CASTAIC LAKE WATER AGENCY

# WATER RESOURCES RECONNAISSANCE STUDY

FINAL
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## CASTAIC LAKE WATER AGENCY

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| Abbreviation | Description |
|---|---|
| afy | Acre-feet per year |
| ASR | Aquifer storage and recovery |
| Basin Plan | Water Quality Control Plan for the Los Angeles Region |
| Carollo | Carollo Engineers, Inc. |
| California Department of Public Health | California Department of Public Health |
| CEC | Constituent of Emerging Concern |
| CEQA | California Environmental Quality Act |
| cf | Cubic feet |
| cfs | Cubic Feet per Second |
| CIP | Capital Improvement Program |
| CLWA | Castaic Lake Water Agency |
| DPR | Direct potable reuse |
| DWR | Department of Water Resources |
| ETo | Evapotranspiration |
| F | Fahrenheit |
| FAT | Full Advanced Treatment |
| ft | Feet |
| ft-msl | feet above sea level |
| GIS | Geographic Information Systems |
| Gpcd | Gallons per capita day |
| gpd/ac | Gallons per day per acre |
| GSI | GSI Water Solutions, Inc. |
| HCF | Hundred Cubic Feet |
| IS/MND | Initial Study/Mitigated Negative Declaration |
| IWMP | Integrated Water Master Plan |
| LACSD | Los Angeles County Sanitation District |
| LACFCD | Los Angeles County Flood Control District |
| LACWWD 36 | Los Angeles County Waterworks District 36 |
| MCL | Maximum Contaminant Limit |
| µg/L | Micrograms per liter |
| MG | Million Gallons |
| mg/L | Milligrams per liter |
| mgd | Million gallons per day |
| mi | Mile |

| Abbreviation | Description |
|---|---|
| Min. | Minimum |
| N/A | Not applicable |
| NEPA | National Environmental Policy Act |
| NCWD | Newhall County Water District |
| NL | Notification Level |
| O&M | Operations and Maintenance |
| psi | Pounds per square inch |
| RO | Reverse Osmosis |
| Regional Water Quality Control Board | Regional Water Quality Control Board |
| RWC | Recycled Water Contribution |
| SNMP | Salt Nutrient Management Plan |
| SCWD | Santa Clarita Water Division |
| Study | Water Resources Reconnaissance Study |
| SWP | State Water Project |
| SWRCB | State Water Resource Control Board |
| TDS | Total Dissolved Solids |
| USBR | United States Bureau of Reclamation |
| USGS | United States Geological Survey |
| UWMP | Urban Water Management Plan |
| VWC | Valencia Water Company |

## Chapter 1

# INTRODUCTION

The Santa Clarita Valley (Valley) is located in northern Los Angeles County, California and has a population of over 200,000 residents whose water supplies are provided by the Castaic Lake Water Agency (CLWA) and four retail water purveyors. CLWA is the wholesale water agency that was formed in 1962 for the purpose of contracting with the Department of Water Resources (DWR) to acquire and distribute imported State Water Project (SWP) water to the water purveyors in the Valley. In addition to SWP water, the Valley's other water supply sources are (1) groundwater from a local aquifer system (comprised of the surficial Alluviual Aquifer and the underlying Saugus Formation) and (2) recycled water from local treatment plants operated by Los Angeles Sanitation District (LACSD). As shown in Figure 1, the CLWA service area encompasses 195 square miles in Los Angeles and Ventura Counties and includes the following four retail water purveyors:

- Santa Clarita Water Division (SCWD) has a service area that includes a portion of the City of Santa Clarita and unincorporated portions of Los Angeles County in the communities of Saugus, Canyon Country, and Newhall. Water is supplied from both groundwater and CLWA turnouts.
- Los Angeles County Waterworks District 36 (LACWWD 36) has a service area that encompasses approximately 6,600 acres in the Hasley Canyon area and the unincorporated community of Val Verde. The District has traditionally obtained its full water supply from a connection to the CLWA's Castaic Conduit; however, in 2012, the water supply for LAWWD 36 was mostly derived from pumping from the Saugus Formation.
- Newhall County Water District's (NCWD) service area includes portions of the City of Santa Clarita and unincorporated portions of Los Angeles County in the communities of Newhall, Canyon Country, Valencia, and Castaic. NCWD supplies water from both groundwater and CLWA turnouts.
- Valencia Water Company's (VWC) service area serves portion of the City of Santa Clarita and in the unincorporated communities of Castaic, Newhall, Saugus, Stevenson Ranch, and Valencia. VWC supplies water from both groundwater and CLWA turnouts; VWC also delivers recycled water for a small amount of non-potable use.

Although CLWA is able to meet approximately half of the Valley's water demand with imported water supplies, the availability of SWP supply fluctuates from year to year depending on precipitation (especially snowfall) in the Sierra Nevada, regulatory restrictions, legislative restrictions, and operational conditions and is subject to severe curtailment during a sequence of dry years in the Sierra Nevada. While future supply restrictions are unknown at this time, it is widely believed that similar SWP constraints will continue into the near future and be repeated over the coming decades.

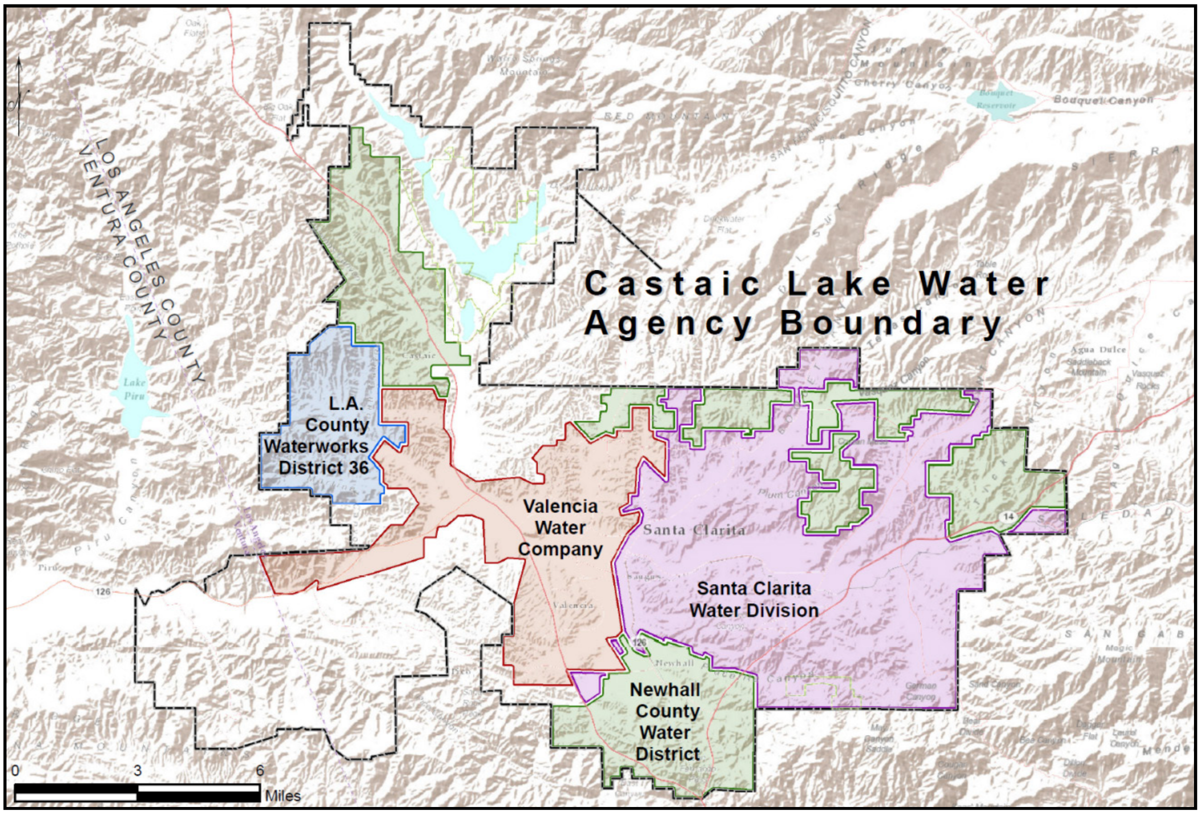

**Figure 1 CLWA Service Area**

To address the issue of increasing demands within the Valley and fluctuations in SWP water supply deliveries, CLWA and the local water retailers have commissioned this Water Resources Reconnaissance Study to evaluate alternatives for expanding local supplies to offset future periodic occurrences of significant shortfalls in imported water supplies.

## Chapter 2

# STUDY OBJECTIVES

This Study has been designed to provide CLWA and the local retailers with a planning basis from which to move forward with one or more near-term water supply augmentation strategies (i.e., can be implemented within 10 years) to provide between 5,000 afy and 15,000 afy of supply to the Valley during droughts. The purpose of water supply augmentation is to enhance the reliability of the Valley's water supplies by conducting projects that store and/or reuse water on a long-term basis and thereby provide an increased amount of local water supply that CLWA and the local retailers can draw from during periods when SWP water supplies are significantly curtailed. This objective was agreed to in Workshop 1.

The study evaluates a variety of water supply augmentation alternatives, including a thorough analysis of the relationship of the alternatives to the Valley's groundwater supply, which currently is the largest local source of water supply. Groundwater modeling was conducted for several water supply augmentation alternatives to evaluate the potential benefits and/or impacts to the local groundwater supply. Details of the groundwater modeling analyses, which were conducted by GSI Water Solutions, Inc., are presented in Appendixes B-2, B-3, and C.

In addition to the groundwater modeling analyses, other alternative supply strategies are evaluated in this study, including the use of stormwater, recycled water and other groundwater enhancement strategies. Upon the completion of the review of the initial water resource concepts, the most feasible alternatives have been selected for further development.

To obtain feedback and input, a series of workshops were conducted with CLWA, water purveyors, and other stakeholders including Los Angeles County Sanitation Districts and Los Angeles County Flood Control District. Materials from these workshops are provided in Appendix A.

# STUDY AREA SUPPLY AND DEMAND

## 3.1 Santa Clarita Valley Water Supply

### 3.1.1 Imported Water

CLWA currently has an imported water supply contract (Table A) with DWR for 95,200 acre-feet per year (afy) of SWP. CLWA also has an agreement with the Buena Vista Water Storage District (BVWSD) and the Rosedale-Rio Bravo Water Storage District (RRBWSD) to receive 11,000 acre-feet (af) of supplies through either an exchange of Buena Vista's and Rosedale Rio Bravo's SWP supplies or through direct delivery of water to the California Aqueduct via the Cross Valley Canal. All imported water is delivered through SWP facilities and treated at CLWA's Earl Schmidt Filtration Plant or Rio Vista Treatment Plant and is delivered to retail purveyors through transmission mains owned and operated by CLWA.

The term of CLWA's current SWP contract is through 2038 and is renewable after that year. The allocation of SWP water can fluctuate each year; however, available carryover water, flexible storage, and groundwater banking programs are in place to improve supply reliability within the Valley. Projections of long-term dry year SWP reliability show a potential 5 percent to 15 percent decrease in Table A deliveries based on climate change projections. For CLWA, this equates to a reduction of approximately 5,000 afy to 15,000 afy compared with earlier projections for dry years in the SWP. To offset this projected decline in SWP supply during dry years, alternative supply strategies have been evaluated.

### 3.1.2 Groundwater Pumping

The Valley's retail water purveyors (as well as private well owners) draw water from two local aquifers: a surficial Alluvial Aquifer and a deeper and more aerially extensive aquifer residing in the Saugus Formation. These two aquifers are in direct hydraulic connection and together comprise the DWR-designated Santa Clara River Valley East Subbasin. As shown in Figure 2, these aquifers lie almost entirely within CLWA's service area. A schematic depiction of the groundwater system is shown in cross-sectional view on Figure 3. The Alluvial and Saugus aquifers are described in further detail below. Neither aquifer is managed by adjudication. However, CLWA and the local retail water purveyors utilize the annual Santa Clarita Valley Water Report, the Urban Water Management Plan process, an AB-3030 Groundwater Management Plan and other planning efforts such as this Study to collaborate on groundwater basin management and maintain the long-term sustainability and reliability of local groundwater supplies.

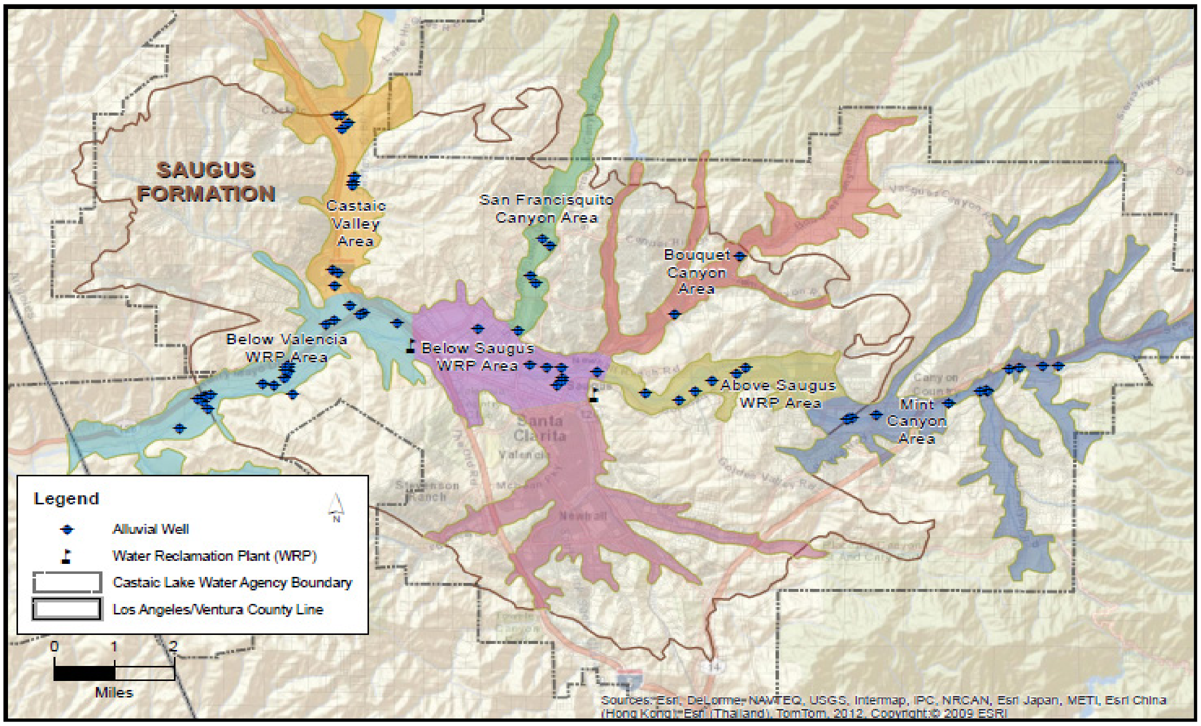

Figure 2 Alluvium and Saugus Formation

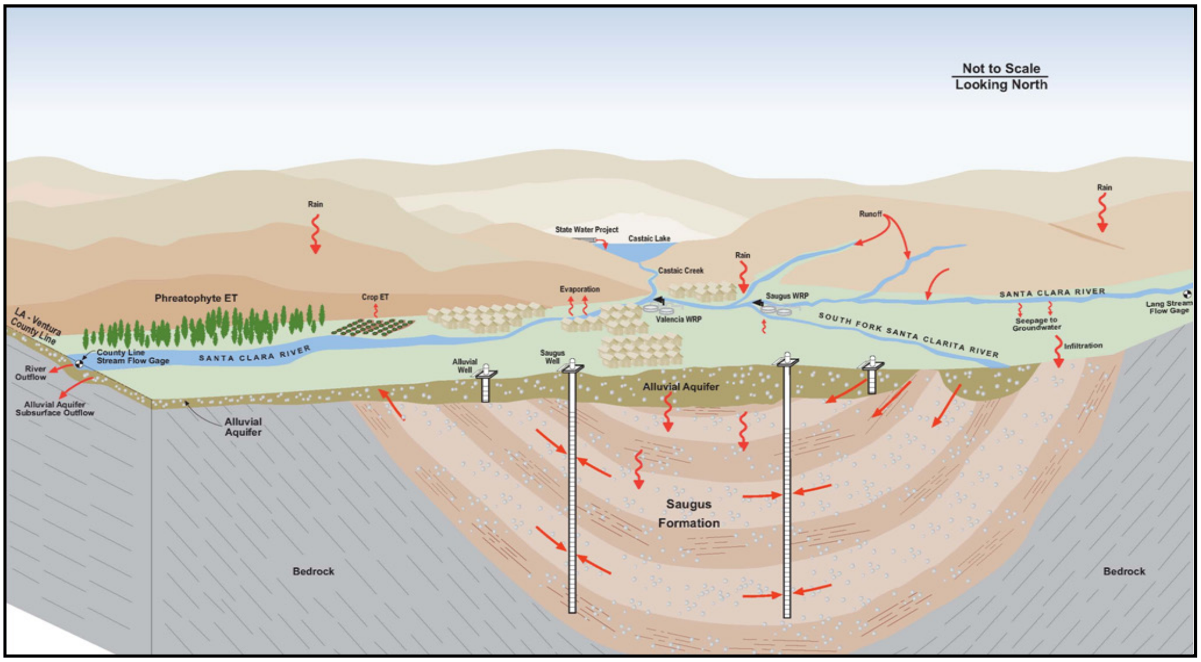

Figure 3 Santa Clarita Valley Groundwater System Cross Section Schematic

#### *3.1.2.1 Alluvial Aquifer*

Based on the Valley's formal Groundwater Management Plan (2003, LSCE) and a later studies of the sustainable yield of the groundwater basin (2005, CH2M HILL and LSCE; 2009, LSCE and GSI), the groundwater operating plan for the Alluvial Aquifer specifies an annual pumping rate from the Alluvial Aquifer in the range of 30,000 to 40,000 acre-feet per year (afy) during locally wet/normal years, and reduced pumping (30,000 to 35,000 afy) during dry years (i.e., years of below-normal local rainfall). This operating plan is based in part on the historical operating experiences of the local retail water purveyors during multiple hydrologic cycles, and has also been found to be a sustainable plan when subjected to testing with the purveyors' groundwater flow model of the East Subbasin (2005, CH2M HILL and LSCE; 2009, LSCE and GSI). Pumping from the Alluvial Aquifer has ranged between about 39,000 and 42,000 afy since 2007, and has decreased gradually as local drought conditions have intensified during the past four years.

Groundwater level records collected by the purveyors and agricultural well owners show no evidence of any historic or recent trend toward permanent long-term declines in groundwater levels or the volume of groundwater in storage. However, over shorter-term multi-year periods, groundwater levels in the eastern portion of the Alluvial Aquifer show significant fluctuations that arise from the cyclical nature of local rainfall. Rainfall records dating to the early 1900s in the Valley and elsewhere in southern California show that a very high (El Nino) winter rainfall season occurs once every few years, with generally below-normal rainfall occurring during the several consecutive years that occur between El Nino years. The hydrologic records maintained by the water purveyors in the eastern portion of the Alluvial Aquifer show that groundwater levels typically rise several tens of feet (even 100 feet) during the rainy months of an El Nino, then decline gradually over the ensuing years until the next El Nino event occurs. The most recent El Nino event occurred in the late 2004 / early 2005 winter season, and resulted in significant water level recovery in the eastern part of the Valley. This 2004/2005 El Nino was preceded by about six prior years (spring 1999 through fall 2004) of below-normal rainfall and declining groundwater levels in the eastern part of the Valley.

More recently, 10 years have elapsed since the most recent El Nino event, and the past four years have been characterized by rainfall so low as to provide little, if any, recharge to the Alluvial Aquifer. This has caused a steep decline in the yields of wells in the eastern portion of the Alluvial Aquifer, and some wells were not operated in 2013 and 2014 because groundwater levels had dropped into or near the pump intakes. A recent modeling analysis (2014, GSI) found that the current well network might produce 5,600 to 10,300 afy less groundwater from the Alluvial Aquifer than the amount normally targeted for pumping during locally dry years. The GSI analysis found that this condition arises not only because of local hydrologic conditions, but also because of operational constraints (the spatial distribution of wells, and the depths of the pump intakes in certain wells). Accordingly, for the Alluvial Aquifer, this Reconnaissance Study evaluates various options (artificial recharge and spatial redistribution of pumping) for improving groundwater levels and well yields in the eastern portion of this surficial Alluvial Aquifer system.

### *3.1.2.2 Saugus Formation*

The Valley's Groundwater Management Plan (2003, LSCE) calls for pumping the Saugus Formation in the range of 7,500 to 15,000 afy during normal years ; up to 25,000 afy during the first and second years of a significant SWP curtailment; and up to 35,000 afy during the third and subsequent years of a significant SWP curtailment. As with the operating plan for the Alluviual Aquifer, the ranges of Saugus pumping were first presented in the Groundwater Management Plan (LSCE, 2003) and were later identified by groundwater modeling studies to be sustainable on a long-term basis (2005, CH2M HILL and LSCE; 2009, LSCE and GSI).

The Saugus Formation has never been pumped at rates exceeding the 15,000 afy production volume, which is the maximum specified in the Groundwater Management Plan for years when SWP supplies are not significantly curtailed. Production volumes ranged between about 12,000 and 15,000 afy during the early 1990s, with this pumping occurring in a limited geographic area located along and west of the South Fork Santa Clara River. In 1997, perchlorate was detected in four of the Saugus Formation wells in this area. Those wells were subsequently taken offline, whereupon the remaining wells pumped between 3,700 and 5,500 afy for the next several years. In 2005, Valencia Water Company began operating a new well much further west (at Magic Mountain), which allowed Saugus pumping to increase to about 6,500 to 7,500 afy. In late 2010, pumping resumed at two of the perchlorate-impacted wells (CLWA's Saugus 1 and Saugus 2 wells), but at lower production rates and with perchlorate treatment at the wellhead. With the return of those two wells to service, total pumping from the Saugus Formation was about 8,100 afy in 2010. However, in early 2011, perchlorate was detected in a fifth Saugus Formation well (owned by VWC) that was subsequently shut down, and another nearby Saugus well was also shut down as a precautionary measure. Accordingly, total pumping from the Saugus Formation declined to between 5,000 and 6,000 afy at that time and has remained at that level through 2014. In summary, Saugus pumping rates were near the normal-year maximum rate of 15,000 afy until 1997, since that time perchlorate detections in the Saugus Formation have limited the pumping to rates generally below the lower (7,500 afy) limit that is specified in the operating plan for normal years.

Modeling analyses conducted in 2005 and in support of other planning projects have indicated that the Valley's groundwater pumping plan for the Saugus Formation is sustainable, including during periods of significant SWP curtailments. This finding arises in part because the SWP water supply projections (as presented in DWR's 2013 Delivery Reliability Report) indicate that significant SWP curtailments can be expected to occur in fewer than 25 percent of years (when considering time frames on the order of multiple decades). Those same projections also indicate that between 10 and 15 percent of those years would include an SWP curtailment that lasts longer than two years, which in turns suggests that Saugus groundwater pumping rates of 35,000 afy would be necessary only during 10 to 15 percent of years on a long-term basis.

Based on these observations, this Reconnaissance Study evaluates various artificial recharge concepts for improving groundwater levels and well yields from the Saugus Formation during SWP curtailment periods (particularly during curtailments lasting 3 years or longer).

### 3.1.3 Stormwater/Runoff

Since runoff in the Valley is associated with rainfall, the Santa Clara River and tributaries are generally dry most of the time upstream of the Mint Canyon Area unless a large storm event occurs. Most of the rain falling within the watershed percolates into the Alluvium along the Santa Clara River and its tributaries except during the more intense rainfall events when the rate of flow exceeds streambed infiltration capacities and/or when the underlying groundwater basin is reaching saturation. Unlike major watershed in other parts of Los Angeles County (e.g., San Gabriel River, Tujunga and Littlerock Creek) the Santa Clara River is unlined, and its watershed contains no upstream dams behind which runoff from more significant storm events can be held and later released for infiltration in a more managed system. Currently there are no in-stream or off-stream structures that retain and infiltrate excess flows.

Within the Valley's urbanized areas, the City of Santa Clarita and the Los Angeles County Department of Public Works are preparing an Enhanced Watershed Management Plan (EWMP) as part of their compliance with MS-4 runoff pollution management permit requiremetns. The objective of the EWMP is to illustrate how these entities will comply with runoff management requirements by managing the 85th percentile of runoff volume within their watersheds. Best Management Practices (BMPs) being proposed include runoff retention and infiltration in some locations. The City and County have estimated that potential BMPs will manage up to approximately 150 af of runoff per storm event by 2022 and up to approximately 500 af by 2035 (Merenda, H. 2015). Note that not all of this managed runoff is expected to enter the local groundwater and the not all of the identified projects may be built due to a number of different compliance factors. Thus, while the infiltration component of these project is acknowledged, the benefit to water supplies for purposes of this Study have not been included.

## 3.2 Recycled Water Supply

Recycled water is a source of water that could be maximized within the CLWA service area. Recycled water enhances water supply reliability within the region by reducing the reliance on groundwater and imported water supplies. Since 2003, CLWA has constructed recycled water distribution facilities that have the capacity to deliver approximately 1,700 afy of recycled water to the VWC service area. Usage types include landscape irrigation at golf course and roadway medians. Current and future recycled water supply availability at Los Angeles County Sanitation District's (LACSD) Saugus and Valencia water reclamation plants are shown below in Table 1.

**Table 1 Recycled Water Supply Availability from Water Reclamation Plants**
**Water Resources Reconnaissance Study**
**Castaic Lake Water Agency**

| | Saugus WRP | Valencia WRP |
|---|---|---|
| **Recycled Water Supply** | **MGD** | **MGD** |
| **Current Availability (Year 2014)** | | |
| Capacity | 6.5 | 21.6 |
| Average Inflow | 5.0 | 15.0 |
| Discharge to River(2) | 4.5 | 8.6 |
| Available Water | 0.5 | 6.4 |
| **Future Availability (Year 2035)** | | |
| Capacity | 6.5 | 21.6 |
| Average Inflow | 6.5 | 21.3 |
| Discharge to River(2) | 4.5 | 8.6 |
| Available Water | 2.0 | 12.7 |

Notes:
(1) Based on data provided by LACSD in September 2014.
(2) LACSD is anticipating a future minimum flow requirement. Flows provided here are based on internal evaluation by LACSD and have not been reviewed by the RWQCB or SWRCB.

As shown in Table 1, the existing recycled water supply at Saugus WRP is approximately 0.4 mgd (or 560 afy) and the existing recycled water supply at Valencia WRP is approximately 6.4 mgd (or 7,200 afy). By the year 2035, it is anticipated that the recycled water supply would increase to approximately 2.0 mgd (or 2,250 afy) at the Saugus WRP and to approximately 12.7 mgd (or 14,600 afy) at the Valencia WRP. For planning purposes, the available recycled water balance accounts for the maximum diversion of flow to the river, which may change based on future environmental review.

## 3.3 Santa Clarita Valley Water Demand

As shown in Table 2, water use in the Valley between 2012 and 2014 ranged from 81,100 to 89,600 afy. Of that volume, a range of 31,100 af to 35,600 af or 41 to 48 percent) was imported water and a range of 29,700 to 34,600 af (or 33 to 43 percent) was groundwater. Less than 1 percent (or 400 to 500 afy) of demand included recycled water. Of the 34,600 af that was pumped from the ground in 2014, 71 percent was from the Valley's alluvial formations and the remaining 29 percent was from the Saugus.

Based on the projections in the 2010 UWMP, demand is anticipated to increase by 1.8 percent per year through the year 2050, which would equate to approximately 138,968 afy by the year 2050.

**Table 2 2012-2014 Santa Clarita Valley Supply and Use (Acre-Feet per Year)**
**Water Resources Reconnaissance Study**
**Castaic Lake Water Agency**

| **Source(1, 2)** | **2012** | **2013** | **2014** |
|---|---|---|---|
| **Imported Water** | **35,600** | **43,300** | **33,100** |
| Municipal Alluvial Pumping | 25,600 | 21,400 | 24,700 |
| Municipal Saugus Pumping | 8,100 | 8,300 | 9,900 |
| **Municipal Pumping Subtotal** | **33,700** | **29,700** | **34,600** |
| **Recycled Water Use** | **400** | **400** | **500** |
| Agricultural Alluvial Pumping | 15,100 | 15,500 | 12,200 |
| Agricultural Saugus Pumping | 600 | 700 | 700 |
| **Agricultural Pumping Subtotal** | **15,700** | **16,200** | **12,900** |
| **Total Water Use** | **85,400** | **89,600** | **81,100** |

Notes:

(1) Values were obtained from the 2012 and 2013 annual water reports for the Santa Clarita Valley (2013 and 2014, Luhdorff & Scalmanini Consulting Engineers) and (for 2014) from preliminary data tabulations prepared by Luhdorff & Scalmanini Consulting Engineers.
(2) Values are rounded to the nearest hundreds of acre-feet for easy visual comparison.

Since the purveyors within the CLWA service area primarily rely on imported water and groundwater to meet the demands within the region, it is imperative that alternatives are evaluated to increase supply reliability within the region due to the fluctuations in imported water supplies and the decrease in water levels within the groundwater basin due to ongoing dry weather conditions.

## 3.4 Climate Change Considerations

As noted in the 2010 UWMP (2011, Kennedy/Jenks Consultants), a topic of concern is climate change and the potential impacts it could have on California's future water supplies. Climate change models have predicted that potential effects from climatic changes may result in increased temperature, reduction in Sierra Nevada snowpack depth, early snowmelt and a rise in sea level.

In June 2005, former Governor Arnold Schwarzenegger issued Executive Order S-3-05, which requires biennial reports on climate change impacts in several areas, including water resources. The Climate Action Team (CAT) was formed in response to Executive Order S-3-05. To help unify analysis across topic areas, the CAT worked with scientists from the California Applications Program's California Climate Change Center to select a set of future climate projections to be used for analysis. In the assessment *"Using Future Climate Projections to Support Water Resources Decision Making in California,"* the CAT selected six different global climate change models to evaluate climate change impacts, assuming two different greenhouse gas emission levels (a high end and a low end), for a total of 12 scenarios. The results of the study indicated that climate change has already been observed, in that in the last 100 years air temperatures have risen about one degree Fahrenheit and there has been a documented greater variance in precipitation, with greater extremes in both heavy flooding and severe droughts.

In July 2006, DWR issued "*Progress on Incorporating Climate Change into Management of California's Water Resources*," as required by Executive Order S-3-05. That report demonstrated how various analytical tools could be used to address issues related to climate change. The report presents analysis results showing potential impacts on SWP operations, including reservoir inflows, delivery reliability, and average annual carryover storage, as well as many other operational parameters. Some of the main impacts include changes to south-of- Delta SWP deliveries (from an increase of about one percent in a wetter climate change scenario to about a ten percent reduction for a drier scenario), increased winter runoff and lower SWP allocations in the three driest scenarios, lower carryover storage in drier scenarios and higher carryover storage in the wetter scenario.

In the update of the DWR California Water Plan (2009, DWR) and the State Water Project Final Delivery Reliability Report (2013, DWR), multiple scenarios of future climate conditions were evaluated. These changing hydrological conditions could affect future planning efforts, which are typically based on historic conditions. The *California Water Plan* identifies the following probable impacts due to changes in temperature and precipitation:

- Decrease in snowpack, which is a major part of annual water storage, due to increasing winter temperatures.
- More winter runoff and less spring/summer runoff due to warmer temperatures.
- Greater extremes in flooding and droughts.

- Greater water demand for irrigation and landscape water due to increased temperatures and their impacts on plant water needs.

- Increased sea level rise, further endangering the functions of the SWP, which can depend on movement of water through the low-lying channels of the low-lying Sacramento-San Joaquin Delta. Sea level rise could also require the SWP to release additional storage water to avoid sea water intrusion into the Delta.

In its State Water Project Delivery Reliability Report (2009, DWR), DWR included the potential effects of climate change in its analysis of SWP delivery reliability under future conditions. For that report, DWR used a single climate change scenario, selecting a scenario with median effects out of a number of climate change scenarios it analyzed in 2009. Since 2009, the reliability report was updated in 2011 and 2013 to include projected SWP deliveries up to 20 years in the future. The estimates reflect potential hydrologic changes that could result from climate change along with current Delta water quality regulations and the requirements of U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS)

Even without population changes, water demand could increase. Precipitation and temperature influence water demand for outdoor landscaping and irrigated agriculture. Outdoor water use is a large component of Santa Clarita Valley water demands. Lower spring rainfall increases the need to apply irrigation water. Further, warmer temperatures increase crop evapotranspiration, which increases water demand.

These effects and their potential to impact the supplies available to the Santa Clarita Valley have been evaluated indirectly in DWR's State Water Project Delivery Reliability Report (2009, DWR), and their potential to impact demand was considered in CLWA's assessment of demands in the 2010 UWMP (2011, Kennedy/Jenks Consultants).

## Chapter 4

# CONCEPT DEVELOPMENT

## 4.1 Initial Concept Definition

To address the goal of expanding local water supplies use from within the Valley, multiple concepts were explored during an initial concept evaluation phase performed through Workshops 1 and 2 with stakeholders and water purveyors. Initial concepts included:

- Groundwater replenishment with recycled water
- Aquifer storage and recovery
- Enhanced stormwater capture
- Direct potable reuse
- Pumping redistribution
- Expanded contaminated groundwater treatment

### 4.1.1 Groundwater Replenishment with Recycled Water

This concept would replenish the local groundwater basin with the available recycled water flow from LACSD's Valencia and Saugus WRPs. Recharge sites would be selected based on groundwater modeling, infiltration rates, and regulatory requirements for the use of recycled water for groundwater replenishment. The majority of the effort considered using tertiary treated recycled water because of its current availability from the WRPs without the need for adding further treatment processes. However, for both this concept and as well as for ASR and DPR (described below), there was some consideration of full advanced treatment (FAT) of recycled water.

FAT of recycled water utilizes a number of specialized treatment processes such microfiltration, reverse osmosis (RO), and advanced oxidation with ultraviolet light. Together, these processes bring the quality of recycled water to near that of distilled water. Such treatment systems are currently in use in Orange County at the Orange County Water District Groundwater Replenishment System (GWRS) project, and in Los Angeles County in facilities operated by West Basin Municipal Water District and Water Replenishment District.

Implementing FAT of recycled water opens up a number of benefits in the use of recycled water for water supply. These include

- Allowing for a higher blending ratio for groundwater replenishment (up to 100 percent)
- Ability to use in direct injection/ASR systems

- Higher public acceptance
- Reduced salinity in the Valley
- Enhanced opportunity to implement DPR in the future

However, some significant drawbacks of FAT include:

- FAT generates a 5 to 8 percent brine stream, which requires expensive brine management. In the case of the Santa Clarita Valley, this would entail constructing an expensive brine line either to the ocean or to the City of Los Angeles (as previously investigated by LACSD).
- The cost to implement FAT is significantly higher than tertiary alternatives.
- To make the economics more favorable, FAT would need to be built to treat as much of the available recycled water as possible.

FAT generally takes several years of planning, permitting, design, and construction to implement under the best of circumstances. In the case of the Valley, without ready access to a brine disposal option, this process could take several more years. As such, FAT was not considered viable within the time frame of the Study.

### 4.1.2 Aquifer Storage and Recovery (ASR)

This concept would inject potable water directly into the local groundwater basin, which would then be recovered and distributed into the potable water system during years of significant SWP curtailments. Available SWP water would be injected during years when SWP supplies are not significantly curtailed, and recycled water treated using FAT, if implemented, also could provide part or all of the injection water supply for an ASR program. ASR would raise water levels and help maintain Saugus well pumping capacity during periods of extended drought than would otherwise be the case. It does not otherwise create a new source of supply.

### 4.1.3 Enhanced Stormwater Capture

This concept would build on preliminary recommendations of the Los Angeles County Flood Control District to capture and recharge excess runoff in either in-stream or off-stream recharge basins. Several candidate sites have already been identified by the Flood Control District that lie along the Santa Clara River and certain tributaries to it. Spreading grounds or rubber dams would be constructed at these sites and would infiltrate captured runoff directly into the underlying Alluvial Aquifer.

### 4.1.4 Direct Potable Reuse (DPR)

DPR is the treatment of recycled water using FAT technologies followed by the direct delivery into the potable water system without an environmental buffer (e.g., a groundwater basin or water supply reservoir).

Currently, the only approved use of recycled water for potable use in California is through supplemental groundwater recharge that follows a series of requirements for levels of treatment, blending recycled water with non-recycled water, travel/residence time in the aquifer, and water quality monitoring and reporting requirements. However, with the successful implementation of the large-scale FAT facilities, research and planning is now underway in earnest in California and elsewhere to determine the feasibility of direct potable reuse. The Division of Drinking Water at the California SWRCB is due to release its recommendations on DPR sometime in 2016.

A key benefit of DPR over groundwater replenishment is that it significantly reduces the amount of supporting infrastructure (e.g., wells, pumps, and pipelines) that is needed to deliver recycled water for potable use. This brings the cost of such systems down considerably and makes them more cost competitive than either non-potable purple pipe systems or ocean desalination. One remaining drawback of direct potable reuse however, is that the RO process generates a brine waste that must be disposed.

DPR in California has not yet been approved by State regulators. While proponents are hopeful that regulations will be in place shortly, implementation of permitted DPR system in California is likely at least 10 years away. While the Study will continue to focus on other near term opportunities, DPR should remain an option for future water supply development for the Valley.

### 4.1.5 Pumping Redistribution

This concept would modify the current groundwater pumping strategy during prolonged local droughts, when groundwater levels are declining and causing reductions in the yields of wells in the eastern portion of the Alluvial Aquifer. Under this concept, as groundwater production begins declining in the eastern areas after the first few years of a local drought, the reduced production would be made up in whole or in part by increasing the amount of groundwater pumping that occurs in the western portion of the Alluvial Aquifer (where groundwater levels are comparatively less sensitive to fluctuations in annual rainfall and surface recharge). Implementing this concept would likely require that pumps be lowered in certain wells; changes be made to distribution piping and interties at certain locations (to allow water to be moved across different pressure zones and/or between different water purveyors); and new wells be installed at certain locations.

### 4.1.6 Expanded Contaminated Groundwater Treatment

Perchlorate has been a water quality concern in the Valley since it was detected in 1997 in four well sites within the eastern Saugus formation, near the former Whittaker-Bermite facility. Since 1997, additional well sites have detected the chemical, which led to the establishment of the "Rapid Response Fund" in 2007 to expedite the treatment of wells that have been impacted by perchlorate. Prior to the establishment of this funding, contaminated well sites within the VWC service area had been taken out of service. In addition, new Saugus Formation production wells have been installed further west (at Magic Mountain). The replacement and reactivation of impacted Saugus wells, augmented by planned and funded replacement wells to be installed in the near future in the Saugus Formation, has added to the overall ability to increase the utilization of the local water supplies within the Valley.

Since the establishment of the "Rapid Response Fund" in 2007, the impacted purveyors (SCWD, NCWD, and VWC) along with CLWA have implemented a plan to combine pumping from impacted wells with a water treatment process at the Saugus Perchlorate Treatment Facility (SPTF) to restore the impacted pumping capacity and control migration of perchlorate in the aquifer. A cleanup plan for the source area (on the Whittaker-Bermite site) and a hydraulic containment plan for offsite areas (using the retail purveyors' Saugus production wells) have been developed through a coordinated effort between CLWA, the three impacted retail water purveyors, the Whittaker Corporation, the State Department of Toxic Substances Control (DTSC), the State Division of Drinking Water (DDW), and the US Army Corps of Engineers.

As part of this Reconnaissance Study, an initial analysis of treatment technologies (such as fixed bed biofiltration, GAC, or ion exchange) to treat contaminated groundwater and expand local water supply was not considered cost effective and would require coordination and approval between multiple parties prior to implementation. As with DPR, while the Study will continue to focus on other near term opportunities, expanded groundwater treatment should remain an option for future water supply development in the Valley.

## 4.2 Final Concept Development

The final concepts developed as part of this Study are as follows:

- Concept 1 – Groundwater Replenishment with Recycled Water
- Concept 2 – Aquifer Storage and Recovery
- Concept 3 – Enhanced Stormwater Capture
- Concept 4 – Pumping Redistribtuion

### 4.2.1 Concept 1 - Groundwater Replenishment with Recycled Water

#### *4.2.1.1 Supply Source and General Description*

The recycled water supply sources utilized within this concept originate from the Valencia WRP. Current available flows from the Saugus WRP and future projected flows are inadequate for meeting the Concept 1 objective of maximizing recharge potential (due to river discharge requirements that are necessary to reduce chloride levels through discharge blending between the Saugus WRP and Valencia WRP). As listed in Table 1, the current available flow from the Valencia WRP is approximately 7,200 afy and the future 2035 flow is approximately 14,600 afy. The targeted goal for this concept is to utilize 10,000 afy of recycled water to replenish the groundwater aquifer. The amount of actual water supply yield that would be derived from this recharge concept would depend on the number and location of down gradient water supply wells. For the purposes of our analysis, it has been assumed that up to 70 percent of the water that is recharged may be translated to water supply yield (i.e., 30 percent is not recovered).

#### *4.2.1.2 Analysis*

Based on groundwater modeling analysis and known hydrogeologic characteristics within the region, three potential recharge locations were identified, which are shown on Figure 4. The sites were selected based on the premise that recharged recycled water would meet the regulatory requirement of a six-month travel time prior to being captured by potable water wells within the vicinity. After further evaluation, Site 2 was eliminated due to its proximity to existing potable water well sites.

Site 1 and Site 3 were then analyzed further to determine recharge capacity potential, which included an evaluation of infiltration rates and diluent water blending volumes from surface and subsurface sources. Using an assumed infiltration rate of 3 feet per day, the recharge capacities and surface areas of each site would allow 5,000 afy or more to be infiltrated at each site. For planning purposes, a 20 percent diluent water blending ratio limit was assumed which is the generally limit set by DDW regulations on the recharge of groundwater using tertiary treated recycled water (see Appendix E). Because infrastructure to capture and measure surface water, such as stormwater, currently does not exist, the volume was considered negligible. Groundwater modeling was then conducted to estimate the rates at which infiltrated water would mix with ambient groundwater flow (including periodic recharge that occurs nearby from rainfall over the alluvium and from natural infiltration within the bed of the Santa Clara River). The estimated blending potential of subsurface flow was based on the entire width of the aquifer. A key consideration in determining recycled water recharge potential is establishing how blending is evaluated (illustrated in Figure 5). Historically, evaluation of tertiary water for groundwater replenishment and approval by DDW has been limited and conducted on a case-by-case basis.

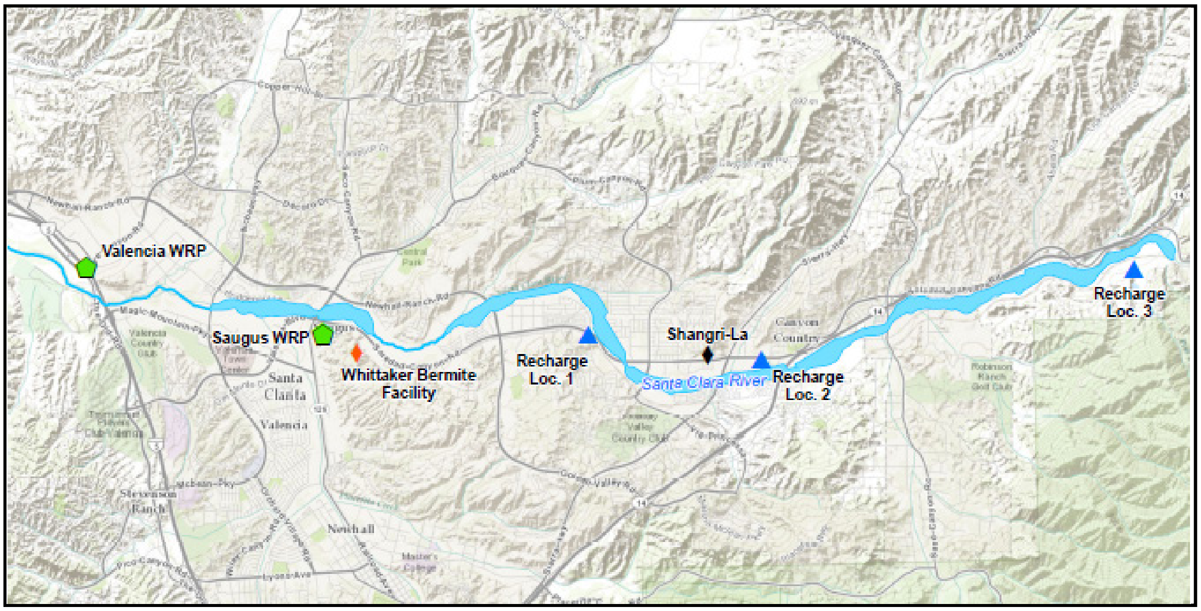

**Figure 4** **Recycled Water Recharge Locations**

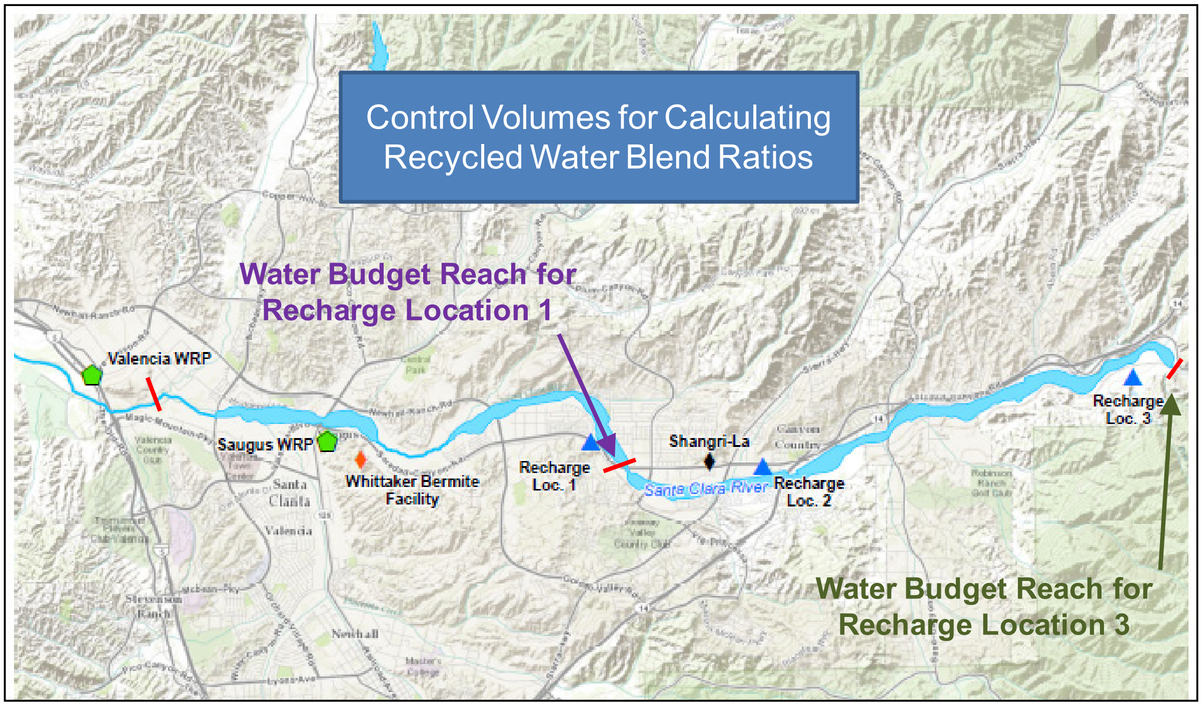

**Figure 5** **Recycled Water Recharge Blending**

As listed in Table 3, the subsurface flow volume maximizes the ability to recharge recycled water. By utilizing this method, up to 7,000 afy of recycled water could be recharged under existing system conditions and 10,000 afy of recycled water could be recharged under future system conditions. For purposes of this study, the recycled water recharge volume at each site was assumed to be the same. Further evaluation of the hydrogeology and recharge area at each site, along with potential non-potable customers who could be served off of the delivery pipeline will ultimately determine the desired recharge volume and delivery capacity to each recharge site.

Prior to implementation, this method would need to be approved by the Division of Drinking Water (DDW) and the characterization of the hydrogeologic conditions at Site 3 would require further analysis. Once a system is in operation and sufficient groundwater monitoring data is available, it may be possible to request approval from DDW to increase the allowed blending ratio (to as high as 50 percent) if additional groundwater replenishment is needed (and sufficient recycled water is available) and more stringent water quality and monitoring requirements can be met.

**Table 3 Recycled Water Recharge Blending**
**Water Resources Reconnaissance Study**
**Castaic Lake Water Agency**

| Year | Recharge Site | Available RW Volume (afy) | Subsurface Flow(1) (afy) | RWC(2) |
|---|---|---|---|---|
| 2014 | Site 1 | 3,500 | 58,000 | 6% |
| | Site 3 | 3,500 | 36,000 | 10% |
| 2035 | Site 1 | 5,000 | 58,000 | 9% |
| | Site 3 | 5,000 | 36,000 | 14% |

Notes:
(1) Based on groundwater modeling data from GSI. For conservative planning purposes, last 12 months of data (2011) was used as the average subsurface flow volume.
(2) RWC – Recycled Water Contribution. The maximum RWC for tertiary-treated recycled water is 20% based on DDW guidelines (see Appendix E).

### *4.2.1.3 Facilities and Operational Considerations*

For planning purposes, conveyance and recharge facilities were sized for the maximum targeted potential recycled water usage of 10,000 afy to either recharge site as monthly deliveries, as well as potential peak day deliveries, may require such sizing. As shown on Figure 6, recharge Site 1 and Site 3 would receive flow from the Valencia WRP through the following facilities:

- Over 14 miles of 24-inch diameter recycled water pipeline:
  - Approximately 6 miles of pipeline from the Valencia WRP to Ruether Pump Station (PS), and
  - Approximately 8 miles of pipeline from the Ruether PS to Site 3
- Two pump stations to boost water from the Valencia WRP to Site 3:
  - Valencia PS: Four 1,600 gpm pumps (plus one spare) at 1,200 HP
    - Sized to pump recycled water from Valencia WRP to Ruether's PS

  - Ruether PS: Four 1,600 gpm pumps (plus one spare) at 1,800 HP
    - Sized to pump recycled water from Ruether PS to Site 3

- Site Work at both recharge locations:
  - Earthwork
  - Basin piping
  - Control building
  - Rubber dam

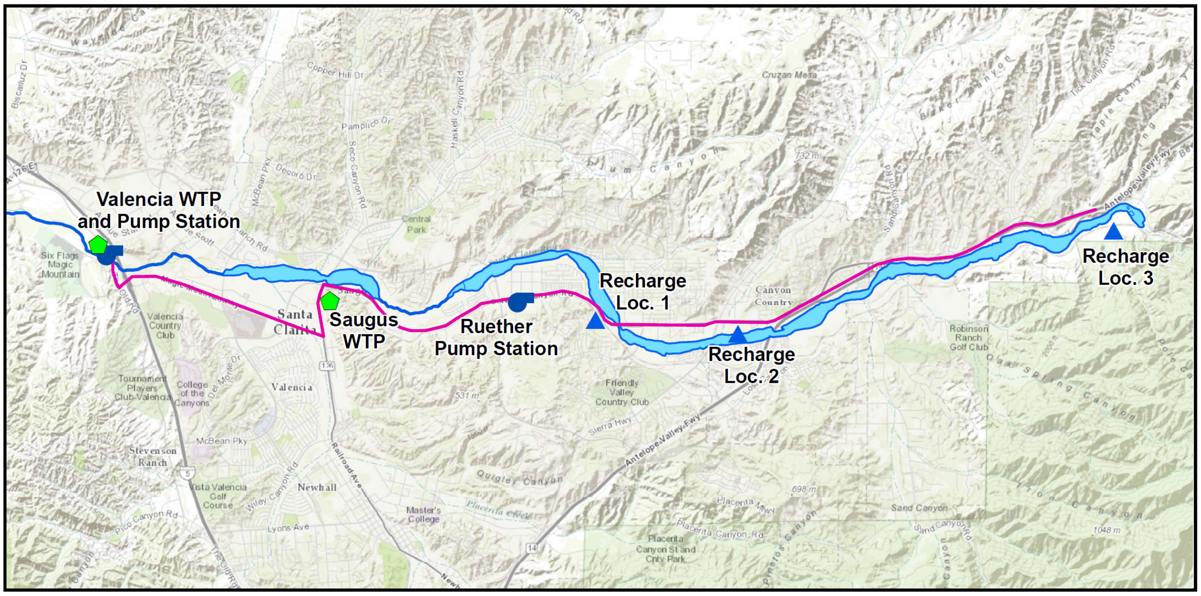

**Figure 6 Recycled Water Recharge Facilities**

### *4.2.1.4 Implementation Considerations*

Based on the subsurface flow blending, the projected recycled water recharge volumes at Site 1 and Site 3 would be a total of 7,000 afy under existing conditions and 10,000 afy under future conditions. At this time, the analysis does not show a need for supplemental diluent water to the natural underflow (e.g., SWP water) in order to meet RWC limits for groundwater recharge with recycled water.

While the RWC does not appear to be an issue, another issue may be the Basin Objectives for chloride in the reach of the Santa Clara River (Reach 7) and the groundwater subunit (the Santa Clara-Mint Canyon subunit) proposed for surface spreading of tertiary water for groundwater recharge. According to LACSD, current chloride levels in the effluent from the Valencia and Saugus WRPs are greater than 120 mg/L. This level exceeds the surface water discharge objective of 100 mg/L but is less than the groundwater objective of 150 mg/L. Further discussion with the RWQCB and possible revision to the Salt and Nutrient Management Plan will be needed to determine if and how the project could be designed and managed around these limits (e.g. using off-stream recharge basins).

Another consideration that may be analyzed in further detail is adding advanced treatment facilities at Valencia WRP to reduce Total Dissolved Solids (TDS) and Total Organic Compounds (TOC), which would potentially increase the diluent water blending ratio. The limitation of expanding RO facilities to include additional treatment for groundwater recharge supplies is brine disposal and the timeline to implement new facilities. Other alternative technologies, such as ozone, may also be considered; however, the timeline to implement the new facilities would extend beyond 10 years.

Current Groundwater Recharge Regulations are presented in Appendix E.

#### *4.2.1.5 Costs*

The capital cost of Groundwater Replenishment with Recycled Water is estimated to be $90 million. The annual O&M costs are estimated to be about $2 million per year. Based on the project's targeted yield of 10,000 afy, the estimated unit cost of this project is $800 per af of water delivered to the recharge basins. Assuming that up to 25-30 percent may not be recoverable by existing wells, the actual supply yield will be less than 10,000 afy and thus, the anticipated cost for the water supply benefit may be closer to $1,100 per af. Further study will be needed to refine these costs. The design criteria and cost estimating assumptions utilized for this scenario are presented in Appendix D.

## 4.3 Concept 2 - Aquifer Storage and Recovery

### 4.3.1 Supply Source and General Description

Two locations were identified for potential ASR well siting. Location 1, shown in Figure 7 below, is considered a location for new ASR wells. Location 2 was considered as a location where either new ASR wells could be installed or existing wells retrofitted. In both cases, the presumed water supply would be treated SWP water available during normal and wet years. Injection rates were assumed to be 5,000 afy at each site, based on a 10,000 afy target volume under Concept 2. If at some time in the future, FAT for recycled water were implemented, it could serve as an injection supply for the ASR wells. We have assumed that most of the injected water is recoverable.

