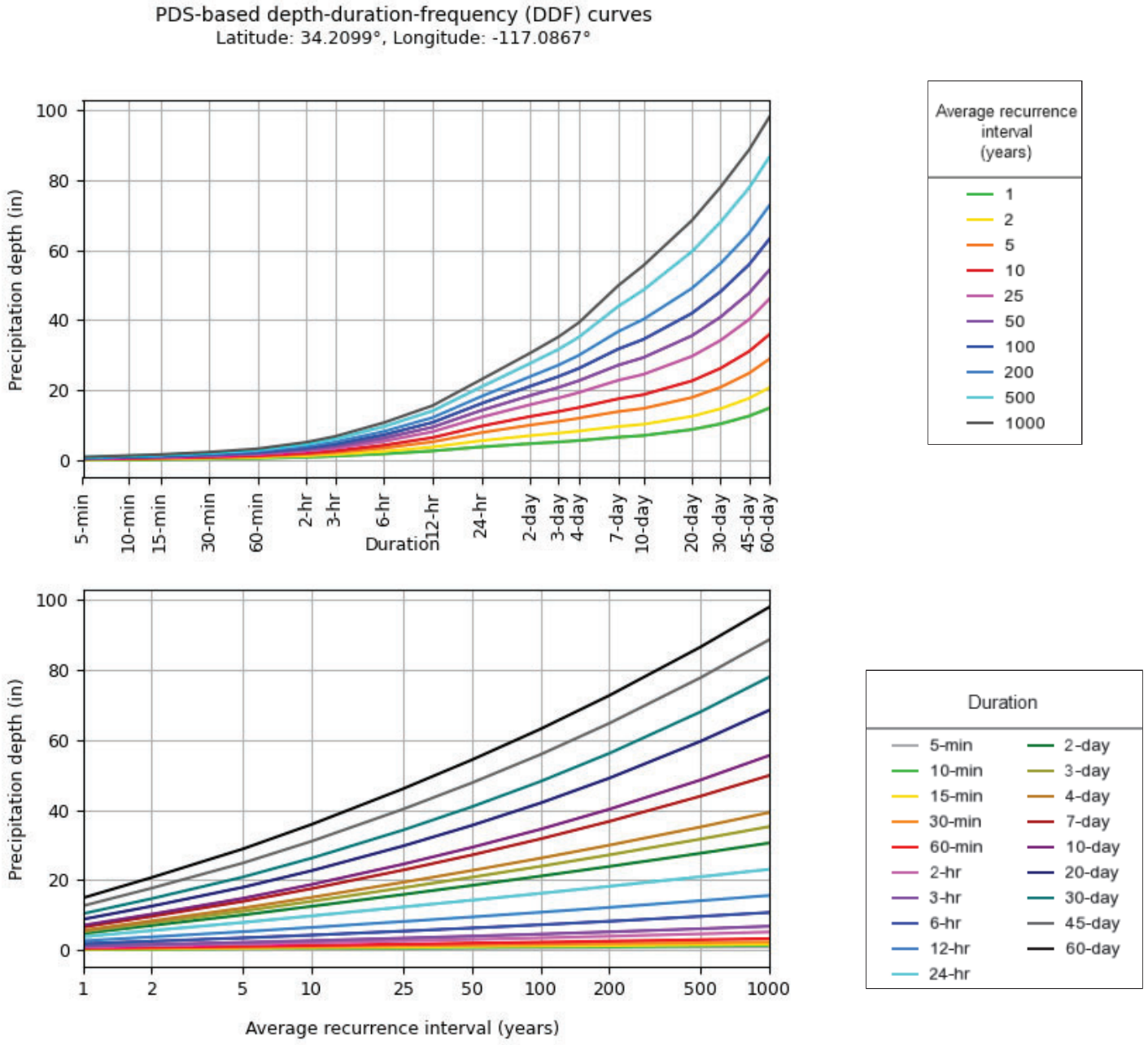
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Back to Top

PF graphical



NOAA Atlas 14, Volume 6, Version 2

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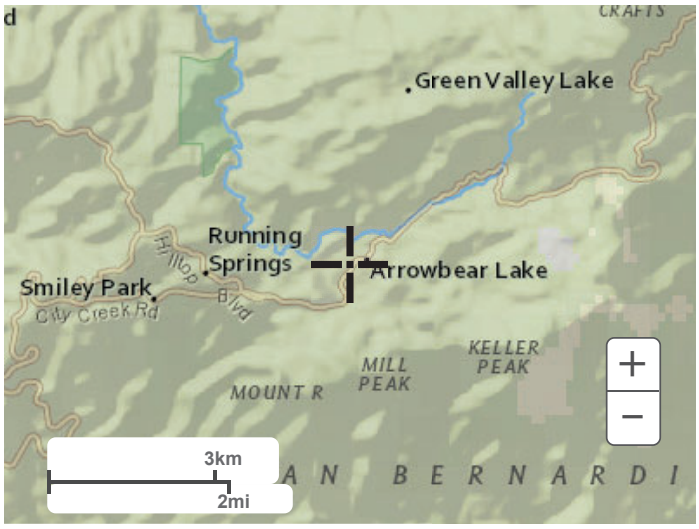
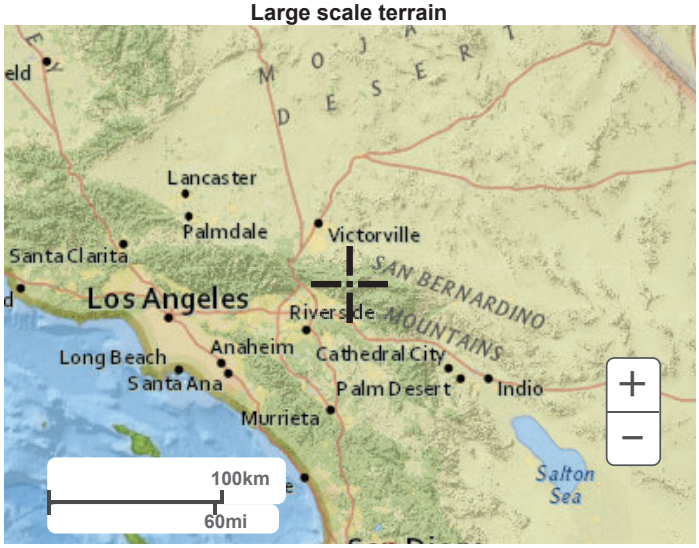
Back to Top

Maps & aerials

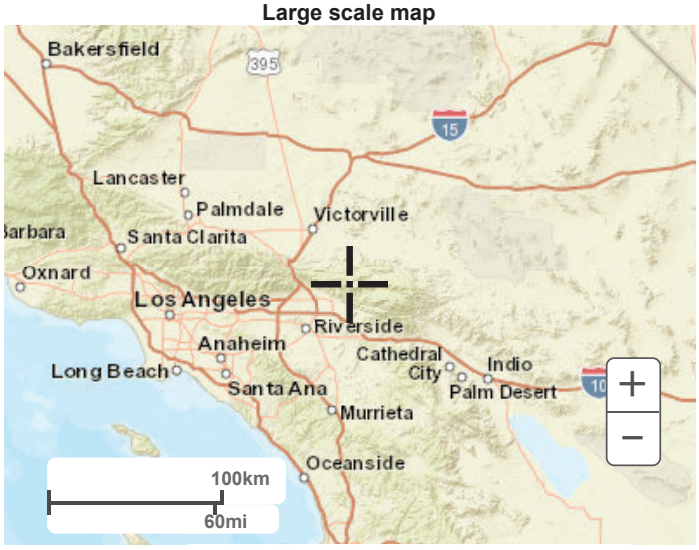
Small scale terrain



Large scale terrain



Large scale map



Large scale aerial

Adjusted Rainfall Intensities

	2 Year Interval		10 Year Interval		25 Year Interval		100 Year Interval	
Sub- Area	Duration (Min)	Intensity (in/hr)	Duration (Min)	Intensity (in/hr)	Duration (Min)	Intensity (in/hr)	Duration (Min)	Intensity (in/hr)
	--	--	5	4.91	--	--	5	8.09
	10	2.12	10	3.52	10	4.4	10	5.79
	15	1.71	15	2.84	15	3.54	15	4.67
	30	1.2	30	1.99	30	2.48	30	3.27
Pre-Development								
DMA 1	10.00	2.12	10.00	3.52	10.00	4.40	10.00	5.79
DMA 2	11.14	2.03	11.14	3.36	11.14	4.20	11.14	5.53
Post-Development								
DMA 1	10.00	2.12	10.00	3.52	10.00	4.40	10.00	5.79
DMA 2	10.36	2.09	10.36	3.47	10.36	4.34	10.36	5.71
DMA 3	10.93	2.04	10.93	3.39	10.93	4.24	10.93	5.58
Existing Drainage Ditch and Culvert								
DMA 1	--	--	6	4.63	--	--	6	7.63
DMA 2	--	--	13.36	2.59	--	--	13.36	5.04
DMA 3	--	--	13.5	3.04	--	--	13.5	5.01

1. Rainfall intensities from Atlas 14
2. Adjusted rainfall intensities for time of concentration calculated using linear interpolation

Curve (1) Numbers of Hydrologic Soil-Cover Complexes For Pervious Areas-AMC II

Cover Type (3)	Quality of Cover (2)	Soil Group A	B	C	D
NATURAL COVERS -					
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
URBAN COVERS -					
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
AGRICULTURAL COVERS -					
Fallow (Land plowed but not tilled or seeded)		77	86	91	94

SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

CURVE NUMBERS FOR PERVIOUS AREAS

Figure C-3 (1 of 2)

