A Review of Water Use
&
Water Management Alternatives
in Cambria, California

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Abbreviations, Acronyms & Definitions

Ann: Annual

Acre-foot: 325,851 gallons, which is enough water to flood one acre of land one foot deep or supply about four single-family households with enough water for one year

AF: An acre-foot of

AFY: Acre-feet per year

AVG: Average

Baseflow: Stream flow provided by groundwater sources draining into creeks, streams, and rivers. Baseflow can be very important for maintaining flow during dry seasons and providing cool water inflow and water temperature stability since groundwater temperature is usually stable and cool.

BMPs: Best Management Practices, in the context of this report, the water conservation Best Management Practices overseen by the California Urban Water Conservation Council. The BMPs are a list of 14 water conservation measures that are generally accepted to be cost-effective and effective for conserving water, and represent a minimal water conservation program effort for responsible urban water management utilities in California.

CCF: One hundred cubic feet, which equates to 748 gallon and is the basic unit of water use for the Cambria Community Services District billing system

CCSD: Cambria Community Services District, the local public water utility that serves Cambria, California.

CII: Commercial, Industrial, and Institutional water service accounts

CPI: Consumer price index

CUWCC: The California Urban Water Conservation Council, which was established in 1991 to oversee the implementation of water conservation Best Management Practices.

DMM: Demand management measure, or a water conservation technology, practice or program.

ENR: Engineering News-Record, a publication that includes the Construction Cost Index and a Building Cost index that are used to project varying costs over time. (enr.construction.com)

Evapotranspiration: water lost to the atmosphere by evaporation from the soil and from transpiration from plants growing in the soil.

GIS: Geographic Information System, a computer database, software and analytical technique for cataloging and analyzing natural features and systems. GIS can be utilized for sophisticated tracking, analysis, and modeling of geographic features, including natural systems and watershed features.

GPCD: Gallons per capita per day

GPM: Gallons per minute

kWh: Kilowatt-hour, or 1,000 watts of energy used for a duration of 1 hour

Marginal Cost: the cost of producing one more unit of a good, or in this report the cost of producing or saving an acre-foot of water. The marginal cost provides a mechanism to compare the cost of water provided by different water management options on a realistic cost comparison basis, including capital and operating costs for the various options.

MFR: Multi-family residential water service accounts

MG: Million gallons

MGD: Million gallons per day, a 1 MGD facility is theoretically capable of producing 1,120 acre-feet of water per year if operated at 100% capacity for 365 days a year

MOU: Memorandum of Understanding, the agreement that defines the California water conservation Best Management Practices and the implementation efforts necessary for signature urban water utilities in California to be in compliance. Implementation by water utilities is voluntary, but implementation efforts are usually taken into account for water rights issues and in qualifying for state supported grant programs.

NPW: Net Present Worth, generally used in a manner equivalent to Net Present Value

NPV: Net Present Value, a term used to account for the discounted future value of dollars

O&M: Operations and maintenance, this will exclude project design, capital costs and financing

Riparian Zone: the interface area between land and a river system or stream. They provide many benefits including habitat and biodiversity, floodwater storage, natural biofilters, and protecting aquatic environments from excessive sedimentation and polluted surface runoff and erosion.

Runoff: the flow of water, from rain, snow melt, or other sources, over land that may combine with groundwater inflow into rivers, streams, and wetlands, and ultimately flow out of a watershed. Runoff can be measured as an indication of the amount of water produced by a watershed, much of which is often utilized to support human activities.

SFR: Single-family residential water service accounts

UWMP: Urban Water Management Plan, the plans are required from water utilities every 5 years.

Water Supply Yield: the amount of water produced by a system such as watershed runoff, or groundwater storage, or water recycling.

Watershed: an area of land where all the water that drains under it or off of it emerges at a single place such as a river or stream. All land areas are essentially part of one watershed or another, but they may have very differing water runoff characteristics.

Project Description

For the Cambria Community Services District (CCSD) service area, this report provides a review and analysis of demand management efforts and water use trends in recent decades, the CCSD 2008 Water Master Plan projections for future water needs, and the publicly identified costs associated with the proposed desalination facility. The Cambria desalination costs were compared to available costs from other facilities proposed in California.

Summary of Findings

CCSD's water use forecasts from early-2000s were serious overestimates. Instead of a projected annual water production of about 1,500 acre-feet per year (afy), water production has been declining and has averaged about 690 afy for the last four years. The 50% "quality of life" water use increase adopted by the CCSD board in 2003 in retrospect was an unrealistic and inappropriate policy. On April 26, 2012, the CCSD board adopted a policy for a new water supply minimum of 220 additional acre-feet per year above the existing baseline at buildout.[1] The CCSD analysis supporting this new policy was not clear at the time of this report.

CCSD was very active with conservation programs and appears to have made impressive progress until early-2000s. It is likely that a substantial percentage of single-family residences were retrofitted as a part of the demand offset program. However, the retrofit status of about 1,000 single-family sites is not clear, and may represent a significant water conservation opportunity. Based on available documents, it is possible that a much smaller percent of multi-family residential and commercial sites have been retrofitted, and may represent a substantial market for additional water efficiency opportunity.

CCSD documents suggest the emphasis on implementing efficiency measures tapered off starting around 2002 or 2003. This is about the same time that a 50% "quality of life" increase in water use was adopted as a policy and the desalination project was adopted as the preferred alternative. It may only be coincidental, but it may also be that these are connected events and water conservation was no longer viewed as an important priority. Or, at least not a priority worthy of significant ongoing funding and staff effort.

CCSD made significant progress in reducing unaccounted losses from an average of 15% or more in the early-1990s, to less than 10% for each of the last 6 years. CCSD now indicates an annual unaccounted losses goal of 8%.[2] However, with new advanced water meters now in place a goal of 5-6% is viable, and has been achieved by CCSD in some recent years and by another utility in the region. A very aggressive effort to further minimize water leaks would be sensible before moving forward with an expensive new water supply project.

The cost of the proposed desalination facility appears to be seriously underestimated. Based on the costs of other proposed and constructed facilities, the costs would likely be 2 to 3 times the CCSD costs estimates.

Given water use trends in the last decade, a large new water supply appears unnecessary when the buildout limit of 4,650 residential service connections is reached. Less costly alternatives appear to be available and sufficient to provide for CCSD service areas needs now and when the buildout limit occurs. If cost-effective water efficiency measures are implemented, and leakage rates are further reduced, it is unlikely that new water supply in excess of the 50 afy that could be supplied by recycled water will be needed at buildout.

Improved watershed and floodplain management practices have not been adequately explored as part of a package of cost-effective alternatives, along with water recycling and ongoing improvement in water efficiency, to improve watershed health, decrease fire risk, and improve water supply reliability, particularly in dry years.

Summary of Recommendations

1. Conduct a comprehensive water conservation baseline study to determine present day saturation of water conservation fixtures and technologies and landscape irrigation practices in single-family, multi-family, commercial, and institutional accounts. Use the results to better focus future water conservation programs.

2. Place more emphasis on summer water conservation programs that will address summer population peaks and irrigation water use. These programs should include:
    - Installation of 1.28 gallon toilets in single-family, multi-family, and commercial services that presently have toilets using more than 1.6 gallons per flush
    - Installation of waterless urinals in public facilities
    - Promoting low-water-use landscapes and irrigation efficiency
    - Pursuing recycled water for landscaping
    - Use of graywater for landscape water use
    - Review and optimization of landscape/irrigation ordinances and audits, irrigation restrictions
    - Providing incentives for installing efficient clothes washers
    - Evaluation of separate landscape water meters to track landscape water use and encourage conservation

3. Establish a citizens advisory committee to help CCSD assess new water conservation opportunities, review water supply alternatives, including financial and environmental implications and community acceptability, assess appropriate levels of drought risk, and help assess the potential role of improved watershed management on water supply reliability

4. Continue to address distribution system and lateral line leaks. Reduce unaccounted water losses to 5-6%

5. Pursue water recycling for 50 acre-feet per year of new supply to offset existing water use for landscape irrigation

6. Implement the Buildout Reduction Program to maintain and protect the local community character and reduce future water supply needs

7. Continue the 2:1 conservation offset program for new connections to help support the conservation programs

8. Evaluate and pursue watershed management opportunities as a potential source of improved water supply reliability

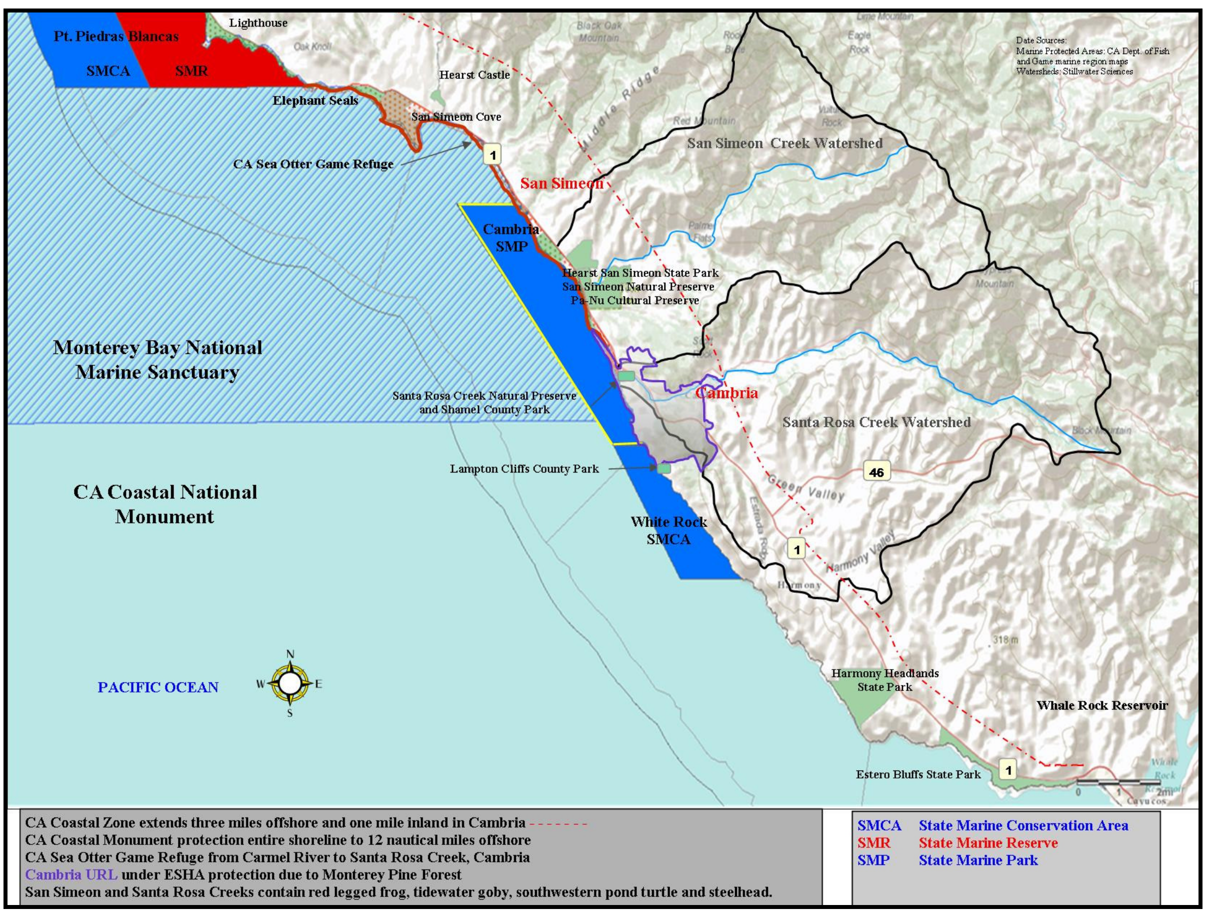
Description of Cambria & CCSD Service Area

The unincorporated town of Cambria, Calif., is a small coastal community located approximately 35 miles north of the City of San Luis Obispo in San Luis Obispo County. Cambria is relatively isolated with the Pacific Ocean immediately to the west and the Santa Lucia Mountain Range to the east. The Cambria Community Services District provides water and wastewater services to the community, along with fire protection, garbage collection, and some other services. CCSD is a public municipality, governed by a five-member board elected at-large for four-year terms.

Cambria is surrounded by expanses of open space and has approximately 3,500 acres of Monterey pine forest. Monterey pine forest is considered "one of the most threatened native forests in the world." [3] As noted in the 2002 Cambria Forest Management Plan, this represents about 17% of the "remaining native Monterey pine forest in California and Baja California."[4] Coast live oak is also found co-occurring in the Cambria's forest lands.

Cambria is located within the Coastal Zone and is the focal point of numerous sensitive and protected terrestrial, estuarine and marine resources in its vicinity. Many of these are depicted in Figure 1. Cambria's watershed hosts an important Steelhead run. Rock fish, tidewater gobies, snowy plovers, red legged frogs and numerous other species are known to inhabit the watershed, creeks, lagoon, beaches, and near shore waters.

Figure 1
Cambria Area and Environmentally Sensitive Areas



Map produced by Mary Webb

Sensitive and protected areas include:

- California Coastal National Monument
- California Sea Otter Game Refuge
- Cambria State Marine Conservation Area
- Estero Bluffs State Park
- Harmony Headlands State Park
- Hearst San Simeon State Park
- Lampton Cliffs County Park
- Monterey Bay National Marine Sanctuary
- Pt. Piedras Blancas State Marine Conservation Area
- Pt. Piedras Blancas State Marine Reserve
- Santa Rosa Creek Natural Preserve
- San Simeon Natural Preserve
- San Simeon Pa-Nu Cultural Preserve
- Santa Rosa Creek Natural Preserve
- Shamel County Park
- White Rock (Cambria) State Marine Conservation area

Summer temperatures in Cambria are moderated by proximity to the Pacific Ocean and the influence of a marine air layer and coastal fog. Cambria receives an average of about 20 inches of rainfall per year, with all of it generally occurring in the winter months.[5] The water supply is provided by the San Simeon and Santa Rosa Creek aquifers, which are recharged by San Simeon and Santa Rosa Creeks.[6] The San Simeon and Santa Rosa Creek aquifers are relative shallow alluvial deposits situated along the lower elevations of the creeks and water production is dependent on runoff and infiltration from their local watersheds.

