

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

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Plunge Creek Recharge Basins

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**DRAFT** July 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
<b>Volume 2</b> 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
<b>Volume 3</b> Plunge Creek Watershed	Oak Creek Recharge Basins (OCRB)	OCRB Construction Alternative
	Plunge Creek Recharge Basins (PCRB)	PCRB Interim Construction Alternative
		PCRB Ultimate Construction Alternative
<b>Volume 4</b> Mill Creek	Mill Creek Recharge Basins (MCRB)	MC Grading Alternative 1
		MC Grading Alternative 2
		MC Grading Alternative 3

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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 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



*Plunge Creek*

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
<b>Total Score</b>	<b>4.55</b>
<b>Rank (of 10)</b>	<b>1</b>

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**).

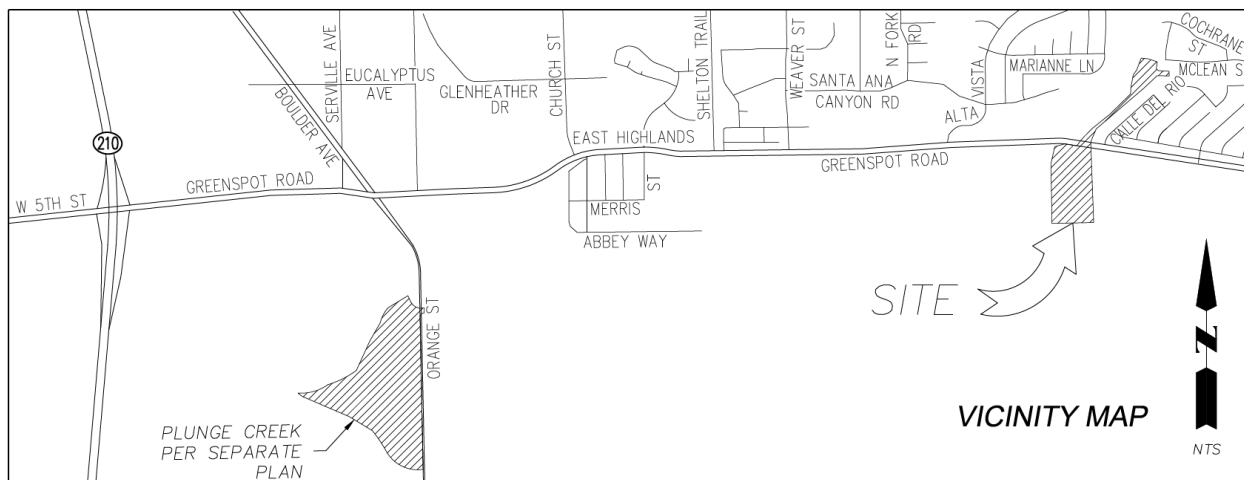


Figure 1. OCRB Construction Alternative Site

### 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**.



## 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.

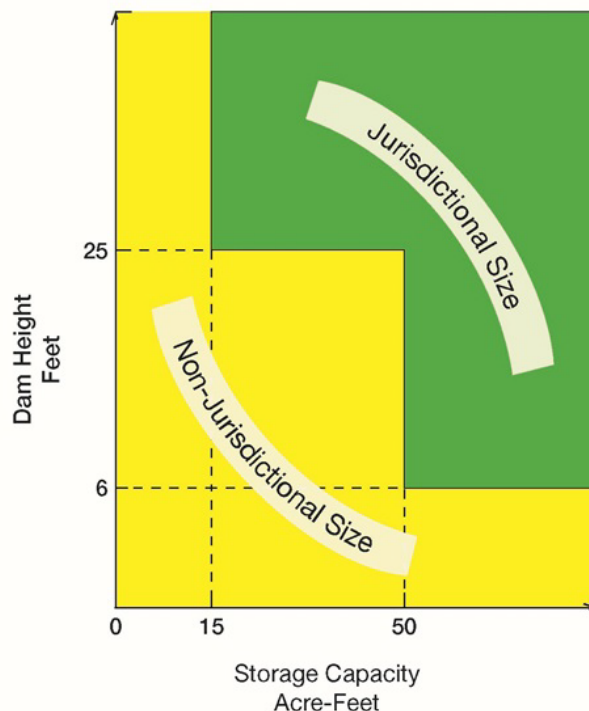


Figure 3. DSOD Jurisdictional Size Chart

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 [Appendix D](#).

