2019-2020

ENGINEER'S REPORT ON

GROUNDWATER CONDITIONS,

WATER SUPPLY AND BASIN UTILIZATION

IN THE

ORANGE COUNTY WATER DISTRICT

FEBRUARY 2021

SINCE 1933

ORANGE COUNTY WATER DISTRICT

ORANGE COUNTY'S GROUNDWATER AUTHORITY

February 17, 2021

Michael R. Markus
General Manager
Orange County Water District
Post Office Box 8300
Fountain Valley, CA 92728-8300

Dear Mr. Markus:

In accordance with Section 26 of the District Act, the 2019-2020 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, 2019 through June 30, 2020 within the District's boundaries averaged 13.38 inches, which was ninety nine 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 161,434 acre-feet which represented seventy 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 22,093 acre-feet.

Total water demands within the District for the 2019-2020 water year were 397,419 acre-feet (excluding water used for groundwater replenishment and barrier maintenance). The use of supplemental water in the District's service area during the water year totaled 119,701 acre-feet. Groundwater production within the basin for the water year totaled 286,498 acre-feet (including In-Lieu Program water) which was a decrease of 5.6 percent from the prior water year.

The accumulated basin overdraft decreased from 236,000 acre-feet on June 30, 2019 to 200,000 acre-feet on June 30, 2020 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 2021-2022 water year could be equal to an amount necessary to purchase up to 144,000 acre-feet of replenishment water.

Truly yours,

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 397,419 acre-feet (AF) for the 2019-20 water year (beginning on July 1, 2019 and ending on June 30, 2020). Groundwater production for the water year totaled 286,498 AF including any available In-Lieu Program water. The use of supplemental water in OCWD's service area during the 2019-20 water year totaled 119,701 AF of which 90,198 AF resulted from the direct use by water agencies and districts and 29,503 AF were used for the purpose of groundwater replenishment and maintenance of seawater intrusion control barriers.

For the water year which ended on June 30, 2020, the "annual overdraft" (annual basin storage decrease without supplemental replenishment water) was 91,300 AF. The accumulated overdraft decreased from 236,000 AF on June 30, 2019 to 200,000 AF on June 30, 2020. Precipitation within the basin was ninety nine percent of the long-term average during the water year, totaling 13.38 inches.

Based on the groundwater basin conditions for the water year ending on June 30, 2020, OCWD may purchase up to 144,000 AF of water for groundwater replenishment during the ensuing water year, beginning on July 1, 2021, 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 2019-20 Basic Data Report which is placed on file at the office of OCWD in Fountain Valley.

GLOSSARY OF ACRONYMS

ABIP	Alamitos Barrier Improvement Project
AF	Acre-Feet
ARTIC	Anaheim Regional Transportation Intermodal Center
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
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, 2019 to June 30, 2020 is as follows.

GROUNDWATER CONDITIONS
2019-20 SUMMARY OF FINDINGS

1. Groundwater production (including the In-Lieu Program water) totaled 286,498 acre-feet (AF) for the 2019-20 water year.

2. Groundwater stored in the basin increased by 36,000 AF for the 2019-20 water year.

3. Accumulated Overdraft[1] on June 30, 2020 was 200,000 AF.[2]

4. Annual Overdraft was 91,300 AF for the 2019-20 water year.

5. Average Annual Overdraft[3] for the immediate past five water years (2015-16 through 2019-20) was 124,300 AF.

6. Projected Annual Overdraft[3] for the current 2020-21 water year is 98,000 AF.

7. Projected Annual Overdraft[3] for the ensuing 2021-22 water year is 69,000 AF.

8. Projected Accumulated Overdraft[2] on June 30, 2021 is 198,000 AF.

9. Under the provisions of Section 27 of the District Act, a portion of the 2021-22 Replenishment Assessment (RA) could be equal to an amount necessary to purchase up to 144,000 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 (124,300 AF) to one-tenth of the accumulated overdraft (200,000 AF) which results in the following:*
124,300 AF + [(200,000 AF) x 0.10] = 144,300 AF (or 144,000 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, 2019, yielded an average of 13.38 inches of rainfall within OCWD's boundaries, which is approximately ninety nine 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 (2018-19) was 21.46 inches. The average annual rainfall in the OCWD service area for the five-year period (from July 1, 2015 through June 30, 2020) was 13.02 inches, and below-average rainfall in the watershed tends to lead to lower flows in the SAR reaching Orange County. Stream flow in the SAR measured downstream of Prado Dam for the water year 2019-20 totaled 161,434 AF which was approximately 70 percent of the 30-year flow average of 228,605 AF.

GROUNDWATER PRODUCTION

Groundwater production from wells within OCWD for the 2019-20 water year totaled 277,195 AF (excluding In-Lieu Program water, MWD Groundwater Storage Program extractions, and any groundwater used for the Talbert Barrier): 276,445 AF for non-irrigation and 750 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 2019-20 water year, the In-Lieu Program water was available for purchase from MWD in the amount of 9,303 AF. 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 1970-71 through 2019-20.

Groundwater production and In-Lieu Program quantities for 2019-20 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

