FINAL REPORT

CONJUNCTIVE USE AND ENHANCED AQUIFER RECHARGE (Component 3)

Proposition 50

State Water Resources Control Board

Integrated Regional Water Management Implementation Grant

Northern Santa Cruz County Integrated Regional Water Management Plan

Agreement No. 07-507-550-2

February 2013

Prepared by:

Santa Cruz County Environmental Health Services

Submitted to:

Regional Water Management Foundation
State Water Resources Control Board

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Grantee: Regional Water Management Foundation

Agreement Period: July 1, 2007 – May 1, 2013

Component Project No.: 3

Component Title: Conjunctive Use Feasibility

Subgrantee/Component Lead: Santa Cruz County Environmental Health Services

Component Grant Award: $227,500

Matching Funds Total: $835,856 (120% of committed amount)

Watershed: Lower San Lorenzo River

Project Type: Planning, Research, Monitoring and Assessment; Water Conservation, Reliability Enhancement and Recycling

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GRANT SUMMARY

Completed Grant Summaries are made available to the public on the State Water Resources Control Board's (SWRCB) website at http://www.waterboards.ca.gov/funding/grantinfo.html

Date filled out: 6/17/2008; updated 11/9/2012

Grant Information: Please use complete phrases/sentences. Fields will expand as you type.

1. **Grant Agreement Number:** 07-507-550-0; as amended 07-507-550-2

2. **Project Title:** Northern Santa Cruz County Integrated Regional Water – Conjunctive Use and Enhanced Aquifer Recharge (Component 3)

3. **Project Purpose – Problem Being Addressed:** The Santa Margarita Groundwater Basin (SMGB) is situated in the lower San Lorenzo River watershed in northern Santa Cruz County, CA. The increasing use of groundwater from the early 1980's though the early 2000's and the loss of natural aquifer recharge caused by development during this time period has resulted in precipitous decline in groundwater levels in the local aquifers. Groundwater levels in some parts of the Scotts Valley area have declined as much as 200-feet over the past 25-years. A groundwater basin model completed in 2006 suggests that lost aquifer storage in the basin may exceed 12,000 AF between 1985 and 2007.

4. **Project Goals**

   a. **Short-term Goals:**

   The Conjunctive Use Project is intended to address the following issues:

   - Evaluate the hydrogeological conditions in the southern SMGB to identify areas with available aquifer storage and conditions suitable for groundwater recharge.
   - Determine the maximum average annual surface water rights availability and to whom and when they are available within the study area.
   - Determine the maximum surface water that can be feasibly diverted on an average annual basis to support a conjunctive use project in the study area and at what times of the year the water is available, based on flow, water quality, other water rights, and instream flow needs. Assess differences in water availability during wet years and dry years.
   - Identify existing infrastructure, such as historic sand quarries, that can be used to support a conjunctive use project(s). Screen a large number of potential water sources and aquifer recharge methods to identify three preferred alternatives.
   - Develop conceptual-level engineering analyses, order-of-magnitude cost estimates, and conceptual implementation plans for each of the three alternatives

   b. **Long-term Goals**:

   1. Improve the reliability of drinking water supplies in the Scotts Valley area
   2. Improve the fishery conditions in the San Lorenzo River and its tributaries with the focus on improving summertime baseflows primarily in the tributary streams that are critical for fish rearing.

5. **Project Location**: (lat/longs, watershed, etc.) Lower San Lorenzo River Watershed / Santa Margarita Groundwater Basin	
a. **Physical Size of Project**: (miles, acres, sq. ft., etc.) 30 square miles (Santa Margarita Goundwater Basin	
b. **Counties Included in the Project:** Santa Cruz	
c. **Legislative Districts:** (Assembly and Senate) Assembly 27 and Senate 15	
6. **Which SWRCB program is funding this grant?** Please "X" box that applies. ☐ Prop 13 ☐ Prop 40 ☒ Prop 50 ☐ EPA 319(h) ☐ Other	
Grant Contact: Refers to Grant Project Director. **Name:** 1. Christina Cuevas	**Job Title:** 1. Grant Project Director
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Grant Time Frame: Refers to the implementation period of the grant. **From:** 7/1/2007	**To:** 3/31/2013
Project Partner Information: Name all agencies/groups involved with project. Regional Water Management Foundation, Santa Cruz County, Scotts Valley Water District	
Nutrient and Sediment Load Reduction Projection: (If applicable) N/A	

Please provide a hard copy to your Grant Manager and an electronic copy to your Program Analyst for SWRCB website posting. All applicable fields are mandatory. Incomplete forms will be returned.

TABLE OF CONTENTS

1.0 Executive Summary 1

2.0 Problem Statement & Relevant Issues 2

3.0 Project Goals 4

4.0 Project Description 5

4.1 Task 1: Hydrogeologic/Conjunctive Use Evaluation 6

4.2 Task 2: Surface Water Availability Assessment 7

4.3 Task 3: Engineered Facilities Evaluation 7

4.4 Task 4: Regional Water Demand Projection 8

4.5 Task 5: Feasibility Analysis of Potential Conjunctive Use Projects 8

4.5.1 Water Source Screening 9

4.5.2 Water (Recharge) Application Screening 10

4.5.3 Groundwater Modeling Overview 11

4.5.4 Recharge Application Screening Results 12

4.5.5 Potential Project Screening 13

4.5.6 Conjunctive Use Alternatives Ranking 14

4.5.7 Conjunctive Use Alternatives 16

5.0 Public Outreach 24

6.0 Conclusions ..... Error! Bookmark not defined.

6.1 Project Assessment and Evaluation 24

6.2 Next Steps 28

7.0 APPENDICES 30

A. List of References
B. List of Items for Submittal (Items for Review)
C. List of Sub-Contractors
D. Project Assessment and Evaluation Plan (PAEP)

TABLES

Table 1. 25 Short-Listed Potential Projects 14
Table 2. Top 10 Potential Projects 17
Table 3. Project Performance Measures (*from* PAEP) 25

FIGURES

Figure 1. Santa Margarita Groundwater Basin 3
Figure 2. Map with District Boundaries 4
Figure 3. Alternatives Screening Analysis Diagram (step-by-step process) 9
Figure 4. Alternative 1 – Potential Areas for Implementation (shown in red) 19
Figure 5. Alternative 2 Potential Areas for Implementation 21
Figure 6. Alternative 3 – Potential Areas for Implementation 23

1.0 EXECUTIVE SUMMARY

Groundwater levels in the Santa Margarita Groundwater Basin (SMGB) have declined by as much as 200 feet in between 1985 and 2007. Local stream baseflow and water quality have been impacted by the groundwater decline, resulting in numerous wells drying up and a significant decline in groundwater quality. This project conducted a series of technical analyses and evaluated a wide range of water source and aquifer recharge alternatives to reverse groundwater decline for the benefit of domestic water supply and fisheries habitat.

Eight technical evaluations formed the basis of this study, the Conjunctive Use Project. The evaluations were broken into hydrogeologic analyses (regional hydrogeology, groundwater recharge potential of various locations, and groundwater modeling of potential projects), surface water resource analyses (water rights, stream flow, and fisheries needs), engineering analyses (current water sources, existing and potentially new infrastructure, planning level cost estimates), and regional water demand analyses (current and future local demands, current and future supply sources). From these evaluations potential project types and project components were identified and screened to determine which projects best achieve the project's goal of determining the feasibility of conjunctively managing water resources to benefit quality and supply of surface water and reduce groundwater overdraft in the Lower San Lorenzo River Watershed and Santa Margarita Groundwater Basin.

Three preferred alternative project types were identified: 1) enhanced stormwater recharge in the Scotts Valley area using low impact design (LID), 2) inter-district exchange of water for in-lieu recharge of aquifers, and 3) surface water diversion at Felton, CA for groundwater recharge in the Hanson Quarry area. Conceptual-level engineering analyses, order-of-magnitude cost estimates, and conceptual implementation plans were developed for each of the three alternatives.

The following report summarizes a series of technical memorandums and a final report prepared by the County's consultant team consisting of Kennedy-Jenks, Balance Hydrologics, D.W. Alley and Associates and Montclair Environmental. The following documents were prepared as part of the Conjunctive Use and Enhanced Aquifer Recharge study:

- Technical Memorandum 1A – Hydrogeology Evaluation
- Technical Memorandum 1B – Evaluation of Recharge Potential
- Technical Memorandum 1C – Groundwater Modeling Evaluation
- Technical Memorandum 2A – Water Rights Evaluation
- Technical Memorandum 2B – Source Water Assessment
- Technical Memorandum 2C – Fisheries Evaluation
- Technical Memorandum 3 – Engineered Facilities Evaluation
- Technical Memorandum 4 – Regional Water Demand
- Final Report (August 2011)

The County of Santa Cruz, in conjunction with other local partners, has already begun utilizing the findings of this study (Component 3 - Conjunctive Use Feasibility) to inform and implement projects. For example, this study's preferred alternative 1 (enhance stormwater recharge) informed work conducted under Component 6 (Enhance and Protect Groundwater Recharge) of the Proposition 50 Integrated Regional Water Management

(IRWM) Implementation grant which developed project designs for a stormwater recharge project that was utilized at the new City of Scotts Valley library. Another example of the ongoing work informed by the findings of this study is work currently underway by the County and local partners on Phase 2 of the Conjunctive Use Feasibility study; the Phase 2 work more fully develops the inter-district water transfer project with engineering designs, regulatory analysis and cost estimates.

2.0 PROBLEM STATEMENT & RELEVANT ISSUES

The Santa Margarita Groundwater Basin (SMGB) is situated in the lower San Lorenzo River watershed in northern Santa Cruz County, CA (Figure 1). Groundwater extraction since the 1980's combined with the loss of natural aquifer recharge resulted in a precipitous decline in groundwater levels. Groundwater levels in some parts of the Scotts Valley area have declined as much as 200-feet over the past 25-years. A groundwater basin model completed for Scotts Valley Water District in 2006 suggests that lost aquifer storage in the basin may exceed 12,000 Acre-Feet (AF) between 1985 and 2007. In addition to pumping, the loss of natural recharge areas within the Scotts Valley City limits may account for the loss of over 500 AFY of aquifer storage since the mid-1980s. While current water management efforts have reduced pumping volumes to within the modeled sustainable range, groundwater levels have not shown a clear indication of stabilization, much less recovery.

The documented impacts from the overdraft include the drying-up of numerous wells in the region and a significant decline in groundwater quality. It is inferred that local stream baseflow and water quality have been impacted by the groundwater decline. Groundwater elevations near proximal streams, while historically much higher than the stream bed elevations, are currently lower than the elevation of the stream bed. This suggests that affected stream reaches have changed from a gaining to a losing regime (i.e., there is a "loss" of water from the stream into the ground due to infiltration as a result of the drop in the elevation water table below the elevation of the streambed). The affected streams, especially Bean Creek, a tributary to the Santa Lorenzo River, are habitat to the federally listed endangered and threatened species of coho salmon and steelhead trout. Bean Creek has been identified by NOAA Fisheries as a critical watershed for the recovery of the federally listed coho salmon.

The water resources in this region are shared among the various stakeholders (Figure 2). Typically, stakeholders have access to a single resource; either groundwater or surface water. Individually, each stakeholder does not have the ability to bring the regional water balance back into equilibrium. This project examines conjunctive use alternatives and aquifer recharge enhancements that may be able to balance the basin and will require cooperation of the major stakeholders.