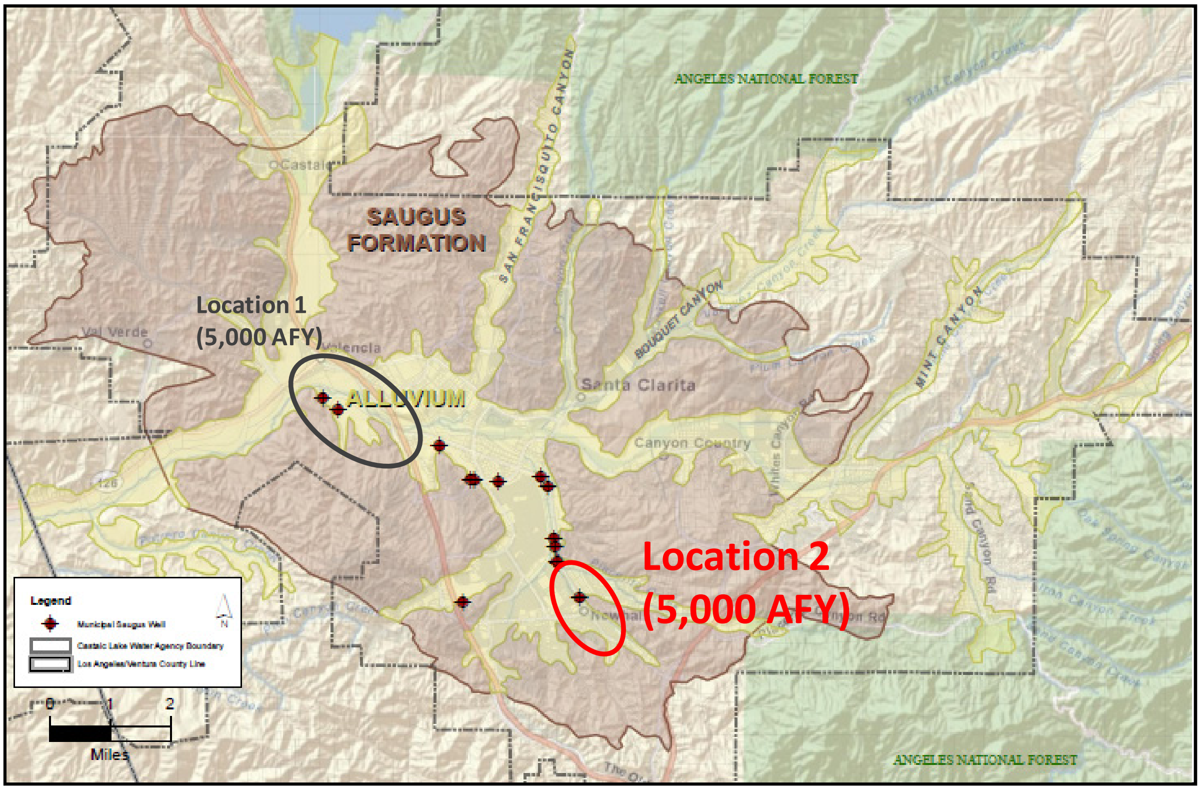

**Figure 7**      **Potential ASR Well Locations**

### *4.3.1.1 Analysis*

Modeling results showed that, in both locations, injection during wet years and extraction during dry years generally increased water levels, which would assist with well performance and help maintain Saugus groundwater production at levels that are higher than would otherwise be the case without ASR. This benefit manifests itself by allowing greater pumping during the first year of a significant long term drought. However, the benefits of additional pumping with ASR begin to dissipate after the first year unless the injection is resumed the following year.

One issue seen at Location 1 is that groundwater discharges to the Santa Clara River would increase during injection periods. This occurs because increased pressure heads in the Saugus Formation during injection will in turn increase groundwater levels in the overlying Alluvial Aquifer, which is in direct connection to the river and provides baseflow to the river in the western portion of the Valley. The increase in Alluvial Aquifer groundwater discharge was found to be equivalent to about 25 percent of the injection volume; however, it is important to note that the injected water itself would not appear in the river, due to the significant depth at which injection would occur in the Saugus Formation. Nonetheless, because of Location 1's close proximity to the river, the preliminary recommendation would be to focus ASR projects in the Location 2 area, which is farther from the river.

### 4.3.2 Facilities and Operational Considerations

The facilities required for an ASR program would consist of wells capable of extracting 1 mgd or more each. In general, injection rates are normally about three-fourths of the extraction rates. Another operational consideration is the timing of injection versus extraction. Injection would occur primarily in the winter during normal years of SWP deliveries when demand is relatively low. Injection would not occur when there are insufficient SWP deliveries and the wells are needed to be pumped. Pumping of the ASR wells, like other Saugus wells, would occur primarily during summer months when SWP deliveries are curtailed. For this reason, it is difficult to determine how much water would be in storage and available for recovery in any given year. However, historical normal or above normal SWP deliveries occur in approximately 6 out of every 10 years and so we anticipate that there will always be water in storage, except during extended years of SWP curtailment.

### 4.3.3 Implementation Considerations

ASR wells are capable of being readily implemented and can either be implemented individually or in clusters. One potential consideration to implementing ASR in the Saugus aquifer is the potential effect that injection may have on the migration of the perchlorate contaminant plume that has migrated in groundwater from the Whitaker-Bermite site. While no specific modeling was performed as part of this Study, it is generally believed that injection at Location 1 could potentially help limit the migration of perchlorate, which lies east of Location 1. At Location 2, modeling analyses would need to be conducted to evaluate the effects (if any) of an ASR program on the offsite perchlorate containment plan that has been developed by CLWA, the retail purveyors, the Whittaker Corporation, and state regulatory agencies.

### 4.3.4 Costs

Using a 2 mgd ASR program, the cost to retrofit existing wells is estimated to be $0.7 to $0.8 million with operations and maintenance costs of approximately $0.4 million per year. This equates to approximately $200 to $300 per af. If using new well construction, capital costs would be approximately $3.5 million with similar operations and maintenance costs of $0.4 million per year. This equates to approximately $400 to $600 per af. This is approximately 20 percent more than a standard Saugus well; however, ASR generally provides the ability to pump longer during drought without adverse effects and produces somewhat higher initial yield so that the reliability of the supply from Saugus wells is maintained and enhanced.

## 4.4 Concept 3 - Enhanced Stormwater Capture

### 4.4.1 Supply Source and General Description

As listed in Table 4 and shown on Figure 8, the Los Angeles County Flood Control District identified multiple sites to capture and recharge stormwater in either in-stream or off-stream recharge basins. Preliminary estimates suggest that an estimated 5,500 afy could be recharged through stormwater capture within the CLWA service area. This would require the implementation of more than 1,800 af of stormwater storage facilities in-stream or off-stream of existing channels, creeks, and rivers. Furthermore, these diversion and retention structures would need to be spread out over the entire service area due to the diffuse nature of stormwater accumulation.

**Table 4 Stormwater/Runoff Supply from Conceptual Stormwater Capture Projects Identified by Los Angeles County Flood Control District**
**Water Resources Reconnaissance Study**
**Castaic Lake Water Agency**

| Site | Size (af) | Average Capture (afy) |
|---|---|---|
| South Fork Rubber Dam #1 at Pedestrian Bridge | 109 | 330 |
| South Fork Rubber Dam #2 Near Covala Dr | 112 | 330 |
| South Fork Rubber Dam #3 | 60 | 180 |
| South Fork Rubber Dam #4 at Valencia Bridge | 115 | 340 |
| SCR Rubber Dam at Bouquet Canyon | 80 | 270 |
| SCR in-Stream Spreading Grounds #1 | 180 | 550 |
| SCR Off Stream SPREADING Grounds | 220 | 670 |
| Scr in-Stream Spreading Grounds #2 | 70 | 220 |
| SCR Spreading Grounds at Sand Canyon Rd | 350 | 1,040 |
| SCR Spreading Grounds at Franklin Parkway | 0 | 0 |
| Placerita Creek Spreading Grounds | 75 | 220 |
| Newhall Creek Spreading Grounds | 0 | 75 |
| Upper San Francisquito Spreading Grounds | 230 | 700 |
| Lower San Francisquito Spreading Grounds | 190 | 570 |
| **Total** | **1,800** | **5,500** |

Source:
Santa Clara River Watershed - 2007 Water Conservation Feasibility Study

To focus the effort, the South Fork area was selected due to its configuration and higher flow volumes. The total estimated stormwater recharge within the South Fork area is approximately 630 afy, but could vary considerably with rainfall from one year to the next (and could be zero during drought periods).

Other sites where recycled water recharge is a feasible option were also targeted as potential stormwater capture sites. The estimated stormwater capture at the recycled water recharge locations discussed in Section 4.2.1 is approximately 550 afy at Site 1 and approximately 220 afy at Site 3 based on the data presented in Table 4.

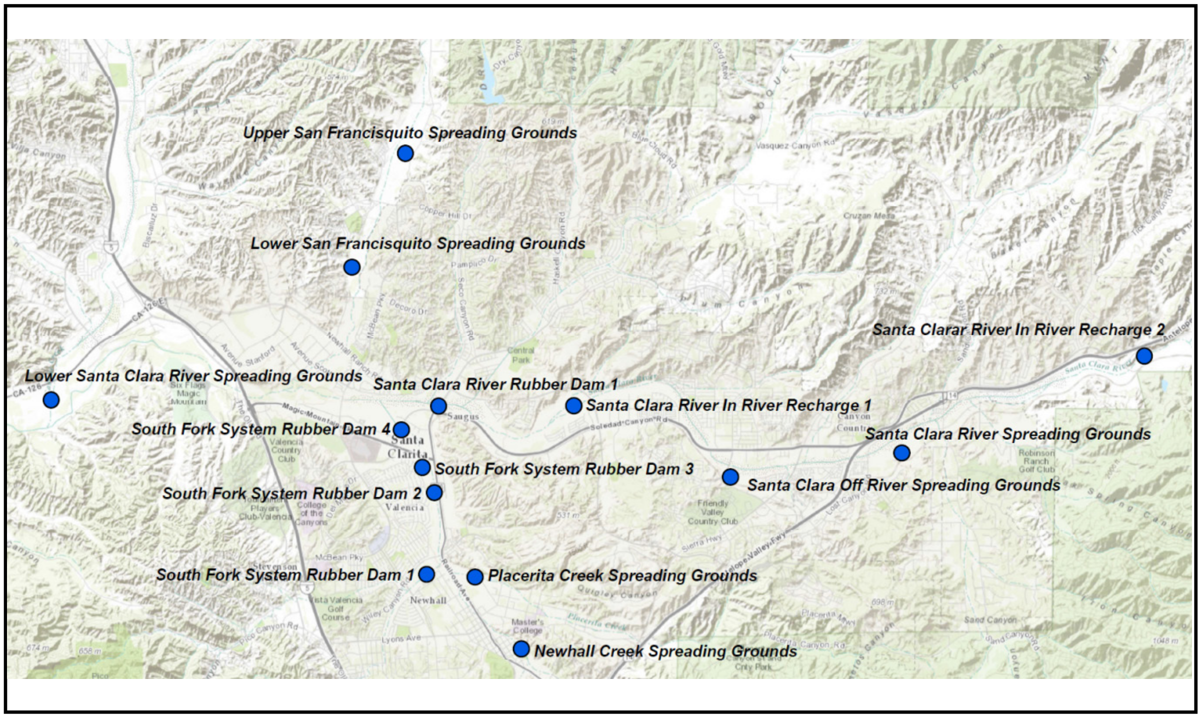

**Figure 8 Stormwater/Runoff Capture Sites**

### 4.4.1.1 Analysis

The Santa Clara River and its tributaries reside in alluvial floodplains and are unlined, which provides a generally high infiltration capacity in the river bottoms. The South Fork area shown on Figure 9 was selected for evaluation in this Reconnaissance Study because it is more channelized than the Santa Clara River and its tributaries. This configuration increases the potential for in-stream water impounding as long as the invert is relatively flat to maximize storage. The South Fork of the Santa Clarita River begins near the Interstate 5 at Wiley and Towsley Canyons, then crosses the southwestern part of the City of Santa Clarita and joins the Santa Clara River just east of the McBean Parkway crossing. The South Fork travels through a large portion of the City of Santa Clarita where the Newhall Creek joins the South Fork near the Via Princessa crossing. This area receives water from several smaller creeks in a mostly undeveloped mountainous area near the Interstate 5 crossing on the southwestern part of the City of Santa Clarita.

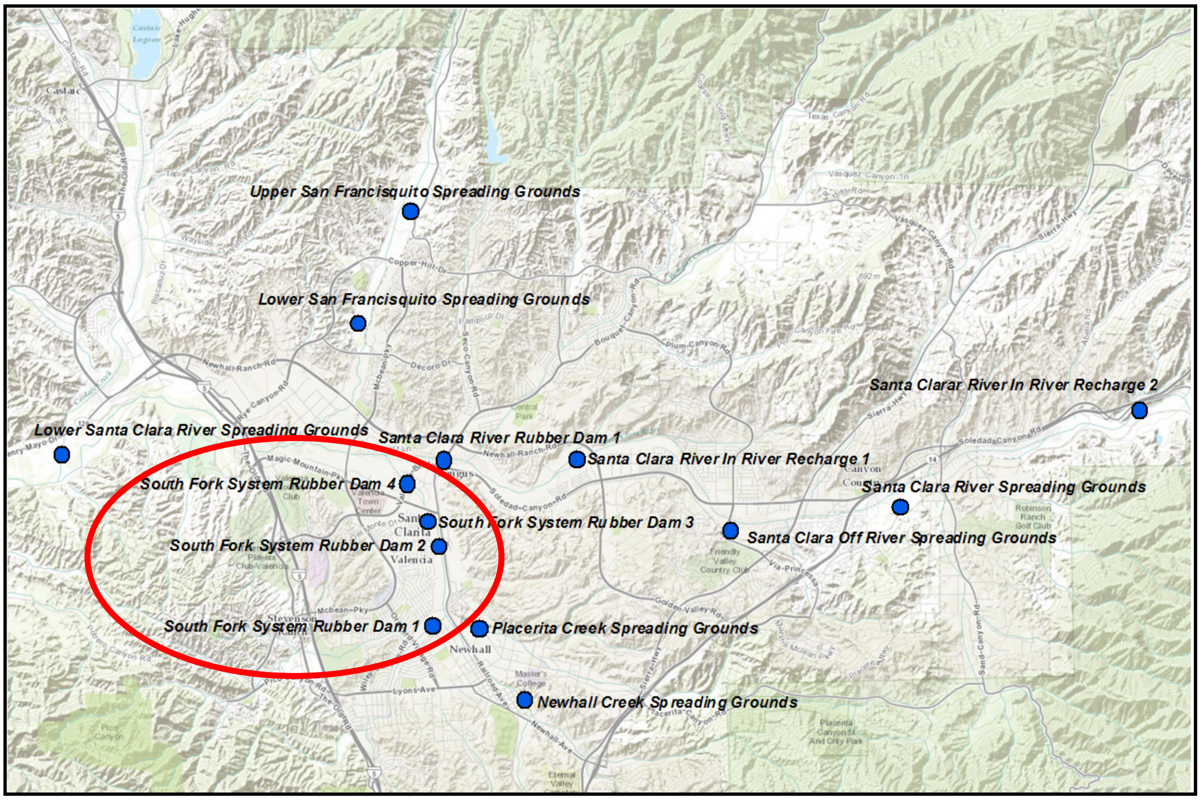

**Figure 9** South Fork Stormwater Capture Sites

In addition to South Fork, enhanced stormwater capture was considered at the recycled water recharge locations discussed in Section 4.2.1. The recycled water recharge locations were selected based on the premise of maximizing the potential for recharging recycled water and not stormwater capture.

### *4.4.1.2 Facilities and Operational Considerations*

The development of rubber dams along the South Fork of the Santa Clara River would be most practical for groundwater recharge since the banks of the river have been modified and drop structures exist. The South Fork is also the least environmentally restricted area and includes numerous locations for habitat restoration in the event that mitigation is required.

If the projects were implemented, a routine operations and maintenance program would be required since the Santa Clara River spreading grounds are subject to the accumulation of fine-grained sediments during infiltration, which impairs the ability to effectively recharge captured stormwater until the floor of the infiltration basin is cleaned out.

### *4.4.1.3 Implementation Considerations*

At this time, the Los Angeles County Flood Control District (LACFCD) has developed designs for South Fork Rubber Dam System 1. Estimates are currently in progress for

South Fork Rubber Dam Systems 2 and 3. From a planning level perspective, installation of stream flow gaging stations would be recommended prior to implementation to obtain a more detailed model of the South Fork to determine the feasibility of these projects, since the estimated stormwater flow rates do not meet the 5,000 to 15,000 afy water supply target of the Reconnaissance Study. Additionally, from the standpoint of groundwater supply, the actual increase in groundwater supply production is likely to be much lower than the infiltrated stormwater flow volume because the Alluvial Aquifer in this area is too thin to develop for water supply purposes (as evidenced by the fact that groundwater supply development to date in this area has consisted solely of constructing wells in the Saugus Formation). Because the aquifer is thin in this area, and because the nearest water supply wells are substantial distances down gradient from the proposed facilities, these projects may produce no measurable increase in the production capabilities of existing water supply wells.

#### *4.4.1.4 Costs*

The capital cost of Enhanced Stormwater Capture is estimated at about \$9 million to \$10 million. This estimate was based on the analysis provided by the Los Angeles Department of Public Works. For planning purposes, the annual O&M costs are estimated at about \$1,000,000 per year. Based on the project's average capture volume of 630 afy, the estimated unit cost of this project is approximately \$2,000 per acre-foot. The actual benefit to the groundwater basin--and thus increased yield for these types of projects; however, would be expected to be a fraction of this captured volume and will be site specific. In addition, this cost does not include the cost for environmental mitigation or permitting. Based on the unit cost per acre-foot and the anticipated yield, the project does not meet the objectives of the Reconnaissance Study.

### 4.4.2 Concept 4 - Pumping Redistribution

#### *4.4.2.1 Supply Source and General Description*

This concept reviews the current groundwater pumping targets in the Alluvial Aquifer during drought years and evaluates the ability to redistribute pumping from the eastern end of the basin (at wells owned by NCWD and SCWD) to the central and western portions of the basin (at wells owned by VWC) to meet target production volumes during local drought years. Groundwater modeling was utilized to analyze the effects of shifting pumping to obtain the Alluvial Aquifer production targets listed in Table 5 and shown on Figure 10.

**Table 5 Initial Concept for Groundwater Pumping Redistribution**
**Water Resources Reconnaissance Study**
**Castaic Lake Water Agency**

| Water Purveyor | Original Pumping Plan (afy)[(1)(2)] | Redistribution Pumping Plan (afy)[(1)(2)] | Differential in Pumping (afy) |
|---|---|---|---|
| NCWD (Pinetree) | 700 | 350 | -350 |
| NCWD (Castaic) | 600 | 1,050 | 450 |
| SCWD | 8,150 | 4,500 | -3,650 |
| VWC | 12,850 | 21,500 | 8,650 |
| Total | 22,300 | 27,400 | 5,100 |

Notes:
(1) Groundwater modeling conducted by GSI .
(2) Based on drought year pumping targets.

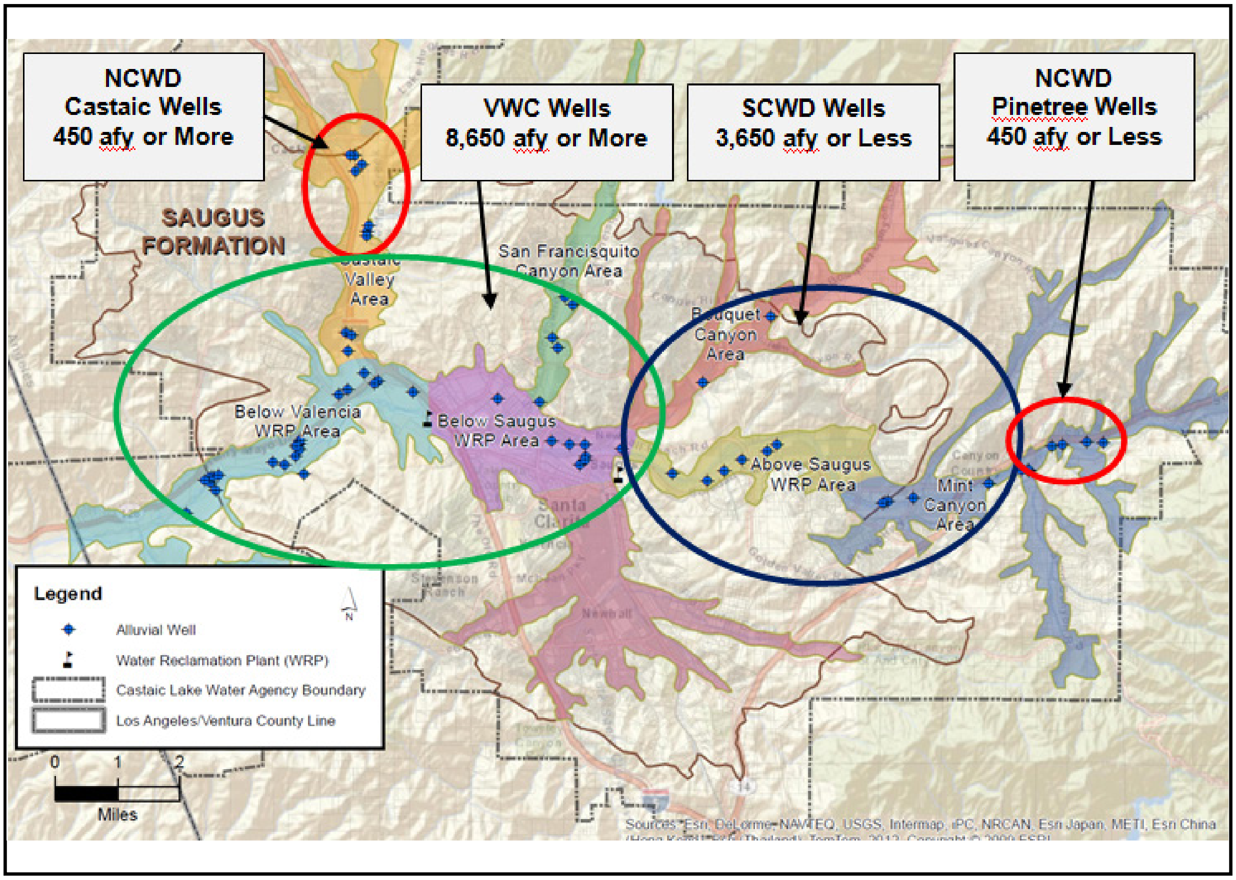

**Figure 10 Initial Concept for Groundwater Pumping Redistribution Plan**

As listed in Table 5, the purveyors' collective dry-year pumping target is approximately 22,300 afy. During the early years of a local drought, groundwater pumping theoretically could be increased more in the central and western portions of the basin than is reduced in the eastern portion. The scenario that was initially tested with the groundwater model consisted of increasing pumping by VWC's wells and NCWD's Castaic wells by a combined total of 9,100 afy while reducing pumping in the eastern end of the basin by about 4,000 afy. This scenario envisions a net increase in groundwater production of 5,100 afy during a local drought, as shown in Table 5 and Figure 10.

As listed in Table 5, the dry-year pumping without redistribution is approximately 22,300 afy. With pumping redistribution, the pumping yield is anticipated to increase by 5,100 afy to an estimated total of 27,400 afy. Since majority of the wells are located within the VWC service area and the groundwater conditions within this region have been less impacted by the drought, the planned pumping is estimated to increase from 12,850 afy to 21,500 afy. This net increase of 8,650 afy is the largest impact to an individual purveyor under the pumping redistribution plan.

#### *4.4.2.2 Analysis*

Groundwater modeling analyses indicate that the redistribution concept shown in Table 5 and Figure 11 is viable under certain drought conditions, but are not likely to be sustainable on a permanent basis. Further modeling indicated that continued drought conditions observed during 2014 would not allow this pumping redistribution concept to continue at the higher (27,400 afy) target amount. (See Appendix C for the details of that analysis.)

#### *4.4.2.3 Facilities and Operational Considerations*

As part of optimizing groundwater production to meet water supply targets during years of local drought conditions, well site modifications may be considered to maintain or increase pumping yields. This would require lowering pumps at existing well sites or potentially constructing new well sites. Furthermore, if pumping redistribution were implemented, the inter-ties and distribution infrastructure between purveyors would require further analysis to determine if capacity is sufficient.

#### *4.4.2.4 Implementation Considerations*

Based on the analysis completed, it was determined that pumping redistribution would not increase the overall pumping yield within the near-term under existing hydrologic and infrastructure conditions; therefore, the concept would not meet the objectives of the Reconnaissance Study. Pumping redistribution may be considered under temporary circumstances if SWP is curtailed or in response to local drought conditions that reduce the yields of Alluvial Aquifer wells in the eastern portion of the Valley.

#### *4.4.2.5 Costs*

At this time, the costs to redistribute pumping have not been analyzed since the concept was not considered under the Reconnaissance Study. If this plan were considered at a later time, an analysis of the effects on the operational and maintenance costs to individual purveyors would be determined along with the estimated costs for upgraded or new infrastructure. Agreements between the local purveyors within the CLWA service area would be recommended to share in the costs of the operational changes under this plan.

## Chapter 5

# CONCEPT SCREENING CRITERIA

Consistent evaluation of the concepts presented in Chapter 4 required developing the appropriate screening criteria. For the Reconnaissance Study, draft-screening criteria were presented and discussed at the December 19, 2014 workshop with the water purveyors. Comments were incorporated and resulted in the following criteria:

- Ability to meet study objectives with reliability
- Cost and cost per acre-foot
- Phasing opportunities
- Institutional considerations
- Other factors

The description for each criteria is outlined below. Analysis using this criteria was then performed and the results are presented in Section 5.6.

## 5.1 Ability to Meet Study Objectives with Reliability

While every acre-foot of water is precious, the objective the Study is to recommend concepts for further evaluation that can significantly reduce water supply uncertainty, particularly during dry years. For this Study, this has been defined as the ability to deliver 5,000 afy or more of local water supply even during either local dry years or SWP dry years. Qualitative criteria are as follows:

- *Low:* under 2,000 afy
- *Medium:* 2,000-5,000 afy
- *High:* 5,000+ afy

## 5.2 Project Cost and Cost per Acre-Foot

Costs are considered in two ways: the first is overall capital cost as this influences how much money is needed to begin implementing the project. The second is the cost effectiveness of the water supply (as cost per acre-foot of water provided by the project) which can then be compared to current water supply costs as well as alternative water supply costs. It is important to point out that this does not necessarily translate into the cost per acre-foot of water supply *yield*, as this will vary with a number of factors. At this level of analysis, the purpose of this cost information is to assess if there is sufficient value associated with the project to continue further evaluation.

Qualitative criteria are as follows:

- *Low:* High up front implementation cost ($25 million+) and low cost effectiveness ($2,000+ per acre-foot).
- *Medium:* Either low up front implementation cost (>$25 million) or high cost effectiveness (<$2,000 per acre-foot)
- *High:* Both low implementation cost (<$25 million) and high cost effectiveness (<$2,000 per acre-foot)

## 5.3 Phasing Opportunities

Projects that can be phased are often easier to have approved, funded, and receive regulatory approvals. Qualitative criteria are as follows:

- *Low:* Little to no phasing opportunities.
- *High:* Two or more phasing opportunities

## 5.4 Institutional Considerations

In many settings, including the Santa Clarita Valley, there could be multiple parties involved with implementing local water supply projects. In general, the more parties involved, the more difficult (and more time consuming) it can be to achieve consensus, craft agreements, and pool funding. Qualitative criteria are as follows:

- *Low:* Requires participation, approvals, and funding from multiple parties.
- *Medium:* Requires participation from 3 or less parties.
- *High:* Does not require partnering with other entities.

## 5.5 Other Factors

For the Reconnaissance Study, a number of other factors to consider have been grouped into a final category. These other factors may include water quality, environmental benefits, and/or community or stakeholder concerns. The challenges of these factors will be qualitatively considered either low, medium or high.

## 5.6 Analysis and Results

Using the defined screening criteria, Carollo Engineers evaluated each of the concepts presented in Section 4.2. The analysis and results of this analysis are summarized in Table 6. Based on this screening, the recommended project concept for further development at this time are Concept 1 (Recharge with Recycled Water) and Concept 2 (ASR).

## Table 6
## Concept Screening Analysis and Results

| **Screening Criteria** | **1. Recharge with Recycled Water** | **2. Aquifer Storage and Recovery** | **3. Enhanced Stormwater Capture** | **4. Pumping Redistribution** |
|---|---|---|---|---|
| **A. Ability to Meet Study Objectives with Reliability** | • With both recharge and non-potable deliveries, project yield will exceed 5,000 afy.<br>• Water supply reliability is high due to use of reclaimed wastewater<br>• Will require significant permitting steps which can slow or jeopardize the process<br>**Rank: High** | • Could replenish 5,000 afy or more during normal to wet years.<br>• Allows for more Saugus pumping during Years 1 and 2 of SWP curtailments. However, no further benefit after Year 2.<br>• Relies on State Water Project Water.<br>**Rank: Medium** | • Individual project(s) generate under 1,000 afy of water on average.<br>• Does not provide reliable annual supply.<br>• Effectiveness of enhanced capture systems (e.g. berms or inflatable dames) over current natural conditions is not clear.<br>• Greater effectiveness and reliability would require multiple installations.<br>**Rank: Low** | • Could increase basin yield up to 5,000 afy during early years of a drought, but not if drought continues.<br>• Recent modeling raised concern about reliability during long-term drought<br>• Would need to be coupled with modifications to existing systems.<br>• May be better suited as a temporary measure with lower yield.<br>**Rank: Low** |
| **B. Cost and Cost per Acre-Foot** | • Capital investment is high, even for initial phases of the project.<br>• Cost per Acre-Foot, estimated at $400 to $800 is competitive with other alternative supplies.<br>**Rank: Medium** | • Capital investment is generally low.<br>• Cost of additional water is paid for as needed.<br>• Cost per Acre-Foot, estimated at $200 to $400 is competitive with other alternative supplies<br>**Rank: High** | • Capital costs per project are generally reasonable and LACFCD may fund up to ½ the cost.<br>• Cost per Acre-Foot, estimated at $2,000/af is relatively high and does not include mitigation costs.<br>**Rank: Low** | • Capital costs are likely reasonable but aren't well defined at this time.<br>• Cost per Acre-Foot, could not determined at this time but are expected to be reasonable.<br>**Rank: Medium** |
| **C. Phasing Opportunities** | • Construction can be phased over time to first deliver water to non-potable customers and then the recharge facilities.<br>• Future phasing opportunities using either more tertiary water or Advanced Treatment water can be integrated into the project.<br>**Rank: High** | • Implementation of injection and extraction wells (either new wells or retrofits to existing wells) can be made one at a time.<br>• Purchase of injection water can be made as needed<br>• Could use Advanced Treated recycled water in place of potable.<br>**Rank: High** | • Projects could be constructed in multiple locations.<br>• May be able to integrate with recycled water recharge project(s).<br>• However, no economies of scale as each site would need to be evaluated, acquired, permitted, designed and constructed.<br>**Rank: Medium** | • Some additional pumping could occur in an early phase without significant cost.<br>• Future phases and expanded pumping would require additional wells, pipelines, pumps and treatment.<br>**Rank: Medium** |
| **D. Institutional Considerations** | • Will involve the Sanitation District, CLWA, and possibly VWC, SCWD and NCWD.<br>• Permitting and approvals will be needed by multiple agencies, including Division of Drinking Water.<br>**Rank: Low** | • Involves CLWA to provide injection supply and possibly one water retailer at a time.<br>• Permitting needed only by the RWQCB<br>**Rank: High** | • Implementation would require LACFCD working with permitting agencies.<br>• Cost contribution from water purveyors for both capital and O&M would need to be worked out.<br>• Potential project sites may not be for sale or are being reserved for development or separate project(s) by the City.<br>**Rank: Medium** | • Involves most if not all purveyors to participate<br>• Requires extra pumping by VWC that may affect current pumping and water quality.<br>• May require CLWA to take pumped groundwater into is transmission system.<br>• Won't require special permitting<br>**Rank: Low** |
| **E. Other Factors including Water Quality, Environmental Benefits, and Community/Stakeholder Issues** | • *Water quality:* may lead to slight increase in TDS in groundwater over time.<br>• *Environmental:* Recharge basin location may also be developed for open space/habitat benefit<br>• *Community:* May be community concern about use of recycled water for potable use.<br>**Rank: Medium** | • *Water quality*: ASR effects on the perchlorate containment program will require evaluation.<br>• *Environmental:* no issues.<br>• *Community:* no issues.<br>**Rank: Medium** | • *Water quality*: no impact<br>• *Environmental:* will impact the river channel and require special permits to do so.<br>• *Community:* Creates an opportunity for a community water feature or other park amenity.<br>**Rank: Medium** | • *Water quality*: will generally decrease water quality unless treatment is utilized<br>• *Environmental:* by drawing down basin, may draw more water in from the Santa Clara River.<br>• *Community:* generally no issues<br>**Rank: Medium** |
| **RESULTS** | • *High: 2*<br>• *Medium: 2*<br>• *Low: 1* | • *High: 3*<br>• *Medium: 2*<br>• *Low: 0* | • *High: 0*<br>• *Medium: 3*<br>• *Low: 2* | • *High: 0*<br>• *Medium: 3*<br>• *Low: 2* |

## Chapter 6

# RECOMMENDATIONS AND CONCLUSION

The Study was designed to serve as a vehicle for identifying promising and realistic local water supply concepts for the Santa Clarita Valley and providing appropriate context for their implementation. During the Study development, some concepts were screened out from further evaluation because of either stakeholder preferences and/or because the concept did not meet the objectives of the Study. It should be noted that this does not necessarily imply these projects are infeasible or that they should not be considered further at another point in time.

Within this context, we have identified and present our recommendations as (1) recommended projects for further development, (2) opportunity projects, and (3) future projects.

## 6.1 Recommended Projects for Further Development

Based on the results from the concept development and screening, the following project concepts are recommended for subsequent development, feasibility analysis, and facility planning:

- Groundwater recharge of the alluvial aquifer with recycled water and delivery to non-potable customers.
- Aquifer storage and recovery

If these two projects are able to provide the results estimated in this Study, together they will be able to recharge up to 15,000 acre-feet into the local groundwater basins. Because some losses are anticipated, the actual additional yield associated with these projects will be less, but nevertheless significant and potentially on the order of 10,000 afy when fully implemented. In addition, by having ongoing replenishment of the alluvial aquifer, groundwater levels will generally remain higher and should allow for more normal pumping during dry year conditions.

Further details on implementation steps for these projects are presented in Section 7.

## 6.2 Opportunity Projects

The Study has also identified “opportunity projects” for the water purveyors and stakeholders to continue to consider. While each opportunity project can provide added water supply benefits, a high cost per acre-foot, an inability to contribute enough toward meeting the study objectives, and/or the complexity of implementation suggest that the project should not be recommended for development at this time, but instead be categorized as an opportunity project – i.e., a project to consider, re-evaluate, and even implement if the right conditions develop in the future.

The opportunity projects identified in the Study, and the conditions under which these project should be reconsidered are as follows:

### 6.2.1 Enhanced Stormwater Capture

This concept has been classified as an opportunity project because, on an individual basis, the potential water supply yield from each project (< 1,000 afy on average) is relatively low in relation to the project cost, the reliability of that yield, and the challenges associated with implementation. However, certain conditions that could trigger further development of such projects may include the following:

- Need for water quality compliance, either for meeting *MS*-4 permit requirements or for helping to achieve groundwater quality as outlined in the Basin Plan (which may undergo amendment with the development of the Salt and Nutrient Management Plan as well as chloride reduction strategies to be implemented at the Valencia and Saugus WRPs).
- Acquisition and development of parcels within or adjacent to the Santa Clara River for use as parks, open space, wildlife enhancement, and/or other community amenities. Such acquisition and development could be used as mitigation for real estate development elsewhere in the watershed.

### 6.2.2 Pumping Redistribution

This concept has also been classified as an opportunity project because of expected challenges associated with implementation on the scale needed to contribute significantly and reliably toward the Study objectives (e.g., over 3,000-4,000 afy). As noted in the Study, implementation at this scale would require a substantial increase in pumping from the Valencia Water Company service area, followed by treatment and conveyance into the CLWA transmission system for distribution to other water purveyors in the Valley. Under the current institutional structure of water management in the Valley, it does not appear that such a high degree of dry year pumping redistribution is readily feasible. However, as is currently taking place, short-term and temporary pumping redistribution on a smaller scale is both technically, financially, and institutionally feasible and thus should remain an opportunity under dry-year conditions such as those now being experienced.

### 6.2.3 Expanded Treatment of Contaminated Groundwater

Groundwater contamination has been a significant factor impacting the reliability of the local groundwater supply. A current goal of groundwater treatment for perchlorate in the Saugus aquifer is to return existing wells back to service that had been shut down due to contamination. Meanwhile, as part of the existing settlement agreement with the Whittaker

Corporation, cleanup is to continue on the Whittaker-Bermite site to prevent site contamination from continuing to migrate to offsite portions of the Saugus aquifer. However, stakeholders acknowledged that additional production wells could be installed in the contaminated area, with the pumped water treated and delivered for potable supply. This added production could speed cleanup by drawing more contaminated water out of the groundwater basin while also providing additional water supply.

However, implementing additional pumping and treatment in a manner that would affect current Operating Unit systems would require going through another extensive approval process with the PRPs and with EPA without certainty of acceptance. This may take additional time, further evaluation, and implementation of new treatment facilities for which it is not certain if the PRPs could be held accountable for the costs.

## 6.3 Future Projects

During the Study, project concepts were presented that could make significant contributions toward the Study's water supply goals. However, some of the projects were screened out from further development because their expected implementation timeline extended beyond the 10-year window established by the Study stakeholders as an objective. Nevertheless, these projects should remain under consideration for the future and we recommend that the water purveyors continue to take active steps toward their implementation.

### 6.3.1 Full Advanced Treatment (FAT) of Recycled Water at One or Both of the Valley's WRPs

As described in the Study, FAT would provide substantially greater flexibility and yield of recycled water as a water supply. New opportunities that it would create include more groundwater replenishment through surface spreading, direct injection using aquifer storage and recovery, and as regulations continue to evolve, the direct delivery of FAT recycled water into the potable system (i.e., direct potable reuse or DPR). The key challenges to implementing FAT for recycled water are brine generation/disposal and cost effectiveness. Given the high cost associated with brine disposal alternatives as well as in the construction and operation of an advanced water treatment (AWT) facility, the following steps would need to occur in order for FAT to continue to be considered:

- Develop a plan to fully utilize all the recycled water produced from the WRPs except for what is necessary for discharge to the river to meet any minimum flow requirements.
- Conduct a feasibility study for a brine line for disposal of the maximum amount of brine projected.
- Develop this Study's near-term recommended projects (i.e., spreading basins, ASR wells) taking into account a possible future FAT facility.

- Follow ongoing developments with DPR regulations and, as water supply projects are implemented over the next 10 years, evaluate the implications that a DPR concept may have on them.

## Chapter 7

# IMPLEMENTATION

This section provides an overview of the studies, design and construction considerations, institutional considerations, and funding considerations necessary to implement the recommended projects. The purpose of this information is to briefly describe the next steps.

## 7.1 Studies, Design and Construction Considerations

### 7.1.1 Recharge with Recycled Water

To proceed with developing the groundwater recharge with recycled water project, the following studies will need to be undertaken:

#### *7.1.1.1 Feasibility and Siting Study*

The analysis and recommendations from the Reconnaissance Study are based on a number of assumptions that need to be further evaluated. These include:

- More precisely identifying or defining the area(s) to be used for spreading basins and analyzing the percolation rates in those locations
- Evaluating in-stream or off-channel basins as well as the use of temporary earthen berms (that could require re-grading after storm events) and/or permanent structures (e.g., inflatable dams)
- Evaluating alternative pipeline routes and other facilities needed to transport recycled water from the Valencia WRP to the recharge location
- Evaluating the potential to serve non-potable customers along the identified pipeline routes and their demands
- Perform additional groundwater modeling to confirm diluent water quantities, travel times to potable wells, and any increase in pumping yields
- Identifying permitting requirements for the project, the most significant of which will be the Title 22 permit from the RWQCB, an amended Waste Discharge Requirement (WDR) permit, streambed alteration permit from California Department of Fish and Wildlife, and Section 404 and 408 permits from the U.S. Army Corps of Engineers

#### *7.1.1.2 Develop and Execute an Outreach Plan*

During the preparation of the Feasibility and Siting Study, an outreach and communications plan should be prepared and executed to educate the public about the use of recycled water for groundwater replenishment and, as needed, the construction of recharge basins in or adjacent to the Santa Clara River.

#### *7.1.1.3 Prepare a Facility Plan*

If the results of the Feasibility and Siting Study result in a recommended project, a Facility Plan will need to be prepared to refine the design and operating criteria along the with the cost and the construction footprint of the project. Information in the Facility Plan will then be used as the basis for an Environmental Impact Report, the Title 22 Engineering Report and other project permits. Coordination with the LACSD will be necessary during this phase of the project to integrate facilities and to confirm availability of recycled water.

#### *7.1.1.4 Prepare the EIR*

Using the Facility Plan as the basis, an EIR will need to be prepared to document the environmental impacts associated with the project and the measures necessary to mitigate those impacts where possible. The EIR will also identify the permits needed for construction of the project.

#### *7.1.1.5 Prepare Title 22 Engineering Report*

Following DDW's guidelines for the use of recycled water for potable reuse, prepare a Title 22 Engineering Report for review and approval by the RWQCB. The report will describe the operation of the project, water quality, and proposed monitoring requirements.

#### *7.1.1.6 Design and Construction*

Prepare the necessary design and construction documents for the project while obtaining the necessary approvals, permits, and easements from entities identified in the Facility Plan and EIR.

### 7.1.2 Aquifer Storage and Recovery

To implement the recommended ASR project, the following steps will need to be taken:

#### *7.1.2.1 Feasibility and Siting Study*

The analysis and recommendations from the Reconnaissance Study are based on a number of assumptions that need to be further evaluated. These include:

- Finalize the location of ASR wells, including conducting groundwater modeling evaluations of potential effects on perchlorate containment programs already under implementation.
- Determine if using new wells or retrofitting existing wells. Confirm potable water supply availability and infrastructure to deliver water to the ASR wells for injection.

#### *7.1.2.2 Facility Plan*

Prepare a Facility Plan to document the design criteria and operational parameters for the ASR wells.

#### *7.1.2.3 RWQCB Permitting*

The RWQCB will be responsible for permitting the ASR well. Requirements of the permit will include documenting water quality impacts. If in the proximity of the perchlorate plume, some groundwater modeling may be necessary to document the impacts, if any, on plume migration and cleanup operations.

#### *7.1.2.4 CEQA*

CEQA documentation will need to be prepared for the project. Given the limited construction impact associated with the project, and negative declaration (ND) or a mitigated negative declaration (MND) (rather than a full EIR) could suffice.

#### *7.1.2.5 Design and Construction*

Prepare the necessary design and construction documents for the project while obtaining the necessary approvals, permits, and easements from entities identified in the Facility Plan and the CEQA documentation.

## 7.2 Institutional and Funding Considerations

An aspect of the projects identified in this Study is that, on some level, they are providing regional benefit to the Santa Clarita Valley and, in particular, the Valley's groundwater basins. There is not necessarily one entity who is implementing the project(s) alone nor is their one entity benefitting. As such, as the projects are developed, it will be important to confirm who should be responsible for implementing the projects and who should be responsible for the project costs.

### 7.2.1 ASR Project(s)

For the ASR project(s), responsibility is expected to reside with the well owner. They will be responsible for not only procuring the supply needed for injection but also extraction. However, because of both the construction and operational cost associated with ASR, some accounting mechanism will need to be developed and implemented so that the investment/storage made by the ASR well owner/operator can be documented.

### 7.2.2 Recharge with Recycled Water

For the recycled water project, implementation may be led by CLWA or in conjunction with the purveyors through either a project agreement or formation of a Joint Powers Authority. The costs of the project could be recovered through direct sales of recycled water to non-potable customers and through a cost recovery mechanism tied to additional pumping/yield created by the project (e.g., a pump tax) for downstream wells.

Given the new water supply generated by this project, it may be able to qualify for various grants. For example, Proposition 1, which was passed by California voters in November 2014, provides several hundred millions of dollars for funding recycled water projects. Meanwhile, because the project may also capture stormwater runoff in wet years, LACDPW has indicated that it may be able to fund up to 50 percent of the cost for that portion of the project.

# APPENDIX A - REFERENCES

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# APPENDIX B - WORKSHOP MATERIALS (PRESENTATIONS AND MEETING MINUTES)

# APPENDIX B-1

# Workshop 1 Materials

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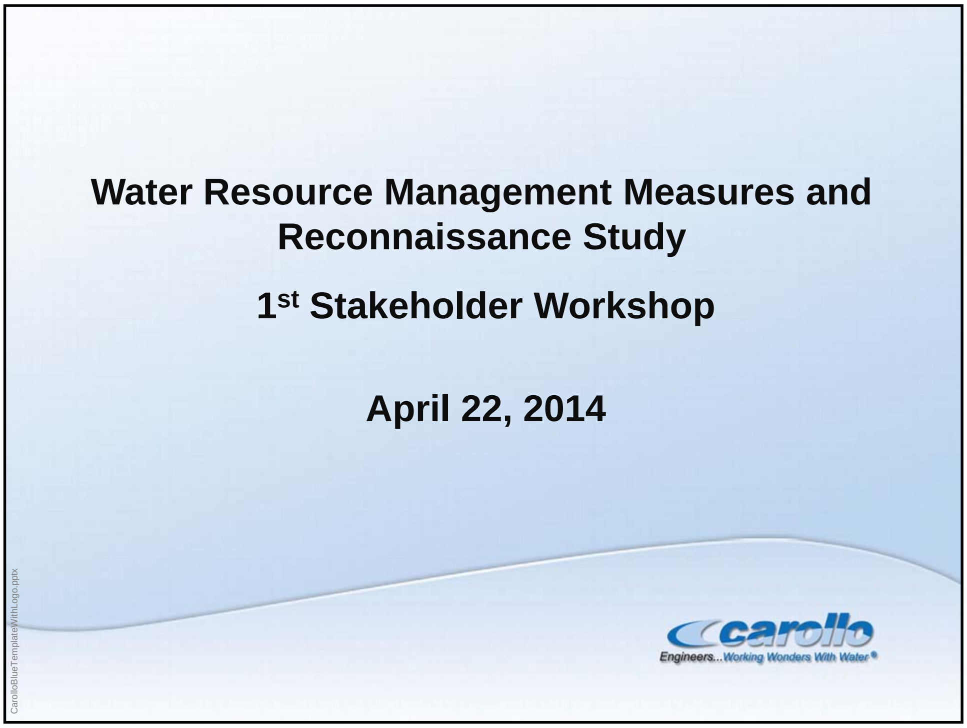
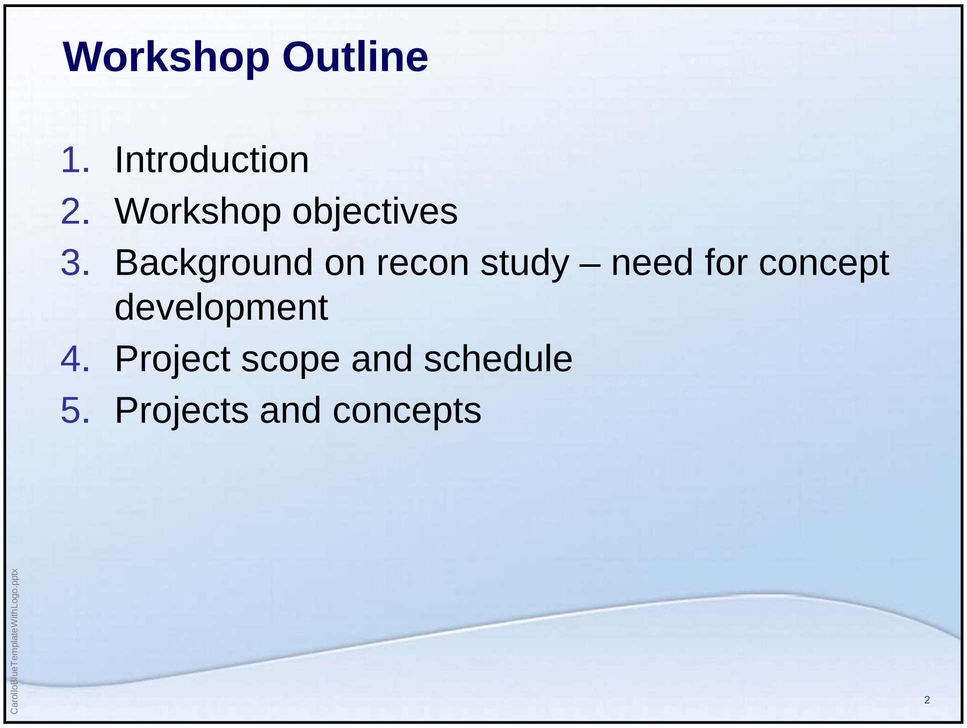


# Water Resource Management Measures and Reconnaissance Study

## 1st Stakeholder Workshop

April 22, 2014



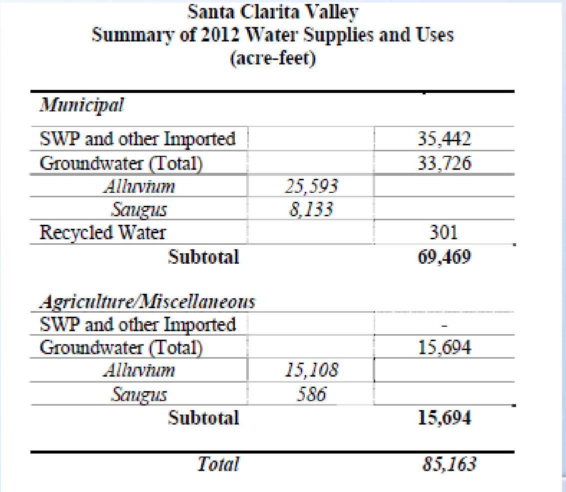
## Workshop Outline

1. Introduction
2. Workshop objectives
3. Background on recon study – need for concept development
4. Project scope and schedule
5. Projects and concepts

## Workshop Objectives

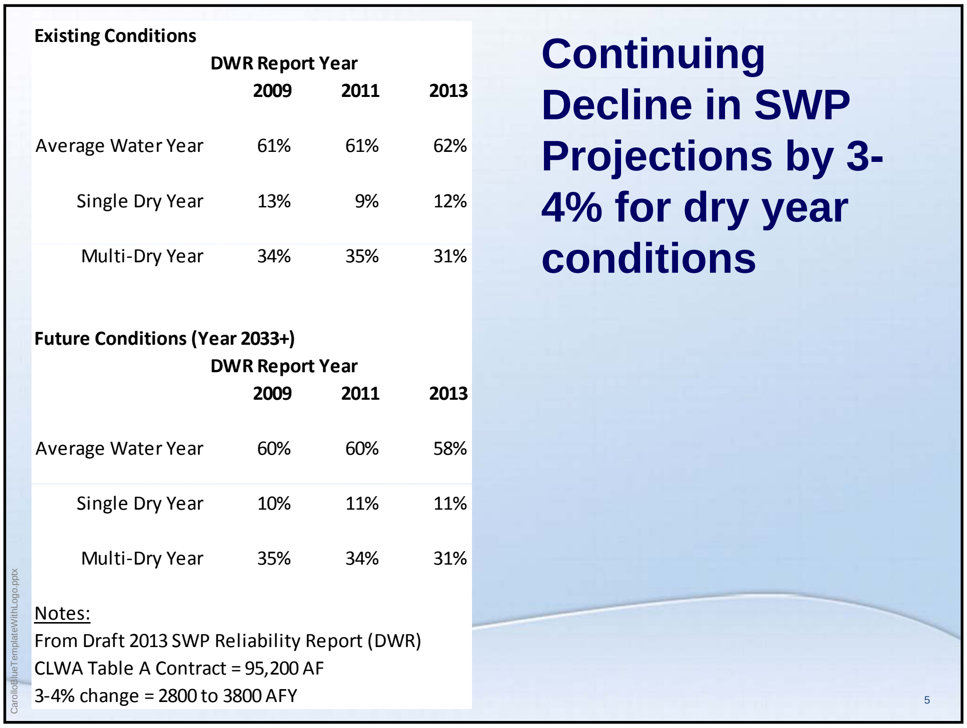
- Re-iterate need for local supply development
- Discuss local supply concepts
  - Targeting 5,000 – 15,000 afy
- Get feedback on concepts and supporting information
- Discuss next steps

## 2012 Supply Balance Illustrates SWP Contribution



Santa Clarita Valley
Summary of 2012 Water Supplies and Uses
(acre-feet)

| | | |
|---|---|---|
| *Municipal* | | |
| SWP and other Imported | | 35,442 |
| Groundwater (Total) | | 33,726 |
| *Alluvium* | *25,593* | |
| *Saugus* | *8,133* | |
| Recycled Water | | 301 |
| **Subtotal** | | **69,469** |
| *Agriculture/Miscellaneous* | | |
| SWP and other Imported | | - |
| Groundwater (Total) | | 15,694 |
| *Alluvium* | *15,108* | |
| *Saugus* | *586* | |
| **Subtotal** | | **15,694** |
| *Total* | | *85,163* |



## Continuing Decline in SWP Projections by 3-4% for dry year conditions

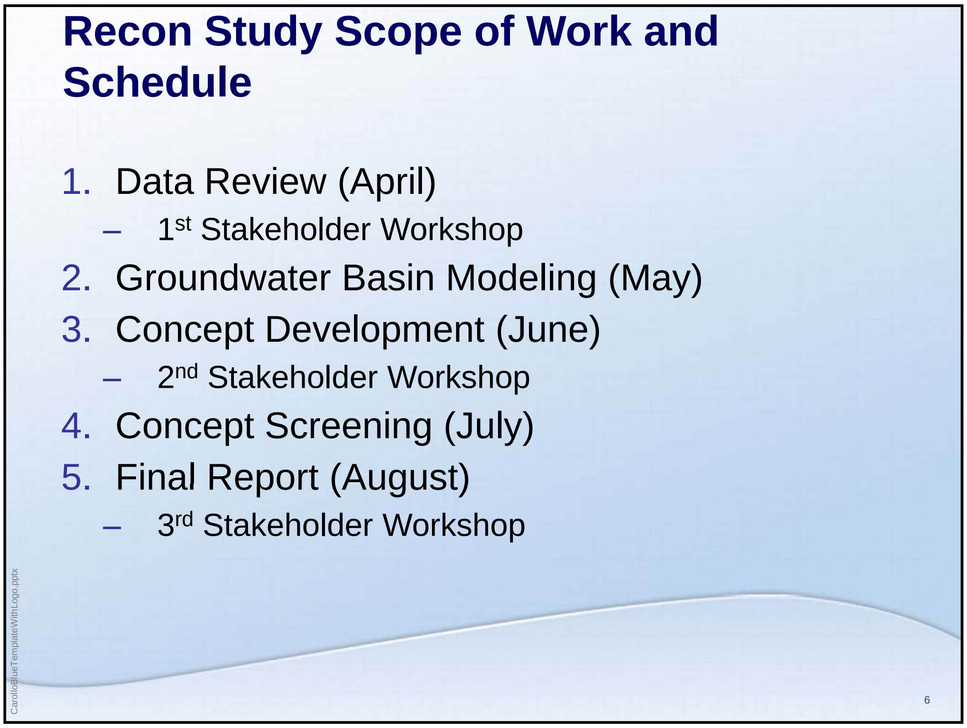
**Existing Conditions**

|  | DWR Report Year |  |  |
|---|---|---|---|
|  | **2009** | **2011** | **2013** |
| Average Water Year | 61% | 61% | 62% |
| Single Dry Year | 13% | 9% | 12% |
| Multi-Dry Year | 34% | 35% | 31% |

