2022-2023 Engineer's Report on the Groundwater Conditions, Water Supply and Basin Utilization in the Orange County Water District

Photo Cover:

City of Fullerton PFAS Water Treatment Main Plant in Construction
Fullerton, California

2022-2023

ENGINEER'S REPORT ON

GROUNDWATER CONDITIONS,

WATER SUPPLY AND BASIN UTILIZATION

IN THE

ORANGE COUNTY WATER DISTRICT

FEBRUARY 2024

SINCE 1933

ORANGE COUNTY WATER DISTRICT

ORANGE COUNTY'S GROUNDWATER AUTHORITY

February 21, 2024

John C. Kennedy
General Manager
Orange County Water District
Post Office Box 8300
Fountain Valley, CA 92728-8300

Dear Mr. Kennedy:

In accordance with Section 26 of the District Act, the 2022-2023 Engineer's Report on the Groundwater Conditions, Water Supply and Basin Utilization in the District is hereby submitted.

Precipitation for the water year July 1, 2022 through June 30, 2023 within the District's boundaries averaged 21.12 inches, which was one hundred fifty eight percent of the long-term average rainfall. The average discharge of Santa Ana River flow past Prado Dam for the water year was measured to be 286,907 acre-feet which represented one hundred thirty two percent of the 30-year average flow. Flow past the District's spreading grounds (including any flow from the Santiago Creek) that was lost to the Pacific Ocean totaled 16,390 acre-feet.

Total water demands within the District for the water year 2022-2023 were 351,719 acre-feet (excluding water used for groundwater replenishment and barrier maintenance), the lowest demands in the past fifty water years. The use of supplemental water in the District's service area during the water year totaled 107,723 acre-feet. Groundwater production within the basin for the water year totaled 245,210 acre-feet which was a decrease of 4.5 percent from the prior water year.

The accumulated basin overdraft decreased from 258,000 acre-feet on June 30, 2022 to 189,000 acre-feet on June 30, 2023 using the three-layer approach and the new benchmark for full-basin conditions. Under the provisions of Section 27 of the District Act, a portion of the Replenishment Assessment for the ensuing 2024-2025 water year could be equal to an amount necessary to purchase up to 123,000 acre-feet of replenishment water.

Sincerely,

Chris S. Olsen
Director of Engineering

Lo Tan
Principal Engineer

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EXECUTIVE SUMMARY

Total water demands within Orange County Water District (OCWD) were 351,719 acre-feet (AF) for the 2022-23 water year (beginning on July 1, 2022 and ending on June 30, 2023). Groundwater production for the water year totaled 245,210 AF including any available In-Lieu Program water. The use of supplemental water in OCWD's service area during the 2022-23 water year totaled 107,723 AF of which 88,441 AF resulted from the direct use by water agencies and districts and 19,282 AF were used for the purpose of groundwater basin replenishment and maintenance of seawater intrusion control barriers.

For the water year which ended on June 30, 2023, the "annual overdraft" (annual basin storage decrease without supplemental replenishment water) was 52,250 AF. The accumulated overdraft decreased from 258,000 AF on June 30, 2022 to 189,000 AF on June 30, 2023. Precipitation within the groundwater basin was one hundred fifty eight percent of the long-term average during this water year, totaling 21.12 inches.

Based on the groundwater basin conditions for the water year ending on June 30, 2023, OCWD may purchase up to 123,000 AF of water for groundwater replenishment during the ensuing water year, beginning on July 1, 2024, pursuant to the District Act.

ACKNOWLEDGMENTS

A number of public and private entities contributed data used in this report including:

City of Anaheim
City of Buena Park
East Orange County Water District
City of Fountain Valley
City of Fullerton
City of Garden Grove
Golden State Water Company
City of Huntington Beach
Irvine Ranch Water District
City of La Palma
Mesa Water District
Metropolitan Water District of Southern California
Municipal Water District of Orange County
City of Newport Beach
City of Orange
County of Orange, Public Works Department
Orange County Sanitation District
City of Santa Ana
Santa Ana Watershed Project Authority
City of Seal Beach
Serrano Water District
City of Tustin
United States Geological Survey
City of Westminster
Yorba Linda Water District

The cooperation received from all agencies is gratefully acknowledged.

This report is based on the 2022-23 Basic Data Report which is placed on file at the office of OCWD in Fountain Valley.

GLOSSARY OF ACRONYMS

AF	Acre-Feet
AWPF	Advanced Water Purification Facility
BEA	Basin Equity Assessment
BPP	Basin Production Percentage
CPTP	Coastal Pumping Transfer Program
CUP	Conjunctive Use Program
EOS	Extraordinary Supply
GAP	Green Acres Project
GWRS	Groundwater Replenishment System
IDP	Irvine Desalter Project
IRWD	Irvine Ranch Water District
MF	Microfiltration
mg/L	Milligrams per Liter
MBI	Mid-Basin Injection
MGD	Million Gallons per Day
MSL	Mean Sea Level
MWD	Metropolitan Water District of Southern California
MWDOC	Municipal Water District of Orange County
NO_3	Nitrate
O&M	Operation and Maintenance
OC San	Orange County Sanitation District
OCWD	Orange County Water District
PFAS	per- and polyfluoroalkyl substances
RA	Replenishment Assessment
RO	Reverse Osmosis
RTS	Readiness-to-Serve
SAR	Santa Ana River
SARCCUP	Santa Ana River Conservation and Conjunctive Use Program
SBVMWD	San Bernardino Valley Municipal Water District
SPW	State Project Water
TDS	Total Dissolved Solids
UV	Ultraviolet
WRD	Water Replenishment District of Southern California

PART I: GROUNDWATER CONDITIONS

Section 25 of the OCWD Act requires that OCWD order an annual investigation to report on the groundwater conditions within the District's boundaries. A summary of the groundwater conditions for the water year covering July 1, 2022 to June 30, 2023 is as follows.

GROUNDWATER CONDITIONS
2022-23 SUMMARY OF FINDINGS

1. Groundwater production (including any In-Lieu Program water) totaled 245,210 acre-feet (AF) for the 2022-23 water year.

2. Groundwater stored in the basin increased by 69,000 AF for the 2022-23 water year.

3. Accumulated Overdraft[1] on June 30, 2023 was 189,000 AF.[2]

4. Annual Overdraft was 52,250 AF for the 2022-23 water year.

5. Average Annual Overdraft[3] for the immediate past five water years (2018-19 through 2022-23) was 103,700 AF.

6. Projected Annual Overdraft[3] for the current 2023-24 water year is 98,000 AF.

7. Projected Annual Overdraft[3] for the ensuing 2024-25 water year is 110,000 AF.

8. Projected Accumulated Overdraft[2] on June 30, 2024 is 168,000 AF.

9. Under the provisions of Section 27 of the District Act, a portion of the 2024-25 Replenishment Assessment (RA) could be equal to an amount necessary to purchase up to 123,000 AF of replenishment water.[4]

[1] *Accumulated overdraft was calculated using OCWD's three-layer storage change methodology adopted on March 21, 2007 and the associated new benchmark for full-basin conditions. Water year 2005-06 was the first year this methodology was used. Additional explanation can be found in the report on "Evaluation of Orange County Groundwater Basin Storage and Operational Strategy" by OCWD in 2007.*

[2] *Water from the Metropolitan Water District of Southern California Long-Term Groundwater Storage Program was included as part of the total stored water in determining the basin's accumulated overdraft.*

[3] *Annual overdraft is defined in the District Act as "the quantity, determined by the Board of Directors, by which the production of groundwater supplies within said District during the water year exceeds the natural replenishment of such groundwater supplies in such water year."*

[4] *Determined by adding the five-year average annual overdraft (103,700 AF) to one-tenth of the accumulated overdraft (189,000 AF) which results in the following:*
103,700 AF + [(189,000 AF) x 0.10] = 122,600 AF (or 123,000 AF when rounded).

BASIN HYDROLOGY

Groundwater conditions in the Orange County groundwater basin are influenced by the natural hydrologic conditions of rainfall, capture and recharge of Santa Ana River (SAR) and Santiago Creek stream flows, natural infiltration of surface water, and the transmissive capacity of the basin. The basin is also influenced by groundwater extraction and injection through wells, use of imported water for groundwater replenishment, wastewater reclamation and water conservation efforts and activities throughout OCWD's service area.

The water year beginning on July 1, 2022, yielded an average of 21.12 inches of rainfall within OCWD's boundaries, which is approximately one hundred fifty eight percent of the long-term annual average of 13.40 inches. Rainfall data within OCWD's boundaries was provided by the Orange County Public Works Department. The rainfall for the previous water year (2021-22) was 6.84 inches. The average annual rainfall in the OCWD service area for the five-year period (from July 1, 2018 through June 30, 2023) was 13.56 inches, and above-average rainfall in the watershed tends to lead to higher flows in the SAR reaching Orange County. Stream flow in the SAR measured downstream of Prado Dam for the water year 2022-23 totaled 286,907 AF which was approximately 132 percent of the 30-year flow average of 216,401 AF.

GROUNDWATER PRODUCTION

Groundwater production from wells within OCWD for the 2022-23 water year totaled 245,210 AF (excluding In-Lieu Program water, MWD Groundwater Storage Program extractions, and any groundwater used for the Talbert Barrier): 244,674 AF for non-irrigation and 536 AF for irrigation uses. The term "irrigation" used in the District Act and herein refers to irrigation for agricultural, horticultural, or floricultural crops and for pasture grown for commercial purposes.

OCWD's In-Lieu Program replaces groundwater supplies with imported water to reduce groundwater pumping. During the 2022-23 water year, OCWD did not purchase In-Lieu Program water from MWD in spite of its availability. Historical data on the annual groundwater production and In-Lieu quantities within OCWD are shown in Figure 1. Table 1 summarizes the annual groundwater production and In-Lieu Program water for the period of 1973-74 through 2022-23.

Groundwater production and In-Lieu Program quantities for 2022-23 for the major groundwater producers are summarized in Appendix 1. The groundwater production for all producers exceeding 25 AF per year for non-irrigation and irrigation purposes are presented in Appendices 2 and 3, respectively.

