

**Actual Versus Projected Water Demand  
For Denver Water Customers  
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Denver Water implemented its Tap Smart water conservation effort in 2007 – accelerating its timeline to 2016 from 2050. Per the Water Conservation Plan of 2015;

“In this plan, 39,400 AF of water savings was apportioned in the following manner: 10,000 AF of permanent savings as a result of behavioral and structural changes from the 2002-2004 drought; a 4,400 AF reduction achieved as a result of an inclining block rate structure; and a 25,000 AF reduction from a combination of active and passive savings (WCP, 2015 page 3).”

Water conservation efforts by Denver Water have been successful and are evident in the reduction in actual water demand noted between 2000 and 2016. This report compiles water sales data from yearly comprehensive financial reports - published by Denver Water - to document actual water demand in the 2000s. Potable water use in 10 year increments is summarized in each financial report (page III-16 in 2015 annual financial report). Non-potable raw and reuse water data for individual years are noted in each annual report - included here as pdf files and on pages III-18 and III-21 of the 2015 financial report. Both potable and non-potable water demand is shown in Table 1.

Water use is reported annually in Denver Water’s financial statements which can be accessed online. Water use was available annually prior to issue of the Moffat Project FEIS in April, 2014 and the Moffat Project ROD in July, 2017. Declining actual water and per capita use in the 2000s were fully documented in the financial statements prior to issuing both the FEIS and the ROD. FEIS water demand projections are based on 1973 to 1999 water use data used in regression analyses to define water use, by customer category, by water provider, and by year (Appendix A-1, Harvey Economics, 2004, page 5). The 2012 revised projections updated demographic information (FEIS Appendix A-4, Harvey Economics, 2012, first page) but did not revisit relationships between water use and population growth (FEIS Appendix A-4, Harvey Economics, 2012, first page) – water use that is based on old data collected prior to full and modern metering of the CSA. Water demand projections need to be updated using more current and accurate water use data.

**Actual Potable and Non-Potable Water Use**

Potable metered water use is presented in a summary table in Section III of the financial reports entitled “Treated Water Sold in Gallons by Type of Customer.” Under “metered general customers” and “other sales to public entities”, customer type is further broken down to inside city, outside city- read and bill, and outside city- total service. “Inside City” includes customers that reside inside the City of Denver and “Outside City” includes customers outside of the City of Denver but within Denver Water’s Combined

Service Area (CSA). A map of the CSA is included in Section III of each financial report – page III-13 in the 2015 financial report.

The last category for treated and metered water sales in each summary table - “Sales of Treated Water for Resale” - includes customers on Master Meter contracts who are outside the City of Denver but inside the CSA and those to which Denver Water exports treated water to “Outside the Combined Service Area.” Entities which received treated water via master meter contracts are noted on page III-30 of the 2015 financial report.

Each treated water summary table ends with a “Reconciliation of Water Treated, Delivered, Consumption, Sales, and Non-Revenue Water” in which total water production in Denver Water’s treatment plants is adjusted for any changes in its clear (treated) water storage to calculate the total amount of treated – potable- water that was delivered to customers each year. This amount is noted under the “Total Potable Water” column in Table 1 below. Total sales of water, or metered water, is subtracted from the total amount delivered to calculate non-revenue water that is either lost in the system or not billed. Total metered water equals the sum of water sales to both inside and outside the CSA (columns 2 plus 3 in Table 1 below). Percent of non-revenue water is based on comparison to the total potable water delivered.

