2010 INTEGRATED WATER MASTER PLAN UPDATE

Prepared for

Rancho Murieta Community Services District, Rancho Murieta, CA

October 18, 2010

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Job Number 138708.200

Brown AND Caldwell

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LIST OF ABBREVIATIONS

AB	Assembly Bill
ADWF	average dry weather flow
BC	Brown and Caldwell
CARB	California Air Resources Board
CDO	Cease and Desist Order
CDPH	California Department of Public Health
cfs	cubic feet per second
County	Sacramento County
District	Rancho Murieta Community Services District
DU	dwelling unit
DWR	California Department of Water Resources
EDU	equivalent dwelling unit
ft	feet
GPCD	gallons per capita day
gpd	gallons per day
HDR	HDR Engineering, Inc.
I&I	inflow and infiltration
IPR	indirect potable reuse
IWMP	Integrated Water Master Plan
mgd	million gallons per day
PDO	Pacific Decadal Oscillation
Project	Integrated Water Master Plan Project
RMCC	Rancho Murieta Country Club
RMCSD	Rancho Murieta Community Services District
RWQCB	Regional Water Quality Control Board
SB	Senate Bill
SB7	The Water Conservation Act of 2009
SMUD	Sacramento Municipal Utilities District
SVM	Shared Vision Model
SWTR	Surface Water Treatment Rule
UCD	University of California, Davis
WDR	Waste Discharge Requirements
WTP	Water Treatment Plant
WWRP	Wastewater Reclamation Plant

EXECUTIVE SUMMARY

The Rancho Murieta Community Services District (District) has initiated this Integrated Water Master Plan (IWMP) Project (Project) to update their 2006 IWMP due to recent changes in state legislation regarding water use targets and greenhouse gas emissions, federal and state guidance regarding recycled water, and to address climate change risks by modeling future droughts' estimated impacts on the District's water supply reliability. The 2010 IWMP and Shared Vision Model (SVM) MS Excel source files are an update that fully replaces the IWMP that was issued in 2006. Where applicable, information from the 2006 IWMP has been retained, and only where needed, Brown and Caldwell (BC) has updated information or expanded on the analysis from the last IWMP planning effort performed by HDR Engineering, Inc. (HDR).

The updated IWMP serves as a guide for the District to address the following recent and emerging issues:

- Reductions in per capita water demand by 2020 according to The Water Conservation Act of 2009, known as the Senate Bill X7-7 (SB7) legislation passed in November 2009
- Climate change impacts on supply availability
- Greenhouse gas emission regulations impacts on system operations
- State recycled water policy influence on District's future expansion of water recycling
- Trend towards higher density development lowering water demands per dwelling unit
- New water balance modeling approach that expands analysis on supply reliability, with updated demands and supply options

The goals of the 2010 Project are to:

- Update the 2006 water balance evaluation of the District's water supply, potable water, treated effluent, and recycled water assets. BC has expanded the analysis to assess more options for maximizing the beneficial use of all of District's water resources by evaluating more alternatives for drought augmentation.
- Update the water supply and potable/recycled water needs based on three growth scenarios and projected reductions in potable water demand due to the recent legislation. A comprehensive background on SB7 and District plans to address these new water conservation requirements are presented in the 2020 Compliance Plan (Brown and Caldwell, July 2010).
- Analyze potential higher water supply shortfalls in times of drought due to the observed and forecasted changes in water supply availability due to climate change. (This requires evaluating shifts in runoff hydrology due to climate change impacts on the natural variability of flows on the Cosumnes River. These shifts may affect the District's raw water pumping to the reservoirs in the future due to more limited withdrawals from the Cosumnes River based on climate change hydrology scenarios provided by the University of California, Davis.)
- Amend the policy recommendations from 2006 IWMP prepared by HDR, as a comprehensive plan for maximizing the use of District water resources while simultaneously addressing the community's needs during drought conditions and with reservoir draw downs.
- Explain the potential impacts of state requirements for greenhouse gas emissions regulations (e.g., California Assembly Bill (AB) 32) on utility operations.

Existing and Future Supply Conditions

The District was formed in 1982 to provide water supply, wastewater, storm drainage and flood control services to the community of Rancho Murieta. The area served by the District encompasses approximately 3,500 acres. Land uses within this service area provide for the development of approximately 2,000 acres for single-family residences, townhouses, apartments, duplexes and manufactured homes.

The District's water supply consists of seasonal diversion from the Cosumnes River that is normally diverted to three storage reservoirs (Calero, Chesbro, and Clementia). In addition to other use limitations, the total amount of water taken from the Cosumnes River cannot exceed 6,368 acre-feet (ft) per year.

A summary of key information developed for current and future buildout conditions is presented in Table ES-1 pertaining to raw water supply, potable water demand, wastewater production and recycled water. Assuming SB7 compliance will be achieved, raw water supply and water treatment needs may lower by 20 percent as compared to without SB7 compliance and sewage treatment by 8 percent due to reduced indoor potable demands leading to lower wastewater generation and recycled water treatment, storage and production quantities. The lower end of the ranges presented in Table ES-1 represent conditions if SB7 targets are achieved and the upper end of the ranges are based on the original assumptions from past planning studies (with updated forecasts due to minor adjustments in projected connections and/or equivalent dwelling units (EDUs) for the medium growth scenario).

Table ES-1. Summary of Existing and Future Buildout Conditions

Service and Parameter	Units	Existing Conditions	Buildout Conditions[1]
Raw Water Supply			
Projected Demand	acre-ft/year	2,010	3,640-4,550
Available Water Rights	acre-ft/year	6,368	6,368
Water Treatment			
Projected Maximum Demand	mgd	3.4	5.3-6.7 [2]
Available Capacity	mgd	3.5	5.6-7.0
Wastewater Treatment			
Projected Production (ADWF)[3]	mgd	0.5	0.97-1.05
Available Capacity (ADWF)[3]	mgd	1.55	1.55
Recycled Water Production			
Projected Peak Month Demand	mgd	1.5	1.4-1.5
Available Capacity	mgd	3.0	3.0
Recycled Water Storage			
Projected Storage Needs	acre-ft	430	1,000-1,100
Available Storage Volume	acre-ft	756	756
Additional Storage Requirements	acre-ft	None	
Recycled Water Treatment			
Projected Production	acre-ft/year	565	1,020-1,110
Golf Course Irrigation Demands	acre-ft/year	550	550
Excess Recycled Water	acre-ft/year	Supplementary water required	

[1] When assuming SB7 compliance will be achieved, buildout conditions may lower demand by 20 percent (represented by lower end of range) for raw water supply and water treatment needs and 8 percent lower for wastewater quantities, due to reduced indoor potable demands leading to lower wastewater generation.

[2] Based on planning water demands of 750 gpd per equivalent dwelling unit. Actual average demands have been approximately 680 gpd per equivalent dwelling unit based on data from 2004 to 2009 for large estate lots. If recycled water is used for landscape irrigation in the future, demand factors will reduce, and an offset in treatment plant production will occur.

[3]Average dry weather flow (ADWF)

Existing and Future Water Demands

Given the population is estimated to stay constant between 2010 and 2015, due to economic conditions resulting in the community not further developing approved lots, water demands would also remain relatively constant during that timeframe (without the water conservation activities targeting gallons per capita per day (GPCD) reductions by the year 2020). In 2030, based on the projection shown in Figure ES-1, water demand increases from 1,710 acre-ft per year based on 2010 conditions to 3,659 acre-ft per year at buildout, assuming that demand reduction measures are not implemented.

The projected water demand without achieving 2020 targets is based on the conservative estimate of 750 gpd per EDU. The actual water use per EDU is lower than 750 gpd. Using the higher estimate of 750 gpd is a conservative approach in planning future water demand. The projected water demand with meeting the 2020 target of 20 percent reductions in per capita demand is based on achieving an estimated demand of 600 gpd per EDU. The planning assumption adjustment with 2020 compliance of 600 gpd per EDU is based on 80 percent of the planning assumption baseline of 750 gpd per EDU for large estate lots greater than 12,000 square feet. Both the projected and actual water production includes 10 percent system losses as higher than average conservative planning number.

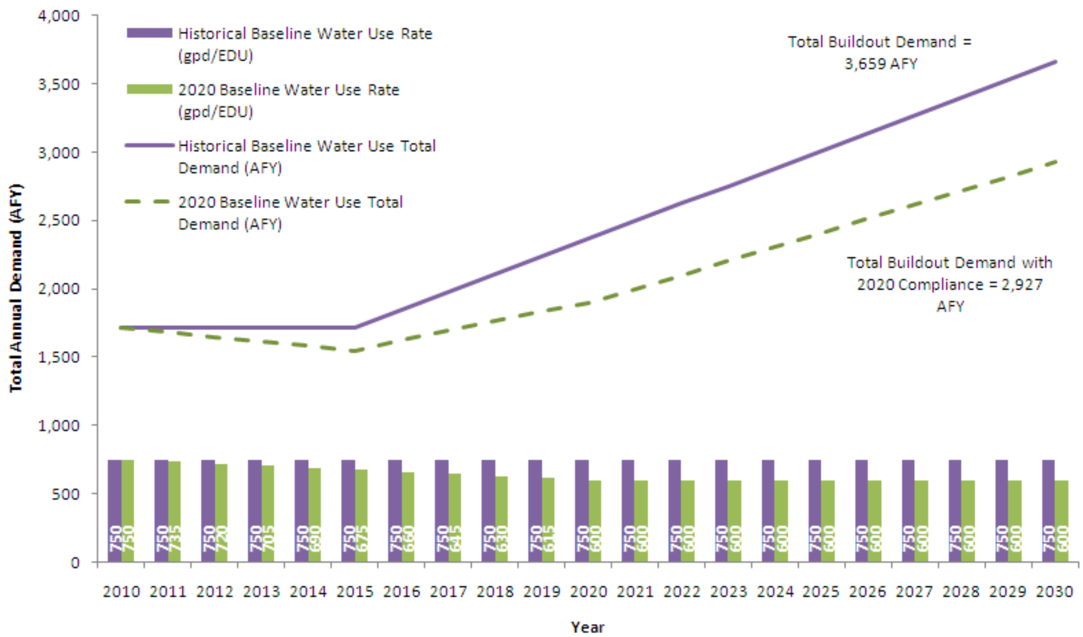


Figure ES-1. Total Buildout Water Demand Projections without and with 2020 GPCD Targets Achieved

Water Supply Reliability to Meet Future Demands

A water balance model was initially developed for the 2006 IWMP to estimate reservoir volumes and water levels during both normal and drought conditions. Due to changes in projected water demands and the goal of testing additional drought and climate change hydrology scenarios, the water balance model was revised and expanded.

Figures ES-2 and ES-3 show projected usable water volumes (i.e., reservoir capacity with flashboards installed but not considering dead storage) and levels in the reservoirs for existing and future conditions.

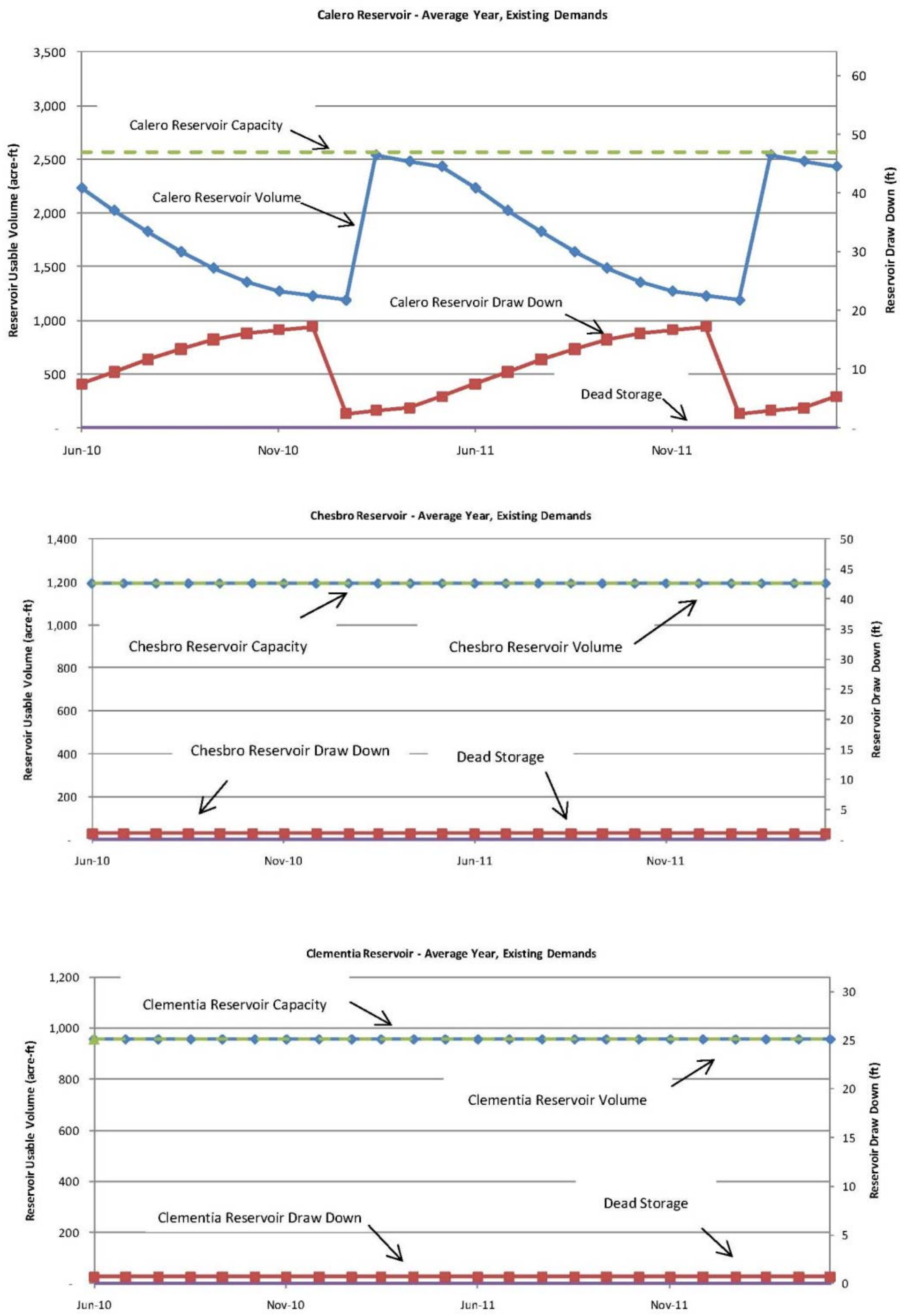


Figure ES-2. Estimated Usable Reservoir Volume and Water Levels – Existing Conditions

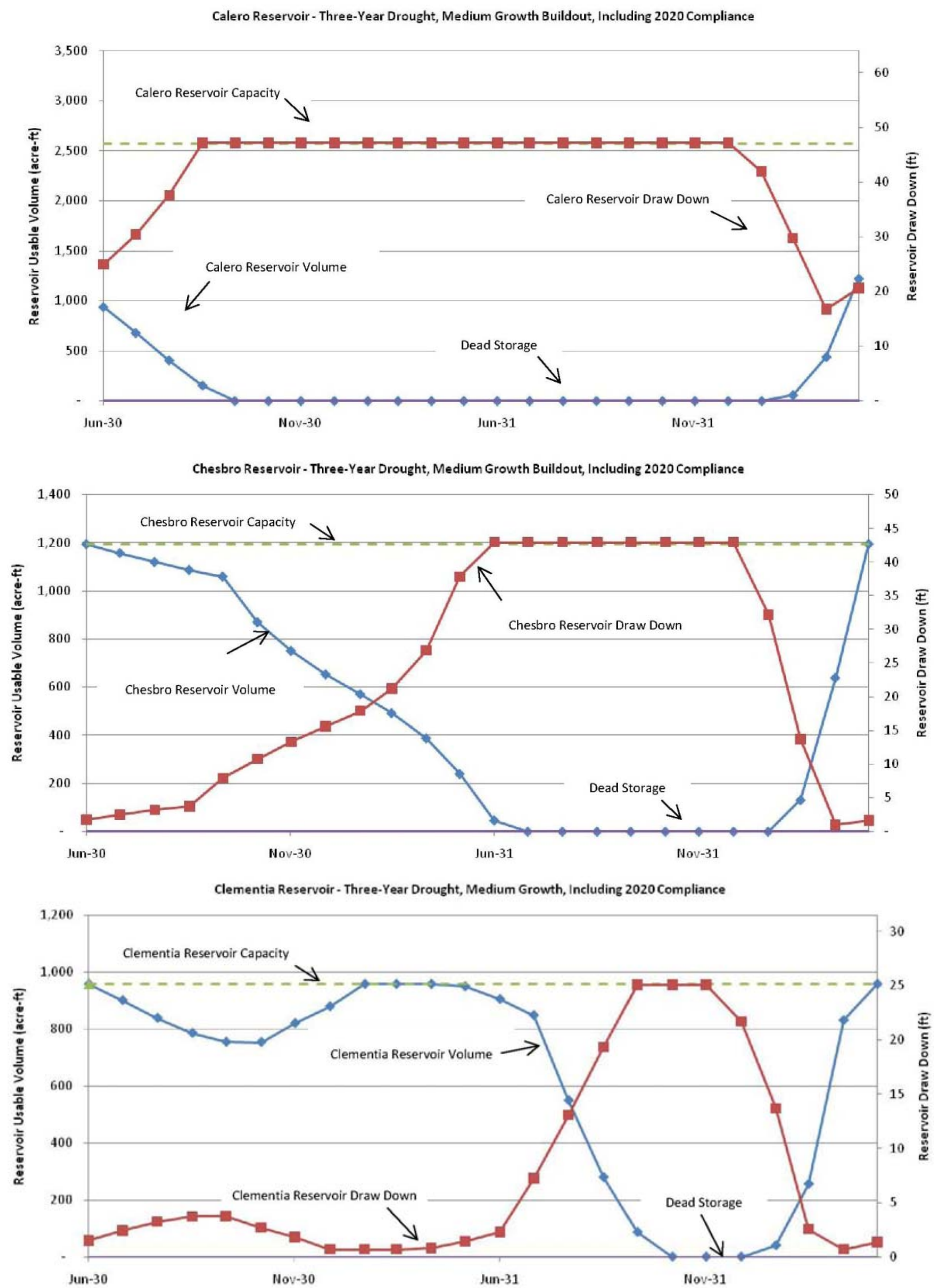


Figure ES-3. Estimated Usable Reservoir Volumes and Water Levels – Future Conditions

The following summarizes key results derived from the reservoir water balance model:

Demand Cutbacks

RMCSD uses the existing Policy 90-2 as a baseline scenario for future cutbacks in extreme drought. This policy equates to a 50 percent reduction in Year 2020 and beyond for extreme drought conditions. A 50 percent reduction in extreme drought conditions is reflective of 2020 compliance and an estimated 37.5 percent demand reduction during extreme drought.

The RMCSD Water Shortage Contingency Plan includes that Stages 4 and 5 drought conditions target a 50 percent reduction of water use. However, stakeholders expressed interest in testing within the IWMP model whether or not a 25 percent reduction in Stages 4 and 5 drought (i.e., "extreme drought") conditions may suffice. If combined with 2020 compliance targets (i.e., 20 percent reduction by 2020), a 25 percent demand cutback would result in a compounded reduction of 40 percent.

Existing Conditions

- Based on the water supply scenario with three consecutive average water years (i.e., hydrology modeled for years 1935, 1935, and 1935, to reflect three years of average water supply) and current water demands, the following conclusions can be made:
  - Calero reservoir's volume is sufficient to meet the community's water supply needs.
  - Chesbro reservoir is generally expected to be full throughout the year since it is replenished by Calero.
  - Clementia reservoir experiences a maximum draw down of 5 feet due to naturally occurring evaporation and seepage.
- Based on the water supply scenario that reflects the three consecutive driest water years on record (i.e., hydrology for 1976, 1977, and 1978) and current water demands, the following conclusions can be made:
  - Calero and Chesbro reservoirs are capable of meeting the community's water supply needs under severe drought conditions (three driest year sequence of 1976, 1977, 1978 drought event), provided that water use in the community is reduced by 25 percent (or more) in Stages 4 and 5 drought conditions.
  - If demand cutback is limited to 25 percent during Stages 4 and 5 drought conditions, Calero and Chesbro reservoirs reach dead storage, and about 200 acre-ft/yr (a maximum of 5 feet of drawdown) is lost from Clementia Reservoir to evaporation.

Future Buildout Conditions (Year 2030) with Medium Growth Scenario

- Only Calero reservoir is needed to meet the community's water needs during average year hydrologic conditions for buildout demand (i.e., Year 2030) under the medium growth scenario. Clementia reservoir experiences a maximum draw down of 5 feet due to naturally occurring evaporation and seepage.
- Based on the scenario with water supply that reflects the three consecutive driest water years on record (i.e., hydrology for 1976, 1977, and 1978), compliance with 2020 water use targets, and medium growth buildout, the following conclusions can be made:
  - There is no estimated shortfall when demands are curtailed by a 50 percent compounded reduction, including 37.5 percent maximum demand cutback in Stages 4 and 5 drought conditions and 2020 compliance. However, Clementia would have to be used.
  - If demand cutback is limited to a compounded 40 percent (i.e., a 25 percent maximum demand cutback during Stages 4 and 5 drought conditions and 2020 compliance), all three reservoirs reach dead storage, and supplemental supply options would need to be considered to overcome an estimated 690 acre-ft per year of shortfall.
- An additional water supply of 300 acre-ft is suggested as contingency storage. This is the level of shortfall estimated under severe drought conditions with climate change under the "warm dry" scenario with a

compounded 60 percent demand cutback (i.e., 50 percent maximum demand cutback in Stages 4 and 5 drought and 2020 compliance). Under this extreme worst case drought condition all three reservoirs are expected to reach dead storage. The additional 300 acre-ft estimate includes a safety factor approximately equal to one peak month's water demand (or two average month's demand) in addition to the estimated drought deficit, and also assumes water use in the community is reduced overall by 50 percent (i.e., beyond the 2020 compliance).

- In order to have more abundant supply to help mitigate any potential impacts of future climate change, an additional 300 acre-ft may be considered for a total contingency storage of 600 acre-ft. Given the economies of scale for developing supplemental well or surface water supply at a volume of 300 acre-ft versus 600 acre-ft, the District may consider adding this larger amount of contingency storage for the incremental cost increase.
- To allow for use in times of drought, RMCSD would need to pursue CDPH approval of Clementia Reservoir for drinking water supply.

Recommendations

Workshops open to the community were held with District staff on February 19, May 5, June 18, and July 21, 2010 to review past policy recommendations, updated assumptions, model results and updated policy and supply augmentation options. As described in Section 5, a total of 11 strategies were reviewed. Of these strategies and policies, five were considered viable options and were selected for further consideration. Figure ES-4 summarizes the drought mitigation strategies recommended for the District to adopt or implement.

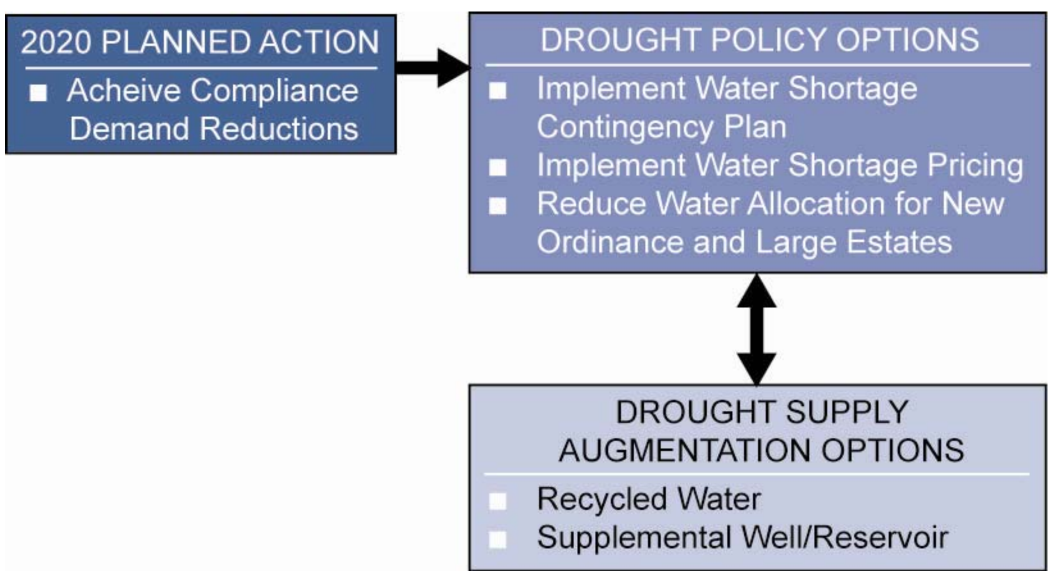


Figure ES-4. Recommended IWMP Drought Mitigation Strategies

The recommended integrated solution is comprised of potential strategies described below. The first two options are policy solutions. Future consideration of costly physical improvements is also recommended. At this time, it is envisioned that the existing policy options will be implemented as adopted and that new options will be adopted. In addition, the District should pursue a more in-depth feasibility assessment of the physical improvement options with one or both of these supply augmentation options pursued further in the future.

- **Achieve 2020 Compliance Plan Targets to Lower Water Demands:** SB7 requires water demands statewide to be reduced 20 percent by 2020. Achieving this level of demand reduction will effectively increase supply reliability, as overall demand on the system at buildout is projected to be more than 700 acre-ft less than projected without compliance with 2020 GPCD targets. This is a policy that is already being planned for adoption by the District Board and implemented between 2011 and 2020.
- **Drought Policy Solutions:**
  - Implement Water Shortage Contingency Plan**:** the policy is based on achieving up to a 50 percent level of water conservation during severe drought conditions, since this was established as the baseline conservation rate in both this and past planning projects and is the planning requirement under state law for systems with more than 3,000 connections.
  - Water Shortage Pricing**:** implement a shortage pricing mechanism in the form of a drought surcharge to assist with encouraging compliance with mandatory water reductions and reduced water allocations in later stages of the water shortage contingency plan.
  - Reduced Water Allocations based on New County Landscape Ordinance and for Large Estates**:** support the County's implementation of the new landscape ordinance for new lots and promote water conscious landscaping throughout the community. In addition, the District should implement a reduced water allocation policy that provides the ability to influence water demands associated with highest future growth classification. The policy may also serve as the basis for other modified allocations for other lot classifications. The policy developed should describe the level of service to be provided during normal conditions for specific or all lot classifications.
  - Recycled water policy: consider adopting a policy regarding recycled water use for new connections.
- **Drought Supply Augmentation Options:** All physical improvements which maximize the use of all available water resources to provide additional supply for normal, drought, and emergency conditions, and address the community's long-term treated effluent disposal needs should be considered. The following three options should be evaluated further for feasibility, in no particular order or priority:
  - Expand recycled water service to new residential customers: this option would offset potable demands and help achieve 2020 compliance in addition to aiding in effluent disposal needs. This option also has the direct benefit of allowing more storage to be maintained during times of drought, thus increasing water supply reliability. Also can consider expanding recycled water service to more existing customers, such as parks and/or commercial area, depending on cost feasibility and timing and availability of excess recycled water beyond residential landscape irrigation.
  - New well supply: investigate new groundwater supply to address normal and drought water supply reliability needs. Given the community is wholly supplied via surface water, groundwater wells would serve as emergency supply option under normal conditions and supplemental supply in times of shortage in surface water supplies.
  - New surface reservoir: a new reservoir may be supplied with diverted river water provided the new reservoir could be added to the existing permit. This new reservoir could only be used during droughts and may be used in conjunction with the supplemental well supply option.

Recommended Next Steps

The recommended next steps are described below:

- Approve IWMP as basis for water planning.
- Re-adopt District Board Policy 90-2 (Appendix B) to determine conservation level and number of units served and trigger for when new augmentation supplies are needed.
- Select appropriate augmentation projects and size, including prudent reserve; set the new fee.
- Refine water shortage contingency plan to better define timing of drought stages, related to reservoir levels, early warning forecasts, etc.
- Re-engineer Water Treatment Plant (WTP) and Wastewater Reclamation Plant (WWRP) phase planning, as well as recycled water transmission and storage facilities.
- Develop direction for future studies and policy changes.
- Pursue CDPH approval of Clementia Reservoir for drinking water supply in times of drought.

1. INTRODUCTION

Rancho Murieta Community Services District (District) has responded to changes in recent legislation and guidance from federal and state agencies that have affected the community's water supply reliability with an update to the 2006 Integrated Water Master Plan (IWMP). This Draft 2010 IWMP is an updated and expanded analysis from the 2006 IWMP that is designed to provide Rancho Murieta with more robust drought planning and thus prudent investment of ratepayer dollars in future capital projects.

The updated IWMP serves as a guide for the District to address the following recent and emerging issues:

- **Reductions in Per Capita Water Demand by 2020.** State legislation SB X7-7 (SB7), is a new mandate passed by state legislature to respond to the Sacramento-San Joaquin Delta water crisis. The mandate targets upstream and downstream diverters to achieve a minimum of a statewide 10 percent cutback by 2015 and a 20 percent cutback in urban per capita water demand by 2020 in their service area. In response to SB7, a Draft 2020 Compliance Plan has been prepared and is currently under review by the District.

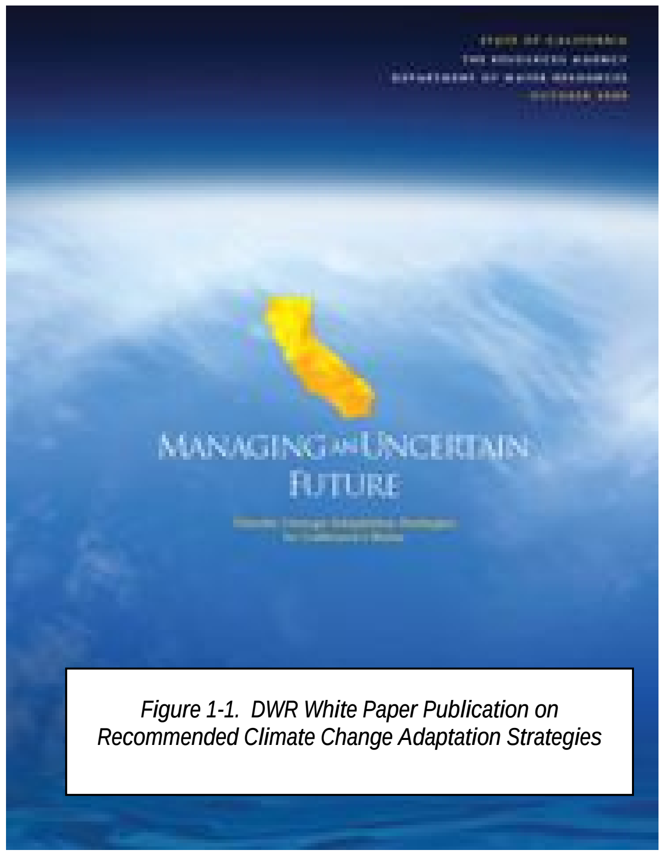


Figure 1-1. DWR White Paper Publication on Recommended Climate Change Adaptation Strategies

- **Climate Change Impacts.** Federal and state resource agencies are calling for better planning to include possible and future climate change. These agencies are investing in the scientific studies needed to bracket the uncertainty surrounding climate change impacts. Using the historic dry years data and updated runoff hydrology datasets for the Cosumnes River have helped refine the probability of wet, normal and drought years. Brown and Caldwell (BC) has updated the MS Excel water balance model used in the 2006 IWMP analysis accommodating for two climate change scenarios.
- **Greenhouse Gas Emission Regulations.** The California Air Resources Board (CARB) is charged with regulating greenhouse gas emissions per Assembly Bill (AB) 32. The CARB has started requiring inventories of emissions from large emitters (e.g., large industry). BC has provided a summary of these regulations and applicability to the District in Section 4.9.
- **State Recycled Water Policy Update.** The State Water Resources Control Board released an updated policy on recycled water and is more aggressively funding investment in recycled water systems through Proposition 84. A new trend is to consider indirect potable reuse (IPR) as an alternative supply. IPR is the practice of routing treated wastewater back to a raw water source of supply as allowed under conditional permits issued by the California Department of Public Health. BC has incorporated IPR into

the IWMP Model as a drought supply mitigation option to test the benefits of the District considering this alternative.

