Mojave Basin Area Watermaster Appendix F Consumptive Use Update

Prepared by: Wagner & Bonsignore, Engineers Robert C. Wagner, PE Watermaster Engineer David Wong, EIT February 28, 2024



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MEMORANDUM

To: Mojave Basin Area Watermaster

From: Robert C. Wagner, P.E. & David Wong

Date: February 28, 2024

Re: Consumptive Use Analysis

Introduction

The purpose of this update to the consumptive water use values for the Mojave Basin Area Watermaster for the 2021-22 water year is to refine estimates of consumptive use and return flow and ultimately re-calculate Production Safe Yield (PSY). The area of study is the five subareas of the Mojave Basin Area as identified in the Judgment After Trial - January 10, 1996. Consumptive water use for all the water production in the Mojave Basin Area was estimated based on the water use type and location.

Some portion of the water applied to beneficial uses is lost to the water supply system. Consumptive Water Use is the evapotranspiration and the evaporation of water applied to beneficial uses. This is the water permanently removed from the system. The difference between water produced (pumped from the ground) and water consumed is return flow; return flow is considered part of the supply to the extent that it returns to the groundwater basin.

The consumptive use crop unit values for irrigated acres are estimated using the Consumptive Use Program Plus (CUP+) from the California Department of Water Resources (DWR). The climate data used for CUP+ is from the California Irrigation Management Information System (CIMIS) for the Victorville and Newberry Springs stations and the crop coefficients for various crop types are from the Food and Agriculture Organization of the United Nations 56 (FAO 56). CUP+ in conjunction with CIMIS data utilized the Penman-Monteith equation to calculate a reference evapotranspiration value along with an applied water use value for each crop type.

Reference evapotranspiration calculated by CIMIS differs from the output of DWR's CUP+. CIMIS uses a modified Penman equation (referred to as the "CIMIS Penman equation"), while CUP+ uses a modified Penman-Monteith equation to calculate reference evapotranspiration. In addition, in order to complete the monthly climatological record, missing daily climate values were manually computed as the average of the previous day and the following day. On occasions when

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there was missing climatological data for many consecutive days, climate data was filled with data from the nearest CIMIS station.

For agriculture, a land use study using CUP+ applied water values and aerial photography were used to determine how much water should have been used if a crop is 100% efficient and is being irrigated to obtain optimal yield and coverage. For much of the Mojave Basin Area, crops are under-irrigated, and this can be seen by the quality of the crop where there may be poor coverage (dead spots) or a crop may be fallowed during certain times of the year. This is especially true for the Baja subarea where many crops may be grown for only one quarter of the year or where orchards may appear under-irrigated to the point where many trees may have died. For this report, the assumptions made for orchards are that the trees are mature, that the coverage of trees is optimal, and that the size and quality of the fruit (or nut) is high. If any of these conditions are not met, the orchard is most likely being under-irrigated, and therefore, does not contribute to any return flow.

Consumptive Use of Municipal Production

Consumptive use of municipal production is determined by separating indoor use from outdoor use. For the purposes of this study, indoor domestic use is assumed to be 100% return flow and outdoor use is considered to be 100% consumed. High rates of evaporation in the desert, conservation, restrictions on outdoor uses, changes in landscaping to desert landscapes, ordinances preventing over irrigation, and improved leak detection all support the assumption of 100% outdoor consumptive use. Indoor consumptive use is difficult to measure, and whether water is discharged to sewer or septic, it is assumed to be returned to the system. Municipal leaks in distribution systems are assumed to not contribute to return flow. Leaks are assumed to be repaired timely and thus do not contribute to return flow.

To determine indoor use, the Victor Valley Wastewater Reclamation Authority's (VVWRA) 2009 Flow Projection Analysis was used to estimate gallons per capita per day (gpcd). For a singlefamily residence (SFR), the sewer generation rate is 57.5 gpcd and for a multi-family residence (MFR), the sewer generation rate is 46.7 gpcd. Total indoor use is determined by population from census data. Resident population estimates for individual municipalities was determined by using census data and Beacon Economics Growth Forecast (2015). SFR and MFR population numbers were determined by extrapolating total single-family homes versus total multi-family homes. The VVWRA Flow Projection Analysis estimated an average of 3.50 persons per edu, and assumed that the average occupancy of a SFR is the same as the average occupancy of a MFR. Sewered and septic parcels are determined using GIS data for sewer laterals & manholes and 2020 census block data. Population numbers for the sewered parcels were obtained by extrapolating population data from census blocks bounded by water purveyor boundary and containing both a census block(s) and sewer later/manhole see Figure 1.



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The municipal production is broken down into different categories including SFR, MFR, commercial, industrial, irrigation, other, and system losses. Since the municipal producers do not report this information to the Watermaster, the values were extrapolated using the 2015 and 2020 Urban Water Management Plans for each municipality, where these values were reported to the State.

