Program for Expansion of Recharge Capacity (PERC) Comprehensive Feasibility Study

Volume 3

Detailed Feasibility Analysis of PERC Project Alternatives in the Plunge Creek Watershed

Oak Creek Recharge Basins

Plunge Creek Recharge Basins

November 2025

San Bernardino Valley Water Conservation District
Helping Nature Store Our Water

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Introduction to Volume 3

Detailed Feasibility Analysis of Program for Expansion of Recharge Capacity (PERC) Project Alternatives in the Plunge Creek Watershed

Volume 3 of the *PERC Comprehensive Feasibility Study* includes Detailed Feasibility Analyses for the following *new construction projects* as PERC Project Alternatives in the Plunge Creek Watershed:

- Oak Creek Recharge Basins
- Plunge Creek Recharge Basins (two alternatives; Interim and Ultimate)

Table 1 lists all ten PERC Project Alternatives with the corresponding Study Volume, geographic location, and site for each.

Table 1. PERC Comprehensive Feasibility Study Alternatives

Volume/ Location	Site	PERC Alternative
Volume 2 East Twin Creek Watershed	Waterman Recharge Basins	Waterman Grading Alternative
	Twin Creek Recharge Basins (TCRB)	TCRB Small Grading Alternative
		TCRB Large Grading Alternative
	Lynwood Recharge Basins	Lynwood Operational Alternative
Volume 3 Plunge Creek Watershed	Oak Creek Recharge Basins (OCRB)	OCRB Construction Alternative
	Plunge Creek Recharge Basins (PCRB)	PCRB Interim Construction Alternative
		PCRB Ultimate Construction Alternative
Volume 4 Mill Creek	Mill Creek Recharge Basins (MCRB)	MC Grading Alternative 1
		MC Grading Alternative 2
		MC Grading Alternative 3

Technical details supporting Volume 3 can be found in the Preliminary Design Reports for *Oak Creek Groundwater Recharge Project* (Appendix A), *Plunge Creek Groundwater Recharge Interim Project* (Appendix B), *and Plunge Creek Groundwater Recharge Ultimate Project* (Appendix C), provided as Appendices. Additional documentation is provided in the Citations at the end of this report.

About Plunge Creek Watershed

Plunge Creek

Plunge Creek Watershed is a large and productive watershed that historically has not been used for engineered recharge. As a part of PERC planning, San Bernardino Valley Water Conservation District (SBVWCD) assessed existing concepts previously developed in the region for potential recharge of native water flows (Scheevel, 2016). As a result, SBVWCD designed and constructed the Plunge Creek Conservation Project in September 2020 to spread water using "soft engineering" techniques to direct water into the historic high-flow braided channels of Plunge Creek at low flows to generate habitat benefits and to "sink" more water in the Upper Santa Ana River Wash.

The PERC Comprehensive Feasibility Study expands the potential for groundwater recharge by evaluating sites both upstream (Oak Creek) and downstream (Plunge Creek at Orange Street) of the Plunge Creek Conservation Project. PERC Project Alternatives these new locations were sized to their respective available stormwater flow rates, volumes, and timing of land availability. This work is described for three independent projects in Volume 3:

- Oak Creek Recharge Basins (OCRB) Construction Alternative
- Plunge Creek Recharge Basins (PCRB) Interim Construction Alternative
- PCRB Ultimate Construction Alternative

The PCRB Interim Alternative is a near-term consideration whereas the Ultimate Alternative would be implemented decades in the future under changed conditions.

Oak Creek Recharge Basins Alternative

1 Executive Summary

The **Oak Creek Recharge Basins (OCRB) PERC Project Construction Alternative** (OCRB Construction Alternative) would divert stormwater from Oak Creek Channel runoff and two existing storm drains in Greenspot Road into a newly constructed recharge basin system. It would also be capable of receiving water as part of the Forecast Informed Reservoir Operations (FIRO) program within the watershed.

The OCRB Construction Alternative will provide an estimated net new 1,020 AFY of recharge with approximately 23.3 cfs infiltration-rate capacity. The 46.5-year period of operation would provide **54,242 AF of net groundwater recharge** as forecast "firm yield."

OCRB Construction Alternative Scores and Rank

Consideration (MAA Account)	Score
Groundwater Recharge Benefits	1.98
Cost Aspects	1.57
Other Technical Aspects	0.41
Social Aspects	0.08
Legal Aspects	0.51
Total Score	**4.55**
Rank (of 10)	**1**

The OCRB Construction Alternative will require approximately 3.5 years to build. With a project decision date of July 1, 2025, projected operations span from July 1, 2029 to the end of the 50-year project planning horizon, December 31, 2075. The projected capital cost (in present value) is $18,446,000 and annual Operations & Maintenance (O&M) cost, in 2025 value, is estimated to be $83,077.

The OCRB Construction Alternative is ranked 1st out of the 10 potential PERC projects evaluated. It has the **highest priority of all PERC projects** when considering the characteristics most suited for near-term application of available human resources, financial resources, and political capital.

2 Introduction

In this document, the **OCRB Construction Alternative** is evaluated based on the five aspects identified by SBVWCD and project partners as important and relevant to ranking PERC Project Alternatives, which are:

- Groundwater Recharge Benefits
- Cost Aspects
- Other Technical Aspects
- Social Aspects
- Legal Aspects

A complete description of these aspects, their respective components, and the ranking methodology for PERC Project Alternatives is provided in **Volume 1**.

Sections 3 through 5 below provide information specific to the OCRB Construction Alternative, including the following:

- **Section 3–Site and Features**: Descriptions of the Alternative's site location, existing facilities, geologic setting, and surrounding watershed.
- **Section 4–Design and Analysis**: Descriptions of the Alternative's water sources, proposed design, and characteristics as they align with the five aspects (listed above).
- **Section 5–Summary Results**: Tables presenting the Alternative's scores and rank.

3 Site and Features

The OCRB Construction Alternative Site is an 18.1-acre unimproved parcel of land owned by the San Bernardino Valley Municipal Water District (SBVMWD). It is located along Greenspot Road near the juncture with Cone Camp Road, across from Calle Del Rio. The south boundary of the property adjoins Power Line Road; an unimproved road aligned east to west that extends Abbey Way on the other side of Plunge Creek (**Figure 1**).

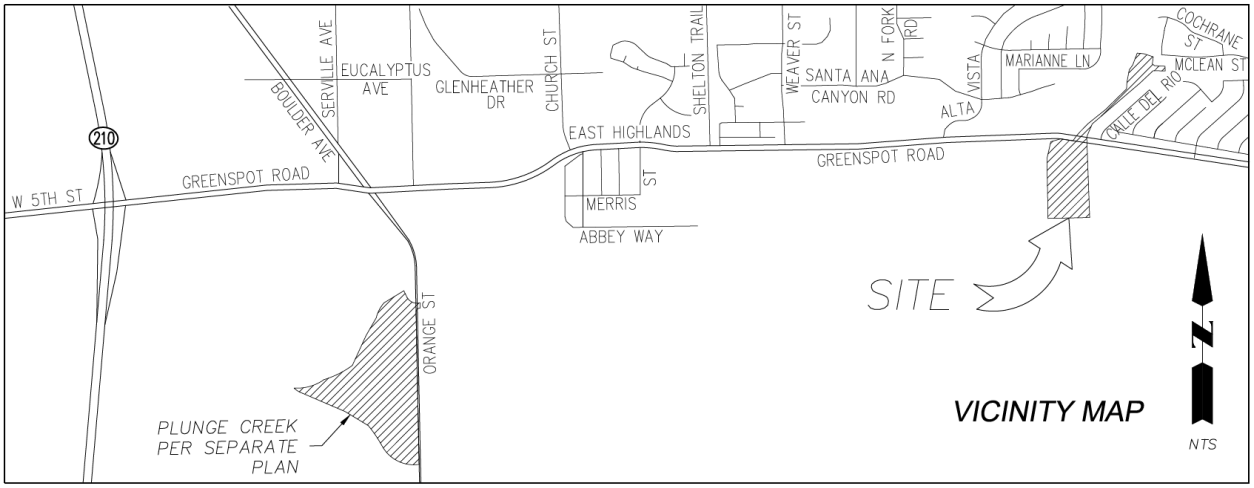

Figure 1. OCRB Construction Alternative Site

3.1 Existing Facilities

There are three existing facilities at and adjoining the Site that benefit the development of engineered groundwater recharge at this location.

- **Storm Pipes**: Stormwater is conveyed under Greenspot Road in two large-diameter storm pipes. The pipes' proximity to the Site, and grade line above the location, enables a gravity drop of water into the proposed OCRB Construction Alternative basins.
- **Foothill Pipeline**: The Site overlies the SBVMWD Foothill Pipeline. This 78-inch pressurized pipeline can move excess native flows of the Santa Ana River to the Site as a part of the FIRO program currently under development for Seven Oaks Dam.
- **Power Line**: The power line abutting the Site makes energizing any prospective operations simpler and eliminates the need to develop a utility easement for electrification if energy is required.

The Site location is shown in wide-scale aerial view in **Figure 2**.

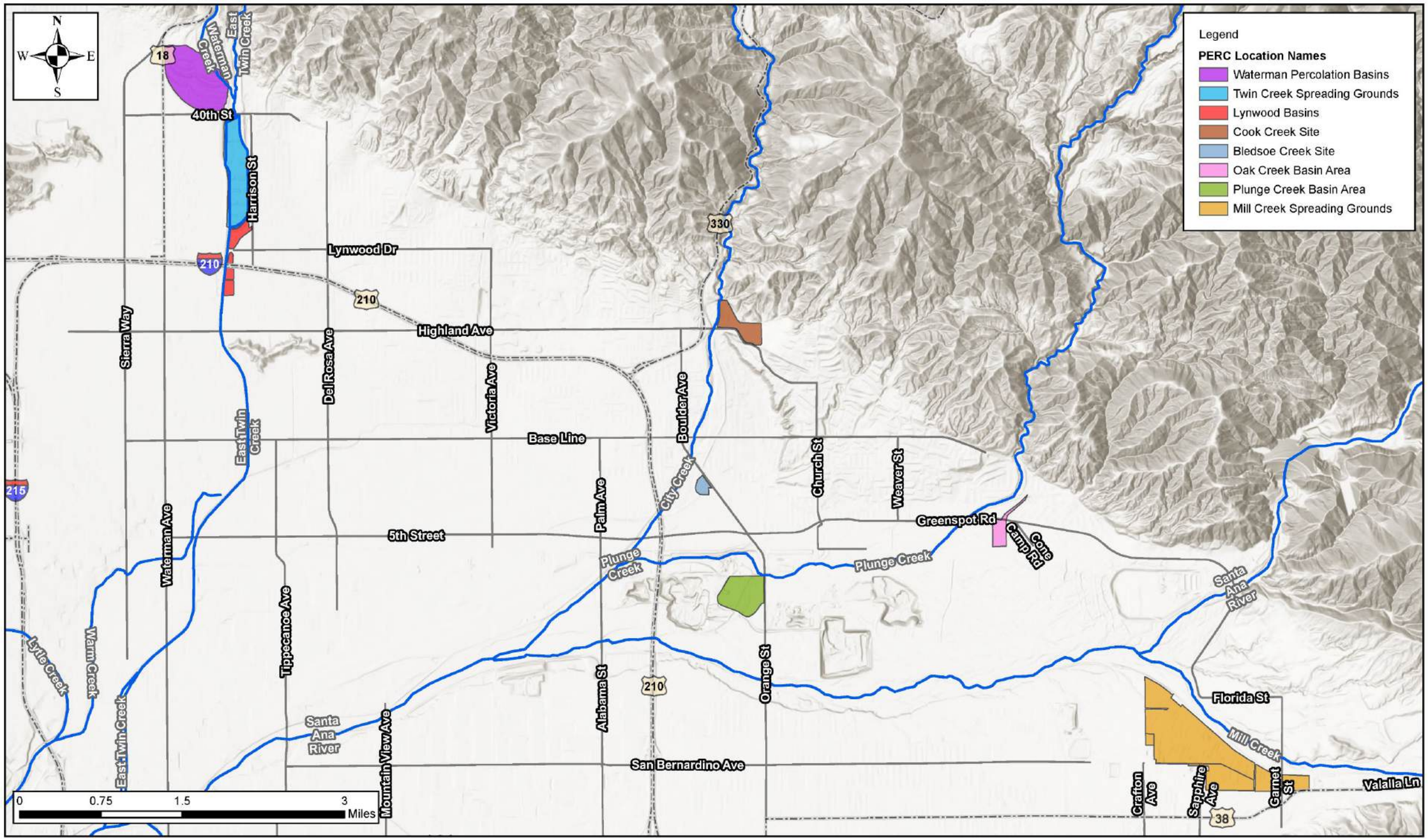

Figure 2. PERC Project Locations

3.2 Site Assessment

The OCRB Construction Alternative site assessment included topographic survey and site walk.

3.2.1 Topographic Survey

An existing 1-meter Digital Elevation Model (DEM) produced by high resolution LiDAR data by the USGS (USGS, 2022) was used for analysis of grade lines at and around the property. The overall slope across the property is 1.8%. For recharge basins, this slope is relatively steep. This grade line indicates that thoughtful consideration should be given to the arrangement of the future recharge basins so that the basins can avoid being categorized as California Division of Safety of Dams (DSOD) "Jurisdictional Dams." The limiting factor identified was the maximum dam height of six feet as measured from the toe (i.e., bottom) of the downstream berm or levee to the maximum water surface elevation, generally taken as the spillway elevation. If this designed height stays below 6 feet, then the storage volume can be any size and still not be considered a Jurisdictional Dam; as shown along the lower portion of **Figure 3**. This planning is further described in Volume 1.

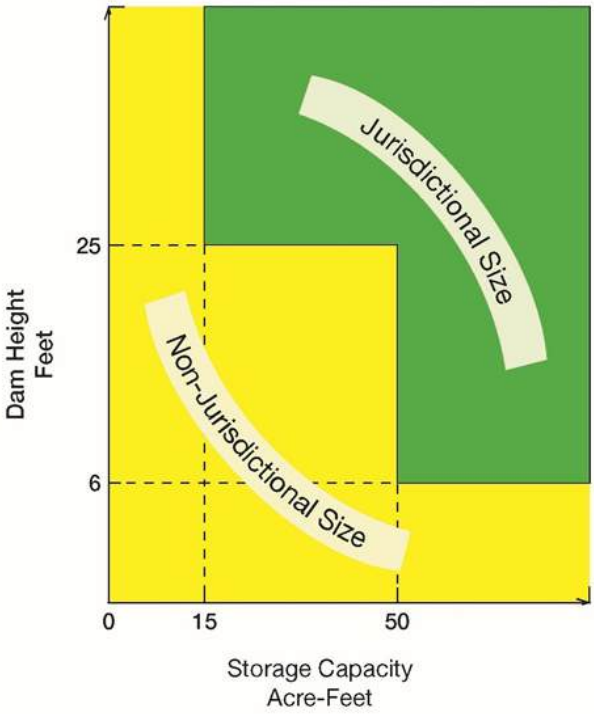

Figure 3. DSOD Jurisdictional Size Chart

The high-resolution DEM provided the basis for a detailed topographic mapping used in the site design. An additional topographic survey of the Plunge Creek channel was conducted to the west of the Oak Creek Basins site to evaluate recent channel developments and the Plunge Creek Conservation Project (Inland Aerial Surveys, 2022).

3.2.2 Site Walk

A site walk was conducted in January 2024 by SBVWCD staff. Images from the site walk are provided in the Appendix.

3.3 Geotechnical Assessment and Analysis

The surficial geology at the Oak Creek Basins is differentiated young "wash" and alluvial fan deposits (**Figure 4**). This differentiation means that the deposition occurred either in the

general pathway of the watercourse (i.e., wash deposits) or on the surface of an alluvial fan built up at the boundary of flows.

The sedimentary deposits beneath the Oak Creek Basins had routinely been subjected to flushing flows, but alluvial fan deposits grew around the northwestern edge and along their eastern boundary. These deposits would be expected to be relatively coarse-grained overall given their proximity to the canyon mouth and its grade line.

A geotechnical field exploration was conducted on December 13 and 14, 2022 and January 18 and 19, 2023 and consisted of drilling a total of 7 exploratory borings. In addition, four borehole percolation tests were conducted.

Subsurface conditions encountered in exploratory borings were indicative of the location explored. The site was "underlain by alluvial soil materials capped by a relatively thin layer of fill materials, locally." The alluvial soil materials "were noted to consist of units ranging from silty sand with gravel, cobbles, and boulders to well graded gravel with sand, cobbles, and boulders." (LOR, 2023)

The proposed OCRB Construction Alternative was found to be **feasible** from a soil engineering standpoint, provided that the recommendations provided in the *Preliminary Feasibility Geotechnical and Infiltration Feasibility Investigation* report (LOR, 2023) are incorporated into design and implemented during construction. Test results indicated good infiltration characteristics for the soils tested.

Borehole percolation tests were conducted at depths which varied from approximately 8 feet to 15 feet. Infiltration rates were calculated from the test data using the Porchet Method and ranged from 2.5 inches/hour to 6.5 inches/hour.

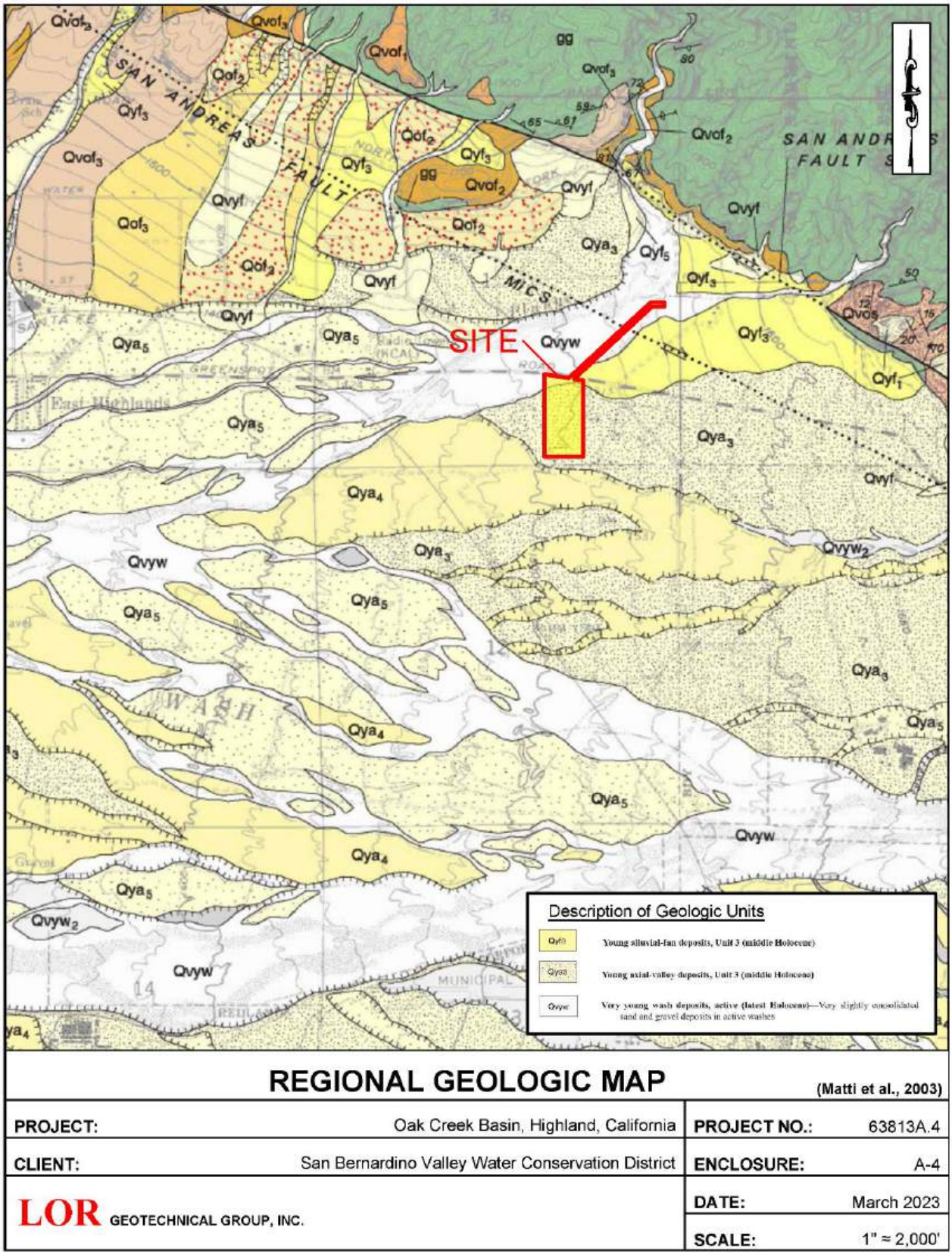

Figure 4. Sedimentary Geologic-Units Map with OCRB Construction Alternative site

4 Design and Analysis

The **OCRB Construction Alternative** would create a *new location* for engineered recharge in the Upper Santa Ana River's eastern tributaries. The project site is situated on lands upslope of lower Plunge Creek below Greenspot Road, allowing excess surface water that overflows and exits the new basins to flow downslope into the existing Plunge Creek Conservation Project downstream. The water-spreading action from this project creates the added benefit of improved habitat.

4.1 Proposed Design

The proposed OCRB Construction Alternative design consists of the following:

- Two recharge basins in series (Basin 1 and Basin 2)
- Diversion from Oak Creek Channel
- Diversions from two existing storm drains in Greenspot Road
- Turnout from Foothill Pipeline (for FIRO flows, if available)

The Oak Creek and Storm Drain diversion lines would be combined in a vault with a single outfall line to Basin 1. The single outfall line would include a sensor for flow measurement. When overtopping, flow from Basin 1 will cross a spillway into Basin 2. The proposed OCRB Construction Alternative also includes a turnout from the existing 78" water transmission line (FIRO diversion), should FIRO become an available water source for recharge.

The project site is adjacent to two residential properties to the east and southeast. Project design and construction would be done to limit impacts to these residences consistent with existing conditions of other water infrastructure through and adjacent to these residences.

The overall layout of the project design is provided in **Figure 5**. Additional details about the proposed design are available in the *Preliminary Design Report (PDR) Oak Creek Groundwater Recharge Project* (CASC, 2025) provided as Appendix A. The conceptual design plan sheets are included in PDR Addendum OC-1.

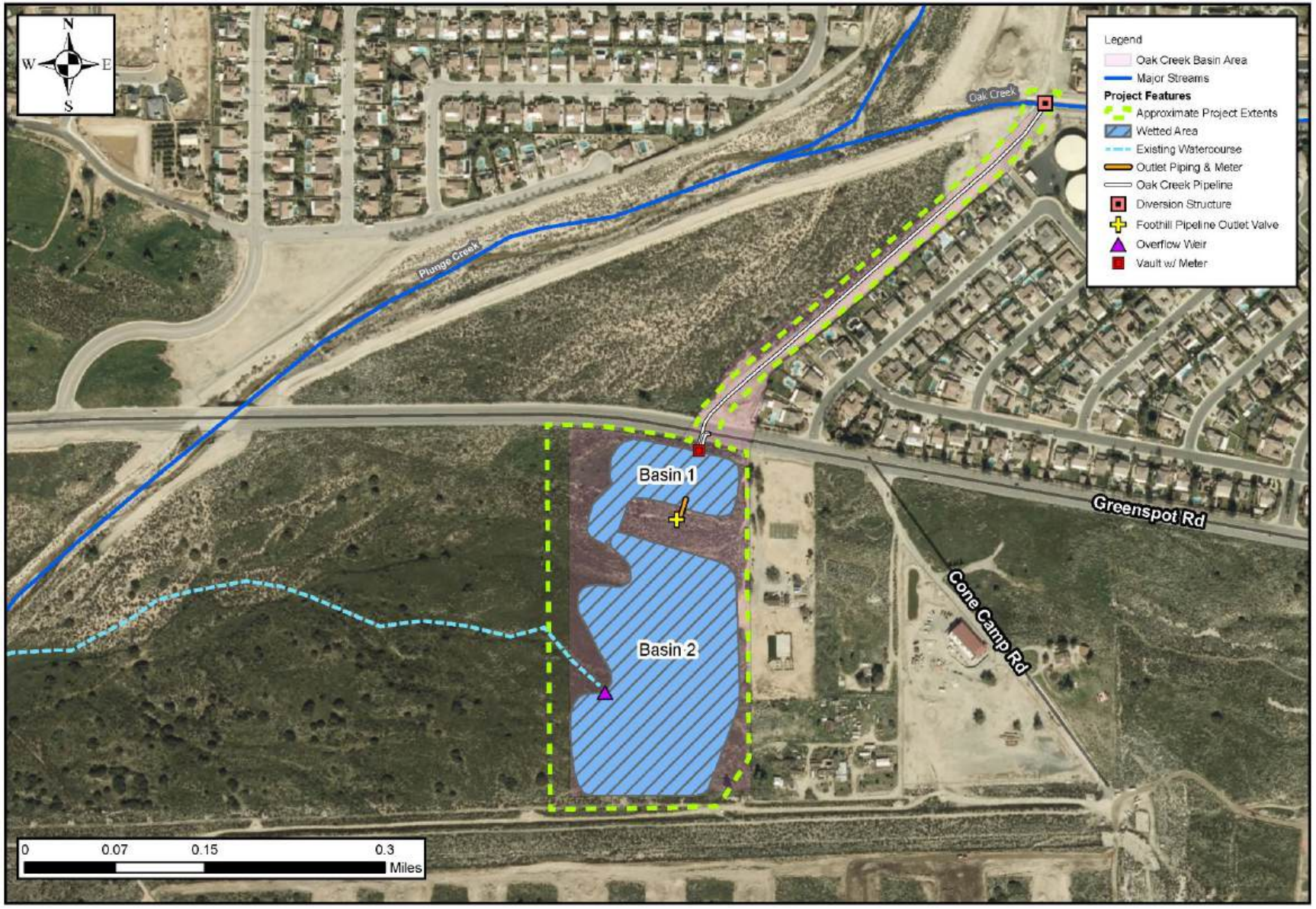

Figure 5. OCRB Construction Alternative Overview

4.1.1 Recharge Basins and Spillways

The proposed OCRB Construction Alternative includes two recharge basins in series. The upstream basin (Basin 1) will receive runoff from diversions of Oak Creek and the two storm drains in Greenspot Road. An internal spillway will convey runoff that exceeds Basin 1's capacity to Basin 2. Basin 2 will receive runoff that flows over the internal spillway. Basin 2 will have an overflow spillway that will discharge excess runoff to the Santa Ana River.

Conceptual basin grading is provided in PDR Addendum OC-1. The conceptual grading assumes side slopes at 2:1 (horizontal to vertical) with a 20'-wide access road along the perimeter. The proposed design does not trigger Division of Safety of Dams (DSOD) jurisdiction because the impounded water storage (WS) elevation of 1497 is not more than 6' higher than the downstream elevation of the embankment (1491).

Table 2. Proposed Oak Creek Basin Data

Basin Name	Bottom WS Elevation	Top WS Elevation	Bottom Area (acres)	Storage Volume (AF)
Basin 1	1483	1495	0.8	14.6
Basin 2	1483	1497	5.8	98.6

4.1.2 Oak Creek Diversion

The proposed diversion at Oak Creek is a grated drop structure. The proposed structure would be sized for full diversion of flows up to 14 cfs from Oak Creek Channel and would convey flows via a proposed 24" reinforced concrete pipe (RCP) to Basin 1.

4.1.3 Storm Drain Diversions

The proposed diversion structures for the existing storm drains in Greenspot Road are drop manholes with the 24" RCP diversion pipe soffit a minimum of 1 foot below the invert of the main line. The proposed diversion structures and pipes would be designed for full interception of 5 cfs each.

4.1.4 FIRO Diversion

Conceptual design of a Foothill Pipeline Turnout and Flow Control Facility to convey FIRO flows is provided as PDR Addendum OC-6. This facility would tap into the existing 78" Foothill Pipeline owned by SBVMWD. The proposed turnout facility would include a 30"-diameter cement-mortar-lined steel pipe to deliver a continuous flow rate of 35 cfs.

4.1.5 Geotechnical Considerations

The *Preliminary Feasibility Geotechnical and Infiltration Feasibility Investigation, Oak Creek Basin and Diversion Project, Highland, California* (LOR, 2023) provides recommendations for the following:

- Shoring Design Parameters
- Culvert Areas
- Preparation of Box Culvert and Retaining Wall Areas
- Preparation of Pipeline Areas
- Culvert Box and Retaining Wall Design
- Engineered Compacted Fill
- Slope Construction
- Slope Protection
- Infiltration

4.1.6 Project Operations

Project operations could occur at virtually any time of year. During the **winter rainy season,** storm flows would be an expected part of the operations. During a storm, the diversions at Oak Creek and the existing Storm Drains in Greenspot Road would convey flows to the vault at the north end outfall to Basin 1. When Basin 1's capacity is exceeded, overflow will discharge via the internal spillway to Basin 2. When Basin 2's capacity is exceeded, its overflow spillway will discharge excess runoff to the Santa Ana River. The proposed drop gate at Oak Creek does not include a gate to shut off the diversion in a high flow event. This could be added in during final design. The storm drain diversion systems are assumed to be *passive systems*, without gates.

4.1.7 Timeline

As described in Volume 1 in the *Comprehensive PERC Feasibility Study Report*, the timeline for project alternatives is calculated by estimating the time to design, permit, fund, and construct a project. Volume 1 summarizes estimates for all ten PERC Project Alternatives. Specific timeline factors for the OCRB Construction Alternative are described below.

- **Design Time**: Design of the OCRB Construction Alternative to the 65+% level required for permitting consideration is estimated to take **18 months**.
- **Permit Time**: The permit time forecast for OCRB Construction Alternative is **12 months**. All permit requirements are expected to be accomplished within a single

overlapping one-year period. This is based on SBVWCD and SBVMWD experience, and programmatic expertise.

- **Funding Time**: The time forecast spanning from project decision-making to having a capital funding plan in place is estimated to be **0 months**. The funding timeline is thought to be initiated after the Design and Permitting Time. The timing of project funding then is **January 1, 2028**. This is the timeline used to generate a net present value factor for capital funding needs.

- **Construction Time**: The construction period includes the time needed to take project designs into biddable specifications and contract documents, conduct a public bidding process for contractor selection, the project construction period, and project works commissioning. For the OCRB Construction Alternative, this construction period is estimated to require **18 months**.

The project operational period is estimated to be **July 1, 2029 to December 31, 2075**. The project O&M costs are estimated over this period. Estimated groundwater recharge yield is predicated on a 46.5-year operating period.

4.2 Watershed Hydrology

Four sub-watersheds (Elder Creek, Plunge Creek, Oak Creek, and Storm Drain) were defined above the proposed OCRB Construction Alternative, as shown in **Figure 6**.

Analysis of the 35-year record of stream gage data from Upper Plunge Creek Gage #110555000 indicated 187 distinct storm events in the sub-watershed area from water year (WY) 1989 through part of WY 2024. These storm events were scaled by overlaying the PRISM 30-year normal data over the four defined sub-watersheds. Reduction Factors for each sub-watershed were then calculated as the product of the sub-watershed area and the weighted precipitation average as presented in **Table 3**.

Table 3. Calculated Sub-Watershed Ratios

Sub-Watershed	Area (acres)	Precipitation (inches)	Product (AF)	Reduction Factor
Elder Creek	3,082	14.19	3,645	0.164
Oak Creek (ungaged)	1,527	16.34	2,079	0.094
Plunge Creek (gaged)	10,974	24.26	22,185	1.000
Greenspot Storm Drain	547	13.46	613	0.028

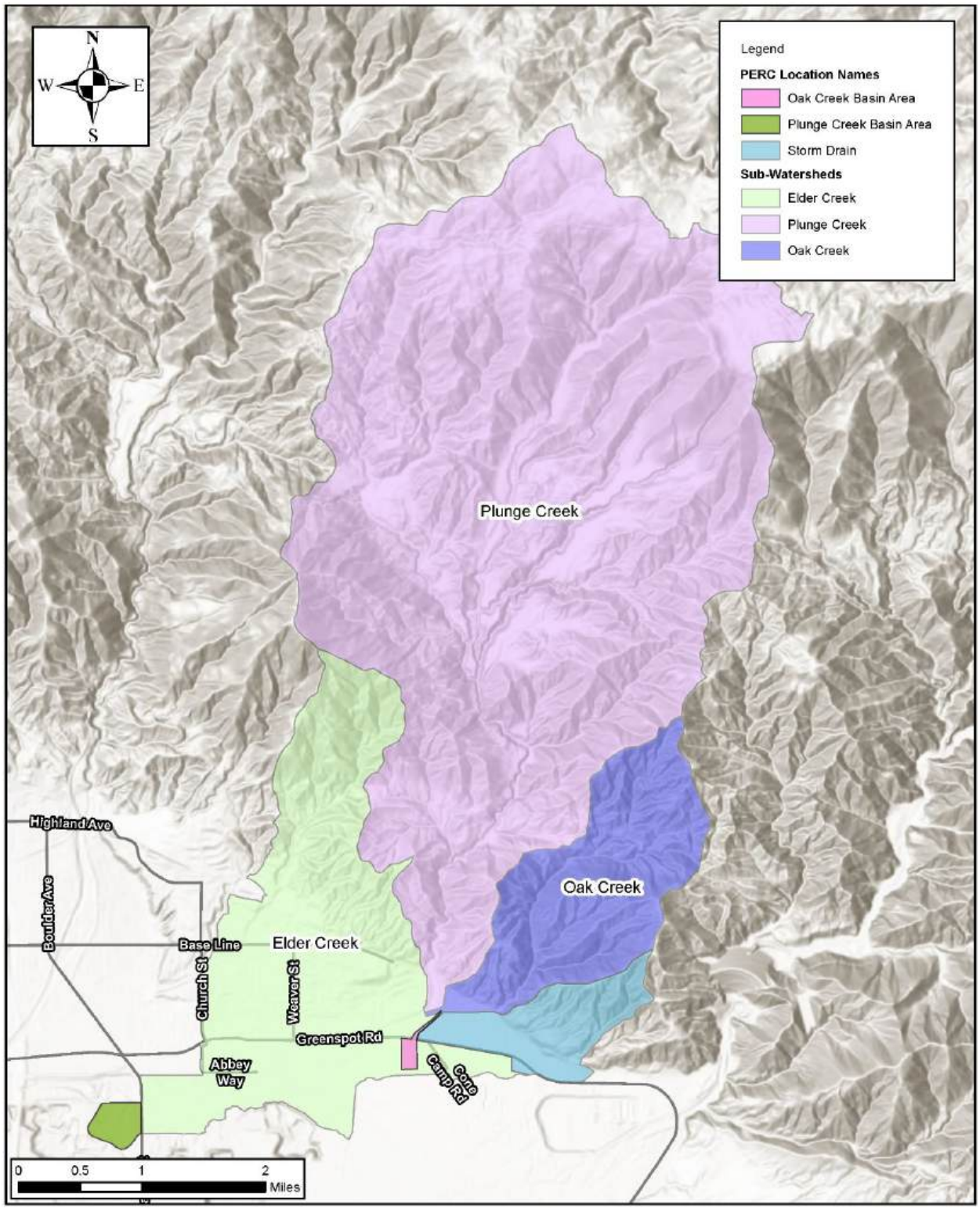

Figure 6. Watershed Areas above proposed PERC Project Sites at Oak Creek and Plunge Creek

Applying a Log Pearson Type 3 distribution to the adjusted set of storm flow events determined 50th, 80th, and 90th percentile peak flow rates (**Table 4**).

Table 4. Peak Flow Rates

Subbasin/Combination	50th Percentile Peak Flow Rate (cfs)	80th Percentile Peak Flow Rate (cfs)	90th Percentile Peak Flow Rate (cfs)
Oak Creek	11.0	27.6	47.7
Greenspot Storm Drain	3.3	8.2	14.2
Plunge + Elder	135.7	342.0	590.4
Plunge + Elder + Oak	146.6	369.6	638.1

After discussion with SBVWCD, it was determined that the **50th percentile peak flow rate** would be used for the OCRB Construction Alternative design, as well as for design of the other Volume 3 projects (PCRB Interim Construction Alternative and PCRB Ultimate Construction Alternative).

4.3 Water Source Hydrology

Project hydrology for groundwater recharge in the proposed OCRB consists of **three water sources**:

- Oak Creek Diversions
- Stormwater Runoff from the neighborhood above the 2 pipes in Greenspot Road
- Santa Ana River water delivered under FIRO from Seven Oaks Dam operations

Below is a description of the analysis that determined the inflow volumes to be expected from storm events and FIRO deliveries to the OCRB Construction Alternative.

4.3.1 Storm Events

One of the storm events in the gage data, Event 121, had a peak flow rate that was a close match to the chosen 50th percentile peak flow rate. Event 121 was selected as the model hydrograph, known as the project typical hydrograph (PTH), to use for design. The analysis of the gage data and typical hydrograph development is included in PDR Addendum OC-2.

The Oak Creek and Storm Drain watersheds (shown previously in Figure 5) were combined to scale the PTH for design and analysis. Resulting peak flow and volume are shown in **Table 5**. The resulting hydrograph was used to develop the inflow event to model storm events entering OCRB.

Table 5. OCRB Construction Alternative PTH Data

Subbasin/Combination	Peak Flow (cfs)	Volume (acre-feet)
Oak Creek + Storm Drain	14.3	71

4.3.2 FIRO Events

The primary function of SBVMWD's Foothill Pipeline is to deliver imported water. However, it can also function to divert FIRO flows and deliver them to PERC Project Alternatives along its alignment. The concept of FIRO delivery to PERC projects and forecast projections are described in Volume 1 of the *PERC Comprehensive Feasibility Study*.

FIRO hydrology indicates that peak flows are estimated to be available in approximately **1 out of every 4 years** to PERC projects with access. For that hydrology, the estimate is a delivery over 52 days of a uniform flow rate. For the OCRB Construction Alternative, there will be new infrastructure to deliver water out of the Foothill Pipeline to the proposed OCRB, conceptually designed and analyzed at 35 cfs.

4.4 Groundwater Recharge Benefits

The events described above were analyzed to evaluate and estimate the probable groundwater recharge yield of the OCRB Construction Alternative:

- **Native Inflows:** Analyzes the PTH from Oak Creek entering the proposed OCRB for recharge. This condition provides a flow of water for approximately 56 days.
- **FIRO Flows:** Analyzes a FIRO flow of 35 cfs delivered to the proposed OCRB. This condition provides a flow of water for approximately 52 days.

4.4.1 Native Inflows

Native inflows consisting of five consecutive PTH with no time gap between the end of one storm and the beginning of the next was created for basin routing analysis of native runoff. The resulting event had the characteristics shown in **Table 6**.

Table 6. Native Inflow Characteristics

Duration (Days)	Peak Flow (cfs)	Cumulative Volume (AF)
56	14.0	354.5

4.4.2 FIRO Inflows

Routing analysis was also conducted in the case where FIRO water is discharged into Basin 1 at a constant rate of 35 cfs over fifty-two consecutive days (**Table 7**).

Table 7. FIRO Inflow Characteristics

Duration (Days)	Peak Flow (cfs)	Cumulative Volume (AF)
52	35	3,610.3

4.4.3 Estimated Groundwater Recharge

Basin modeling for the OCRB Construction Alternative was conducted under three scenarios:

- Recharge of Native Inflows using the unclogged infiltration rate
- Recharge of Native Inflows using the clogged infiltration rate
- Recharge of FIRO Inflows using the unclogged infiltration rate

The clogged infiltration rate *was not conducted* for the FIRO scenario because it is assumed that SBVWCD would remove sediments from the basins prior to receiving the inflows. Estimated recharge volume modeling results are presented in **Table 8**.

Table 8. OCRB Construction Alternative Groundwater Recharge Modeling Results

Scenario	Inflow Volume (AF)	Infiltrated Volume (AF)	Overflow Volume (AF)
Native Inflow / Unclogged	354.5	354.5	0
Native Inflow / Clogged	354.5	354.5	0
FIRO/ Unclogged	2,083	1,159.5	923.5

Note that the total infiltration for the unclogged and clogged conditions is the *full inflow volume of 354.5 AF*, since the system does not allow any bypass. The Basin Routing Technical Memorandum and Stage Storage Tables that support Table 8 are included in PDR Addendum OC-3.

4.4.3.1 Annual Average Recharge

Native inflows from Oak Creek resulted in an estimated annual average yield of 354.5 AFY. FIRO inflows resulted in an estimated 1,159.5 AFY. The resulting groundwater recharge benefit for the OCRB Construction Alternative is estimated to be **~1,020 AFY**.

4.4.3.2 Infiltration-Rate Capacity

The OCRB infiltration-rate capacity is estimated at **23.3 cfs**.

4.4.3.3 Firm Yield Over Planning Horizon

The OCRB Construction Alternative has a 46.5-year period of operation in the 50-year planning horizon. Based on the increased average annual yield, a rated net increase in firm

yield of **54,242 AF** of engineered recharge is calculated over the PERC Feasibility Study's planning horizon.

4.4.4 Groundwater Recharge Benefits Summary

Below are the Groundwater Recharge Benefits values associated with the OCRB Construction Alternative that were input to the MAA Model for final scoring.

Table 9. OCRB Construction Alternative Groundwater Recharge Benefits Summary

Groundwater Recharge Benefits Summary		
Annual Average New Recharge (AFY)	Infiltration Rate Capacity Increase (cfs)	Firm Yield over 50-Year Planning Horizon (AF)
1,514 AFY	23.3 cfs	54,242 AF

4.5 Cost Aspects

4.5.1 Capital Costs

The estimated capital costs are detailed in PDR Addendum OC-4 and total $21,613,000 on a 2025 basis. But the timing of the capital needed is January 1, 2028 to fund construction. The discount factor used for capital is 4% with an expectation that the cost of money is 7% and inflation is 3%. A general contingency of 30-percent was added to each alternative. The Present Value of the capital needed January 1, 2028 equates to **$18,446,000**.

4.5.2 Operations & Maintenance

OCRB maintenance would principally be for siltation management and basin clogging. An estimated 1,600 cubic yards/year of sediment loading would occur. This amount of sediment is projected to trigger a basin scraping and cleaning effort **once every other year** to clear Basin 1 infill. Other maintenance measures are integrated to O&M costs via replacement cycles for meters and telecommunications equipment and would be addressed in a subsequent phase.

O&M Costs are forecast on an annual equivalent basis. The day-to-day operations for Oak Creek Recharge Basins would be overseen by the Water Systems Daily Operator, Supervisor, and Engineering. Basin cleaning and maintenance operations are projected to be an every-other-year effort for scraping out sediment and a singular annual inspection of basin operating conditions. Comparison of operating costs are made in present day dollars. The average annual costs of basin maintenance are estimated at **$83,077 per year**. The O&M costs are not discounted for the sake of comparison since they will be incurred in the year that they occur. Therefore, projecting a borrowing cost for capital is not pertinent for operations. Similarly, inflationary factors are not material to comparing costs that would be similarly inflated over a similar period.

4.5.3 Cost Aspects Summary

Table 10 presents the Cost Aspects values associated with the OCRB Construction Alternative that were input to the MAA Model for final scoring.

Table 10. OCRB Construction Alternative Cost Aspects Summary

Cost Aspects Summary	
Capital Costs (2025$)	Annual O&M Costs (2025$)
$18,446,000	$83,077/year

4.6 Other Technical Aspects

Other aspects of the OCRB Construction Alternative are summarized here. For comparison among other PERC Alternatives in the Multiple Accounts Analysis (MAA), see Volume 1.

4.6.1 Groundwater Quality Improvements

Additional recharge into the Bunker Hill Basin Zone B is rated on its prospective annual average recharge for the equivalent in millions of gallons per day (MGD). That quantification is in keeping with the discussions and evaluations of Salt & Nutrient Management Planning. The OCRB Construction Alternative estimated average daily recharge rate based on a historic probability-based calculation of how often and how much water is materially available and the annual average groundwater recharge potential equates to **1.0 MGD**.

4.6.2 Conservation and Habitat Benefits

Technical studies will be required to evaluate potential habitat impacts because the proposed project site is currently undeveloped. The project siting and construction is near to known Endangered Species Act preservation areas. There may be specific habitats for aquatic or terrestrial species in the footprint of the Oak Creek Basins that would require mitigation for impacts and/or relocation of individual populations within the project footprint. Recommendations from the technical studies will be incorporated as mitigation measures into the project.

An added benefit from this groundwater recharge project would be improved habitat from the water-spreading action. Excess surface water flowing downslope from the project will eventually enter the existing Plunge Creek Conservation Project downstream.

The diversion of surface water from the Oak Creek tributary to Plunge Creek is a Covered Activity under the Upper Santa Ana River Habitat Conservation Plan, identified as "*Plunge Creek – Basin 1 (ID: VD.2.06).*" (ICF, 2025) The OCRB are planned for lands covered by the Wash Habitat Conservation Plan (Wash HCP), making the environmental permitting process more transparent and flexible.

The southern portion of the site is located in the Santa Ana River Wash HCP, however it is not located within the preserve assembly. The expected benefit to flows in the Santa Ana River is **0.9 cfs** as a chronic year-round rate.

4.6.3 Hydraulic Stress and Pressure Zone Influence

The value of relief to the hydraulic stress is described in Volume 1. It equates to the distance from the PERC Project Alternative to the center of the Pressure Zone near West 5th Street and Waterman Avenue in the City of San Bernardino. The proposed OCRB are measured as **13,500 yards** or approximately 7.7 miles.

4.6.4 Access to State Water Project Supply

The proposed Oak Creek Recharge Basins will be capable of directly receiving State Water Project supplies.

4.6.5 Groundwater Mounding

Potential groundwater mounding from the proposed project is analyzed in the report *Groundwater Modeling for Oak Creek Diversion and Basins Project Feasibility Study*, dated January 29, 2025 (Geoscience, 2025). Analysis in the report indicated that the peak mounding from the Oak Creek project would occur around forty-four days after the start of recharge in both clogged and unclogged conditions. Under FIRO diversion, maximum mounding occurred at 52 days after the start of recharge. The model indicated that recharge would not increase the area of shallow groundwater (groundwater less than fifty feet below ground surface). The results are summarized in **Table 11**.

Table 11. Potential Groundwater Mounding at Proposed Oak Creek Recharge Basins

Scenario	Maximum Change in Groundwater Elevation (ft)	Time of Maximum Mounding (days after start of recharge)
Clogged	2	44
Unclogged	2	44
FIRO Unclogged	11	52

4.6.6 Other Technical Aspects Summary

Table 12 presents a summary of the Other Technical Aspects values associated with the OCRB Construction Alternative that were input to the MAA Model for final scoring.

Table 12. OCRB Construction Alternative Other Technical Aspects Summary

Other Technical Aspects Summary				
Average Annual Recharge Rate (MGD)	Santa Ana River Contribution (cfs)	Proximity to Groundwater Pressure Zone (yds)	Access to SWP Supply	Groundwater Mounding
1.0	0.9	13,500	Direct access	No

4.7 Social Aspects

4.7.1 Job Creation

The OCRB Construction Alternative projected construction employment in FTE is equal to **60 full-time jobs for 18 months**. The total employment forecast for O&M for the OCRB Construction Alternative is **0.23 FTE** on a perpetual basis.

4.7.2 Ponded Water Depth

The OCRB Construction Alternative ponded water depth is **14 feet**. One social aspect that will be taken into consideration is prevention of drowning. Experience at SBVWCD basins demonstrates that water basins will attract unhoused individuals or passersby in hot weather to enter the basin. Access control will be a key consideration in design. Additionally, graded slopes for easy ingress and egress may reduce drowning and other safety hazards from sloped ground.

4.7.3 Social Aspects Summary

Table 13 presents the Social Aspects values associated with the OCRB Construction Alternative that were input to the MAA Model for final scoring.

Table 13. OCRB Construction Alternative Social Aspects Summary

Social Aspects Summary		
Construction Jobs (FTE/time period)	O&M Jobs (FTE)	Ponded Water Depth (ft)
60 /18 months	0.23	14

4.8 Legal Aspects

4.8.1 CEQA and Permitting Analysis

A brief review of the potential permit needs and issues for the OCRB Construction Alternative is provided in **Table 14** below.

Table 14. Potential Permit Requirements for the OCRB Construction Alternative

Potential Permit	Preliminary Review Determination
California Environmental Quality Act (CEQA)	Based on a preliminary review of the OCRB Construction Alternative, it is anticipated that the project will require an EIR. Actual determination of the most appropriate environmental document will be determined at the time technical studies are completed.
U.S. Fish and Wildlife Service (USFWS)	Addressed under the Upper Santa Ana River HCP.
California Department of Fish and Wildlife (CDFW) CESA (2081)	Addressed under the Upper Santa Ana River HCP.
CDFW LSA /1600	Addressed under the Upper Santa Ana River HCP.
USACE 401/ Regional Water Quality Control Board (RWQCB)	Addressed under the Upper Santa Ana River HCP.
USACE 404	Required, but SBVWCD has a standing permit which will apply to this Alternative.
USACE 408	None Required
California Division of Safety of Dams (DSOD) Jurisdictional Dam	None Required
San Bernardino County Flood Control District (SBCFCB)	The Oak Creek Construction Alternative will require a Major Construction Permit from SBCFCD, which has jurisdiction over Plunge Creek.

Time frame for the CEQA process is expected to be between 28 and 32 weeks. Permits could then be obtained within 6 to 12 months following CEQA approval.

The OCRB are outside the Federal Aviation Administration (FAA) secondary buffer zone of 10,000 feet, Perimeter B, from San Bernardino International Airport (FAA, 2020). FAA has specific design and permitting review for water holds that could provide nesting habitat for waterfowl; a flight safety hazard. However, it is within Perimeter C, 5-miles, for San Bernardino International Airport which triggers notification recommendations for the project proponents to the airport operators, and triggers the need for management actions by the airport operators such as providing assessment criteria for wildlife strike risks.

4.8.2 Land Availability

This land is currently owned by a partner agency.

4.8.3 Support for Claimed Water Rights

The support for new Water Rights not yet perfected is equated to the maximum diversion rate to groundwater recharge. estimated at **23.3 cfs** for this alternative.

4.8.4 Legal Aspects Summary

Table 15 presents the Legal Aspects values associated with the OCRB Construction Alternative that were input to the MAA Model for final scoring.

Table 15. OCRB Construction Alternative Legal Aspects Summary

Legal Aspects Summary		
CEQA/Permits Required	Land Availability	Support for Claimed Water Rights (cfs)
See Table 9	Yes	23.3

5 Summary Results

The PERC Comprehensive Feasibility Study looked at each Project Alternative's characteristics and viability over the following key considerations:

- **Groundwater Recharge Benefits**: How much water will be captured and stored as groundwater by the project each year? Over the next 50 years?
- **Cost Aspects:** Do the economics indicate the project's financial viability, including costs, benefits, and projected return on investment?
- **Technical Aspects:** Are the necessary technology, resources, and expertise available and sufficient to implement the project?
- **Social Aspects:** How well does the project align with the available human resources and how well can it align with existing operations?
- **Legal Aspects:** Are there legal or regulatory requirements that could impact the project?

In some respects, this amounts to a discovery process to identify whether any proposed project has fatal flaws that prevent its execution. The OCRB Construction Alternative **does not** have any apparent fatal flaws. More information can and would be developed for the project—if it is taken forward as a project for permitting, design, and construction—that may identify design considerations, but fatal flaws do not appear likely. Operationally, the OCRB Construction Alternative is judged to be a **very good fit** to benefit habitat and greatly enhance groundwater recharge.

5.1 MAA Indicator Values

PERC and its regional partners chose an integrated multiple accounts analysis (MAA) method to consistently assess PERC Alternatives against what they chose as the most important feasibility considerations. The MAA developed for PERC is described in Volume 1. **Table 16** shows the MAA Indicators and their respective OCRB Construction Alternative Values.

Table 16. OCRB Construction Alternative MAA Indicator Values

Account	Subaccounts	Indicators	OCRB Construction Alternative Values
Groundwater Recharge Benefits	Groundwater Recharge-Benefit (Net AFY)	AFY	1,020
	Infiltration-rate-capacity increase (cfs)	Net Increase in Infiltration Rate Capacity (cfs)	23.3

Account	Subaccounts	Indicators	OCRB Construction Alternative Values
		Ease of Maintenance (FTE)	0.07
		Timeline to Implement (years)	3.5
	Recharge benefit on a "firm yield" 50-year horizon (AF)	AF	54,242
Cost Aspects	Capital Costs	Capital Costs NPV	$18,446,000
		Grant Sources	25%
	O&M	O&M in 2025 $	$83,077
Other Technical Aspects	Groundwater Quality Improvements *(Salt & Nutrient Management Planning)*	Volume of Annual Recharge (MGD)	1.04
	Conservation and Habitat Benefits	Santa Ana River Contribution	0.9
		Habitat Restoration	32
		Species/ Habitat Impacts	27.0
	Proximity to Groundwater Pressure Zone	Distance to Pressure Zone (yds)	13,500
	Access to State Water Project Supply	Direct, Indirect, or No Access	Direct
	Groundwater Mounding	Rate Limiting Mounding *(Liquefaction Issue)*	No
Social Aspects	Project Job Creation	Number of Jobs Forecast for Construction	60
		Number of Jobs Forecast for Operational Needs	0.23
	Public Safety Hazards of Project	Ponded Water Depth (ft)	14.0
Legal Aspects	CEQA	CEQA Filing Type (e.g. NOE)	EIR

Account	Subaccounts	Indicators	OCRB Construction Alternative Values
	Permits Required/ Requirements	U.S. FWS Permit Requirements	River-HCP
		CDFW CESA 2081 Permit Requirements	River-HCP
		CDFW LSA 1600 Permit Requirement	River-HCP
		USACE/RWQCB 401 Permit Required	River-HCP
		USACE 404 Permit Required	Standing Permit
		USACE 408 Permit Required	None-Required
		CA DOSD Jurisdictional Dam	None-Required
		City of San Bernardino Consent Decree Area Permit	None-Required
		SBCFCD	None-Required
	Land Availability	Property Ownership by Partner Agencies (Y/N)	Y
	Water Rights	Support for utilization of water rights not yet Licensed	23.3

5.2 Score and Rank

The MAA Summary Scoring prioritizes the **OCRB Construction Alternative as the #1 priority project out of 10 potential PERC projects**. The MAA takes into consideration the stakeholder developed characteristics, criteria, and their weighted importance in meeting regional goals. The OCRB Construction Alternative ranks **highest** on the characteristics desired for near-term project prioritization to apply available human resources, financial resources, and political capital.

The Final OCRB Construction Alternative MAA summary scores are shown in **Table 17**.

Table 17. OCRB Construction Alternative MAA Scoring Summary

Account	OCRB Construction Alternative MAA Summary Score
Groundwater Recharge Benefits	1.98
Cost Aspects	1.57
Other Technical Aspects	0.41
Social Aspects	0.08
Legal Aspects	0.51
Total	**4.55**
Priority Rank (of 10)	**1st**

Plunge Creek Recharge Basins Alternatives

1 Executive Summary

There are two PERC Project Alternatives for the Plunge Creek Recharge Basins (PCRB): 1) **Interim Construction Alternative**, and 2) **Ultimate Construction Alternative**. Both projects propose diverting stormwater runoff from Plunge Creek Channel west of Orange Street into a new recharge basin system south of the proposed diversion.

PCRB Interim Construction Alternative Summary

The PCRB Interim Construction Alternative consists of three recharge basins, a diversion from Plunge Creek, and a storm drain system to convey diverted runoff to the proposed basins. It is designed to be implemented in the *near-term* and its benefits will be realized sooner than most other PERC Alternatives. It has an estimated annual groundwater recharge benefit of **1,790 AFY** and estimated infiltration-rate capacity of 23.5 cfs.

The Interim Alternative generates a **firm yield of 40,874 AF** of recharge over the 50-year planning horizon (2025-2075) from the 17.5-year period of operation that falls within the horizon. The projected capital cost is $16.4 million. The annual O&M cost, in 2025 value, is estimated to be $67,000.

The PCRB Interim Construction Alternative ranks **very high** according to the priorities established by the PERC partners, placing as the **2nd highest scoring PERC Alternative**.

PCRB Interim Construction Alternative Scores and Rank

Consideration (MAA Account)	Score
Groundwater Recharge Benefits	1.85
Cost Aspects	1.57
Other Technical Aspects	0.33
Social Aspects	0.08
Legal Aspects	0.54
Total Score	**4.37**
Rank (of 10)	**2nd**

PCRB Ultimate Construction Alternative Summary

The PCRB Ultimate Construction Alternative consists of one large basin, a diversion from Plunge Creek, and a storm drain system to convey diverted runoff to the proposed basin. It is designed to be implemented in the *distant future*, after mining operations are assumed to have excavated the proposed basin area.

The Ultimate Alternative has an estimated annual groundwater recharge benefit of **3,656 AFY** and estimated infiltration-rate capacity of 80 cfs. It generates a **firm yield of 49,351 AF** of recharge over the 50-year planning horizon (2025-2075) from the period of operation that falls within the horizon. The projected capital cost is $8.2 million. The annual O&M cost, in 2025 value, is estimated to be $120,319.

The PCRB Ultimate Construction Alternative is a feasible construction project that will expand groundwater recharge to the Bunker Hill Basin. It ranks as the **4th highest scoring PERC Alternative** according to the priorities established by the PERC partners.

PCRB Ultimate Construction Alternative Scores and Rank

Consideration (MAA Account)	Score
Groundwater Recharge Benefits	1.62
Cost Aspects	1.52
Other Technical Aspects	0.38
Social Aspects	0.07
Legal Aspects	0.59
Total Score	**4.19**
Rank (of 10)	**4th**

2 Introduction

There are two potential PERC Project Alternatives for the PCRB:

1) PCRB **Interim** Construction Alternative
2) PCRB **Ultimate** Construction Alternative

Both projects propose diverting stormwater runoff from Plunge Creek Channel west of Orange Street into a new recharge basin system south of the proposed diversion. The **Interim Alternative** is intended to be implemented relatively soon – beginning operations as early as 2028 – whereas the **Ultimate Alternative** is envisioned to be constructed in the distant future – around 2062 – after the proposed basin site is used for mining operations.

In this document, the PCRB Construction Alternatives are evaluated based on the five aspects identified by SBVWCD and project partners as important and relevant to ranking PERC Project Alternatives, which are:

- Groundwater Recharge Benefits
- Cost Aspects

- Other Technical Aspects
- Social Aspects
- Legal Aspects

A complete description of these aspects, their respective components, and the ranking methodology for PERC Project Alternatives is provided in Volume 1.

Sections 3 through 5 below provide information specifically for the two PCRB Construction Alternatives, including the following:

- **Section 3–Site and Features**: Descriptions relevant to both alternatives including site location, existing facilities, geologic setting, and surrounding watershed.
- **Section 4–PCRB Interim Construction Alternative**: Descriptions of the Interim Alternative's water sources, proposed design, and characteristics as they align with the five aspects; as well as tables presenting the Alternative's scores and rank.
- **Section 5–PCRB Ultimate Construction Alternative**: Descriptions of the Ultimate Alternative's water sources, proposed design, and characteristics as they align with the five aspects; as well as tables presenting the Alternative's scores and rank.

3 Site and Features

The proposed PCRB Site is an approximately 80-acre parcel located west of Orange Avenue and south of Plunge Creek, on lands owned by the U.S. Bureau of Land Management (BLM). Ground surface elevations range from 1290 feet above mean sea level to 1230 feet. The slope is generally from east to west with an approximate grade of 2%. A map of the site location is provided as **Figure 7**.

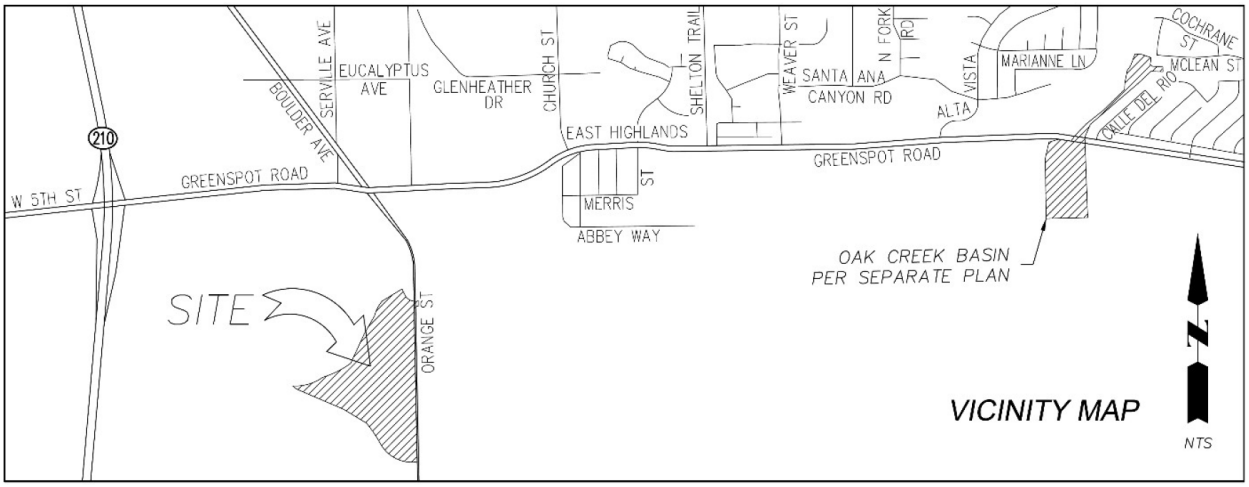

Figure 7. Proposed Plunge Creek Recharge Basin Site

3.1 Existing Facilities

The proposed site is crossed by dirt roads, dotted with various dirt mounds, and includes a large silt pond that is approximately 50 feet deep serving the adjacent cement operation.

Plunge Creek is north of the site and flows from east to west.

- East of Orange Avenue, Plunge Creek is an unimproved stream bed that is periodically maintained by the San Bernardino County Flood Control District (SBCFCD).
- At the Orange Street bridge, the creek becomes a concrete rectangular channel.
- Approximately 100 feet downstream of the bridge, the rectangular channel drops approximately 50 feet through a spillway that is 81 feet wide and approximately 140 feet long to a grouted riprap apron that widens the channel to 170 feet at its downstream end.

The as-built plans for the spillway show a design flow rate of 13,000 cfs. From the end of the apron, the creek resumes as an unimproved channel westerly until its confluence with City Creek approximately 1.5 miles downstream.

The project parcel location was previously presented in Figure 2.

3.1.1 Anticipated Changes to Existing Plunge Creek Channel

The PCRB Construction Alternatives were developed in coordination with the City of Highland because ongoing and upcoming project work is expected to modify the Plunge Creek Channel.

- The existing Plunge Creek channel is 81' wide, but it is likely that it will be wider by the time either of the Plunge Creek Construction Alternatives is built because the City of Highland is planning to widen the Orange Avenue bridge.
- As part of the proposed bridge widening, Plunge Creek channel would be widened to 192 feet downstream of the bridge.
- The future (rectangular) channel would include 12-foot-high side walls.

The exhibits in Preliminary Design Report (PDR) Addendum PCI-1 and PCU-1 show the *future channel plan* described above as the de facto condition at the time of construction. Both Plunge Creek Construction Alternatives (Interim and Ultimate) reflect the City of Highland's existing conceptual plan, profile, and section as the basis of design for the proposed Plunge Creek diversion structures.

3.2 Site Assessment

Preliminary site assessment for the PCRB Construction Alternatives included a topographic survey, site walk, local geologic setting review, and on-site subsurface exploration.

3.2.1 Topographic Survey

The topographic survey was conducted by Inland Aerial Surveys. A copy of the survey is provided as Appendix E.

3.2.2 Site Walk

A site walk survey by SBVWCD staff on January 31, 2024 and March 14, 2025 recorded site conditions. Relevant photos are provided as Appendix F.

3.2.3 Local Geologic Setting Review

The geotechnical report, "*Alternate Preliminary Infiltration Feasibility Investigation Plunge Creek Basin, Highland/Redlands, California, Project 63913B.4, May 31, 2023 (5th Draft), Final Date: January 8, 2025,"* described the site area as: "underlain by young alluvial soil materials. The alluvial materials were noted to consist of units ranging from silty sand with gravel, cobbles, and boulders to well graded gravel with sand, cobbles, and boulders. The native units in the quarries varied from light brown to brown in color, were generally wet, and were typically in a dense to very dense in-place state" (LOR, 2025).

3.2.4 On-site Subsurface Exploration

Preliminary testing of native materials assumed to be similar to those underlying the PCRB Construction Alternatives site indicated favorable infiltration characteristics will be present within the area of the proposed Alternatives (LOR, 2025).

3.3 Geotechnical Assessment and Analysis

The geotechnical investigation for the PCRB Construction Alternatives site is described in the report, "*Alternate Preliminary Infiltration Feasibility Investigation Plunge Creek Basin, Highland/Redlands, California, Project 63913B.4, May 31, 2023 (5th Draft), Final Date: January 8, 2025*" (LOR 2025). The precise PCRB site was inaccessible at the time of the investigation. A map showing the two alternate investigation locations with comparable characteristics, the Robertson's and Cemex sites, is provided as **Figure 8**.

The geotechnical investigation included:

- Excavation of total of four (4) exploratory trenches with a track-mounted mini excavator
    - Two trenches were excavated at the Cemex site
    - Two trenches were excavated at the Robertson's site

    - Trench depths were between 5 feet and 8.5 feet below existing ground surface
- One single-ring infiltrometer test taken at the Cemex site
- Three double-ring infiltration tests
    - Two at the Robertson's site
    - One at the Cemex site
- In-place density testing at the Cemex site
- Sieve analysis
- Testing for measurement of hydraulic conductivity of coarse-grained soils (ASTM D2434)

The field investigation and testing program results indicated that the proposed basin improvements should provide adequate infiltration characteristics provided that the investigation's recommendations are incorporated into design. Interpretation of the results of the field investigation and test data on nearby sites with expected similar soil conditions indicated the site soils at the depths of the proposed basin are conducive to infiltration. Recommendations for design and maintenance of the proposed system are provided in the report (LOR, 2025).

Figure 8. Geotechnical Investigation Site Locations

3.4 Watershed Hydrology

Three sub-watersheds (Elder Creek, Plunge Creek, Oak Creek) were defined above the proposed PCRB Construction Alternatives location, as shown previously in Figure 6.

Analysis of the 35-year record of stream gage data from Upper Plunge Creek Gage #110555000 indicated 187 distinct storm events in the sub-watershed area from water year (WY) 1989 through part of WY 2024. These storm events were scaled by overlaying the PRISM 30-year normal data over the three defined sub-watersheds. Reduction Factors for each sub-watershed were then calculated as the product of the sub-watershed area and the weighted precipitation average as presented in **Table 18**.

Table 18. Calculated Sub-Watershed Ratios

Sub-Watershed	Area (acres)	Precipitation (inches)	Product (AF)	Reduction Factor
Elder Creek	3,082	14.19	3,645	0.164
Oak Creek	1,527	16.34	2,079	0.094
Plunge Creek	10,974	24.26	22,185	1.000

Applying a Log Pearson Type 3 distribution to the adjusted set of storm flow events determined 50th, 80th, and 90th percentile peak flow rates (**Table 19**).

Table 19. Peak Flow Rates

Subbasin/Combination	50th Percentile Peak Flow Rate (cfs)	80th Percentile Peak Flow Rate (cfs)	90th Percentile Peak Flow Rate (cfs)
Oak Creek	11.0	27.6	47.7
Plunge + Elder	135.7	342.0	590.4
Plunge + Elder + Oak	146.6	369.6	638.1

After discussion with SBVWCD, it was determined that the **50th percentile peak flow rate** would be used for design of the PCRB Construction Alternatives, as well as for design of the other Volume 3 project (OCRB Construction Alternative).

3.5 Water Source Hydrology

One of the storm events in the gage data, Event 121, had a peak flow rate that was a close match to the chosen 50th percentile peak flow rate. Event 121 was selected as the model hydrograph, known as the project typical hydrograph (PTH), to use for design. The

analysis of the gage data and typical hydrograph development is included in PDR Addendum PCI-2 (Interim) and PCU-2 (Ultimate). The PTH was scaled up for the combined Plunge + Elder + Oak watershed. The resulting hydrograph was used to develop the inflow event for design and analysis of the PCRB Construction Alternatives.

A Routing Inflow Event consisting of five consecutive PTH with no time gap between the end of one storm and the beginning of the next was created for basin routing analysis of native runoff. The resulting Routing Inflow Event had the characteristics shown in **Table 20**.

Table 20. PCRB Construction Alternatives Native Inflow Characteristics

Duration (days)	Peak Flow (cfs)	Cumulative Volume (AF)
56	144.7	3656

This event was modeled to determine the groundwater benefits associated with each PCRB Construction Alternative, as described in Section 4 (Interim) and Section 5 (Ultimate) below.

4 PCRB Interim Construction Alternative

The **PCRB Interim Construction Alternative** would divert stormwater runoff from Plunge Creek Channel west of Orange Street into a proposed recharge basin system south of the proposed diversion. It is designed to be implemented in the near-term, beginning operations as early as 2028.

4.1 Proposed Design

The PCRB Interim Construction Alternative consists of three recharge basins, a diversion from Plunge Creek, and a storm drain system to convey diverted runoff to the proposed basins. Two diversion alternatives are being considered – a pneumatically operated gate, or a grated drop structure. Project features are shown in **Figure 9** and described below.

4.1.1 Recharge Basins

The proposed layout of the PCRB Interim Construction Alternative consists of three basins, for which data are presented in **Table 21**.

- **Basin 1 and Basin 2**: Runoff would be diverted from Plunge Creek into these two small upstream basins for debris entrapment, limiting aggregation of debris in the primary basin (Basin 3).
- **Basin 3**: Overflow (from Basins 1 and 2) would spill into this larger downstream basin via proposed spillways.

Basin 3 would have an overflow spillway that would discharge excess runoff to the Santa Ana River. The conceptual grading assumes side slopes at 2:1 (horizontal to vertical) with 20'-wide access roads.

Table 21. PCRB Interim Construction Alternative Basin Data

Basin	Bottom Elevation	Top Elevation	Spillway Elevation	Bottom Area (acres)	Storage Volume (AF)
Basin 1	1254	1270	1266	0.95	14.9
Basin 2	1254	1266	1262	1.37	13.1
Basin 3	1244	1260	1258	1.95	99.7

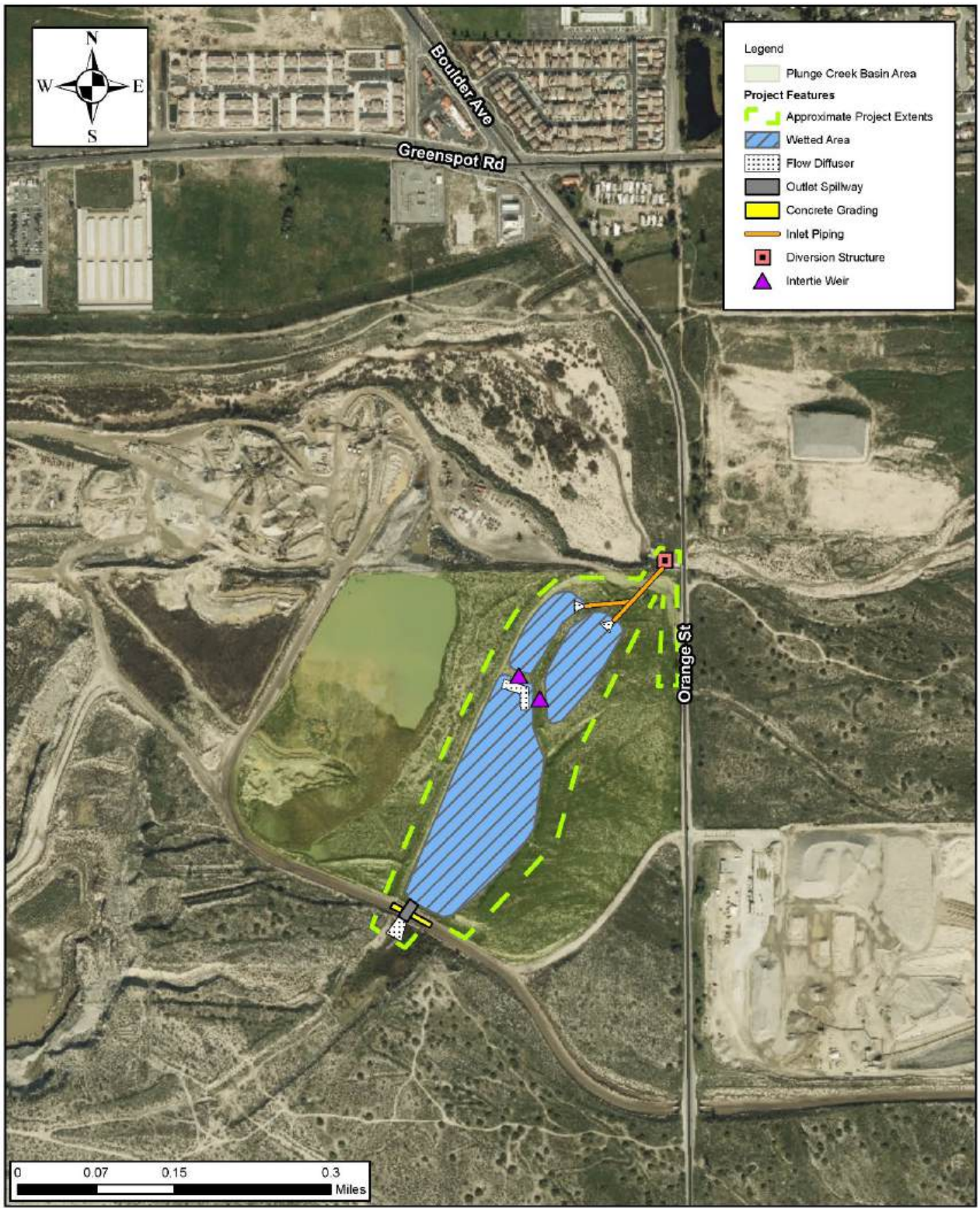

Figure 9. PCRB Interim Construction Alternative Overview

4.1.2 Diversion Alternative 1 – Pneumatically Operated Gate

Diversion Alternative 1 for the PCRB Interim Construction Alternative is a pneumatically operated gate for diversion from Plunge Creek. The metal gate would be raised and lowered by inflating a bladder directly behind the gate panels. The system would be located within Plunge Creek Channel, recessed below the invert of the channel. The gate would span the width of the channel and be 8-feet-high when fully raised. When the gate is raised, impounded water would be diverted through a 6-foot-wide by 5-foot-high opening in the south channel wall into a proposed outlet structure connected to an outlet pipe. The invert of the opening would be 3 feet above the channel invert, allowing sediments and debris to settle in the channel while the comparatively cleaner runoff at the top of the water column is diverted. Accumulated sediments in the channel would then be flushed out when the gate is lowered during high flow events. A section drawing of this preliminary design is provided as an Addendum to the PDR.

4.1.3 Diversion Alternative 2 – Grated Drop Structure

Diversion Alternative 2 for the PCRB Interim Construction Alternative is a grated drop structure for diversion from Plunge Creek. The proposed structure would be sized to intercept up to 145 cfs from Plunge Creek and convey it to Basins 1 and 2. Hydraulic details for the design of the grated drop structure are in the PDR. The grated drop structure would have a sloped invert to carry the intercepted runoff to the outlet structure. *In contrast with Diversion Alternative 1*, the proposed opening in the wall for this alternative would be 6-feet-wide by 7.2-feet-high for a larger flume gate, due to the submerged flow condition downstream. The outlet is submerged in this alternative because the invert of the wall opening is 12 feet lower than the opening in Diversion Alternative 1.

4.1.4 Storm Drain and Junction Box

The preliminary design for the PCRB Interim Construction Alternative includes 48-inch RCP storm drains to convey runoff from the diversion to Basins 1 and 2. A single storm drain would carry diverted stormwater to a junction box that has two outlet pipes, each with a slide gate to control flows. The junction box would allow one basin to remain operational while the other is maintained.

4.1.5 Geotechnical Considerations

The geotechnical investigation focused on infiltration feasibility and did not include formal grading recommendations. However, the investigation included a slope stability analysis assuming a 120-foot-tall, 2:1 cut slope. The analysis also assumed soil strength information from LOR's investigation of Oak Creek (LOR, 2025). Based on these assumptions, the analysis indicated the proposed cut slope to be stable. In a rapid draw scenario at the top and bottom of the basin, the analysis determined factors of safety of 1.5 for static, and 1.2 for pseudostatic conditions.

4.1.6 Project Operations

During the winter rainy season PTH flows would be an expected part of the operations.

4.1.7 Timeline

As described in Volume 1 in the Comprehensive PERC Feasibility Study Report, the timeline for project alternatives is calculated by estimating the time to design, permit, fund, and construct a project. Volume 1 summarizes these estimates alongside those for the other PERC Project Alternatives. Each timeline factor for the PCRB Interim Construction Alternative is described below.

- **Design Time**: Design of the PCRB Interim Construction Alternative to the 65+% level required for permitting consideration is estimated to take **12 months**.
- **Permit Time**: The permit time forecast for PCRB Interim Construction Alternative is **18 months**. This is controlled primarily by the expectation that a USACE 404 Permit will be required and can take 6-12 months to receive after the CEQA document is approved. All other permit requirements are expected to be met within that same overlapping period. This is based on SBVWCD and SBVMWD experience and programmatic expertise.
- **Funding Time**: The time forecast spanning from project decision-making to having a capital funding plan in place is estimated to be **0 months**. The funding timeline is thought to be initiated after the Design and Permitting Time. The timing of project funding then is **January 1, 2028**. This is the timeline used to generate a net present value factor for capital funding needs.
- **Construction Time**: The construction period includes the time needed to take project designs into biddable specifications and contract documents, conduct a public bidding process for contractor selection, the project construction period, and project works commissioning. For the PCRB Interim Construction Alternative, this construction period is estimated to require **6 months**.

The project operational period is estimated to be **July 1, 2028 to December 31, 2045**. The project O&M costs are estimated over this period. Estimated groundwater recharge yield is predicated on a 17.5-year operating period.

4.2 Groundwater Recharge Benefits

Two conditions that were analyzed to estimate the probable groundwater recharge yield for the PCRB Interim Construction Alternative:

- **Condition 1 – Unclogged:** Analyzes the PTH entering the proposed PCRB Alternative for recharge at unclogged infiltration rates.

- **Condition 2 – Clogged:** Analyzes the PTH entering the proposed PCRB Alternative for recharge at clogged filtration rates.

The PCRB Interim Construction Alternative modeling analysis assumed that all three basins would be active during a routing event. The two upstream basins (Basin 1 and Basin 2) would operate in parallel, receiving the initial inflows from the diversion and then sending the excess over their respective spillways to Basin 3. Inflows were assumed to be evenly split between Basin 1 and Basin 2.

The inflows were routed through the basin system model assuming clogged and unclogged infiltration rates. The model results are summarized in **Table 22**.

Table 22. PCRB Interim Construction Alternative Modeling Results

Scenario	Inflow Volume (AF)	Infiltrated Volume (AF)	Overflow Discharged Volume (AF)
Unclogged	3,656	2,336	1,320
Clogged	3,656	1,245	2,411

The Basin Routing Technical Memorandum and Stage-Storage-Discharge Table are provided as PDR Addenda.

4.2.1 Annual Average Recharge

Based on a year of five 50th percentile events, the estimated annual groundwater recharge benefit for the PCRB Interim Construction Alternative is **1,790 AFY**.

4.2.2 Infiltration-Rate Capacity

The PCRB Interim Construction Alternative infiltration-rate capacity is estimated at **23.5 cfs**.

4.2.3 Firm Yield Over Planning Horizon

The PCRB Interim Construction Alternative has a 17.5-year period of operation that falls within the PERC 50-year planning horizon (2025-2075). Based on the average annual yield, the firm yield is **40,874 AF** of engineered recharge over the 50-year planning horizon.

4.2.4 Groundwater Recharge Benefits Summary

Table 23 presents the Groundwater Recharge Benefits values associated with this PERC Project Alternative that were input to the MAA Model for final scoring.

Table 23. PCRB Interim Construction Alternative Groundwater Recharge Benefits Summary

Groundwater Recharge Benefit Summary		
Annual Average New Recharge (AFY)	Infiltration Rate Capacity Increase (cfs)	Firm Yield over 50-Year Planning Horizon (AF)
1,790 AFY	23.5 cfs	40,874 AF

4.3 Cost Aspects

4.3.1 Capital Costs

The estimated capital costs for the PCRB Interim Construction Alternative are detailed in PDR Addendum PCI-4 and range from $16.5M-$18M on a 2025 basis, depending upon which alternative is selected to divert water from Plunge Creek channel to the new basins (a gated drop structure or a pneumatically operated gate). A general contingency of 30-percent was added to each alternative.

The timing of the capital needed is **January 1, 2028 to fund construction.** The discount factor used for capital is 4% with an expectation that the cost of money is 7% and inflation is 3%. Using this discount factor, the Present Value of the capital needed today to fund on January 1, 2028 equates to **$16,393,000**. The projected construction employment in FTE equates to **50 full-time jobs for 6 months**.

4.3.2 Operations & Maintenance

O&M Costs are forecast on an annual equivalent basis. The basin cleaning and maintenance operations vary depending on which alternative is selected to divert water from Plunge Creek channel to the new basins (Pneumatically Operated Gate or Gated Drop Structure). Recent observations of flood flows in Plunge Creek show runoff with considerable TSS, and the potential for large boulders as part of the discharge.

- Diversion Alternative 1 (Pneumatically Operated Gate) is designed to minimize the TSS loading into the basins by having the diversion raised three feet above the channel invert, which would allow some TSS to settle out. Accumulated sediments in the 3-foot trough would then be flushed out when the gate is lowered.
- Diversion Alternative 2 (Gated Drop Structure) would at least restrict the object size in the flow (to one foot or less) since the slots are designed to be one-foot wide. TSS and smaller sediments would be carried more readily in the diverted runoff, however, since no settling trough is provided.

Comparison of operating costs are made in present day dollars. The average annual costs of basin maintenance are estimated at **~$67,437 per year**. The O&M costs are not discounted for the sake of comparison since they will be incurred in the year that they occur. Therefore, projecting a borrowing cost for capital is not pertinent for operations. Similarly, inflationary factors are not material to comparing costs that would be similarly inflated over a similar period of time. The total employment forecast for O&M of the PCRB Interim Construction Alternative is **0.21 FTE** on a perpetual basis.

4.3.3 Cost Aspects Summary

Table 24 presents the Cost Aspects values associated with this PERC Project Alternative that were input to the MAA Model for final scoring.

Table 24. PCRB Interim Construction Alternative Cost Aspects Summary

PCRB Interim Construction Alternative Cost Aspects Summary	
Capital Costs (2025$)	Annual O&M Costs (2025$)
$16,393,000	$67,437/year

4.4 Other Technical Aspects

Other aspects of the PCRB Interim Construction Alternative are summarized here for use in the comparison among other PERC Alternatives in the MAA, as presented in Volume 1.

4.4.1 Groundwater Quality Improvements

The addition of recharge into the Bunker Hill Basin Zone B is rated on its prospective annual average recharge for the equivalent MGD. That quantification is in keeping with the discussions and evaluations of Salt & Nutrient Management Planning. PCRB estimated average daily recharge rate based on a historic probability-based calculation of how often and how much water is materially available in the annual average groundwater recharge potential equates to **1.6 MGD**.

4.4.2 Conservation and Habitat Benefits

Because the proposed project site is currently undeveloped, technical studies will be required to evaluate potential habitat impacts. Recommendations from the technical studies will be incorporated as mitigation measures into the project. Potential impacts to biological resources are expected to be less than significant with the incorporation of mitigation measures. The site, currently undeveloped, is classified as "Riversidean Alluvial Fan Sage Scrub" and "Annual Grassland" vegetation in the City of Redlands General Plan.

The Project site is located in the Santa Ana River Wash Habitat Conservation Plan however it is not located within the preserve assembly.

This project will not contribute additional flows to the Santa Ana River.

4.4.3 Hydraulic Stress and Pressure Zone Influence

The value of relief to hydraulic stress is described in Volume 1. It equates to the distance from the PERC Project Alternative to the center of the Pressure Zone near West 5th Street and Waterman Avenue in the City of San Bernardino. PCRB Interim Construction Alternative features are measured as **7,950 yds**.

4.4.4 Access to State Water Project Supply

The PCRB Interim Construction Alternative **does not** have access to State Water Project Supply.

4.4.5 Groundwater Mounding

Analysis indicated that the peak mounding from the PCRB Interim Construction Alternative would occur around 50 days after the start of spreading in both clogged and unclogged conditions (Geoscience, 2025). Recharge would also result in an increase in the area of shallow groundwater (groundwater less than fifty feet below ground surface). Results are summarized in **Table 25**.

Table 25. Groundwater Mounding Results Summary (PCRB Interim Alternative)

Scenario	**Maximum Change in Groundwater Elevation** (ft)	**Time of Maximum Mounding** (days after start of recharge)	**Baseline Area of Shallow Groundwater** (acres)	**Recharge Scenario of Shallow Groundwater** (acres)
Clogged	10	52	1,324	1,379
Unclogged	20	51	1,322	1,418

4.4.6 Other Technical Aspects Summary

Table 26 presents the Other Technical Aspects values associated with this PERC Project Alternative that were input to the MAA Model for final scoring.

Table 26. PCRB Interim Construction Alternative Other Technical Aspects Summary

Other Technical Aspects Summary				
Average Annual Recharge Rate (MGD)	Santa Ana River Contribution (cfs)	Proximity to Groundwater Pressure Zone (yds)	Access to SWP Supply	Groundwater Mounding
1.6	0	7,950	No Access	Yes

4.5 Social Aspects

4.5.1 Job Creation

The PCRB Interim Construction Alternative projected construction employment in FTE is equal to **50 full-time jobs for 18 months**. The total employment forecast for O&M for the OCRB Construction Alternative is **0.21 FTE** on a perpetual basis.

4.5.2 Ponded Water Depth

The PCRB Interim Construction Alternative ponded water depth is **14 feet**. One social aspect that will be taken into consideration is prevention of drowning. Experience at SBVWCD basins demonstrates that water basins will attract unhoused individuals or passersby in hot weather to enter the basin. Access control will be a key consideration in design. Additionally, graded slopes for easy ingress and egress may reduce drowning and other safety hazards from sloped ground.

4.5.3 Social Aspects Summary

Table 27 presents the Social Aspects values associated with this PERC Project Alternative that were input to the MAA Model for final scoring.

Table 27. PCRB Interim Construction Alternative Social Aspects Summary

Social Aspects Summary		
Construction Jobs (FTE/time period)	O&M Jobs (FTE)	Ponded Water Depth (ft)
50 /6 months	0.21	14

4.6 Legal Aspects

4.6.1 CEQA and Permitting Analysis

The PCRB Interim Construction Alternative will be subject to CEQA as described in PDR Addendum PCU-5. A brief overview of the potential permit needs and issues for this alternative is provided in **Table 28** below.

Table 28. Potential Permit Requirements for the PCRB Interim Construction Alternative

Potential Permit	Preliminary Review Determination
CEQA	Based on preliminary assessment of the existing site conditions, an Initial Study will be required, which is expected to result in a Mitigated Negative Declaration (IS/MND).
USFWS	Addressed under the Upper Santa Ana River HCP and the Wash Plan.
CDFW CESA 2081	Addressed under the Upper Santa Ana River HCP and the Wash Plan.
CDFW LSA /1600	Addressed under the Upper Santa Ana River HCP.
USACE 401/ RWQCB	Addressed under the Upper Santa Ana River HCP.
USACE 404	Required. Once the CEQA document is approved it can take from 6-12 months to receive a 404 Permit.
USACE 408	None required.
CA DOSD Jurisdictional Dam	None required.
SBCFCD	The project will require a Major Construction Permit from SBCFCD, which has jurisdiction over Plunge Creek. Reviews by SBCFCD can take up to six weeks per review cycle depending on the complexity of the review. As this project will involve the construction of permanent facilities within SBCFCD's jurisdiction, permits from other agencies, and the execution of an agreement for operation and maintenance of the proposed facilities, longer review cycles are anticipated.

The PCRB Interim Construction Alternative CEQA process is expected to take approximately 28-32 weeks. Permits that require an approved CEQA document and Notice of Determination (NOD) are anticipated to be obtained within 6 to 12 months following CEQA approval.

The PCRB footprint is inside the Federal Aviation Administration (FAA) secondary buffer zone of 10,000 feet, Perimeter B, from San Bernardino International Airport (FAA, 2020). The FAA

has specific design and permitting review for water holds that could provide nesting habitat for waterfowl; a flight safety hazard. If the PCRB Interim Construction Alternative moves forward, FFA should be consulted to ensure all requirements are met.

4.6.2 Land Availability

This land is currently owned by a partner agency.

4.6.3 Support for Claimed Water Rights

The support for new Water Rights not yet perfected is equated to the maximum diversion rate to groundwater recharge, estimated at **23.5 cfs** for the PCRB Interim Construction Alternative.

4.6.4 Legal Aspects Summary

Below are the Legal Aspects values associated with this PERC Project Alternative that were input to the MAA Model for final scoring.

Table 29. PCRB Interim Construction Alternative Legal Aspects Summary

Legal Aspects Summary		
CEQA/Permits Required	Land Availability	Support for Claimed Water Rights (cfs)
See Table 9	Yes	23.5

4.7 Summary Results

The PERC Comprehensive Feasibility Study looked at each Project Alternative's characteristics and viability over the following key considerations: Technical, Economic, Operational, and Legal Feasibility. In some respects, this amounts to a discovery process to identify whether the project has any fatal flaws that prevent its execution. The PCRB Interim Construction Alternative **does not have any apparent fatal flaws**. It has a short implementation timeline with a period of operation potentially starting as early as July 1, 2028. More information can and would be developed for the PCRB Interim Construction Alternative if it is taken forward as a PERC project for permitting, design, and construction.

4.7.1 MAA Indicator Values

PERC and its regional partners executed an integrated multiple accounts analysis (MAA) by assessing their key considerations and weighting them. The MAA developed for PERC as a comprehensive analytical tool and the weighted scoring method are described in Volume 1.

Table 30 shows the MAA Indicators and their respective PCRB Interim Construction Alternative Values.

Table 30. PCRB Interim Construction Alternative MAA Indicator Values

Account	Subaccounts	Indicators	PCRB Interim Construction Alternative Values
Groundwater Recharge Benefits	Groundwater Recharge-Benefit (Net AFY)	AFY	1,790
	Infiltration-rate-capacity increase (cfs)	Net Increase in Infiltration Rate Capacity (cfs)	23.50
		Ease of Maintenance (FTE)	0.10
		Timeline to Implement (years)	2.5
	Recharge benefit on a "firm yield" 50-year horizon (AF)	AF	40,874
Cost Aspects	Capital Costs	Capital Costs NPV	$16,393,000
		Grant Sources	25%
	O&M	O&M in 2025 $	$67,437
Other Technical Aspects	Groundwater Quality Improvements *(Salt & Nutrient Management Planning)*	Volume of Annual Recharge (MGD)	1.6
	Conservation and Habitat Benefits	Santa Ana River Contribution (cfs)	0
		Habitat Restoration (acres)	8
		Species/ Habitat Impacts (acres)	4
	Proximity to Groundwater Pressure Zone	Distance to Pressure Zone (yds)	7,950
	Access to State Water Project Supply	Direct, Indirect or No Access	No Access
	Groundwater Mounding	Rate Limiting Mounding *(Liquefaction Issue)*	Yes

Account	Subaccounts	Indicators	PCRB Interim Construction Alternative Values
Social Aspects	Project Job Creation	Number of Jobs Forecast for Construction	50
		Number of Jobs Forecast from Operational Needs	0.21
	Public Safety Hazards of Project	Ponded Water Depth (ft)	14
Legal Aspects	CEQA	CEQA Filing Type (e.g. NOE)	IS-MND2
	Permits Required/ Requirements	USFWS Permit Requirements	River HCP & Wash Plan
		CDFW CESA (2081) Permit Requirements	River HCP & Wash Plan
		CDFW LSA /1600 Permit Requirement	River HCP
		USACE/RWQCB 401 Permit Required	River HCP
		USACE 404 Permit Required	Yes
		USACE 408 Permit Required	None
		CA DOSD Jurisdictional Dam	Yes
		City of San Bernardino Consent Decree Area Permit	None
		SBCFCD	Yes
	Land Availability	Property Ownership by Partner Agencies (Y/N)	Yes
	Water Rights	Support for utilization of water rights not yet Licensed (New cfs)	23.5

4.7.2 Score and Rank

The MAA Summary Scoring prioritizes the PCRB Interim Construction Alternative **very high with 2nd priority ranking** (out of 10) when considering the stakeholder-developed characteristics, criteria, and their weighted importance in meeting regional goals. It is a feasible and viable project that **warrants near-term prioritization** for applying human resources, financial resources, and political capital.

The summary scoring for the PCRB Interim Construction Alternative is shown in **Table 31**.

Table 31. PCRB Interim Construction Alternative MAA Scoring Summary

Account	PCRB Interim Construction Alternative MAA Summary Score
Groundwater Recharge Benefits	1.85
Cost Aspects	1.57
Other Technical Aspects	0.33
Social Aspects	0.08
Legal Aspects	0.54
Total	**4.37**
Priority Rank	**2nd**

5 PCRB Ultimate Construction Alternative

The **PCRB Ultimate Construction Alternative** would divert stormwater runoff from Plunge Creek Channel west of Orange Street into a proposed recharge basin south of the proposed diversion in the same manner as described for the Interim Alternative. However, this Ultimate Alternative is envisioned to be built in the distant future – around 2062 – after the proposed basin site is used by others for mining operations, thereby excavating the site prior to the beginning of construction.

5.1 Proposed Design

The PCRB Ultimate Construction Alternative consists of one large basin, a diversion from Plunge Creek, and a storm drain system to convey diverted runoff to the proposed basin. Like the Interim Alternative, two diversion alternatives are being considered for the Ultimate Alternative: a pneumatically operated gate, or a grated drop structure. The project features are shown in **Figure 10** and described below.

5.1.1 Recharge Basin

The proposed layout consists of one large basin, for which data is presented in **Table 32**. Runoff would be diverted from Plunge Creek via one of the diversion structure alternatives described below, which would be connected to a 48" RCP storm drain that would convey and discharge runoff into the basin. The proposed basin would have an overflow spillway that would discharge excess runoff to the Santa Ana River. The conceptual grading assumes side slopes at 2:1 (horizontal to vertical) with 20-foot-wide access roads.

Table 32. PCRB Ultimate Construction Alternative Basin Data

Basin	Bottom Elevation	Top Elevation	Spillway Elevation	Bottom Area (acres)	Storage Volume (AF)
Basin 1	1160	1232	1230	26.36	2431.2

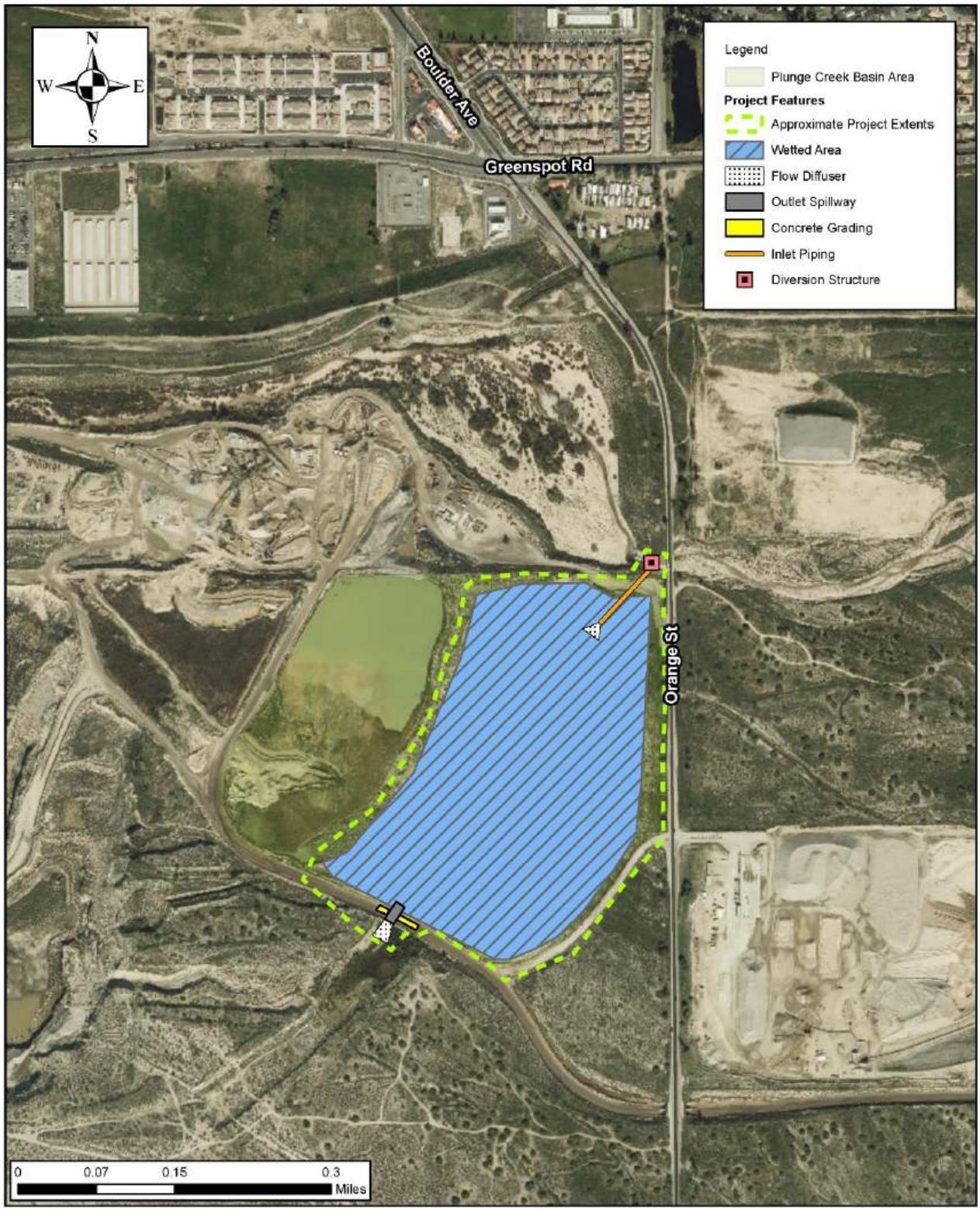

Figure 10. PCRB Ultimate Construction Alternative Overview

5.1.2 Diversion Alternative 1 – Pneumatically Operated Gate

Diversion Alternative 1 for the PCRB Ultimate Construction Alternative is a pneumatically operated gate for diversion from Plunge Creek. The metal gate would be raised and lowered by inflating a bladder directly behind the gate panels. The system would be located within Plunge Creek Channel, recessed below the invert of the channel. The gate would span the width of the channel and be 8-feet-high when fully raised. When the gate is raised, impounded water would be diverted through a 6-foot-wide by 5-foot-high opening in the south channel wall into a proposed outlet structure connected to an outlet pipe. The invert of the opening would be 3 feet above the channel invert, allowing sediments and debris to settle in the channel while the comparatively cleaner runoff at the top of the water column is diverted. Accumulated sediments in the channel would then be flushed out when the gate is lowered during high flow events. A section drawing of this preliminary design is provided as an Addendum to the PDR.

5.1.3 Diversion Alternative 2 – Grated Drop Structure

Diversion Alternative 2 for the PCRB Ultimate Construction Alternative is a grated drop structure for diversion from Plunge Creek. The proposed structure would be sized to intercept up to 145 cfs from Plunge Creek and convey it to Basins 1 and 2. Hydraulic details for the design of the grated drop structure are in the PDR. The grated drop structure would have a sloped invert to carry the intercepted runoff to the outlet structure. *In contrast with Diversion Alternative 1*, the proposed opening in the wall for this alternative would be 6-feet-wide by 7.2-feet-high for a larger flume gate, due to the submerged flow condition downstream. The outlet is submerged in this alternative because the invert of the wall opening is 12 feet lower than the opening in Diversion Alternative 1.

5.1.4 Storm Drain and Junction Box

The preliminary design for the PCRB Ultimate Construction Alternative includes a 48” RCP storm drain to convey runoff from the diversion to Basin 1.

5.1.5 Geotechnical Considerations

The geotechnical investigation focused on infiltration feasibility and did not include formal grading recommendations. However, the investigation included a slope stability analysis assuming a 120-foot-tall, 2:1 cut slope. The analysis also assumed soil strength information from LOR’s investigation of Oak Creek (LOR, 2025). Based on these assumptions, the analysis indicated the proposed cut slope to be stable. In a rapid draw scenario at the top and bottom of the basin, the analysis determined factors of safety of 1.5 for static, and 1.2 for pseudostatic conditions.

5.1.6 Project Operations

During the winter rainy season PTH flows would be an expected part of the operations.

5.1.7 Timeline

As described in Volume 1 in the Comprehensive PERC Feasibility Study Report, the timeline for project alternatives is calculated by estimating the time to design, permit, fund, and construct a project. Volume 1 summarizes these estimates alongside those for the other PERC Project Alternatives. Each timeline factor for the PCRB Ultimate Construction Alternative is described below.

- **Design Time**: Design of the PCRB Ultimate Construction Alternative to the 65+% level required for permitting consideration is estimated to take **15 months**.
- **Permit Time**: The permit time forecast for PCRB Ultimate Construction Alternative is **36 months**. This is controlled primarily by the expectation that a USACE 404 Permit will be required and can take 6-12 months to receive after the CEQA document is approved. All other permit requirements are expected to be met within that same overlapping period. This is based on SBVWCD and SBVMWD experience and programmatic expertise.
- **Funding Time**: The time forecast spanning from project decision-making to having a capital funding plan in place is estimated to be **0 months**. The funding timeline is thought to be initiated after the Design and Permitting Time. The timing of project funding then is **July 1, 2061**. This is the timeline used to generate a net present value factor for capital funding needs.
- **Construction Time**: The construction period includes the time needed to take project designs into biddable specifications and contract documents, conduct a public bidding process for contractor selection, the project construction period, and project works commissioning. For the PCRB Ultimate Construction Alternative, this construction period is estimated to require **12 months**.

The project operational period is estimated to be **July 1, 2062 to December 31, 2075**. The project O&M costs are estimated over this period. Estimated groundwater recharge yield is predicated on a 13.5-year operating period.

5.2 Groundwater Recharge Benefits

Two conditions that were analyzed to estimate the probable groundwater recharge yield for the PCRB Ultimate Construction Alternative:

- **Condition 1 – Unclogged:** Analyzes the PTH entering the proposed PCRB Alternative for recharge at unclogged infiltration rates.
- **Condition 2 – Clogged:** Analyzes the PTH entering the proposed PCRB Alternative for recharge at clogged filtration rates.

The PCRB Ultimate Construction Alternative modeling analysis routed inflow through the basin model assuming clogged and unclogged infiltration rates. The model results are summarized in **Table 33**.

Table 33. PCRB Ultimate Construction Alternative Modeling Results

Scenario	Inflow Volume (AF)	Infiltrated Volume (AF)	Overflow Discharged Volume (AF)
Unclogged	3,656	3,656	0
Clogged	3,656	3,656	0

The Basin Routing Technical Memorandum and Stage-Storage-Discharge Table are provided as PDR Addenda.

5.2.1 Annual Average Recharge

Based on a year of five 50th percentile events, the estimated annual groundwater recharge benefit for the PCRB Ultimate Construction Alternative is **3,656 AFY**.

5.2.2 Infiltration-Rate Capacity

The PCRB Ultimate Construction Alternative infiltration-rate capacity is estimated to be **80.0 cfs**.

5.2.3 Firm Yield Over Planning Horizon

The PCRB Ultimate Construction Alternative has a 13.5-year period of operation that falls within the PERC 50-year planning horizon (2025-2075). Based on the average annual yield, the firm yield is **49,351 AF** of engineered recharge over the 50-year planning horizon, though the project will continue to provide benefit far beyond the 2075 horizon date.

5.2.4 Groundwater Recharge Benefits Summary

Table 34 presents the Groundwater Recharge Benefits values associated with this PERC Project Alternative that were input to the MAA Model for final scoring.

Table 34. PCRB Ultimate Construction Alternative Groundwater Recharge Benefits Summary

Groundwater Recharge Benefit Summary		
Annual Average New Recharge (AFY)	Infiltration Rate Capacity Increase (cfs)	Firm Yield over 50-Year Planning Horizon (AF)
3,656 AFY	80.0 cfs	49,351 AF

5.3 Cost Aspects

5.3.1 Capital Costs

The estimated capital costs for the PCRB Ultimate Construction Alternative are detailed in PDR Addendum PCU-4 and range from $21.6M-$23M on a 2025 basis, depending upon which alternative is selected to divert water from Plunge Creek channel to the new basins (a gated drop structure or a pneumatically operated gate). A general contingency of 30-percent was added to each alternative.

The timing of the capital needed is **July 1, 2061 to fund construction.** The discount factor used for capital is 4% with an expectation that the cost of money is 7% and inflation is 3%. Using this discount factor, the Present Value of the capital needed today to fund on January 1, 2028 equates to **$8,170,000**. The projected construction employment in FTE equates to **30 full-time jobs for one-year**.

5.3.2 Operations & Maintenance

O&M Costs are forecast on an annual equivalent basis. The basin cleaning and maintenance operations vary depending on which alternative is selected to divert water from Plunge Creek channel to the new basins (Pneumatically Operated Gate or Gated Drop Structure). Recent observations of flood flows in Plunge Creek show runoff with considerable TSS, and the potential for large boulders as part of the discharge.

- Diversion Alternative 1 (Pneumatically Operated Gate) is designed to minimize the TSS loading into the basins by having the diversion raised three feet above the channel invert, which would allow some TSS to settle out. Accumulated sediments in the 3-foot trough would then be flushed out when the gate is lowered.
- Diversion Alternative 2 (Gated Drop Structure) would at least restrict the object size in the flow (to one foot or less) since the slots are designed to be one-foot wide. TSS and smaller sediments would be carried more readily in the diverted runoff, however, since no settling trough is provided.

Costs for basin maintenance are projected to be for scraping out sediment and a singular annual inspection of basin operating conditions. Comparison of operating costs are made in present day dollars. The average annual costs of basin maintenance are estimated at **~$120,319 per year**. The O&M costs are not discounted for the sake of comparison since they will be incurred in the year that they occur. Therefore, projecting a borrowing cost for capital is not pertinent for operations. Similarly, inflationary factors are not material to comparing costs that would be similarly inflated over a similar period of time. The total employment forecast for O&M of the PCRB Ultimate Construction Alternative is **0.28 FTE** on a perpetual basis.

5.3.3 Cost Aspects Summary

Table 35 presents the Cost Aspects values associated with this PERC Project Alternative that were input to the MAA Model for final scoring.

Table 35. PCRB Ultimate Construction Alternative Cost Aspects Summary

PCRB Interim Construction Alternative Cost Aspects Summary	
Capital Costs (2025$)	Annual O&M Costs (2025$)
$8,170,000	$120,319/year

5.4 Other Technical Aspects

Other aspects of the PCRB Ultimate Construction Alternative are summarized here for use in the comparison among other PERC Alternatives in the MAA, as presented in Volume 1.

5.4.1 Groundwater Quality Improvements

The addition of recharge into the Bunker Hill Basin Zone B is rated on its prospective annual average recharge for the equivalent MGD. That quantification is in keeping with the discussions and evaluations of Salt & Nutrient Management Planning. PCRB estimated average daily recharge rate based on a historic probability based calculation of how often and how much water is materially available in the annual average groundwater recharge potential equates to **3.3 MGD**.

5.4.2 Conservation and Habitat Benefits:

Because the PCRB Ultimate Construction Alternative is based on the premise that the project site will already be developed because of mining operations, the environmental impacts could be reduced as compared to construction on an undeveloped site.

This Alternative **will not contribute** additional flows to the Santa Ana River.

5.4.3 Hydraulic Stress and Pressure Zone Influence

The value of relief to hydraulic stress is described in Volume 1. It equates to the distance from the PERC Project Alternative to the center of the Pressure Zone near West 5th Street and Waterman Avenue in the City of San Bernardino. PCRB Ultimate Construction Alternative features are measured as **7,800 yds**.

5.4.4 Access to State Water Project Supply:

The PCRB Ultimate Construction Alternative does not have access to State Water Project Supply.

5.4.5 Groundwater Mounding

Analysis indicated that the peak mounding from the PCRB Ultimate Construction Alternative would occur around 56 days after the start of spreading assuming clogged conditions, and around 47 days assuming unclogged conditions (Geoscience, 2025). Recharge would also result in an increase in the area of shallow groundwater (groundwater less than fifty feet below ground surface). Results are summarized in **Table 36**.

Table 36. Groundwater Mounding Results Summary (PCRB Ultimate Alternative)

Scenario	**Maximum Change in Groundwater Elevation** (ft)	**Time of Maximum Mounding** (days after start of recharge)	**Baseline Area of Shallow Groundwater** (acres)	**Recharge Scenario of Shallow Groundwater** (acres)
Clogged	22	56	1,331	1,457
Unclogged	31	47	1,315	1,453

5.4.6 Other Technical Aspects Summary

Table 37 presents the Other Technical Aspects values associated with this PERC Project Alternative that were input to the MAA Model for final scoring.

Table 37. PCRB Ultimate Construction Alternative Other Technical Aspects Summary

Other Technical Aspects Summary				
Average Annual Recharge Rate (MGD)	Santa Ana River Contribution (cfs)	Proximity to Groundwater Pressure Zone (yds)	Access to SWP Supply	Groundwater Mounding
3.3	0	7,800	No Access	Yes

5.5 Social Aspects

5.5.1 Job Creation

The PCRB Interim Construction Alternative projected construction employment in FTE is equal to **30 full-time jobs for xx months**. The total employment forecast for O&M for the OCRB Construction Alternative is **0.28 FTE** on a perpetual basis.

5.5.2 Ponded Water Depth

The PCRB Interim Construction Alternative ponded water depth is **80 feet**. One social aspect that will be taken into consideration is prevention of drowning. Experience at SBVWCD

basins demonstrates that water basins will attract unhoused individuals or passersby in hot weather to enter the basin. Access control will be a key consideration in design. Additionally, graded slopes for easy ingress and egress may reduce drowning and other safety hazards from sloped ground.

5.5.3 Social Aspects Summary

Table 38 presents the Social Aspects values associated with this PERC Project Alternative that were input to the MAA Model for final scoring.

Table 38. PCRB Ultimate Construction Alternative Social Aspects Summary

Social Aspects Summary		
Construction Jobs (FTE/time period)	O&M Jobs (FTE)	Ponded Water Depth (ft)
30 /12 months	0.28	80

5.6 Legal Aspects

5.6.1 CEQA and Permitting Analysis

The PCRB Ultimate Construction Alternative will be subject to CEQA as described in PDR Addendum PCU-5. A brief overview of the potential permit needs and issues for this alternative is provided in **Table 39** below.

Table 39. Review of Potential Permit Requirements for PCRB Ultimate Construction Alternative

Potential Permit	Preliminary Review Determination
CEQA	Based on preliminary assessment of the existing site conditions, an Initial Study will be required, which is expected to result in a Mitigated Negative Declaration (IS/MND).
USFWS	Addressed under the Upper Santa Ana River HCP and the Wash Plan.
CDFW CESA 2081	Addressed under the Upper Santa Ana River HCP and the Wash Plan.
CDFW LSA /1600	Addressed under the Upper Santa Ana River HCP.
USACE 401/ RWQCB	Addressed under the Upper Santa Ana River HCP.
USACE 404	Required. Once the CEQA document is approved it can take from 6-12 months to receive a 404 Permit.
USACE 408	None required.

Potential Permit	Preliminary Review Determination
CA DOSD Jurisdictional Dam	None required assuming water level does not reach 6 feet above ground surface on the downstream berm. Design should avoid exceeding the 6-foot requirement to avoid consultation requirement.
SBCFCD	The project will require a Major Construction Permit from SBCFCD, which has jurisdiction over Plunge Creek. Reviews by SBCFCD can take up to six weeks per review cycle depending on the complexity of the review. As this project will involve the construction of permanent facilities within SBCFCD's jurisdiction, permits from other agencies, and the execution of an agreement for operation and maintenance of the proposed facilities, longer review cycles are anticipated.

The PCRB Ultimate Construction Alternative CEQA process is expected to take approximately 28-32 weeks. Permits that require an approved CEQA document and Notice of Determination (NOD) are anticipated to be obtained within 6 to 12 months following CEQA approval.

The PCRB footprint is inside the Federal Aviation Administration (FAA) secondary buffer zone of 10,000 feet, Perimeter B, from San Bernardino International Airport (FAA, 2020). The FAA has specific design and permitting review for water holds that could provide nesting habitat for waterfowl; a flight safety hazard. If the PCRB Interim Construction Alternative moves forward, FFA should be consulted to ensure all requirements are met.

