

Goleta Water District

Water Supply Management Plan

Steven Bachman, PhD

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11 Technical Appendix – Historical Supply Strategies

The strategy of how to interactively use GWD’s water supplies is as important as the reliability of each of those supplies. For instance, if groundwater supplies have been pumped down prior to a drought, then the usually-reliable groundwater supplies may not be available in that drought. In this chapter, the individual supply sources are discussed and evaluated for reliability, critical supply components are identified, and the reliability of the current supply strategies are evaluated.

11.1 Sources of Supply

GWD has a variety of local and supplemental water supplies available to meet customers’ needs. Water supplies include local surface water supplies from Lake Cachuma, groundwater from the Goleta Groundwater Basin, recycled water from the Goleta Sanitation District, and importation of State Water. The proportion of each of these supplies has varied considerably over time, with State Water replacing groundwater use over the past 15 or so years so that the groundwater basin could recharge (Figure 11-1). In the last ten years, GWD has obtained approximately 76% of its water supplies from Lake Cachuma, 16% from State Water (direct delivery and exchange water), 6% from recycled, and 2% from groundwater. Of those supplies, about 11% were for non-potable uses though recycled water and Goleta West Conduit deliveries.

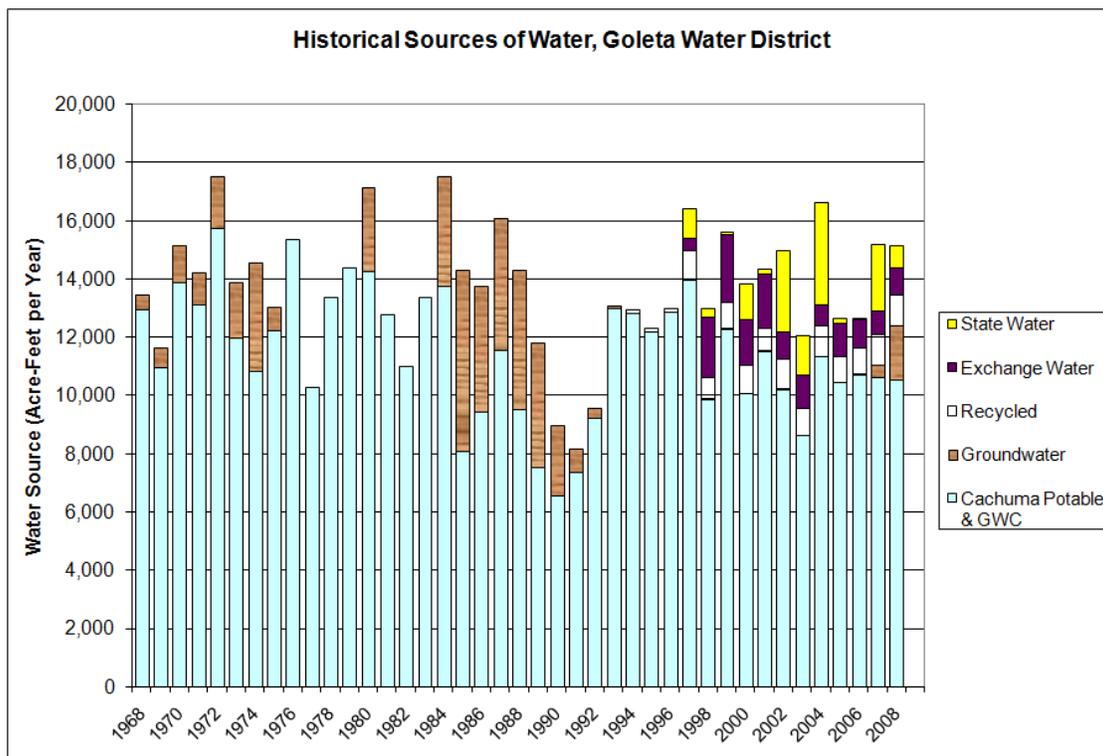


Figure 11-1. Historical sources of GWD water. Of these supplies, about 11% were for non-potable uses (recycled water, Goleta West Conduit).

Monthly use is highest during August of most years (Figure 11-2), with Cachuma supplying an increasing amount of supply during the summer months.