To improve the water supply yield, and protect from seawater intrusion, CCSD pumps treated wastewater to percolation ponds at the lower elevation area of the San Simeon Creek Aquifer, downstream of the potable supply wells. This helps provide a subsurface barrier between seawater intrusion into the aquifer and seaward migration of freshwater from the aquifer.[7]

CCSD presently does not provide recycled water for landscape use, but water planning documents indicate that in the future up to 50 acre-feet per year could be utilized without reducing aquifer recharge and storage levels.[8]

Tourism is the primary economic activity of Cambria and there are numerous summer homes, visitor rental, bed & breakfasts, and hotels. As a result, Cambria experiences an influx of visitors in the summer months which impacts water use.

As noted in CCSD's 2010 Urban Water Management Plan:

> "In November 2001, the District's Board of Directors declared a Water Code 350 emergency and ceased issuing additional connection permits until an adequate long-term supply project was completed. Current planning calls for a seawater desalination facility to provide drought protection, improve supply reliability, and to augment existing groundwater supplies. To date, no new connections are being issued and the District remains under a Water Code 350 declaration."[9]

Since that time, CCSD has been pursuing a new water supply, and has evaluated a number of alternatives. Seawater desalination emerged as the preferred new supply alternative based on cost analysis developed in the years 2000 through 2004.

CCSD Water Use Profile

To review historical water use patterns and trends, water production, billed water use, and population figures were compiled. Numerous factors may influence these trends including water conservation programs and improved technologies, drought years and the perception of shortages, economic conditions and cycles, and also increasing environmental concern and the view that water should be used carefully. Many of these factors are further evaluated in this report.

Historic Water Use
Table 1 provides the total annual water production, annual billed water use, calculated annual unaccounted losses, population, gallons per capita per day (gpcd) water use, and number of service connections for the CCSD service area for recent decades.[10]

As shown in Table 1, total water production peaked at 819.5 af in 1988. The second highest year of production was 809.5 af in 2002. These are the only two years in which production exceeded 800 af. Since 2002, total production and billed water deliveries steadily declined. Total annual production averaged 690.7 afy for the last four years, 2008-2011.

Table 1 shows unaccounted losses (water lost through pipeline leakage and unmeasured water use from inaccurate water meters) declined from a peak of 20.7% per year in 1992, to an annual average of 7.5% for the years 2006 through 2011. This is further discussed in the section on Unaccounted Losses in this report.

The population figures are based on 10 year U.S. census counts for Cambria, and averaged for the years in between. The census population figures indicate that population peaked at 6,232 in the year 2000, and then declined to 6,032 in 2010.

The per capita water use is derived from census population figures and total annual water production. Daily per capita use peaked at 181.1 gpcd in 1976, then declined to an average of 106.9 gpcd for the ten year period 1990-1999. Per capita water use then increased slightly to 110.6 for the ten year period 2000-2009. However, per capita water use has averaged 102.0 gpcd for the last four years, 2008-2011. Per capita water use is further discussed in subsequent sections of this report.

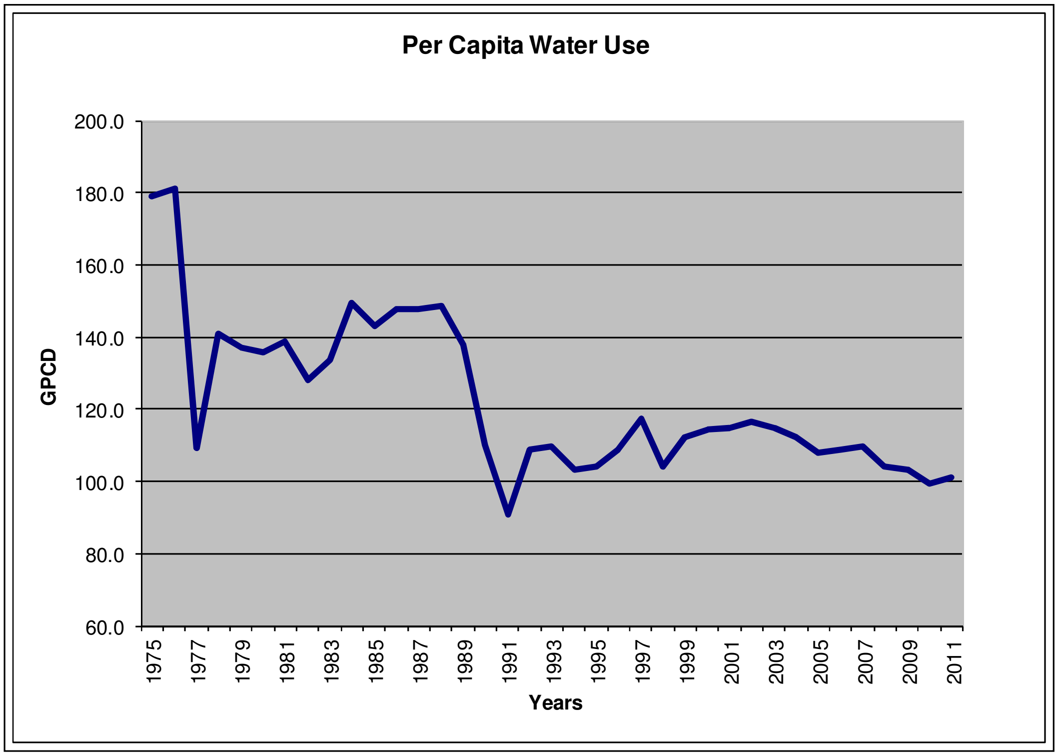
Table 1
Cambria Historic Water Use

Year	Production (AF)	Billed Deliveries (AF)	Unaccounted (AF)	% Unaccounted	Population	GPCD	Total Connections
1970	?	?	?	?	1,716	?	?
1975	483.4	?	?	?	2,413	178.8	?
1976	517.8	?	?	?	2,552	181.1	?
1977	330.0	?	?	?	2,692	109.4	?
1978	447.5	?	?	?	2,831	141.1	?
1979	456.4	?	?	?	2,971	137.2	?
1980	473.1	?	?	?	3,110	135.8	?
1981	518.5	?	?	?	3,337	138.7	?
1982	510.6	?	?	?	3,564	127.9	?
1983	568.4	?	?	?	3,792	133.8	?
1984	672.4	?	?	?	4,019	149.4	?
1985	681.0	?	?	?	4,246	143.2	?
1986	740.6	?	?	?	4,473	147.8	?
1987	777.0	?	?	?	4,700	147.6	?
1988	819.5	725.3	94.2	11.5%	4,928	148.5	?
1989	797.0	715.9	81.1	10.2%	5,155	138.0	?
1990	663.8	586.8	77.0	11.6%	5,382	110.1	?
1991	555.7	473.2	82.5	14.8%	5,467	90.7	3,316
1992	677.7	537.5	140.2	20.7%	5,552	109.0	3,342
1993	691.4	570.4	121.0	17.5%	5,637	109.5	3,399
1994	662.0	597.7	64.3	9.7%	5,722	103.3	3,436
1995	677.8	601.0	76.8	11.3%	5,807	104.2	3,454
1996	718.3	642.8	75.5	10.5%	5,892	108.8	3,548
1997	785.8	646.0	139.8	17.8%	5,977	117.4	3,642
1998	705.7	614.3	91.4	13.0%	6,062	103.9	3,770
1999	774.1	668.5	105.6	13.6%	6,147	112.4	3,796
2000	798.8	687.2	111.6	14.0%	6,232	114.4	3,887
2001	798.0	693.2	104.8	13.1%	6,212	114.7	3,882
2002	809.5	700.1	109.4	13.5%	6,192	116.7	3,966
2003	792.9	698.5	94.4	11.9%	6,172	114.7	3,980
2004	772.6	659.4	113.2	14.7%	6,152	112.1	3,991
2005	741.2	645.5	95.7	12.9%	6,132	107.9	3,993
2006	746.1	688.3	57.8	7.8%	6,112	109.0	4,007
2007	748.2	677.5	70.7	9.4%	6,092	109.6	3,999
2008	707.6	668.9	38.7	5.5%	6,072	104.0	4,019
2009	699.5	660.5	39.0	5.6%	6,052	103.2	4,021
2010	672.4	619.1	53.3	7.9%	6,032	99.5	4,024
2011	682.9	620.7	62.2	9.1%	6,032	101.1	4,024

Figure 2 plots daily per capita water use. Per capita water use dropped sharply during the drought of 1976-77. It then rebounded and averaged about 130 to 150 gpcd, with an upward trend until the late 1980s. As a result of drought in the late 1980s, and presumably long-term conservation measures, per capita water use again dropped sharply. In about 1993, per capita use rebounded to a new, lower average range between 100 and 120 gpcd. However, a gradual decline in per capita use began around 2003 and continued through 2011.

As noted in the subsequent section on CCSD's rate structure, a drought surcharge was in place for some part of the year in 2002 and 2004, and the second half of 2007.[11] It is unlikely that the drought surcharge by itself had a large effect on the declining water use in recent years. The recent recession may have also had an impact of declining water use. But the downward trend in water use started well before the recession began in early 2008.

Figure 2
Per Capita Water Use Trend for CCSD Service Area



Annual water use by customer class and by billing period for 2009 through 2011 is shown in Table 2. This annual water use breakdown is provided in Appendix A for 1999 through 2011. These provide clear indication of seasonal water use patterns and water use patterns by customer class. Table 2 clearly shows water use peaking at about 20% per billing period in the summer billing periods, and declining to about 14% per billing period in the winter. Table 2 also shows the relative water use by the different customer classes.

Note the lack of separate large landscape water meters in Table 2 and Appendix A.[12] Separate landscape meters for non-residential sites are becoming a common practice for many urban water utilities in California. Without separate landscape water meters, irrigation water use is very difficult to track and manage efficiently. Table 2 shows that water use increases in the summer billing periods for all the customer classes. Since Cambria appears to have a substantial seasonal summer population, this further obscures the sources of peak summer water demands - whether much of it is indoor water use from an increased summer population, or if much of it is landscape irrigation.

Table 2
Water Use by Customer Class & Billing Period
(Years 1999 through 2011 included in Appendix A)

2009	SFR (ccf)	MFR (ccf)	Comm (ccf)	Internal Accts (ccf)	Vac Rental (ccf)	Total Usage (ccf)	Total Usage (af)	Percent
Jan/Feb	25,402	1,379	7,790	999	1,870	37,440	**85.9**	**13.0%**
Mar/Apr	29,336	1,471	9,612	2,165	2,030	44,614	**102.4**	**15.5%**
May/Jun	35,481	1,737	12,124	2,535	2,729	54,606	**125.3**	**19.0%**
Jul/Aug	38,098	1,679	13,869	2,334	3,301	59,281	**136.1**	**20.6%**
Sep/Oct	33,182	1,612	11,081	1,362	2,487	49,724	**114.1**	**17.3%**
Nov/Dec	28,776	1,514	9,006	609	2,153	42,058	**96.5**	**14.6%**
Totals (ccf)	**190,275**	**9,392**	**63,482**	**10,004**	**14,570**	**287,723**	**660.5**	**100.0%**
Totals (af)	**436.8**	**21.6**	**145.7**	**23.0**	**33.4**	**660.5**		
Percent	**66.1%**	**3.3%**	**22.1%**	**3.5%**	**5.1%**	**100.0%**		

2010	SFR (ccf)	MFR (ccf)	Comm (ccf)	Internal Accts (ccf)	Vac Rental (ccf)	Total Usage (ccf)	Total Usage (af)	Percent
Jan/Feb	22,504	1,364	7,085	429	1,625	33,007	**75.8**	**12.2%**
Mar/Apr	26,850	1,520	9,984	544	1,945	40,843	**93.8**	**15.1%**
May/Jun	33,260	1,631	11,289	857	2,327	49,364	**113.3**	**18.3%**
Jul/Aug	38,096	1,808	14,227	1,529	3,406	59,066	**135.6**	**21.9%**
Sep/Oct	32,751	1,569	11,891	541	2,536	49,288	**113.1**	**18.3%**
Nov/Dec	26,170	1,486	8,399	172	1,887	38,114	**87.5**	**14.1%**
Totals (ccf)	**179,631**	**9,378**	**62,875**	**4,072**	**13,726**	**269,682**	**619.1**	**100.0%**
Totals (af)	**412.3**	**21.5**	**144.3**	**9.3**	**31.5**	**619.1**		
Percent	**66.6%**	**3.5%**	**23.3%**	**1.5%**	**5.1%**	**100.0%**		

2011	SFR (ccf)	MFR (ccf)	Comm (ccf)	Internal Accts (ccf)	Vac Rental (ccf)	Total Usage (ccf)	Total Usage (af)	Percent
Jan/Feb	25,882	1,481	8,501	133	1,823	37,820	**86.8**	**14.0%**
Mar/Apr	25,173	1,457	8,599	219	1,685	37,133	**85.2**	**13.7%**
May/Jun	36,868	1,949	13,304	698	2,660	55,479	**127.4**	**20.5%**
Jul/Aug	32,703	1,716	13,036	900	2,755	51,110	**117.3**	**18.9%**
Sep/Oct	32,319	1,562	11,901	718	2,194	48,694	**111.8**	**18.0%**
Nov/Dec	27,273	1,651	8,822	487	1,938	40,171	**92.2**	**14.9%**
Totals (ccf)	**180,218**	**9,816**	**64,163**	**3,155**	**13,055**	**270,407**	**620.7**	**100.0%**
Totals (af)	**413.7**	**22.5**	**147.3**	**7.2**	**30.0**	**620.7**		
Percent	**66.6%**	**3.6%**	**23.7%**	**1.2%**	**4.8%**	**100.0%**		

Unaccounted Losses

Unaccounted losses are generally defined as the difference between the water measured and billed from end user water meter readings, and the total water produced from supply sources. The unaccounted losses can reflect a range of issues including inaccurate water meters that under record actual water use by customers, leaks and breaks in distribution system pipelines, water theft from unmetered connections, and inaccurate meters measuring the production sources. Historically, unaccounted losses have sometimes ranged as high as 20% to 30% for water utilities. But with an increased focus on water conservation, particularly in the arid western states, many utilities have rehabilitated their facilities and brought unaccounted losses down to around 10% or less, with some utilities bringing it as low as around 5%.