5.6.2 Land Availability

This land is currently owned by a partner agency.

5.6.3 Support for Claimed Water Rights:

The support for new Water Rights not yet perfected is equated to the maximum diversion rate to groundwater recharge, estimated at **80 cfs** for the PCRB Ultimate Construction Alternative.

5.6.4 Legal Aspects Summary

Below are the Legal Aspects values associated with this PERC Project Alternative that were input to the MAA Model for final scoring.

Table 40. PCRB Ultimate Construction Alternative Legal Aspects Summary

Legal Aspects Summary		
CEQA/Permits Required	Land Availability	Support for Claimed Water Rights (cfs)
See Table 9	Yes	80

5.7 Summary Results

The PERC Comprehensive Feasibility Study looked at each Project Alternative's characteristics and viability over the following key considerations: Technical, Economic, Operational, and Legal Feasibility. In some respects, this amounts to a discovery process to identify whether the project has any fatal flaws that prevent its execution. The PCRB Ultimate Construction Alternative **does not have any apparent fatal flaws**. More information can and would be developed for the PCRB Ultimate Construction Alternative if it is taken forward as a PERC project for permitting, design, and construction.

5.7.1 MAA Indicator Values

PERC and its regional partners executed an integrated multiple accounts analysis (MAA) by assessing their key considerations and weighting them. The MAA developed for PERC as a comprehensive analytical tool and the weighted scoring method are described in Volume 1. **Table 41** shows the MAA Indicators and their respective PCRB Ultimate Construction Alternative Values.

Table 41. PCRB Ultimate Construction Alternative MAA Indicator Values

Account	Subaccounts	Indicators	PCRB Ultimate Construction Alternative Values
Groundwater Recharge Benefits	Groundwater Recharge-Benefit (Net AFY)	AFY	3,656
	Infiltration-rate-capacity increase (cfs)	Net Increase in Infiltration Rate Capacity (cfs)	80.00
		Ease of Maintenance (FTE)	0.20
		Timeline to Implement (years)	38.5

Account	Subaccounts	Indicators	PCRB Ultimate Construction Alternative Values
	Recharge benefit on a "firm yield" 50-year horizon (AF)	AF	49,351
Cost Aspects	Capital Costs	Capital Costs NPV	$8,170,000
		Grant Sources	25%
	O&M	O&M in 2025 $	$120,319
Other Technical Aspects	Groundwater Quality Improvements *(Salt & Nutrient Management Planning)*	Volume of Annual Recharge (MGD)	3.3
	Conservation and Habitat Benefits	Santa Ana River Contribution (cfs)	0
		Habitat Restoration (acres)	43
		Species/ Habitat Impacts (acres)	13
	Proximity to Groundwater Pressure Zone	Distance to Pressure Zone (yds)	7,800
	Access to State Water Project Supply	Direct, Indirect or No Access	No Access
	Groundwater Mounding	Rate Limiting Mounding *(Liquefaction Issue)*	Yes
Social Aspects	Project Job Creation	Number of Jobs Forecast for Construction	30
		Number of Jobs Forecast from Operational Needs	0.28
	Public Safety Hazards of Project	Ponded Water Depth (ft)	80
Legal Aspects	CEQA	CEQA Filing Type (e.g. NOE)	IS-MND1
	Permits Required/ Requirements	USFWS Permit Requirements	River HCP & Wash Plan
		CDFW CESA (2081) Permit Requirements	River HCP & Wash Plan

Account	Subaccounts	Indicators	PCRB Ultimate Construction Alternative Values
		CDFW LSA /1600 Permit Requirement	River HCP
		USACE/RWQCB 401 Permit Required	River HCP
		USACE 404 Permit Required	Yes
		USACE 408 Permit Required	None
		CA DOSD Jurisdictional Dam	Yes
		City of San Bernardino Consent Decree Area Permit	None
		SBCFCD	Yes
	Land Availability	Property Ownership by Partner Agencies (Y/N)	Yes
	Water Rights	Support for utilization of water rights not yet Licensed (New cfs)	80

5.7.2 Score and Rank

The MAA Summary Scoring prioritizes the PCRB Ultimate Construction Alternative high, with a **4th priority** ranking (out of 10), when taking into consideration the stakeholder-developed characteristics, criteria, and their weighted importance in meeting regional goals. The PCRB Ultimate Construction Alternative is a feasible and viable project that warrants prioritization for applying human resources, financial resources, and political capital.

The summary scoring for the PCRB Ultimate Construction Alternative is shown in **Table 42**.

Table 42. PCRB Ultimate Construction MAA Scoring Summary

Account	PCRB Ultimate Construction Alternative MAA Summary Score
Groundwater Recharge Benefits	1.62
Cost Aspects	1.52
Other Technical Aspects	0.38
Social Aspects	0.07
Legal Aspects	0.59
Total	**4.19**
Priority Rank	**4th**

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Appendices

- **Appendix A**: Preliminary Design Report for Oak Creek Groundwater Recharge Project
- **Appendix B**: Preliminary Design Report for Plunge Creek Groundwater Recharge Interim Project
- **Appendix C**: Preliminary Design Report for Plunge Creek Groundwater Recharge Ultimate Project
- **Appendix D**: Field Photos of Oak Creek Basins Site Location Existing Conditions
- **Appendix E**: Field Photos of Plunge Creek Basins Site Location Existing Conditions
- **Appendix F**: Plunge Creek Site Survey

Appendix A

Preliminary Design Report for Oak Creek Basins

San Bernardino Valley Water Conservation District
Program for Expansion of Recharge Capacity (PERC) Comprehensive Feasibility Study

Volume 3

Detailed Feasibility Analysis of PERC Project Alternatives for Plunge Creek Watershed

Preliminary Design Report

Oak Creek Groundwater Recharge Project

Prepared for:

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_____
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April 2025

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Addendum OC-2: Gage Data Analysis

Addendum OC-3: Basin Routing

Addendum OC-4: Cost Estimates

Addendum OC-5: Permitting Technical Memorandum

Addendum OC-6: FIRO Turnout Technical Memorandum

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1 INTRODUCTION

Casc Engineering and Consulting, Inc. (Casc) is under contract with San Bernardino Valley Water Conservation District to provide support services for the preparation of a Feasibility Study (by the District) for a proposed groundwater recharge basin at Oak Creek. The proposed project would divert stormwater runoff from Oak Creek Channel into a proposed recharge basin system south of Greenspot Road and approximately eight hundred feet (800') west of Cone Camp Road. Additional diversions from the existing storm drains in Greenspot Road are also part of the proposed project.

The project is also being considered for diversion of water from the existing 78" water transmission line from San Bernardino Valley Municipal Water District as part of the Forecast Informed Reservoir Operations (FIRO) within the watershed.

1.1 PURPOSE

The purpose of this report is to summarize the information gained from the various studies conducted under this contract. The detailed technical studies are listed as references at the end of this report. Additional details and memoranda that are not part of formal detailed technical studies are in the Addenda of this summary report.

Questions answered in this report include:

- How much stormwater runoff to divert in terms of peak flow and volume?
- How much recharge occurs in a planned FIRO diversion?
- What are the proposed designs for the diversions?
- What is the proposed capacity of the Oak Creek Basin system?
- What are the expected permitting requirements for the project?
- What is the conceptual estimated cost to construct the project?
- What is the extent of expected groundwater mounding if the project becomes operational?
-

2 PROJECT DESCRIPTION

2.1 EXISTING CONDITIONS

The proposed basin site is an approximately eighteen (18) acre parcel located south of Greenspot Road and approximately 800' west of Cone Camp Road. Ground surface elevations range from approximately 1515 above sea level to 1490. The slope is generally from east to west at an approximate grade of 2%. The site is currently undeveloped and with sparse vegetation typical of the areas in the Santa Ana River valley that do not receive constant flow.

The existing Oak Creek Channel runs parallel to and located south of McLean Street. The channel was constructed as part of Tract 14326, and is a concrete trapezoidal channel that is 15' wide at the base with 2:1 side slopes and a depth of 7.5 feet. The design capacity of the channel is 2,992 cfs per County of San Bernardino records.

Two storm drains in Greenspot Road will have runoff diverted into the proposed basin system. One storm drain, constructed for runoff from Tract 14326, is a 54" RCP with a 100- year design flow rate (q) of 220 cfs. The other storm drain is a 78" RCP with a 100-year q of 622 cfs, also constructed as part of Tract 14326, but to convey off-site flows around the development.

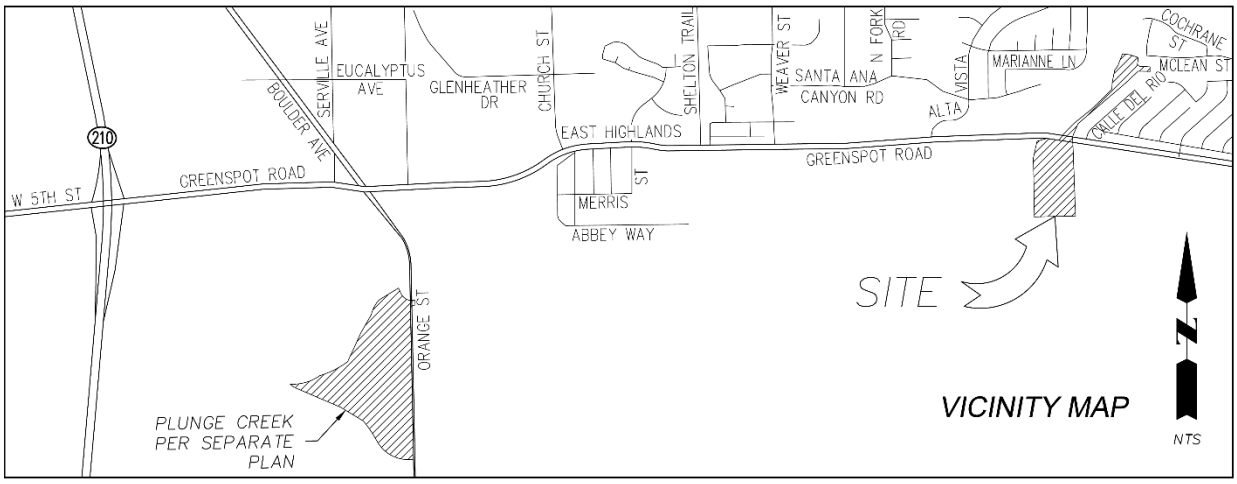


Figure 2-1: Project Location.

2.2 PROPOSED PROJECT

The proposed design consists of two recharge basins in series, a diversion from Oak Creek Channel, and diversions from existing storm drains in Greenspot Road. These three diversion lines would be combined in a vault with a single outfall line to Basin 1. The single outfall line would include a sensor for flow measurement.

The proposed project also includes a diversion from the existing 78" water transmission line (FIRO diversion) should that become an available water source for recharge. The project features are described below.

2.2.1 Recharge Basins and Spillways

The proposed recharge basin system for Oak Creek is two basins in series. The upstream basin (Basin 1) will receive runoff from diversions of Oak Creek and the two storm drains in Greenspot Road. An internal spillway will convey runoff that exceeds Basin 1's capacity to Basin 2. The invert elevation of the internal spillway is at 1495. Basin 2 will receive runoff that flows over the internal spillway. Basin 2 will have an overflow spillway (elevation 1497) that will discharge excess runoff to the Santa Ana River.

Conceptual basin grading is shown in Addendum 1. The conceptual grading assumes side slopes at 2:1 (horizontal to vertical) with a 20'-wide access road along the perimeter. The proposed design does not trigger Division of Safety of Dams (DSOD) jurisdiction because the impounded water storage elevation of 1497 is not more than six feet (6') higher than the downstream elevation of the embankment (1491).

Table 2-1: Oak Creek Basin Data

Basin Name	Bottom WS Elevation	Top WS Elevation	Bottom Area (acres)	Storage Volume (Acre-Ft)
Basin 1	1483	1495	0.8	14.6
Basin 2	1483	1497	5.8	98.6

2.2.2 Oak Creek Diversion

The proposed diversion structure at Oak Creek is a grated drop structure per FHWA HEC-14, Chapter 11, Drop Structures, Section 11.1.2. Grate Design. The proposed diversion structure would be sized for full diversion of flows up to 14 cfs from Oak Creek Channel and would convey it via a proposed 24" RCP to Basin 1. Hydraulic details for the design of the grated drop structure are in Section 5.

2.2.3 Storm Drain Diversions

The proposed diversion structures for the existing storm drains in Greenspot Road are drop manholes with the 24" RCP diversion pipe soffit a minimum of one foot (1') below the invert of the main line. The proposed diversion structures and pipes would be designed for full interception of 5 cfs each. Hydraulic details for the proposed drop manholes are in Section 5.

2.2.4 FIRO Diversion

Casc contracted with Wood-Rodgers for the conceptual design of a Foothill Pipeline Turnout and Flow Control Facility. This facility would tap into the existing 78" Foothill Pipeline owned by the San Bernardino Valley Municipal Water District (SBVMWD). The proposed turnout facility would include

a 30” diameter cement mortar lined steel pipe to deliver a continuous flow rate of 35 cfs. Working pressure for the pipeline would be approximately 200 psi.

Detailed description of the proposed facility is in Addendum OC-6.

3 HYDROLOGY – GAGE DATA ANALYSIS

3.1 METHODOLOGY

An analysis of the 35-year record from Stream Gage Data from Upper Plunge Creek gage 110555000 (water year 1989 through part of water year 2024) detected 187 distinct storm events for that time frame. These storm events were then scaled for the ungaged watetrsheds by overlaying the PRISM 30-year normal data over all four watersheds (gaged Plunge Creek, ungaged Oak Creek, Greenspot Storm Drain, and Elder Creek. Reduction Factors for each watershed were then calculated as the product of the watershed area and the weighted precipitation average. The Reduction Factors shown in Table 3-1:

Table 3-1: Calculated Watershed Ratios

Subbasin	Area (Ac)	Precipitation (inches)	Product (ac-ft)	Reduction Factor
Elder Creek	3,082	14.19	3,645	0.164
Oak Creek	1,527	16.34	2,079	0.094
Plunge Creek	10,974	24.26	22,185	1.000
Storm Drain	547	13.46	613	0.028

3.2 DESIGN STORM DETERMINATION

A Log Pearson Type 3 distribution was applied to the adjusted set of storm flow events to determine 50th, 80th, and 90th percentile peak flow rates. The results of this distribution produced the percentile peak flow rates shown in Table 3-2:

Table 3-2: Watershed Peak Flow Rates (50th, 80th, 90th)

Subbasin/Combination	50th Percentile Peak Flow Rate (cfs)	80th Percentile Peak Flow Rate (cfs)	90th Percentile Peak Flow Rate (cfs)
Oak Creek	11.0	27.6	47.7
Storm Drain	3.3	8.2	14.2
Plunge + Elder	135.7	342.0	590.4
Plunge + Elder+Oak	146.6	369.6	638.1

After discussion with the SBVWCD, it was determined that the 50th percentile peak flow rate would be used for design. One of the storm events in the gage data, Event 121, had a peak flow rate that was a close match to the 50th percentile peak flow rate shown in Table 3-2. Event 121 was selected as the model hydrograph to use for design, i.e. the project typical hydrograph (PTH).

The Oak Creek and Storm Drain watersheds were combined to scale the PTH for the design and analysis of Oak Creek Basin:

Table 3-3: Oak Creek Basin Project Typical Hydrograph Data

Subbasin/Combination	Peak Flow (cfs)	Volume (acre-feet)
Oak Creek+Storm Drain	14.3	71

The resulting hydrograph was used to develop the inflow event for Oak Creek basin routing (see Section 5). The analysis of the gage data and typical hydrograph development is in Addendum OC-2.

4 GEOTECHNICAL

4.1 INVESTIGATION SUMMARY

LOR Geotechnical conducted a geotechnical investigation for Oak Creek as described in their report: Preliminary Feasibility Geotechnical and Infiltration Feasibility Investigation Oak Creek Basin and Diversion Project, Highland, CA, Project 63813A.4, March 1, 2023, Final Date: January 8, 2025 [LOR 63913A.4]. The investigation scope of services included:

- A subsurface field investigation consisting of seven (7) exploratory borings
- Laboratory testing of selected samples obtained during the field investigation
- Four (4) borehole method percolation tests

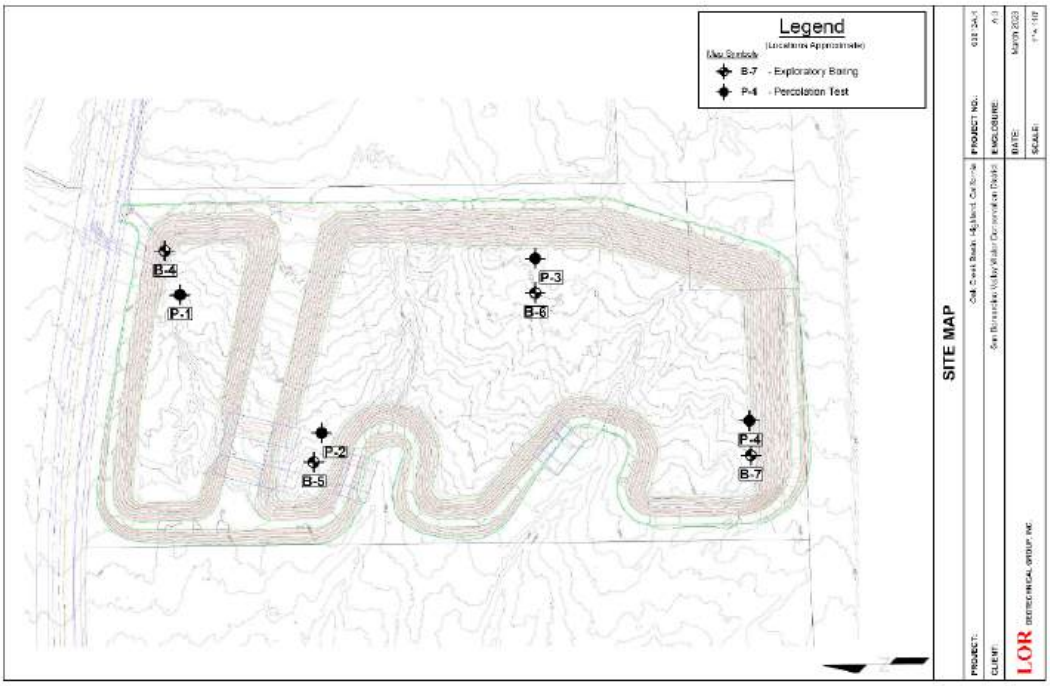


Figure 4-1: Oak Basin Geotechnical Investigation Map

4.2 SITE SOILS

The investigation report described the site as being "underlain by alluvial soil materials capped by a relatively thin layer of fill materials, locally" [LOR 63913A.4, p.3]. The alluvial soil materials "were noted to consist of units ranging from silty sand with gravel, cobbles, and boulders to well graded gravel with sand, cobbles, and boulders" [LOR 63913A.4, p.3].

4.3 GROUNDWATER

LOR's report stated that groundwater was not encountered in any of their borings. The maximum depth of the seven borings was about forty-one feet (41'). The report noted that the shallowest

recorded groundwater measurement at the nearest well (State Well No. 01S03W07C001S) was 84± feet below ground level.

4.4 INFILTRATION

At the Oak Creek Basin location, LOR conducted four borehole percolation tests at depths which varied from approximately 8 feet to 15 feet. Infiltration rates were calculated by LOR from the test data using the Porchet Method, and ranged from 2.5 inches/hour to 6.5 inches/hour.

SBVWCD reviewed the results and developed the design rates to use for clogged and unclogged conditions. SBVWCD converted the results to feet/day, calculated the geometric mean of the results and then calculated a factor of safety of 1.875 using the method in Appendix D of the Technical Guidance Document for Water Quality Management Plans, June 7, 2013, prepared by CDM Smith, Inc. The resulting design rate of 4.46 feet/day was proposed for the unclogged rate. For the clogged rate, SBVWCD proposed assigning an additional reduction factor of 2 to simulate clogging over time prior to basin maintenance, resulting in a clogged rate of 2.23 feet/day. These assumptions and calculations were reviewed and agreed to by the design team and SBVWCD.

Table 4-1: Oak Basin Design Infiltration Rates

Location	Clogged Rate (ft/day)	Unclogged Rate (ft/day)
Oak Creek Basin Site	2.23	4.46

4.5 GRADING RECOMMENDATIONS

The investigation report included grading recommendations and slope stability analysis [LOR 63913A.4, p.9ff]. The report stated that for slopes constructed at 2:1 (horizontal to vertical) and a maximum height of fifteen feet (15') can be considered stable without any analysis [LOR 63913A.4, p.9]. LOR noted that rapid draw down of accumulated stormwater may affect stability; therefore, LOR conducted a rapid draw down analysis. The analysis indicated that the proposed slope would remain stable during a rapid draw down event [LOR 63913A.4, p.10].

For slope construction, the report recommended that cut and fill slopes be constructed no steeper than 2h:1v. A minimum of ninety percent (90%) relative compaction was recommended for fill materials [LOR 63913A.4, p.17].

5 HYDRAULICS

5.1 BASIN ROUTING

A Routing Inflow Event (Native Inflows) consisting of five consecutive Project Typical Hydrographs (PTH) with no time gap between the end of one storm and the beginning of the next was created for basin routing analysis of native runoff. The resulting Routing Inflow Event had the characteristics shown in Table 5-1:

Table 5-1: Routing Inflow Event (Native Inflows) Characteristics

Duration (Days)	Peak Flow (cfs)	Cumulative Volume (ac-ft)
56	14.0	354.5

Routing analysis was also conducted in the case where FIRO water is discharged into Basin 1 at a constant rate of 35 cfs over fifty-two consecutive days. Basin Routing for Oak Creek was conducted under these scenarios:

- Native Inflows using the unclogged infiltration rate
- Native Inflows using the clogged infiltration rate
- FIRO routing using the unclogged infiltration rate

The clogged infiltration rate was not used for the FIRO routing because it is assumed that SBVWCD would remove sediments from the basins prior to receiving the inflows.

Table 5-2: Basin Routing Results

Scenario	Inflow Volume (Ac-Ft)	Infiltrated Volume (Ac-Ft)	Overflow (Discharged) Volume (Ac-Ft)
Native Inflow / Unclogged	354.5	354.5	0
Native Inflow / Clogged	354.5	354.5	0
FIRO/ Unclogged	2,083	1,159.5	923.5

The Basin Routing Technical Memorandum and Stage Storage Tables are in Addendum OC-3.

5.2 OAK CREEK DIVERSION

The proposed diversion structure at Oak Creek is a grated drop structure per U.S. Department of Transportation, Federal Highway Administration, Hydraulic Engineering Circular No.14, Third Edition, Hydraulic Design of Energy Dissipators for Culverts and Channels, [FHWA HEC-14], Chapter 11, Drop Structures, Section 11.1.2. Grate Design, as shown in Figure 5-1.

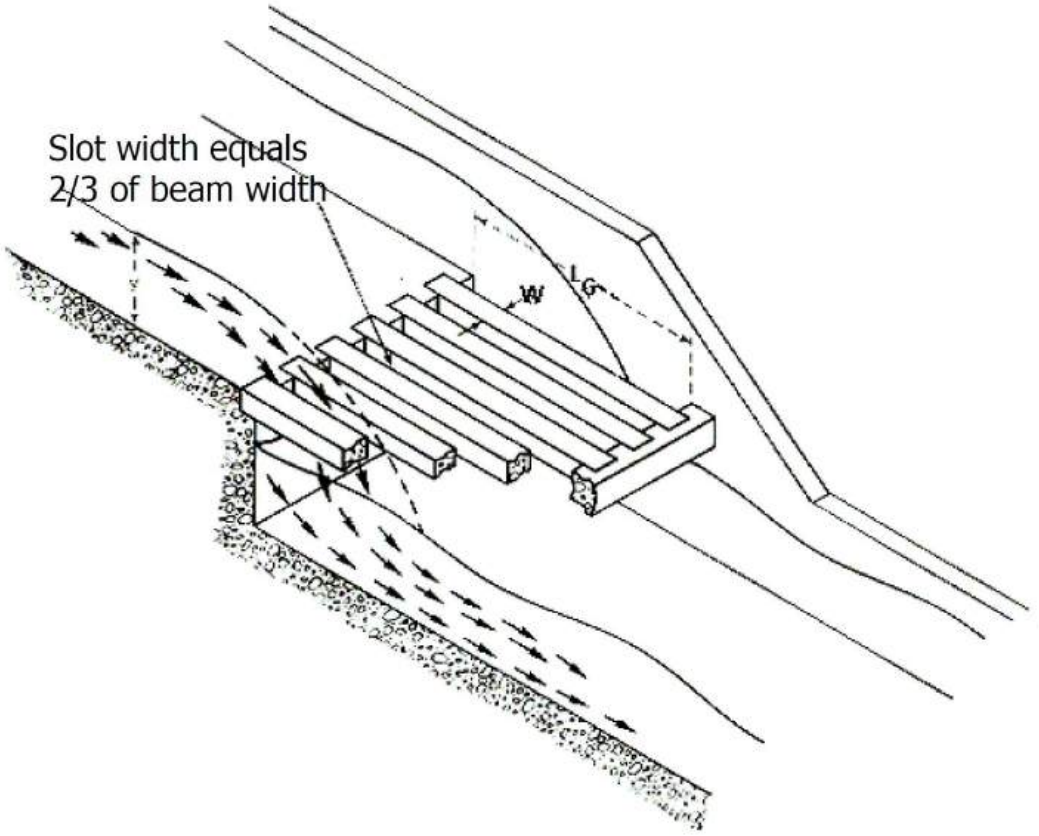


Figure 5-1: Oak Creek Diversion Structure

The proposed diversion structure would be sized for full diversion of flows (q) up to 14 cfs from Plunge Creek Channel. The length of the grate (L_G) is calculated from Equation 11.4 in HEC-14:

$$L_G = \frac{q}{CWN(2gy_o)^{1/2}}$$

Where:

C = experimental coefficient equal to 0.245

W = width of the slots, ft

N = number of slots (spaces) between beams

y_o = approach flow depth, ft (0.16 feet – normal depth for 14 cfs)

Assuming a beam width (w) of one-half foot (0.5') the slot width (W) is one-third of a foot (0.33'), and N is 19 for a channel that is 15' wide. From these parameters, the grate length (L_G) is calculated to be approximately 2.8 feet.

The proposed system does not include a gate to shut off the diversion in a high flow event. This could be added in during final design. Without a gate, the proposed structure would capture approximately 62.5 cfs per the equation above in a 100-year event, assuming a depth of flow in the channel (approach flow depth) of four feet (4').

5.3 Storm Drain Diversions

The proposed diversion structures for the existing storm drains in Greenspot Road are drop manholes with the 24" RCP diversion pipe soffit a minimum of one foot (1') below the invert of the main line. The proposed diversion structures and pipes will be designed for full interception of 5 cfs.

These storm drain diversion systems are assumed to be passive systems, without gates; therefore, additional runoff may be diverted to the proposed basins under high flow conditions. The HGL of both the 54" and 78" storm drains is about four feet (4') above the invert; therefore, the HGL would be six feet (6') above the centroid of each 24" diversion pipe. Using the orifice equation:

$$q = CA\sqrt{2gh},$$

with h = 6' and C =0.6, maximum diversion q for each pipe is calculated to be approximately 37 cfs.

5.4 Spillways

Both the internal spillway and overflow spillway are designed to convey the total peak flow diversion from the storm drains and Oak Creek Channel. Per the maximum diversion q calculations in the above subsections, the peak flow diversion is about 136.5 cfs (62.5 +37 +37). The table below shows the depth of flow over each weir calculated using the weir equation with a weir coefficient of 3. The maximum q calculation in the table assumes a depth of flow equal to two feet (2'), which allows for one foot (1') of freeboard.

Table 5-3: Weir Calculation Results

Weir	Weir Width (ft)	Depth of Flow for q=136.5 cfs (ft)	Maximum q for h=2' (cfs)
Internal	62	0.81	526.0
Overflow	67	0.77	568.5

6 SEDIMENT TRANSPORT

Chang Consultants prepared a sediment transport analysis for Plunge Creek using a FLUVIAL-12 Model. Although a separate analysis for Oak Creek was not part of the project scope of work, it would be expected that sediment transport within the Oak Creek watershed would be very similar to Plunge Creek given their proximity. The preliminary results and analysis are in the report Sediment Transport Analysis for Plunge Creek, dated April 22, 2025. The study included sediment transport analysis for the 100-year storm and what was described as the Rainy Average storm. The Rainy Average Storm is no longer part of the study, having been replaced with the gage data analysis and determination of the Project Typical Hydrograph from that analysis. Nevertheless, the Rainy Average model (peak flow approximately 180 cfs) provides some insight into anticipated sediment transport from a Project Typical Hydrograph event (peak flow 145 cfs).

Figure 9 in the sediment transport study shows the sediment delivery during the Rainy Average event. The curve is relatively flat from the downstream end of the study (Plunge Creek at Orange Avenue) to approximately 12,000 feet upstream (near Plunge Creek and Greenspot Road), indicating an approach to equilibrium. The conclusion of the report states, “Sediment delivery trends towards equilibrium below the alluvial foothill.” While sediment delivery during a typical storm may trend toward equilibrium, recent observations of flood flows in Plunge Creek show runoff with considerable TSS, and the potential for large boulders as part of the discharge.

The proposed grated drop structure would at least restrict the object size in the diverted flow to four inches (4”) or less based on the proposed slot width. TSS and smaller sediments would be carried more readily in the diverted runoff, however, since no settling trough is provided.

7 GROUNDWATER

By design, the proposed can cause groundwater mounding nearby. Geoscience, Inc. analyzed potential groundwater mounding from the proposed project in the report Groundwater Modeling for Oak Creek Diversion and Basins Project Feasibility Study, dated January 29, 2025 (Groundwater Report). The analysis in the report indicated that the peak mounding from the Oak Creek project would occur around forty-four days after the start of recharge in both clogged and unclogged conditions. Under FIRO diversion, the time of maximum mounding occurred at 52 days after the start of recharge.

Geoscience's model also indicated that recharge would not result in an increase in the area of shallow groundwater (groundwater less than fifty feet below ground surface). The results are summarized in Table 7-1:

Table 7-1: Groundwater Mounding

Scenario	Maximum Change in Groundwater Elevation (ft)	Time of Maximum Mounding (days after start of recharge)
Clogged	2	44
Unclogged	2	44
FIRO Unclogged	11	52

8 VALUE ENGINEERING/CONSTRUCTION COST

The estimated cost to construct is based on the design shown in Addendum OC-1. The evolution of the proposed design for the Oak Creek basins has included value engineering and constructability considerations throughout. The following modifications were made to the preliminary conceptual plans received from SBVWCD at the start of the project:

Table 8-1: Value Engineering Changes

Design Change	Explanation
Reduced the number of basins from 4 to 2	Simplify the grading design.
Removed inlet and pipe connections between basins	Spillway design used instead. Design simplification.
Removed complex storm drain and channel diversion structure and replaced with individual drop manhole diversions for storm drain diversion.	Change in design goal led to simpler design with smaller pipes and diversions.

Additional opportunities for value engineering are likely to occur during final design as the hydraulics of the system are optimized.

8.1 COST ESTIMATE

Construction costs for the proposed project shown in Addendum OC-1 are summarized in the tables below. Detailed cost estimates are in Addendum OC-4.

Table 8-2: Construction Cost Estimate Summary

Construction Items	Soft Costs	Total
$11,281,000	$10,332,000	$21,613,000

Note: Soft costs include 30% contingency, design & permitting, habitat mitigation, and construction administration.

9 PERMITTING REQUIREMENTS

The project will require compliance with the California Environmental Quality Act (CEQA). The technical memorandum in Addendum OC-5 describes the requirements and CEQA process anticipated for this project. Based on the scope of the project, it is anticipated that an Initial Study/Mitigated Negative Declaration (IS/MND) will be required.

The project may also require permits from the Santa Ana Regional Water Quality Control Board (RWQCB), the California Department of Fish and Wildlife (CDFW), and the United Staes Army Corps of Engineers (ACOE). Agency permitting will require an approved CEQA document and notice of determination.

Time frame for the CEQA process is expected to be between 28 and 32 weeks. Permits could then be obtained within 6 to 12 months following CEQA approval.

9.1 SAN BERNARDINO COUNTY FLOOD CONTROL DISTRICT PERMITTING

The project will require a Major Construction Permit from the San Bernardino County Flood Control District (SBCFCD), which has jurisdiction over Plunge Creek. Key issues in SBCFCD's review include:

- How will the project affect existing SBCFCD facilities
- Will the project affect SBCFCD's ability to operate and maintain their facilities
- What entity will be responsible for the operation and maintenance of the proposed facilities

The encroachment permit application would include:

- Completed permit application
- PDF of plans signed by a Registered Civil Engineer
- PDF of hydrology/hydraulic calculations

Applicants are to pay a fee calculated by SBCFCD after application is submitted. Reviews will not begin until the fee is paid. If review and inspection costs exceed the initial fee, the applicant is required to pay the difference.

Reviews by SBCFCD can take up to six weeks per review cycle depending on the complexity of the review. As this project will involve the construction of permanent facilities within SBCFCD's jurisdiction, permits from other agencies, and the execution of an agreement for operation and maintenance of the proposed facilities, longer review cycles are anticipated.

10 CONCLUSION

This report summarizes the technical reports prepared to support the San Bernardino County Water Conservation District's feasibility study for the Oak Creek Basin Project. The proposed project envisions two recharge basins, a diversion from Oak Creek Channel, diversions from existing storm drains in Greenspot Road, and a turnout and flow control facility for Foothill Pipeline. Target peak flow for the proposed diversion is 14 cfs based on statistical analysis of the data from the Plunge Creek gage. Incoming peak flow from the turnout is expected to be 35 cfs.

The project is expected to infiltrate 355 acre-feet per year under clogged or unclogged conditions based on a year of five 50th percentile events. Recharge volume from Foothill Pipeline Turnout (FIRO) assuming 35 cfs over 52 days is 1,160 acre-feet. Cost to construct is approximately $22,000,000.

11 REFERENCES

Chang (Chang Consultants), 2025. Sediment Transport Analyses for Plunge Creek, dated April 22, 2025.

FWHA (U.S. Department of Transportation, Federal Highway Administration), HEC-14. Hydraulic Engineering Circular No. 14, Third Edition, Hydraulic Design of Energy Dissipators for Culverts and Channels, Publication No. FHWA-NHI-06-086, July 2006.

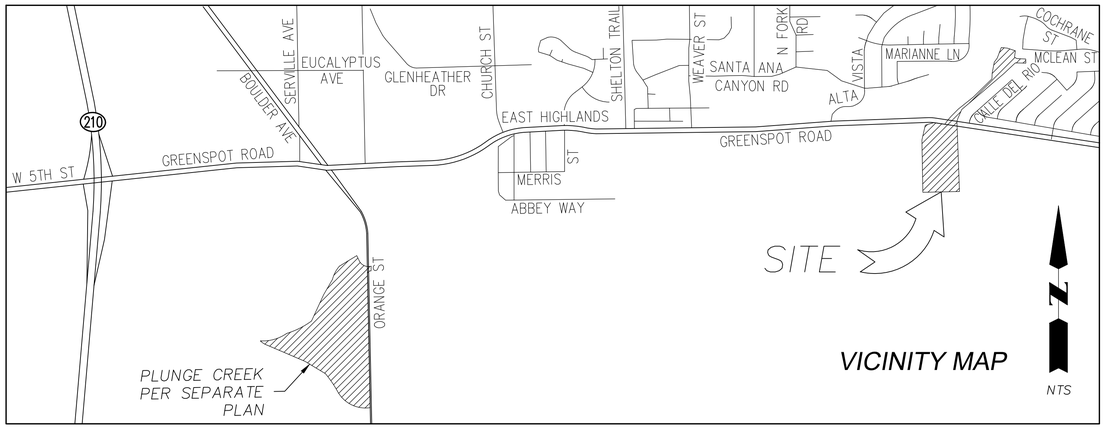
Geoscience (Geoscience Support Services, Inc.), 2025. Groundwater Modeling for Oak Creek Diversion and Basins Project Feasibility Study. Prepared for Casc Engineering and Consulting, Inc. Engineering Feasibility Study Support Services for San Bernardino Valley Water Conservation District, dated January 29, 2025.

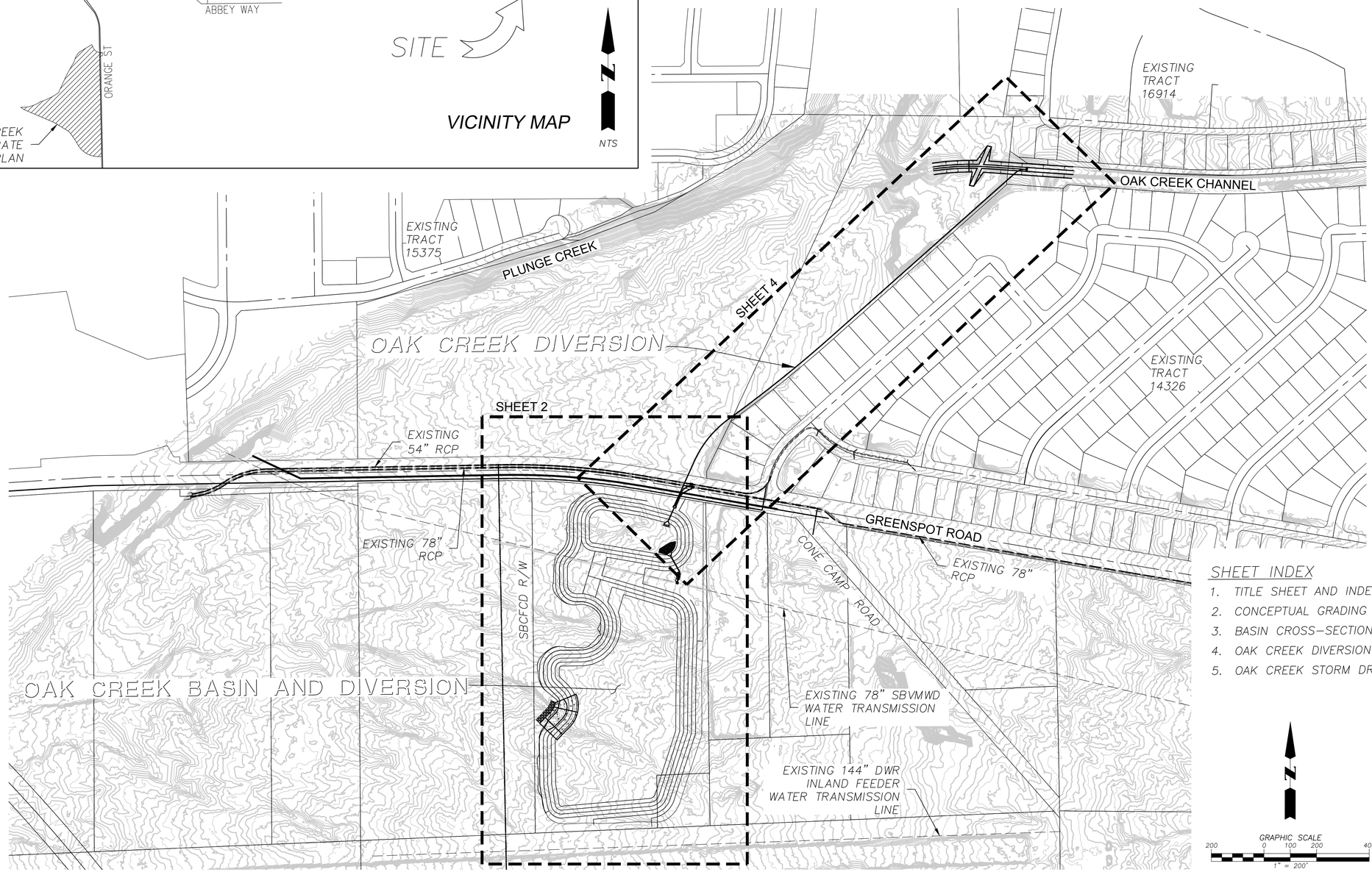
LOR (LOR Geotechnical Group, Inc.), 63813A.4. Preliminary Geotechnical Feasibility and Infiltration Feasibility Investigation Oak Creek Basin and Diversion Project Highland, California. Prepared for Casc Engineering & Consulting, dated March 1, 2023, Final Date: January 8, 2025.

LOR (LOR Geotechnical Group, Inc.), 63813B.4. Alternate Preliminary Geotechnical Feasibility and Infiltration Feasibility Investigation Plunge Creek Basin Highland/Redlands, California. Prepared for Casc Engineering & Consulting, dated May 31, 2023, Final Date: January 8, 2025

ADDENDA

ADDENDUM OC-1: PROPOSED DESIGN EXHIBITS





SHEET INDEX

1. TITLE SHEET AND INDEX SHEET
2. CONCEPTUAL GRADING PLAN
3. BASIN CROSS-SECTIONS
4. OAK CREEK DIVERSION PLAN AND PROFILE
5. OAK CREEK STORM DRAIN LATERAL PLAN AND PROFILE

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REVIEWED BY: JOHN LAMBIE, PE, CEG, PG
CONSULTING CHIEF ENGINEER AND HYDROGEOLOGIST
SAN BERNARDINO VALLEY WATER CONSERVATION DISTRICT.

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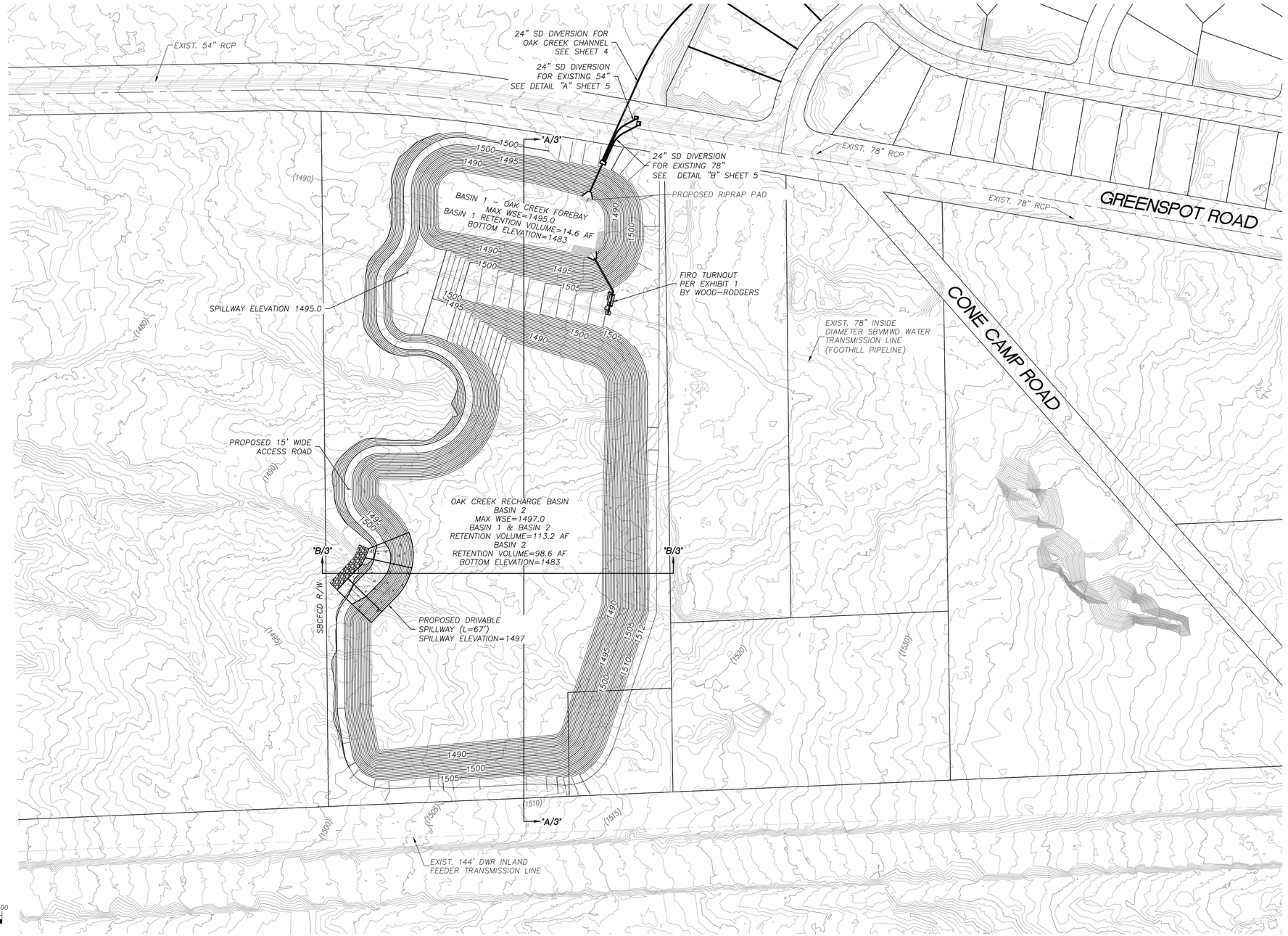
PROJECT NO. SBVWCD - xxx

OAK CREEK GROUNDWATER RECHARGE PRELIMINARY CONCEPTUAL DESIGN FEATURES TITLE SHEET

SHEET 1 OF 5



BASIN DATA TABLE

BASIN NO.	MAX. WSE (FT)	BASIN FLOOR (FT)	BASIN TOP VARIES (FT)	STORAGE (AC–FT)
1	1495.0	1483.0	1500.0 TO 1509.0	14.6
2	1497.0	1483.0	1500.0 TO 1513.0	98.6

GRAPHIC SCALE
100 0 50 100 200
1" = 100'

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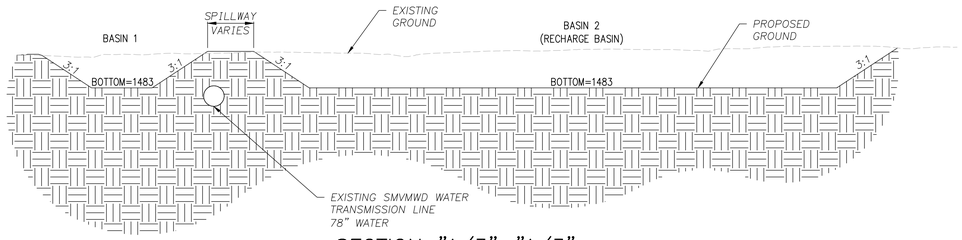
OAK CREEK GROUNDWATER RECHARGE
PRELIMINARY CONCEPTUAL DESIGN FEATURES
CONCEPTUAL GRADING PLAN

SHEET 2
OF 5



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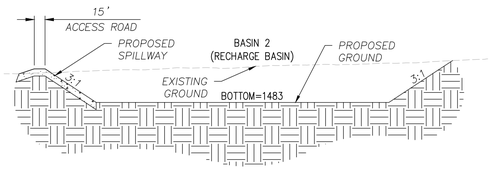

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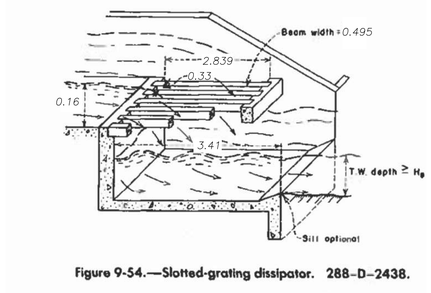
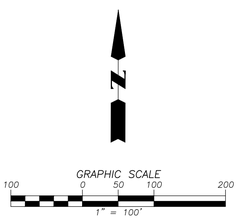


Figure 9-54.—Slotted-grating dissipator. 288-D-2438.

OAK CREEK CANYON USBR SLOTTED GRATED DISSIPATOR								
Q	L_G	W	N	H_E	L_B	BEAM WIDTH	WIDTH	SLOPE
14	2.839	0.33	19	0.16	3.41	0.495	15.18	0.0352

USBR SMALL DAMS
SLOTTED GRATING DISSIPATER

N.T.S.



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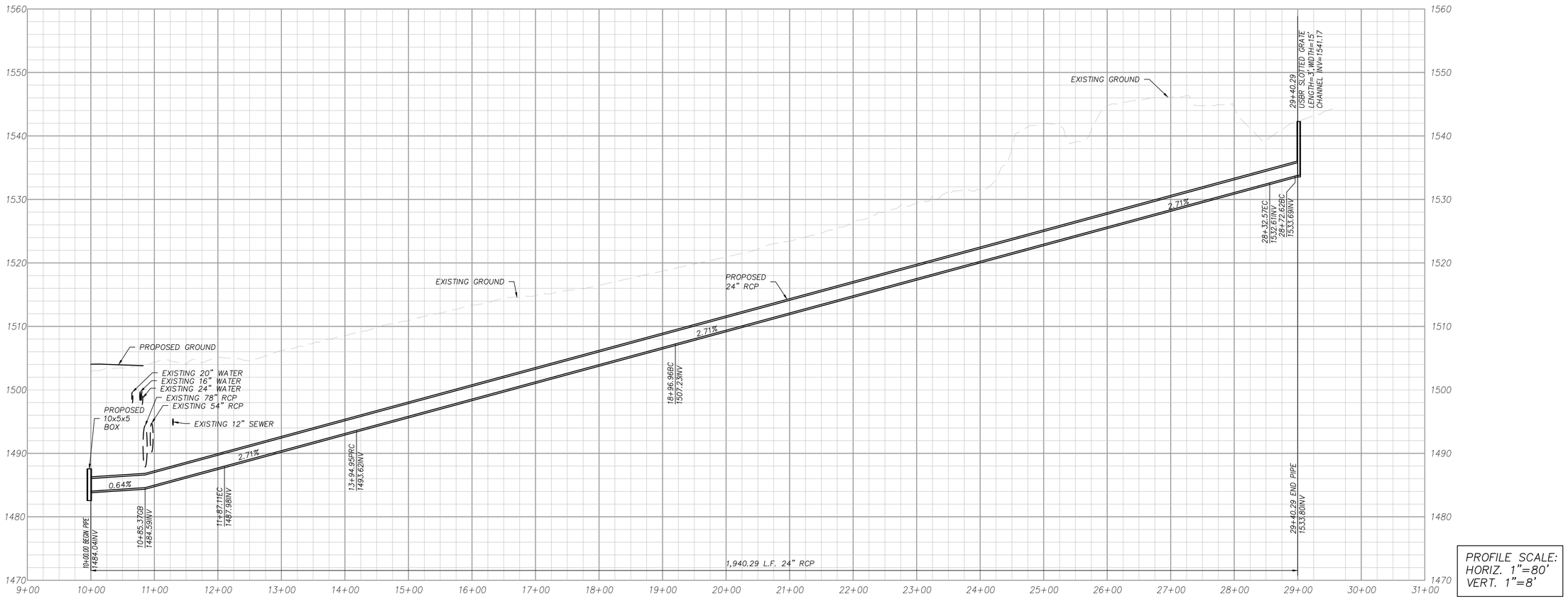
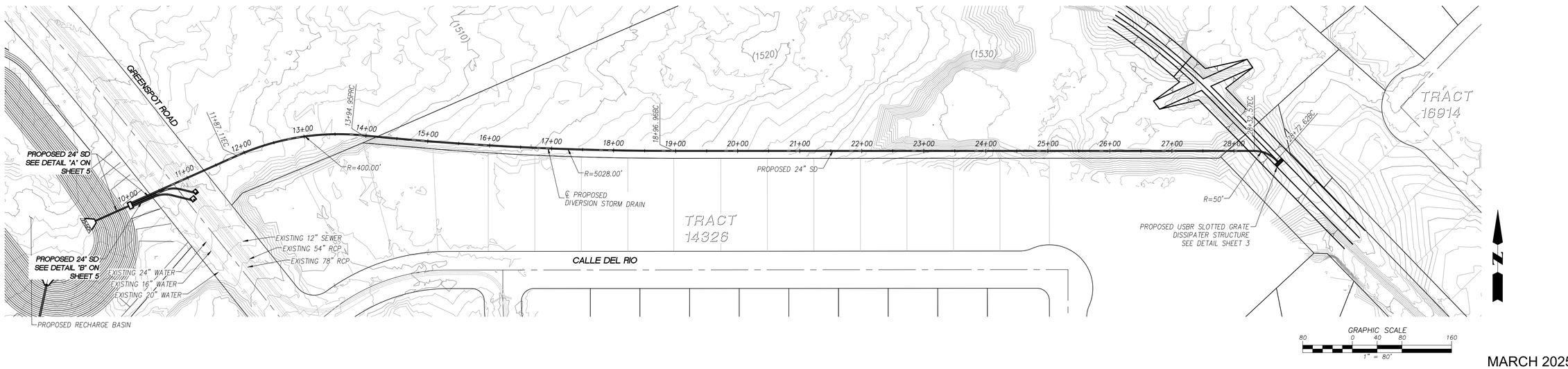
OAK CREEK GROUNDWATER RECHARGE
PRELIMINARY CONCEPTUAL DESIGN FEATURES
BASIN CROSS-SECTIONS AND DETAILS

SHEET 3
OF 5





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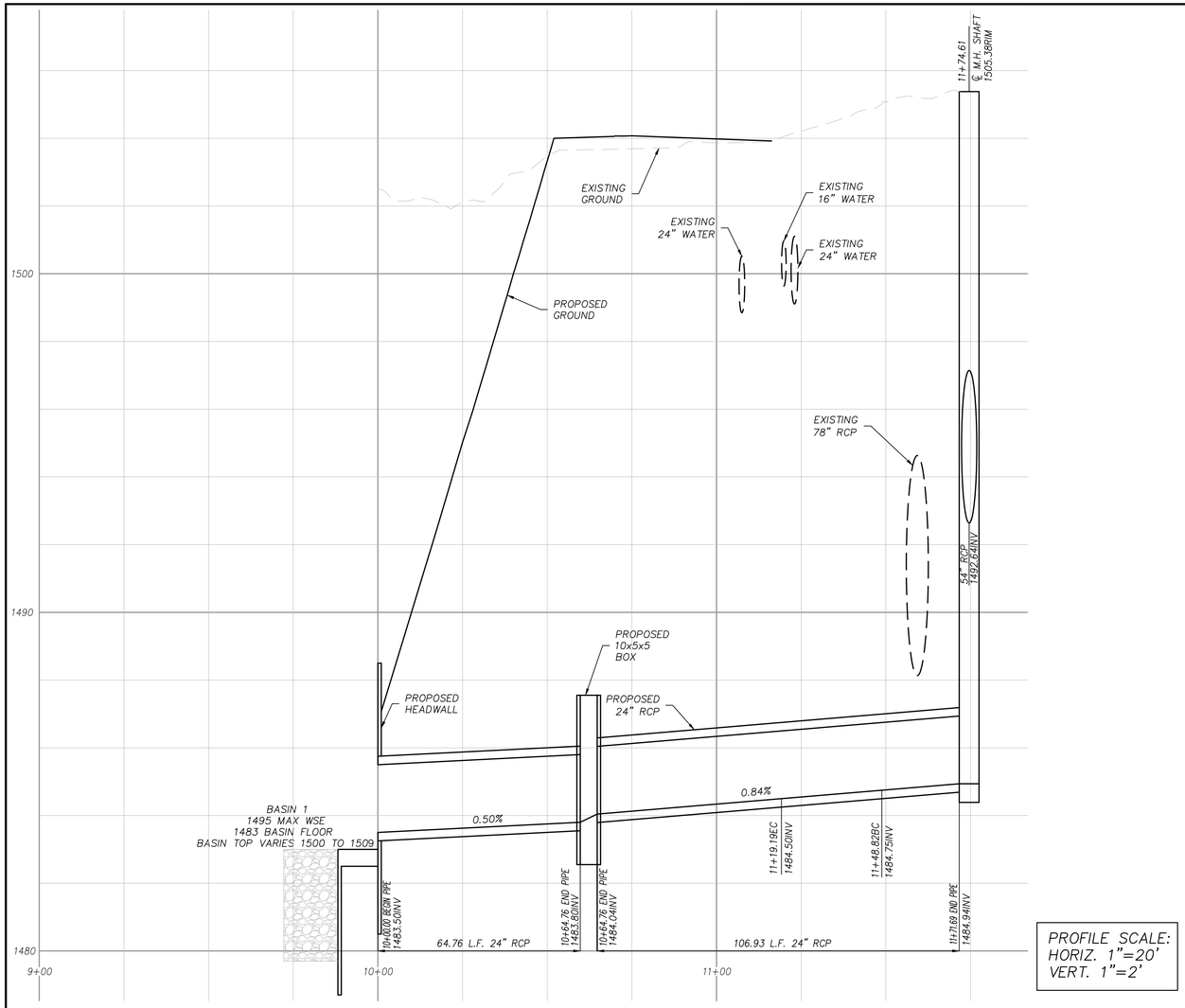
OAK CREEK GROUNDWATER RECHARGE
PRELIMINARY CONCEPTUAL DESIGN FEATURES
OAK CREEK DIVERSION PLAN & PROFILE

SHEET 4
OF 5



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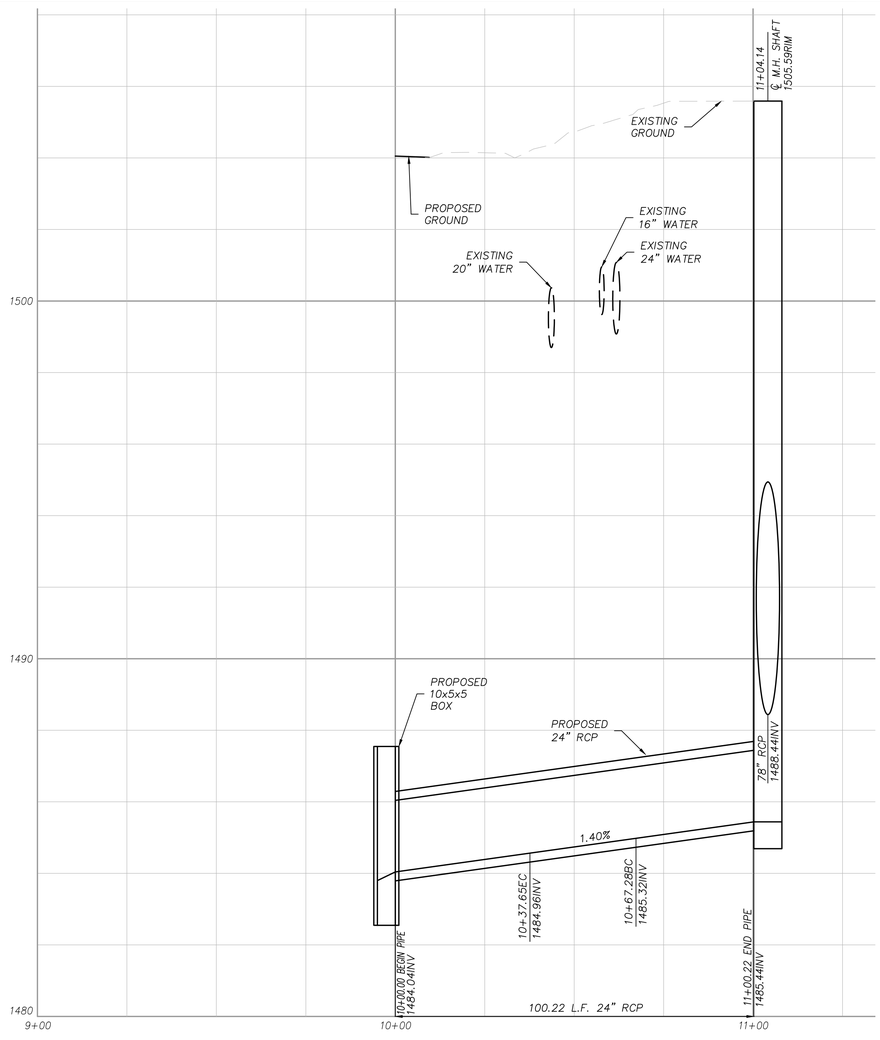
VERT. 1"=2'



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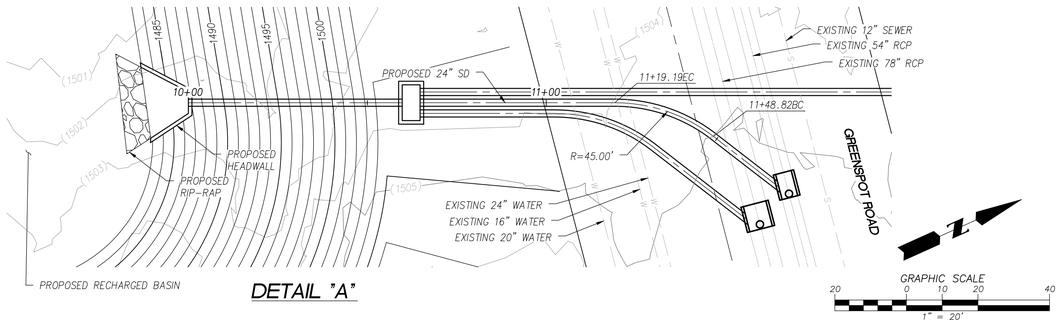

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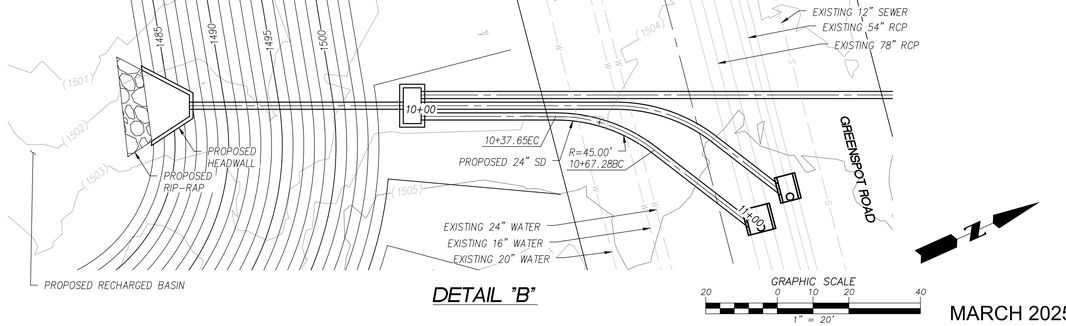

DETAIL "B"

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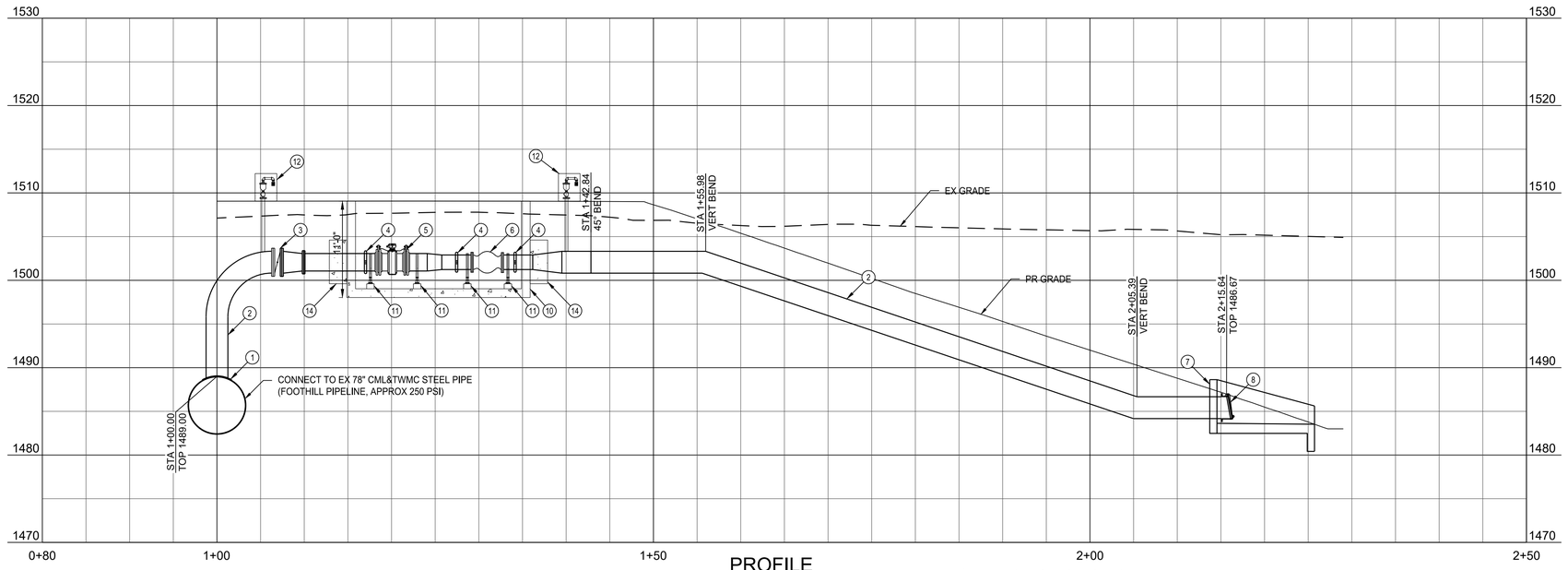
OAK CREEK GROUNDWATER RECHARGE PRELIMINARY CONCEPTUAL DESIGN FEATURES

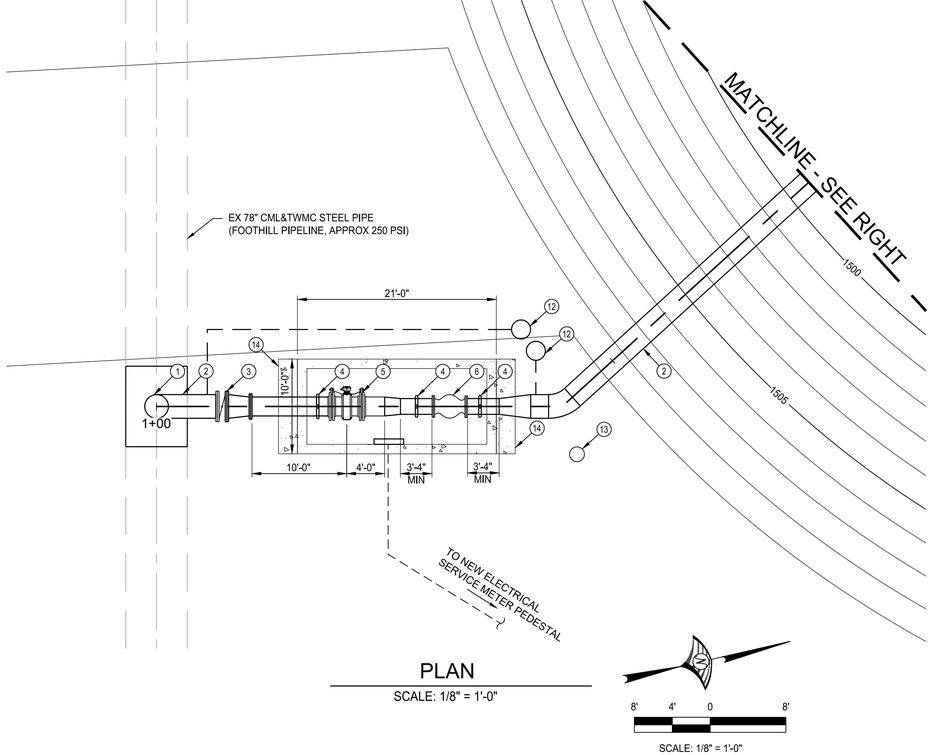
OAK CREEK STORM DRAIN LATERAL PLAN AND PROFILE

SHEET 5
OF 5



PROFILE

SCALE HORIZ: 1/8" = 1'-0"
VERT: 1/8" = 1'-0"

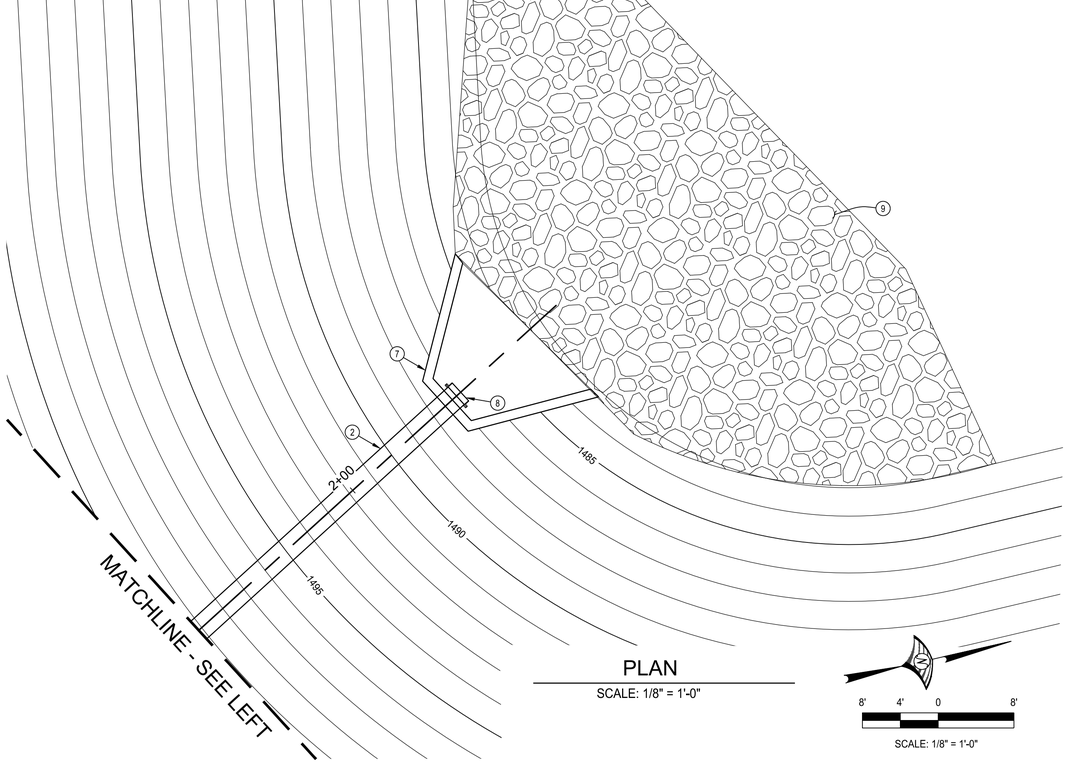


PLAN

SCALE: 1/8" = 1'-0"

8' 4' 0 8'

SCALE: 1/8" = 1'-0"



PLAN

SCALE: 1/8" = 1'-0"

8' 4' 0 8'

SCALE: 1/8" = 1'-0"

CONSTRUCTION NOTES

1. CUT IN CONNECTION TO EX 78" CML&TWMC STEEL PIPE (3/8" THK) WITH COLLAR
2. 30" WELDED STEEL PIPE (3/8" THK), REFERENCE GENERAL NOTES 1 AND 2.
3. 30" TRIPLE OFFSET BUTTERFLY VALVE
4. VICTAULIC COUPLING
5. 24" MAGNETIC FLOWMETER
6. 20" 150# AXIAL CONTROL VALVE (MOKVELD)
7. CONCRETE HEADWALL
8. FLAPGATE (HYDROGATE SERIES 50C)
9. RIP RAP
10. CONCRETE VAULT (H-20 LOADING). DIMENSIONS SHOWN ARE APPROXIMATE.
11. PIPE SUPPORT
12. COMBINATION AIR RELEASE/VAC VALVES
13. TELEMETRY ANTENNA
14. CONCRETE THRUST RESTRAINT (APPROX 2' THK x 5' x 10')

GENERAL NOTES

1. BURIED PIPE SHALL BE CEMENT MORTAR LINED AND TAPE WRAPPED WITH MORTAR COATING (CML&TWMC) STEEL PIPE.
2. EXPOSED PIPE (WITHIN VAULT) SHALL BE EPOXY LINED AND COATED.

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DATE PREPARED: MARCH 2025

SAN BERNARDINO VALLEY WATER CONSERVATION DISTRICT

FOOTHILL PIPELINE TURNOUT AND FLOW CONTROL FACILITY

EXHIBIT 1: CONCEPTUAL LAYOUT

J:\Jobs\185001_Foothill Pipeline Turnout\Civil\Dwg\EXHIBIT - TURNOUT.dwg 3/25/2025 2:53 PM Alia Meier

ADDENDUM OC-2: GAGE DATA ANALYSIS

Technical Memorandum

Date: **October 8, 2024**

To: **John Lambie, PE, Chief Engineer San Bernardino Valley Water Conservation District**

From: **Joseph L. Castaneda, P.E.**

Re: **Amendment to Feasibility Study Support Services ARTP Plunge Creek and Oak Creek Diversion and Basin(s)**

Introduction

This technical memorandum was produced for the San Bernardino Valley Water Conservation District (SBVWCD) in support of the District's feasibility study for the design of the proposed recharge basins and diversion mechanisms for Plunge Creek and for Oak Creek.

Stream gage data from Upper Plunge Creek gage 110555000 were analyzed to determine distinct runoff events and their associated flow rates and volumes. The analysis detected 187 events. PRISM 30-year normal data was then used to scale these data to the ungauged watersheds that are tributary to Elder Creek, Oak Creek, and the Greenspot Storm Drain respectively. All four watersheds (Upper Plunge Creek, Elder Creek, Oak Creek, and Greenspot Storm Drain) are shown on Figure A. 50th, 80th, and 90th percentile flow rates were determined for each respective watershed as candidate diversion flow rates.

The candidate diversion flow rates, either individually or in combination, were used to calculate diverted, bypassed, and total volumes for each basin location. Statistics were compiled for the Oak Creek and Greenspot Storm Drain watersheds separately. Statistics for the Plunge Creek Basin were compiled for Upper Plunge Creek and Elder Creek combined, and for the combination of Upper Plunge Creek, Elder Creek, and Oak Creek.

Statistical distributions were applied to the results, and 50th, 80th, and 90th percentile peak flow rates from the set of events were also determined.

Analysis Overview

An approximately 35-year record, extending from water year 1989 through water year 2024, of 15-minute stream gage data from Upper Plunge Creek gage 110555000 was analyzed and used to cultivate a statistical representation of prospective flows tributary to the proposed Oak Creek and Plunge Creek Recharge Basins. Note that approximately five months of water year 2024 were included which was the available

data at the start of this study. The results of the study are discussed and represented below.

Existing Data Analysis

These Upper Plunge Creek stream gage data were evaluated to determine the flow duration frequencies in the 35 year record. All periods with no flow were excluded from the determination of flow frequencies. The 50th, 80th, and 90th percentile flow rates were identified to be of interest by SBVWCD. These values will define candidate diversion rates in the remainder of the analysis. The results for Upper Plunge Creek gage data are shown below:

Table 1: *Plunge Flow Frequency*

Percentile (%)	50th	80th	90th
Flowrate (cfs)	1.90	6.74	15.00

The 35 year record was further analyzed to partition the continuous record into a set of discrete, meaningful flow events. In this context, events are hydrographs which result from a storm event and are characterized by a rising limb, peak, and receding limb forming a simple hydrograph. Simply put, a meaningful flow event is one in which the magnitude of the peak and the duration of the hydrograph are substantial enough to survive a low pass filter (“gaussian smoothing”) of the data set which was used to remove noisy, high frequency perturbations in the flow signal. A total of 187 events were identified in the 35 year record. The events were distributed through the 35 year record as shown below, in terms of water years.

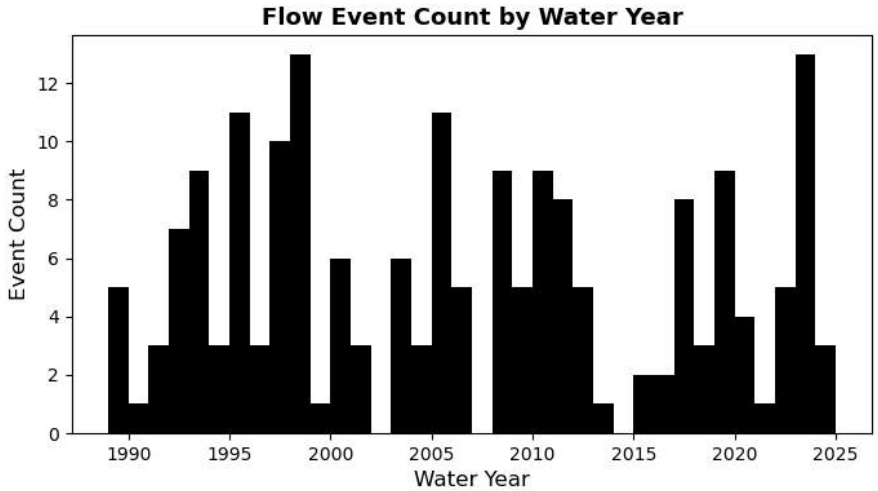


Figure 1: *Flow Event Count By Water Year*

Through meetings with SBVWCD, a flow rate of 0.63 cfs, the 30th percentile flow duration frequency rate, was used to define the end of a flow event in the record from Upper Plunge Creek.

The event-separation duration, time interval between flow events in days, was determined between flow events using the low flow cutoff rate. The event-separation duration was excluded when the interval spanned between water years to avoid bias in the resulting analysis. Descriptive statistics are provided for the resulting collection of event-separation durations computed. A normal distribution was fit to the dataset as requested by SBVWCD and is shown below:

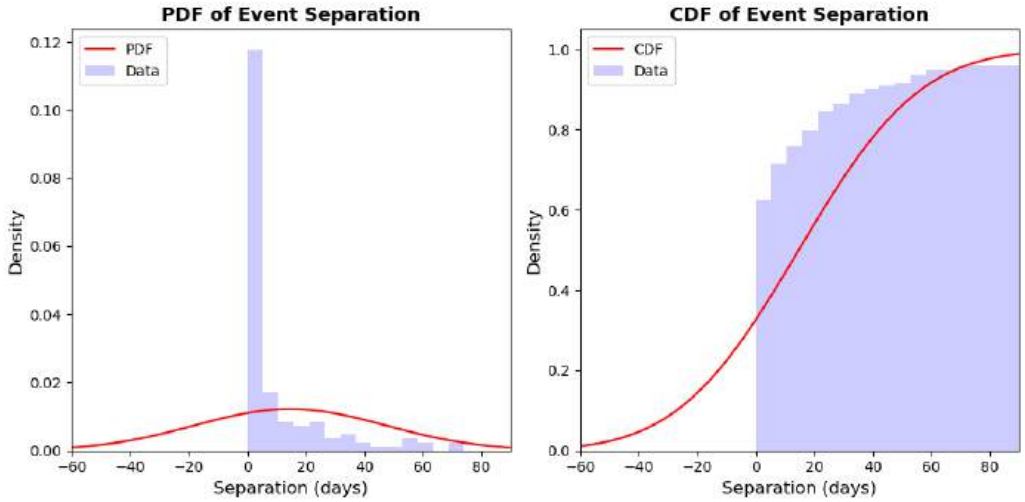


Figure 2: *PDF & CDF of Flow Separation via Normal Distribution*

Table 2: *Sample Moments/Statistics for Event Separation*

Sample Moment	Value (days)
Mean	14.70
Standard Deviation	32.70
Median	0.00
Skew*	4.09

*Skew is dimensionless, is not represented in Normal Distribution as parameter

Similarly, the event duration, the time interval from the beginning to the end of a given event in days , was determined for each flow event. A set of 187 durations (units=days) were calculated from the gage data. Descriptive statistics are provided for the resulting collection of event durations computed. A normal distribution was fit to the dataset as requested by SBVWCD and is shown below:

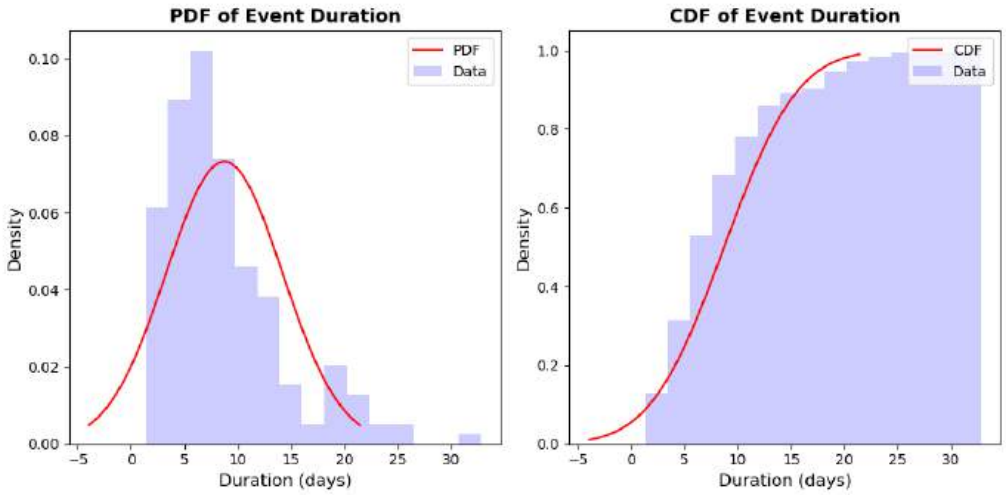


Figure 3: *PDF & CDF of Flow Duration via Normal Distribution*

Table 3: *Sample Moments/Statistics for Event Duration*

Sample Moment	Value (days)
Mean	8.73
Standard Deviation	5.44
Median	7.35
Skew*	1.42

*Skew is dimensionless, is not represented in Normal Distribution as parameter

PRISM 30-Year Precipitation Normals Scaling of Watershed Subbasin Runoff

The PRISM 30-year precipitation normals (https://prism.oregonstate.edu/) were retrieved for the project area at a grid resolution of 800m. The dataset defines the 30-year annual average precipitation per grid cell adjusted by topography. The area of each Plunge Creek subbasin was calculated in GIS. The weighted average of the PRISM total precipitation values was computed for watershed subbasins of interest: Elder Creek, Upper Plunge Creek, Oak Creek, and Greenspot Storm Drain, see Figure A. To scale runoff volume, the product of precipitation and area was determined as a scalar for each Plunge Creek subbasin. Using the PRISM runoff volume for Upper Plunge Creek as a reference, a ratio of relative volume was determined for each subbasin. Figure A illustrates the superposition of the PRISM data on the project area.

Table 4: *Relative PRISM-Area Weighted Runoff Volume. P_w is weighted precipitation, V_w is weighted Volume, R_v is volume ratio*

Subbasin	A (ac)	P_w (in)	V_w (ac-ft)	R_v (-)
Elder Creek	3082.29	14.19	3645.24	0.164
Oak Creek	1527.27	16.34	2079.47	0.094
Plunge Creek	10974.08	24.26	22185.08	1.000
Storm Drain	547.03	13.46	613.40	0.028

The subsequent ratios were used to scale the Upper Plunge Creek stream gage record as a means for extrapolating the flow signal for the adjacent subbasins (Elder Creek, Oak Creek, and Greenspot Storm Drain).

Calculated Flow-Duration Frequency Flow Rates for Study Scenarios

The flow-duration frequency for each scenario is defined in Table 4.1 shown below. The 50th, 80th, and 90th percentile flows were quantified for the extrapolated for the following scenarios:

1. Oak Creek Flows Only
2. Greenspot Storm Drain Flows Only
3. Elder Creek + Upper Plunge Creek Flows
4. Elder Creek + Oak Creek + Upper Plunge Creek Flows

These values represent candidate diversion rates. To obtain these values, the overall stream gage record was scaled with the ratios defined from the PRISM data for each location (Elder, Oak, Greenspot Storm Drain). The resulting scaled datasets (and Plunge) were combined in accordance with the study scenarios and analyzed for flow-duration frequency.

Table 4.1: *Calculated Scaled Flow-Duration Frequency*

Flow Data Source/Combination	Flow Frequency (%, cfs)		
	50th	80th	90th
Oak Only	0.18	0.63	1.41
Storm Drain Only	0.05	0.19	0.42
Plunge + Elder	2.21	7.85	17.46
Plunge + Elder + Oak	2.39	8.48	18.87

Oak Creek Subbasin Storm Event Volume Analysis –Oak Creek Storm Flows Only

The description of the volume analysis for Oak Creek flows serves as a template for understanding the analysis in the following sections. The following sections contain variations of this assessment which include different combinations of flow.

A potential diversion scenario is that Oak Creek Basin would receive flows from Oak Creek above its confluence with Plunge Creek. For each potential diversion rate from Oak Creek only, the 187 flow events scaled for Oak Creek using the PRISM ratio were integrated to assess the divertible storm volume, the likely bypass volume, and the total volume of runoff for each event. The resulting set of calculated individual storm-event volumes per candidate diversion rate were statistically assessed. Through agreement with SBVWCD, JLC Engineering applied the following statistical distributions to each type of storm-event volume calculated from the PRISM scaled gage data:

Table 5: *Distribution used w/ respect to Volume Type Characterized*

Volume Type	Applied Distribution
Diverted	Normal
Bypass	Log-Normal
Total	Log-Pearson 3

Figure 4 demonstrates the probability distribution function (PDF) and cumulative distribution function (CDF) of the applied distribution assumptions for divertible storm-event volumes (Normal Distribution) and total storm-event volumes (Log-Pearson Type 3 distribution, LP3) for the 187 scaled storm-flow events in Oak Creek at the corresponding candidate diversion rates (i.e., 50th, 80th, and 90th percentile flow-duration frequency flow).

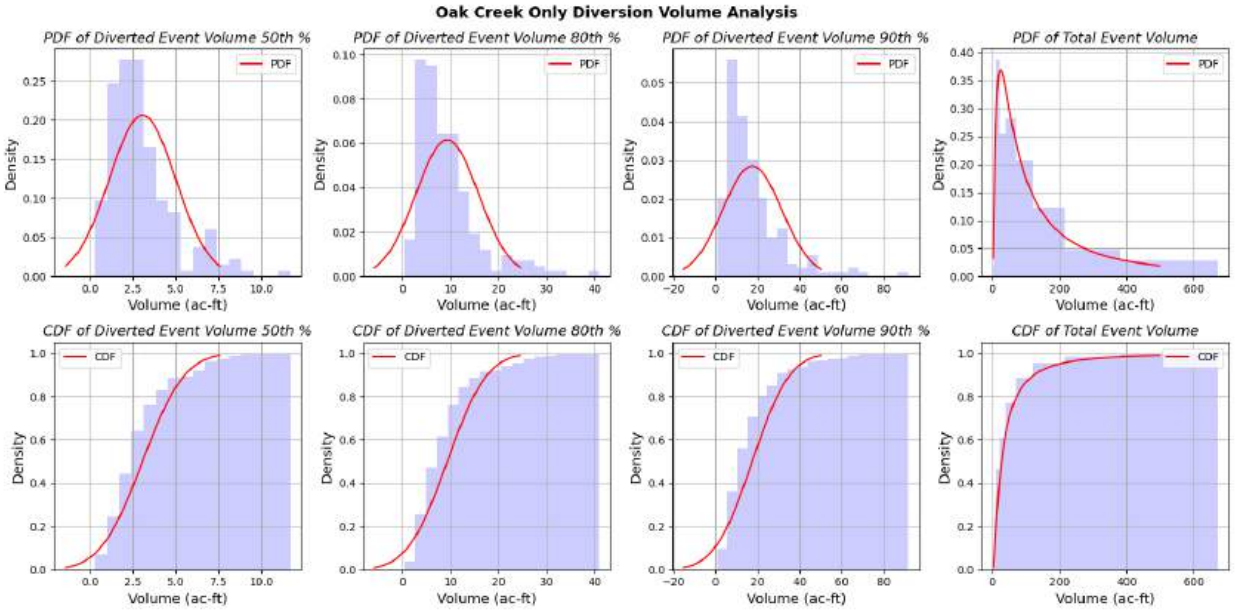
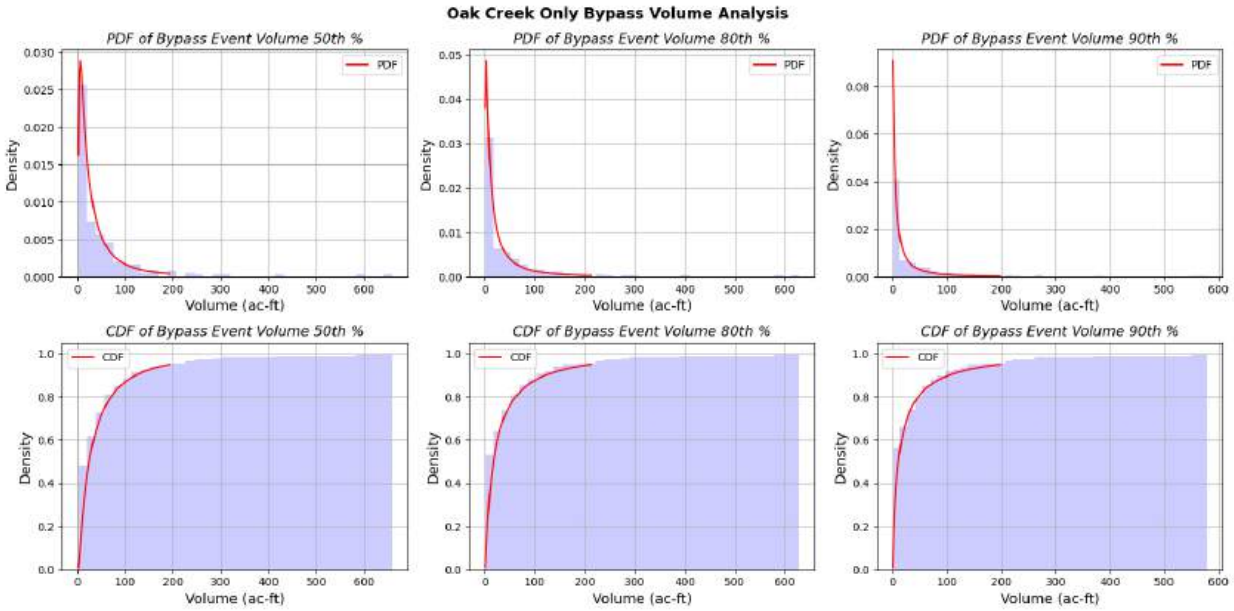


Figure 4: *PDF & CDF of Divertible Volumes at 3 Candidate Percentile Rates and Total Event Volumes (right-hand charts) per Event via Normal and LP3 Assumptions, respectively from Oak Creek Calculated Storm Events*

Figure 5 on the next page depicts the PDF and CDF of the applied Log-Normal distribution assumption overlaid on the histogram of candidate-diversion-rate-based bypass volumes.



Distribution

Figure 5: *PDF & CDF Bypassed Volumes per Event at 3 Candidate Percentile Rates via Log-Normal Distribution of Oak Creek Calculated Storm Events*

Table 6 depicts the CDF deciles for each Volume Type of interest across all candidate diversion rates.

Table 6: *Divertible and Bypassed Storm Volumes at Three Flow Diversion Rates & Total Storm Volume of Oak Creek Scaled Historic Storm-Events*

Candidate Diversion Flow-Duration Percentile (%)	Volume Type	Scaled Storm-Event Volume Deciles from CDF (ac-ft)								
		10th	20th	30th	40th	**50th=Median Volume**	60th	70th	80th	90th
50th Percentile (0.18 cfs)	Divertible	0.6	1.4	2.1	2.6	**3.1**	3.6	4.1	4.7	5.6
	Bypassed	5.4	9.0	13.1	18.2	**24.8**	33.9	47.4	70.4	122.0
80th Percentile (0.63 cfs)	Divertible	1.1	3.9	6.0	7.8	**9.4**	11.0	12.8	14.9	17.7
	Bypassed	2.7	5.0	7.8	11.6	**17.0**	25.0	37.7	61.4	120.9
90th Percentile (1.41 cfs)	Divertible	-0.4	5.7	10.2	14.0	**17.5**	21.1	24.9	29.3	35.5
	Bypassed	1.1	2.3	4.1	6.7	**10.5**	16.5	26.7	47.1	103.2
-	Total	7.6	11.6	15.9	21.1	**27.7**	36.7	50.0	72.6	124.5

Oak Creek Basin Storm-Event Volume Analysis – Greenspot Storm Drain Flows

The same approach for the Oak Creek Only flows was used to study the Greenspot Storm Drain (Greenspot SD) only flows. A summary of the analysis is contained within

the following figures and tables. Figure 6 and 7 demonstrate the PDF and CDF of the same applied distribution assumptions overlaid on the histogram of divertible volumes (Normal), bypassed volumes (Log-Normal), and total storm-event volumes (LP3).

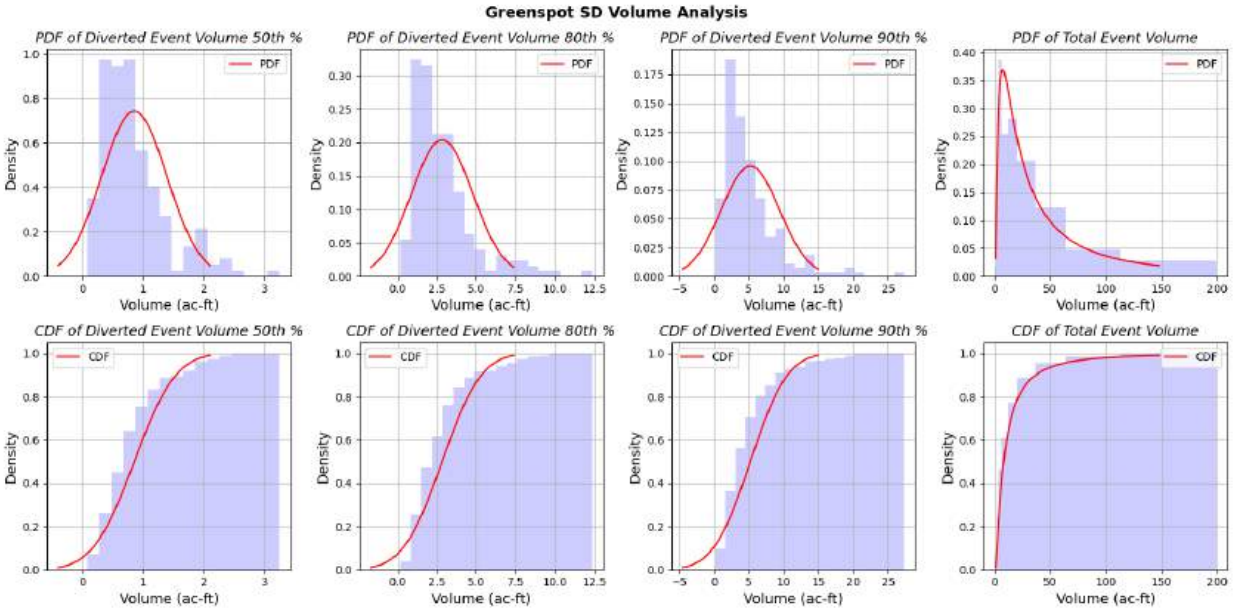


Figure 6: *PDF & CDF of Divertible Volumes at 3 Candidate Percentile Rates and Total Event Volumes (right-hand charts) per Event via Normal and LP3 Assumptions, respectively of Greenspot SD Calculated Storm Events*

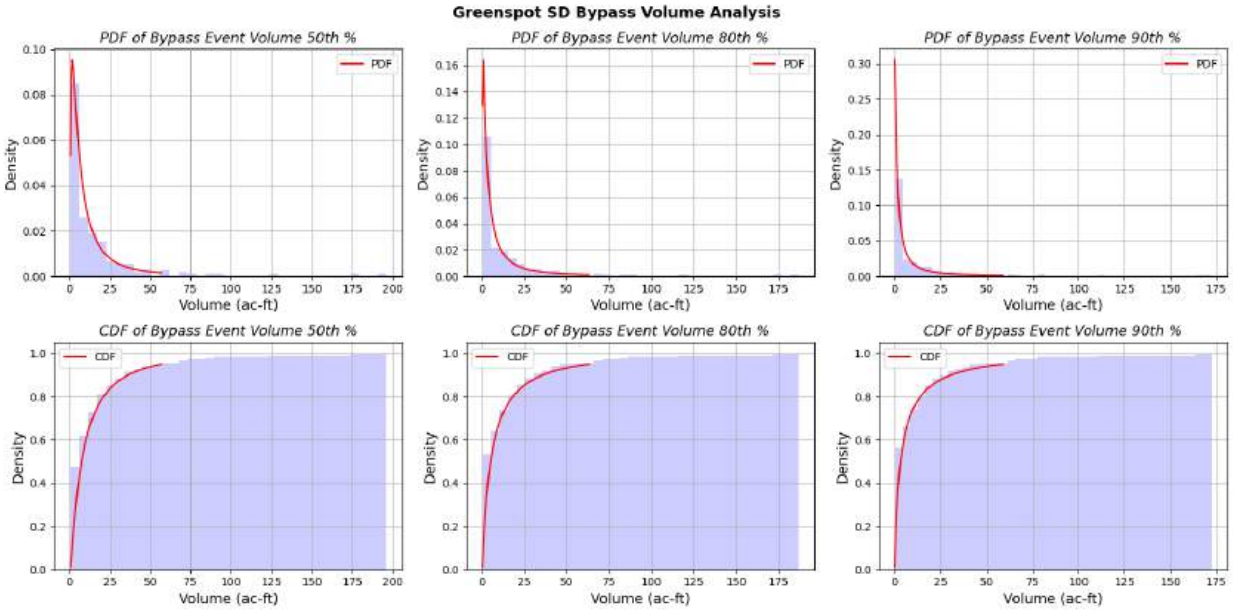


Figure 7: *PDF & CDF Bypassed Volumes per Event at 3 Candidate Percentile Rates via Log-Normal Distribution of Greenspot SD Calculated Storm Events*

Table 7 depicts the CDF deciles for each Volume Type of interest across all candidate diversion rates

Table 7: *Divertible and Bypassed Storm Volumes at Three Flow Diversion Rates & Total Storm Volume of Greenspot SD Scaled Historic Storm-Events*

Candidate Diversion Flow-Duration Percentile (%)	Volume Type	Scaled Storm-Event Volume Deciles from CDF (ac-ft)								
		10th	20th	30th	40th	**50th=Median Volume**	60th	70th	80th	90th
50th Percentile (0.05 cfs)	Divertible	0.17	0.4	0.57	0.72	**0.85**	0.99	1.14	1.31	1.54
	Bypassed	1.64	2.72	3.97	5.49	**7.47**	10.19	14.22	21.04	36.31
80th Percentile (0.19 cfs)	Divertible	0.32	1.18	1.8	2.33	**2.83**	3.32	3.85	4.47	5.33
	Bypassed	0.8	1.46	2.31	3.44	**5.04**	7.4	11.2	18.24	35.97
90th Percentile (0.42 cfs)	Divertible	-0.13	1.71	3.03	4.16	**5.22**	6.28	7.41	8.73	10.57
	Bypassed	0.32	0.7	1.22	1.98	**3.12**	4.9	7.96	14.02	30.76
-	Total	2.26	3.45	4.74	6.29	**8.26**	10.93	14.88	21.62	37.07

Plunge Creek Combined Event Analysis – Elder Creek + Plunge Creek

The same approach for the Oak Creek Only flows was used to study the combination of Elder Creek and Plunge Creek flows only with no contribution from Oak Creek. A summary of the analysis is contained within the following figures and tables. Figure 8 and 9 demonstrate the PDF and CDF of the same applied distribution assumptions overlaid on the histogram of recorded diverted volumes, bypass volumes, and total volumes.

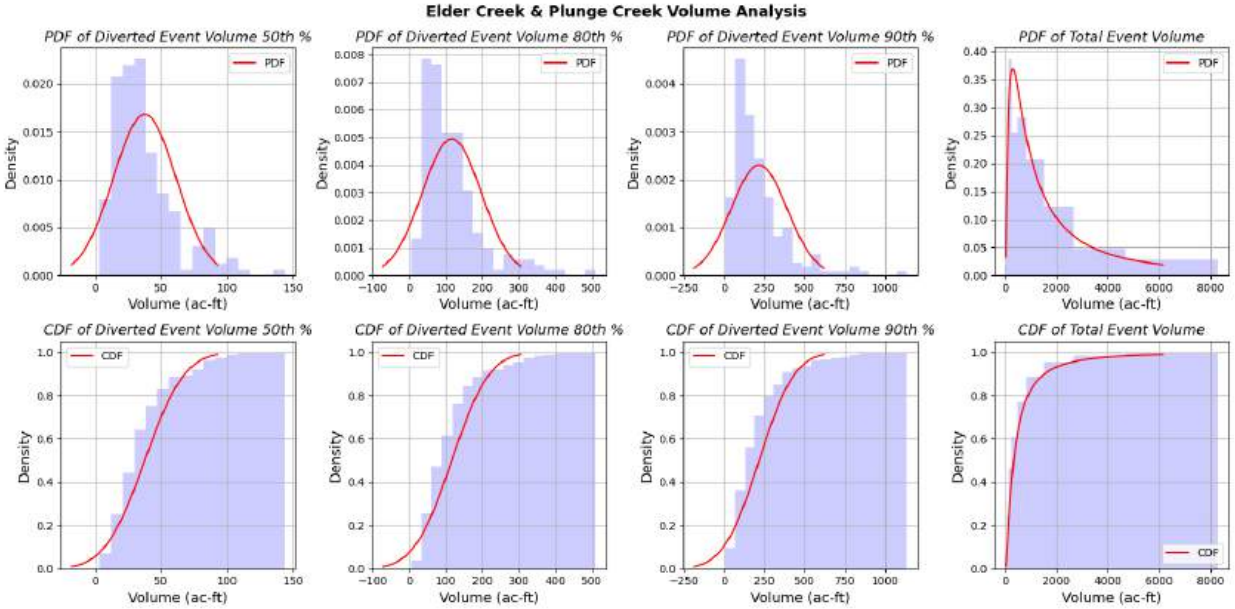


Figure 8: *PDF & CDF of Divertible Volumes at 3 Candidate Percentile Rates and Total Event Volumes (right-hand charts) per Event via Normal and LP3 Assumptions, respectively of Elder Creek + Plunge Creek Calculated Storm Events*

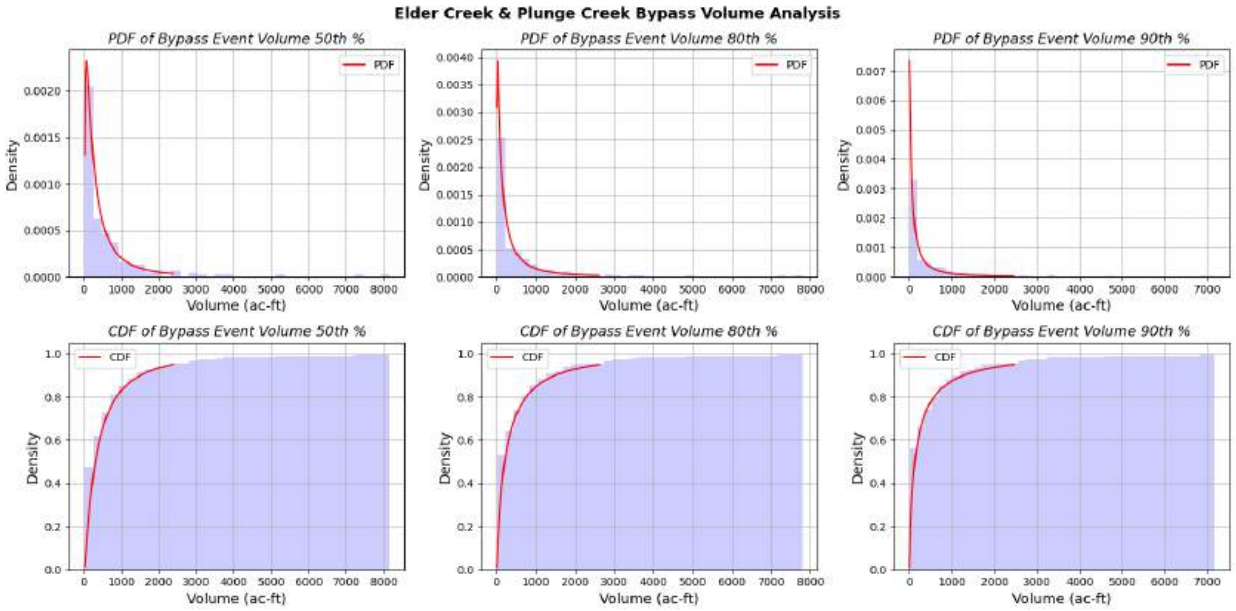


Figure 9: : *PDF & CDF Bypassed Volumes per Event at 3 Candidate Percentile Rates via Log-Normal Distribution of Elder Creek + Plunge Creek Calculated Storm Events*

Table 8 depicts the CDF deciles for each Volume Type of interest across all candidate diversion rates.

Table 8: *Divertible and Bypassed Storm Volumes at Three Flow Diversion Rates & Total Storm Volume of Elder Creek + Plunge Creek Scaled Historic Storm-Events*

Candidate Diversion Flow-Duration Percentile (%)	Volume Type	Scaled Storm-Event Volume Deciles from CDF (ac-ft)								
		10th	20th	30th	40th	**50th=Median Volume**	60th	70th	80th	90th
50th Percentile (2.21 cfs)	Divertible	7.26	17.71	25.24	31.68	**37.7**	43.72	50.15	57.69	68.14
	Bypassed	67.12	111.46	162.58	225.67	**307.59**	420.19	587.74	871.97	1509.95
80th Percentile (7.85 cfs)	Divertible	13.41	48.96	74.59	96.5	**116.97**	137.44	159.35	184.98	220.53
	Bypassed	33.59	61	96.21	143.56	**209.95**	308.28	466.4	759.18	1496.2
90th Percentile (17.46 cfs)	Divertible	-5.34	70.97	125.99	173	**216.95**	260.89	307.9	362.92	439.23
	Bypassed	13.21	28.89	50.87	82.5	**129.67**	203.84	330.73	582.78	1278.59
-	Total	93.92	143.28	197.13	261.45	**343.24**	454.24	618.59	898.57	1541.09

Plunge Creek Combined Event Analysis – Elder Creek + Plunge Creek + Oak Creek

As above, a combination of flows were considered which include Elder Creek, Plunge Creek, and Oak Creek. A summary of the analysis is contained within the following figures and tables.

Figure 10 and 11 demonstrate the PDF and CDF of the applied distribution overlaid on the histogram of recorded diverted volumes, bypass volumes, and total volumes.

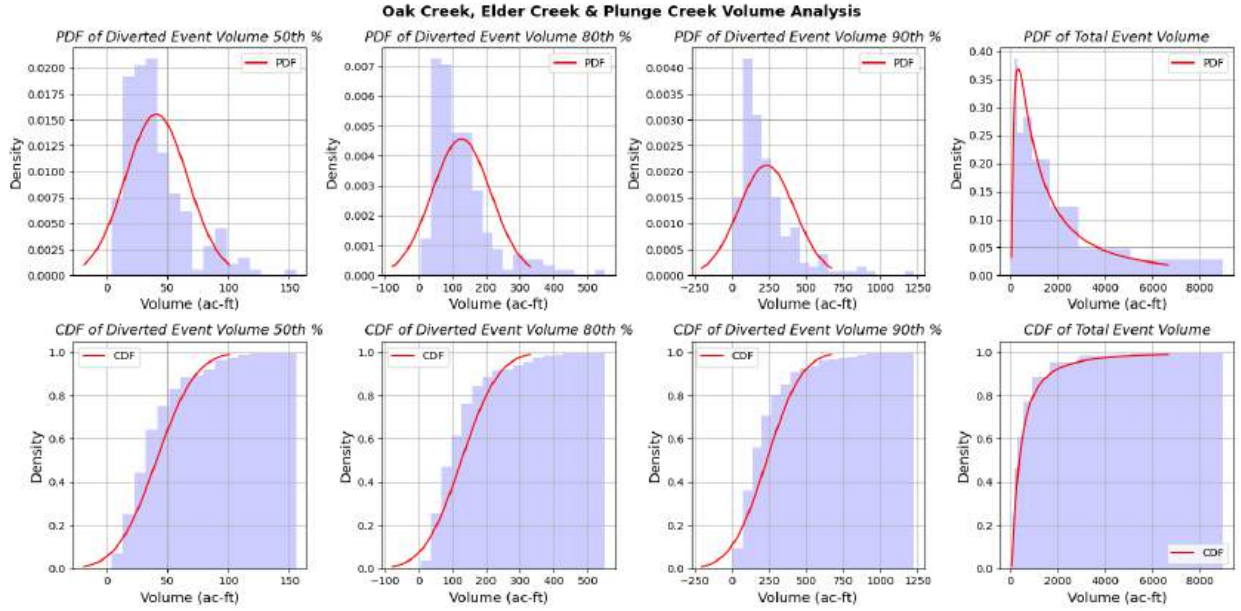


Figure 10: *PDF & CDF of Divertible Volumes at 3 Candidate Percentile Rates and Total Event Volumes (right-hand charts) per Event via Normal and LP3 Assumptions, respectively of Elder Creek + Plunge Creek + Oak Creek Calculated Storm Events*

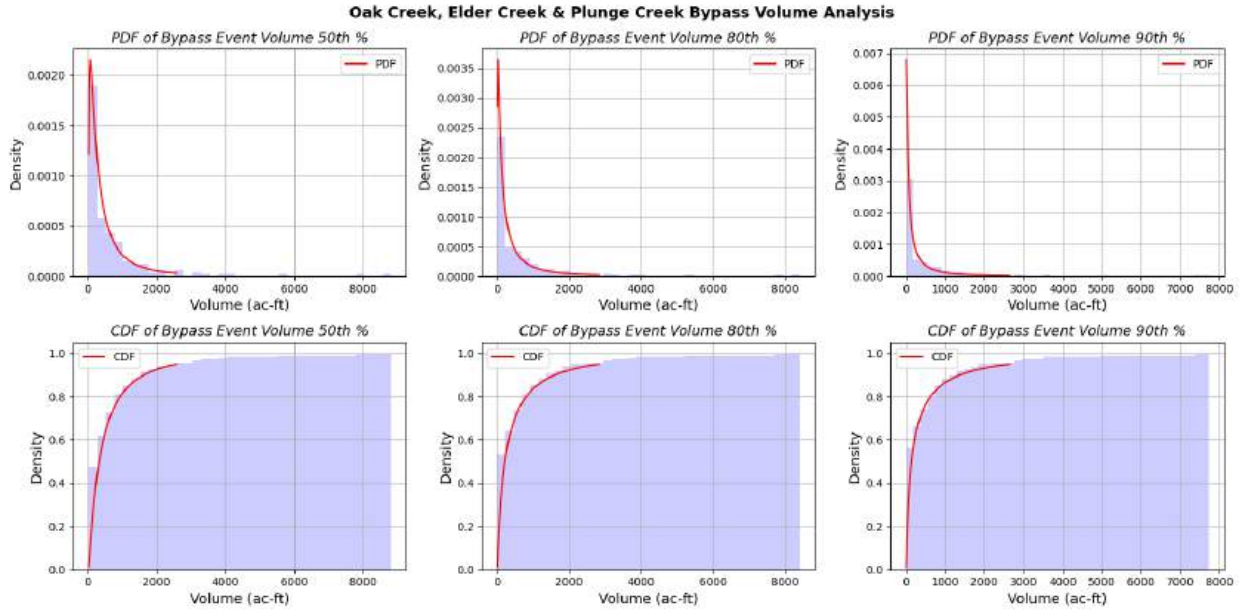


Figure 11: *PDF & CDF Bypassed Volumes per Event at 3 Candidate Percentile Rates via Log-Normal Distribution of Elder Creek + Plunge Creek + Oak Creek Calculated Storm Events*

Table 9 depicts the CDF deciles for each Volume Type of interest across all candidate diversion rates.

Table 9: *Divertible and Bypassed Storm Volumes at Three Flow Diversion Rates & Total Storm Volume of Elder Creek + Plunge Creek + Oak Creek Scaled Historic Storm Events*

Candidate Diversion Flow-Duration Percentile (%)	Volume Type	Scaled Storm-Event Volume Deciles from CDF (ac-ft)								
		10th	20th	30th	40th	**50th=Median Volume**	60th	70th	80th	90th
50th Percentile (2.39 cfs)	Divertible	7.85	19.15	27.3	34.26	40.77	47.27	54.24	62.39	73.69
	Bypassed	72.53	120.44	175.69	243.87	332.39	454.08	635.16	942.35	1631.89
80th Percentile (8.48 cfs)	Divertible	14.49	52.9	80.59	104.25	126.37	148.48	172.14	199.84	238.24
	Bypassed	36.32	65.94	104.01	155.19	226.95	333.24	504.14	820.57	1617.1
90th Percentile (18.87 cfs)	Divertible	-5.77	76.7	136.16	186.97	234.46	281.96	332.77	392.23	474.7
	Bypassed	14.27	31.23	54.97	89.16	140.14	220.3	357.44	629.85	1381.85
-	Total	101.5	154.85	213.05	282.57	370.95	490.92	668.54	971.13	1665.54

Identification of Historic Peak Flowrates by Percentile

Table 10 summarizes peak flow rates that are based upon a Log Pearson Type 3 distribution being applied to each scenarios' adjusted set of storm flow events to identify the median storm. This summary of peak flowrates is relevant to informing the selection of a project hydrograph for use in hydraulic assessments of potential recharge basins at the two project locations: (1) south of Greenspot Road near Plunge Creek, and (2) adjacent Plunge Creek at Orange Street.