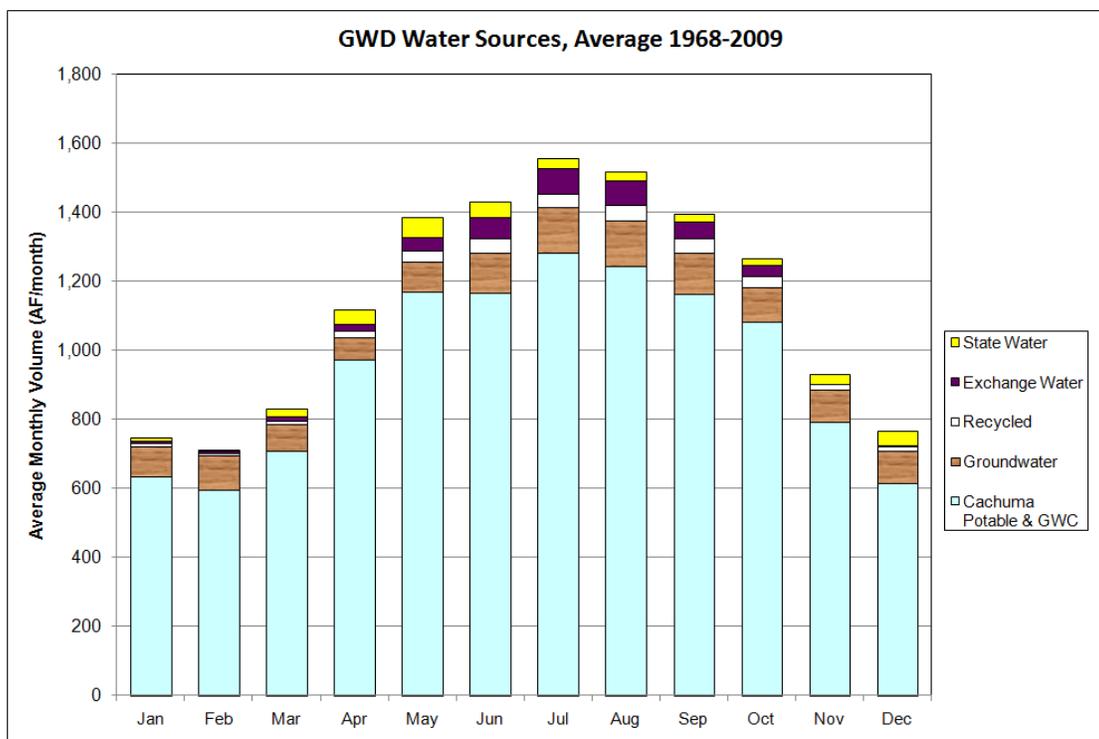


Figure 11-2. Sources of water supply by month for period 1968 to 2009. Note that State Water was not available for the entire period and groundwater was not pumped for over a decade as the basin was allowed to refill.

11.1.1 Cachuma Reservoir

Cachuma Reservoir was constructed by the Bureau of Reclamation and is operated by the Cachuma Operations Management Board (COMB) under contract to the Bureau. Entitlements, costs, constraints, and reliability are summarized in Table 11-1.

11.1.1.1 Cachuma Supply

Entitlement – GWD’s share of the Cachuma yield is 9,322 AFY; with the addition of spill water, the average of Cachuma deliveries for the period 1997 to 2008 has been 10,675 AFY (Figure 11-6). Current Cachuma operations have been optimized by COMB based on modeling using the Santa Ynez River Model.

Carryover Water – Entitlement that is not used in any Cachuma water year (October through September) is carried over to the following years. When Cachuma spills (on the average of once every three years), all carryover water is considered to have been spilled and the accounting for carryover water is returned to zero. Thus, it is important to use carryover water as soon as possible, giving it the highest priority of use.

Spill Water – When Cachuma spills, GWD can take as much water as it can use, without debiting its entitlement for that year. The amount of spill water that GWD can actually use for customer demand and for groundwater injection is largely limited by GWD’s treatment and injection capacity. Once the spill ceases, further use of Cachuma water by GWD is debited against its annual entitlement as if the spill had not occurred. The WSMP modeling calculated the additional Cachuma yield from spill water by allocating spill water to customer demand in each month that Cachuma spilled. The average amount of spill water allocated to customer demand over the 86-year model period was 870 acre-feet per year. An additional 280 acre-feet per month of spill water was allocated to injection in each month that Cachuma spilled. The average amount of spill water allocated to injection over the 86-year model period was 295 acre-feet per year of water (it is a coincidence that this number is close to the 280 acre-foot per month treatment/injection capacity). The occurrence of spills during the 86 years of the Santa Ynez River Model is indicated in Figure 11-3. Spills generally occur during the months of January through May (Figure 11-4) and usually occur over one to four months in duration (Figure 11-5).

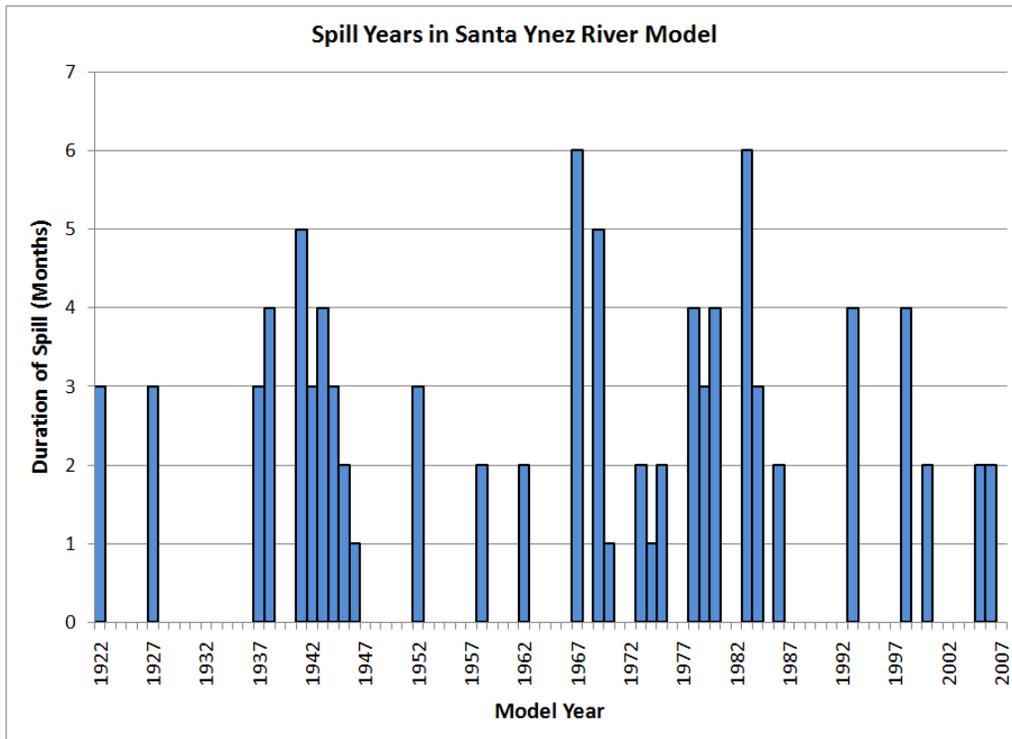


Figure 11-3. Years in which there is a Cachuma spill in the Santa Ynez River model.