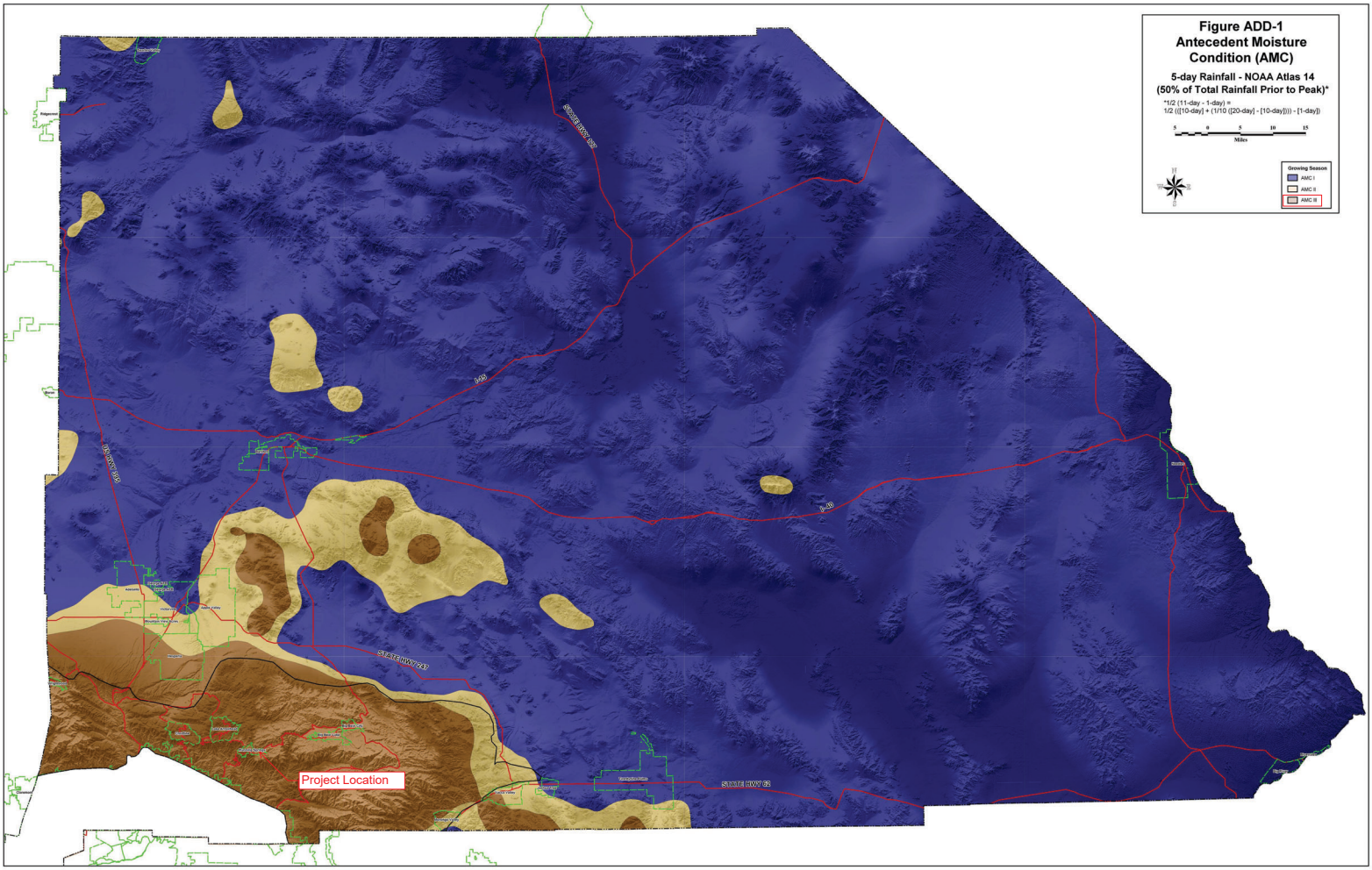
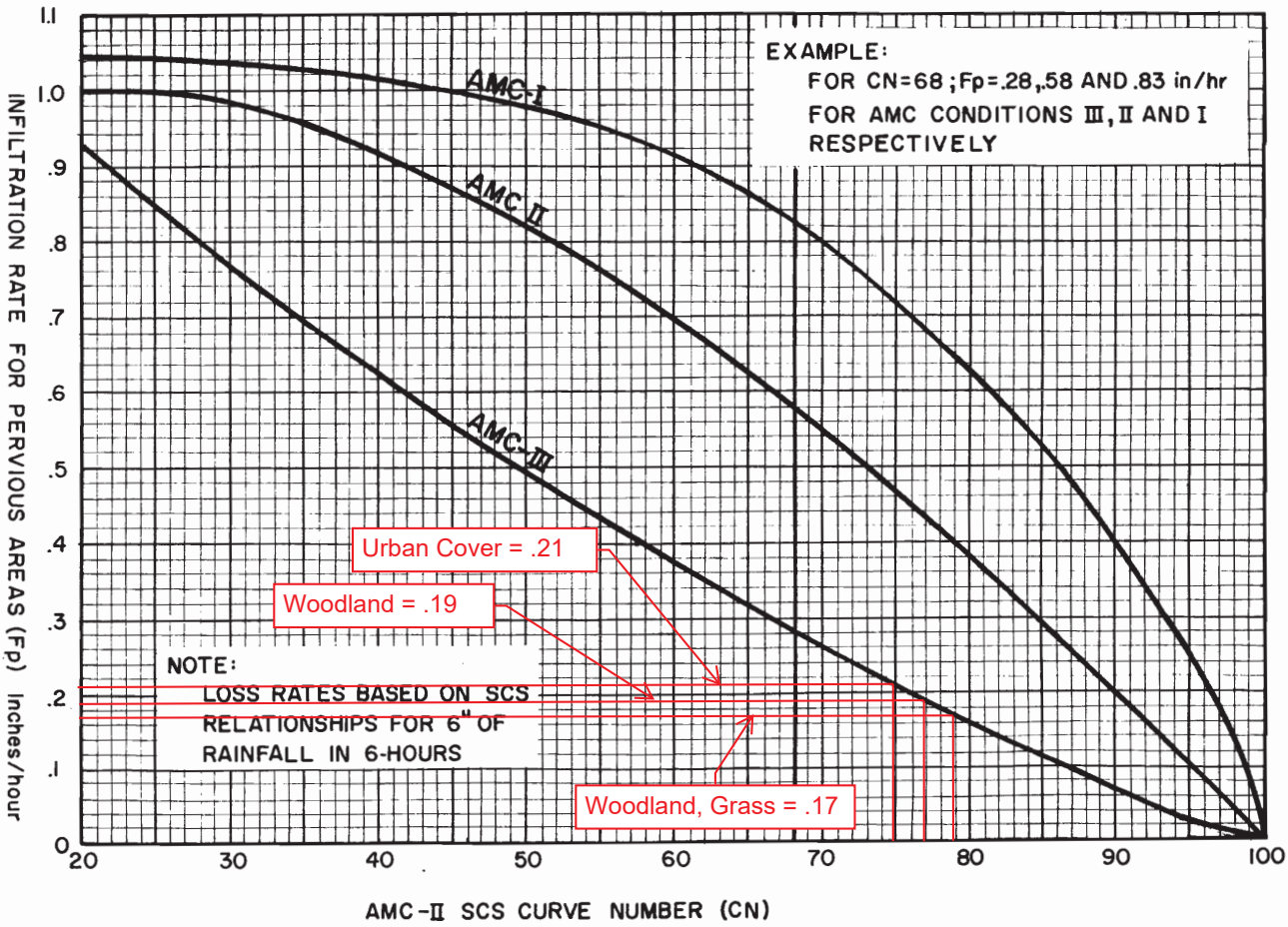
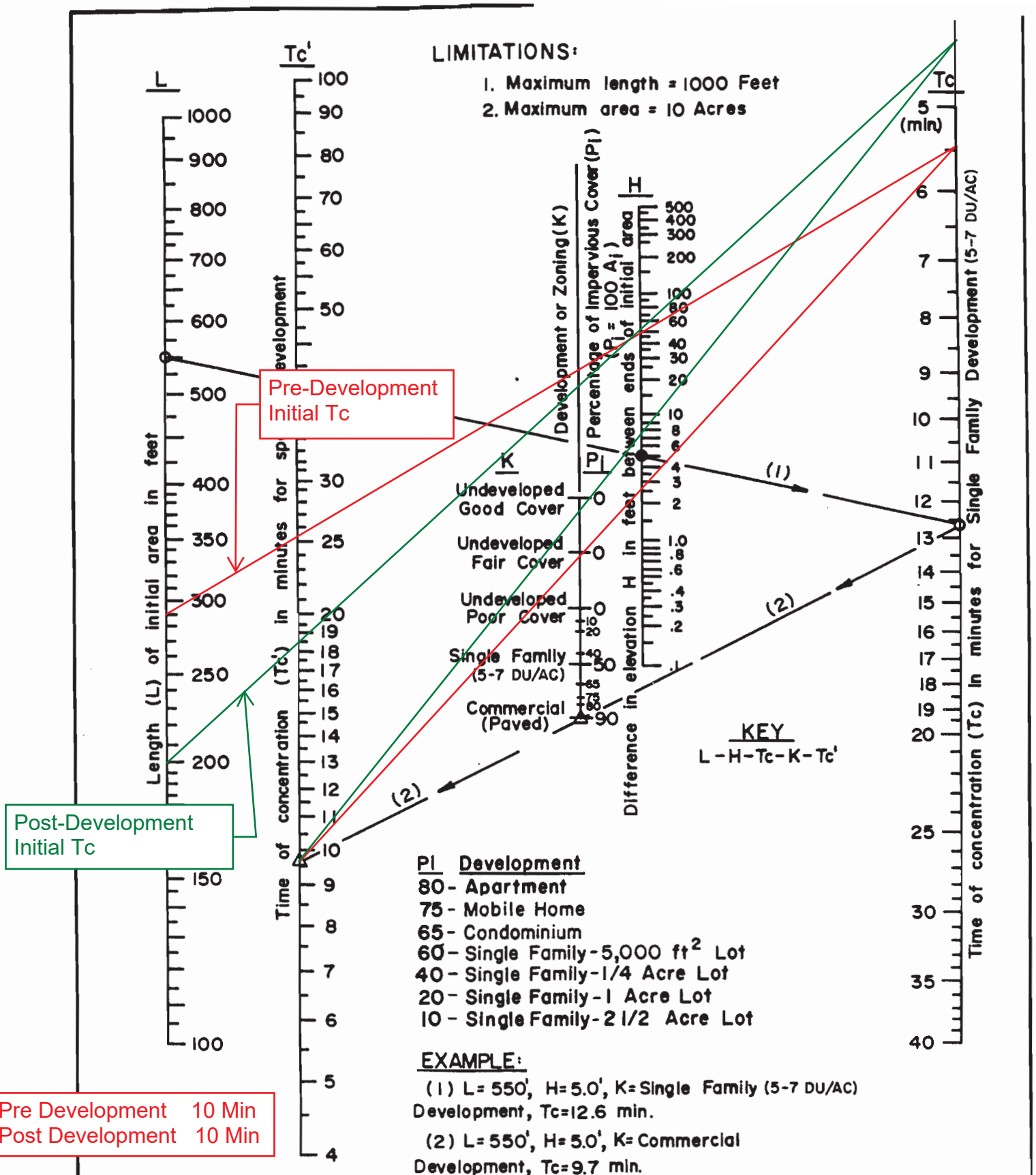


Figure ADD-1
Antecedent Moisture Condition (AMC)
5-day Rainfall - NOAA Atlas 14
(50% of Total Rainfall Prior to Peak)*
*1/2 ((11-day - 1-day) +
1/2 ([10-day] + (1/10 ([20-day] - [10-day]))) - [1-day])
5 0 5 10 15
Miles
Growing Season
AMC I
AMC II
AMC III
STATE HWY 99
STATE HWY 58
I-5
STATE HWY 43
STATE HWY 65
Project Location



INFILTRATION RATE FOR PERVIOUS AREAS VERSUS SCS CURVE NUMBERS

Figure C-6



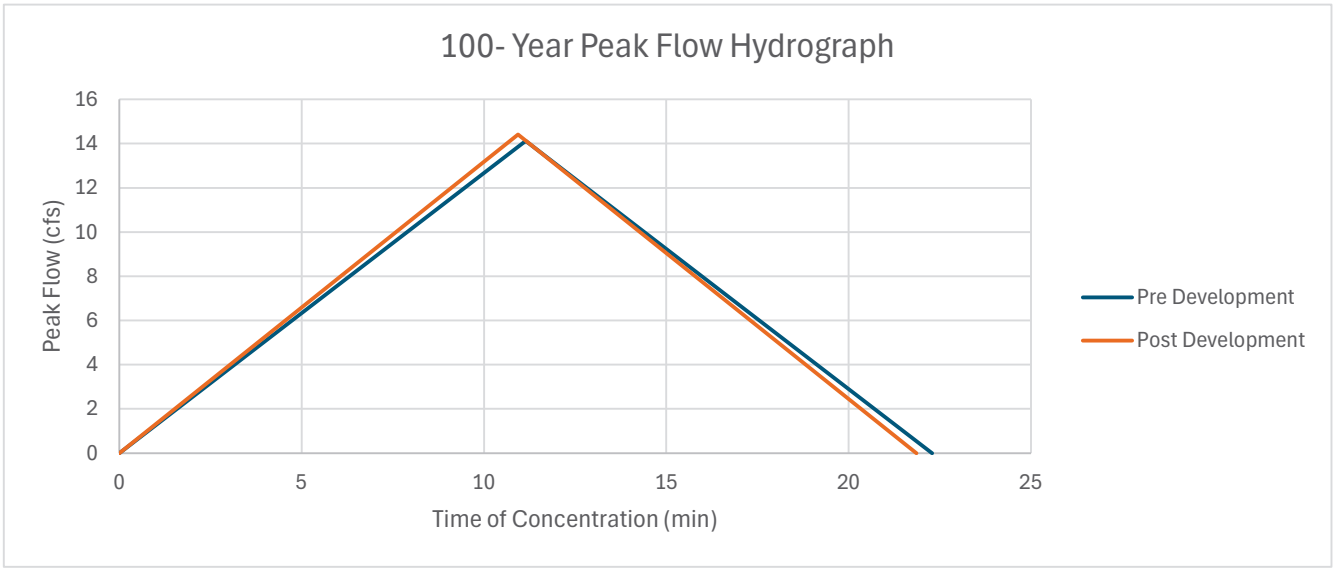
SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