**Future Conditions (Year 2033+)**

|  | DWR Report Year |  |  |
|---|---|---|---|
|  | **2009** | **2011** | **2013** |
| Average Water Year | 60% | 60% | 58% |
| Single Dry Year | 10% | 11% | 11% |
| Multi-Dry Year | 35% | 34% | 31% |

Notes:
From Draft 2013 SWP Reliability Report (DWR)
CLWA Table A Contract = 95,200 AF
3-4% change = 2800 to 3800 AFY



## Recon Study Scope of Work and Schedule

1. Data Review (April)
   - 1st Stakeholder Workshop
2. Groundwater Basin Modeling (May)
3. Concept Development (June)
   - 2nd Stakeholder Workshop
4. Concept Screening (July)
5. Final Report (August)
   - 3rd Stakeholder Workshop

## Local Supply Concepts for Development

1. Recycled Water
    a. Indirect Potable Reuse (IPR)
    b. Direct Potable Reuse (DPR)
2. Stormwater Conservation
3. Groundwater Concepts
    a. Operational adjustment/redistribution
    b. Groundwater treatment
4. Uniform water supply reliability

One to three concepts selected for further development and refinement

## 1. RECYCLED WATER CONCEPTS

## Recycled Water Information Sources

- Draft Recycled Water Master Plan (2002)
- Recycled Water Optimization Study (Oct. 2013)
- Santa Clarita Valley Sanitation District Chloride Compliance Facilities Plan and EIR

## Existing Recycled Water

- Current Sources
  - Valencia WRP (2011 avg. 15 mgd)
  - Saugus WRP (2011 avg. 5 mgd)
- 1,700 afy currently under contract from SCVSD
- 2011 Usage: 337 afy
- 2.0 mgd from Valencia earmarked for chloride reduction

## Future Recycled Water Supplies Available

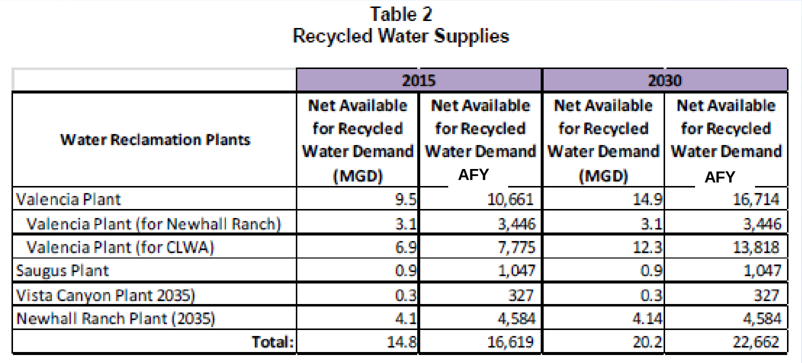


Table 2
Recycled Water Supplies

| Water Reclamation Plants | 2015 Net Available for Recycled Water Demand (MGD) | 2015 Net Available for Recycled Water Demand AFY | 2030 Net Available for Recycled Water Demand (MGD) | 2030 Net Available for Recycled Water Demand AFY |
|---|---|---|---|---|
| Valencia Plant | 9.5 | 10,661 | 14.9 | 16,714 |
| Valencia Plant (for Newhall Ranch) | 3.1 | 3,446 | 3.1 | 3,446 |
| Valencia Plant (for CLWA) | 6.9 | 7,775 | 12.3 | 13,818 |
| Saugus Plant | 0.9 | 1,047 | 0.9 | 1,047 |
| Vista Canyon Plant 2035) | 0.3 | 327 | 0.3 | 327 |
| Newhall Ranch Plant (2035) | 4.1 | 4,584 | 4.14 | 4,584 |
| Total: | 14.8 | 16,619 | 20.2 | 22,662 |

Assumes no seasonal storage

## Potential Recycled Water Concepts

- Indirect potable reuse via recharge
  - Spreading basins (using tertiary or AWT)
  - Injection wells (requires AWT)
- Direct potable reuse
  - Not yet approved; DPH feasibility report due in 2016
  - Concepts:
    - AWT with delivery to a WTP
    - AWT with direct delivery to potable system (using engineered storage/monitoring)

# 2. GROUNDWATER CONCEPTS

## Topics

Groundwater sources
Hydrogeology overview
Current basin pumping plan
    Design
    Sustainability
Prior recharge ideas
Groundwater treatment

## Topics

Groundwater sources

Hydrogeology overview

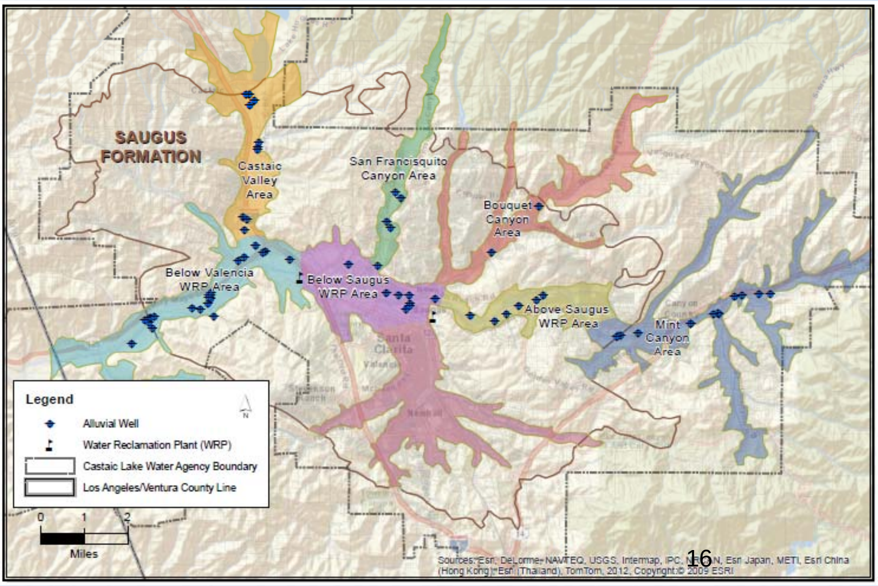
Current basin pumping plan

- Design
- Sustainability

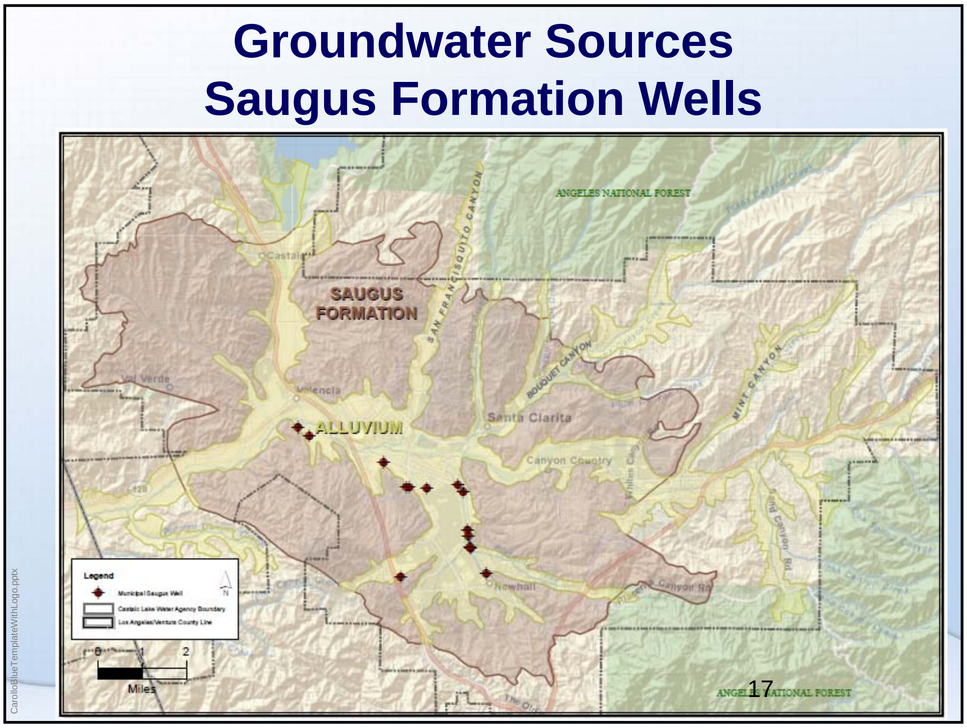
Prior recharge ideas

Groundwater treatment

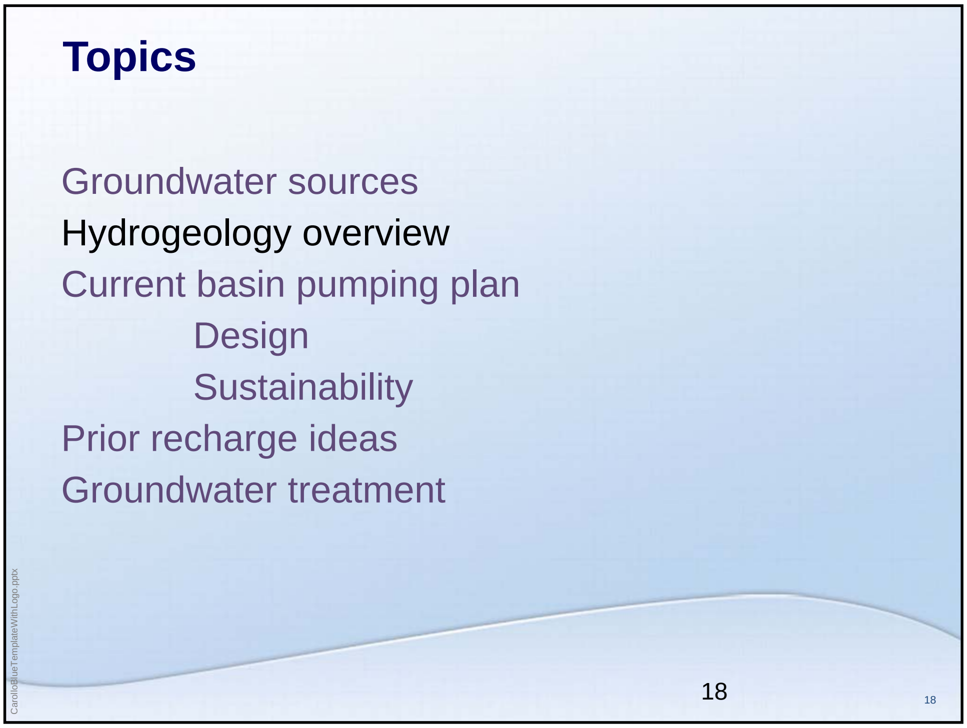
## Groundwater Sources
## Alluvial Aquifer – Subareas and Wells



Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, IPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2012, Copyright© 2009 ESRI



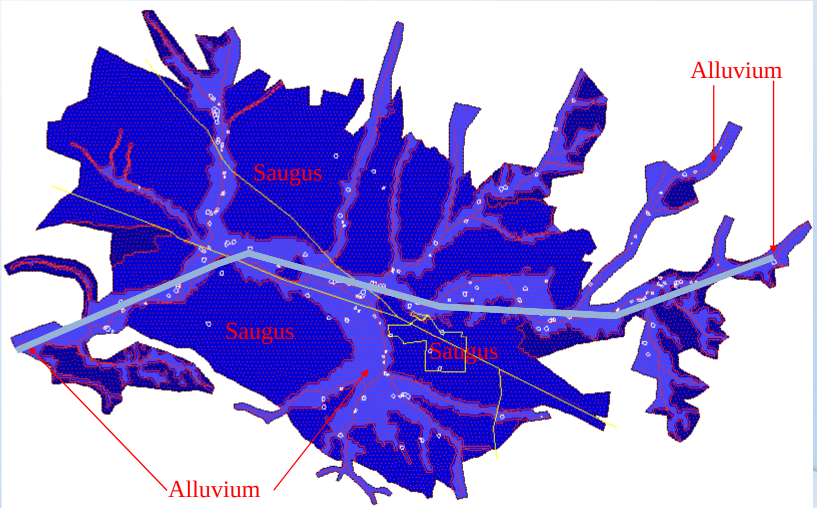
## Groundwater Sources
## Saugus Formation Wells



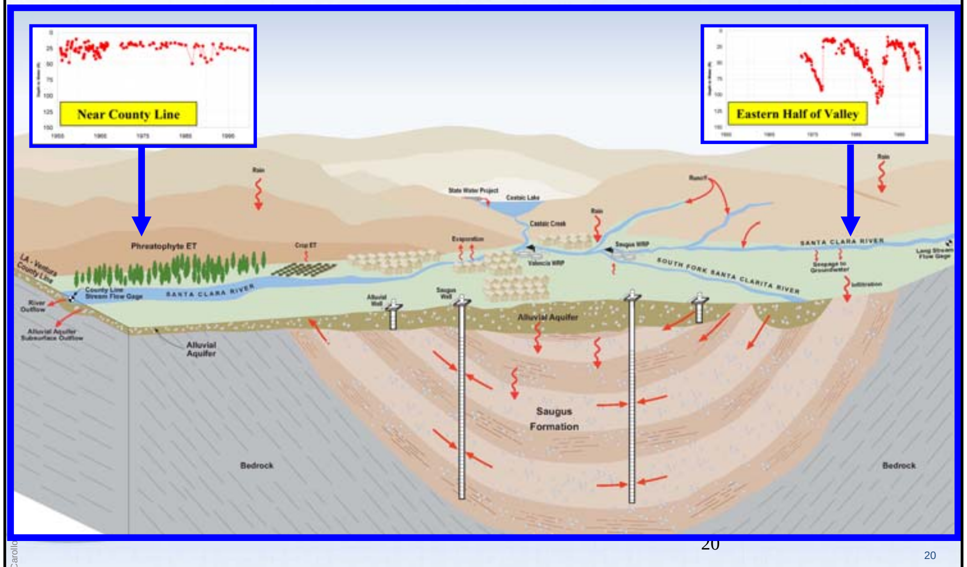
## Topics

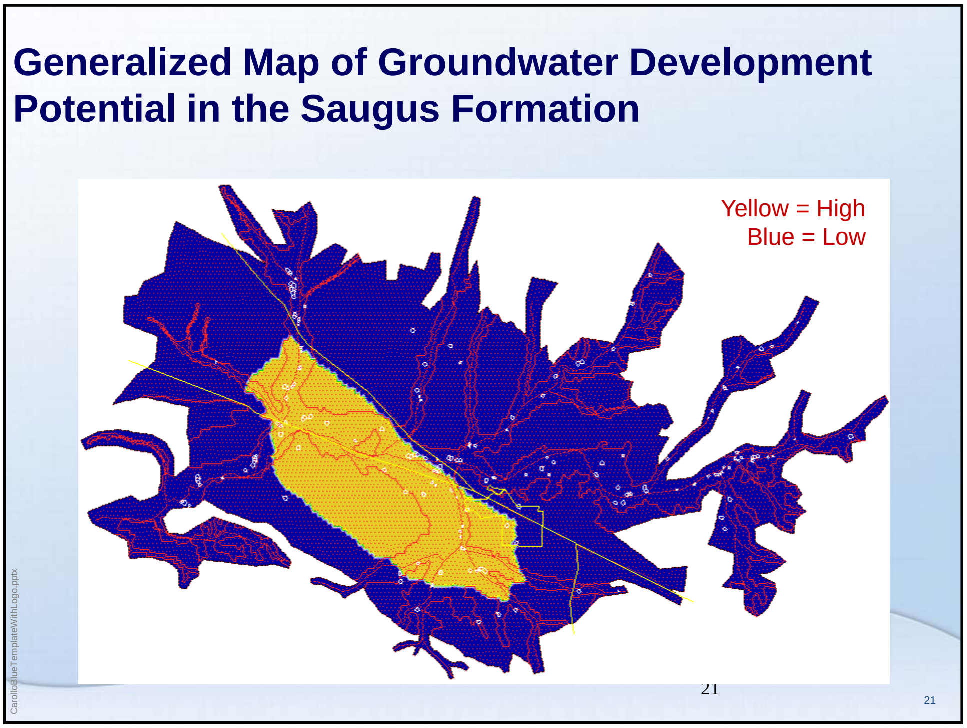
Groundwater sources
Hydrogeology overview
Current basin pumping plan
    Design
    Sustainability
Prior recharge ideas
Groundwater treatment

## Modeled Hydrogeology and Cross Section Along Santa Clara River



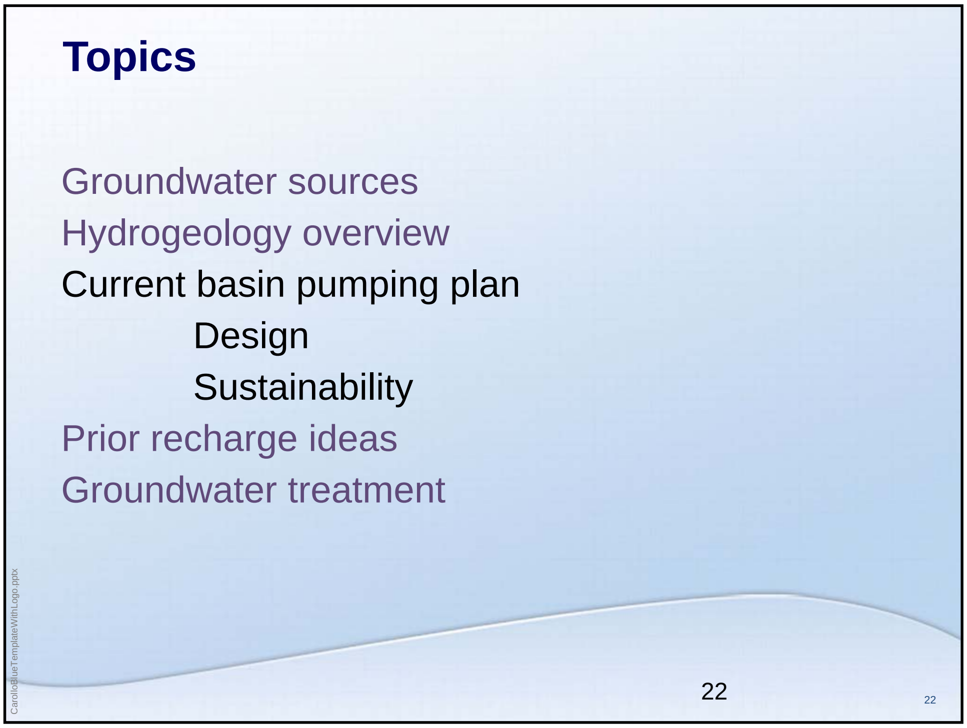
## Schematic Cross Section Showing Basin Hydrologic System





## Generalized Map of Groundwater Development Potential in the Saugus Formation

Yellow = High
Blue = Low



## Topics

Groundwater sources
Hydrogeology overview
Current basin pumping plan
    Design
    Sustainability
Prior recharge ideas
Groundwater treatment

## Current Basin Pumping Plan

| HYDROLOGY | ALLUVIUM | SAUGUS | TOTAL |
|---|---|---|---|
| Normal, wet | 30,000 – 40,000<br>(38,600) | 7,500 – 15,000<br>(12,485) | 37,500 – 55,000<br>(51,085) |
| Drought year 1 | 30,000 – 35,000<br>(36,500) | 7,500 – 25,000<br>(19,125) | 37,500 – 60,000<br>(55,625) |
| Drought year 2 | 30,000 – 35,000<br>(34,850) | 21,000 – 25,000<br>(25,227) | 51,000 – 60,000<br>(60,077) |
| Drought year 3 | 30,000 – 35,000<br>(34,850) | 21,000 – 35,000<br>(34,977) | 51,000 – 70,000<br>(69,827) |

Local Hydrology → Alluvial Pumping

SWP Hydrology → Saugus Pumping

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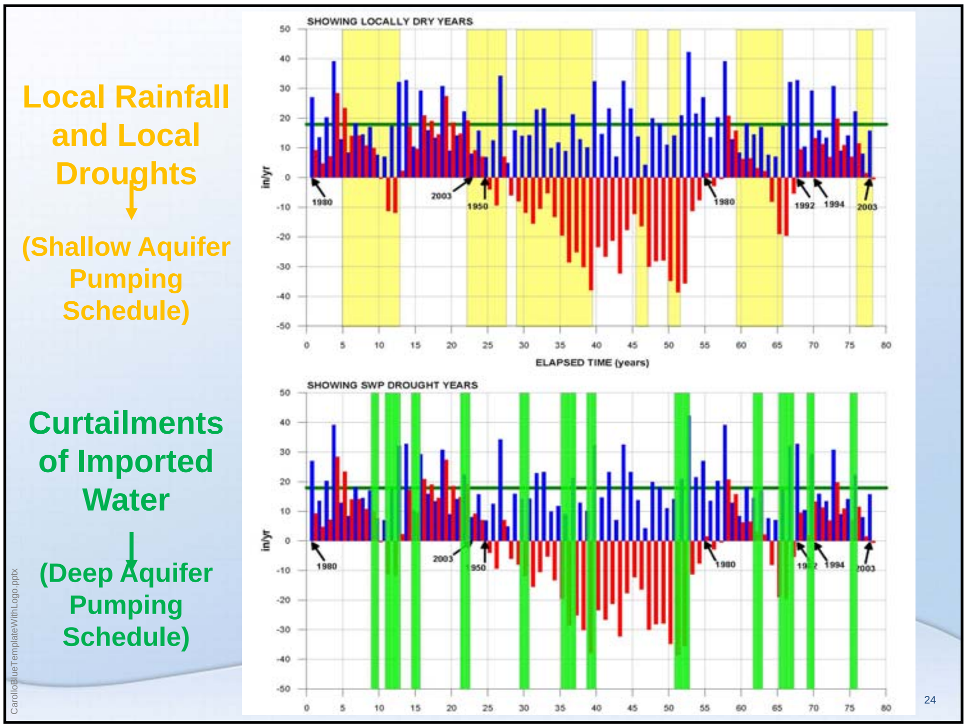

Local Rainfall and Local Droughts

↓

(Shallow Aquifer Pumping Schedule)

Curtailments of Imported Water

↓

(Deep Aquifer Pumping Schedule)

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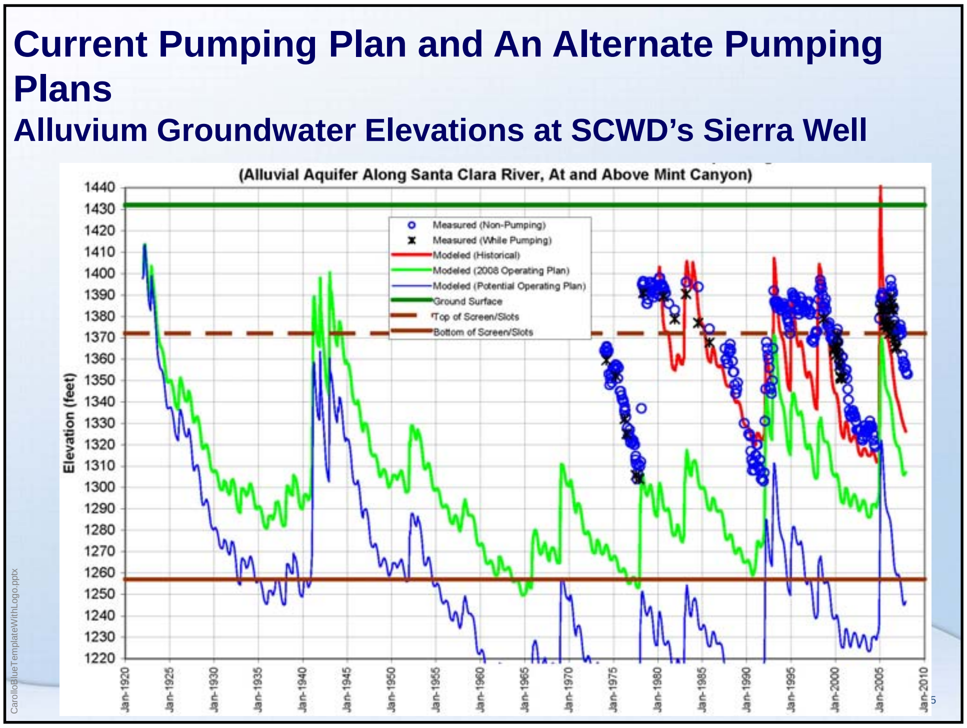
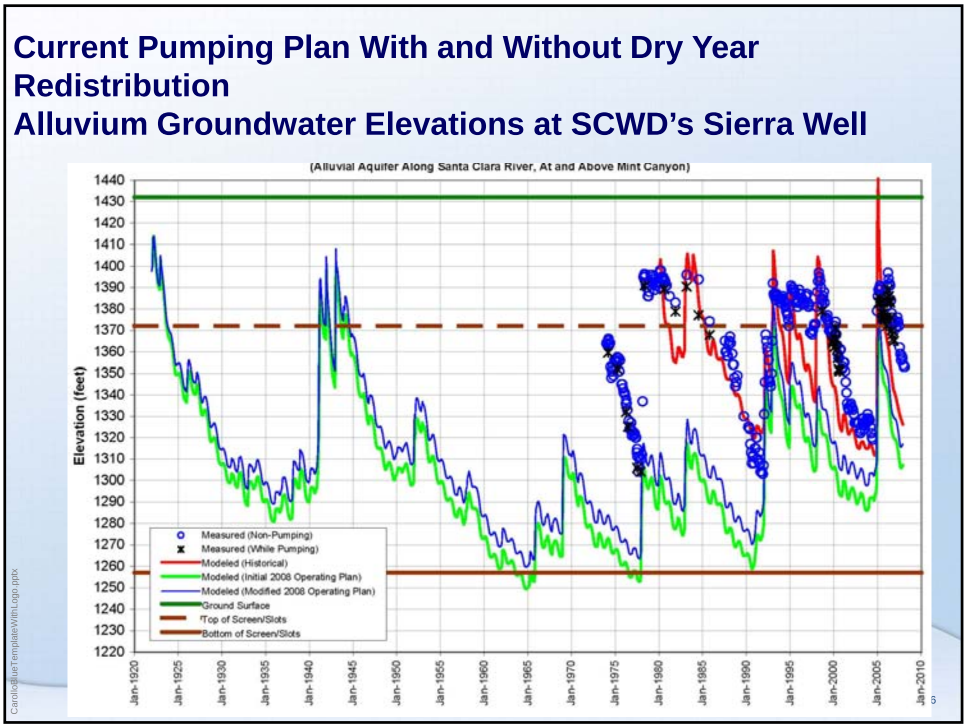


## Current Pumping Plan and An Alternate Pumping Plans

### Alluvium Groundwater Elevations at SCWD's Sierra Well



## Current Pumping Plan With and Without Dry Year Redistribution

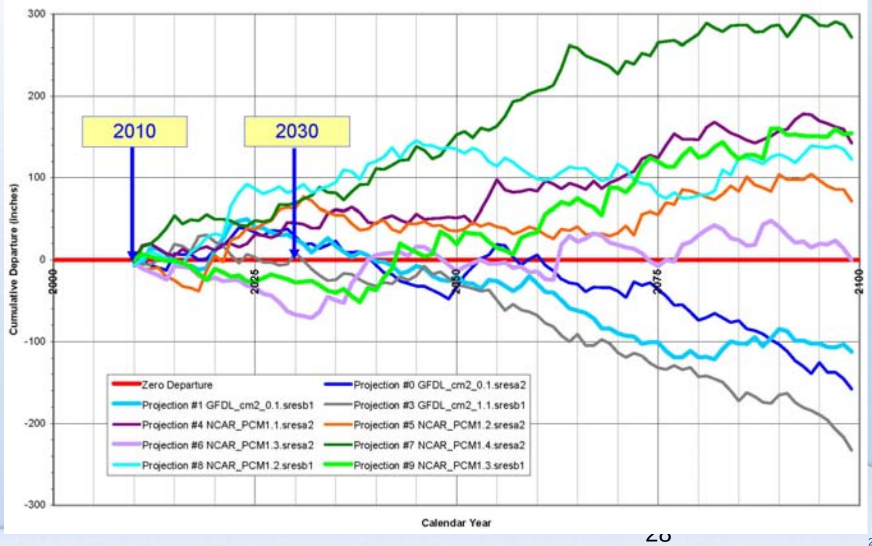
### Alluvium Groundwater Elevations at SCWD's Sierra Well

## Sustainability of Pumping Plan: Climate Change Considerations

**Rainfall Projections**

## Rainfall Estimates from Climate Models

### (Future Projections of Cum. Departure)



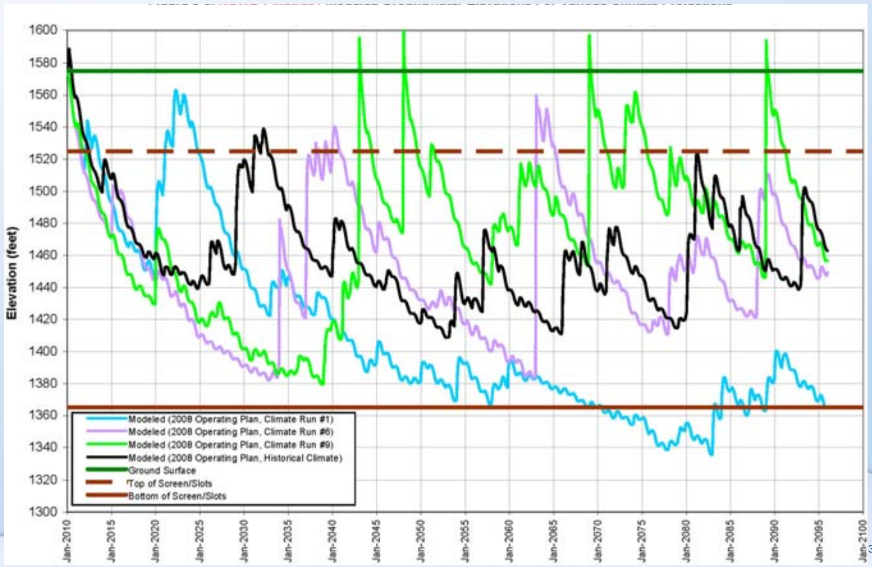
## Rainfall in Selected Climate Models

### (Cum. Departure 2010-2095)

## Sustainability of Pumping Plan: Climate Change Considerations

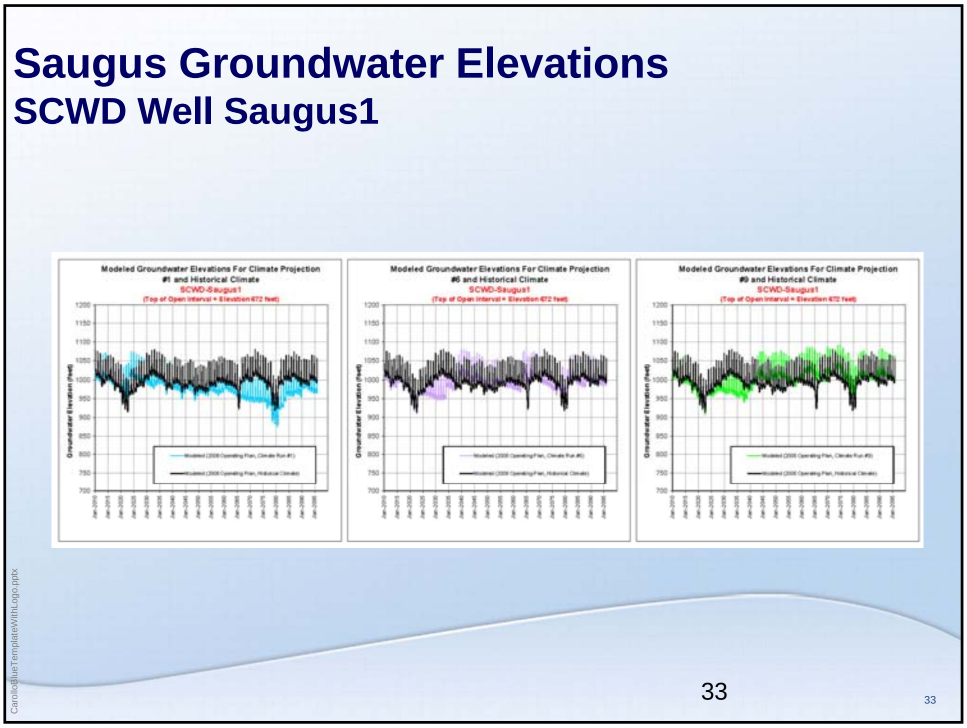
<u>Effects at Alluvial Wells</u>

## Alluvium Groundwater Elevations Above Mint Canyon (At NCWD Well Pinetree1)



## Sustainability of Pumping Plan: Climate Change Considerations

### Effects at Saugus Wells



## Saugus Groundwater Elevations

### SCWD Well Saugus1

## Sustainability Conclusions in 2009

1. **The basin pumping plan is sustainable**

2. **Operational difficulties in Eastern Alluvium during dry periods**
   - Redistribute pumping to achieve the Operating Plan
   - Lower end of Operating Plan rates if no redistribution occurs

3. **Climate change impacts are possible**
   - Wide range of possibilities
     No unique climate or sustainability outcomes
   - Continued long-term sustainability if average to wetter
   - Loss of long-term sustainability if drier
   - Continued sustainability through UWMP horizon, with some local short-term achievability issues

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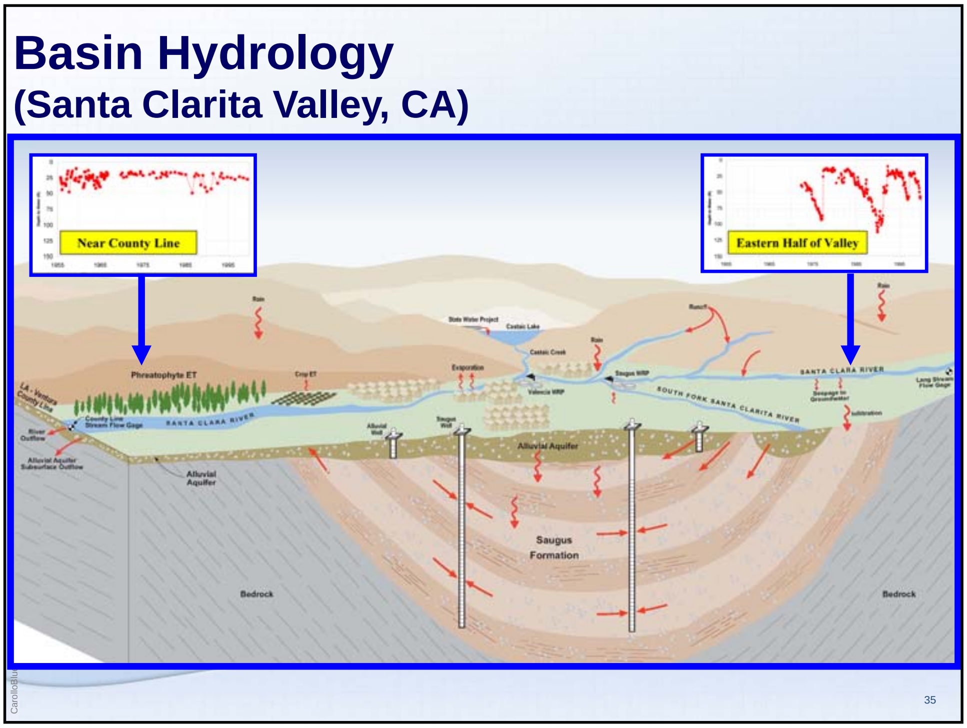
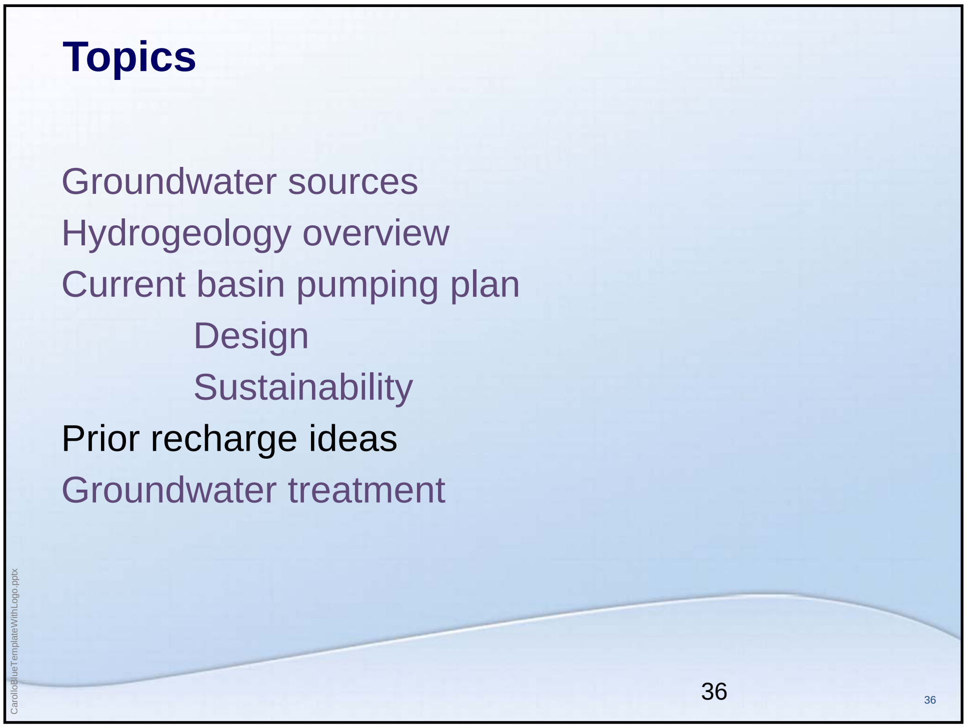


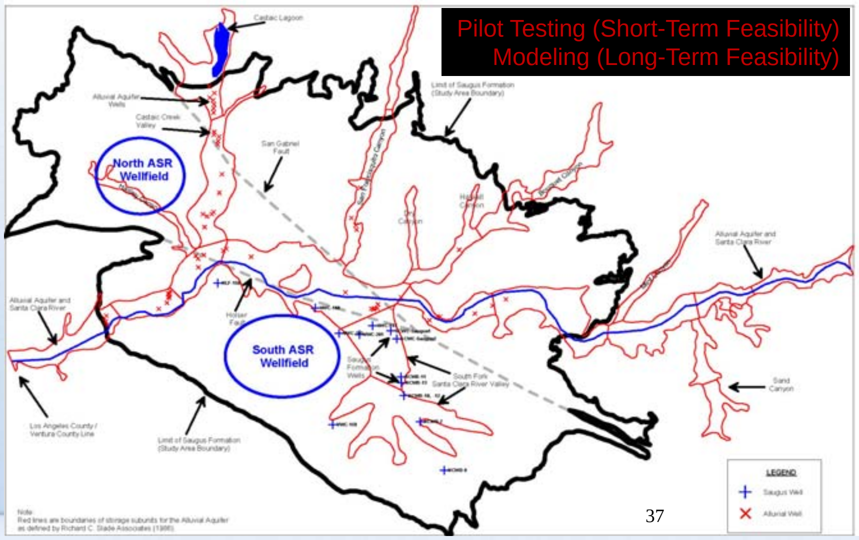
# Basin Hydrology
## (Santa Clarita Valley, CA)



# Topics

Groundwater sources
Hydrogeology overview
Current basin pumping plan
    Design
    Sustainability
Prior recharge ideas
Groundwater treatment

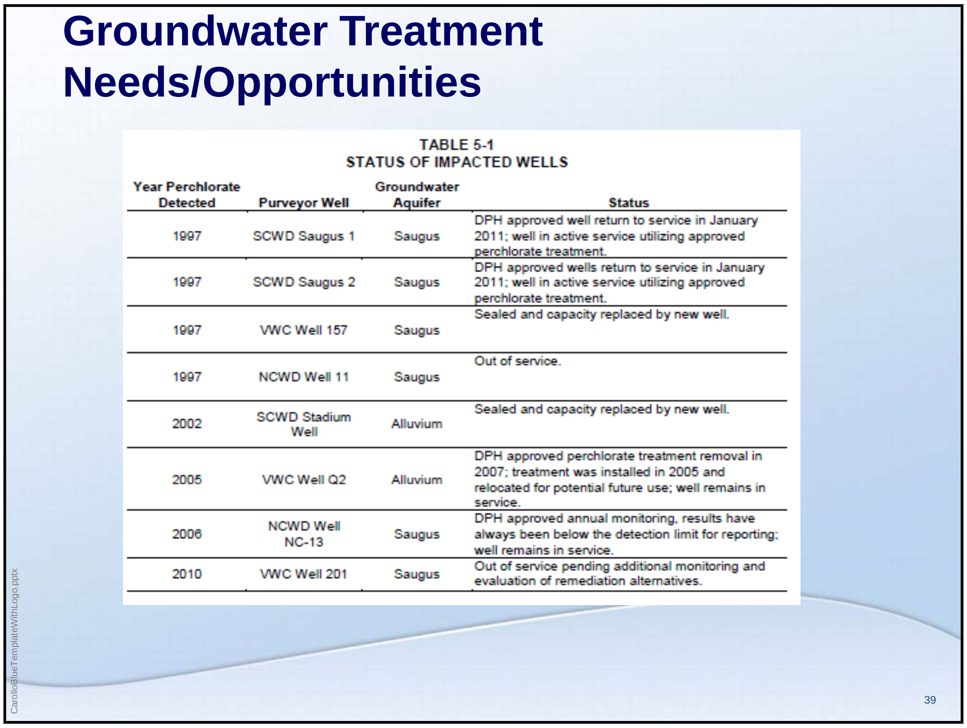
## Prior Study of Aquifer Storage and Recovery (ASR) in the Saugus Formation



Pilot Testing (Short-Term Feasibility)
Modeling (Long-Term Feasibility)

## Topics

Groundwater sources
Hydrogeology overview
Current basin pumping plan
  Design
  Sustainability
Prior recharge ideas
Groundwater treatment



## Groundwater Treatment Needs/Opportunities

TABLE 5-1
STATUS OF IMPACTED WELLS

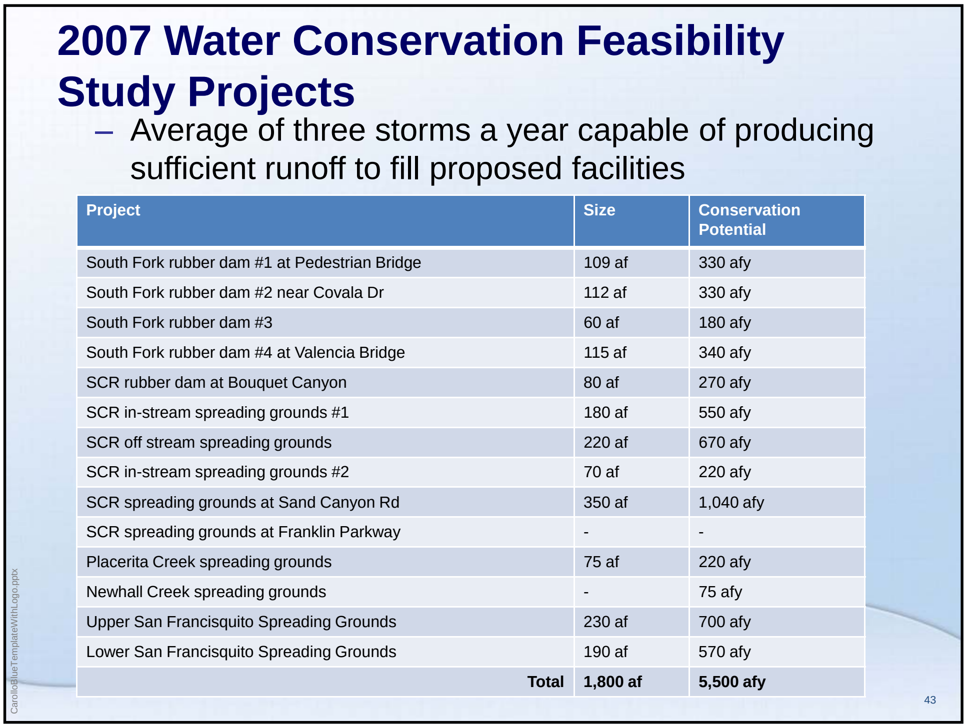
| Year Perchlorate Detected | Purveyor Well | Groundwater Aquifer | Status |
|---|---|---|---|
| 1997 | SCWD Saugus 1 | Saugus | DPH approved well return to service in January 2011; well in active service utilizing approved perchlorate treatment. |
| 1997 | SCWD Saugus 2 | Saugus | DPH approved wells return to service in January 2011; well in active service utilizing approved perchlorate treatment. |
| 1997 | VWC Well 157 | Saugus | Sealed and capacity replaced by new well. |
| 1997 | NCWD Well 11 | Saugus | Out of service. |
| 2002 | SCWD Stadium Well | Alluvium | Sealed and capacity replaced by new well. |
| 2005 | VWC Well Q2 | Alluvium | DPH approved perchlorate treatment removal in 2007; treatment was installed in 2005 and relocated for potential future use; well remains in service. |
| 2006 | NCWD Well NC-13 | Saugus | DPH approved annual monitoring, results have always been below the detection limit for reporting; well remains in service. |
| 2010 | VWC Well 201 | Saugus | Out of service pending additional monitoring and evaluation of remediation alternatives. |

## Potential Saugus Replacement Well Sites

# 3. STORMWATER CONSERVATION CONCEPTS

## Potential Stormwater Sources

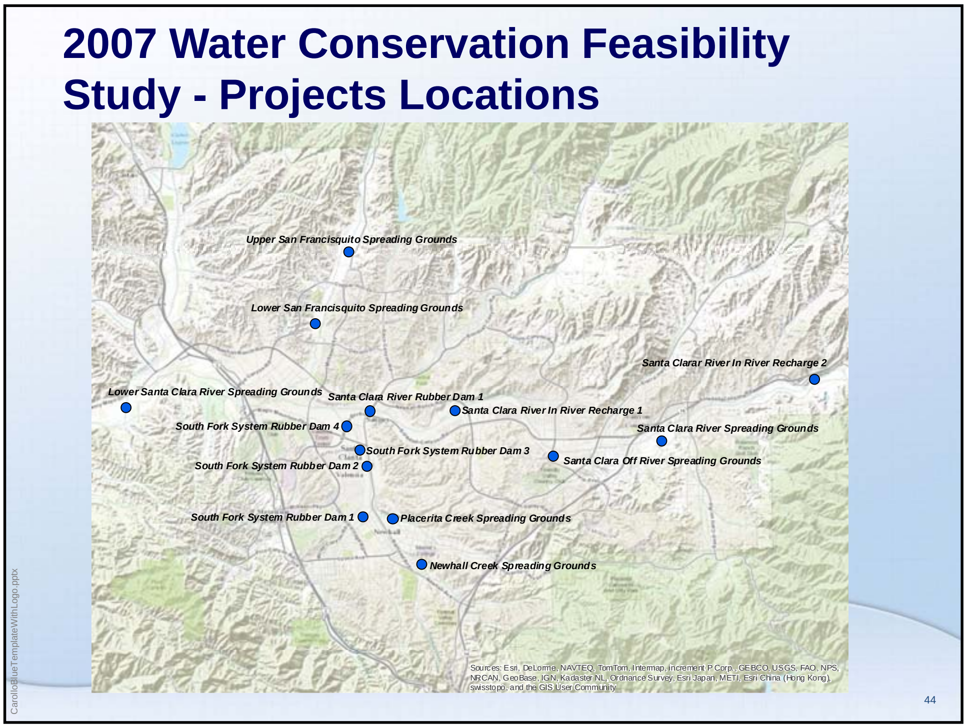
- Santa Clara River Watershed conservation projects
  - 14 projects totaling 5,500 afy
  - Range from 75 to 1,000 afy
- MS-4 compliance projects (via EWMP process)
  - Expected recharge volume?



## 2007 Water Conservation Feasibility Study Projects

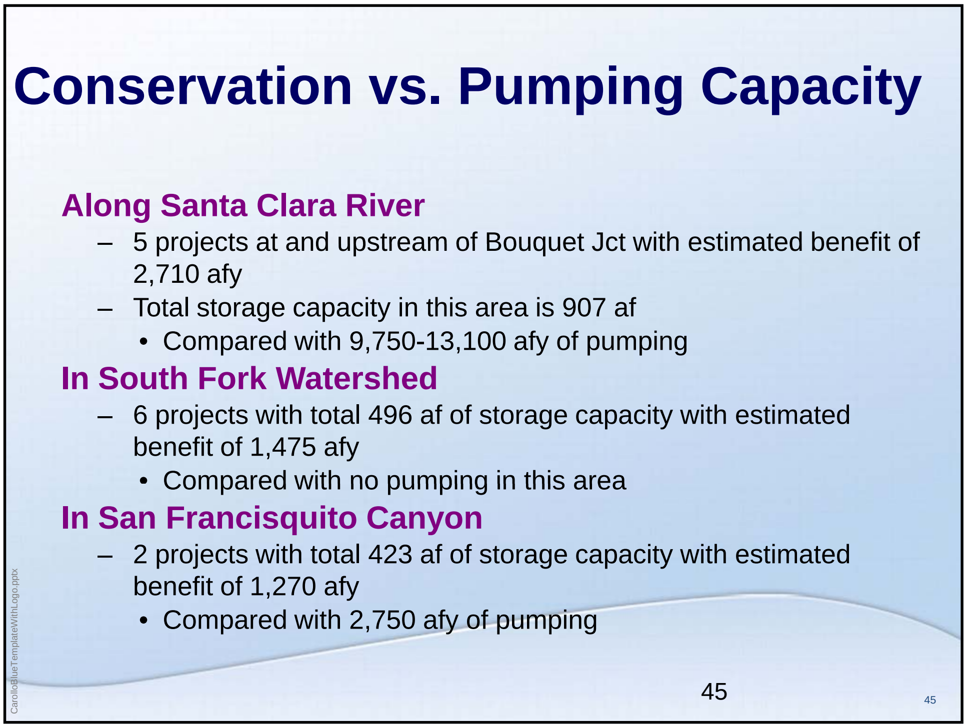
– Average of three storms a year capable of producing sufficient runoff to fill proposed facilities

| Project | Size | Conservation Potential |
|---|---|---|
| South Fork rubber dam #1 at Pedestrian Bridge | 109 af | 330 afy |
| South Fork rubber dam #2 near Covala Dr | 112 af | 330 afy |
| South Fork rubber dam #3 | 60 af | 180 afy |
| South Fork rubber dam #4 at Valencia Bridge | 115 af | 340 afy |
| SCR rubber dam at Bouquet Canyon | 80 af | 270 afy |
| SCR in-stream spreading grounds #1 | 180 af | 550 afy |
| SCR off stream spreading grounds | 220 af | 670 afy |
| SCR in-stream spreading grounds #2 | 70 af | 220 afy |
| SCR spreading grounds at Sand Canyon Rd | 350 af | 1,040 afy |
| SCR spreading grounds at Franklin Parkway | - | - |
| Placerita Creek spreading grounds | 75 af | 220 afy |
| Newhall Creek spreading grounds | - | 75 afy |
| Upper San Francisquito Spreading Grounds | 230 af | 700 afy |
| Lower San Francisquito Spreading Grounds | 190 af | 570 afy |
| **Total** | **1,800 af** | **5,500 afy** |



## 2007 Water Conservation Feasibility Study - Projects Locations

Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community



## Conservation vs. Pumping Capacity

**Along Santa Clara River**

- 5 projects at and upstream of Bouquet Jct with estimated benefit of 2,710 afy
- Total storage capacity in this area is 907 af
  - Compared with 9,750-13,100 afy of pumping

**In South Fork Watershed**

- 6 projects with total 496 af of storage capacity with estimated benefit of 1,475 afy
  - Compared with no pumping in this area

**In San Francisquito Canyon**

- 2 projects with total 423 af of storage capacity with estimated benefit of 1,270 afy
  - Compared with 2,750 afy of pumping

## 4. UNIFORM SUPPLY RELIABILITY

## Uniform Supply Reliability?

**Objective**

- Achieve uniform supply reliability through CLWA service area

**Questions**

- Where is reliability less?
- What are options for increasing?

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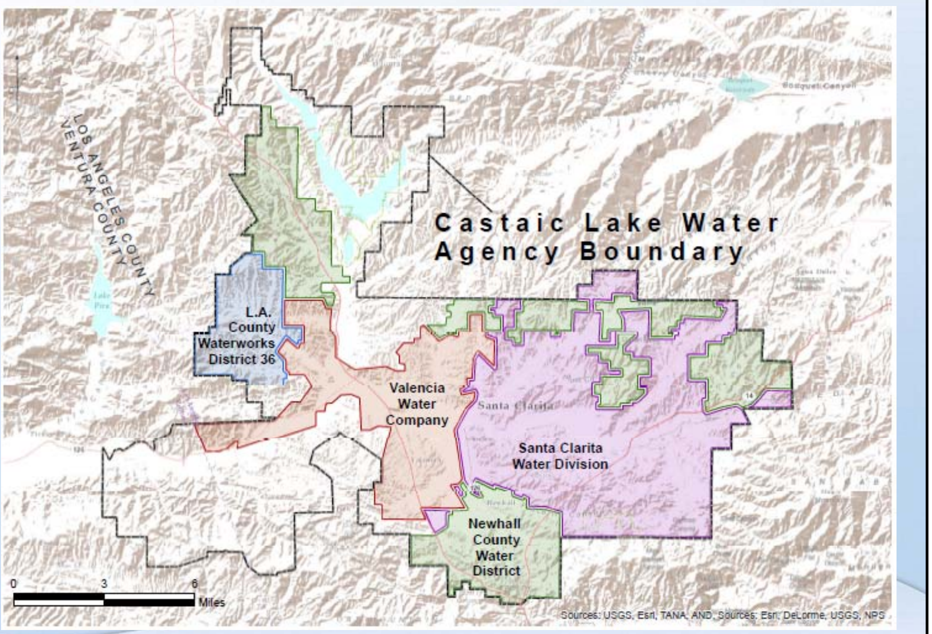

Sources: USGS, Esri, TANA, AND, Sources: Esri, DeLorme, USGS, NPS

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## Next Steps

1. Data Review (April)
    - 1st Stakeholder Workshop
2. Groundwater Basin Modeling (May)
3. Concept Development (June)
    - 2nd Stakeholder Workshop
4. Concept Screening (July)
5. Final Report (August)
    - 3rd Stakeholder Workshop

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## APPENDIX B-2

# Workshop 2 Materials

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# CLWA Water Resources
# Reconnaissance Study

## Model Testing of Recharge and Pumping Concepts

*Using the Purveyors Numerical Groundwater Model*

*Prepared for*

Task 2 Workshop

*Prepared by*

John Porcello - GSI Water Solutions

*July 8, 2014*

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# Model Testing of
# Recharge and Pumping Concepts

## Study Objectives

1. How much can groundwater yield be increased through the targeted use of recharge programs?
   - **Alluvial Aquifer:** Spreading basins east of Saugus WRP
     - Primary source: recycled water
     - Secondary sources: Stormwater capture, SWP
   - **Saugus Formation:** Aquifer storage and recovery (ASR)
     - Primary source: SWP
2. How feasible is this?
   - Are new wells needed?
   - Would we have flooding or artesian conditions?