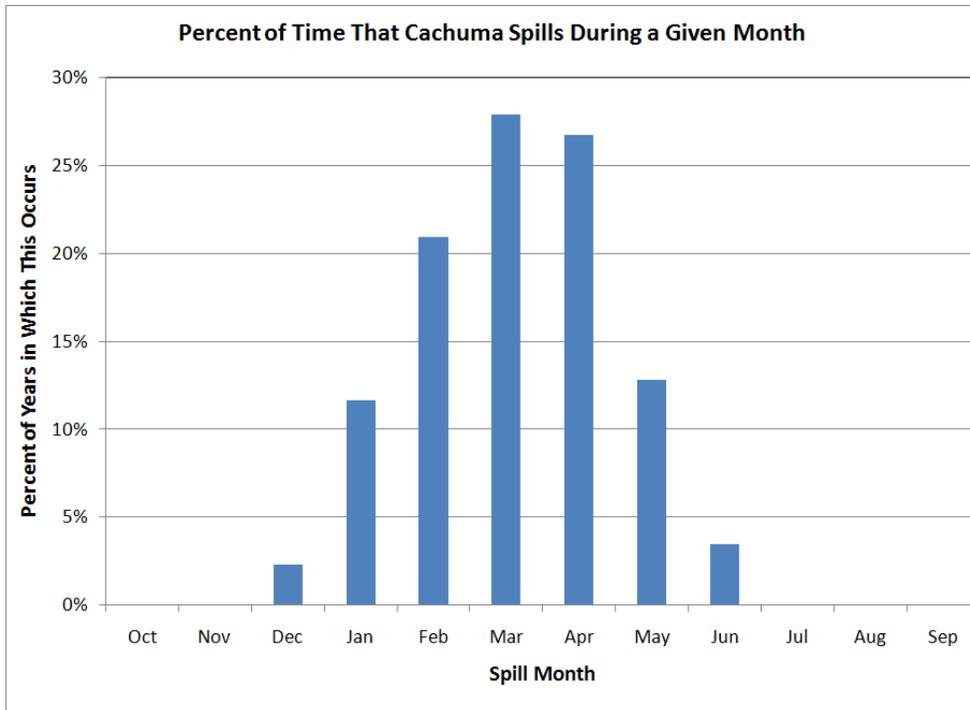


Figure 11-4. Months during which Cachuma spills, based on 86 years of Santa Ynez River Model.

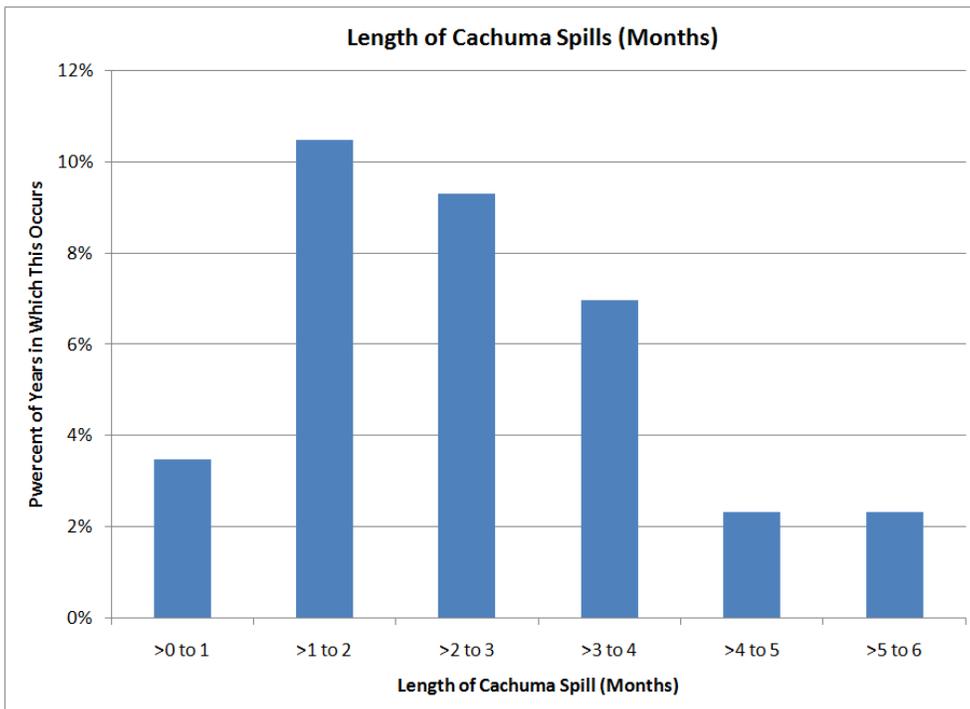


Figure 11-5. Length of Cachuma spills, based on 86 years of Santa Ynez River Model.

11.1.1.2 Cachuma Reliability

Water is diverted from the reservoir at a fixed rate that is somewhat higher than the yield of the reservoir, with deliveries cut back by 20% during drought periods. The adjustments for the water supply from Lake Cachuma are mutually agreed to by the Cachuma member agencies. For example, the Cachuma entitlements for all water purveyors were reduced by 40% in 1991, during the 1987-92 drought. If the “March miracle” of 1991 hadn’t filled Cachuma Reservoir, there was the possibility of more severe reductions in deliveries. Scenarios #1b-drght, #2c, and #4 of the WSMP modeling depict such a possibility.

Over the 86-year period of the WSMP, 97% of its Cachuma entitlement was available to GWD. Carryover water is generated only in a few years when Cachuma spills and GWD’s entitlement is not used during those spill months. The WSMP evaluates whether, and how often, carryover water is lost in the various management scenarios.

Whenever there is a large storm event or following a fire in the Cachuma watershed, material is washed down the river and is caught behind Bradbury Dam. This “siltation” slowly fills the reservoir and decreases the yield of the Cachuma Project. River models take this into account for current conditions; some predict future siltation. The Santa Ynez River Model uses current conditions, so the Cachuma yield in the future (such as in the 2030 model runs) is likely overstated.