According to CCSD's 2010 Urban Water Management Plan, "The CCSD replaced all of its residential water meters during 2005 and 2006 with remote read meters, which has helped lower the amount of unaccounted water that may otherwise pass through older meters without being registered."[13] The billing records and production reports shown in Table 1 indicate a drop in unaccounted water occurring after 2005. Previous to 2005, unaccounted losses were generally well over 10% with a peak of 20.7% in 1992, a low of 9.7% in 1994, and most years falling between 12% and 15%. After the water meter replacements starting in 2005, unaccounted losses consistently decreased. A low of 5.5% occurred in 2008 and a high of 9.1% in 2011. It is not clear if all of the reduction in unaccounted losses was from the meter replacements, or if some was also from distribution system repairs and improvements. If much of the unaccounted losses in years before 2005 were from slow reading customer meters that under-recorded actual water use, then actual water use has declined even more impressively in recent years than is reflected in Table 1.

CCSD's 2010 Urban Water Management Plan indicates an assumed future unaccounted losses average of 8%. However, CCSD's 2005 Urban Water Management Plan recommended CCSD "adopt 5% or less of unaccounted water as a long-term performance goal."[14] Given CCSD's limited supply situation, and interest in costly seawater desalination, a future goal of 5-6%, or even better a maximum of 40 afy as was achieved in 2008 and 2009, may be more appropriate and would be consistent with some of the most conservation oriented agencies in the region. For example, the City of San Luis Obispo reported unaccounted losses that averaged 5.1% for the years 1999 through 2007.[15]

CCSD Water Conservation Program Overview

A review of CCSD's Urban Water Management Plans, and other conservation related reports suggests CCSD had an aggressive water conservation program starting the late 1980s and continuing through the early-2000s. However, around 2003 or 2004, it appears the emphasis on long-term conservation programs declined. The conservation program history is summarized below.

Rate Structure

In addition to a revenue source for capital improvements and operations, a water utility's rate structure provides an opportunity to send price signals that promote efficient water use. Many water utilities in California have adopted inclining block/tiered rate structures, in which water use over a basic level becomes more expensive for each unit of use. Tiered rates are often combined with a base fee or basic service charge. Optimum base fees, tier break points, and price for each tier are complicated issues that involve many variables. These issues are addressed in numerous publicly available water conservation and rate structure planning guidebooks.

CCSD has an inclining block rate structure that bills for water use in units of 748 gallons, or CCFs, every two months. For residential services, a base fee includes 1 to 6 units of water use for $23.82. This is equivalent to $3.97 per CCF for 6 CCFs of water use. CCSD then charges $6.05 for each additional CCF from 7 to 15 CCFs. There are numerous tiers up to a highest tier of $7.86 per CCF.[16]

CCSD's rate structure for commercial services includes a base fee for 1 to 6 units of water use for $55.18. CCSD then charges $6.69 for each additional unit from 7 to 15 units, with numerous tiers up to top tier of $9.02.[17]

CCSD also enacts a drought surcharge that increases the cost of the tiers. A review of CCSD board resolutions indicates that since 2002, drought surcharges were in place for at least some part of the year in 2002, 2004, and 2007.[18] In the most recent period with drought surcharges, the surcharges were enacted by CCSD board resolution on June, 28, 2007, and rescinded on January 22, 2008. While it may have had some impact, it is unlikely that the drought surcharge during these limited time periods by itself had a large effect on the declining water use in recent years.

CCSD's volumetric pricing and tiered rates should help in promoting efficient water use. However, CCSD's tier prices are relatively flat. Many conservation oriented water utilities in California have much more steeply priced tiers, in which an efficiency based water budget sets the lowest tier and the top tier may be several times the price of the lower tiers. Also, CCSD's lowest tier of $6.05 (after the base fee) is relatively high in California. CCSD may find value in increasing the price of the higher tiers, and lowering the price for lower tiers so that customers shifting to higher water use see a stronger price signal. To some extent, the drought surcharge accomplishes this for the years it is in place. But it is utilized only in drought years, and does not decrease lower tiers.

Water Conservation Site Surveys

On-site water use surveys or consultations and recommendations for efficiency improvements have become a cornerstone of water conservation programs for urban water utilities in California.

CCSD's 2005 Urban Water Management Plan indicates that on average 250 single-family residential surveys were completed per year from 1998 through 2002.[19] This would amount to 1,250 single-family surveys, or 34.3% of the 3,644 single-family connections reported in the 2010 Urban Water Management Plan. The 2005 Urban Water management Plan also states that all of the multi-family sites received surveys during this period.[20]

The 2005 Urban Water Management Plan projected an annual average of 180 surveys per year for 2006 through 2010. However, with a minimal staffing level of 0.5 FTE allocated to conservation during this time period, this would be very difficult to achieve without allocating additional staff. CCSD's annual reports for BMP No. 1 in the Best Management Practices annual reports, subsequently reviewed in this report, suggests very few site surveys have been conducted since 2005.

It is unclear if water conservation site surveys have been conducted for commercial and large landscape sites. If not, this may represent a significant additional water conservation opportunity.

Toilet Replacement Program

Replacement of old, water guzzling toilets, often using as much as 5 to 7 gallons per flush, with water efficient toilets using as little as 1.28 gallons per flush is widely recognized as one of the most effective water conservation programs for urban communities.

According to CCSD's 2010 Urban Water Management Plan:

> "Since beginning a rebate program for replacement of toilets in 1989, approximately 2,615 single-family residences have been retrofitted with ultra-low-flow toilets (1.6 gpf). This is the result of direct customer rebates as well as the existing CCSD plumbing retrofit program. It is estimated that a total of approximately 5,200 ultra-low-flow toilets (1.6 gpf) have been installed to date"[21]

As noted in Table 7, CCSD had 3,644 single-family connections in 2011. Therefore, the toilet retrofit status of about 1,000 of the single-family accounts is uncertain. Some of these sites have probably been retrofitted due to remodels and replacement of malfunctioning fixtures. However, it is possible that a large number of 3.5 gallon per flush and 5-8 gallon per flush toilets still exist in single-family sites. The known retrofitted toilets are 1.6 gallon per flush. Significant future water savings can be expected as the new generation 1.28 gallon per flush toilets replaces older stock.

The 2005 and 2010 Urban Water Management Plans do not describe or quantify the installation of efficient toilets in multi-family and commercial sites. These may represent a substantial additional conservation opportunity.

Clothes Washer Retrofits
Clothes washers represent one of the largest water uses in residential households. Replacement of old clothes washers with a new generation of high-efficiency clothes washers is an important water conservation program for California water utilities.

CCSD's 2010 Urban Water Management Plan states:

> The District previously offered a $150 rebate on every energy-star washing machine installed. However, this program was suspended due to a budget shortfall during FY2009/2010. Regardless of this interim setback, the CCSD remains committed to moving forward with DMM F as funding becomes available. Each energy-star washing machine saves on average approximately 4.8 units (3,580 gallons) of water per year. Since this program began in 2002, the District has funded the installation of __ energy-star rated washing machines. In developing the actual program costs, approximately $25 was added to the rebate for staff processing time.[22]

CCSD's 2005 Urban Water Management Plan indicates rebates were provided for efficient clothes washers beginning in 2002.[23] Table 3 provides the number of clothes washer rebates provided by CCSD, as reported in its UWMPs and BMP reports since 2002.

Table 3
CCSD Annual Clothes Washer Rebates

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Rebates	26	89	69	47	?	20	33	?	0	0

As shown later in Table 7, there were 3,643 single-family accounts in the CCSD service area in 2010. The 2010 U.S. census indicates there were a total of 4,062 dwelling units in the CCSD service area.[24] This suggests there were 419 multi-family dwelling units in the service area. Since a total of only 284 clothes washer replacements are documented, a very large market for efficient clothes washers appears to exist. Since clothes washers have an average operational life of about 14 years,[25] some of these may have been replaced. Also, many vacant dwelling units appear to exist in Cambria for part of the year, but clothes washers in these sites may be very heavily used in peak season.

A program to replace old clothes washers with a new generation of efficient technology appears to represent a substantial new water conservation opportunity for CCSD. Furthermore, providing more efficient clothes washer in commercial coin-operated Laundromats, and for businesses such as hotels may provide significant additional water conservation opportunity.

New federal requirements for more efficient residential clothes washers are under development and expected to become effective in 2013 or 2014.[26] Over the next couple of decades a large portion of the old clothes washers will be replaced with more efficient machines. If CCSD offered an effective financial incentive program such as rebates, it could accelerate this process and provide a more immediate and cost-effective improvement in water supply reliability.

Review of Water Conservation "Best Management Practices" Reports
The California Urban Water Conservation Council was established in 1991 and supports the implementation of the urban water conservation "Best Management Practices" (BMPs).[27] The BMPs are defined in a Memorandum of Understanding (MOU) that also defines the level of water conservation program effort signatory agencies must make to remain in compliance with the MOU. Agency program effort and compliance are tracked with annual reports to the Council. The BMPs do not represent every possible water conservation measure, but are intended to represent a suite of water conservation programs that will generally be cost-effective and beneficial for urban water utilities to implement as part of responsible water management.

The MOU defining the water conservation Best Management Practices originally identified 16 water conservation programs. It has been modified and updated over the years to reflect advances in water conservation technologies and policies. During the period when CCSD was filing annual reports (2005 through 2008) there were 14 BMPs. Signatory agencies agreed to implement, or to implement similar programs "at least as effective as" each BMP. The 14 BMPs, as they existed during the years CCSD submitted reports, are summarized in Table 4.

Table 4
Water Conservation Best Management Practices in California[28]

BMP 1	Residential Water Conservation Site Surveys
BMP 2	Residential Plumbing Retrofit
BMP 3	Distribution System Leak Audits & Repair
BMP 4	Metering & Commodity Rates
BMP 5	Large Landscape Conservation Programs & Incentives
BMP 6	Clothes Washer Rebates
BMP 7	Public Information Programs to Support Conservation
BMP 8	School Education Programs
BMP 9	Conservation Programs for Commercial, Industrial and Institutional Accounts
BMP 10	Wholesale Agency Assistance
BMP 11	Conservation Pricing
BMP 12	Conservation Coordinator
BMP 13	Water Waste Prohibitions
BMP 14	Residential Toilet Replacements

The BMPs are generally accepted cost-effective water conservation programs appropriate for urban water utilities in California. They represent a minimum water conservation effort that should be expected by water utilities.

Recital F in BMP Memorandum of Understanding states**:**

> "It is the intent of this MOU that individual signatory water suppliers (1) develop comprehensive conservation BMP programs using sound economic criteria and (2) consider water conservation on an equal basis with other water management options."[29]

Section 1.2 states:

> "Implementation" means achieving and maintaining the staffing, funding, and in general, the priority levels necessary to achieve the level of activity called for in the descriptions of the various BMPs and to satisfy the commitment by the signatories to use good faith efforts to optimize savings from implementing BMPs as described in Section 4.4 of this MOU. Section B of Exhibit 1 to this MOU establishes the schedule for initial implementation of BMPs.[30]

Section 4.5 of the MOU addresses exemptions. It states exemptions are allowed when:

> Adequate funds are not and cannot reasonably be made available from sources accessible to the water supplier including funds from other entities. However, this exemption cannot be used if a new, less cost-effective water management option would be implemented instead of the BMP for which the water supplier is seeking this exemption.[31]

CCSD is a signatory of the MOU. In its 2005 and 2010 Urban Water Management Plans, CCSD cites compliance with the MOU as a core component of its present day water conservation programs.[32]

CCSD's annual reports to the California Urban Water Conservation Council were obtained to help determine CCSD's water conservation efforts in recent years. Apparently reports were only filed for the years 2005 through 2008. The reports are summarized for each year reported in Appendix B. CCSD has implemented some of the BMPs such as a conservation rate structure and toilet replacements in single-family residential services. However, the BMP annual reports suggest that minimal effort was made between 2005 and 2008 to implement the full range of BMPs, and in particular the BMPs with measurable water savings such as retrofit of old water wasting fixtures.

Buildout Reduction Program

In 2005 CCSD convened a citizens committee to "study the feasibility of a buildout reduction in Cambria."[33] The committee deliberated and in 2006 presented its findings and recommendations to the CCSD board. The 2006 report states,

> The Buildout Reduction Program seeks to retire or merge enough potential building sites so that there is a near match between those who are authorized to build under the cap of 4,650 existing and new residential water connections, and the number of suitable building sites. This will happen over a projected 22 years.
>
> Funding would come from four suggested sources: an additional fee for new water connections, a special water rate increase, an additional fee for remodels, and sale of some unallocated water connections that fall within the 4,650 existing and future residential connections cap. Without the last source of funds, the first three increases would have to be much higher.
>
> Local land trusts would sell three unallocated water connections a year over the projected 22-year life of the program, and use the proceeds to purchase and retire potential building sites. Sale of properties to the land trusts would be voluntary; no landowner would be forced to sell. Lots would be retired with a deed restriction.[34]

The program is designed to reduce the number of lots available for new construction to a level commensurate with San Luis Obispo County planning targets. This would help maintain the present nature of Cambria's community and reduce the need for future water supply.

The cost was projected to be $38,827,800. Funding has been a challenge for the program, particularly when coupled with the need to also fund a proposed seawater desalination facility subsequently reviewed in this report. The Buildout Reduction Program was initially conceived as a mechanism to maintain community character and to reduce future water use to a level that could then be supplied with the proposed desalination facility. However, as noted in Table 1, total and per capita water use in the CCSD service area has been declining. This trend is likely to continue and raises the question if the Buildout Reduction Program coupled with additional water conservation and water recycling would be adequate for future water supply needs.

Water Conservation and 2:1 Retrofit Ordinances

CCSD has ordinances requiring the retrofit of existing services under certain conditions. Municipal Code, Chapter 4.16 requires retrofit to low-water-use plumbing and plumbing fixtures on time of resale or change use.[35] CCSD Municipal Code, Chapter 4.20 provides a 2:1 conservation offset program for new connections.[36] New connections are provided once adequate conservation retrofits identified in the ordinance are conducted to conserve twice the amount of water needed by the new connection. These ordinances appear to have been the mechanism for a large number of CCSD conservation retrofits.

As noted in CCSD's 2010 Urban Water Management Plan:

> Since 1989, approximately 88-percent of the single-family residential connections within Cambria have had plumbing retrofits completed. Retrofitting of an existing house is a requirement upon resale or remodeling. The District uses a point system to develop equivalencies for any new home construction as well as remodels. Once the total points are determined, new construction and remodels are required to either retrofit a set number of retrofit points within the service area, or pay into a retrofit in-lieu fee. Collected fees from this program are used to support water conservation programs throughout the District. The District's retrofit program was designed to achieve a 2:1 water savings goal, with retrofitted homes providing twice the water savings as the projected demand from new construction. Planned Measures – The District proposes to continue with its existing retrofit program."