Year	Potable Water Use				Total Potable Water Delivered (AF)	Total Non-Potable (Raw and Reuse) Water Use (AF)	Total Potable and Non-Potable Water Use (AF)
	Inside CSA Metered Water (AF)	Delivered Outside CSA (AF)	Non-Revenue Water				
			(AF)	(%)			
2000	249,144	NA	7,369	2.87	256,513	54,997	311,511
2001	232,431	4,650	11,667	4.69	248,737	35,213	283,951
2002	216,669	4,967	8,410	3.64	230,845	40,612	271,457
2003	185,344	8,022	5,387	2.68	200,703	39,979	240,682
2004	174,964	7,553	3,393	1.83	185,909	31,139	217,048
2005	198,444	7,709	3,984	1.90	210,138	37,060	247,198
2006	214,247	9,566	5,509	2.40	229,322	50,373	279,695
2007	200,193	10,686	5,415	2.50	216,294	32,538	248,832
2008	208,065	9,231	3,589	1.62	220,886	38,475	259,361
2009	179,425	8,907	2,267	1.19	190,599	28,396	218,995
2010	196,764	9,272	7,851	3.67	213,887	35,632	249,520
2011	190,448	8,493	10,544	5.03	209,484	37,751	247,236
2012	200,761	10,919	9,183	4.16	220,864	38,576	259,440
2013	169,431	8,419	6,936	3.75	184,785	30,804	215,589
2014	169,786	10,208	7,776	4.14	187,770	25,213	212,983
2015	167,752	9,660	7,077	3.84	184,489	28,930	213,419
2016	191,587	2,543	5,360	2.69	199,489	29,887	229,376

Denver Water plans to build-out its reuse system for irrigation, industrial use, and lakes in parks and golf courses such that, ultimately, over “5 billion gallons” or more than 15,000 AF is reused in the future (WCP,2015 page 6). Though raw and reuse water is differentiated in the financial statements, Table 1 above includes only the total non-potable water use summarized in the statements. Denver Water also entered water use data into the CWCB Water Efficiency database for 2013 through 2016 (Table 2). Non-potable raw and reuse water was differentiated in this database.

Data obtained from each source are compared here to confirm that data from both originate from the annual financial statements. Total produced potable water from the CWCB database (Table 2) matches total potable water delivered volumes in Table 1, above, taken from the financial statements for 2013 to 2016. It is unclear why potable water delivered to the CSA system (CWCB database in Table 2) is slightly lower than the sum of metered and exported water from the financial statements (Table 1) that total 177,850 (1,536 AF), 179,994 (2,431 AF), 177,412 (2,583 AF), and 194,130 (4,871 AF) AF in 2013 through 2016, respectively. Numbers in parentheses equal the difference in the two data sources.

Year	Potable Water Use (AF)			Non-Potable Raw Water Use (AF)			Non-Potable Reuse (AF)		
	Total Produced	Delivered Outside CSA	Delivered To CSA System	Total Produced	Delivered Outside CSA	Delivered To CSA System	Total Produced	Delivered Outside CSA	Delivered To CSA System
2013	184,733	8,419	176,314	24,738	21,370	3,368	4,815	3,115	1,700
2014	187,771	10,208	177,563	16,801	15,195	1,606	3,878	1,980	1,898
2015	184,489	9,660	174,829	24,895	21,487	3,408	3,952	1,951	2,001
2016	199,489	10,230	189,259	24,356	5,266	19,090	5,273	2,457	2,816

Total non-potable water use from the financial statements (Table 1 above) are higher than the sum of total raw and reuse non-potable water in Table 2 above because effluent sales - 1,252, 417, 83, and 257 AF in 2013 through 2016, respectively - noted in the financial statements were not included in the CWCB database. In addition, in 2014, total produced raw water noted in the CWCB database (Table 2) did not include 4,118 AF of exported, or delivered outside the CSA, non-potable raw water listed in the financial statement under “other non-potable water deliveries.” This exported water was included in total raw water deliveries every other year. It is unclear why it was omitted in 2014 in the CWCB database.

The total of potable and non-potable actual water use shown in Table 1 was used for comparison to water demand projections.

**Comparison to Denver Water Demand Projections**

Projected water demand for Denver Water customers was evaluated as part of the Moffat Project Environmental Impact Statement. Demand projections are included in Table 1-1 of the FEIS, 2014, for unrestricted demand as well as for system demand reduced by historic conservation and natural replacement savings. Unrestricted demand includes fixed contracts without drought restrictions,

historical conservation, or natural replacement. The latter projection includes natural or passive water savings associated with replacement of outdated, inefficient plumbing fixtures with water-efficient fixtures; efforts that are independent of Denver Water’s conservation programs. It also includes historic water conservation savings created by conservation efforts between 1980 and 2000 (FEIS, 2014 page 1-16).