## 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.

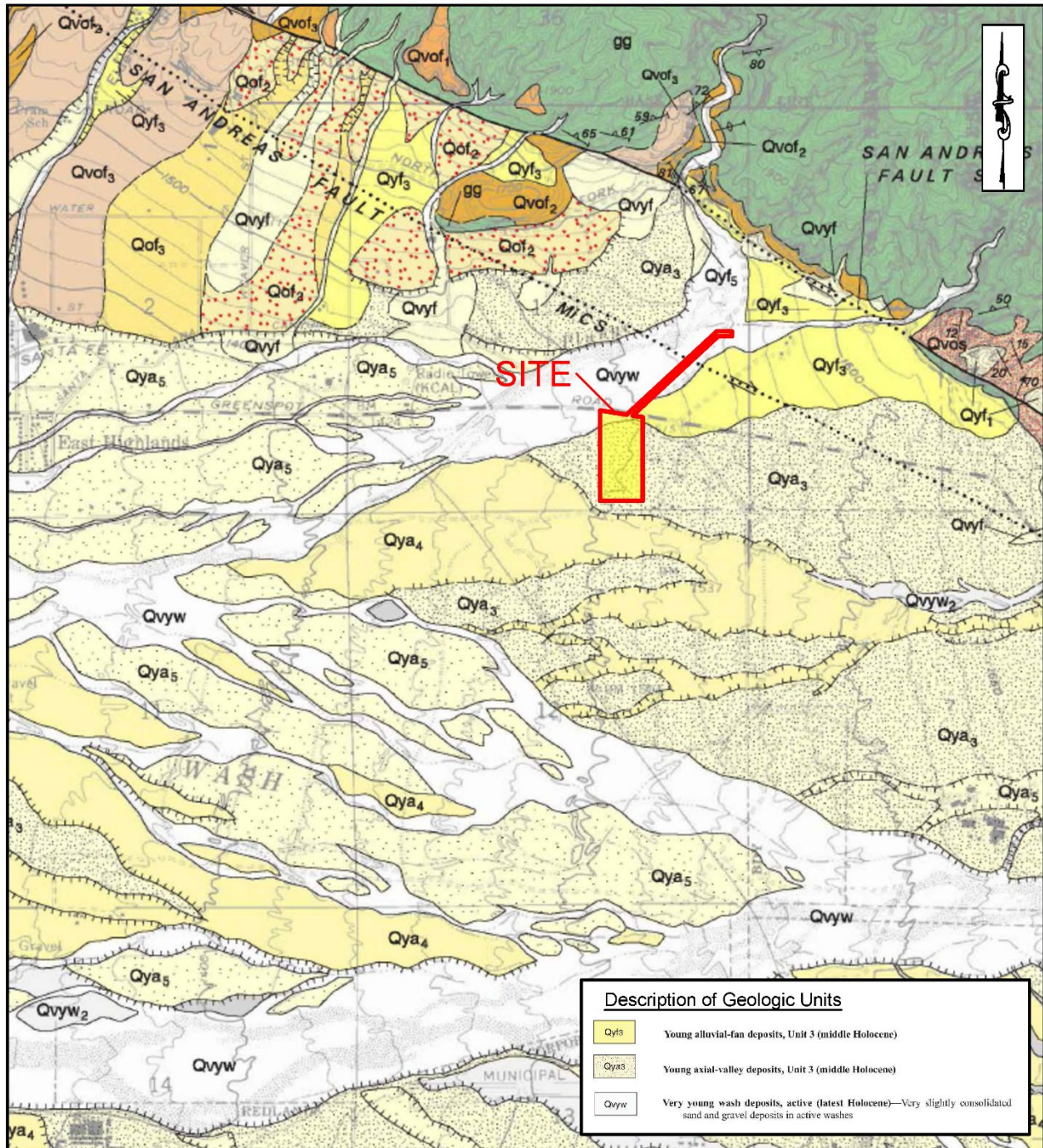
The sedimentary deposits beneath the Oak Creek Basins had routinely been subjected to flushing flows, but alluvial fan deposits grew around the northwestern edge and along their eastern boundary. These deposits would be expected to be relatively coarse-grained overall given their proximity to the canyon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



**REGIONAL GEOLOGIC MAP**

(Matti et al., 2003)

<b>PROJECT:</b>	Oak Creek Basin, Highland, California	<b>PROJECT NO.:</b>	63813A.4
<b>CLIENT:</b>	San Bernardino Valley Water Conservation District	<b>ENCLOSURE:</b>	A-4
<b>LOR</b> GEOTECHNICAL GROUP, INC.		<b>DATE:</b>	March 2023
		<b>SCALE:</b>	1" ≈ 2,000'

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.