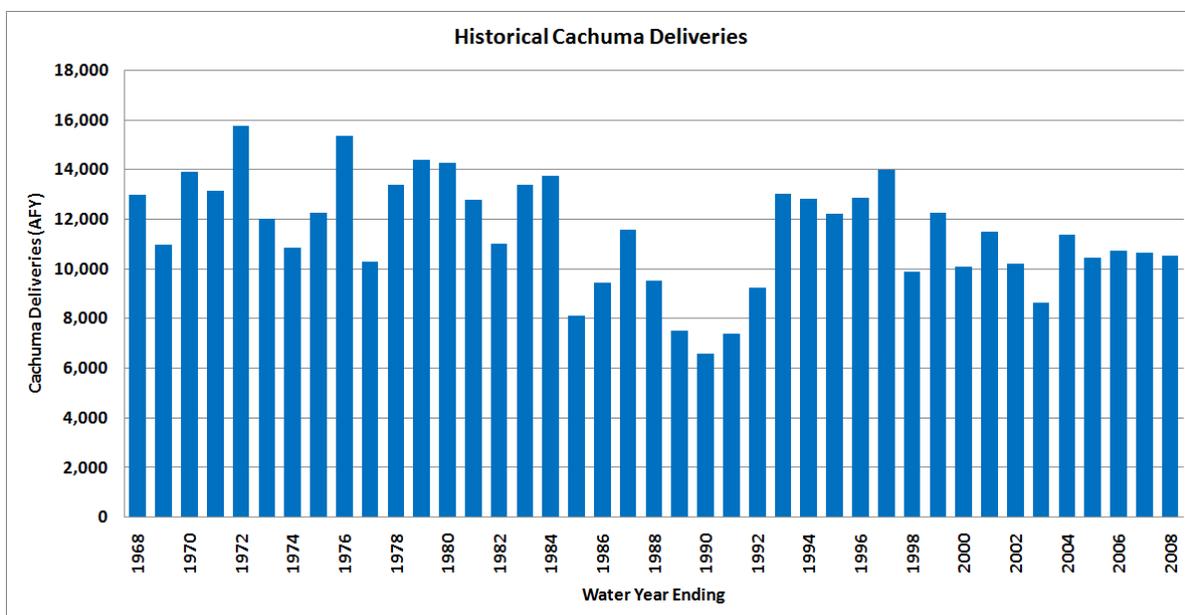


Figure 11-6. Historical Cachuma potable and Goleta West Conduit deliveries to GWD.

11.1.1.3 Cachuma Costs

GWD pays an annual fixed cost of \$2,574,000 to COMB and \$450,000 to the Cachuma Conservation Release Board (CCRB) for its share for operating Cachuma Reservoir. The cost for GWD to treat the water delivered from Cachuma is an additional \$67 per acre foot. However, since 1997 an average of 700 AFY of the untreated water is routed to the Goleta West pipeline, where treatment costs are only \$22 per acre foot. Fixed and variable costs are illustrated in Figure 11-7 through Figure 11-9. The Goleta West Conduit deliveries from Cachuma have a slightly reduced Agency fee of \$320 (instead of \$324 for potable deliveries), based on the amount of water that is estimated to be used.

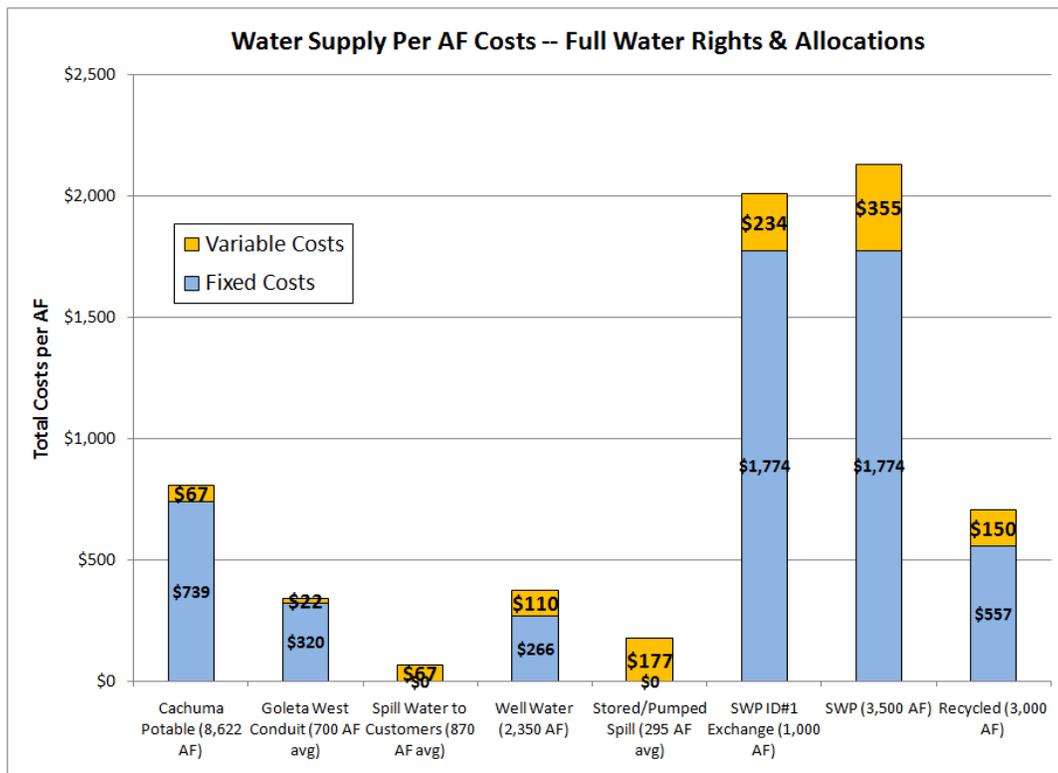


Figure 11-7. Cost per acre-foot of GWD's water supplies. Fixed costs for recycled water are based on capacity of 3,000 acre-feet per year, although there are currently customers for only about 1,000 acre-feet per year of recycled water.