Figure 1. Santa Margarita Groundwater Basin

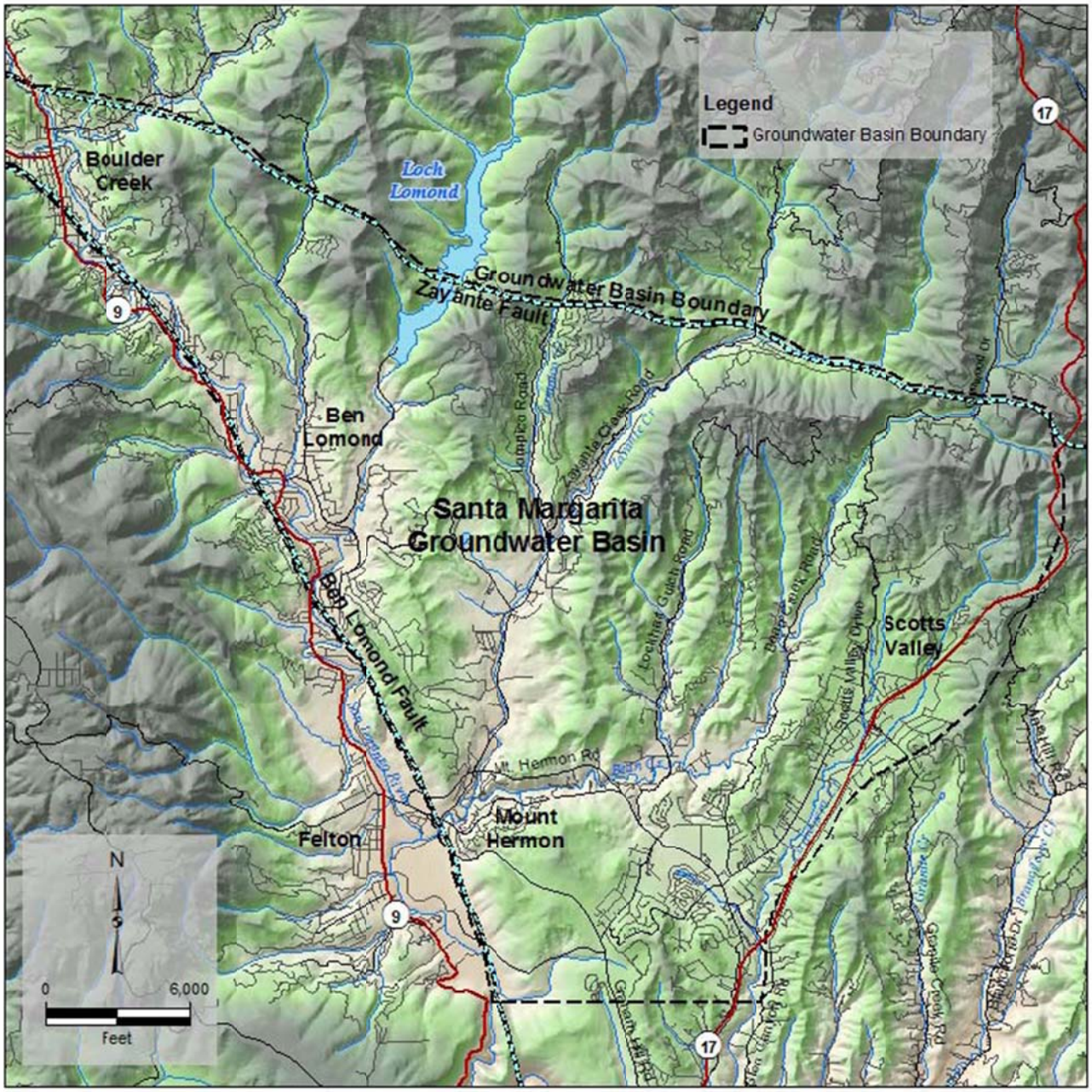
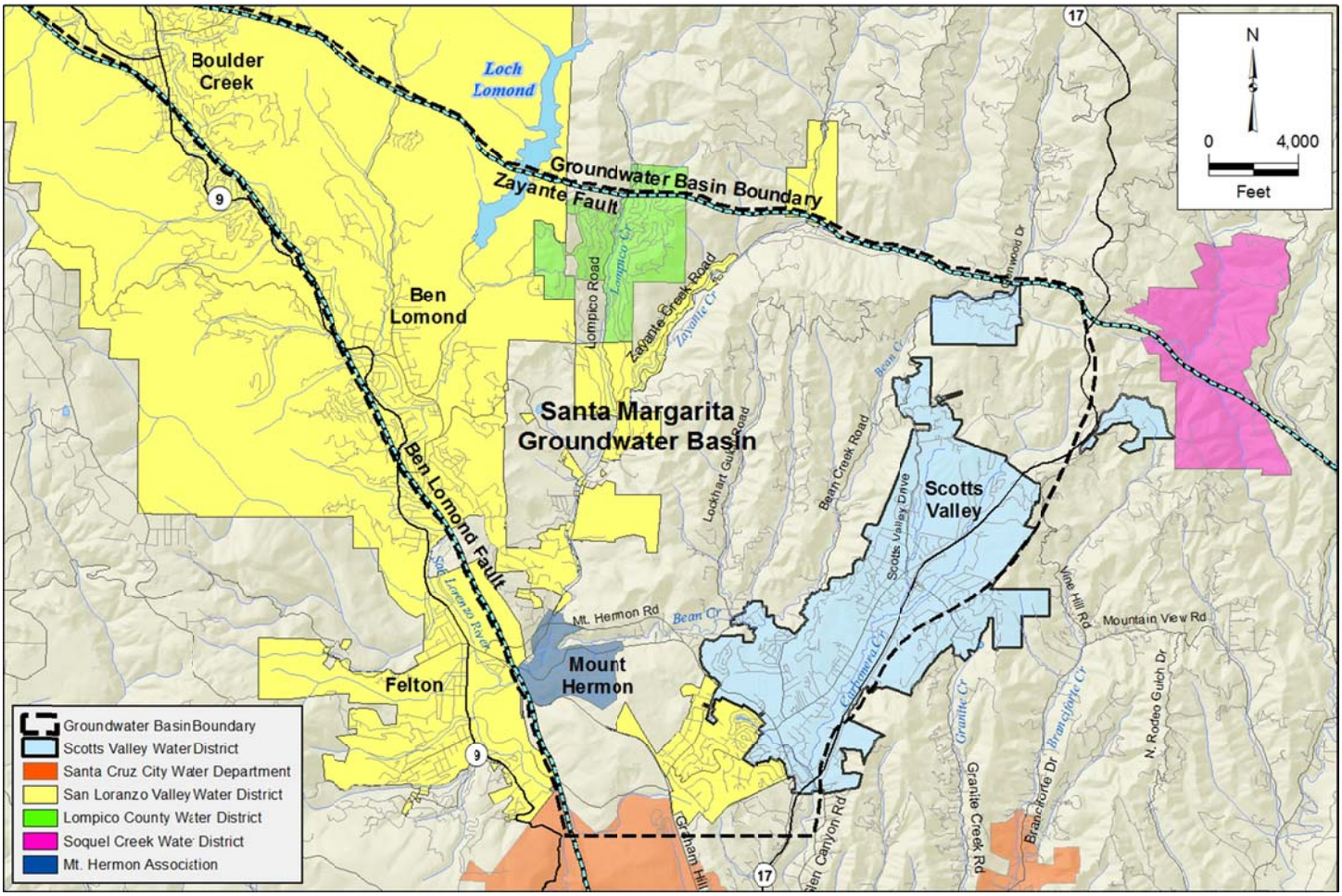


Figure 2. Map with District Boundaries



3.0 PROJECT GOALS

As described in the Performance Assessment and Evaluation Plan (PAEP; Table 3), the goal of the Conjunctive Use Project is to determine the feasibility of conjunctively managing water resources to benefit quality and supply of surface water and reduce groundwater overdraft in the Lower San Lorenzo River Watershed and Santa Margarita Groundwater Basin. The desired outcomes of the project include:

1. Determining the potential conjunctive use alternatives based upon a systematic evaluation of surface and groundwater resources and infrastructure
2. Defining the recharge potential and storage capacity of potential conjunctive use alternatives
3. Identifying and prioritize the areas where active groundwater recharge would help mitigate groundwater supply issues
4. Completing a preliminary conceptual implementation plan
5. Greater collaboration amongst regional agencies

4.0 PROJECT DESCRIPTION

Eight technical and regulatory studies were conducted to support the identification and evaluation of potential conjunctive use alternatives and projects. These studies were conducted by a consultant team consisting of Kennedy/Jenks Consultants Inc., Balance Hydrologics, and D.W. Alley and Associates. The following sections summarize the scope and results of these assessments. For additional details, the reader is referred to the source documents, Technical Memorandums 1 - 4 (Appendices E-M).

The study area for the Conjunctive Use Project was the Santa Margarita Groundwater Basin (SMGB), which includes portions of the lower San Lorenzo River watershed and the tributary streams, Carbonera and Bean Creeks. The SMGB is a significant groundwater basin that covers over 30 square miles in the Santa Cruz Mountains, which forms a roughly triangular area that extends from Scotts Valley in the east, to Boulder Creek in the northwest, to Felton in the southwest (Figure 1). The San Lorenzo River is the primary surface water feature and the majority of the SMGB is in the San Lorenzo River Watershed.

To restore groundwater levels and improve stream health, it is estimated that conjunctive use will need to provide between 5,000 to 10,000 acre-feet to groundwater storage over 20 years and provide a long-term increase summertime baseflow in the San Lorenzo River tributaries (primarily Bean Creek) between 0.35 to 0.7 cubic feet per second (cfs). The Conjunctive Use Project investigated the opportunities to use water exchanges, winter streamflow diversion, and stormwater runoff to increase groundwater levels in the SMGB.

The Conjunctive Use Project addressed the following tasks:

- Evaluate the hydrogeological conditions in the southern SMGB to identify areas with available aquifer storage and conditions suitable for groundwater recharge.
- Determine the maximum average annual surface water rights availability and to whom and when they are available within the study area.
- Determine the maximum surface water that can be safely diverted on an average annual basis to support a conjunctive use project in the study area and at what times of the year the water is available, based on flow, water quality, other water rights, and instream flow needs. Assess differences in water availability during wet years and dry years.
- Compile and analyze potentially available water resources (i.e. surface water, groundwater, recycled water, desalinated seawater, and storm water runoff) for each of the major water purveyors within the study area, when and where these resources are available, and the purveyors' current and projected needs.
- Identify existing infrastructure, such as historic sand quarries, that can be used to support a conjunctive use project(s).
- Screen a large number of potential water sources and aquifer recharge methods to identify three preferred alternatives
- Identify additional infrastructure and water rights that would be needed to support a conjunctive use project(s).

This approach considered a wide range of issues related to conjunctive use alternatives. The focus of the project was on evaluation of regional solutions by screening a variety of conjunctive use alternatives. The project evaluated a variety of approaches to off-stream diversion of water to optimize utilization of flows to off-stream groundwater recharge facilities in a manner that satisfies aquatic habitat preservation

requirements while fulfilling operational objectives. In addition to the grant funded work, the County and stakeholder agencies provided in-kind services including management and technical support including ongoing hydrogeologic work of the SMGB. Further, a regional SMGB groundwater model developed under a previous grant project was used to support this project.