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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. **Table A in 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

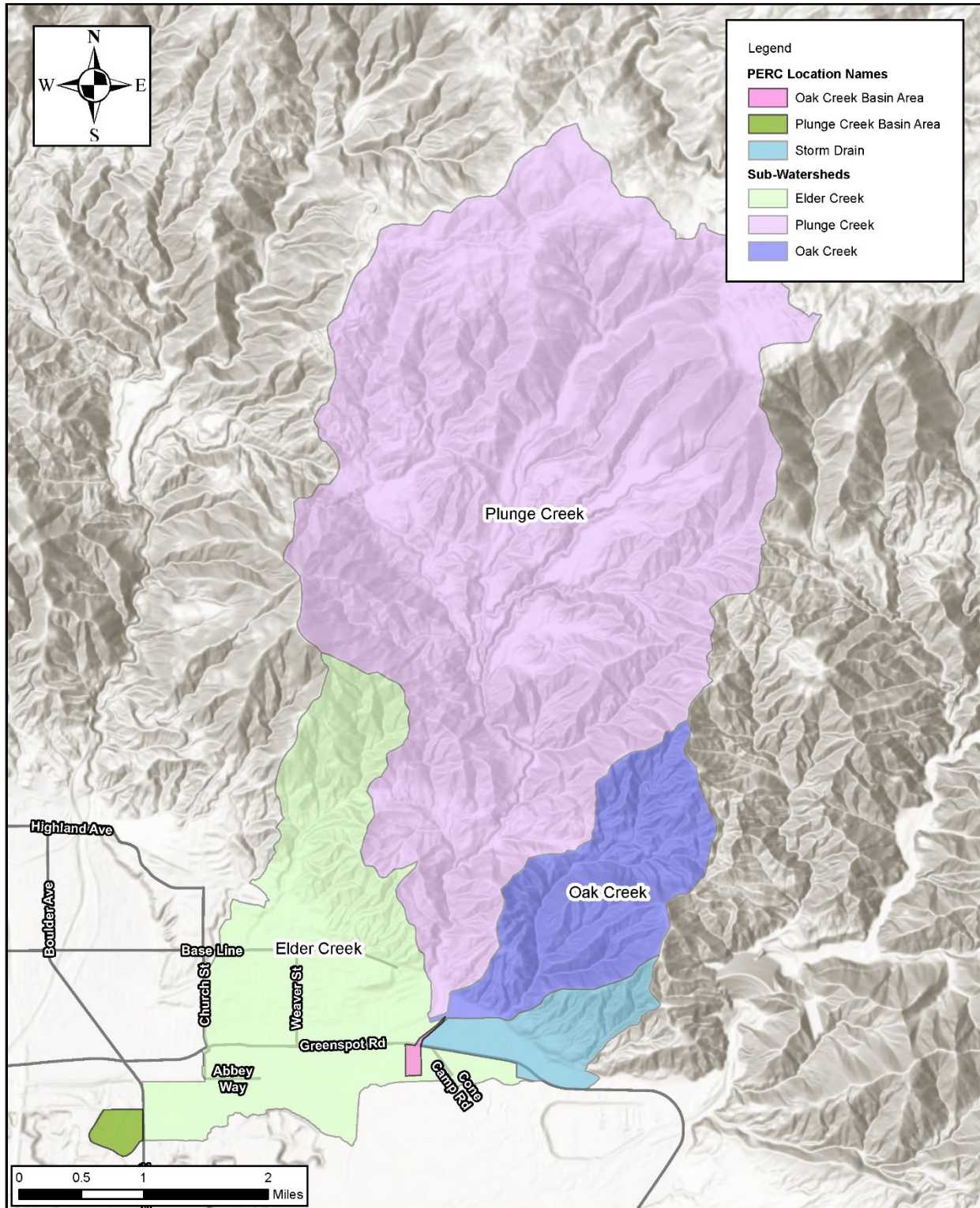


Figure 6. Watershed Areas above proposed PERC Project Sites at Oak Creek and Plunge Creek