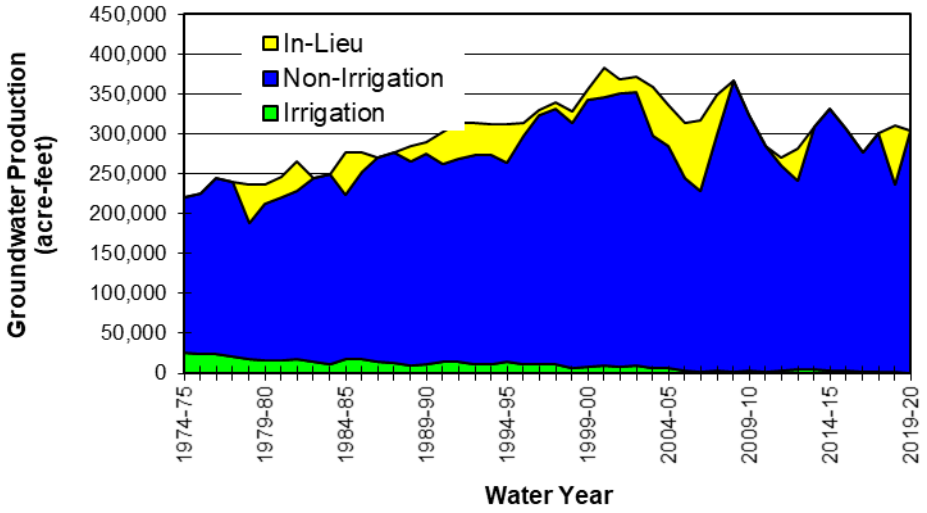


TABLE 1. Historical Groundwater Production Within OCWD

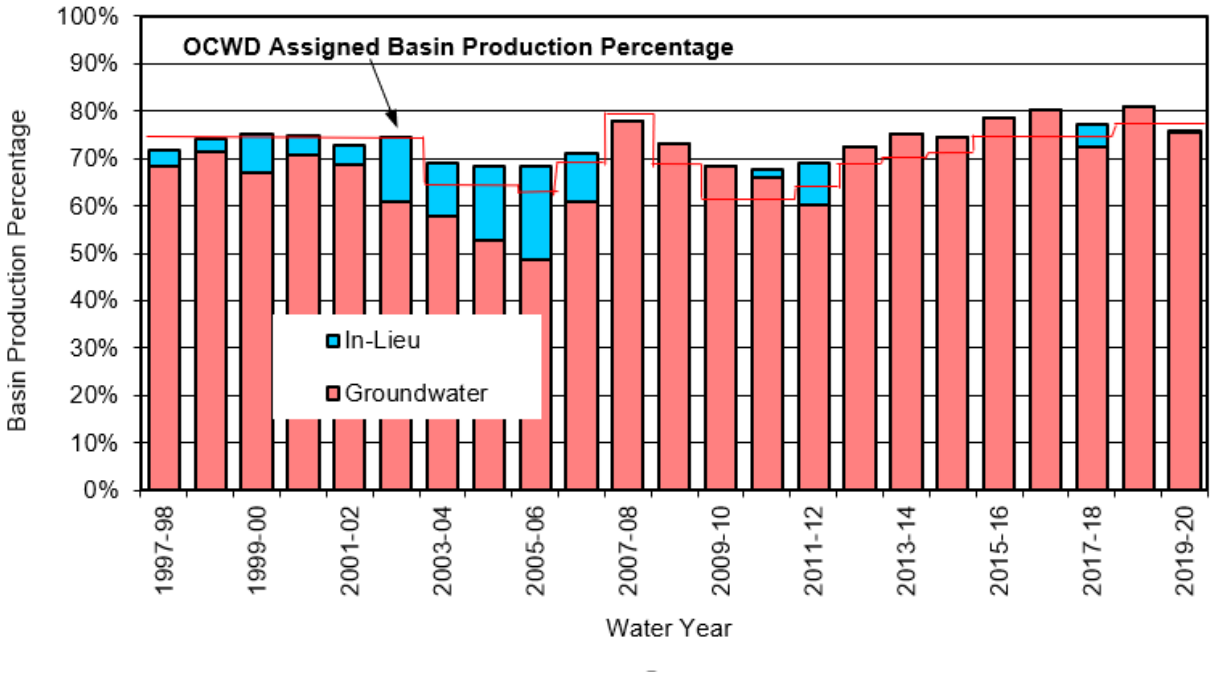
Water Year Jul 1-Jun 30	Groundwater Production (AF)	In-Lieu Program (AF)	Water Year Jul 1-Jun 30	Groundwater Production (AF)	In-Lieu Program (AF)
1970-71	203,923	-	1995-96	324,111	5,542
1971-72	229,048	-	1996-97	331,406	7,883
1972-73	214,983	-	1997-98	313,805	15,096
1973-74	218,863	-	1998-99	342,823	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	48,290	2002-03	297,191	61,463
1978-79	213,290	23,792	2003-04	284,621	52,168
1979-80	221,453	24,861	2004-05	244,370	69,617
1980-81	228,943	36,373	2005-06	228,159	89,216
1981-82	244,184	-	2006-07	299,118	50,740
1982-83	249,548	-	2007-08	366,185	-
1983-84	223,207	52,822	2008-09	324,147	-
1984-85	252,070	25,198	2009-10	285,575	-
1985-86	270,932	-	2010-11	259,861	10,435
1986-87	276,354	-	2011-12	241,082	40,564
1987-88	265,226	18,856	2012-13	309,295	-
1988-89	275,077	15,022	2013-14	330,782	-
1989-90	261,190	38,961	2014-15	305,259	-
1990-91	266,745	44,588	2015-16	277,090	-
1991-92	271,224	39,789	2016-17	301,637	-
1992-93	273,587	38,900	2017-18	236,916	73,108
1993-94	264,159	48,134	2018-19	303,496	-
1994-95	298,217	15,622	2019-20	277,195	9,303

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 2019-20 water year was established at 77.0 percent by the OCWD Board of Directors. The overall BPP achieved within OCWD for non-irrigation use in the 2019-20 water year was 75.9 percent. The achieved pumping is less than 77.0 percent 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 2020 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 70 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 slightly seaward (ranging from 0.1 to 1.2 miles) when compared to its alignment the prior year, indicating an increase in groundwater levels in the principal aquifer system from June 2019 to June 2020.

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 2019 to June 2020 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 along much of Los Angeles County line where the change was negligible and in the vicinity of OCWD's recharge facilities at Santiago basins in Orange where groundwater levels declined by 10 to 50 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, and 2018-19, but the response is largest at AM-14 due to its proximity to OCWD's spreading grounds.

The increase of total storage of 36,000 AF resulted from a moderate rise in groundwater levels throughout most of the basin from June 2019 to June 2020. In the shallow aquifer, groundwater levels rose approximately 5 feet throughout much of the pressure area and Anaheim/Fullerton Forebay area and as much as 15 feet surrounding the OCWD recharge facilities in Anaheim. This increase was only partially offset by a large but localized decline of 20 to 40 feet immediately surrounding Santiago Basin in the Orange Forebay area. Shallow aquifer groundwater levels near the Talbert Barrier had a negligible change

from June 2019 to June 2020 while remaining at or above protective elevations for seawater intrusion control. In the principal aquifer, groundwater levels rose approximately 5 feet throughout the central portion of the basin, 15 to 20 feet near the OCWD recharge facilities in Anaheim, 10 to 30 feet in the greater Santa Ana area surrounding the MBI wells and also 10 to 30 feet in the eastern half of the Irvine Sub-basin adjacent the Santa Ana Mountain-front. Similar to the shallow aquifer, groundwater levels in the principal aquifer in the vicinity of the Santiago basins declined 30 to 50 feet. A smaller decline of 5 to 10 feet was observed in the Costa Mesa area. In the deep aquifer, groundwater levels rose by 5 to 15 feet throughout most of the basin and by as much as 30 feet in the eastern half of the Irvine sub-basin, while experiencing mild localized declines of 5 to 10 feet in the Tustin area and the southwest portion of the Irvine sub-basin.

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 2019-20 water year, it is estimated that the volume of groundwater in storage increased by 36,000 AF. Approximately 127,300 AF of water was supplied to the basin as follows: 1) directly from the percolation or injection of purchased imported water from the Colorado River and State Water Project, 2) use of recycled water to supplement purchased imported water in the Alamitos seawater intrusion barrier, and 3) use of GWRS recycled water for basin replenishment. Therefore, the annual overdraft was 91,300 AF for the 2019-20 water year. For the five-year period from July 1, 2015 to June 30, 2020, an annual average of approximately 160,000 AF of supplemental water and recycled water as percolated or injected into the underground basin for replenishment 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 124,300 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

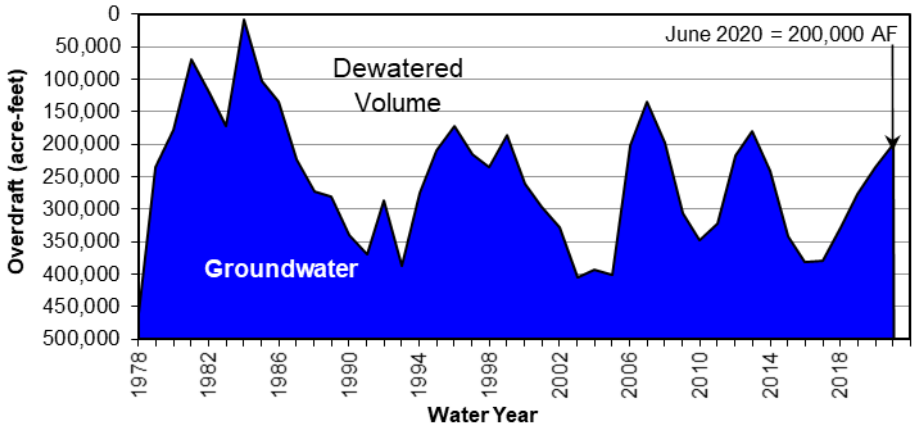
Alamitos seawater intrusion control projects have been implemented to prevent landward movement of ocean water into the fresh groundwater body. Due to the operation of seawater intrusion barrier facilities, there is no longer a direct correlation between accumulated overdraft and controlling seawater 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 2019-20 has been completed. Based on the three-layer methodology, an accumulated overdraft of 200,000 AF was calculated for the water year ending June 30, 2020. The accumulated overdraft for the prior water year ending June 30, 2019 was 236,000 AF (also calculated using the three-layer storage method). Therefore, an annual increase of 36,000 AF (reported earlier herein this report) in stored groundwater was calculated as the difference between the June 2019 and June 2020 accumulated overdrafts.