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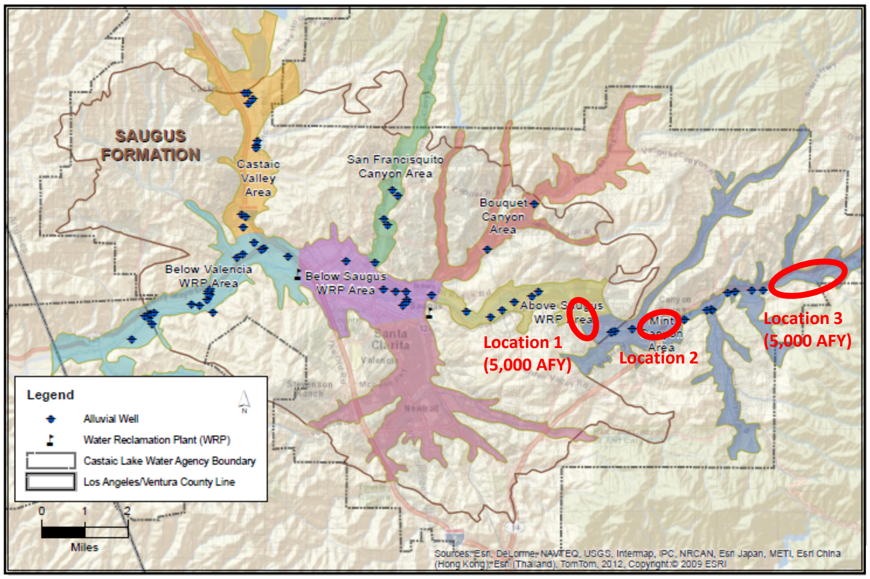
# Alluvial Aquifer
## Wells and Spreading Basin Sites



Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, IPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2012, Copyright © 2009 ESRI

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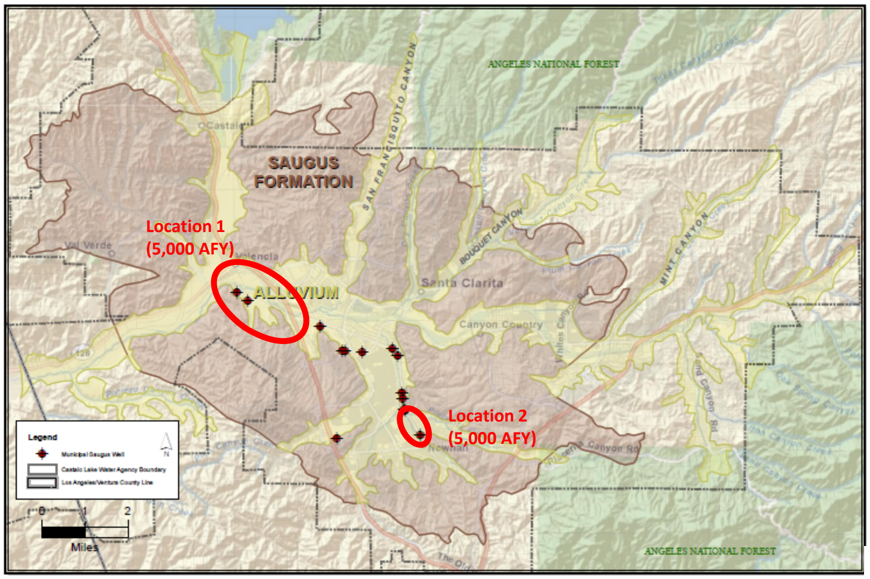
# Saugus Formation
## ASR Locations and Existing Wells



## Model Testing of
## Recharge and Pumping Concepts

# Modeling Approach

1. Simulate the current Groundwater Operating Plan
   - Alluvial Aquifer:
     - Locally dry years: 30,000 to 35,000 AFY
     - Other years: 35,000 to 40,000 AFY
   - Saugus Formation:
     - SWP curtailment years: Gradual ramp-up to 35,000 AFY
     - Other years: 7,500 to 15,000 AFY
   - Run the model for a 32-year period with monthly variations in rainfall, streamflow, irrigation, and pumping demands
     - 1980 through 2011 (time period for calibration to historical data)

*AFY = acre-feet per year*

---

## Model Testing of
## Recharge and Pumping Concepts

# Modeling Approach

2. Test possibilities in the Alluvial Aquifer
   a. Location 3: Spreading basins east of NCWD Pinetree wells
      - Area with most severe water level declines during droughts
   b. Location 1: Spreading basins just downstream of Mint Cyn
   c. Test 5,000 AFY in each area
      - Exception: Assume 2,500 AFY during local drought years
   d. Use current pumping, then add 70% of recharged amount
   e. Run model several times to test what might happen under a range of potential aquifer conditions (mainly Location 3)
      - Thickness (depth to underlying bedrock), and permeability

# Model Testing of Recharge and Pumping Concepts

## Modeling Approach

3. Test possibilities in the Saugus Formation
    a. Valencia Water Company service area
    b. Newhall County Water District
    c. Test 5,000 AFY injection in each area, with 90% recovery
        - Recovery occurs only during years of SWP curtailments
        - No injection during SWP curtailments; recover during all 12 months
        - Other years: no recovery, just inject during 8 months of the year
    d. Run model several times to test what might happen under a range of potential well depths
        - 1,000 to 1,200 feet (2 to 3 model layers)
        - 2,000 feet (4 model layers)

# Model Testing of Recharge and Pumping Concepts

## Modeling Runs and Yields

| Scenario | Artificial Recharge (AFY) | Normal-Year Groundwater Pumping Volume (AFY) | Dry-Year Groundwater Pumping Volume (AFY) |
|---|---|---|---|
| **Current** | **0** | **53,600** | **70,000 to 75,000** |
| Alluvial Recharge (Low) | 5,000 | 57,150 | 78,550 |
| Alluvial Recharge (Mod) | 10,000 | 60,700 | 82,100 |
| Saugus Recharge (Low) | 5,000 | 53,600 | 78,100 |
| Saugus Recharge (Mod) | 10,000 | 53,600 | 82,600 |
| **Total Recharge (Mod)** | **20,000** | **60,700** | **91,100** |

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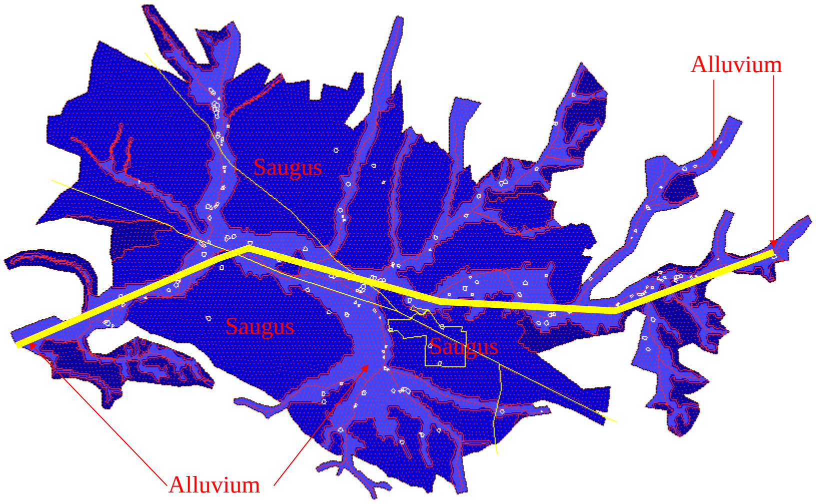
# Modeled Hydrogeology and Cross Section Along Santa Clara River



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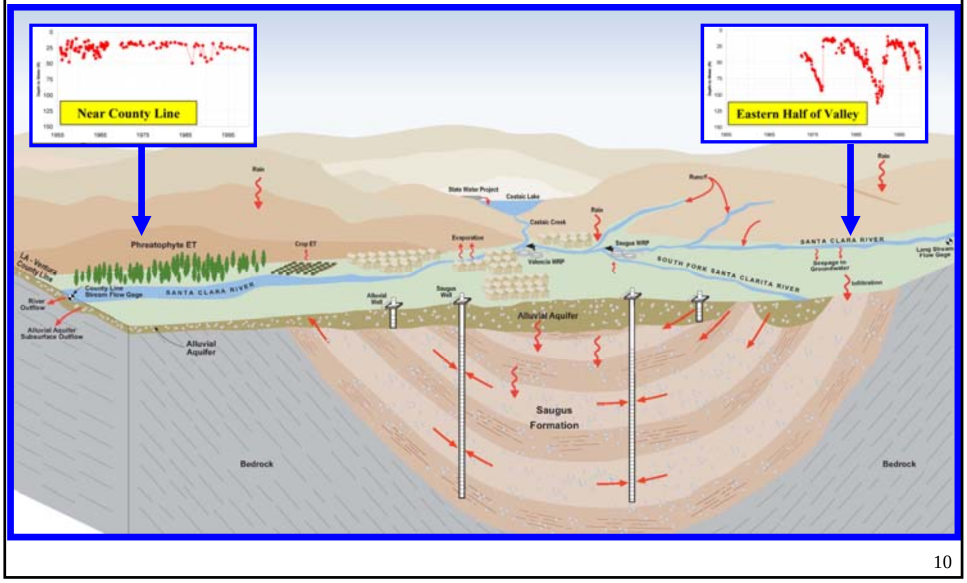
# Schematic Cross Section Showing Basin Hydrologic System



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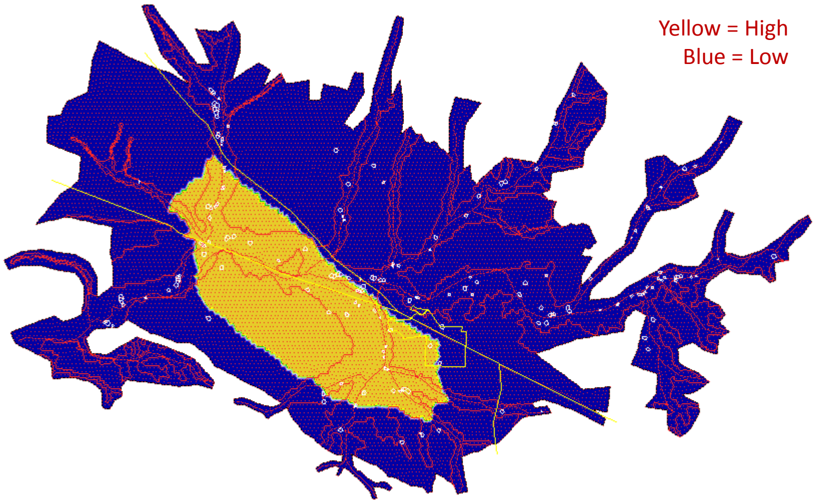
# Generalized Map of Groundwater Development Potential in the Saugus Formation



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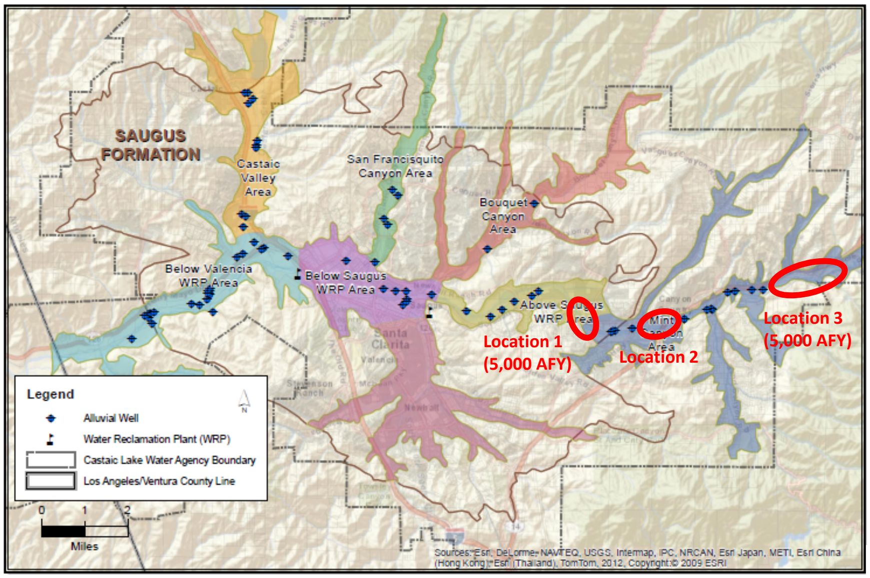
# Alluvial Aquifer
# Wells and Spreading Basin Sites



Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, IPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2012, Copyright:© 2009 ESRI

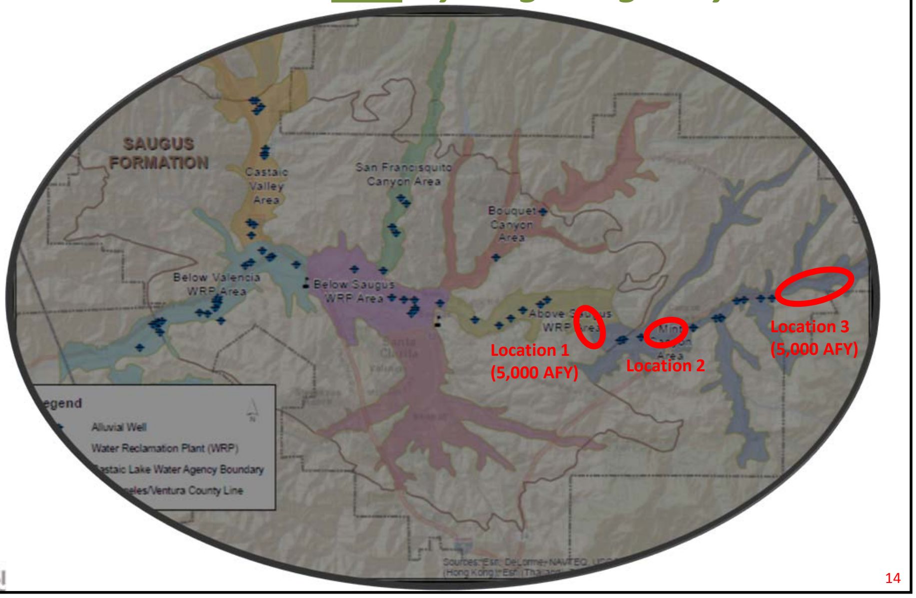
# Model Testing of Recharge and Pumping Concepts

## Conclusions – Alluvial Aquifer

1. Spreading basin recharge is an effective technique for increasing long-term groundwater production
2. But two design factors need more understanding and careful planning for a successful project
    - Not 100% certain that the aquifer can receive and transmit the target recharge volumes (particularly at Location 3)
        - Lack of wells in each location, lack of aquifer characterization
    - Land availability: need enough space to avoid excessive water-table mounding and flooding of nearby areas
        - Or percolate directly in the riverbed?

# Alluvial Aquifer

## *If Locations 1 and 3 ARE Hydrogeologically Feasible*



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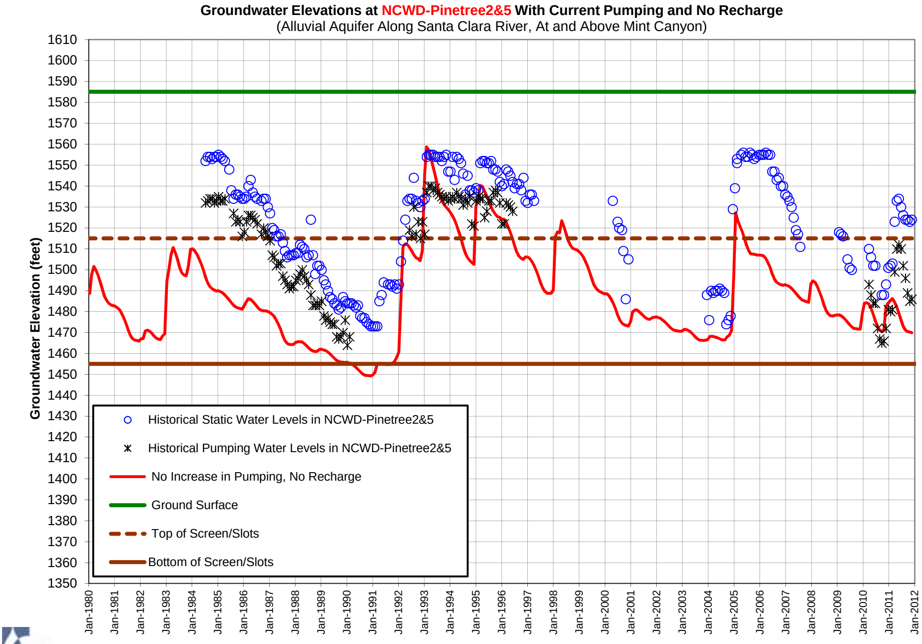
# Downgradient of Spreading Basin Location 3



**Groundwater Elevations at NCWD-Pinetree2&5 With Current Pumping and No Recharge**
(Alluvial Aquifer Along Santa Clara River, At and Above Mint Canyon)

15

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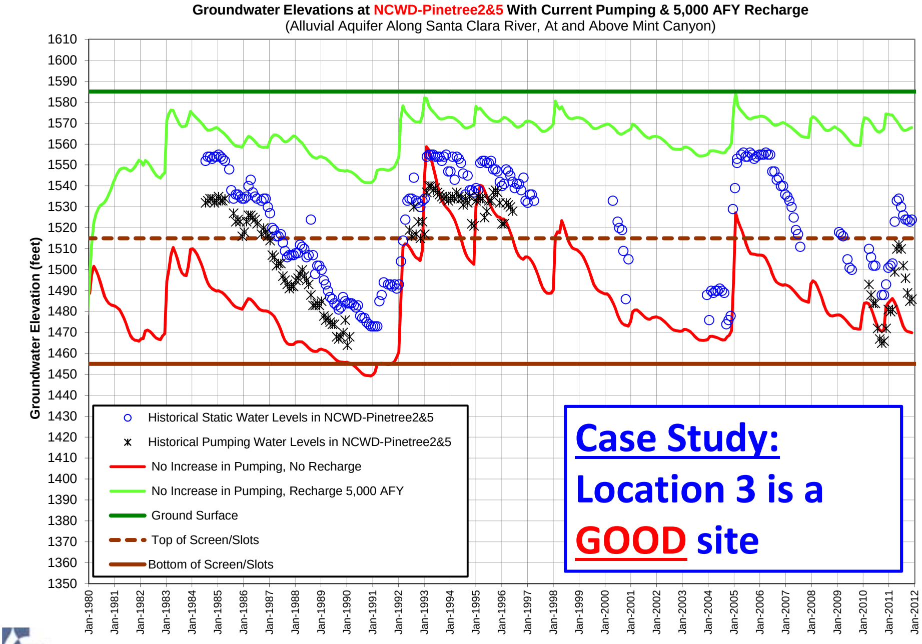
# Downgradient of Spreading Basin Location 3



**Groundwater Elevations at NCWD-Pinetree2&5 With Current Pumping & 5,000 AFY Recharge**
(Alluvial Aquifer Along Santa Clara River, At and Above Mint Canyon)

**Case Study:**
**Location 3 is a**
**GOOD site**

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# Downgradient of Spreading Basin Location 3

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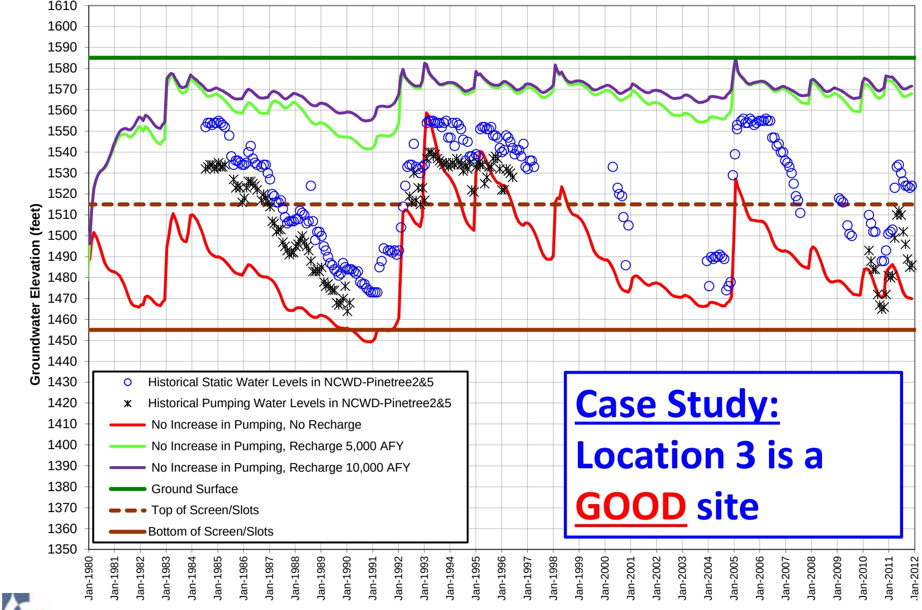
**Groundwater Elevations at NCWD-Pinetree2&5 For Various Pumping Programs & 10,000 AFY Recharge**
(Alluvial Aquifer Along Santa Clara River, At and Above Mint Canyon)



**Case Study: Location 3 is a GOOD site**

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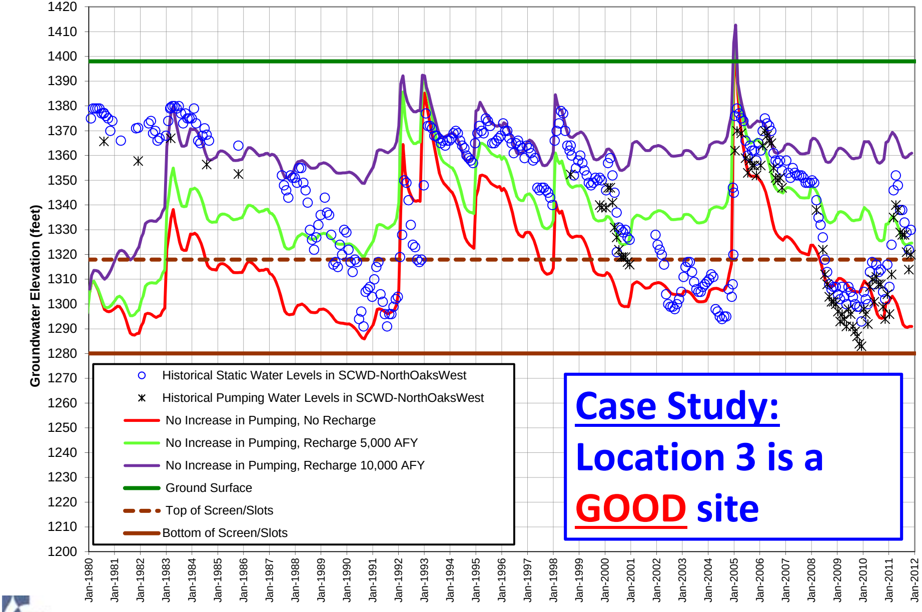
# Between Spreading Basin Locations 1 and 3

**Groundwater Elevations at SCWD-NorthOaksWest For Various Pumping Programs & 10,000 AFY Recharge**
(Alluvial Aquifer Along Santa Clara River, At and Above Mint Canyon)



**Case Study: Location 3 is a GOOD site**

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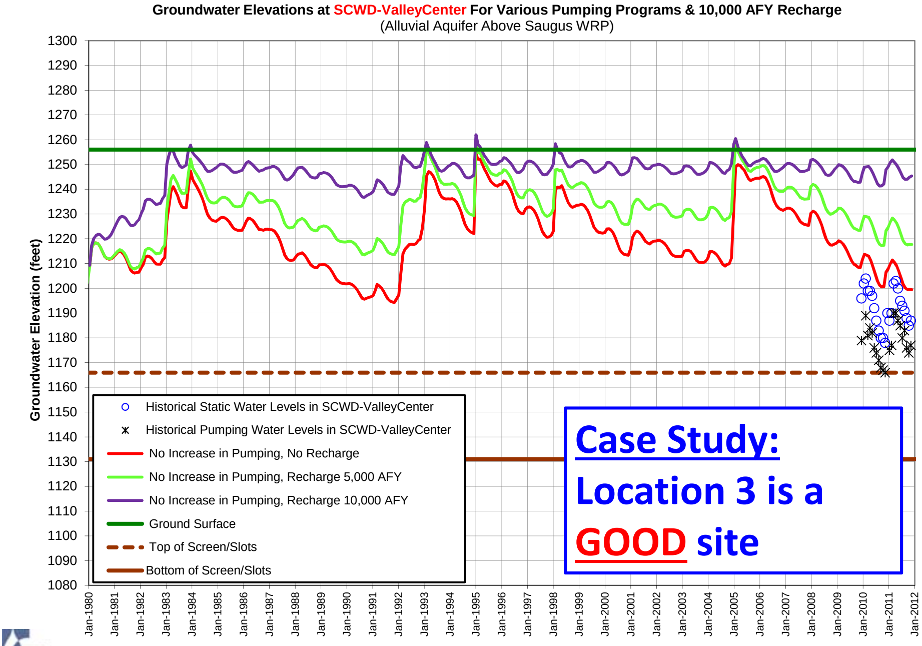
## Downgradient of Spreading Basin Locations 1 and 3



**Case Study:**
**Location 3 is a**
**GOOD site**

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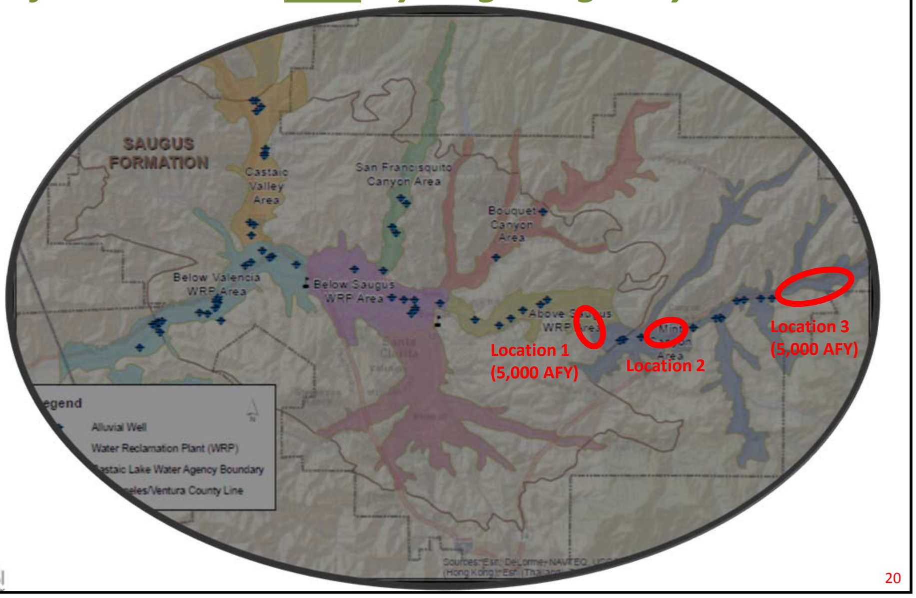
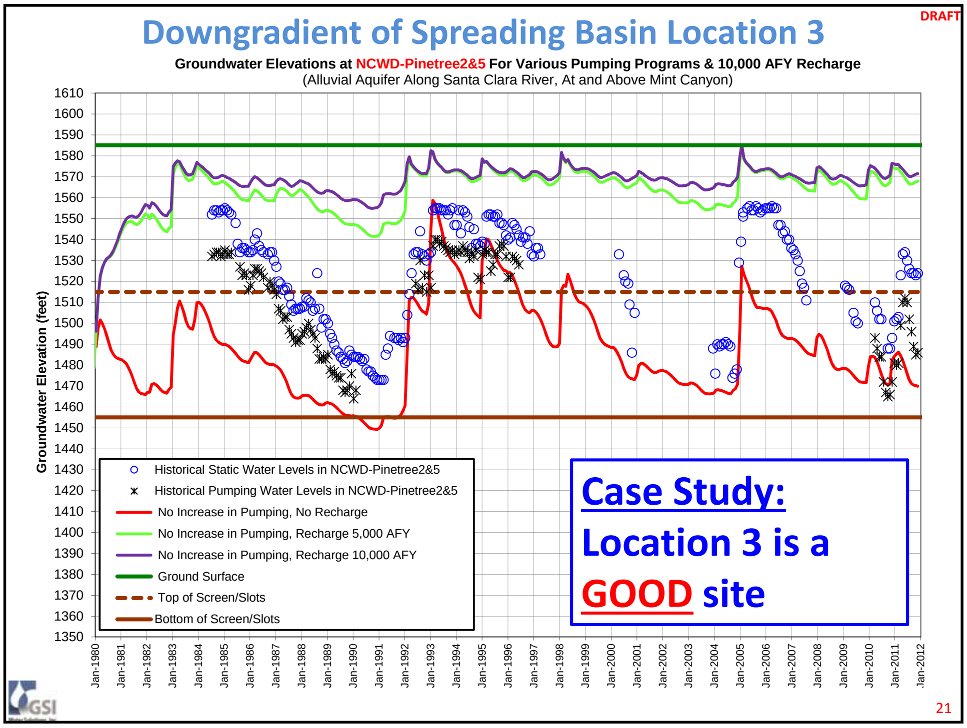
# Alluvial Aquifer

## *If Location 3 is NOT Hydrogeologically Feasible*

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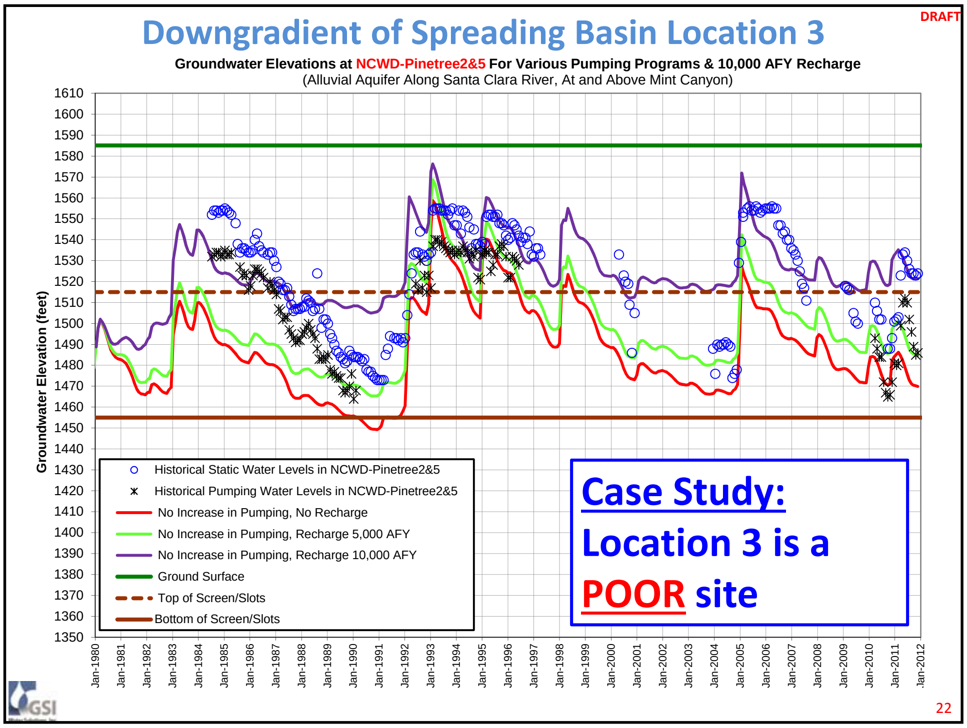
# Downgradient of Spreading Basin Location 3

**Case Study:**
**Location 3 is a**
**GOOD site**

21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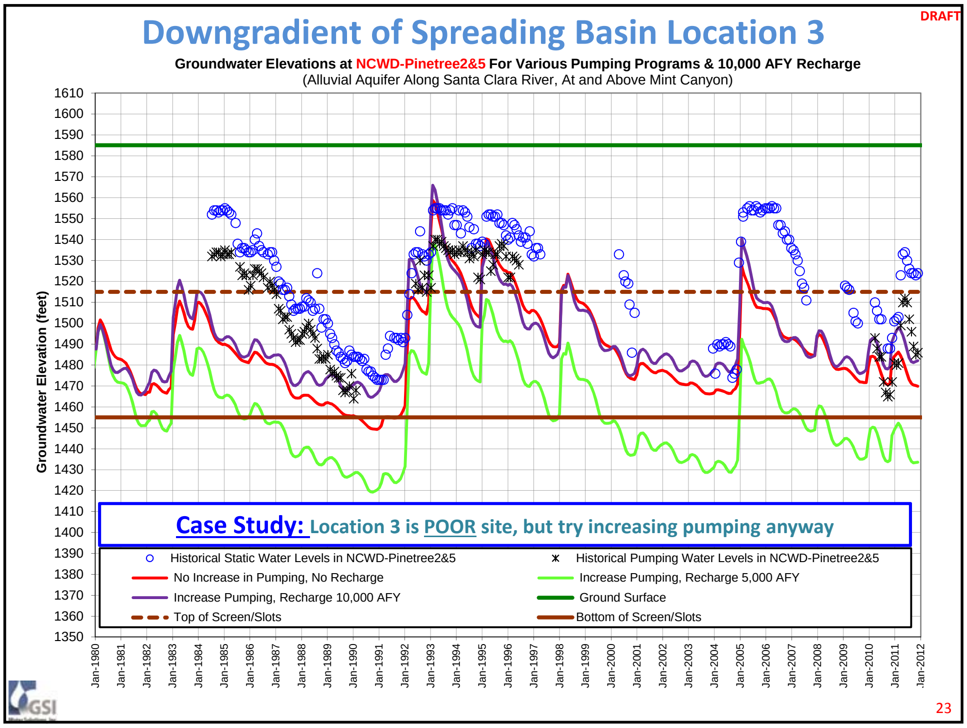
# Downgradient of Spreading Basin Location 3

**Case Study:**
**Location 3 is a**
**POOR site**

22



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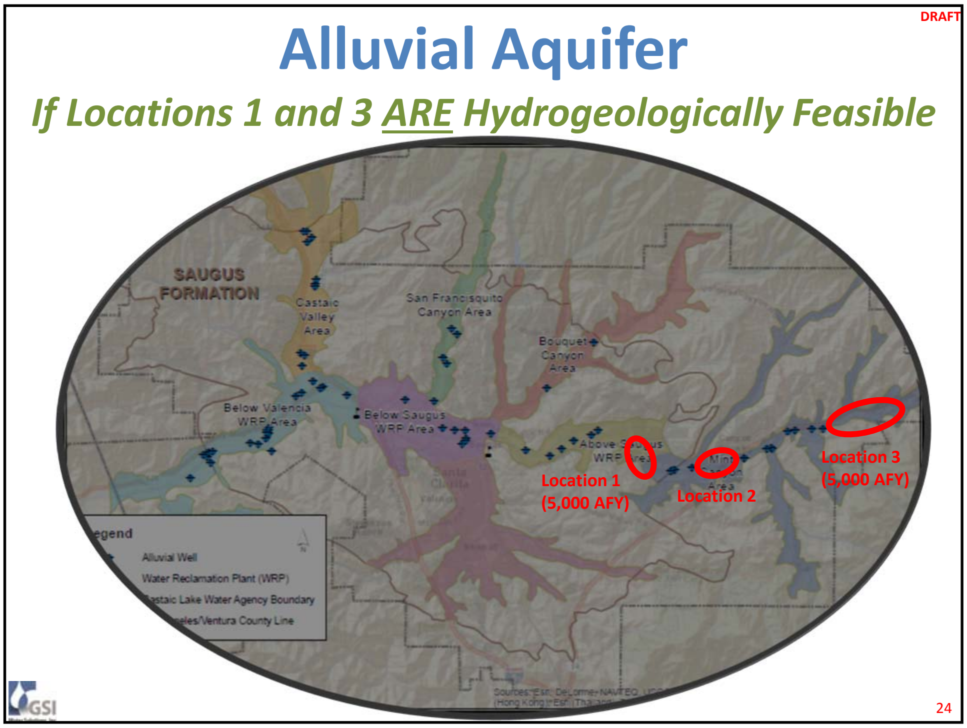
## Downgradient of Spreading Basin Location 3

**Groundwater Elevations at NCWD-Pinetree2&5 For Various Pumping Programs & 10,000 AFY Recharge**
(Alluvial Aquifer Along Santa Clara River, At and Above Mint Canyon)

**Case Study:** Location 3 is POOR site, but try increasing pumping anyway

- ○ Historical Static Water Levels in NCWD-Pinetree2&5
- ✱ Historical Pumping Water Levels in NCWD-Pinetree2&5
- No Increase in Pumping, No Recharge
- Increase Pumping, Recharge 5,000 AFY
- Increase Pumping, Recharge 10,000 AFY
- Ground Surface
- Top of Screen/Slots
- Bottom of Screen/Slots



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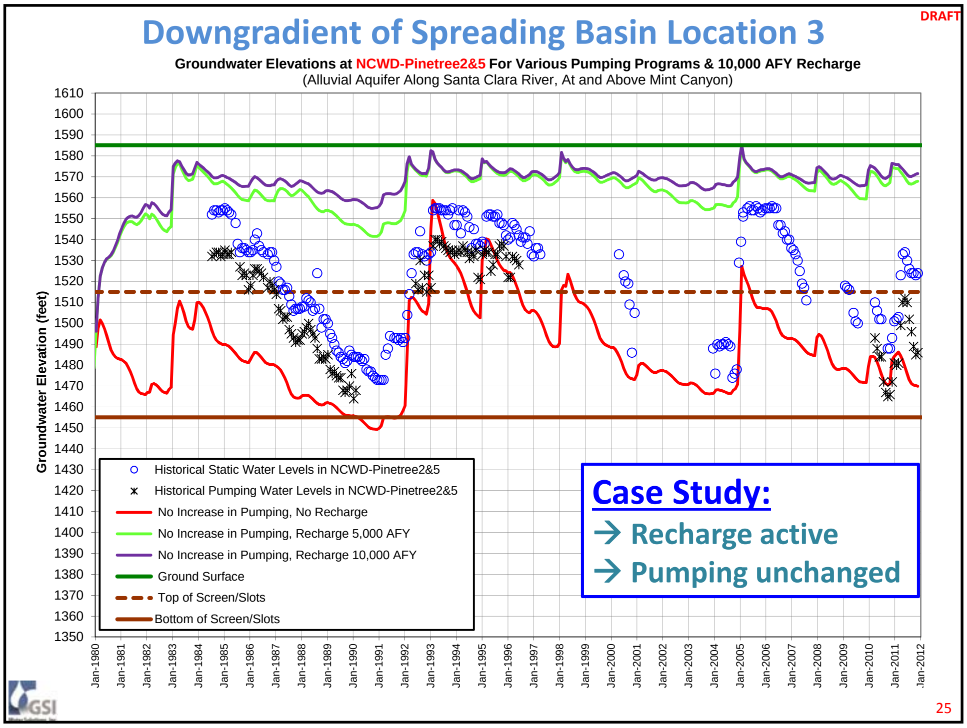
# Alluvial Aquifer

## *If Locations 1 and 3 ARE Hydrogeologically Feasible*



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# Downgradient of Spreading Basin Location 3

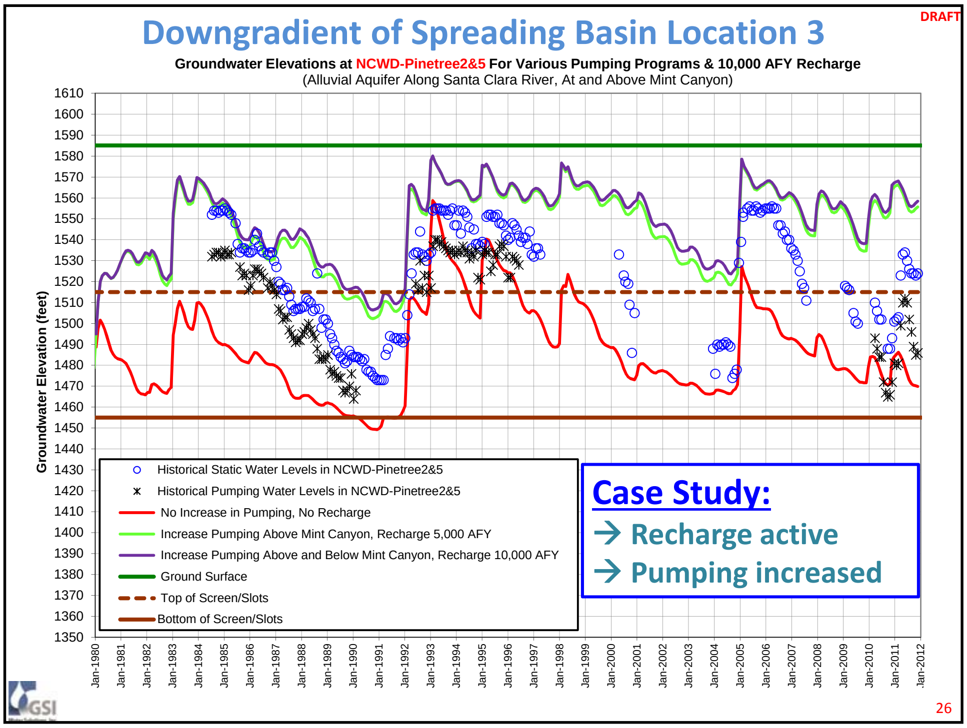
**Groundwater Elevations at NCWD-Pinetree2&5 For Various Pumping Programs & 10,000 AFY Recharge**
(Alluvial Aquifer Along Santa Clara River, At and Above Mint Canyon)

**Case Study:**

→ Recharge active

→ Pumping unchanged

25



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# Downgradient of Spreading Basin Location 3

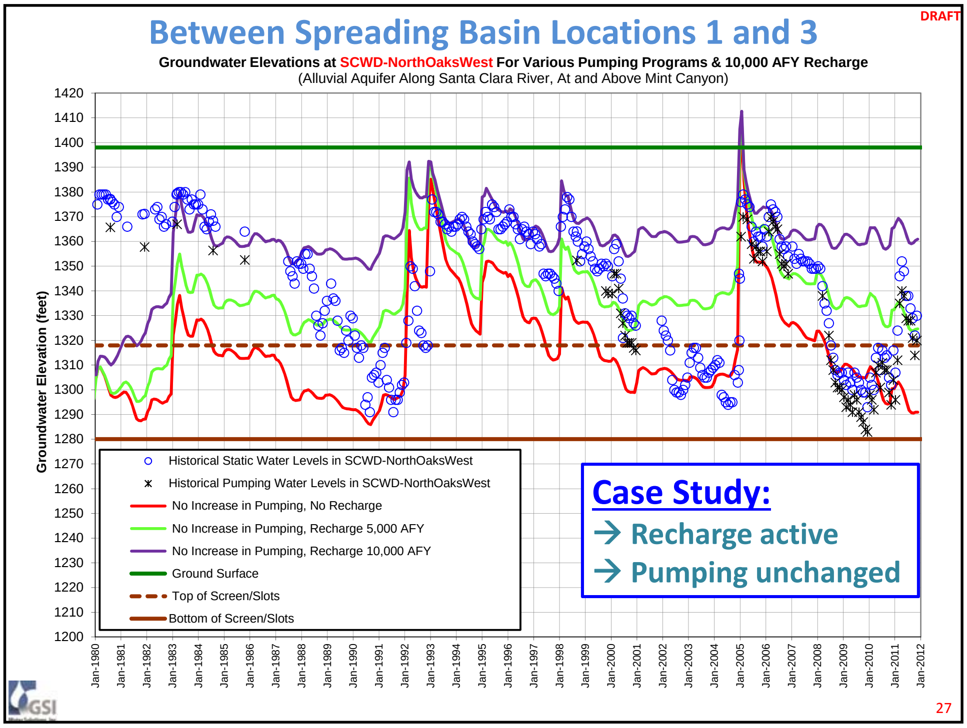
**Groundwater Elevations at NCWD-Pinetree2&5 For Various Pumping Programs & 10,000 AFY Recharge**
(Alluvial Aquifer Along Santa Clara River, At and Above Mint Canyon)

**Case Study:**

→ Recharge active

→ Pumping increased

26



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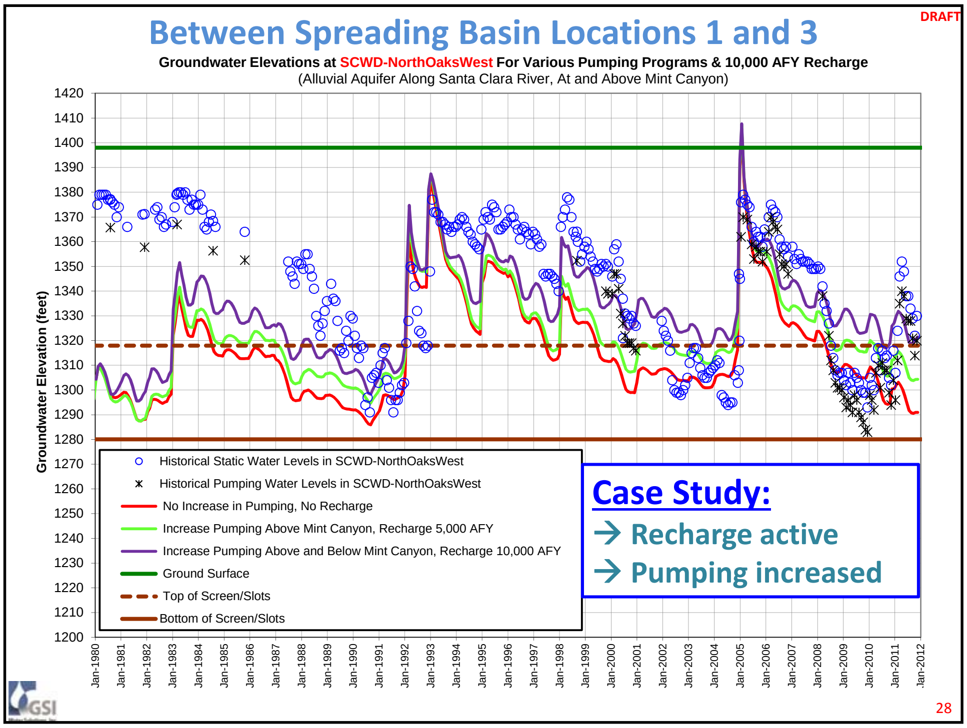
# Between Spreading Basin Locations 1 and 3

**Groundwater Elevations at SCWD-NorthOaksWest For Various Pumping Programs & 10,000 AFY Recharge**
(Alluvial Aquifer Along Santa Clara River, At and Above Mint Canyon)

○ Historical Static Water Levels in SCWD-NorthOaksWest
⁎ Historical Pumping Water Levels in SCWD-NorthOaksWest
— No Increase in Pumping, No Recharge
— No Increase in Pumping, Recharge 5,000 AFY
— No Increase in Pumping, Recharge 10,000 AFY
— Ground Surface
- - Top of Screen/Slots
— Bottom of Screen/Slots

**Case Study:**
→ Recharge active
→ Pumping unchanged

27



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# Between Spreading Basin Locations 1 and 3

**Groundwater Elevations at SCWD-NorthOaksWest For Various Pumping Programs & 10,000 AFY Recharge**
(Alluvial Aquifer Along Santa Clara River, At and Above Mint Canyon)

○ Historical Static Water Levels in SCWD-NorthOaksWest
⁎ Historical Pumping Water Levels in SCWD-NorthOaksWest
— No Increase in Pumping, No Recharge
— Increase Pumping Above Mint Canyon, Recharge 5,000 AFY
— Increase Pumping Above and Below Mint Canyon, Recharge 10,000 AFY
— Ground Surface
- - Top of Screen/Slots
— Bottom of Screen/Slots

**Case Study:**
→ Recharge active
→ Pumping increased

28

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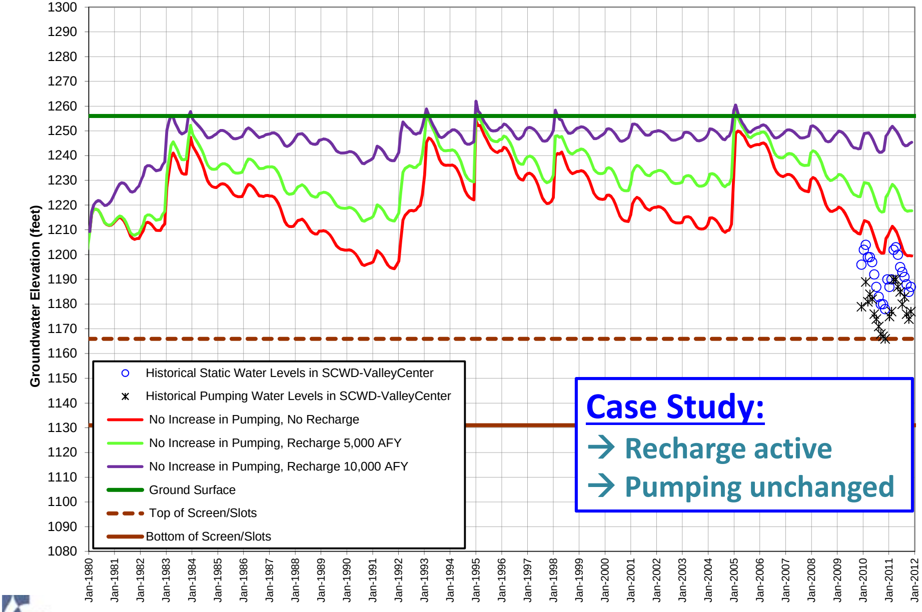
# Downgradient of Spreading Basin Locations 1 and 3

**Groundwater Elevations at SCWD-ValleyCenter For Various Pumping Programs & 10,000 AFY Recharge**
(Alluvial Aquifer Above Saugus WRP)



**Case Study:**
→ Recharge active
→ Pumping unchanged

29

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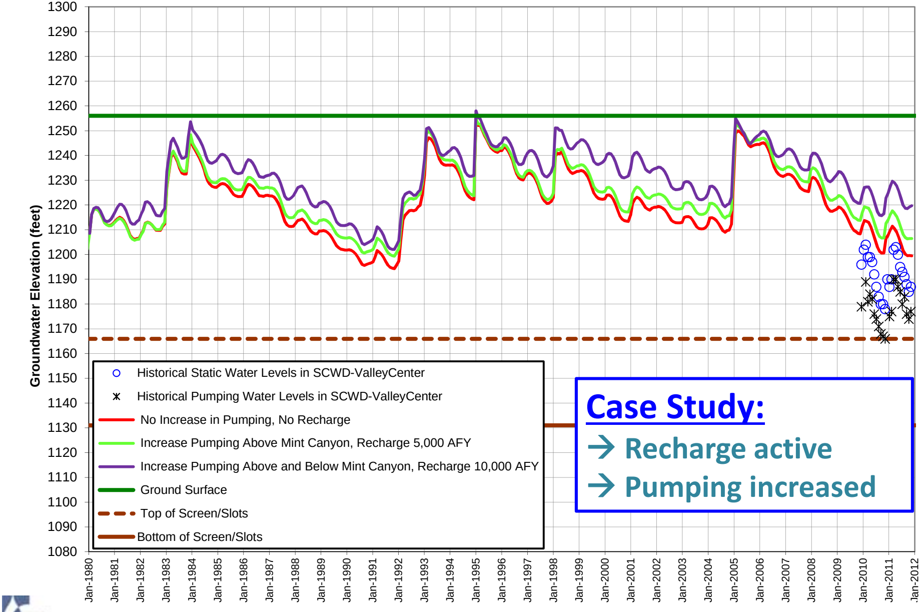
# Downgradient of Spreading Basin Locations 1 and 3

**Groundwater Elevations at SCWD-ValleyCenter For Various Pumping Programs & 10,000 AFY Recharge**
(Alluvial Aquifer Above Saugus WRP)



**Case Study:**
→ Recharge active
→ Pumping increased

30

# Model Testing of Recharge and Pumping Concepts

## Conclusions – Alluvial Aquifer

3. Production is best increased by:
    - Recharging at both locations 1 and 3 (not just one of them)
    - Careful management of pumping rates during dry years
4. Two other factors will affect recharge siting and design
    - Distance of wells to spreading basins
        - Six-month travel time minimum
    - Starting assumption (negotiable with DPH):
      Recharged water should comprise 25% or less of the groundwater volume in the local aquifer area during any 10-year period

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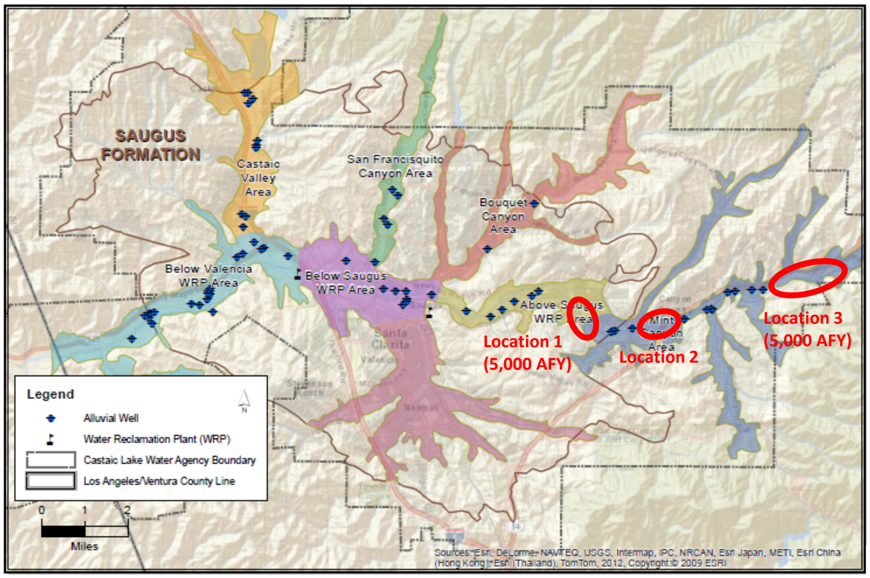
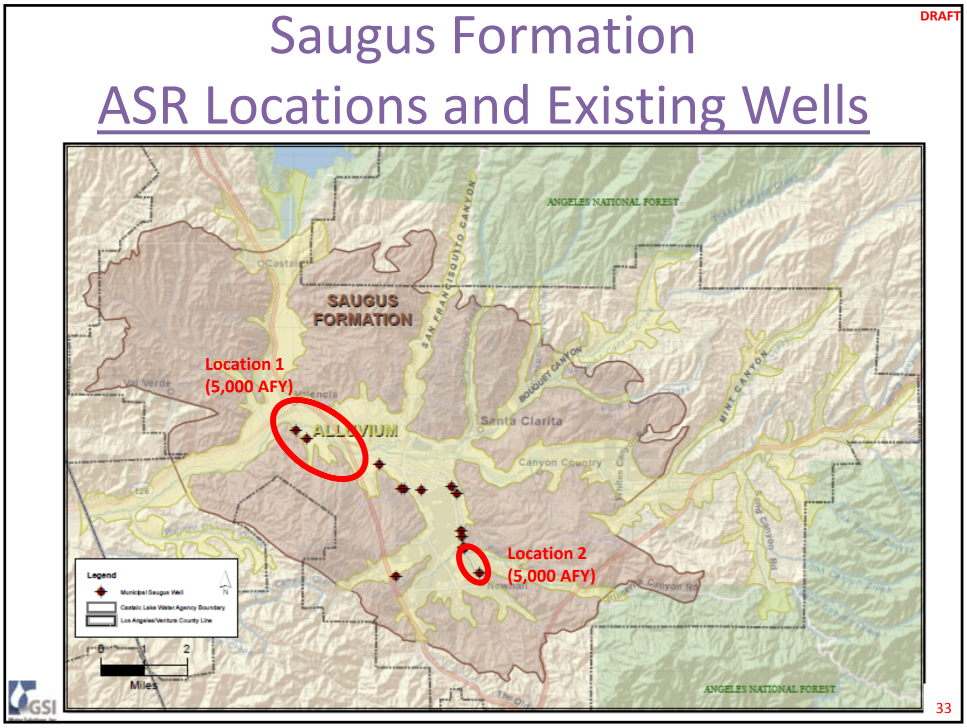
# Alluvial Aquifer Wells and Spreading Basin Sites



Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, IPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2012, Copyright:© 2009 ESRI



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# Saugus Formation
## ASR Locations and Existing Wells

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# Model Testing of
## Recharge and Pumping Concepts

## Conclusions – Saugus Formation

1. Increasing long-term groundwater production might not require implementing an ASR recharge program
   - Water levels well above the top of the screen in most wells
     - Historically and in predictive scenarios that were modeled
2. But some benefits to existing wells are still possible:
   - Modestly higher water levels during SWP curtailment years
     - Ranging from 5 to 30 feet higher
     - Higher water level might reduce need to change pump settings
   - Notably higher water levels during non-curtailment years
     - 10 to 60 feet (NCWD), 5 to 35 feet (SCWD and VWC)

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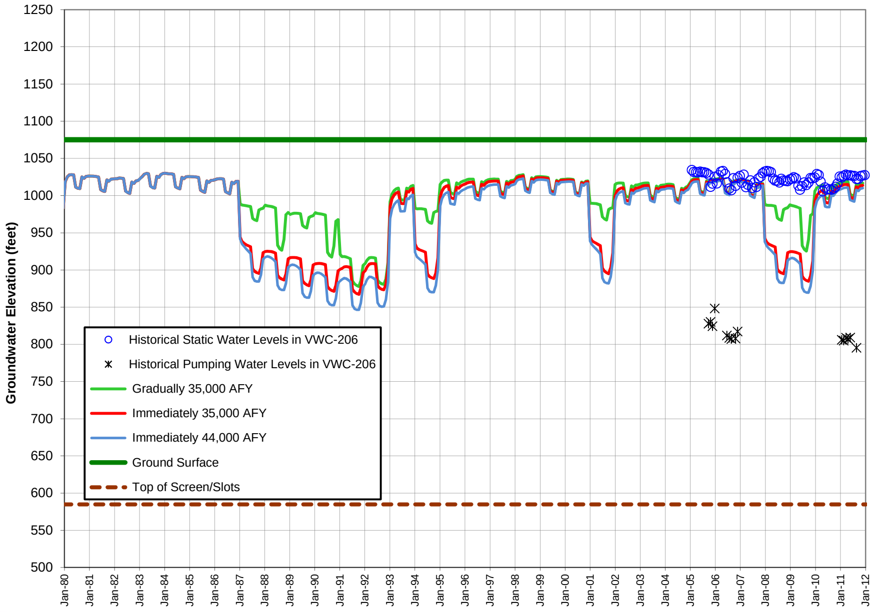
# Near Modeled Locations of Magic Mtn. ASR Wells

**Influence of Pumping and Injection Programs on Groundwater Elevations at VWC-206**



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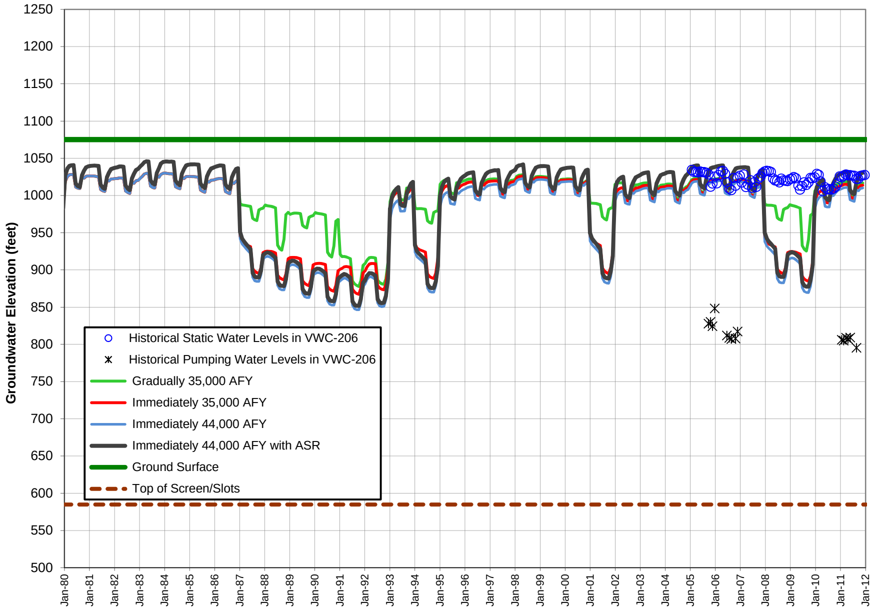
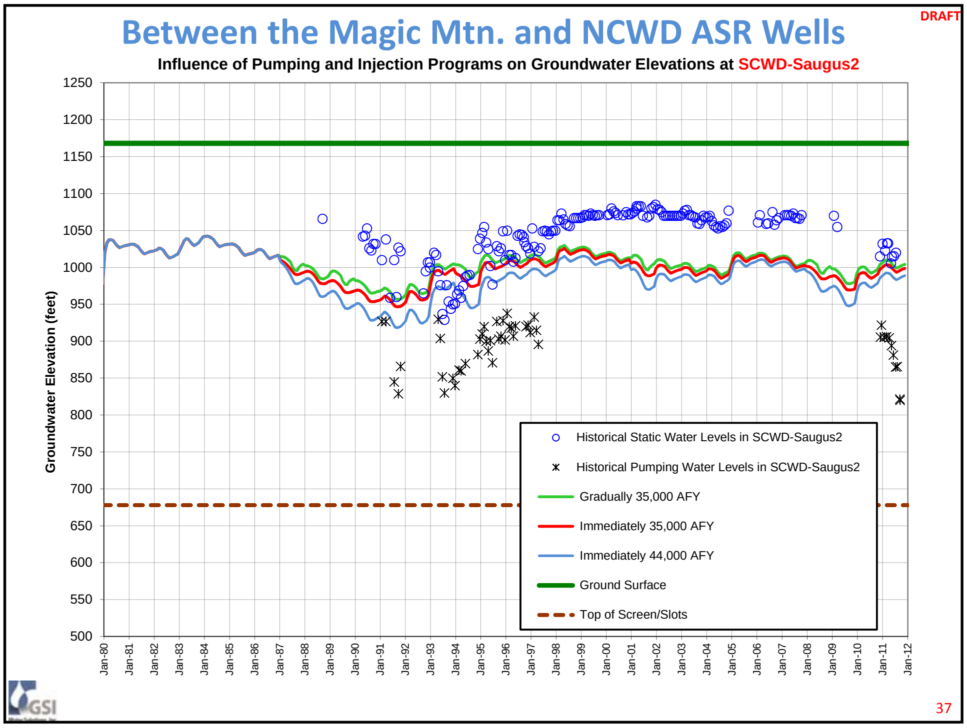
# Near Modeled Locations of Magic Mtn. ASR Wells

**Influence of Pumping and Injection Programs on Groundwater Elevations at VWC-206**





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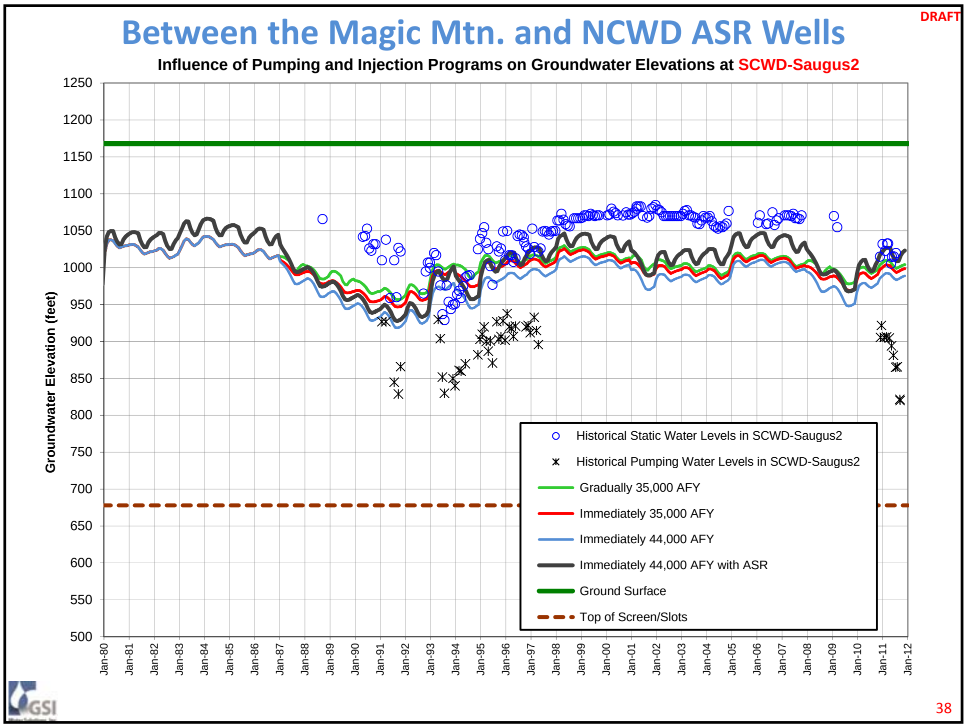
## Between the Magic Mtn. and NCWD ASR Wells

Influence of Pumping and Injection Programs on Groundwater Elevations at SCWD-Saugus2

37



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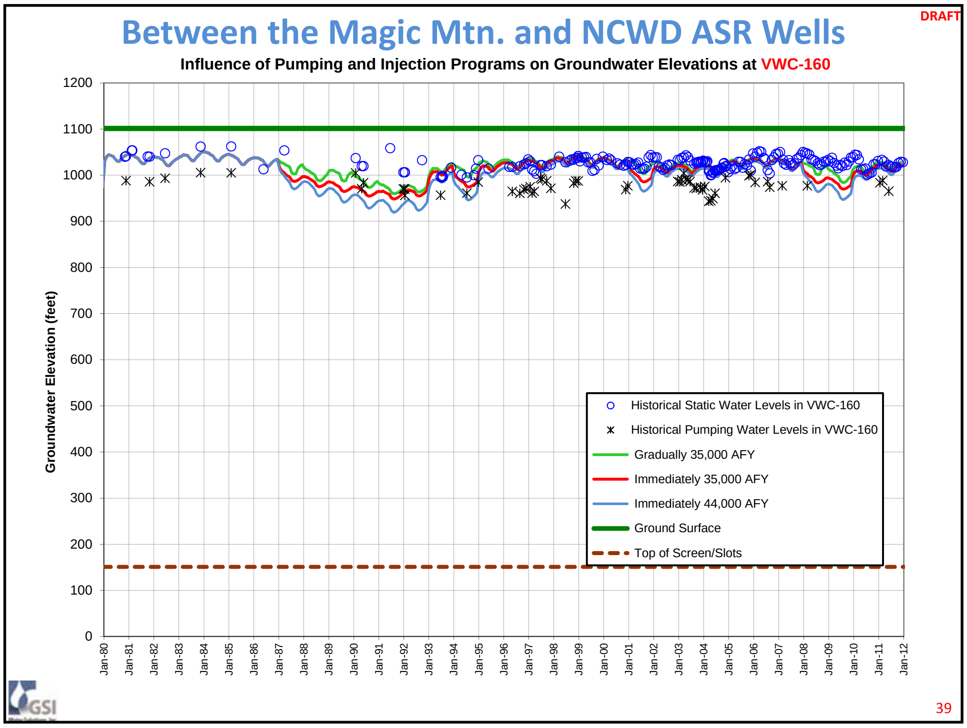
## Between the Magic Mtn. and NCWD ASR Wells

Influence of Pumping and Injection Programs on Groundwater Elevations at SCWD-Saugus2

38



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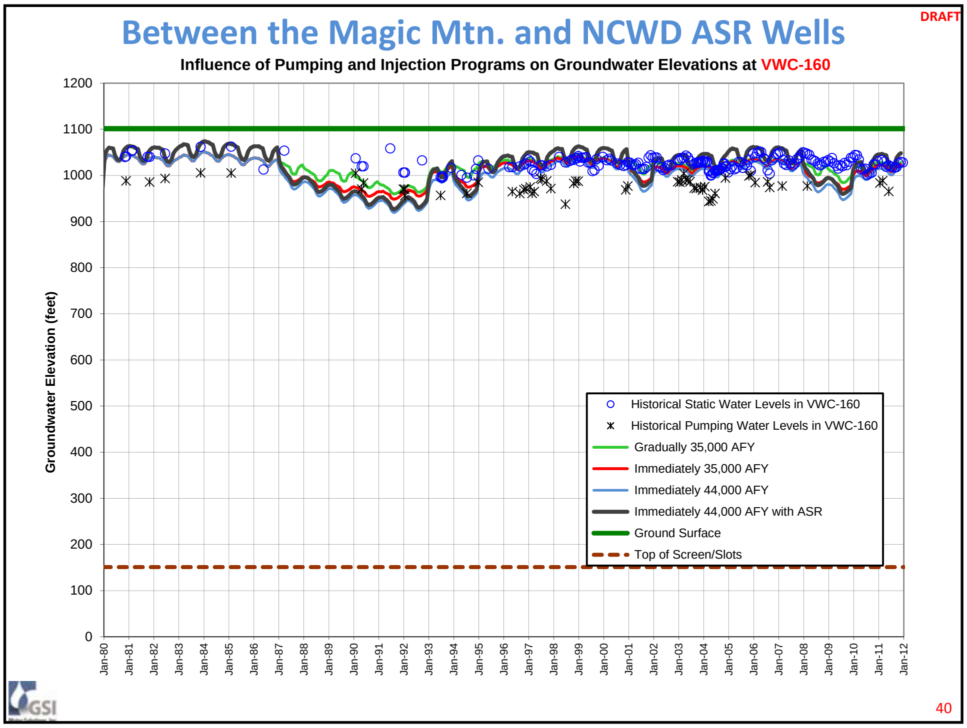
## Between the Magic Mtn. and NCWD ASR Wells

**Influence of Pumping and Injection Programs on Groundwater Elevations at VWC-160**



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## Between the Magic Mtn. and NCWD ASR Wells

**Influence of Pumping and Injection Programs on Groundwater Elevations at VWC-160**

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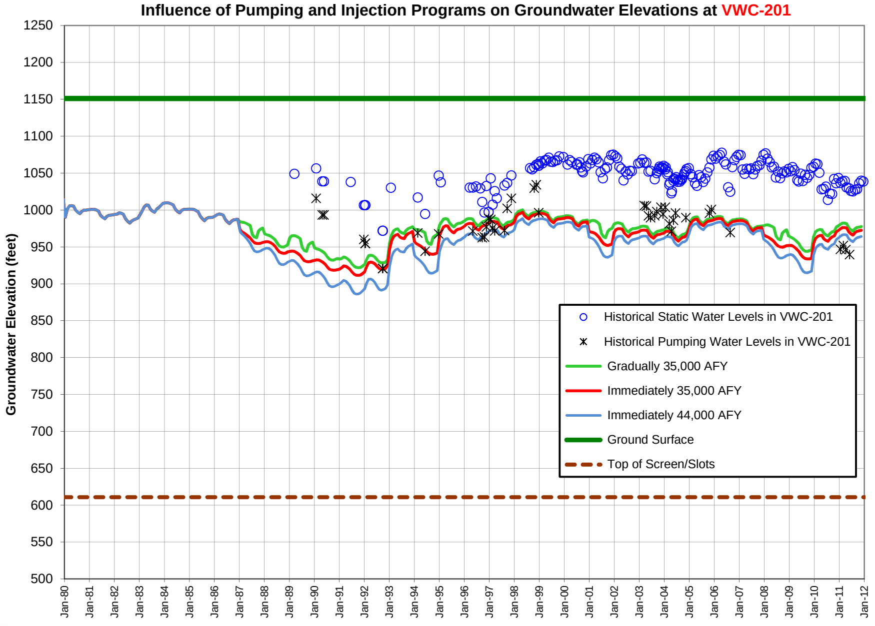
# Between the Magic Mtn. and NCWD ASR Wells


Influence of Pumping and Injection Programs on Groundwater Elevations at VWC-201

GSI

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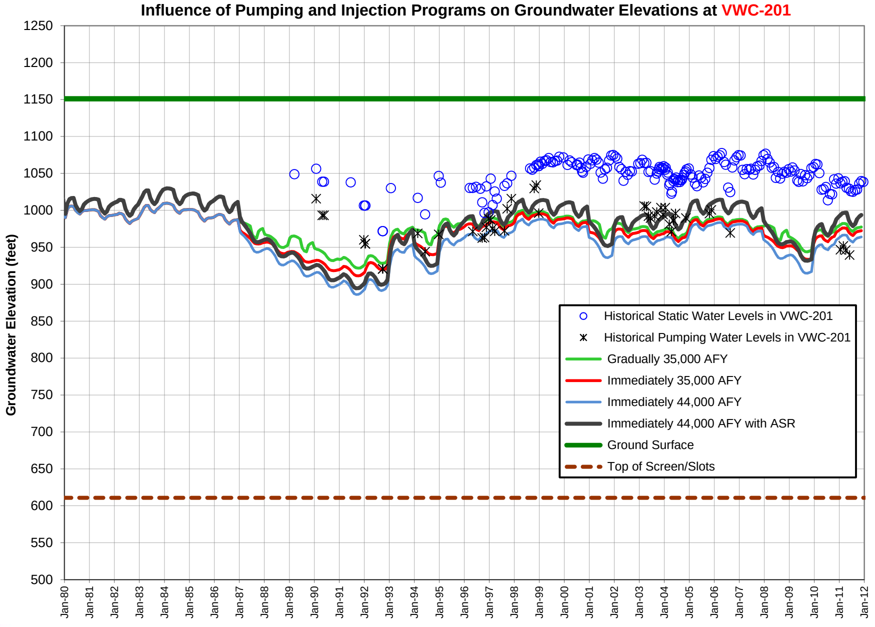
# Between the Magic Mtn. and NCWD ASR Wells


Influence of Pumping and Injection Programs on Groundwater Elevations at VWC-201

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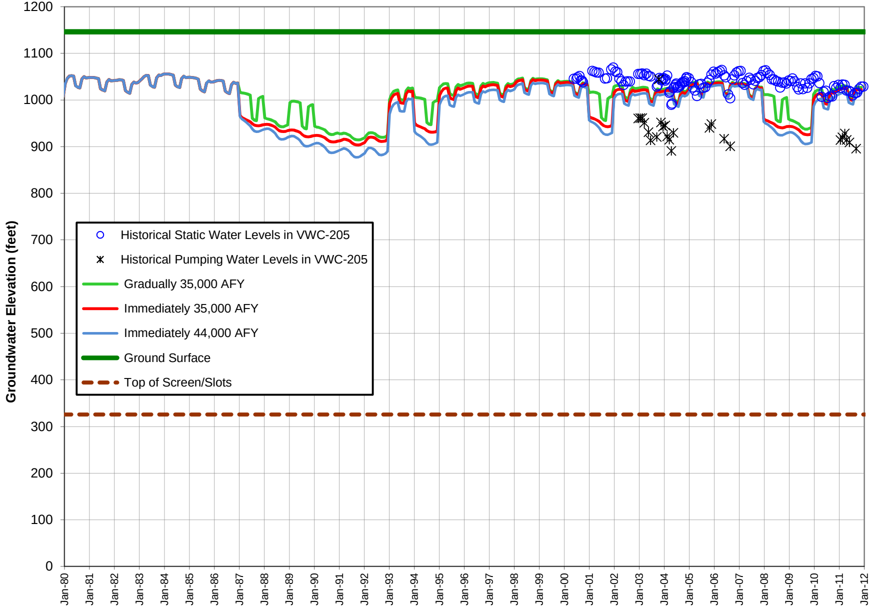
## Between the Magic Mtn. and NCWD ASR Wells

**Influence of Pumping and Injection Programs on Groundwater Elevations at VWC-205**



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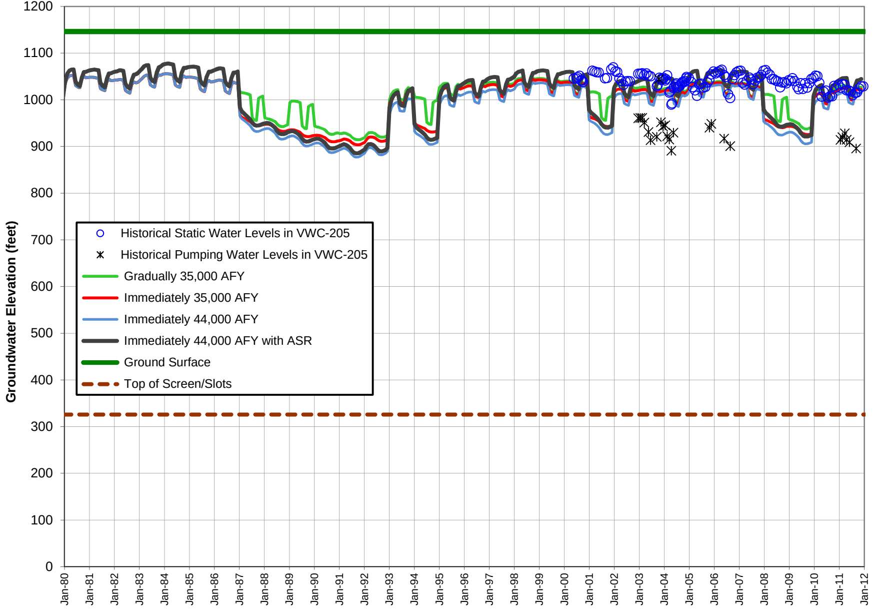
## Between the Magic Mtn. and NCWD ASR Wells

**Influence of Pumping and Injection Programs on Groundwater Elevations at VWC-205**



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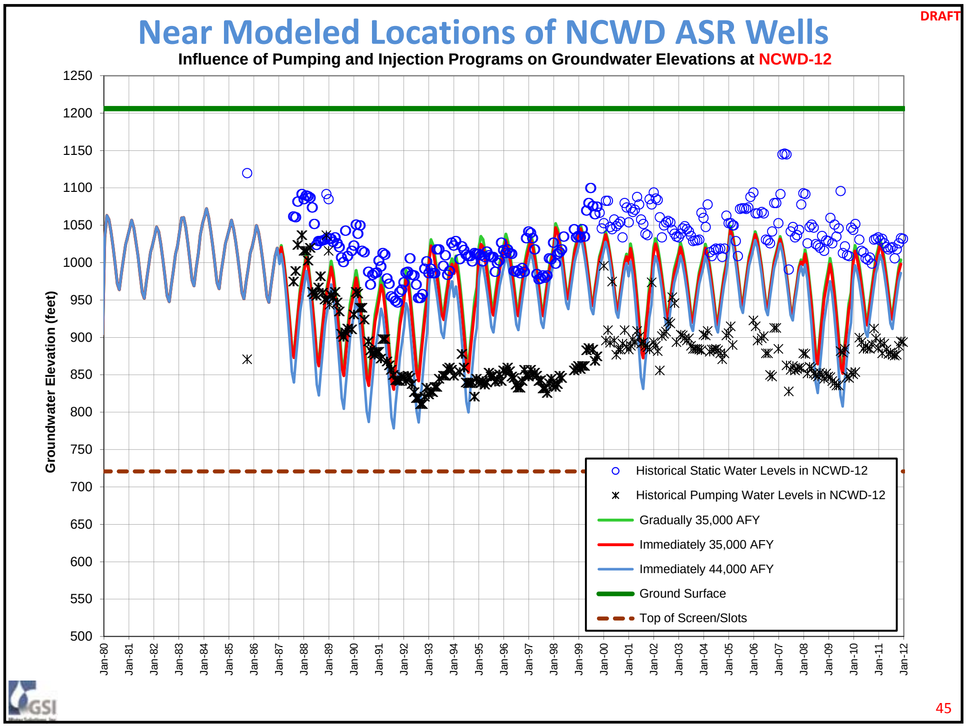

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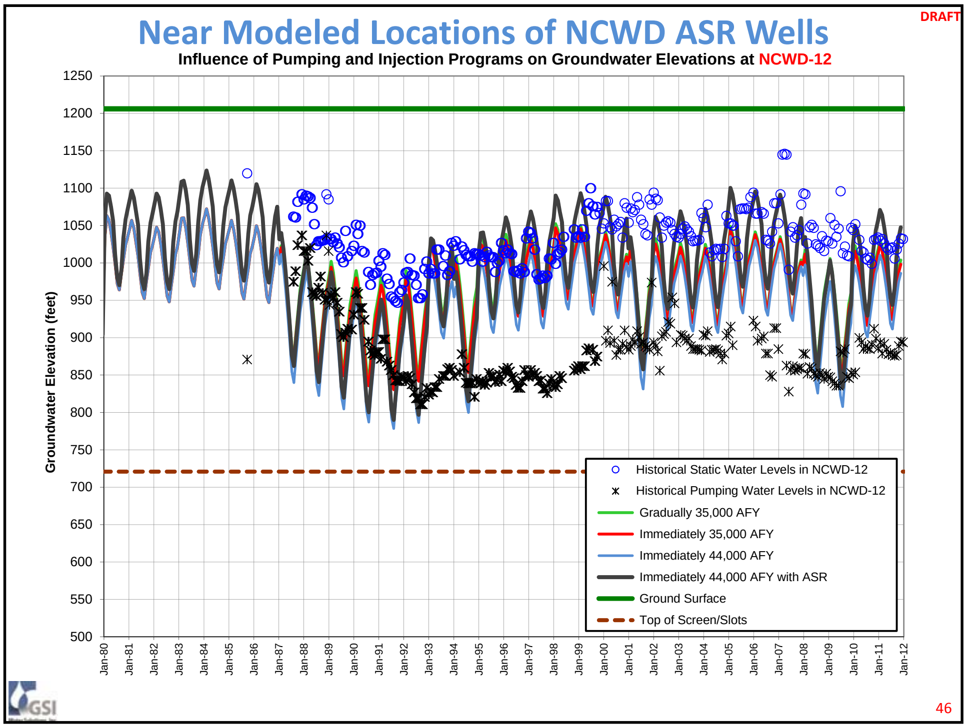
# Near Modeled Locations of NCWD ASR Wells

Influence of Pumping and Injection Programs on Groundwater Elevations at NCWD-12

45



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# Near Modeled Locations of NCWD ASR Wells

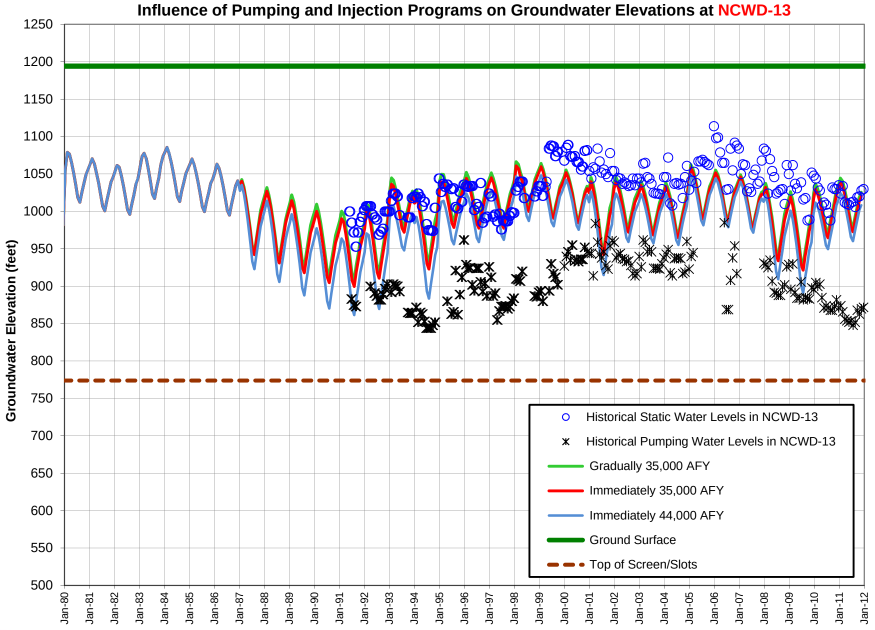
Influence of Pumping and Injection Programs on Groundwater Elevations at NCWD-12

46

**DRAFT**

# Near Modeled Locations of NCWD ASR Wells

## Influence of Pumping and Injection Programs on Groundwater Elevations at NCWD-13



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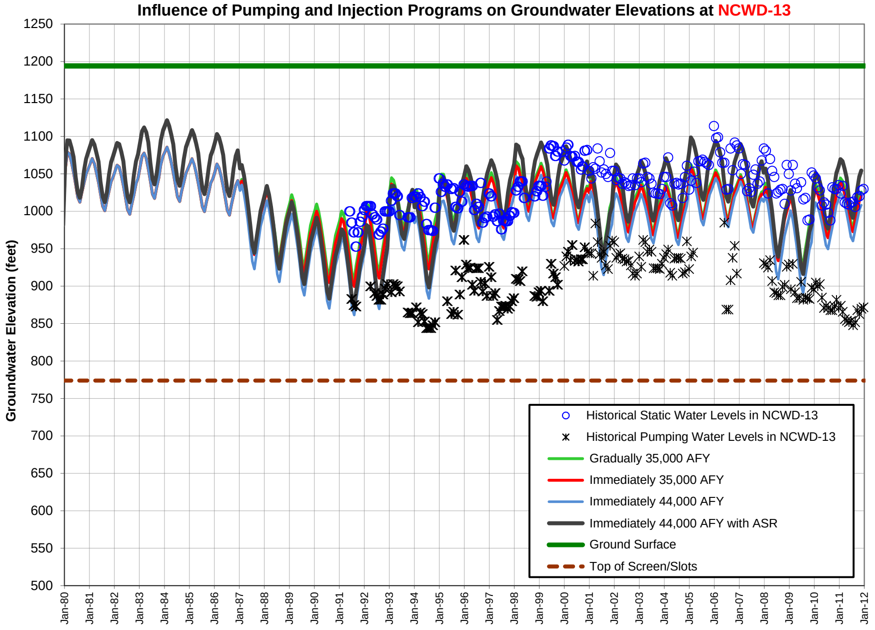
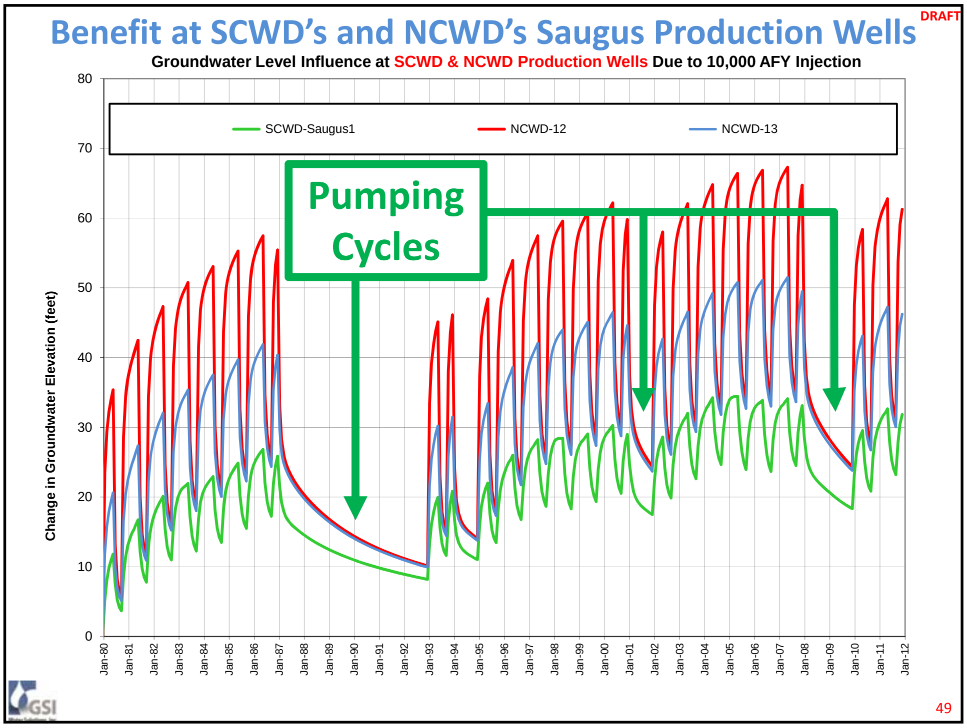
# Near Modeled Locations of NCWD ASR Wells

## Influence of Pumping and Injection Programs on Groundwater Elevations at NCWD-13





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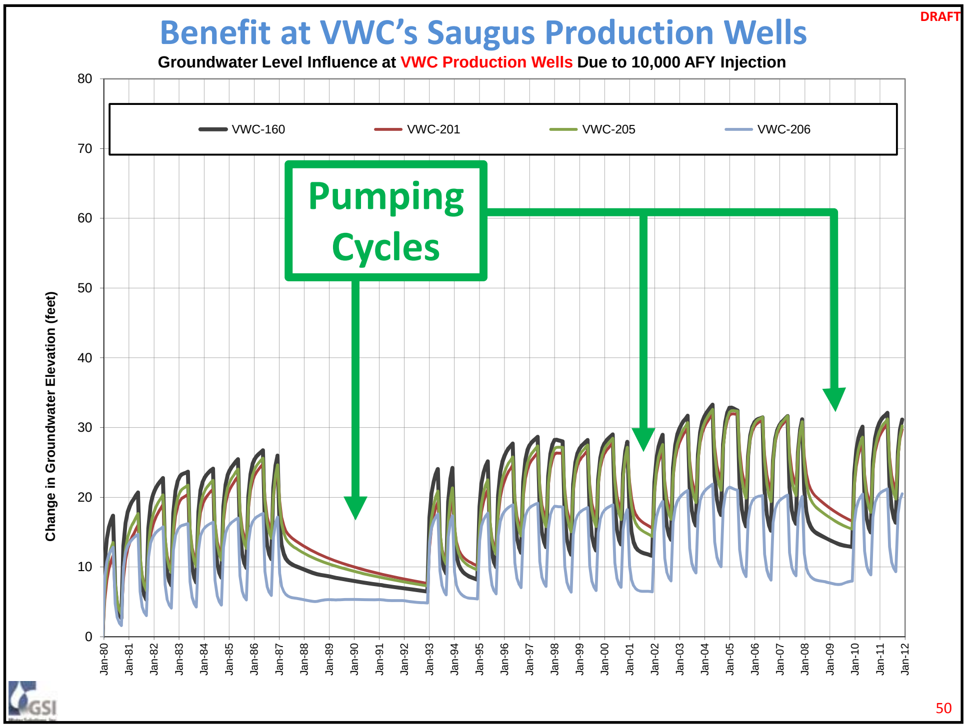
## Benefit at SCWD's and NCWD's Saugus Production Wells

Groundwater Level Influence at SCWD & NCWD Production Wells Due to 10,000 AFY Injection

Pumping Cycles

49



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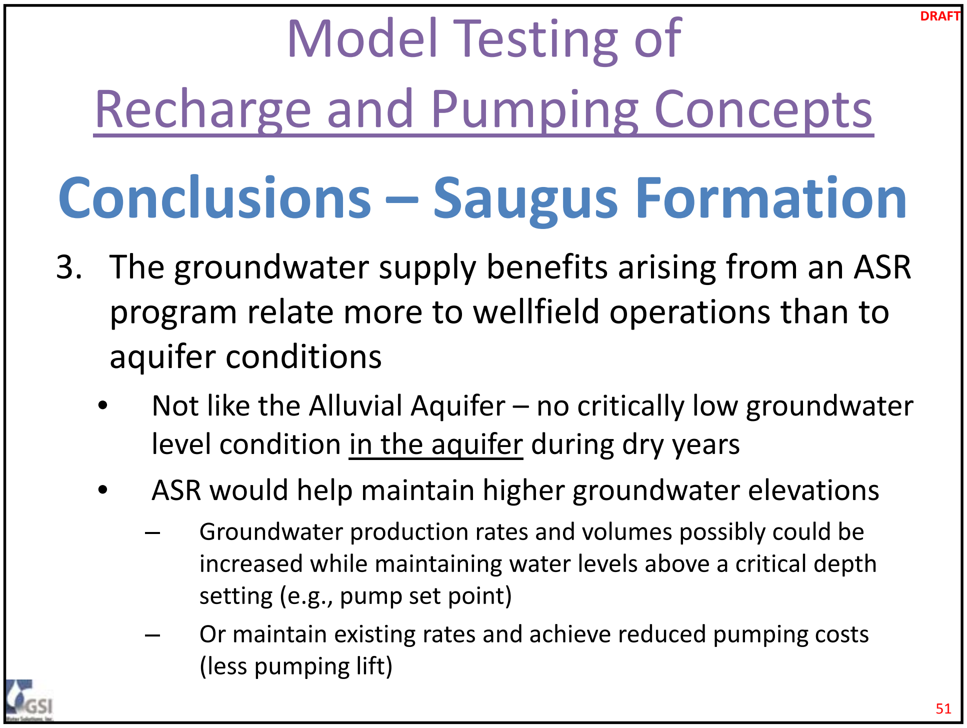
## Benefit at VWC's Saugus Production Wells

Groundwater Level Influence at VWC Production Wells Due to 10,000 AFY Injection

Pumping Cycles

50



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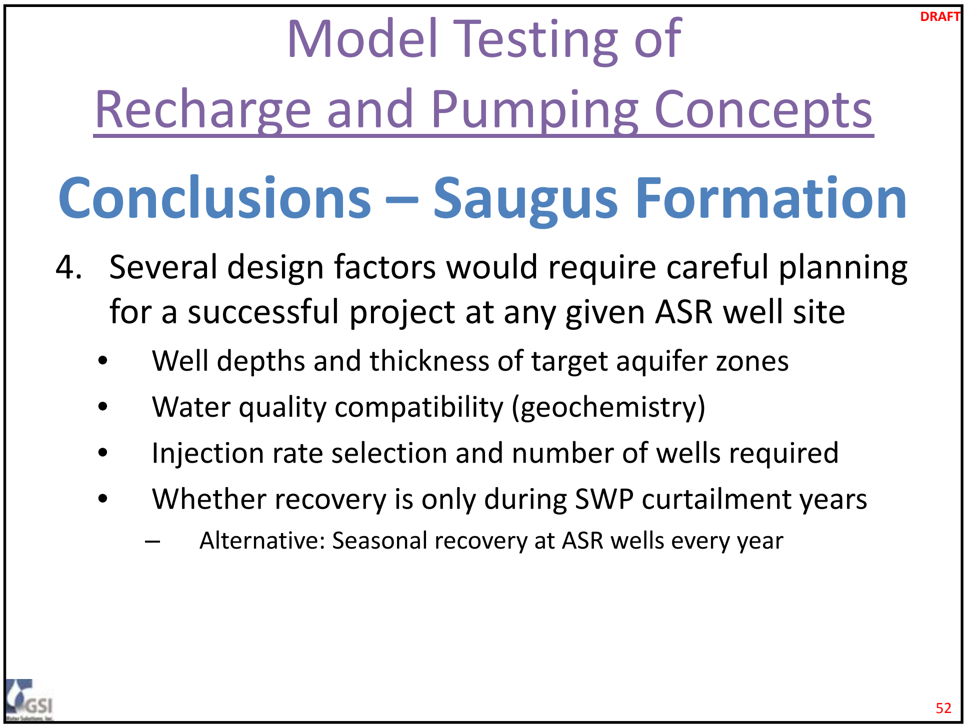
## Model Testing of Recharge and Pumping Concepts

## Conclusions – Saugus Formation

3. The groundwater supply benefits arising from an ASR program relate more to wellfield operations than to aquifer conditions
    - Not like the Alluvial Aquifer – no critically low groundwater level condition in the aquifer during dry years
    - ASR would help maintain higher groundwater elevations
        - Groundwater production rates and volumes possibly could be increased while maintaining water levels above a critical depth setting (e.g., pump set point)
        - Or maintain existing rates and achieve reduced pumping costs (less pumping lift)

GSI



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## Model Testing of Recharge and Pumping Concepts

## Conclusions – Saugus Formation

4. Several design factors would require careful planning for a successful project at any given ASR well site
    - Well depths and thickness of target aquifer zones
    - Water quality compatibility (geochemistry)
    - Injection rate selection and number of wells required
    - Whether recovery is only during SWP curtailment years
        - Alternative: Seasonal recovery at ASR wells every year

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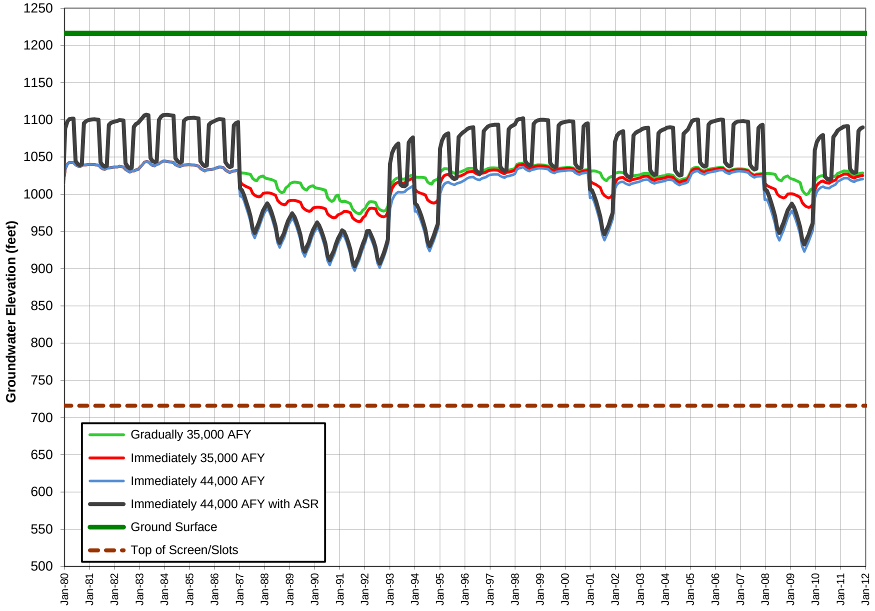
# At ASR Wells Near Magic Mountain

**Groundwater Elevations at CLWA-ASR2 For Various Pumping and Injection Programs**



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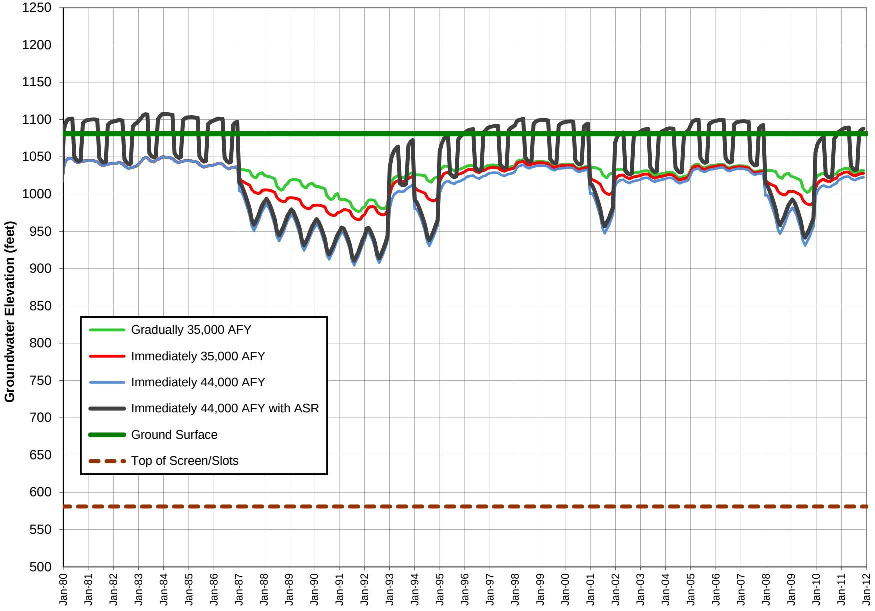
# At ASR Wells Near Magic Mountain

**Groundwater Elevations at CLWA-ASR3 For Various Pumping and Injection Programs**



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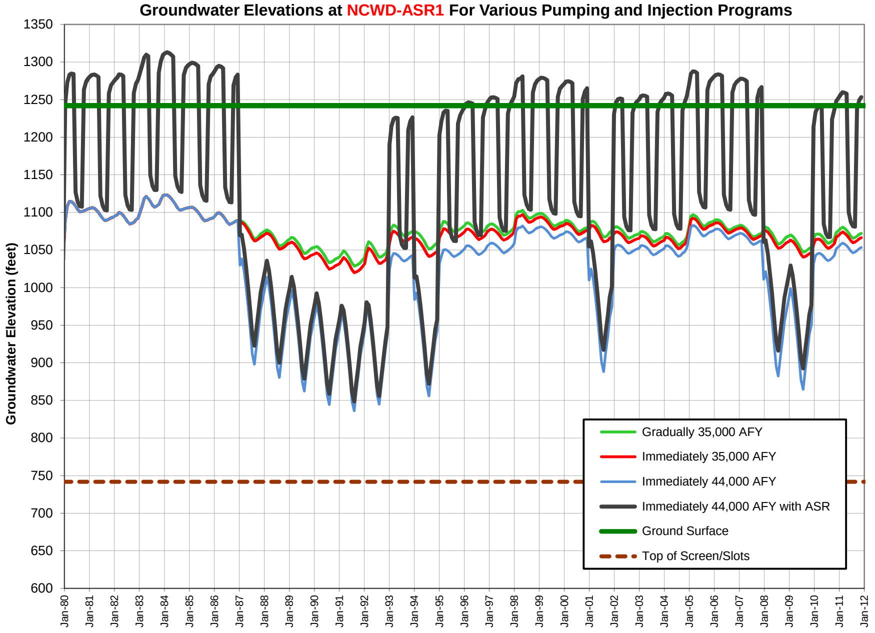
# At ASR Wells Near NCWD Wellfield



GSI

55

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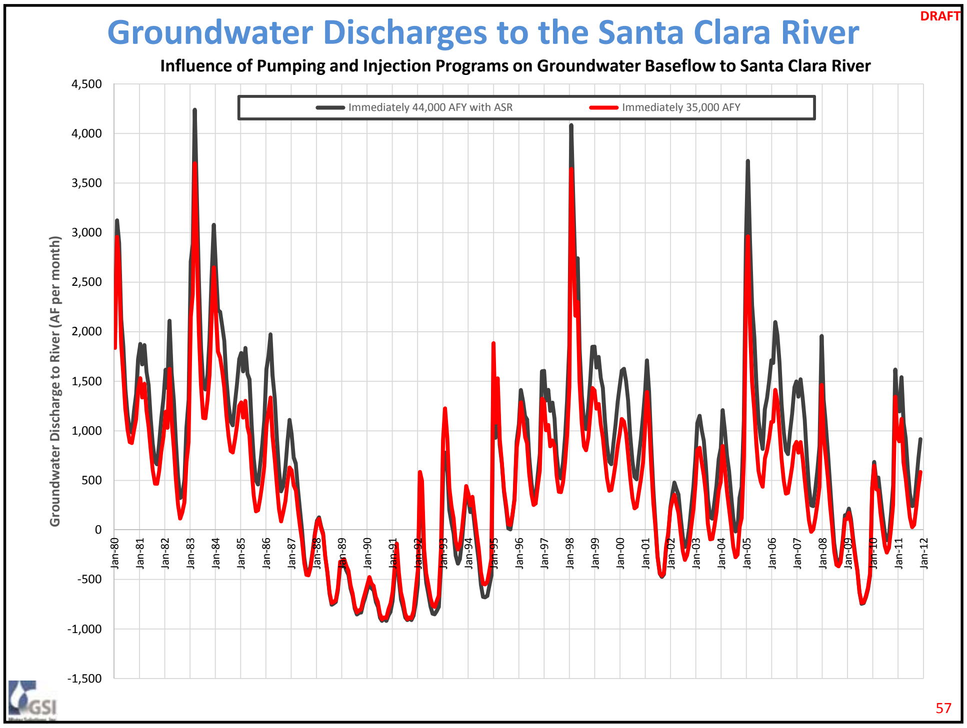
# Model Testing of Recharge and Pumping Concepts

## Conclusions – Saugus Formation

5. ASR would change groundwater discharges to the Santa Clara River (i.e., non-storm baseflow)
   - Notably higher during ASR injection cycles
   - Slightly lower during ASR pumping cycles

GSI

56



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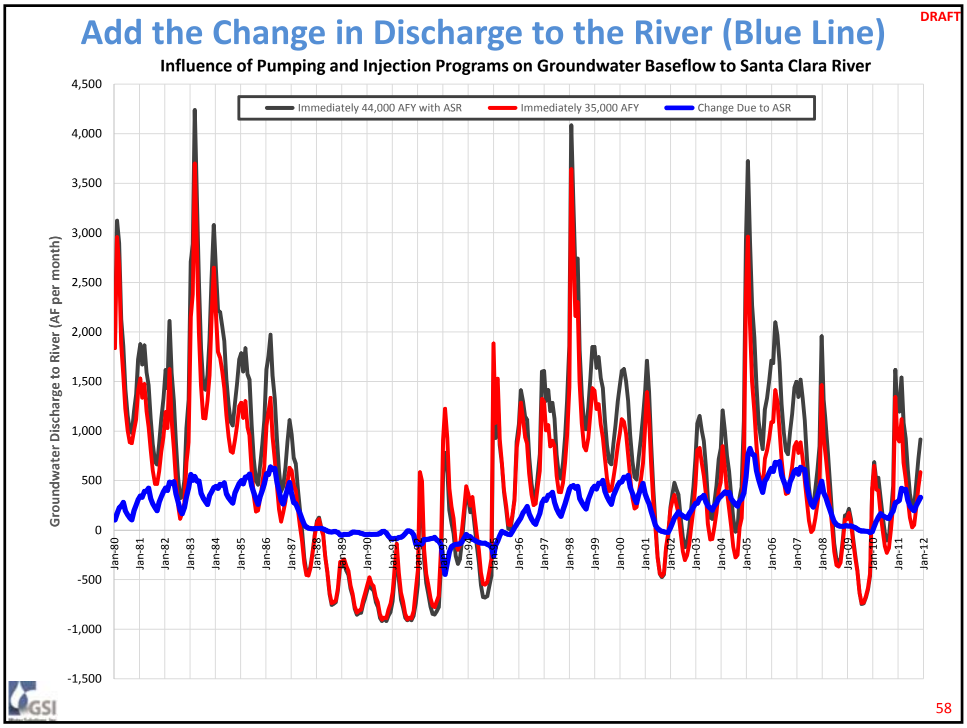
# Groundwater Discharges to the Santa Clara River

**Influence of Pumping and Injection Programs on Groundwater Baseflow to Santa Clara River**

57



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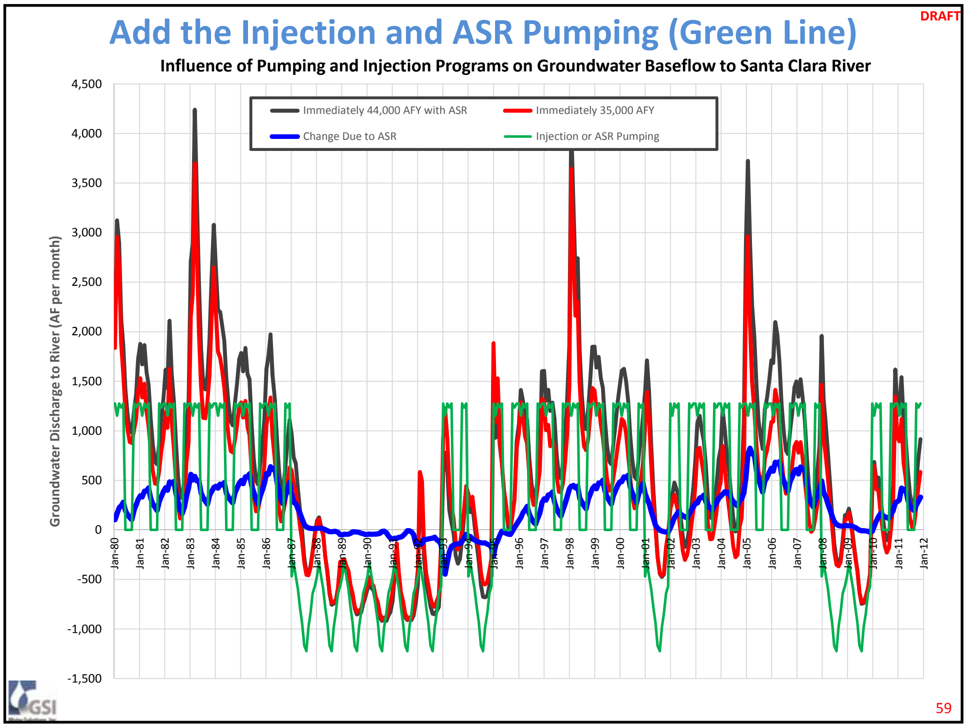
# Add the Change in Discharge to the River (Blue Line)

**Influence of Pumping and Injection Programs on Groundwater Baseflow to Santa Clara River**

58



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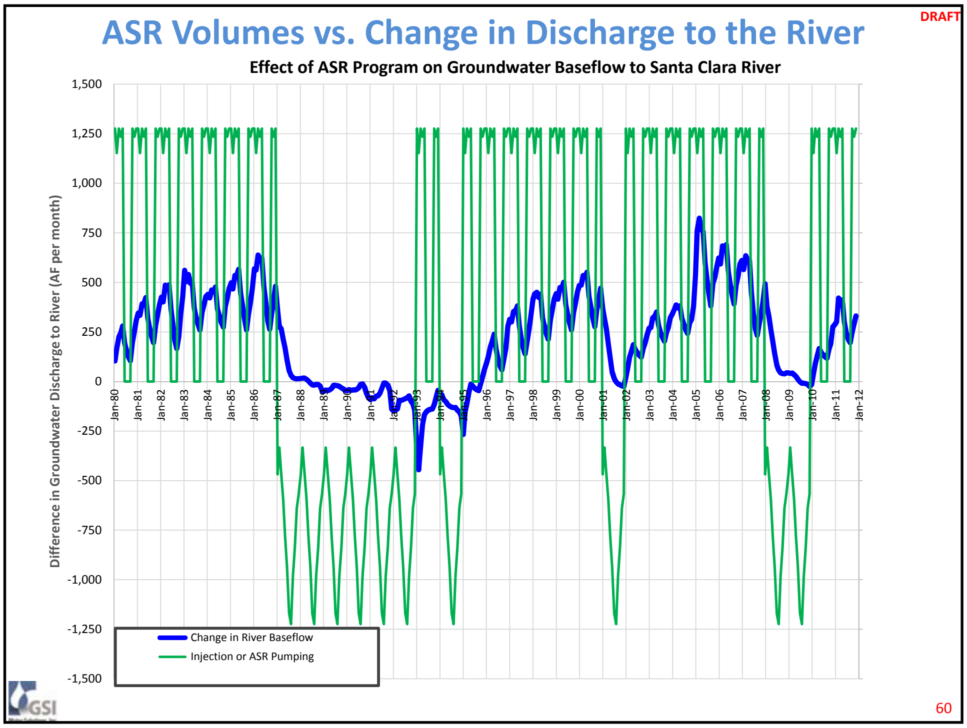
# Add the Injection and ASR Pumping (Green Line)