State Water Board IRWM grant funding supported the consultant's work in developing the following Technical Memorandums (TM): 1A Hydrogeologic Evaluation; 1B Evaluation of Recharge Potential; 1C Groundwater Modeling Evaluation of Potential Conjunctive Use Projects; 2A Water Rights Evaluation; 2B Streamflow and Stormwater Assessment; 2C Fisheries Study; TM-3 Engineered Facilities Evaluation; TM-4 Regional Water Demand. The grant costs are summarized below:

Budget Category	**Grant Funds**
Personnel Services (County of Santa Cruz; local agencies)	$1,820
Professional and Consultant Services	$227
Technical Memos (1-4)	
Hydrogeologic/Conjunctive Use Evaluation	$44,752
Surface Water Availability Assessment	$56,325
Engineered Facilities Evaluation	$24,986
Regional Water Demand Projection	$12,542
Feasibility Analysis of Potential Conjunctive Use Projects	$37,125
Phase 1 Project Report Preparation	$30,988
Public / Stakeholder Outreach and Participation	$3,945
Project Management and Quality Assurance / Control	$14,791
Subtotal	$227,500

4.1 Task 1: Hydrogeologic/Conjunctive Use Evaluation

The goal of Task 1 was to characterize the hydrogeologic framework of the study area to address the following topics:

- Update information of the areas where significant historical groundwater level declines have occurred;
- Define the recharge potential across the study area;
- Evaluate the potential effectiveness of the various conjunctive use alternatives in terms of the changes in long-term groundwater levels and stream baseflows, and;
- Prioritize the various groundwater recharge options in terms of effectiveness.

The results of Task 1 are summarized in three technical memoranda (1A, 1B, 1C) used to support the screening analysis in Task 5 to identify the preferred alternatives. The Task 1 technical memoranda include:

Technical Memorandum 1A (TM-1A) Hydrogeology Evaluation – Describes the hydrogeological framework of the southern SMGB by providing a summary of the geology, aquifer characteristics, groundwater flow, historical changes in groundwater levels, groundwater-surface water interactions and water quality issues based on existing reports and data.

Technical Memorandum 1B (TM-1B) Evaluation of Recharge Potential - Provides a summary of the factors effecting the suitability and potential feasibility of groundwater recharge projects (e.g., soil conditions, aquifer characteristics and operational issues) to provide a general evaluation of the aquifer recharge potential and storage capacity of the southern SMGB.

Technical Memorandum 1C (TM-1C) Groundwater Modeling Evaluation of Potential Conjunctive Use Projects - Uses the existing SMGB groundwater model to provide a quantitative analysis of the effectiveness of various potential aquifer recharge projects on long-term groundwater levels, aquifer storage and stream baseflow (with a focus on summertime baseflow).

4.2 Task 2: Surface Water Availability Assessment

The goal of Task 2 was to characterize the hydrogeologic framework of the study area to address the following topics:

- Evaluate the quantities of surface water and stormwater that may be available for a conjunctive use project.
- Summarize existing water rights and entitlements to water supplies in the project area.
- Provide a summary of the local issues regarding San Lorenzo Valley watershed fishery with emphasis on the Coho salmon and steelhead trout.

The assessment includes determining the quantity of water available for recharge, identifying potential diversion locations, and evaluating the water quality characteristics of available flows to determine suitability and pre-treatment requirements for recharge. These are used in the screening process in Task 5. The results of Task 2 are summarized in three technical memoranda that include:

Technical Memorandum 2A (TM-2A) Water Rights Evaluation – Provides a summary of the existing or potentially available water rights on the San Lorenzo River and key tributaries.

Technical Memorandum 2B (TM-2B) Streamflow Availability and Stormwater Assessment – Assesses the local surface water sources to quantify the volumes of streamflows on the San Lorenzo River and key tributaries during different climatic conditions, stream baseflow with emphasis on summertime baseflows, and stormwater characteristics including changes due to urbanization.

Technical Memorandum 2C (TM-2C) Fisheries Study – Provides a summary of the local issues regarding San Lorenzo Valley watershed fishery with emphasis on the Coho salmon and steelhead trout. Assess previous recommendations for bypass requirements to sustain instream flows supporting winter habitat needs.

4.3 Task 3: Engineered Facilities Evaluation

The goal of Task 3 was to develop preliminary engineering evaluations. This included preparing an inventory of existing and potential future infrastructure that could potentially be incorporated into the conjunctive use alternatives. The results of Task 3 are documented in Technical Memorandum 3 (TM-3) – Engineered Facilities Evaluation. TM-3 provides a comparison of the engineering requirements and costs for the potential conjunctive use alternatives. The comparisons were used in the screening process in Task 5. The work for Task 3 included developing:

- Ann inventory of existing facilities that could be used for conjunctive use.

- A conceptual list of the water supply facilities relevant to conjunctive use, and the understanding of characteristics and parameters associated with evaluating those facilities.

4.4 Task 4: Regional Water Demand Projection

The goal of Task 4 was to compile and analyze water resources potentially available from each major water purveyor in the region, to identify when and where these resources are available, and identify the purveyors' current and projected water needs. This regional evaluation assessed potential partners outside the specific project area. The results of Task 4 are documented in Technical Memorandum 4 (TM-4) – Regional Water Demand. TM-4 provides a summary of the available water supplies, especially those supplies that provide opportunities for in-lieu water exchanges for use in the alternative screening process in Task 5. The work for Task 4 included:

- An inventory current and future water supply and demand based on existing reports to summarize the regional water supplies.
- Identification of potential water supplies, including non-traditional water sources, for potential use in the conjunctive use alternatives.
- Identification of potential water supply issues including water quantity, quality, and availability issues, and regulatory requirements for the use of various sources of water for recharge to a drinking water aquifer.

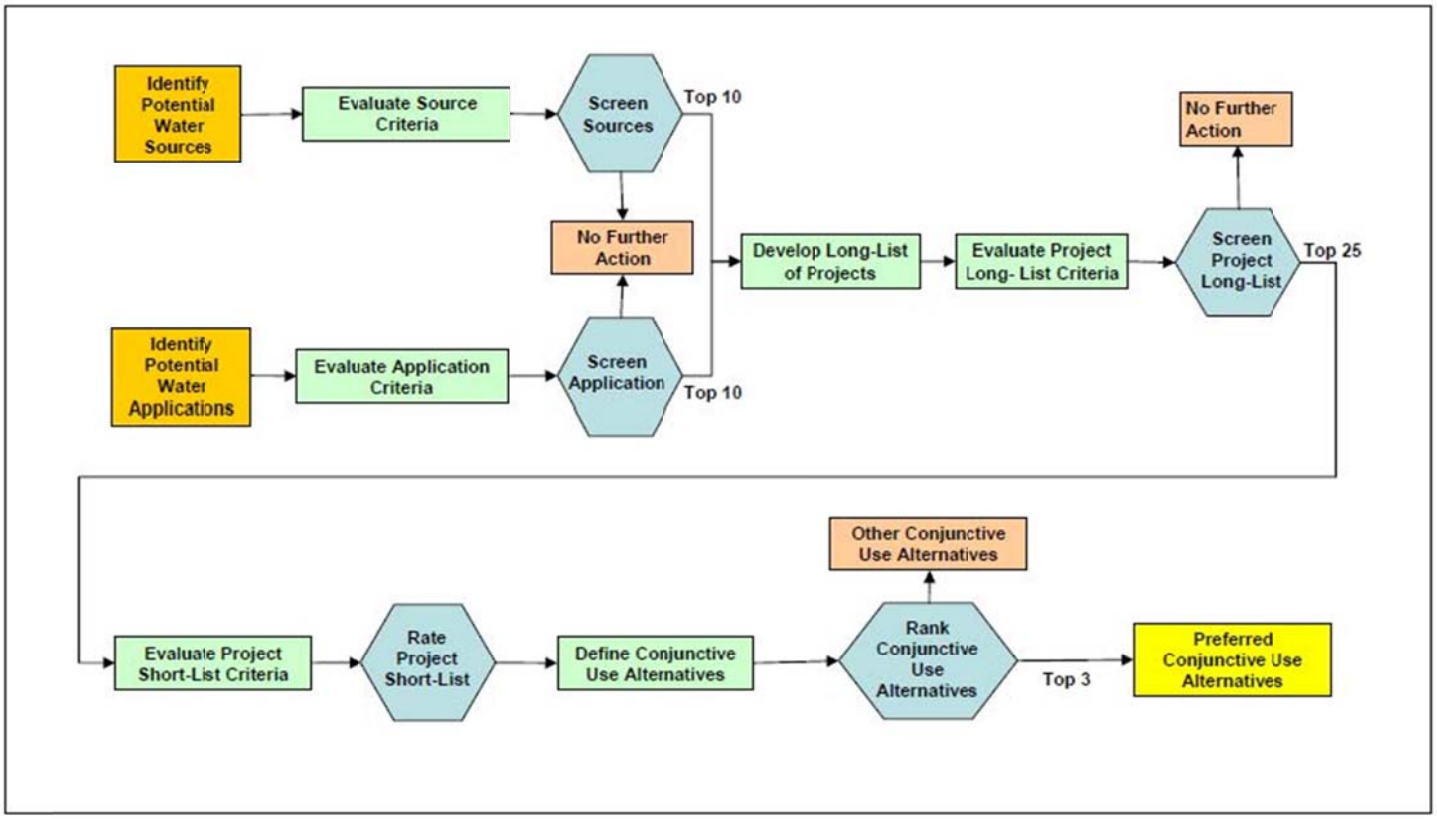
4.5 Task 5: Feasibility Analysis of Potential Conjunctive Use Projects

Task 5 uses the analyses from Tasks 1 through 4 to identify and screen potential conjunctive use alternatives. A systematic screening process was developed using a set of performance criteria to provide a consistent basis for the comparison of the various conjunctive use alternatives. The project alternatives consisted of two parts – (1) water sources and (2) recharge applications. Based on this process, the various alternatives were screened and ranked. The alternatives were also evaluated with respect to critical issues or "fatal flaws" that render an alternative infeasible. From this analysis, a set of preferred alternatives was identified for addressing groundwater issues in the project area. The project goal was to identify three preferred alternatives. A systematic screening process was used to prioritize and rank the potential alternatives using the following approach:

- *Develop Potential Conjunctive Use Projects* - Generate a list of potential conjunctive use projects based on the analysis conducted in Tasks 1 through 4.
- *Establish Alternatives Screening Criteria* - Develop the screening criteria to prioritize the list of potential conjunctive use projects with the highest potential for success in addressing the goals of the Conjunctive Use Project.
- *Potential Conjunctive Use Alternative Screening* – Apply screening criteria to the list of potential conjunctive use projects in a systematic manner that provides a consistent comparison. The screening was conducted primarily on a technical evaluation of effectiveness and preliminary order-of-magnitude cost estimates.
- *Conceptual Implementation of Preferred Alternatives* - For three (3) of the preferred Conjunctive Use Alternatives, prepare preliminary conceptual implementation plans that identify the major steps

necessary to implement these alternatives. These conceptual plans will be further developed in future phases of this project.

Figure 3. Alternatives Screening Analysis Diagram (step-by-step process)



4.5.1 Water Source Screening

A step-by-step process was applied in evaluating potential water sources during the Alternatives Screening Analysis; Figure 3 provides a diagram of this process. Potential water sources were evaluated independently to identify these water sources on their own merits separate from other project components. Drawing on information developed under the Technical Memoranda (primarily TM-1A, TM-2A, TM-2B, TM-2C, TM-3 and TM-4), estimates of available quantity, potential for permitting, and other information necessary to evaluate the water sources using the screening criteria were estimated. This section provides a summary of this process.