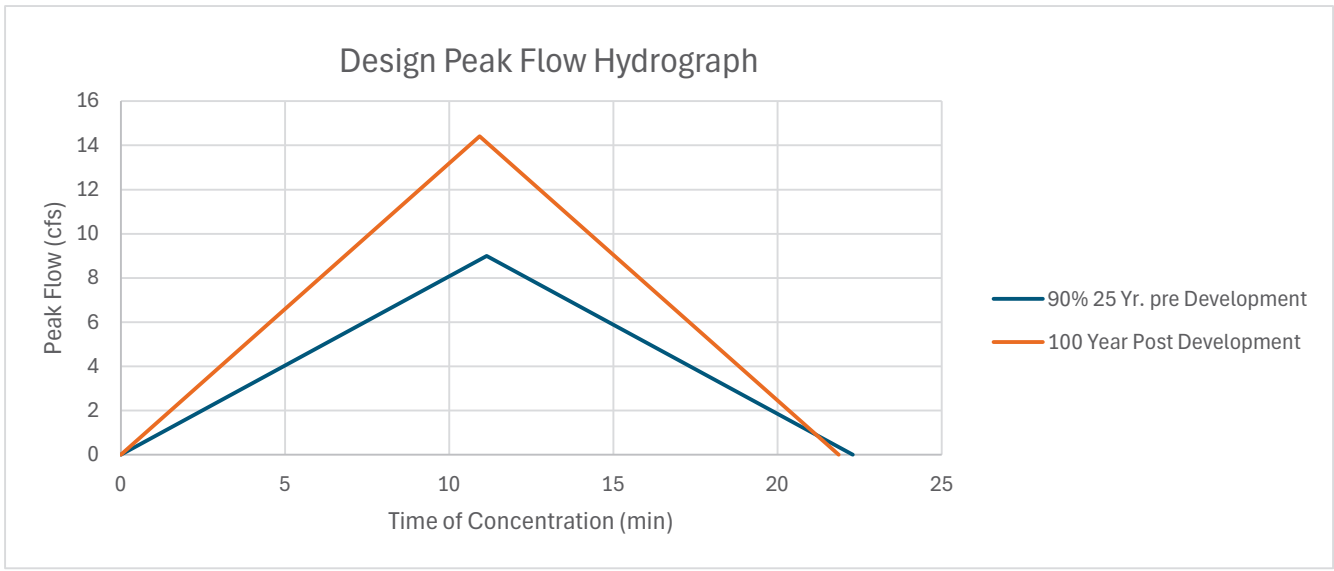
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

Sub-Basin Summary Table					
	Area (ft2)	Area (Acre)	Impervious Area (Acre)	Impervious %	Pervious %
Pre Development					
DMA 1	33,297.18	0.7644	0.0251	0.03	0.97
DMA 2	94,118.59	2.1607	0.2086	0.10	0.90
Total	127,415.77	2.9251	0.2337	0.08	0.92
Post Development					
DMA 1	21,860.66	0.5019	0.0000	0.00	1.00
DMA 2	15,355.71	0.3525	0.3331	0.94	0.06
DMA 3	90,019.41	2.0666	0.6634	0.32	0.68
Total	127,235.78	2.9209	0.9965	0.34	0.66
Run On					
RUN-ON 1	89,452.79	2.0536	1.0170	0.50	0.50
RUN-ON 2	83,125.73	1.9083	0.0000	0.00	1.00
RUN-ON 3	27,665.41	0.6351	0.2945	0.46	0.54
Total	200,243.93	4.5970	1.3115	0.29	0.71

	Summary of Peak Flow Rates				
		Pre-Development		Post-Development	
	Storm Frequency	Peak Flow Rate (cfs)	Time of Concentration (min)	Peak Flow Rate (cfs)	Time of Concentration (min)
2-Year	2-Year	4.88	11.14	5.10	10.93
10-Year	10-Year	8.41	11.14	8.65	10.93
25-Year	25-Year	10.61	11.14	10.88	10.93
100-Year	100-Year	14.12	11.14	14.41	10.93





Pre Development Calculation Summary Table																			
Sub-Basin	Area		Soil Type	Dev Type	Curve Number	Tf	Tc	I	Ap	Fp	Fm	Peak Flow	Node	Flow Length	Upstream Elevation	Downstream Elevation	Slope	V	Hydraulics and Notes
	Sub Area	Total				(min)	(min)	(in/hr)			(in/hr)	(cfs)		ft	ft	ft	(ft/ft)	(ft/sec)	
2 Year																			
DMA 1	0.7644	0.7644	D	Woodland	77	10	10.00	2.12	0.97	0.19	0.18	1.33	Node 1	275.4	6088.0	6033.5	0.198		Initial sub-basin
DMA 2	2.1607	2.9251	D	Woodland	77	1.14	11.14	2.03	0.90	0.19	0.17	**4.88**	Node 2	81.7	6033.5	6031.5	0.024	1.19	Natural Channel
10 Year																			
DMA 1	0.7644	0.7644	D	Woodland	77	10	10.00	3.52	0.97	0.19	0.18	2.29	Node 1	275.4	6088.0	6033.5	0.198		Initial sub-basin
DMA 2	2.1607	2.9251	D	Woodland	77	1.14	11.14	3.36	0.90	0.19	0.17	**8.41**	Node 2	81.7	6033.5	6031.5	0.024	1.19	Natural Channel
25 Year																			
DMA 1	0.7644	0.7644	D	Woodland	77	10	10.00	4.40	1.00	0.19	0.19	2.90	Node 1	275.4	6088.0	6033.5	0.198		Initial sub-basin
DMA 2	2.1607	2.9251	D	Woodland	77	1.14	11.14	4.20	0.90	0.19	0.17	**10.61**	Node 2	81.7	6033.5	6031.5	0.024	1.19	Natural Channel
100 Year																			
DMA 1	0.7644	0.7644	D	Woodland	77	10	10.00	5.79	0.97	0.19	0.18	3.86	Node 1	275.4	6088.0	6033.5	0.198		Initial sub-basin
DMA 2	2.1607	2.9251	D	Woodland	77	1.14	11.14	5.53	0.90	0.19	0.17	**14.12**	Node 2	81.7	6033.5	6031.5	0.024	1.19	Natural Channel

1: Initial Sub-basin Tc values were collected from San Bernardino County Hydrology Manual Figure D-1, downstream Tc calculated per Section D.3

2: Rainfall Intensities were collected using NOAA Atlas 14, See Appendix B

3: Percent Pervious (ap) was calculated based on hydrology exhibits presented in Appendix A

4: Infiltration Rates for Pervious Areas (Fp) values were selected using figure C-3 and Figure C-4, See Appendix B

Post Development Calculation Summary Table

Sub-Basin	Area		Soil Type	Dev Type	Curve Number	Tf	Tc	I	Ap	Fp	Fm	Peak Flow	Node	Flow Length	Upstream Elevation	Downstream Elevation	Slope	V	Hydraulics and Notes
	Sub Area	Total				(min)	(min)	(in/hr)			(in/hr)	(cfs)		ft	ft	ft	(ft/ft)	(ft/sec)	
2 Year																			
DMA 1	0.5019	0.5019	D	Woodland	77	10	10.00	2.12	1.00	0.19	0.19	0.87	Node 1	201.0	6088.0	6036.0	0.259		Initial sub-basin
DMA 2	0.3525	0.8544	D	Urban	75	0.36	10.36	2.09	0.06	0.21	0.01	1.60	Node 2	89.2	6036.0	6033.0	0.041	4.12	Urban
DMA 3	2.0666	2.9210	D	Woodland	77	0.57	10.93	2.04	0.54	0.19	0.10	**5.10**	Node 3	455.8	Slope Per Plan		0.005	13.4	Pipe Flow
10 Year																			
DMA 1	0.5019	0.5019	D	Woodland	77	10	10	3.52	1.00	0.19	0.19	1.50	Node 1	201.0	6088.0	6036.0	0.259		Initial sub-basin
DMA 2	0.3525	0.8544	D	Urban	75	0.36	10.36	3.47	0.06	0.21	0.01	2.66	Node 2	89.2	6036.0	6033.0	0.041	4.12	Urban
DMA 3	2.0666	2.9210	D	Woodland	77	0.57	10.93	3.39	0.54	0.19	0.10	**8.65**	Node 3	455.8	Slope Per Plan		0.005	13.4	Pipe Flow
25 Year																			
DMA 1	0.5019	0.5019	D	Woodland	77	10	10.00	4.40	1.00	0.19	0.19	1.90	Node 1	201.0	6088.0	6036.0	0.259		Initial sub-basin
DMA 2	0.3525	0.8544	D	Urban	75	0.36	10.36	4.34	0.06	0.21	0.01	3.33	Node 2	89.2	6036.0	6033.0	0.041	4.12	Urban
DMA 3	2.0666	2.9210	D	Woodland	77	0.57	10.93	4.24	0.54	0.19	0.10	**10.88**	Node 3	455.8	Slope Per Plan		0.005	13.4	Pipe Flow
100 Year																			
DMA 1	0.5019	0.5019	D	Woodland	77	10	10.00	5.79	1.00	0.19	0.19	2.53	Node 1	201.0	6088.0	6036.0	0.259		Initial sub-basin
DMA 2	0.3525	0.8544	D	Urban	75	0.36	10.36	5.71	0.06	0.21	0.01	4.38	Node 2	89.2	6036.0	6033.0	0.041	4.12	Urban
DMA 3	2.0666	2.9210	D	Woodland	77	0.57	10.93	5.58	0.54	0.19	0.10	**14.41**	Node 3	455.8	Slope Per Plan		0.030	13.4	Pipe Flow

1: Initial Sub-basin Tc values were collected from San Bernardino County Hydrology Manual Figure D-1, downstream Tc calculated per Section D.3

2: Rainfall Intensities were collected using NOAA Atlas 14, See Appendix B

3: Percent Pervious (ap) was calculated based on hydrology exhibits presented in Appendix A

4: Infiltration Rates for Pervious Areas (Fp) values were selected using figure C-3 and Figure C-4, See Appendix B

