WRFP Study No. 3435-010

LVMWD Report No. 2500.00

Las Virgenes Municipal Water District

Recycled Water Seasonal Storage Project Feasibility Study

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Appendices

List of Abbreviations

ADWF	average dry weather flow
ADD	average daily demand
AF	acre-foot
AFY	acre-feet per year
AWWF	average wet weather flow
BA	biological assessment
CCR	California Code of Regulations
CEQA	California Environmental Quality Act
DEIR	Draft Environmental Impact Report
DWQ	Drinking Water Quality
EA	environmental assessment
EIR	Environmental Impact Report
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ET	Evapotranspiration
FAA	Financial Assistance Application
FCS	Federal Cost Share
FEIR	Final Environmental Impact Report
FONSI	Finding of No Significant Impact
gpd	gallons per day
Gpm	gallons per minute
GWR	Groundwater Recharge
Hp	Horsepower
MDD	maximum daily demand
MG	million gallons
mg/l	milligrams per liter
mgd	million gallons per day
MOU	memorandum of understanding
District, LVMWD	Las Virgenes Municipal Water District
LABOS	City of Los Angeles, Bureau of Sanitation
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration

NOI	Notice of Intent
NOT	Notice of Termination
NPDES	National Pollutant Discharge Elimination System
O&M	Operation and Maintenance
OE	Ordinance and Explosives
REPOG	Regional Plenary Oversight Group
RMC	RMC Water and Environment
RWMP	Recycled Water Master Plan
RWQCB	Regional Water Quality Control Board
sf	square feet
SHPO	State Historic Preservation Officer
SRF	State Revolving Fund
SWRCB	State Water Resources Control Board
TDS	Total Dissolved Solids
TPC	Total Project Cost
TSS	Total Suspended Solids
USFWS	U.S. Fish & Wildlife Service
WQO	water quality objective
WQO	water quality objective

Executive Summary

This feasibility study evaluates the feasibility of a Recycled Water Seasonal Storage Project (RWSSP), including three seasonal storage alternatives, along with various expansions of the District recycled water conveyance system that would be made possible due to the construction of the RWSSP. The study uses information developed from previous studies to compare these alternatives with other water supply alternatives and also includes discussion of a conceptual groundwater recharge option.

Study Area

The study area for the project is composed of the District service area and neighboring agencies, including Calleguas Municipal Water District, Camrosa Water District, Triunfo Sanitation District, the City of Los Angeles and Los Angeles County Waterworks District #29 (WW#29). These agencies are interested in using recycled water to offset their imported potable water demands and could potentially provide multiple sources of funding support for this project.

Existing Recycled Water Facilities

Recycled water is primarily supplied to the District by treated sewage from the Tapia WRF. Additional supplies are provided by two groundwater wells that supplement the sewer collection system tributary to Tapia WRF, and potable water that may be introduced into the system, from Morrison Tank, Reservoir 2 and Cordillera Reservoir during the summer peak demand season. Overall, the recycled water distribution system consists of five pumping stations, four tanks, three reservoirs (not including those in TSD's service area) and 66 miles of pipeline.

The District has limited natural water sources and relies on importing 100 percent of its potable water supply from the Metropolitan Water District of Southern California (MWD). Currently, this imported water supplies approximately 80 percent of the District's total water demand (26,000 AFY, LVMWDc). The other 20 percent of demands are supplied by recycled water for irrigation needs. However, MWD's water supply is becoming more limited as existing water supplies from the Colorado River and Northern California face increasing restrictions from the impacts of drought, habitat protection, and climate change. This trend increases the need to explore local sources of water such as recycled water.

The efficient use of recycled water requires that the supplies and demands for irrigation customers be balanced as they vary significantly throughout the year. The District does not currently have this capability. Surplus recycled water generated during winter months (when irrigation demands are low to none) is currently discharged to Malibu Creek because the District lacks the storage capacity to hold it until it can be utilized in the summer. As a result, recycled water supplies must be supplemented with groundwater and potable water during the high demands months of the summer and early fall irrigation season.

Needs of the Project

The District's problem/needs can be described as having three main components:

Supply

The District relies on imported water for approximately 80 percent of its annual water supply. Thus, the current reliability of the District's water depends on the reliability of its imported water supplies. Increasingly stringent environmental regulations and competition for State Water Project water has resulted in reduced imported supplies inside the study area. At the same time, a number of significant factors affect imported water reliability, including uncertainties such as Bay Delta pumping restrictions, endangered species impacts, climate change, sea level rise, and Delta levee vulnerability. As a result, the District continues to actively pursue other options for a low-cost, reliable water supply, such as utilizing the recycled water that is already discharged to Malibu Creek as additional irrigation supply.

Operational

Another challenge the District has been working to resolve is the seasonal imbalance between the available recycled water supply and irrigation demands. Since the majority of the District's recycled water is used for irrigation, sales are highly variable with peak demands occurring during the summer. Based on recycled water demand data from the *2007 Recycled Water System Master Plan Update*, the peak demand during the summer months is approximately 1,000 acre-feet per month (AF/month) (or 10.5 mgd). During summer months, irrigation demands must be supplemented with potable water supply. The estimated maximum daily potable water supplement during the peak summer months is approximately 2.8 mgd.

The daily supply of recycled water from the Tapia WRF is fairly constant. The Tapia WRF currently produces an average of approximately 9.5 to 10 mgd of recycled water. On occasion, the influent flow varies significantly, primarily due to infiltration and inflow. In the past, these influences have doubled the daily influent flows to the treatment plant during significant winter storm events.

Regulatory

Due to environmental regulations and revised water quality limits included to protect beneficial uses of the waterways, the District's release option for surplus recycled water has become increasingly more costly to implement. Surplus recycled water discharge to Malibu Creek is prohibited from April 15 through November 15 except in cases when discharge flows are needed to maintain a total of 2.5 cubic feet per second (cfs) in Malibu Creek for habitat preservation. Since the District nearly always has surplus recycled water, even frequently during summer month due to unpredictable weather conditions that could reduce irrigation demands significantly on a daily basis, other disposal alternatives are required. The LARWQCB has permitted the District to release water into the LA River during the Malibu Creek prohibition months. However, potential revitalization improvements and other water-related projects in the LA River are currently in the planning stages. If any of the projects come to fruition, the LARWQCB could pose more stringent disposal requirements and limitations on recycled water released into the LA River.

The District is also subject to SBx7-7 water use reduction requirements and has set forth a plan in the 2010 Urban Water Management Plan to reduce per capita water demands 20 percent by 2020.

Recycled Water Current/Projected Demands

The latest recycled water demands are based on the average consumption data from January 2006 to December 2010. The total recycled water average day demand was 5.9 mgd (6,620 AFY) per the meter data. This includes demands from the District's Western and Eastern Recycled Water System, as well as the Las Virgenes Valley System and a portion of TSD's service area. Average monthly demands during peak summer months occasionally exceed average monthly supply, but the District has experienced consecutive weeks during the wet season when irrigation demands were reduced to essentially zero. In addition, an average of approximately 4,180 AF of recycled water goes to Malibu Creek or other effluent management practices during the winter wet season months.

Recycled water demands have steadily increased over the past 30 years since the inception of the District's recycled water system. However, the lack of seasonal storage and infrastructure to expand the recycled water system to other customers inside and outside of the service area is limiting recycled water use in the area, even though surplus recycled water supply is available.

Projected recycled water demands are expected to increase to 8.0 mgd (8,980 AFY) by the year 2030. Other recycled water expansion projects that would increase demands inside and outside of the District's service area include the Thousand Oak Boulevard Extension, Woodland Hills Golf Course and Agoura Road Gap, and LADWP.

Project Objectives

The objectives of the RWSSP to meet the project needs are as follows:

Supply:

- Decrease reliance on imported water by offsetting 2,360 AFY or more with new recycled water customers and seasonal storage capacity[1]
  - New customer demands inside District service area = 2,074 AFY
  - New customers demands outside District service area = 286 AFY

Operational:

- Enable the District to balance seasonal recycled water supplies and demands by providing approximately 2,000 AF (1,900 to 2,200) of storage capacity and thereby expand the recycled water system to create 2,360 AFY of demand that would not be possible without the storage.
- Enable the District to reduce or eliminate the use of supplemental groundwater
- Enable the District to reduce or eliminate the use of supplemental potable water
- Provide a forum to initiate regional partnerships with other water and wastewater agencies

Regulatory:

- Enable the District to reduce (not eliminate) annual discharges of effluent to Malibu Creek, the LA River, and other non-customer uses
- Enable the District to comply with all applicable regulatory requirements
- Enable the District to comply with discharge prohibition from April 15th to November 15th of every year
- Enable the District to comply with minimum flow requirements for endangered trout habitat in Malibu Creek

This analysis finds that the only type of project that will satisfy these objectives is a seasonal storage reservoir with an expanded recycled water distribution system and new demands. Three potential RWSSP alternatives are compared against a "no-project" alternative in this analysis. The "no project" alternative consists of the continued use of imported water to meet peak irrigation demands and the continued use of effluent management practices to prevent discharges of recycled water to Malibu Creek during the prohibition period.

In addition, a seasonal storage reservoir could help to set the stage for potentially removing discharge prohibitions to Malibu Creek form Tapia WRF as new evidence emerges about the impacts of recycled water on the creek. The project would also provide energy benefits and help to reduce carbon dioxide emissions by cutting down on pumping to the Los Angeles River and to the Rancho Las Virgenes Composting Facility spray fields. It would help to provide a "green" solution to the issues outlined above, and it would enable the District to continue its role as a regional recycled water leader.

[1] It is important to note that seasonal storage capacity is not a solution intended to eliminate discharges to Malibu Creek year-round.

Description of Alternatives

Non-Potable Reuse Projects

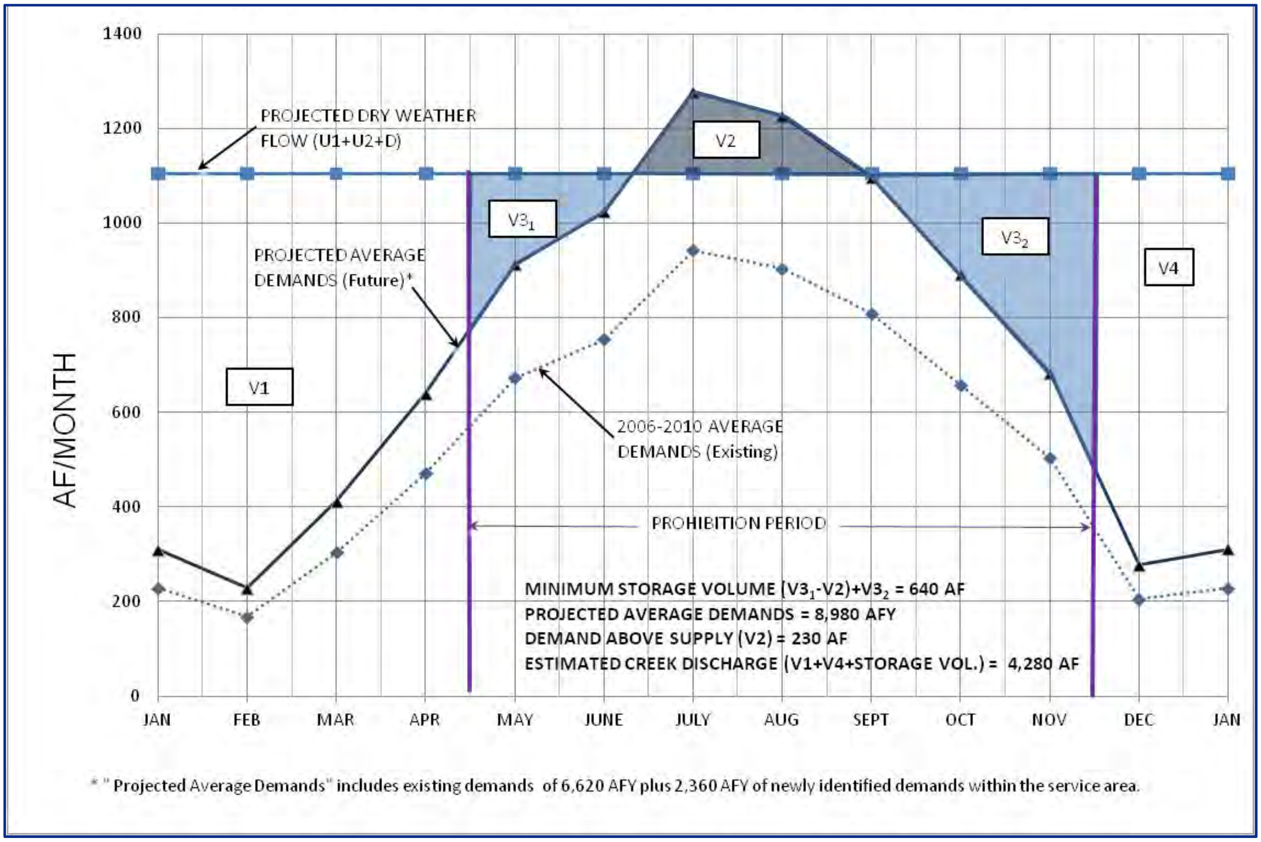
The RWSSP alternatives considered for this project are summarized in **Table ES-1**.

Table ES-1: Summary of RWSSP Alternatives

Alternative	Reservoir Details	Distribution System Improvements	Additional Demand Served (AFY)
April Canyon	• *Volume* = 2,200 AF • *Surface area* = 58 acres • *Dam dimensions*: 1,000'x185'	• *Transmission main*, 30-inch diameter, 12,500 ft. • *Various pipelines*, 8 to 14-inch diameter, 83,600 ft. (total) *April Pump Station (P.S.).*, 1,000 Hp, 8,333 gpm • *Decker P.S.*, 300 Hp, 500 gpm • *Decker Tank*, 0.375 MG	2,360
Stokes Canyon	• *Volume* = 1,900 AF • *Surface area* = 48 acres • *Dam dimensions*: 2,000'x165'	• *Transmission main*, 30-inch diameter, 14,000 ft. • *Various pipelines*, 8 to 14-inch diameter, 83,600 ft. (total) *Stokes P.S.*, 900 Hp, 8,333 gpm • *Decker P.S.*, 300 Hp, 500 gpm • *Decker Tank*, 0.375 MG	2,360
Hope Site	• *Volume* = 2,000 AF • *Surface area* = 45 acres • *Dam dimensions*: 950'x200'	• *Transmission main*, 30-inch diameter, 4,900 ft. • *Various pipelines*, 8 to 14-inch diameter, 83,600 ft. (total) *Hope P.S*, 800 Hp, 8,333 gpm • *Decker P.S.*, 300 Hp, 500 gpm • *Decker Tank*, 0.375 MG	2,360

Figure ES-1 shows the supply and demand curve for Tapia WRF assuming that all identified recycled water demands are realized. The projected average dry weather recycled water flows available from Tapia WRF (supply) are shown as the blue horizontal line, representing 12 mgd (13,260 AFY). "U1", "U2", and "D" signify the three sanitation districts that are tributary to Tapia. The prohibition period is shown between the two vertical purple lines, and the current and projected demand curves are shown as the dotted and solid "bell" shaped curves, respectively. Current average dry weather recycled water flows are approximately 900 AFM (not shown).

Figure ES-1: Tapia WRF Supply-Demand Curve with Future Identified Demands



The figure indicates that the required storage volume within the discharge prohibition period of April 15th to November 15th is approximately 640 AF, which is less than the storage volume that would be provided by any of the three reservoirs. This means that any of the three would provide a sufficient amount of storage to supply peak summer demands and avoid Malibu Creek discharges during the prohibition period. Recycled water stored and not used during the prohibition period (equal to the required storage volume of 640 AF) would be discharged to the Creek during non-prohibition months. The total volume discharged to the Creek during non-prohibition months would be approximately 4,280 AFY.[2] This analysis assumes that the projected seasonal demand pattern would be similar to the existing seasonal demand pattern.

Conceptual GWR Project

This analysis includes a description of a conceptual groundwater recharge (GWR) project that could potentially be implemented to use the remaining recycled water produced by the Tapia WRF. This conceptual GWR project would create a balanced system, wherein all or nearly all of the recycled water supplied by the plant is supplied to end uses other than discharge to Malibu Creek.

This conceptual project assumes that LADWP can utilize the remaining 4,280 AFY of recycled water from Tapia WRF in facilities that the agency would construct and operate at the Donald C. Tillman Water Reclamation Plant and at spreading basins owned and operated by Los Angeles County Department of Public Works (LACDPW). It also assumes that LADWP would construct any necessary facilities to use recycled water from the District inside the LADWP service area, that no treatment changes would be

[2] The amount of remaining flow that is discharged to Malibu Creek is equal to the total future supply from Tapia WRF (13,260 AFY) minus the projected demands (8,980 AFY).

required at Tapia WRF, and that MWD treated replenishment water would otherwise be used in the "no project" alternative.

Finally, the conceptual project assumes that spreading operations can take place at a relatively constant rate throughout the year. This would allow all of the remaining Tapia WRF effluent to be reused without exceeding the capacity of the proposed April (2,200 AF), Stokes (1,900 AF), or Hope (2,000 AF) reservoir sites. In actual practice, the spreading of recycled water would be heavily dependent on rainfall and the subsequent impact on the infiltration capacity of the spreading basins. Winter months, typically the wet season, would normally see more rainfall and reduce the spreading capacity at the basins. A management plan would be required to maximize the infiltration of recycled water. [3]

Table ES-2 summarizes the main facilities included in the conceptual GWR project.

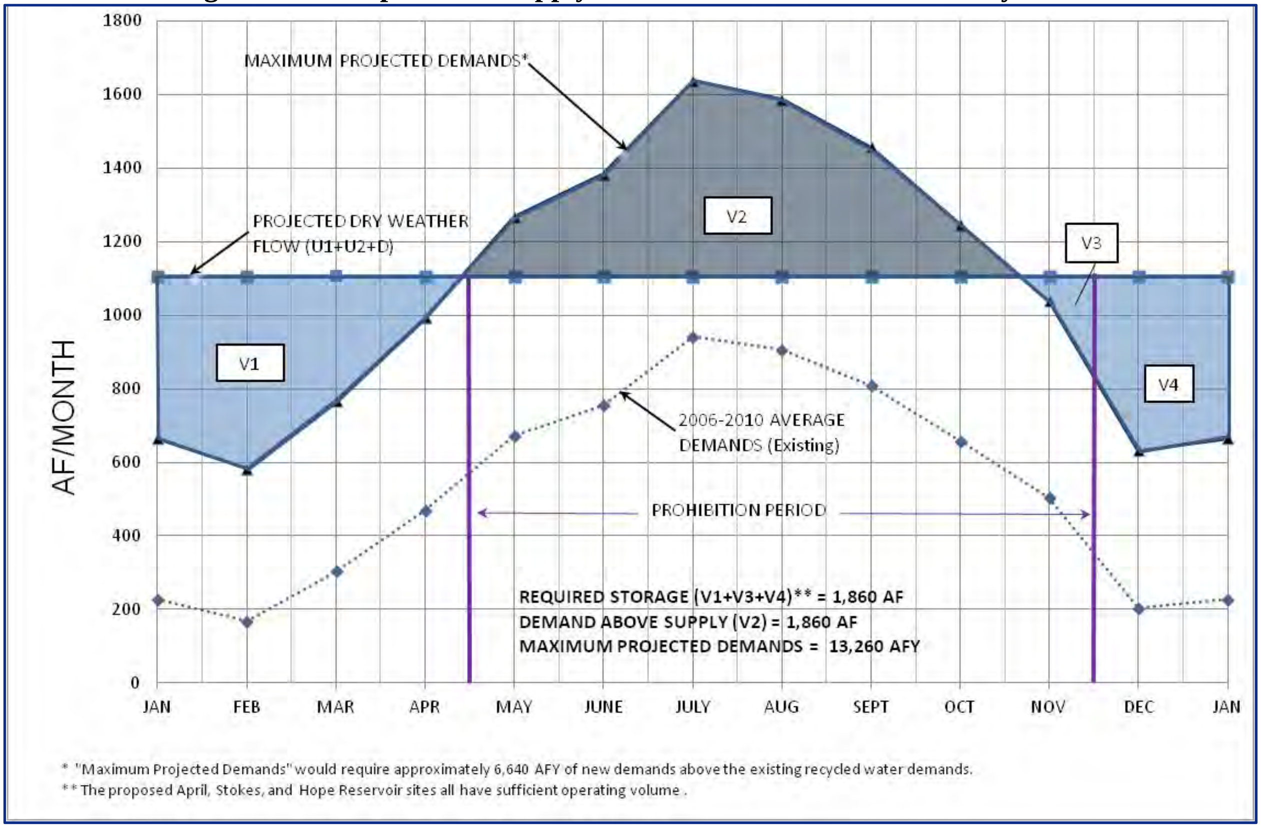
Table ES-2: Summary of Conceptual GWR Project

Alternative	Distribution System Improvements	Additional Demand Served (AFY)
Conceptual GWR Project	• *Conveyance pipeline*, 14-inch diameter, 26,400 ft. • *Upsize of Reservoir P.S.,* 200 Hp, 2,700 gpm • *Upsize of RWPS East P.S.*, 500 Hp, 2,700 gpm	4,280

Figure ES-2 below indicates the balanced system condition for Tapia WRF with full reuse of recycled water. The graph combines the 2,360 AFY of new demands identified above with 4,280 AFY of demand for the conceptual GWR project, for a total of approximately 6,640 AFY in new demand.

[3] For example, if seasonal rainfall patterns prevented use of the spreading basins during winter months (November to April), a considerably larger reservoir capacity would be necessary to reuse all of the remaining 4,280 AFY of Tapia WRF effluent.

Figure ES-2: Tapia WRF Supply-Demand Curve with Balanced System



Conceptually speaking, it is possible that there would be no excess recycled water discharged to Malibu Creek during a typical year if this type of project could be implemented. The graph in Figure ES-2 assumes that recycled water is delivered to the conceptual GWR project at a constant flow rate. To put this in context, 4,280 AFY is not a large percentage of the overall volume recharged at the spreading basins in the San Fernando Valley;[4] so it is feasible that the delivery rate could be fairly constant. The total projected demands of recycled water (i.e., both non-potable of 6,620 AFY plus GWR) are 13,260 AFY, an increase of approximately 6,640 AFY from 2006-2010 average demands.

Economic Analysis

The capital and annualized total costs for each of the three non-potable (NPR) reservoir alternatives are presented below in Tables ES-3 through ES-5. All three reservoir alternatives would supply an additional 2,360 AFY of recycled water demands above current demands. The costs for the conceptual GWR project, which could provide additional demands of 4,280 AFY (for a total of 6,640 AFY) are also provided.

[4] The 2012 Los Angeles Department of Water and Power *Recycled Water Master Planning* documents indicate that there may be more than 4,280 AFY of recharge capacity at each of the three major spreading basins in the San Fernando Valley (Hansen, Pacoima, and Tujunga), even after accounting for average stormwater infiltration and planned LADWP GWR projects (LADWP, 2012).

Table ES-3: April Canyon Reservoir Alternative Engineering Costs

Option	Total RW Supply (AFY)	Capital Cost – Reservoir (2011$)	Capital Cost – Other Facilities (2011$)	Total Capital Cost (2011$)	Total Annualized Cost (2011$/year)	Unit Cost (2011$/AF)
NPR	2,360	$62.2M	$54.9M	$117.2M	$8.1M	$3,450
NPR+GWR	6,640	$62.2M	$67.3M	$129.5M	$9.2M	$1,380

Note: Total annualized cost includes O&M and assumes interest rates of 5% over a 50 year period.

Table ES-4: Stokes Canyon Reservoir Alternative Engineering Costs

Option	Supply (AFY)	Capital Cost – Reservoir (2011$)	Capital Cost – Other Facilities (2011$)	Total Capital Cost (2011$)	Total Annualized Cost (2011$/year)	Unit Cost (2011$/AF)
NPR	2,360	$96.7M	$56.0M	$152.7M	$10.5M	$4,460
NPR+GWR	6,640	$96.7M	$68.3M	$165.0M	$11.6M	$1,740

Note: Total annualized cost includes O&M and assumes interest rates of 5% over a 50 year period.

Table ES-5: Hope Reservoir Alternative Engineering Costs

Option	Supply (AFY)	Capital Cost – Reservoir (2011$)	Capital Cost – Other Facilities (2011$)	Total Capital Cost (2011$)	Total Annualized Cost (2011$/year)	Unit Cost (2011$/AF)
NPR	2,360	$62.9M	$51.1M	$113.9M	$7.8M	$3,320
NPR+GWR	6,640	$62.9M	$63.4M	$126.2M	$8.9M	$1,340

Note: Total annualized cost includes O&M and assumes interest rates of 5% over a 50 year period.

Table ES-6 presents the annualized total costs for the "no project" alternative, which consists of continuing to purchase imported water to meet demands and continued effluent management practices to avoid discharging to Malibu Creek during the prohibition period. Avoided costs are presented for the NPR projects and for the NPR project combined with the conceptual GWR project. Imported water costs assume Tier 2 rates for the 2,360 AFY of NPR demands and treated replenishment rates for the 4,280 AFY of groundwater recharge demands. It should be noted that avoided costs for purchasing treated replenishment costs are costs that apply to the region and not to the District directly. Project partners would be necessary to realize these regional benefits.

Table ES-6: Costs of Imported Water and Continued Effluent Management

Supply (AFY)	Net Present Value of 50-year Imported Purchases (2011$)	Equivalent Annual Cost of 50-year Imported Purchases (2011$/yr)	Equivalent Annual Cost of 50-year Effluent Management (2011$/yr)	Total Annual Cost (2011$/yr)
2,360	$105.2M	$5.8M	$0.4M	$6.2M
6,640	$240.5M	$13.2M	$0.4M	$13.6M

Note: Annualized capital cost assumes interest rates of 5% over a 50 year period.

The net benefit analysis for the project is presented in **Table ES-7**. It is based on a comparison of costs for the most likely alternative projects which, as described above, would be continuing the purchase of imported water and continuing effluent management practices. Thus, the annual regional benefits total between $6.2M and $13.6M in avoided costs.

Table ES-7: Net Benefits of RWSSP

Option	RWSSP Annual Cost (2011$/AF)	Alternative Project Annual Cost (2011$/AF)	Net Benefit in Annual Costs (2011$/AF)	Cost/Benefit Ratio
NPR	$7.8M – 10.5M	$6.2M	-$1.6M to -$4.3M	1.3 - 1.7
NPR+GWR	$8.9M – 11.6M	$13.6M	$2.0M to $4.7M	0.7 – 0.9

The net annual benefit of the project depends on whether the conceptual GWR project is pursued. For the NPR project options alone, there is a cost of $1.30 to $1.70 for every potential dollar of benefit gained by the RWSSP. However, for the combined NPR and conceptual GWR projects, there is a cost of $0.70 to $0.90 for every potential dollar of benefit gained by the RWSSP. A hypothetical “break even” point with 2,360 AFY of NPR and approximately 2,200 AFY of GWR (around half the proposed GWR project capacity) provides a cost of exactly $1.00 for every potential dollar of benefit gained by the RWSSP.

The District will be responsible for all operation and maintenance of the facilities proposed in the RWSSP.

Selection of Proposed Project

This study finds that all three seasonal storage reservoir site projects would be feasible from a technical perspective. In terms of economics, it would be necessary to include some version of the conceptual GWR project to provide more benefits than costs. Of the three reservoir alternatives, the lowest cost alternative is the Hope Reservoir Site; and on the basis of cost this is selected as the proposed RWSSP. [5]

Other Considerations

Environmental issues, legal and institutional issues, the financial capability of the sponsor, and research needs are also described in this analysis.

[5] It should be noted that the three sites differ in terms of the ease with which appropriate land can be acquired and in the potential difficulty of obtaining regulatory and permitting approval.

Chapter 1 Introduction

1.1 Background

The Las Virgenes Municipal Water District (District) has been a pioneer in water reuse by replacing imported, potable water with recycled water for irrigation since the early 1970s. The District has built one of the most extensive recycled water distribution systems in the state, reusing approximately 65-70 percent of the available tertiary effluent on an ongoing basis. In recent years, the availability of imported water has become less reliable and the value of recycled water has increased. The District continues to examine ways to maximize recycled water reuse beyond previous successes to date to meet a significant portion of its water demands. Doing so will (1) reduce its reliance on increasingly costly and less reliable imported water, (2) reduce the need to use supplemental potable water to meet peak irrigation demands and (3) provide a more reliable strategy to comply with prohibition of discharges of recycled water to Malibu Creek during a period imposed by the Los Angeles Regional Water Quality Control Board (LARWQCB).

A Joint Powers Authority (JPA) composed of the District and Triunfo Sanitation District (TSD) oversees the production of recycled water at the Tapia Water Reclamation Facility (Tapia WRF). The Tapia WRF operates under a National Pollution Discharge Elimination System (NPDES) permit issued by the LARWQCB under the 1972 Federal Clean Water Act. This permit initially allowed the release of all surplus recycled water into Malibu Creek. The District typically needs to discharge surplus recycled water during wet months of the year and needs to supplement recycled water supplies with potable during the peak demand months of the summer and early fall irrigation season.

In 1997, LARWQCB restricted the release of recycled water from the Tapia WRF to six months out of the year, from May 1 through October 31, except in the case of an operational emergency or storm event. In 1999, the LARWQCB extended the prohibition to seven months, from April 15 through November 15, except in cases when discharge flows are needed to maintain a total of 2.5 cubic feet per second (cfs) in Malibu Creek. This minimum flow in the Creek is intended to preserve the habitat of steelhead trout, an endangered species. When release of supplemental flow during the prohibition period is necessary, the District must obtain written permission from the LARWQCB Executive Officer. The releases are required, typically in the late summer months.

The longer prohibition period, especially during the low irrigation demand months of April and November, increased the need for a non-weather-dependent alternative to manage surplus recycled water. In an attempt to address this, the District’s 1999 NPDES permit allowed Tapia WRF effluent to be discharged into the Los Angeles River (LA River) after all other disposal strategies are exhausted. These “other” disposal strategies included discharging recycled water to spray farm fields at the Rancho Las Virgenes Composting Facility; and diverting raw wastewater to the City of Los Angeles, Bureau of Sanitation (BOS) sewer system. In 2005, the LARWQCB modified the permit to allow recycled water to be released into the LA River at any time throughout the year. The District releases an average of approximately 430 AFY to the LA River (LVMWDg). The LA River discharge requires that recycled water be conveyed through a high-elevation portion of the District’s recycled water distribution system.

The LARWQCB also imposed additional nutrient limits established by the U.S. Environmental Protection Agency in 2003 for effluent discharges to Malibu Creek and the LA River. New nitrification/denitrification facilities were recently completed at the Tapia WRF to meet these requirements for live stream discharges.

To study water reuse and reduce recycled water disposal, the District produced the *Tapia Effluent Alternatives Study* in December 2005 (TEA Study), which examined a wide range of options for long-term creek release avoidance (LVMWDb). The study evaluated several potential projects for the release of surplus recycled water from the Tapia WRF. Potential alternatives included seasonal storage reservoir sites coupled with an expansion of the recycled water distribution system. These were more costly than ocean outfall and LA River disposal options but would allow greater reuse and pose fewer environmental challenges.

This feasibility study evaluates the feasibility of a Recycled Water Seasonal Storage Project (RWSSP), including three seasonal storage alternatives along with various expansions of the District recycled water conveyance system. The study uses information developed from previous studies to compare these alternatives with other water supply alternatives.

1.2 Non-federal Project Sponsors

The District would be the primary non-federal project sponsor. Other agencies that could potentially be involved in the study to provide in-kind services and/or financial assistance include:

- Triunfo Sanitation District (TSD)
- Metropolitan Water District of Southern California (MWD)
- Los Angeles Department of Water and Power (LADWP)
- Calleguas Municipal Water District (CMWD)
- Camrosa Water District (CWD)
- Other retail water agencies in Ventura County
- Los Angeles County Waterworks District No. 29

TSD, the other member of the JPA that owns and operates Tapia WRF, is currently not participating in the RWSSP Feasibility Study but may do so at a later date.

1.3 Study Area

The District owns and operates a potable and recycled water system that serves the cities of Agoura Hills, Calabasas, Hidden Hills, and Westlake Village, as well as unincorporated areas in the western portions of Los Angeles County. The total service area covers approximately 122 square miles, with elevations ranging from a few feet above sea level to over 2,500 feet. The topography of the service area has resulted in a potable water distribution system with 22 separate service zones, with an equal number of pump stations and storage tank facilities (LVMWDa, 2007). The recycled water system extends to the nearby TSD service area which includes Lake Sherwood and Oak Park/North Ranch within Ventura County. The District serves a population of approximately 80,000.

The study area for the project is composed of the District service area and neighboring agencies, including CMWD, CWD, TSD, the City of Los Angeles and Los Angeles County Waterworks District #29 (WW#29). These agencies are interested in using recycled water to offset their imported potable water demands and could potentially provide funding support for this project.

Figure 1-1 shows the District’s service area, neighboring water agencies, and the three potential recycled water reservoir sites evaluated in this study.

1.4 Existing Recycled Water Facilities

Recycled water is primarily supplied to the District by treated sewage from the Tapia WRF. Additional supplies are provided by two groundwater wells that supplement the sewer collection system tributary to Tapia WRF, and potable water is seasonally introduced into the system, at the Morrison Tank, Reservoir 2 and Cordillera Reservoir.

There are four pressure zones within the District recycled water service area. They are listed as follows:

- Las Virgenes Valley System
- Eastern System

- Western System
- Parkway System

The Las Virgenes Valley Recycled Water System consists of an effluent pump station and pipelines from the Tapia WRF to Reservoir No. 2. This system supplies recycled water to other recycled water systems and supplies users located within Las Virgenes Valley, south of the District headquarters. Major users within this system include Pepperdine University, which uses up to 140 AF of recycled water per year, Mountains Recreation and Conservancy Agency (King Gillette Ranch) and the Las Virgenes Unified School District. The capacity of the 18-inch pipeline in Las Virgenes Road from Tapia WRF to Mulholland Highway was recently supplemented with a new 24-inch pipeline. Construction of the new pipeline was complete October 2010.

The Eastern Recycled Water System consists of the Recycled Water Pump Station East (RWPS East) at District headquarters, 14 and 18-inch pipelines to Reservoir No. 3 and Cordillera Tank, and smaller distribution piping throughout the Calabasas area located south of the Ventura Freeway. Major recycled water users in this area include the Calabasas Golf Course and Calabasas High School. The system also connects to the Mountain Gate Service area north of the Ventura Freeway and is also referred to as the Calabasas System.

The Western System consists of the Recycled Water Pump Station West (RWPS West), the Morrison Supplement Facility (Morrison Pump Station), 24 and 20-inch main pipelines that connect to the Indian Hills Tank and many smaller pipelines that serve several users within the Western System. Water is also delivered to TSD service areas via a 14-inch pipeline in Kanan Road which supplies the connection to the Oak Park/North Ranch; and a 16-inch spur pipeline which serves Lake Sherwood. The Oak Park area has a tank and pump station that is owned and operated by the CMWD.

The Parkway Recycled Water System is the most recent of the four systems. It was constructed in 2005 and consists of a small pump station and tank within the New Millennium development. It draws water from the Eastern System and serves the higher elevations within the development through the Parkway Pump Station and Parkway Tank. The primary user is the Homeowners' Association which uses recycled water to irrigate a small park and various common areas.

Overall, the recycled water distribution system consists of five pumping stations, four tanks, three reservoirs (not including those in TSD's service area) and 66 miles of pipeline. **Figure 1-2** shows the District's existing recycled water system. Water purveyors in Ventura County and wholesale water agencies in the vicinity are shown in **Figure 1-3**.

Figure 1-1 Las Virgenes Municipal Water District and Neighboring Agencies

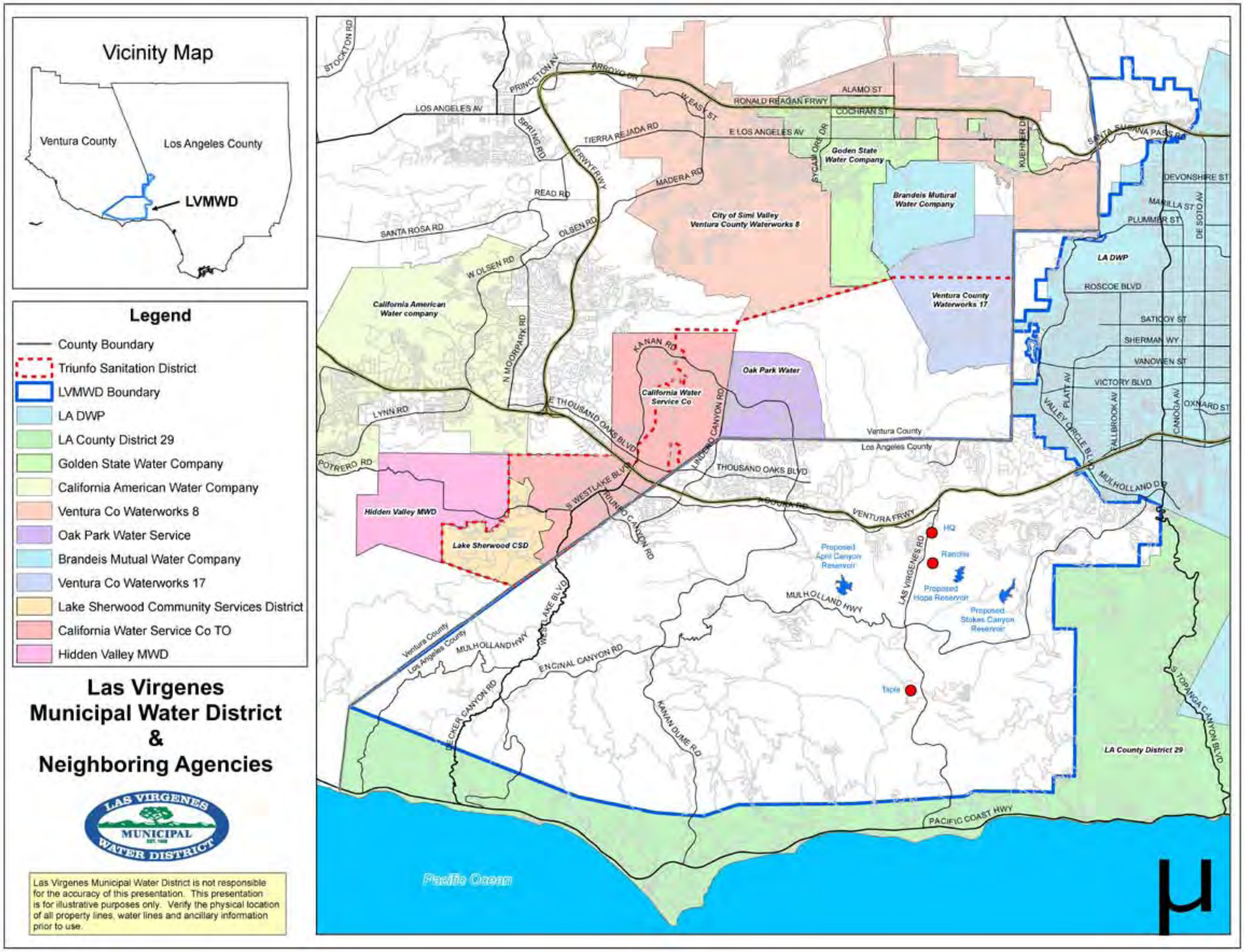


Figure 1-2 Existing Recycled Water System

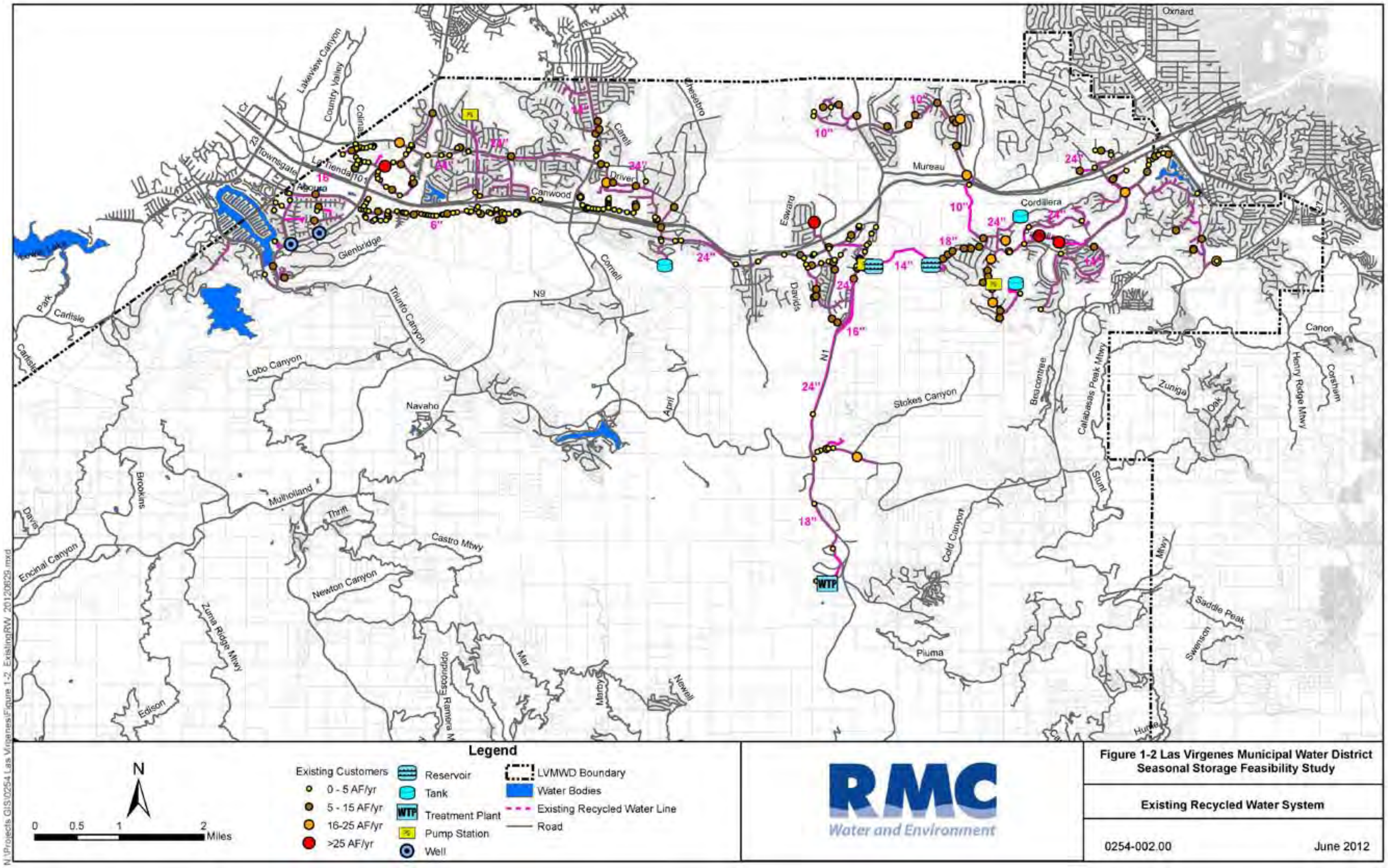
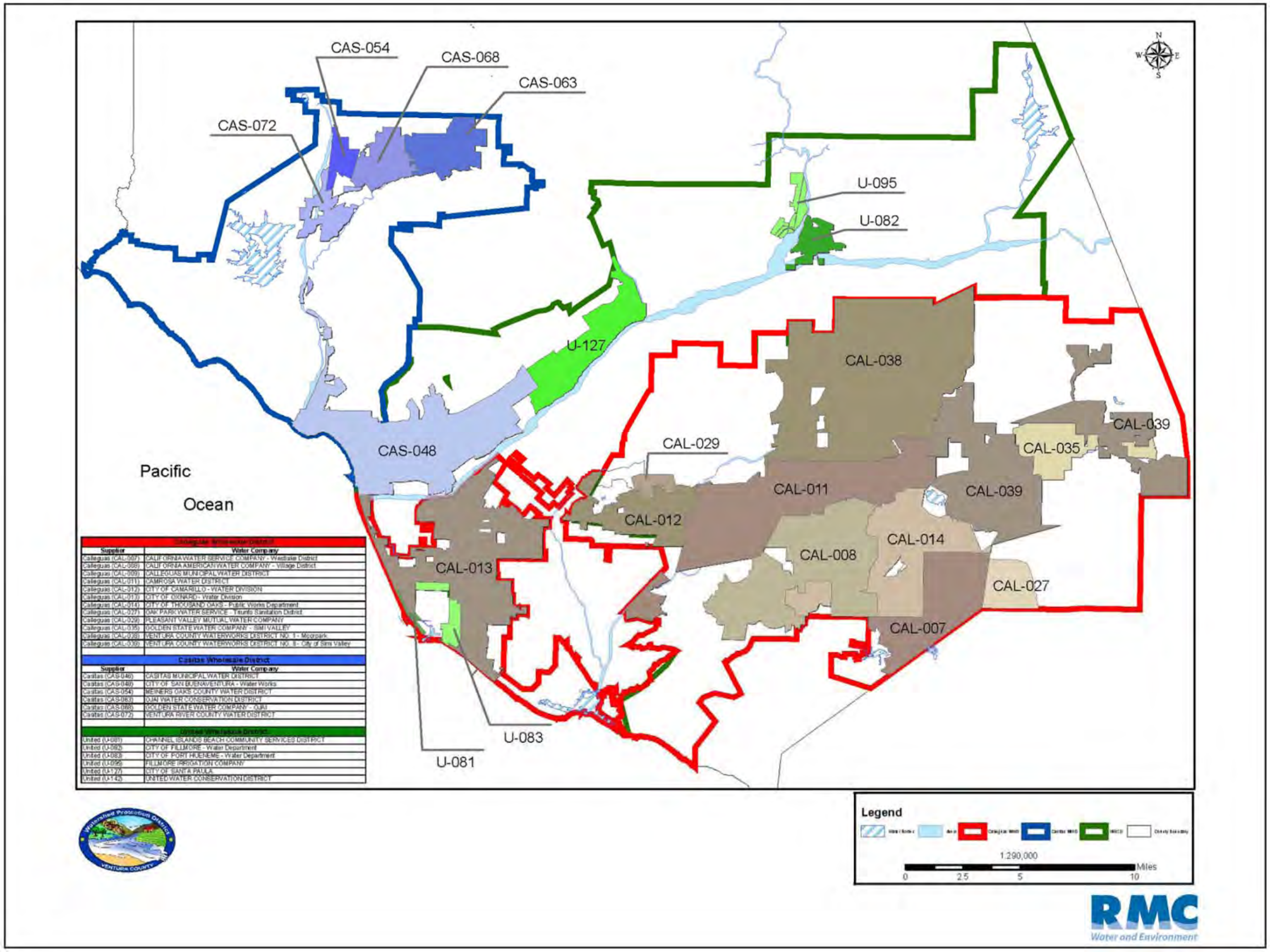


Figure 1-3: Wholesale Water Districts and Water Purveyors in Ventura County



Chapter 2 Statement of Problems and Needs

2.1 Problems/Needs

The District has limited natural water sources and relies on importing all of its potable water supply from MWD. Currently, this imported water supplies approximately 80 percent of the District's total (potable and non-potable) water demand (26,000 AFY). The other 20 percent of demands are supplied by recycled water. However, MWD's water supply is becoming more limited as existing water supplies from the Colorado River and Northern California face increasing restrictions from the impacts of drought, habitat protection, and climate change. This trend increases the need to explore local sources of water such as recycled water.

The efficient use of recycled water requires that recycled water storage and use for irrigation customers is balanced as demand varies throughout the year. The District does not currently have the ability to utilize all of its available recycled water supply on an annual basis. Surplus recycled water generated during winter months (when irrigation demands are low to none) is currently discharged to Malibu Creek because the District lacks the storage capacity and customer demands to fully utilize it. Also, recycled water supplies must be supplemented with groundwater and potable water during the high demand months of the summer and early fall irrigation season. Furthermore, during lower-demand portions of the creek discharge prohibition period (April 15 through May and September through November 15), the volume of tertiary discharge from Tapia often exceeds the RW demand, resulting in the need to discharge recycled water to the LA River and/or dispose of Tapia effluent at the spray fields in the vicinity of the Composting Facility if weather allows.

The District's problem/needs can be categorized as follows:

- Supply
- Operational
- Regulatory

Each of these components is discussed in further detail in the following sections.

2.1.1 *Supply*: Reliance on Imported Water

The District relies on imported water for approximately 80 percent of its annual water supply. Thus, the current reliability of the District's water depends on the reliability of its imported water supplies. Increasingly stringent environmental regulations and competition for State Water Project water has resulted in reduced imported supplies inside the study area. At the same time, continued population and economic growth increase demands within the District, imposing an even greater burden on all available water supplies. A number of significant factors affect imported water reliability, including uncertainties such as Bay Delta pumping restrictions, endangered species impacts, climate change, sea level rise, and Delta levee vulnerability. As a result, the District continues to actively pursue other options for a low-cost, reliable water supply. A more detailed discussion on the future of imported water supply will be provided in Chapter 5.

2.1.2 *Operational*: Seasonal Imbalance between Supply and Demand

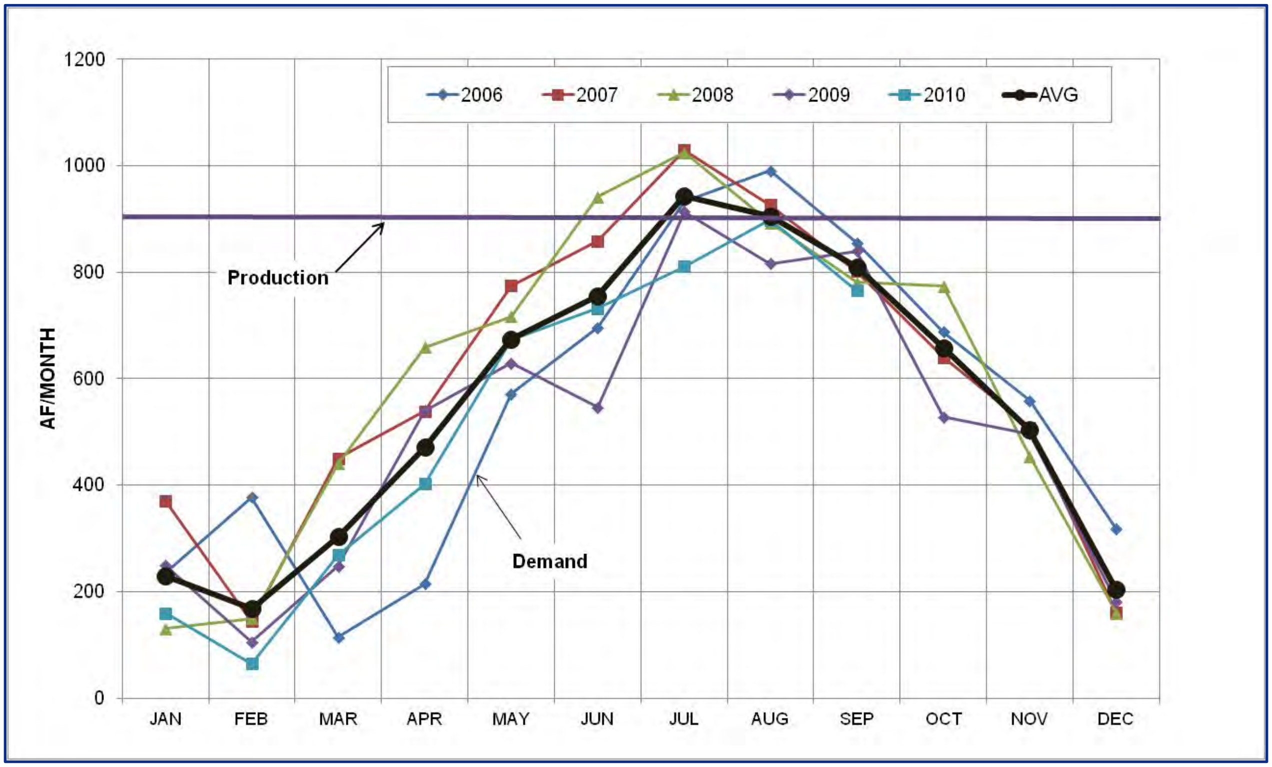
Another challenge the District has been working to resolve is the seasonal imbalance between the available recycled water supply and irrigation demands. Since the majority of the District's recycled water is used for irrigation, sales are highly variable with peak demands occurring during the summer. Based on recycled water demand data from the *2007 Recycled Water System Master Plan Update*, the monthly average demand during the peak summer months fluctuates from 800 to 1,000 acre-feet per month (AF/month) (or from 8.5 mgd to 10.5 mgd). During peak summer months, irrigation demands must be supplemented with potable water supply. The estimated maximum supplement with potable water during the peak summer months is approximately 2.8 mgd.

The daily supply of recycled water from the Tapia WRF is fairly constant except during rain events. The Tapia WRF currently produces an average of approximately 9.5 to 10 mgd of recycled water. On occasion, the influent flow varies significantly, primarily due to infiltration and inflow. In the past, these influences have doubled the daily influent flows to the treatment plant during significant winter storm events.

Figure 2-1 shows the historic monthly averages for supply (average of 9.75 mgd) and demand of recycled water from 2006 to 2010. Based on these data, average monthly demands during peak summer months occasionally exceed average monthly supply. An average of approximately 6,650 AFY of recycled water goes to Malibu Creek or other effluent management practices during the winter wet season months.

Figure 2-1

Recycled Water Production and Demand



2.1.3 *Regulatory*: Discharges to Malibu Creek and SBx7-7 Requirements

Due to environmental regulations and revised water quality limits included to protect beneficial uses of waterways, the District's release option for surplus recycled water has become increasingly more difficult to implement. Surplus recycled water discharge to Malibu Creek is prohibited from April 15 through November 15 except in cases when discharge flows are needed to maintain a total of 2.5 cubic feet per second (cfs) in Malibu Creek for habitat preservation. Since the District nearly always has surplus recycled water, even frequently during summer months, other reliable, weather-independent disposal alternatives are required. The LARWQCB has requested that the District to release water into the LA

River during the Malibu Creek prohibition months. However, potential revitalization improvements and other water-related projects in the LA River are currently in the planning stages. If any of the projects come to fruition, the LARWQCB could pose more stringent disposal requirements and limitations on recycled water released into the LA River.

Regulatory requirements have prompted the construction of a biological nutrient removal facility at the Tapia WRF to lower the nitrite and nitrate levels to below 8 mg/L (nitrate plus nitrite). Construction was completed in August 2009 and the facility subsequently began operation. Also per the District's latest NPDES permit, dichlorobromomethane (DCBM) levels in the recycled water must be reduced to below 46 µg/L and total trihalomethanes (TTHMs) levels below 80 µg/L by 2014. This will require the District to implement additional disinfection technologies. The chosen solution to limit DCBM and TTHM levels in Tapia effluent is the implementation of a new ammonia addition system, which is currently under design.

The current NPDES permit requires the District to continue supplementing Malibu Creek flows to maintain 2.5 cfs of total flow, when necessary. The purpose of this flow augmentation is to sustain habitat for steelhead trout, a species that has been identified as endangered. The NPDES permit contains provisions for supplemental discharge during the prohibition period, which can be authorized with written permission from the LARWQCB Executive Officer. Because of this potential requirement and the challenges of doubling the District's current recycled water demands, it is unlikely that zero-discharge to Malibu Creek could be achieved.

The District is also subject to SBx7-7 water use reduction requirements and has set forth a plan in the 2010 Urban Water Management Plan to reduce per capita water demands 20 percent by 2020.

2.2 Water Supplies

The District provides water, sanitation, and recycled water services to a population of approximately 80,000 over nearly 75,000 acres. The District currently has four sources of water supply to meet growing demands, with the following supply breakdown from the Final 2010 Urban Water Management Plan:

- Imported treated, potable water from the MWD (78%)
- Recycled water from the Tapia WRF (18%)
- Groundwater from Russell Valley Basin (used to supplement recycled water supplies) (1%)
- Surface water runoff to Las Virgenes Reservoir (3%)

2.2.1 Imported Water

The District typically purchases 25,000 AFY of imported water from MWD, primarily supplied by the State Water Project (SWP) and originating from northern California. The water is treated at the Joseph Jensen Filtration Plant before the water is delivered to the District.

Other sources of potable water include purchases from Ventura County Waterworks District No. 17 and the City of Simi Valley, both of which are supplied indirectly from MWD through CMWD. The District typically receives 150 AFY of treated water from Ventura County and Simi Valley. The inter-tie connections provide potable water to two small areas in the hills west of the San Fernando Valley. The District has plans to connect these customers to their distribution system (LVMWDc).

Water Quality – MWD SWP water originates in the Northern California mountains, rivers, and streams that flow through the Sacramento-San Joaquin Delta before entering the California Aqueduct. The water purchased by LVMWD is filtered at the Jensen Filtration Plant. Since treated water from this plant is not blended with water from the Colorado River[6], the total dissolved solids (TDS) or salinity levels are relatively low ranging from 320 to 370 mg/L per the *2009 LVMWD Annual Water Quality Report*.

Other contaminants of potential concern are disinfection by-products, including N-nitrosodimethylamine (NDMA), Trihalomethanes (THMs) and Haloacetic Acids (HAAs). THMs and HAAs have been found to cause cancer in laboratory animals at specified levels. The 2009 *LVMWD Annual Water Quality Report* showed these levels were below the State and Federal maximum contaminant levels (MCLs). NDMA is an emerging contaminant that may impact the water supply as a suspected carcinogen. There is concern that chlorine and monochloramine can react with organic nitrogen precursors to form NDMA in recycled water. Currently however, MWD's water supplies are indicating non-detect levels for NDMA.

2.2.2 Recycled Water

Recycled water is produced at the Tapia WRF and comprises about 20 percent of the District's total annual water use (LVMWDc). The facility currently treats 7.5 to 11.5 mgd of wastewater on an average dry-weather day. Of this, as much as 8.2 mgd, and an annual average of approximately 6 mgd, has been delivered to recycled water customers. This number was estimated from 2007 historical data which was the highest recycled water consumption year recorded from January 2006 to August 2010, based on meter data provided by the District.

Water Quality - The Tapia WRF will supply tertiary treated effluent for the study area. The plant effluent is treated to comply with the requirements of Title 22 of the California Code of Regulations and the LARWQCB. The use of recycled water is regulated under Water Reclamation Requirements contained in Order No. 87-086 which was later readopted on May 12, 1997, through General Order No. 97-072. The Tapia WRF discharges surplus recycled water to Malibu Creek and the LA River pursuant to waste discharge requirements (WDRs) contained in Order No. R4-2010-0165 and NPDES Permit No. CA0056014, adopted by the Los Angeles RWQCB on September 2, 2010. The previous Order No. R4-2005-0074 included a prohibition of discharge to Malibu Creek from April 15th to November 15th of each calendar year, to minimize the contribution of Tapia WRF's discharge to breaching of sandbars at the mouth of Malibu Lagoon, which would impact both wildlife and human health beneficial uses. The Order also assigned effluent limitations of 8 mg/L for nitrate to the LA River, 8 mg/L of nitrite as nitrogen for discharge to Malibu Creek and dichlorobromomethane (DCBM) at an average monthly limit of 46 μg/L and a daily maximum limit of 64 μg/L.

In August 2009, the District completed the construction of nitrification and denitrification (NDN) facilities at the Tapia WRF. The staff has been optimizing these processes to consistently achieve effective nutrient reductions to meet the final effluent limitations in Order No. R4-2005-0074 and repeated in Order No. R4-2010-0165.