Identification of Potential Water Sources

An extensive list of individual water sources was grouped into broad categories that represent the key potential water sources, these include:

- Surface water including the San Lorenzo River and its tributaries
- Stormwater runoff

- Recycled water from the Scotts Valley Wastewater Treatment Plant
- Inter-district exchange of water from existing water sources.

Surface Water Sources

The surface water sources evaluated for the Conjunctive Use Project is limited to the San Lorenzo River and its tributaries. The surface water sources considered for the screening analysis includes the following streams:

- San Lorenzo River
- Bean Creek
- Carbonera Creek
- Zayante Creek

As described in detail in TM-2A and TM-2B, there is a range of supply sources of varying quantities and qualities that can be used conjunctively within the SMGB. TM-3 provides more detailed information on the engineering requirements for surface water diversions structure requirements.

4.5.2 Water (Recharge) Application Screening

The step-by-step process was also applied in evaluating the potential water (recharge) applications in the Alternatives Screening Analysis. Potential applications of aquifer recharge were evaluated independently and ranked based on their own merits separate for other project components. Technical information supporting the development of the screening criteria and application of the screening method are supported by the analysis in the attached Technical Memoranda including TM-1B, TM-1C, TM-2B, and TM-3. This section provides a discussion of this process.

Identification of Potential Recharge Applications

Various aquifer recharge methods were evaluated for use in conjunctive use projects. Based on this evaluation, a map was produced that defines the areas where active groundwater recharge by either surface infiltration or injection wells would help mitigate groundwater supply issues in the project area. Additional information on the requirements of these different aquifer recharge methodologies is discussed in more detail in TM-1B, TM-1C, and TM-3.

Additional analysis evaluating the potential for recharge applications for these different areas is provided in TM-1A, TM-1B, and TM-1C. TM-1A provides a summary of the general hydrogeology and how the geologic structure and groundwater flow characteristics play a role in groundwater recharge. TM-1B provides an assessment of the recharge potential for the different methods based on geologic and engineering analysis. TM-1C provides the results of using the SMGB groundwater model to evaluate the potential benefits of long-term groundwater storage in the SMGB and on summertime baseflows in the streams in the study area.

Recharge Application Screening Criteria

The screening criteria used for evaluating recharge applications emphasize the potential benefits to groundwater storage, summertime stream baseflows, CEQA and regulatory issues, and engineering aspects. Much of the technical basis for the screening criteria to identify and screen potential conjunctive use alternatives was developed for Tasks 1 through 4 and is presented in the Technical Memoranda, primarily TM-1B, TM-1C, TM-2B, and TM-3. The screening criteria consist of the following:

- Potential Groundwater Benefit – Assess potential for increasing the volume of groundwater in aquifer storage through groundwater recharge.
- Potential Baseflow Benefit – Assesses the potential for increasing summertime baseflows in key streams in the area, primarily Bean Creek, through groundwater recharge
- Engineering Facilities Requirements – Provides a conceptual assessment of the anticipated engineering infrastructure required to implement the recharge application. Supporting information provided in TM-3.
- Implementability – Assesses a broad range of issues in implementing the recharge application. This is a subjective evaluation based on current understanding of the type of recharge application under consideration. Supporting information provided in TM-1B and TM-3.
- Public Acceptance – Provides a subjective assessment of public acceptance issues associated with potential water sources based on current issues, visibility of the project, and potential disruption from utilizing the water source.

Each screening criteria were assigned a score between one (1) and five (5) with one (1) being the least favorable and five (5) the most favorable, based on how well a project met the each criterion. An emphasis was placed on maintaining scoring consistency. Each was assigned a weighting factor based on the perceived relative importance of the screening criteria. A score was calculated by multiplying the screening criteria score by the assigned criteria weighting factor. The scores for each criterion were added together for the final score. If a criterion was determined to have a "fatal flaw" such that it was considered infeasible, a score of zero (0) was assigned and the average score was assigned zero (0) as well. The projects were ordered from highest to lowest. The screening-level analysis focused on a technical evaluation of the identified recharge applications in meeting the project goals. The Alternative Screening Analysis of the recharge applications is based on the technical information presented in the Technical Memorandums, a conceptual-level engineering analysis, and local knowledge by the consultant team and the TAC.

4.5.3 Groundwater Modeling Overview

The SMGB groundwater model was used to evaluate the 16 potential groundwater recharge project scenarios to cover different enhanced groundwater recharge configurations, locations, and timings. Full documentation of the model scenarios is provided in TM-1C. These model scenarios are considered as a screening-level analysis to help support the development of the screening criteria for Task 5. These were general scenarios that were developed and run prior to the initiation of Task 5; therefore, the model scenarios are not exact combinations used for Task 5. The model scenarios used future conditions that repeated the natural hydrologic conditions from 1985 through 2005. The locations for recharge were chosen based on their expected ability to transmit water into the deep aquifer fairly quickly. Specifically, areas where the Santa Margarita aquifer directly overlies the Lompico aquifer were targeted. In these areas, the Monterey formation, which has relatively low permeability, is not present thus allowing direct communication between the Santa Margarita and Lompico. For most of the model scenarios, the total aquifer recharge is assumed to be 1,000 afy. However, the in-lieu recharge scenarios were limited by the available reduction in groundwater pumping available for the chosen time interval. The goal of this analysis was to determine how the changes to the water budget created by the directed recharge varied with the recharge magnitude and location. The scenarios were set up as follows.

Base Case: This scenario is essentially identical to the final model from ETIC (2006). No directed recharge is applied to the model. The results of this scenario were used as a comparative tool, to quantify the changes effected by the directed recharge systems applied in large percolation ponds. Recharge was applied to Model Layer 1 (the Santa Margarita) only.

Injection Wells: Four scenarios were created to simulate injection wells completed within the Lompico (Model Layer 3).

Low Impact Development: Two scenarios were created to simulate surface recharge in a more dispersed system to simulate the use of low-impact development on existing urbanized areas to capture and recharge stormwater to groundwater. This setup was intended to mimic numerous small recharge points, such as in a stormwater recharge system. Recharge was applied to Model Layer 1 only.

In-Lieu Recharge: Three scenarios were created to simulate in-lieu recharge, which is accomplished by reducing pumping in existing groundwater wells rather than actively adding water to the basin. These scenarios assume that the water supply needs are met by utilizing another water source that is outside of the basin. In these scenarios, pumping in wells is decreased in specific areas, or from specific layers.

Bean Creek Wellfield: Two scenarios were constructed to simulate the effect of pumping from the aquifer to capture wintertime groundwater discharges to Bean Creek when streamflows are high. The objective is to evaluate how much of an impact this type of pumping has on the aquifer and streams. The aquifer recharge from the simulated Conjunctive Use Projects assumed that the recharge period would occur during the cool, wet months of the year, starting in mid-November and ending in mid-May. The SMGB model is subdivided into three-month-long stress periods that represent seasonal variations. For Surface Recharge, Lompico Injection, and Low Impact Development scenarios, the project groundwater recharge was varied seasonally, with 25% of water recharged during the first quarter of the water year (October through December), 50% in the second quarter, 25% in the third quarter, and 0% in the fourth quarter. This distribution represents the proposed seasonal operation of a conjunctive use project to take advantage of the distribution of precipitation in the region, where winters are wet and summers dry.

4.5.4 Recharge Application Screening Results

The screening of the recharge applications was applied systematically using the criteria discussed above. Based on the results of this analysis, the top ten recharge applications were identified as the following:

- Stormwater Low Impact Development in South Scotts Valley (score of 8.7) Stormwater Low Impact Development in Camp Evers area (score of 8.7)
- Injection Wells in South Hanson Quarry (score of 7.5)
- Injection Wells in North Hanson Quarry (score of 7.2)
- In-Lieu Recharge between SCWD, SLVWD and SVWD (score of 7.0)
- Percolation Ponds in South Hanson Quarry (score of 6.8)
- Injection Wells in South Scotts Valley (score of 6.8)
- Injection Wells in Camp Evers area (score of 6.8)
- Percolation Ponds in South Scotts Valley (score of 6.5)
- In-Lieu Recharge between SCWD and SVWD (score of 6.3)

The top ten recharge applications were used in the analysis to develop a list of potential conjunctive use projects from which three preferred Conjunctive Use Alternatives were identified.

4.5.5 Potential Project Screening

The step-by-step process of the Alternatives Screening Analysis defined potential conjunctive use projects based on the results of the screening analysis of potential water sources and recharge applications. The potential conjunctive use projects were evaluated using a separate set of screening criteria that emphasize engineering feasibility and water sustainability parameters. Each project was independently evaluated based its own merits separate for other projects. This section provides a discussion of this process.

Define Project Long-List

The development of potential conjunctive use projects was done by combining the results of the screening analysis for potential water sources and recharge applications. The top-ten list for each project component has been combined to develop a long-list of 100 potential conjunctive use projects.

Project Screening Criteria

The Conjunctive Use and Enhanced Aquifer Recharge Final Report (Kennedy/Jenks Consultants, August 2011 summarizes the screening criteria used to evaluate potential conjunctive use projects, including a description of each screening criterion, the basis for the developing a screening score, and the criterion weighting factor. The screening criteria used for evaluating projects emphasize engineering feasibility and water sustainability aspects. Much of the technical basis for the screening criteria to identify and screen potential conjunctive use projects was developed for Tasks 1 through 4. The screening criteria consist of the following:

- Component Compatibility – Assesses whether the potential water source and recharge application could be combined into a practical project.
- Constructability – Assesses issues that could arise for the construction of the potential project including the likelihood of finding a suitable construction site, compatibility with nearby land use, and an initial assessment of the complexity of constructing the project.
- Conveyance – Assesses issues related to moving water from the water source to the recharge application including conceptual-level costs, right-of-way issues, site conditions, and environmental issues during construction.
- Project Engineering – Assesses issues related to engineering design including a general assessment of complexity of project design, use of existing infrastructure, and need for detailed site-specific data are considered.
- Long-Term Sustainability – Assesses the projects long-term ability to meet the Conjunctive Use Project goals based on current engineering knowledge of other similar projects and knowledge of the regional hydrological conditions.
- Water Source Rating – Incorporates scores from the water source screening analysis into the project score so that the previous analysis can influence the project screening. Recharge Application Rating – Incorporates scores from the recharge application screening analysis into the project score so that the previous analysis can influence the project screening.

Component compatibility assessed whether the matching of a potential water source and recharge application could be combined into a practical project. If a project was considered as incompatible, it was removed from

the screening process at this point. The remaining screening criteria were scored similarly as the project components with a assigned score ranging between one (1) and five (5) with one (1) being the least favorable and five (5) being the most favorable with respect to the criteria, based on how well a project met the each criteria. An emphasis was placed on maintaining relative scoring consistency. Each criterion was assigned a weighting factor based on the perceived relative importance of the screening criteria. A score was calculated by multiplying the screening criteria score by the assigned criteria weighting factor. The project components or projects being evaluated were ordered from highest to lowest.

Screening Results

The results of the Alternatives Screening Analysis including the selected short-list of 25 projects are provided in Table 1. The following sections, 4.5.6 and 4.5.7, provide a general evaluation of the screening results with respect to both water sources and recharge applications.