Figure 3 shows the accumulated basin overdraft quantities for the period 1978 through 2020.

FIGURE 3. Accumulated Basin Overdraft



The accumulated overdraft for the current water year ending on June 30, 2021 is projected to be 198,000 AF. The projected annual overdraft is estimated to be 98,000 AF. This quantity is based on assumed annual groundwater production of approximately 253,000 AF for the current water year (including groundwater pumping within the BPP, In-Lieu Program water, groundwater pumped above the 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 155,000 AF for the basin under average rainfall conditions. In addition, GWRS production is projected to reach 97,000 AF.

Projected annual overdraft for the ensuing water year 2021-22 is estimated to be 69,000 AF. This estimate is based on the assumption that total annual groundwater production for the ensuing water year will be 250,000 AF, a figure that is based upon an assumed BPP of 77 percent and includes 22,000 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 181,000 AF (average of last five years) under average rainfall conditions, and the GWRS production is projected to be 97,000 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 2019-20 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. The SARCCUP 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 bank include imported water and surplus State Project Water (SPW) from San Bernardino Valley Municipal Water District (SBVMWD). 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 be considered 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 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, Western Municipal Water District and Eastern Municipal Water District. OCWD is expecting to begin placing water into the SARCCUP water bank in water year 2020-21.

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 2021-22 is limited to the amount needed to purchase 144,000 AF as calculated below:

Five-year (7/1/2015 through 6/30/2020) Average Annual Overdraft* = 124,300 AF
Accumulated Overdraft (End of Water Year 2019-20) = 200,000 AF
Assumed Time Period to Eliminate Accumulated Overdraft = 10 years
Potential Water Purchase Amount: 124,300 AF + (200,000 AF/10 years) = 144,300 AF (use 144,000 AF)

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

Table 2 presents the proposed 2021-22 water budget expenses, which shows the proposed quantity of purchased water (3,000 AF) being significantly less than the prescribed limit of 144,000 AF as allowed for under the provisions of Section 27(b) of the District Act.

TABLE 2. 2021-22 Water Budget Expenses

Water Source	Amount (AF)	Unit Cost ($/AF)	Costs ($)
Alamitos Barrier	3,000	$1,258.00	$ 3,772,500
MWD Untreated Full-Service Water	0	$788.00	$ 0
Water Purchases Sub-total	3,000	—	$ 3,772,500
Applicable Charges			**Costs ($)**
MWD Readiness to Serve Charge	—	—	$ 3,300,000
MWDOC Groundwater Charge	—	—	$ 335,000
MWD Capacity Charge	—	—	$ 1,100,000
Total Expenses			$ 8,507,500

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 77 percent is currently being proposed for the ensuing water year 2021-22. 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 2021-22 without detriment to the basin. Under normal conditions, the annual groundwater production could reach 323,000 AF. However, it is anticipated that the groundwater production for the ensuing water year 2021-22 will decrease to approximately 250,000 AF due to the water quality impacts of per- and polyfluoroalkyl substances (PFAS). Because of the State Division of Drinking Water setting of a Response Level of 10 parts per trillion for perfluorooctanic acid and 40 parts per trillion for perfluorooctane sulfonic acid, OCWD anticipates that up to 70 production wells could be shutdown until treatment systems can be installed.

In order to achieve water quality objectives in the groundwater basin, it is estimated for the ensuing water year 2021-22 that additional production of approximately 22,000 AF (above the BPP) will be undertaken by the City of Tustin, City of Garden Grove, City of Huntington Beach, Mesa Water District and Irvine Ranch Water District (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 2021, 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 2021, staff will again apprise the OCWD Board of Directors on the status of the aforementioned conditions. If the estimates 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
2019-20 SUMMARY OF FINDINGS

1. Water usage from all supplemental sources and non-local water sources (if any) totaled 119,701 AF for the 2019-20 water year including any available In-Lieu Program water.

2. Water usage from recycled water produced from within OCWD including the GWRS totaled 118,442 AF for the 2019-20 water year.

3. Water demands within OCWD totaled 397,419 AF for the 2019-20 water year.

4. Estimated demands for groundwater for the ensuing 2021-22 water year are 250,000 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. 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.

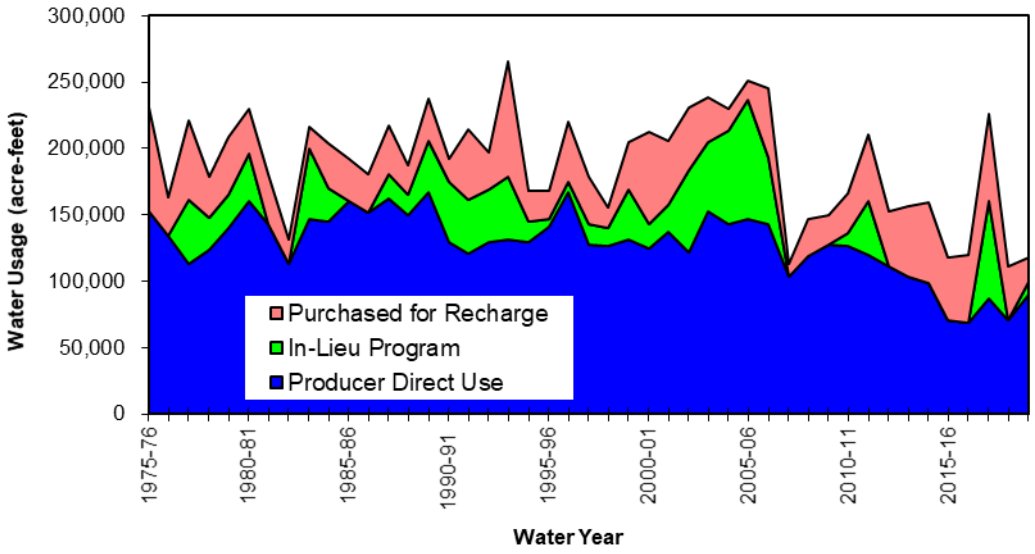
Water agencies utilizing supplemental water are listed in Appendix 1. As summarized in Table 3, the use of supplemental water in OCWD's service area during the 2019-20 water year totaled 119,701 AF of which 90,198 AF resulted from the direct use by water agencies and districts and 29,503 AF (including any available In-Lieu Program water) were used for groundwater replenishment purposes. The supplemental water used by water agencies included 87,652 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 2019-20 water year. A breakdown of non-local water purchases by OCWD from water years 2000-2001 through 2019-20 is presented in Appendix 4.