- **Trend towards Higher Density Development.** Legislation, such as SB 221, ties land and water use decisions together by requiring Water Supply Verifications to receive Final Map approvals. Additionally, local planning efforts, such as the Sacramento Area Council of Government (SACOG)'s Blueprint Project, are aimed at analyzing the benefits from higher density development. Builders are capitalizing on the "green" building trend with a growing market share from builder initiatives like "Build It Green." BC has reviewed future demands due to the landscape ordinance going into effect and potential for smaller lots being built than originally planned in the District's service area. The IWMP Model allows for various demand scenarios to be tested along with a custom plan for future development by equivalent dwelling unit (EDU).
- **New Modeling Approach.** BC created an expanded new model relying on the 2006 HDR model assumptions as appropriate (e.g., runoff evaporative, and seepage). In the new model much of the basic assumptions and historical data remain. BC embedded user friendly scenario analyses to include density and lot alternatives; historical and state mandated drought year scenarios; 2020 compliance; conservation level targets; climate change scenarios; variable augmentation supplies and capacities; and variable and alternative supply curtailments. The updated model and IWMP will allow staff, board and community to forecast the potential impacts of future droughts, assess water supply reliability, and envision possible capital infrastructure investments for water, wastewater and recycled water treatment and storage needs in a well thought out and prudent manner.

1.1 District Service Area Description

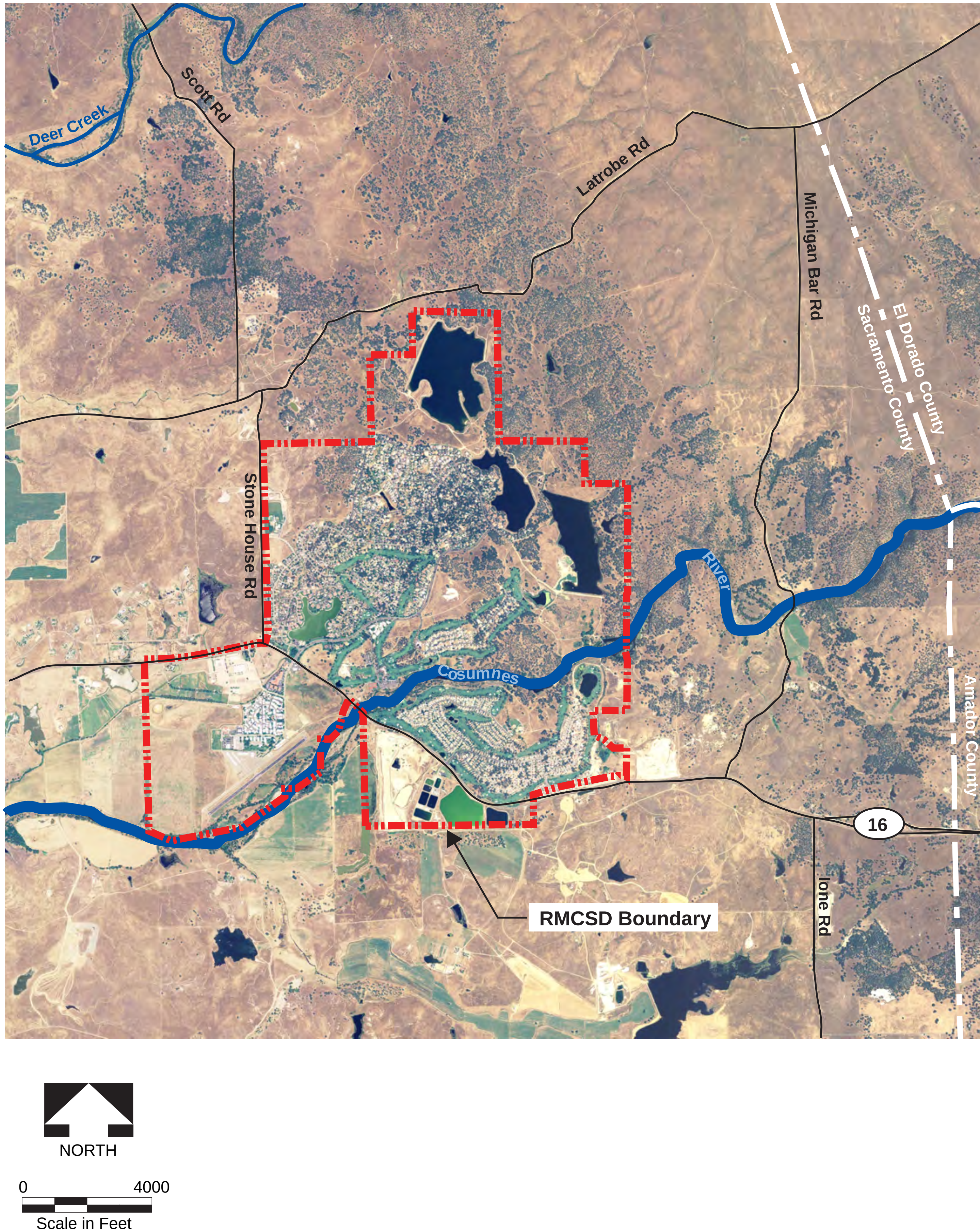
The District was formed in 1982 to provide water supply collection, treatment and distribution; wastewater collection, treatment and reuse; as well as storm drainage collection, disposal and flood control services for the community of Rancho Murieta. The area served by the District encompasses approximately 3,500 acres. Land uses within this service area include approximately 2,000 acres for single family residences, townhouses, apartments, duplexes and mobile homes. According to the County's approved Planned Unit Development Plan (Sacramento County, 1983), the development of this area represents a potential of roughly 5,189 residential units at buildout. The service area boundary map is presented on Figure 1-2.

1.2 IWMP Update Goals and Objectives

The Final 2010 IWMP and IWMP Model MS Excel source files are an update that fully replaces the IWMP that was issued in November 2006. Where applicable, information from the 2006 IWMP has been retained such as rainfall and runoff contributions and evaporation and seepage losses, and only where needed, BC has updated information or expanded on the analysis from the last planning effort performed by HDR. The assumptions retained are of small incremental volumes, on the order of less than 10 percent of overall monthly storage or losses compared to diversions and demands. Therefore, even a 10 to 20 percent change in refining these planning assumptions would equal only a 1 to 2 percent change in overall results, and thus not change the Plan recommendations.

The goal of this 2010 effort is to:

- Update the 2006 water balance evaluation of the District's water supply, potable water, treated effluent, and recycled water assets. BC has expanded the analysis to assess more options for maximizing the beneficial use of all of the District's water resources by evaluating more alternatives to drought augmentation.



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Brown AND Caldwell	PROJECT 138708-200	SITE Draft IWMP Plan Rancho Murieta CSD, Sacramento County, CA	Figure 1-2
	DATE 8-6-10	TITLE Service Area Map	

- Update the water supply and potable/recycled water needs based on three growth scenarios and projected reductions in potable water demand to meet gallon per capita per day goals outlined in SB7.
- Analyze higher potential water supply shortfalls in times of drought due to the observed and forecasted changes in water supply availability. This required evaluating shifts in runoff hydrology due to climate change impacts on the natural variability of flows on the Cosumnes River, which may affect the District's raw water pumping to the storage reservoirs in the future due to more limited withdrawals from the Cosumnes River based on climate change hydrology scenarios provided by the University of California, Davis.
- Amend the policy recommendations from 2006 IWMP prepared by HDR, as a comprehensive plan for maximizing the use of District water resources while simultaneously addressing the community's concerns and needs in regard to drought conditions and reservoir draw downs.
- Explain the potential impacts of state requirements for greenhouse gas emissions regulations (e.g., California Assembly Bill 32) on utility operations.

Upon completion of this planning effort, the District will have an updated and expanded IWMP that will allow the District Board, staff, and customers to understand the benefits of different management options in order to make the best informed capital planning decisions with ratepayer dollars, grants, or other utility (e.g., Sacramento Municipal Utilities District [SMUD]) partnership funds to address the myriad of challenges facing the District.

Specific sections in this Plan have been created to address each objective for the 2010 IWMP Update project which include:

- **Section 2 - Existing Conditions:** BC has updated the past characterization of existing conditions within the community in regard to water connections and water supply, raw water treatment, wastewater treatment and treated effluent/reuse needs based on a review of historic data (Section 2).
- **Section 3 - Future Conditions:** BC has updated, where applicable, the existing demands and discussed the potential influences of changing needs for the three buildout scenarios, historic growth patterns and new 2020 compliance requirements from SB7. These changes in demand are then evaluated in Section 4 for impacts on the projected water supply, raw water treatment, wastewater treatment, and treated effluent disposal/reuse alternatives. BC has not altered the fundamental planning assumptions related to treatment expansion plans to reduce projected expansion projects based on lower water demands, wastewater generation and recycled water availability due to 2020 compliance. As 2020 compliance is being achieved, these capital expansions plans should be revisited as the fundamental planning assumptions will have changed.
- **Section 4 - Water Supply Reliability to Meet Future Demands:** BC has reassessed and expanded the water balance approach previously developed by HDR and has reevaluated reservoir drawdown levels and drought deficits based on updated existing and future conditions.
- **Section 5 - Drought Mitigation Strategies:** With the District Board and staff and community input, BC has revisited the 2006 strategies and, based on expanded analysis, identified new strategies, reevaluated potential policies and drought mitigation strategies, all of which can be used to address water supply deficits and reservoir levels.
- **Section 6 - Recommendations:** BC has presented new recommendations which update the previous 2006 IWMP proposed strategies to address potential water supply deficits.

1.3 Section Summary

This section provides introductory and background information about the District, drivers for initiating an update to the 2006 IWMP and the goals for the Project.

The goals of this 2010 Project are to:

- Update the 2006 water balance evaluation of the District's water supply, potable water, treated effluent, and recycled water assets. BC has expanded the analysis to assess more options for maximizing the beneficial use of all of the District's water resources by evaluating more alternatives to drought augmentation.
- Update the water supply and potable/recycled water needs based on three growth scenarios and projected reductions in potable water demand due to recent legislation, The Water Conservation Act of 2009 (SB7). A comprehensive background on SB7 and District plans to address these new water conservation requirements is presented in the Draft 2020 Compliance Plan (Brown and Caldwell, July 2010).
- Analyze higher potential shortfalls in times of drought due to the observed and forecasted changes in water supply availability. This required evaluating shifts in runoff hydrology due to climate change impacts on the natural variability of flows on the Cosumnes River, which may affect the District's raw water pumping to their potable supply reservoirs in the future due to more limited withdrawals from the Cosumnes River based on climate change hydrology scenarios provided by the University of California, Davis.
- Amend the policy recommendations from 2006 IWMP prepared by HDR, as a comprehensive plan for maximizing the use of District water resources while simultaneously addressing the community's needs in regard to drought conditions and reservoir draw downs.
- Explain the potential impacts of state requirements for greenhouse gas emissions regulations (e.g., California Assembly Bill 32) on utility operations.

2. EXISTING CONDITIONS

This chapter describes the present conditions of the District's service area which serves as a baseline for planning by establishing the following parameters:

- Existing service connections
- Water rights and conditions for water withdrawal
- Historical drought conditions
- Water supply infrastructure
- Water treatment plant demands
- Wastewater and recycled water system treatment capacity
- Golf course irrigation demands

These parameters have been incorporated into the IWMP model (described in Section 4) that was used to analyze current water supply reliability under existing conditions.

2.1 Existing Service Connections

The District currently serves 2,604 connections comprised of 2,502 residential, 97 commercial and 5 parks connections. However, Sacramento County has approved development of 520 lots within RMCSD's service area, plus an additional 150 units (100 residential and 50 commercial equivalent dwelling units) currently being considered for approval, bringing the total likely to be approved in the near future to 670 units. Table 2-1 shows the existing number of connections and EDUs and the projected number of connections and EDUs for years 2020 and 2030 (i.e., build out) for three different growth scenarios: low, medium, and high. The medium growth scenario is considered the baseline for considering future water demands.

The District projects water service demand using 750 gallons per day (gpd) per EDU as a conservative water demand factor for planning purposes. EDU is a unit measure for demand. It is used by water purveyors to equalize demand for various land use classifications and structure types. As shown in Table 2-1, various types of lots or user classes are assigned a ratio that converts a lot size or user class to an EDU value. For example, a large estate lot greater than 12,000 square feet is expected to have greater water demand than a smaller townhouse lot. A large estate lot is assigned a ratio of 1.0 EDU (750 GPD/unit) while the smaller townhouse lot is assigned ratio of 0.5 EDU (375 gpd/unit). The EDU value is used to project demands between development units in various types of lots and user classes. Commercial EDUs are derived by taking the total commercial connections' annualized water use and dividing by 750 gpd.

Table 2-1. Summary of 2010 Service Connections and EDUs				
Lot or User Class	Planning Assumption for Use (gpd/DU)[1]	EDU Conversion Ratio [2]	Number of Connections[3]	Number of EDUs[4]
Residential Units				
Estate > 12,000 sf	750	1.0	729	729
Estate < 12,000 sf	750	0.9	555	500
Circle	750	0.7	440	308
Cottage	750	0.7	274	192
Halfplex	750	0.5	59	30
Townhouse	750	0.5	256	128
Mobile Home	750	0.3	189	57
		Subtotal	2,502	1,943
Non-Residential Units				
Commercial/Industrial	750	NA[5]	97	272
Parks	750	NA	5	54
School	750	NA	0	0
		Total	2,604	2,269

[1] Gallons per day (gpd) per dwelling unit (DU) based on planning assumptions of 750 gpd/EDU. The 5-year average demand from 2005 to 2009 was 685 gpd/EDU

[2] Rounded to the nearest tenth.

[3] As of July 2010, there are 2502 occupied lots (units) and 45 vacant lot and 620 new approved lots and 50 EDU of connections yet to be constructed.

[4] Equivalent dwelling unit (EDU). Equal to the product of the EDU conversion and the number of lots based on data as of July 2010.

[5] Conversion ratio is not applicable for non-residential units given the actual demand is divided by the planning assumption of 750gpd/EDU to determine the number of equivalent dwelling units.

2.2 Water Supply and Infrastructure

The following describes the District's existing water rights, river diversions under normal conditions, raw water supply infrastructure, reservoir operating rules, reservoir losses, and historic water supply trends.

2.2.1 Existing Water Rights

The District's water supply consists of seasonal diversions from the Cosumnes River that are normally diverted to three storage reservoirs (Calero, Chesbro and Clementia). The District's water rights permit, 16762, states the following:

- Between the dates of the allowable diversion period (November 1 and May 31), surface water can be diverted from the Cosumnes River at Granlees Dam into the District's water storage reservoirs.
- Diversions are limited as follows:
    1. No water may be diverted when river flows are less than 70 cubic feet per second (cfs) at Michigan Bar gauging station.
    2. For river flows between 70 and 175 cfs, a maximum diversion rate of 6 cfs is allowed provided this diversion does not reduce downstream flow below 70 cfs.
    3. When river flows exceed 175 cfs, diversion of up to 46 cfs is allowed for direct use plus an additional 3,900 acre-ft for storage as follows:
        a. 1,250 acre-ft to Chesbro Reservoir.

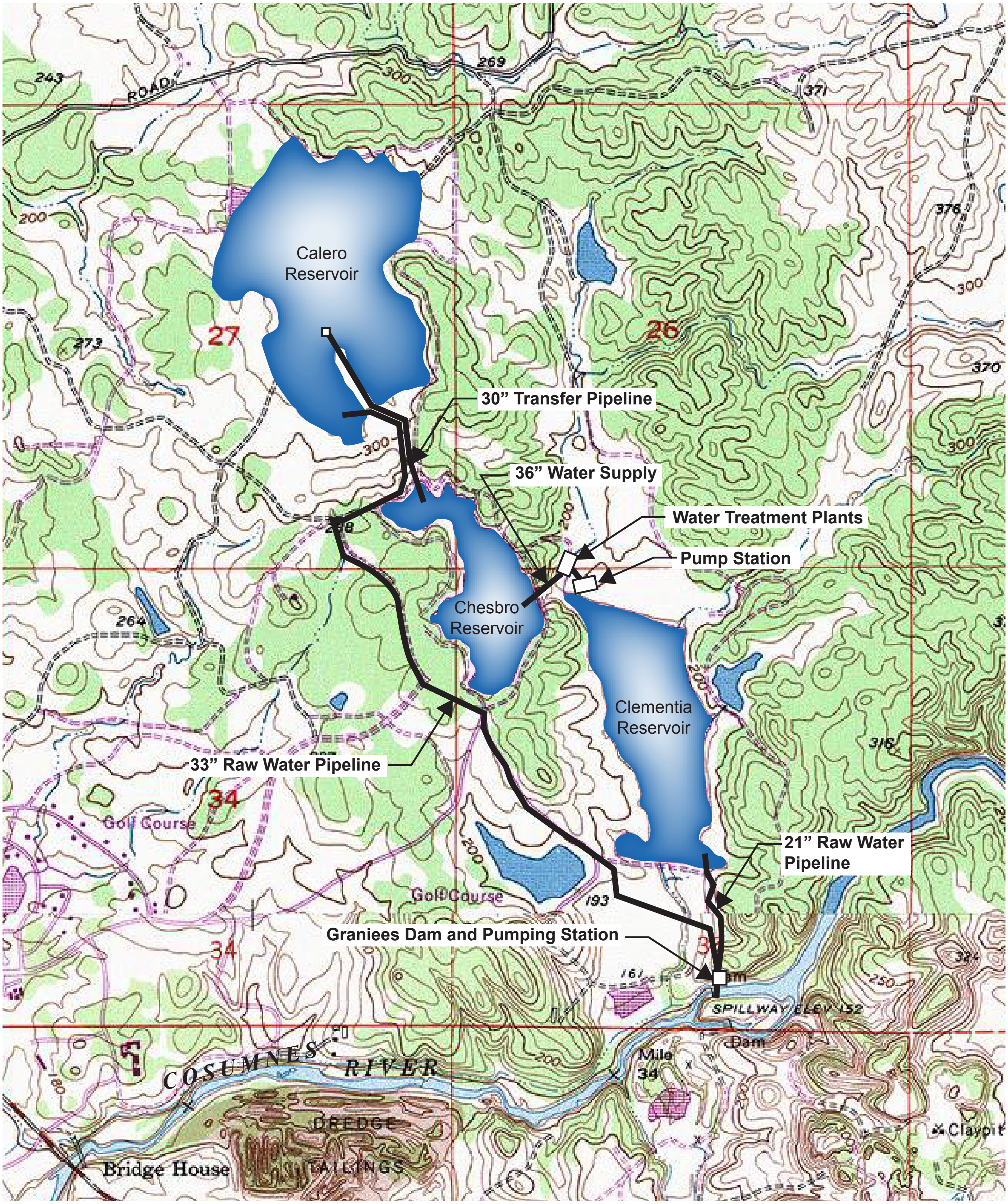
   b. 2,610 acre-ft to Calero Reservoir.
   c. 850 acre-ft to Clementia Reservoir.
   d. 40 acre-ft to South Course Lake 10.
4. The combined amount of items b, c, and d above cannot exceed 2,650 acre-ft./year
5. The maximum allowable diversion rate to storage is 46 cfs.
6. If at least 400 acre-ft has not been diverted by February 1st, up to 46 cfs may be diverted during February if the river flow is above 70 cfs.
7. If on March 1st at least 2,000 acre-ft has not been diverted; up to 46 cfs may be diverted during the month of March if the river flow is above 70 cfs.
8. If on April 1st at least 4,400 acre-ft has not been diverted; up to 46 cfs may be diverted for the rest of the season if the river flow is above 70 cfs.
9. The equivalent of the continuous flow allowance by direct diversion for any 7-day period may be diverted in a shorter time if there is no interference with vested rights.
10. No water shall be diverted during the allowable period (November 1-May 31) except during such time as there is visible surface flow in the bed of the Cosumnes River from point of diversion to the McConnell gauging station at Highway 99.
11. The total amount of water taken from the river cannot exceed 6,368 acre-ft per year from October 1 to September 30.

Water right permit 16762 was issued in 1969 and amended in 1980. In 2001, the permit was renewed and extended with no new permit requirements through 2020 in consideration that the community was not at full build-out. It now appears likely that in 2020, the community will not have reached full build-out and the permit will need to be extended again.

2.2.2 Raw Water Infrastructure

The District's raw water infrastructure consists of an intake from the Cosumnes River (Granlees Dam and a diversion structure), booster pumps and three primary raw water storage reservoirs (see Figure 2-1). The three primary storage reservoirs (Chesbro, Calero and Clementia) have an estimated combined usable storage volume of 4,225 acre-ft without flashboards or dead storage included, 4,732 of useable volume with flashboards, and overall total storage capacity is 5,132 acre-ft

Raw water can be conveyed from Granlees Dam to either Calero or Chesbro Reservoirs via a 33-inch pipeline or Clementia Reservoirs via a 21-inch pipeline. Calero Reservoir is at the highest elevation of the three reservoirs and is the first to be drawn down. It is drawn down by transferring raw water via a 30-inch siphon pipeline to Chesbro Reservoir. Raw water needed to meet the community's needs is drawn from Chesbro Reservoir to the water treatment plants through a gravity-driven 36-inch raw water supply pipeline. In addition to raw water storage, Clementia Reservoir can be used to route water to a number of other areas within the community. Clementia Reservoir is also used for irrigation supply and recreational uses. Clementia Reservoir is currently not authorized to be used as a source of public drinking water without first restricting body contact as approved by the California Department of Public Health.



Source: National Geographic TOPO!, 2001

NORTH

0 1600

Scale in Feet

P:\38000\138708 - RM IWMP Update-2020 Compliance Plan\Graphics

Brown AND Caldwell	PROJECT 138708-200	SITE	Draft IWMP Report Rancho Murieta CSD, Sacramento County, CA	Figure 2-1
	DATE 10-14-10	TITLE	Infrastructure Map	

2.2.3 Current Reservoir Operating Rules

Operation of the raw water system is based on a water balance where annual supply meets demand. Although this concept may seem simple, the actual implementation of balanced operation becomes complicated because of the District's water rights restrictions and seasonal demands. The basic equation for raw water supply is:

$$\Delta Storage = \sum_{in} Flow - \sum_{out} Flow$$

For an average rainfall year during the diversion season, flow into the system is greater than flow out of the system. Surplus water is moved to storage, and reservoir depth increases until they are filled to capacity. The opposite state occurs during the summer-to-fall draw down season, when flow out of the storage is greater than flow into storage. Reservoirs decrease in volume depth until the minimum allowable reservoir volume is reached (dead storage) or until the diversion season starts once again. Typically the District enters into the draw down period with all three reservoirs filled to capacity. During severe drought conditions, flow out of storage to the water treatment plant facility remains greater than flow into the system for most of the drought period including the diversion season.

2.2.4 Historic Water Supply Trends

Figure 2-2 presents the annual average total storage in all three reservoirs and the total amount of potable water use produced by the water treatment plant for the past 10 years (1999-2009).

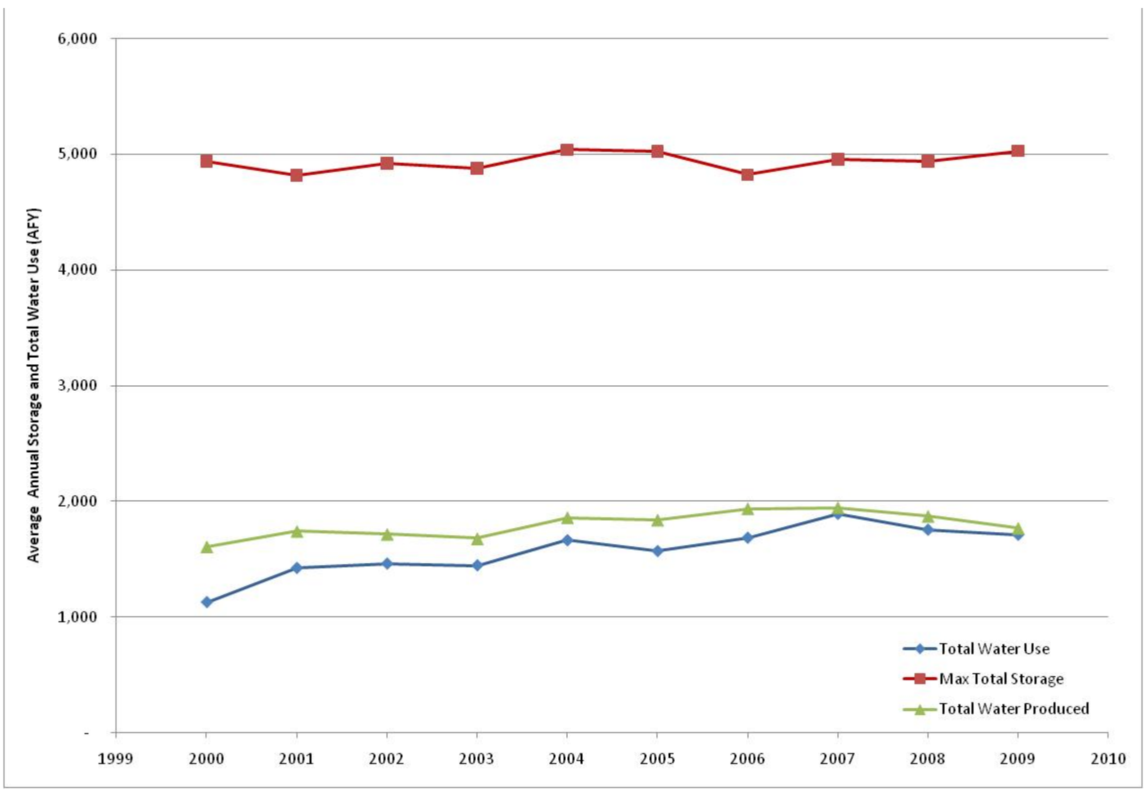


Figure 2-2. Maximum Water Storage, Total Water Produced and Potable Water Use – Fiscal Year 1999/2000 through 2008/2009

2.2.5 Reservoir Losses

Past studies used an assumed an annual average reservoir loss of 25 percent to account for evaporation and reservoir seepage. Evaporation rates were estimated using pan evaporation rates and estimated surface areas of the three water supply reservoirs. For the 2010 IWMP model, losses associated with reservoir seepage were calculated based on a rate of 2.5 feet per year and the interface between water volume and the reservoir's total bottom surface area.

In the 2006 IWMP, HDR compared the amount of water pumped from Granlees Dam to raw water storage and evaluated the amount of water produced at the water treatment plant. Where applicable, information from the 2006 IWMP has been retained such as rainfall and runoff contributions and evaporation and seepage losses, and only where needed, BC has updated information or expanded on the analysis from the last planning effort performed by HDR and based on the 1990 Giberson Study.

The assumptions retained from the District's prior planning efforts, are of small incremental volumes, on the order of less than 5 percent of overall monthly storage or losses compared to diversions and demands. Therefore, even a 10 to 20 percent change in refining these planning assumptions would equal only a 0.5 to 1 percent change in overall results, and thus not change the overall Plan recommendations. For the purposes of the 2010 IWMP Update, losses associated with seepage were based on a rate of 2.5 feet per year (1990 Giberson Study Report).

Figure 2-3 shows the estimated annual raw water supply and treated water production between 1985 and 2003. The solid line in the figure represents the raw water supply with no reservoir losses and the volume of water pumped from Granlees Dam to storage is equal to the total amount of water produced. As shown, the best fit line (developed based on a regression analysis of historic values of reservoir losses from 1986-2009) and all historic values fall on or below the solid line shown in the figure that is associated with no reservoir losses. This result indicates water losses do occur in the reservoir. Reservoir losses vary significantly from year to year and range between 100 and 800 acre-ft evaporation and seepage per year. Overall, analysis of historical data determined that average annual losses appear to be 20 percent of the total water supply, or 5 percent less than previous estimates assumed for past studies prior to the 2006 IWMP. After review of past studies and analysis, BC elected to use the basis for the evaporation from the 1990 Giberson Study and the seepage-elevation-surface area curves developed for 2006 IWMP that were validated based on historical data.

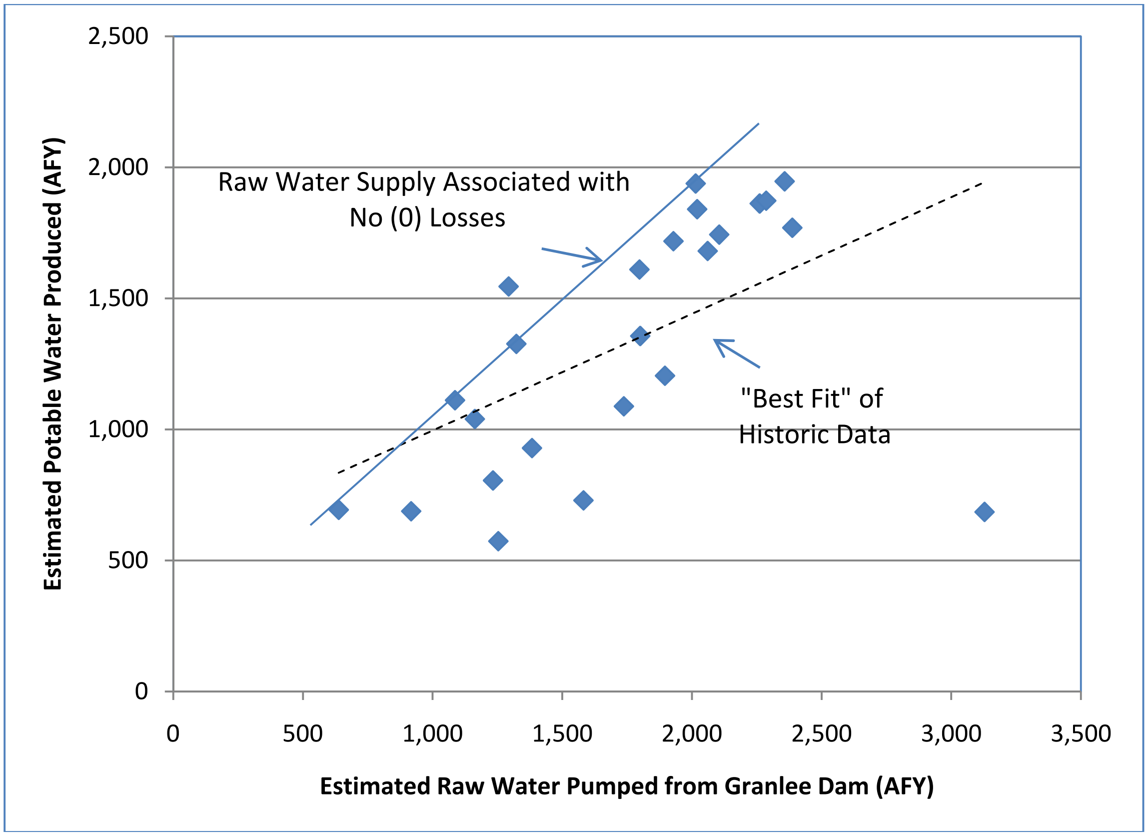


Figure 2-3. Reservoir Loss Estimate, Comparison of Raw Water Supply and Treated Water Produced (1986-2009)

2.3 Water Treatment, Demands and Uses

The following are descriptions of the District's existing water treatment plant and historic potable water demands and characteristics.