Table 10: *Percentile Peak Flowrates*

Flow Data Source/Combination	LP3 50th Percentile Flow (cfs)	LP3 80th Percentile Flow (cfs)	LP3 90th Percentile Flow (cfs)
Oak Creek Only	11.0	27.6	47.7
Greenspot SD Only	3.3	8.2	14.2
Plunge + Elder Only	135.7	342.0	590.4
Plunge + Elder + Oak Only	146.6	369.6	638.1

Total storm volume may be useful during project hydrograph selection as well. The storm-volume return frequencies (e.g. 2-year return or median storm) were calculated by applying a LP3 Distribution to the 187 events peak stormflow rates in the scaled data to the scenarios. Those total storm volumes are shown in the volume analysis at the bottom of Tables 6, 7, 8, and 9 for each flow scenario evaluated. The three percentile storm volumes used here are highlighted in Tables 6, 7, 8, and 9 for cross reference. Some examples of representative hydrographs have been included in Appendix A, for Oak Creek, and in Appendix B, for the Plunge+Elder+Oak scaled flows in combination scenario.

Summary of Findings

This technical memorandum evaluates the Plunge Creek gage data and PRISM precipitation data to develop a 35 year record of flow in Plunge Creek, Elder Creek, Oak Creek and in the Greenspot SD. A series of 187 total events were defined on the raw dataset were isolated and studied to statistically represent typical storm durations (time period of events) and storm separations (time between events within same water year).

The 35 year record for each contributing water source was evaluated by scaling the Upper Plunge Creek gage record of real-time . Various flow source scenario combinations were developed and studied to estimate flow-duration frequencies for each over the period of record. Scenarios of interest included individual flow sources or combinations of them. The 50th, 80th, and 90th percentile flow-duration frequencies were used as candidate rates for flow diversion within each scenario of interest. These candidate values for flow rate diversion were used to quantify the divertible volume and the bypassed volume for each event defined in the record after being scaled and combined according to the scenario. The various results were analyzed with probability distributions to characterize the probabilistic frequency of these two volumes, potentially intercepted by diversion or potentially lost to bypass at each candidate diversion flow rate.

Peak flowrates and total event volume were studied with a Log-Pearson Type 3 distribution. The 50th, 80th, and 90th percentile approximations of total storm-event volumes for each flow scenario are summarized in each scenario's respective volume analysis table. Tables 6, 7, 8 and 9 (along with other deciles). In addition to percentile peak flowrates are listed in Table 10 for these same sized storms. The percentile storm identifies its return frequency (e.g., the 80th percentile storm is a 5-year return frequency event). Peak flow rates by return frequency storm event may aid in identifying a good diversion rate sizing at either of the project sites.

ATTACHED FIGURES

Subbasin	A (ac)	P_w (in)	V_w (ac-ft)	R_v (-)
Elder Creek	3082.29	14.19	3645.24	0.164
Oak Creek	1527.27	16.34	2079.47	0.094
Plunge Creek	10974.08	24.26	22185.08	1.000
Storm Drain	547.03	13.46	613.40	0.028

Ratios of Annual Precipitation Volume:
Volume = Precipitation * Area

Note that all ratios are with reference to Plunge Creek. Therefore, ratios are computed as:

Wshed Ratio = Volume Wshed / Volume Plunge

Elder / Plunge

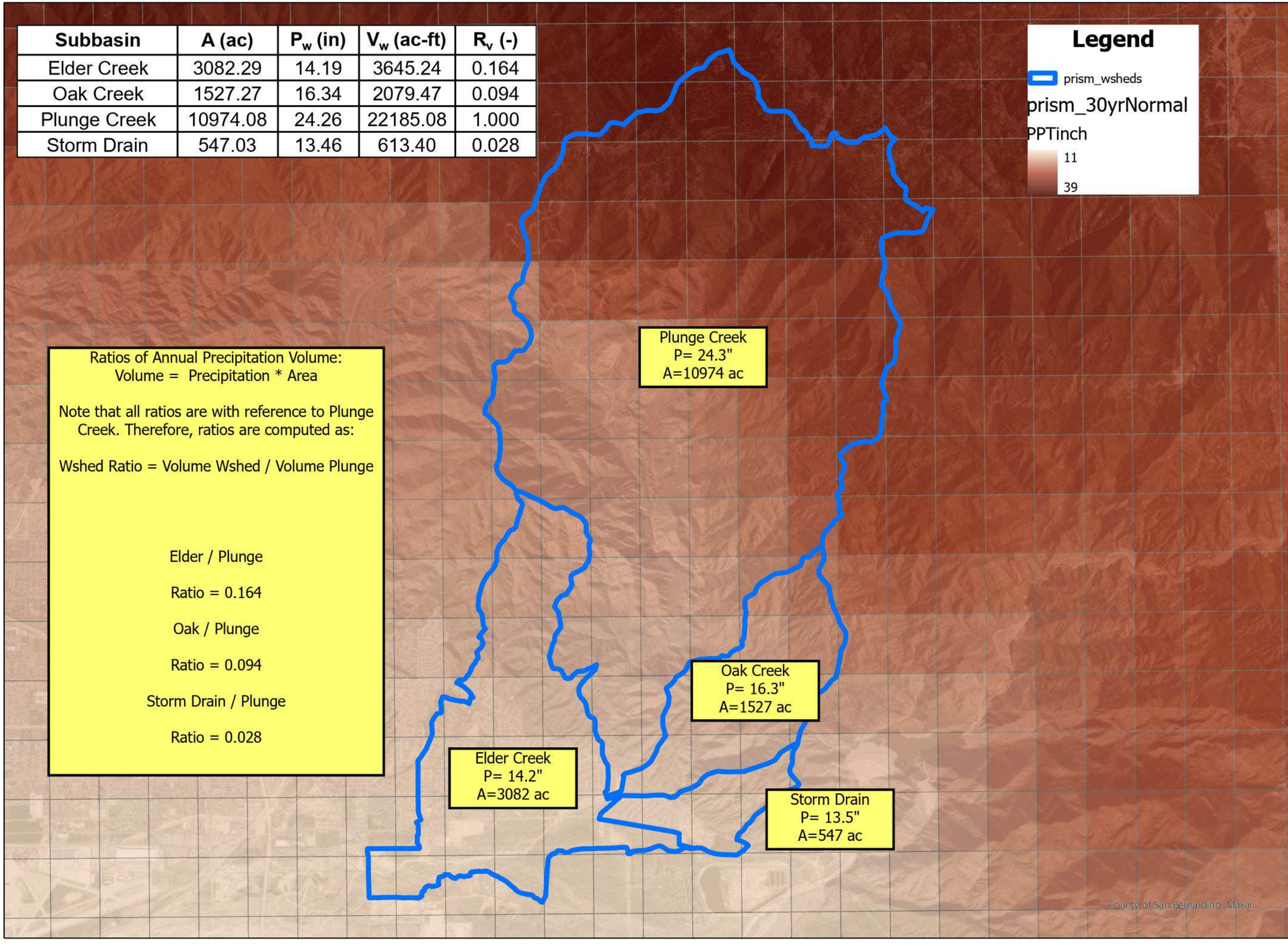
Ratio = 0.164

Oak / Plunge

Ratio = 0.094

Storm Drain / Plunge

Ratio = 0.028



TITLE: PRISM DATA MAP

PROJECT: Plunge Creek, Highland, CA

SCALE: 1:55,000

DATE: 9/17/24

JLC Engineering & Consulting, Inc.
MURRIETA, CA 92562
Office 951.304.9552 Fax 951.304.3568

FILE NAME:

FIGURE

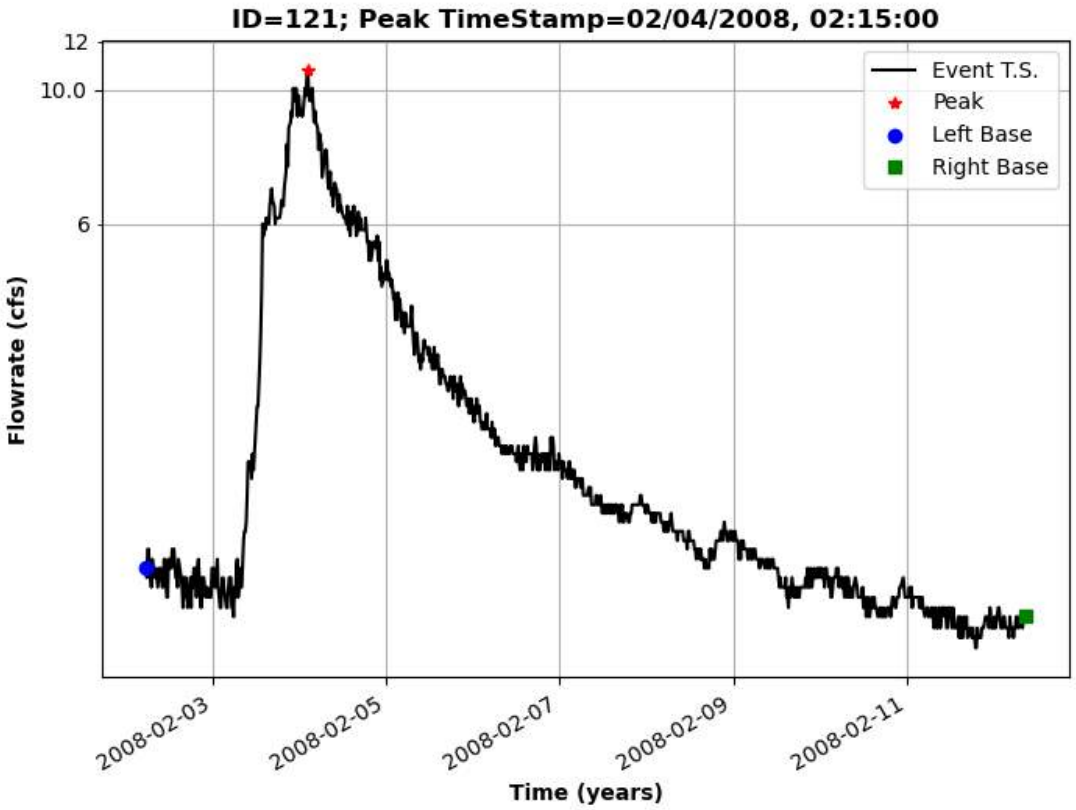
A

Appendix A: Oak Creek Only – Representative Hydrographs

Appendix A:

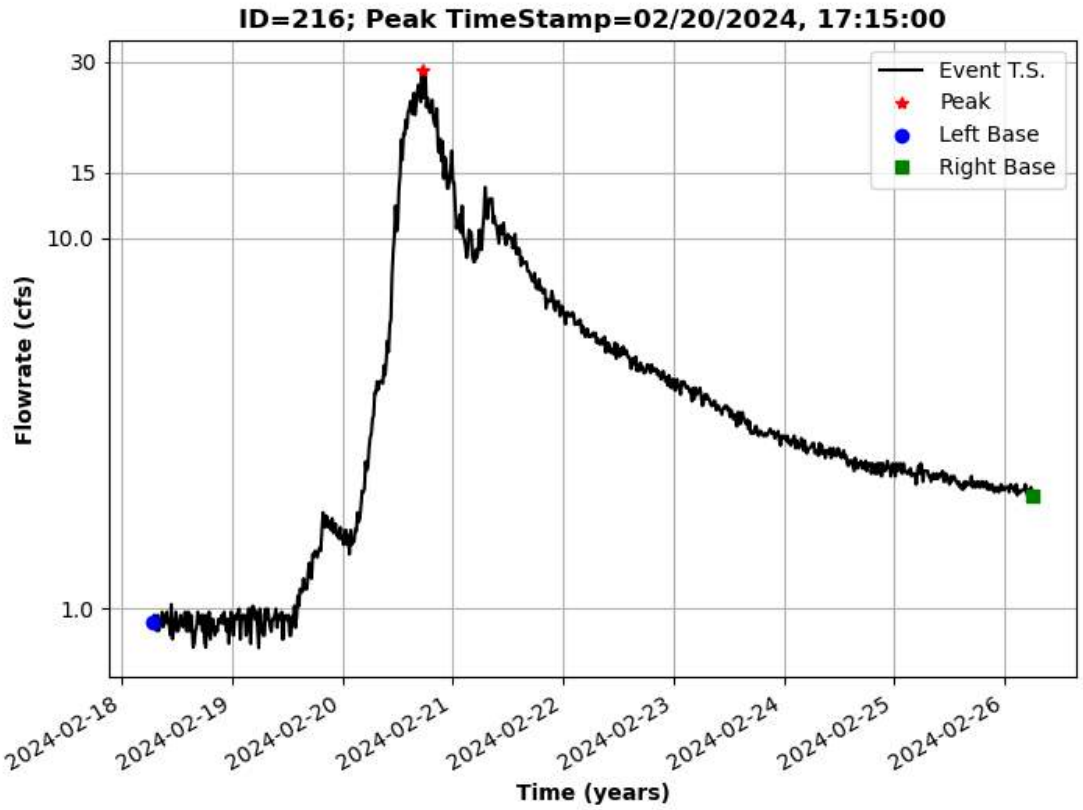
Representative events are selected by choosing the event (of 187 possible events) which has a peak flowrate closest to the corresponding probabilistic peak flowrate from Table 10 for the given scenario. For example, Oak Creek 50th percentile peak flowrate is 11 cfs. Figure A.1 shows an event which has a peak of 10.8 cfs. Note that events are scaled based on the scenario described, in this case scaled to Oak Creek Only flows. Note each hydrograph denotes duration (Dur), left base flowrate (Ql), right base flowrate (Qr), peak flowrate (Qp), and total volume (Vt). Approximately five months of flow for Water Year 2023 and 2024 have been provided. Both figures demonstrate continuous periods of time where the flow exceeds the low flow cutoff and demonstrates character of subsequent events in the system.

Figure A.1: 50th Percentile Representative Event



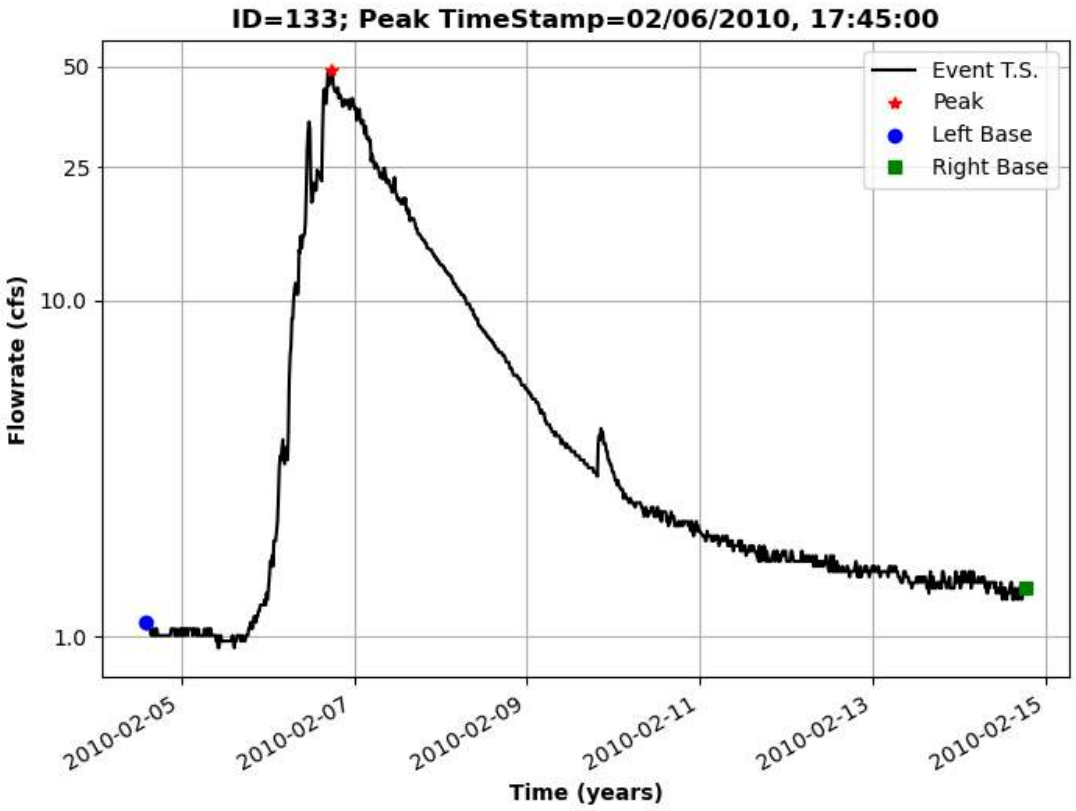
Dur=10.1 days, Ql=1.6 cfs, Qp=10.8 cfs, Qr=1.3 cfs, Vt=54.6 ac-ft

Figure A.2: 80th Percentile Representative Event



Dur=8.0 days, Ql=0.9 cfs, Qp=28.6 cfs, Qr=2.0 cfs, Vt=72.9 ac-ft

Figure A.3: 90th Percentile Representative Event



Dur=10.2 days, Ql=1.1 cfs, Qp=49.0 cfs, Qr=1.4 cfs, Vt=132.8 ac-ft

Figure A.4: WY 2023 Subsequent Events

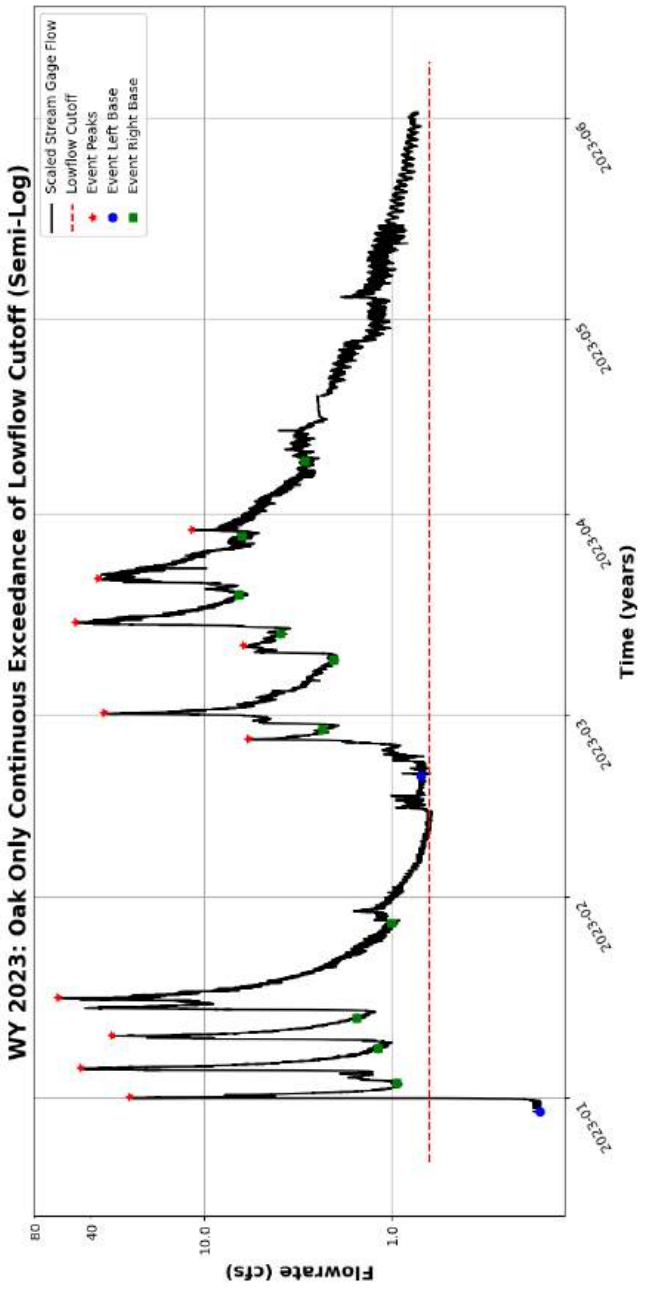
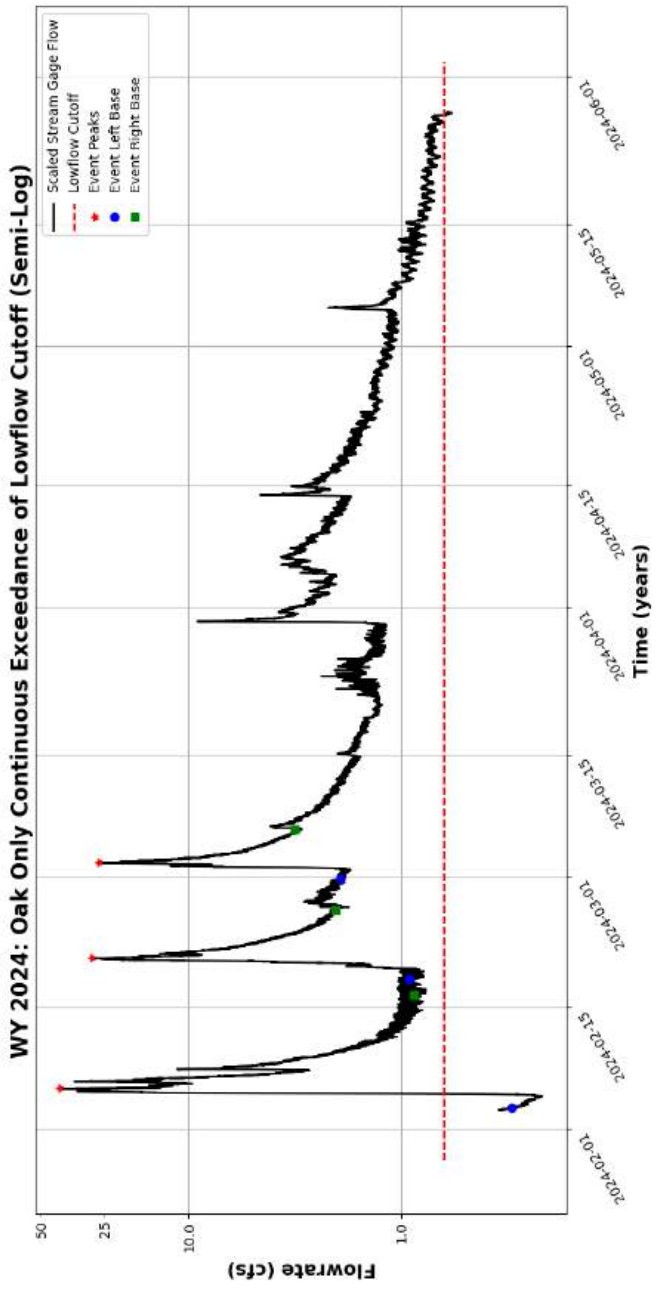


Figure A.5: WY 2024 Subsequent Events

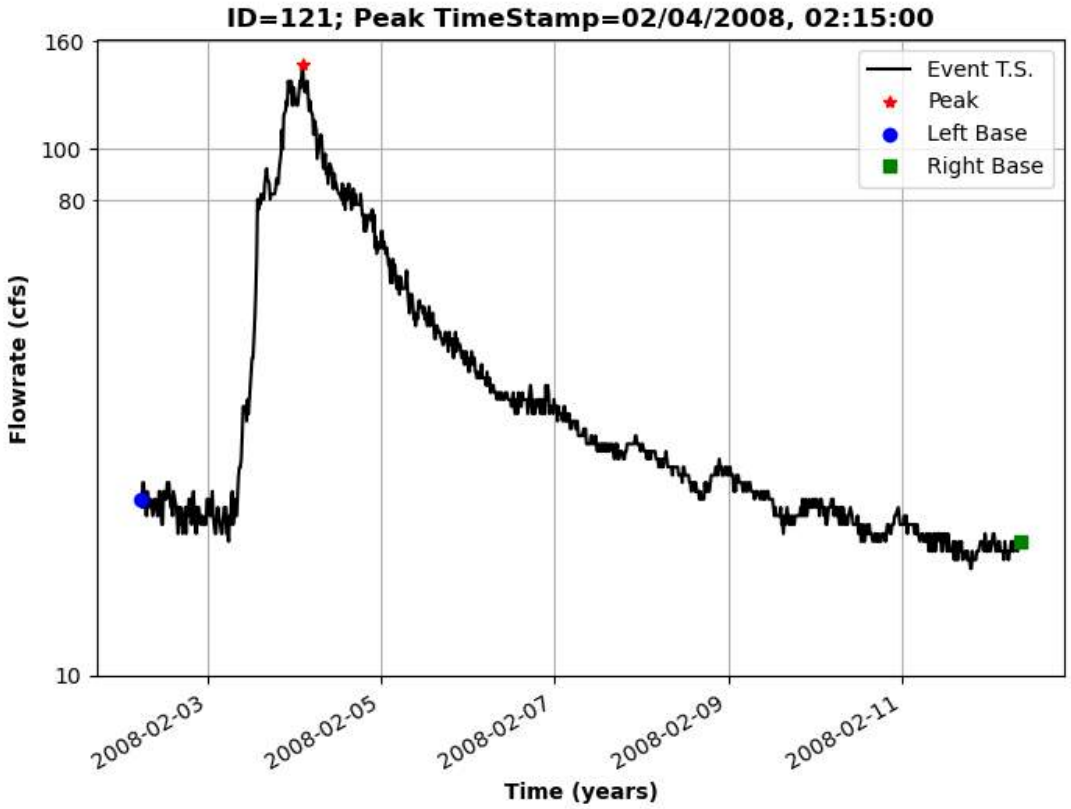


Appendix B: Plunge/Elder/Oak Creek – Representative Hydrographs

Appendix B:

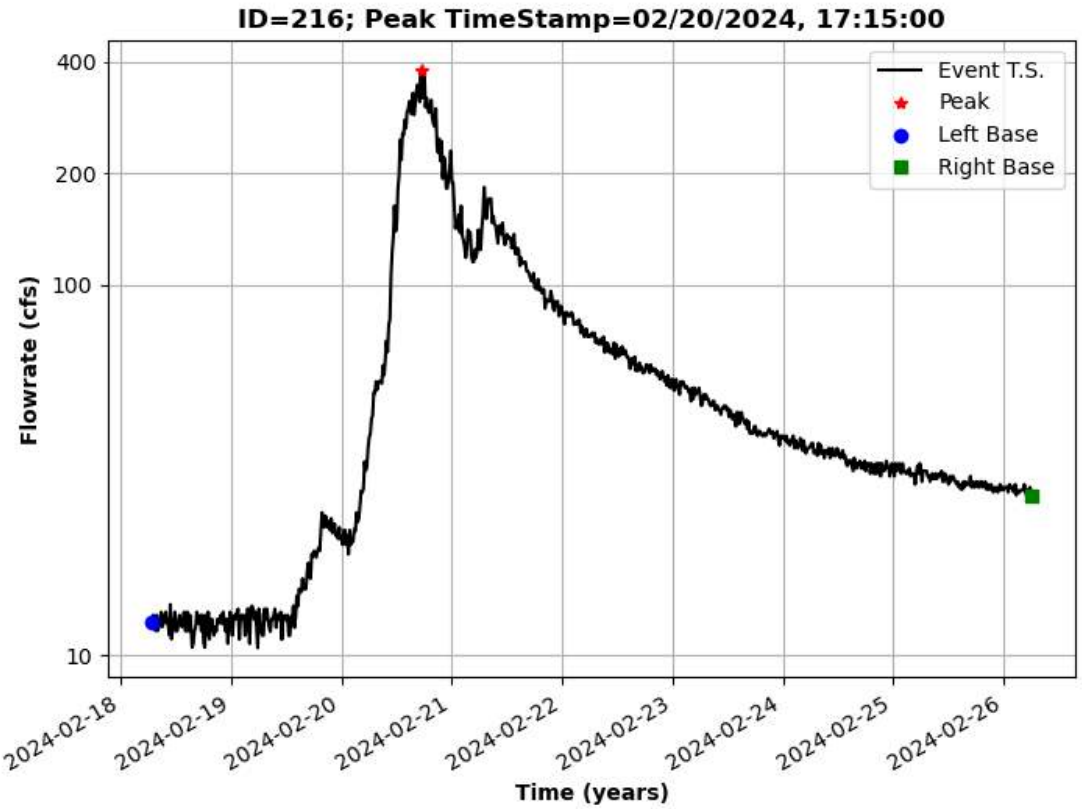
Representative events are selected by choosing the event (of 187 possible events) which has a peak flowrate closest to the corresponding probabilistic peak flowrate from Table 10 for the given scenario. For example, Plunge/Elder/Oak Creek 50th percentile peak flowrate is 146.6 cfs. Figure B.1 shows an event which has a peak of 144.7 cfs. Note that events are scaled based on the scenario described, in this case scaled to Plunge/Elder/Oak combined flows. Note each hydrograph denotes duration (Dur), left base flowrate (Ql), right base flowrate (Qr), peak flowrate (Qp), and total volume (Vt). Approximately five months of flow for Water Year 2023 and 2024 have been provided. Both figures demonstrate continuous periods of time where the flow exceeds the low flow cutoff and demonstrates character of subsequent events in the system.

Figure B.1: 50th Percentile Representative Event



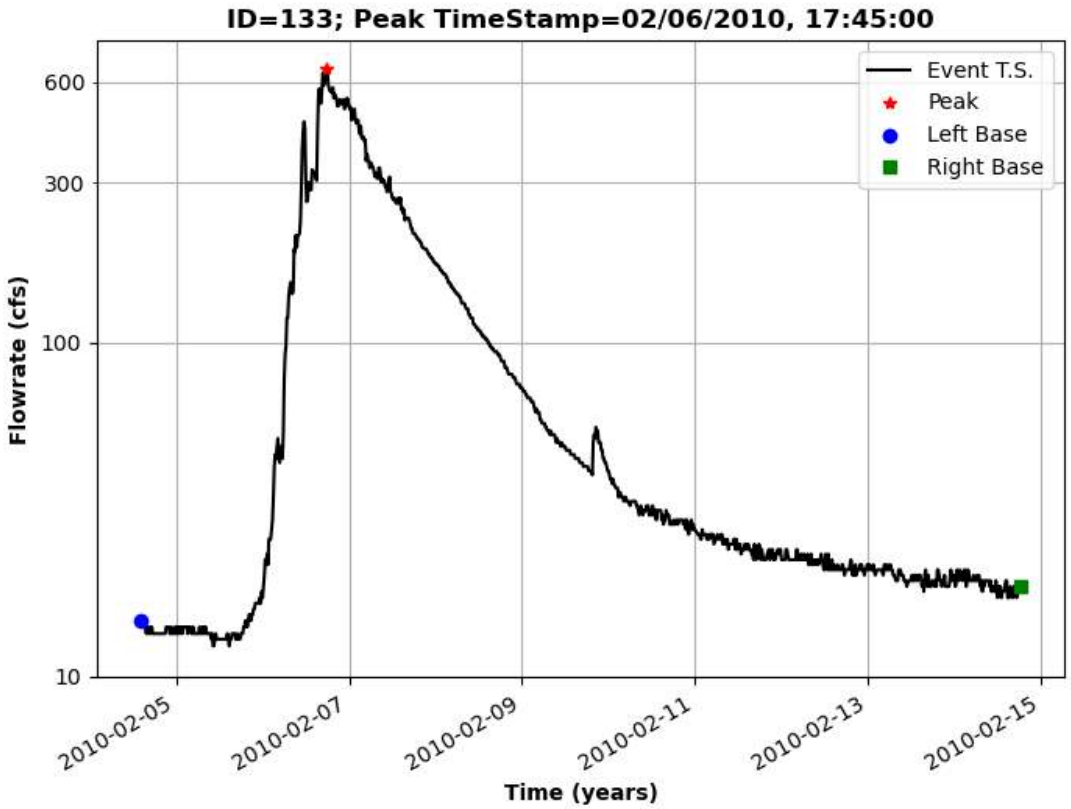
Dur=10.1 days, Ql=21.6 cfs, Qp=144.7 cfs, Qr=18.0 cfs, Vt=730.8 ac-ft

Figure B.2: 80th Percentile Representative Event



Dur=10.1 days, Ql=21.6 cfs, Qp=144.7 cfs, Qr=18.0 cfs, Vt=730.8 ac-ft

Figure B.3: 90th Percentile Representative Event



Dur=10.2 days, Ql=14.7 cfs, Qp=655.4 cfs, Qr=18.6 cfs, Vt=1777.8 ac-ft

Figure B.4: WY 2023 Subsequent Events

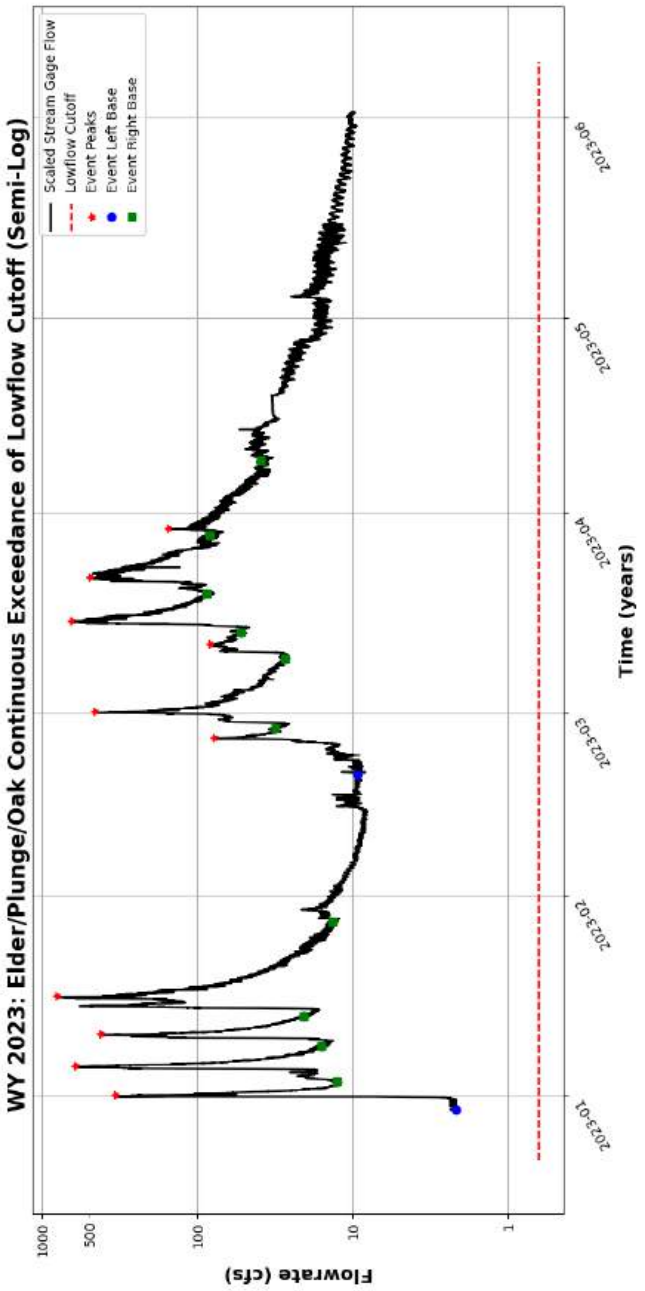
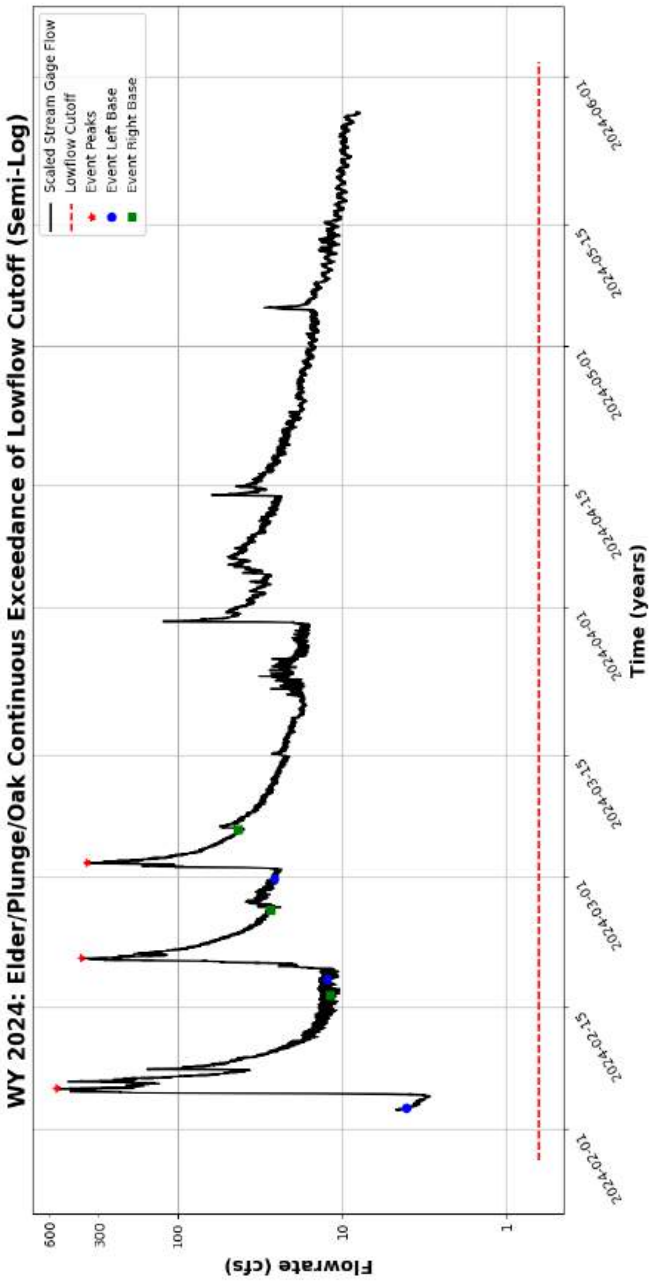


Figure B.5: WY 2024 Subsequent Events



ADDENDUM OC-3: BASIN ROUTING

Oak Creek Basin Project

Basin 1: Stage-Storage-Discharge Table

Elevation	Depth	Area (ac)	Incremental Volume (ac-ft)	Cumulative Volume (ac-ft)	Unclogged Flowrate (cfs)	Clogged Flowrate (cfs)
1483	0	0.84	0.00	0.00	0.00	0.00
1484	1	0.90	0.87	0.87	2.03	1.01
1485	2	0.96	0.93	1.80	2.16	1.08
1486	3	1.02	0.99	2.79	2.30	1.14
1487	4	1.08	1.05	3.84	2.43	1.21
1488	5	1.14	1.11	4.96	2.57	1.28
1489	6	1.21	1.18	6.13	2.72	1.35
1490	7	1.27	1.24	7.37	2.86	1.43
1491	8	1.34	1.31	8.68	3.01	1.50
1492	9	1.41	1.37	10.05	3.17	1.58
1493	10	1.48	1.44	11.49	3.32	1.65
1494	11	1.55	1.51	13.00	3.48	1.73
1495	12	1.62	1.58	14.58	3.64	1.81
1496	13	1.69	1.65	16.24	3.80	1.89
1497	14	1.76	1.73	17.97	3.97	1.98
1498	15	1.84	1.80	19.77	4.14	2.06
1499	16	1.92	1.88	21.65	4.31	2.15
1500	17	2.00	1.96	23.60	4.49	2.23

Basin 2: Stage-Storage-Discharge Table

Elevation	Depth	Area (ac)	Incremental Volume (ac-ft)	Cumulative Volume (ac-ft)	Unclogged Flowrate (cfs)	Clogged Flowrate (cfs)
1483	0	5.81	0.00	0.00	0.00	0.00
1484	1	5.98	5.90	5.90	13.46	6.70
1485	2	6.15	6.07	11.97	13.84	6.89
1486	3	6.33	6.24	18.20	14.23	7.08
1487	4	6.50	6.41	24.62	14.62	7.28
1488	5	6.67	6.58	31.20	15.01	7.47
1489	6	6.85	6.76	37.96	15.41	7.67
1490	7	7.03	6.94	44.90	15.81	7.87
1491	8	7.21	7.12	52.01	16.22	8.07
1492	9	7.39	7.30	59.31	16.63	8.28
1493	10	7.58	7.48	66.79	17.04	8.48
1494	11	7.76	7.67	74.46	17.47	8.69
1495	12	7.95	7.86	82.32	17.90	8.91
1496	13	8.15	8.05	90.37	18.33	9.13
1497	14	8.35	8.25	98.62	18.78	9.35
1498	15	8.55	8.44	107.06	19.23	9.57
1499	16	8.75	8.65	115.71	19.69	9.80
1500	17	8.96	8.85	124.56	20.15	10.03

Technical Memorandum

Date: **January 26, 2025**

To: **John Lambie, PE, Chief Engineer San Bernardino Valley Water Conservation District**

From: **Joseph L. Castaneda, P.E.**

Re: **Plunge Creek Basins & Oak Creek Basins Routing Assessment**

Introduction

This technical memorandum was produced for the San Bernardino Valley Water Conservation District (SBVWCD) in support of the requested routing assessment of the proposed Plunge Creek and Oak Creek basins. The Oak Creek and Plunge Creek Project Alternatives have been assessed with a basin routing model to develop an understanding of their functionality. The basins have been independently assessed using basin routing for the following Project Alternatives:

1. Oak Creek Basins (see Addendum A)
2. Plunge Creek Interim Conditions Basins (see Addendum B)
3. Plunge Creek Mined-Conditions Basins (see Addendum C)

The inflow data which is routed through each basin is defined as:

- **Native Inflow** - Inflow defined by the Technical Memorandum for the Oak Creek Basin and Plunge Creek Basin feasibility study using statistical assessment in order to identify a historic project site typical hydrograph (PTH TM, JLC, Oct. 2024).

The inflow data which is routed only through the Oak Creek Basin is defined as:

- **FIRO Inflow** - Inflow defined by the SBVWCD in coordination with the Forecast-Informed Reservoir Operations (FIRO) program.

The PTH TM was developed in coordination with SBVWCD staff to statistically define expected inflow events. Stream gage data in Plunge Creek was studied to identify candidate inflow hydrographs. Approximately 187 events were detected and statistically assessed by their runoff volume production using applicable probability distributions for hydrologic event analysis. The event data was extrapolated to adjacent watershed areas using watershed area and relative precipitation over each watershed area as a

proxy for variability in runoff volume scale between watersheds. The precipitation data used for this process was determined using the PRISM dataset which defines 30 year normal annual precipitation for the region. The PTH TM identified storm event #121 of 187 as a typical, median sized stormflow event (i.e., middle of the range) to be considered for analysis of the proposed basin infrastructure. Note that event #121, the typical hydrograph, is scaled differently based on the basin it is applied to in order to account for the different magnitude in flows tributary to each basin.

For analysis of Oak Creek Basin, storm event #121 has been scaled to account for flow from the Oak Creek watershed and nearby Greenspot Storm Drain watershed area. For analysis of Plunge Creek Basin, storm event #121 has been scaled to account for flow from Oak Creek watershed, Plunge Creek watershed, and Elder Creek watershed. The watersheds are in reference to Figure A of the PTH TM.

Based on an approximation of five storms per year (assumed due to 187 storms found over 35 year record), SBVWCD requested that the routing inflow event referred to as the project typical hydrograph (PTH) and defined by the PTH TM consist of five consecutive typical hydrographs to determine how the proposed basins would operate under this condition. SBVWCD requested that the events be consecutive with no separation between events such that the first time step of the subsequent event follow the last time step of the previous event. This decision is based upon findings that the median separation between storm events in the region is zero days in the PTH TM analysis.

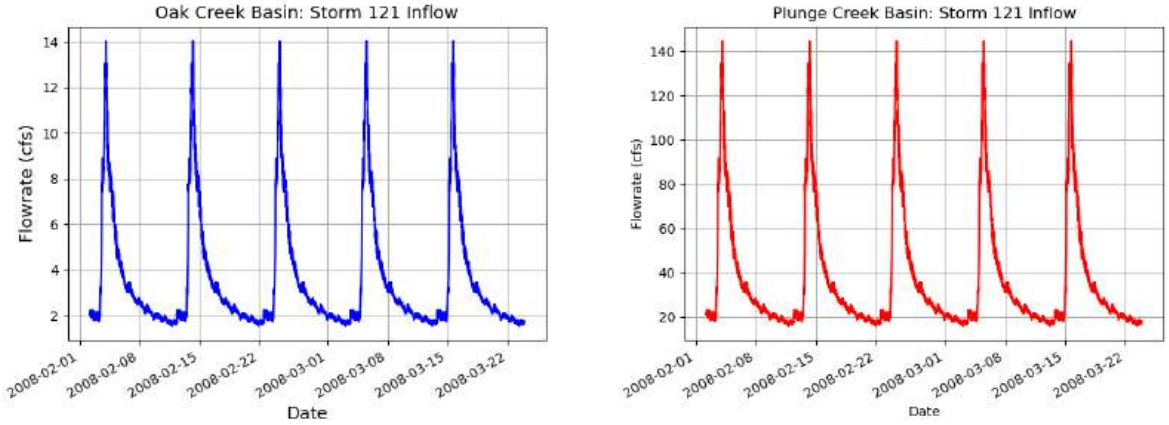


Figure 1: *Native Inflow for Oak Creek Basin (left) and Plunge Creek Basin (right)*

The decision to model the inflows in this fashion is consistent with behavior observed from the stream gage analysis of Plunge Creek in the PTH TM. Generally, most events occur in the spring between February and May of any given year. The receding tail of any single event is generally long and drawn out over a long period which creates long periods of constant low flows through Plunge Creek and Oak Creek. The long period of consistent lows flows with intermittent peak flows from periodic median storm events are the primary target for infiltration. Inflow events of this character will be applied to both Oak Creek and Plunge Creek Basins. The duration of the five consecutive hydrographs

is approximately 50 days (about 10 days per event). The peak flow for each hydrograph in the set is approximately 14 cfs and 145 cfs in Oak Creek and Plunge Creek, respectively. The cumulative volume of each hydrograph is 354.5 ac-ft and 3655.5 ac-ft in Oak Creek and Plunge Creek, respectively.

Coordination between SBVWCD and the FIRO program have created an opportunity for periods of constant inflow to the Oak Creek basin only. The FIRO program allows a coordinated release of flow from upstream reservoirs as dictated by state water managers. As a result, SBVWCD has requested that the Oak Creek basin be assessed for a constant inflow event given an inflow magnitude and duration. The FIRO inflow has been requested as 35 cfs over 52 days.

HEC-HMS: Routing Model

HEC-HMS, developed by the US Army Corp of Engineers (USACE), was used to model the routing of inflow hydrographs through the proposed basins. Due to the simple configuration of the proposed basins and inflow scenarios of interest, the most cost/time effective modeling approach was identified to be routing with the Modified Puls Method (also known as level pool routing). The long duration of inflows that were requested to be modeled by the SBVWCD necessitated the use of HEC-HMS over other tools capable of invoking the Modified Puls Method.

The Modified Puls Method is widely used and powerful for understanding storage in a large reservoir (basin) such as the proposed Oak Creek and Plunge Creek basins. The method is developed through discretizing the continuity equation and is one-dimensional. The equation is as follows:

$$\overline{I_t} - \overline{O_t} = \frac{\Delta S}{\Delta t}$$

where $\overline{I_t}$ and $\overline{O_t}$ are time averaged inflow/outflow over a time period Δt, and ΔS is the change in storage during that period. This concept can be simplified to mean that the rate at which stored volume in the basin is changing (increasing/decreasing) is simply the difference between the inflow and outflow at the given time step. Therefore, if inflow is greater than outflow there is an accumulation of runoff stored in the basin. In contrast, if outflow exceeds inflow then there is a decrease in runoff stored in the basin.

This method relies on the development of a function governing the relationship between stage and outflow in the proposed basin. The outflow mechanisms in each basin are (1) spillway and (2) infiltration. Both are a function of stage and can be tabulated and provided to the HEC-HMS routing model for use in resolving the Modified Puls method. Spillways are resolved by modeling the proposed spillways as rectangular weirs with the weir equation. Infiltration is modeled based upon the provided clogged and unclogged infiltration rates from SBVWCD. As requested by the district, outflow due to infiltration was modeled as a function of wetted area which was approximated by the surface area of each enclosed topographic contour defined by the basin grading. As a result, the

outflow due to infiltration increases as a function of stage by way of the corresponding increase in wetted area.

The **clogged** and **unclogged** infiltration rates were provided by SBVWCD. SBVWCD requested that the infiltration rate be considered to increase as a function of wetted area and that the infiltration rate not decay in time. The area of the water surface for a given water surface elevation was used as a proxy for wetted area when evaluating the infiltration outflow in each basin.

The HEC-HMS model for each basin consists of the following elements:

1. Source (Inflow)
2. Reservoir (Basin = Storage)
3. Sink (Outflow)
    a. Infiltration
    b. Overflow via Emergency Spillway

Note that outflow through the spillway and outflow through infiltration are both modeled as sinks which extract flow from the basin. Infiltration outflow is enabled to begin as soon as a non-zero depth of water is achieved in the basin element. The spillway outflow is enabled to begin once the depth of water exceeds the spillway invert in the basin.

Infiltration Rate

The infiltration rates used in the models were determined from the results of the infiltration testing conducted by LOR Geotechnical (LOR), and further analyzed by SBVWCD. LOR conducted infiltration testing at the proposed Oak Creek Basin site (Report 63813A.4), and in the proximity of the Plunge Creek Basin Site (Report 63813B.4). At the Oak Creek Basin location, LOR conducted four borehole percolation tests at depths which varied from approximately 8 feet to 15 feet. Infiltration rates were calculated by LOR from the test data using the Porchet Method, and ranged from 2.5 inches/hour to 6.5 inches/hour. Near the Plunge Creek Basin site, LOR conducted three double-ring infiltrometer, and one single-ring infiltrometer test at depths of approximately 0.5 feet to 1 foot below existing ground surface. Infiltration rates were calculated by LOR from the test data and ranged from 2.6 inches/hour (5.1 ft/day) to 5.8 inches/hour (11.6 ft/day).

SBVWCD reviewed the results and developed the design rates to use for clogged and unclogged conditions. SBVWCD calculated the geometric mean of the results and then calculated a factor of safety at each basin using the method in Appendix D of the Technical Guidance Document for Water Quality Management Plans, June 7, 2013, prepared by CDM Smith, Inc to determine the unclogged rate. SBVWCD proposed assigning an additional reduction factor of 2 to simulate clogging prior to basin maintenance, resulting in a clogged rate.

SBVWCD provided infiltration rates for the **clogged** and **unclogged** conditions as **1.77 ft/day** and **3.55 ft/day**, respectively, for Plunge Creek Basin. Infiltration rates for the **clogged** and **unclogged** conditions are **2.23 ft/day** and **4.46 ft/day**, respectively, for Oak Creek Basin.

Oak Creek Basins

The Oak Creek proposed basin will consist of two connected sub-basins in series. Flow will enter from the north into Basin 1; flows will overtop Basin 1 and cross a spillway into Basin 2.

Table 1a: *Oak Creek Basin Physical Characteristics for Basin 1&2*

Basin Name	Basin Bottom (ft)	Basin Top (ft)	Spillway Invert (ft)	Max Storage @ Spillway Invert (ac-ft)
Basin 1	1483	1500	1495	14.6
Basin 2	1483	1500	1497	98.6

Table 1b: *Oak Creek Basin Inflow Scenarios*

Inflow Name	Duration (days)	Peak Flow (cfs)	Cumulative Volume (ac-ft)
Native	56	14.0	354.5
FIRO	52	35	3,610.3

Note that modeling the Oak Creek Basins requires some assumptions since it consists of two smaller basins which are connected only by a spillway at elevation 1495' (basin bottom is 1483'). At this time, each basin (Basin 1 and Basin 2) are modeled as independent basins in series. As a result, the following assumptions are made regarding their operation:

- **Volume created by the spillway between 1495' and 1497' is partially ignored.** The contours which enclose the entire system were approximated for each independent basin by holding the proposed slope adjacent to the spillways to close the contours above 1495' on each basin. The ignored volume amounts to approximately 1.5 ac-ft of storage which exists over the spillway. Basin 1 and Basin 2 have a combined storage of approximately 147 ac-ft. Therefore, the ignored volume is about 1% of the volume and is negligible. Under 100% volume utilization these basins will retain marginally more volume than the routing dictates.
- **Volume created by Basin 1 between 1495' and 1497' due to backwater effect of Basin 2 is ignored.** Influence of the tailwater created by the flow over spillway from Basin 1 into Basin 2 is ignored since basins are assumed to operate independently. The impacts are considered negligible and only influence the FIRO flow condition which has the potential to fill Basin 2. This assumption has no impact on the analysis of the Native Inflow.

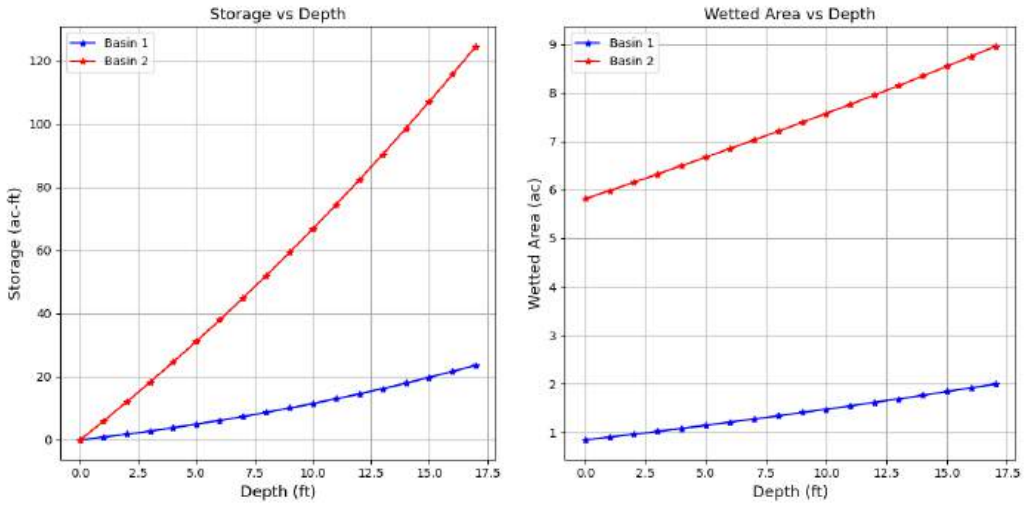


Figure 2a: *Oak Creek Basin Storage vs Depth (left) and Wetted Area vs Depth (right); Water surface area is a proxy for wetted area.*

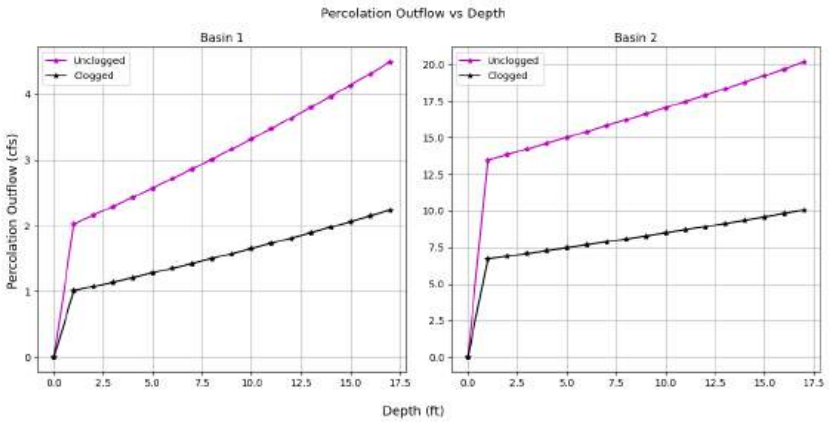


Figure 2b: *Oak Creek Basin Percolation Outflow vs Depth*

The Oak Creek Basins have a single graded condition to be considered. It will be assessed for both the Native Inflow and the FIRO Inflow. The results of the routing analysis are described below.

Table 1c: *Oak Creek Basin Routing Results (Native Inflow)*

Condition	Basin Name	Max Stage (ft)	Max Storage (ac-ft)	Inflow Volume (ac-ft)	Infiltrated Volume (ac-ft)	Bypass Volume (ac-ft)
Unclogged	Basin 1	1495.0	14.6	354.5	316.1	38.4
	Basin 2	1483.3	1.7	38.4	38.4	0.0
Clogged	Basin 1	1495.1	14.7	354.5	193.9	160.6
	Basin 2	1484.2	6.9	160.6	160.6	0.0

Note that the total infiltration for the unclogged and clogged conditions is the full inflow volume of 354.5 ac-ft since the system as a whole does not allow any bypass.

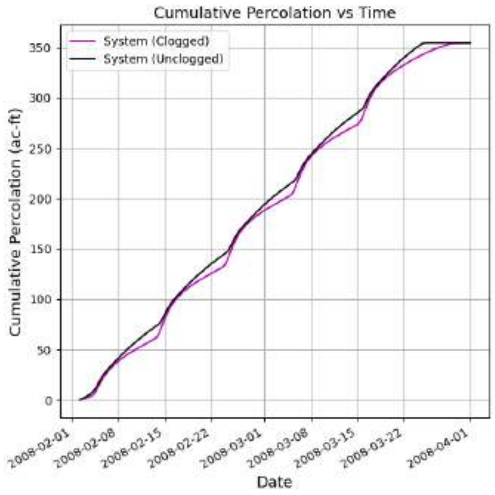


Figure 2c: *Oak Creek Basin Cumulative Percolation (Native Flow)*

Table 1d: *Oak Creek Basins Routing Results (FIRO Inflow)*

Condition	Basin Name	Max Stage (ft)	Max Storage (ac-ft)	Inflow Volume (ac-ft)	Infiltrated Volume (ac-ft)	Bypass Volume (ac-ft)
Unclogged	Basin 1	1495.2	14.9	3,610.3	392.4	3,217.9
	Basin 2	1497.1	99.1	3,217.9	2,012.2	1,205.7

The FIRO inflow condition was only examined for the unclogged condition as requested. Over the 52 day period, a total infiltration volume of 2,404.6 ac-ft was simulated. The FIRO inflow achieves steady state within the Oak Creek Basins after approximately 3.5 days (88.5 hours). This means that Basin 1 and Basin 2 are both full and outflow through the overflow spillway in Basin 2 out of the Oak Creek Basin system is constant. At steady state, the flow out of Basin 2 is approximately 12.5 cfs. After 52 days of constant inflow, the transient period until the basins are empty is approximately 5.2 days.

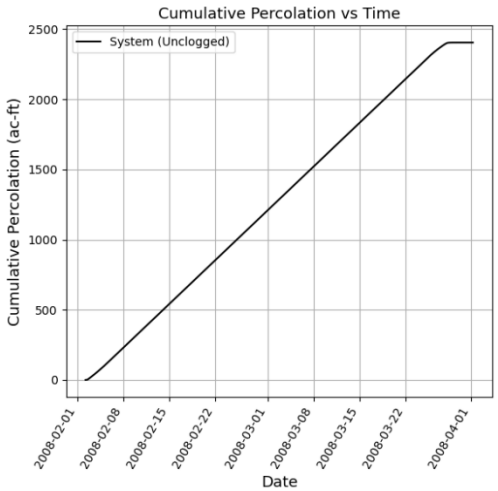


Figure 2d: *Oak Creek Basin Cumulative Percolation (FIRO flow)*

Plunge Creek Basin Interim-Conditions Basin Project Alternative

The Plunge Creek Interim-Conditions Basins project alternative consists of three basins: two small basins at the upstream end for debris entrapment and a single larger basin downstream. The two small debris basins will limit the aggregation of debris in the primary basin; however, all three basins will be considered for infiltration in the routing model. Flow will enter from the north into the basins 1 and 2 before passing into basin 3. Basin 1 and 2 operate in parallel.

Table 2a: *Interim Plunge Creek Basin Physical Characteristics for Basin 1, 2, & 3*

Basin Name	Basin Bottom (ft)	Basin Top (ft)	Spillway Invert (ft)	Max Storage @ Spillway Invert (ac-ft)
Basin 1	1254	1270	1266	14.9
Basin 2	1254	1266	1262	13.1
Basin 3	1244	1260	1258	99.7

Table 2b: *Plunge Creek Basin Inflow Scenarios*

Inflow Name	Duration (days)	Peak Flow (cfs)	Cumulative Volume (ac-ft)
Native	56	144.7	3655.5

At this time the following assumptions have been made about the Plunge Creek Interim-Conditions Basins:

- **Basin 1 & 2 have a spillway with length of 30ft and Basin 3 has a spillway with length of 50 ft.** At this time, the assessment is completed based upon the apparent weir length on the provided design file from the District. The spillway is assumed to be rectangular and broad-crested.
- **Flows are diverted upstream of Basin 1 & 2 before entering the basins separately via storm drain. It is assumed the inflow is evenly split between Basin 1 and Basin 2.** There is no way to assess how flows are diverted at this time. This is a convenient assumption and has minimal influence since the inflow event drastically exceeds the total system storage capacity.

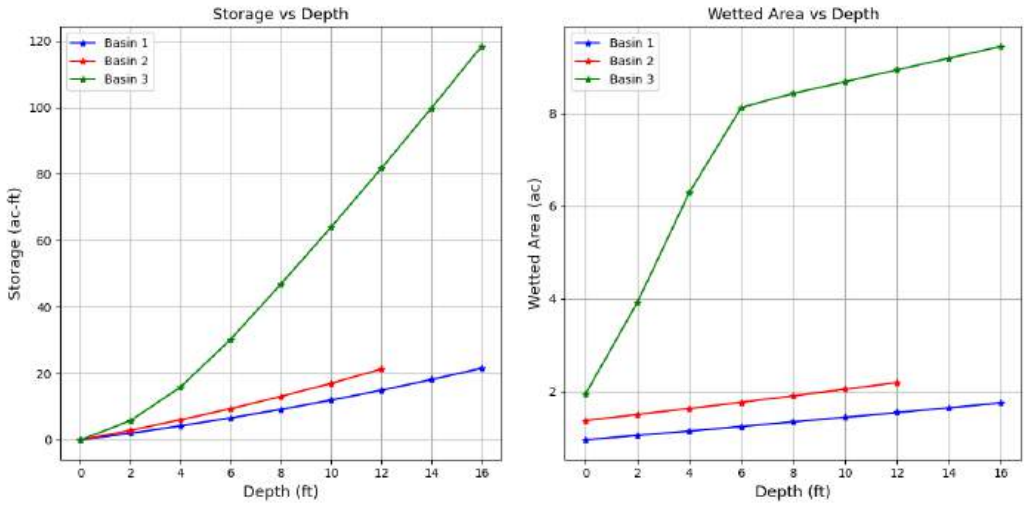


Figure 3a: *Plunge Creek Interim Basins Storage vs Depth (left) and Wetted Area vs Depth (right); Water surface area is a proxy for wetted area.*

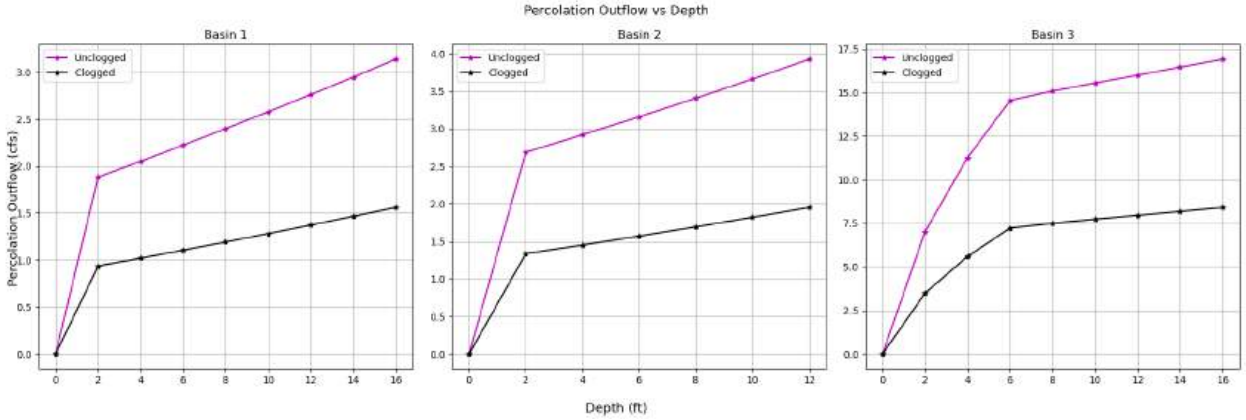


Figure 3b: *Plunge Creek Interim Basins Percolation Outflow vs Depth*

Table 2c: *Interim Plunge Creek Basins Routing Results (Native Inflow)*

Condition	Basin Name	Max Stage (ft)	Max Storage (ac-ft)	Inflow Volume (ac-ft)	Infiltrated Volume (ac-ft)	Bypass Volume (ac-ft)
Unclogged	Basin 1	1266.8	16.25	1827.8	294.4	1533.2
	Basin 2	1262.8	14.68	1827.8	358.5	1469.2
	Basin 3	1258.2	101.41	3002.4	1682.7	1319.4
Clogged	Basin 1	1266.8	16.27	1827.8	154.1	1673.6
	Basin 2	1262.8	14.71	1827.8	185.1	1642.6
	Basin 3	1258.2	101.52	3316.2	905.8	2410.3

Note that the total infiltration for the unclogged and clogged conditions is 2335.6 ac-ft and 1245 ac-ft, respectively.

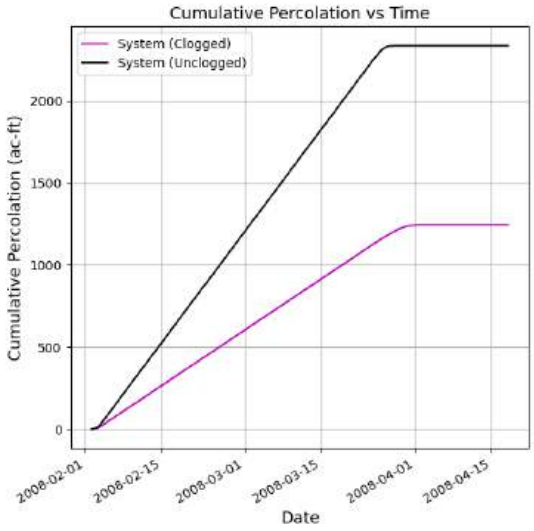


Figure 3c: *Plunge Creek Interim-Conditions Basins Cumulative Percolation (Native Flow)*

Plunge Creek Mined-Condition Basins Project Alternative

The Plunge Creek proposed basins Project Alternative after mining will consist of a single large basin. Flow will enter from the north into the basin.

Table 3a: *Ultimate Plunge Creek Basin Physical Characteristics for Basin*

Basin Bottom (ft)	Basin Top (ft)	Spillway Invert (ft)	Max Storage @ Spillway Invert (ac-ft)
1160	1232	1230*	2431.2

*Assumed spillway invert at this time.

Table 3b: *Ultimate Plunge Creek Basin Inflow Scenario*

Inflow Name	Duration (days)	Peak Flow (cfs)	Cumulative Volume (ac-ft)
Native	56	144.7	3655.5

At this time the following assumptions have been made about the ultimate condition Plunge Creek Basin:

- **The small basin adjacent to the primary Plunge Creek Basin is excluded from this analysis.** At this time, the assessment is completed based upon the design files received from the District. The proposed sub-basins do not have known names and the function of the smaller proposed basin is unknown.

- **An overflow emergency spillway is assumed to be a 10 ft rectangular broad-crested weir. At this time, the spillway design is unknown.** There is

no ramification to this modeling choice since the inflow event cannot exceed the basin storage capacity.

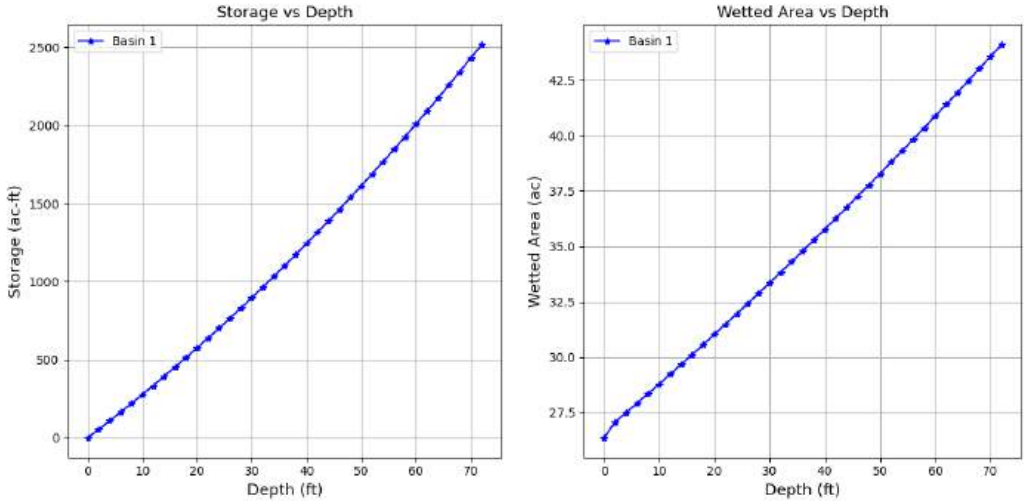


Figure 4a: *Plunge Creek Mined-Conditions Basin Storage vs Depth (left) and Wetted Area vs Depth (right); Water surface area is a proxy for wetted area.*

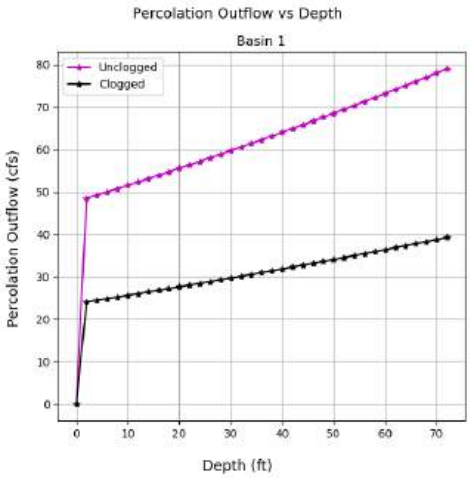


Figure 4b: *Plunge Creek Mined-Conditions Basin Percolation Outflow vs Depth*

Table 3c: *Plunge Creek Mined-Conditions Basin Routing Results (Native Inflow)*

Condition	Max Stage (ft)	Max Storage (ac-ft)	Inflow Volume (ac-ft)	Infiltrated Volume (ac-ft)	Bypass Volume (ac-ft)
Unclogged	1166.1	167.52	3655.5	3655.5	0.0
Clogged	1192.7	989.70	3655.5	3655.5	0.0

Note that the total infiltration for the unclogged and clogged conditions is the full inflow volume of 3655.5 ac-ft since the system as a whole does not allow any bypass.

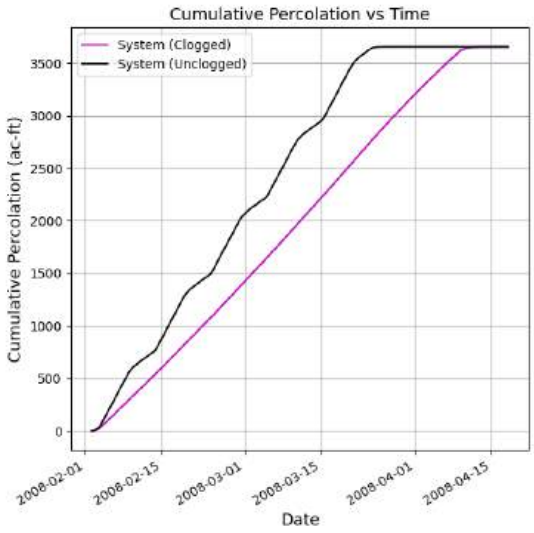


Figure 4c: *Plunge Creek Mined-Conditions Basin Cumulative Percolation (Native Flow)*

References

JLC Engineering & Consulting, Technical Memorandum (PTH TM), “Amendment to Feasibility Study Support Services ARTP Plunge Creek and Oak Creek Diversion and Basin(s)”, October 8, 2024

ADDENDUM OC-4: COST ESTIMATES

OAK CREEK BASINS
FEASIBILITY STUDY WORKING COST ESTIMATE

March 27, 2025
Casc Engineering & Consulting, Project No. 1526-0001

No.	ITEM	QTY	UNIT	UNIT COST	ITEM COST	NOTES
1	MOBILIZATION	1	LS	$1,030,000	$1,030,000	ASSUMED 10% BID ITEM COST
2	CLEAR AND GRUB	21	AC	$1,000	$21,000	
3	REMOVE EXISTING CONCRETE CHANNEL BOTTOM	2	CY	$625	$1,250	UNIT COST FROM CONCRETE REMOVAL FOR RIALTO CHANNEL (RANDALL) AVERAGE - QUANTITY PER CAD
4	EXCAVATION	303,490	CY	$5	$1,517,450	UNIT COST PER SBVWCD DISCUSSION - QUANTITY CALCULATED BY COMPARING PROPOSED GRADING SURFACE TO EXISTING TOPO SURFACE RECEIVED FROM DISTRICT
5	BACKFILL (TYPICAL)	10,565	CY	$12	$126,780	UNIT COST PER SBVWCD DISCUSSION - QUANTITY CALCULATED BY COMPARING PROPOSED GRADING SURFACE TO EXISTING TOPO SURFACE RECEIVED FROM DISTRICT
6	BACKFILL (COMPACTED)	-	CY	$16	$0	UNIT COST PER SBVWCD DISCUSSION
7	EXPORT	292,925	CY	$15	$4,393,875	UNIT COST PER SBVWCD DISCUSSION - DIFFERENCE BETWEEN ITEM 4 AND ITEM 5
8	IMPORT FILL (TYPICAL)	-	CY	$21	$0	UNIT COST PER SBVWCD DISCUSSION
9	IMPORT FILL (COMPACTED)	-	CY	$25	$0	UNIT COST PER SBVWCD DISCUSSION
10	STRUCTURE EXCAVATION	140	CY	$55	$7,700	UNIT COST PER SBVWCD DISCUSSION- QUANTITY PER CAD
11	GRATED DROP STRUCTURE	14	CY	$2,000	$28,000	USING 2024 RCFC&WCD PLANNING COST OF $2000/CY - QUANTITY PER CAD
12	RECT. CONCRETE CHANNEL & WALLS		CY	$1,050	$0	2024 RCFC&WCD PLANNING COST $1044.50/CY INCL. STEEL - QUANTITY PER CAD
13	CONCRETE OUTLET STRUCTURE	-	CY	$2,000	$0	HOUSES RUBICON GATE; USING 2024 RCFC&WCD PLANNING COST OF $2000/CY (transition structure or junction structure) INCL. STEEL - QUANTITY PER CAD
14	FIRO TURNOUT	1	EA	$1,324,150	$1,324,150	PER WOOD-RODGERS (excluding contingency). SEE ATTACHED FOR DETAILED COST.
15	EQUILIZATION RCB	-	EA		$0	
16	OULET STRUCTURE	-	EA		$0	
17	INLET (DIVERSION) STRUCTURE	-	EA		$0	
18	TRASH RACK	-	CY		$0	
19	RETAINING WALLS	-	CY		$0	
20	FLOW METER	1	EA	$45,000	$45,000	COST PER WOOD-RODGERS FIRO. ASSUME SAME FOR STORM FLOW.
21	GREENSPOT SD DIVERSION DROP MH	50	CY	$2,000	$100,000	USING 2024 RCFC&WCD PLANNING COST OF $2,000/CY (transition structure or junction structure) INCL. STEEL-QUANTITY PER CAD
22	CONCRETE JUNCTION STRUCTURE	50	CY	$2,000	$100,000	USING 2024 RCFC&WCD PLANNING COST OF $2000/CY - QUANTITY PER CAD
23	24" RCP	2,210	LF	$348	$769,080	2024 RCFC&WCD PLANNING COST $348/LF WITH HMA- QUANTITY PER CAD
24	CONCRETE HEADWALL & WINGWALLS	12	CY	$2,000	$24,000	USING 2024 RCFC&WCD PLANNING COST OF $2000/CY - QUANTITY PER CAD
25	1/4 TON RIPRAP (NON-CONCRETED)	260	CY	$150	$39,000	2024 RCFC&WCD PLANNING COST $150/CY - QUANTITY PER CAD
26	CONCRETE SPILLWAY	510	CY	$650	$331,500	2024 RCFC&WCD PLANNING COST $650/CY (TRAP CHANNEL CONCRETE) - QUANTITY PER CAD
27	BALLAST ROACK	1	EA		$0	
28	6' CHAIN LINK FENCING	4,000	LF	$58	$232,000	2024 RCFC&WCD PLANNING COST $58/LF - QUANTITY PER CAD.
29	DOUBLE DRIVE GATE	4	EA	$10,000	$40,000	UNIT COST AND QUANTITY PROVIDED BY SBVWCD
30	EROSION CONTROL / SWPPP	1	LS	$150,000	$150,000	UNIT COST PROVIDED BY SBVWCD
31	UTILITIES	1	LS	$500,000	$500,000	UNIT COST PROVIDED BY SBVWCD
32	SCADA	1	LS	$500,000	$500,000	UNIT COST PROVIDED BY SBVWCD
	TOTAL BID ITEMS				$11,280,785	
	CONTINGENCY (30%)				$3,380,000	
	DESIGN and PERMITTING (20%)				$2,260,000	
	HABITAT MITIGATION MEASURES	1	LS	$3,000,000	$3,000,000	
	CONSTRUCTION ADMIN (15%)				$1,692,000	
	TOTAL PROJECT CONSTRUCTION COST				$21,613,000	

FOOTHILL PIPELINE TURNOUT
OPINION OF PROBABLE CONSTRUCTION COST
March 2025

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL AMOUNT
1	Connection to Existing 78-inch Pipe (Cut in Tee)	LS	1	$ 175,000	$ 175,000
2	CML&TWC Welded Steel Water Main (3/8-inch Wall, 30-inch, Reducers, Cathodic Protection)	LF	140	$ 3,000	$ 420,000
3	30-inch Triple Offset Butterfly Valve with Bypass	EA	1	$ 82,500	$ 82,500
4	Energy Dissipating Valve (Mokveld Axial Control Valve)	EA	1	$ 286,650	$ 286,650
5	Cast in Place Concrete (Valve Vault and Thrust Restraint)	CY	65	$ 4,000	$ 260,000
6	24-inch Magnetic Flow Meter	EA	1	$ 45,000	$ 45,000
7	Air Valves, Victaulics, Pipe Supports, Misc Accessories	LS	1	$ 55,000	$ 55,000
8	Headwall, Flapgate, Rip Rap	LS	1	$ 75,000	$ 75,000
9	Electrical (including SCE Service)	LS	1	$ 60,000	$ 60,000
10	Instrumentation and Control	LS	1	$ 40,000	$ 40,000
				TOTAL AMOUNT	**$ 1,324,150**
				Contingency (50%)	**$ 662,075**
				TOTAL	**$ 1,986,225**

ADDENDUM OC-5: PERMITTING TECHNICAL MEMORANDUM

January 27, 2025

Michael J. Gentile, PE, QSD/P
Senior Engineer
Casc Engineering and Consulting
1470 E. Cooley Drive, Colton, CA 92324
mgentile@cascinc.com
909.809.0035

Re: Technical Memorandum: Oak Creek Groundwater Recharge Project CEQA Requirements

Dear Mr. Gentile,

This technical memorandum outlines the anticipated requirements under the California Environmental Quality Act (CEQA) for the Oak Creek Groundwater Recharge Project ("Project"). The Project site is identified as assessor parcel numbers (APN) 121-038-106, -107, -113 located in the City of Highland. This Memorandum provides discussion on the following topic areas:

- Project Site Overview
- CEQA Process Overview
- Key CEQA Considerations for Project
- Agency Permits Requiring CEQA Documentation
- Example of CEQA Schedule

If you have any questions feel free to contact me, I can be reached by phone at (909) 362-7645, or by email at fcoyle@cascinc.com.

Sincerely,

CASC ENGINEERING AND CONSULTING

Frank Coyle
Director of Planning
(909)362-7645
fcoyle@cascinc.com

EXECUTIVE SUMMARY

Based on our preliminary assessment of the existing site conditions, an Initial Study will be required for the Project, which is expected to result in a Mitigated Negative Declaration (IS/MND). This means that with the implementation of mitigation measures, potential impacts will be reduced to a level below significant. Potential impact areas include Air Quality, Biological Resources, Cultural Resources, Greenhouse Gas Emissions, Geology/Soils, Hydrology/Water Quality, Noise, and Tribal Cultural Resources. Furthermore, the Project may require permits from the Santa Ana Regional Water Quality Control Board (RWQCB), the California Department of Fish and Wildlife (CDFW), and the United States Army Corps of Engineers (ACOE). The CEQA process is expected to take approximately 28-32 weeks. Permits that require an approved CEQA document and Notice of Determination (NOD) are anticipated to be obtained within 6 to 12 months following CEQA approval.

PROJECT SITE OVERVIEW

The proposed Project site is currently undeveloped and is located north and south of Greenspot Road and west of Calle Del Rio Street . The Project includes three (3) parcels (APNs: 121-038-106, 107, -113,) located in the City of Highland. Adjacent uses include Oak Creek Channel to the north, single-family residences to the east, and undeveloped land to the south and west. The proposed Project consists of the development of one (1) retention basin (Basin 1), one (1) recharge basin (Basin 2), and one (1) diversion structure to divert storm water from the Oak Creek Channel into the proposed basins, refer to *Figure 1, Site Plan*. Basin 1 is proposed to have a storage capacity of 14.6 acre-feet (ac-ft), and Basin 2 is proposed to have a storage capacity of 78.3 ac-ft.

General Plan Land Use Designation:

APN: 121-038-113: AG/EQ (Agriculture/Equestrian Residential)

APN: 121-038-106: OS (Open Space)

APN: 121-038-107: OS (Open Space)

Zoning Designation:

APN: 121-038-113: Agriculture/Equestrian Residential

APN: 121-038-106: Open Space

APN: 121-038-107: Open Space

The northern portion of the Project site is located in an Open Space Zoning District and the southern portion of the site is located in a Residential Zoning District. The proposed Project is permitted in the Residential and Open Space Districts subject to the approval of a staff review application.

CEQA PROCESS OVERVIEW

Under California law, each public agency must adopt local implementation guidelines to establish objectives, criteria, and specific procedures for administering its responsibilities under the California Environmental Quality Act (CEQA). The CEQA process ensures that potential environmental impacts of a project are identified, analyzed, and mitigated when feasible. The following is a brief summary of the CEQA process:

1. Preliminary Review: The lead agency determines if the activity is a "project" under CEQA. If it is exempt, no further CEQA action is needed.
2. Initial Study (IS): If the project is not exempt, the agency conducts an Initial Study to assess potential environmental impacts.
3. Determination of Impact:
    - If no significant impacts are identified, a Negative Declaration (ND) or Mitigated Negative Declaration (MND) is prepared.
    - If significant impacts are identified, an Environmental Impact Report (EIR) is required.

4. Public Review and Comment:
    - The draft ND, MND, or EIR is circulated for public and agency review (typically 30 days (45 days for EIR)).
    - Comments from the public and agencies are collected and addressed.
5. Final Documentation:
    - For an EIR, a Final EIR is prepared, including responses to comments and any revisions to the draft.
    - The lead agency certifies the EIR or adopts the ND/MND.
6. Decision and Mitigation:
    - The lead agency decides whether to approve or deny the project.
    - If approved, a Mitigation Monitoring and Reporting Program (MMRP) is adopted to ensure mitigation measures are implemented.
7. Post-Approval Actions:
    - Notices of Determination (NOD) are filed, marking the end of the CEQA process and triggering legal timelines for challenges.
8. Statute of Limitations for Appeals:
    - Filling of court challenges to an approved CEQA document is permitted per CEQA Guidelines *Section 15112, Statutes of Limitations*. The statute of limitations for appealing an NOD is 30 days from the date the notice is filed and posted.

Based on a preliminary review of the Project it is anticipated that the Project will require an Initial Study that will culminate in a Mitigated Negative Declaration (IS/MND), thus reducing impacts to a less than significant impact with mitigation incorporated. Actual determination of the most appropriate environmental document will be determined at the time technical studies are completed.

Lead Agency under CEQA

CEQA Guidelines Section 15051 states where two or more public agencies will be involved with a project, the determination of which agency will be the Lead Agency shall be governed by the following criteria:

(a) If the project will be carried out by a public agency, that agency shall be the Lead Agency even if the project would be located within the jurisdiction of another public agency.

Though the Project is located within the City of Highland, the Project would be carried out by the San Bernardino Valley Water Conservation District (WCD). It is anticipated that WCD would be the Lead Agency under CEQA, however, this would be determined during the application process.

KEY CEQA CONSIDERATIONS FOR PROJECT

The following is an overview of key CEQA considerations of the proposed Project based on a preliminary review of the site and surrounding resources.

ASSEMBLY BILL 52 (AB52) TRIBAL CONSULTATION

Assembly Bill 52 (AB52) is a California law enacted in 2014 that amended CEQA to include specific protections for tribal cultural resources. The law enhances collaboration between California Native American tribes and lead agencies during the environmental review process for proposed projects. The following is a brief overview of the AB52 consultation process as it pertains to the proposed Project:

1. Tribal Notification: Within 14 days of determining that a project application is complete, the lead agency must notify California Native American tribes that have requested notification of projects in their area. This typically includes a letter emailed to the Tribal representative.
2. Tribal Request for Consultation: Tribes have 30 days from receiving the notice to request formal consultation with the lead agency.
3. Consultation Process:
    - If a tribe requests consultation, the lead agency must engage in good-faith discussions to identify and address potential impacts on tribal cultural resources.

- Topics may include the identification of resources, project alternatives, mitigation measures, and project modifications to avoid or minimize impacts.

4. Mitigation and Agreements:
   - If tribal cultural resources are identified, the lead agency and tribe collaborate on feasible mitigation measures.
   - Agreements reached during consultation should be documented and included in the environmental document (IS/MND).
5. Documentation and CEQA Compliance:
   - The lead agency must incorporate findings and mitigation measures into the environmental analysis (Tribal Cultural Resources section of the IS/MND).
   - If consultation does not lead to agreement, the lead agency retains discretion but must explain how tribal concerns were addressed.

The results of the AB 52 consultation process will be incorporated into the Tribal Cultural Resources section of the Initial Study and any mitigation measures agreed upon by the Lead Agency and consulting tribe will be incorporated into the Mitigation, Monitoring and Reporting Program.

Technical Studies Anticipated

To accurately analyze environmental impacts of the proposed Project in accordance with CEQA Guidelines Appendix G: Environmental Checklist form (Initial Study), technical studies will be required for the proposed Project. The following is a list of anticipated technical studies that will be required to complete the Initial Study. Standard timeframe for completing technical studies is included in *Table 1: Example of Typical CEQA Schedule*.

- Air Quality Impact Analysis (impacts to sensitive receptors will need to be analyzed due to the single-family residences located adjacent to the Project site).
- Biological Resources Assessment
- Cultural Resources Assessment
- Drainage Study
- Focused Species Surveys - Focused surveys for plants need to be performed during the blooming period for those species and focused surveys for Burrowing Owl will need to be performed during breeding season (Mar-Aug). Focused studies for plants and animals are typically valid for one year.
- Greenhouse Gas Assessment
- Paleontological Resources Assessment
- Riparian/Riverine Assessment
- Jurisdictional Delineation (water features)
- Phase I Environmental Site Assessment
- Noise Analysis Report
- Geotechnical Investigation Report
- Water Quality Management Plan (WQMP)

CEQA Guidelines Appendix G: Environmental Checklist Form

The CEQA Environmental Checklist Form is a tool used to evaluate the potential environmental impacts of a proposed project. It covers various environmental topics, such as air quality, biological resources, water quality, and cultural resources, to ensure a comprehensive assessment. Each topic includes specific questions to determine whether the project may have significant environmental effects. The checklist helps guide the preparation of an Initial Study and supports decision-making on whether a Negative Declaration, Mitigated Negative Declaration, or Environmental Impact Report (EIR) is required. The following is a brief analysis of the proposed Project's potential environmental impacts under CEQA.

AESTHETICS

The Project site does not contain any scenic resources, and the nearest State designated scenic highway is a portion of State Route 38 located approximately 19 miles northeast of the Project site. No impact is expected to occur.

AGRICULTURAL AND FORESTRY RESOURCES
According to the California Important Farmland Finder (FMMP) the Project site is identified as "Grazing Land". The Project site does not contain any agriculture or forestry resources, and no impact is expected to occur.

AIR QUALITY
The Project's potential impacts on air quality will be assessed utilizing a project specific Air Quality Impact Analysis and the South Coast Air Quality Management District (SCAQMD) 2022 Air Quality Management Plan. Single-family residences located east of the Project site are considered sensitive receptors to pollutants, and potential impacts on these receptors should be evaluated in the Air Quality Impact Analysis. Less than significant impacts to air quality are anticipated during the construction phase of the Project due to the use of construction equipment. No impacts to air quality are anticipated during the operational phase of the Project.

BIOLOGICAL RESOURCES
Potential impacts to biological resources are expected to be less than significant with the incorporation of mitigation measures. The site, currently undeveloped, is identified as a "Natural Community" in the City of Highland General Plan. The southern portion of the site is located in the Santa Ana River Wash Habitat Conservation Plan however it is not located within the preserve assembly. A Biological Resources Assessment will be required to evaluate the potential presence of special-status plant and animal species onsite. According to the National Wetlands Inventory Mapper, a blue-lined stream runs through the southern portion of the site and is classified as R4SBC Riverine Habitat, thus it is likely a Jurisdictional Delineation may also be required to assess potential impacts to water features regulated by the Santa Ana Regional Water Quality Control Board (RWQCB), California Department of Fish and Wildlife (CDFW), and U.S. Army Corps of Engineers (ACOE) if located onsite. Recommendations from these technical studies will be incorporated as mitigation measures into the Mitigation Monitoring and Reporting Program (MMRP) for the IS/MND.

CULTURAL RESOURCES
The Project site is identified as "areas of sensitivity for archeological resources" under the Highland General Plan. Further evaluation of potential impacts on cultural and historical resources will be required utilizing a Project specific Cultural Resources Assessment in addition to the results of AB52 tribal consultation.

ENERGY
Construction of the Project would result in fuel consumption from construction tools and equipment, vendor and haul truck trips, and vehicle trips generated by construction workers traveling to and from the site. Construction activities and corresponding fuel energy consumption would be temporary and localized. The use of diesel fuel and heavy-duty equipment would not be a typical condition of the Project. There are no unusual Project characteristics that would cause construction equipment to be less energy efficient compared with other similar construction sites in other parts of the State. Impacts are anticipated to be less than significant.

GEOLOGY/SOILS
The Project site is not located on or near a seismic fault and is not prone to landslides due to its relatively flat topography. The site lies within the Seven Oaks Dam inundation area and is identified as having high liquefaction susceptibility in the City of Highland General Plan. The potential for significant geological or soil-related impacts, including soil suitability for basin construction, will be further evaluated through a Project-specific Geotechnical Investigation. Impacts are expected to be less than significant with the implementation of recommendations from the Geotechnical Investigation.

GREENHOUSE GAS EMISSIONS
Less than significant impacts to greenhouse gas emissions are anticipated during the construction phase of the Project due to the use of construction equipment. No impacts to greenhouse gas emissions are anticipated during the operation phase of the Project. A Greenhouse Gas Assessment would further quantify emissions to substantiate CEQA analysis.

HYDROLOGY/WATER QUALITY

The Project site is located within a 100-year floodplain (Zones A, AE, AO). Potential impacts on hydrology and water quality under CEQA will be evaluated through a Project-specific Drainage Study and Water Quality Management Plan (WQMP). The analysis will examine whether the Project could lead to increased runoff, water quality degradation, or changes to drainage patterns. Compliance with stormwater management regulations, including the implementation of best management practices (BMPs), will also be assessed. Impacts are expected to be less than significant.

HAZARDS AND HAZRDOUS MATERIALS

Given the site is undeveloped and surrounding residential uses, the potential for recognized environmental conditions (RECs) is considered low. Utilizing a Project specific Phase I ESA and the Department of Toxic Substance Control Cortese List, the Project will be further evaluated for the presence of hazardous materials. This includes an assessment of any contamination, such as hazardous waste or underground storage tanks that could pose a risk to human health or the environment. Any recommendations in the Phase I ESA would be incorporated into the MMRP of the IS/MND.

LAND USE/ PLANNING

The Project is consistent with the Open Space and Agriculture/Equestrian Residential land use designations of the subject to staff review of the permit application. No impacts are anticipated.

MINERAL RESOURCES

The Project site is classified as MRZ-2 and MRZ-3, indicating the likely presence of significant PCC-grade aggregate resources based on geologic data. While the site likely contains mineral resources acknowledged by the State, it is not currently used for mineral extraction. Potential impacts are expected to be less than significant.

NOISE

The Project's potential to generate noise affecting surrounding land uses would primarily occur during the construction phase. A Noise Impact Analysis should be conducted to quantify construction-related noise and assess whether it exceeds jurisdictional thresholds for sensitive receptors located adjacent to the site.

POLULATION/HOUSING

The Project would not induce population growth, nor does it include housing. No impacts are anticipated.

PUBLIC SERVICES AND RECREATION

Though the Project is designated as Open Space and Agriculture/Equestrian Residential, it does not contain any recreational facilities. Furthermore, the Project would not impact public services such as fire, police, schools or libraries as the Project does not include a use that would increase population at the site. No impacts are anticipated.

UTILITIES AND SERVICE SYSTEMS

The Project is the expansion of stormwater facilities to divert stormwater from the Oak Creek channel into the proposed recharge basins. The Project would not generate a demand for service systems and the expansion of storm water facilities is anticipated to result in less than significant impacts with mitigation incorporated as indicated in the MMRP for the Project.

TRANSPORTATION

Traffic generated by the Project would occur during the construction phase and during operations due to routine maintenance trips to the site. These trips are anticipated to be negligible, and the Project is anticipated to screen out of Vehicle Miles Travelled (VMT) analysis. Impacts are anticipated to be less than significant.

TRIBAL CULTURAL RESOURCES

The results of the AB52 consultation process would determine any impacts to Tribal Cultural Resources (TCR). Given the stie is not identified in a General Plan (Redlands and Highland) as having TCR's, impacts are anticipated to be less than significant with mitigation incorporated in the event of inadvertent discoveries.

WILDFIRE

North of Greenspot Road is located in a "Very High Wildfire Hazard Severity Zone" for fire hazards. Access to the site must adhere to fire code standards to ensure emergency vehicles are able to access the site. As the site would not include the construction of structures nor would it induce population growth at the site, impacts are anticipated to be less than significant.

AGENCY PERMITS REQUIRING CEQA DOCUMENTATION

Once a Notice of Determination (NOD) is adopted under CEQA, other agencies whose approval is required for the project (Responsible Agencies) use the certified environmental document (e.g., EIR or IS/MND) prepared by the lead agency to fulfill their CEQA obligations. These agencies evaluate the document to ensure their jurisdictional concerns are addressed and rely on it when issuing permits or approvals, such as those related to water quality, wetlands, or endangered species. Coordination between the lead and responsible agencies helps streamline the process, ensuring compliance with CEQA and other applicable regulations.

A preliminary review of the site and surrounding resources indicates potential impacts to biological resources and jurisdictional water features. If confirmed by a Jurisdictional Delineation and Biological Resources Assessment, approvals from state and federal agencies will be necessary before grading permits can be issued. Below is a summary of the relevant agencies that would require an NOD/approved CEQA document, the permits likely required, and the estimated timeframe for obtaining them.

Santa Ana Regional Water Quality Control Board (RWQCB) – 401 Water Quality Certification

A 401 Water Quality Certification is required under the Clean Water Act for projects that may result in discharges into waters of the United States, including wetlands and other jurisdictional features. Issued by the Santa Ana Regional Water Quality Control Board (RWQCB), the certification ensures that the project complies with state water quality standards and does not adversely impact water resources. If it is determined that water features under the RWQCB will be impacted by the proposed Project, a 401 Water Quality Certification will be required from the RWQCB pursuant to Section 401 of the Clean Water Act.

The certification process typically involves submitting a detailed application, including a project description, maps, and an analysis of potential impacts on water quality. The RWQCB reviews the application to confirm compliance with state and federal water quality regulations. The process may also require mitigation measures to offset impacts. The timeframe for obtaining a 401 certification varies but generally ranges from 3 to 12 months, depending on project complexity and the completeness of the application. Coordination with other regulatory agencies, such as the U.S. Army Corps of Engineers, is often required. Once the CEQA document is approved it typically takes 3-6 months to receive 401 Certification.

United States Army Corps of Engineers (ACOE) – 404 Permit

A 404 Permit, issued by the U.S. Army Corps of Engineers (ACOE) under Section 404 of the Clean Water Act, is required for projects that involve the discharge of dredged or fill material into waters of the United States, including wetlands, rivers, and streams. This permit ensures that such activities minimize environmental impacts and comply with federal environmental regulations. If it is determined that water features under the ACOE jurisdiction will be impacted by the proposed Project, a 401 Water Quality Certification will be required from the RWQCB pursuant to Section 401 of the Clean Water Act.

The permit process includes submitting an application with project details, public review for Individual Permits, environmental evaluation, and mitigation for unavoidable impacts. Once the CEQA document is approved it can take from 6-12 months to receive a 404 Permit.

California Department of Fish and Wildlife (CDFW) – Streambed Alteration Agreement & Incidental Take Permit

A Streambed Alteration Agreement (SAA) is required under Section 1600 of the California Fish and Game Code for projects that may impact rivers, streams, or lakes, including their beds, banks, and associated riparian vegetation. The agreement, issued by the California Department of Fish and Wildlife (CDFW), ensures that potential impacts to fish and wildlife resources are mitigated. If it is determined in a Jurisdictional Delineation that impacts would occur to water and habitat resources under the jurisdiction of CDFW, then WCD must submit a Notification of Lake or

Streambed Alteration, detailing project activities and potential environmental effects to CDFW. CDFW then evaluates the application, conducts site visits if necessary, and negotiates mitigation measures to avoid or minimize impacts. Processing time varies, but agreements are typically finalized within 60 to 120 days. The time it takes to obtain a SAA from CDFW after the CEQA document is approved typically ranges from 3 to 6 months. However, this timeline can vary depending on several factors, including the complexity of the project, the specifics of the stream or waterway being impacted, and the completeness of the application.

An Incidental Take Permit (ITP) from CDFW is required under the California Endangered Species Act (CESA) when a project is expected to result in the incidental take (harm or death) of a state-listed endangered, threatened, or candidate species during the course of development or land use activities. A Biological Resources Assessment would determine the potential for special-status species on the Project site. The time it takes to receive an ITP can vary significantly depending on several factors, including the complexity of the project and the species involved. Estimated timeframes can be from 6 to 12 months plus. After CEQA approval, it generally takes about 3 to 6 months to receive an Incidental Take Permit (ITP) from CDFW, assuming that the application is complete and no significant revisions or additional information are needed.

EXAMPLE CEQA SCHEDULE

The following schedule outlines a typical timeline for completing the various stages of the CEQA process, including preparing technical studies, the Initial Study, public review periods, preparation of environmental documents (such as a Draft EIR or Negative Declaration), and final approval. This helps all stakeholders understand the expected sequence of events and deadlines.

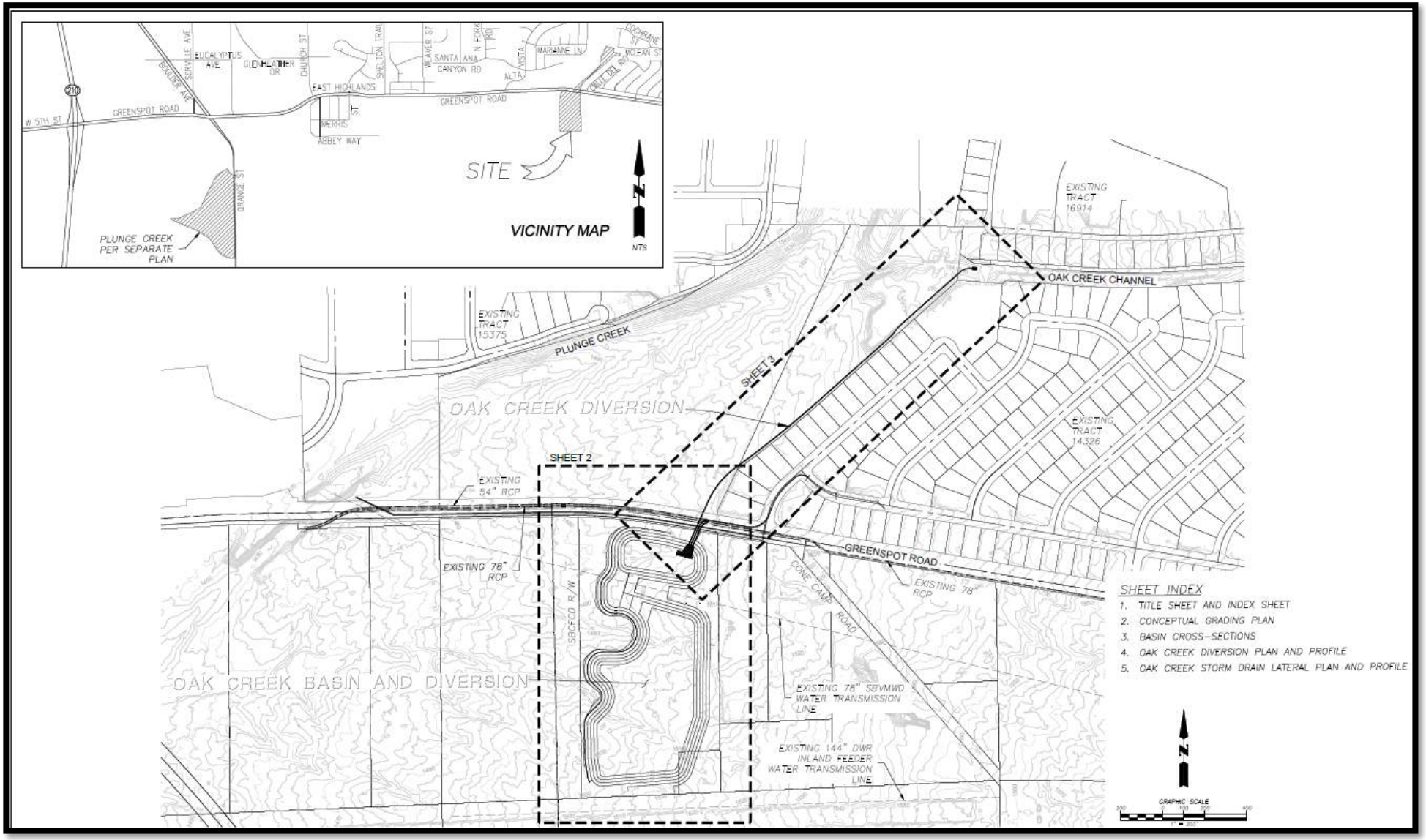
Table 1: Example of Typical CEQA Schedule

TASK	DESCRIPTION	START DATE	END DATE
1.	PROJECT INITIATION	Week 1	Week 1
2.	PROJECT DESCRIPTION	Week 1	Week 2
3.	PREPARE TECHNICAL STUDIES	Week 2	Week 8
4.	GIS Exhibits For IS/ND or MND, MMRP	Week 2	Week 4
5.	PREPARE IS/ND or MND, MMRP	-	-
5A.	Prepare 1st Screencheck IS/ND or MND, MMRP *(Agency Review: Week 10-13)*	Week 3	Week 10
5B.	Prepare 2nd Screencheck IS/ND or MND, MMRP *(Agency Review: Weeks 17-18)*	Week 14	Week 16
6.	PREPARE PROOF CHECK DRAFT IS/ND or MND, MMRP	Week 19	Week 20
7.	CIRCULATION OF DRAFT IS/ND OR MND, MMRP *(30-Day Review Period)*	Week 21	Week 25
8.	PREPARE RESPONSES TO COMMENTS *(County Review: Week 26)*	Week 25	Week 26
9.	PUBLIC HEARING (typically occurs two – four weeks after the completion of the 30-day review period)	Week 28	Week 32

REFERENCES

1. 2024 CEQA Statute and Guidelines 2024 CEQA Statutes and Guidelines
2. California State Scenic Highways Viewer California State Scenic Highway System Map
3. California Department of Conservation California Important Farmland Finder DLRP Important Farmland Finder
4. City of Highland General Plan-General Plan | Highland, CA
    a. Land Use Element
    b. Conservation and Open Space Element
5. City of Highland Municipal Code Chapter 16.28 OPEN SPACE DISTRICTS
6. San Bernardino County Countywide Plan- Policy Plan – San Bernardino County
7. San Bernardino Valley Water Conservation District, The Upper Santa Ana River Habitat Conservation Plan- 2024_Wash_Plan_Annual_Report_11.01.2024.pdf
8. San Bernardino Valley Municipal Water District Divisions - San Bernardino Valley Municipal Water District Divisions | San Bernardino County
9. San Bernardino Land Use Services-Planning_Project_Review_Flowchart_VERTICAL.pdf
10. California State Water Boards, San Bernardino County MS4 Permit- Stormwater | Santa Ana Regional Water Quality Control Board
11. San Bernardino County EZ Online Permitting Is My Parcel in the County? – EZ Online Permitting
12. City of Highland Community Viewer- Highland Community Viewer - Experience Builder
13. East Valley Water District- District Map | East Valley Water District, CA - Official Website
14. U.S. Fish and Wildlife Service National Wetlands Inventory Mapper National Wetlands Inventory

Figure 1: Site Plan



ADDENDUM OC-6: FIRO TURNOUT TECHNICAL MEMORANDUM

Technical Memorandum

WOOD RODGERS

To: Michael J. Gentile, PE, QSD/P
Senior Engineer
Casc Engineering and Consulting

From: Kevin Gustorf, P.E.
Alia Meier, P.E.
Wood Rodgers

Date: March 26, 2025

Subject: Foothill Pipeline Turnout and Flow Control Facility – Feasibility Study

---

1. EXISTING CONDITIONS

An alternative water supply for basin recharge is the adjacent Foothill Pipeline, owned by the San Bernadino Valley Municipal Water District (SBVMWD). The Foothill Pipeline is a 78-inch diameter cement mortar lined and tape wrap with cement mortar coating (CML&TWMC) welded steel pipe, conveying raw water. The existing pipe has a wall thickness of 3/8 of an inch. The operating pressure in the pipeline varies, however at the proposed project location, the pipeline is rated for 450 feet of head, or roughly 200 psi. As there is no turnout nor an existing outlet near the proposed recharge basins, the concept design for a new turnout and flow control facility is explored herein.

2. CONCEPT DESIGN CONSIDERATIONS

The following assumptions have been used to develop a concept plan along with the opinion of probable construction cost (OPCC):

- **Standards:** Design standards and approved materials list for SBVMWD were not readily available during the development of the conceptual design. It is recommended to request these documents prior to the next design phase to ensure the preferences and standards of SBVMWD are met.
- **Ownership**: Easements, property lines, etc. have not been shown on the conceptual plan nor included in the OPCC. The stakeholders will need to coordinate whom will own and be responsible for maintenance of the turnout. There is an existing 50-ft wide easement along the Foothill Pipeline, and a temporary construction easement may be required.
- **Connection to Existing Pipe:** The Foothill Pipeline can be taken out of service and drained to construct a new turnout. It is assumed SBVMWD will take the Foothill Pipeline offline and drain the pipeline (no costs involving draining, discharge, etc. are included in the OPCC). The connection is currently shown as a cut in tee, however, alternative and less costly connections may be considered in the subsequent phases of design.
- **Pipeline Considerations:**
    - **Sizing**: The turnout facility and new pipeline have been sized to deliver a continuous flowrate of 35 cubic feet per second (cfs). Acceptable industry values for velocities in cement mortar lined steel pipe are 8 feet per second (fps) for long term use and 12 fps for short term use. A 30-inch diameter pipe will have a velocity of 7.13 fps and is therefore the selected size based on the current flow rate.
    - **Pressure**: As noted above, working pressure of the pipeline is approximately 200 psi; the design pressure for this concept development will therefore be 250 psi.

  - **Material**: The new piping is assumed to be the same material, lining, coating, and steel cylinder thickness as the existing pipe. Wall thickness may be refined during design phase. Cathodic protection will need to be considered for the metallic piping. In addition, the piping following the energy dissipating valve is under significantly lower pressure than the mainline; therefore it may be advantageous to consider alternative pipe materials to reduce project costs.

- **Security / Valve Vault**: The flow control facility components of the turnout connection will be placed in a secure, person-accessible cast-in-place concrete vault (rated for H-20 loading). Equipment access will be provided via removable concrete panels, personnel access will be provided via a spring-loaded hatch with an interior ladder. The vault will include other ancillary features including vents, a sump pump, concrete thrust restraints, and other appurtenances to provide functionality of this buried structure.
  - A potentially cost-saving alternative would be to eliminate buried vault(s) and place piping above grade. Security fencing would be required but would be significantly less in cost in comparison to the large, buried, cast-in-place concrete vault.
- **Electrical, Instrumentation & Control**: The vault will require low voltage power and telemetry for lighting, an actuated valve, control, flow metering, data logging, and communication.
  - Actuation for the energy dissipating valve can become costly, depending on the selected mode; basic electrical actuation is assumed for the purpose of this feasibility study.
  - A new service with SCE will need to be established.
  - Currently, a telemetry antenna is shown on the conceptual plan.
  - Input on control and data preferences will be solicited from the owner during the next design phase.
- **Appurtenances:**
  - **Flowmeter**: A magnetic flow meter is shown currently; however, a venturi meter could be suitable for this application and may even be preferred by the owner. Magnetic flow meters are known to require more labor during calibration whereas venturi meters require less labor to setup and for long term maintenance.
  - **Energy Dissipating Valve**: There are many energy dissipating valves available in the current market, but not all are suitable for this application. As such, a high-level comparison is provided in **Table 1**. An axial control valve (Mokveld) is the recommended valve type primarily due to its effective design, compact lay length, and relatively low cost.
  - Minor mechanical appurtenances along with electrical and supervisory control and data acquisition (SCADA) devices are not shown in the concept plan but will be required once the design progresses.

Table 1: Energy Dissipating Valve Comparison

Type	Notes	Lead Time	Budgetary Costs[1]
Sleeve Valve **Pratt** **Model No. 30-20-30**	Axial Flow Multijet. Water jets strike themselves in the center rather than on valve walls (preventing damage). Does not eliminate cavitation completely. Maintenance can be performed while valve is in line. 10 x Diameter upstream/downstream straight length required.	50 weeks	$320,000
Axial Control Valve **Mokveld** **20"**	Custom design. Water enters cage to dissipate energy. Complete elimination of downstream cavitation, compact, easy to actuate. Cage material can be selected to combat wear and tear or harsh conditions. 2 x Diameter upstream/downstream straight length required.	*Lead time not yet provided. Shipped from Netherlands, assume 50 weeks.*	$200,000
Plunger Valve	Limited in anti-cavitation designs	*Not pursued*	*Not pursued*
Globe Valve **ClaVal** **Model No. 100-01**	Need two in series with KO trim and would still need to consider reducing residual pressure	*Not pursued*	$95,000 Each (two required)

[1]*Includes cost of valve and freight, does not include contractor markup or installation*

Equipment lead times are important to understand for project planning purposes; Table 2 provides estimates of lead times for major equipment based upon manufacturer input and recent projects.

Table 2: Major Equipment Lead Times

Component	Lead Time
Sleeve Valve	50 weeks
Axial Control Valve	*Not yet provided, assumed 50 weeks*
Triple Offset Butterfly Valve	22 weeks
Magnetic Flow Meter	20 weeks
SCE Electrical Service	52 weeks
Steel Pipe	30 weeks (following lay drawing acceptance)

Exhibit 1: Foothill Turnout Concept Plan depicts the concept design as described herein.

3. OPINION OF PROBABLE CONSTRUCTION COST

An OPCC has been developed for this feasibility study, and the estimate includes input received from manufacturers contacted during the preparation of this concept.

Note, due to the stage of design and associated unknowns, a 50% contingency has been applied to the total amount.