4.5.6 Conjunctive Use Alternatives Ranking

The step-by-step process of ranking the projects for the Alternatives Screening Analysis has two parts. The previous section covered the screening from a long-list of 100 potential projects to a short-list of 25 projects (Table 1). This section covers a second ranking of the short-listed projects using a separate set of screening criteria that emphasize project costs and system reliability factors to arrive at the three preferred alternatives. Each project was independently evaluated based its own merits separate for other projects. This section provides a discussion of this process.

Table 1. 25 Short-Listed Potential Projects

Rank	Source	Application	Project Score
1	Stormwater - Roofs	CE - Aquifer Recharge - Low Impact Development	9.83
2	Stormwater - Roofs	SSV - Aquifer Recharge - Low Impact Development	9.83
3	City of Santa Cruz Graham Hill WTP	In Lieu SVWD + SLVWD - 75% Dec-Mar water usage	9.03
4	Stormwater - Street and Parking Lots	CE - Aquifer Recharge - Low Impact Development	8.86
5	Stormwater - Street and Parking Lots	SSV - Aquifer Recharge - Low Impact Development	8.86
6	City of Santa Cruz Graham Hill WTP	In Lieu SVWD - 75% Dec-Mar water usage	8.42
7	Zayante Creek - Surface Diversion	SHQ - Aquifer Recharge - Injection Wells	8.36
8	City of Santa Cruz - Felton Diversion	SHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	8.31
9	Zayante Creek - Surface Diversion	SHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	8.25
10	Bean Creek - Surface Diversion	SHQ - Aquifer Recharge - Injection Wells	8.22
11	San Lorenzo River - Surface Diversion	SHQ - Aquifer Recharge - Injection Wells	8.11
12	Bean Creek - Surface Diversion	SHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	8.11
13	City of Santa Cruz - Felton Diversion	SHQ - Aquifer Recharge - Injection Wells	7.92
14	City of Santa Cruz - Felton Diversion	NHQ - Aquifer Recharge - Injection Wells	7.86
15	Zayante Creek - Surface Diversion	NHQ - Aquifer Recharge - Injection Wells	7.81
16	Bean Creek - Surface Diversion	NHQ - Aquifer Recharge - Injection Wells	7.67
17	City of Santa Cruz - Felton Diversion	In Lieu SVWD + SLVWD - 75% Dec-Mar water usage	7.50
18	San Lorenzo River - Surface Diversion	NHQ - Aquifer Recharge - Injection Wells	7.39
19	San Lorenzo River - Surface Diversion	SHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	7.33
20	Bean Creek - Nearby Wellfield	In Lieu SVWD + SLVWD - 75% Dec-Mar water usage	7.22
21	Bean Creek - Nearby Wellfield	In Lieu SVWD - 75% Dec-Mar water usage	7.11
22	Loch Lomond + SLVWD-SVWD Exchange	In Lieu SVWD + SLVWD - 75% Dec-Mar water usage	7.08
23	Stormwater - Intercept Storm Drains	SSV - Aquifer Recharge - Infiltration Basin/Percolation Ponds	7.00
24	City of Santa Cruz - Felton Diversion	In Lieu SVWD - 75% Dec-Mar water usage	6.89
25	Stormwater - Intercept Storm Drains	SSV - Aquifer Recharge - Injection Wells	6.89

CE = Camp Evers
SSV – South Scotts Valley
SVWD = Scotts Valley Water District
SLVWD = San Lorenzo Valley Water District

SHQ = South Hanson Quarry
NHQ = North Hanson Quarry

Define Project Short-List

The project alternatives were ranked according to the maximum screening level score for a single project. Using this methodology assures that the highest rated projects are selected for the preferred alternatives, and that a highly ranked project does not get diluted by being mixed with lower ranking projects in the alternative grouping process. The assumption is that a poorly ranked project included in an alternative would not have to be implemented; therefore, the ranking should be guided by the highest ranking project.

Project Screening Criteria

The screening criteria used for evaluating the short-list of projects emphasize costs and system reliability factors. A summary of screening criteria applied for the short-list of projects includes the following:

- Relative Design and Build Cost – Provides conceptual evaluation of potential project costs based on analogy with similar projects. These are considered relative, preliminary order-of-magnitude costs that could vary significantly based on actual site conditions and project requirements.
- Relative Long-Term Operations and Maintenance (O&M) Costs – Provides a conceptual evaluation of potential O&M costs based on similar projects. These are considered generalized estimates that could vary significantly based on actual site conditions and project requirements.
- Outside Funding Potential – Provides an initial assessment of the potential for obtaining outside funding to construct the project based on knowledge of what types of projects are currently being funded by the State and Federal agencies.
- Stakeholder Acceptance – Provides a criterion to account for the level of support by the local stakeholders to implement the project based on local knowledge and input from the TAC.
- Relative Cost of Water – Provides a conceptual evaluation of the relative cost of water based on an assessment of the relative design and build cost and long-term O&M costs versus the potential groundwater and baseflow benefits.
- System Reliability – Provides a general assessment of the project's long-term reliability to have a long project life based on current engineering knowledge of other similar projects and knowledge of the regional hydrological conditions. This is considered a screening-level analysis to provide an initial technical evaluation of the ability of the implementability of the project. The Alternative Screening Analysis is based on the technical information presented in the attached Technical Memoranda, a conceptual-level engineering analysis, and local knowledge by the consultant team and the TAC.

Alternative Screening Evaluation

This screening-level analysis focused on an initial technical evaluation of the effectiveness of the identified project in meeting the Conjunctive Use Project goals. The Alternative Screening Analysis of the project screening is based on the technical information presented in the Technical Memoranda, a conceptual-level engineering analysis, and local knowledge by the consultant team and the TAC. For each of the preferred alternatives, a conceptual-level engineering analysis, preliminary order-of-magnitude cost estimates, and a conceptual implementation plan was developed. The conceptual implementation plan identifies the major steps necessary for future implementation of each preferred alternative.

Alternative Ranking

The analysis performed was a screening-level analysis that focused primarily on an initial technical evaluation of the effectiveness of the identified project screening in meeting the conjunctive use project goals. The alternative screening analysis of the project screening is based on the technical information presented in the Technical Memoranda, a conceptual-level engineering analysis, and local knowledge by the consultant team and the TAC. The results of the alternatives screening analysis including the selected short-list of 25 projects are provided on Table 1.

4.5.7 Conjunctive Use Alternatives

The Conjunctive Use Project sought to identify three preferred alternatives. In defining the preferred alternatives, projects with similar characteristics were grouped together. The list of 25 projects were grouped into 10 alternatives to allow the future phases of the feasibility study to evaluate a broader range of related project features, and not cause unwarranted limitations on future evaluations.

Table 2. Top 10 Potential Projects

Alter-native	Source	Application	Source Rating	Application Rating	Project Rating	Alternative Rating	Preference Score
1	Stormwater - Roofs	CE - Aquifer Recharge - Low Impact Development	8.3	8.7	9.8	9.0	9.0
	Stormwater - Roofs	SSV - Aquifer Recharge - Low Impact Development	8.3	8.7	9.8	9.0	9.0
	Stormwater - Street and Parking Lots	CE - Aquifer Recharge - Low Impact Development	7.5	8.7	8.9	7.7	8.2
	Stormwater - Street and Parking Lots	SSV - Aquifer Recharge - Low Impact Development	7.5	8.7	8.9	7.3	8.1
2	City of Santa Cruz Graham Hill WTP	In Lieu SVWD + SLVWD - 75% Dec-Mar water usage	8.2	7.0	9.0	8.3	8.1
	City of Santa Cruz Graham Hill WTP	In Lieu SVWD - 75% Dec-Mar water usage	8.2	6.3	8.4	8.3	7.8
3	City of Santa Cruz - Felton Diversion	SHQ - Aquifer Recharge - Injection Wells	7.0	7.5	7.9	6.7	7.3
	City of Santa Cruz - Felton Diversion	NHQ - Aquifer Recharge - Injection Wells	7.0	7.2	7.9	6.5	7.1
	City of Santa Cruz - Felton Diversion	SHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	7.0	6.8	8.3	6.2	7.1
4	City of Santa Cruz - Felton Diversion	In Lieu SVWD + SLVWD - 75% Dec-Mar water usage	7.0	7.0	7.5	6.2	6.9
	City of Santa Cruz - Felton Diversion	In Lieu SVWD - 75% Dec-Mar water usage	7.0	6.3	6.9	6.2	6.6
5	Bean Creek - Nearby Wellfield	In Lieu SVWD + SLVWD - 75% Dec-Mar water usage	6.3	7.0	7.2	6.8	6.8
	Bean Creek - Nearby Wellfield	In Lieu SVWD - 75% Dec-Mar water usage	6.3	6.3	7.1	6.8	6.7
6	Stormwater - Intercept Storm Drains	SSV - Aquifer Recharge - Infiltration Basin/Percolation Ponds	6.5	6.5	7.0	6.3	6.6
	Stormwater - Intercept Storm Drains	SSV - Aquifer Recharge - Injection Wells	6.5	6.8	6.9	6.3	6.6
7	Zayante Creek - Surface Diversion	SHQ - Aquifer Recharge - Injection Wells	6.7	7.5	8.4	4.0	6.6
	Zayante Creek - Surface Diversion	SHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	6.7	6.8	8.3	4.0	6.4
	Zayante Creek - Surface Diversion	NHQ - Aquifer Recharge - Injection Wells	6.7	7.2	7.8	4.0	6.4
8	Loch Lomond + SLVWD-SVWD Exchange	In Lieu SVWD + SLVWD - 75% Dec-Mar water usage	6.5	7.0	7.1	5.2	6.4
9	Bean Creek - Surface Diversion	SHQ - Aquifer Recharge - Injection Wells	5.8	7.5	8.2	4.0	6.4
	Bean Creek - Surface Diversion	SHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	5.8	6.8	8.1	4.0	6.2
	Bean Creek - Surface Diversion	NHQ - Aquifer Recharge - Injection Wells	5.8	7.2	7.7	4.0	6.2
10	San Lorenzo River - Surface Diversion	SHQ - Aquifer Recharge - Injection Wells	5.2	7.5	8.1	2.3	5.8
	San Lorenzo River - Surface Diversion	NHQ - Aquifer Recharge - Injection Wells	5.2	7.2	7.4	2.3	5.5
	San Lorenzo River - Surface Diversion	SHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	5.2	6.8	7.3	2.7	5.5