2.3.1 Description of Existing Water Treatment Plant and Expansion Plan

The District's first water treatment plant (Plant 1) was constructed in 1975 and had a design capacity of 1.5 million gallons per day (mgd). Plant components and processes include:

- Drum screen
- Flash mixing
- Flocculation
- Sedimentation
- Traveling bridge filter
- Chlorine contact basin
- Booster pumps

The second water treatment plant (Plant 2) was constructed in 1988 with a rated capacity of 2.0 mgd. Plant components and processes for Plant 2 are the same as those in Plant 1. In 1995, both Plants 1 and 2 were retrofitted to meet the new Surface Water Treatment Rule (SWTR). Since then, the plants have generally operated well to provide a 1.5 and 2.0 mgd, respectively, resulting in 3.5 mgd of total combined capacity. The current maximum day demand is estimated to be 3.4 mgd from the District's 2009 Annual Water Report to California Department of Public Health (CDPH).

Both plants can accommodate peak flows over short periods. Extended periods at peak capacity increase backwash cycles due to increased sediment build up. More backwash water is wasted, causing greater inefficiency and increased water demand.

To ensure adequate water supply for future development, the District has initiated a draft of the Phase 3 Water Treatment Plant Expansion Project. This future project will expand the District's water treatment system. Key objectives of this project include:

- Modifying the existing raw water pipeline to accommodate higher flows to Plant 1 and provide raw water screening upstream of Plant 1.
- Retrofitting Plant 1 with submerged membrane filtration technology and increasing its maximum day capacity from 1.5 to 2.2 mgd in accordance with current and foreseeable future regulations. This replacement is required due to age and regulatory constraints.
- The existing Plant 2 treatment system will remain in service and will not be modified as part of this project.

Following this Phase 3 expansion project, the firm rated capacity of the District's water treatment system will be 4.2 mgd.

A second expansion project (the Phase 4 Water Treatment Plant Expansion Project) will be initiated further in the future as needed. The purpose of this future project will be to increase the rated capacity of Plant 2 from 2.0 to 4.75 mgd. Once this project is completed, the firm rated capacity of the District's water system will be approximately 7.0 mgd. With 2020 compliance projected to be achieved, this expansion may be smaller scale on the order of 6.7 mgd.

2.3.2 Historic Potable Water Demands

Annual and running five year average total water uses over the past 20 years are presented in Figure 2-4. As shown, individual annual average water uses have varied between 438 and 662 gpd per connection. In general, the lowest water demand on a per connection basis occurred in the late 1980's and early 1990's and some of the highest demands have occurred in the last seven years. Increases in water demand are explained with larger lots being developed later and increased irrigation demands from the drought conditions in 2007-2009. Figure 2-4 illustrates the higher demands in 2007 and then lower demands in 2008 and 2009 due to notifying customers of the drought conditions and asking for voluntary conservation. These conservation savings are expected to be temporary, given the drought conditions have abated in 2010.

The highest running five year average use of 590 gpd per connection occurred in 2008. The average annual demand per EDU from estate lots greater than 12,000 square feet from 2004 through 2009 was 680 gpd per EDU. Overall, 15-year average (1994-2009) residential demand was 495 gpd per connection.

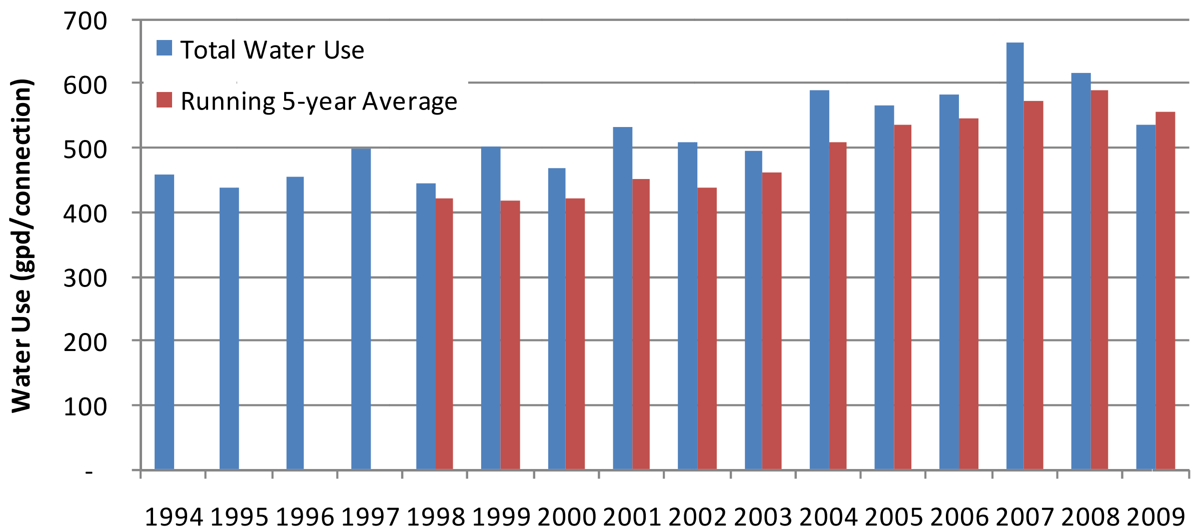


Figure 2-4. Annual and Running Five Year Average Water Use in the District's Service Area

Figure 2-5 presents the historical demand trend from 1994 through 2009 and goals for reduction to meet new state mandates in SB7. The difference between the historical baseline of 298 GPCD, and the 2015 target of 30 GPCD reduction and the overall goal of 2020 GPCD target of 238 GPCD represents a reduction of 60 GPCD. At the Board Workshop on May 5, 2010, the GPCD target of 238.5 GPCD using Method 1 was selected. Figure 2-5 shows the historical demand and 2015 and 2020 targets as determined for SB7 compliance. For more details on potable demand reduction targets based on gallons per capita per day analysis, refer to the 2020 Compliance Plan (Brown and Caldwell, 2010) and Section 3.4.

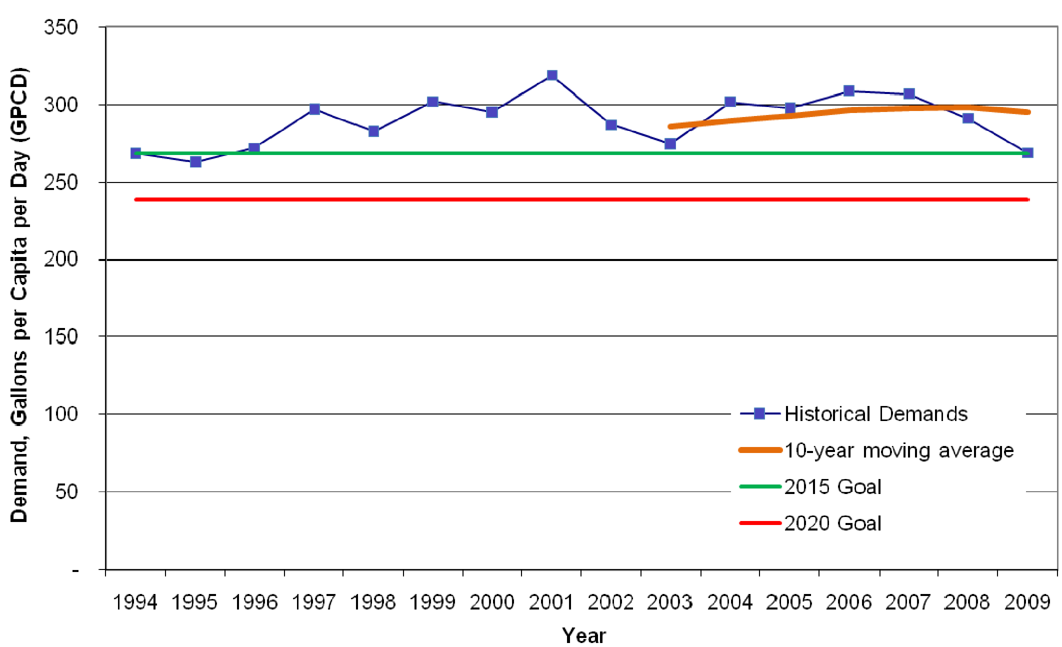


Figure 2-5. Historical GPCD Demands and SB7 Method 1 Goals

2.3.2.1 Water Use Characteristics

Figure 2-6 provides a breakdown of the total average potable water demands by user category from 1994-2009. As shown, residential demands account for 74 percent of the total water produced. Of this amount, residential outdoor uses account for 46 percent of total residential demand. The remaining demand (28 percent) is comprised of indoor residential uses. If the percentages were based on total annual single family demand only, the percentage of outdoor demand is 61 percent and indoor demand is 39 percent. In other words, residences in the District use about two-thirds of their water outdoors.

Non-residential uses account for 16 percent of the total water produced and, of that amount, 50 percent is associated with outdoor uses.

Overall system losses have varied between 1994-2009. The past five year average has been 8 percent. For planning and modeling purposes, 10 percent is assumed as the annual average water loss.

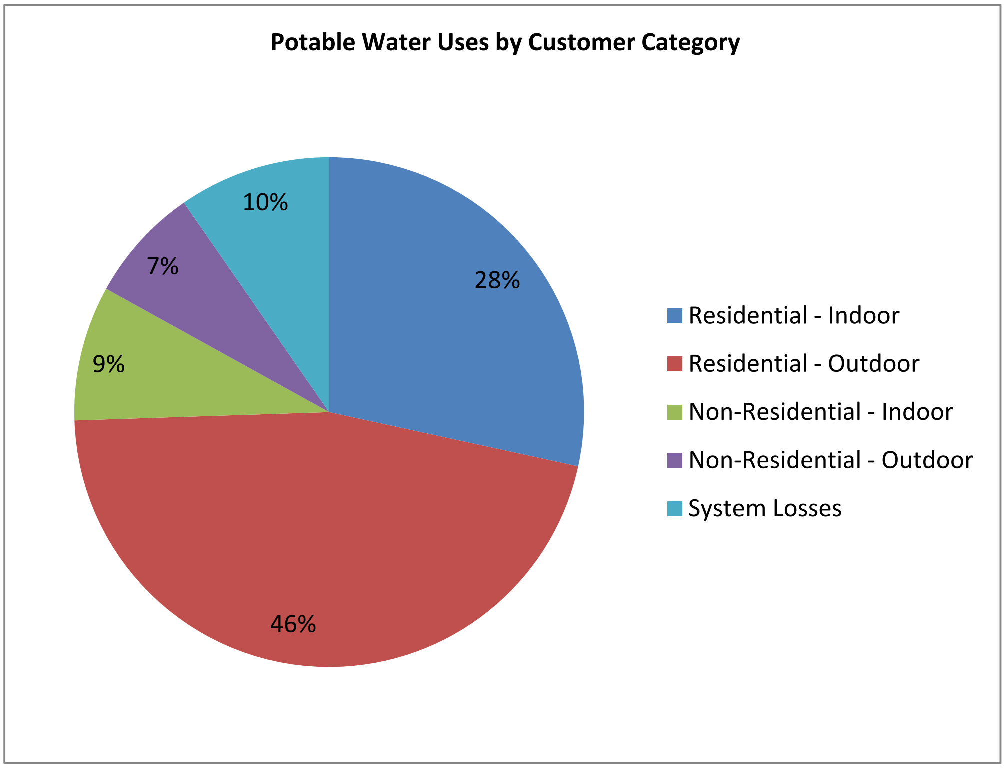


Figure 2-6. Potable Water Use by Category

Estimates for indoor and outdoor water uses were developed from historical seasonal patterns. Figure 2-7 shows types of estimated uses over the past 20 years. Currently, residential and non-residential indoor use averages about 211 gpd per connection, while outdoor uses are currently between 242 and 395 gpd per connection.

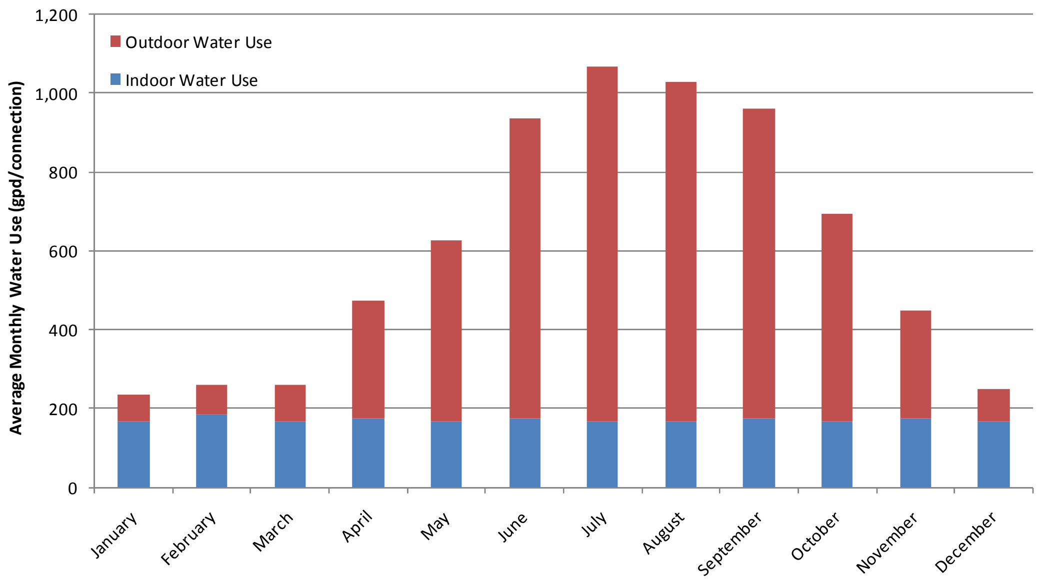


Figure 2-7. Estimated Indoor and Outdoor Water Use (1997-2009)

2.3.2.2 Seasonal Characteristics

Another factor that influences current and future water demands are seasonal variances between winter and summer demand. Figure 2-8 shows seasonal total water demands. As shown, the months of January, February and December have significantly lower water demand than the remaining months of the year due to lower or no outdoor water use. Overall, average winter demand during these months is approximately 248 gpd per connection, compared to 722 gpd per connection in the remaining nine months of the year. The difference between these two demands is primarily attributed to outdoor water use (e.g., landscape irrigation).

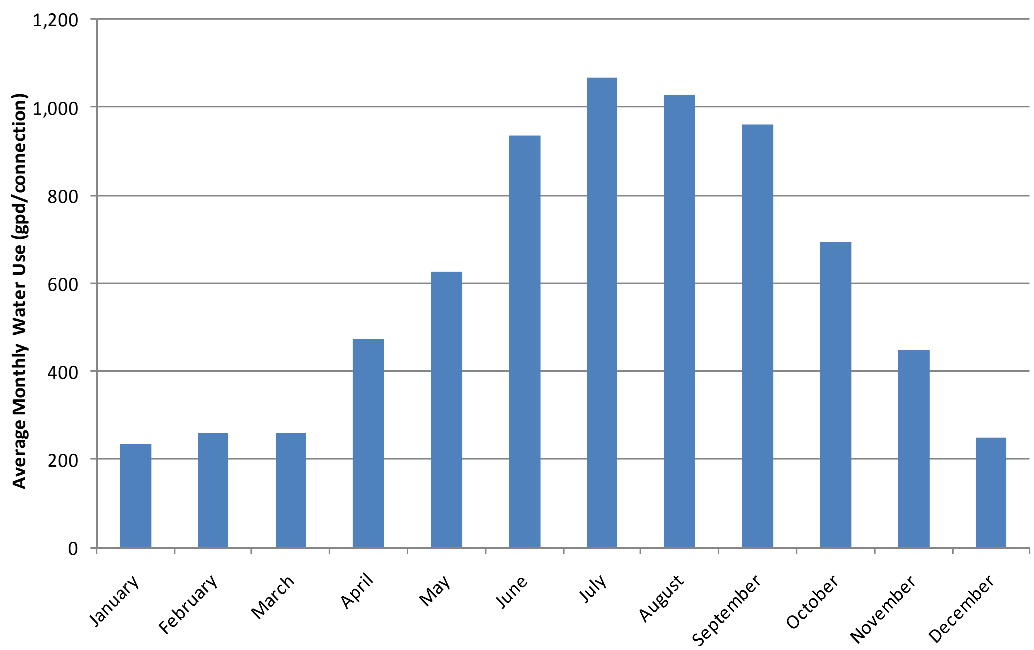


Figure 2-8. Average Monthly Water Demands

2.3.2.3 Distribution System Losses

Distribution system losses, which are defined as losses after water treatment (e.g. distribution leaks, water used for fire hydrant testing, etc.), account for an average of 8 percent of the total water produced over the past five years. Table 2-2 presents the system losses between 2005 and 2009.

Table 2-2. Distribution System Losses

Year	System Losses as a Percent of Potable Water Production
2005	15%
2006	13%
2007	3%
2008	6%
2009	3%
Average	8%

The downward trend in distribution system losses is due to the following actions taken by the District in recent years:

- All accounts and use is now completely metered, including fire hydrant use and District uses, and documented as to actual demands. Previously, these unmetered demands would register within the difference between demand and production what was used to estimate distribution system losses.
- Water Treatment Plant meter was replaced in 2009 providing more accurate production data.
- Replacement of District meters on the order of 50-100 per year, which may include replacement of older meters, registers, batteries, radio receivers.
- New connections have less leakage due to using PVC for distribution mains and service lines.

2.4 Wastewater Treatment and Recycling

The District operates the Rancho Murieta Wastewater Reclamation Plant (WWRP) which provides wastewater treatment for the entire Rancho Murieta community. Raw wastewater sources are residential homes in the Rancho Murieta community and commercial facilities such as stores and restaurants which serve the community. There are no industrial dischargers to the WWRP requiring pretreatment.

The collection system consists of gravity sewer lines which flow to ten lift stations located throughout the community. Six of the lift stations are located on the north side of the Cosumnes River and four are located south of the river. Ultimately, wastewater is conveyed to the WWRP by three lift stations: Main Lift North, Main Lift South, and Lift Station 6B. The volume of influent flow entering the WWRP is calculated by totaling flow readings from these three lift stations.

The WWRP consists of a secondary wastewater treatment facility and a tertiary treatment plant. Wastewater receives secondary treatment through five aerated facultative ponds that are operated in series. Treated effluent is stored in two storage reservoirs before receiving tertiary treatment. The tertiary treatment facilities for recycled water consist of two dissolved air flotation units, two rapid sand filters, a chlorine contact chamber and a concrete lined equalization basin.

The tertiary treatment plant is generally operated each year from April through November. During the winter period, secondary treated effluent is stored in the WWRP's two storage reservoirs which have a total capacity of 756 acre-ft. After receiving tertiary treatment, reclaimed water is pumped to the golf courses and stored in five reservoirs (Lake 10, Lake 11, Lake 16, Lake 17 and Bass Lake) situated around the golf courses. Depending on irrigation demands, recycled water stored in Lake 10, Lake 11 and Bass Lake may be supplemented with water from the Cosumnes River or Clementia Reservoir. At buildout, all water used for golf course irrigation is expected to be reclaimed wastewater.

Residual biosolids produced at the WWRP are collected and treated prior to landfill disposal. On-site biosolids treatment consists of two sludge drying bed trains.

Historically, treated effluent disposal through spray irrigation on 250 acres of land used for Rancho Murieta North and South golf courses has been the only method for effluent disposal. However, the District has recently initiated two projects to increase the number of effluent disposal methods and the overall treated effluent disposal capacity. Both of these projects were initiated to address Cease and Desist Order No. R5-2006-0001 (CDO).

2.4.1 Historic Wastewater and Recycled Water Production

Figure 2-9 shows total wastewater production at the WWRP, estimated average dry weather flows (ADWFs) and customer contributions (acre-ft/year per connection) for the past 23 years. ADWFs shown in this figure are based on the average historical flow during the dry season (June through September). Wastewater contributions have decreased from approximately 0.30 acre-ft/year per connection experienced in the late 1980's) to 0.20 acre-ft/year per connection in 2009.

For comparison purposes, the average annual wastewater contribution rate of 0.20 acre-ft/year per connection in 2009 equates to an average annual wastewater contribution of approximately 210 gpd per EDU (including residential and commercial and excluding irrigation EDUs). As described in the next chapter, the District uses a residential unit wastewater average dry weather production rate of 210 gpd per EDU for planning purposes. Wastewater contributions, on an acre-ft/year per connection basis, have overall remained relatively constant over the past 15 years with changes for wet and dry from infiltration and inflow. (HydroScience Engineers, 2007)

Currently, annual wastewater production at 537 acre-ft/year equates to an average dry flow of approximately 0.48 mgd. The estimated ADWF for the last three years has been approximately 0.48 mgd, which is significantly lower than the WWRP's rated capacity as described below. In general, recycled water production is considered equal to wastewater generation less minor losses through the WWTF and WWRP. These losses do not include distribution or evaporation losses downstream of the WWRP or any rainfall contributions entering the recycled water storage reservoirs.

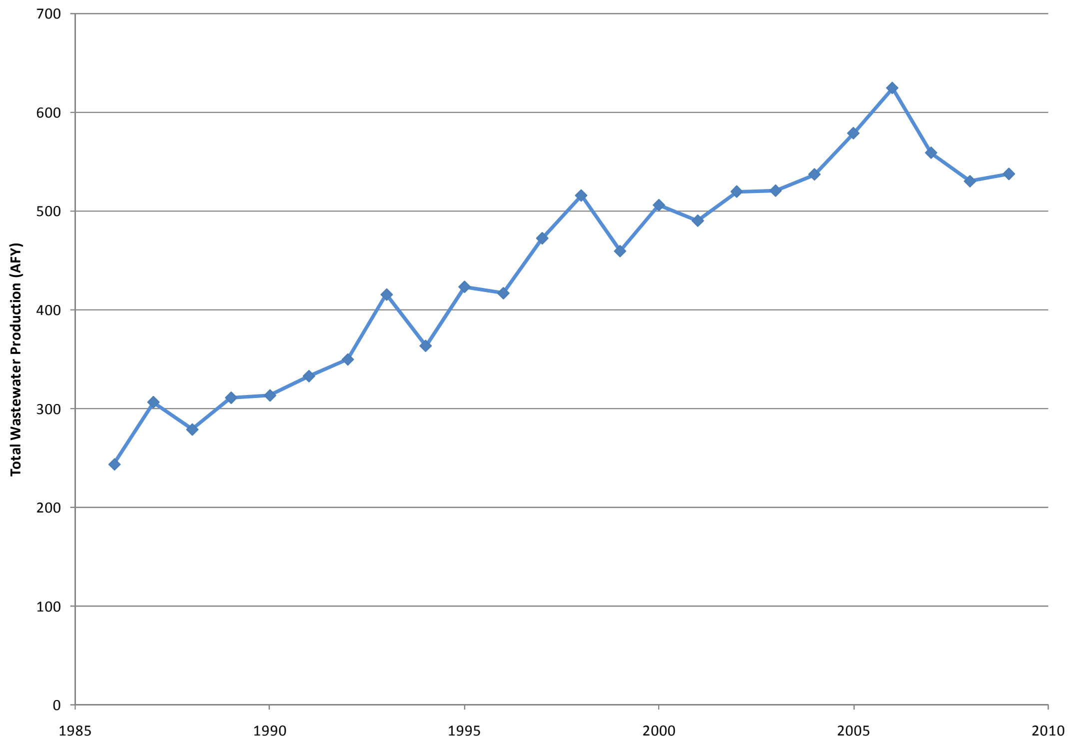


Figure 2-9. Annual Wastewater Generation

2.4.2 Secondary and Tertiary Treatment Capacities

The secondary treatment portion of the WWRP was designed to accommodate complete buildout of the community. The secondary treatment facility average month and peak month capacities are 1.55 and 2.0 mgd, respectively. As described above, current ADWF routed to the WWRP is estimated at approximately 0.48 mgd. According to the District's Waste Discharge Requirements (WDRs), the maximum 30 day ADWF shall not exceed 3.0 mgd.

The design flow rate for the tertiary portion of the WWRP is 3.0 mgd; however it is currently limited to a maximum of 2.3 mgd due to disinfection contact time requirements. The maximum 30 day average limitation is associated with peak month irrigation demands as opposed to peak daily or weekly needs.

2.4.3 Effluent Storage and Reuse

The WWRP has two large storage reservoirs for secondary effluent storage. These reservoirs provide seasonal storage of secondary effluent during the winter when tertiary treatment is not employed at the WWRP. Current operating protocols usually limit golf course irrigation with reclaimed water after October 15. Typically, golf course irrigation with recycled water does not resume until April 15.

The two secondary effluent storage reservoirs were constructed with a 3-foot thick clay liner and are connected in series. Together they have a combined capacity of approximately 728 acre-ft while maintaining a minimum two feet of freeboard in each reservoir. According to the Wastewater Facilities Expansion and Financing Report (HydroScience Engineers, 2007), these storage reservoirs have adequate capacity to contain secondary effluent throughout the winter months. The District submitted water balances to the RWQCB which show the storage reservoirs are currently providing sufficient capacity to contain allowable wastewater flow, inflow infiltration and all flows from seasonal precipitation using a 100-year annual precipitation return period.

Following tertiary treatment, recycled water is pumped to the Rancho Murieta North and South golf courses. As previously described, a total of five storage reservoirs are located around the golf courses. The storage reservoirs are clay lined and were installed to provide operational flexibility rather than reliable seasonal storage. According to District staff, the total surface area of these storage reservoirs is 45 acres, including side slopes. Recycled water is disposed through computer-controlled spray irrigation on each golf course. Table 2-3 provides a summary of annual golf course demands in normal, wet and drought years.

Table 2-3. Annual Golf Course Irrigation Demands

	Normal Year	Wet Year	Dry Year
Estimated Irrigation Demand (ac-ft)	550	450	650

2.5 Section Summary

This section presents facilities and statistics pertaining to the District's existing service area and water supply, potable water, and wastewater production rates and recycled water production demands. A summary of the key information presented in this chapter is provided below:

- **Service Area**: The District currently serves a total of 2,502 residential and 102 nonresidential connections, which represents 2,269 EDUs.
- **Water Supply**:
  - Water supply (5-year annual average based on total maximum storage Calero, Chesbro, Clementia): 4,972 acre-ft (Average annual from 2005-2009)
  - Total Water Storage for 2009: 5,052 acre-ft
  - Average reservoir losses: 20 percent of water supply
- **Water Treatment**:
  - Current maximum day demand 3.1 mgd
  - Current treatment capacity: 3.5 mgd
  - Capacity following upgrades:
    - Phase 3 Project: 4.2 mgd
    - Phase 4 Project: 7.0 mgd (approximately)
- **Potable Water Production and Uses**:
  - Treated water production from 1994-2009: 1,600 acre-ft
  - Treated water production from 2005-2009: 1,672 acre-ft
  - Treated water production for 2009: 1,769 acre-ft
  - Overall actual annual average demand (average based 2005-2009 average per connection demand for large estate lots greater than 12,000 square feet): 680 gpd per EDU
  - Residential Demand (Average annual from 2005-2009): 495 gpd per connection
  - Historical Use Patterns (1994-2009):
    1. Residential: 78 percent of total water produced

a. Outdoor residential use: 46 percent of residential use
b. Outdoor water use has ranged from 242 gpd/connection in 1998 to 395 gpd per connection in 2007.

2. Non-Residential: 16 percent

- Total average annual system losses from water produced (2007-2009): 8 percent

- **Wastewater Treatment**:
  - Secondary plant capacity: 1.55 mgd
    1. The current average dry weather flow is estimated to be 0.48 mgd which is lower than the rated secondary treatment plant capacity.
  - Tertiary plant capacity: 3.0 mgd, currently limited to 2.3 mgd due to disinfection contact time requirement.
    2. The current peak recycled water demand is estimated to be 1.5 mgd which is lower than the rated tertiary treatment plant capacity.
- **Effluent Storage**:
  - Required storage volume: 432 acre-ft
  - Available storage capacity: 756 acre-ft
  - Existing storage reservoirs have adequate capacity to serve existing conditions.
- **Effluent Disposal**:
  - Available recycled water: 565 acre-ft/year
  - Effluent disposal:
    1. Golf course irrigation demands:
       a. Normal year: 550 acre-ft/year
          Demands are greater than production, thus requiring supplementary water.
       b. Drought condition: 600 to 700 acre-ft/year
    2. Pasture irrigation:
       a. Normal year: 280 acre-ft/year
       b. Drought condition: Not applicable; short term solution and planned to be decommissioned
    3. Total combined capacity:
       a. Normal year: 855 acre-ft/year (short term)
          575 acre-ft/year (long-term)
       b. Drought condition: 600 to 700 acre-ft/year

3. FUTURE CONDITIONS

This chapter describes the future conditions of the District's service area which serves as a baseline for planning by establishing the following parameters:

- Projected demographics and land use
- Summary forecasted demand reductions from the Draft 2020 Compliance Plan
- Summary recycled water irrigation demands
- Summary higher density development demands
- Projected water supply needs
- Projected water treatment needs
- Wastewater and recycled water system treatment capacity
- Golf course irrigation demands

These parameters have been incorporated into the IMWP model used to analyze current water supply reliability under existing conditions.

3.1 Projected Demographics and Land Use

The District's original master plan projected a total of 5,189 residential units at buildout. However, due to economic influences, environmental constraints and consumer home-buying trends, developers propose to reduce buildout projections from 5,199 EDUs (high growth scenario) to 4,498 connections (medium growth scenario). This decrease represents an overall unit reduction of approximately 16 percent at buildout.

Three projected growth scenarios were developed for estimating future water, wastewater and recycled water production: low, medium and high. The medium density projected growth scenario was based on the total 4,356 EDUs provided by the developers as of July 2010.

Similar to past planning studies, the medium projected growth scenario will serve as the basis for developing the recommended integrated water management plan. Reservoir impacts and drought deficits for the other two projected growth scenarios have been prepared to help the District develop a different course of action if lower population growth occurs or if the community elects to pursue full buildout potential of approximately 5,189 residential units approved in the approved master plan. In the District's service area, since every dwelling unit is a metered connection, residential units match exactly with the number of residential connections.

The projected water supply, treated water, wastewater treatment, effluent storage, and recycled water needs and productions based on the low and high growth scenarios have not been adjusted since the previous 2006 IWMP due to nominal changes. The following summarizes the three projected growth scenarios. A summary of the total number of existing and future connections and EDUs for the three projected growth scenarios is presented in Table 3-1 and described below.

- **Low Growth Scenario:** This scenario is based on the future connections associated with the medium growth scenario described above, less 500 residential units. All future connections are assumed to be estate lots greater than 12,000 square feet (equal to 1 EDU), except for the currently approved and anticipated approvals by Sacramento County for 620 units. As shown in Table 3-1, this scenario shows a total of 3,998 connections and a total of 3,856 EDUs at buildout.

- **Medium Growth Scenario (Base Case):** Future connections and EDUs based on the information provided by the developers and the breakdown of future units provided by the District. As shown in Table 3-1, this scenario is associated with a total of 4,356 EDUs at buildout, which includes both residential and nonresidential units. Except for the currently 620 approved units as shown in Table 3-1, the number and type of future non-residential connections are the same for all three projected growth scenarios.
- **High Growth Scenario:** This scenario is based on a total of 5,189 residential units at buildout. All future connections are assumed to be estate lots greater than 12,000 square feet (equal to 1 EDU again except for the approved 620 units residential). As shown in Table 3-1, this scenario shows a total (residential and non-residential) of 5,199 EDUs at buildout, which is approximately equal to the total EDU count projected in the original master plan.

Table 3-1. Existing and Projected Number of Connections and EDUs at Buildout[1]

Lot or User Class	Existing Service Area[2]		Low Growth Scenario		Medium Growth Scenarios[3]		High Growth Scenario	
	Number of Units (Connections)	Number of EDUs (EDUs)	Number of Units (Connections)	Number of EDUs (EDUs)	Number of Units (Connections)	Number of EDUs (EDUs)	Number of Units (Connections)	Number of EDUs (EDUs)
Residential Units								
Estate >12,000	729	729	1,453	1,453	1,953	1,953	2,796	2,796
Estate <12,000	555	500	1,091	982	1,091	982	1,091	982
Circle	440	308	440	308	440	308	440	308
Cottage	274	192	274	192	274	192	274	192
Halfplex	59	30	59	30	59	30	59	30
Townhouse	256	128	340	170	340	170	340	170
Mobile Home	189	57	189	57	189	57	189	57
Subtotal	2,502	1,943	3,846	3,191	4,346	3,691	5,189	4,534
Non-residential Units								
Commercial	97	272	120	372	120	372	120	372
Park	5	54	8	269	8	269	8	269
School	0	0	24	24	24	24	24	24
Subtotal	102	326	152	665	152	665	152	665
Total	2,604	2,269	3,998	3,856	4,498	4,356	5,341	5,199

[1] *For planning purposes, the 45 vacant are included as large estate lots in each of the three build out scenarios.*

[2] *Existing Service Connections based on 2009 data and assumed no development until 2015.*

[3] *Base scenario. Buildout projected timeframe is estimated in year 2030.*

3.2 Projected Water Supply Needs

Annual water supply needs for existing and buildout conditions during normal rainfall years are estimated based on annual water demands. These estimates take into account system losses, direct rainfall and runoff and reservoir evaporation and seepage losses as described below.