Applying a Log Pearson Type 3 distribution to the adjusted set of storm flow events determined 50<sup>th</sup>, 80<sup>th</sup>, and 90<sup>th</sup> 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 **~1,514 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%. Using this discount factor, 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 5<sup>th</sup> 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 <u>Initial Study</u> that will culminate in a <u>Mitigated Negative Declaration</u> (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.
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 SBCFCB, 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
<b>Cost Aspects</b>	Capital Costs	Capital Costs NPV	\$18,446,000
		Grant Sources	25%
	O&M	O&M in 2025 \$	\$83,077
<b>Other Technical Aspects</b>	Groundwater Quality Improvements ( <i>Salt &amp; Nutrient Management Planning</i> )	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 ( <i>Liquefaction Issue</i> )	No
<b>Social Aspects</b>	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
<b>Legal Aspects</b>	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
<b>Total</b>	<b>4.55</b>
<b>Priority Rank (of 10)</b>	<b>1<sup>st</sup></b>

# 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.

#### 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
<b>Total Score</b>	<b>4.37</b>
<b>Rank (of 10)</b>	<b>2<sup>nd</sup></b>

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

## 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 **xx-year** 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.

### 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
<b>Total Score</b>	<b>4.19</b>
<b>Rank (of 10)</b>	<b>4<sup>th</sup></b>

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

## 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**.

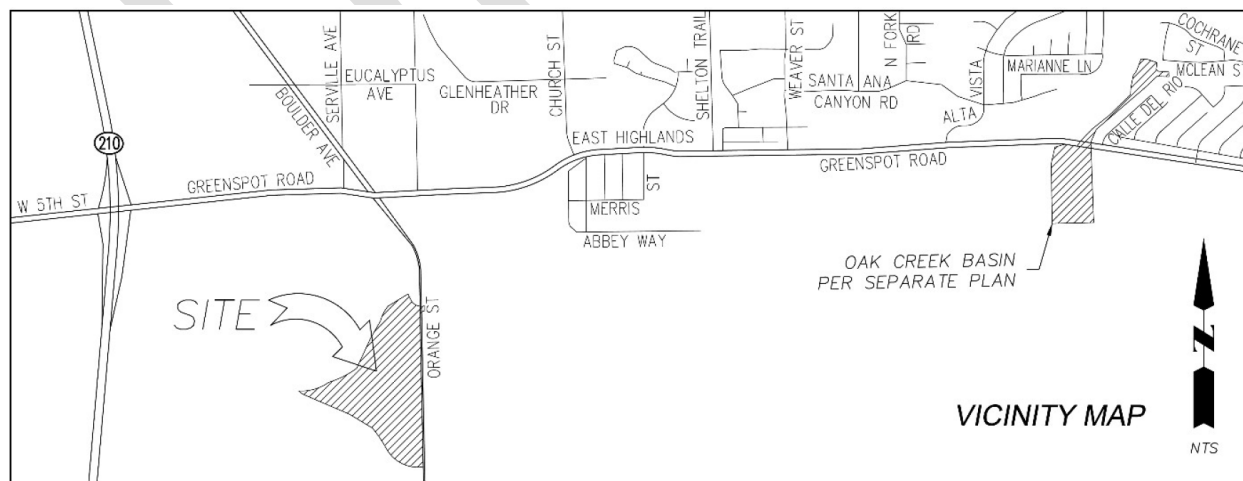


Figure 7. Proposed Plunge Creek Recharge Basin Site

### 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 PCR 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).

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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 50<sup>th</sup>, 80<sup>th</sup>, and 90<sup>th</sup> 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

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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