Table 3: Opinion of Probable Construction Cost

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
1	Connection to Existing 78-inch Pipe (Cut in Tee)	LS	1	$ 175,000	$ 175,000
2	CML&TWC Welded Steel Water Main (3/8-inch Wall, 30-inch, Reducers, Cathodic Protection)	LF	140	$ 3,000	$ 420,000
3	30-inch Triple Offset Butterfly Valve with Bypass	EA	1	$ 82,500	$ 82,500
4	Energy Dissipating Valve (Mokveld Axial Control Valve)	EA	1	$ 286,650	$ 286,650
5	Cast in Place Concrete (Valve Vault and Thrust Restraint)	CY	65	$ 4,000	$ 260,000
6	24-inch Magnetic Flow Meter	EA	1	$ 45,000	$ 45,000
7	Air Valves, Victaulics, Pipe Supports, Misc Accessories	LS	1	$ 55,000	$ 55,000
8	Headwall, Flapgate, Rip Rap	LS	1	$ 75,000	$ 75,000
9	Electrical (including SCE Service)	LS	1	$ 60,000	$ 60,000
10	Instrumentation and Control	LS	1	$ 40,000	$ 40,000
				SUBTOTAL	$1,324,150
				Contingency (50%)	$662,075
				TOTAL	$1,986,225

Should this concept be determined as a desirable option for discharge to the basins, the next step would be to solicit input from the stakeholders to ensure the turnout and flow control facility design incorporates owner preferences and requirements.

Appendix B

Preliminary Design Report of Plunge Creek Interim Conditions PERC Project Alternative

San Bernardino Valley Water Conservation District
Program for Expansion of Recharge Capacity (PERC) Comprehensive Feasibility Study

Volume 3
Detailed Feasibility Analysis of PERC Project Alternatives for Plunge Creek Watershed

Preliminary Design Report

Plunge Creek Groundwater Recharge

Interim Project

Prepared for:

San Bernardino Valley Water Conservation District
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Prepared by:

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_____

Michael J. Gentile, PE

April 2025

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Addendum PCI-2: Gage Data Analysis

Addendum PCI-3: Basin Routing

Addendum PCI-4: Total Suspended Solids Memorandum

Addendum PCI-5: Cost Estimates

Addendum PCI-6: Permitting Technical Memorandum

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1 INTRODUCTION

Casc Engineering and Consulting, Inc. (Casc) is under contract with San Bernardino Valley Water Conservation District (District) to provide support services for the preparation of a Feasibility Study (by the District) for a proposed groundwater recharge basin at Plunge Creek. The proposed project would divert stormwater runoff from Plunge Creek Channel west of Orange Street into a proposed recharge basin system south of the proposed diversion.

The proposed recharge basin system described in this report is the Interim Project as labeled by the District. Another project being considered by the District at the same location is the Ultimate Project, which is described in a separate report.

1.1 PURPOSE

The purpose of this report is to summarize the information gained from the various studies conducted under this contract. The detailed technical studies are listed as references at the end of this report. Additional details and memoranda that are not part of formal detailed technical studies are in the Addenda of this summary report.

Questions to be answered in this report include:

- How much stormwater runoff to divert in terms of peak flow and volume?
- What are the proposed designs for the diversions?
- What is the proposed capacity of the Plunge Creek Interim Project basin system?
- What are the expected permitting requirements for the project?
- What is the conceptual estimated cost to construct the project?
- What is the extent of expected groundwater mounding if the project becomes operational?

2 PROJECT DESCRIPTION

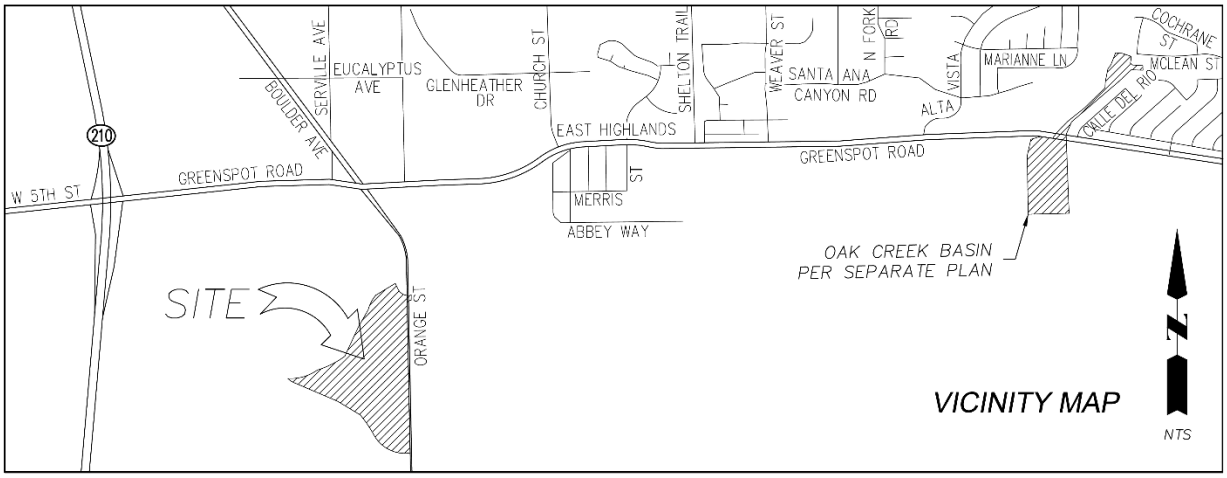


Figure 2-1: Project Location

2.1 EXISTING CONDITIONS

The proposed basin site is an approximately eighty (80) acre parcel located west of Orange Avenue and south of Plunge Creek, owned by the US Government, Bureau of Land Management. Ground surface elevations range from 1290' above mean sea level to 1230'. The slope is generally from east to west with an approximate grade of 2%. The site is cris-crossed by dirt roads, dotted with various dirt mounds, and includes a large silt pond that is approximately 50' deep serving the adjacent cement operation.

Plunge Creek is north of the site and flows from east to west. East of Orange Avenue, Plunge Creek is an unimproved stream bed that is periodically maintained by the San Bernardino County Flood Control District. At the Orange Street bridge the creek becomes a concrete rectangular channel. Approximately one hundred feet (100') downstream of the bridge, the rectangular channel drops approximately fifty feet through a spillway that is eighty-one feet (81') wide and approximately one hundred and forty feet (140') long to a grouted riprap apron that widens the channel to one hundred seventy feet (170') at its downstream end. The as-built plans for the spillway show a design flow rate of 13,000 cfs.

From the end of the apron, the creek resumes as an unimproved channel westerly until its confluence with City Creek approximately one and a half miles downstream.

2.1.1 Existing Condition 100-Year Floodplain

JLC Engineering & Consulting, Inc. developed a HEC-RAS model of the existing condition 100-year floodplain for Plunge Creek, as described in their report: Hydrology & Hydraulic Report for Plunge Creek, dated May 25, 2023 (JLC 2023). The JLC model substantially conformed with prior modeling done by West Consultants in 2009 for their approved report: San Bernardino County FEMA Levee Certification Non-Federal Levees – Phase II Hydraulic Report (West, 2009). The model showed flooding at Orange Street under current conditions (81'-wide channel at Orange Street).

2.2 Future Conditions – Basis of Design

The existing Plunge Creek channel is 81' wide, but it is likely that it will be wider by the time the Plunge Creek Interim Project is constructed. The City of Highland is currently preparing plans to widen the Orange Avenue bridge. As part of the proposed design, Plunge Creek channel would be widened to one hundred ninety-two feet (192') downstream of the bridge. The future rectangular channel would include side walls that are twelve feet (12') high. The hydraulic design for this project is expected to convey the 100-year peak flow without flooding, thereby protecting the proposed basins from the 100-year floodplain. The preliminary hydraulic studies are described in the Structure Type Selection Report: Orange Street Bridge over Plunge Creek Overflow, prepared by IDC Consulting Engineers, November 2020 (IDC 2020).

Casc received a conceptual plan, profile, and section from the City of Highland to use as the basis of design for the proposed Plunge Creek diversion structures. The exhibits in Addendum PCI-1 show the future channel plan as the de facto condition at the time of construction.

2.3 Proposed Project

The Plunge Creek Groundwater Recharge Interim Project consists of three recharge basins, a diversion from Plunge Creek, and a storm drain system to convey diverted runoff to the proposed basins. Two diversion alternatives are being considered – a pneumatically operated gate, or a grated drop structure. The project features are described below.

2.3.1 Recharge Basins

The proposed layout consists of three basins. Runoff would be diverted from Plunge Creek into either upstream basin (Basin 1 or Basin 2). Overflow from these basins would spill into the downstream basin (Basin 3) via proposed spillways. Basin 3 would have an overflow spillway that would discharge excess runoff to the Santa Ana River.

Preliminary basin grading for the Interim Project is shown in Addendum PCI-1. The conceptual grading assumes side slopes at 2:1 (horizontal to vertical) with 20'-wide access roads.

Table 2-1: Plunge Creek Basin Data

Basin Nam	Bottom Elevation	Top Elevation	Spillway Elevation	Bottom Area (Acres)	Storage Volume (Acre-Ft)
Basin 1	1254	1270	1266	0.95	14.9
Basin 2	1254	1266	1262	1.37	13.1
Basin 3	1244	1260	1258	1.95	99.7

2.3.2 Plunge Creek Diversion – Alternative 1 – Pneumatically Operated Gate

Alternative 1 for diversion from Plunge Creek is a pneumatically operated gate. The proposed pneumatically operated gate would be a metal gate that is raised and lowered by inflating a bladder directly behind the gate panels. The system would be located within Plunge Creek Channel, recessed below the invert of the channel.

Casc contacted Obermeyer Hydro, Inc., for assistance with the preliminary design. A section drawing of the preliminary design is in Addendum PCI-1. The proposed gate would span the width of the channel and be eight feet (8') high when fully raised, measured from the invert of the channel. Obermeyer Hydro described the control systems as including one or two air compressors (depending on redundancy needs), dryers, an air tank, mechanical control panel, and programmable logic controller (PLC) cabinet. The system components would either be housed in a small building or outdoor rated cabinet depending on the size of the components.

When the gate is raised, impounded water would be diverted through a 6'-wide by 5'-high opening in the south channel wall into a proposed outlet structure that houses a flume gate (Rubicon FGB-6-4.5 or equal) and is connected to a 48" RCP outlet pipe. The invert of the opening would be three feet (3') above the invert of the channel, allowing the gate to operate in free-flow conditions, and allowing sediments and debris to settle in the channel while the comparatively cleaner runoff at the top of the water column is diverted. Accumulated sediments in the channel would then be flushed out when the gate is lowered during high flow events.

2.3.3 Plunge Creek Diversion – Alternative 2 – Grated Drop Structure

Alternative 2 for diversion from Plunge Creek is a grated drop structure (FHWA HEC-14, Chapter 11, Drop Structures, Section 11.1.2. Grate Design). The proposed diversion structure would be sized to intercept up to 145 cfs from Plunge Creek and convey it to Basins 1 and 2. Hydraulic details for the design of the grated drop structure are in Section 5.

The grated drop structure would have a sloped invert to carry the intercepted runoff to the outlet structure. In contrast with Alternative 1, the proposed opening in the wall for this alternative would be 6'-wide by 7.2' high for the larger flume gate (Rubicon FGB-6-7.2) due to the submerged flow condition downstream. The outlet is submerged in this alternative because the invert of the wall opening is twelve feet (12') lower than the wall opening in Alternative 1.

2.3.4 Storm Drain and Junction Box

The preliminary design includes 48" RCP storm drains to convey runoff from the diversion to Basins 1 and 2. A single storm drain would carry diverted stormwater to a junction box that has two outlet pipes, each with a slide gate to control flows. The junction box would allow one basin to remain operational while the other is maintained.

2.4 Potential Floodplain Impact

The proposed project is not expected to have material effects on the 100-year floodplain, subject to review by the San Bernardino County Flood Control District. The main reason for this expectation is that the design of the proposed diversion structure does not alter the invert or geometrics of the future Plunge Creek channel downstream of the proposed Orange Street bridge improvements. Both diversion designs are configured to allow flood flows above 145 cfs to continue unabated through the channel. While there may be minor losses involved, it is not expected that these would materially increase the water level in the channel during a 100-year event beyond the capacity of the future improvements. Detailed studies and review by San Bernardino County Flood Control District are to be part of the next phase of development for the Plunge Creek projects.

3 HYDROLOGY – GAGE DATA ANALYSIS

3.1 METHODOLOGY

An analysis of the 35-year record from Stream Gage Data from Upper Plunge Creek gage 110555000 (water year 1989 through part of water year 2024) detected 187 distinct storm events for that time frame. These storm events were then scaled for the ungaged watersheds by overlaying the PRISM 30-year normal data over all four watersheds (gaged Plunge Creek, ungaged Oak Creek, Greenspot Storm Drain, and Elder Creek. Reduction Factors for each watershed were then calculated as the product of the watershed area and the weighted precipitation average. The Reduction Factors shown in Table 3-1:

Table 3-1: Calculated Watershed Ratios

Subbasin	Area (Ac)	Precipitation (inches)	Product (ac-ft)	Reduction Factor
Elder Creek	3,082	14.19	3,645	0.164
Oak Creek	1,527	16.34	2,079	0.094
Plunge Creek	10,974	24.26	22,185	1.000
Storm Drain	547	13.46	613	0.028

3.2 DESIGN STORM DETERMINATION

A Log Pearson Type 3 distribution was applied to the adjusted set of storm flow events to determine 50th, 80th, and 90th percentile peak flow rates. The results of this distribution produced the percentile peak flow rates shown in Table 3-2:

Table 3-2: Percentile Peak Flow Rates

Flow Data Source/Combination	50th Percentile Peak Flow Rate (cfs)	80th Percentile Peak Flow Rate (cfs)	90th Percentile Peak Flow Rate (cfs)
Oak Creek	11.0	27.6	47.7
Storm Drain	3.3	8.2	14.2
Plunge + Elder	135.7	342.0	590.4
Plunge + Elder + Oak	146.6	369.6	638.1

After discussion with the District, it was determined that the 50th percentile peak flow rate would be used for design. One of the storm events in the gage data, Event 121, had a peak flow rate that was a very close match to the 50th percentile peak flow rate shown in Table 3-2 for Oak Creek. Event 121 was selected as the model hydrograph to use for design, i.e. the project typical hydrograph (PTH).

The PTH was then scaled up for the combined Plunge+Elder+Oak watershed. The resulting hydrograph was used to develop the inflow event for Plunge Creek basin routing (see Section 5) and for the hydraulic design of the project elements.

The analysis of the gage data and the typical hydrograph development may be found in the technical memos in Addendum PCI-2.

4 GEOTECHNICAL

4.1 INVESTIGATION SUMMARY

LOR Geotechnical conducted a geotechnical investigation near the Plunge Creek site, as described in their report: Alternate Preliminary Infiltration Feasibility Investigation Plunge Creek Basin, Highland/Redlands, California, Project 63913B.4, May 31, 2023 (5th Draft), Final Date: January 8, 2025 [LOR 63913B.4]. The Plunge Creek site itself was inaccessible at the time of the investigation. The investigation scope of services included:

- Excavation of total of four (4) exploratory trenches with a track-mounted mini excavator. Two trenches were excavated at the Cemex site, and two were excavated at the Robertson's site. Trench depths were between 5 feet and 8.5 feet below existing ground surface.
- One single-ring infiltrometer test taken at the Cemex site
- Three double-ring infiltration tests: two at the Robertson's site, and one at the Cemex site
- In-place density testing at the Cemex site
- Sieve analysis
- Testing for measurement of hydraulic conductivity of coarse grained soils (ASTM D2434)

Figure 4-1: Plunge Creek Basin geotechnical investigation map from Project 63913B.4.

The Cemex site investigation took place on February 17, 2023, and was revisited on April 28, 2023, to collect bulk samples and conduct in-place density tests. The Robertson's site investigation took place on March 9, 2023.

4.2 Site Soils

The investigation report described the site as being "underlain by young alluvial soil materials. The alluvial materials were noted to consist of units ranging from silty sand with gravel, cobbles, and boulders to well graded gravel with sand, cobbles, and boulders. The native units in the quarries varied from light brown to brown in color, were generally wet, and were typically in a dense to very dense in-place state." [LOR 63913B.4, p.4].

4.3 Groundwater

The investigation report noted that both sites "had experienced recent rainfall events and ponding water existed at both sites during the time of our investigation. In addition, approximately 1 to 1 ½ weeks prior to our trench excavations at the Cemex site, this site had been flooded with recharge water." [LOR 63913B.4, p.4]. As a result, the investigation encountered shallow groundwater at the Cemex site, but no groundwater was encountered at the Robertson's site. The report had "no clear explanation for the difference in water conditions noted between the two sites" [LOR 63913B.4, p.4].

The investigation report noted that the shallowest groundwater depth recorded by the nearest well, State Well Number 01S03W10K0025, was approximately 74 feet below ground surface in April 2012. Most of the remaining measurements from this well were in the range of 100 to 150+ feet below ground surface.

4.4 Infiltration

Near the Plunge Creek Basin site, LOR conducted three double-ring infiltrometer, and one single-ring infiltrometer test at depths of approximately 0.5 feet to 1 foot below existing ground surface. Infiltration rates were calculated by LOR from the test data and ranged from 2.6 inches/hour (5.1 ft/day) to 5.8 inches/hour (11.6 ft/day).

The District calculated the geometric mean of the results and then calculated a factor of safety of 2.1875 using the method in Appendix D of the Technical Guidance Document for Water Quality Management Plans, June 7, 2013, prepared by CDM Smith, Inc. The resulting design rate of 3.55 feet/day was proposed for the unclogged rate. For the clogged rate, the District proposed assigning an additional reduction factor of 2 to simulate clogging prior to basin maintenance, resulting in a clogged rate of 1.77 feet/day. These assumptions and calculations were reviewed and agreed to by the design team and the District.

Table 4-1: Plunge Creek Design Infiltration Rates

Location	Clogged Rate (ft/day)	Unclogged Rate (ft/day)
Plunge Creek Basin Site	1.77	3.55

4.5 GRADING RECOMMENDATIONS

While the report did not include formal grading recommendations, the investigation included a slope stability analysis using the computer program STEDwin, version 2.9. The analysis assumed a 120' tall, 2:1 cut slope. The analysis also assumed soil strength information from LOR's investigation of Oak Creek (Preliminary Feasibility Geotechnical and Infiltration Feasibility Investigation Oak Creek Basin and Diversion Project, Highland, CA, Project 63813A.4, March 1, 2023, Final Date: January 8, 2025). Based on these assumptions, the analysis indicated the proposed cut slope to be stable. In a rapid draw scenario at the top and bottom of the basin, the analysis determined factors of safety of 1.5 for static, and 1.2 for pseudostatic conditions.

5 HYDRAULICS

5.1 BASIN ROUTING

A Routing Inflow Event (Native Inflows) consisting of five consecutive Project Typical Hydrographs (PTH) with no time gap between the end of one storm and the beginning of the next was created for basin routing analysis of native runoff. The resulting Routing Inflow Event had the characteristics shown in Table 5-1:

Table 5-1: Routing Inflow Event (Native Inflows) Characteristics

Duration (Days)	Peak Flow (cfs)	Cumulative Volume (ac-ft)
56	144.7	3656

The routing analysis described in JLC Technical Memorandum dated January 26, 2025, Plunge Creek Basins & Oak Creek Basins Routing Assessment, assumed that all three basins would be active during a routing event. The two upstream basins (Basin 1 and Basin 2) would operate in parallel, receiving the initial inflows from the diversion and then sending the excess over their respective spillways to Basin 3. Inflows were assumed to be evenly split between Basin 1 and Basin 2.

The inflows were routed through the basin system assuming clogged and unclogged infiltration rates. The routing results are summarized in Table 5-2:

Table 5-2: Basin Routing Results

Scenario	Inflow Volume (Ac-Ft)	Infiltrated Volume (Ac-Ft)	Overflow (Discharged) Volume (Ac-Ft)
Unclogged	3,656	2,336	1,320
Clogged	3,656	1,245	2,411

The Basin Routing Technical Memorandum and Stage-Storage-Discharge Table are in Addendum PCI-3.

5.2 ALTERNATIVE 2 - GRATED DROP STRUCTURE - HYDRAULICS

The proposed diversion structure for Alternative 2 is a grated drop structure per U.S. Department of Transportation, Federal Highway Administration, Hydraulic Engineering Circular No.14, Third Edition, Hydraulic Design of Energy Dissipators for Culverts and Channels, [FHWA HEC-14], Chapter 11, Drop Structures, Section 11.1.2. Grate Design, as shown in Figure 5-1.

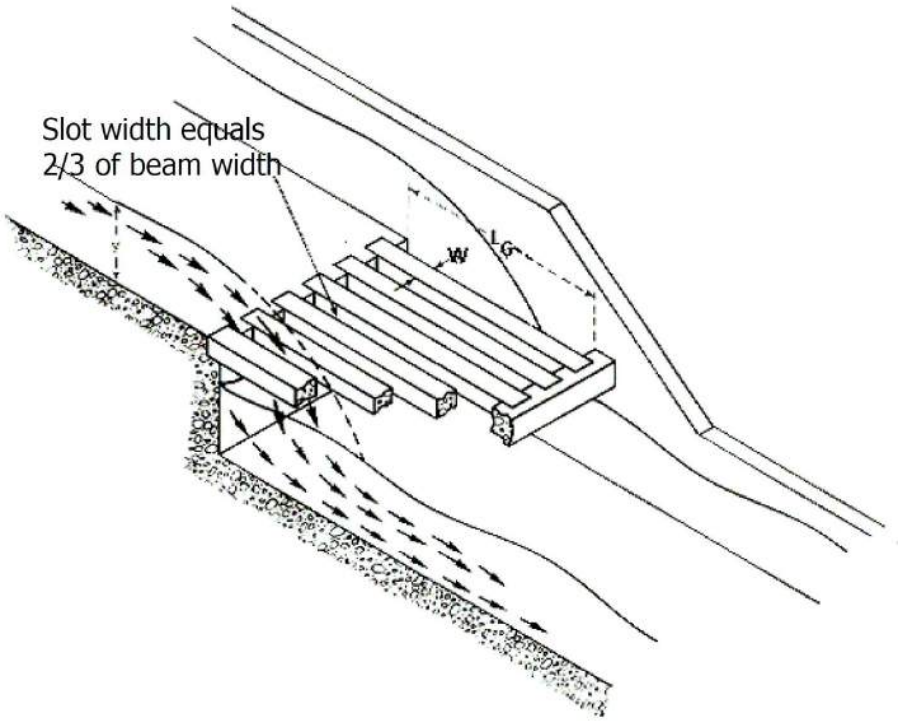


Figure 5-1: Plunge Creek Basin Alternative 2 Diversion Structure

The proposed diversion structure will be sized for full diversion of flows (q) up to 145 cfs from Plunge Creek Channel. The length of the grate (L_G) is calculated from Equation 11.4 in HEC-14:

$$L_G = \frac{q}{CWN(2gy_o)^{1/2}}$$

Where:

C = experimental coefficient equal to 0.245

W = width of the slots, ft

N = number of slots (spaces) between beams

y_o = approach flow depth, ft (0.11 feet – normal depth for 145 cfs)

Assuming a beam width (w) of one and a half feet (1.5'), the slot width (W) is one foot (1'), and N is 77 for a channel that is 192' wide. From these parameters, the grate length (L_G) is calculated to be approximately 2.9 feet. Three feet (3') is used in the drawings for design and estimating.

5.3 SPILLWAYS

The overflow spillways for all three basins are designed to convey the peak flow diversion of 145 cfs. The table below shows the depth of flow over each weir calculated using the weir equation ($q=CLH^{3/2}$) with a weir coefficient (C) of 3. The maximum q calculation in the table assumes a depth of flow that allows for one foot (1') of freeboard.

Table 5-3: Spillway Calculation Results

Spillway	Weir Width (ft)	Depth of Flow for q=145 cfs (ft)	Max depth (H) with 1' freeboard	Maximum q with 1' freeboard
Basin 1	30	1.37	3	467.7
Basin 2	30	1.37	7	1,666.8
Basin 3	50	0.98	1	150

6 SEDIMENT TRANSPORT

Chang Consultants prepared a sediment transport analysis for Plunge Creek using a FLUVIAL-12 Model. The preliminary results and analysis are in the report Sediment Transport Analysis for Plunge Creek, dated April 22, 2025 (Chang 2025). The study included sediment transport analysis for the 100-year storm and what was described as the Rainy Average storm. The Rainy Average Storm is no longer part of the study, having been replaced with the gage data analysis and determination of the Project Typical Hydrograph (PTH) from that analysis. Nevertheless, the Rainy Average model (peak flow approximately 180 cfs) provides some insight into anticipated sediment transport from a Project Typical Hydrograph event (peak flow 145 cfs).

Figure 9 in the sediment transport study shows the sediment delivery during the Rainy Average event. The curve is relatively flat from the downstream end of the study (Plunge Creek at Orange Avenue) to approximately 12,000 feet upstream (near Plunge Creek and Greenspot Road), indicating an approach to equilibrium. The conclusion of the report states, "Sediment delivery trends towards equilibrium below the alluvial foothill." While sediment delivery during a typical storm may trend toward equilibrium, recent observations of flood flows in Plunge Creek show runoff with considerable TSS, and the potential for large boulders as part of the discharge.

Alternative 1 (Pneumatically Operated Gate) is designed to minimize the TSS loading into the basins by having the diversion raised three feet above the channel invert, which would allow some TSS to settle out. Accumulated sediments in the 3' trough would then be flushed out when the gate is lowered. Alternative 2 would at least restrict the object size in the flow to one foot or less since the slots are designed to be one foot wide. TSS and smaller sediments would be carried more readily in the diverted runoff, however, since no settling trough is provided.

6.1 TOTAL SUSPENDED SOLIDS ASSESSMENT

JLC Engineering & Consulting, Inc. assessed total suspended solids expected to be carried with the sediment bedload using the data from the model in the Chang 2025 report and the grain size distribution data from the Grain Size Distribution Analysis, Project No. 63813A.42 prepared by LOR Geotechnical, dated October 13, 2023 (LOR 63813A.42).

The distribution analysis showed the percentage of silts and clays for each sample and ranged from 0.7% to 14%. The assessment used conservative values of 15% and 20% to calculate expected TSS volumes for the Rainy Average storm. The resulting calculations showed a TSS delivery of 50 cubic yards (assuming 15%) and 70 cubic yards (assuming 20%) for the Rainy Average storm, which is a 24-hour storm, whereas the PTH is about ten days long. Details are in Addendum PCI-4. Further refinement of this initial analysis is expected as part of future project development.

7 GROUNDWATER

By design, the proposed can cause groundwater mounding nearby. Geoscience, Inc. analyzed potential groundwater mounding from the proposed project in the report Groundwater Modeling for Plunge Creek Diversion and Basins Project Feasibility Study, dated January 31, 2025 (Groundwater Report). The analysis in the report indicated that the peak mounding from the Plunge Interim project would occur around fifty days after the start of spreading in both clogged and unclogged conditions. Recharge would also result in an increase in the area of shallow groundwater (groundwater less than fifty feet below ground surface). The results are summarized in Table 7-1:

Table 7-1: Groundwater Mounding

Scenario	Maximum Change in Groundwater Elevation (ft)	Time of Maximum Mounding (days after start of recharge)	Baseline Area of Shallow Groundwater (acres)	Recharge Scenario of Shallow Groundwater (acres)
Clogged	10	52	1,324	1,379
Unclogged	20	51	1,322	1,418

8 VALUE ENGINEERING/CONSTRUCTION COST

The estimated cost to construct is based on the design shown in Addendum PCI-1. The proposed grading design was provided by the District and remains unchanged. Casc revised the design of the proposed diversion as the objectives of the project were clarified. Items removed from the project design include:

Table 8-1: Value Engineering Changes

Design Element Removed	Explanation
Concrete Return Channel	Project design goal changed to divert up to a maximum flow rate of 145 cfs; proposed diversions are now designed with that capacity so that flows in excess of capacity bypass diversion.
Coanda Screen Diversion Structure	Considered redundant
Trapezoidal Channel Diversion Structure	Considered redundant
Basin Outlet Structures (Riser and Pipe Outlet)	Proposed spillways satisfy the need to provide overflow. Considered redundant.

Additional opportunities for value engineering are likely to occur during final design as the hydraulics of the system are optimized.

8.1 CONSTRUCTION COST ESTIMATE

Construction costs for the proposed project shown in Addendum PCI-1 are summarized in the tables below. Detailed cost estimates are in Addendum PCI-5.

Table 8-2: Construction Cost Estimate Summary

Alternative	Construction Items	Soft Costs	Total
Pneumatically Operated Gate	$9,059,000	$8,889,000	$17,948,000
Grated Drop Structure	$8,237,000	$8,356,000	$16,593,000

Note: Soft costs include 30% contingency, design & permitting, habitat mitigation, and construction administration.

9 PERMITTING REQUIREMENTS

The project will require compliance with the California Environmental Quality Act (CEQA). The technical memorandum in Addendum PCI-6 describes the requirements and CEQA process anticipated for this project. Based on the scope of the project, it is anticipated that an Initial Study/Mitigated Negative Declaration (IS/MND) will be required.

The project may also require permits from the Santa Ana Regional Water Quality Control Board (RWQCB), the California Department of Fish and Wildlife (CDFW), and the United Staes Army Corps of Engineers (ACOE). Agency permitting will require an approved CEQA document and notice of determination.

Time frame for the CEQA process is expected to be between 28 and 32 weeks. Permits could then be obtained within 6 to 12 months following CEQA approval.

Due to the project's proximity to San Bernardino International Airport (SBIA), the project may require review by SBIA and the Federal Aviation Administration (FAA) to assess potential wildlife hazards posed by the proposed basin.

9.1 SAN BERNARDINO COUNTY FLOOD CONTROL DISTRICT PERMITTING

The project will require a Major Construction Permit from the San Bernardino County Flood Control District (SBCFCD), which has jurisdiction over Plunge Creek. Key issues in SBCFCD's review include:

- How will the project affect existing SBCFCD facilities
- Will the project affect SBCFCD's ability to operate and maintain their facilities
- What entity will be responsible for the operation and maintenance of the proposed facilities

The encroachment permit application would include:

- Completed permit application
- PDF of plans signed by a Registered Civil Engineer
- PDF of hydrology/hydraulic calculations

Applicants are to pay a fee calculated by SBCFCD after application is submitted. Reviews will not begin until the fee is paid. If review and inspection costs exceed the initial fee, the applicant is required to pay the difference.

Reviews by SBCFCD can take up to six weeks per review cycle depending on the complexity of the review. As this project will involve the construction of permanent facilities within SBCFCD's jurisdiction, permits from other agencies, and the execution of an agreement for operation and maintenance of the proposed facilities, longer review cycles are anticipated.

10 CONCLUSION

This report summarizes the technical reports prepared to support the San Bernardino County Water Conservation District's feasibility study for the Plunge Creek Basin Interim Project. The proposed project envisions three recharge basins and two alternatives for diversion from Plunge Creek. Target peak flow for the proposed diversion is 145 cfs based on statistical analysis of the data from the Plunge Creek gage.

The project is expected to infiltrate 2,366 acre-feet per year (1,245 acre-feet assuming clogged conditions), based on a year of five 50th percentile events. Cost to construct is approximately $17,000,000 to $18,000,000.

11 REFERENCES

Chang (Chang Consultants), 2025. Sediment Transport Analyses for Plunge Creek. Prepared for Casc Engineering & Consulting, dated April 22, 2025.

FWHA (U.S. Department of Transportation, Federal Highway Administration), HEC-14. Hydraulic Engineering Circular No. 14, Third Edition, Hydraulic Design of Energy Dissipators for Culverts and Channels, Publication No. FHWA-NHI-06-086, July 2006.

Geoscience (Geoscience Support Services, Inc.), 2025. Groundwater Modeling for Plunge Creek Diversion and Basins Project Feasibility Study. Prepared for Casc Engineering and Consulting, Inc. Engineering Feasibility Study Support Services for San Bernardino Valley Water Conservation District, dated January 31, 2025.

IDC (IDC Consulting Engineers, Inc.), 2020. Structure Type Selection Report: Orange Stret Bridge over Plunge Creek Overflow. Prepared for City of Highland, dated November 2020.

JLC (JLC Consulting & Engineering, Inc.), 2023. Hydrology & Hydraulic Report for Plunge Creek Existing Floodplain. Prepared for San Bernardino Valley Water Conservation District, dated May 25, 2023.

LOR (LOR Geotechnical Group, Inc.), 63813A.4. Preliminary Geotechnical Feasibility and Infiltration Feasibility Investigation Oak Creek Basin and Diversion Project Highland, California. Prepared for Casc Engineering & Consulting, dated March 1, 2023, Final Date: January 8, 2025.

LOR (LOR Geotechnical Group, Inc.), 63813B.4. Alternate Preliminary Geotechnical Feasibility and Infiltration Feasibility Investigation Plunge Creek Basin Highland/Redlands, California. Prepared for Casc Engineering & Consulting, dated May 31, 2023, Final Date: January 8, 2025.

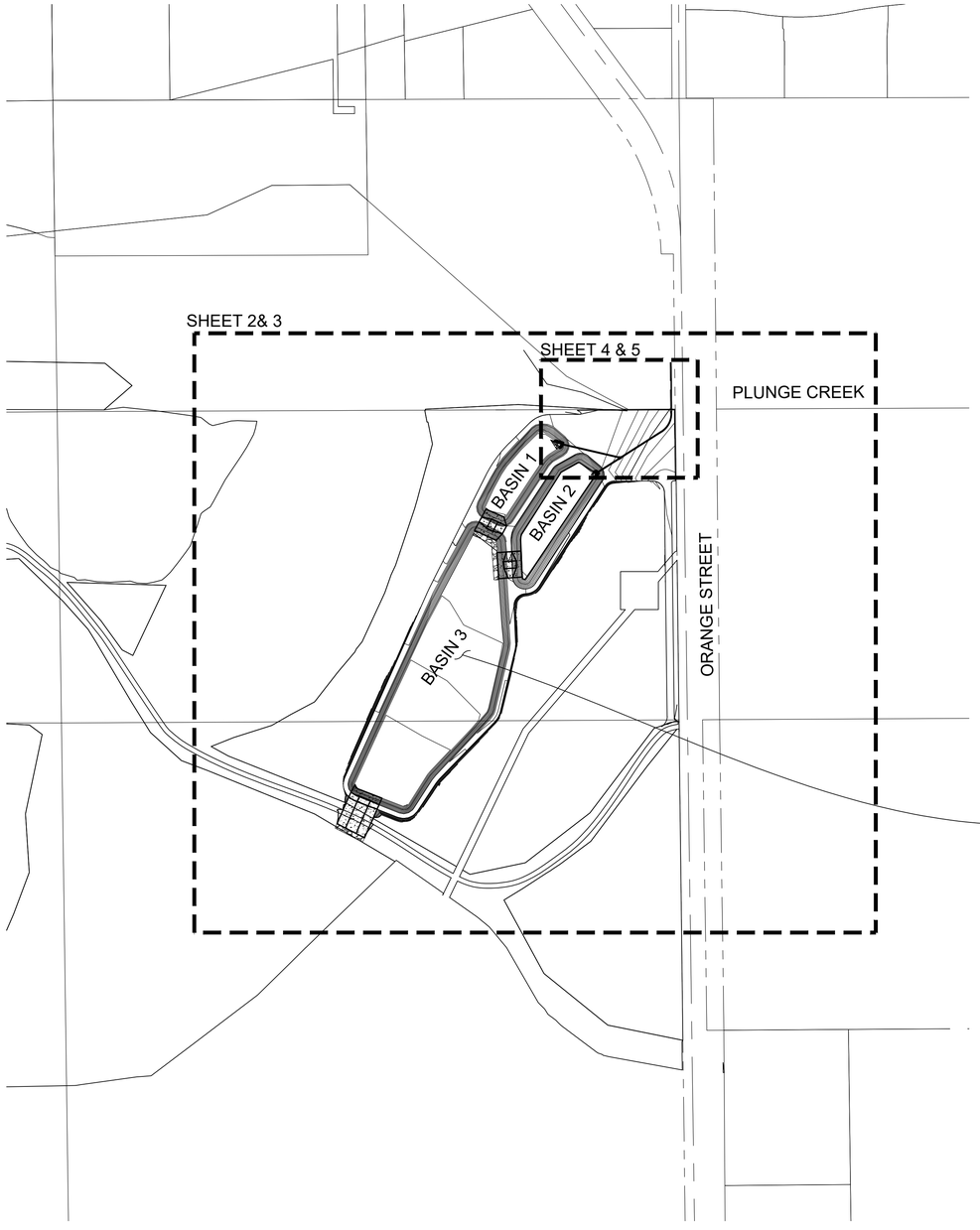
LOR (LOR Geotechnical Group, Inc.), 63813A.42. Grain Size Distribution Analysis, Plunge Creek and Oak Creek Basins/Diversion Projects, Highland/Redlands, California. Letter to Casc Engineering & Consulting, dated October 13, 2023.

West (West Consultants, Inc.), 2009. San Bernardino County FEMA Levee Certification Non-Federal Levees – Phase II, Hydraulic Report, Plunge Creek Levee IDs 13a, 13c, and 14. Prepared for HDR Engineering, Inc., dated August 4, 2009.

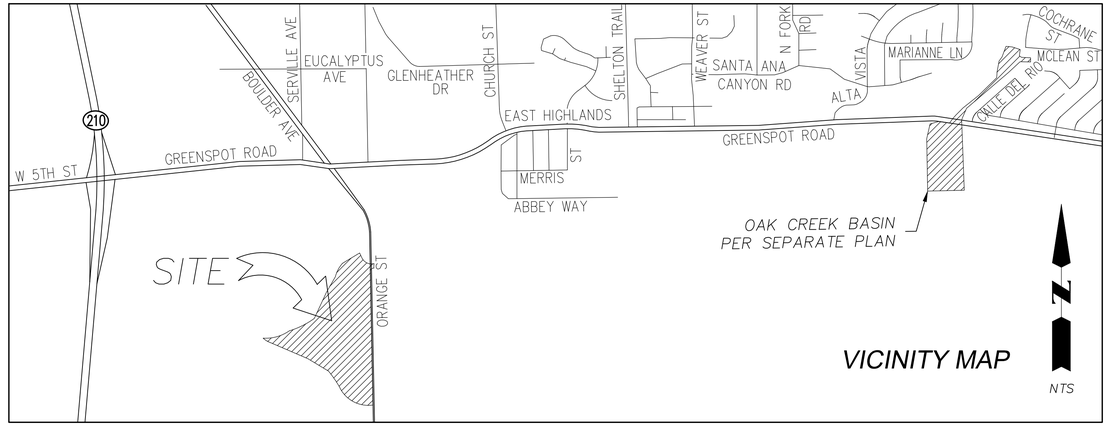
ADDENDA

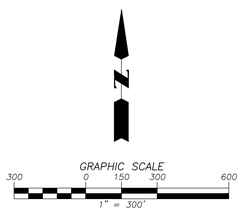
ADDENDUM PCI-1: PROPOSED DESIGN EXHIBITS

PLUNGE CREEK GROUNDWATER RECHARGE PROJECT ALTERNATIVE
PRELIMINARY CONCEPTUAL DESIGN FEATURES
INTERIM PROJECT



PLUNGE CREEK FORMER
SILT POND QUARRY BASINS
(INTERIM PROJECT)





SHEET INDEX

1. TITLE SHEET AND INDEX SHEET
2. CONCEPTUAL BASIN GRADING PLAN
3. GRADING CROSS–SECTIONS
4. PLAN AND PROFILE PNEUMATICALLY OPERATED GATE (ALTERNATIVE 1)
5. PLAN AND PROFILE GRATED DROP STRUCTURE (ALTERNATIVE 2)
6. PLAN AND PROFILE BASIN 2 DIVERSION OUTLET LATERAL
7. PLAN AND PROFILE BASIN 1 DIVERSION OUTLET LATERAL

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PLUNGE CREEK GROUNDWATER RECHARGE PROJECT ALTERNATIVE
PRELIMINARY CONCEPTUAL DESIGN FEATURES

TITLE SHEET

SHEET 1
OF 7

BASIN DATA TABLE

BASIN NO.	BOTTOM AREA (AC)	STORAGE CAPACITY (AC-FT)
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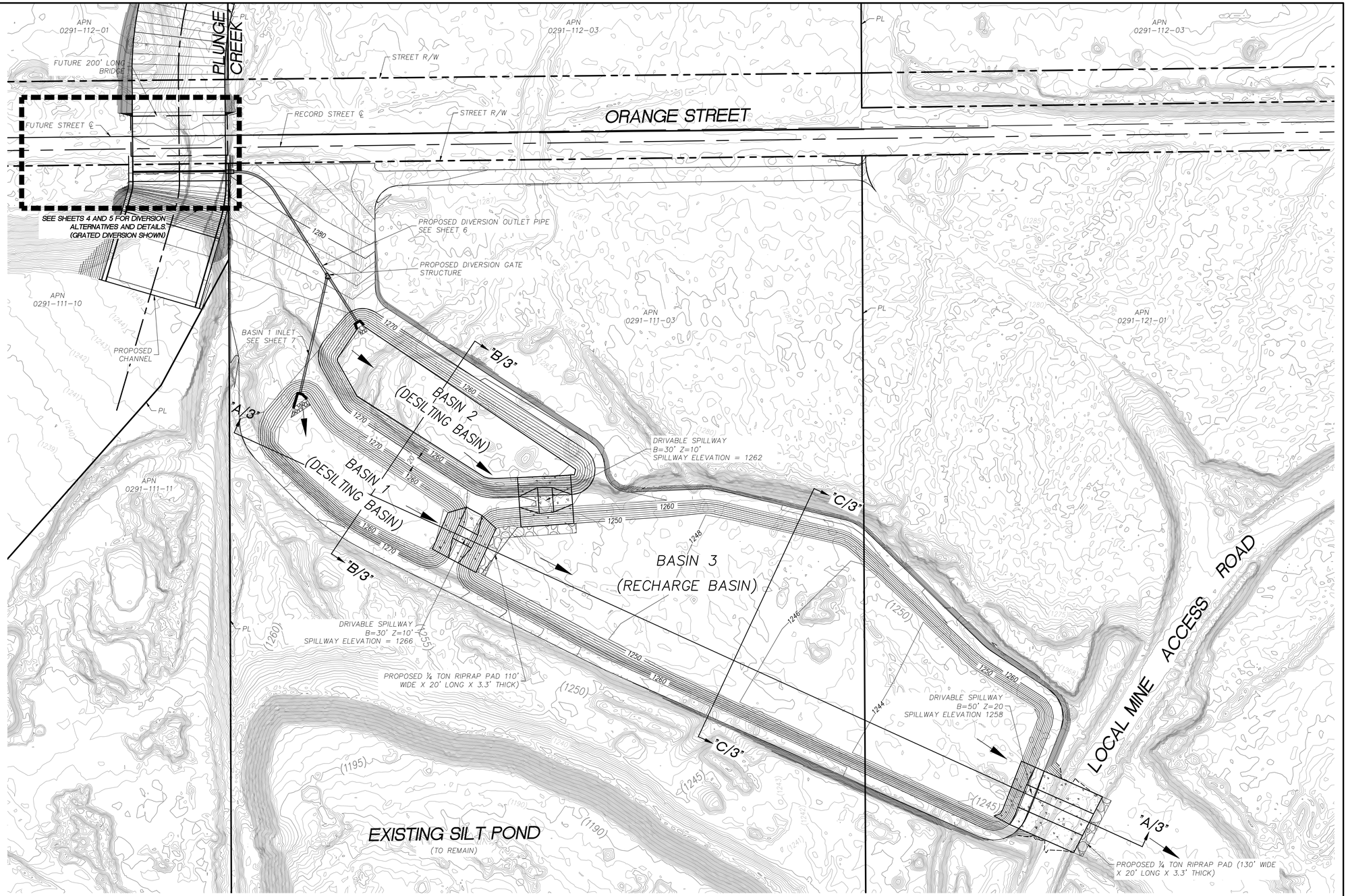
3	7.83	100



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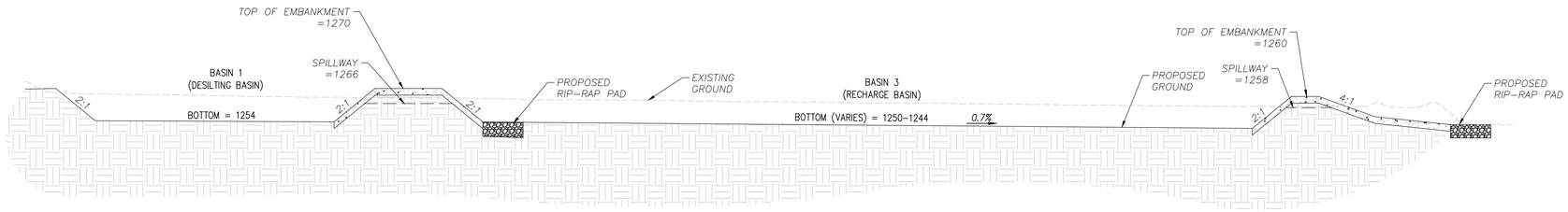
PLUNGE CREEK GROUNDWATER RECHARGE PROJECT ALTERNATIVE
PRELIMINARY CONCEPTUAL DESIGN FEATURES
CONCEPTUAL GRADING PLAN

SHEET 2
OF 7



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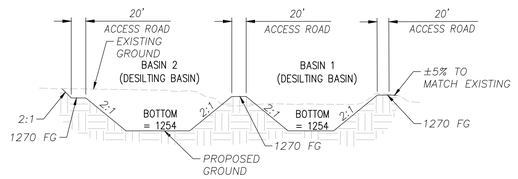

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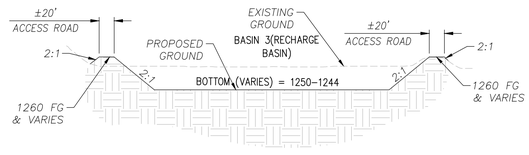

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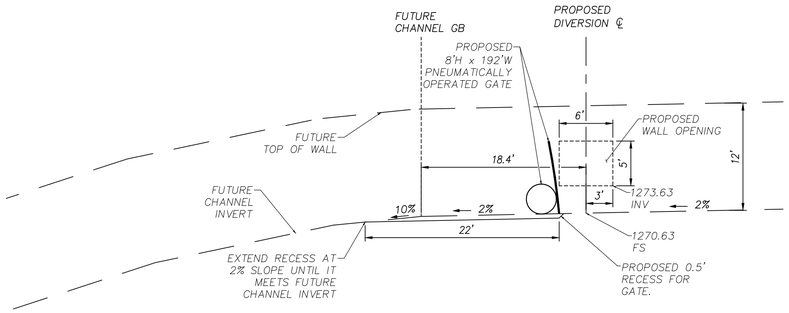
PLUNGE CREEK GROUNDWATER RECHARGE PROJECT ALTERNATIVE
PRELIMINARY CONCEPTUAL DESIGN FEATURES
BASIN CROSS-SECTIONS

SHEET 4
OF 7



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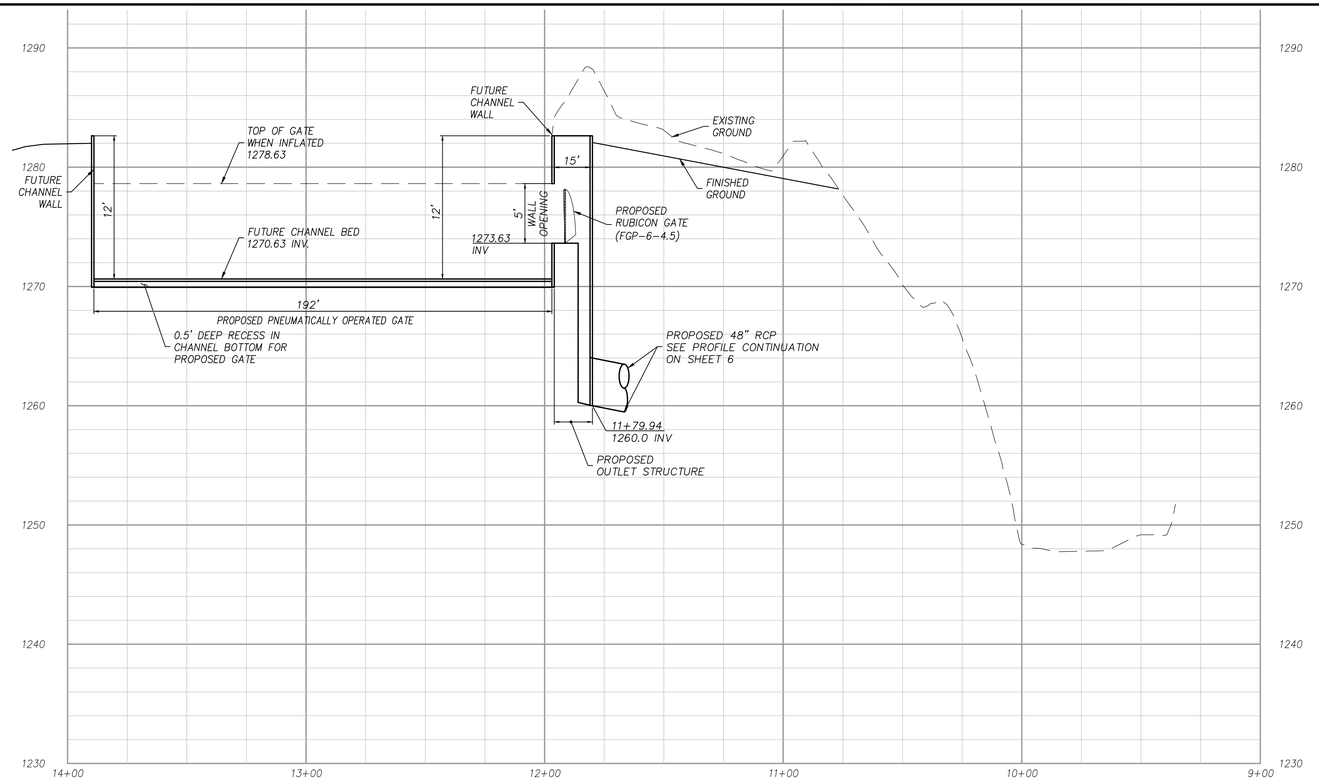

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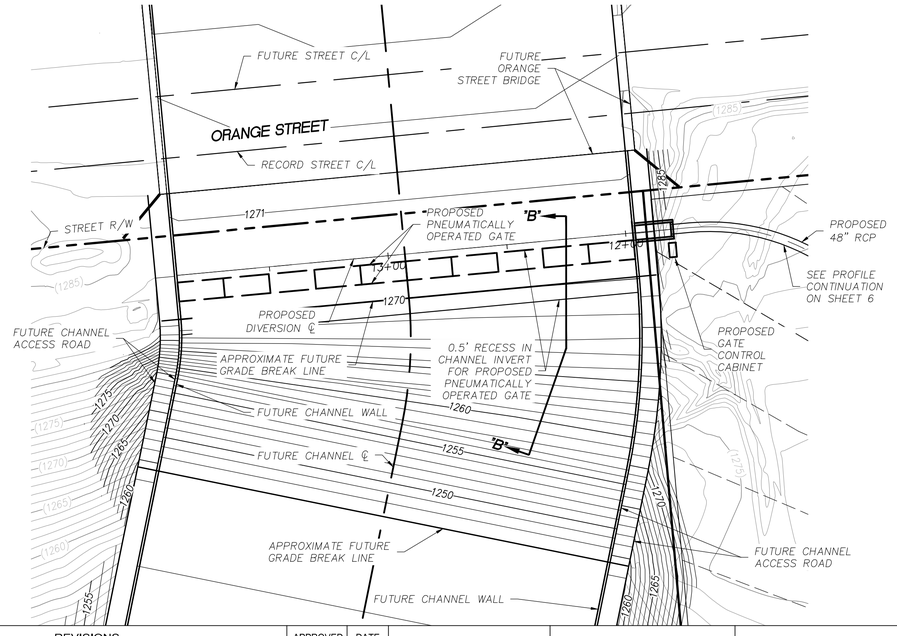

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MARCH 2025

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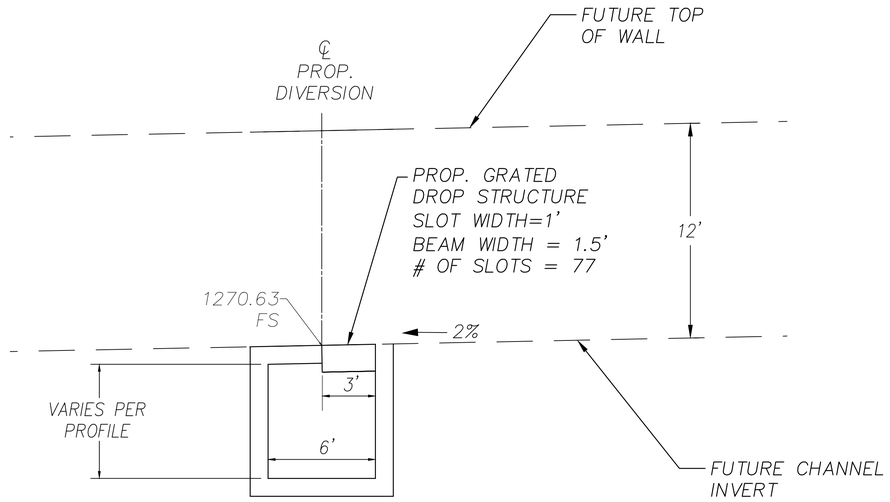
PLUNGE CREEK GROUNDWATER RECHARGE PROJECT ALTERNATIVE
PRELIMINARY CONCEPTUAL DESIGN FEATURES

ALTERNATIVE 1 DIVERSION STRUCTURE
PNEUMATICALLY OPERATED GATE

SHEET 4 OF 7



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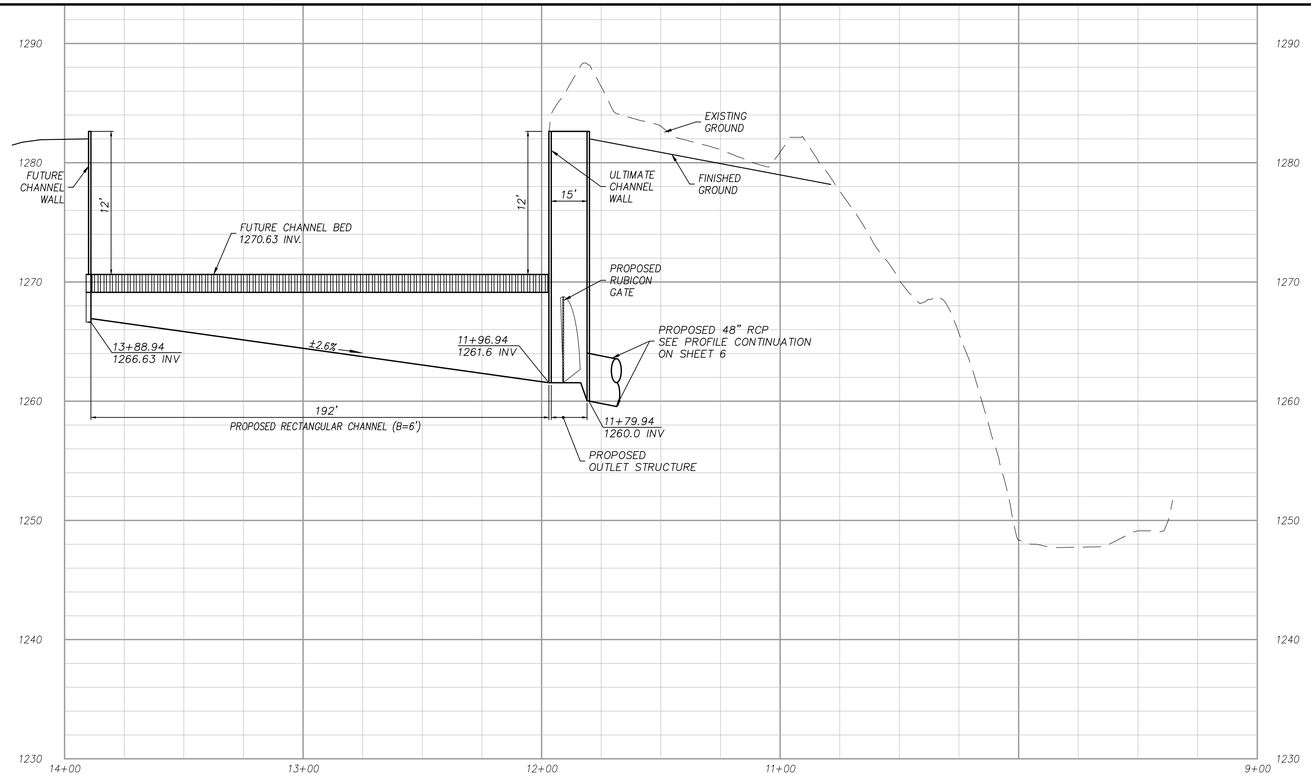

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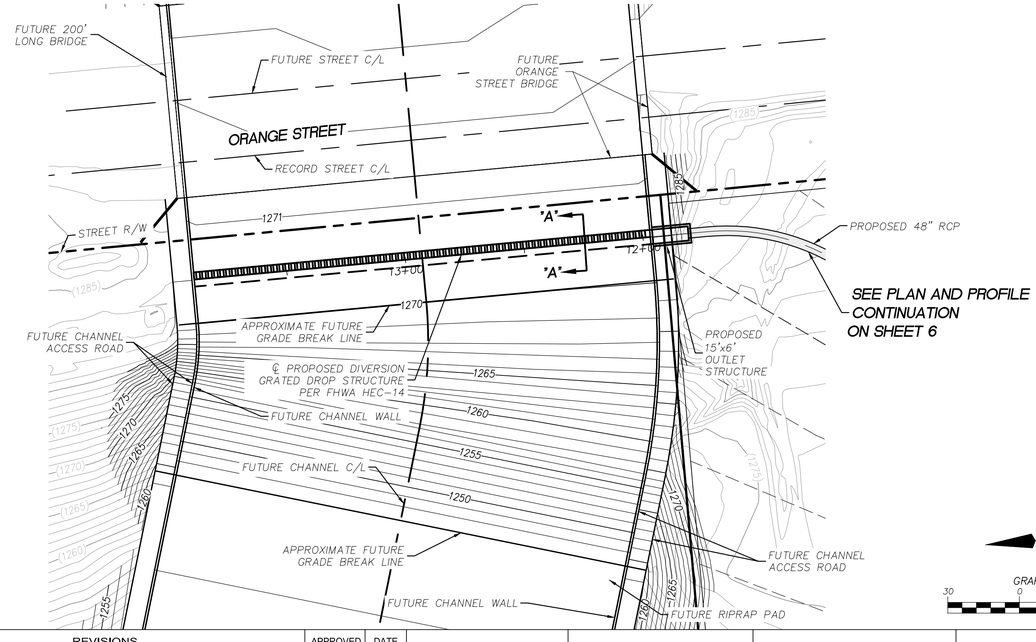
VERT. 1"=6'



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MARCH 2025

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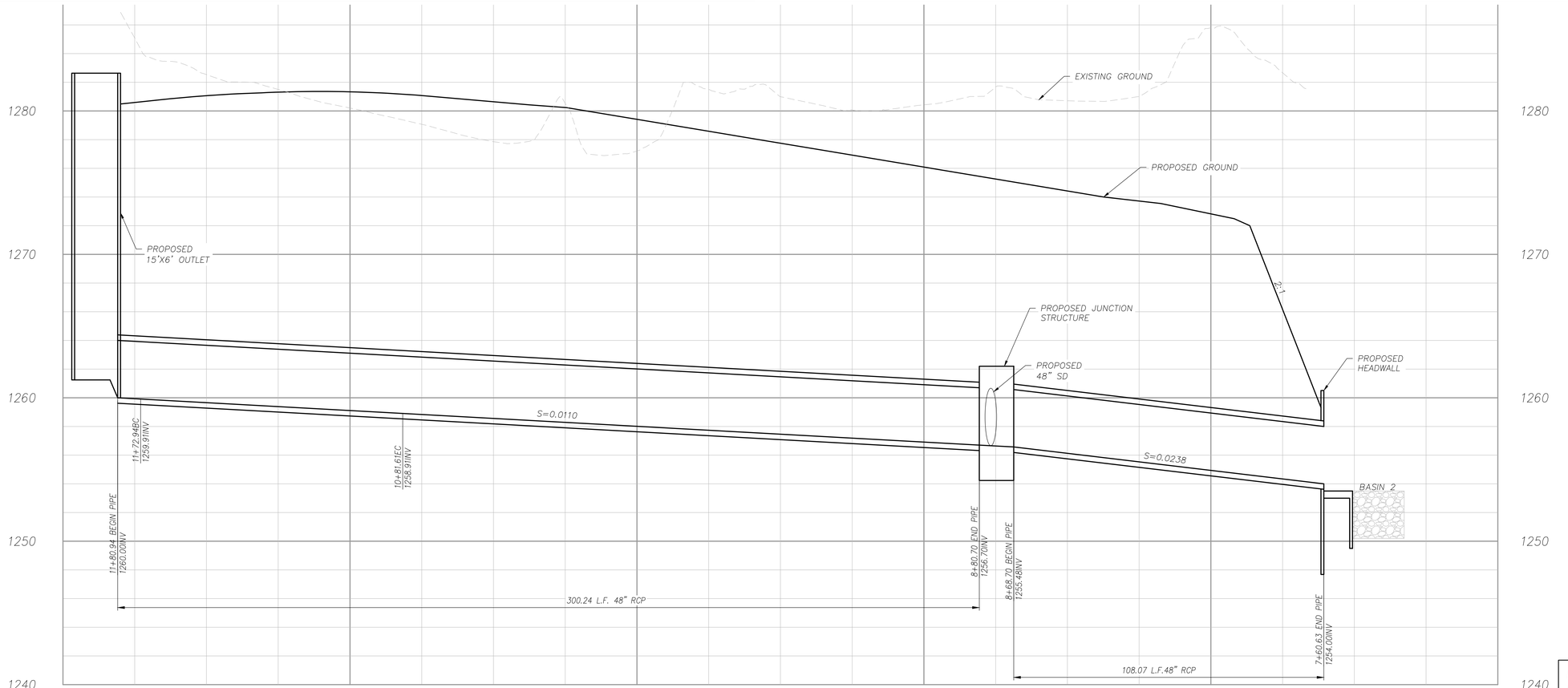
PLUNGE CREEK GROUNDWATER RECHARGE PROJECT ALTERNATIVE
PRELIMINARY CONCEPTUAL DESIGN FEATURES

ALTERNATIVE 2 DIVERSION STRUCTURE GRATED DROP STRUCTURE

SHEET 5 OF 7



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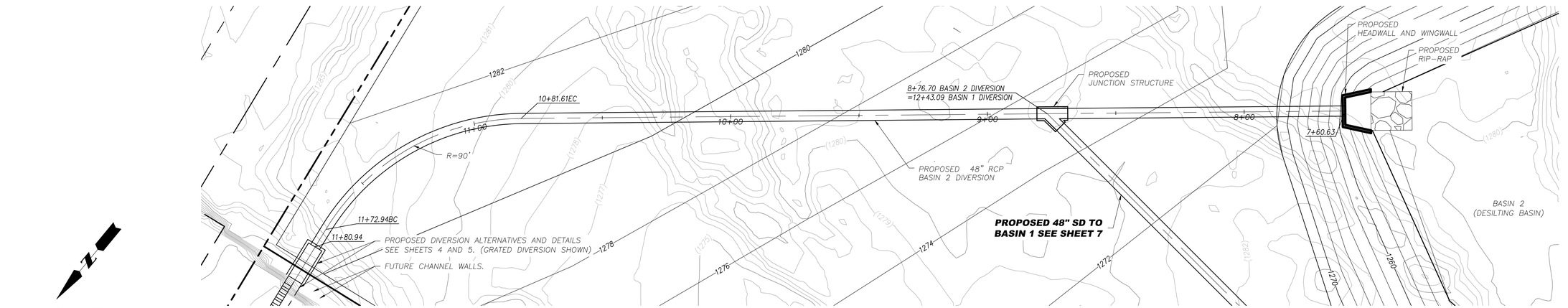
VERT. 1"=4'



BASIN 2 DIVERSION

MARCH 2025

CASC Engineering and Consulting
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PH. (909) 783-0101 FAX (909) 783-0108
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SUBMITTED BY: MICHAEL GENTILE, PE, PROJECT MANAGER, CASC ENGINEERING & CONSULTING, INC.
DESIGNED BY: JOE CASTANEDA, PE, JLC ENGINEERING, INC.
DRAWN BY: GABRIEL MARQUEZ, PE, CASC ENGINEERING & CONSULTING, INC.
REVIEWED BY: JOHN LAMBIE, PE, CEG, PG, CONSULTING CHIEF ENGINEER AND HYDROGEOLOGIST, SAN BERNARDINO VALLEY WATER CONSERVATION DISTRICT.

NO.	DATE	REVISIONS	APPROVED	DATE
1				
2				
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San Bernardino Valley Water Conservation District
Helping Nature Store Our Water

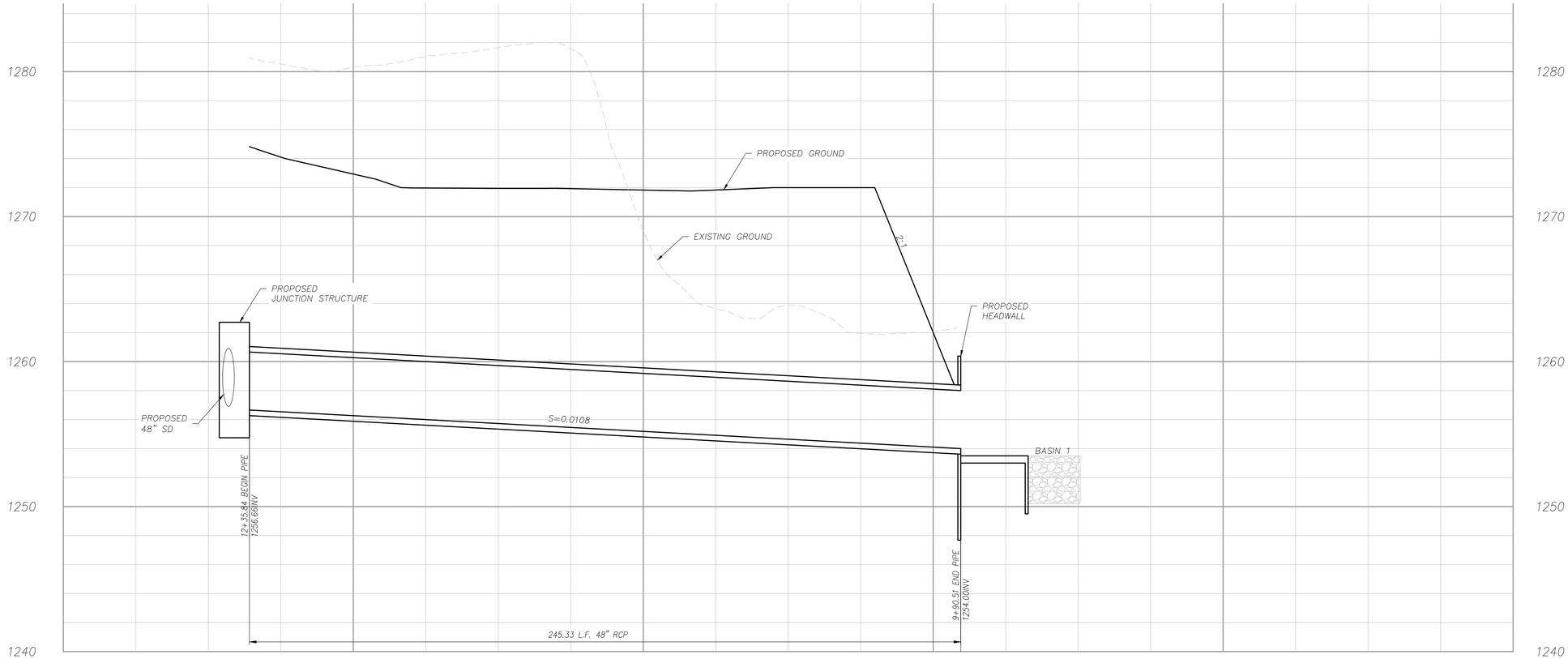
SAN BERNARDINO VALLEY WATER CONSERVATION DISTRICT

PROJECT NO. SBVWCD - xxx

PLUNGE CREEK GROUNDWATER RECHARGE PROJECT ALTERNATIVE
PRELIMINARY CONCEPTUAL DESIGN FEATURES

BASIN 2 DIVERSION OUTLET PLAN AND PROFILE

SHEET 6 OF 7



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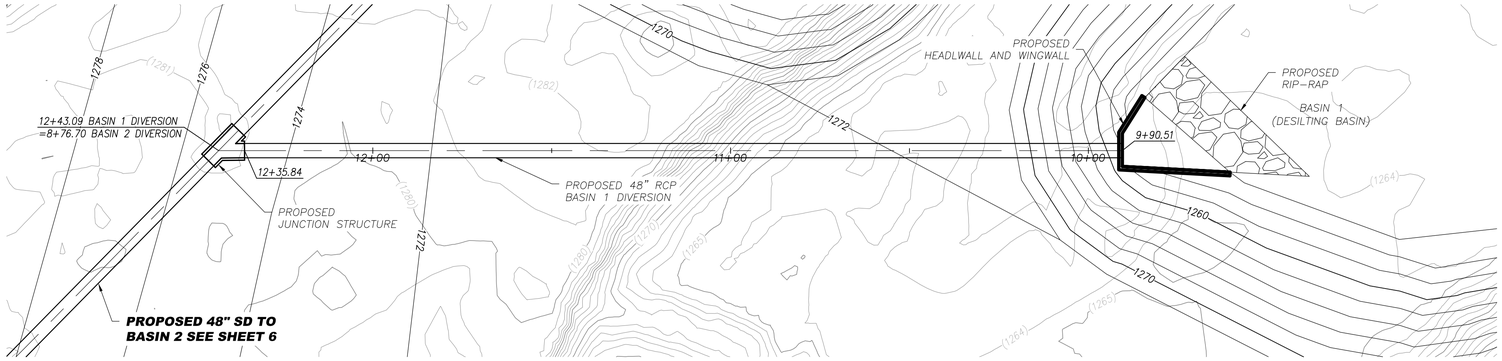
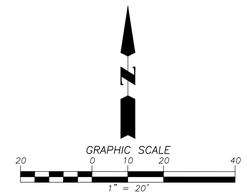


BASIN 1 DIVERSION



MARCH 2025

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REVIEWED BY: JOHN LAMBIE, PE, CEG, PG
CONSULTING CHIEF ENGINEER AND HYDROGEOLOGIST
SAN BERNARDINO VALLEY WATER CONSERVATION DISTRICT.

NO.	DATE	REVISIONS	APPROVED	DATE
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San Bernardino Valley
Water Conservation District
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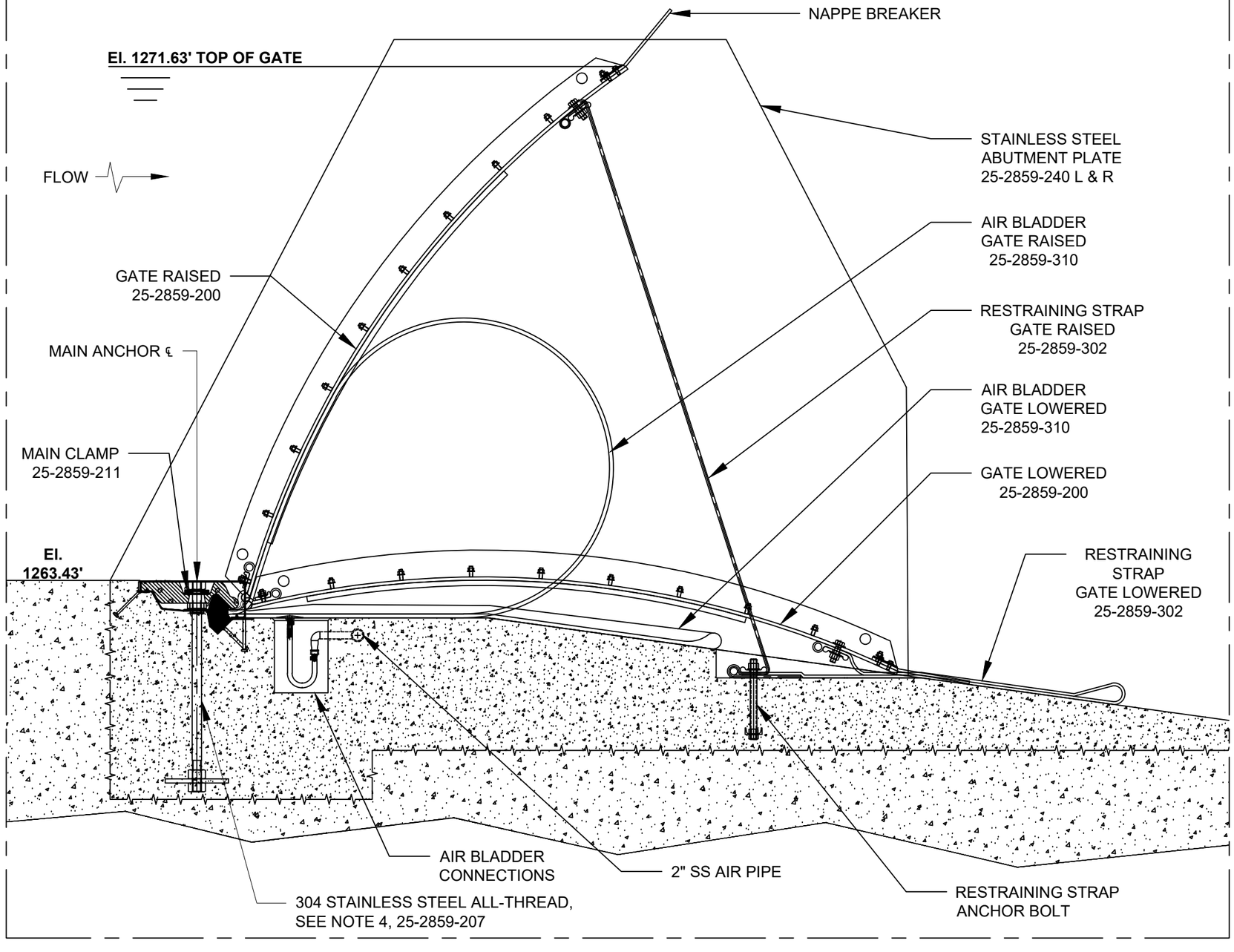
SAN BERNARDINO VALLEY WATER CONSERVATION DISTRICT

PROJECT NO.
SBVWCD -
xxx

PLUNGE CREEK GROUNDWATER RECHARGE PROJECT ALTERNATIVE
PRELIMINARY CONCEPTUAL DESIGN FEATURES

BASIN 1 DIVERSION OUTLET PLAN AND PROFILE

SHEET 7
OF 7



ELEVATION VIEW

NOTES:

1) CONCRETE FINISH: CONCRETE UNDER GATE SYSTEM **MUST** HAVE HIGH QUALITY TROWEL FINISH AND BE FLAT WITHIN ±1/8".
A BROOM FINISH IS **NOT** ACCEPTABLE AND WILL RESULT IN ACCELERATED WEAR OF AIR BLADDERS.

2) THE HORIZONTAL CONCRETE CLAMPING SURFACE EXTENDING 6" DOWNSTREAM OF MAIN ANCHOR BOLT CENTERLINE AND 6" UPSTREAM OF MAIN ANCHOR BOLT CENTERLINE SHOULD BE LEVEL WITHIN ±1/4" FROM ABUTMENT TO ABUTMENT AND SHOULD NEVER VARY MORE THAN 1/8" PER FOOT.

3) ALL DIMENSIONS TO WITHIN ±1/8" OF TRUE POSITION UNLESS OTHERWISE DIMENSIONED OR NOTED ON PART DRAWING. SPACING OF ADJACENT MAIN ANCHOR BOLTS SHOULD NOT VARY MORE THAN 1/16" FROM NOMINAL SPACING.

4) ALL MAIN ANCHOR BOLTS TO BE PLUMB WITHIN ±1/8". MAIN ANCHOR BOLT CENTER LINE TO BE PERPENDICULAR TO ABUTMENT FACE ±0.1°.

5) DURING CONCRETE PLACEMENT, THE FORM WORK SUPPORTING THE ABUTMENT PLATES MUST BE HELD PLANAR, PLUMB AND PERPENDICULAR TO THE MAIN ANCHOR BOLTS WITHIN 1/8" PER FOOT AND WITHIN 1/4" OVERALL. RIGID STEEL BRACING OF FORMS IS RECOMMENDED. CONCRETE LIFTS SHOULD BE LIMITED SO AS TO NOT EXCEED ABOVE DEFLECTION LIMITS OF FORMS.

6) CONTRACTOR RESPONSIBLE FOR ALL CONCRETE CUTTING, GROUTING, GROUT, AIR PIPE, AIR PIPE FITTINGS, WELDING, VALVING, ELECTRICAL CONDUIT, CONDUIT FITTINGS, ASSOCIATED TOOLS, REBAR, ANCHORING AND SURFACE EPOXY, AND ANYTHING ELSE PERTAINING TO COMPONENTS NOT SUPPLIED BY OBERMEYER HYDRO, INC. OR INCLUDED IN THE OBERMEYER BILL OF MATERIALS.

7) THIS DOCUMENT AND ATTACHED DRAWINGS ARE PROPERTY OF OBERMEYER HYDRO, INC. AND IS NOT TO BE USED, DISRAISED, REPRODUCED OR TRANSMITTED BY ELECTRONIC OR ANY OTHER MEANS WITHOUT PRIOR WRITTEN AUTHORIZATION.

8) ALL ANCHOR BOLTS, BOLTS, FASTENERS TO BE ACCURATELY TORQUED TO APPROPRIATE LEVEL AS DEFINED IN THE OBERMEYER INSTALLATION PROCEDURE.

9) THERE IS **NO WELDING ALLOWED** ON THE MAIN ANCHOR BOLTS. WELDING TO HEAT TREATED ANCHOR BOLTS CAN CAUSE FRACTURE AND CATASTROPHIC SYSTEM FAILURE.

10) ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED.

NO	REVISION DESCRIPTION	DATE APR'D	APR'D	DRAWN
1	NEW DRAWING	25 MAR 2025		VCH
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DRAWING DESCRIPTION
ELEVATION VIEW

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SHEETS	SCALE
1 of 1	NO SCALE

JOB: PLUNGE CREEK DIV.

DWG. NO.: 25-2859-110

ADDENDUM PCI-2: GAGE DATA ANALYSIS

Technical Memorandum

Date: **October 8, 2024**

To: **John Lambie, PE, Chief Engineer San Bernardino Valley Water Conservation District**

From: **Joseph L. Castaneda, P.E.**

Re: **Amendment to Feasibility Study Support Services ARTP Plunge Creek and Oak Creek Diversion and Basin(s)**

Introduction

This technical memorandum was produced for the San Bernardino Valley Water Conservation District (SBVWCD) in support of the District's feasibility study for the design of the proposed recharge basins and diversion mechanisms for Plunge Creek and for Oak Creek.

Stream gage data from Upper Plunge Creek gage 110555000 were analyzed to determine distinct runoff events and their associated flow rates and volumes. The analysis detected 187 events. PRISM 30-year normal data was then used to scale these data to the ungauged watersheds that are tributary to Elder Creek, Oak Creek, and the Greenspot Storm Drain respectively. All four watersheds (Upper Plunge Creek, Elder Creek, Oak Creek, and Greenspot Storm Drain) are shown on Figure A. 50th, 80th, and 90th percentile flow rates were determined for each respective watershed as candidate diversion flow rates.

The candidate diversion flow rates, either individually or in combination, were used to calculate diverted, bypassed, and total volumes for each basin location. Statistics were compiled for the Oak Creek and Greenspot Storm Drain watersheds separately. Statistics for the Plunge Creek Basin were compiled for Upper Plunge Creek and Elder Creek combined, and for the combination of Upper Plunge Creek, Elder Creek, and Oak Creek.

Statistical distributions were applied to the results, and 50th, 80th, and 90th percentile peak flow rates from the set of events were also determined.

Analysis Overview

An approximately 35-year record, extending from water year 1989 through water year 2024, of 15-minute stream gage data from Upper Plunge Creek gage 110555000 was analyzed and used to cultivate a statistical representation of prospective flows tributary to the proposed Oak Creek and Plunge Creek Recharge Basins. Note that approximately five months of water year 2024 were included which was the available

data at the start of this study. The results of the study are discussed and represented below.

Existing Data Analysis

These Upper Plunge Creek stream gage data were evaluated to determine the flow duration frequencies in the 35 year record. All periods with no flow were excluded from the determination of flow frequencies. The 50th, 80th, and 90th percentile flow rates were identified to be of interest by SBVWCD. These values will define candidate diversion rates in the remainder of the analysis. The results for Upper Plunge Creek gage data are shown below:

Table 1: *Plunge Flow Frequency*

Percentile (%)	50th	80th	90th
Flowrate (cfs)	1.90	6.74	15.00

The 35 year record was further analyzed to partition the continuous record into a set of discrete, meaningful flow events. In this context, events are hydrographs which result from a storm event and are characterized by a rising limb, peak, and receding limb forming a simple hydrograph. Simply put, a meaningful flow event is one in which the magnitude of the peak and the duration of the hydrograph are substantial enough to survive a low pass filter (“gaussian smoothing”) of the data set which was used to remove noisy, high frequency perturbations in the flow signal. A total of 187 events were identified in the 35 year record. The events were distributed through the 35 year record as shown below, in terms of water years.

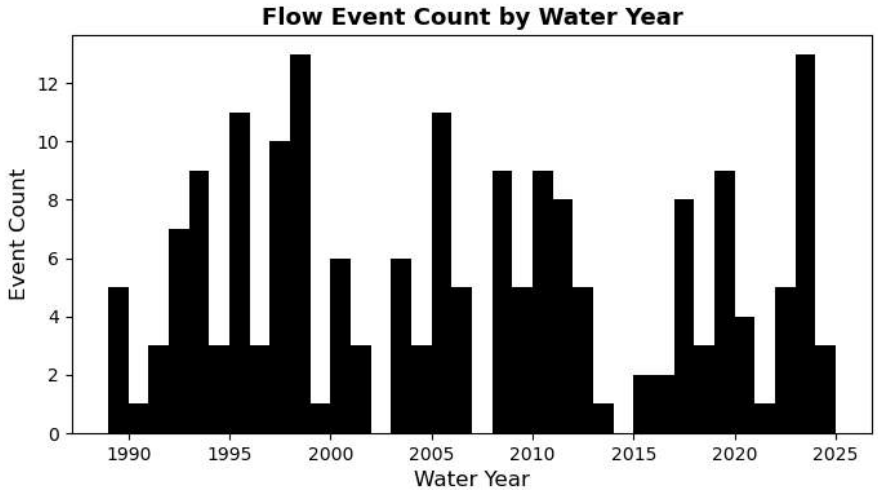


Figure 1: *Flow Event Count By Water Year*

Through meetings with SBVWCD, a flow rate of 0.63 cfs, the 30th percentile flow duration frequency rate, was used to define the end of a flow event in the record from Upper Plunge Creek.

The event-separation duration, time interval between flow events in days, was determined between flow events using the low flow cutoff rate. The event-separation duration was excluded when the interval spanned between water years to avoid bias in the resulting analysis. Descriptive statistics are provided for the resulting collection of event-separation durations computed. A normal distribution was fit to the dataset as requested by SBVWCD and is shown below:

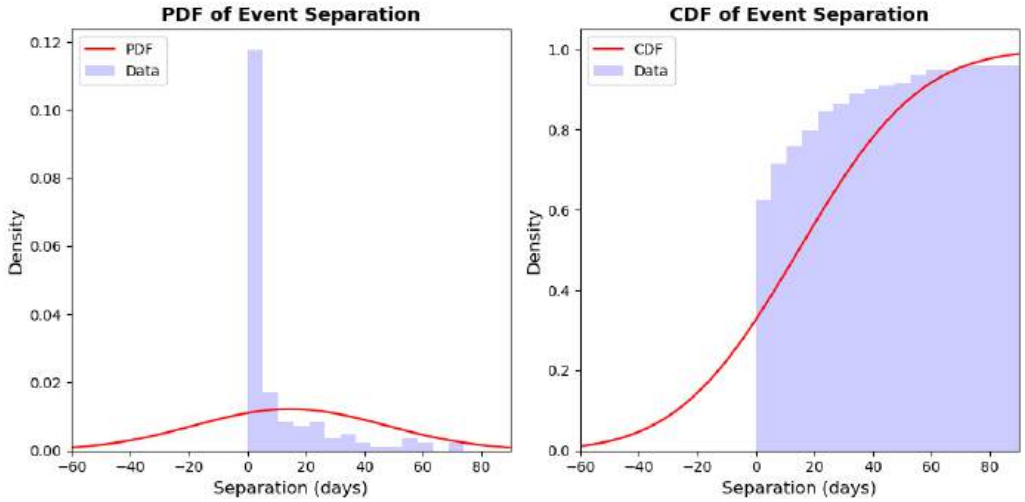


Figure 2: *PDF & CDF of Flow Separation via Normal Distribution*

Table 2: *Sample Moments/Statistics for Event Separation*

Sample Moment	Value (days)
Mean	14.70
Standard Deviation	32.70
Median	0.00
Skew*	4.09

*Skew is dimensionless, is not represented in Normal Distribution as parameter

Similarly, the event duration, the time interval from the beginning to the end of a given event in days , was determined for each flow event. A set of 187 durations (units=days) were calculated from the gage data. Descriptive statistics are provided for the resulting collection of event durations computed. A normal distribution was fit to the dataset as requested by SBVWCD and is shown below:

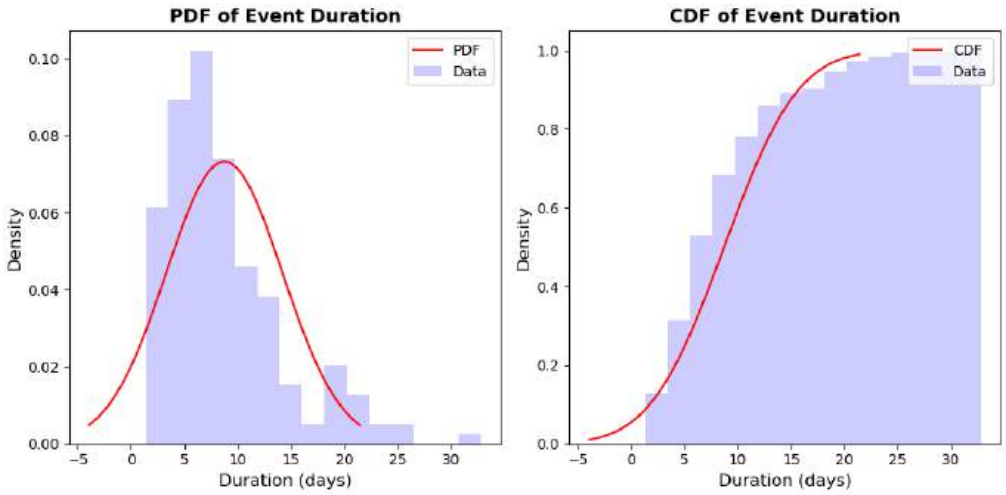


Figure 3: *PDF & CDF of Flow Duration via Normal Distribution*

Table 3: *Sample Moments/Statistics for Event Duration*

Sample Moment	Value (days)
Mean	8.73
Standard Deviation	5.44
Median	7.35
Skew*	1.42

*Skew is dimensionless, is not represented in Normal Distribution as parameter

PRISM 30-Year Precipitation Normals Scaling of Watershed Subbasin Runoff

The PRISM 30-year precipitation normals (https://prism.oregonstate.edu/) were retrieved for the project area at a grid resolution of 800m. The dataset defines the 30-year annual average precipitation per grid cell adjusted by topography. The area of each Plunge Creek subbasin was calculated in GIS. The weighted average of the PRISM total precipitation values was computed for watershed subbasins of interest: Elder Creek, Upper Plunge Creek, Oak Creek, and Greenspot Storm Drain, see Figure A. To scale runoff volume, the product of precipitation and area was determined as a scalar for each Plunge Creek subbasin. Using the PRISM runoff volume for Upper Plunge Creek as a reference, a ratio of relative volume was determined for each subbasin. Figure A illustrates the superposition of the PRISM data on the project area.

Table 4: *Relative PRISM-Area Weighted Runoff Volume. P_w is weighted precipitation, V_w is weighted Volume, R_v is volume ratio*

Subbasin	A (ac)	P_w (in)	V_w (ac-ft)	R_v (-)
Elder Creek	3082.29	14.19	3645.24	0.164
Oak Creek	1527.27	16.34	2079.47	0.094
Plunge Creek	10974.08	24.26	22185.08	1.000
Storm Drain	547.03	13.46	613.40	0.028

The subsequent ratios were used to scale the Upper Plunge Creek stream gage record as a means for extrapolating the flow signal for the adjacent subbasins (Elder Creek, Oak Creek, and Greenspot Storm Drain).

Calculated Flow-Duration Frequency Flow Rates for Study Scenarios

The flow-duration frequency for each scenario is defined in Table 4.1 shown below. The 50th, 80th, and 90th percentile flows were quantified for the extrapolated for the following scenarios:

1. Oak Creek Flows Only
2. Greenspot Storm Drain Flows Only
3. Elder Creek + Upper Plunge Creek Flows
4. Elder Creek + Oak Creek + Upper Plunge Creek Flows

These values represent candidate diversion rates. To obtain these values, the overall stream gage record was scaled with the ratios defined from the PRISM data for each location (Elder, Oak, Greenspot Storm Drain). The resulting scaled datasets (and Plunge) were combined in accordance with the study scenarios and analyzed for flow-duration frequency.

Table 4.1: *Calculated Scaled Flow-Duration Frequency*

Flow Data Source/Combination	Flow Frequency (%, cfs)		
	50th	80th	90th
Oak Only	0.18	0.63	1.41
Storm Drain Only	0.05	0.19	0.42
Plunge + Elder	2.21	7.85	17.46
Plunge + Elder + Oak	2.39	8.48	18.87

Oak Creek Subbasin Storm Event Volume Analysis –Oak Creek Storm Flows Only

The description of the volume analysis for Oak Creek flows serves as a template for understanding the analysis in the following sections. The following sections contain variations of this assessment which include different combinations of flow.

A potential diversion scenario is that Oak Creek Basin would receive flows from Oak Creek above its confluence with Plunge Creek. For each potential diversion rate from Oak Creek only, the 187 flow events scaled for Oak Creek using the PRISM ratio were integrated to assess the divertible storm volume, the likely bypass volume, and the total volume of runoff for each event. The resulting set of calculated individual storm-event volumes per candidate diversion rate were statistically assessed. Through agreement with SBVWCD, JLC Engineering applied the following statistical distributions to each type of storm-event volume calculated from the PRISM scaled gage data:

Table 5: *Distribution used w/ respect to Volume Type Characterized*

Volume Type	Applied Distribution
Diverted	Normal
Bypass	Log-Normal
Total	Log-Pearson 3

Figure 4 demonstrates the probability distribution function (PDF) and cumulative distribution function (CDF) of the applied distribution assumptions for divertible storm-event volumes (Normal Distribution) and total storm-event volumes (Log-Pearson Type 3 distribution, LP3) for the 187 scaled storm-flow events in Oak Creek at the corresponding candidate diversion rates (i.e., 50th, 80th, and 90th percentile flow-duration frequency flow).

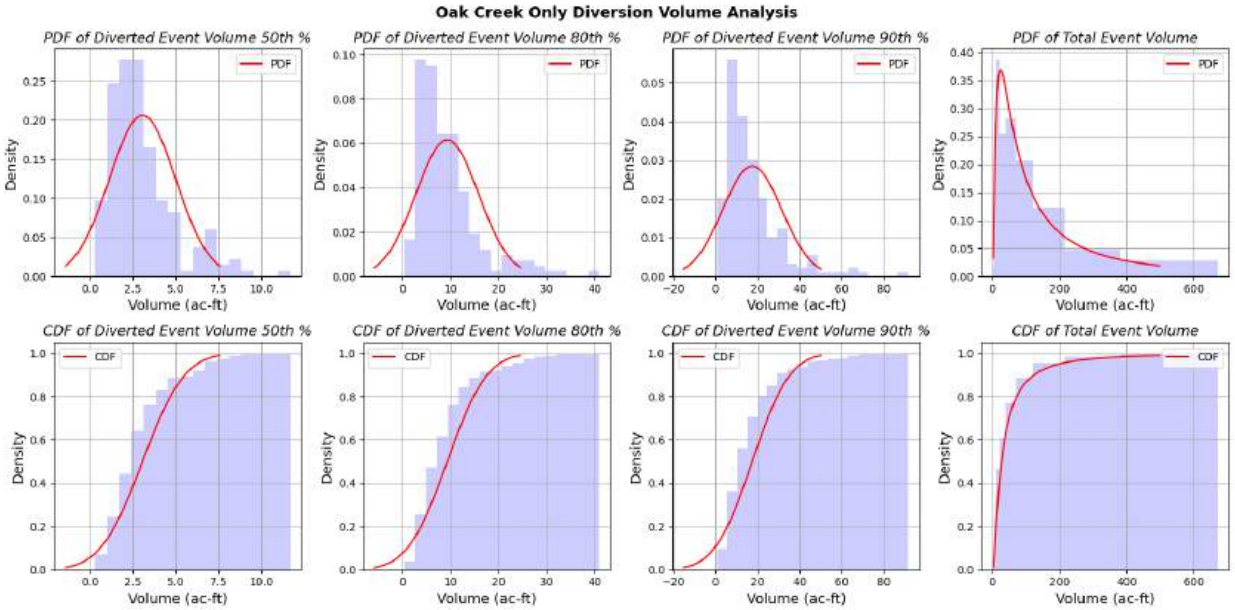
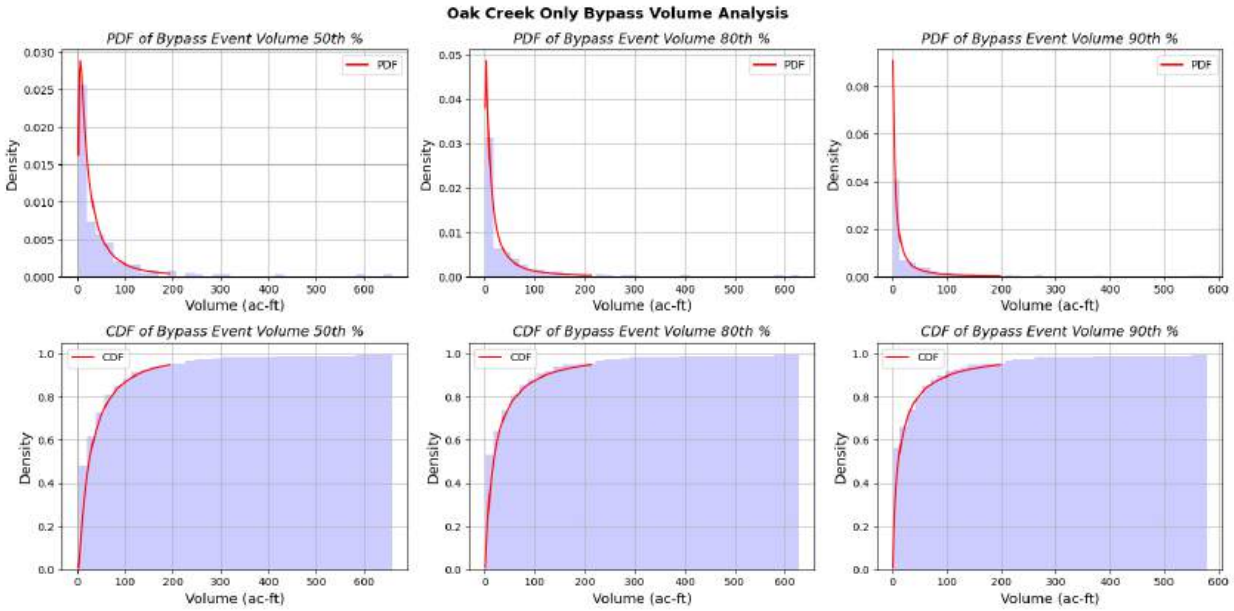


Figure 4: *PDF & CDF of Divertible Volumes at 3 Candidate Percentile Rates and Total Event Volumes (right-hand charts) per Event via Normal and LP3 Assumptions, respectively from Oak Creek Calculated Storm Events*

Figure 5 on the next page depicts the PDF and CDF of the applied Log-Normal distribution assumption overlaid on the histogram of candidate-diversion-rate-based bypass volumes.



Distribution

Figure 5: *PDF & CDF Bypassed Volumes per Event at 3 Candidate Percentile Rates via Log-Normal Distribution of Oak Creek Calculated Storm Events*

Table 6 depicts the CDF deciles for each Volume Type of interest across all candidate diversion rates.

Table 6: *Divertible and Bypassed Storm Volumes at Three Flow Diversion Rates & Total Storm Volume of Oak Creek Scaled Historic Storm-Events*

Candidate Diversion Flow-Duration Percentile (%)	Volume Type	Scaled Storm-Event Volume Deciles from CDF (ac-ft)								
		10th	20th	30th	40th	**50th=Median Volume**	60th	70th	80th	90th
50th Percentile (0.18 cfs)	Divertible	0.6	1.4	2.1	2.6	**3.1**	3.6	4.1	4.7	5.6
	Bypassed	5.4	9.0	13.1	18.2	**24.8**	33.9	47.4	70.4	122.0
80th Percentile (0.63 cfs)	Divertible	1.1	3.9	6.0	7.8	**9.4**	11.0	12.8	14.9	17.7
	Bypassed	2.7	5.0	7.8	11.6	**17.0**	25.0	37.7	61.4	120.9
90th Percentile (1.41 cfs)	Divertible	-0.4	5.7	10.2	14.0	**17.5**	21.1	24.9	29.3	35.5
	Bypassed	1.1	2.3	4.1	6.7	**10.5**	16.5	26.7	47.1	103.2
-	Total	7.6	11.6	15.9	21.1	**27.7**	36.7	50.0	72.6	124.5

Oak Creek Basin Storm-Event Volume Analysis – Greenspot Storm Drain Flows

The same approach for the Oak Creek Only flows was used to study the Greenspot Storm Drain (Greenspot SD) only flows. A summary of the analysis is contained within

the following figures and tables. Figure 6 and 7 demonstrate the PDF and CDF of the same applied distribution assumptions overlaid on the histogram of divertible volumes (Normal), bypassed volumes (Log-Normal), and total storm-event volumes (LP3).

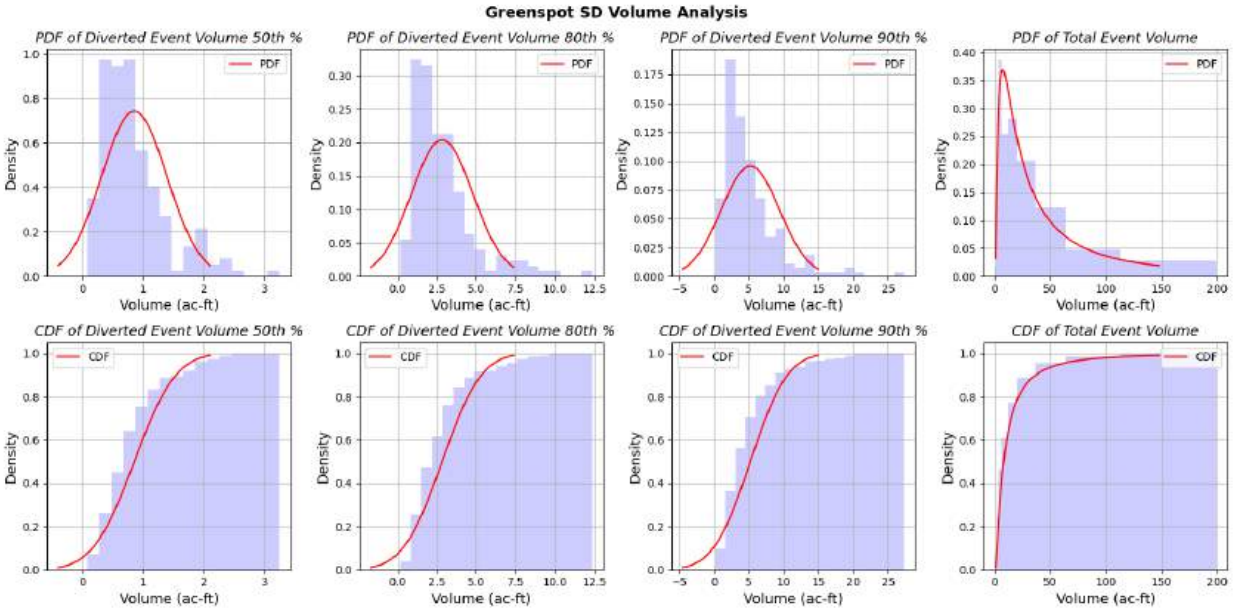


Figure 6: *PDF & CDF of Divertible Volumes at 3 Candidate Percentile Rates and Total Event Volumes (right-hand charts) per Event via Normal and LP3 Assumptions, respectively of Greenspot SD Calculated Storm Events*

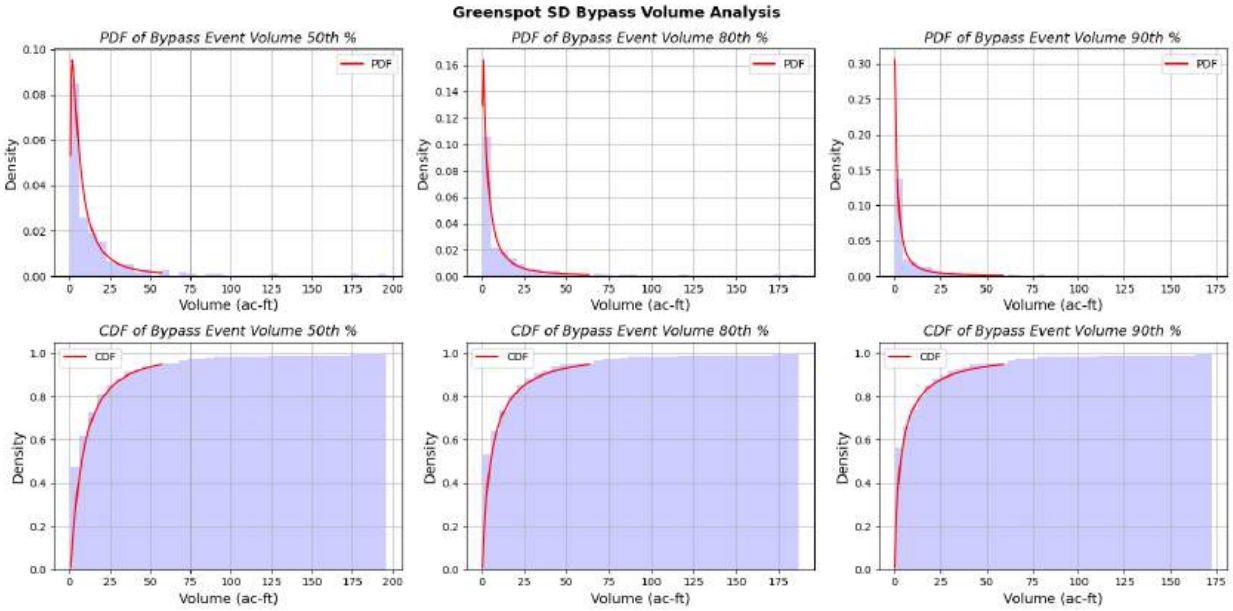


Figure 7: *PDF & CDF Bypassed Volumes per Event at 3 Candidate Percentile Rates via Log-Normal Distribution of Greenspot SD Calculated Storm Events*

Table 7 depicts the CDF deciles for each Volume Type of interest across all candidate diversion rates

Table 7: *Divertible and Bypassed Storm Volumes at Three Flow Diversion Rates & Total Storm Volume of Greenspot SD Scaled Historic Storm-Events*

Candidate Diversion Flow-Duration Percentile (%)	Volume Type	Scaled Storm-Event Volume Deciles from CDF (ac-ft)								
		10th	20th	30th	40th	**50th=Median Volume**	60th	70th	80th	90th
50th Percentile (0.05 cfs)	Divertible	0.17	0.4	0.57	0.72	**0.85**	0.99	1.14	1.31	1.54
	Bypassed	1.64	2.72	3.97	5.49	**7.47**	10.19	14.22	21.04	36.31
80th Percentile (0.19 cfs)	Divertible	0.32	1.18	1.8	2.33	**2.83**	3.32	3.85	4.47	5.33
	Bypassed	0.8	1.46	2.31	3.44	**5.04**	7.4	11.2	18.24	35.97
90th Percentile (0.42 cfs)	Divertible	-0.13	1.71	3.03	4.16	**5.22**	6.28	7.41	8.73	10.57
	Bypassed	0.32	0.7	1.22	1.98	**3.12**	4.9	7.96	14.02	30.76
-	Total	2.26	3.45	4.74	6.29	**8.26**	10.93	14.88	21.62	37.07

Plunge Creek Combined Event Analysis – Elder Creek + Plunge Creek

The same approach for the Oak Creek Only flows was used to study the combination of Elder Creek and Plunge Creek flows only with no contribution from Oak Creek. A summary of the analysis is contained within the following figures and tables. Figure 8 and 9 demonstrate the PDF and CDF of the same applied distribution assumptions overlaid on the histogram of recorded diverted volumes, bypass volumes, and total volumes.

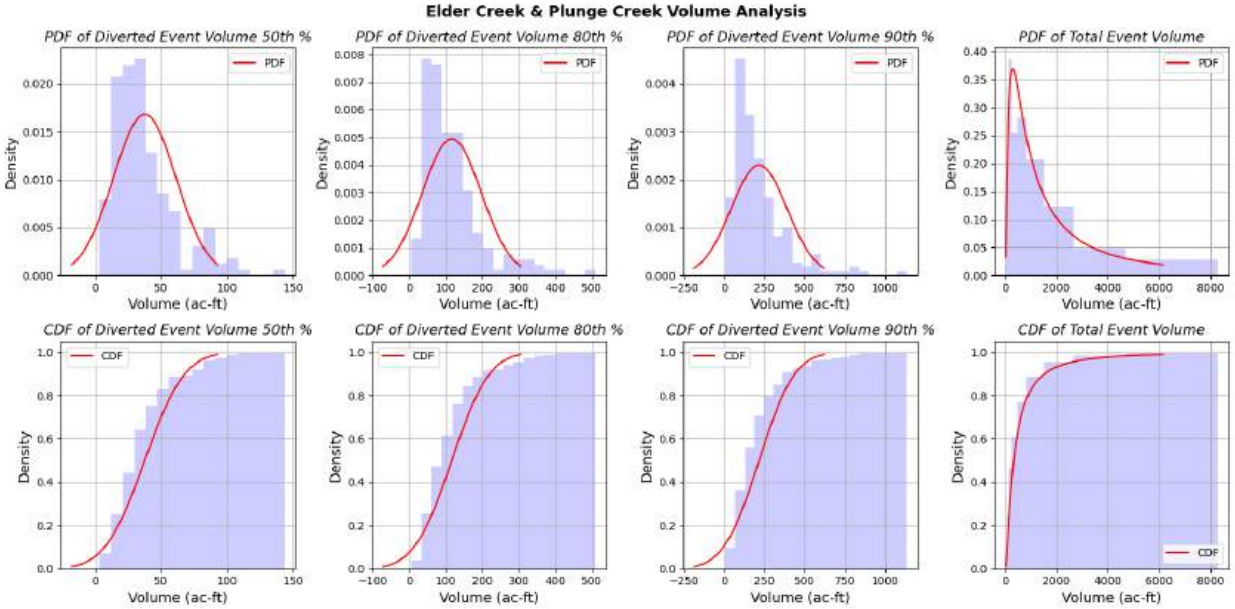


Figure 8: *PDF & CDF of Divertible Volumes at 3 Candidate Percentile Rates and Total Event Volumes (right-hand charts) per Event via Normal and LP3 Assumptions, respectively of Elder Creek + Plunge Creek Calculated Storm Events*

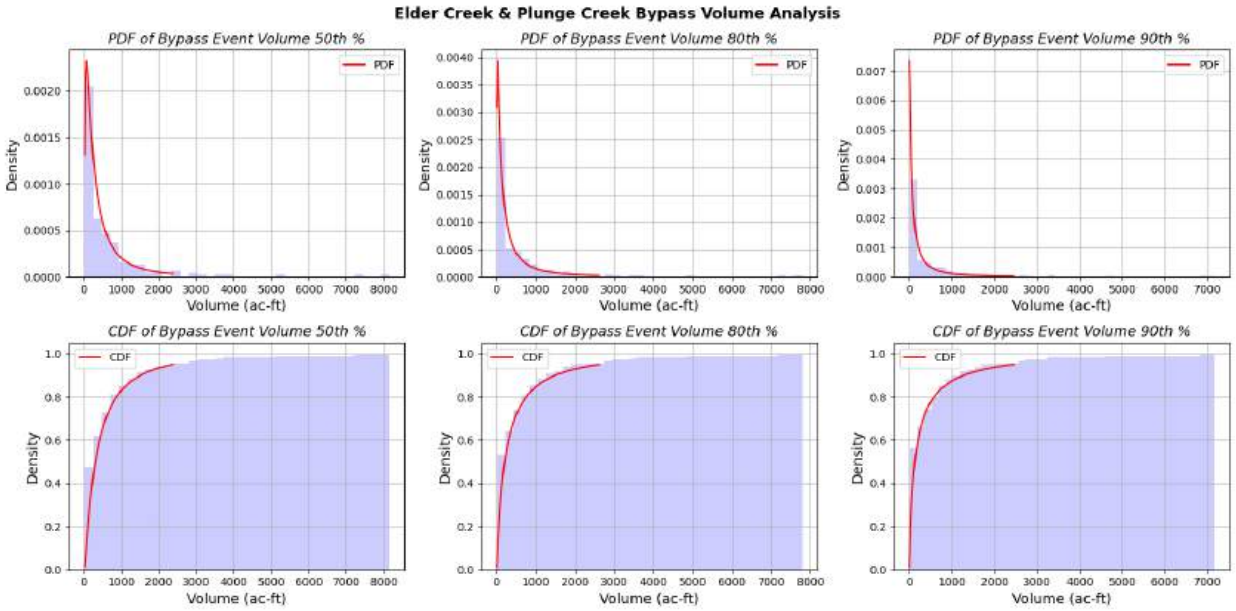


Figure 9: : *PDF & CDF Bypassed Volumes per Event at 3 Candidate Percentile Rates via Log-Normal Distribution of Elder Creek + Plunge Creek Calculated Storm Events*

Table 8 depicts the CDF deciles for each Volume Type of interest across all candidate diversion rates.

Table 8: *Divertible and Bypassed Storm Volumes at Three Flow Diversion Rates & Total Storm Volume of Elder Creek + Plunge Creek Scaled Historic Storm-Events*

Candidate Diversion Flow-Duration Percentile (%)	Volume Type	Scaled Storm-Event Volume Deciles from CDF (ac-ft)								
		10th	20th	30th	40th	**50th=Median Volume**	60th	70th	80th	90th
50th Percentile (2.21 cfs)	Divertible	7.26	17.71	25.24	31.68	**37.7**	43.72	50.15	57.69	68.14
	Bypassed	67.12	111.46	162.58	225.67	**307.59**	420.19	587.74	871.97	1509.95
80th Percentile (7.85 cfs)	Divertible	13.41	48.96	74.59	96.5	**116.97**	137.44	159.35	184.98	220.53
	Bypassed	33.59	61	96.21	143.56	**209.95**	308.28	466.4	759.18	1496.2
90th Percentile (17.46 cfs)	Divertible	-5.34	70.97	125.99	173	**216.95**	260.89	307.9	362.92	439.23
	Bypassed	13.21	28.89	50.87	82.5	**129.67**	203.84	330.73	582.78	1278.59
-	Total	93.92	143.28	197.13	261.45	**343.24**	454.24	618.59	898.57	1541.09

Plunge Creek Combined Event Analysis – Elder Creek + Plunge Creek + Oak Creek

As above, a combination of flows were considered which include Elder Creek, Plunge Creek, and Oak Creek. A summary of the analysis is contained within the following figures and tables.

Figure 10 and 11 demonstrate the PDF and CDF of the applied distribution overlaid on the histogram of recorded diverted volumes, bypass volumes, and total volumes.