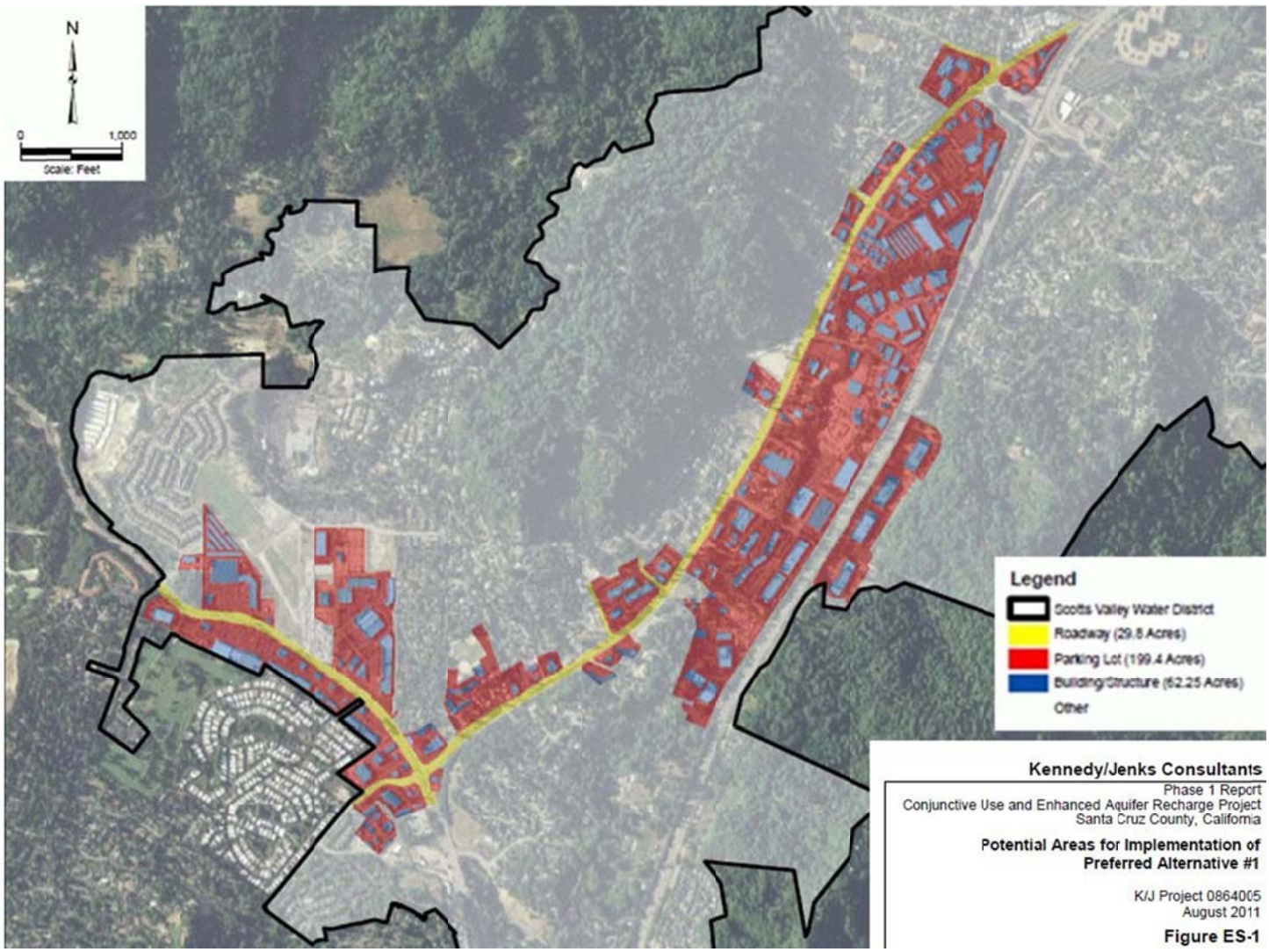
Preferred Alternatives

Alternative #1 - Enhanced Stormwater Recharge in Scotts Valley Using Low Impact Development

Alternative #1 uses stormwater from roofs, parking lots and streets along Mount Hermon Road and Scotts Valley Drive for groundwater recharge using low impact development facilities such as infiltration basins, pervious pavement, vegetated swales, and landscape islands (Figure 4). The techniques would capture stormwater that is currently routed away from the SMGB by storm drains; capturing the stormwater allows for infiltration and groundwater recharge to help restore natural groundwater recharge lost to the effects of

urbanization. Implementing this alternative on the scale necessary to achieve the project goals will require retrofitting the existing commercial and business property with low impact development facilities to accommodate recharge of stormwater. The main advantage of this alternative is that it is relatively straightforward in concept and would produce benefits to both groundwater storage and summertime baseflows (especially in Bean Creek) as well as potential water quality benefits in the surface waters. Stormwater sources have the advantage of being derived directly from rainfall and lack the complications of water rights and fisheries issues identified in other alternatives.. Enhanced stormwater recharge is generally encouraged by the California Department of Water Resources and the State Water Resources Control Board and there are potential funding sources to help with implementation of this alternative. This alternative requires negotiating with private land owners to access property to implement this alternative, which is considered a limitation. Water quality is another concern as stormwater can pick up contaminants from contact with streets, parking lots and structures. The potential impacts of contaminant plumes in the Camp Evers area will have to be included in future evaluations to fully implement this alternative because of the potential to remobilize these plumes. The designs for this type of project were developed under Component 6 of the Proposition 50 grant. The design features were utilized by the City of Scotts Valley in the construction of a recharge gallery that captures stormwater runoff from a parking lot and roof at the recently renovated Scotts Valley library.

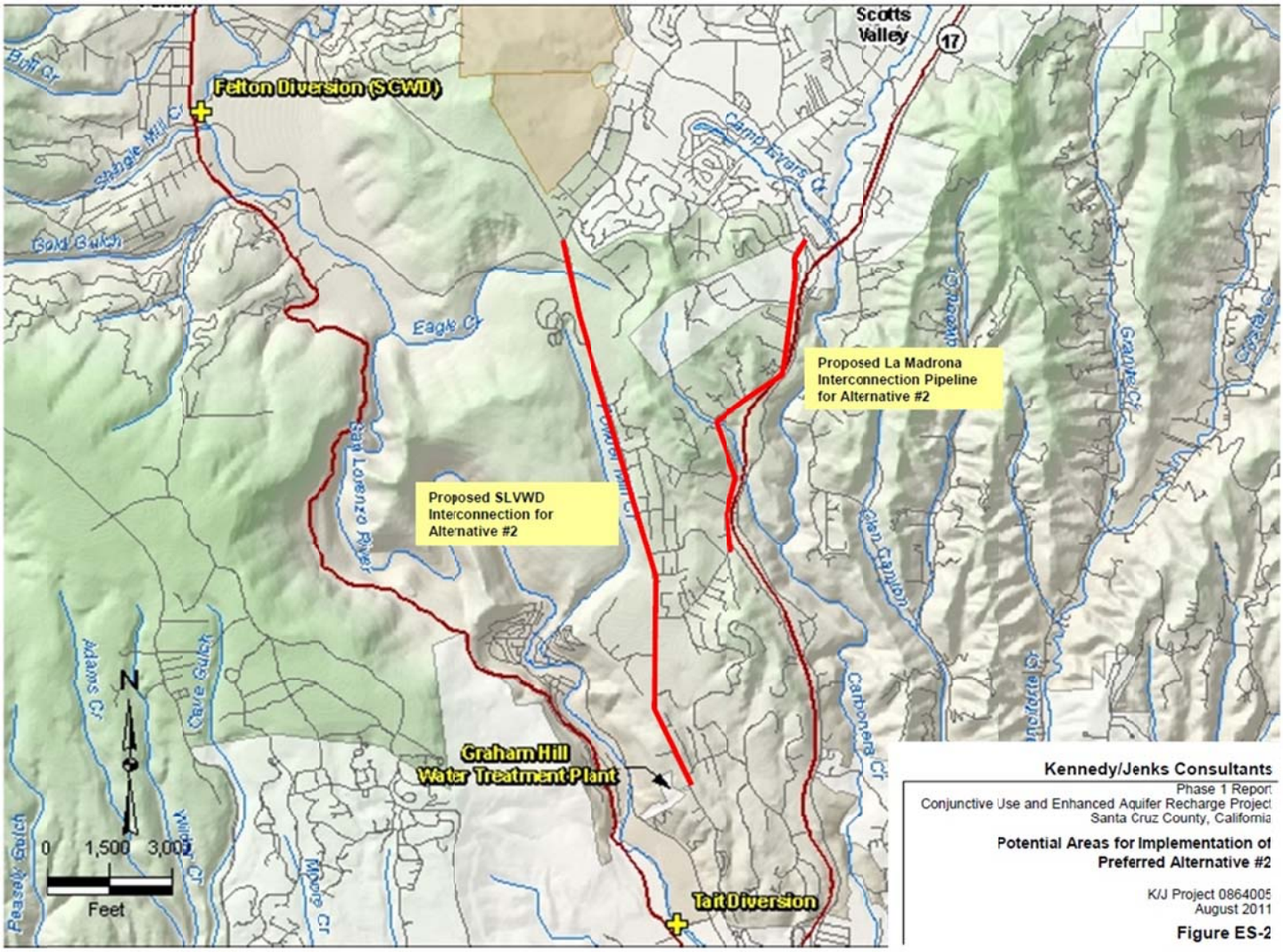
Figure 4. Alternative 1 – Potential Areas for Implementation (shown in red)



Alternative #2 - Inter-District Exchange for In-Lieu Recharge

Alternative #2 utilizes the existing water sources used by the participating water districts. Since these include a combination of surface water and groundwater resources, this alternative proposes that the water districts set up agreements to sell, trade or share these water resources to take advantage of natural cycles. The general concept is to use more surface water during high flow seasons and/or years instead (or in-lieu) of groundwater pumping. More specifically, Alternative #2 proposes to utilize excess capacity at the SCWD's Graham Hill Water Treatment Plant (WTP) during the winter months when water demand is relatively low and water availability is high. Treated potable water from the Graham Hill WTP would be conveyed to the SVWD and SLVWD for use in-lieu of groundwater pumping. The SLVWD's Felton WTP is another potential source of water; however it may not have additional treatment capacity that is available at the Graham Hill WTP. Over time, the reduced pumping in the SMGB will allow groundwater levels to rise. During low surface flow periods, reliance would be shifted back to groundwater or other sources. The advantage of this alternative is the use of existing water supplies and infrastructure. This reduces project costs and minimizes environmental impacts. In-lieu recharge is generally highly efficient in increasing groundwater storage. Increasing groundwater levels in the SMGB as a result of this project would also increase summertime baseflows in streams such as Bean Creek. The main limitations include the cost of constructing pipelines to interconnect the different water districts, engineering issues of making these systems compatible, and water rights issues. The feasibility of this alternative may be significantly affected by the conditions of a Habitat Conservation Plan in negotiation between the City of Santa Cruz and NOAA fisheries. Another potential limitation is that agreements will need to be negotiated between the districts to define the volume, timing and payment for these exchanges. However, individual districts have already initiated discussions and planning-level work to explore this concept in greater detail