- **Water Demands:** Based on the current and projected EDU count and a demand of 750 gpd/EDU.

- **System Losses:** As previously discussed in Section 2.3.2, system losses are estimated to be approximately 8 percent of the overall existing water demand. As described, this component is comprised of un-metered uses such as distribution leaks, flows required for fire hydrant testing, etc. For purposes of estimating water demands, a value of 8 percent is the annual average based on review of previous six year's data for system losses from 2004-2009. For planning purposes, 10 percent is used to estimate system losses for all three future scenarios.
- **Direct Rainfall and Runoff:** The rainfall and runoff assumptions retained from HDR's prior planning efforts, are of small incremental volumes, on the order of less than 10 percent of overall monthly storage or losses compared to diversions and demands. Therefore, even a 10 to 20 percent change in refining these planning assumptions would equal only a 1 to 2 percent change in overall results, and thus not change the Plan recommendations. The mean annual rainfall for Rancho Murieta is approximately 21 inches per year. Because Clementia Reservoir does not typically contribute to raw water supply under normal conditions, rainfall contributions to the raw water supply are based on surface areas associated with Calero and Chesbro Reservoirs only. Runoff contributions are only accounted for to Lake Clementia.
- **Reservoir Losses (Evaporation and Seepage):** As described in previous studies and reports, including the 1990 Giberson Study and 2006 IWMP, evaporation and seepage represent a significant portion of the overall raw water demand. These two components are collectively referred to as reservoir losses since this volume of water is lost specifically as a consequence of open area surface water storage and seepage into the groundwater table. As previously described in Figure 2-3, reservoir losses constitute about 20 percent of overall raw water demand on average. The 2010 IWMP Update model uses storage volume, elevation, surface area curves developed using regression equations for the 2006 IWMP, which are further referenced to published in 1990 "Water Supply Issues" Giberson Report and was validated against historical data provided by the District. In the SVM used for the 2010 IWMP, the evaporation losses are based on the evaporation rates from 1990 Giberson Report for corresponding surface area curve for the calculated monthly storage volume in each reservoir. The same evaporation rates published in the 1990 Giberson report are used. For seepage rates, the regression equations were from the 2006 IWMP were also used based on calculated monthly storage volumes in the 2010 IWMP modeling approach. The respective evaporation and seepage losses for each reservoir in each month were calculated based on the first of month storage volumes, and then used as part of the water balance equations to subtract from the available supplies as an added demand in the SVM.
- **Treated Water Production:** Total average annual treated water produced between 2005 and 2009 was 1,873 acre-ft per year, which is higher than the estimated value of 1,730 acre-ft per year. This can be partially explained by higher demands due to the dry year conditions in 2007, 2008 and 2009 that increased irrigation demands. The 10-year historical average is 1,798 acre-ft per year which is approximately equal to the projected demand.
- **Raw Water Diverted:** Total estimated raw water supplied based on historic data was 2,195 acre-ft in fiscal year 2003/04 and 2,008 acre-ft in fiscal year 2004/05. The average of these two is 2,101 acre-ft per year, approximately 10 percent less than the estimated value of 2,300 acre-ft per year. The most likely cause for this discrepancy is lower reservoir losses, which were significantly lower than the 20 percent value used in the projections. During 2003/04 and 2004/05, reservoir losses were respectively estimated at 14 and 11 percent. (2006 IWMP, HDR). These assumptions were not updated using 2006-209 data due to the drought conditions during this period. Table 3-2 summarizes estimated treated water production and raw water supply needs for the three growth scenarios based on 750 gpd per EDU.
- **Projected Water Needs:** The projected influence from reduced total potable water demand assuming SB7 compliance is achieved is an estimated 20 percent. As a result, raw water supply deliveries to the water treatment plant may lower by 20 percent on the order of 2,957 acre-ft/yr from the original estimate of 3,659 acre-ft/yr at buildout (medium growth scenario). The total estimated water supply need may also

be reduced to 3,640 acre-ft/yr from 4,551 acre-ft/yr, which would equate to an increase in water supply reliability in normal and dry years, given more water supply could be retained as storage in the reservoirs.

Table 3-2. Estimated Treated and Raw Water Needs

Raw Water Demand Component	Existing Conditions (acre-ft per year)	Projected Buildout Scenarios (acre-ft per year)		
		Low Growth	Medium Growth	High Growth
Residential and Non-residential Demands	1,906	3,239	3,659[1]	4,368
System Losses (10%)	190	324	366	436
Estimated Treated Water Production	2,096	3,563	4,025	4,804
Direct Rainfall and Runoff[2]	(287)	(287)	(287)	(287)
Reservoir Losses[2]	813	813	813	813
Total Estimated Water Supply Need	2,622	4,089	4,551[1]	5,330

1 *When assuming SB7 compliance will be achieved, raw water supply deliveries to the water treatment plant may lower by 20 percent on the order of 2,957 acre-ft/yr from the original estimate of 3,659 acre-ft/yr at buildout (medium growth scenario). The total estimated water supply need may also be reduced to 3,640 acre-ft/yr from 4,551 acre-ft/yr.*

2 *Evaporation and seepage losses are dependent on storage volumes and surface area of each reservoir. Storage volume to surface area curves were developed using regression analysis for the 2006 IWMP based on historical data for each reservoir. These equations were reviewed and retained use for the 2010 IWMP Update. The minimum amount of total losses is experienced under extreme drought event when storage volumes and surface area is in critically low condition or at dead storage volumes. Total losses for the extreme drought event using 1977 hydrology was estimated at 492 acre-ft in both the 2006 IWMP and 2010 IWMP Update. .*

3.3 Projected Water Treatment Needs

Maximum day potable water demands were developed as part of the Phases 3 and 4 Water Treatment Plant Expansion Basis of Design Report (August 2003) using the assumption of 750 gpd per EDU. The adjustments to buildout projections of EDUs are within 2 percent of the original buildout projections used for the Water Treatment Plant Expansion Report, and as a result the total projected maximum day potable water demands have not been adjusted for the 2010 IWMP.

As Table 3-3 of this document shows projected average and maximum day flow requirements of 3.2 and 6.7 mgd respectively, this implies an average to maximum day peaking factor of approximately 2.1. As previously described, the District has initiated expansion to the water treatment's firm capacity to approximately 7.0 mgd. As shown in Table 3-3, this capacity upgrade is adequate to serve both the projected low and projected medium growth scenarios. Additional capacity may be required if the community begins to expand beyond the number of units described in the projected medium growth scenario.

The projected influence from reduced total potable water demand assuming SB7 compliance is achieved is an estimated 20 percent. As a result, maximum day demand reduction is projected to also lower water treatment plant production expansion needs by 20 percent on the order of 5.3 mgd from the original estimate of 7.0 mgd at buildout (medium growth scenario).

There is additional potential to defer or downsize the future water treatment plant expansion in Phase 4 due to projected excess recycled water. The estimated 470-560 acre-ft/year of excess recycled water could further reduce future potable water demands.

Table 3-3. Projected Maximum Day Potable Water Demands[1]

Raw Water Demand Component	Units	Buildout Scenarios		
		Low Growth	Medium Growth	High Growth
Treated Water Production[2]	acre-ft/year	3,239	3,659	4,368
Equivalent Average Day Demand[3]	mgd	2.9	3.2	4.0
Peaking factor (Max to Ave Day)	--	2.1	2.1	2.1
Estimated Maximum Day Demand[3]	mgd	6.2	6.7[4]	8.3

[1]Unadjusted values from the Water Treatment Design Report (August 2003). Assumes 750 gpd per EDU demands. Given the intent of complying with 2020 mandates to lower water demand, these values may be adjusted down in the future. Current average annual demands are 680 gpd per EDU.

[2]From Table 3-2

[3]Without system losses

[4] With SB7 compliance reducing water demands from new development and existing connections on the order of 20%, future maximum day water demand may be reduced to 5.3 mgd. In addition, if recycled water were used to further offset potable demands.

3.4 Summary Forecasted Demand with meeting the 2020 Reduction Targets

Given the population is estimated to stay constant between 2010 and 2015 due to economic conditions resulting in the community not further developing approved lots, baseline water demands would also remain relatively constant (without the water conservation activities targeting GPCD reductions by the year 2020). Based on the projection shown in Figure 3-1, water demand increases from 1,710 acre-ft per year based on 2010 conditions to 3,659 acre-ft per year at buildout (2030), assuming that demand reduction measures are not implemented.

The projected water demand without achieving 2020 targets is based on the estimate of 750 gpd per EDU. The projected water demand with meeting 2020 target of 20 percent reductions is based on achieving an estimated demand of 600 gpd per EDU. The planning assumption adjustment with 2020 compliance of 600 gpd per EDU is based on 80 percent of the planning assumption baseline of 750 gpd per EDU for large estate lots greater than 12,000 square feet. Both the projected and actual production includes 10 percent system losses.

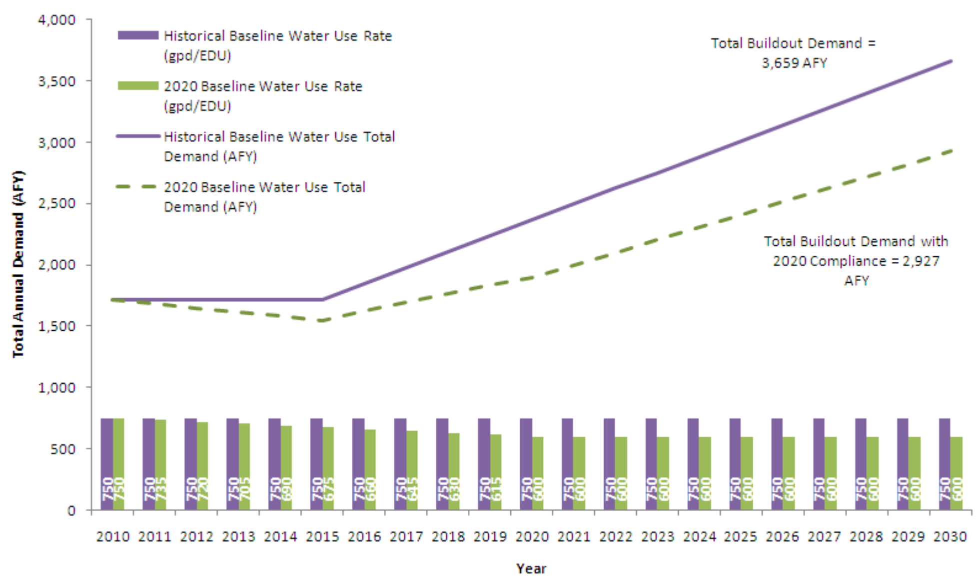


Figure 3-1. Total Buildout Water Demand Projections without and with 2020 Reduction Targets Achieved

3.5 Demand Reduction Potential due to Future Recycled Water Projects

An analysis was performed to review the potential for reducing future potable demands using non-potable supplies (recycled water) for meeting irrigation demands, for compliance with future demand reduction mandates under Senate Bill 7 (SB7) discussed in the Draft 2020 Compliance Plan (Brown and Caldwell, 2010). Recycled water demand reduction potential is per residential equivalent dwelling unit based on the 0.31 acre-year per connection determined in the Recycled Water Feasibility Study (HDR, June 2009).

At a workshop on June 18, 2010, the District Board decided to select a 2020 Compliance Plan alternative that did not include mandating future recycled water as a means to achieving 2020 potable demand reduction targets. For the draft 2020 Compliance Plan, it is assumed that the most cost effective conservation measures will be pursued first and to reduce potable demands by 20 percent between 2010 and 2020 without the use of recycled water. The use of recycled water and its effects on water treatment plant expansion projects will be evaluated further in the future when recycled water may be used to substitute projected potable water demands and actual reductions in the demand are being achieved by conservation measures.

3.6 Demand Reduction Potential due to High Density Development

Shifts to higher density demands have been accommodated within the demand projections presented in Section 3.1. Overall, the EDUs projected in the 2006 IWMP and this Draft 2010 IWMP are approximately the same EDUs for the baseline (medium growth) scenario of 4,230 and 4,356 total EDUs, respectively. The trend to higher density development can be seen in Table 3-1 for all growth scenarios where there are 1,091 estate lots less than 12,000 square feet which is increased from 832 estate lots less than 12,000 square feet in Table 4 of the previous 2006 IWMP.

Overall, the projected demands based on updated projections of buildout EDUs of 4,356 compared to the previous 2006 IWMP estimate of 4,230 EDUs is reflective of a nominal 1.5 percent increase in projected demand. The affect on potable demand projections will be impacted more through meeting 2020 reduction targets or bringing recycled water online to substitute potable water demands as discussed above.

3.7 Projected Wastewater Production and Treatment Needs

The same methodology used in the 2006 IWMP (HDR, 2006) used in the 2006 IWMP was retained in this Draft 2010 IWMP to project future wastewater flows at buildout. A system average ADWF unit production rate of 210 gpd per DU was used to estimate future ADWFs.

To estimate ADWF at buildout for a particular growth scenario, a system average ADWF unit wastewater production rate of 210 gpd per residential DU was applied to the projected number of residential DUs at buildout (see Table 3-4). Average annual flows were estimated by adding inflow and infiltration (I&I) rates equal to 5 percent of projected ADWF (HydroScience Engineers, 2007).

The projected influence from reduced indoor potable water demand assuming SB7 compliance is achieved is an estimated 8 percent reduction. This indoor potable demand is projected to also reduce average flows generated to the wastewater treatment plant by 8 percent on the order of 1.02 mgd from the original estimate of 1.11 mgd at buildout (medium growth scenario).

Table 3-4. Projected Average Dry Weather and Annual Average Flows[1]				
Wastewater Component	Units	Buildout Scenarios		
		Low Growth	Medium Growth	High Growth
Projected Number of Units at Buildout	Number of units	3,998	4,498	5,341
Wastewater Flow Contribution	gpd per unit	210	210	210
Projected ADWF	mgd	0.96	1.05	1.23
Inflow and Infiltration Contribution	mgd	0.05	0.05	0.06
Projected Average Annual Flow	mgd	1.00	1.11[2]	1.29

[1]Wastewater Facilities Expansion and Financing Report (HydroScience Engineers, 2007). The conservation measures targeted in the 2020 Compliance Plan mainly seek to lower outdoor irrigation peak demands, and as a result do not have a significant impact on wastewater flows which are correlated with indoor water demands.

[2] With SB7 compliance reducing indoor potable water demands from new development and existing connections on the order of 8%, future average annual flow may be reduced to 1.02 mgd.

3.8 Recycled Water and Effluent Disposal Implications

For the 2006 IWMP, water balances were developed for each of the projected growth scenarios (including 2004/05 conditions) to estimate storage requirements and irrigation needs under normal precipitation conditions. The water balances estimated monthly net reclaimed water generated for irrigation at the golf courses along with change in storage volume in the tertiary effluent equalization basin. Changes in storage volume are the difference between total inflow (ADWF, I&I and rainfall) less total outflow (evaporation and irrigation flows).

Table 3-5 summarizes the previously estimated recycled water storage volume requirements and estimated amounts of reclaimed water available for golf course irrigation. As previously described, the secondary effluent storage reservoirs have a total combined capacity of approximately 756 acre-ft. As shown in the table, additional storage will be required in the future for each of the buildout scenarios. Supplementary water is needed to satisfy overall golf course irrigation needs under current conditions as recycled water production is less than the amount required annually. In the future, reclaimed water production may surpass golf course irrigation needs and an additional means of effluent disposal will be needed.

The projected influence from reduced indoor potable water demand assuming SB7 compliance is achieved is an estimated 8 percent reduction. This indoor potable demand is projected to also reduce recycled water storage and disposal needs by 8 percent. Future recycled water storage needs may be lower on the order of 1,000 acre-ft/yr from the original estimate of 1,100 acre-ft/yr at buildout (medium growth scenario). Future recycled water disposal needs may be lower on the order of 1,020 acre-ft/yr from the original estimate of 1,110 acre-ft/yr at buildout (medium growth scenario). Excess recycled water may also be lowered by 90 acre-ft/yr.

Table 3-5. Estimated Recycled Water Storage Volume and Disposal Area Requirements

Component	Units	Growth Scenario			
		Current	Low	Medium	High
Current Available Storage Capacity	acre-ft/yr	756[a]	756	756	756
Future Projected Storage Requirements	acre-ft/yr	430[a]	1,000	1,100[1]	1,250
Additional Storage Requirements	acre-ft/yr	None	280	380	530
Recycled Water Production[2]	acre-ft/yr	565	1,005	1,110[1]	1,290
Golf Course Needs	acre-ft/yr	550	550	550	550
Supplementation	acre-ft/yr	10	0	0	0
Excess Recycled Water	acre-ft/yr	0	465	560[3]	740

[1] Based on 2006 IWMP projected storage requirements as referred to in the Wastewater Facilities Expansion and Financing Report (HydroScience Engineers, 2007). With SB7 compliance achieved, projected future recycled water storage needs may be reduced to 1,020 acre-ft/yr. Excess recycled water may be lowered by 90 acre-ft/yr.

[2] Includes precipitation and evaporation

3.9 Section Summary

This section used known and collected data presented in the previous sections to project future water supply, treated water needs and recycled water production. Implications associated with these projections are also discussed. A summary of the key information presented in this chapter along with key implications are provided below: may need more revisions.

- **Buildout Growth Projections:** Developer growth projections have been reduced from 5,199 EDUs in the original approve master plan to 4,356 EDUs in the medium growth scenario due to economic influences, environmental constraints and consumer home-buying trends (Table 3-1).
- **Growth Scenarios:** Three growth scenarios were developed. The medium density scenario was based on the developer growth projections of 4,346 residential units. This scenario served as the basis for developing the updated IWMP (and the previous 2006 IWMP).
- **Water Supply** (medium growth scenario):
  - Projected Water Supply Needs: 4,551 acre-ft per year
  - Current Water Rights (maximum): 6,368 acre-ft per year
- **Treated Water** (medium growth scenario):
  - Projected Average Day Demand: 3.2 mgd
  - Projected Maximum Day Demand: 5.3-6.7 mgd[1]
  - Production Capacity: 5.6-7.0 mgd[1]
- **Wastewater Treatment** (medium growth scenario):
  - Projected Average Dry Weather Flow: 0.97-1.05 mgd[1]
  - Projected Average Annual Flow: 1.11 mgd
  - Treatment Plant Capacity: 1.55 mgd (ADWF)

[1]With SB7 compliance lowering potable water demands on the order of 20% and indoor potable demand by 8% per the Draft 2020 Compliance selected conservation measures, a lower range of potentially reduced expansion requirements is estimated.

- **Effluent Storage** (medium growth scenario):
  - Required Storage Volume: 1,000-1,100 acre-ft[1]
  - Available Storage Capacity: 756 acre-ft
  - Additional Capacity Required: 380 acre-ft (minimum)
- **Recycled Water** (medium growth scenario):
  - Projected Recycled Water Production: 1,020-1,110 acre-ft per year[1]
  - Golf Course Irrigation Demands: 550 acre-ft per year
  - Excess Recycled Water: 560-635 acre-ft per year[1]

4. WATER SUPPLY RELIABILITY

To determine the reliability of a water supply to a community, it's necessary to understand system vulnerability in times of supply shortage based on existing and historical conditions and to seek to define uncertainties surrounding any anticipated future changes in supply availability. Through analyzing sources of supply based on historical hydrology and future shifts in runoff due to climate change on the Cosumnes River, the District has sought to quantify the risk in not being able to divert water, and if that leads to having shortfalls in meeting community water demands in times of drought conditions. Several drought scenarios were tested using current water rights and system operating rules for the reservoirs under various water demand scenarios from serving existing connections to projected future growth scenarios. The basis for these drought and demand scenarios is reliant on the known information presented in Section 2 and Section 3. This section describes the District's Water Balance Model approach and how model inputs were updated where necessary from past modeling efforts for the 2006 IWMP and the 1990 Giberson Study. This updated model was used to re-evaluate risk by quantifying if and how much shortfall is estimated to occur in times of drought and water system reliability in meeting existing and future demands.

4.1 Water Balance Model Approach

The 1990 Giberson drought report used a water balance model to estimate the magnitude of drought deficits, and was based on three primary components: supply, demand and storage. This model was analyzed and re-created by HDR Engineering in 2005 as part of the Infrastructure Program Update Water Supply and Wastewater Disposal Project to estimate the drought deficit associated with alternative projected buildout scenarios. The re-created model developed in 2005 followed the general format of the original Giberson model. Subsequent analyses of the models for past District projects focused on the 200-year drought event and followed by 25 year event at buildout and a 50 percent level of water conservation. For the 200-year drought analysis, the Giberson model simulated a two-year duration from the beginning of the draw down season (June 1) through an average summer draw down, a 200- year drought winter, a drought summer, and followed with a 25-year drought ending May 31. This critically dry condition in conjunction with a 50 percent level of water conservation serves as the criteria used to estimate historical drought deficits and compare alternative solutions in the 2006 IWMP and this 2010 IWMP update.

4.1.1 Shared Vision Modeling Approach

The re-created Giberson model updated by HDR Engineering was used as a starting point to develop the Shared Vision Water Balance Model (SVM) developed by Brown and Caldwell for this 2010 IWMP Update to further analyze the District's water supply system.

The District envisioned a more detailed approach with additional "what if" scenarios that could evaluate social, institutional, and political impacts of water shortages together with stakeholders. The shared vision approach was selected as it addresses the difficulties of integrating economic, environmental and social factors into defensible integrated water management decisions. Throughout the shared vision process, the Microsoft© Excel based SVM was built with District Board, agency staff and community stakeholder input during Board workshops on February 19, May 5, and June 18, 2010 as a framework for creating a dynamic, consensus-based view of the District's water system.

4.1.2 Shared Vision Model Overview

The Shared Vision Water Balance Model is used to test reliability under numerous "what if" scenarios that estimate reservoir water levels and magnitude of shortfall in terms of acre-feet of unmet monthly water demands during normal and drought conditions. Adjustments were made to the updated model to reflect existing and future planned development using best available EDU estimates and updates to other model inputs described in Section 4.2 below.

The SVM incorporates needs defined by stakeholders, experts, and water agency staff. The SVM provides a structure for virtual drought simulations under various future demand conditions and climate change scenarios. The SVM offers the user the opportunity to review information, assumptions, and data references with embedded data and comments throughout the model. It is comprised of 21 worksheets with color coded tabs that distinguish between different types of model components. The District's system infrastructure, supply constraints, and operating rules are modeled. SVM output capabilities, including supply, shortfall, and reservoir drawdown estimates, allow for a parallel comparison of system reliability.

The approach to shared vision modeling consists of creating simulations of the District's worst case drought scenario using historic dry year conditions. "Worst case" scenarios were constructed from historical hydrology runoff data and a review of best available monthly runoff hydrology data sets projected fewer than two future climate change scenarios for the Cosumnes River watershed as provided by the University of California, Davis. System reliability is analyzed by including proposed demand mitigation and supply projects and comparing the projected supply shortages during each drought and climate scenario.

4.2 Description of SVM Model Inputs

The following section describes information on the inputs and assumptions used for each of the key modeling components, including:

- Supply under extreme drought conditions
- Supply under potential climate change impacts
- Monthly river diversions
- Diversions under normal conditions
- Diversions under drought conditions
- Diversions under potential future climate change conditions
- Reservoir storage capacity and operation
- Supply from direct rainfall and runoff
- Losses due to reservoir seepage and evaporation
- Reservoir operating rules
- Demands under normal and drought conditions with existing and various growth scenarios.

The modeling effort and assumptions build on the information described data presented in Sections 2 and 3.

4.2.1 Supply in Drought Conditions

Water balances considered all major available raw water supplies which include river diversions, direct rainfall and runoff as described below.

Historical Streamflow Hydrology under Drought Conditions

The Cosumnes River water supply is subject to drought restrictions. In 1976 and 1977, California experienced the driest single year drought span on record. This drought also represented the driest three year sequence drought event (1976, 1977, and 1978). Figure 4-1 illustrates the four dry year periods in the streamflow record on the Cosumnes River at Michigan Bar Gauge Station No. 11335000. In each of these historical droughts, the District's water withdrawals would have been significantly curtailed or ceased all together.

The California Water Code in Section 10632 (a) mandates planning for water suppliers with more than 3,000 connections or 3,000 acre-ft served to use the single worst year in historical record and the driest three year sequence. Given the District has nearly 3,000 existing connections (the District will exceed the state's applicable criteria when the County approved additional 670 units are constructed), the District has decided to follow state mandate planning criteria for this 2010 IWMP.

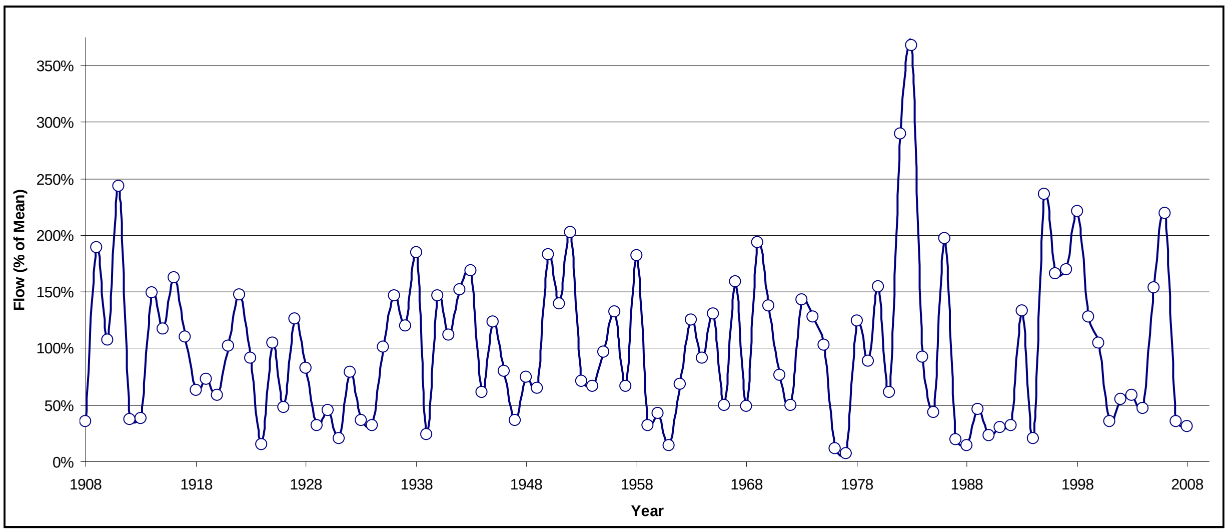
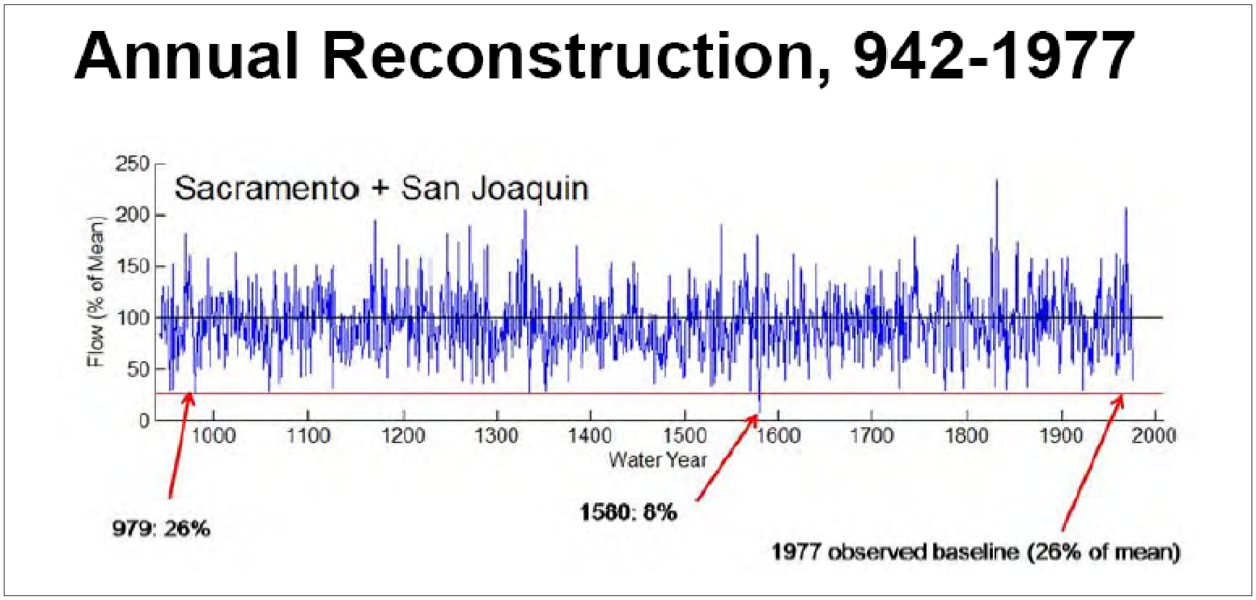


Figure 4-1. Historical Streamflows on Cosumnes River at Michigan Bar Gauge Station (USGS, 2009)

The SVM Model analyzes three different multi-year drought scenarios and one "normal" hydrology scenario using historical hydrology on the Cosumnes River at Michigan Bar described as follows:

- Driest three year sequence: 1976, 1977, 1978
- Historical planning scenario: 1923, 1924, 1977
- Most recent consecutive dry years: 1987, 1988, 1990
- Average year (101.5 percent of historical mean annual runoff): 1935, 1935, 1935

For added perspective on droughts in Northern California, Figure 4-3 illustrates the historical variability in climate based on tree ring studies that were used to reconstruct runoff hydrology on the Sacramento and San Joaquin Rivers from 942 to 1977.



Source: Meko, 2009 http://tree.ltrr.arizona.edu/~dmeko/

Figure 4-2. Reconstructed Streamflow Hydrology on the Sacramento and San Joaquin Rivers

4.2.2 Supply with Potential Climate Change Impacts

The SVM model includes consideration of future climate change. Two potential climate change scenarios are included in the SVM model. Application of the climate change scenarios allows the District to assess the potential additive effects of climate change when evaluating different drought scenarios and when developing implementation activities that will minimize drought impact.

Evidence of Warming Trends in California

The IWMP effort is largely based on past hydrological experience. Historical information such as precipitation patterns and associated surface water runoff are considered when developing programs, policies, and projects that minimize drought impact. Future climate change, caused by both naturally recurring cyclic patterns and human activities, may impact the intensity and duration of future droughts. As a result, future droughts may exhibit different characteristics than those observed during recent droughts. Changing long-term climate patterns likely are responsible for observed differences in the duration and intensity of drought in the paleoclimatic record as compared to those recorded during the twentieth century.

It is important to consider and plan for the potential effects of climate change related to temperature and precipitation changes. Predictions have been made that climate cycles are on a warming trend. As described by the Intergovernmental Panel on Climate Change in the Fourth Assessment Report, "Climate Change 2007 – The Physical Science Basis," the consensus opinion among the 152 lead authors from more than 30 countries and 600 reviewers is global climate change is a normal occurrence that results from cyclical patterns that is now on a warming trend that is extending beyond natural cycles that have been observed in the paleoclimatic record.