TABLE 3. 2019-20 Supplemental Water Usage

Direct Agency Use	**AF**
Imported Water[1]	87,652
Santiago Creek Native Water	2,546
Subtotal	**90,198**
Groundwater Replenishment (Purchased)	**AF**
In-Lieu Program[2]	9,303
Forebay Recharge[3]	18,098
Alamitos Barrier[4]	2,100
Talbert Barrier	2
Subtotal	**29,503**
TOTAL	**119,701**

[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. 2019-20 Recycled Water Usage

Groundwater Replenishment	Water Usage (AF)
GWRS AWPF (for Talbert Barrier)	23,777
GWRS AWPF (for Recharge Basins)[1]	70,220
GWRS AWPF (for Mid-Basin Injection)	3,722
Subtotal	**97,719**
Irrigation	**Water Usage (AF)**
IRWD[2]	16,517
OCWD (Green Acres Project)[3]	4,206
Subtotal	**20,723**
TOTAL	**118,442**

[1]Includes 87 AF of GWRS recycled water delivered to City of Anaheim Canyon Power Plant and Anaheim Regional Transportation Intermodal Center (ARTIC).
[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 provided untreated full-service water supplies to groundwater-basin agencies during the water year 2019-20 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 2021-22. OCWD is not planning to purchase untreated full-service water to recharge its groundwater basin in the ensuing water year 2021-22 due to the expected decrease in groundwater production caused by the PFAS water quality issue.

WATER DEMANDS

During the 2019-20 water year, the total water demands within OCWD's service area were 397,419 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 and water conservation credits given to groundwater producers for their conservation efforts.

Water demands for 2019-20 and projected water demands for 2020-21 and 2021-22 are summarized in Table 5. The water demands for the current year 2020-21 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 2021-22 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]
2019-20					
Non-Irrigation	285,748	87,652	2,546	-	375,946
Irrigation	750	0	-	20,723	21,473
Total	**286,498**	**87,652**	**2,546**	**20,723**	**397,419**
2020-21 (Current Year)[5]					
Non-Irrigation	252,200	125,000	2,000	-	379,200
Irrigation	800	-	-	20,000	20,800
Total	**253,000**	**125,000**	**2,000**	**20,000**	**400,000**
2021-22 (Ensuing Year)[5]					
Non-Irrigation	249,200	127,000	2,500	-	378,700
Irrigation	800	-	-	20,500	21,300
Total	**250,000**	**127,000**	**2,500**	**20,500**	**400,000**

[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.*

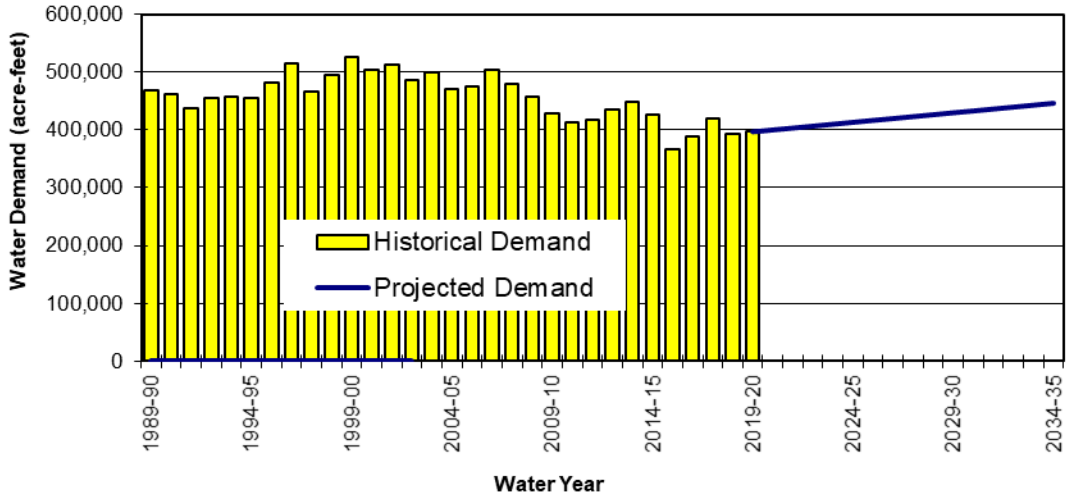
[3] *"Imported Water" and "Santiago Creek Native Water" are both counted as supplemental water.*

[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 amount 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 2035. These projections include the effect of local water conservation efforts. Figure 5 illustrates the historical and the projected water demands for OCWD's service area to the year 2035.

Population within OCWD's service area is expected to increase from the current 2.28 million people (based on Census 2010 demographic data) to approximately 2.59 million people by the year 2035. This population growth is expected to increase water demands from the current 397,419 AF per year to 447,000 AF per year in 2035 (a water demand projection that takes into consideration future water conservation savings). In an effort to support increasing water demands, OCWD will look to increase basin production by developing new local water supply projects that are economically cost effective.

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 ultraviolet (UV) light disinfection in combination with hydrogen peroxide. For water year 2019-20, the GWRS treated wastewater from the OC San to drinking water standards and delivered 97,719 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 2019-20, 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 20,723 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 historical production is typically 3 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 UV light disinfection. 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 2019-20 and supplied 335.7 AF of purified recycled water to OCWD's portion of the Alamitos Barrier, which represented sixteen 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 Advanced Water Quality Assurance 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 2019-20 was determined to have a flow-weighted average of 427 milligrams per liter (mg/L) of total dissolved solids (TDS) which is lower than the average TDS concentration of 452 mg/L

reported for the prior year (2018-19). The average groundwater TDS concentration for the basin for 2019-20 was 429 mg/L (compared to 447 mg/L reported for 2018-19), ranging from a low of 220 mg/L in coastal areas (such as Seal Beach) to a high of approximately 686 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 2019-20 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 2019-20 water year and the previous water year (2018-19) is included in Appendix 5.

TABLE 6. 2019-20 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	560	2.4	316	502	1.5	260
Buena Park	444	1.7	267	440	1.4	250
East Orange County Water District	574	3.3	353	422	0.2	184
Fountain Valley	352	1.1	212	352	1.1	212
Fullerton	434	2.2	247	431	1.8	234
Garden Grove	556	3.5	328	489	1.9	255
Golden State Water Company	421	1.6	245	421	1.3	232
Huntington Beach	299	0.4	157	336	0.3	165
Irvine Ranch Water District[6]	350*	1.0*	133*	361*	0.9*	140*
La Palma	297	ND[8]	139	297	ND[8]	139
Mesa Water District	325	0.5	111	330	0.5	115
Newport Beach	284	1.2	153	325	0.9	162
Orange	463	2.2	276	453	1.8	254
Santa Ana	399	2.2	250	404	1.8	234
Seal Beach	220	ND[8]	102	288	ND[8]	130
Serrano Water District	617	2.2	341	590	1.2	339
Tustin[6]	598*	5.3*	331*	591*	5.1*	325*
Westminster	359	1.5	224	373	1.2	215
Yorba Linda Water District	686	1.3	331	561	0.8	261
Weighted Average[7]	**429**	**1.8**	**231**	**427**	**1.4**	**219**

[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 2019-20 are as follows:*

MWD Water Quality			*Santiago Reservoir Water Quality*		
TDS	=	*421 mg/L*	*TDS*	=	*557 mg/L*
NO_3-N	=	*0.9 mg/L*	*NO_3-N*	=	*0.0 mg/L*
Hardness (as $CaCO_3$)	=	*183 mg/L*	*Hardness (as $CaCO_3$)*	=	*336 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 Advanced Water Quality Assurance Laboratory is 0.1 mg/L.*

PART III: WATER PRODUCTION COSTS FOR ENSUING WATER YEAR (2021-22)

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 (2021-22) WATER PRODUCTION COSTS SUMMARY OF FINDINGS

1. Cost for producing water from the groundwater basin within OCWD including a replenishment assessment for 2021-22 is estimated to be $786.00 per acre-foot.