Culvert and Existing Ditch Hydrology Summary Table																			
Sub-Basin	Area		Soil Type	Dev Type	Curve Number	Tf	Tc	I	Ap	Fp	Fm	Peak Flow	Node	Flow Length	Upstream Elevation	Downstream Elevation	Slope	V	Hydraulics and Notes
	Sub Area	Total				(min)	(min)	(in/hr)			(in/hr)	(cfs)		ft	ft	ft	(ft/ft)	(ft/sec)	
10 Year																			
DMA 1	2.0536	2.05	D	Woodland	77	6	6	4.63	0.50	0.19	0.10	8.38	Node 1R	207.11	6085	6058.5	0.128		Initial Sub-Basin
DMA 2	1.9090	3.96	D	Woodland	77	7.3592	13.359	2.59	1.00	0.19	0.19	8.55	Node 3R	512.2	6058.5	6031	0.054	1.16	
Sub-Total		3.96					13.359					8.55							
DMA 3	0.6351	0.64	D	Woodland	77	13.5	13.5	3.04	0.54	0.19	0.10	1.68	Node 2R	663.2	6110	6035	0.113		Initial Sub-Basin
Total												**11.97**							
100 Year																			
RUN-ON 1	2.0536	2.05	D	Woodland	77	6	6	7.63	0.50	0.19	0.10	13.92	Node 1R	207.11	6085	6058.5	0.128		Initial Sub-Basin
RUN-ON 2	1.9090	3.96	D	Woodland	77	7.3592	13.359	5.04	1.00	0.19	0.19	17.29	Node 3R	512.2	6058.5	6031	0.054	1.16	
Sub-Total		3.96					13.359					17.29							
RUN-ON 3	0.6351	0.64	D	Woodland	77	13.5	13.5	5.01	0.54	0.19	0.10	2.80	Node 2R	663.2	6110	6035	0.113		Initial Sub-Basin
Total												**20.16**							

1: Initial Sub-basin Tc values were collected from San Bernardino County Hydrology Manual Figure D-1, downstream Tc calculated per Section D.3

2: Rainfall Intensities were collected using NOAA Atlas 14 and Figure D-3, See Appendix B

3: Percent Pervious (ap) was calculated based on hydrology exhibits presented in Appendix A

4: Infiltration Rates for Pervious Areas (Fp) values were selected using figure C-3 and Figure C-4, See Appendix B

Detention Basin Analysis (Volume Based Mitigation)

Pre- Development					
100yr P24	16.2 in				
AREA	2.9251 Acre				
Sub Area	CN	S	Ia	Y	Area Fraction
DMA 1	77	2.99	0.60	0.81	0.26
DMA 2A	77	2.99	0.60	0.81	0.68
DMA 2B	98	0.20	0.04	0.99	0.06
24 hr Storm Runoff Yield				0.82	
Existing Cond. Volume	3.2340 acre ft				
Existing Cond. Volume	140,872 CF				

Post- Development					
100yr P24	16.2 in				
AREA	2.9209 Acre				
Sub Area	CN	S	Ia	Y	Area Fraction
DMA 1	77	2.99	0.60	0.81	0.17
DMA 2	98	0.20	0.04	0.99	0.12
DMA 3a	98	0.20	0.04	0.99	0.23
DMA 3b	77	2.99	0.60	0.81	0.48
24 hr Storm Runoff Yield				0.87	
Proposed Cond. Volume	3.4299 acre ft				
Proposed Cond. Volume	149,407 CF				

Mitigation Volume	**8,535 CF**

1. Curve numbers were selected based on COSB Hydrology Mannal Figure.

2. Equation C.3 was used to calculate 24Hr Storm Runoff Yield Fraction for Subarea (Y)

3. Mitigation Volume = Pre-Develop. - Post-Develop.

4. 100yr-24hr Rainfall Depth was identified using Atlas 14 included in Appendix B

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for San Bernardino National Forest Area, California

March 10, 2025

Contents

Soil Map..... 8
Soil Map.....9
Legend.....10
Map Unit Legend..... 12
Map Unit Descriptions..... 12
San Bernardino National Forest Area, California.....14
123—Runningsprings-Cedarpines-Plaskett complex, 15 to 35 percent slopes.....14
135—Urban land..... 17
References.....18

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:1,850 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 25 50 100 150

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Bernardino National Forest Area, California
Survey Area Data: Version 16, Sep 3, 2024

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 17, 2022—Jun 12, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND	MAP INFORMATION
	imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
123	Runningsprings-Cedarpines-Plaskett complex, 15 to 35 percent slopes	14.6	95.9%
135	Urban land	0.6	4.1%
Totals for Area of Interest		**15.3**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however,

onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

San Bernardino National Forest Area, California

123—Runningsprings-Cedarpines-Plaskett complex, 15 to 35 percent slopes

Map Unit Setting

National map unit symbol: 2dvmf
Elevation: 4,620 to 6,770 feet
Mean annual precipitation: 25 to 43 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Runningsprings and similar soils: 45 percent
Cedarpines and similar soils: 25 percent
Plaskett and similar soils: 15 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Runningsprings

Setting

Landform: Mountain slopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from granitoid

Typical profile

A - 0 to 9 inches: sandy loam
Bw - 9 to 18 inches: sandy loam
Cr - 18 to 28 inches: bedrock

Properties and qualities

Slope: 15 to 35 percent
Surface area covered with cobbles, stones or boulders: 2.0 percent
Depth to restrictive feature: 10 to 20 inches to paralithic bedrock
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Ecological site: F019XG914CA - Loamy Hills >30"ppt
Hydric soil rating: No

Description of Cedarpines

Setting

Landform: Mountain slopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium and/or residuum weathered from granitoid

Typical profile

A - 0 to 5 inches: cobbly sandy loam
Bw - 5 to 20 inches: cobbly sandy loam
C - 20 to 24 inches: extremely cobbly sand
Cr - 24 to 39 inches: bedrock

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: 24 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Ecological site: F019XG914CA - Loamy Hills >30"ppt
Hydric soil rating: No

Description of Plaskett

Setting

Landform: Ridges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Mountaintop
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from granitoid

Typical profile

Oi - 0 to 4 inches: slightly decomposed plant material
A - 4 to 13 inches: very gravelly sandy loam
AB - 13 to 23 inches: very gravelly sandy loam
R - 23 to 33 inches: bedrock

Properties and qualities

Slope: 15 to 35 percent
Surface area covered with cobbles, stones or boulders: 10.0 percent
Depth to restrictive feature: 12 to 28 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to low (0.00 to 0.01 in/hr)

Depth to water table: More than 80 inches
Frequency of flooding: None
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: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Ecological site: F019XG914CA - Loamy Hills >30"ppt
Hydric soil rating: No

Minor Components

Heapspeak

Percent of map unit: 5 percent
Landform: Ridges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Mountaintop
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Stargazer

Percent of map unit: 5 percent
Landform: Mountain slopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Canyonspring

Percent of map unit: 3 percent
Landform: Mountain slopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Rock outcrop

Percent of map unit: 2 percent
Landform: Mountain slopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank
Down-slope shape: Convex
Across-slope shape: Convex

135—Urban land

Map Unit Setting

National map unit symbol: 2dvmt
Elevation: 4,400 to 6,870 feet
Mean annual precipitation: 21 to 42 inches
Mean annual air temperature: 48 to 55 degrees F
Frost-free period: 110 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Ecological site: R019XG911CA - Loamy Fan

Minor Components

Xerorthents

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

References

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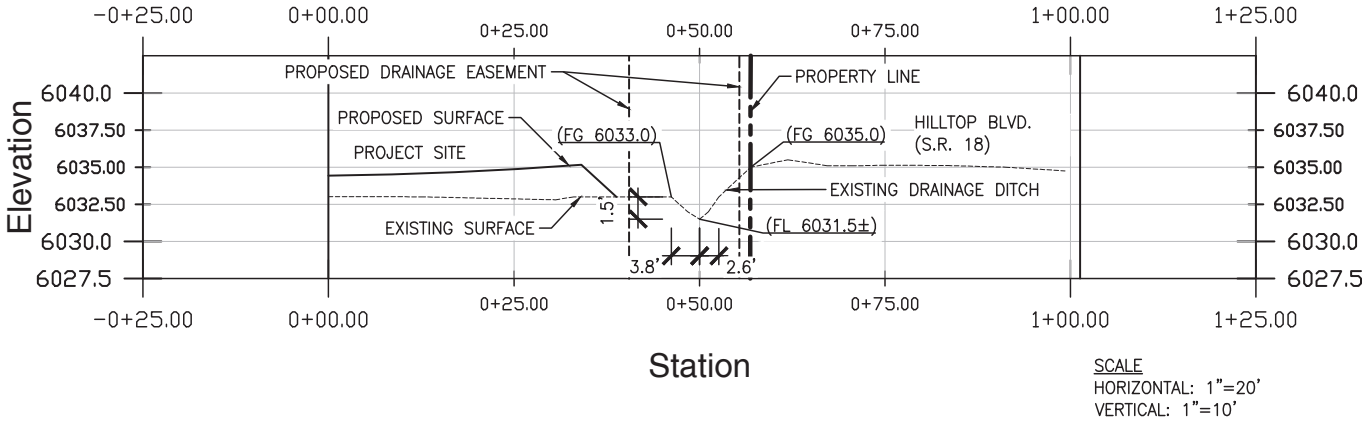
Appendix C: Detention Basin Design

Form 4.3-5 Volume Based Biotreatment
Proposed Bioretention Basin Biotreatment Volume

Biotreatment BMP Type *(Bioretention w/underdrain, planter box w/underdrain, other comparable BMP)*	Bioretention w/ underdrain
[1] Pollutants addressed with BMP *List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in Table 5-5 of the TGD for WQMP*	Pathogens (Bacteria Indicators/ Virus), Metals, Nutrients, Organic Compounds, Pesticides/Herbicides, Sediments/Suspended Solids, Trash and Debris, Oil and Grease
[2] Amended soil infiltration rate *Typical ~ 5.0*	5.0
[3] Amended soil infiltration safety factor *Typical ~ 2.0*	2.0
[4] Amended soil design percolation rate (in/hr) P_{design} *= Item 2 / Item 3*	2.5
[5] Ponded water drawdown time (hr) *Copy Item 6 from Form 4.2-1*	48
[6] Maximum ponding depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*	2.0
[7] Ponding Depth (ft) d_{BMP} *= Minimum of (1/12 * Item 4 * Item 5) or Item 6*	2.0
[8] Amended soil surface area (ft^2)	3,181
[9] Amended soil depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*	1.5
[10] Amended soil porosity, *n*	0.25
[11] Gravel depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*	1.0
[12] Gravel porosity, *n*	0.40
[13] Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	3
[14] Biotreated Volume (ft3) $V_{biotreated}$ *= Item 8 * [(Item 7/2) + (Item 9* Item 10) +(Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*	7,634
[15] Total biotreated volume from bioretention and/or planter box with underdrains BMP: *Sum of Item 14 for all volume-based BMPs included in this form*	

Appendix D:Hydraulic Calculations and Resources



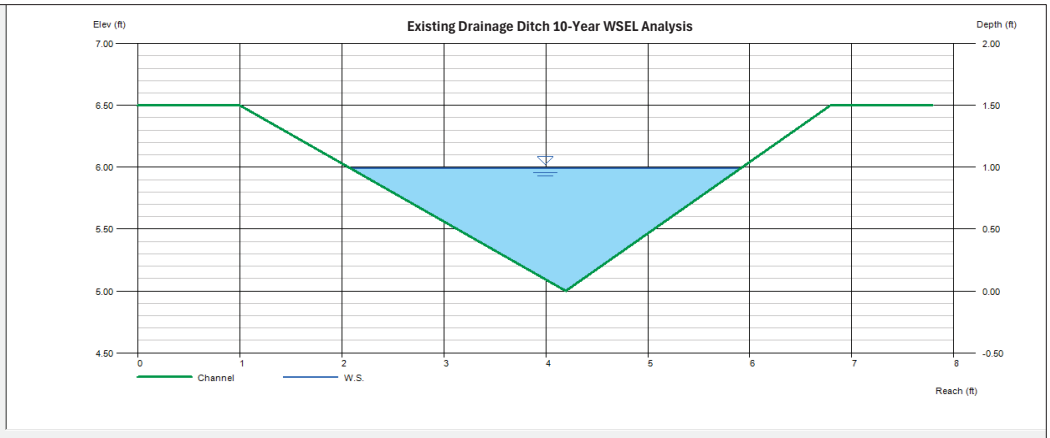
SCALE
HORIZONTAL: 1"=20'
VERTICAL: 1"=10'

