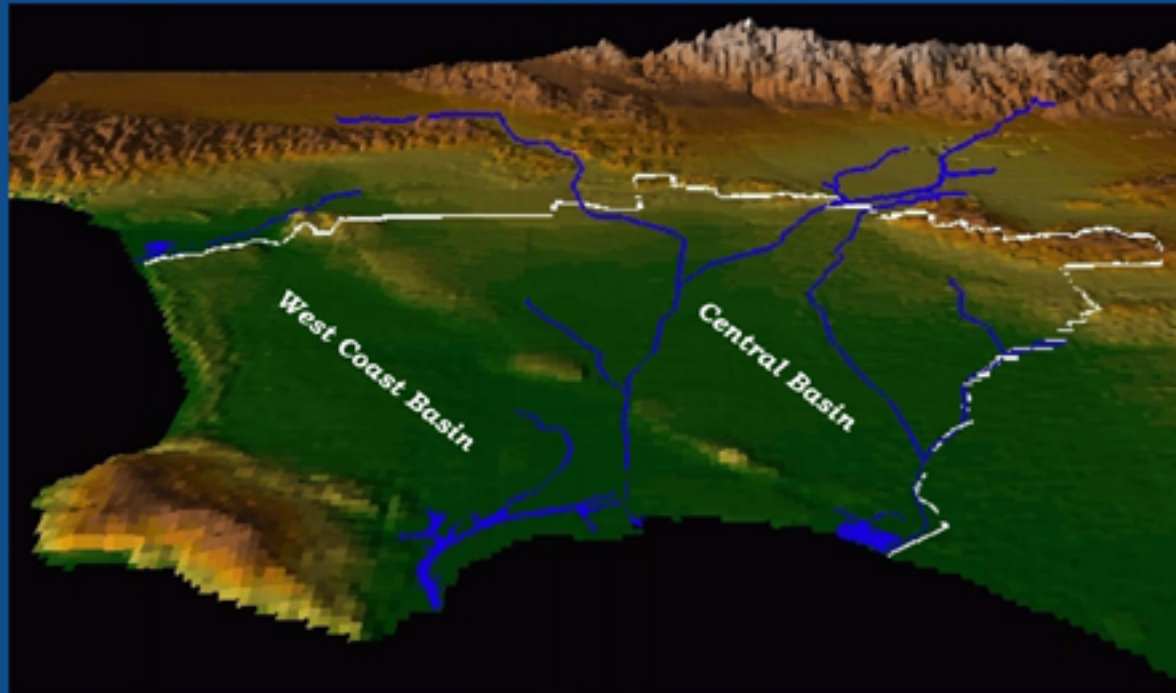


Water Replenishment District of Southern California



Engineering Survey and Report



2014

March 6, 2014

Updated:
May 1, 2014

Water Replenishment District Of Southern California

ENGINEERING SURVEY AND REPORT, 2014 Updated May 1, 2014

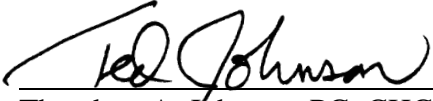


Management

Robb Whitaker, PE (Vacant)	General Manager
Ted Johnson, PG/CHG	Assistant General Manager
Scott Ota, CPA	Chief Hydrogeologist
Jenna Shaunessy	Chief Financial Officer
Elsa Lopez	Manager of Finance and Administration
Francisco Leal	Manager of Public Affairs
	Interim District Council

Professional Certification

This Engineering Survey and Report has been prepared under the direct supervision of the California Professional Geologist whose signature appears below. This individual certifies that the information contained in the report has been prepared in accordance with the generally accepted principles and practices of his profession.


Theodore A. Johnson, PG, CHG
Chief Hydrogeologist





MEMORANDUM

DATE: MAY 1, 2014

TO: INTERESTED PARTIES

FROM: ROBB WHITAKER, GENERAL MANAGER

SUBJECT: UPDATED 2014 ENGINEERING SURVEY AND REPORT

The Water Replenishment District of Southern California (“WRD” or “District”) is the groundwater management agency responsible for safe and reliable groundwater in the Central Basin and West Coast Basin in southern coastal Los Angeles County. Groundwater constitutes nearly 40% of the total water demand used by the 4 million residents and businesses in the 43 cities in the WRD service area.

On March 6, 2014, WRD completed an Engineering Survey and Report (“ESR”) as required by the California Water Code (Section 60300) to present information on the past, current, and anticipated future conditions in the two groundwater basins. Information is presented on groundwater pumping, groundwater conditions (water levels, overdraft, changes in storage), projects related to groundwater supply and quality, and the amount, sources, and cost of replenishment water needed to replace the annual pumping overdraft.

According to Water Code Section 60305, the ESR must be completed by March of each year. However, the annual Replenishment Assessment (“RA”) assessed on groundwater production is typically not set until April or May. Therefore, new and updated information is often received in the months between the initial ESR in March and the setting of the RA later on. To document any changes, the District publishes an updated ESR following adoption of the RA. This May 1, 2014 ESR updates and replaces the earlier March 6, 2014 report and contains the latest information on replenishment water sources and costs within the District.

Updated information includes the following:

- On April 10, 2014, the Los Angeles Regional Water Quality Control Board approved a request by WRD to increase the allowable percentage of recycled water to be recharged at the Montebello Forebay spreading grounds from 35% to 45% as a drought relief measure. This major action will allow continued use of historic amounts of recycled water for longer periods of time should the dry conditions continue, and might allow for additional recycled water for recharge should normal to wet hydrologic conditions return. This will allow WRD

to continue to maximize use of recycled water for groundwater recharge as part of its Water Independence Now, or WIN, initiative.

- On May 1, 2014, the WRD Board of Directors adopted the 2014/2015 RA at \$268 per acre foot (AF) of groundwater pumped within the WRD Service area, which is the same rate as the previous year for a zero percent increase. This rate will go into effect July 1, 2014 and will last through June 30, 2015. This information was added to the report as appropriate.
- Several of the tables in the back of the report regarding historical amounts of seawater barrier injection water were updated to reflect more current numbers. In particular Tables A-2, A-4, and A-6 were updated. No other significant changes were made to the report.

My staff and I welcome any comments or questions you may have regarding this updated ESR. Additional copies are available by calling the District at (562) 921-5521 or by downloading it from our web site at <http://www.wrd.org>. Thank you for your interest and input on groundwater conditions in the Central Basin and West Coast Basin.

BOARD SUMMARY

District Staff is pleased to present the 2014 Engineering Survey and Report (“ESR”). It was prepared pursuant to the California Water Code, Section 60300 et seq. and determines the past, current, and ensuing year groundwater conditions in the Central Basin and West Coast Basin (“CBWCB”). The report contains information on groundwater production, annual and accumulated overdraft, water levels, quantity, source, and cost of replenishment water, and a discussion of necessary projects and programs to protect and preserve the groundwater resources of the basins.

The ESR provides the Board of Directors with the necessary information to justify the setting of a replenishment assessment (“RA”) for the ensuing fiscal year (July 1 – June 30) to purchase replenishment water and to fund projects and programs related to groundwater replenishment and groundwater quality over the water year (October 1 – September 30).

The following is a summary of the required ESR elements from the Water Code:

1. Groundwater Production

- Adjudicated Amount: 281,835.25 acre-feet (AF)
- Previous Water Year: 238,678 AF
- Current Water Year: 240,000 AF (estimated)
- Ensuing Water Year: 242,000 AF (estimated)

2. Annual Overdraft

- Previous Water Year: 153,000 AF
- Current Water Year: 119,800 AF (estimated)
- Ensuing Water Year: 96,800 AF (estimated)

3. Accumulated Overdraft

- Previous Water Year: 757,500 AF
- Current Water Year: 780,700 AF (estimated)

4. Groundwater Levels

Because of the dry winter of the previous year 2012/2013, groundwater levels over the entire WRD Service area fell on average 4 feet and 68,000 AF were removed from storage. Most of this storage loss (57,300 AF or 84%) occurred in the Montebello Forebay, which is the major headworks that supplies much of the rest of the District with recharge water. The Montebello Forebay region alone had an average water level drop of nearly 13 feet. However, the groundwater basins are enormous underground reservoirs that are able to accommodate large swings in storage and water level

Board Summary

changes. WRD manages water levels in the basins utilizing an Optimum Quantity and Accumulated Overdraft approach. So far, the basins are operating within range and there should not be any problems with the groundwater supply meeting the needs of the overlying users in the current and ensuing years. Details of the groundwater levels in the CBWCB are described in Chapter III.

5. Quantity of Replenishment Water Required in the Ensuing Year

The District determines replenishment water needs based on averages from a long-term (30 year) hydrologic record and computer models, meaning extremely wet years and extremely dry years in addition to average precipitation years are accounted for in deriving the average replenishment needs. Other considerations by the Board are also incorporated into replenishment water needs. Chapter IV details the quantity of water that WRD plans to purchase in the ensuing water year. A summary is below:

- Spreading Water: 71,000 AF (55,000 recycled; 16,000 imported)
- Seawater Barrier Water: 28,100 AF (3,900 AF imported; 24,200 AF recycled)
- In-Lieu Program Water: 0 AF (suspended due to lack of MWD seasonal water)
- Total Water: 99,100 AF

6. Source of Replenishment Water

The sources of replenishment water to the District for the ensuing water year are detailed in Chapter IV. Discounted replenishment water from MWD has not been available for In-Lieu or spreading since October 2011. MWD has not yet adopted a new replenishment program and for now only the more expensive Tier 1 or Tier 2 water is potentially available. WRD is budgeting for Tier 1 water in the ensuing year. A summary of the sources of replenishment water available to WRD is as follows:

- Recycled Water: Tertiary water for spreading from the Sanitation Districts of Los Angeles County (SDLAC). Advanced-treated water for the West Coast Basin Barrier Project (WCBBP) from the West Basin Municipal Water District, for the Dominguez Gap Barrier Project (DGBP) from the City of Los Angeles, and for the Alamitos Barrier Project (ABP) from WRD.
- Imported Water: Raw untreated Tier 1 water for spreading from MWD member agencies such as Central Basin Municipal Water District or others. WCBBP water and DGBP water from West Basin Municipal Water District. ABP water from the City of Long Beach.

7. Cost of Replenishment Water

WRD has estimated it will need 99,100 AF of replenishment water in the ensuing year. WRD purchases replenishment water from MWD member agencies and recycled water providers. These agencies set the price for the replenishment water that WRD buys for the spreading grounds, seawater barrier injection wells, and In-Lieu water when available. The cost for replenishment water is a direct pass-through from WRD to the water suppliers on WRD's replenishment assessment.