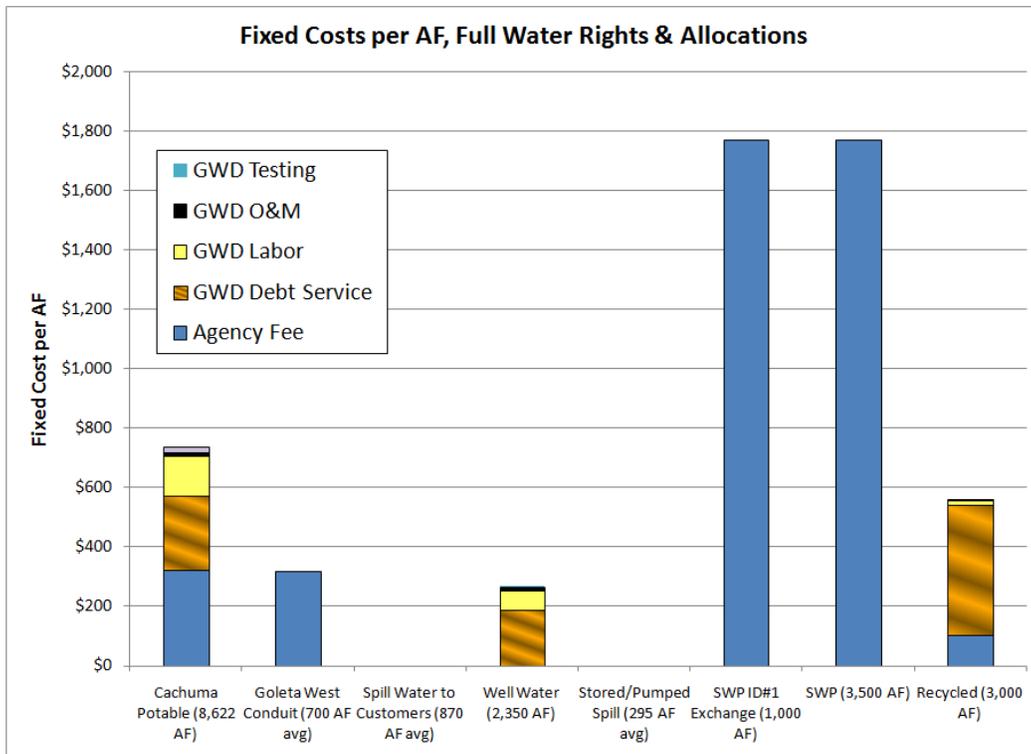


Figure 11-8. Elements in fixed costs per acre-foot for GWD’s water supply sources. Fixed costs for Cachuma are not reflected in the cost of spill water because these costs are accrued irrespective of whether there is a spill. Recycled fixed costs are distributed across the full recycled water capacity.

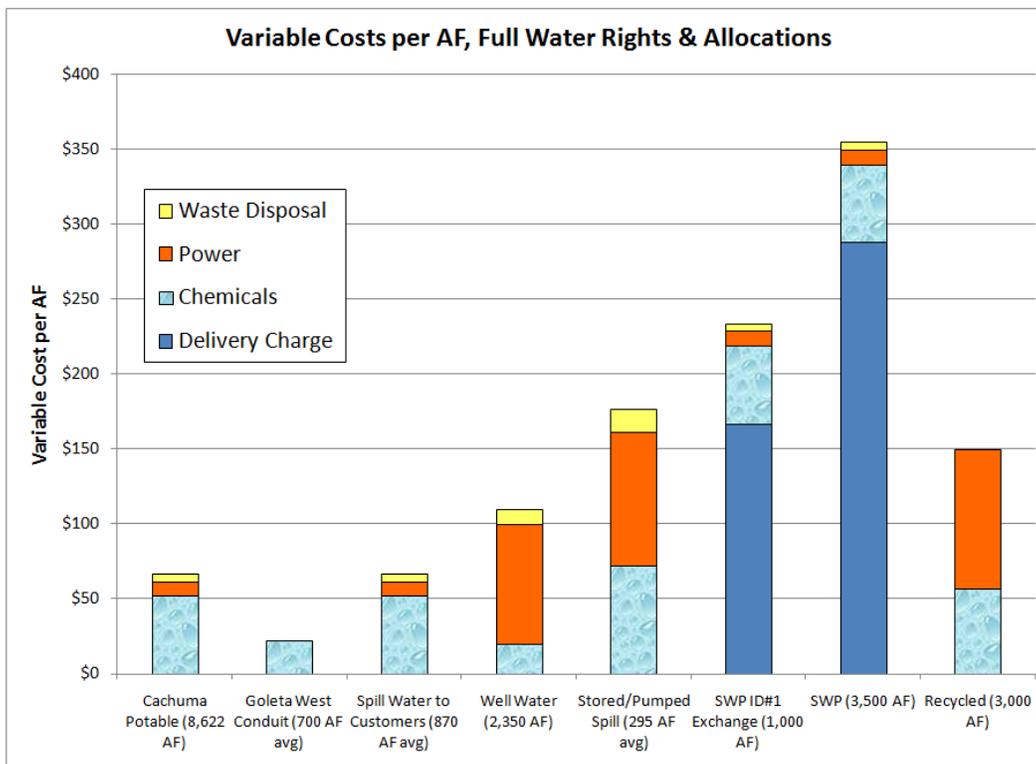


Figure 11-9. Variable costs per acre-foot for GWD’s water supply sources.