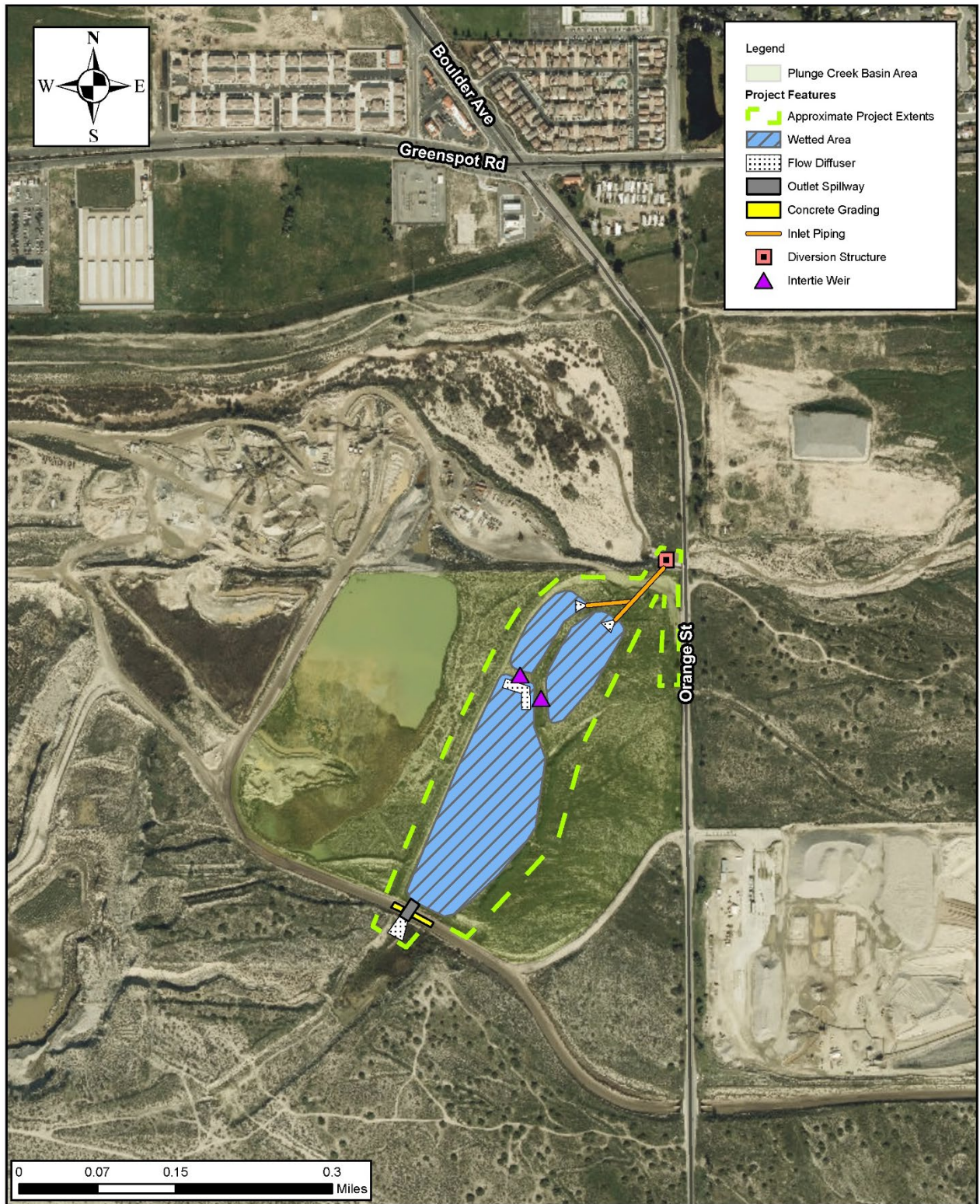


Figure 9. PCRB Interim Construction Alternative Overview

#### 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

(writeup of project operations in progress)

#### 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 50<sup>th</sup> 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).

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 5<sup>th</sup> 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 /18 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).

Potential Permit	Preliminary Review Determination
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
		Net Increase in Infiltration Rate Capacity (cfs)	23.50

Account	Subaccounts	Indicators	PCRB Interim Construction Alternative Values
	Infiltration-rate-capacity increase (cfs)	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
<b>Cost Aspects</b>	Capital Costs	Capital Costs NPV	\$16,393,000
		Grant Sources	25%
	O&M	O&M in 2025 \$	\$67,437
<b>Other Technical Aspects</b>	Groundwater Quality Improvements ( <i>Salt &amp; Nutrient Management Planning</i> )	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 ( <i>Liquefaction Issue</i> )	Yes
<b>Social Aspects</b>	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

Account	Subaccounts	Indicators	PCRB Interim Construction Alternative Values
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 2<sup>nd</sup> 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

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

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## 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

