Montecito Water District

Future Water Demand
And
Water Supply Options

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EXECUTIVE SUMMARY

Montecito Water District (MWD) has largely had a sufficient water supply in the past to supply customers' water use. An exception to this was during the drought of 1986-1991, when MWD had to reduce deliveries by as much as 40% during the worst year. Since the drought, MWD has increased both water supplies and supply flexibility through the addition of State Water. However, customer water use has also increased substantially in the years following the drought. The amount of water that MWD must produce annually has risen from a little over 4,000 acre-feet per year (AFY) in 1995 to about 6,000 AFY in 2005. This increase is partly caused by continuing housing construction (customer water meters have increased from 3,600 to 4,600 during that time) and partly by increased water use by each customer. There may also be future increasing water use associated with land-use decisions such as affordable housing and second units being permitted on single family residence parcels.

To ensure that MWD can meet customer demand in the future, the District has investigated the amount of water that will be available in the future through its varied portfolio of water supplies. The largest determining factor in the availability of water is the weather – it is plentiful during wet years and in short supply during dry years. Future weather conditions cannot be forecast with certainty, but are likely to be similar to past weather patterns as to how often and for how long drought and wet periods occur. To understand these patterns, MWD used the Santa Ynez River Model which takes the past 76 years of actual rainfall and streamflow to predict the amount of water that MWD would have available from local sources during drought and wet conditions. Similar analyses have been done by the State to predict the availability of State Water with varying rainfall in northern California.

The combination of customer demand and available water supplies during wet and dry weather cycles determines how MWD meets current and future water needs. MWD used these factors to determine how effectively the District will meet customer demand over the next twenty to twenty-five years. Each of these factors was analyzed in turn.

Future Demand – Future customer demand can partly be predicted by using the buildout allowances in the County's General Plan for Montecito, Summerland, and Toro Canyon (around 1,000 new meters would be required to meet buildout). Added to this is the possibility that customers will increase their individual water use in the future, as has occurred over more than a decade since the end of the last drought. If customers remain at their current usage per household or business, MWD water production would climb from the current 6,000 acre-feet per year to about 7,300 acre-feet per year by 2030. However, individual usage has increased by over 1% per year for the past ten years. If these usage increases continue along with the addition of new meters, MWD water production would have to increase to over 9,000 acre-feet per year by 2030.

Future Supply – Future water supply is largely controlled by weather and the yield of MWD water projects. These supplies were determined using a combination of the Santa Ynez River Model and State Water supply calculations. The worst conditions for water supply are when there is a simultaneous drought both locally and in northern California – luckily, this doesn't occur every time that it is dry locally. Two periods during the past century created the worst potential supply shortages – in the 1930s a simultaneous drought resulted in almost a decade-long dry period and in the late 1980s and early 1990s a simultaneous drought was shorter but more intense. Global climate change may also affect water supplies; current research indicates that the significant change will be in more rain and less snow in the Sierra Nevada. The California Department of Water Resources is currently studying methods to lessen this impact on water supply reservoirs.

The supply and demand forecasting resulted in three significant findings:

1) MWD must increase its supply reliability to meet customer demand during dry periods at both current demand levels and at future demand levels up to about 7,000 acre-feet per year of demand. This enhanced supply reliability can be achieved through banking of unused supplies in a combination of surface and groundwater storage projects. These enhancement projects would increase the cost of water to customers.

2) When MWD production reaches 7,000 acre-feet per year, there will be supply shortages during dry years. These shortages become very large when production reaches 8,000 acre-feet per year. The limiting factors that create these shortages include both lack of supply and limitations of capacity in the pipelines that bring water from Cachuma Reservoir and the State Water Project. There would be significant incremental costs for additional water and projects to prevent even larger water shortages at demand levels between 7,000 and 8,000 acre-feet per year. At demand levels of 9,000 acre-feet per year, there would likely be a continuous shortfall of water supply.

3) The projected future shortfall in supply during dry years requires management of both demand and supply. Water supplies can be enhanced by storage of unused water for use during dry periods and by judicious purchase of additional supplies when they are available. Water demand must be managed within reasonable limits to prevent widespread shortages during dry periods. Demand management strategies include customer conservation programs and water rate structure.

MWD is near a crossroads in terms of meeting future water demands. If supply projects (particularly storage projects) are implemented over the next several years, and the District addresses the growth in water demand, then future water shortages should be minimized. Without these actions, demand will soon overtake supply during dry years and District customers will suffer shortfalls of supply during these dry years.

MWD'S WATER SUPPLY RELIABILITY

Both MWD's 2005 *Water Supply Optimization Plan* and *Urban Water Management Plan* identified rising demand that will require additional water supplies to meet a shortfall of supplies, particularly during drought periods. This rising demand is created by two factors – continuing housing construction as the District moves towards buildout and rising water use per customer. District water supplies are limited and vary dramatically based on hydrologic conditions. After a State-wide search, District staff and their consultant could not find any additional cost-effective water supplies. Even if additional water can be found and purchased, there are constraints imposed by the major water conveyance pipelines (Coastal Aqueduct bringing State Water to Cachuma Reservoir and South Coast Conduit bringing water from Cachuma Reservoir).

Two questions arise when evaluating MWD's water supply reliability:

1) What quantities of water must be available as a drought buffer to ensure current and future water supply reliability?
2) What is the maximum amount of demand that MWD can reliably absorb without having shortfalls during drought periods.

The answer to the first question varies with customer demand – the higher the demand for water, the larger the required drought buffer. The second question depends upon whether MWD uses its current water sources to meet demand (assuming there is also a drought buffer supply) or that the only restrictions are pipeline capacities (MWD would buy additional water to meet demand).

MWD'S FUTURE WATER DEMAND

Currently the District has 4,599 customer water meters. Based on an analysis of the Montecito, Summerland, and Toro Canyon General Plans, as many as 914 water meters will be added to the District customer base at final build-out for an anticipated total of 5,513 meters[*]. This increase in meters will increase future demand substantially. This future water demand can be forecast using various methods and it is instructive to compare the various results:

<u>Method 1</u> Project future demand based on changes in demand over the past years – simply construct a best-fit line through historic demand and extend it into the future.

<u>Method 2</u> Project demand using current use-per-meter and increase District meters according to General Plan buildout allowances.

[*] There may be additional factors in demand that the District will need to address in its future five-year updates of the Urban Water Management Plan. For instance, the changing policies on affordable housing and second units may change demand in ways that are not fully understood at this time. As land use policy becomes clearer, these factors can be integrated into the District's demand management planning.

Method 3 Determine pattern of changing use-per-meter and combine this with General Plan buildout allowances as per #2.

The projection of historic demand (Figure 1) used production numbers from 1995 through 2006 – values earlier than 1995 did not reflect the integration of Summerland into the District. This projection predicts that MWD production demand will be at 7,000 AFY by 2010 and at 8,000 AFY by 2017. Demand levels of almost 8,500 AFY are predicted by 2020. This sustained rapid increase in demand is not likely, because it includes an increase in per-meter water use that continues to climb for the next 15 years (see following discussion of per-meter use). If demand did climb as projected on this chart, MWD would have difficulty meeting this high water demand; this limitation is discussed later in this section.