The recently adopted Order No. R4-2010-0165 includes the aforementioned constituent limitations for discharges to Malibu Creek and the LA River in addition to a new monthly average effluent limitation of 80 μ/L for Total Trihalomethanes (TTHM). The TTHM and DCBM regulatory limits requirements have prompted the District to investigate alternative disinfection technologies to modify or replace their current disinfection process that uses sodium hypochlorite. Chlorine produces TTHM and DCBM (one of four chemicals that make up THMs) as a by-product in the treated effluent. As a result, the District selected chloramination as their alternative technology. These improvements to the Tapia WRF will need to be in operation by 2014 to meet permit requirements.

[6] The salinity in the Colorado River water averages 650 mg/L and has the highest level of all of MWD's sources of supply.

2.2.3 Groundwater

The District does not have access to groundwater of sufficient quality to use as a source for potable supply, but non-potable groundwater wells are used to supplement influent flows to Tapia WRF to attenuate high mineral content and consequently increase the amount of recycled water produced. The District owns and operates two groundwater wells located in Westlake Village in the Russell Valley Basin near the intersection of Lindero Canyon and Lakeview Canyon Road. Each well has a nominal capacity of approximately 400 gallons per minute (gpm). Collectively, they have a capacity of approximately 1.15 mgd.

With proper blending or treatment, supplemental groundwater may be introduced into the recycled water system using the sewer system. The District has provided blending by conveying the groundwater to Tapia WRF using existing trunk sewers. The groundwater is blended with the influent sewer flows treated at the plant. The wells are only used when supplemental water is needed to meet peak demands. Timing and control of well operation requires careful planning and coordination so that surplus flow does not accumulate at the Tapia WRF, especially during the creek discharge flow prohibition period.

Water Quality - Existing groundwater from the two wells at Westlake Village are within the Russell Valley Basin within the South Coast Hydrologic Region. The area is a relatively small alluvial basin bounded by semi-permeable rocks of the Santa Monica Mountains. The basin underlies a surface area of about 3,100 acres or five square miles.

According to California's Groundwater Bulletin 118 (2004), the ground water quality generally contains sodium bicarbonate or calcium bicarbonate. The TDS content usually ranges from 800 to 1,200 mg/L with the upper limit reaching as high as 2,800 mg/L in some areas of the hydrologic region. Sulfate content averages 300 mg/L in most wells and is probably due to the volcanic basalt that constitutes the basement rock of the aquifer (LVMWDc).

There is also a frequent occurrence of inorganic contaminants, such as iron and manganese, from the groundwater wells. These have caused staining and other aesthetic problems in concrete structures and sidewalks when groundwater was first used to supplement the recycled water system via a direct connection to the distribution piping.

2.2.4 Surface Water

There are no significant surface water sources within the District service area. The Las Virgenes Reservoir, which is owned and operated by the District, serves to attenuate peak flows and provide emergency storage as imported water from MWD is withdrawn or replenished. The main storage reservoir has a storage volume of 9,600 acre feet. However, the watershed around the reservoir does not supply a significant source of water in most years; it merely provides adequate runoff to offset evaporative losses (LVMWDc).

Water Quality - The majority of the water in the reservoir is imported water from the SWP via MWD; it is used to attenuate peak demands in the potable water system and provide emergency storage. Surface water will not be used to supplemental the recycled water system in the study area, therefore, surface water quality data are not included in this report.

2.2.5 Potential Sources of Additional Water

The District is exploring other potential sources of water to meet their customers growing demands. One potential source identified in the 2005 Urban Water Management Plan was to interconnect with CMWD on the west side of the District's boundary to refill the Las Virgenes Reservoir with up to 20 cfs of imported water during the winter months. This would help refill Las Virgenes Reservoir. Another potential source of water is MWD's Seawater Desalination Program that was launched in August 2001.

The program would indirectly impact the water sources available in the region and therefore provide an indirect benefit to the District.

2.3 Recycled Water Demands

In order to properly analyze and assess the needs of the recycled water system, existing and projected future flows must first be established. Recycled water demands vary greatly throughout the day. Peak demands for recycled water generally occur during the night due mainly to irrigation restrictions and practice, with substantial reductions in demand during the day. Recycled water demands also vary greatly over the seasons, and are very sensitive to drought and wet periods. The District has experienced consecutive weeks during the wet season when irrigation demands were reduced to essentially zero.

2.3.1 Current Demands

The latest recycled water demands are based on the average consumption data from January 2006 to December 2010. The total recycled water average day demand was 5.9 mgd (6,621 AFY) per the meter data. This includes demands from the District's Western and Eastern Recycled Water System, as well as the Las Virgenes Valley System and a portion of TSD's service area.

Recycled water demands have steadily increased over the past 30 years since the inception of the District's recycled water system. However, the lack of seasonal storage and infrastructure to expand the recycled water system to other customers inside and outside of the service area is limiting recycled water use in the area, even though surplus recycled water supply on an annual basis is available.

2.3.2 Projected Demands

The 2007 RWMP estimated an additional 20 percent (approximately 1,330 AFY) of demand from in-fill development by the year 2030. An additional 0.9 mgd (approximately 1,000 AFY) was also identified from potential large customers in and near the District service area that could be served through an extension of the recycled water system. Potential customers that would be served include the Malibu Country Club Golf Course, the Medea Valley, the Fire Camps, Saddlerock Ranch, and Calamigos Ranch. These customers were identified as the Decker Canyon Project in the master plan, and would play a significant role in offsetting costs associated with expansion of a potable water system which is currently nearing maximum capacity in the area. Some of the customer demands have been adjusted in this report to accommodate the pipeline alignments proposed in Section 4.7. The proposed transmission pipeline in the Decker Canyon Project has been incorporated into the proposed facilities in this study.

Other recycled water expansion projects that could potentially increase demands inside and outside of the District's service area include the Thousand Oak Boulevard Extension, Agoura Road Gap, the Calabasas City Center, Woodland Hills Golf Course, and other LADWP customers. Projected recycled water demands are expected to increase to 8.0 mgd (8,980 AFY) by the year 2030.

Table 2-1 summarizes the estimated average day and maximum day demands for build-out year 2030. Each of the alternatives described in Chapter 4 serve all of these demands.

Table 2-1: District Recycled Water Demand Build-out (2030)

No.	Description/Project	Annual Demand (acre-feet)	Average Daily Demand (MGD)	Maximum Daily Demand (MGD)
1	Current Demand (2009 - 2010)	6,621	5.91	13.5
2	In-fill Development	1,330	1.19	2.38
3	Decker Canyon Project	364	0.33	0.66
4	Thousand Oak Blvd. Extension	251	0.22	0.44
5	Calabasas City Center	24	0.02	0.04
6	Agoura Road Gap	38	0.03	0.06
7	Woodland Hills Golf Course	230	0.21	0.42
8	Louisville High School	51	0.05	0.09
9	Serrania Avenue Park	30	0.03	0.05
10	Church at Mulholland Drive and Deseret	6	0.01	0.01
11	Motion Picture and Television Fund Hospital	5	0.004	0.01
12	Topanga Mountain School	~1	0.00	0.00
13	Mulholland Drive Medians	5	0.004	0.01
14	Alice Stelle School, Freedom Park & Other	24	0.02	0.04
	Total	**8,980**	**8.0**	

Note: Data for items 2 to 6 were obtained from the 2007 *Recycled Water Master Plan* prepared by Boyle Engineering (October 2007), and data for items 7 through 14 were obtained from the *Woodland Hills Country Club Recycled Water Service Study, Second Draft* (LVMWD #2467.00, January 2011). Values for items 2 through 6 were adjusted to include demands served by the pipelines proposed in Section 4.7 of this report. All of the alternatives described in Chapter 4 of this document serve all of the demands listed above.

Customers located in LADWP service area include the Woodland Hills Country Club, Louisville High School, the Motion Picture Hospital, and other potential users. They are all situated in the southwest portion of the San Fernando Valley, just east of Calabasas.

The total additional recycled water demand that would be served by the proposed recycled water distribution system expansion is approximately 2,360 acre-feet.

2.4 Water Quality Issues

The water quality of the District's water supply varies depending upon the source. The following sections describe the current and projected water quality issues associated with the available and potential water sources.

2.4.1 Current Water Quality Issues

The quality of recycled water produced by the Tapia WRF meets Title 22 standards for human contact and is acceptable for irrigation use, but it deteriorates within the distribution system. There have been reports of live organisms – snails, worms and shrimp in sprinklers (LVMWDc) and in the tanks and reservoirs of the recycled water system. Part of the problem may be attributed to the lack of chlorine residual in the system. The District has measured low chlorine residual, particularly in the Eastern System, with somewhat higher levels in the Western System.

The feasibility study will identify alternatives to address these water quality issues as they affect customer acceptance of the product water and limit its use.

2.4.2 Projected Water Quality Issues

The water quality of recycled water from the Tapia WRF is regulated by the discharge requirements in the NPDES permit. Even with seasonal storage and new recycled water customers, some effluent management that involves discharges to the LA River during the prohibition period is likely to continue. If the water quality requirements for recycled water become more restrictive, requiring further upgrades to the treatment plant; then this would make the District’s pursuit of other beneficial uses or disposal options more economical.

As new studies are conducted and advanced detection technologies are developed, more stringent regulatory limits are being established. Malibu Creek is 303(d) listed as an impaired water body under the Clean Water Act for algae and scum/foam. The EPA set the numeric target for total nitrogen at 8 mg/L during the winter season for streams, lakes and lagoons. This is more stringent than the Basin Plan numeric objective of 10 mg/L. The LARWQCB included an effluent limit of 8 mg/L for total nitrogen in the 2005 and 2010 permits. For total phosphorous, LARWQCB included a limit of 3 mg/L for Malibu Creek. The nutrient criteria were established to address the abundant algal blooms. However, studies to determine which constituent was more limiting were inconclusive. Other factors such as flow, light, and natural sources from the Monterey Formation also contribute to the algal growth. However, the EPA determined it would be necessary and appropriate to set nutrient targets because the Basin Plan has nutrient objectives for total nitrogen and evidence of algae in the winter. The EPA ultimately set numeric targets during the winter months that are less stringent than those of summer months, but more stringent than the Basin Plan numeric objective. Seasonal limits were established for total nitrogen and total phosphorous because of the “significant uncertainty concerning the relationship between algal growth and nutrient levels in the winter months.” Because of lower (to zero) effluent discharges from Tapia WRF during the summer as compared to the winter, the LARWQCB has allowed an extension of the winter limits to be year round.

The greatest level of water quality deterioration is likely to occur in the open-air reservoirs where sunlight dissipates chlorine and promotes photosynthesis, and contact of stored recycled water occurs with the earthen berms that have no concrete lining. These factors increase the rate of algae growth. The algae growth further depletes the chlorine and attracts animals and organisms that can contaminate the reservoir.

In addition, the improvement of advanced detection technologies may lead to regulatory limits for emerging contaminants.

2.5 Wastewater and Disposal Options

2.5.1 Current

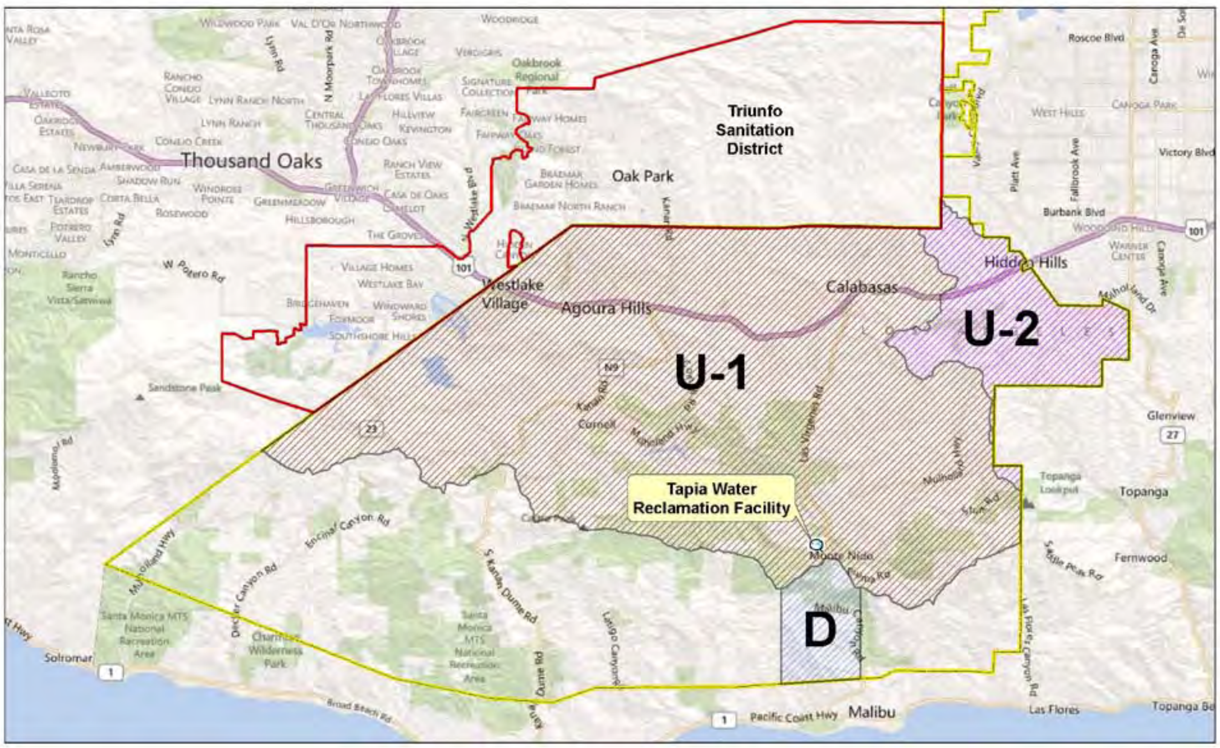
In 1964, the District and TSD entered into a Joint Exercise of Powers Agreement to construct, operate, maintain and provide regional sewer service and wastewater treatment within the two district boundaries.

The District provides wastewater management to a portion of Los Angeles County; and TSD serves the southeast portion of Ventura County that is tributary to the Malibu Creek watershed. The District provides sewer, potable water and recycled water services for a population of about 80,000 over an area approximately 150 square miles in size. The Tapia WRF was constructed after the partnership was formed.

Currently, approximately 9.5 to 10.3 mgd of raw wastewater is collected and treated at the Tapia WRF. It was originally designed to treat up to 16 mgd but was upgraded to provide nutrient removal for up to 12 mgd. Future wastewater flow projections to the year 2030, in the 2007 RWMP, do not anticipate flows above 12 mgd. The nutrient removal facility is designed to meet a maximum monthly average concentration limit of 8 mg/l for nitrate plus nitrite, and 2.3 mg/l for ammonia.

The tributary areas to the Tapia WRF are the U-1, U-2, and D Sanitation Districts and TSD which contributes approximately 3.1 mgd to the total sewer flow. The sanitation districts are shown below in **Figure 2-1**.

Figure 2-1: LVMWD Sanitation Districts



The District also operates a complex distribution system, consisting of pipelines, pump stations, tanks and reservoirs, and associated appurtenances to deliver the recycled water to users in various areas of Calabasas, Agoura Hills, Westlake Village and other areas in Los Angeles and Ventura Counties. Within TSD, the service area includes Lake Sherwood and Oak Park/North Ranch (LVMWDb). TSD wastewater collection treatment and disposal facilities include approximately 255 miles of collection system piping; pump stations; 1 mile of force mains; and wastewater treatment and recycled water infrastructure. The District's current recycled water system includes five recycled water pump stations, four tanks, three reservoirs; four pressure reducing stations and 66 miles of pipeline.

The District currently manages treated wastewater using various combinations of five different disposal options. These include (1) discharge to Malibu Creek during the wet season, (2) expansion of recycled water system, (3) diversion of raw wastewater to the City of Los Angeles Sewer System, (4) diversion of recycled water to the LA River, and (5) diversion of recycled water to spray fields on vacant lands. **Table 2-2** summarizes the capacities of the various disposal options. Westlake Golf Course and the Incentive Program are available but have not been used in recent years.

Table 2-2: District Creek Avoidance Compliance Capacity of Disposal Options

Disposal Options	Capacity (mgd)
005 to LA River	6.00
Sewer diversion to City of LA	0.85
Farm	0.34
Westlake Golf Course	0.26
Incentive Program	0.90
TOTAL	**8.35**

Discharge to Malibu Creek

As previously mentioned, the Tapia WRF operates under an NPDES permit issued by the LARWQCB. The primary discharge outfall into Malibu Creek is Discharge No. 001 from November 16th to April 14th of each calendar year. Discharge No. 001 is located about 0.3 mile upstream of the confluence with Cold Creek (about 5 miles upstream of the lagoon). Discharge No. 002 flows into lower Las Virgenes Creek, and is used to release surplus recycled water from Las Virgenes Reservoir No. 2. Reservoir No. 2 is located behind the District headquarters buildings and is rarely discharged. Discharge Point No. 003 is located above the County gauging station (R-13 in Order No. 2005-0075) on Malibu Creek and is only used as an additional outlet during extremely high flow conditions. Discharge Point No. 4 was eliminated in 1999. Finally, surplus recycled water may be pumped over the Calabasas grade and discharged into the Arroyo Calabasas via Discharge Point No. 5 (tributary to the LA River). **Figure 2-3** shows the locations of discharge points within the JPA service area (*LARWQCB Order No. R4-2010-0165).*

Expansion of Recycled Water System

The District was among the earliest agencies to aggressively promote recycled water for beneficial use through irrigation. A District ordinance mandates that commercial customers use recycled water where it is available. To beneficially recycle Tapia WRF effluent, the District has created an extensive system of pumping, storage and distribution facilities that deliver tertiary treated recycled water with sufficient pressure for irrigation. Effluent is pumped up Malibu Canyon from the Tapia WRF facility to Reservoir No. 2, an open reservoir, behind District headquarters where pumping stations provide the necessary pressure for distribution. The District recycles approximately 50 percent of the water treated at the Tapia WRF in its service area. The JPA transmission system provides TSD with its supply of recycled water, which totals an average additional 20 percent of the water treated at the Tapia WRF. That brings the total amount of water recycled to 70 percent of the influent.

As outlined in the *Tapia Effluent Alternatives Study, Phase 3 Final Report*, the JPA has steadily expanded its recycled water system. Since November 1997, the JPA has added 74 new recycled water connections, with these new customers utilizing as much as an additional 750 acre-feet of recycled water annually, which is a 15 percent increase in recycled water demand (LVMWDe, 2006).

Diversion of Raw Wastewater to the City of LA Sewer System

To reduce inflows to the Tapia WRF and enable the District to meet the current 7-month creek discharge prohibition, a recurring five-year agreement is negotiated with the City of Los Angeles that allows temporary diversion of some of the raw wastewater from portions of the District service area within the Los Angeles River Watershed (specifically portions of Calabasas and Hidden Hills) to LABOS treatment facilities. In addition to a rental charge for capacity, this agreement requires separate payment for treatment costs. To accurately measure the flow being diverted, a meter was installed at the sewer connection between the District mainline and the LABOS system.

Diversion of Recycled Water to the LA River

The critical need for a non-weather-dependant alternative to meet the creek discharge prohibition led to a limited, permitted discharge of Tapia WRF effluent outside the Malibu Creek Watershed. In the District's 1999 NPDES permit, LARWQCB included a discharge outlet for Tapia WRF effluent in eastern Calabasas (located within the LA River watershed) that allows effluent to be diverted to the LA River. Nitrification/denitrification facilities were recently completed to comply with new discharge limits for nitrate (8 mg/l) that were established in March 2003. The new limits apply to monthly averages and only apply during times when the Tapia WRF discharges to Malibu Creek or the LA River (LVMWDb, 2007).

Disposal of Recycled Water Using Land Spraying

The District sprays surplus recycled water for disposal on just over 70 acres of District land at the Rancho Las Virgenes Composting Facility. All land spraying is closely monitored to avoid soil saturation and to prevent runoff (LVMWDe, 2006).

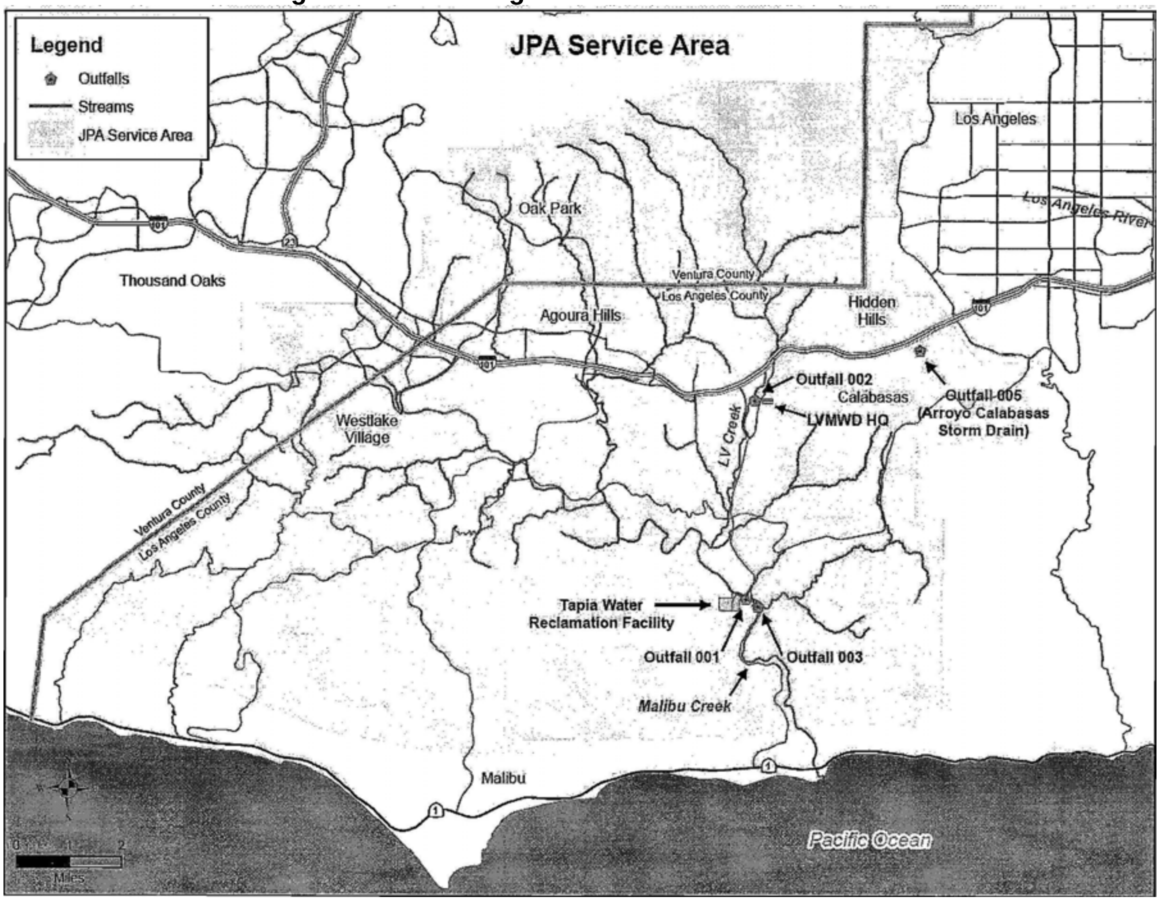
2.5.2 Projected

Previously, the District investigated a project that would divert all of the dry-weather flows, 2.0 to 2.3 mgd, from the U-2 Sanitation District to Los Angeles (LVMWDb). This sewer flow would be allowed to be directed to the Tapia WRF should it be required for recycled water production. It should be noted that other areas of the District, such as, Sanitation Districts U-3 and B are tributary to Los Angeles. Additionally, homes located on the south slope of the Santa Monica Mountains use on-site septic systems or other means because they do not have access to sewer collection systems. Based on estimated future dwelling units for water and sewer projections, a higher portion of new development is expected in these more remote, rugged areas resulting in higher estimated water demands than projected wastewater flows by 2030 (LVMWDb).

New wastewater and collection system facilities are not required for a seasonal storage project. The volume of recycled water the Tapia WRF is capable of producing on a daily basis exceeds the existing average daily demands except during intermittent periods during summer months.

The preferred method of effluent management, as recommended in this report, is to implement the RWSSP, including three seasonal storage alternatives, along with various expansions of the District recycled water conveyance system that would be made possible due to the construction of the RWSSP. The implementation could also include a conceptual groundwater recharge option.

Figure 2-3: Discharge Points in JPA Service Area



Source: LARWQCB Waste Discharge Requirements for the Las Virgenes Municipal Water District, Tapia WRF, Discharge to Malibu Creek and Los Angeles River, Order No. R4-2010-0165, Revised Tentative, July 2, 2010.

Chapter 3 Water Reclamation and Reuse Opportunities

3.1 Recycled Water Uses

Approximately 60 percent of the treated wastewater at the Tapia WRF is recycled and used on an annual basis for the primary purpose of landscape irrigation. Currently, recycled water is also used at the Tapia WRF, Pepperdine University, Rancho Las Virgenes Composting Facility and Rancho Las Virgenes Farm. In order to fully utilize all of the available recycled water produced by the Tapia WRF, the recycled water demands during the peak summer months would need to be nearly double the current maximum daily demand (assuming a similar seasonal demand profile).

A list of identified recycled water users was developed based on potential customers' acreage and demands as identified in the 1999 Master Plan and updated in the 2007 RWMP. Identified recycled water users included:

- Parks
- Schools
- Median landscaping
- Housing developments
- Commercial developments
- Golf courses
- Fairgrounds
- Dust control
- Construction activities

3.2 Potential Uses & Market Assessment Procedures

The recycled water produced at the Tapia WRF and distributed by the JPA will be used primarily for urban irrigation with minimal usage for dust control and construction activities. An extensive analysis of consumption records from 1993 to 1998 was performed as part of the 1999 LVMWD Master Plan. These data along with updated consumption records and SCADA data were used in the 2007 RWMP to refine overall water demands, populate a hydraulic model, estimate peaking factors and determine current and future maximum daily recycled water demands.

Irrigation demands typically exhibit a higher usage at night than during the day and are seasonal with greater demands in the summer months (July and August) and low to no demands in the winter months (December and January). Only a few recycled water customers use water during the day, particularly for construction activities and dust control purposes.

Peaking factors were estimated using recycled water demand data from 2002, because this year had the highest usage at the time the 2007 RWMP was developed. Average daily demands were calculated and a maximum day demand peaking factor of 2.5 and peak hour peaking factor of 2.0 were used. Potential recycled water demand areas within the JPA and outside of this service area were identified. Their projected demands were estimated based on the amount of landscaped area, user type, and unit recycled water demands from the 2007 RWMP. **Table 3-1** shows unit demands for various user types.

Table 3-1: Recycled Water Unit Demand

User Type	Acre-ft/acre/year
Schools	2.7
Medians/Parkways	5.5
Parks	3.5
Slopes	2.6
Homeowners' Association	2.8
Commercial	5.8
Golf Courses	3.5

Other potential recycled water opportunities were also identified in the 2007 RWMP, earlier master plans, and the *Tapia Effluent Alternatives Study*. However, these opportunities were not included in the 2007 hydraulic model and an economic and engineering feasibility analysis would need to be performed to determine the impacts of these projects on the existing system. The potential recycled water opportunities listed below use recycled water for landscape irrigation. Refinements to the City of Los Angeles customer information were subsequently made in the 2011 *Woodland Hills Country Club Recycled Water Service Study, 2nd Draft*.

- In-Fill Development
- Alternative Decker Canyon Project
- Thousand Oaks Boulevard Extension
- Agoura Road Gap
- Woodland Hills Golf Course and other irrigation customers in the City of Los Angeles' service area

The RWSSP would allow the District to store up to 2,200 acre-feet of recycled water at the April Canyon Reservoir site, between 1,400 and 1,900 acre feet at the Stokes Canyon reservoir site, and up to 2,000 acre-feet at the Hope Reservoir site. Potential recycled water customers would be served from the proposed reservoir sites through an expansion of the recycled water distribution system. The list of potential recycled water customers identified for each of the sites is provided in **Appendix A**.

The recycled water is available, but storage and distribution facilities would be required in order to expand delivery to new customers. The recycled water demand analysis confirmed that the District service area and adjacent communities could use additional recycled water and that potable water would be offset, thereby helping to meet potable water supply needs. An expansion project with seasonal storage could serve many existing and new water users inside the District's service area.

As part of this feasibility study, it was determined that identifying potential recycled water demands outside of the District's service area would be beneficial in meeting the water supply needs in the region and obtaining funding support for the project. By doing so, this would make the project more cost effective for participating agencies.

Implementing recycled water use would entail disconnecting existing customer irrigation systems from the potable water system and reconnection directly into the new recycled water system. Cross-connection testing would be performed at all facilities in accordance with California Water Code regulations. New users would connect their irrigation systems directly to the recycled water main. The recycled water distribution system would be designed to provide water at a minimum pressure of 40 pounds per square inch (psi) at the point of connection. Costs for on-site retrofits of existing systems are included as part of this feasibility study and are assumed to be designed and constructed in accordance with applicable health, safety, and water resources standards, including but not limited to Title 17 and Title 22 of the California Code of Regulations (CCR), the California Porter Cologne Water Quality Control Act, the Federal Clean Water Act, and the Department of Water Resources, Division of Safety of Dams.

3.3 Considerations

This section describes the different considerations involved with implementing a proposed recycled water project. These include the need to retrofit existing systems, gain public acceptance, implement competitive pricing, address water quality issues, and improve water reliability.

Converting an existing irrigation system from potable to recycled water is likely to be an expensive undertaking involving preparing design plans, obtaining approval from the Department of Public Health, connection retrofitting, connection testing, and signing of customer agreements with the District. However, the increasing cost for potable water, water scarcity and project timing (particularly close to a drought period) is making recycled water a more viable and attractive alternative water source despite the upfront conversion cost. Although growth within the District service area is near build-out, new developments that install separate piping for recycled water would be significantly less expensive than retrofitting.

Public perception of the use of recycled water for landscape irrigation has become more positive with the recent water shortages related to SWP pumping restrictions for Delta smelt and the drought period from 2007 to 2009. The need for a more reliable and drought resistant water source is critical for customers that depend on an uninterruptable water source, such as golf courses or agricultural users. Golf courses are more apt to convert to recycled water if the water quality is low in salinity (typically maximum 1,000 mg/L of TDS) and relatively consistent in quality, for ease of maintenance. Other constituents in the water also impact turf growth and health, such as sodium, chlorides and pH. It should be noted that functional drainage systems are essential for effective golf course irrigation to allow leaching and or periodic flushing of salinity. Another critical service the District would provide is regular monitoring of the recycled water effluent at the treatment plant to confirm and report water quality. This would serve to reassure existing and potential customers that the recycled water the District is providing meets the minimum water quality requirements established by regulatory agencies and signed customer agreements.

Currently, the District is promoting conservation measures through the Southern California WaterSmart program with a rebate for residential customers with less than five dwellings that (1) use water-saving devices and (2) whose water bills are not paid by a Homeowners Association or property management company. Recycled water rates in southern California are approximately 80 percent to 90 percent of the cost of potable water, depending upon the water purveyor. The relatively lower recycled water rate, reliability, and increasing trend in potable water rates is incentive for customers to seriously consider alternative sources of water such as recycled water.

3.4 Water and Wastewater Agencies

The following agencies have jurisdiction over the service area and/or source for the recycled water:

- Triunfo Sanitation District: jointly owns, operates and maintains the Tapia WRF with the District
- Metropolitan Water District of Southern California
- Cities of Agoura Hills, Calabasas, Hidden Hills and Westlake Village

- Los Angeles County – unincorporated areas
- Los Angeles Department of Water and Power

3.5 Recycled Water

3.5.1 Sources and Facilities

Recycled water is primarily supplied by the treatment of raw sewage at the Tapia WRF. As discussed previously in Section 2.2, groundwater is used to supplement sewage flows into Tapia during peak demand months. Potable water is also periodically supplied by MWD to supplement the recycled water system and meet peak summer demands. **Figure 3-1** shows schematically the three potable connections and other sources of supply. The Morrison Supplemental Facility, located in Agoura Hills, can currently provide 1,100 gpm even though it is designed for 2,000 gpm. Limitations on the existing potable water system prevent the facility from delivering at its design capacity. With the anticipated completion of the Agoura Road Pipeline in 2016, this problem will be mitigated. Reservoir No. 2 and the Cordillera Tank in the Eastern System can supplement the recycled water system with 2,100 gpm and 1,200 gpm of potable water, respectively. All of the potable supplement locations are equipped with an air gap prior to discharging into a reservoir or pump station to avoid cross contamination.

3.5.2 Current Disposal and Reuse

As discussed in Section 2.5, current disposal and reuse strategies include discharging recycled water to spray farm fields at the Rancho Las Virgenes Composting Facility (300 AFY) and LA River Basin (275 AFY); discharging to Malibu Creek; recycled water reuse; diverting raw wastewater to the LABOS sewer system; and discharge of treated effluent to the LA River.

3.5.3 Technology

The treatment process at the Tapia WRF removes solids and organic materials from the effluent and disinfects the effluent prior to discharge. All of the secondary-treated effluent receives tertiary treatment pursuant to regulations set forth by the State Water Regional Control Board and Department of Public Health for the production of tertiary treated wastewater, as defined by Title 22 of the CCR for "unrestricted reuse." The recycled water is then suitable for unrestricted irrigation of landscapes, residential front yards, agricultural crops, golf courses, parks, cemeteries, and playing fields.

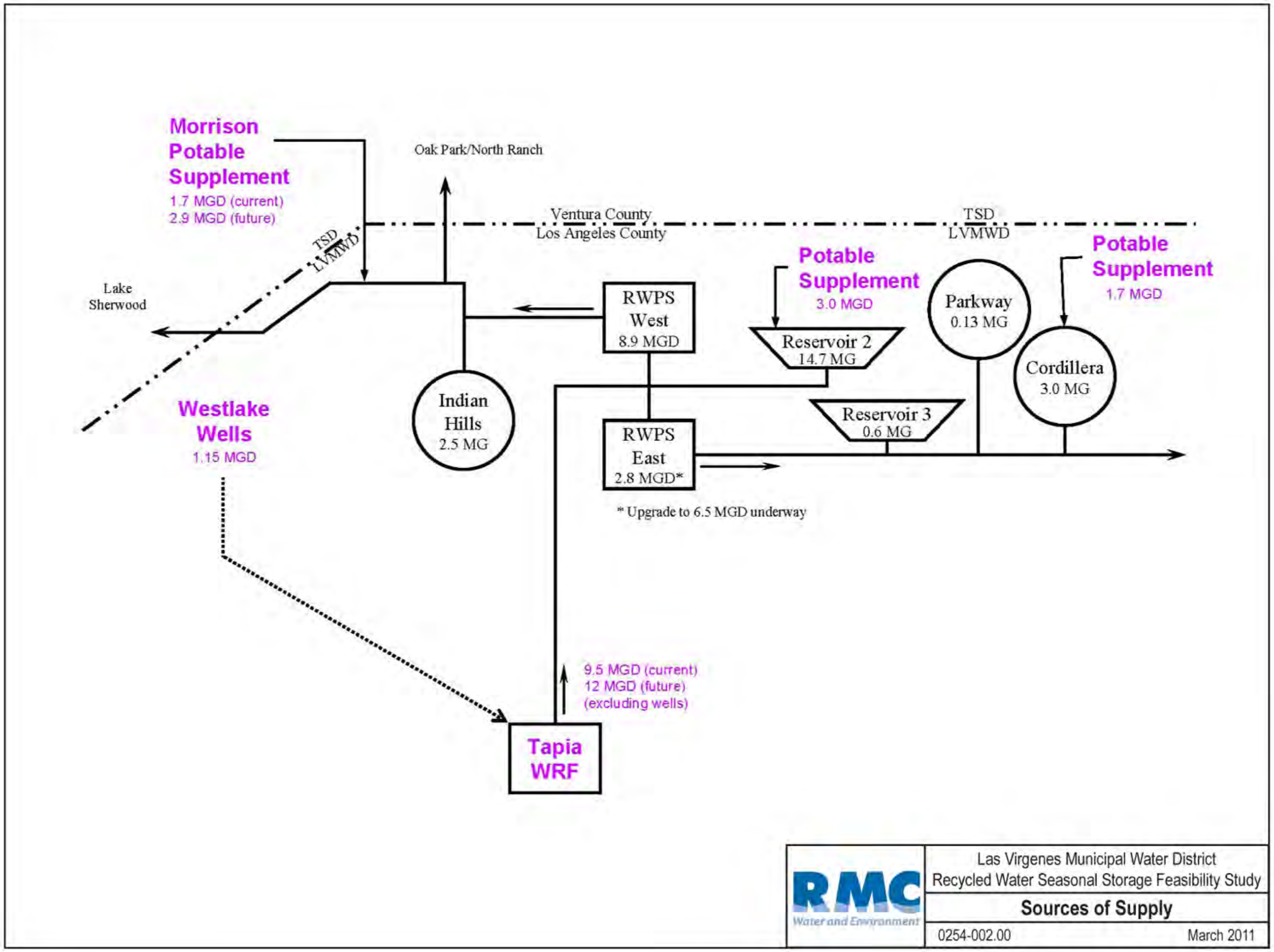
The Tapia WRF has capacity to treat up to 12 mgd (average dry weather flow) to a tertiary level of treatment. The tertiary treatment process sequence is as follows: Coarse screening, grit removal, primary sedimentation, secondary treatment, tertiary treatment, chlorination and dechlorination. For secondary treatment, Tapia WRF uses an activated sludge process with nitrification and denitrification (NDN), followed by secondary clarification. Tertiary treatment includes coagulation, flocculation and filtration through anthracite media. Sodium Hypochlorite solution is added for effluent disinfection, and sodium bisulfate is added for dechlorination prior to discharge to live streams. **Figure 3-2** shows a schematic of the treatment train process at Tapia WRF.

The treatment plant also has an off-site digester, dewatering, and composting facility that has been in service since 1994, the Rancho Las Virgenes Composting Facility. This facility treats biosolids from the wastewater treatment plant. It uses a composting process to transform biosolids into a useable, rich soil amendment. The biosolids are transported through four miles of underground pipelines. Processing includes two anaerobic digesters, centrifuge dewatering, in-vessel composting using processing bays, and curing before it is ready for distribution as a Class A garden compost on lawns and gardens, including vegetables grown for human consumption.

Plans for improved technologies included construction of alternative disinfection systems to reduce TTHM and DCBM limits for surplus recycled water discharges to Malibu Creek and the LA River. The District selected chloramination as the disinfection alternative.

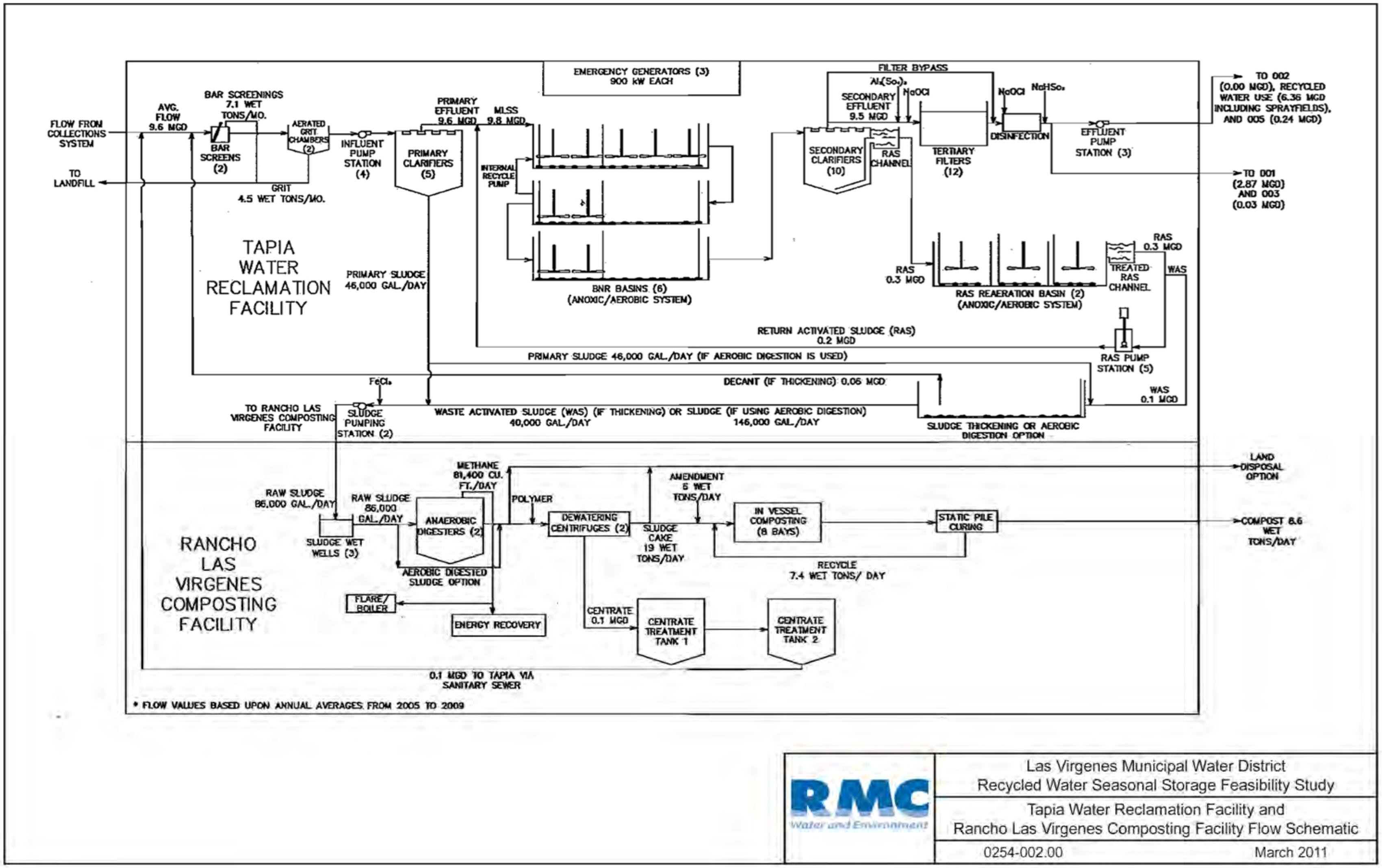
Other potential technologies for the District's recycled water system include the addition of a post-treatment facility at the proposed seasonal storage reservoir site. Reservoirs that are open to the environment typically benefit from filtering and disinfection, or additional concrete lining and a cover system, before stored water is introduced into the distribution system. This would provide quality assurance for customers and protect equipment and facilities within the recycled water distribution system.

Figure 3-1 Sources of Supply



Source: Recycled Water Master Plan Update 2007 by Boyle Engineering

Figure 3-2: Tapia Water Reclamation Facility and Rancho Treatment Train and Rancho Las Virgenes Composting Facility Schematic



Source: LARWQCB Waste Discharge Requirements for the Las Virgenes Municipal Water District, Tapia WRF, Discharge to Malibu Creek and Los Angeles River, Order No. R4-2010-0165, Revised Tentative, July 2, 2010.

Chapter 4 Description of Alternatives

This section presents a description of alternatives evaluated to determine the proposed project that could be implemented by the District. This analysis evaluated four potential water supply alternatives. Three are potential recycled water expansion projects with seasonal storage reservoirs and the fourth is an increase in imported water supply. The optimal alternative is recommended as a viable project for the District to pursue.

4.1 Non-federal Funding Condition

The District is the lead entity for the RWSSP. Without the project, the District will continue purchasing imported water for the demands listed above in Section 2. The non-federal funding condition will potentially meet traditional imported water supply needs for irrigation but will not satisfy the objectives outlined below.

4.2 Objectives

In order to secure a more reliable water source at a reasonable cost for southern California, agencies and municipalities must develop innovative and cooperative solutions to solve the ever-growing water shortage issue in this region. The District's RWSSP has the potential to provide recycled water to customers within its service area as well as a surplus amount to outside agencies.

The objectives of the RWSSP are as follows:

<u>Supply</u>:

- Decrease reliance on imported water by offsetting 2,360 AFY with new recycled water customers
    - New customer demands inside District service area = 1,757 AFY
    - New customers demands outside District service area = 603 AFY

<u>Operational</u>:

- Enable the District to balance seasonal recycled water supplies and demands by providing approximately 2,000 AF (1,900 to 2,200) of storage capacity.
- Enable the District to reduce or eliminate the use of supplemental groundwater
- Enable the District to reduce or eliminate the use of supplemental potable water
- Provide a forum to initiate regional partnerships to expand recycled water reuse with other water and wastewater agencies

<u>Regulatory</u>:

- Enable the District to reduce annual discharges of effluent to Malibu Creek, the LA River, and other non-customer uses
- Enable the District to comply with all applicable regulatory requirements
- Enable the District to comply with discharge prohibition from April 15th to November 15th of every year
- Enable the District to comply with minimum flow requirements for endangered trout habitat in Malibu Creek

4.3 Supply and Effluent Management Alternatives Previously Considered

Supply and effluent management alternatives previously considered by the District include:

- Groundwater pumping
- Conservation
- New ocean outfall
- Additional Los Angeles River diversions
- Additional raw sewage diversions to City of Los Angeles
- Increase use of imported water from MWD

Although each of these alternative concepts can help to address one or two of the objectives listed in Section 4.2, the only alternative concept that addresses all three objectives is a combination of:

1. recycled water seasonal storage
2. additional distribution infrastructure
3. additional non-potable demands

For this reason, only variations on this alternative concept are considered in this feasibility study.

4.4 Water Supply Alternatives

Recycled water produced by the Tapia WRF is in abundance and is a readily available local resource for irrigation purposes. In order to utilize this local resource, the distribution facilities to store and transport this supply to customers would need to be developed. This feasibility study evaluates three seasonal storage facility sites identified within the District service area to provide storage for surplus recycled water produced by the Tapia WRF. The cost to construct these reservoirs along with the associated recycled water expansions of the existing system are compared to a baseline water supply alternative that consists of purchasing additional imported water from MWD. The three proposed seasonal storage locations are identified as April Canyon Reservoir, Stokes Canyon Reservoir, and Hope Reservoir. Only one of these reservoir site alternatives would be implemented as part of the RWSSP. All of these alternatives are discussed in more detail in the following sections. The RWSSP proposed reservoir site locations are shown in **Figure 4-1.**

The uncertain reliability of imported MWD water makes recycled water a more attractive and dependable alternative. A more detailed discussion on the increased cost for this supply alternative is provided in Chapter 5 Economic Analysis.

4.4.1 Seasonal Storage of Recycled Water

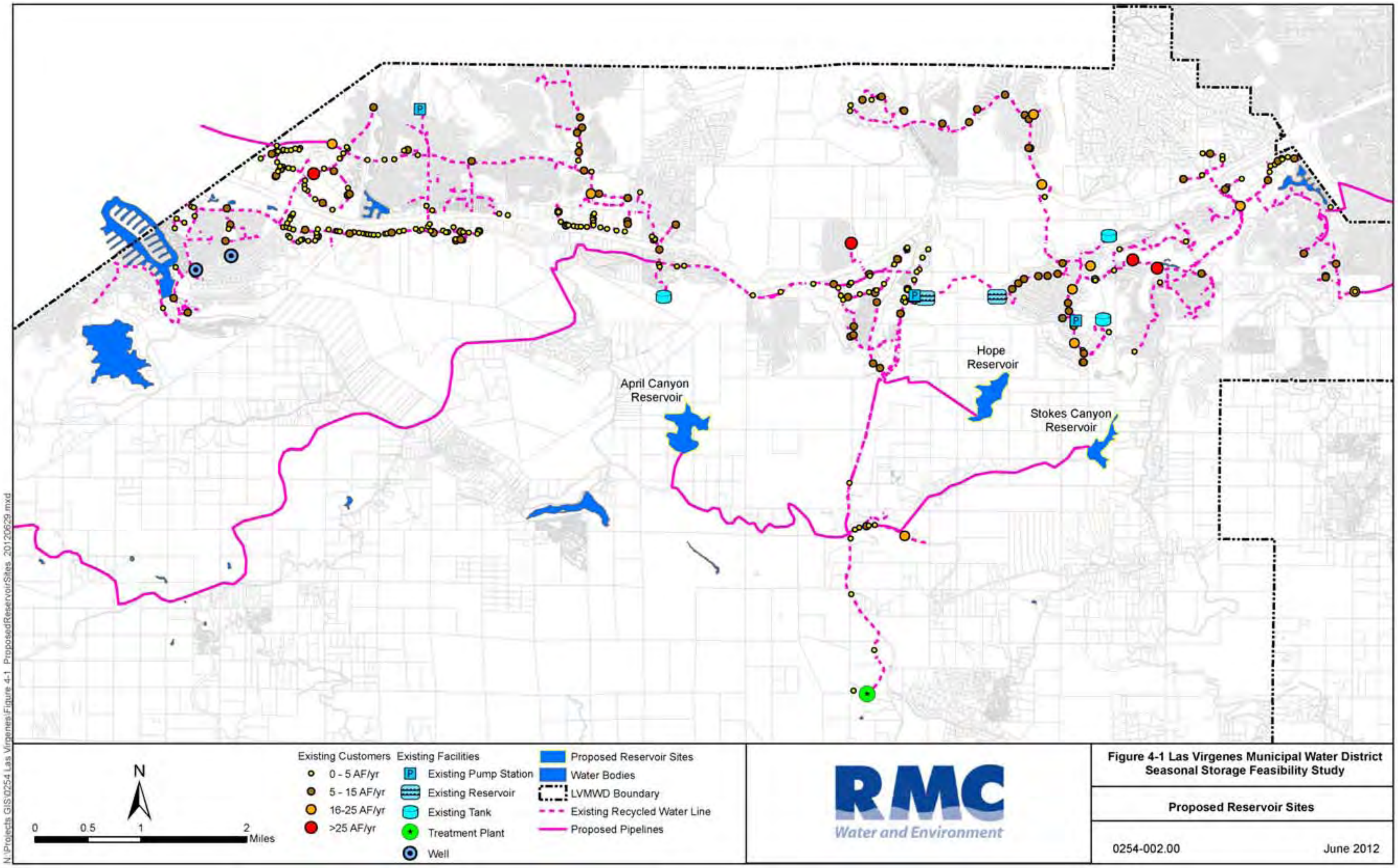
In order to meet peak summer water demands characteristic of irrigation customers, seasonal storage of recycled water during the winter months is a viable solution. In the past, the District has investigated numerous potential reservoir sites. One of the studies evaluated 80 potential reservoir sites which were ultimately refined to four reservoir sites. The evaluation criteria consisted of approximate construction cost, geotechnical considerations, access roads, facilities, environmental impacts and property acquisition and easements which were used to rank each of the reservoirs. Since then, land development changes, the rising cost of imported water, and water conservation mandates promulgated under SBx7-7 prompted the need to reevaluate some of the previously evaluated sites. For example, current land ownership and development plans at the potential Donnell and Ahmanson Reservoir sites would no longer make these sites cost effective because of the increased cost for land acquisition and the need to negotiate with a larger number of property owners.

4.4.2 Increase Imported Water

The expansion of the recycled water distribution system would increase reuse of the recycled water produced at the Tapia WRF. Without seasonal storage, recycled water produced in the winter cannot be reused in full and requires a disposal option of some kind. During brief summer periods when demand exceeds supply, potable water supplements from the Morrison Tank, Cordillera Tank, and Reservoir No. 2 would be required. An average of approximately 150 AFY of supplemental imported water is required to serve current demands (LVMWDg).

As a conceptual alternative to seasonal storage with non-potable recycled water distribution facilities, an “imported water alternative” is examined in this feasibility study. This alternative consists of simply continuing to purchase imported water to supply the 2,360 AFY of additional demands identified. This alternative would require fewer capital facilities to be constructed; however, the reliability of this water supply in the event of drought is still a concern for customers for whom a reliable supply is critical (see Section 5.1). In addition, this alternative does not address the need to reuse surplus recycled water produced locally at the Tapia WRF and the need to reduce discharges to Malibu Creek.

Figure 4-1: Proposed Reservoir Sites



4.5 Potential Seasonal Storage Sites

Three potential seasonal storage sites were evaluated based on previous environmental, geotechnical and engineering reports of the area. The sites are generally located near Las Virgenes Road, south of Highway 101 and north of the Tapia WRF. The three sites are identified as the April Canyon, Upper Stokes Canyon, and Hope reservoir sites. These sites were once ruled out in previous reports because of costs and number of properties that would need to be acquired. However, changes to land ownership, lack of development around the sites, conservation mandates, and imported water costs have made these sites more feasible and worth reevaluating. Descriptions of each of the reservoir sites are provided below in further detail.

4.5.1 April Canyon Reservoir Site

April Canyon Reservoir would be located approximately 0.5 miles north of Mulholland Highway and 1.5 miles west of Las Virgenes Road, on a small un-named drainage basin in the Santa Monica Mountains that is tributary to Malibu Creek. The drainage basin tributary to the dam site is approximately 250 acres (reservoir and upstream drainage basin). The reservoir location is shown on the previously described **Figure 4-1**, and **Figure 4-2** shows the site topography and land use from an aerial perspective.

The April Reservoir site was identified in reclaimed water planning studies in 1973 and 1990; however, reconnaissance-level environmental and geologic studies have been performed only recently. Available studies include:

- *Preliminary Reclaimed Water System Master Plan – Phase I*, by Boyle Engineering Corporation, Dated December 10, 1973.
- *Search for Potential Reclaimed Water Seasonal Storage Sites*, by Boyle Engineering Corporation, dated April 1990.
- *Geotechnical Desktop Study and Preliminary Opinion of Geotechnical Conditions, LVWMD April Road Dam Site No. 1*, by Fugro West, Inc., dated January 15, 2009.
- *LVWMD April Road Reservoir Environmental Constraints Analysis*, by ESA, dated August 2009.

No site-specific topographic mapping, hydrologic studies or subsurface investigations of the dam and reservoir site have been conducted. April Dam and Reservoir would be regulated by the California Division of Safety of Dams. While hydrologic/downstream hazard studies have not been conducted at the site, it is expected that the dam and spillway will likely need to be designed for an Inflow Design Flood (IDF) based on the Probable Maximum Precipitation (PMP) which we have assumed to be approximately 30-inches.

Figure 4-2: Aerial View of April Canyon Reservoir Site

The 2009 geologic reconnaissance studies indicate the April Canyon site is underlain by dipping, interbedded sedimentary bedrock of the Calabasas Formation, overlain by surficial soil deposits of alluvium and landslide debris. The dam foundation is expected to consist of sandstone with interbedded siltstone and claystone. Several potential landslides were mapped in the dam and reservoir area. No active or potentially active faults are mapped across or projecting toward the project site, however there are faults in the nearby area. The study did not identify any major geologic hazards that would preclude development of the proposed dam and reservoir, however based on the reconnaissance findings, key geologic/geotechnical constraints require careful consideration/mitigation during design, including:

- Stability of the slopes in the dam abutment and reservoir area
- Potential for seepage through sandstone or bedrock fractures
- Suitability of on-site materials for embankment construction
- Seismic shaking associated with local seismicity

The prior studies did not provide preliminary conclusions or recommendations for a specific type of dam. However based on the similar geologic setting at the Upper Stokes Site, we have assumed that embankment feasibility/design requirements would be similar to those previously recommended for Upper Stokes. We have therefore assumed based on prior reports by others that foundation conditions will be suitable for an earthfill dam, with an excavated core trench and grout curtain to provide foundation underseepage control. The dam would be constructed as a zoned embankment with the core and shells of the dam constructed using materials selectively excavated onsite, using processed onsite or imported materials for filter and drainage zones, and using imported riprap for erosion protection. We have also assumed that the embankment would have upstream and downstream slopes of 3.5H:1V and 3H:1V, respectively.

We also have assumed that the spillway could be constructed with a conventional overflow crest and chute on one of the abutments, or alternatively as a morning glory spillway with a discharge conduit passing under the dam.

Based on USGS quadrangle topographic maps, storage-elevation characteristics at the site were evaluated to determine approximate size of the dam embankment. **Figure 4-3** presents a storage-area versus elevation curve for a reservoir with an operational storage capacity of 2,200 acre-feet, based on the following assumptions:

- dead/sediment storage - 200 ac-ft below the minimum pool elevation of 1020 feet
- operational storage - 2,200 ac-ft up to the normal maximum pool elevation of 1096 feet
- operational freeboard - 2 feet (125 ac-ft) below the emergency spillway crest elevation of 1098 feet (to avoid incidental unpermitted NPDES discharges due to uncontrolled pumping or rainfall up to a 100-year rainfall event)
- flood routing storage/freeboard - 6-feet (315 ac-feet) from the emergency spillway up to the dam crest elevation of 1104 feet (based on routing storage of approximately ½ of the inflow design flood plus a minimum 1.5 feet of residual freeboard to prevent overtopping)

Based on this preliminary analysis, a reservoir with 2,200 ac-feet of operational storage would have a surface area, at normal maximum pool, of approximately 58 acres; and it would require a dam approximately 1,000 feet long and 185 feet high. See **Figure 4-4** for a profile along the axis of the dam. The dam is expected to be constructed as a zoned earth embankment using predominantly onsite materials, but with supplemental imported materials for filter/drainage zones, erosion protection and gravel surfacing. Assuming embankment slopes of 3H:1V downstream, and 3.5H:1V upstream, a 25-foot crest width; and including an allowance of 15 percent for foundation excavation, the total embankment dam volume would be approximately 2.5 million cubic-yards. Detailed dam calculations are included in **Appendix D**.

Figure 4-5 presents a conceptual layout of the dam and reservoir, including a possible location for an emergency spillway and the inlet/outlet conduit beneath the dam.

Detailed site-specific topographic, hydrologic, geologic/geotechnical, and environmental studies will be required to confirm site feasibility and support project design, dam safety review/approvals and environmental permitting. It is expected that construction of the reservoir will take two years after bidding.

The findings of the environmental constraints analysis performed for the April Canyon Reservoir site are summarized in Section 7.3.2. No fatal flaws were indicated.