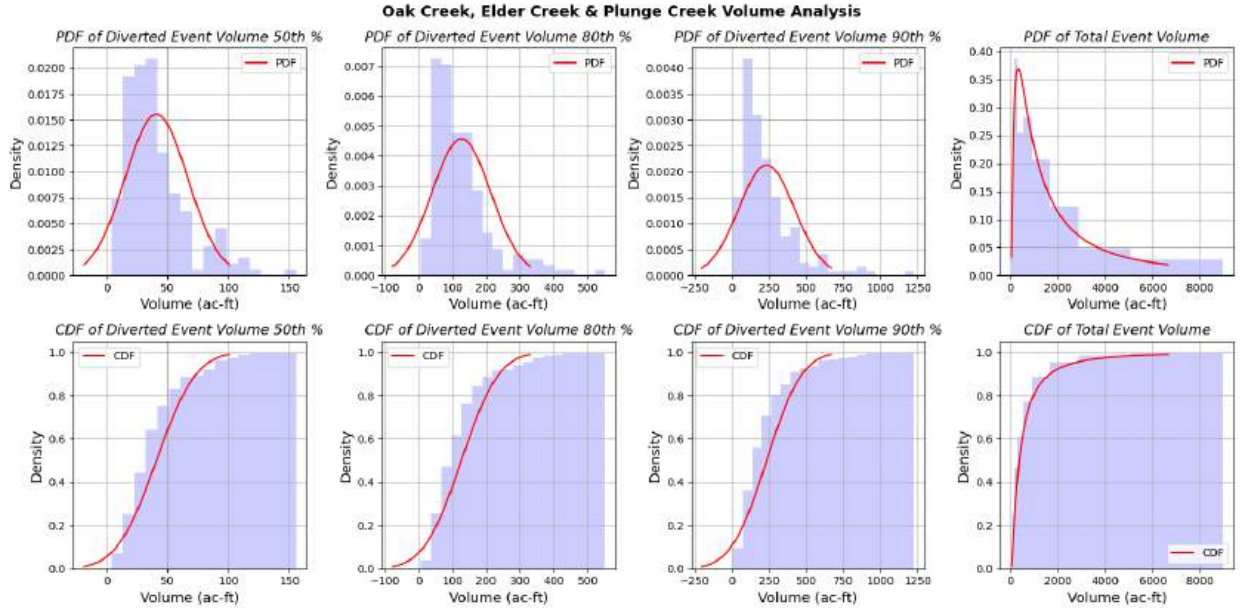


Figure 10: *PDF & CDF of Divertible Volumes at 3 Candidate Percentile Rates and Total Event Volumes (right-hand charts) per Event via Normal and LP3 Assumptions, respectively of Elder Creek + Plunge Creek + Oak Creek Calculated Storm Events*

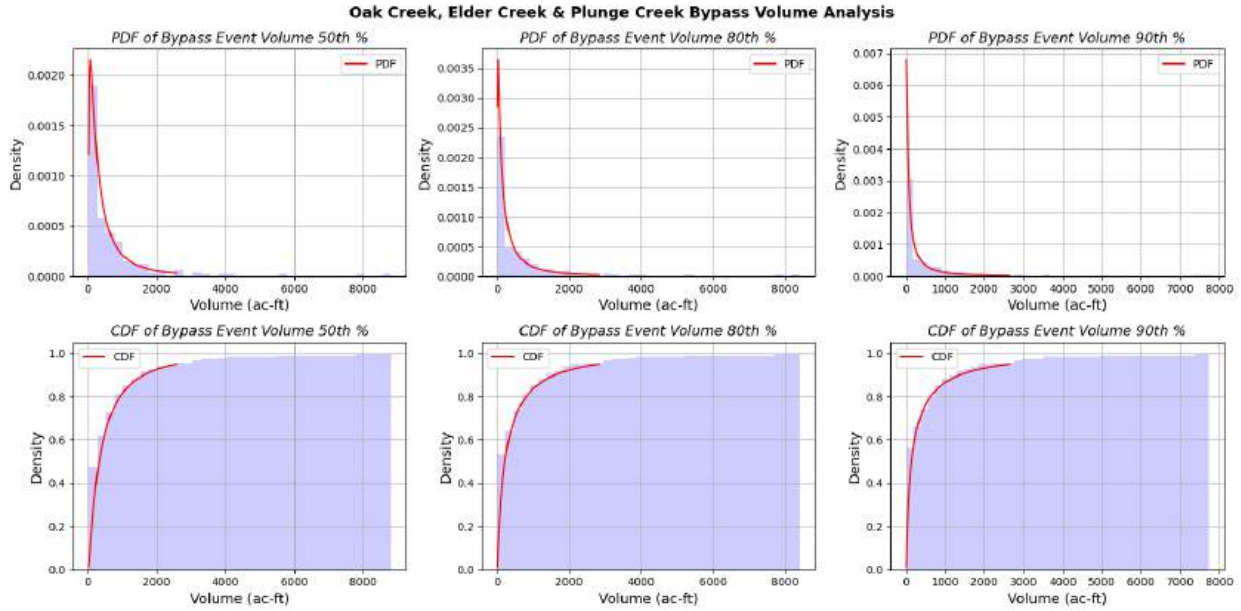


Figure 11: *PDF & CDF Bypassed Volumes per Event at 3 Candidate Percentile Rates via Log-Normal Distribution of Elder Creek + Plunge Creek + Oak Creek Calculated Storm Events*

Table 9 depicts the CDF deciles for each Volume Type of interest across all candidate diversion rates.

Table 9: *Divertible and Bypassed Storm Volumes at Three Flow Diversion Rates & Total Storm Volume of Elder Creek + Plunge Creek + Oak Creek Scaled Historic Storm Events*

Candidate Diversion Flow-Duration Percentile (%)	Volume Type	Scaled Storm-Event Volume Deciles from CDF (ac-ft)								
		10th	20th	30th	40th	**50th=Median Volume**	60th	70th	80th	90th
50th Percentile (2.39 cfs)	Divertible	7.85	19.15	27.3	34.26	40.77	47.27	54.24	62.39	73.69
	Bypassed	72.53	120.44	175.69	243.87	332.39	454.08	635.16	942.35	1631.89
80th Percentile (8.48 cfs)	Divertible	14.49	52.9	80.59	104.25	126.37	148.48	172.14	199.84	238.24
	Bypassed	36.32	65.94	104.01	155.19	226.95	333.24	504.14	820.57	1617.1
90th Percentile (18.87 cfs)	Divertible	-5.77	76.7	136.16	186.97	234.46	281.96	332.77	392.23	474.7
	Bypassed	14.27	31.23	54.97	89.16	140.14	220.3	357.44	629.85	1381.85
-	Total	101.5	154.85	213.05	282.57	370.95	490.92	668.54	971.13	1665.54

Identification of Historic Peak Flowrates by Percentile

Table 10 summarizes peak flow rates that are based upon a Log Pearson Type 3 distribution being applied to each scenarios' adjusted set of storm flow events to identify the median storm. This summary of peak flowrates is relevant to informing the selection of a project hydrograph for use in hydraulic assessments of potential recharge basins at the two project locations: (1) south of Greenspot Road near Plunge Creek, and (2) adjacent Plunge Creek at Orange Street.

Table 10: *Percentile Peak Flowrates*

Flow Data Source/Combination	LP3 50th Percentile Flow (cfs)	LP3 80th Percentile Flow (cfs)	LP3 90th Percentile Flow (cfs)
Oak Creek Only	11.0	27.6	47.7
Greenspot SD Only	3.3	8.2	14.2
Plunge + Elder Only	135.7	342.0	590.4
Plunge + Elder + Oak Only	146.6	369.6	638.1

Total storm volume may be useful during project hydrograph selection as well. The storm-volume return frequencies (e.g. 2-year return or median storm) were calculated by applying a LP3 Distribution to the 187 events peak stormflow rates in the scaled data to the scenarios. Those total storm volumes are shown in the volume analysis at the bottom of Tables 6, 7, 8, and 9 for each flow scenario evaluated. The three percentile storm volumes used here are highlighted in Tables 6, 7, 8, and 9 for cross reference. Some examples of representative hydrographs have been included in Appendix A, for Oak Creek, and in Appendix B, for the Plunge+Elder+Oak scaled flows in combination scenario.

Summary of Findings

This technical memorandum evaluates the Plunge Creek gage data and PRISM precipitation data to develop a 35 year record of flow in Plunge Creek, Elder Creek, Oak Creek and in the Greenspot SD. A series of 187 total events were defined on the raw dataset were isolated and studied to statistically represent typical storm durations (time period of events) and storm separations (time between events within same water year).

The 35 year record for each contributing water source was evaluated by scaling the Upper Plunge Creek gage record of real-time . Various flow source scenario combinations were developed and studied to estimate flow-duration frequencies for each over the period of record. Scenarios of interest included individual flow sources or combinations of them. The 50th, 80th, and 90th percentile flow-duration frequencies were used as candidate rates for flow diversion within each scenario of interest. These candidate values for flow rate diversion were used to quantify the divertible volume and the bypassed volume for each event defined in the record after being scaled and combined according to the scenario. The various results were analyzed with probability distributions to characterize the probabilistic frequency of these two volumes, potentially intercepted by diversion or potentially lost to bypass at each candidate diversion flow rate.

Peak flowrates and total event volume were studied with a Log-Pearson Type 3 distribution. The 50th, 80th, and 90th percentile approximations of total storm-event volumes for each flow scenario are summarized in each scenario's respective volume analysis table. Tables 6, 7, 8 and 9 (along with other deciles). In addition to percentile peak flowrates are listed in Table 10 for these same sized storms. The percentile storm identifies its return frequency (e.g., the 80th percentile storm is a 5-year return frequency event). Peak flow rates by return frequency storm event may aid in identifying a good diversion rate sizing at either of the project sites.

ATTACHED FIGURES

Subbasin	A (ac)	P_w (in)	V_w (ac-ft)	R_v (-)
Elder Creek	3082.29	14.19	3645.24	0.164
Oak Creek	1527.27	16.34	2079.47	0.094
Plunge Creek	10974.08	24.26	22185.08	1.000
Storm Drain	547.03	13.46	613.40	0.028

Ratios of Annual Precipitation Volume:
Volume = Precipitation * Area

Note that all ratios are with reference to Plunge Creek. Therefore, ratios are computed as:

Wshed Ratio = Volume Wshed / Volume Plunge

Elder / Plunge

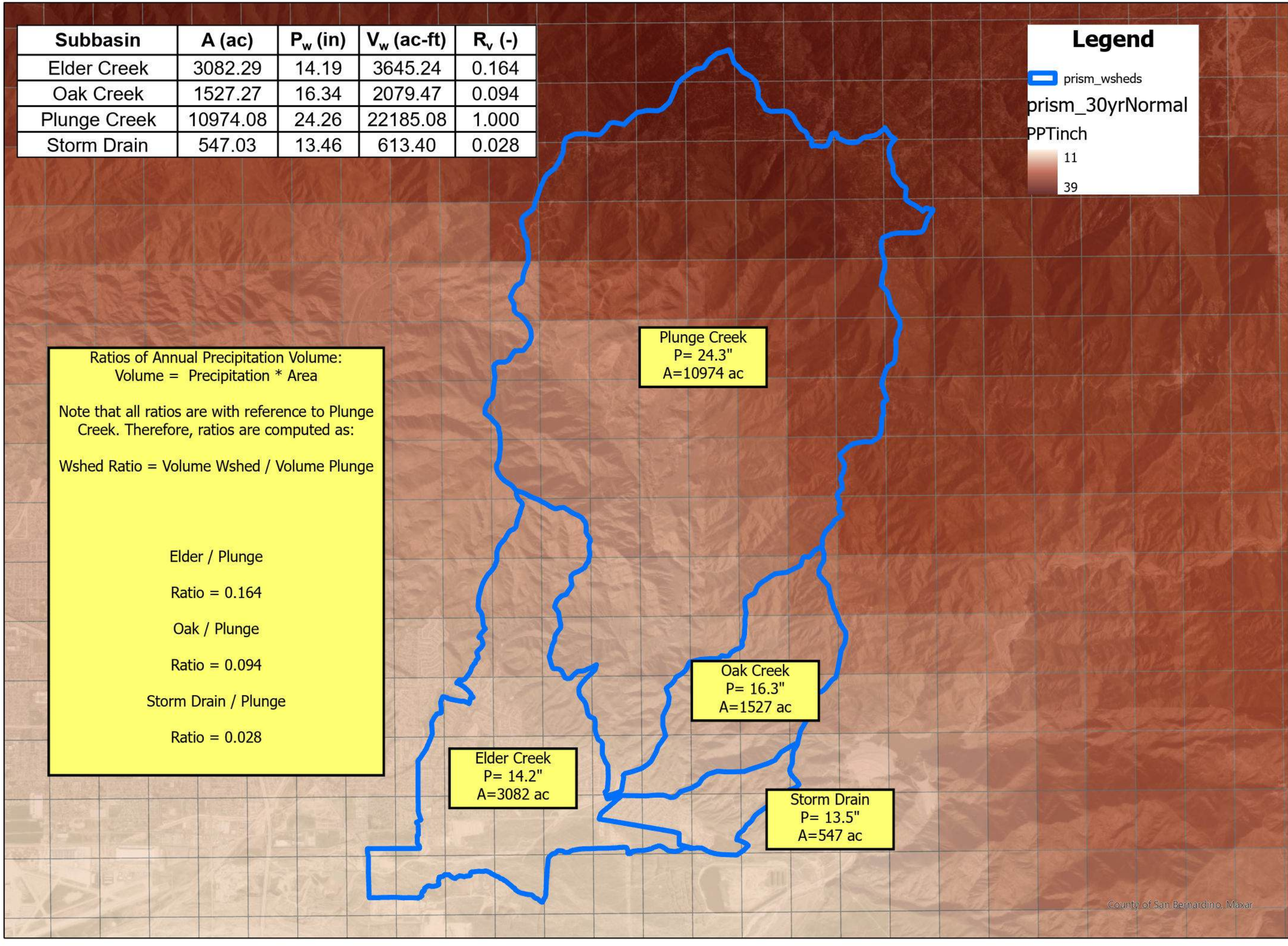
Ratio = 0.164

Oak / Plunge

Ratio = 0.094

Storm Drain / Plunge

Ratio = 0.028



TITLE: PRISM DATA MAP

PROJECT: Plunge Creek, Highland, CA

SCALE: 1:55,000

DATE: 9/17/24

JLC Engineering & Consulting, Inc.
MURRIETA, CA 92562
Office 951.304.9552 Fax 951.304.3568

FILE NAME:

FIGURE

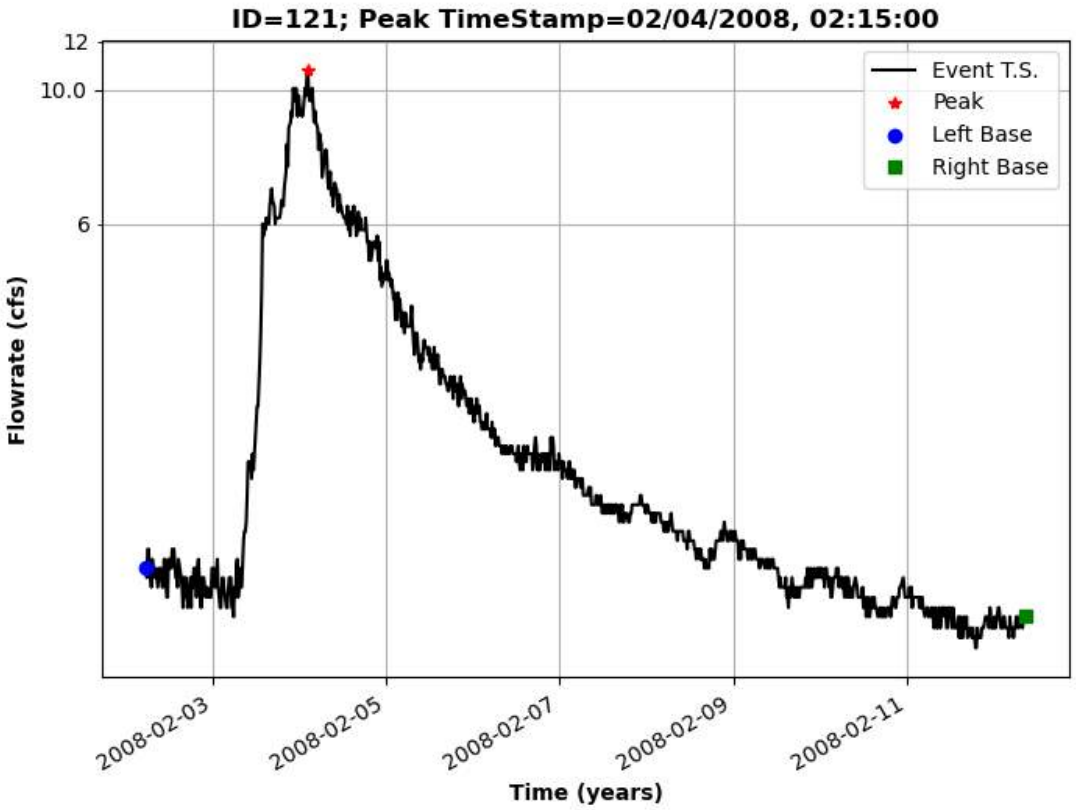
A

Appendix A: Oak Creek Only – Representative Hydrographs

Appendix A:

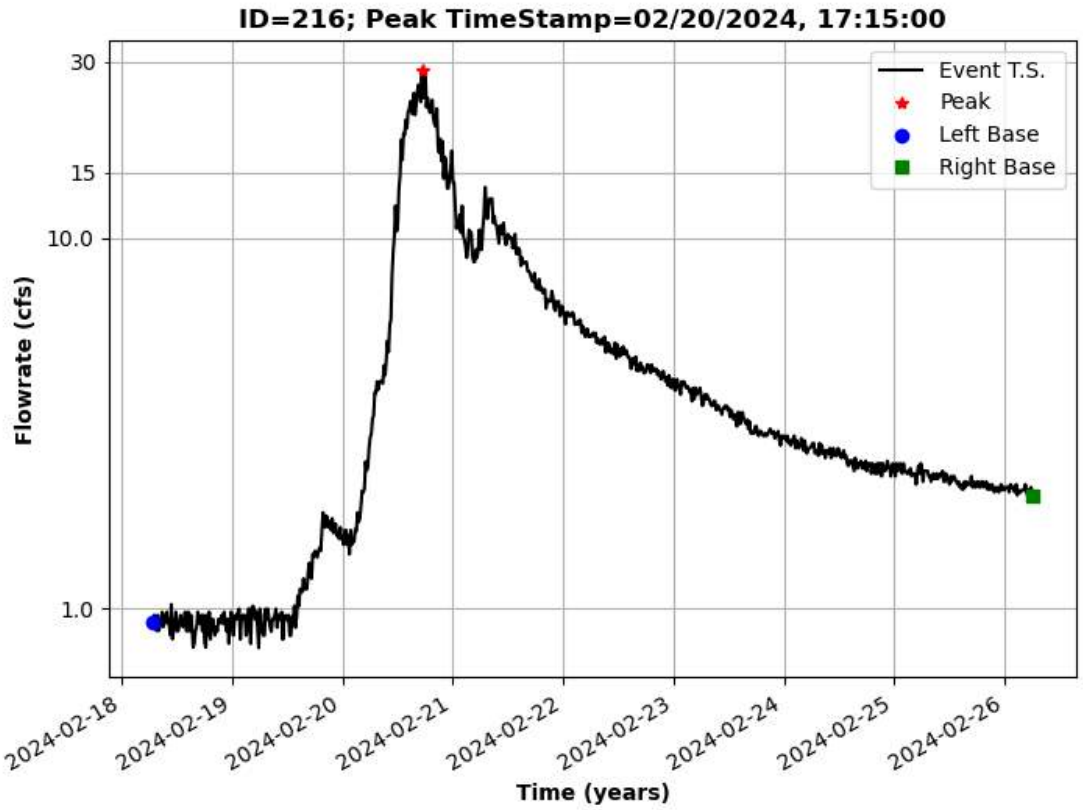
Representative events are selected by choosing the event (of 187 possible events) which has a peak flowrate closest to the corresponding probabilistic peak flowrate from Table 10 for the given scenario. For example, Oak Creek 50th percentile peak flowrate is 11 cfs. Figure A.1 shows an event which has a peak of 10.8 cfs. Note that events are scaled based on the scenario described, in this case scaled to Oak Creek Only flows. Note each hydrograph denotes duration (Dur), left base flowrate (Ql), right base flowrate (Qr), peak flowrate (Qp), and total volume (Vt). Approximately five months of flow for Water Year 2023 and 2024 have been provided. Both figures demonstrate continuous periods of time where the flow exceeds the low flow cutoff and demonstrates character of subsequent events in the system.

Figure A.1: 50th Percentile Representative Event



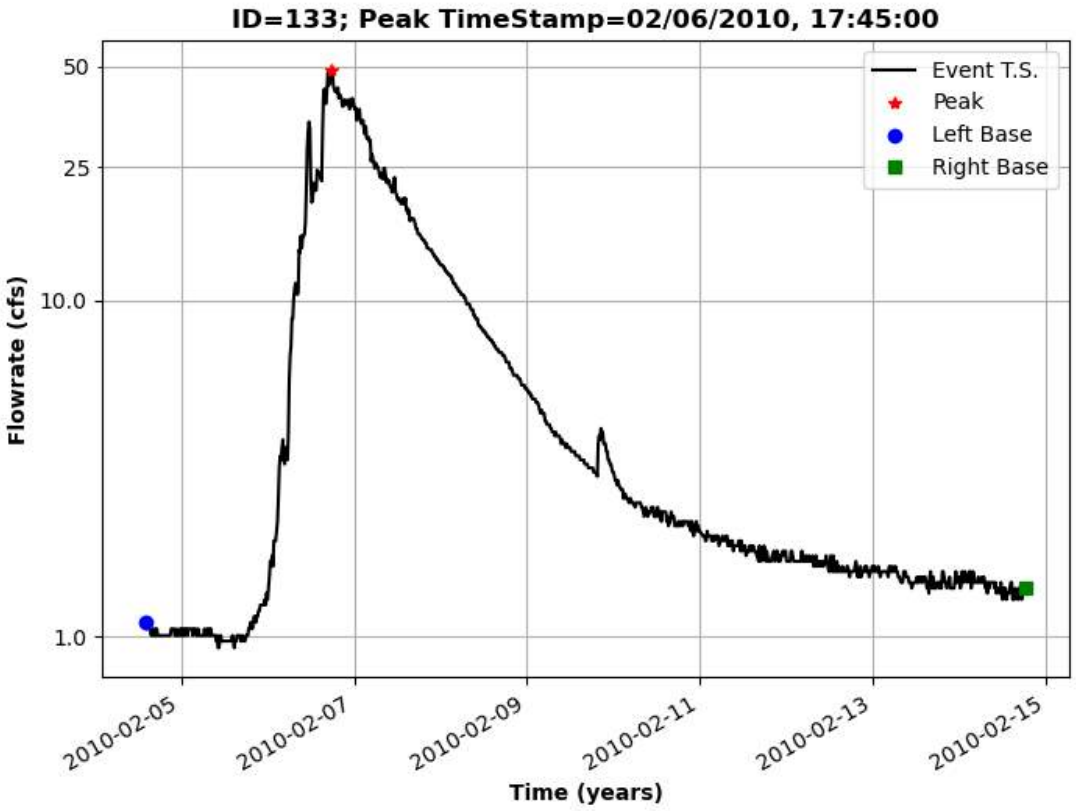
Dur=10.1 days, Ql=1.6 cfs, Qp=10.8 cfs, Qr=1.3 cfs, Vt=54.6 ac-ft

Figure A.2: 80th Percentile Representative Event



Dur=8.0 days, Ql=0.9 cfs, Qp=28.6 cfs, Qr=2.0 cfs, Vt=72.9 ac-ft

Figure A.3: 90th Percentile Representative Event



Dur=10.2 days, Ql=1.1 cfs, Qp=49.0 cfs, Qr=1.4 cfs, Vt=132.8 ac-ft

Figure A.4: WY 2023 Subsequent Events

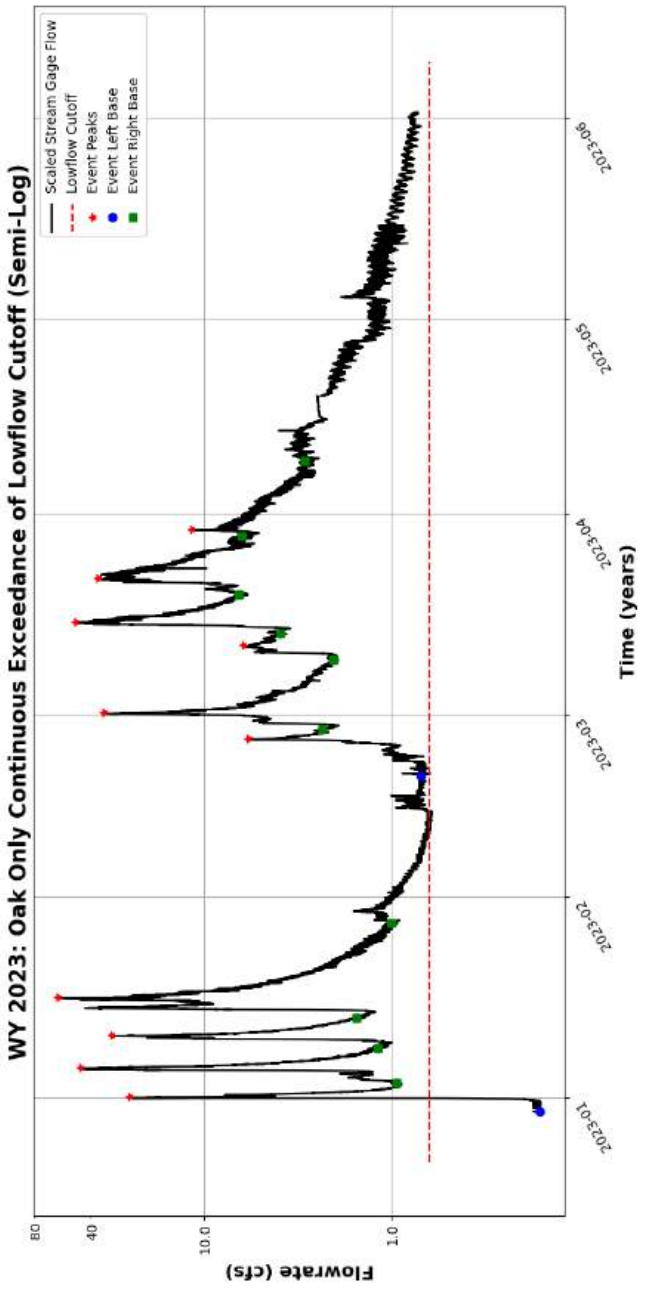
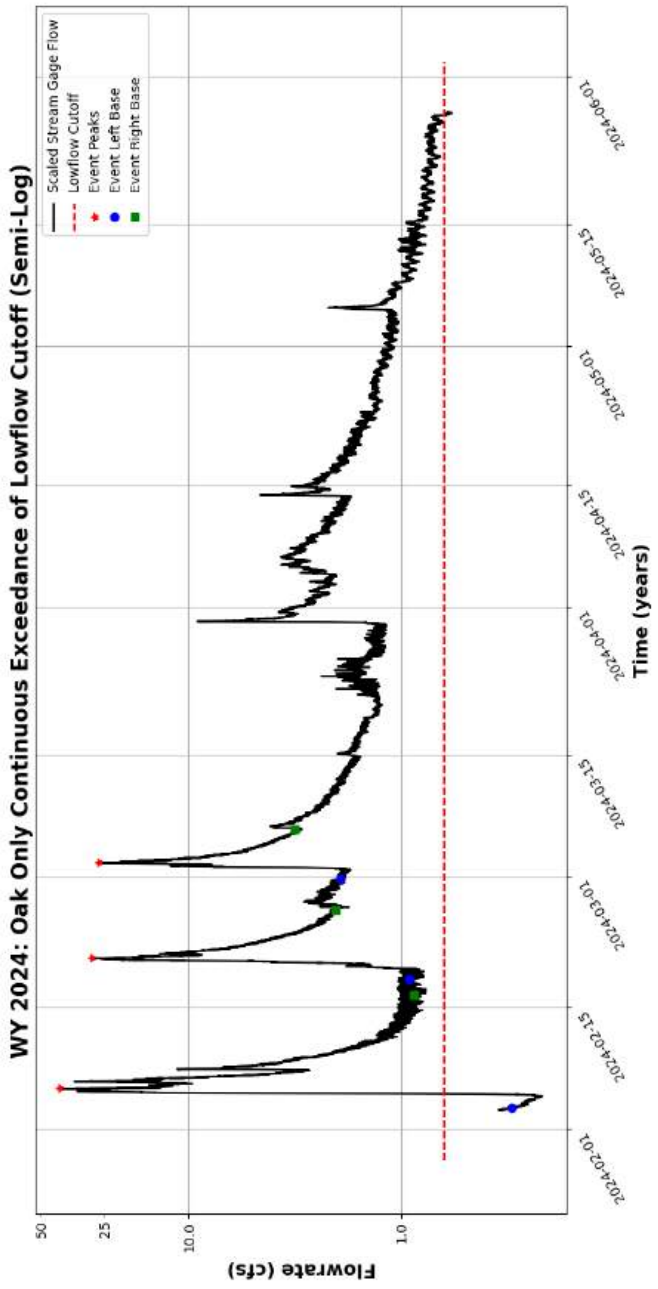


Figure A.5: WY 2024 Subsequent Events

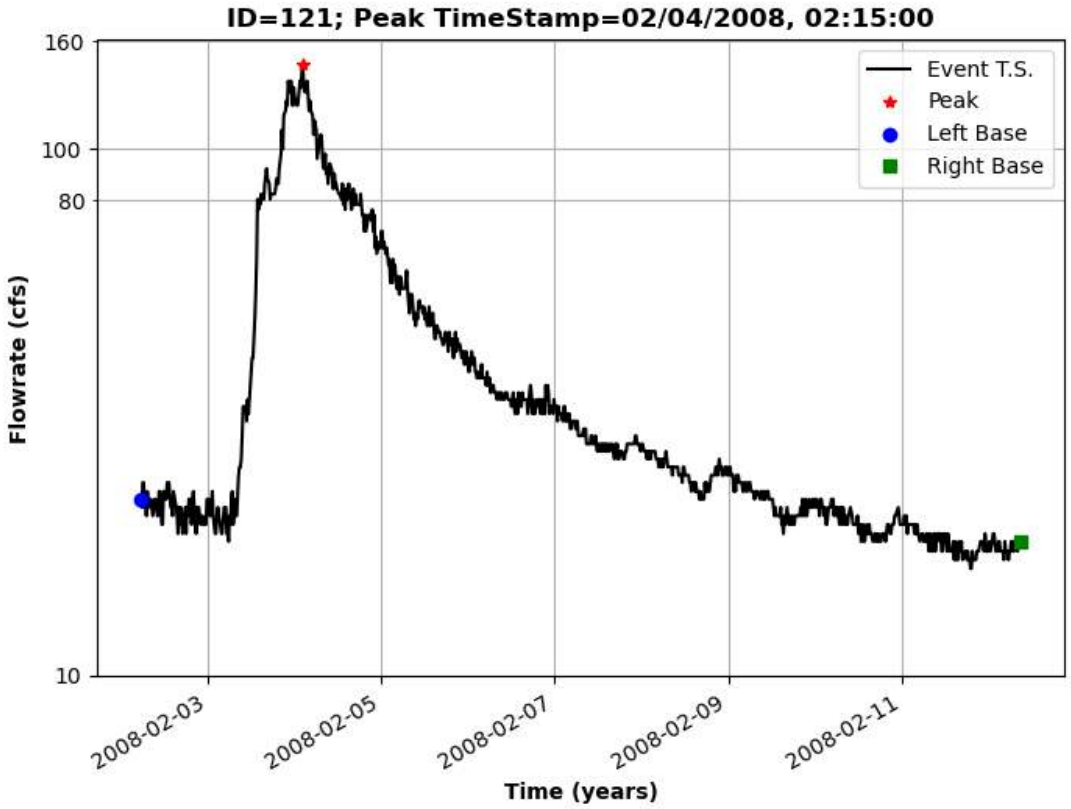


Appendix B: Plunge/Elder/Oak Creek – Representative Hydrographs

Appendix B:

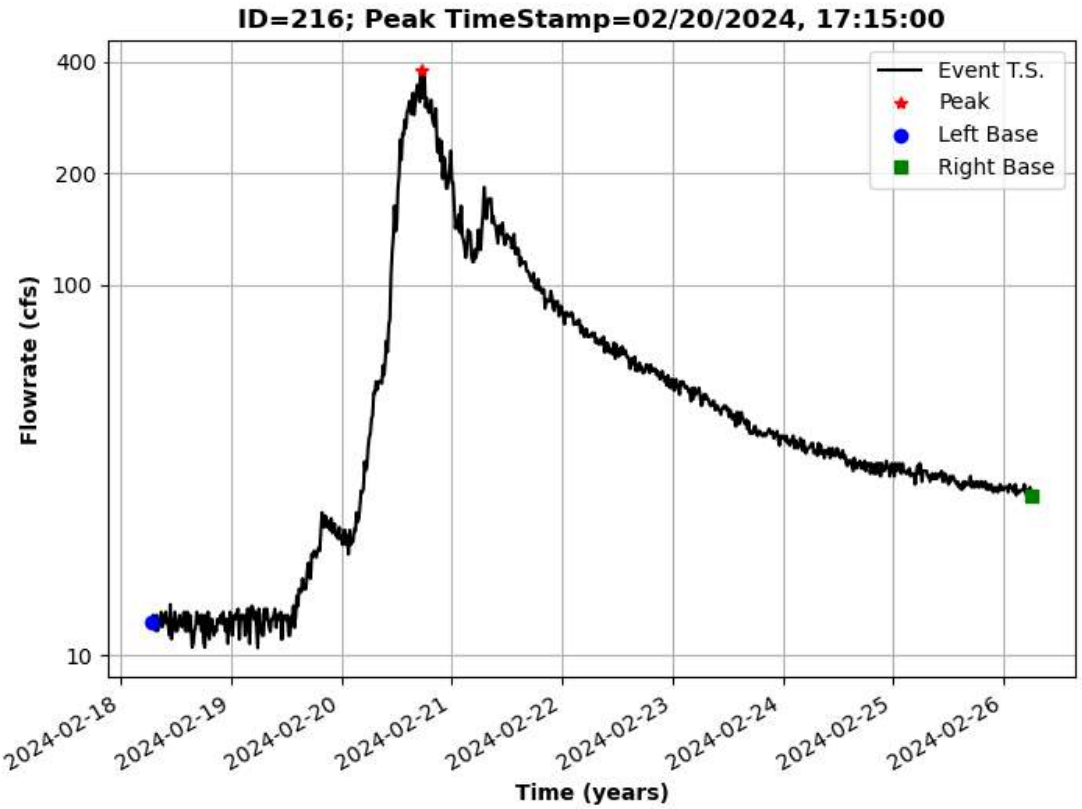
Representative events are selected by choosing the event (of 187 possible events) which has a peak flowrate closest to the corresponding probabilistic peak flowrate from Table 10 for the given scenario. For example, Plunge/Elder/Oak Creek 50th percentile peak flowrate is 146.6 cfs. Figure B.1 shows an event which has a peak of 144.7 cfs. Note that events are scaled based on the scenario described, in this case scaled to Plunge/Elder/Oak combined flows. Note each hydrograph denotes duration (Dur), left base flowrate (Ql), right base flowrate (Qr), peak flowrate (Qp), and total volume (Vt). Approximately five months of flow for Water Year 2023 and 2024 have been provided. Both figures demonstrate continuous periods of time where the flow exceeds the low flow cutoff and demonstrates character of subsequent events in the system.

Figure B.1: 50th Percentile Representative Event



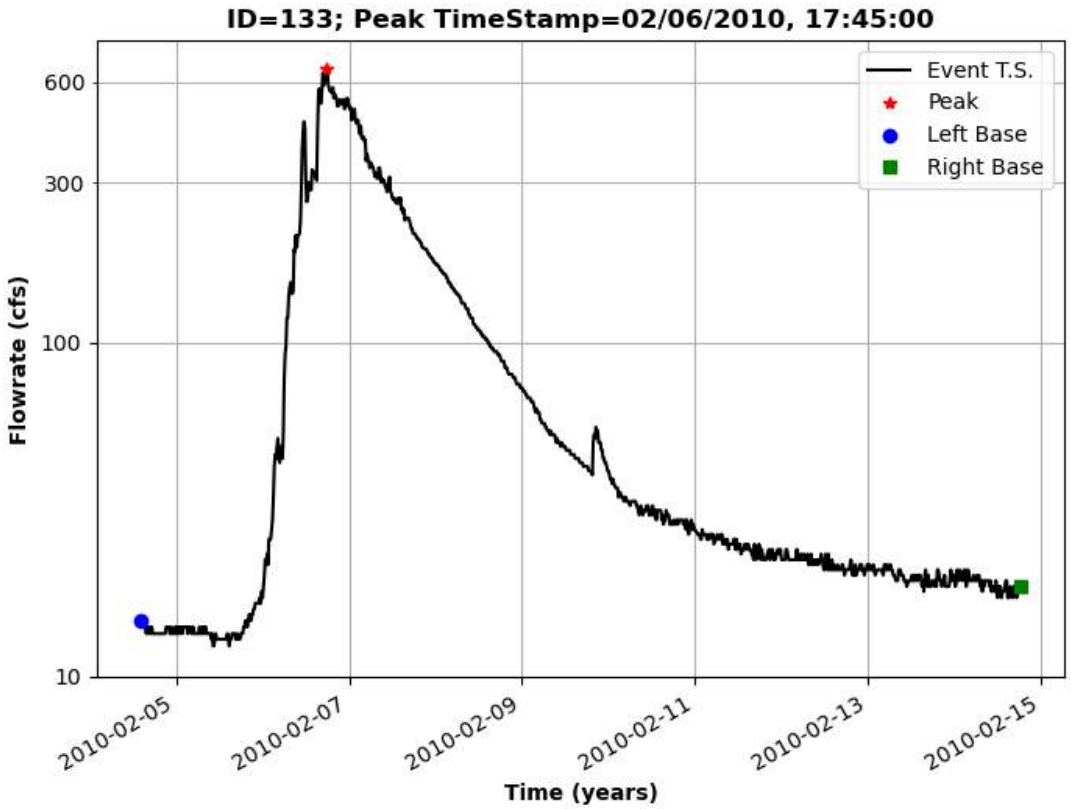
Dur=10.1 days, Ql=21.6 cfs, Qp=144.7 cfs, Qr=18.0 cfs, Vt=730.8 ac-ft

Figure B.2: 80th Percentile Representative Event



Dur=10.1 days, Ql=21.6 cfs, Qp=144.7 cfs, Qr=18.0 cfs, Vt=730.8 ac-ft

Figure B.3: 90th Percentile Representative Event



Dur=10.2 days, Ql=14.7 cfs, Qp=655.4 cfs, Qr=18.6 cfs, Vt=1777.8 ac-ft

Figure B.4: WY 2023 Subsequent Events

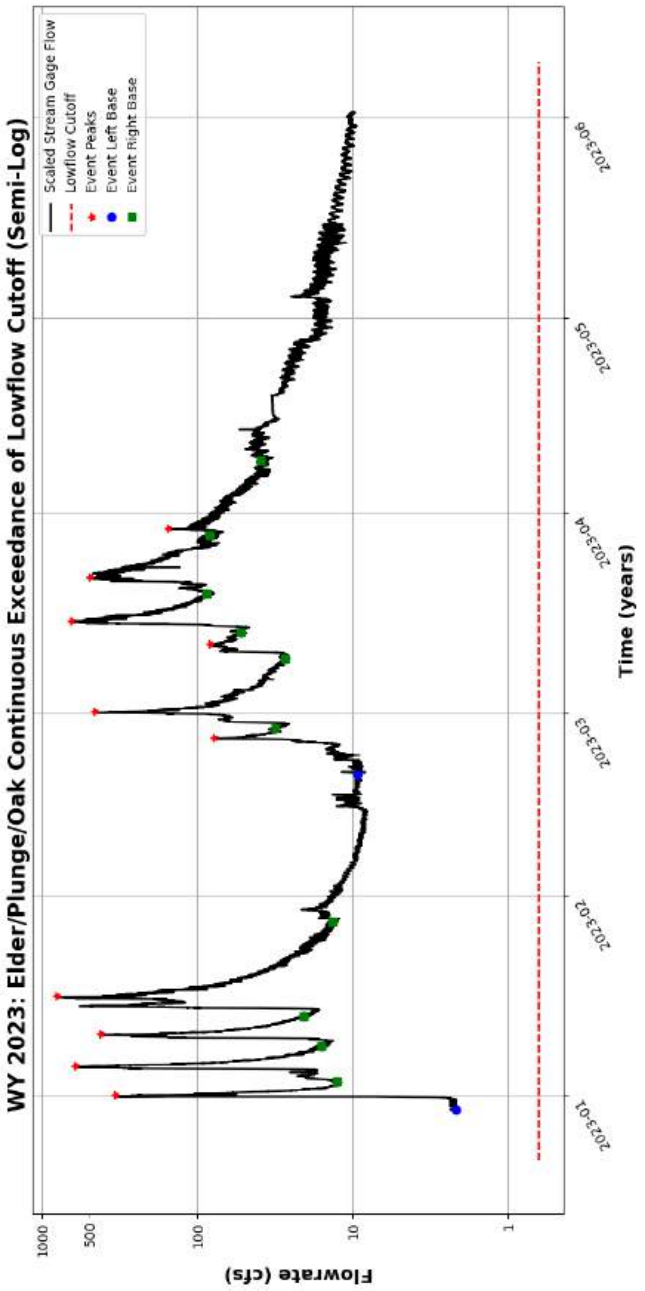
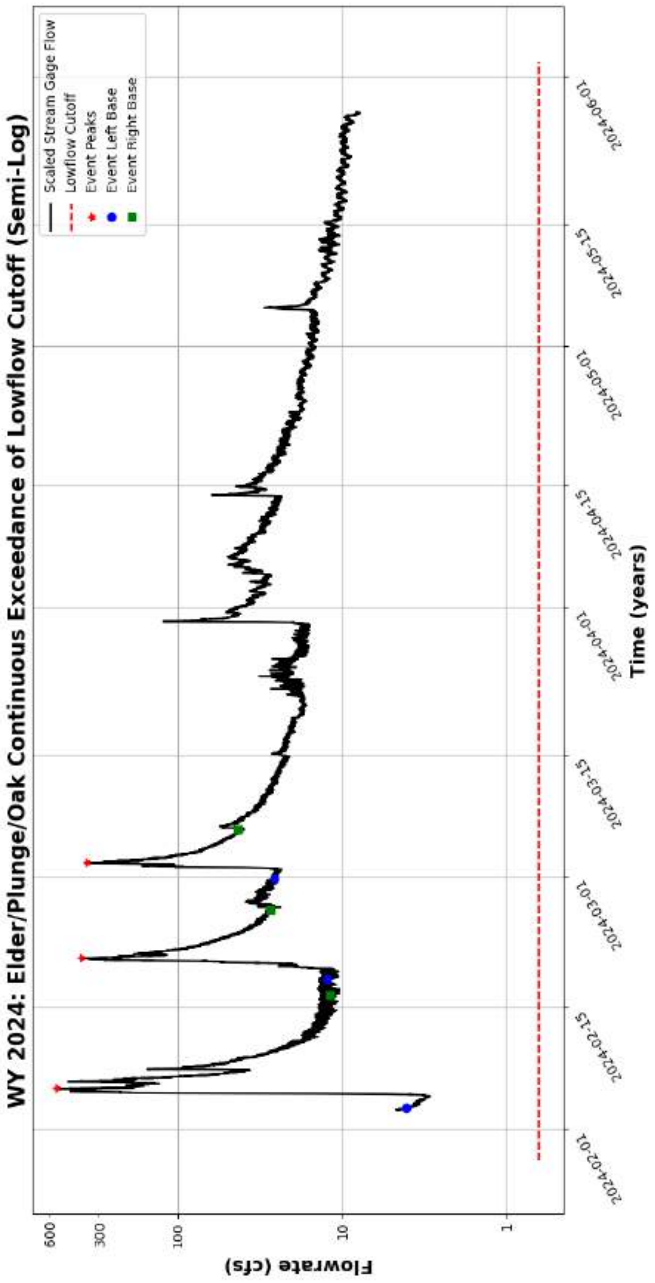


Figure B.5: WY 2024 Subsequent Events



ADDENDUM PCI-3: BASIN ROUTING

Plunge Creek Interim Project
Basin 1: Stage-Storage-Discharge Table

Elevation	Depth (ft)	Area (ac)	Incremental Volume (ac-ft)	Cumulative Volume (ac-ft)	Unclogged Flowrate (cfs)	Clogged Flowrate (cfs)
1254	0	0.95	0.00	0.00	0.00	0.00
1256	2	1.05	2.00	2.00	1.88	0.94
1258	4	1.15	2.20	4.20	2.05	1.02
1260	6	1.24	2.39	6.59	2.22	1.11
1262	8	1.34	2.58	9.17	2.40	1.19
1264	10	1.44	2.78	11.95	2.58	1.28
1266	12	1.54	2.98	14.93	2.76	1.37
1268	14	1.65	3.19	18.12	2.95	1.47
1270	16	1.75	3.40	21.51	3.14	1.56

The Flowrate ("Discharge") shown in the table is infiltration not outflow.

Plunge Creek Interim Project
Basin 2: Stage-Storage-Discharge Table

Elevation	Depth (ft)	Area (ac)	Incremental Volume (ac-ft)	Cumulative Volume (ac-ft)	Unclogged Flowrate (cfs)	Clogged Flowrate (cfs)
1254	0	1.37	0.00	0.00	0.00	0.00
1256	2	1.50	2.87	2.87	2.69	1.34
1258	4	1.63	3.13	6.00	2.92	1.45
1260	6	1.76	3.39	9.40	3.16	1.57
1262	8	1.90	3.67	13.06	3.41	1.69
1264	10	2.05	3.95	17.01	3.66	1.82
1266	12	2.19	4.24	21.25	3.93	1.95

The Flowrate ("Discharge") shown in the table is infiltration not outflow.

Plunge Creek Interim Project
Basin 3: Stage-Storage-Discharge Table

Elevation	Depth (ft)	Area (ac)	Incremental Volume (ac-ft)	Cumulative Volume (ac-ft)	Unclogged Flowrate (cfs)	Clogged Flowrate (cfs)
1244	0	1.95	0.00	0.00	0.00	0.00
1246	2	3.92	5.76	5.76	7.03	3.49
1248	4	6.30	10.13	15.88	11.27	5.60
1250	6	8.13	14.38	30.27	14.55	7.23
1252	8	8.43	16.56	46.83	15.09	7.50
1254	10	8.69	17.12	63.94	15.55	7.73
1256	12	8.94	17.62	81.57	16.00	7.96
1258	14	9.19	18.13	99.70	16.46	8.18
1260	16	9.45	18.64	118.34	16.91	8.41

The Flowrate ("Discharge") shown in the table is infiltration not outflow.

Technical Memorandum

Date: **January 26, 2025**

To: **John Lambie, PE, Chief Engineer San Bernardino Valley Water Conservation District**

From: **Joseph L. Castaneda, P.E.**

Re: **Plunge Creek Basins & Oak Creek Basins Routing Assessment**

Introduction

This technical memorandum was produced for the San Bernardino Valley Water Conservation District (SBVWCD) in support of the requested routing assessment of the proposed Plunge Creek and Oak Creek basins. The Oak Creek and Plunge Creek Project Alternatives have been assessed with a basin routing model to develop an understanding of their functionality. The basins have been independently assessed using basin routing for the following Project Alternatives:

1. Oak Creek Basins (see Addendum A)
2. Plunge Creek Interim Conditions Basins (see Addendum B)
3. Plunge Creek Mined-Conditions Basins (see Addendum C)

The inflow data which is routed through each basin is defined as:

- **Native Inflow** - Inflow defined by the Technical Memorandum for the Oak Creek Basin and Plunge Creek Basin feasibility study using statistical assessment in order to identify a historic project site typical hydrograph (PTH TM, JLC, Oct. 2024).

The inflow data which is routed only through the Oak Creek Basin is defined as:

- **FIRO Inflow** - Inflow defined by the SBVWCD in coordination with the Forecast-Informed Reservoir Operations (FIRO) program.

The PTH TM was developed in coordination with SBVWCD staff to statistically define expected inflow events. Stream gage data in Plunge Creek was studied to identify candidate inflow hydrographs. Approximately 187 events were detected and statistically assessed by their runoff volume production using applicable probability distributions for hydrologic event analysis. The event data was extrapolated to adjacent watershed areas using watershed area and relative precipitation over each watershed area as a

proxy for variability in runoff volume scale between watersheds. The precipitation data used for this process was determined using the PRISM dataset which defines 30 year normal annual precipitation for the region. The PTH TM identified storm event #121 of 187 as a typical, median sized stormflow event (i.e., middle of the range) to be considered for analysis of the proposed basin infrastructure. Note that event #121, the typical hydrograph, is scaled differently based on the basin it is applied to in order to account for the different magnitude in flows tributary to each basin.

For analysis of Oak Creek Basin, storm event #121 has been scaled to account for flow from the Oak Creek watershed and nearby Greenspot Storm Drain watershed area. For analysis of Plunge Creek Basin, storm event #121 has been scaled to account for flow from Oak Creek watershed, Plunge Creek watershed, and Elder Creek watershed. The watersheds are in reference to Figure A of the PTH TM.

Based on an approximation of five storms per year (assumed due to 187 storms found over 35 year record), SBVWCD requested that the routing inflow event referred to as the project typical hydrograph (PTH) and defined by the PTH TM consist of five consecutive typical hydrographs to determine how the proposed basins would operate under this condition. SBVWCD requested that the events be consecutive with no separation between events such that the first time step of the subsequent event follow the last time step of the previous event. This decision is based upon findings that the median separation between storm events in the region is zero days in the PTH TM analysis.

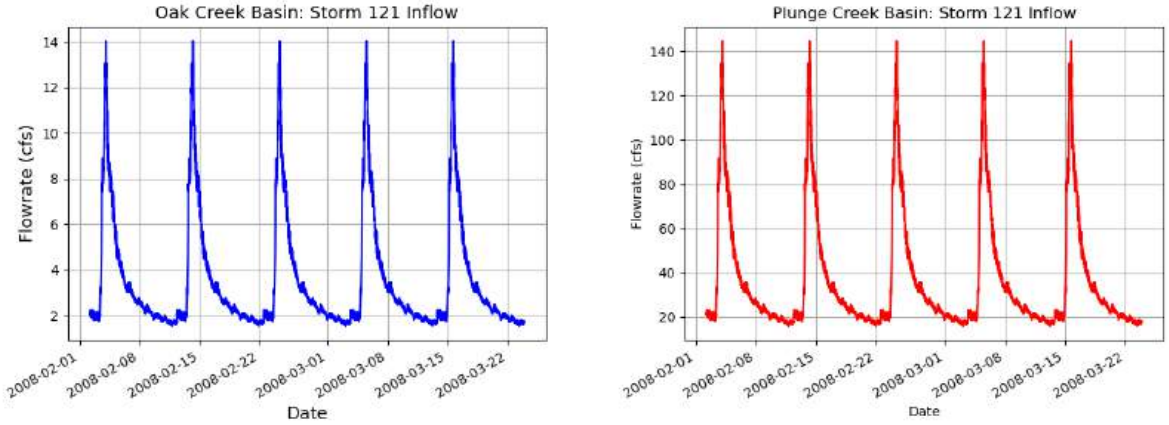


Figure 1: *Native Inflow for Oak Creek Basin (left) and Plunge Creek Basin (right)*

The decision to model the inflows in this fashion is consistent with behavior observed from the stream gage analysis of Plunge Creek in the PTH TM. Generally, most events occur in the spring between February and May of any given year. The receding tail of any single event is generally long and drawn out over a long period which creates long periods of constant low flows through Plunge Creek and Oak Creek. The long period of consistent lows flows with intermittent peak flows from periodic median storm events are the primary target for infiltration. Inflow events of this character will be applied to both Oak Creek and Plunge Creek Basins. The duration of the five consecutive hydrographs

is approximately 50 days (about 10 days per event). The peak flow for each hydrograph in the set is approximately 14 cfs and 145 cfs in Oak Creek and Plunge Creek, respectively. The cumulative volume of each hydrograph is 354.5 ac-ft and 3655.5 ac-ft in Oak Creek and Plunge Creek, respectively.

Coordination between SBVWCD and the FIRO program have created an opportunity for periods of constant inflow to the Oak Creek basin only. The FIRO program allows a coordinated release of flow from upstream reservoirs as dictated by state water managers. As a result, SBVWCD has requested that the Oak Creek basin be assessed for a constant inflow event given an inflow magnitude and duration. The FIRO inflow has been requested as 35 cfs over 52 days.

HEC-HMS: Routing Model

HEC-HMS, developed by the US Army Corp of Engineers (USACE), was used to model the routing of inflow hydrographs through the proposed basins. Due to the simple configuration of the proposed basins and inflow scenarios of interest, the most cost/time effective modeling approach was identified to be routing with the Modified Puls Method (also known as level pool routing). The long duration of inflows that were requested to be modeled by the SBVWCD necessitated the use of HEC-HMS over other tools capable of invoking the Modified Puls Method.

The Modified Puls Method is widely used and powerful for understanding storage in a large reservoir (basin) such as the proposed Oak Creek and Plunge Creek basins. The method is developed through discretizing the continuity equation and is one-dimensional. The equation is as follows:

$$\overline{I_t} - \overline{O_t} = \frac{\Delta S}{\Delta t}$$

where $\overline{I_t}$ and $\overline{O_t}$ are time averaged inflow/outflow over a time period Δt, and ΔS is the change in storage during that period. This concept can be simplified to mean that the rate at which stored volume in the basin is changing (increasing/decreasing) is simply the difference between the inflow and outflow at the given time step. Therefore, if inflow is greater than outflow there is an accumulation of runoff stored in the basin. In contrast, if outflow exceeds inflow then there is a decrease in runoff stored in the basin.

This method relies on the development of a function governing the relationship between stage and outflow in the proposed basin. The outflow mechanisms in each basin are (1) spillway and (2) infiltration. Both are a function of stage and can be tabulated and provided to the HEC-HMS routing model for use in resolving the Modified Puls method. Spillways are resolved by modeling the proposed spillways as rectangular weirs with the weir equation. Infiltration is modeled based upon the provided clogged and unclogged infiltration rates from SBVWCD. As requested by the district, outflow due to infiltration was modeled as a function of wetted area which was approximated by the surface area of each enclosed topographic contour defined by the basin grading. As a result, the

outflow due to infiltration increases as a function of stage by way of the corresponding increase in wetted area.

The **clogged** and **unclogged** infiltration rates were provided by SBVWCD. SBVWCD requested that the infiltration rate be considered to increase as a function of wetted area and that the infiltration rate not decay in time. The area of the water surface for a given water surface elevation was used as a proxy for wetted area when evaluating the infiltration outflow in each basin.

The HEC-HMS model for each basin consists of the following elements:

1. Source (Inflow)
2. Reservoir (Basin = Storage)
3. Sink (Outflow)
    a. Infiltration
    b. Overflow via Emergency Spillway

Note that outflow through the spillway and outflow through infiltration are both modeled as sinks which extract flow from the basin. Infiltration outflow is enabled to begin as soon as a non-zero depth of water is achieved in the basin element. The spillway outflow is enabled to begin once the depth of water exceeds the spillway invert in the basin.

Infiltration Rate

The infiltration rates used in the models were determined from the results of the infiltration testing conducted by LOR Geotechnical (LOR), and further analyzed by SBVWCD. LOR conducted infiltration testing at the proposed Oak Creek Basin site (Report 63813A.4), and in the proximity of the Plunge Creek Basin Site (Report 63813B.4). At the Oak Creek Basin location, LOR conducted four borehole percolation tests at depths which varied from approximately 8 feet to 15 feet. Infiltration rates were calculated by LOR from the test data using the Porchet Method, and ranged from 2.5 inches/hour to 6.5 inches/hour. Near the Plunge Creek Basin site, LOR conducted three double-ring infiltrometer, and one single-ring infiltrometer test at depths of approximately 0.5 feet to 1 foot below existing ground surface. Infiltration rates were calculated by LOR from the test data and ranged from 2.6 inches/hour (5.1 ft/day) to 5.8 inches/hour (11.6 ft/day).

SBVWCD reviewed the results and developed the design rates to use for clogged and unclogged conditions. SBVWCD calculated the geometric mean of the results and then calculated a factor of safety at each basin using the method in Appendix D of the Technical Guidance Document for Water Quality Management Plans, June 7, 2013, prepared by CDM Smith, Inc to determine the unclogged rate. SBVWCD proposed assigning an additional reduction factor of 2 to simulate clogging prior to basin maintenance, resulting in a clogged rate.

SBVWCD provided infiltration rates for the **clogged** and **unclogged** conditions as **1.77 ft/day** and **3.55 ft/day**, respectively, for Plunge Creek Basin. Infiltration rates for the **clogged** and **unclogged** conditions are **2.23 ft/day** and **4.46 ft/day**, respectively, for Oak Creek Basin.

Oak Creek Basins

The Oak Creek proposed basin will consist of two connected sub-basins in series. Flow will enter from the north into Basin 1; flows will overtop Basin 1 and cross a spillway into Basin 2.

Table 1a: *Oak Creek Basin Physical Characteristics for Basin 1&2*

Basin Name	Basin Bottom (ft)	Basin Top (ft)	Spillway Invert (ft)	Max Storage @ Spillway Invert (ac-ft)
Basin 1	1483	1500	1495	14.6
Basin 2	1483	1500	1497	98.6

Table 1b: *Oak Creek Basin Inflow Scenarios*

Inflow Name	Duration (days)	Peak Flow (cfs)	Cumulative Volume (ac-ft)
Native	56	14.0	354.5
FIRO	52	35	3,610.3

Note that modeling the Oak Creek Basins requires some assumptions since it consists of two smaller basins which are connected only by a spillway at elevation 1495' (basin bottom is 1483'). At this time, each basin (Basin 1 and Basin 2) are modeled as independent basins in series. As a result, the following assumptions are made regarding their operation:

- **Volume created by the spillway between 1495' and 1497' is partially ignored.** The contours which enclose the entire system were approximated for each independent basin by holding the proposed slope adjacent to the spillways to close the contours above 1495' on each basin. The ignored volume amounts to approximately 1.5 ac-ft of storage which exists over the spillway. Basin 1 and Basin 2 have a combined storage of approximately 147 ac-ft. Therefore, the ignored volume is about 1% of the volume and is negligible. Under 100% volume utilization these basins will retain marginally more volume than the routing dictates.
- **Volume created by Basin 1 between 1495' and 1497' due to backwater effect of Basin 2 is ignored.** Influence of the tailwater created by the flow over spillway from Basin 1 into Basin 2 is ignored since basins are assumed to operate independently. The impacts are considered negligible and only influence the FIRO flow condition which has the potential to fill Basin 2. This assumption has no impact on the analysis of the Native Inflow.

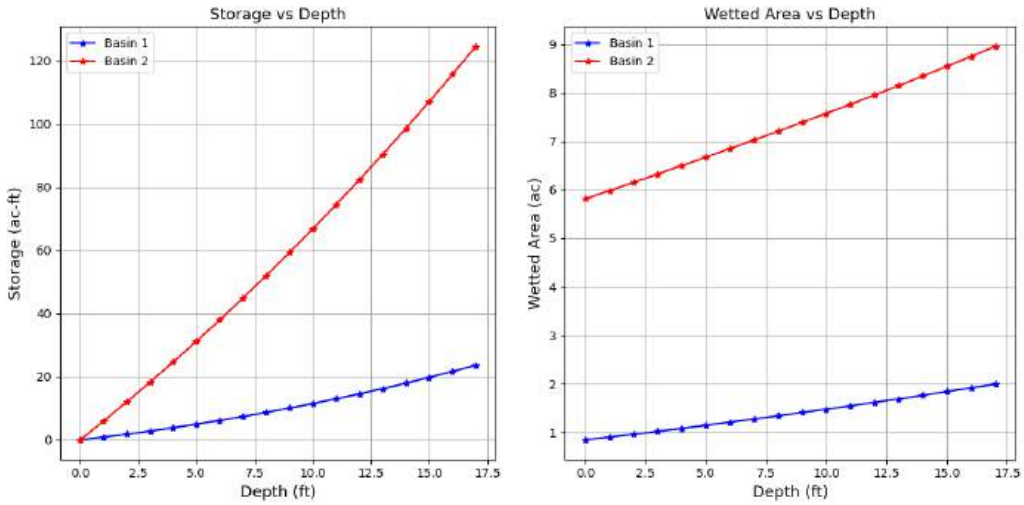


Figure 2a: *Oak Creek Basin Storage vs Depth (left) and Wetted Area vs Depth (right); Water surface area is a proxy for wetted area.*

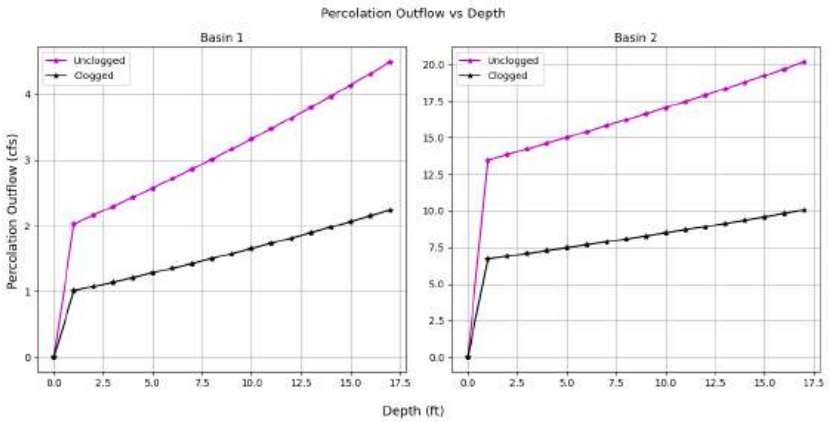


Figure 2b: *Oak Creek Basin Percolation Outflow vs Depth*

The Oak Creek Basins have a single graded condition to be considered. It will be assessed for both the Native Inflow and the FIRO Inflow. The results of the routing analysis are described below.

Table 1c: *Oak Creek Basin Routing Results (Native Inflow)*

Condition	Basin Name	Max Stage (ft)	Max Storage (ac-ft)	Inflow Volume (ac-ft)	Infiltrated Volume (ac-ft)	Bypass Volume (ac-ft)
Unclogged	Basin 1	1495.0	14.6	354.5	316.1	38.4
	Basin 2	1483.3	1.7	38.4	38.4	0.0
Clogged	Basin 1	1495.1	14.7	354.5	193.9	160.6
	Basin 2	1484.2	6.9	160.6	160.6	0.0

Note that the total infiltration for the unclogged and clogged conditions is the full inflow volume of 354.5 ac-ft since the system as a whole does not allow any bypass.

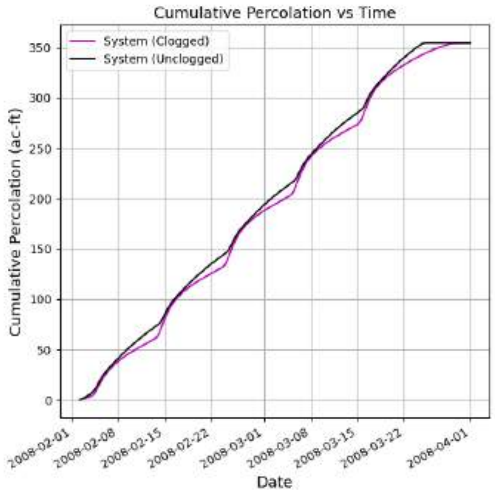


Figure 2c: *Oak Creek Basin Cumulative Percolation (Native Flow)*

Table 1d: *Oak Creek Basins Routing Results (FIRO Inflow)*

Condition	Basin Name	Max Stage (ft)	Max Storage (ac-ft)	Inflow Volume (ac-ft)	Infiltrated Volume (ac-ft)	Bypass Volume (ac-ft)
Unclogged	Basin 1	1495.2	14.9	3,610.3	392.4	3,217.9
	Basin 2	1497.1	99.1	3,217.9	2,012.2	1,205.7

The FIRO inflow condition was only examined for the unclogged condition as requested. Over the 52 day period, a total infiltration volume of 2,404.6 ac-ft was simulated. The FIRO inflow achieves steady state within the Oak Creek Basins after approximately 3.5 days (88.5 hours). This means that Basin 1 and Basin 2 are both full and outflow through the overflow spillway in Basin 2 out of the Oak Creek Basin system is constant. At steady state, the flow out of Basin 2 is approximately 12.5 cfs. After 52 days of constant inflow, the transient period until the basins are empty is approximately 5.2 days.

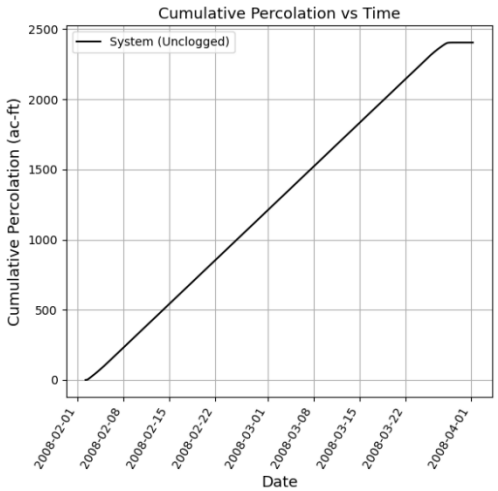


Figure 2d: *Oak Creek Basin Cumulative Percolation (FIRO flow)*

Plunge Creek Basin Interim-Conditions Basin Project Alternative

The Plunge Creek Interim-Conditions Basins project alternative consists of three basins: two small basins at the upstream end for debris entrapment and a single larger basin downstream. The two small debris basins will limit the aggregation of debris in the primary basin; however, all three basins will be considered for infiltration in the routing model. Flow will enter from the north into the basins 1 and 2 before passing into basin 3. Basin 1 and 2 operate in parallel.

Table 2a: *Interim Plunge Creek Basin Physical Characteristics for Basin 1, 2, & 3*

Basin Name	Basin Bottom (ft)	Basin Top (ft)	Spillway Invert (ft)	Max Storage @ Spillway Invert (ac-ft)
Basin 1	1254	1270	1266	14.9
Basin 2	1254	1266	1262	13.1
Basin 3	1244	1260	1258	99.7

Table 2b: *Plunge Creek Basin Inflow Scenarios*

Inflow Name	Duration (days)	Peak Flow (cfs)	Cumulative Volume (ac-ft)
Native	56	144.7	3655.5

At this time the following assumptions have been made about the Plunge Creek Interim-Conditions Basins:

- **Basin 1 & 2 have a spillway with length of 30ft and Basin 3 has a spillway with length of 50 ft.** At this time, the assessment is completed based upon the apparent weir length on the provided design file from the District. The spillway is assumed to be rectangular and broad-crested.
- **Flows are diverted upstream of Basin 1 & 2 before entering the basins separately via storm drain. It is assumed the inflow is evenly split between Basin 1 and Basin 2.** There is no way to assess how flows are diverted at this time. This is a convenient assumption and has minimal influence since the inflow event drastically exceeds the total system storage capacity.

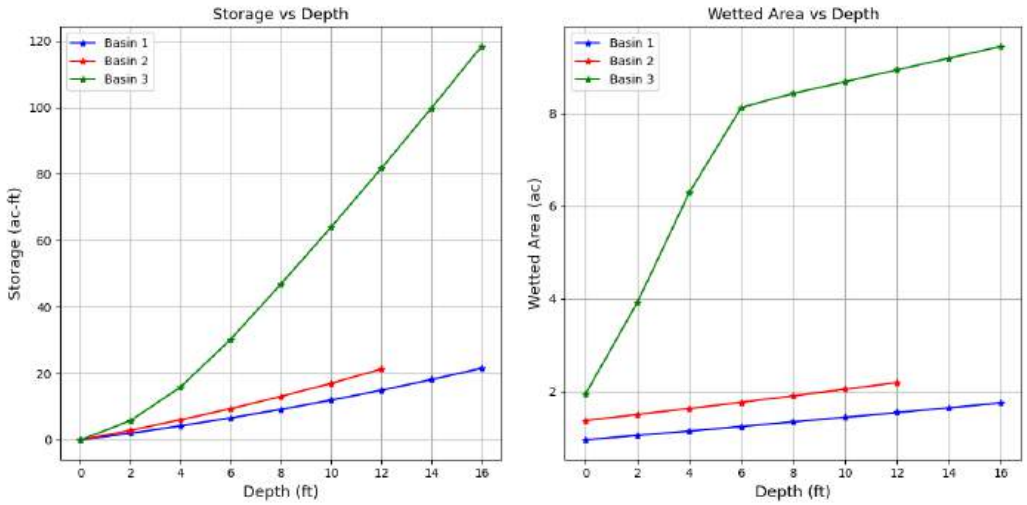


Figure 3a: *Plunge Creek Interim Basins Storage vs Depth (left) and Wetted Area vs Depth (right); Water surface area is a proxy for wetted area.*

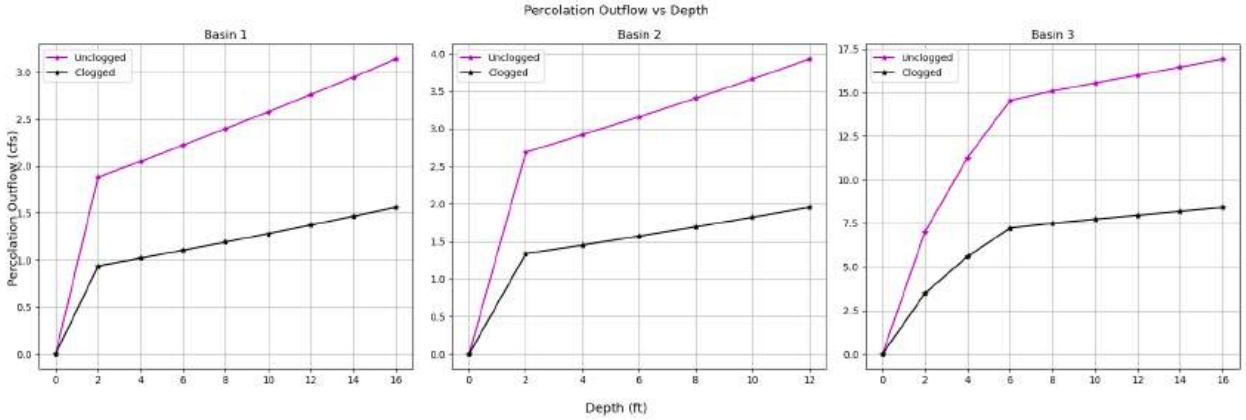


Figure 3b: *Plunge Creek Interim Basins Percolation Outflow vs Depth*

Table 2c: *Interim Plunge Creek Basins Routing Results (Native Inflow)*

Condition	Basin Name	Max Stage (ft)	Max Storage (ac-ft)	Inflow Volume (ac-ft)	Infiltrated Volume (ac-ft)	Bypass Volume (ac-ft)
Unclogged	Basin 1	1266.8	16.25	1827.8	294.4	1533.2
	Basin 2	1262.8	14.68	1827.8	358.5	1469.2
	Basin 3	1258.2	101.41	3002.4	1682.7	1319.4
Clogged	Basin 1	1266.8	16.27	1827.8	154.1	1673.6
	Basin 2	1262.8	14.71	1827.8	185.1	1642.6
	Basin 3	1258.2	101.52	3316.2	905.8	2410.3

Note that the total infiltration for the unclogged and clogged conditions is 2335.6 ac-ft and 1245 ac-ft, respectively.

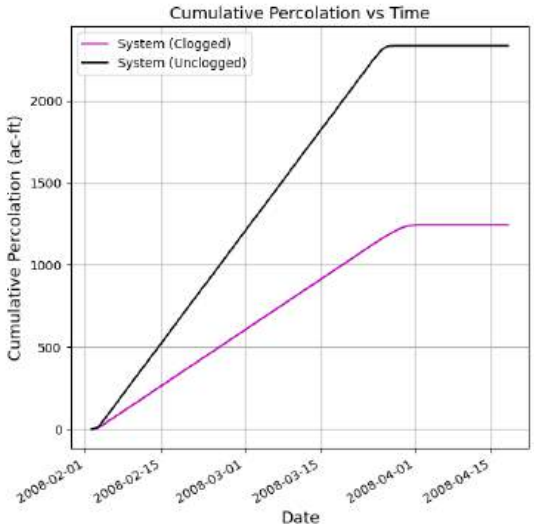


Figure 3c: *Plunge Creek Interim-Conditions Basins Cumulative Percolation (Native Flow)*

Plunge Creek Mined-Condition Basins Project Alternative

The Plunge Creek proposed basins Project Alternative after mining will consist of a single large basin. Flow will enter from the north into the basin.

Table 3a: *Ultimate Plunge Creek Basin Physical Characteristics for Basin*

Basin Bottom (ft)	Basin Top (ft)	Spillway Invert (ft)	Max Storage @ Spillway Invert (ac-ft)
1160	1232	1230*	2431.2

*Assumed spillway invert at this time.

Table 3b: *Ultimate Plunge Creek Basin Inflow Scenario*

Inflow Name	Duration (days)	Peak Flow (cfs)	Cumulative Volume (ac-ft)
Native	56	144.7	3655.5

At this time the following assumptions have been made about the ultimate condition Plunge Creek Basin:

- **The small basin adjacent to the primary Plunge Creek Basin is excluded from this analysis.** At this time, the assessment is completed based upon the design files received from the District. The proposed sub-basins do not have known names and the function of the smaller proposed basin is unknown.

- **An overflow emergency spillway is assumed to be a 10 ft rectangular broad-crested weir. At this time, the spillway design is unknown.** There is

no ramification to this modeling choice since the inflow event cannot exceed the basin storage capacity.

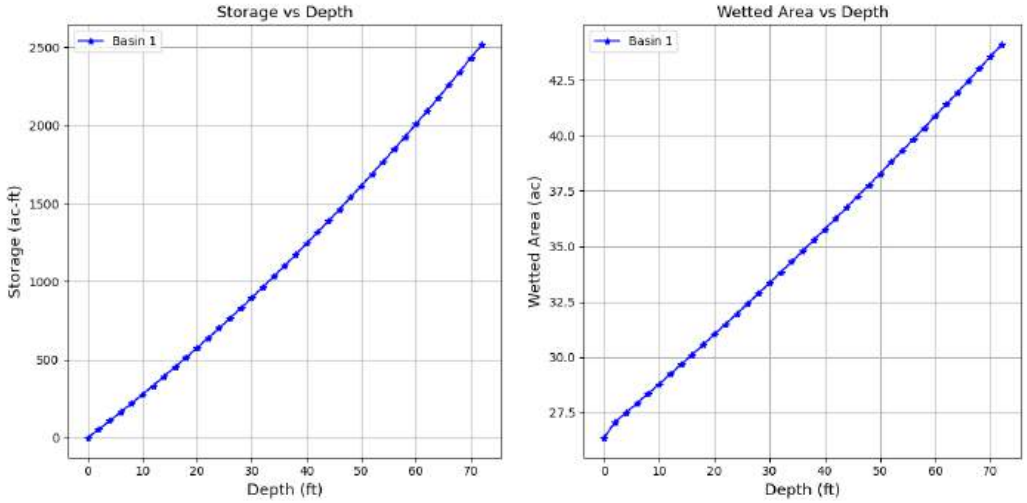


Figure 4a: *Plunge Creek Mined-Conditions Basin Storage vs Depth (left) and Wetted Area vs Depth (right); Water surface area is a proxy for wetted area.*

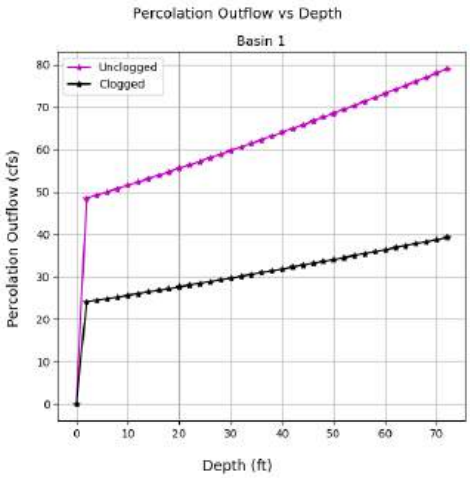


Figure 4b: *Plunge Creek Mined-Conditions Basin Percolation Outflow vs Depth*

Table 3c: *Plunge Creek Mined-Conditions Basin Routing Results (Native Inflow)*

Condition	Max Stage (ft)	Max Storage (ac-ft)	Inflow Volume (ac-ft)	Infiltrated Volume (ac-ft)	Bypass Volume (ac-ft)
Unclogged	1166.1	167.52	3655.5	3655.5	0.0
Clogged	1192.7	989.70	3655.5	3655.5	0.0

Note that the total infiltration for the unclogged and clogged conditions is the full inflow volume of 3655.5 ac-ft since the system as a whole does not allow any bypass.

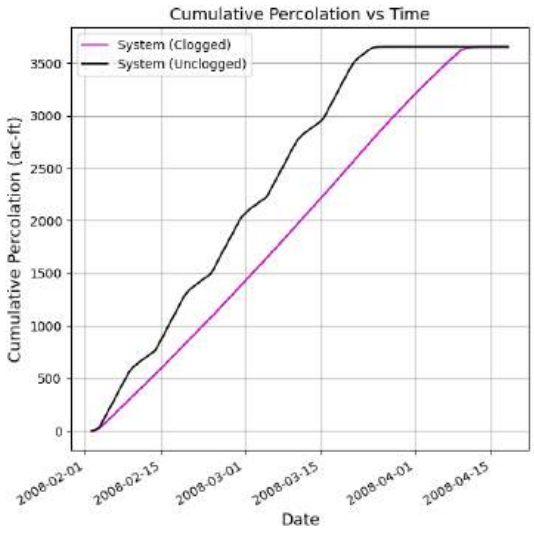


Figure 4c: *Plunge Creek Mined-Conditions Basin Cumulative Percolation (Native Flow)*

References

JLC Engineering & Consulting, Technical Memorandum (PTH TM), “Amendment to Feasibility Study Support Services ARTP Plunge Creek and Oak Creek Diversion and Basin(s)”, October 8, 2024

ADDENDUM A

ADDENDUM B

ADDENDUM C

ADDENDUM PCI-4: TOTAL SUSPENDED SOLIDS MEMORANDUM

Technical Memorandum

Date: **April 22, 2025**

To: **Michael Gentile, PE**

From: **Joseph L. Castaneda, P.E.**

Re: **Total Suspended Solids for Plunge Creek**

Overview

At the request of San Bernardino Valley Water Conservation District, the Project Team was requested to quantify the potential total suspended solids for Plunge Creek that can potentially be conveyed by the Plunge Creek Diversion Structure downstream of Orange Street Bridge. The purpose of determining the total suspended solids is to compute a potential sediment volume that may be collected by the proposed Plunge Creek Recharge Basin. The location of the Plunge Creek Diversion Structure has been identified in Figure 1 which is located within the Plunge Creek Spillway, which is a concrete lined channel that controls flows through the Orange Street Bridge and to the existing downstream natural channel. The Plunge Creek Spillway was completed in March 1992. It is JLC's opinion that the structure was constructed to stabilize Plunge Creek and the existing check dam located upstream of Orange Street due to the ongoing mining activities.

The most accurate method to determine total suspended solids is to sample runoff from the Plunge Creek and use laboratory methods to determine the total mass of the suspended solids with respect to the volume sample. However, rather than performing physical sampling a secondary approach was proposed that can establish a rough order magnitude of the potential total suspended solids. The approach that was used is documented below:

1. The project team utilized the Sediment Transport Analyses for Plunge Creek, dated March 3, 2024 to obtain sediment delivery results for Plunge Creek using a Rainy Average Hydrograph which had an approximate peak flow rate of 200 ft^3/s. The sediment transport study that was prepared represented the existing condition Plunge Creek terrain based on topographic mapping prepared for the project dated March 2022. The sediment transport analyses that was performed utilized Plunge Creek cross section for the existing condition floodplain model that was studied as

part of the Hydrology and Hydraulics Report for Plunge Creek Existing Floodplain, dated May 25, 2023. The purpose of the existing sediment transport study was to determine the existing sediment delivery for Plunge Creek existing condition. The sediment delivery results are provided in tons and represent the bedload material that consists of sands and gravels.

2. The project team utilized the soil samples and gradation test taken along Plunge Creek and within the Cemex Site to determine the composition of the in-situ soil. The soil samples and gradation test were performed by LOR Geotechnical. The gradation test provides the percent finer by weight and the particle size of the soil sample. Additionally, the gradation sample also provides the percentage of silts or clays obtained from the soil sample. A total of 10 samples were taken along Plunge Creek which are shown in Figure 2.

3. The analyses assume that the total suspended solids are composed of sediments smaller than a #200 sieve which represents the silts and clays. The silts and clays are assumed to be in suspension and will be transported by the runoff.

4. Cross Section 1982 shown in Figure 3 and Figure 4 was used to represent the location to determine the sediment delivery relative to time. The sediment transport results provide total sediment delivery as a function of time. The results from Cross Section 1982 were tabulated and a graphical representation was provided. The tabulated data is included in Table 1 and the graphical representation is included as Graph #1.

5. Based on the review of the gradation tests, Samples 3 and Sample 6 consisted of approximately 14% and 12% of the material that was smaller than the # 200 Sieve, respectively. Once again, these samples were taken along the Plunge Creek Streambed. Samples 3 and Sample 6 were selected since these had the highest percentage of material smaller than the #200 Sieve. The sediment transport study provided sediment delivery for the bedload which does not include material smaller than a #200 sieve. JLC utilized the gradation test to determine the potential total suspended solids, material that are smaller than the #200 sieve, by using the gradation test percentage. To determine the total suspended solids a value of 15% was used to represent the amount of sediment by weight that passes the #200 sieve. Fifteen percent was selected to be conservative by using a rounding to the nearest 5%. This results in 85% of the material being represented as bedload material. The table below provides the breakdown from the gradation test and the value to be used as part of the Total Suspended Solids Assessments.

LOR Soil Samples and Gradation Test		
Sample Number	Sediment Percentage not Passing the #200 Sieve	Sediment Percentage Passing the #200 Sieve
3	86%	14%
6	88%	12%
Sediment Material Breakdown for Total Suspended Solid Assessment(1)		

	Bedload Percentage	Total Suspended Solids
Assessment	85%	15%

(1) The TSS Assessment used 15% to represent the total suspended solids by rounding the results from Sample #3 and Sample #6 to the nearest 5%.

6. As previously stated, LOR provided sediment samples for the Cemex Site located west of the Plunge Creek basin, see Figure 5. This site is a mining pit that collects runoff from a sheet flow area that extends east of the project. The gradation test for the Cemex sample were taken at the following depths:
    a. 0 to 4 inches of Depth
    b. 4 inches to 12 inches of Depth

    The percentage for the sample taken at 0-4 inches was not used since the material can be impacted by air transport fines and the local environment that may skew the results. As a result, JLC's opinion was to sue the samples taken at 4" to 12" of depth from the Cemex Site. The sample at 4" to 12" indicates that 20% of the sediment material is less than the #200 sieve. This gradation test was used to compare with the sampling taken from the Plunge Creek stream bed. The Cemex sample at a depth of 4" to 12" has a close correlation to the samples taken within Plunge Creek for Sample 3 and Sample 6

7. Table 1 provides the bedload in tons over the duration of the hydrograph for the Rainy Average Flow Rate. The sediment transport results only provide the total bedload quantity. To determine the Total Suspended Loads the bedload quantity had to be used to determine the total suspended load using the gradation test percentage results for the material greater than the #200 Sieve and the material smaller than the #200 Sieve. The table below provides the multiplier used to compute the Total Suspended Load using 15% of the sediment material smaller than the #200 Sieve and 20% of the sediment material smaller than the #200 Sieve based on the gradation test.

Percent Greater than #200	Percent Smaller than #200	Multiplier to Adjust Sediment Transport Bedload Results to Obtain Total Bedload and Suspended Load (1)
85%	15%	1.176
80%	20%	1.25

(1) The sediment transport results represent the total bedload. This represents the quantity that is greater than the #200 sieve. The total suspended solids represents the load smaller than the #200 sieve. As a result, the bedload has to be multiplied by a factor that will result in a distribution that amounts to 100% of the total material which includes bedload and suspended loads.

The results in Table 1 and Graph #1 provide the following data in tons and cubic yards:
    a. Total Bedload
    b. Total Suspended Loads [15%] - (15% Material Smaller than #200)
    c. Total Suspended Loads [20%] - (20% Material Smaller than #200)

Conclusion

Based on the analysis performed using the sediment transport data and the total suspended solids assessment, JLC anticipates that the Plunge Creek Recharge Basin can anticipate 50 cubic yards to 70 cubic yards of total suspended solids that will be diverted into the basins for a single 24 hour storm that has an equivalent hydrograph as the Rainy Average Hydrogrpah.

TABLE 1 – Sediment Delivery for Plunge Creek Section 19+82

Table 1: Sediment Delivery for Plunge Creek: Section 19+82						
Time (hrs)	Bed Load (tons)	Suspended Load [15%] (tons)	Suspended Load [20%] (tons)	Bed Load (yd^3)	Suspended Load [15%] (yd^3)	Suspended Load [20%](yd^3)
1.00	0.78	0.14	0.19	0.58	0.10	0.14
2.00	5.40	0.95	1.35	4.00	0.70	1.00
3.00	15.55	2.74	3.89	11.52	2.03	2.88
4.00	28.64	5.04	7.16	21.22	3.73	5.30
5.00	45.32	7.98	11.33	33.57	5.91	8.39
6.00	58.70	10.33	14.68	43.48	7.65	10.87
7.00	70.87	12.47	17.72	52.50	9.24	13.12
8.00	82.64	14.54	20.66	61.21	10.77	15.30
9.00	94.47	16.63	23.62	69.97	12.32	17.49
10.00	106.61	18.76	26.65	78.97	13.90	19.74
11.00	120.00	21.12	30.00	88.89	15.64	22.22
12.00	130.29	22.93	32.57	96.51	16.99	24.13
13.00	142.38	25.06	35.60	105.47	18.56	26.37
14.00	156.27	27.50	39.07	115.75	20.37	28.94
15.00	173.41	30.52	43.35	128.46	22.61	32.11
16.00	198.33	34.91	49.58	146.91	25.86	36.73
17.00	227.00	39.95	56.75	168.15	29.59	42.04
18.00	258.24	45.45	64.56	191.29	33.67	47.82
19.00	280.90	49.44	70.23	208.08	36.62	52.02
20.00	299.61	52.73	74.90	221.93	39.06	55.48
21.00	313.33	55.15	78.33	232.10	40.85	58.02
22.00	323.21	56.89	80.80	239.42	42.14	59.85
23.00	331.90	58.42	82.98	245.86	43.27	61.46
24.00	343.51	60.46	85.88	254.45	44.78	63.61
25.00	354.34	62.36	88.59	262.48	46.20	65.62
26.00	361.67	63.65	90.42	267.90	47.15	66.98
27.00	365.07	64.25	91.27	270.42	47.59	67.61
28.00	367.48	64.68	91.87	272.20	47.91	68.05
29.00	369.88	65.10	92.47	273.98	48.22	68.50
30.00	371.27	65.34	92.82	275.01	48.40	68.75
31.00	372.67	65.59	93.17	276.05	48.58	69.01
32.00	374.07	65.84	93.52	277.09	48.77	69.27
33.00	376.00	66.18	94.00	278.52	49.02	69.63
34.00	376.88	66.33	94.22	279.17	49.13	69.79
35.00	377.00	66.35	94.25	279.26	49.15	69.81
35.72	377.00	66.35	94.25	279.26	49.15	69.81

GRAPH 1 – Sediment Delivery Over Time for Plunge Creek Section 19+82

GRAPH #1 FOR PLUNGE CREEK SECTION 1982

FIGURE 1 – VICINITY MAP PLUNGE CREEK DIVERISON STRUCTURE

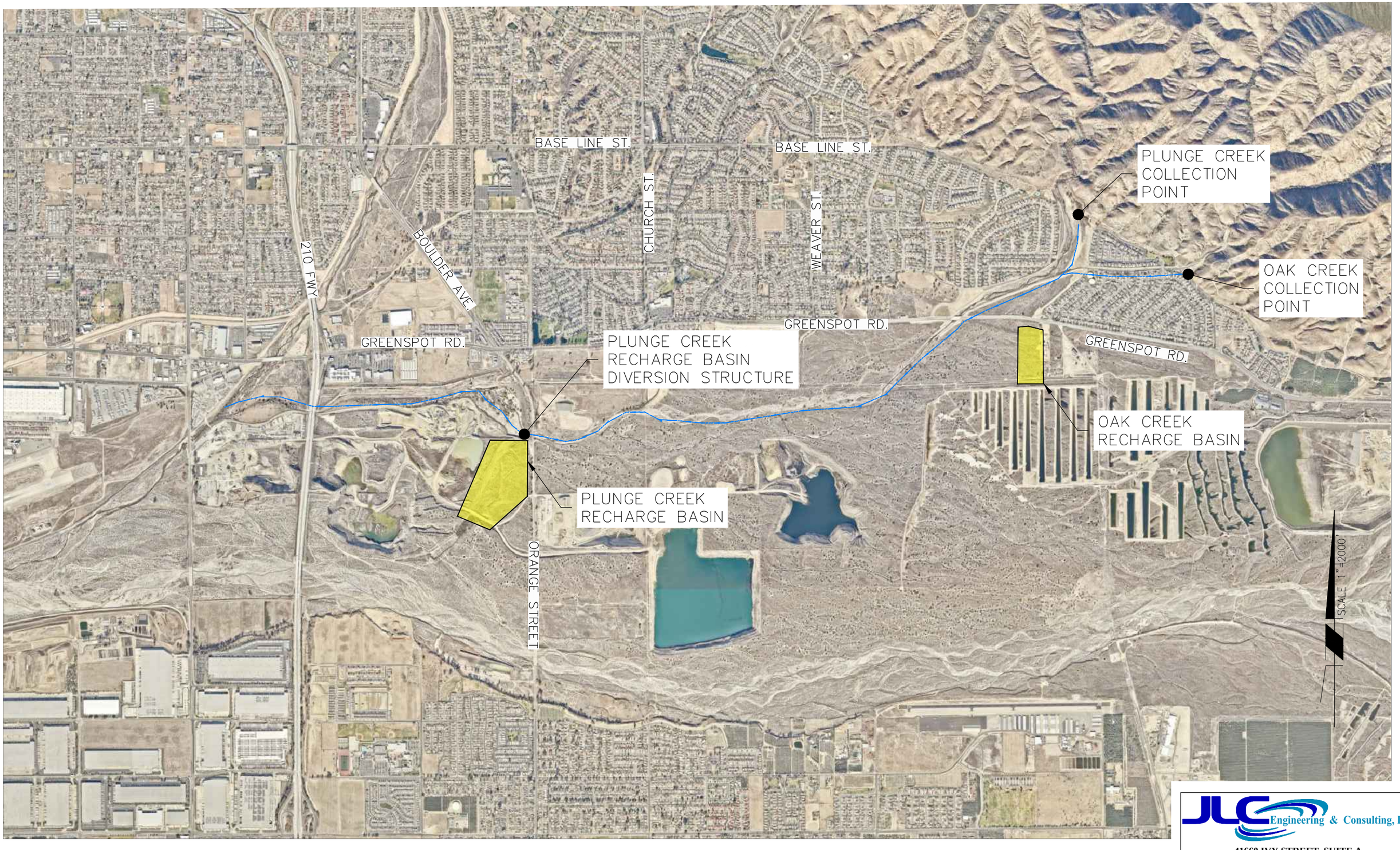


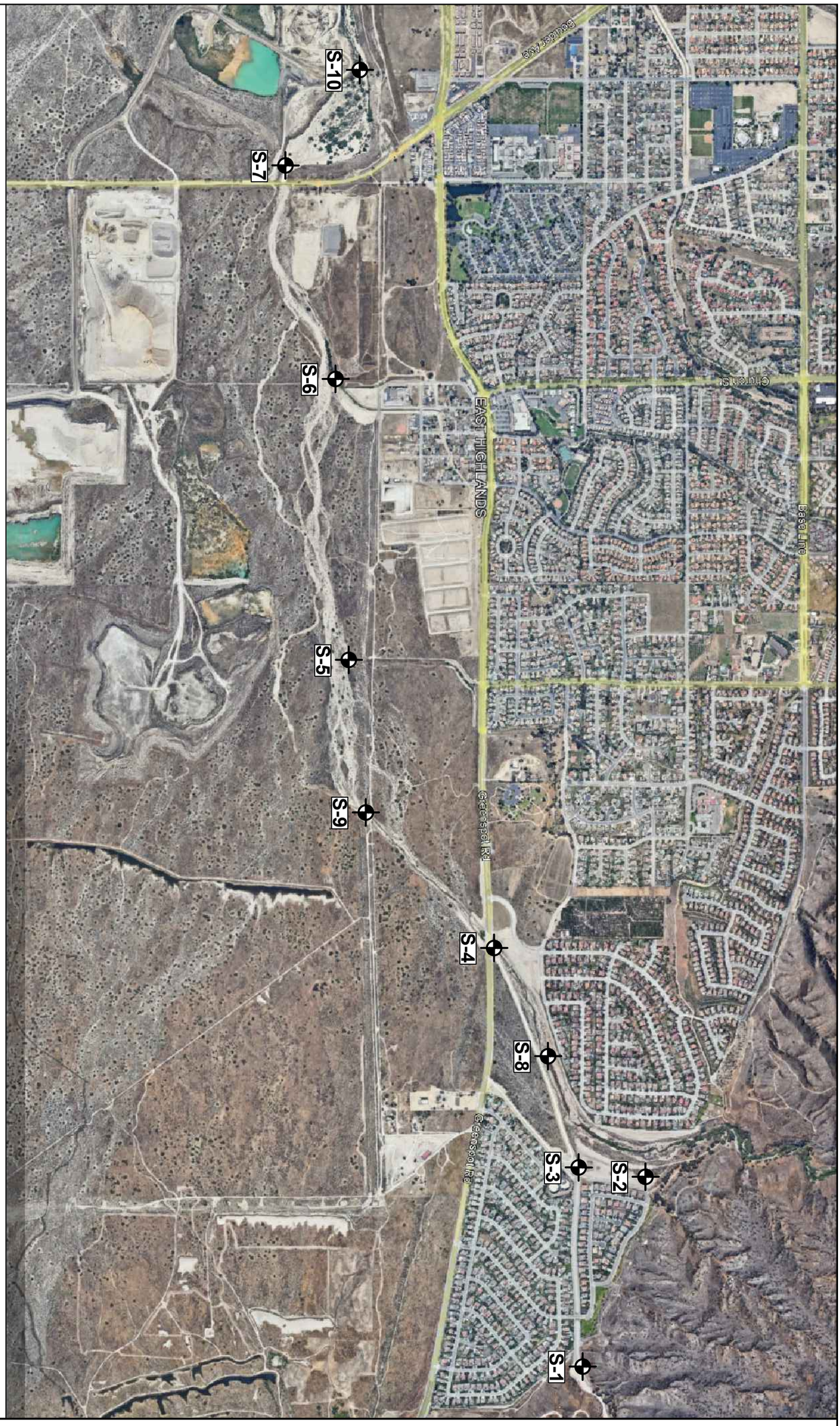
FIGURE 1 - VICINITY MAP

JLC Engineering & Consulting, Inc.
41660 IVY STREET, SUITE A
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

Drawing Name: D:\105.05.22\Engineering\Hydrology_Plan\Sediment Transport\Figures\Figure_1_Vicinity_Map.dwg
Last Opened: Apr 23, 2025 7:50am by Joe

FIGURE 2 – SEDIMENT SOIL SAMPLE LOCATIONS

FIGURE 2



Legend

(Locations Approximate)

Map Symbols

S-10 - Exploratory Sample

SAMPLE LOCATION MAP

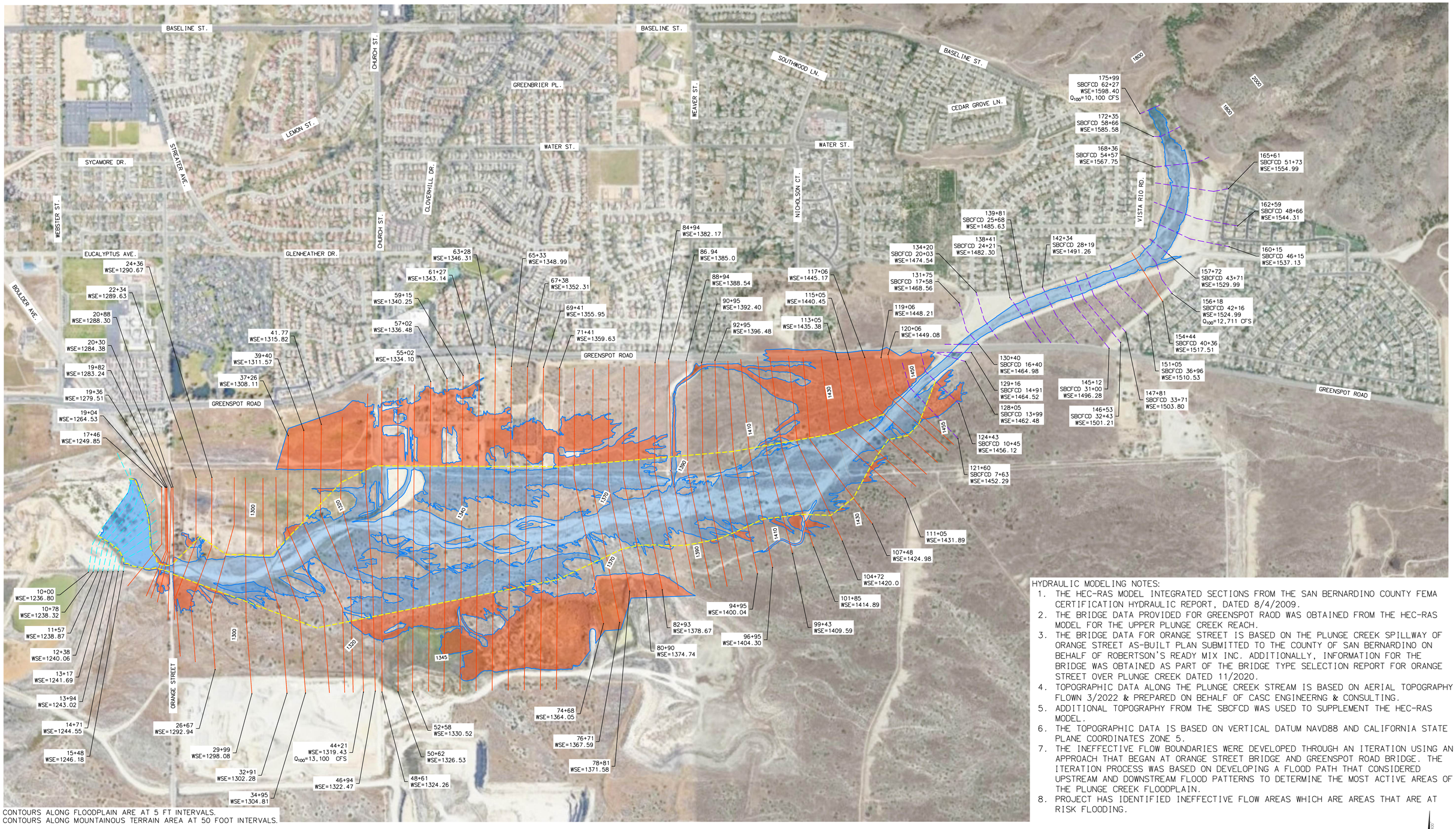
PROJECT:	Proposed Diversion and Basin, Highland, California	**PROJECT NO.:**	63813A.4
CLIENT:	CASC Engineering & Consulting	**ENCLOSURE:**	A-1
LOR GEOTECHNICAL GROUP, INC.		**DATE:**	October 2023
		SCALE:	1" ≈ 1,200'

FIGURE 3 –PLUNGE CREEK FLOODPLAIN EXHIBIT

CITY OF HIGHLAND PLUNGE CREEK EXISTING CONDITION FLOODPLAIN

IN THE CITY OF ONTARIO, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA

SBVWCD PLUNGE CREEK RECHARGE BASIN PROJECT



CONTOURS ALONG FLOODPLAIN ARE AT 5 FT INTERVALS.
CONTOURS ALONG MOUNTAINOUS TERRAIN AREA AT 50 FOOT INTERVALS.

HYDRAULIC MODELING NOTES:

1. THE HEC-RAS MODEL INTEGRATED SECTIONS FROM THE SAN BERNARDINO COUNTY FEMA CERTIFICATION HYDRAULIC REPORT, DATED 8/4/2009.
2. THE BRIDGE DATA PROVIDED FOR GREENSPOT RAOD WAS OBTAINED FROM THE HEC-RAS MODEL FOR THE UPPER PLUNGE CREEK REACH.
3. THE BRIDGE DATA FOR ORANGE STREET IS BASED ON THE PLUNGE CREEK SPILLWAY OF ORANGE STREET AS-BUILT PLAN SUBMITTED TO THE COUNTY OF SAN BERNARDINO ON BEHALF OF ROBERTSON'S READY MIX INC. ADDITIONALLY, INFORMATION FOR THE BRIDGE WAS OBTAINED AS PART OF THE BRIDGE TYPE SELECTION REPORT FOR ORANGE STREET OVER PLUNGE CREEK DATED 11/2020.
4. TOPOGRAPHIC DATA ALONG THE PLUNGE CREEK STREAM IS BASED ON AERIAL TOPOGRAPHY FLOWN 3/2022 & PREPARED ON BEHALF OF CASC ENGINEERNG & CONSULTING.
5. ADDITIONAL TOPOGRAPHY FROM THE SBCFCD WAS USED TO SUPPLEMENT THE HEC-RAS MODEL.
6. THE TOPOGRAPHIC DATA IS BASED ON VERTICAL DATUM NAVD88 AND CALIFORNIA STATE PLANE COORDINATES ZONE 5.
7. THE INEFFECTIVE FLOW BOUNDARIES WERE DEVELOPED THROUGH AN ITERATION USING AN APPROACH THAT BEGAN AT ORANGE STREET BRIDGE AND GREENSPOT ROAD BRIDGE. THE ITERATION PROCESS WAS BASED ON DEVELOPING A FLOOD PATH THAT CONSIDERED UPSTREAM AND DOWNSTREAM FLOOD PATTERNS TO DETERMINE THE MOST ACTIVE AREAS OF THE PLUNGE CREEK FLOODPLAIN.
8. PROJECT HAS IDENTIFIED INEFFECTIVE FLOW AREAS WHICH ARE AREAS THAT ARE AT RISK FLOODING.

LEGEND:

- EFFECTIVE FLOODPLAIN
- INEFFECTIVE FLOODPLAIN
- SBCFCD LOWER REACH SECTIONS
- SBVWCD HEC-RAS SECTIONS
- SBCFCD UPPER REACH SECTIONS
- INEFFECTIVE FLOW BOUNDARIES

400 200 0 400
SCALE: 1"=400'

FIGURE 3

JLC Engineering & Consulting, Inc.
41660 IVY STREET, SUITE A
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

SBVWCD - PLUNGE CREEK RECHARGE BASIN PROJECT

EXISTING CONDITION FLOODPLAIN

Drawing Name: G:\105.05.22\Engineering\HEC-RAS\Exhibits\EXHIBIT_FLOODPLAIN.dwg
Last Opened: May 18, 2023 - 4:50pm by jse

FIGURE 4 – PLUNGE CREEK DIVERSION STRUCTURE

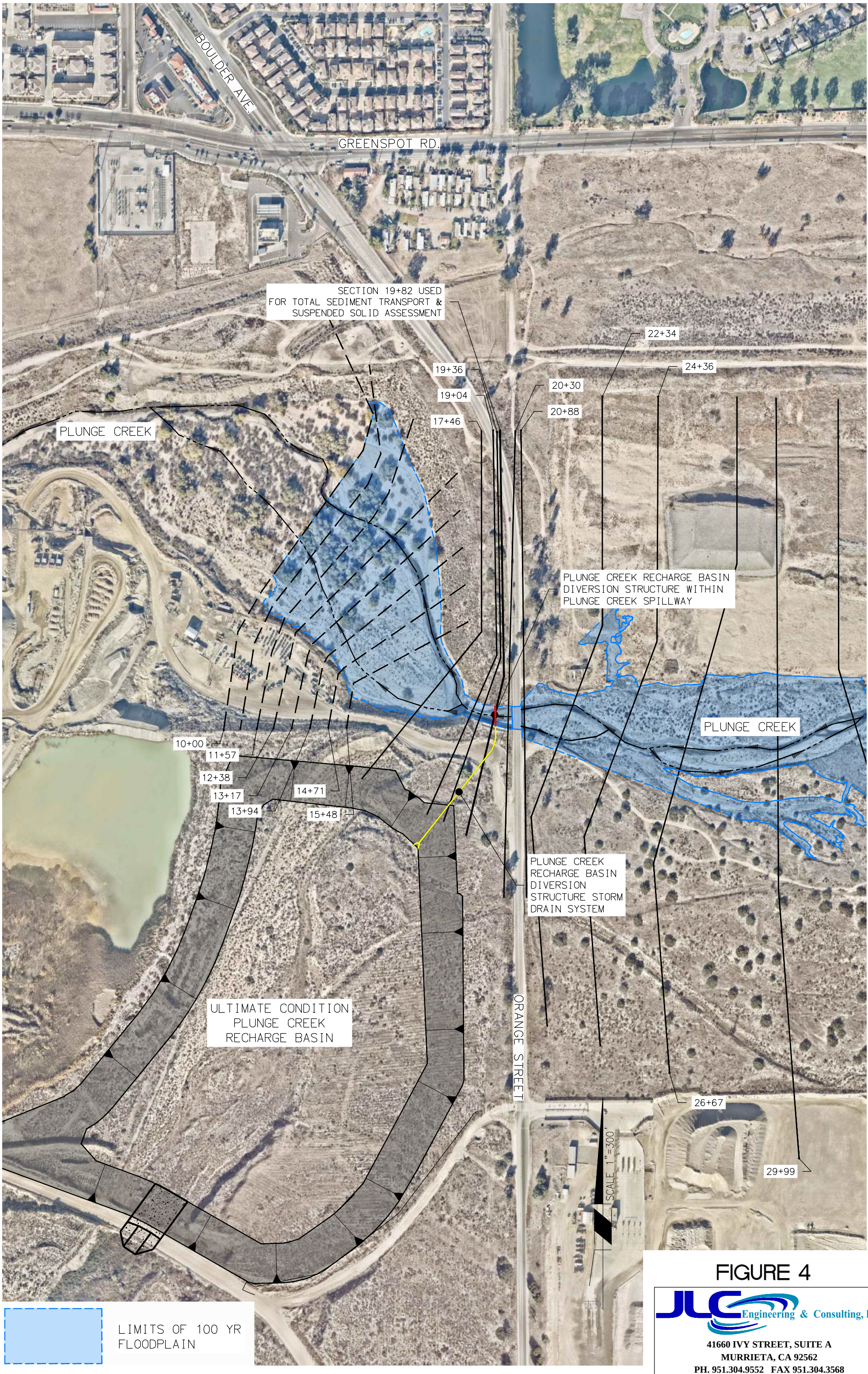


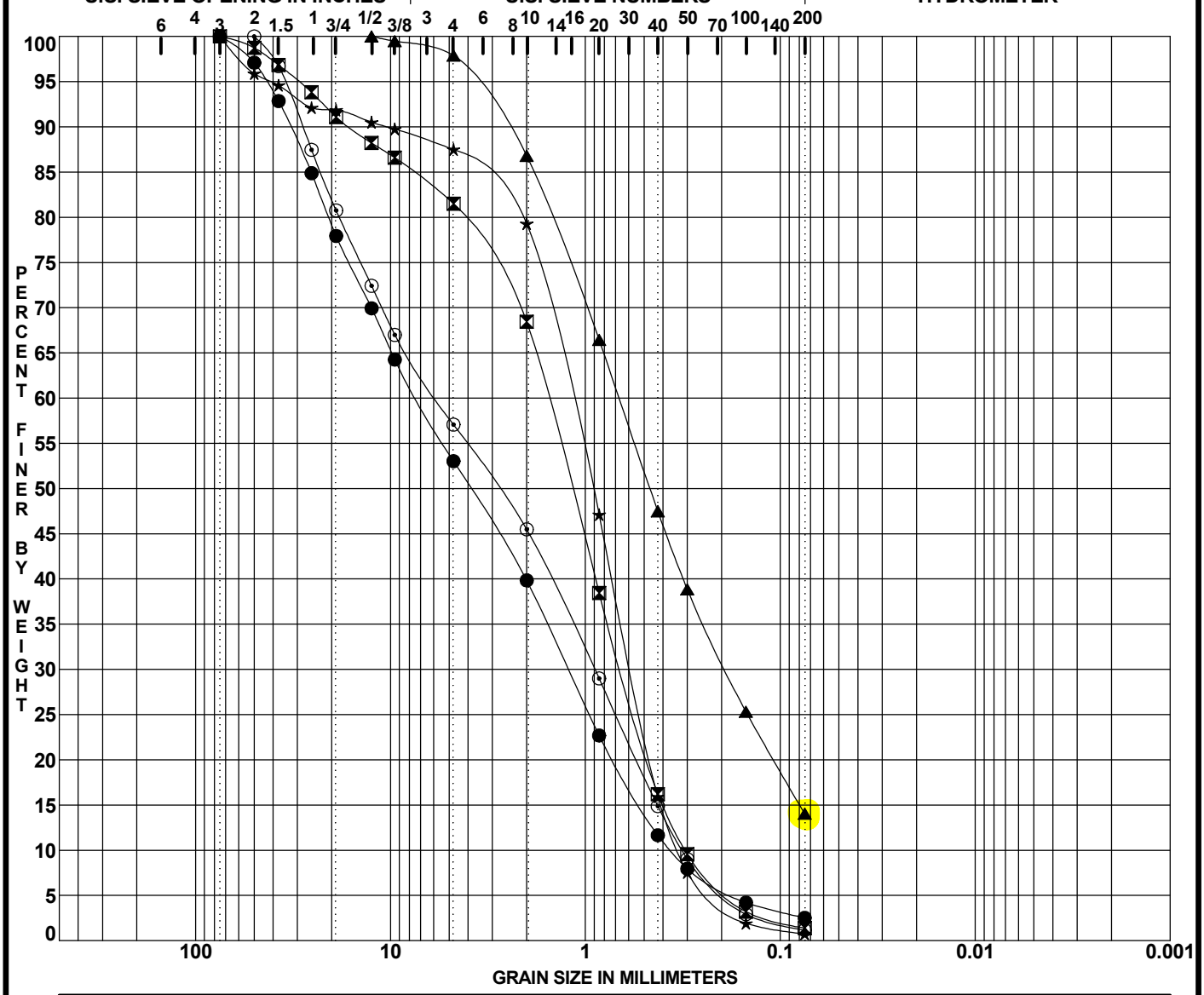
FIGURE 4

JLC Engineering & Consulting, Inc.
41660 IVY STREET, SUITE A
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

Drawing Name: O:\105.05.22\Engineering\Hydrology_Plan\Sediment Transport\Figures\Figure_4_DIVERSION STRUCTURE_FLOODPLAIN.dwg
Last Opened: Apr 24, 2025 – 6:20am by joe

GRADATION TEST FOR PLUNGE CREEK SOIL SAMPLES

JLC Engineering & Consulting, Inc.