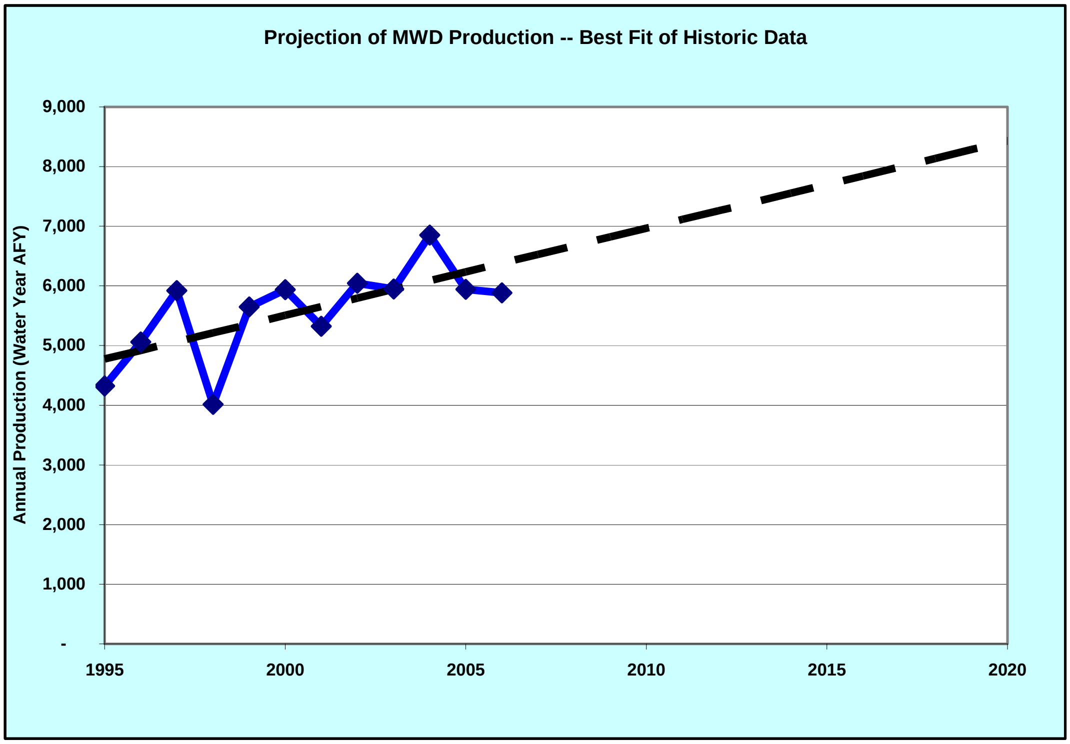

Figure 1. Production demand projections using Method 1 – extend best fit line of actual data into the future. Solid line represents actual production; dashed line is least-squares trend that is projected into the future.

Forecast methods 2 and 3 require knowledge of customer use patterns (calculated as use per-meter). Historic use per-meter since the last drought is indicated in Figure 2. This upward trend in per-meter water use for the past decade or so is opposite of the trend in water use evident in most of Southern California, where per-meter use has been relatively flat since the last drought. Examples of this flat trend are locally in City of Santa Barbara water use and regionally with customers of Metropolitan Water District of Southern California.

The most obvious cause of the difference between rising water use in Montecito and level water use in much of Southern California is water rate structure. Most of these other areas retained their inverted block-rate or tiered fee structure following the drought whereas MWD reverted to its previous uniform rate. Tiered rates were used during the drought as an effective way to reduce water consumption, and continue to be used by other water agencies. In Montecito, where it was not clear whether pricing structure would reduce use by affluent customers, water use per customer under tiered rates was actually reduced by 45% from an average of about 1.5 AF per meter in 1985-1988 to 0.82 AF per meter in 1992 (Figure 3). Some of this reduction can likely be attributed to public awareness of the drought, but water use began to steadily increase following the removal of tiered rates in the late 1990s.

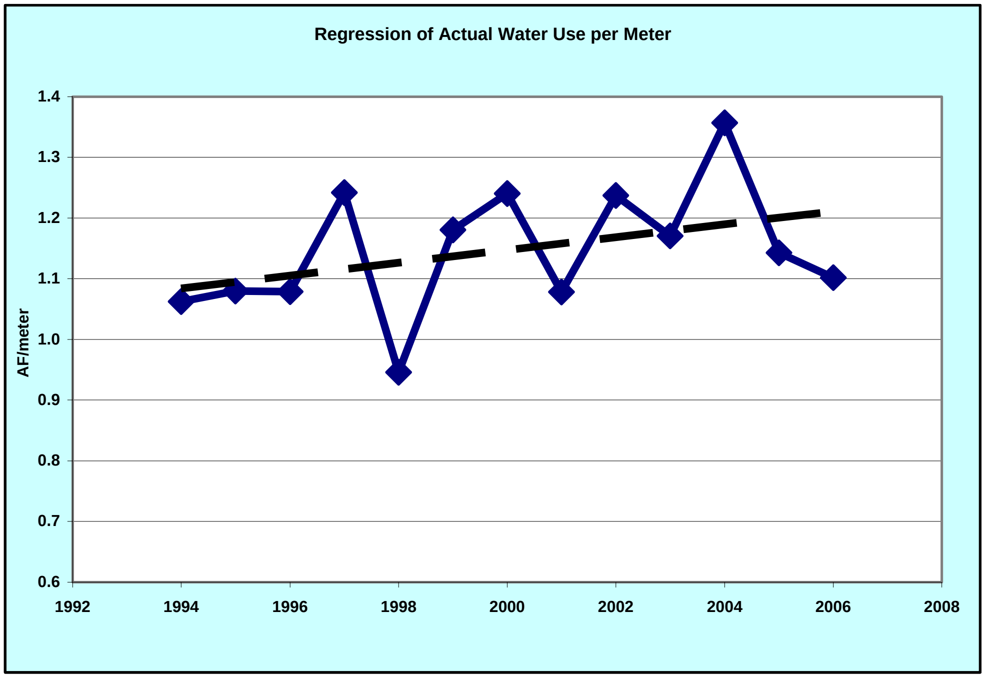

Figure 2. Historic use per-meter, indicating increasing water use since the end of the last drought. Dashed line is least-squares fit of the data.

It is not clear how high the current increased use of water by customers will go. Between 1960 and the last drought, customer water use averaged 1.5 AF per meter (Figure 3), well above current usage. If customers return to these historic levels of water use, production demand will rise significantly.

Method 2 of forecasting future water demand assumes that current water use per-meter will remain stable at today's value (best fit value of about 1.2 AF/meter). Then, using the County General Plan annual growth allowances for Montecito, Summerland, and Toro Canyon, the increase in production demand can be calculated to buildout. Figure 4 indicates increases in production demand using method 2. This forecast predicts that MWD production demand will be at 7,000 AFY by around 2023 and will not reach 8,000 AFY at buildout.