Figure 4-3: Storage-Area vs. Elevation Curves for April Canyon Reservoir

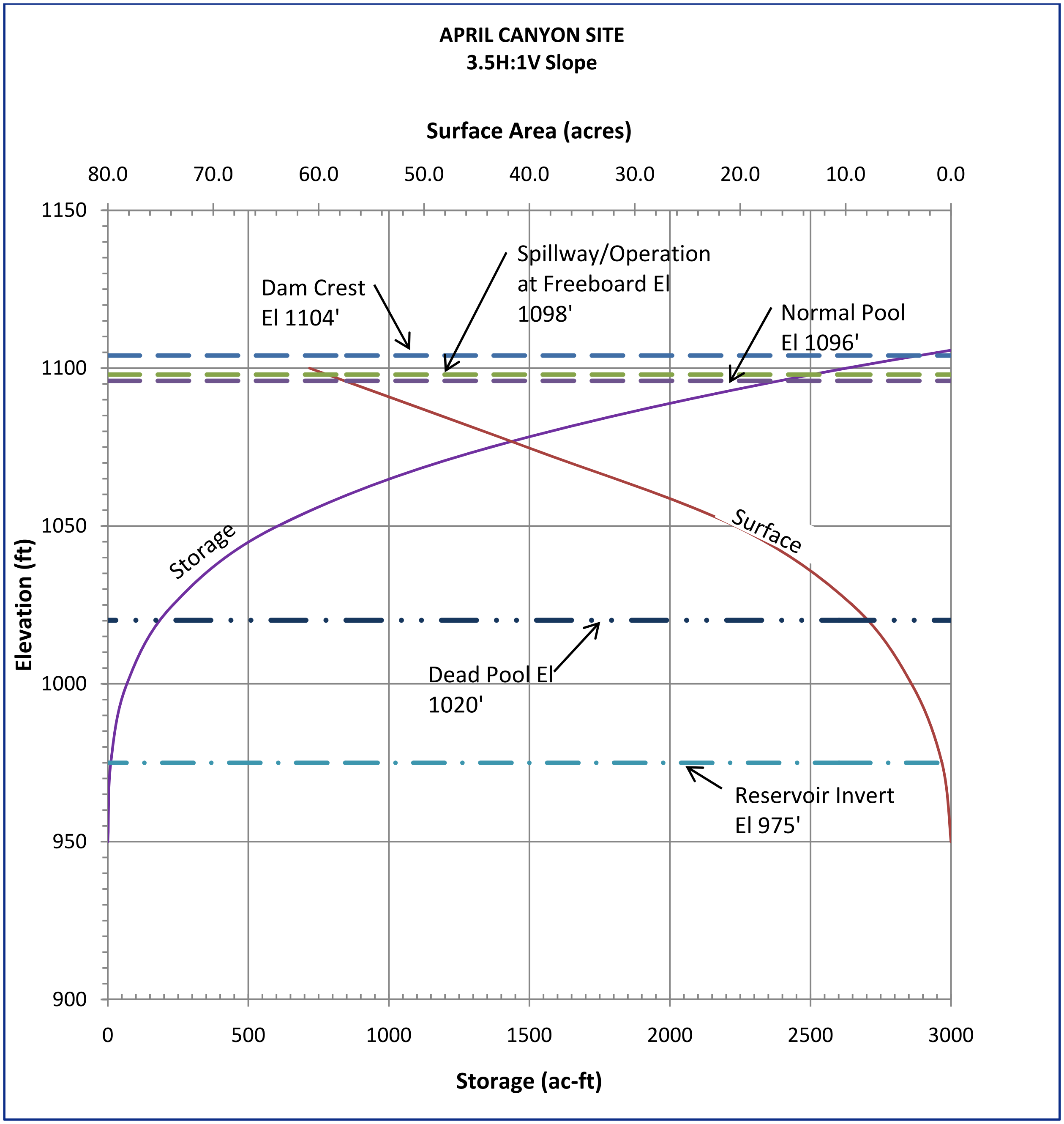


Figure 4-4: April Canyon Dam Profile along Centerline

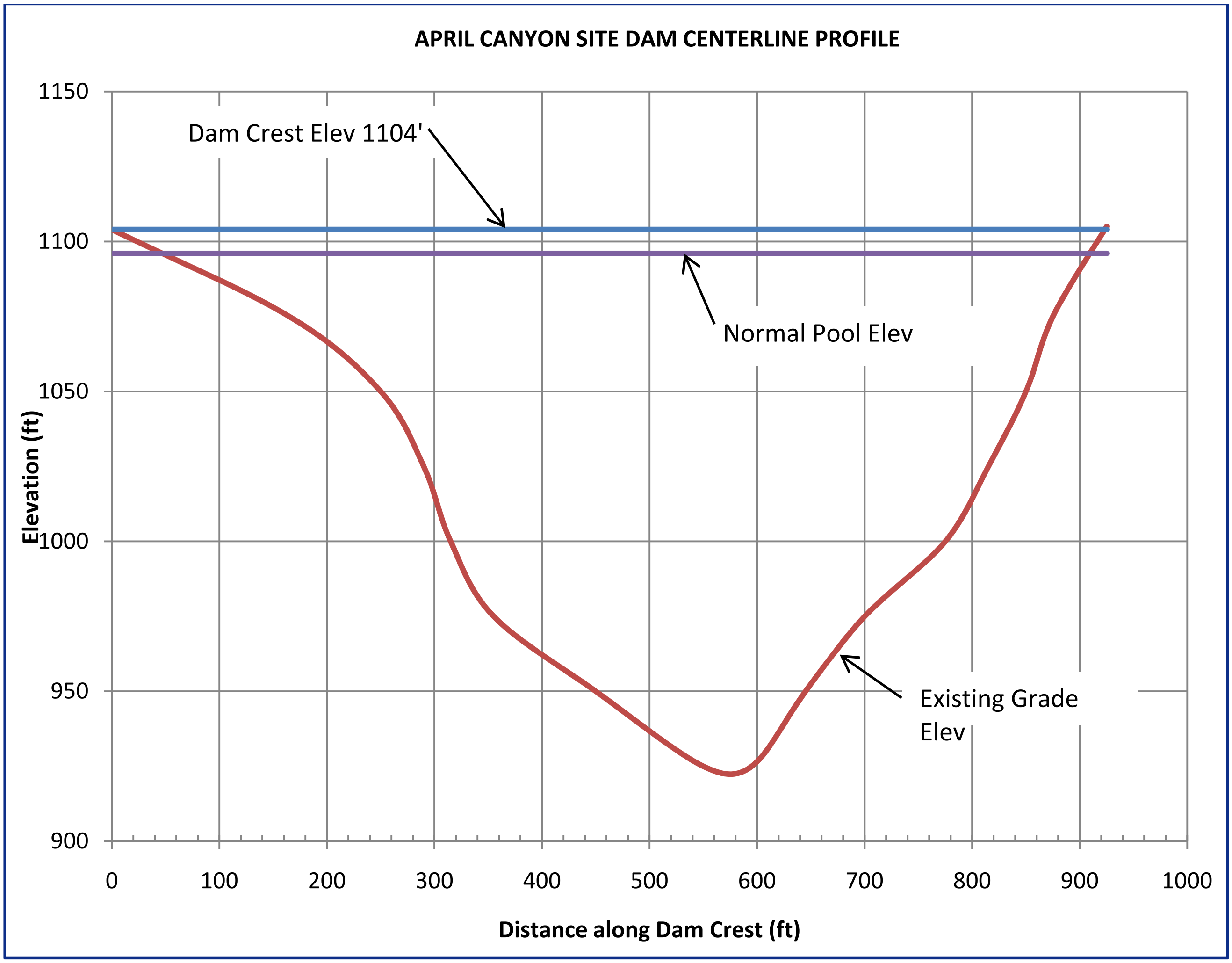


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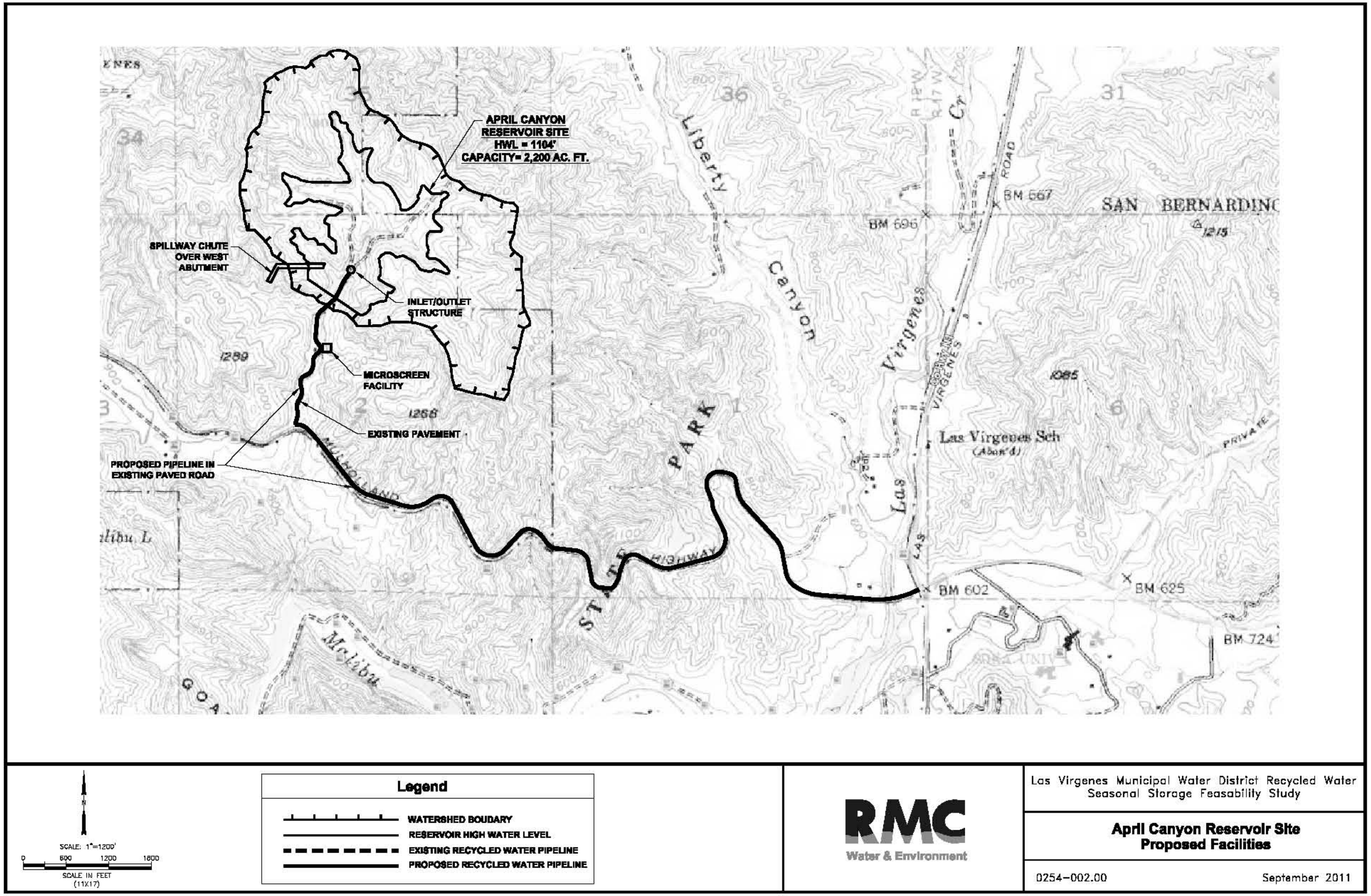
Figure 4-5: Conceptual Layout of April Canyon Reservoir Site Proposed Facilities



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4.5.2 Stokes Canyon Reservoir

The Stokes Canyon Reservoir had a relatively significant amount of information as it was one of the finalists of potential reservoir sites previously evaluated.

Stokes Canyon Reservoir would be located approximately 2 miles northeast of the junction of Stokes Canyon Road with Mulholland Highway, on an intermittent drainage that is tributary to Malibu Creek about 3 miles downstream of the dam site. The drainage basin tributary to the dam site is approximately 552 acres (reservoir and upstream drainage basin). The reservoir location is shown on **Figure 4-1**, and **Figure 4-6** shows the site topography and land use from an aerial perspective.

Figure 4-6: Aerial View of Stokes Canyon Reservoir Site

The Upper Stokes Reservoir site was identified and evaluated in a number of master plan and reconnaissance-level site studies conducted in the late 1980's and early 1990's. These studies include:

- *Preliminary Geologic Reconnaissance Study for Stokes Canyon Water Storage Reservoir,* by Staal, Gardner & Dunne, Inc., dated January 1989
- *Search for Potential Reclaimed Water Seasonal Storage Reservoir Sites,* by Boyle Engineering Corporation, dated April 1990.
- *Geologic Information Provided by SGD for the Lower and Upper Stokes Sites*, by SGD, dated September 1991.
- *Conceptual Level Geotechnical Evaluation of Dam Sites* by Woodward-Clyde Consultants, and Staal, Gardner & Dunne, Inc. Dated December 1991; Volume 4 of Reclaimed Water Seasonal Storage Project - Phase 1 Environmental and Engineering Studies.
- *Preliminary Environmental and Regulatory Assessment of Surface Storage,* by Woodward-Clyde Consultants , and Bauer Environmental Services, dated December 1991; Volume 5 of Reclaimed Water Seasonal Storage Project - Phase 1 Environmental and Engineering Studies.
- *Engineering Data, Facilities and Costs*, by Boyle Engineering Corporation, dated December 1991, Volume 6 of Reclaimed Water Seasonal Storage Project - Phase 1 Environmental and Engineering Studies.

No site-specific topographic mapping, hydrologic studies or subsurface investigations of the dam and reservoir site have been conducted. Upper Stokes Canyon Dam & Reservoir would be regulated by the California Division of Safety of Dams. While hydrologic/downstream hazard studies have not been conducted at the site, it is expected that the dam and spillway will likely need to be designed to for an Inflow Design Flood (IDF) based on the Probable Maximum Precipitation (PMP) which we have assumed to be approximately 30-inches.

The 1991 geologic reconnaissance studies indicate the Upper Stokes site is underlain by steeply dipping, interbedded sedimentary bedrock of the Calabasas Formation, overlain by surficial soil deposits of alluvium and landslide debris. The dam foundation is expected to consist of generally weak sandstone with interbedded siltstone and claystone. Several ancient landslides have been mapped in the left abutment area, and an un-named fault traverses the dam site. The study did not identify any major geologic hazards that would preclude development of the proposed dam and reservoir, however they did identify several geologic/geotechnical constraints that require careful consideration/mitigation during design, including:

- Characterization of un-named fault in the dam area
- Stability of the slopes in the dam abutment and reservoir area
- Potential for seepage through sandstone or bedrock fractures
- Suitability of on-site materials for embankment construction
- Seismic shaking associated with local seismicity

The studies concluded that the foundation conditions appear suitable for an earthfill dam, with an excavated core trench and grout curtain for control of foundation underseepage. The dam would be constructed as a zoned embankment with the core and shells of the dam constructed using materials selectively excavated onsite, using processed onsite or imported materials for filter and drainage zones, and using imported riprap for erosion protection. The study recommended upstream and downstream embankment slopes of 3.5H:1V and 3H:1V, respectively.

The study concluded that the spillway could be constructed with a conventional overflow crest and chute on the right abutment, or alternatively as a morning glory spillway with a discharge conduit passing under the dam.

Based on USGS quadrangle topographic maps, storage-elevation characteristics at the site were evaluated to determine approximate size of the dam embankment. **Figure 4-7** presents a storage-area versus elevation curves for a reservoir with an operational storage capacity of 1,900 acre-feet, based on the following assumptions:

- dead/sediment storage - 200 ac-ft below the minimum pool elevation of 974 feet
- operational storage - 1,900 ac-ft up to the normal maximum pool elevation of 1045 feet
- operational freeboard - 6 feet (275 ac-ft) below the emergency spillway crest elevation of 1051 feet (to avoid incidental unpermitted NPDES discharges due to uncontrolled pumping or rainfall up to a 100-year rainfall event)
- flood routing storage/freeboard - 12-feet (690 ac-feet) from the emergency spillway up to the dam crest elevation of 1104 feet (based on routing storage of approximately ½ of the inflow design flood plus a minimum 1.5 feet of residual freeboard to prevent overtopping)

Based on this preliminary analysis, a reservoir with 1,900 ac-feet of operational storage would have a surface area at normal maximum pool of approximately 48 acres, and would require a dam approximately 2,000 feet long and 165 feet high. See **Figure 4-8** for a profile along the axis of the dam. The dam is expected to be constructed as a zoned earth embankment using predominantly onsite materials, but with supplemental imported materials for filter/drainage zones, erosion protection and gravel surfacing. Assuming embankment slopes of 3H:1V downstream, and 3.5H:1V upstream, a 25-foot crest width; and including an allowance of 15 percent for foundation excavation, the total embankment dam volume would be approximately 4.6 million cubic-yards. Detailed dam calculations are included in **Appendix D**.

Figure 4-9 presents a conceptual layout of the dam and reservoir, including a possible location for an emergency spillway and the inlet/outlet conduit beneath the dam.

Detailed site-specific topographic, hydrologic, geologic/geotechnical, and environmental studies will be required to confirm site feasibility and support project design, dam safety review/approvals and environmental permitting. It is expected that construction of the reservoir will take two years after bidding.

Figure 4-7: Storage-Area vs. Elevation Curves for Stokes Canyon Reservoir

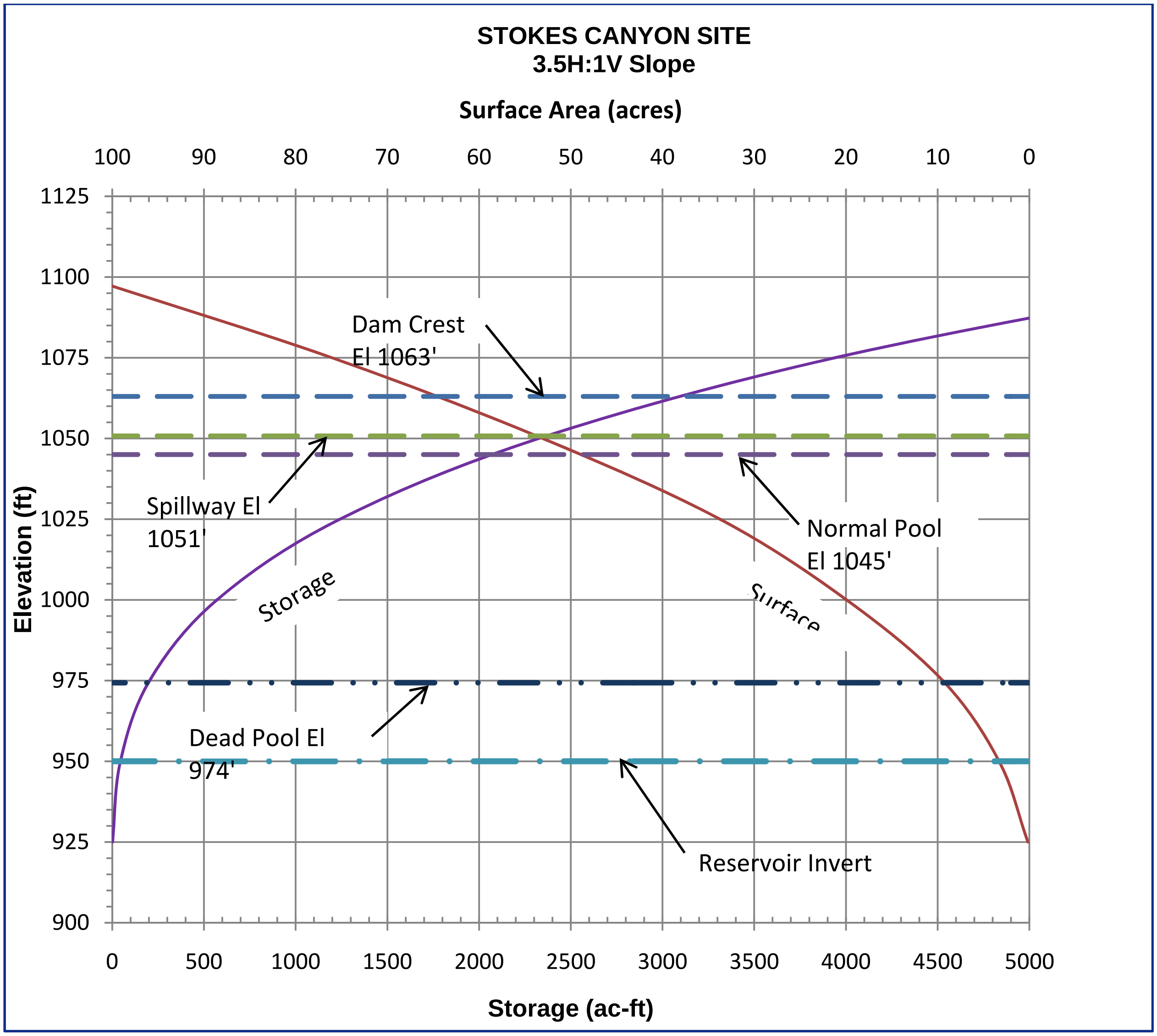

Figure 4-8: Stokes Canyon Dam Profile along Centerline

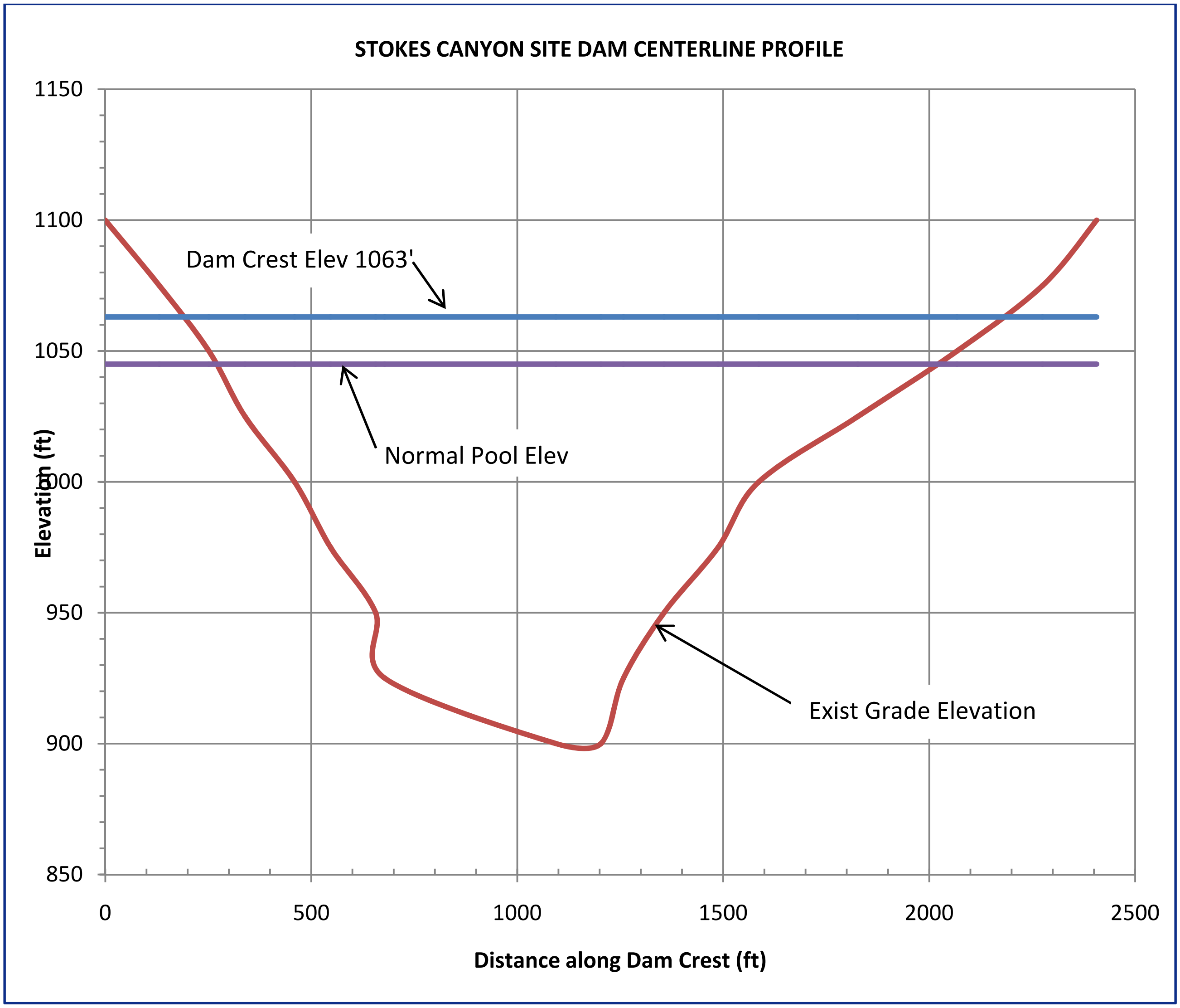

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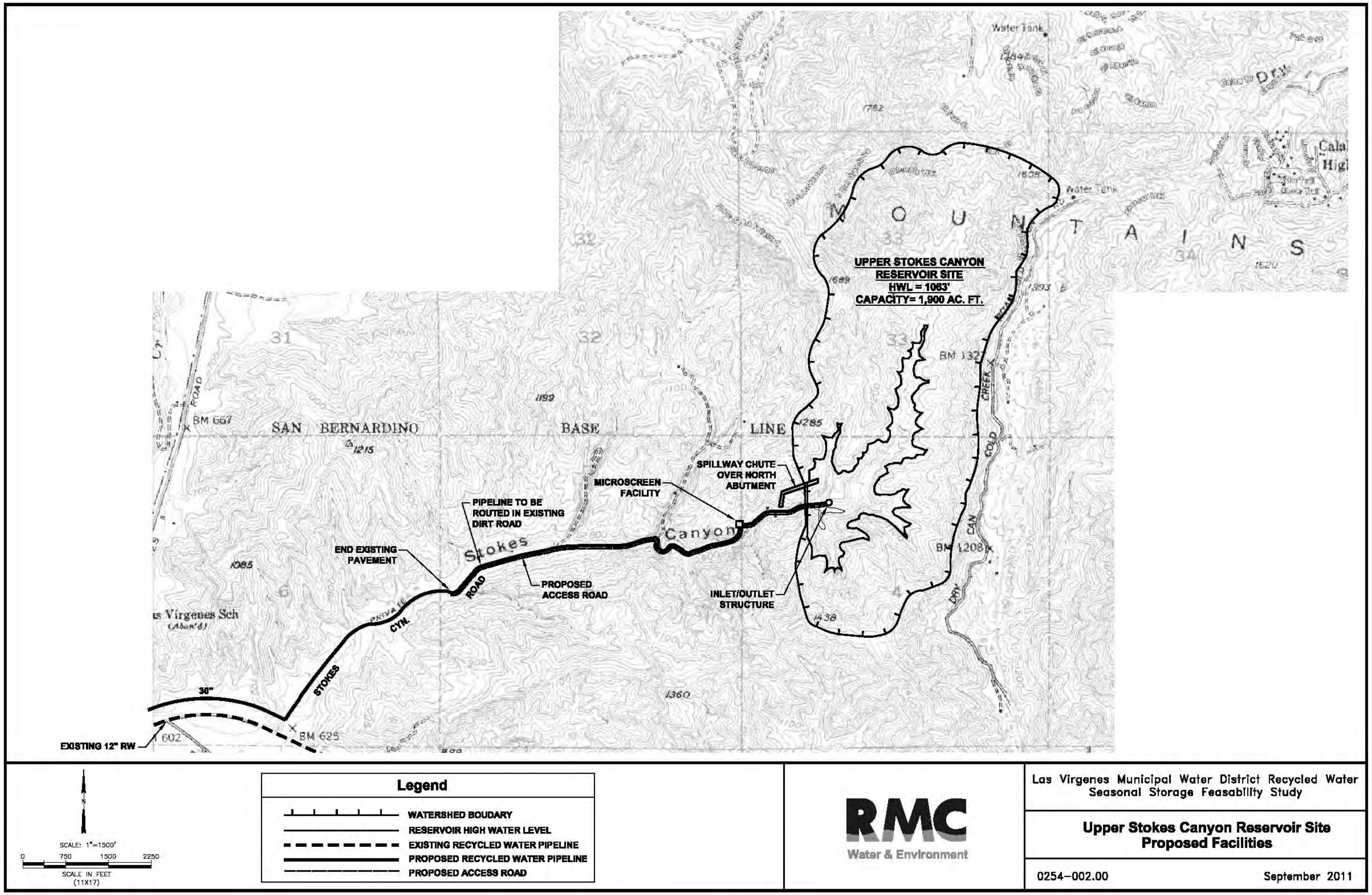
Figure 4-9: Conceptual Layout of Stokes Canyon Dam and Reservoir



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4.5.3 Hope Reservoir

Hope Reservoir would be located approximately 0.5 mile north of Mulholland Highway and 1 mile east of Las Virgenes Road, on a small un-named drainage in the Santa Monica Mountains that is tributary to Malibu Creek about 2.5 miles downstream of the dam site. The drainage basin tributary to the dam site is approximately 343 acres (reservoir and upstream drainage basin). The reservoir location is shown on previously mentioned **Figure 4-1**, and **Figure 4-10** shows the site topography and land use from an aerial perspective.

Figure 4-10 Aerial View of Hope Reservoir Site

The Hope Reservoir site was identified in the 1990 reclaimed water planning study noted below; however no site-specific environmental or engineering studies have been performed at the site ever since. The 1990 study considered the Hope site as one of seven potentially feasible sites that warranted further study, however, it was not included in the subsequent study of six reservoir storage sites during 1991 and 1992. Apparently, the site was dropped from further study due to property acquisition issues. We understand that the property issues may no longer be an obstacle, and that LVWMD is now again considering the Hope site for reclaimed water storage, including authorizing initial site feasibility studies by AECOM. The relevant studies include:

- *Search for Potential Reclaimed Water Seasonal Storage Sites*, by Boyle Engineering Corporation, dated April 1990.
- *Reclaimed Water Seasonal Storage Project, Volume 1 – Summary Report*, by Boyle Engineering Corporation, Woodward-Clyde Consultants, Staal, Gardner and Dunne, Inc., and Bauer Environmental Services, dated February 1992. (did not cover the Hope site)

- *Draft Hope Reservoir Preliminary Feasibility Study*, by AECOM, July 2011(ongoing, draft map but no report available)
- *Geotechnical Desktop Study and Preliminary Opinion of Geotechnical Conditions, Las Virgenes Municipal Water district, Hope Reservoir Site,* By Fugro, 2011 (desktop study, reconnaissance review of the published data and aerial photographs.)
- *Las Virgenes Municipal Water District Hope Reservoir Project, Constraints Report,* by Environmental Science Associates, July 2011.

The topography shown in the draft reservoir plan by AECOM indicates mapping with 5-foot contours may be available for the Hope site as opposed to the 25-foot contour interval used on USGS topographic quad maps. It is not known if this is based on regional GIS map coverage or if it is based on detailed site topographic mapping. For the purposes of the current study, and to be consistent with the evaluation of the April Road and Upper Stokes Canyon site, we are utilizing the USGS topographic maps for development of site storage-area-elevation relationships at the Hope site. No site-specific hydrologic studies or subsurface investigations of the dam and reservoir site have been conducted, while Fugro recently carried the geologic reconnaissance for the proposed project area.

Hope Dam and Reservoir would be regulated by the California Division of Safety of Dams. While hydrologic/downstream hazard studies have not been conducted at the site, it is expected that the dam and spillway will likely need to be designed to for an Inflow Design Flood (IDF) based on the Probable Maximum Precipitation (PMP) which we have assumed to be approximately 30-inches.

The regional geologic map (Yerkes and Campbell, 1980) indicates that the Hope site is underlain by dipping, interbedded sedimentary bedrock of the Miocene Calabasas Formation. This is the same geologic formation that underlies the April Road and Upper Stokes Canyon sites. While the regional mapping does not show any mapped landslide deposits at the Hope site as are shown at the April Road and Upper Stokes Canyon sites, preliminary aerial photographic mapping conducted by Fugro suggested the presence of landslides within the proposed dam foundation footprint, in the reservoir impoundment area, and proximal to the reservoir slopes. These landslide materials can be excavated for fill material. Similarly, the regional mapping does not show significant deposits of alluvium at the Hope site; however, it is likely that they are present along the valley bottom and along drainage ways, which may need to be removed to place the dam foundation on bedrock. The regional map shows a northwest-southeast trending fault crossing the Hope reservoir site approximately ½ mile upstream of the dam location. The Northward dip of the bedrock strata is generally favorable for the dam currently proposed. The fault is called the Red Rock Fault, and is the same fault that was noted in the previous studies of the Upper Stokes site. This fault is shown as pre-Quaternary (greater than 1.6 million years old) on the “Fault Activity Map” published on the website of the California Geological Survey (CGS), and is therefore considered inactive.

Groundwater levels within the Calabasas Formation bedrock are estimated to be in excess of 100 feet below the canyon bottom, but it is not anticipated to be significant within the bedrock. They may occur as perched zones along planes of discontinuity or in higher permeability zones within the bedrock. CGS hazard maps of the area show no liquefaction hazard at the Hope site, but fairly widespread hazard for earthquake induced landslides. Aerial photo mapping and a field geologic reconnaissance of the Hope site are necessary to confirm site-specific geologic conditions and the presence or absence of hazards such as landslides. There is a potential for saturated granular materials to liquefy in response to a strong earthquake. The dam footprint may need to be over excavated to be founded in competent bedrock materials prior to construction of the dam, so that the potential for liquefaction and/or dry sand settlement to affect the dam foundation would be mitigated. Studies conducted by Fugro indicate landslides located within the dam foundation, reservoir and proximal to the reservoir slopes, thus mitigation design needs to be evaluated for the project.

Based on the published mapping, the Hope site is expected to have similar geologic conditions and hazards as at the April Road and Upper Stokes Canyon sites. The dam foundation is expected to consist primarily of silty shale and siltstone with lesser amounts of sandstone. Steep slopes may be susceptible to landslides and landslides may be present. No active or potentially active faults are mapped across or projecting toward the project site, however there are faults in the nearby area. The nearest known active faults are the Malibu Cost and Anacapa-Dume faults, located 3-4 miles from the project site with maximum earthquake magnitude of around 7 according to USGS.

The potential for ground rupture due to faulting is considered to be low, since the site does not locate within an Alquist-Priolo fault rupture hazard zone and there are no known active faults close to the site. Historic review indicates that the vicinity of the project site may have experienced ground accelerations of about 0.19g in the past two centuries, with a maximum peak horizontal acceleration of about 0.25g. This number is much lower than the peak horizontal acceleration corresponding to an earthquake event with a 10 percent probability of exceedance in a 50- year exposure period (return period of 475 years).

While no major geologic hazards are expected that would preclude development of the proposed dam and reservoir, key geologic/geotechnical constraints will require careful consideration/mitigation during design, including:

- Stability of the slopes in the dam abutment and reservoir area (moderate seismic ground motion potential)
- Potential for seepage through sandstone or bedrock fractures
- Suitability of on-site materials for embankment construction (the bedrock is anticipated to consist of weathered moderately to thinly interbedded siltstone and shale with lesser amounts of thickly bedded to massive, resistant sandstone units. The sandstone beds trending northwest through the reservoir footprint, near the southeastern abutment, and south of the proposed dam may be suitable as source material for the dam embankment fill.)
- Seismic shaking associated with local seismicity

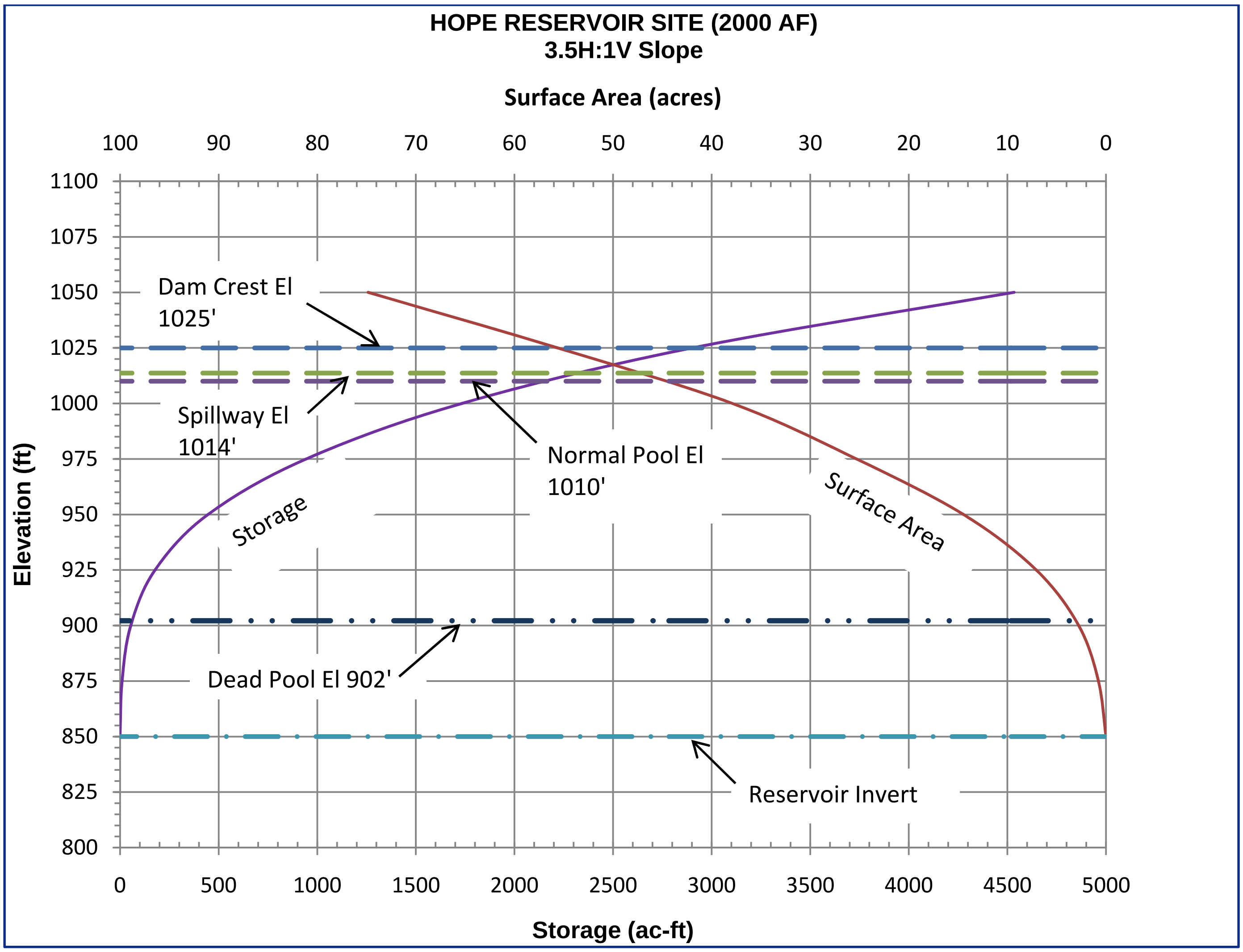
Based on the similar geologic setting to those at the Upper Stokes Site, we have assumed that embankment feasibility/design requirements would be similar to those previously recommended for Upper Stokes. We have therefore assumed that foundation conditions will be suitable for an earthfill dam, with an excavated core trench and grout curtain to provide foundation underseepage control. The dam would be constructed as a zoned embankment with the core and shells of the dam constructed using materials selectively excavated onsite, using processed onsite or imported materials for filter and drainage zones, and using imported riprap for erosion protection. We have also assumed that the embankment would have upstream and downstream slopes of 3.5H:1V and 3H:1V, respectively. Slopes in the vicinity of the proposed dam site and reservoir are generally inclined at about 1.5H:1V to 2H:1V. Detailed dam calculations are included in **Appendix D**.

We also have assumed that the spillway could be constructed with a conventional overflow crest and chute on one of the abutments, or alternatively as a morning glory spillway with discharge conduit passing under the dam.

Based on USGS quadrangle topographic maps, storage-elevation characteristics at the site were evaluated to determine approximate size of the dam embankment. **Figure 4-11** presents a storage-area versus elevation curves for a reservoir with an operational storage capacity of 2,000 acre-feet, based on the following assumptions:

- 200 ac-ft dead/sediment storage below minimum pool elevation 902
- 2,000 ac-ft operational storage up to normal maximum pool elevation of 1010
- 4 feet (172 ac-ft) operational freeboard below emergency spillway crest elevation of 1014 (to avoid incidental unpermitted NPDES discharges due to uncontrolled pumping or rainfall up to 100-year rainfall event)
- 11-feet (429 ac-feet) flood routing storage/freeboard from emergency spillway up to dam crest elevation of 1125. (based on routing storage of approximately ½ of the inflow design flood plus a minimum 1.5 feet of residual freeboard to prevent overtopping)

Figure 4-11: Storage-Area vs. Elevation Curves for Hope Reservoir



Based on this preliminary analysis, a reservoir with 2,000 ac-feet of operational storage would have a surface area at normal maximum pool of approximately 45 acres, and would require a dam approximately

950 feet long and 200 feet high. See **Figure 4-12** for a profile along the axis of the dam. The dam is expected to be constructed as a zoned earth embankment using predominantly onsite materials, but with supplemental imported materials for filter/drainage zones, erosion protection and gravel surfacing. Assuming embankment slopes of 3H:1V downstream, and 3.5H:1V upstream, a 25-foot crest width; and including an allowance of 15% for foundation excavation, the total embankment dam volume would be approximately 2.6 million cubic-yards.

Figure 4-12: Hope Site Dam Profile along Centerline

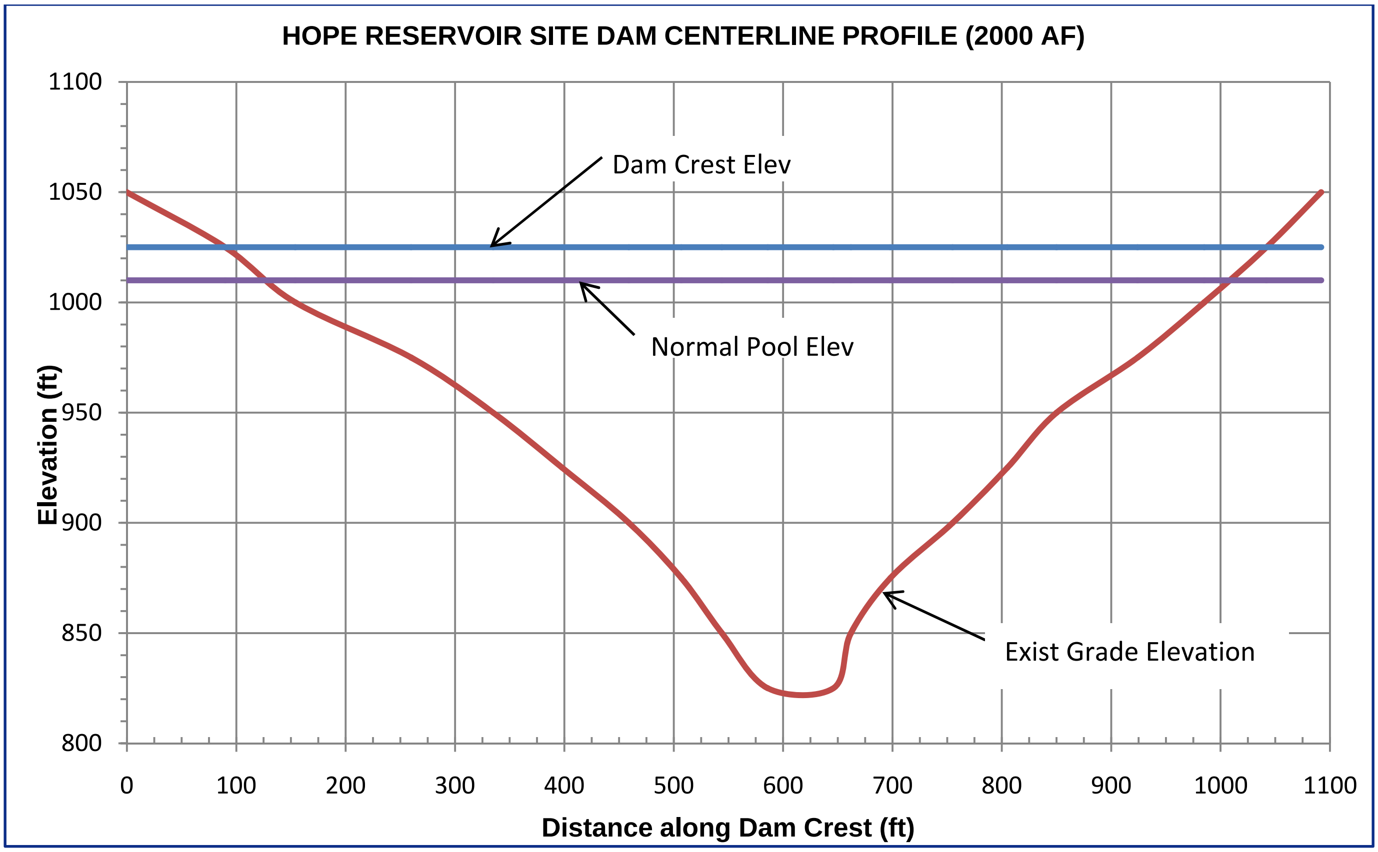


Figure 4-13 presents a conceptual layout of the dam and reservoir, including a possible location for an emergency spillway and the inlet/outlet conduit beneath the dam.

Detailed site-specific topographic, hydrologic, geologic/geotechnical, and environmental studies will be required to confirm site feasibility and support project design, dam safety review/approvals and environmental permitting. It is expected that construction of the reservoir will take two years after bidding.

The findings of the environmental constraints analysis performed for the Hope Reservoir site are summarized in Section 7.3.4. No fatal flaws were indicated.

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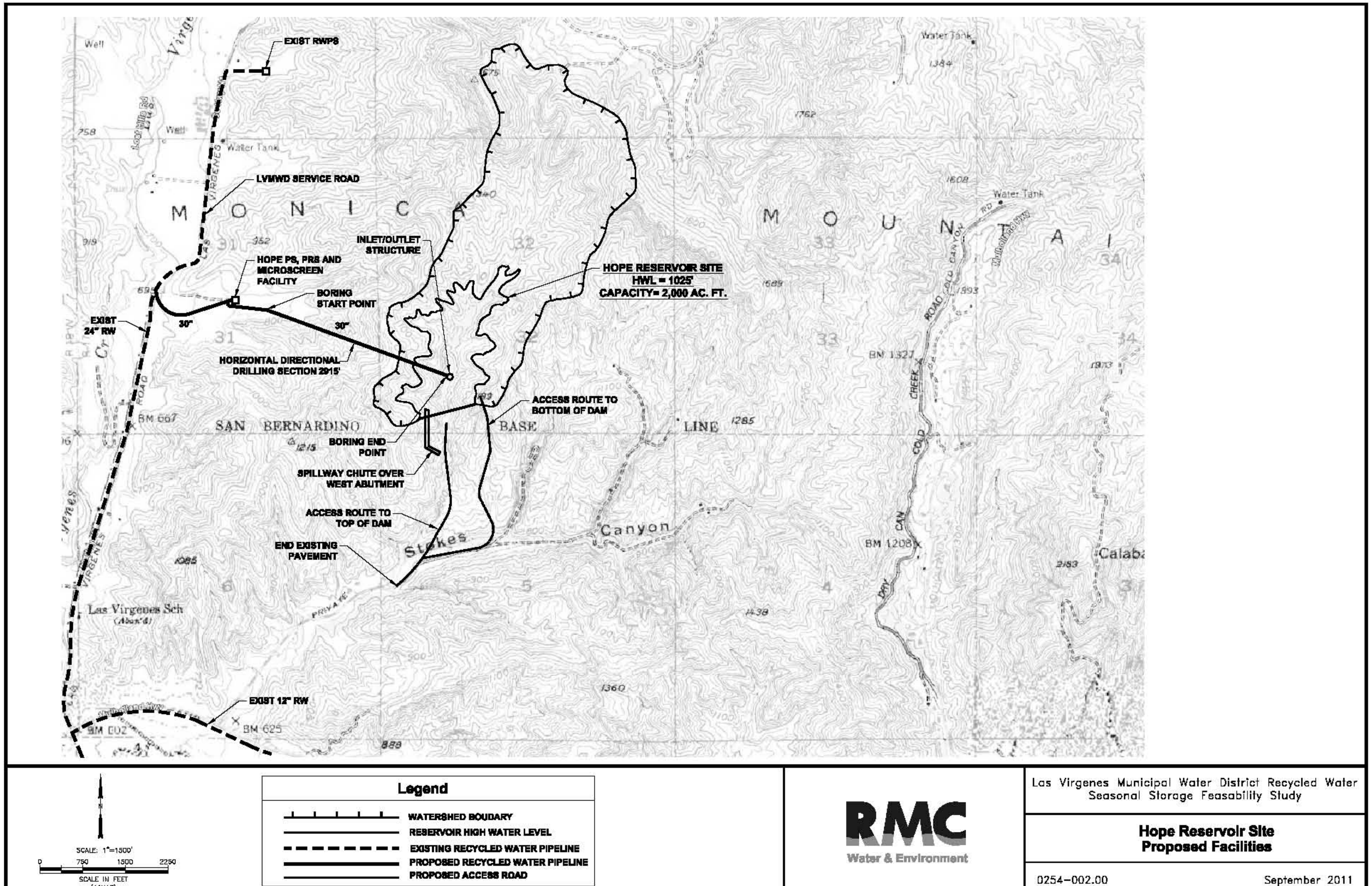
Figure 4-13: Conceptual Layout of Hope Dam and Reservoir



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4.6 Recycled Water Distribution System Alternatives

This chapter presents the development and evaluation of recycled water distribution system alternatives, including development of facility sizing based on system hydraulics and an evaluation of alternative pipeline alignments. This section will identify a recommended distribution system for each of the proposed seasonal storage reservoirs. The most viable recycled water distribution system along with its respective supply source is presented in Chapter 6.

4.6.1 Design Criteria and Hydraulic Analysis

This section provides the hydraulic design and performance criteria to be used for facility planning. The system would be designed to deliver peak hourly flow to all customers. **Table 4-1** summarizes design and performance criteria that will be used to size recycled water facilities.

Table 4-1: Recycled Water Distribution System Hydraulic Performance Criteria

Category	Parameter	Criteria	Source
Recycled Water Supply	Supply Flow	Must be able to meet Max Day Demands (MDD)	2007 Recycled Water Master Plan
Pipeline Hydraulic Criteria	Max Velocity at Peak Flow Max Headloss at Peak Flow Minimum Pipe Diameter	5 fps (new) 10 fps (existing) 5 ft/1,000 ft 2.2 psi/1,000 ft 4-inch	2007 Recycled Water Master Plan
Pipeline Friction Factors (Hazen-Williams "C")	Polyvinyl Chloride Pipe Asbestos Cement Pipe Ductile Iron Pipe Unlined Steel or Cast Iron	140 120 120 Determined per case	2007 Recycled Water Master Plan
System Pressure	Min Pressure Max Pressure Minimum residual pressure for pipelines serving customers	20 psi 150 psi (static) 65 psi	2007 Recycled Water Master Plan
Peaking Factors	Average Day Demand (ADD) Maximum Day Demand (MDD) for LVMWD Triunfo Sanitation District MDD Oak Park/North Ranch Lake Sherwood Thousand Oaks Extension Peak Hours Demand (PHD)/MDD	1.0 2.5 x ADD 2.6 x ADD 3.5 x ADD 2.5 x ADD 2.0 (minimum)	2007 Recycled Water Master Plan

Category	Parameter	Criteria	Source
Storage Tanks	Min Storage Capacity Tank Fill Duration Refill Usable Reservoir Storage Demand Flow Used Typical Irrigation Period	24 hours of MDD 15 hrs in day Daily, if possible 80% of total volume PHD at Max Day 9 hrs at night	2007 Recycled Water Master Plan
Pump Stations		One standby pump equal to the capacity of the largest duty pump	Industry Standard
Woodland Hills Golf Course	Peak Flow Irrigation Duration Min Pressure Required	1800 gpm 4 hrs 100 psi	Woodland Hills Country Club Recycled Water Service Study (LVMWD #2467.00)

4.7 Alternatives Development

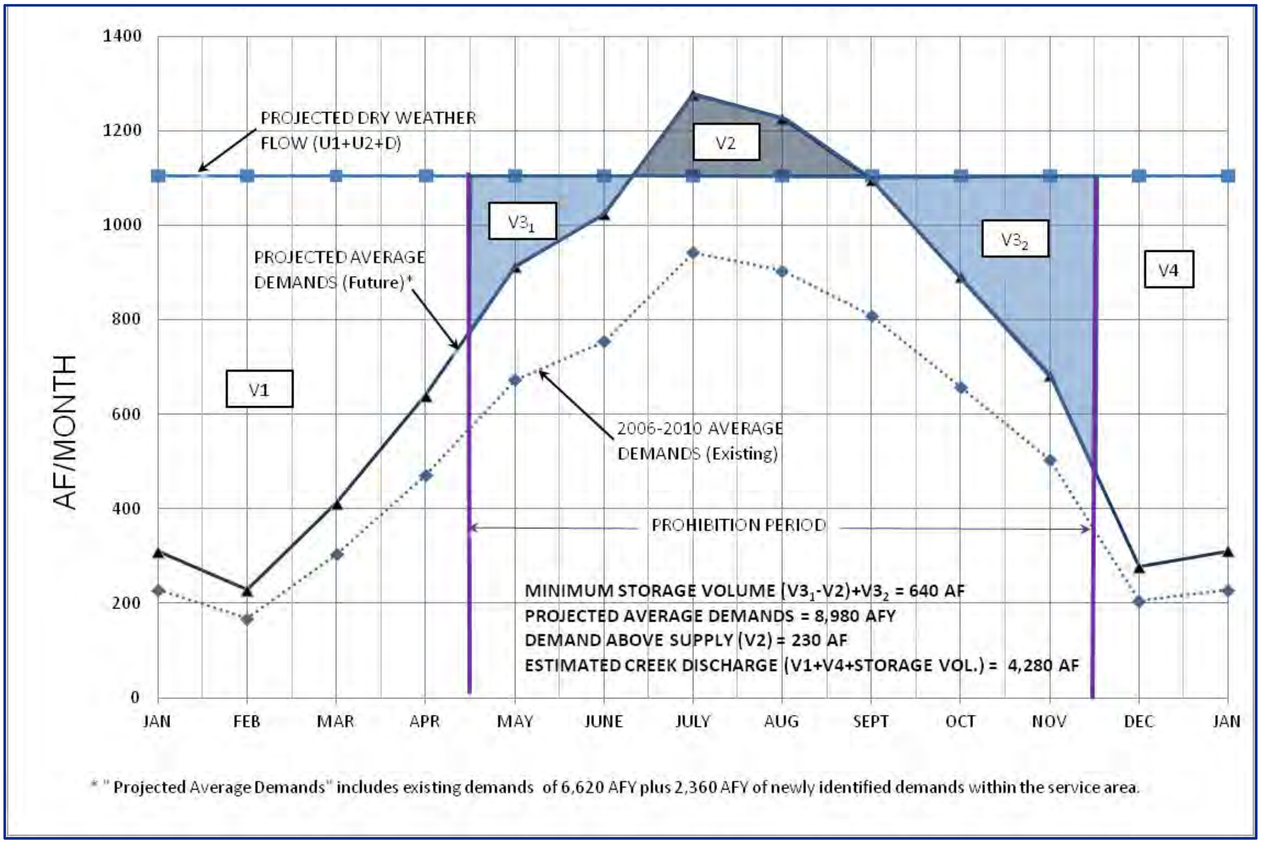
4.7.1 Supply-Demand Curve with Future Identified Demands

The three recycled water reservoirs discussed in this section all have sufficient volume to accommodate the projected recycled water demands identified in Section 3.2, while allowing the District to avoid discharges to Malibu Creek (and other effluent management practices) during the prohibition period. Figure 4-14 shows the supply and demand curve for Tapia WRF assuming that all identified recycled water demands are realized.

The projected average dry weather recycled water flows available from Tapia WRF (supply) are shown as the blue horizontal line, representing 12 mgd (1,105 AFM or 13,260 AFY). "U1", "U2", and "D" signify the three sanitation districts that are tributary to Tapia. The prohibition period is shown between the two vertical purple lines, and the current and projected demand curves are shown as the dotted and solid "bell" shaped curves, respectively. Current average dry weather recycled water flows are approximately 900 AFM (not shown).

The figure indicates that the required storage volume is approximately 640 AF, based on projected recycled water sales of an additional 2,360 AFY beyond 2010 levels. This is less than the available storage volume in any of the three reservoirs. This means that any of the three would provide a sufficient amount of storage to supply peak summer demands and avoid Creek discharges during the prohibition period. Recycled water stored and not used during the prohibition period (equal to the required storage volume of 640 AF) would be discharged to the Creek during non-prohibition months. The total volume discharged to the Creek during non-prohibition months would be approximately 4,280 AFY.

Figure 4-14: Tapia WRF Supply-Demand Curve with Future Identified Demands



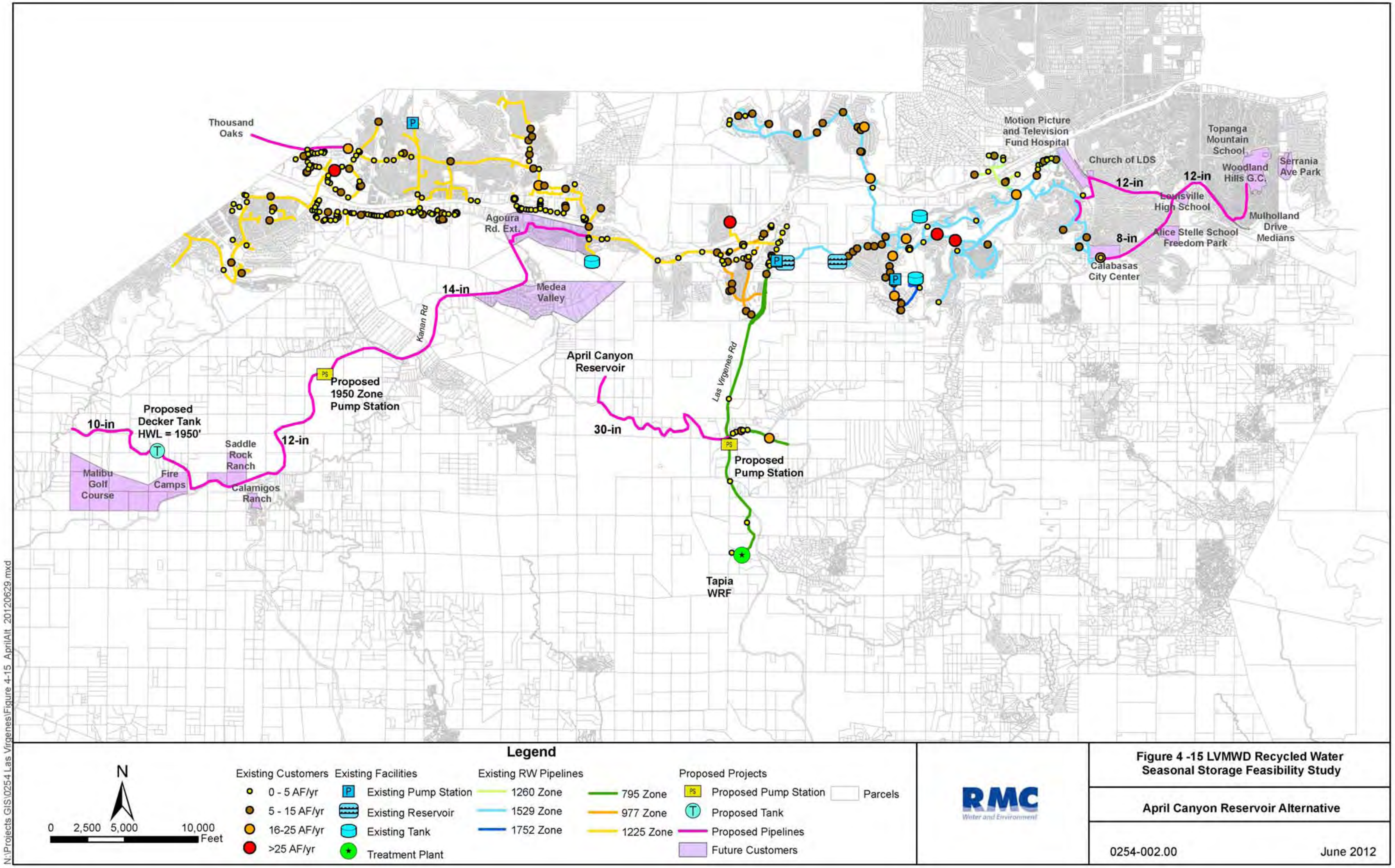
The discussions that follow present additional details on each of the recycled water seasonal storage reservoirs. The supply-demand curve in **Figure 4-14** applies to each.

4.7.2 April Canyon Seasonal Storage Site and Recycled Water System Expansion

In the April Canyon Reservoir scenario, water is pumped to the April Canyon Reservoir during the 7-month prohibition period. A new booster station, located near the intersection of Las Virgenes Road and Mulholland Highway, will boost from the existing 795 Zone to the reservoir. A new 30-inch transmission main will be constructed in Mulholland Highway to the new reservoir. During the winter months, water will be sent to the distribution system via the same 30-inch pipeline. Excess flow will be sent south to the plant for discharge into the creek. Water sent to the distribution system will drain by gravity via a pressure reducing valve into the parallel 16- and 24-inch transmission main in Las Virgenes Road to feed Recycled Water Pump Station West (RWPS West), which boosts to the 1225 Zone, and RWPS East, which boosts to the 1529 Zone.