DESIGNED BY: EJC DATE: 10/17/2025	WALSH ENGINEERING WALSHENGINEERING.NET (805) 319-4948 1108 GARDEN STREET, SUITE 202-204 SAN LUIS OBISPO, CA 93401	DIESS BOAT STORAGE EXISTING DRAINAGE DITCH CROSS-SECTION EXHIBIT		1 OF 1

Existing Drainage Ditch
WSEL Hydraflow Model

Item	Input
Section Type =	Triangular
Btm Width (ft)	-0-
Side Slope, z:1 =	2.13; 1.73
Tot Depth (ft) =	1.50
Inv Elev(ft) =	5.00
Slope (%) =	5.10
n-value =	0.030
Compute by =	Known Q
Q (cfs) =	11.97

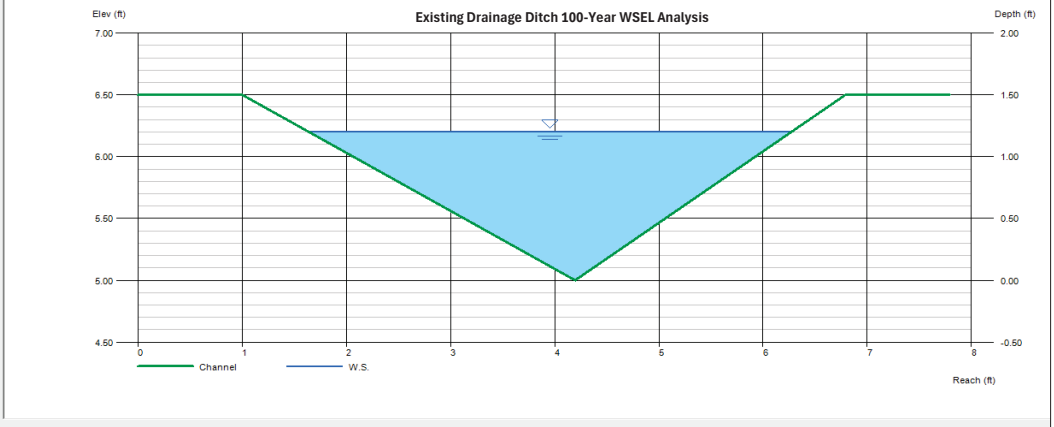
Run



Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(ft)	(cfs)	(sqft)	(ft/s)	(ft)	(ft)	(ft)	(ft)
0.99	11.97	1.892	6.33	4.31	1.20	3.82	1.61

Item	Input
Section Type =	Triangular
Btm Width (ft)	-0-
Side Slope, z:1 =	2.13; 1.73
Tot Depth (ft) =	1.50
Inv Elev(ft) =	5.00
Slope (%) =	5.10
n-value =	0.030
Compute by =	Known Q
Q (cfs) =	20.16

Run

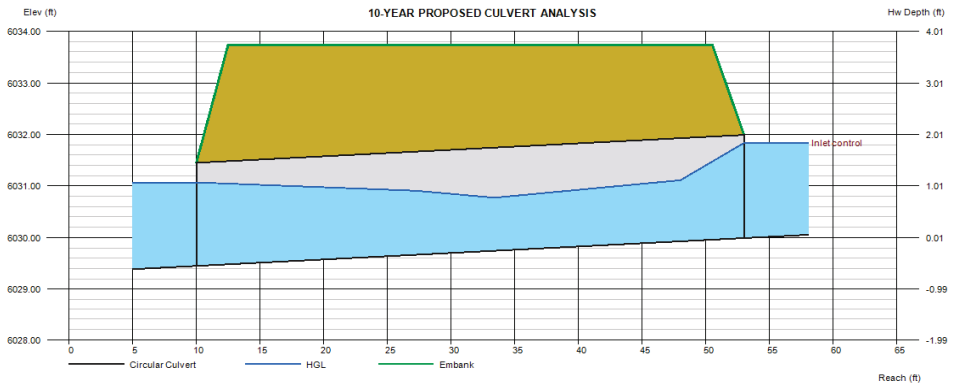


Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(ft)	(cfs)	(sqft)	(ft/s)	(ft)	(ft)	(ft)	(ft)
1.20	20.16	2.779	7.25	5.22	1.47	4.63	2.02

Hydraflow Culvert Analysis Model

Inv Elev Dn =	6029.45
Length (ft) =	43.00
Slope (%) =	1.26
Inv Elev Up =	6029.99
Rise (in) =	24.0
Shape =	Circular
Span (in) =	24.0
No. Barrels =	1
n-value =	0.012
Culvert Type =	Circular Culvert
Culvert Entrance =	Smooth tapered inlet throat
Top Elev =	6033.74
Top Width (ft) =	38.00
Crest Len (ft) =	2.00
Q Min (cfs) =	0.00
Q Max (cfs) =	11.97
Q Incr (cfs) =	1.70
Tailwater (ft) =	(dc+D)/2

Run



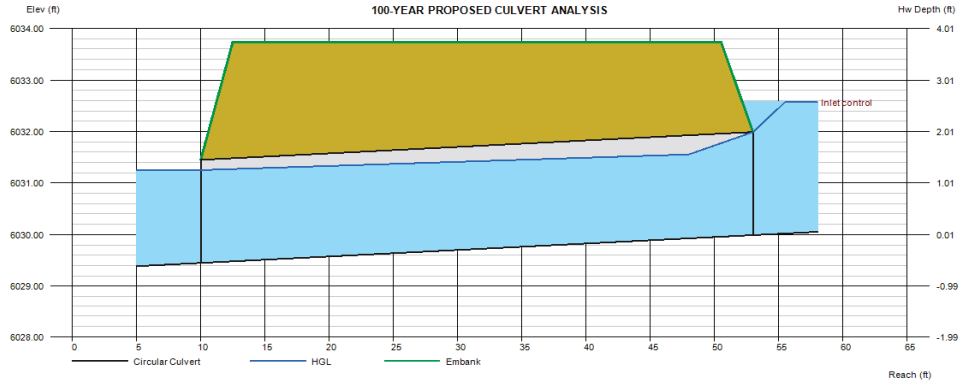
Q			Veloc		Depth		HGL			
Total	Pipe	Over	Dn	Up	Dn	Up	Dn	Up	Hw	Hw/D
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)	(ft)	(ft)	(ft)	
5.10	5.10	0.00	2.18	4.38	16.77	9.54	6030.85	6030.79	6031.14	0.58
6.80	6.80	0.00	2.76	4.79	17.54	11.09	6030.91	6030.91	6031.34	0.68
8.50	8.50	0.00	3.32	5.16	18.23	12.46	6030.97	6031.03	6031.52	0.77
10.20	10.20	0.00	3.85	5.50	18.86	13.71	6031.02	6031.13	6031.68	0.85
11.90	11.90	0.00	4.37	5.83	19.43	14.85	6031.07	6031.23	6031.84	0.92

Hydraflow Culvert Analysis Model

Inv Elev Dn =	6029.45
Length (ft) =	43.00
Slope (%) =	1.26
Inv Elev Up =	6029.99
Rise (in) =	24.0
Shape =	Circular
Span (in) =	24.0
No. Barrels =	1
n-value =	0.012
Culvert Type =	Circular Culvert
Culvert Entrance =	Smooth tapered inlet throat
Top Elev =	6033.74
Top Width (ft) =	38.00
Crest Len (ft) =	2.00
Q Min (cfs) =	0.00
Q Max (cfs) =	20.16
Q Incr (cfs) =	1.00
Tailwater (ft) =	(dc+D)/2

Run

or enter a known elevation.



Q			Veloc		Depth		HGL			
Total	Pipe	Over	Dn	Up	Dn	Up	Dn	Up	Hw	Hw/D
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)	(ft)	(ft)	(ft)	
16.00	16.00	0.00	5.56	6.60	20.65	17.29	6031.17	6031.43	6032.29	1.15
17.00	17.00	0.00	5.85	6.80	20.91	17.82	6031.19	6031.48	6032.35	1.18
18.00	18.00	0.00	6.14	6.99	21.16	18.32	6031.21	6031.52	6032.42	1.22
19.00	19.00	0.00	6.42	7.20	21.40	18.80	6031.23	6031.56	6032.50	1.25
20.00	20.00	0.00	6.71	7.40	21.63	19.26	6031.25	6031.60	6032.57	1.29

Appendix E: FEMA and DWR Floodplain Maps

National Flood Hazard Layer FIRMette

FEMA

117°5'31"W 34°12'51"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

117°4'54"W 34°12'21"N

Basemap Imagery Source: USGS National Map 2023

Legend

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

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 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*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

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 3/18/2025 at 4:51 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.

CALIFORNIA DEPARTMENT OF
WATER RESOURCES

Floodplain Information

Latitude: 34.21048, Longitude: -117.08798

San Bernardino County, Bureau of Land Management, Esri, HERE, Garmin, INCREMENT P, USGS, METI/NASA, … Powered by Esri

County: San Bernardino (34.21048, -117.08798)

Floodplain Layer	100-YR	200-YR	500-YR
FEMA Effective	N	N/A	N
DWR Awareness	N	N/A	N/A
Regional/Special Studies	N	N/A	N
USACE Comp. Study	N	N	N

Y: The location is within the floodplain
N: The location is not within the floodplain
N/A: Data not available
✓ = Active Layer(s)

Floodplains are displayed using semi transparent colors. When viewing overlapping floodplains, the combination of multiple semi transparent colors will not match the legend colors. For accurate color representation, view floodplains individually.

No legend

Appendix F: Infiltration Report

REPORT OF INFILTRATION FEASIBILITY STUDY
FOR A PROPOSED STORMWATER RETENTION SYSTEM
32864 HILLTOP BOULEVARD
ARROWBEAR LAKE, CA 92382

PROJECT NO.: 1669-01

REPORT NO.: 1

OCTOBER 10, 2025

SUBMITTED TO:

DARREN DIESS

P. O. BOX 2266

LAKE ARROWHEAD, CA 92352

PREPARED BY:

HILLTOP GEOTECHNICAL, INC.

786 SOUTH GIFFORD AVENUE

SAN BERNARDINO, CA 92408

HILLTOP GEOTECHNICAL
INCORPORATED

786 S. GIFFORD AVENUE • SAN BERNARDINO • CA 92408
Phone **909-890-9079** • FAX 909-890-9055
hilltopg@hgeotech.com

October 10, 2025

Darren Diess
P. O. BOX 2266
Lake Arrowhead, CA 92352

Project No.: 1669-01
Report No.: 1

Subject: **Report of Infiltration Feasibility Study for a Proposed Stormwater Retention System, 32864 Hilltop Boulevard, Arrowbear Lake, CA 92382.**

References: 1. **Walsh Engineering**, *ON THE MOUNTAIN BOAT & THE BOATYARD, 32864 Hilltop Blvd., Arrowbear Lake, CA 92314, C1.0 and C1.1.*

2. **San Bernardino County**, May 19, 2011, *Technical Guidance Document Appendices, Appendix VII. Infiltration Rate Evaluation Protocol and Factor of Safety Recommendations.*

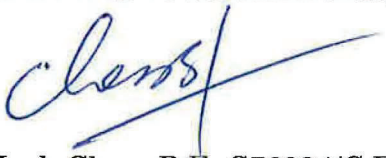
Gentleman,

In accordance with your request, we have performed an infiltration feasibility study on the subject property. This infiltration testing was performed in general accordance with Technical Guidance Document Appendix VII-Infiltration Rate Evaluation Protocol and Factor of Safety Recommendations.