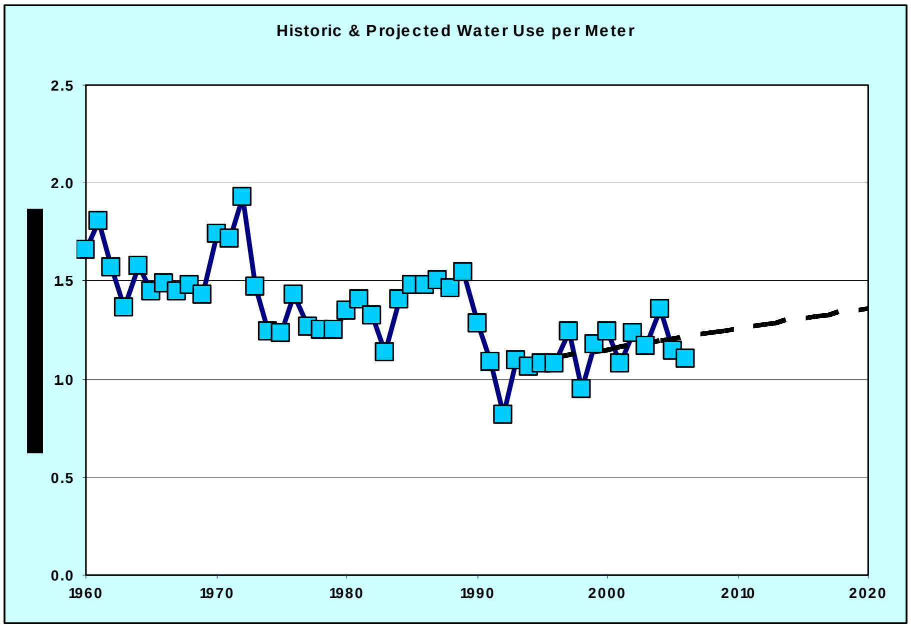

Figure 3. Long-term historic use per-meter, with dashed line representing projection of least-squares fit line of Figure 2 that was used in production demand calculations of Figure 5. The increase in use per-meter from the projection is within historic use patterns.

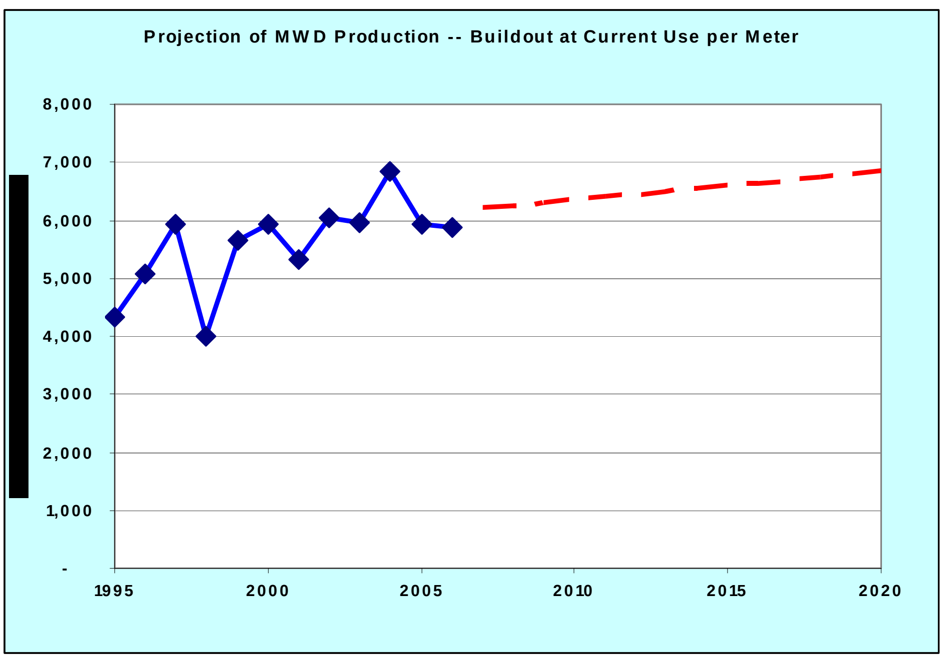

Figure 4. Production demand projections using Method 2 – extend projection based on current water use per-meter (about 1.2 AF/meter) and planned buildout. Solid line represents actual data; dashed line is projection.

Method 3 uses the growth allowances of Method 2 but allows use per-meter to increase employing the least-squares fit of Figure 2 and Figure 3 (1.06% annual increase). Figure

5 indicates increases in production demand using method 3. This forecast predicts that MWD production demand will be at 7,000 AFY during 2013 and at 8,000 AFY during 2021.

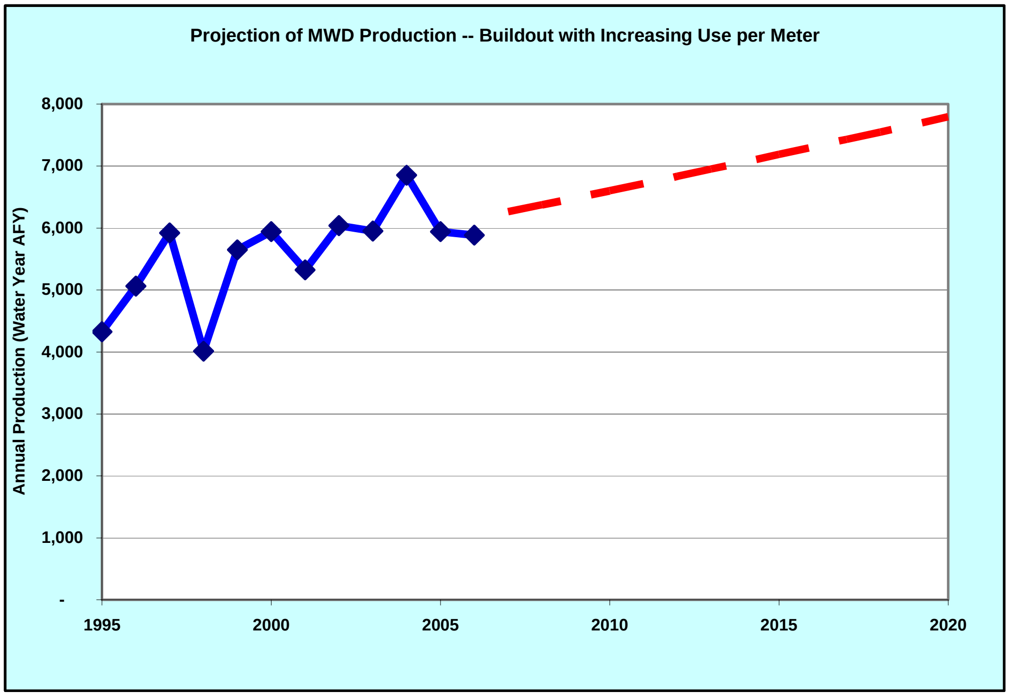

Figure 5. Production demand projections using Method 3 – extend projection based on increasing water use per-meter and planned buildout. Solid line represents actual data; dashed line is projection.

The three methods of forecasting future demand give significantly different results (Table 1). If Method 1 is used to forecast future demand, MWD will have production demand of 7,000 AFY in 2010, just 4 years from now, and 8,000 AFY of demand 7 years later. Using method #2, if current use per-meter can be maintained closer to what it is today, then 8,000 AFY of demand is never reached even at buildout. As discussed in the following section, MWD's water supply is stretched very thinly at a production demand of 8,000 AFY and drought shortages would be significant and difficult to avoid.

Forecast Method	***Method 1*** ***Project Demand***	***Method 2*** ***Genrl Plan @ 1.2AFY***	***Method 3*** ***Genrl Plan @ 1.06% Incr Use***
Year @ 7,000 AFY Demand	2010	2023	2013
Year @ 8,000 AFY Demand	2017	--	2021
Demand in Year 2030 (AF)	9,890	7,310	9,100

Table 1. Comparison of results of three methods of forecasting future production demand.

SUPPLY RELIABILITY AT HIGHER LEVELS OF DEMAND

In the *Water Supply Optimization Plan*, MWD's water supplies were analyzed at production demand levels of 6,000, 7,000, and 8,000 AFY using the 76-year Santa Ynez River Model. The model included varying availability of State Water for the model period as analyzed by the Department of Water Resources. The 76 years of the model included not only the last drought (1986-1991) which was severe but relatively short, but also the drought of the 1930s, whose individual drought years where less severe but the duration of the drought was much longer.

