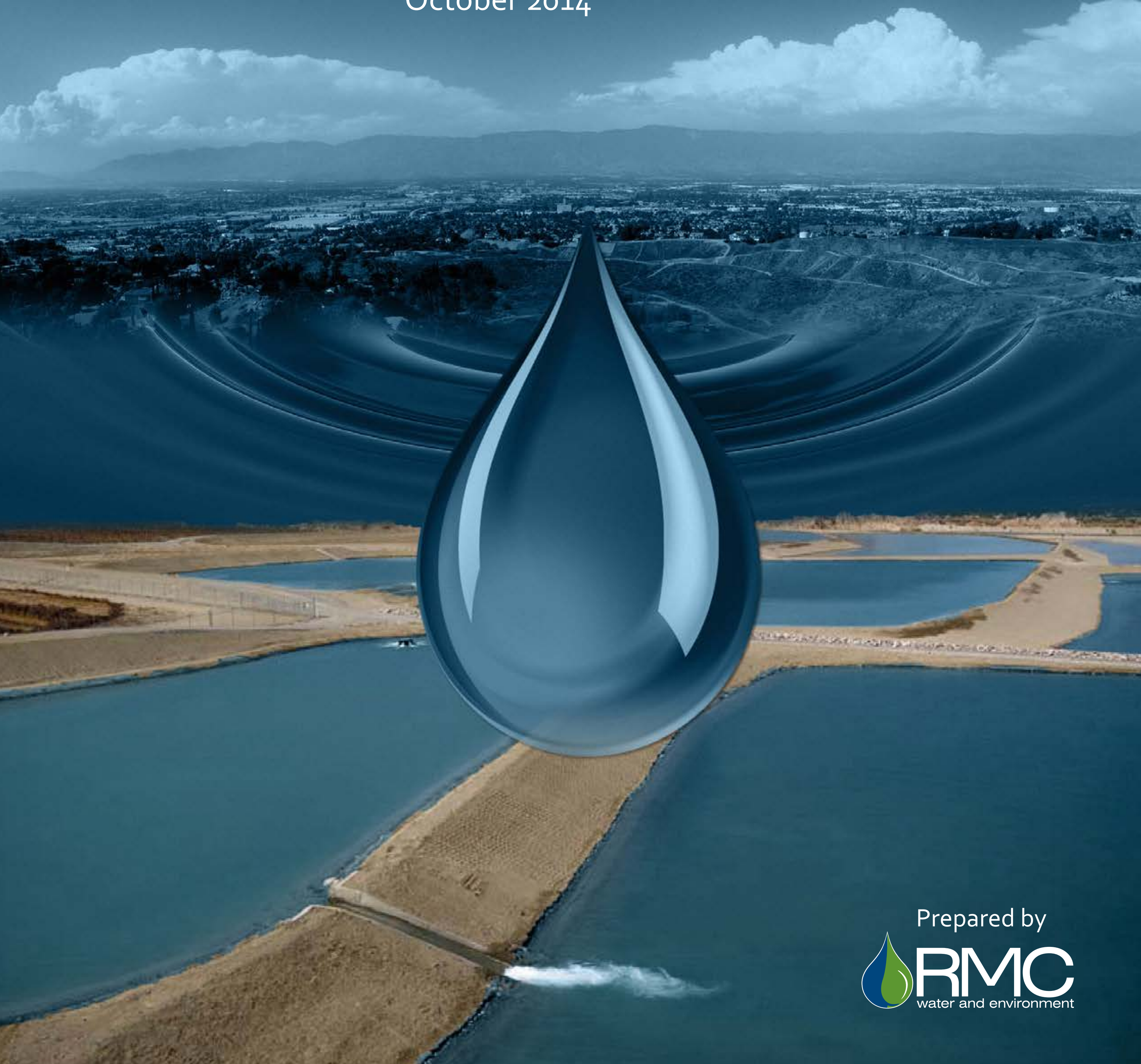
East Valley Water District

# Recycled Water Feasibility Study

October 2014



Prepared by RMC water and environment

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# Recycled Water Feasibility Study Final Report

**Prepared by:**

RMC water and environment

**October 2014**

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## Acknowledgements

The Recycled Water Feasibility Study was prepared by a core team of the East Valley Water District (District) and RMC Water and Environment (RMC) staff, with the input of a number of participants and stakeholders that we would like to acknowledge herein.

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## List of Abbreviations

| | |
|---|---|
| μg/L | micrograms per liter |
| ADA | anti-degradation analysis |
| ADWF | average dry weather flow |
| AF | acre-feet |
| AFY | acre-feet per year |
| AHHG | Area of Historic High Groundwater |
| ASR | aquifer storage and recovery |
| BTAC | Basin Technical Advisory Committee |
| CCC | Criteria Continuous Concentration |
| CDBM | Chlorodibromomethane |
| CDFW | California Department of Fish and Wildlife |
| CDPH | California Department of Public Health |
| CEC | constituents of emerging concern |
| CEQA | California Environmental Quality Act |
| CIP | Capital Improvement Program |
| CMC | Criteria Maximum Concentration |
| CT | chlorine residual x modal contact time |
| CTR | California Toxics Rule |
| CWA | Clean Water Act |
| CWC | California Water Code |
| DB | design-build |
| DBB | design-bid-build |
| DCBM | Dichlorobromomethane |
| DDW | Division of Drinking Water |
| District | East Valley Water District |
| DWR | Department of Water Resources |
| EDU | equivalent dwelling unit |
| EIR | Environmental Impact Report |
| EIS | Environmental Impact Statement |
| ER | Engineering Report |
| FEMA | Flood Emergency Management Agency |
| GIS | Geographic Information System |
| GMP | guaranteed maximum price |

| | |
|---|---|
| gpd | gallons per day |
| gpm | gallons per minute |
| GWR | groundwater recharge |
| GWR-RW | Groundwater recharge-recycled water |
| H&SC | California Health and Safety Code |
| IPR | indirect potable reuse |
| IRWMP | Integrated Regional Water Management Plan |
| JPA | Joint Powers Agreement |
| LF | linear feet |
| MBR | membrane bioreactor |
| MCL | maximum contaminant level |
| MF/RO | microfiltration/reverse osmosis |
| mg/L | milligrams per liter |
| MGD | million gallons per day |
| mL | milliliters |
| MPN | most probable number |
| MUN | municipal and domestic supply |
| MWB | middle water bearing member |
| NaCl | sodium chloride |
| NDMA | N-nitrosomethylamine |
| NEPA | National Environmental Policy Act |
| ng/L | nanograms per liter |
| NLs | notification levels |
| NPDES | National Pollutant Discharge Elimination System |
| NPR | non-potable reuse |
| NPW | net present worth |
| NTR | National Toxics Rule |
| NTU | nephelometric turbidity units |
| O&M | operations and maintenance |
| Plant 134 | Philip A. Disch Surface Water Treatment Plant |
| PMC | Pathogenic Microorganism Control |
| Prop | Proposition |
| RA | reservoir augmentation |
| RBFM | Refined Basin Model Flow |

| | |
|---|---|
| RIX | Rapid Infiltration and Extraction |
| RMC | RMC Water and Environment |
| ROWD | Report of Waste Discharge |
| RRT | Response Retention Time |
| RTP | 2008 Regional Transportation Plan |
| RWC | recycled water contribution |
| RWQCB | Regional Water Quality Control Board |
| SANBAG | San Bernardino Associated Governments |
| SAR | Santa Ana River |
| SARI | Santa Ana River Interceptor |
| SAT | soil aquifer treatment |
| SBBA | San Bernardino Basin Area |
| SBCFCD | San Bernardino County Flood Control District |
| SBR | sequential batch reactor |
| SBVMWD | San Bernardino Valley Municipal Water District |
| SBVWCD | San Bernardino Valley Water Conservation District |
| SBWRF | San Bernardino Water Reclamation Facility |
| SIP | Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California |
| SNMP | Salt Nutrient Management Plan |
| SRF | State Revolving Fund |
| Stantec | Stantec Consulting |
| Study | Recycled Water Feasibility Study |
| SWRCB | State Water Resources Control Board |
| TDS | total dissolved solids |
| Title 17 | California Code of Regulations, Title 17 – Public Health, Chapter 5, Subchapter 1, Group 4 – Drinking Water Supplies, sections 7583 through 7630 |
| Title 22 | California Code of Regulations, Title 22, Division 4, Chapter 3 |
| TMDL | total maximum daily load |
| TOC | total organic carbon |
| TSS | total suspended solids |
| UCM | unconfined member |
| UF | ultrafiltration |
| USACE | U.S. Army Corps of Engineers |
| USBR | United States Bureau of Reclamation |

| | |
|---|---|
| USEPA | United States Environmental Protection Agency |
| USGS | United States Geological Survey |
| UV | ultraviolet |
| UWB | upper water bearing member |
| WDR | waste discharge requirement |
| WEI | Wildermuth Environmental, Inc. |
| Western | Western Municipal Water District |
| Western Judgment | Western-San Bernardino Judgment of 1969 |
| WRP | water recycling plant |
| WRR | Water Reuse Requirement |
| WSMP | 2014 Water System Master Plan |
| WWCSMP | 2013 Wastewater Collection System Master Plan |

# Executive Summary

The East Valley Water District (District) has a historic opportunity to provide an increased level of service to its customers through implementation of a recycled water program. A recycled water program will provide the District's customers with the following benefits:


- A new, locally controlled, highly reliable source of water to help meet the District's and the region's water supply needs;
- Greater control over the cost of wastewater treatment by bringing that component of service completely under the control of the District; and
- Reduced costs associated with providing long-term service to the existing customer base and reduced cost of connection and service for new customers.

It is recommended that the District initiate a recycled water program to treat all flows collected by the District by constructing the Sterling Recharge Facility. It is recommended that the Sterling Recharge Facility be a Membrane BioReactor (MBR) facility, with the treated flows used for groundwater recharge, providing the greatest benefit to the District's customers. This approach makes the District self-reliant rather than relying on the City of San Bernardino for treatment and disposal.

# Unique Opportunity

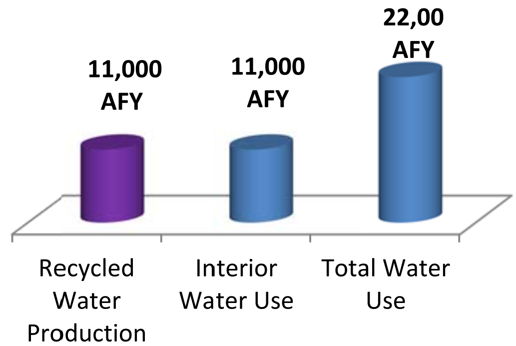
The timing could not be better for the East Valley Water District to implement the Sterling Recharge Facility. Some of the factors creating the unique timing of this opportunity include:

1. California is currently in the third year of severe drought, bringing to light the availability and reliability of the District's water supplies. Implementing projects to protect against the impacts of future droughts is critical to providing a long-term reliable water supply. The most appropriate response for the District is to develop a locally-controlled, sustainable recycled water supply.
2. California is facing continued challenges and costs associated with importing water through the Sacramento-San Joaquin Delta, including water deliveries to the District's service area. The most appropriate response for the District is to develop a locally-controlled, sustainable recycled water supply that can augment imported water supplies.
3. The California legislature has passed historic groundwater management legislation that will bring a greater focus on groundwater management throughout California, including the Bunker Hill Groundwater Basin underlying the District. The most appropriate response for the District is to develop a locally-controlled, sustainable recycled water supply to assist in managing the local groundwater basin.
4. The California State Water Resources Control Board has an objective of creating over 1 million acre-feet of recycled water use by the year 2020, and over 2 million acre-feet per year by the year 2030. The State is providing incentivized funding to assist in meeting this goal. The most appropriate response for the District is to develop a locally-controlled, sustainable recycled water supply in support of the State's objective.

5. The California legislature has placed a bond measure on the November, 2014 ballot to provide $7.5 billion of funding for water development in California. The most appropriate response for the District is to access potentially available funding to develop a locally-controlled, sustainable recycled water supply.

## Need for Recycled Water

The District currently relies on the City of San Bernardino to treat its wastewater, which is then discharged to the Santa Ana River. The treated water from the San Bernardino treatment plant is a valuable resource that is not presently available to serve the water supply needs of the District's customers. The Bunker Hill Groundwater Basin, which lies beneath all of the District's service area, has seen declining water levels over the past several years as local runoff has diminished and imported water deliveries have been reduced. In fact, the Bunker Hill Groundwater Basin is at historic lows in terms of the amount of water in the basin.




Recycled water will provide a drought-proof supply equal to the interior water use of the District's customers, providing assurance of critical water supply in future droughts.

Using recycled water to help recharge the groundwater basin would be a significant local water supply to use to assist in managing the Bunker Hill Groundwater Basin levels and providing a long-term reliable water supply. Further, the recycled water production will be approximately equal to the indoor use of treated water delivered by the District to its customers, providing its water customers with a drought-proof supply for indoor water use.

## Avoided Costs

The District's recently completed water and wastewater master plans identified the need for additional water supply and the need for increased wastewater conveyance capacity. Implementing the proposed Sterling Recharge Facility will provide additional water supply and will reduce the level of required investment in wastewater system conveyance improvements. The estimated savings to the District's customers in the required level of wastewater infrastructure improvements is estimated to be approximately $20 million.

## Why Groundwater Recharge?

Groundwater recharge was found to be the most appropriate use due to a number of factors, including lower cost, increased local water supply, and long-term benefits to the District's customers. Other uses of recycled water were evaluated, but were found to be less advantageous.

The use of recycled water to replenish groundwater basins has been successfully implemented throughout Southern California since the early 1950s. The use of recycled water for groundwater recharge is regulated by the State of California, who earlier this year adopted a new set of regulations for increased recycled water use, paving the way for increasing the use of recycled water for recharging groundwater basins and improving water supply reliability.

Implementing the Sterling Recharge Facility would provide a reliable local water supply for the region and help offset the need for increased amounts of imported water. Some of the key benefits that would result from using recycled water for groundwater recharge are summarized in the table below.

**Key Benefits of a Groundwater Recharge Program**

| Benefit Category | Benefit Description |
|---|---|
| Water Supply Reliability | Provides new source of water supply that is reliable, "drought-proof," and locally- controlled |
| | Diversifies regional water supply portfolio |
| Resource Management | Provides year-round beneficial use for recycled water |
| | Promotes highest and greatest beneficial use of recycled water |
| Integration/Synergies with Other Practices | Augments current groundwater recharge practices employed by the San Bernardino Valley Municipal Water District |
| Consistency with State Goals and Objectives | Embraces State guidelines and policies relative to recycled water, groundwater management, and diversification of water supplies |

# What are the Options?

Three fundamental approaches for meeting the District's wastewater treatment needs were evaluated:

- Continue to send all of the District's flows to the City of San Bernardino
- Treat 60 percent of the District's flows at a new plant located on Sterling Avenue
- Treat all of the District's flows at a new plant located on Sterling Avenue

These three fundamental approaches were evaluated on a comparative cost basis over a 20-year planning period. The results showed that there is a clear advantage to the District's customers if the District the Sterling Recharge Facility and treats all flows.

If the District were to continue to send flows to San Bernardino, costs would increase approximately 24% over the next 20 years, as compared to increasing only 7% over the same period of time if the District constructs a plant and treats all flows. Furthermore, there is a similar clear advantage to the cost per EDU (Equivalent Dwelling Unit) for future connections if the District treats all flows.

| Project Option | Comparative 20-Year Cost Increase |
|---|---|
| All Flow Treated by City of San Bernardino | 24% |
| 60% of Flow Treated by District | 19% |
| All Flow Treated by District | 7% |

Treating all flows provides the least increase in cost of the three options available to East Valley Water District.

This relative comparison of costs has assumed the cost of treatment by the City of San Bernardino does not increase over the next 20 years, and that the value of the recycled water similarly does not increase over the next 20 years. Both of these assumptions are conservative in their nature and therefore reinforce the conclusion that the least cost option is for the District to implement a recycled water program.

## Value of the Created Resource

Recycled water will constitute a new water resource for the District. The value of this resource is best established by comparing it to the existing cost of California State Project Water. The current cost of State Project Water (2014) is $662 per acre-foot, delivered to the East Branch turnout near Highland, California. The cost of State Project Water will increase in the future due to a number of factors, including the cost of the Delta fix, currently known as the Bay Delta Conservation Plan (BDCP). A 10 MGD plant flow will generate approximately 11,200 acre-feet per year of water with a relative current annual value of approximately $7.4 million.

## Proposed Project

The proposed project consists of constructing an MBR-based recycled water treatment plant, associated pipelines and pumping stations, with recharge to the groundwater basin. Several facility sites were evaluated for use and ranked based on specific criteria. The District-owned property located at Sterling and 5th Avenues, adjacent to the San Bernardino Airport, has been selected as the most appropriate site for the proposed facility. The site lends itself well to potential multi-beneficial development options, which will be explored during project implementation.

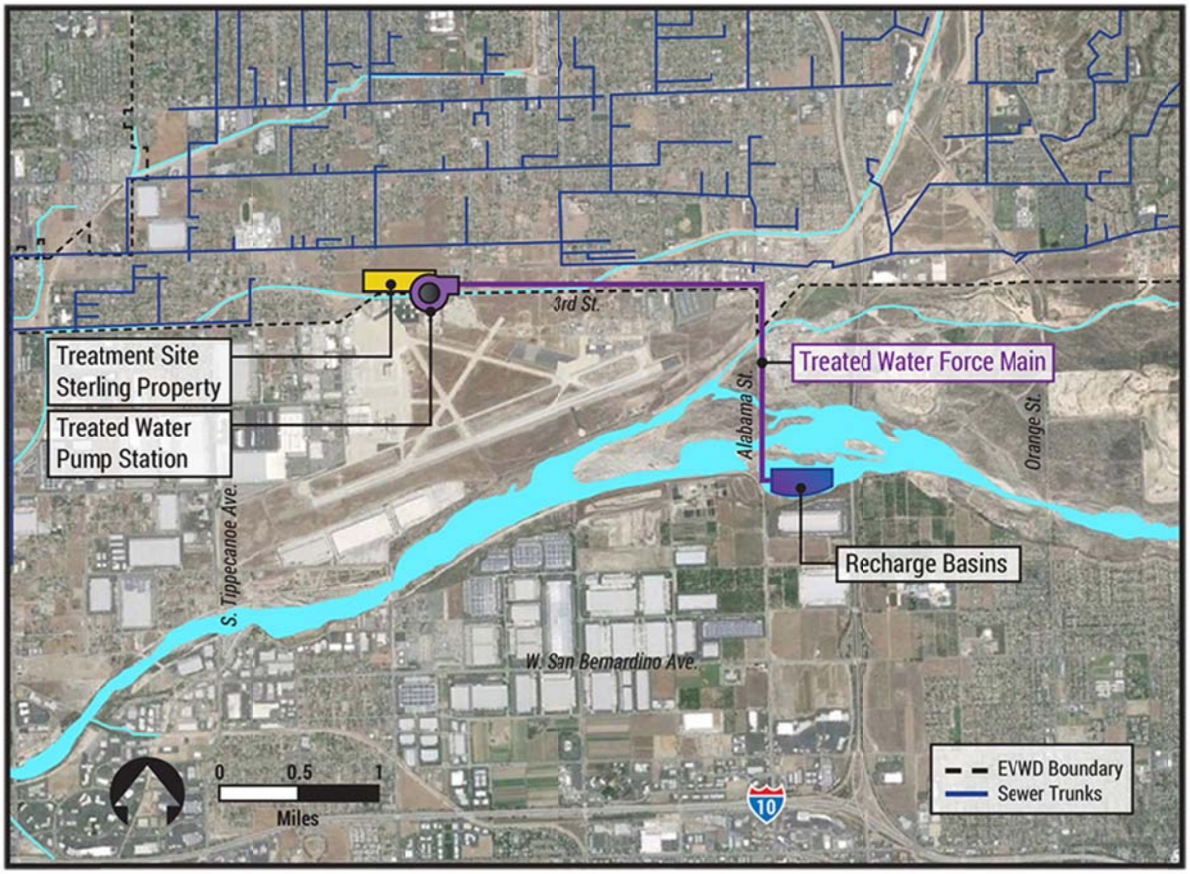
**Recycled water is a valuable resource.**

- *A 10 MGD plant will produce 11,200 acre-feet per year*
- *An acre-foot of State Project Water costs $662*
- *The value of 10 MGD of water is $7.4 million per year*

The proposed site is owned by the District and is located adjacent to the San Bernardino Airport.

The Sterling Recharge Facility would be constructed on a District-owned parcel of land, located at Sterling Avenue between East 5th Street and East 3rd Street. Approximately half of the service area flows would be intercepted at the intersection of East 6th Street and diverted to the new treatment plant. The remaining portion of the service area flows would be captured at the low end of the collection system and pumped east along East 5th Street to the new treatment plant.

The treatment plant would utilize the most advanced technology – Membrane BioReactors (MBR) - to produce disinfected tertiary Title 22 recycled water that would meet all applicable requirements for recharge into the Bunker Hill Groundwater Basin. Recharge is proposed to be through existing recharge basins, facilitated by cooperating agreements between the District and the owners of the existing basins.




The proposed project includes a new treatment plant located near Sterling Avenue on District property.

## Consistency with the Community

An MBR treatment facility utilizes the most up-to date technology available. Use of this technology lends itself to making the treatment facility a good neighbor in any neighborhood due to the smaller foot-print of the treatment process, which provides the ability to enclose the treatment facility to eliminate odors and noise impacts to the surrounding community. The proposed plant location is adjacent to the San Bernardino Airport. There are numerous commercial/industrial development opportunities being considered on surrounding properties, and the treatment facility can be constructed in a manner to be consistent with the potential development opportunities.

MBR technology provides the ability to build and operate a treatment plant that is a good neighbor – producing no odors and no noise.

Similar treatment plants have been constructed and are in use in communities throughout the country. District officials visited three similar facilities – a demonstration facility in Anaheim, California, and two treatment plants near Seattle, Washington– the Lighthouse Plant and the Brightwater Plant. All three of these facilities produce high-quality recycled water with no odor or noise impacts to the surrounding community.

A similar approach can be utilized for the East Valley facility. The Sterling Recharge Facility can be designed to:

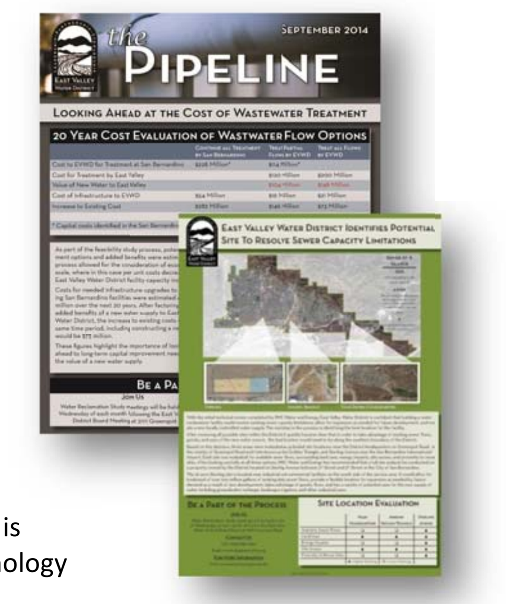
- Be consistent with developments surrounding or near the proposed facility site;
- Be a multi-use site, where other development could be made on the District's existing land in concert with a new treatment plant;
- Be designed to produce no odors or noise;
- Be aesthetically pleasing; and
- Provide opportunities for community uses such as meetings, training, classrooms, and similar uses.

## Community Involvement

The District has conducted and will continue to conduct an extensive community outreach program for the Sterling Recharge Facility project. Monthly workshops were conducted to inform the Board and the public about the project, the project issues, opportunities, and recommendations.

The District conducted community forums, provided information in the newspaper, in mailers, and on its website to assist in informing the public about the challenges facing the District and the opportunity that can be afforded by implementing a recycled water program.

The District conducted a public tour of the Anaheim Water Recycling Demonstration Facility. The City of Anaheim facility is located adjacent to City Hall and employs the same MBR technology that is being recommended for East Valley Water District.




The District conducted an extensive outreach program to inform the community and to receive input to the planning process.

## Economic Benefits

**The financial benefit to the local economy from construction of a recycled water treatment plant is estimated to be $215 million.**

Investment in the Sterling Recharge Facility recycled water program will result in additional benefits to the local economy. According to estimates provided by SRRI, a group associated with the Sacramento Area Commerce and Trade Organization, a $1 million investment in infrastructure and public works projects generates an additional $825,858 of output through indirect and induced activities. Constructing the Sterling Recharge Facility, with a capital cost of approximately $118 million, would have an added local economic benefit of $97 million, providing a net financial benefit of $215 million to the local economy. Further, according to the SRRI estimates, construction of a new facility would generate over 800 direct construction jobs, and over 1,400 total new jobs.

# Budgetary Cost Estimate

The following table summarizes the estimated costs for each major component for the proposed project. These estimates are budgetary cost estimates and should be refined as project planning progresses. Costs presented below are based on the ultimate plant capacity of 10 MGD.

### 10 MGD Project Budgetary Cost Estimate

| Project Components | Estimated 10 MGD Project Cost |
|---|---|
| Water Reclamation Plant | $103.3 M |
| Treated Water Conveyance System | $15.2 M |
| **Total Capital Cost** | **$118.5 M** |

Implementation of the Sterling Recharge Facility will be phased. The existing flows from the entire District are approximately 6 MGD, necessitating a minimum initial plant capacity of 6 MGD. Projected flows will require increases in the treatment plant to a future capacity 10 MGD. The initial treatment plant capacity and associated phasing will be refined during the next phase of the project. Presented below are the budgetary cost estimates of an initial 6 MGD treatment plant that can be expanded to a future 10 MGD capacity. Under this scenario, the treated water conveyance system is constructed to accommodate the full projected flow of 10 MGD.