The average consumptive use for municipal producers varies by subarea. In the Upper Alto region, the average 2022 municipal consumptive use was 48%. In the Transition Zone, the average 2022 municipal consumptive use was 65%. In the Centro subarea, the average 2022 municipal consumptive use was 22%. In the Baja subarea, the average 2018 municipal consumptive use was 66%. In the Este subarea, the average 2022 municipal consumptive use was 66%. In the Este subarea, the average 2022 municipal consumptive use was 68%.

Commercial water use values for Alto Subarea were calculated by multiplying the total commercial area by a standard Industrial/Commercial unit flow factor of 0.25 gallons per square foot per day (gal/sf/day). The commercial square footage for Apple Valley, Hesperia and Victorville were obtained from the VVWRA Flow Projection Analysis with values updated to present time based on average population growth from Beacon Economics (2015). In all other subareas, commercial water use is assumed to be 100% consumptively used.

Consumptive use for domestic production uses the average indoor production estimates for each subarea. It is assumed that the production for single family residences with a well is comparable to single family residences on municipal water. This is done for each subarea including the Transition Zone separate from the Upper Alto region.

Dairy production is assumed to be 100% consumptively used. The water used for dairy operations is either consumed by the cows or evaporated after a wash down of the dairy facilities.

Consumptive use for golf courses is estimated in the same manner as other irrigated lands. Irrigated areas classified as grass, sod, and park were assumed to have the same consumptive use factor as golf courses.

Industrial production is assumed to be 100% consumptively use.

Consumptive use for recreational lakes is calculated at 100% of verified production. For recreational lakes, the quantification of consumptive use corresponds to the losses due to evaporation. Aquaculture consumptive use is considered the same as a recreational lake.

See Table 1 for a Summary of Production, Consumptive Use, and Return Flow by Subarea and Table 2 for Production and Consumptive Use from 2018 to 2023.



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In the Judgment, a Minimal Producer is defined as a producer who used less than 10 acre-feet during the 1986-90 base period. Minimal producer total production is assumed to be the same as reported by Albert A. Webb Associates in February 2000. The consumptive use for minimal producers is treated the same as domestic use and is calculated based on the average indoor use for single family residences. The only exception is for Baja subarea where minimal producer population was used to estimate consumptive use. Baja minimal producer consumptive use was calculated differently because several of the minimal producers have private lakes and small orchards and therefore, use water differently than minimal producers in the other subareas.





FIGURE 1 Mojave Water Agency Map Showing Alto Subarea Sewered and Septic Areas San Bernardino County, California

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Numbered Water Purveyors

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10

11

12

13

14

Apple Valley Foothill County Water District	15	Desert Springs Mutual Water Company	29	Juniper-Riviera County
Apple Valley Heights County Water District	16	Golden State Water Company Apple Valley North System	30	Liberty Utilities Apple V
Apple Valley View Mutual Water Company	17	Golden State Water Company Apple Valley South System	31	Liberty Utilities Yermo
Bar H Mutual Water Company	18	Golden State Water Company Barstow System	32	Lucerne Valley Mutual
Bighorn-Desert View Water Agency	19	Golden State Water Company Desert View System	33	Lucerne Vista Mutual W
Center Water Company	20	Golden State Water Company Lucerne Valley System	34	Mariana Ranchos Count
Chamisal Mutual Water Company	21	Gordon Acres Water Company	35	Navajo Mutual Water C
City of Adelanto Water District	22	Helendale Community Services District	36	Phelan Pinon Hills Com
County Service Area 42	23	Hesperia Water District	37	Rancheritos Mutual Wat
County Service Area 64	24	Hi-Desert Water District	38	Rand Communities Wat
County Service Area 70 J	25	Hi Desert Mutual Water Company	39	Sheep Creek Water Con
County Service Area 70 W4	26	Indian Wells Valley Water District	40	Thunderbird County Wa
Daggett Community Services District	27	Joshua Basin Water District	41	Victorville Water Distric
Desert Dawn Mutual Water Company	28	Jubilee Mutual Water Company	42	West End Mutual Water

Purveyor Population Breakdown According to Sewer Service

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Purveyor	Population	Sewered Population	Septic Population	Percent of Sewered Population
County Service Area 70J	10,666	0	10,666	0%
County Service Area 64	10,372	10,372	0	100%
Golden State Water South	6,027	717	5,310	12%
Hesperia	102,757	41,102	61,655	40%
Liberty Utilities	63,327	31,482	31,845	50%
Victorville	149,820	124,268	25,552	83%
Adelanto	-	-	-	-