The modeling assumes that current supplies will remain available as they have in the past, although fish releases and other environmental uses of water have been built into both the Santa Ynez River model and those for the State Water Project. What are not factored into the model at this time are any effects of global climate change. Ongoing studies of this issue by California Department of Water Resources (DWR)[†] indicate that rainfall in southern California will not change significantly, although higher temperatures will increase evapotranspiration and likely cause a proportionate increase in water use. The State Water Project, which relies on winter snow pack in the Sierra Nevada for its water, will be affected differently. Climate modeling indicates that precipitation will increase in wet years in the Sierra, but decrease in dry years. This modeling suggests that these effects will likely be less than a 10% swing in precipitation in either direction. Of larger concern is that more of the precipitation will fall as winter rain rather than as snow. DWR is currently evaluating how reservoir operations can be modified to reflect these changes. DWR updates its State Water delivery probability curves regularly; as global climate change is integrated into these curves, MWD should use these updates to update its own supply projections.

The results of the modeling done for this report indicate that using only existing water supplies, there are shortages in supply during drought years, even at 6,000 AFY production demand which the District has met or surpassed seven times in the last ten years (Table 2).

Production Demand	***6,000 AFY***	***7,000 AFY***	***8,000 AFY***
Supply Shortfall Drought 1986-91	1,250 AFY	2,260 AFY	3,315 AFY
Supply Shortfall Worst Drought 1917-1993	1,450 AFY	2,680 AFY	3,760 AFY

Table 2. Modeled shortfalls of supply at varying demand levels during the most recent drought and during the worse drought within the 76 years of the Santa Ynez River Model. These numbers vary slightly from those in the *Water Supply Optimization Plan* because the modeling now takes into account annual changes in customer demand from wet to dry years.

With a Cachuma Bank operating, these shortages are lessened somewhat (Table 3), except at demand levels of 8,000 AFY where pipeline capacities limit the ability to bring in supplemental water at critical times. When supplemental water is purchased in the

[†] California Department of Water Resources, 2006, *Progress on Incorporating Climate Change into Management of California's Water Resources*, Technical Memorandum Report, 338 pages.

first year following a spill to assist in filling the Cachuma Bank, shortfalls are eliminated or lessened (except at 8,000 AFY demand level).

Production Demand	***6,000 AFY***	***7,000 AFY***	***8,000 AFY***
Drought Shortfall with Cachuma Bank – only utilize unused portions of MWD's State Water to fill Bank	810 AFY	2,680 AFY	3,760 AFY
Drought Shortfall with Cachuma Bank – adding supplemental water to fill Bank as recommended	None	None	3,760 AFY

Table 3. Modeled shortfalls of supply at varying demand levels during the worse drought within the 76 years of the Santa Ynez River Model. The first calculation assumes that MWD uses only its own State Water Allocation to fill the Cachuma Bank. The second calculation assumes that supplemental water is used to help fill the Bank in the first year following a spill year when supplemental water is more likely to be available, as recommend in the Cachuma Bank operating procedures in the Appendix. Pipeline capacities limit the amount of supplemental water that can be purchased, especially at higher demand levels.

When a groundwater bank is run concurrently with the Cachuma Bank, shortages are further reduced (Table 4). The groundwater bank is assumed to be operated somewhere along the State Water Project, either in the San Joaquin Valley or along the Coastal Aqueduct. Shortages are caused by pipeline capacities – even if the water was available from the groundwater bank, MWD's share of pipeline capacities has already been used.

Production Demand	***6,000 AFY***	***7,000 AFY***	***8,000 AFY***
Drought Shortfall with Cachuma Bank and a concurrent groundwater bank	None	890 AFY	3,650 AFY
Drought Shortfall with Cachuma Bank, a concurrent groundwater bank, and supplemental water to fill Bank	Not needed	890 AFY[‡]	2,075 AFY

Table 4. Modeled shortfalls of supply at varying production demand levels during the worse drought within the 76 years of the Santa Ynez River Model. A groundwater bank somewhere along the State Water Project aqueduct and pipelines is added to operate concurrently with a Cachuma Bank. Pipeline capacities limit the amount of supplemental water that can be purchased, as well as the amount of banked water that can be delivered to MWD from the groundwater bank.

There are two factors that limit the effectiveness for MWD of water banks and the purchase of supplemental supplies:

1) For the Cachuma Bank, there are at least three instances during the 76-year model period when there is insufficient State Water available to fill the bank following a spill year. Thus, the bank has less than optimum storage when entering some of the drought periods. This is partially compensated for when supplemental water is purchased to assist in refilling the bank in the year following a spill.

[‡] For both 7,000 AFY banking scenarios, the shortfall is caused by inadequate MWD capacity in the Coastal Aqueduct to transport banked water to MWD, rather than a shortage in the groundwater bank itself.

2) At higher demand levels, there is insufficient MWD capacity in the Coastal Aqueduct at times to bring State Water to the Cachuma Bank or to convey water from a supplemental bank (such as a groundwater bank in the Central Valley). This limitation becomes especially important at higher demand levels, and limits the ability to purchase and convey supplemental sources of water if needed. MWD may be able to time the conveyance of water above its dedicated aqueduct capacity if done during low-demand periods (e.g., winter months), effectively increasing aqueduct capacity. Such conveyance would have to be carefully planned.

MAXIMUM SUSTAINABLE WATER DEMAND

It is clear that limitations on MWD's water supply occur as production demand increases. These limitations can be overcome with careful planning, use of water banking, and occasional purchase of supplemental supplies at demand levels up to about 7,000 AFY (there is a small shortfall at 7,000 AFY that can likely be minimized through careful use of supplies). Above 7,000 AFY, it becomes more difficult to get through a drought without supply shortfalls; by 8,000 AFY shortfalls reach nearly half of demand. This shortfall is similar to that of the drought of 1986-1991, when MWD water deliveries were reduced by about 40%. Thus, the maximum water demand that MWD can sustain without shortages during a drought is somewhere around 7,000 AFY. It should be noted that the cost of supply strategies such as water banks rises significantly at demands over 6,000 AFY.

If it is assumed that around 7,000 AFY is the highest production demand that MWD can realistically supply without dry-year shortfalls, then an easy calculation can be made as to what level of per-meter use matches this supply. As indicated in Table 5, customer use of an average of 1.14 AFY per meter allows MWD to remain within a sustainable demand, very similar to customers' usage during the last two years. Thus, it will be important to have policies that encourage customers to remain at this usage level in the future. If use per meter drops in the future by price incentives and conservation, this should result in a reduction in the size and cost of water banks.

Element	*Amount*
Max Water Supply	7,000 AFY
Water to City SB	300 AFY
Pipe Leakage @ 6%	420 AFY
Water to Customers	6,280 AFY
Meters in Year 2030	5,513
Use per Meter	1.14 AFY

Table 5. Calculation of water use per meter at production demand level of 7,000 AFY.

WATER SUPPLY OPTIONS INVESTIGATED

It is clear from the previous section that a series of water supply options need to be investigated to provide drought protection in the future. The Cachuma Water Bank is currently operational under a strategy discussed in the *Water Supply Optimization Plan*. This section includes a number of water banking and supplemental water strategies that have been investigated by the District over the past two years. It also includes modifications to the operation of the Cachuma Water Bank

COOPERATIVE AGREEMENT WITH CARPINTERIA VALLEY WATER DISTRICT

Carpinteria Valley Water District (CVWD) has a relatively large groundwater basin that can be used for conjunctive use of groundwater and surface water supplies. This allows CVWD to use more local surface water and State Water supplies during wetter periods to allow the aquifer to recharge, and more groundwater during drier periods when other water sources are scarcer. Because both CVWD and MWD rely on the South Coast conduit to transport water from Lake Cachuma into their respective districts, MWD proposed to CVWD that there could be an operating plan for the conduit that benefits both parties. Such a strategy has been discussed with the Engineering Committee of CVWD, but there are currently no plans to move forward jointly on this option.