Using currently available information and estimates for the cost of replenishment water to WRD in the ensuing year, the estimated cost of water for the ensuing year is \$36,557,980. **Tables 1 and 2** provide a detailed breakdown of these costs.

These estimated costs are for water purchases only and do not include the additional costs for water replenishment and water quality projects and programs. These projects and programs are discussed in detail in Chapter V. The anticipated costs of these projects and programs will be further discussed in District budget workshops, Budget Advisory Committee (BAC) meetings, and other public meetings before the Board of Directors adopts the 2014/2015 Replenishment Assessment in May.

8. Projects and Programs

A list of the projects and programs in which WRD is involved related to groundwater replenishment and the protection and preservation of water quality is shown on **Table 3**. Funds are required to finance these projects and programs. Sections 60221, 60230 and 60224 of the Water Code authorize the WRD to undertake a wide range of capital projects and other programs aimed at enhancing groundwater replenishment and improving groundwater quality.

These projects and programs address any existing or potential problems related to the basin's groundwater, and may extend beyond the District's boundaries if the threat of contamination is outside those boundaries. The programs span all phases of planning, design, and construction and are financed by the collection of a replenishment assessment. A more detailed description of each project and program is presented in Chapter V of the report.

9. Conclusions

Based upon the information presented in the ESR, a replenishment assessment is necessary in the ensuing year to purchase replenishment water and to finance projects and programs to perform replenishment and water quality activities. These actions will ensure sufficient supplies of high quality groundwater within the District for the benefit of the residents and businesses in the Central Basin and West Coast Basin.

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Plate 2: Groundwater Elevation Contour Map for Fall 2013

Plate 3: Change in Groundwater Levels Fall 2012 to Fall 2013

GLOSSARY OF ACRONYMS

ABP	Alamitos Barrier Project
AF	Acre-Feet (equivalent to 325,851 gallons)
AFY	Acre-Feet per Year
APA	Allowed Pumping Allocation
BAC	Budget Advisory Committee
BoS	Bureau of Sanitation (City of Los Angeles Dept. of Public Works)
CB	Central Basin
CBMWD	Central Basin Municipal Water District
CDPH	California Department of Public Health
CEC	Constituents of Emerging Concern
CEQA	California Environmental Quality Act
CHG	California Certified Hydrogeologist
CIP	Capital Improvement Program
CPI	Consumer Price Index
CBWCB	Central Basin and West Coast Basin
DGBP	Dominguez Gap Barrier Project
DTSC	California Department of Toxic Substances Control
DWR	California Department of Water Resources
EIR	Environmental Impact Report
EPA	U.S. Environmental Protection Agency
ESR	Engineering Survey and Report
FY	Fiscal Year (July 1 – June 30)
GAC	Granular Activated Carbon
GIS	Geographic Information System
IRWMP	Integrated Regional Water Management Plan
LACDHS	Los Angeles County Department of Health Services
LACDPW	Los Angeles County Department of Public Works (Flood Control)
LADWP	City of Los Angeles Department of Water and Power
LBWD	City of Long Beach Water Department
MAR	Managed Aquifer Recharge
Met	Metropolitan Water District of Southern California
MCL	Maximum Contaminant Level
MF	Microfiltration
MFI	Modified Fouling Index

GLOSSARY OF ACRONYMS (continued)

mgd	Million Gallons per Day
MOU	Memorandum of Understanding
msl	Mean Sea Level
MWD	Metropolitan Water District of Southern California
NDMA	N-Nitrosodimethylamine
O&M	Operations and Maintenance
PG	California Professional Geologist
ppb	Parts Per Billion ($\mu\text{g/L}$)
ppm	Parts Per Million (mg/L)
PRC	Program Review Committee
PWRP	Pomona Water Reclamation Plant
RA	Replenishment Assessment
RO	Reverse Osmosis
RTS	Readiness-to-Serve Charge
RWQCB	Regional Water Quality Control Board (Los Angeles Region)
SAT	Soil Aquifer Treatment
SDLAC	Sanitation Districts of Los Angeles County
SDWP	Safe Drinking Water Program
SGVMWD	San Gabriel Valley Municipal Water District
SJCWRP	San Jose Creek Water Reclamation Plant
TAC	Technical Advisory Committee
TITP	Terminal Island Treatment Plant
USGS	United States Geological Survey
USGVMWD	Upper San Gabriel Valley Municipal Water District
UV	Ultraviolet Light Treatment
VOC	Volatile Organic Compound
WAS	Water Augmentation Study
WBMWD	West Basin Municipal Water District
WCB	West Coast Basin
WCBBP	West Coast Basin Barrier Project
WIN	Water Independence Now program
WNWRP	Whittier Narrows Water Reclamation Plant
WRD	Water Replenishment District of Southern California
WRP	Water Reclamation Plant
WY	Water Year (October 1 – September 30)

CHAPTER I

INTRODUCTION

Purpose of the Engineering Survey & Report

To facilitate the Board of Directors' decisions and actions, the Water Replenishment District Act requires that an engineering survey and report (“ESR”) be prepared each year. This *Engineering Survey and Report 2014* is in conformity with the requirements of Section 60300 et seq. Water Replenishment District Act and presents the necessary information on which the Board of Directors can declare whether funds shall be raised to purchase water for replenishment during the ensuing year, as well as to finance projects and programs aimed at accomplishing groundwater replenishment. With the information in this ESR, the Board can also declare whether funds shall be collected to remove contaminants from the groundwater supplies or to exercise any other power under Section 60224 of the California Water Code. The information presented in this report along with the District’s strategic planning and budget preparation presents the necessary information on which the Board of Directors can base the establishment of a replenishment assessment for the ensuing fiscal year effective July 1, 2014 through June 30, 2015.

Scope of Engineering Survey & Report

This report contains specific information outlined in Chapter I, Part 6 of Division 18 of the Water Code (the Water Replenishment District Act, § 60300 and § 60301). The following is a brief description of the contents of this report:

- 1) *a discussion of groundwater production within the District (Chapter II);*
- 2) *an evaluation of groundwater conditions within the District, including estimates of the annual overdraft, the accumulated overdraft, changes in water levels, and the effects of water level fluctuations on the groundwater resources (Chapter III);*
- 3) *an appraisal of the quantity, availability, and cost of replenishment water required for the ensuing water year (Chapter IV); and*
- 4) *a description of current and proposed programs and projects to accomplish replenishment goals and to protect and preserve high quality groundwater supplies within the District (Chapter V).*

Schedule for Setting the Replenishment Assessment

The following actions are required by the Water Code to set the Replenishment Assessment:

- 1) *The Board shall order the preparation of the ESR no later than the second Tuesday in February each year (see Section 60300).*
- 2) *The Board shall declare by resolution whether funds shall be collected to purchase replenishment water and to fund projects and programs related to replenishment and/or water quality activities on or before the second Tuesday in March each year and after the ESR has been completed (see Section 60305).*
- 3) *A Public Hearing will be held for the purpose of determining whether District costs will be paid for by a replenishment assessment. The Public Hearing will be opened on the second Tuesday in April and may be adjourned from time to time but will be completed by the first Tuesday in May (see Sections 60306 and 60307).*

Introduction

- 4) *The Board by resolution shall levy a replenishment assessment for the ensuing fiscal year no later than the second Tuesday in May (see Sections 60315, 60316 and 60317).*

Although dates specified in the code refer generally to ‘on or before certain Tuesdays’, the Water Code (Section 60043) also states that “*Whenever any act is required to be done or proceeding taken on or set for a particular day or day of the week in any month, the act may be done or proceeding set for and acted upon a day of the month otherwise specified for a regular meeting of the board*”. Therefore, there is flexibility as to the actual dates when Board actions are taken regarding the ESR, adopting resolutions, conducting public hearings, and the setting the replenishment assessment.

The ESR is generally completed in March of each year to comply with the Water Code and to provide the Board with the necessary information to determine whether a replenishment assessment will be needed in the ensuing year to purchase replenishment water and to fund projects and programs related to water quality and replenishment activities. However, in the subsequent months leading up to the adoption of the replenishment assessment, new information is normally received that affects the findings presented in the March ESR. This new information is typically related to the amount of water and price that WRD expects to pay for replenishment water in the ensuing water year. The final information used by the Board when they adopt the replenishment assessment is reflected in an updated ESR that is published after adoption of the replenishment assessment.

CHAPTER II GROUNDWATER PRODUCTION

Adjudication and Demand

Prior to the adjudication of groundwater rights in the early 1960s, annual production (pumping) reached levels as high as 259,400 AF in the Central Basin (“CB”) and 94,100 AF in the West Coast Basin (“WCB”). This total of 353,500 AF was more than double the natural safe yield of the basins as determined by the California Department of Water Resources in 1962 (173,400 AF). Due to this serious overdraft, water levels declined, groundwater was lost from storage, and seawater intruded into the coastal aquifers. To remedy this problem, the courts adjudicated the two basins to put a limit on pumping. The West Coast Basin adjudication was set at 64,468.25 acre-feet per year (“AFY”). The Central Basin “Allowed Pumping Allocation” (“APA”) was set at 217,367 AFY. Therefore, the current amount allowed to be pumped from both basins is 281,835.25 AFY, plus any carryover or other provisions as described at the end of this Section.

The adjudicated pumping amounts were set higher than the natural replenishment amounts, creating an annual deficit known as the “Annual Overdraft”. WRD is enabled under the California Water Code to purchase and recharge additional water to make up this overdraft, which is known as artificial replenishment or managed aquifer recharge (MAR). WRD has the authority to levy a replenishment assessment on all pumping within the District to raise the monies necessary to purchase the artificial replenishment water and to fund projects and programs necessary for replenishment and groundwater quality activities.

Groundwater Production

Under the terms of Section 60326.1 of the Water Replenishment District Act, each groundwater producer must submit a report to the District summarizing their monthly production activities (quarterly for smaller producers). The information from these reports is the basis by which each producer pays the replenishment assessment.

Previous Water Year:

Per the Water Code, WRD tracks and reports on groundwater production (pumping) on a Water Year (“WY”) basis covering the time frame of October 1 - September 30 of each year. For the previous WY (2012/2013), groundwater production in both basins totaled 238,677.68 AF (196,414.31 AF in CB and 42,263.37 AF in the WCB). This is 2,738.99 AF less than the previous year (-1.1%), of which CB had 594.79 AF more pumping (0.3%) and the WCB had 3,333.78 AF less pumping (-7.3%). Because the adjudicated rights are 281,835.25 AF, there were a total of 43,157.57 AF of rights that were not pumped from the CBWCB.

Plate 1 illustrates the groundwater production in the CBWCB during the previous water year and **Table A-5** presents historical pumping amounts.