FIGURE 1. Groundwater Production

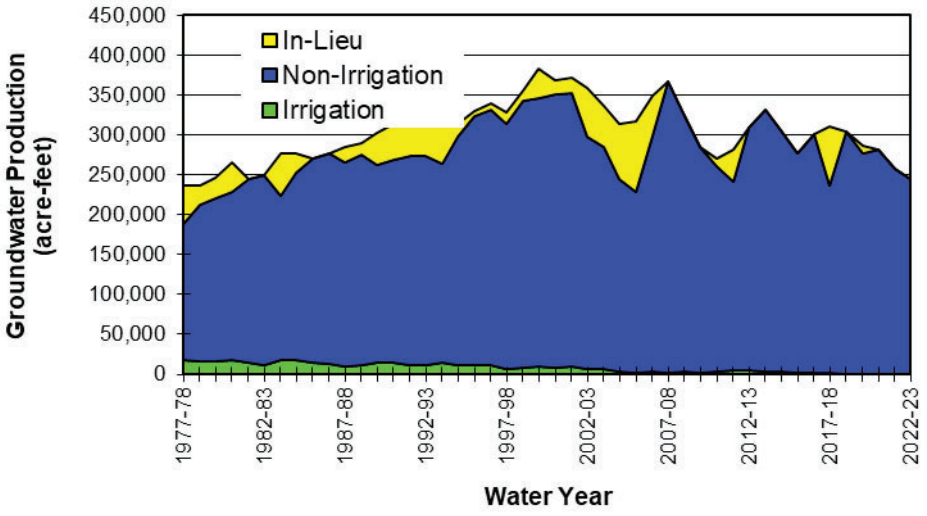


TABLE 1. Historical Groundwater Production Within OCWD

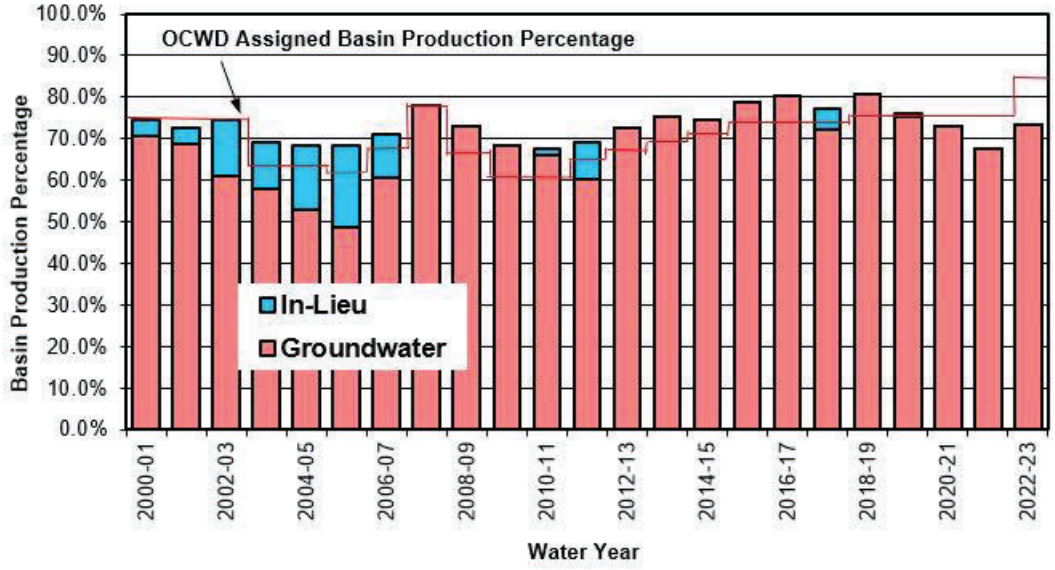
Water Year Jul 1-Jun 30	Groundwater Production (AF)	In-Lieu Program (AF)	Water Year Jul 1-Jun 30	Groundwater Production (AF)	In-Lieu Program (AF)
1973-74	218,863	-	1998-99	342,823	13,352
1974-75	225,597	-	1999-00	345,362	38,007
1975-76	245,456	-	2000-01	350,385	18,640
1976-77	243,511	-	2001-02	352,113	19,473
1977-78	188,407	-	2002-03	297,191	61,463
1978-79	213,290	48,290	2003-04	284,621	52,168
1979-80	221,453	23,792	2004-05	244,370	69,617
1980-81	228,943	24,861	2005-06	228,159	89,216
1981-82	244,184	36,373	2006-07	299,118	50,740
1982-83	249,548	-	2007-08	366,185	-
1983-84	223,207	-	2008-09	324,147	-
1984-85	252,070	52,822	2009-10	285,575	-
1985-86	270,932	25,198	2010-11	259,861	10,435
1986-87	276,354	-	2011-12	241,082	40,564
1987-88	265,226	-	2012-13	309,295	-
1988-89	275,077	18,856	2013-14	330,782	-
1989-90	261,190	15,022	2014-15	305,259	-
1990-91	266,745	38,961	2015-16	277,090	-
1991-92	271,224	44,588	2016-17	301,637	-
1992-93	273,587	39,789	2017-18	236,916	73,108
1993-94	264,159	38,900	2018-19	303,496	-
1994-95	298,217	48,134	2019-20	277,195	9,355
1995-96	324,111	5,542	2020-21	281,793	-
1996-97	331,406	7,883	2021-22	256,921	-
1997-98	313,805	15,096	2022-23	245,210	-

BASIN PRODUCTION PERCENTAGE

The Basin Production Percentage (BPP) is defined in the District Act as "*…the ratio that all water to be produced from groundwater supplies within the district bears to all water to be produced by persons and operators within the district from supplemental sources as well as from groundwater within the district.*" The BPP applies only to water producers that utilize more than 25 AF of groundwater per water year. Water producers that use 25 AF or less from the groundwater basin are excluded from the production percentage limitation.

The BPP for the 2022-23 water year was initially established at 77.0 percent by the OCWD Board of Directors, but effectively increased to 85% in February 2023 for the remainder of the water year. The overall BPP achieved within OCWD for non-irrigation use in the 2022-23 water year was 73.3 percent. The achieved pumping is less than the assigned BPP for the water year primarily due to the water quality impacts of per- and polyfluoroalkyl substances (PFAS). The production percentage achieved by each major producer for non-irrigation use is presented in Appendix 1. Historical assigned and achieved BPPs are illustrated below in Figure 2.

FIGURE 2. Groundwater BPP



GROUNDWATER LEVELS

Groundwater levels in the Orange County groundwater basin are shown on Plate 1. Groundwater level data used to prepare this plate were collected during late June and early July 2023 from over 500 production and monitoring wells screened within the principal aquifer system (approximately 300 to 1,200 feet deep), from which over 90% of basin pumping occurs. The groundwater elevation contours range from 10 to 80 feet below mean sea level in the coastal area of the basin due to pumping. A general indicator of changing basin levels is the location of the zero (0) mean sea level (MSL) elevation contour each year (MSL elevations are referenced to Vertical Datum NGVD 29). The zero MSL contour moved seawards (ranging from 0.1 to 1.7 miles) when compared to its alignment of the prior year, indicating an increase in groundwater levels in the principal aquifer system from June 2022 to June 2023.

Plate 1 also shows the relatively large depression in groundwater levels in the southern Santa Ana and northern Costa Mesa area due to the large concentration of production wells in this area. Groundwater levels are 40 to 50 feet lower than the surrounding areas. The potential impacts of this pumping depression include increased seawater intrusion and low well water levels which have been mitigated by OCWD's basin management programs including the Talbert seawater barrier expansion, the Groundwater Replenishment System (GWRS) and the mid-basin injection (MBI) wells. However, should groundwater production in this area substantially increase or groundwater elevations continue to decrease, the potential negative impacts should be evaluated in advance as they could, at least, partially offset the mitigative benefits of the aforementioned basin management programs.

Plate 2 shows the change in groundwater levels from June 2022 to June 2023 for the principal aquifer system. In the principal aquifer, groundwater levels generally rose by approximately 10 to 20 feet throughout most of the groundwater basin except at the OCWD Santiago Basin recharge facility in Orange where groundwater levels rose by 60 to 80 feet, at the OCWD recharge facilities in Anaheim where groundwater levels rose by 20 to 30 feet, and in the Irvine Sub-basin where groundwater levels rose by 20 to 40 feet.

Plate 3 shows the groundwater elevation trends within the principal aquifer since 1980 at four key well locations across the groundwater basin. In the pressure area of the basin at key wells GG-16 and COS-PLAZ, seasonal groundwater level fluctuations are noticeably larger than at AM-14 and IDM-3 located in the Anaheim and Irvine Forebay areas, respectively. All four key well locations show an increased water level response during or immediately following high-recharge wet periods such as 2005-06, 2011-12, 2018-19, and most recently 2022-23, but the response is largest at AM-14 due to its proximity to OCWD's spreading grounds.

The storage increase of 69,000 AF resulted primarily from a significant rise in groundwater levels throughout most of the basin from June 2022 to June 2023. In the shallow aquifer, groundwater levels increased approximately 30 to 40 feet in the Anaheim Forebay area surrounding the OCWD recharge facilities, 20 to 50 feet near Santiago Basin, and 5 to 10 feet throughout the greater Anaheim/Fullerton Forebay area. Shallow aquifer groundwater levels increased approximately 0 to 5 feet in the pressure area of the basin and were stable relative to the prior year near the Talbert Barrier, where elevations remained at or above protective elevations for seawater intrusion control.

In the principal aquifer, groundwater levels rose approximately 20 to 30 feet surrounding the OCWD Anaheim recharge facilities, 20 to 60 feet in the Santiago area, 10 to 20 feet in the greater Anaheim/Fullerton Forebay area, and 20 to 40 feet in the Irvine Sub-basin. Principal aquifer groundwater levels rose 5 to 10 feet throughout most of the pressure area of the basin, except for the Irvine Ranch Water District (IRWD) Dyer Road Well Field and west end of the Talbert Barrier, where water levels slightly decreased 0 to 5 feet.

In the deep aquifer, groundwater levels surrounding the OCWD recharge facilities rose 10 to 20 feet in Anaheim, 20 to 30 feet in Orange near the SAR, and 20 to 40 feet near Santiago Basin. Deep aquifer groundwater levels rose 10 to 20 feet in the greater Anaheim/Fullerton Forebay area, 5 to 20 feet in the Irvine Sub-basin, and 0 to 10 feet in the pressure area.

In all three aquifers, groundwater levels in the Central Basin near the county line generally increased as much or more than in western Orange County.

ANNUAL OVERDRAFT

Annual groundwater basin overdraft, as defined in the District Act, is the quantity, determined by the Board of Directors, by which the production of groundwater supplies within the District during the water year exceeds the natural replenishment of such groundwater supplies in such water year. This difference between extraction and replenishment can be estimated by determining the change in volume of groundwater in storage that would have occurred had supplemental and recycled water not been used for any groundwater recharge purpose, including seawater intrusion protection, advanced water reclamation and the In-Lieu Program.

For the 2022-23 water year, it is estimated that the volume of groundwater in storage increased by 69,000 AF. The annual overdraft was 52,250 AF for the 2022-23 water year. For the five-year period from July 1, 2018 to June 30, 2023, an annual average of approximately 121,300 AF of supplemental water and recycled water were percolated for replenishment of groundwater basin or injected into the underground basin via wells for seawater intrusion control or used directly in place of pumping groundwater (i.e., In-Lieu

Program). The average annual overdraft during the same five-year period was approximately 103,700 AF.

GROUNDWATER BASIN ACCUMULATED OVERDRAFT

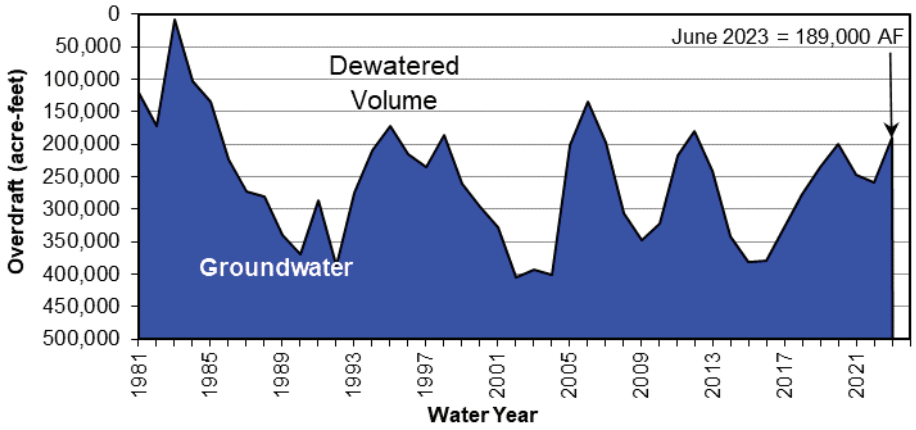
The accumulated overdraft, as defined in the District Act, is the quantity of water needed to be replaced at OCWD's intake area to prevent landward movement of ocean water into the fresh groundwater body. Landward movement of ocean water can be prevented if groundwater levels near the coast are several feet above sea level. Groundwater levels along the coast are related to the volume of water stored in the intake area, water pumped from the entire basin and the pattern or location of pumping. However, the Talbert and Alamitos seawater intrusion control projects have been implemented to prevent landward movement of ocean water into the fresh groundwater body. Due to the operation of seawater intrusion barrier facilities, there is no longer a direct correlation between accumulated overdraft and controlling seawater intrusion. These facilities allow greater utilization of the storage capacity of the groundwater basin. OCWD is also dedicated to maximizing its replenishment capabilities by actively negotiating with the U.S. Army Corps of Engineers to increase its water conservation program behind Prado Dam and implementing a Long-Term Facilities Plan to evaluate cost-effective improvements to its groundwater recharge capabilities.