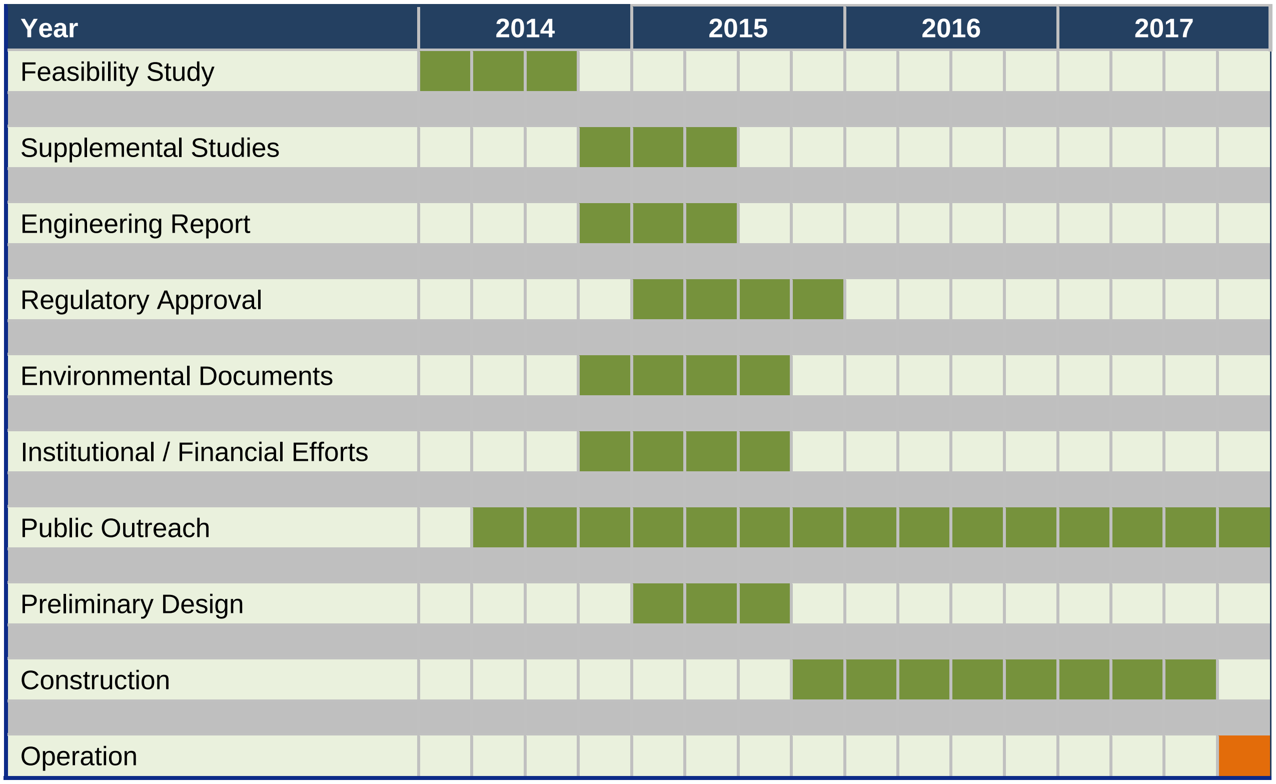
### 6 MGD Project Budgetary Cost Estimate

| Project Components | Estimated 6 MGD Project Cost |
|---|---|
| Water Reclamation Plant | $61.4 M |
| Treated Water Conveyance System | $15.2 M |
| **Total Capital Cost** | **$76.6 M** |

# Implementation Plan

Implementation of Sterling Recharge Facility will require numerous activities – permitting, environmental reviews, financial evaluations, engineering development, and ultimately construction and initiation of operations. The timeline requires a focused, parallel approach to permitting, environmental compliance, and preliminary design.

Proposed Implementation Timeline




## Conclusions

Implementing Sterling Recharge Facility recycled water program will provide the District a valuable water resource benefitting all District customers and the region overlying the Bunker Hill Groundwater Basin. Utilizing recycled water for groundwater recharge will augment current recharge activities in the basin and will avoid costs associated with the City of San Bernardino continuing to providing wastewater treatment. Cost savings associated with upgrades to the District's wastewater collection system will partially offset capital and annual operations and maintenance costs associated with implementation of the proposed project.

Implementing the Sterling Recharge Facility will result in the lowest cost for wastewater treatment to existing District customers and the lowest incremental cost for new customers connecting to the District's system. Further, during construction, the proposed project would provide an estimated $185 million economic benefit to the local economy and would generate over 1,400 new jobs.

Finally, the addition of a new, locally-controlled and highly reliable water supply will have an annual economic value of up to $7.4 million.

# Chapter 1 Introduction

The Recycled Water Feasibility Study Final Report (Study) was conducted by RMC Water and Environment (RMC) as a consultant to the East Valley Water District (District). Currently, the District collects the wastewater generated by its customers which is treated at the City of San Bernardino Water Reclamation Facility (SBWRF). The purpose of this Study was to determine if the District should engage in wastewater treatment and delivery as a part of their overall mission to provide water and wastewater services to its customers. The results of this Study indicate a number of advantages to the District that can be achieved by engaging in wastewater treatment and groundwater recharge with recycled water (GWR-RW). This chapter provides background on the Study, discusses the purpose and scope as well as the stakeholder coordination process.

## 1.1 Background

This section provides a brief description of the Study area as well as a discussion of the need for implementing GWR-RW projects in the Study area.

### 1.1.1 Study Area

The District provides water to over 97,000 residents through 23,135 service connections in the cities of Highland, San Bernardino, and unincorporated portions of San Bernardino County. The 30 square mile service area lies in the foothills of the San Bernardino Mountains at the confluence of the Santa Ana River (SAR) and City Creek. Although historically known for citrus agriculture, the service area's land use is predominantly residential. The District serves 18 million gallons per day (MGD) of water to customers using three water sources: Bunker Hill Groundwater Basin (90%), the SAR (9%) and State Water Project (SWP) imports (1%). The District diverts SAR water east of Seven Oaks Dam via the North Fork Canal to the Philip A. Disch Surface Water Treatment Plant (Plant 134), capable of treating 8 MGD. Groundwater is pumped from the Bunker Hill Basin through a series of 18 District owned wells. Approximately 1% of The District's water supply is imported from SWP purchased through the San Bernardino Valley Municipal Water District (SBVMWD) and treated at Plant 134.

The District also owns, operates, and maintains the service area's wastewater collection system. Wastewater is currently conveyed to the SBWRF via the East Trunk Sewer. The District maintains the right to discharge wastewater into the East Trunk Sewer (or other tributary sewers) through the Joint Powers Agreement (JPA) of 1957. The City of San Bernardino charges the District for wastewater treatment services, which is paid by District customers through monthly rates.

The District is projecting a 30-46% population growth in their service area by the year 2035, when full build out is expected to occur. A substantial portion of the growth is attributed to proposed areas for new development including Harmony, Arnott Ranch, Highland Hills Ranch, and Greenspot Village and Marketplace. The timing of construction and occupancy of these new developments is a crucial component to understanding the facility needs for the District. A discussion of population growth is provided in Chapter 5.

### 1.1.2 Need for Groundwater Recharge Using Recycled Water

The reliability of water supplies is becoming an increasingly important consideration for the long-term health and economic wellbeing of communities throughout California. With increases in demand and increased restrictions on water deliveries, it has become increasingly more valuable for communities to consider means of recycling water and including recycled water in the overall water supply portfolio. Implementation of recycled water for the District would help in addressing the following needs:

- **Increasing Demand** – Projected Population growth suggests a potential increase in demand in water supply of approximately 9,600 acre-feet per year (AFY) by the year 2035.

- **Groundwater Supply** – The Bunker Hill Groundwater Basin supplies approximately 90% of the District's system demands. In 2014, the San Bernardino Valley Water Conservation District (SBVWCD) conducted an Engineering Investigation of the basin, which indicated that the basin storage is 444,322 acre-feet (AF) below the amount that has been considered full since 1993 (SBVWCD, 2014). Recharging the basin is crucial to maintaining groundwater as a viable water source for the future. Implementing a recycled water project would result in providing thousands of AFY of new water supply to the customers of the District and the producers of Bunker Hill basin.
- **State Water Project Supply Reliability –** The District currently relies on SWP water for approximately 1% of the overall demands. SWP deliveries can vary between 5% and 100% of contractor entitlements depending on availability of water and conveyance means. The additional supply resulting from a recycled water project further protects the District's water supply self-reliance.
- **Increased control of wastewater treatment and disposal costs –** In 1957, the District entered into the JPA with the City of San Bernardino to obtain wastewater treatment. Implementing a WRP would provide the District with the opportunity to increase operational efficiency while planning for the future needs.
- **Avoided Sewer upgrades** – The District has identified the need for substantial wastewater collection system improvements to accommodate expected growth in the service area. Approximately $20 million in capital improvements costs could be avoided by treating these flows in a new WRP, eliminating the need to convey flow to the SBWRF.

## 1.2 Study Purpose and Scope

The main purpose of the Study was to evaluate the feasibility of developing a water supply project for the District utilizing GWR-RW as the primary mechanism. The Study focused on the feasibility of the project from an institutional, regulatory, technical, and financial perspective. These opportunities and challenges were studied in sufficient detail to develop an implementation plan and schedule, providing the District with the basis for making a decision on how to move forward with implementing a WRP for GWR-RW.

### 1.2.1 Study Scope

The Study was designed to develop a recycled water project concept that could be supported by interested stakeholders, an implementation plan that delineates how the project would be built, an implementation schedule, and a project funding strategy. The implementation plan takes into consideration potential environmental and other regulatory requirements as well as project component siting, sizing, and costs. Alternative strategies to implement a recycled water project, particularly a groundwater recharge project, were evaluated, taking into consideration related regional initiatives, regulatory approval pathways, water rights, institutional issues, and cost implications. These alternative strategies considered both water supply reliability and effluent management benefits deemed to be feasible. The specific approach for each technical task and associated outcomes are presented in the different chapters of this report.

### 1.2.2 Stakeholder Coordination

A key objective of this Study was to meaningfully engage local agencies and stakeholders to obtain a broad spectrum of input, to build support for the Study outcomes, and to facilitate coordination with other regional initiatives. The District has taken the lead on engaging community stakeholders and RMC provided ongoing support to the District in order to facilitate public meetings and presentations. Monthly workshops were conducted at the Board of Directors meetings to facilitate communication and public dialogue.

# Chapter 2 Recycled Water Overview

Recycled water standards are specified in the California Code of Regulations, Title 22, Division 4, Chapter 3 (Title 22). Recycled water is monitored by local, state, and federal regulatory agencies to ensure that it meets these strict standards. This chapter is intended to provide a general overview of Recycled Water Reuse and further definition of GWR and GWR-RW.

## 2.1 Non-Potable and Indirect Potable Reuse

The primary recycled water reuse opportunity evaluated in this study is indirect potable reuse (IPR), however discussion of non-potable reuse (NPR) is included since it was evaluated as a secondary reuse opportunity that may provide additional revenue to the District.

**NPR**

NPR refers to the use of recycled water for applications that do not require drinking water quality standards, including landscape irrigation (e.g., golf course, parks, roadway medians, and cemeteries), cooling towers and other industrial uses, toilet flushing, wetlands restoration, decorative fountains, and irrigation of food crops. NPR requires a source of supply, a dedicated recycled water pipeline to distribute the water, and a customer demand (end use) for the water.

**IPR**

IPR refers to the use of recycled water to augment drinking water supplies to be subsequently treated for potable use. IPR applications generally fit into two categories: groundwater recharge of recycled water (GWR) and reservoir augmentation (RA). GWR-RW utilizes natural soil aquifer treatment (SAT), while RA requires surface water treatment to meet drinking water quality standards. This Study focused on IPR through groundwater recharge (GWR-RW) and did not consider reservoir augmentation.

## 2.2 Bunker Hill Groundwater Basin

The Bunker Hill Groundwater Basin consists of alluvial material and is bounded by the San Gabriel Mountains, San Bernardino Mountains, Crafton Hills as well as several faults including the Banning, Redlands, San Andreas, Glen Helen, and San Jacinto faults. The basin is located within what is referred to as the San Bernardino Basin Area (SBBA) and stores approximately six million AF of water, which is the primary water source for the District's service area. The basin is made up of two sub-basins: Bunker Hill A to the North-West and Bunker Hill B to the South-East. The District's service area overlies Bunker Hill Basin B. The basin is adjudicated under the Western-San Bernardino Judgment of 1969 with a court-appointed Watermaster including representatives from SBVMWD and Western Municipal Water District (Western). The proposed basin management process could be under the authority of the SBVMWD and Western Boards of Directors with inputs from other significant producers. The City of San Bernardino Municipal Water Department (SBMWD) and Western are responsible for managing a groundwater spreading/management program using imported SWP water as well as SAR water under the Seven Oaks Accord. The SBVWCD operates the artificial recharge facilities as part of this program and provides regular reporting of recharge activities to maintain basin equilibrium.

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# Chapter 3 District Water Reuse Setting

Potential strategies for GWR-RW as well as implementation strategies are dependent on a combination of primary factors, including hydrogeology of the Study area (e.g., volume, quality, yield, and transmissivity), expected recycled water availability and quality as well as diluent water reliability and quality.

This chapter documents and analyzes the primary factors listed above. Potential strategies were developed based on this analysis of the GWR setting and the regulatory analysis documented in **Chapter 6**. The potential strategies are presented in **Chapter 12**.

## 3.1 Existing Reports and Data

Many relevant reports have been prepared over the past 10 years or are currently being developed by various agencies in San Bernardino Valley. These reports were reviewed to support this Study.

In addition to these reports, relevant data was obtained directly from the potential project partners. Readily available, and most current water quality, flow, and various other data was directly summarized or referred to in the text. Geographic Information System (GIS) data was used to develop the maps and figures included in this Study. Due to non-disclosure agreements signed with the partner agencies, the GIS data are not provided in electronic form in this report.

## 3.2 Recycled Water Resources

The sole source of recycled water considered for this study will be generated from wastewater collected within the District's service area encompassing the City of Highland and portions of the City of San Bernardino and unincorporated areas of the County of San Bernardino. The proposed WRP effluent is the only source of recycled water considered for GWR.

For the purpose of this study, the key information necessary relative to the treatment plant is as follows:

- Treatment Capacity
- Water Quality
- Source Control

### 3.2.1 Recycled Water Source

This Study assumes that all District wastewater flow, which is currently treated at the SBWRF is available to be treated at the WRP to produce recycled water for GWR-RW.

### 3.2.2 Recycled Water Quality

Recycled water quality is a fundamental driver in defining potential alternatives. Title 22 establishes treatment and other requirements for NPR and GWR. Higher levels of treatment provide greater opportunities for the types of reuse applications that can be considered; however, the feasibility of alternatives is related to local demand.

### 3.2.3 Recycled Water Demands

For this purpose of this study NPR and IPR alternatives have been evaluated as potential reuse opportunities based on potential demands.

**NPR Demands**

A market analysis of the District's service area is summarized in **Chapter 4**. Although the overall NPR demand in the District's service area is relatively insignificant, irrigation customers and potential recycled water customers, and associated demands were identified in the District's 2014 *Water System Master*

*Plan*. Based on the demands, it would be possible to serve NPR customers from a proposed conveyance system for an IPR. Providing these customers with recycled water for irrigation or other NPR uses will secure an additional revenue stream for the District.

**IPR Demands**

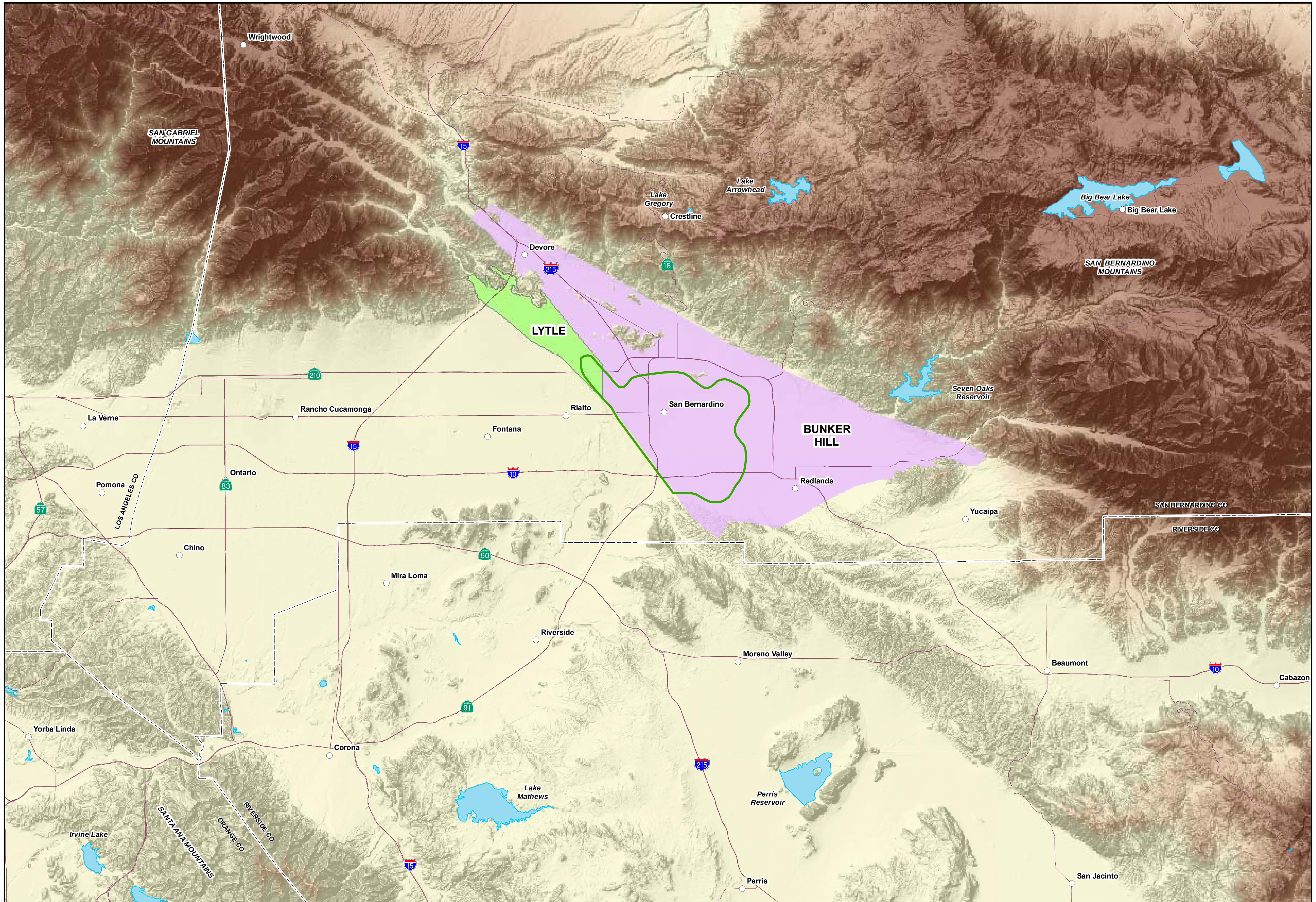
Demand for a GWR-RW project is defined by the service area's potable water demand along with the water balance and the storage capacity within the local groundwater basin. A hydrogeological analysis and characterization of the Study area was performed to determine the basin's available storage capacity and state of equilibrium as a result of current and projected pumping for potable water demands. The following section summarizes the Study area's hydrogeological conditions.

## 3.3 Hydrogeology

The SBBA includes the Bunker Hill basin as well as the Lytle Groundwater Basin as shown in **Figure 3-1**. The District's service area overlies Bunker Hill Basin. Approximately 600,000 residents in the SBBA including the District's service area depend upon this groundwater basin as their primary water source.

Groundwater in the SBBA generally flows westerly from the SAR and Mill Creek and southeasterly from Lytle Creek and Cajon Creek toward the Pressure Zone area. The San Jacinto Fault generally runs perpendicular to the groundwater flow and acts as a barrier, or underground dam, causing the groundwater "pool" behind the fault to rise toward land surface in the form of high groundwater. The water in this area also rises due to the pressure caused by the water on the outer edges of the basin, which is at a higher elevation. The area defined by this high groundwater condition is located entirely within the City of San Bernardino and is commonly referred to as the Pressure Zone or the Area of Historic High Groundwater (AHHG). In the past, water levels in the AHHG rose high enough to cause artesian conditions (groundwater rising above land surface).

The SBBA is also plagued by groundwater contamination plumes as shown in **Figure 3-2**. Contaminants have mainly been found within the shallow, unconfined member (from land surface to 75 feet below land surface), the upper water bearing zone member (between 75 feet and 300 feet below land surface) and the middle water bearing member (between 400 feet and 600 feet below land surface). Due to the presence of groundwater contamination and a high salt content, local water agencies deliberately avoid extracting groundwater from the unconfined member (UCM), portions of the upper water bearing member (UWB), and the middle water bearing member (MWB) (Geoscience 2009).




# GENERAL PROJECT LOCATION

# Figure 3-1

EXPLANATION

- Bunker Hill Groundwater Basin
- Lytle Groundwater Basin
- Pressure Zone
- County Boundary

30-Sep-09

Prepared by: DWB

Map Projection: State Plane 1983, Zone V, feet

NORTH

0 5 10 Miles

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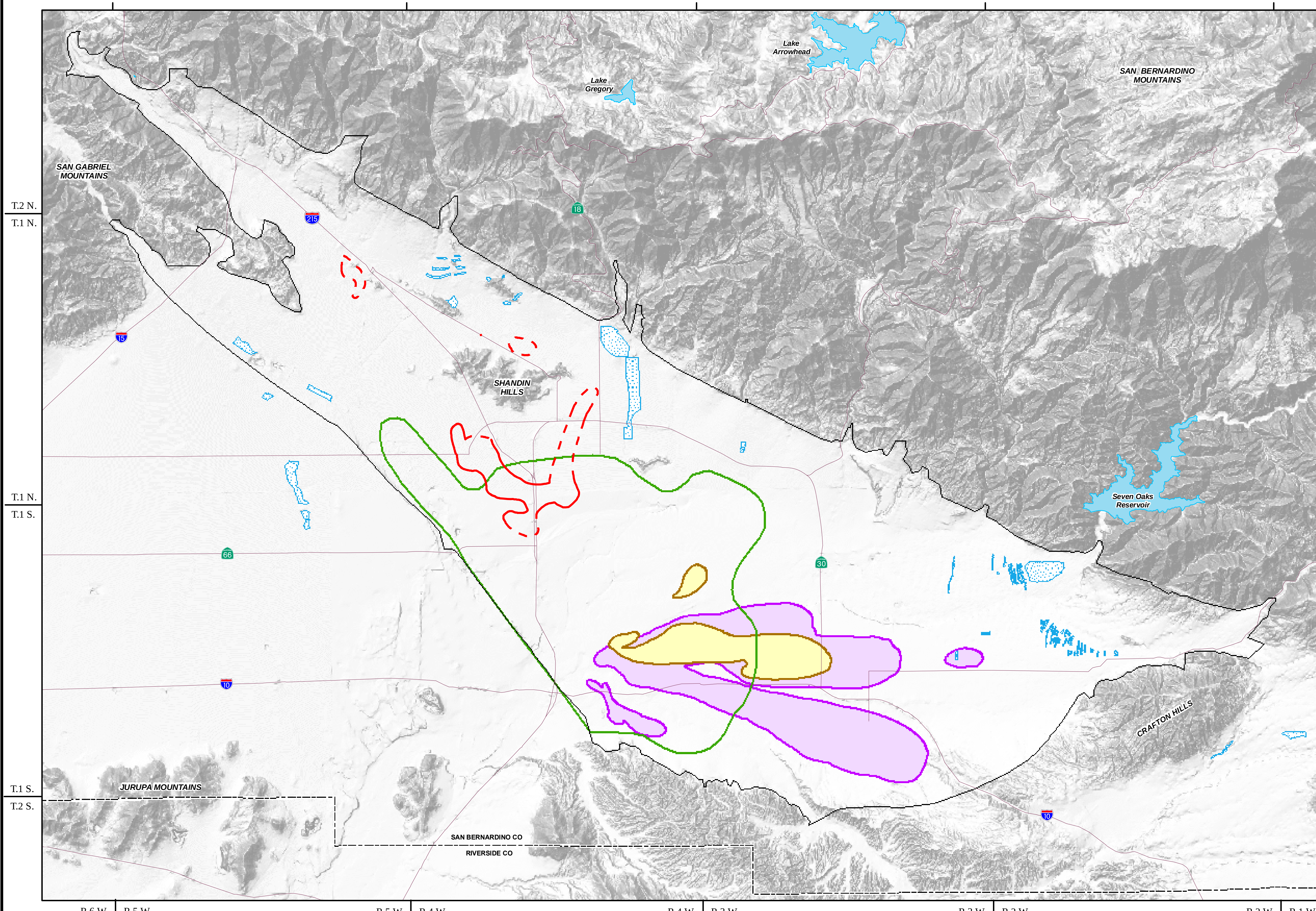
SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

SAN BERNARDINO BASIN AREA
REFINED BASIN FLOW MODEL AND SOLUTE TRANSPORT MODEL REPORT

# GROUNDWATER CONTAMINANT PLUMES IN THE SBBA

## Figure 3-2




EXPLANATION

- PCE Groundwater Contaminant Plume (5 ug/L) Dashed where less certain (Source: SECOR, 2007.)
- TCE Groundwater Contaminant Plume (5 ug/L) (Source: TetraTech, 2008.)
- Perchlorate Groundwater Contaminant Plume (6 ug/L) (Source: TetraTech, 2008.)
- Spreading Grounds or Basins
- San Bernardino Basin Area Groundwater Basin Boundary
- Pressure Zone
- County Boundary

30-Sep-09

Prepared by: DWB

Map Projection: State Plane 1983, Zone V, feet

NORTH

0 2 4 Miles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# Chapter 4 NPR Overview

This section summarizes findings from the District's 2014 Water System Master Plan (WSMP) that pertain to the feasibility of producing disinfected tertiary recycled water for NPR uses. In that study, a market analysis was performed to identify potential recycled water customers and quantify potential recycled water demands. Preliminary distribution system element sizing and planning level cost estimates were developed as part of this study. Information provided herein was produced as a result of the WSMP.

## 4.1 NPR Demand

In order to identify potential recycled water customers the following potential uses were evaluated:

- Landscape irrigation (cemeteries, freeways, parks, playgrounds, schools, golf courses, etc.)
- Commercial and industrial uses (cooling, boiler feed, process water, laundry, car-washing, concrete mixing etc.)
- Groundwater Recharge
- Decorative fountains
- Recreational lakes (restricted and unrestricted)
- Other uses (dust control, soil compaction, street sweeping, sewer flushing)

The District's billing records were analyzed to identify potential customers with an irrigation billing classification and/or demand over 10 gallons per minute (gpm) (16 AFY). A total of 296 potential customers were identified representing a potable water demand of 3,028 gpm (4,873 AFY). Estimating potential recycled water demand from potable water demand considered the following criteria:

- It was assumed that all irrigation billing accounts could be fully served by recycled water.
- It was assumed that schools would be able to use recycled water to meet 50% of their irrigation needs in areas such as sports fields, lawns etc.
- It was assumed that parks would be able to use recycled water to meet 80% of their irrigation needs.
- It was assumed that 30% of the total demands from billing accounts associated with commercial or industrial uses could be met by recycled water. In such facilities, there are needs for on-site irrigation, industrial cooling etc. However, further study would be required to determine more specific demands for each customer.
- Demands associated with commercial properties, apartment buildings, and trailer park communities were assumed to not have recycled water needs. While they have large water demands, these demands are typically associated with potable water uses.
- Demands associated with temporary service accounts were assumed to have no recycled water needs.