The findings of this study indicate that the proposed stormwater retention system at the selected area is feasible provided the recommendations presented in the attached report are incorporated into the project design and implemented during the project construction.

We appreciate the opportunity of providing geotechnical services on this project. Should you have any questions regarding this subject, please do not hesitate to contact us.

Respectfully submitted,
HILLTOP GEOTECHNICAL, INC.



S. Mack Chen, P.E. C76834/C.E.G. 2688
Principal Engineer/Geologist

Attachment:
Plate No. 1, Site Plan and Test Locations
Plate No. 2, Subsurface Exploration Legend
Plate Nos. 3 through 5, Subsurface Exploration Log
Plate Nos. 6 and 7, Infiltration Data Sheet

Distribution:
(1) Via Email to
Mr. Darren Diess (darrendiess@gmail.com)
Matt Walsh <matt@walshengineering.net>

TABLE OF CONTENTS

Section Title **Page No.**

LOCATION OF PROJECT SITE 1
SITE CONDITIONS 1
LOCATION OF INFILTRATION SITES 1
SOIL CHARACTERISTICS OF SUBJECT SITE 2
Soil Profile 2
Groundwater 2
INFILTRATION TEST PROCEDURES 2
TEST RESULTS 3
DISCUSSION 3
RECOMMENDATIONS 4
CLOSURE 4

REPORT OF INFILTRATION FEASIBILITY STUDY
FOR A PROPOSED STORMWATER RETENTION SYSTEM
32864 HILLTOP BOULEVARD
ARROWBEAR LAKE, CA 92382

LOCATION OF THE PROJECT SITE

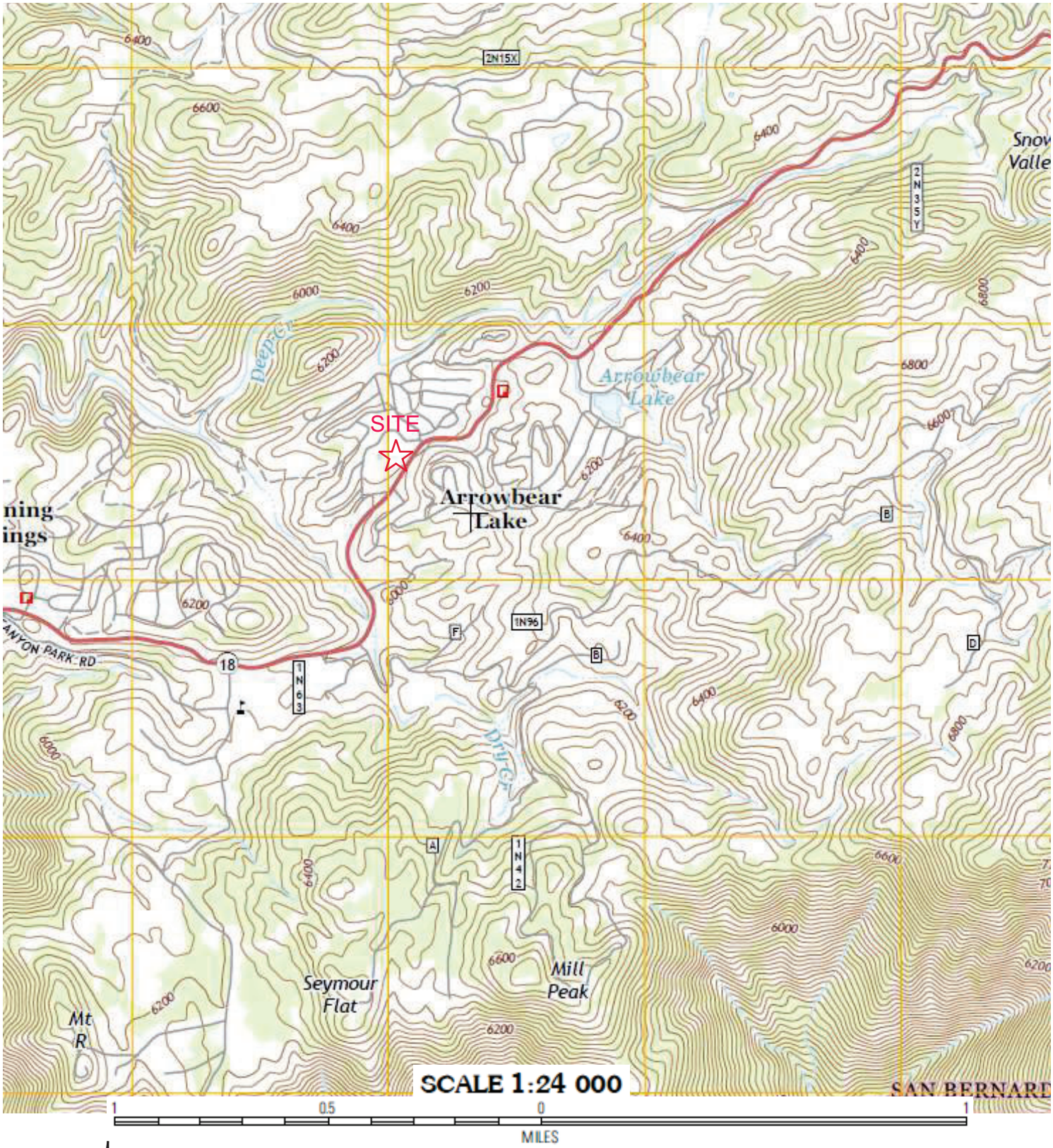
The subject site is located at 32864 Hilltop Boulevard in the area of Arrowbear Lake, CA 92382 (**Figure 1**) and is bounded by Highway 18 to the southeast, commercial property to the northeast, and by residences in other directions. Per the proposed precise grading plan, the proposed stormwater retention basin is located at the southeast corner of the subject property.

SITE CONDITIONS

The subject property comprised approximately 5.88 acres and was irregular in shape. The immediate area of the subject site was located on the eastern portion of a small hill. Much of the area to the east and south of the hill has been graded flat to accommodate the previous commercial application of the property. The northern portion of the property, which appears to have undergone very little grading, has a shallow, downward inclination toward the southeast at an average gradient of approximately 5.0 percent. The hillside adjacent to the largest proposed structure has an average gradient of approximately 30 percent. Total on-site relief in the area of the proposed project was approximately 50 feet. On-site drainage was accomplished by sheetflow toward the southeast and south.

LOCATION OF INFILTRATION TESTS

Per the information provided by the project civil engineer, the bottom of the proposed stormwater retention basin will be at the southwest corner of the site. The bottom of the retention basin will be at depths of 1 to 2 below the existing ground surface (bgs). Two 8-inch-diameter soil borings P-1 and P-2 were drilled to 2 feet bgs. One boring B-1 was drilled to 7.2 feet bgs for groundwater clearance. The groundwater was encountered at 7 feet bgs during our field exploration, which meets at least 5 feet of separation from the chamber bottom to the groundwater table. The two eight-inch-diameter borings were used to infiltration tests. Two inches of gravel were added to the bottom of the borings prior to the perforated pipe placement.



Source: Copied from USGS Topo Map-
Keller Peak Quadrangle 2012

HILLTOP GEOTECHNICAL INCORPORATED

SITE LOCATION MAP

32864 Hilltop Boulevard, Arrowbear Lake, CA 92382

By: MC	Date: 10/2025
Project No.: 1669-02	**Figure 1**

SOIL CHARACTERISTICS OF THE SUBJECT SITE

- The soil characteristics for the subject site are classified as hydrologic soil group A.
- Silty sand was encountered at both test locations.
- The topography of the existing ground surface is planar at the designated test locations.
- Per the on-site soil conditions, the proposed stormwater retention chamber on the site is feasible.

Soil Profile

The earth materials encountered on the subject site during our field exploration on October 3, 2025 were identified as artificial fill and native soil.

Artificial fill was encountered at all three borings from the ground surface to 1 to 2 feet bgs consisting of light grayish brown silty fine-grained sand, with medium to coarse grained gravel, in dry to slightly moist and loose conditions. Native soil was encountered within all three borings from bottoms of artificial fill to 7.2 feet bgs and consisted of grayish brown to brown silty sand with trace to few medium gravels in slightly moist to wet and loose to medium dense conditions.

Groundwater

Groundwater was encountered at a depth of 7 feet bgs during our exploration. Since the proposal stormwater basin will situate near the existing ground surface with 1 to 2-foot surficial removal, the basin bottom meet a minimum of 5 feet of separation from the groundwater.

INFILTRATION TEST PROCEDURES

a) Test Method: Infiltration testing was conducted in general accordance with shallow percolation test method in Appendix A-Infiltration Testing (Reference 2).

b) Drilling: two boreholes were approximately eight inches in diameter, drilled to 2 feet bgs by an 8-inch-diameter auger; and one boring was extended to 7.2 feet bgs to clarify groundwater depth. The infiltration testing was performed in silty sand. After drilling, approximately two inches of gravel was placed at the bottoms of the test holes.

c) Soaking Period: The test holes were pre-soaked by filling each borehole up to 4 inches bgs on October 3, 2025. Two consecutive measurements showed that more than six inches of water seeped away within 25 minutes, the infiltration testing was conducted on the same day. The test was run for an additional hour with measurements taken every 10 minutes.

d) Measurement of the infiltration rate: Measurements were taken with a precision of 0.1 inches using a water indicator.

TEST RESULTS

The infiltration rates were converted to infiltration rates using the Porchet Method. The final infiltration rates obtained are presented below in **Table 1**:

Table 1: Final Infiltration Rates

Infiltration Test #	Tested Infiltration Rate (in/hr)
P-1	5.3
P-2	10.2

DISCUSSION

The rates presented above were generally as anticipated with respect to the on-site soil. The earth materials for the infiltration tests consist mainly of silty sand. The tested results indicate that the infiltration rate in Test hole P-1 was slower than that in Test hole P-2. It is likely that Test hole P-1 contains more fine particles than Test hole P-2.

Field infiltration tests are subject to many factors that affect the infiltration rate, including soil texture, the condition of the soil surface, soil-moisture tension or the

degree of saturation, the temperature of the water and soil, the percentage of entrapped air in the soil, and the head of the applied water.

RECOMMENDATIONS

Based on the San Bernardino County Guidelines, a factor of safety should be applied to the infiltration rates. A factor of safety of two was applied to the rates below in Table 2.