In February 2007, OCWD staff completed a report entitled "Evaluation of Orange County Groundwater Basin Storage and Operational Strategy." This report presented a new methodology that had been developed, tested, and documented for calculating accumulated overdraft and storage change based on a three-aquifer layer approach. Furthermore, the report provided the basis for calculating accumulated overdraft using a new full-basin benchmark that was developed for each of the three aquifer layers, which in effect replaces the traditional single-layer full benchmark of 1969.

The annual analysis of basin storage change and accumulated overdraft for water year 2022-23 has been completed. Based on the three-layer methodology, an accumulated overdraft of 189,000 AF was calculated for the water year ending on June 30, 2023. The accumulated overdraft for the prior water year ending on June 30, 2022 was 258,000 AF (also calculated using the three-layer storage method). Therefore, an annual increase of 69,000 AF (reported earlier herein this report) was calculated as the difference between the June 2022 and June 2023 accumulated overdrafts.

Figure 3 shows the accumulated basin overdraft quantities for the period 1981 through 2023.

FIGURE 3. Accumulated Basin Overdraft



The accumulated overdraft for the current water year ending on June 30, 2024 is projected to be 167,000 AF. The projected annual overdraft is estimated to be 98,000 AF. This quantity is based on assumed annual groundwater production of approximately 280,000 AF for the current water year (including groundwater pumping within the BPP, In-Lieu Program water, groundwater pumped above the basin production percentage (BPP) from water quality improvement projects and MWD Groundwater Storage Program extractions) and that natural replenishment (including captured SAR flows and incidental recharge) is estimated to be approximately 182,000 AF for the basin under average rainfall conditions. In addition, GWRS production is projected to reach 117,000 AF.

Projected annual overdraft for the ensuing water year 2024-25 is estimated to be 110,000 AF. This estimate is based on the assumption that total annual groundwater production for the ensuing water year will be 292,000 AF, a figure that is based upon an assumed BPP of 85 percent and includes 15,000 AF of production above the BPP from water quality improvement projects (discussed further in the subsequent section entitled Recommended Basin Production Percentage). The natural replenishment is estimated to be 182,000 AF (average of last five years) under average rainfall conditions, and the GWRS production is projected to be 128,000 AF.

OCWD, MWD, the Municipal Water District of Orange County (MWDOC) and participating producers approved the funding agreement for the MWD Long-Term Groundwater Storage Program on June 25, 2003. This conjunctive use program (also informally referred to as MWD CUP) provides for MWD to store up to 66,000 AF in the OCWD groundwater basin to be pumped (less basin losses) by participating producers in place of receiving imported supplies during water shortage events. A compensation package from MWD was included in the agreement to build eight new groundwater

production wells, improvements to the seawater intrusion barrier, construction of the Diemer Bypass Pipeline and an annual administrative fee. The preferred means to store water in the MWD storage account has been through the In-Lieu deliveries to participating groundwater producers. Water into the MWD storage account has also been conducted through direct replenishment utilizing OCWD Forebay recharge basins. In any event, the water stored or extracted by MWD is considered as MWD supply and not groundwater production. There was no MWD CUP water stored or extracted in water year 2022-23 and the balance remains zero AF in the MWD CUP account at the end of the water year. The annual quantities and cumulative totals of MWD water stored since the inception of the program are shown in Appendix 4. It is important to note that the reported quantities do not include pumping extractions from the account or basin losses.

In April 2019, OCWD established the Santa Ana Conservation and Conjunctive Use Program (SARCCUP) water bank in the OCWD groundwater basin. Other SARCCUP water bank owners which include San Bernardino Valley Municipal Water District (SBVMWD), Western Municipal Water District (WMWD) and Eastern Municipal Water District (EMWD) also established water banks within their own service areas. The OCWD water bank can contain up to 36,000 AF of water to be used during dry years, as determined by OCWD. Sources of water for the SARCCUP banks include surplus State Project Water (SPW) from SBVMWD, imported water purchased from MWD, and water purchased on the open market. The SBVMWD, a SPW contractor, and MWD have an agreement in which surplus SPW purchased by MWD is made available to OCWD and other SARCCUP agencies for storage in the multiple water banks in the SAR watershed. Surplus SPW purchased from MWD can qualify as Extraordinary Supply (EOS) water which can be used during years when MWD reduces imported supplies via an allocation process. For accounting purposes, two types of water will be tracked in the OCWD SARCCUP water bank. The first is imported water, which is designated as local water and can be used in dry years as determined by OCWD. The second is the EOS water which is surplus SPW. The EOS water can be used during dry years or during allocation years.

The SARCCUP water bank was financed by a $55M Proposition 84 Integrated Regional Water Management grant from the Department of Water Resources and local matching funds from participating agencies including OCWD, SBVMWD, Inland Empire Utilities Agency, WMWD and EMWD. To date, 2,000 AF of imported water is in SARCCUP OCWD water bank.

REPLENISHMENT RECOMMENDATION

Section 27(b) of the District Act states the following:

"*The total of the replenishment assessment levied in any year shall not exceed an amount of money found to be necessary to purchase sufficient water to replenish the average annual overdraft for the immediate past five water years plus an additional amount of water sufficient to eliminate over a*

period of not less than 10 years nor more than 20 years, the accumulated overdraft, plus an amount of money to pay the costs of initiating, carrying on, and completing any of the powers, projects and purposes for which this district is organized."

Based upon Section 27(b), that portion of the RA that is used for water purchases for the ensuing water year 2024-25 is limited to the amount needed to purchase 123,000 AF as calculated below:

Five-year (7/1/2018 through 6/30/2023) Average Annual Overdraft* = 103,700 AF
Accumulated Overdraft (End of Water Year 2022-23) = 189,000 AF
Assumed Time Period to Eliminate Accumulated Overdraft = 10 years
Potential Water Purchase Amount: 103,700 AF + (189,000 AF/10 years) = 122,600 AF (use 123,000 AF)

**Referred to as the Average Annual Overdraft in Section 27(b) of the District Act.*

Table 2 presents the proposed 2024-25 water budget expenses, which shows the proposed quantity of purchased water (3,000 AF) being significantly less than the prescribed limit of 123,000 AF as allowed for under the provisions of Section 27(b) of the District Act.

TABLE 2. 2024-25 Water Budget Expenses

Water Source	Amount (AF)	Unit Cost ($/AF)	Total Cost ($)
Alamitos Barrier	3,000	$ 1,440.00	$ 4,320,000
MWD Untreated Full-Service Water	0	$ 879.50	$ 0
Water Purchases Sub-total	3,000	—	$ 4,320,000
Applicable Charges			**Total Cost ($)**
MWD Readiness to Serve Charge	—	—	$ 1,300,000
MWDOC Groundwater Charge	—	—	$ 400,000
MWD Capacity Charge	—	—	$ 10,000
Total Expenses			$ 6,030,000

RECOMMENDED BASIN PRODUCTION PERCENTAGE

In December 2002, OCWD approved a basin management approach for determining the BPP for future water years. The management approach is based upon the development of a base amount of groundwater production the basin can annually sustain utilizing dependable water supplies OCWD expects to receive. It is a policy for OCWD to provide an estimate of the BPP each January for the following fiscal year to assist the groundwater producers in the preparation of their annual budgets.

The BPP does not restrict the amount of groundwater that a groundwater producer may pump; but a groundwater producer must pay the basin equity assessment (BEA) on any groundwater production (other than BEA-exempt groundwater) above the BPP. The BEA

is set at an amount so that groundwater production above the BPP cost the same amount as imported supplemental water. If groundwater producers produced groundwater significantly above the BPP, this additional groundwater production could increase the annual overdraft (and, over time, increase the accumulated overdraft), with potential detriments to the basin, including seawater intrusion. Substantial groundwater production significantly above the BPP could also impair OCWD's ability to manage the groundwater basin for sustainable groundwater production. The OCWD Act provides regulatory powers to OCWD that can be exercised by OCWD, including the setting of basin production limitations and surcharges, and mid-year modifications to the BPP, BEA, and production limitations/surcharges, to address potential production of significant quantities of groundwater above the BPP. The OCWD Board of Directors may approve a surcharge, in an amount to be determined in its discretion, for production by a producer in excess of any production limitation.

A BPP of 85 percent is currently being proposed for the ensuing water year 2024-25. Analysis of the groundwater basin's projected accumulated overdraft, the available supplies to the basin (assuming below-average hydrology) and the projected pumping demands indicate that this level of pumping could potentially be sustained for 2024-25 without detriment to the basin. Under normal conditions, the annual groundwater production could reach 315,000 AF. However, it is anticipated that the groundwater production for the ensuing water year 2024-25 will be approximately 292,000 AF due to the water quality impacts of PFAS causing wells to be shut down.

In order to achieve water quality objectives in the groundwater basin, it is estimated for the ensuing water year 2024-25 that additional production of approximately 15,000 AF (above the BPP) will be undertaken by the City of Tustin, City of Huntington Beach, Mesa Water District and IRWD. These agencies need the additional pumping allowance in order to accommodate groundwater quality improvement projects. As in prior years, production above the BPP from these projects would be partially or fully exempt from the BEA as a result of the benefit provided to the basin by removing poor-quality groundwater and treating it for beneficial use.

In March 2024, staff will review with the OCWD Board of Directors the basis and the assumptions made for the proposed BPP and receive any direction on the matter. In April 2024, staff will again apprise the OCWD Board of Directors on the status of the aforementioned conditions. If the estimate of basin supplies in the current or ensuing year are substantially different than those contained in the respective conditions, a revised BPP may then be recommended.

PART II: WATER SUPPLY AND BASIN UTILIZATION

Section 31.5 of the District Act requires an investigation and annual report setting forth the following information related to water supply and basin utilization within the OCWD service area, together with other information as OCWD may desire:

WATER SUPPLY AND BASIN UTILIZATION
2022-23 SUMMARY OF FINDINGS

1. Water usage from all supplemental sources and non-local water sources (if any) totaled 107,723 AF for the 2022-23 water year.

2. Water usage from recycled water produced from within OCWD including the GWRS totaled 120,018 AF for the 2022-23 water year.