This results in an estimated potential recycled water demand of 1,383 gpm (2,229 AFY), primarily made up of landscape irrigation reuse applications. **Table 4-1** summarizes the potential recycled water demand by customer type.

**Table 4-1: Summary of Potential Recycled Water Customers**

| Potential Recycled | Potable Demands (AFY) | Potential Recycled Water use (AFY) | Percent of Recycled Water Use by Category (%) |
|---|---|---|---|
| Fire Service | 298 | 298 | 13% |
| Landscape Irrigation | 1,845 | 1,845 | 83% |
| Church/School | 235 | 81 | 4% |
| Not Specified | 201 | 0 | 0% |
| Hospital | 16 | 5 | 0% |
| Residential Multi-Unit | 101 | 0 | 0% |
| Apartments | 914 | 0 | 0% |
| Trailer Park | 469 | 0 | 0% |
| Commercial/Industrial | 280 | 0 | 0% |
| Restaurant Lounge | 184 | 0 | 0% |
| Temporary Service | 330 | 0 | 0% |
| **Total** | **4,873** | **2,229** | **-** |

The feasibility of NPR is also a function of the achievability of distributing the recycled water to customers from the proposed WRP. In order to plan for distribution of recycled water a geographic assessment of potential customers must be performed, along with the possibility of conversion (requiring backflow preventers, separate meters, and associated piping and valving). By determining where clusters of different levels of demands are located, it then becomes possible to consider preliminary sizing of distribution piping, pumping stations and storage tanks. Serving these customers in groups can also be an opportunity for implementation phasing to meet regulatory and/or financial constraints. Nonetheless, the potential for NPR versus GWR-RW is substantively less given that there is insufficient demand in the region. Thus, the GWR-RW alternative appears to have more promise with the option of serving NPR customers which require minimal infrastructure.

# Chapter 5 IPR Overview

This section provides an overview of the following considerations for implementing an IPR project through GWR-RW in the Study area:

- Potable water supply and demand
- Groundwater basin adjudication
- Type of GWR project
- Availability of blend water sources

## 5.1 Demand

For the purpose of this Study, the potable water demand analysis performed in the 2014 Water System Master Plan (WSMP) is sufficient to establish that GWR-RW will benefit the community and aid in meeting future demands. The District expects a significant increase in potable water demand as a result of residential and non-residential growth in the Study area. These increased demands are planned to be met through a combination of imported surface water and increased groundwater pumping. The timing of this population growth depends on the construction schedule for several anticipated residential developments in the Study area. Water demand projections derived from the WSMP are presented in this section.

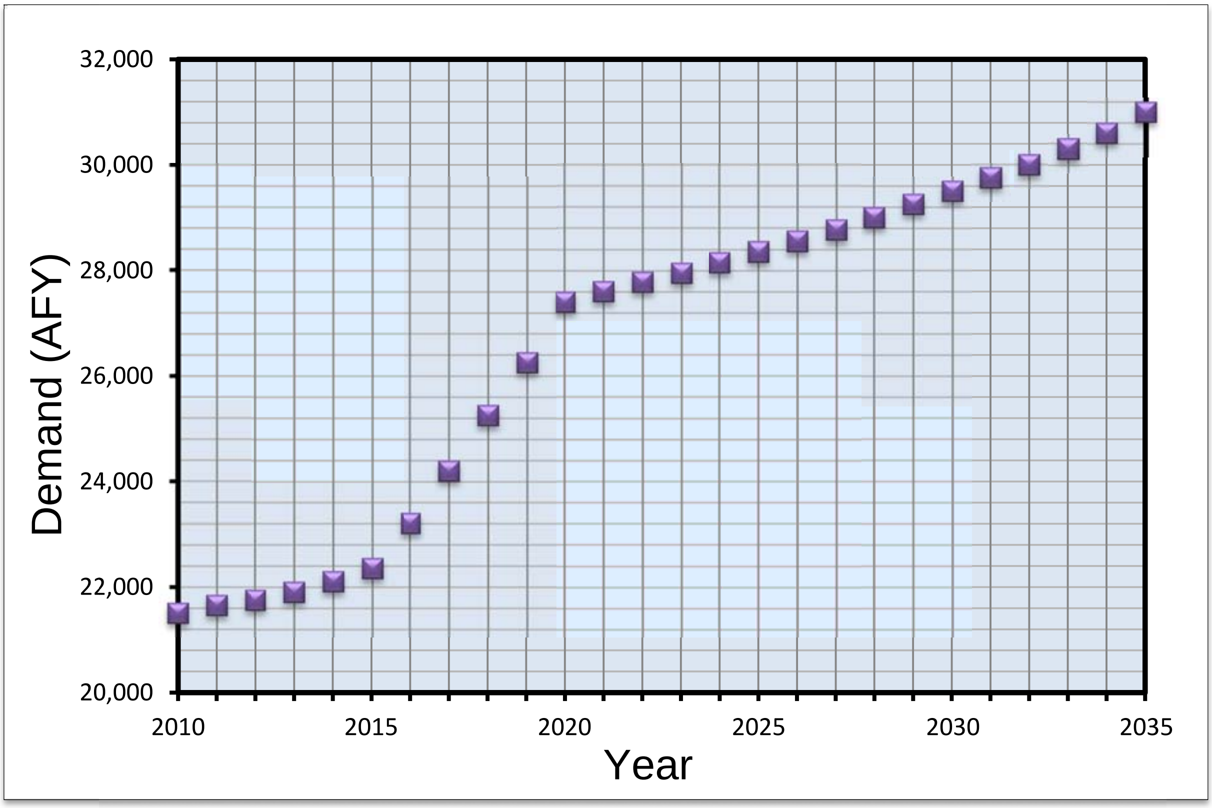
### 5.1.1 Per Capita Water Usage

The per capita water use is expected to decline in the future as a result of water conservation measures and implementation of the state of California's 20x2020 Water Conservation Plan. The 2014 WSMP establishes that the current per capita water usage for the service area is 197 gallons per day (gpd). The WSMP estimates future per capita usage to be 172 gpd based on Method 2 of the 2010 Urban Water Management Plan Guidebook. This represents a 13% decrease in per capita usage resulting from water conservation measures.

### 5.1.2 Projected Demand

**Figure 5-1** illustrates the District's projected potable water demands with a significant increase from 2015 to 2020 as a result of new residential developments in the service area. The current demand of 21,400 AFY is projected to increase by approximately 45% to 31,000 AFY by 2035. Thus, an additional supply of 9,600 AFY must be procured in order to meet these projected demands. Implementing a WRP for GWR-RW will assist the District in meeting these demands through groundwater pumping. Additionally, augmenting current artificial recharge activities with GWR-RW will allow for existing surface and imported water supplies that are currently used for groundwater replenishment to be utilized for potable use.

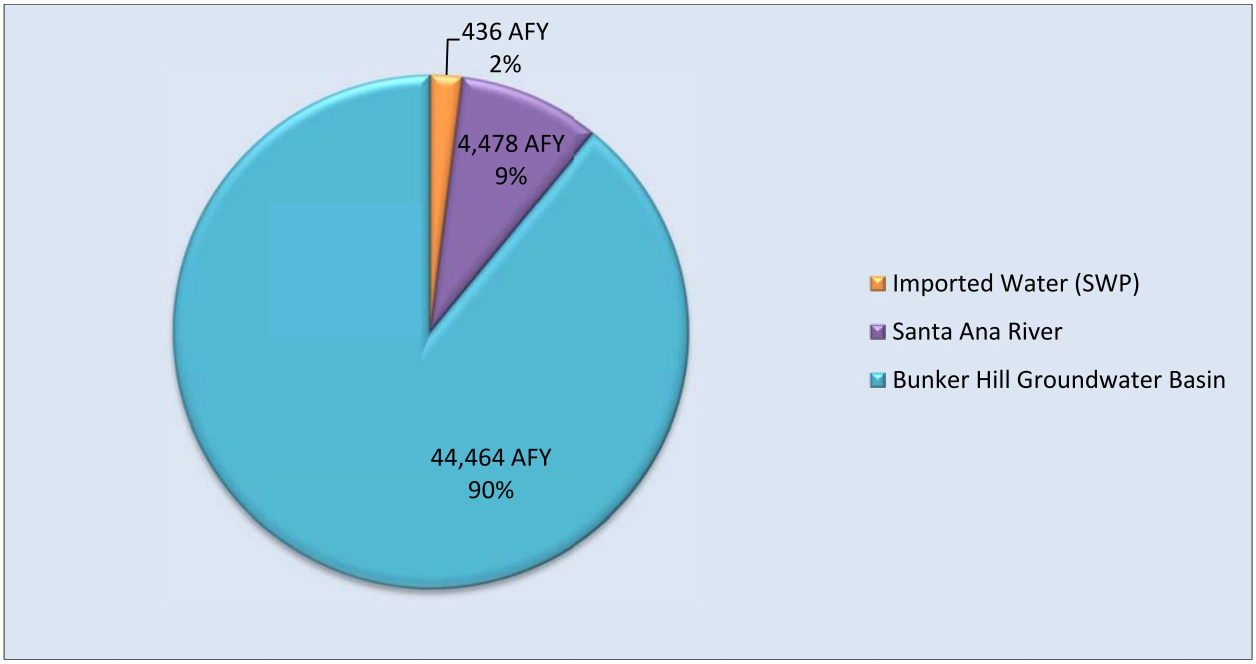
**Figure 5-1: Potable Water Demand Projections**




## 5.2 Supply

The District's water supply portfolio currently consists of groundwater, local surface water, and imported water as illustrated in **Figure** 5-2. The District treats and delivers local surface water and imported SWP water. SWP water is imported by the SBVMWD on behalf of the local water agencies, including the District.

**Figure 5-2: Water Supply Portfolio**




Source: 2014 Water System Master Plan and Consumer Confidence Report, 2013.

Groundwater is the primary source of water for the District and is pumped from Bunker Hill Basin through a series of 18 groundwater wells. The District also owns 3 wells that were decommissioned due to water quality issues and another is currently planned for decommissioning. Once this happens, the combined capacity of the 17 wells will be 39.7 MGD (44,464 AFY).

Surface water is diverted from the SAR to Plant 134, where it is treated using membrane microfiltration and has a treatment capacity of 8 MGD. The District holds SAR water rights through stock ownership in the North Fork Mutual Water Company and is currently entitled to 4 MGD, which is expected to increase to 6.5 MGD as remaining agricultural properties are converted. Plant 134 also treats a small amount of SWP water, which is purchased directly from SBVMWD as needed to supplement supply.

## 5.3 Basin Adjudication

The right to groundwater, along with an established mechanism to account for “foreign” water such as recharged recycled water, is paramount to the implementation of a GWR-RW project.

The Western-San Bernardino Judgment of 1969 (Western Judgment) generally defines the SBBA as the region above the San Jacinto Fault, while excluding Yucaipa, San Timoteo, Oak Glen, and Beaumont Basins. This area produces 71% of groundwater extracted from the Santa Ana Watershed and includes the Bunker Hill sub-basins, which underlie the District’s service area.

The Western Judgment identifies regional representative agencies to be responsible, on behalf of the numerous parties bound thereby, for implementing the replenishment obligations and other requirements of the Western Judgment. The representative entities are SBVMWD and Western Municipal Water District (Western). SBVMWD is solely responsible for providing replenishment of the SBBA if extractions exceed the safe yield of the basin. The court-appointed Watermaster includes representatives from SBVMWD and Western. The proposed basin management process could be under the authority of the SBVMWD and Western Boards of Directors with inputs from other significant producers. The following is a summary of pertinent basin management information related to the Western Judgment:

### 5.3.1 Western Judgment

- **Natural Safe Yield** – The natural safe yield was established at 232,100 AFY. The Plaintiffs' (Western entities) rights are capped at 27.95% of the natural safe yield, or 64,862 AF, notwithstanding any Additional Extraction Agreements or "new conservation," as defined in the judgment. The Non- Plaintiffs' (SBVMWD entities) rights are unlimited provided that an equal amount of basin replenishment occurs to offset any amount that the Non-Plaintiff production exceeds—72.05% of the natural safe yield, or 167,238 AF. An annual report, entitled Annual Report of the Western-San Bernardino Watermaster, provides an "accounting" of basin extractions.

- **Replenishment** – SBVMWD is responsible for replenishing the SBBA for that amount of Non-Plaintiff extractions exceeding 167,238 AF. The replenishment obligation may be met by any of the following means:

  a) Return flow from excess extractions;

  b) Replenishment provided in excess of that required;

  c) Amounts extracted without replenishment obligations (i.e., Additional Production Agreement);

  d) That amount of water extracted below the natural safe yield; and

  e) Return flow from imported water.

- **New Conservation –** This is defined in the Western Judgment as "any increase in replenishment from natural precipitation which results from operation of works and facilities not now in existence." The judgment contemplated that the parties would develop facilities that would result in the capture of more natural runoff. The construction of the Seven Oaks Dam within the SAR has provided such an opportunity, and SBVMWD and Western are seeking to obtain a water right from the State Water Resources Control Board (SWRCB) and to construct the facilities necessary to capture SAR water that was not historically captured. The parties under the Western Judgment will have their adjusted extraction rights increased to include a proportionate share of any New Conservation, provided that each Plaintiff party pays its proportionate share of the costs to develop said New Conservation.

As a non-plaintiff party to the Western Judgment, the District was allotted production rights of 14,217 AFY. The Judgment states that the District may pump more than this to meet demands, while SBVMWD is responsible for recharging the basin. Through implementing a GWR-RW project, the District will be contributing to basin recharge along with SBVMWD, which would provide an opportunity for this contribution to be credited to SBVMWD towards their current obligation (2013 Regional Water Management Plan), therefore offsetting supplies currently utilized for groundwater recharge. For the purpose of this Study it is assumed that the value of this contribution is equal to the cost of imported water currently utilized for groundwater recharge.

### 5.3.2 Seven Oaks Accord

The Seven Oaks Accord is a settlement agreement that requires SBVMWD and Western to develop a groundwater spreading program in cooperation with other signed parties including the District. The program is intended to maintain groundwater levels at specific wells in the region. This prompted local agencies to include groundwater management in the Upper Santa Ana River Integrated Resource Management Plan and collectively prepare an annual Regional Water Management Plan since 2008.

SBVWCD and SBVMWD entered into a settlement agreement in 2005, whereby the agencies will work cooperatively to develop an annual groundwater management plan. SBVWCD is responsible for operating the region's recharge facilities (spreading grounds) and is one of the active members of the Basin Technical Advisory Committee (BTAC) formed by the IRWMP stakeholders. The BTAC is an open forum, hosted by the SBVMWD, where any interested stakeholders can participate.

## 5.4 Type of Groundwater Recharge Project

The GWR Regulations allow for two types of projects using recycled water: (1) surface application (e.g., spreading) and subsurface application (e.g., injection or vadose wells). The minimum treatment requirements are substantively different depending on the type of application. For surface application, the minimum treatment is disinfected tertiary recycled water. For subsurface application, the minimum treatment is reverse osmosis and advanced oxidation applied to the full volume of water recharged. Subsurface application was determined to be infeasible due to additional costs associated with advanced treatment, recycled water injection, and brine disposal. It is far more cost effective to utilize existing recharge facilities and augment current artificial recharge activities with GWR-RW. Consequently, for the remainder of the Study, the alternative considered was GWR-RW using disinfected tertiary recycled water.

## 5.5 Availability of Diluent Water

Diluent water is a necessary component of a GWR-RW project based on regulatory requirements discussed in **Chapter 6**. The primary source of diluent water is anticipated to be imported water obtained from SBVMWD since it is already used for recharge. Another potential source of diluent water could be stormwater complying with the GWR Regulations. The Montebello Forebay and Chino Basin GWR-RW projects, both of which apply disinfected tertiary recycled water via spreading, use imported water and stormwater as their diluent supply. For this Study the emphasis is placed on SAR water and imported SWP water because it is a more available and predictable diluent water source. Further analysis is required to determine implementation considerations associated with utilizing stormwater as diluent water for GWR-RW. It should be noted that the City of Redlands is currently recharging its basin without any diluent water with secondary treated recycled water.

Further discussion of regulatory requirements with regards to diluent water is provided in **Chapter 6** and site specific analyses are provided in **Chapter 7** and **Chapter 10.**

### 5.5.1 Primary Diluent Water Source – Imported Water

SBVMWD is the SWP contractor that supplies imported water to agencies in the region including the District. Additionally, SBVMWD is obligated under the Western Judgment to recharge the basin, and on average provides approximately 32,400 AFY of imported SWP water (Geoscience, 2009). Additional recharge is provided by spreading SAR water in approximately the same volume as SWP water depending on seasonal and annual availability. Recharge requirements vary annually based on basin management accounting performed under the Western Judgment. Untreated SWP water is a good candidate for diluent water since it is already used for GWR by SBVMWD; artificial recharge credit would be preserved, providing a dual use for this groundwater.

The SAR Spreading Grounds, operated by the SBVWCD could be considered for GWR-RW in this Study as this is a primary location for current artificial recharge activities. However, the SAR Spreading Grounds are located at a high elevation within the service area of the District, which presents economic challenges associated with energy requirements necessary to pump recycled water to this location.

### 5.5.2 Secondary Diluent Water Source – Santa Ana River Water

The SBVMWD diverts SAR water at the Seven Oaks Dam upstream of reach 5 of the river. The SBVWCD utilizes this water for recharge at the Santa Ana River Spreading Grounds along with imported water. This may also be considered as a primary source of diluent water depending on the location of the selected recharge site, however, the use of this water may require significant additional infrastructure for delivery as diluent. Further investigation is required to determine costs associated with conveying SAR water to potential recharge sites. SBVWCD has rights to 10,400 AFY or more SAR water depending on availability beyond the rights allocated to senior water rights holders, which is variable.

### 5.5.3 Stormwater as a Diluent

Traditionally, allowances have been made in local basins (e.g. Chino Basin), during years of heavy precipitation, for stormwater to be captured and used as a diluent water source. These strategies should be a part of the overall implementation program.

# Chapter 6 Regulatory Analysis

## 6.1 Introduction

The purpose of this chapter is to provide an overview of regulatory and permitting requirements related to implementation of a GWR-RW project in the District service area. The use of recycled water for planned groundwater replenishment projects in California is regulated under the Federal Safe Drinking Water Act, and several State laws, regulations, and policies, with different responsibilities assigned to the SWRCB, the nine Regional Water Quality Control Boards (RWQCBs), and the SWRCB Division of Drinking Water, formerly the California Department of Public Health (CDPH) Drinking Water Program.[1]

## 6.2 Regulatory Policy Overview

### 6.2.1 Regulatory Agencies and Authority

Division of Drinking Water

Protection of public health and regulation of drinking water and recycled water in California falls under the jurisdiction of the Division of Drinking Water (DDW), which establishes uniform criteria for NPR and GWR-RW, and is mandated by State law to develop criteria for surface water augmentation using recycled water and to consider if uniform criteria can be developed for direct potable reuse. For GWR-RW projects, DDW approves proposed projects and their Engineering Reports (ER). SWRCB/DDW may also assume responsibility for issuing GWR-RW permits; with input from the jurisdictional RWQCB (currently the RWQCB would issue the permit). It is not likely that this change in permitting function will be determined or effectuated during Fiscal Year 2014/15.

State Water Resources Control Board

The SWRCB is responsible for the preservation, enhancement, and restoration of California's water resources. SWRCB oversees the allocation of water resources and coordinates the State's nine RWQCBs. The SWRCB issues Policies and Plans that apply to the use of recycled water for GWR-RW and NPR. In 2014, the SWRCB issued General Waste Discharge Requirements for Recycled Water (General Permit) that provides statewide authorization of all of Title 22 uses of recycled water by producers, distributors, and users except GWR-RW and is intended to streamline project permitting. The SWRCB also allocates surface water rights, including changes in discharges of wastewater to surface waters (California Water Code 1211 Petition for Change).

Regional Water Quality Control Board

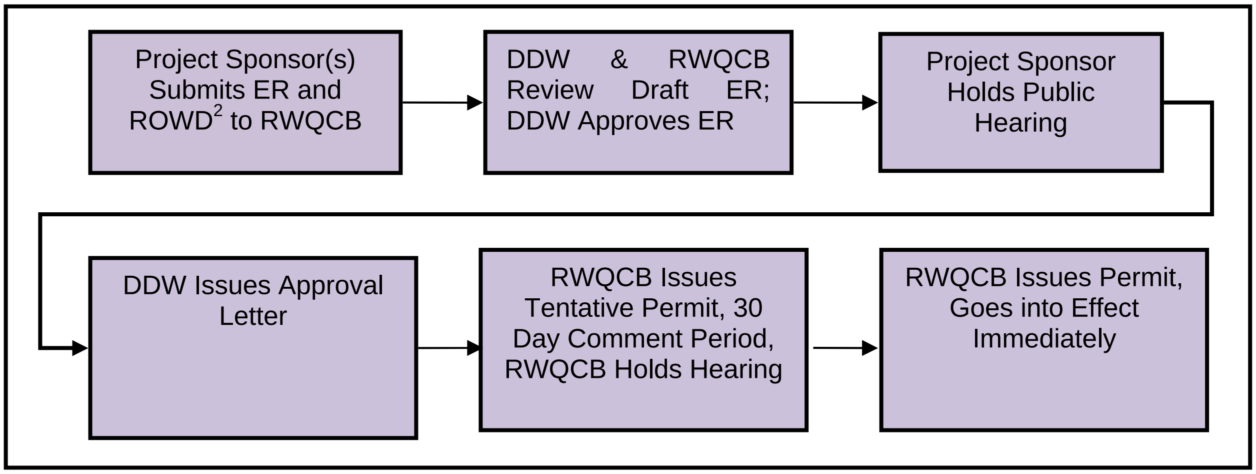
The Santa Ana RWQCB provides local implementation of SWRCB policies and regulations and develops and implements a regional Water Quality Control Plan (Basin Plan) to protect surface water and groundwater quality and beneficial uses. Currently, the RWQCB issues GWR-RW permits and individual NPR permits. The issuance of the SWRCB General Order is intended to replace issuance of new individual permits by the RWQCB.

The current (or potentially interim) process for project approval and permitting of GWR-RW projects is depicted in **Figure 6-1**. The RWQCB would issue the permit based on requirements consistent with the GWR Regulations, the Santa Ana Basin Plan, and State policies. The type of permit (Waste Discharge

[1] Effective July 1, 2014, the CDPH Drinking Water Program was moved to the SWRCB and named the Division of Drinking Water, including water reclamation and potable water reuse. At the same time, the California Water Code was amended giving the SWRCB (and thus the DDW) the authority to carry out the duties granted to a RWQCB pursuant to Chapter 7 of the California Water Code (Water Reclamation sections 13500 – 13557, which include issuing potable reuse permits).

Requirement [WDR] and/or Water Recycling Requirement [WRR]) issued depends on how and where the recycled water is "discharged".

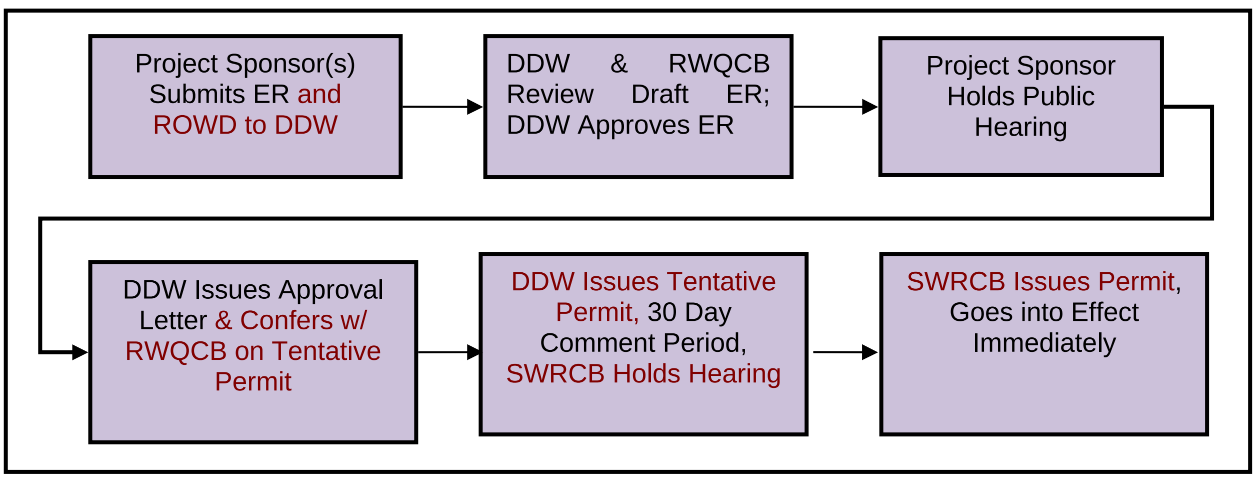
**Figure 6-1: Current Regulatory Process for GWR-RW Projects**




1. ROWD – Report of Waste Discharge.

If SWRCB/DDW becomes the permitting authority for GWR-RW projects, the possible approval and permitting process may follow the steps shown in **Figure 6-2**.

**Figure 6-2: Potential Regulatory Process for GWR-RW Projects**




## 6.3 Regulatory Analysis

This Section provides an analysis of how current regulations may impact the District's GWR-RW project and identifies issues that may require further investigation in order to better characterize recharge facility siting alternatives. These regulatory issues may impact other project requirement including treatment, design and implementation strategy. Several existing recharge facilities in the District's service area have been evaluated for discharge of recycled water as discussed in **Chapter 10**. Several constraints must be considered from a permitting perspective while evaluating recharge facility sites. The following requirements may impact the recharge facility site location.

### 6.3.1 Groundwater Recharge Regulations

Prior to June 18, 2014, Title 22 included narrative requirements for planned GWR-RW projects. The regulations stated that recycled water "shall be at all times of a quality that fully protects public health" and that DDW recommendations will be made on "an individual case basis" and "will be based on all relevant aspects of each project, including the following factors: treatment provided; effluent quality and quantity; spreading area operations; soil characteristics; hydrogeology; residence time; and distance to withdrawal."

Since 1976, DDW issued numerous draft versions of more detailed GWR-RW regulations that served as guidance for the six permitted GWR projects in California (all of which are located in Southern California). Final GWR Regulations were adopted and went into effect June 18, 2014 (CDPH 2014). The GWR Regulations are organized by type of project:

- Surface application (surface spreading); and
- Subsurface application (injection or vadose zone wells).

The regulations address the following key project requirements:

- Source control.
- Emergency response plan.
- Pathogen control.
- Nitrogen control.
- Regulated chemicals control.
- Initial recycled water contribution (RWC).
- Increased RWC.
- Advanced treatment criteria.
- Application of advanced treatment.
- SAT performance (surface application).
- Response retention time (RRT).