It is possible that a large percentage of the single-family residences are retrofitted. However, we were unable to obtain any report that gave specific numbers of retrofits each year, the actual fixtures and devices retrofitted, and how this compares to the potential retrofit market, or the number of high-water-use fixtures that originally existed in the service area. Beyond the single-family retrofit market, multi-family and commercial retrofit saturation appears unknown, but may represent a significant water savings opportunity.

It is likely that retrofit activity in the 2:1 offset program has been low during the last decade since 44 new connections have occurred since 2003, and 5 new connections since 2008. Some portion of these new connections may have been the 20 undefined "other" and "internal" accounts added since 2006 (see Table 7 and Appendix A)

Little definitive documentation appears to exist on conservation program saturation rates in the CCSD service area. An important question remains as to why per capita water use in the CCSD service area is on the lower side of the typical range. Is it due to a high level of conservation device saturation? Is it due to a relatively low amount of landscape water use? Is it due to more careful water use by local residents? How much of a role has the slow economy in recent years played? Are there other important factors? These are very important questions that should be answered as a fundamental part of future water management planning. A comprehensive water conservation baseline study should be conducted to resolve these issues.

Water Use Projections

50% "Quality of Life" Water Use Increase

On July 24, 2003, the CCSD board voted to pursue a desalination facility as a new water supply project and to size the facility to provide "the maximum goal of average residential water use from 12 to 18 units."[37] This represents a 50% increase in allowable water use and is a key assumption in the 2008 Water Master Plan.

As noted in Table 1, in 2002, the year preceding the vote, the average gallons per capita per day (gpcd) water use was 116.7. This represented relatively low water use in California by 2002 standards. The policy adopted in 2003 for a 50% increase would provide for an average water use of 175 gpcd. By contrast, 2011 water use for CCSD was 101.1 gpcd. As noted in the water conservation program analysis, this decrease in per capita water use occurred despite what appears to have been minimal water conservation program support by CCSD for the most recent decade.

Task 4, Future Water Use Projections

In its 2008 Water Master Plan, CCSD uses future water use projections from its "Assessment of Long-Term Water Supply Alternatives" as the basis of its projected need for new water supply. The report was finalized in 2004 and "Appendix C" in the 2004 report provides the assumptions and background on the future demand analysis.

The key water use assumptions in CCSD's 2004 future water use projects, including the 50% "quality of life" water use increase, are provided in Table 5 below, along with the actual in 2011.

Table 5
CCSD Water Master Plan Assumptions for Water Use Projections

Category	Master Plan Assumptions[38]	2011 Actual
Annual water use per residential connection	0.161 afy	0.116 afy
Low Estimate - annual water use per connection (all connections)	0.205 afy (with avg 1.66 persons/household)	0.154 afy (with avg 1.48 persons/household)
High Estimate - annual water use per connection (all connections)	0.255 afy (with avg 2.21 persons per household)	0.154 afy (with avg 1.48 persons/household)
Annual water use per commercial connection	0.959 afy	0.643 afy
Unaccounted losses[39]	24%	9.1%, with stated future goal of 8%
"Quality of Life" water use increase	50% increase in per capita water use	12% decrease in per capita water use

The Task 4 report states the water use projections are based on water use in the single year of 1999. But the 1999 water use per connection figures in Task 4, Appendix C are actually significantly higher than the water use figures in CCSD's 1999 Public Water System Statistics report submitted to the California Department of Water Resources (see Table 7 and Appendix A of this report).[40] The 1999 water use, adjusted with the assumptions in Table 5, along with the expected number of dwelling units at buildout, lead to the conclusion that a large new water supply is needed – which in turn lead to the focus on seawater desalination as the only viable alternative. Since nearly a decade of time has passed since these assumptions and calculations occurred, it is now possible to assess the accuracy of the assumptions shown in Table 5 and explored in more detail below.

Actual Water Use per Service Connection

An analysis of water use per service connection is provided in Table 6. Note that after some rebound from the drought of the late 1980s, there is a general downward trend in water use per service connection.

Table 6
Water Use per Service Connection

Year	Total Billed (af)	Total Conn	Use per Conn (af)
1991	473.2	3,316	0.143
1992	537.5	3,342	0.161
1993	570.4	3,399	0.168
1994	597.7	3,436	0.174
1995	601.0	3,454	0.174
1996	642.8	3,548	0.181
1997	646.0	3,642	0.177
1998	614.3	3,770	0.163
1999	668.5	3,796	0.176
2000	687.2	3,887	0.177
2001	693.2	3,882	0.179
2002	700.1	3,966	0.177
2003	698.5	3,980	0.175
2004	659.4	3,991	0.165
2005	645.5	3,993	0.162
2006	688.3	4,007	0.172
2007	677.5	3,999	0.169
2008	668.9	4,019	0.166
2009	660.5	4,021	0.164
2010	619.1	4,024	0.154
2011	620.7	4,024	0.154

A more detailed breakdown by type of customer class for the years 2000 through 2011 is provided in Table 7. As previously noted, CCSD appears to have reduced water conservation program support starting around 2003, but an overall decline in water use by connection continued to occur. Furthermore, the decline in water use began and continued before the economic downturn that began in the end of 2007.

Table 7
Analysis of Water Use per Customer Class Service Connection[41]

Year	Total Conn	Total Resi Conn	SFR Conn	MFR Conn	CII Conn	Internal/ Other Conn	Water Use/Total Conn	Water Use/SFR Conn	Water Use/MFR Conn	Water Use/ Resi Conn (SFR & MFR)	Water Use/ CII Conn
1999	3,796	3,585	?	?	211	?	0.176	?	?	0.139	0.776
2000	3,887	3,674	3,587	87	213	?	0.178	?	?	0.139	0.785
2001	3,882	3,668	3,574	94	214	?	0.178	?	?	0.143	0.783
2002	3,966	3,750	3,647	103	216	?	0.177	?	?	0.139	0.826
2003	3,980	3,758	3,647	111	220	2	0.176	?	?	0.143	0.727
2004	3,991	3,768	3,648	120	221	2	0.166	?	?	0.132	0.730
2005	3,993	3,769	3,642	127	222	2	0.162	0.156	0.179	0.156	0.600
2006	4,007	3,772	3,642	130	221	14	0.172	0.134	0.154	0.135	0.741
2007	3,999	3,772	3,640	132	225	2	0.169	0.125	0.180	0.127	0.706
2008	4,019	3,772	3,641	131	227	20	0.166	0.119	0.168	0.121	0.662
2009	4,021	3,773	3,643	130	228	20	0.164	0.120	0.166	0.121	0.639
2010	4,024	3,775	3,643	132	229	20	0.154	0.113	0.163	0.115	0.630
2011	4,024	3,775	3,644	131	229	20	0.154	0.114	0.172	0.116	0.643

Urban Water Management Plan Water Use Projections
In its 1989 Urban Water Management Plan, CCSD forecasted 1994 annual water demand of 1,041.5 acre-feet.[42] However, as noted in Table 1, CCSD records indicate 1994 total production was actually 662 acre-feet. Of the 662 acre-feet, 598 was billed water use. The remainder was unaccounted losses, which may include system leaks and meter inaccuracies.

In its 2005 Urban Water Management Plan, CCSD forecasted annual demand of about 1,300 acre-feet in the year 2010, which includes the 50% quality of life water use increase. However, CCSD records indicate total production in 2010 was 672.4 acre-feet.[43]

The future water use projections from CCSD's past Urban Water Management Plans are summarized in Table 8.

Table 8
Past UWMP Water Use Projections[44]

UWMP Year	Water Use Projection Year	Projected Water Use (AF)	Actual Water Use (AF)
1989	1994	1,041.5	662
2005	2010	1,284	672
2005	2015	1,483	NA
2005	2020	1,514	NA
2005	2025	1,514	NA

California's 2009 Water Conservation Act (also frequently referred to as SB7-7 or the 20x2020 legislation) provides a goal for urban water utilities to reduce overall water use 20% by the year 2020.

Water utilities are allowed several methods of calculating baseline water use and future water use targets to meet this goal, and can select a result that provides for the most water use of the range of options.[45] In its 2010 Urban Water Management Plan, CCSD address this requirement and indicates a 10-year water use average of 112.4 gpcd, and a 5-year average of 110.7 gpcd.[46] CCSD then selected a year 2020 water use target of 105 gpcd, which represents 95% of its 5-year per capita water use average, and a year 2015 interim water use target of 109 gpcd.[47] This actually represents an increase in per capita increase water use compared to an average of 102 gpcd for the last four years (see Table 1).

CCSD's 2010 Urban Water Management Plan then uses these per capita water use targets as the basis of future overall water demands, which are summarized in Table 9.

Table 9
2010 UWMP Water Use Projections

Year	Water Use Projection (AF)	With 8% Unaccounted Losses (AF)
2015	740	799.2
2020	799	862.9
2025	836	902.1
2030	836	902.1
2035	836	902.1

As noted in Table 9, CCSD's 2010 Urban Water Management Plan projects that when buildout of the community occurs in the year 2025, total annual metered water use will be 836 acre-feet (not including system unaccounted losses). The 2010 Urban Water Management Plan projects an ongoing 8% system unaccounted water loss, which would bring the total annual water use to 902.1 acre-feet per year. This represents about a 200 afy increase in water demand from the present demand of about 700 afy (see Table 1).

Regarding assumptions in the 2010 Urban Water Management Plan, the plan states, "Beyond the build-out scenarios, there is also an unknown associated with the population in Cambria decreasing by three percent from 2000 to 2010. Some have speculated the drop in population occurred due to the economic recession forcing people to move away and find employment elsewhere. For purposes of forecasting, the lost three percent of population (approximately 200) was assumed to come back into the area as the economy improves. Therefore, the forecasting assumed the earlier 2000 census total would be re-established by 2015 in each scenario. The future projections also used the 1990 and 2000 census averages of approximately 1.66 persons per housing unit."[48]

The 2010 Urban Water management Plan provides a more realistic water use forecast compared to previous plans. However, by selecting the highest 10-year and 5-year averages for the baselines use, as with past water use projections that have proven faulty, the 2010 Urban Water Management Plan projections assume per capita and overall water use will increase from present day levels and trends. It is entirely possible that the population will not increase as forecasted, and that improvements in water use efficiency due to replacement of old, malfunctioning fixtures will continue to reduce per capita water use in future years. If so, the water use projections in the 2010 Urban Water Management Plan, like the previous plans, may significantly overestimate the need for new supply.

Water Use Projections Based on Present Day Per Capita Trends

As noted in Table 1, per capita water use has continued to decline in recent years. New national appliance efficiency standards are likely to lead to further declines, even in the absence of CCSD water conservation programs supporting retrofits. Therefore, an analysis of future water use at buildout based on present day per capita water use may prove useful.

As noted in Table 7, CCSD has 3,775 residential service connections in 2011. The adopted buildout limit is 4,650 residential connections, which represents a 23.2% increase.

As noted in Table 1, for the last four years, 2008 through 2011, water use averaged 102.0 gpcd, including all production and unaccounted losses. Using the last four years for this analysis avoids using 2007 when CCSD's rate structure included drought surcharges.

If we evaluate the average number of persons per service connection, increase the number of residential service connections 23.2% at buildout, and use the recent 102.0 gpcd as the future water use, we can arrive at future water use projections based on the actual recent water use trend. Table 10 provides this analysis with both the 2000 and 2010 census population density as two separate scenarios.

Assumptions for analysis:

102.0 gpcd average water use for 2008-2011, including all production and unaccounted losses
3,775 Residential service connections in 2011
4,650 Residential connections at buildout
23.2% Percent increase in service connections and population at buildout
6,232 CCSD service area population in 2000
6,032 CCSD service area population in 2010

Table 10
Projected Water Use at Buildout Based on Per Capita Water Use Patterns in Recent Years

Scenario 1	(Based on 2000 Census)
7,678	Population at buildout, 23.2% increase in connections
876.8 afy	Total annual water production with buildout population of 7,678 and 102.0 gpcd
Scenario 2	(Based on 2010 Census)
7,431	Population at buildout, 23.2% increase in connections
848.7 afy	Total annual water production with buildout population of 7,431 and 102.0 gpcd

As shown in Table 10, future water use projection based on actual water use in the most recent four years indicates that at buildout, total water production would range between 848.7 afy and 876.8 afy. Note that these figures include all production, including unaccounted losses.

A simpler calculation for projecting future water use is to assume the same 23.2% increase in all connections, increase total billed water use in recent years 23.2% and add in reasonable assumptions for unaccounted losses to then project a total water use for the service area. Table 11 provides this analysis for both 6% and 8% unaccounted losses. Scenario 3 is based on average annual water use from 2008-2011. Since water use has continued to decline in recent years, Scenario 4 is based on just the last two years of water use.

Table 11
Projected Total Water Use at Buildout Based on 23.2% Increase in Water Use

Scenario 3	
642.3 afy	Total averaged annual billed water use for 2008-2011
791.3 afy	Total billed water use with 23.2% increase at buildout
838.8 afy	Total annual water production, 6% unaccounted losses included
854.6 afy	Total annual water production, 8% unaccounted losses included
Scenario 4	
619.9 afy	Total averaged annual billed water use for 2010-2011
763.7 afy	Total billed water use with 23.2% increase at buildout
809.5 afy	Total annual water production, 6% unaccounted losses included
824.8 afy	Total annual water production, 8% unaccounted losses included

In the four scenarios in Table 10 and Table 11, the future total water production at buildout ranges from a low of 809.5 afy to a high of 876.8 afy. As noted in Table 1, CCSD's highest year of total production was 819.5 afy in 1988. Numerous other years have been close to 800 afy.

The recent economic downturn may have played a role in reducing water use in recent years. But a downward trend in both per capita and total water use began well before the economic downturn started in 2008. With new, more stringent water efficiency standards for appliances expected to become effective in 2013 or 2014, interior per capita residential water use can be expected to further decline in future years. This pattern is already widely observed for urban water utilities. A recent study by AquaCraft, which has conducted numerous studies in the U.S. tracking the decline in urban per capita water use, concluded that interior water use may continue to decline to as low as 40 gpcd once the latest generation of high efficiency water use fixtures fully saturate the market.[49]

If CCSD pursues new water conservation opportunities that appear to exist for commercial, multi-family and single-family services, and strives to reduce potable water use for landscaping, future water use may decline well below the buildout levels identified in Table 10 and Table 11.