A new pipeline feeding the Agoura Road Extension, Medea Valley, Saddlerock Ranch, the Fire Camps and the Malibu Golf Course will be constructed in Kanan Road from the Zone 1225 Indian Hills tank. A booster station on Kanan Road will boost water to the new 0.375 MG Decker Tank at a HWL of 1950 feet. Thus the Medea Valley and Agoura Road extensions would be fed from the 1225 Zone and the Saddlerock Ranch, Fire Camps and Malibu Golf Course demands would be fed from the new 1950 Zone. The proposed recycled water system expansion for the April Canyon alternative is shown in **Figure 4-15**.

Figure 4-15: Proposed Recycled Water System Expansion for April Canyon Alternative



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Note: Future customer representations on maps are approximated using tax assessment parcels.

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It should be noted than an alternate alignment through the Cornell Valley (south of Medea Valley) is another potential project that would serve the customers in that area.

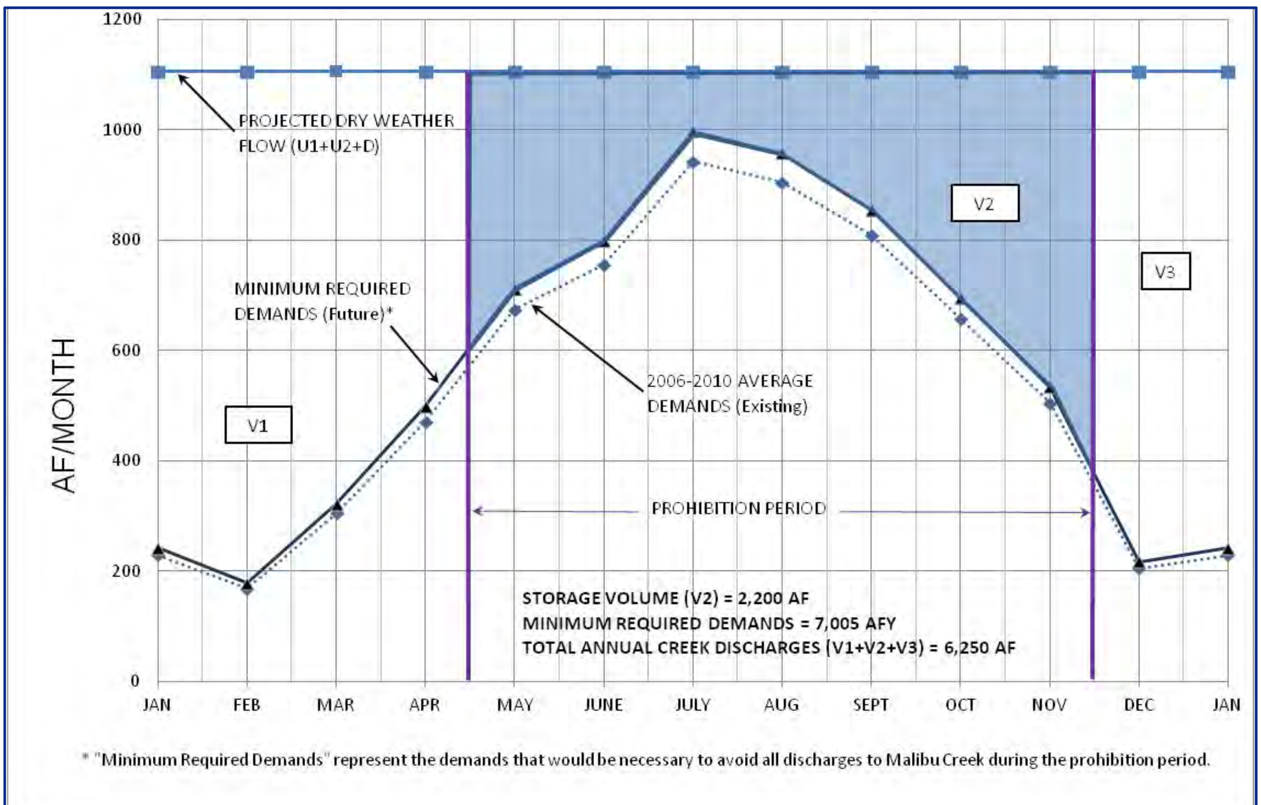
The booster stations will be supplied by the local power company through a connection to be determined during pre-design. The reservoir pump station would have a total installed duty horsepower of 1,000 hp with variable speed pumps. The Decker Pump Station would have a total installed duty horsepower of 300 hp with variable speed pumps. Pressure reducing valves will be required at several turnouts where the system pressure exceeds 100 pounds per square inch (psi). Other appurtenances of the system include isolation valves, a combination of air release valves, and blow-off valves.

The proposed April Canyon Reservoir has a potential operational storage volume of 2,200 acre-feet (AF). This volume is more than sufficient to supply peak demands and avoid creek discharges during the prohibition period (only 640 AF required), assuming that all new identified demands are realized. If fewer customers are actually connected, the required storage volume to prevent creek discharges will increase.

Figure 4-16 below is a modified version of Figure 4-14 that shows the minimum new recycled water demands that would be necessary to avoid creek discharges during the prohibition period at April Canyon. The graph assumes that the surplus recycled water within the prohibition period is stored instead of being discharged. The average volume of excess recycled water that would be discharged to Malibu Creek during non-prohibition months would be approximately 6,250 AF for a given year.

The minimum total required demands for recycled water would be 7,005 AFY, an increase of approximately 385 AFY from 2006-2010 average demands.

Figure 4-16: Minimum Demands Required for April Canyon Storage Volume



4.7.3 Stokes Canyon Seasonal Storage Site and Recycled Water System Expansion

The potential Stokes Canyon reservoir is located at Stokes Road and Mulholland Highway and would store up to 1,900 acre-feet of recycled water on about 50 acres. In the Stokes Canyon reservoir scenario, water is pumped to the new Stokes Canyon reservoir during the 7-month prohibition period. A new booster station, located near the intersection of Las Virgenes Road and Mulholland Highway, will boost from the existing 795 Zone to the reservoir. A new 30-inch transmission main will be constructed in the Mulholland Highway and Stokes Canyon Road to supply water to the new reservoir. During the winter months, water will be sent to the distribution system via the same 30-inch pipeline. Excess flow will be sent south to the plant for discharge into the creek. Water sent to the distribution system will drain by gravity via a pressure reducing valve into the parallel 16- and 24-inch transmission main in Las Virgenes Road to feed RWPS West, which boosts to the 1225 Zone, and RWPS East, which boosts to the 1529 Zone.

Just as with the April Canyon Reservoir scenario, a new pipeline feeding the new western demands (Agoura Road Extension, Medea Valley, Saddlerock Ranch, the Fire Camps and the Malibu Golf Course) will be constructed in Kanan Road from the Zone 1225 Indian Hills tank. A booster station on Kanan Road will boost water to the new 0.3 MG Decker Tank at a HWL of 1950. Again, the Medea Valley and Agoura Road extensions would be fed from the 1225 Zone and the Saddlerock Ranch, Fire Camps and Malibu Golf Course demands would be fed from the new 1950 Zone. The proposed recycled water system expansion for the Stokes Canyon alternative is shown in **Figure 4-17**.

The booster stations will be supplied by the local power company at a connection point to be determined during pre-design. The reservoir pump station would have a total installed duty horsepower of 800 hp with variable speed pumps. The Decker Pump Station would have a total installed duty horsepower of 300 hp with variable speed pumps. Pressure reducing valves will be required at several turnouts where the system pressure exceeds 100 pounds per square inch (psi). Other appurtenances of the system include isolation valves, a combination of air release valves, and blow-off valves.

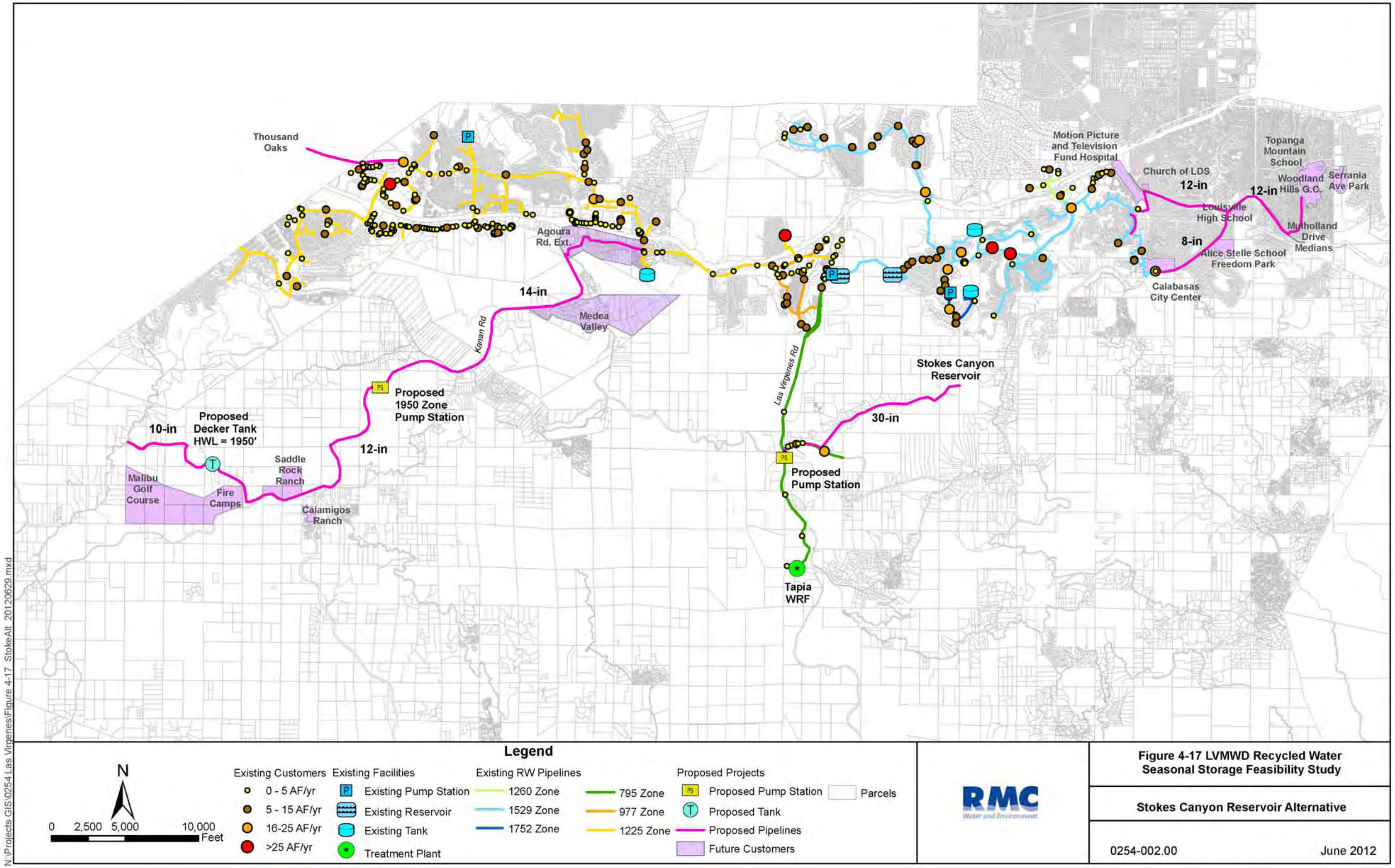
The proposed Stokes Canyon Reservoir has a potential operational storage volume of 1,900 acre-feet (AF). This volume is more than sufficient to supply peak demands and avoid creek discharges during the prohibition period (only 640 AF required), assuming that all new identified demands are realized. If fewer customers are actually connected, the required storage volume to prevent creek discharges will increase.

Figure 4-18 below is a modified version of Figure 4-14 that shows the minimum new recycled water demands that would be necessary to avoid creek discharges during the prohibition period at Stokes Canyon. The graph assumes that the surplus recycled water within the prohibition period is stored instead of being discharged. The average volume of excess recycled water that would be discharged to Malibu Creek during non-prohibition months would be approximately 5,870 AF for a given year.

The minimum total required demands for recycled water would be 7,390 AFY, an increase of approximately 770 AFY from 2006-2010 average demands.

It should be noted than an alternate alignment through the Cornell Valley (south of Medea Valley) is another potential project that would serve the customers in that area.

Figure 4-17: Proposed Recycled Water System Expansion for Stokes Canyon Alternative



Note: Future customer representations on maps are approximated using tax assessment parcels.

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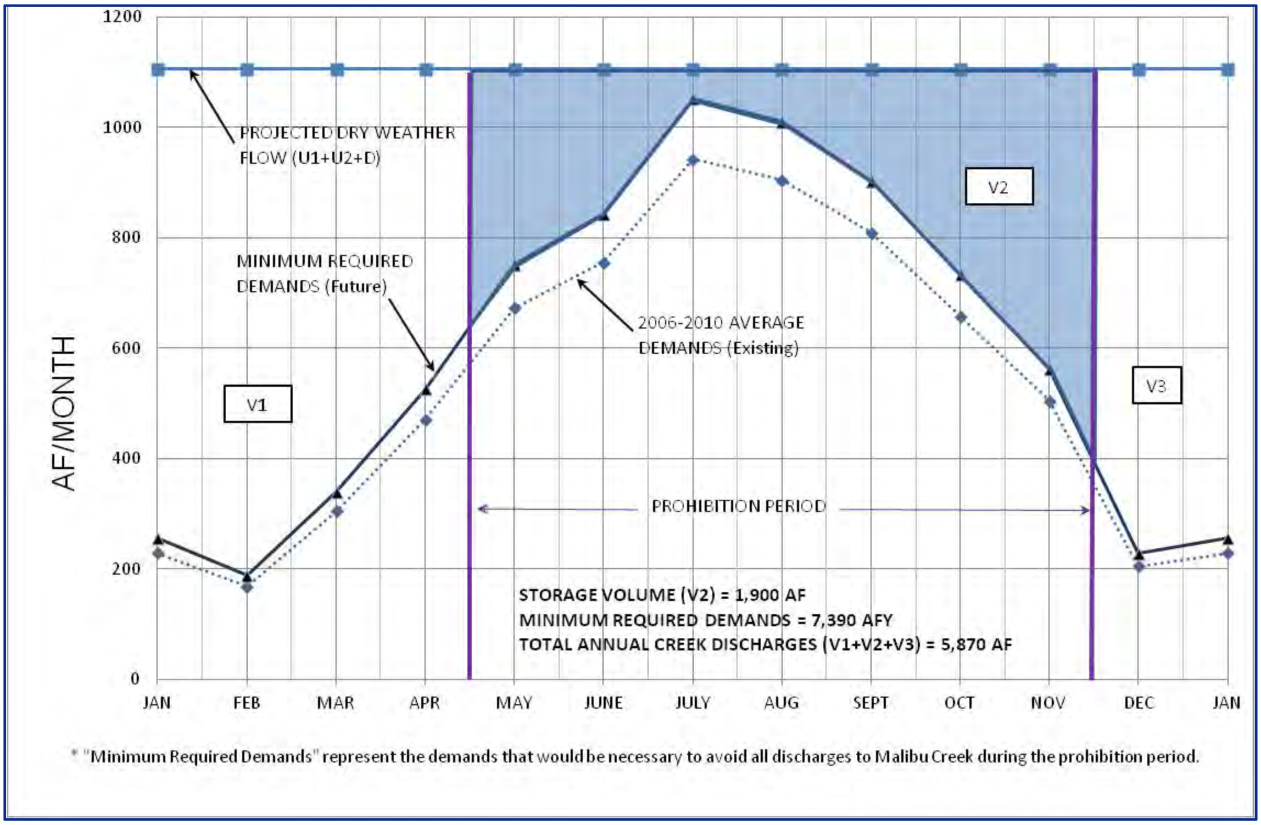
Figure 4-18: Minimum Demands Required for Stokes Canyon Storage Volume



4.7.1 Hope Seasonal Storage Site and Recycled Water System Expansion

The potential Hope reservoir is located at Stokes Road and Mulholland Highway and would store up to 2,000 acre-feet of recycled water on about 60 acres. In the Hope reservoir scenario, water is pumped to the new Hope reservoir during the 7-month prohibition period. A new booster station, located within the boundaries of the existing Rancho Las Virgenes Composting Facility, will boost from the existing 795 Zone to the reservoir. A new 30-inch transmission main will be constructed in the service road off of Las Virgenes Road to the composting facility and then boring under the hillside will be completed to supply water to the new reservoir during the prohibition period. During the winter months, water will be sent to the distribution system via the same 30-inch pipeline. Excess flow will be sent south to the plant for discharge into the creek. Water sent to the distribution system will drain by gravity via a pressure reducing valve prior to flowing into the parallel 16- and 24-inch transmission main in Las Virgenes Road to feed RWPS West, which boosts to the 1225 Zone, and RWPS East, which boosts to the 1529 Zone.

Just as with the April Canyon and Stokes Canyon Reservoir scenarios, a new pipeline feeding the new western demands (Agoura Road Extension, Medea Valley, Saddlerock Ranch, the Fire Camps and the Malibu Golf Course) will be constructed in Kanan Road from the Zone 1225 Indian Hills tank. A booster station on Kanan Road will boost water to the new 0.3 MG Decker Tank at a HWL of 1950. Again, the Medea Valley and Agoura Road extensions would be fed from the 1225 Zone and the Saddlerock Ranch, Fire Camps and Malibu Golf Course demands would be fed from the new 1950 Zone. The proposed recycled water system expansion for the Hope Reservoir alternative is shown in **Figure 4-19**.

The booster stations will be supplied by the local power company through a connection at the Rancho Las Virgenes Composting Facility. The reservoir pump station would have a total installed duty horsepower of 800 hp with variable speed pumps. The Decker Pump Station would have a total installed duty horsepower of 300 hp with variable speed pumps. Pressure reducing valves will be required at several turnouts where the system pressure exceeds 100 psi. Other appurtenances of the system include isolation valves, a combination of air release valves, and blow-off valves.

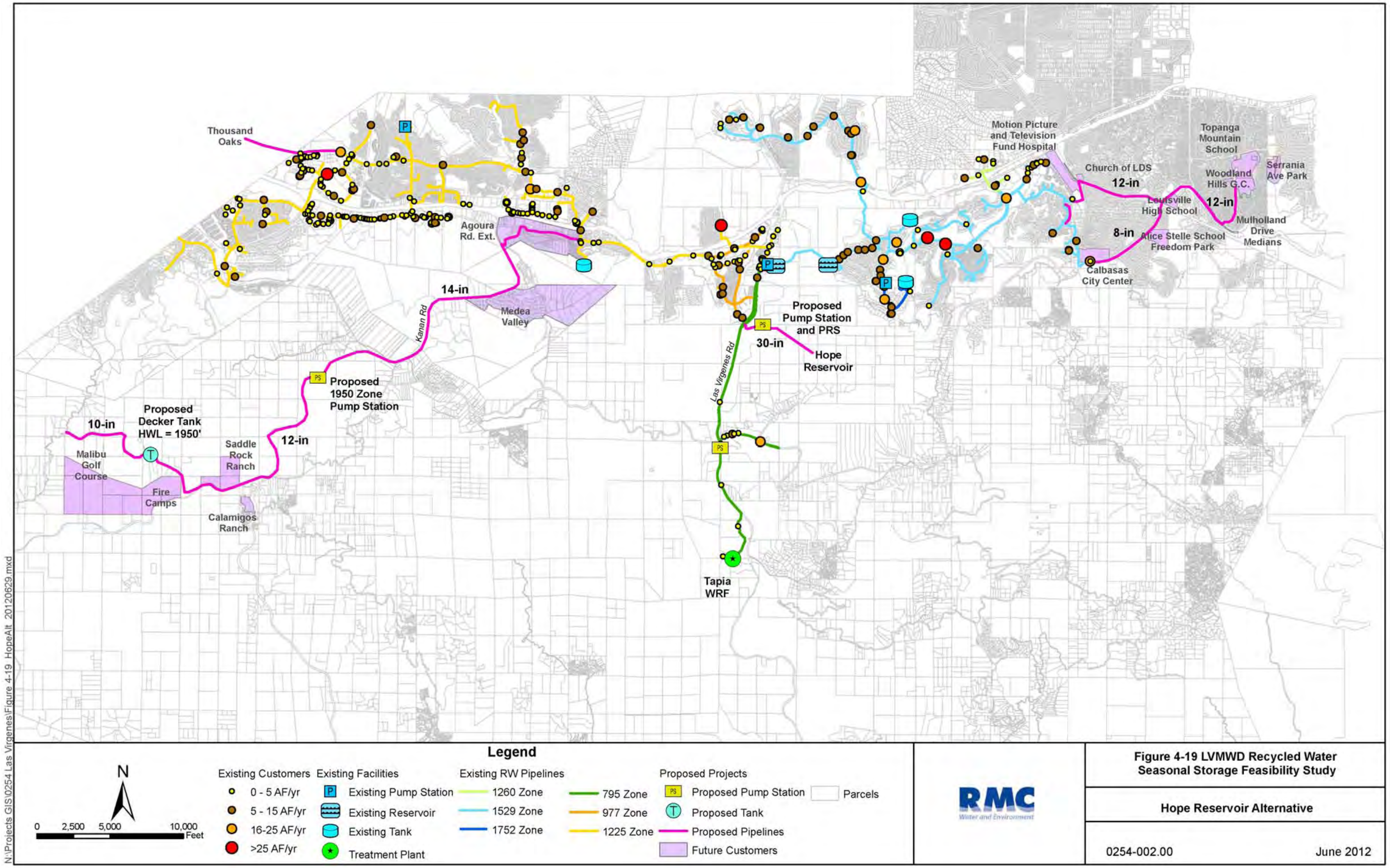
The proposed Hope Canyon Reservoir has a potential operational storage volume of 2,000 acre-feet (AF). This volume is more than sufficient to supply peak demands and avoid creek discharges during the prohibition period (only 640 AF required), assuming that all new identified demands are realized. If fewer customers are actually connected, the required storage volume to prevent creek discharges will increase.

Figure 4-20 below is a modified version of Figure 4-14 that shows the minimum new recycled water demands that would be necessary to avoid creek discharges during the prohibition period at April Canyon. The graph assumes that the surplus recycled water within the prohibition period is stored instead of being discharged. The average volume of excess recycled water that would be discharged to Malibu Creek during non-prohibition months would be approximately 6,000 AF for a given year.

The minimum total required demands for recycled water would be 7,260 AFY, an increase of approximately 640 AFY from 2006-2010 average sales.

It should be noted than an alternate alignment through the Cornell Valley (south of Medea Valley) is another potential project that would serve the customers in that area.

Figure 4-19: Proposed Recycled Water System Expansion for Hope Alternative



Note: Future customer representations on maps are approximated using tax assessment parcels.

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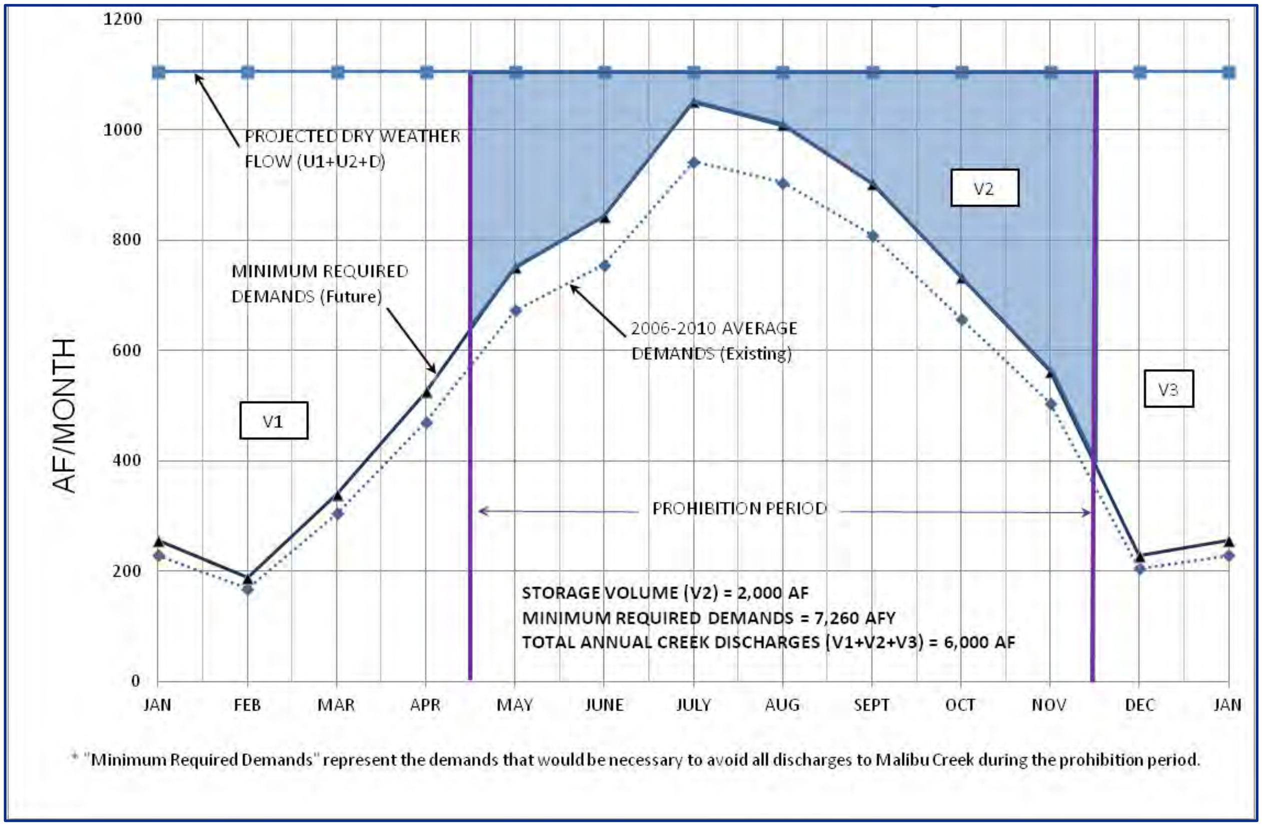
Figure 4-20: Minimum Demands Required for Hope Site Storage Volume



4.7.2 "No Project" Alternative - Increase Imported Water Supply

The "no project" alternative consists of the continued disposal of surplus recycled water with no changes or expansions of the existing recycled water distribution system. Imported water would continue to be purchased to supplement seasonal peaks in irrigation demands during the summer months and would continue to serve the end users identified as potential recycled water customers. This alternative may be compared with the RWSSP using the projected costs for treated potable water (determined by MWD) and a characterization of lost value from using a less reliable water source.

4.7.3 Conceptual Groundwater Recharge Project

This analysis includes a description of a conceptual groundwater recharge (GWR) project that could potentially be implemented to use the remaining recycled water produced by the Tapia WRF. This conceptual GWR project would create a balanced system, wherein all or nearly all of the recycled water supplied by the plant is supplied to end users and is not discharged to Malibu Creek.

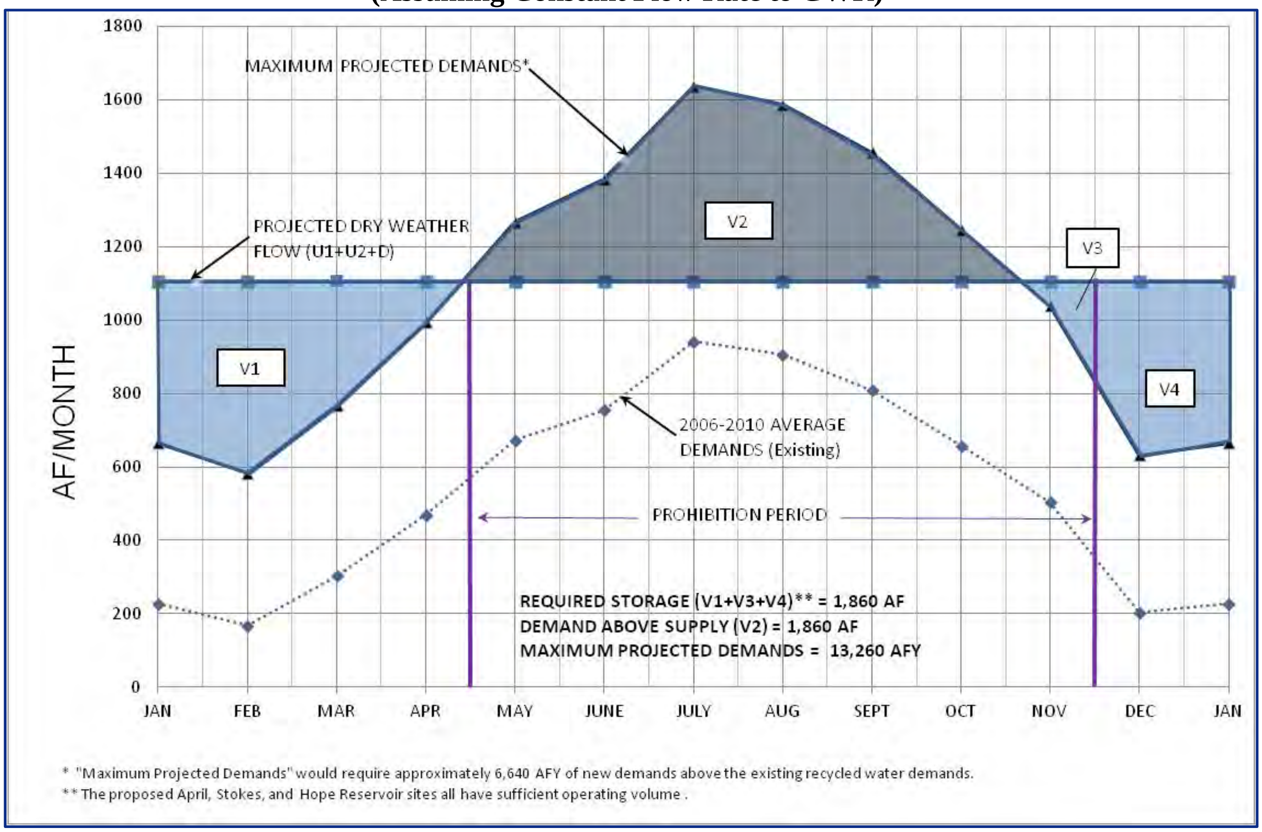
This conceptual project assumes that LADWP can utilize the remaining 4,280 AFY of recycled water from Tapia WRF in facilities that the agency would construct and operate at the Donald C. Tillman Water Reclamation Plant and at spreading basins owned and operated by LADWP. It also assumes that LADWP would construct any necessary facilities to use and/or treat recycled water from the District inside the LADWP service area, that MWD treated replenishment water would be used in the "no project" alternative, and that no additional treatment facilities are needed at Tapia WRF.

The conceptual GWR project would include the following facilities:

- Pump station at reservoir – an additional 200 HP, 2,700 gpm pump would be necessary to convey recycled water from each of the three reservoir sites to Recycled Water Pump Station East (RWPS East)
- Pump station at RWPS East – a 500 HP, 2700 gpm pump would need to be added to RWPS East to convey recycled water to the edge of the District service area
- Pipeline - approximately 5 miles of 14-inch diameter pipe would be necessary to convey recycled water from the existing RWPS East to the edge of the District service area

Figure 4-21 below is a modified version of Figure 4-14 that shows the balanced system condition for Tapia WRF with full reuse of recycled water. The graph combines the 2,360 AFY of new demands identified above with 4,280 AFY of demand for the conceptual GWR project, for a total of approximately 6,640 AFY in new demand.

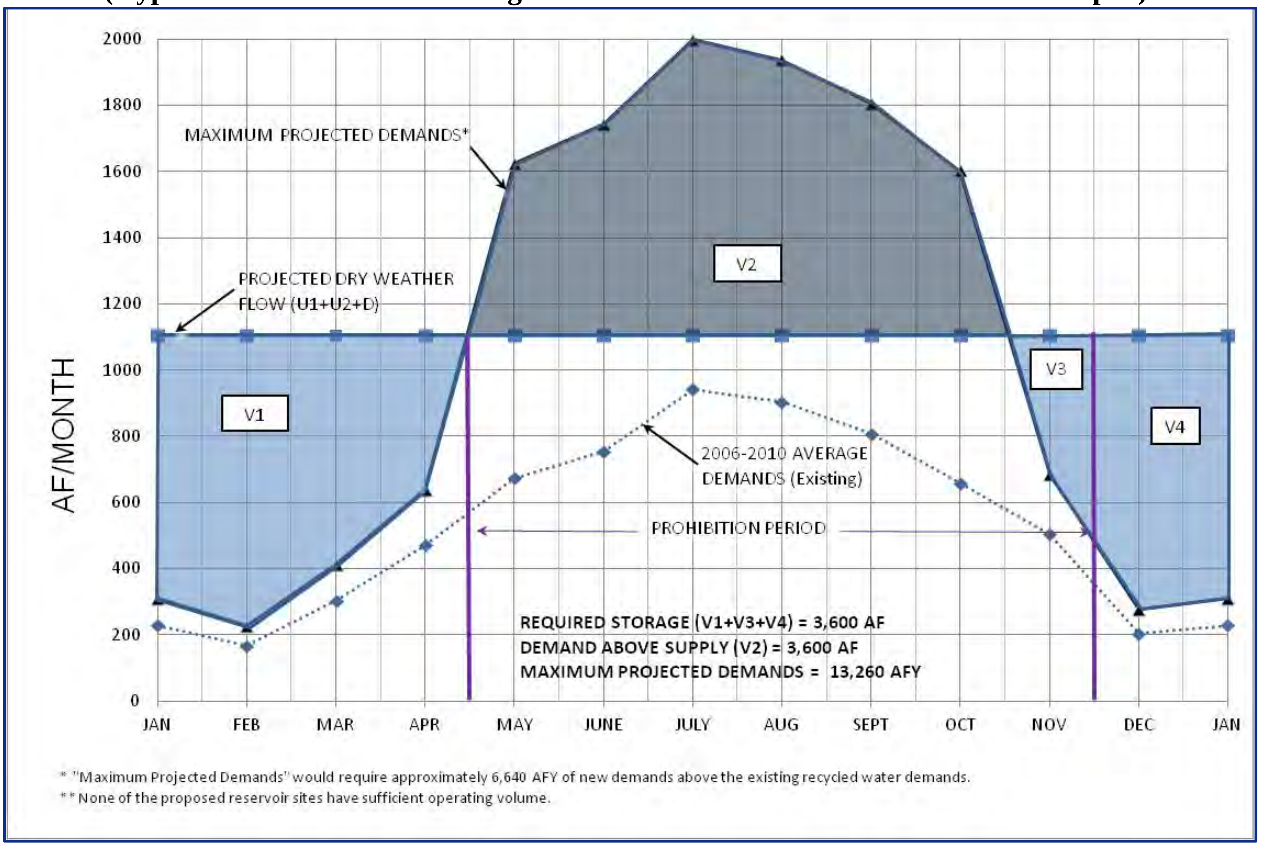
Figure 4-21: Tapia WRF Supply-Demand Curve with Balanced System (Assuming Constant Flow Rate to GWR)



Conceptually speaking, it is possible that there would be no excess recycled water discharged to Malibu Creek during a typical year if this type of project could be implemented. The graph in Figure 4-21 assumes that recycled water is delivered to the conceptual GWR project at a constant flow rate. To put this in context, 4,280 AFY is not a large percentage of the overall volume recharged at the spreading basins in the San Fernando Valley;[7] so it is feasible that the delivery rate could be fairly constant. The total projected demands of recycled water (i.e., both non-potable of 6,620 AFY plus GWR) are 13,260 AFY, an increase of approximately 6,640 AFY from 2006-2010 average demands.

The rate of recycled water delivery to the conceptual GWR project is important and will need to be analyzed in more detail. **Figure 4-22** below demonstrates how potential restrictions on the delivery rate could affect the capacity of the project to reuse 100 percent of the effluent from Tapia WRF. The graph in the figure assumes that no recycled water can be delivered to spreading grounds during the winter months of November through April. In this "hypothetical scenario", none of the storage reservoir sites would have sufficient volume to store six months of Tapia WRF effluent. The required volume would be 3,600 AF and even the largest of the proposed reservoir sites (April Canyon at 2,200 AF) would not provide adequate capacity.

Figure 4-22: Tapia WRF Supply-Demand Curve with Balanced System (Hypothetical Scenario Assuming No Flows to GWR Between November and April)



It should be noted that additional discharges to the creek might be necessary for years with higher-than-average effluent flows, or for years when the LARWQCB requests supplemental discharges to Malibu

[7] The 2012 Los Angeles Department of Water and Power *Recycled Water Master Planning* documents indicate that there may be more than 4,280 AFY of recharge capacity at each of the three major spreading basins in the San Fernando Valley (Hansen, Pacoima, and Tujunga), even after accounting for average stormwater infiltration and planned LADWP GWR projects (LADWP, 2012).

Creek to sustain habitat for steelhead trout. In other years when summer demands exceed the average, supplemental imported water or groundwater might be necessary to supply these demands (or alternately, a smaller amount of recycled water could be supplied to the conceptual GWR project).

Chapter 5 Economic Analysis

This section presents an economic analysis of the proposed project relative to other water supply alternatives that could be implemented by the District. This analysis will identify the degree to which the proposed project and alternatives are cost-effective, and it will outline the economic benefits that are to be realized after implementation. This economic analysis includes the following sections:

- Existing and projected conditions in the service area of the project;
- Cost comparison of alternatives (including conceptual GWR project);
- Net benefit analysis of alternatives;
- Description of benefits difficult to quantify.

5.1 Existing and Projected Conditions in Service Areas

This analysis assumes that if no project is implemented, the District will continue purchasing imported water at Tier 2 commodity rates from MWD to meet demands. It also assumes that the District will continue to pay for effluent management practices at the Rancho spray fields, LA River disposal, and LABOS raw sewage disposal; and it assumes that dechlorination of all disinfected tertiary effluent is required for all discharges to Malibu Creek and the LA River and that the regulatory requirements remain the same. The following sections provide the background for the economic analysis of existing and projected conditions in the service area.

Basic Cost Estimating Assumptions

The following assumptions in **Table 5-1** were used to calculate the cost estimates presented below:

Table 5-1: Cost Estimating Assumptions

Financing Terms	
Interest Rate	5%
Term (project lifespan)	50 years
Contingencies	
Construction	20%
Engineering, Construction Management, Administration	20%
Legal, Environmental/Permits, Mitigation	10%
O&M Costs	
Reservoirs	1.5% of construction costs
Pipelines	0.25% of construction costs
Pump Station O&M	1.5% of construction costs
Power (electricity)	cost/kwh = $0.15
Above-Ground Tank	0.5% of construction costs
Land Costs	
	$55/ft^2
Conversion/Retrofit Costs	
For existing users that convert to recycled water (not infill)	$100/AFY

Imported Water Reliability Assumptions

MWD, as the local imported water provider to the District, has been unable to meet 100 percent of demand every year. MWD's 1991 shortage was as a result of multiple years of severe drought conditions. Supplies were also curtailed in 2009 and 2010, a result of sustained drought and required cut-backs in the State Water Project (SWP) supplies originating from events in the San Francisco Bay Delta. Former Gov. Arnold Schwarzenegger declared a statewide drought in June 2008 and a state of emergency in February 2009 because of low water levels. In March of 2011, the drought emergency was declared over by current Governor Jerry Brown. Subsequently, MWD lifted its mandatory restrictions on April 13, 2011.

Despite the lifting of restrictions, more drought allocations are anticipated by MWD in the future. According to MWD's 2010 Integrated Regional Plan, future drought conditions will result in the expected shortage frequencies shown in **Table 5-2.** Given that these are the assumptions used by MWD, it is assumed that District supplies would also reflect this frequency of shortage. Therefore, this analysis assumes that there is a 5 percent chance that imported supplies would be short in 2035 (5 of every 100 years or 1 of every 25 years). The economic analysis assumes that MWD Tier 2 water will be available at this frequency. For the conceptual GWR project, it is assumed that treated replenishment water will be available.

Table 5-2: MWD Shortage Frequency and Magnitude Projections

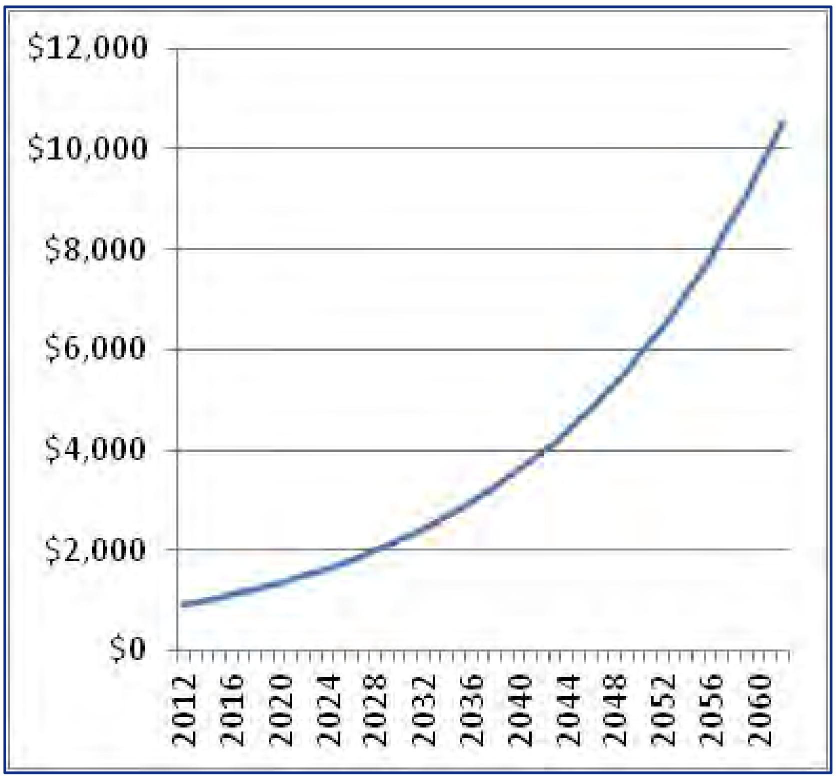
	2015	2025	2035
Frequency of Shortage	12%	4%	5%
Magnitude of Shortages	659,000 AF (12%)	350,000 AF (6% of demand)	191,000 AF (3% of demand)

MWD, 2010. Table 2.8.

Imported Water Cost Assumptions

Imported water costs are based on recent Tier 2 projections for MWD supply as shown in **Figure 5-1**. The rate projections are expressed in future dollars. The unit costs assume an escalation rate of 7.5 percent based on the historical MWD Tier 2 rates for the period between 1960 and 2010.

Figure 5-1: MWD Tier 2 Potential Rate Projection (Expressed in 2011 Dollars)



Note: These rates use a 7.5% per year escalation rate based on historical MWD Tier 2 rates over the period from 1960 to 2010.

It is assumed that NPR projects in this analysis would be replaced with MWD Tier 2 imported water in the "no project" alternative. For the conceptual GWR project, it is assumed that treated replenishment water would be used in the "no project" alternative.

5.2 Project Alternatives

The following section presents the capital and annualized total costs for each of the three reservoir alternatives. Detailed cost estimates are provided in Appendix B.

5.2.1 April Canyon Seasonal Storage Site and Recycled Water System Expansion

The April Canyon reservoir alternative would provide 2,200 AF of additional storage as well as transmission facilities to meet an additional 2,360 AFY of non-potable (NPR) recycled water demand. **Table 5-3** describes the capital costs, total annualized costs, and unit costs for the project. The costs for the conceptual GWR project, which could provide an additional demand of 4,280 AFY for a total of 6,640 AFY, are also provided in the table.

Table 5-3: April Canyon Reservoir Alternative Engineering Costs

Option	Total RW Supply (AFY)	Capital Cost – Reservoir (2011$)	Capital Cost – Other Facilities (2011$)	Total Capital Cost (2011$)	Total Annualized Cost (2011$/year)	Unit Cost (2011$/AF)
NPR	2,360	$62.2M	$54.9M	$117.2M	$8.1M	$3,450
NPR+GWR	6,640	$62.2M	$67.3M	$129.5M	$9.2M	$1,380

Note: Total annualized cost includes O&M and assumes interest rates of 5% over a 50 year period.

5.2.2 Stokes Canyon Seasonal Storage Site and Recycled Water System Expansion

The Stokes Canyon reservoir alternative would provide 1,900 AF of additional storage as well as transmission facilities to meet an additional 2,360 AFY of recycled water demand. **Table 5-4** describes the capital costs, total annualized costs, and unit costs for the project. The costs for the conceptual GWR project, which could provide an additional demand of 4,280 AFY for a total of 6,640 AFY, are also provided in the table.

Table 5-4: Stokes Canyon Reservoir Alternative Engineering Costs

Option	Supply (AFY)	Capital Cost – Reservoir (2011$)	Capital Cost – Other Facilities (2011$)	Total Capital Cost (2011$)	Total Annualized Cost (2011$/year)	Unit Cost (2011$/AF)
NPR	2,360	$96.7M	$56.0M	$152.7M	$10.5M	$4,460
NPR+GWR	6,640	$96.7M	$68.3M	$165.0M	$11.6M	$1,740

Note: Total annualized cost includes O&M and assumes interest rates of 5% over a 50 year period.

5.2.3 Hope Reservoir Seasonal Storage Site and Recycled Water System Expansion

The Hope reservoir alternative would provide 2,000 AF of additional storage as well as transmission facilities to meet an additional 2,360 AFY of recycled water demand. **Table 5-5** describes the capital costs, total annualized costs, and unit costs for the project. The costs for the conceptual GWR project, which could provide an additional demand of 4,280 AFY for a total of 6,640 AFY, are also provided in the table.

Table 5-5: Hope Reservoir Alternative Engineering Costs

Option	Supply (AFY)	Capital Cost – Reservoir (2011$)	Capital Cost – Other Facilities (2011$)	Total Capital Cost (2011$)	Total Annualized Cost (2011$/year)	Unit Cost (2011$/AF)
NPR	2,360	$62.9M	$51.1M	$113.9M	$7.8M	$3,320
NPR+GWR	6,640	$62.9M	$63.4M	$126.2M	$8.9M	$1,340

Note: Total annualized cost includes O&M and assumes interest rates of 5% over a 50 year period.

5.2.4 Continue Imported Water Purchases and Creek Discharges ("No Project")

If no seasonal storage reservoir sites are developed, the District would continue to purchase MWD imported water to supply customer demands and would continue to use the Rancho spray fields, the LA River disposal option, and the BOS raw sewage diversion to dispose of excess recycled water during the prohibition period. For the purposes of this economic analysis, it is assumed that these activities would continue for at least 50 years, equivalent to the shortest lifespan of the capital facilities included in the reservoir alternatives.

For comparison purposes, the annual costs for imported water and effluent management are determined and then the net present value is calculated. Finally, the net present values are converted to equivalent annual cost and then to unit cost per AF of new recycled water supply. The costs assume a 7.5 percent escalation rate for MWD imported water rates, a 2.5 percent inflation rate, and a 5 percent discount rate.

Table 5-6 presents the annualized total costs for the "no project" alternative. Avoided costs are presented for the NPR projects and for the NPR project combined with the conceptual GWR project. Imported water costs assume Tier 2 rates for the 2,360 AFY of NPR demands and treated replenishment rates for the 4,280 AFY of groundwater recharge demands. It should be noted that avoided costs for purchasing treated replenishment costs are costs that apply to the region and not to the District directly. Project partners would be necessary to realize these regional benefits. Detailed estimates for avoided costs may be found in Appendix C.

Table 5-6: Costs of Imported Water and Continued Effluent Management

Supply (AFY)	Net Present Value of 50-year Imported Purchases (2011$)	Equivalent Annual Cost of 50-year Imported Purchases (2011$/yr)	Equivalent Annual Cost of 50-year Effluent Management (2011$/yr)	Total Annual Cost (2011$/yr)
2,360	$105.2M	$5.8M	$0.4M	$6.2M
6,640	$240.5M	$13.2M	$0.4M	$13.6M

Note: Annualized capital cost assumes interest rates of 5% over a 50 year period.

5.3 Net Benefit Analysis

The net benefit analysis for the project is presented in **Table 5**-7. It is based on a comparison of costs for the most likely alternative projects which, as described above, would be continuing the purchase of imported water and continuing effluent management practices. Thus, the annual regional benefits total between $6.2M and $13.6M in avoided costs (from Section 5.2).[8]

Table 5-7: Net Benefits of RWSSP

Option	RWSSP Annual Cost (2011$/AF)	Alternative Project Annual Cost (2011$/AF)	Net Benefit in Annual Costs (2011$/AF)	Cost/Benefit Ratio
NPR	$7.8M – 10.5M	$6.2M	-$1.6M to -$4.3M	1.3 - 1.7
NPR+GWR	$8.9M – 11.6M	$13.6M	$2.0M to $4.7M	0.7 – 0.9

The net annual benefit of the project depends on whether the conceptual GWR project is pursued. For the NPR project options alone, there is a cost of $1.30 to $1.70 for every potential dollar of benefit gained by the RWSSP. However, for the combined NPR and conceptual GWR projects, there is a cost of $0.70 to $0.90 for every potential dollar of benefit gained by the RWSSP. A hypothetical "break even" point with 2,360 AFY of NPR and approximately 2,200 AFY of GWR (around half the proposed GWR project capacity) provides a cost of exactly $1.00 for every potential dollar of benefit gained by the RWSSP.

5.4 Qualitative Benefits

5.4.1 Live-stream Discharge for Environmental Benefit

Though not a new benefit provided by the project(s), the facilities proposed for all three reservoir alternatives would maintain continued access to recycled water discharges from Tapia WRF for habitat maintenance in Malibu Creek.

5.4.2 Non-quantified Benefits to District and other Agencies

The facilities proposed for all three reservoir sites would provide recycled water benefits to the District, as well as potentially Triunfo Sanitation District and LADWP. The non-quantified benefits are summarized in **Table 5-8**.

Table 5-8: Non-Quantified Benefits of RWSSP

Benefit	RWSSP	No Project
Reduce reliance on imported water	Provides reduced dependence	Does not provide
Increase use of local water resources	Increases use of local resources	Does not increase
Reduce discharges to Malibu Creek	Reduces discharges to creek	Requires continued effluent management practices
Provide increase seasonal flexibility	Provides seasonal flexibility	Does not provide

[8] It should be noted that the assumptions made about future costs of MWD Tier 2 water are critical to the economic analysis. If rates increase at a lower or higher escalation rate than the 7.5% assumed, the analysis would yield different results for the 50-year period.

Chapter 6 Selection of Proposed Project

This study finds that all three seasonal storage reservoir site projects would be feasible from a technical perspective. In terms of economics, it would be necessary to include some version of the conceptual GWR project to provide more benefits than costs. Of the three alternatives, the lowest cost alternative is the Hope Reservoir Site; and on the basis of cost this is selected as the proposed RWSSP. [9]

The RWSSP consists of an open reservoir approximately 2,000 AF in volume and improvements/expansions to the recycled water distribution system to provide up to 2,360 AFY of recycled water from the Tapia WRF to urban users in the District service area and to neighboring agencies. The project would also include the 4,280 AFY conceptual GWR project.

The RWSSP includes the following facilities for the Hope reservoir site:

NPR Facilities:

- open reservoir with all appurtenant dam facilities (e.g., spillway, outlet works, screens, etc.)
- a connection to the existing 24-inch pipeline in Las Virgenes Road, including a post-treatment facility at the proposed reservoir and pipelines,
- distribution system consisting of approximately 98,000 linear feet of pipeline within existing roadway rights-of-way,
- one storage tank referred to as the Decker Tank,
- two intermediate pump stations, one located at Las Virgenes Road and Mulholland Highway, the other located on Kanan Road southwest of the intersection with Triunfo Canyon Road, and
- pressure reducing valves and appurtenances.

GWR Facilities:

- Pump station at reservoir – an additional 200 HP, 2,700 gpm pump would be necessary to convey recycled water from each of the three reservoir sites to RWPS East
- Pump station at RWPS East – a 500 HP, 2,700 gpm pump would need to be added to RWPS East to convey recycled water to the edge of the District service area
- Pipeline - approximately 5 miles of 14-inch diameter pipe would be necessary to convey recycled water from the existing RWPS East to the edge of the District service area

The estimated capital cost for the RWSSP in 2011 dollars totals $126M to $165M, resulting in an annualized unit cost of between $1,300 and $1,800 per AF. These costs include the conceptual GWR project. For the combined NPR and conceptual GWR projects, there is a cost of $0.70 to $0.90 for every dollar of potential benefit provided by the RWSSP. Detailed cost estimates are included in Appendix B and avoided cost estimates are included in Appendix C. The District will be responsible for all operation and maintenance of the facilities proposed in the RWSSP.

[9] It should be noted that the three sites differ in terms of the ease with which appropriate land can be acquired and in the potential difficulty of obtaining regulatory and permitting approval.

Chapter 7 Environmental Considerations and Potential Effects

The goal of this chapter is to evaluate the potential environmental impacts of the proposed RWSSP alternatives in order to support the District in the selection of a preferred alternative. The environmental evaluation is based on readily available existing information and limited observations. The environmental evaluation will assess whether there are any "fatal flaws" associated with any of the alternatives that would essentially cause the alternative to be unviable or infeasible. All three of the reservoir sites are included in the environmental impact analysis.

7.1 Environmental Compliance

The California Environmental Quality Act (CEQA) requires that all state and local government agencies consider the environmental consequences of projects over which they have discretionary authority before taking an action that has the potential to affect the environment. The District would serve as the lead agency for achieving CEQA compliance prior to approval of the preferred RWSSP. The National Environmental Policy Act (NEPA) requires federal agencies to integrate environmental values into their decision-making processes by considering the environmental impacts of their proposed actions and reasonable alternatives to those actions. Due to the potential for federal funding for construction of the preferred RWSSP, USBR would serve as the lead agency for NEPA compliance.

To comply with both CEQA and NEPA concurrently, the District can prepare a joint Environmental Impact Report/Environmental Assessment (EIR/EA) or an Environmental Impact Report /Environmental Impact Statement (EIR/EIS), depending on findings regarding the level of significant impacts to federal issues of concern. The EIR/EA or EIR/EIS would fully evaluate the potential impacts of the preferred project and alternatives. A project EIR is defined (CEQA Guidelines §15161) as one which "examines the environmental impacts of a specific development project." The EIR/EA or EIR/EIS would provide a site-specific review of all phases of the preferred project and alternatives, including planning, construction, and operation.

7.2 Setting

The study area for the RWSSP alternatives includes April Canyon and surrounding areas, Stokes Canyon and surrounding areas, a small un-named drainage located between April Canyon and Stokes Canyon (Hope site), and the proposed recycled water distribution system extensions to Agoura Road, Medea Valley, Saddlerock Ranch, the Fire Camps, and the Malibu Golf Course. The study area falls within the Malibu Beach and Point Dume USGS 7.5 minute quadrangles. The April Canyon site is owned by private and public landowners and is located west of Las Virgenes Road and north of Mulholland Highway. The Stokes Canyon site is owned by private and public landowners and is located east of Las Virgenes Road and north of Mulholland Highway. The Hope site is owned by private and public landowners and is located east of Las Virgenes Road and north of Mulholland Highway, approximately 2 miles west of the Stokes Canyon site.

7.2.1 Biological Resources

The Santa Monica Mountains represent one of the largest protected areas of the Mediterranean-type ecosystems in Southern California. The Santa Monica Mountains are considered a "significant ecological area" and an area providing "regional wildlife linkages" in the Los Angeles County Draft General Plan 2035 (Los Angeles County 2011: http://planning.lacounty.gov/generalplan). Vegetation communities within the Santa Monica Mountains include: coast live oak woodland, coastal sage scrub, coastal sage chaparral scrub, valley oak savannah, non-native grassland, chamise chaparral, southern willow scrub, mule fat scrub, sycamore-oak riparian woodland, and southern coast live oak riparian forest (California State Parks 2005: http://www.parks.ca.gov/?page_id=22886; ESA 2009; Woodward-Clyde 1991). The study area does not lie within critical habitat mapped by the U.S. Fish and Wildlife Service (USFWS).

Southern coast live oak riparian forest is considered a sensitive plant community by CDFG. This plant community occurs within riparian corridors and is known to provide a variety of habitat to both common and special status wildlife. Although coastal sage scrub and coast live oak woodland are not considered sensitive plant communities by CDFG, they are both known to provide habitat for a wide array of wildlife and special status species. The scrub, chaparral, woodland, and non-native grasslands all provide nesting habitat for breeding birds.

A quadrangle search of the California Natural Diversity Database (CNDDB 2011) identified the following sensitive wildlife species with potential to occur near the April Canyon and Stokes Canyon Reservoir sites: golden eagle (*Aquila chrysaetos*), southern steelhead - southern California DPS (*Oncorhynchus mykiss irideus*), arroyo chub (Gila orcuttii), tidewater goby (*Eucyclogobius newberryi*), Yuma myotis (*Myotis yumanensis*), western small-footed myotis (*Myotis ciliolabrum*), western red bat (*Lasiurus blossevillii*), spotted bat (*Euderma maculatum*), western mastiff bat (*Eumops perotis californicus*), San Diego desert woodrat (*Neotoma lepida intermedia*), western pond turtle (*Emys marmorata*), coast horned lizard (*Phrynosoma blainvillii*), coastal whiptail (*Aspidoscelis tigris stejnegeri*), San Bernardino ringneck snake (*Diadophis punctatus*), California mountain kingsnake - San Diego population (*Lampropeltis zonata (pulchra*)), and monarch butterfly (*Danaus plexippus*).

The CNDDB search identified the following sensitive plant species with potential to occur near the April Canyon and Stokes Canyon Reservoir sites: Malibu baccharis (*Baccharis malibuensis*), Santa Susana tarplant (*Deinandra minthornii*), Coulter's goldfields (*Lasthenia glabrata ssp. Coulteri*), Lyon's pentachaeta (*Pentachaeta lyonii*), Coulter's saltbush (*Atriplex coulteri*), Blochman's dudleya (*Dudleya blochmaniae ssp. Blochmaniae*), marcescent dudleya (*Dudleya cymosa ssp. Marcescens*), Santa Monica dudleya (*Dudleya cymosa ssp. ovatifolia*), Braunton's milk-vetch (*Astragalus brauntonii*), round-leaved filaree (*California macrophylla*), slender mariposa-lily (*Calochortus clavatus var. gracilis*), and Plummer's mariposa-lily (*Calochortus plummerae*).

Targeted records and field observations (ESA 2011) identified the following sensitive wildlife species with potential to occur near the Hope site: Santa Monica grasshopper (*Trimerotropis occidentiloides),* Coastal whiptail (*Aspidoscelis tigris stejnegeri*), San Bernardino ringneck snake (*Diadophis punctatus*), California mountain kingsnake - San Diego population (*Lampropeltis zonata (pulchra*)), Coast (San Diego) horned lizard (*Phrynosoma coronatum (blainvillii)*), Cooper's hawk (*Accipiter cooperii),* Southern California rufous-crowned sparrow (*Aimophila ruficeps canescens),* Golden eagle (*Aquila chrysaetos*), Coastal California gnatcatcher (*Polioptila californica),* Pallid bat (*Antrozous pallidus),* Western mastiff bat (*Eumops perotis californicus*), Western red bat (*Lasiurus blossevillii*), Hoary bat (*Lasiurus cinereus),* Western small-footed myotis (*Myotis ciliolabrum*), San Diego desert woodrat (*Neotoma lepida intermedia*).