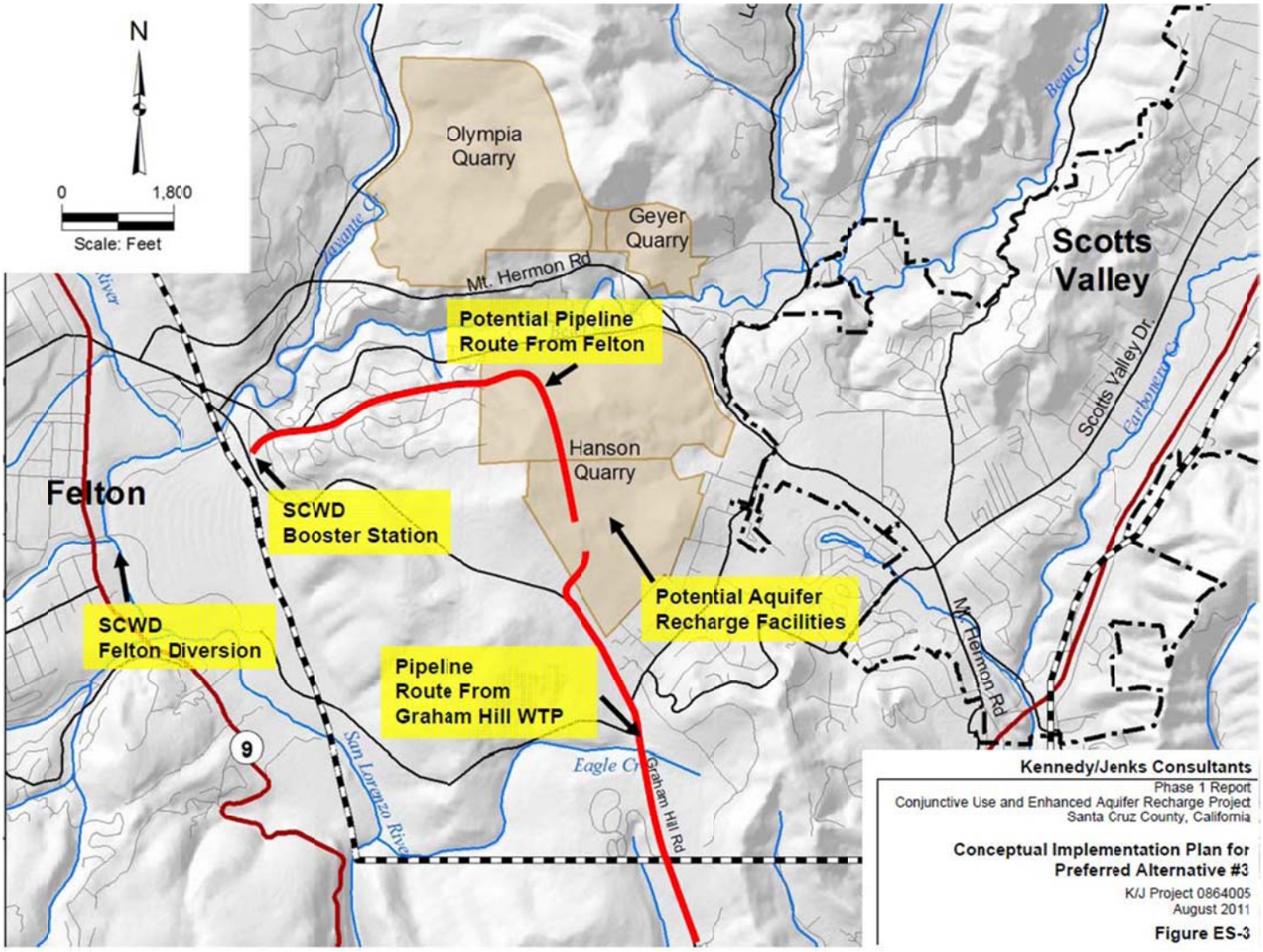
Figure 5. Alternative 2 Potential Areas for Implementation



Alternative #3 - Surface Water from Felton Diversion for Aquifer Recharge in Hanson Quarry Area

Alternative #3 diverts water from the existing Felton Diversion on the San Lorenzo River to convey water to aquifer recharge facilities in the Hanson Quarry area west of Scotts Valley (Figure 6). The concept utilizes surface water during high flow periods for aquifer recharge to increase groundwater levels in the SMGB. Aquifer recharge would be via percolation ponds, injection wells or a combination of both. Further evaluation including identification of a final site would be required to determine the more viable option. The Hanson Quarry is identified because it is a large area of potentially available land that could accommodate a large recharge facility; however, other locations in this vicinity could be considered if necessary. Advantages are that this alternative can potentially add significant volumes of groundwater to the basin to help increase groundwater levels and help to increase summertime baseflows. This alternative uses existing infrastructure at the Felton Diversion to lower the project costs. The main limitations of this alternative are water rights, environmental and fishery concerns with the San Lorenzo River diversion. Because of the geologic complexity of the basin, there are limited areas for potential sites; however, this varies with recharge method. For example, injection wells are more flexible with respect to location than percolation ponds. The size and complexity of the engineering and operation of these facilities also increase capital and operational costs. A large aquifer recharge facility requires a significant amount of land at a site with the appropriate geology.

Figure 6. Alternative 3 – Potential Areas for Implementation



5.0 PUBLIC OUTREACH

A Technical Advisory Committee (TAC) consisting of stakeholders and those with technical expertise was assembled to review and provide input to the consultant during the project. The TAC was composed of members from County EHS, Scotts Valley Water District (SVWD), San Lorenzo Valley Water District (SLVWD), Santa Cruz Water Department (SCWD) and the University of California at Santa Cruz. While the project was underway, County Water Resources staff gave regular oral project status updates at public forums such as the County Board of Supervisors, County Water Advisory Commission, Santa Margarita Groundwater Basin Advisory Commission, and local water district board meetings. Minutes for the Santa Margarita Groundwater Basin Advisory Committee were submitted to the SWRCB as a grant item for review; the Commission met on:

- May 24, 2007
- October 25, 2007
- April 24, 2008
- October 23, 2008
- May 4, 2009
- November 4, 2009
- May 27, 2010
- November 17, 2010
- May 25, 2011
- November 16, 2011
- May 16, 2012
- November 14, 2012

6.0 Project Assessment and Evaluation

A State Water Board requirement of the Proposition 50 grant award was the completion of a Project Assessment and Evaluation Plan (PAEP). This document provides the framework for a discussion of the relative success and benefit of project implementation. The PAEP includes a Project Performance Measures Table intended to facilitate an evaluation of the project's progress in meeting its stated goals, outcomes, and targets. The Project Performance Measures table from the PAEP is included for reference below (Table 3); the complete PAEP is included in Appendix D.

Table 3. Project Performance Measures (*from* PAEP)

Component Goals	Desired Outcomes	Output Indicators	Outcome Indicators	Measurement Tools and Methods	Targets
Determine the feasibility of conjunctively managing water resource project(s) to benefit quality and supply of surface water and reduce groundwater overdraft in the Lower San Lorenzo River Watershed and Santa Margarita Groundwater Basin	1. Potential conjunctive use alternatives based upon a systematic evaluation of surface and groundwater resources and infrastructure 2. Define the recharge potential and storage capacity of potential conjunctive use alternatives 3. Identify and prioritize the areas where active groundwater recharge would help mitigate groundwater supply issues 4. A preliminary conceptual implementation plan 5. Greater collaboration amongst regional agencies	1. Hydrogeologic and aquifer recharge evaluation (aquifer characterization, storage potential, containment, recovery, quality, recharge methods) 2. Surface Water Availability Evaluation, source water characterization (Type, volume, availability, water rights, water usage, trends) 3. Engineered Facilities Evaluation (conveyance, facility, treatment, size; Unit cost analysis; Inventory of existing infrastructure) 4. Regional Water Demand Projection 5. Stakeholder committee documentation 6. Technical memorandum evaluating alternatives and feasibility of potential conjunctive use projects	1. Enhanced understanding of the region's of surface and groundwater resources 2. Enhanced understanding of infrastructure and stormwater capture, conveyance, storage capabilities 3. Enhanced understanding of aquifer storage and stream baseflow 4. Enhanced understanding of water rights as it pertains to local conjunctive use 5. TAC and stakeholder support of preferred alternative(s)	1. Existing data and reports review 2. Hydro-geological conceptual model 3. Groundwater model 4. Feasibility criteria 5. TAC meeting, participation log	Support and improve local and regional water supply reliability by identifying and evaluating the feasibility of up to three alternatives for large-scale water exchanges and aquifer recharge enhancements to provide up to 500 - 1500 AFY of recharge or in lieu recharge

Goal

The goal of this project was to ***determine the feasibility of conjunctively managing water resource project(s) to benefit quality and supply of surface water and reduce groundwater overdraft in the Lower San Lorenzo River Watershed and Santa Margarita Groundwater Basin***. The project's goal was achieved through the completion of eight technical studies. These studies examined the key concerns thought to be limiting the feasibility of conjunctive use projects, including water quality and water rights, fisheries, geotechnical, water supply, and engineering constraints. A systematic examination of these concerns led to the identification of three, high-priority projects for which preliminary plans were developed.

Outcomes

The project's PAEP identifies outcomes that provide more specific measures of how well the project achieved its goal. The following provides additional detail about what the project set out to accomplish, and how that was reflected in the work that was completed.

Each of the technical memorandums applied existing data and knowledge to answer specific questions about the feasibility of conjunctive use projects in the lower San Lorenzo River watershed and the Santa Margarita Groundwater basin. Much work was previously done in the study area; this project enhanced that knowledge with new information about the loss of potential recharge caused by development, and concluded that reversing that trend should be a priority. We also learned additional details about fisheries restrictions, and about potential water quality concerns with source water for a conjunctive use project. This project inventoried existing infrastructure that could be used in future conjunctive use projects, and enhanced our understanding about aquifer storage and stream baseflow. The water rights analysis demonstrated that some potential sources of water for a conjunctive use project (i.e., Carbonera Creek) are likely infeasible. The work also identified specific analyses that would need to be performed to further assess sources of supply. Finally, the collaborative work on this project strengthened relationships amongst agencies that will be involved in implementing a solution to the area's water resources challenges. Specific outcomes in the PAEP are discussed below:

1. ***Identify potential conjunctive use alternatives based upon a systematic evaluation of surface and groundwater resources and infrastructure:*** As mentioned, technical studies established the technical, physical and regulatory constraints for a conjunctive use project. Over 100 project alternatives were screened, and preliminary engineering, cost and paths were established for 3 preferred alternatives.

2. ***Define the recharge potential and storage capacity of potential conjunctive use alternatives:*** technical memorandum 1B Provides a summary of the factors that control the application of a groundwater recharge projects including the soil conditions, aquifer characteristics and operational issues to provide a general evaluation of the aquifer recharge potential and storage capacity of the southern Santa Margarita Groundwater Basin. The finding indicate multiple locations within the lower San Lorenzo River watershed that would be good locations for recharge. Recharge could be accomplished by passively letting water infiltrate into sandy soils, or by active, engineered solutions

that inject water directly into the sub surface. However accomplished, the findings indicate significant storage capacity in the basin.

3. ***Identify and prioritize the areas where active groundwater recharge would help mitigate groundwater supply issues:*** Technical memorandums 1 – 3 describe the hydrogeologic framework for the Santa Margarita Groundwater Basin, summarize the factors that control the application of a groundwater recharge project, and analyze the potential effectiveness of such projects. Areas within the lower San Lorenzo River watershed that have high recharge potential due to based upon geology and site characteristics should be a priority in locating recharge efforts. For example, sites with sandy, permeable and transmissive soils that readily infiltrate water into the underlying aquifer.

4. ***A preliminary conceptual implementation plan:*** A conceptual implementation plan was developed for each of the three preferred project alternatives. These plans identify engineering, cost and regulatory considerations, and present a theoretical path for implementation. Local agencies are pursuing these alternatives.

5. ***Greater collaboration amongst regional agencies:*** Interagency coordination has been a hallmark of Santa Cruz IRWM effort. However, there has historically been tension between some of the agencies working in the lower San Lorenzo River watershed. This project featured collaboration of all of these agencies, which has helped to build collaborative partnerships. This is illustrated by the continued involvement of these agencies in the development of a water exchange project, which in part, was initiated through this project.

Target

This project's target was to support and improve local and regional water supply reliability by identifying and evaluating the feasibility of up to three alternatives for large-scale water exchanges and aquifer recharge enhancements to provide up to 500 - 1500 AFY of recharge or in lieu recharge. This target was achieved. The completion of the technical studies enabled a feasibility analysis of potential sources of water and recharge applications, the identification and assessment of more than 100 project alternatives, from which three preferred alternatives were identified.