2. Cost of treated, non-interruptible supplemental water for 2021-22 is estimated to be $1,203.00 per acre-foot.

GROUNDWATER PRODUCTION COSTS FOR NON-IRRIGATION USE

Cost for producing an acre-foot of groundwater in the ensuing 2021-22 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 2020. 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 2021-22.

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 2021-22 water year is estimated to be $786 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 $72 per AF. Operation and Maintenance (O&M) costs ranged from $5 to $142 per acre-foot with a median cost of approximately $82 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 54 percent.

TABLE 7. Estimated 2021-22 Groundwater Production Costs

Cost Item	Non-Irrigation Use	
	Annual Cost ($)	Cost per AF ($/AF)
Energy	187,200	72[2]
RA	1,318,200	507[3]
Capital	325,000[1,4]	125[1,4]
O&M	213,200	82[2]
Total Cost to Producers	2,043,600	786

[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 2021-22.*
[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 2020-21 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 2020-21 is summarized in Table 9 and also in Figure 6. Values used in Figure 6 are presented in tabular form in Appendix 7.

TABLE 8. Estimated 2021-22 Supplemental Water Cost[1]

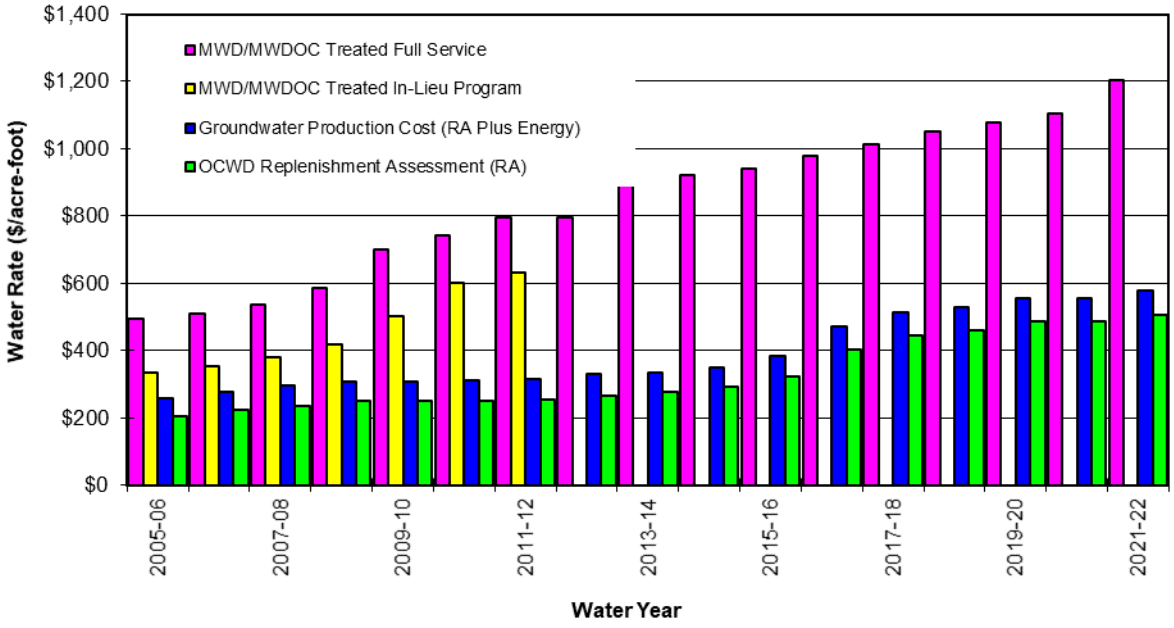
Rate and Charge Components	Treated Water Rate ($/AF)
Firm Deliveries	**Full Service Water**
MWD Supply Rate (MWDOC Melded Rate)	243.00
MWD System Access Rate	381.00
MWD System Power Rate	164.00
MWD Water Stewardship Rate	0.00
MWD Treatment Surcharge	335.00
MWD RTS and Capacity Charges[2]	80.00
Total	**1,203.00**

[1] *Rates are an average of calendar year 2021 and calendar year 2022. 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. The Water Stewardship charge is used to support MWD's financial commitment to conservation,

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



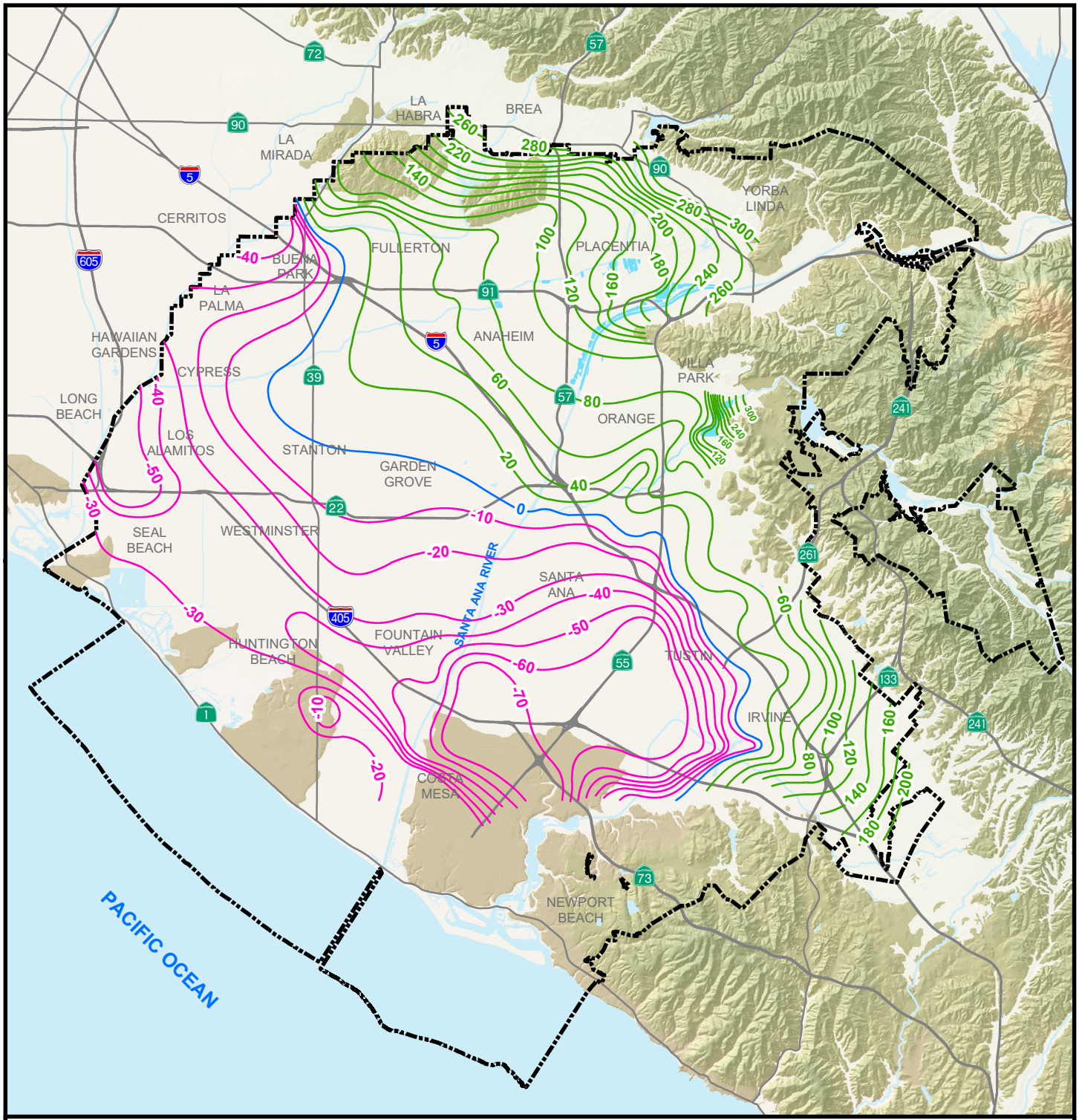
[1] *Refer to Appendix 7 for actual values used in Figure 6.*