Targeted records and field observations (ESA 2011) identified the following sensitive plant species with potential to occur near the Hope site: Braunton's milk-vetch (*Astragalus brauntonii*), Malibu baccharis (*Baccharis malibuensis*), Round-leaved filaree (*California macrophylla*), Slender mariposa-lily (*Calochortus clavatus var. gracilis*), Plummer's mariposa-lily (*Calochortus plummerae*), San Fernando Valley spineflower (*Chorizanthe parryi var. fernandina*), Parry's spineflower (*Chorizanthe parryi var. parryi*), Santa Susana tarplant (*Deinandra minthornii*), Agoura Hills dudleya (*Dudleya cymosa spp. agourensis*), Marcescent dudleya (*Dudleya cymosa spp. marcescens*), Santa Monica dudleya (*Dudleya cymosa ssp. ovatifolia*), Ojai navarretia (*Navarretia ojaiensis*), Chaparral nolina (*Nolina cismontana*), Lyon's pentachaeta (*Pentachaeta lyonii*).

7.2.2 Cultural Resources

Cultural resources within the study area that may be impacted by the proposed project alternatives include historic and/or prehistoric buildings, structures, objects, or archaeological resources. Similarly, Native American heritage resources or traditional cultural properties (places and things of religious or traditional value) may be impacted by the project alternatives. ESA (2009) conducted a detailed database search of the South Central Coastal Information Center (SCCIC), a member of the California Historical Resources Information System, which indicated no recorded cultural resources within the April Canyon reservoir and the surrounding ½-mile radius. However, a site visit resulted in observation of three historic structures and some historic artifacts. Woodward-Clyde (1991) report that a database search for the Stokes Canyon site resulted in no evidence of prehistoric or historical archeological resources. However, scattered building rubble and foundation remains were noted on the site. ESA (2011) conducted a detailed database search of the SCCIC, which indicated that the majority of the Hope site area has undergone an archaeological study in the past. While several of these studies occurred over ten years ago, they indicate the presence of at least one previously recorded cultural resource on the project site.

7.2.3 Hydrology/Water Quality

April Canyon, Stokes Canyon, and the Hope site are all located within the Malibu Creek watershed. April Canyon is located along an unnamed ephemeral tributary to Malibu Creek whose confluence is just south of Malibu Lake. Stokes Canyon is located on an unnamed intermittent tributary to Las Virgenes Creek, which also drains to Malibu Creek downstream of the lake. The Hope site is located on a small un-named drainage in the Santa Monica Mountains that is tributary to Stokes Creek, which flows downstream to Malibu Creek. The study area is not located within a 100-year or 500-year flood zone designated by the Federal Emergency Management Agency (ESA 2009 and ESA 2011).

Malibu Creek is on the LARWQCB's list of 303(d) impaired water bodies for coliform bacteria, fish barriers, invasive species, nutrients (algae), scum/foam, sedimentation/siltation, selenium, sulfates, and trash. Total Maximum Daily Loads (TMDLs) have been developed to reduce pollutant loading for coliform bacteria (2002), nutrients (2003), and scum/foam (2003) (LARWQCB 2009: http://www.waterboards.ca.gov/losangeles/water_issues/programs/303d/2008/Final%20303(d)/Appendix_F_08Aug09.pdf).

7.2.4 Land Use

April Canyon is owned by California State Parks and private landowners. The site is surrounded by the City of Agoura Hills, private lands, and California State Parks (Malibu Creek State Park) properties. Construction of a reservoir would require the District to acquire two privately held 20-acre parcels and to negotiate with California State Parks for permanent development of the land. Currently, there are several homes located within the reservoir footprint.

Stokes Canyon is owned by Los Angeles County and private landowners. The site is surrounded by the City of Calabasas, private lands, and California State Parks (King Gillette Ranch Park) properties. Construction of a reservoir would require the District to acquire nine privately held parcels from five separate parties.

The Hope site area is located within the City of Calabasas, and contains land owned by multiple public and private owners (ESA 2011). The site contains two privately held parcels, two parcels held by California State Parks, and land held by the Las Virgenes Municipal Water District. Construction of a reservoir would require the District to acquire two privately owned parcels and to negotiate with California State Parks for permanent development of the land. Currently there are no active uses on the land, and the site and its surrounding areas are undeveloped.

7.2.5 Seismic Hazards

All three potential alternatives (April Canyon, Stokes Canyon, and Hope Site) are located within the Malibu Beach Quadrangle as defined by the California Department of Conservation (California Geological Survey 2007). The Malibu Beach Quadrangle is mapped as part of the Alquist-Priolo Earthquake Fault Zoning Act, because it contains the Malibu Coast fault zone. The Malibu Coast fault zone is located approximately 5 miles southwest of April Canyon, 5.5 miles southwest of the Hope Site, and 6 miles southwest of Stokes Canyon. In addition, the project area containing all three alternatives is located within a Seismic Hazard Zone as defined by the California Department of Conservation, because it contains land that could potentially be impacted by seismically-induced liquefaction and landslides (California Department of Conservation 2001).

7.2.6 Traffic

Access to April Canyon is via Udell Road, Mulholland Highway, Las Virgenes Road/County Highway N1, and U.S. Highway 101. Access to Stokes Canyon is via Stokes Canyon Road, Mulholland Highway, Las Virgenes Road/County Highway N1, and U.S. Highway 101. Mulholland Highway has a single lane in each direction with a very narrow bike lane. There is currently no direct access to the Hope site. The nearest access road to the Hope site is Las Virgenes Road, which is located approximately one mile west of the proposed reservoir location.

7.3 Potential Effects

Key issues addressed in the CEQA and NEPA processes include: biological resources, cultural resources, hydrology/water quality, land use, seismic hazards, and traffic. Although additional environmental resource topics will be fully assessed in the EIR/EA or EIR/EIS, this environmental evaluation is intended to assess whether there are any "fatal flaws" associated with any of the alternatives that would essentially cause the alternative to be unviable or infeasible.

7.3.1 Evaluation Criterion

Biological Resources

Criterion 1: Jurisdictional Wetlands and Waters

Wetlands and other waters are considered to be sensitive biological resources and are protected by various federal, state, and local regulations. The U.S. Army Corps of Engineers (USACE) and the Los Angeles Regional Water Quality Control Board (LARWQCB) regulate waters of the U.S., including wetlands, under the authority of Sections 404 and 401, respectively, of the federal Clean Water Act (CWA). The term "waters of the U.S." encompasses many types of waters, including waters currently or historically used in interstate or foreign commerce, waters subject to the ebb and flow of tides, interstate waters, tributaries of waters of the U.S., and wetlands adjacent to waters of the U.S. The California Department of Fish and Game (CDFG) takes jurisdiction over lakes, rivers, and streams under Section 1600 et seq. of the Fish and Game Code. CDFG jurisdiction extends across the bed, banks, and channel of these features and includes areas beneath a riparian canopy, even if the canopy areas are well away from the stream channel (such as in riparian areas).

Criterion 2: Sensitive Vegetation Communities

Sensitive vegetation communities in the study area consist of a variety of upland and wetland/riparian vegetation communities, including coast live oak woodland, southern mixed chaparral, non-native grassland, and freshwater marsh. These areas are considered sensitive, in part, because they contain many different species of plants and animals and their size (acreage) is dwindling. In addition, these vegetation communities provide potentially suitable habitat for numerous sensitive plants and wildlife.

Criterion 3: Sensitive Species

Plant and animal species are considered sensitive if they have been listed as such by federal or state agencies or one or more special interest groups, such as the California Native Plant Society (CNPS). The federal Endangered Species Act (ESA) provides for the conservation of species that are endangered or threatened throughout all or a significant portion of their range, and the conservation of the ecosystems on which they depend. The USFWS manages land and freshwater species, while the National Oceanic and Atmospheric Administration (NOAA) Fisheries Service manages marine species and anadromous. The CESA (Fish & Game Code Section 2050, *et seq.*) generally parallels the main provisions of the federal ESA and is administered by CDFG. CDFG publishes separate comprehensive lists for plants and animals through the CNDDB (CDFG 2003). These include taxa officially listed by the state and federal governments as Endangered, Threatened, or Rare, and candidates for state or federal listing. Impacts to sensitive species should be avoided to the maximum extent feasible.

Cultural Resources

Criterion 4: Cultural Resources

Historic and prehistoric cultural resources are recognized as being important to the nation as a whole, as illustrated by the requirements of the National Historic Preservation Act of 1966 (16 U.S.C. 470) and the Preservation of Historical and Archaeological Data Act of 1974 (16 U.S.C. 469 *et seq*.), which direct public agencies to avoid damaging effects to cultural sites. These values are re-iterated at the state and local level through CEQA. Unavoidable adverse impacts to Register-eligible cultural resources must be mitigated through a data recovery program that captures the essence of what makes the resource significant.

Criterion 5: Native American Values

Religious and traditional values of local Native American cultures are recognized as being important to local Native American populations and to the region as a whole, as illustrated by the requirements of the National Historic Preservation Act of 1966 (16 U.S.C. 470) and the Native American Religious Freedom Act (42 U.S.C 1996), which direct public agencies to consult with traditional Native American religious leaders to avoid damaging effects to Native American values, including known burial locations, sacred areas, and the sites of mythical events.

Hydrology/Water Quality

Criterion 6: Water Quality

As described under Criterion 1, any public agency proposing to discharge dredged or fill material into Waters of the U.S., including jurisdictional wetlands, must obtain a permit from USACE. USACE regulates activities under CWA Section 404 that involve a discharge of dredged or fill material including, but not limited to, grading, placing of riprap for erosion control, pouring concrete, laying sod, and stockpiling excavated material.

The dam is expected to be constructed as a zoned earth embankment using predominantly onsite materials, but with supplemental imported materials for filter/drainage zones, erosion protection, and gravel surfacing. Dam construction could impact water quality through erosion and sedimentation (assessed below), as well as potential hazardous material leaks and spills associated with construction activities.

Criterion 7: Erosion/Sedimentation

Dam construction could impact water quality through erosion and sedimentation associated with the excavation of onsite materials, removal and placement of embankment materials, and turbidity at the intake/outlet location. Quarry areas established onsite would denude previously vegetated areas and increase susceptibility to erosion.

Land Use

Criterion 8: Land Use Disturbance

Construction-related activities could involve the displacement of residential, commercial, or agricultural structures located within the project footprint areas, or result in hardship on local residents. Implementation of the RWSSP alternatives could also potentially conflict with existing land use and zoning designations.

Seismic Hazards

Criterion 9: Seismic-Related Hazards

Alternatives located within areas susceptible to seismic-related hazards such as strong seismic ground shaking, liquefaction, or landslides could potentially expose people or structures to potential substantial adverse effects. In addition, alternatives located within an Alquist-Priolo Earthquake Fault Zoning Map could potentially be susceptible to rupture of a known earthquake fault.

Traffic

Criterion 10: Traffic Impacts

Alternatives involving construction traffic along heavily traveled roadways would have a greater impact on residents and businesses than construction traffic on less traveled roadways. These impacts would result in temporary construction inconveniences, such as re-routing, detours, and additional traffic from construction equipment. In some cases, construction will necessitate the relocation or closure of existing roads and/or the construction of new temporary roads.

7.3.2 April Canyon Reservoir

As described above, an April Canyon reservoir with 2,200 ac-feet of operational storage would have a surface area at normal maximum pool of approximately 62 acres, and would require a dam approximately 1,000 feet long and 185 feet high (see **Figure 4-4** in Chapter 4).

Biological Resources

Criterion No. 1: Jurisdictional Wetlands and Waters

Construction of the April Canyon Reservoir would likely result in impacts to resources under the jurisdiction of one or more of the following agencies: USACE, CDFG, and/or RWQCB. The April Canyon Reservoir would impact approximately 7,920 linear feet (1.5 miles) of the unnamed drainage within the reservoir footprint and the additional acreage surrounding the inlet/outlet structure located downstream of the dam, both permanently through the placement of structures and temporarily through construction activities. ESA (2009) determined that the April Canyon tributary supports a riparian corridor with a defined bed and bank and has a significant nexus to the perennial waters of Malibu Creek; therefore it is jurisdictional for USACE and CDFG. A formal wetlands delineation in accordance with USACE and CDFG requirements must be prepared to determine the acreage of these impacts.

Criterion No. 2: Sensitive Vegetation Communities

Construction of the April Canyon Reservoir would result in impacts to a total of 62 acres of undeveloped, vegetated area for a reservoir filled to a normal maximum pool elevation of 1,096 feet. Additional acreage associated with the dam embankment, inlet/outlet structure, and microscreen facility would also be permanently affected. ESA (2009) estimates that approximately 320 acres would be distributed for construction and operation of the reservoir. Impacts to 14 acres of southern coast live oak riparian forest, designated as a sensitive community by CDFG, would be a significant impact under CEQA. Further, impacts to 84 acres of coastal sage scrub and 8 acres of coast live oak woodland, considered important communities by Los Angeles County, would also be a significant impact under CEQA. Construction of the April Canyon Reservoir would require compensatory mitigation to offset these losses.

Criterion No. 3: Sensitive Species

Construction of the April Canyon Reservoir would result in impacts to sensitive vegetation communities that have the potential to support sensitive species. These areas provide suitable nesting habitat for birds and raptors protected under the Federal Migratory Bird Treaty Act and the Fish and Game Code. If present, the wildlife threatened and endangered species most likely to be significantly impacted by construction would be the San Diego desert woodrat, western pond turtle, and coast horned lizard. Additionally, reservoir construction could result in the removal of Los Angeles County-protected coast live oak and valley oak trees.

Cultural Resources

Criterion 4: Cultural Resources

Construction of the April Canyon Reservoir would require consultation under Section 106 because of the federal funding action. Although three historic structures and artifacts were found during a site visit (ESA 2009), the report concluded that due to their dilapidated condition, the structures would be unlikely to provide historical information and would not create a significant obstacle to reservoir construction. If the project has the potential to affect a property listed on the National Register of Historic Places (NRHP) or a property eligible for listing, additional analysis and mitigation (protection, redesign, or excavation) of this potential impact would be needed.

Criterion 5: Native American Values

Construction of the April Canyon Reservoir has the potential to uncover buried known or unknown Native American resources. Additional coordination with Native American representatives is needed to make a final determination. Due to the potential for discovery of unknown resources, construction monitoring is generally conducted per standard CEQA mitigation.

Hydrology/Water Quality

Criterion 6: Water Quality

Construction of a new dam at the April Canyon Reservoir site would require the use of heavy machinery, such as backhoes and excavators. Use of heavy equipment could cause accidental releases or spills of construction-related contaminants (e.g., fuels, oil, concrete, paint, trash) both within the canyon and in downstream areas. Storm events could then wash contaminated soils into low points within the reservoir site or into nearby receiving waters, including Malibu Creek, and thereby impair water quality and aquatic habitats. Additionally, dewatering could potentially occur during construction of the dam foundation. Improper disposal of dewatered groundwater could result in degradation of adjacent surface waters.

Criterion 7: Erosion/Sedimentation

Earth-moving activities associated with dam construction could alter water quality both within the reservoir site and in downstream areas west of the dam. Excavation of foundation soils during the construction phase would encourage erosion within the canyon. Runoff from the construction phase would be heavily laden with sediment and may cause downstream impacts if released below the construction site, particularly since Malibu Creek is already on the 303(d) list for sedimentation/siltation. Additionally, if the velocity or volume of downstream flows is increased due to construction activities, scour and erosion could occur along downstream creek banks. Sedimentation would reduce the capacity of the creek channel, as well as degrade the ecological functions provided by the creek.

Land Use

Criterion 8: Land Use Disturbance

Several existing residential structures within April Canyon would be directly impacted by project construction. Construction activities would displace individuals living within the project footprint area. Additionally, the proposed project would conflict with Los Angeles County's designation of a "sensitive ecological area". Further, nearby residents could experience some inconvenience and hardship due to construction traffic for an extended period of time.

Seismic Hazards

Criterion 9: Seismic-Related Hazards

Although the Malibu Quadrangle contains a known active fault that is potentially susceptible to ground rupture, April Canyon is located approximately 5 miles from this fault and would not likely experience ground rupture. The California Department of Conservation designates April Canyon as being located within an area that is potentially susceptible to seismically induced hazards such as landslides and liquefaction. In conjunction with its proximity to a known active fault, this indicates that an April Canyon Reservoir could expose people or structures to potential substantial adverse effects due to strong seismic ground shaking, seismic-related ground failure (liquefaction), or landslides. In accordance with the Alquist-Priolo Earthquake Fault Zoning Act, the District would be required to complete a Geologic Report prepared by a geologist registered in the State of California. This report should make recommendations to reduce potential impacts associated with seismic-related hazards.

Traffic

Criterion 10: Traffic Impacts

Construction traffic in April Canyon is not expected to have a significant impact on the local roadways. Although Las Virgenes Road/County Highway N1 is considered a major highway by the County, construction truck traffic would be limited to non-peak hours per standard CEQA mitigation. Residential access from Udell Road would be maintained during construction. However, residents would have to share the road with construction vehicles, which could cause some traffic delays.

7.3.3 Stokes Canyon Reservoir

As described above, a Stokes Canyon reservoir with 1,900 acre-feet of operational storage would have a surface area at normal maximum pool of approximately 65 acres, and would require a dam approximately 2,000 feet long and 165 feet high (see **Figure 4-7** in Chapter 4).

Biological Resources

Criterion No. 1: Jurisdictional Wetlands and Waters

Construction of the Stokes Canyon Reservoir would likely result in impacts to resources under the jurisdiction of one or more of the following agencies: USACE, CDFG, and/or RWQCB. The Stokes Canyon Reservoir would impact approximately 6,340 linear feet (1.2 miles) of the unnamed drainage within the reservoir footprint and the additional acreage surrounding the inlet/outlet structure located downstream of the dam, both permanently through the placement of structures and temporarily through construction activities. Because the drainage is intermittent and has a nexus to the perennial waters of Malibu Creek, it will likely be jurisdictional for USACE and CDFG. A formal wetlands delineation in accordance with USACE and CDFG requirements must be prepared to determine the acreage of these impacts.

Criterion No. 2: Sensitive Vegetation Communities

Construction of the Stokes Canyon Reservoir would result in impacts to a total of 65 acres of undeveloped, vegetated area filled to a normal maximum pool elevation of 1,045 feet. Woodward-Clyde (1991) report that approximately 65 acres would be distributed for construction and operation of the reservoir. Impacts to coast live oak riparian forest, designated as a sensitive community by CDFG, would be a significant impact under CEQA. Further, impacts to coastal sage scrub and coast live oak woodland, considered important communities by Los Angeles County, would also be a significant impact under CEQA. Construction of the Stokes Canyon Reservoir would require compensatory mitigation to offset these losses.

Criterion No. 3: Sensitive Species

Construction of the Stokes Canyon Reservoir would result in impacts to sensitive vegetation communities that have the potential to support sensitive species. These areas provide suitable nesting habitat for birds and raptors protected under the Federal Migratory Bird Treaty Act and the Fish and Game Code. Woodward-Clyde (1991) note that existing vegetation communities provide nesting habitat for willow flycatcher, least Bell's vireo, yellow-breasted shat, and sharp-shinned and Cooper's hawks. If present, the wildlife threatened and endangered species most likely to be significantly impacted by construction would be the San Diego desert woodrat, western pond turtle, and coast horned lizard.

Cultural Resources

Criterion 4: Cultural Resources

Construction of the Stokes Canyon Reservoir would require consultation under Section 106 because of the federal funding action. Although the SCCIC database search resulted in no historic records, additional surveys of the scattered rubble and building foundations on the site are needed. If the project has the potential to affect a property listed on the NRHP or a property eligible for listing, additional analysis and mitigation (protection, redesign, or excavation) of this potential impact would be needed. Additional database searches from SCIC are needed to make a final determination.

Criterion 5: Native American Values

Construction of the Stokes Canyon Reservoir has the potential to uncover buried known or unknown Native American resources. Additional coordination with Native American representatives is needed to make a final determination. Due to the potential for discovery of unknown resources, construction monitoring is generally conducted per standard CEQA mitigation.

Hydrology/Water Quality

Criterion 6: Water Quality

Construction of a new dam at the Stokes Canyon Reservoir site would require the use of heavy machinery, such as backhoes and excavators. Use of heavy equipment could cause accidental releases or spills of construction-related contaminants (e.g., fuels, oil, concrete, paint, trash) both within the canyon and in downstream areas. Storm events could then wash contaminated soils into low points within the reservoir site or into to nearby receiving waters, including Malibu Creek, and thereby impair water quality and aquatic habitats. Additionally, dewatering could potentially occur during construction of the dam foundation. Improper disposal of dewatered groundwater could result in degradation of adjacent surface waters.

Criterion 7: Erosion/Sedimentation

Earth-moving activities associated with dam construction could alter water quality both within the reservoir site and in downstream areas west of the dam. Excavation of foundation soils during the construction phase would encourage erosion within the canyon. Runoff from the construction phase would be heavily laden with sediment and may cause downstream impacts if released below the construction site, particularly since Malibu Creek is already on the 303(d) list for sedimentation/siltation. Additionally, if the velocity or volume of downstream flows is increased due to construction activities, scour and erosion could occur along downstream creek banks. Sedimentation would reduce the capacity of the creek channel, as well as degrade the ecological functions provided by the creek.

Land Use

Criterion 8: Land Use Disturbance

No structures within Stokes Canyon would be directly impacted by project construction; the existing water tank within the vicinity would not be located within the reservoir footprint. Construction activities are not expected to displace individuals living within the project footprint areas. However, nearby residents could experience some inconvenience and hardship due to construction traffic for an extended period of time.

Seismic Hazards

Criterion 9: Seismic-Related Hazards

Although the Malibu Quadrangle contains a known active fault that is potentially susceptible to ground rupture, Stokes Canyon is located approximately 6 miles from this fault and would not likely experience ground rupture. The California Department of Conservation designates Stokes Canyon as being located within an area that is potentially susceptible to seismically induced hazards such as landslides and liquefaction. Combined with its proximity to a known active fault, this indicates that a Stokes Canyon Reservoir could expose people or structures to potential substantial adverse effects due to strong seismic ground shaking, seismic-related ground failure (liquefaction), and landslides. In accordance with the Alquist-Priolo Earthquake Fault Zoning Act, the District would be required to complete a Geologic Report prepared by a geologist registered in the State of California. This report should make recommendations to reduce potential impacts associated with seismic-related hazards.

Traffic

Criterion 10: Traffic Impacts

Construction traffic in Stokes Canyon is not expected to have a significant impact on the local roadways. Although Las Virgenes Road/County Highway N1 is considered a major highway by the County, construction truck traffic would be limited to non-peak hours per standard CEQA mitigation. Residential access from Stokes Canyon Road would be maintained during construction. However, residents would have to share the road with construction vehicles, which could cause some traffic delays.

7.3.4 Hope Site Reservoir

As described above, a reservoir located at the Hope site with approximately 2,000 acre-feet of operational storage would have a surface area at normal maximum pool of approximately 45 acres, and would require a dam of approximately 950 feet long and 200 feet high (see **Figure 4-11** in Chapter 4).

Biological Resources

Criterion No. 1: Jurisdictional Wetlands and Waters

Construction of a reservoir at the Hope site would likely result in impacts to resources under the jurisdiction of one or more of the following agencies: USACE, CDFG, RWQCB, and/or County of Los Angeles. The Hope Site Reservoir would impact approximately 4,240 linear feet (0.8 miles) of the unnamed drainage within the reservoir footprint and the additional acreage surrounding the inlet/outlet structure located downstream of the dam, both permanently through the placement of structures and temporarily through construction activities. Because the drainage is ephemeral and has a nexus to the perennial waters of Malibu Creek, it will likely be jurisdictional for USACE and CDFG. A formal wetlands delineation in accordance with USACE and CDFG requirements must be prepared to determine the acreage of these impacts.

Criterion No. 2: Sensitive Vegetation Communities

Construction of the Hope Site Reservoir would result in impacts to 8.1 acres of coastal sage scrub, 14.7 acres of Venturan coastal sage scrub, and 3.9 acres of coast live oak woodland plant communities, which are considered important communities according to the County of Los Angeles. Because coastal sage scrub, Venturan coastal sage scrub, and coast live oak woodland are considered important communities by Los Angeles County, impacts to these vegetation communities would be considered a significant impact under CEQA. Therefore, construction of the Hope Site Reservoir would require compensatory mitigation to offset these losses.

Additionally, construction of the Hope Site Reservoir could result in the removal of up to 500 oak trees protected by Los Angeles County. The removal of oak woodlands is considered to be a significant impact, with the potential to generate substantial public opposition.

Criterion No. 3: Sensitive Species

Construction of the Hope Site Reservoir would result in impacts to vegetation communities that have the potential to support sensitive species. These areas provide suitable nesting habitat for birds and raptors protected under the Federal Migratory Bird Treaty Act and the Fish and Game Code, and could also potentially contain protected plant species.

The Hope Site is located in a pristine, undeveloped area consisting of undisturbed native habitat. ESA (2011) notes that oak woodland, scrub, and chaparral habitats within the Hope Site area could potentially provide nesting and foraging habitat for raptor species such as red-tailed hawks, Cooper's hawks, and several owl species. In addition, ESA notes that threatened and/or endangered wildlife such as the Coastal California Gnatcatcher (CAGN) could be present within the vegetation communities present at the proposed Hope Site Reservoir location. If CAGN or other protected wildlife species are present, construction of the Hope Site Reservoir would constitute a significant impact to protected biological resources.

Construction of the Hope Site Reservoir would also impact vegetation communities that could potentially contain special-status plant species. In their 2011 field survey, ESA noted that Plummer's mariposa-lily (a special-status plant species) was observed adjacent to the proposed reservoir site, and would therefore be expected to occur within the reservoir footprint. Although no California or federally threatened, endangered, or candidate plant species were observed during field surveys, ESA noted that there would be low to medium potential for such species to be present within the proposed reservoir footprint. If protected plant species are present, construction of the Hope Site Reservoir would constitute a significant impact to protected biological resources.

Cultural Resources

Criterion 4: Cultural Resources

Construction of the Hope Site Reservoir would impact one known (previously recorded) archaeological resource. The site consists of a low-density lithic scatter located on a ridge above the ephemeral stream. The researchers theorized that the site represents a small, specialized activity area, possibly an ancillary hunting site, and that it was occupied during the Late Prehistoric Period (ESA 2011). It is recommended that this known site be relocated and re-evaluated by a qualified archaeologist to determine if it is eligible for listing in the National Register and California Register. If this site is eligible for listing, it should be avoided during construction of the Hope Site Reservoir. If avoidance of this site is not feasible, a site treatment plan or other protection measures should be developed.

In addition, the Hope Site Reservoir could potentially contain unknown sensitive cultural resources. ESA's 2011 assessment of the Hope Site indicated many recorded prehistoric resources within the vicinity of this proposed reservoir site, which demonstrates that this area is highly archaeologically sensitive. Therefore, it is recommended that the project area undergo an archaeological survey prior to project implementation. Identification of archeological resources within the reservoir footprint would comprise a significant environmental impact requiring excavation and museum curation prior to reservoir construction.

Criterion 5: Native American Values

Construction of the Hope Site Reservoir has the potential to uncover buried known or unknown Native American resources. Due to the potential for discovery of unknown resources, an archaeological assessment should be conducted in consultation with local Native American groups.

Hydrology/Water Quality

Criterion 6: Water Quality

Construction of a new dam at the Hope Site Reservoir would require the use of heavy machinery, such as backhoes and excavators. Use of heavy equipment could cause accidental releases or spills of construction-related contaminants (e.g., fuels, oil, concrete, paint, trash) both within the canyon and in downstream areas. Storm events could then wash contaminated soils into low points within the reservoir site or into to nearby receiving waters, including Malibu Creek, and thereby impair water quality and aquatic habitats. Additionally, dewatering could potentially occur during construction of the dam foundation. Improper disposal of dewatered groundwater could result in degradation of adjacent surface waters.

Criterion 7: Erosion/Sedimentation

Earth-moving activities associated with dam construction could alter water quality both within the reservoir site and in downstream areas west of the dam. Excavation of foundation soils during the construction phase would encourage erosion within the canyon. Runoff from the construction phase would be heavily laden with sediment and may cause downstream impacts if released below the construction site, particularly since Malibu Creek is already on the 303(d) list for sedimentation/siltation. Additionally, if the velocity or volume of downstream flows are increased due to construction activities, scour and erosion could occur along downstream creek banks. Sedimentation would reduce the capacity of the creek channel, as well as degrade the ecological functions provided by the creek.

Land Use

Criterion 8: Land Use Disturbance

The Hope Site Reservoir location is currently undeveloped; therefore no structures would be directly impacted by project construction. In addition, construction activities are not expected to displace individuals living within the project footprint areas. However, nearby residents could experience some inconvenience and hardship due to construction traffic for an extended period of time.

In addition, implementation of the Hope Site Reservoir would be anticipated to conflict with existing land use and zoning designations according to City of Calabasas General Plan (ESA 2011). These conflicts could potentially require a General Plan Amendment; however consultation with the City of Calabasas would be required to determine the severity of this potential impact prior to project implementation.

Seismic Hazards

Criterion 9: Seismic-Related Hazards

Although the Malibu Quadrangle contains a known active fault that is potentially susceptible to ground rupture, the Shope Site Reservoir is located approximately 5.5 miles from this fault and would not likely experience ground rupture. The California Department of Conservation designates the Hope Site as being located within an area that is potentially susceptible to seismically induced hazards such as landslides and liquefaction. Combined with its proximity to a known active fault, this indicates that a Hope Site Reservoir could expose people or structures to potential substantial adverse effects due to strong seismic ground shaking, seismic-related ground failure (liquefaction), and landslides. In accordance with the Alquist-Priolo Earthquake Fault Zoning Act, the District would be required to complete a Geologic Report prepared by a geologist registered in the State of California. This report should make recommendations to reduce potential impacts associated with seismic-related hazards.

Traffic

Criterion 10: Traffic Impacts

There is currently no direct access to the proposed Hope Site Reservoir location. Access to the site would likely occur from Las Virgenes Road, which is west of the proposed reservoir site. Construction activities associated with the Hope Site Reservoir location are not expected to have a significant impact on local roadways. Although Las Virgenes Road is considered a major highway by the County, construction traffic would be limited to non-peak hours per standard CEQA mitigation. Residential access from Las Virgenes Road would be maintained during construction. However, residents would have to share the road with construction vehicles, which could cause some traffic delays.

7.3.5 April Canyon Seasonal Storage Recycled Water System Expansion

Refer to **Figure 4-15** in Chapter 4 for the location of the proposed recycled water pipelines.

Biological Resources

Criterion No. 1: Jurisdictional Wetlands and Waters

Construction of a new booster pump station at Las Virgenes Road/Mulholland Highway and a 30-inch transmission main along Mulholland Highway to the reservoir site would be unlikely to result in impacts to jurisdictional wetlands and waters. Construction of new booster pump station and distribution pipelines along Kanan Road would also be unlikely to impact jurisdictional wetlands and waters. A formal wetlands delineation in accordance with USACE and CDFG requirements must be prepared to confirm these assumptions.

Criterion No. 2: Sensitive Vegetation Communities

Because construction of transmission and distribution pipelines is generally conducted within roadway rights-of-way, it is unlikely that pipeline construction would significantly impact sensitive vegetation communities. However, the potential sites for the proposed booster pump stations must be surveyed to ensure that no sensitive vegetation communities would be permanently disturbed during construction.

Criterion No. 3: Sensitive Species

Because construction of transmission and distribution pipelines is generally conducted within roadway rights-of-way, it is unlikely that pipeline construction would significantly impact sensitive wildlife or plant species. However, the potential sites for the proposed booster pump stations must be surveyed to ensure that no sensitive wildlife or plant species would be permanently disturbed during construction. Further, adjacent vegetated areas may provide suitable nesting habitat for birds and raptors protected under the Federal Migratory Bird Treaty Act and the Fish and Game Code. If present, the District would need to mitigate (through buffers, relocation, or compensation) for impacts to these wildlife species.

Cultural Resources

Criterion 4: Cultural Resources

Because construction of transmission and distribution pipelines is generally conducted within existing disturbed rights-of-way, it is unlikely that pipeline construction would disturb known or unknown cultural resources. Additional database search from SCIC is needed to make a final determination.

Criterion 5: Native American Values

Because construction of transmission and distribution pipelines is generally conducted within existing disturbed rights-of-way, it is unlikely that pipeline construction would disturb known or unknown Native American resources. Additional coordination with Native American representatives is needed to make a final determination.

Hydrology/Water Quality

Criterion 6: Water Quality

Construction of transmission and distribution pipelines, as well as booster pump stations, would require the use of heavy machinery, such as backhoes and excavators. Use of heavy equipment could cause accidental releases or spills of construction-related contaminants (e.g., fuels, oil, concrete, paint, trash) within the roadway and adjacent areas, which could be washed into nearby receiving waters. Additionally, dewatering could potentially occur during trenching for the pipelines. Improper disposal of dewatered groundwater could result in degradation of adjacent surface waters.

Criterion 7: Erosion/Sedimentation

Earth-moving activities associated with pipeline and pump station construction could alter water quality of nearby receiving waters. Runoff from the construction phase would be heavily laden with sediment and may cause downstream impacts if released below the construction site. These potential impacts would be mitigated through compliance with the LARWQCB's General Construction Permit.

Land Use

Criterion 8: Land Use Disturbance

No structures are anticipated to be disturbed during construction of the transmission or distribution pipelines and the booster pump stations. Construction activities are not expected to displace individuals living within the project footprint areas. However, nearby residents could experience some inconvenience and hardship due to construction traffic for an extended period of time.

Seismic Hazards

Criterion 9: Seismic-Related Hazards

Transmission and distribution pipelines, booster pump stations, and other conveyance facilities potentially associated with the April Canyon Reservoir would be located within the Malibu Quadrangle, which contains a known active fault that is potentially susceptible to ground rupture. However, these facilities would be located at least 4 miles from the nearest active fault, and would therefore not likely experience impacts associated with ground rupture. According to California Department of Conservation, proposed facilities associated with the April Canyon Reservoir could expose people or structures to potential substantial adverse effects due to strong seismic ground shaking, seismic-related ground failure (liquefaction), and landslides. In accordance with the Alquist-Priolo Earthquake Fault Zoning Act, the District would be required to complete a Geologic Report to reduce potential impacts associated with seismic-related hazards.

Traffic

Criterion 10: Traffic Impacts

Construction traffic, trenching and associated lane closures, and potential road closures on Las Virgenes Road/County Highway N1, Mulholland Highway, and Kanan Road would create some traffic delays for local residents. With implementation of a traffic control plan per standard CEQ mitigation, these potential impacts should be temporary and not significant.

7.3.6 Stokes Canyon Seasonal Storage Recycled Water System Expansion

Refer to **Figure 4-17** in Chapter 4 for the location of the proposed recycled water pipelines.

Biological Resources

Criterion No. 1: Jurisdictional Wetlands and Waters

Construction of a new booster pump station at Las Virgenes Road/Mulholland Highway and a 30-inch transmission main along Mulholland Highway and Stokes Canyon Road to the reservoir site would be unlikely to result in impacts to jurisdictional wetlands and waters. Construction of new booster pump station and distribution pipelines along Kanan Road would also be unlikely to impact jurisdictional wetlands and waters. A formal wetlands delineation in accordance with USACE and CDFG requirements must be prepared to confirm these assumptions.

Criterion No. 2: Sensitive Vegetation Communities

Because construction of transmission and distribution pipelines is generally conducted within roadway rights-of-way, it is unlikely that pipeline construction would significantly impact sensitive vegetation communities. However, the potential sites for the proposed booster pump stations must be surveyed to ensure that no sensitive vegetation communities would be permanently disturbed during construction.

Criterion No. 3: Sensitive Species

Because construction of transmission and distribution pipelines is generally conducted within roadway rights-of-way, it is unlikely that pipeline construction would significantly impact sensitive wildlife or plant species. However, the potential sites for the proposed booster pump stations must be surveyed to ensure that no sensitive wildlife or plant species would be permanently disturbed during construction. Further, adjacent vegetated areas may provide suitable nesting habitat for birds and raptors protected under the Federal Migratory Bird Treaty Act and the Fish and Game Code. If present, the District would need to mitigate (through buffers, relocation, or compensation) for impacts to these wildlife species.

Cultural Resources

Criterion 4: Cultural Resources

Because construction of transmission and distribution pipelines is generally conducted within existing disturbed rights-of-way, it is unlikely that pipeline construction would disturb known or unknown cultural resources. Additional database search from SCIC is needed to make a final determination.

Criterion 5: Native American Values

Because construction of transmission and distribution pipelines is generally conducted within existing disturbed rights-of-way, it is unlikely that pipeline construction would disturb known or unknown Native American resources. Additional coordination with Native American representatives is needed to make a final determination.

Hydrology/Water Quality

Criterion 6: Water Quality

Construction of transmission and distribution pipelines, as well as booster pump stations, would require the use of heavy machinery, such as backhoes and excavators. Use of heavy equipment could cause accidental releases or spills of construction-related contaminants (e.g., fuels, oil, concrete, paint, trash) within the roadway and adjacent areas, which could be washed into nearby receiving waters. Additionally, dewatering could potentially occur during trenching for the pipelines. Improper disposal of dewatered groundwater could result in degradation of adjacent surface waters.

Criterion 7: Erosion/Sedimentation

Earth-moving activities associated with pipeline and pump station construction could alter water quality of nearby receiving waters. Runoff from the construction phase would be heavily laden with sediment and may cause downstream impacts if released below the construction site. These potential impacts would be mitigated through compliance with the LARWQCB’s General Construction Permit.

Land Use

Criterion 8: Land Use Disturbance

No structures are anticipated to be disturbed during construction of the transmission or distribution pipelines and the booster pump stations. Construction activities are not expected to displace individuals living within the project footprint areas. However, nearby residents could experience some inconvenience and hardship due to construction traffic for an extended period of time.

Seismic Hazards

Criterion 9: Seismic-Related Hazards

Transmission and distribution pipelines, booster pump stations, and other conveyance facilities potentially associated with the Stokes Canyon Reservoir would be located within the Malibu Quadrangle, which contains a known active fault that is potentially susceptible to ground rupture. However, these facilities would be located at least 5 miles from the nearest active fault, and would therefore not likely experience impacts associated with ground rupture. According to the California Department of Conservation, proposed facilities associated with the Stokes Canyon Reservoir could expose people or structures to potential substantial adverse effects due to strong seismic ground shaking, seismic-related ground failure (liquefaction), and landslides. In accordance with the Alquist-Priolo Earthquake Fault Zoning Act, the District would be required to complete a Geologic Report to reduce potential impacts associated with seismic-related hazards.

Traffic

Criterion 10: Traffic Impacts

Construction traffic, trenching and associated lane closures, and potential road closures on Las Virgenes Road/County Highway N1, Mulholland Highway, Stokes Canyon Road, and Kanan Road would create some traffic delays for local residents. With implementation of a traffic control plan per standard CEQ mitigation, these potential impacts should be temporary and not significant.

7.3.7 Hope Site Seasonal Storage Recycled Water System Expansion

Refer to **Figure 4-19** in Chapter 4 for the location of the proposed recycled water pipelines.

Biological Resources

Criterion No. 1: Jurisdictional Wetlands and Waters

Construction of facilities associated with the Hope Site Reservoir would potentially result in impacts to jurisdictional wetlands and waters. There are three potential pipeline alignments to the proposed site, which would likely result in impacts to resources under the jurisdiction of one or more of the following jurisdictions: USACE, CDFG, RWQCB, and/or County of Los Angeles. A formal wetlands delineation in accordance with USACE and CDFG requirements must be prepared to determine the potential acreage of these impacts and other impacts associated with proposed supporting facilities.

Criterion No. 2: Sensitive Vegetation Communities

Construction of transmission and distribution pipelines is generally conducted within roadway rights-of-way where possible; however the precise locations of pipeline alignments for the Hope Site Reservoir are currently unknown. In addition, other supporting infrastructure such as booster pump stations, could potentially impact sensitive vegetation communities. The proposed sites for pipeline alignments and other infrastructure components must be surveyed to ensure that no sensitive vegetation communities would be permanently disturbed during construction. If present, the District would need to mitigate (through buffers, relocation, or compensation) for impacts to any sensitive vegetation communities.

Criterion No. 3: Sensitive Species

Construction of transmission and distribution pipelines is generally conducted within roadway rights-of-way where possible; however, the precise locations of pipeline alignments for the Hope Site Reservoir are currently unknown. In addition, other supporting infrastructure such as booster pump stations, could potentially impact sensitive species. The proposed sites for pipeline alignments and other infrastructure components must be surveyed to ensure that no sensitive species would be permanently disturbed during construction. If present, the District would need to mitigate (through buffers, relocation, or compensation) for impacts to these wildlife species.

Cultural Resources

Criterion 4: Cultural Resources

Because construction of transmission and distribution pipelines is generally conducted within existing disturbed rights-of-way, it is unlikely that pipeline construction would disturb known or unknown cultural resources. However, the precise location of these facilities is unknown at this time, and the Hope Site Reservoir was determined to have high archaeological sensitivity. Therefore, the archaeological assessment conducted for the Hope Site Reservoir should also include an assessment of all potential supporting facility locations.

Criterion 5: Native American Values

Because construction of transmission and distribution pipelines is generally conducted within existing disturbed rights-of-way, it is unlikely that pipeline construction would disturb known or unknown Native American resources. However, the precise location of these facilities is unknown at this time, and the Hope Site Reservoir was determined to have high archaeological sensitivity. Therefore, the archaeological assessment conducted for the Hope Site Reservoir should also include an assessment of all potential supporting facility locations. This assessment should include additional coordination with Native American representatives to make a final determination.

Hydrology/Water Quality

Criterion 6: Water Quality

Construction of transmission and distribution pipelines, as well as booster pump stations, would require the use of heavy machinery, such as backhoes and excavators. Use of heavy equipment could cause accidental releases or spills of construction-related contaminants (e.g., fuels, oil, concrete, paint, trash) within the roadway and adjacent areas, which could be washed into nearby receiving waters. Additionally, dewatering could potentially occur during trenching for the pipelines. Improper disposal of dewatered groundwater could result in degradation of adjacent surface waters.

Criterion 7: Erosion/Sedimentation

Earth-moving activities associated with pipeline and pump station construction could alter water quality of nearby receiving waters. Runoff from the construction phase would be heavily laden with sediment and may cause downstream impacts if released below the construction site. These potential impacts would be mitigated through compliance with the LARWQCB’s General Construction Permit.

Land Use

Criterion 8: Land Use Disturbance

No structures are anticipated to be disturbed during construction of the transmission or distribution pipelines and the booster pump stations. Construction activities are not expected to displace individuals living within the project footprint areas. However, nearby residents could experience some inconvenience and hardship due to construction traffic for an extended period of time.

In addition, construction in and around the Hope Reservoir Site Could potentially conflict with existing land use and zoning designations according to City of Calabasas General Plan (ESA 2011). These conflicts could potentially require a General Plan Amendment; however consultation with the City of Calabasas would be required to determine the severity of this potential impact prior to project implementation.

Seismic Hazards

Criterion 9: Seismic-Related Hazards

Transmission and distribution pipelines, booster pump stations, and other conveyance facilities potentially associated with the Hope Site Reservoir would be located within the Malibu Quadrangle, which contains a known active fault that is potentially susceptible to ground rupture. However, these facilities would be located at least 5.5 miles from the nearest active fault, and would not likely experience impacts associated with ground rupture. According to the California Department of Conservation, proposed facilities associated with the Hope Site Reservoir could expose people or structures to potential substantial adverse effects due to strong seismic ground shaking, seismic-related ground failure (liquefaction), and landslides. In accordance with the Alquist-Priolo Earthquake Fault Zoning Act, the District would be required to complete a Geologic Report to reduce potential impacts associated with seismic-related hazards.

Traffic

Criterion 10: Traffic Impacts

There is currently no direct access to the proposed Hope Site Reservoir location, and access to the site would likely occur from Las Virgenes Road, which is west of the proposed reservoir site. Construction activity associated with the Hope Site Reservoir location is not expected to have a significant impact on the local roadways. Although Las Virgenes Road is considered a major highway by the County, construction truck traffic would be limited to non-peak hours per standard CEQA mitigation. Residential access from Las Virgenes Road would be maintained during construction. However, residents would have to share the road with construction vehicles, which could cause some traffic delays.

7.3.8 "No Project Alternative" - Increase Imported Water Supply

Biological Resources

Criterion No. 1: Jurisdictional Wetlands and Waters

Increased purchase of imported water supplies to meet seasonal peaks in irrigation demands would not impact jurisdictional wetlands or waters in the study area. All environmental impacts associated with the capture, storage, transmission, and pumping of imported water supplies has been addressed by the relevant State (Department of Water Resources [DWR]) and regional (MWD) water wholesalers.

Criterion No. 2: Sensitive Vegetation Communities

Increased purchase of imported water supplies to meet seasonal peaks in irrigation demands would not impact sensitive vegetation communities within the study area. All environmental impacts associated with the capture, storage, transmission, and pumping of imported water supplies has been addressed by the relevant State (DWR) and regional (MWD) water wholesalers.

Criterion No. 3: Sensitive Species

Increased purchase of imported water supplies to meet seasonal peaks in irrigation demands would not impact sensitive wildlife or plant species within the study area. All environmental impacts associated with the capture, storage, transmission, and pumping of imported water supplies has been addressed by the relevant State (DWR) and regional (MWD) water wholesalers.

Cultural Resources

Criterion 4: Cultural Resources

Increased purchase of imported water supplies to meet seasonal peaks in irrigation demands would not disturb known or unknown cultural resources within the study area. All environmental impacts associated with the capture, storage, transmission, and pumping of imported water supplies has been addressed by the relevant State (DWR) and regional (MWD) water wholesalers.

Criterion 5: Native American Values

Increased purchase of imported water supplies to meet seasonal peaks in irrigation demands would not disturb known or unknown Native American resources within the study area. All environmental impacts associated with the capture, storage, transmission, and pumping of imported water supplies has been addressed by the relevant State (DWR) and regional (MWD) water wholesalers.

Hydrology/Water Quality

Criterion 6: Water Quality

Increased purchase of imported water supplies to meet seasonal peaks in irrigation demands would not result in degradation of local surface waters within the study area. All environmental impacts associated with the capture, storage, transmission, and pumping of imported water supplies has been addressed by the relevant State (DWR) and regional (MWD) water wholesalers.

Criterion 7: Erosion/Sedimentation

Increased purchase of imported water supplies to meet seasonal peaks in irrigation demands would not result in sedimentation and erosion in Malibu Creek. All environmental impacts associated with the capture, storage, transmission, and pumping of imported water supplies has been addressed by the relevant State (DWR) and regional (MWD) water wholesalers.

Land Use

Criterion 8: Land Use Disturbance

Increased purchase of imported water supplies to meet seasonal peaks in irrigation demands would not result in disturbance of land uses within the study area. All environmental impacts associated with the capture, storage, transmission, and pumping of imported water supplies has been addressed by the relevant State (DWR) and regional (MWD) water wholesalers.

Seismic Hazards

Criterion 9: Seismic-Related Hazards

Increased purchase of imported water supplies to meet seasonal peaks in irrigation demands would not result in seismic-related hazards such as strong seismic ground shaking, seismic-related ground failure, or landslides. All environmental impacts associated with the capture, storage, transmission, and pumping of imported water supplies has been addressed by the relevant State (DWR) and regional (MWD) water wholesalers.

Traffic

Criterion 10: Traffic Impacts

Increased purchase of imported water supplies to meet seasonal peaks in irrigation demands would not result in traffic impacts within the study area. All environmental impacts associated with the capture, storage, transmission, and pumping of imported water supplies has been addressed by the relevant State (DWR) and regional (MWD) water wholesalers.

7.4 Permitting Requirements

It is anticipated that a preferred RWSSP project would require, at a minimum, permits from the following federal and state agencies: USACE, USFWS, CDFG, LARWQCB, and the State Office of Historic

Preservation (SHPO). Appropriate right-of-way easements and permits would also be required for any access roads or staging areas on land owned by other jurisdictions.

Table 7-1 below provides a summary of the anticipated permits associated with construction and operation of a preferred RWSSP project.

Table 7-1: Overview of Regulatory Permitting Requirements

Agency	Regulation	Trigger	Permit
USACE	Section 404 of the CWA	Impacts to Waters of the U.S.	404 Authorization (Nationwide or Individual Permit)
USFWS/ NOAA Fisheries	Section 7 of the FESA	Impacts to federally listed species and/or critical habitat where a federal agency has discretionary action	Biological Opinion; jeopardy decision; incidental take permit
CDFG	Section 1602 of the Fish and Game Code	Impacts to Waters of the State	Streambed Alteration Agreement (1602 Permit)
CDFG	Section 2080.1 of the CESA or Section 2081 of the CESA	Impacts to State-listed species that are included in a FESA permit or Impacts to State-listed species	Consistency Determination or Incidental Take Permit
RWQCB	Section 401 of the CWA	Impacts to Waters of the U.S.	401 Water Quality Certification
RWQCB	Section 402 of the CWA	Construction; dewatering	NPDES Permit (General Construction Permit)
RWQCB	Porter-Cologne Act	Impacts to Waters of the State	Waste Discharge Requirement
RWQCB/CDPH	CA Water Code Section 13523; CA Code of Regulations, Title 22	Production, distribution, monitoring, and application of recycled water	Water Recycling Requirements
SHPO	Section 106 of the NHPA	Section 404 Permit	106 Compliance

7.5 Public Involvement

As part of the CEQA compliance process, the District would invite responsible agencies and the public to participate in the development of the EIR/EA or EIR/EIS. The District would prepare and circulate a Notice of Preparation of a Draft EIR/EA or EIR/EIS (CEQA Guidelines §5082(a), 15103, and 15375) with a 30-day comment period. This comment period, along with a public scoping meeting, would allow interested parties to identify potential environmental impacts to be addressed in the Draft EIR/EIS.

Upon completion of the Draft EIR/EA or EIR/EIS, the District would file a Notice of Completion with the State Office of Planning and Research to begin a 45-day public review period (Public Resources Code §21161). Concurrent with this public review period, the Draft EIR/EA or EIR/EIS would be distributed to responsible and trustee agencies, other affected agencies, surrounding cities, and interested parties, as well as all parties requesting a copy of the EIR in accordance with Public Resources Code §21092(b)(3).

This public review period, along with a public hearing, would allow interested parties to comment on the scope and content of the Draft EIR/EIS.

Following the public review period, the District would prepare a Final EIR/EA or EIR/EIS that responds to each individual comment submitted (both in writing and at the hearing) about the preferred project. This entire administrative record would be presented to the District's governing body for consideration when it certifies that CEQA compliance has been achieved and the project can be approved.

Chapter 8 Legal and Institutional Requirements

8.1 Water and Wastewater Rights

There are no anticipated issues related to water or wastewater rights resulting from the implementation of RWSSP. All water limitations and obligations are (or would be) defined in various agreements between the District, TSD, CWD, CMWD, and LADWP. These agreements are discussed in Section 8.2.

8.2 Agreements

The following key agreements are necessary to proceed with project implementation:

1. Joint Powers Authority between the District and Triunfo Sanitation District (TSD) - In 1964, the District and TSD formed a JPA to jointly own and operate the Tapia Water Reclamation Facility. The JPA also operates a complex distribution system consisting of pipelines, pump stations, tanks and reservoirs, and associated appurtenances to deliver recycled water to users in areas of Calabasas, Agoura Hills, Westlake Village and other areas in Los Angeles and Ventura Counties. Within TSD, the service area includes Lake Sherwood and Oak Park/North Ranch. TSD is currently not participating in the RWSSP but may do so at a later date.
2. Service agreement between the District and the City of Los Angeles, Department of Water and Power for service to Woodland Hills Golf Course, Louisville High School, Serrania Avenue Park, Mulholland Drive/Deseret Church, the Motion Picture and Television Fund Hospital, Topanga Mountain School, Mulholland Drive medians, Alice Stelle School, Freedom Park, and other City of Los Angeles customers.

8.3 Unresolved Issues

The only unresolved issues to date are the permits to be acquired for RWSSP construction and operation and completion of CEQA/NEPA compliance requirements. These requirements will be satisfied prior to construction.

8.4 Wastewater Discharge Requirements

The current wastewater discharge requirements are discussed in Section 2.5. The District currently manages treated wastewater using various combinations of five different disposal options. These include (1) discharge to Malibu Creek during the wet season, (2) expansion of recycled water system, (3) diversion of raw wastewater to the City of Los Angeles Sewer System, (4) diversion of recycled water to the LA River, and (5) diversion of recycled water to spray fields on vacant lands.

The use of recycled water is regulated under Water Reclamation Requirements contained in Order No. 87-086 which was later readopted on May 12, 1997, through General Order No. 97-072. The Tapia WRF discharges surplus recycled water to Malibu Creek and the LA River pursuant to waste discharge requirements (WDRs) contained in Order No. R4-2010-0165 and NPDES Permit No. CA0056014, adopted by the Los Angeles RWQCB on September 2, 2010.

8.5 Proposition 218 Process

Prop 218 amended the California Constitution (Articles XIIIC and XIIID) which, as it relates to assessments, requires the local government agencies to have a vote of the affected property owners for any proposed new or increased assessment before it could be levied. The Proposition was passed by California voters in November 5, 1996, and the assessments portion placed in effect on July 1, 1997.

Local government agencies, including the District, are required to obtain ballot approval from the property owners before levying rate increases if there is no majority protest. The last Prop. 218 hearing that Las Virgenes MWD held for rate increases was in 2009. See attached information that was sent to the pubic pertaining to the Prop 218 rate increase (included as **Appendix E**).

8.6 Public Hearing

The District will hold a public hearing for the proposed RWSSP and for acceptance of the proposed feasibility study. The estimated public hearing date is approximately 4 weeks from the SWRCB approval of the responses to the comments provided by the SWRCB. Information pertaining to the public hearing, agenda, and notes will be included as **Appendix F** after the public hearing date.

Chapter 9 Financial Capability of Sponsor

This section of the project feasibility provides discussion of the following features:

- Willingness of the non-Federal project sponsor to pay for its share of capital costs and the full operation, maintenance, and replacement costs;
- A plan for funding the construction, operation, maintenance, and replacement costs by the non-Federal sponsor;
- A description of all Federal and non-Federal sources of funding;
- Proposed schedule for project implementation.

9.1 Willingness of District to Pay its Share of the Project

The District is a public agency responsible to its customers, the citizens within the cities of Calabasas, Agoura Hills, Hidden Hills, Westlake Village and unincorporated areas of Agoura, Chatsworth, Lake Manor, Malibu Lake, Monte Nido and West Hills. The District is, by its legal basis and enabling acts, willing and required to develop and manage reliable water supplies in the public interest. Thus, the District is willing to pay its share of the project. The following are key features of this public character of the agency:

- The District is a Water District, organized and operating under and in accordance with the Water District Law codified in Part 5 of Division 12 of the Water Code, at sections 30000 and following. The District is a special district and a political subdivision of the State of California.
- The District is governed by five directors elected from within the District's jurisdictional boundaries. The District's Board of Directors exercises the powers enumerated in the Water District Law and employs a General Manager to administer the District.
- The District has authority under Water Code section 31180 and other provisions of the County Water District law to borrow money, incur indebtedness, and issue bonds or other evidences of the indebtedness, including revenue bonds.
- The District has the power under the County Water District Law, the Government Code and the Health and Safety Code to set and collect rates and charges for water and sewer services.
- The District has authority under Water Code section 31001 to perform all acts necessary to carry out fully the provisions of the County Water District Law.
- The District has more specific authority under Water Code sections 31048 and 31049 to cooperate with other agencies and to contract with public agencies and any public or private corporation of any kind, and persons.
- As a public agency, the District has authority under other provisions of law, including Government Code sections 5956 and following, relating to infrastructure financing.

9.2 A Funding Plan for the Construction, O&M, and Replacement Costs

The District has instituted a mandatory recycled water use policy (Administrative Code Title 4 - Recycled Water Service, Section 4-2.104) that states the following:

"(a) When, in the judgment of the board, service can be feasibly provided to a particular parcel for particular uses, the General Manager shall require the use of recycled water in lieu of potable water for those uses. As used herein, the term "feasible" means recycled water is available for delivery to the property in compliance with all applicable federal, state, and local laws, ordinances and regulations and such recycled water can be delivered to the property at an overall cost to the user which does not exceed the overall cost of potable water service. (b) A permit for recycled water service shall be issued by the General Manager when the conditions described herein are met."

A copy of the District's Administrative Code for Recycled Water is included as Appendix G.

There are a variety of financing methods available to special districts to finance capital improvements, replacements, and expansion of water systems. They include pay-as-you-go (cash reserves and operating revenues), state revolving fund loans, grants, and tax exempt borrowings, such as general obligation bonds, special tax bonds, assessment bonds, revenue bonds, bond pools, and certificates of participation. With entities like the District that have dedicated sources of revenues, such as those generated from water rates and charges, the typical financing method is revenue supported, such as revenue bonds, bond pools, and certificates of participation. All of the revenue-supported, tax-exempt borrowing methods have a similar structure where revenues of the issuer are pledged to pay the annual debt service (principal and interest) and the issuer covenants that net revenues (gross revenues less operation and maintenance expenses) are maintained above a minimum level. The security of the issue (i.e. utility revenue) is identified and can be reasonably forecasted.

Project Costs and Revenues

This section presents the Project capital costs, financing costs, annual expenditures, and annual revenues. The purpose of this financial analysis is to provide the District with a preliminary understanding of the costs of developing and maintaining the Project. The Project cost estimates used for this analysis are summarized in **Table 9-1**. The costs were estimated in 2011 dollars and are escalated to the appropriate year assuming an inflation rate of 3.0%. Construction is estimated to start in 2017 and to be completed in 2019 and operations to start in 2020. Therefore, the mid-point of implementation costs is 2014 and the mid-point of construction is 2018.

Table 9-1: Hope Reservoir Site Cost Estimate Summary

	In 2011 Dollars	Escalated to Mid-Point	Mid-Point (Year)
Construction Cost	79,273,000	97,496,000	2018
Implementation Costs	34,660,000	37,874,000	2014
Annual O&M Cost	1,595,300		

Note: Detailed cost estimate is included in Appendix A.

The annual costs and revenue projections for the first 50 years of Project operations are defined in **Appendix H** and are based on the following assumptions:

- Inflation rate of 3.0%
- Implementation Costs would be funded by existing funds / District General Fund.
- Construction costs would be financed by a loan with a 50-year repayment period at a 5.0 percent interest rate. Debt service is $5.3 million per year and will begin in 2017.
- No grant contributions were assumed since no grant is anticipated to be secured in the short-term.
- Annual expenses are assumed to result from annual O&M costs and debt service. O&M costs will start in 2020 and are adjusted to increase by the inflation rate of 3.0% annually.

- The District's recycled water rate structure includes four tiers with a range of unit costs from $553/AF for Tier 1 to $1,563/AF for Tier 4 as of July 1, 2011. To simplify the analysis, an average rate was applied to estimate recycled water rate revenue for the Project. An average rate of $1,145/AF was applied based on FY 2011 recycled water rate revenue and sales ($5.036 M and 4,400 AF, respectively).[10]
- Annual recycled water sales for the Project will average 2,360 AFY starting in 2020.
- Project will avoid the need to purchase an average of 2,360 AFY of MWD water. MWD rate projections are discussed/included in Section 5.2.4/Appendix C.