Current Water Year:

For the first two months of the current WY (October through November), production was 35,371.27 AF (27,974.49 AF in the CB and 7,396.78 AF in the WCB). This is 1,311.53 AF (3.9%) more than the same period of the year earlier. Because these numbers represent only 2 months of data out of

Groundwater Production

12, they are difficult to forecast through the rest of the year. Therefore, taking into account averages over the past 3 to 5 years, excluding the anomalously low year of 2010/2011 due to the special In-lieu program, the current dry winter causing increased water use than normal for this time of year, and the Governor's request for conservation during the drought, the projected pumping for the current year is 240,000 AF (196,000 AF in the CB and 44,000 AF in the WCB).

Ensuing Water Year:

To estimate production for the ensuing year, recent averages are used in addition to knowledge of changing conditions that might affect pumping. Actual pumping patterns can vary considerably throughout the year based on a pumper's individual operational needs, water demands, conservation efforts and hydrology.

To estimate the ensuing year's groundwater pumping, WRD used the averages over the past 3 to 5 years, not including the anomalously low year of 2010/2011, and made adjustments based on anticipated conditions such as a continuing drought, conservation efforts, and reports by some pumpers that they plan on drilling new wells or bringing back online other wells. Using these methods produced a forecast for pumping in the ensuing year at 242,000 AF (198,000 AF in the CB and 44,000 AF in the WCB).

Table 1 shows the groundwater production amounts for the previous, current, and ensuing water years.

Measurement of Production

With few exceptions, meters installed and maintained by the individual producers measure the groundwater production from their wells. Through periodic testing by Watermaster to verify the accuracy of individual meters, corrective measures are required when necessary. The production of the few wells that are not metered is estimated on the basis of electrical energy consumed by individual pump motors or other reasonable means.

Carryover and Drought Provisions

The carryover of unused pumping rights in any given year influences the actual amount of production for the ensuing year. The carryover for any single year is 30% of the allotted pumping right in the Central Basin and 20% in the West Coast Basins. This provision of the Judgments extends the flexibility with which the pumpers can operate.

During emergency or drought conditions, WRD can allow under certain conditions an additional 27,000 AF of extractions for a four-month period (17,000 for CB and 10,000 for WCB). This provision has yet to be exercised but offers the potential use of an additional 7.8% pumping in the CB and 15% in the WCB.

The Central Basin Judgment also contains an additional Drought Carryover provision available to all Central Basin water rights holders after a declaration of a Water Emergency by the WRD Board of Directors. The Drought Carryover allows water rights holders to carryover an additional 35% of their APA (or 35 AF, whichever is larger) beyond the annual carryover described above during the period the Declared Water Emergency is in effect.

The intent of the action is prevent further degradation of the groundwater basins by helping to restore groundwater levels and improving the water supply in the aquifers by providing an incentive to groundwater producers in the Central Basin to reduce pumping for a particular period of time.

A Declared Water Emergency is defined in the Central Basin Judgment as:

"A period commencing with the adoption of a resolution of the Board of Directors of the Central and West Basin Water Replenishment District [renamed Water Replenishment District of Southern California] declaring that conditions within the Central Basin relating to natural and imported supplies of water are such that, without implementation of the water emergency provisions of this Judgment, the water resources of the Central Basin risk degradation. In making such declaration, the Board of Directors shall consider any information and requests provided by water producers, purveyors and other affected entities and may, for that purpose, hold a public hearing in advance of such declaration. A Declared Water Emergency shall extend for one (1) year following such resolution, unless sooner ended by similar resolution."

CHAPTER III

GROUNDWATER CONDITIONS

Introduction

The California Water Code Section 60300 requires WRD to determine annually in the Engineering Survey and Report (“ESR”) the following items related to groundwater conditions in the Central Basin and West Coast Basin (“CBWCB”):

- 1) Total groundwater production for the previous water year and estimates for the current and ensuing water years;
- 2) The Annual Overdraft for the previous water year and estimates for the current and ensuing water years;
- 3) The Accumulated Overdraft for previous water year and an estimate for the current water year;
- 4) Changes in groundwater levels (pressure levels or piezometric heights) within the District and the effects these changes have on groundwater supplies within the District; and
- 5) An estimate of the quantity, source, and cost of water available for replenishment during the ensuing water year;

To meet these requirements, WRD’s hydrogeologists and engineers closely monitor and collect data to manage the groundwater resources of the District throughout the year. They track groundwater levels from WRD’s network of specialized monitoring wells and from groundwater producers’ production wells. They update and run computer models developed by the United States Geological Survey (“USGS”) and others to simulate groundwater conditions and to predict future conditions. They use their geographic information system (“GIS”) and database management system to store, analyze, map, and report on the information required for the ESR. They work closely with the Los Angeles County Department of Public Works (“LACDPW”) on spreading grounds and seawater barrier wells to determine current and future operational impacts to groundwater supplies. They work closely with the Metropolitan Water District of Southern California (“MWD” or “Met”), the local MWD member agencies, and the Sanitation Districts of Los Angeles County (“SDLAC”) on the current and future availability of replenishment water. They also work with regulators on replenishment criteria for water quality and recycled water use, and with the groundwater pumpers, the pumpers’ Technical Advisory Committee (“TAC”), the Budget Advisory Committee (“BAC”), and other stakeholders to discuss the current and future groundwater conditions and beneficial projects and programs within the District and neighboring basins.

The information on Annual Overdraft, Accumulated Overdraft, water levels, and change in storage are discussed in the remainder of this chapter. Groundwater production was previously discussed in Chapter II. The estimated quantity, source, and cost of replenishment water will be discussed in Chapter IV. Projects and programs are discussed in Chapter IV.

Groundwater Conditions

Annual Overdraft

Section 60022 of the Water Replenishment District Act defines Annual Overdraft as "...the amount...by which the quantity of groundwater removed by any natural or artificial means from the groundwater supplies within such replenishment district during the water year exceeds the quantity of non-saline water replaced therein by the replenishment of such groundwater supplies in such water year by any natural or artificial means other than replenishment under the provisions of Part 6 of this act or by any other governmental agency or entity." (Part 6 of the Act pertains to water that WRD purchases for replenishment). Therefore, the Annual Overdraft equals the natural inflows to basins (not including WRD purchased water) minus all of the outflows (mostly pumping). There is an Annual Overdraft almost every year for the simple fact that the groundwater extractions typically exceed the natural groundwater replenishment. It has been one of the District's main responsibilities since 1959 to help make up this Annual Overdraft by purchasing artificial replenishment water to recharge the aquifers and supplement the natural recharge.

To determine the Annual Overdraft for the previous water year, WRD determines the inflows and outflows of the CBWCB. In the previous Water Year 2012/2013, natural inflows (storm water capture, areal recharge, and net groundwater underflow) totaled 85,684 AF and WRD or others contributed 84,994 AF of recharge water at the seawater barrier wells and spreading grounds. Total natural and artificial inflows, therefore, equaled 170,678 AF. Total pumping in the basins was 238,678 AF. The Annual Overdraft is the natural inflows minus total outflows, or 152,994 AF (rounded to 153,000 AF).

For the current and ensuing WY estimates for Annual Overdraft, the concept of "Average Annual Groundwater Deficiency" is utilized. The Average Annual Groundwater Deficiency is the long-term average of natural inflows minus total outflows and represents the long term average deficit (Annual Overdraft) in the basins. The development of the USGS/WRD computer model derived these long term average inflow and outflow terms. **Table 4** presents this information, which concluded that the Average Annual Groundwater Deficiency is 105,385 AFY. Values of the average deficiency are based on the long term (30 year average) inflows and outflows as calculated by the computer model. Long-term average inflows are influenced by the amount of precipitation falling on the District as well as for storm water capture at the spreading grounds. **Table 5** and **Figure A** show the historical precipitation at LACDPW Station #107D, located in Downey near the Montebello Forebay, or alternate stations nearby if Station #107D data are not reliable or available.

The calculation of the Average Annual Groundwater Deficiency represents in general that WRD needs to replenish about 105,385 AFY assuming long-term average conditions for the water balance to reach equilibrium, the overall change in storage to equal zero, and groundwater levels to remain relatively constant. As shown in **Table 6**, adjustments are made to the long term average inflows and outflows for the current and ensuing WY to reflect estimates of the Annual Overdraft for those particular years. The current year has been very dry to date. Therefore, the projected Annual Overdraft is expected to be greater than the long term average. Based on these adjustments, the current year Annual Overdraft is estimated at 119,800 AF and the ensuing year is estimated at 96,800 AF.

Accumulated Overdraft

Section 60023 of the Water Replenishment District Act defines "Accumulated Overdraft" as "...the aggregate amount...by which the quantity of ground water removed by any natural or artificial

means from the groundwater supplies...during all preceding water years shall have exceeded the quantity of nonsaline water replaced therein by the replenishment of such ground water supplies in such water years by any natural or artificial means...”

In connection with the preparation of Bulletin No. 104-Appendix A (1961), the DWR estimated that the historically utilized storage (Accumulated Overdraft) between the high water year of 1904 and 1957¹ was 1,080,000 AF (780,000 in CB, 300,000 in WCB). Much of this storage removal was from the forebay areas (Montebello Forebay and Los Angeles Forebay), where aquifers are merged, unconfined and serve as the "headwaters" to the confined pressure aquifers. Storage loss from the confined and completely full, deeper aquifers was minimal in comparison or was replaced by seawater intrusion, which cannot be accounted for under the language of the Water Code since it is considered saline water.

The goal of groundwater basin management by WRD is to ensure a sufficient supply of safe and reliable groundwater in the basins for annual use by the pumpers, to keep a sufficient supply in storage for times of drought when imported water supplies may be curtailed for several consecutive years as well as to keep suitable room available in the basins to receive natural water replenishment in very wet years, such as an El Niño type year.

To compute the Accumulated Overdraft since this initial amount of 1,080,000 AF, WRD takes each consecutive year's Annual Overdraft and replenishment activities and determines the change in storage. It adds to or subtracts the corresponding value from the Accumulated Overdraft. Since the base level, the aggregate excess of extractions over recharge from the basins has been reduced due to the replenishment by LACDPW in the earlier years and WRD since 1959, the reduction of pumping established by the adjudications, and the replenishment from the seawater barrier well injection. The Accumulated Overdraft at the end of the previous WY was determined to be 757,500 AF. For the current year, due to the statewide drought, the Accumulated Overdraft is forecast to decrease to 780,700 AF. This could change if hydrology or pumping patterns or planned artificial replenishment activities vary considerably.

Table 7 presents information for the previous and current Accumulated Overdraft estimate. The annual changes in storage are presented on **Table 8**.