TABLE 9. Estimated 2021-22 Water Production Cost Comparison

Non-Irrigation Use	Groundwater Cost ($/AF)	Supplemental Water Cost ($/AF)
Fixed Cost	125.00[1]	1,203.00[3]
Variable Cost	661.00[2]	-[3]
Total	**786.00**	**1,203.00**

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

water recycling, groundwater recovery and other water management programs approved by MWD. 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.



Estimated Groundwater Elevations Within The Principal Aquifer Feet above Mean Sea Level* (ft MSL)

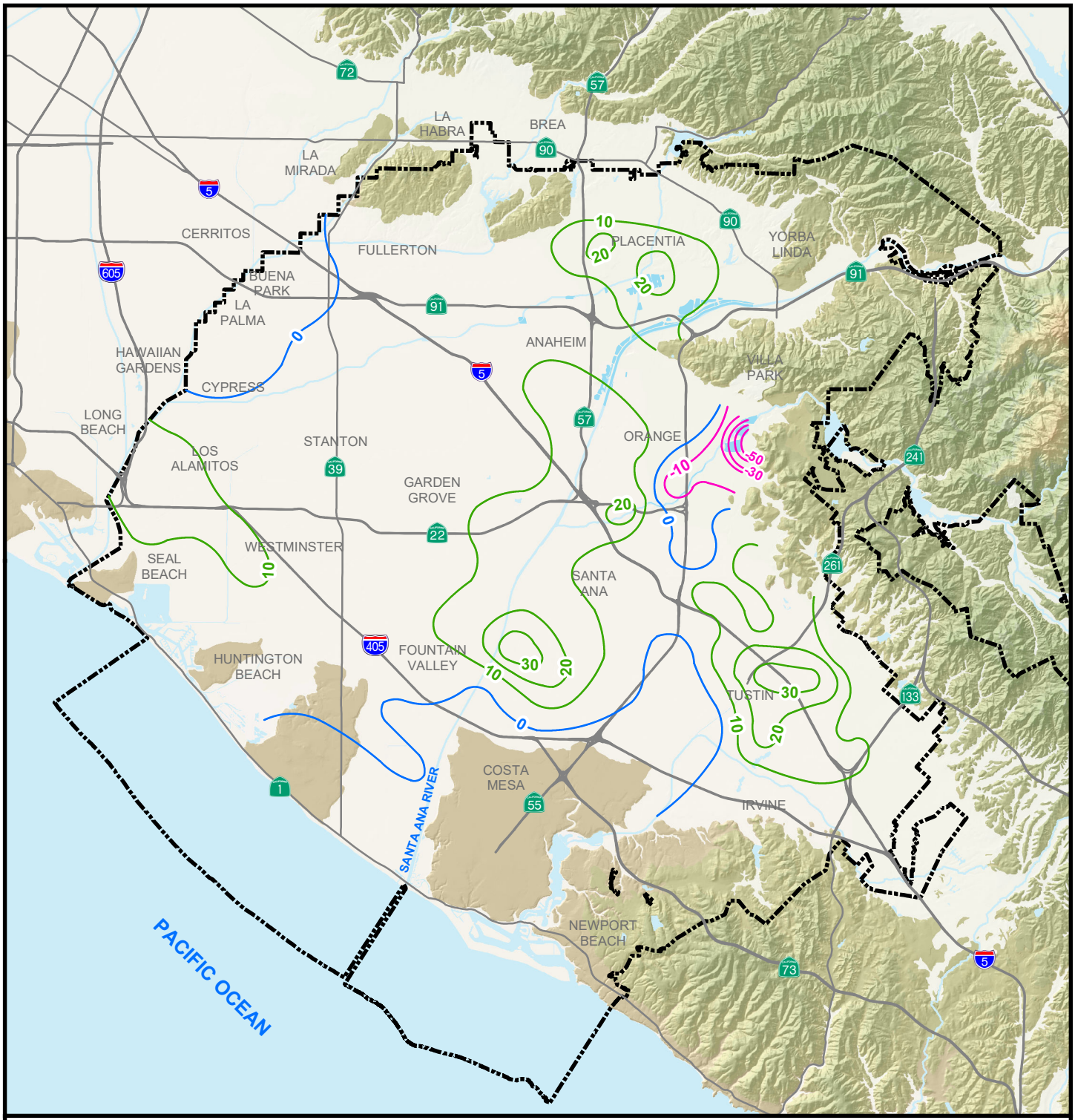
- -70 to -10
- 0
- 20 to 300
- Recharge Facility Areas
- Freeways / Highways
- Rivers / Streams
- Orange County Water District
- Water Bodies

PLATE 1
GROUNDWATER CONTOUR MAP
JUNE 2020

0 1 2 4 Miles

N W E S

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



Estimated Groundwater Elevation Changes Within The Principal Aquifer (Feet)

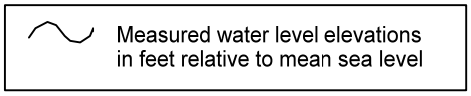
- -50 to -10
- 0
- 10 to 30
- Recharge Facility Areas
- Freeways / Highways
- Rivers / Streams
- Orange County Water District
- Water Bodies

PLATE 2
CHANGE IN GROUNDWATER LEVEL FROM JUNE 2019 TO JUNE 2020

0 1 2 4 Miles

N W E S

PLATE 3
KEY WELL GROUNDWATER ELEVATION TRENDS IN THE PRINCIPAL AQUIFER



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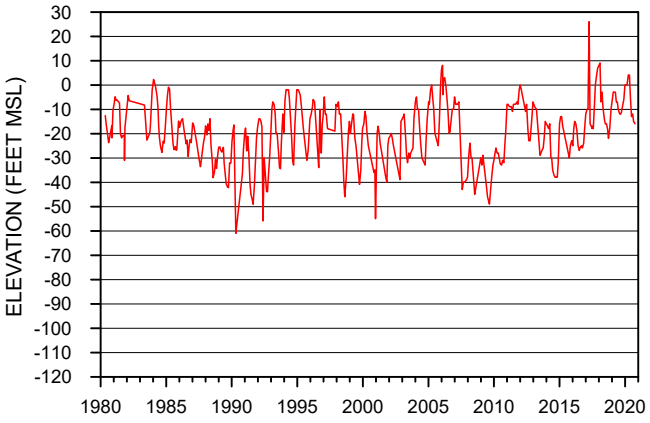