The financing analysis findings, included in Appendix H, include:

- The present value of annual Project costs is $150.1 M ($8.22 M/year)
- The present value of annual recycled water sales revenues is $71.0 M ($3.89 M/year)
- The present value of the balance of funds, which is assumed to be provided by the General Fund, is $79.1 M ($4.33 M/year)
- The Project will avoid the purchase of $97.0 M ($5.31 M/year) of MWD water in present value terms
- After accounting for avoided MWD purchase costs, the Project results in net present revenues of $17.9 M ($0.98 M/year) over 50 years

9.3 Description of all Federal and Non-Federal Funding Sources and their Limitations

There are several funding sources for RWSSP which the District may pursue to obtain up to $30 million in grants for construction of capital facilities and potentially up to another $30 million in ongoing grant assistance from MWD's Local Resource Program. In addition, the District has its own funding mechanisms (as outlined in Section 9.2), and may pursue partnering opportunities with neighboring agencies:

- **U.S. Bureau of Reclamation Title XVI** - Grants of up to 25 percent of project costs or $20 million, whichever is less, are potentially available from the Bureau of Reclamation under its Title XVI program.
- **Proposition 84** – Funding may be available through an Integrated Regional Water Management implementation grant under Proposition 84. Implementation grants of up to $25 million have been awarded in past funding rounds. It is reasonable to assume that up to $10 million could be requested for a project like the RWSSP.
- **Metropolitan Water District of Southern California** – Up to $250 per AF of recycled water made available could be funded by MWD through their Local Resources Program. This would amount to up to $590,000 per year for 2,360 AFY of recycled water, or up to approximately $30 million in 2011 dollars for the 50-year life of the project.
- **Certificates of Participation** - The District has the ability to issue tax-exempt debt. One financing method is for the District to issue certificates of participation ("COPs"), which are

[10] Source: http://www.lvmwd.com/index.aspx?page=40

similar to revenue bonds, except the district issues certificates with an interest and principal component that are repaid and secured by the net revenues of the district.

- **Partnering Opportunities -** Another financing approach is for the District to join with another public agency in the area, such as LADWP, which has expressed interest in the RWSSP, and has the authority to manage water supply within Los Angeles County and issue revenue bonds pursuant to the Mark-Roos Local Bond Pooling Act of 1985 bonds. The District could also participate in a bond pool in California (a joint powers authority) and issue similar revenue bonds. All of these approaches are very similar in terms of structure, interest rates, and costs and are secured and paid by net revenues of the issuer.

9.4 Project Schedule

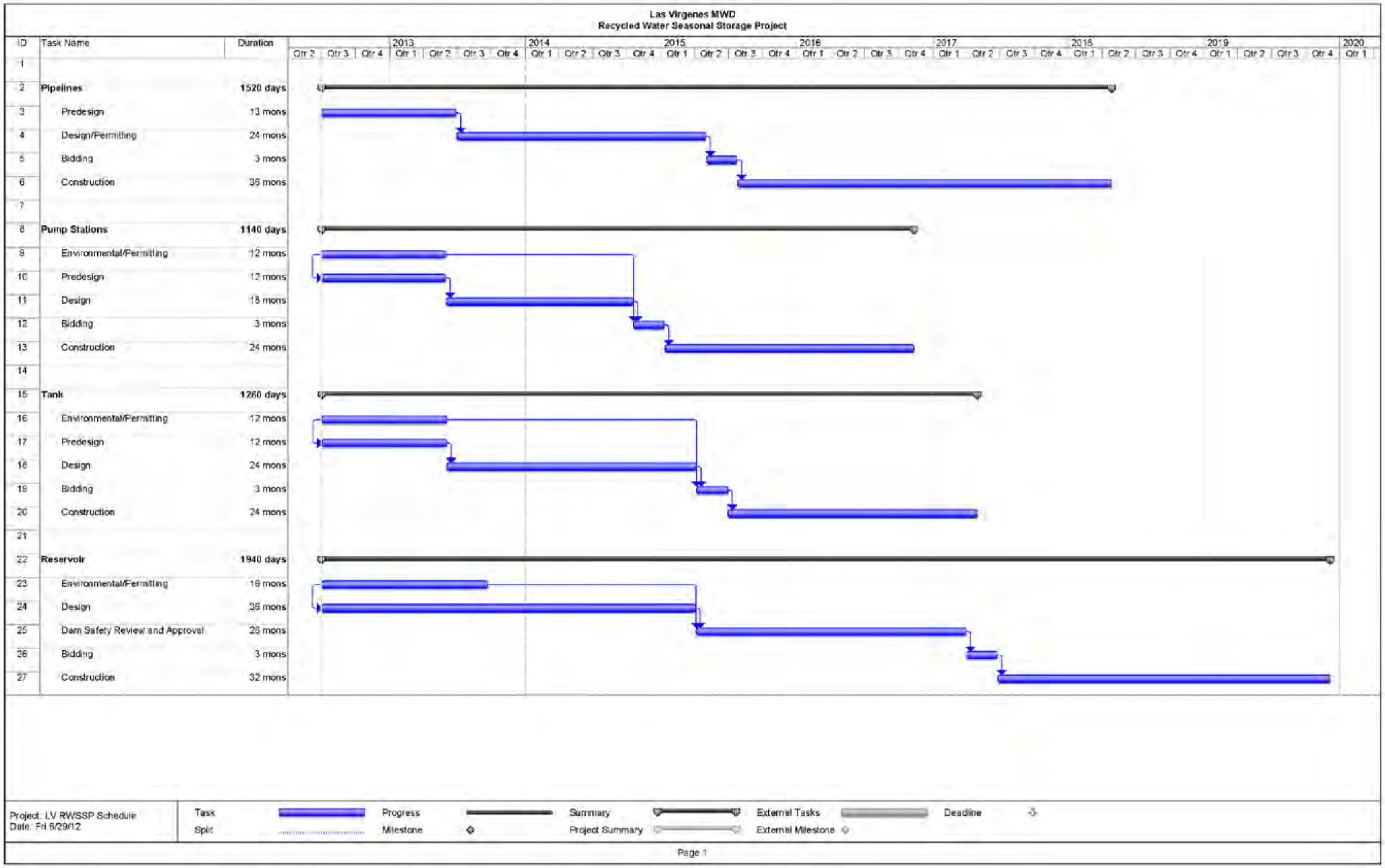
The proposed project schedule for the RWSSP includes non-construction implementation, construction, and commencement of operations. Non-construction implementation includes initiating the necessary permits, completing CEQA/NEPA documentation, completing design, going out to bid, obtaining the authority to award the construction contracts, awarding contracts, and issuing notices to proceed. Construction is anticipated to begin by immediately following the Notice to Proceed issuance. Facilities operations would begin at the end of construction activities.

The schedule does not include the conceptual GWR project.

Assuming the four components proceed simultaneously, the reservoir portion, which would require the longest duration, sets the completion date of the RWSSP. If non-construction implementation costs were started in 2012, it is anticipated that the notice to proceed for the reservoir construction would be given in 2017. Construction is anticipated to begin immediately following the Notice to Proceed issuance, and be substantially completed by the end of 2019. It is anticipated that it would take three to six months to fill the reservoir. Facilities operations would begin in 2020. The project schedule is shown in **Figure 9-1**.

It should be noted that the project schedule for the conceptual GWR project facilities is dependent on implementation of a GWR project by the City of Los Angeles. The RWSSP could be phased to implement the NPR facilities first, followed by the conceptual GWR facilities at a later time.

Figure 9-1: Project Schedule for RWSSP



Chapter 10 Research Needs

Additional research to evaluate the selected reservoir site and a recycled water market assessment would be required in order to implement the RWSSP. The project consists of an open storage reservoir in which initial investigations have identified no "fatal flaws" with this site. The distribution system consisting of new pipelines, pump stations, pressure reducing station and micro-screen facility at the reservoir are already using proven technologies. Additional investigation is needed to determine the ability to acquire the necessary land for each reservoir site and the regulatory and permitting issues that may be more or less difficult at each site. Additional investigation is also needed to determine the likelihood of a City of Los Angeles GWR project in the San Fernando Valley and whether a partnership with the District on such a project can be developed.

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California's Groundwater Bulletin 118 (2004)

Appendix A – List of Potential Recycled Water Customers

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Potential Recycled Water Customers

No.	Description/Project	Annual Demand[1] (acre-feet)	Average Daily Demand (MGD)	Maximum Daily Demand (MGD)	Existing/Future	Connection Date	Onsite Retrofits Required by District[2]	Retrofits Costs[3]	Map Where Referenced[4]
1	Current Demand (2009 - 2010)	6,621	5.91	13.5	Existing	Existing	no	--	Figures 1-2, 4-15, 4-17, 4-19
2	In-fill Development	1,330	1.19	2.38	Future	2020	no	--	Figures 4-15, 4-17, 4-19
3	Decker Canyon Project (Includes Malibu Golf Course, Fire Camps, Saddle Rock Ranch, Calamigos Ranch, and Medea Valley)	364	0.33	0.66	Future	2019	yes	$36,400	Figures 4-15, 4-17, 4-20
4	Thousand Oak Blvd. Extension	251	0.22	0.44	Future	2020	yes	$25,100	Figures 4-15, 4-17, 4-21
5	Calabasas City Center	24	0.02	0.04	Future	2017	yes	$2,400	Figures 4-15, 4-17, 4-22
6	Agoura Road Gap (also called "Agoura Road Extension")	38	0.03	0.06	Future	2020	yes	$3,800	Figures 4-15, 4-17, 4-23
7	Woodland Hills Golf Course	230	0.21	0.42	Future	2020	yes	$23,000	Figures 4-15, 4-17, 4-24
8	Louisville High School	51	0.05	0.09	Future	2020	yes	$5,100	Figures 4-15, 4-17, 4-25
9	Serrania Avenue Park	30	0.03	0.05	Future	2020	yes	$3,000	Figures 4-15, 4-17, 4-26
10	Church at Mulholland Drive and Deseret (also called "Church of LDS")	6	0.01	0.01	Future	2020	yes	$600	Figures 4-15, 4-17, 4-27
11	Motion Picture and Television Fund Hospital	5	0.004	0.01	Future	2020	yes	$500	Figures 4-15, 4-17, 4-28
12	Topanga Mountain School	~1	0	0	Future	2020	yes	$100	Figures 4-15, 4-17, 4-29
13	Mulholland Drive Medians	5	0.004	0.01	Future	2020	yes	$500	Figures 4-15, 4-17, 4-30
14	Alice Stelle School, Freedom Park & Other	24	0.02	0.04	Future	2020	yes	$2,400	Figures 4-15, 4-17, 4-19
	Total	**8,980**	**8.0**				**Total**	**$102,900**	

Notes:
1. Data for items 2 to 6 were obtained from the 2007 Recycled Water Master Plan prepared by Boyle Engineering (October 2007), and data for items 7 through 14 were obtained from the Woodland Hills Country Club Recycled Water Service Study, Second Draft (LVMWD #2467.00, January 2011). Values for items 2 through 6 were adjusted to include demands served by the pipelines proposed in Section 4.7 of this report. All of the alternatives described in Chapter 4 of this document serve all of the demands listed above.
2. Conversion/retrofits costs for infill will be paid by developers
3. Conversions/retrofit costs are estimated at $100/AF
4. Future customer representations on maps are approximated using tax assessment parcels.

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Appendix B – Project Cost Estimates

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Las Virgenes Municipal Water District
Recycled Water Seasonal Storage Feasibility Study
Cost Estimate Summary

RMC Water and Environment
5/20/2012
M. Uyeda, B. Dietrick

Preliminary Cost Estimate for Proposed April Canyon Reservoir Recycled Water Project

Item	Description	Direct Construction Cost	Implementation Costs	Total Capital Cost	Annualized Capital Cost	Annual O&M Cost	Total Annualized Costs	Incremental Unit Cost $/AF
1	April Canyon Reservoir	$40,730,000	$21,512,000	$62,242,000	$3,409,000	$902,115	$4,311,115	$1,830
2	Pipelines	$34,972,000	$10,493,000	$45,465,000	$2,490,000	$114,000	$2,604,000	$1,103
3	Pump Stations	$4,656,000	$2,498,000	$7,154,000	$392,000	$591,150	$983,150	$417
4	New Decker Storage Tank	$1,368,000	$961,000	$2,329,000	$128,000	$108,600	$236,600	$100
		$81,726,000	$35,464,000	$54,948,000	$67,259,000	**Total Annual Unit Cost $/AF**		**3,450**
				$117,190,000	$129,501,000		$8,134,865	$3,446.98
							$9,186,965	$1,383.58

Preliminary Cost Estimate for Proposed Stokes Canyon Reservoir Recycled Water Project

Item	Description	Direct Construction Cost	Implementation Costs	Total Capital Cost	Annualized Capital Cost	Annual O&M Cost	Total Annualized Costs	Incremental Unit Cost $/AF
1	Stokes Canyon Reservoir	$63,710,000	$32,972,000	$96,682,000	$5,296,000	$1,407,015	$6,703,015	$2,840
2	Pipelines	$36,052,000	$10,817,000	$46,869,000	$2,567,000	$118,000	$2,685,000	$1,138
3	Pump Stations	$4,380,000	$2,414,000	$6,794,000	$372,000	$536,850	$908,850	$385
4	New Decker Storage Tank	$1,368,000	$961,000	$2,329,000	$128,000	$108,600	$236,600	$100
		$ 105,510,000	$ 47,164,000	$55,992,000	$68,303,000	**Total Annual Unit Cost $/AF**		**4,463**
				$152,674,000	$164,985,000		$10,533,465	$4,463.33
							$11,585,565	$1,744.81

Preliminary Cost Estimate for Proposed Hope Reservoir Recycled Water Project

Item	Description	Direct Construction Cost	Implementation Costs	Total Capital Cost	Annualized Capital Cost	Annual O&M Cost	Total Annualized Costs	Incremental Unit Cost $/AF
1	Hope Reservoir	$41,253,000	$21,602,000	$62,855,000	$3,443,000	$919,440	$4,362,440	$1,850
2	Pipelines	$30,892,000	$9,269,000	$40,161,000	$2,200,000	$101,000	$2,301,000	$975
3	Pump Stations	$5,760,000	$2,828,000	$8,588,000	$470,000	$467,250	$937,250	$397
4	New Decker Storage Tank	$1,368,000	$961,000	$2,329,000	$128,000	$108,600	$236,600	$100
		$79,273,000	$34,660,000	$51,078,000	$63,389,000	**Total Annual Unit Cost $/AF**		**3,322**
				$113,933,000	$126,244,000		$7,837,290	$3,320.89
							$8,889,390	$1,338.76

Preliminary Cost Estimate for Conceptual Groundwater Recharge Project
Additional 3.8 mgd 4,280 AFY)

Item	Description	Direct Construction Cost	Implementation Costs	Total Capital Cost	Annualized Capital Cost	Annual O&M Cost	Total Annualized Costs	Incremental Unit Cost $/AF
1	RWPS East Upsize	$420,000	$147,000	$567,000	$31,000	$9,000	$281,500	$66
2	14" Pipeline	$8,880,000	$2,664,000	$11,544,000	$632,000	$29,000	$661,000	$154
	Common Total	***$9,300,000***	***$2,811,000***	***$12,111,000***	***$663,000***	***$38,000***	***$942,500***	***$220***
3	New Reservoir PS Upsize	$200,000	$0	$200,000	$10,000	$99,600	$109,600	$26
						Total Annual Unit Cost $/AF		**246**
			Total Additional Facility Cost	**$12,311,000**	**$673,000**	**$137,600**	**$1,052,100**	

Las Virgenes Municipal Water District
Recycled Water Seasonal Storage Feasibility Study
April Canyon Reservoir Cost Estimate

RMC Water and Environment
5/20/2012
M. Uyeda, B. Dietrick

No.	Description	Qty	Unit	Unit Price	Total Amt
1	**Earthfill Dam Capital Costs**				
	Dam Embankment	2,530,000	CY	$ 10.00	$ 25,300,000
	Outlet Works & Spillway	1	LS	$ 10,000,000	$ 10,000,000
	Other Sitework and Ancillary Facilities	1	LS	$ 3,530,000	$ 3,530,000
	Direct Construction Subtotal				$ 38,830,000
	Construction Contingency			20%	$ 7,766,000
	Engineering, CM, Admin			20%	$ 7,766,000
	Legal, Env/Permits, Mitigation			10%	$ 3,883,000
	Total Dam Capital Costs				**$ 58,245,000**
2	**Connecting Facilities Capital Costs**				
	Microscreen Facility, 1 acre lot				
	Grading	4,840	SY	$ 2.00	$ 10,000
	Facility Construction	1	LS	$ 790,000	$ 790,000
	Power to Site	8,000	LF	$ 65	$ 520,000
	Pressure Reducing Station	1	LS	$ 400,000	$ 400,000
	Subtotal				$ 1,720,000
	Access Roads in Existing Dirt Road, 12' Wide	1,800	LF	$ 100	$ 180,000
	Direct Construction Subtotal				$ 1,900,000
	Construction Contingency			20%	$ 380,000
	Engineering, CM, Admin			20%	$ 380,000
	Total Connecting Facilities Capital Costs				**$ 2,660,000**
3	**Right of Way Costs**				
	Reservoir	130	AC	10,000	$ 1,300,000
	Access Roads and Pipelines in Private Property	2.7	AC	10,000	$ 27,000
	Pressure Reducing Station	0.01	AC	$ 10,000.00	$ -
	Microscreen Facility	1	AC	10,000	$ 10,000
	Total Right of Way Costs				**$ 1,337,000**
	Total Capital Costs				**$ 62,242,000**
4	**Operation and Maintenance Cost**				
	Reservoir Dam			1.5%	$ 873,675
	Microscreen Facility			3%	$ 28,440
	Total Annual O&M Cost				**$ 902,115**
5	**Annualized Costs**				
	Interest Rate	5%			
	EAC Period	50			
	Annualized Capital Cost				$3,409,000
	Annual O&M Cost				$ 902,115
	Total Annualized Costs				**$ 4,311,000**
6	**Estimated Additional RW Annual Yield**	**2360**	**AF**		
	Estimated Reservoir Capacity	2200	AF		
7	**Unit Cost per Acre-foot Delivered**				**$ 1,830**

Notes:
1. Los Angeles ENR CCI for April 2011 is 10044.55. **1.6**
2. ENR L.A. CCI Dec 1992 6348.55
3. 1 acre = 43,560 ft^2

Las Virgenes Municipal Water District
Recycled Water Seasonal Storage Feasibility Study
April Canyon Recycled Water Pipeline Cost Estimate

RMC Water and Environment
5/20/2012
M. Uyeda, B. Dietrick

Item	Description	Quantity	Units	Unit Cost, $	Cost, $
1	8-in Pipe	7,000	LF	$ 220	$ 1,540,000
2	10-in Pipe	9,300	LF	$ 240	$ 2,240,000
3	12-in Pipe	54,300	LF	$ 260	$ 14,120,000
4	14-in Pipe	13,000	LF	$ 280	$ 3,640,000
5	30-in Pipe	12,500	LF	$ 600	$ 7,500,000
6	Conversion/retrofits	1,030	AF	$ 100	$ 103,000
					$ 29,143,000
	Contingency			20%	$ 5,829,000
	Direct Pipeline Construction Cost				*$ 34,972,000*
	Engineering/Admin/CM			20%	$ 6,995,000
	Environmental/Permitting/Legal			10%	$ 3,498,000
	Land Acquisition				$ -
	Total Implementation Costs				*$ 10,493,000*
	Total Estimated Capital Cost (2011$)				**$ 45,465,000**
	EAC Period (Yrs)			50	
	Interest Rate			5%	
	Annualized Capital Cost ($/Yr)				*$2,490,000*
	Post-construction O&M Costs				
	Pipeline O&M Costs ($/Yr)			0.25%	$ 114,000
	Annual O&M Cost ($/Yr)				*$ 114,000*
	Total Annualized Cost				**$ 2,604,000**
	Projected Average RW Yield Above Existing Demands (AFY)				2360
	Estimated Unit Cost for RW Pipeline ($/AF)				**$ 1,103**

Las Virgenes Municipal Water District
Recycled Water Seasonal Storage Feasibility Study
April Canyon Pump Station Cost Estimate

RMC Water and Environment
5/20/2012
M. Uyeda, B. Dietrick

Item	Description	Quantity	Units	Unit Cost, $	Cost, $
1	Pump Station, 500 gpm (from 1225 Zone to Decker Tank)	200	Hp	$ 6,900	$ 1,380,000
2	Pump Station, 8333 gpm (from 795 Zone to April Res (1104')	1,000	Hp	$ 2,300	$ 2,300,000
3	Paving	20,000	SF	$ 5	$ 100,000
4	Grading	2,222	SY	$ 2	$ 10,000
5	Fencing	800	LF	$ 50	$ 40,000
6	Landscaping	1	LS	$ 50,000	$ 50,000
					$ 3,880,000
	Contingency			20%	$ 776,000
	Direct Pump Station Construction Cost				*$ 4,656,000*
	Engineering/Admin/CM			20%	$ 932,000
	Environmental/Permitting/Legal			10%	$ 466,000
	Land Acquisition				$ 1,100,000
	Total Implementation Costs				*$ 2,498,000*
	Total Estimated Capital Cost (2011$)				**$ 7,154,000**
	EAC Period (Yrs)			50	
	Interest Rate			5%	
	Annualized Capital Cost ($/Yr)				*$392,000*
	Post-construction O&M Costs				
	Pump Station O&M Costs ($/Yr)			1.50%	$ 108,000
	Power Costs ($/Yr)			$0.15/kwh	$ 483,150
	Annual O&M Cost ($/Yr)				*$ 591,150*
	Total Annualized Cost				**$ 983,150**
	Projected Average RW Yield Above Existing Demands (AFY)				2360
	Estimated Unit Cost for RW Pump Station ($/AF)				**$ 417**

Costs:

Facility (cost per hp)	2007 MP	2011
Pump Station - 200 hp	$6,100	$6,900
Pump Station - 300 hp	$5,500	$6,300
Pump Station - 400 hp	$4,700	$5,400
Pump Station - 500 hp	$4,000	$4,600
Pump Station - 600 hp	$3,500	$4,000
Pump Station - 800 hp	$2,800	$3,200
Pump Station - 900 hp	$2,300	$2,600
Pump Station - 1000 hp	$2,000	$2,300

Comments

*Unit price for pump stations were obtained from 2007 RW Master Plan Cost Estimating Factors, Sec. 3.8.

Las Virgenes Municipal Water District
Recycled Water Seasonal Storage Feasibility Study
Decker Tank Cost Estimate

RMC Water and Environment
5/20/2012
M. Uyeda, B. Dietrick

Item	Description	Quantity	Units	Unit Cost, $	Cost, $
1	Decker Storage Tank, Buried Conc.	375,000	Gal	$ 2.75	$ 1,040,000
2	Paving	10,000	SF	$ 5	$ 50,000
3	Grading	1,111	SY	$ 2	$ 10,000
4	Fencing	400	LF	$ 50	$ 20,000
5	Landscaping	1	LS	$ 20,000	$ 20,000
					$ 1,140,000
			Contingency	20%	$ 228,000
			Direct Tank Construction Cost		*$ 1,368,000*
			Engineering/Admin/CM	20%	$ 274,000
			Environmental/Permitting/Legal	10%	$ 137,000
			Land Acquisition		$ 550,000
			Total Implementation Costs		*$ 961,000*
			Total Estimated Capital Cost (2011$)		**$ 2,329,000**
			EAC Period (Yrs)	50	
			Interest Rate	5%	
			Annualized Capital Cost ($/Yr)		*$128,000*
			Post-construction O&M Costs		
			Tank O&M Costs ($/Yr)	0.50%	$ 12,000
			Power Costs ($/Yr)	$0.15/kwh	$ 96,600
			Annual O&M Cost ($/Yr)		*$ 108,600*
			Total Annualized Cost		**$ 236,600**
			Projected Average RW Yield Above Existing Demands (AFY)		2360
			Estimated Unit Cost for RW Tank ($/AF)		**$ 100**

Note: Regardless of the proposed reservoir site, the Decker Storage Tank construction cost and size is the same.

Additional Detail on Storage Tank Sizing

Tank Volume	50,134	cf
Tank Diameter	60	ft
Tank Cross-sectional Area	2827	sf
Tank Height (Operational)	18	ft
Dead Storage Height	5	ft
Freeboard Height	2	ft
Overall Tank Height	25	ft
Non-operational Volume	19792	cf
% of Non-oper to Oper Volume	39%	

Las Virgenes Municipal Water District
Recycled Water Seasonal Storage Feasibility Study
Stokes Canyon Reservoir Cost Estimate

RMC Water and Environment
5/20/2012
M. Uyeda, B. Dietrick

No.	Description	Qty	Unit	Unit Price	Total Amt
1	**Earthfill Dam Capital Costs**				
	Dam Embankment	4,570,000	CY	$ 10.00	$ 45,700,000
	Outlet Works & Spillway	1	LS	$ 10,000,000	$ 10,000,000
	Other Sitework and Ancillary Facilities	1	LS	$ 5,570,000	$ 5,570,000
	Direct Construction Subtotal				$ 61,270,000
	Construction Contingency			20%	$ 12,254,000
	Engineering, CM, Admin			20%	$ 12,254,000
	Legal, Env/Permits, Mitigation			10%	$ 6,127,000
	Total Dam Capital Costs				**$ 91,905,000**
2	**Connecting Facilities Capital Costs**				
	Microscreen Facility, 1 acre lot				
	Grading	4,840	SY	$ 2.00	$ 10,000
	Facility Construction	1	LS	$ 790,000	$ 790,000
	Power to Site	8,000	LF	$ 65	$ 520,000
	Pressure Reducing Station	1	LS	$ 400,000	$ 400,000
	Subtotal				$ 1,720,000
	Access Roads in Existing Dirt Road, 12' wide	7,200	LF	$ 100	$ 720,000
	Direct Construction Subtotal				$ 2,440,000
	Construction Contingency			20%	$ 488,000
	Engineering, CM, Admin			20%	$ 488,000
	Total Connecting Facilities Capital Costs				**$ 3,416,000**
3	**Right of Way Costs**				
	Reservoir	130	AC	$ 10,000.00	$ 1,300,000
	Access Roads and Pipelines in Private Property	5.1	AC	$ 10,000.00	$ 51,000
	Pressure Reducing Station	0.01	AC	$ 10,000.00	$ -
	Microscreen Facility	1	AC	$ 10,000.00	$ 10,000
	Total Right of Way Costs				**$ 1,361,000**
	Total Capital Costs				**$ 96,682,000**
4	**Operation and Maintenance Cost**				
	Reservoir Dam			1.5%	$ 1,378,575
	Microscreen Facility			3%	$ 28,440
	Total Annual O&M Cost				**$ 1,407,015**
5	**Annualized Costs**				
	Interest Rate	5%			
	EAC Period	50			
	Annualized Capital Cost				$5,296,000
	Annual O&M Cost				$ 1,407,015
	Total Annualized Costs				**$ 6,703,000**
6	**Estimated Additional RW Annual Yield**	**2360**	**AF**		
	Estimated Reservoir Capacity	1900	AF		
7	**Unit Cost per Acre-foot Delivered**				**$ 2,840**

Notes:

1. Los Angeles ENR CCI for April 2011 is 10044.55. 1.6
2. ENR L.A. CCI Dec 1992 6348.55
3. 1 acre = 43,560 ft^2

Las Virgenes Municipal Water District
Recycled Water Seasonal Storage Feasibility Study
Stokes Canyon Pipeline Cost Estimate

RMC Water and Environment
5/20/2012
M. Uyeda, B. Dietrick

Item	Description	Quantity	Units	Unit Cost, $	Cost, $
1	8-in Pipe	7,000	LF	$ 220	$ 1,540,000
2	10-in Pipe	9,300	LF	$ 240	$ 2,240,000
3	12-in Pipe	54,300	LF	$ 260	$ 14,120,000
4	14-in Pipe	13,000	LF	$ 280	$ 3,640,000
5	30-in Pipe	14,000	LF	$ 600	$ 8,400,000
6	Conversion/retrofits	1,030	AF	$ 100	$ 103,000
					$ 30,043,000
			Contingency	20%	$ 6,009,000
			Direct Pipeline Construction Cost		*$ 36,052,000*
			Engineering/Admin/CM	20%	$ 7,211,000
			Environmental/Permitting/Legal	10%	$ 3,606,000
			Land Acquisition		$ -
			Total Implementation Costs		*$ 10,817,000*
			Total Estimated Capital Cost (2011$)		**$ 46,869,000**
			EAC Period (Yrs)	50	
			Interest Rate	5%	
			Annualized Capital Cost ($/Yr)		*$2,567,000*
			Post-construction O&M Costs		
			Pipeline O&M Costs ($/Yr)	0.25%	$ 118,000
			Annual O&M Cost ($/Yr)		*$ 118,000*
			Total Annualized Cost		**$ 2,685,000**
			Projected Average RW Yield Above Existing Demands (AFY)		2360
			Estimated Unit Cost for RW Pipeline ($/AF)		**$ 1,138**

Las Virgenes Municipal Water District
Recycled Water Seasonal Storage Feasibility Study
Stokes Canyon Pump Station Cost Estimate

RMC Water and Environment
5/20/2012
M. Uyeda, B. Dietrick

Item	Description	Quantity	Units	Unit Cost, $	Cost, $
1	Pump Station, 500 gpm from 1225 Zone to Decker Tank	200	Hp	$ 6,900	$ 1,380,000
2	Pump Station, 8333 gpm from 795 to Stokes Res (1063')	900	Hp	$ 2,300	$ 2,070,000
3	Paving	20,000	SF	$ 5	$ 100,000
4	Grading	2,222	SY	$ 2	$ 10,000
5	Fencing	800	LF	$ 50	$ 40,000
6	Landscaping	1	LS	$ 50,000	$ 50,000
					$ 3,650,000
			Contingency	20%	$ 730,000
			Direct Pump Station Construction Cost		*$ 4,380,000*
			Engineering/Admin/CM	20%	$ 876,000
			Environmental/Permitting/Legal	10%	$ 438,000
			Land Acquisition		$ 1,100,000
			Total Implementation Costs		*$ 2,414,000*
			Total Estimated Capital Cost (2011$)		**$ 6,794,000**
			EAC Period (Yrs)	50	
			Interest Rate	5%	
			Annualized Capital Cost ($/Yr)		*$372,000*
			Post-construction O&M Costs		
			Pump Station O&M Costs ($/Yr)	1.50%	$ 102,000
			Power Costs ($/Yr)	$0.15/kwh	$ 434,850
			Annual O&M Cost ($/Yr)		*$ 536,850*
			Total Annualized Cost		**$ 908,850**
			Projected Average RW Yield Above Existing Demands (AFY)		2360
			Estimated Unit Cost for RW Pump Station ($/AF)		**$ 385**

Costs:

Facility (cost per hp)	**2007 MP**	**2011**
Pump Station - 200 hp	$6,100	$6,900
Pump Station - 300 hp	$5,500	$6,300
Pump Station - 400 hp	$4,700	$5,400
Pump Station - 500 hp	$4,000	$4,600
Pump Station - 600 hp	$3,500	$4,000
Pump Station - 800 hp	$2,800	$3,200
Pump Station - 900 hp	$2,300	$2,600
Pump Station - 1000 hp	$2,000	$2,300

Comments

*Unit price for pump stations were obtained from 2007 RW Master Plan Cost Estimating Factors, Section 3.8.

Las Virgenes Municipal Water District
Recycled Water Seasonal Storage Feasibility Study
Hope Reservoir Cost Estimate

RMC Water and Environment
5/20/2012
M. Uyeda, B. Dietrick

No.	Description	Qty	Unit	Unit Price	Total Amt
1	**Earthfill Dam Capital Costs**				
	Dam Embankment	2,600,000	CY	$ 10.00	$ 26,000,000
	Outlet Works & Spillway	1	LS	$ 10,000,000	$ 10,000,000
	Other Sitework and Ancillary Facilities	1	LS	$ 3,600,000	$ 3,600,000
	Direct Construction Subtotal				$ 39,600,000
	Construction Contingency			20%	$ 7,920,000
	Engineering, CM, Admin			20%	$ 7,920,000
	Legal, Env/Permits, Mitigation			10%	$ 3,960,000
	Total Dam Capital Costs				**$ 59,400,000**
2	**Connecting Facilities Capital Costs**				
	Microscreen Facility, 1 acre lot				
	Grading	4,840	SY	$ 2.00	$ 10,000
	Facility Construction	1	LS	$ 790,000	$ 790,000
	Power to Site	200	LF	$ 65	$ 13,000
	Pressure Reducing Station	1	LS	$ 400,000	$ 400,000
	Subtotal				$ 1,213,000
	Access Roads in Existing Dirt Road, 12' wide 20' Wide, 6" AC	4,400	LF	$ 100	$ 440,000
	Direct Construction Subtotal				$ 1,653,000
	Construction Contingency			20%	$ 331,000
	Engineering, CM, Admin			20%	$ 331,000
	Total Connecting Facilities Capital Costs				**$ 2,315,000**
3	**Right of Way Costs**				
	Reservoir	112	AC	$ 10,000.00	$ 1,120,000
	Access Roads and Pipelines in Private Property	2.0	AC	$ 10,000.00	$ 20,000
	Pressure Reducing Station	0.0	AC	$ 10,000.00	$ -
	Microscreen Facility	0.0	AC	$ 10,000.00	$ -
	Total Right of Way Costs				**$ 1,140,000**
	Total Capital Costs				**$ 62,855,000**
4	**Operation and Maintenance Cost**				
	Reservoir Dam			1.5%	$ 891,000
	Microscreen Facility			3%	$ 28,440
	Total Annual O&M Cost				**$ 919,440**
5	**Annualized Costs**				
	Interest Rate	5%			
	EAC Period	50			
	Annualized Capital Cost				$3,443,000
	Annual O&M Cost				$ 919,440
	Total Annualized Costs				**$ 4,362,000**
6	**Estimated Additional RW Annual Yield**	**2360**	**AF**		
	Estimated Reservoir Capacity	2000	AF		
7	**Unit Cost per Acre-foot Delivered**				**$ 1,850**

Notes:
1. Los Angeles ENR CCI for April 2011 is 10044.55. **1.6**
2. ENR L.A. CCI Dec 1992 6348.55
3. 1 acre = 43,560 ft^2

Las Virgenes Municipal Water District
Recycled Water Seasonal Storage Feasibility Study
Hope Pipeline Cost Estimate

RMC Water and Environment
5/20/2012
M. Uyeda, B. Dietrick

Item	Description	Quantity	Units		Unit Cost, $	Cost, $
1	8-in Pipe	7,000	LF		$ 220	$ 1,540,000
2	10-in Pipe	9,300	LF		$ 240	$ 2,240,000
3	12-in Pipe	54,300	LF		$ 260	$ 14,120,000
4	14-in Pipe	13,000	LF		$ 280	$ 3,640,000
5	30-in Pipe	2,000	LF		$ 600	$ 1,200,000
6	30-in Pipe HDD	2,900	LF		$ 1,000	$ 2,900,000
6	Conversion/retrofits	1,030	AF		$ 100	$ 103,000
						$ 25,743,000
				Contingency	20%	$ 5,149,000
				Direct Pipeline Construction Cost		*$ 30,892,000*
				Engineering/Admin/CM	20%	$ 6,179,000
				Environmental/Permitting/Legal	10%	$ 3,090,000
				Land Acquisition		$ -
				Total Implementation Costs		*$ 9,269,000*
				Total Estimated Capital Cost (2011$)		**$ 40,161,000**
				EAC Period (Yrs)	50	
				Interest Rate	5%	
				Annualized Capital Cost ($/Yr)		*$2,200,000*
				Post-construction O&M Costs		
				Pipeline O&M Costs ($/Yr)	0.25%	$ 101,000
				Annual O&M Cost ($/Yr)		*$ 101,000*
				Total Annualized Cost		**$ 2,301,000**
				Projected Average RW Yield Above Existing Demands (AFY)		2360
				Estimated Unit Cost for RW Pipeline ($/AF)		**$ 975**

Las Virgenes Municipal Water District
Recycled Water Seasonal Storage Feasibility Study
Hope Pump Station Cost Estimate

RMC Water and Environment
5/20/2012
M. Uyeda, B. Dietrick

Item	Description	Quantity	Units		Unit Cost, $	Cost, $
1	Pump Station, 500 gpm	200	Hp		$ 6,900	$ 1,380,000
2	Pump Station, 8333 gpm	700	Hp		$4,600	$ 3,220,000
3	Paving	20,000	SF		$ 5	$ 100,000
4	Grading	2,222	SY		$ 2	$ 10,000
5	Fencing	800	LF		$ 50	$ 40,000
6	Landscaping	1	LS		$ 50,000	$ 50,000
						$ 4,800,000
				Contingency	20%	$ 960,000
				Direct Pump Station Construction Cost		*$ 5,760,000*
				Engineering/Admin/CM	20%	$ 1,152,000
				Environmental/Permitting/Legal	10%	$ 576,000
				Land Acquisition		$ 1,100,000
				Total Implementation Costs		*$ 2,828,000*
				Total Estimated Capital Cost (2011$)		**$ 8,588,000**
				EAC Period (Yrs)	50	
				Interest Rate	5%	
				Annualized Capital Cost ($/Yr)		*$470,000*
				Post-construction O&M Costs		
				Pump Station O&M Costs ($/Yr)	1.50%	$ 129,000
				Power Costs ($/Yr)	$0.15/kwh	$ 338,250
				Annual O&M Cost ($/Yr)		*$ 467,250*
				Total Annualized Cost		**$ 937,250**
				Projected Average RW Yield Above Existing Demands (AFY)		2360
				Estimated Unit Cost for RW Pump Station ($/AF)		**$ 397**

Costs:

Facility (cost per hp)	2007 MP	2011
Pump Station - 200 hp	$6,100	$6,900
Pump Station - 300 hp	$5,500	$6,300
Pump Station - 400 hp	$4,700	$5,400
Pump Station - 500 hp	$4,000	$4,600
Pump Station - 600 hp	$3,500	$4,000
Pump Station - 800 hp	$2,800	$3,200
Pump Station - 900 hp	$2,300	$2,600
Pump Station - 1000 hp	$2,000	$2,300

Comments

*Unit price for pump stations were obtained from 2007 RW Master Plan Cost Estimating Factors, Section 3.8.

Las Virgenes Municipal Water District
Recycled Water Seasonal Storage Feasibility Study
Conceptual GWR Pipeline Cost Estimate

RMC Water and Environment
05/20/2012
M. Uyeda, B. Dietrick

Item	Description	Quantity	Units		Unit Cost, $		Cost, $
1	8-in Pipe	0	LF	$	220	$	-
2	10-in Pipe	0	LF	$	240	$	-
3	12-in Pipe	0	LF	$	260	$	-
4	14-in Pipe	26,400	LF	$	280	$	7,400,000
5	30-in Pipe	0	LF	$	600	$	-
6	30-in Pipe HDD	0	LF	$	1,000	$	-
						$	7,400,000
			Contingency		20%	$	1,480,000
			Direct Pipeline Construction Cost			*$*	*8,880,000*
			Engineering/Admin/CM		20%	$	1,776,000
			Environmental/Permitting/Legal		10%	$	888,000
			Land Acquisition			$	-
			Total Implementation Costs			*$*	*2,664,000*
			Total Estimated Capital Cost (2011$)			**$**	**11,544,000**
			EAC Period (Yrs)		50		
			Interest Rate		5%		
			Annualized Capital Cost ($/Yr)				*$632,000*
			Post-construction O&M Costs				
			Pipeline O&M Costs ($/Yr)		0.25%	$	29,000
			Annual O&M Cost ($/Yr)			*$*	*29,000*
			Total Annualized Cost			**$**	**661,000**
			Projected Average RW Yield Above Existing Demands (AFY)				4280
			Estimated Unit Cost for RW Pipeline ($/AF)			**$**	**154**

Las Virgenes Municipal Water District
Recycled Water Seasonal Storage Feasibility Study
Conceptual Ground Water Recharge Project Added Pump Cost Estimate

RMC Water and Environment
5/20/2012
M. Uyeda, B. Dietrick

Item	Description	Quantity	Units	Unit Cost, $	Cost, $
1	Add Pump for April, 2700 gpm, 200 HP	1	EA	$150,000	$ 150,000
					$ 150,000
			Contingency	20%	$ 30,000
			Direct Pump Station Construction Cost		*$ 180,000*
			Total Estimated Capital Cost (2011$)		**$ 180,000**
			Life Cycle Period (Yrs)	50	
			Interest Rate	5%	
			Annualized Capital Cost ($/Yr)		*$10,000*
			Tank O&M Costs ($/Yr)	1.50%	$ 3,000
			Power Costs ($/Yr)	$0.15/kwh	$ 96,600
			Annual O&M Cost ($/Yr)		*$ 99,600*
			Total Annualized Cost		**$ 109,600**
			Projected Average RW Yield Above Existing Demands (AFY)		4280
			Estimated Unit Cost for Added Pump ($/AF)		**$ 26**
2	Add Pump for Stokes, 2700 gpm, 200 HP	1	EA	$150,000	$ 150,000
					$ 150,000
			Contingency	20%	$ 30,000
			Direct Pump Station Construction Cost		*$ 180,000*
			Total Estimated Capital Cost (2011$)		**$ 180,000**
			EAC Period (Yrs)	50	
			Interest Rate	5%	
			Annualized Capital Cost ($/Yr)		*$10,000*
			Tank O&M Costs ($/Yr)	1.50%	$ 3,000
			Power Costs ($/Yr)	$0.15/kwh	$ 96,600
			Annual O&M Cost ($/Yr)		*$ 99,600*
			Total Annualized Cost		**$ 109,600**
			Projected Average RW Yield Above Existing Demands (AFY)		4280
			Estimated Unit Cost for Added Pump ($/AF)		**$ 26**
3	Add Pump for Hope, 2700 gpm, 200 HP	1	EA	$150,000	$ 150,000
					$ 150,000
			Contingency	20%	$ 30,000
			Direct Pump Station Construction Cost		*$ 180,000*
			Total Estimated Capital Cost (2011$)		**$ 180,000**
			EAC Period (Yrs)	50	
			Interest Rate	5%	
			Annualized Capital Cost ($/Yr)		*$10,000*
			Tank O&M Costs ($/Yr)	1.50%	$ 3,000
			Power Costs ($/Yr)	$0.15/kwh	$ 96,600
			Annual O&M Cost ($/Yr)		*$ 99,600*
			Total Annualized Cost		**$ 109,600**
			Projected Average RW Yield Above Existing Demands (AFY)		4280
			Estimated Unit Cost for Added Pump ($/AF)		**$ 26**
4	Add Pump for RWPS East 2700 gpm, 500 HP	1	EA	$300,000	$ 300,000
	Site Modification	1	LS	$50,000	$ 50,000
					$ 350,000
			Contingency	20%	$ 70,000
			Direct Pump Station Construction Cost		*$ 420,000*
			Engineering/Admin/CM	25%	$ 105,000
			Environmental/Permitting/Legal	10%	$ 42,000
			Land Acquisition		$ -
			Total Implementation Costs		*$ 147,000*
			Total Estimated Capital Cost (2011$)		**$ 567,000**
			Life Cycle Period (Yrs)	50	
			Interest Rate	5%	
			Annualized Capital Cost ($/Yr)		*$31,000*
			Post-construction O&M Costs		
			Tank O&M Costs ($/Yr)	1.50%	$ 9,000
			Power Costs ($/Yr)	$0.15/kwh	$ 241,500
			Annual O&M Cost ($/Yr)		*$ 250,500*
			Total Annualized Cost		**$ 281,500**
			Projected Average RW Yield Above Existing Demands (AFY)		4280
			Estimated Unit Cost for RW Pump Station ($/AF)		**$ 66**

Costs:

Facility (cost per hp)	2007 MP	2011
Pump Station - 200 hp	$6,100	$6,900
Pump Station - 300 hp	$5,500	$6,300
Pump Station - 400 hp	$4,700	$5,400
Pump Station - 500 hp	$4,000	$4,600
Pump Station - 600 hp	$3,500	$4,000
Pump Station - 800 hp	$2,800	$3,200
Pump Station - 900 hp	$2,300	$2,600
Pump Station - 1000 hp	$2,000	$2,300

Comments

*Unit price for pump stations were obtained from 2007 RW Master Plan Cost Estimating Factors, Section 3.8.

Las Virgenes Municipal Water District
Recycled Water Seasonal Storage Feasibility Study
Power Cost Estimate for Pump Stations

RMC Water and Environment
5/20/2012
M. Uyeda, B. Dietrick

Assumptions:
Power Unit Cost 0.15 $/kWh
Operating Time: running 6 months out of the year, 24 hrs per day, at max day demands.

Pump Station	Brake Hp	Pump Hrs (hrs/yr)	Annual Power (Kwh/yr)	Annual Energy Cost ($)	Yield (AF)	EAC Period	Interest Rate	Unit Cost ($/AF)
April	1000	4320	3,221,000	$ 483,150	2360	50	5%	$204.72
Stokes	900	4320	2,899,000	$ 434,850	2360	50	5%	$184.26
Hope	700	4320	2,255,000	$ 338,250	2360	50	5%	$143.33
Decker[1]	200	4320	644,000	$ 96,600	2360	50	5%	$40.93
GWR	500	4320	1,610,000	$ 241,500	4280	50	5%	$56.43

Notes:
1. This includes the power cost estimate for the additional pumps at April, Stokes, and Hope for the conceptual GWR project.

Las Virgenes Municipal Water District
Recycled Water Seasonal Storage Feasibility Study
Pipe Sizing Calculations

RMC Water and Environment
5/20/2012
M. Uyeda, B. Dietrick

Segment ID	Diam (in)	Length (LF)	Demand Served	MDD (MGD)	PHD (MGD)	Cost	Scenario	$/in dia/LF
1	12	3,800	Thousand Oaks	1	2	$ 988,000	Either	$ 21.67
2	10	2,800	Thousand Oaks	1	2	$ 672,000	Either	$ 24.00
3	12	7,900	Woodland Hills	1	2	$ 2,054,000	Either	$ 21.67
4	12	8,600	Woodland Hills	1	2	$ 2,236,000	Either	$ 21.67
5	8	7,000	Calabasas City Center	0.1	0.2	$ 1,540,000	Either	$ 27.50
6	10	6,500	Malibu Golf Course	0.6	1.2	$ 1,560,000	Either	$ 24.00
7	12	20,000	Malibu Golf Course, Fire Camps, Saddlerock Ranch	0.9	1.8	$ 5,200,000	Either	$ 21.67
8	12	14,000	Malibu Golf Course, Fire Camps, Saddlerock Ranch	0.9	1.8	$ 3,640,000	Either	$ 21.67
9	14	13,000	Malibu Golf Course, Fire Camps, Saddlerock Ranch, Agoura Road Ext, Medea Valley	1.6	3.2	$ 3,640,000	Either	$ 20.00
10	30	2,000	April Reservoir	12	--	$ 1,200,000	April	$ 20.00
11	30	12,500	April Reservoir	12	--	$ 7,500,000	April	$ 20.00
12	30	14,000	Stokes Reservoir	12	--	$ 8,400,000	Stokes	$ 20.00
13	30	2,000	Hope Reservoir	12	--	$ 1,200,000	Hope	$ 20.00
14	30	2,900	Hope Reservoir	12	--	$ 2,900,000	Hope	$ 33.33
15	14		Conceptual GWR (assuming constant flow)	3.8	3.8			

Notes:

ENR (2007 MP)	8871
ENR (2011 Avg)	10022.47
Cost Incr Ratio	1.1298016

Pipeline Costs ($/LF)	2007 MP	2011 Equiv.
8-inch	$ 190	$ 220
10-inch	$ 210	$ 240
12-inch	$ 225	$ 260
14-inch	$ 240	$ 280
30-inch	--	$ 600
30-inch	--	$ 1,000

Las Virgenes Municipal Water District
Recycled Water Seasonal Storage Feasibility Study
Pump Station Sizing Calculations

RMC Water and Environment
5/20/2012
M. Uyeda, B. Dietrick

Pump Stations	From 1225 Zone to Decker Tank	From 795 Zone to April Res (1104')	From 795 Zone to Stokes Res (1063')	From 795 Zone to Hope Res (1025')
Q (gpm)	500	8333	8333	8333
Head (ft)	925	350	304	230
Brake Hp	160	990	850	650
Installed Hp	200	1000	900	700
New or Replace Existing	New	New	New	New

1. Assumed 75% efficiency for pumps when calculating average Brake Hp.

Groundwater Recharge Option

Additional Pumps to New Pump Station		From 795 Zone to April Res (1104')	From 795 Zone to Stokes Res (1063')	From 795 Zone to Hope Res (1025')	RWPS West From 795 Zone to 1225 Zone 795' to 1225'
Q (gpm)		2700	2700	2700	2700
Head (ft)		315	272	232	580
Brake Hp		290	250	210	530
Installed Hp		300	200	200	500
New or Replace Existing	New	New	New	New	New

1. Assumed 75% efficiency for pumps when calculating average Brake Hp.
2. 1225 Zone to Decker Tank Pump Station or RW PS West has an existing capacity of 6200 gpm, current peak demands are 7.75 mgd. An additional 3.2 mgd for GWR would bring this total to 11 mgd (7700 gpm). Therefore, additional pump of 1500 gpm is necessary.

Appendix C – Avoided Cost Estimates

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LVMWD Recycled Water Seasonal Storage Feasibility Study
Economic Analysis - Avoided Costs

RMC Water and Environment
1/15/2012
M. Uyeda, B. Dietrick

Description: This spreadsheet calculates avoided costs for the RWSSP. These include the avoided costs of purchasing imported water to meet demands for customers that will use recycled water; and it includes the avoided costs of disposal for unused recycled water during the prohibition period. Annual costs are calculated for 50 years (2012-2062) since that is the shortest lifespan for major facilities included in the cost estimates. The Present Value is then calculated and converted to an Equivalent Annual Cost and Unit Cost (per AF of new recycled water demand served).

Assumptions:

(1) MWD prices are based on published rates up to the year 2012, followed by a projection that assumes annual increases based on historical MWD price increases (7.5%) between 1960 and 2010. Tier 2 rates are assumed for NPR demands and treated replenishment rates are assumed for GWR demands.

(2) Inflation rate = 2.5%
(3) Discount rate = 5%
(4) Interest rate = 5%
(5) New RW demand = 2360 AFY
(6) MWD escalation = 7.5%
(7) EAC period = 50 yrs

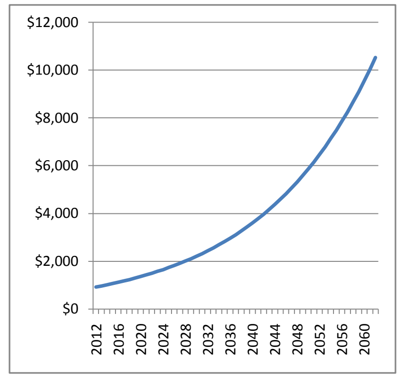
Unit cost represents the avoided costs of purchasing MWD Tier 2 water in lieu of supplying w/RW

Unit cost represents the avoided costs of Rancho spray fields, pumping to LA River, and BOS raw sewage disposal (per AF of new RW demands)

	MWD Tier 2 Rate								Current Disposal Methods		
Year	Tier 2	Escalation Rate	Inflation	Real Escalation Rate	Annual Cost $2011	Present Value	Equivalent Annual Cost	Unit Cost ($/AF)	Average Annual Cost	Escalation Rate	Unit Cost ($/AF)
2010	$811	published			n/a						
2011	$861	published	2.5%		n/a	$105,229,029	($5,764,103)	($2,442)	$ 362,064		$153
2012	$918	published	2.5%		$2,166,480	$2,063,314.29					
2013	$964	7.5%	2.5%	5.0%	$2,274,804	$2,063,314.29					
2014	$1,012	7.5%	2.5%	5.0%	$2,388,544	$2,063,314.29					
2015	$1,063	7.5%	2.5%	5.0%	$2,507,971	$2,063,314.29					
2016	$1,116	7.5%	2.5%	5.0%	$2,633,370	$2,063,314.29					
2017	$1,172	7.5%	2.5%	5.0%	$2,765,038	$2,063,314.29					
2018	$1,230	7.5%	2.5%	5.0%	$2,903,290	$2,063,314.29					
2019	$1,292	7.5%	2.5%	5.0%	$3,048,455	$2,063,314.29					
2020	$1,356	7.5%	2.5%	5.0%	$3,200,878	$2,063,314.29					
2021	$1,424	7.5%	2.5%	5.0%	$3,360,922	$2,063,314.29					
2022	$1,495	7.5%	2.5%	5.0%	$3,528,968	$2,063,314.29					
2023	$1,570	7.5%	2.5%	5.0%	$3,705,416	$2,063,314.29					
2024	$1,649	7.5%	2.5%	5.0%	$3,890,687	$2,063,314.29					
2025	$1,731	7.5%	2.5%	5.0%	$4,085,221	$2,063,314.29					
2026	$1,818	7.5%	2.5%	5.0%	$4,289,482	$2,063,314.29					
2027	$1,908	7.5%	2.5%	5.0%	$4,503,956	$2,063,314.29					
2028	$2,004	7.5%	2.5%	5.0%	$4,729,154	$2,063,314.29					
2029	$2,104	7.5%	2.5%	5.0%	$4,965,612	$2,063,314.29					
2030	$2,209	7.5%	2.5%	5.0%	$5,213,892	$2,063,314.29					
2031	$2,320	7.5%	2.5%	5.0%	$5,474,587	$2,063,314.29					
2032	$2,436	7.5%	2.5%	5.0%	$5,748,316	$2,063,314.29					
2033	$2,558	7.5%	2.5%	5.0%	$6,035,732	$2,063,314.29					
2034	$2,685	7.5%	2.5%	5.0%	$6,337,519	$2,063,314.29					
2035	$2,820	7.5%	2.5%	5.0%	$6,654,395	$2,063,314.29					
2036	$2,961	7.5%	2.5%	5.0%	$6,987,115	$2,063,314.29					
2037	$3,109	7.5%	2.5%	5.0%	$7,336,470	$2,063,314.29					
2038	$3,264	7.5%	2.5%	5.0%	$7,703,294	$2,063,314.29					
2039	$3,427	7.5%	2.5%	5.0%	$8,088,458	$2,063,314.29					
2040	$3,599	7.5%	2.5%	5.0%	$8,492,881	$2,063,314.29					
2041	$3,779	7.5%	2.5%	5.0%	$8,917,525	$2,063,314.29					
2042	$3,968	7.5%	2.5%	5.0%	$9,363,402	$2,063,314.29					
2043	$4,166	7.5%	2.5%	5.0%	$9,831,572	$2,063,314.29					
2044	$4,374	7.5%	2.5%	5.0%	$10,323,150	$2,063,314.29					
2045	$4,593	7.5%	2.5%	5.0%	$10,839,308	$2,063,314.29					
2046	$4,823	7.5%	2.5%	5.0%	$11,381,273	$2,063,314.29					
2047	$5,064	7.5%	2.5%	5.0%	$11,950,337	$2,063,314.29					
2048	$5,317	7.5%	2.5%	5.0%	$12,547,854	$2,063,314.29					
2049	$5,583	7.5%	2.5%	5.0%	$13,175,247	$2,063,314.29					
2050	$5,862	7.5%	2.5%	5.0%	$13,834,009	$2,063,314.29					
2051	$6,155	7.5%	2.5%	5.0%	$14,525,709	$2,063,314.29					
2052	$6,463	7.5%	2.5%	5.0%	$15,251,995	$2,063,314.29					
2053	$6,786	7.5%	2.5%	5.0%	$16,014,594	$2,063,314.29					
2054	$7,125	7.5%	2.5%	5.0%	$16,815,324	$2,063,314.29					
2055	$7,481	7.5%	2.5%	5.0%	$17,656,090	$2,063,314.29					
2056	$7,855	7.5%	2.5%	5.0%	$18,538,895	$2,063,314.29					
2057	$8,248	7.5%	2.5%	5.0%	$19,465,840	$2,063,314.29					
2058	$8,661	7.5%	2.5%	5.0%	$20,439,132	$2,063,314.29					
2059	$9,094	7.5%	2.5%	5.0%	$21,461,088	$2,063,314.29					
2060	$9,548	7.5%	2.5%	5.0%	$22,534,143	$2,063,314.29					
2061	$10,026	7.5%	2.5%	5.0%	$23,660,850	$2,063,314.29					
2062	$10,527	7.5%	2.5%	5.0%	$24,843,892	$2,063,314.29					
					$478,392,138	$105,229,029					

Description: The table below calculates the average annual costs of the current RW disposal methods.

	Current RW Disposal Methods		
	Rancho Spray Fields Annual Costs	**LA River Disposal** Annual Costs	**BOS Raw Sewage Diversion** Annual Costs
2001			
2002			
2003	$ 113,251		$ 110,139
2004	$ 217,746		$ 62,523
2005	$ 202,836		$ 179,375
2006	$ 248,037	$ 35,481	$ 214,854
2007	$ 266,329	$ 18,900	$ 22,296
2008	$ 197,485	$ 554	$ 163,220
2009	$ 227,160	$ 53,226	
2010	$ 221,145	$ 16,411	
Average =	$ 211,749	$ 24,914	$ 125,401



LVMWD Recycled Water Seasonal Storage Feasibility Study
Economic Analysis - Avoided Costs

RMC Water and Environment
1/15/2012
M. Uyeda, B. Dietrick

Description: This spreadsheet calculates avoided costs for the RWSSP. These include the avoided costs of purchasing imported water to meet demands for customers that will use recycled water; and it includes the avoided costs of disposal for unused recycled water during the prohibition period. Annual costs are calculated for 50 years (2012-2062) since that is the shortest lifespan for major facilities included in the cost estimates. The Present Value is then calculated and converted to an Equivalent Annual Cost and Unit Cost (per AF of new recycled water demand served).

Assumptions:

(1) MWD prices are based on published rates up to the year 2012, followed by a projection that assumes annual increases based on historical MWD price increases (7.5%) between 1960 and 2010. Tier 2 rates are assumed for NPR demands and treated replenishment rates are assumed for GWR demands.