WATER BANKING WITH GOLETA WATER DISTRICT

The Goleta Water District (GWD) has a groundwater banking program in place that is being upgraded and potentially expanded. On two occasions during the past two years, MWD has met with GWD’s Engineering Committee to discuss MWD’s potential future involvement in storing water in the groundwater basin. MWD suggested that part of GWD’s cost of operating their banking program could be offset by MWD. GWD did not turn down MWD outright, but replied that GWD was not ready at this point to involve MWD in the bank. The possibility of future banking with MWD was left open.

The Goleta Groundwater Bank would have some advantages to MWD. The water would be stored on the South Coast, unaffected by capacity issues with the Coastal Aqueduct and free from loss during spilling of Lake Cachuma. The Goleta Groundwater basin has also been adjudicated, with rights to storage clearly spelled out. A disadvantage is that it is not known how current pumpers in the basin would react to an outside agency sharing a storage program with GWD.

LA CUMBRE MUTUAL WATER COMPANY

There have been informal discussions with La Cumbre Mutual Water Company (LCMWC) on conjunctive use operations of State Water. LCMWC stated that they were not interested in such a program at this time.

PURCHASE OF DRY-YEAR WATER FROM NORTHERN CALIFORNIA

The purchase of Dry-Year Water from supplies in northern California is a possible option to meet MWD demand during dry years. Potential purchase strategies vary from a year-by-year purchase that has no guarantee of future availability to a long-term contract to purchase water in all years of the contract regardless of whether the water is needed to meet MWD demand. The year-by-year strategy is the least expensive approach because no water is held specifically for MWD – it is simply delivered upon purchase. The risk of this approach is that the water may not be available when it is needed. The long-term contract approach is the most expensive because it is take-or-pay for every year of the contract, but the water is set aside for MWD and is a much more reliable source. These two approaches were explored by MWD.

DWR DRY-YEAR PROGRAM

The California Department of Water Resources (DWR) has provided the opportunity in past years for State Water Contractors to purchase Dry-Year Water during dry years in southern California. The source of this water is irrigators in northern California who reduce plantings or otherwise have surplus water available. The cost of the water is the same to all Contractors, and is coordinated through CCWA. Based on past DWR Dry-Year programs, the cost of this water might include a purchase charge of $125/AF, an administrative fee of $5/AF, and a CCWA delivery cost of $310/AF. In addition, a carriage loss of 20% has been used, bringing the effective cost of Dry-Year water delivered to Cachuma to $475/AF. However, the future price and availability of this supply is not guaranteed. Increasing water demand within California and future transfer of some of the water supply to environmental uses will lessen the chance that sufficient supplies will be available to MWD in the future. Thus, this strategy of meeting MWD demand during dry periods is likely to be higher risk and is not recommended as the primary source of additional water to meet MWD demand during dry years.

BROWNS VALLEY IRRIGATION DISTRICT

As part of the Yuba River Accord that is now being finalized, some local Yuba River diverters will have a right to substantial amounts of surface water, including some under pre-1917 water rights. Any lease or sale of these water rights would likely be accomplished through agreements and protocols with the Yuba County Water Agency. Browns Valley Irrigation District, one of the diverters with pre-1917 water rights, is pursuing long-term water contracts to lease a portion of their water right. Although costs would have to be negotiated, a similar contract in the area leased water rights for about $3,000/AF (one-time cost). Amortizing this capital cost over 30 years (5.5% interest rate) would equate to an annual fixed cost of $206/AF, plus a CCWA delivery cost of $310/AF on any water delivered to Cachuma. Whether there would also be annual administrative fees is not known at this time. The actual cost of this source of water depends upon how often this water is used by MWD – supply and demand modeling indicates that this water would be used about every fifth year. Thus the overall cost of this dry-year supply would be about $1,300/AF for water delivered to Cachuma. MWD could attempt to sell the unused water when it was not needed, but the cost and efficacy of this strategy is unknown.

MWD discussed a possible water transfer with Browns Valley's General Manager and General Counsel in May 2006. There was general agreement that the most likely lessee would be a developer or other entity that needed a reliable supply of water every year and was willing to pay the high price for this water. It was agreed that the two districts would keep in touch if any new developments arose on pricing or other aspects that would make this water more attractive to MWD.

SEMITROPIC GROUNDWATER BANK

The Semitropic Groundwater Bank was used as the example of how a groundwater banking project would fit into MWD's long-term water supply reliability in the MWD *Water Supply Optimization Plan* report. As a follow-up to a recommendation in the report, MWD approached Semitropic Water Storage District in conjunction with CCWA. A white paper was developed on the water bank entitled *Semitropic Water Storage Bank – Evaluation as a Potential Banking Option for Montecito Water District*. The recommendation from the white paper concluded that there is no immediate need to commit to this type of banking project, because a Cachuma Bank (with an occasional purchase of dry-year water) offers drought protection at the current 6,000 AFY production demand level. However, as demand levels increase significantly above 6,000 AFY, a Cachuma Bank alone is not sufficient. Therefore, it would be prudent to continue to investigate other banking options, both within the CCWA service area and in the Central Valley, to be prepared to add such an option in the future. In the meantime, some of the uncertainties with the water bank that were discussed in the Semitropic white paper may be resolved for MWD.

PURCHASE OF STATE WATER FROM COUNTY'S ALLOCATION

The unused portion of Santa Barbara County's State Water allocation is available for purchase by member agencies of the Central Coast Water Authority (CCWA). The allocation can be purchased on a permanent basis for the following costs:

Cost Element	***Cost***	***Cost @ 3000 AFY Allocation***
One-Time Purchase Cost	$900/AF	$2,700,000
Finance of Purchase Cost	30 yr@5.4%	$175,000/yr
Annual Fixed Cost	$90/AF	$270,000/yr
Delivery Cost	$310/AF	Depends upon DWR delivery %

Table 6. Costs of purchase of State Water from Santa Barbara County's allocation.

Costs of the purchase and use of the additional State Water (Table 6) were based on 3,000 AFY of allocation, which is the appropriate amount of supplemental water for MWD production demand of 7,000 AFY. The 3,000 AFY was derived from using the results of the Santa Ynez River Model to determine the amount of additional water needed during the drought periods represented in the 76 years of the model. The actual water available from the 3,000 AFY allocation varies each year depending upon northern California rainfall and reservoir storage – these variations are built into the model. This additional State Water allocation would supplement a Cachuma Bank and replace any other added storage or supply (e.g., groundwater bank, purchase of Dry-Year water).

A purchase of additional State Water allocation from the County does not include any added capacity in the Coastal Aqueduct. Thus, this additional water must be delivered to MWD within its current 3,300 AFY of aqueduct capacity or during times of low aqueduct use during winter months.

The average cost of purchasing and using this additional State Water allocation was determined from the results of the modeling. For comparison with other supplemental water sources, the average costs of existing State Water, Cachuma Banking, and the additional purchase of State Water allocation (7,000 AFY production demand level) were combined for an average annual cost of $860,000. This cost is the highest of the various supplemental water sources evaluated (Table 8).