3. Water demands within OCWD totaled 351,719 AF for the 2022-23 water year.

4. Estimated demands for groundwater for the ensuing 2024-25 water year are 292,000 AF.

SUPPLEMENTAL WATER

Supplemental water is used by water agencies within OCWD's boundary to augment groundwater supplies in satisfying their user demands and by OCWD to recharge the groundwater basin. Supplemental water, as defined in Section 31.5 of the District Act, is any water that originates from outside the SAR watershed (comprised of an area of 2,081 square miles) with the exception of that portion of that watershed on and along Santiago Creek upstream of the downstream toe of the slope of the Villa Park Flood Control Dam which is counted as supplemental water. It is important to note that the Santiago Creek watershed lies entirely within the SAR watershed. Sources of supplemental water typically include imported deliveries from MWD and diversions from Irvine Lake/Santiago Reservoir (i.e., Santiago Creek) that are conveyed to users within OCWD boundaries. MWD deliveries originate from either the Colorado River or the SWP. In addition, supplemental water would also include deliveries from within the SAR watershed that involve water exchanges (i.e., releasing a quantity of water that originates from within the SAR watershed while importing an equal quantity of supplemental water to replace it).

Non-local waters are defined, for the purposes of this report, as waters purchased from agencies outside of OCWD's boundary for use within OCWD. Non-local waters include all water deliveries to OCWD where the water source is located within the SAR watershed. Water deliveries to OCWD from the Arlington Desalter in Riverside and the San Bernardino Valley Municipal Water District's High Groundwater Mitigation Project are considered non-local waters. Although not utilized in recent years, both projects involve pumping (and treatment in Arlington's case) and release of groundwater from the SAR upstream groundwater basins to OCWD via the SAR for groundwater replenishment at OCWD Forebay recharge facilities. For the purpose of being consistent with previous Engineer's Reports and to present information in a concise manner, non-local water deliveries that are purchased and used by OCWD for groundwater replenishment are included in the supplemental water totals in this report. However, while accounted for in the supplemental water totals in this Engineer's Report for convenience and consistency purposes, these non-local waters are not supplemental sources of water as defined in Section 31.5 of the District Act because the non-local waters originate within the SAR watershed. These non-local water deliveries are not included in the accounting of supplemental sources that address water demands within OCWD as shown in Table 5.

Recycled wastewater produced and used within OCWD is considered, for the purposes of this report, as neither non-local water nor supplemental water (sometimes referred to as neutral water). Therefore, recycled water that originates from within OCWD is reported separately from supplemental water totals. However, recycled water used in the Alamitos Barrier is supplied by Water Replenishment District of Southern California

(WRD) and originated from outside the SAR watershed, and, as such, is categorized as supplemental water.

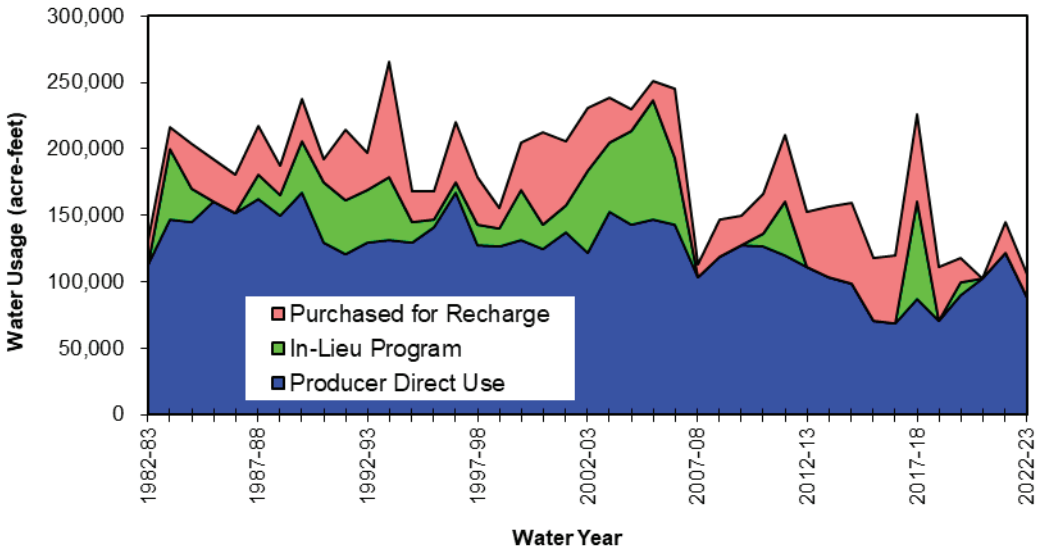
Water agencies utilizing supplemental water are listed in Appendix 1. As summarized in Table 3, the use of supplemental water in OCWD's service area during the 2022-23 water year totaled 107,723 AF of which 88,441 AF resulted from the direct use by water agencies and districts and 19,282 AF were used for groundwater replenishment purposes. The supplemental water used by water agencies included 86,510 AF for municipal and industrial use and zero AF for agricultural purposes. Historical supplemental water usage is illustrated in Figure 4. The GWRS delivered recycled water to OCWD Forebay recharge basins and the Talbert seawater intrusion barrier throughout the 2022-23 water year. A breakdown of non-local water purchases by OCWD from water years 2003-2004 through 2022-23 is presented in Appendix 4.

TABLE 3. 2022-23 Supplemental Water Usage

Direct Agency Use	**AF**
Imported Water[1]	86,510
Santiago Creek Native Water	1,931
Subtotal	**88,441**
Groundwater Replenishment (Purchased)	**AF**
In-Lieu Program[2]	0
Forebay Recharge[3]	16,865
Alamitos Barrier[4]	2,414
Talbert Barrier	3
Subtotal	**19,282**
TOTAL	**107,723**

[1]Includes any extractions from MWD Groundwater Storage Program.
[2]Any amount reported herein includes water received by OCWD's groundwater producers as In-Lieu water.
[3]Full service rate untreated water.
[4]Total amount combines imported and recycled water deliveries.

FIGURE 4. Historical Supplemental Water Usage



Recycled water use within OCWD is presented in Table 4 (excluding WRD-supplied recycled water to the Alamitos Barrier because this water is categorized as supplemental water and already included in the total amount reported in Table 3). The major uses of recycled water are groundwater replenishment (including Kraemer, Miller, Miraloma and La Palma recharge basins and Talbert Barrier injection wells) and supply water for irrigation and industrial users.

TABLE 4. 2022-23 Recycled Water Usage

Groundwater Replenishment	Water Usage (AF)
GWRS AWPF (for Talbert Barrier)	19,747
GWRS AWPF (for Recharge Basins)[1]	74,687
GWRS AWPF (for Mid-Basin Injection)	7,516
Subtotal	**101,950**
Irrigation	**Water Usage (AF)**
IRWD[2]	14,672
OCWD (Green Acres Project)[3]	3,396
Subtotal	**18,068**
TOTAL	**120,018**

[1]Includes 63 AF of GWRS recycled water delivered to City of Anaheim Canyon Power Plant and Anaheim Regional Transportation Intermodal Center.
[2]Recycled water used within the portion of OCWD that lies within IRWD's boundaries (excludes OCWD/IRWD intertie water deliveries to the Green Acres Project).
[3]Excludes deliveries to the Orange County Sanitation District and includes IRWD/OCWD Intertie deliveries to the Green Acres Project.

AVAILABILITY OF SUPPLEMENTAL REPLENISHMENT WATER

MWD's untreated full-service water supply for any groundwater-basin agencies was available during the water year 2022-23 as a result of its allocation of State Project Water and normal rainfall conditions. Supplemental water from MWD to recharge the groundwater basin is available in the current water year and is expected to be available in the ensuing water year 2024-25. OCWD is not planning to purchase untreated full-service water to recharge its groundwater basin in the ensuing water year 2024-25 due to the relatively full condition of the groundwater basin.

WATER DEMANDS

During the 2022-23 water year, the total water demands within OCWD's service area were 351,719 AF. Total demands include the use of groundwater, MWD In-Lieu Program water, supplemental sources (including imported water and Santiago Creek native water) and recycled water (which is not included within supplemental sources if originating within the SAR watershed). Total demands exclude any groundwater, supplemental water, and recycled water (such as the GWRS recycled water) used by OCWD for groundwater recharge.

Water demands for 2022-23 and projected water demands for 2023-24 and 2024-25 are summarized in Table 5. The water demands for the current year 2023-24 were determined by assessing the data that is presently available for the first half of the water year and projecting that data to develop the total annual water demands. The water demands for the ensuing year 2024-25 are based on the projections provided by the retail water agencies within OCWD's service area. Long-term projections are presented in Figure 5.

TABLE 5. Water Demands Within OCWD

	Ground-water[1]	Imported Water[2,3]	Santiago Creek Native Water[3]	Recycled Water[4]	Total[6]
2022-23					
Non-Irrigation	244,674	86,510	1,931	-	333,115
Irrigation	536	0	-	18,068	18,604
Total	**245,210**	**86,510**	**1,931**	**18,068**	**351,719**
2023-24 (Current Year)[5]					
Non-Irrigation	279,400	70,000	2,000	-	351,400
Irrigation	600	-	-	18,000	18,600
Total	**280,000**	**70,000**	**2,000**	**18,000**	**370,000**
2024-25 (Ensuing Year)[5]					
Non-Irrigation	291,300	59,000	2,000	-	350,300
Irrigation	700	-	-	18,000	18,700
Total	**292,000**	**59,000**	**2,000**	**18,000**	**370,000**

[1] *Includes In-Lieu Program water, if available. Also includes groundwater pumped under water quality improvement agreements entered into between OCWD and certain producers pursuant to Section 38.1 of the District Act where the produced groundwater is exempted from payment of all or a portion of the BEA. The BEA-exempt groundwater is deducted from the projection of total groundwater used to calculate the BPP.*

[2] *Excludes water conservation credits and imported water used for groundwater replenishment.*

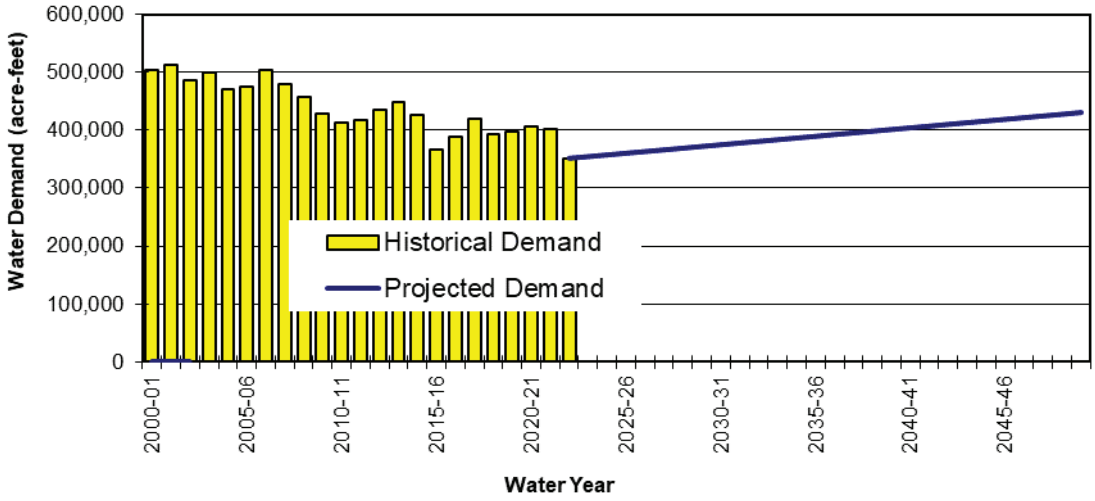
[3] *"Imported Water" and "Santiago Creek Native Water" are both counted as supplemental water.*

[4] *Excludes GWRS recycled water recharged into the groundwater basin. Includes recycled water from IRWD and OCWD's Green Acres Project (excluding Orange County Sanitation District's usage).*

[5] *Water demands are estimated by OCWD assuming average hydrology.*

[6] *Includes all groundwater and non-groundwater sources and is greater than the number of supplemental sources used in the calculation of BPP. For purposes of this table, supplemental water is calculated as the sum of Imported Water and Santiago Creek Native Water and does not include Recycled Water.*

FIGURE 5. Water Demand Projections



WATER DEMAND FORECAST

OCWD participates with MWDOC and retail groundwater producers to predict future demands in OCWD's service area. Each groundwater producer projected its total water demands to the year 2050. These projections include the effect of local water conservation efforts and slight increase in population. Figure 5 illustrates the historical and the projected water demands for OCWD's service area to the year 2050.