(2) Inflation rate = 2.5%
(3) Discount rate = 5%
(4) Interest rate = 5%
(5) New RW demand = 4280 AFY
(6) MWD escalation = 7.5%
(7) EAC period = 50 yrs

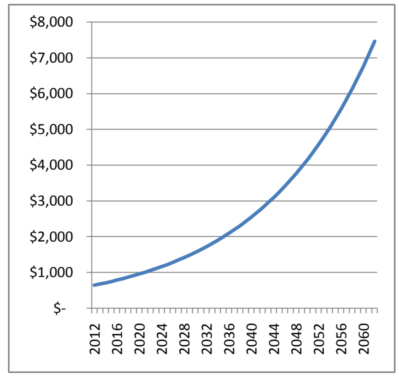
Unit cost represents the avoided costs of purchasing MWD Tier 2 water in lieu of supplying w/RW

Unit cost represents the avoided costs of Rancho spray fields, pumping to LA River, and BOS raw sewage disposal (per AF of new RW demands)

	MWD Treated Replenishment Rate								Current Disposal Methods		
Year	Treated Repl.	Escalation Rate	Inflation	Real Escalation Rate	Annual Cost $2011	Present Value	Equivalent Annual Cost	Unit Cost ($/AF)	Average Annual Cost	Escalation Rate	Unit Cost ($/AF)
2010	$ 558	published			n/a						
2011	$ 601	published	2.5%		n/a	$135,333,600	($7,413,133)	($1,732)	$ 362,064		$85
2012	$ 651	published	2.5%		$2,786,280	$2,653,600.00					
2013	$684	7.5%	2.5%	5.0%	$2,925,594	$2,653,600.00					
2014	$718	7.5%	2.5%	5.0%	$3,071,874	$2,653,600.00					
2015	$754	7.5%	2.5%	5.0%	$3,225,467	$2,653,600.00					
2016	$791	7.5%	2.5%	5.0%	$3,386,741	$2,653,600.00					
2017	$831	7.5%	2.5%	5.0%	$3,556,078	$2,653,600.00					
2018	$872	7.5%	2.5%	5.0%	$3,733,882	$2,653,600.00					
2019	$916	7.5%	2.5%	5.0%	$3,920,576	$2,653,600.00					
2020	$962	7.5%	2.5%	5.0%	$4,116,605	$2,653,600.00					
2021	$1,010	7.5%	2.5%	5.0%	$4,322,435	$2,653,600.00					
2022	$1,060	7.5%	2.5%	5.0%	$4,538,557	$2,653,600.00					
2023	$1,113	7.5%	2.5%	5.0%	$4,765,484	$2,653,600.00					
2024	$1,169	7.5%	2.5%	5.0%	$5,003,759	$2,653,600.00					
2025	$1,228	7.5%	2.5%	5.0%	$5,253,946	$2,653,600.00					
2026	$1,289	7.5%	2.5%	5.0%	$5,516,644	$2,653,600.00					
2027	$1,353	7.5%	2.5%	5.0%	$5,792,476	$2,653,600.00					
2028	$1,421	7.5%	2.5%	5.0%	$6,082,100	$2,653,600.00					
2029	$1,492	7.5%	2.5%	5.0%	$6,386,205	$2,653,600.00					
2030	$1,567	7.5%	2.5%	5.0%	$6,705,515	$2,653,600.00					
2031	$1,645	7.5%	2.5%	5.0%	$7,040,791	$2,653,600.00					
2032	$1,727	7.5%	2.5%	5.0%	$7,392,830	$2,653,600.00					
2033	$1,814	7.5%	2.5%	5.0%	$7,762,472	$2,653,600.00					
2034	$1,904	7.5%	2.5%	5.0%	$8,150,595	$2,653,600.00					
2035	$2,000	7.5%	2.5%	5.0%	$8,558,125	$2,653,600.00					
2036	$2,100	7.5%	2.5%	5.0%	$8,986,031	$2,653,600.00					
2037	$2,205	7.5%	2.5%	5.0%	$9,435,333	$2,653,600.00					
2038	$2,315	7.5%	2.5%	5.0%	$9,907,100	$2,653,600.00					
2039	$2,430	7.5%	2.5%	5.0%	$10,402,455	$2,653,600.00					
2040	$2,552	7.5%	2.5%	5.0%	$10,922,577	$2,653,600.00					
2041	$2,680	7.5%	2.5%	5.0%	$11,468,706	$2,653,600.00					
2042	$2,814	7.5%	2.5%	5.0%	$12,042,142	$2,653,600.00					
2043	$2,954	7.5%	2.5%	5.0%	$12,644,249	$2,653,600.00					
2044	$3,102	7.5%	2.5%	5.0%	$13,276,461	$2,653,600.00					
2045	$3,257	7.5%	2.5%	5.0%	$13,940,284	$2,653,600.00					
2046	$3,420	7.5%	2.5%	5.0%	$14,637,298	$2,653,600.00					
2047	$3,591	7.5%	2.5%	5.0%	$15,369,163	$2,653,600.00					
2048	$3,770	7.5%	2.5%	5.0%	$16,137,621	$2,653,600.00					
2049	$3,959	7.5%	2.5%	5.0%	$16,944,503	$2,653,600.00					
2050	$4,157	7.5%	2.5%	5.0%	$17,791,728	$2,653,600.00					
2051	$4,365	7.5%	2.5%	5.0%	$18,681,314	$2,653,600.00					
2052	$4,583	7.5%	2.5%	5.0%	$19,615,380	$2,653,600.00					
2053	$4,812	7.5%	2.5%	5.0%	$20,596,149	$2,653,600.00					
2054	$5,053	7.5%	2.5%	5.0%	$21,625,956	$2,653,600.00					
2055	$5,305	7.5%	2.5%	5.0%	$22,707,254	$2,653,600.00					
2056	$5,571	7.5%	2.5%	5.0%	$23,842,617	$2,653,600.00					
2057	$5,849	7.5%	2.5%	5.0%	$25,034,748	$2,653,600.00					
2058	$6,142	7.5%	2.5%	5.0%	$26,286,485	$2,653,600.00					
2059	$6,449	7.5%	2.5%	5.0%	$27,600,809	$2,653,600.00					
2060	$6,771	7.5%	2.5%	5.0%	$28,980,850	$2,653,600.00					
2061	$7,110	7.5%	2.5%	5.0%	$30,429,892	$2,653,600.00					
2062	$7,465	7.5%	2.5%	5.0%	$31,951,387	$2,653,600.00					
					$615,253,520	$135,333,600					

Description: The table below calculates the average annual costs of the current RW disposal methods.

	Current RW Disposal Methods		
	Rancho Spray Fields Annual Costs	**LA River Disposal** Annual Costs	**BOS Raw Sewage Diversion** Annual Costs
2001			
2002			
2003	$ 113,251		$ 110,139
2004	$ 217,746		$ 62,523
2005	$ 202,836		$ 179,375
2006	$ 248,037	$ 35,481	$ 214,854
2007	$ 266,329	$ 18,900	$ 22,296
2008	$ 197,485	$ 554	$ 163,220
2009	$ 227,160	$ 53,226	
2010	$ 221,145	$ 16,411	
Average =	$ 211,749	$ 24,914	$ 125,401



Appendix D – Dam Calculations

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Las Virgenes Municipal Water District
Seasonal Storage Feasibility Study

April Reservoir Dam Centerline Profile Data
3.5H:1V Slope Upstream of Reservoir

Elevation (ft)	Surface Area (sf)	Surface Area (acres)	Storage Capacity (acre-feet)	Total Capacity (acre-feet)	Dam Crest Elev (ft)	Oper Free-board Elev (ft)	Spillway/ Oper Elev (ft)	Normal Pool Elev (ft)	Reservoir Invert Elev (ft)	Dead Pool Elev (ft)
1125	3,602,971	82.7	1795	4423	1105		1098	1096	975	1020
1100	2,650,848	60.9	1264	2628	1105		1098	1096	975	1020
1075	1,754,235	40.3	759	1364	1105		1098	1096	975	1020
1050	891,600	20.5	373	605	1105		1098	1096	975	1020
1025	407,721	9.4	164	232	1105		1098	1096	975	1020
1000	162,946	3.7	57	68	1105		1098	1096	975	1020
975	36,977	0.8	11	11	1105		1098	1096	975	1020
950	0	0.0	0	0	1105		1098	1096	975	1020
925										

From Craig Miller:

Contour 1125' = 3,602,970.66 sq. ft. perimeter = 16,540.98 ft.
Contour 1100' = 2,650,847.66 sq. ft. perimeter = 13,930.61 ft.
Contour 1075' = 1,754,234.85 sq. ft. perimeter = 11,774.95 ft.
Contour 1050' = 891,600.49 sq. ft. perimeter = 8,209.01 ft.
Contour 1025' = 407,720.71 sq. ft. perimeter = 4,769.77 ft.
Contour 1000' = 162,945.92 sq. ft. perimeter = 2,556.93 ft.
Contour 975' = 36,977.38 sq. ft. perimeter = 846.72 ft.

Drainage Boundary 10,899,093.70 sq. ft = 250 acres
Assumed Rainfall = 6 inches
Estimated Runoff Volume from Watershed = 125 ac-ft

Assumed Flood Routing Rainfall = 30 inches
Estimated Runoff Volume from Watershed = 626 ac-ft
Assume Half Runoff Volume from Watershed = 313 ac-ft

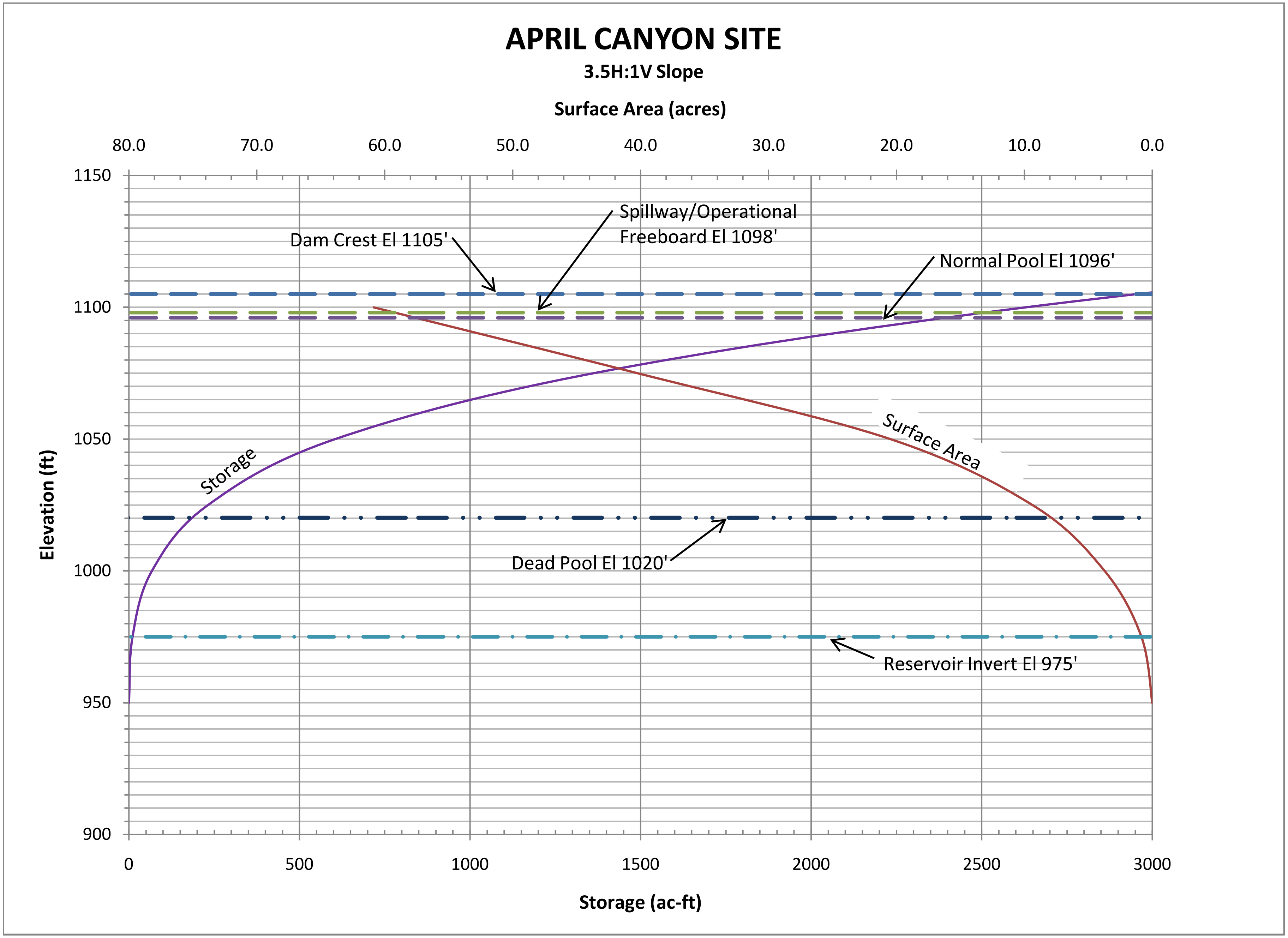
Dead Pool Storage	200 ac-ft	200 ac-ft	1,020 ft	
April Reservoir Storage				
(Previous Studies) Normal Pool	**2,200 ac-ft**	**2,400 ac-ft**	**1,096 ft**	Maximum Operational Volume with Dam Crest Elev at 1109 ft
Normal Pool to Spillway Vol	125 ac-ft	2,525 ac-ft	1,098 ft	
Dam Safety/Flood Routing	313 ac-ft	**2,838 ac-ft**	**1,102.9 ft**	Dam Crest Elevation
Residual Freeboard (waves)			**1,105.0 ft**	Dam crest with min 1.5' freeboard above Max Flood Pool

65 acres

ASSUMPTIONS:

1. Normal pool elevation is based on 2,200 ac-ft of operational storage capacity.
2. Dead pool storage assumed to be 200 ac-feet. Reservoir invert assumed to be 975'.
3. Spillway used 125 ac-ft of storage above normal pool elevation to account for Operational Freeboard to Prevent Accidental Discharge (NPDES Permit issue).
   Rainfall data in area obtained from wunderground.com and rain station. Max precipitation in a given day was 3.34 inches between January 1, 2006 to December 31, 2010
   Assumed 6 inches of rainfall to estimate runoff from watershed for a 100-year storm event. This should be confirmed prior to design with hydrology study.
      Reference: http://www.wunderground.com/weatherstation/WXDailyHistory.asp?ID=KCAAGOUR2&graphspan=custom&month=1&day=1&year=2006&monthend=12&dayend=31&yearend=2010
      History for KCAAGOUR2
      Foothills south of US 101, Agoura, CA
      Daily Summary for January 1, 2006 - December 31, 2010
4. Assumed 3.5H:1V slope upstream side of dam.
5. Operational freeboard for recycled water reservoirs per NPDES requirement to allow additional storage to avoid accidental spill when reservoir is full and a storm event occurs.

6. Dam Safety/Flood Routing. Because of it's size (> 25 ft per http://www.water.ca.gov/damsafety/jurischart/index.cfm) the dam will be considered a jurisdictional dam by the CA Division of Safety of Dams (DSOD). The attached hydrologic technical reference (Fitz, 1989)from the DSOD website ID's procedures for determining the required design storm need to design spillway in conjunction with freeboard for storing/routing flood and determining dam crest elev. The storm will be determined by separate hazard classification/hydrologic study, but will be somewhere between a 1000 year event and the PMP (Probable Maximum Precipitation), depending on a Total Class Weight (TCW) described in the paper. From inspection of the TCW Fig in the paper, my guess is that the likely TCW will be close to 30 – meaning the design storm will be close to the full PMP. Per the NOAA website, http://www.nws.noaa.gov/oh/hdsc/studies/pmp.html, it looks like HMR 58/59 is now used in coastal CA rather than the HMP 36 referenced in the Fitz paper. From looking at Plate 1 in HMR 59, it looks like the PMP will be in the range of 27 to 33 inches for a 24-hr general storm. If we assume 30-inches, and 100% runoff from the 250 acre watershed, the total flood volume would be about 625 ac-ft. Without any flood routing benefit from a spillway, you would need approximately 10-11-feet flood storage freeboard above the spillway to contain the entire PMF runoff. (Note DSOD requires that flood storage/routing be started with the reservoir full – at the spillway crest). With a small overflow spillway, you might route the storm and limit the WS rise to about half of that (or less) - meaning the max flood WS elev would be approximately 1103 to 1104 (5 to 6 feet above the spillway elevation of 1098). CA DSOD requires a residual freeboard of at least 1.5' between the max flood elevation and the dam crest (to prevent wave overtopping). Email from Joe Green-Heffen.


APRIL CANYON SITE
3.5H:1V Slope
Surface Area (acres)
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1150
1100
1050
1000
950
900
Elevation (ft)
Spillway/Operational
Freeboard El 1098'
Dam Crest El 1105'
Normal Pool El 1096'
Storage
Surface Area
Dead Pool El 1020'
Reservoir Invert El 975'
0
500
1000
1500
2000
2500
3000
Storage (ac-ft)

Las Virgenes Municipal Water District
Seasonal Storage Feasibility Study

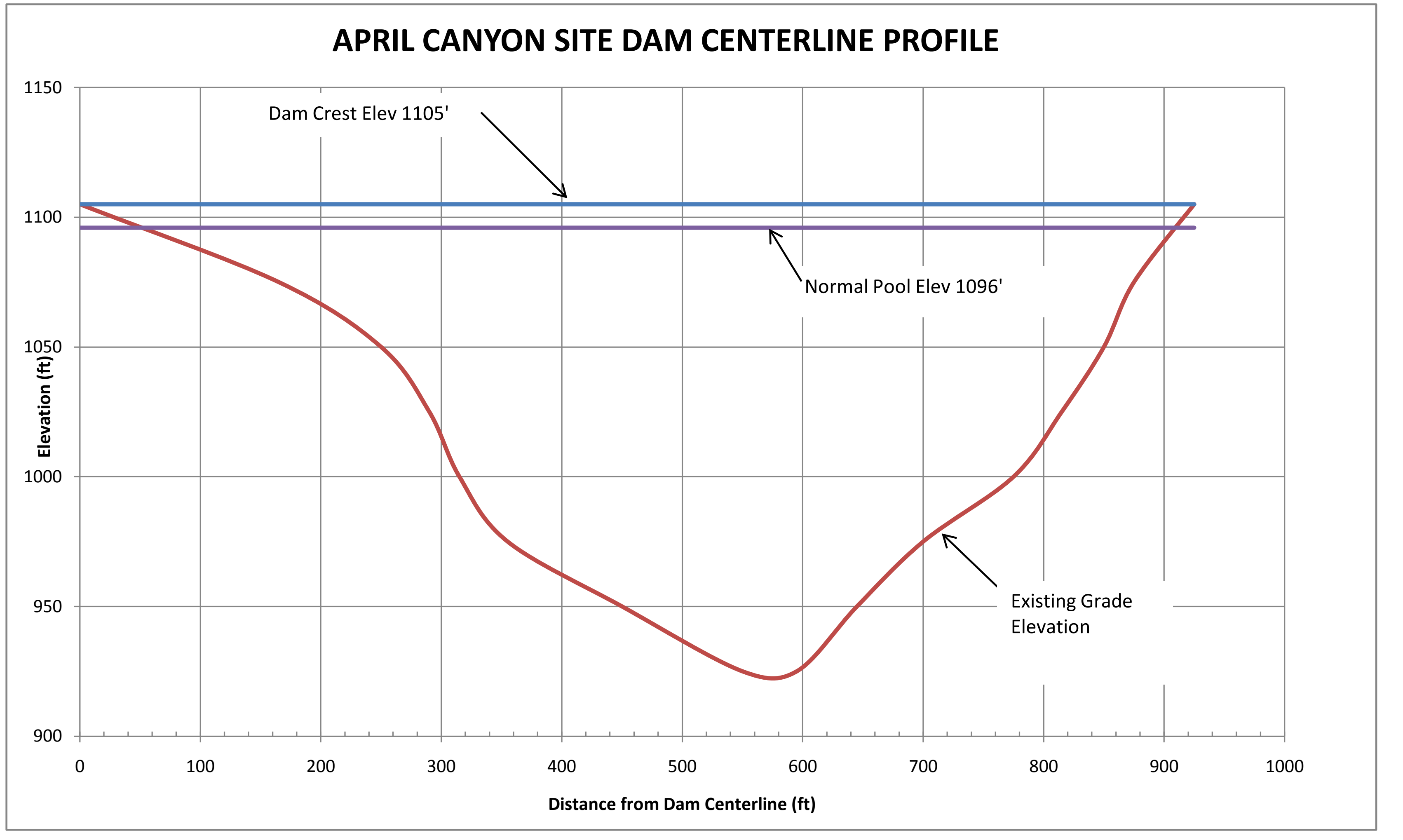
April Reservoir Dam Centerline Profile Data & Dam Embankment Volume

Distance Along Dam (ft)	Original Ground Elevation (ft)	Dam Crest Elev (ft)	Normal Pool Elev (ft)	Emb X-Sec Area (sq ft)	Emb Vol Inc (CY)	Emb Vol Cum (CY)
0	1105	1105	1096	0	0	0
165	1075	1105	1096	3675	22458	22458
250	1050	1105	1096	11206	41064	63522
290	1025	1105	1096	22800	42079	105601
315	1000	1105	1096	38456	46163	151764
355	975	1105	1096	58175	114671	266435
450	950	1105	1096	81956	390709	657145
550	925	1105	1096	109800	558438	1215582
595	925	1105	1096	109800	274500	1490082
645	950	1105	1096	81956	253438	1743520
700	975	1105	1096	58175	201979	1945498
775	1000	1105	1096	38456	187622	2133120
815	1025	1105	1096	22800	62264	2195384
850	1050	1105	1096	11206	29304	2224688
875	1075	1105	1096	3675	8591	2233279
925	1105	1105	1096	0	3403	2236682
	925					

Above Ground Embankment Volume	2,240,000
Foundation Excavation (15% allowance)	340,000
Total Embankment Volume	2,580,000

Embankment quantities assume 25' crest width, and 3.5H:1V upstream and and 3H:1V downstream slopes.
Additions/Changes in red by Jgreen-Heffern 1/25/2011

0	1105
0.33	1075
0.5	1050
0.58	1025
0.63	1000
0.71	975
0.9	950
1.1	925
1.19	925
1.29	950
1.4	975
1.55	1000
1.63	1025
1.7	1050
1.75	1075
1.85	1105



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Las Virgenes Municipal Water District
Seasonal Storage Feasibility Study

Hope Reservoir Dam Centerline Profile Data
3.5H:1V Slope Upstream of Reservoir

Elevation (ft)	Surface Area (sf)	Surface Area (acres)	Storage Capacity (acre-feet)	Total Capacity (acre-feet)	Dam Crest Elev (ft)	Oper Free-board Elev (ft)	Spillway Elev (ft)	Normal Pool Elev (ft)	Reservoir Invert Elev (ft)	Dead Pool Elev (ft)
1050	3,260,857	74.9	1631	4534	1025	0	1014	1010	850	902
1025	2,423,033	55.6	1169	2903	1025	0	1014	1010	850	902
1000	1,651,131	37.9	790	1734	1025	0	1014	1010	850	902
975	1,102,281	25.3	497	944	1025	0	1014	1010	850	902
950	630,062	14.5	269	446	1025	0	1014	1010	850	902
925	308,384	7.1	123	177	1025	0	1014	1010	850	902
900	120,938	2.8	44	54	1025	0	1014	1010	850	902
875	33,513	0.8	10	10	1025	0	1014	1010	850	902
850	0	0.0	0	0	1025	0	1014	1010	850	902

From Craig Miller:
AREA EL. 1050' = 3,260,857 sq. ft.
AREA EL. 1025' = 2,423,033 sq. ft.
AREA EL. 1000' = 1,651,131 sq. ft.
AREA EL. 975' = 1,102,281 sq. ft.
AREA EL. 950' = 630,062 sq. ft.
AREA EL. 925' = 308,384 sq. ft.
AREA EL. 900' = 120,938 sq. ft.
AREA EL. 875' = 33,513 sq. ft.

Drainage Boundary 14,952,007.09 sq ft = 343 acres
Assumed Rainfall = 6 inches
Estimated Runoff Volume from Watershed = 172 ac-ft

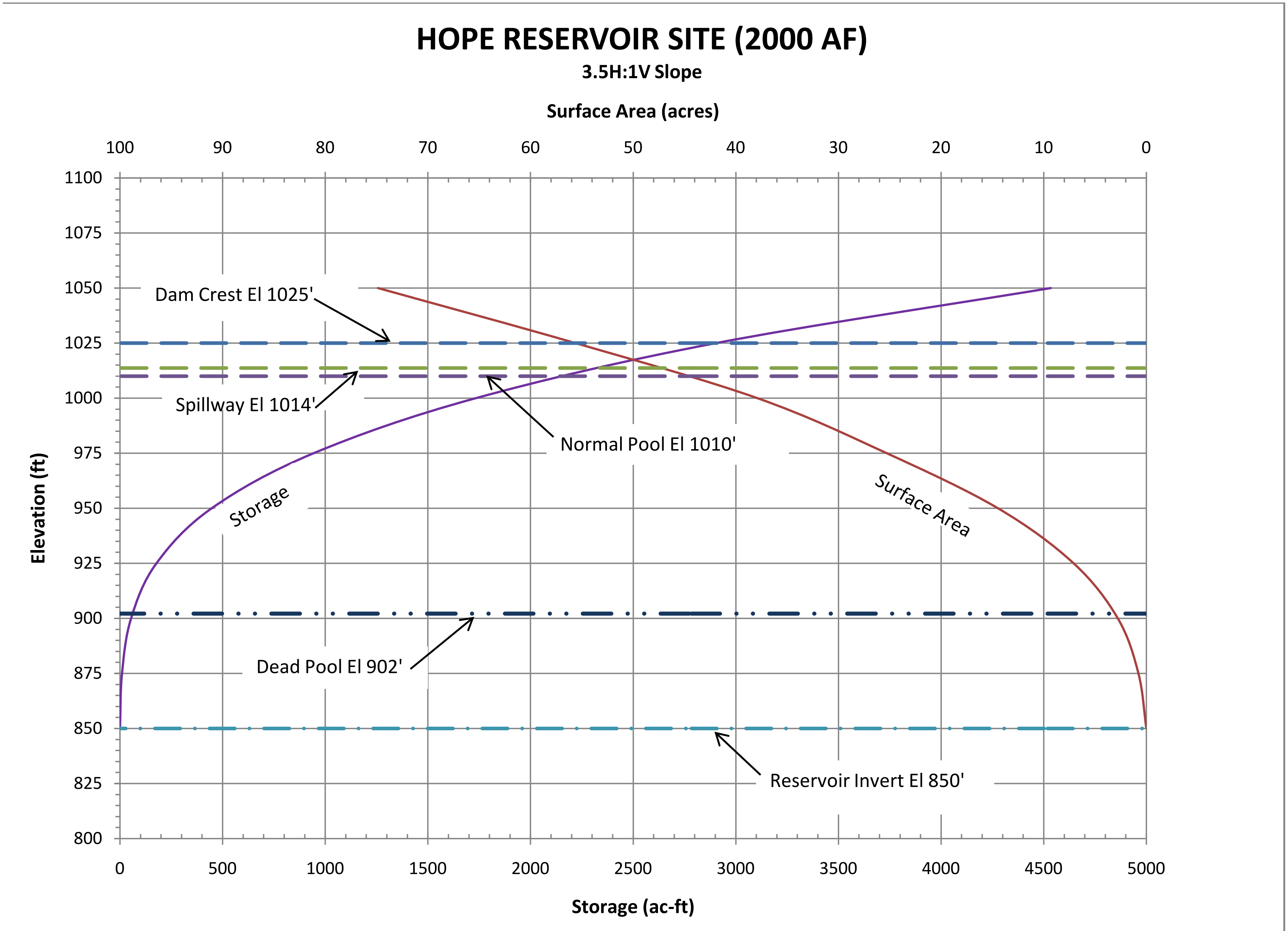
Assumed Flood Routing Rainfall = 30 inches
Estimated Runoff Volume from Watershed = 858 ac-ft
Assume Half Runoff Volume from Watershed = 429 ac-ft

Dead Pool Storage	200 ac-ft	200 ac-ft	902 ft		
Hope Reservoir Storage					
Normal Pool	**2,000 ac-ft**	**2,200 ac-ft**	**1,010 ft**	Maximum Operational Volume with Dam Crest Elev at 1109 ft	50 acres
Normal Pool to Spillway Vol	172 ac-ft	2,372 ac-ft	1,014 ft		
Dam Safety/Flood Routing	429 ac-ft	**2,801 ac-ft**	**1,023.0 ft**		
Residual Freeboard (waves)			**1,025 ft**	Dam crest with min 1.5' freeboard above Max Flood Pool	1,015 @ 2000AF Storage per AECOM Feasibility Study
			56 acres		

ASSUMPTIONS:

1. Normal pool elevation is based on 2,000 ac-ft of operational storage capacity.
2. Dead pool storage assumed to be 200 ac-feet. Reservoir invert assumed to be 950'.
3. Spillway used 172 ac-ft of storage above normal pool elevation to provide Operational Freeboard to Prevent Accidental Discharge (NPDES Permit issue).
   Rainfall data in area obtained from wunderground.com and rain station. Max precipitation in a given day was 3.34 inches between January 1, 2006 to December 31, 2010
   Assumed 6 inches of rainfall to estimate runoff from watershed for a 100-year storm event. This should be confirmed prior to design with hydrology study.
   Reference: http://www.wunderground.com/weatherstation/WXDailyHistory.asp?ID=KCAAGOUR2&graphspan=custom&month=1&day=1&year=2006&monthend=12&dayend=31&yearend=2010
   History for KCAAGOUR2
   Foothills south of US 101, Agoura, CA
   Daily Summary for January 1, 2006 - December 31, 2010
4. Assumed 3.5H:1V slope on water surface side of dam. 3H:1V slope on other side.

5. Dam Safety/Flood Routing. Because of it's size (> 25 ft per http://www.water.ca.gov/damsafety/jurischart/index.cfm) the dam will be considered a jurisdictional dam by the CA Division of Safety of Dams (DSOD). The attached hydrologic technical reference (Fitz, 1989)from the DSOD website ID's procedures for determining the required design storm need to design spillway in conjunction with freeboard for storing/routing flood and determining dam crest elev. The storm will be determined by separate hazard classification/hydrologic study, but will be somewhere between a 1000 year event and the PMP (Probable Maximum Precipitation), depending on a Total Class Weight (TCW) described in the paper. From inspection of the TCW Fig in the paper, my guess is that the likely TCW will be close to 30 – meaning the design storm will be close to the full PMP. Per the NOAA website, http://www.nws.noaa.gov/oh/hdsc/studies/pmp.html, it looks like HMR 58/59 is now used in coastal CA rather than the HMP 36 referenced in the Fitz paper. From looking at Plate 1 in HMR 59, it looks like the PMP will be in the range of 27 to 33 inches for a 24-hr general storm. If we assume 30-inches, and 100% runoff from the 343 acre watershed, the total flood volume would be about 858 ac-ft. Without any flood routing benefit from a spillway, you would need approximately 17 feet flood storage freeboard above the spillway to contain the entire PMF runoff. (Note DSOD requires that flood storage/routing be started with the reservoir full – at the spillway crest). With a small overflow spillway, you might route the storm and limit the WS rise to about half of that (or less) - meaning the max flood WS elev would be approximately 1023 (9 feet above the spillway elevation of 1014). CA DSOD requires a residual freeboard of at least 1.5' between the max flood elevation and the dam crest (to prevent wave overtopping). Email from Joe Green-Heffen.


HOPE RESERVOIR SITE (2000 AF)
3.5H:1V Slope
Surface Area (acres)
100
90
80
70
60
50
40
30
20
10
0
1100
1075
1050
1025
1000
975
950
925
900
875
850
825
800
Elevation (ft)
Dam Crest El 1025'
Spillway El 1014'
Normal Pool El 1010'
Storage
Surface Area
Dead Pool El 902'
Reservoir Invert El 850'
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
Storage (ac-ft)

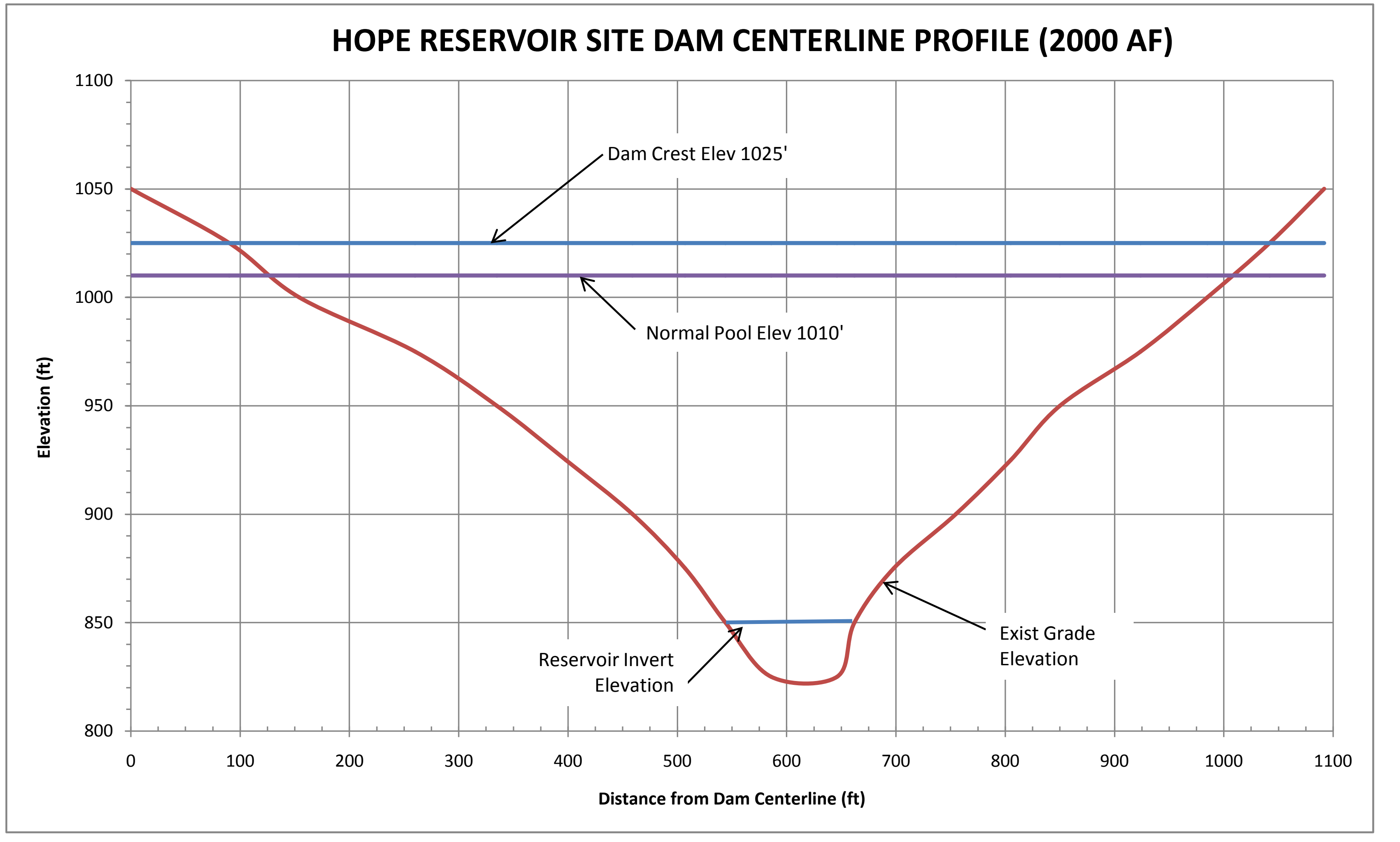
Las Virgenes Municipal Water District
Seasonal Storage Feasibility Study

Hope Reservoir Dam Centerline Profile Data & Dam Embankment Volume

Distance Along Dam (ft)	Original Ground Elevation (ft)	Dam Crest Elev (ft)	Normal Pool Elev (ft)	Emb X-Sec Area (sq ft)	Emb Vol Inc (CY)	Emb Vol Cum (CY)
0	1050	1025	1010	0	0	0
90	1025	1025	1010	0	0	0
154	1000	1025	1010	2656	6296	6296
260	975	1025	1010	9375	42020	48316
335	950	1025	1010	20156	69010	117326
398	925	1025	1010	35000	105182	222509
459	900	1025	1010	53906	161325	383834
507	875	1025	1010	76875	184583	568417
544	850	1025	1010	103906	195064	763481
586	825	1025	1010	135000	290816	1054297
646	825	1025	1010	135000	450000	1504297
662	850	1025	1010	103906	101574	1605871
698	875	1025	1010	76875	171771	1777642
755	900	1025	1010	53906	194948	1972590
805	925	1025	1010	35000	114728	2087318
850	950	1025	1010	20156	62760	2150078
924	975	1025	1010	9375	53316	2203394
985	1000	1025	1010	2656	16591	2219986
1042	1025	1025	1010			
1092	1050	1025	1010			
	825					

Above Ground Embankment Volume	2,220,000
Foundation Excavation (15% allowance)	330,000
Total Embankment Volume	2,550,000

Embankment quantities assume 25' crest width, and 3.5H:1V upstream and and 3H:1V downstream slopes.



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Las Virgenes Municipal Water District
Seasonal Storage Feasibility Study

Stokes Reservoir Dam Centerline Profile Data
3.5H:1V Slope Upstream of Reservoir

Elevation (ft)	Surface Area (sf)	Surface Area (acres)	Storage Capacity (acre-feet)	Total Capacity (acre-feet)	Dam Crest Elev (ft)	Oper Free-board Elev (ft)	Spillway Elev (ft)	Normal Pool Elev (ft)	Reservoir Invert Elev (ft)	Dead Pool Elev (ft)
1100	4,489,265	103.1	2239	6179	1063	0	1051	1045	950	974
1075	3,312,095	76.0	1614	3940	1063	0	1051	1045	950	974
1050	2,311,046	53.1	1085	2326	1063	0	1051	1045	950	974
1025	1,468,883	33.7	671	1242	1063	0	1051	1045	950	974
1000	867,878	19.9	367	571	1063	0	1051	1045	950	974
975	410,692	9.4	159	204	1063	0	1051	1045	950	974
950	143,307	3.3	43	45	1063	0	1051	1045	950	974
925	7,012	0.2	2	2	1063	0	1051	1045	950	974
900	0	0.0	0	0	1063	0	1051	1045	950	974

From Craig Miller:
El. 1100 = 4,489,264.70 sq. ft.
El. 1075 = 3,312,095.12 sq. ft.
EL. 1050 = 2,311,045.69 sq. ft.
EL. 1025 = 1,468,882.67 sq. ft.
El. 1000 = 867,877.73 sq. ft.
EL. 975 = 410,692.05 sq. ft.
EL. 950 = 143,306.65 sq. ft.
EL. 925 = 7,012.08 sq. ft.

Drainage Boundary 24,027,974.26 sq. ft. = 552 acres
Assumed Rainfall = 6 inches
Estimated Runoff Volume from Watershed = 276 ac-ft

Assumed Flood Routing Rainfall = 30 inches
Estimated Runoff Volume from Watershed = 1379 ac-ft
Assume Half Runoff Volume from Watershed = 690 ac-ft

Dead Pool Storage	200 ac-ft	200 ac-ft	974 ft	
Stokes Reservoir Storage				
(Previous Studies) Normal Pool	**1,900 ac-ft**	**2,100 ac-ft**	**1,045 ft**	Maximum Operational Volume with Dam Crest Elev at 1109 ft
Normal Pool to Spillway Vol	276 ac-ft	2,376 ac-ft	1,051 ft	
Dam Safety/Flood Routing	690 ac-ft	**3,065 ac-ft**	**1,061.5 ft**	Dam Crest Elevation
Residual Freeboard (waves)			**1,063 ft**	Dam crest with min 1.5' freeboard above Max Flood Pool

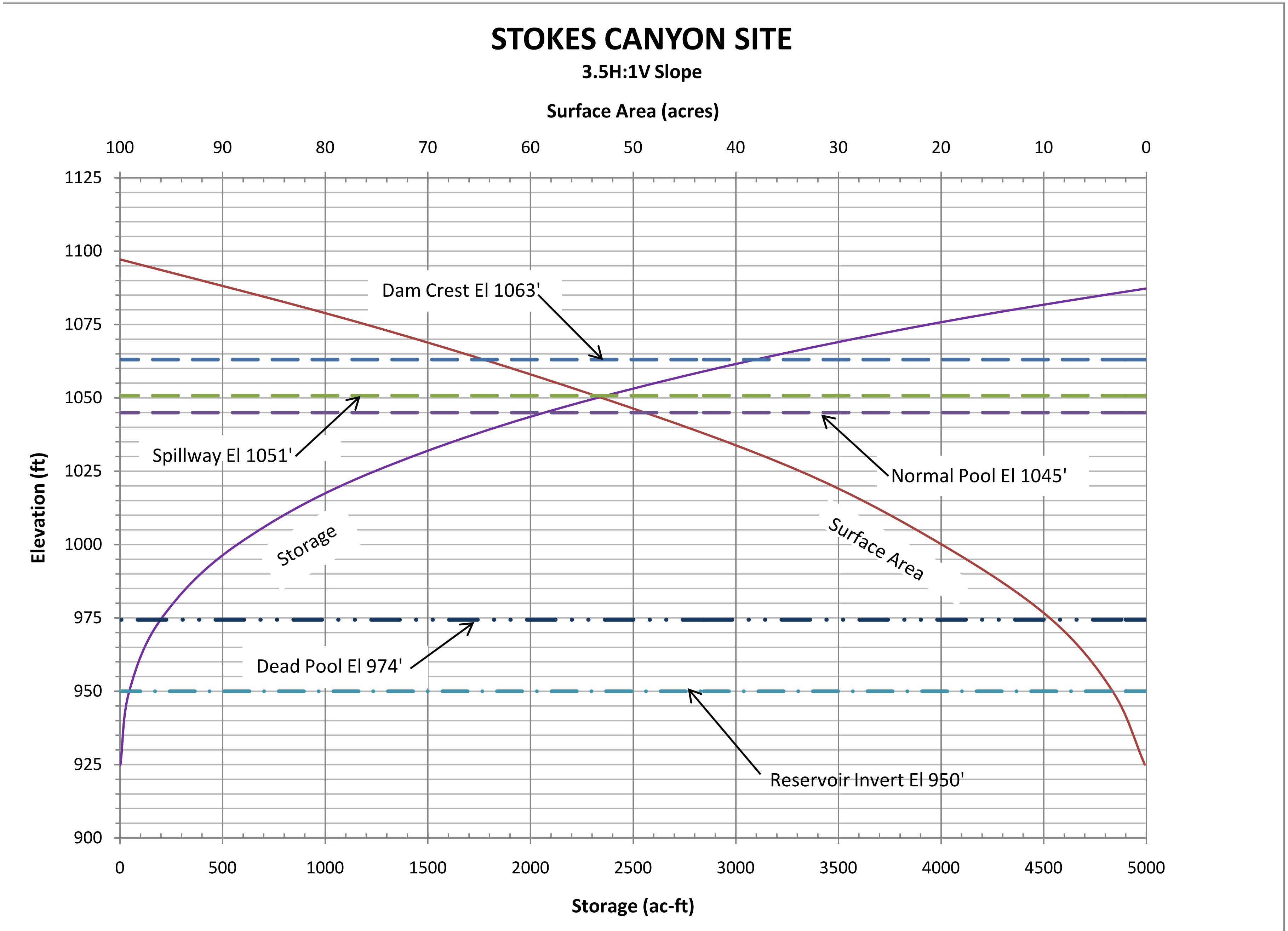
1,045 per previous studies

65 acres

ASSUMPTIONS:

1. Normal pool elevation is based on 1,900 ac-ft of operational storage capacity.
2. Dead pool storage assumed to be 200 ac-feet. Reservoir invert assumed to be 950'.
3. Spillway used 276 ac-ft of storage above normal pool elevation to provide Operational Freeboard to Prevent Accidental Discharge (NPDES Permit issue).
   Rainfall data in area obtained from wunderground.com and rain station. Max precipitation in a given day was 3.34 inches between January 1, 2006 to December 31, 2010
   Assumed 6 inches of rainfall to estimate runoff from watershed for a 100-year storm event. This should be confirmed prior to design with hydrology study.
   Reference: http://www.wunderground.com/weatherstation/WXDailyHistory.asp?ID=KCAAGOUR2&graphspan=custom&month=1&day=1&year=2006&monthend=12&dayend=31&yearend=2010
   History for KCAAGOUR2
   Foothills south of US 101, Agoura, CA
   Daily Summary for January 1, 2006 - December 31, 2010
4. Assumed 3.5H:1V slope on water surface side of dam. 3H:1V slope on other side.

5. Dam Safety/Flood Routing. Because of it's size (> 25 ft per http://www.water.ca.gov/damsafety/jurischart/index.cfm) the dam will be considered a jurisdictional dam by the CA Division of Safety of Dams (DSOD). The attached hydrologic technical reference (Fitz, 1989)from the DSOD website ID's procedures for determining the required design storm need to design spillway in conjunction with freeboard for storing/routing flood and determining dam crest elev. The storm will be determined by separate hazard classification/hydrologic study, but will be somewhere between a 1000 year event and the PMP (Probable Maximum Precipitation), depending on a Total Class Weight (TCW) described in the paper. From inspection of the TCW Fig in the paper, my guess is that the likely TCW will be close to 30 – meaning the design storm will be close to the full PMP. Per the NOAA website, http://www.nws.noaa.gov/oh/hdsc/studies/pmp.html, it looks like HMR 58/59 is now used in coastal CA rather than the HMP 36 referenced in the Fitz paper. From looking at Plate 1 in HMR 59, it looks like the PMP will be in the range of 27 to 33 inches for a 24-hr general storm. If we assume 30-inches, and 100% runoff from the 552 acre watershed, the total flood volume would be about 1379 ac-ft. Without any flood routing benefit from a spillway, you would need approximately 20 feet flood storage freeboard above the spillway to contain the entire PMF runoff. (Note DSOD requires that flood storage/routing be started with the reservoir full – at the spillway crest). With a small overflow spillway, you might route the storm and limit the WS rise to about half of that (or less) - meaning the max flood WS elev would be approximately 1061 to 1062 (10 to 11 feet above the spillway elevation of 1051). CA DSOD requires a residual freeboard of at least 1.5' between the max flood elevation and the dam crest (to prevent wave overtopping). Email from Joe Green-Heffen.



STOKES CANYON SITE
3.5H:1V Slope
Surface Area (acres)
100
90
80
70
60
50
40
30
20
10
0
1125
1100
1075
1050
1025
1000
975
950
925
900
Elevation (ft)
Dam Crest El 1063'
Spillway El 1051'
Normal Pool El 1045'
Storage
Surface Area
Dead Pool El 974'
Reservoir Invert El 950'
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
Storage (ac-ft)

Las Virgenes Municipal Water District
Seasonal Storage Feasibility Study

Stokes Reservoir Dam Centerline Profile Data & Dam Embankment Volume

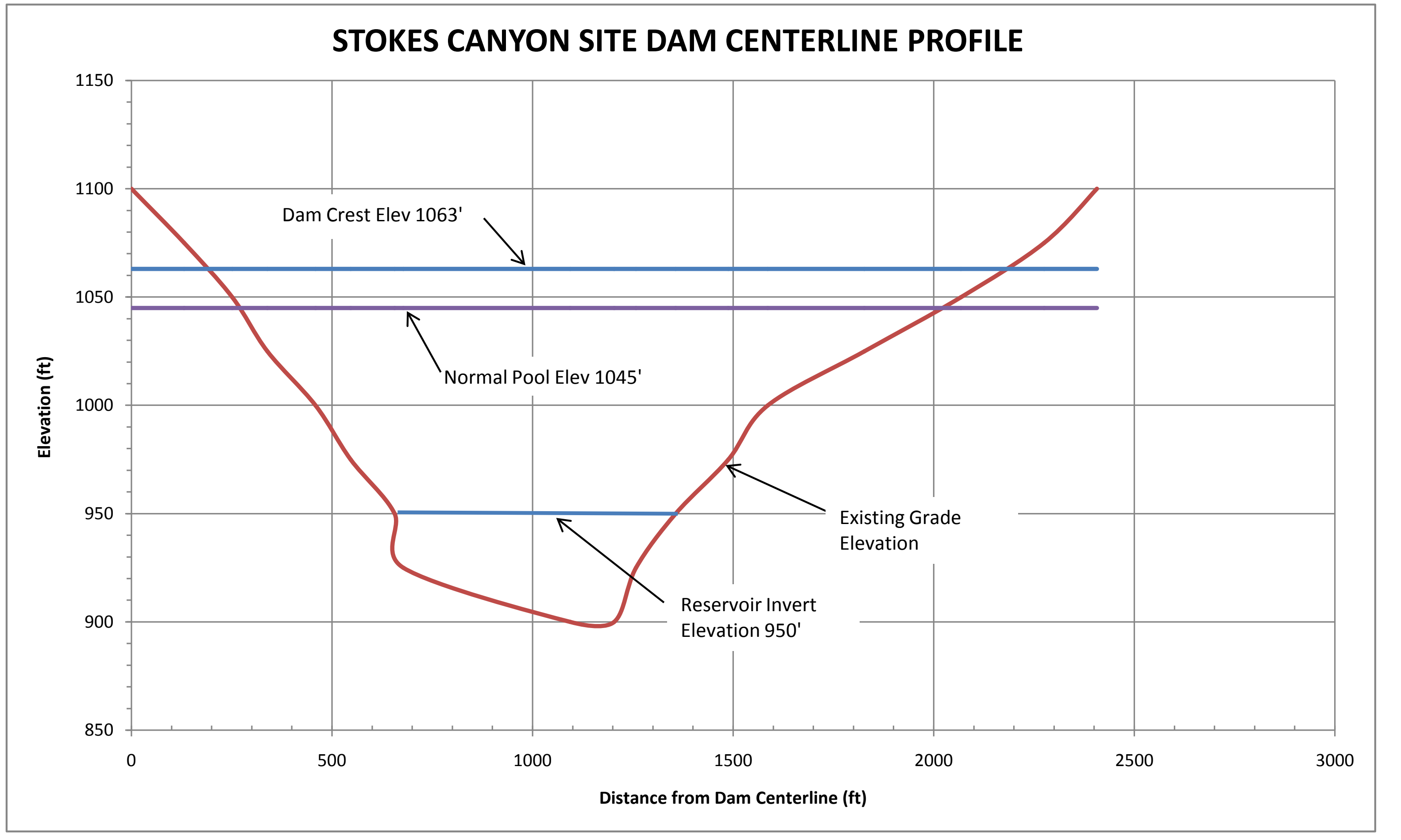
Distance Along Dam (ft)	Original Ground Elevation (ft)	Dam Crest Elev (ft)	Normal Pool Elev (ft)	Emb X-Sec Area (sq ft)	Emb Vol Inc (CY)	Emb Vol Cum (CY)
0	1100	1063	1045	0	0	0
131.28	1075	1063	1045	168	817	817
251.62	1050	1063	1045	874	4271	5088
339.14	1025	1063	1045	5643	19709	24796
459.48	1000	1063	1045	14474	77088	101884
547	975	1063	1045	27368	112172	214056
656.4	950	1063	1045	44324	235041	449097
678.28	925	1063	1045	65343	70912	520008
1094	900	1063	1045	90424	1895310	2415318
1203.4	900	1063	1045	90424	549578	2964897
1258.1	925	1063	1045	65343	223976	3188873
1356.56	950	1063	1045	44324	280778	3469651
1487.84	975	1063	1045	27368	240826	3710478
1586.3	1000	1063	1045	14474	102684	3813161
1826.98	1025	1063	1045	5643	114814	3927976
2067.66	1050	1063	1045	874	32944	3960920
2275.52	1075	1063	1045	168	4659	3965579
2406.8	1100	1063	1045	0	408	3965987

900

Above Ground Embankment Volume	3,970,000
Foundation Excavation (15% allowance)	600,000
Total Embankment Volume	4,570,000

Embankment quantities assume 25' crest width, and 3.5H:1V upstream and and 3H:1V downstream slopes.

Distance Scaled fron	Elevation
0	1100
0.12	1075
0.23	1050
0.31	1025
0.42	1000
0.5	975
0.6	950
0.62	925
1	900
1.1	900
1.15	925
1.24	950
1.36	975
1.45	1000
1.67	1025
1.89	1050
2.08	1075
2.2	1100



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Appendix E – Prop 218 Rates

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August 17, 2009 [+45 days minimum notice = 10/1/09] DRAFT (5) 07/22/09

Notice of public hearing on potable water rates.

Dear Customer,

As part of providing water service to you, Las Virgenes Municipal Water District (LVMWD) is entirely dependent on water supplied by the Metropolitan Water District of Southern California (MWD); LVMWD has no local water sources. Recently MWD adopted increases in water rates to its member agencies effective September 2009 and another in January 2010, resulting in increased water cost to this agency and exceeding the LVMWD's ability to recover those costs under the existing rate structure. This notice informs you of LVMWD's intent to pass these increases through to customers, as a revision to the potable water rate structure adopted in 2007. However, LVMWD will not pass along the September 2009 increase to its customers until January 2010.

Las Virgenes Municipal Water District is a public agency. As such, rate revenue is not used to pay shareholders or for profit. All funds collected for water service are used to benefit the customer by purchasing water from MWD, operating and maintaining the delivery system, implementing water conservation related programs and for repair and replacement projects necessary to the maintain the District's extensive potable water infrastructure.

If adopted, the restructured rate schedule will pass through the MWD-approved wholesale water rate increase and allow for passing through wholesale water cost increases as they occur in the future.

This proposed revision in rates does not impact sanitation (sewer treatment) charges or recycled water rates. Funding for the sanitation enterprise was determined to be adequate for the fiscal year 2009/10, resulting in the LVMWD Board of Directors foregoing a scheduled increase on July 1, 2009.

On Tuesday October 13, 2009 at 5 p.m. the Board of Directors will hold a public hearing at the District office, 4232 Las Virgenes Road, Calabasas, California to consider water rate adjustments described in this notification and to consider protests. If adopted, a typical single family residential customer using 70 billing units (52,360 gallons) could expect to see an average increase of $7.71 per month, billed every two months, for water service charge.

Prior to the public hearing, if you have any questions or comments regarding LVMWD's proposed rate adjustment, please contact the District at gm@lvmwd.com; by telephone at 818-251-2200 or by mail to 4232 Las Virgenes Rd, Calabasas, CA 91302.

Sincerely,

John R. Mundy
General Manager

Proposed Water Rate Change Overview

Cost of purchasing water is the most significant cost element in your water rates. When water costs increase, Las Virgenes Municipal Water District (LVMWD) has very little ability to absorb this cost and must pass it along to the customer. In turn, the revenues the District receives from its customers are then used to acquire water, operate and maintain the delivery system, implement conservation programs and fund repairs and replacement projects through the District's infrastructure investment program. Because LVMWD is a public agency, all funds are used to the benefit of the customer.

LVMWD is entirely dependent on the Metropolitan Water District of Southern California for supplies of potable water. There are no local sources of water. Every gallon of potable water you receive must be conveyed some 400 miles through the facilities of the State Water Project. In June 2009, Metropolitan adopted substantial rate increases to its member agencies, reflecting the impacts of water supply shortages, infrastructure needs, and escalating energy and treatment costs.

To cover the increasing costs being passed along to LVMWD, the District is proposing the following changes to its rates. These proposed increases only reflect the additional cost of purchased water. The District is not raising water rates at this time for any other purpose.

Proposed changes to Water Volume Charges

Potable Water Volume Charge	**Charges per Hundred cubic feet (Hcf). 1 Hcf = 748 gallons**			
	Current	*Proposed* Effective Jan 1, 2010	*Proposed* Effective July 1, 2010	*Proposed* Effective July 1, 2011
Tier 1	$1.32	$1.42	$1.56	$1.73
Tier 2	$1.65	$1.78	$1.96	$2.18
Tier 3	$2.46	$2.65	$2.91	$3.23
Tier 4	$3.69	$3.97	$4.37	$4.85

** Tier allotment is determined by meter size

Illustration of bimonthly water charges for a single family residence using 70 Hcf				
	Current	*Proposed* January 1, 2010	*Proposed* July 1, 2010	*Proposed* July 1, 2011
Readiness to serve*	$25.34	$25.34	$26.35	$27.40
Tier 1 (16 units)	$21.12	$22.74	$24.96	$27.68
Tier 2 (51 units)	$84.15	$90.78	$99.96	$111.18
Tier 3 (3 units)	$7.38	$7.95	$8.73	$9.69
Total bimonthly water charges	$137.99	$146.81	$160.00	$175.95

*This illustration presumes a single family residential customer with ¾" meter at Zone 1 elevation and customer is within the District's adopted water conservation budgeted use allotment. Illustration does not include sanitation charges. *The "Readiness to serve" rate structure through 2011 was adopted in 2007.*

In addition to the above rate revisions, by this notice and consistent with Government Code Sections 52755 - 53756, LVMWD will "pass through" future increases in wholesale water costs from the Metropolitan Water District of Southern California as they may occur.

If you have any questions or comments regarding LVMWD's proposed rate adjustment, please contact the District at gm@lvmwd.com; by telephone at 818-251-2200 or by mail to 4232 Las Virgenes Rd, Calabasas, CA 91302.

For water conservation information, please visit our website, www.LVMWD.com or www.bewaterwise.com.

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Appendix F – Public Hearing Information

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Appendix G – Administrative Code

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TITLE 4 - RECYCLED WATER SERVICE

CHAPTER 1 - GENERAL

ARTICLE 1 - PURPOSE AND SCOPE

4-1.101 PURPOSE

The District wishes to conserve water resources by collecting, treating and recycling sewage and wastewater and beneficially reusing the resultant recycled water.

Where service is desired for landscape irrigation, agricultural irrigation, industrial process water, or a recreational impoundment, the district shall provide the applicant, owner, or customer with recycled water in lieu of potable water whenever deemed possible and appropriate by the district. Determinations on the specific uses to be allowed shall be in accordance with the standards of treatment and water quality requirements set forth in the California Administrative Code, to protect the public health.

4-1.102 SCOPE

The provisions of this Title govern the commencement of recycled water service, the conditions of such service and the regulations which must be followed for such service to continue.

ARTICLE 2 - DEFINITIONS

4-1.201 GENERAL

The terms set forth in this Article are defined for the purposes of this title unless otherwise apparent from context.

4-1.202 AIR-GAP SEPARATION

"Air-Gap Separation" is a physical break between a supply pipe and a receiving vessel. The air-gap shall be at least double the diameter of the supply pipe, measured vertically above the top rim of the vessel, and in no case less than one inch.

4-1.203 APPLICANT

"Applicant" is any person, firm, corporation, association, or agency who desires, or is required by this Title, to obtain recycled water service.

4-1.204 APPROVED REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTION DEVICE

"Approved Reduced Pressure Principle Backflow Prevention Device" is a device containing two independently acting approved check valves together with a hydraulically operating, mechanically independent pressure relief valve located between the check valves, designed to maintain a reduced pressure between the check valves. The unit shall include properly located test cocks and tightly closing shut-off valves at each end of the assembly.

4-1.205 AUTOMATIC SYSTEM

"Automatic System" in reference to landscape irrigation systems includes automatic controllers, valves, and associated equipment required for the programming of effective water application rates when using recycled water.

4-1.206 AUXILIARY WATER SUPPLY

"Auxiliary Water Supply" shall mean any water supply on or available to the premises other than the district's potable water and recycled water supplies.

4-1.207 CROSS-CONNECTION

"Cross-connection" shall mean any unprotected connection between any part of a water system used or intended to supply water for drinking purposes and any source or system containing recycled water or any other auxiliary water supply that is not or cannot be approved as safe, wholesome, and potable for human consumption.

4-1.208 CUSTOMER

"Customer" shall mean any person, firm, corporation, association, or agency who receives recycled water service from the district.

4-1.209 DESIGN AREA

"Design Area" shall mean the specific land area designated to be irrigated through on-site facilities when used in reference to landscape sprinkler irrigation systems.

4-1.210 OFF-SITE FACILITIES

"Off-site Facilities" shall mean facilities under the control of the district, including recycled water pipelines, reservoirs, pumping stations, manholes, valve connections, treatment facilities, and other appurtenances and property up to the point of connection with the customer's facilities. For recycled water service, the off-site facilities shall be those upstream of the district's meter and the meter box.

4-1.211 ON-SITE FACILITIES

"On-site Facilities" shall mean facilities under the control of the applicant, owner, or customer including but not limited to residential or commercial landscape irrigation systems, agricultural irrigation systems, and backflow devices on the potable water service to prevent cross-connection from auxiliary water supplies. For recycled water service, the on-site facilities shall be those downstream of the district's recycled and potable meters.

4-1.212 ON-SITE RECYCLED WATER SUPERVISOR

"On-site Recycled Water Supervisor" shall mean a qualified person designated by a recycled water applicant and approved by the district. This person shall be knowledgeable in the construction and operation of irrigation systems and in the application of the guidelines, criteria, standards, and rules and regulations governing the proper use of recycled water.

4-1.213 POTABLE WATER

"Potable Water" shall mean that water furnished by the district to the customer for domestic purposes.

4-1.214 RECYCLED WATER

"Recycled Water" as defined in Title 22, Chapter 4, of the California Administrative Code means water which, as a result of tertiary treatment of domestic and industrial wastewater, is suitable for a direct beneficial use or a controlled use that otherwise would not occur.

4-1.215 SERVICE CONNECTION

"Service Connection" shall mean the piping necessary to conduct water from the district's water main to the particular property designated in the application for water service including the meter, meter box, valves and piping equipment within the meter box.

4-1.216 SERVICE

"Service" shall mean the delivery of recycled water.

4-1.217 UNIT

"Unit" is 100 cubic feet of water.

CHAPTER 2 - COMMENCEMENT OF SERVICE

ARTICLE 1 - APPLICATIONS

4-2.101 GENERAL

No person shall make connection to recycled water facilities of the district without a permit issued by the district.