Groundwater Levels

A groundwater elevation contour map representing water levels within the District in fall 2013 (end of the water year) was prepared for this report and is presented as **Plate 2**. The data for the map were collected from wells that are screened in the deeper basin aquifers where the majority of groundwater pumping occurs. These deeper aquifers include the Upper San Pedro Formation aquifers, including the Lynwood, Silverado, and Sunnyside. Water level data was obtained from WRD's network of monitoring wells and from groundwater production wells that are screened in the deeper aquifers.

As can be seen on **Plate 2**, groundwater elevations range from a high of about 170 feet above mean sea level (msl) in the northeast portion of the basin above the spreading grounds in the Whittier Narrows to a low of about 100 feet below msl in the Gardena and Long Beach areas. With the

¹ DWR Bulletin 104-A did not refer to the ending year for the storage determination. WRD has assumed it to be the year 1957, as this is the end year for their detailed storage analysis presented in Bulletin 104-B – Safe Yield Determination.

Groundwater Conditions

exception of the Montebello Forebay and along the West Coast Basin Barrier Project, the majority of groundwater levels in the District are below sea level (red colored contours on **Plate 2**), which is why continued injection at the seawater barriers is needed to prevent saltwater intrusion.

Plate 2 also shows the location of the key wells used for long-term water level data. These long-term hydrographs have been presented in the ESR for years, and provide a consistent basis from which to compare changing water levels. A discussion of water levels observed in the key wells is presented below.

Los Angeles Forebay

The Los Angeles Forebay occupies the westerly portion of the Central Basin Non-Pressure Area. Historically a recharge area for the Los Angeles River, this forebay's natural recharge capability has been substantially reduced since the river channel was lined and open areas paved over. Recharge is now limited to deep percolation of precipitation in limited areas, In-Lieu replenishment when available, subsurface inflow from the Montebello Forebay, the northern portion of the Central Basin outside of WRD's boundary, and the San Fernando Valley through the Los Angeles Narrows.

Key well #2778 (2S/13W-10A01) represents the water level conditions of the Los Angeles Forebay (see **Figure B**). The water level high was observed in 1938 and by 1962 water levels had fallen nearly 180 feet due to basin over-pumping and lack of sufficient natural recharge. Since then, basin adjudication and managed aquifer recharge by WRD and others have improved water levels in this area by over 80 feet. Over the past 10 years, groundwater levels in this well have remained relatively constant with only minor fluctuations. This past year saw a 2.8 foot water level drop in the well between September 2012 and September 2013. The average water level change throughout the entire Los Angeles Forebay was a drop of 4.2 feet.

Montebello Forebay

The Montebello Forebay lies in the northeastern portion of the Central Basin and connects with the San Gabriel Basin to the north through the Whittier Narrows. The Rio Hondo and San Gabriel River Spreading Grounds (often called the "Montebello Forebay Spreading Grounds") provide a substantial amount of recharge water to the CBWCB since the aquifers there are unconfined and allow easy infiltration of surface water impounded at the spreading grounds to the deeper groundwater.

Three key wells help describe the groundwater level conditions in the Montebello Forebay, a northern well, a middle well, and a southeastern well (**Plate 2**). The historic water levels in these three key wells are discussed below:

- Well Pico1_4 (2S/11W-18C07) is in the northern part of the Montebello Forebay. The upper chart on **Figure C** shows the water levels for this well. Historic water levels at this well or its predecessors have ranged from a high elevation of 164.7 feet above mean sea level in April 1944 to a low of 42.8 feet msl in December 1957. At the end of WY 2012/2013, groundwater levels in this well were at an elevation of 97.0 feet msl and were 17 feet lower than the previous year.
- Well 1601T (2S/12W-24M08) is centrally located between the Rio Hondo and San Gabriel spreading grounds. This well is monitored weekly to assess water levels in the middle of the

forebay. The center chart on **Figure C** shows the water levels for this well. The historic water level high was observed in 1942 at an elevation of 137.8 feet above mean sea level, but by 1957 it had fallen 117 feet to an all-time low elevation of 20.9 feet msl due to basin over-pumping and insufficient natural recharge. As described above for the Los Angeles Forebay, adjudication of pumping rights and managed aquifer recharge helped restore water levels in the Montebello Forebay. At the end of WY 2012/2013, groundwater levels in this well were at an elevation of 72.8 feet msl and were 11 feet lower than the previous year. So far in the current year, water levels have continued to drop through winter because of the extremely dry year. As of February 2014, water levels are at an elevation of 65.8 feet msl.

- Well 1615P (3S/12W-01A06) is located downgradient and southeast of the spreading grounds near the southern end of the Montebello Forebay. Water level responses in this well are typically less pronounced than the other two wells because it is further from the spreading grounds and the recharge that occurs there. The lower chart on **Figure C** shows the water level history for this well. The historic water level high was observed in 1947 at an elevation of 113.6 feet above mean sea level but by 1957 had dropped 102 feet to an all-time low elevation of 11.4 feet msl. Since then, water levels have recovered to approximately 60 feet above mean sea level. At the end of WY 2012/2013, groundwater levels were at an elevation of 52.9 feet msl and were 8 feet lower than the previous year.

The average water level change throughout the entire Montebello Forebay during the previous water year was a decline of 12.7 feet.

Central Basin Pressure Area

The District monitors key wells 906D (4S/13W-12K01) and 460K (4S/12W-28H09) which represent the conditions of the pressurized groundwater levels in the Central Basin Pressure Area. The hydrographs for these two wells are shown on **Figure D**.

Groundwater highs were observed in these wells in 1935 when they began to continually drop over 110 feet until their lows in 1961 due to the over-pumping and insufficient natural recharge. Groundwater levels recovered substantially during the early 1960s as a result of replenishment operations and reduced pumping. Between 1995 and 2007 there were 100-foot swings in water levels each year between winter and summer caused by pumping pattern changes by some of the Central Basin producers who operate with more groundwater in the summer months and less groundwater in the winter months, and took advantage of the MWD and WRD In-Lieu programs. From May 2007 to March 2011 the In-Lieu water was not available, so pumping remained more constant throughout those years and water levels remain low. Since then, In-Lieu with the City of Long Beach has occurred on several occasions, with resulting water levels rising as the pumps go off, and falling when the pumps come on.

At the end of WY 2012/2013, groundwater levels in well 906D were at an elevation of 61.9 feet below sea level and were 16.4 feet lower than the previous year. Water levels in well 460K were at an elevation of 90.9 below sea level and were 48.7 feet lower than the previous year. The average change in water levels in the entire Central Basin Pressure Area during the previous water year was a drop of 6.9 feet.

Groundwater Conditions

West Coast Basin

The West Coast Basin is separated from the Central Basin by the Newport-Inglewood Uplift, which is a series of discontinuous, sub-parallel hills and faults that act as a partial barrier to groundwater flow in some places but not in others. Groundwater moves across the uplift based on water levels on both sides and the “tightness” (permeability) of the uplift along various reaches.

Figure E shows the hydrographs of key wells 760C (3S/14W-22L01) and Wilmington1_3 (which has replaced well 4S/13W-22P01). These two wells represent the general conditions of the water levels in the West Coast Basin. In 1955, the control of groundwater extractions in the West Coast Basin resulted in stabilizing and reversal of the declining water levels in the center of the basin (well 760C), whereas at the eastern end near the Dominguez Gap Barrier water levels continued to decline until about 1971, when a recovery began due mostly to the startup of the Dominguez Gap Barrier Project.

At the end of the previous WY 2012/2013, water levels in well 760C were at an elevation of 17.2 feet below sea level and were 4.6 feet lower than the previous year. Water levels in well Wilmington1_3 were at an elevation of 34.3 feet below sea level and were 11.7 feet higher than the previous year due to reduced pumping in the area near the well. Over the entire West Coast Basin, the average water level change was a rise of 1.8 feet.

Plate 3 shows the water level changes over the entire CBWCB over the previous water year. Because of the dry year and reduced replenishment water, the WRD service area saw on average a decrease in water levels of 4 feet, with specific regions having greater or lesser amounts as described above.

For the current WY, rainfall is significantly below normal and the State of California has declared a drought emergency. Therefore, although WRD is maximizing recycled water replenishment within regulatory limits, the District expects a decrease in water levels in both the Central Basin and West Coast Basin in WY 2013/2014 which will result in a decrease in the amount of groundwater in storage.

Because the current groundwater levels in the CBWCB are within historic ranges and the anticipated replenishment activities by WRD will continue as planned, the District anticipates that there will continue to be sufficient supplies of safe and reliable groundwater to meet the demands of the pumpers in our service area in the current and ensuing years.

Change in Storage

The District determines the annual change in groundwater storage by comparing water levels from one year to the next, and factoring in the storage coefficients of the major aquifer layers. Rising groundwater means there is an increase in the amount of groundwater in storage whereas a drop in groundwater levels means there is a decrease in storage. Using groundwater elevation data collected from WRD's monitoring well network and selected production wells, the District constructs a groundwater level change map showing water level differences from one year to the next (**Plate 3**). The data from this map are converted to grids in the District's Geographic Information System (GIS) and multiplied by the storage coefficient value grids for the aquifer layers as obtained from the

USGS calibrated Modflow computer model of the District. This calculation produces the change in storage value for the previous water year.

For WY 2012/2013, there was an overall drop in water levels with a resulting loss from storage in the amount of 68,000 AF. Most of this storage loss (57,300 AF or 84%) occurred in the Montebello Forebay, which is the gateway for large amounts of recharge water to enter the aquifer systems and flow into the rest of the District. This loss from storage occurred due to the dry year resulting in reduced replenishment water. However, the groundwater basins are operating properly as an enormous underground reservoir – accepting water and rising when replenishment water is plentiful and pumping demands are low, and draining to meet the demands when replenishment water is lacking and pumping is high. **Table 8** provides the historical groundwater storage changes in the CBWCB.

Optimum Groundwater Quantity

In response to a 2002 State audit of the District’s activities, the Board of Directors adopted an Optimum Quantity for groundwater amounts in the CBWCB. The Optimum Quantity is based on the Accumulated Overdraft (AOD) concept described in the Water Code and this ESR. The historic maximum groundwater drawdown due to over pumping reported in the CBWCB between 1904 and 1957 was 1,080,000 AF. This is defined as the historic maximum AOD. As pumping eased and artificial replenishment occurred, more water was put back into the basins and the AOD was reduced resulting in rising water levels.

After considerable analysis and discussion, the Board of Directors on April 19, 2006 established an Optimum Quantity of an AOD of 612,000 AF. This value was based on an extensive review of over 70 years of water level fluctuations in the District and recognizing that at the end of WY 1999/2000 groundwater amounts were at an acceptable quantity to sustain the adjudicated pumping rights in the basins. The AOD at that time was 611,900 AF (rounded to 612,000 AF), and therefore was set by the Board of Directors as the Optimum Quantity.