OTHER OPTIONS

Other supply enhancement options are being investigated by CCWA for its member agencies, including groundwater storage along the Coastal Aqueduct. MWD has expressed its interest to CCWA that such options be actively investigated.

SUMMARY

The annual cost of various sources of supplemental water is indicated in Table 8 through Table 9. These annual costs include the costs of both buying and storing the banked water and/or supplemental water, but do not include the fixed capital costs of MWD's State Water Project allocation (which must be paid regardless of use of the water). The costs are averaged over the 76 years of the Santa Ynez River Model, which include multiple wet and dry periods. The Cachuma Bank is the least expensive, but there are shortfalls in supply during some dry years. Purchasing additional water if available for the Cachuma Bank significantly reduces shortages in dry years. Costs are highest for the Semitropic Water Bank or for purchase of some of the County's State Water allocation.

A supplemental source of water besides the Cachuma Bank is needed, even at today's demand levels, if additional supply reliability is desired. Near 6,000 AFY of production demand, the purchase of water from the State Water Project (such as turnback pool water) could be this source of supply (this is discussed more fully in the following section). However, as production demand moves above 7,000 AFY, the addition of a second water bank that is not susceptible to spilling (such as a groundwater bank) will be required to maintain complete supply reliability. A closer (South Coast or along the Coastal Aqueduct), less expensive groundwater bank would be the best option. If such a water bank becomes available in the future, it could become the primary bank for MWD. Switching from the Cachuma Bank to another bank could be easily done because there are no extra facilities or capital costs involved in the current program of banking water in Cachuma Reservoir.

Supplemental Water Source	***Average Cost Supplemental Water @ 6,000 AFY Production Demand***	***% Of Years With Shortfall***	***% Supply Shortfall Worst Drought***
No Bank or Supplemental Water	$0/yr	34%	24%
Cachuma Bank	$106,000/yr	5%	14%
Cachuma Bank + Supplemental Water to Fill Bank	$115,000/yr	0%	0%
Cachuma Bank + Semitropic Groundwater Bank	$151,000/yr	0%	0%
Cachuma Bank + Semitropic Groundwater Bank + Supplemental Water to Fill Bank	Not Needed	---	---
Cachuma Bank + Purchase of County SWP	$420,000/yr	0%	0%

Table 7. Annual costs of different supply and storage projects at 6,000 AFY production demand. Annual costs include delivery costs of current SWP allocation, 1,800 AF Cachuma Bank, and additional water source indicated in each row. Annual costs are averaged over the 76 years of the Santa Ynez River Model. Purchase of County's State Water allocation is for 3,000 AF. Table indicates the percentage of years in the model that have supply shortfalls, even with the supplemental water source available. Percentage of supply shortage is indicated for the worst drought year during the model period. Shortfalls in supply occur for different reasons with each supplemental water source, but include insufficient State Water allocation for direct use and/or for storage, Coastal Aqueduct capacity limitations, and annual input/output limitations of a groundwater bank.

Of equal importance to securing a supplemental supply of water is ensuring that customer demand does not outstrip the District's ability to supply water. As discussed earlier, per-meter use must be maintained near its current level to have an adequate water supply at buildout. This demand can best be managed through a combination of conservation efforts and pricing structure

Supplemental Water Source	***Average Cost Supplemental Water @ 7,000 AFY Production Demand***	***% Of Years With Shortfall***	***% Supply Shortfall Worst Drought***
No Bank or Supplemental Water	$0/yr	41%	38%
Cachuma Bank	$90,000/yr	28%	38%
Cachuma Bank + Supplemental Water to Fill Bank	$432,000/yr	0%	0%
Cachuma Bank + Semitropic Groundwater Bank	$478,000/yr	9%[§]	13%
Cachuma Bank + Semitropic Groundwater Bank + Supplemental Water to Fill Bank	$503,000/yr	3[**]%	13%
Cachuma Bank + Purchase of County SWP	$530,000/yr	3%	5%

Table 8. Annual costs of different supply and storage projects at 7,000 AFY production demand. Annual costs include 2,000 AF Cachuma Bank and additional water source indicated in each row. Annual costs are averaged over the 76 years of the Santa Ynez River Model. Purchase of County's State Water allocation is for 3,000 AF. See Table 7 for explanation of column headings.

[§] For all but two years, shortfall is caused by inadequate MWD capacity in Coastal Aqueduct to transport water from groundwater storage bank to MWD.

[**] All shortfalls are caused by inadequate MWD capacity in Coastal Aqueduct to transport water from groundwater storage bank to MWD.

Supplemental Water Source	*Average Cost Supplemental Water @ 8,000 AFY Production Demand*	*% Of Years With Shortfall*	*% Supply Shortfall Worst Drought*
No Bank or Supplemental Water	$0/yr	55%	47%
Cachuma Bank	$65,000/yr	39%	47%
Cachuma Bank + Supplemental Water to Fill Bank	$552,000/yr	14%	24%
Cachuma Bank + Semitropic Groundwater Bank	$836,000/yr	25%[††]	46%
Cachuma Bank + Semitropic Groundwater Bank + Supplemental Water to Fill Bank	$1,027,000/yr	13%[‡‡]	26%
Cachuma Bank + Purchase of County SWP	$569,000/yr	25%	34%

Table 9. Annual costs of different supply and storage projects at 8,000 AFY production demand. Annual costs include 4,000 AF Cachuma Bank and additional water source indicated in each row. Annual costs are averaged over the 76 years of the Santa Ynez River Model. Purchase of County's State Water allocation is for 3,000 AF. See Table 7 for explanation of column headings. Water banks that are not supplemented by the purchase of additional water beyond MWD's State Water allocation do not change the severity of the worst drought because there is insufficient water to adequately recharge the banks.

[††] For all but three years, shortfall is caused by inadequate MWD capacity in Coastal Aqueduct to transport water from groundwater storage bank to MWD.
[‡‡] All shortfalls are caused by inadequate MWD capacity in Coastal Aqueduct to transport water from groundwater storage bank to MWD.

RECOMMENDATIONS

1. Bank surplus State Water in Lake Cachuma in order to increase water supply reliability during dry years. Adopt the operating guidelines proposed in the Appendix.

2. Review the Semitropic Groundwater bank at some time in the future to determine if MWD's concerns have been addressed.

3. Adopt measures to reduce and ideally reverse the consumption of water per meter in MWD.

4. Because of reliability concerns and cost of State Water deliveries, do not purchase additional State Water allocation through Santa Barbara County.

5. Encourage CCWA to aggressively pursue conjunctive use opportunities in San Luis Obispo and Santa Barbara counties.

6. Continue to look for opportunities to reduce MWD water demand and increase water supply reliability.

APPENDIX A – CACHUMA WATER BANK GUIDELINES

Several methods of operating the Cachuma Water Bank were discussed in the *Water Supply Optimization Plan*. The primary considerations were how fast to replenish banked water that is periodically lost when Cachuma spills and how large a bank to maintain. Since the 2005 report, additional work has been done to fine-tune the Cachuma Bank. A set of new considerations was applied to the operation of the Bank to lessen the cost of the Bank and lower the amount of water needed to be stored in the Bank.

MODIFYING OPERATIONS OF THE CACHUMA WATER BANK

The new considerations for operating the Cachuma Water Bank include:

1) <u>Coastal Aqueduct capacity (MWD's share is 3,300 AFY)</u>: This pipeline capacity potentially limits the amount of supplemental water that can be conveyed to the Bank to refill it following a spill year. Although discussions with CCWA indicate that additional water could be conveyed if MWD moved the water during periods of lower demand (i.e., during winter months), the modified Cachuma Bank operating plan attempted to minimize the number of times that this capacity became an issue.