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Soil Classification	SE	RV	PL	PI	Cc	Cu
●	S-01	@ 1-2'	(SP) Poorly Graded Sand w/ Gravel	--	--			0.56	20.1
⊠	S-02	@ 1-2'	(SP) Poorly Graded Sand w/ Gravel	--	--			0.88	5.1
▲	S-03	@ 1-2'	(SM) Silty Sand	--	--				
★	S-04	@ 1-2'	(SP) Poorly Graded Sand	--	--			0.85	3.6
⊙	S-05	@ 1-2'	(SP) Poorly Graded Sand w/ Gravel	--	--			0.43	18.3

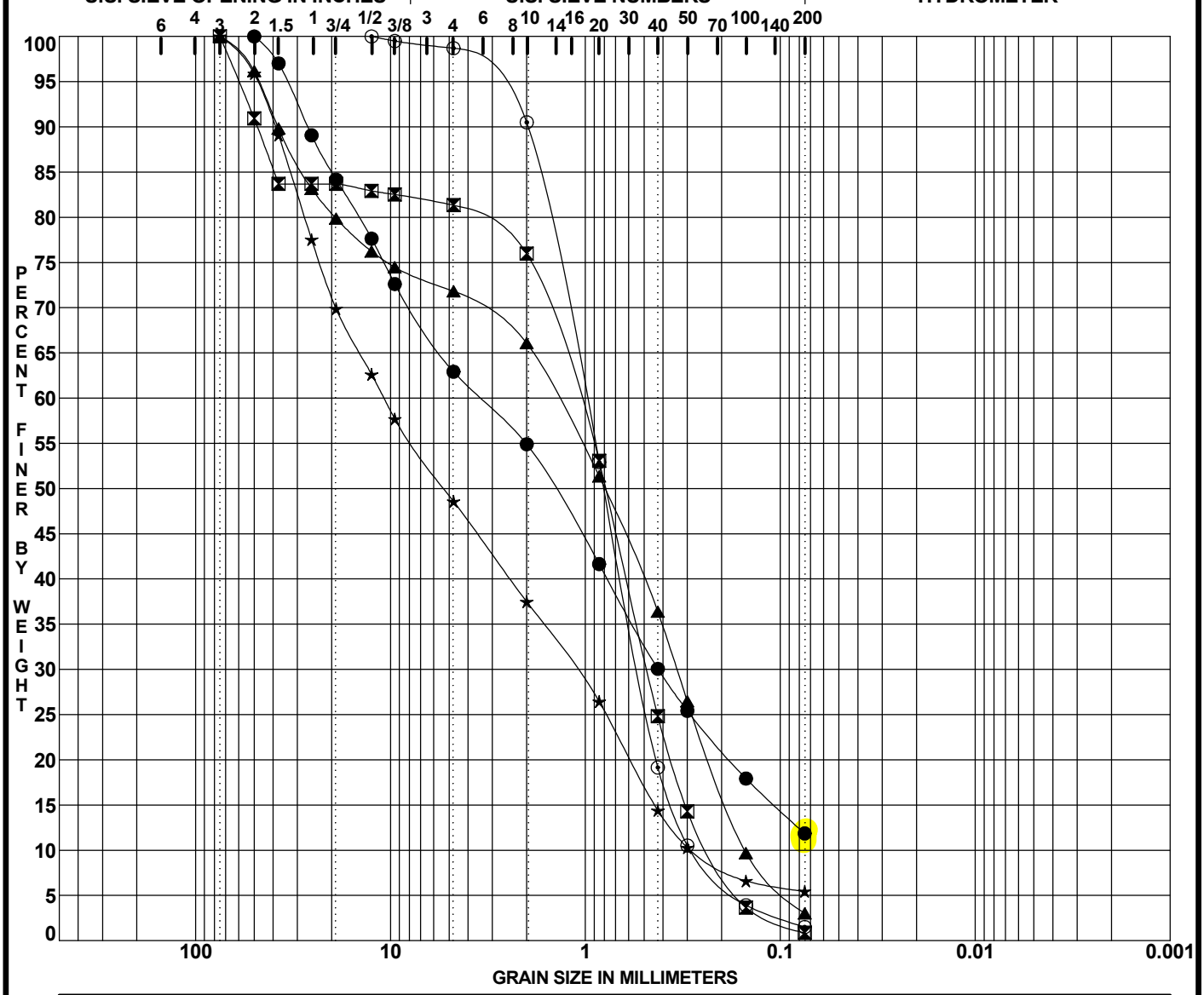
	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	S-01	@ 1-2'	75.00	7.30	1.224	0.3639	47.0	50.5	2.5	
⊠	S-02	@ 1-2'	75.00	1.57	0.653	0.3071	18.5	80.1	1.4	
▲	S-03	@ 1-2'	12.50	0.67	0.191		2.1	83.8	14.0	
★	S-04	@ 1-2'	75.00	1.20	0.581	0.3322	12.5	86.8	0.7	
⊙	S-05	@ 1-2'	50.00	5.83	0.895	0.3181	42.9	55.9	1.2	

PROJECT:	Proposed Diversion & Basin	**PROJECT NO.:**	63813A.4
CLIENT:	CASC Engineering & Consulting	**DATE:**	October 2023

GRADATION CURVES

LOR GEOTECHNICAL GROUP, INC.

ENCLOSURE: B-1



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Soil Classification	SE	RV	PL	PI	Cc	Cu
●	S-06	@ 1-2'	(SP) Poorly Graded Sand w/ Silt & Gravel	--	--			0.85	57.1
⊠	S-07	@ 1-2'	(SP) Poorly Graded Sand w/ Gravel	--	--			0.93	4.9
▲	S-08	@ 1-2'	(SP) Poorly Graded Sand w/ Gravel	--	--			0.54	9.2
★	S-09	@ 1-2'	(GP) Poorly Graded Gravel w/ Silt & Sand	--	--			0.41	38.0
⊙	S-10	@ 1-2'	(SP) Poorly Graded Sand	--	--			0.99	3.5

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	S-06	@ 1-2'	50.00	3.47	0.423		37.1	51.1	11.9	
⊠	S-07	@ 1-2'	75.00	1.10	0.483	0.2267	18.7	80.5	0.9	
▲	S-08	@ 1-2'	75.00	1.40	0.340	0.1520	28.2	68.8	3.0	
★	S-09	@ 1-2'	75.00	10.80	1.120	0.2844	51.4	43.1	5.5	
⊙	S-10	@ 1-2'	12.50	1.00	0.531	0.2840	1.3	97.2	1.5	

PROJECT:	Proposed Diversion & Basin	**PROJECT NO.:**	63813A.4
CLIENT:	CASC Engineering & Consulting	**DATE:**	October 2023

GRADATION CURVES

LOR GEOTECHNICAL GROUP, INC.

ENCLOSURE: B-2

GRADATION TEST FOR CEMEX SITE

JLC Engineering & Consulting, Inc.

Postal Service
Highland Grove Elementary School
Elementary School
Beattie Middle School
Stater Bros. Markets
Prolific Protection Private Security...
Aurantia Park
JJ's Bar & Grill
EAST HIGHLANDS
Greenspot Rd
EAST HIGHLAND VILLAGE
In-N-Out Burger
Greenspot Rd
7-Eleven
Greenspot Rd
Lowe's Home Improvement
Esporta Fitness
Boulder Ave
CEMEX Highland Redlands Aggregates...
Plunge Creek Basin
SITE
SITE
Robertson's
(see Enclosure A-3)
Cemex
SITE
Cemex
(see Enclosure A-4)
Martin A Mitchell Hwy
Foothill Fwy
Santa Ana River
Redlands Shooting Park
Red Park
Trinity Eateries Corporation
Google
Santa Ana River

FIGURE 5

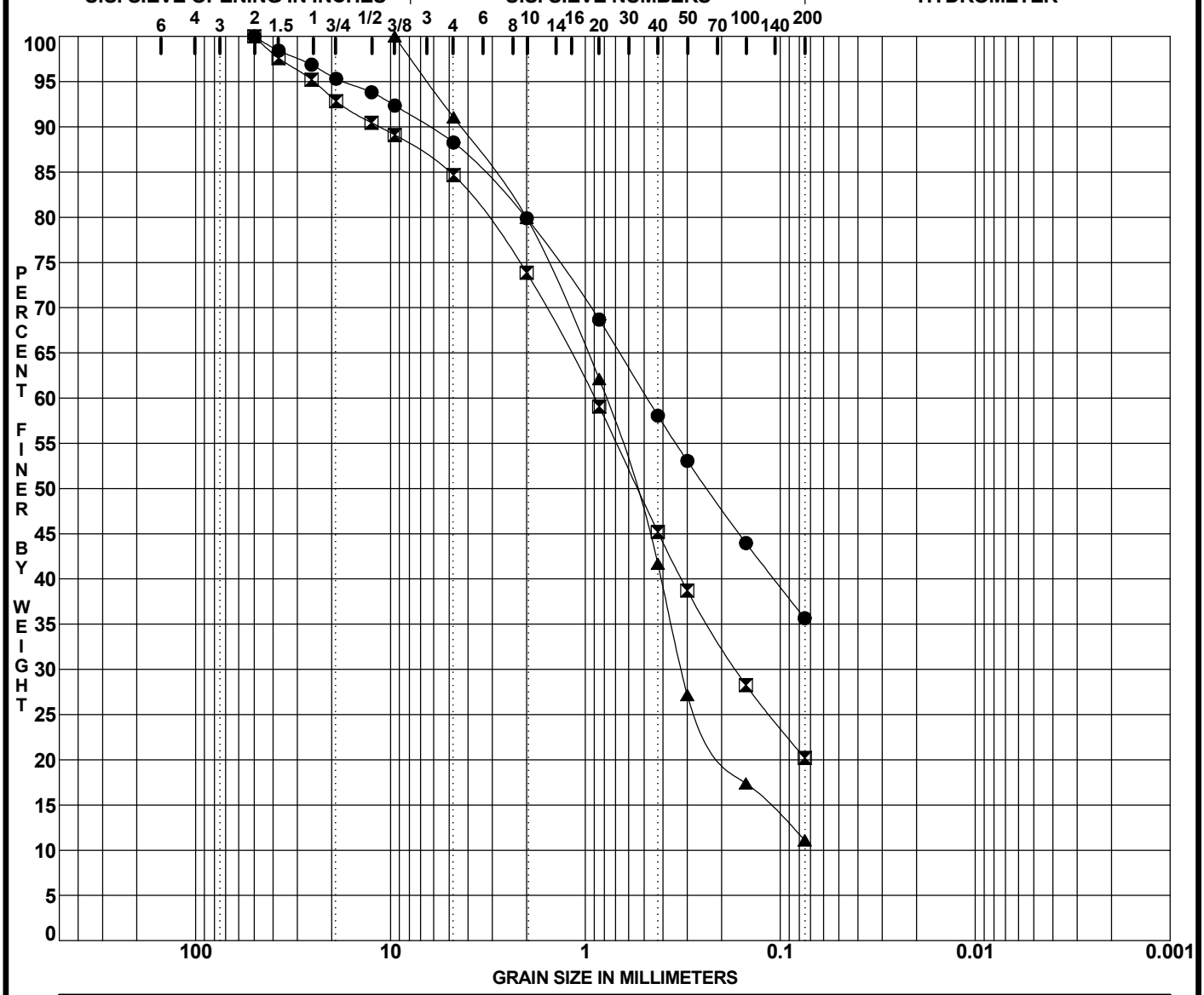
OVERALL SITE PLAN

PROJECT:	Plunge Creek Basin, Highland/Redlands, California
CLIENT:	CASC Engineering and Consulting
PROJECT NO.:	63813B.4
ENCLOSURE:	A-2
DATE:	April 2023
SCALE:	1" ≈ 1,020'

LOR GEOTECHNICAL GROUP, INC.

ROBERTSON'S SITE

PROJECT:	Plunge Creek Basin, Highland/Redlands, California	**PROJECT NO.:**	63813B.4
CLIENT:	CASC Engineering and Consulting	**ENCLOSURE:**	A-4
LOR GEOTECHNICAL GROUP, INC.		**DATE:**	April 2023
		SCALE:	1" ≈ 140'



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Soil Classification	SE	RV	PL	PI	Cc	Cu
● D-1 @ 0 - 0.33 ft	(SM) Silty Sand	--	--				
⊠ D-1 @ 0.33 - 1 ft	(SM) Silty Sand	--	--				
▲ T-1 -3/8" @ 3.5-4'	(SW) Well Graded Sand w/ Silt	--	--			1.96	11.9

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● D-1 @ 0 - 0.33 ft	50.00	0.48			11.7	52.6	35.7	
⊠ D-1 @ 0.33 - 1 ft	50.00	0.90	0.168		15.3	64.5	20.2	
▲ T-1 -3/8" @ 3.5-4'	9.50	0.79	0.321		8.9	80.0	11.1	

PROJECT:	Proposed Diversion & Basin	**PROJECT NO.:**	63813B.4
CLIENT:	CASC Engineering & Consulting	**DATE:**	May 2023

GRADATION CURVES

LOR GEOTECHNICAL GROUP, INC.

ENCLOSURE: D-1

ADDENDUM PCI-5: COST ESTIMATES

PLUNGE CREEK BASINS
(FORMER SILT POND-INTERIM PROJECT)
PNEUMATICALLY OPERATED GATE DIVERSION OPTION
FEASIBILITY STUDY WORKING COST ESTIMATE

March 25, 2025
Casc Engineering & Consulting, Project No. 1526-0001

No.	ITEM	QTY	UNIT	UNIT COST	ITEM COST	NOTES
1	MOBILIZATION	1	LS	$820,000	$820,000	ASSUMED 10% BID ITEM COST
2	CLEAR AND GRUB	22	AC	$1,000	$22,000	OK
3	REMOVE EXISTING CONCRETE CHANNEL AND WALLS	160	CY	$625	$100,000	UNIT COST FROM CONCRETE REMOVAL FOR RIALTO CHANNEL (RANDALL) AVERAGE - QUANTITY PER CAD
4	EXCAVATION	172,000	CY	$5	$860,000	UNIT COST PER SBVWCD DISCUSSION - QUANTITY CALCULATED BY COMPARING PROPOSED GRADING SURFACE TO EXISTING TOPO SURFACE RECEIVED FROM DISTRICT
5	BACKFILL (TYPICAL)	52,900	CY	$12	$634,800	UNIT COST PER SBVWCD DISCUSSION - QUANTITY CALCULATED BY COMPARING PROPOSED GRADING SURFACE TO EXISTING TOPO SURFACE RECEIVED FROM DISTRICT
6	BACKFILL (COMPACTED)	-	CY	$16	$0	UNIT COST PER SBVWCD DISCUSSION
7	EXPORT	119,100	CY	$15	$1,786,500	UNIT COST PER SBVWCD DISCUSSION - DIFFERENCE BETWEEN ITEM 4 AND ITEM 5
8	IMPORT FILL (TYPICAL)	-	CY	$21	$0	UNIT COST PER SBVWCD DISCUSSION
9	IMPORT FILL (COMPACTED)	-	CY	$25	$0	UNIT COST PER SBVWCD DISCUSSION
10	STRUCTURE EXCAVATION	455	CY	$55	$25,025	UNIT COST PER SBVWCD DISCUSSION - QUANTITY PER CAD
11	PNEUMATICALLY OPERATED GATE SYSTEM	1	EA	$950,000	$950,000	QUOTE FROM OBEMEYER (8'H x 192'W GATE)
12	RECT. CONCRETE CHANNEL & WALLS	160	CY	$1,050	$168,000	2024 RCFC&WCD PLANNING COST $1044.50/CY INCL. STEEL - QUANTITY PER CAD
13	CONCRETE OUTLET STRUCTURE	46	CY	$2,000	$92,000	HOUSES RUBICON GATE; USING 2024 RCFC&WCD PLANNING COST OF $2000/CY (transition structure or junction structure) INCL. STEEL - QUANTITY PER CAD
14	RUBICON GATE	1	EA	$73,000	$73,000	RUBICON FGB-6-4.5 QUOTED $36,500 DELIVERED AND INSPECTED. ASSUME DOUBLE FOR INSTALLED COST.
15	EQUILIZATION RCB	-	EA		$0	
16	OULET STRUCTURE	-	EA		$0	
17	INLET (DIVERSION) STRUCTURE	-	EA		$0	
18	TRASH RACK	-	CY		$0	
19	RETAINING WALLS	-	CY		$0	
20	FLOW METER (INCL STRUCTURE)	-	EA		$0	
21	SLIDE GATE (IN JUNCTION STRUCTURE)	2	EA	$42,000	$84,000	RUBICON SGA-1200-2400 QUOTE IS $21,000 EACH FOR DELIVERED. ASSUME DOUBLE FOR INSTALLED.
22	CONCRETE JUNCTION STRUCTURE	10	CY	$2,000	$20,000	USING 2024 RCFC&WCD PLANNING COST OF $2000/CY - QUANTITY PER CAD
23	48" RCP	660	LF	$542	$357,720	2024 RCFC&WCD PLANNING COST $542/LF - QUANTITY PER CAD
24	CONCRETE HEADWALL & WINGWALLS	88	CY	$2,000	$176,000	USING 2024 RCFC&WCD PLANNING COST OF $2000/CY - QUANTITY PER CAD
25	1/4 TON RIPRAP (NON-CONCRETED)	960	CY	$150	$144,000	2024 RCFC&WCD PLANNING COST $150/CY - QUANTITY PER CAD
26	CONCRETE SPILLWAY	1,725	CY	$650	$1,121,250	2024 RCFC&WCD PLANNING COST $650/CY (TRAP CHANNEL CONCRETE) - QUANTITY PER CAD
27	BALLAST ROCK	-	CY		$0	
28	6' CHAIN LINK FENCING	7,500	LF	$58	$435,000	2024 RCFC&WCD PLANNING COST $58/LF - QUANTITY PER CAD.
29	DOUBLE DRIVE GATE	4	EA	$10,000	$40,000	UNIT COST AND QUANTITY PROVIDED BY SBVWCD
30	EROSION CONTROL / SWPPP	1	LS	$150,000	$150,000	UNIT COST PROVIDED BY SBVWCD
31	UTILITIES	1	LS	$500,000	$500,000	UNIT COST PROVIDED BY SBVWCD
32	SCADA	1	LS	$500,000	$500,000	UNIT COST PROVIDED BY SBVWCD
	TOTAL BID ITEMS				$9,059,295	
	CONTINGENCY (30%)				$2,720,000	
	DESIGN and PERMITTING (20%)				$1,810,000	
	HABITAT MITIGATION MEASURES	1	LS	$3,000,000	$3,000,000	
	CONSTRUCTION ADMIN (15%)				$1,359,000	
	TOTAL PROJECT CONSTRUCTION COST				$17,948,000	

PLUNGE CREEK BASINS
(FORMER SILT POND-INTERIM PROJECT)
GRATED DROP STRUCTURE DIVERSION OPTION
FEASIBILITY STUDY WORKING COST ESTIMATE

March 25, 2025
Casc Engineering & Consulting, Project No. 1526-0001

No.	ITEM	QTY	UNIT	UNIT COST	ITEM COST	NOTES
1	MOBILIZATION	1	LS	$750,000	$750,000	ASSUMED 10% BID ITEM COST
2	CLEAR AND GRUB	22	AC	$1,000	$22,000	
3	REMOVE EXISTING CONCRETE CHANNEL AND WALLS	64	CY	$625	$40,000	UNIT COST FROM CONCRETE REMOVAL FOR RIALTO CHANNEL (RANDALL) AVERAGE - QUANTITY PER CAD
4	EXCAVATION	172,000	CY	$5	$860,000	UNIT COST PER SBVWCD DISCUSSION - QUANTITY CALCULATED BY COMPARING PROPOSED GRADING SURFACE TO EXISTING TOPO SURFACE RECEIVED FROM DISTRICT
5	BACKFILL (TYPICAL)	52,900	CY	$12	$634,800	UNIT COST PER SBVWCD DISCUSSION - QUANTITY CALCULATED BY COMPARING PROPOSED GRADING SURFACE TO EXISTING TOPO SURFACE RECEIVED FROM DISTRICT
6	BACKFILL (COMPACTED)	-	CY	$16	$0	UNIT COST PER SBVWCD DISCUSSION
7	EXPORT	119,100	CY	$15	$1,786,500	UNIT COST PER SBVWCD DISCUSSION - DIFFERENCE BETWEEN ITEM 4 AND ITEM 5
8	IMPORT FILL (TYPICAL)	-	CY	$21	$0	UNIT COST PER SBVWCD DISCUSSION
9	IMPORT FILL (COMPACTED)	-	CY	$25	$0	UNIT COST PER SBVWCD DISCUSSION
10	STRUCTURE EXCAVATION	747	CY	$55	$41,085	UNIT COST PER SBVWCD DISCUSSION- QUANTITY PER CAD
11	GRATED DROP STRUCTURE	176	CY	$2,000	$352,000	USING 2024 RCFC&WCD PLANNING COST OF $2000/CY - QUANTITY PER CAD
12	RECT. CONCRETE CHANNEL & WALLS	10	CY	$1,050	$10,500	2024 RCFC&WCD PLANNING COST $1044.50/CY INCL. STEEL - QUANTITY PER CAD
13	CONCRETE OUTLET STRUCTURE	46	CY	$2,000	$92,000	HOUSES RUBICON GATE; USING 2024 RCFC&WCD PLANNING COST OF $2000/CY (transition structure or junction structure) INCL. STEEL - QUANTITY PER CAD
14	RUBICON GATE	1	EA	$120,000	$120,000	RUBICON FGB-6-7.2 QUOTED $60,000 DELIVERED AND INSPECTED. ASSUME DOUBLE FOR INSTALLED COST.
15	EQUILIZATION RCB	-	EA		$0	
16	OULET STRUCTURE	-	EA		$0	
17	INLET (DIVERSION) STRUCTURE	-	EA		$0	
18	TRASH RACK	-	CY		$0	
19	RETAINING WALLS	-	CY		$0	
20	FLOW METER (INCL STRUCTURE)	-	EA		$0	
21	SLIDE GATE (IN JUNCTION STRUCTURE	2	EA	$42,000	$84,000	RUBICON SGA-1200-2400 QUOTE IS $21,000 EACH FOR DELIVERED. ASSUME DOUBLE FOR INSTALLED.
22	CONCRETE JUNCTION STRUCTURE	10	CY	$2,000	$20,000	USING 2024 RCFC&WCD PLANNING COST OF $2000/CY - QUANTITY PER CAD
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24	CONCRETE HEADWALL & WINGWALLS	88	EA	$2,000	$176,000	USING 2024 RCFC&WCD PLANNING COST OF $2000/CY - QUANTITY PER CAD
25	1/4 TON RIPRAP (NON-CONCRETED)	960	CY	$150	$144,000	2024 RCFC&WCD PLANNING COST $150/CY - QUANTITY PER CAD
26	CONCRETE SPILLWAY	1,725	CY	$650	$1,121,250	2024 RCFC&WCD PLANNING COST $650/CY (TRAP CHANNEL CONCRETE) - QUANTITY PER CAD
27	BALLAST ROACK	1	EA		$0	
28	6' CHAIN LINK FENCING	7,500	LF	$58	$435,000	2024 RCFC&WCD PLANNING COST $58/LF - QUANTITY PER CAD.
29	DOUBLE DRIVE GATE	4	EA	$10,000	$40,000	UNIT COST AND QUANTITY PROVIDED BY SBVWCD
30	EROSION CONTROL / SWPPP	1	LS	$150,000	$150,000	UNIT COST PROVIDED BY SBVWCD
31	UTILITIES	1	LS	$500,000	$500,000	UNIT COST PROVIDED BY SBVWCD
32	SCADA	1	LS	$500,000	$500,000	UNIT COST PROVIDED BY SBVWCD
	TOTAL BID ITEMS				$8,236,855	
	CONTINGENCY (30%)				$2,470,000	
	DESIGN and PERMITTING (20%)				$1,650,000	
	HABITAT MITIGATION MEASURES	1	LS	$3,000,000	$3,000,000	
	CONSTRUCTION ADMIN (15%)				$1,236,000	
	TOTAL PROJECT CONSTRUCTION COST				$16,593,000	

ADDENDUM PCI-6: PERMITTING TECHNICAL MEMORANDUM

January 27, 2025

Michael J. Gentile, PE, QSD/P
Senior Engineer
Casc Engineering and Consulting
1470 E. Cooley Drive, Colton, CA 92324
mgentile@cascinc.com
909.809.0035

Re: Technical Memorandum: Plunge Creek Interim Condition Project CEQA Requirements

Dear Mr. Gentile,

This technical memorandum outlines the California Environmental Quality Act (CEQA) compliance requirements for the proposed Plunge Creek Interim Condition Project ("Project"). Per CEQA Guidelines, the environmental impacts of the Project must be evaluated to ensure that the potential effects on the environment are properly addressed. This technical memorandum provides an overview of the key components of CEQA compliance, including the necessary environmental review process and required documentation as follows:

- Project Site Overview
- CEQA Process Overview
- Key CEQA Considerations for Project
- Agency Permits Requiring CEQA Documentation
- Example of CEQA Schedule
- Potential Development & Environmental Impact Considerations

If you have any questions, feel free to contact me, I can be reached by phone at (909) 362-7645, or by email at fcoyle@cascinc.com.

Sincerely,

CASC ENGINEERING AND CONSULTING

Frank Coyle
Director of Planning
(909)362-7645
fcoyle@cascinc.com

EXECUTIVE SUMMARY

Based on our preliminary assessment of the existing site conditions, an Initial Study will be required for the Project, which is expected to result in a Mitigated Negative Declaration (IS/MND). This means that with the implementation of mitigation measures, potential impacts will be reduced to a level below significant. Potential impact areas include Air Quality, Biological Resources, Cultural Resources, Greenhouse Gas Emissions, Geology/Soils, Hydrology/Water Quality, Mineral Resources, and Tribal Cultural Resources. Furthermore, the Project may require permits from the Santa Ana Regional Water Quality Control Board (RWQCB), the California Department of Fish and Wildlife (CDFW), and the United States Army Corps of Engineers (ACOE). The CEQA process is expected to take approximately 28-32 weeks. Permits that require an approved CEQA document and Notice of Determination (NOD) are anticipated to be obtained within 6 to 12 months following CEQA approval.

This memo assumes impacts will be assessed based on existing conditions; however, if the Water Conservation District (WCD) installs the proposed basins on an already developed site, environmental impacts, technical study requirements, and permitting under CEQA could be significantly reduced.

PROJECT SITE OVERVIEW

The proposed Project site is currently undeveloped and is located west of Orange Street and north of Dishong Street with the Santa Ana River Wash. The Project site includes one (1) parcel (APN: 029-112-101) located in the City of Redlands and one (1) parcel (APN: 029-111-103) located in the City of Highland. Adjacent uses include CEMEX Highlands Redlands Aggregates Quarry to the east, an existing silt pond to the west and undeveloped land to the north and south. The proposed Project consists of the development of two (2) desilting basins (Basin 1A and Basin 1B), a recharge basin (Basin 2), a diversion structure from Orange Street and associated spillways, refer to *Figure 1, Site Plan*. Basin 1A is approximately 1.0 acre; Basin 1B is approximately 1.3 acres; and Basin 2 is approximately 8.0 acres in size with a storage capacity of 100 acre-feet (ac-ft).

General Plan Land Use Designation

APN: 029-112-101: Open Space, City of Redlands

APN: 029-111-103: Open Space, City of Highland

Zoning Designation

APN: 029-112-101: Open Land District, City of Redlands

APN: 029-111-103: Open Space (OS), City of Highland

The proposed use of recharge basins is consistent with the existing land use designations of Open Space which permits water management areas such as groundwater recharge (City of Redlands) and water conservation facilities (City of Highland).

CEQA PROCESS OVERVIEW

Under California law, each public agency must adopt local implementation guidelines to establish objectives, criteria, and specific procedures for administering its responsibilities under the California Environmental Quality Act (CEQA). The CEQA process ensures that potential environmental impacts of a project are identified, analyzed, and mitigated when feasible. The following is a brief summary of the CEQA process:

1. Preliminary Review: The lead agency determines if the activity is a "project" under CEQA. If it is exempt, no further CEQA action is needed.
2. Initial Study (IS): If the project is not exempt, the agency conducts an Initial Study to assess potential environmental impacts.
3. Determination of Impact:
    - If no significant impacts are identified, a Negative Declaration (ND) or Mitigated Negative Declaration (MND) is prepared.
    - If significant impacts are identified, an Environmental Impact Report (EIR) is required.

4. Public Review and Comment:
    - The draft ND, MND, or EIR is circulated for public and agency review (typically 30 days (45 days for EIR)).
    - Comments from the public and agencies are collected and addressed.
5. Final Documentation:
    - For an EIR, a Final EIR is prepared, including responses to comments and any revisions to the draft.
    - The lead agency certifies the EIR or adopts the ND/MND.
6. Decision and Mitigation:
    - The lead agency decides whether to approve or deny the project.
    - If the MND is approved, a Mitigation Monitoring and Reporting Program (MMRP) is adopted to ensure mitigation measures are implemented.
7. Post-Approval Actions:
    - Notices of Determination (NOD) are filed, marking the end of the CEQA process and triggering legal timelines for challenges.
8. Statute of Limitations for Appeals:
    - Filling of court challenges to an approved CEQA document is permitted under CEQA Guidelines Section 15112, Statutes of Limitations. The statute of limitations for appealing an NOD is 30 days from the date the notice is filed and posted.

Based on a preliminary review of the Project it is anticipated that the Project will require an Initial Study that will culminate in a Mitigated Negative Declaration (IS/MND), thus reducing impacts to a less than significant impact with mitigation incorporated. Actual determination of the most appropriate environmental document will be determined at the time technical studies are completed.

Lead Agency under CEQA

CEQA Guidelines Section 15050 states, where a project is to be carried out or approved by more than one public agency, one public agency shall be responsible for preparing an EIR or Negative Declaration for the project. This agency shall be called the Lead Agency. The Project site is situated within the cities of Highland and Redlands and includes the Plunge Creek Facility, managed by the San Bernardino County Flood Control District (FCD). FCD has executed a Planning Memorandum of Understanding (MOU) with the San Bernardino Valley Water Conservation District (WCD) to perform feasibility studies of FCD facilities (MOU, January 26, 2021). CEQA Guidelines Section 15051 states where two or more public agencies will be involved with a project, the determination of which agency will be the Lead Agency shall be governed by the following criteria:

> (a) If the project will be carried out by a public agency, that agency shall be the Lead Agency even if the project would be located within the jurisdiction of another public agency.

It is anticipated that WCD would be the Lead Agency under CEQA as it would be the public agency carrying out the Project. Thus, WCD would be responsible for the CEQA process as listed above. CEQA Guidelines Section 15381 states that Responsible Agencies includes all public agencies other than the Lead Agency which have discretionary approval power over the project. The Lead Agency shall consult with all responsible agencies early in the CEQA process (CEQA Guidelines Section 21080.3). As the Project site is located within multiple jurisdictions, potential Responsible Agencies outside of the typical resource's agencies (CDFW, RWQCB, etc.) under CEQA include FCD, City of Redlands and City of Highland.

KEY CEQA CONSIDERATIONS FOR PROJECT

The following is an overview of key CEQA considerations of the proposed Project based on a preliminary review of the site and surrounding resources.

Assembly Bill 52 (Ab52) Tribal Consultation

Assembly Bill 52 (AB52) is a California law enacted in 2014 that amended CEQA to include specific protections for tribal cultural resources. The law enhances collaboration between California Native American tribes and lead agencies during the environmental review process for proposed projects. The following is a brief overview of the AB52 consultation process as it pertains to the proposed Project:

1. Tribal Notification: Within 14 days of determining that a project application is complete, the lead agency must notify California Native American tribes that have requested notification of projects in their area. This typically includes a letter emailed to the Tribal representative.
2. Tribal Request for Consultation: Tribes have 30 days from receiving the notice to request formal consultation with the lead agency.
3. Consultation Process:
    - If a tribe requests consultation, the lead agency must engage in good-faith discussions to identify and address potential impacts on tribal cultural resources.
    - Topics may include the identification of resources, project alternatives, mitigation measures, and project modifications to avoid or minimize impacts.
4. Mitigation and Agreements:
    - If tribal cultural resources are identified, the lead agency and tribe collaborate on feasible mitigation measures.
    - Agreements reached during consultation should be documented and included in the environmental document (IS/MND).
5. Documentation and CEQA Compliance:
    - The lead agency must incorporate findings and mitigation measures into the environmental analysis (Tribal Cultural Resources section of the IS/MND).
    - If consultation does not lead to agreement, the lead agency retains discretion but must explain how tribal concerns were addressed.

The results of the AB 52 consultation process will be incorporated into the Tribal Cultural Resources section of the Initial Study and any mitigation measures agreed upon by the Lead Agency and consulting tribe will be incorporated into the Mitigation, Monitoring and Reporting Program.

Technical Studies Required

To accurately analyze environmental impacts of the proposed Project in accordance with CEQA Guidelines Appendix G: Environmental Checklist form (Initial Study), technical studies will be required for the proposed Project. The following is a list of anticipated technical studies that will be required to complete the Initial Study. Standard timeframe for completing technical studies is included in *Table 1: Example of Typical CEQA Schedule.*

- Air Quality Impact Analysis
- Biological Resources Assessment
- Cultural Resources Assessment
- Drainage Study
- Focused Species Surveys (focused surveys for plants need to be performed during the blooming period for those species and focused surveys for Burrowing Owl will need to be performed during breeding season (Mar-Aug). Focused studies for plants and animals are typically valid for one year.
- Greenhouse Gas Assessment
- Paleontological Resources Assessment
- Riparian/Riverine Assessment
- Jurisdictional Delineation (water features)
- Phase I Environmental Site Assessment (potentially, a Phase II site assessment will be required dependent on any recognized environmental conditions (RECs) identified in the Phase I ESA).
- Noise Analysis Report
- Geotechnical Investigation Report
- Water Quality Management Plan (WQMP)

CEQA Guidelines Appendix G: Environmental Checklist Form

The CEQA Environmental Checklist Form is a tool used to evaluate the potential environmental impacts of a proposed project. It covers various environmental topics, such as air quality, biological resources, water quality, and cultural resources, to ensure a comprehensive assessment. Each topic includes specific questions to determine whether the project may have significant environmental effects. The checklist helps guide the preparation of an Initial Study and supports decision-making on whether a Negative Declaration, Mitigated Negative Declaration, or Environmental Impact Report (EIR) is required. The following is a brief analysis of the proposed Project's potential environmental impacts under CEQA.

AESTHETICS

The Project site does not contain any scenic resources, and the nearest State designated scenic highway is a portion of State Route 38 located approximately 20 miles northeast of the Project site. No impact is expected to occur.

AGRICULTURAL AND FORESTRY RESOURCES

According to the California Important Farmland Finder (FMMP) the Project site is identified as "Grazing Land" and "Other Land". The Project site does not contain any agriculture or forestry resources, and no impact is expected to occur.

AIR QUALITY

The Project's potential impacts on air quality will be assessed utilizing a project specific Air Quality Impact Analysis and the South Coast Air Quality Management District (SCAQMD) 2022 Air Quality Management Plan. Less than significant impacts to air quality are anticipated during the construction phase of the Project due to the use of construction equipment. No impacts to air quality are anticipated during the operation phase of the Project.

BIOLOGICAL RESOURCES

Potential impacts to biological resources are expected to be less than significant with the incorporation of mitigation measures. The site, currently undeveloped, is classified as "Riversidean Alluvial Fan Sage Scrub" and "Annual Grassland" vegetation in the City of Redlands General Plan. The Project site is located in the Santa Ana River Wash Habitat Conservation Plan however it is not located within the preserve assembly. A Biological Resources Assessment will be required to evaluate the potential presence of special-status plant and animal species onsite. Given the site's location within the Santa Ana River Wash, a Jurisdictional Delineation may also be required to assess potential impacts to water features regulated by the Santa Ana Regional Water Quality Control Board (RWQCB), California Department of Fish and Wildlife (CDFW), and U.S. Army Corps of Engineers (ACOE). Recommendations from these technical studies will be incorporated as mitigation measures into the Mitigation Monitoring and Reporting Program (MMRP) for the IS/MND.

CULTURAL RESOURCES

The Project site does not contain any cultural resources as indicated under the Redlands and Highland General Plans. However, due to the site being undeveloped, further evaluation of potential impacts on cultural and historical resources will be required utilizing a Project specific Cultural Resources Assessment in addition to the results of AB52 tribal consultation.

ENERGY

Construction of the Project would result in fuel consumption from construction tools and equipment, vendor and haul truck trips, and vehicle trips generated from construction workers traveling to and from the site. Construction activities and corresponding fuel energy consumption would be temporary and localized. The use of diesel fuel and heavy-duty equipment would not be a typical condition of the Project. There are no unusual Project characteristics that would cause construction equipment that would be less energy efficient compared with other similar construction sites in other parts of the State. Impacts are anticipated to be less than significant.

GEOLOGY/SOILS

The Project site is not located on or near a seismic fault and is not prone to landslides due to its relatively flat topography. However, the site is located within the Seven Oaks Dam inundation area and has been identified as having a high susceptibility to liquefaction as identified in the City of Redlands General Plan (southern portion of the site), and the City of Highland General Plan (northern portion of the site). The potential for significant geological or soil-related impacts, including soil suitability for basin construction, will be further evaluated through a Project-specific

Geotechnical Investigation. Impacts are expected to be less than significant with the implementation of recommendations from the Geotechnical Investigation.

GREENHOUSE GAS EMISSIONS

Less than significant impacts to greenhouse gas emissions are anticipated during the construction phase of the Project due to the use of construction equipment. No impacts to greenhouse gas emissions are anticipated during the operation phase of the Project. A Greenhouse Gas Assessment would further quantify emissions to substantiate CEQA analysis.

HYDROLOGY/WATER QUALITY

The Project site is located within a 100-year floodplain (Zones A, AE, AO). Potential impacts on hydrology and water quality under CEQA will be evaluated through a Project-specific Drainage Study and Water Quality Management Plan (WQMP). The analysis will examine whether the Project could lead to increased runoff, water quality degradation, or changes to drainage patterns. Compliance with stormwater management regulations, including the implementation of best management practices (BMPs), will also be assessed. Impacts are expected to be less than significant.

HAZARDS AND HAZRDOUS MATERIALS

Given the site is adjacent to existing mining operations there is the potential for recognized environmental conditions (RECs)at the site. Utilizing a Project specific Phase I ESA and the Department of Toxic Substance Control Cortese List, the Project will be evaluated for the presence of hazardous materials. This includes an assessment of any contamination, such as hazardous waste or underground storage tanks that could pose a risk to human health or the environment. Any recommendations in the Phase I ESA would be incorporated into the MMRP of the IS/MND.

Per the City of Highland, the site lies within the San Bernardino International Airport (SBIA) Influence Area and "Airport Compatible Zone E – Negligible Risk". The proposed stormwater basin is a permitted use in "Zone E". However, per FAA Advisory Circular 150/5200-33C (Feb. 21, 2020), the basin may pose a wildlife hazard as it is located within 10,000 feet of the SBIA. As determined by the Lead Agency and the City of Highland (Responsible Agency), the Project may require review by San Bernardino International Airport Authority (SBIAA) and FAA, including submission of FAA Form 7460-1 (Notice of Proposed Construction or Alteration). To reduce wildlife hazards, mitigation may include vegetative management, fencing/netting, and bird-deterrent basin design (e.g., steep slopes, rapid drainage, no standing water). These mitigation measures will be addressed during design and entitlement and if applicable, measures will be incorporated into the CEQA document prior to Project approval.

LAND USE/ PLANNING

The Project is consistent with the Open Space land use designations of the site under the Redlands and Highlands General Plan Land Use Maps. No impacts are anticipated.

MINERAL RESOURCES

The Project site is classified as MRZ-2, indicating the presence of significant PCC-grade aggregate resources based on geologic data. Additionally, the site is located within a sector identified by the State Mining and Geology Board (1987) as containing regionally significant PCC-grade aggregate resources. While the site contains mineral resources acknowledged by the State, it is not currently used for mineral extraction. Potential impacts are expected to be less than significant.

NOISE

The Project's potential to generate noise affecting surrounding land uses would primarily occur during the construction phase. A Noise Impact Analysis should be conducted to quantify construction-related noise and assess whether it exceeds jurisdictional thresholds.

POLULATION/HOUSING

The Project would not induce population growth, nor does it include housing. No impacts are anticipated.

PUBLIC SERVICES AND RECREATION

Though the Project is designated as Open Space, it does not contain any recreational facilities. Furthermore, the Project would not impact public services such as fire, police, schools or libraries as the Project does not include a use that would increase population at the site. No impacts are anticipated.

UTILITIES AND SERVICE SYSTEMS

The Project is the expansion of stormwater facilities to create recharge basins in the Santa Ana River Wash. The Project would not generate a demand for service systems and the expansion of storm water facilities is anticipated to result in less than significant impacts with mitigation incorporated as indicated in the MMRP for the Project.

TRANSPORTATION
Traffic generated by the Project would occur during the construction phase and during operations due to routine maintenance trips to the site. These trips are anticipated to be negligible, and the Project is anticipated to screen out of Vehicle Miles Travelled (VMT) analysis. Impacts are anticipated to be less than significant.

TRIBAL CULTURAL RESOURCES
The results of the AB52 consultation process would determine any impacts to Tribal Cultural Resources (TCR). Given the stie is not identified in a General Plan (Redlands and Highland) as having TCR's, impacts are anticipated to be less than significant with mitigation incorporated in the event of inadvertent discoveries.

WILDFIRE
The Project site is located in a Federal Responsibility Area (FRA) for fire protection and CalFire has identified the site as "Very High Threat" to "High Threat" for fire hazards. Access to the site must adhere to fire code standards to ensure emergency vehicles are able to access the site. As the site would not include the construction of structures nor would it induce population growth at the site, impacts are anticipated to be less than significant.

AGENCY PERMITS REQUIRING CEQA DOCUMENTATION

Once a Notice of Determination (NOD) is adopted under CEQA, other agencies whose approval is required for the project (Responsible Agencies) use the certified environmental document (e.g., EIR or IS/MND) prepared by the lead agency to fulfill their CEQA obligations. These agencies evaluate the document to ensure their jurisdictional concerns are addressed and rely on it when issuing permits or approvals, such as those related to water quality, wetlands, or endangered species. Coordination between the lead and responsible agencies helps streamline the process, ensuring compliance with CEQA and other applicable regulations.

A preliminary review of the site and surrounding resources indicates potential impacts to biological resources and jurisdictional water features. If confirmed by a Jurisdictional Delineation and Biological Resources Assessment, approvals from state and federal agencies will be necessary before grading permits can be issued. Below is a summary of the relevant agencies that would require an NOD/approved CEQA document, the permits likely required, and the estimated timeframe for obtaining them.

Santa Ana Regional Water Quality Control Board (RWQCB) – 401 Water Quality Certification
A 401 Water Quality Certification is required under the Clean Water Act for projects that may result in discharges into waters of the United States, including wetlands and other jurisdictional features. Issued by the Santa Ana Regional Water Quality Control Board (RWQCB), the certification ensures that the project complies with state water quality standards and does not adversely impact water resources. If it is determined that water features under the RWQCB will be impacted by the proposed Project, a 401 Water Quality Certification will be required from the RWQCB pursuant to Section 401 of the Clean Water Act.

The certification process typically involves submitting a detailed application, including a project description, maps, and an analysis of potential impacts on water quality. The RWQCB reviews the application to confirm compliance with state and federal water quality regulations. The process may also require mitigation measures to offset impacts. The timeframe for obtaining a 401 certification varies but generally ranges from 3 to 12 months, depending on project complexity and the completeness of the application. Coordination with other regulatory agencies, such as the U.S. Army Corps of Engineers, is often required. Once the CEQA document is approved it typically takes 3-6 months to receive 401 Certification.

United States Army Corps of Engineers (ACOE) – 404 Permit
A 404 Permit, issued by the U.S. Army Corps of Engineers (ACOE) under Section 404 of the Clean Water Act, is required for projects that involve the discharge of dredged or fill material into waters of the United States, including wetlands, rivers, and streams. This permit ensures that such activities minimize environmental impacts and comply with federal environmental regulations. If it is determined that water features under the ACOE jurisdiction will be impacted by the proposed Project, a 401 Water Quality Certification will be required from the RWQCB pursuant to Section 401 of the Clean Water Act.

The permit process includes submitting an application with project details, public review for Individual Permits, environmental evaluation, and mitigation for unavoidable impacts. Once the CEQA document is approved it can take from 6-12 months to receive a 404 Permit.

California Department of Fish and Wildlife (CDFW) – Streambed Alteration Agreement & Incidental Take Permit

A Streambed Alteration Agreement (SAA) is required under Section 1600 of the California Fish and Game Code for projects that may impact rivers, streams, or lakes, including their beds, banks, and associated riparian vegetation. The agreement, issued by the California Department of Fish and Wildlife (CDFW), ensures that potential impacts to fish and wildlife resources are mitigated. If it is determined in a Jurisdictional Delineation that impacts would occur to water and habitat resources under the jurisdiction of CDFW, then WCD must submit a Notification of Lake or Streambed Alteration, detailing project activities and potential environmental effects to CDFW. CDFW then evaluates the application, conducts site visits if necessary, and negotiates mitigation measures to avoid or minimize impacts. Processing time varies, but agreements are typically finalized within 60 to 120 days. The time it takes to obtain a SAA from CDFW after the CEQA document is approved typically ranges from 3 to 6 months. However, this timeline can vary depending on several factors, including the complexity of the project, the specifics of the stream or waterway being impacted, and the completeness of the application.

An Incidental Take Permit (ITP) from CDFW is required under the California Endangered Species Act (CESA) when a project is expected to result in the incidental take (harm or death) of a state-listed endangered, threatened, or candidate species during the course of development or land use activities. A Biological Resources Assessment would determine the potential for special-status species on the Project site. The time it takes to receive an ITP can vary significantly depending on several factors, including the complexity of the project and the species involved. Estimated timeframes can be from 6 to 12 months plus. After CEQA approval, it generally takes about 3 to 6 months to receive an Incidental Take Permit (ITP) from CDFW, assuming that the application is complete and no significant revisions or additional information are needed.

EXAMPLE CEQA SCHEDULE

The following schedule outlines a typical timeline for completing the various stages of the CEQA process, including preparing technical studies, the Initial Study, public review periods, preparation of environmental documents (such as a Draft EIR or Negative Declaration), and final approval. This helps all stakeholders understand the expected sequence of events and deadlines.

Table 1: Example of Typical CEQA Schedule

TASK	DESCRIPTION	START DATE	END DATE
1.	PROJECT INITIATION	Week 1	Week 1
2.	PROJECT DESCRIPTION	Week 1	Week 2
3.	PREPARE TECHNICAL STUDIES	Week 2	Week 8
4.	GIS Exhibits For IS/ND or MND, MMRP	Week 2	Week 4
5.	PREPARE IS/ND or MND, MMRP	-	-
5A.	Prepare 1st Screencheck IS/ND or MND, MMRP *(Agency Review: Week 10-13)*	Week 3	Week 10
5B.	Prepare 2nd Screencheck IS/ND or MND, MMRP *(Agency Review: Weeks 17-18)*	Week 14	Week 16
6.	PREPARE PROOF CHECK DRAFT IS/ND or MND, MMRP	Week 19	Week 20
7.	CIRCULATION OF DRAFT IS/ND OR MND, MMRP *(30-Day Review Period)*	Week 21	Week 25
8.	PREPARE RESPONSES TO COMMENTS *(County Review: Week 26)*	Week 25	Week 26
9.	PUBLIC HEARING (typically occurs two – four weeks after the completion of the 30-day review period)	Week 28	Week 32

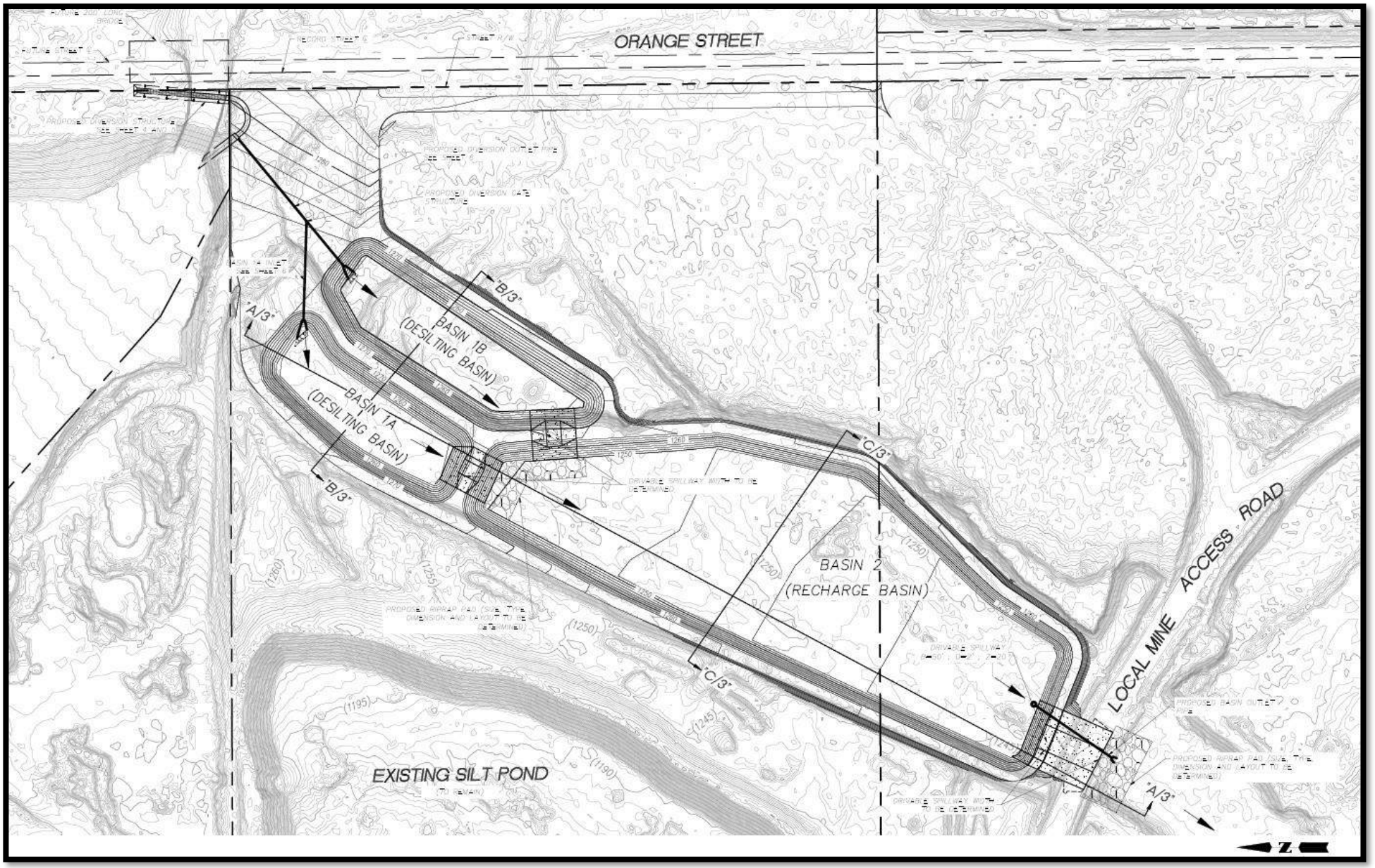
POTENTIAL DEVELOPMENT & ENVIRONMENTAL IMPACT CONSIDERATIONS

The Project site is currently vacant and undeveloped. This memo assumes the Project would proceed based on the existing site conditions. According to discussions with staff, there is a possibility that the site could first be developed into an excavation mine, after which the Water Conservation District (WCD) would take over and develop the proposed recharge basins. Any onsite development that requires discretionary approvals would be considered a "Project" under CEQA and would need to follow the CEQA process outlined in this memo. If WCD were to implement the proposed recharge basins after the site has been developed and disturbed, the environmental impacts would likely be less significant. As a result, fewer permits and technical studies may be required, as the site would already be disturbed and impacted.

REFERENCES

1. 2024 CEQA Statute and Guidelines 2024 CEQA Statutes and Guidelines
2. California State Scenic Highways Viewer California State Scenic Highway System Map
3. California Department of Conservation California Important Farmland Finder DLRP Important Farmland Finder
4. City of Highland General Plan-General Plan | Highland, CA
    a. Land Use Element
    b. Conservation and Open Space Element
5. City of Redlands General Plan- General Plan 2035 - City of Redlands
    a. Chapter 4- Livable Community
    b. Chapter 6- Vital Environment
6. San Bernardino County Countywide Plan- Policy Plan – San Bernardino County
7. San Bernardino Valley Water Conservation District, The Upper Santa Ana River Habitat Conservation Plan- 2024_Wash_Plan_Annual_Report_11.01.2024.pdf
8. San Bernardino Valley Municipal Water District Divisions-San Bernardino Valley Municipal Water District Divisions | San Bernardino County
9. San Bernardino Land Use Services-Planning_Project_Review_Flowchart_VERTICAL.pdf
10. California State Water Boards, San Bernardino County MS4 Permit- Stormwater | Santa Ana Regional Water Quality Control Board
11. Public San Bernardino County Parcel Viewer

Figure 1: Site Plan



Appendix C

Preliminary Design Report of Plunge Creek Ultimate Conditions PERC Project Alternative

San Bernardino Valley Water Conservation District
Program for Expansion of Recharge Capacity (PERC) Comprehensive Feasibility Study

Volume 3
Detailed Feasibility Analysis of PERC Project Alternatives for Plunge Creek Watershed

Preliminary Design Report

Plunge Creek Groundwater Recharge

Ultimate Project

Prepared for:

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Michael J. Gentile, PE

April 2025

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Addendum PCU-1: Proposed Design Exhibits

Addendum PCU-2: Gage Data Analysis

Addendum PCU-3: Basin Routing

Addendum PCU-4: Total Suspended Solids Memorandum

Addendum PCU-5: Cost Estimates:

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1 INTRODUCTION

Casc Engineering and Consulting, Inc. (Casc) is under contract with San Bernardino Valley Water Conservation District (District) to provide support services for the preparation of a Feasibility Study (by the District) for a proposed groundwater recharge basin at Plunge Creek. The proposed project would divert stormwater runoff from Plunge Creek Channel west of Orange Street into a proposed recharge basin system south of the proposed diversion.

The proposed recharge basin system described in this report is the Ultimate Project as labeled by the District. Another project being considered by the District at the same location is the Interim Project, which is described in a separate report.

1.1 PURPOSE

The purpose of this report is to summarize the information gained from the various studies conducted under this contract. The detailed technical studies are listed as references at the end of this report. Additional details and memoranda that are not part of formal detailed technical studies are in the Addenda of this summary report.

Questions to be answered in this report include:

- How much stormwater runoff to divert in terms of peak flow and volume?
- What are the proposed designs for the diversions?
- What is the proposed capacity of the Plunge Creek Ultimate Project?
- What are the expected permitting requirements for the project?
- What is the conceptual estimated cost to construct the project?
- What is the extent of expected groundwater mounding if the project becomes operational?

2 PROJECT DESCRIPTION

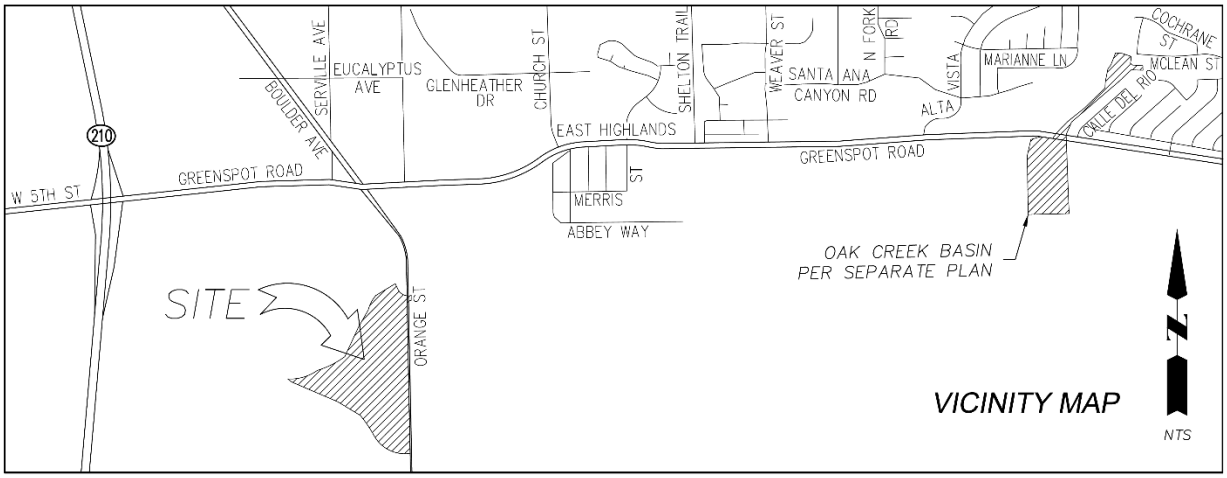


Figure 2-1: Project Location

2.1 EXISTING CONDITIONS

The proposed basin site is an approximately eighty (80) acre parcel located west of Orange Avenue and south of Plunge Creek, owned by the US Government, Bureau of Land Management. Ground surface elevations range from 1290' above mean sea level to 1230'. The slope is generally from east to west with an approximate grade of 2%. The site is cris-crossed by dirt roads, dotted with various dirt mounds, and includes a large silt pond that is approximately 50' deep serving the adjacent cement operation.

Plunge Creek is north of the site and flows from east to west. East of Orange Avenue, Plunge Creek is an unimproved stream bed that is periodically maintained by the San Bernardino County Flood Control District. At the Orange Street bridge the creek becomes a concrete rectangular channel. Approximately one hundred feet (100') downstream of the bridge, the rectangular channel drops approximately fifty feet through a spillway that is eighty-one feet (81') wide and approximately one hundred and forty feet (140') long to a grouted riprap apron that widens the channel to one hundred seventy feet (170') at its downstream end. The as-built plans for the spillway show a design flow rate of 13,000 cfs.

From the end of the apron, the creek resumes as an unimproved channel westerly until its confluence with City Creek approximately one and a half miles downstream.

2.1.1 Existing Condition 100-Year Floodplain

JLC Engineering & Consulting, Inc. developed a HEC-RAS model of the existing condition 100-year floodplain for Plunge Creek, as described in their report: Hydrology & Hydraulic Report for Plunge Creek, dated May 25, 2023 (JLC 2023). The JLC model substantially conformed with prior modeling done by West Consultants in 2009 for their approved report: San Bernardino County FEMA Levee Certification Non-Federal Levees – Phase II Hydraulic Report (West, 2009). The model showed flooding at Orange Street under current conditions (81'-wide channel at Orange Street).

2.2 Future Conditions – Basis of Design

The existing Plunge Creek channel is 81' wide, but it is likely that it will be wider by the time the Plunge Creek Ultimate Project is constructed. The City of Highland is currently preparing plans to widen the Orange Avenue bridge. As part of the proposed design, Plunge Creek channel would be widened to one hundred ninety-two feet (192') downstream of the bridge. The future rectangular channel would include side walls that are twelve feet (12') high. The hydraulic design for this project is expected to convey the 100-year peak flow without flooding, thereby protecting the proposed basins from the 100-year floodplain. The preliminary hydraulic studies are described in the Structure Type Selection Report: Orange Street Bridge over Plunge Creek Overflow, prepared by IDC Consulting Engineers, November 2020 (IDC 2020).

Casc received a conceptual plan, profile, and section from the City of Highland to use as the basis of design for the proposed Plunge Creek diversion structures. The exhibits in Addendum PCU-1 show the future channel plan as the de facto condition at the time of construction.

The Ultimate Project also assumes that the proposed basin site will be mined by others prior to construction. The mining operation is assumed to have excavated the proposed basin area to the bottom depth shown on the conceptual grading plan, but with side slopes at 1.5:1 by the time the District begins construction of the Ultimate Project.

2.3 Proposed Project

The Plunge Creek Groundwater Recharge Ultimate Project consists of one large basin, a diversion from Plunge Creek, and a storm drain system to convey diverted runoff to the proposed basin. Two diversion alternatives are being considered – a pneumatically operated gate, or a grated drop structure. The project features are described below.

2.3.1 Recharge Basin

The proposed layout consists of one large basin. Runoff would be diverted from Plunge Creek via one of the diversion structures described below, which would be connected to a 48" RCP storm drain that would convey and discharge runoff into the basin. The proposed basin would have an overflow spillway that would discharge excess runoff to the Santa Ana River.

Preliminary basin grading for the Ultimate Project is shown in Addendum PCU-1. The conceptual grading assumes side slopes at 2:1 (horizontal to vertical) with 20'-wide access roads.

Table 2-1: Plunge Creek Basin Data

Basin Nam	Bottom Elevation	Top Elevation	Spillway Elevation	Bottom Area (Acres)	Storage Volume (Acre-Ft)
Basin 1	1160	1232	1230	26.36	2431.2

2.3.2 Plunge Creek Diversion – Alternative 1 – Pneumatically Operated Gate

Alternative 1 for diversion from Plunge Creek is a pneumatically operated gate. The proposed pneumatically operated gate would be a metal gate that is raised and lowered by inflating a bladder

directly behind the gate panels. The system would be located within Plunge Creek Channel, recessed below the invert of the channel.

Casc contacted Obermeyer Hydro, Inc., for assistance with the preliminary design. A section drawing of the preliminary design is in Addendum PCU-1. The proposed gate would span the width of the channel and be eight feet (8') high when fully raised, measured from the invert of the channel. Obermeyer Hydro described the control systems as including one or two air compressors (depending on redundancy needs), dryers, an air tank, mechanical control panel, and programmable logic controller (PLC) cabinet. The system components would either be housed in a small building or outdoor rated cabinet depending on the size of the components.

When the gate is raised, impounded water would be diverted through a 6'-wide by 5'-high opening in the south channel wall into a proposed outlet structure that houses a flume gate (Rubicon FGB-6-4.5 or equal) and is connected to a 48" RCP outlet pipe. The invert of the opening would be three feet (3') above the invert of the channel, allowing the gate to operate in free-flow conditions, and allowing sediments and debris to settle in the channel while the comparatively cleaner runoff at the top of the water column is diverted. Accumulated sediments in the channel would then be flushed out when the gate is lowered during high flow events.

2.3.3 Plunge Creek Diversion – Alternative 2 – Grated Drop Structure

Alternative 2 for diversion from Plunge Creek is a grated drop structure (FHWA HEC-14, Chapter 11, Drop Structures, Section 11.1.2. Grate Design). The proposed drop structure structure would be sized to intercept up to 145 cfs from Plunge Creek. Hydraulic details for the design of the grated drop structure are in Section 5.

The grated drop structure would have a sloped invert to carry the intercepted runoff to the outlet structure. In contrast with Alternative 1, the proposed opening in the wall for this alternative would be 6'-wide by 7.2' high for the larger flume gate (Rubicon FGB-6-7.2) due to the submerged flow condition downstream. The outlet is submerged in this alternative because the invert of the wall opening is twelve feet (12') lower than the wall opening in Alternative 1.

2.3.4 Storm Drain

The preliminary design includes a 48" RCP storm drain to convey runoff from the diversion to Basin 1.

2.4 Potential Floodplain Impact

The proposed project is not expected to have material effects on the 100-year floodplain, subject to review by the San Bernardino County Flood Control District. The main reason for this expectation is that the design of the proposed diversion structure does not alter the invert or geometrics of the future Plunge Creek channel downstream of the proposed Orange Street bridge improvements. Both diversion designs are configured to allow flood flows above 145 cfs to continue unabated through the channel. While there may be minor losses involved, it is not expected that these would materially increase the water level in the channel during a 100-year event beyond the capacity of the future improvements. Detailed studies and review by San Bernardino County Flood Control District are to be part of the next phase of development for the Plunge Creek projects.

3 HYDROLOGY – GAGE DATA ANALYSIS

3.1 METHODOLOGY

An analysis of the 35-year record from Stream Gage Data from Upper Plunge Creek gage 110555000 (water year 1989 through part of water year 2024) detected 187 distinct storm events for that time frame. These storm events were then scaled for the ungaged watersheds by overlaying the PRISM 30-year normal data over all four watersheds (gaged Plunge Creek, ungaged Oak Creek, Greenspot Storm Drain, and Elder Creek. Reduction Factors for each watershed were then calculated as the product of the watershed area and the weighted precipitation average. The Reduction Factors shown in Table 3-1:

Table 3-1: Calculated Watershed Ratios

Subbasin	Area (Ac)	Precipitation (inches)	Product (ac-ft)	Reduction Factor
Elder Creek	3,082	14.19	3,645	0.164
Oak Creek	1,527	16.34	2,079	0.094
Plunge Creek	10,974	24.26	22,185	1.000
Storm Drain	547	13.46	613	0.028

3.2 DESIGN STORM DETERMINATION

A Log Pearson Type 3 distribution was applied to the adjusted set of storm flow events to determine 50th, 80th, and 90th percentile peak flow rates. The results of this distribution produced the percentile peak flow rates shown in Table 3-2:

Table 3-2: Percentile Peak Flow Rates

Flow Data Source/Combination	50th Percentile Peak Flow Rate (cfs)	80th Percentile Peak Flow Rate (cfs)	90th Percentile Peak Flow Rate (cfs)
Oak Creek	11.0	27.6	47.7
Storm Drain	3.3	8.2	14.2
Plunge + Elder	135.7	342.0	590.4
Plunge + Elder + Oak	146.6	369.6	638.1

After discussion with the District, it was determined that the 50th percentile peak flow rate would be used for design. One of the storm events in the gage data, Event 121, had a peak flow rate that was a very close match to the 50th percentile peak flow rate shown in Table 3-2 for Oak Creek. Event 121 was selected as the model hydrograph to use for design, i.e. the project typical hydrograph (PTH).

The PTH was then scaled up for the combined Plunge+Elder+Oak watershed. The resulting hydrograph was used to develop the inflow event for Plunge Creek basin routing (see Section 5) and for the hydraulic design of the project elements.

The analysis of the gage data and the typical hydrograph development may be found in the technical memos in Addendum PCU-2.

4 GEOTECHNICAL

4.1 INVESTIGATION SUMMARY

LOR Geotechnical conducted a geotechnical investigation near the Plunge Creek site, as described in their report: Alternate Preliminary Infiltration Feasibility Investigation Plunge Creek Basin, Highland/Redlands, California, Project 63913B.4, May 31, 2023 (5th Draft), Final Date: January 8, 2025 [LOR 63913B.4]. The Plunge Creek site itself was inaccessible at the time of the investigation. The investigation scope of services included:

- Excavation of total of four (4) exploratory trenches with a track-mounted mini excavator. Two trenches were excavated at the Cemex site, and two were excavated at the Robertson's site. Trench depths were between 5 feet and 8.5 feet below existing ground surface.
- One single-ring infiltrometer test taken at the Cemex site
- Three double-ring infiltration tests: two at the Robertson's site, and one at the Cemex site
- In-place density testing at the Cemex site
- Sieve analysis
- Testing for measurement of hydraulic conductivity of coarse grained soils (ASTM D2434)

Figure 4-1: Plunge Creek Basin geotechnical investigation map from Project 63913B.4.

The Cemex site investigation took place on February 17, 2023, and was revisited on April 28, 2023, to collect bulk samples and conduct in-place density tests. The Robertson's site investigation took place on March 9, 2023.

4.2 SITE SOILS

The investigation report described the site as being "underlain by young alluvial soil materials. The alluvial materials were noted to consist of units ranging from silty sand with gravel, cobbles, and boulders to well graded gravel with sand, cobbles, and boulders. The native units in the quarries varied from light brown to brown in color, were generally wet, and were typically in a dense to very dense in-place state." [LOR 63913B.4, p.4].

4.3 GROUNDWATER

The investigation report noted that both sites "had experienced recent rainfall events and ponding water existed at both sites during the time of our investigation. In addition, approximately 1 to 1 ½ weeks prior to our trench excavations at the Cemex site, this site had been flooded with recharge water." [LOR 63913B.4, p.4]. As a result, the investigation encountered shallow groundwater at the Cemex site, but no groundwater was encountered at the Robertson's site. The report had "no clear explanation for the difference in water conditions noted between the two sites" [LOR 63913B.4, p.4].

The investigation report noted that the shallowest groundwater depth recorded by the nearest well, State Well Number 01S03W10K0025, was approximately 74 feet below ground surface in April 2012. Most of the remaining measurements from this well were in the range of 100 to 150+ feet below ground surface.

4.4 INFILTRATION

Near the Plunge Creek Basin site, LOR conducted three double-ring infiltrometer, and one single-ring infiltrometer test at depths of approximately 0.5 feet to 1 foot below existing ground surface. Infiltration rates were calculated by LOR from the test data and ranged from 2.6 inches/hour (5.1 ft/day) to 5.8 inches/hour (11.6 ft/day).

The District calculated the geometric mean of the results and then calculated a factor of safety of 2.1875 using the method in Appendix D of the Technical Guidance Document for Water Quality Management Plans, June 7, 2013, prepared by CDM Smith, Inc. The resulting design rate of 3.55 feet/day was proposed for the unclogged rate. For the clogged rate, the District proposed assigning an additional reduction factor of 2 to simulate clogging prior to basin maintenance, resulting in a clogged rate of 1.77 feet/day. These assumptions and calculations were reviewed and agreed to by the design team and the District.

Table 4-1: Plunge Creek Design Infiltration Rates

Location	Clogged Rate (ft/day)	Unclogged Rate (ft/day)
Plunge Creek Basin Site	1.77	3.55

4.5 GRADING RECOMMENDATIONS

While the report did not include formal grading recommendations, the investigation included a slope stability analysis using the computer program STEDwin, version 2.9. The analysis assumed a 120' tall, 2:1 cut slope. The analysis also assumed soil strength information from LOR's investigation of Oak Creek (Preliminary Feasibility Geotechnical and Infiltration Feasibility Investigation Oak Creek Basin and Diversion Project, Highland, CA, Project 63813A.4, March 1, 2023, Final Date: January 8, 2025). Based on these assumptions, the analysis indicated the proposed cut slope to be stable. In a rapid draw scenario at the top and bottom of the basin, the analysis determined factors of safety of 1.5 for static, and 1.2 for pseudostatic conditions.

5 HYDRAULICS

5.1 BASIN ROUTING

A Routing Inflow Event (Native Inflows) consisting of five consecutive Project Typical Hydrographs (PTH) with no time gap between the end of one storm and the beginning of the next was created for basin routing analysis of native runoff. The resulting Routing Inflow Event had the characteristics shown in Table 5-1:

Table 5-1: Routing Inflow Event (Native Inflows) Characteristics

Duration (Days)	Peak Flow (cfs)	Cumulative Volume (ac-ft)
56	144.7	3656

The routing analysis is described in JLC Technical Memorandum dated January 26, 2025, Plunge Creek Basins & Oak Creek Basins Routing Assessment. The inflows were routed through the basin assuming clogged and unclogged infiltration rates. The routing results are summarized in Table 5-2:

Table 5-2: Basin Routing Results

Scenario	Inflow Volume (Ac-Ft)	Infiltrated Volume (Ac-Ft)	Overflow (Discharged) Volume (Ac-Ft)
Unclogged	3,656	3,656	0
Clogged	3,656	3,656	0

The Basin Routing Technical Memorandum and Stage-Storage-Discharge Table are in Addendum PCU-3.

5.2 ALTERNATIVE 2 - GRATED DROP STRUCTURE - HYDRAULICS

The proposed diversion structure for Alternative 2 is a grated drop structure per U.S. Department of Transportation, Federal Highway Administration, Hydraulic Engineering Circular No.14, Third Edition, Hydraulic Design of Energy Dissipators for Culverts and Channels, [FHWA HEC-14], Chapter 11, Drop Structures, Section 11.1.2. Grate Design, as shown in Figure 5-1.

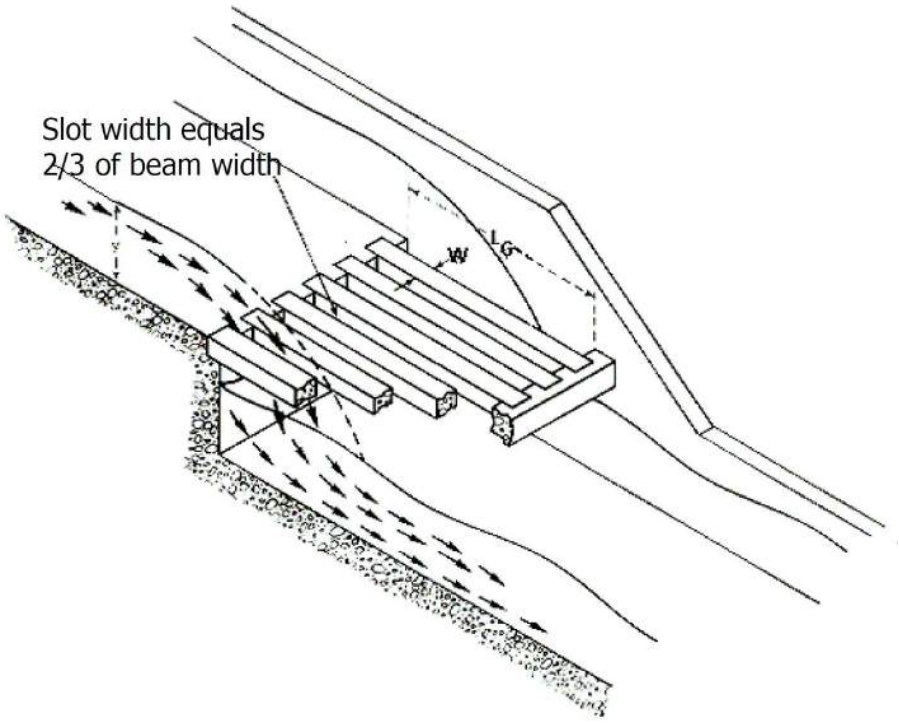


Figure 5-1: Plunge Creek Basin Alternative 2 Diversion Structure

The proposed diversion structure will be sized for full diversion of flows (q) up to 145 cfs from Plunge Creek Channel. The length of the grate (L_G) is calculated from Equation 11.4 in HEC-14:

$$L_G = \frac{q}{CWN(2gy_o)^{1/2}}$$

Where:

C = experimental coefficient equal to 0.245

W = width of the slots, ft

N = number of slots (spaces) between beams

y_o = approach flow depth, ft (0.11 feet – normal depth for 145 cfs)

Assuming a beam width (w) of one and a half feet (1.5'), the slot width (W) is one foot (1'), and N is 77 for a channel that is 192' wide. From these parameters, the grate length (L_G) is calculated to be approximately 2.9 feet. Three feet (3') is used in the drawings for design and estimating.

5.3 SPILLWAYS

The overflow spillway will be designed to convey the peak flow diversion of 145 cfs. The table below shows the depth of flow over the proposed spillway calculated using the weir equation ($q=CLH^{3/2}$) with a weir coefficient (C) of 3. The maximum q calculation in the table assumes a depth of flow that allows for one foot (1') of freeboard.

Table 5-3: Spillway Calculation Results

Spillway	Weir Width (ft)	Depth of Flow for q=145 cfs (ft)	Max depth (H) with 1' freeboard	Maximum q with 1' freeboard
Basin 1	50	0.98	1	150

6 SEDIMENT TRANSPORT

Chang Consultants prepared a sediment transport analysis for Plunge Creek using a FLUVIAL-12 Model. The preliminary results and analysis are in the report Sediment Transport Analysis for Plunge Creek, dated March 3, 2024. The study included sediment transport analysis for the 100-year storm and what was described as the Rainy Average storm. The Rainy Average Storm is no longer part of the study, having been replaced with the gage data analysis and determination of the Project Typical Hydrograph from that analysis. Nevertheless, the Rainy Average model (peak flow approximately 180 cfs) provides some insight into anticipated sediment transport from a Project Typical Hydrograph event (peak flow 145 cfs).

Figure 9 in the sediment transport study shows the sediment delivery during the Rainy Average event. The curve is relatively flat from the downstream end of the study (Plunge Creek at Orange Avenue) to approximately 12,000 feet upstream (near Plunge Creek and Greenspot Road), indicating an approach to equilibrium. The conclusion of the report states, "Sediment delivery trends towards equilibrium below the alluvial foothill." While sediment delivery during a typical storm may trend toward equilibrium, recent observations of flood flows in Plunge Creek show runoff with considerable TSS, and the potential for large boulders as part of the discharge.

Alternative 1 (Pneumatically Operated Gate) is designed to minimize the TSS loading into the basins by having the diversion raised three feet above the channel invert, which would allow some TSS to settle out. Accumulated sediments in the 3' trough would then be flushed out when the gate is lowered. Alternative 2 would at least restrict the object size in the flow to one foot or less since the slots are designed to be one foot wide. TSS and smaller sediments would be carried more readily in the diverted runoff, however, since no settling trough is provided.

6.1 TOTAL SUSPENDED SOLIDS ASSESSMENT

JLC Engineering & Consulting, Inc. assessed total suspended solids expected to be carried with the sediment bedload using the data from the model in the Chang 2025 report and the grain size distribution data from the Grain Size Distribution Analysis, Project No. 63813A.42 prepared by LOR Geotechnical, dated October 13, 2023 (LOR 63813A.42).

The distribution analysis showed the percentage of silts and clays for each sample and ranged from 0.7% to 14%. The assessment used conservative values of 15% and 20% to calculate expected TSS volumes for the Rainy Average storm. The resulting calculations showed a TSS delivery of 50 cubic yards (assuming 15%) and 70 cubic yards (assuming 20%) for the Rainy Average storm, which is a 24-hour storm, whereas the PTH is about ten days long. Details are in Addendum PCU-4. Further refinement of this initial analysis is expected as part of future project development.

7 GROUNDWATER

By design, the proposed can cause groundwater mounding nearby. Geoscience, Inc. analyzed potential groundwater mounding from the proposed project in the report Groundwater Modeling for Plunge Creek Diversion and Basins Project Feasibility Study, dated January 31, 2025 (Groundwater Report). The analysis in the report indicated that the peak mounding from the Plunge Ultimate Project would occur around fifty-six days after the start of spreading assuming clogged conditions, and around 47 days assuming unclogged conditions. Recharge would also result in an increase in the area of shallow groundwater (groundwater less than fifty feet below ground surface). The results are summarized in Table 7-1:

Table 7-1: Groundwater Mounding

Scenario	Maximum Change in Groundwater Elevation (ft)	Time of Maximum Mounding (days after start of recharge)	Baseline Area of Shallow Groundwater (acres)	Recharge Scenario of Shallow Groundwater (acres)
Clogged	22	56	1,331	1,457
Unclogged	31	47	1,315	1,453

8 VALUE ENGINEERING/CONSTRUCTION COST

The estimated cost to construct is based on the design shown in Addendum PCU-1. The proposed grading design for the large basin was provided by the District and remains unchanged. The design provided by the District also included a second basin located southeast of Basin 1. This second basin was removed. Casc also revised the design of the proposed diversion as the objectives of the project were clarified. Items removed from the project design include:

Table 8-1: Value Engineering Changes

Design Element Removed	Explanation
Secondary Basin	Grading plan showed that basin would not add capacity.
Concrete Return Channel	Project design goal changed to divert up to a maximum flow rate of 145 cfs; proposed diversions are now designed with that capacity so that flows in excess of capacity bypass diversion.
Coanda Screen Diversion Structure	Considered redundant
Trapezoidal Channel Diversion Structure	Considered redundant
Basin Outlet Structures (Riser and Pipe Outlet)	Proposed spillways satisfy the need to provide overflow. Considered redundant.

Additional opportunities for value engineering are likely to occur during final design as the hydraulics of the system are optimized.

8.1 CONSTRUCTION COST ESTIMATE

Construction costs for the proposed project shown in Addendum PCU-1 are summarized in the tables below. Detailed cost estimates are in Addendum PCU-5.

Table 8-2: Construction Cost Estimate Summary

Alternative	Construction Items	Soft Costs	Total
Pneumatically Operated Gate	$12,106,000	$10,866,000	$22,972,000
Grated Drop Structure	$11,296,000	$10,344,000	$21,640,000

Note: Soft costs include 30% contingency, design & permitting, habitat mitigation, and construction administration.

9 PERMITTING REQUIREMENTS

The project will require compliance with the California Environmental Quality Act (CEQA). The technical memorandum in Addendum PCU-6 describes the requirements and CEQA process anticipated for this project. Based on the scope of the project, it is anticipated that an Initial Study/Mitigated Negative Declaration (IS/MND) will be required.

The project may also require permits from the Santa Ana Regional Water Quality Control Board (RWQCB), the California Department of Fish and Wildlife (CDFW), and the United Staes Army Corps of Engineers (ACOE). Agency permitting will require an approved CEQA document and notice of determination.

Time frame for the CEQA process is expected to be between 28 and 32 weeks. Permits could then be obtained within 6 to 12 months following CEQA approval.

Due to the project's proximity to San Bernardino International Airport (SBIA), the project may require review by SBIA and the Federal Aviation Administration (FAA) to assess potential wildlife hazards posed by the proposed basin.

9.1 SAN BERNARDINO COUNTY FLOOD CONTROL DISTRICT PERMITTING

The project will require a Major Construction Permit from the San Bernardino County Flood Control District (SBCFCD), which has jurisdiction over Plunge Creek. Key issues in SBCFCD's review include:

- How will the project affect existing SBCFCD facilities
- Will the project affect SBCFCD's ability to operate and maintain their facilities
- What entity will be responsible for the operation and maintenance of the proposed facilities

The encroachment permit application would include:

- Completed permit application
- PDF of plans signed by a Registered Civil Engineer
- PDF of hydrology/hydraulic calculations

Applicants are to pay a fee calculated by SBCFCD after application is submitted. Reviews will not begin until the fee is paid. If review and inspection costs exceed the initial fee, the applicant is required to pay the difference.

Reviews by SBCFCD can take up to six weeks per review cycle depending on the complexity of the review. As this project will involve the construction of permanent facilities within SBCFCD's jurisdiction, permits from other agencies, and the execution of an agreement for operation and maintenance of the proposed facilities, longer review cycles are anticipated.

10 CONCLUSION

This report summarizes the technical reports prepared to support the San Bernardino County Water Conservation District's feasibility study for the Plunge Creek Basin Ultimate Project. The proposed project envisions one large basin inherited from an expected mining operation on the project site, and two alternatives for diversion from Plunge Creek. Target peak flow for the proposed diversion is 145 cfs based on statistical analysis of the data from the Plunge Creek gage.

The project is expected to infiltrate 3,656 acre-feet per year based on a year of five 50th percentile events. Cost to construct is approximately $22,000,000 to $23,000,000.

11 REFERENCES

Chang (Chang Consultants), 2025. Sediment Transport Analyses for Plunge Creek. Prepared for Casc Engineering & Consulting, dated April 22, 2025.

FWHA (U.S. Department of Transportation, Federal Highway Administration), HEC-14. Hydraulic Engineering Circular No. 14, Third Edition, Hydraulic Design of Energy Dissipators for Culverts and Channels, Publication No. FHWA-NHI-06-086, July 2006.

Geoscience (Geoscience Support Services, Inc.), 2025. Groundwater Modeling for Plunge Creek Diversion and Basins Project Feasibility Study. Prepared for Casc Engineering and Consulting, Inc. Engineering Feasibility Study Support Services for San Bernardino Valley Water Conservation District, dated January 31, 2025.

IDC (IDC Consulting Engineers, Inc.), 2020. Structure Type Selection Report: Orange Stret Bridge over Plunge Creek Overflow. Prepared for City of Highland, dated November 2020.

JLC (JLC Consulting & Engineering, Inc.), 2023. Hydrology & Hydraulic Report for Plunge Creek Existing Floodplain. Prepared for San Bernardino Valley Water Conservation District, dated May 25, 2023.

LOR (LOR Geotechnical Group, Inc.), 63813A.4. Preliminary Geotechnical Feasibility and Infiltration Feasibility Investigation Oak Creek Basin and Diversion Project Highland, California. Prepared for Casc Engineering & Consulting, dated March 1, 2023, Final Date: January 8, 2025.

LOR (LOR Geotechnical Group, Inc.), 63813B.4. Alternate Preliminary Geotechnical Feasibility and Infiltration Feasibility Investigation Plunge Creek Basin Highland/Redlands, California. Prepared for Casc Engineering & Consulting, dated May 31, 2023, Final Date: January 8, 2025.

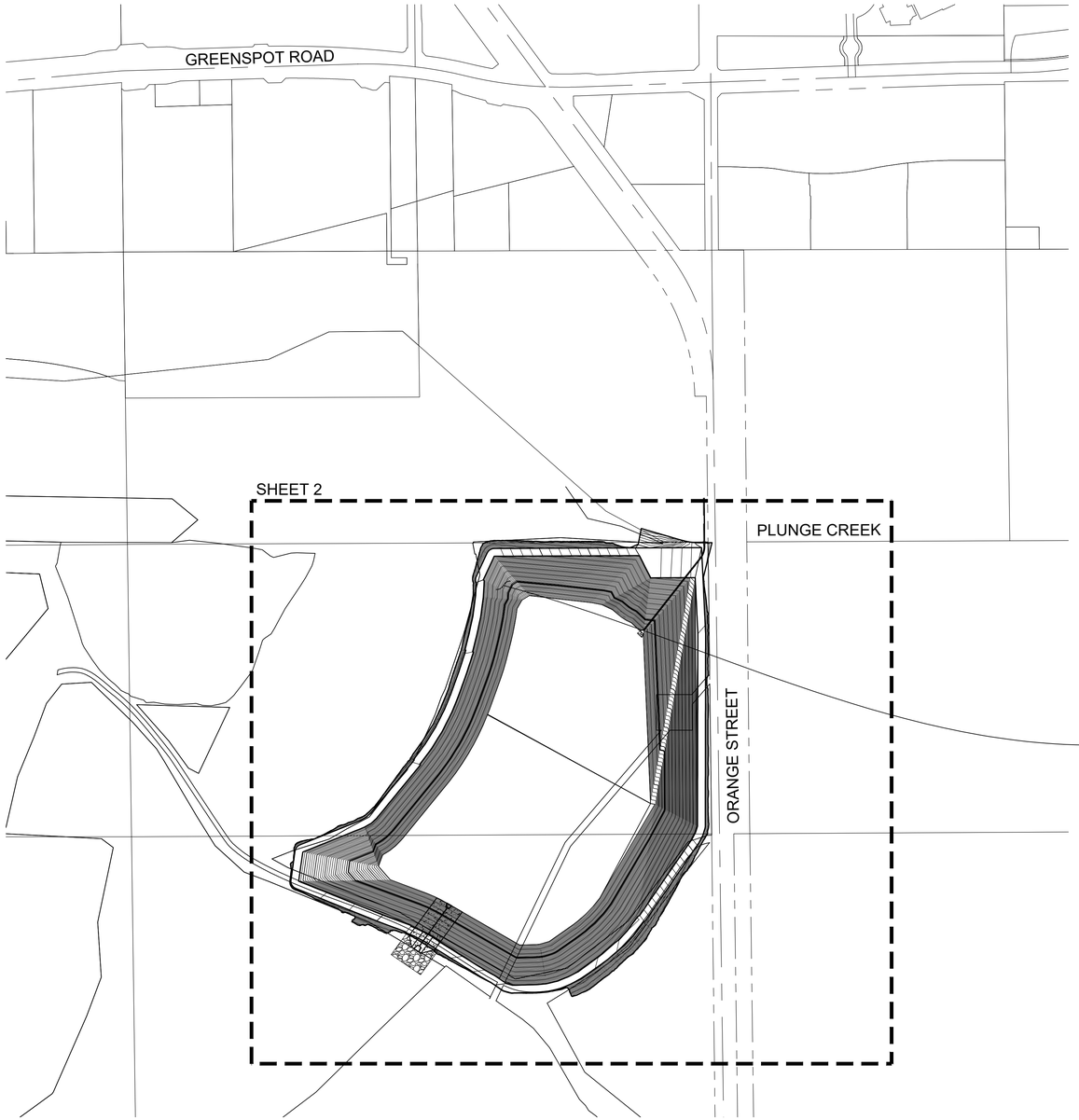
LOR (LOR Geotechnical Group, Inc.), 63813A.42. Grain Size Distribution Analysis, Plunge Creek and Oak Creek Basins/Diversion Projects, Highland/Redlands, California. Letter to Casc Engineering & Consulting, dated October 13, 2023.

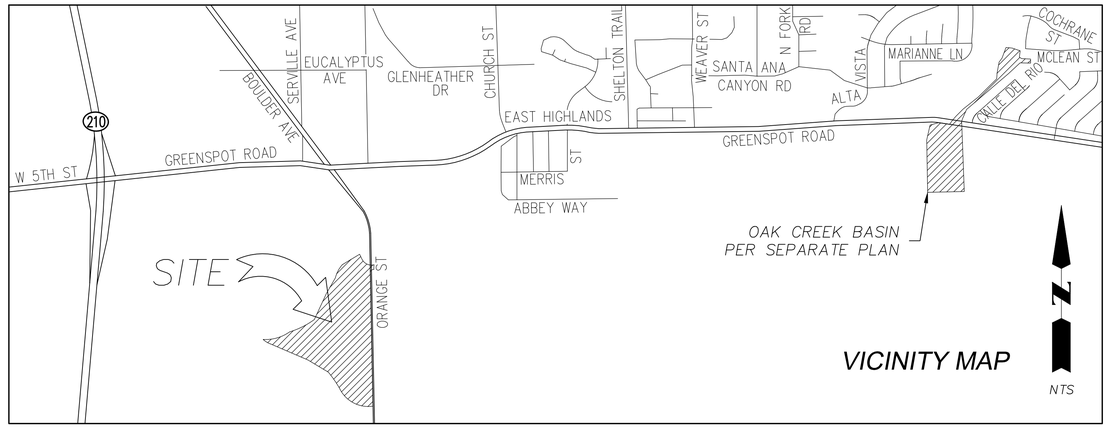
West (West Consultants, Inc.), 2009. San Bernardino County FEMA Levee Certification Non-Federal Levees – Phase II, Hydraulic Report, Plunge Creek Levee IDs 13a, 13c, and 14. Prepared for HDR Engineering, Inc., dated August 4, 2009.

ADDENDA

ADDENDUM PCU-1: PROPOSED DESIGN EXHIBITS

PLUNGE CREEK GROUNDWATER RECHARGE PROJECT ALTERNATIVE
PRELIMINARY CONCEPTUAL DESIGN FEATURES
ULTIMATE PROJECT

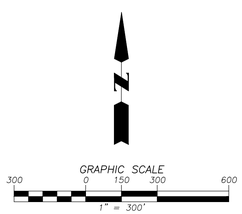




PLUNGE CREEK FORMER SILT POND QUARRY BASINS ULTIMATE PROJECT

SHEET INDEX

1. *TITLE SHEET AND INDEX SHEET*
2. *CONCEPTUAL BASIN GRADING PLAN*
3. *GRADING CROSS–SECTIONS*
4. *PLAN AND PROFILE PNEUMATICALLY OPERATED GATE (ALTERNATIVE 1)*
5. *PLAN AND PROFILE GRATED DROP STRUCTURE (ALTERNATIVE 2)*
6. *PLAN AND PROFILE DIVERSION PIPE*



MARCH 2025

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REVIEWED BY: JOHN LAMBIE, PE, CEG, PG, CONSULTING CHIEF ENGINEER AND HYDROGEOLOGIST, SAN BERNARDINO VALLEY WATER CONSERVATION DISTRICT.

NO.	DATE	REVISIONS	APPROVED	DATE
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San Bernardino Valley Water Conservation District
Helping Nature Store Our Water

SAN BERNARDINO VALLEY WATER CONSERVATION DISTRICT

PLUNGE CREEK GROUNDWATER RECHARGE PROJECT ALTERNATIVE
PRELIMINARY CONCEPTUAL DESIGN FEATURES

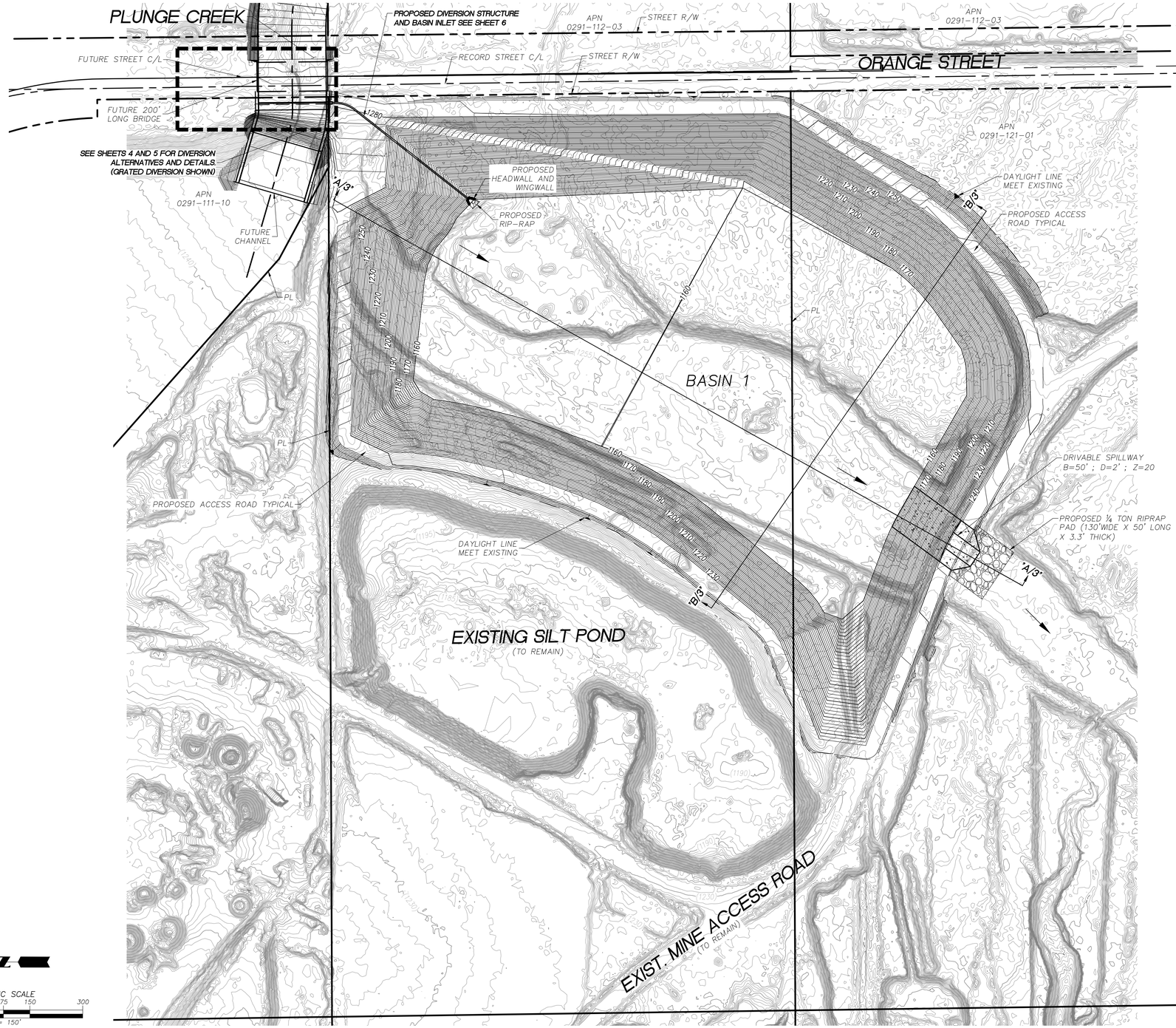
TITLE SHEET

PROJECT NO. SBVWCD - xxx

SHEET 1 OF 6

BASIN DATA TABLE

BASIN NO.	BOTTOM AREA (AC)	STORAGE CAPACITY (AC-FT)
1	26.5	2,431



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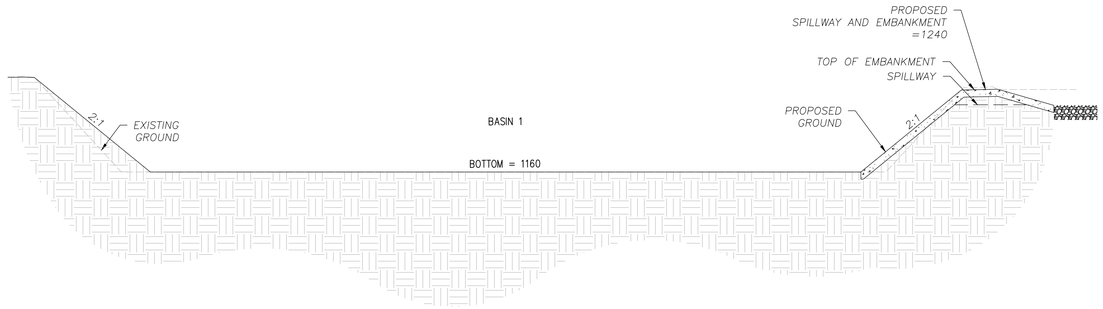
PROJECT NO. SBVWCD - xxx

PLUNGE CREEK GROUNDWATER RECHARGE PROJECT ALTERNATIVE
PRELIMINARY CONCEPTUAL DESIGN FEATURES

CONCEPTUAL GRADING PLAN

SHEET 2
OF 6



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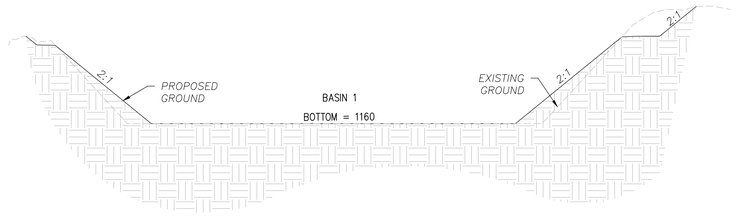

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San Bernardino Valley
Water Conservation District
Helping Nature Store Our Water

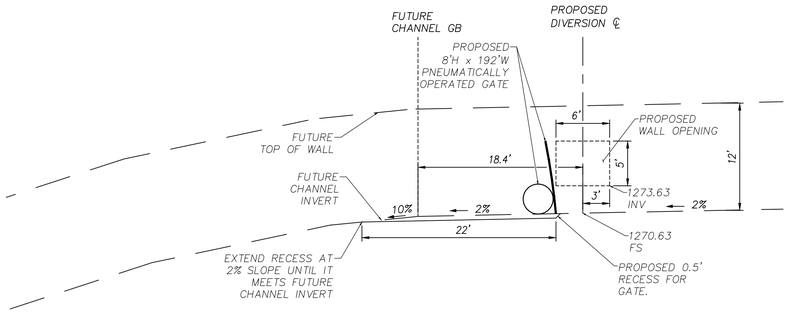
SAN BERNARDINO VALLEY WATER CONSERVATION DISTRICT

PROJECT NO.
SBVWCD -
xxx

PLUNGE CREEK GROUNDWATER RECHARGE PROJECT ALTERNATIVE
PRELIMINARY CONCEPTUAL DESIGN FEATURES

ULTIMATE BASIN CROSS-SECTIONS

SHEET 3
OF 6



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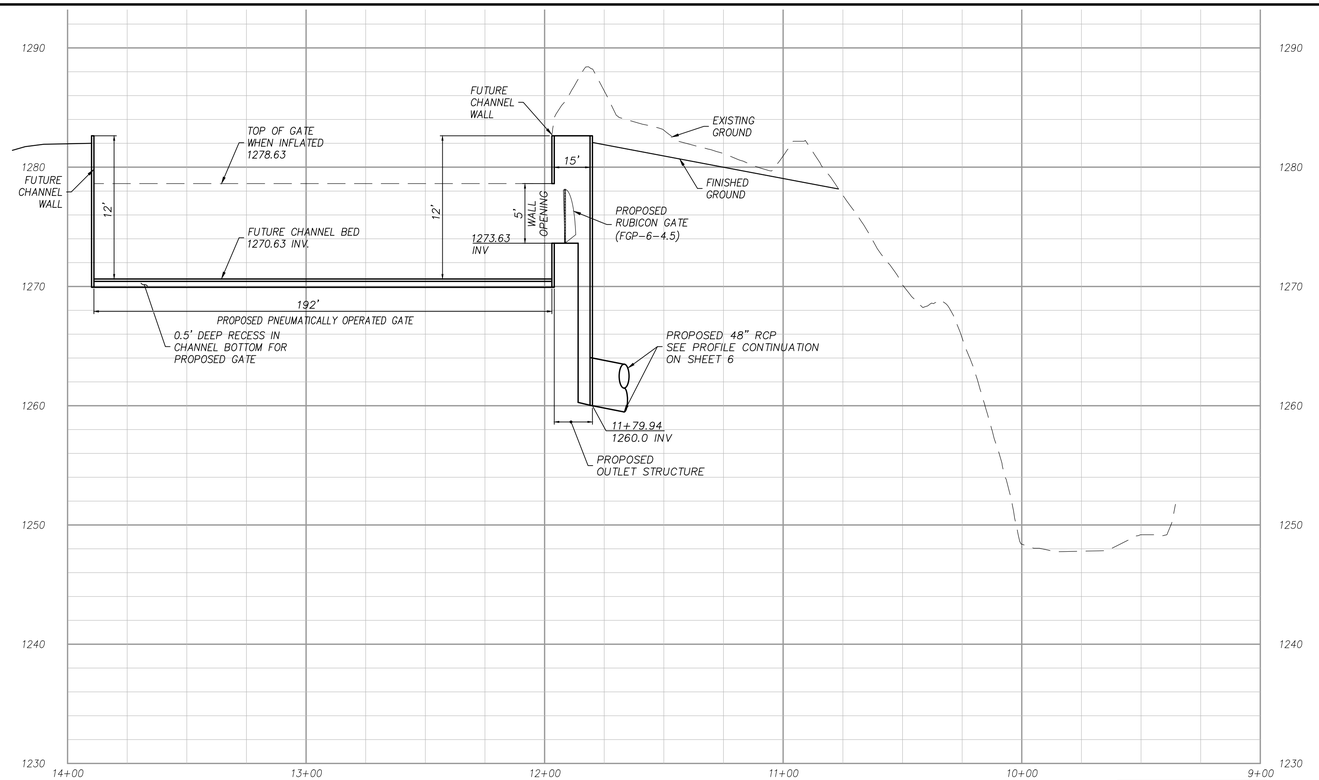

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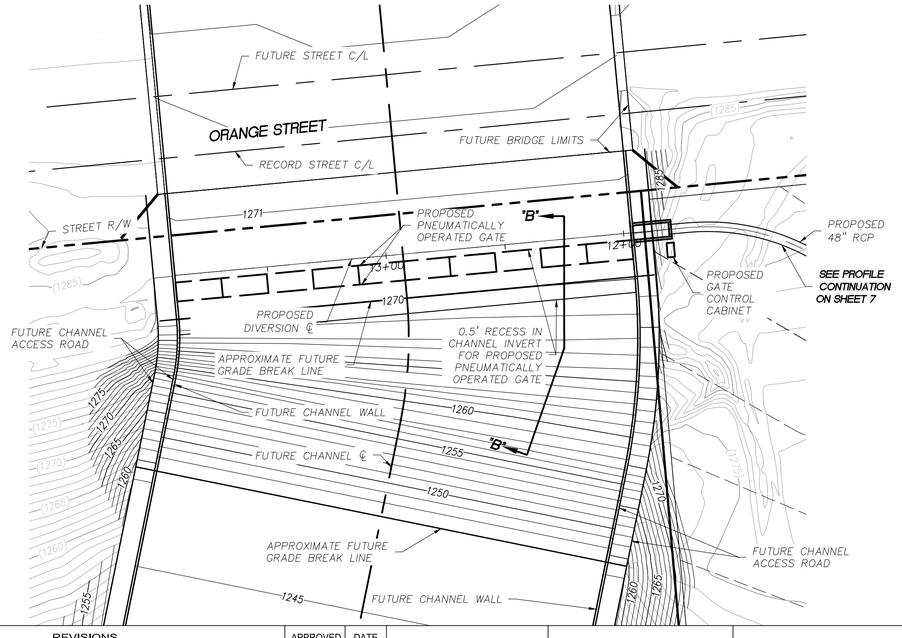

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NOTE: FUTURE CHANNEL AND ORANGE STREET BRIDGE IMPROVEMENTS TAKEN FROM CONCEPTUAL PLAN AND PROFILE FOR THE ORANGE STREET BRIDGE REPLACEMENT PROJECT PREPARED BY INNOVATIVE DESIGN COMPANY FOR THE CITY OF HIGHLAND, JANUARY 2025.

MARCH 2025

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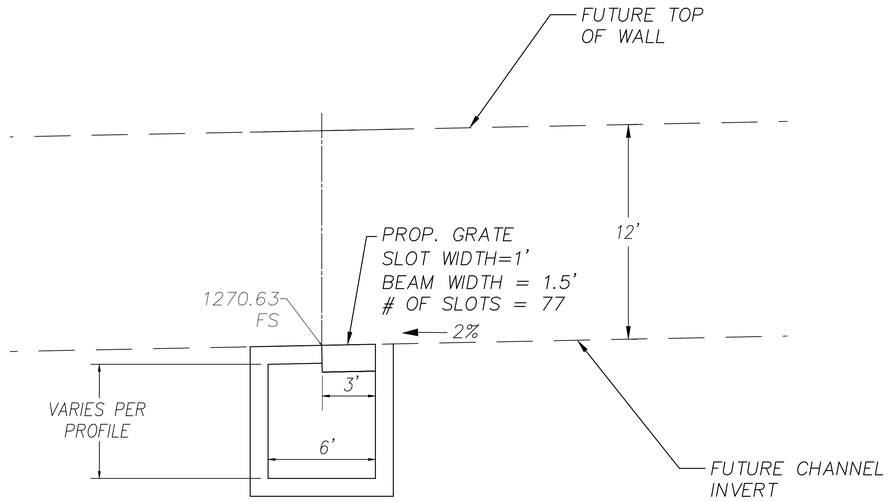
PROJECT NO. SBVWCD - xxx

PLUNGE CREEK GROUNDWATER RECHARGE PROJECT ALTERNATIVE
PRELIMINARY CONCEPTUAL DESIGN FEATURES

ALTERNATIVE 1 DIVERSION STRUCTURE
PNEUMATICALLY OPERATED GATE

SHEET 4 OF 6



SECTION "A"–"A"

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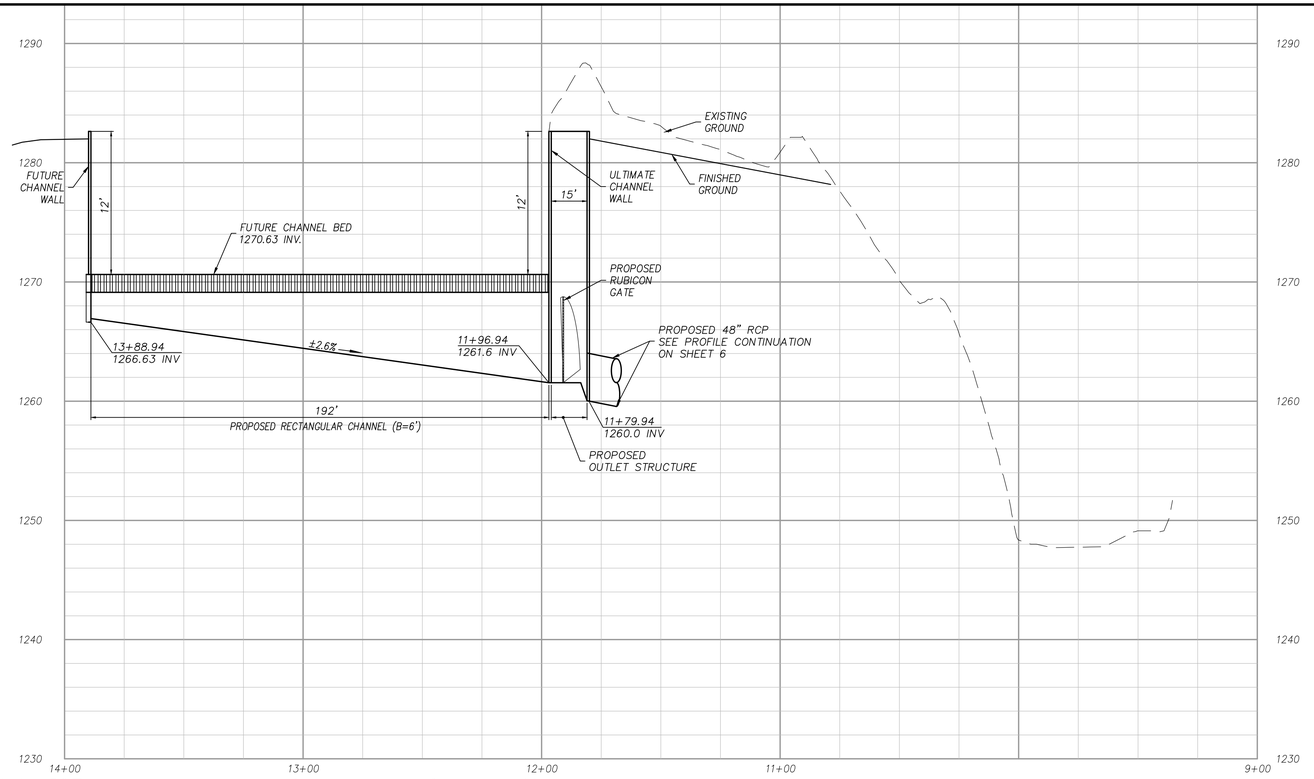

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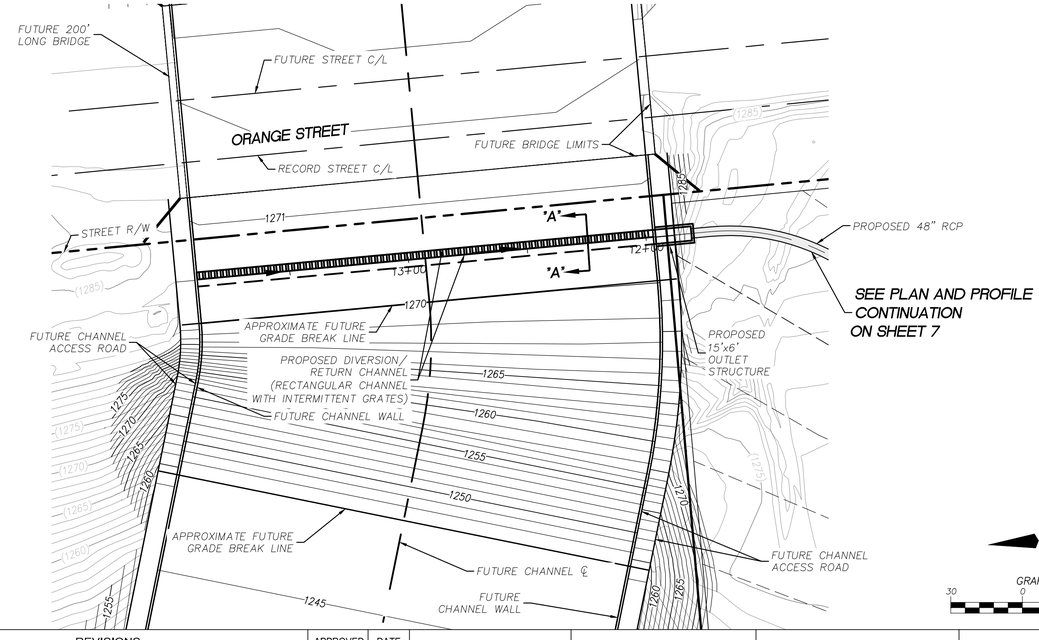

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1" = 30'

NOTE: FUTURE CHANNEL AND ORANGE STREET BRIDGE IMPROVEMENTS TAKEN FROM CONCEPTUAL PLAN AND PROFILE FOR THE ORANGE STREET BRIDGE REPLACEMENT PROJECT PREPARED BY INNOVATIVE DESIGN COMPANY FOR THE CITY OF HIGHLAND, JANUARY 2025.

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SAN BERNARDINO VALLEY WATER CONSERVATION DISTRICT.