ADVANCED WASTEWATER RECLAMATION

Groundwater, supplemental water, and local surface water have historically been the primary water sources within OCWD. In recent decades, wastewater reclamation has increasingly become a significant source of additional water. Purified recycled water has been produced by OCWD for use as injection water in the Talbert Barrier and as percolation water in Kraemer, Miller, Miraloma and La Palma recharge basins. OCWD and IRWD also recycle wastewater at their respective treatment plants for irrigation and industrial uses.

The GWRS is an advanced wastewater reclamation project jointly funded by OCWD and the Orange County Sanitation District (OC San). The project was operational in January 2008. The advanced treatment processes utilized in the GWRS consist of microfiltration (MF) followed by reverse osmosis (RO) membranes and advanced oxidation process of ultraviolet (UV) light in combination with hydrogen peroxide. For the water year 2022-23, the GWRS treated wastewater from the OC San to drinking water standards and delivered 101,950 AF of purified water for direct injection into the

Talbert seawater intrusion barrier and percolation into the OCWD groundwater basin via recharge basins and MBI well.

For water year 2022-23, OCWD and IRWD recycled water deliveries for landscape irrigation and industrial uses in Fountain Valley, Costa Mesa, Huntington Beach, Newport Beach, Santa Ana and IRWD's service area within OCWD totaled 18,068 AF.

WRD operates the Alamitos Barrier Recycled Water Project, known as the Leo J. Vander Lans Water Treatment Facility, that has a design capacity of 8 MGD; however, its recent production is typically 4 MGD. This project supplies highly treated recycled water to the Alamitos Barrier. The Leo J. Vander Lans advanced wastewater treatment facility located in Long Beach utilizes the treatment processes of MF, RO and advanced oxidation process of UV light and hydrogen peroxide. This project is ultimately intended to replace most of the imported water used to supply the Alamitos Barrier with purified recycled water. The project operated throughout the water year 2022-23 and supplied 1,619.9 AF of purified recycled water to OCWD's portion of the Alamitos Barrier, which represented 67.1 percent of the barrier's supply that OCWD is responsible for payment. Recycled water deliveries from the Leo J. Vander Lans plant to the Orange County portion of the Alamitos Barrier are classified as supplemental water because this recycled water originates from outside the SAR watershed.

WATER QUALITY

OCWD maintains a comprehensive groundwater protection policy that includes water quality monitoring, removal of contaminants, regulatory agency support, toxic residuals removal and hazardous waste management. In addition, OCWD provides water quality information to regulatory agencies, other water agencies and the general public. In order to meet the current and future water quality testing requirements, OCWD operates the Philip L. Anthony Water Quality Laboratory at the Fountain Valley campus. The laboratory houses approximately 31 chemists and laboratory technicians, 12 water quality monitoring personnel and all the analytical instruments that are needed to perform more than 400,000 analyses of approximately 20,000 water samples taken each water year. The laboratory supports the extensive water quality testing requirements for the GWRS.

When blended together by the major agencies within OCWD's service area, the blended groundwater (without treatment) and treated supplemental water for 2022-23 was determined to have a flow-weighted average of 440 milligrams per liter (mg/L) of total dissolved solids (TDS) which is lower than the average TDS concentration of 465 mg/L reported for the prior year (2021-22). The average groundwater TDS concentration for the basin for 2022-23 was 415 mg/L (compared to 402 mg/L reported for 2021-22), ranging from a low of 235 mg/L in coastal areas (such as Seal Beach) to a high of approximately 716 mg/L in certain inland areas.

Average concentrations of TDS, nitrate (NO_3) and hardness for groundwater and groundwater combined with supplemental water supplied by agencies within OCWD's service area during the 2022-23 water year are summarized in Table 6. These concentrations were determined from groundwater and supplemental water analyses and from production reports submitted to and filed with OCWD by each water agency. The City of Tustin and IRWD have active groundwater treatment projects that help to reduce certain constituents reported in Table 6 in their groundwater supply prior to service to their customers (see note 6 for detailed explanation).

WATER RESOURCES DATA

A summary of water resources data within OCWD for the 2022-23 water year and the previous water year (2021-22) is included in Appendix 5.

TABLE 6. 2022-23 Water Quality Summary

City/Agency	Groundwater[1,7]			Delivered Blend[1,2,7]		
	TDS[3]	NO_3-N[4]	Hard-ness[5]	TDS[3]	NO_3-N[4]	Hard-ness[5]
Anaheim	509	2.1	300	506	0.8	247
Buena Park	416	1.4	256	425	1.3	253
East Orange County Water District	588	3.4	336	504	0.3	225
Fountain Valley	334	1.0	190	334	1.0	190
Fullerton	516	2.3	252	513	1.8	246
Garden Grove	517	3.5	330	515	2.9	310
Golden State Water Company	392	1.4	233	441	0.9	229
Huntington Beach	287	0.4	142	355	0.4	168
Irvine Ranch Water District[6]	316*	0.6*	109*	326*	0.6*	115*
La Palma	286	ND[8]	144	287	ND[8]	144
Mesa Water District	306	0.5	117	306	0.5	117
Newport Beach	302	1.2	175	338	1.0	184
Orange	472	2.4	274	478	2.0	264
Santa Ana	396	2.1	242	424	1.6	238
Seal Beach	235	ND[8]	88	292	ND[8]	116
Serrano Water District	576	1.5	310	560	1.1	314
Tustin[6]	716*	6.6*	425*	621*	3.8*	336*
Westminster	373	1.8	244	376	1.8	244
Yorba Linda Water District	672	1.2	332	648	1.1	317
Weighted Average[7]	**415**	**1.6**	**220**	**440**	**1.2**	**222**

[1] *All groundwater results (alone or blend) are for untreated groundwater (see note 6 below). Units are reported in mg/L.*

[2] *Delivered blend includes untreated groundwater and treated imported MWD water (i.e., blend of Colorado River water and State Project water as measured at the MWD Diemer Plant), except Serrano Water District, which blends with treated Santiago Reservoir water. Units are reported in mg/L. Annual average water qualities for MWD and Santiago Reservoir (Irvine Lake) for 2022-23 are as follows:*

MWD Water Quality			*Santiago Reservoir Water Quality*		
TDS	=	*504 mg/L*	*TDS*	=	*533 mg/L*
NO_3-N	=	*0.29 mg/L*	*NO_3-N*	=	*0.43 mg/L*
Hardness (as $CaCO_3$)	=	*225 mg/L*	*Hardness (as $CaCO_3$)*	=	*321 mg/L*

[3] *Secondary Drinking Water Standards for TDS are as follows:*

500 mg/L = recommended limit
1,000 mg/L = upper limit

[4] *Primary Drinking Water Standard for nitrate NO_3-N (i.e., nitrate expressed as nitrogen) is 10 mg/L.*

[5] *Hardness is reported as mg/L of $CaCO_3$. General classifications of hard and soft water are within the following concentration ranges:*

0-75 mg/L	=	*soft*	*150-300 mg/L*	=	*hard*
75-150 mg/L	=	*moderately hard*	*300 and up mg/L*	=	*very hard*

[6] *Agencies with active groundwater quality improvement projects that treat for one or more of the constituents listed in the table. The results shown herein for "groundwater" and "delivered blend" reflect results from untreated groundwater. Water quality constituents that are marked with an asterisk (*) are reduced prior to delivery to customers.*

[7] *All water quality results are flow-weighted averages based on groundwater and imported water delivered to each agency.*

[8] *ND = not detected. Nitrate (expressed as NO_3-N) analytical detection limit for OCWD Philip L. Anthony Water Quality Laboratory is 0.1 mg/L.*

PART III: WATER PRODUCTION COSTS FOR ENSUING WATER YEAR (2024-25)

Section 31.5 of the District Act requires that costs of producing groundwater and obtaining supplemental water be evaluated annually. These costs vary for each groundwater producer and depend on many factors. Although these variations in cost are recognized, it is necessary for the purpose of this report to arrive at figures representing the average cost of producing groundwater and purchasing supplemental water.

ENSUING WATER YEAR (2024-25) WATER PRODUCTION COSTS SUMMARY OF FINDINGS

1. Cost for producing water from the groundwater basin within OCWD including a replenishment assessment for 2024-25 is estimated to be $1,009.00 per acre-foot.

2. Cost of treated, non-interruptible supplemental water for 2024-25 is estimated to be $1,380.00 per acre-foot.

GROUNDWATER PRODUCTION COSTS FOR NON-IRRIGATION USE

Cost for producing an acre-foot of groundwater in the ensuing 2024-25 water year has been estimated for a potable water well for a large groundwater producer (i.e., a city water department, water district) in OCWD's service area. Operations and maintenance (O&M) and energy costs were determined using the cost information provided by nineteen large groundwater producers from a survey conducted by OCWD in fall 2023. The capital cost component was derived using the current capital cost of a typical production well (including design and construction costs) financed with an annual interest rate of five percent and amortized over a 30-year repayment period. Appendix 6 contains several of the key design characteristics for a typical production well. The OCWD RA used in the determination of groundwater production cost is the proposed RA for 2024-25.

The estimated cost for groundwater production for a large groundwater producing entity such as a city water department or a water district is presented in Table 7. The total cost to produce an acre-foot of groundwater within OCWD in the ensuing 2024-25 water year is estimated to be $1,009 per acre-foot. Based on the responses to the aforementioned survey, the flow-weighted average (based upon the quantity of groundwater pumped) for energy cost equaled $110 per AF. The O&M costs ranged from $5 to $395 per acre-foot with a median cost of approximately $86 per acre-foot. Elements that influence these costs include load factors and variations in groundwater levels. Recently drilled wells are generally deeper than those drilled decades ago. From the aforementioned survey, the average load factor which indicates the percent-of-use of an extraction facility equaled 50 percent.

TABLE 7. Estimated 2024-25 Groundwater Production Costs

Cost Item	Non-Irrigation Use	
	Annual Cost ($)	Cost per AF ($/AF)
Energy	286,000	110[2]
RA	1,788,800	688[3]
Capital	325,000[1,4]	125[1,4]
O&M	223,600	86[2]
Total Cost to Producers	2,623,400	1,009

[1] *Based upon an annual average production of 2,600 AF per production well.*
[2] *Based on survey of major agencies within OCWD's service area, non-irrigation groundwater users.*
[3] *Proposed RA for 2024-25.*
[4] *Assuming $5,000,000 capital cost (including design and construction) with an interest rate of five percent amortized over a 30-year period and excluding cost of land purchase.*

COST OF SUPPLEMENTAL WATER

Supplemental water is supplied to OCWD's service area by MWD. MWD delivers both treated and untreated water as either an uninterruptible supply or an interruptible supply. As a result, there are several categories of water available from MWD. The categories most applicable for purposes of this report are 1) uninterruptible (i.e., firm) treated water, which is referred to as "full-service water," and 2) uninterruptible untreated water. Treated water is purchased and used directly by various groundwater producers for municipal and industrial purposes, while untreated water is purchased and recharged into the basin by OCWD to support higher groundwater production. Table 8 shows the estimated cost for the MWD uninterruptible treated water (full-service water) cost for the ensuing 2024-25 water year. Figure 6 illustrates the historical supplemental water costs along with the historical groundwater production costs. A comparison of estimated costs for groundwater versus supplemental water (non-irrigation use) during the ensuing water year 2024-25 is summarized in Table 9 and in Figure 6. Values used in Figure 6 are presented in tabular form in Appendix 7.