Water District

Valley

Water Company

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FIGURE 1

Mojave Water Agency Map Showing Alto Subarea Sewered and Septic Areas

San Bernardino County, California

Wagner&Bonsignore

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September 2023

TABLE 1

Summary of Production, Consumptive Use, and Return Flow by Subarea

2022

	Alto	TZ	Alto Total	Baja	Centro	Este	Oeste
Agricultural Production (af)	30	1,210	1,240	6,092	5,863	2,514	2
Agricultural Consumptive Use (af)	30	919	949	6,092	5,863	2,514	2
Agricultural Return Flow (af)	0	291	291	0	0	0	0
Agricultural Return Flow (% of Agricultural Production)	0%	24%	23%	0%	0%	0%	0%
Municipal Production (af)	54,291	4,325	58,616	306	5,756	536	2,790
Municipal Consumptive Use (af)	25,303	1,611	26,914	203	2,789	326	1,897
Municipal Return Flow (af)	29,134	2,721	31,855	103	2,970	210	893
Municipal Return Flow (% of Municipal Production)	54%	63%	54%	34%	52%	39%	32%
Domestic Production (af)	1,544	710	2,254	3,224	1,619	1,110	242
Domestic Consumptive Use (af)	696	702	1,398	2,820	388	734	74
Domestic Return Flow (af)	848	8	856	404	1,231	376	168
Domestic Return Flow (% of Domestic Production)	55%	1%	38%	13%	76%	34%	69%
Golf Course Production (af)	3,279	1,014	4,293	0	2	0	0
Golf Course Consumptive Use (af)	2,529	875	3,404	0	0	0	0
Golf Course Return Flow (af)	750	139	889	0	2	0	0
Golf Course Return Flow (% of Golf Course Production)	23%	14%	21%	0	100%	0	0
Industrial Production (af)	3,091	1,380	4,471	1,180	3,444	810	7
Industrial Consumptive Use (af)	3,091	1,380	4,471	1,180	3,444	810	7
Industrial Return Flow (af)	0	0	0	0	0	0	0
Industrial Return Flow (% of Industrial Production)	0%	0%	0%	0%	0%	0%	0%
Parks Production (af)	150	35	185	54	0	62	0
Parks Consumptive Use (af)	150	35	185	8	0	0	0
Parks Return Flow (af)	0	0	0	46	0	62	0
Parks Return Flow (% of Parks Production)	0%	0%	0%	84%	0%	100%	0
Recreational Lakes Production (af)	4,827	2,240	7,067	1,701	35	36	0
Recreational Lakes Consumptive Use (af)	1,926	1,853	3,779	1,701	0	5	0
Recreational Lakes Return Flow (af)	2,901	387	3,288	0	35	31	0
Recreational Lakes Return Flow (% of Recreational Lakes Production)	60%	17%	47%	0%	100%	87%	0
Aquaculture Production (af)	20	0	20	6	0	0	0
Aquaculture Consumptive Use (af)	20	0	20	4	0	0	0
Aquaculture Return Flow (af)	0	0	0	2	0	0	0
Aquaculture Return Flow (% of Aquaculture Production)	0%	0	0%	27%	0	0	0
Dairy Production (af)	0	0	0	16	264	0	66
Dairy Consumptive Use (af)	0	0	0	16	264	0	66
Dairy Return Flow (af)	0	0	0	0	0	0	0
Dairy Return Flow (% of Dairy Production)	0	0	0	0%	0%	0	0%
Total Production (incl. Minimals) (af)	67,232	10,914	78,146	12,579	16,983	5,068	3,107
Total Consumptive Use (af)	33,745	7,375	41,120	12,025	12,748	4,388	2,046
Total Return Flow (af)	33,633	3,546	37,179	554	4,238	680	1,061
Total Return Flow (% of Total Production)	50%	0	48%	4%	0	0	0

TABLE 2

Pumping & Consumptive Use by Subarea 2018 - 2023

Values are in Acre-Feet

Pumping

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	2018	2019	2020	2021	2022	2023	Average
Alto Pumping	64,986	61,033	64,129	69,593	67,232	62,354	64,888
TZ Pumping	12,700	11,939	12,618	11,809	10,914	10,039	11,670
Alto Total Pumping	77,686	72,972	76,747	81,402	78,146	72,393	76,558
Baja Pumping	24,524	23,389	20,912	15,095	12,579	11,343	17,974
Centro Pumping	20,665	19,784	18,309	19,685	16,983	16,392	18,636
Este Pumping	5,055	4,983	5,181	5,258	5,068	4,501	5,008
Oeste Pumping	3,944	3,618	3,677	3,798	3,107	2,845	3,498
Total	131,874	124,746	124,826	125,238	115,883	107,474	121,673

Consumptive Use

			-				
	2018	2019	2020	2021	2022	2023	Average
Alto Consumptive Use	34,001	30,386	33,489	37,871	33,745	31,927	33,570
TZ Consumptive Use	7,913	7,294	8,052	7,301	7,375	6,859	7,466
Alto Total Consumptive Use	41,914	37,680	41,541	45,172	41,120	38,786	41,035
Baja Consumptive Use	24,002	22,611	20,144	13,589	12,025	10,834	17,201
Centro Consumptive Use	16,451	15,094	14,044	14,035	12,748	12,279	14,108
Este Consumptive Use	3,827	3,634	4,116	4,377	4,388	3,812	4,026
Oeste Consumptive Use	2,931	2,572	2,528	2,574	2,046	1,869	2,420
Total	89,125	81,591	82,372	79,746	72,328	67,579	78,790