The Board of Directors on April 19, 2006 also adopted a policy to make up the Optimum Quantity should it fall too low. The policy is as follows:

An Accumulated Overdraft greater than the Optimum Quantity is a deficit. WRD will make up the deficit within a 20 year period as decided by the Board on an annual basis. If the deficit is within 5 percent of the Optimum Quantity, then no action needs to be taken to allow for natural replenishment to makeup the deficit.

The Accumulated Overdraft at the end of WY 2012/2013 was 757,500 AF, or 145,500 AF below the Optimum Quantity.

CHAPTER IV GROUNDWATER REPLENISHMENT: QUANTITIES, AVAILABILITY, AND COSTS

As discussed in the previous chapter, the Central Basin and West Coast Basin (“CBWCB”) have an annual overdraft because more groundwater is pumped out than is naturally replaced. The District purchases supplemental water (artificial replenishment water) each year to help offset this overdraft through managed aquifer recharge. The purchased water enters the groundwater basins at the Montebello Forebay spreading grounds, at the seawater barrier injection wells, and through the District's In-Lieu Program. The purpose of this Chapter is to determine the quantities of water needed for purchase in the ensuing year and to determine the availability and cost of that water.

Sources of Replenishment Water

The District currently has available to it recycled and imported water sources for use as artificial replenishment water. These two sources are described below:

- **Recycled Water:** Recycled water is wastewater from the sewer systems that is reclaimed through extensive treatment at water reclamation plants (“WRP”s). The water is treated to high quality standards so that it can be reused safely. Some agencies and businesses use recycled water for non-potable purposes, such as for irrigation of parks, golf courses, and street medians, or for industrial purposes (known as “purple-pipe projects”). WRD has successfully used recycled water for groundwater recharge since 1962. In semi-arid areas such as Southern California where groundwater and imported water are in short supply, recycled water has proven to be a safe and reliable additional resource to supplement the water supply. Recycled water is used at the spreading grounds and the seawater barrier wells. Although recycled water is high quality, relatively low cost, and a reliable supply all year long, the District is limited by regulatory agencies in the amount it can use for replenishment. Therefore, imported water is also used for recharge.
- **Imported Water:** Raw river water from northern California (State Water Project) and the Colorado River is imported into Southern California by the Metropolitan Water District of Southern California (“MWD” or “Met”). MWD then sells this water as raw or treated to their member agencies for multiple uses, including potable water and groundwater recharge. WRD uses raw (untreated) imported water at the spreading grounds and uses treated potable water for injection at the seawater barrier wells and the In-Lieu program. Because of treatment and transportation costs, imported water is the most expensive type for groundwater replenishment. Prior to October 2011, MWD offered seasonally-available discounted water that could be purchased for replenishment. In turn for the discount, it was considered by MWD to be interruptible and they could stop deliveries at any time. But due to a lack of surplus supplies caused by drought and other factors, MWD has suspended offering this type of water. Instead, replenishment agencies such as WRD must now purchase what is known as “Tier 1” or “Tier 2” water from MWD member agencies for spreading and In-Lieu. This water is at a higher price and relies on available allocation from the member agency, but is firm delivery (not interruptible). The barrier injection water has always been and continues to be Tier 1 water so that deliveries cannot be interrupted.

Groundwater Replenishment

Recommended Quantities of Replenishment Water

With the information presented in the preceding chapters regarding the pumping demands in the CBWCB and the overall condition of the groundwater basins, WRD can estimate its projected need for replenishment water in the ensuing year.

Spreading

Groundwater recharge through surface spreading occurs in the Montebello Forebay Spreading Grounds adjacent to the Rio Hondo and the San Gabriel River, within the unlined portion of the San Gabriel River, and behind the Whittier Narrows Dam in the Whittier Narrows Reservoir. Owned and operated by the Los Angeles County Department of Public Works (“LACDPW”), they were originally constructed in 1938 for flood control and conservation of local storm water, but have been used since the 1950s to replenish the basins with imported water and since 1962 with recycled water.

Since recycled water is a high quality, less expensive, and available year-round source of replenishment water, the District maximizes its use within established regulatory limits. These limits are discussed below under “Expected Availability of Replenishment Water”. The District has historically targeted 50,000 AFY of recycled water for spreading to meet regulatory limits. However, with the recent modifications to the District’s permit to allow 45% recycled water over a running 10-year average (see below under Expected Availability of Replenishment Water), the District can now target 55,000 AFY of recycled water as long as sufficient dilution water is available from storm water and imported water.

Additional replenishment water is needed beyond the 55,000 AFY of recycled water and will have to come from imported water. In 2003, the WRD Board adopted the long term average of 27,600 AFY of imported water to purchase for spreading. This value was based on long-term (30 year) averages of the overall water budget of the basins using the USGS computer model. The 2003 ESR discusses the derivation of this value in more detail.

Since that time, the District has invested in cooperative projects with the LACDPW to capture more storm water and to lessen the need for imported water as part of WRD’s Water Independence Now program, or WIN. Improvements to the Whittier Narrows Conservation Pool are expected to conserve an additional 3,000 AFY of storm water on average. Two new rubber dams were built in the San Gabriel River near Valley Boulevard and are expected to conserve an additional 3,600 AFY on average. And with the revisions to the recycled water permit discussed in the previous paragraph, 5,000 additional AF of recycled water can be planned thus lowering imported water by 5,000 AFY. Therefore, the new Long Term Average for imported spreading demands is 16,000 AFY.

Table 9 presents the anticipated imported water replenishment needs at the spreading grounds.

Injection

Another way of replenishing the groundwater supply is to inject water at the three seawater intrusion barriers owned and operated by the LACDPW, including the West Coast Basin Barrier, Dominguez Gap Barrier, and Alamitos Barrier. Although the primary purpose of the barriers is for seawater intrusion control, groundwater replenishment also occurs as the freshwater is injected into the CBWCB aquifers and then moves inland towards pumping wells.

To determine the amount of barrier water estimated for the ensuing year, WRD under an Agreement with LACDPW gets annual estimates from the expected demand at the barriers. WRD reviews these estimates, reviews recent 5-year averages of actual injection amounts, and makes adjustments as necessary. For the ensuing year, WRD estimates the West Coast Basin Barrier Project will require 17,000 AF, of which all will be recycled water from WBMWD's Edward C. Little Water Recycling Facility assuming the project is completed this year as planned. For the Dominguez Gap Barrier Project, a total of 7,000 AF will be needed, of which half will be imported water and half recycled water from the City of Los Angeles' Terminal Island Treatment Plant. For the Alamitos Barrier Project, 4,100 AF will be required by WRD (does not include barrier water purchased by Orange County Water District for their side of the barrier), which includes 3,700 AF of recycled water from the expanded VanderLans plant and 400 AF of imported water.

The total barrier demand for WRD in the ensuing year is estimated at 28,100 AF, including 3,900 AF imported water (14%) and 24,200 AF of recycled water (86%) (see **Table 9**).

In-Lieu Replenishment Water

The basic premise of WRD's In-Lieu Program is to offset the pumping in the basin to lower the annual overdraft and reduce the artificial replenishment needs. It helps provide an alternate means of replenishing the groundwater supply by encouraging basin pumpers to purchase imported water when available instead of pumping groundwater. This can help raise water levels in areas that are otherwise more difficult to address. MWD has ceased providing seasonally discounted water for the In-Lieu program since 2011, so WRD's program has been put on hold with the exception of a few localized projects with the City of Long Beach. For the ensuing year, WRD is not budgeting for the In-Lieu program, although may consider new programs if opportunities arise.

Expected Availability of Replenishment Water

The availability of water supplies for the ensuing water year has been taken into account when determining how funds should be raised. If a particular resource is expected to be unavailable during a given year, money can still be raised to fund the purchase of that quantity of water in a succeeding year.

Recycled Water

- Recycled water is reliable all year round but its use for recharge is capped by regulatory limits. The current limits for recycled water spreading in the Montebello Forebay are established by the Los Angeles Regional Water Quality Control Board ("RWQCB") and are detailed in Order No. 91-100 adopted on September 9, 1991 with amendments on April 2, 2009 under Order No. R4-2009-0048 and June 4, 2013 (letter approval from RWQCB Executive Officer). On April 10, 2014, under Order No. R4-2009-0048-A-01, the RWQCB approved a request by WRD to increase the allowable percentage of recycled water to be recharged at the Montebello Forebay spreading grounds from 35% to 45% over a 10-year running average as a drought relief measure. This major action will allow continued use of historic amounts of recycled water for longer periods of time should the dry conditions continue, and might allow for additional recycled water for recharge should normal to wet hydrologic conditions return. This will allow WRD to continue to maximize use of recycled water for groundwater recharge as part of its Water Independence Now, or WIN, initiative.

Groundwater Replenishment

The Sanitation Districts of Los Angeles County (“SDLAC”) provides the recycled water to WRD for spreading by LACDPW. This water comes from the Whittier Narrows Water Reclamation Plant (“WNWRP”), San Jose Creek Water Reclamation Plant (“SJCWRP”), and Pomona Water Reclamation Plant (“PWRP”). For planning purposes, the District assumes purchasing 55,000 AFY of recycled water in the ensuing year, although this amount can vary based on percentage limits and availability of the recycled water and the spreading grounds.

Recycled water for injection into the seawater barrier wells comes from different agencies depending on the specific barrier. At the WCBBP, the water is provided by WBMWD's Edward C. Little Water Recycling Facility. Per regulatory limits, this resource can provide up to 100% recycled water to the Barrier under their Phase V construction activities. For the ensuing year, it will be estimated that 100% of the barrier water will be recycled water since the Phase V plant expansion is expected to be completed in the current year.

Recycled water for the DGBP is typically available from the City of Los Angeles’ Terminal Island Treatment Plant (Harbor Recycled Water Project). The plant is permitted to provide the barrier with up to 5 million gallons per day (mgd) or 5,600 AFY, or 50% of the total barrier supply, whichever is less. For the ensuing year, it is estimated that of the 7,000 AF demand next year, half will be imported water and half will be recycled water. Plans are underway to increase the recycled percentage amount to 100% and eliminate the need for imported water.

Recycled water for the ABP is available from WRD's Leo J. Vander Lans Water Treatment Facility. This treatment plant will be permitted to provide up to 100% of the barrier with recycled water in 2014 after completion of the plant expansion that is currently underway. For the ensuing year, of the 4,100 AF estimated to be injected at the barrier, the majority (3,700 AF) will be recycled water with 400 AF estimated to be imported water to make up any plant shut downs for maintenance or other startup issues. These amounts do not include the barrier water purchased by Orange County Water District on their side of the barrier, which will also be a majority of VanderLans water with imported water as needed for makeup water.