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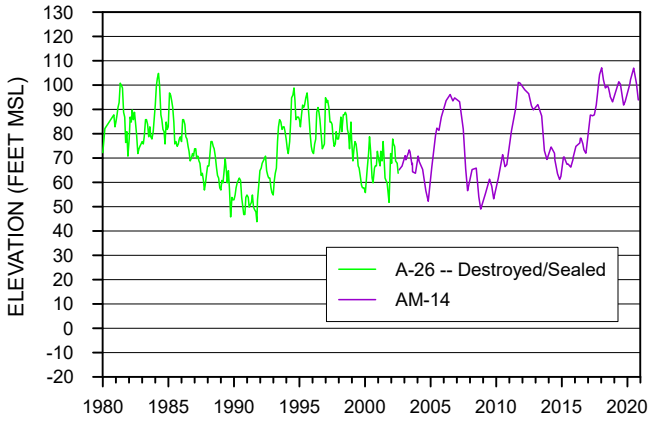

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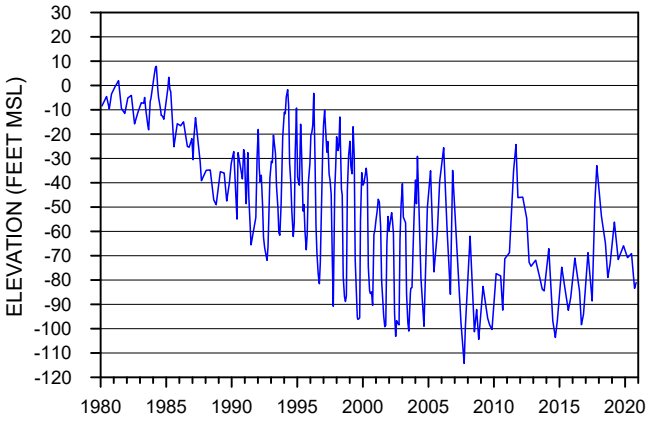

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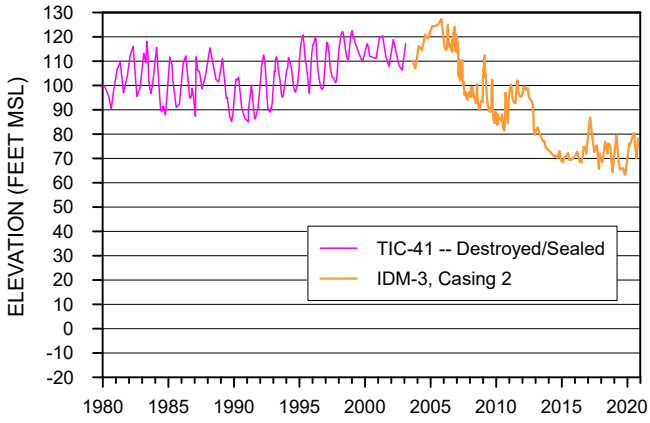
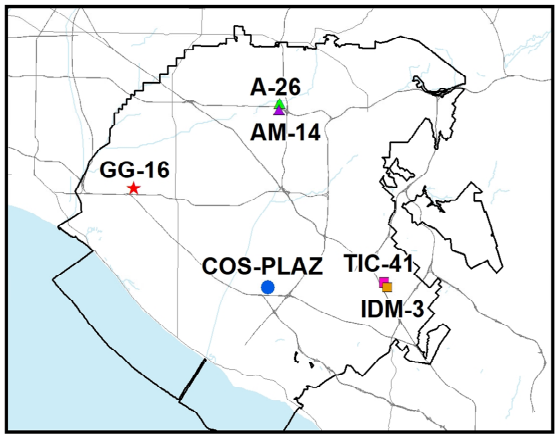
05S/09W-36B02





APPENDIX 1. 2019-20 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 [7]	34,013.2	-	-	34,013.2	24,182.5	-	24,182.5	58,195.7	58.4%
Buena Park, City of [7]	10,590.6	-	-	10,590.6	2,657.0	-	2,657.0	13,247.6	79.9%
East Orange County Water District	4.7	-	-	4.7	781.7	-	781.7	786.4	0.6%
County of Orange	90.2	-	-	90.2	150.6	-	150.6	240.8	37.5%
Fountain Valley, City of	8,686.8	-	-	8,686.8	-	-	0.0	8,686.8	100.0%
Fullerton, City of	18,759.7	-	-	18,759.7	5,040.9	-	5,040.9	23,800.6	78.8%
Garden Grove, City of [4, 7]	11,026.9	-	-	11,026.9	10,951.7	-	10,951.7	21,978.6	50.2%
Golden State Water Company [7]	18,335.5	-	-	18,335.5	5,017.5	-	5,017.5	23,353.0	78.5%
Huntington Beach, City of [3]	18,296.4	3,405.6	-	21,702.0	4,264.3	-	4,264.3	25,966.3	83.6%
Irvine Ranch Water District [3,4,5]	42,427.4	5,310.2	-	47,737.6	1,560.7	-	1,560.7	49,298.3	96.8%
La Palma, City of	1,959.3	-	-	1,959.3	0.4	-	0.4	1,959.7	100.0%
Mesa Water District [3,4]	15,248.8	587.6	-	15,836.4	328.4	-	328.4	16,164.8	98.0%
Newport Beach, City of	10,077.2	-	-	10,077.2	4,255.2	-	4,255.2	14,332.4	70.3%
Orange, City of [5]	20,637.1	-	-	20,637.1	6,358.0	-	6,358.0	26,995.1	76.4%
Orange County Water District [6]	1,583.5	-	-	1,583.5	-	-	0.0	1,583.5	100.0%
Santa Ana, City of [7]	25,598.8	-	-	25,598.8	7,649.0	-	7,649.0	33,247.8	77.0%
Seal Beach, City of	2,140.4	-	-	2,140.4	1,099.8	-	1,099.8	3,240.2	66.1%
Serrano Water District [5]	1,388.2	-	-	1,388.2	1,133.7	-	1,133.7	2,521.9	55.0%
Tustin, City of [4]	10,075.2	-	-	10,075.2	375.5	-	375.5	10,450.7	96.4%
Westminster, City of [7]	8,203.2	-	-	8,203.2	2,450.0	-	2,450.0	10,653.2	77.0%
Yorba Linda Water District [7]	10,246.2	-	-	10,246.2	9,084.4	-	9,084.4	19,330.6	53.0%
Total Major Groundwater Producers	269,389.3	9,303.4	0.0	278,692.7	87,341.3	0.0	87,341.3	366,034.0	76.1%
Other Producers	6,538.8	-	750.0	7,288.8	2,857.0	-	2,857.0	10,145.8	
Exempt Well Production	516.8	-	-	516.8	0.0	-	0.0	516.8	
Total Amount	276,444.9	9,303.4	750.0	286,498.3	90,198.3	0.0	90,198.3	376,696.6	
Basin Production Percentage Overall									**75.9%**

[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] *These agencies participated in the MWD In-Lieu Water program during water year 2019-20.*