Comparison to Other Water Utilities
The per capita water use in the CCSD service area is relatively low in California. However, Watsonville is an example of lower per capita water use. Further afield, Santa Fe, N.M., provides an example of a city with a large visitor population and lower per capita water use, even factoring in the visitor water use with local population water use.

Watsonville, Calif.
Watsonville is located in Pajaro Valley in the Monterey Bay area. Watsonville has a population of 65,739. In its 2010 Urban Water Management Plan, Watsonville reports a 10-year (2001-2010) daily per capita water use average of 104.4 gallons, and a 5-year (2006 - 2010) per capita water use average of 98.7 gallons. [50]

Santa Fe, N.M.
Santa Fe's full time, water service area population was 84,877 in 2010.[51] Annual rainfall is 14 inches, with about 17" of snow. Santa Fe receives a large number of visitors each year, between 1 and 2

million, which affects water use.[52] Santa Fe has implemented a comprehensive suite of conservation programs resulting in a decline of per capita water use from 168 gpcd in 1995 to 98 gpcd in 2009, including visitor water use, and without a call for rationing in recent years.[53]

Review of CCSD Desalination Cost Projections

On July 24, 2003, the CCSD board voted to pursue a desalination facility as a new water supply project and to size the facility to increase "the maximum goal of average residential water use from 12 to 18 units."[54] One factor influencing this decision was the 50% "quality of life" water use increase. Other factors included population and density assumptions that have proven to be significantly overestimated. Another factor appears to be the projected cost of seawater desalination compared to other water supply improvement alternatives. An additional factor appears to have been the conclusion that only seawater desalination, as a stand-alone alternative, was capable of providing the project water supply increase of 602 afy necessary based on the 50% quality of life water use increase along with the projected number of new water service connections.

The cost projections for seawater desalination were developed in a series of reports released between 2000 and 2004.[55] These reports provide the basis of the seawater desalination production and cost figures included in CCSD's Final Water Master Plan – Program Environmental Impact Report released in July 2008.[56] The most recent updates to the figures included a solar option and CPI/ENR construction cost updates.

Facility Capacities Considered by CCSD

The CCSD cost projections were developed for four levels of design capacity noted in Table 12. The design capacity provided in the cost reports was in the units of gallons per minute (gpm). Table 12 provides afy and mgd conversions to facilitate comparisons to present day projections of new water supply need, and the costs of other existing and proposed seawater desalination facilities.

Table 12
Design Capacity Levels

CCSD Design Capacity	MGD Potential at Full Capacity	CCSD Indicated Operating Capacity in AFY[57]	AFY Potential at Full Capacity
300 gpm	0.43 MGD	300 afy	484 afy
600 gpm	0.86 MGD	520 afy	968 afy
740 gpm	1.07 MGD	602 afy	1,194 afy
900 gpm	1.30 MGD	820 afy	1,452 afy

Source for blue shaded figures: CCSD 1998 Water Supply Master Plan – Program Environmental Impact Report, p. 13-211, 13-212.

In addition to the CCSD indicated water production, Table 12 provides the MGD and AFY production potential calculated with the facility operated at 100% design capacity 365 days per year. Actual operating parameters may result in lower annual water production and CCSD documents indicate that the facility would be operated primarily to provide extra water supply in the summer dry season. However, it should be noted that the AFY water production potential for a facility being operated a full capacity is much greater than indicated by the CCSD documents. A facility capable of producing 740 gpm, if operated at full capacity throughout the year, would have the ability to supply 1,194 afy, which is about twice the actual annual water use in the CCSD service area in recent years (see Table 1).

CCSD Projected Cost of Water Produced
In its 1998 Program EIR, CCSD released costs for seawater desalination facilities with the four levels of production capacity. These are provided in Table 13. The costs include an option without a solar power array, and an option with a solar array for offsetting energy use included in the cost estimates. [58]

Table 13
CCSD Seawater Desalination Cost Projections (2008)

CCSD gpm	CCSD afy	Cap Cost	Fixed O&M	Ann Fixed Cost	Variable Costs $/Af	Net Present Worth (30 yr, 4%)	$/AF 30 yr PW basis
No Solar Array Included:							
300	300	$8,247,000	$107,000	$584,000	$800	$18,425,091	$2,047
600	520	$9,920,000	$132,000	$706,000	$710	$19,810,509	$1,256
740	602	$11,257,000	$144,000	$795,000	$700	$21,033,916	$1,165
900	820	$12,785,000	$157,000	$895,000	$680	$22,578,516	$918
Solar Array Included:							
300	300	$11,546,280	$107,000	$584,000	$280	$16,311,273	$1,812
600	520	$14,940,800	$132,000	$706,000	$249	$19,810,185	$1,270
740	602	$17,220,180	$144,000	$795,000	$245	$22,260,635	$1,233
900	820	$19,813,400	$157,000	$895,000	$238	$25,005,783	$1,016

Source for blue shaded figures: CCSD 1998 Water Supply Master Plan – Program Environmental Impact Report, p. 13-211, 13-212.

The CCSD cost projections indicate the preferred 740 gpm facility (operating at 50.4% of its theoretical full annual capacity) could produce new water supply at a marginal cost of $1,165/af without the solar array to offset energy use, and $1,233/af with the solar array option. The solar array increases the capital costs and decreases the ongoing variable O&M costs. But the overall cost of water produced is slightly higher with the solar array included.

Since some of the cost analysis and assumptions are not fully documented in the CCSD reports, it is uncertain how the CCSD cost figures were developed. It appears that a CPI/ENR of 3% was used and an interest rate of 4% was used. The discount rate for deriving "Net Present Worth" was not documented and attempts by Cambria community members to obtain this information, along with other details on the cost calculations, were denied a response by CCSD staff.[59]

A facility operating at 50.4% of its full design capacity would typically result in higher cost per acre-foot of water produced compared to a facility operating at full capacity. While some energy and other O&M costs would be reduced from the reduced operating capacity, and the total annual cost to CCSD would be reduced, many of the costs including financing and many personnel and O&M costs are fixed. Therefore, fixed costs would be spread over less water produced, raising the overall cost per acre-foot of water actually produced.

Since it was not entirely clear how the CCSD costs figures were calculated, an analysis was conducted with commonly used financing assumptions for this type of project using CCSD capital, and variable cost estimates as inputs. For this analysis, assumptions included a 30-year financing term, a commonly used 5% interest for long-term public utility financing, a 3% CPI, and a 2% discount rate. Using these assumptions provides an opportunity to compare the CCSD costs estimated to other facilities that have used similar financing assumptions to better determine if the cost estimates appear realistic. Table 14 provides the results without a solar array included.

Table 14
Financial Analysis Based on CCSD Cost Estimates and Assumptions: 30 Yrs Financing, 5% Interest, 3% CPI, 2% Discount Rate

CCSD gpm	CCSD afy	Full Production Capacity afy	Cap Cost, (30 yrs, 5% Int, 3% cpi, 2% discount rate, no solar)	CCSD Fixed Annual O&M	CCSD Ann Fixed Cost	Variable Costs $/af	Annual Variable Cost at CCSD afy	Total Annual O&M at CCSD afy	Annual Variable Costs at Full Capacity afy	Total Annual O&M at Full Capacity afy	Marginal Cost Based on CCSD afy Production	Marginal Cost Based on Full Capacity afy
300	300	484	$368,228	$107,000	$584,000	$800	$240,000	$347,000	$387,122	$494,122	**$2,384**	**$1,782**
600	520	968	$442,927	$132,000	$706,000	$710	$369,200	$501,200	$687,141	$819,141	**$1,816**	**$1,304**
740	602	1,194	$502,624	$144,000	$795,000	$700	$421,400	$565,400	$835,538	$979,538	**$1,774**	**$1,242**
900	820	1,452	$570,849	$157,000	$895,000	$680	$557,600	$714,600	$987,160	$1,144,160	**$1,568**	**$1,181**

Source for blue shaded figures: CCSD 1998 Water Supply Master Plan – Program Environmental Impact Report, p. 13-211, 13-212.

The blue shaded columns are drawn directly from CCSD planning documents.[60] The marginal costs results are based on the noted financing assumptions and CCSD costs estimate inputs. The analysis includes marginal costs based on CCSD proposed annual production levels, and marginal costs with the various sized facilities operating at full capacity for the full year. The marginal costs at the CCSD production level provides an indication of what CCSD customers would actually be paying for the water produced under the CCSD operational scheme and CCSD costs estimates. The full capacity marginal costs figures provide a more level comparison to other seawater desalination facility costs, allowing for an assessment of how realistic the Capital and O&M costs figures may be compared to other existing and planned seawater desalination facilities.

Table 15 provides a marginal cost assessment at both CCSD production levels and full capacity production, with the costs separated into annual O&M and annual capital costs per acre-foot of water produced.

Table 15
Marginal Costs of Water Produced Based on CCSD Cost Estimates & Assumptions: 30 Yrs Financing, 5% Interest, 3% CPI, 2% Discount Rate

CCSD gpm	CCSD afy	Full Production Capacity afy	Cap Cost/af at CCSD Production Capacity	Fixed & Variable O&M Cost/af at CCSD Production Capacity	Marginal Cost Based on CCSD afy Production	Cap Cost/af at Full Production capacity	Fixed & Variable O&M Cost/af at Full Production Capacity	Marginal Cost Based on Full Capacity afy
300	300	484	$1,227	$1,157	**$2,384**	$761	$1,021	**$1,782**
600	520	968	$852	$964	**$1,816**	$458	$846	**$1,304**
740	602	1,194	$835	$939	**$1,774**	$421	$821	**$1,242**
900	820	1,452	$696	$871	**$1,568**	$393	$788	**$1,181**

Source for blue shaded figures: CCSD 1998 Water Supply Master Plan – Program Environmental Impact Report, p. 13-211, 13-212.

With these financing assumptions, the marginal cost is much higher for the CCSD production levels and slightly higher for the full capacity production level than the cost figures reported in CCSD public documents. For example, for the 740 gpm facility without solar, CCSD indicated a cost of $1,165/af of water produced. With these financing assumptions, the marginal cost for the same facility and the CCSD production level is $1,774/af, and $1,242/af at full capacity production of 1,194 afy.

The basis of the CCSD seawater desalination cost figures were developed about a decade ago. Since that time, there has been much interest in better determining realistic costs for seawater desalination in California.

Cost Comparison to Other Seawater Desalination Facilities
An independent report released in 2010 evaluated existing and proposed seawater desalination facilities in the U.S. and California. The report concluded that seawater desalination facilities in California, in the best of conditions using the latest technology, would have a marginal costs ranging from $2,000 to $3,000 per acre-foot of water produced.[61] This cost range was for facilities significantly larger than the proposed CCSD facility seawater facilities. Presumably large facilities benefit from economy-of-scale cost savings.

Capital Cost Comparison
As previously noted in Table 13, CCSD projects a capital cost of $11,257,000 for a 740 gpm seawater desalination facility. This is the alternative adopted by the CCSD board for providing 602 afy of water during the summer months. Table 16 provides an analysis of the capital cost per acre-foot of design capacity with the facility operated at full capacity. The capital cost for a 740 gpm facility identified in CCSD documents is $10.6 million per MGD of full design capacity. [62]

Table 16
Analysis of CCSD Capital Cost per MGD Capacity (no solar)

CCSD Gpm	CCSD Afy	Full Capacity afy	MGD at Full Capacity	CCSD Capital Cost	CCSD Capital Cost in Millions/MGD at Full Capacity
740	602	1,194	1.07	$11,257,000	$10.6

Source for blue shaded figures: CCSD 1998 Water Supply Master Plan – Program Environmental Impact Report, p. 13-211, 13-212.

To gain a sense of how realistic this capital cost/MGD of design capacity may be, a comparison was conducted to the proposed seawater desalination facility for the Marin Municipal Water District in the San Francisco Bay Area and the proposed Carlsbad facility in Carlsbad, Calif. The cost estimates were publicly released for Marin facility for a 5 MGD design capacity and a 10 MGD design capacity. The proposed Carlsbad facility would have a 50 MGD capacity. Table 17 provides the capital cost comparison per MGD of design capacity.

Table 17
Capital Cost per MGD of Design Capacity[63]

Project	CCSD (740 gpm)	CCSD (900 gpm)	Carlsbad	Marin	Marin
Design Capacity (Full Production)	1.07 MGD	1.30 MGD	50 MGD	10 MGD	5 MGD
Capital Cost (Millions)	$11.3	$12.8	$655	$131.4	$88.6
$ (Millions)/MGD	$10.6	$9.9	$13.1	$13.1	$17.7

The Marin capital cost figures include costs for connecting to Marin's water distribution system. CCSD's Final Project design Report states its "treated water distribution pipeline will follow a utility corridor from the RO facility to the District's existing 14-inch distribution main along San Simeon Creek Road."[64] The costs for this distribution system connection were not clear. Since the siting for the proposed Cambria facility and ocean intake and discharge structures is not settled, it is unclear if this existing utility corridor will be useful or if an alternative must ultimately be developed for connecting a desalination facility to CCSD's distribution system.

The Marin capital cost figures are based on shared use of a nearby pier for placing much of the seawater intake and outfall structures, which would significantly reduce the cost of these structures. The Carlsbad capital costs are based on use of existing ocean intake and outfall structures owned by a power plant at the proposed site. CCSD presently does not have a plan for siting intake and discharge structures. Given the environmental sensitivity of the Cambria nearby coastal areas (see Figure 1), the challenge of locating and constructing seawater intake and brine discharge structures may add considerably to CCSD's capital cost estimates.

The capital costs for Marin and Carlsbad are notably higher per MGD of capacity compared to CCSD cost estimates. For a 5 MGD facility in Marin, capital costs were estimated at $17.7 million/MGD of capacity. This compares to a CCSD capital cost estimate of $10.6 million for a much smaller 1.07 MGD facility, and $9.9 million for a 1.30 MGD facility. Some economies of scale would be likely to reduce construction cost for the larger Marin facility compared to the CCSD facility, and the intake and discharge structures are likely to be considerable more costly for the CCSD facility. Based on this comparison, it appears the CCSD capital costs have been seriously underestimated and may ultimately be significantly higher, even double the CCSD estimates.