Imported Water

Since October 2011, MWD terminated its discounted replenishment water program which the District utilized since 1959, and has not yet offered a new replenishment program. Replenishment agencies must rely on the more expensive Tier 1 water if it is available from MWD-member agencies, or pay the even higher priced Tier 2 water if Tier 1 water is unavailable. Over the past few years, WRD has budgeted for Tier 1 water for the spreading grounds and the In-Lieu program.

For the imported water used for injection at the seawater barrier wells, the District had paid the treated Tier 1 rate for decades to ensure availability. Because of the increasing price of Tier 1 water, the District is looking at ways to reduce costs. Methods such as reduction of pumping near the barriers, increased recycled water to offset imported water, or banking water at lower seasonal rates are being explored or implemented. At the ABP, the City of Long Beach and WRD have entered into an agreement to bank seasonal treated water and Tier 1 water through inland injection wells and then extract the water for injection at the barriers when needed, thus saving considerable costs on barrier water. In 2009/2010, the 2,000 AF of Tier 1 water banked in 2008/2009 was utilized. The seasonal water banked in 2004/2005 through 2006/2007 has 2,160 AF remaining and can be called at any time that serves the District most effectively.

Projected Cost of Replenishment Water

WRD has estimated it will need 99,100 AF of replenishment water in the ensuing year. Using currently available information and estimates for the cost of replenishment water to WRD from the various water suppliers, the 99,100 AF will cost WRD approximately \$36,557,980.

Tables 1 and 2 provide a detailed breakdown of the estimated replenishment water costs for the ensuing water year. These estimated costs are for water purchases only and do not include the additional costs for water replenishment and water quality projects and programs. These projects and programs are discussed in detail in Chapter V. The anticipated costs of these projects and programs will be further discussed in District budget workshops, Budget Advisory Committee (“BAC”), and other public meetings before the Board of Directors adopts the 2014/2015 Replenishment Assessment in May.

CHAPTER V PROJECTS AND PROGRAMS

California Water Code Sections 60220 through 60226 describe the broad purposes and powers of the District to perform any acts necessary to replenish, protect, and preserve the groundwater supplies of the District. In order to meet its statutory responsibilities, WRD has instituted numerous projects and programs in a continuing effort to effectively manage groundwater replenishment and groundwater quality in the Central Basin and West Coast Basin (“CBWCB”). These projects and programs include activities that enhance the replenishment program, increase the reliability of the groundwater resources, improve and protect groundwater quality, and ensure that the groundwater supplies are suitable for beneficial uses.

These projects and programs have had a positive influence on the basins, and WRD anticipates continuing these activities into the ensuing year. The following is a discussion of the projects and programs that WRD intends to continue or initiate during the ensuing year.

001 – Leo J. Vander Lans Water Treatment Facility Project

The Leo J. Vander Lans Water Treatment Facility provides advanced treated recycled water to the Alamitos Seawater Intrusion Barrier. The facility receives tertiary-treated water from the Sanitation Districts and provides the advanced treatment through a process train that includes microfiltration, reverse-osmosis, and ultraviolet light. The facility’s operations permit was approved by the Los Angeles Regional Water Quality Control Board (“RWQCB”) on September 1, 2005, and the replenishment operations of this facility started in October 2005. The product water has since been discharging to the barrier to replace up to 50% of the potable imported water formerly used, thereby improving the reliability and quality of the water supply to the barrier. The plant has been producing 3 million gallons a day (“MGD”) for delivery to the barrier. The Long Beach Water Department (“LBWD”) is responsible for operation and maintenance of the treatment plant under contract with WRD.

Construction is in progress to expand the capacity of the facility to 8 MGD so that it is capable of providing up to 100% of the barrier demand with advanced treated recycled water, thereby eliminating altogether the need for imported water. The anticipated completion date for the plant expansion is fall 2014. Expected operations costs for the coming year will involve operation and maintenance of the plant and groundwater monitoring at the barrier. Because the primary purpose of this project is to provide a more reliable means of replenishing the basin through injection, 100% of the costs are drawn from the Replenishment Fund. The capital costs for the expansion are funded by federal and state grants as well as the District’s bond proceeds.

002 – Robert W. Goldsworthy Desalter Project

The Robert W. Goldsworthy Desalter has been operating since 2002 to remove over 20,000 AF of brackish groundwater from a seawater intrusion plume (aka “saline plume”) in the Torrance area that was stranded inland of the West Coast Basin Barrier after the barrier project was put into operation in the 1950s and 1960s. The production well and desalting facility are located within the City of Torrance and the product water is delivered for potable use to the City’s distribution system. The

Projects and Programs

treatment plant capacity is about 2,200 AFY. The City is responsible for operation and maintenance of the treatment plant under contract with WRD. Expected costs for the coming year will involve operation and maintenance of the plant.

The District completed a feasibility study that evaluated several options for expanding the capacity of the treatment plant to 4,800 AFY. Work has begun on the final design of the treatment plant expansion along with two new source water wells and associated pipelines. Construction of these new facilities is expected to begin in late 2014. The purpose of the desalter expansion is directly related to remediating degraded groundwater quality and costs will be funded through WRD's Capital Improvement Program.

Additional measures may be necessary in the future to fully contain and remediate the saline plume, which extends outside of the Torrance area. WRD is completing work on a groundwater master plan for the West Coast Basin to determine long-term solutions to this problem. The District continues to work with the City of Torrance Municipal Water Department, the pumpers' Technical Advisory Committee, and other West Coast Basin stakeholders on the future of the saline plume removal in the West Coast Basin.

004 – Recycled Water Program

Recycled water (reclaimed municipal wastewater) has been successfully used for groundwater recharge by WRD since 1962. Recycled water provides a reliable source of high quality water for surface spreading in the Montebello Forebay and for injection at the seawater intrusion barriers. In view of the recurring drought conditions in California and uncertainties about future water availability and cost of imported water supplies, recycled water has become increasingly vital as a replenishment source.

In order to ensure that the use of recycled water for groundwater recharge remains a safe and reliable practice, WRD participates in various research and monitoring activities, proactively contributes to the regulatory and legislative development processes, and engages in information exchange and dialogue with regulatory agencies and other recycled water users. The District continues to closely coordinate with the County Sanitation Districts of Los Angeles County ("SDLAC"), which produces the recycled water used for surface spreading in the Montebello Forebay, on permit compliance activities, including groundwater monitoring, assessment, and reporting. Many monitoring and production wells are sampled frequently by WRD staff, and the results are reported to the regulatory agencies.

In addition to compliance monitoring and sampling associated with the spreading grounds, WRD is partnering with others to more fully investigate the effectiveness of soil aquifer treatment ("SAT") during groundwater recharge. Research is underway to more fully characterize the percolation process and to quantify the filtering and purifying properties of the underlying soil with respect to constituents of concern, such as nitrogen, total organic carbon, and chemicals of emerging concern ("CECs"). The District continues to be vigilant in monitoring research on the occurrence, significance, attenuation, and removal of CECs, including pharmaceuticals, endocrine disruptors, and personal care products.

Three separate groundwater tracer studies were performed in 2003-2005, 2005-2006, and 2010-2011 for the purpose of tracking and verifying the movement of recycled water from the spreading grounds by testing the monitoring wells and the production wells. Results showed that the depth rather than the horizontal distance from the recharge ponds is the key factor influencing arrival times of recycled water to wells. Travel time to deeper wells is greater than to shallower wells, even if the deeper wells are very near the spreading grounds. In some cases, WRD made modifications to wells to seal off their shallow perforations so that the wells would only produce from the deeper aquifers. Tracer tests subsequent to well modification demonstrated an increased travel time compared to earlier results. These efforts, in addition to periodic studies assessing health effects and toxicological issues, are necessary to provide continued assurances that the use of recycled water for groundwater recharge remains safe and compliant with all regulatory standards.

In addition, WRD, in concert with other stakeholders, is working closely with the California Department of Public Health (“CDPH”) to review, update, and help shape the regulations on groundwater recharge using recycled water. WRD contributed to the amendment of the Recycled Water Policy, adopted by the State Water Resources Control Board in January 2013 to assure that the required monitoring of groundwater recharge projects will be conducted using sound, scientifically credible methods.

Recycled water is also injected into the Los Angeles County Department of Public Works’ three seawater intrusion barriers located along the coast of Los Angeles County (Alamitos, West Coast, and Dominguez Gap barriers). Highly purified recycled water used for injection at the Alamitos Barrier is produced at WRD’s Leo J. Vander Lans Water Treatment Facility. The recycled water for the Dominguez Gap Barrier is generated at the City of Los Angeles’ Terminal Island Water Reclamation Plant. And the recycled water for the West Coast Barrier is produced at the West Basin Municipal Water Districts’ Edward C. Little Water Recycling Facility. Extensive recycled water monitoring and regular groundwater modeling are performed to ensure that the treatment plants are operating as intended and that the injected water is making a positive contribution to the groundwater basins. All three barrier projects are in various phases of expanding the recycled water produced for the barrier operations, with the ultimate goal of completely phasing out the potable water used at the barriers. Alamitos Barrier will reach the goal of 100% recycled water recharge in 2014, with the other two barriers following in the near future.

Projects under this program help improve the reliability and utilization of an available local resource, i.e. locally produced recycled water. This resource is used to improve replenishment capabilities and is thus funded from the Replenishment Fund.

005 – Groundwater Resources Planning Program

The Groundwater Resources Planning Program was instituted to evaluate basin management issues and to provide a means of assessing project impacts in the District’s service area. Prior to moving forward with a prospective project, an extensive evaluation is undertaken. Within the Groundwater Resources Planning Program, new projects and programs are analyzed based on benefits to overall basin management. This analysis includes performing an extensive economic evaluation to compare estimated costs with anticipated benefits. As part of this evaluation process, all capital projects are brought to the District’s Technical Advisory Committee for review and recommendation. The

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culmination of this review and evaluation process is the adoption of the five - year Capital Improvement Program (“CIP”) by the District’s Board of Directors.

One of the main programs underway is the development of a Programmatic Environmental Impact Report (“PEIR”) for the District’s Groundwater Basins Master Plan. This effort will evaluate, at the programmatic level, the potential environmental impacts of future groundwater replenishment and extraction scenarios. This effort is expected to be completed in late 2014.

Also under this program, District staff will continue to monitor state and federal funding programs to determine applicability to the District’s list of prospective projects. In the coming year, the District will continue participation in Integrated Regional Water Management Planning (“IRWMP”) for Greater Los Angeles County. Collaborative development of the region’s IRWM plan is a requirement for entities to secure grant funding under Proposition 84 was passed in November 2006. Grant applications for Proposition 84, Round 3 are expected to be submitted to the California Department of Water Resources in the upcoming year. The District anticipates submitting an application for the Groundwater Reliability Improvement Program (“GRIP”) under this program.