For planning purposes, the key requirements are the initial RWC and the underground retention time requirements pursuant to the pathogen control and RRT provisions.

#### Recycled Water Contribution

The RWC is defined as: (1) the recycled water applied at the GWR Project ÷ (recycled water + credited dilution water), and (2) the Initial Minimum RWC = 0.5 milligrams per liter (mg/L) ÷ the maximum total organic carbon (TOC) concentration in the recycled water (before or after recharge) based on a 20-week running average. For surface spreading projects, the GWR Regulations allow an initial RWC of 20% for at least the first year of operation unless an alternative initial RWC is approved by DDW based on: (1) the review of the engineering report and (2) information obtained as a result of the public hearing and (3) the project sponsor demonstrates that the treatment processes preceding SAT can reliably achieve a TOC 20-week running average no greater than 0.5 mg/L (namely advanced treatment).

#### Retention Time

The GWR Regulations include two requirements that relate to retention time: Pathogen Control and RRT. For surface spreading projects, for Pathogen Control, the recycled water must meet Title 22 disinfected tertiary effluent requirements. The treatment system must achieve a 12-log enteric virus reduction, a 10-

log *Giardia* cyst reduction, and a 10-log *Cryptosporidium* oocyst reduction using at least 3 treatment barriers. For each pathogen, a separate treatment process can only be credited up to a 6-log reduction and at least 3 processes must each achieve no less than 1.0-log reduction. Retention time credit is allowed for virus (only) of 1-log/month.

RRT is the time recycled water must be retained underground to identify any treatment failure and implement actions so that inadequately treated recycled water does not enter a potable water system, including the plan to provide an alternative water supply or treatment. The minimum RRT is 2 months, but must be justified by the project sponsor(s).

The greatest of the horizontal and vertical distances reflecting the retention times required for Pathogen Control or for RRT is utilized to establish the zone within which drinking water wells cannot be constructed (this effectively establishes a boundary between potable and non-potable use of the groundwater basin).

For planning purposes, the GWR Regulations allow use of groundwater modeling to estimate residence time for project facility siting. A project sponsor must validate retention time using an added tracer or a DDW approved intrinsic tracer within the first three months of operation.

RMC performed a groundwater modeling analysis for two proposed recharge sites, which is summarized in Chapter 7. Based on this work, an estimated 6-10 months of retention time will be required for the District's GWR-RW project. The actual required retention time will be determined by the Division of Drinking Water (DDW) during the regulatory approval process.

### 6.3.2 California Water Code (CWC) section 1211

California Water Code (CWC) section 1211 requires that approval must be obtained from the SWRCB prior to making any change in the point of discharge, place of use, or purpose of treated wastewater that has historically been discharged to a surface stream. Such approval may be required for implementation of a new recycled water facility that would result in reducing the discharge to the Santa Ana River. Any new flows may be exempt from this requirement. The California Environmental Quality Act (CEQA) applies to non-exempt wastewater change petitions, and if the SWRCB does require a change petition, CEQA compliance will need to be completed prior to the SWRCB taking any action on the requested change petition.

To avoid delays in implementing water recycling projects, it is important to coordinate the wastewater change petition with other approvals needed for the re-use project.

# Chapter 7 Groundwater Modeling

## 7.1 Project Area

An analysis of the San Bernardino Basin Area (SBBA) was performed through groundwater modeling by Geoscience. The project area defined for this analysis extends beyond the District's service area to the boundaries of SBBA. This extended boundary is necessary in order to determine the potential impact percolating recycled water at the proposed recharge sites will have on groundwater production wells located with the Cities of Highland, Redlands, San Bernardino, and Loma Linda.

## 7.2 Data Sources

Data used for this study was obtained from the *Second Report of Recharge Parties Pursuant to RWQCB Resolution* (Geoscience, 2013). Multiple sources were used to gather information for the study. The primary sources and the types of data provided by them are summarized as follows:

- Metropolitan Water District of Southern California: electronic files of historical TDS and nitrate-nitrogen concentrations of SWP water for Silverwood Lake at Devil Canyon;
- San Bernardino County Flood Control District: electronic files of historical precipitation data;
- United States Geological Survey (USGS): electronic file of streamflow and water quality data for gaging stations in the study area;
- Watermaster Support Services (Mr. Steve Mains): electronic files of historical water levels and pumping data;
- Wildermuth Environmental, Inc. (WEI): electronic files of current ambient TDS and nitrate-nitrogen concentrations for management zones; and
- Ms. Linda Woolfenden of USGS: numerical groundwater model files for the USGS Rialto-Colton Groundwater Basin.

## 7.3 Groundwater Model

### 7.3.1 Description of Model

The USGS Basin Flow Model was collaboratively refined by Stantec and GEOSCIENCE and is known as the Refined Basin Flow Model (RBFM). In order to refine the USGS Basin Flow Model, a three-dimensional lithologic model was developed. More than 400 water wells with categorical lithology value for intervals in the well bore were obtained and used for the development of the three-dimensional lithology model. These lithology logs were derived from both driller's logs and geophysical logs measured over the last several decades. The basic goal behind the three-dimensional lithologic modeling was to estimate the type of lithology at each cell of a three-dimensional mesh. Using this geostatistical approach, the variation of the lithologic data in approximately 400 wells was modeled. This model was used to guide the estimation of the lithologic property, using an estimation technique known as ordinary kriging, on a mesh comprised of 23 million cells. Upon the completion of the three-dimensional lithologic model, it was used to interpret the location of the five model layer boundaries. Land surface elevation, as determined from Digital Elevation Models (DEMs) for the 7.5 minute topographic quadrangles in the model area, were used as the top of model Layer 1. This was an iterative process whereby geologists interpreted the model layer boundary locations along ten cross-sections extracted from the three-dimensional lithologic model. After the model layer boundaries were determined, they were interpolated and then corrected to include a minimum thickness and made to truncate at crystalline basement outcroppings. Lastly, the positions of these boundaries were imposed on meshes used for input to MODFLOW.

### 7.3.2 Conceptual Model

The RBFM is an integrated streamflow and groundwater model developed for streams and the valley-fill aquifer of the SBBA including the Bunker Hill and Lytle Basins. The groundwater model consists of five model layers:

- Layer 1 contains the upper confining member and upper water-bearing zone
- Layer 2 represents the middle confining member
- Layer 3 consists of the middle water-bearing zone
- Layer 4 represents the lower confining member
- Layer 5 contains the lower water bearing zone

Groundwater flow between the five layers is restricted by numerous fine-grained deposits in the alluvial deposits. Near the mountain front, the fine grained materials thin to extinction and the five layers act as one. The streams crossing the model area in the aquifers can be both influent (losing water to the aquifer) and effluent (gaining water from the aquifer). The streamflow inflow components are generated from surface runoff originating from precipitation events, as well as water gained from aquifers. The streamflow outflow components include deep percolation to underlying aquifers and outflow from the basin. The primary sources of recharge to the model area include seepage from gaged streams, seepage from ungaged runoff, direct infiltration of precipitation, recharge from local runoff (i.e. runoff originating from precipitation), artificial recharge of imported water, return flow from groundwater pumping, and underflow from adjacent groundwater areas. The primary discharge terms are groundwater extraction, evapotranspiration and subsurface outflow.

Artificial recharge of imported water was based on the historically measured imported water delivered to each of the spreading grounds. A recharge rate of 95% of the imported water was used to simulate water that actually recharged the groundwater systems (Danskin, et al., 2006). During the period from 1945 to 2000, artificial recharge of imported water for the SBBA ranged from 0 AFY (artificial recharge began in 1972) to 30,400 AFY with an annual average of 2,900 AFY.

Groundwater extraction quantities were based on measured data obtained from Steve Mains (Watermaster) and major water agencies in the SBBA for 779 production wells. The amount of groundwater pumped from each well was distributed to model Layers 1 through 5 based on the perforated interval and the hydraulic conductivity of adjacent deposits. The proportion of pumping from each well from each layer is a function of the length of the well screen in that layer and the hydraulic conductivity of the layer. Annual groundwater pumping over the period from 1945 to 2000 ranged from 122,900 acre-ft to 238,500 AF with an annual average of 178,100 AFY.

Recharge from underflow to the SBBA occurs across the Crafton Fault. The amount of annual recharge from underflow ranged from 3,700 AF to 6,700 AF with an annual average of 5,000 AFY for the period from 1945 to 2000 (Danskin, et al., 2006). Groundwater outflow from the SBBA occurs across the San Jacinto Fault and Barrier E. The amount of subsurface outflow ranged from 2,200 AF to 13,400 AF with an annual average of 5,500 AFY for the period from 1945 to 2000 (Danskin, et al., 2006).

### 7.3.3 Model Methodology

Both groundwater flow and solute transport distributed parameters were used in the analyses for the Bunker Hill-A, Bunker Hill-B, and Lytle Management Zones. Specifically, the models used were:

- MODFLOW Groundwater Flow Model:

  The MODFLOW-2000 was the computer code used to simulate the various recharge and discharge terms including artificial recharge of SWP water.

## 7.4 Modeling Scenarios

Geoscience performed a technical analysis through groundwater modeling in order to provide the relevant data for assessment of IPR-related criteria related to implementation of GWR-RW. The following model run scenarios were performed:

**Model Scenario 1:** 10 MGD of Title 22 unrestricted effluent applied at the Redlands Water Recycling Plant Recharge Basin.

**Model Scenario 2:** 10 MGD of Title 22 unrestricted effluent applied at the SAR Spreading Grounds.

The Redlands Recharge Basin and SAR Spreading Grounds were selected for groundwater modeling as result of the siting evaluation described in **Section 10.3**.

The following criteria were analyzed for each model run:

- Model predicted travel distance for recycled water particle in 6 months.
- Travel time to existing groundwater production wells that may be impacted within 25 years after water is percolated.
- Simulated distribution of percent recycled water after 6 months

## 7.5 Modeling Results

### 7.5.1 Model Predicted Travel Distance

A simulated tracer analysis was performed for a travel time of 6 months in order to determine the distance that a particle of water travels in this time. This information not only indicates the potential impact on nearby wells within this period but also provides a basis for determining where to locate groundwater monitoring wells required for implementing potential recharge sites. **Figure 7-1** illustrates the predicted particle travel distance for recycled water applied to the Redlands Recharge Basin and **Figure 7-2** illustrates the same information for the SAR Spreading Grounds.

**Redlands Recharge Basin**

**Figure 7-1** seems to indicate that nearby production wells would not be impacted by recycled water recharge at the Redlands Recharge Basin and that monitoring wells may need to be installed within approximately 200-400 feet of the North and West basin boundaries.

**SAR Spreading Grounds**

In comparing the results for each potential recharge site it is clear that water travels through the soils downstream of the SAR Spreading Grounds significantly faster than that of the Redlands Recharge Basin. It appears as though the District's production well for Plant No. 125 as well as Redland's Airport Well No. 1 may be impacted by recharged recycled water at the SAR Spreading grounds, however additional analysis is required to determine the depth of recharged recycled water relative to the depth from which production wells extract groundwater. Due to the variable distribution illustrated in **Figure 7-2**, it appears that several monitoring wells may be required in order to use the SAR Spreading Grounds for GWR-RW.

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EAST VALLEY WATER DISTRICT - RECYCLED WATER FEASIBILITY STUDY

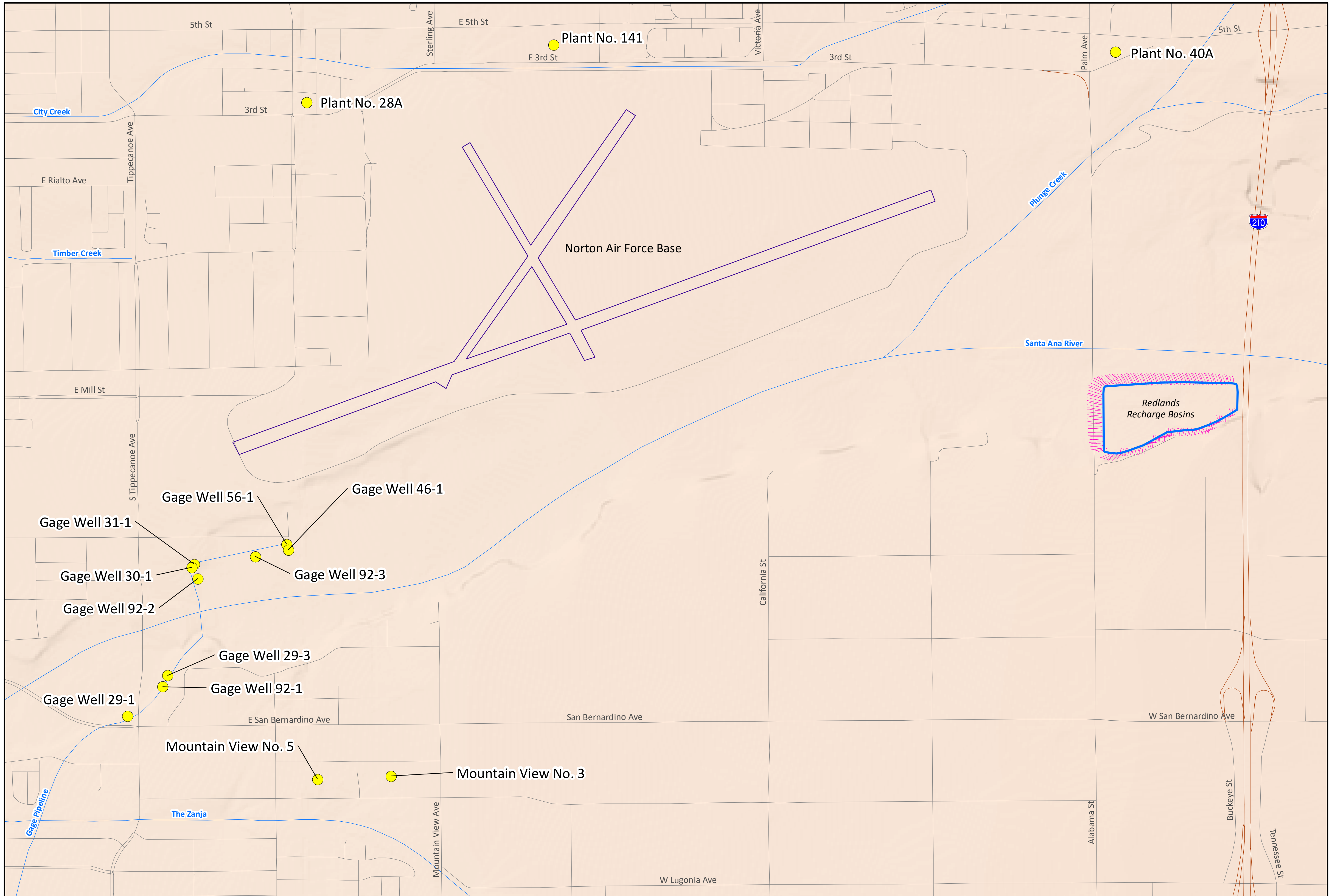


**Figure 7-1**

**MODEL PREDICTED TRAVEL DISTANCE FOR RECYCLED WATER IN 6 MONTHS, REDLAND RECHARGE BASIN**

EXPLANATION

Active Production Well

Recycled Water Particle Track

Recharge Basin

**Recharge of 10 MGD of Recycled Water at the Redlands Recharge Basins**

23-Sep-14

Prepared by: DWB. Map Projection: State Plane 1983, Zone V.



NORTH

0 1,000 2,000 4,000 Feet

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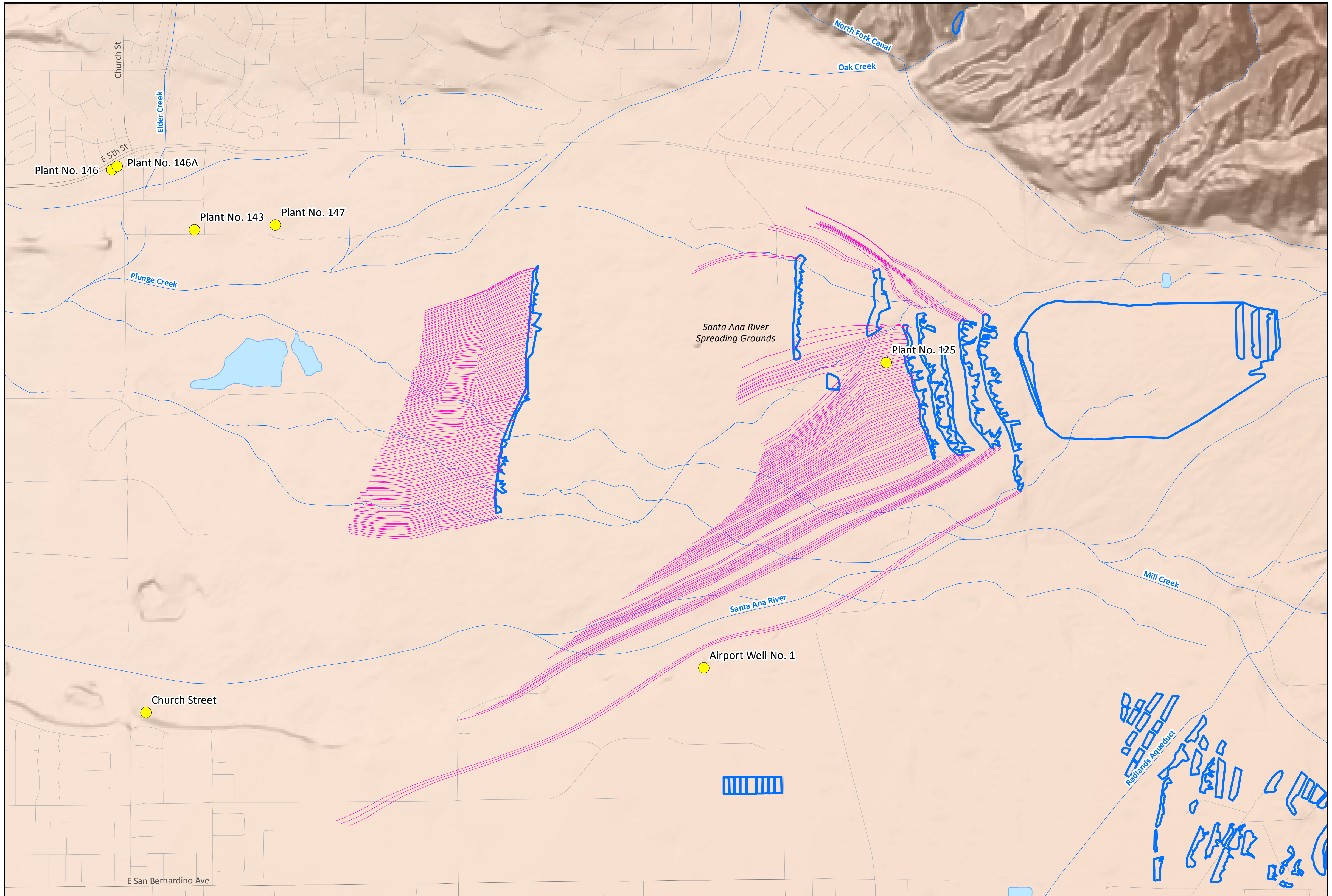


## Figure 7-2

## MODEL PREDICTED TRAVEL DISTANCE FOR RECYCLED WATER IN 6 MONTHS, SANTA ANA RIVER SPREADING GROUNDS

EXPLANATION

- Active Production Well
- Recycled Water Particle Track
- Recharge Basin
- Surface Water

**Recharge of 10 MGD of Recycled Water at the Santa Ana River Spreading Grounds**

23-Sep-14

Prepared by: DWB. Map Projection: State Plane 1983, Zone V.



NORTH

0 1,000 2,000 4,000 Feet

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### 7.5.2 Travel Time to Existing Groundwater Production Wells

A long term groundwater analysis was performed to determine the potential impact on specific groundwater production wells within vicinity of each potential recharge site. **Figure 7-3** presents hydrographs for each well downstream of the Redlands Recharge Basin indicating the percent of recycled water that may be in the vicinity of the well relative to time since GWR-RW starts. **Figure 7-4** presents the same data for the SAR Spreading Grounds.

**Redlands Recharge Basin**

The hydrographs in **Figure 7-3** appear to indicate that downstream production wells are not adversely affected by GWR-RW at the Redlands Recharge Basin. According to the modeling results it appears to take upwards of seven years for recharged recycled water to reach the nearest wells.

**SAR Spreading Grounds**

The hydrographs in **Figure 7-4** appear to further confirm that the District's production well for Plant No. 125 as well as Redland's Airport Well No. 1 may be impacted by GWR-RW at the SAR Spreading grounds. Again, additional analysis is required to determine the depth of recharged recycled water relative to the depth from which production wells extract groundwater. Recharged recycled water may not reach the remaining downstream wells for two or more years after GWR-RW begins.

### 7.5.3 Simulated Distribution of Recycled Water

**Figure 7-5** and **Figure 7-6** show contour lines that represent the distribution of recycled water as percentage concentration relative to the groundwater. Contour lines are shown for each layer of the groundwater model, which vary in relative depth from the ground surface, where Layer 1 represents the uppermost and Layer 5 represents the lowermost of water bearing zones. The purpose of this analysis is to illustrate the distribution of recycled water present after 6 months of recycled water recharge. Additionally, this analysis provides a preliminary basis for determining if partial dilution of the recharged recycled water may be achieved through the underflow associated with upstream recharge activities, however further analysis is necessary to determine the extent to which this may occur.

**Redlands Recharge Basin**

**Figure 7-5** further confirms that water moves fairly slowly through soils, both vertically and laterally in the vicinity of the Redlands Recharge Basin. Contours indicate that the uppermost model layers contain higher concentrations and further dilution occurs in lower water bearing zones. The highest recycled water concentration of in the uppermost layer is 35 percent and a 10 percent maximum concentration is achieved in Layer 4.

**SAR Spreading Grounds**

**Figure 7-6** shows a wide distribution of recycled water in the vicinity of the SAR Spreading Grounds, which further confirms the relatively fast movement of water through the soils. The uppermost water bearing zone shows a concentration as high as 30 percent and a 10 percent maximum concentration of 10 percent is achieved in Layer 3, shallower than that of the Redlands Recharge Basin.

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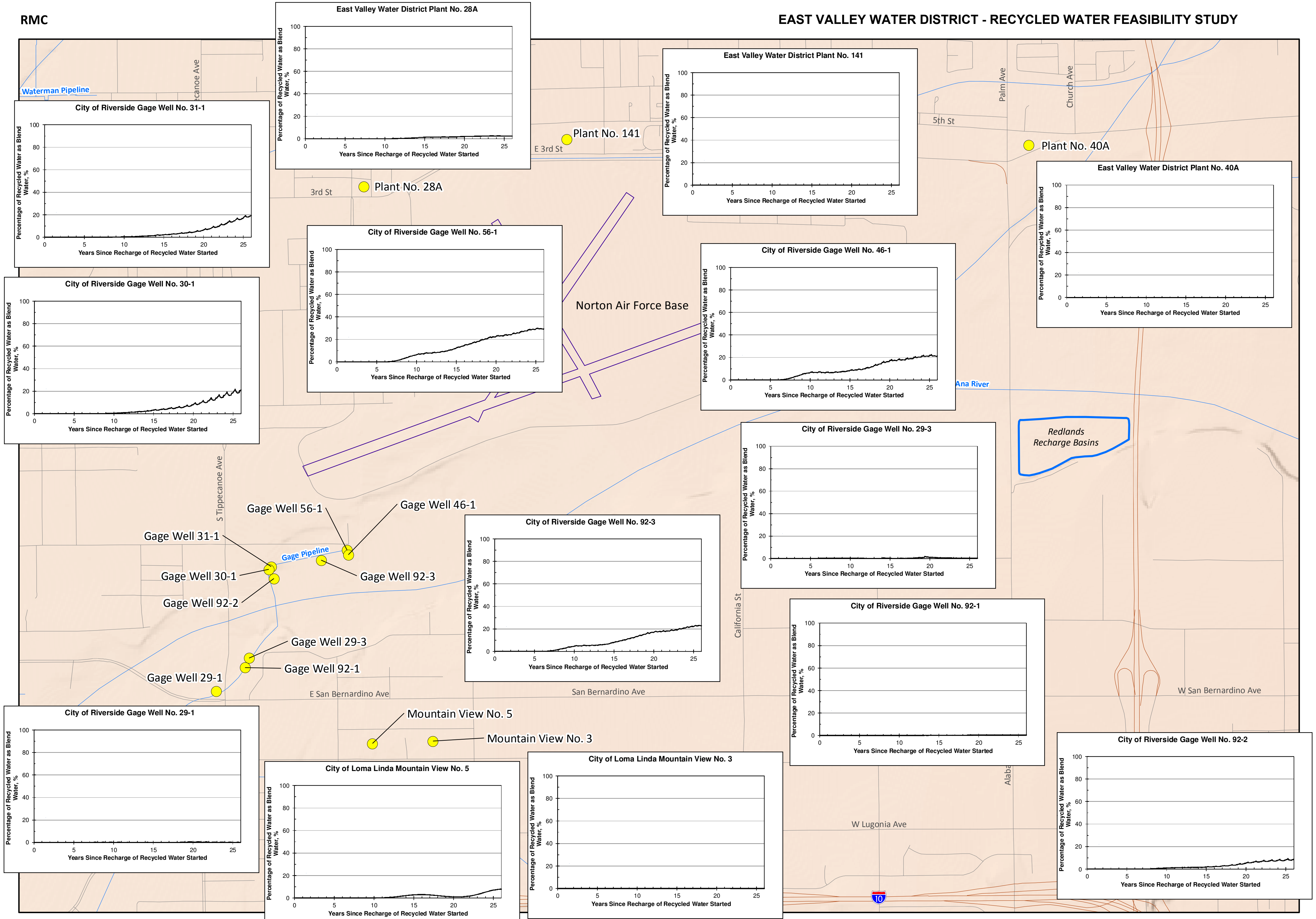


NORTH

0 1,000 2,000 4,000 Feet

# Figure 7-3

## PERCENT RECYCLED WATER BLEND AT PRODUCTION WELLS, REDLANDS RECHARGE BASIN

EXPLANATION

Active Production Well

Recharge Basin

**Recharge of 10 MGD of Recycled Water at the Redlands Recharge Basins**

23-Sep-14

Prepared by: DWB. Map Projection: State Plane 1983, Zone V.