11.1.2 Groundwater

Groundwater used by GWD is pumped from its own wells within the Goleta Groundwater basin, with both the amount and timing of the pumping determined in part by the Wright Judgment and GWD's SAFE Ordinance. Water rights, costs, constraints, and reliability are summarized in Table 11-1.

11.1.2.1 Groundwater Supply and Constraints

Wright Judgment – GWD has a current water right to 2,350 AFY of groundwater from the Goleta Groundwater basin under the terms of the Wright Judgment. Unexercised groundwater rights at the end of a year revert to a stored water right in the basin. GWD can also store water by injecting water in the basin for later extraction. The amount of water stored in the basin is reported annually by GWD; as of 2009, GWD storage in the basin was 43,253 acre-feet (GWD, 2010). The details of how both the Wright Judgment and the SAFE Ordinance affect groundwater use by GWD are contained in GWD's and La Cumbre Mutual Water Company's Groundwater Management Plan for the Goleta Groundwater basin (GWD, 2010).

SAFE Ordinance – How this groundwater is used is regulated by GWD's SAFE Ordinance, which specifies conditions under which groundwater is either pumped or stored. The key determining factors are groundwater elevations in the basin and the availability of Cachuma water in any year. When groundwater elevations are below those measured in 1972, groundwater cannot be pumped and a pre-determined amount of water must be stored annually in the basin as a drought buffer. The exception to this rule is when there are reduced deliveries of Cachuma water – SAFE allows for pumping of groundwater during these “drought” conditions. The Groundwater Management Plan specifies which wells to use in determining groundwater elevations in 1972 and in subsequent years (GWD, 2010) (Figure 11-10).

Groundwater Elevations Below 1972 Levels – When groundwater elevations are below 1972 levels, SAFE requires some actions to be taken. As discussed above, groundwater cannot be pumped unless Cachuma supplies have been reduced. In addition, an “Annual Storage Commitment” of at least 2,000 acre-feet per year is required under the SAFE Ordinance for replenishment to 1972 levels (this has risen to 2,378 acre-feet per year in 2010 as new customers have been connected – see section 14.2.3). Any excess State Water actually delivered over 3,800 acre-feet per year shall be stored in the Central subbasin until the basin is replenished to its 1972 level. There can be no new service connections unless all the obligations for water service and the Annual Storage Commitment are met.

Physical Facilities – GWD currently has five fully operational groundwater production wells, with accompanying treatment facilities. Well extraction and treatment capacity is about 300 acre-feet per month. The wells are located in the North and Central subbasins of the Goleta Groundwater basin.

The same wells used for extracting groundwater can also be used for injection. Historically, the source water for injection has been spill water from Cachuma. This injection of Cachuma spill water occurs in both GWD's well and in La Cumbre Mutual Water Company's wells. The injection capacity during spill events is controlled by the capacity of treatment facilities (raw water can't be introduced in the distribution system)

and well injection capacity. GWD's injection capacity is currently about 280 acre-feet per month (3 mgd). Injection of Cachuma entitlement water or State Water could also be accomplished during periods when the wells are not used for extraction. This possibility is investigated in this WSMP.

Groundwater in Storage Above 1972 Groundwater Elevations – Because much of the groundwater in the Goleta basin is stored in confined aquifers, there cannot be a simple calculation of water in storage from groundwater elevations. However, the groundwater modeling (CH2MHill, 2010) gives an estimate of how much water can be pumped from above 1972 groundwater elevations – it takes roughly 10,000 acre-feet of cumulative GWD pumping to drop from high groundwater elevations (10+ ft msl) to the 1972 elevation (-26 ft msl).

Pumping from the Drought Buffer – The Drought Buffer can only be used for delivery to existing customers when a drought on the South Coast causes a reduction in GWD's annual deliveries from Lake Cachuma, and cannot be used as a supplemental supply for new or additional water demands. The amount of water that can be pumped from the Drought Buffer has been calculated in the Groundwater Model (CH2MHill, 2010), the results of which have incorporated into the WSMP (see Section 14.4). For instance, in the current-demand scenario with an extended drought (Scenario #2c that has two drought years added to the 1986-1991 drought), an average of 2,900 acre-feet per year was pumped from the basin for six consecutive years, resulting in a drop in groundwater elevations of 46 feet (well within the Drought Buffer). In the future-demand scenario with an extended drought (Scenario #4), an average of 4,500 acre-feet per year was pumped for six years, resulting in a drop in groundwater elevations of 70 feet (which is most of the Drought Buffer if beginning groundwater elevations are near 1972 elevations).

In the Groundwater Management Plan (GWD, 2010), it was calculated that during the drought of 1986-1991 groundwater elevations dropped about 8 feet per year when GWD pumped about 4,500 acre-feet per year (rather than a little more than 10 feet per year calculated here). This suggests that the Groundwater Model (and subsequently, the WSMP) may somewhat overestimate the effect of drought pumping on the basin.

11.1.2.2 Groundwater Reliability

Prior to the Wright Judgment and SAFE Ordinance, GWD used groundwater as an important source of its water supply, with groundwater elevations dropping to historical lows during the drought of 1986-1991 (left portion of Figure 11-10). Since the drought, GWD has largely foregone pumping the basin to any extent, which allowed the basin to rise to near-historical high groundwater elevations (right side of Figure 11-10). As the result, there is a significant amount of groundwater in the basin that GWD has the right to pump (over 43,000 acre-feet as of 2009). Thus, the reliability of groundwater is currently very good. Groundwater is a less expensive source of water than State Water, but its use must be balanced by the need to maintain a drought buffer of groundwater to ensure a reliable supply when Cachuma and/or State Water supplies are reduced in a drought. Determining this balance is one of the primary purposes of this WSMP.