NO.	DATE	REVISIONS	APPROVED	DATE
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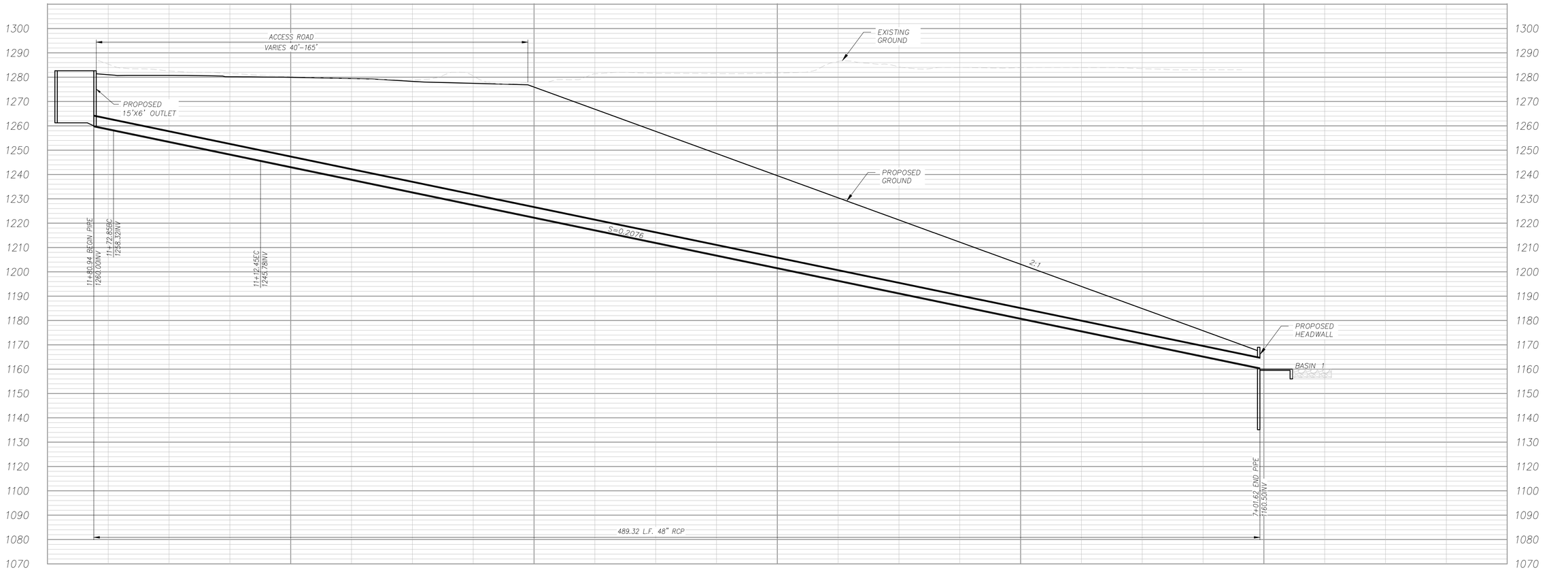
PROJECT NO.
SBVWCD -
XXX

PLUNGE CREEK GROUNDWATER RECHARGE PROJECT ALTERNATIVE
PRELIMINARY CONCEPTUAL DESIGN FEATURES

ALTERNATIVE 2 DIVERSION STRUCTURE
GRATED DROP STRUCTURE

SHEET 5
OF 6



PROFILE SCALE:
HORIZ. 1"=20'
VERT. 1"=20'

GRAPHIC SCALE
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1" = 20'

MARCH 2025

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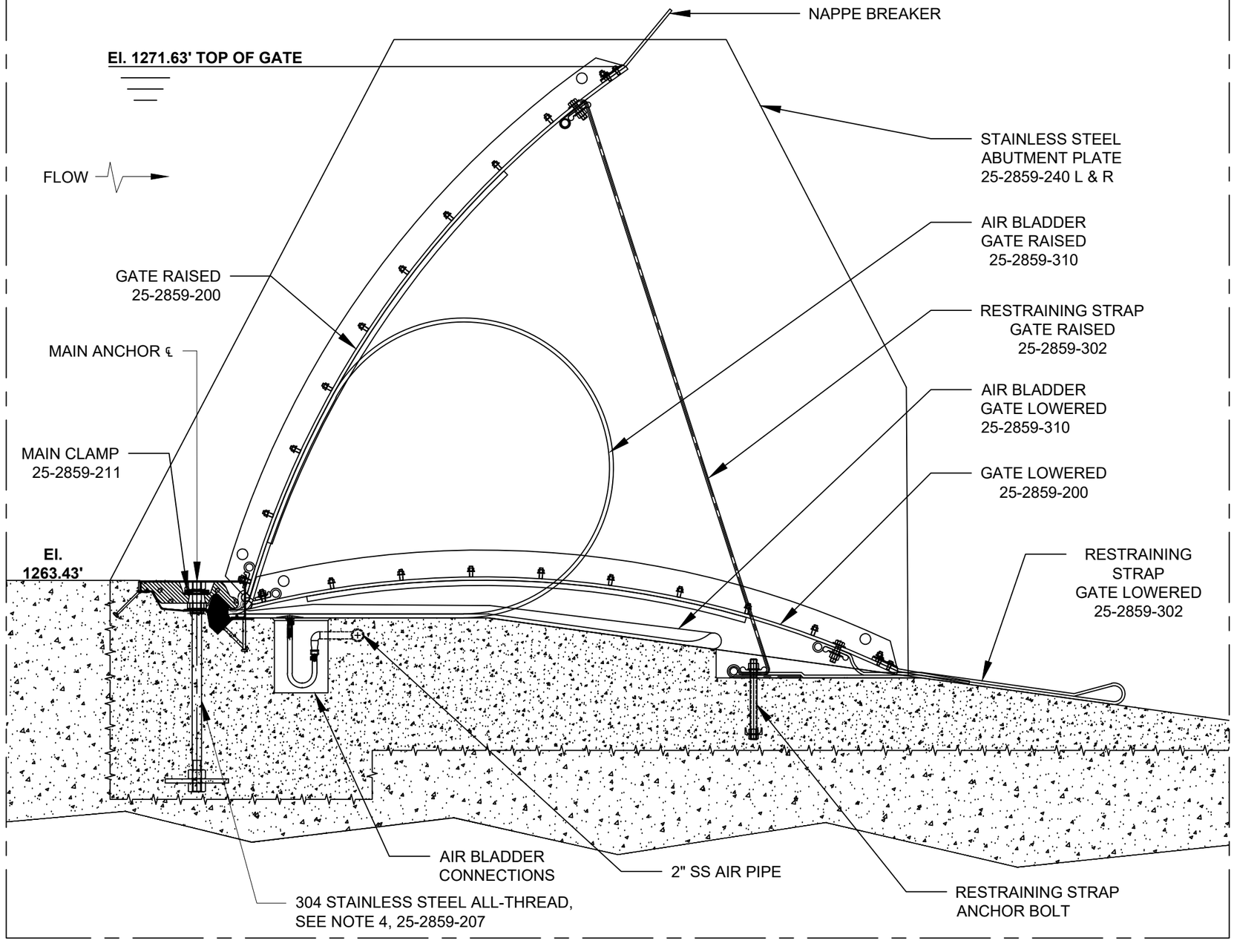
PROJECT NO.
SBVWCD - xxx

PLUNGE CREEK GROUNDWATER RECHARGE PROJECT ALTERNATIVE
PRELIMINARY CONCEPTUAL DESIGN FEATURES

DIVERSION PLAN AND PROFILE

SHEET 6
OF 6



ELEVATION VIEW

NOTES:

1) CONCRETE FINISH: CONCRETE UNDER GATE SYSTEM **MUST** HAVE HIGH QUALITY TROWEL FINISH AND BE FLAT WITHIN ±1/8".
A BROOM FINISH IS **NOT** ACCEPTABLE AND WILL RESULT IN ACCELERATED WEAR OF AIR BLADDERS.

2) THE HORIZONTAL CONCRETE CLAMPING SURFACE EXTENDING 6" DOWNSTREAM OF MAIN ANCHOR BOLT CENTERLINE AND 6" UPSTREAM OF MAIN ANCHOR BOLT CENTERLINE SHOULD BE LEVEL WITHIN ±1/4" FROM ABUTMENT TO ABUTMENT AND SHOULD NEVER VARY MORE THAN 1/8" PER FOOT.

3) ALL DIMENSIONS TO WITHIN ±1/8" OF TRUE POSITION UNLESS OTHERWISE DIMENSIONED OR NOTED ON PART DRAWING. SPACING OF ADJACENT MAIN ANCHOR BOLTS SHOULD NOT VARY MORE THAN 1/16" FROM NOMINAL SPACING.

4) ALL MAIN ANCHOR BOLTS TO BE PLUMB WITHIN ±1/8". MAIN ANCHOR BOLT CENTER LINE TO BE PERPENDICULAR TO ABUTMENT FACE ±0.1°.

5) DURING CONCRETE PLACEMENT, THE FORM WORK SUPPORTING THE ABUTMENT PLATES MUST BE HELD PLANAR, PLUMB AND PERPENDICULAR TO THE MAIN ANCHOR BOLTS WITHIN 1/8" PER FOOT AND WITHIN 1/4" OVERALL. RIGID STEEL BRACING OF FORMS IS RECOMMENDED. CONCRETE LIFTS SHOULD BE LIMITED SO AS TO NOT EXCEED ABOVE DEFLECTION LIMITS OF FORMS.

6) CONTRACTOR RESPONSIBLE FOR ALL CONCRETE CUTTING, GROUTING, GROUT, AIR PIPE, AIR PIPE FITTINGS, WELDING, VALVING, ELECTRICAL CONDUIT, CONDUIT FITTINGS, ASSOCIATED TOOLS, REBAR, ANCHORING AND SURFACE EPOXY, AND ANYTHING ELSE PERTAINING TO COMPONENTS NOT SUPPLIED BY OBERMEYER HYDRO, INC. OR INCLUDED IN THE OBERMEYER BILL OF MATERIALS.

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8) ALL ANCHOR BOLTS, BOLTS, FASTENERS TO BE ACCURATELY TORQUED TO APPROPRIATE LEVEL AS DEFINED IN THE OBERMEYER INSTALLATION PROCEDURE.

9) THERE IS **NO WELDING ALLOWED** ON THE MAIN ANCHOR BOLTS. WELDING TO HEAT TREATED ANCHOR BOLTS CAN CAUSE FRACTURE AND CATASTROPHIC SYSTEM FAILURE.

10) ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED.

NO	REVISION DESCRIPTION	DATE APR'D	APR'D	DRAWN
1	NEW DRAWING	25 MAR 2025		VCH
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DRAWING DESCRIPTION
ELEVATION VIEW

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SHEETS	SCALE
1 of 1	NO SCALE

JOB: PLUNGE CREEK DIV.

DWG. NO.: 25-2859-110

ADDENDUM PCU-2: GAGE DATA ANALYSIS

Technical Memorandum

Date: **October 8, 2024**

To: **John Lambie, PE, Chief Engineer San Bernardino Valley Water Conservation District**

From: **Joseph L. Castaneda, P.E.**

Re: **Amendment to Feasibility Study Support Services ARTP Plunge Creek and Oak Creek Diversion and Basin(s)**

Introduction

This technical memorandum was produced for the San Bernardino Valley Water Conservation District (SBVWCD) in support of the District's feasibility study for the design of the proposed recharge basins and diversion mechanisms for Plunge Creek and for Oak Creek.

Stream gage data from Upper Plunge Creek gage 110555000 were analyzed to determine distinct runoff events and their associated flow rates and volumes. The analysis detected 187 events. PRISM 30-year normal data was then used to scale these data to the ungauged watersheds that are tributary to Elder Creek, Oak Creek, and the Greenspot Storm Drain respectively. All four watersheds (Upper Plunge Creek, Elder Creek, Oak Creek, and Greenspot Storm Drain) are shown on Figure A. 50th, 80th, and 90th percentile flow rates were determined for each respective watershed as candidate diversion flow rates.

The candidate diversion flow rates, either individually or in combination, were used to calculate diverted, bypassed, and total volumes for each basin location. Statistics were compiled for the Oak Creek and Greenspot Storm Drain watersheds separately. Statistics for the Plunge Creek Basin were compiled for Upper Plunge Creek and Elder Creek combined, and for the combination of Upper Plunge Creek, Elder Creek, and Oak Creek.

Statistical distributions were applied to the results, and 50th, 80th, and 90th percentile peak flow rates from the set of events were also determined.

Analysis Overview

An approximately 35-year record, extending from water year 1989 through water year 2024, of 15-minute stream gage data from Upper Plunge Creek gage 110555000 was analyzed and used to cultivate a statistical representation of prospective flows tributary to the proposed Oak Creek and Plunge Creek Recharge Basins. Note that approximately five months of water year 2024 were included which was the available

data at the start of this study. The results of the study are discussed and represented below.

Existing Data Analysis

These Upper Plunge Creek stream gage data were evaluated to determine the flow duration frequencies in the 35 year record. All periods with no flow were excluded from the determination of flow frequencies. The 50th, 80th, and 90th percentile flow rates were identified to be of interest by SBVWCD. These values will define candidate diversion rates in the remainder of the analysis. The results for Upper Plunge Creek gage data are shown below:

Table 1: *Plunge Flow Frequency*

Percentile (%)	50th	80th	90th
Flowrate (cfs)	1.90	6.74	15.00

The 35 year record was further analyzed to partition the continuous record into a set of discrete, meaningful flow events. In this context, events are hydrographs which result from a storm event and are characterized by a rising limb, peak, and receding limb forming a simple hydrograph. Simply put, a meaningful flow event is one in which the magnitude of the peak and the duration of the hydrograph are substantial enough to survive a low pass filter (“gaussian smoothing”) of the data set which was used to remove noisy, high frequency perturbations in the flow signal. A total of 187 events were identified in the 35 year record. The events were distributed through the 35 year record as shown below, in terms of water years.

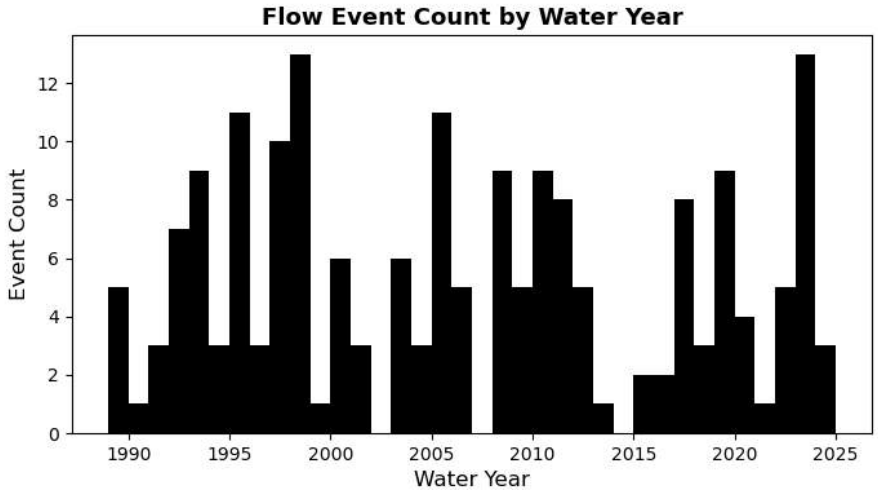


Figure 1: *Flow Event Count By Water Year*

Through meetings with SBVWCD, a flow rate of 0.63 cfs, the 30th percentile flow duration frequency rate, was used to define the end of a flow event in the record from Upper Plunge Creek.

The event-separation duration, time interval between flow events in days, was determined between flow events using the low flow cutoff rate. The event-separation duration was excluded when the interval spanned between water years to avoid bias in the resulting analysis. Descriptive statistics are provided for the resulting collection of event-separation durations computed. A normal distribution was fit to the dataset as requested by SBVWCD and is shown below:

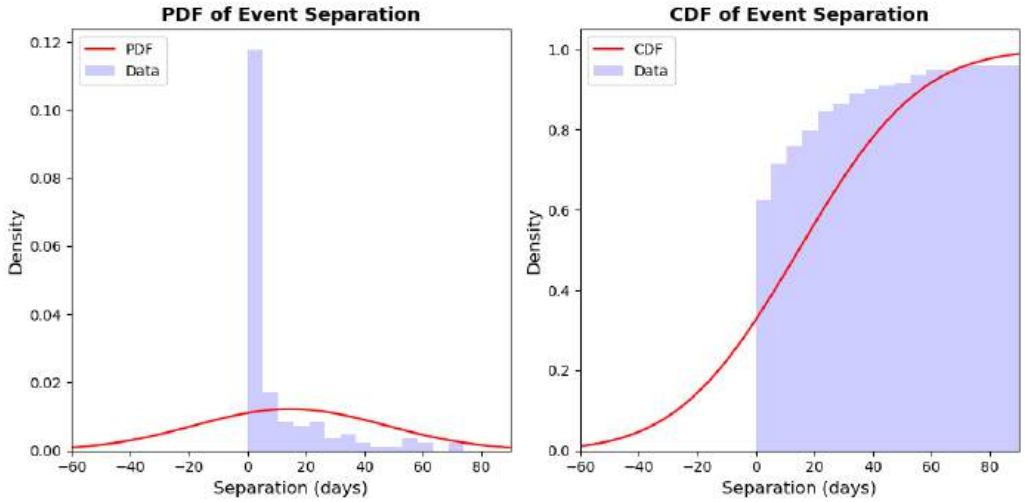


Figure 2: *PDF & CDF of Flow Separation via Normal Distribution*

Table 2: *Sample Moments/Statistics for Event Separation*

Sample Moment	Value (days)
Mean	14.70
Standard Deviation	32.70
Median	0.00
Skew*	4.09

*Skew is dimensionless, is not represented in Normal Distribution as parameter

Similarly, the event duration, the time interval from the beginning to the end of a given event in days , was determined for each flow event. A set of 187 durations (units=days) were calculated from the gage data. Descriptive statistics are provided for the resulting collection of event durations computed. A normal distribution was fit to the dataset as requested by SBVWCD and is shown below:

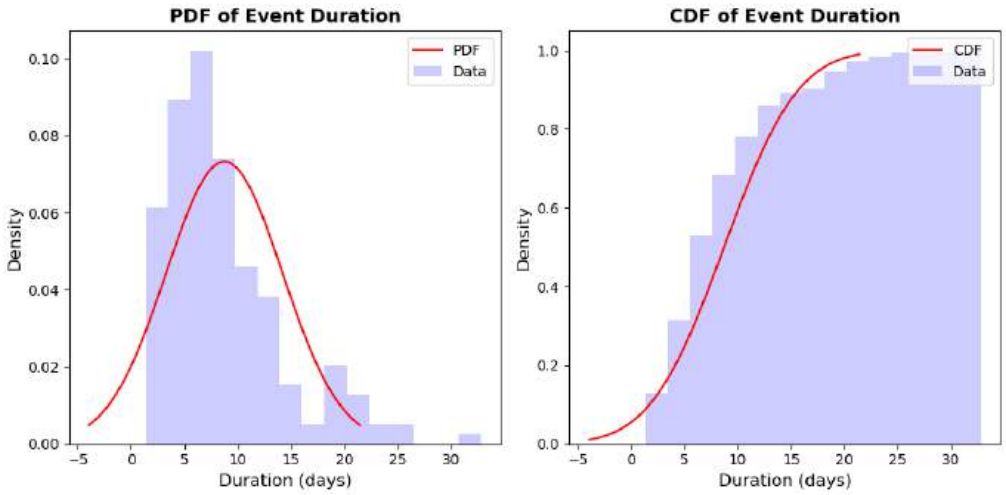


Figure 3: *PDF & CDF of Flow Duration via Normal Distribution*

Table 3: *Sample Moments/Statistics for Event Duration*

Sample Moment	Value (days)
Mean	8.73
Standard Deviation	5.44
Median	7.35
Skew*	1.42

*Skew is dimensionless, is not represented in Normal Distribution as parameter

PRISM 30-Year Precipitation Normals Scaling of Watershed Subbasin Runoff

The PRISM 30-year precipitation normals (https://prism.oregonstate.edu/) were retrieved for the project area at a grid resolution of 800m. The dataset defines the 30-year annual average precipitation per grid cell adjusted by topography. The area of each Plunge Creek subbasin was calculated in GIS. The weighted average of the PRISM total precipitation values was computed for watershed subbasins of interest: Elder Creek, Upper Plunge Creek, Oak Creek, and Greenspot Storm Drain, see Figure A. To scale runoff volume, the product of precipitation and area was determined as a scalar for each Plunge Creek subbasin. Using the PRISM runoff volume for Upper Plunge Creek as a reference, a ratio of relative volume was determined for each subbasin. Figure A illustrates the superposition of the PRISM data on the project area.

Table 4: *Relative PRISM-Area Weighted Runoff Volume. P_w is weighted precipitation, V_w is weighted Volume, R_v is volume ratio*

Subbasin	A (ac)	P_w (in)	V_w (ac-ft)	R_v (-)
Elder Creek	3082.29	14.19	3645.24	0.164
Oak Creek	1527.27	16.34	2079.47	0.094
Plunge Creek	10974.08	24.26	22185.08	1.000
Storm Drain	547.03	13.46	613.40	0.028

The subsequent ratios were used to scale the Upper Plunge Creek stream gage record as a means for extrapolating the flow signal for the adjacent subbasins (Elder Creek, Oak Creek, and Greenspot Storm Drain).

Calculated Flow-Duration Frequency Flow Rates for Study Scenarios

The flow-duration frequency for each scenario is defined in Table 4.1 shown below. The 50th, 80th, and 90th percentile flows were quantified for the extrapolated for the following scenarios:

1. Oak Creek Flows Only
2. Greenspot Storm Drain Flows Only
3. Elder Creek + Upper Plunge Creek Flows
4. Elder Creek + Oak Creek + Upper Plunge Creek Flows

These values represent candidate diversion rates. To obtain these values, the overall stream gage record was scaled with the ratios defined from the PRISM data for each location (Elder, Oak, Greenspot Storm Drain). The resulting scaled datasets (and Plunge) were combined in accordance with the study scenarios and analyzed for flow-duration frequency.

Table 4.1: *Calculated Scaled Flow-Duration Frequency*

Flow Data Source/Combination	Flow Frequency (%, cfs)		
	50th	80th	90th
Oak Only	0.18	0.63	1.41
Storm Drain Only	0.05	0.19	0.42
Plunge + Elder	2.21	7.85	17.46
Plunge + Elder + Oak	2.39	8.48	18.87

Oak Creek Subbasin Storm Event Volume Analysis –Oak Creek Storm Flows Only

The description of the volume analysis for Oak Creek flows serves as a template for understanding the analysis in the following sections. The following sections contain variations of this assessment which include different combinations of flow.

A potential diversion scenario is that Oak Creek Basin would receive flows from Oak Creek above its confluence with Plunge Creek. For each potential diversion rate from Oak Creek only, the 187 flow events scaled for Oak Creek using the PRISM ratio were integrated to assess the divertible storm volume, the likely bypass volume, and the total volume of runoff for each event. The resulting set of calculated individual storm-event volumes per candidate diversion rate were statistically assessed. Through agreement with SBVWCD, JLC Engineering applied the following statistical distributions to each type of storm-event volume calculated from the PRISM scaled gage data:

Table 5: *Distribution used w/ respect to Volume Type Characterized*

Volume Type	Applied Distribution
Diverted	Normal
Bypass	Log-Normal
Total	Log-Pearson 3

Figure 4 demonstrates the probability distribution function (PDF) and cumulative distribution function (CDF) of the applied distribution assumptions for divertible storm-event volumes (Normal Distribution) and total storm-event volumes (Log-Pearson Type 3 distribution, LP3) for the 187 scaled storm-flow events in Oak Creek at the corresponding candidate diversion rates (i.e., 50th, 80th, and 90th percentile flow-duration frequency flow).

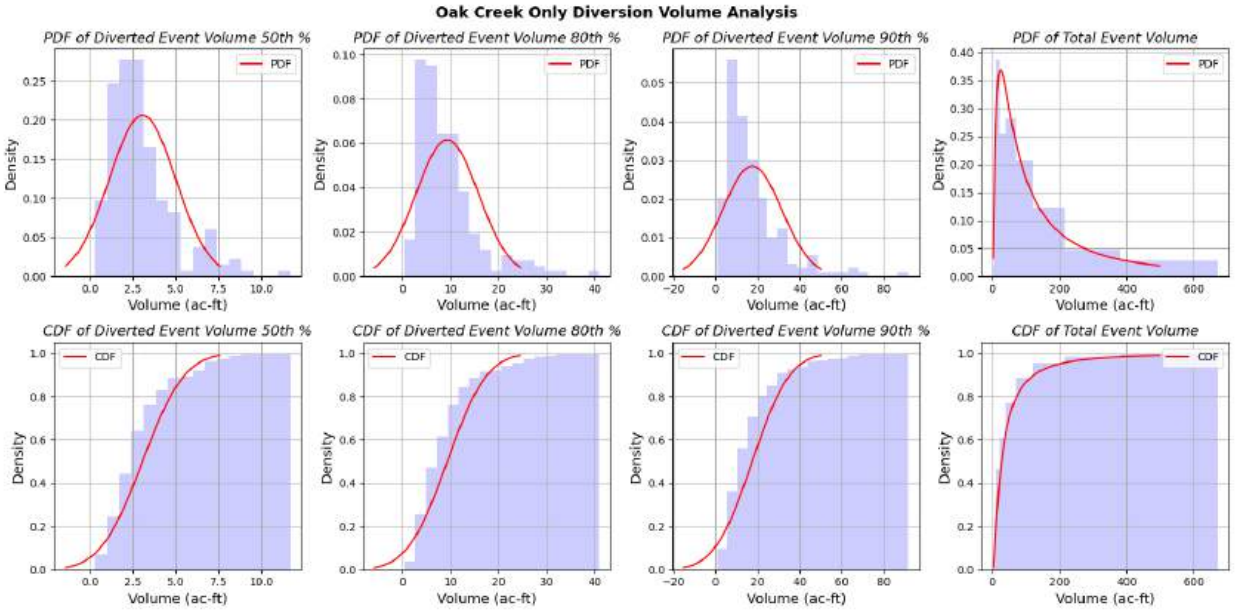
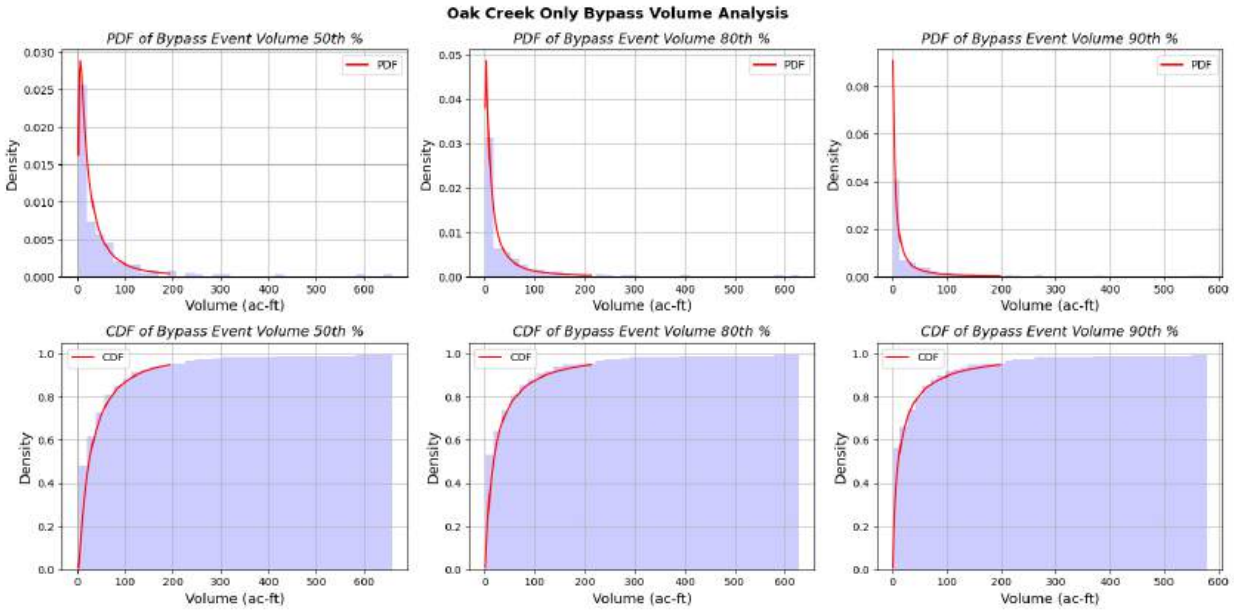


Figure 4: *PDF & CDF of Divertible Volumes at 3 Candidate Percentile Rates and Total Event Volumes (right-hand charts) per Event via Normal and LP3 Assumptions, respectively from Oak Creek Calculated Storm Events*

Figure 5 on the next page depicts the PDF and CDF of the applied Log-Normal distribution assumption overlaid on the histogram of candidate-diversion-rate-based bypass volumes.



Distribution

Figure 5: *PDF & CDF Bypassed Volumes per Event at 3 Candidate Percentile Rates via Log-Normal Distribution of Oak Creek Calculated Storm Events*

Table 6 depicts the CDF deciles for each Volume Type of interest across all candidate diversion rates.

Table 6: *Divertible and Bypassed Storm Volumes at Three Flow Diversion Rates & Total Storm Volume of Oak Creek Scaled Historic Storm-Events*

Candidate Diversion Flow-Duration Percentile (%)	Volume Type	Scaled Storm-Event Volume Deciles from CDF (ac-ft)								
		10th	20th	30th	40th	**50th=Median Volume**	60th	70th	80th	90th
50th Percentile (0.18 cfs)	Divertible	0.6	1.4	2.1	2.6	**3.1**	3.6	4.1	4.7	5.6
	Bypassed	5.4	9.0	13.1	18.2	**24.8**	33.9	47.4	70.4	122.0
80th Percentile (0.63 cfs)	Divertible	1.1	3.9	6.0	7.8	**9.4**	11.0	12.8	14.9	17.7
	Bypassed	2.7	5.0	7.8	11.6	**17.0**	25.0	37.7	61.4	120.9
90th Percentile (1.41 cfs)	Divertible	-0.4	5.7	10.2	14.0	**17.5**	21.1	24.9	29.3	35.5
	Bypassed	1.1	2.3	4.1	6.7	**10.5**	16.5	26.7	47.1	103.2
-	Total	7.6	11.6	15.9	21.1	**27.7**	36.7	50.0	72.6	124.5

Oak Creek Basin Storm-Event Volume Analysis – Greenspot Storm Drain Flows

The same approach for the Oak Creek Only flows was used to study the Greenspot Storm Drain (Greenspot SD) only flows. A summary of the analysis is contained within

the following figures and tables. Figure 6 and 7 demonstrate the PDF and CDF of the same applied distribution assumptions overlaid on the histogram of divertible volumes (Normal), bypassed volumes (Log-Normal), and total storm-event volumes (LP3).

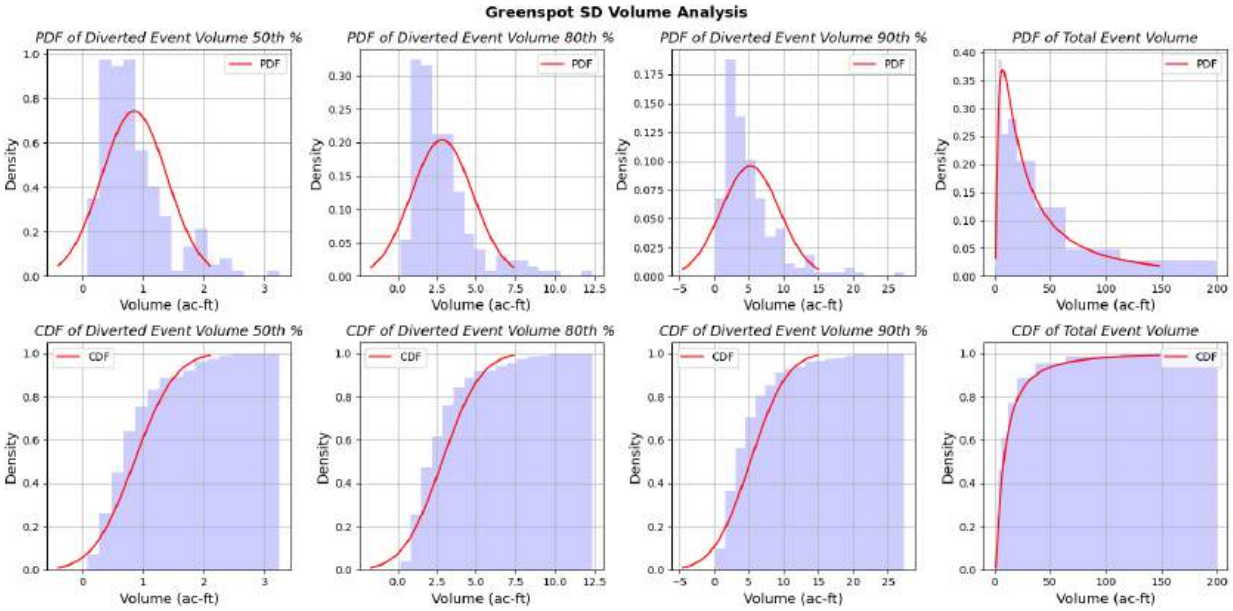


Figure 6: *PDF & CDF of Divertible Volumes at 3 Candidate Percentile Rates and Total Event Volumes (right-hand charts) per Event via Normal and LP3 Assumptions, respectively of Greenspot SD Calculated Storm Events*

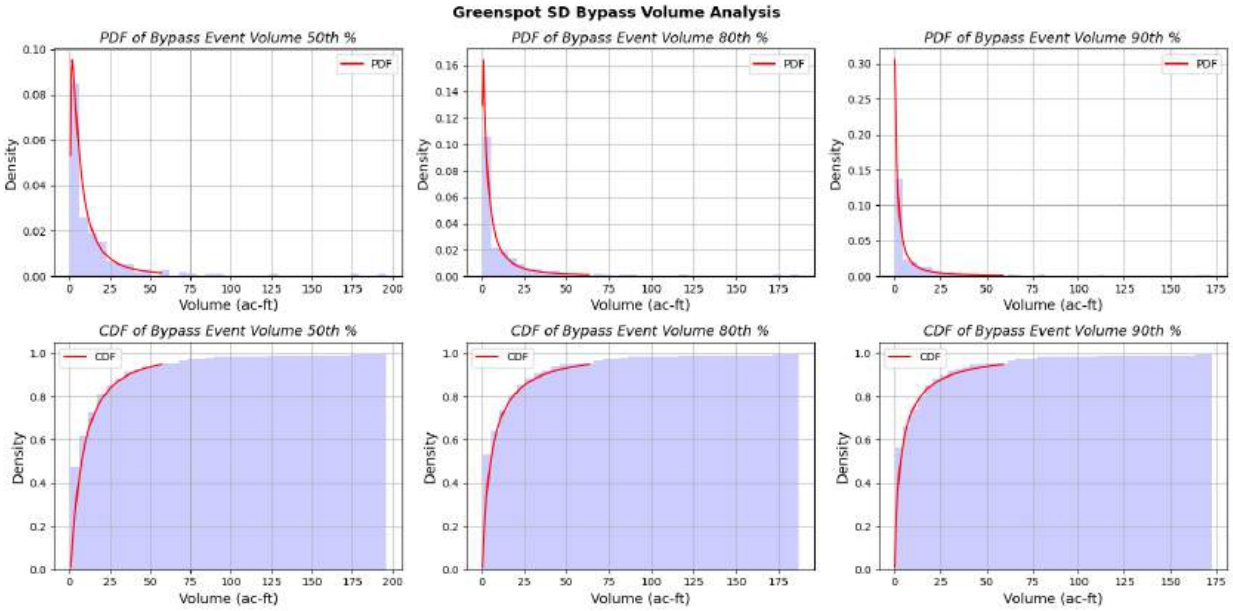


Figure 7: *PDF & CDF Bypassed Volumes per Event at 3 Candidate Percentile Rates via Log-Normal Distribution of Greenspot SD Calculated Storm Events*

Table 7 depicts the CDF deciles for each Volume Type of interest across all candidate diversion rates

Table 7: *Divertible and Bypassed Storm Volumes at Three Flow Diversion Rates & Total Storm Volume of Greenspot SD Scaled Historic Storm-Events*

Candidate Diversion Flow-Duration Percentile (%)	Volume Type	Scaled Storm-Event Volume Deciles from CDF (ac-ft)								
		10th	20th	30th	40th	**50th=Median Volume**	60th	70th	80th	90th
50th Percentile (0.05 cfs)	Divertible	0.17	0.4	0.57	0.72	**0.85**	0.99	1.14	1.31	1.54
	Bypassed	1.64	2.72	3.97	5.49	**7.47**	10.19	14.22	21.04	36.31
80th Percentile (0.19 cfs)	Divertible	0.32	1.18	1.8	2.33	**2.83**	3.32	3.85	4.47	5.33
	Bypassed	0.8	1.46	2.31	3.44	**5.04**	7.4	11.2	18.24	35.97
90th Percentile (0.42 cfs)	Divertible	-0.13	1.71	3.03	4.16	**5.22**	6.28	7.41	8.73	10.57
	Bypassed	0.32	0.7	1.22	1.98	**3.12**	4.9	7.96	14.02	30.76
-	Total	2.26	3.45	4.74	6.29	**8.26**	10.93	14.88	21.62	37.07

Plunge Creek Combined Event Analysis – Elder Creek + Plunge Creek

The same approach for the Oak Creek Only flows was used to study the combination of Elder Creek and Plunge Creek flows only with no contribution from Oak Creek. A summary of the analysis is contained within the following figures and tables. Figure 8 and 9 demonstrate the PDF and CDF of the same applied distribution assumptions overlaid on the histogram of recorded diverted volumes, bypass volumes, and total volumes.

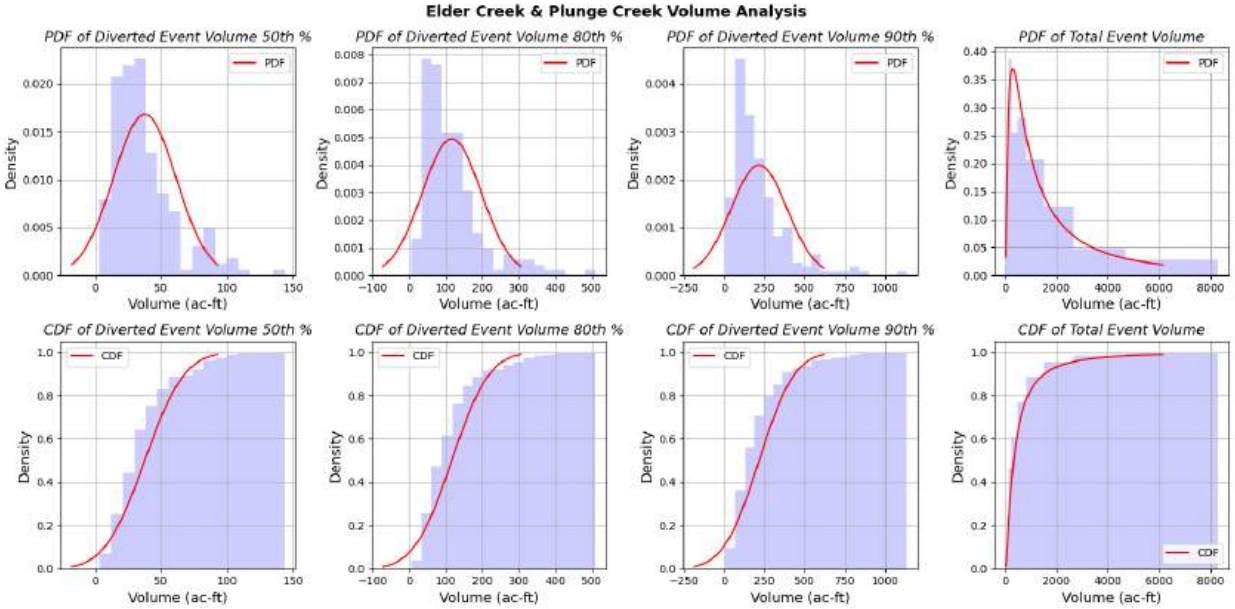


Figure 8: *PDF & CDF of Divertible Volumes at 3 Candidate Percentile Rates and Total Event Volumes (right-hand charts) per Event via Normal and LP3 Assumptions, respectively of Elder Creek + Plunge Creek Calculated Storm Events*

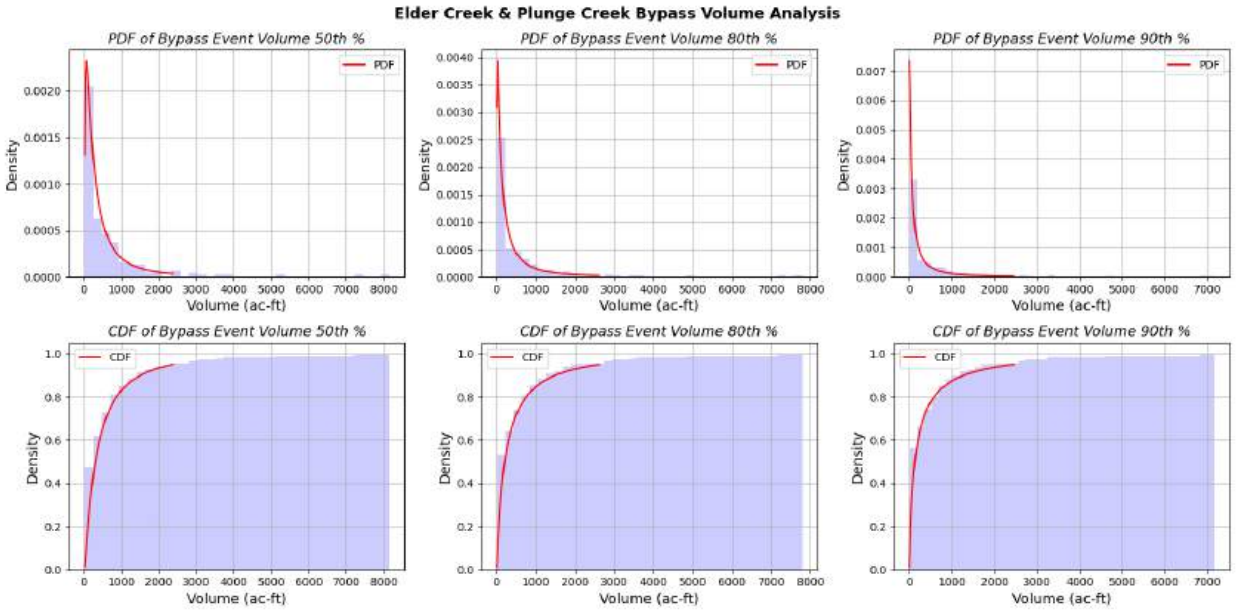


Figure 9: : *PDF & CDF Bypassed Volumes per Event at 3 Candidate Percentile Rates via Log-Normal Distribution of Elder Creek + Plunge Creek Calculated Storm Events*

Table 8 depicts the CDF deciles for each Volume Type of interest across all candidate diversion rates.

Table 8: *Divertible and Bypassed Storm Volumes at Three Flow Diversion Rates & Total Storm Volume of Elder Creek + Plunge Creek Scaled Historic Storm-Events*

Candidate Diversion Flow-Duration Percentile (%)	Volume Type	Scaled Storm-Event Volume Deciles from CDF (ac-ft)								
		10th	20th	30th	40th	**50th=Median Volume**	60th	70th	80th	90th
50th Percentile (2.21 cfs)	Divertible	7.26	17.71	25.24	31.68	**37.7**	43.72	50.15	57.69	68.14
	Bypassed	67.12	111.46	162.58	225.67	**307.59**	420.19	587.74	871.97	1509.95
80th Percentile (7.85 cfs)	Divertible	13.41	48.96	74.59	96.5	**116.97**	137.44	159.35	184.98	220.53
	Bypassed	33.59	61	96.21	143.56	**209.95**	308.28	466.4	759.18	1496.2
90th Percentile (17.46 cfs)	Divertible	-5.34	70.97	125.99	173	**216.95**	260.89	307.9	362.92	439.23
	Bypassed	13.21	28.89	50.87	82.5	**129.67**	203.84	330.73	582.78	1278.59
-	Total	93.92	143.28	197.13	261.45	**343.24**	454.24	618.59	898.57	1541.09

Plunge Creek Combined Event Analysis – Elder Creek + Plunge Creek + Oak Creek

As above, a combination of flows were considered which include Elder Creek, Plunge Creek, and Oak Creek. A summary of the analysis is contained within the following figures and tables.

Figure 10 and 11 demonstrate the PDF and CDF of the applied distribution overlaid on the histogram of recorded diverted volumes, bypass volumes, and total volumes.

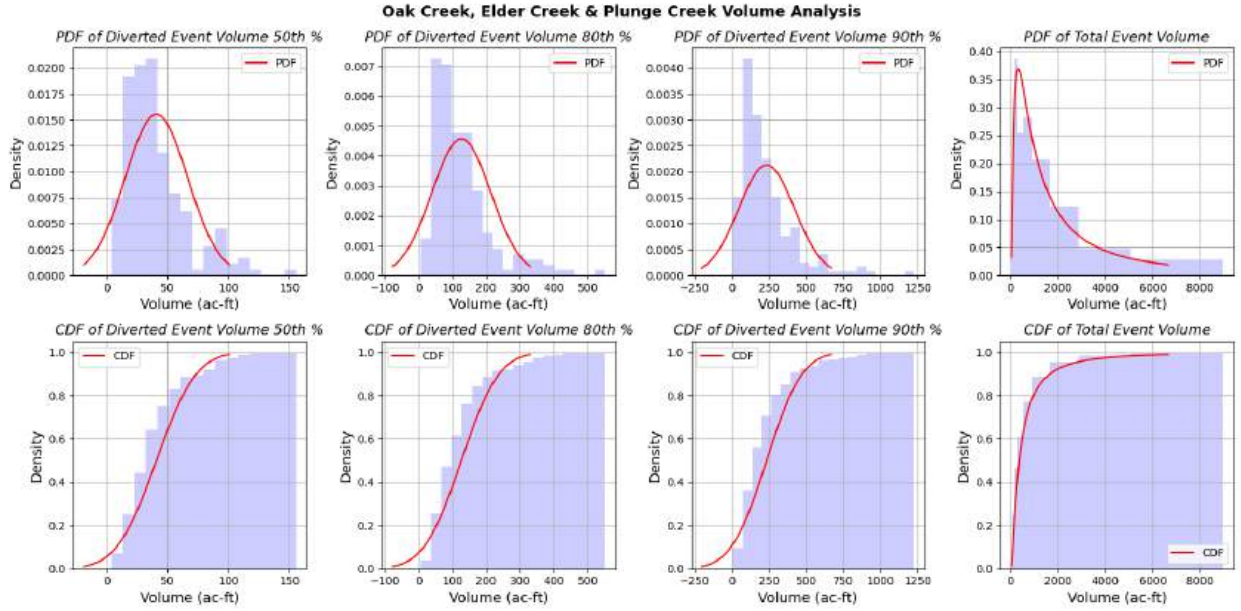


Figure 10: *PDF & CDF of Divertible Volumes at 3 Candidate Percentile Rates and Total Event Volumes (right-hand charts) per Event via Normal and LP3 Assumptions, respectively of Elder Creek + Plunge Creek + Oak Creek Calculated Storm Events*

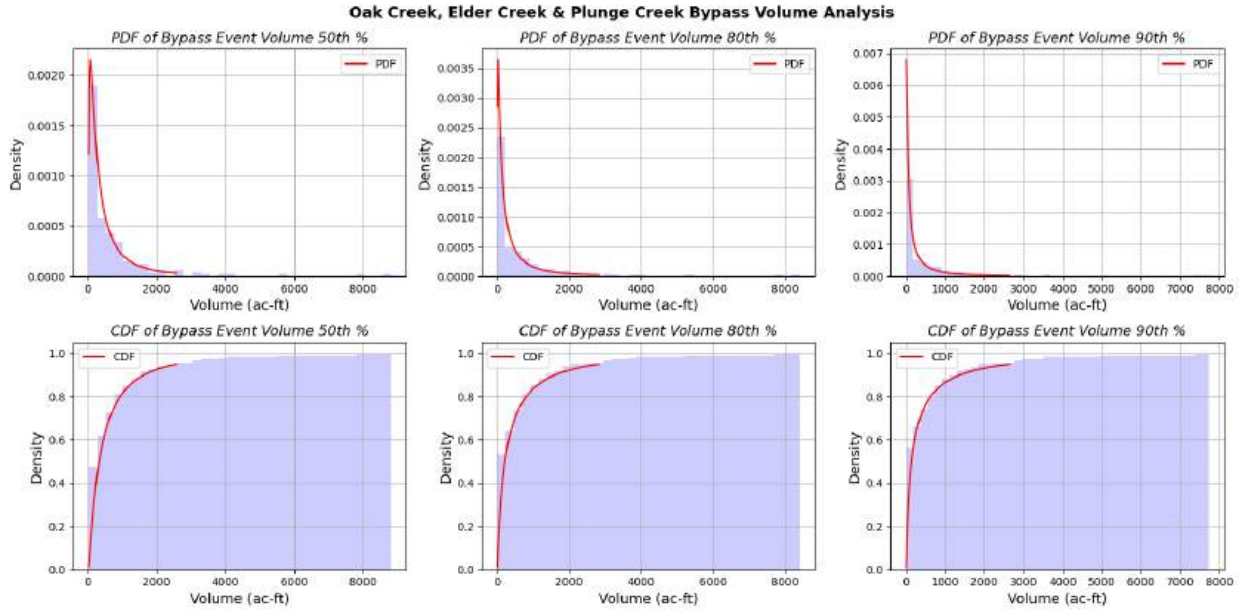


Figure 11: *PDF & CDF Bypassed Volumes per Event at 3 Candidate Percentile Rates via Log-Normal Distribution of Elder Creek + Plunge Creek + Oak Creek Calculated Storm Events*

Table 9 depicts the CDF deciles for each Volume Type of interest across all candidate diversion rates.

Table 9: *Divertible and Bypassed Storm Volumes at Three Flow Diversion Rates & Total Storm Volume of Elder Creek + Plunge Creek + Oak Creek Scaled Historic Storm Events*

Candidate Diversion Flow-Duration Percentile (%)	Volume Type	Scaled Storm-Event Volume Deciles from CDF (ac-ft)								
		10th	20th	30th	40th	**50th=Median Volume**	60th	70th	80th	90th
50th Percentile (2.39 cfs)	Divertible	7.85	19.15	27.3	34.26	40.77	47.27	54.24	62.39	73.69
	Bypassed	72.53	120.44	175.69	243.87	332.39	454.08	635.16	942.35	1631.89
80th Percentile (8.48 cfs)	Divertible	14.49	52.9	80.59	104.25	126.37	148.48	172.14	199.84	238.24
	Bypassed	36.32	65.94	104.01	155.19	226.95	333.24	504.14	820.57	1617.1
90th Percentile (18.87 cfs)	Divertible	-5.77	76.7	136.16	186.97	234.46	281.96	332.77	392.23	474.7
	Bypassed	14.27	31.23	54.97	89.16	140.14	220.3	357.44	629.85	1381.85
-	Total	101.5	154.85	213.05	282.57	370.95	490.92	668.54	971.13	1665.54

Identification of Historic Peak Flowrates by Percentile

Table 10 summarizes peak flow rates that are based upon a Log Pearson Type 3 distribution being applied to each scenarios' adjusted set of storm flow events to identify the median storm. This summary of peak flowrates is relevant to informing the selection of a project hydrograph for use in hydraulic assessments of potential recharge basins at the two project locations: (1) south of Greenspot Road near Plunge Creek, and (2) adjacent Plunge Creek at Orange Street.

Table 10: *Percentile Peak Flowrates*

Flow Data Source/Combination	LP3 50th Percentile Flow (cfs)	LP3 80th Percentile Flow (cfs)	LP3 90th Percentile Flow (cfs)
Oak Creek Only	11.0	27.6	47.7
Greenspot SD Only	3.3	8.2	14.2
Plunge + Elder Only	135.7	342.0	590.4
Plunge + Elder + Oak Only	146.6	369.6	638.1

Total storm volume may be useful during project hydrograph selection as well. The storm-volume return frequencies (e.g. 2-year return or median storm) were calculated by applying a LP3 Distribution to the 187 events peak stormflow rates in the scaled data to the scenarios. Those total storm volumes are shown in the volume analysis at the bottom of Tables 6, 7, 8, and 9 for each flow scenario evaluated. The three percentile storm volumes used here are highlighted in Tables 6, 7, 8, and 9 for cross reference. Some examples of representative hydrographs have been included in Appendix A, for Oak Creek, and in Appendix B, for the Plunge+Elder+Oak scaled flows in combination scenario.

Summary of Findings

This technical memorandum evaluates the Plunge Creek gage data and PRISM precipitation data to develop a 35 year record of flow in Plunge Creek, Elder Creek, Oak Creek and in the Greenspot SD. A series of 187 total events were defined on the raw dataset were isolated and studied to statistically represent typical storm durations (time period of events) and storm separations (time between events within same water year).

The 35 year record for each contributing water source was evaluated by scaling the Upper Plunge Creek gage record of real-time . Various flow source scenario combinations were developed and studied to estimate flow-duration frequencies for each over the period of record. Scenarios of interest included individual flow sources or combinations of them. The 50th, 80th, and 90th percentile flow-duration frequencies were used as candidate rates for flow diversion within each scenario of interest. These candidate values for flow rate diversion were used to quantify the divertible volume and the bypassed volume for each event defined in the record after being scaled and combined according to the scenario. The various results were analyzed with probability distributions to characterize the probabilistic frequency of these two volumes, potentially intercepted by diversion or potentially lost to bypass at each candidate diversion flow rate.

Peak flowrates and total event volume were studied with a Log-Pearson Type 3 distribution. The 50th, 80th, and 90th percentile approximations of total storm-event volumes for each flow scenario are summarized in each scenario's respective volume analysis table. Tables 6, 7, 8 and 9 (along with other deciles). In addition to percentile peak flowrates are listed in Table 10 for these same sized storms. The percentile storm identifies its return frequency (e.g., the 80th percentile storm is a 5-year return frequency event). Peak flow rates by return frequency storm event may aid in identifying a good diversion rate sizing at either of the project sites.

ATTACHED FIGURES

Subbasin	A (ac)	P_w (in)	V_w (ac-ft)	R_v (-)
Elder Creek	3082.29	14.19	3645.24	0.164
Oak Creek	1527.27	16.34	2079.47	0.094
Plunge Creek	10974.08	24.26	22185.08	1.000
Storm Drain	547.03	13.46	613.40	0.028

Ratios of Annual Precipitation Volume:
Volume = Precipitation * Area

Note that all ratios are with reference to Plunge Creek. Therefore, ratios are computed as:

Wshed Ratio = Volume Wshed / Volume Plunge

Elder / Plunge

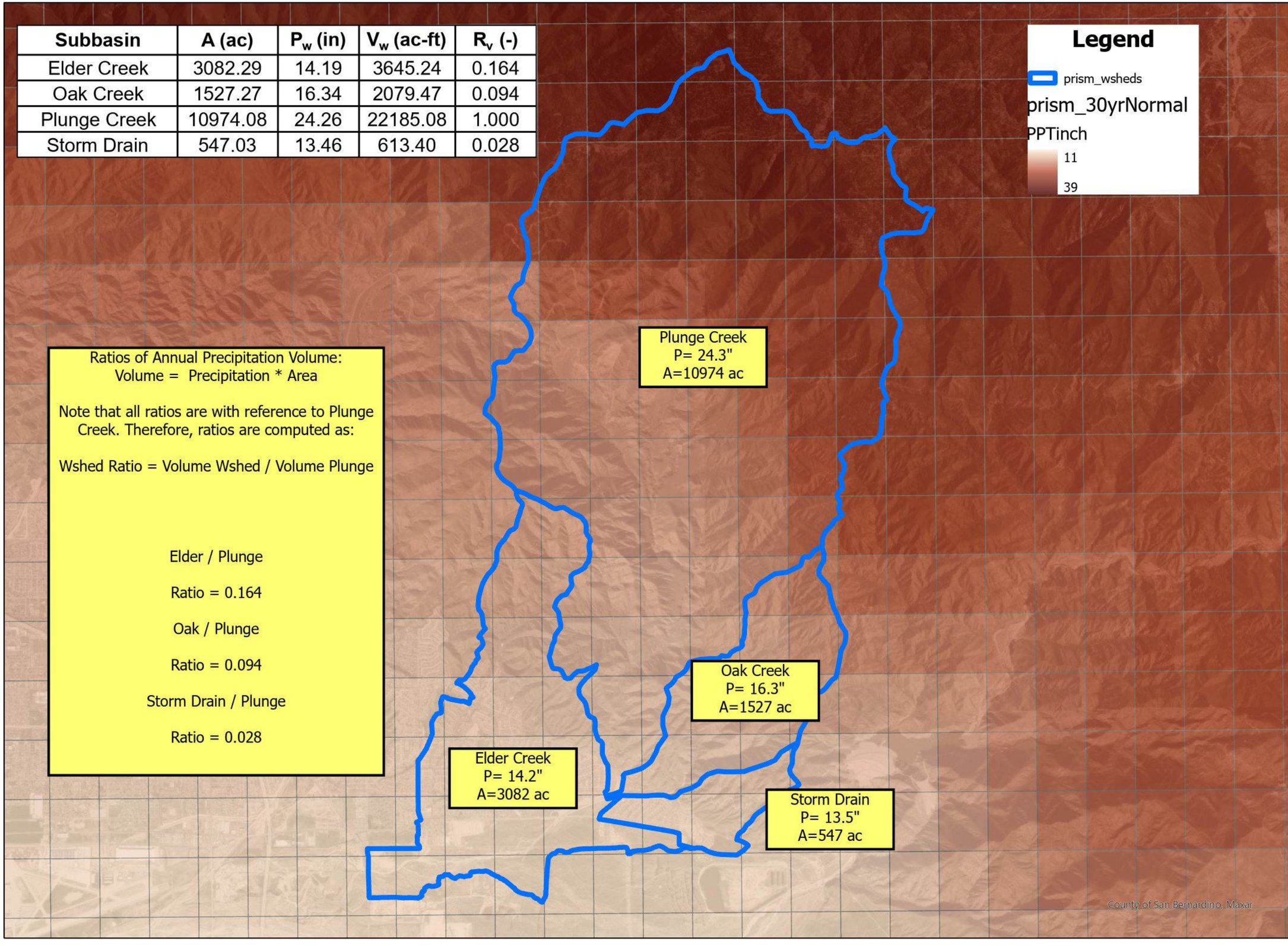
Ratio = 0.164

Oak / Plunge

Ratio = 0.094

Storm Drain / Plunge

Ratio = 0.028



TITLE: PRISM DATA MAP

PROJECT: Plunge Creek, Highland, CA

SCALE: 1:55,000

DATE: 9/17/24

JLC Engineering & Consulting, Inc.
MURRIETA, CA 92562
Office 951.304.9552 Fax 951.304.3568

FILE NAME:

FIGURE

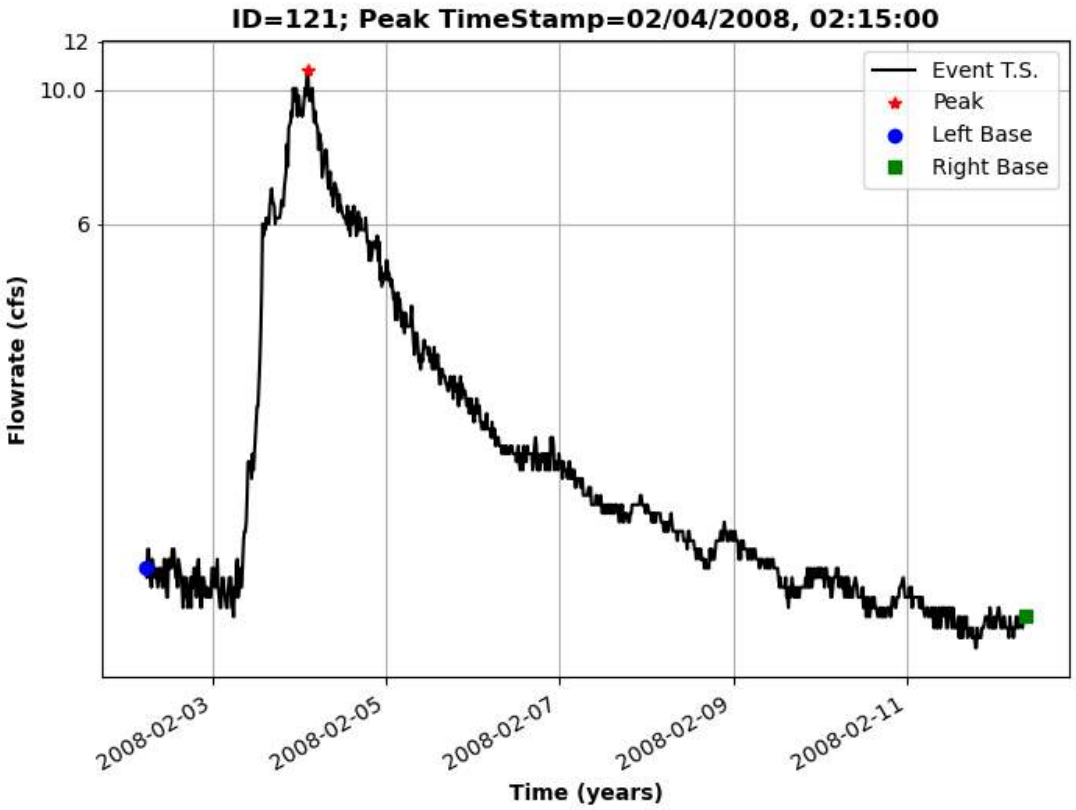
A

Appendix A: Oak Creek Only – Representative Hydrographs

Appendix A:

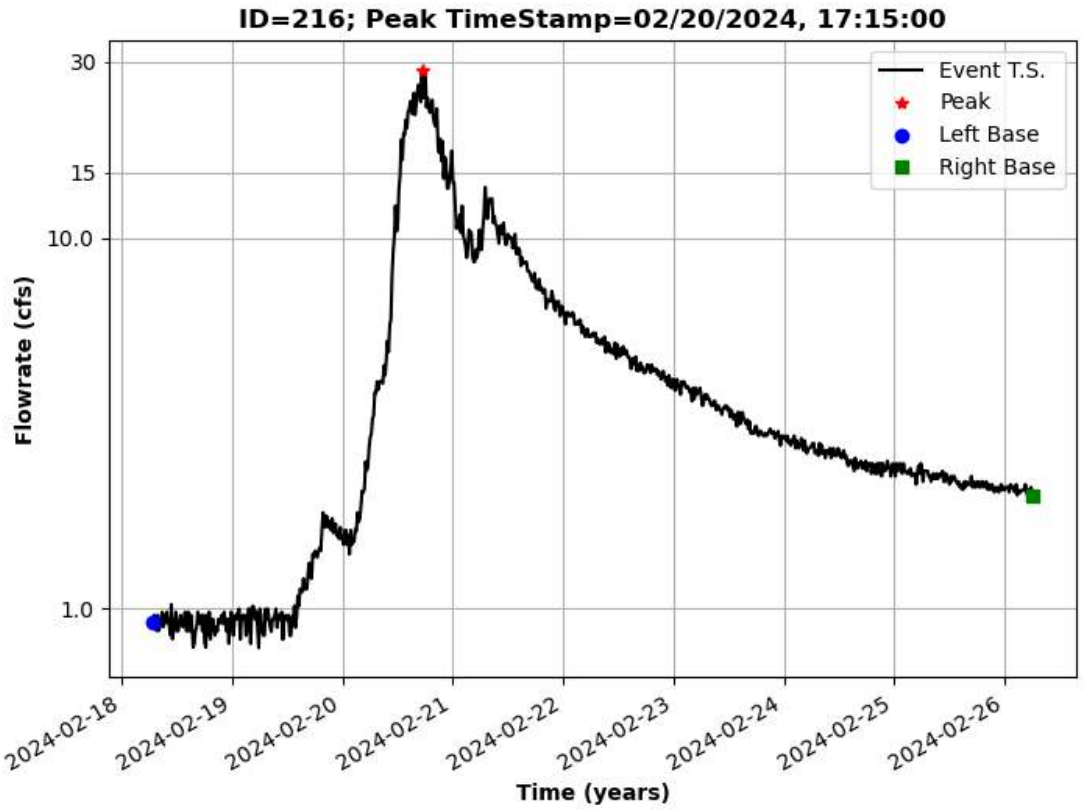
Representative events are selected by choosing the event (of 187 possible events) which has a peak flowrate closest to the corresponding probabilistic peak flowrate from Table 10 for the given scenario. For example, Oak Creek 50th percentile peak flowrate is 11 cfs. Figure A.1 shows an event which has a peak of 10.8 cfs. Note that events are scaled based on the scenario described, in this case scaled to Oak Creek Only flows. Note each hydrograph denotes duration (Dur), left base flowrate (Ql), right base flowrate (Qr), peak flowrate (Qp), and total volume (Vt). Approximately five months of flow for Water Year 2023 and 2024 have been provided. Both figures demonstrate continuous periods of time where the flow exceeds the low flow cutoff and demonstrates character of subsequent events in the system.

Figure A.1: 50th Percentile Representative Event



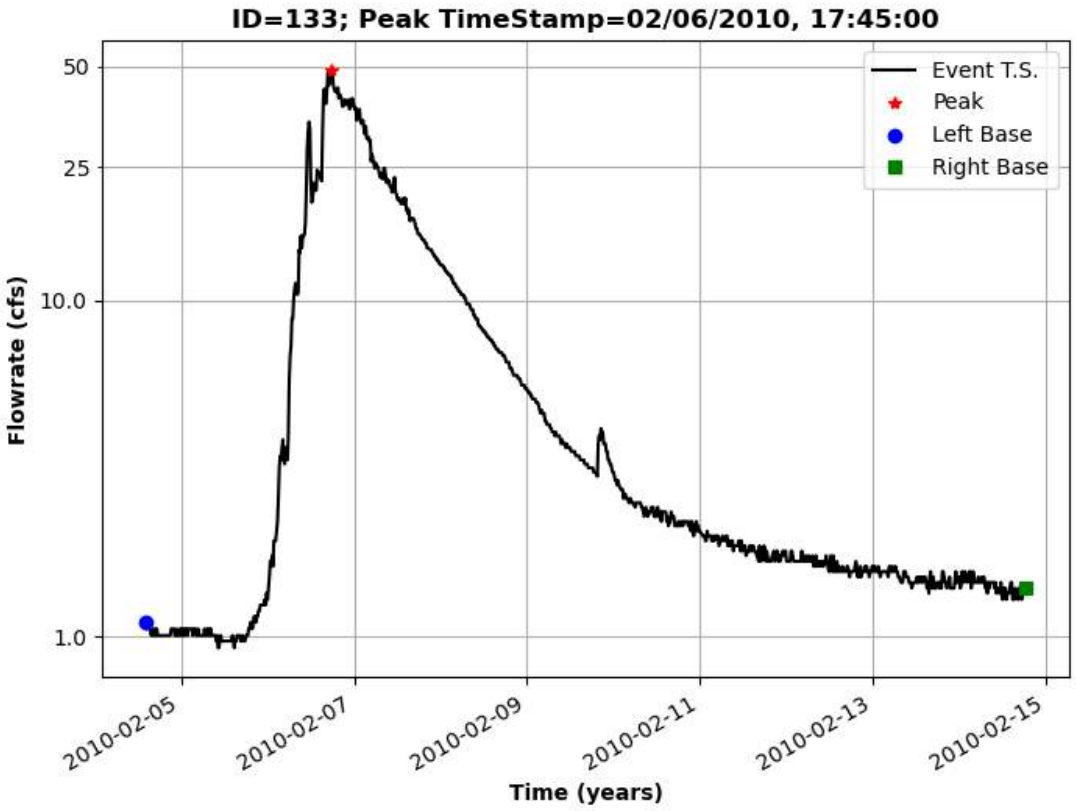
Dur=10.1 days, Ql=1.6 cfs, Qp=10.8 cfs, Qr=1.3 cfs, Vt=54.6 ac-ft

Figure A.2: 80th Percentile Representative Event



Dur=8.0 days, Ql=0.9 cfs, Qp=28.6 cfs, Qr=2.0 cfs, Vt=72.9 ac-ft

Figure A.3: 90th Percentile Representative Event



Dur=10.2 days, Ql=1.1 cfs, Qp=49.0 cfs, Qr=1.4 cfs, Vt=132.8 ac-ft

Figure A.4: WY 2023 Subsequent Events

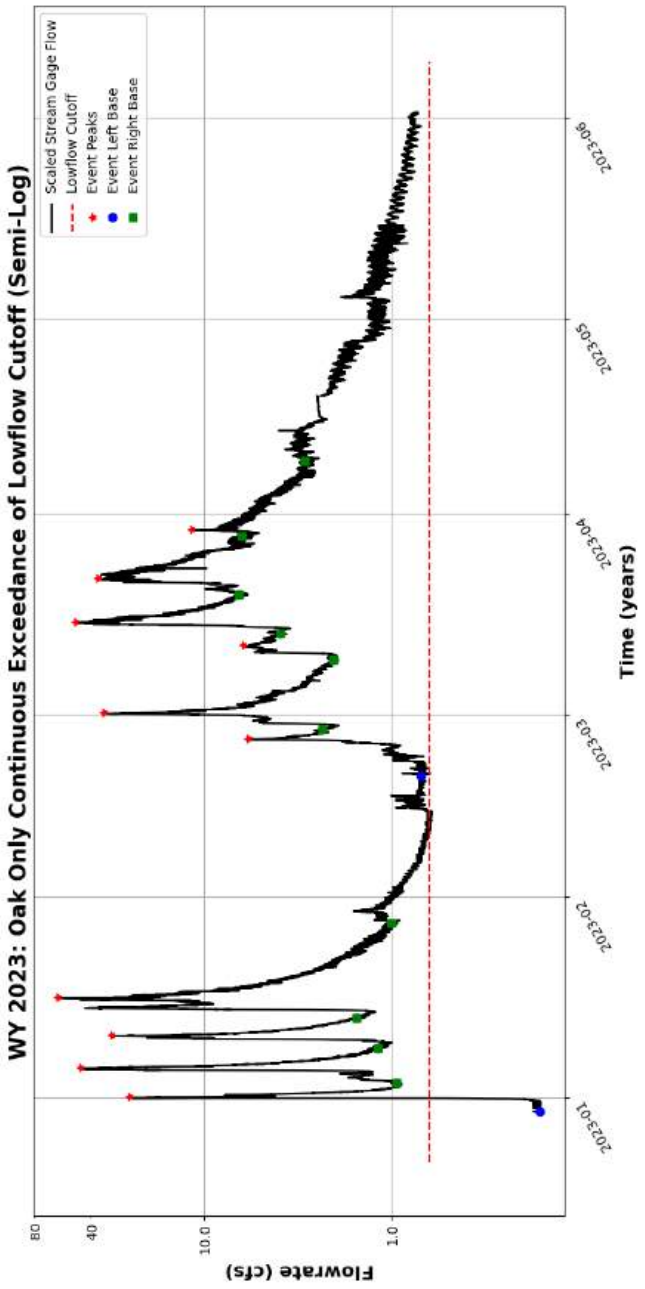
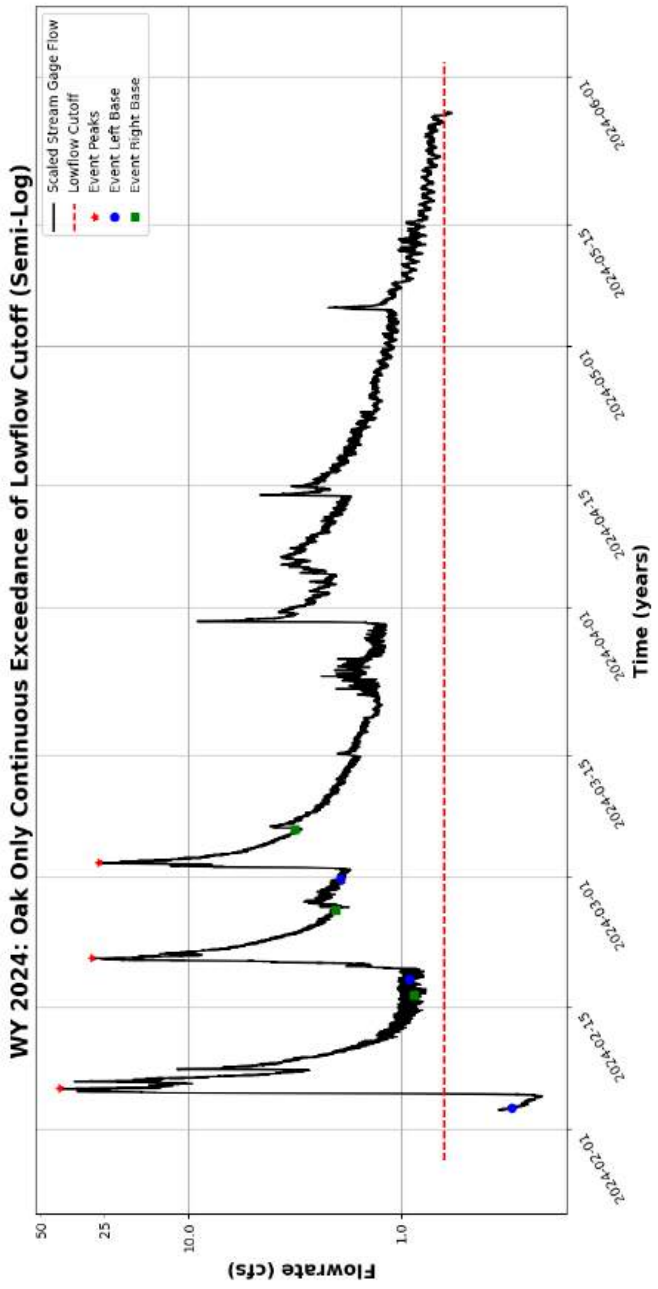


Figure A.5: WY 2024 Subsequent Events

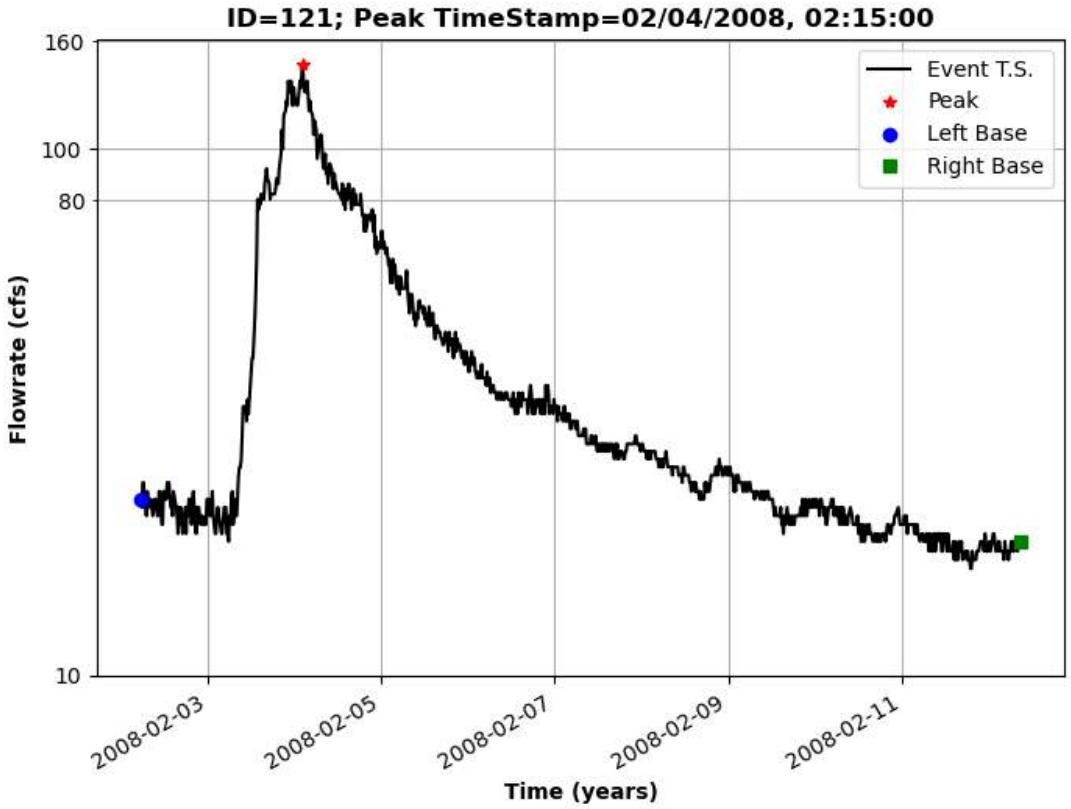


Appendix B: Plunge/Elder/Oak Creek – Representative Hydrographs

Appendix B:

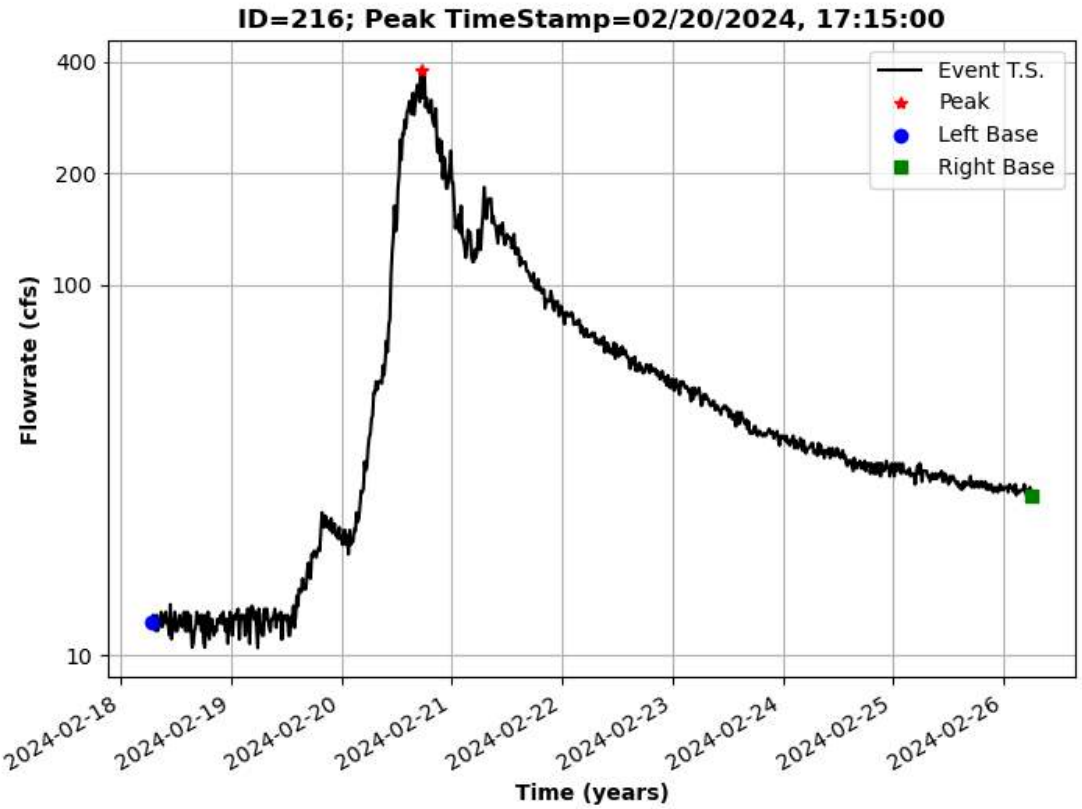
Representative events are selected by choosing the event (of 187 possible events) which has a peak flowrate closest to the corresponding probabilistic peak flowrate from Table 10 for the given scenario. For example, Plunge/Elder/Oak Creek 50th percentile peak flowrate is 146.6 cfs. Figure B.1 shows an event which has a peak of 144.7 cfs. Note that events are scaled based on the scenario described, in this case scaled to Plunge/Elder/Oak combined flows. Note each hydrograph denotes duration (Dur), left base flowrate (Ql), right base flowrate (Qr), peak flowrate (Qp), and total volume (Vt). Approximately five months of flow for Water Year 2023 and 2024 have been provided. Both figures demonstrate continuous periods of time where the flow exceeds the low flow cutoff and demonstrates character of subsequent events in the system.

Figure B.1: 50th Percentile Representative Event



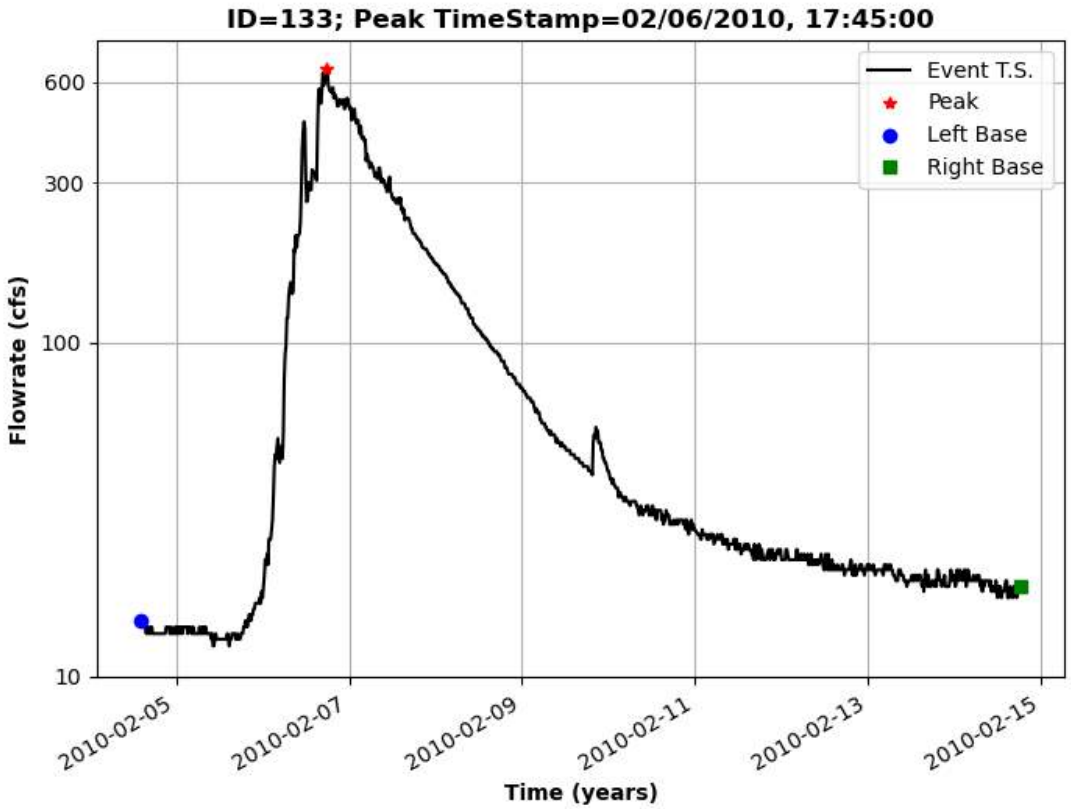
Dur=10.1 days, Ql=21.6 cfs, Qp=144.7 cfs, Qr=18.0 cfs, Vt=730.8 ac-ft

Figure B.2: 80th Percentile Representative Event



Dur=10.1 days, Ql=21.6 cfs, Qp=144.7 cfs, Qr=18.0 cfs, Vt=730.8 ac-ft

Figure B.3: 90th Percentile Representative Event



Dur=10.2 days, Ql=14.7 cfs, Qp=655.4 cfs, Qr=18.6 cfs, Vt=1777.8 ac-ft

Figure B.4: WY 2023 Subsequent Events

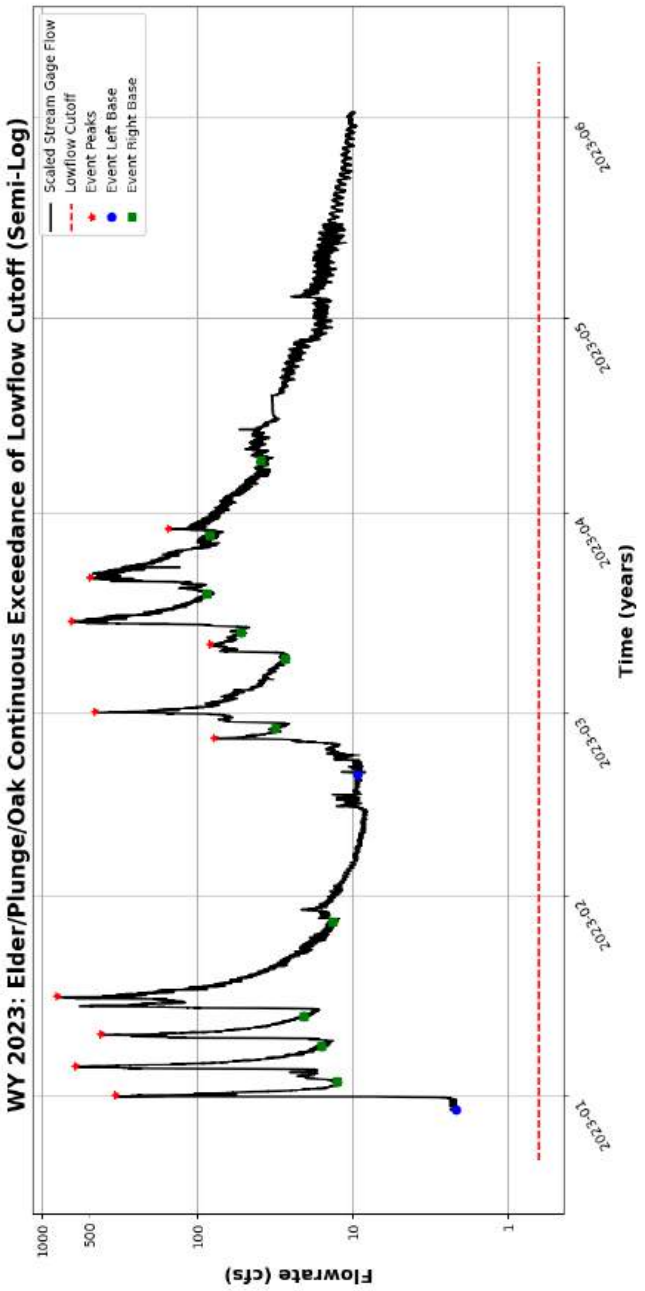
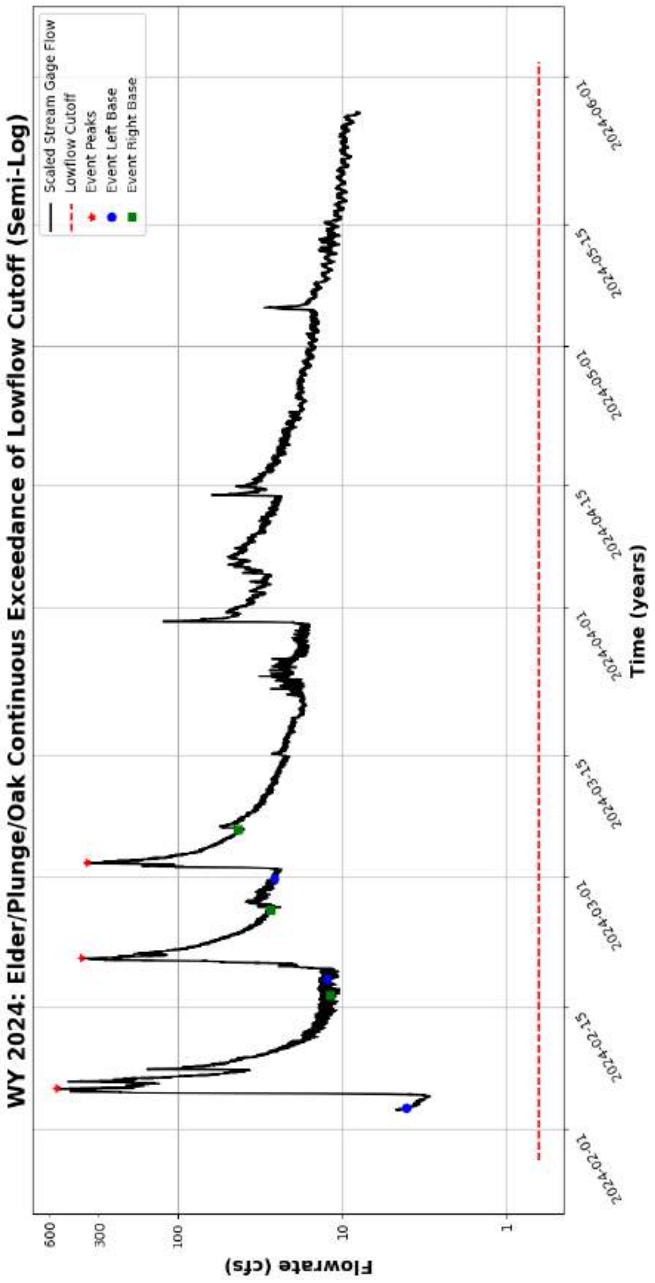


Figure B.5: WY 2024 Subsequent Events



ADDENDUM PCU-3: BASIN ROUTING

Plunge Creek Ultimate Project
Basin 1: Stage-Storage-Discharge Table

Elevation	Depth (ft)	Area (ac)	Incremental Volume (ac-ft)	Cumulative Volume (ac-ft)	Unclogged Flowrate (cfs)	Clogged Flowrate (cfs)
1160	0	26.36	0.00	0.00	0.00	0.00
1162	2	27.07	53.43	53.43	48.46	24.09
1164	4	27.50	54.56	108.00	49.22	24.47
1166	6	27.92	55.42	163.42	49.98	24.85
1168	8	28.36	56.28	219.70	50.76	25.24
1170	10	28.79	57.15	276.85	51.54	25.63
1172	12	29.23	58.03	334.87	52.33	26.02
1174	14	29.68	58.91	393.78	53.12	26.41
1176	16	30.12	59.80	453.58	53.92	26.81
1178	18	30.57	60.70	514.28	54.73	27.21
1180	20	31.03	61.60	575.88	55.54	27.62
1182	22	31.49	62.52	638.40	56.36	28.02
1184	24	31.95	63.43	701.83	57.19	28.43
1186	26	32.41	64.36	766.20	58.02	28.85
1188	28	32.88	65.30	831.49	58.86	29.27
1190	30	33.35	66.24	897.73	59.70	29.69
1192	32	33.83	67.18	964.91	60.56	30.11
1194	34	34.31	68.14	1033.05	61.42	30.54
1196	36	34.79	69.10	1102.16	62.28	30.97
1198	38	35.28	70.07	1172.23	63.15	31.40
1200	40	35.77	71.05	1243.28	64.03	31.84
1202	42	36.26	72.04	1315.31	64.91	32.28
1204	44	36.76	73.03	1388.34	65.80	32.72
1206	46	37.26	74.03	1462.37	66.70	33.16
1208	48	37.77	75.03	1537.40	67.61	33.61
1210	50	38.28	76.05	1613.44	68.52	34.07
1212	52	38.79	77.07	1690.51	69.43	34.52
1214	54	39.30	78.09	1768.60	70.36	34.98
1216	56	39.82	79.13	1847.73	71.29	35.44
1218	58	40.35	80.17	1927.90	72.22	35.91
1220	60	40.87	81.22	2009.12	73.16	36.38
1222	62	41.40	82.28	2091.40	74.11	36.85
1224	64	41.94	83.34	2174.74	75.07	37.32
1226	66	42.47	84.41	2259.15	76.03	37.80
1228	68	43.02	85.49	2344.64	77.00	38.28
1230	70	43.56	86.58	2431.22	77.97	38.77
1232	72	44.11	87.67	2518.88	78.95	39.26

The Flowrate ("Discharge") shown in the table is infiltration not outflow.

Technical Memorandum

Date: **January 26, 2025**

To: **John Lambie, PE, Chief Engineer San Bernardino Valley Water Conservation District**

From: **Joseph L. Castaneda, P.E.**

Re: **Plunge Creek Basins & Oak Creek Basins Routing Assessment**

Introduction

This technical memorandum was produced for the San Bernardino Valley Water Conservation District (SBVWCD) in support of the requested routing assessment of the proposed Plunge Creek and Oak Creek basins. The Oak Creek and Plunge Creek Project Alternatives have been assessed with a basin routing model to develop an understanding of their functionality. The basins have been independently assessed using basin routing for the following Project Alternatives:

1. Oak Creek Basins (see Addendum A)
2. Plunge Creek Interim Conditions Basins (see Addendum B)
3. Plunge Creek Mined-Conditions Basins (see Addendum C)

The inflow data which is routed through each basin is defined as:

- **Native Inflow** - Inflow defined by the Technical Memorandum for the Oak Creek Basin and Plunge Creek Basin feasibility study using statistical assessment in order to identify a historic project site typical hydrograph (PTH TM, JLC, Oct. 2024).

The inflow data which is routed only through the Oak Creek Basin is defined as:

- **FIRO Inflow** - Inflow defined by the SBVWCD in coordination with the Forecast-Informed Reservoir Operations (FIRO) program.

The PTH TM was developed in coordination with SBVWCD staff to statistically define expected inflow events. Stream gage data in Plunge Creek was studied to identify candidate inflow hydrographs. Approximately 187 events were detected and statistically assessed by their runoff volume production using applicable probability distributions for hydrologic event analysis. The event data was extrapolated to adjacent watershed areas using watershed area and relative precipitation over each watershed area as a

proxy for variability in runoff volume scale between watersheds. The precipitation data used for this process was determined using the PRISM dataset which defines 30 year normal annual precipitation for the region. The PTH TM identified storm event #121 of 187 as a typical, median sized stormflow event (i.e., middle of the range) to be considered for analysis of the proposed basin infrastructure. Note that event #121, the typical hydrograph, is scaled differently based on the basin it is applied to in order to account for the different magnitude in flows tributary to each basin.

For analysis of Oak Creek Basin, storm event #121 has been scaled to account for flow from the Oak Creek watershed and nearby Greenspot Storm Drain watershed area. For analysis of Plunge Creek Basin, storm event #121 has been scaled to account for flow from Oak Creek watershed, Plunge Creek watershed, and Elder Creek watershed. The watersheds are in reference to Figure A of the PTH TM.

Based on an approximation of five storms per year (assumed due to 187 storms found over 35 year record), SBVWCD requested that the routing inflow event referred to as the project typical hydrograph (PTH) and defined by the PTH TM consist of five consecutive typical hydrographs to determine how the proposed basins would operate under this condition. SBVWCD requested that the events be consecutive with no separation between events such that the first time step of the subsequent event follow the last time step of the previous event. This decision is based upon findings that the median separation between storm events in the region is zero days in the PTH TM analysis.

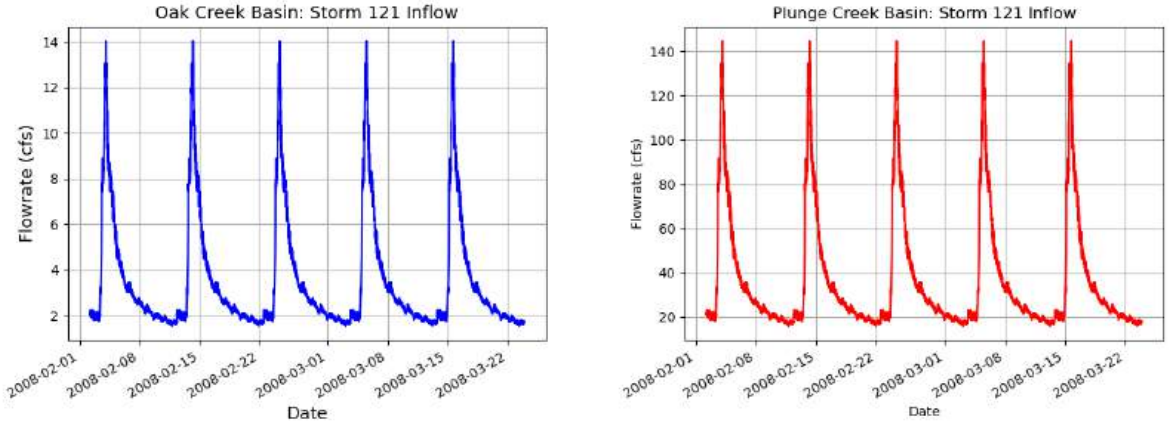


Figure 1: *Native Inflow for Oak Creek Basin (left) and Plunge Creek Basin (right)*

The decision to model the inflows in this fashion is consistent with behavior observed from the stream gage analysis of Plunge Creek in the PTH TM. Generally, most events occur in the spring between February and May of any given year. The receding tail of any single event is generally long and drawn out over a long period which creates long periods of constant low flows through Plunge Creek and Oak Creek. The long period of consistent lows flows with intermittent peak flows from periodic median storm events are the primary target for infiltration. Inflow events of this character will be applied to both Oak Creek and Plunge Creek Basins. The duration of the five consecutive hydrographs

is approximately 50 days (about 10 days per event). The peak flow for each hydrograph in the set is approximately 14 cfs and 145 cfs in Oak Creek and Plunge Creek, respectively. The cumulative volume of each hydrograph is 354.5 ac-ft and 3655.5 ac-ft in Oak Creek and Plunge Creek, respectively.

Coordination between SBVWCD and the FIRO program have created an opportunity for periods of constant inflow to the Oak Creek basin only. The FIRO program allows a coordinated release of flow from upstream reservoirs as dictated by state water managers. As a result, SBVWCD has requested that the Oak Creek basin be assessed for a constant inflow event given an inflow magnitude and duration. The FIRO inflow has been requested as 35 cfs over 52 days.

HEC-HMS: Routing Model

HEC-HMS, developed by the US Army Corp of Engineers (USACE), was used to model the routing of inflow hydrographs through the proposed basins. Due to the simple configuration of the proposed basins and inflow scenarios of interest, the most cost/time effective modeling approach was identified to be routing with the Modified Puls Method (also known as level pool routing). The long duration of inflows that were requested to be modeled by the SBVWCD necessitated the use of HEC-HMS over other tools capable of invoking the Modified Puls Method.

The Modified Puls Method is widely used and powerful for understanding storage in a large reservoir (basin) such as the proposed Oak Creek and Plunge Creek basins. The method is developed through discretizing the continuity equation and is one-dimensional. The equation is as follows:

$$\overline{I_t} - \overline{O_t} = \frac{\Delta S}{\Delta t}$$

where $\overline{I_t}$ and $\overline{O_t}$ are time averaged inflow/outflow over a time period Δt, and ΔS is the change in storage during that period. This concept can be simplified to mean that the rate at which stored volume in the basin is changing (increasing/decreasing) is simply the difference between the inflow and outflow at the given time step. Therefore, if inflow is greater than outflow there is an accumulation of runoff stored in the basin. In contrast, if outflow exceeds inflow then there is a decrease in runoff stored in the basin.

This method relies on the development of a function governing the relationship between stage and outflow in the proposed basin. The outflow mechanisms in each basin are (1) spillway and (2) infiltration. Both are a function of stage and can be tabulated and provided to the HEC-HMS routing model for use in resolving the Modified Puls method. Spillways are resolved by modeling the proposed spillways as rectangular weirs with the weir equation. Infiltration is modeled based upon the provided clogged and unclogged infiltration rates from SBVWCD. As requested by the district, outflow due to infiltration was modeled as a function of wetted area which was approximated by the surface area of each enclosed topographic contour defined by the basin grading. As a result, the

outflow due to infiltration increases as a function of stage by way of the corresponding increase in wetted area.

The **clogged** and **unclogged** infiltration rates were provided by SBVWCD. SBVWCD requested that the infiltration rate be considered to increase as a function of wetted area and that the infiltration rate not decay in time. The area of the water surface for a given water surface elevation was used as a proxy for wetted area when evaluating the infiltration outflow in each basin.

The HEC-HMS model for each basin consists of the following elements:

1. Source (Inflow)
2. Reservoir (Basin = Storage)
3. Sink (Outflow)
    a. Infiltration
    b. Overflow via Emergency Spillway

Note that outflow through the spillway and outflow through infiltration are both modeled as sinks which extract flow from the basin. Infiltration outflow is enabled to begin as soon as a non-zero depth of water is achieved in the basin element. The spillway outflow is enabled to begin once the depth of water exceeds the spillway invert in the basin.

Infiltration Rate

The infiltration rates used in the models were determined from the results of the infiltration testing conducted by LOR Geotechnical (LOR), and further analyzed by SBVWCD. LOR conducted infiltration testing at the proposed Oak Creek Basin site (Report 63813A.4), and in the proximity of the Plunge Creek Basin Site (Report 63813B.4). At the Oak Creek Basin location, LOR conducted four borehole percolation tests at depths which varied from approximately 8 feet to 15 feet. Infiltration rates were calculated by LOR from the test data using the Porchet Method, and ranged from 2.5 inches/hour to 6.5 inches/hour. Near the Plunge Creek Basin site, LOR conducted three double-ring infiltrometer, and one single-ring infiltrometer test at depths of approximately 0.5 feet to 1 foot below existing ground surface. Infiltration rates were calculated by LOR from the test data and ranged from 2.6 inches/hour (5.1 ft/day) to 5.8 inches/hour (11.6 ft/day).

SBVWCD reviewed the results and developed the design rates to use for clogged and unclogged conditions. SBVWCD calculated the geometric mean of the results and then calculated a factor of safety at each basin using the method in Appendix D of the Technical Guidance Document for Water Quality Management Plans, June 7, 2013, prepared by CDM Smith, Inc to determine the unclogged rate. SBVWCD proposed assigning an additional reduction factor of 2 to simulate clogging prior to basin maintenance, resulting in a clogged rate.

SBVWCD provided infiltration rates for the **clogged** and **unclogged** conditions as **1.77 ft/day** and **3.55 ft/day**, respectively, for Plunge Creek Basin. Infiltration rates for the **clogged** and **unclogged** conditions are **2.23 ft/day** and **4.46 ft/day**, respectively, for Oak Creek Basin.

Oak Creek Basins

The Oak Creek proposed basin will consist of two connected sub-basins in series. Flow will enter from the north into Basin 1; flows will overtop Basin 1 and cross a spillway into Basin 2.

Table 1a: *Oak Creek Basin Physical Characteristics for Basin 1&2*

Basin Name	Basin Bottom (ft)	Basin Top (ft)	Spillway Invert (ft)	Max Storage @ Spillway Invert (ac-ft)
Basin 1	1483	1500	1495	14.6
Basin 2	1483	1500	1497	98.6

Table 1b: *Oak Creek Basin Inflow Scenarios*

Inflow Name	Duration (days)	Peak Flow (cfs)	Cumulative Volume (ac-ft)
Native	56	14.0	354.5
FIRO	52	35	3,610.3

Note that modeling the Oak Creek Basins requires some assumptions since it consists of two smaller basins which are connected only by a spillway at elevation 1495' (basin bottom is 1483'). At this time, each basin (Basin 1 and Basin 2) are modeled as independent basins in series. As a result, the following assumptions are made regarding their operation:

- **Volume created by the spillway between 1495' and 1497' is partially ignored.** The contours which enclose the entire system were approximated for each independent basin by holding the proposed slope adjacent to the spillways to close the contours above 1495' on each basin. The ignored volume amounts to approximately 1.5 ac-ft of storage which exists over the spillway. Basin 1 and Basin 2 have a combined storage of approximately 147 ac-ft. Therefore, the ignored volume is about 1% of the volume and is negligible. Under 100% volume utilization these basins will retain marginally more volume than the routing dictates.
- **Volume created by Basin 1 between 1495' and 1497' due to backwater effect of Basin 2 is ignored.** Influence of the tailwater created by the flow over spillway from Basin 1 into Basin 2 is ignored since basins are assumed to operate independently. The impacts are considered negligible and only influence the FIRO flow condition which has the potential to fill Basin 2. This assumption has no impact on the analysis of the Native Inflow.

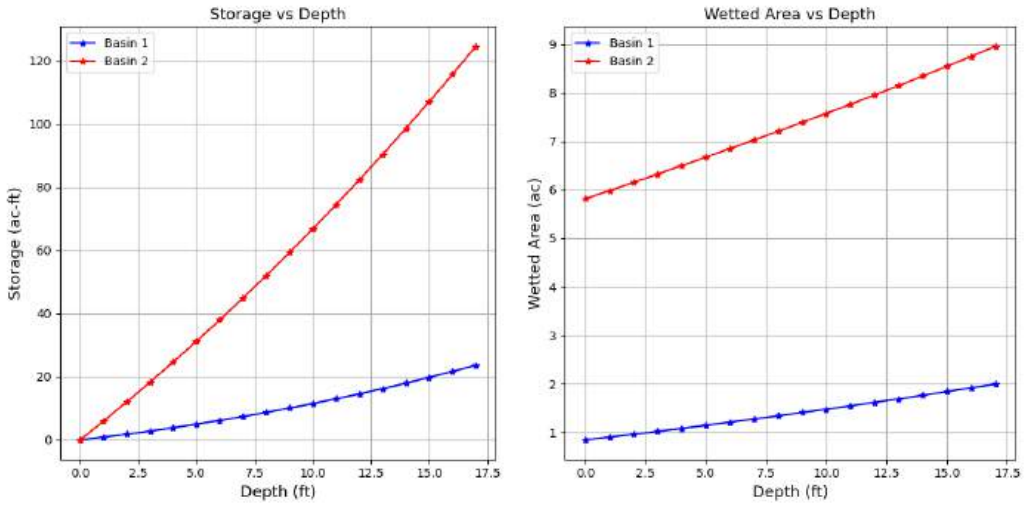


Figure 2a: *Oak Creek Basin Storage vs Depth (left) and Wetted Area vs Depth (right); Water surface area is a proxy for wetted area.*

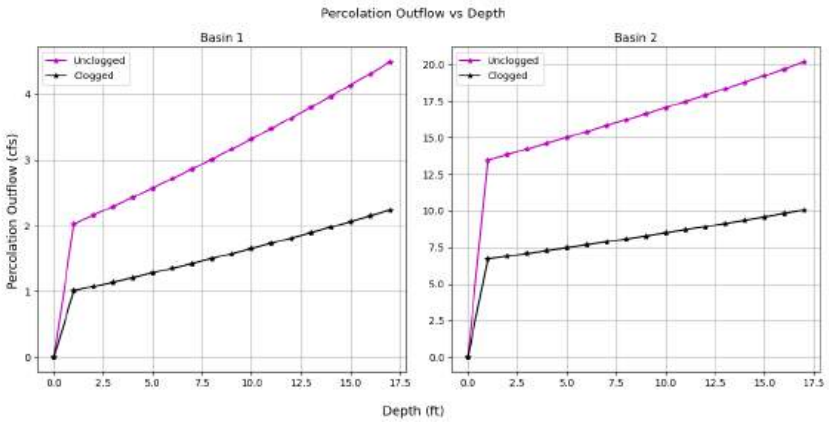


Figure 2b: *Oak Creek Basin Percolation Outflow vs Depth*

The Oak Creek Basins have a single graded condition to be considered. It will be assessed for both the Native Inflow and the FIRO Inflow. The results of the routing analysis are described below.

Table 1c: *Oak Creek Basin Routing Results (Native Inflow)*

Condition	Basin Name	Max Stage (ft)	Max Storage (ac-ft)	Inflow Volume (ac-ft)	Infiltrated Volume (ac-ft)	Bypass Volume (ac-ft)
Unclogged	Basin 1	1495.0	14.6	354.5	316.1	38.4
	Basin 2	1483.3	1.7	38.4	38.4	0.0
Clogged	Basin 1	1495.1	14.7	354.5	193.9	160.6
	Basin 2	1484.2	6.9	160.6	160.6	0.0

Note that the total infiltration for the unclogged and clogged conditions is the full inflow volume of 354.5 ac-ft since the system as a whole does not allow any bypass.

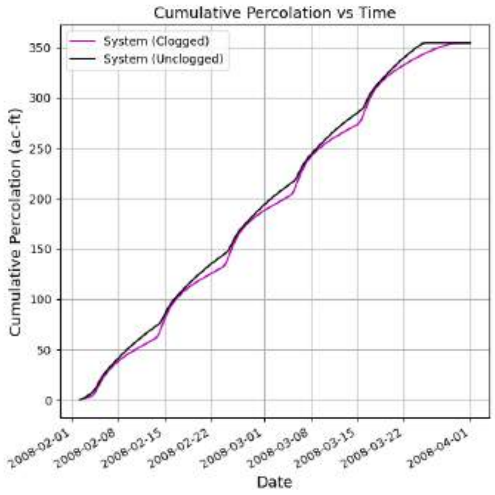


Figure 2c: *Oak Creek Basin Cumulative Percolation (Native Flow)*

Table 1d: *Oak Creek Basins Routing Results (FIRO Inflow)*

Condition	Basin Name	Max Stage (ft)	Max Storage (ac-ft)	Inflow Volume (ac-ft)	Infiltrated Volume (ac-ft)	Bypass Volume (ac-ft)
Unclogged	Basin 1	1495.2	14.9	3,610.3	392.4	3,217.9
	Basin 2	1497.1	99.1	3,217.9	2,012.2	1,205.7

The FIRO inflow condition was only examined for the unclogged condition as requested. Over the 52 day period, a total infiltration volume of 2,404.6 ac-ft was simulated. The FIRO inflow achieves steady state within the Oak Creek Basins after approximately 3.5 days (88.5 hours). This means that Basin 1 and Basin 2 are both full and outflow through the overflow spillway in Basin 2 out of the Oak Creek Basin system is constant. At steady state, the flow out of Basin 2 is approximately 12.5 cfs. After 52 days of constant inflow, the transient period until the basins are empty is approximately 5.2 days.

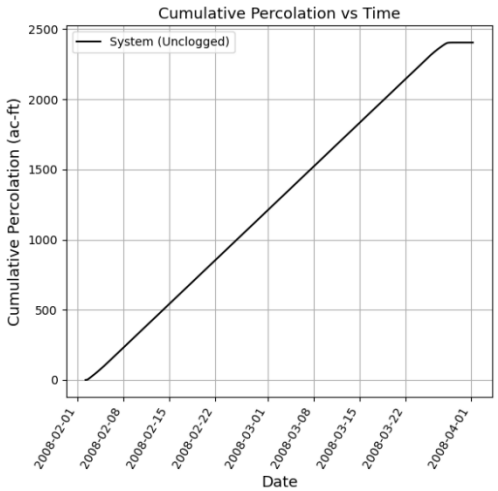


Figure 2d: *Oak Creek Basin Cumulative Percolation (FIRO flow)*

Plunge Creek Basin Interim-Conditions Basin Project Alternative

The Plunge Creek Interim-Conditions Basins project alternative consists of three basins: two small basins at the upstream end for debris entrapment and a single larger basin downstream. The two small debris basins will limit the aggregation of debris in the primary basin; however, all three basins will be considered for infiltration in the routing model. Flow will enter from the north into the basins 1 and 2 before passing into basin 3. Basin 1 and 2 operate in parallel.

Table 2a: *Interim Plunge Creek Basin Physical Characteristics for Basin 1, 2, & 3*

Basin Name	Basin Bottom (ft)	Basin Top (ft)	Spillway Invert (ft)	Max Storage @ Spillway Invert (ac-ft)
Basin 1	1254	1270	1266	14.9
Basin 2	1254	1266	1262	13.1
Basin 3	1244	1260	1258	99.7

Table 2b: *Plunge Creek Basin Inflow Scenarios*

Inflow Name	Duration (days)	Peak Flow (cfs)	Cumulative Volume (ac-ft)
Native	56	144.7	3655.5

At this time the following assumptions have been made about the Plunge Creek Interim-Conditions Basins:

- **Basin 1 & 2 have a spillway with length of 30ft and Basin 3 has a spillway with length of 50 ft.** At this time, the assessment is completed based upon the apparent weir length on the provided design file from the District. The spillway is assumed to be rectangular and broad-crested.
- **Flows are diverted upstream of Basin 1 & 2 before entering the basins separately via storm drain. It is assumed the inflow is evenly split between Basin 1 and Basin 2.** There is no way to assess how flows are diverted at this time. This is a convenient assumption and has minimal influence since the inflow event drastically exceeds the total system storage capacity.

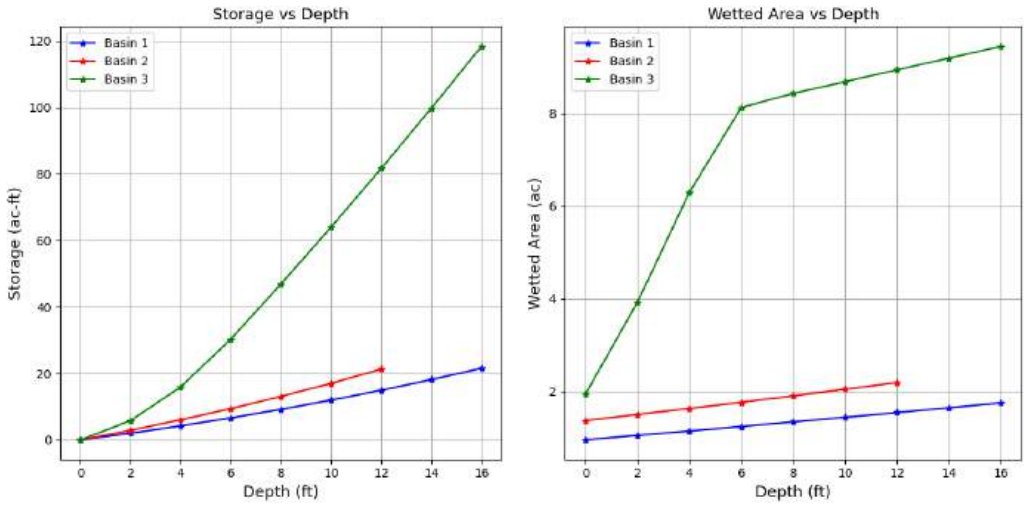


Figure 3a: *Plunge Creek Interim Basins Storage vs Depth (left) and Wetted Area vs Depth (right); Water surface area is a proxy for wetted area.*

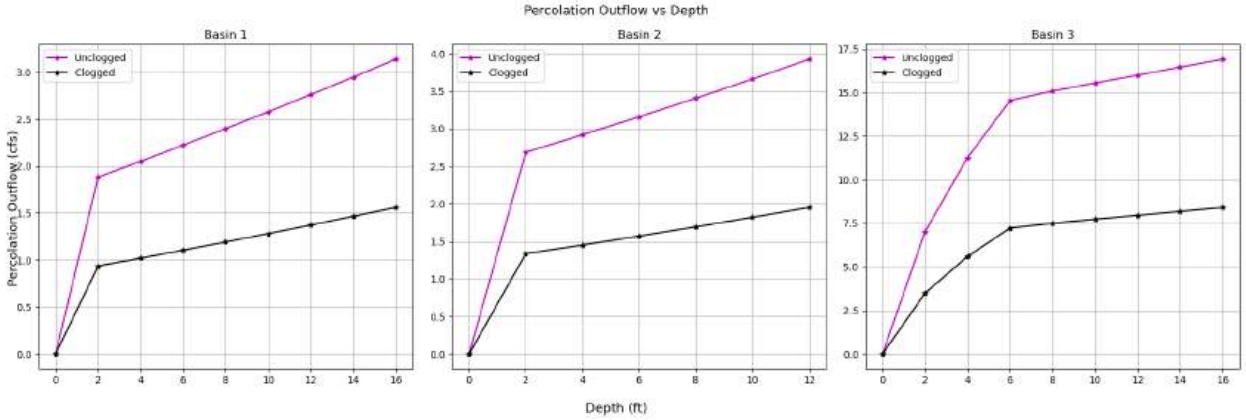


Figure 3b: *Plunge Creek Interim Basins Percolation Outflow vs Depth*

Table 2c: *Interim Plunge Creek Basins Routing Results (Native Inflow)*

Condition	Basin Name	Max Stage (ft)	Max Storage (ac-ft)	Inflow Volume (ac-ft)	Infiltrated Volume (ac-ft)	Bypass Volume (ac-ft)
Unclogged	Basin 1	1266.8	16.25	1827.8	294.4	1533.2
	Basin 2	1262.8	14.68	1827.8	358.5	1469.2
	Basin 3	1258.2	101.41	3002.4	1682.7	1319.4
Clogged	Basin 1	1266.8	16.27	1827.8	154.1	1673.6
	Basin 2	1262.8	14.71	1827.8	185.1	1642.6
	Basin 3	1258.2	101.52	3316.2	905.8	2410.3

Note that the total infiltration for the unclogged and clogged conditions is 2335.6 ac-ft and 1245 ac-ft, respectively.