> "Global atmospheric concentrations of carbon dioxide, methane and nitrous oxide have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values determined from ice cores spanning many thousands of years. The global

> increases in carbon dioxide concentration are due primarily to fossil fuel use and land use change, while those of methane and nitrous oxide are primarily due to agriculture.
>
> The understanding of anthropogenic warming and cooling influences on climate has improved since the Third Assessment Report, leading to very high confidence[7] that the global average net effect of human activities since 1750 has been one of warming,"

– Fourth Assessment Report, "Climate Change 2007 – The Physical Science Basis (IPCC, 2007)

One cyclical pattern is Pacific Decadal Oscillation (PDO), a climatic cycle like El Nino, which refers to the 20 to 30 year fairly regular patterns of high and low pressure systems over the Pacific Ocean, which correlates to wetter and drier periods. PDO is anticipated to be entering a warmer period, which would result in drier weather. Others attribute a warming trend to be a consequence of human activity.

Water resource planners do not, however, have to determine why climate variability occurs, but rather need to plan for how to deal with the resulting impacts. Predictions are that average temperatures during the next 100 years will increase by approximately two degrees Celsius. The California Department of Water Resources (DWR) released a white paper "Managing an Uncertain Future – Climate Change Adaption Strategies for California Water" in October 2008. If these predications are accurate, the result would be less snowpack and more runoff during the winter months in Northern California including the Cosumnes River watershed, and much lower stream flows during the summer months, which would exacerbate drought conditions. As a result, water supply reliability assessments and drought preparedness planning conducted without consideration of the potential effects of climate change on the supplies of individual water agencies would be incomplete and could result in unanticipated impacts.

Impacts on Future Runoff Hydrology on Cosumnes River

Projections of future climate change points to changes in seasonal river flow patterns. This scenario includes lessening amounts of water stored in snow pack, reductions in average annual precipitation amounts, and, most relevant to this planning study, an increase in the extent and frequency of drought. The SVM demonstrates only the magnitude of drought scenarios and does not address the future frequency of droughts.

4.2.3 Monthly River Diversions

Annual river diversions were based on the following equation for normal conditions:

$$= \sum_{i=1}^{12} Consumptive\ Use + \sum_{i=1}^{12} Storage\ Requirement + \sum_{i=1}^{12} Seepage + \sum_{i=1}^{12} Evaporation - \sum_{i=1}^{12} Rain - \sum_{i=1}^{12} Runoff$$

where:
i=$Month_1$, $Month_2$, ... $Month_{12}$

Monthly diversions for normal conditions were based on typical diversion percentages obtained from an analysis of historical data.

4.2.4 Diversions Under Normal Conditions

Monthly river diversions for "normal" conditions are relative to historical hydrology and as time passes and more data is collected, "normal" conditions shift. The average year conditions used in the SVM were based on a review of historical hydrology and selecting the annual runoff that was closest to the mean value. The "normal" condition is based on 1935 as 101.5 percent of the historical mean runoff on the Cosumnes River at the Michigan Bar USGS gauge station.

4.2.5 Diversions Under Drought Conditions

Monthly river diversions for the driest three year sequence and average year conditions are shown in Table 4-1. These values were obtained from the SVM. As shown in Table 4-1, it is estimated based on the District's water right diversion allowances, system operating rules and available capacity in the supply reservoirs that:

- No water would be able to be diverted under the most extreme single dry year conditions based on the historical hydrology for 1977.
- 5,039 acre-ft of water would be available during driest three-year drought events based on historical hydrology for 1976, 1977, 1978.
- Full diversion availability at 4,400 acre-ft of water could be used during average year conditions based on historical hydrology for 1935.

In previous modeling efforts, as described in the 2006 IWMP (HDR, 2006), Giberson used regression analyses to determine available diversions for specific drought conditions. For background, in the 200-year drought condition an estimated 277 acre-feet could be diverted and for the 25-year drought condition an estimated 4,485 acre-ft could be diverted. These diversions do not include an evaluation of system operating rules and available reservoir capacity that were constraints in the SVM analysis.

Table 4-1. Monthly Diversion Possible Surface Storage Reservoirs under Average and Dry Year Conditions

Month	Available Diversions[1] (acre-ft)			
	Driest Three-Year Sequence Drought Conditions[2]			Average-Year Conditions[3]
	1976	1977	1978	1935
November	0	0	0	0
December	0	0	0	0
January	0	0	0	0
February	345	0	565	2,555
March	369	0	2,028	2,828
April	357	0	1,003	1,003

Table 4-1. Monthly Diversion Possible Surface Storage Reservoirs under Average and Dry Year Conditions

Month	Available Diversions[1] (acre-ft)			
	Driest Three-Year Sequence Drought Conditions[2]			Average-Year Conditions[3]
	1976	1977	1978	1935
May	369	0	0	0
June	0	0	0	0
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
October	0	0	0	0
Total	1,440	0	3,596	6,386

[1] *Available diversions are dependent on available capacity remaining in the storage reservoirs. Diversions will not exceed total surface storage capacity of 5,123 acre-feet which is the combined maximum capacity for all three reservoirs including flashboards and dead storage volume.*

[2] *Driest Three Year Sequence is used as the planning basis for critically dry conditions per California Water Code Section 10632.*

[3] *Average year conditions based on actual flow data for 1935, which is representative of 101.5% of historical annual mean river flows on the Cosumnes River at Michigan Bar USGS gauge station 11335000.*

4.2.6 Diversions Under Potential Future Climate Change Conditions

In order to incorporate the likely potential for climate change, various climate scenario factors are applied to the actual hydrological record and dry-year scenarios that were included in the SVM Model.

These factors represent the relationship between actual hydrology and two types of shifts in hydrologic runoff conditions, based on regionally applied scenarios developed by Dr. Jay Lund (University of California at Davis) and his research analysis team. Dr. Lund's information for Cosumnes River watershed flows under two different scenarios was used to index the runoff hydrology to reflect the possible impact due to climate change. Each of the two scenarios reference monthly Cosumnes River flow data collected from October 1921 through September 1993. The data are adjusted for climate change predictions for the year 2100. The two scenarios consist of the following:

1. **Warm Only** – a warmer climate in year 2100 marked by a lower snowline in the Sierra-Nevada Mountains, causing increased runoff in early spring and decreased snow melt in the dry season
2. **Warm Dry** – a warmer and drier climate by year 2100

Monthly river diversions for the driest three year sequence incorporating the influence of climate change conditions using either scenario is the extreme worst case.

4.2.7 Supply from Direct Rainfall and Runoff

A secondary minor supply source is from rainfall and watershed runoff. The following summarizes the criteria used to estimate direct rainfall water supply contributions in the water balance model.

Normal Conditions

The direct rainfall assumptions in the SVM are taken from the 1990 Giberson Report analysis as the hydrology runoff analysis (also used in the 2006 IWMP) and represent less than 10 percent of the storage volume on an annual basis, as follows:

- Direct rainfall contributions were based on the total combined reservoir surface area of 234 acres. This value is equal to the estimated surface area when all three reservoirs are completely full.

- Rainfall contributions were based on an annual precipitation level of 21 inches, which is Rancho Murieta's mean annual rainfall. Estimated annual contributions from direct rainfall are 410 acre-ft.
- Monthly rainfall contributions were based on the 30-year average monthly precipitation pattern for the Sacramento area.

Drought Conditions

The SVM uses the analysis of water balance model created by HDR Engineering for the monthly rainfall contributions that were based on the 30-year average monthly precipitation pattern for the Sacramento area. Calero and Chesbro Reservoirs' estimated combined water supply contribution associated with runoff from the Calero and Chesbro watersheds is less than 100 acre-ft per year under normal conditions and less than 40 acre-ft under an extreme (200-year) drought event. These contributions are considered negligible compared to overall community water supply needs. By comparison, Clementia has a relatively large watershed encompassing approximately 1,150 acres, which is a significant water supply contribution. Similar to the Giberson report, runoff contributions from the Clementia watershed were added to the overall water supply budget based on annual rainfall totals, monthly precipitation patterns and a runoff coefficient of 0.3.

4.2.8 Reservoir Losses from Evaporation and Seepage

A demand on the supplies is related to raw water storage losses due to water that is lost as a consequence of evaporation from the open area surface water storage reservoirs and seepage into the groundwater table. As described in previous studies and reports, including the 1990 Giberson Study and 2006 IWMP, evaporation and seepage represent a significant portion of the overall raw water demand. The following summarizes the criteria used to estimate evaporation and seepage losses in the water balance model:

- The 2010 IWMP Update model uses storage volume, elevation, surface area curves developed using regression equations for the 2006 IWMP, which are further referenced to published in 1990 "Water Supply Issues" Giberson Report and were validated against historical data provided by the District in 2006.
- For evaporation losses, the evaporation rates from 1990 Giberson Report are used based on estimated evaporation from the surface area that is calculated from monthly storage volume in each reservoir. The same evaporation rates published in the 1990 Giberson report are used in the 2006 IWMP.
- For seepage rates, the regression equations developed for the 2006 IWMP were also used based on calculated monthly storage volumes in the 2010 IWMP modeling approach.
- The monthly evaporation and seepage losses were then used as part of the water balance equations to subtract from the available supplies, which serves as an added demand, given there will be less water available to be withdrawn from each reservoir to meet community demands.

4.2.9 Reservoir Storage Capacity and Operation

As shown in Table 4-2, three primary storage reservoirs have an estimated total combined storage capacity of 5,123 acre-ft. Each reservoir has a minimum storage volume that cannot be put into use. This minimum storage level is called dead storage. Dead storage volume for the Calero, Chesbro and Clementia Reservoirs are 300, 50, and 50 acre-ft, respectively. Usable reservoir volume is limited to 4,723 acre-ft; this is total combined storage capacity minus dead storage.

Table 4-2. Reservoir Storage Capacity

Description	Units	Reservoirs			Total Combined
		Calero	Chesbro	Clementia	
Surface Area When Full	Acres	118	46	70	234
Total Volume at Full Capacity[1]	acre-ft	2,872	1,244	1,007	5,123
Dead Storage	acre-ft	300	50	50	400
Useable Volume[2]	acre-ft	2,572	1,194	957	4,723

[1] *Estimated volume with flashboards without freeboard (top of reservoir at maximum capacity)*

[2] *Total volume minus dead storage*

4.2.10 Reservoir Operating Rules

The following assumptions, similar to assumptions made in previous projects, were used to form the basis of the water balance model:

- All three reservoirs were assumed to be at capacity at the beginning of each model run.
- The reservoirs were drawn down in the following sequence: Calero, Chesbro and Clementia.
- Each reservoir was drawn down until the water reached the dead storage level. Supply then came from the next hierarchical reservoir or directly from river diversion when available.
- At the beginning of each SVM model run, Calero Reservoir was used to supply consumptive use and any reservoir losses associated with Chesbro such that Chesbro was kept full and at capacity.
- While Clementia was not being used to supply consumptive use, Clementia sustained monthly reservoir losses without supply from Calero or Chesbro.
- Once the reservoir reached dead storage level, it continued to experience seepage and evaporation losses and demands the following months.
- Once Clementia reaches dead storage, a net system deficit, otherwise known as "shortfall" indicates that there is unmet demand in the community even when the Drought Contingency Plan at 50percent demand curtailment is selected. Shortfall is calculated from monthly consumptive use rates. A total annual deficit can be calculated from each monthly shortfall and this shortfall condition will prevail until monthly direct diversions can meet monthly consumptive use rates.

4.3 Water Demands

The following section describes the difference of water demands under normal conditions without any drought conditions and when the water supply conditions are stressed due to drought and demand cutbacks are called for according to the District's approved Water Shortage Contingency Plan.

4.3.1 Community Water Demands Under Normal Conditions

Demands consist of consumptive and non-consumptive uses. Residential and non-residential demands were included collectively as consumptive use based on projected EDU count and a unit demand of 750 gpd/EDU as previously described. Table 4-3 in the following section provides a summary of water consumptive water demands from the community under normal and water shortage conditions.

Non-consumptive uses mainly consist of distribution (system) losses. A 10 percent system loss was used in the water balance model to account for system losses. The assumption of 10 percent is based on rounding up from the 2005-2009 annual average of 8 percent. The average annual potable demand for 2005-2009 was 1,725 acre-ft/year compared to an average annual production of 1,873 acre-ft/year.

4.3.2 Water Demands Under Water Shortage Conditions

The District's Board approved Water Shortage Contingency Plan calls for the following stage cutbacks from normal demand conditions:

- Stage 1 = 0% (normal unconstrained demands)
- Stage 2 = 0 to 10%
- Stage 3 = 11 to 25%
- Stage 4 = 26 to 50%Stage 5 = 50+%

The following Table 4-3 presents the monthly total community demands under normal conditions and at each stage of demand cutback used in the SVM for three key scenarios: (1) existing service connections, (2) existing plus approved service connections; and (3) future buildout under medium growth. In the SVM, these levels of demand cutbacks are automatically triggered based on available storage volumes. In addition, an added feature to the model is allowing variability in the level of cutback at each stage.

Table 4.3 Monthly Demands for Existing and Future Growth Scenarios within IWMP Model

Month	Demands under Existing Conditions (2010-2015)						Demands under Future Conditions (Medium Growth)					
	Baseline Normal	Stage 1 Use	Stage 2 Use	Stage 3 Use	Stage 4 Use	Stage 5 Use	Baseline Normal	Stage 1 Use	Stage 2 Use	Stage 3 Use	Stage 4 Use	Stage 5 Use
January	69	69	62	51	34	34	117	117	105	88	59	59
February	63	63	57	48	32	32	108	108	98	81	54	54
March	84	84	76	63	42	42	143	143	129	108	72	72
April	127	127	114	95	63	63	217	217	195	163	108	108
May	180	180	162	135	90	90	307	307	277	231	154	154
June	209	209	188	157	105	105	357	357	322	268	179	179
July	233	233	210	175	117	117	398	398	358	299	199	199
August	226	226	204	170	113	113	387	387	348	290	193	193
September	182	182	164	136	91	91	310	310	279	233	155	155
October	158	158	142	118	79	79	269	269	242	202	135	135

Table 4.3 Monthly Demands for Existing and Future Growth Scenarios within IWMP Model

Month	Demands under Existing Conditions (2010-2015)						Demands under Future Conditions (Medium Growth)					
	Baseline Normal	Stage 1 Use	Stage 2 Use	Stage 3 Use	Stage 4 Use	Stage 5 Use	Baseline Normal	Stage 1 Use	Stage 2 Use	Stage 3 Use	Stage 4 Use	Stage 5 Use
November	100	100	90	75	50	50	170	170	153	127	85	85
December	82	82	74	62	41	41	141	141	127	105	70	70
Annual Total	1,715	1,714	1,543	1,285	857	857	2,928	2,925	2,633	2,194	1,463	1,463
Percent Cutbacks	0%	0%	10%	25%	50%	50%	0%	0%	10%	25%	50%	50%

Note: Baseline normal demands are based on 2007, which was the highest demand for the District on record and a dry-year even, with normal supplies available (thus, Water Shortage Contingency Plan not implemented).

The Water Shortage Contingency Plan was prepared in accordance with California Water Code section 10632(a) calls for staged actions planning for up to a 50 percent supply shortage. The Water Shortage Contingency Plan, and in particular, the 50% maximum potential cutback that it calls for, has been a noteworthy element of the District's overall level of service since District Policy 90-2 (Appendix B) was adopted in 1990. A copy of the Water Shortage Contingency Plan approved at the time of this plan's development contains the descriptions of the specific actions to be taken at each stage is included in Appendix A. In addition, a copy of District Board Policy 90-2 is provided in Appendix B. More details related to water shortage policy are discussed in Section 5.1.2.

4.4 Modeling Results Under Normal, Drought and Climate Change Conditions

Currently, only Calero and Chesbro Reservoirs are used for residential and municipal supply. Calero is at the highest elevation; it is the first to drain and last to fill. Water is routed from Calero to Chesbro and is withdrawn. From Chesbro, water is directed to the water treatment plants for subsequent treatment and distribution.

Clementia is open to the residents for recreational use, including body contact activities such as swimming. However, Clementia's water level is projected to be five feet below the maximum water level by the end of the summer season due to natural evaporation and seepage. At this level, the swimming area becomes unusable because it is relatively shallow compared to other parts of the reservoir. Under current operating practice, water can be routed from Clementia to smaller irrigation holding lakes and ponds. Raw water stored in Clementia is not currently drawn for consumptive uses during years when the community's water needs can be met from direct diversion and storage from Calero and Chesbro. In the future, use of Clementia for raw water supply is dependent on growth. Table 4-4 poses questions about the future operation of Clementia.

Table 4-4. Projected Clementia Reservoir Use During Normal and Drought Conditions[1]

Question	Projected Buildout Growth Scenario (with 2020 Compliance Achieved)[4]		
	Low Growth	Medium Growth	High Growth
1. Will Clementia Reservoir be required to satisfy raw water demands under normal "average year" conditions in the future (based on 1935 hydrology)? In other words, is dead storage reached in Chesbro Reservoir under normal conditions?	No	No	No
2. Will Clementia Reservoir be required to satisfy raw water demands under normal conditions in the future (based on 1935 hydrology) with climate change factors applied? In other words, is dead storage reached in Chesbro Reservoir under normal conditions?	No	No	No
3. Will Clementia Reservoir be required to satisfy raw water demands during the driest three year sequence (based on 1976, 1977, 1978 hydrology)? In other words, is dead storage reached in Chesbro Reservoir under this drought scenario?	Yes	Yes	Yes
4. Will Clementia Reservoir reach dead storage and will shortfall exist during the driest three year sequence (based on 1976, 1977, 1978 hydrology)?	No	No	No
5. Will Clementia Reservoir reach dead storage and will shortfall exist during the driest three year sequence (based on 1976, 1977, 1978 hydrology) with "warm dry" climate change factors applied?	No	No	Yes

[1] Assumes District Board approved Water Shortage Contingency Plan is used allowing up to 50% demand reductions in time of drought. Same assumption as used in the 2006 IWMP (HDR, 2006).

[2]Clementia Reservoir will not be completely filled throughout the year. The water level will fluctuate based on evaporation, rainfall, runoff and the amount of water available to refill Clementia Reservoir.

[3] Based on drought conditions and monthly distributions described for the Shared Vision Model and past modeling efforts as applicable. Estimates based on a driest three year drought sequence.

[4] Chesbro is protected to be within 150 acre-ft of reaching dead storage under normal conditions at buildout. Calero is projected to reach dead storage under this condition.

The findings when climate change hydrology was tested is not in total volume that can be diverted but rather when the diversion can occur.

The findings are unchanged from the drought conditions without climate given the diversion are to off-stream reservoirs in the winter months between November and May. These results illustrate that the impacts from climate change are not in total volume that can be diverted but rather when the diversion can occur.

It is estimated based on the District's water right diversion allowances with the "Warm Dry" climate change hydrology scenario, current system operating rules and available capacity in the supply reservoirs that:

- No water would be able to be diverted under the most extreme single dry year conditions based on the historical hydrology for 1977.
- 3,946 acre-ft of water would be available during driest three-year drought events based on historical hydrology for 1976, 1977, 1978.
- Full diversion availability at 6,386 acre-ft of water could be used during average year conditions based on historical hydrology for 1935.

4.4.1 Estimated Storage Levels - Normal Conditions

One of the objectives of the reservoirs' water balance model is to estimate water levels under normal conditions. Water balance models were developed for two conditions, existing and future, and for the three projected growth scenarios previously described. Table 4-5 summarizes key model results. If the District desires, this information can be used to make policy decisions and evaluate the basis of specific management components and strategy recommendations. As an example, the District could use model results to identify a maximum draw down level for each reservoir and address community concerns over increasing reservoir draw downs.

Figure 4-3 and Figure 4-4 illustrate existing volumes and draw down levels for each individual reservoir under existing and future conditions based on the medium projected growth scenario.

Figure 4-3 and Figure 4-4 can be used to predict reservoir volumes and draw down levels throughout the year under normal precipitation conditions. An example for estimating Calero volume and draw down values for September 30th under existing normal conditions is presented below:

- A vertical line associated with September 30th is drawn in the Calero Curve.
- A horizontal line is drawn at the intersection of the September 30 line and the reservoir draw down curves. From this intersection, a horizontal line is drawn to the right until it intersects the reservoir draw down axis. The value located at the intersection of the horizontal line and the reservoir draw down axis is the estimated draw down level on September 30. For this example, the value is approximately 19 feet.
- A second horizontal line is drawn at the intersection of the September 30 line and the reservoir volume curve. From this intersection, a horizontal line is drawn to the left until it intersects the Calero volume axis. The value located at the intersection of the horizontal line and the Calero volume axis is the estimated Calero volume on September 15. For this example, the value is 1,191 acre-ft.

Comparison of these historical values to projections in Figure 4-3 indicates the following results:

- Overall, draw down projections in Figure 4-3 correlate well with historic values in regard to draw down magnitude and timing.
- Reservoir draw down projections are based on a planning level water demand medium growth scenario assuming 2020 compliance targets are achieved. Projected draw downs are expected to be greater than historic values due to future growth. Actual average water demands over the past five years have been approximately 680 gpd per EDU (less than the 750 gpd per EDU used for planning purposes). At 2020 Compliance the average gpd per EDU will be less, and estimated to be on average 600 gpd per EDU (Figure 3-1) but may vary due to uncertainty in the future types of lots yet to be built.
- Reservoir draw down projections are based on assumed operating conditions. Actual operating conditions may vary from the assumed conditions presented in the water balance projections. For example, Chesbro may have been used to supply the community's water for a portion of the year, increasing its draw down while reducing Calero's draw down.

As presented in Figure 4-3, Calero is the only reservoir required to meet the community's water supply needs under existing normal hydrologic conditions. Operating the reservoirs in a hierarchical fashion (Calero, Chesbro, and Clementia) is expected to result in a 15 foot draw down of Calero occurring in November of each year. Chesbro is projected to be full throughout the year due to replenishment from Calero. As shown in Figure 4-3, Clementia does experience volume and draw down fluctuation throughout the year. However, these fluctuations are attributed to natural reservoir losses (evaporation and seepage) and are not associated with meeting the community's water supply needs.

In the future under medium growth buildout in an average water conditions (1935 hydrology), Calero will reach 25 feet of drawdown. Additional water supply is not needed from Chesbro or Clementia to meet anticipated water demands. However, Clementia will have fluctuations are attributed to natural reservoir losses (evaporation and seepage) and are not associated with meeting the community's water supply needs.

4.4.2 Estimated Storage Levels - Drought Conditions

Figure 4-5 shows projected available water volumes in the three reservoirs during a severe drought event (i.e., a driest three-year sequence drought event) for the medium growth scenario. As shown, all three reservoirs are required to meet the community's water needs. The estimated drought shortfall deficit associated with this scenario is 89 acre-ft in the second year of drought (based on 1977 hydrology) and no shortfall in the third year based on using the Water Shortage Contingency Plan with up to a 50 percent level of drought demand curtailment and assuming that 2020 Compliance demand reductions are achieved.

Appendix C provides a more comprehensive summary of model results under various normal and drought supply conditions.

Table 4-5. Estimated Draw Down and Deficits – Drought Conditions (50% Cutback, including 2020 Compliance Achieved)

Scenario	Residential Units[5]	Maximum Draw Down[1] – Worst Case Conditions (ft)			Estimated Annual Drought Shortfall Deficits[3] (acre-ft)	Drought Deficit Plus Contingency[3] (acre-ft)
		Calero	Chesbro	Clementia[2]		
Existing	2,502	47	14	5	0	300
Existing Plus Approved Lots	3,122	47	35	5	0	300
Build-out - Low Growth	3,846	47	43	5	0	300
Build-out - Medium	4,346	47	43	10	89	400
Build-out - High	5,189	47	43	15	682	1,000

[1] Draw down relative to vertical height below each reservoir spillway. The maximum working depths of Calero, Chesbro, and Clementia are estimated to be 50, 55, and 26 feet, respectively.

[2] Natural drawdown due to evaporation and seepage for Lake Clementia is 5 ft. Note that Lake Clementia is not planned for serving drought demands under existing and approved lots conditions but is envisioned to be used in the future upon CDPH approval.

[3]Deficits based on the three existing reservoirs only. Overall drought shortfall is representative of the three driest year droughts based on 1976, 1977 and 1978 hydrology and worst single dry year is represented by 1977 drought under each of the scenarios.

[4]Values equal to estimated drought deficit plus 300 acre-ft (approximately one peak month or two average months contingency).

[5] Existing Non Residential =326 EDUs; All Build-out Scenarios Non- Residential = 665 EDUs

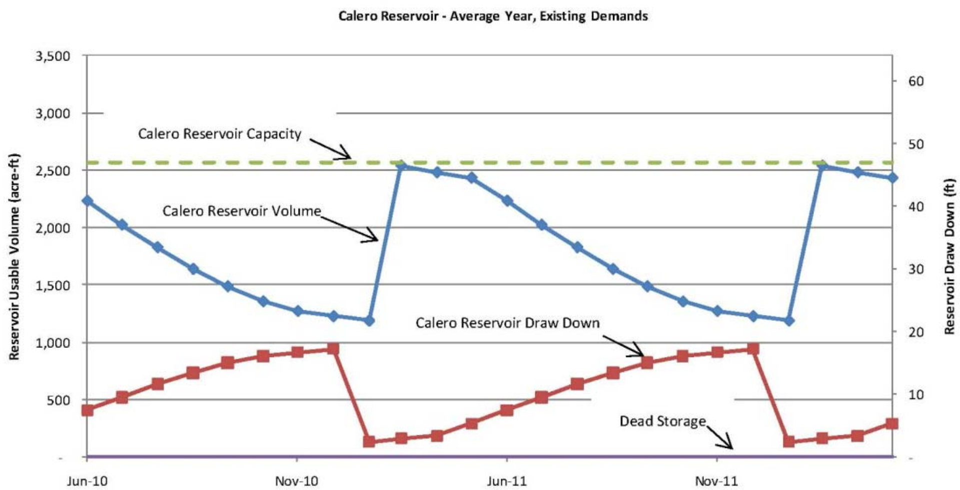
Only the medium and high growth scenarios require supply from all three reservoirs under severe drought conditions at full build-out. However, with the 2020 compliance targets met, Clementia will have 192 acre-ft of storage remaining under the high growth scenario even under severe drought conditions. Both Calero and Chesbro are projected to reach dead storage under all three projected growth scenarios. The varying maximum draw down levels shown for Chesbro and Clementia are associated with the time when dead storage volume is reached and continued evaporation and seepage.

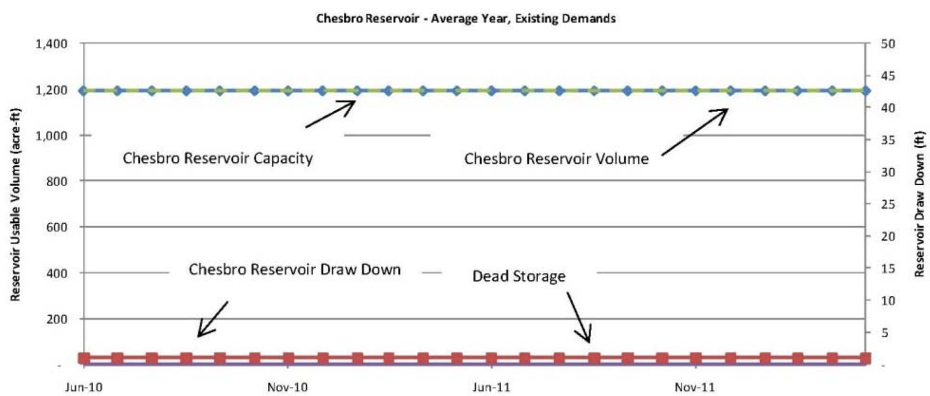
In keeping with the recommendations of past studies and reports and the 2006 IWMP, Brown and Caldwell recommends that a safety factor approximately equal to three highest month's water demand added to the estimated drought shortfall. Using the Board approved shortage contingency plan with up to 50 percent demand reduction, a volume of approximately 300 acre-ft is estimated average peak month (average of June demand at 179 acre-ft/yr, July demand at 199 acre-ft/yr and August at 193 acre-ft/yr) added to 89 acre-ft/yr projected shortfall. For comparison purposes, a volume of two average month demands is 244 acre-ft/yr (based on 122 acre-ft/yr as annual average month demand) when using a 50% curtailment from the shortage contingency plan.

In order to have more abundant supply to help mitigate any potential impacts of future climate change, an additional 300 acre-ft may be considered for a total contingency storage of 600 acre-ft. Given the economies of scale for developing supplemental well or surface water supply at a volume of 300 acre-ft versus 600 acre-ft, the District may consider adding this larger amount of contingency storage for the incremental cost increase.

The following is a summary of model results for normal average year conditions (based on 1935 hydrology as 101.5% of mean annual flow for the period of record in Cosumnes River) and normal levels of precipitation:

- Calero's volume is sufficient to meets the existing community's water supply needs under normal conditions. Calero's maximum draw down is estimated to be approximately 15 feet and is expected to occur in October or November.
- Chesbro is expected to be full throughout the year.
- Clementia experiences a maximum draw down of approximately 5 feet due to naturally occurring evaporation and seepage. Clementia is not needed for water supply under this condition.