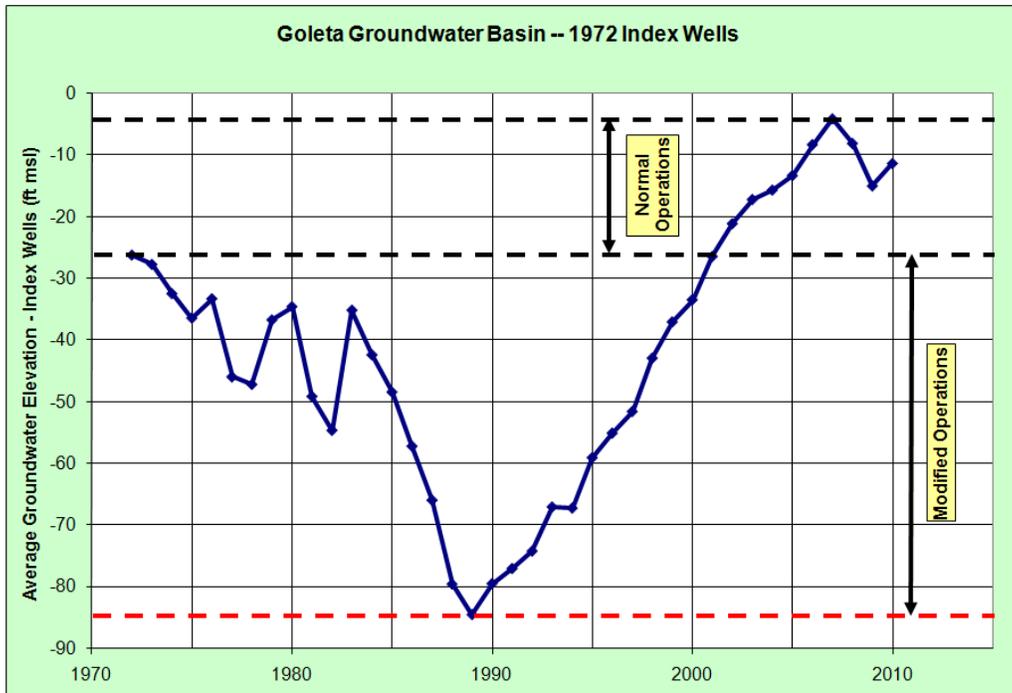


Figure 11-10. Groundwater elevations in the Goleta Groundwater basin, as indicated by the seven-well 1972 Index Wells average (GWD, 2010). The 1972 groundwater elevation used in the SAFE Ordinance is indicated at -27 ft elevation.

11.1.2.3 Groundwater Costs

Extraction of Groundwater – The cost to extract and treat groundwater is about \$110 per acre-foot. The fixed costs of groundwater production are about \$266 per acre-foot per year, spread across GWD’s 2,350 acre-foot annual water right in the basin.

Groundwater Injection – The cost for groundwater injection of spill water is the treatment cost for the source water. These treatment costs are about \$67 per acre-foot. When the water is pumped back out for use, the \$110 for groundwater extraction must be added, resulting in an overall variable cost of \$177 per acre-foot.

Fixed and variable costs are illustrated in Figure 11-7 through Figure 11-9.

11.1.3 State Water

In 1991, voters within the service area of GWD chose to purchase an allocation of State Water. In 1994, voters increased the amount of State Water purchased (but not the pipeline capacity) so that the reliability of State Water could be increased. Treated State Water is delivered to GWD by the Central Coast Water Authority (CCWA) using the Coastal Branch of the California Aqueduct. The terminus of the Coastal Branch is Lake Cachuma, where State Water is de-chlorinated and mixed with untreated Cachuma water. The physical mixture of State and Cachuma water must be re-treated before delivery to customers. Allocations, costs, constraints, and reliability are summarized in Table 11-1.

11.1.3.1 State Water Supply and Constraints

Allocation – GWD has a State Water allocation of 7,000 acre-feet per year, plus an additional allocation of 450 acre-feet per year through the CCWA Drought Buffer. However, GWD only purchased 4,500 acre-feet per year of capacity in the Coastal Branch of the California Aqueduct. The higher allocation than carrying capacity reflects the reality that the State Project cannot on average deliver the full amount of its customers’ allocations.

Storage – GWD currently uses two means of storing State Water –Cachuma Reservoir and CCWA storage in San Luis Reservoir. Long-term storage of State Water (such as for drought protection) in Cachuma Reservoir is problematic because Cachuma spills on average every three years, with State Water considered the first water over the spillway.

CCWA stores State Water that has been ordered by its member agencies but is unused at the end of the year. This relatively new program uses San Luis Reservoir (an off-aqueduct reservoir along the California Aqueduct) as the storage site. Stored water can also be “spilled” from San Luis when DWR moves a large amount of water into the reservoir for temporary storage and displaces the CCWA stored water. This is likely to happen in 2011. Although no upper limits for storage have been set, CCWA considers that 4,000 acre-feet of storage for GWD is likely a reasonable number. The WSMP modeling suggests that the Bank can be re-filled in a year or two after it has been depleted. During a serious drought, the Bank is very helpful in the early stages of the drought; when it is depleted, it is not likely to be re-filled until the drought is over.

Exchange Water – From 1997 to 2008, about 52% of GWD’s State Water delivery was involved in an exchange with Santa Ynez River Water Conservation District-Improvement District No. 1.

11.1.3.2 State Water Reliability

Delivery of water from the State Water Project varies with climatic conditions in northern California and environmental/regulatory issues in the Sacramento Delta. The allocation is based each year on reservoir levels, the amount of snow runoff expected, and constraints on pumping from the Delta into the California Aqueduct. The California Department of Water Resources (DWR) has calculated probabilities of water delivery over a range of climatic conditions and environmental constraints, both for current conditions and those projected for 2029. DWR has been updating the reliability studies every two years or so. The latest reliability study for 2009 (DWR, 2010) was used in the WSMP modeling for both current demand and projected 2030 demand. Overall, the reliability of State Water is now considered to be 60% of Table A allocation, with a low of 7% during the driest year to a high of 81% during the wettest year.