2) <u>Optimizing the use of the least expensive water to refill the Bank:</u> The least expensive source of water to refill the Bank following a spill is the first 559 AFY of MWD's State Water allocation. The current cost of this water is $135/AF (variable cost) versus $310/AF for the remaining portion of the allocation. This first 559 AF is used by MWD in most years, but is not fully utilized in wet years (i.e., spill years). If any portion of this cheap water remains after meeting customer demand during spill years (demand is low during those years), it should be purchased during <u>the summer immediately following a spill event</u>. This action refills the Bank faster, helping resolve the most critical problem for the Bank – putting water in the Bank during times when dry years immediately follow a Cachuma spill year and the Bank cannot meet customer demand during a subsequent drought. This critical condition occurred three times during the 76-year period of the Santa Ynez River Model, including the drought of 1986-1991 – in these three case, dry years leading to a drought immediately followed a spill year.

3) <u>Changing customer demand during wet and dry years</u>: Since 1995, customer demand has increased by an average of 6% during dry years and decreased by an average of 11% during wet years. These changes were added to the results from the Santa Ynez River Model. The effect to these changes is that more of MWD's State Water allocation is available for storage during wet years, but the Bank must help meet higher demand during dry years. Previous modeling used a flat rate for MWD demand for each scenario (i.e., 6,000, 7,000, and 8,000 AFY demand).

4) <u>Purchasing supplemental water during non-drought years</u>: Previous modeling obtained supplemental water in the years when MWD supplies and the Cachuma Bank could not meet customer demand. These years were commonly times when the whole State was experiencing a drought. The purchase of supplemental water

> during these times of drought is problematic – additional water could be in short supply and expensive. The Cachuma Bank operations have now been modified to purchase some of the supplemental water earlier in the drought cycle, when water is likely more available and less expensive.

Modifying the Cachuma Bank operations has had a large benefit in reducing the size of bank. For 6,000 AFY of production demand, the recommended Bank size has been reduced from 2,545 AF to 1,800 AF. For 7,000 AFY of production demand, the Bank size has been reduced from 7,732 AF to 2,200 AF. The smaller Bank size for 6,000 AFY of production demand operates more efficiently than the operations of the previous Bank scenario. However, the same is not true for the Bank at 7,000 AFY of demand – the new Bank size simply reflects the inability to convey such large amounts of water to the Bank in a sort period of time. The limitations of the Bank for 7,000 AFY of demand are discussed in the following section.

RULE CURVES FOR OPERATING CACHUMA WATER BANK

A set of curves were constructed for operation of the Cachuma Water Bank at both 6,000 and 7,000 AFY production demand. They are explained below.

RULE CURVES FOR 6,000 AFY PRODUCTION DEMAND

The rule curves assume that as much water as necessary is removed from the Bank during dry years. The curves quantify the amount of water that needs to be put into the Bank under various conditions. Figure 6 indicates the amount of water in the Bank along the x axis and the amount of water to be purchased in any year along the y axis. Using these operating criteria, supplemental water only needs to be purchased in the middle of a drought once in the 76-years of the Santa Ynez River Model, and the capacity of the Coastal Aqueduct is not exceeded.

Year of a Spill (see nomenclature in Table 10) – Purchase up to 559 AF of State Water allocation (Figure 6). Only purchase the portion of the first 559 AF of State Water that is not used for direct delivery to customers. Thus, if 300 AF of State Water allocation is used by customers, purchase 259 AF for the Bank.

Example Year	***Name of Year***
Spill Date March 2006	
WY 2006 (Oct 2005-Sep 2006)	Year of a Spill
WY 2007 (Oct 2006-Sep 2007)	Year Following a Spill Year
WY 2008 (Oct 2007-Sep 2008)	2 Years Following a Spill Year

Table 10. Example of a spill date and the nomenclature for subsequent years used in the Cachuma Bank rule curve.

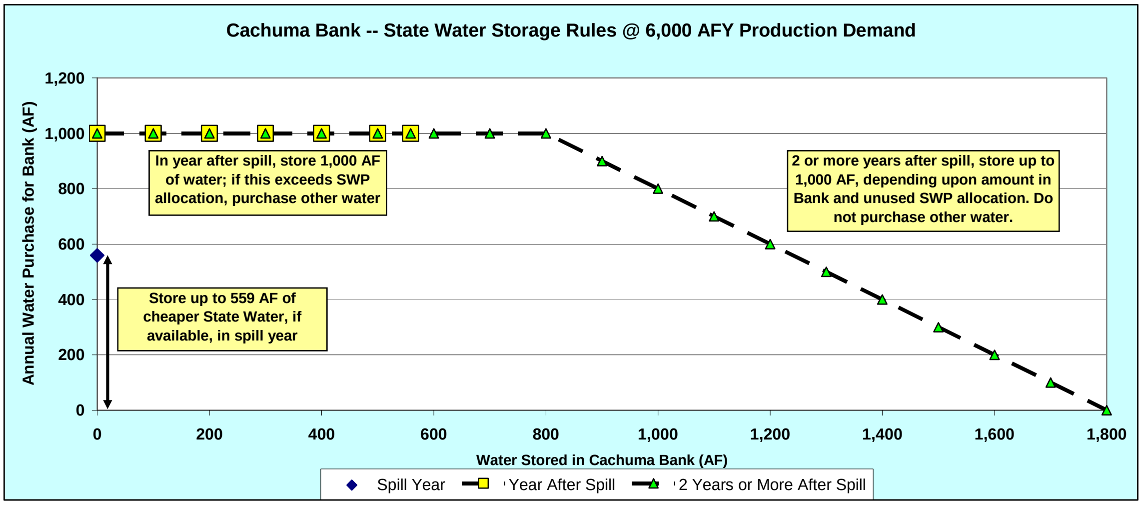

Figure 6. Rule curve for purchase of water for Cachuma Bank at production demand level of 6,000 AFY.

Year Following a Spill Year (see Table 10): Purchase 1,000 AF of water to put in the Bank. If the required purchase exceeds the MWD State Water allocation available, purchase the additional water by other means (e.g., available State Water from other CCWA agencies, turnback pool for State Water, etc.).

2 or More Years Following a Spill Year (see Table 10)**:** Purchase up to 1,000 AF of water, depending upon the curve in Figure 6. However, do not purchase water in excess of the available MWD State Water allocation. Do not exceed 1,800 AF of total water stored in the bank.

RULE CURVES FOR 7,000 AFY PRODUCTION DEMAND

The rule curves assume that as much water as necessary is removed from the Bank during dry years. The curves quantify the amount of water that needs to be put into the Bank under various conditions. Figure 7 indicates the amount of water in the Bank along the x axis and the amount of water to be purchased in any year along the y axis. Using these operating criteria, supplemental water still needs to be purchased in the middle of a drought 10 years out of the 76 years of the Santa Ynez River Model, and the capacity of the Coastal Aqueduct is exceeded in three years.

Year of a Spill (see nomenclature in Table 10) – Purchase up to 559 AF of State Water allocation. Only purchase the portion of the first 559 AF of State Water that is not used for direct delivery to customers. Thus, if 300 AF of State Water allocation is used by customers, purchase 259 AF for the Bank.