Projects under the Groundwater Resources Planning Program serve to improve replenishment operations and general basin management. Accordingly, this program is also wholly funded through the Replenishment Fund.

006 – Groundwater Quality Program

This program is an ongoing effort to address water quality issues that affect WRD projects and the pumpers’ facilities. The District monitors and evaluates the impacts of proposed, pending and recently promulgated drinking water regulations and legislation. The District assesses the justification and reasoning used to draft these proposals and, if warranted, joins in coordinated efforts with other interested agencies to resolve concerns during the early phases of the regulatory and/or legislative process.

Annually, the District offers a groundwater quality workshop to water purveyors. At the workshop, field experts and regulators provide information on the latest water quality regulations, state of the groundwater in the local basins, information on the cutting edge technology for contaminant removal or well rehabilitation, and other topics that are of key interest to the District’s water purveyors. This annual workshop gives a comprehensive overview of the resources provided under the District’s Groundwater Quality Program.

The District continually evaluates compliance with current and anticipated water quality regulations in production wells, monitoring wells, and spreading/injection waters of the basins. If noncompliance is suspected, WRD quickly investigates to confirm or determine the causes of noncompliance, develops recommended courses of action and estimates their associated costs to address the problem, and implements the best alternative to achieve compliance.

Effective January 1, 2007, the District assumed responsibility for the Central Basin Title 22 Groundwater Monitoring Program. The program involves working with participating pumpers to comply with regulatory requirements for well water monitoring, including: (1) scheduling the

collection and analysis of samples for Title 22 compliance required by CDPH and special sampling such as the Unregulated Contaminant Monitoring Rule (“UCMR”) required by the United States Environmental Protection Agency (“EPA”); (2) coordinating the submittal of results to the CDPH; and 3) preparing the annual Consumer Confidence Reports for the pumpers. This program is available to pumpers who choose to participate and agree to reimburse the District the actual monitoring costs, including District staff time in administering the program. The District presently has 21 pumpers/participants in this program, which involves a total of 83 wells.

In recent years, new chemicals CECs have been identified nationwide as potentially impacting surface water and groundwater. Constituents such as perchlorate, n-nitroso dimethylamine (“NDMA”), hexavalent chromium, and 1,4-dioxane have emerged as CECs and may pose a potential threat to water resources. Their detection in the environment does not necessarily mean that they pose a health threat at their measured concentrations. WRD is actively monitoring surface spreading and injection activities for water quality constituents, including CECs, and based on its findings, advises the State Water Resources Control Board with regards to the development of policies related to water recycling, refinement of the anti-degradation policies, and technical reports concerning groundwater contamination. In addition, the District supports research evaluating CEC removals using innovative treatment technologies.

WRD’s service area contains a large and diverse industrial and commercial base. Consequently, many potential groundwater contamination sources exist within District boundaries. Examples of potential contamination sources include leaking underground storage tanks, petroleum pipeline leaks at refineries and petrochemical plants, and discharges from dry cleaning facilities, auto repair shops, metal works facilities, and others. Such contamination sources may pose a threat to the drinking water aquifers. Accordingly, WRD established its Groundwater Contamination Prevention Program as a key component of the Groundwater Quality Program in an effort to minimize or eliminate threats to groundwater supplies. The Groundwater Contamination Prevention Program includes several ongoing efforts:

- Central Basin and West Coast Basin Groundwater Contamination Forum: More than 10 years ago, WRD established this data-sharing and discussion forum with key stakeholders including the EPA, the California Department of Toxic Substances Control (“DTSC”), the RWQCB, the CDPH, the United States Geological Survey (“USGS”), and various cities and purveyors. Stakeholders drafted and signed a Memorandum of Understanding (“MOU”) agreeing to meet regularly and share data on contaminated groundwater sites within the District. WRD acts as the meeting coordinator and data repository/distributor, helping stakeholders to characterize the extent of contamination to identify pathways for contaminants in shallow aquifers to reach deeper drinking water aquifers and develop optimal methods for remediating contaminated groundwater.
- With the cooperation and support of all stakeholders in the Groundwater Contamination Forum, WRD developed a list of high-priority contaminated groundwater sites located within the District. This list is a living document, subject to cleanup and “closure” of sites, as well as discovery of new sites warranting further attention. Currently, the list includes 46 sites across the CBWCB. WRD works with the lead regulatory agencies for each of these sites to keep

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abreast of their status, offer data collection, review and recommendations as needed, and facilitate progress in site characterization and cleanup.

- Beginning in April 2010, WRD commenced work with the USGS on the Central Basin Groundwater Contamination Study. The purpose of this study is to characterize the threat of multiple contaminant plumes moving downward through potential preferential pathways to deeper potable aquifers in the Central Basin. The study area encompasses a large portion of the Central Basin, including the locations of several high-priority contaminated groundwater sites. Study tasks include compilation of existing data, sequence stratigraphic analysis, water quality sampling, geochemical analyses, and characterization of the groundwater flow system. The study is expected to be completed by June 2014. WRD received AB303 grant funding to support this project.
- In 2012, WRD formed the Los Angeles Forebay Groundwater Task Force to coordinate and align regulators and water purveyors/agencies to collaboratively address groundwater contamination in the Los Angeles Forebay that is a threat to drinking water resources. The Task Force members currently include WRD, DTSC, EPA, RWQCB, CDPH, USGS, City of Vernon, City of Los Angeles and others. WRD and DTSC are investigating and collecting data to assess the extent of regional volatile organic compound and perchlorate plumes and find the source(s) of this contamination. This data will be utilized by the regulatory agencies to eventually facilitate remediation of the plumes.

WRD remains committed to projects seeking opportunities and innovative project concepts to enhance capture and recharge of local stormwater runoff in order to augment local groundwater resources, as follows:

- For many years, the District has participated on the Technical Advisory Committee (“TAC”) for the Water Augmentation Study (“WAS”) of the Los Angeles and San Gabriel Rivers Watershed Council. WAS is a multi-year investigation into the feasibility of capturing more local storm runoff, which would otherwise discharge into the storm drains, channels, and ultimately be lost to the ocean. Local stormwater captured from small-scale sites (e.g. neighborhoods, parks, ball fields, etc.) using various infiltration practices (e.g. bioswales, infiltration basins, and porous pavements) represents a potential source of new replenishment water, above and beyond the stormwater currently captured and used for percolation at the existing spreading grounds. As a TAC member, WRD helps to steer the study to examine and ensure that this new source of recharge water does not degrade groundwater quality if allowed to percolate at local sites. In 2012, with financial contributions from the District, two lysimeters were installed as part of the WAS investigation to evaluate the potential impacts of the locally captured stormwater on groundwater quantity and quality at the Elmer Avenue neighborhood BMP demonstration project constructed in 2009. Monitoring of the lysimeters began in early 2013. To date, the Elmer Ave project received only one storm of sufficient size for collecting stormwater samples from the lysimeters, in December 2013; however, the collected volumes were not sufficient to allow laboratory analysis. Therefore, the lysimeter monitoring program will be extended through 2014.

- The Stormwater Recharge Feasibility Study, which began mid-2011 and was completed in August 2012, investigated regional and distributed alternatives to capture more stormwater from parcels within the District service area for groundwater recharge. To identify and prioritize catchments or parcels with greatest potential to provide additional groundwater recharge and reduce pollutant loading to surface water bodies, an in-depth, regional assessment was conducted using spatial analysis and locally developed models, including the Structural Best management practices Prioritization and Analysis Tool (“SBPAT”), the Groundwater Augmentation Model (“GWAM”), and the WRD/USGS MODular three-dimensional finite-difference ground-water FLOW model (“MODFLOW”). The assessment considered a suite of factors important to siting groundwater recharge projects (e.g. surface flows, soil conditions, depth to water, and subsurface geologic conditions, preexisting contamination, and permanent dewatering activities) as well as local water quality objectives.

The study identified 17 high priority catchments within the District service area where expected water supply benefits were estimated at 4,300 AFY if appropriate infiltration facilities are installed and maintained. A single 100 acre catchment was selected, and concept designs for a catchment-wide pilot stormwater capture and recharge facilities were completed. Results from the analyses and pilot project are scalable to inform future decisions about widespread implementation of distributed and regional stormwater capture projects. Findings of the study were presented to various audiences, including water purveyors, regulators, local environmental groups, and at regional and national stormwater conferences. The benefit cost analyses, which examined multiple factors including but not limited to water quality improvements, water supply benefits, and social benefits garnered wide interest from water quality agencies, water supply agencies, and policymakers.

In 2012, the District partnered with the City of Los Angeles Bureau of Sanitation (the lead applicant) to pursue Proposition 84 funding (Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006) to implement a portion of the concept design to increase stormwater infiltration and to assist the City of Los Angeles in its compliance with total maximum daily load (water quality-related) requirements. The proposed project area is located in the City of Los Angeles south of the 10 freeway and east of the 110 freeway. The combined watershed of all proposed stormwater infiltration projects is approximately 228 acres with mixed land uses. In 2013, the City was awarded \$2,939,361 by the State Water Resources Control Board to construct and monitor the project. Known as the “Broadway Neighborhood Stormwater Greenway (Broadway) Project, this project is slated to be completed in 2016.

Much of the work for the coming year will involve additional investigations at well sites known to have contaminated water, continued tracking of water quality regulations and policies affecting production and replenishment operations, further characterization of contaminant migration into the deeper aquifers, and monitoring and expediting cleanup activities at contaminated sites. All work under this program is related to water quality and cleanup efforts and is funded from the Clean Water Fund.

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010 – Geographic Information System (“GIS”)

The District maintains an extensive in-house database and Geographic Information System (GIS). The database includes water level and water quality data for WRD’s service area with information drawn not only from the District’s Regional Groundwater Monitoring Program and permit compliance monitoring, but also from water quality data obtained from the CDPH. The system requires continuous update and maintenance but serves as a powerful tool for understanding basin characteristics and overall basin health.

The GIS is used to provide better planning and basin management. It is used to organize and store an extensive database of spatial information, including well locations, water level data, water quality information, well construction data, production data, aquifer locations, and computer model files. In the coming year, this information will be further integrated with readily available data from other state and federal agencies. Staff uses the system daily for project support and database management. Specific information is available upon request to any District pumper or stakeholder and can be delivered through the preparation of maps, tables, reports, or in other compatible formats. Additionally, the District has made its web-based Interactive Well Search tool available to selected users. This web site provides these users with limited access to WRD’s water quality and production database.