Table 2 Recommended Design Infiltration Rates

Infiltration Test #	Tested Infiltration Rate (in/hr)	Recommended Design Infiltration Rate w/ Factor of Safety (2) (in/hr)
P-1	5.3	2.65
P-2	10.2	5.1

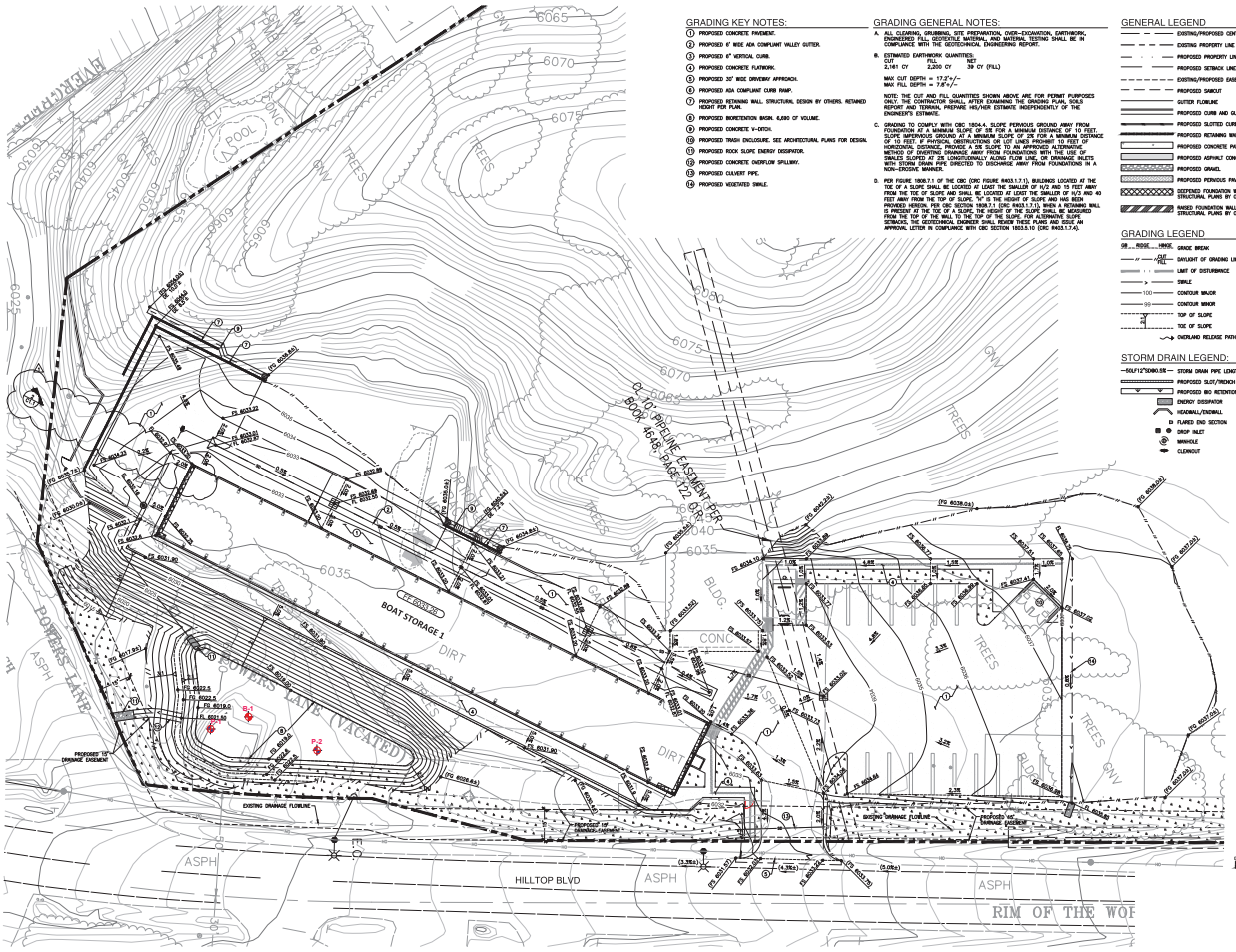
Our field infiltration test results indicate that tested infiltration rates were 5.3 and 10.3 inches per hour at depth of two (2) feet bgs. Both tested infiltration rates were greater than the minimum 0.3 inches/hour required by the Infiltration Guidelines. Based on the tested results with factor of safety of 2, design infiltration rates were 2.65 and 5.1 inches/hour. For a conservative purpose, the design infiltration rate of **2.65 inches/hour** is recommended to be used for design of the proposed stormwater retention basin. Since the groundwater table was 7 feet bgs, the bottom of the proposed stormwater retention basin shall not be placed at a depth deeper than 2 feet bgs.

Caution should be used in determining an infiltration rate for the proposed stormwater retention systems. Eventual siltation, from windblown silt, water-borne silt from irrigation and precipitation runoff, and the accumulation of organic material in surface soils due to landscape grass and plant growth, can drastically reduce infiltration rates over time. We recommend that suitable methods to prevent siltation be considered in project design.

CLOSURE

Findings of this report were prepared in accordance with generally accepted professional engineering principles and practice in the field of geotechnical

engineering. The conclusions are based on results of field exploration and testing. If conditions are encountered during construction that appear to be different than those indicated by this report, this firm shall be notified.



Source: modified from grading & drainage plan Sheet C1.0 by Walsh Engineering.

GRADING KEY NOTES:

1. PROPOSED CONCRETE PAVEMENT.
2. PROPOSED 6" WIDE ADA COMPLIANT VALLEY GUTTER.
3. PROPOSED 6" VERTICAL CURB.
4. PROPOSED CONCRETE FLATWORK.
5. PROPOSED 30' WIDE DRIVEWAY APPROACH.
6. PROPOSED ADA COMPLIANT CURB RAMP.
7. PROPOSED RETAINING WALL. STRUCTURAL DESIGN BY OTHERS. RETAINED HEIGHT PER PLAN.
8. PROPOSED BIORETENTION BASIN. 8,050 CF VOLUME.
9. PROPOSED CONCRETE V-DITCH.
10. PROPOSED TRASH ENCLOSURE. SEE ARCHITECTURAL PLANS FOR DESIGN.
11. PROPOSED ROCK SLOPE ENERGY DISSIPATOR.
12. PROPOSED CONCRETE OVERFLOW SPILLWAY.
13. PROPOSED CULVERT PIPE.
14. PROPOSED VEGETATED SWALE.

GRADING GENERAL NOTES:

A. ALL CLEARING, GRUBBING, SITE PREPARATION, OVER-EXCAVATION, EARTHWORK, ENGINEERED FILL, GEOTEXTILE MATERIAL, AND MATERIAL TESTING SHALL BE IN COMPLIANCE WITH THE GEOTECHNICAL ENGINEERING REPORT.

B. ESTIMATED EARTHWORK QUANTITIES:

CUT	FILL	NET
2,161 CY	2,200 CY	39 CY (FILL)

MAX CUT DEPTH = 17.5'+/-
MAX FILL DEPTH = 7.5'+/-

NOTE: THE CUT AND FILL QUANTITIES SHOWN ABOVE ARE FOR PERMIT PURPOSES ONLY. THE CONTRACTOR SHALL, AFTER EXAMINING THE GRADING PLAN, SOILS REPORT AND TERRAIN, PREPARE HIS/HER ESTIMATE INDEPENDENTLY OF THE ENGINEER'S ESTIMATE.

C. GRADING TO COMPLY WITH CBC 1804.4. SLOPE PERVIOUS GROUND AWAY FROM FOUNDATION AT A MINIMUM SLOPE OF 5% FOR A MINIMUM DISTANCE OF 10 FEET. SLOPE IMPERVIOUS GROUND AT A MINIMUM SLOPE OF 2% FOR A MINIMUM DISTANCE OF 5 FEET. IF PHYSICAL OBSTRUCTIONS OR LOT LINES PROHIBIT 5 FEET OF HORIZONTAL DISTANCE, PROVIDE A 12" SLOPE TO AN APPROVED ALTERNATIVE METHOD OF DIVERTING DRAINAGE AWAY FROM FOUNDATIONS WITH THE USE OF SWALES SLOPED AT 2% LONGITUDINALLY ALONG FLOW LINE, OR DRAINAGE INLETS WITH STORM DRAIN PIPE DIRECTED TO DISCHARGE AWAY FROM FOUNDATIONS IN A NON-ERODIVE MANNER.

D. PER FIGURE 1809.7.1 OF THE CBC (CRC FIGURE R403.1.7.1), BUILDINGS LOCATED AT THE TOE OF A SLOPE SHALL BE LOCATED AT LEAST THE SMALLER OF H/3 AND 15 FEET AWAY FROM THE TOE OF SLOPE AND SHALL BE LOCATED AT LEAST THE SMALLER OF H/2 AND 40 FEET AWAY FROM THE TOP OF SLOPE, "H" IS THE HEIGHT OF SLOPE AND HAS BEEN PROVIDED HEREON. PER CBC SECTION 1808.7.1 (CRC R403.1.7.1), WHEN A RETAINING WALL IS USED TO MEET THE SETBACK, THE HEIGHT SHALL BE MEASURED FROM THE BOTTOM FROM THE TOP OF THE WALL TO THE TOP OF THE SLOPE. FOR ALTERNATIVE SLOPE SETBACKS, THE GEOTECHNICAL ENGINEER SHALL REVIEW THESE PLANS AND ISSUE AN APPROVAL LETTER IN COMPLIANCE WITH CBC SECTION 1803.5.10 (CRC R403.1.7.4).

GENERAL LEGEND

- EXISTING/PROPOSED CENTERLINE (E)
- EXISTING PROPERTY LINE (EX. E)
- PROPOSED PROPERTY LINE (E)
- PROPOSED SETBACK LINE
- EXISTING/PROPOSED EASEMENT
- PROPOSED SWALE/T
- GUTTER FLOWLINE
- PROPOSED CURB AND GUTTER
- PROPOSED SLOTTED CURB
- PROPOSED RETAINING WALL. HEIGHT PER PLAN.
- PROPOSED CONCRETE PAVEMENT/HARDSCAPE
- PROPOSED ASPHALT CONCRETE PAVEMENT
- PROPOSED GRAVEL
- PROPOSED PERVIOUS PAVEMENT
- EMBEDDED FOUNDATION WALL. RETAINED HEIGHT PER PLAN. SEE STRUCTURAL PLANS BY OTHERS FOR CONSTRUCTION DETAILS.
- RAISED FOUNDATION WALL. RETAINED HEIGHT PER PLAN. SEE STRUCTURAL PLANS BY OTHERS FOR CONSTRUCTION DETAILS.