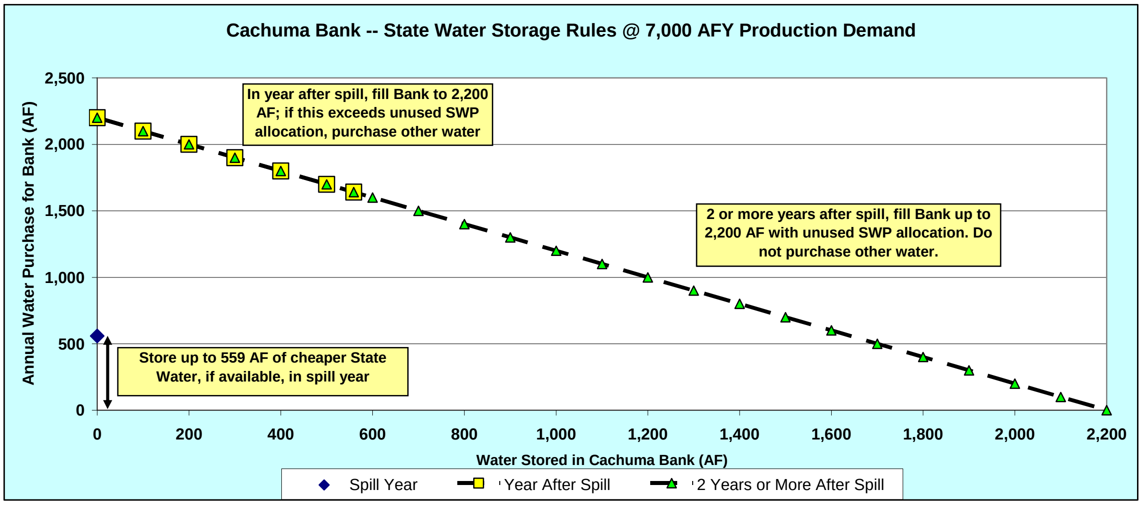

Figure 7. Rule curve for purchase of water for Cachuma Bank at production demand level of 7,000 AFY.

Year Following a Spill Year (see Table 10): Purchase enough water to fill Bank to 2,200 AF. The actual amount of water purchased depends upon the amount of water currently stored in the Bank (see Figure 7). If the required purchase exceeds the amount of MWD State Water allocation available, purchase the additional water by other means (e.g., available State Water from other CCWA agencies, turnback pool for State Water).

2 or More Years Following a Spill Year: (see Table 10)**:** Purchase enough water to fill Bank to 2,200 AF. However, do not purchase water in excess of the available MWD State Water allocation.

APPENDIX B – JAMESON RECOMMENDED RESERVOIR OPERATIONS

In order to have both the Cachuma Bank and Jameson operating criteria in the same document for easy reference, the Jameson recommended reservoir operations criteria (from MWD Water Supply Optimization Plan, 2005) are repeated here.

Jameson Reservoir is MWD's most valuable water supply in terms of low cost and its ability to serve as a supplemental water supply to maintain reservoir levels when the South Coast Conduit alone cannot meet MWD demand and to deliver water to high-elevation portions of the District. The operating scenario that was evaluated as providing the most value to the District was:

- Drafting the reservoir at a rate up to 2,000 AFY, based on MWD supplies, with a reduced annual rate when the reservoir drops beneath certain levels of stored water remaining.

Drafting at up to 2,000 AFY with a reduction at reservoir storage levels below 4,400 AF (Figure 8) combines the advantages of a high draft level during wet and normal years and a safety net during dry years. This operating rule results in a Jameson yield of 1,470 to

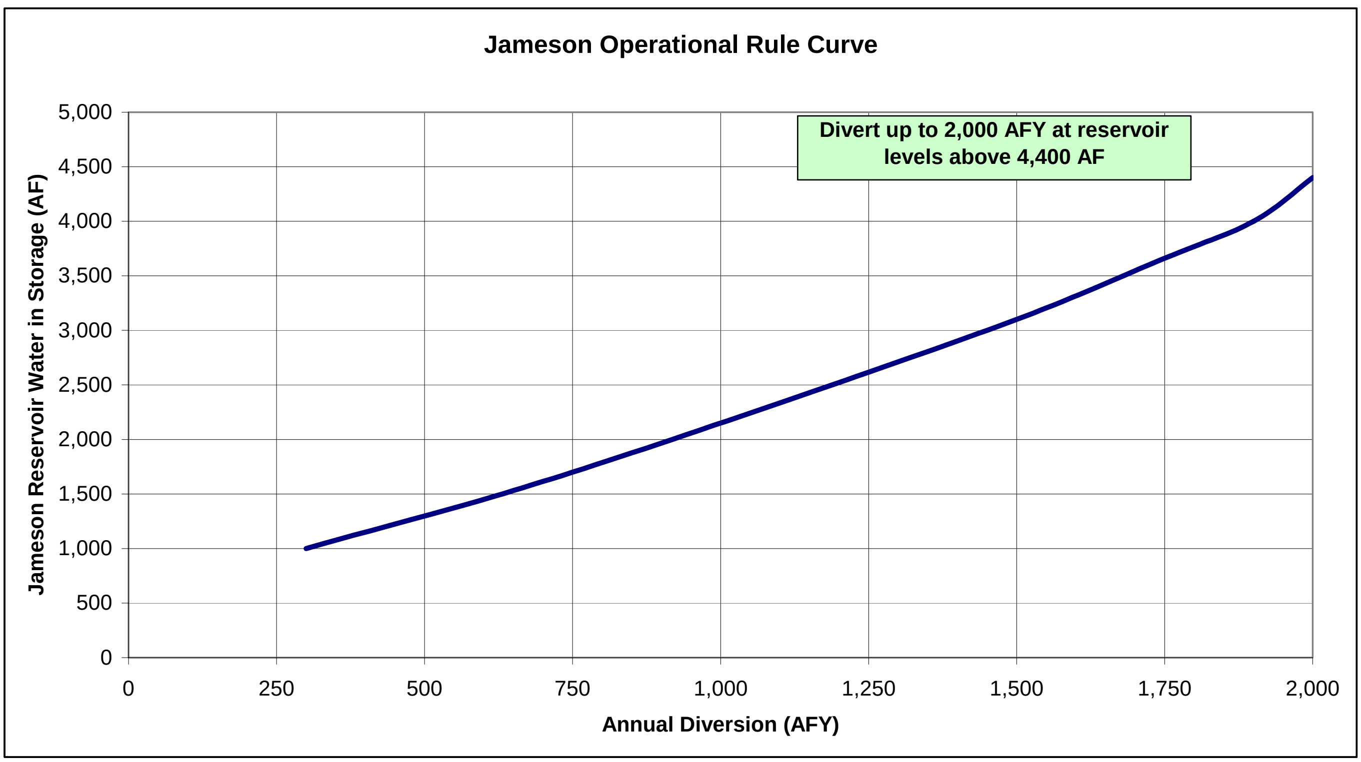

Figure 8. Jameson Rule Curve for determining the annual draft based on reservoir storage levels. In wet years when MWD demand is lower, it may not be possible to use all of the recommended diversion.

1,571 AFY (depending upon MWD demand levels and customer drought conservation), not significantly different from the current reservoir yield. However, the recommended reduced draft rate would see MWD through a repetition of all of the last century's wet and dry hydrologic cycles.

The Jameson Rule Curve (Figure 8) is a summary of a two-part equation relating reservoir levels, demand, and available supplies. The reservoir storage indicated on the y-axis is the average storage during the year. In practice, this average is not known at the beginning of the water year; therefore, diversions will have to be adjusted as the water year progresses. The only time that this will have significant effects is when reservoir levels are low at the beginning of the water year and the year is very wet, with reservoir levels changing rapidly.