Influence of Pumping and Injection Programs on Groundwater Baseflow to Santa Clara River



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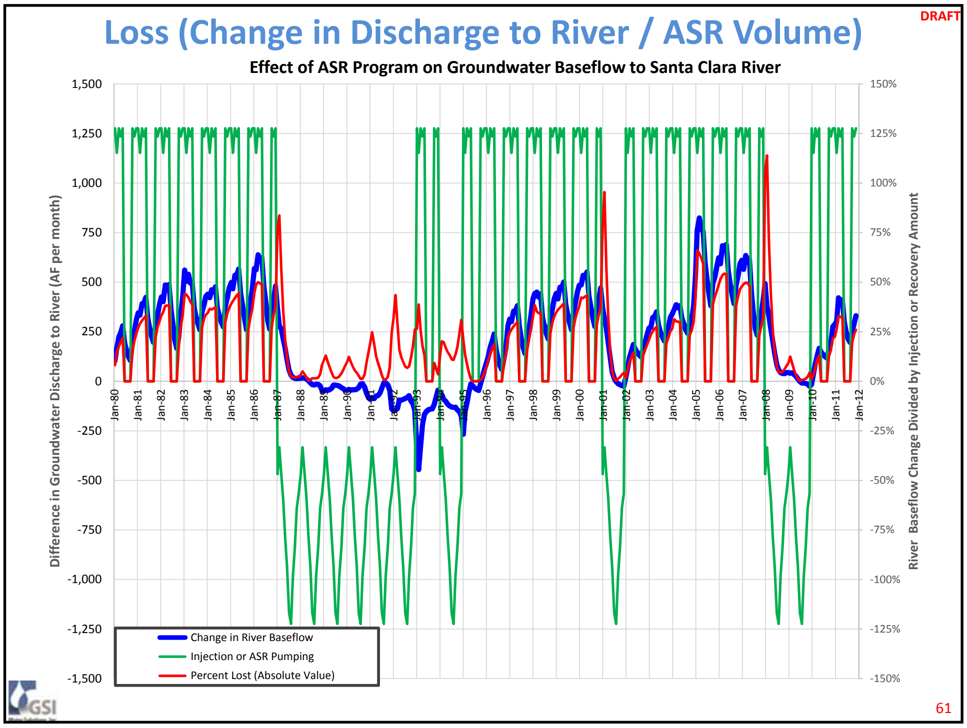
# ASR Volumes vs. Change in Discharge to the River

Effect of ASR Program on Groundwater Baseflow to Santa Clara River



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## Loss (Change in Discharge to River / ASR Volume)

Effect of ASR Program on Groundwater Baseflow to Santa Clara River

61

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## Model Testing of

## Recharge and Pumping Concepts

# Conclusions – Saugus Formation

6. Strategically located ASR wells could help with perchlorate plume containment
7. Concept:
   - Inject between VWC's two Saugus wellfields
     - Just east of Magic Mountain, west of V160/V201/V205
   - Build up hydraulic mound that limits perchlorate spreading west of the V201 and V205 wells

62

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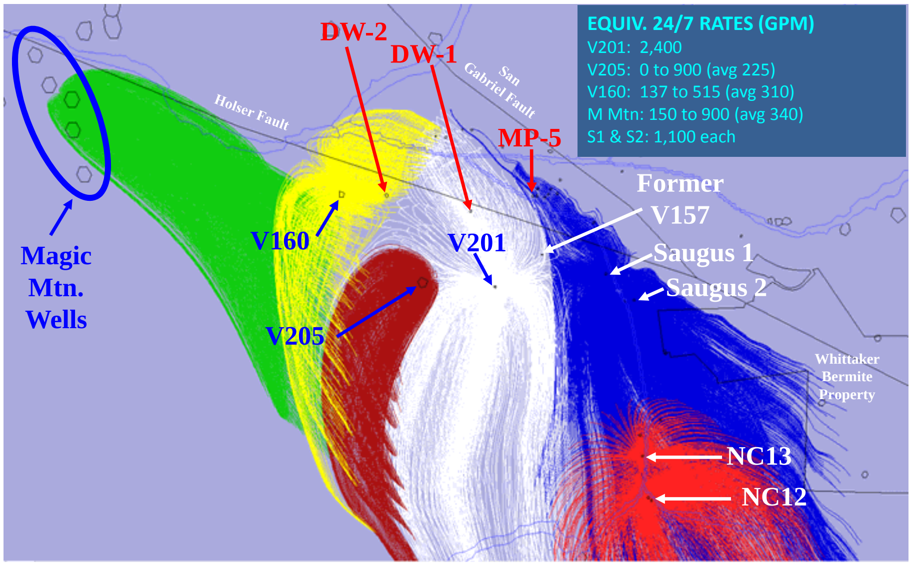
## Containment without ASR (SWP Non-Curtailment Years)



EQUIV. 24/7 RATES (GPM)
V201: 2,400
V205: 0 to 900 (avg 225)
V160: 137 to 515 (avg 310)
M Mtn: 150 to 900 (avg 340)
S1 & S2: 1,100 each

**Source:** March 2014 Draft Report by GSI and LSCE titled
*Perchlorate Containment Plan for Well V201 and Saugus Formation Groundwater in the Santa Clarita Valley (Task 3 of the Well V201 Restoration Program)*

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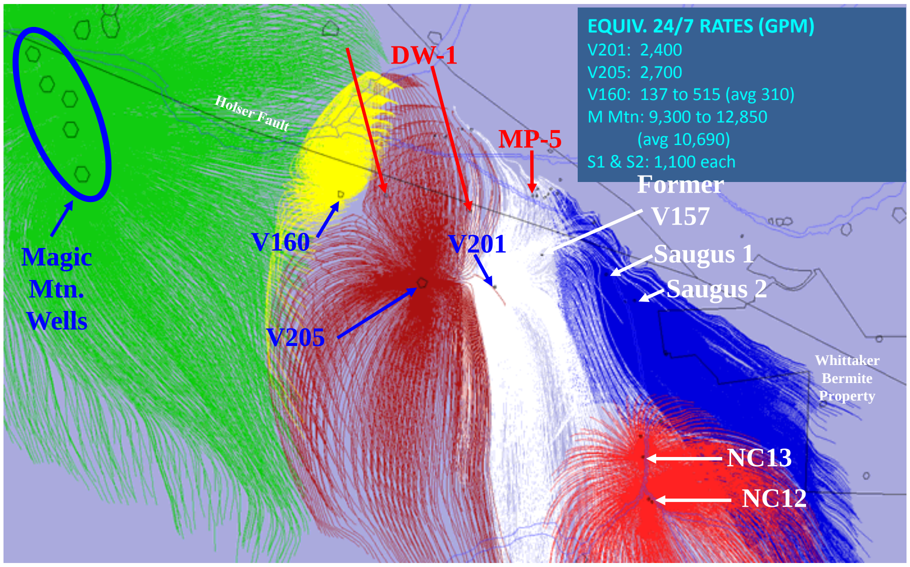
## Containment without ASR (SWP Curtailment Years)



EQUIV. 24/7 RATES (GPM)
V201: 2,400
V205: 2,700
V160: 137 to 515 (avg 310)
M Mtn: 9,300 to 12,850
(avg 10,690)
S1 & S2: 1,100 each

**Source:** March 2014 Draft Report by GSI and LSCE titled
*Perchlorate Containment Plan for Well V201 and Saugus Formation Groundwater in the Santa Clarita Valley (Task 3 of the Well V201 Restoration Program)*

# Model Testing of Recharge and Pumping Concepts

## Summary – Saugus ASR

1. Benefits
   - Modestly higher water levels at existing wells
     - Less pumping lift, lower pumping costs
   - Strategically located ASR wells could help with perchlorate plume containment
2. Other considerations / challenges / potential concerns
   - Loss of water to the Santa Clara River
   - Cost/benefit: is it worth the cost of SWP water?
   - Integration with other programs

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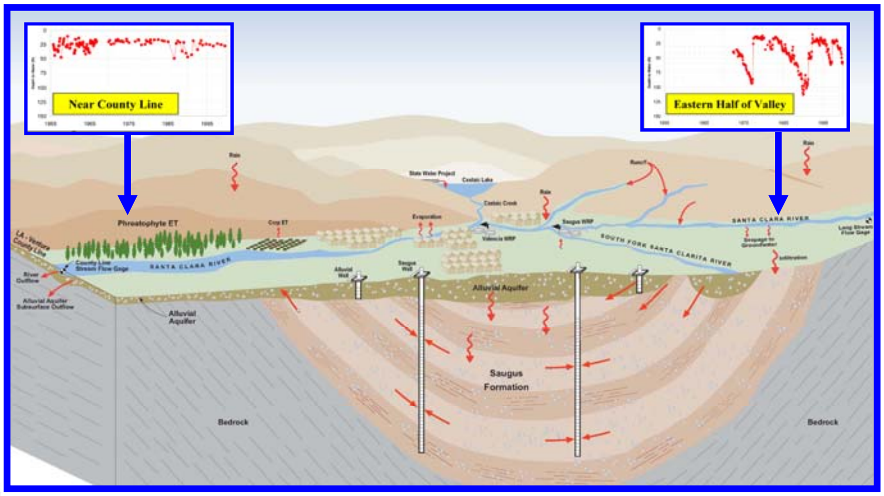
# Discussion, Questions

John J. Porcello – GSI Water Solutions

*with assistance from Jeff Barry/GSI and Tom West/Carollo*

(503) 239-8799



# APPENDIX B-3

# Workshop 3 Materials

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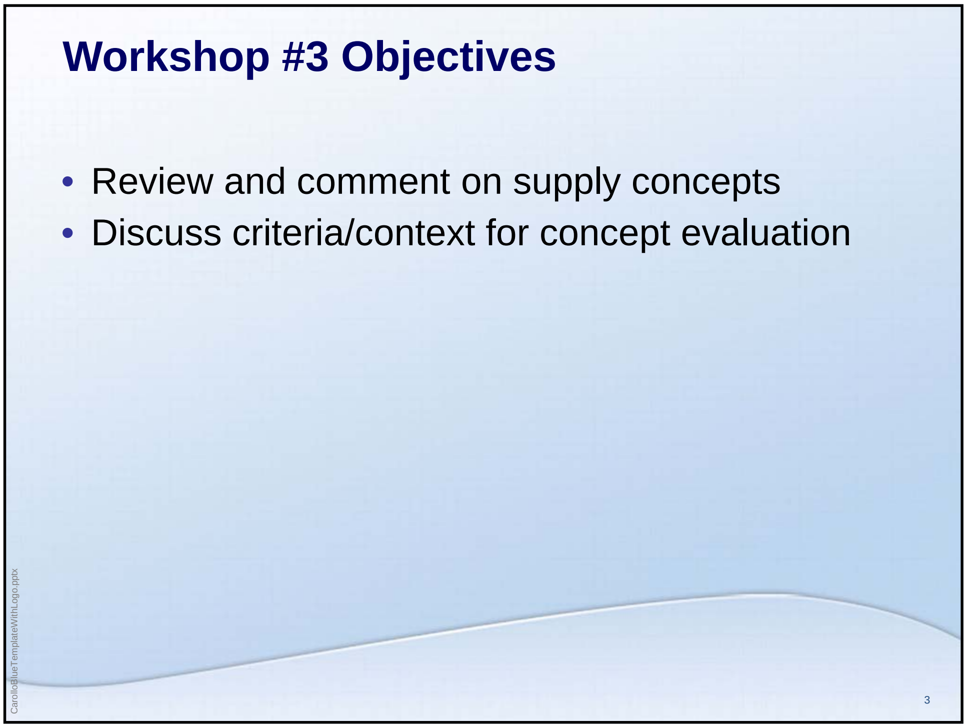
# Water Resource Management Measures and Reconnaissance Study

## 3rd Stakeholder Workshop

September 29, 2014

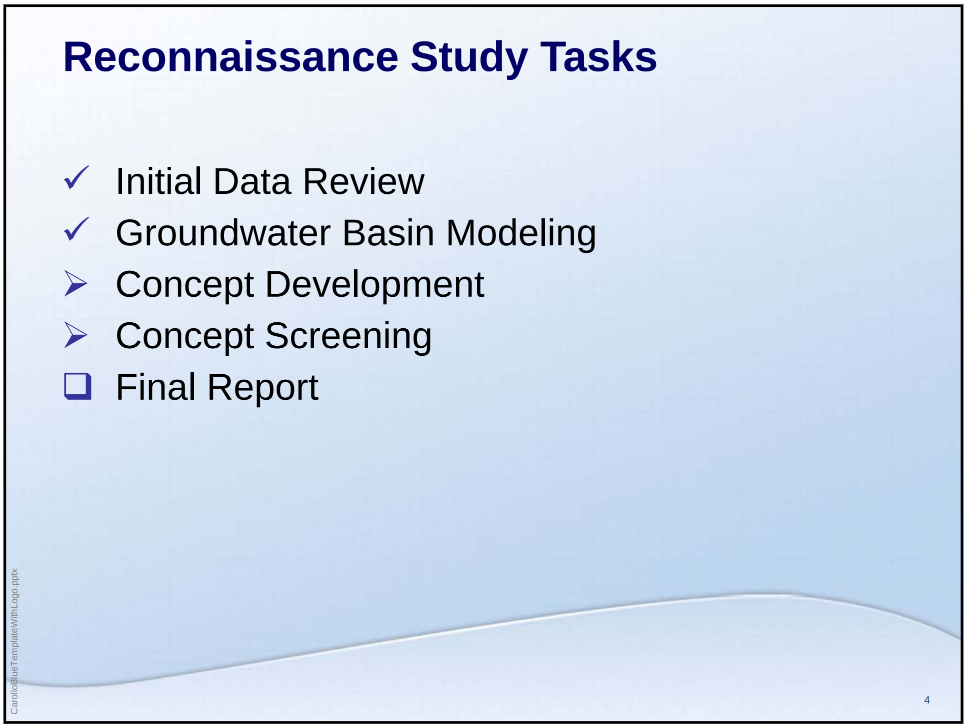
## Workshop #3 Outline

1. Introduction
2. Draft Concept Review
3. Next Steps



## Workshop #3 Objectives

- Review and comment on supply concepts
- Discuss criteria/context for concept evaluation



## Reconnaissance Study Tasks

✓ Initial Data Review
✓ Groundwater Basin Modeling
➢ Concept Development
➢ Concept Screening
❑ Final Report

## Concepts Developed From July Workshop

1. Pumping Redistribution
   - Targeting additional 5,000 afy
2. Groundwater Recharge with Recycled Water
   - Targeting 5,000 – 10,000 afy in alluvial aquifer
3. Enhanced Stormwater Capture
4. Aquifer Storage-Recovery (ASR)
   - Targeting Saugus aquifer

---

## 1. PUMPING REDISTRIBUTION

# 2. GROUNDWATER RECHARGE WITH RECYCLED WATER

## Alluvial Aquifer Recharge Locations 1 and 3

Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community

## Recycled Water Supply Availability - Current

- Valencia Plant
  - Current Plant Capacity: 21.6 mgd
  - Existing Average Inflow (2014): 15 mgd
  - Projected Effluent Diverted to River & RO Brine Losses: 8.7 mgd
    - Effluent to River includes 1.9 mgd of RO Permeate
  - Current Recycled Water Customer Usage: 325 AFY

**Available Recycled Water Supply for GWR:**

**6.3 mgd (or 7,000 AFY)**

---

## Recycled Water Supply Availability - Future

- Valencia Plant
  - Plant Capacity: 21.6 mgd
  - Average Inflow (2035): 21.3 mgd
  - Projected Effluent Diverted to River & RO Brine Losses: 8.7 mgd
    - Effluent to River includes 2 mgd of RO Permeate
  - Recycled Water Customer Usage: 325 AFY

**Available Recycled Water Supply for GWR:**

**12 mgd (or 13,000 AFY)**

# Diluent Water to Blend with Recycled Water

- 20% Blend Ratio Target
  - Based on 120 month rolling average
  - Assumed TOC Level is within Acceptable Limit
- Diluent Water Sources Utilized for Blending:
  - Surface Flow: Rainfall, Storm Water, Irrigation Runoff
  - Subsurface Flows: Lateral Groundwater Flow
    - Method 1 – Flows at and Downstream of Recharge Basins
    - Method 2 – Flows Just at Recharge Basins
- Diluent Water Values Derived from GSI Groundwater Model

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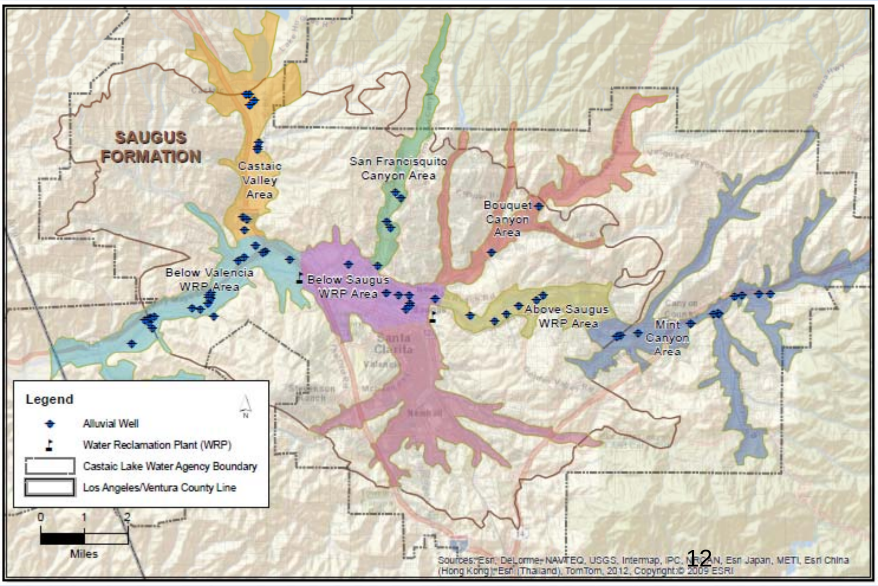
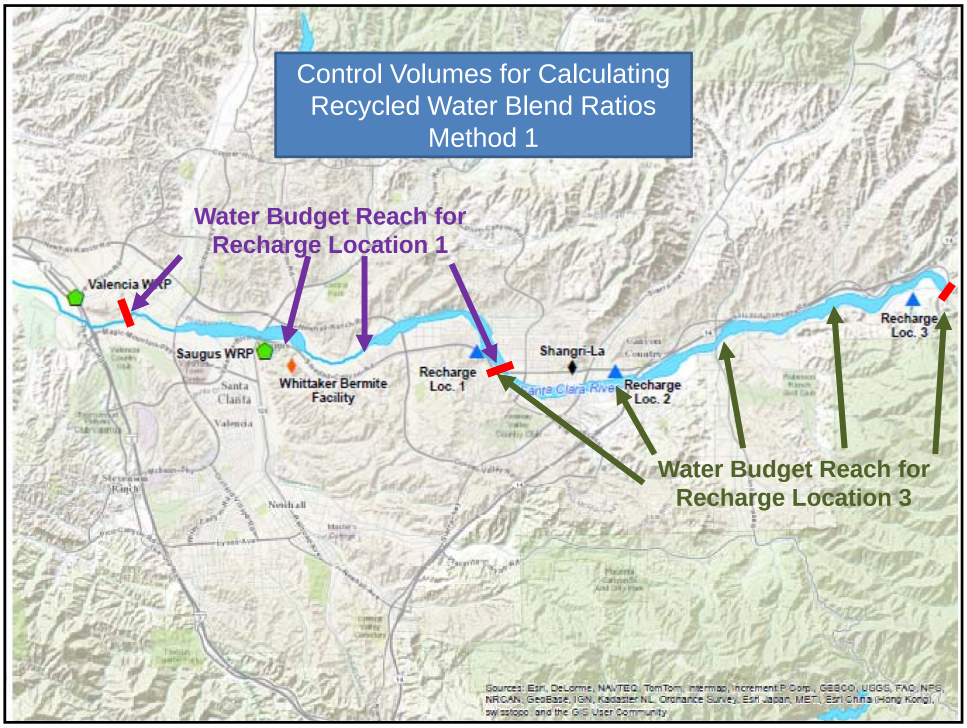
# Groundwater Sources
# Alluvial Aquifer – Subareas and Wells



Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, IPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2012, Copyright:© 2009 ESRI

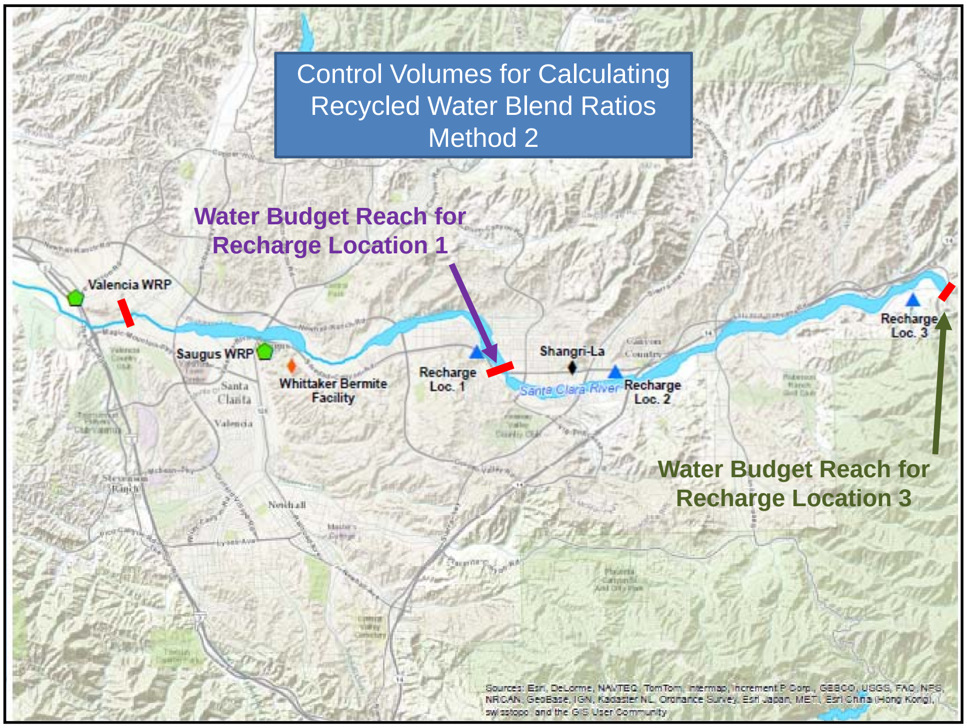


## Control Volumes for Calculating Recycled Water Blend Ratios Method 1

**Water Budget Reach for Recharge Location 1**

**Water Budget Reach for Recharge Location 3**

Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community



## Control Volumes for Calculating Recycled Water Blend Ratios Method 2

**Water Budget Reach for Recharge Location 1**

**Water Budget Reach for Recharge Location 3**

Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community

# Recycled Water Blend Calculation Method 1

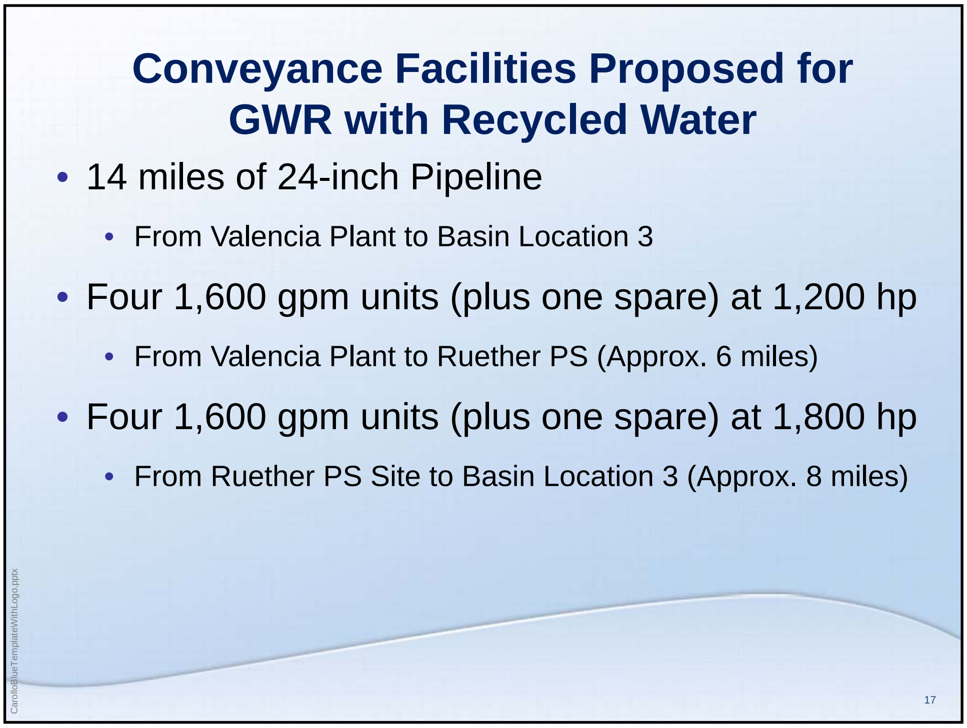
| Method 1 – Utilizes Entire Sub-Basin | | | | | |
|---|---|---|---|---|---|
| | Recharge Site | RW Available AFY | Subsurface Flow AFY | Surface Flow AFY | RWC |
| 2014 | Site 1 | 3,500 | 57,000 | 2,400 | 6% |
| | Site 3 | 3,500 | 22,000 | 100 | 11% |
| 2035 | Site 1 | 6,600 | 57,000 | 2,400 | 11% |
| | Site 3 | 6,600 | 22,000 | 100 | 21% |

- Flows are lowest 120 month rolling average over past 30 years.
- Conclusion: can get up to 10,000 AFY recycled water
- HOWEVER, approach is less conservative; may not get DDW approval.

# Recycled Water Blend Calculation Method 2

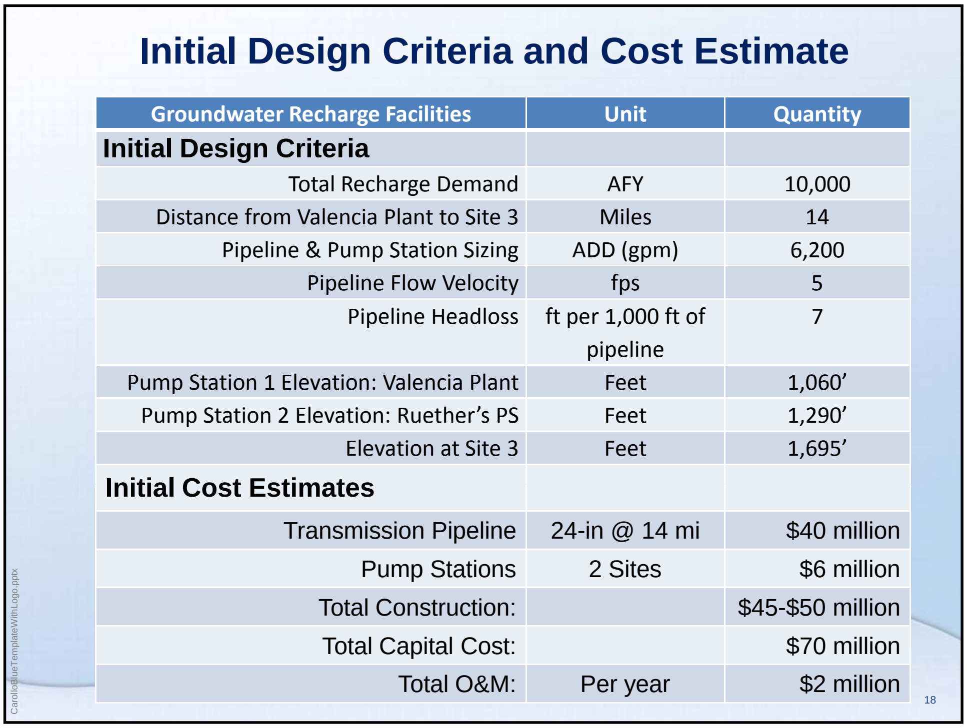
| Method 2 – Aquifer Cross Section at Recharge Location | | | | | |
|---|---|---|---|---|---|
| | Recharge Site | RW Available AFY | Subsurface Flow AFY | Surface Flow AFY | RWC |
| 2014 | Site 1 | 3,500 | 18,000 | 0 | 20% |
| | Site 3 | 3,500 | 5,000 | 0 | 70% |
| 2035 | Site 1 | 6,600 | 18,000 | 0 | 40% |
| | Site 3 | 6,600 | 5,000 | 0 | 130% |

- Flows are lowest 120 month rolling average over past 30 years.
- Conclusion: At 20% blending limit, recharge with recycled water would be limited to:
  - Site 1: 3,500 AFY
  - Site 2: 1,000 AFY
- Note: Characterization, particularly at Site 3, is VERY SPECULATIVE and likely conservative. More hydrogeological investigation is needed.



## Conveyance Facilities Proposed for GWR with Recycled Water

- 14 miles of 24-inch Pipeline
  - From Valencia Plant to Basin Location 3
- Four 1,600 gpm units (plus one spare) at 1,200 hp
  - From Valencia Plant to Ruether PS (Approx. 6 miles)
- Four 1,600 gpm units (plus one spare) at 1,800 hp
  - From Ruether PS Site to Basin Location 3 (Approx. 8 miles)



## Initial Design Criteria and Cost Estimate

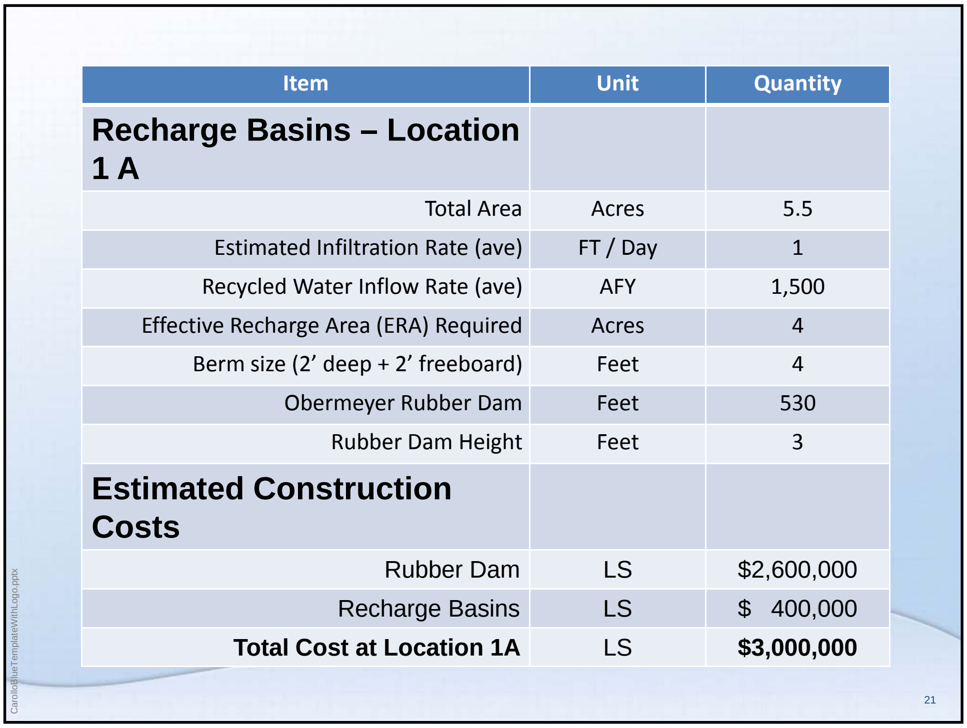
| Groundwater Recharge Facilities | Unit | Quantity |
|---|---|---|
| **Initial Design Criteria** | | |
| Total Recharge Demand | AFY | 10,000 |
| Distance from Valencia Plant to Site 3 | Miles | 14 |
| Pipeline & Pump Station Sizing | ADD (gpm) | 6,200 |
| Pipeline Flow Velocity | fps | 5 |
| Pipeline Headloss | ft per 1,000 ft of pipeline | 7 |
| Pump Station 1 Elevation: Valencia Plant | Feet | 1,060’ |
| Pump Station 2 Elevation: Ruether’s PS | Feet | 1,290’ |
| Elevation at Site 3 | Feet | 1,695’ |
| **Initial Cost Estimates** | | |
| Transmission Pipeline | 24-in @ 14 mi | $40 million |
| Pump Stations | 2 Sites | $6 million |
| Total Construction: | | $45-$50 million |
| Total Capital Cost: | | $70 million |
| Total O&M: | Per year | $2 million |

# Recharge Facilities

Rubber Dam

Recharge Basin Location 1A Approx 5.5 acres

Recycled Water Inflow

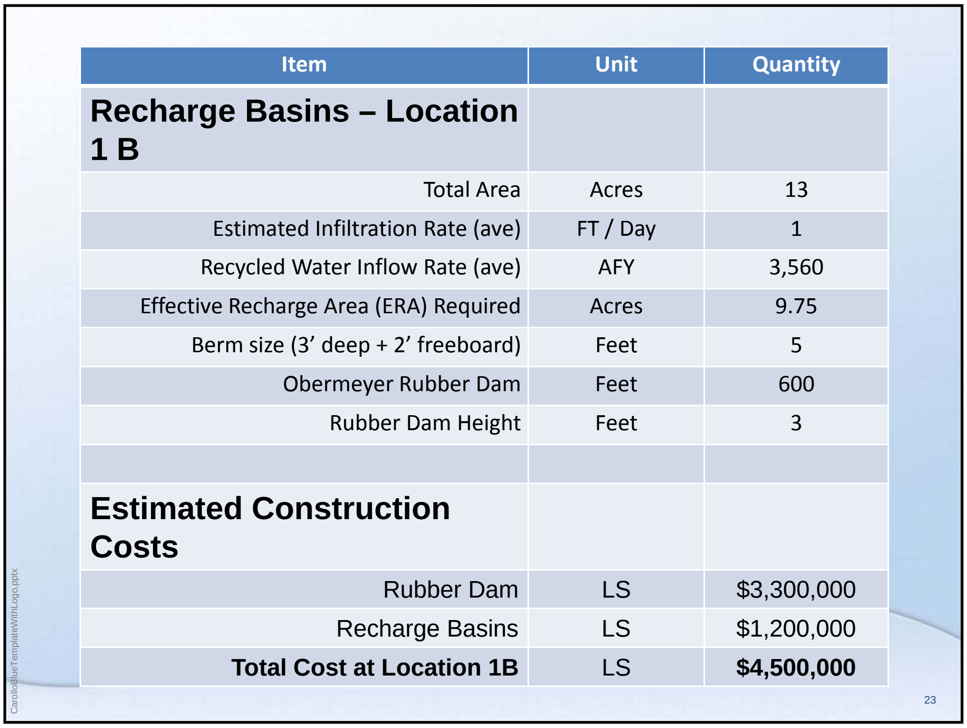


| Item | Unit | Quantity |
|---|---|---|
| **Recharge Basins – Location 1 A** | | |
| Total Area | Acres | 5.5 |
| Estimated Infiltration Rate (ave) | FT / Day | 1 |
| Recycled Water Inflow Rate (ave) | AFY | 1,500 |
| Effective Recharge Area (ERA) Required | Acres | 4 |
| Berm size (2’ deep + 2’ freeboard) | Feet | 4 |
| Obermeyer Rubber Dam | Feet | 530 |
| Rubber Dam Height | Feet | 3 |
| **Estimated Construction Costs** | | |
| Rubber Dam | LS | $2,600,000 |
| Recharge Basins | LS | $ 400,000 |
| **Total Cost at Location 1A** | LS | **$3,000,000** |

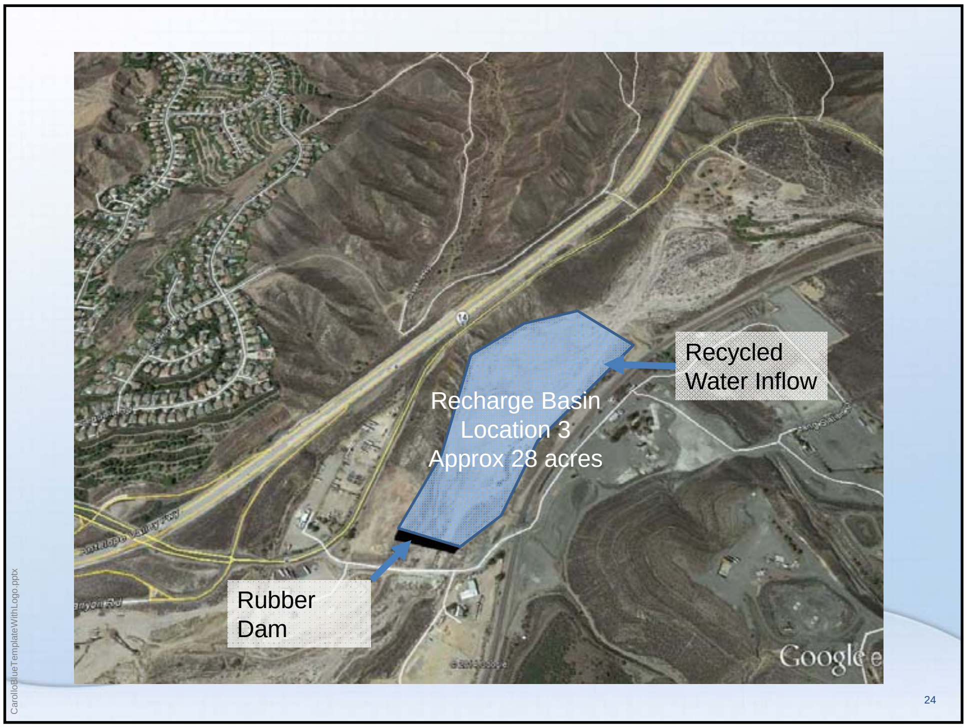
Rubber Dam

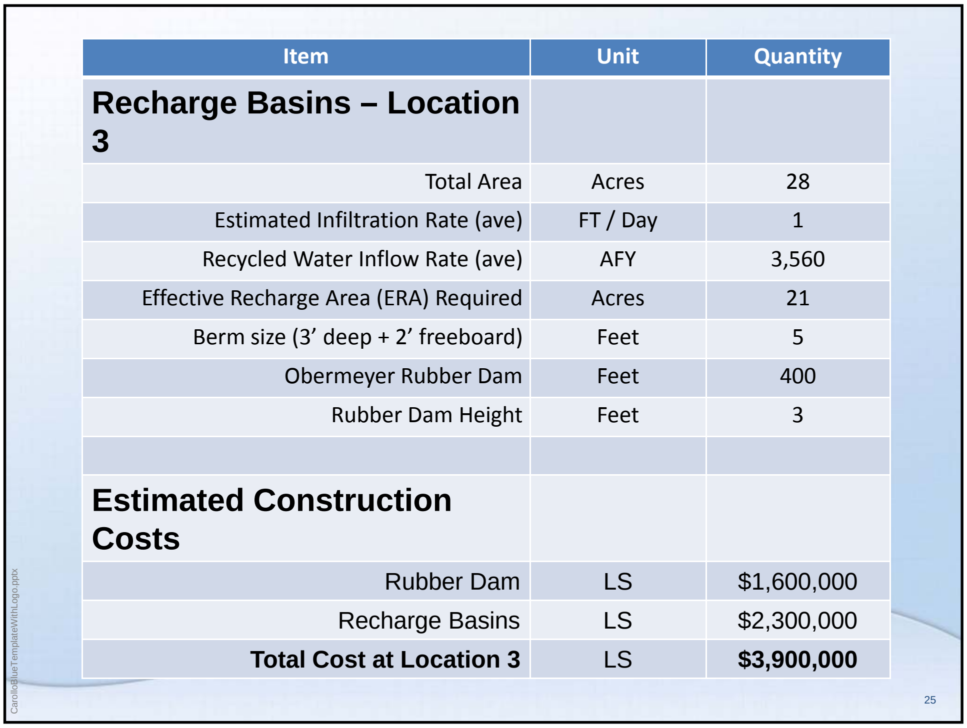
Recharge Basin – Location 1B
Approx. 13 acres

Recycled Water Inflow

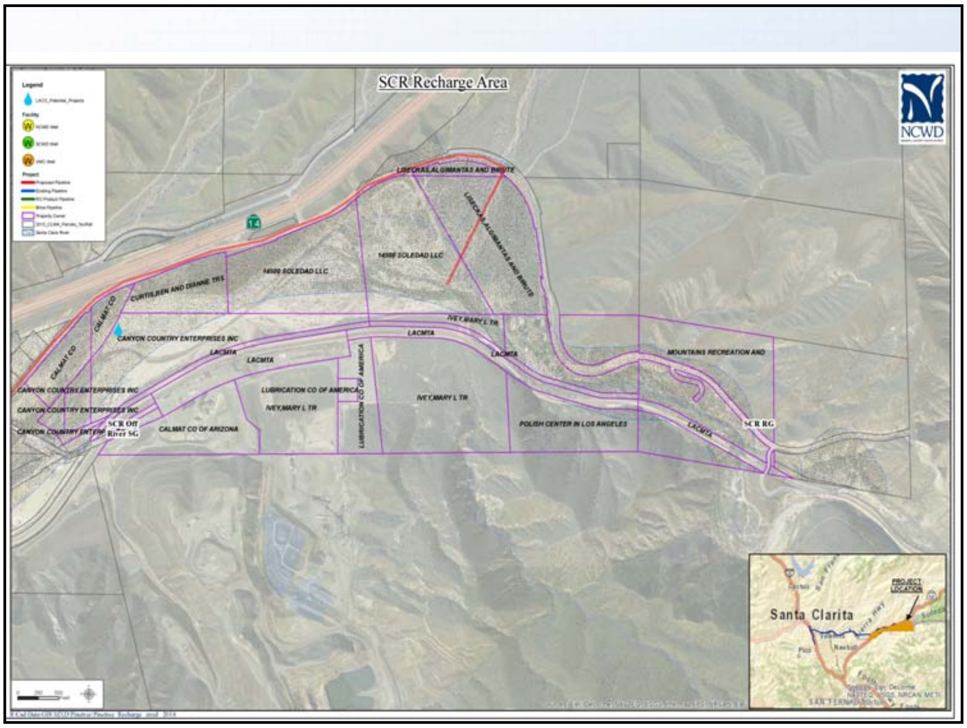


| Item | Unit | Quantity |
|---|---|---|
| **Recharge Basins – Location 1 B** | | |
| Total Area | Acres | 13 |
| Estimated Infiltration Rate (ave) | FT / Day | 1 |
| Recycled Water Inflow Rate (ave) | AFY | 3,560 |
| Effective Recharge Area (ERA) Required | Acres | 9.75 |
| Berm size (3’ deep + 2’ freeboard) | Feet | 5 |
| Obermeyer Rubber Dam | Feet | 600 |
| Rubber Dam Height | Feet | 3 |
| | | |
| **Estimated Construction Costs** | | |
| Rubber Dam | LS | $3,300,000 |
| Recharge Basins | LS | $1,200,000 |
| **Total Cost at Location 1B** | LS | **$4,500,000** |





| Item | Unit | Quantity |
|---|---|---|
| **Recharge Basins – Location 3** | | |
| Total Area | Acres | 28 |
| Estimated Infiltration Rate (ave) | FT / Day | 1 |
| Recycled Water Inflow Rate (ave) | AFY | 3,560 |
| Effective Recharge Area (ERA) Required | Acres | 21 |
| Berm size (3’ deep + 2’ freeboard) | Feet | 5 |
| Obermeyer Rubber Dam | Feet | 400 |
| Rubber Dam Height | Feet | 3 |
| | | |
| **Estimated Construction Costs** | | |
| Rubber Dam | LS | $1,600,000 |
| Recharge Basins | LS | $2,300,000 |
| **Total Cost at Location 3** | LS | **$3,900,000** |



## Preliminary Conclusions on Recycled Water for Groundwater Recharge

- Long-term, sufficient recycled supply is available
- Recycled water blend ratio will control recharge:
  - Need to confirm hydrogeology at Site 3
  - Consider using SWP for blending?
- Begin contemplating land for recharge sites
- Refine cost estimates:
  - Currently at 10,000 AFY, estimated cost is ~$1,000 - $1,500/AF

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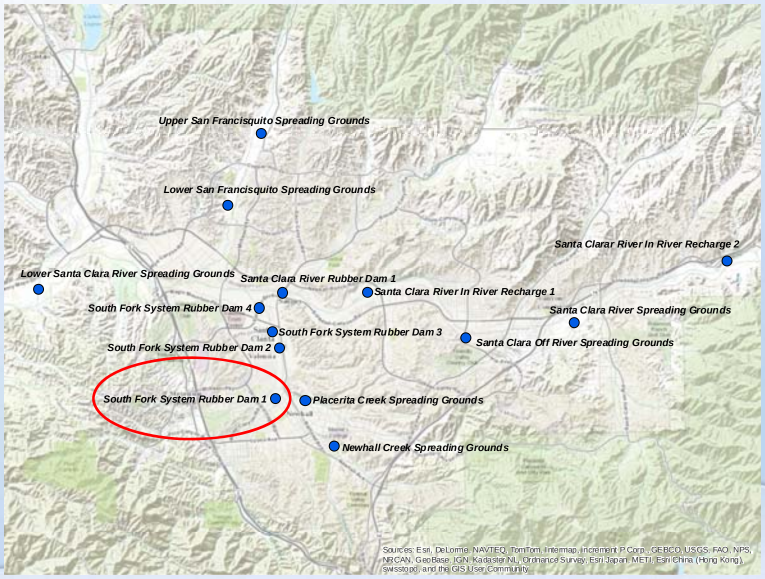
## 3. ENHANCED STORMWATER CAPTURE

# 2007 Water Conservation Feasibility Study - Projects Locations



Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community

# 2007 Water Conservation Feasibility Study Projects

– Average of three storms a year capable of producing sufficient runoff to fill proposed facilities

| Project | Size | Conservation Potential |
|---|---|---|
| South Fork rubber dam #1 at Pedestrian Bridge | 134 af | 402 afy |
| South Fork rubber dam #2 near Covala Dr | 32 af | 96 afy |
| South Fork rubber dam #3 | 44 af | 132 afy |
| South Fork rubber dam #4 at Valencia Bridge | 115 af | 340 afy |
| SCR rubber dam at Bouquet Canyon | 80 af | 270 afy |
| SCR in-stream spreading grounds #1 | 180 af | 550 afy |
| SCR off stream spreading grounds | 220 af | 670 afy |
| SCR in-stream spreading grounds #2 | 70 af | 220 afy |
| SCR spreading grounds at Sand Canyon Rd | 350 af | 1,040 afy |
| SCR spreading grounds at Franklin Parkway | - | - |
| Placerita Creek spreading grounds | 75 af | 220 afy |
| Newhall Creek spreading grounds | - | 75 afy |
| Upper San Francisquito Spreading Grounds | 230 af | 700 afy |
| Lower San Francisquito Spreading Grounds | 190 af | 570 afy |
| **Total** | **1,800 af** | **5,500 afy** |

## Conclusions on Stormwater Capture

- Met with Los Angeles County DPW
- County has developed designs for Dam #1 on South Fork with estimates for Dams 1, 2 and 3
- Estimated yield:  660 AFY
- Estimated cost:  $9 - $10 million
- Conclusions:
  - Yields need to be confirmed
  - At reported yield, cost is ~$2,000/AF
  - Not enough yield to meet recon study objectives alone

## 4. AQUIFER STORAGE AND RECOVERY

# NEXT STEPS

---

## Reconnaissance Study Next Steps

- Finalize concepts:
  - Refine estimated costs (including $/AF)
  - Review feasibility and determine next steps
- Screen concepts; prepare recommendations
- Draft report
- Final Report

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# CLWA Water Resources Reconnaissance Study

## Updated & Refined Modeling Analyses

*Further Evaluation of Concepts Discussed in Task 2 Workshop*

*Prepared for*

Task 3 Workshop

*Prepared by*

John Porcello - GSI Water Solutions

*September 29, 2014*

---

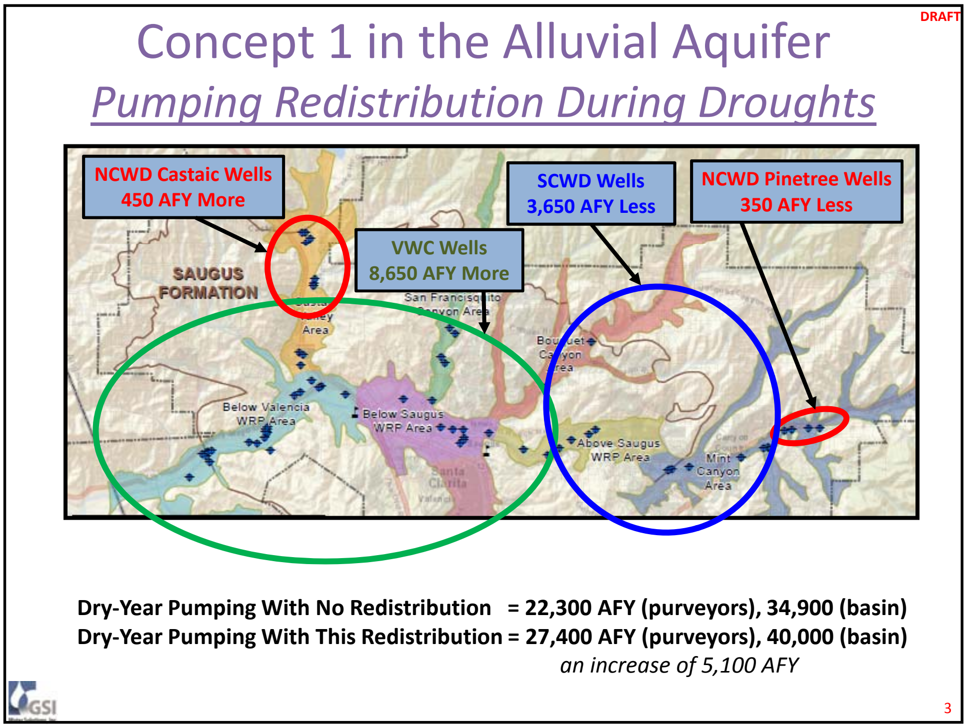
# Recent Refined Model Testing of Redistribution and ASR Concepts

## Topics

1. Redistribution (Concept #1)
    - Alluvial Aquifer – spatial relocation
    - Saugus Formation – new wells, and higher pumping
2. ASR (Concept #4)
    - Injection and recovery
    - Injection only

# Concept 1 in the Alluvial Aquifer

## *Pumping Redistribution During Droughts*



**NCWD Castaic Wells 450 AFY More**

**VWC Wells 8,650 AFY More**

**SCWD Wells 3,650 AFY Less**

**NCWD Pinetree Wells 350 AFY Less**

**Dry-Year Pumping With No Redistribution = 22,300 AFY (purveyors), 34,900 (basin)**
**Dry-Year Pumping With This Redistribution = 27,400 AFY (purveyors), 40,000 (basin)**
*an increase of 5,100 AFY*

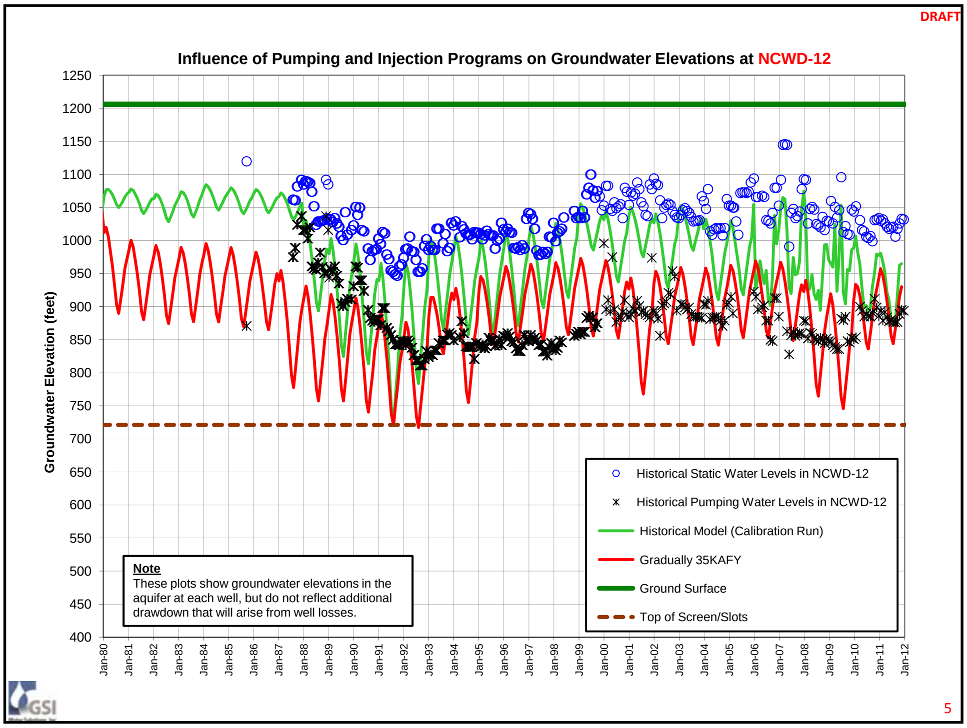
---

# Concept 1 in the Saugus Formation

## *Pumping Redistribution During Droughts*

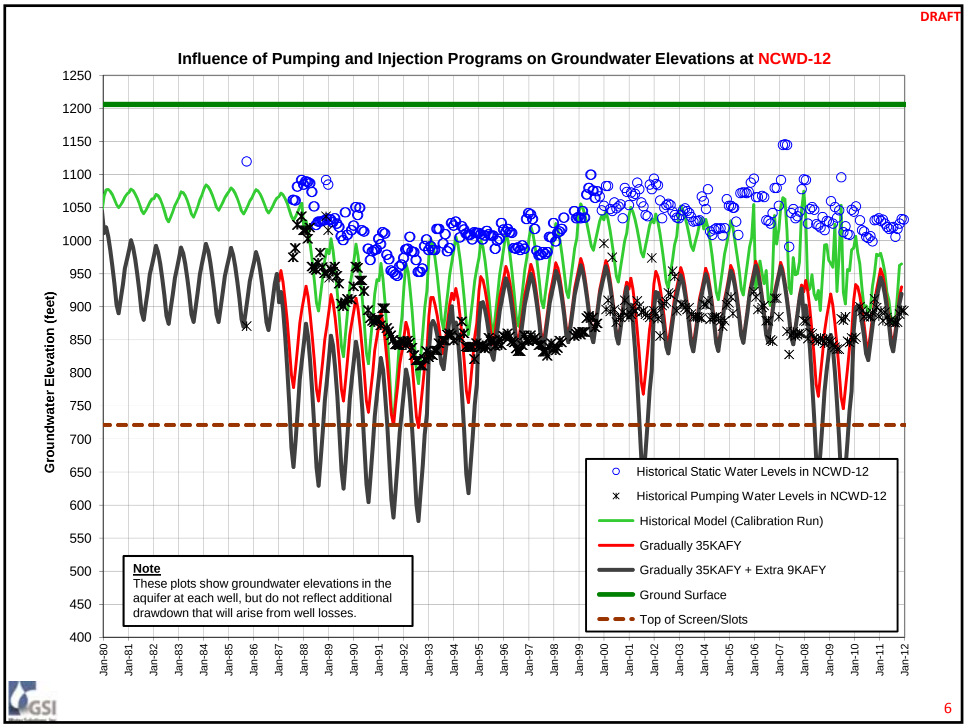
## Conclusions

1. The aquifer can support 35,000 AFY or more of yield
2. Might not be able to sustain this at some wells
   - Operating constraints
     - Water levels lower than in past, higher pumping costs
     - Water levels close to screen / perforations in some wells
     - Pump depths and operating set points
   - Wells
     - Primarily NCWD
     - Should be evaluated closely at other Saugus wells
   - Might need more Saugus wells
     - Even multi-level wells?