O&M Cost Analysis and Comparison

In 1992, a 6.7 MGD facility was completed in Santa Barbara at a capital cost of $34 million[65] ($59.6 million in 2009 dollars). The facility was mothballed four months after completion and since that time has not been operated for water supply production. After several original utility partners withdrew from further participation in the project, some of the facility components were removed and sold. The remaining facility has been maintained by the City of Santa Barbara in a mothballed state for a cost of about $100,000 per year.[66] A recent detailed engineering analysis of the facility by Carollo Engineers determined it could be rehabilitated with up-to-date technology and reactivated for $20.2 million. The result would be a facility with a 2.8 MGD capacity.[67]

The 2009 Carollo report for Santa Barbara determined the O&M cost of a rehabilitated facility, excluding past and rehabilitation capital cost, would be $1,470 per acre-foot of water produced.[68] Energy costs were based on September 2008 pricing for the city of $0.086/kWh.[69] This may not be realistic for future energy costs as evidenced by the actual 2009 energy cost for the Tampa Bay project of $0.096/kWh[70] and projected energy costs for the proposed project in Marin of $0.12/kWh and Carlsbad of $0.116/kWh.

Even with the potentially low energy cost assumption, the O&M cost alone for a rehabilitated and modernized facility in Santa Barbara is projected to be $1,470 per acre-foot of water produced. As is evidenced by past capital costs for the Santa Barbara facility and the figures for the Marin facility in Table 3, the capital cost will result in a total marginal cost well above $2,000 per acre-foot of water produced if the facility is brought back into operation.

In developing its desalination O&M costs, CCSD documents indicate that energy was estimated to cost $0.15/kWh. This is nearly twice the Santa Barbara cost of $0.086/kWh. Since energy is a major cost of operating a seawater desalination facility, this would suggest that the Santa Barbara operating cost estimate would be significantly higher for the CCSD service area due to the higher energy cost.

As noted in Table 18, CCSD documents suggest the fixed and variable O&M cost would be $821/af of water produced for a 740 gpm facility operating a full capacity and $939/af at the CCSD proposal operational capacity.

Table 18
Analysis of CCSD Fixed and Variable O&M Costs per Acre-foot

CCSD gpm	CCSD afy	Full afy	Fixed & Variable O&M/af at CCSD Production	Fixed & Variable O&M/af at Full Production
300	300	484	$1,157	$1,021
600	520	968	$964	$846
740	602	1,194	$939	$821
900	820	1,452	$871	$788

Source for blue shaded figures: CCSD 1998 Water Supply Master Plan – Program Environmental Impact Report, p. 13-211, 13-212.

With significantly higher energy costs compared to Santa Barbara, it is unclear how CCSD could produce seawater desalinated water at an O&M cost about half of what is expected in Santa Barbara. Both facilities would have similar ocean intake water conditions. If anything Santa Barbara may have slightly warmer intake water, which would slightly reduce energy use and operating costs. It seems likely that the CCSD O&M costs are seriously underestimated and would probably be about twice the costs projected in CCSD reports.

Marginal Costs Comparison to the Proposed Carlsbad Desalination Facility
There has been considerable interest in the realistic marginal cost of water produced from a proposed 50 MGD facility Poseidon Resources is working to develop in Carlsbad, Calif.

In December, 2011, Poseidon received approval to sell $780 million in tax-exempt "Private Activity Bonds" to cover capital cost for the 50 MGD facility.[71] However, $125 million of the bond money is expected to be used for debt service during the construction period, if and when the project receives final permits and approvals and construction begins. Therefore, it now appears that the construction capital cost will be about $780 million, less the $125 million in construction period debt service, or $655 million. This is up from the previous capital cost estimates of $534 million, which itself was the result of numerous increases in capital cost estimates. As noted in Table 16, a capital cost of $655 million for a 50 MGD facility results in a capital of $13.1 million/MGD of design capacity.

Poseidon's most recent cost estimate is $1,865/acre-foot of water produced in 2011 dollars.[72] This cost estimate was released before more recent reports indicated that in addition to the $780 in bond money, another $26 million to $41 million will be needed to connect the facility to the San Diego water distribution system.[73] Given the history of cost overruns with desalination facilities constructed in the U.S., it is likely that the cost of water produced from the proposed Carlsbad facility would rise well above $2,000/af. This is for a large facility, with economy-of-scale cost benefits, and that would share a preexisting intake/discharge structure with a local power plant, and also benefit from warmer intake water compared to CCSD.

CCSD's seawater desalination cost projections are based on analysis now nearly a decade old. They were done at a time of considerable optimism that the costs would be competitive with other alternatives. However, comparative costs of other existing and proposed seawater desalination facilities, with more recent costs estimates than relied on by CCSD, and which reflect a greater degree of knowledge of the costs and challenges in producing water with present-day best available seawater desalination technology, suggests water produced by the relatively small CCSD facility would cost at least 2 to 3 times the estimates in CCSD documents. Without new technological breakthroughs, the cost for a CCSD facility, which is faced with serious siting challenges and would be presumably operated at well below full capacity, is likely to be at least $3,000 to $4,000 per acre-foot of water produced.

A cost of $3,000 to $4,000 per af of water produced may ultimately be an acceptable cost for CCSD customers. However, the cost should be clear to CCSD customers and should be clearly weighed against other water supply management alternatives. Given the very high cost of water produced by seawater desalination, and the financial impacts it would place on the water utility, it would probably seriously constrain capital available for other, potentially more cost-effective and environmentally friendly water management options.

CCSD has an agreement with the U.S. Corps of Engineers whereby the Corps may subsidize 75% of construction costs of a new seawater desalination facility, up to a $10.3 million for the Corps portion.[74] It is unclear what would happen if, as is very likely, the capital cost is much higher than the CCSD documents indicate, or if annual federal budget appropriations were not available for the facility. Even with heavily subsidized construction costs, just the actual O&M costs are likely to be higher than CCSD projected for the full marginal costs. This, along with any non-subsidized portion of capital costs, will place a substantial new revenue burden on CCSD and its ratepayers. The increased financial burden would occur at a time when per capita water use is likely to continue declining due to a number long-term efficiency dynamics such as new appliance efficiency standards. This would likely limit CCSD's ability to fund more cost-effective and environmentally friendly alternatives. Furthermore, with the national budget in a state of serious deficit, many may see this as a questionable use of federal funds, since the need is very doubtful and less costly alternatives appear to exist.

Guidelines for Considering Alternatives

A detailed review and analysis of other water supply alternatives was outside the scope of this project. However, some consideration of the cost implications of seawater desalination and frameworks for comparing alternatives would be useful.

The American Water Works Association was established in 1881 and serves as a focal point for education, research, and information sharing for water utilities in the U.S. AWWA now has "more than 57,000 members in 43 sections—and in 100 countries outside of North America. These members provide about 85% of the North American population with safe drinking water."[75]

Definition of Integrated Resources Planning
The American Water Works Association defines Integrated Resources Planning as "a comprehensive form of planning that encompasses least-cost analyses of demand-side and supply-side management options as well as an open and participatory decision-making process, the development of water resource alternatives that incorporates consideration of a community's quality of life and environmental issues that may be impacted by the ultimate decision, and recognition of the multiple institutions concerned with water resources and the competing policy goals among them. IRP attempts to consider all direct and indirect costs and benefits of demand management, supply management, and supply augmentation by using alternative planning scenarios, analyses across disciplines, community involvement in the planning, decision making, and implementation process, and consideration of other societal and environmental benefits."[76]

A forum such as an advisory committee composed of Cambria community members that represent a broad cross section of community issues and interests would provide an important step in improving community input and consensus in water management planning in Cambria.

Watershed Management Alternative
Cambria's water supply is provided by two local watersheds that capture rainfall and recharge the local aquifers. There are important linkages between watershed management practices (or neglect) and annual runoff, aquifer recharge dynamics, water supply yield, and wet season flood risk. Changes in vegetation communities, development and increased hardpan surfaces, fire suppression and wildfire, and erosion and stream channel conditions can substantially affect the runoff and groundwater storage dynamics of a watershed. Many water agencies in California have watershed management responsibilities, but generally have not fully integrated watershed management practices with the implications for water supply yield. Improved watershed and floodplain management practices as alternatives that improve water supply reliability appear to have received minimal consideration in CCSD planning documents.

A description of the Cambria area by the Portola Expedition in September 1769 indicates the valley for Santa Rosa Creek was "surrounded with hills of pine" and had numerous flowing creeks and springs.[77] Much of the Monterey pine forest has now been removed to provide for roads, agriculture, rangelands and urban development. The present day condition of the local watersheds has probably accelerated runoff and exacerbated downstream flash flooding conditions in heavy rainfall/runoff events, while also reducing groundwater recharge and dry season baseflows in Santa Rosa and San Simeon Creeks. Channel incising in Santa Rosa and San Simeon creeks is believed to have resulted in a condition in which aquifer storage has been reduced.[78]

Cambria has important remaining stands of Monterey pine. Monterey pine forests have the ability to capture fog and drip substantial quantities of water into the surrounding soil, even during the dry summer months when fog is prevalent. This may now be particularly important in low lying riparian zones where some of the remaining Monterey pines are found in the Santa Rosa Creek watershed.

By selectively treating forests and open spaces for excess fuel load buildup, and leaving a healthy density of trees with varying age structure intact, more water from wet season rainfall events may be absorbed by the forest floor. Removing undesirable non-native invasive species, that often have higher evapotranspiration demand than native species, can also reduce excessive evapotranspiration in a watershed. This allows more water to percolate into local aquifers for groundwater storage. Some of the storage would then be slowly released into nearby streams and rivers for improved dry season baseflows.

The Cambria Forest Management Plan sponsored by CCSD notes the need for improved management of Cambria's forests. But the plan appears to have suffered from a lack of funding. The plan does not address the issue of the impact of invasive exotics and fuel load buildup on total evapotranspiration and wet season runoff. This issue is also not addressed in CCSD water supply planning documents and plans or considered as an alternative to improve water supply reliability. However, with well-designed and adequately funded vegetation management practices, it may be possible to significantly increase groundwater recharge, and dry season baseflows from the watershed, while also improving habitat conditions and reducing flood and fire risk to local communities. This may significantly improve the economics and attractiveness of funding comprehensive vegetation management on Cambria's watersheds.

It may be advantageous to integrate forest treatment activities with improved meadow and floodplain management to capture and temporarily store peak flood flows in appropriate areas, which may also contribute to aquifer recharge. The Yolo Bypass near Sacramento provides an example of a floodway utilized for seasonal flooding that protects important developed areas. The Yolo Bypass also provides a mosaic of seasonal wetlands, open space and recreational areas, and areas for seasonal agricultural.

Historic descriptions of the Santa Rosa Creek Watershed indicate a lake or "Laguna" once existed. The Laguna is depicted on a map included in Don Julian Estrada's 1841 land grant application and is believed to have been at the confluence of Perry Creek and Green Valley Creek and extending north towards Santa Rosa Creek.[79] The area is now used for agricultural purposes including crops and grazing. However, it may be possible to develop a willing seller program whereby the land could be purchased outright, or conservation or winter flood easements purchased from willing property owners, to allow restoring a "Laguna Estrada" and its associated seasonal wetlands. In addition to providing increased groundwater recharge, the Laguna could be managed as a flood retention basin to reduce downstream flood risk for Cambria during high rainfall/runoff events. Furthermore, the restored lake could provide excellent habitat for songbirds, migrating waterfowl, and recreational opportunities for Cambria residents and visitors.

The economics and hydrologic implications should be carefully evaluated. But working with willing property owners and willing sellers on restoring the Laguna, and other similar opportunities for restoring seasonal wetlands in watershed may be possible. Combined with improved forest management and incised channel restoration projects, these measures could significantly improve aquifer storage and water supply reliability for the Cambria community while enhancing environmental and recreational conditions. This may prove to be much more broadly beneficial use of the $10.3 million in federal funding now targeted for a desalination facility.

Through improved watershed and floodplain management practices, improved runoff conditions and increased water supply yield have been documented in the recent Feather River watershed studies and Working for Water studies in South Africa.[80] Importantly, increased water yield can occur while also improving the health of forests and native vegetation communities.

Watershed management projects can also provide local living wage employment opportunities. A recent financial analysis of the cost of improving watersheds to reduce the fuel load buildup and improve water yield has the potential to provide increased water supply yield for a cost of about $688 to $1,210 per acre-foot, depending on local watershed conditions.[81] The investment in local watershed management would remain local, supporting a local economy. In comparison, investing in a desalination facility may divert much local capital outside the region to pay for facility materials and energy use.

A comprehensive, multi-purpose program to improve forest management and watershed conditions, reduce fire risk, reduce flood risk, improve water supply yield, and improve ecological heath of the watershed and its water courses may provide a much better investment of limited community capital compared to a single-purpose seawater desalination facility. This is an alternative that should be more thoroughly evaluated.

Conclusion

CCSD once had per capita water use that was relatively low for its region in California. However, as other agencies have implemented comprehensive water conservation measures, CCSD's capital water use is no longer so unique.

With the limited number of additional water service connections expected until reaching local buildout, and the trend for declining per capita and per connection water use, a large new water supply appears unnecessary. A seawater desalination facility would be a very costly alternative, and it is unlikely future water demand in the CCSD service would support the financial impact of a desalination facility without dramatic increases in rates and water bills. Renewed water conservation programs, the use of recycled water, and improved watershed management practices appear to offer viable and cost effective alternatives which are likely to provide for Cambria water needs through buildout conditions.

A comprehensive water conservation saturation study to provide definitive information is needed to best target renewed water conservation efforts. Additional analysis of improved watershed and floodplain management strategies and their implications on water supply yield is warranted.

Similar to many communities in California in which the water utility is pursuing an expensive desalination facility, strong community opposition to the facility has emerged.[82] Without a credible water conservation saturation study to assess the potential for additional cost-effective conservation measures, and realistic project marginal costs and future water use forecasts, it is unclear if a new water supply is really needed and what would be the optimum package of alternatives. There is a clear lack of consensus on these issues in Cambria.

To address these complex issues, and help determine the use of conserved water and an acceptable level of water shortage risk in drought, an advisory committee that represents a cross section of community interests in Cambria could provide a valuable forum for increased community participation and consensus.

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About the Author
James Fryer is an environmental scientist and water resources management consultant. James provides environmental and water resource management expertise, research, and analysis to a variety of non-governmental organizations (NGOs) and governmental organizations focused on conservation, sustainable watershed, and water resource management projects. He has over 20 years of experience working on freshwater, estuarine, and marine conservation policies, programs, and projects. He has produced numerous papers and reports on water management policies, practices, and economics, and conducted sophisticated GIS computer analyses of watershed and water management issues.