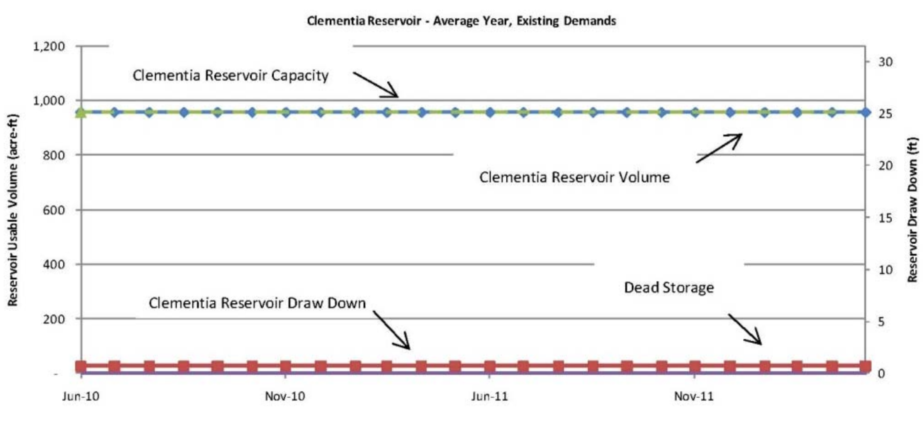


Figure 4-3. Estimated Reservoir Volumes and Draw Down Levels – Existing Conditions (without 2020 Compliance)

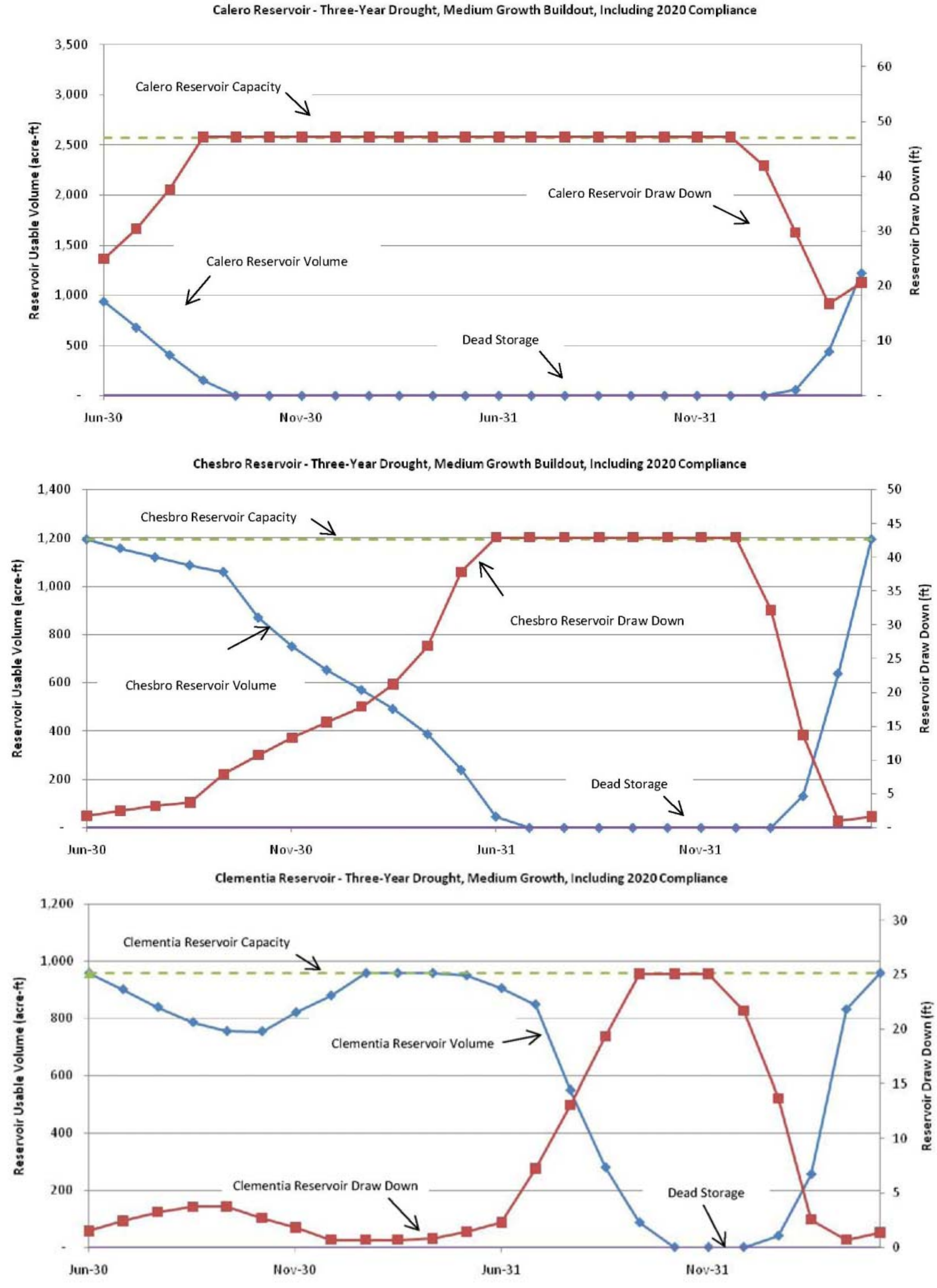


Figure 4-4. Estimated Reservoir Levels and Draw Downs – Future Conditions (Medium Growth Scenario added 2020 Compliance)

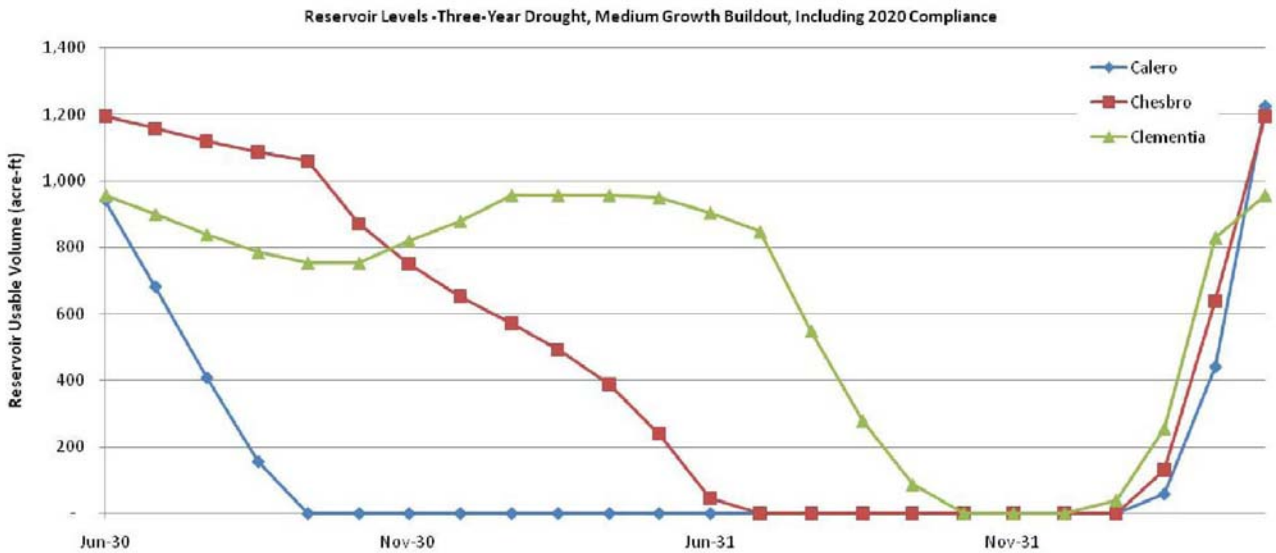


Figure 4-5. Drought Condition Reservoir Draw Down Curves – Medium Growth Scenario, 2020 Compliance and 50 Percent Level of Water Conservation

The following is a summary of model results based on buildout conditions and normal levels of precipitation (medium growth scenario) with 2020 compliance demand reductions being achieved under drought conditions (driest three-year sequence for 1976, 1977, 1978) using the water shortage contingency plan at up to 50 percent reduction:

- Both Calero and Chesbro will be needed to meet the community's water supply needs.
- Calero is expected to be at dead storage.
- Chesbro is required to supply water once Calero reaches dead storage. Its maximum draw down is projected nominally to be approximately near 43 feet and dead storage.
- Clementia experiences a draw down of approximately 5 feet due to naturally occurring evaporation and seepage. Its maximum draw down is projected nominally to be approximately near 3 feet.
- The total reservoir storage levels under this scenario are illustrated in Figure 4-6 below. For comparison, Figure 4-7 is the same assumptions with only exclude the 2020 compliance and shows an estimated shortfall of 89 acre-ft/yr.
- The worst case scenario is climate change drought "warm dry" scenario, without 2020 compliance using medium growth projections and using the water shortage contingency plan at up to 50 percent reduction. The total estimated storage volume under this extreme worst case scenario is shown in Figure 4-8 and overall estimated shortfall of 312 acre-ft/yr is illustrated in Figure 4-9.
- Overall, the model results indicate that an additional water supply on the order of 300 acre-ft will be needed under severe drought conditions. Under these conditions all three reservoirs are expected to reach dead storage. The 300 acre-ft supply includes a safety factor approximately equal to one peak month demand (200 acre-ft/yr) or approximately two months of average demand (122 acre-ft) down water demand in addition to the estimated drought shortfall (89 acre-ft/yr).
- In order to have more abundant supply to help mitigate any potential impacts of future climate change, an additional 300 acre-ft may be considered for a total contingency storage of 600 acre-ft. Given the economies of scale for developing supplemental well or surface water supply at a volume of 300 acre-ft

versus 600 acre-ft, the District may consider adding this larger amount of contingency storage for the incremental cost increase.

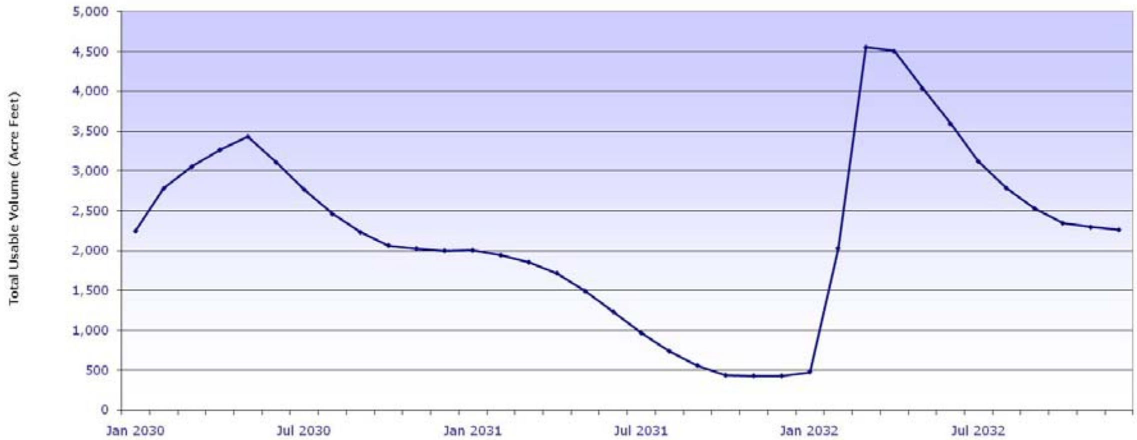


Figure 4-6. Drought Condition: Total Reservoir Storage Volumes

(Medium Growth Scenario, with 2020 Compliance and 50 Percent Level of Water Conservation)

Figure 4-7. Drought Condition: Total Reservoir Storage Volumes

(Medium Growth Scenario, included 2020 Compliance and 50 Percent Level of Water Conservation)

Figure 4-8. Climate Change "Warm Dry" Drought Condition: Total Reservoir Storage Volumes (Medium Growth Scenario, included 2020 Compliance and 50 Percent Level of Water Conservation)

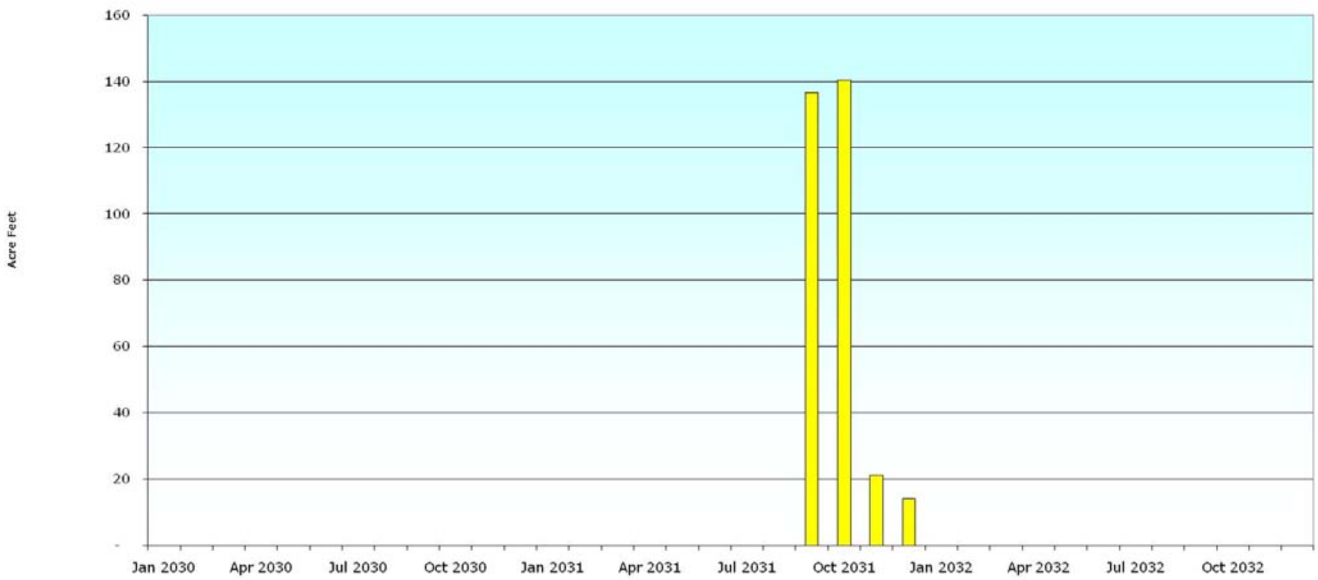


Figure 4-9. Climate Change "Warm Dry" Drought Condition: Total Estimated Water Supply Shortfall (Medium Growth Scenario, included 2020 Compliance and 50 Percent Level of Water Conservation)

4.5 Risk of Supply Curtailment Under Drought Conditions

Several scenarios were tested in the Shared Vision Model to assess the risk of shortfall under various conditions including the following:

- Protecting Lake Clementia for recreational use only and not allowable for use as a drought supply. Lake Clementia is not presently authorized to be used as a source of public drinking water.
- Removal of raised flashboards from spillways in dry years effectively reducing storage combined capacity for all three reservoirs by 450 acre-ft.
- Due to the need for more instream flows to the Bay-Delta estuary, assume that the District's Cosumnes River monthly diversions would be reduced by 10% in any given month pumping would occur according to their water right permit allowances.
- Assume river diversions reduced by 15% due to decreased growth (5,199 to 4,356 EDUs) and thus reduction in permitted water withdrawals.
- Emergency condition of reduced usable storage capacity simulated as the largest reservoir offline (Calero Reservoir) at 2,572 acre-ft.

Effects of the curtailments are evident when the options are selected in the SVM. For each scenario, the impacts can be quantified in terms of any resulting unmet demand for the community in acre-ft per month shortfall. The purpose of testing these scenarios was to understand overall system vulnerability in terms of the magnitude of risk from each of these threats to water supply reliability. Therefore, none of these scenarios are considered to be baseline scenario for the purposes of determining integrated water management strategies.

The following risks are described in more detail below: water right curtailments, reservoir drawdown constraints and potential effects from greenhouse emissions regulations on system operations.

4.5.1 Water Rights and Normal Condition Draw Down Considerations

According to District staff, the District's water rights permit currently provides an allotment for aesthetics and environmental purposes. Moreover, California is currently in need of identifying additional water supplies to meet its future projected water demands. Given those two results, it is unlikely that modifications to increase the District's existing water rights or the addition of a new surface water storage reservoir used to lessen the community's reservoir draw down levels will be permitted for aesthetic or environmental conditions. However, the addition of a new surface water storage reservoir to address the drought deficit may be possible and was modeled as part of the drought mitigation options discussed in Section 5.

4.5.2 Reservoir Draw Down Constraints

It is understood that the District is not held to a specific maximum draw down level. Therefore, this report assumes that the District can operate the water supply reservoirs in accordance with the standard operation procedures and requirements. As such, fluctuations in reservoir depth and volume are acceptable and expected to occur to accommodate water demands and annual replenishment needs, and are supported by the water rights diversions and storage replenishment allotments.

4.5.3 Potential Effects on Future System Operations from Greenhouse Gas Emission Reduction Regulations

The future impact of greenhouse gas emission regulations on water/wastewater facilities is uncertain at this time. Currently, none of the regulatory actions would significantly impact water/wastewater facilities. The mandatory emission reporting requirements under AB32 and recent federal regulations apply primarily to facilities that directly emit greater than 25,000 metric tons of greenhouse gases or those that generate and sell electricity. At this time, these regulations would not apply to water/wastewater facilities. However, the agencies have embarked on a regulatory development program, the size of which has not been seen since the Clean Air Act Amendments of 1990. The full scope of the regulatory program will not be evident for 5 – 10 years and, in the end, is likely to impact water/wastewater facilities. The following are some of the probable future regulatory actions that could result in impacts to water/wastewater facilities:

- The California Air Resources Board has indicated that they plan on reducing the applicability threshold for the AB32 mandatory reporting regulations in the future. A likely scenario is that the threshold will be reduced to 10,000 metric tons in the next 3-5 years and to some lower level after that. At some point, the threshold will lower below the point at which water/wastewater facilities will be captured.
- Little is known about greenhouse gas emissions from wastewater processes and considerable research is being conducted across the country. The most likely result of this research is that greenhouse gas emission inventories from wastewater facilities will increase, perhaps dramatically.
- It is anticipated that either a state or federal cap and trade program will be effectively implemented in the next 3-5 years. At present, it is unclear whether water/wastewater facilities will be included initially, but it is expected that they will be included at some point.
- Numerous performance standards are being promulgated in California for the purpose of reducing greenhouse gas emissions. Examples include requirements for landfill gas collection, low carbon fuel standards, etc. It is anticipated that performance standards affecting water/wastewater facilities will eventually be promulgated.

Currently, AB32 requires the following facility types in California to report and verify their annual greenhouse gas emissions:

- Electricity generating facilities,
- Electricity retail providers and power marketers,
- Oil refineries,
- Hydrogen plants,
- Cement plants,
- Cogeneration facilities, and
- Industrial sources that emit over 25,000 metric tons of CO_2 each year from on-site stationary source combustions.

Table 4-6 presents the trigger levels of fuels that must be used on-site by the District in order to invoke applicability for AB32 requirements.

Table 4-6. Quantities of Fuel Combusted (On-Site) Resulting in 25,000 Metric Tons of CO_2 Per Year

Fuel Type	Amount of Fuel Use to Produce 25,000 MT of CO_2
Natural Gas	459,140,464 standard cubic feet
Propane	4,317,757 gallons
Gasoline	2,841,174 gallons
Landfill Gas	916,301,950 standard cubic feet
Coal	9,879 short tons

4.6 Section Summary

A reservoir Shared Vision Water Balance Model was developed to expand on "what if" scenarios modeled as part of past planning efforts. The SVM used estimated reservoir volumes and water levels during normal and drought conditions. Adjustments were made to the model to reflect existing and future (buildout) conditions which have been updated since the previous 2006 IWMP. The SVM output was compared to past modeling efforts. Overall, draw down projections were found to correlate well with historic modeling efforts in regard to draw down magnitude and timing. The following assumptions were used to form the basis for reservoir operation:

- The model assumed that the reservoirs were drawn down in the following sequence: Calero, Chesbro, and Clementia.
- Each reservoir was drawn down until the water level reached dead storage or diversion began. Supply then came from the next hierarchical reservoir or directly from river diversion when available.
- At the beginning, Calero was used to supply consumptive use and any reservoir losses associated with Chesbro, such that Chesbro was kept at capacity.
- While Clementia was not being used to supply consumptive use, Clementia sustained monthly reservoir losses, due to naturally occurring evaporation and seepage, without supply from Calero or Chesbro.
- If Clementia reached dead storage, a shortfall deficit was calculated from monthly consumptive uses. An overall total deficit was calculated until monthly diversions can meet monthly consumptive use rates.

Overall, the model results indicate that an additional water supply on the order of 300 acre-ft will be needed under severe drought conditions. Under these conditions all three reservoirs are expected to reach dead storage. The 300 acre-ft supply includes a safety factor approximately equal to one peak month demand (200 acre-ft/yr) or approximately two months of average demand (122 acre-ft) down water demand in addition to the estimated drought shortfall (89 acre-ft/yr).

In order to have more abundant supply to help mitigate any potential impacts of future climate change, an additional 300 acre-ft may be considered for a total contingency storage of 600 acre-ft. Given the economies of scale for developing supplemental well or surface water supply at a volume of 300 acre-ft versus 600 acre-ft, the District may consider adding this larger amount of contingency storage for the incremental cost increase.

5. DROUGHT MITIGATION STRATEGIES

Workshops for the 2010 IWMP were held with District staff on February 19, May 5, June 18 and July 21, 2010 to present preliminary project results and obtain public input. The workshops were also used to identify, describe and evaluate drought mitigation strategies that could be used to address drought shortfalls and fluctuating reservoir water levels.

The information presented in this section is updated from the 2006 IWMP including revisions to potential policies and drought mitigation projects or strategies aimed at avoiding shortfalls in future drought conditions. The Board Workshops on June 18, 2010 and July 21, 2010, Directors, District staff and community stakeholders reviewed and discussed the following potential policies and physical improvements, which are options that can be selected in the SVM, to assess the benefit on supply reliability in either partially or wholly eliminating estimated drought shortfalls:

- **Achieve 20x2020 Demand Reduction Targets** - incorporates the assumption that an across the board 20% reduction in gallons per capita per day water demands will be achieved. This assumption has been translated into savings on an acre-ft per month basis and benefits in terms of reduced draw down levels. These quantified savings have yet to be achieved and also have a foreseen demand hardening effect, which is non-quantifiable, on the future potential of customers to respond to water shortage plan calls to action. As a result, the estimates provided for existing normal conditions in this IWMP do not include 2020 Compliance and estimates based on all future buildout conditions do include achieving 2020 Compliance.
- **Water Shortage Contingency Plan** - implementation of the policies for the five stage approach leading up to more than a 50% reduction in water demands with the option to select the amount of cutbacks at each drought stage. Based on stakeholder feedback at the workshop in June, an option to only curtail the community to a 25% reduction was added for comparison purposes.
- **Water Shortage Pricing** – implementation of a drought surcharge in the event of a severe drought shortage.
- **Model Landscape Ordinance** – assume all new lots would comply with the County's pending landscape ordinance which equates to a 12.5 percent reduction in total buildout demand (medium growth scenario).
- **Reduced Water Allocation** – limit new large estates with lots greater than 12,000sf to have 650 gpd per EDU allocation. This equates to reduction of 100 gpd per EDU (which matches the same allocation for large estate lots less than 12,000 sf).
- **Recycled Water Alternatives** – incorporate the ability to lower future projected water demands by using reclaimed water to meet (a) irrigation demand for new connections; or (b) irrigation demand for new connections and existing parks. Current planned recycled water projects only benefit new lots, which are projected to be brought online after 2015 and prior to 2030.
- **Supplemental Well Supply** – bring ground supply online in times of drought.
- **Supplemental Surface Storage** – bring a new reservoir online designated as a dedicated drought supply.

As presented in Table 5-1, these approaches aimed at increasing water supply reliability are based on a revised projected medium growth scenario (base scenario) and slight increase in estimated drought shortfall of 300 acre-ft or up to 600 acre-ft if climate change is factored into shortfall estimates. Many of these policies and strategies were initially discussed during the development of the 2006 IWMP workshops. Additionally, in 2008, the District Board adopted a Water Shortage Contingency Policy and ordinance. This table also describes relative advantages and disadvantages and describes the options the District chose not to consider further during the workshop.

Table 5-1. Potential Strategies for Integrated Resource Management

Policy or Physical Improvement Title and Description	Policy Component or Physical Improvement	Estimated Water Supply Increase or Savings (acre-ft/yr)	Projected Impact (%) Drought Deficit (300 acre-ft)	Order of Magnitude Cost	Relative Advantages	Relative Disadvantages	Decision	Priority Level
Achieve 20x2020 Demand Reduction Targets	Policy	732	100%	$50,000-$100,000/yr	• Planned action by the District • Assists with reliability of water supplies by lowering overall demands	• Demand hardening effect in terms of customers ability to attain additional savings in times of drought	Planned Action	High
Implement Water Shortage Contingency Plan	Policy	1,830	100%	$25,000-$50,000	• Implement Board adopted Shortage Contingency Plan	• Stage 3, 4 and 5 actions can serve to sacrifice quality of life (e.g., loss of landscaping)	Adopted Policy for Use During Droughts	High
Implement Water Shortage Pricing	Policy	350	100%	$50,000-$100,000	• Low cost option that allows for individual customer choice in response • Over usage fees may increase customer bills • Balance revenue shortfalls in times of drought	• No assurance that savings goals will be achieved • Requires on-going education and awareness • Increases customer service needs	Planned Action	Medium
Future Development: Reduced Water Allocation: Model Landscape Ordinance	Policy	190	60%	$10,000-$25,000	• No impact on existing customers • Leads to more water efficient landscape installed in future developments	• Low cost option • Requires on-going education and awareness	Planned Action	High
Future Development: Reduced Water Allocation for Large Estate Lots only	Policy	140	50%	$50,000-$100,000	• No impact on existing customers • Leads to more water efficient landscape installed in future developments	• Low cost option • Requires on-going education and awareness	Consider for Further Analysis	Medium

Table 5-1. Potential Strategies for Integrated Resource Management

Policy or Physical Improvement Title and Description	Policy Component or Physical Improvement	Estimated Water Supply Increase or Savings (acre-ft/yr)	Projected Impact (%) Drought Deficit (300 acre-ft)	Order of Magnitude Cost	Relative Advantages	Relative Disadvantages	Decision	Priority Level
Future Development: Recycled Water Alternative: New Connections	Physical Improvement	85	20%	$11.5 million capital costs	• No impact on existing customers • Helps meet 2020 goals • Helps meet effluent disposal needs	• Costly option • Economic downturn has slowed development with uncertain future timeframe for implementation	Consider for Further Analysis	Medium
Future Development: Recycled Water Alternative: New Connections, and Conversion Existing Parks and commercial irrigation accounts	Physical Improvement	130	40%	$11.75 million	• No impact on existing customers • Helps meet effluent disposal needs	• Costly option • Requires retrofit of existing potable irrigation systems for Riverview and Stonehouse Parks	Consider for Further Analysis	Medium
New Supplemental Well Supply	Physical Improvement	500 to 2,000	100	$1-3 million	• Need more in-depth feasibility assessment • Completely addresses drought shortfall	• Costly option • Adds complexity to system operations	Consider for Further Analysis	Medium
New Surface Storage Reservoir	Physical Improvement	500 to 2,000	100	$5-15 million	• Completely addresses drought shortfall	• Costly option	Consider for Further Analysis	Low

Each of the strategies described in Table 5-1 can be grouped into potential drought mitigation policies or physical improvements categories designed to increase supply reliability. In general, water shortage contingency policies would be implemented to address fluctuating reservoir levels, whereas physical improvements would be implemented to address drought shortfalls. In some cases however, policy options would provide added benefit since these options assist with hedging against anticipated drought shortfalls. More detailed descriptions are presented in this section regarding potential mitigation strategies and physical improvements the District elected to pursue.

5.1 Water Shortage Policies

Policies are described below which could be adopted by the District to support reducing demand in times of drought. Except for the mandatory water reduction through implementation of the water shortage contingency plan and water shortage pricing, these policies could be implemented to address reservoir draw downs under normal conditions.

5.1.1 Achieve 2020 Targets

As described in Section 2 above and in more detail in the 2020 Compliance Plan, SB7 requires utilities to lower potable water demand by 20% by 2020. Achieving this level of demand reduction will effectively increase supply reliability, as overall demand on the system at buildout is projected to be more than 700 acre-ft less than projected without compliance with 2020 GPCD targets. This reduced demand will allow the District to reserve more supply in storage and add to operational flexibility in times of drought.

There is potential for a demand hardening effect on responsiveness by customers to the Water Shortage Contingency Plan given some conservation activities will have been implemented. The 2020 Compliance Plan is focused on long-term savings and as a result mainly targets "hardware" changes in terms of changing equipment (e.g., replacing toilets, upgrading irrigation systems) to lower water demand. The Water Shortage Contingency Plan targets "behavioral" uses with actions such as modifying customer uses like car washing, cutting back, or in the most extreme droughts, eliminating outdoor irrigation and sacrificial domestic uses (shorter showers). Estimates of customer response in times of drought are challenging to determine in advance of a drought event. There is estimated to be on the order of less than 10-15% overlap in conservation savings due to demand hardening effects between the two approaches.

5.1.2 Implement Water Shortage Contingency Plan

During droughts when an awareness campaign is put into place and local media attention is tuned into the low water supply conditions, customers respond and demands tend to decrease in response to water shortages. Demands reduced in times of drought are commonly temporary with a rebound effect back to average levels of recent years when the water supply crisis subsides. Therefore, annual average water use rates cannot be used to predict total water consumption during periods of drought. In addition, demands during droughts are commonly excluded from calculations of longer range average values to avoid lowering the average use being derived for planning purposes.

According to California Water Code Section 10632(a), utilities are directed to plan for up to a 50 percent level of reduction in water demand in the event of a water supply shortage from drought or other emergencies. This level of 50 percent cutback in demand is an element of the District's overall level of water service that has been used as the base line in this 2010 IWMP Update and past projects to estimate remaining drought shortfalls. The District recently adopted a Water Shortage Contingency Plan outlining staged actions aimed at reducing the community's water demands with higher stages leading to higher anticipated water savings and more severe penalties for non-compliance for mandatory measures. A copy of the Water Shortage

Contingency Plan is provided in Appendix A, and a copy of the District Board Policy 90-2 is provided in Appendix B.

Significant reductions in overall water demand are a necessity during periods of extreme drought.

> *Studies have indicated that customers are responsive to requests for voluntary conservation in the magnitude of 20% - 25% during a drought. Studies have also found that customer hardship is not usually incurred until conservation rates exceed 25% and that customer hardship increases dramatically above 35% conservation rates.*
>
> *Conservation rates in the range of 50% - 60% were recorded during the 1977 drought in several severely impacted water agencies. While significant customer hardship and economic losses occurred, customers seemed to adapt and service the crisis (Giberson & Associates, 1990).*

Table 5-2 presents a table with projected demands under normal water supply conditions and under extreme drought conditions using up to the 50 percent maximum cutback per the Water Shortage Contingency Plan. Residential and non-residential indoor demands have priority and some outdoor irrigation is anticipated, which would allow some discretionary use for outdoor demand (e.g., irrigation to support high value landscaping, such as mature trees). Table 5-3 presents a summary of the water demand cutbacks and resulting water use.

Table 5-2. Potential Water Cutbacks for Extreme Drought Events for up to a 50% Reduction Goal (Stage 4)[1]

Water Use Category	Normal Conditions		Extreme Drought Conditions	
	Percent of Total	Demand (gpd/account)	Percent of Total	Demand (gpd/account)[2]
Residential	78%	662	50%	331
Minimum Month (Indoor) Demand	32%	267	52%	220
Seasonal (Outdoor) Demand	47%	395	26%	111
Non-Residential	12%	99	12%	49
Minimum Month (Indoor) Demand	6%	49	9%	39
Seasonal (Outdoor) Demand	6%	50	1%	5
Total Demand	90%	761	50%	380
System Losses	10%	84	10%	42
Total	100%	845	50%	422
Minimum (Indoor) Subtotal	37%	316	61%	259
Seasonal (Outdoor) Subtotal	53%	445	27%	116

[1] *Water Shortage Contingency Plan Stage 5 would omit outdoor irrigation when more than 50% rationing in the community was needed.*

[2] *Indoor residential demand based on 55 gallons per capita per day (gpcd) assuming 4 persons per household.*

Lot or User Class	EDU Conversion Factors	Demand Factor gpd/EDU	50% cutback	Actual Demand per EDU (2000-09)	Actual Demand less 20% for 2020	Actual Percent Cutback needed
Residential						
Estate > 12,000 sf	1.0	750	375	658	526	29%
Estate < 12,000 sf	0.9	675	338	432	346	2%
Circle	0.7	525	263	548	438	40%
Cottage	0.7	525	263	441	353	26%
Halfplex	0.5	375	188	350	280	33%
Townhouse (includes villas lots)	0.5	375	188	232	186	-1%
Murieta Village	0.3	225	113	164	131	14%

Table 5-3. Summary of Estimated Residential Water Demand Cutbacks

As previously shown in Figure 2-4, approximately 50 percent of the community's overall water demand is for outdoor uses. These are considered discretionary uses and thus can be significantly reduced during severe drought conditions.

According to the California Water Code Section 350, first priority for water supply in times of drought is for public health and safety and sanitation needs.

> *California Water Code Section 350. The governing body of a distributor of a public water supply, whether publicly or privately owned and including a mutual water company, may declare a water shortage emergency condition to prevail within the area served by such distributor whenever it finds and determines that the ordinary demands and requirements of water consumers cannot be satisfied without depleting the water supply of the distributor to the extent that there would be insufficient water for human consumption, sanitation, and fire protection.*

Under such conditions, the District's potential total usage is planned for a cutback by 50 percent in line with California Water Code Section 10632(a) and the District approved Water Shortage Contingency Plan. Lower reduction levels, especially for outdoor use, are also being planned for as part of compliance with SB7 to meet 2020 compliance targets following common water conservation best management practices, which will occur during times of less extreme water supply shortages.

5.1.3 Reduced Water Allocations

The policy for future development is pending adoption in the new County Landscape Ordinance and the Board may adopt a reduced water allocation for large estate lots greater than 12,000 sf. Both of these policies are described further in the following two subsections.

5.1.3.1 Reduced Water Allocation due to County Landscape Ordinance

With the passage of Assembly Bill (AB) 1881, the California Department of Water Resources was required to update the AB 325 Model Landscape Ordinance. A new statewide ordinance was adopted and became effective January 31, 2010 which currently applies to any new development in Sacramento County. The local agencies have an option to adopt an "least as effective as" ordinance. Sacramento County is currently working to revise the statewide ordinance into and adopt as local code in 2011.