**Note**
These plots show groundwater elevations in the aquifer at each well, but do not reflect additional drawdown that will arise from well losses.

5



**Note**
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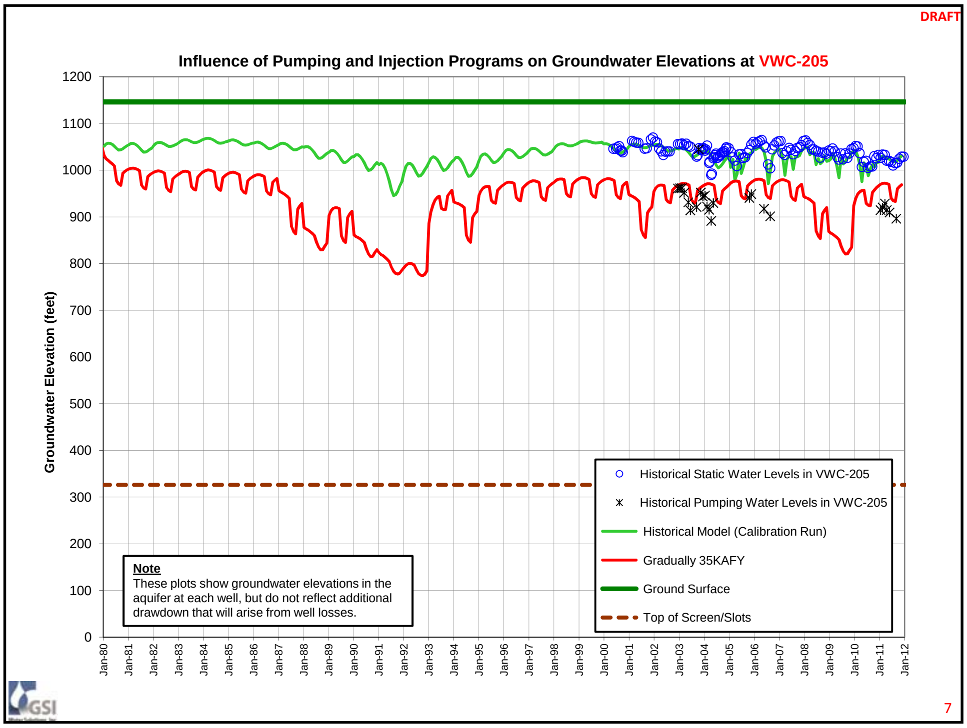
6

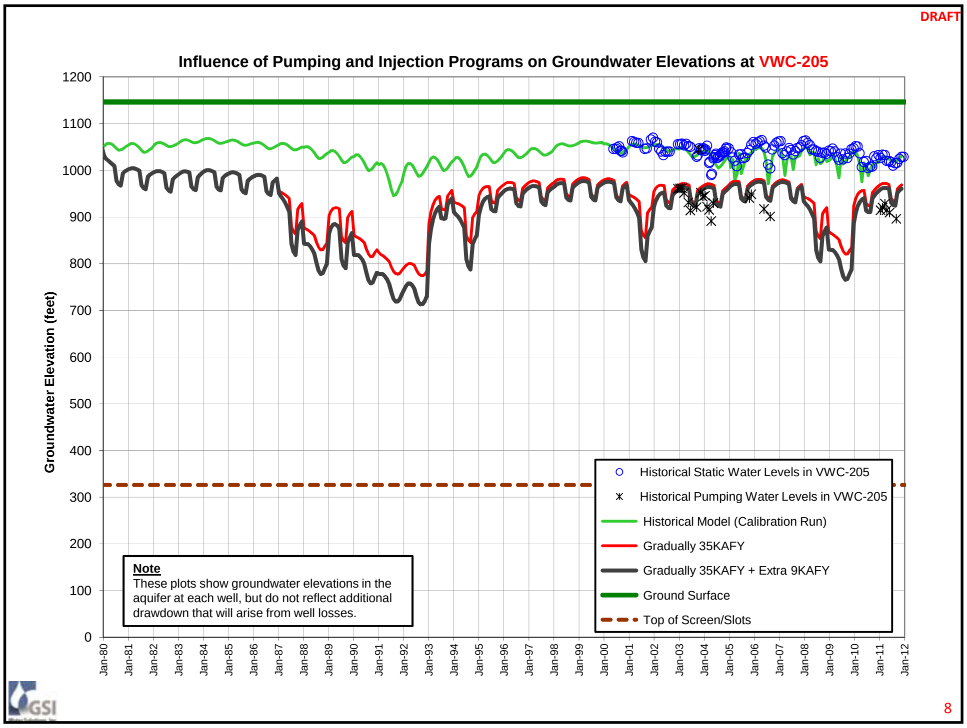


DRAFT

**Influence of Pumping and Injection Programs on Groundwater Elevations at VWC-205**

- ○ Historical Static Water Levels in VWC-205
- ✕ Historical Pumping Water Levels in VWC-205
- Historical Model (Calibration Run)
- Gradually 35KAFY
- Ground Surface
- Top of Screen/Slots

**Note**
These plots show groundwater elevations in the aquifer at each well, but do not reflect additional drawdown that will arise from well losses.

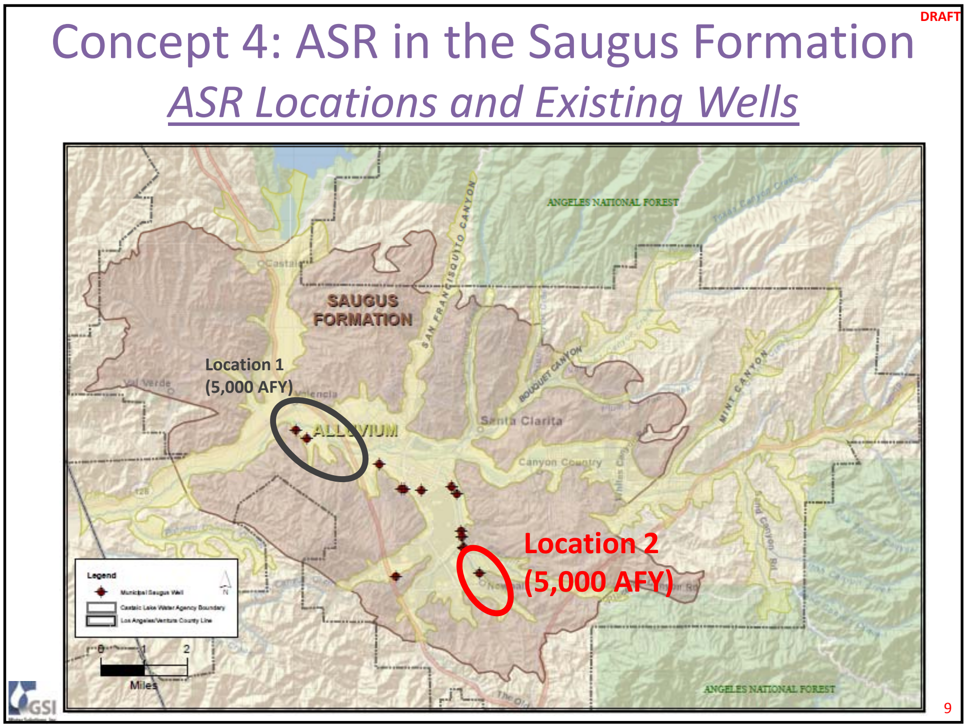


DRAFT

**Influence of Pumping and Injection Programs on Groundwater Elevations at VWC-205**

- ○ Historical Static Water Levels in VWC-205
- ✕ Historical Pumping Water Levels in VWC-205
- Historical Model (Calibration Run)
- Gradually 35KAFY
- Gradually 35KAFY + Extra 9KAFY
- Ground Surface
- Top of Screen/Slots

**Note**
These plots show groundwater elevations in the aquifer at each well, but do not reflect additional drawdown that will arise from well losses.



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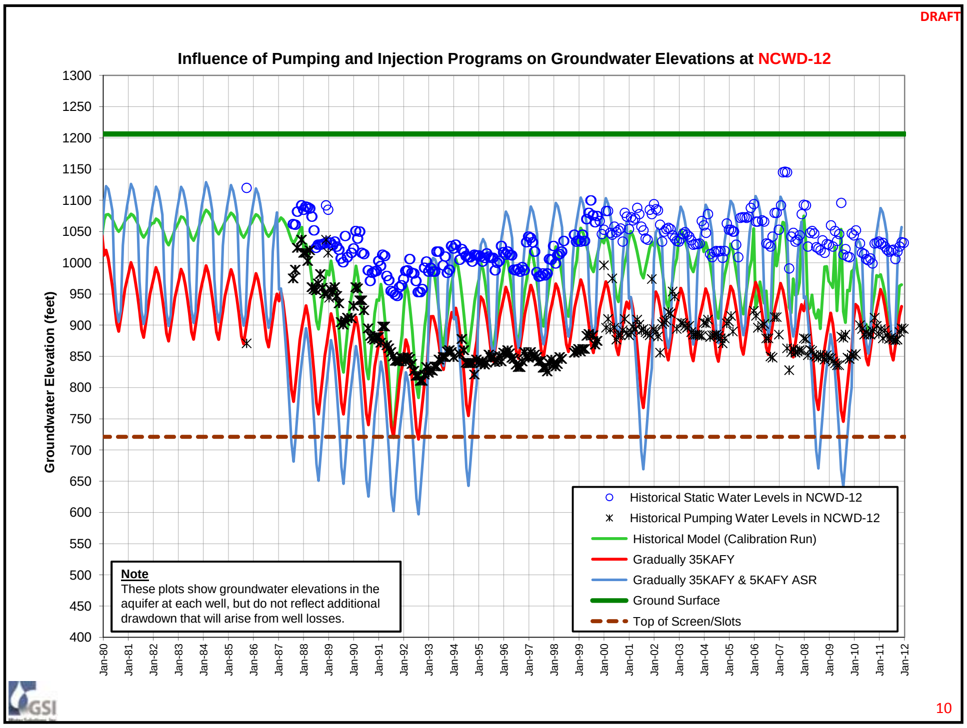
# Concept 4: ASR in the Saugus Formation

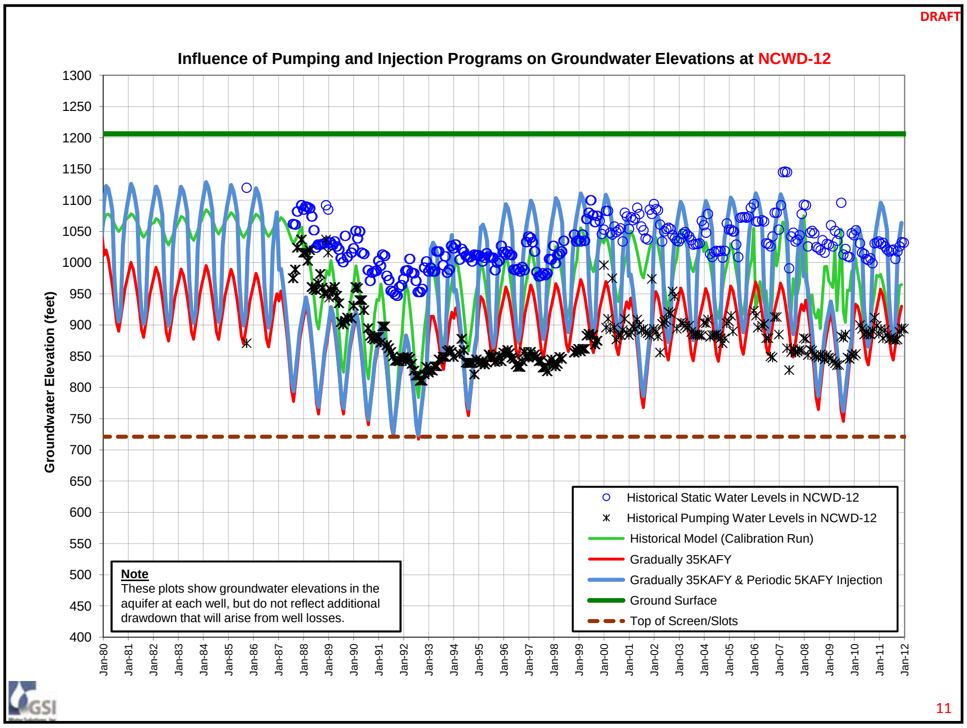
## *ASR Locations and Existing Wells*



DRAFT

Influence of Pumping and Injection Programs on Groundwater Elevations at NCWD-12

**Note**
These plots show groundwater elevations in the aquifer at each well, but do not reflect additional drawdown that will arise from well losses.



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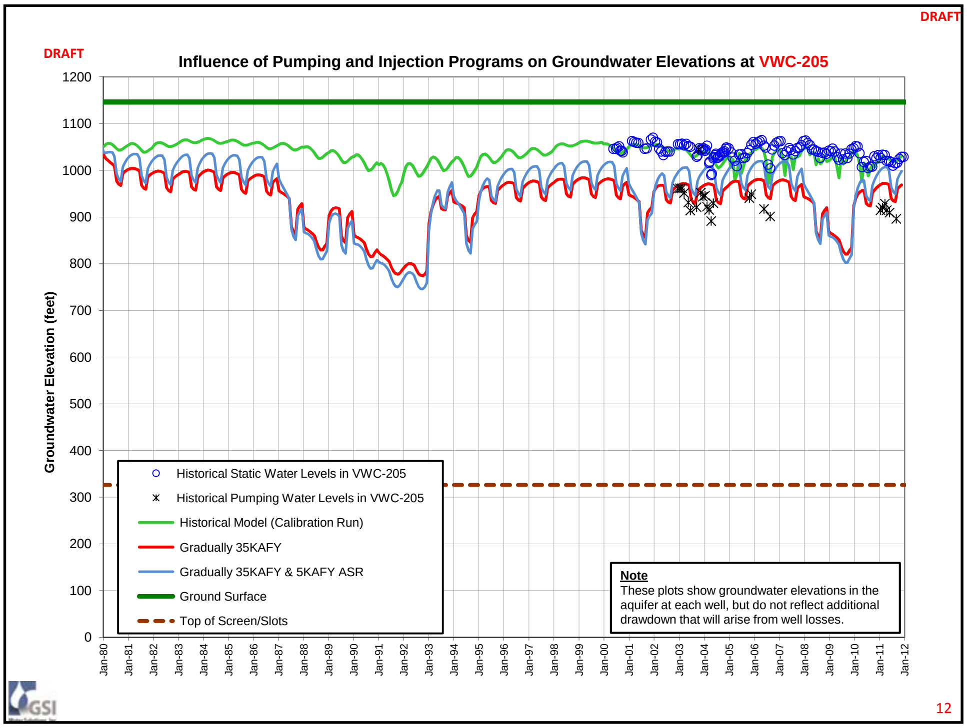
Influence of Pumping and Injection Programs on Groundwater Elevations at NCWD-12

**Note**
These plots show groundwater elevations in the aquifer at each well, but do not reflect additional drawdown that will arise from well losses.

11



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Influence of Pumping and Injection Programs on Groundwater Elevations at VWC-205

**Note**
These plots show groundwater elevations in the aquifer at each well, but do not reflect additional drawdown that will arise from well losses.

12

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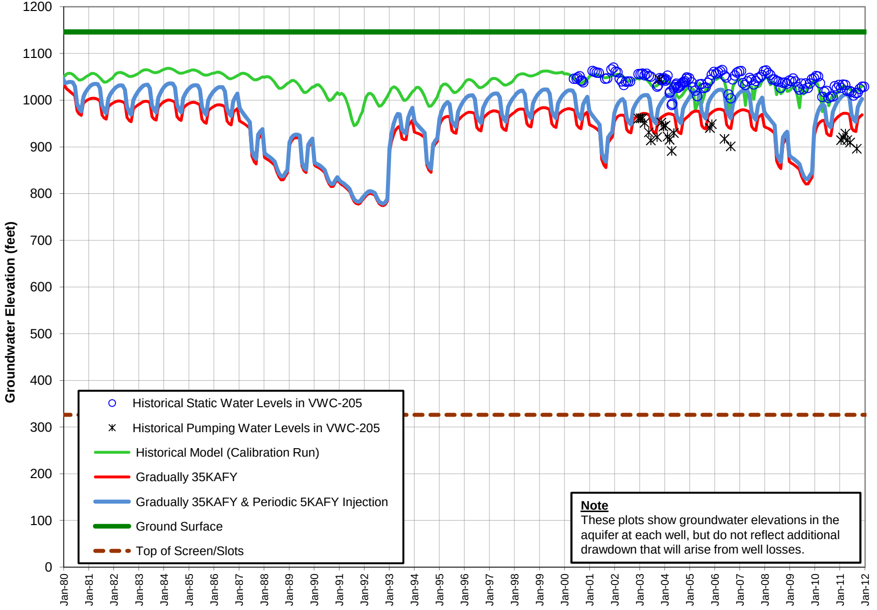
### Influence of Pumping and Injection Programs on Groundwater Elevations at VWC-205



**Note**
These plots show groundwater elevations in the aquifer at each well, but do not reflect additional drawdown that will arise from well losses.

GSI

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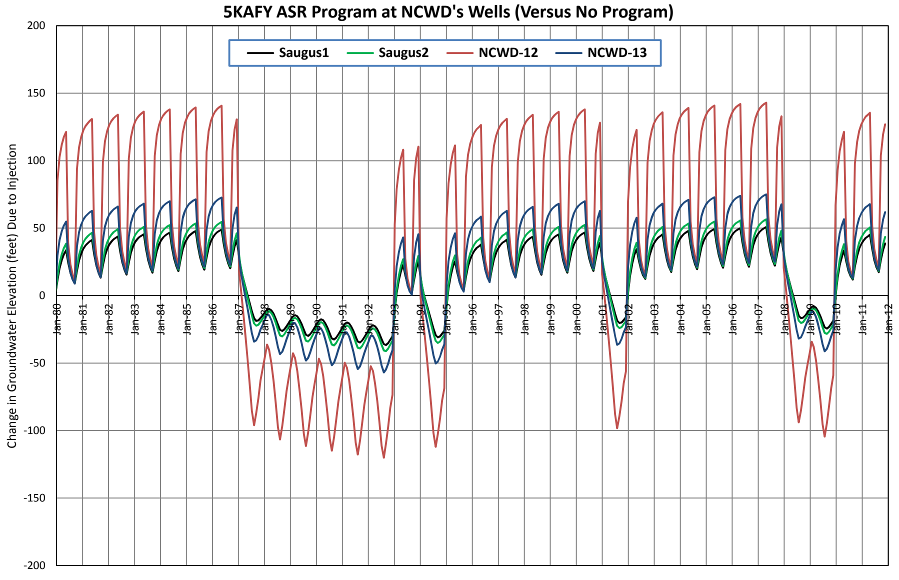
### Effect on Groundwater Levels in SCWD & NCWD Wells of a 5KAFY ASR Program at NCWD's Wells (Versus No Program)



GSI

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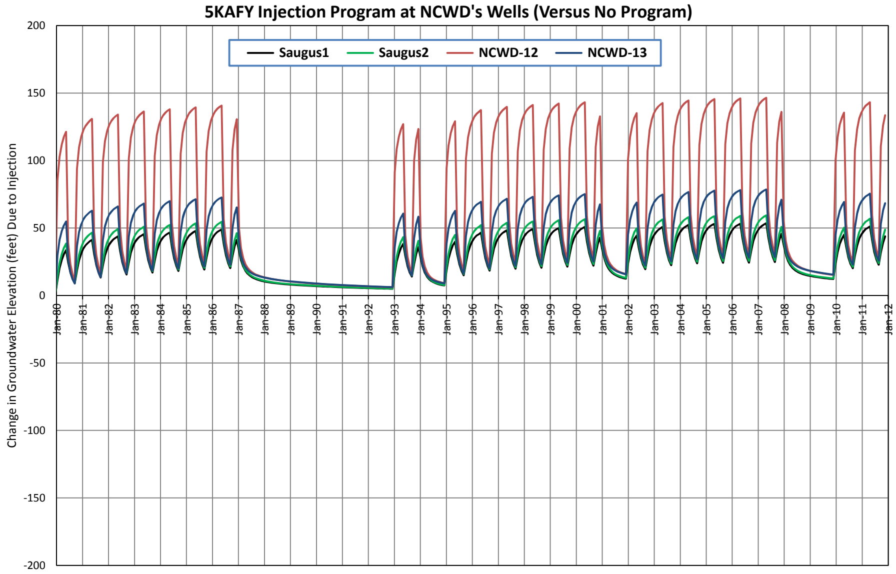
## Benefit to Groundwater Levels in SCWD & NCWD Wells of a 5KAFY Injection Program at NCWD's Wells (Versus No Program)



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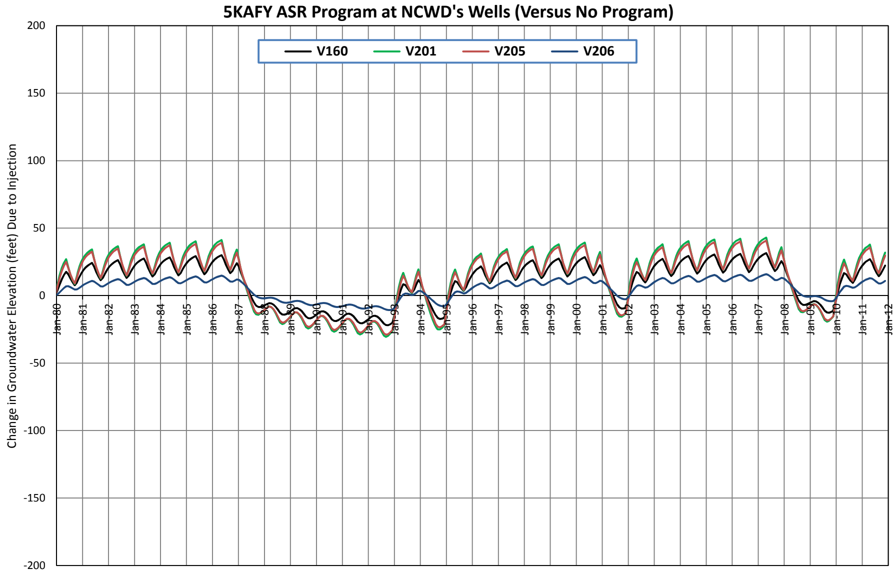
DRAFT

## Effect on Groundwater Levels in VWC Wells of a 5KAFY ASR Program at NCWD's Wells (Versus No Program)



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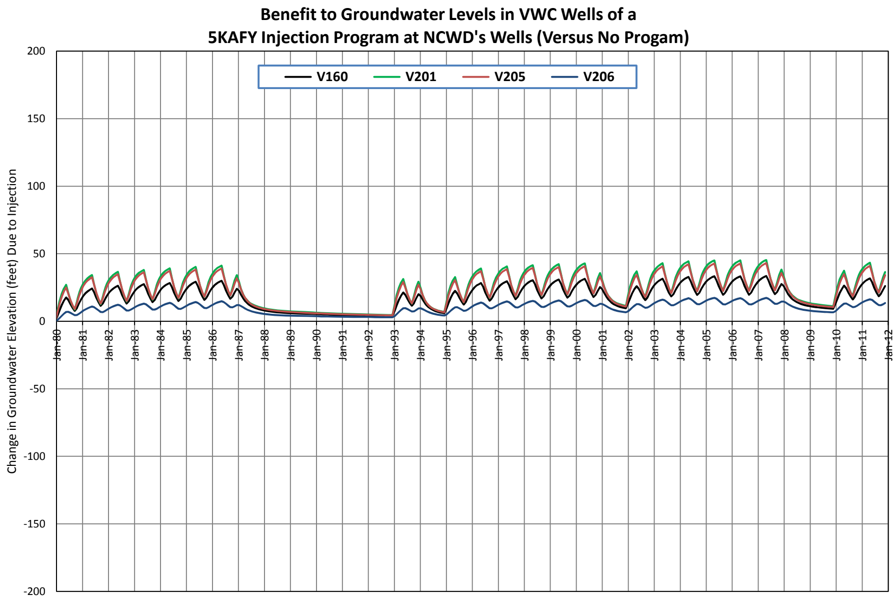


Benefit to Groundwater Levels in VWC Wells of a 5KAFY Injection Program at NCWD's Wells (Versus No Progam)

DRAFT

# Concept 4

## *Operations and ASR in the Saugus Formation*

## Items for Future Evaluation

1. Conduct more detailed review of operations
   - Pump settings and pump curves, relative to depth to water
   - Ability to maintain target pumping rates
2. Consider injecting more than 5,000 AFY in general vicinity of Location 2 when SWP water is available
   - Addresses potential operational issues at NCWD wells
   - Raises groundwater levels at other existing Saugus wells
3. Evaluate effect of injection on perchlorate containment

DRAFT

# Planning-Level Cost Estimate for 2 MGD ASR Program

| | Capital | Engineering | O&M |
|---|---|---|---|
| Retrofit Existing Well | $720K | $120K | $400K |
| | | | |
| New Well | $3.12M | $468K | $400K |

Contingency added to capital = 20%
Engineering = 15% of capital cost
O&M for 2MGD system (based on City of Beaverton, Oregon actual costs)
Does not include land cost
Assumes that pump to waste available on-site - storm/sanitary discharge
No permitting cost included

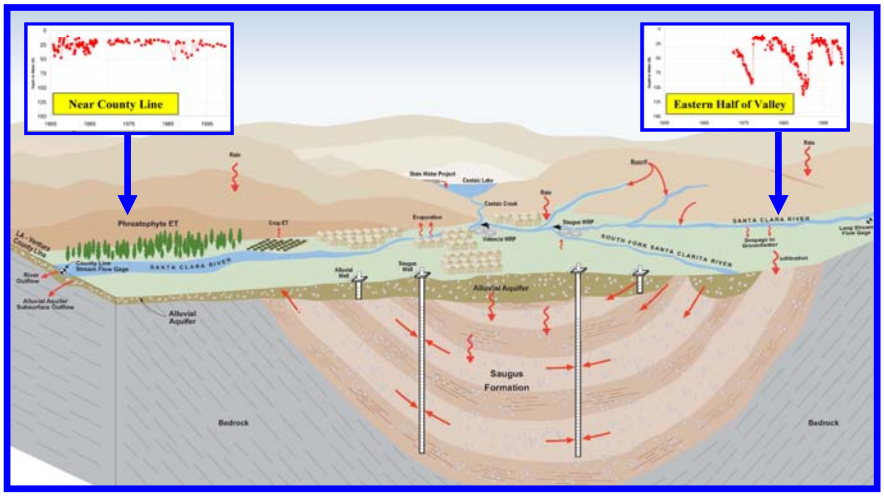
DRAFT

# Discussion, Questions

John J. Porcello – GSI Water Solutions

*with assistance from Jeff Barry/GSI and Tom West/Carollo*

(503) 239-8799



## APPENDIX B-4

# Workshop 4 Materials

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# Water Resources Reconnaissance Study

## Concept Update and Screening Discussion

Castaic Lake Water Agency
December 19, 2014

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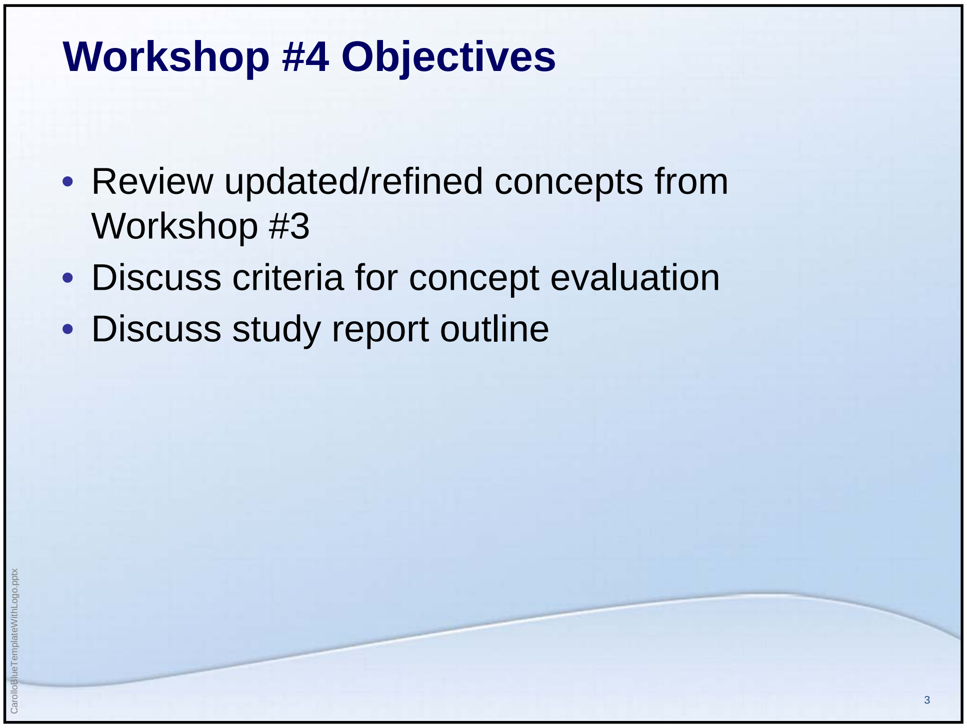
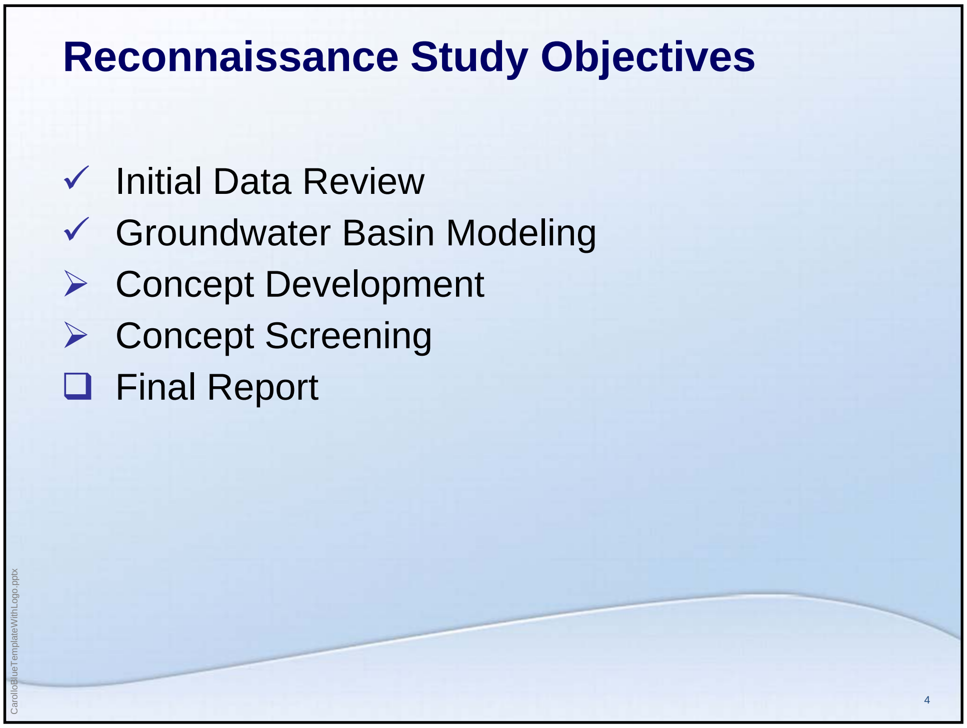
## Agenda

1. Review updated concepts
2. Review criteria for screening/evaluation
3. Study report



## Workshop #4 Objectives

- Review updated/refined concepts from Workshop #3
- Discuss criteria for concept evaluation
- Discuss study report outline



## Reconnaissance Study Objectives

✓ Initial Data Review
✓ Groundwater Basin Modeling
➢ Concept Development
➢ Concept Screening
❑ Final Report

# 1. REVIEW UPDATED CONCEPTS

## Concepts

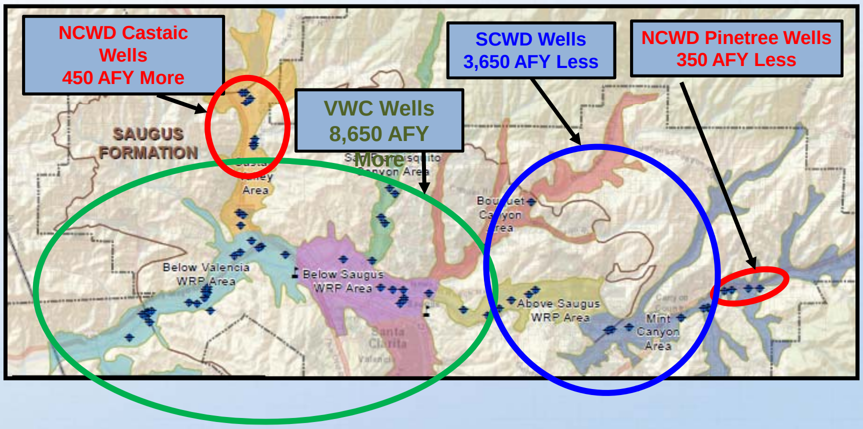
1. Pumping Redistribution
2. Groundwater Replenishment with Recycled Water.
3. Enhanced Stormwater Capture
4. Aquifer Storage/Recovery

## Summary of Conclusions from Sept. 29 Workshop No. 3

1. Pumping Redistribution
    - *Possible with some hydraulic and water quality considerations*
2. Groundwater Replenishment with Recycled Water
    - *Tertiary water recharge constrained by blending ratio*
    - *Consider other alternatives to improve concept*
3. Enhanced Stormwater Capture
    - *Limited volume, low cost effectiveness on its own*
4. Aquifer Storage/Recovery
    - *Provides benefits to the basin; further analysis needed to refine*
    - *Need to use SWP water when available*

## 1. PUMPING REDISTRIBUTION

## Preliminary Pumping Re-distribution Conclusions Presented Sept. 29



NCWD Castaic Wells
450 AFY More

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8,650 AFY More

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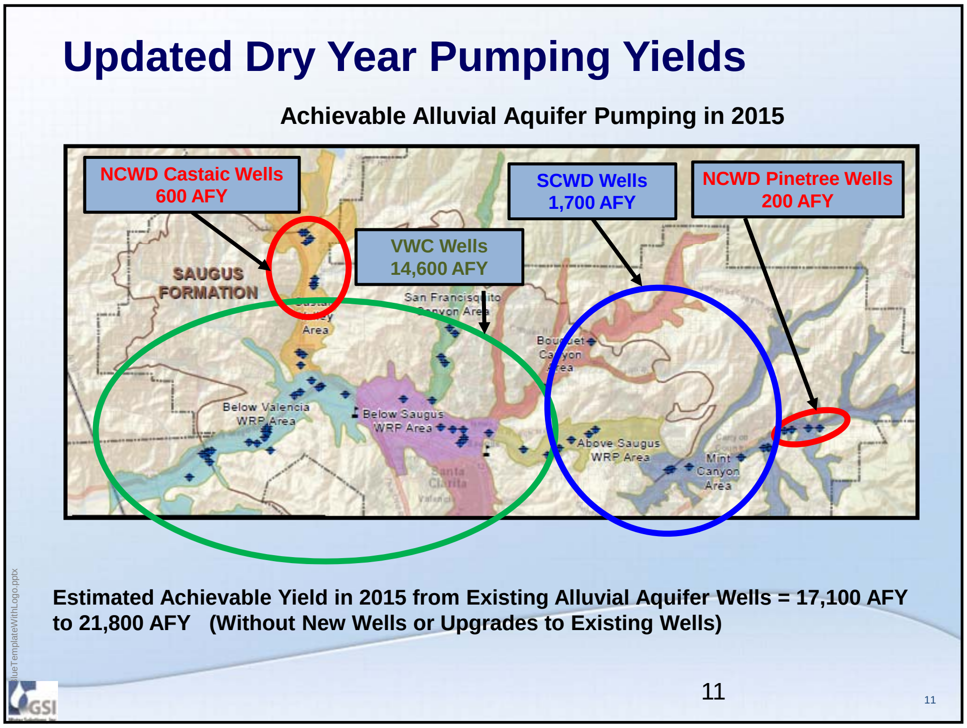
350 AFY Less

**Dry-Year Pumping With No Redistribution = 22,300 AFY (purveyors), 34,900 (basin)**
**Dry-Year Pumping With This Redistribution = 27,400 AFY (purveyors), 40,000 (basin)**
*an increase of 5,100 AFY*

## Dry Year Analysis Conducted Since Sept. 29 workshop

- Dry year yields under current conditions appear to be less that previously assumed
- Influences appear to be:
  - Hydrologic changes different from historical conditions
  - Infrastructure limitations
- Yields may improve with the following:
  - Rainfall, stream flow, and groundwater recharge
  - Infrastructure Improvements (e.g. Lower Pumps at Well Sites)
  - Construct new wells within the Alluvial Aquifer to account for the pumping deficit



# Updated Dry Year Pumping Yields

Achievable Alluvial Aquifer Pumping in 2015

**NCWD Castaic Wells**
600 AFY

**VWC Wells**
14,600 AFY

**SCWD Wells**
1,700 AFY

**NCWD Pinetree Wells**
200 AFY

Estimated Achievable Yield in 2015 from Existing Alluvial Aquifer Wells = 17,100 AFY to 21,800 AFY (Without New Wells or Upgrades to Existing Wells)

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# 2. GROUNDWATER RECHARGE WITH RECYCLED WATER

## Alluvial Aquifer Recharge Locations 1 and 3

Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community

## Estimated Recycled Water Supply Availability

- Valencia Plant
  - 2014 available: 7,000 AFY
  - 2035 available: 13,000 AFY
- Saugus Plant:
  - 2014 available: 500 AFY
  - 2035 available: 2,000 AFY

- Accounts for brine losses, RO discharges, and committed flows to the SC River.

# Recharge with Tertiary Water Limited by Blend Ratio

**Method 2 – Aquifer Cross Section at Recharge Location**

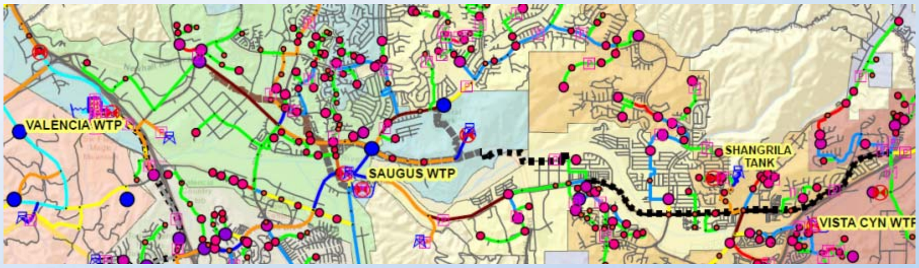
| | Recharge Site | RW Available AFY | Subsurface Flow AFY | Surface Flow AFY | RWC |
|---|---|---|---|---|---|
| 2014 | Site 1 | 3,500 | 18,000 | 0 | 20% |
| | Site 3 | 3,500 | 5,000 | 0 | 70% |
| 2035 | Site 1 | 6,600 | 18,000 | 0 | 40% |
| | Site 3 | 6,600 | 5,000 | 0 | 130% |

- Flows are lowest 120 month rolling average over past 30 years.
- Conclusion: At 20% blending limit, recharge with recycled water would be limited to:
  - Site 1: 3,500 AFY
  - Site 3: 1,000 AFY

# Revised GWR-RW Analysis

- Site 3 was removed from the analysis due to the distance and limited recycled water blending
- Incorporate non-potable customers en route to recharge basin to offset costs per AF
- The hydrogeology of Site 1 is the most suitable for GWR and is estimated to provide at least 6 month travel time to nearest wells
- Re-consider using more RO treatment to increase blend ratio

# Consider Potential Non-Potable Demand Along Route to Recharge Location



- Estimated Non-Potable Demand Along Alignment = 500 - 2,000 AFY

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# Previous Conveyance Facilities Proposed for GWR-RW

- 14 miles of 24-inch Pipeline
  - From Valencia Plant to Basin Locations 1 and 3
- Four 1,600 gpm units (plus one spare) at 1,200 hp
  - From Valencia Plant to Ruether PS (Approx. 6 miles)
- Four 1,600 gpm units (plus one spare) at 1,800 hp
  - From Ruether PS Site to Basin Location 3 (Approx. 8 miles)
- **Total capital cost: $70 million**
- *Note: sized for 10,000 afy. Will consider downsizing to 4,500 afy and add in non-potable demands en route.*

# Conveyance Facilities Proposed for Revised GWR Analysis

Revised Conveyance Facilities Using Updated GWR Potential & Estimated Non-Potable Customer Usage:

- 9 miles of 18-inch Pipeline
  - From Valencia Plant to Basin Location 1
- Four 875 gpm units (plus one spare) at 700 hp
  - From Valencia Plant to Ruether PS (Approx. 6 miles)
- Four 875 gpm units (plus one spare) at 600 hp
  - From Ruether PS Site to Basin Location 1 (Approx. 3 miles)
- **Total capital cost: $45 million**

# Other GWR-RW Concepts Under Evaluation

A. Increased pumping in VWC area to draw more recycled water from SC River
  - Limitations with existing infrastructure, hydraulics to move water out
  - Hardness at well sites would need to be addressed
  - 6 mo. travel time requirement may be an issue

B. Recharge in other locations with 6 mo. travel time
  - Issues with infiltration at closer upstream locations due to hydrogeology

C. Expand RO water use (lowers TOC and TDS means increased blend ratio) but would take >10 years.
  - Need for brine line ($85 million). Puts cost at >$2,000 AF.
  - Consider in the context of Full Advanced Treatment for full available WRP flow to improve cost effectiveness

D. Consider Alternative technology to RO to lower TOC
  - Ozone – Biologically Active Carbon (BAC) approach
  - Again, implementation >10 years.

# 3. ENHANCED STORMWATER CAPTURE

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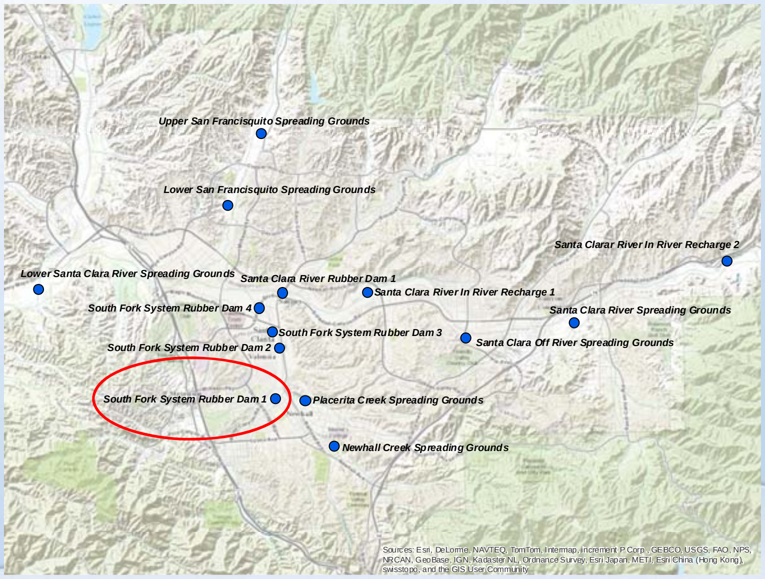
# 2007 Water Conservation Feasibility Study - Projects Locations



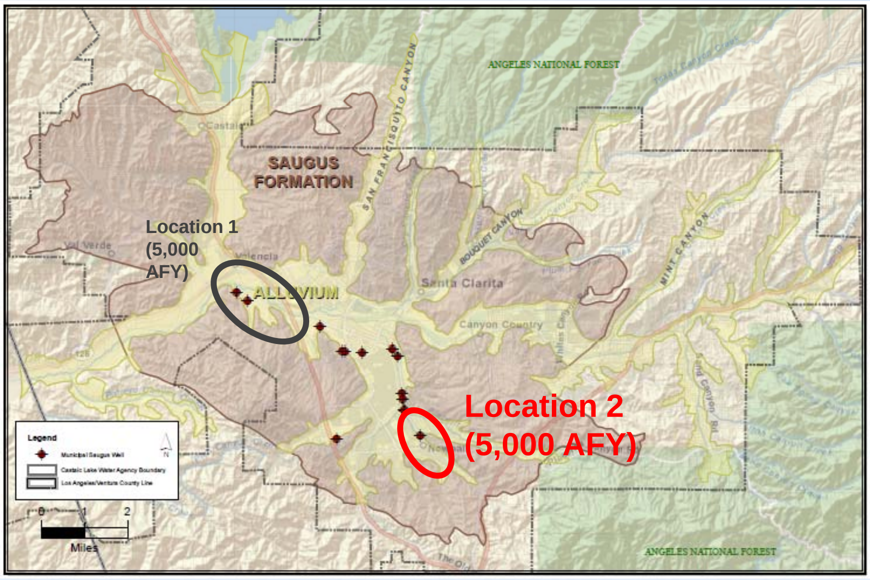
Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community

## Conclusions on Stormwater Capture

- Met with Los Angeles County DPW
- County has developed designs for Dam #1 on South Fork with estimates for Dams 1, 2 and 3
- Estimated yield: 660 AFY
- Estimated cost: $9 - $10 million
- Conclusions:
  - Yields need to be confirmed
  - At reported yield, cost is ~$2,000/AF
  - Not enough yield to meet recon study objectives alone
  - **Ongoing recharge (i.e. with recycled water) not feasible due to thin aquifer thickness.**

## 4. AQUIFER STORAGE AND RECOVERY

## ASR Locations Considered



## ASR Conclusions and Items for Future Evaluation

1. Conduct more detailed review of operations
   - Pump settings and pump curves, relative to depth to water
   - Ability to maintain target pumping rates
2. Consider injecting more than 5,000 AFY in general vicinity of Location 2 when SWP water is available
   - Addresses potential operational issues at NCWD wells
   - Raises groundwater levels at other existing Saugus wells
3. Evaluate effect of injection on perchlorate containment

# REVIEW CRITERIA FOR EVALUATION AND SCREENING

## Evaluation and Screening Considerations

1. Ability to meet study objectives with reliability
2. Cost and cost per AFY
    - Lower cost and/or lower cost/AFY favorable.
3. Phasing opportunities
    - Ability to phase is more favorable.
4. Institutional considerations
    - Ease of addressing institutional issues (sharing of benefits and costs, agreements)
5. Other factors
    - Water quality
    - Environmental benefits
    - Community/stakeholder issues

# PROPOSED STUDY REPORT OUTLINE

## Proposed Study Report Outline

1. Introduction
2. Study Overview
3. Data Compilation
4. Concept Development
5. Refinement
6. Screening
7. Conclusions

<u>Appendices</u>

A. Workshop Materials
B. Groundwater Modeling
C. Groundwater Recharge Regulations
D. Cost Estimates

# NEXT STEPS

## Next Steps

- Refine concept analysis as outlined/discussed today
- Perform an initial screening
- Circulate for review and comment
- Meanwhile, prepare draft study report
  - Circulate in early January
  - Workshop at end of January
- Final study report in February

## APPENDIX B-5

# MEETING MINUTES

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# MEETING NOTES

**Project:** Reconnaissance Study for CLWA
**Meeting Date:** April 22, 2014
**Client:** Castaic Lake Water Agency
**Issue Date:** May 16, 2014
**Location:** CLWA Offices - 27234 Bouquet Canyon Road, Santa Clarita, CA 91350

**Attendees:**

Stakeholders:
Jeff Ford
Dirk Marks
Mike Sullivan
Steve Cole
Mauricio Guardado
Keith Abercrombie
Jeanne Duarte
Robert Newman
Allison Wong
Ken Zimmer
Russ Bryden
David Rydman
Dan Masnada
Mike Alvord
Cris Perez
Matt Bao

Carollo:
Tom West
John Meyerhofer

GSI:
Jeff Barry

**Purpose:** Stakeholder Meeting Summary for CLWA Reconnaissance Study (DRAFT)
**Distribution:**
**File:** 9556A00

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*Discussion:*
*The following is our understanding of the subject matter covered in this conference. If this differs with your understanding, please notify us. Note that some discussion in the meeting may have been re-categorized for organizational purposes.*

## 1. Project Objectives – Slide 2 and Slide 3

Carollo reviewed the objectives for the project which include the following:

a. Need for local supply
b. Need for approximately 5,000 to 15,000 afy of supply
c. Receive feedback on concepts
d. Need for additional data

## 2. Background and need for study – Slide 4 and Slide 5

Carollo reviewed the background and basis for the study.

a. 2012 supply balance study presents currently supply breakdown
    - Expectation for a roughly 50/50 split during normal years,
    - Groundwater production split roughly between Alluvium and Saugus aquifers
    - State Water Project water supply reliability is trending downward
    - The 2013 DWR supply reliability report shows average year SWP supply at 60% of Table A, single dry at 10% and multiple dry year at 30%
    - Future SWP conditions expected to decrease as well

  - Overall suggests there is a need/value for between 5,000 to 15,000 afy of additional local supply.

### 3. Scope and schedule – Slide 6

Carollo reviewed the scope and schedule for the project which includes the following tasks.

a. Data review

b. Groundwater basin modeling

c. Concept development

d. Concept Screening

e. Final Report

### 4. Projects and Concepts – Slide 7

Carollo reviewed the potential project concepts with the stakeholders for general feedback.

a. Recycled Water

  - Focus will be on potable reuse options rather than expansion of irrigation (e.g. purple pipe) system.

b. Stormwater

  - Capture and recharge

c. Groundwater

  - Adjust operations
  - Redistribute pumping
  - Groundwater treatment
  - Replacement and/or expansion

d. Uniform Supply Reliability

  - Future supply options will need to improve reliability and prevent shortages under specific conditions

### 5. Recycled Water – Slide 8 to Slide 12

Carollo reviewed in more detail the concepts for recycled water.

a. Existing studies that have been referred to for this work include the 2002 Recycled Water Master Plan (Draft), the 2013 Recycled Water Optimization Study, and the Santa Clara Valley Sanitation District's Chloride Compliance Facilities Plan and EIR (October 2013).

b. October 2013 EIR describes RO capacity of approximately 2 MGD. San Districts commented they thought the actual capcity is closer to 5.6 MGD (plant capacity)

  - Advanced treatment discharge already is needed for discharge into the river for dilution purposes
  - Might also be a 13 MGD endangered species requirement
  - Room for subsequent analysis to bring this number down from 13 MGD

LACSD is looking into the details and will provide to Carollo.

c. In the future, with further population growth, additional recycled water supply is projected and could be made available. Uses for this supply still need to be explored

- Advanced treatment could allow for injection
- Direct potable reuse (DPR) is on the horizon but still has a ways to go until implementable in California:
  - Still requires a way to directly tap into existing potable system
  - Acceptance and regulation will be a challenge
  - The state report on DPR will be out in 2016, and it will probably take another 5 years of rule/guideline work before DPR is written into the California water code
- Comments on recycled water in general were:
  - Majority of recycled water planning to date has been around purple pipe for irrigation purposes.
  - There are many different directions for recycled water.I CLWA commented it would like to see a package that is cheaper and more efficient than the current CIP.
  - Groundwater recharge is attractive because you don't have additional infrastructure need
  - Brine disposal is a major concern. Capacity for RO treated water may have limits. There is a "crossover point" at which there needs to be a brine line rather than deep well injection. This crossover point will determine feasibility. Tertiary treatment with blending and surface recharge leaves no brine issues which makes it attractive. Just need to confirm that CDPH blending requirements are met.
  - Reycled water regulations on groundwater recharge have been in place for 15 years so there is now good acceptance of the practices.

d. Spatial proximity represents a similar crossover point, close purple pipe for large areas works great, but further away for small developments it stops being cost effective

e. Ultimately, IPR is closer to providing a currently usable, cost effective supply.

### 6. Groundwater – Slide 13 to Slide 40

GSI reviewed groundwater concepts with the stakeholder group in further detail.

a. GSI has developed the groundwater model currently being used for the Valley.

b. Increasing and augmenting the basin yield is the goal, in a manner that is both safe and sustainable in the long term

c. GSI map presentation shows:

- Division of valley in east, middle, and west
- Saugus wells are 1,500 to 2,000 feet deep
- Saugus is a U shaped formation

  - Bowl shaped, which includes (from limited date we have) some silt and clay, but mostly gravel
  - Saugus discharges on the west end of the basin into the alluvium
- Alluvial aquifer is on the surface
  - Alluvium discharges to the river on the far west side of the valley
- Rainfall data slide show that additional pumping during periods of drought (and therefore reduced local recharge) is typically damaging to the aquifer (e.g. reduces groundwater levels to the point where Alluvial wells can no longer pump).
- Redistributed alluvial pumping is beneficial for supply reliability and groundwater supply
- Alluvial wells are sensitive and susceptible to drought, especially over long periods of time
- The Saugus also experiences water level drops during local droughts on the order of 100 feet
- The vulnerability of both alluvial and Saugus wells to drought conditions and reduced recharge has implications for supply reliability and long term sustainability
- Aquifer storage and recovery
  - Project piloted injection using water from the distribution system
  - The pilot program was a success: sawno clogging, no chemical reactions, no loss of production in other wells, and saw an increase in pressure. ASR seems to be a viable option for the Saugus wells

d. Areas of contaminated groundwater. Question has primarily been how to maintain capacity from the wells

- Is there a need to increase pumping or treatment? is there a possibility to do more that could result in a greater supply or more reliable supply?
  - A lot of unknowns surrounding this question
  - Current thinking is that existing wells contain the contamination plume
  - To pump more, additional wells would be required
    - (1) Replacement wells will be needed to achieve what is in the operating agreement
    - (2) Well contamination issues will be involves
    - (3) There is a need for more pumping capacity
      - (i) Whitaker property is looking at doing on-site treatment
      - (ii) That water will go somewhere
      - (iii) Might be usable or re-injecta ble
  - CLWA is still learning how to replace lost capacity
  - If lost capacity is not replaceable, then plume treatment will be looked at

7. **Stormwater – Slide 41 to Slide 45**

   a. The 2007 study by the LA County Flood Control District contained 14 projects

   b. MS-4 compliance projects are another source of potential stormwater projects but the current planning effort (the “Enhanced Watershed Management Plan” is still underway with a plan to scheduled for delivery until June 2015. At this time, there is not an expectation that these projects would have a significant impact on the results of this Reconnaissance Study.

   c. Conservation needs to be done as a holistic effort

      - TMDLs will have solutions involving all the stakeholders
      - Shangri-La – extraction of water for slope stability providing 60,000 to 100,000 gallons per day
        - Has water quality issues but could be treated easily

8. **Uniform Supply Reliability – Slide 46 to Slide 48**

   a. Reliability from a few different angles

      - Water supply reliability
      - Balancing groundwater extraction
      - Balanced infrastructure
      - Total supply

   b. This essentially serves as a criterion, and not necessarily as a stand-alone concept. Thus, the other concepts developed will be analyzed to determine if/how much they assist with increasing water supply reliablity in the more vulnerable areas.

9. **Next steps – Slide 49**

   a. Next meeting in June (date TBD)

   b. Follow up:

      - Obtain further information on theShangri-La project from the City of Santa Clarita.
      - Sanitation District to provide clarification on the chloride reduction project capacities.
      - Carollo to email out workshop summary and groundwater modeling scenarios to stakeholder group for comment (in early May).