TABLE 8. Estimated 2024-25 Supplemental Water Cost[1]

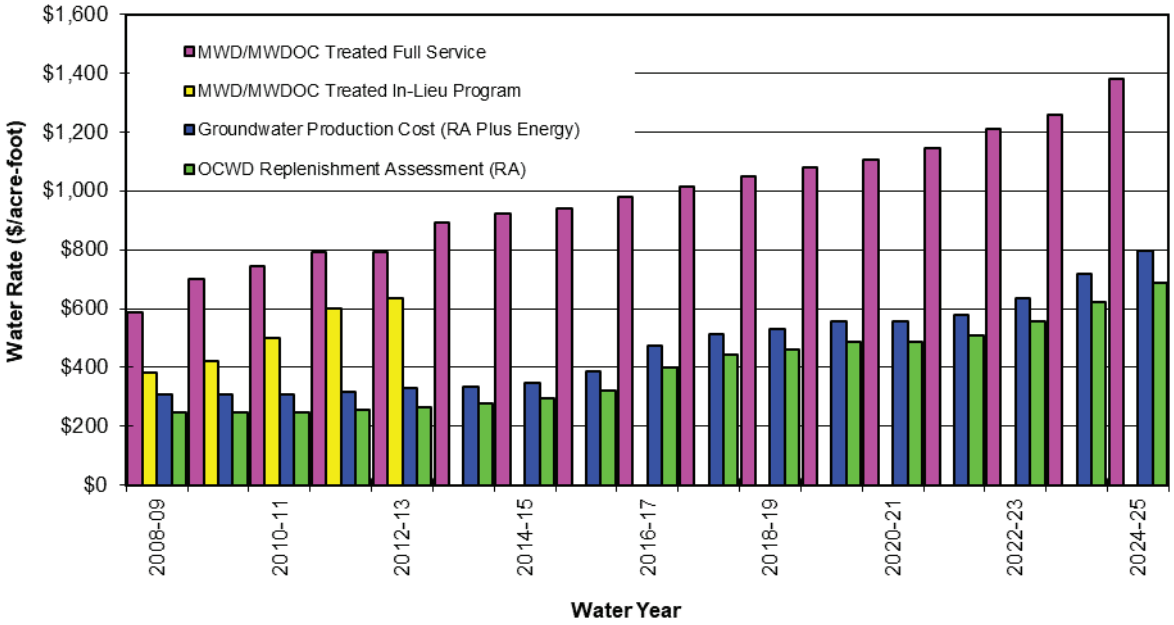
Rate and Charge Components	Treated Water Rate ($/AF)
Firm Deliveries	**Full-Service Water**
MWD Supply Rate (MWDOC Melded Rate)	343.50
MWD System Access Rate	402.50
MWD System Power Rate	188.50
MWD Treatment Surcharge	365.50
MWD RTS and Capacity Charges[2]	80.00
Total	**1,380.00**

[1] *Rates are an average of calendar year 2024 and calendar year 2025. Supplemental water costs for MWD's member agencies (i.e., Anaheim, Fullerton, and Santa Ana) are not reported herein due to the variability among these agencies on water supply allocations between MWD's Tier 1 and Tier 2.*

[2] *Readiness-to-Serve (RTS) and Capacity Charges have been converted to an approximate cost per acre-foot but are not normally reported in terms of unit cost.*

Cost components for supplemental treated and untreated water are listed in Table 8. Beyond the normally expected water supply, treatment and power charges, there are several other charges. The System Access charge is for costs associated with the conveyance and distribution system, including capital and O&M costs. MWD uses the Capacity Charge to recover its cost for use of peaking capacity within its distribution system. The RTS charge is to recover MWD's cost associated with providing standby and peak conveyance capacity and system emergency storage capacity.

FIGURE 6. Adopted and Projected Water Rates for Non-Irrigation Use[1]

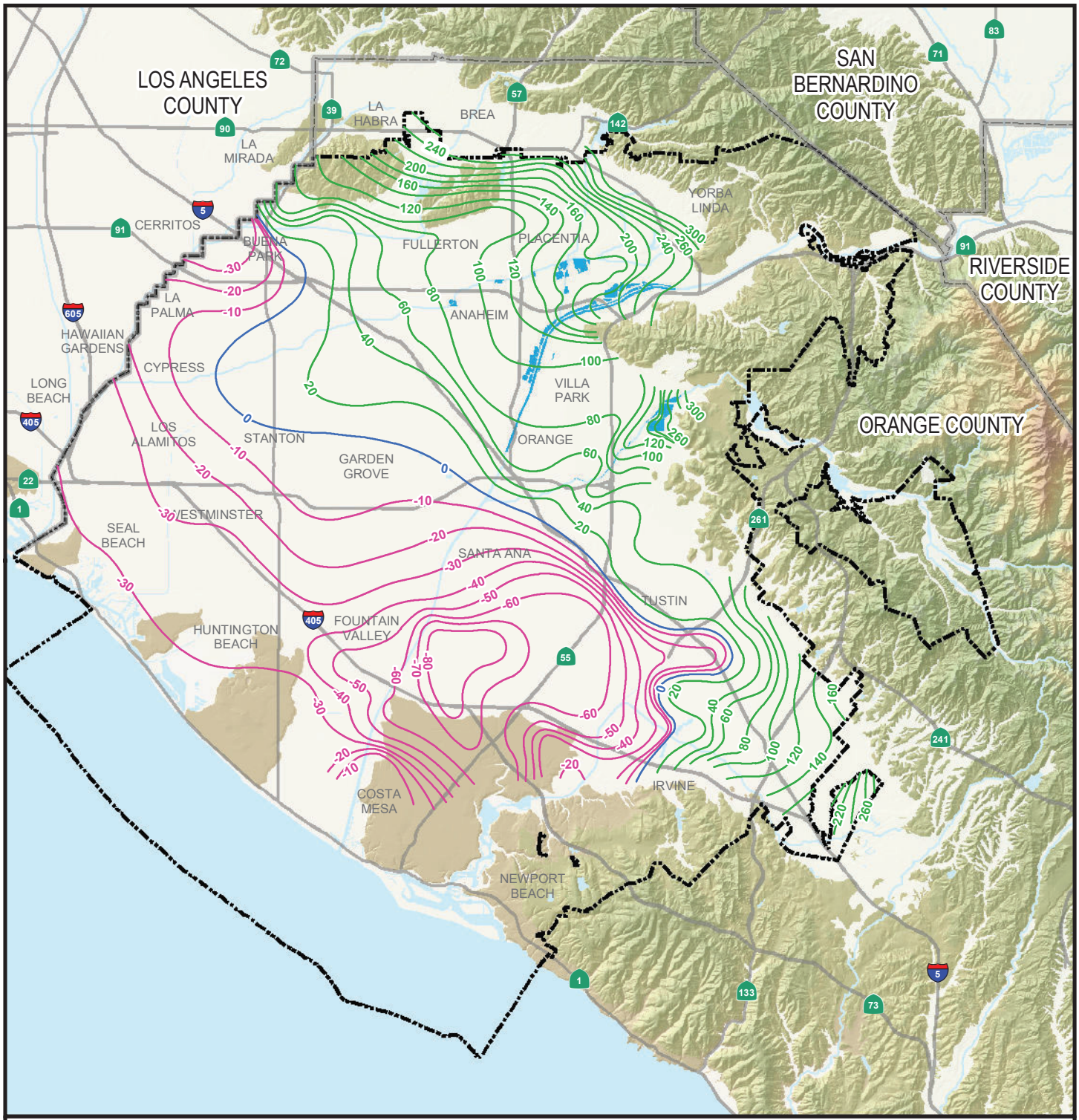


[1] *Refer to Appendix 7 for actual values used in Figure 6.*

TABLE 9. Estimated 2024-25 Water Production Cost Comparison

Non-Irrigation Use	Groundwater Cost ($/AF)	Supplemental Water Cost ($/AF)
Fixed Cost	125.00[1]	1,380.00[3]
Variable Cost	884.00[2]	-[3]
Total	**1,009.00**	**1,380.00**

[1] *Capital cost.*
[2] *Cost for energy, O&M and proposed RA.*
[3] *Delineation of fixed and variable costs is not available.*



Estimated Groundwater Elevations within the Principal Aquifer
Feet above Mean Sea Level* (ft MSL)

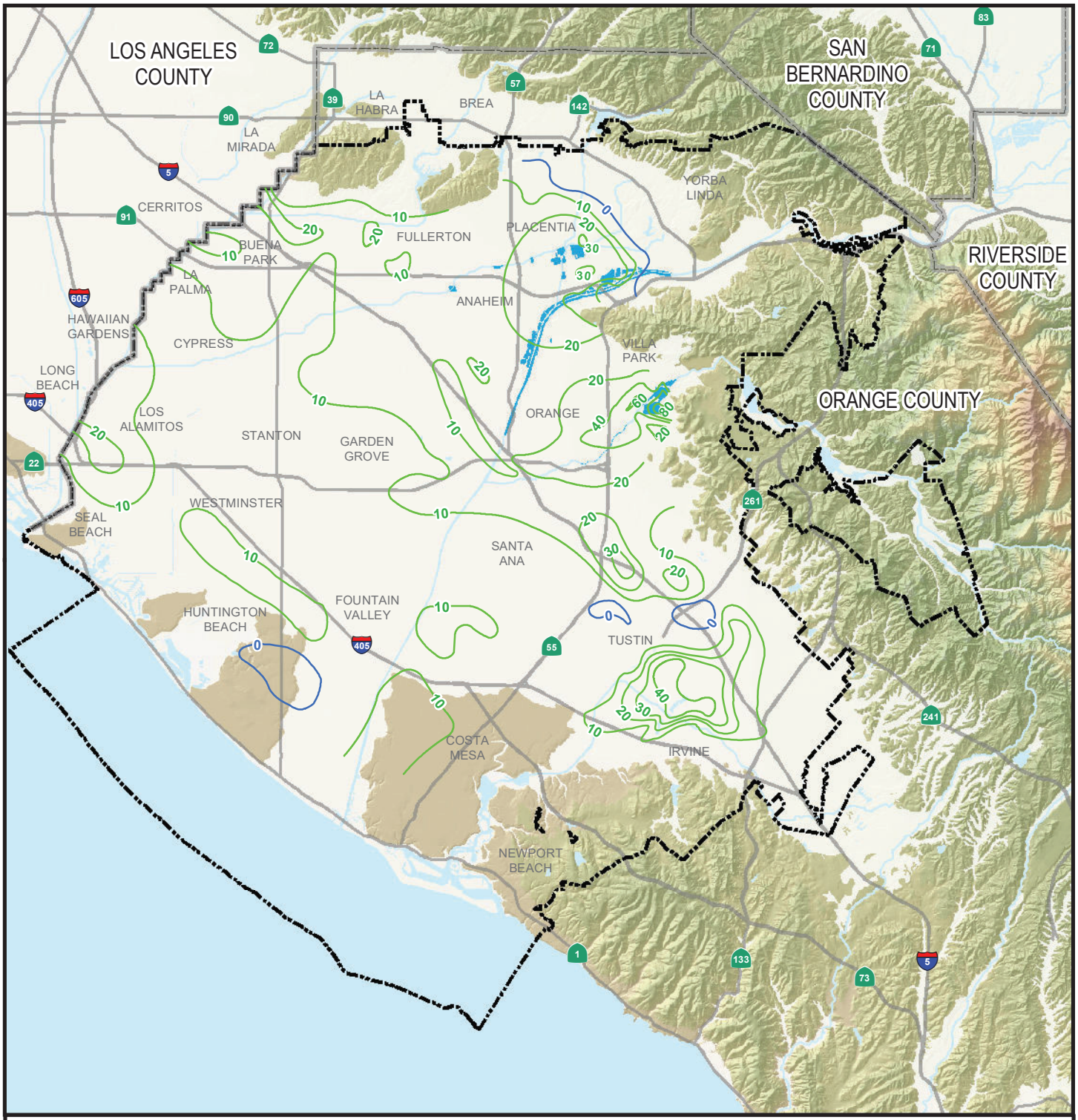
- -80 to -10
- 0
- 20 to 300
- Recharge Facility Areas
- Freeways / Highways
- Rivers / Streams
- Orange County Water District
- Water Bodies