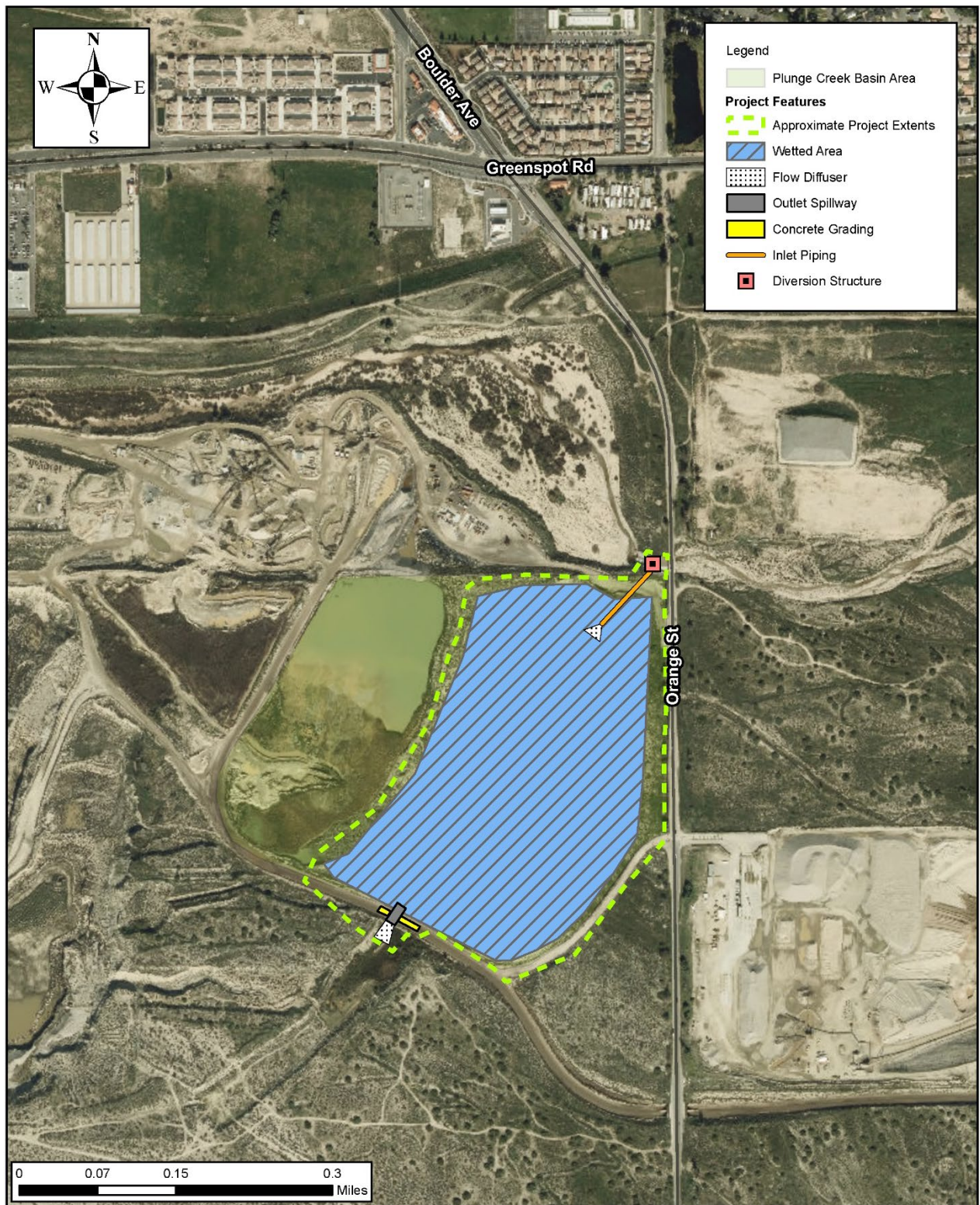


Figure 10. PCRB Ultimate Construction Alternative Overview

### 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

TOM: Where do we find this information? There is a sediment transport analysis – which I guess speaks to maintenance?

### 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. **Table A in 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 50<sup>th</sup> 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).

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 day-to-day operations for PCRB Ultimate Construction Alternative would be **XXX**.

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.

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Costs for basin maintenance are projected to be at around a **XX**-year interval 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*

<b>PCRB Interim Construction Alternative Cost Aspects Summary</b>	
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 5<sup>th</sup> 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 PCRB 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 /18 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).

Potential Permit	Preliminary Review Determination
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 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
<b>Groundwater Recharge Benefits</b>	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
	Recharge benefit on a “firm yield” 50-year horizon (AF)	AF	49,351
<b>Cost Aspects</b>	Capital Costs	Capital Costs NPV	\$8,170,000
		Grant Sources	25%
	O&M	O&M in 2025 \$	\$120,319
<b>Other Technical Aspects</b>	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
<b>Social Aspects</b>	Project Job Creation	Number of Jobs Forecast for Construction	30

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Account	Subaccounts	Indicators	PCRB Ultimate Construction Alternative Values
		Number of Jobs Forecast from Operational Needs	0.28
	Public Safety Hazards of Project	Ponded Water Depth (ft)	80
<b>Legal Aspects</b>	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
		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 **4<sup>th</sup> 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*

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

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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

# 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

# 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

# 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

*(Insert photos)*

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# 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

*(Insert photos)*

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# 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