Each of the technical memorandums is a wealth of information pertinent to water resources planning in the lower San Lorenzo River watershed and the Santa Margarita Groundwater basin. These memorandums update existing knowledge about surface water availability and aquifer storage. They provide a clear analysis of constraints associated with water rights and fisheries regulations, and they inventory existing infrastructure that could be utilized for a conjunctive use project. An analysis of over 100 project alternatives resulted in identifying three priority project alternatives. The alternatives feature varying levels of complexity and benefit, though generally the greater the benefit, the greater the cost and complexity. The three preferred alternatives are:

Alternative 1: retrofit existing impervious surfaces in the Scotts Valley area to enhance recharge. The consultant team estimated that this could result in enhanced recharge on the order of 300 – 500 acre-feet per year.

Alternative 2: inter-district surface water exchange for in-lieu of recharge. The basic concept for this project involves using 'surplus' winter runoff treated at the City's treatment plant and providing that water to surrounding groundwater purveyors. This would allow the districts relying upon groundwater to rest their wells and allow the basin to recover. The estimated benefit for this project is 400 – 800 acre-feet per year.

Alternative 3: surface water diversion on the San Lorenzo River to provide water for aquifer recharge in the Hanson Quarry in the Scotts Valley Area. This alternative is similar to alternative two in that it seeks to utilize 'surplus' river flow, but instead of direct use the water would be used for recharge of the groundwater basin. The recharge estimate for this project is approximately 1,000 acre-feet per year.

7.0 CONCLUSIONS

To address the substantial decline in groundwater levels in the Santa Margarita Groundwater Basin (SMGB) and the associated adverse impacts to local stream baseflow and water quality, the County of Santa Cruz undertook a conjunctive use feasibility assessment. This assessment included a series of technical analyses and an evaluation of various water source and aquifer recharge alternatives aimed at reversing the groundwater decline. The primary goal of this project was to determine the feasibility of conjunctively managing water resource projects to benefit quality and supply of surface water and reduce groundwater overdraft in the Lower San Lorenzo River Watershed and Santa Margarita Groundwater Basin.

The project's goal was met primarily through the development of several technical memorandums that provided additional insight to the study area. They applied existing data and knowledge to answer specific questions about the feasibility of conjunctive use projects in the lower San Lorenzo River watershed and the Santa Margarita Groundwater basin. These studies examined the key concerns thought to be limiting the feasibility of conjunctive use projects, including water quality and water rights, fisheries, geotechnical, water supply, and engineering constraints. A systematic examination of these concerns led to the identification of three, high-priority projects for which preliminary plans were developed.

7.1 Next Steps

The County of Santa Cruz has already initiated work on the next phase (Phase II) of this project. The County, with other local agency partners, is presently working on a technical study (*Conjunctive Use and Water Transfers Phase II)* to further evaluate and advance the preferred alternatives identified in this project. The principal tasks to be conducted in Phase II are:

- Review Phase I project work and recommendations
- Develop preliminary project engineering designs
- Address legal and regulatory issues
- Develop engineering-level cost estimates

Work to date has included modeling operational scenarios of flows available for inter-district water transfers and conjunctive use, as well as reviewing the process for evaluating the impact of stream diversions for

transfers on downstream flows and fish habitat. Funding for Phase II is provided by the County ($57,515) and the Department of Water Resources IRWM grant program ($164,500). Other participating local agencies include Scotts Valley Water District, City of Santa Cruz, San Lorenzo Valley Water District, and Soquel Creek Water District. The Phase II technical study is scheduled to be completed by September 2013.

7.0 APPENDICES

A. List of References

B. List of Items for Submittal (Review)

C. List of Sub-Contractors

D. Project Assessment and Evaluation Plan (PAEP)

APPENDIX A

References

ETIC Engineering, 2006, Groundwater Modeling Study of the Santa Margarita Groundwater Basin, ETIC Engineering, Oakland, CA.

APPENDIX B

List of Items for Submittal

All items for review have been submitted to the SWRCB. The Component 3 Items for Review table from the Grant Agreement is provided below for reference.

Item for Review	Estimated Due Date	Estimated Due Date	Date Submitted
Exhibit A	1.1 GPS Information	7/3/2008	6/30/2008
	1.2 Project Assessment and Evaluation Plan (PAEP)	7/3/2008	7/2/2008
	Annual Assessment of PAEP Status	Annually by Dec. 15th	12/15/2009
			12/14/2010
			12/15/2011
	2.3.1 Hydrogeology, Water Availability, and Facilities Studies	6/30/2011	Mar-2011
	2.3.2 Technical Memorandum(s)	6/30/2011	Mar-2011
	2.3.3 Outreach Documentation	6/30/2011	Dec-2012
	2.3.4 Studies, Technical Memorandum and Documentation of Stakeholder Involvement	12/31/2011	Mar-2011
Exhibit B	6.2 Grant Summary Form	7/3/2008	7/2/2008
	6.3 NRPI	5/1/2009	No longer required by SWRCB
	6.4 Draft Component Report	12/31/2011	Dec-2012
	6.5 Final Component Report	3/31/2012	Feb-2012

Item 2.3.2 Technical Memorandums (TM) include:

TM-1A - Hydrogeologic Evaluation

TM-1B - Evaluation of Recharge Potential

TM-1C - Groundwater Modeling Evaluation of Potential Conjunctive Use Projects

TM-2A - Water Rights Evaluation

TM-2B - Streamflow and Stormwater Assessment

TM-2C - Fisheries Study

TM-3 - Engineered Facilities Evaluation

TM-4 - Regional Water Demand

Item 2.3.4 includes the final consultant (Kennedy/Jenks, Inc.) report (August 2011)

APPENDIX C

List of Sub-Contractors

Kennedy/Jenks Consultants (Primary Contractor to County of Santa Cruz)

Balance Hydrologics (Subcontractor to Kennedy/Jenks)

D.W. Alley & Associates-(Subcontractor to Kennedy/Jenks)

Montclair Environmental - (Subcontractor to Kennedy/Jenks)

APPENDIX D

Project Assessment and Evaluation Plan (PAEP)

Northern Santa Cruz County Integrated Regional Water Management Plan

Conjunctive Use and Enhanced Aquifer Recharge (Component 3)

Project Assessment and Evaluation Plan (PAEP)

I. Project Summary

A. Funding Program:

Proposition 50 Integrated Regional Water Management (IRWM) Implementation Grant for the Northern Santa Cruz County. Agreement No. 07-507-550-0 administered by the Regional Water Management Foundation to the sub-grantee County of Santa Cruz, Environmental Health Services.

B. Project Description:

The County of Santa Cruz, Environmental Health Services (EHS) will support the implementation of groundwater recharge and conjunctive use projects in the Lower San Lorenzo River Watershed and Santa Margarita Groundwater Basin by conducting technical studies to determine capacity and feasibility for large-scale water exchanges and aquifer recharge enhancements. The benefits from this project include protecting water supply reliability and groundwater quality, improving surface water quality by increasing baseflows to streams, providing flood control and stormwater management benefits, and fostering regional collaboration.

This PAEP describes the objectives, outcomes, outputs and targets of this project and provides a framework for how the project will be documented to ensure that the goals and objectives are met.

C. Problem Statement:

Groundwater levels in some parts of the Scotts Valley area have declined as much as 200-feet over the past 25-years. A groundwater basin model completed in 2006 suggests that the rate of basin overdraft is significantly higher than that identified in the original groundwater model developed in the early 1990s. The documented impacts from this overdraft include the drying-up of numerous wells in the region and a significant decline in groundwater quality. It is inferred that local stream baseflow and water quality have

been impacted by the groundwater decline, yet there is insufficient documentation to verify this concern.

This project will examine conjunctive use alternatives and aquifer recharge enhancements. The timing of this project is critical because two sand quarries in this region recently ceased operations and are going through post-closure maintenance. Not only are these properties the last large undeveloped tracts of land in this region, one of the properties is in what County technical staff interpret to be a prime groundwater recharge location and the other property is in a area that will be conducive to increase nearby stream baseflows should the project be implemented. If the conjunctive use project is feasible and will enhance groundwater supplies, then the County and partners will examine potential purchase of the land needed for aquifer recharge enhancements.

D. Project Activities or Tasks:

1. Develop, manage, and document the evaluations of Hydrogeology, Surface Water Availability, Engineered Facilities and the Regional Water Demand Projection.
2. Prepare a Technical Memorandum evaluating potential conjunctive use projects and establishing feasibility.
3. Involve the Technical Advisory Committee (TAC) and Stakeholder Committee in the ongoing review and feasibility determination.

E. Category of Project Activities or Tasks:

1. Planning, Research, Monitoring and Assessment

2. Water Conservation, Reliability Enhancement, and Recycling

II. Project Goals & Desired Outcomes

The goal of this project is to determine the feasibility of conjunctively managing water resource project(s) to benefit quality and supply of surface water and reduce groundwater overdraft in the Lower San Lorenzo River Watershed and Santa Margarita Groundwater Basin.

The desired outcomes include the completion of the technical studies and analyses necessary to support the implementation of groundwater recharge and conjunctive use projects. The associated desired outcomes include:

1. Determining the potential conjunctive use alternatives based upon a systematic evaluation of surface and groundwater resources and infrastructure

2. Defining the recharge potential and storage capacity of potential conjunctive use alternatives

3. Identifying and prioritize the areas where active groundwater recharge would help mitigate groundwater supply issues

4. A preliminary conceptual implementation plan

5. Greater collaboration amongst regional agencies

III. Project Performance Measures Table - Conjunctive Use and Enhanced Aquifer Recharge (Component 3)

Component Goals	Desired Outcomes	Output Indicators	Outcome Indicators	Measurement Tools and Methods	Targets
Determine the feasibility of conjunctively managing water resource project(s) to benefit quality and supply of surface water and reduce groundwater overdraft in the Lower San Lorenzo River Watershed and Santa Margarita Groundwater Basin	1. Potential conjunctive use alternatives based upon a systematic evaluation of surface and groundwater resources and infrastructure 2. Define the recharge potential and storage capacity of potential conjunctive use alternatives 3. Identify and prioritize the areas where active groundwater recharge would help mitigate groundwater supply issues 4. A preliminary conceptual implementation plan 5. Greater collaboration amongst regional agencies	1. Hydrogeologic and aquifer recharge evaluation (aquifer characterization, storage potential, containment, recovery, quality, recharge methods) 2. Surface Water Availability Evaluation, source water characterization (Type, volume, availability, water rights, water usage, trends) 3.Engineered Facilities Evaluation (conveyance, facility, treatment, size; Unit cost analysis; Inventory of existing infrastructure) 4. Regional Water Demand Projection 5. Stakeholder committee documentation 6. Technical memorandum evaluating alternatives and feasibility of potential conjunctive use projects	1. Enhanced understanding of the region's of surface and groundwater resources 2. Enhanced understanding of infrastructure and stormwater capture, conveyance, storage capabilities 3. Enhanced understanding of aquifer storage and stream baseflow 4. Enhanced understanding of water rights as it pertains to local conjunctive use 5. TAC and stakeholder support of preferred alternative(s)	1. Existing data and reports review 2. Hydro-geological conceptual model 3. Groundwater model 4. Feasibility criteria 5. TAC meeting, participation log	1. Support and improve local and regional water supply reliability by identifying and evaluating the feasibility of up to three alternatives for large-scale water exchanges and aquifer recharge enhancements to provide up to 500 - 1500 AFY of recharge or in lieu recharge