GRADING LEGEND

- GB — RIDGE — HINGE — GRADE BREAK
- DAYLIGHT OF GRADING LIMITS (CUT/FILL LINE)
- LIMIT OF DISTURBANCE
- SWALE
- 100 — CONTOUR MAJOR
- 95 — CONTOUR MINOR
- TOP OF SLOPE
- TOE OF SLOPE
- OVERLAND RELEASE PATH

STORM DRAIN LEGEND:

- 60LF 12"SD@0.5% — STORM DRAIN PIPE LENGTH, SIZE AND SLOPE (SD)
- PROPOSED SLOT/TRENCH DRAIN
- PROPOSED BIO RETENTION BASIN
- ENERGY DISSIPATOR
- HEADWALL/ENDWALL
- FLARED END SECTION
- DROP INLET
- MANHOLE
- CLEANOUT

B-1 Boring Location

P-1 Percolation Test Location

WILLDAN GEOTECHNICAL	**SITE PLAN AND TEST LOCATIONS**
	32864 Hilltop Boulevard, Arrowbear Lake, CA 92382
	By: MC — Date: 10/2025
	Project No.: 1669-02 — **Plate No. 1**

SUBSURFACE EXPLORATION LEGEND

UNIFIED SOIL CLASSIFICATION SYSTEM
Visual-Manual Procedure (ASTM D2488-09a)

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
Coarse-Grained Soils* More than 50 % Retained on No. 4 Sieve	Gravels 50 % or more of Coarse Fraction Retained on No. 4 Sieve	Clean Gravels	GW	Well Graded Gravels and Gravel-Sand Mixtures, Little or no Fines
			GP	Poorly Graded Gravels and Gravel-Sand Mixtures, Little or no Fines
		Gravels with Fines	GM	Silty Gravels, Gravel-Sand-Silt Mixtures**
			GC	Clayey Gravel, Gravel-Sand-Clay Mixtures**
	Sands More than 50 % of Coarse Fraction Passes No. 4 Sieve	Clean Sands	SW	Well Graded Sands and Gravely Sands, Little or no Fines
			SP	Poorly Graded Sands and Gravelly Sands, Little or no Fines
		Sands with Fines	SM	Silty Sands, Sand-Silt Mixtures**
			SC	Clayey Sands, Sand-Clay Mixtures**
Fine Grained Soils* 50 % or more Passes No. 200 Sieve	Silts and Clays Liquid Limits 50 % or less		ML	Inorganic Silts, Sandy Silts, Rock Flour
			CL	Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays
			OL	Organic Silts and Organic silty Clays of Low Plasticity
	Silts and Clays Liquid Limits Greater than 50 %		MH	Inorganic Silts, Micaceous or Diatomaceous silts, Plastic Silts
			CH	Inorganic Clays of High Plasticity, Fat Clays
			OH	Organic Clays of Medium to High Plasticity
Highly Organic Soils			PT	Peat, Muck, or Other Highly Organic Soils

CONSISTENCY / RELATIVE DENSITY

CRITERIA

Reference: 'Foundation Engineering', Peck, Hansen, Thornburn, 2nd Edition.

Standard Penetration Test
Granular Soils

Penetration Resistance, N, (Blows / Foot)	Relative Density
0 - 4	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
> 50	Very Dense

Standard Penetration Test
Cohesive Soils

Penetration Resistance, N, (Blows / Foot)	Consistency	Unconfined Compressive Strength, (Tons / Sq. Ft.)
< 2	Very Soft	< 0.25
2 - 4	Soft	0.25 - 0.5
5 - 8	Firm (Medium Stiff)	0.5 - 1.0
9 - 15	Stiff	1.0 - 2.0
16 - 30	Very Stiff	2.0 - 4.0
> 31	Hard	> 4.0

* Based on material passing the 3-inch sieve.

** More than 12% passing the No. 200 sieve; 5% to 12% passing No. 200 sieve requires use of duel symbols (i.e., SP-SM., GP-GM, SP-SC, GP-GC, etc.); Border line classifications are designated as CH/Cl, GM/SM, SP/SW, etc.

U.S. Standard Sieve Size 12" 3" 3/4" #4 #10 #40 #200

Unified Soil Classification Designation	Boulders	Cobbles	Gravel		Sand			Silt and Clay
			Coarse	Fine	Coarse	Medium	Fine	

Moisture Condition

Dry	Absence of moisture, dusty, dry to the touch.
Moist	Damp but no visible moisture.
Wet	Visible free water, usually below the water table.

Material Quantity

Trace	< 5 %
Few	5 - 10%
Little	15 - 25%
Some	30 - 45 %
Mostly	50-100%

Other Symbols

C - Core Sample
S - SPT Sample
B - Bulk Sample
CK - Chunk Sample
R - Ring Sample
N - Nuclear Gauge Test
∇ - Water Table

Hilltop Geotechnical
786 S. Gifford Avenue, San Bernardino, California, 92408
Phone: 909 890 9079

Boring No.: B-1

Latitude	: -31.03688	Drill Supplier	: Hilltop Geotechnical	Job Number	: 1669-02	Sheet	: 1 OF 1
Longitude	: 151.74015	Driller Company	: Hilltop Geotechnical	Client	: Darren Diess		
Elevation	: Not Surveyed	Logged By	: Jose Garcia	Project	: 32864 Hilltop Boulevard		
Total Depth	: 7 Ft	Date	: 10/03/2025	Location	: 32864 Hilltop Blvd, Running Springs, CA 92382, USA		

Depth (ft)	Samples: Bulk	Samples: Mod Cal Sample	Samples: SPT Sample	Blows per 6"	Graphic Log	Soil Origin	Classification Code	Material Description	Fines (%)	Moisture (%)	Dry Density (pcf)	Other
1.0 (1)						Fill	SM	SILTY SAND WITH GRAVEL: with medium to coarse sized gravel, silty fine grained sand, loose, dry, light grayish brown, dead weeds at surface. gravel varies from <1" to >1".				
						Fill	SM	SILTY SAND: silty fine to medium grained sand, loose, trace to few medium sized gravel, moist to slightly moist, dark brown, broken glass encountered.				
2.0 (2)						Alluvium	SM	SILTY SAND WITH GRAVEL: with fine to medium sized gravel, silty medium grained sand, loose, slightly moist, grayish brown, slight oxidation staining.				
3.0 (3)						Alluvium	SM	SILTY SAND: silty fine to medium grained sand, medium dense, slightly moist, trace fine to medium sized gravel, brown mottled with light brown and light yellowish brown.				
4.0 (4)						Alluvium	SM	SILTY SAND: silty fine to medium grained sand, medium dense, slightly moist, trace to few medium sized gravel, brown to light brown.				
5.0 (5)						Alluvium	SM	SILTY SAND: silty fine to medium grained sand, medium dense, very moist to moist, trace fine to medium sized gravel, dark brown mottled with light brown and orange brown.				
6.0 (6)						Alluvium	SM	SILTY SAND: silty fine to medium grained sand, medium dense, wet to very moist, little to some medium sized gravel, dark brown mottled with orange brown, wet soil started at 6'.				
6.5						Alluvium	SM	SILTY SAND: silty medium grained sand, medium dense, wet, trace medium sized gravel, grey mottled with black and orange brown.				
								B-1Terminated at 7.2 ft. Groundwater encountered at 7'.				

Hilltop Geotechnical
786 S. Gifford Avenue, San Bernardino, California, 92408
Phone: 909 890 9079

Boring No.: P-1

Latitude	: -31.03688	Drill Supplier	: Hilltop Geotechnical	Job Number	: 1669-02	Sheet	: 1 OF 1
Longitude	: 151.74015	Driller Company	: Hilltop Geotechnical	Client	: Darren Diess		
Elevation	: Not Surveyed	Logged By	: Jose Garcia	Project	: 32864 Hilltop Boulevard		
Total Depth	: 2 Ft	Date	: 10/03/2025	Location	: 32864 Hilltop Blvd, Running Springs, CA 92382, USA		

Depth (ft)	Samples: Bulk	Samples: Mod Cal Sample	Samples: SPT Sample	Blows per 6"	Graphic Log	Soil Origin	Classification Code	Material Description	Fines (%)	Moisture (%)	Dry Density (pcf)	Other
1.0						Fill	SM	SILTY SAND WITH GRAVEL: with medium to coarse sized gravel, silty fine to medium grained sand, loose, dry, light grayish brown.				
						Alluvium	SM	SILTY SAND WITH GRAVEL: with coarse sized gravel, silty fine grained sand, loose, slightly moist to dry, light grayish brown to, large gravel >2", very fine to fine silty sand.				
								P-1 Terminated at 2 ft. No Groundwater Encountered.				

Hilltop Geotechnical
786 S. Gifford Avenue, San Bernardino, California, 92408
Phone: 909 890 9079

Boring No.: P-2

Latitude	: -31.03688	Drill Supplier	: Hilltop Geotechnical	Job Number	: 1669-02	Sheet	: 1 OF 1
Longitude	: 151.74015	Driller Company	: Hilltop Geotechnical	Client	: Darren Diess		
Elevation	: Not Surveyed	Logged By	: Jose Garcia	Project	: 32864 Hilltop Boulevard		
Total Depth	: 2 Ft	Date	: 10/03/2025	Location	: 32864 Hilltop Blvd, Running Springs, CA 92382, USA		

Depth (ft)	Samples: Bulk	Samples: Mod Cal Sample	Samples: SPT Sample	Blows per 6"	Graphic Log	Soil Origin	Classification Code	Material Description	Fines (%)	Moisture (%)	Dry Density (pcf)	Other
1.0						Fill	SM	SILTY SAND WITH GRAVEL: with medium to coarse sized gravel, silty fine to medium grained sand, loose, dry, light grayish brown.				
						Alluvium	SM	SILTY SAND WITH GRAVEL: with medium sized gravel, silty medium to coarse grained sand, loose, slightly moist to dry, light grayish brown to grayish brown.				
								P-2 Terminated at 2ft. No Groundwater Encountered.				

Plate No. 5

HILLTOP GEOTECHNICAL
INCORPORATED

INFILTRATION DATA SHEET

Project Name:	32864 Hilltop Blvd	Project Number:	1669-02
Test Hole Number:	P-1	Date Tested:	10/3/25
Depth of Boring in feet:	2.0	Tested By:	JG
Radius of boring feet:	0.33	Time of Presoaking:	50 minutes
Presoak: Time Initial	10:55 AM		

Depth of Bottom (ft)	Time Initial	Time Final	Time Interval (minutes)	Depth of Water - Initial (ft)	Depth of Water - Final (ft)	Change in Water Level (ft)	$H_{average}$ (ft)	Rate, It (In/Hr)	Rate, It (Cm/Hr)
2.00	10:55	11:30	25.0	0.30	1.70	1.40	1.00	5.71	14.50
2.00	11:21	11:46	25.0	0.30	1.65	1.35	1.03	5.39	13.69
2.00	11:47	11:57	10.0	0.30	1.01	0.71	1.35	5.59	14.19
2.00	11:58	12:08	10.0	0.30	0.98	0.68	1.36	5.30	13.46
2.00	12:10	12:20	10.0	0.30	1.00	0.70	1.35	5.49	13.94
2.00	12:21	12:31	10.0	0.30	1.00	0.70	1.35	5.49	13.94
2.00	12:31	12:41	10.0	0.30	0.99	0.69	1.36	5.39	13.70
2.00	12:42	12:52	10.0	0.30	0.98	0.68	1.36	5.30	13.46

Plate No. 6

HILLTOP GEOTECHNICAL INCORPORATED

INFILTRATION DATA SHEET

Project Name:	32864 Hilltop Blvd	Project Number:	1669-02
Test Hole Number:	P-2	Date Tested:	10/3/25
Depth of Boring in feet:	2.0	Tested By:	JG
Radius of boring feet:	0.33	Time of Presoaking	50 minutes
Presoak: Time Initial	10:58 AM on 10/03/25		

Depth of Bottom (ft)	Time Initial	Time Final	Time Interval (minutes)	Depth of Water - Initial (ft)	Depth of Water - Final (ft)	Change in Water Level (ft)	$H_{average}$ (ft)	Rate, It (In/Hr)	Rate, It (Cm/Hr)
2.00	10:58	11:16	18.0	0.30	2.00	1.70	0.85	11.05	28.08
2.00	11:17	11:36	19.0	0.30	2.00	1.70	0.85	10.47	26.60
2.00	11:50	12:00	10.0	0.30	1.49	1.19	1.11	11.13	28.27
2.00	12:01	12:11	10.0	0.30	1.45	1.15	1.13	10.59	26.90
2.00	12:12	12:22	10.0	0.30	1.44	1.14	1.13	10.46	26.56
2.00	12:23	12:33	10.0	0.30	1.45	1.15	1.13	10.59	26.90
2.00	12:33	12:43	10.0	0.30	1.42	1.12	1.14	10.20	25.90
2.00	12:44	12:54	10.0	0.30	1.42	1.12	1.14	10.20	25.90

Plate No. 7