#### Safety Factor

DW demand projections originally added a safety factor of 30,000 AF to the annual demand numbers (FIES Appendix A, Harvey Economics, 2004 report). The safety factor was removed from the demand projections as part of the 2012 update (FEIS Appendix A, Harvey Economics, 2012 and footnote 3 of FEIS Table 1-1):

“Denver Water’s 30,000-AF safety factor is not included in the calculation of the shortfall because it is not considered available for meeting the total system demand each and every year. Rather it is intended to address uncertainties and/or unforeseen events.”

This was confirmed by comparing the 2030 projected demand noted in Exhibit 1 of the Harvey Economics 2004 report - which incorporated the safety factor – of 409,000 AF with that in Attachment 3 of the Harvey Economics 2012 updated report – which did not include the safety factor – of 379,000 AF, also listed in FEIS Table 1-1 for year 2032.

#### Conveyance Losses

Conveyance losses upstream of the water treatment plants are not included in the actual or projected water demands. In footnote number 2 of FEIS Table 1-3, Yield of Denver Water’s System, it states for the Moffat Tunnel Collection System:

“Amount sent directly to demand, not total importation. Net of evaporation and transit losses.”

For exchange and reuse supply, footnote number 4 of Table 1-3 states:

“Net of evaporation and transit losses. Includes reusable water exchanged from Metro WWTP, Bi-City WWTP, and Denver Water exchange gravel pits. Includes reusable supply used to augment miscellaneous raw water demands....[and] non-potable recycling project demands.”

Water supply firm yield is the amount of water that is available at the WTP after adjusting for conveyance and evaporative losses. Therefore, actual demands noted in Table 1 do not need to be adjusted for conveyance losses for comparison to DW projected demands.

#### Distribution Losses

FEIS projected demands include a 6 percent distribution loss. Non-revenue water, measured and reported in the financial records, averaged 3.09 percent of total water demand from 2000 to 2016 and is already included in actual water use figures; therefore, actual water demand was not further adjusted for distribution losses.

## Recycle and Reuse

Reuse and WWTP effluent water were retained in the total actual demand though, to be accurate, it do not increase the need for additional fresh water and could be subtracted from the total actual demand. Reuse and exchange water in the FEIS, Table 1-3, supplement water supply and are not factored into projected demand numbers. Therefore, actual water demands reported in Table 1 above are conservative as they reduce the difference between projected and actual water demands.

## Special Contract Obligations - Outside the CSA

FEIS projected water demands include full water delivery contract amounts to entities located outside Denver Water's CSA. A total of 66,600 AF per year of contracted water was added to annual water demand projections in the 2012 update (and increase of 5,600 AF over the 2002 projections). Raw (49,539 AF), recycled (6,400 AF), and treated water (11,988 AF) contract amounts are shown in Attachment C, Article I.B-1 of the Colorado River Cooperative Agreement (CRCA). The full amount of these contracts has not typically been requested. Using CWCB data for 2013 to 2016 (except for 2014 raw water delivery which used data in the financial statement), water deliveries outside the city to contract entities totaled 32,903 AF, 31,501 AF, 33,098 AF, and 17,952 AF equal to 49 %, 47 %, 50 %, and 27 % of 66,600 AF. Actual data use was not adjusted to the full contract amount since the unused portions of the contracts were not requested from Denver Water and were not lost to the system as are, for example, conveyance losses.