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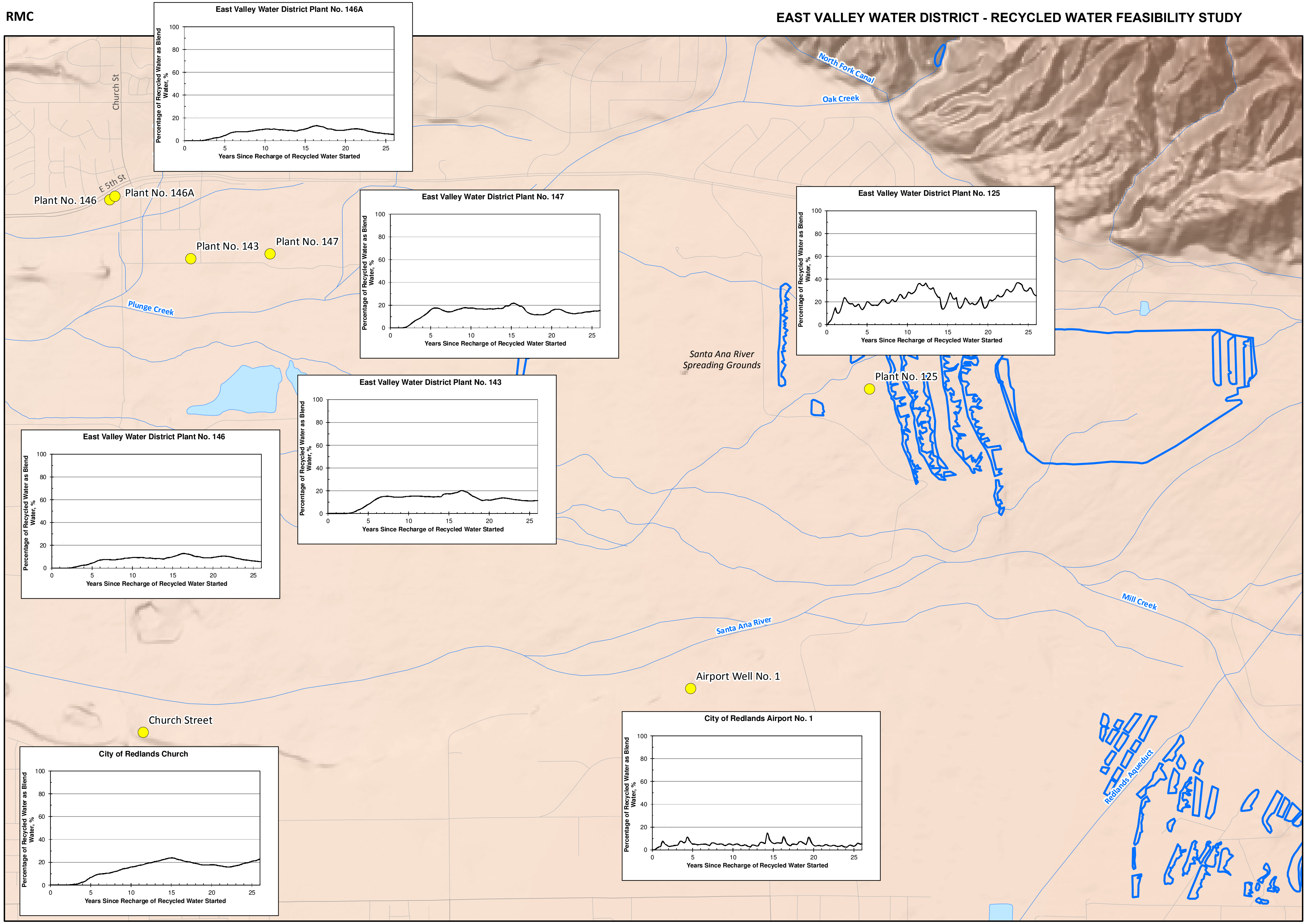
EAST VALLEY WATER DISTRICT - RECYCLED WATER FEASIBILITY STUDY

# Figure 7-4

## PERCENT RECYCLED WATER BLEND AT PRODUCTION WELLS, SANTA ANA RIVER SPREADING GROUNDS




EXPLANATION

Active Production Well

Recharge Basin

Surface Water

**Recharge of 10 MGD of Recycled Water at the Santa Ana River Spreading Grounds**

23-Sep-14

Prepared by: DWB. Map Projection: State Plane 1983, Zone V.



NORTH

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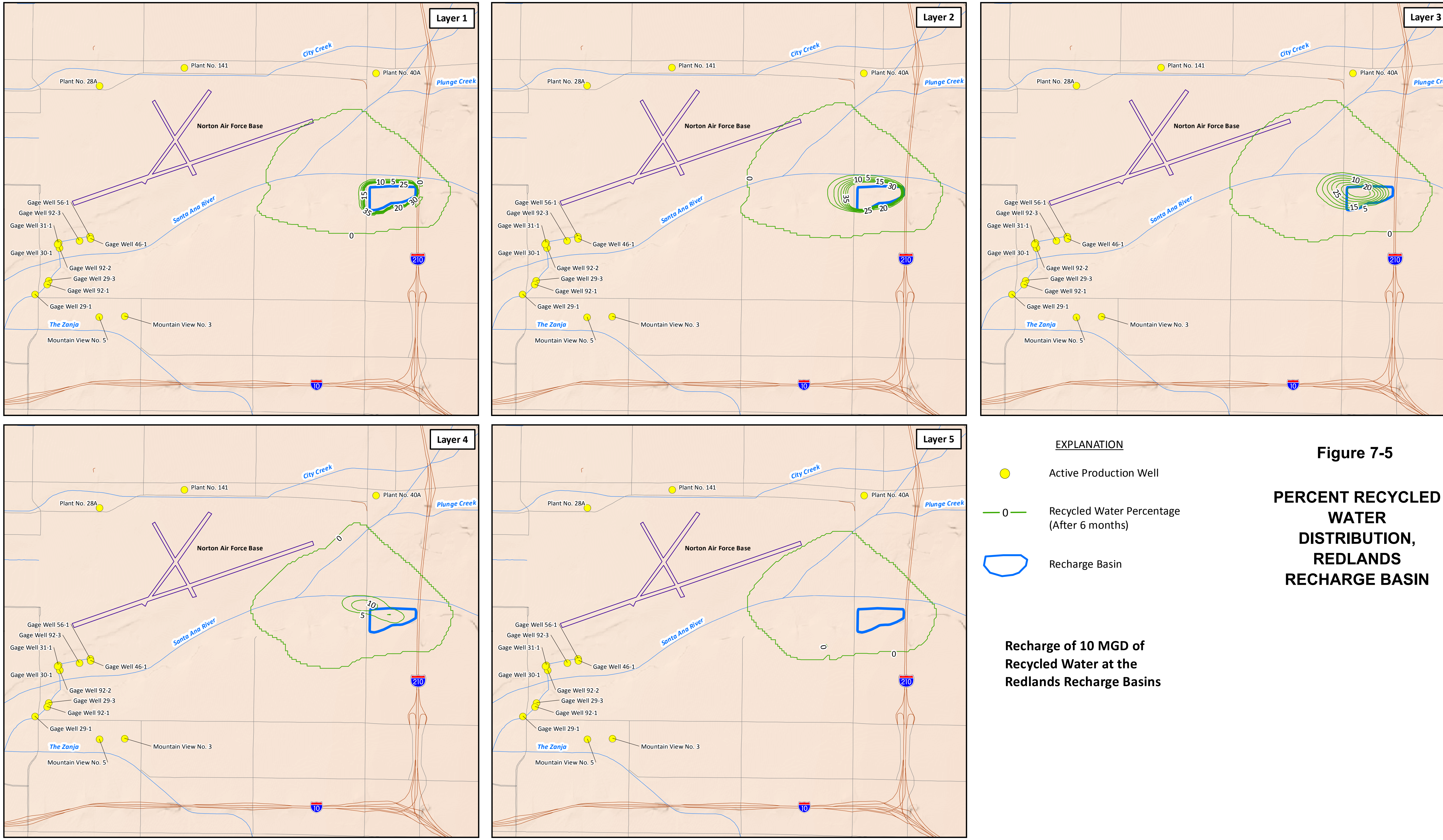


EXPLANATION

Active Production Well

Recycled Water Percentage (After 6 months)

Recharge Basin

## Figure 7-5

## PERCENT RECYCLED WATER DISTRIBUTION, REDLANDS RECHARGE BASIN

**Recharge of 10 MGD of Recycled Water at the Redlands Recharge Basins**

23-Sep-14

Prepared by: DWB. Map Projection: State Plane 1983. Zone V.



NORTH

0 0.5 1 2 Miles

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EAST VALLEY WATER DISTRICT - RECYCLED WATER FEASIBILITY STUDY

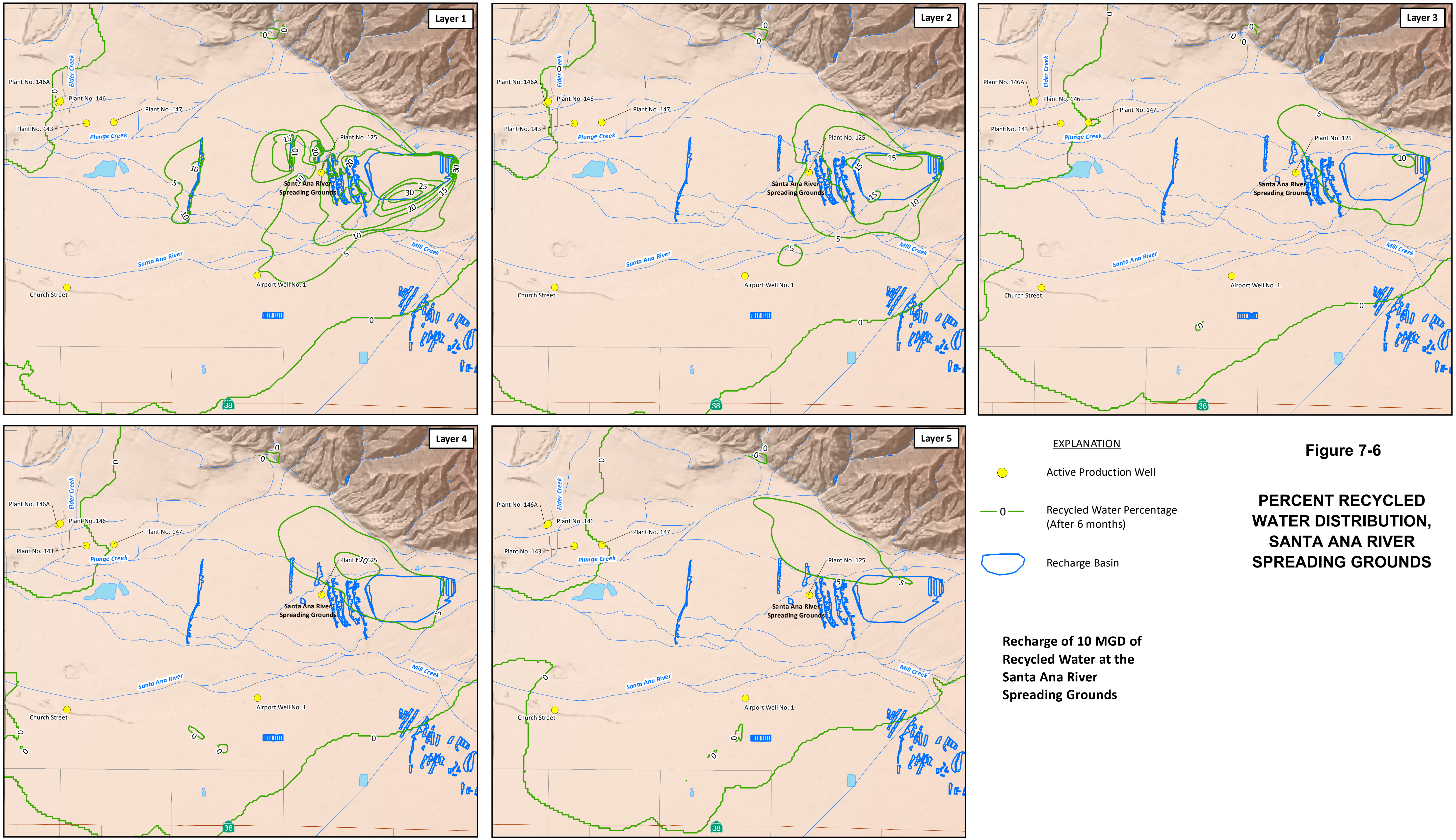


Figure 7-6

**PERCENT RECYCLED WATER DISTRIBUTION, SANTA ANA RIVER SPREADING GROUNDS**

**Recharge of 10 MGD of Recycled Water at the Santa Ana River Spreading Grounds**

23-Sep-14

Prepared by: DWB. Map Projection: State Plane 1983. Zone V.



NORTH

0 0.5 1 2 Miles

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## 7.6 Conclusion

The groundwater modeling results appear to indicate that both the Redlands Recharge Basin and SAR Spreading Grounds are viable alternatives for GWR-RW, however both sites may have implications that warrant further analysis. Further analysis is required to determine assimilative capacity of the basin based on regulatory requirements related to recycled water contribution and diluent water.

### 7.6.1 Redlands Recharge Basin

In order to determine the volume of diluent water required for use of this site for GWR-RW further analysis is required to determine the extent of dilution achieved by the underflow resulting from upstream artificial recharge activities at the SAR Spreading Grounds. Groundwater in the region generally travels from east to west and tends to follow the direction of the SAR. For this reason it is fair to assume that a significant portion of the underflow associated with this artificial recharge passes through the vicinity of the Redlands Recharge Basin. Further analysis is necessary to determine the extent to which this occurs such that a diluent credit may be given for this underflow as a result of the regulatory permitting process. This credit along with TOC requirements will drive the required volume of additional diluent water applied at the site.

It appears as though production wells are not likely to be impacted by the recycled water within the likely required 6-10 month residence time. The actual required residence time will be determined during the regulatory permitting process.

Further analysis is required to determine the impact that recharging recycled water has on the contamination plumes in the District's service area shown in **Figure 3-2**. As part of the permitting process, regulators will be interested in seeing evidence that recycled water recharge will not cause contaminant plumes to migrate over time and adversely impact beneficial use in the region.

### 7.6.2 SAR Spreading Grounds

Use of SAR Spreading Grounds for GWR-RW greatly simplifies challenges associated with regulatory requirements for diluent water as this is the site currently used for artificial recharge of imported and SAR water. No additional analysis is required to determine underflow credit for this site. Historical recharge records and future recharge activities will serve as the basis for establishing the required recycled water contribution.

Further analysis is required to determine the potential impact on groundwater production wells in the vicinity of the SAR Spreading grounds. From the groundwater modeling performed as part of this study it appears as though the travel time for recycled water to reach production wells may be less than the likely required 6-10 months for several wells. The actual required residence time will be determined during the regulatory permitting process. If it cannot be demonstrated that the required residence time is achieved, other measure may be taken to provide it such as:

- Relocate wells to an area not impacted by GWR-RW
- Install well packers to limit the depth from which groundwater is extracted or seal out specific zones in the depth of the well. This will prohibit recycled water from entering the well from the depth where it may be present, forcing it to travel a greater distance before extraction, therefore increasing travel time.

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# Chapter 8 Future Flow Projections and Phasing

## 8.1 Introduction

### 8.1.1 Background and Purpose

An analysis of sewer flow projections for the District's service area was performed in order to refine options for the size and phasing of necessary sewer facility upgrades within the time period of 2015 to 2035. The purpose of this analysis was to evaluate the potential of intercepting and treating future sewer flows at a new WRP to offset the need for Capital Improvement Program (CIP) projects that would be required to accommodate the projected sewer flows. Future flow projections were evaluated based on three potential interception points as illustrated in **Figure 8-1**.

The District has determined that all current and future wastewater flows generated in the service area shall be treated at the new WRP and that no flow will be conveyed to SBWRF after the WRP is implemented. Consequently, a portion of the anticipated Greenspot West CIP (Black and Veatch, 2013) is required in order to convey current and future flow to the new WRP. As a result of implementing the WRP, the CIPs west of Sterling Avenue along 5$^{th}$ Street and the CIPs along the Eastern trunk sewer line may be avoided, therefore, offsetting significant cost. The purpose of this chapter is to describe the opportunity for phased project implementation such that all current and future flow may be treated at the new WRP.

## 8.2 Future Sewer Flow and Phasing

This section evaluates potential sewer flow projections from future developments and population growth in the service area. The WWCSMP identified several major developments in the area that will cause sewer flow to increase at a faster rate in comparison to normal population growth. Therefore, this section estimates the potential sewer flow projected from the major developments and population growth separately.

### 8.2.1 Future Flow Increase

As part of the WWCSMP sewer flows were projected from 2013 to 2035 based on the existing sewer collection system model. Average dry weather flow (ADWF) projection was used for the flow generation analysis because it provides relatively consistent source water for the proposed WRP. **Table 8-1** presents the estimated future flow and net flow increase between 2013 and 2035 according to the sewer system modeling results. Projected flows are presented for the portion of the wastewater collection system East (upstream) as well as West (downstream) of the potential WRP site at Sterling Avenue, which is discussed in **Chapter 10.**

**Table 8-1: Estimated Future ADWF in the District's Service Area**

| Location | 2013 Existing (MGD) | 2017 Future (MGD) | 2022 Future (MGD) | 2035 Future (MGD) |
|---|---|---|---|---|
| Service Area | 6.50 | 7.16 | 10.1 | 11.59 |
| East of Sterling Site | 2.35 | 2.65 | 5.13 | 6.09 |
| West of Sterling Site | 4.15 | 4.51 | 4.97 | 5.50 |

It should be noted the District has implemented conservation practices and will continue to do so, which is expected to decrease future wastewater flows. It is expected that with the conservation mandate of decreasing consumption 20 percent by the year 2020, the ultimate plant capacity will be approximately 10 MGD, which is utilized for the purposes of this feasibility study.

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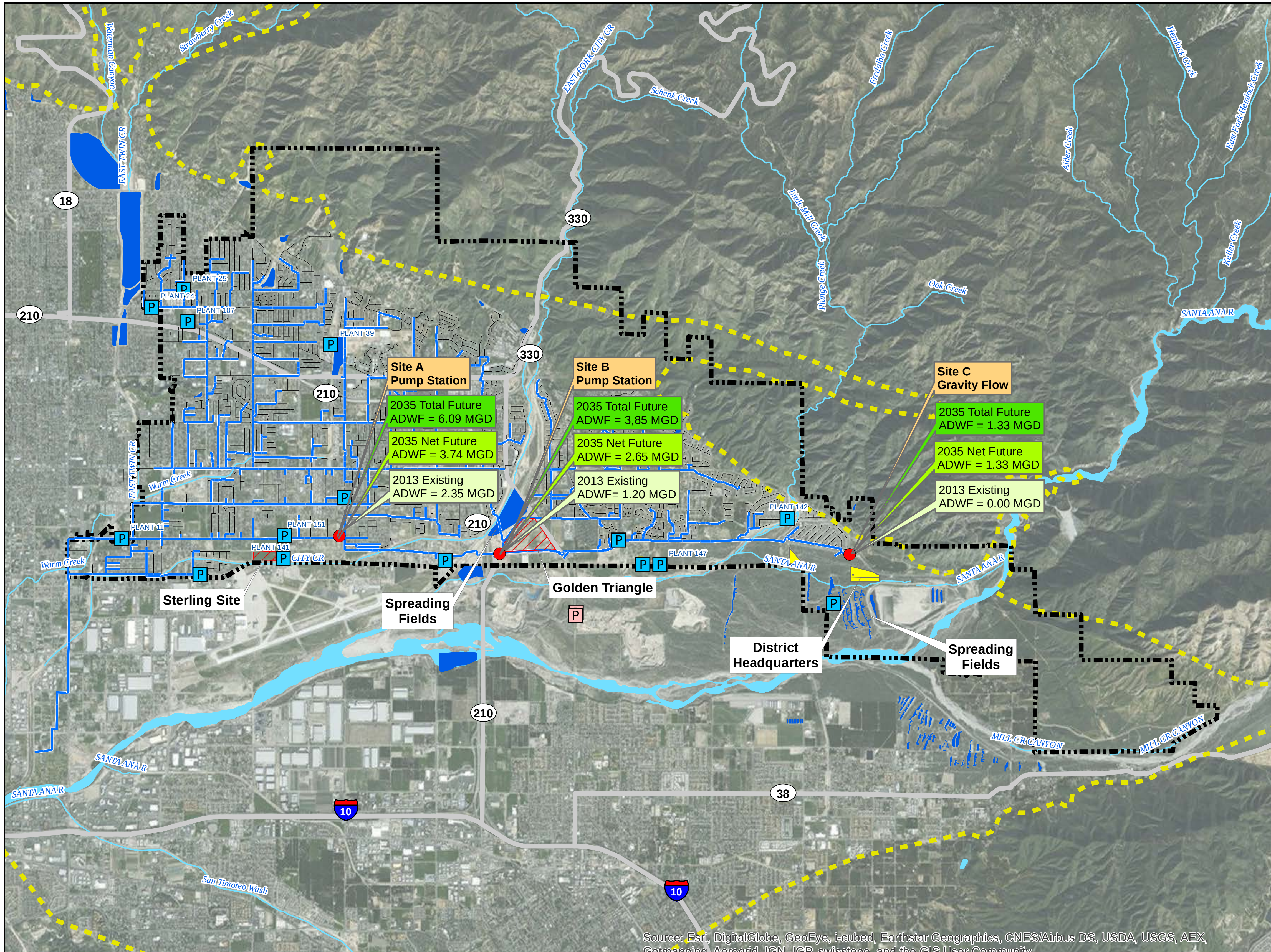
# Recycled Water Feasibility Study

## Figure 8-1

## Flow Generation




### Legend

**Production Wells**

- P EVWD
- P Redlands
- Sites
- Modeled Trunks
- Sewer Mains
- Recharge Basins
- Site Options
- EVWD Boundary
- Bunker Hill Basin
- Major Roads
- Rivers

N

0 0.5 1 2

Miles

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### 8.2.2 Flow Increase from Major Developments

The findings in **Section 8.2.1** are consistent with the proposed major developments in the District's service area. The WWCSMP identified four major developments in the service area. **Table 8-2** summarizes their sewer generation potential.

**Table 8-2: Estimated Future ADWF from Major Developments**

| **Major Developments** | **ADWF** (MGD) |
|---|---|
| Arnott Ranch Development | 0.08 |
| Harmony Development | 1.33 |
| Highland Hills Development | 0.39 |
| Greenspot Development | 0.31 |
| **Total** | **2.11** |

The previous WWCSMP utilized an aggressive schedule for major developments to take place in the District's service area, assuming all developments will be built out within 5 years starting from 2012. An updated development schedule obtained from the District indicates that construction of the Harmony Development will most likely occur in 2017. For this analysis, it is assumed that flows from all major developments are going to increase linearly from 2017 to 2022. **Table 8-3** summarizes the projected flow increase from major developments.

**Table 8-3: Project New Sewer Flow at Interception Points from Major Developments**

| **Location** | **2013 Existing** (MGD) | **2017 Future (MGD)** | **2035 Future** (MGD) |
|---|---|---|---|
| Service Area | 0 | 0 | 2.11 |
| East of Sterling Site | 0 | 0 | 2.11 |
| West of Sterling Site | 0 | 0 | 0 |

It should be noted that this assumed aggressive growth rate provides for a conservative estimated flow projection. While it may take upwards of twelve or more years to build out these new developments, the District should be prepared to provide sewer service to residents in the case that this aggressive buildout schedule is met. The identical flows shown in 2022 and 2035 is a result of flow generated from new developments east of Sterling Avenue.

### 8.2.3 Flow Increase from Normal Population Growth

In addition to flow increase from major developments, normal (background) population growth in the area also contributes to additional sewer flow. For the purposes of this study, normal population growth is assumed to occur linearly from 2013 to 2035. The sewer flow from normal population growth will take place linearly as well. **Table 8-4** summarizes projected flow increase from background population growth.

**Table 8-4: Projected New Sewer Flow at Interception Points from Normal Population Growth**

| Location | 2013 Existing (MGD) | 2017 Future (MGD) | 2022 Future (MGD) | 2035 Future (MGD) |
|---|---|---|---|---|
| Service Area | 0 | 0.66 | 1.49 | 2.98 |
| East of Sterling Site (Gravity) | 0 | 0.20 | 0.45 | 1.09 |
| West of Sterling Site (Pumped) | 0 | 0.46 | 1.04 | 1.89 |

### 8.2.4 Combined Flow Projection from Developments and Population Growth

Based on the findings in the sections above, **Table 8-5** summarizes the total ADWF increase from both major development and population growth in the study area. This flow represents all new flow above the baseline year of 2013. Sewer flow is projected to be available from 2013 to 2035. Prior to year 2017, only normal population growth will contribute to the net flow increase in the system. The total additional flow will reach 0.66 MGD by 2017. Flow increase will occur most rapidly during periods of major developments assumed to be between 2017 and 2022. During this time, total flow increase will change from 0.66 MGD to 3.60 MGD. After 2022, the future flows gradually increase again with population growth through 2035 to approximately 5.09 MGD.

**Table 8-5: Projected Sewer Flow Increase at Interception Points (MGD)**

| Location | 2013 Existing (MGD) | 2017 Future (MGD) | 2022 Future (MGD) | 2035 Future (MGD) |
|---|---|---|---|---|
| Service Area | 0 | 0.66 | 3.6 | 5.09 |
| East of Sterling Site (Gravity) | 0 | 0.2 | 2.56 | 3.2 |
| West of Sterling Site (Pumped) | 0 | 0 | 0 | 0 |

## 8.3 Recommended Project Phasing

### 8.3.1 Treatment Capacity Phasing

The District has made the decision to treat all the existing wastewater flow in its service area and to implement plant expansions that will support future population growth and major developments. Based on future flows estimated in the WWCSMP the WRP would need to treat up to 7.2 MGD ADWF in 2017 and at least 10 MGD by 2022 assuming that all developments will be built out in five years. It is possible that projected future growth is slower than the aggressive schedule described in the WWCSMP. This coupled with the effects of water conservation in the District's service area may result in the need for less capacity in 2017 and delayed plant expansion. It is recommended that the District monitor the impact of water conservation efforts as well as the anticipated schedule for new developments in order to provide ample treatment capacity, while avoiding premature investment in plant expansion. This will provide the ability to control the rate of expanding treatment capacity in the plant to match the wastewater flow projections. For the purpose of this study it is recommended that the plant be initially sized for 10 MGD while installing equipment required for treating up to 6 MGD in order to treat the initial flow for the plant. Plant expansions may be implemented as necessary to treat anticipated flows while considering the rate of development and impact of water conservation. If wastewater flows continue to grow as projected in the WWCSMP, the WRP would be expanded to an ultimate capacity of 12 MGD by 2035

### 8.3.2 Infrastructure Sizing

In order to provide the capability for phased capacity upgrades, specific project components should be sized based on ultimate flow conditions when possible. The design of pumping stations, pipelines, buildings, and storage tanks should take into account projected capacity requirements in order to prevent costly future expansion improvements to such facilities. Project components are sized accordingly and discussed in **Chapter 9.**

## 8.4 Evaluation of Septic Systems

### 8.4.1 Introduction

There are 770 customers within the District's service area that have septic systems and are not connected to sewer system. An evaluation was performed to estimate the potential new sewer flow that could be generated if these customers were converted from septic systems and connected to the sewer system. This section summarizes the results of this evaluation.