PLATE 1
GROUNDWATER CONTOUR MAP
JUNE 2023

N W E S

0 1 2 4 Miles

*NOTE: MSL elevations are referenced to Vertical Datum NGVD 29



Estimated Groundwater Elevation Changes within the Principal Aquifer (Feet)

- 0
- 10 to 80
- Recharge Facility Areas
- Freeways / Highways
- Rivers / Streams
- Orange County Water District
- Water Bodies

PLATE 2
CHANGE IN GROUNDWATER LEVEL FROM JUNE 2022 TO JUNE 2023

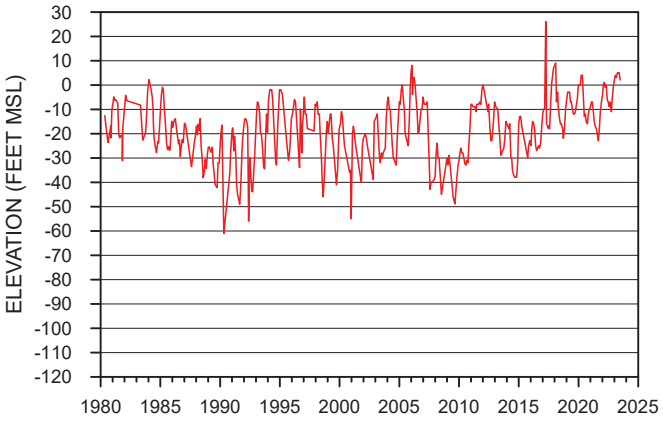
N W E S

0 1 2 4 Miles

PLATE 3
KEY WELL GROUNDWATER ELEVATION TRENDS IN THE PRINCIPAL AQUIFER

Measured water level elevations in feet relative to mean sea level

GG-16
04S/11W-33L01



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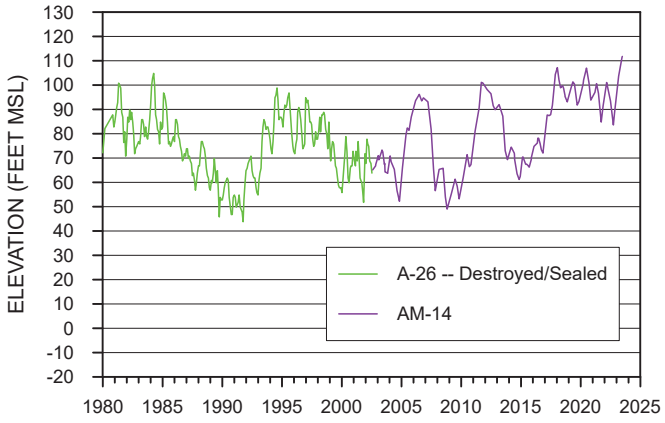

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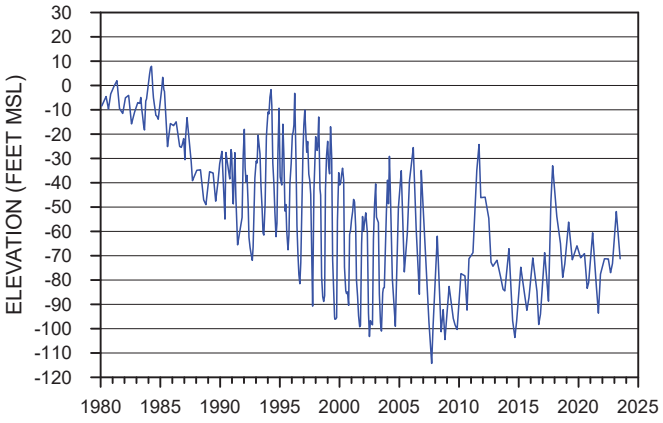

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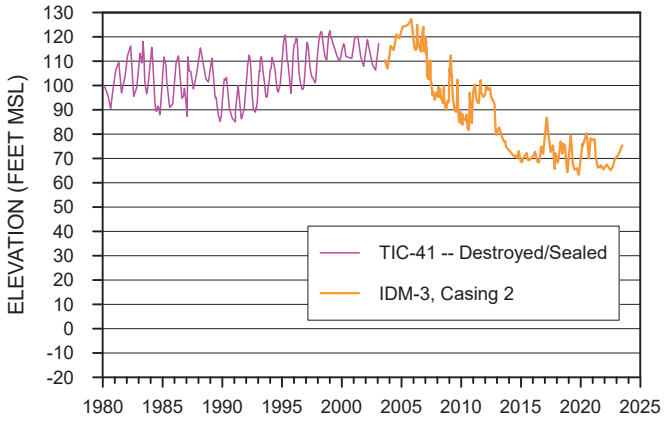

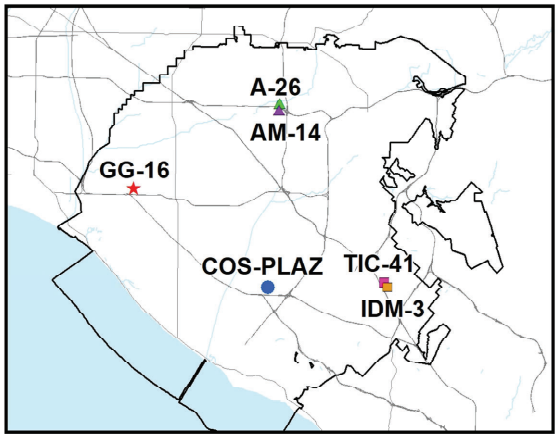

APPENDIX 1. 2022-23 Water Production Data

Groundwater Producer	Groundwater (AF)				Supplemental Water (AF)			Grand Total (AF)	Actual BPP Non-Irrigation [1] Only
	Non-Irrigation [1]		Irrigation Pumping	Total	Non-Irrigation Deliveries	Irrigation Deliveries	Total		
	Pumping	In-Lieu [2]							
Anaheim, City of [6]	15,482.1	-	-	15,482.1	36,572.9	-	36,572.9	52,055.0	29.7%
Buena Park, City of [6]	10,465.3	-	-	10,465.3	1,302.3	-	1,302.3	11,767.6	88.9%
East Orange County Water District	2.5	-	-	2.5	753.9	-	753.9	756.4	0.3%
County of Orange	103.5	-	-	103.5	59.1	-	59.1	162.6	63.7%
Fountain Valley, City of	7,854.8	-	-	7,854.8	-	-	0.0	7,854.8	100.0%
Fullerton, City of	15,469.5	-	-	15,469.5	5,058.1	-	5,058.1	20,527.6	75.4%
Garden Grove, City of [3,6]	16,136.2	-	-	16,136.2	3,641.7	-	3,641.7	19,777.9	81.6%
Golden State Water Company [6]	11,393.7	-	-	11,393.7	8,813.0	-	8,813.0	20,206.7	56.4%
Huntington Beach, City of	16,108.6	-	-	16,108.6	7,257.9	-	7,257.9	23,366.5	68.9%
Irvine Ranch Water District [3,4]	43,964.0	-	-	43,964.0	2,212.4	-	2,212.4	46,176.4	95.2%
La Palma, City of	1,610.2	-	-	1,610.2	4.1	-	4.1	1,614.3	99.7%
Mesa Water District [3]	14,777.9	-	-	14,777.9	9.8	-	9.8	14,787.7	99.9%
Newport Beach, City of	10,595.9	-	-	10,595.9	2,248.8	-	2,248.8	12,844.7	82.5%
Orange, City of [4]	18,390.1	-	-	18,390.1	4,374.3	-	4,374.3	22,764.4	80.8%
Orange County Water District [5]	1,558.0	-	-	1,558.0	-	-	0.0	1,558.0	100.0%
Santa Ana, City of [6]	22,674.2	-	-	22,674.2	7,894.3	-	7,894.3	30,568.5	74.2%
Seal Beach, City of	2,152.5	-	-	2,152.5	569.9	-	569.9	2,722.4	79.1%
Serrano Water District [4]	1,803.6	-	-	1,803.6	852.4	-	852.4	2,656.0	67.9%
Tustin, City of [3]	5,296.2	-	-	5,296.2	4,279.7	-	4,279.7	9,575.9	55.3%
Westminster, City of [6]	9,499.7	-	-	9,499.7	218.2	-	218.2	9,717.9	97.8%
Yorba Linda Water District [6]	14,239.7	-	-	14,239.7	2,318.7	-	2,318.7	16,558.4	86.0%
Total Major Groundwater Producers	239,578.2	0.0	0.0	239,578.2	88,441.5	0.0	88,441.5	328,019.7	73.0%
Other Producers	5096.3	-	535.5	5,631.8	-	-	-	5,631.8	
Total Amount	244,674.5	0.0	535.5	245,210.0	88,441.5	0.0	88,441.5	333,651.5	
Basin Production Percentage Overall									**73.3%**

[1] *Water classed as being used for purposes other than commercial agriculture.*

[2] *Imported MWD water purchased for domestic use to offset groundwater pumping.*

[3] *Agencies that participate in a groundwater water quality improvement project.*

[4] *Agencies that receive Santiago Creek native water above Villa Park Dam which are conveyed to users within OCWD. Such water, if delivered, is included within the classification of "Supplemental Water"*

[5] *Groundwater quantity reported herein is that quantity used by OCWD for purposes other than seawater intrusion barrier maintenance.*

[6] *These agencies participated in the MWD Long-Term Groundwater Storage Program for which groundwater was extracted and accounted for as supplemental water.*

APPENDIX 2. 2022-23 Groundwater Production — Non-Irrigation Use Production Over 25 Acre-feet