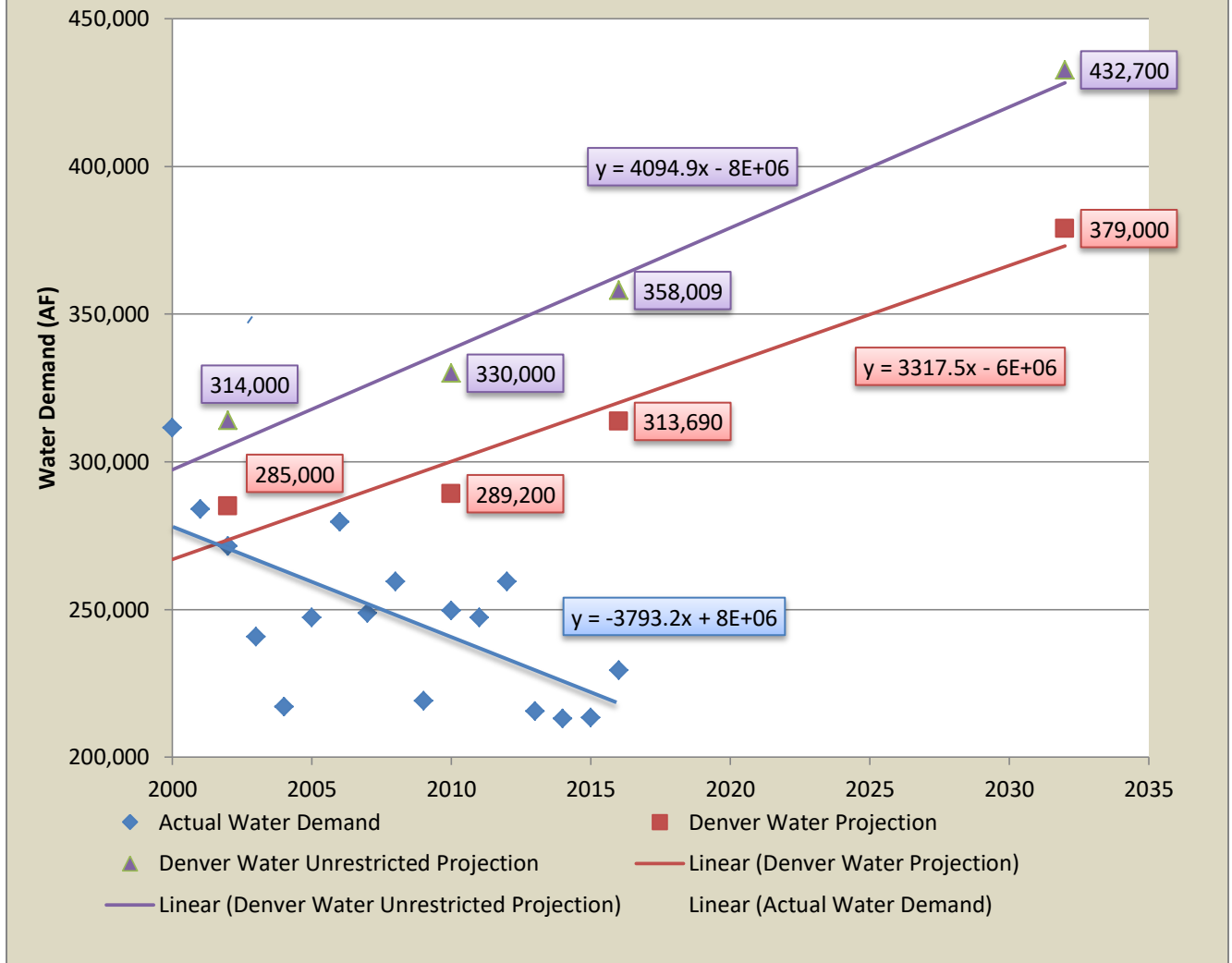
## Comparison of Projected and Actual Water Demand

Demand forecasts from Table 1-1 of the FEIS are shown in Table 3 and graphically in Figure 1 below. Projected demands for 2016 were determined by extrapolating between projected demands in 2010 and 2032.

Year	Unrestricted Projected Demand (AF/YR)	Projected Demand with Conservation (AF/YR)	Actual Water Use – Table 1 Above (AF/YR)
2002	314,000	285,000	271,457
2010	330,000	289,200	249,520
2016	358,009	313,690	229,376
2032	432,700	379,000	NA

FEIS projected water demands increase over time though at a lower rate (lower slope of the trend line) for projections that include past and passive conservation savings (Figure 1). This is in contrast to the negative slope of the actual water use trend line indicating that actual water use in the 2000s has decreased over time, likely due to successful water conservation efforts by Denver Water.

**Figure 1: Comparison of Actual With FEIS Projected Water Demands for Denver Water Customers**



The reduction in total gallons per capita per day (gpcd) noted in Figure 2 of the WCP, 2015, from approximately 180 gpcd in 2007/2008 to 142 in 2013 and an average of 160 gpcd between 2009 and 2013 also supports the observation of reduced water demand with time in the 2000s. Total gpcd was also included in statistical summary tables in both the 2013 and 2016 financial reports (page III-3). Total gpcd is displayed graphically in Figure 2. Total per capita use has trended downward between 2004 and 2016.

**Figure 2: Total Per Capita Water Demand:  
Denver Water Customers**