Estimated savings for this policy are based on a comparison of the past AB 325 Ordinance compared to the AB 1881 ordinance. Sacramento County is not planning to lower the site Maximum Applied Water Allowance (MAWA) water budget calculations found in the new statewide AB 1881 Model Landscape Ordinance. An overall savings per site of 12.5 percent on annual irrigation demand was determined using the following comparison of the new versus the old ordinance for a 12,000 sf irrigated area on a large estate lot using the Fair Oaks CIMIS station (closest available to Rancho Murieta) and has an annual average reference evapotranspiration (ET) value of 50.50 inches per year:

- Based on the new Model Landscape Ordinance AB 1881 - MAWA is estimated at 263,000 gallons per year per connection.
- Based on the old Model Landscape Ordinance AB 325 - MAWA is estimated at 300,000 gallons per year per connection.

Using the DWR provided Water Budget calculator, the Estimated Total Water Use (budget) for new connections for large estates will be limited to 263,000 gallons per year (or 1,753 gpd over the 5-month irrigation season from April-October).

Total savings related to increase supply reliability to offset a drought deficit is estimated at 190 acre-ft/yr savings based on the following assumptions:

- Total new residential connections is 1,844 (medium growth scenario)
- 12.5 percent savings is 94 gpd/EDU based on 750 gpd/EDU planning assumption.

If the reduced water allocation for large estate lots was lowered from 750 gpd/EDU down to 650 gpd/EDU (adoption of the policy described in Section 5.1.3.2) then the savings would be reduced to 170 acre-ft/yr.

5.1.3.2 Reduced Water Allocation for Large Landscape Lots

The relative impact on managing water demands by reducing water allocation for a specific lot or user classification has been evaluated. According to Table 3-1, approximately 52 percent of all future growth (medium growth scenario) within the community will be large estate lots greater than 12,000 sf. As previously described, these units have a projected water use of 750 gpd per unit since these units represent one equivalent dwelling unit. If these new estates were allowed the same water allocation as existing large estates, their demand alone would represent 950 of the total 1,635 acre-ft demand increase (58 percent of total increase). According to District staff, several dwelling units within this classification have demands in excess of the 750 gpd allotment. If this demand were to occur with the new estates, the District would experience higher water demands than currently projected.

One potential water management strategy reduces water allocated for all future large estates. If this strategy were implemented, it may be possible to reduce water allocations to the next lower water allocation, or 650 gpd per large estate. In this scenario, both large and small estates are allocated the same amount of water. If 2020 GPCD targets were achieved the baseline 750 gpd per EDU could be reduced to 650 gpd per new large estate lots.

Estimated water savings associated with this scenario are 85 acre-ft per year as shown in Table 5-1. These water savings will not impact draw down levels at Calero since it is less than the volume required to be withdrawn from Chesbro annually under buildout conditions.

5.1.4 Water Shortage Pricing

The demand for water is inelastic. In other words, when the price of water increases, the expected reaction is smaller than the price increase. Table 5-4 summarizes the previous results of HDR's review of several reports and studies for the 2006 IWMP regarding water shortage pricing: the estimated price increase for each source was 10 percent. The corresponding demand reduction ranged from 1 to 7 percent. The overall estimated demand reduction was estimated at 3.5 percent. This degree of reduction was assumed to evaluate this particular policy for Rancho Murieta.

The potential water savings for this strategy is estimated at 350 acre-ft per year, equal to the savings shown for the reduced water allocation example.

Table 5-4. Water Pricing Increases and Corresponding Demand Reductions

Water Price Increase (%)	Measured Demand Reduction	Source
10	1.6	*Measuring Price Responsiveness of Residential Water Demand (California Department of Water Resources, May 1998)*
10	7	*How to Conserve Water and Use It Effectively (EPA, April 1995)*
10	2 to 4	*Conservation Pricing of Water and Wastewater (Stallworth, April 2000)*
10	1 to 5	*Orange County Water and Sewer Authority Conservation Pricing Study (January 2003)*
Estimated Average	3.5	Approximately equal to the arithmetic average.

Source: 2006 IWMP, HDR Engineering

5.2 Physical Improvement Options for Supply Augmentation

Beyond using policy as means to partially address estimated drought shortfalls, there are alternatives to add supply sources that could be tapped under shortage conditions. These physical improvements have added assurances in the ability to deliver supply (versus requesting voluntary or mandatory cuts in demand) and can be designed to increase reliability significantly from partially up to 100 percent coverage of the drought shortfall, or even providing additional reliability beyond 100 percent given future uncertainties in water supply availability. The disadvantages to using physical improvements include the significant capital and operating costs required, potential for environmental impacts and navigating approval processes that can delay a sources coming online prior to the next severe drought. There are three categories of physical improvements that are being considered and described further below: (1) expanded recycled water service; (2) groundwater supplies; and (3) more surface water storage.

5.2.1 Expanded Recycled Water Service

The following describes the physical improvements which could be adopted by the District to address the projected 300 acre-ft drought shortfall and contingency needs or 600 acre-ft if climate change potential impacts are considered. This and past reports have shown that an additional means for wastewater effluent disposal will be needed in the future because treated effluent production will surpass golf course irrigation needs. Expansion of the District's recycled water program within the community is one way to address this issue along with reduced draw down levels and drought deficits. The estimated annual treated effluent surpluses for normal and drought conditions are estimated at 535 and 420 acre-ft, respectively. The 390 acre-ft drought recycled water surplus is based on the average of the values presented in the Wastewater Facilities Expansion and Financing Report (HSE, 2007). Buildout projections used to prepare these estimates are within 1 percent of the medium growth projections described in this report.

One of the most cost effective means for expanding the recycled water program is installing the required infrastructure for new customers during construction. The total annual treated water demand for new customers is projected to be 1,635 acre-ft per year. Of this, approximately 835 acre-ft per year is projected for outdoor use. Comparison of this 835 acre-ft demand with the projected recycled water surpluses indicate all of the excess recycled water could be utilized for outdoor irrigation, assuming all outdoor water use is supplied by recycled water. However, implementing this alternative would require additional recycled water storage. This strategy is expected to eliminate draw down in Chesbro altogether and reduce Calero draw down by approximately 6.5 feet (20 percent) under normal conditions.

During drought conditions, outdoor annual use is projected to decrease from 1,810 to 515 acre-ft per year based on the water use cutbacks shown in Table 5-4 and the medium growth scenario. If this strategy were implemented, one benefit for new customers is that an additional 420 acre-ft would be available for outdoor irrigation during drought conditions. If this surplus was dedicated to new residences, outdoor allocation would only have to be reduced by 50 percent instead of the 70 percent previously described. In addition, this strategy could reduce water treatment plant expansion needs after Phase 4 due to reduced potable water demands from outdoor irrigation.

One drawback associated with this strategy is the need for the District to manage and oversee the recycled water program to ensure it is in compliance with recycled water regulations for residential use. Potential managerial and administrative tasks include verifying that lawn and landscaping runoff does not enter the storm drain system, that distribution systems are properly labeled and marked accordingly, and initiating and maintaining a cross-connection prevention program.

5.2.1.1 Recycled Water for New Connections

A summary of the basis for recycled water estimated savings of 85 acre-ft/yr for supplementing planned irrigation demand is based on the following assumptions:

- All new residential connections based on the updated projected 1,844 connections between 2015 and buildout (medium growth scenario) will use recycled water for irrigation demand between the months of April-October.
- Total of 100 gpd/EDU of recycled water would be available for use to offset potable irrigation demands.
- Cost is assumed to be $11.5 million recycled water system capital costs.
- Benefits are the avoided potable water delivered and recycled water disposed at $2.35 million and $2.75 million per Table ES-2 in Recycled Water Feasibility Study (HDR, June 2009).

Recycled water demand per residential equivalent dwelling unit is 0.31 acre-year/account (Recycled Water Feasibility Study, HDR, June 2009)

5.2.1.2 Recycled Water New Connections and Converted Parks

A summary of the basis for recycled water estimated savings of 130 acre-ft/yr for supplementing planned irrigation demand is based on the following assumptions:

- Recycled water demand per residential equivalent dwelling unit is 0.31 acre-year/account (Recycled Water Feasibility Study, HDR, June 2009).
- All new residential connections based on the updated projected 1,844 connections between 2015 and buildout (medium growth scenario) will use recycled water for irrigation demand between the months of April-October.
- Total of 100 gpd/EDU of recycled water would be available for use to offset potable irrigation demands.
- Assumes only Stonehouse and Riverview Parks would be converted to recycled water for 40.6 acre-feet per year and 5.7 acre-feet per year, respectively.

- Cost is assumed to be $11.5 million recycled water system capital costs plus $250,000 for park conversions.
- Benefits are the avoided potable water delivered and recycled water disposed at $2.35 million and $2.75 million per Table ES-2 in Recycled Water Feasibility Study (HDR, June 2009).

5.2.1.3 Indirect Potable Reuse

Indirect potable reuse (IPR) is the practice of taking recycled water that meets all regulatory requirements for non-potable use, treating it further with several advanced treatment processes to meet potable water standards, and adding it to an untreated potable water supply, usually a water body such as a surface water reservoir or a groundwater aquifer. The term “indirect” refers to the distinction that highly-treated recycled water is not plumbed directly to the potable distribution system. During a long residence time, the highly-treated recycled water blends with the source water in Calero the largest reservoir, which would be diverted water from the Cosumnes River and local watershed drainage. Extensive permitting and regulatory interaction is required prior to starting an IPR project. Regulations require the recycled water receive extensive advanced treatment, plus additional natural treatment processes that occur in a groundwater basin or reservoir. Prior to entering the District’s potable water system, the blended raw water from Calero would be transferred to Chesbro reservoir for further mixing and then gravity fed to the potable water treatment plant or if injected into the groundwater aquifer then additional treatment would be at a wellhead treatment facility.

It is assumed that increased supply reliability through indirect potable reuse where supplies are stored and mixed with raw water for later use in the water supply system according to California Department of Public Health requirements may become a viable option in the future that would be a least cost recycled water alternative that would provide benefits all residents.

A feasibility assessment would be needed to validate the approach for either surface or groundwater storage alternatives and determine estimated costs for implementation for the District.

5.2.1.4 Recycled Water - Other options

There are several agricultural fields in close proximity of Rancho Murieta. Potentially, the District could form an agreement with a local rancher or farmer to trade recycled water for groundwater. This option requires installation of pipeline and conveyance infrastructure to route raw water from the groundwater well to Chesbro Reservoir, and recycled water from the storage reservoir to the agricultural application area.

This option provides the most benefits relative to other options; it could address the issues of reservoir draw down under normal conditions, drought deficits and future treated effluent disposal needs. Similar to the previous option, it also uses groundwater during normal and drought conditions to significantly reduce reservoir draw down while eliminating drought deficits. The primary drawback of this option is the District reliance on a rancher or farmer to dispose of excess recycled water.

5.2.2 Drought Supplemental Groundwater Supply

Previous studies show that providing new groundwater supply is more cost effective than installing a new off stream storage reservoir. Preliminary well field explorations show that potential well fields exist within close proximity of Rancho Murieta. Preliminary findings indicate an individual well could provide up to 600 gpm. However, a capacity of only 400 gpm would be required if this option were used to eliminate drought deficit only. A detailed description of the infrastructure required for this option was presented in the Evaluation of the 2006 IWMP (HDR, 2006).

This conjunctive option could use groundwater during both normal and drought conditions along with stored surface water, as well as during emergency conditions. This is only one of the two options that could potentially be used to significantly reduce reservoir draw down while eliminating drought deficits.

5.2.3 Drought Surface Storage

Previous studies evaluated and compared potential reservoir sites. The total estimated amount of water diverted to storage reservoirs is estimated to be less than 2,500 acre-ft for buildout conditions under the driest three-year drought sequence. Based on this review, it appears the new reservoir would need new supplies to be diverted from river water provided the new reservoir is added to the existing permit. As previously described, the new reservoir could only be used during droughts. This strategy would have no impact on reservoir draw down levels during normal conditions. This new reservoir may be used in conjunction with the supplemental well supply option.

5.3 Section Summary

Workshops were held with District staff on February 19, May 5, June 18, and July 21, 2010 to present preliminary findings and project results. Potential strategies that could be used to address the projected drought shortfalls were also discussed during the July 21st workshop. Numerous strategies discussed, the following were considered as options:

- **Achieve 2020 Compliance Plan Targets to Lower Water Demands:** SB7 requires utilities to lower potable water demand by 20 percent by 2020. Achieving this level of demand reduction will effectively increase supply reliability, as overall demand on the system at buildout is projected to be more than 700 acre-ft less than projected without compliance with 2020 GPCD targets. This is a policy that is already being planned for adoption by the District Board and implemented between 2011 and 2020.
- **Drought Policy Solutions:**
  - <u>Implement Water Shortage Contingency Plan</u>**:** the policy is based on achieving up to a 50 percent level of water conservation during severe drought conditions, since this was established as the baseline conservation rate in both this and past planning projects and required by state law for systems with more than 3,000 connections.
  - <u>Water Shortage Pricing</u>**:** implement a shortage pricing mechanism in the form of a drought surcharge to assist with enforcing mandatory water reductions and reduced water allocations in later stages of the water shortage contingency plan.
  - <u>Reduced Water Allocations based on New County Landscape Ordinance and for Large Estates</u>**:** support the County's implementation of the new landscape ordinance for new lots and promote water conscious landscaping throughout the community. In addition, the District should implement a reduced water allocation policy that provides the ability to influence water demands associated with highest future growth classification. The policy may also serve as the basis for other modified allocations for other lot classifications. The policy developed should describe level of service to be provided during normal conditions for specific or all lot classifications.
- **Drought Supply Augmentation Options:** All physical improvements which maximize the use of all available water resources, provides additional supply for normal, drought, and emergency conditions, and addresses the community's long-term treated effluent disposal needs should be considered. The following four options should be evaluated further for feasibility:
  - <u>Expand recycled water service</u>: this option would offset potable demands and help achieve 2020 compliance in addition to aiding in effluent disposal needs. This option also has the direct benefit of allowing more storage to be maintained during times of drought, thus increasing water supply

reliability. Also consider expanding recycled water service to more existing customers. This option had three alternatives considered:

- New connections only
- New connections and conversion of parks and or commercial area
- Indirect Potable Reuse

- New well supply: investigate new groundwater supply to address normal and drought water supply reliability needs. Given the community is wholly supplied via surface water, groundwater wells would serve as emergency supply option under normal conditions and supplemental supply in times of shortage in surface water supplies.
- New surface reservoir – a new reservoir may be supplied with diverted river water provided the new reservoir could be added to the existing permit. This new reservoir could only be used during droughts and may be used in conjunction with the supplemental well supply option.
- Recycled water policy – consider adopting a policy regarding recycled water use for new customers.

6. RECOMMENDATIONS

An integrated solution is required to increase water supply reliability, reduce reservoir draw downs, eliminate the drought shortfalls and minimize community hardship in the next severe drought. Figure 6-1 illustrates the recommended approach for addressing these issues.

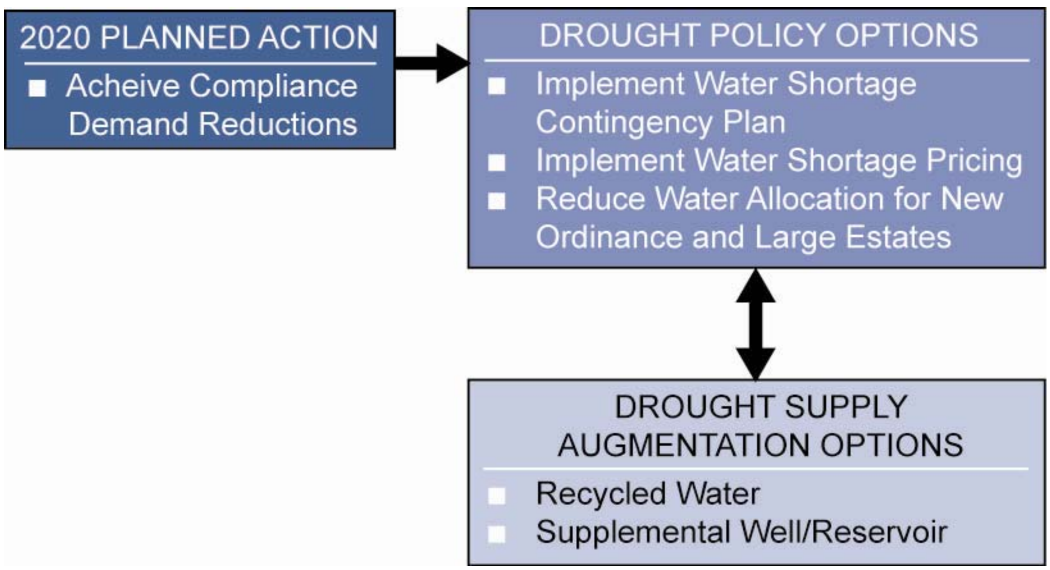


Figure 6-1. Recommended IWMP Drought Mitigation Strategies

The solution is comprised of the five potential options described below, the first four of which are policy related. The fifth component is comprised of two options for costly physical improvements. At this time, it is envisioned that the policy options will be adopted and the physical improvement option would be further analyzed resulting in one option being selected to pursue further.

6.1 Achieve 2020 Compliance Plan Targets to Lower Water Demands

SB7 requires water demands statewide to be reduced 20 percent by 2020. Achieving this level of demand reduction will effectively increase supply reliability, as overall demand on the system at buildout is projected to be more than 700 acre-ft less than projected without compliance with 2020 GPCD targets. This is a policy that is already being planned for adoption by the District Board and implemented between 2011 and 2020.

6.2 Drought Policy Solutions

- Implement Water Shortage Contingency Plan**:** the policy is based on achieving up to a 50 percent level of water conservation during severe drought conditions, since this was established as the baseline conservation rate in both this and past planning projects and is the planning requirement under state law for systems with more than 3,000 connections.

- Water Shortage Pricing: implement a shortage pricing mechanism in the form of a drought surcharge to assist with encouraging compliance with mandatory water reductions and reduced water allocations in later stages of the water shortage contingency plan.
- Reduced Water Allocations based on New County Landscape Ordinance and for Large Estates: support the County's implementation of the new landscape ordinance for new lots and promote water conscious landscaping throughout the community. In addition, the District should implement a reduced water allocation policy that provides the ability to influence water demands associated with highest future growth classification. The policy may also serve as the basis for other modified allocations for other lot classifications. The policy developed should describe the level of service to be provided during normal conditions for specific or all lot classifications.
- Recycled Water Policy: consider adopting a policy regarding recycled water use for new connections.

6.3 Drought Supply Augmentation Options

- Expand recycled water service to new residential customers: this option would offset potable demands and help achieve 2020 compliance in addition to aiding in effluent disposal needs. This option also has the direct benefit of allowing more storage to be maintained during times of drought, thus increasing water supply reliability. Also can consider expanding recycled water service to more existing customers, such as parks and/or commercial area, depending on cost feasibility and timing and availability of excess recycled water beyond residential landscape irrigation.
- New well supply: investigate new groundwater supply to address normal and drought water supply reliability needs. Given the community is wholly supplied via surface water, groundwater wells would serve as emergency supply option under normal conditions and supplemental supply in times of shortage in surface water supplies.
- New surface reservoir: a new reservoir may be supplied with diverted river water provided the new reservoir could be added to the existing permit. This new reservoir could only be used during droughts and may be used in conjunction with the supplemental well supply option.

6.4 Recommended Next Steps

The recommended next steps are described below:

- Approve IWMP as basis for water planning.
- Re-adopt District Board Policy 90-2 (Appendix B) to determine conservation level and number of units served and trigger for when new augmentation supplies are needed.
- Select appropriate augmentation projects and size, including prudent reserve; set the new fee.
- Refine water shortage contingency plan to better define timing of drought stages, related to reservoir levels, early warning forecasts, etc.
- Re-engineer Water Treatment Plant (WTP) and Wastewater Reclamation Plant (WWRP) phase planning, as well as recycled water transmission and storage facilities.
- Develop direction for future studies and policy changes.
- Pursue CDPH approval of Clementia Reservoir for drinking water supply in times of drought.

7. LIMITATIONS

Report Limitations

This document was prepared solely for Rancho Murieta Community Services District in accordance with professional standards at the time the services were performed and in accordance with the contract between Rancho Murieta Community Services District and Brown and Caldwell dated January 21, 2010. This document is governed by the specific scope of work authorized by Rancho Murieta Community Services District; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by Rancho Murieta Community Services District and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

This document sets forth the results of certain services performed by Brown and Caldwell with respect to the property or facilities described therein (the Property). District recognizes and acknowledges that these services were designed and performed within various limitations, including budget and time constraints. These services were not designed or intended to determine the existence and nature of all possible environmental risks (which term shall include the presence or suspected or potential presence of any hazardous waste or hazardous substance, as defined under any applicable law or regulation, or any other actual or potential environmental problems or liabilities) affecting the Property. The nature of environmental risks is such that no amount of additional inspection and testing could determine as a matter of certainty that all environmental risks affecting the Property had been identified. Accordingly, THIS DOCUMENT DOES NOT PURPORT TO DESCRIBE ALL ENVIRONMENTAL RISKS AFFECTING THE PROPERTY, NOR WILL ANY ADDITIONAL TESTING OR INSPECTION RECOMMENDED OR OTHERWISE REFERRED TO IN THIS DOCUMENT NECESSARILY IDENTIFY ALL ENVIRONMENTAL RISKS AFFECTING THE PROPERTY.

Further, Brown and Caldwell makes no warranties, express or implied, with respect to this document, except for those, if any, contained in the agreement pursuant to which the document was prepared. All data, drawings, documents, or information contained this report have been prepared exclusively for the person or entity to whom it was addressed and may not be relied upon by any other person or entity without the prior written consent of Brown and Caldwell unless otherwise provided by the Agreement pursuant to which these services were provided

APPENDIX A: WATER SHORTAGE CONTINGENCY PLAN

RANCHO MURIETA COMMUNITY SERVICES DISTRICT

WATER SHORTAGE CONTINGENCY PLAN

In an effort to provide a uniform basis for requesting cutbacks in consumption due to cutbacks in supply from minor to emergency, Rancho Murieta Community Services District developed a program of five stages of water conservation measures. The District previously adopted conservation measures, which are included in Chapter 14-Water Code of the District Code as a result of the prolonged drought conditions in the early 1990's. This Water Shortage Action Plan expands the District Code's conservation measures.

STAGES OF ACTION

The stage determination and declaration shall be made by the General Manager. One of five stages shall always be in effect, and a change of stage requires that the board of directors be notified and a public notice posted at the District headquarters.

STAGE 1 - NORMAL SUPPLY

The District's supply or distribution system is able to meet all the water demands of its customers in the near future.

Triggering Mechanism:	Full storage in all lakes to provide full water supply to all customers.
Consumption Limits:	No percentage cutback required.
District Actions:	During Stage 1, all normal conservation programs would continue.
Requested Consumer Action:	Follow the basic conservation measures set forth in Stage 1 of the five-stage conservation program.
Penalties:	For the first and subsequent violations, customers will receive a conservation letter or visit from a conservation specialist; a second letter offering services such as the Master Gardener; a written notice of action; a letter indicating a date for discontinuance of service; and finally service is discontinued and a progressive reconnect fee charged.

STAGE 2 - WATER ALERT

There is a probability that the District's supply or distribution system will not be able to meet all the water demands of its customers.

Triggering Mechanism: 90-95% storage in all lakes to provide 90-95% water supply to all customers. Determination made June 1.

Consumption Limits: All customers would be required to reduce consumption by 5 - 10% for the duration of the water alert.

District Actions: Continue the basic conservation program elements, and initiate public information campaign. Explain the supply condition to the public. Request voluntary water conservation.

Requested Consumer Actions: Customers will be asked to implement Stage 2 water conservation measures and adhere to the "no waste" ordinance.

Penalties: For the first and subsequent violations, customers will receive a conservation letter or visit from a conservation specialist; a second letter offering services such as the Master Gardener; a written notice of action; a letter indicating a date for discontinuance of service; and finally service is discontinued and a progressive reconnect fee charged.

Stage 3 - WATER WARNING

The District's supply or distribution system will not be able to meet all the water demands of its customers.

Triggering Mechanism: 75-89% storage projected in all lakes to provide 75-89% water supply to all customers. Determination made May 1.

Consumption Limits: Customers would be required to reduce consumption by 11 - 25% for the duration of the water warning condition.

District Actions: Continue conservation program and District actions listed through Stage 2, mandate compliance to Stage 3 Water Conservation Measures of the District's Five Stage Water Conservation Measures. Continue rigorous public information campaign. Explain supply shortage and disseminate technical information as needed.

Requested Customer Actions: Customers will be notified that Stage 3 water conservation measures are in effect and compliance will be requested.

Penalties: For the first and subsequent violation of the water conservation measures in force, customers will receive the following sequence of enforcement actions within a two week time frame: customers will receive a conservation letter or visit from a conservation specialist; a second letter offering services such as the Master Gardener; a written notice of action; a letter indicating a date for discontinuance of service; and finally service is discontinued and a progressive reconnect fee charged.

STAGE 4 WATER CRISIS:

The District's supply or distribution system is not able to meet all the water demands of its customers under Stage 3 - Water Warning requirements.

Triggering Mechanism: 50-74% storage in all lakes to provide 50-74% water supply to all customers. Determination made April 1.

Consumption Limits: All customers would be required to reduce consumption by 26 - 50% until the water crisis has been declared over.

District Actions: Continue all conservation program and District action elements through Stage 3, and mandate adherence to all water conservation measures required under Stage 4 of the District's Five Stage Water Conservation Measures. Institute a rationing program through percentage cutbacks.

Request assistance from family agencies with available groundwater to augment supply with groundwater pumping from their wells.

Requested Customer Actions: Customers will be requested to comply with all Stage 4 conservation measures listed in the Five Stage Water Conservation Measures.

Penalties: For the first and subsequent violations, customers will receive the following actions within a one week time frame: customers will receive a conservation letter or visit from a conservation specialist; a second letter offering services such as the Master Gardener; a written notice of action; a letter indicating a date for discontinuance of service; and finally service is discontinued and a progressive reconnect fee charged.

STAGE 5 WATER EMERGENCY

The District is experiencing a major failure of a supply, storage or distribution facility.

Triggering Mechanism:	Less than 50% storage in all lakes to provide less than 50 water supply to all customers. Determination made January 1.
Consumption Limits:	All customers would be required to restrict consumption to 50% (or less) of normal supply for the duration of the water emergency.
District Actions:	Continue all conservation programs and District action elements through Stage 4, and mandate that all Stage 5 conservation measures be implemented immediately and strictly enforced. Intensify media outreach program with regular updates on the state of the emergency.
Requested Customer Actions:	Customers will be required to comply with all Stage 5 water conservation measures.
Penalties:	For the first and subsequent violations, retail customers will receive the following actions within a one-week time frame: A conservation letter and visit from a conservation specialist. A District notice of action with service discontinuance date. Discontinuance of service and charge of a progressive reconnect fee.

RANCHO MURIETA COMMUNITY SERVICES DISTRICT

WATER CONSERVATION MEASURES
STAGE DEFINITIONS

Stage One – Normal Water Supply:

The District's supply or distribution system is able to meet all water demands of its customers in the immediate future.

Stage Two – Water Alert:

There is a probability that the District's supply or distribution system will not be able to meet all the water demands of its customers.

Stage Three – Water Warning:

The District's supply or distribution system will not be able to meet all the water demands of its customers.

Stage Four – Water Crisis:

The District's supply or distribution system is not able to meet all the water demands of its customers under **Stage 3 - Water Warning** requirements.

Stage Five – Water Emergency:

The District is experiencing a major failure of a water supply, storage, or distribution facility.

RANCHO MURIETA COMMUNITY SERVICES DISTRICT

WATER CONSERVATION MEASURES
STAGE DEFINITIONS

Stage One - Normal Supply

1. Water will be used for beneficial uses; all unnecessary and wasteful uses of water are prohibited.

2. Use water efficiently. Water shall be confined to the consumer's property and shall not be allowed to run off to adjoining property or to the roadside ditch or gutter. Care shall be taken not to water past the point of saturation.

3. Prohibit free-flowing hoses for all uses including vehicle and equipment washing, ponds, evaporative coolers, and livestock watering troughs. Attach automatic shut-off devices on any hose or filling apparatus in use.

4. Leaking consumer pipes or faulty sprinklers shall be repaired within five (5) days or less if warranted by the severity of the problem.

5. All pool, spas, and ornamental fountains/ponds shall be equipped with a recirculating pump and shall be constructed to be leak-proof. Pool draining and refilling shall be allowed only for health, maintenance, or structural considerations. Customer requests must be substantiated in writing by a pool consultant and approved by the District.

6. Discourage washing of streets, parking lots, driveways, sidewalks, or buildings, except as necessary for health or sanitary purposes.

7. Water efficient plumbing fixtures, water efficient appliances, and high efficiency irrigation techniques, such as drip, are encouraged.

RANCHO MURIETA COMMUNITY SERVICES DISTRICT

WATER CONSERVATION MEASURES
STAGE DEFINITIONS

Stage Two - Water Alert

1. All Stage 1 actions remain in force.

2. All pool, spas, and ornamental fountains/ponds shall be equipped with a recirculating pump and shall be constructed to be leak-proof. Pool draining and refilling shall be allowed only for health, maintenance, or structural considerations. Customer requests must be substantiated in writing by a pool consultant and approved by the District.

3. Automatic sprinkler system timers shall be set to operate during off-peak electrical hours, (between midnight and 10:00 a.m.), with the exception of avoiding irrigation during water peak use (between 6 a.m. and 8 a.m.).

4. Prohibit washing of streets, parking lots, driveways, sidewalks, or buildings, except as necessary for health or sanitary purposes.

5. Landscape and pasture irrigation shall be limited to a maximum of **three days per week** when necessary based on the following **odd-even** schedule.

   - Customers with street addresses that end with **odd** numbers may irrigate only on **Monday, Wednesday and Friday**.

   - Customers with street addresses that end with **even** number may irrigate only on **Tuesday, Thursday and Saturday.**

   - **Sunday irrigation is not allowed.**

6. Restaurants shall serve water only upon specific request.

RANCHO MURIETA COMMUNITY SERVICES DISTRICT

WATER CONSERVATION MEASURES
STAGE DEFINITIONS

Stage Three - Water Warning

1. All Stage 1 and 2 actions remain in force.

2. Landscape and pasture irrigation shall be limited to a maximum of **two days per week** when necessary based on the following **odd-even** schedule.

    a. Customers with street addresses that end with **odd** numbers may irrigate only on **Tuesdays and Saturdays**.

3. Customers with street addresses that end with **even** number may irrigate only on **Wednesdays and Sundays**.

4. Restaurants shall serve water only upon specific request.

5. Residents are encouraged to reduce indoor water use by limiting showers, clothes washing and dish washing.

6. Conservation pricing may be instituted to promote more efficient water use to meet conservation goals.

RANCHO MURIETA COMMUNITY SERVICES DISTRICT

WATER CONSERVATION MEASURES
STAGE DEFINITIONS

Stage Four - Water Crisis

1. All Stage 1, 2 and 3 actions remain in force.

2. Landscape and pasture irrigation shall be limited to a maximum of **one day per week** when necessary based on the following **odd-even** schedule.

    - Customers with street addresses that end with **odd** numbers may irrigate only on **Saturdays**.

    - Customers with street addresses that end with **even** number may irrigate only on **Sundays**.

3. No irrigation is permitted on **Mondays, Tuesdays, Wednesdays, Thursdays, and Fridays.**

4. No potable water from the District's system shall be used to fill or refill new swimming pools, artificial lakes, ponds, or streams until the **Water Crisis** has been declared over.

5. Prohibit water use for ornamental ponds and fountains.

6. Washing of automobiles or equipment shall be done at a commercial establishment that uses recycled or reclaimed water.