He was the head of Marin Municipal Water District's water conservation programs in the 1990s. He developed and implemented a model water conservation program and was responsible for the Urban Water Management Plan. He helped advance the science of water conservation by pioneering the use of water conservation baselines studies and public opinion surveys as a fundamental component of program design, implementation, and monitoring. Working closely with the professional landscaping community, he developed innovative and consensus–based landscape water management programs. James was a very active participant in developing and establishing the California Urban Water Conservation Council. He is a past steering committee member, served on numerous technical and planning committees, and played a lead role in establishing efficient clothes washers as a water conservation Best Management Practice.

In subsequent work with the NGO community in the Florida Keys, he directed coral reef and water quality monitoring programs. He helped establish the Tortugas Ecological Reserve, a 191 square nautical mile, and largest marine protected area in U.S. continental waters while serving on the Florida Keys National Marine Sanctuary Advisory Committee. He developed a conservation planning GIS analysis of the Indian River Lagoon watershed, a 156-mile stretch of coastal lagoons and surrounding watershed in Southeast Florida, considered the most biologically diverse estuary in North America, and served on the Indian River Lagoon National Estuary Program Advisory Committee. He also assisted the Florida Dept. of Environmental Protection with the development of statewide water conservation recommendations for Florida.

One Earth Day in the early 1980s, James painted the first "No Dumping – Drains to Bay" fish signs on stormwater drains in Marin County, California. He participated in the 1990's process to legalize graywater use in California, and the more recent effort to update the code for more cost-effective and practical standards. In 1997, he served on the U.S./South Africa Bilateral Commission sent to South Africa to assist the Mandela government with watershed and water resources planning, and where he became acquainted with the newly established Working for Water program. Previously, he served as an adviser to the British Columbia Water and Wastewater Association for development of a regional planning effort.

He has a M.S. in Environmental Management from the University of San Francisco where his thesis project was developing an Integrated Floodplain Management model for the San Francisco Bay-Delta watershed. He can be contacted at jfryer.iwrca@gmail.com.

Appendix A

Water Use by Year, Customer Class, and Billing Period

1999	Resi (ccf)	Comm (ccf)	Total Usage (ccf)	Total Usage (af)	Percent
Jan/Feb	28,394	8,643	37,037	**85.0**	**12.3%**
Mar/Apr	31,479	10,403	41,881	**96.1**	**13.9%**
May/Jun	39,581	13,130	52,711	**121.0**	**17.5%**
Jul/Aug	45,767	16,502	62,269	**142.9**	**20.6%**
Sep/Oct	36,575	12,764	49,339	**113.3**	**16.3%**
Nov/Dec	34,563	9,932	44,495	**102.1**	**14.7%**
Totals (ccf)	**216,360**	**71,374**	**287,733**	**660.5**	**95.3%**
Totals (af)	**496.7**	**163.8**	**660.5**		
Percent	**75.2%**	**24.8%**	**100.0%**		

2000	Resi (ccf)	Comm (ccf)	Total Usage (ccf)	Total Usage (af)	Percent
Jan/Feb	28,882	9,584	38,466	**88.3**	**12.7%**
Mar/Apr	32,136	10,642	42,779	**98.2**	**14.2%**
May/Jun	42,086	13,322	55,408	**127.2**	**18.3%**
Jul/Aug	47,754	16,733	64,486	**148.0**	**21.4%**
Sep/Oct	39,032	13,030	52,062	**119.5**	**17.2%**
Nov/Dec	33,291	9,540	42,831	**98.3**	**14.2%**
Totals (ccf)	**223,182**	**72,850**	**296,032**	**679.6**	**98.0%**
Totals (af)	**512.3**	**167.2**	**679.6**		
Percent	**75.4%**	**24.6%**	**100.0%**		

2001	Resi (ccf)	Comm (ccf)	Total Usage (ccf)	Total Usage (af)	Percent
Jan/Feb	32,812	9,497	42,308	**97.1**	**14.0%**
Mar/Apr	32,716	10,586	43,302	**99.4**	**14.3%**
May/Jun	42,657	13,531	56,188	**129.0**	**18.6%**
Jul/Aug	48,416	15,552	63,968	**146.8**	**21.2%**
Sep/Oct	41,951	15,334	57,285	**131.5**	**19.0%**
Nov/Dec	30,407	8,512	38,919	**89.3**	**12.9%**
Totals (ccf)	**228,958**	**73,012**	**301,970**	**693.2**	**100.0%**
Totals (af)	**525.6**	**167.6**	**693.2**		
Percent	**75.8%**	**24.2%**	**100.0%**		

2002	Resi (ccf)	Comm (ccf)	Total Usage (ccf)	Total Usage (af)	Percent
Jan/Feb	31,034	9,375	40,409	**92.8**	**13.3%**
Mar/Apr	35,582	11,649	47,231	**108.4**	**15.5%**
May/Jun	42,195	13,112	55,308	**127.0**	**18.1%**
Jul/Aug	48,921	19,847	68,769	**157.9**	**22.5%**
Sep/Oct	38,362	13,992	52,354	**120.2**	**17.2%**
Nov/Dec	31,148	9,749	40,897	**93.9**	**13.4%**
Totals (ccf)	**227,242**	**77,725**	**304,967**	**700.1**	**100.0%**
Totals (af)	**521.6**	**178.4**	**700.1**		
Percent	**74.5%**	**25.5%**	**100.0%**		

2003	Resi (ccf)	Comm (ccf)	Total Usage (ccf)	Total Usage (af)	Percent
Jan/Feb	39,650	8,769	48,419	**111.1**	**15.9%**
Mar/Apr	29,879	10,621	40,500	**93.0**	**13.3%**
May/Jun	36,480	10,739	47,219	**108.4**	**15.5%**
Jul/Aug	48,136	15,641	63,777	**146.4**	**21.0%**
Sep/Oct	45,472	15,106	60,578	**139.1**	**19.9%**
Nov/Dec	34,951	8,826	43,777	**100.5**	**14.4%**
Totals (ccf)	**234,568**	**69,702**	**304,270**	**698.5**	**100.0%**
Totals (af)	**538.5**	**160.0**	**698.5**		
Percent	**77.1%**	**22.9%**	**100.0%**		

2004	Resi (ccf)	Comm (ccf)	Total Usage (ccf)	Total Usage (af)	Percent
Jan/Feb	29,129	8,380	37,509	**86.1**	**13.1%**
Mar/Apr	36,226	12,292	48,518	**111.4**	**16.9%**
May/Jun	42,359	13,866	56,225	**129.1**	**19.6%**
Jul/Aug	43,071	14,649	57,720	**132.5**	**20.1%**
Sep/Oct	36,167	12,279	48,446	**111.2**	**16.9%**
Nov/Dec	29,998	8,844	38,842	**89.2**	**13.5%**
Totals (ccf)	**216,950**	**70,310**	**287,260**	**659.4**	**100.0%**
Totals (af)	**498.0**	**161.4**	**659.4**		
Percent	**75.5%**	**24.5%**	**100.0%**		

2005	Resi (ccf)	MFR (ccf)	Total Usage (ccf)	Total Usage (af)	Percent
Jan/Feb	26,164	7,876	34,040	**78.1**	**12.1%**
Mar/Apr	29,492	9,654	39,146	**89.9**	**13.9%**
May/Jun	37,996	12,215	50,211	**115.3**	**17.9%**
Jul/Aug	44,739	15,857	60,594	**139.1**	**21.5%**
Sep/Oct	38,135	11,605	49,742	**114.2**	**17.7%**
Nov/Dec	36,706	10,769	47,482	**109.0**	**16.9%**
Totals (ccf)	**213,232**	**67,976**	**281,214**	**645.5**	**100.0%**
Totals (af)	**566.5**	**133.3**	**699.8**		
Percent	**81.0%**	**19.0%**	**100.0%**		

2006	SFR (ccf)	MFR (ccf)	Comm (ccf)	Other	Total Usage (ccf)	Total Usage (af)	Percent
Jan/Feb	30,085	0	9,314	279	39,678	**91.1**	**13.2%**
Mar/Apr	28,107	802	9,340	531	38,786	**89.0**	**12.9%**
May/Jun	36,933	1,795	11,527	802	51,052	**117.2**	**17.0%**
Jul/Aug	46,133	2,318	19,882	784	69,117	**158.7**	**23.1%**
Sep/Oct	37,586	2,013	12,145	662	52,406	**120.3**	**17.5%**
Nov/Dec	33,814	1,777	9,087	4,112	48,791	**112.0**	**16.3%**
Totals (ccf)	**212,657**	**8,704**	**71,295**	**7,170**	**299,825**	**688.3**	**100.0%**
Totals (af)	**488.2**	**20.0**	**163.7**	**16.5**	**688.3**		
Percent	**70.9%**	**2.9%**	**23.8%**	**2.4%**	**100.0%**		

2007	SFR (ccf)	MFR (ccf)	Comm (ccf)	Internal Accts (ccf)	Vac Rental (ccf)	Total Usage (ccf)	Total Usage (af)	Percent
Jan/Feb	28,683	1,589	9,164	978	1,898	42,312	**97.1**	**14.3%**
Mar/Apr	30,853	1,724	10,450	686	1,931	45,644	**104.8**	**15.5%**
May/Jun	38,786	1,909	12,853	918	2,397	56,863	**130.5**	**19.3%**
Jul/Aug	39,538	1,920	14,678	884	3,099	60,119	**138.0**	**20.4%**
Sep/Oct	32,411	1,714	12,495	829	2,069	49,518	**113.7**	**16.8%**
Nov/Dec	27,266	1,490	9,547	683	1,715	40,701	**93.4**	**13.8%**
Totals (ccf)	**197,537**	**10,346**	**69,187**	**4,978**	**13,109**	**295,157**	**677.5**	**100.0%**
Totals (af)	**453.5**	**23.7**	**158.8**	**11.4**	**30.1**	**677.5**		
Percent	**66.9%**	**3.5%**	**23.4%**	**1.7%**	**4.4%**	**100.0%**		

2008	SFR (ccf)	MFR (ccf)	Comm (ccf)	Internal Accts (ccf)	Vac Rental (ccf)	Total Usage (ccf)	Total Usage (af)	Percent
Jan/Feb	23,846	1,482	8,975	374	1,436	36,113	**82.9**	**12.4%**
Mar/Apr	28,156	1,450	9,012	926	1,916	41,460	**95.2**	**14.2%**
May/Jun	34,009	1,718	12,884	2,013	2,395	53,019	**121.7**	**18.2%**
Jul/Aug	38,041	1,591	13,297	2,647	3,451	59,027	**135.5**	**20.3%**
Sep/Oct	34,923	1,748	12,563	1,466	2,602	53,302	**122.4**	**18.3%**
Nov/Dec	29,549	1,601	8,688	6,439	2,196	48,473	**111.3**	**16.6%**
Totals (ccf)	**188,524**	**9,590**	**65,419**	**13,865**	**13,996**	**291,394**	**668.9**	**100.0%**
Totals (af)	**432.8**	**22.0**	**150.2**	**31.8**	**32.1**	**668.9**		
Percent	**64.7%**	**3.3%**	**22.5%**	**4.8%**	**4.8%**	**100.0%**		

*There is a discrepancy in the 2005 figures available from CCSD. The 2010 UWMP figures were used for the customer class totals since these are widely available to the public. The billing period figures are from CCSD's 2005 Public Water System Statistics report. Some of the discrepancy may be due to CCSD's transition to different customer classes in 2006.

2009	SFR (ccf)	MFR (ccf)	Comm (ccf)	Internal Accts (ccf)	Vac Rental (ccf)	Total Usage (ccf)	Total Usage (af)	Percent
Jan/Feb	25,402	1,379	7,790	999	1,870	37,440	**85.9**	**13.0%**
Mar/Apr	29,336	1,471	9,612	2,165	2,030	44,614	**102.4**	**15.5%**
May/Jun	35,481	1,737	12,124	2,535	2,729	54,606	**125.3**	**19.0%**
Jul/Aug	38,098	1,679	13,869	2,334	3,301	59,281	**136.1**	**20.6%**
Sep/Oct	33,182	1,612	11,081	1,362	2,487	49,724	**114.1**	**17.3%**
Nov/Dec	28,776	1,514	9,006	609	2,153	42,058	**96.5**	**14.6%**
Totals (ccf)	**190,275**	**9,392**	**63,482**	**10,004**	**14,570**	**287,723**	**660.5**	**100.0%**
Totals (af)	**436.8**	**21.6**	**145.7**	**23.0**	**33.4**	**660.5**		
Percent	**66.1%**	**3.3%**	**22.1%**	**3.5%**	**5.1%**	**100.0%**		

2010	SFR (ccf)	MFR (ccf)	Comm (ccf)	Internal Accts (ccf)	Vac Rental (ccf)	Total Usage (ccf)	Total Usage (af)	Percent
Jan/Feb	22,504	1,364	7,085	429	1,625	33,007	**75.8**	**12.2%**
Mar/Apr	26,850	1,520	9,984	544	1,945	40,843	**93.8**	**15.1%**
May/Jun	33,260	1,631	11,289	857	2,327	49,364	**113.3**	**18.3%**
Jul/Aug	38,096	1,808	14,227	1,529	3,406	59,066	**135.6**	**21.9%**
Sep/Oct	32,751	1,569	11,891	541	2,536	49,288	**113.1**	**18.3%**
Nov/Dec	26,170	1,486	8,399	172	1,887	38,114	**87.5**	**14.1%**
Totals (ccf)	**179,631**	**9,378**	**62,875**	**4,072**	**13,726**	**269,682**	**619.1**	**100.0%**
Totals (af)	**412.3**	**21.5**	**144.3**	**9.3**	**31.5**	**619.1**		
Percent	**66.6%**	**3.5%**	**23.3%**	**1.5%**	**5.1%**	**100.0%**		

2011	SFR (ccf)	MFR (ccf)	Comm (ccf)	Internal Accts (ccf)	Vac Rental (ccf)	Total Usage (ccf)	Total Usage (af)	Percent
Jan/Feb	25,882	1,481	8,501	133	1,823	37,820	**86.8**	**14.0%**
Mar/Apr	25,173	1,457	8,599	219	1,685	37,133	**85.2**	**13.7%**
May/Jun	36,868	1,949	13,304	698	2,660	55,479	**127.4**	**20.5%**
Jul/Aug	32,703	1,716	13,036	900	2,755	51,110	**117.3**	**18.9%**
Sep/Oct	32,319	1,562	11,901	718	2,194	48,694	**111.8**	**18.0%**
Nov/Dec	27,273	1,651	8,822	487	1,938	40,171	**92.2**	**14.9%**
Totals (ccf)	**180,218**	**9,816**	**64,163**	**3,155**	**13,055**	**270,407**	**620.7**	**100.0%**
Totals (af)	**413.7**	**22.5**	**147.3**	**7.2**	**30.0**	**620.7**		
Percent	**66.6%**	**3.6%**	**23.7%**	**1.2%**	**4.8%**	**100.0%**		