### 8.4.2 Flows Generated by Septic System Conversation

In order to estimate the total sewer generation potential from these areas, household counts were estimated based on the number of developed parcels. The WWCSMP projects that a single dwelling unit will generate 245 gpd of sewer flow (Black & Veatch, 2013). The analysis concluded that septic system conversion of all 770 potential customers would produce approximately 0.18 MGD of new sewer flow in the service area.

### 8.4.3 Capital Costs Associated with Septic Conversion

A planning level cost estimate was prepared for the septic system conversions in the service area. The estimated cost for converting the 19 septic areas and connecting them to the sewer system is approximately $8 million to $12 million, which is approximately $10,000 to $15,000 per household. The cost for septic system conversions is typically the responsibility of the property owner. For the purpose of this Study, it is assumed that septic system conversions will be performed when the District can secure outside funding to assist in this endeavor. It is recommended that the District conduct a study to evaluate the cost of septic tank system conversion to sewer, potential funding opportunities, and the net cost to customers if any.

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# Chapter 9 Treatment Process Selection and Sizing

## 9.1 Effluent Quality Requirements

Surface application of recycled water for indirect potable reuse requires disinfected tertiary effluent as defined in Title 22 of the California Code of Regulations (CCR):

> Filtration: For granular media filtration, can meet an average of 2 Nephelometric Turbidity Units (NTU) within a 24-hour period, 5 NTU more than 5% of the time within a 24-hour period, and 10 NTU at any time. For membrane filtration (such as MBRs for the proposed WRP), can meet 0.2 NTU more than 5% of the time within a 24-hour period and 0.5 NTU at any time.
>
> Disinfection: For chlorination, must provide a CT (chlorine residual x modal contact time) of at least 450 milligram-minutes per liter with a modal contact time of 90 minutes or a disinfection process that combined with the filtration process can inactivate 5-logs of F-specific bacteriophage MS2, or polio virus in the wastewater; and the 7-day median total coliform is less than 2.2 Most Probable Number (MPN)/100 milliliters (mL) and the total coliform is less than 23 MPN/100 mL in more than one sample in any 30-day period. No sample shall exceed an MPN of 240 total coliform bacteria per 100 mL.

Effluent quality must also meet the Basin Plan objectives for groundwater quality in order to protect existing and potential beneficial uses. **Table 9-1** provides a summary of Basin Plan objectives for key constituents.

**Table 9-1: Basin Plan Groundwater Objectives, Key Constituents**

| Constituents | Objective in Groundwater (mg/L) |
|---|---|
| TDS | 330 |
| Chloride | 500 |
| Sodium | 180 |
| Sulfate | 500 |
| Boron | 0.75 |
| Nitrate-N | 7.3 |

## 9.2 Treatment Process and Sizing

The water quality requirements discussed in **Section 9.1** can be achieved with treatment through an MBR system. The MBR system is an activated sludge process that treats primary wastewater and when disinfected produces tertiary filter effluent to Title 22 standards. This section provides an overview of the proposed treatment system as well as its advantages and disadvantages between MBR and conventional activated sludge systems such as Sequential Batch Reactor (SBR).

### 9.2.1 MBR Process Overview

The MBR system is a biological wastewater treatment process that combines secondary activated sludge treatment with tertiary filtration using low-pressure membrane filtration. The MBR process provides biological removal of organic matter and nitrogen, and can also be setup to biologically or chemically remove phosphorus as well. The liquid portion of the treated wastewater is filtered through either MF or ultrafiltration (UF) membranes that have pore sizes ranging from approximately 0.035 µm to 0.4 µm, depending upon the manufacturer. This filtration process replaces the conventional settling tank and is a more robust process that provides reliable, higher quality effluent.

### 9.2.2 Comparison with SBR Process

An SBR system is a secondary treatment process that produces high quality effluent. The SBR system has a relatively large footprint. Compared to conventional SBR process, the use of membrane filtration for the solids separation in an MBR process allows high quality effluent to be produced at all times, regardless of the influent quality, and eliminates the sedimentation process that can potentially cause problems in the treatment process. Therefore, the MBR effluent is consistently of high quality, with low turbidity, low BOD, and TSS.

The effluent produced from an MBR plant is considered to be tertiary effluent. As a result, additional treatment is not required to meet regulatory requirements for Title 22 unrestricted use. Contrary to the SBR process where a tertiary process such as sand or media filtration needs to be added, the MBR process can be integrated upstream of the advanced treatment process very easily.

In addition to reliable effluent water quality, the MBR system has smaller space requirements and is more robust in variations in loading without upsets. The membrane reactors are commonly enclosed so that the odor impact is minimized compared to the activated sludge process. This will reduce public concerns from nearby residential and commercial areas. Some key advantages are summarized in **Table 9-2**.

**Table 9-2: Comparison of SBR and MBR Processes**

| System Attribute | SBR System | MBR System |
|---|---|---|
| **Operational Stability and Reliability** | Effluent upsets can be caused by poor settling | More Robust process capable of handling variations in loading without upset |
| **Effluent Water Quality** | Secondary | Tertiary |
| **Footprint** | Larger | Smaller |
| **Expansion Potential** | Concrete tanks inconvenient for future expansion | Modular - Easy |
| **Incorporating Reverse Osmosis Advanced Treatment** | Tertiary filtration process required before advanced treatment | Can be directly incorporated upstream of reverse osmosis advanced treatment |
| **Public Concerns** | High odor complaints | Relatively smaller with enclosed units |

### 9.2.3 Disinfection Process

Disinfection is the final treatment barrier required to produce Title 22 recycled water. The process is intended to destroy and prevent growth of microbes in the WRP effluent. It is assumed that the WRP will utilize free chlorine disinfection as it is a proven, cost effective, and reliable process. Free chlorine disinfection provides the additional security of chlorine residual in the effluent, which may be a benefit in the case of a treatment process disruption such as membrane breakage. Free chlorine disinfection requires a relatively large footprint due to the need for a baffled chlorine contact chamber to allow time for disinfection to occur, while reducing the residual to an acceptable level.

Another viable solution is to utilize UV light for disinfection. This process requires a smaller footprint and is also quite effective in producing Title 22 recycled water. However, it is industry practice that a backup free chlorine system be used in conjunction with UV disinfection as treatment process disruptions resulting in excessive particulate matter, turbidity, and dissolved compounds in the effluent may reduce the effectiveness of UV. A backup chlorine disinfection system thus provides ample residual in the case of a treatment process disruption. The disinfection process would be refined during the implementation phase in discussions with the permitting and regulatory agencies.

### 9.2.4 Solids Handling

Secondary wastewater treatment processes produce a concentration of solids that must be periodically disposed. The concentrated solids are composed of highly organic material that can go through an additional digestion process and dewatering process to produce a sludge that is acceptable for disposal in a landfill or usable as a soil enhancer (i.e., fertilizer). The nearby Redlands Water Reclamation Plant and Yucaipa's Henry N. Wochholz Regional Water Recycling Facility both produce dried sludge which is hauled offsite to and utilized as fertilizer. The District's proposed WRP would utilize an aerobic or anaerobic digestion process followed by a belt thickener dewatering system. **Table 9-3** summarizes key advantages and disadvantages associated with aerobic and anaerobic digestion.

**Table 9-3: Aerobic Verses Anaerobic Digestion**

| Aerobic Digestion | | Anaerobic Digestion | |
|---|---|---|---|
| **Advantages** | **Disadvantages** | **Advantages** | **Disadvantages** |
| Easily controlled process and startup | No renewable energy | Produces methane used as renewable energy | Slow and sensitive start-up requires close monitoring |
| Low BOD in return stream | Energy intensive process | Destroys pathogens | Costly heating, mixing, and gas collection equipment |
| Fewer odors | Not ideal for primary sludge due to high oxygen demand | Reduces volatile content | High BOD in return stream |
| No explosive gases | Produces more biomass | Produces less biomass | Confined space hazard |
| | Sludge is more difficult to dewater | Sludge is more easily dewatered | Cleaning and maintenance challenges from sealed tanks |
| | Performance varies with seasonal temperature changes | | Produces explosive gas |

## 9.3 Sizing and Footprint

For the purposes of this study, the proposed WRP will be sized for an initial design flow of 6 MGD with the ability to expand to 10 MGD to keep pace with projected increases in flow due to increases in population and new developments. It is anticipated that there could be a total flow of 10 MGD at or near build-out conditions. The plant should be planned for an ultimate expansion up to 10 MGD to treat future flows projected in the WWCSMP for 2035. Lower than the projected flows are anticipated due to conservation efforts already in place and compliance with SBx7-7, requiring a 20% reduction in water use by the year 2020. It is estimated that approximate 8 to 10 acres of land will be required for an MBR treatment plant with on-site solids handling. The precise plant area will be refined during design phase of the project.

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# Chapter 10 Project Siting Alternatives

## 10.1 Introduction

### 10.1.1 Background and Purpose

This Chapter summarizes the results from an analysis of potential sites for the proposed WRP and groundwater recharge facilities for indirect potable reuse. **Chapter 8**, "Future Flow Projections and Phasing" identified three locations to intercept sewer flow from the main sewer trunk line along 5th Street/Greenspot Road. These three locations were identified as potential WRP sites and evaluated to determine the feasibility of implementation. Tertiary effluent from the WRP will be conveyed to a groundwater recharge facility for IPR. Therefore, sites were also identified as potential groundwater recharge locations while considering proximity to the potential WRP sites.

### 10.1.2 Sizing of Facilities

Based on the future sewer flow projections in the District's service area, the ultimate capacity of the WRP is estimated to be 10 MGD. The WRP will require approximately 8 to 10 acres of land for the treatment equipment, solids handling facilities, and other ancillary facilities.

As previously discussed, the regulators will ultimately dictate diluent water requirements; therefore the required recharge capacity cannot be confirmed at this time. Some recycled water contribution credit may be obtained through groundwater underflow associated with artificial recharge activities upstream of the GWR-RW site. Additionally, recycled water contribution requirements may be reduced after the first year of operation. For planning purposes, the recharge capacities stated above represent a conservative scenario where no underflow credit is provided and recycled water contribution requirements are not reduced.

## 10.2 WRP Site Selection

### 10.2.1 Potential Sites

**Figure 10-6** shows the location of three potential treatment sites under consideration and identified as follows:

Site 1 – District Headquarters

Site 2 – Flood Control District Parcel (location near Highway 210 and 5th Street)

Site 3 – Sterling Property (property at Sterling Avenue and 5th Street)

These sites were selected based on their proximity to the sewer interception points identified in **Chapter 8**. A description of each site is presented herein.

#### Treatment Site 1 - District Headquarters

The District Headquarters site is located at the eastern end of the District's service area and is comprised of two adjacent parcels, as shown on **Figure 10-1** below prior to the construction of the District Headquarters. The new Headquarters building was constructed on the northern parcel, while the southern parcel remains undeveloped. The southern parcel is approximately 13 acres based on GIS maps. The southern parcel can be characterized as having an undulating terrain with overgrown vegetation and large rock and boulder outcroppings (see **Figure 10-2** for photograph of site). A significant effort in clearing, grubbing, and site preparation would be required to make this parcel suitable for the WRP.

This property is also adjacent to several existing and planned residential communities located within 0.5 miles of this site. The Arnott Range Development is a major development that is proposed to be constructed across the street from the District Headquarters. Additionally, the District Headquarters is located at an elevation that is 400 to 600- feet higher than the lower elevation of the majority of the District, requiring significant long-term pumping and energy use to provide flows to this site.

**Figure 10-1: Potential Treatment Site at the District Headquarters**

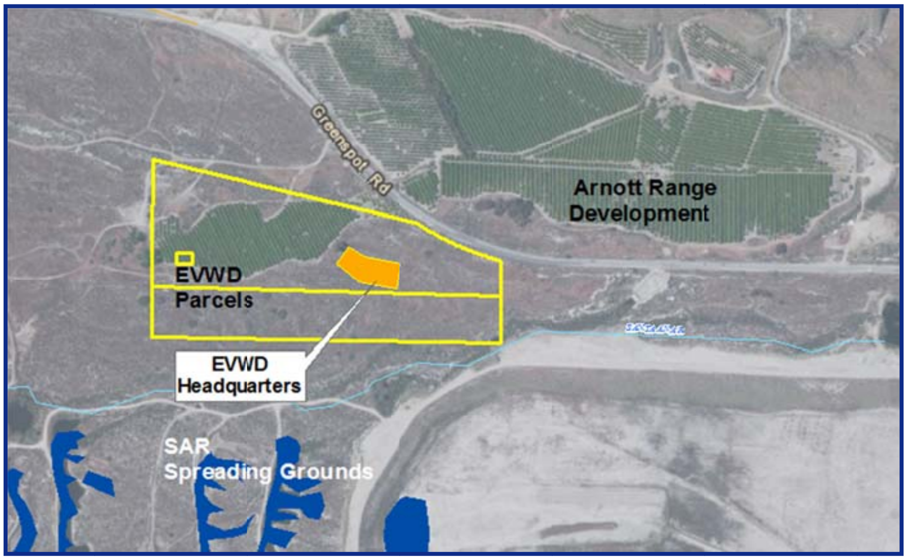
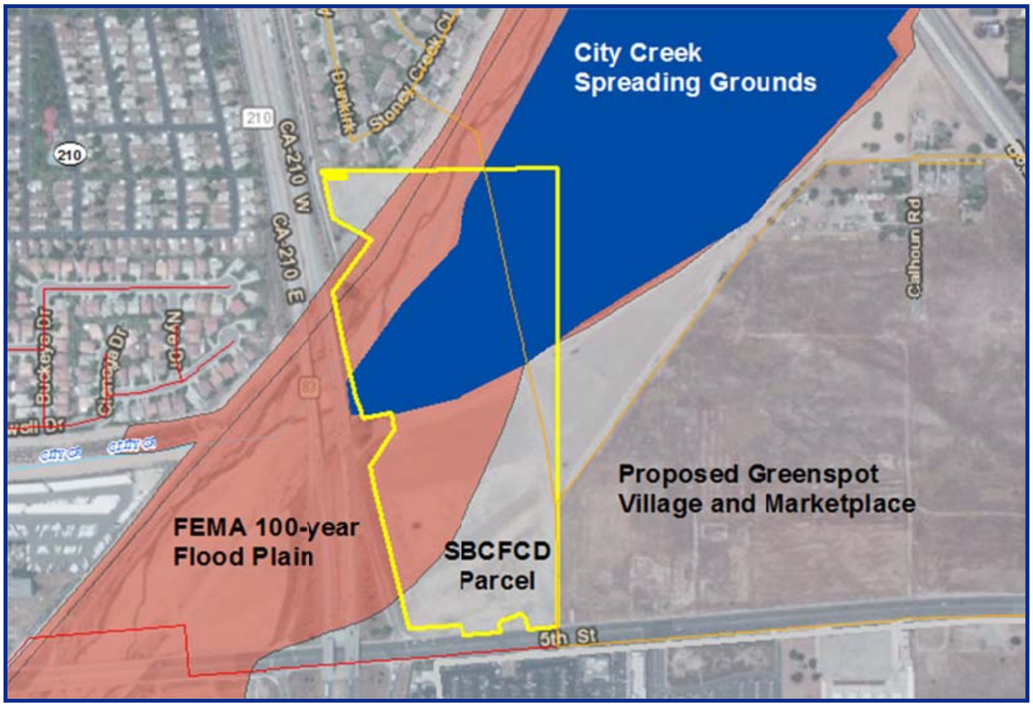



**Figure 10-2: View of Southern Parcel of District Headquarters (looking south)**

## Treatment Site 2 – Flood Control District Parcel

The San Bernardino County Flood Control District (SBCFCD) owns an undeveloped parcel at the northeast corner of the Highway 210 and 5th Street intersection. The southeast portion of the parcel that is outside of the 100-year flood plain is approximately 13 acres, as shown on **Figure 10-3**. This site is not optimal for a WRP due to a number of issues. First, it is located in a heavily travelled area near the 5th Street exit off of Highway 210. Additionally, there is a proposed major development east of this site known as the Greenspot Village and Marketplace development. If this site were to be acquired by the District, it could also be utilized for commercial development, which would bring additional revenue to the City of Highland.

**Figure 10-3: Potential Treatment Site near Highway 210**




## Treatment Site 3 - Sterling Property

The District currently owns two adjacent parcels west of Highway 210 near the intersection of Sterling Avenue and 5th Street in San Bernardino. The total size of these parcels is approximately 22 acres. **Figure 10-4** below presents an aerial view of this site. This property is adjacent to the San Bernardino Airport in a lightly developed area zoned as light commercial with a few small businesses and residential properties. The Sterling property is undeveloped and is characterized as flat, wide open with short scrubs and grass. A view of the Sterling property is shown on **Figure 10-5**. This property has very few adjacent neighbors. The adjacent parcels to the immediate north and west are completely open and undeveloped. The airport is to the immediate south across of 3rd Street. Only the parcel to the east is developed with a commercial automobile towing company. Because this area is zoned for commercial developments and because the District is classified as a special district, local permitting requirements may not pertain to this site.

A water production well (Plant 141) owned by the District is located on the east parcel at the far eastern end of the property. Because the well is relatively small and off to the side, a WRP should be able to be constructed with the minimum 500-foot regulatory clearance from the well.

**Figure 10-4: Potential Treatment Site at Sterling Property**

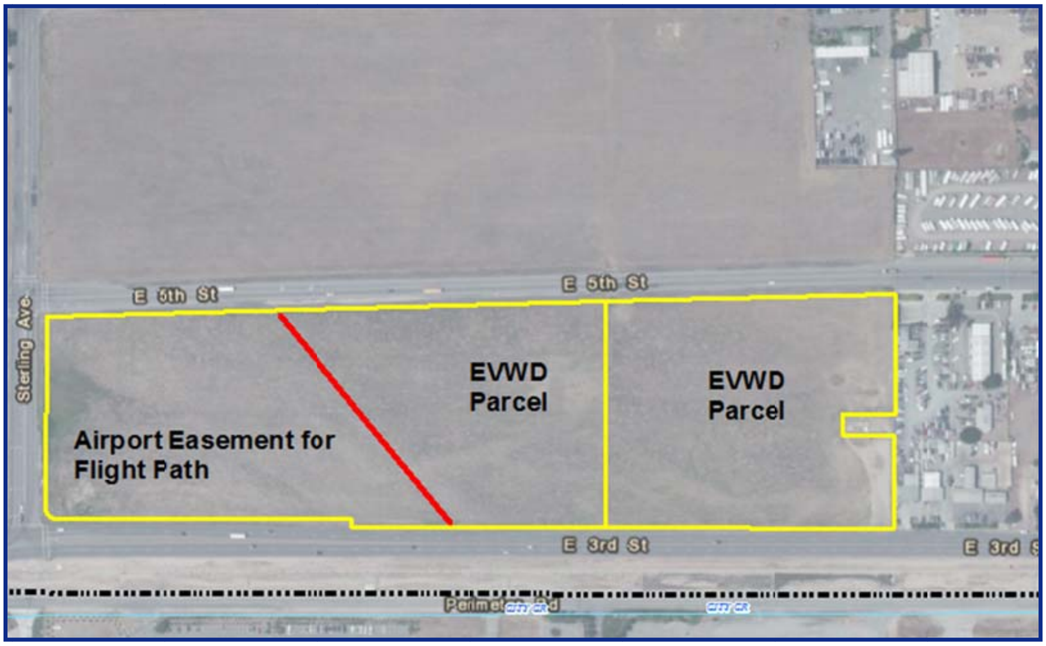
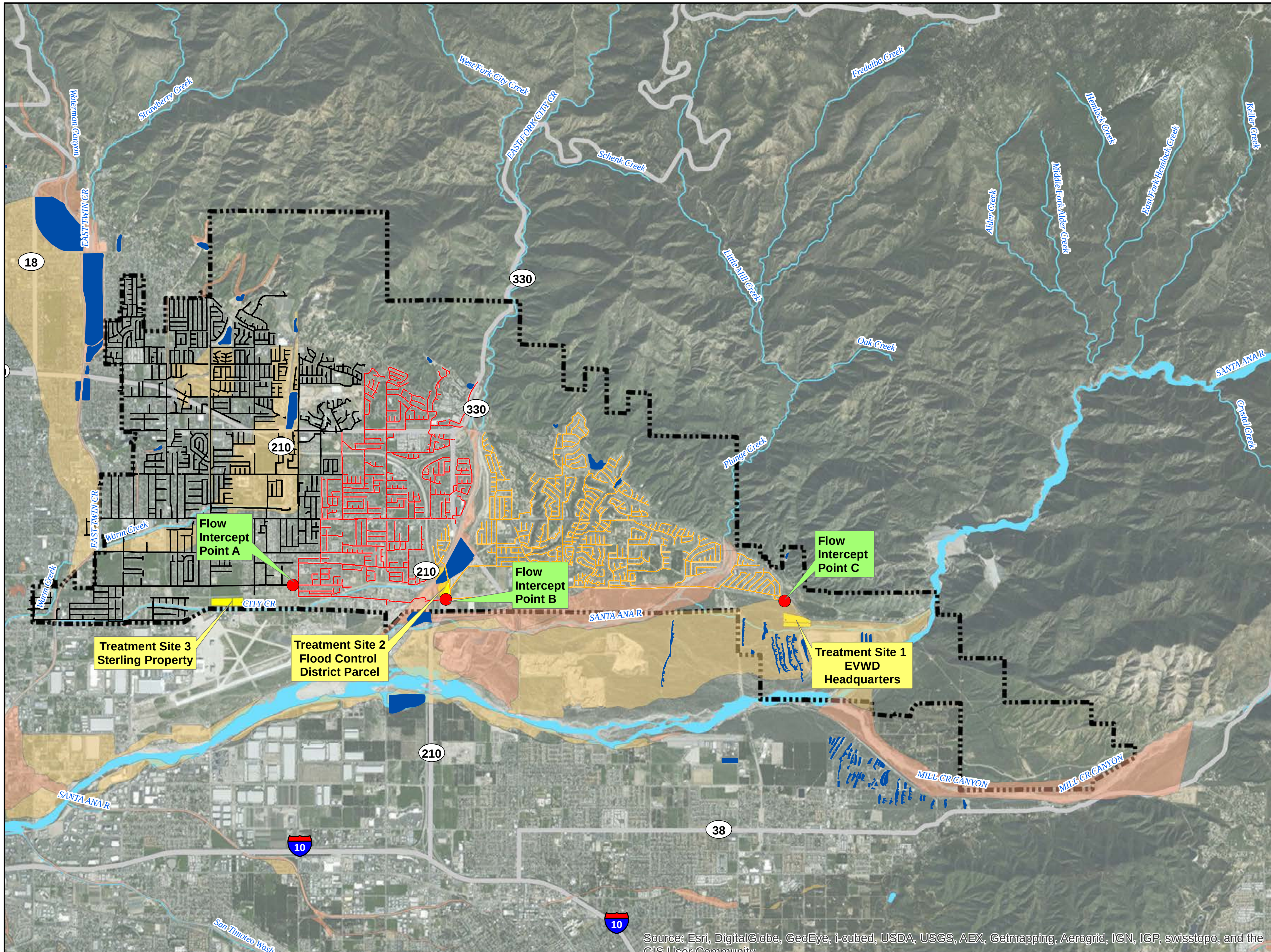



**Figure 10-5: View of Sterling Property (from Sterling Ave. looking east)**

## Recycled Water Feasibility Study

## Figure 10-6
## Potential Treatment Sites




- Potential Interception Points
- Potential Recharge Basins
- Potential Treatment Sites

**Upstream Collection System**

- Interception Point A
- Interception Point B
- Not Intercepted

**FEMA Flood Zone**

- 100 year flood zone
- 500 year flood zone
- EVWD Boundary
- Major Roads
- Rivers

N

0 0.75 1.5 3
Miles

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### 10.2.2 Treatment Site Ranking

Each site was scored based on specific evaluation criteria where a score of 1 indicates that it scores best in relation to the other sites and 3 indicates that it scores the worst. Therefore, the site with the lowest total score indicates that it is the most desirable location, when compared to the other sites.

Based on the analysis and ranking provided in **Table 10-1**, the Sterling Property site was determined to be the most preferred of the three sites for the following reasons:

1. The Sterling location has the largest amount of sewer flow available via gravity flow.
2. The Sterling location is located at a lower elevation and does not require pumping to divert flow to the WRP.
3. The District already owns the two parcels that make up the Sterling property.
4. The area around the Sterling property is lightly developed, is zoned as light commercial and has few immediate residential neighbors.

**Table 10-1: Treatment Site Evaluation Matrix**

| Evaluation Criteria | Site 1 District HQ | Site 2 SBCFCD | Site 3 Sterling |
|---|---|---|---|
| Availability of Supply | 3 | 2 | 1 |
| Elevation | 3 | 2 | 1 |
| Ease of Acquisition | 1 | 3 | 1 |
| Public Concern | 3 | 3 | 1 |
| Total Score | 10 | 10 | 4 |
| **Overall Ranking** | **3** | **3** | **1** |

Proximity to recharge facilities must be evaluated as part of the overall site selection process and is considered in the recharge site selection process described below.

## 10.3 Recharge Basin Site Selection

### 10.3.1 Potential Sites

The recycled water produced by the proposed WRP would be primarily used for GWR-RW with the potential to serve NPR customers close to the distribution system from the proposed WRP to the spreading grounds. A number of sites were identified as potential recharge basin locations within the boundary of the Bunker Hill B groundwater basin.