PRODUCER	AF	PRODUCER	AF
Alta Vista Country Club	168.5	Mesa Verde Country Club	280.1
Anaheim Cemetery	43.5	Mesa Water District	14,777.9
Anaheim, City of	15,482.1	Midway City Mutual Water Co.	127.7
Billy Casper Golf	193.0	Mile Square Golf Course	69.0
Buena Park, City of	10,465.3	Newport Beach Golf Course	102.3
Canyon RV Park	65.8	Newport Beach, City of	10,595.9
County of Orange	103.5	Old Ranch Country Club	319.9
DS Services of America, Inc.	158.1	Orange County Water District	1,557.9
Eastlake Village HOA	53.3	Orange, City of	18,390.1
Eastside Water Association	171.0	River View Golf	181.3
Fairhaven Memorial Park	136.5	Santa Ana Cemetery	51.7
Forest Lawn Memorial Park	120.3	Santa Ana Country Club	214.5
Fountain Valley, City of	7,854.8	Santa Ana, City of	22,674.2
Fullerton, City of	15,469.5	Seal Beach, City of	2,152.5
Garden Grove, City of	16,136.2	Serrano Water District	1,803.6
Golden State Water Company	11,393.7	SMCM Water Co.	63.5
Hargis and Associates, Inc.	57.1	The Boeing Company	156.3
Huntington Beach, City of	16,108.6	The Good Shepherd Cemetery	51.6
Hynes Estates, Inc.	71.2	The Lakes Master Association	59.6
Irvine Ranch Water District	43,964.0	Tustin, City of	5,296.2
Knott's Berry Farm	150.8	Westminster Memorial Park	277.5
La Palma, City of	1,610.2	Westminster, City of	9,499.7
Laguna Beach County Water District	450.4	Yorba Linda Country Club	298.9
Lockheed Martin Corp.	27.0	Yorba Linda Water District	14,239.7
Los Alamitos Race Course	161.9		
		Total	**243,857.9**

APPENDIX 3. 2022-23 Groundwater Production — Irrigation Use Production Over 25 Acre-feet

PRODUCER	AF
OG Citrus Pickers, Inc.	40.7
Orange County Produce	346.9
Treesap Farms, LLC	122.9
Total	**510.5**

APPENDIX 4. Non - Local Water Purchased by OCWD for Water Years 2003-04 through 2022-23

	Water Exchange		Talbert Barrier		Forebay Recharge		In-Lieu Program		SARCCUP	SAR Upstream Groundwater Projects		TOTAL
	Western	Alamitos	FV[1]	Mesa WD	Forebay	CUP[2]	CUP[2]		Water	Arlington	SBVMWD	
	Mun. WD	Barrier	OC32A	OC44B	Recharge	Recharge	In-Lieu	In-Lieu	Bank[3]	Desalter		
Water	Purch.	Purch.	Purch.	Purch.	Purchase	Delivery	Delivery	Purch.	Delivery	Purch.	Purch.	Delivery and Purchase
Year	AF	AF	AF	AF	AF	AF	AF	AF	AF	AF	AF	AF
2003-04	3,605.0	1,938.3	1,703.3	3,380.6	14,832.0	2,462.7	2,479.6	49,688.8	-	4,087.3	-	84,177.6
2004-05	-	1,914.9	2,451.8	8,368.6	3,810.8	-	15,021.1	54,596.1	-	567.5	-	86,730.8
2005-06	-	833.0[4]	1,079.9	5,431.1	7,256.7	-	15,452.9	73,763.1[5]	-	-	-	103,816.7
2006-07	1,745.0	534.1[4]	143.9	7,394.7	42,173.0	-	14,427.3	36,313.0	-	227.6	-	102,958.6
2007-08	2,882.4	1,505.7[4]	-	4,581.4	-	-	-	-	-	1,266.6	-	10,236.1
2008-09	3,663.5	2,094.2[4]	-	4,140.3	18,100.0	-	-	-	-	428.2	-	28,426.2
2009-10	-	1,321.9[4]	-	176.9	20,535.7	-	-	-	-	106.2	-	22,140.7
2010-11	-	1,689.1[4]	-	100.5	11,038.6	16,500.0	-	10,435.4	-	-	-	39,763.6
2011-12	-	1,198.7[4]	-	1.9	41,230.8	7,709.6	9,719.9	30,843.6	-	-	-	90,704.5
2012-13	-	1,721.8[4]	-	3.7	24,356.1	15,570.8	-	-	-	-	-	41,652.4
2013-14	-	2,370.2[4]	-	6.2	50,700.5	-	-	-	-	-	-	53,076.9
2014-15	-	2,236.3[4]	-	17.7	48,616.8	-	-	-	-	-	-	60,870.8[6]
2015-16	-	2,398.9[4]	-	7.0	45,118.0	-	-	-	-	-	-	47,523.9
2016-17	-	1,166.1[4]	-	7.8	48,918.1	-	-	-	-	-	-	50,092.0
2017-18	-	912.2[4]	-	18.4	66,113.5	-	-	73,108.6	-	-	-	140,152.7
2018-19	-	2,015.2[4]	-	20.1	40,344.9	-	-	-	-	-	-	42,380.2
2019-20	-	2,100.0[4]	-	2.0	18,098.2	-	-	9,354.7	-	-	-	29,554.9
2020-21	-	2,617.6[4]	1.3	15.7	-	-	-	-	2,000.0	-	-	4,634.6
2021-22	-	2,704.0[4]	-	14.1	22,982.1	-	-	-	-	-	-	25,700.2
2022-23	-	2,414.0[4]	-	3.6	16,865.0	-	-	-	-	-	-	19,282.6
Total	11,895.9	35,686.2	5,380.2	33,692.3	541,090.8	42,243.1	57,100.8	338,052.0	2,000.0	6,683.4	0	1,083,824.7

[1] Includes only imported water and excludes groundwater deliveries from Fountain Valley to OCWD.

[2] CUP is the multi-agency conjunctive use program (known as the MWD Long-Term Groundwater Storage Program or MWD CUP). Basin losses are excluded.

[3] Both EOS and imported water from MWD will be tracked in the SARCCUP water bank.

[4] Includes both MWD imported deliveries and supplemental recycled water deliveries.

[5] Includes 16,000 AF of 2005-06 MWD Supplemental Storage Program (i.e., "Super In-Lieu") water that was received as In-Lieu by the groundwater producers.

[6] Includes purchase of 10,000 AF of stored water from MWD CUP storage account at full-service untreated water rate in water year 2014-15.

APPENDIX 5. 2022-23 Water Resources Summary

	2022-2023 Water Year (AF)	2021-2022 Water Year (AF)	Change from last year to this year
SUMMARY OF BASIN CONDITIONS			
BASIN SUPPLIES			
Water Purchases from MWD (excludes In-Lieu)	16,865	22,982	-6,117
Water into MWD Storage Account (excludes In-Lieu)	0	0	0
SAR & Santiago Creek Flows[1]	313,265	127,168	186,097
GWRS AWPF Water to Forebay Recharge Basins	74,624	60,774	-13,850
GWRS AWPF Water to Mid-Basin Injection	7,516	7,807	-291
GWRS AWPF Water to Talbert Barrier	19,747	23,980	-4,233
Imported Water to Talbert Barrier (OC-44 & Fountain Valley)	25	14	11
Alamitos Barrier	2,414	2,704	-290
Incidental Recharge	23,921	20,449	3,472
Evaporation from Recharge Facilities	-3,449	-2,567	882
SAR Flow Lost to Ocean	-141,373	-16,390	-124,983
Total Groundwater Recharge	**313,555**	**246,921**	**66,634**
WATER PRODUCTION			
Groundwater Production	245,210	256,921	-11,711
MWD Storage Program Extractions	0	0	0
Total Groundwater Production	**245,210**	**256,921**	**-11,711**
BASIN STATUS			
Change in Groundwater Storage	69,000	-10,000	79,000
Change in Groundwater Storage excluding MWD Stored Water	69,000	-10,000	79,000
Accumulated Overdraft (AOD)	189,000	258,000	69,000
AOD without MWD Storage Program Water	189,000	258,000	69,000
IN-LIEU WATER			
OCWD In-Lieu Purchases	0	0	0
MWD In-Lieu Storage	0	0	0
Total In-Lieu	**0**	**0**	**0**
OTHER KEY INFORMATION			
1. Total Dissolved Solids of SAR below Prado Dam (mg/L)	656	646	10
2. Total Nitrogen of SAR below Prado Dam (mg/L)	1	4	-3
3. Total GWRS AWPF Production[2]	101,950	92,623	9,327
4. Green Acres Project	3,396	3,827	-431
5. Base Flow of Santa Ana River	67,753	71,141[3]	-3,388
6. Year-end Storage behind Prado Dam	1	0[3]	1
7. Year-end Storage in Recharge Facilities	21,250	10,876[3]	10,374
8. Total Artificial Recharge (percolation plus barriers)	289,632	226,472	63,159
9. Rainfall Measured at OCWD Field Headquarters (inches)	26	7	19
10. Annual Mean Temperature at Santa Ana Fire Station (°F)	65	67	-2

[1] Accounts for storage to/from recharge facilities.
[2] Total includes deliveries to recharge basins, Talbert Barrier, MBI, Anaheim Canyon Power Plant and ARTIC
[3] These values were revised after the publication of 2021-22 Engineer's Report.

APPENDIX 6. Typical Groundwater Extraction Facility Characteristics

PARAMETER	CHARACTERISTICS
Water System Pressure	62 psi
Load (Use) Factor	63%
Design Flow Rate	2,563 gpm
Annual Production	2,600 AF
Bowl Efficiency (minimum)	84%
Motor Horsepower	325 hp
Type Motor	Electric
Well Casing Diameters	16 – 20 inches
Type of Pump	Vertical Turbine
Depth of Well	1,052 feet
Depth of Bowls	278 feet
Total Dynamic Head	325 feet
Estimated Life	30 years
Annual Cost of Facilities[1]	$325,000

[1] Assuming $5,000,000 capital cost (including design and construction) with an interest rate of five percent amortized over a 30-year period and excluding the cost for land purchase.

APPENDIX 7. Values Used in Figure 6 For Water Rates for Non-Irrigation Use

Water Year	RA ($/AF)	Estimated Groundwater Production Cost[1,2] ($/AF)	MWD Treated Interruptible Rate (In-Lieu and Replenishment Water Programs)[2,3] ($/AF)	MWD Treated Uninterruptible Rate (Full Service)[2,3] ($/AF)
1989-90	45	119	136	231
1990-91	48	91	137	232
1991-92	51	100	156	263
1992-93	60	116	206	325
1993-94	67.5	124	257	389
1994-95	88	145	279	416
1995-96	85	140	294	440
1996-97	88	140	303	448
1997-98	91	141	303	455
1998-99	94	143	303	458
1999-00	100	150	303	459
2000-01	107	150	303	459
2001-02	117	162	303	459
2002-03	127	176	299	455
2003-04	149	203	301	460
2004-05	172	229	318	479
2005-06	205	258	337	494
2006-07	223	278	354	510
2007-08	237	296	382	538
2008-09	249	307	420	586
2009-10	249	308	501[4]	701
2010-11	249	310	602[4]	744
2011-12	254	315	633[4]	794
2012-13	266	330	-[5]	794
2013-14	276	334	-[5]	890
2014-15	294	349	-[5]	923
2015-16	322	386	-[5]	942
2016-17	402	473	-[5]	979
2017-18	445	513	-[5]	1,015
2018-19	462	529	-[5]	1,050
2019-20	487	557	-[5]	1,078
2020-21	487	555	-[5]	1,104
2021-22	509	581	-[5]	1,143
2022-23	544	620	-[5]	1,209
2023-24	624	720	-[5]	1,256
2024-25	688[3]	798	-[5]	1,380[4]

[1] *Includes RA plus energy cost to produce groundwater.*
[2] *Rate is rounded.*
[3] *Rate is proposed.*
[4] *Rate is estimated.*
[5] *This rate is no longer available because MWD terminated the Replenishment Program.*