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|---|---|---|---|
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| Tom West | Carollo Engineers | (213) 500-9911 | twest@carollo.com |
| Mike Sullivan | Los Angeles County Sanitation Districts | (562) 908-4288 ext. 2801 | msullivan@lacsd.org |
| Steve Cole | Newhall County Water District | (661) 259-3610 | scole@ncwd.org |
| Mauricio Guardado | Santa Clarita Water Division | (661) 259-2737 | mguardado@clwa.org |
| Keith Abercrombie | Valencia Water Company | (661) 294-0828 | kabercrombie@valenciawater.com |
| Adam Ariki | Los Angeles County Waterworks District #36 | (626) 300-3300 | AARIKI@dpw.lacounty.gov |
| Jeanne Duarte | Storm Water Resources/VIA/One Water | (661) 295-3013 | jduarte@swres.org |
| Robert Newman | City of Santa Clarita | (661) 284-1429 | rnewman@santa-clarita.com |
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| Matt Bao | Los Angeles County Sanitation Districts | (562) 908-4288 ext. 2809 | mbao@lacsd.org |

# Draft Meeting Notes
# Comprehensive Facilities Master Plan Update
# Padre Dam Municipal Water District

**Meeting Date:** September 29, 2014
**Meeting Time:** 1:30 p.m. – 3:30 p.m.
**Meeting Notes:** CLWA Workshop 3
**Topic** Review Draft Concepts
**Location:** Castaic Lake Water Agency – 27234 Bouquet Canyon Rd, Santa Clarita, CA 91350
**Attendees:**

| | |
|---|---|
| CLWA | |
| LACSD | Mike Sullivan (MS), Matt Bao (MB) |
| LACFCD | |
| GSI | John Porcello (JP) |
| Carollo Engineers: | Tom West (TW), Amy Martin (AM) |

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1. **Introduction**
   a. The primary purpose of Workshop 3 is to review and comment on the draft concepts that were proposed at Workshop 2 in July 2014. The draft concepts include:
      1) Operational redistribution of pumping
      2) Groundwater recharge with recycled water
      3) Enhanced stormwater capture
      4) Aquifer storage and recovery
2. **Concept 1 – Operational Redistribution of Pumping**
   a. John Porcello (JP) presented the modeling results for the pumping redistribution during drought years in the shallow alluvial aquifer and the results of higher pumping.
   b. Pumping under the original plan (no redistribution) equates to approximately 22,300 afy during drought years. With pumping redistribution, pumping increased to 27,400 afy, which resulted in the following changes for each purveyor:
      1) NCWD Castaic Wells: 450 afy more pumping
      2) VWC Wells: 8,650 afy more pumping
      3) SCWD Wells: 3,650 afy less pumping
      4) NCWD Pinetress Wells: 350 afy less pumping
   c. Question: Could pumping be redistributed to other purveyors so that Valencia isn't pumping majority of the water under this scenario? **[Action Item (JP-GSI)– Evaluate moving pumping to the east end of the aquifer]**

    d. Question: Could there be an interconnection into CLWA system? **[Action Item (JP-GSI) – Evaluate]**

        1) There is excess capacity in the winter months and SWP is used to offset water supply during peak demand periods

    e. According to the model, the aquifer can support 35,000 afy or more of yield; however, this may not be sustainable at some of the well sites. Operational constraints may exist due to lower water levels within the aquifer. Wells that would contribute to the increase in pumping are within the NCWD. The new wells that Newhall is proposing may include multi-level pumping depths. **[Action Item (JP-GSI) – Run model utilizing multi-level wells]**

3. **Concept 4 – ASR in Saugus Formation**

    a. John Porcello (JP) presented the concept of ASR wells for deep aquifer pumping. This concept was re-introduced as a potential viable concept option for supply reliability. Two ASR well site locations were selected and evaluated to analyze the affects on the groundwater levels with and without ASR injection. **[Action Item (JP-GSI) and (Rob Buss –Carollo) – Conduct a more detailed review of operations. Consider injecting more than 5,000 afy near Location 2 when SWP is available. Evaluate the effect of injection on perchlorate containment]**

    b. Planning level costs were presented for a 2 mgd ASR program. **[Action Item (JP-GSI) – Refine cost estimates.]**

4. **Concept 2 – Groundwater Recharge with Recycled Water**

    a. Tom West (TW) presented the concept of groundwater recharge (GWR) with recycled water. Two recharge locations were selected (Location 1 and Location 3) as viable options for this concept. Location 2 was not considered viable due to its proximity to existing production wells.

    b. Recycled water supply availability was analyzed using the current effluent flows and future effluent flows from Valencia. It was assumed that the effluent flows would come from the Valencia Plant due to the supply availability. Currently, 6.3 mgd is available for GWR and 12 mgd would be available in the future. The available supply for GWR accounts for deductions due to diversions to the Santa Clara River, RO brine losses, RO permeate and recycled water customer usage. The brine permeate is used for chloride reduction to the Santa Clara River. The side stream RO process is utilized at the Valencia Plant when chloride levels exceed the maximum discharge levels to the river. The capacity of the RO system is 5.6 mgd and the average permeate is about 1.9 mgd. Average flows were utilized when conducting the supply availability analysis, which were provided by the LACSD.

    c. Groundwater modeling was conducted to estimate the subsurface flows and surface flows (diluent water) that would be utilized for recycled water blending (20% ratio). Two methods were evaluated for subsurface flow blending. Method 1 utilized the underflow for the entire sub-basin and Method 2 utilized a cross sectional area of the aquifer at each recharge location site. If Method 1 is utilized to calculate subsurface flow blending, then the maximum goal of recharging 10,000 afy can be met. If Method 2 is utilized to calculate the subsurafce flow blending, a maximum of 4,500 afy can be recharged at both sites. Diluent water blending is the control factor in maximizing GWR. **[Action Item (JP – GSI) and (TW & AM – Carollo) – Review blending alternatives, such as SWP, and impacts if advanced treatment is utilized.]**

d. Planning level costs were presented, which were based on the maximum recharge rate of 10,000 afy of recycled water. It was assumed that new facilities would be constructed to convey the water to both basin sites. **[Action Item (TW & AM – Carollo) – Determine impacts of utilizing existing recycled water infrastructure and refine cost estimates.]**

5. **Concept 3 – Enhanced Stormwater Capture**

a. Tom West (TW) presented the concept of enhanced stormwater capture. Based on the 2007 Water Conservation Feasibility Study Projects, an average of three storms a year are capable of producing sufficient runoff to fill proposed facilities at South Fork rubber dams 1, 2, and 3, which have an estimated yield of 660 afy. Due to the cost per acre-foot, the concept would not be considered feasible to meet the recon study objectives alone. If the project moved forward, there would be the potential that the Flood Control District would partner on the project. **[Action Item (TW – Carollo) – Evaluate if stormwater blending could be utilized to reduce chloride levels.]**

6. **Next Steps**

- Finalize Concepts, which include:
  - Refining cost estimates (Including $/af)
  - Review feasibility and determine next steps **[Action Item (TW – Carollo) – Send out an outline of the next steps .]**
  - Screen concepts and prioritize in recommendations.
    - (i) Draft Report
    - (ii) Final Report

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# MEETING NOTES (DRAFT)

| | | | |
|---|---|---|---|
| **Project:** | Reconnaissance Study for CLWA | **Meeting Date:** | December 19, 2014 |
| **Client:** | Castaic Lake Water Agency | **Issue Date:** | January 13, 2014 |
| **Location:** | CLWA Offices - 27234 Bouquet Canyon Road, Santa Clarita, CA 91350 | | |
| **Attendees:** | Stakeholders:<br>Jeff Ford<br>Dirk Marks<br>Mike Sullivan<br>Steve Cole<br>Mauricio Guardado<br>Keith Abercrombie<br>Dan Masnada<br>Mike Alvord | | Carollo:<br>Tom West<br><br>GSI:<br>Jeff Barry |
| **Purpose:** | Stakeholder Meeting No. 4 | | |
| **Distribution:** | | **File:** | 9556A00 |

*Discussion:*
*The following is our understanding of the subject matter covered in this conference. If this differs with your understanding, please notify us. Note that some discussion in the meeting may have been re-categorized for organizational purposes.*

## A. Concept Discussion and Refinement

1. Pumping Redistribution
   - Additional analysis run during Fall 2014 at request of purveryors shows lower dry year yield than previously thought.
   - Previously, thought dry year yield of 22,300 AFY without redistribution. 27,400 AFY with redistribution.
   - More refined analysis shows: dry year yield of 17,100 AFY to 21,800 AFY without new wells or upgrades to existing wells.

*Conclusions:*

1. Results may be different if we have recharge in place – do we need to run this scenario?
2. Can increase yields by making well modifications
   a. Can we estimate now what those improvements are?
   b. Recommend a more detailed CIP analysis and prioritization
3. Can achieve further increase with pumping redistribuion
   a. How many new wells?
   b. Treatment?
   c. Connecting in hydraulically

2. ASR
    - Benefit based on location to Saugus.
    - Not traditional storage.
    - Did not look at ASR in alluvial. Should we consider? Discuss with GSI.
    - Factor in cost of water. Would only do with excess SWP water. What does that cost CLWA?

3. Recharge with recycled water
    - Projected wastewater flows seem lower the previously studied. Because it takes into account both brine losses and minimum flows. Data comes directly from San District.
        - Question about how Newhall development would affect flows. Plan to use extensive resue throughout development.
        - Noted however that this is likely mostly summer demand. Limited demand in winter means water available then for recharge.

    - Consider removing location 3 from recharge (or at least phasing).
        - Go to site 1 first. Size pipe and pump capacities however for potential full delivery
        - Refine deliveries to non-potable customers along the way

    - Start going through feasibility, engineering and permitting steps
        - Check on consistency with SNMP to do tertiary recharge.
        - Go back and look at past Site 1 modeling results to confirm pumping benefits/enhancements.

    - Prepare a side analysis on the potential use of full RO + brine line. In particular, identify how proposed system would be consistent with this.
        - Size for full system
            - Benefits to surface recharge blend
            - Benefits to ASR

    - Discuss fatal flaws of other possibilities:
        - Just pumping more from VWC
        - Using more RO water to lower TOC and increase blend ratio
            - Plus cost of adding advanced oxidation process
        - Non-RO options (can’t get enough TOC removal)

4. Stormwater Capture
    - Re-evaluate in light of 50% cost share with the County.
    - Really should couple with other projects/benefits
    - Size of project alone doesn’t get to project objective.

## B. Screening Criteria

1. Ability to meet study objectives with reliability
2. Cost and cost per AFY
    - Lower cost and/or lower cost/AFY favorable.
3. Phasing opportunities
    - Ability to phase is more favorable.
4. Institutional considerations
    - Ease of addressing institutional issues (sharing of benefits and costs, agreements)
5. Other factors
    - Water quality
    - Environmental benefits
    - Community/stakeholder issues

# APPENDIX C - GROUNDWATER MODELING DETAILS

This appendix includes the following items:

- C-1 GSI Initial Pumping Plan
- C-2 Refined Modeling Scenario and Yields

# APPENDIX C-1

# GSI INITIAL PUMPING PLAN

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## Summary of Current Plan for Spatially Redistributing Pumping from the Shallow Alluvial Aquifer During Local Droughts

Santa Clarita Valley, California

DRAFT
9-23-2014

| Retail Purveyor | Pumping Under Original Plan (AF/yr) | | | Pumping Under Redistribution Plan (AF/yr) | | | Change in Pumping Resulting from Redistribution Plan (AF/yr) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Normal/Wet Years | Drought Years | Drought-Year Change | Normal/Wet Years | Drought Years | Drought-Year Change | Normal/Wet Years | Drought Years | Drought-Year Change | | | |
| NCWD Pinetree | 1,100 | 700 | -400 | 1,100 | 350 | -750 | 0 | -350 | -350 | 4% | 0.25 | 0.75 |
| NCWD Castaic | 850 | 600 | -250 | 850 | 1,050 | 200 | 0 | 450 | 450 | 3% | 800 | |
| **NCWD Total** | **1,950** | **1,300** | **-650** | **1,950** | **1,400** | **-550** | **0** | **100** | **100** | 8% | **200** | 600 |
| **SCWD Total** | **11,050** | **8,150** | **-2,900** | **11,050** | **4,500** | **-6,550** | **0** | **-3,650** | **-3,650** | 43% | | |
| **VWC Total** | **12,850** | **12,850** | **0** | **12,850** | **21,500** | **8,650** | **0** | **8,650** | **8,650** | 50% | | |
| **NCWD+SCWD+VWC** | **25,850** | **22,300** | **-3,550** | **25,850** | **27,400** | **1,550** | **0** | **5,100** | **5,100** | | | |

| Main Points: | Main Points: | Main Points: |
|---|---|---|
| VWC originally planned to not vary its pumping much from one year to the next. In contrast, NCWD and SCWD planned for reductions during drought years. | SCWD curtails more than planned; NCWD relies more on the Castaic wellfield; and VWC now makes up shortfalls enough to provide drought-year groundwater supplies slightly in excess of normal/wet year production. | During drought years:<br>VWC pumps 1.67 times the amount originally planned.<br>NCWD pumps nearly as much as originally planned.<br>SCWD pumps only 55% of what was originally planned.<br>Total drought-year pumping is 5,100 AFY higher than originally. |

### Monthly Production Volumes

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly % of Annual Use | 5.2% | 3.7% | 5.2% | 6.6% | 8.7% | 10.4% | 13.0% | 13.6% | 10.9% | 9.3% | 7.1% | 6.3% | 100.0% |
| **NCWD Total AF/month** | **73** | **52** | **73** | **92** | **122** | **146** | **182** | **190** | **153** | **130** | **99** | **88** | **1,400** |
| **SCWD Total AF/month** | **234** | **167** | **234** | **297** | **392** | **468** | **585** | **612** | **491** | **419** | **320** | **284** | **4,500** |
| **VWC Total AF/month** | **1,118** | **796** | **1,118** | **1,419** | **1,871** | **2,236** | **2,795** | **2,924** | **2,344** | **2,000** | **1,527** | **1,355** | **21,500** |

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## APPENDIX C-2

# REFINED MODELING SCENARIO AND YIELDS

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Water Solutions, Inc.

# DRAFT Technical Memorandum

**To:** Keith Abercrombie/Valencia Water Company
Steve Cole/Newhall County Water District
Mauricio Guardado/Santa Clarita Water Division of CLWA
Dirk Marks/Castaic Lake Water Agency (CLWA)

**From:** John Porcello/GSI Water Solutions, Inc.
Walt Burt/GSI Water Solutions, Inc.

**Date:** December 15, 2014

**Subject: Evaluation of Groundwater Pumping Targets for the Alluvial Aquifer in 2015 Santa Clara River Valley East Subbasin (Santa Clarita Valley, California)**

## Introduction

This technical memorandum presents the results of an analysis conducted by GSI Water Solutions, Inc. (GSI), to evaluate the achievability of target production volumes identified by the local retail water purveyors for groundwater pumping during 2015 from the local Alluvial Aquifer system in the Santa Clarita Valley, California. As specified in GSI's scope of work (dated October 6, 2014), this effort evaluated whether the target production volumes from Alluvial Aquifer wells during 2014 would be achievable in 2015 if ongoing local drought conditions and curtailments of State Water Project water were to continue into 2015.

The analysis was conducted for the 33 purveyor-owned production wells that currently operate in the Alluvial Aquifer (15 wells owned and operated by Valencia Water Company [VWC]; 6 wells owned and operated by Newhall County Water District [NCWD]; and 12 wells owned and operated by the Santa Clarita Water Division [SCWD] of the Castaic Lake Water Agency [CLWA]). The purveyors' Groundwater Operating Plan calls for the Alluvial Aquifer to provide between 30,000 and 35,000 acre-feet per year (AFY) of groundwater supply during local drought years. Of this amount, approximately 27,500 AFY are specified to be pumped by the three retail water purveyors (VWC, SCWD, and NWCD). The Groundwater Operating Plan was first established for the local groundwater basin during the 2000s (CH2M HILL and LSCE,

2005) and subsequently was updated in 2009 (LSCE and GSI, 2009) and 2014 (GSI and LSCE, 2014).

From the fall of 2013 through the fall of 2014, the three retail water purveyors together pumped approximately 25,000 AFY of Alluvial Aquifer groundwater, or about 10 percent less than the 27,500 AFY target production volume that is identified in the Groundwater Operating Plan for the Alluvial Aquifer during locally dry years. Several wells experienced difficulty achieving their target volumes during 2014, particularly wells owned by SCWD and NCWD that are located in the upper reaches of the watershed (where groundwater levels and groundwater recharge rates are highly sensitive to year-to-year variations in rainfall and streamflow). During the period from the fall of 2013 to the fall of 2014, each of three wells owned by SCWD pumped less than 100 AFY, and four wells owned by SCWD did not operate at all. Personnel from SCWD and NCWD have stated to GSI that in the absence of recharge during the winter of 2014/spring of 2015, more wells could be taken offline or used in an even more restricted manner than occurred in 2014.

## Approach

GSI's study approach consisted of first developing an initial assessment of each well's recent and projected operating condition. In November 2014, GSI provided these detailed assessments to each purveyor for their review, comment, and follow-on discussion. GSI then conducted a final assessment that incorporated any new information provided by a given water purveyor, as well as any changes to the 2015 target pumping volumes that the retail water purveyor requested by analyzed.

For both the draft and final assessments, the results were derived by combining (1) groundwater modeling projections of groundwater level trends in the aquifer with (2) information on well designs, pump settings, and pumping operations at each production well. The groundwater modeling work was conducted using the water purveyors' numerical model of the local groundwater basin. GSI's analysis assumed that in 2015:

- No new wells would be drilled.
- No modifications would occur to the depths or shut-off settings at any existing well.
- No deepening, reconditioning, or other alterations would occur to the construction of any existing well.

# Conclusions

Rainfall records, groundwater level monitoring, and groundwater modeling together indicate that little to no recharge has occurred to the Alluvial Aquifer since the winter of 2010/spring of 2011 rainfall season. The groundwater level monitoring program shows that groundwater levels have declined at a fairly steady rate since that time, as has been observed in other past periods of local drought conditions (such as occurred in 1984 through 1992 and again in 1999 through 2004). The continued decline in groundwater levels that was observed in 2014 at many Alluvial Aquifer wells will continue in 2015 if little to no rainfall and streamflow recharge occurs to the local aquifer systems during the winter of 2014/spring of 2015 rainfall season.

Under this scenario, and assuming there are no new wells or modifications to existing wells and pumping systems, GSI's primary conclusions regarding the achievability of the target pumping volumes from the Alluvial Aquifer in 2015 are presented in Table 1 and are summarized as follows:

1. For the three retail water purveyors combined, the achievable yield from the Alluvial Aquifer in 2015 is likely between 17,100 and 21,800 AFY. The Groundwater Operating Plan's drought-year target of 27,400 AFY of collective production by the three retail water purveyors will not be achievable if the drought continues through the winter of 2014/spring of 2015 rainfall season.
2. The largest shortfall in yield is estimated to occur for VWC. The estimated achievable production volume for VWC wells (between 14,600 and 17,900 AFY in 2015) creates shortfalls of (a) 3,600 to 6,900 AFY compared with VWC's target production under the Groundwater Operating Plan and (b) 1,100 to 4,400 AFY compared with the 2015 target production volume that was of interest to VWC.
3. The estimated shortfalls in groundwater production from the Alluvial Aquifer are notably smaller for SCWD and NCWD than for VWC.
    a. SCWD's wells likely can produce between 1,700 and 2,700 AFY from the Alluvial Aquifer in 2015. This represents a shortfall of 1,800 to 2,800 AFY compared with the Groundwater Operating Plan, and a shortfall of 1,500 to 2,500 AFY compared with the 2015 target production volume that was tested by GSI.
    b. NCWD's wells likely can produce between 800 and 1,200 AFY from the Alluvial Aquifer in 2015. This represents a shortfall of 200 to 600 AFY compared with the Groundwater Operating Plan, and a shortfall of zero to 500 AFY compared with the 2015 target production volume that was tested by GSI.
4. The estimates of the achievable yield listed in Table 1 are reasonable estimates of the groundwater production capacity from the Alluvial Aquifer that the three retail water purveyors can expect to achieve in 2015 should the local drought

continue. Actual groundwater production volumes from the Alluvial Aquifer could be notably higher if there are appreciable amounts of rainfall, streamflow, and groundwater recharge during the winter of 2014/spring of 2015 rainfall season.

5. Some of the purveyors' wells currently have pump depths that pose a significant limitation on usage of the well. Higher volumes of production may be possible in 2015 if the pumps are lowered for those wells where the pumps are set notably higher than the bottom of the well. Based on GSI's analysis and conversations with representatives of each water purveyor, it appears that the right physical conditions may exist to lower the pump columns of certain wells (7 wells owned by VWC; at least 1 well, and perhaps 5 wells, owned by SCWD; and 2 or 3 wells owned by NCWD). However, any increases in 2015 groundwater production that arise from lowering the pump at a given well may prove to be only temporary if the drought continues. This in turn means that the post-modification production volumes ***after*** 2015 could be the same as (or lower than) the production that would have been achieved ***during*** 2015 without any modifications to the pumps and their shut-off settings.

## References

CH2M HILL and LSCE. 2005. *Analysis of Groundwater Basin Yield, Upper Santa Clara River Groundwater Basin, East Subbasin, Los Angeles County California.* Prepared for The Upper Basin Water Purveyors (Castaic Lake Water Agency, Newhall County Water District, Santa Clarita Water Division of CLWA, and Valencia Water Company) by CH2M HILL and Luhdorff and Scalmanini Consulting Engineers (LSCE). August 2005.

LSCE and GSI. 2009. *Analysis of Groundwater Supplies and Groundwater Basin Yield, Upper Santa Clara River Groundwater Basin, East Subbasin.* Prepared for the Santa Clarita Valley Municipal Water Purveyors by Luhdorff and Scalmanini Consulting Engineers (LSCE) and GSI Water Solutions (GSI). August 2009.

GSI and LSCE. 2014. *Draft Report: Perchlorate Containment Plan for Well V201 and Saugus Formation Groundwater in the Santa Clarita Valley (Task 3 of the Well V201 Restoration Program).* Prepared for Valencia Water Company. Prepared by GSI Water Solutions (GSI) and Luhdorff and Scalmanini Consulting Engineers (LSCE). March 2014.

## Table 1

DRAFT

## Alluvial Aquifer Pumping Analysis for 2015 - All Retail Water Purveyors

*Prepared by GSI Water Solutions, Inc.*

| Retail Water Purveyor | Drought-Year Pumping Target in Groundwater Operating Plan | 2015 Pumping Target Tested by GSI | Estimated Achievable Yield in 2015 from Existing Alluvial Aquifer Wells | Potential Shortfall in Meeting the Drought-Year Pumping Target in the Groundwater Operating Plan | Potential Shortfall in Meeting the 2015 Pumping Target Tested by GSI | Retail Water Purveyor |
|---|---|---|---|---|---|---|
| VWC | 21,500 | 19,000 | 14,600 to 17,900 | -6,900 to -3,600 | -4,400 to -1,100 | VWC |
| SCWD | 4,500 | 4,200 | 1,700 to 2,700 | -2,800 to -1,800 | -2,500 to -1,500 | SCWD |
| NCWD | 1,400 | 1,300 | 800 to 1,200 | -600 to -200 | -500 to -100 | NCWD |
| **TOTAL** | **27,400** | **24,500** | **17,100 to 21,800** | **-10,300 to -5,600** | **-7,400 to -2,700** | **TOTAL** |

All volumes are in units of acre-feet per year (AF/year).

All listed values for shortfalls and likely achievable yields are estimates and are not guaranteed.

VWC = Valencia Water Company SCWD = Santa Clarita Water Division of the Castaic Lake Water Agency NCWD = Newhall County Water District

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# APPENDIX D- DESIGN ASSUMPTIONS AND COST ESTIMATING DETAILS

This appendix details the design and cost estimating assumptions for the proposed concepts listed in Section 5 of the Reconnaissance Study.

## D.1 CONCEPT 1 - RECYCLED WATER RECHARGE

### D.1.1 Design Assumptions

#### D.1.1.1 Distribution Facilities

The design criteria used to size the infrastructure for Concept 1 subsurface flow blending is summarized in Table 1.

**Table 1 Recycled Water Recharge – Initial Distribution Facilities Design Criteria**

| Item | Unit | Quantity |
|---|---|---|
| **Initial Design Criteria** | | |
| Total Recharge Demand | AFY | 10,000 |
| Distance from Valencia Plant to Site 3 | Miles | 14 |
| Pipeline & Pump Station Sizing | ADD (gpm) | 6,200 |
| Pipeline Flow Velocity | fps | 5 |
| Pipeline Headloss | ft per 1,000 ft of pipeline | 7 |
| Pump Station 1 Elevation: Valencia Plant | Feet | 1,060’ |
| Pump Station 2 Elevation: Ruether’s PS | Feet | 1,290’ |
| Elevation at Site 3 | Feet | 1,695’ |

### D.1.1.2 Recharge Basins Improvements

The design criteria used for recharge basin modifications and stormwater capture is summarized in Table 2 and shown on Figure D.1, Figure D.2, and Figure D.3.

**Table 2 Recycled Water Recharge – Basin Improvements Design Criteria**

| Item | Unit | Quantity |
|---|---|---|
| **Recharge Basin 1A** | | |
| Total Area | Acres | 5.5 |
| Estimated Infiltration Rate | Ft/day | 1 |
| Recycled Water Inflow Rate | AFY | 1,500 |
| Effective Recharge Area Required | Acres | 4 |
| Berm Size | Feet | 4 |
| Obermeyer Rubber Dam | Feet | 530 |
| Rubber Dam Height | Feet | 3 |
| **Recharge Basin 1B** | | |
| Total Area | Acres | 13 |
| Estimated Infiltration Rate | ft/day | 1 |
| Recycled Water Inflow Rate | AFY | 3,560 |
| Effective Recharge Area Required | Acres | 9.75 |
| Berm Size | Feet | 5 |
| Obermeyer Rubber Dam | Feet | 600 |
| Rubber Dam Height | Feet | 3 |
| **Recharge Basin 3** | | |
| Total Area | Acres | 28 |
| Estimated Infiltration Rate | ft/day | 1 |
| Recycled Water Inflow Rate | AFY | 3,560 |
| Effective Recharge Area Required | Acres | 21 |
| Berm Size | Feet | 5 |
| Obermeyer Rubber Dam | Feet | 400 |
| Rubber Dam Height | Feet | 3 |

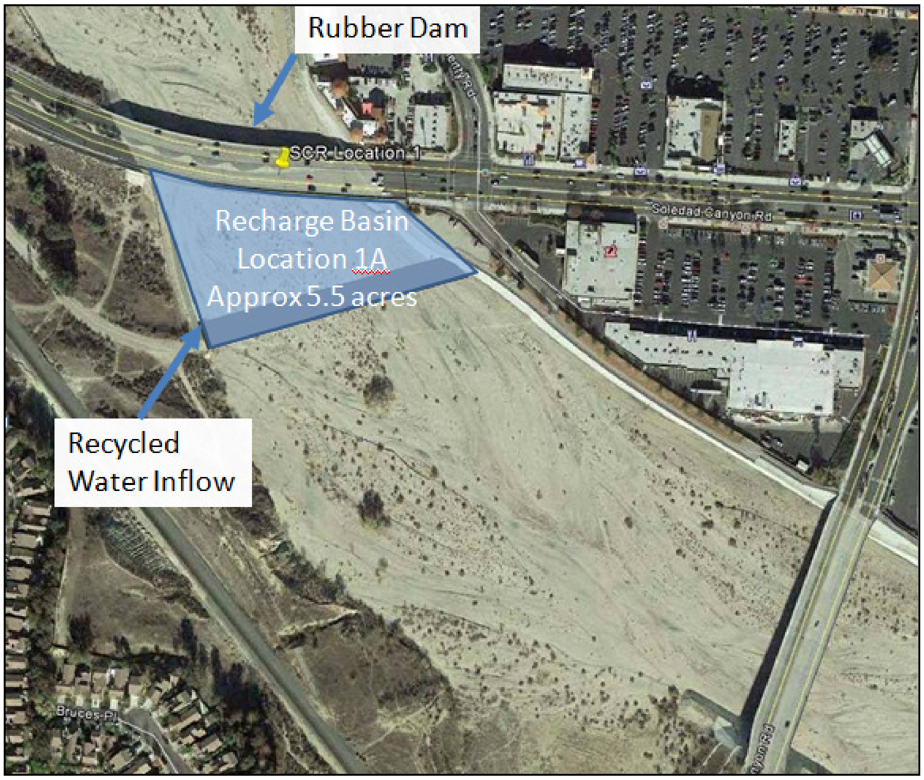

**Figure D.1 Site 1A**

**Figure D.2 Site 1B**

**Figure D.3 Site 3**

## D.1.2 Capital Improvement Project Costs – Distribution Facilities

The cost estimates presented in Table 3 and Section 5 of this study are opinions developed from bid tabulations, cost curves, information obtained from previous studies, and Carollo Engineers, Inc. (Carollo) experience on other projects. The costs are based on an Engineering News Record Construction Cost Index (ENR CCI) 10,756 (Los Angeles, December 2014).

**Table 3 Recycled Water Recharge – Final Distribution Facilities Cost Estimates**

| Item | Unit | Quantity |
|---|---|---|
| **Initial Cost Estimates** | | |
| Transmission Pipeline | 24-in @ 14 mi | $61 million |
| Pump Stations | 2 Sites | $15 million |
| Total Construction Cost | | $54 million |
| Total Capital Cost (Does Not Include Basin Improv.) | | $76 million |
| Total O&M | Per year | $2 million |

### D.1.2.1 Cost Estimating Accuracy

The cost estimates presented in Concept 1 of this Study have been prepared for general planning purposes and for guidance in project evaluation and implementation. Final costs of a project will depend on actual labor and material costs, competitive market conditions, final project scope, implementation schedule, and other variable factors such as preliminary alignment generation, investigation of alternative routings, and detailed utility and topography surveys.

The Association for the Advancement of Cost Engineering (AACE) defines an Order of Magnitude Estimate, deemed appropriate for master plan studies, as an approximate estimate made without detailed engineering data. It is normally expected that an estimate of this type would be accurate within plus 50 percent to minus 30 percent. This section presents the assumptions used in developing order of magnitude cost estimates for recommended facilities.

## D.1.3 CONSTRUCTION UNIT COSTS

The construction costs are representative of water system facilities under normal construction conditions and schedules. Costs have been estimated for public works construction.

### D.1.3.1 Pipeline Unit Costs

Unit costs for the construction of pipelines are shown in Table 4. The construction cost estimates are based upon these unit costs. The unit costs are for “typical” field conditions with construction in stable soil at a depth ranging between 10 feet to 15 feet.

**Table 4 Unit Construction Costs - Pipelines**

| Pipe Size (inches) | Unit Construction Cost(1) ($/LF) |
|---|---|
| **Potable Water Mains** | **New Construction** |
| 4" | $105 |
| 6" | $160 |
| 8" | $170 |
| 10" | $210 |
| 12" | $220 |
| 16" | $295 |
| 18" | $330 |
| 20" | $370 |
| 24" | $420 |
| 30" | $440 |
| 36" | $525 |
| 42" | $630 |
| 48" | $695 |

Note:
(1) Costs are based on ENR CCI 10,756 (Los Angeles, December 2014)

### D.1.3.2 Pump Station Unit Costs

This Study includes pump station improvement projects to move water from lower elevations to higher elevation. Costs were generated by inputting the appropriate capacity and calculating the corresponding construction costs. Unit costs are shown in Table 5.

**Table 5 Unit Construction Costs – Pump Stations**

| Station Size (HP) | Unit Construction Cost ($/HP) |
|---|---|
| 100 hp | $5,000 |
| 200 hp | $4,000 |
| 250 hp | $4,000 |
| 300 hp | $4,000 |
| 350 hp | $3,000 |
| 400 hp | $3,000 |
| 500 hp | $3,000 |
| 650 hp | $3,000 |
| 700 hp | $3,000 |
| 750 hp and larger | $3,000 |

## D.1.4 PROJECT COSTS AND CONTINGENCIES

Project cost estimates are calculated based on elements, such as the project location, size, length, land acquisition needs, and other factors. Allowances for project contingencies consistent with an “Order of Magnitude” estimate are also included in the project costs prepared as part of this study, as outlined in this section.

### D.1.4.1 Baseline Construction Cost

This is the total estimated construction cost, in dollars, of the proposed improvement projects. Baseline construction costs were calculated by multiplying the estimated number of units by the unit cost, such as length of pipeline times the average cost per lineal foot of pipeline.

### D.1.4.2 Capital Improvement Cost

Other project construction contingency costs include costs associated with project engineering, construction phase professional services, and project administration. Engineering services associated with new facilities include preliminary investigations and reports, Right of Way (ROW) acquisition, foundation explorations, preparation of drawings and specifications during construction, surveying and staking, sampling of testing material, and start-up services. Construction phase professional services cover such items as construction management, engineering services, materials testing, and inspection during construction. Finally, there are project administration costs, which cover such items as legal fees, environmental/California Environmental Quality Act (CEQA) compliance requirements, financing expenses, administrative costs, and interest during construction.

The cost of these items can vary, but for the purpose of this study, it is assumed that the other project contingency costs will equal approximately 27.5 percent of the Estimated Construction Cost.

The capital improvement cost is the total cost of all project construction contingencies (construction, engineering services, construction management, and project administration), which is 65.8 percent of the baseline construction cost. Calculation of the 65.8 percent is the overall mark-up on the baseline construction cost to arrive at the capital improvement cost. It is not an additional contingency.

### D.1.4.3 Operations and Maintenance Costs

The Operations and Maintenance (O&M) cost estimates utilized for Concept 1 were based on 1 percent of the total pipeline capital cost, 2 percent of the total pump station capital cost and 1 percent of the total basin improvement capital cost (described below). It was assumed that the pump stations would operate 8 hours a day for 365 days a year; therefore, a cost of 15 cents per kW/hr was included as part of the O&M.

## D.1.5 Capital Improvement Project Costs – Basin Improvements

The cost estimates presented in Table 6 and Section 5 of this study are opinions developed from bid tabulations, cost curves, information obtained from previous studies, and Carollo Engineers, Inc. (Carollo) experience on other projects. The costs are based on an Engineering News Record Construction Cost Index (ENR CCI) 7716 (2006). A breakdown of the costs is presented in Table 7, Table 8 and Table 9.

| **Table 6** | **Recycled Water Recharge – Basin Improvements Construction Costs** | | |
|---|---|---|---|
| | **Item** | **Unit** | **Quantity** |
| | **Recharge Basin 1A** | | |
| | Rubber Dam | LS | $2,600,000 |
| | Recharge Basins | LS | $400,000 |
| | *Total 1A Cost* | *LS* | *$3,000,000* |
| | **Recharge Basin 1B** | | |
| | Rubber Dam | LS | $3,300,000 |
| | Recharge Basins | LS | $1,200,000 |
| | *Total 1B Cost* | *LS* | *$4,500,000* |
| | **Recharge Basin 3** | | |
| | Rubber Dam | LS | $1,600,000 |
| | Recharge Basins | LS | $2,300,000 |
| | *Total 3 Cost* | *LS* | *$3,900,000* |

## Table 7

| Basin Location 1B Construction Costs | | | |
|---|---|---|---|
| Earthwork - CUT | CY | $/CY | Sub-Total |
| | 20,973 | $ 8.00 | $ 167,787 |
| Earthwork - FILL | CY | $/CY | |
| | 12,000 | $ 10.00 | $ 120,000 |
| Structures | EA | $/EA | |
| | 3 | $ 5,000 | $ 15,000 |
| Basin Piping | LF | $/LF | |
| (16", 24") | 1,200 | $ 300 | $ 360,000 |
| Rubber Dam | LS | $/LS | |
| | 1 | $ 2,000,000 | $ 2,000,000 |
| Control Bldg | LS | $/LS | |
| (with Elec) | 1 | $ 50,000 | $ 50,000 |
| | | **Total $** | **$ 2,712,787** |
| Gen Con;OH&P | | | |
| (18% of Total) | | | $ 488,302 |
| Contingency | | | |
| (30% of Total) | | | $ 813,836 |
| Engineering, | | | |
| (25% of Total) | | | $ 678,197 |
| | | **Project Total** | **$ 4,693,121** |

## Table 8

| Basin Location 1A Construction Costs | | | |
|---|---|---|---|
| Earthwork - CUT | CY | $/CY | Sub-Total |
| | 8,873 | $ 8.00 | $ 70,987 |
| Earthwork - FILL | CY | $/CY | |
| | 0 | $ 10.00 | $ - |
| Structures | EA | $/EA | |
| | 1 | $ 5,000 | $ 5,000 |
| Basin Piping | LF | $/LF | |
| (16", 24") | 600 | $ 300 | $ 180,000 |
| Rubber Dam | LF | $/LF | |
| | 1 | $ 1,428,000 | $ 1,428,000 |
| Control Bldg | LS | $/LS | |
| (with Elec) | 1 | $ 50,000 | $ 50,000 |
| | | **Total $** | **$ 1,733,987** |
| Gen Con;OH&P | | | |
| (18% of Total) | | | $ 312,118 |
| Contingency | | | |
| (30% of Total) | | | $ 520,196 |
| Engineering, | | | |
| (25% of Total) | | | $ 433,497 |
| | | **Project Total** | **$ 2,999,797** |

## Table 9

| Basin Location 1A Construction Costs | | | |
|---|---|---|---|
| Earthwork - CUT | CY | $/CY | Sub-Total |
| | 45,173 | $ 8.00 | $ 361,387 |
| Earthwork - FILL | CY | $/CY | |
| | 20,500 | $ 10.00 | $ 205,000 |
| Structures | EA | $/EA | |
| | 5 | $ 5,000 | $ 25,000 |
| Basin Piping | LF | $/LF | |
| (16", 24") | 1800 | $ 300 | $ 540,000 |
| Rubber Dam | LF | $/LF | |
| | 1 | $ 1,090,000 | $ 1,090,000 |
| Control Bldg | LS | $/LS | |
| (with Elec) | 1 | $ 50,000 | $ 50,000 |
| | | **Total $** | **$ 2,271,387** |
| Gen Con;OH&P | | | |
| (18% of Total) | | | $ 408,850 |
| Contingency | | | |
| (30% of Total) | | | $ 681,416 |
| Engineering, | | | |
| (25% of Total) | | | $ 567,847 |
| | | **Project Total** | **$ 3,929,499** |

# GROUNDWATER RECHARGE REGULATIONS

This appendix summarizes the existing regulatory environment that affects recycled water and groundwater recharge along with the anticipated future regulatory changes that may present impacts and challenges for Castaic Lake Water Agency (CLWA).

## E.1 RECYCLED WATER

The production, discharge, distribution, and use of recycled water are subject to federal, state, and local regulations. The primary objective of these regulations is to protect public health. This chapter starts with a discussion of the roles and responsibilities of the agencies involved in the use of recycled water. Subsequently, the existing regulations on federal, state, regional, and local level are described. This section is concluded with a discussion on future regulations and the impact to the CLWA.

### E.1.1 OVERVIEW OF REGULATING AGENCIES

Wastewater treatment, wastewater discharges, and recycled water use within the study area are regulated by the Los Angeles RWQCB, CDPH, and County of Los Angeles Department of Environmental Health (DEH).

### E.1.2 REGIONAL WATER QUALITY CONTROL BOARD

The RWQCB has primary authority to permit and regulate recycled water treatment and use within the study area. Recycled water discharges to groundwater (such as recycled water irrigation or groundwater recharge) are regulated by the RWQCB pursuant to requirements established within the State of California Porter-Cologne Water Quality Act. Through authority delegated by the USEPA, the RWQCB also regulates recycled water or wastewater discharges to inland surface waters, estuarine waters, and marine waters in accordance with requirements established pursuant to the federal Clean Water Act.

To implement state and federal water quality laws, regulations, and policies, the RWQCB:

- Designates beneficial uses for each watershed within the Los Angeles Region,
- Establishes ground and surface water quality objectives required to protect the beneficial uses, and
- Regulates wastewater discharges to implement the ground and surface water quality objectives.

#### E.1.2.1 Waste Discharge Requirements

The use of recycled water for land application (e.g. irrigation) or groundwater recharge is regulated by the RWQCB through the issuance of a discharge permit called "waste discharge requirements" (WDRs). The WDRs identify project-specific effluent limits, recycled water use requirements, treatment requirements, prohibitions, and other applicable water quality regulations or policies.

Effluent concentration standards are established within the WDRs to implement Basin Plan water quality objectives in accordance with implementation procedures and recycled water use policies and regulations established within the Basin Plan.  The WDRs also incorporate requirements of other agencies (e.g. CDPH) which have jurisdiction in the regulation of recycled water use.

Prior to operating any new or modified recycled water treatment facilities, recycled water agencies must file a "report of waste discharge" in application for WDRs (or modified WDRs).  The report of waste discharge describes proposed recycled water treatment and use operations, addresses compliance with projected RWQCB and CDPH requirements, and documents compliance with provisions of the California Environmental Quality Act.

#### E.1.2.2 NPDES Permits

Federally-regulated surface waters include rivers, streams, wetlands, lakes, reservoirs, lands subject to flooding with a 100-year storm, and other "navigable" surface waters. Through authority delegated by EPA, the RWQCB regulates the discharge of recycled water to federally-regulated surface waters through the issuance of NPDES (National Pollutant Discharge Elimination System) permits.  The NPDES permits include effluent concentration standards that implement applicable state water quality policies and standards, including those established within the Basin Plan, State of California *Enclosed Bays and Estuaries Plan* (SWRCB, 2009) and *California Toxics Rule* (CTR).

The CTR regulations are established by EPA within Title 40, Section 131 of the Code of Federal Regulations (40 CFR 131). The CTR establishes water quality standards for inland surface waters of California for the protection of aquatic habitat and the protection of human health. The CTR standards are applicable to recycled water discharges to federally regulated surface waters.

### E.1.3 CDPH REGULATION

CDPH regulates public water systems and establishes standards for recycled water treatment and reuse to protect public health. CDPH serves as the primary permitting agency for public water systems. CDPH implements applicable state and federal drinking water, source water, treatment, and distribution regulations through the issuance of water supply permits to municipal potable water purveyors.

The RWQCB serves as the primary permitting agency for recycled water treatment and use. CDPH serves as a consulting agency in the RWQCB recycled water permitting process;  recycled water WDRs issued by the RWQCB implement applicable CDPH recycled water treatment and reuse regulations and requirements.

### E.1.3.1 <u>Recycled Water Treatment and Use</u>

CDPH statewide regulations governing the use of recycled water are established within Title 22, Division 4, Chapter 3 of the *California Code of Regulations* (Title 22). CDPH Title 22 regulations establish treatment requirements and effluent limits for a variety of potential recycled water irrigation uses. Key classes of recycled water addressed in the Title 22 regulations include:

- *Disinfected tertiary* recycled water, applicable for use on areas of high degree of public contact, including irrigation of parks, playgrounds, schoolyards, residential commons, golf courses near home sites, non-restricted recreational impoundments, and the irrigation of food crops where the recycled water may contact the edible portion of the crop.
- *Disinfected secondary-2.2* recycled water, applicable for use on areas of limited public contact, including cemeteries, freeway landscaping, golf courses with limited public access and no adjacent housing, impoundments that restrict body-contact recreation, ornamental nursery stock, pastures, or other non-edible vegetation.
- *Disinfected secondary-23* recycled water, applicable for use on agricultural areas where the public is excluded, including the irrigation of fiber or fodder crops, non food-bearing trees, and vineyards and orchards where the recycled water does not contact the edible portion of the crop.

CDPH Title 22 treatment requirements and effluent standards for each of these classes of recycled water as summarized in Table E.1. As noted, the CDPH Title 22 regulations are implemented within the recycled water WDRs issued by the RWQCB.  In addition to the requirements presented in Table E.1, CDPH also establishes reliability requirements that mandate one or more of the following:

- Alarms, and multiple units capable of handling the design flow with one unit out of operation,
- Alarms, short-term retention or disposal provisions, and standby replacement equipment,
- Alarms, and long-term storage or disposal provisions, or
- Automatically-actuated long-term storage or disposal provisions.

Prior to initiating operation of recycled water treatment facilities, recycled water agencies must submit a report (Title 22 Report) to CDPH and the RWQCB that describes recycled water treatment operations and documents compliance with CDPH Title 22 treatment, disinfection, and reliability requirements.

The recycled water uses allowed by Title 22 are dependent on the effluent quality of the supply source. As the effluent of the Valencia and Saugus Water Reclamation Facility are classified as ‘Disinfected Tertiary Recycled Water’ per Title 22, the effluent water quality of each meets or exceeds the criteria listed in Table E.1.

Regardless of the approved regulatory uses of Title 22 water, the CLWA is limited to those uses stated either in its individual permit, or in a general permit that covers multiple users in the area. Other additional uses of recycled water not identified in the permit would need approval from the local RWQCB and CDPH office.

The most recent compilation of recycled water laws, also known as the “Purple Book”, can be found online [http://www.cdph.ca.gov/certlic/drinkingwater/Pages/Lawbook.aspx].

**Table E.1 Summary of CDPH Title 22 Recycled Water Requirements**

| | | **CDPH Irrigation Reuse Category** | | |
|---|---|---|---|---|
| **Parameter** | **Units** | **Disinfected Tertiary[1,2]** | **Disinfected Secondary-2.2[1,3]** | **Disinfected Secondary-2.3[1,4]** |
| Required Treatment | --- | Secondary, tertiary filtration[5] & disinfection | Secondary & disinfection | Secondary and disinfection |
| Minimum CT[6,7] | mg-min/l[6] | 450 | No Requirement | No Requirement |
| Modal Chlorine Contact Time[7,8] | minutes | 90 | No Requirement | No Requirement |
| Mean Turbidity[9] (filter effluent) | NTU | 2[9] | No Requirement | No Requirement |
| Mean Turbidity[10] (filter influent) | NTU | 5[10] | No Requirement | No Requirement |
| Virus removal | % | 99.999[11] | No Requirement | No Requirement |
| 7-Day Median Total Coliform[12] | organisms per 100 ml | 2.2 | 2.2 | 23 |
| 30-day Maximum Total Coliform[13] | organisms per 100 ml | 23 | 23 | 240 |
| Maximum Day Total Coliform[14] | organisms per 100 ml | 240 | No Requirement | No Requirement |

**Table E.1 Summary of CDPH Title 22 Recycled Water Requirements**

| | | CDPH Irrigation Reuse Category | | |
|---|---|---|---|---|
| **Parameter** | **Units** | **Disinfected Tertiary[1,2]** | **Disinfected Secondary-2.2[1,3]** | **Disinfected Secondary-2.3[1,4]** |

Notes:

1) From Title 22, Division 4 of the *California Code of Regulations.*
2) Applicable for areas of high degree of public contact, including irrigation of parks, playgrounds, schoolyards, residential commons, golf courses near homesites, non-restricted recreational impoundments, and the irrigation of food crops where the recycled water may contact the edible portion of the crop.
3) Applicable for areas of limited public contact, including cemeteries, freeway landscaping, golf courses with limited public access and no adjacent housing, impoundments where body-contact recreation is restricted, ornamental nursery stock, pastures, or other non-edible vegetation.
4) Applicable for agricultural areas where the public is excluded, including the irrigation of fiber or fodder crops, non food-bearing trees, and vineyards and orchards where the recycled water does not contact the edible portion of the crop.
5) Does not require coagulation so long as compliance is maintained with the listed turbidity requirements.
6) Chlorine concentration multiplied by the chlorine modal contact time. Requirement not to be exceeded at any time. CT units are expressed in terms of milligram-minutes per liter (mg-min/l).
7) Ultraviolet disinfection may be substituted for chlorination with approval by CDPH.
8) Based on peak dry weather design flow.
9) Not to exceed 5 NTU more than 5 percent of the time, nor exceed 10 NTU at any time.
10) Not to exceed a turbidity of 5 NTU for more than 15 minutes, and to never exceed a turbidity of 10 NTU.
11) In lieu of achieving the required minimum CT of 450 mg-minutes per liter and 90 minute modal contact time, the discharger may demonstrate that the combination of filtration and disinfection achieves a 99.999% (five log or $10^5$) removal rate for units of plaque-forming units of F-specific bacteriophage MS2 or polio virus in the wastewater.
12) Median based on results from the last 7 days for which analyses have been completed.
13) Never to be exceeded in more than one sample during any 30-day period.
14) Maximum never to be exceeded in any sample.

### E.1.3.2 <u>Draft Groundwater Recharge Legislation</u>

CDPH is developing regulations that address groundwater replenishment for aquifers designated as sources of drinking water using recycled water from domestic wastewater sources. The current draft version of the groundwater recharge regulations (issued in 2013) address recycled water recharge to groundwater aquifers using surface recharge and subsurface groundwater injection.

California Water Code Section 13562 required CDPH to adopt the regulations by December 31, 2013, but time required for CDPH to proceed through the formal regulation adoption process has delayed the probable date of adoption until 2014. Until the regulations are finalized, CDPH is using the draft regulations as guidelines in reviewing projects that involve the recharge of recycled water to potable water aquifers.

Table E.2 summarizes key requirements in the Draft CDPH Groundwater Recharge Regulations. As shown in the table, advanced treatment including reverse osmosis and oxidation is required for the subsurface application (injection recharge) of recycled water to potable groundwater basins. Under the draft regulations, required minimum initial recycled water underground retention times range from two months (if tracer study using an added tracer is performed) to six months if a computer model is used to estimate retention time.

The draft recharge regulations specify the use of diluent water (water from other sources mixed with the recharged water) to achieve designated recycled water contribution (RWC) targets. The draft regulations allow CDPH flexibility to assign RWC targets based on recycled water treatment and total organic carbon (TOC) concentrations.

To ensure compliance with drinking water standards for nitrate, the draft recharge regulations specify that total nitrogen concentrations in water recharged to the ground not exceed 10 mg/L.

CDPH regulations regarding recycled water recharge to groundwater aquifers are implemented through (1) recycled water groundwater recharge WDRs issued by the RWQCB, and (2) the CDPH water supply permit issued to the municipal water purveyor utilizing the recharged aquifer.

**Table E.2 Summary of Draft CDPH Groundwater Recharge Regulations**

| | Recycled Water Recharge Method | |
|---|---|---|
| **Parameter** | **Surface Application** | **Subsurface Application** |
| Required Treatment Processes | Secondary, tertiary filtration & disinfection[2] | Full advanced treatment[3] |
| Minimum required removal: | | |
| Enteric virus | 12-log ($10^{12}$) | 12-log ($10^{12}$) |
| Giardia cysts | 10-log ($10^{10}$)[4] | 10-log ($10^{10}$)[4] |
| *Cryptosporidium* oocyst | 10-log ($10^{10}$)[4] | 10-log ($10^{10}$)[4] |
| Minimum required number of separate treatment processes that achieve at least 1 log reduction each for virus, Giardia, and *Cryptosporidium* | 3[5] | 3[5] |
| Virus removal credit for aquifer retention: | | |
| Tracer study using added tracer[6] | 1 log/month | 1 log/month |
| Tracer study using intrinsic tracer[7] | 0.67 log/month | 0.67 log/month |
| Numerical computer modeling[8] | 0.5 log/month | 0.5 log/month |
| Analytical modeling[9] | 0.25 log/month | 0.25 log/month |
| Total nitrogen in water recharged to the ground | 10 mg/L[10] | 10 mg/L[10] |
| Initial maximum Recycled Water Contribution (RWC) unless alternate RWC is approved by CDPH | 0.20[11] | Project-specific[12] |
| TOC in recycled water | 0.5 mg/l/RWC[11] | 0.5 |
| Required retention response time: | | |
| Tracer study using added tracer[6] | No less than 2 months[13] | No less than 2 months[13] |
| Tracer study using intrinsic tracer[7] | No less than 3 months[13] | No less than 3 months[13] |
| Numerical computer modeling[8] | No less than 4 months[13] | No less than 4 months[13] |
| Analytical modeling[9] | No less than 8 months[13] | No less than 8 months[13] |

**Table E.2 Summary of Draft CDPH Groundwater Recharge Regulations**

| | Recycled Water Recharge Method | |
|---|---|---|
| Parameter | Surface Application | Subsurface Application |

Notes:

1) Draft proposed CDPH groundwater recharge regulations (June 26, 2013 version). CDPH (2014)
2) Tertiary filtration and disinfection that conforms to Title 22 "disinfected tertiary" recycled water requirements. See Table 2.10.
3) Full advanced treatment includes reverse osmosis and an oxidation treatment process that achieves a nominal sodium chloride removal rate of 99 percent and during the first 20 weeks of operation produces a permeate where no more than 5 percent of the samples exceed a TOC concentration of 0.25 mg/l. The treatment shall also achieve either (1) a 0.5 log removal of 1,4-dioxane, or (2) 0.5 log removals of hydroxyl aromatic, amino/acylamino aromatic, non-aromatic carbon double bonded, deprotonated amine, alkoxy polyaromatic, alkoxy aromatic, and alkyl aromatic compounds, and 0.3 log removal of saturated aliphatic and nitro aromatic indicator compounds.
4) A project that involves the use of Title 22 tertiary filtered and disinfected water and achieves 6 months of underground retention is deemed to achieve a 10-log reduction of both Giardia and Cryptosporidium.
5) At least three treatment processes are required to achieve a minimum of 1 log reduction of virus, 1 log reduction of Giardia, and 1 log reduction of Cryptosporidium. No more than 6-log removal credit is to be assigned to any individual process.
6) Retention time as determined by a tracer study involving added tracer to determine the time required for 10 percent of the added tracer to be detected at the withdrawal point.
7) Retention time as determined by a tracer study involving an intrinsic tracer to determine the time required for 10 percent of the tracer to be detected at the withdrawal point.
8) Retention time (time required for 10 percent of a tracer to be observed at the withdrawal point), as determined by a numerical computer model (e.g., finite element or finite difference) using validated and verified computer codes for simulating groundwater flow.
9) Retention time (time required for 10 percent of a conservative tracer to be observed at the withdrawal point), as determined by an analytical modeling using academically accepted equations (e.g. Darcy's Law) to estimate groundwater flow conditions.
10) Recycled water groundwater recharge operations are to be suspended if four consecutive recharge water samples exceed a total nitrogen concentration of 10 mg/l; recharge is not to be resumed until two consecutive samples show groundwater total nitrogen concentrations of less than 10 mg/l.
11) CDPH can sequentially assign RWC values of 0.5 and 0.75 if the project achieves 20-week TOC concentrations do not exceed 0.5 mg/l divided by the designated maximum RWC.
12) Maximum RWC to be assigned by CDPH upon review of project-specific conditions.
13) Recycled water shall be retained underground for a sufficient period of time to allow the project proponent to identify treatment failures and implement actions to protect public health. Allowable retention credits shall be reduced depending on the method of demonstrating retention time as indicated above.

### E.1.4 COUNTY DEPARTMENT OF ENVIRONMENTAL HEALTH

CDPH delegates authority to the DEH for the application and enforcement of Title 22 regulations regarding recycled water conveyance, recycled water use, public notification, backflow prevention, cross connection prevention, and to ensure that recycled water is applied in a manner consistent with protecting public health.

In this capacity, DEH reviews recycled water use plans, conduct site inspections, monitors field tests to assess cross connection and backflow prevention, and evaluates conformance with Title 22 signage requirements. DEH also monitors irrigation sites to ensure compliance with Title 22 use regulations and to ensure that recycled water irrigation operations do not present a risk to public health.

DEH requires that recycled water use sites pass an initial cross-connection control shut down test; shut-down tests are conducted every four years thereafter.

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