7. Conservation pricing will be implemented to ensure conservation goals are met.

RANCHO MURIETA COMMUNITY SERVICES DISTRICT

WATER CONSERVATION MEASURES
STAGE DEFINITIONS

Stage Five - Water Emergency

1. All Stage 1, 2, 3, and 4 actions remain in force.

2. **Landscape and pasture irrigation shall not be allowed.**

3. Flushing of sewers or fire hydrants is prohibited except in case of emergency and for essential operations.

4. No potable water from the District's system shall be used for construction purposes such as dust control, compaction, or trench jetting.

5. New connections to the District system will not be allowed.

6. Drought conservation pricing will be instituted to ensure no outside landscape irrigation.

7. Aggressive enforcement of no landscape irrigation shall include up to mandatory misdemeanor citations with fines up to $1000 per day per incident or six months in jail.

APPENDIX B: RANCHO MURIETA COMMUNITY SERVICES DISTRICT BOARD POLICY 90-2

ORDINANCE NO. 87-9

AN ORDINANCE OF THE
RANCHO MURIETA COMMUNITY SERVICES DISTRICT
AMENDING CHAPTER 14 OF THE DISTRICT CODE
RELATING TO WATER SERVICE

BE IT ORDAINED by the Board of Directors of the Rancho Murieta Community Services District, Rancho Murieta, Sacramento County, California, as follows:

SECTION ONE:

The Water Code, Chapter 14 of the District Code, is amended in part as follows:

7.05 Rates for Metered Service.

(a) General metered service shall be as follows:

BI-MONTHLY BILLING

Basic service charge [Includes 500 cf]	$15.60
Volumetric rate: [Excess of 500 cf]	$.66/100 cf

SURCHARGE for multiple units above one: $8.00 per unit.

(b) Metered service to residential lots at Murieta Village shall be as follows:

BI-MONTHLY BILLING

Basic service charge [Includes 500 cf]	$11.70
Volumetric rate: [Excess of 500 cf]	$.66/100 cf

(c) Metered service to commercial irrigation lots [15,000+ cubic feet] shall be as follows:

BI-MONTHLY BILLING

Basic service charge	$51.30
Volumetric rate:	$.40/100 cf

7.06 Rates for Special Flat Rate Service. Special flat rates are established for the following services:

(a) Equestrian Center $450.00 per month

<u>7.08 Fees for Line Extension Applications and Plan Reviews.</u> Fees for line extension applications, plan reviews, and construction inspection shall be as established by the General Manager, based upon the reasonable costs of providing the service.

<u>10.09 Irrigation and Sprinkling.</u> Excessive runoff, as determined by the District Manager, from irrigation and sprinkling shall not be allowed.

<u>SECTION TWO:</u> To the extent the terms and provisions of this Ordinance may be inconsistent or in conflict with the terms and provisions of any prior District ordinance, resolution, rule or regulation, the terms of this Ordinance shall prevail with respect to the subject matter hereof and such inconsistent or conflicting terms and provisions of prior ordinances, resolutions, rules and regulations are hereby repealed.

<u>SECTION THREE:</u> The establishment, modification, structuring, restructuring and approval of the fees, rates and charges set forth in Section One hereof, are for the purpose of continuing to provide funds to meet the District's cost of operation and maintenance, supply and equipment, financial reserve, debt service and capital replacement needs, and are necessary to maintain and improve service within the District's existing service boundaries.

<u>SECTION FOUR:</u> This Ordinance shall be published within 10 days of adoption in a newspaper of general circulation published within the District. Because the District's fiscal year and billing period begins on July 1, this ordinance shall take effect on July 1, 1987.

PASSED AND ADOPTED by the Board of Directors of the Rancho Murieta Community Services District, Rancho Murieta, Sacramento County, California, at a meeting duly held on June 29, 1987, by the following roll call vote:

AYES: Directors: Brandt, Dudley, Devlin, Simpson, Wegner
NOES: None
ABSENT: None
ABSTAIN: None

Richard E Brandt

President, Board of Directors,
Rancho Murieta Community Services
District

ATTEST:

Linda Eversole

Secretary, Board of Directors
Rancho Murieta Community Services District

APPENDIX C: SUMMARY OF IWMP MODEL RESULTS

Table C-1. Summary of IWMP Modeled Scenarios Results Matrix

Water Year or Climate Scenario	Water Supply Augmentation Needs Added 2020 Compliance (acre-ft/yr)			Water Supply Augmentation Needs Including 2020 Compliance (acre-ft/yr)		
	Existing	Existing plus approved lots	Future Medium Growth Buildout	Existing	Existing plus approved lots	Future Medium Growth Buildout
Total EDUs	2,269	2,843	4,356	2,269	2,843	4,356
Under Board Approved 50% Maximum Targeted Demand Cutbacks with Flashboards						
Average year	-	-	-	-	-	-
Average year - emergency supplies[a]	-	-	-	-	-	300
1923, 24, 77 Drought Conditions	-	-	-	-	-	-
1976, 77, 78 Drought Conditions	-	-	-	-	-	89
1987, 88, 90 Drought Conditions	-	-	-	-	-	-
Warm Only Climate Change for 1976, 77, 78 Drought Conditions	-	-	-	-	-	89
Warm Dry Climate Change for 1976, 77, 78 Drought Conditions	-	-	-	-	-	312
Under Possible 25% Maximum Targeted Demand Cutbacks with Flashboards	-	-	-			
Average year	-	-	-	-	-	-
Average year - emergency supplies[a]	-	-	-	-	-	300
1923, 24, 77 Drought Conditions	-	-	132	-	-	1,283
1976, 77, 78 Drought Conditions	-	-	691	-	-	1,463
1987, 88, 90 Drought Conditions	-	-	-	-	-	-
Warm Only Climate Change for 1976, 77, 78 Drought Conditions	-	-	691	-	-	1,463
Warm Dry Climate Change for 1976, 77, 78 Drought Conditions	-	-	987	-	287	1,771
Under Board Approved 50% Maximum Targeted Demand Cutbacks without Flashboards						
Average year	-	-	-	-	-	-
Average year - emergency supplies[a]		-	-	-	-	300
1923, 24, 77 Drought Conditions	-	-	-	-	-	43
1976, 77, 78 Drought Conditions	-	-	-	-	-	86
1987, 88, 90 Drought Conditions	-	-	-	-	-	-
Warm Only Climate Change for 1976, 77, 78 Drought Conditions	-	-	-	-	-	86
Warm Dry Climate Change for 1976, 77, 78 Drought Conditions	-	-	6	-	-	720
Under Possible 25% Maximum Targeted Demand Cutbacks without Flashboards	-	-	-	-	-	-
Average year	-	-	-	-	-	-
Average year - emergency supplies[a]	-	-	-	-	-	300
1923, 24, 77 Drought Conditions	-	-	502	-	-	1,695
1976, 77, 78 Drought Conditions	-	-	923	-	111	1,580
1987, 88, 90 Drought Conditions	-	-	-	-	-	-
Warm Only Climate Change for 1976, 77, 78 Drought Conditions	-	-	923	-	111	1,580
Warm Dry Climate Change for 1976, 77, 78 Drought Conditions	-	82	1,076	-	517	2,032

[a] Note: Average year emergency supplies is based on the greater value of either: (1) the peak month demand rounded up to the nearest 100 or (2) two average months demands rounded up to the nearest 100.

APPENDIX D: PUBLIC COMMENTS

Revisions to Address Public Comments

The following is a list of updates and/or modifications to address public comments on the Public Review Draft dated September 1, 2010.

Changes to Address Comments from John Sullivan:

- Added footnote to Table ES-1 stating that water factor could potentially be reduced with increased recycled water use and that an offset in treatment plant production would occur.
- Added bullet under Drought Supply Options in Executive Summary and Section 6 related to a suggestion for a policy for recycled water for new customers.
- Replaced "parks" with "commercial irrigation accounts" in Executive Summary and Table 5-1
- Added in the Executive Summary and Section 6 recommendations for supply augmentation to expand options for recycled water use.

Changes to Address Comments from CDPH:

- Updated Table 4-5 with new information that includes existing and existing plus approved conditions.
- Added language to clarify that RMCSD should pursue CDPH approval of Clementia Reservoir for drinking water supply in times of drought in Executive Summary and Section 6.
- Added statement in Section 4.5 that Clementia is not currently authorized for a drinking water supply.

Other Updates

- Added new table 5-3
- Revised Figures ES-3, 4-4, and 4-5
- Revised descriptions of demand cutbacks, as follows:
  - "Including 2020 Compliance": Replaces "without 2020 compliance" to reflect a total demand cutback of 50 percent in extreme drought.
  - "Added 2020 Compliance": Replaces "with 2020 compliance" to reflect a higher level of demand cutback, with compounded effects of reducing demands: (1) by 20 percent in the Year 2020 and beyond along with (2) an additional 50 percent demand cutback (per RMCSD's Policy 90-2 and adopted Water Shortage Contingency Plan).
- Revised text in Executive Summary and Section 6 to reflect that a total cutback of 50 percent (i.e., "including 2020 compliance") is RMCSD's selected baseline (rather than a 60 percent compounded reduction, comprised of 20 percent from 2020 compliance and 50 percent drought cutbacks).
- Clarified that RMCSD's selected planning approach is founded on total demand cutbacks in extreme drought (i.e., Stage 4 drought) is a maximum of 50 percent (i.e., not Stage 5).
- Added the recommendations for next steps in Executive Summary and in Section 6.
- Clarified that 1710AF was used as a projection of reduced annual demands for 2020 compliance; however, the model relied on 750 gpd/EDU to forecast demand.

COMMENTS AND CLARIFICATIONS

FROM: JOHN M SULLIVAN-LOT 314/MURIETA PARKWAY

TO: RMCSD

RE: 2010 IWMP UPDATE

I would like to thank RMCSD for undertaking proactively the IWMP Update for 2010. I would formally request that my comments regarding the IWMP from the September 15th, 2010 meeting be incorporated for reference in the public comments section of the plan.

Here are my additional comments:

ES-2 Table ES-1 Recycled Water Production for Buildout conditions should be 2.6-3.0 mgd (1.4-1.5 shown in table)

ES-8: I strongly recommend that Drought Supply Augmentation Options be:

1. 2020 compliance
2. Expansion of RW service to all new residential customers
3. Expand RW use by substituting RW for potable on all parks and common areas that use "potable" water
4. Complete RW/Raw water loop to commercial users – (Plaza/Murieta Gardens/RMMV/Airport/Equestrian Center/ etc)
5. New surface reservoir (identify and build)
6. Well Supply
   [The District has spend augmentation money for a well supply which has not been proven sufficient to meet the drought augmentation needs of the community]

STUDY RW offset of potable demand on water treatment peaking capacity. In addition to water balance, drought planning, and aesthetics is the all important element of "COST".

The lowest system cost can be achieved by using Recycled Water as a direct offset to the peaking demand of the combined water treatment plant(s) capacity. Lowering the peaking demand by utilizing the available recycled water in the months of June, July, Aug and Sept will eliminate the need to construct any more than 4.2-4.4mgd of capacity for water treatment.

The savings from this is 2-fold. First the engineering and construction expenses (possibly as much as $7-$8 million) and the replacement reserves necessary to maintain the plants would be sufficient to build Recycled Water tanks and trunk lines to serve the "new" development. These Recycle "costs" should be looked at again for accuracy and 'cost'. It may be possible to use the MBA density RW above RMCC needs (535-592 A.F.) by sending RW to parks/commercial loop and new residential development only, with demand to spare.

Table 3-3 should be shown with water treatment needs "modified" for RW use. See attached RMCC RW Use / New Irrigation Use schedule attached. "A"

Additionally I have attached ea. 4 = 11x17

1. Residential Counts / Use and Gpday with yearly averages
   20 x 2020 compliance and net effect of reduced water demand
2. Current residential Interior and Exterior uses as well as 20x2020 modifications to residential uses. Additionally is the Build-out (MBA) density Residential and Commercial counts and WWTP inflow by residential and non-residential [part of my comments of 9/15/2010 stated that the non-residential volumes of water and WASTEWATER needed to be confirmed
3. Using the MBA densities and wastewater flows and water usage, this page shows the Wastewater to secondary storage. This shows that with 4400 / 665 (MBA density) that the water to secondary storage will not exceed current storage capacity, if carry over storage is less than 100 A.F. (regulatory requirement) and the New Irrigation usage is as estimated. [Again these irrigation demands need to be confirmed, but having a dynamic model and being able to front load RW irrigation usage should draw down all water necessary from secondary storage before Nov. 1 each year. [Evaporation and rainfall issues will still require management of RW in storage for RMCC use]
4. Current and future Residential and Commercial Demand. Shows monthly usage and RW monthly demand. In addition Unmodified Demand and Savings are shown. This identifies that 592 A.F. of additional stored water will be in Chesbro and/or Calero. This reduced net demand from 2884 A.F. /yr. to 2292 A.F./yr.

These numbers were generated independently of the work performed for RMCSD by Brown and Caldwell. We all appreciate the opportunity to make public comments on this Administrative DRAFT.

RMCC RW USE MO	BY MONTH	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	550	2429.029839
							100					0			
Secondary Storage	20xx														
INFLOW RM WWTP		100.6	97.4	100.6	100.6	97.4	100.6	97.4	100.6	100.6	90.9	100.6	100.6	1187.80	1187.80
RMCC RW USAGE	AF Est. JMS	-110	-120	-120	-75	-25	-15	-5	0	0	0	-25	-75		-570
New Irrigation USE		-107	-127	-125	-120	-75	-37	-8.7	0	0	0	-41	-54		-694.7
															-76.90

"A"

		JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY		
RESIDENTIAL CSD CUSTOMER COUNT	**FYE 2007**	2496	2486	2488	2489	2489	2489	2488	2492	2494	2497	2497	2497		
	FYE 2008	2502	2498	2498	2500	2500	2500	2500	2500	2500	2500	2499	2498		
	FYE 2009	2506	2502	2496	2500	2501	2504	2504	2504	2504	2504	2506	2506		
	FYE 2010	2510	2506	2506	2507	2507	2507	2507	2507	2507	2507	2507	2510		
RESIDENTIAL COUNT	**AVERAGE**	**4400**	**4400**	**4400**	**4400**	**4400**	**4400**	**4400**	**4400**	**4400**	**4400**	**4400**	**4400**		
COMMERICIAL COUNT		**665**	**665**	**665**	**665**	**665**	**665**	**665**	**665**	**665**	**665**	**665**	**665**		
AVERAGE USE	**CUBIC FT**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**	**NOV**	**DEC**	**JAN**	**FEB**	**MARCH**	**APRIL**	**MAY**		
2192	**FYE 2007**	3413	4404	3451	3388	2283	1728	911	946	879	1053	1923	1935		
2150	**FYE 2008**	3138	3523	3753	3431	2965	1662	1189	923	826	1215	1912	2183		
1865	**FYE 2009**	2865	3067	3027	3245	2333	1478	950	827	776	727	1530	1747		
2202	**FYE 2010**	2423	3145	3242	2945	1961	1498	916	743	763	732	1031	1497		
AVERAGE CF															
GALLONS PER DAY		**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**	**NOV**	**DEC**	**JAN**	**FEB**	**MARCH**	**APRIL**	**MAY**		
547	**FYE 2007**	851	1098	861	845	569	431	227	236	219	262	480	482		
536	**FYE 2008**	782	878	936	855	739	414	297	230	206	303	477	544		
465	**FYE 2009**	714	765	755	809	582	369	237	206	193	181	382	436		
549	**FYE 2010**	604	784	808	734	489	374	228	185	190	182	257	373		
524	**AVE GPD**	**738**	**881**	**840**	**811**	**595**	**397**	**247**	**214**	**202**	**232**	**399**	**459**	3556	**9571**
544	**MOD AVE**		FYE												
	100.00%	**WATER**	**YEAR**				BEGIN	D I V E R S I O N + P E R I O D					E N D----		
NET EFFECT 20X2020	**0.85**	2759185	3295875	3141600	3032205	2224365	1484780	924715	858000	858000	867680	1492260	1715725		22654390
UNMODIFIED USAGE		***3246100***	***3877500***	***3696000***	***3567300***	***2616900***	***1746800***	***1087900***	***942700***	***888800***	***1020800***	***1755600***	***2018500***		26464900
BILLING MO. DAYS	**# OF DAYS**	**31**	**30**	**31**	**31**	**30**	**31**	**30**	**31**	**31**	**28**	**31**	**31**		
UNMODIFIED RES. MONTH		100629100	116325000	114576000	110586300	78507000	54150800	32637000	29223700	27552800	28582400	54423600	62573500	**2485**	809769685
NET EFFECT 2020 MO	**0.85**	85534735	98876250	97389600	93998355	66730950	46028180	27741450	26598000	26598000	24295040	46260060	53187475	**2128**	693240223
SAVINGS MO. GALS		15094365	17448750	17186400	16587945	11776050	8122620	4895550	2625700	954800	4287360	8163540	9386025	**357**	116529462
Unmodified Comm Use		750	750	750	750	600	400	300	300	300	400	500	600		
UNMODIFIED USAGE		498750	498750	498750	498750	399000	266000	199500	199500	199500	266000	332500	399000		4256000
Unmodified Comm MONTH		15461250	14962500	15461250	15461250	11970000	8246000	5985000	6184500	6184500	7448000	10307500	12369000	**354**	130040750
Nef Effect 2020 Comm	**0.85**	13142063	12718125	13142063	13142063	10174500	7009100	5087250	5256825	5256825	6330800	8761375	10513650	**300**	110534638
	0.75	11595938	11221875	11595938	11595938	8977500	6184500	4488750	5256825	5256825	5586000	7730625	9276750	**270**	98767463
2020 (0.85) DROUGHT SVC	**0.66**	65126686	73652288	72950897	70712676	50757597	35004605	21666942	21024185	21024185	20213054	36314147	42042743	**1628**	530490003
SAVED GAL/MO COM		2319188	2244375	2319188	2319188	1795500	1236900	897750	927675	927675	1117200	1546125	1855350	**53**	19506113
TOTAL 2020 4400/665		98676798	111594375	110531663	107140418	76905450	53037280	32828700	31854825	31854825	30625840	55021435	63701125	**2466**	803775199
NON INTERIOR USE		68089098	81993375	79943963	76552718	47304450									353883603
TOTAL RECYCLE		30587700	29601000	30587700	30587700	29601000	30587700	29601000	30587700	30587700	27627600	30587700	30587700	**1107**	361133163
RECYCLE GENERATED		26598000	25740000	26598000	26598000	25740000	26598000	25740000	26598000	26598000	24024000	26598000	26598000	**963**	314028963
COMMERCIAL RW	0.15	3989700	3861000	3989700	3989700	3861000	3989700	3861000	3989700	3989700	3603600	3989700	3989700	**144**	47104200
GRAND TOT UNMODIFIED		116090350	131287500	130037250	126047550	90477000	62396800	38622000	35408200	33737300	36030400	64731100	74942500		939807950

EDU STANDARD C

750	**750**	**750**
5065	**4400**	**665**
3,798,750	3,300,000	498,750
365	365	365
1,386,543,750	**1,204,500,000**	**182,043,750**
325,851	325,851	325,851
4255	**3696**	**558**

A.F.
325,851

CURRENT USE RES.														0.57	184357	
RESIDENTIAL	INTERIOR	6045	5850	6045	6045	5850	6045	5850	6045	6045	5460	6045	6045		71370	
RESIDENTIAL	EXTERIOR	16833	20580	19995	19096	12000	6262	1560	589	217	1037	6324	8494		112987	
RESIDENTIAL 2020	EXT. 75%	7681	10008	9813	9039	4860	1339	0	0	0	0	1346	2492		46578	
RESIDENTIAL 2020	EXT. 50%	3106	4722	4371	4011	1290	0	0	0	0	0	0	0		17500	
		JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY		RECYCLE WATER	
RESIDENTIAL COUNT	Units	4400	4400	4400	4400	4400	4400	4400	4400	4400	4400	4400	4400			
COMMERICIAL COUNT	Comm EDU	665	665	665	665	665	665	665	665	665	665	665	665			
Billing Days CSD		31	30	31	31	30	31	30	31	31	28	31	31			
Res Gal per Day	Ave Usage	738	881	840	811	595	397	247	214	202	232	399	459			
Comm Gal per Day	Est Com Use	750	750	750	750	600	400	300	300	300	400	500	600			
Residential to WWTP	Interior Use	195	195	195	195	195	195	195	195	195	195	195	195			
Irrigation Residential	EXT USE	543	686	645	616	400	202	52	19	7	37	204	264			
Comm to WWTP	Interior Use	300	300	300	300	300	300	300	300	300	300	300	300			
Irrigation Comm	EXT USE	450	450	450	450	300	100	0	0	0	100	200	300			
																WWTP INFLOWS
Water to RM WWTP	Non-Res	6184500	5985000	6184500	6184500	5985000	6184500	5985000	6184500	6184500	5586000	6184500	6184500			
Water to RM WWTP	Residents	26598000	25740000	26598000	26598000	25740000	26598000	25740000	26598000	26598000	24024000	26598000	26598000	1108		361133163
AF to WWTP for Mo.	A.F.	100.6	97.4	100.6	100.6	97.4	100.6	97.4	100.6	100.6	90.9	100.6	100.6		1,188	
	Mo to WWTP	32782500	31725000	32782500	32782500	31725000	32782500	31725000	32782500	32782500	29610000	32782500	32782500	1187		387,046,187

																WWTP INFLOWS
Water to RM WWTP	Non-Res	6184500	5985000	6184500	6184500	5985000	6184500	5985000	6184500	6184500	5586000	6184500	6184500			
Water to RM WWTP	Residents	26598000	25740000	26598000	26598000	25740000	26598000	25740000	26598000	26598000	24024000	26598000	26598000	1108		361133163
AF to WWTP for Mo.	A.F.	**100.6**	**97.4**	**100.6**	**100.6**	**97.4**	**100.6**	**97.4**	**100.6**	**100.6**	**90.9**	**100.6**	**100.6**		**1,188**	
	Mo to WWTP	32782500	31725000	32782500	32782500	31725000	32782500	31725000	32782500	32782500	29610000	32782500	32782500	1187		387,046,187
RES ENTITLEMENTS	2010	2600	2600	2600	2600	2600	2600	2600	2600	2600	2600	2600	2600			
COMMERCIAL	2010	326	326	326	326	326	326	326	326	326	326	326	326			
NEW COMMERCIAL	AFTER 2010	339	339	339	339	339	339	339	339	339	339	339	339			
NEW RESIDENTIAL	AFTER 2010	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800			
NEW RES IRRIGATE	DAILY	976950	1235250	1161000	1108350	719550	363600	94050	34650	12600	66600	367200	474750	**523**		6615073
New Res Irr Total	MONTH	30285450	37057500	35991000	34358850	21586500	11271600	2821500	55800	390600	1864800	11383200	14717250	**568.6**	185268150	170550900
NEW COMM DAILY	DAILY	152550	152550	152550	152550	101700	33900	0		0	33900	67800	101700	**79**		949200
TOT NEW COMM IRR	MONTH	4729050	4576500	4729050	4729050	3051000	1050900	0	0	0	949200	2101800	3152700			29069250
TOT NEW IRR	GRAND TOT	**35014500**	**41634000**	**40720050**	**39087900**	**24637500**	**12322500**	2821500	55800	390600	2814000	13485000	**17869950**			
All New Irr Use AF Mo		**107.5**	**127.8**	**125.0**	**120.0**	**75.6**	**37.8**	**8.7**	**0.2**	**1.2**	**8.6**	**41.4**	**54.8**	**708.5**	648.4	
Commercial Only		9276750	8977500	9276750	9276750	5985000	2061500	0	0	0	33900	67800	6184500			
		28.5	**27.6**	**28.5**	**28.5**	**18.4**	**6.3**	**0.0**	**0.0**	**0.0**	**0.1**	**0.2**	**19.0**			
RMCC RW USE MO	BY MONTH													550	**2429.029839**	
		JUNE	**JULY**	**AUG**	**SEPT**	**OCT**	**NOV**	**DEC**	**JAN**	**FEB**	**MARCH**	**APRIL**	**MAY**			
							100					**0**				
Secondary Storage	20xx															
INFLOW RM WWTP		**100.6**	**97.4**	**100.6**	**100.6**	**97.4**	**100.6**	**97.4**	**100.6**	**100.6**	**90.9**	**100.6**	**100.6**	**1187.80**	**1187.80**	
RMCC RW USAGE	AF Est. JMS	**-110**	**-120**	**-120**	**-75**	-25	-15	-5	**0**	**0**	**0**	**-25**	**-75**		**-570**	
New Irrigation USE		**-107**	**-127**	**-125**	**-120**	-75	-37	-8.7	**0**	**0**	**0**	**-41**	**-54**		**-694.7**	
															-76.90	
		-116.39	-149.64	-144.39	-94.39	-2.64	148.61	**83.66**	**100.61**	**100.61**	**90.87**	34.61	-28.39	**23.10**		

		JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	
Current Residential	**2010 App.**	2600	2600	2600	2600	2600	2600	2600	2600	2600	2600	2600	2600	**LOTS**
Future Residential	**MBA**	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	LOTS - DU
Monthly Usage	**Current**	**738**	**881**	**840**	**811**	**595**	**397**	**247**	**214**	**202**	**232**	**399**	**459**	GPD
Current Demand	**Daily Gal**	**1918150**	**2291250**	**2184000**	**2107950**	**1546350**	**1032200**	**642850**	**557050**	**525200**	**603200**	**1037400**	**1192750**	Daily
Future Demand	**Daily Fut**	**1327950**	**1586250**	**1512000**	**1459350**	**1070550**	**714600**	**445050**	**385650**	**363600**	**417600**	**718200**	**825750**	Fut Daily
Total RES Demand	**Future Total**	**3246100**	**3877500**	**3696000**	**3567300**	**2616900**	**1746800**	**1087900**	**942700**	**888800**	**1020800**	**1755600**	**2018500**	Fut Res
Grand Total Current	Res & Comm	2162650	2535750	2428500	2352450	1741950	1162600	740650	654850	623000	733600	1200400	1388350	Total
Grand Total Future	Med Capacity	3744850	4376250	4194750	4066050	3015900	2012800	1287400	1142200	1088300	1286800	2088100	2417500	Grand Tot
Total Com Demand	**Future Total**	498750	498750	498750	498750	399000	266000	199500	199500	199500	266000	332500	399000	Total
Future Com Demand	**Daily fut**	254250	254250	254250	254250	203400	135600	101700	101700	101700	135600	169500	203400	Fut Com
Current Com Demand	**Daily**	244500	244500	244500	244500	195600	130400	97800	97800	97800	130400	163000	195600	Daily
Monthly Usage	**Comm EDU**	750	750	750	750	600	400	300	300	300	400	500	600	GPD
Future Commercial	**Med Density**	339	339	339	339	339	339	339	339	339	339	339	339	FUT. C-EDU
Current Commercial	**2010 App.**	326	326	326	326	326	326	326	326	326	326	326	326	C-EDU

Daily New Irr. Demand	0.85	953,000	1,170,000	1,112,000	1,070,000	668,000	340,000	80,000	0	0	0	400,000	500,000
Total WTP - (RW)	DAILY AVE M(	2,791,850	3,206,250	3,082,750	2,996,050	2,347,900	1,672,800	1,207,400	1,142,200	1,088,300	1,286,800	1,688,100	1,917,500
RW MONTHLY DEMAND	MO. TOTAL	29543000	35100000	34472000	33170000	20040000	10540000	2400000	0	0	0	12400000	15500000
RW MONTHLY AF	A.F. NEW IRR	**90.66**	**107.72**	**105.79**	**101.79**	**61.50**	**32.35**	**7.37**	**0.00**	**0.00**	**0.00**	**38.05**	**47.57**
Unmodified Demand		116090350	131287500	130037250	126047550	90477000	62396800	38622000	35408200	33737300	36030400	64731100	74942500
Unmodified EDU		**356.27**	**402.91**	**399.07**	**386.83**	**277.66**	**191.49**	**118.53**	**108.66**	**103.54**	**110.57**	**198.65**	**229.99**
		116090350											

ACRE FEET
592
SAVINGS
193165000
592.80 **GALLONS**
939807950
2884.16 **2884**
ACRE FEET
2291.36 2292
NET USE
746642950
GALLONS

BILLING MO. DAYS	**# OF DAYS**	**31**	**30**	**31**	**31**	**30**	**31**	**30**	**31**	**31**	**28**	**31**	**31**
		JUNE	**JULY**	**AUG**	**SEPT**	**OCT**	**NOV**	**DEC**	**JAN**	**FEB**	**MARCH**	**APRIL**	**MAY**

State of California—Health and Human Services Agency
California Department of Public Health

MARK B HORTON, MD, MSPH
Director

ARNOLD SCHWARZENEGGER
Governor

October 5, 2010

PWS No. 3410005

Mr. Ed Crouse, P.E.
Rancho Murieta Community Services District
P.O. Box 1050
Rancho Murieta, CA 95683

REVIEW OF RANCHO MURIETA CSD'S DRAFT 2010 INTEGRATED WATER MASTER PLAN UPDATE

Dear Mr. Crouse:

We recently became aware of the Rancho Murieta Community Services District (RMCSD) Public Review Draft of the 2010 Integrated Water Master Plan Update (IWMPU). We apologize for the tardiness of these comments. We have very quickly reviewed the IWMPU. We have some major reservations about the assumptions used in the report and the long term adequacy of the RMCSD drinking water source capacity.

The IWMPU concludes that Calero and Chesboro reservoirs are capable of meeting the community's water supply needs under severe drought conditions; with the caveat *"provided the water use in the community is reduced 50 percent AND* [emphasis added] *and the 2020 compliance targets are achieved"*. SB7 requires 20% reduction in water use by 2020 in urban areas. It is not reasonable to assume that the community will be able to achieve both a 20% and then an additional 50% reduction.

The above calculation is further compromised by the fact that the treated water production projection starts using 1710 ac-ft per year for 2010. This is an additional 8%; less than the average production for the last 5 years. NOTE: Title 22 regulations require that for other calculations, such as the Maximum Day Demand and Peak Hour Demand, the highest usage is used as a baseline rather than the average or latest number.

In reviewing the usage information on page 3-3 which explains the decision to use 1710 ac-ft per year as a baseline, the Report states: *"This* [higher 5 year average demand] *can be partially explained by higher demands due to dry year conditions in 2007, 2008 and 2009 that increased irrigation demands"*. The fact that demand increased during low rainfall years does not support the presumption that 20% plus 50% reductions will be achievable.

The IWMPU also appears to include all three reservoirs as permitted sources of drinking water. This is incorrect. Clementia is not presently authorized to be used as a source of public drinking water. If RMCSD wishes to have it considered as such, then body contact recreation would most likely have to be prohibited.

On page ES-6, the 4th bullet concludes that under the medium build-out scenario: *"If the community demand is only reduced to 25% drought curtailment under this scenario* [in addition to the 20% SB7 reduction], *all three reservoirs reach dead storage and 690 ac-ft per year of shortfall is estimated that would need to be added to supplemental supply options."* We believe that the 25% reduction, in addition to the 20% reduction, is a much more plausible scenario. That said, RMCSD appears to have a significant capacity shortfall even using the non-permitted Clementia reservoir (957 acre-ft of usable storage).

We concur and support your findings that the existing water treatment facilities need to be expanded. We recommend that the upgrades be timed so that additional capacity is on-line prior to a significant number of new service connections being added.

If you have any questions or we may be of assistance, please feel free to me at (916) 327-8302 or Michael Tolin by at (916) 552-9995 or by email at Michael.Tolin@cdph.ca.gov.

Sincerely,

Kim Wilhelm, P.E.
Chief, Northern California Drinking Water Section
Field Operations Branch

cc: Joyce Horizumi
via email
HorizumiJ@saccounty.net

Trish Stevens
via email
StevensT@saccounty.net

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via email
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REFERENCES

Brown and Caldwell, Draft 2020 Compliance Plan (July 2010)

Giberson & Associates, Rancho Murieta Water Supply: Planning for Future Droughts (February 1990)

HDR Engineering, Phases 3 and 4 Water Treatment Plant Expansion Basis of Design Report (August 2003)

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