Appendix B – Water Conservation Best Management Practices Reports

Summary of CCSD BMP Implementation Reports

BMP	Description	Years			
		2005	2006	2007	2008
1	**Residential Water Conservation Site Surveys**	No program reported	No program reported	No program reported	No program reported
2	**Residential Plumbing Retrofit**	Reported enforceable ordinance. Estimated 88% SFR showerhead saturation and 100% MFR showerhead saturation. But no device distribution, tracking, or budget expenditure reported.	No information reported	Reported enforceable ordinance. Estimated 89% SFR showerhead saturation and 95% MFR showerhead saturation. Report that no devices were provided, but relied on time-of-resale retrofit ordinance	Reported enforceable ordinance. Estimated 92% SFR showerhead saturation and 95% MFR showerhead saturation.
3	**Distribution System Leak Audits & Repair**	No information reported	No information reported	Reported prescreening audit and 7.7% unaccounted.	Reported prescreening audit and 9.2% unaccounted.
4	**Metering & Commodity Rates**	Reported 100% meter accounts	No information reported	Reported 3,636 SFR, 133 MFR, 225 Commercial, 0 Industrial, and 15 Institutional metered accounts	Reported 3,635 SFR, 136 MFR, 226 Commercial, 0 Industrial, and 18 Institutional metered accounts
5	**Large Landscape Conservation Programs & Incentives**	Reported 5 dedicated landscape meters, reported no marketing or targeting strategy, no irrigation trainings, no public information program, no financial incentives, and no landscape water budgets	No information reported	Reported 7 dedicated landscape meters. Began offering irrigation trainings. Reported no marketing or targeting strategy, no public information program, no financial incentives, and not landscape water budgets	Reported 7 dedicated landscape meters. Offered irrigation trainings. reported no marketing or targeting strategy, no public information program, no financial incentives, and no landscape water budgets
6	**Clothes Washer Rebates**	Reported that a rebate was offered, but not rebate number reported	No information reported	Reported a total of 20 rebates provided	Reported 35 rebates provided
7	**Public Information Programs to Support Conservation**	Reported PSAs, bill inserts/newsletters/brochures, bill showing previous year's usage	No information reported	Stated "Mostly reach public through water conservation literature. Try to partake in at least one public event per year." Reported PSAs, bill inserts/newsletters/brochures, bill showing previous year's usage, special/media events, coordinate with other groups	Stated "Mostly reach public through water conservation literature. Try to partake in at least one public event per year." Reported PSAs, bill inserts/newsletters/brochures, bill showing previous year's usage, special/media events, coordinate with other groups
8	**School Education Programs**	Indicted no program	No information reported	Indicted no program	Indicted no program

9	**Conservation Programs for CII**	Report indicates that commercial, Industrial and institutional accounts were identified and ranked, but no conservation program support	No information reported	Report indicates that commercial, industrial and institutional accounts were identified and ranked, but no conservation program support	Report indicates that commercial, industrial and institutional accounts were identified and ranked, but no conservation program support
10	**Wholesale Agency Assistance**	Not applicable	Not applicable	Not applicable	Not applicable
11	**Conservation Pricing**	Indicated one rate schedule for all service types	No information reported	Reported increasing block rates for residential, commercial, institutional and irrigation accounts	Reported increasing block rates for residential, commercial, institutional and irrigation accounts
12	**Conservation Coordinator**	Reported 50% Full Time Employee	No information reported	Reported 40% Full Time Employee	Reported 50% Full Time Employee
13	**Water Waste Prohibition**	Reported restrictions on gutter flooding	No information reported	Ordinance language included in BMP report, includes landscape watering, dust control, washing vehicles, leak repair, water by request in eating establishments, and water softeners	Ordinance language included in BMP report, includes landscape watering, dust control, washing vehicles, leak repair, water by request in eating establishments, and water softeners
14	**Residential Toilet Replacement Programs**	Offered $100 rebate for 1.6 gal ULFTs, $150 rebate for 1.28 gal HETs, Rebated 19 toilets for SFR, 0 for MFR	No information reported	Reported 1 rebate for SFR, 0 for MFR	Reported 14 rebates for SFR, 0 for MFR

Endnotes:

[1] Cambria Community Services District, Board of Directors Regular Meeting Minutes (Draft), April 26, 2012. Item C. p. 5.
[2] "2010 Urban Water Management Plan." Cambria Community Services District. p. 6-4.
[3] "Cambria Forest Management Plan." Cambria Forest Committee, April 2002. p. 1-1. Available at: http://www.cambriacsd.org/cm/water_wastewater/Urban%20Water%20Management%20Plan.html Accessed 3-17-12
[4] "Cambria Forest Management Plan." Cambria Forest Committee, April 2002. p. 1-2.
[5] "2010 Urban Water Management Plan." Cambria Community Services District. p. 2-4.
[6] "2010 Urban Water Management Plan." Cambria Community Services District. p. 4-2.
[7] "2010 Urban Water Management Plan." Cambria Community Services District. p. 4-8.
[8] "2010 Urban Water Management Plan." Cambria Community Services District. p. 4-8.
[9] "2010 Urban Water Management Plan." Cambria Community Services District. p. 2-3.
[10] Total annual water production and annual billed water use was obtained from annual Public Water System Statistics report filed with the California Department of Water Resources for the years these reports were available. Some years, including 2005, utilized data from the 2010 Urban Water Management Plan. Annual production from 1975 through 1987 is from CCSD's 1994 Environmental Impact Report, Table 2, p. 3-8. The total number of connections for each year from CCSD's Public Water System Statistics reports when available, and for some of the earlier years from a CCSD Memo from Tammy Rudock to the California Coastal Commission, May 11, 2005, as part of the Pine Knolls Water Tanks Appeal Number A-3-SLO-05-017, Exhibit S, page 6 of 13. The population is from the U.S. census Bureau and averaged for years in between 1970, 1980, 1990, 2000 and 2010. The GPCD for each year is derived from the total annual production and the population. The unaccounted losses are calculated as the difference between the total production and billed water use.
[11] Cambria Community Services District, Board of Directors Resolutions 42-202, 52-2004 and 50-2007.
[12] Note CCSD BMP reports that indicate the presence of a small number of landscape meters, but they are not reflected in the billing records.
[13] "2010 Urban Water Management Plan." Cambria Community Services District. p. 3-6.
[14] "2005 Urban Water Management Plan." Cambria Community Services District. p. 8-5.
[15] Derived from San Luis Obispo water conservation Best Management Practices annual reports filed with the California Urban Water Conservation Council. www.cuwcc.org.
[16]http://www.cambriacsd.org/Library/PDFs/ADMIN%20FINANCE/Rates/7.1.09%20Residential%20Rates.pdf . Accessed 5-21-12
[17]http://www.cambriacsd.org/Library/PDFs/ADMIN%20FINANCE/Rates/7.1.09%20Commercial%20Rates.pdf. Accessed 5-21-12
[18] Cambria Community Services District, Board of Directors Resolutions 42-202, 52-2004 and 50-2007.
[19] "2005 Urban Water Management Plan." Cambria Community Services District. p 8-1
[20] "2005 Urban Water Management Plan." Cambria Community Services District. p 8-1.
[21] "2010 Urban Water Management Plan." Cambria Community Services District. p. 6-10.
[22] "2010 Urban Water Management Plan." Cambria Community Services District. p 6-5.
The blank in this quoted section is as it appears in the final 2010 Urban Water Management Plan.
[23] "2005 Urban Water Management Plan." Cambria Community Services District. p 8-7.
[24] http://2010.census.gov/2010census/popmap/ipmtext.php?fl=06. Accessed 5-10-12.
[25] "Water Use Efficiency Comprehensive Evaluation." CALFED Bay-Delta Program Water Use Efficiency Element, August 2006. P. 145.
[26] More information on the residential clothes washer standards is available from the U.S. Department of Energy "Building Technologies Program" website. Accessed 6-9-12. http://www1.eere.energy.gov/buildings/appliance_standards/residential/clothes_washers.html
[27] www.cuwcc.org
[28] This is the list of BMPs as it existed during the period of years CCSD submitted report from 2005 through 2008. More information about the California Urban Water Conservation Council and the present day BMPs can be found at www.cuwcc.org.
[29] Memorandum of Understanding, amended 9-14-11, p. 4. http://www.cuwcc.org, accessed 4-12-12
[30] Memorandum of Understanding, amended 9-14-11, p. 5. http://www.cuwcc.org, accessed 4-12-12
[31] Memorandum of Understanding, amended 9-14-11, Section 4.5 (b). p. 9. http://www.cuwcc.org, accessed 4-12-12

[32] "2010 Urban Water Management Plan." Cambria Community Services District. p. 6-1 through 6-10.
"2005 Urban Water Management Plan." Cambria Community Services District. p. 8-1 through 8-13.
"Water Master Plan Program Environmental Impact Report." Prepared for Cambria Community Services District by RBF Consulting. July 2008. p. 13-64.

[33] CCSD website, Buildout Reduction Program page, accessed 5-24-12
http://www.cambriacsd.org/cm/projects/Buildout%20Reduction%20Program.html

[34] Buildout Reduction Program Report, By the Buildout Reduction Program Citizens Finance Committee. Town Hall Meeting Final Draft, May 16, 2006. P. 2. Accessed 5-24-12.
http://www.cambriacsd.org/Library/PDFs/PROJECTS/Buildout%20Reduction/5.16.06%20Final%20Report.pdf

[35] "2010 Urban Water Management Plan." Cambria Community Services District. Appendix D.

[36] "2010 Urban Water Management Plan." Cambria Community Services District. Appendix D.

[37] Cambria Community Services District, Minutes of the Regular meeting of Board of Directors, Item VIII. D., July 24, 2003. p. 9.

[38] Appendix C, Excerpt from "Task 3: Potable Water System Modeling" Report. Final Report – Assessment of Long-term Water Supply Alternatives. Prepared for the Cambria Community Services District by Kennedy/Jenks Consultants, June 2004.

[39] As noted in the Unaccounted Losses sections of this report, CCSD's 2005 Urban Water Management Plan indicated an unaccounted losses goal of 5%. CCSD's 2010 Urban Water Management Plan indicates a goal of 8%.

[40] 'Appendix C" in Task 4 of the Water Supply Plan indicates "the residential consumption per residential connection averaged 0.161 AFA." However, CCSD's report to DWR indicates the annual average use per residential connection was actually 0.139 afy (See Table 7 of this report). Task 4, Appendix C of the Water Supply Plan indicates commercial use per connection averaged "0.959 AFA" whereas the CCSD report DWR indicates the commercial use per connect was 0.776 afy (Table 7).

[41] The number of multi-family connections for the years between 2001 through 2005 is averaged and derived from the Public Water System Statistics reports CCWD submitted to the California Department of Water Resources in 2000 and 2006. These are then subtracted from the total number of residential connections to provide the number of single-family connections. For the years 2006 through 2011, the number of connections for each customer class is from the Public Water System Statistics reports.

[42] "1989 Urban Water Management Plan." Cambria Community Services District. p. 10.

[43] "2011 CCSD Water Production by Source, Acre-feet" table provided by Mary Webb

[44] "1989 Urban Water Management Plan." Cambria Community Services District. p. 10.,
"2005 Urban Water Management Plan." Cambria Community Services District. p. 4-2.

[45] "Guidebook to Assist Urban Water Suppliers to Prepare a 2010 Urban Water Management Plan." California Department of Water Resources, March, 2011. Section D.

[46] "2010 Urban Water Management Plan." Cambria Community Services District. p. 3-2, 3-3.

[47] "2010 Urban Water Management Plan." Cambria Community Services District. p. 3-3.

[48] "2010 Urban Water Management Plan." Cambria Community Services District. p. 2-7

[49] Mayer, Peter, P.E. "Assessing Changes in Single Family Water Use." Webinar presentation for the Alliance for Water Efficiency. 12-6-11.

[50] "2010 Urban Water Management Plan." Watsonville, CA. p. 13. Accessed 4-24-12
http://www.water.ca.gov/urbanwatermanagement/2010uwmps/Watsonville,%20City%20of/UWMP%202010%20FINAL.pdf

[51] 2010 census as per "Santa Fe Trends 2012" p. iii. Accessed 6-9-12
http://www.santafenm.gov/index.aspx?NID=1107

[52] "Santa Fe Trends 2012" p. 1

[53] "Annual Water Report." City of Santa Fe. September, 2010, p. 6. Accessed 6-9-12
http://www.santafenm.gov/index.aspx?NID=2300

[54] Cambria Community Services District, Minutes of the Regular meeting of Board of Directors, Item VIII. D., July 24, 2003. p. 9.

[55] "Final Project Design Report – Desalination Project Management Services." by Kennedy/Jenks Consultants for Cambria Community Services District, April 13, 2000.
"Update of Cambria Desalination Project Costs – Water Master Plan Update." Letter from Kennedy/Jenks Consultants to Mr. Robert Gresens. July 10, 2002.

"Final Report- Assessment of Long-term Water Supply Alternatives" by Kennedy/Jenks Consultants for Cambria Community Services District, June 2004.

[56] "Final Water Master Plan Program Environmental Impact Report." Prepared for Cambria Community Services District by RBF Consulting, July 2008. p. 13-211, 13-212.

[57] "Final Water Master Plan Program Environmental Impact Report." Prepared for Cambria Community Services District by RBF Consulting, July 2008. p. 13-211.

[58] Final Water Master Plan Program Environmental Impact Report." Prepared for Cambria Community Services District by RBF Consulting, July 2008. p. 13-211, 13-212.

[59] Personal email communication from Jerry Gruber, General Manager, Cambria Community Services District, to Mary Webb, April 26, 2012.

[60] Final Water Master Plan Program Environmental Impact Report." Prepared for Cambria Community Services District by RBF Consulting, July 2008. p. 13-211.

[61] Fryer, James. "An Investigation of the Marginal Costs of Seawater Desalination in California." Residents for Responsible Desalination. March 18, 2010.
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Additional information on the Plumas County Watershed Management planning process can be obtained at
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