**Figure 10-7** shows locations for the five recharge sites that were selected for evaluation based on previous reports produced by Geoscience and the SBVWCD. The recharge basins from east to west are listed as follows:

Site 1 – Santa Ana River Spreading Grounds

Site 2 – Mill Creek Spreading Grounds

Site 3 – City Creek Spreading Grounds

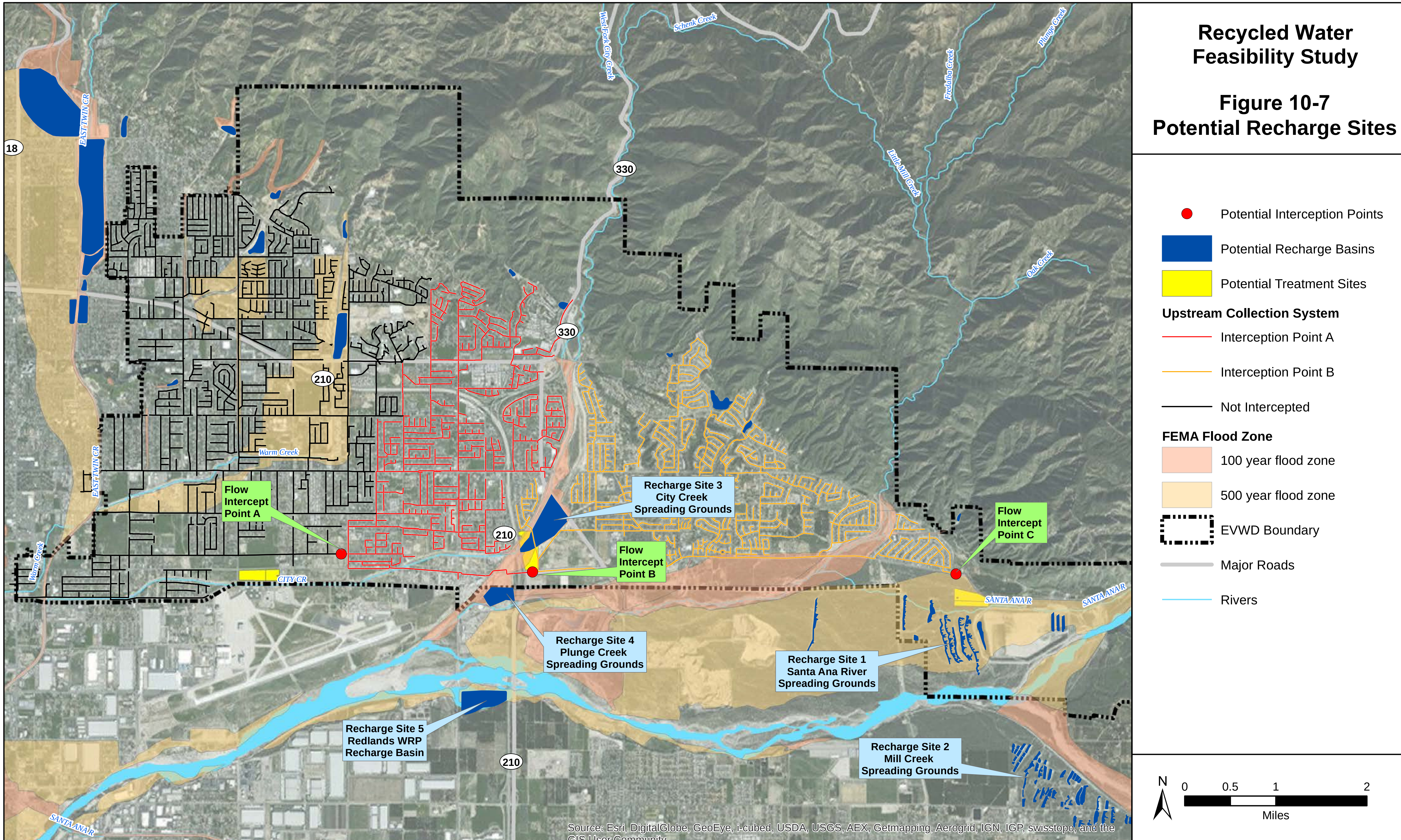
Site 4 – Plunge Creek Spreading Grounds

Site 5 – Redlands Recharge Basin

There are other potential spreading grounds in the northwest region of the District service area, however, they are not considered to be as advantageous because they are at a significantly higher elevation and/or located a long distance from the potential treatment plant sites along 5$^{th}$ Street/Greenspot Road. These locations were not considered for further evaluation in this Study. Geophysical survey investigations have been conducted for some of the potential basins. A description of each of the potential recharge basin locations is presented herein.

# Recycled Water Feasibility Study

## Figure 10-7
## Potential Recharge Sites



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## Recharge Site 1 - Santa Ana River Spreading Grounds

The Santa Ana River (SAR) spreading grounds is an existing facility operated by the SBVWCD for groundwater recharge. The basins are located south of the District Headquarters and along the Santa Ana River (see **Figure 10-8** for aerial view of the basins). The District's Plant 125 is located within 0.1 miles west of the recharge basins. The SAR spreading grounds is the primary recharge area for the SBVWCD with the source water originating from the Santa Ana River via Seven Oaks Dam and State Project Water via the Metropolitan Water District of Southern California. In the water year 2011/2012, 30,000 acre-feet of water was recharged at the SAR spreading ground (SBVWCD, 2012). The SBVWCD applied to the State for water rights licenses for the diversion of water, and received two licenses for the diversion of a total of 10,400 acre-feet per year (AFY) of Santa Ana River water in 1945.

The spreading grounds are comprised of a number of constructed recharge basins where water from the Santa Ana River is diverted into a series of concrete channels and unlined canals and basins for artificial recharge of the groundwater basin. There is also the ability to divert State Project Water into the recharge basins.

**Figure 10-8: Santa Ana River Spreading Grounds**


Source: SBVWCD, 2012

**Table 10-2: Site Parameters at Santa Ana River Spreading Grounds**

| Parameters | Site 1 |
|---|---|
| Size (Acreage) | 64 |
| Elevation (Feet) | 1640 |
| Recharge Type | Diverted |
| Infiltration Rate (ft/day) | 6 |
| Recharge Capacity (MGD) | 195 |
| Diluent Water Available | Santa Ana River water and State Project Water |
| Distance to Water Well | <0.1 mile to Plant 125 |
| Recharge activity in last water year (AF) | 30,000 |

## Recharge Site 2 - Mill Creek Spreading Grounds

Mill Creek spreading grounds is another potential recharge location that is currently managed by SBVWCD. It is located south of the SAR spreading grounds by Mill Creek. **Figure 10-9** shows the aerial view of the Mill Creek spreading grounds. The source water primarily comes from Mill Creek. It can also receive water from other nearby agencies. The facilities connecting Mill Creek and SAR spreading grounds provide a great degree of flexibility of water that can be diverted to both recharge facilities. In 1945, SBVWCD obtained the water rights to divert up to 10,400 AFY for groundwater recharge in both SAR and Mill Creek spreading grounds. In the water year 2011/2012, 18,000 AFY was recharged at the Mill Creek spreading ground (SBVWCD, 2012).

**Figure 10-9: Mill Creek Spreading Grounds**


Source: SBVWCD, 2012

**Table 10-3: Site Parameters at Mill Creek Spreading Grounds**

| Parameters | Site 2 |
|---|---|
| Size (Acreage) | 66 |
| Elevation (Feet) | 1840 |
| Recharge Type | Diverted |
| Infiltration Rate (ft/day) | 3 |
| Recharge Capacity (MGD) | 64.5 |
| Diluent Water Available | Santa Ana River water and State Project Water |
| Distance to Water Well | <2 miles from Plant 125 |
| Recharge activity in last water year (AF) | 18,000 |

## Recharge Site 3 - City Creek Spreading Grounds

The existing City Creek spreading grounds are located north of 5th Street near Highway 210, within one mile from Plant 40. **Figure 10-10** shows an aerial view of the City Creek spreading grounds. It had historically been used for surface water spreading of stormwater and runoff from City Creek and operated by the SBVWCD. This site was considered as a potential site for additional stormwater capture and in-stream recharge in the 2012 Storm Flow and Capture Analysis report (Geoscience, 2012) conducted for the SBVWCD. According to the most recent water balance model, 7,564 AFY of stormwater can be recharged to groundwater at this location.

The City Creek spreading grounds is undeveloped and would require significant construction to accommodate the discharge and dilution of IPR water into the spreading grounds. In 2011, this site was evaluated for use as a diverted stormwater capture and recharge basin (Geoscience 2012). A planning level cost estimate of $1.55 million was developed, which equates to $1.65 million in 2014 dollar. It should be noted that this cost is a point of reference, however further analysis is required to determine specific improvements required to use this basin for groundwater recharge of recycled water. The San Bernardino County Flood Control District also owns a portion of the spreading grounds and would require their approval and coordination to discharge IPR water into the spreading grounds

**Figure 10-10: City Creek Spreading Grounds**

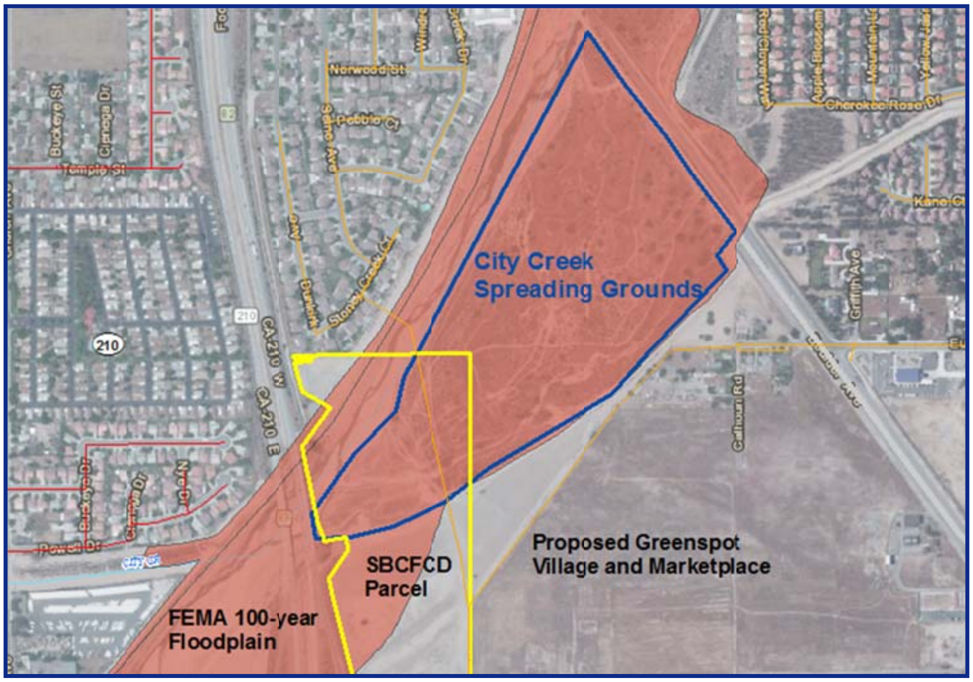


**Table 10-4: Site Parameters at City Creek Spreading Grounds**

| Parameters | Site 3 |
|---|---|
| Size (Acreage) | 45.6 |
| Elevation (Feet) | 1,260 |
| Recharge Type | In-stream |
| Infiltration Rate (ft/day) | 6.7 |
| Recharge Capacity (MGD) | 99.6 |
| Diluent Water Available | Natural runoff or stormwater |
| Distance to Water Well | <1 mile from Plant 40 |

## Recharge Site 4 - Plunge Creek Spreading Grounds

The Plunge Creek spreading grounds do not currently exist, but were considered as a potential location for runoff and stormwater recharge in the 2012 Storm Flow and Capture Analysis report (Geoscience, 2012). This proposed location is south of the site of the City Creek spreading grounds; south of 5th Street and west of Highway 210. **Figure 10-11** shows an aerial view of the proposed Plunge Creek location. According to the most recent water balance model, annual groundwater recharge projection using storm water at this location averages 3,962 AFY (Geoscience, 2012). Currently, no artificial recharge activities take place at this site.

The Plunge Creek spreading grounds would require significant construction to accommodate the discharge and dilution of IPR water into the spreading grounds. In 2011, this site was evaluated for use as a diverted stormwater capture and recharge basin (Geoscience 2012). A planning level cost estimate of

$1.21 million was developed, which equates to $1.29 million in 2014 dollar. It should be noted that this cost is a point of reference, however further analysis is required to determine specific improvements required to use this basin for groundwater recharge of recycled water.

**Figure 10-11: Potential Plunge Creek Spreading Grounds**

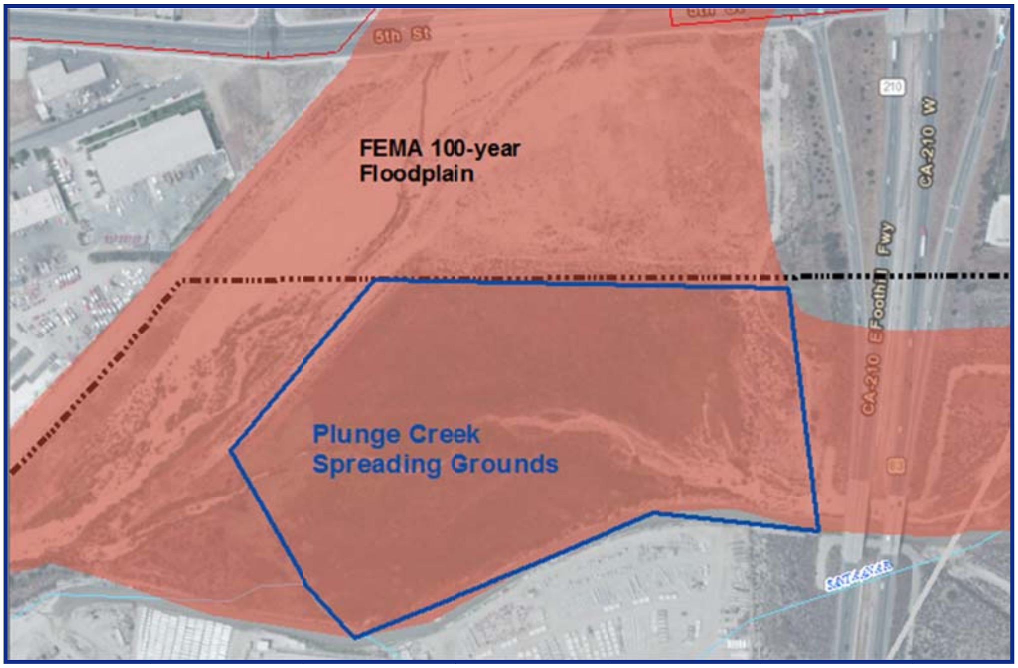


**Table 10-5: Site Parameters at Plunge Creek Spreading Grounds**

| Parameters | Site 4 |
|---|---|
| Size (Acreage) | 37.6 |
| Elevation (Feet) | 1,220 |
| Recharge Type | In-stream |
| Infiltration Rate (ft/day) | 6.7 |
| Recharge Capacity (MGD) | 127.0 |
| Diluent Water Available | Natural runoff or stormwater |
| Distance to Water Well | <0.5 mile from Plant 40 |

## Recharge Site 5 - Recharge Basin at the City of Redlands Water Reclamation Plant

The City of Redlands has a water reclamation plant and an adjacent recharge basin. The original wastewater treatment plant was a 10 MGD secondary treatment plant which discharged the plant effluent to an adjacent recharge basin for groundwater recharge. The basin is located south of the Santa Ana River between Alabama Street and Highway 210, as shown on **Figure 10-12**. In 2004, the plant was upgraded to a 6 MGD tertiary water reclamation plant with membrane bioreactor technology. The WRP effluent is currently used for beneficial reuse and is delivered to the 1,056 megawatt Mountainview Power Company power plant owned by Southern California Edison to supply water to its cooling towers. Because the

Redlands WRP effluent water is delivered to the power plant, the adjacent spreading basins may not be in current use and could potentially be an available recharge site. The potential availability of this site needs to be confirmed with staff at the City of Redlands WRP.

If the spreading basins are no longer used by Redlands, this creates a potential opportunity for the District to use the spreading basins for groundwater recharge. This location is in close proximity to the Sterling Property site for a potential WRP location; therefore, this would be an ideal location for receiving IPR water from the Sterling site. The recharge capacity for the basins is not estimated in the available Geoscience reports. However, it is reasonable to assume that the basins can receive water in the range of 5 to 10 MGD, which is the size range of the original wastewater treatment plant. Additional data from the City of Redlands and further analysis is required to better characterize this recharge basin and determine the potential cost associated with upgrading the site for GWR-RW.

**Figure 10-12: Redlands Recharge Basin**

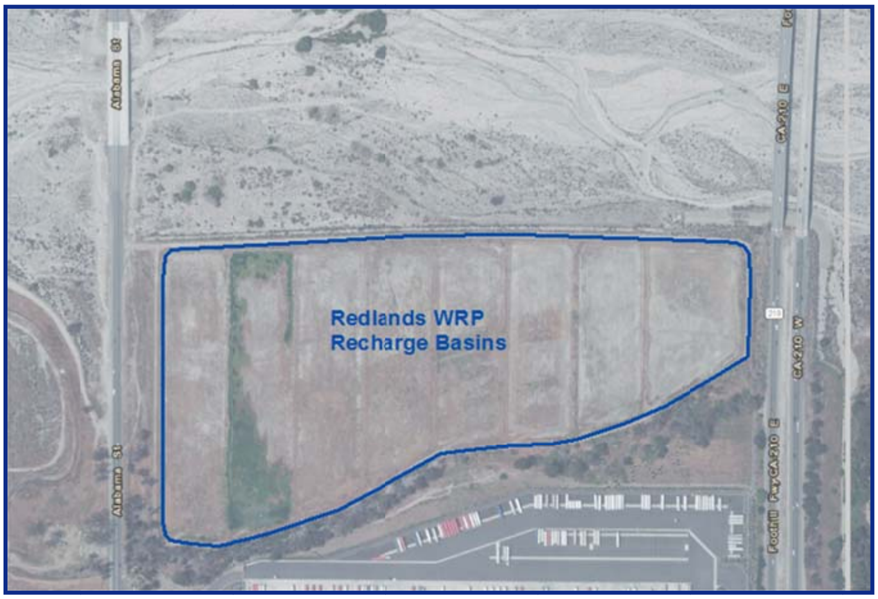


**Table 10-6: Site Parameters at Redlands Recharge Basin**

| Parameters | Site 5 |
|---|---|
| Size (Acreage) | 35 |
| Elevation (Feet) | 1,220 |
| Inside 100-year Floodplain | No |
| Recharge Type | Diverted |
| Infiltration Rate (ft/day) | 3 |
| Recharge Capacity (MGD) | 34.2 |
| Diluent Water Available | Santa Ana River water |
| Distance to Water Well | None |

### 10.3.2 Recharge Site Ranking

Each site was scored based on specific evaluation criteria where a score of 1 indicates that it scores best in relation to the other sites and 3 indicates that it scores the worst. Therefore, the site with the lowest total score indicates that it is the most desirable location when compared to the other sites.

Based on the results illustrated in **Table 10-7**, the Mill Creek Spreading Grounds, Redlands Recharge Basin and SAR Spreading Grounds were determined to be the most preferable of the five sites.

**Table 10-7: Recharge Site Evaluation Matrix**

| Evaluation Criteria | Site 1 Santa Ana River | Site 2 Mill Creek | Site 3 City Creek | Site 4 Plunge Creek | Site 5 Redlands Basin |
|---|---|---|---|---|---|
| Existing Recharge Infrastructure | 1 | 1 | 3 | 3 | 1 |
| Diluent Water Availability | 1 | 1 | 3 | 3 | 2 |
| Distance to Water Production Wells | 3 | 2 | 2 | 3 | 1 |
| **Total Score** | 5 | 4 | 8 | 9 | 4 |
| **Overall Ranking** | **2** | **1** | **3** | **3** | **1** |

**Table 10-8** summarizes the three preferred recharge site's recharge capacities and proximity to the proposed WRP at the preferred Sterling Site. It should be noted that the SAR Spreading Grounds and Mill Creek Spreading Grounds are currently utilized for artificial recharge by the SBVWCD and the Redlands Recharge Basin is currently not used. Further analysis is required to verify the recharge capacity of Redlands Recharge Capacity.

**Table 10-8: Recharge Site Properties**

| Facility | Recharge Capacity (MGD) | Distance to Sterling Site (miles) |
|---|---|---|
| Santa Ana River Spreading Grounds | 126.0 | 8.0 |
| Mill Creek Spreading Grounds | 64.5 | 11.0 |
| Redlands Recharge Basin | 34.2[1] | 3.8 |

Notes:

1. Estimated recharge capacity is based on an infiltration rate of 3 ft/day according to data collected in the surrounding area.

## 10.4 Project Alternatives

The analysis presented above indicates that the highest ranking WRP site is the Sterling Property. This is relatively close to the Redlands Recharge Basin, which is one of the highest ranking recharge sites. The combination of a WRP at the Sterling Property with IPR recharge facilities at the Redlands Recharge Basin appears to be the best combination.

It is recommended that the following the WRP at Sterling Property with IPR recharge at Redlands Recharge Basin project alternative be further considered for implementation:

# Chapter 11 Economic Evaluation

## 11.1 Introduction

The purpose of this chapter is to provide a cost comparison of potential operational scenarios under which the District could augment water supplies through GWR-RW, while providing wastewater treatment to its customers. Planning level cost estimates were developed for each operational scenario along with the benefit provided in the form of a new water supply.

Previous chapters in this report have identified flow projection and potential locations of the proposed WRP and associated infrastructure, including pipelines, pumping stations, and potential basin improvements, which were presented in technical memoranda for this Study. The Sterling Site and Redlands Recharge Basin have been identified as the most viable sites for wastewater treatment and groundwater replenishment, therefore this chapter focuses on these locations for the purpose of comparing costs and benefits associated with the following project alternatives:

- **No Project:** The City of San Bernardino continues to treat all District wastewater at the SBWRF
- **6 MGD WRP:** The District treats current flows collected east of the Sterling site at the proposed WRP
- **10 MGD WRP:** The District treats all wastewater flows at the proposed WRP

The following sections summarize the estimated capital and operations and maintenance (O&M) cost information for each alternative while accounting for the value of water supply generated.

## 11.2 No Project Alternative Costs

This section presents the basis for capital and O&M costs as well as the benefit received by the value of water produced as a result of no project implementation, which requires the City of San Bernardino to continue to treat all of the District's wastewater flows.

### 11.2.1 Capital Cost

Capital costs associated with the No Project Alternative are a result of wastewater collection system CIP costs and are accounted for in the cost comparison provided herein (**Table 11-6**).

### 11.2.2 O&M Cost

The O&M cost considered for this alternative includes the cost for the District to send wastewater to the City of San Bernardino for wastewater treatment. The District anticipates adding approximately 11,500 new wastewater customer connections by 2035. Each connection pays a monthly fee of $30.58 for wastewater treatment services. Projecting these costs based on a constant rate of growth until 2035 results in a total treatment cost of $195.8M or an average annual cost of $9.8M.

### 11.2.3 Value of Water Supply

There is no value of water supply associated with this alternative since all flows will be sent to the City of San Bernardino and no new water supply is created.

## 11.3 Project Alternative Cost

This section presents the basis for capital and O&M costs as well as the benefit received by the value of water produced as a result of implementing a 6 MGD WRP and 10 MGD WRP. It should be noted that there may be costs associated with project alternatives that are not included for the cost comparison conducted herein. At the feasibility study stage of planning there is some uncertainty as to whether specific project components may or may not be required. In order to perform a cost comparison analysis only confirmed required project components are included.

## Water Recycling Plant

On-line research was conducted and identified the construction cost of eight MBR plants at capacities between 4 and 12 MGD that were constructed between 1998 and 2012. This cost data was escalated to 2014 dollars and plotted against treatment capacity to develop a cost curve as the basis for determining the potential cost for the District to implement a new MBR WRP. The resulting construction cost of a 6 MGD and 10 MGD WRP are presented in **Table 11-1**. It should be noted that these estimated costs are based on cost curves and not site specific conditions. Cost estimates can be developed to a higher degree of confidence in the future as better definition of the project evolves.

**Table 11-1: Estimated Cost of Water Recycling Plant**

| Plant Capacity (MGD) | Capital Cost ($M) | Design, Env, Admin[1] ($M) | Total Cost ($M) |
|---|---|---|---|
| 6 | 49.1 | 12.3 | 61.4 |
| 10 | 82.6 | 20.7 | 103.3 |

[1] 25% for design, environmental documentation, administration costs

## Treated Water Conveyance System

A treated water conveyance system is required to convey tertiary effluent to the Redlands Recharge Basin for GWR-RW. The system requires 18,000 LF of up to a 24-inch diameter pipeline to deliver up to 10 MGD of treated water flow to the recharge basin. Construction cost of the pipeline was estimated using a per unit cost of $20 per inch-diameter per foot. Construction cost of the pumping station is estimated based on construction cost curves from Pumping Station Design (Sanks et al., 1989). SBVMWD has indicated it has rights to an existing 36-inch diameter pipeline that crosses the Santa Ana River in the Alabama Street Bridge. SBVMWD has indicated that they would allow the District to utilize the 36-inch pipeline. This estimate assumes that the District could use the existing pipeline at no additional cost. A summary of the treated water conveyance system improvements cost for each project alternative are shown in **Table 11-2.**

**Table 11-2: Estimated Cost of Treated Water Conveyance System**

| Plant Capacity (MGD) | Total Infrastructure Cost to Plant ($M) | Design, Env, Admin[1] ($M) | Total Cost ($M) |
|---|---|---|---|
| 6 | 9.9 | 2.5 | 12.4 |
| 10 | 12.2 | 3.0 | 15.2 |

[1] 25% for design, environmental documentation, administration costs

## Total Project Capital Cost

The cost estimates for each project component in the previous sections are presented based on projected flow phasing in **Table 11-3**. Phased implementation of a 10 MGD plant may be a viable alternative for the District. In the case that the District were able to take advantage of this approach due to the variables discussed in **Section 8.3.1**, an initial capacity of 6 MGD could be provided allowing for future expansion of the plant. While this approach presents the opportunity for savings associated with the WRP, treated water conveyance costs would be sized for the ultimate capacity of 10 MGD. The total project cost estimate is considered a planning-level cost estimate and is based on information available at this time. The accuracy of the cost estimate will improve as greater project detail is developed over time.

**Table 11-3: Estimated Project Cost for Various Plant Capacities[1]**

| System Components | 6 MGD Ultimate Capacity ($M) | 6 MGD Expandable to 10 MGD ($M) | 10 MGD Ultimate Capacity ($M) |
|---|---|---|---|
| Water Recycling Plant | 61.4 | 61.4 | 103.3 |
| Treated Water Conveyance System | 12.4 | 15.2 | 15.2 |
| **Total Project Capital Cost** | **73.8** | **76.6** | **118.5** |

[1] Costs include 25% for design, environmental documentation, and administration

### 11.3.2 O&M Cost

Based on available cost data from the Redlands Water Recycling Plant, the O&M cost of an MBR plant is approximately $1M per MGD of capacity. For the purpose of this Study, this conservative basis is used as the basis for estimated O&M costs as presented in **Table 11-4**.

**Table 11-4: Estimated Annual O&M Cost for the Proposed WRP**

| Plant Capacity (MGD) | Total O&M ($M) |
|---|---|
| 6 | 6.0 |
| 10 | 10.0 |

## 11.4 Project Benefits

Project benefits discussed in this section may provide additional value as a result of implementation of a potable reuse project. This value is expressed monetarily for the purpose of performing a comparative cost-benefit analysis. Benefits discussed are a result of the proposed project alternative. Additional benefit from recycled water sales to customers for non-potable reuse water may be readily available under an alternate project configuration. However, the proposed project configuration still provides opportunity for future development of a recycled water distribution system that could generate additional benefit to the District. Project benefits are discussed below.