11.1.3.3 State Water Costs

State Water costs are divided into fixed (capital) and variable (operational) costs. GWD currently pays \$7,051,000 a year to CCWA for its share of the fixed costs for State Water. The variable rate is considered below.

Table A Water Delivered to Cachuma – The variable cost of State Water delivered to Cachuma Reservoir and subsequently treated for GWD customers is \$355 per acre-foot.

The fixed cost per acre-foot is \$1,774 when it is proportioned across the total of 4,500 acre-feet per year of average yield/aqueduct capacity.

Exchange Water with ID #1 – The variable cost of State Water delivered and treated through the exchange agreement with ID#1 is \$234. The fixed cost per acre-foot is \$1,774 when it is proportioned across the total of 4,500 acre-feet per year of average yield/aqueduct capacity.

Storage – There is currently no supplemental charge for storing State Water in either Cachuma Reservoir or San Luis Reservoir.

Fixed and variable costs are illustrated in Figure 11-7 through Figure 11-9.

11.1.4 Recycled Water

Through an agreement with the Goleta Sanitation District, recycled water is delivered within GWD for non-potable uses such as landscape irrigation. This water would otherwise have been discharged into the ocean. Capacities, costs, constraints, and reliability are summarized in Table 11-1.

11.1.4.1 Supply and Constraints

Current Capacity – The recycled water project (treatment and distribution) currently has a seasonal treatment and distribution capacity of approximately 3,000 AFY. The recycled water plant has a design capacity of 3 million gallons per day (mgd), which is about 9 acre-feet per day (GSD, 2006). GWD is currently delivering approximately 1,000 AFY to the University of California Santa Barbara campus, several golf courses, and other irrigation users, most of whom were previously using the District potable water for irrigation.

Future Capacity – There is currently about 2,000 acre-feet per year of unused recycled water capacity. GWD plans on expanding use of recycled water, but that expansion is linked to further public acceptance of using recycled water. Any expansion beyond the current capacity would most likely require an expanded distribution system. If current infrastructure could deliver additional recycled water, then recycled water is one of the least expensive options for increasing GWD supplies. If additional infrastructure and capital costs were required, the cost of delivering additional recycled water would be increased.

11.1.4.2 Recycled Water Reliability

Recycled water has very good delivery reliability because the amount of wastewater flowing into the Goleta Sanitary District even in severe drought conditions exceeds the recycled water demand.

11.1.4.3 Recycled Water Costs

Recycled water currently costs \$707 per acre-foot when fixed costs are distributed across the 3,000 acre-feet per year of capacity. If the fixed costs are distributed across the current deliveries of about 1,000 AFY, the variable and fixed costs are \$1,821 per acre-foot. Fixed and variable costs are illustrated in Figure 11-7 through Figure 11-9. It is important to note, however, that the variable cost of \$150 per acre-foot makes it one of the least expensive sources

of additional supply because most of the fixed costs for treating another 2,000 acre-feet per year are already being paid.

| Supply Source | Annual Allocation, Entitlement, or Water Right (AFY) | Fixed Costs (per AF) | Variable Costs (per AF) | Constraints | Reliability (% of Full Supply) |
|-------------------------------------------------------------------|------------------------------------------------------|----------------------|-------------------------|-----------------------------|--------------------------------|
| Cachuma Potable ⁵ | 8,622 | \$739 | \$67 | None | 97% |
| Cachuma – Goleta West Conduit | 700 | \$320 | \$22 | None | 97% |
| Cachuma – Spill Water to Customers ⁶ | 875 | \$0 | \$67 | None; Irregular Reliability | N/A |
| Cachuma – Spill Water to Injection, Later Extraction ⁷ | 296 | \$0 | \$177 | 280 AF/month | N/A |
| Groundwater ⁸ | 2,350 | \$266 | \$110 | 300 AF/month SAFE | 100%/92% |
| State Water – Table A ⁹ | 3,500 | \$1,774 | \$355 | 4,500 AFY Pipeline | 60% |
| State Water – ID#1 Exchange ¹⁰ | 1,000 | \$1,774 | \$234 | Included above | 60% |
| Recycled Water ¹¹ | 3,000 | \$557 | \$150 | Only 1,000 AFY demand | 100% |

Table 11-1. Summary of all sources of GWD water supply, including costs, constraints, and reliability. Availability of these sources varies annually, and is regularly assessed by the District throughout any given year. Additionally, the table does not reflect total system losses, which are approximately 6%. Costs were developed by T. Bunosky, GWD.

11.2 Critical Supply Components

There are several critical supply components that affect the reliability of GWD’s water supplies. These include: 1) Cachuma supplies in a severe drought; 2) State Water availability during droughts or emergencies; 3) GWD capacity in the Coastal Aqueduct of the State Water Project; 4) restrictions on timing of use of groundwater; and 5) treatment/pumping limitations.

⁵ Reliability is percent of full entitlement available over 86 years of WSMP Model.

⁶ Annual amount is average over 86 years of WSMP Model. If demand increases, this number will also increase.

⁷ Amount is average over 86 years of WSMP Model. Constraint is treatment capacity for spill water.

⁸ Reliability reflects that groundwater right is always available over 86 years of WSMP Model, but SAFE requires storage but no pumping in some years.

⁹ 4,500 AFY is GWD’s portion of the Coastal Aqueduct. Fixed costs spread over 4,500 AFY of reliable supply and aqueduct capacity.

¹⁰ Amount is average since State Water was first delivered.

¹¹ Amount is current capacity. Only 1,000 AFY of current customers. Fixed cost calculated on 3,000 AFY of capacity.