Persons desiring or required to obtain service shall make application for a recycled water permit by providing such information as the General Manager deems appropriate to evaluate the request including but not limited to:

(a) Applicant's and on-site recycled water Supervisor's name;
(b) Identity of property to be served;
(c) Owner of property to be served;
(d) Design area;
(e) On-site irrigation piping plan map and
(f) Anticipated land use requiring irrigation.

4-2.102 APPLICATION PROCEDURE

(a) An application for a permit shall be made in writing, signed by the applicant, owner, or customer, if they are not one and the same.

(b) The applicant for a permit must agree to comply with the requirements of any and all applicable Federal, State and local statutes, ordinances, regulations, and other requirements. Current requirements are available at the district office on request. The district may, in its discretion, require specific prior approval of any permit by any Federal, State or local agency having jurisdiction over or an interest in the operation of the district's facilities.

(c) Upon receipt of an application, the General Manager shall review the application and make such investigation relating thereto as necessary. The General Manager may prescribe requirements in writing to the applicant as to the facilities necessary to be constructed, the manner of connection, the financial requirements and the use of the service, including the availability of adequate on-site recycled water facilities to ensure initial and future continued compliance with the district's regulations and any other applicable requirements.

(d) If the application is for a commercial account in the name of a corporation or partnership, the applicant shall provide a personal guarantee from an owner or principal of the applying entity, regardless of the form of organization, as follows:

"I hereby certify I am a principal/officer of the organization listed on the attached application. I accept full responsibility for all fees and charges related to water and sewer service for the organization.

____
Name and Title

4-2.103 PERMIT

(a) The General Manager shall issue a recycled water permit upon approval of an application for recycled water service. The permit shall entitle the applicant to receive recycled water service upon the terms and conditions of this Title.

(b) The permit shall include the following:

(1) Name and address of applicant;

(2) A drawing of the proposed system showing the location and size of all valves, pipes, outlets, and appurtenances;

(3) A statement that no changes in the proposed system will be undertaken without application and approval of an amended permit; and

(4) A statement recognizing potential penalties for violation of district rules and regulations.

4-2.104 MANDATORY SERVICE

(a) When, in the judgment of the board, service can be feasibly provided to a particular parcel for particular uses, the General Manager shall require the use of recycled water in lieu of potable water for those uses. As used herein, the term "feasible" means recycled water is available for delivery to the property in compliance with all applicable federal, state and local laws, ordinances and regulations and such recycled water can be delivered to the property at an overall cost to the user which does not exceed the overall cost of potable water service.

(b) A permit for recycled water service shall be issued by the General Manager when the conditions described herein are met.

ARTICLE 2 - FEES/DEPOSITS

4-2.201 GENERAL

Applicants for recycled water service shall pay for the construction of facilities necessary to deliver recycled water to the applicant's property and to distribute recycled water upon the applicant's property. However, the district shall reimburse the applicant for a portion of the cost of such facilities as set forth in this Article.

4-2.202 FINANCIAL PARTICIPATION BY DISTRICT

(a) The district encourages the use of recycled water by providing reduced rates for the delivery of recycled water. The district will build recycled water facilities to serve ex-potable or potential recycled water customers if the cost is less than $5500/AF/year of usage. This includes everything up to and including a recycled water meter and backflow protection on the potable service.

(b) The district may reimburse a developer for costs incurred to extend a recycled water system to a maximum of 50 percent of developer paid Conservation Fund Fees, after first deducting all district costs incurred for the recycled water system.

(c) In the case of an existing customer, the district may reimburse the cost of portions of an extension of the recycled water distribution system installed to receive service from a district recycled water pipeline. The district shall pay for the installation and all facilities required to provide service or reimburse on half the Water Conservation Fund fees paid for potable service to the property, whichever is less. The district shall pay for the foregoing facilities, without limitation based on the amount of Water Conservation Fund fees when an existing potable irrigation service is connected to the district recycled water system during the installation of the district's system.

(d) Recycled water customers are responsible for paying the cost of necessary recycled water facilities, which are not paid for by the district as described herein.

CHAPTER 3 - CONDITIONS OF SERVICE

ARTICLE 1 - GENERAL

4-3.101 GENERAL

Service will be provided to property within the district which is contiguous to existing recycled water distribution lines for the uses specified herein. Service will be provided to property not contiguous to existing distribution lines if the distribution line is extended to the applicant's property as provided below.

4-3.102 GENERAL REQUIREMENTS: PERMITTED USES

(a) The uses of recycled water may include, but are not limited to landscape irrigation, agricultural irrigation, industrial process water, and recreational impoundment. Each such use must be considered for approval by the district on a case-by-case basis, and the district may determine in its discretion whether it is necessary or desirable to furnish recycled water for the specific use involved. Determination as to specific uses to be allowed shall be in accordance with the standards of treatment and water quality requirements set forth in Title 22 of the California Code of Regulations. Prior to approving such uses, the district may, in its discretion, set forth specific requirements as conditions to providing such services and/or require specific prior approval from the appropriate regulatory agencies.

(b) Recycled water may be used for residential irrigation by individual homeowners provided:

(1) The design and construction of the private irrigation systems shall be approved by the district and

(2) Each homeowner obtains a permit to receive the water and uses it only for irrigation purposes.

(c) Recycled water may be used for common area landscape irrigation provided such use is controlled by the district, or another party other than the customer, through a surveillance program of areas under irrigation, and provided further:

(1) The design and construction of the irrigation system shall be approved by the district and

(2) The owner and operator of the system obtains a permit to receive such water and use it only for irrigation purposes.

4-3.103 OTHER LIMITATIONS

The district shall not be liable for any damage by recycled water or otherwise resulting from defective plumbing, broken or faulty services, or recycled water mains. All applicants for recycled water service shall be required to accept such conditions of pressure and service as are provided by the distribution system at the location of the proposed service connection and to hold the district harmless from all damage arising from low pressure or high pressure conditions or from interruptions of service.

4-3.104 SIZE, LOCATION, AND INSTALLATION OF SERVICE LINE

(a) The district reserves the right to determine the size of the service lines, the service connections, and the meters and shall also have the right to determine the kind and size of backflow protection devices for potable water service, in accordance herewith, and any and all other appurtenances to the service. The service lines shall be installed to a curb or property line of the customer's property, abutting upon a public street, highway, alley, easement, lane or road (other than a freeway) in which is installed recycled water mains of the district.

(b) (1) The district reserves the right to limit the area of land to be supplied by one service connection to one ownership. A service connection shall not be used to supply adjoining property of a different owner.

(2) When property provided with a service connection is subdivided, such connection shall be considered as serving the lot or parcel of land that it directly or first enters. Additional mains and/or recycled water service lines will be required for all subdivided areas in accordance with this Title.

(3) All recycled water used on any premises where a meter is installed must pass through the meter. Customers shall be held responsible and charges for all recycled water passing through their meters.

(4) Every recycled water service line installed by the district shall be equipped with a curb stop or wheel valve on the inlet side of the meter; such valve or curb stop being intended exclusively for the use of the district in controlling the recycled water supply through the service line. If the curb stop or wheel valve is damaged by the customer's use to an extent requiring replacement, such replacement shall be at the customer's expense.

4-3.105 RELOCATION OF RECYCLED WATER SERVICE LINE

Should a service line installed pursuant to the request of the applicant, owner, or customer be of the wrong size or installed at a wrong location, the cost of relocation shall be paid by the applicant, owner, or customer. All services provided prior to final street improvements shall be considered temporary and the costs for all repairs or changes required to be performed by the district shall be paid by the applicant, owner, or customer.

4-3.106 SCHEDULING RECYCLED WATER

The district reserves the right to control and schedule the use of recycled water if, in the opinion of the General Manager, scheduling is necessary for purposes including, but not limited to, the maintenance of an acceptable working pressure in the recycled water system and providing for reasonable safeguards in relation to public health.

4-3.107 EMERGENCY CONNECTIONS TO RECYCLED WATER SYSTEM

If, in the opinion of the General Manager, an emergency exists whereby recycled water is not available, the General Manager may approve a temporary connection to the potable water system. Before such temporary connection is made, the portion without recycled water shall be isolated from the portion with recycled water by an approved air gap. The portion without recycled water shall then be isolated by an approved backflow prevention device, or devices, of the type determined in accordance herewith, and shall be installed on the potable water line or lines in accordance with this Title, and any and all applicable rules and regulations of the State and local health departments. This emergency connection, or connections, shall be removed before connection is reestablished to the remainder of the recycled water system.

4-3.108 CLASSES OF SERVICE

The classes of service for water delivered by the district are:

(a) Las Virgenes Valley Zone, which includes all recycled water customers receiving water that does not require pumping above a hydraulic gradient of 795'. As used in this Title, Hydraulic Gradient, or H.G., shall mean the maximum water elevation represented by the pressure in a water system, or the maximum surface elevation of the water in the reservoir serving the system.

(b) Western Zone, which includes all recycled water customers receiving water that requires pumping to elevation 1225'.

(c) Calabasas Zone, which includes recycled water customers receiving water that requires pumping to elevation 1525'.

ARTICLE 3 - EXTENSION OF FACILITIES

4-3.201 GENERAL

All off-site recycled water facilities and all on-site recycled water facilities shall be designed and constructed according to the requirements, conditions, and standards as adopted and revised by the Board from time to time, which document is on file at the office of the district, and by this reference is incorporated herein. The recycled water system, including both off-site and on-site facilities, shall be separate and independent of any potable water system.

4-3.202 ON-SITE RECYCLED WATER FACILITIES

(a) Any on-site recycled water facility shall be provided by the applicant, owner, or customer, at the applicant's expense. The applicant, owner, or customer shall retain title to all such on-site facilities.

(b) On-site facilities, in addition to conforming to applicable district guidelines shall conform to local governing codes, rules, and regulations.

(c) Plans and specifications and record drawings, in accordance with district requirements, shall be prepared and submitted to the district for on-site facilities. Plans and specifications must be approved by the district prior to commencing construction.

(d) Irrigation schedules must be prepared and approved in accordance with the above referenced specifications. Prior to commencement of service to any on-site system using recycled water, record drawings shall be provided and approved and the installed system shall be tested under active conditions to ensure that the operation is in accordance with this Title.

(e) In those areas where recycled water is not immediately available for use when the design area is ready for construction, and if the district has determined that recycled water will be supplied in the future, on-site facilities shall nevertheless be designed to use recycled water. Provisions shall be made and these regulations followed to allow for connection to the district's off-site recycled water facilities when available. In the interim, potable domestic water will be supplied to the on-site facilities through a temporary connection. A backflow preventer will be required on the temporary connection as long as the on-site facilities are using potable water. The backflow preventer shall be downstream of the meter and a part of the on-site facilities. The district will remove the backflow preventer at the owner's expense, and will make the connection to the on-site facilities when recycled water becomes available.

4-3.203 OFF-SITE RECYCLED WATER FACILITIES

(a) Any off-site recycled water distribution facilities that are required to serve the applicant's property, shall be provided by the applicant, owner, or customer at his expense, unless the district determines it is a district benefit to construct these capital facilities.

(b) The district may require the construction of off-site facilities including reservoirs, pumping facilities, and treatment capacity, either within the area described in the application for service or outside of such area, larger than the size determined by the district to be required for providing adequate service to the property described in the application submitted to the district. In such cases, the district will contract with the applicant, owner or customer for reimbursement on a pro rata basis for the difference between the cost of the facilities that the developer is required to install and the cost of the facilities which otherwise would be required to provide adequate service to the property described in the application for service submitted to the district in the manner herein provided.

(c) The terms, extent, and provisions of such reimbursement agreement shall be determined from time to time by the district in its discretion. In no event shall interest be paid on any such amounts. The period of time in which reimbursement will be made will be determined by the district, dependent upon the amount necessary to be advanced by the applicant, owner, or customer in addition to other normal charges, the probability of receipt of payment and of the anticipated course of development of the particular portion of the district in which the facilities are proposed to be constructed. The amount so advanced for facilities available to lands outside the area described in the application for service shall be taken into account when development occurs for which such facilities are constructed and the district reserves the right to impose and charge additional connection charges, initial charges, and costs, if necessary, to cause equitable reimbursement in any such instances.

(d) Plans and specifications for off-site facilities shall be submitted to and approved by the district in advance of construction.

(e) The district shall provide recycled water to the point of connection of the off-site facilities to on-site facility upon transfer to the district of title to all facilities in the required systems and any necessary easements thereof. All easements shall be in a form acceptable to the district and not subject to outstanding obligations to relocate such facilities or any deeds of trust, except in instances where such is recommended by the General Manager to be in the best interests of the district.

4-3.204 CONVERSIONS OF EXISTING FACILITIES FOR RECYCLED WATER

Where it is planned that an existing water system be converted to a recycled water facility, the facilities to be converted to recycled water shall be investigated in detail, including a review of any record drawings, preparation of required reports, and determinations by the district of measures necessary to bring the system into full compliance with this Title. No existing potable water facilities shall be connected to or incorporated into the recycled water system without district approval.

CHAPTER - 4 CONTINUATION OF SERVICE

ARTICLE 1 - RATES: TIME/MANNER OF PAYMENT

4-4.101 GENERAL

A recycled water customer shall be entitled to continue to receive recycled water service from the district by compliance with the terms of this chapter.

4-4.102 BI-MONTHLY WATER RATES INSIDE THE DISTRICT

A customer obtaining permanent service for property located within the district shall pay the bi-monthly water rates set forth below based upon the size of the meter serving the property.

Size of Meter	Bi-Monthly Service Charge
3/4" - 12"	No Charge

[1] "4-4.103 **Commodity Charges**

(a) In addition to the readiness to serve charge, each recycled water customer shall pay a commodity charge for water delivered through each meter in a bimonthly period based on the class of customer, tier allotments and the elevation zone within which the customer's property is located as follows.

(b) Tier allotments in billing units for recycled water customers shall be determined by multiplying the base tier allotments by the meter capacity ratio for the recycled water meter serving the property.

	Base Tier Allotments
Tier 1	First 16
Tier 2	Next 51
Tier 3	Next 133
Tier 4	Over 200

Meter Size	Meter Capacity Ratio
3/4"	1.0
1"	1.7
1-1/2"	3.3
2"	5.3
3"	10.7
4"	16.7
6"	33.3
8"	53.3
10"	76.7

(c) The volume and elevation zone charge per unit shall be as follows:

Volume/ Elevation Charge	Commencing with meter reads on or after:				
	11/1/2007	7/1/2008	7/1/2009	7/1/2010	7/1/2011
Tier 1	$1.11	$1.14	$1.17	$1.22	$1.27
Tier 2	1.39	1.43	1.47	1.53	1.59
Tier 3	2.09	2.15	2.21	2.30	2.39
Tier 4	3.13	3.22	3.32	3.45	3.59
Las Virgenes Valley Zone	($0.19)	($0.20)	($0.21)	($0.22)	($0.23)

[1] Amended 9/25/07 by Ord 09-05-252

"4-4.104 Recycled Water Temporary Service Rates

(a) A monthly readiness to serve charge shall be paid for each temporary meter to offset the cost of providing facilities to serve the customer and shall be paid following the installation of the meter and regardless of whether the customer takes delivery of water or not, as follows:

Meter Size	Commencing with meter reads on or after:				
	11/1/2007	7/1/2008	7/1/2009	7/1/2010	7/1/2011
1"	$ 24.55	$ 26.27	$ 27.98	$ 29.10	$ 30.26
2-1/2" / 3"	131.25	140.25	149.25	155.25	161.25
4"	201.75	216.00	230.25	239.25	249.00
6"	399.00	426.75	454.50	472.50	491.25
8"	635.25	679.50	723.75	752.25	783.00
10"	910.50	974.25	1038.00	1079.25	1122.75

(b) The monthly volume charge for recycled water delivered through temporary meters shall be 150% of the Tier 4 recycled water volume and elevation zone charges for the site where the temporary meter is connected.

(c) An installation fee of $50.00 shall be paid prior to installation of the temporary meter by district staff. In addition, a meter deposit of $500.00 for a 1" meter or $1,500.00 for a 2-1/2" meter shall be required prior to installation of the meter. Such meter deposit will be refunded, net any costs incurred by the district relative to the temporary meter. For meters larger than 2-1/2", the deposit shall be 2 times the cost of the meter.

(d) Prior to the installation of the temporary meter, the customer shall be required to pay a deposit in an amount sufficient to guarantee the payment of twelve months of water bills as estimated by the General Manager. Such deposit will be refunded, net any costs unpaid to the district for recycled water usage."

ARTICLE 2 - USAGE

4-4.201 FACILITIES OPERATION: OFF-SITE RECYCLED WATER FACILITIES

Operation and surveillance of all of the district's off-site recycled water system facilities, including but not limited to recycled water pipelines, reservoirs, pumping stations, fire hydrants, manholes, valves, connections, supply inter-ties, treatment facilities, and other appurtenances and property up to and including the district's meter, shall be under the management and control of the district. No other persons except authorized employees of the district shall have any right to enter upon, inspect, operate, adjust, change, alter, move, or relocate any portion of the foregoing, or any of the district's property. If such should occur, all charges and penalties shall be applicable and collected. Such action may also be in violation of any and all applicable Federal, State, and local statutes, ordinances, regulations, and other requirements.

4-4.202 FACILITIES OPERATIONS: ON-SITE FACILITIES

(a) The operation and maintenance of on-site recycled water distribution facilities are the responsibility of the applicant, owner or customer.

(b) The operation and maintenance of all on-site recycled water system facilities, including but not limited to landscape irrigation systems, agricultural irrigation systems, systems utilized in relation to use of recycled water for industrial process or construction purposes, or recreational impoundment systems using the district's recycled water shall be under the management of an "on-site Recycled Water Supervisor" designated by the applicant, owner or customer and approved by the district. The district may, from time to time, require that an "on-site Recycled Water Supervisor" obtain instruction in the use of recycled water, such instruction being provided by or approved by the district.

(c) The General Manager shall monitor and inspect the entire recycled water system, including on-site and off-site facilities, and for these purposes shall have the right to enter upon the customer's premises during reasonable hours. Where necessary, keys and/or combinations shall be issued to the district to provide such access.

(d) The applicant, owner or customer shall have the following responsibilities in relation to operation of on-site facilities:

(1) To make sure that all operations personnel are trained and familiarized with the use of recycled water.

(2) To furnish their operations personnel with maintenance instructions, irrigation schedules, and record drawings to ensure proper operation in accordance with the on-site facilities design and this Title.

(3) To prepare and submit to the district one (1) set of record drawings on Mylar or in digital format.

(4) To notify the district of any and all updates or proposed changes, modifications or additions to the on-site facilities, which changes shall be approved by the district and shall be designed and constructed according to the requirements, conditions and standards set forth in the district's "Guidelines of Recycled Water Facilities" and set forth in this title. In accordance with the above referenced requirements, conditions and standards, changes must be submitted to the district for plan check and approval prior to construction. The district shall inspect the construction and the district shall approve revised record drawings and controller charts. The district may, if it deems such to be in the best interest of the district, waive or modify any of the foregoing.

(5) To ensure that the recycled water facilities remain in accordance with this Title.

(6) To operate and control the system in order to prevent direct human consumption of recycled water and to control and limit runoff. The applicant, owner or customer shall be responsible for any and all subsequent uses of the recycled water. Operation and control measures to be utilized in this regard shall include, where appropriate, but not be limited to the following:

(a) On-site facilities shall be operated to prevent or minimize discharge into areas not under control of the customer. Part circle sprinklers shall be used adjacent to sidewalks, roadways, and property lines to confine the discharge from sprinklers to the design area.

(b) The operation of the on-site facilities shall be during the periods of minimal use of the service area. Consideration shall be given to allow a maximum dry-out time before the design area will be used by the public.

(c) Recycled water shall be applied at a rate that does not exceed the infiltration rate of the soil. Where varying soil types are present, the design and operation of the on-site facilities shall be compatible with the lowest infiltration rate present.

(d) To prevent runoff and ponding, automatic systems shall be utilized and programmed to prevent or minimize the ponding and runoff of recycled water. The sprinkler system shall not be allowed to operate for a time longer than the landscape's water requirement. If runoff occurs before the landscape's water requirements are met, the automatic controls shall be reprogrammed to lessen watering cycles to meet the requirements. This method of operation is intended to control and limit runoff.

(e) To report to the district any and all failures in their system that causes an unauthorized discharge of recycled water.

(7) To comply with any and all applicable Federal, State and local statutes, ordinances, regulations, contracts, these Rules and regulations, and all requirements prescribed by the General Manager and the Board. In the event of violation, all charges and penalties shall be applied and collected.

4-4.205 WATER CONSERVATION

It is the desire of the district to effect conservation of water resources whenever possible, such measures being consistent with legal responsibilities to seek to wisely utilize the water resources of the State of California and the district. No irrigation of new or existing parks, median strips, landscaped public areas or landscaped areas, lawns, or gardens surrounding single-family homes, condominiums, townhouses, apartments, and industrial parks shall occur in such a way as to wastewater. The rate and extent of application of water shall be controlled by the consumer so as to minimize runoff from the irrigated areas.

4-4.206 METER TESTING

(a) If the recycled water meter fails to register during any period, or is known to register inaccurately, the customer shall be charged with an average daily consumption at the same season shown by the reading of the meter when in use and registering accurately.

(b) A customer may demand the meter be tested by the district and costs shall be charged to the customer in the same manner as for testing a potable water meter.

ARTICLE 4 - PROTECTIVE MEASURES

4-4.301 CROSS-CONNECTION PREVENTION: GENERAL

The purpose of these provisions is to protect the district's potable water supply against actual or potential cross-connection by isolating within the premises contamination or pollution that may occur because of some undiscovered or unauthorized cross-connection in the premises, and to prevent cross-connections from occurring in the future, in accordance with Title 17, Chapter 5, Section 7583-7622, of the California Administrative Code. These provisions shall be in addition to and not in lieu of the controls and requirements of other regulatory agencies, such as local governmental agencies and local and State health departments. These regulations are intended to protect the district's potable water supply and are not intended to provide regulatory measures for protection of users from the hazards of cross-connections within their own premises.

The district shall provide backflow prevention devices on the potable water service to the premises. Such devices shall be owned and maintained by the district and located on the premises of the property served and shall not be on the district's portion of the system.

4-4.302 CROSS CONNECTION PREVENTION: WHERE PROTECTION IS REQUIRED

(a) On-site recycled water systems are a separate and controlled non-potable system. Under normal conditions, protective devices will be required on the district's potable water service. Under no circumstances will the district tolerate an actual or potential cross-connection between the district's potable water supply and the customer's on-site non-potable water facilities.

(b) The district will require cross-connection control on the district's potable water supply in all cases and shall review each service on a case-by-case basis. The district will require a backflow prevention device on its potable water supply at its discretion, and specifically:

(i) When recycled water is used on individually owned and controlled premises;

(ii) When the recycled water system has additional pressure and

(iii) When determined this is a risk of cross-connection by Las Virgenes.

This type of protection device if required by the district shall be determined by the district.

4-4.303 INSPECTION OF PROTECTIVE DEVICES

The district shall inspect backflow prevention devices at lease once a year, or more often in those instances where successive inspections indicate repeated failure. All inspections and testing shall be performed by a tester certified by the local health department. These devices shall be repaired, overhauled, or replaced at the expense of the water user whenever they are found to be defective. Records of all such tests, repairs and overhauls shall be maintained by a list and made available to the local health department. Northing contained herein shall relieve a potable water customer from the duty to install and maintain backflow prevention devices under Title 3 of this Code.

4-4.304 MARKING SAFE AND UNSAFE WATER LINES

Where the premises contain dual or multiple water systems and piping, the exposed portions for recycled water pipelines shall be painted, banded or marked at sufficient intervals. All outlets from secondary or other potentially contaminated systems shall be posted as being contaminated and unsafe for drinking purposes.

4-4.305 ON-SITE RECYCLED WATER SUPERVISOR

The district, who in turn will notify the local and State Health Departments, and the Regional Water Quality Control Board, shall be kept informed of the identity of the person responsible for the water piping on all premises concerned with these regulations. At each premises where it is necessary in the opinion of the regulatory agency and/or the district, a Water Supervisor shall be designated. This Water Supervisor shall be responsible for the installation and the use of pipelines and equipment and for the prevention of cross-connections.

In the event of contamination or pollution of the drinking water system due to a cross-connection on the premises, the local health officer and the district shall be promptly advised by the person responsible for the water system so that appropriate measures may be taken to overcome the contamination or pollution."

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Appendix H – Construction Financing Plan

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Project Financing Projections

Total Capital Non-Construction Costs	$ 34,660,000	for Design, Environmental, etc.
Non-Construction Costs Esclated to Iimplementation Mid-Point	$ 37,874,000	Assumes mid-point of 2014 Escalated at the inflation rate
Total Construction Cost	$ 79,273,000	
Construction Cost Escalated to Construction Mid-Point	$ 97,496,000	Assumes mid-point of 2018 Escalated at the inflation rate
Annual Payment ($/YR)	$ 5,340,513	for Loan for Construction
Annual O&M ($/YR)	$ 1,595,300	Escalated at the inflation rate
Avg 2011 Recycled Water Rate ($/AF)	$1,145	Escalated at the inflation rate
Recycled Water Sales (AFY)	2,360	

Note: All costs above are in 2011 dollars (except escalated construction costs).

Year	
2017	Start construction activities
2019	Complete construction activities
2020	Start operations

5.0%	Financing Rate
50	Financing Term
3.0%	Inflation Rate
5.0%	Discount Rate

		Costs				Revenues / Funding Sources						
	Year	Capital Non-Construction Costs	Loan Repayment	O&M	Total Annual Cost	RW Sales (AFY)	RW Rate ($/AF)	MWD Rate ($/AF)	Annual RW Sales Revenue	General Fund Supplement	Avoided MWD Purchases	Project Revenue / (Shortfall) w/o General Fund
1	2012	$ 6,932,000	$ -	$ -	**$ 6,932,000**		$1,179	$918	$ -	$ 6,932,000	$ -	$ (6,932,000)
2	2013	$ 7,139,960	$ -	$ -	**$ 7,139,960**		$1,215	$964	$ -	$ 7,139,960	$ -	$ (7,139,960)
3	2014	$ 7,354,159	$ -	$ -	**$ 7,354,159**		$1,251	$1,012	$ -	$ 7,354,159	$ -	$ (7,354,159)
4	2015	$ 7,574,784	$ -	$ -	**$ 7,574,784**		$1,289	$1,063	$ -	$ 7,574,784	$ -	$ (7,574,784)
5	2016	$ 7,802,027	$ -	$ -	**$ 7,802,027**		$1,327	$1,116	$ -	$ 7,802,027	$ -	$ (7,802,027)
6	2017		$ 5,340,513	$ -	**$ 5,340,513**		$1,367	$1,172	$ -	$ 5,340,513	$ -	$ (5,340,513)
7	2018		$ 5,340,513	$ -	**$ 5,340,513**		$1,408	$1,230	$ -	$ 5,340,513	$ -	$ (5,340,513)
8	2019		$ 5,340,513	$ -	**$ 5,340,513**		$1,450	$1,292	$ -	$ 5,340,513	$ -	$ (5,340,513)
9	2020		$ 5,340,513	$ 2,081,505	**$ 7,422,017**	2,360	$1,494	$1,356	$ 3,525,758	$ 3,896,259	$ 3,200,878	$ (695,381)
10	2021		$ 5,340,513	$ 2,143,950	**$ 7,484,462**	2,360	$1,539	$1,424	$ 3,631,531	$ 3,852,932	$ 3,360,922	$ (492,010)
11	2022		$ 5,340,513	$ 2,208,268	**$ 7,548,781**	2,360	$1,585	$1,495	$ 3,740,477	$ 3,808,304	$ 3,528,968	$ (279,337)
12	2023		$ 5,340,513	$ 2,274,516	**$ 7,615,029**	2,360	$1,632	$1,570	$ 3,852,691	$ 3,762,338	$ 3,705,416	$ (56,922)
13	2024		$ 5,340,513	$ 2,342,752	**$ 7,683,264**	2,360	$1,681	$1,649	$ 3,968,272	$ 3,714,993	$ 3,890,687	$ 175,694
14	2025		$ 5,340,513	$ 2,413,034	**$ 7,753,547**	2,360	$1,732	$1,731	$ 4,087,320	$ 3,666,227	$ 4,085,221	$ 418,994
15	2026		$ 5,340,513	$ 2,485,425	**$ 7,825,938**	2,360	$1,784	$1,818	$ 4,209,940	$ 3,615,998	$ 4,289,482	$ 673,484
16	2027		$ 5,340,513	$ 2,559,988	**$ 7,900,501**	2,360	$1,837	$1,908	$ 4,336,238	$ 3,564,263	$ 4,503,956	$ 939,693
17	2028		$ 5,340,513	$ 2,636,788	**$ 7,977,300**	2,360	$1,893	$2,004	$ 4,466,325	$ 3,510,976	$ 4,729,154	$ 1,218,179
18	2029		$ 5,340,513	$ 2,715,891	**$ 8,056,404**	2,360	$1,949	$2,104	$ 4,600,315	$ 3,456,089	$ 4,965,612	$ 1,509,522
19	2030		$ 5,340,513	$ 2,797,368	**$ 8,137,881**	2,360	$2,008	$2,209	$ 4,738,324	$ 3,399,557	$ 5,213,892	$ 1,814,336
20	2031		$ 5,340,513	$ 2,881,289	**$ 8,221,802**	2,360	$2,068	$2,320	$ 4,880,474	$ 3,341,328	$ 5,474,587	$ 2,133,259
21	2032		$ 5,340,513	$ 2,967,728	**$ 8,308,241**	2,360	$2,130	$2,436	$ 5,026,888	$ 3,281,353	$ 5,748,316	$ 2,466,964
22	2033		$ 5,340,513	$ 3,056,760	**$ 8,397,272**	2,360	$2,194	$2,558	$ 5,177,695	$ 3,219,578	$ 6,035,732	$ 2,816,154
23	2034		$ 5,340,513	$ 3,148,463	**$ 8,488,975**	2,360	$2,260	$2,685	$ 5,333,025	$ 3,155,950	$ 6,337,519	$ 3,181,569
24	2035		$ 5,340,513	$ 3,242,916	**$ 8,583,429**	2,360	$2,328	$2,820	$ 5,493,016	$ 3,090,413	$ 6,654,395	$ 3,563,982
25	2036		$ 5,340,513	$ 3,340,204	**$ 8,680,717**	2,360	$2,397	$2,961	$ 5,657,807	$ 3,022,910	$ 6,987,115	$ 3,964,205
26	2037		$ 5,340,513	$ 3,440,410	**$ 8,780,923**	2,360	$2,469	$3,109	$ 5,827,541	$ 2,953,382	$ 7,336,470	$ 4,383,089
27	2038		$ 5,340,513	$ 3,543,622	**$ 8,884,135**	2,360	$2,543	$3,264	$ 6,002,367	$ 2,881,768	$ 7,703,294	$ 4,821,526
28	2039		$ 5,340,513	$ 3,649,931	**$ 8,990,444**	2,360	$2,620	$3,427	$ 6,182,438	$ 2,808,005	$ 8,088,458	$ 5,280,453
29	2040		$ 5,340,513	$ 3,759,429	**$ 9,099,942**	2,360	$2,698	$3,599	$ 6,367,911	$ 2,732,030	$ 8,492,881	$ 5,760,851
30	2041		$ 5,340,513	$ 3,872,212	**$ 9,212,724**	2,360	$2,779	$3,779	$ 6,558,949	$ 2,653,776	$ 8,917,525	$ 6,263,750
31	2042		$ 5,340,513	$ 3,988,378	**$ 9,328,891**	2,360	$2,863	$3,968	$ 6,755,717	$ 2,573,174	$ 9,363,402	$ 6,790,228
32	2043		$ 5,340,513	$ 4,108,030	**$ 9,448,542**	2,360	$2,948	$4,166	$ 6,958,389	$ 2,490,154	$ 9,831,572	$ 7,341,418
33	2044		$ 5,340,513	$ 4,231,270	**$ 9,571,783**	2,360	$3,037	$4,374	$ 7,167,140	$ 2,404,643	$ 10,323,150	$ 7,918,508
34	2045		$ 5,340,513	$ 4,358,209	**$ 9,698,721**	2,360	$3,128	$4,593	$ 7,382,154	$ 2,316,567	$ 10,839,308	$ 8,522,741
35	2046		$ 5,340,513	$ 4,488,955	**$ 9,829,467**	2,360	$3,222	$4,823	$ 7,603,619	$ 2,225,848	$ 11,381,273	$ 9,155,425
36	2047		$ 5,340,513	$ 4,623,623	**$ 9,964,136**	2,360	$3,319	$5,064	$ 7,831,728	$ 2,132,408	$ 11,950,337	$ 9,817,929
37	2048		$ 5,340,513	$ 4,762,332	**$ 10,102,845**	2,360	$3,418	$5,317	$ 8,066,680	$ 2,036,165	$ 12,547,854	$ 10,511,689
38	2049		$ 5,340,513	$ 4,905,202	**$ 10,245,715**	2,360	$3,521	$5,583	$ 8,308,680	$ 1,937,035	$ 13,175,247	$ 11,238,212
39	2050		$ 5,340,513	$ 5,052,358	**$ 10,392,871**	2,360	$3,626	$5,862	$ 8,557,940	$ 1,834,930	$ 13,834,009	$ 11,999,078
40	2051		$ 5,340,513	$ 5,203,929	**$ 10,544,441**	2,360	$3,735	$6,155	$ 8,814,679	$ 1,729,763	$ 14,525,709	$ 12,795,946
41	2052		$ 5,340,513	$ 5,360,047	**$ 10,700,559**	2,360	$3,847	$6,463	$ 9,079,119	$ 1,621,440	$ 15,251,995	$ 13,630,554
42	2053		$ 5,340,513	$ 5,520,848	**$ 10,861,361**	2,360	$3,962	$6,786	$ 9,351,492	$ 1,509,868	$ 16,014,594	$ 14,504,726
43	2054		$ 5,340,513	$ 5,686,474	**$ 11,026,986**	2,360	$4,081	$7,125	$ 9,632,037	$ 1,394,949	$ 16,815,324	$ 15,420,375
44	2055		$ 5,340,513	$ 5,857,068	**$ 11,197,580**	2,360	$4,204	$7,481	$ 9,920,998	$ 1,276,582	$ 17,656,090	$ 16,379,508
45	2056		$ 5,340,513	$ 6,032,780	**$ 11,373,292**	2,360	$4,330	$7,855	$ 10,218,628	$ 1,154,664	$ 18,538,895	$ 17,384,231
46	2057		$ 5,340,513	$ 6,213,763	**$ 11,554,276**	2,360	$4,460	$8,248	$ 10,525,187	$ 1,029,089	$ 19,465,840	$ 18,436,751
47	2058		$ 5,340,513	$ 6,400,176	**$ 11,740,689**	2,360	$4,594	$8,661	$ 10,840,943	$ 899,746	$ 20,439,132	$ 19,539,386
48	2059		$ 5,340,513	$ 6,592,181	**$ 11,932,694**	2,360	$4,731	$9,094	$ 11,166,171	$ 766,523	$ 21,461,088	$ 20,694,565
49	2060		$ 5,340,513	$ 6,789,947	**$ 12,130,459**	2,360	$4,873	$9,548	$ 11,501,156	$ 629,303	$ 22,534,143	$ 21,904,839
50	2061		$ 5,340,513	$ 6,993,645	**$ 12,334,158**	2,360	$5,020	$10,026	$ 11,846,191	$ 487,967	$ 23,660,850	$ 23,172,883
51	2062		$ 5,340,513	$ 7,203,455	**$ 12,543,967**	2,360	$5,170	$10,527	$ 12,201,577	$ 342,391	$ 24,843,892	$ 24,501,502
52	2063		$ 5,340,513	$ 7,419,558	**$ 12,760,071**	2,360	$5,325	$11,053	$ 12,567,624	$ 192,447	$ 26,086,087	$ 25,893,640
53	2064		$ 5,340,513	$ 7,642,145	**$ 12,982,658**	2,360	$5,485	$11,606	$ 12,944,653	$ 38,005	$ 27,390,391	$ 27,352,386
54	2065		$ 5,340,513	$ 7,871,409	**$ 13,211,922**	2,360	$5,650	$12,186	$ 13,332,992	$ -	$ 28,759,911	$ 28,759,911
55	2066		$ 5,340,513	$ 8,107,552	**$ 13,448,064**	2,360	$5,819	$12,796	$ 13,732,982	$ -	$ 30,197,906	$ 30,197,906
	Total		**$ 267,025,630**	**$ 208,975,785**	**$ 512,804,344**	**110,920**			**$ 353,973,776**	**$ 159,236,556**	**$ 570,138,480**	**$410,901,924**
	Present Value				**$ 150,079,693**				**$ 70,994,843**	**$ 79,113,004**	**$ 96,975,771**	**$ 17,862,768**

Project Financing Projections

Total Capital Non-Construction Costs	$ 26,255,000	for Design, Environmental, etc.
Total Construction Cost	$ 87,620,000	
Future Grant Funding	$ (20,000,000)	
Total Construction Cost w/ Grant	$ 67,620,000	
Construction Cost Escalated to Construction Mid-Point	$ 83,164,000	Assumes mid-point of 2018 Escalated at the inflation rate
Annual Payment ($/YR)	$ 4,555,452	for Loan for Construction
Annual O&M ($/YR)	$ 1,595,300	Escalated at the inflation rate
Avg 2011 Recycled Water Rate ($/AF)	$1,145	Escalated at the inflation rate
Recycled Water Sales (AFY)	2,360	

Note: All costs above are in 2011 dollars.

Year	
2017	Start construction activities
2019	Complete construction activities
2020	Start operations

5.0%	Financing Rate
50	Financing Term
3.0%	Inflation Rate
5.0%	Discount Rate

		Costs				Revenues / Funding Sources						
	Year	Capital Non-Construction Costs	Loan Repayment	O&M	Total Annual Cost	RW Sales (AFY)	RW Rate ($/AF)	MWD Rate ($/AF)	Annual RW Sales Revenue	Avoided MWD Purchases	General Fund Supplement	Total Net Revenue Funds
1	2012	$ 5,251,000	$ -	$ -	**$ 5,251,000**		$1,179	$918	$ -	$ -	$ 5,251,000	$ -
2	2013	$ 5,408,530	$ -	$ -	**$ 5,408,530**		$1,215	$964	$ -	$ -	$ 5,408,530	$ -
3	2014	$ 5,570,786	$ -	$ -	**$ 5,570,786**		$1,251	$1,012	$ -	$ -	$ 5,570,786	$ -
4	2015	$ 5,737,909	$ -	$ -	**$ 5,737,909**		$1,289	$1,063	$ -	$ -	$ 5,737,909	$ -
5	2016	$ 5,910,047	$ -	$ -	**$ 5,910,047**		$1,327	$1,116	$ -	$ -	$ 5,910,047	**$ -**
6	2017		$ 4,555,452	$ -	**$ 4,555,452**		$1,367	$1,172	$ -	$ -	$ 4,555,452	**$ -**
7	2018		$ 4,555,452	$ -	**$ 4,555,452**		$1,408	$1,230	$ -	$ -	$ 4,555,452	**$ -**
8	2019		$ 4,555,452	$ -	**$ 4,555,452**		$1,450	$1,292	$ -	$ -	$ 4,555,452	**$ -**
9	2020		$ 4,555,452	$ 2,081,505	**$ 6,636,957**	2,360	$1,494	$1,356	$ 3,525,758	$ 3,200,878	$ -	**$ 89,679**
10	2021		$ 4,555,452	$ 2,143,950	**$ 6,699,402**	2,360	$1,539	$1,424	$ 3,631,531	$ 3,360,922	$ -	**$ 293,050**
11	2022		$ 4,555,452	$ 2,208,268	**$ 6,763,721**	2,360	$1,585	$1,495	$ 3,740,477	$ 3,528,968	$ -	**$ 505,724**
12	2023		$ 4,555,452	$ 2,274,516	**$ 6,829,969**	2,360	$1,632	$1,570	$ 3,852,691	$ 3,705,416	$ -	**$ 728,138**
13	2024		$ 4,555,452	$ 2,342,752	**$ 6,898,204**	2,360	$1,681	$1,649	$ 3,968,272	$ 3,890,687	$ -	**$ 960,754**
14	2025		$ 4,555,452	$ 2,413,034	**$ 6,968,487**	2,360	$1,732	$1,731	$ 4,087,320	$ 4,085,221	$ -	**$ 1,204,054**
15	2026		$ 4,555,452	$ 2,485,425	**$ 7,040,878**	2,360	$1,784	$1,818	$ 4,209,940	$ 4,289,482	$ -	**$ 1,458,544**
16	2027		$ 4,555,452	$ 2,559,988	**$ 7,115,441**	2,360	$1,837	$1,908	$ 4,336,238	$ 4,503,956	$ -	**$ 1,724,753**
17	2028		$ 4,555,452	$ 2,636,788	**$ 7,192,240**	2,360	$1,893	$2,004	$ 4,466,325	$ 4,729,154	$ -	**$ 2,003,239**
18	2029		$ 4,555,452	$ 2,715,891	**$ 7,271,344**	2,360	$1,949	$2,104	$ 4,600,315	$ 4,965,612	$ -	**$ 2,294,583**
19	2030		$ 4,555,452	$ 2,797,368	**$ 7,352,821**	2,360	$2,008	$2,209	$ 4,738,324	$ 5,213,892	$ -	**$ 2,599,396**
20	2031		$ 4,555,452	$ 2,881,289	**$ 7,436,742**	2,360	$2,068	$2,320	$ 4,880,474	$ 5,474,587	$ -	**$ 2,918,319**
21	2032		$ 4,555,452	$ 2,967,728	**$ 7,523,180**	2,360	$2,130	$2,436	$ 5,026,888	$ 5,748,316	$ -	**$ 3,252,024**
22	2033		$ 4,555,452	$ 3,056,760	**$ 7,612,212**	2,360	$2,194	$2,558	$ 5,177,695	$ 6,035,732	$ -	**$ 3,601,215**
23	2034		$ 4,555,452	$ 3,148,463	**$ 7,703,915**	2,360	$2,260	$2,685	$ 5,333,025	$ 6,337,519	$ -	**$ 3,966,629**
24	2035		$ 4,555,452	$ 3,242,916	**$ 7,798,369**	2,360	$2,328	$2,820	$ 5,493,016	$ 6,654,395	$ -	**$ 4,349,042**
25	2036		$ 4,555,452	$ 3,340,204	**$ 7,895,656**	2,360	$2,397	$2,961	$ 5,657,807	$ 6,987,115	$ -	**$ 4,749,265**
26	2037		$ 4,555,452	$ 3,440,410	**$ 7,995,862**	2,360	$2,469	$3,109	$ 5,827,541	$ 7,336,470	$ -	**$ 5,168,149**
27	2038		$ 4,555,452	$ 3,543,622	**$ 8,099,075**	2,360	$2,543	$3,264	$ 6,002,367	$ 7,703,294	$ -	**$ 5,606,586**
28	2039		$ 4,555,452	$ 3,649,931	**$ 8,205,383**	2,360	$2,620	$3,427	$ 6,182,438	$ 8,088,458	$ -	**$ 6,065,513**
29	2040		$ 4,555,452	$ 3,759,429	**$ 8,314,881**	2,360	$2,698	$3,599	$ 6,367,911	$ 8,492,881	$ -	**$ 6,545,911**
30	2041		$ 4,555,452	$ 3,872,212	**$ 8,427,664**	2,360	$2,779	$3,779	$ 6,558,949	$ 8,917,525	$ -	**$ 7,048,810**
31	2042		$ 4,555,452	$ 3,988,378	**$ 8,543,831**	2,360	$2,863	$3,968	$ 6,755,717	$ 9,363,402	$ -	**$ 7,575,288**
32	2043		$ 4,555,452	$ 4,108,030	**$ 8,663,482**	2,360	$2,948	$4,166	$ 6,958,389	$ 9,831,572	$ -	**$ 8,126,478**
33	2044		$ 4,555,452	$ 4,231,270	**$ 8,786,723**	2,360	$3,037	$4,374	$ 7,167,140	$ 10,323,150	$ -	**$ 8,703,568**
34	2045		$ 4,555,452	$ 4,358,209	**$ 8,913,661**	2,360	$3,128	$4,593	$ 7,382,154	$ 10,839,308	$ -	**$ 9,307,801**
35	2046		$ 4,555,452	$ 4,488,955	**$ 9,044,407**	2,360	$3,222	$4,823	$ 7,603,619	$ 11,381,273	$ -	**$ 9,940,485**
36	2047		$ 4,555,452	$ 4,623,623	**$ 9,179,076**	2,360	$3,319	$5,064	$ 7,831,728	$ 11,950,337	$ -	**$ 10,602,989**
37	2048		$ 4,555,452	$ 4,762,332	**$ 9,317,785**	2,360	$3,418	$5,317	$ 8,066,680	$ 12,547,854	$ -	**$ 11,296,749**
38	2049		$ 4,555,452	$ 4,905,202	**$ 9,460,655**	2,360	$3,521	$5,583	$ 8,308,680	$ 13,175,247	$ -	**$ 12,023,272**
39	2050		$ 4,555,452	$ 5,052,358	**$ 9,607,811**	2,360	$3,626	$5,862	$ 8,557,940	$ 13,834,009	$ -	**$ 12,784,139**
40	2051		$ 4,555,452	$ 5,203,929	**$ 9,759,381**	2,360	$3,735	$6,155	$ 8,814,679	$ 14,525,709	$ -	**$ 13,581,006**
41	2052		$ 4,555,452	$ 5,360,047	**$ 9,915,499**	2,360	$3,847	$6,463	$ 9,079,119	$ 15,251,995	$ -	**$ 14,415,614**
42	2053		$ 4,555,452	$ 5,520,848	**$ 10,076,301**	2,360	$3,962	$6,786	$ 9,351,492	$ 16,014,594	$ -	**$ 15,289,786**
43	2054		$ 4,555,452	$ 5,686,474	**$ 10,241,926**	2,360	$4,081	$7,125	$ 9,632,037	$ 16,815,324	$ -	**$ 16,205,435**
44	2055		$ 4,555,452	$ 5,857,068	**$ 10,412,520**	2,360	$4,204	$7,481	$ 9,920,998	$ 17,656,090	$ -	**$ 17,164,569**
45	2056		$ 4,555,452	$ 6,032,780	**$ 10,588,232**	2,360	$4,330	$7,855	$ 10,218,628	$ 18,538,895	$ -	**$ 18,169,291**
46	2057		$ 4,555,452	$ 6,213,763	**$ 10,769,216**	2,360	$4,460	$8,248	$ 10,525,187	$ 19,465,840	$ -	**$ 19,221,811**
47	2058		$ 4,555,452	$ 6,400,176	**$ 10,955,629**	2,360	$4,594	$8,661	$ 10,840,943	$ 20,439,132	$ -	**$ 20,324,446**
48	2059		$ 4,555,452	$ 6,592,181	**$ 11,147,634**	2,360	$4,731	$9,094	$ 11,166,171	$ 21,461,088	$ -	**$ 21,479,625**
49	2060		$ 4,555,452	$ 6,789,947	**$ 11,345,399**	2,360	$4,873	$9,548	$ 11,501,156	$ 22,534,143	$ -	**$ 22,689,900**
50	2061		$ 4,555,452	$ 6,993,645	**$ 11,549,098**	2,360	$5,020	$10,026	$ 11,846,191	$ 23,660,850	$ -	**$ 23,957,943**
51	2062		$ 4,555,452	$ 7,203,455	**$ 11,758,907**	2,360	$5,170	$10,527	$ 12,201,577	$ 24,843,892	$ -	**$ 25,286,562**
52	2063		$ 4,555,452	$ 7,419,558	**$ 11,975,011**	2,360	$5,325	$11,053	$ 12,567,624	$ 26,086,087	$ -	**$ 26,678,700**
53	2064		$ 4,555,452	$ 7,642,145	**$ 12,197,597**	2,360	$5,485	$11,606	$ 12,944,653	$ 27,390,391	$ -	**$ 28,137,446**
54	2065		$ 4,555,452	$ 7,871,409	**$ 12,426,862**	2,360	$5,650	$12,186	$ 13,332,992	$ 28,759,911	$ -	**$ 29,666,041**
55	2066		$ 4,555,452	$ 8,107,552	**$ 12,663,004**	2,360	$5,819	$12,796	$ 13,732,982	$ 30,197,906	$ -	**$ 31,267,884**
	Total		**$ 227,772,621**	**$ 208,975,785**	**$ 464,626,678**	**110,920**			**$ 353,973,776**	**$ 570,138,480**	**$ 41,544,629**	**$ 501,030,207**
	Present Value				**$ 131,144,625**				**$ 70,994,843**	**$ 96,975,771**	**$ 33,790,305**	**$ 70,616,295**

Project Financing Projections

SRF LOAN limited to $25 M

Total Capital Non-Construction Costs	$ 26,255,000	for Design, Environmental, etc.
Total Construction Cost	$ 87,620,000	
Construction Cost Escalated to Construction Mid-Point	$ 107,762,000	Assumes mid-point of 2018 Escalated at the inflation rate
Annual Payment ($/YR)	$ 6,912,623	for Loan for Construction
Annual O&M ($/YR)	$ 1,595,300	Escalated at the inflation rate
Avg 2011 Recycled Water Rate ($/AF)	$1,145	Escalated at the inflation rate
Recycled Water Sales (AFY)	2,360	

Note: All costs above are in 2011 dollars.

Year	
2017	Start construction activities
2019	Complete construction activities
2020	Start operations

2.5%	Financing Rate
20	Financing Term
3.0%	Inflation Rate
5.0%	Discount Rate

		Costs				Revenues / Funding Sources						
	Year	Capital Non-Construction Costs	Loan Repayment	O&M	Total Annual Cost	RW Sales (AFY)	RW Rate ($/AF)	MWD Rate ($/AF)	Annual RW Sales Revenue	Avoided MWD Purchases	General Fund Supplement	Total Net Revenue Funds
1	2012	$ 5,251,000	$ -	$ -	**$ 5,251,000**		$1,179	$918	$ -	$ -	$ 5,251,000	$ -
2	2013	$ 5,408,530	$ -	$ -	**$ 5,408,530**		$1,215	$964	$ -	$ -	$ 5,408,530	$ -
3	2014	$ 5,570,786	$ -	$ -	**$ 5,570,786**		$1,251	$1,012	$ -	$ -	$ 5,570,786	$ -
4	2015	$ 5,737,909	$ -	$ -	**$ 5,737,909**		$1,289	$1,063	$ -	$ -	$ 5,737,909	$ -
5	2016	$ 5,910,047	$ -	$ -	**$ 5,910,047**		$1,327	$1,116	$ -	$ -	$ 5,910,047	**$ -**
6	2017		$ -	$ -	**$ -**		$1,367	$1,172	$ -	$ -	$ -	**$ -**
7	2018		$ -	$ -	**$ -**		$1,408	$1,230	$ -	$ -	$ -	**$ -**
8	2019		$ -	$ -	**$ -**		$1,450	$1,292	$ -	$ -	$ -	**$ -**
9	2020		$ 6,912,623	$ 2,081,505	**$ 8,994,128**	2,360	$1,494	$1,356	$ 3,525,758	$ 3,200,878	$ 2,267,492	**$ -**
10	2021		$ 6,912,623	$ 2,143,950	**$ 9,056,573**	2,360	$1,539	$1,424	$ 3,631,531	$ 3,360,922	$ 2,064,120	**$ -**
11	2022		$ 6,912,623	$ 2,208,268	**$ 9,120,891**	2,360	$1,585	$1,495	$ 3,740,477	$ 3,528,968	$ 1,851,447	**$ -**
12	2023		$ 6,912,623	$ 2,274,516	**$ 9,187,139**	2,360	$1,632	$1,570	$ 3,852,691	$ 3,705,416	$ 1,629,032	**$ -**
13	2024		$ 6,912,623	$ 2,342,752	**$ 9,255,375**	2,360	$1,681	$1,649	$ 3,968,272	$ 3,890,687	$ 1,396,416	**$ -**
14	2025		$ 6,912,623	$ 2,413,034	**$ 9,325,657**	2,360	$1,732	$1,731	$ 4,087,320	$ 4,085,221	$ 1,153,116	**$ -**
15	2026		$ 6,912,623	$ 2,485,425	**$ 9,398,048**	2,360	$1,784	$1,818	$ 4,209,940	$ 4,289,482	$ 898,627	**$ -**
16	2027		$ 6,912,623	$ 2,559,988	**$ 9,472,611**	2,360	$1,837	$1,908	$ 4,336,238	$ 4,503,956	$ 632,417	**$ -**
17	2028		$ 6,912,623	$ 2,636,788	**$ 9,549,411**	2,360	$1,893	$2,004	$ 4,466,325	$ 4,729,154	$ 353,932	**$ -**
18	2029		$ 6,912,623	$ 2,715,891	**$ 9,628,514**	2,360	$1,949	$2,104	$ 4,600,315	$ 4,965,612	$ 62,588	**$ -**
19	2030		$ 6,912,623	$ 2,797,368	**$ 9,709,991**	2,360	$2,008	$2,209	$ 4,738,324	$ 5,213,892	$ -	**$ 242,225**
20	2031		$ 6,912,623	$ 2,881,289	**$ 9,793,912**	2,360	$2,068	$2,320	$ 4,880,474	$ 5,474,587	$ -	**$ 561,149**
21	2032		$ 6,912,623	$ 2,967,728	**$ 9,880,351**	2,360	$2,130	$2,436	$ 5,026,888	$ 5,748,316	$ -	**$ 894,854**
22	2033		$ 6,912,623	$ 3,056,760	**$ 9,969,383**	2,360	$2,194	$2,558	$ 5,177,695	$ 6,035,732	$ -	**$ 1,244,044**
23	2034		$ 6,912,623	$ 3,148,463	**$ 10,061,085**	2,360	$2,260	$2,685	$ 5,333,025	$ 6,337,519	$ -	**$ 1,609,459**
24	2035		$ 6,912,623	$ 3,242,916	**$ 10,155,539**	2,360	$2,328	$2,820	$ 5,493,016	$ 6,654,395	$ -	**$ 1,991,872**
25	2036		$ 6,912,623	$ 3,340,204	**$ 10,252,827**	2,360	$2,397	$2,961	$ 5,657,807	$ 6,987,115	$ -	**$ 2,392,094**
26	2037		$ 6,912,623	$ 3,440,410	**$ 10,353,033**	2,360	$2,469	$3,109	$ 5,827,541	$ 7,336,470	$ -	**$ 2,810,978**
27	2038		$ 6,912,623	$ 3,543,622	**$ 10,456,245**	2,360	$2,543	$3,264	$ 6,002,367	$ 7,703,294	$ -	**$ 3,249,416**
28	2039		$ 6,912,623	$ 3,649,931	**$ 10,562,554**	2,360	$2,620	$3,427	$ 6,182,438	$ 8,088,458	$ -	**$ 3,708,343**
29	2040			$ 3,759,429	**$ 3,759,429**	2,360	$2,698	$3,599	$ 6,367,911	$ 8,492,881	$ -	**$ 11,101,364**
30	2041			$ 3,872,212	**$ 3,872,212**	2,360	$2,779	$3,779	$ 6,558,949	$ 8,917,525	$ -	**$ 11,604,262**
31	2042			$ 3,988,378	**$ 3,988,378**	2,360	$2,863	$3,968	$ 6,755,717	$ 9,363,402	$ -	**$ 12,130,741**
32	2043			$ 4,108,030	**$ 4,108,030**	2,360	$2,948	$4,166	$ 6,958,389	$ 9,831,572	$ -	**$ 12,681,931**
33	2044			$ 4,231,270	**$ 4,231,270**	2,360	$3,037	$4,374	$ 7,167,140	$ 10,323,150	$ -	**$ 13,259,020**
34	2045			$ 4,358,209	**$ 4,358,209**	2,360	$3,128	$4,593	$ 7,382,154	$ 10,839,308	$ -	**$ 13,863,254**
35	2046			$ 4,488,955	**$ 4,488,955**	2,360	$3,222	$4,823	$ 7,603,619	$ 11,381,273	$ -	**$ 14,495,938**
36	2047			$ 4,623,623	**$ 4,623,623**	2,360	$3,319	$5,064	$ 7,831,728	$ 11,950,337	$ -	**$ 15,158,441**
37	2048			$ 4,762,332	**$ 4,762,332**	2,360	$3,418	$5,317	$ 8,066,680	$ 12,547,854	$ -	**$ 15,852,201**
38	2049			$ 4,905,202	**$ 4,905,202**	2,360	$3,521	$5,583	$ 8,308,680	$ 13,175,247	$ -	**$ 16,578,724**
39	2050			$ 5,052,358	**$ 5,052,358**	2,360	$3,626	$5,862	$ 8,557,940	$ 13,834,009	$ -	**$ 17,339,591**
40	2051			$ 5,203,929	**$ 5,203,929**	2,360	$3,735	$6,155	$ 8,814,679	$ 14,525,709	$ -	**$ 18,136,459**
41	2052			$ 5,360,047	**$ 5,360,047**	2,360	$3,847	$6,463	$ 9,079,119	$ 15,251,995	$ -	**$ 18,971,067**
42	2053			$ 5,520,848	**$ 5,520,848**	2,360	$3,962	$6,786	$ 9,351,492	$ 16,014,594	$ -	**$ 19,845,239**
43	2054			$ 5,686,474	**$ 5,686,474**	2,360	$4,081	$7,125	$ 9,632,037	$ 16,815,324	$ -	**$ 20,760,888**
44	2055			$ 5,857,068	**$ 5,857,068**	2,360	$4,204	$7,481	$ 9,920,998	$ 17,656,090	$ -	**$ 21,720,021**
45	2056			$ 6,032,780	**$ 6,032,780**	2,360	$4,330	$7,855	$ 10,218,628	$ 18,538,895	$ -	**$ 22,724,743**
46	2057			$ 6,213,763	**$ 6,213,763**	2,360	$4,460	$8,248	$ 10,525,187	$ 19,465,840	$ -	**$ 23,777,264**
47	2058			$ 6,400,176	**$ 6,400,176**	2,360	$4,594	$8,661	$ 10,840,943	$ 20,439,132	$ -	**$ 24,879,898**
48	2059			$ 6,592,181	**$ 6,592,181**	2,360	$4,731	$9,094	$ 11,166,171	$ 21,461,088	$ -	**$ 26,035,078**
49	2060			$ 6,789,947	**$ 6,789,947**	2,360	$4,873	$9,548	$ 11,501,156	$ 22,534,143	$ -	**$ 27,245,352**
50	2061			$ 6,993,645	**$ 6,993,645**	2,360	$5,020	$10,026	$ 11,846,191	$ 23,660,850	$ -	**$ 28,513,395**
51	2062			$ 7,203,455	**$ 7,203,455**	2,360	$5,170	$10,527	$ 12,201,577	$ 24,843,892	$ -	**$ 29,842,014**
52	2063			$ 7,419,558	**$ 7,419,558**	2,360	$5,325	$11,053	$ 12,567,624	$ 26,086,087	$ -	**$ 31,234,152**
53	2064			$ 7,642,145	**$ 7,642,145**	2,360	$5,485	$11,606	$ 12,944,653	$ 27,390,391	$ -	**$ 32,692,899**
54	2065			$ 7,871,409	**$ 7,871,409**	2,360	$5,650	$12,186	$ 13,332,992	$ 28,759,911	$ -	**$ 34,221,494**
55	2066			$ 8,107,552	**$ 8,107,552**	2,360	$5,819	$12,796	$ 13,732,982	$ 30,197,906	$ -	**$ 35,823,337**
	Total		**$ 138,252,458**	**$ 208,975,785**	**$ 375,106,514**	**110,920**			**$ 353,973,776**	**$ 570,138,480**	**$ 40,187,459**	**$ 589,193,200**
	Present Value				**$ 124,290,837**				**$ 70,994,843**	**$ 96,975,771**	**$ 31,013,966**	**$ 74,693,743**

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