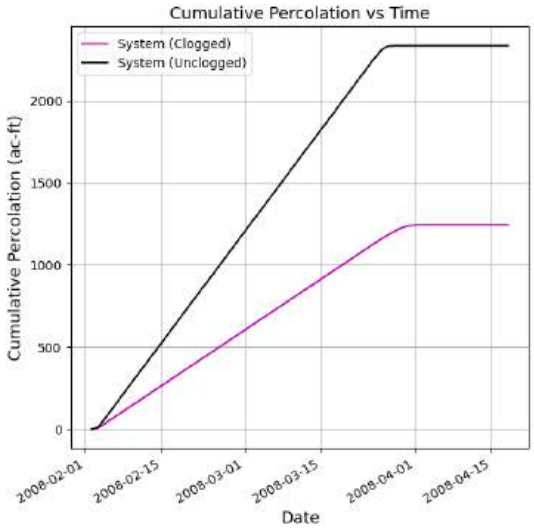


Figure 3c: *Plunge Creek Interim-Conditions Basins Cumulative Percolation (Native Flow)*

Plunge Creek Mined-Condition Basins Project Alternative

The Plunge Creek proposed basins Project Alternative after mining will consist of a single large basin. Flow will enter from the north into the basin.

Table 3a: *Ultimate Plunge Creek Basin Physical Characteristics for Basin*

Basin Bottom (ft)	Basin Top (ft)	Spillway Invert (ft)	Max Storage @ Spillway Invert (ac-ft)
1160	1232	1230*	2431.2

*Assumed spillway invert at this time.

Table 3b: *Ultimate Plunge Creek Basin Inflow Scenario*

Inflow Name	Duration (days)	Peak Flow (cfs)	Cumulative Volume (ac-ft)
Native	56	144.7	3655.5

At this time the following assumptions have been made about the ultimate condition Plunge Creek Basin:

- **The small basin adjacent to the primary Plunge Creek Basin is excluded from this analysis.** At this time, the assessment is completed based upon the design files received from the District. The proposed sub-basins do not have known names and the function of the smaller proposed basin is unknown.

- **An overflow emergency spillway is assumed to be a 10 ft rectangular broad-crested weir. At this time, the spillway design is unknown.** There is

no ramification to this modeling choice since the inflow event cannot exceed the basin storage capacity.

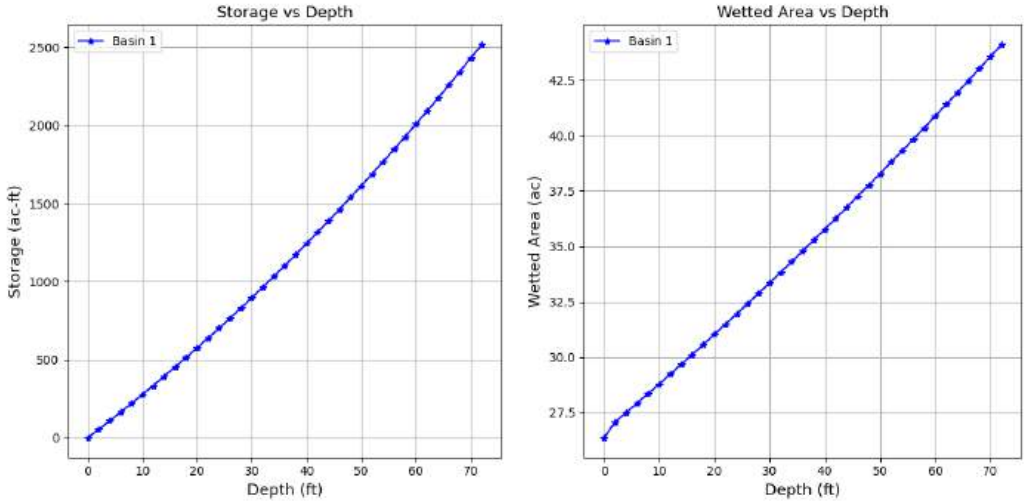


Figure 4a: *Plunge Creek Mined-Conditions Basin Storage vs Depth (left) and Wetted Area vs Depth (right); Water surface area is a proxy for wetted area.*

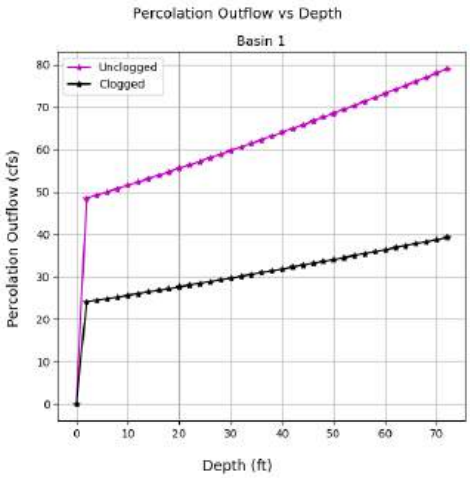


Figure 4b: *Plunge Creek Mined-Conditions Basin Percolation Outflow vs Depth*

Table 3c: *Plunge Creek Mined-Conditions Basin Routing Results (Native Inflow)*

Condition	Max Stage (ft)	Max Storage (ac-ft)	Inflow Volume (ac-ft)	Infiltrated Volume (ac-ft)	Bypass Volume (ac-ft)
Unclogged	1166.1	167.52	3655.5	3655.5	0.0
Clogged	1192.7	989.70	3655.5	3655.5	0.0

Note that the total infiltration for the unclogged and clogged conditions is the full inflow volume of 3655.5 ac-ft since the system as a whole does not allow any bypass.

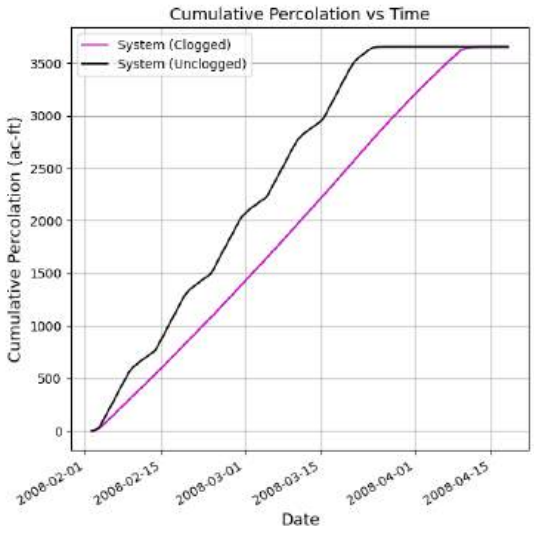


Figure 4c: *Plunge Creek Mined-Conditions Basin Cumulative Percolation (Native Flow)*

References

JLC Engineering & Consulting, Technical Memorandum (PTH TM), “Amendment to Feasibility Study Support Services ARTP Plunge Creek and Oak Creek Diversion and Basin(s)”, October 8, 2024

ADDENDUM A

ADDENDUM B

ADDENDUM C

ADDENDUM PCU-4: TOTAL SUSPENDED SOLIDS MEMORANDUM

Technical Memorandum

Date: **April 22, 2025**

To: **Michael Gentile, PE**

From: **Joseph L. Castaneda, P.E.**

Re: **Total Suspended Solids for Plunge Creek**

Overview

At the request of San Bernardino Valley Water Conservation District, the Project Team was requested to quantify the potential total suspended solids for Plunge Creek that can potentially be conveyed by the Plunge Creek Diversion Structure downstream of Orange Street Bridge. The purpose of determining the total suspended solids is to compute a potential sediment volume that may be collected by the proposed Plunge Creek Recharge Basin. The location of the Plunge Creek Diversion Structure has been identified in Figure 1 which is located within the Plunge Creek Spillway, which is a concrete lined channel that controls flows through the Orange Street Bridge and to the existing downstream natural channel. The Plunge Creek Spillway was completed in March 1992. It is JLC's opinion that the structure was constructed to stabilize Plunge Creek and the existing check dam located upstream of Orange Street due to the ongoing mining activities.

The most accurate method to determine total suspended solids is to sample runoff from the Plunge Creek and use laboratory methods to determine the total mass of the suspended solids with respect to the volume sample. However, rather than performing physical sampling a secondary approach was proposed that can establish a rough order magnitude of the potential total suspended solids. The approach that was used is documented below:

1. The project team utilized the Sediment Transport Analyses for Plunge Creek, dated March 3, 2024 to obtain sediment delivery results for Plunge Creek using a Rainy Average Hydrograph which had an approximate peak flow rate of 200 ft^3/s. The sediment transport study that was prepared represented the existing condition Plunge Creek terrain based on topographic mapping prepared for the project dated March 2022. The sediment transport analyses that was performed utilized Plunge Creek cross section for the existing condition floodplain model that was studied as

part of the Hydrology and Hydraulics Report for Plunge Creek Existing Floodplain, dated May 25, 2023. The purpose of the existing sediment transport study was to determine the existing sediment delivery for Plunge Creek existing condition. The sediment delivery results are provided in tons and represent the bedload material that consists of sands and gravels.

2. The project team utilized the soil samples and gradation test taken along Plunge Creek and within the Cemex Site to determine the composition of the in-situ soil. The soil samples and gradation test were performed by LOR Geotechnical. The gradation test provides the percent finer by weight and the particle size of the soil sample. Additionally, the gradation sample also provides the percentage of silts or clays obtained from the soil sample. A total of 10 samples were taken along Plunge Creek which are shown in Figure 2.

3. The analyses assume that the total suspended solids are composed of sediments smaller than a #200 sieve which represents the silts and clays. The silts and clays are assumed to be in suspension and will be transported by the runoff.

4. Cross Section 1982 shown in Figure 3 and Figure 4 was used to represent the location to determine the sediment delivery relative to time. The sediment transport results provide total sediment delivery as a function of time. The results from Cross Section 1982 were tabulated and a graphical representation was provided. The tabulated data is included in Table 1 and the graphical representation is included as Graph #1.

5. Based on the review of the gradation tests, Samples 3 and Sample 6 consisted of approximately 14% and 12% of the material that was smaller than the # 200 Sieve, respectively. Once again, these samples were taken along the Plunge Creek Streambed. Samples 3 and Sample 6 were selected since these had the highest percentage of material smaller than the #200 Sieve. The sediment transport study provided sediment delivery for the bedload which does not include material smaller than a #200 sieve. JLC utilized the gradation test to determine the potential total suspended solids, material that are smaller than the #200 sieve, by using the gradation test percentage. To determine the total suspended solids a value of 15% was used to represent the amount of sediment by weight that passes the #200 sieve. Fifteen percent was selected to be conservative by using a rounding to the nearest 5%. This results in 85% of the material being represented as bedload material. The table below provides the breakdown from the gradation test and the value to be used as part of the Total Suspended Solids Assessments.

LOR Soil Samples and Gradation Test		
Sample Number	Sediment Percentage not Passing the #200 Sieve	Sediment Percentage Passing the #200 Sieve
3	86%	14%
6	88%	12%
Sediment Material Breakdown for Total Suspended Solid Assessment(1)		

	Bedload Percentage	Total Suspended Solids
Assessment	85%	15%

(1) The TSS Assessment used 15% to represent the total suspended solids by rounding the results from Sample #3 and Sample #6 to the nearest 5%.

6. As previously stated, LOR provided sediment samples for the Cemex Site located west of the Plunge Creek basin, see Figure 5. This site is a mining pit that collects runoff from a sheet flow area that extends east of the project. The gradation test for the Cemex sample were taken at the following depths:
    a. 0 to 4 inches of Depth
    b. 4 inches to 12 inches of Depth

    The percentage for the sample taken at 0-4 inches was not used since the material can be impacted by air transport fines and the local environment that may skew the results. As a result, JLC's opinion was to sue the samples taken at 4" to 12" of depth from the Cemex Site. The sample at 4" to 12" indicates that 20% of the sediment material is less than the #200 sieve. This gradation test was used to compare with the sampling taken from the Plunge Creek stream bed. The Cemex sample at a depth of 4" to 12" has a close correlation to the samples taken within Plunge Creek for Sample 3 and Sample 6

7. Table 1 provides the bedload in tons over the duration of the hydrograph for the Rainy Average Flow Rate. The sediment transport results only provide the total bedload quantity. To determine the Total Suspended Loads the bedload quantity had to be used to determine the total suspended load using the gradation test percentage results for the material greater than the #200 Sieve and the material smaller than the #200 Sieve. The table below provides the multiplier used to compute the Total Suspended Load using 15% of the sediment material smaller than the #200 Sieve and 20% of the sediment material smaller than the #200 Sieve based on the gradation test.

Percent Greater than #200	Percent Smaller than #200	Multiplier to Adjust Sediment Transport Bedload Results to Obtain Total Bedload and Suspended Load (1)
85%	15%	1.176
80%	20%	1.25

(1) The sediment transport results represent the total bedload. This represents the quantity that is greater than the #200 sieve. The total suspended solids represents the load smaller than the #200 sieve. As a result, the bedload has to be multiplied by a factor that will result in a distribution that amounts to 100% of the total material which includes bedload and suspended loads.

The results in Table 1 and Graph #1 provide the following data in tons and cubic yards:
    a. Total Bedload
    b. Total Suspended Loads [15%] - (15% Material Smaller than #200)
    c. Total Suspended Loads [20%] - (20% Material Smaller than #200)

Conclusion

Based on the analysis performed using the sediment transport data and the total suspended solids assessment, JLC anticipates that the Plunge Creek Recharge Basin can anticipate 50 cubic yards to 70 cubic yards of total suspended solids that will be diverted into the basins for a single 24 hour storm that has an equivalent hydrograph as the Rainy Average Hydrogrpah.

TABLE 1 – Sediment Delivery for Plunge Creek Section 19+82

Table 1: Sediment Delivery for Plunge Creek: Section 19+82						
Time (hrs)	Bed Load (tons)	Suspended Load [15%] (tons)	Suspended Load [20%] (tons)	Bed Load (yd^3)	Suspended Load [15%] (yd^3)	Suspended Load [20%](yd^3)
1.00	0.78	0.14	0.19	0.58	0.10	0.14
2.00	5.40	0.95	1.35	4.00	0.70	1.00
3.00	15.55	2.74	3.89	11.52	2.03	2.88
4.00	28.64	5.04	7.16	21.22	3.73	5.30
5.00	45.32	7.98	11.33	33.57	5.91	8.39
6.00	58.70	10.33	14.68	43.48	7.65	10.87
7.00	70.87	12.47	17.72	52.50	9.24	13.12
8.00	82.64	14.54	20.66	61.21	10.77	15.30
9.00	94.47	16.63	23.62	69.97	12.32	17.49
10.00	106.61	18.76	26.65	78.97	13.90	19.74
11.00	120.00	21.12	30.00	88.89	15.64	22.22
12.00	130.29	22.93	32.57	96.51	16.99	24.13
13.00	142.38	25.06	35.60	105.47	18.56	26.37
14.00	156.27	27.50	39.07	115.75	20.37	28.94
15.00	173.41	30.52	43.35	128.46	22.61	32.11
16.00	198.33	34.91	49.58	146.91	25.86	36.73
17.00	227.00	39.95	56.75	168.15	29.59	42.04
18.00	258.24	45.45	64.56	191.29	33.67	47.82
19.00	280.90	49.44	70.23	208.08	36.62	52.02
20.00	299.61	52.73	74.90	221.93	39.06	55.48
21.00	313.33	55.15	78.33	232.10	40.85	58.02
22.00	323.21	56.89	80.80	239.42	42.14	59.85
23.00	331.90	58.42	82.98	245.86	43.27	61.46
24.00	343.51	60.46	85.88	254.45	44.78	63.61
25.00	354.34	62.36	88.59	262.48	46.20	65.62
26.00	361.67	63.65	90.42	267.90	47.15	66.98
27.00	365.07	64.25	91.27	270.42	47.59	67.61
28.00	367.48	64.68	91.87	272.20	47.91	68.05
29.00	369.88	65.10	92.47	273.98	48.22	68.50
30.00	371.27	65.34	92.82	275.01	48.40	68.75
31.00	372.67	65.59	93.17	276.05	48.58	69.01
32.00	374.07	65.84	93.52	277.09	48.77	69.27
33.00	376.00	66.18	94.00	278.52	49.02	69.63
34.00	376.88	66.33	94.22	279.17	49.13	69.79
35.00	377.00	66.35	94.25	279.26	49.15	69.81
35.72	377.00	66.35	94.25	279.26	49.15	69.81

GRAPH 1 – Sediment Delivery Over Time for Plunge Creek Section 19+82

GRAPH #1 FOR PLUNGE CREEK SECTION 1982

FIGURE 1 – VICINITY MAP PLUNGE CREEK DIVERISON STRUCTURE

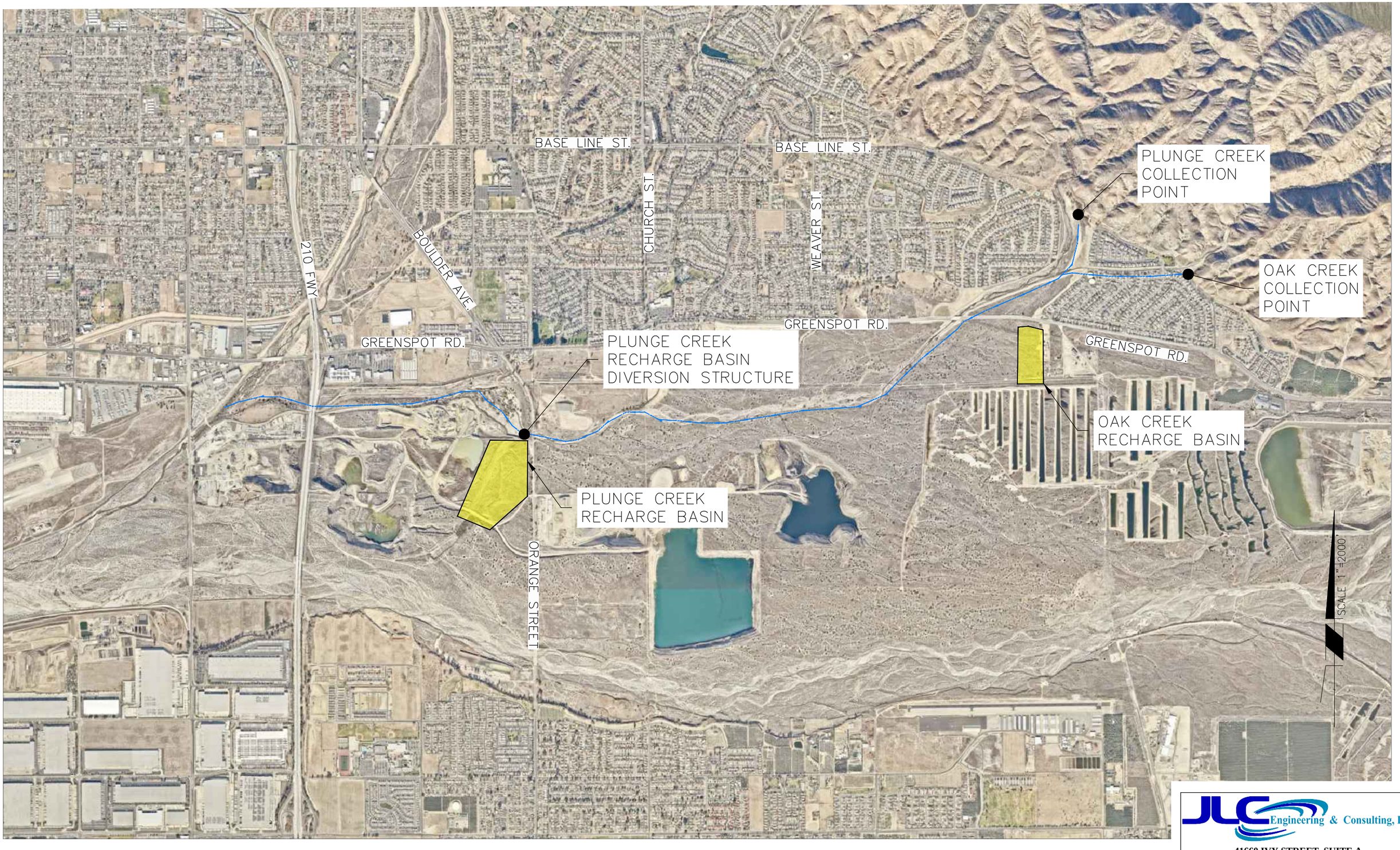


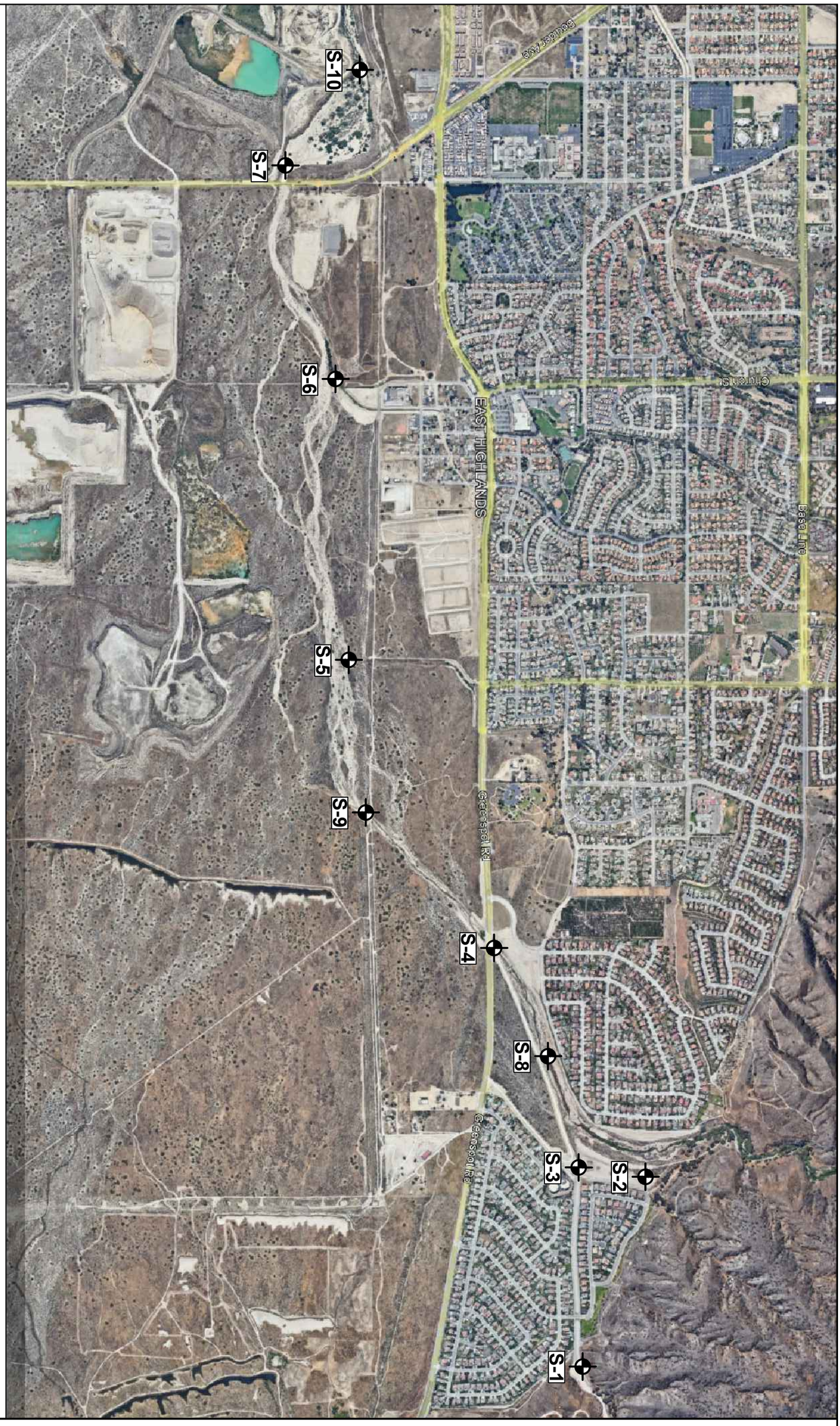
FIGURE 1 - VICINITY MAP

JLC Engineering & Consulting, Inc.
41660 IVY STREET, SUITE A
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

Drawing Name: D:\105.05.22\Engineering\Hydrology_Plan\Sediment Transport\Figures\Figure_1_Vicinity_Map.dwg
Last Opened: Apr 23, 2025 7:50am by Joe

FIGURE 2 – SEDIMENT SOIL SAMPLE LOCATIONS

FIGURE 2



Legend

(Locations Approximate)

Map Symbols

S-10 - Exploratory Sample

SAMPLE LOCATION MAP

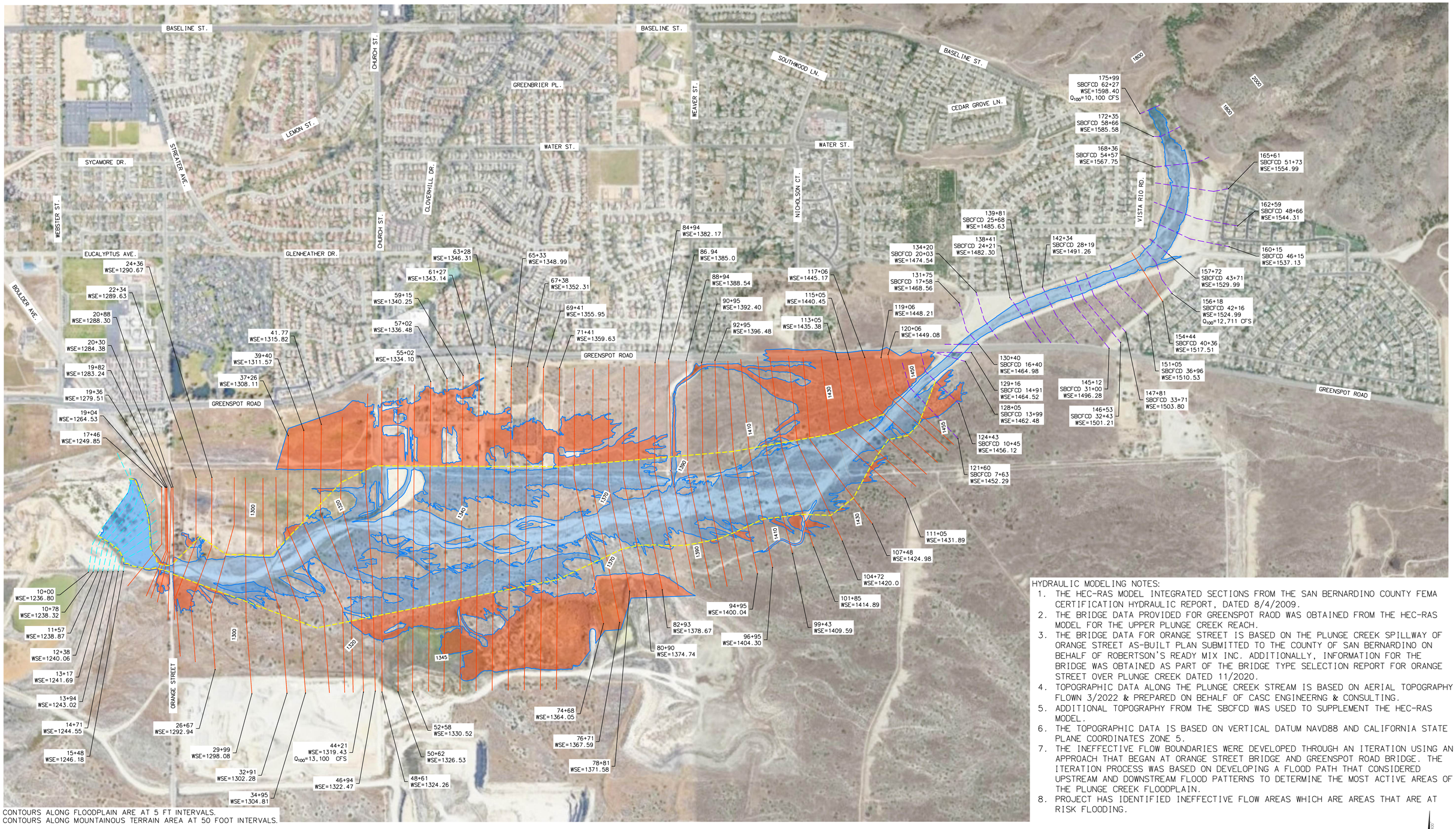
PROJECT:	Proposed Diversion and Basin, Highland, California	**PROJECT NO.:**	63813A.4
CLIENT:	CASC Engineering & Consulting	**ENCLOSURE:**	A-1
LOR GEOTECHNICAL GROUP, INC.		**DATE:**	October 2023
		SCALE:	1" ≈ 1,200'

FIGURE 3 –PLUNGE CREEK FLOODPLAIN EXHIBIT

CITY OF HIGHLAND PLUNGE CREEK EXISTING CONDITION FLOODPLAIN

IN THE CITY OF ONTARIO, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA

SBVWCD PLUNGE CREEK RECHARGE BASIN PROJECT



CONTOURS ALONG FLOODPLAIN ARE AT 5 FT INTERVALS.
CONTOURS ALONG MOUNTAINOUS TERRAIN AREA AT 50 FOOT INTERVALS.

HYDRAULIC MODELING NOTES:

1. THE HEC-RAS MODEL INTEGRATED SECTIONS FROM THE SAN BERNARDINO COUNTY FEMA CERTIFICATION HYDRAULIC REPORT, DATED 8/4/2009.
2. THE BRIDGE DATA PROVIDED FOR GREENSPOT RAOD WAS OBTAINED FROM THE HEC-RAS MODEL FOR THE UPPER PLUNGE CREEK REACH.
3. THE BRIDGE DATA FOR ORANGE STREET IS BASED ON THE PLUNGE CREEK SPILLWAY OF ORANGE STREET AS-BUILT PLAN SUBMITTED TO THE COUNTY OF SAN BERNARDINO ON BEHALF OF ROBERTSON'S READY MIX INC. ADDITIONALLY, INFORMATION FOR THE BRIDGE WAS OBTAINED AS PART OF THE BRIDGE TYPE SELECTION REPORT FOR ORANGE STREET OVER PLUNGE CREEK DATED 11/2020.
4. TOPOGRAPHIC DATA ALONG THE PLUNGE CREEK STREAM IS BASED ON AERIAL TOPOGRAPHY FLOWN 3/2022 & PREPARED ON BEHALF OF CASC ENGINEERNG & CONSULTING.
5. ADDITIONAL TOPOGRAPHY FROM THE SBCFCD WAS USED TO SUPPLEMENT THE HEC-RAS MODEL.
6. THE TOPOGRAPHIC DATA IS BASED ON VERTICAL DATUM NAVD88 AND CALIFORNIA STATE PLANE COORDINATES ZONE 5.
7. THE INEFFECTIVE FLOW BOUNDARIES WERE DEVELOPED THROUGH AN ITERATION USING AN APPROACH THAT BEGAN AT ORANGE STREET BRIDGE AND GREENSPOT ROAD BRIDGE. THE ITERATION PROCESS WAS BASED ON DEVELOPING A FLOOD PATH THAT CONSIDERED UPSTREAM AND DOWNSTREAM FLOOD PATTERNS TO DETERMINE THE MOST ACTIVE AREAS OF THE PLUNGE CREEK FLOODPLAIN.
8. PROJECT HAS IDENTIFIED INEFFECTIVE FLOW AREAS WHICH ARE AREAS THAT ARE AT RISK FLOODING.

LEGEND:

- EFFECTIVE FLOODPLAIN
- INEFFECTIVE FLOODPLAIN
- SBCFCD LOWER REACH SECTIONS
- SBVWCD HEC-RAS SECTIONS
- SBCFCD UPPER REACH SECTIONS
- INEFFECTIVE FLOW BOUNDARIES

400 200 0 400
SCALE: 1"=400'

FIGURE 3

JLC Engineering & Consulting, Inc.
41660 IVY STREET, SUITE A
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

SBVWCD - PLUNGE CREEK RECHARGE BASIN PROJECT

EXISTING CONDITION FLOODPLAIN

Drawing Name: G:\105.05.22\Engineering\HEC-RAS\Exhibits\EXHIBIT_FLOODPLAIN.dwg
Last Opened: May 18, 2023 - 4:50pm by jse

FIGURE 4 – PLUNGE CREEK DIVERSION STRUCTURE

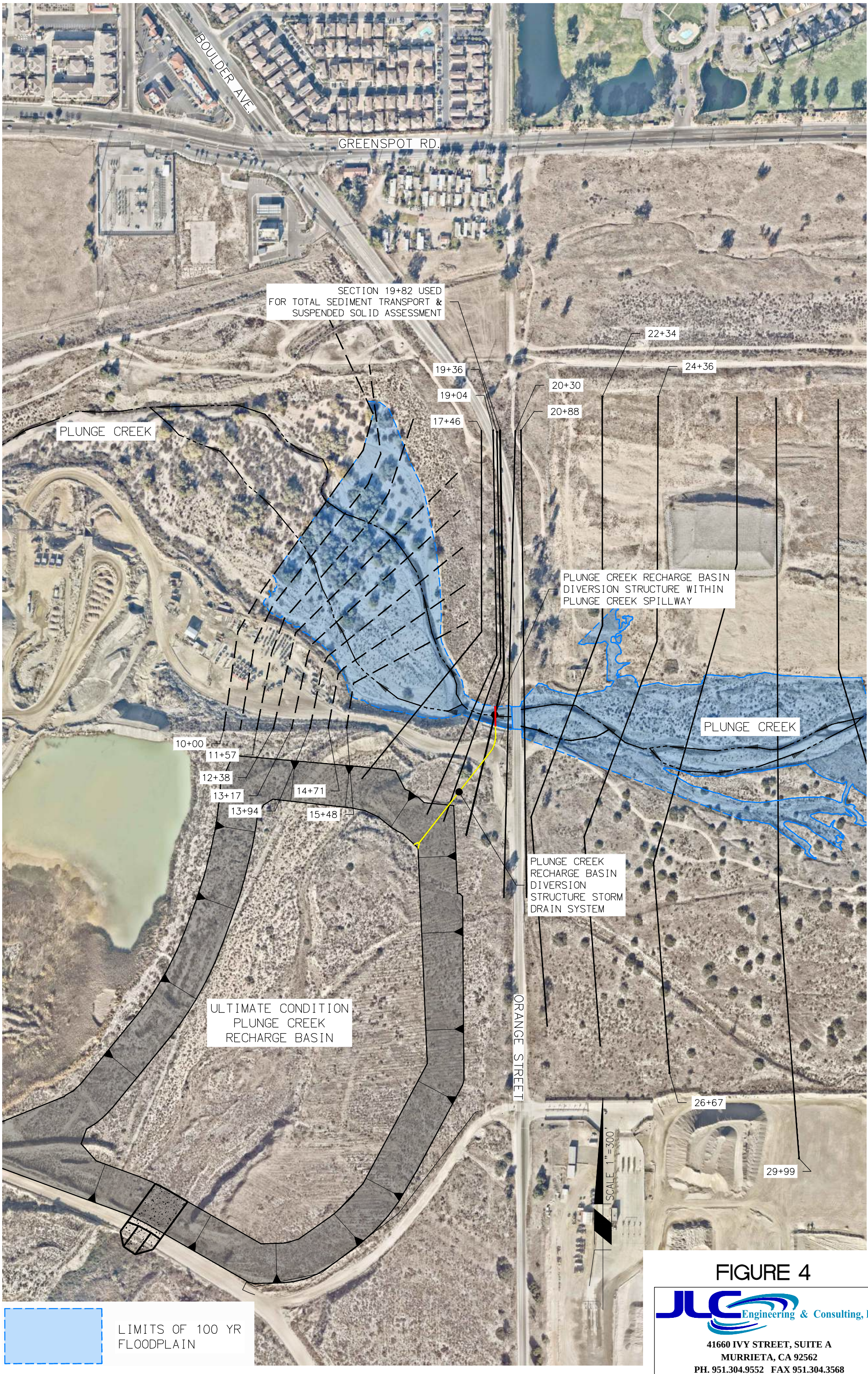


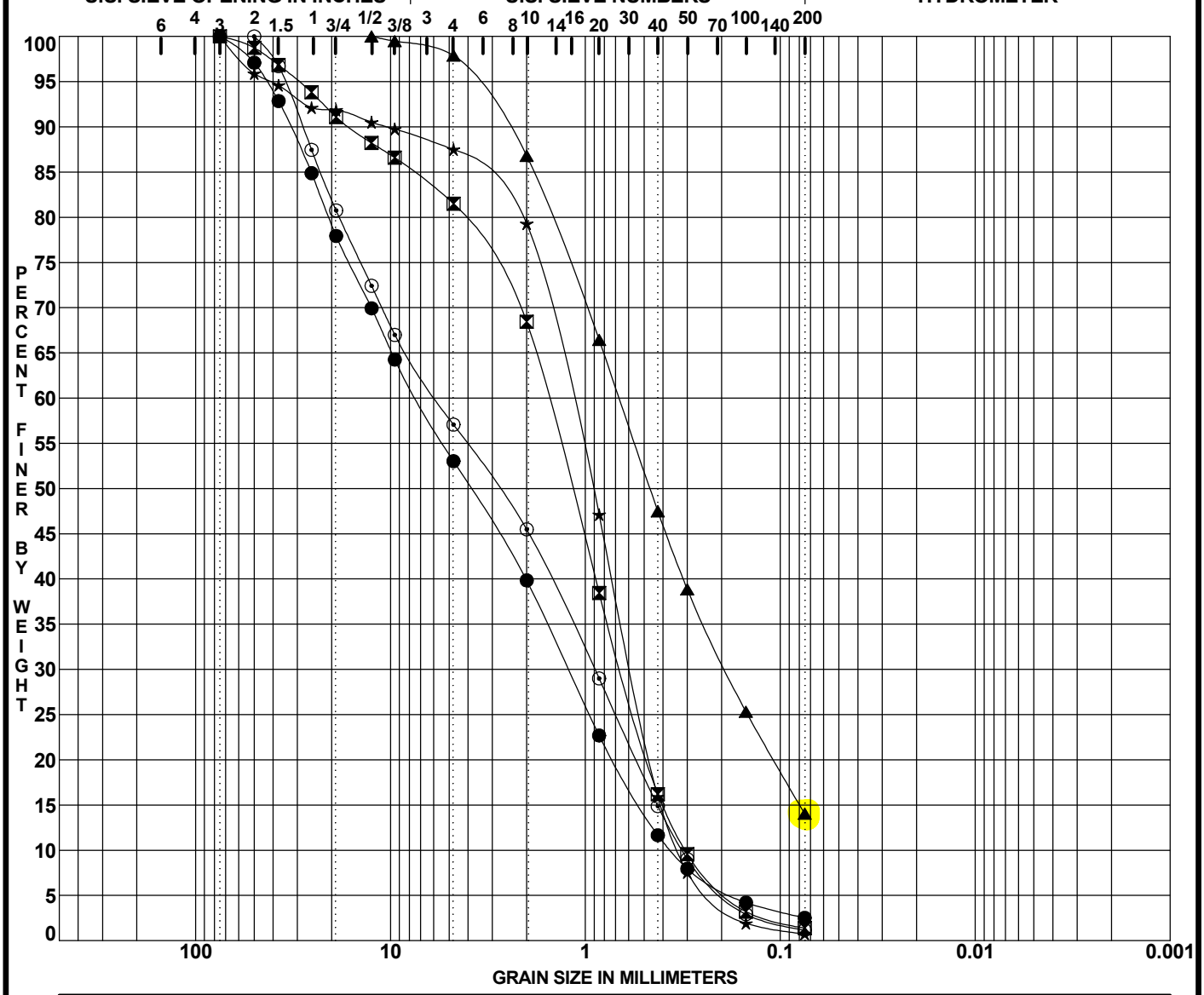
FIGURE 4

JLC Engineering & Consulting, Inc.
41660 IVY STREET, SUITE A
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

Drawing Name: O:\105.05.22\Engineering\Hydrology_Plan\Sediment Transport\Figures\Figure_4_DIVERSION STRUCTURE_FLOODPLAIN.dwg
Last Opened: Apr 24, 2025 – 6:20am by joe

GRADATION TEST FOR PLUNGE CREEK SOIL SAMPLES

JLC Engineering & Consulting, Inc.



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Soil Classification	SE	RV	PL	PI	Cc	Cu
●	S-01	@ 1-2'	(SP) Poorly Graded Sand w/ Gravel	--	--			0.56	20.1
⊠	S-02	@ 1-2'	(SP) Poorly Graded Sand w/ Gravel	--	--			0.88	5.1
▲	S-03	@ 1-2'	(SM) Silty Sand	--	--				
★	S-04	@ 1-2'	(SP) Poorly Graded Sand	--	--			0.85	3.6
⊙	S-05	@ 1-2'	(SP) Poorly Graded Sand w/ Gravel	--	--			0.43	18.3

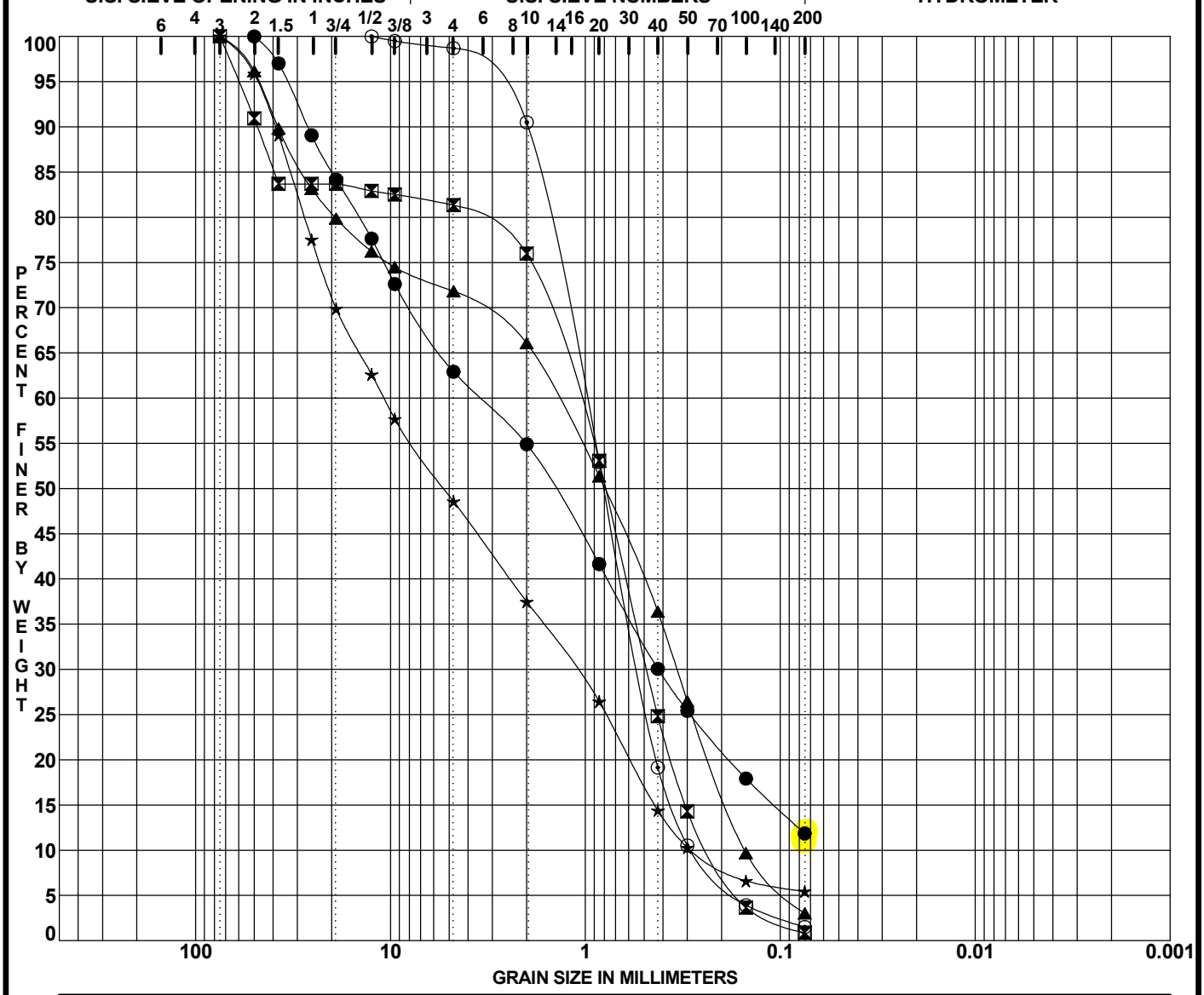
	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	S-01	@ 1-2'	75.00	7.30	1.224	0.3639	47.0	50.5	2.5	
⊠	S-02	@ 1-2'	75.00	1.57	0.653	0.3071	18.5	80.1	1.4	
▲	S-03	@ 1-2'	12.50	0.67	0.191		2.1	83.8	14.0	
★	S-04	@ 1-2'	75.00	1.20	0.581	0.3322	12.5	86.8	0.7	
⊙	S-05	@ 1-2'	50.00	5.83	0.895	0.3181	42.9	55.9	1.2	

PROJECT:	Proposed Diversion & Basin	**PROJECT NO.:**	63813A.4
CLIENT:	CASC Engineering & Consulting	**DATE:**	October 2023

GRADATION CURVES

LOR GEOTECHNICAL GROUP, INC.

ENCLOSURE: B-1



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Soil Classification	SE	RV	PL	PI	Cc	Cu
●	S-06	@ 1-2'	(SP) Poorly Graded Sand w/ Silt & Gravel	--	--			0.85	57.1
⊠	S-07	@ 1-2'	(SP) Poorly Graded Sand w/ Gravel	--	--			0.93	4.9
▲	S-08	@ 1-2'	(SP) Poorly Graded Sand w/ Gravel	--	--			0.54	9.2
★	S-09	@ 1-2'	(GP) Poorly Graded Gravel w/ Silt & Sand	--	--			0.41	38.0
⊙	S-10	@ 1-2'	(SP) Poorly Graded Sand	--	--			0.99	3.5

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	S-06	@ 1-2'	50.00	3.47	0.423		37.1	51.1	11.9	
⊠	S-07	@ 1-2'	75.00	1.10	0.483	0.2267	18.7	80.5	0.9	
▲	S-08	@ 1-2'	75.00	1.40	0.340	0.1520	28.2	68.8	3.0	
★	S-09	@ 1-2'	75.00	10.80	1.120	0.2844	51.4	43.1	5.5	
⊙	S-10	@ 1-2'	12.50	1.00	0.531	0.2840	1.3	97.2	1.5	

PROJECT:	Proposed Diversion & Basin	**PROJECT NO.:**	63813A.4
CLIENT:	CASC Engineering & Consulting	**DATE:**	October 2023

GRADATION CURVES

LOR GEOTECHNICAL GROUP, INC.

ENCLOSURE: B-2

GRADATION TEST FOR CEMEX SITE

JLC Engineering & Consulting, Inc.

Postal Service
Highland Grove Elementary School
Elementary School
Beattie Middle School
Stater Bros. Markets
Prolific Protection Private Security...
Aurantia Park
JJ's Bar & Grill
EAST HIGHLANDS
Greenspot Rd
EAST HIGHLAND VILLAGE
In-N-Out Burger
Greenspot Rd
7-Eleven
Greenspot Rd
Lowe's Home Improvement
Esporta Fitness
Boulder Ave
CEMEX Highland Redlands Aggregates...
Plunge Creek Basin
SITE
SITE
Robertson's
(see Enclosure A-3)
Cemex
SITE
Cemex
(see Enclosure A-4)
Martin A Mitchell Hwy
Foothill Fwy
Santa Ana River
Redlands Shooting Park
Red Park
Trinity Eateries Corporation
Google
Santa Ana River

FIGURE 5

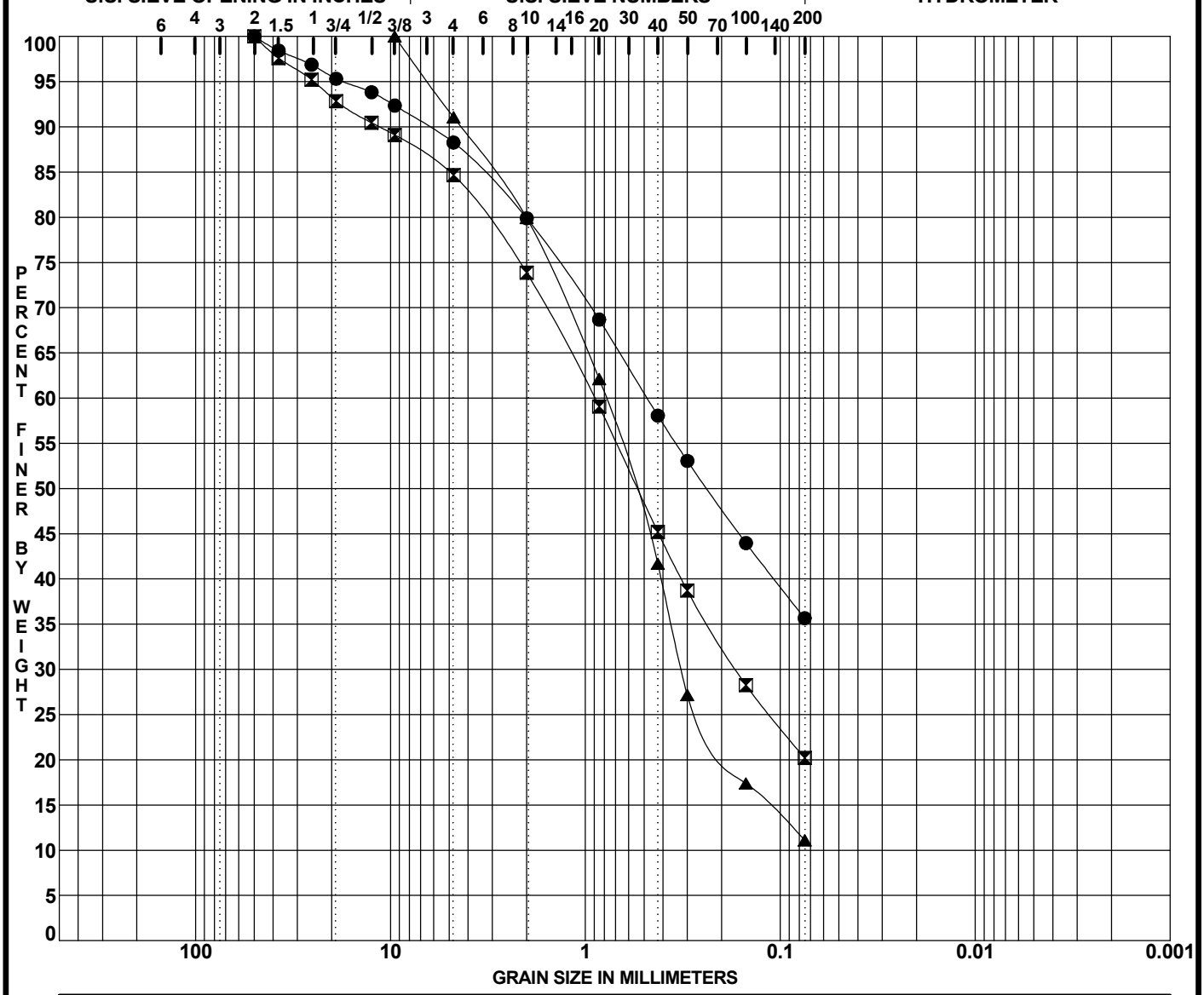
OVERALL SITE PLAN

PROJECT:	Plunge Creek Basin, Highland/Redlands, California
CLIENT:	CASC Engineering and Consulting
PROJECT NO.:	63813B.4
ENCLOSURE:	A-2
DATE:	April 2023
SCALE:	1" ≈ 1,020'

LOR GEOTECHNICAL GROUP, INC.

ROBERTSON'S SITE

PROJECT:	Plunge Creek Basin, Highland/Redlands, California	**PROJECT NO.:**	63813B.4
CLIENT:	CASC Engineering and Consulting	**ENCLOSURE:**	A-4
LOR GEOTECHNICAL GROUP, INC.		**DATE:**	April 2023
		SCALE:	1" ≈ 140'



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Soil Classification	SE	RV	PL	PI	Cc	Cu
● D-1 @ 0 - 0.33 ft	(SM) Silty Sand	--	--				
⊠ D-1 @ 0.33 - 1 ft	(SM) Silty Sand	--	--				
▲ T-1 -3/8" @ 3.5-4'	(SW) Well Graded Sand w/ Silt	--	--			1.96	11.9

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● D-1 @ 0 - 0.33 ft	50.00	0.48			11.7	52.6	35.7	
⊠ D-1 @ 0.33 - 1 ft	50.00	0.90	0.168		15.3	64.5	20.2	
▲ T-1 -3/8" @ 3.5-4'	9.50	0.79	0.321		8.9	80.0	11.1	

PROJECT:	Proposed Diversion & Basin	**PROJECT NO.:**	63813B.4
CLIENT:	CASC Engineering & Consulting	**DATE:**	May 2023

GRADATION CURVES

LOR GEOTECHNICAL GROUP, INC.

ENCLOSURE: D-1

ADDENDUM PCU-5: COST ESTIMATES:

PLUNGE CREEK BASINS
(FORMER SILT POND-ULTIMATE PROJECT AFTER MINING)
PNEUMATICALLY OPERATED GATE DIVERSION OPTION
FEASIBILITY STUDY WORKING COST ESTIMATE

March 25, 2025
Casc Engineering & Consulting, Project No. 1526-0001

No.	ITEM	QTY	UNIT	UNIT COST	ITEM COST	NOTES
1	MOBILIZATION	1	LS	$1,100,000	$1,100,000	ASSUMED 10% BID ITEM COST
2	CLEAR AND GRUB	60	AC	$1,000	$60,000	OK
3	REMOVE EXISTING CONCRETE CHANNEL AND WALLS	160	CY	$625	$100,000	UNIT COST FROM CONCRETE REMOVAL FOR RIALTO CHANNEL (RANDALL) AVERAGE - QUANTITY PER CAD
4	EXCAVATION		CY	$5	$0	UNIT COST PER SBVWCD DISCUSSION
5	BACKFILL (TYPICAL)	-	CY	$12	$0	UNIT COST PER SBVWCD DISCUSSION
6	BACKFILL (COMPACTED)	-	CY	$16	$0	UNIT COST PER SBVWCD DISCUSSION
7	EXPORT		CY	$15	$0	UNIT COST PER SBVWCD DISCUSSION
8	IMPORT FILL (TYPICAL)	320,750	CY	$21	$6,735,750	UNIT COST PER SBVWCD DISCUSSION - QUANTITY CALCULATED BY COMPARING SURFACES. EXISTING SURFACE ASSUMES MINED CONDITION EXCAVATED TO PROPOSED BASIN BOTTOM USING 1.5:1 SLOPES. PROPOSED SURFACE PROVIDED BY DISTRICT (2:1) SLOPES. DISTRICT PROJECT WOULD REGRADE BASIN TO 2:1 SLOPES WITH IMPORTED MATERIAL.
9	IMPORT FILL (COMPACTED)	-	CY	$25	$0	UNIT COST PER SBVWCD DISCUSSION
10	STRUCTURE EXCAVATION	240	CY	$55	$13,200	UNIT COST PER SBVWCD DISCUSSION - QUANTITY PER CAD
11	PNEUMATICALLY OPERATED GATE SYSTEM	1	EA	$950,000	$950,000	QUOTE FROM OBEMEYER (8'H x 192'W GATE)
12	RECT. CONCRETE CHANNEL & WALLS	160	CY	$1,050	$168,000	2024 RCFC&WCD PLANNING COST $1044.50/CY INCL. STEEL - QUANTITY PER CAD
13	CONCRETE OUTLET STRUCTURE	46	CY	$2,000	$92,000	HOUSES RUBICON GATE; USING 2024 RCFC&WCD PLANNING COST OF $2000/CY (transition structure or junction structure) INCL. STEEL - QUANTITY PER CAD
14	RUBICON GATE	1	EA	$73,000	$73,000	RUBICON FGB-6-4.5 QUOTED $36,500 DELIVERED AND INSPECTED. ASSUME DOUBLE FOR INSTALLED COST.
15	EQUILIZATION RCB	-	EA		$0	
16	OULET STRUCTURE	-	EA		$0	
17	INLET (DIVERSION) STRUCTURE	-	EA		$0	
18	TRASH RACK	-	CY		$0	
19	RETAINING WALLS	-	CY		$0	
20	FLOW METER (INCL STRUCTURE)	-	EA		$0	
21	SLIDE GATE (IN JUNCTION STRUCTURE)	-	EA		$0	
22	CONCRETE JUNCTION STRUCTURE	-	CY	$2,000	$0	
23	48" RCP	490	LF	$542	$265,580	USING 2024 RCFC&WCD PLANNING COST $542/LF - QUANTITY PER CAD
24	CONCRETE HEADWALL & WINGWALLS	32	CY	$2,000	$64,000	USING 2024 RCFC&WCD PLANNING COST OF $2000/CY - QUANTITY PER CAD
25	1/4 TON RIPRAP (NON-CONCRETED)	835	CY	$150	$125,250	2024 RCFC&WCD PLANNING COST $150/CY - QUANTITY PER CAD
26	CONCRETE SPILLWAY	1,130	CY	$650	$734,500	2024 RCFC&WCD PLANNING COST $650/CY (TRAP CHANNEL CONCRETE) - QUANTITY PER CAD
27	BALLAST ROCK	-	CY		$0	
28	6' CHAIN LINK FENCING	7,500	LF	$58	$435,000	2024 RCFC&WCD PLANNING COST $58/LF - QUANTITY PER CAD.
29	DOUBLE DRIVE GATE	4	EA	$10,000	$40,000	UNIT COST AND QUANTITY PROVIDED BY SBVWCD
30	EROSION CONTROL / SWPPP	1	LS	$150,000	$150,000	UNIT COST PROVIDED BY SBVWCD
31	UTILITIES	1	LS	$500,000	$500,000	UNIT COST PROVIDED BY SBVWCD
32	SCADA	1	LS	$500,000	$500,000	UNIT COST PROVIDED BY SBVWCD
	TOTAL BID ITEMS				$12,106,280	
	CONTINGENCY (30%)				$3,630,000	
	DESIGN and PERMITTING (20%)				$2,420,000	
	HABITAT MITIGATION MEASURES	1	LS	$3,000,000	$3,000,000	
	CONSTRUCTION ADMIN (15%)				$1,816,000	
	TOTAL PROJECT CONSTRUCTION COST				$22,972,000	

PLUNGE CREEK BASINS
(FORMER SILT POND-ULTIMATE PROJECT AFTER MINING)
GRATED DROP STRUCTURE DIVERSION OPTION
FEASIBILITY STUDY WORKING COST ESTIMATE

March 25, 2025
Casc Engineering & Consulting, Project No. 1526-0001

No.	ITEM	QTY	UNIT	UNIT COST	ITEM COST	NOTES
1	MOBILIZATION	1	LS	$1,030,000	$1,030,000	ASSUMED 10% BID ITEM COST
2	CLEAR AND GRUB	60	AC	$1,000	$60,000	
3	REMOVE EXISTING CONCRETE CHANNEL AND WALLS	64	CY	$625	$40,000	UNIT COST FROM CONCRETE REMOVAL FOR RIALTO CHANNEL (RANDALL) AVERAGE - QUANTITY PER CAD
4	EXCAVATION	-	CY	$5	$0	UNIT COST PER SBVWCD DISCUSSION
5	BACKFILL (TYPICAL)	-	CY	$12	$0	UNIT COST PER SBVWCD DISCUSSION
6	BACKFILL (COMPACTED)	-	CY	$16	$0	UNIT COST PER SBVWCD DISCUSSION
7	EXPORT		CY	$15	$0	UNIT COST PER SBVWCD DISCUSSION
8	IMPORT FILL (TYPICAL)	320,750	CY	$21	$6,735,750	UNIT COST PER SBVWCD DISCUSSION - QUANTITY CALCULATED BY COMPARING SURFACES. EXISTING SURFACE ASSUMES MINED CONDITION EXCAVATED TO PROPOSED BASIN BOTTOM USING 1.5:1 SLOPES. PROPOSED SURFACE PROVIDED BY DISTRICT (2:1) SLOPES. DISTRICT PROJECT WOULD REGRADE BASIN TO 2:1 SLOPES WITH IMPORTED MATERIAL.
9	IMPORT FILL (COMPACTED)	-	CY	$25	$0	UNIT COST PER SBVWCD DISCUSSION
10	STRUCTURE EXCAVATION	747	CY	$55	$41,085	UNIT COST PER SBVWCD DISCUSSION - QUANTITY PER CAD
11	GRATED DROP STRUCTURE	176	CY	$2,000	$352,000	USING 2024 RCFC&WCD PLANNING COST OF $2000/CY - QUANTITY PER CAD
12	RECT. CONCRETE CHANNEL & WALLS	10	CY	$1,050	$10,500	2024 RCFC&WCD PLANNING COST $1044.50/CY INCL. STEEL
13	CONCRETE OUTLET STRUCTURE	46	CY	$2,000	$92,000	HOUSES RUBICON GATE; USING 2024 RCFC&WCD PLANNING COST OF $2000/CY (transition structure or junction structure) INCL. STEEL - QUANTITY PER CAD
14	RUBICON GATE	1	EA	$120,000	$120,000	RUBICON FGB-6-7.2 QUOTED $60,000 DELIVERED AND INSPECTED. ASSUME DOUBLE FOR INSTALLED COST.
15	EQUILIZATION RCB	-	EA		$0	
16	OULET STRUCTURE	-	EA		$0	
17	INLET (DIVERSION) STRUCTURE	-	EA		$0	
18	TRASH RACK	-	CY		$0	
19	RETAINING WALLS	-	CY		$0	
20	FLOW METER (INCL STRUCTURE)	-	EA		$0	
21	JUNCTION STRUCTURE		EA		$0	
22	CATWALK	-	EA		$0	
23	48" RCP	490	LF	$542	$265,580	USING 2024 RCFC&WCD PLANNING COST $542/LF - QUANTITY PER CAD
24	CONCRETE HEADWALL & WINGWALLS	32	CY	$2,000	$64,000	USING 2024 RCFC&WCD PLANNING COST OF $2000/CY - QUANTITY PER CAD
25	1/4 TON RIPRAP (NON-CONCRETED)	835	CY	$150	$125,250	2024 RCFC&WCD PLANNING COST $150/CY - QUANTITY PER CAD
26	CONCRETE SPILLWAY	1,130	CY	$650	$734,500	2024 RCFC&WCD PLANNING COST $650/CY (TRAP CHANNEL CONCRETE) - QUANTITY PER CAD
27	JUNCTION STRUCTURE	-	EA		$0	
28	6' CHAIN LINK FENCING	7,500	LF	$58	$435,000	2024 RCFC&WCD PLANNING COST $58/LF - QUANTITY PER CAD.
29	DOUBLE DRIVE GATE	4	EA	$10,000	$40,000	UNIT COST AND QUANTITY PROVIDED BY SBVWCD
30	EROSION CONTROL / SWPPP	1	LS	$150,000	$150,000	UNIT COST PROVIDED BY SBVWCD
31	UTILITIES	1	LS	$500,000	$500,000	UNIT COST PROVIDED BY SBVWCD
32	SCADA	1	LS	$500,000	$500,000	UNIT COST PROVIDED BY SBVWCD
	TOTAL BID ITEMS				$11,295,665	
	CONTINGENCY (30%)				$3,390,000	
	DESIGN and PERMITTING (20%)				$2,260,000	
	HABITAT MITIGATION MEASURES	1	LS	$3,000,000	$3,000,000	
	CONSTRUCTION ADMIN (15%)				$1,694,000	
	TOTAL PROJECT CONSTRUCTION COST				$21,640,000	

ADDENDUM PCU-6: PERMITTING TECHNICAL MEMORANDUM

January 27, 2025

Michael J. Gentile, PE, QSD/P
Senior Engineer
Casc Engineering and Consulting
1470 E. Cooley Drive, Colton, CA 92324
mgentile@cascinc.com
909.809.0035 M

Re: Technical Memorandum: Plunge Creek Ultimate Condition Project CEQA Requirements

Dear Mr. Gentile,

This technical memorandum outlines the California Environmental Quality Act (CEQA) compliance requirements for the proposed Plunge Creek Ultimate Condition Project ("Project"). Per CEQA Guidelines, the environmental impacts of the Project must be evaluated to ensure that the potential effects on the environment are properly addressed. This technical memorandum provides an overview of the key components of CEQA compliance, including the necessary environmental review process and required documentation as follows:

- Project Site Overview
- CEQA Process Overview
- Key CEQA Considerations for Project
- Agency Permits Requiring CEQA Documentation
- Example of CEQA Schedule
- Potential Development & Environmental Impact Considerations

If you have any questions, feel free to contact me, I can be reached by phone at (909) 362-7645, or by email at fcoyle@cascinc.com.

Sincerely,

CASC ENGINEERING AND CONSULTING

Frank Coyle
Director of Planning
(909)362-7645
fcoyle@cascinc.com

EXECUTIVE SUMMARY

Based on our preliminary assessment of the existing site conditions, an Initial Study will be required for the Project, which is expected to result in a Mitigated Negative Declaration (IS/MND). This means that with the implementation of mitigation measures, potential impacts will be reduced to a level below significant. Potential impact areas include Air Quality, Biological Resources, Cultural Resources, Greenhouse Gas Emissions, Geology/Soils, Hydrology/Water Quality, Mineral Resources, and Tribal Cultural Resources. Furthermore, the Project may require permits from the Santa Ana Regional Water Quality Control Board (RWQCB), the California Department of Fish and Wildlife (CDFW), and the United States Army Corps of Engineers (ACOE). The CEQA process is expected to take approximately 28-32 weeks. Permits that require an approved CEQA document and Notice of Determination (NOD) are anticipated to be obtained within 6 to 12 months following CEQA approval.

This memo assumes impacts will be assessed based on existing conditions; however, if the Water Conservation District (WCD) installs the proposed basins on an already developed site, environmental impacts, technical study requirements, and permitting under CEQA could be significantly reduced.

PROJECT SITE OVERVIEW

The proposed Project site is currently undeveloped and is located west of Orange Street and north of Dishong Street with the Santa Ana River Wash. The Project site includes one (1) parcel (APN: 029-112-101) located in the City of Redlands and one (1) parcel (APN: 029-111-103) located in the City of Highland. Adjacent uses include CEMEX Highlands Redlands Aggregates Quarry to the east, an existing silt pond to the west and undeveloped land to the north and south. The proposed Project consists of the development of two (2) basins (Basin 1 and Basin 2), a diversion structure from Orange Street and associated spillways and culverts, refer to *Figure 1, Site Plan*. Basin 1 is approximately 28 acres with a storage capacity of 2,607 acre-feet (ac-ft), and Basin 2 is approximately 4 acres with a storage capacity of 112 ac-ft.

General Plan Land Use Designation

APN: 029-112-101: Open Space, City of Redlands

APN: 029-111-103: Open Space, City of Highland

Zoning Designation

APN: 029-112-101: Open Land District, City of Redlands

APN: 029-111-103: Open Space (OS), City of Highland

The proposed use of recharge basins is consistent with the existing land use designations of Open Space which permits water management areas such as groundwater recharge (City of Redlands) and water conservation facilities (City of Highland).

CEQA PROCESS OVERVIEW

Under California law, each public agency must adopt local implementation guidelines to establish objectives, criteria, and specific procedures for administering its responsibilities under the California Environmental Quality Act (CEQA). The CEQA process ensures that potential environmental impacts of a project are identified, analyzed, and mitigated when feasible. The following is a brief summary of the CEQA process:

1. Preliminary Review: The lead agency determines if the activity is a "project" under CEQA. If it is exempt, no further CEQA action is needed.
2. Initial Study (IS): If the project is not exempt, the agency conducts an Initial Study to assess potential environmental impacts.
3. Determination of Impact:
    - If no significant impacts are identified, a Negative Declaration (ND) or Mitigated Negative Declaration (MND) is prepared.
    - If significant impacts are identified, an Environmental Impact Report (EIR) is required.

4. Public Review and Comment:
    - The draft ND, MND, or EIR is circulated for public and agency review (typically 30 days (45 days for EIR)).
    - Comments from the public and agencies are collected and addressed.
5. Final Documentation:
    - For an EIR, a Final EIR is prepared, including responses to comments and any revisions to the draft.
    - The lead agency certifies the EIR or adopts the ND/MND.
6. Decision and Mitigation:
    - The lead agency decides whether to approve or deny the project.
    - If the MND is approved, a Mitigation Monitoring and Reporting Program (MMRP) is adopted to ensure mitigation measures are implemented.
7. Post-Approval Actions:
    - Notices of Determination (NOD) are filed, marking the end of the CEQA process and triggering legal timelines for challenges.
8. Statute of Limitations for Appeals:
    - Filling of court challenges to an approved CEQA document is permitted under CEQA Guidelines Section 15112, Statutes of Limitations. The statute of limitations for appealing an NOD is 30 days from the date the notice is filed and posted.

Based on a preliminary review of the Project it is anticipated that the Project will require an Initial Study that will culminate in a Mitigated Negative Declaration (IS/MND), thus reducing impacts to a less than significant impact with mitigation incorporated. Actual determination of the most appropriate environmental document will be determined at the time technical studies are completed.

Lead Agency under CEQA

CEQA Guidelines Section 15050 states, where a project is to be carried out or approved by more than one public agency, one public agency shall be responsible for preparing an EIR or Negative Declaration for the project. This agency shall be called the Lead Agency. The Project site is situated within the cities of Highland and Redlands and includes the Plunge Creek Facility, managed by the San Bernardino County Flood Control District (FCD). FCD has executed a Planning Memorandum of Understanding (MOU) with the San Bernardino Valley Water Conservation District (WCD) to perform feasibility studies of FCD facilities (MOU, January 26, 2021). CEQA Guidelines Section 15051 states where two or more public agencies will be involved with a project, the determination of which agency will be the Lead Agency shall be governed by the following criteria:

> (a) If the project will be carried out by a public agency, that agency shall be the Lead Agency even if the project would be located within the jurisdiction of another public agency.

It is anticipated that WCD would be the Lead Agency under CEQA as it would be the public agency carrying out the Project. Thus, WCD would be responsible for the CEQA process as listed above. CEQA Guidelines Section 15381 states that Responsible Agencies includes all public agencies other than the Lead Agency which have discretionary approval power over the project. The Lead Agency shall consult with all responsible agencies early in the CEQA process (CEQA Guidelines Section 21080.3). As the Project site is located within multiple jurisdictions, potential Responsible Agencies outside of the typical resource's agencies (CDFW, RWQCB, etc.) under CEQA include FCD, City of Redlands and City of Highland.

KEY CEQA CONSIDERATIONS FOR PROJECT

The following is an overview of key CEQA considerations of the proposed Project based on a preliminary review of the site and surrounding resources.

Assembly Bill 52 (Ab52) Tribal Consultation

Assembly Bill 52 (AB52) is a California law enacted in 2014 that amended CEQA to include specific protections for tribal cultural resources. The law enhances collaboration between California Native American tribes and lead agencies during the environmental review process for proposed projects. The following is a brief overview of the AB52 consultation process as it pertains to the proposed Project:

1. Tribal Notification: Within 14 days of determining that a project application is complete, the lead agency must notify California Native American tribes that have requested notification of projects in their area. This typically includes a letter emailed to the Tribal representative.
2. Tribal Request for Consultation: Tribes have 30 days from receiving the notice to request formal consultation with the lead agency.
3. Consultation Process:
    - If a tribe requests consultation, the lead agency must engage in good-faith discussions to identify and address potential impacts on tribal cultural resources.
    - Topics may include the identification of resources, project alternatives, mitigation measures, and project modifications to avoid or minimize impacts.
4. Mitigation and Agreements:
    - If tribal cultural resources are identified, the lead agency and tribe collaborate on feasible mitigation measures.
    - Agreements reached during consultation should be documented and included in the environmental document (IS/MND).
5. Documentation and CEQA Compliance:
    - The lead agency must incorporate findings and mitigation measures into the environmental analysis (Tribal Cultural Resources section of the IS/MND).
    - If consultation does not lead to agreement, the lead agency retains discretion but must explain how tribal concerns were addressed.

The results of the AB 52 consultation process will be incorporated into the Tribal Cultural Resources section of the Initial Study and any mitigation measures agreed upon by the Lead Agency and consulting tribe will be incorporated into the Mitigation, Monitoring and Reporting Program.

Technical Studies Required

To accurately analyze environmental impacts of the proposed Project in accordance with CEQA Guidelines Appendix G: Environmental Checklist form (Initial Study), technical studies will be required for the proposed Project. The following is a list of anticipated technical studies that will be required to complete the Initial Study. Standard timeframe for completing technical studies is included in *Table 1: Example of Typical CEQA Schedule.*

- Air Quality Impact Analysis
- Biological Resources Assessment
- Drainage Study
- Cultural Resources Assessment
- Focused Species Surveys (focused surveys for plants need to be performed during the blooming period for those species and focused surveys for Burrowing Owl will need to be performed during breeding season (Mar-Aug). Focused studies for plants and animals are typically valid for one year).
- Greenhouse Gas Assessment
- Paleontological Resources Assessment
- Riparian/Riverine Assessment
- Jurisdictional Delineation (water features)
- Phase I Environmental Site Assessment (A Phase II site assessment may be required dependent on any recognized environmental conditions (RECs) identified in the Phase I ESA).
- Noise Analysis Report
- Geotechnical Investigation Report
- Water Quality Management Plan (WQMP)

CEQA Guidelines Appendix G: Environmental Checklist Form

The CEQA Environmental Checklist Form is a tool used to evaluate the potential environmental impacts of a proposed project. It covers various environmental topics, such as air quality, biological resources, water quality, and cultural resources, to ensure a comprehensive assessment. Each topic includes specific questions to determine whether the project may have significant environmental effects. The checklist helps guide the preparation of an Initial Study and supports decision-making on whether a Negative Declaration, Mitigated Negative Declaration, or Environmental Impact Report (EIR) is required. The following is a brief analysis of the proposed Project's potential environmental impacts under CEQA.

AESTHETICS

The Project site does not contain any scenic resources, and the nearest State designated scenic highway is a portion of State Route 38 located approximately 20 miles northeast of the Project site. No impact is expected to occur.

AGRICULTURAL AND FORESTRY RESOURCES

According to the California Important Farmland Finder (FMMP) the Project site is identified as "Grazing Land" and "Other Land". The Project site does not contain any agriculture or forestry resources, and no impact is expected to occur.

AIR QUALITY

The Project's potential impacts on air quality will be assessed utilizing a project specific Air Quality Impact Analysis and the South Coast Air Quality Management District (SCAQMD) 2022 Air Quality Management Plan. Less than significant impacts to air quality are anticipated during the construction phase of the Project due to the use of construction equipment. No impacts to air quality are anticipated during the operation phase of the Project.

BIOLOGICAL RESOURCES

Potential impacts to biological resources are expected to be less than significant with the incorporation of mitigation measures. The site, currently undeveloped, is classified as "Riversidean Alluvial Fan Sage Scrub" and "Annual Grassland" vegetation in the City of Redlands General Plan. The Project site is located in the Santa Ana River Wash Habitat Conservation Plan however it is not located within the preserve assembly. A Biological Resources Assessment will be required to evaluate the potential presence of special-status plant and animal species onsite. Given the site's location within the Santa Ana River Wash, a Jurisdictional Delineation may also be required to assess potential impacts to water features regulated by the Santa Ana Regional Water Quality Control Board (RWQCB), California Department of Fish and Wildlife (CDFW), and U.S. Army Corps of Engineers (ACOE). Recommendations from these technical studies will be incorporated as mitigation measures into the Mitigation Monitoring and Reporting Program (MMRP) for the IS/MND.

CULTURAL RESOURCES

The Project site does not contain any cultural resources as indicated under the Redlands and Highland General Plans. However, due to the site being undeveloped, further evaluation of potential impacts on cultural and historical resources will be required utilizing a Project specific Cultural Resources Assessment in addition to the results of AB52 tribal consultation.

ENERGY

Construction of the Project would result in fuel consumption from construction tools and equipment, vendor and haul truck trips, and vehicle trips generated from construction workers traveling to and from the site. Construction activities and corresponding fuel energy consumption would be temporary and localized. The use of diesel fuel and heavy-duty equipment would not be a typical condition of the Project. There are no unusual Project characteristics that would cause construction equipment that would be less energy efficient compared with other similar construction sites in other parts of the State. Impacts are anticipated to be less than significant.

GEOLOGY/SOILS

The Project site is not located on or near a seismic fault and is not prone to landslides due to its relatively flat topography. However, the site lies within the Seven Oaks Dam inundation area and has been identified as having a high susceptibility to liquefaction as identified in the City of Redlands General Plan (southern portion of the site), and the City of Highland General Plan (northern portion of the site). The potential for significant geological or soil-related impacts, including soil suitability for basin construction, will be further evaluated through a Project-specific

Geotechnical Investigation. Impacts are expected to be less than significant with the implementation of recommendations from the Geotechnical Investigation.

GREENHOUSE GAS EMISSIONS

Less than significant impacts to greenhouse gas emissions are anticipated during the construction phase of the Project due to the use of construction equipment. No impacts to greenhouse gas emissions are anticipated during the operation phase of the Project. A Greenhouse Gas Assessment would further quantify emissions to substantiate CEQA analysis.

HYDROLOGY/WATER QUALITY

The Project site is located within a 100-year floodplain (Zones A, AE, AO). Potential impacts on hydrology and water quality under CEQA will be evaluated through a Project-specific Drainage Study and Water Quality Management Plan (WQMP). The analysis will examine whether the Project could lead to increased runoff, water quality degradation, or changes to drainage patterns. Compliance with stormwater management regulations, including the implementation of best management practices (BMPs), will also be assessed. Impacts are expected to be less than significant.

HAZARDS AND HAZRDOUS MATERIALS

Given the site is adjacent to existing mining operations there is the potential for recognized environmental conditions (RECs)at the site. Utilizing a Project specific Phase I ESA and the Department of Toxic Substance Control Cortese List, the Project will be evaluated for the presence of hazardous materials. This includes an assessment of any contamination, such as hazardous waste or underground storage tanks that could pose a risk to human health or the environment. Any recommendations in the Phase I ESA would be incorporated into the MMRP of the IS/MND.

Per the City of Highland, the site lies within the San Bernardino International Airport (SBIA) Influence Area and "Airport Compatible Zone E – Negligible Risk". The proposed stormwater basin is a permitted use in "Zone E". However, per FAA Advisory Circular 150/5200-33C (Feb. 21, 2020), the basin may pose a wildlife hazard as it is located within 10,000 feet of the SBIA. As determined by the Lead Agency and the City of Highland (Responsible Agency), the Project may require review by San Bernardino International Airport Authority (SBIAA) and FAA, including submission of FAA Form 7460-1 (Notice of Proposed Construction or Alteration). To reduce wildlife hazards, mitigation may include vegetative management, fencing/netting, and bird-deterrent basin design (e.g., steep slopes, rapid drainage, no standing water). These mitigation measures will be addressed during design and entitlement and if applicable, measures will be incorporated into the CEQA document prior to Project approval.

LAND USE/ PLANNING

The Project is consistent with the Open Space land use designations of the site under the Redlands and Highlands General Plan Land Use Maps. No impacts are anticipated.

MINERAL RESOURCES

The Project site is classified as MRZ-2, indicating the presence of significant PCC-grade aggregate resources based on geologic data. Additionally, the site is located within a sector identified by the State Mining and Geology Board (1987) as containing regionally significant PCC-grade aggregate resources. While the site contains mineral resources acknowledged by the State, it is not currently used for mineral extraction. Potential impacts are expected to be less than significant.

NOISE

The Project's potential to generate noise affecting surrounding land uses would primarily occur during the construction phase. A Noise Impact Analysis should be conducted to quantify construction-related noise and assess whether it exceeds jurisdictional thresholds.

POLULATION/HOUSING

The Project would not induce population growth, nor does it include housing. No impacts are anticipated.

PUBLIC SERVICES AND RECREATION

Though the Project is designated as Open Space, it does not contain any recreational facilities. Furthermore, the Project would not impact public services such as fire, police, schools or libraries as the Project does not include a use that would increase population at the site. No impacts are anticipated.

UTILITIES AND SERVICE SYSTEMS
The Project is the expansion of stormwater facilities to create recharge basins in the Santa Ana River Wash. The Project would not generate a demand for service systems and the expansion of storm water facilities is anticipated to result in less than significant impacts with mitigation incorporated as indicated in the MMRP for the Project.

TRANSPORTATION
Traffic generated by the Project would occur during the construction phase and during operations due to routine maintenance trips to the site. These trips are anticipated to be negligible, and the Project is anticipated to screen out of Vehicle Miles Travelled (VMT) analysis. Impacts are anticipated to be less than significant.

TRIBAL CULTURAL RESOURCES
The results of the AB52 consultation process would determine any impacts to Tribal Cultural Resources (TCR). Given the stie is not identified in a General Plan (Redlands and Highland) as having TCR's, impacts are anticipated to be less than significant with mitigation incorporated in the event of inadvertent discoveries.

WILDFIRE
The Project site is located in a Federal Responsibility Area (FRA) for fire protection and CalFire has identified the site as "Very High Threat" to "High Threat" for fire hazards. Access to the site must adhere to fire code standards to ensure emergency vehicles are able to access the site. As the site would not include the construction of structures nor would it induce population growth at the site, impacts are anticipated to be less than significant.

AGENCY PERMITS REQUIRING CEQA DOCUMENTATION

Once a Notice of Determination (NOD) is adopted under CEQA, other agencies whose approval is required for the project (Responsible Agencies) use the certified environmental document (e.g., EIR or IS/MND) prepared by the lead agency to fulfill their CEQA obligations. These agencies evaluate the document to ensure their jurisdictional concerns are addressed and rely on it when issuing permits or approvals, such as those related to water quality, wetlands, or endangered species. Coordination between the lead and responsible agencies helps streamline the process, ensuring compliance with CEQA and other applicable regulations.

A preliminary review of the site and surrounding resources indicates potential impacts to biological resources and jurisdictional water features. If confirmed by a Jurisdictional Delineation and Biological Resources Assessment, approvals from state and federal agencies will be necessary before grading permits can be issued. Below is a summary of the relevant agencies that would require an NOD/approved CEQA document, the permits likely required, and the estimated timeframe for obtaining them.

Santa Ana Regional Water Quality Control Board (RWQCB) – 401 Water Quality Certification
A 401 Water Quality Certification is required under the Clean Water Act for projects that may result in discharges into waters of the United States, including wetlands and other jurisdictional features. Issued by the Santa Ana Regional Water Quality Control Board (RWQCB), the certification ensures that the project complies with state water quality standards and does not adversely impact water resources. If it is determined that water features under the RWQCB will be impacted by the proposed Project, a 401 Water Quality Certification will be required from the RWQCB pursuant to Section 401 of the Clean Water Act.

The certification process typically involves submitting a detailed application, including a project description, maps, and an analysis of potential impacts on water quality. The RWQCB reviews the application to confirm compliance with state and federal water quality regulations. The process may also require mitigation measures to offset impacts. The timeframe for obtaining a 401 certification varies but generally ranges from 3 to 12 months, depending on project complexity and the completeness of the application. Coordination with other regulatory agencies, such as the U.S. Army Corps of Engineers, is often required. Once the CEQA document is approved it typically takes 3-6 months to receive 401 Certification.

United States Army Corps of Engineers (ACOE) – 404 Permit
A 404 Permit, issued by the U.S. Army Corps of Engineers (ACOE) under Section 404 of the Clean Water Act, is required for projects that involve the discharge of dredged or fill material into waters of the United States, including wetlands, rivers, and streams. This permit ensures that such activities minimize environmental impacts and comply

with federal environmental regulations. If it is determined that water features under the ACOE jurisdiction will be impacted by the proposed Project, a 401 Water Quality Certification will be required from the RWQCB pursuant to Section 401 of the Clean Water Act. The permit process includes submitting an application with project details, public review for Individual Permits, environmental evaluation, and mitigation for unavoidable impacts. Once the CEQA document is approved it can take from 6-12 months to receive a 404 Permit.

California Department of Fish and Wildlife (CDFW) – Streambed Alteration Agreement & Incidental Take Permit

A Streambed Alteration Agreement (SAA) is required under Section 1600 of the California Fish and Game Code for projects that may impact rivers, streams, or lakes, including their beds, banks, and associated riparian vegetation. The agreement, issued by the California Department of Fish and Wildlife (CDFW), ensures that potential impacts to fish and wildlife resources are mitigated. If it is determined in a Jurisdictional Delineation that impacts would occur to water and habitat resources under the jurisdiction of CDFW, then WCD must submit a Notification of Lake or Streambed Alteration, detailing project activities and potential environmental effects to CDFW. CDFW then evaluates the application, conducts site visits if necessary, and negotiates mitigation measures to avoid or minimize impacts. Processing time varies, but agreements are typically finalized within 60 to 120 days. The time it takes to obtain a SAA from CDFW after the CEQA document is approved typically ranges from 3 to 6 months. However, this timeline can vary depending on several factors, including the complexity of the project, the specifics of the stream or waterway being impacted, and the completeness of the application.

An Incidental Take Permit (ITP) from CDFW is required under the California Endangered Species Act (CESA) when a project is expected to result in the incidental take (harm or death) of a state-listed endangered, threatened, or candidate species during the course of development or land use activities. A Biological Resources Assessment would determine the potential for special-status species on the Project site. The time it takes to receive an ITP can vary significantly depending on several factors, including the complexity of the project and the species involved. Estimated timeframes can be from 6 to 12 months plus. After CEQA approval, it generally takes about 3 to 6 months to receive an Incidental Take Permit (ITP) from CDFW, assuming that the application is complete and no significant revisions or additional information are needed.

EXAMPLE CEQA SCHEDULE

The following schedule outlines a typical timeline for completing the various stages of the CEQA process, including preparing technical studies, the Initial Study, public review periods, preparation of environmental documents (such as a Draft EIR or Negative Declaration), and final approval. This helps all stakeholders understand the expected sequence of events and deadlines.

Table 1: Example of Typical CEQA Schedule

TASK	DESCRIPTION	START DATE	END DATE
1.	PROJECT INITIATION	Week 1	Week 1
2.	PROJECT DESCRIPTION	Week 1	Week 2
3.	PREPARE TECHNICAL STUDIES	Week 2	Week 8
4.	GIS Exhibits For IS/ND or MND, MMRP	Week 2	Week 4
5.	PREPARE IS/ND or MND, MMRP	-	-
5A.	Prepare 1st Screencheck IS/ND or MND, MMRP *(Agency Review: Week 10-13)*	Week 3	Week 10
5B.	Prepare 2nd Screencheck IS/ND or MND, MMRP *(Agency Review: Weeks 17-18)*	Week 14	Week 16
6.	PREPARE PROOF CHECK DRAFT IS/ND or MND, MMRP	Week 19	Week 20
7.	CIRCULATION OF DRAFT IS/ND OR MND, MMRP *(30-Day Review Period)*	Week 21	Week 25
8.	PREPARE RESPONSES TO COMMENTS *(County Review: Week 26)*	Week 25	Week 26
9.	PUBLIC HEARING (typically occurs two – four weeks after the completion of the 30-day review period)	Week 28	Week 32

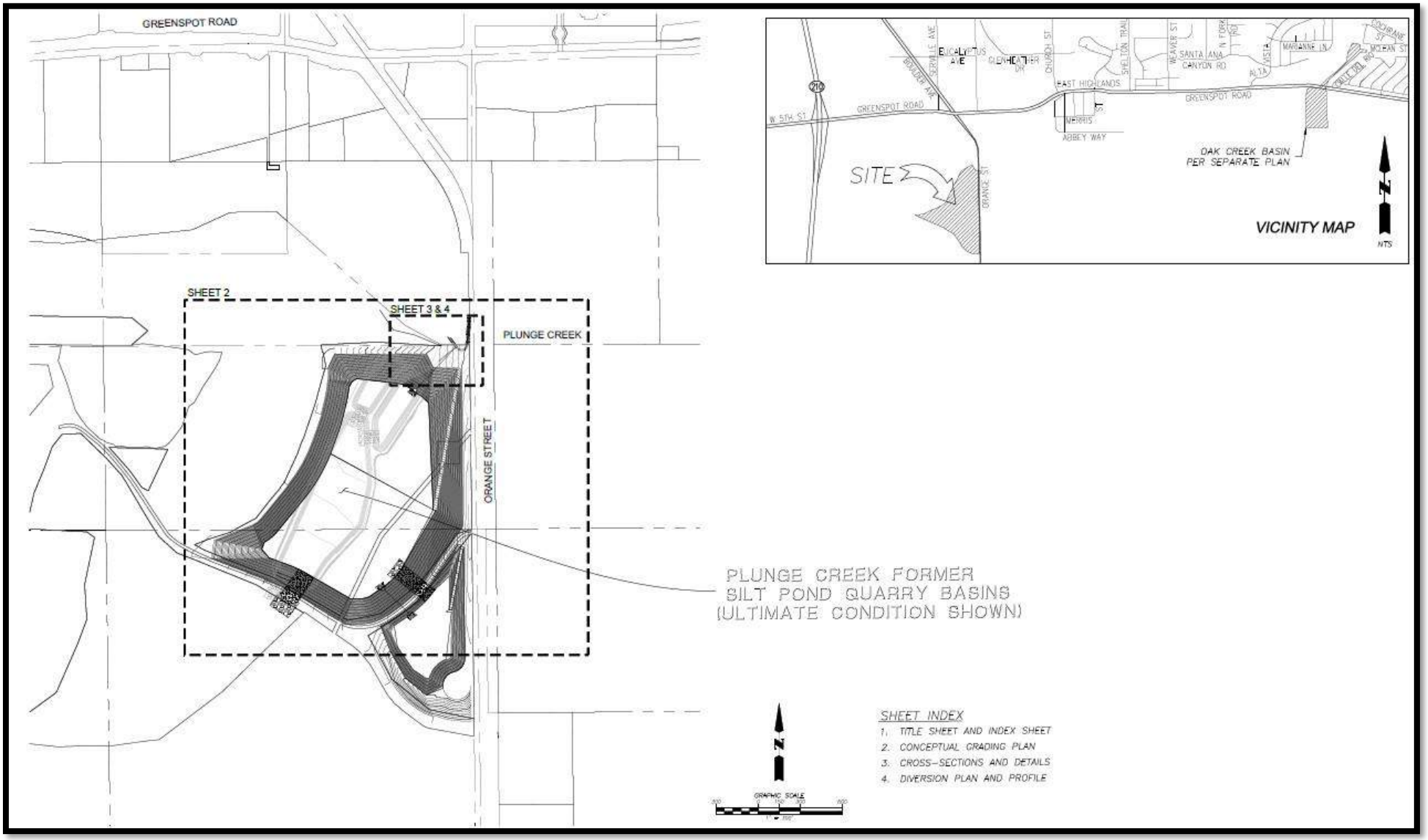
POTENTIAL DEVELOPMENT & ENVIRONMENTAL IMPACT CONSIDERATIONS

The Project site is currently vacant and undeveloped. This memo assumes the Project would proceed based on the existing site conditions. According to discussions with staff, there is a possibility that the site could first be developed into an excavation mine, after which the Water Conservation District (WCD) would take over and develop the proposed recharge basins. Any onsite development that requires discretionary approvals would be considered a "Project" under CEQA and would need to follow the CEQA process outlined in this memo. If WCD were to implement the proposed recharge basins after the site has been developed and disturbed, the environmental impacts would likely be less significant. As a result, fewer permits and technical studies may be required, as the site would already be disturbed and impacted.

REFERENCES

1. 2024 CEQA Statute and Guidelines 2024 CEQA Statutes and Guidelines
2. California State Scenic Highways Viewer California State Scenic Highway System Map
3. California Department of Conservation California Important Farmland Finder DLRP Important Farmland Finder
4. City of Highland General Plan-General Plan | Highland, CA
    a. Land Use Element
    b. Conservation and Open Space Element
5. City of Redlands General Plan- General Plan 2035 - City of Redlands
    a. Chapter 4- Livable Community
    b. Chapter 6- Vital Environment
6. San Bernardino County Countywide Plan- Policy Plan – San Bernardino County
7. San Bernardino Valley Water Conservation District, The Upper Santa Ana River Habitat Conservation Plan- 2024_Wash_Plan_Annual_Report_11.01.2024.pdf
8. San Bernardino Valley Municipal Water District Divisions-San Bernardino Valley Municipal Water District Divisions | San Bernardino County
9. San Bernardino Land Use Services-Planning_Project_Review_Flowchart_VERTICAL.pdf
10. California State Water Boards, San Bernardino County MS4 Permit- Stormwater | Santa Ana Regional Water Quality Control Board
11. Public San Bernardino County Parcel Viewer

Figure 1: Site Plan



Appendix D

Field Photos of Oak Creek Basins Site Location Existing Conditions

San Bernardino Valley Water Conservation District
Program for Expansion of Recharge Capacity (PERC) Comprehensive Feasibility Study

Volume 3
Detailed Feasibility Analysis of PERC Project Alternatives for Plunge Creek Watershed

Date & Time: Wed, Jan 17, 2024 at 13:42:32 PST
Position: +034.113187° / -117.140114° (±15.5ft)
Altitude: 1532ft (±26.2ft)
Datum: WGS-84
Azimuth/Bearing: 092° S88E 1636mils True (±12°)
Elevation Grade: -010%
Horizon Grade: +003%
Zoom: 0.5X
Oak Creek looking east north east at new sub development and edge of basin

Date & Time: Wed, Jan 17, 2024 at 13:43:07 PST
Position: +034.113146° / -117.140090° (±15.6ft)
Altitude: 1536ft (±11.0ft)
Datum: WGS-84
Azimuth/Bearing: 083° N83E 1476mils True (±12°)
Elevation Grade: -041%
Horizon Grade: -002%
Zoom: 0.5X
Oak Creek looking east north east at new sub development

Date & Time: Wed, Jan 17, 2024 at 13:44:08 PST
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Altitude: 1544ft (±11.4ft)
Datum: WGS-84
Azimuth/Bearing: 037° N37E 0658mils True (±12°)
Elevation Grade: 040%
Horizon Grade: -013%
Zoom: 0.5X
Oak Creek looking east north east at new sub development at PLD

Date & Time: Wed, Jan 17, 2024 at 13:45:48 PST
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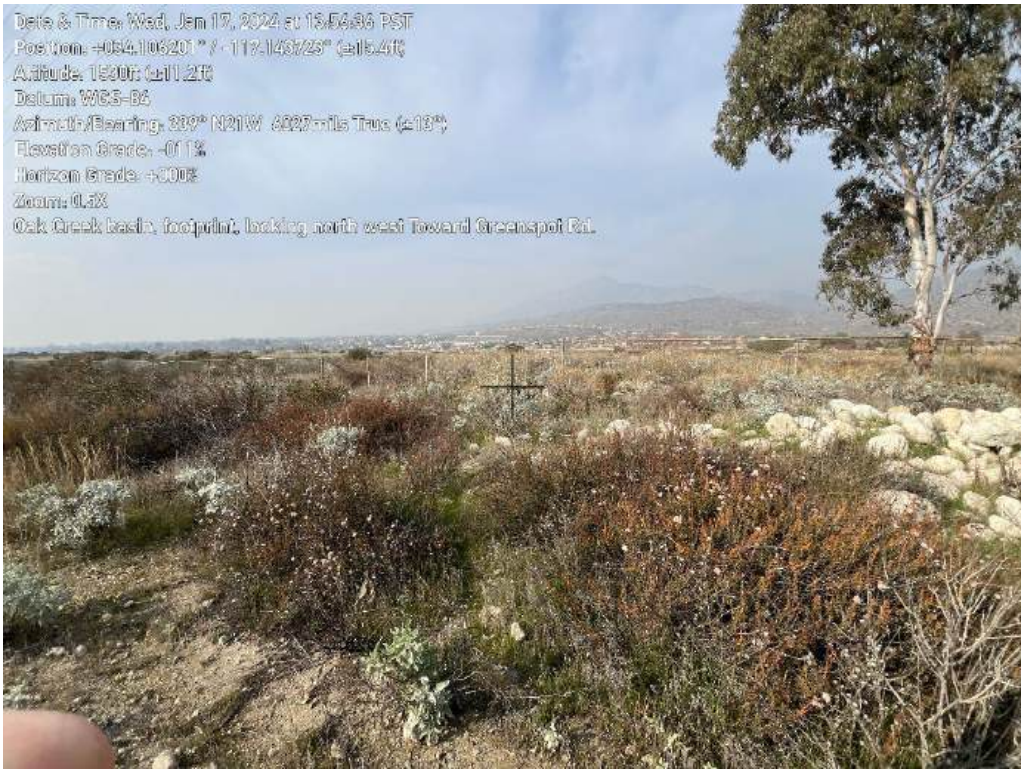
Altitude: 1529ft (±11.2ft)
Datum: WGS-84
Azimuth/Bearing: 288° N72W 5120mils True (±12°)
Elevation Grade: +001%
Horizon Grade: +001%
Zoom: 0.4X
Oak Creek at.. Plunge Creek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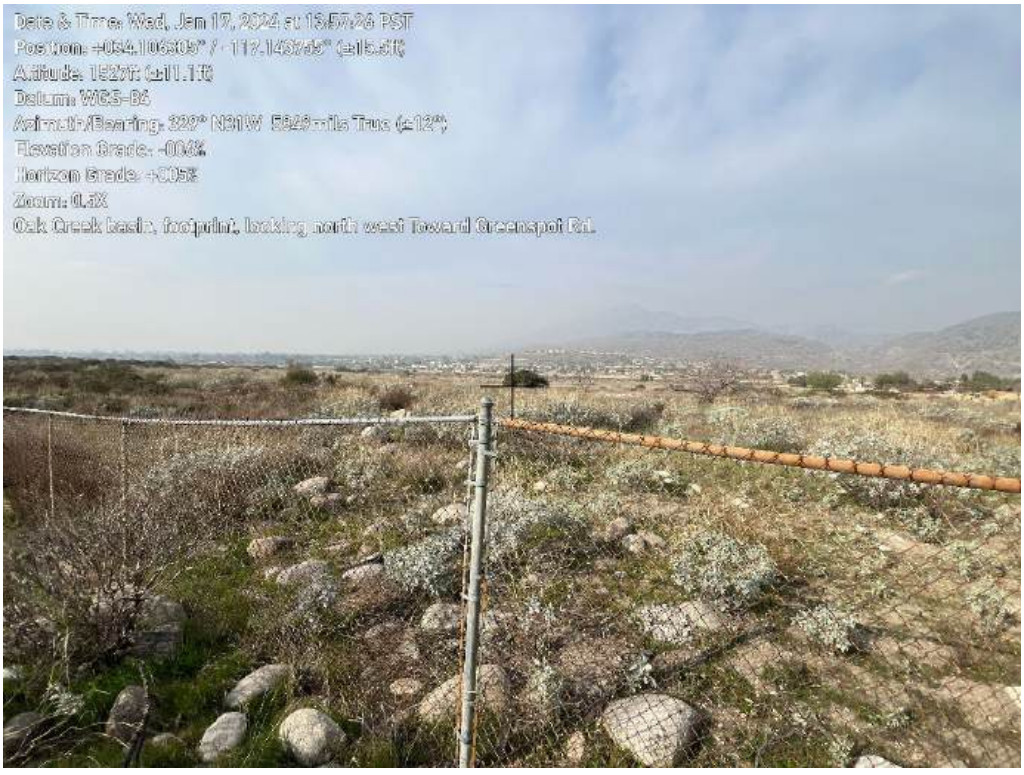
Position: +034.106201 ° / -117.143725° (±15.4ft)
Altitude: 1530ft (±11.2ft)
Datum: WGS-84
Azimuth/Bearing: 329° NW 6827 mils True (±13°)
Elevation Grade: -01%
Horizon Grade: +00%
Zoom: 0.5X
Oak Creek basin, footprint, looking north west Toward Greenspot Rd.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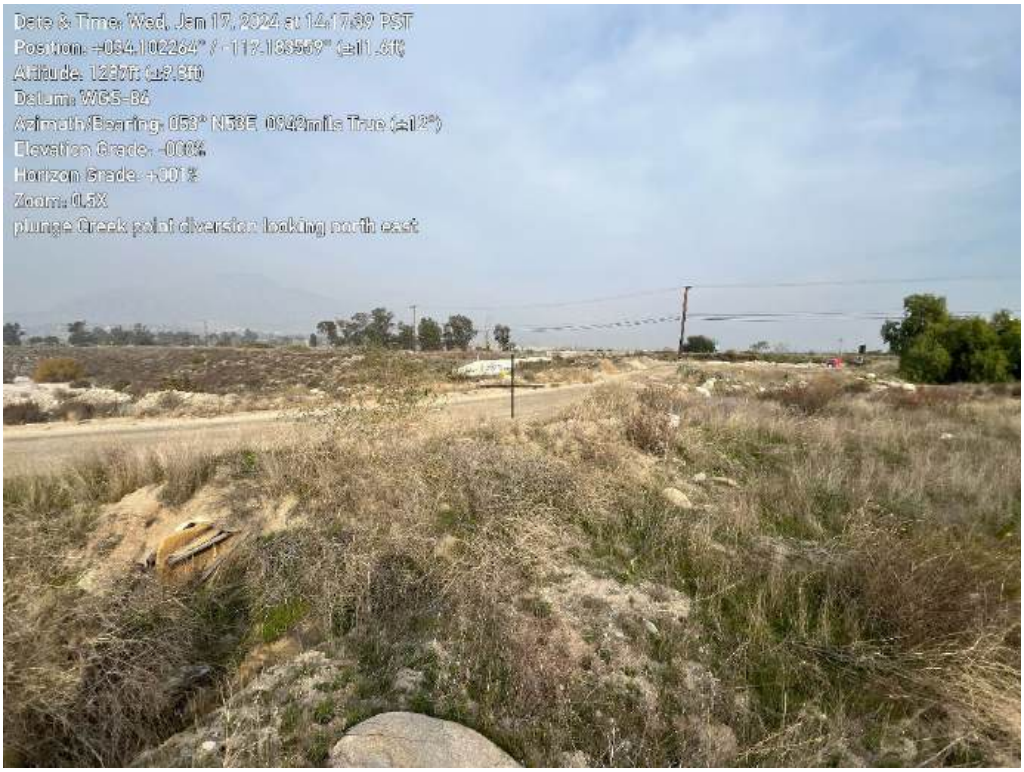
Altitude: 1527ft (±11.1ft)
Datum: WGS-84
Azimuth/Bearing: 329° NW 5828 mils True (±12°)
Elevation Grade: -004%
Horizon Grade: +005%
Zoom: 0.5X
Oak Creek basin, footprint, looking north west Toward Greenspot Rd.

Appendix E

Field Photos of Plunge Creek Basins Site Location Existing Conditions

San Bernardino Valley Water Conservation District
Program for Expansion of Recharge Capacity (PERC) Comprehensive Feasibility Study

Volume 3
Detailed Feasibility Analysis of PERC Project Alternatives for Plunge Creek Watershed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Datum: WGS-84
Azimuth/Bearing: 053° N53E 0048mils True (±1°)
Elevation Grade: -003%
Horizon Grade: +001%
Zoom: 0.5X
plunge Creek point diversion looking north east

Date & Time: Wed, Jan 17, 2024 at 14:16:01 PST
Position: +034.102261° / -117.183543° (±13.0ft)
Altitude: 1274ft (±11.8ft)
Datum: WGS-84
Azimuth/Bearing: 284° S54W 4168mils True (±1°)
Elevation Grade: -017%
Horizon Grade: -002%
Zoom: 0.5X
prospective pl...nge Creek basin. Concrete reel berm would be in the center area.

Appendix F

Plunge Creek Recharge Basins Site Survey

San Bernardino Valley Water Conservation District
Program for Expansion of Recharge Capacity (PERC) Comprehensive Feasibility Study

Volume 3
Detailed Feasibility Analysis of PERC Project Alternatives for Plunge Creek Watershed

CASC
Engineering and Consulting

HORIZONTAL CONTROL PROVIDED BY CASC ENGINEERING & CONSULTING TO INLAND AERIAL SURVEYS, INC. FOR TOPO COMPILED FROM DATA COLLECTED ON FLIGHT DATED MARCH 23, 2022

BASIS OF BEARINGS:

CALIFORNIA STATE PLANE COORDINATE SYSTEM, ZONE 5 TAKEN BETWEEN NATIONAL GEODETIC SURVEY CONTROL CORS REFERENCE STATION DESIGNATION "POTREROCRKCS2004 CORS ARP" PID "DG9740" AND “ESRI GISA CORS ARP” PID “DN5820”.

BEING N52°01'09"W NAD 83 EPOCH 2010.00

BENCHMARK: NATIONAL GEODETIC SURVEY DESIGNATION “IVF 32”

A 3” BRASS DISK STAMPED “METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA IVF 32 1993” WITH PUNCHMARK IN THE TOP OF CURB AT THE WESTERLY NOSE OF A PLANTER CURB AT THE NORTHWEST CORNER OF THE CEMEX PLANT ENTRANCE AT 8731 ORANGE ST.

ELEVATION 1291.90’ NAVD 88 5/1994

Aerial Control Points

Point No.	Northing	Easting	Elevation	Description
1001	1861059.663	6809154.06	1287.192	HV-1 SET MAG/TIN
1002	1861361.199	6810742.054	1311.812	HV-2 SET 1X2/TACK
1003	1862026.088	6812886.25	1340.083	HV-3 SET MAG/TIN
1004	1862598.258	6815352.243	1391.621	HV-4 SET 60D SPK/FTHR
1005	1863029.086	6817200.919	1427.575	HV-5 SET 1X2/TACK
1006	1863563.909	6819229.46	1475.935	HV-6 SET MAG/TIN
1007	1861996.143	6819780.042	1492.911	HV-7 SET 60D SPK/FTHR
1008	1861291.347	6817707.28	1428.963	HV-8 SET 1X2/TACK
1009	1860752.759	6815589.374	1385.725	HV-9 SET 1X2/TACK
1010	1860494.714	6813202.898	1343.722	HV-10 SET 1X2/TACK
1011	1859603.765	6811303.546	1320.596	HV-11 SET 1X2/TACK
1012	1858954.772	6809178.98	1287.965	HV-12 SET MAG/TIN

THIS TOPOGRAPHIC MAP COMPILED BY PHOTOGRAMMETRIC METHODS.

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IAS PROJECT NUMBER: 22-12678

PLOTTED CONTOUR INTERVAL: 1'

PD PROJECT NAME:
Plunge Creek Highland

MAP AND DIGITAL DATA PREPARED FOR:
CASC Engineering

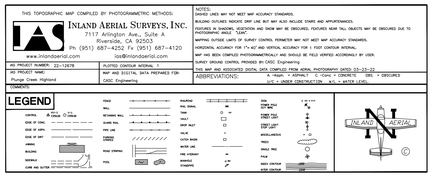
COMMENTS:

NOTES:
SHOWN LINES MAY NOT MEET MAP ACCURACY STANDARDS.
BUILDING OUTLINES INDICATE DRIP LINE BUT MAY ALSO INCLUDE STAIRS AND APPURTENANCES.
FEATURES IN SHADOWS, VEGETATION AND SNOW MAY BE OBSCURED, FEATURES NEAR TALL OBJECTS MAY BE OBSCURED DUE TO PERSPECTIVE OF AERIAL IMAGERY.
MAPPING OUTSIDE LIMITS OF SURVEY CONTROL PERIMETER MAY NOT MEET MAP ACCURACY STANDARDS.
HORIZONTAL ACCURACY FOR 1"=40' AND VERTICAL ACCURACY FOR 1 FOOT CONTOUR INTERVAL.
MAP HAS BEEN COMPILED PHOTOGRAMMETRICALLY AND SHOULD BE FIELD VERIFIED ACCORDINGLY BY USER.
SURVEY GROUND CONTROL PROVIDED BY CASC Engineering

SURVEY MAP AND ASSOCIATED DIGITAL DATA COMPILED FROM AERIAL PHOTOGRAPHY DATED: 03-23-22

ABBREVIATIONS: AC = ASPHALT - CONCRETE - C. CURB - CONCRETE CURB - D = DEGREES
G.C. = GRADE CONSTRUCTION - W.L. = WATER LEVEL

LEGEND



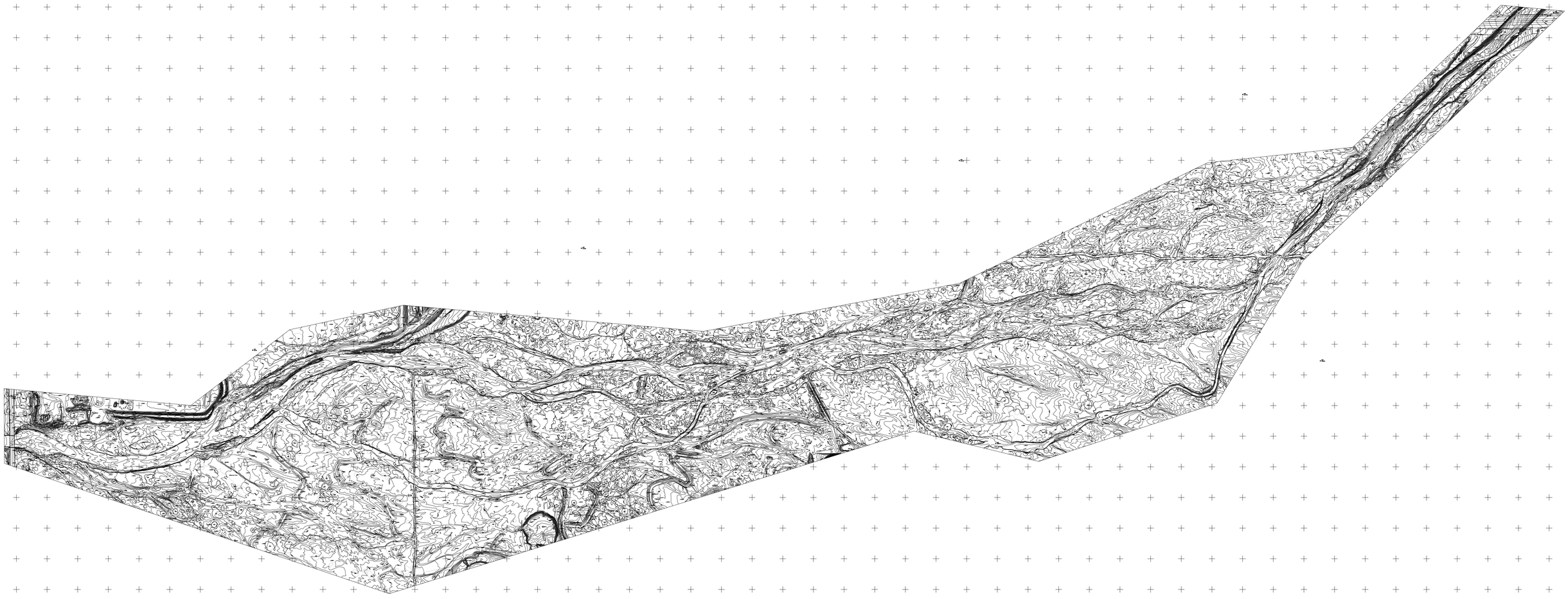
Photogrammetric mapping prepared under the supervision of:

03-23-22

Derek C. Hood, P.L.S. 6799 Date
Inland Aerial Surveys, Inc.

GRAPHIC SCALE

300 150 0 300 600 900



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