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

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

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

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

APPENDIX 2. 2019-20 Groundwater Production — Non-Irrigation Use Production Over 25 Acre-feet

PRODUCER	AF	PRODUCER	AF
Alta Vista Country Club	296.6	Mile Square Golf Course	103.0
Anaheim Cemetery	39.7	Navy Golf Course	415.8
Anaheim, City of	34,013.2	Newport Beach Golf Course	91.0
Billy Casper Golf	172.0	Newport Beach, City of	10,077.2
Buena Park, City of	10,590.6	Old Ranch Country Club	400.0
Canyon RV Park	74.5	Orange County Water District	1,564.0
Coca Cola North America	239.90	Orange, City of	20,637.1
County of Orange	90.2	Page Avenue Mutual Water Company	37.4
DS Services of America, Inc.	377.3	R.J. Noble Company	27.8
Eastlake Village HOA	36.2	Riverview Golf	205.7
Eastside Water Association	194.3	Santa Ana Cemetery	66.9
Fairhaven Memorial Park	148.7	Santa Ana Country Club	261.0
Fountain Valley, City of	8,686.8	Santa Ana, City of	25,598.9
Fullerton, City of	18,759.7	Seal Beach, City of	2,140.4
Garden Grove, City of	11,027.0	Serrano Water District	1,388.2
Golden State Water Company	18,335.5	South Coast Shores HOA c/o Optimum PM	56.5
Hargis and Associates, Inc.	56.9	South Midway City Mutual Water Company	34.8
Huntington Beach, City of	18,296.4	The Boeing Company	259.5
Hynes Estates, Inc.	60.5	The Good Shepherd Cemetery	49.3
Irvine Ranch Water District	42,427.5	The Lakes Master Association	66.8
Knott's Berry Farm	179.6	Tustin, City of	10,075.2
La Palma, City of	1,959.3	Westminster, City of	8,203.2
Laguna Beach County Water District	1,787.7	Westminster Memorial Park	233.2
Los Alamitos Race Course	153.7	Yorba Linda Country Club	354.6
Mesa Verde Country Club	271.2	Yorba Linda Water District	10,246.2
Mesa Water District	15,248.8		
Midway City Mutual Water Company	107.0	**Total**	**276,224.5**

APPENDIX 3. 2019-20 Groundwater Production — Irrigation Use Production Over 25 Acre-feet

PRODUCER	AF
Berumen Farms, Inc.	25.7
F.S. Nursery c/o Southern CA Edison	33.1
Neff Ranch, LTD	79.0
Orange County Produce	528.1
Treesap Farms, LLC	49.3
Total	**715.2**

APPENDIX 4. Non - Local Water Purchased by OCWD for Water Years 2000-2001 through 2019-20

	Water Exchange		Talbert Barrier		Forebay Recharge		In-Lieu Program		Basin	SAR Upstream GW Projects		TOTAL
	Western	Alamitos	FV[1]	MCWD	Forebay	CUP[2]	CUP[2]		WSM	Arlington	SBVMWD	
	Mun. WD	Barrier	OC32A	OC44B	Recharge	Recharge	In-Lieu	In-Lieu	Program[3]	Desalter		
Water	Purch.	Purch.	Purch.	Purch.	Purchase	Delivery	Delivery	Purch.	Purch.	Purch.	Purch.	Delivery and Purchase
Year	AF	AF	AF	AF	AF	AF	AF	AF	AF	AF	AF	AF
2000-01	-	1,672.5	941.7	-	59,138.4	-	-	11,191.0	7,449.0	5,177.9	2,787.6	88,358.1
2001-02	2,990.3	2,282.2	2,673.0	-	30,092.6	-	-	19,472.4	-	5,819.8	4,296.4	67,626.7
2002-03	3,471.4	1,448.7	1,540.1	-	35,755.1	-	-	25,631.0	35,832.0	4,924.7	-	108,603.0
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	-	-	9,303.4	-	-	-	29,503.6
Total	18,357.6	33,354.0	10,533.7	33,658.9	626,229.8	42,243.1	57,100.8	394,346.4	43,281.0	22,605.8	7,084.0	1,298,795.1[6]

[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] Known as Basin Water Supply Management Program (WSM) water. WSM program was terminated on December 31, 2003.

[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. 2019-20 Water Resources Summary

	2019-2020 Water Year (AF)	2018-2019 Water Year (AF)	Change from last year to this year
SUMMARY OF BASIN CONDITIONS			
BASIN SUPPLIES			
Water Purchases from MWD (excludes In-Lieu)	18,098	40,345	(22,247)
Water into MWD Storage Account (excludes In-Lieu)	0	0	0
SAR & Santiago Creek Flows[1]	179,455	240,814	(61,359)
GWRS AWPF Water to Forebay Recharge Basins	70,220	65,970	4,250
GWRS AWPF Water to Mid-Basin Injection	3,722	1,826	1,897
GWRS AWPF Water to Talbert Barrier	23,777	27,424	(3,647)
Imported Water to Talbert Barrier (OC-44 & Fountain Valley)	2	21	(19)
Alamitos Barrier	2,100	2,015	85
Incidental Recharge	41,362	45,236	(3,874)
Evaporation from Recharge Facilities	(3,363)	(3,362)	1
SAR Flow Lost to Ocean	(22,093)	(75,794)	(53,701)
Total Groundwater Recharge	**313,280**	**344,496**	**(31,216)**
WATER PRODUCTION			
Groundwater Production	277,195	303,496	(26,301)
MWD Storage Program Extractions	0	0	0
Total Groundwater Production	**277,195**	**303,496**	**(26,301)**
BASIN STATUS			
Change in Groundwater Storage	36,000	41,000	(5,000)
Change in Groundwater Storage excluding MWD Stored Water	36,000	41,000	(5,000)
Accumulated Overdraft (AOD)	200,000	(236,000)	(36,000)
AOD without MWD Storage Program Water	200,000	(236,000)	(36,000)
IN-LIEU WATER			
OCWD In-Lieu Purchases	9,303	0	9,303
MWD In-Lieu Storage	0	0	0
Total In-Lieu	**9,303**	0	9,303
OTHER KEY INFORMATION			
1. Total Dissolved Solids of SAR below Prado Dam (mg/L)	530	634	(104)
2. Total Nitrogen of SAR below Prado Dam (mg/L)	1.0	5.0	(4.0)
3. Total GWRS AWPF Production[2]	97,719	95,310	2,408
4. Green Acres Project	4,206	3,407	799
5. Base Flow of Santa Ana River	77,984	72,200	5,784
6. Year-end Storage behind Prado Dam	1,482	1	1,481
7. Year-end Storage in Recharge Facilities	15,739	16,783	(1,044)
8. Total Artificial Recharge (percolation plus barriers)	271,833	299,260	(27,427)
9. Rainfall Measured at OCWD Field Headquarters (inches)	14.0	22.04	(8.0)
10. Annual Mean Temperature at Santa Ana Fire Station (°F)	67.0	67.0	0

[1] *Accounts for storage to/from recharge facilities.*
[2] *Total includes deliveries to recharge basins, Talbert Barrier, MBI, Anaheim Canyon Power Plant and ARTIC.*

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 Program)[2,3] ($/AF)	MWD Treated Uninterruptible Rate (Full Service)[2,3] ($/AF)
1985-86	32	85	181	225
1986-87	32	91	187	231
1987-88	32	91	187	231
1988-89	42	105	187	231
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	507	579	-[5]	1,203[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.*