### 11.4.1 Value Created from Additional Water Resources Produced

Each project alternative has a different benefit associated with it based on the volume of effluent produced for GWR-RW. The value of water produced as a result of each project alternative is based on the cost of imported SWP water currently used to recharge the groundwater basin, which is $662/AF. Recycled water produced for IPR will augment current groundwater recharge practices as existing SWP supplies are diverted to surface WTPs in order to support regional increases in demand. The value of water produced by each project alternative is summarized in **Table 11-5**.

**Table 11-5: Estimated Value of Water Created from Proposed WRP**

| Plant Capacity (MGD) | Purified Water Produced (AFY) | Annual Value Created from Purified Water ($M) |
|---|---|---|
| No Project | 0 | 0 |
| 6 | 6,720 | 4.4 |
| 10 | 11,200 | 7.4 |

It should be noted that the value of water produced will be a major consideration while evaluating and negotiating institutional challenges and opportunities. Therefore, the actual monetized value of this water cannot be determined at this time. For the purpose of the cost analysis presented below, this benefit is treated as a revenue stream resulting from the project. Additionally, the cost of imported SWP water is projected by the Metropolitan Water District of Southern California to significantly increase over time. The cost increase will improve the economic benefit to the District, if it produces its own water supply via GWR-RW.

### 11.4.2 Economic Benefits

The District's investment in a recycled water program will result in additional benefits to the local economy. There are a variety of possible methods for determining the local economic impact resulting from construction projects of various types. The Sacramento Regional Research Institute (SRRI), which is associated with the Sacramento Area Commerce and Trade Organization, has developed a tool for estimating such benefits specific to construction of water and wastewater treatment facilities in the state of California. According to SRRI, it estimates a $1 million investment in infrastructure and public works projects generates an additional $825,858 of output through indirect and induced activities. Constructing a new recycled water facility, with a capital cost of $118.5 million, would have additional financial impact to the local economy of $97 million, providing a total financial benefit of $215.5 million to the local economy. Further, construction of a new facility would generate up to 1,400 new jobs, approximately 800 of which are a direct result of the project and 600 of which are a result of indirect and induced activities.

## 11.5 Project Alternative Cost Comparison

A comparative cost-benefit analysis was performed over a 20 year period accounting for capital and O&M costs as well as the value of water produced in order to determine the potential impact on rate payers for the three project alternatives discussed above. It should be noted that for cost comparison purposes it is assumed that there is no escalation for value of water produced or in the cost of treatment at the SBWRF. The cost comparison is summarized in **Table 11-6.**

**Table 11-6: 20-year Cost Comparison**

| District Cost Components | No Project ($M) | 6 MGD WRP ($M) | 10 MGD WRP ($M) |
|---|---|---|---|
| District WRP | 0 | 61.4 | 103.3 |
| Treated Water Conveyance | 0 | 12.4 | 15.2 |
| Anticipated Wastewater System Improvements[1] | 34.6 | 16.2 | 29.2 |
| SBWRF Treatment Costs | 195.8 | 100.2 | 0 |
| District Treatment Costs | 0 | 120 | 200 |
| **Total Costs** | **230.4** | **310.2** | **347.7** |
| Value of Water Supply[2] | 0 | 89.0 | 148.3 |
| **Net Costs** | **230.4** | **221.2** | **199.4** |
| Average Monthly Cost Per Connection ($)[3] | 37.79 | 36.29 | 32.71 |
| Incremental Cost Per Connection ($)[4] | 7.21 | 5.71 | 2.13 |
| **Incremental Percentage Rate Increase** | **24%** | **19%** | **7%** |

Notes:

1. Anticipated wastewater system improvements are included to account for potential avoided costs associated with project alternatives that could affect rates.
2. The value of water produced as a result of each project alternative is based on the cost of imported SWP water currently used to recharge the groundwater basin, which is $662/AF.
3. Based on an average of 25,400 connections over 20 years.
4. Based on the current monthly cost per connection of $30.58

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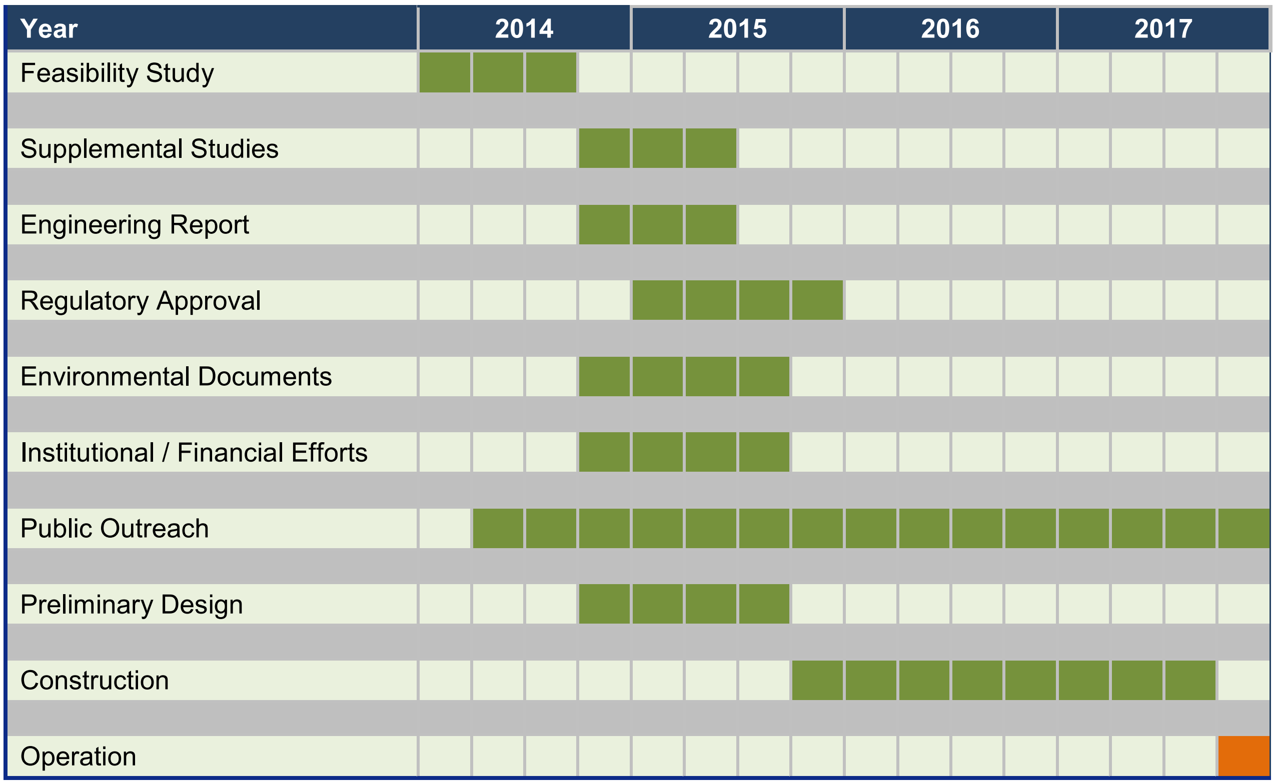
# Chapter 12 Implementation Strategies

**Figure 12-1** summarizes the recommended implementation activities for the proposed project and associated timeline highlighting key decision points. This timeline shows that it would take more than two years after this Study is complete to start using recycled water for the GWR project operation.

The timeline assumes that many activities take place concurrently and that a progressive design-build process is utilized for project construction, in order to meet the project milestone of being on-line by the third quarter of 2017. Further discussion of construction strategy is discussed in **Section 12.4**.

**Figure 12-1: Anticipated Implementation Timeline**




## 12.1 Regulatory Strategy

Components and timelines required to obtain regulatory approval to proceed with the development of a GWR-RW project in the District's service area were developed based on the regulatory analysis conducted for the Study (see **Chapter 6**), and input received from a preliminary discussion with the Regulators. As noted in the regulatory analysis, authorization of a GWR-RW project would be the responsibility of the DDW/SWRCB and the Santa Ana RWQCB.

The proposed project regulatory approval process addresses issuance of the GWR permit and environmental documentation process.

### 12.1.1 GWR Permitting Process

Effective July 1, 2014, the California Department of Public Health Drinking Water Program (including recycled water responsibilities) was transferred to the State Water Resources Control Board (SWRCB) and named the Division of Drinking Water (DDW). Also effective July 1, 2014, the CWC was amended such that the SWRCB (and thus the DDW) may carry out the duties and authority granted to a RWQCB pursuant to Chapter 7 of the CWC (Water Reclamation sections 13500 – 13557, which include issuing potable reuse permits). The transition in permitting responsibilities will evolve over the 2014/15 state fiscal year. Thus, it is not clear at this time if the RWQCB will issue the GWR permit (as currently practiced) or if this responsibility will be the primary responsibility of the DDW. Nevertheless, timely approval of the proposed project will require close coordination and communication with DDW and RWQCB, a process that was started during this study.

The process from planning to permit issuance involves a number of steps and collection of technical information as outlined below. Additional information is provided in Chapter 6.

1. **Project Sponsor Develops an Approved Outline for the Engineering Report:** A GWR project sponsor must submit an engineering report to DDW and RWQCB for review and in the case of DDW for approval. To facilitate preparation and approval of the engineering report it is recommended that the project sponsor work with DDW and RWQCB to develop an approved outline for the report.
2. **Project Sponsor Submits Draft Engineering Report and ROWD:** Typically both the draft engineering report and ROWD are submitted at the same time. The engineering report must describe how the proposed project will meet the final GWR Regulations, the RWQCB Water Quality Control Plan (Basin Plan), and applicable State Policies. Preparation of the engineering report involves compilation of substantive information and studies that address topics including but not limited to:
    - Project Overview and Participants
    - Description of Project Facilities
    - Source Control Program
    - Water Quality Characterization of Raw Wastewater and Tertiary Recycled Water
    - Description of the Groundwater Basin (Hydrogeology, Water Rights, Water Quality, Location of Drinking Water Wells)
    - Groundwater Recharge Impacts Based on Modeling
    - Diluent Water Sources, Water Quality, Source Water Assessment
    - Anti-degradation Assessment
    - Pathogen Control
    - Response Retention Time
    - WRF and Spreading Basin Operations
    - Contingency Plan
    - Proposed Monitoring Plan (Recycled Water, Diluent Water, Groundwater)
3. **Engineering Report Review and Approval:** There are no statutory or regulatory deadlines for review or approval of the engineering report. The approval process is typically iterative, requiring modifications to the report as the review process progresses. Once approved, the DDW will issue an approval letter for the report.
4. **Project Sponsor Holds Public Hearing:** Upon approval of the engineering report, the project sponsor in coordination with DDW would schedule and hold a public hearing. At the conclusion of the hearing, based on the approved engineering report and evidence provided at the hearing, DDW would issue a letter indicating that the proposed project meets all statutory and regulatory requirements. DDW no longer intends to issue Findings of Fact and Conditions for projects now that the GWR Regulations have been promulgated.
5. **RWQCB or DDW Issues Tentative Permit, Receives Public Comments, and Holds Permit Hearing:** Depending on which agency assumes primacy for permitting, either the RWQCB or DDW would issue a tentative permit (WDRs and WRRs) for public review and comment. A

permit hearing date would be set (by the RWQCB or SWRCB), and a public hearing would be held for the tentative permit. The permit would be adopted at the hearing and go into effect immediately. A project sponsor may petition the permit to the SWRCB if it does not agree with the requirements.

### 12.1.2 CEQA / NEPA Documentation

The District must complete the California Environmental Quality Act requirements prior to issuance of the GWR permit. The CEQA process can be conducted concurrently with the preparation of the engineering report and/or facility planning/design. If the proposed project seeks federal funding, then the District must also satisfy the requirements of the National Environmental Policy Act (NEPA), which although similar to CEQA, has its own unique requirements and typically takes a longer time for approval versus CEQA documentation. A few of the substantive differences between NEPA and CEQA are as follows:

- NEPA generally requires that any cost/benefit analysis prepared for the project be incorporated into or attached to the EIS. Incorporation of cost/benefit information is optional under CEQA unless it constitutes the basis for rejecting an environmentally superior alternative.
- NEPA requires that the project and each of the alternatives be analyzed equally and compared. Under CEQA, the analysis of significant effects of alternatives can be evaluated in less detail than the effects of the proposed project; however, each environmental issue should still be addressed for each alternative to allow for comparison of impacts with the proposed project.
- CEQA requires agencies to implement feasible mitigation measures. CEQA also requires the preparation of a Mitigation Monitoring or Reporting Program.
- The standards of significance under NEPA generally are less sensitive than under CEQA.
- It is generally the case that the time commitment for a NEPA process involving an EIS will be longer than the CEQA process.

## 12.2 Institutional Arrangements

There are several entities that require involvement in the implementation of this project. Several of them have been engaged on a preliminary basis; however, further institutional coordination is required in order to establish a cooperative strategy that proves to be mutually beneficial for all parties. This section will highlight specific issues that must be addressed with specific project stakeholders.

#### City of San Bernardino

- **Wastewater Treatment:** The District must come to an agreement with the City of San Bernardino regarding the District's plans to treat wastewater flows currently treated by SBWRF. This will result in modifications to the JPA.

#### City of Redlands

- **Recharge Facility Site:** The District must engage with the City of Redlands to discuss the potential use of the recharge basins located adjacent Redlands Wastewater Treatment Facility. An agreement must be made in order to move forward developing the project with the planned use of this site.
- **Production Wells:** Groundwater modeling conducted as part of this study has suggested that nearby production wells may not be adversely impacted as a result of GWR-RW at the Redlands Recharge Basin, however further analysis is required as part of the Engineering Report to confirm that this is the case. In the case that recycled water has insufficient travel time in the basin and Redlands potable water wells are adversely impacted, such wells may need to be taken

out of service. Under such circumstances, it is anticipated that the District would be responsible for either modifying the wells with well packers to force the well to withdraw from levels without recycled water and/or providing a means of producing an equal amount of replacement water to the City of Redlands; however, specific terms are to be negotiated.

#### San Bernardino Valley Municipal Water District

- **Diluent Water:** The District should engage with the SBVMWD in discussions regarding how to optimize the existing groundwater recharge and management operations of the SBVMWD toward credits for any required levels of dilution water credits. SBVMWD is engaged in significant groundwater recharge activities that potentially represent acceptable levels of dilution water credits. By working collaboratively with SBVMWD and the RWQCB, there is a significant opportunity for the District to meet the regulatory requirements while enhancing the overall groundwater management strategies of SBVMWD.
- **Diluent Water Infrastructure:** The District should engage with SBVMWD to discuss the potential for utilizing SBVMWD's existing imported water conveyance systems in order to deliver diluent water for GWR-RW.
- **Habitat Conservation Plan:** The District should explore possibilities of mutually beneficial opportunities for recycled water development with the SBVMWD.

#### San Bernardino Valley Water Conservation District

- **Recharge Facility Site:** In the event that the use of the SAR Spreading Grounds or Mill Creek Spreading Grounds as a site for GWR-RW is selected, this will require the approval of the SBVWCD. An agreement must be made in order to move forward developing the project with the planned use of this site.
- **Diluent Water:** The District must engage SBVWCD in discussions regarding the use of SAR water and stormwater as diluent. The District could utilize the SAR supply that SBVWCD allocates to groundwater recharge on an annual basis, however depending on the location of the selected recharge site, this supply may need to be conveyed to an alternate location from SBVWCD's current recharge activities. Altering SBVWCD's groundwater recharge location may require a hydrogeological analysis to evaluate the impact and confirm that the altered recharge activities will provide comparable benefits to the basin.
- **Stormwater:** The District must engage SBVWCD in discussions regarding the use of existing stormwater diversion and conveyance infrastructure in order to utilize stormwater as diluent water.

## 12.3 Funding Strategies

### 12.3.1 Sources of Capital Funding

A variety of options exist for the District to secure capital funding of the project. The following potential funding sources are discussed in this section:

- Grants and Loans
- Municipal Revenue Bonds
- State Revenue Bonds
- Revenue Sources

## Grants and Loans

Grant funds and loans may be available from State or Federal agencies for eligible projects. **Table 12-1** summarizes potential GWR-RW project funding sources.

The State Revolving Fund (SRF) Loan Program provides low-interest loan funding for construction of publicly-owned wastewater treatment facilities, local sewers, sewer interceptors, water reclamation facilities, as well as, expanded use projects, such as implementation of non-point source projects or programs and stormwater treatment. Available loan amounts range from $200 to $300 million annually. Under the general terms of the program, loans with a 30-year term carry an interest rate equal to one-half the most recent State General Obligation Bond Rate, typically 2.5% to 3%. However, in response to the current drought, the SWRCB has made a total of $800 million in SRF loans funds available at 1%, 30-year terms. The application process is continuous, but it is recommended that the District initiate this loan application process as soon as practical as there is no obligation to finalize a loan if alternative funding is secured by the District.

**Table 12-1: Grant and Loan Programs**

| Program | Agency | Status | Summary |
|---|---|---|---|
| Water Recycling Facilities Planning Grant Program | SWRCB | Active | Covers 50 percent of eligible costs up to $75,000 for facility planning for recycled water facilities and distribution system projects. |
| Water Recycling Construction Funding Program | SWRCB | Active | Covers 25 percent of eligible costs up to $5 million grants for construction of recycled water facilities and distribution system projects. Low interest SRF Loans are also available through this program. |
| Prop 84 Round 3 Implementation Grant | DWR & SWRCB | Under Development (Spring 2015) | Prop 84 Integrated Regional Water Management Plan (IRWMP) Grant |
| Prop 1 Water Quality, Supply, and Infrastructure Improvement Act of 2014 | DWR & SWRCB | Under Development | $510 million allocated to IRWMP and $725 million for Water Recycling |
| Title XVI WaterSMART Program | United States Bureau of Reclamation (USBR) | Awaiting reauthorization | $21.5 million in competitive grants for water reuse and recycling projects. Construction funds only for projects specifically authorized by U.S. Congress. |

## Municipal Revenue Bonds

Municipal Revenue Bonds are long-term debt obligations for which the revenue of the issuer is pledged for payment of principal and interest. The security pledged is that the project will be operated in such a way that sufficient revenues will be generated to meet debt service obligations.

Typically, issuers provide assurances to bondholders that funds will be available to meet debt service requirements through two mechanisms: provision of a debt service reserve fund or a surety and a pledge to maintain a minimum coverage ratio on the outstanding revenue bond debt. To the extent that the borrower can demonstrate achievement of coverage ratios higher than required, the marketability and interest rates on new issues may be more favorable.

### State Revenue Bonds

Since this is a long term plan and there is interest in the California State Legislature to support water recycling through State Bonds, there will likely be additional State Bond money that will be available at a future date. For example, Proposition 84, which was passed in the November 2006, allocates up to $1 billion to Integrated Regional Water Management Plan (IRWMP) projects. Hence, the agencies should inform their state legislators of the project plan to gain their political support, which may take upwards of two years to accomplish.

### Certificate of Participation Bonds

Certificate of Participation (COP) Bonds are tax-exempt bonds secured with revenue from an equipment or facility lease. While technically avoiding long-term debt through utilizing a COP bond, the District may obtain resources needed for implementing capital improvements without having to obtain a public vote while complying with California debt limitation laws. COP's are structured such that the ownership of the facility, land, or equipment may be vested in a third party entity that would then lease the asset back to the District, providing use or occupancy of the asset in return for lease payments from the District's general fund. The third party entity assigns the lease payments to a trustee, who then remits payment to investors of the COPs.

### Revenue Sources

Revenue sources typically fall into the categories of connection fees, water availability standby charges, system charges, property taxes, and commodity rates.

Connection fees are a commonly used funding source that are paid by developers or individual new connections for the equivalent cost of constructing new water facilities to serve other users to offset the demand created by the development. Connection fees are determined by the overall costs, the allocation to these costs to various benefit zones and the number of new connections expected in each of the benefit zones.

Commodity rates are the per volume unit rates the purveyor charges for supplying water. For this project, it is likely that a water extraction fee would be established for removing water from the recharged groundwater. Also, many banking programs charge a volumetric (commodity) fee per AF of storage per year. This then would be passed along to ultimate consumers by the retailing agency.

### Summary

Given the timing of the project, the most promising source of funding is the Water Recycling Funding Program offered by the SWRCB. The District should apply for the facilities planning grant as well as the construction loan/grant options offered under this program. Retroactive funding of eligible construction costs incurred on or after January 1, 2004, will be available for projects that have started construction prior to receiving a funding commitment from the SWRCB.

Another viable source of funding for the project is Proposition (Prop) 84 dollars provided through the IRWMP process. Although the District is a member agency of the Upper Santa Ana Region IRWMP, the region has not gone through the Department of Water Resources' (DWR) Regional Acceptance Process in order to be eligible for such funding. The Upper Santa Ana Region IRWMP is currently being revised in preparation for eligibility in future grant programs. Depending on the timing of completion of the IRWMP and regional acceptance process, the District may benefit from applying for the 2015 Prop 84 Round 3 Implementation Grant. The District should therefore line up the project through the IRWMP process.

Additionally, the District should track the progress of funding opportunities from the Proposition 1 Water Quality, Supply, and Infrastructure Improvement Act of 2014.

Realistically, an outside source of funding would not cover the entire capital cost for the project, so some form of local funding, such as a bond or certificates of participation will be needed. The most appropriate source of local funding would need to be established through the development of a financial plan. The debt from capital funding as well as O&M costs would be paid through revenue sources, which typically fall into the categories of connection fees, water availability standby charges, system charges, commodity rates, and property taxes.

## 12.4 Construction Strategy

The District is facing the challenge of implementing a WRP prior to completion of new residential developments in the service area that would otherwise drive significant capital improvements to the wastewater collection system required to deliver sewer service to new residents. In order to meet this schedule the WRP must be operational by the third quarter of 2017, which requires several implementation tasks to occur simultaneously as indicated in **Figure 12-1**. The facilities planning, design, and construction activities must all be compressed into a two year period. The optimal way to facilitate such a schedule would be to employ a progressive design-build (DB) construction process. There are several advantages to utilizing such a process when compared to a typical design-bid-build (DBB) process. Recent increased use of collaborative project delivery methods such as progressive DB has resulted in owners reporting quality projects being delivered on time and within budget. This section provides an overview of each of the progressive DB and DBB processes, describes advantages and disadvantages, and recommends strategies for successful implementation of a DB construction project.

### 12.4.1 Traditional Design-Bid-Build

The traditional DBB process typically involves the owner, designer, and builder for implementing a construction project. The designer and builder operate under separate contracts with the owner. The owner typically selects a designer based on qualifications and a detailed proposal specific to the project. The designer prepares bid documents, working with the owner to provide a design that meets the project needs, while managing estimated costs and implementation challenges. The final design package is issued for public bid so that general contractors have an opportunity to compete for the construction contract. The general contractor becomes responsible for constructing the project and securing any necessary subcontractors. Often times the designer may play a role in construction support services during the construction process in order to resolve any construction issues and approve the use of specific equipment and materials selected by the contractor for installation. The general contractor hands over the project to the owner upon completion.

### 12.4.2 Progressive Design-Build

The progressive DB process typically involves the owner and a design/build entity under a single contract. In this arrangement, the designer/builder takes on any risks associated with design flaws. In some cases the designer/builder are two separate entities teamed to work together during implementation. The owner typically selects the designer/builder based on qualifications and negotiates a guaranteed maximum price (GMP) for the project when the project has been sufficiently defined. The District's headquarters facility was successfully constructed utilizing a design-build delivery method. The owner works closely with the designer/builder during the design and construction processes, while managing estimated costs and implementation challenges. If the owner accepts the GMP, then the designer/building is authorized to begin construction activities prior to completion of final design as appropriate. The owner has the opportunity to provide input during design and construction. The project is handed over to the owner upon completion. Advantages related to utilizing a progressive DB process are discussed in detail below:

## Cost

The DB construction process provides a more efficient use of the owner's funding for a project. In a traditional DBB process, owners invest in the procurement of a designer and builder separately. These two separate procurement processes can be costly and time consuming for owner as well as the designer and builder. One cost related challenge presented in DB projects is that a detailed construction cost estimate cannot be developed prior to committing to the project since it has not yet been designed. However, this presents the owner with the opportunity to customize the design with the designer/builder and meet the planned budget. Other cost savings opportunities associated with DB when compared to DBB are as follows:

- Communication efficiencies and integration between design, construction engineering, and construction team members throughout project schedule;
- Reduced construction engineering and inspection costs to the owner when these quality control activities and risks are transferred to the design-builder;
- Fewer change orders resulting from more complete field data and earlier identification and elimination of design errors or omissions that might otherwise show up during the construction phase;
- Reduced potential for claims and litigation after project completion as issues are resolved by the members of the DB team; and
- Shortened project timeline that reduces the level of staff commitment by the DB team.

## Schedule

The need for an aggressive schedule is the primary driver for utilizing a progressive DB process for implementation of the District's WRP. By streamlining the designer/builder procurement process and beginning construction simultaneously with design, the owner has the opportunity to significantly reduce the implementation schedule. Additionally, early contractor involvement enables construction engineering considerations to be incorporated into the design phase, which enhances the constructability of the engineered project plans and reduces time spent on change orders in a DBB process.

## Quality

The progressive DB process promotes greater focus on quality control and quality assurance associated with the continual involvement of the design team throughout implementation. Additionally, project innovations may be customized based on owner requests, unforeseen project needs, and/or contractor capabilities. Other benefits associated with owner interaction in a DB process include:

- Cost analysis of project of available component options can be made as the project progresses;
- Scope adjustments can be made as necessary due to capital constraints; and
- Owner may provide input on the use of local subcontractors.

**Table 12-2** provides a summary of advantages and disadvantages to the owner when implementing a progressive DB construction project.

**Table 12-2: Pros and Cons of Progressive Design-Build Process**

| Advantages | Disadvantages |
|---|---|
| • Fast and inexpensive procurement process<br>• Reduced design/construction schedule<br>• Capital budget management<br>• Flexibility to complete work based on funding<br>• Increased participation in project development<br>• Better opportunities for local subcontracting | • Construction cost is unknown at contract signing<br>• Cost is determined through negotiated and competitive processes |

### 12.4.3 Progressive Design-Build Success Strategies

The following strategies are intended to assist owners in implementing a successful DB process:

- Choose a qualified project team to work with;
- Consider the approach presented by the potential designer/builder;
- Establish a process for making decisions efficiently;
- Involve key stakeholders early in the design process;
- Conduct regular meetings with designer/builder senior management to review project status and issues;
- Jointly address permitting issues, track them, and press agencies for action;
- Manage land acquisition and construction easements as early as possible;
- Communicate capital availability and constraints and integrate in the project execution plan; and
- Celebrate interim success milestone.

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