With the addition of a GIS Analyst in the upcoming year, District staff will continue to streamline and refine the existing data management system and website as well as satisfy both internal and external data requests. As part of the streamlining of the data, staff will work closely with other District departments to evaluate and implement updates to the District’s existing system to facilitate the seamless transfer of data and access to that data. Additionally, District staff will continue the development of applications to more efficiently manage and report groundwater production information. Continued use, upkeep, and maintenance of the GIS are planned for the coming year. The use of the system supports both replenishment activities and groundwater quality efforts. Accordingly, the cost for this program is equally split between the Replenishment and Clean Water Funds.

011 – Regional Groundwater Monitoring Program

WRD has been monitoring groundwater quality and water levels in the CBWCB for over 50 years. The Regional Groundwater Monitoring Program provides for the collection of basic information used for groundwater basin management including groundwater level data and water quality data. It currently consists of a network of over 300 WRD and USGS-installed monitoring wells at over 50 locations throughout the District, supplemented by the existing groundwater production wells operated by the water purveyors. The information generated by this program is stored in the District’s GIS and provides the basis to better understand the dynamic changes in the Central Basin and West Coast Basin. WRD hydrogeologists and engineers, provide the in-house capability to collect, analyze and report groundwater data.

Water quality samples from the monitoring wells are collected twice a year. Water levels are measured in most monitoring wells with automatic data loggers daily, while water levels in all monitoring wells are measured by WRD field staff a minimum of four times per year. On an annual

basis, staff prepares the Regional Groundwater Monitoring Report that documents groundwater level and groundwater quality conditions throughout the District. This report is distributed to the stakeholders in WRD and is also available on the District's website. In 2011, the National Groundwater Association presented WRD with the "2011 Groundwater Protection Project Award" in recognition of the regional groundwater monitoring program.

WRD is also the designated groundwater monitoring entity for the CBWCB under the State of California's CASGEM program (California Statewide Groundwater Elevation Monitoring). WRD collects water level data from 28 of its nested monitoring wells and uploads it to the State's CASGEM website on a regular basis for seasonal and long-term water level trend tracking. Public access to the CASGEM website is at www.water.ca.gov/groundwater/casgem.

Most of the work during the ensuing year will involve equipping and sampling the three new monitoring wells installed by the USGS in 2013/2014, continuous field activities at the other wells including quarterly and semi-annual data collection, well and equipment maintenance, and annual reporting activities. Work associated with the Regional Groundwater Monitoring Program also supports activities relating to both replenishment and water quality projects. The program is funded equally by the Replenishment and Clean Water Funds.

012 – Safe Drinking Water Program

WRD's Safe Drinking Water Program ("SDWP") has operated since 1991 and is intended to promote the cleanup of groundwater resources at specific well locations. Through the installation of wellhead treatment facilities at existing production wells, the District removes contaminants from the underground supply and delivers the extracted water for potable purposes. Projects implemented through this program are accomplished in collaboration with well owners.

One component of the program focuses on the removal of VOCs and offers financial assistance for the design and equipment at the selected treatment facility. Another component offers zero-interest loans for secondary constituents of concern that affect a specific production well. The capital costs of wellhead treatment facilities range from \$800,000 to over \$2,000,000. Due to financial constraints, the initial cost is generally prohibitive to most pumpers. Financial assistance through the District's SDWP makes project implementation much more feasible.

There are several projects in various stages of implementation and new candidates for participation are under evaluation. A total of 16 facilities have been completed and are online and one facility has successfully completed removal of the contamination and no longer needs to treat. While continued funding of this program is anticipated for next year, the District has revised the guidelines of the SDWP to place a greater priority on projects involving VOC contamination or other anthropogenic (man-made) constituents, now classified as Priority A Projects. Treatment projects for naturally-occurring constituents are classified as Priority B Projects and funded as a secondary priority, on a case-by-case basis and only if program monies are still available during the fiscal year. While such projects are of interest to WRD, availability of funding for them will not be determined until after the budget process is completed.

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Projects under the SDWP involve the treatment of contaminated groundwater for subsequent beneficial use. This water quality improvement assists in meeting the District's groundwater cleanup objectives.

018 – Dominguez Gap Barrier Recycled Water Injection

This Project involves the delivery of recycled water from the City of Los Angeles Department of Public Works - Bureau of Sanitation ("BoS") Terminal Island Water Reclamation Plant/Advanced Water Treatment Facility ("AWTF") to the Dominguez Gap Barrier ("DGB"). Delivery of recycled water to the barrier, which commenced in late February 2006, was temporarily interrupted for about a year starting November 2011 when the AWTF shut down for plant upgrade and maintenance. Recycled water delivery to the DGB resumed in December 2012.

Prior to injection at the barrier, the recycled water produced at the AWTF undergoes advanced treatment processes including microfiltration, reverse osmosis, and chlorination. The DGB injection project was permitted by LARWQCB in conjunction with CDPH for up to 5 mgd of recycled water and 50% recycled water contribution (meaning recycled water may not exceed 50% of the total injected volume with the remainder consisting of potable water). Water quality requirements, including turbidity and modified fouling index ("MFI"), must also be satisfied to minimize potential fouling of DGB injection wells owned and operated by the County of Los Angeles Department of Public Works. WRD is working with BoS to expand the amount of recycled water produced for the DGB, with the ultimate goal of eliminating all potable water used for barrier injection.

While LADWP is responsible for the treatment and delivery of the recycled water and the water quality monitoring of the recycled water, WRD has responsibility for groundwater monitoring and compliance. As part of the DGB injection permit requirements, WRD conducts groundwater monitoring to measure and track water quality conditions, evaluate potential impact of recycled water on groundwater, and identify potential problems well before recycled water arrives at any downgradient drinking water wells. In addition, an extensive tracer study was conducted from the start of recycled water injection in February 2006 through fall 2010 to determine the extent of travel and movement of the recycled water blend through the aquifers. The tracer study confirmed that after injection, adequate mixing and further blending of recycled water with diluent water occurs in the ground and that groundwater samples collected were representative of the recycled water blend.

Recycled water use at the seawater intrusion barriers in Los Angeles County improves the reliability of a supply in continuous demand. Traditionally, water purchases for the barriers have been viewed as a replenishment function. Therefore, this program is funded 100% through the Replenishment Fund.

023 – Replenishment Operations

WRD actively monitors the operation and maintenance practices at the LACDPW-owned and operated spreading grounds and seawater barriers within the District. Optimizing replenishment opportunities is fundamentally important to WRD, in part because imported and recycled water deliveries directly affect the District's annual budget. Consequently, the District seeks to ensure that

the conservation of stormwater is maximized, and that imported and recycled water replenishment is optimized.

Due to the reduction and unreliability of imported water for replenishment, WRD is working on its Water Independence Now (“WIN”) program to eventually become independent from imported water for groundwater recharge. Currently, the District needs about 19,900 AF of imported water for recharge; 16,000 AF for spreading and 3,900 AF for injection at the seawater barriers. By maximizing the use of recycled water and stormwater, the amount of imported water needed can eventually be reduced or eliminated, thereby providing the groundwater basins with full replenishment needs through locally-derived water.

WRD coordinates regular meetings with LACDPW, MWD, SDLAC, and other water interests to discuss replenishment water availability, spreading grounds operations, barrier operations, scheduling of replenishment deliveries, seawater barrier improvements, upcoming maintenance activities, and facility outages or shutdowns. The District tracks groundwater levels in the Montebello Forebay weekly to assess general basin conditions and determine the level of artificial replenishment needed. WRD also monitors the amount of recycled water used at the spreading grounds and seawater barriers to maximize use while complying with pertinent regulatory limits.

While improvements undertaken in recent years by LACDPW/WRD (e.g., expansion of Whittier Narrows Conservation Pool, installation of rubber dams on San Gabriel River, Interconnection Pipeline) have considerably increased the stormwater portion of WRD’s supply portfolio, the potential for further increasing the use of stormwater for groundwater augmentation remains significant. Working with the Army Corps of Engineers and LACDPW on additional improvements to the Whittier Narrows Conservation Pool will allow capture of more stormwater, as will development of Montebello Forebay projects to lower the water table through increased pumping and delivery downgradient to free up underground space to capture more storm water and/or recycled water.

The District plans to continue working with the LACDPW on several design projects for the Rio Hondo and San Gabriel Coastal Spreading Grounds with the goal of increasing the volume of recycled water conserved. The District is continually looking for opportunities to work with the LACDPW on improvement projects at the recharge facilities. Several potential projects have been identified and are being further evaluated to determine if they should be pursued. Two such projects are currently in the design and permitting stage. These projects consist of the construction of turnout structures along the San Gabriel River which will allow the delivery of increased recycled water to 1) the San Gabriel Coastal Spreading Grounds – Basin #2 & Interconnection Pipeline and 2) the portion of the unlined San Gabriel River south of Rubber Dam #4. Together these two turnout structures will help increase the spreading of recycled water at the San Gabriel Coastal and Rio Hondo Coastal Spreading Grounds and minimize the loss of recycled water to the ocean.

As its name implies, the Replenishment Operations Program deals primarily with replenishment issues and therefore its costs are borne by the Replenishment Fund.

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025 – Hydrogeology Program

This program accounts for the projects and programs related to hydrogeologic investigations of the District and surrounding areas to ensure safe and reliable groundwater. Work performed under this program includes the preparation of the annual Engineering Survey and Report, which incorporates the calculation and determination of annual overdraft, accumulated overdraft, changes in storage, pumping amounts, and replenishment water availability into a document to help the District assess its replenishment needs and costs in the ensuing year. Extensive amounts of data are compiled and analyzed by staff to determine these values. Maps are created showing water levels in the basins and production patterns and amounts. Much of this information is published in Technical Bulletins – easy to read two-page documents that summarize groundwater issues of importance in the District.

An ongoing effort at the District to better characterize the hydrogeologic conditions across the Central and West Coast Basins is called the "Hydrogeologic Conceptual Model". This long-term project involves compiling and interpreting the extensive amounts of data generated during drilling and logging of the WRD/USGS monitoring wells and collected from historical information for production wells and oil wells within the District. In 2013, WRD obtained extensive seismic reflection data which is being analyzed to help fill in gaps in the geologic structure. The ultimate goal of this project is to incorporate the data in WRD's database/GIS and apply the system to generate aquifer surfaces and cross-sections for comparison with historical interpretations of basin hydrogeology. The final conceptual model will significantly improve the understanding of the aquifer depths, extents and thicknesses throughout the District and will assist staff, pumpers and stakeholders with planning for groundwater resource projects such as new well drilling, storage opportunities or modeling. The data will also be made available on WRD's website to be used as a reference source for hydrogeologic interpretations and to fill project-related data requests.

The conceptual model updates are being incorporated into the USGS numerical model updates. The updates to the numerical model are being performed based on the new information gleaned from the additional aquifer-specific WRD monitoring wells installed since 2000 and the extensive groundwater monitoring that the District has performed since then to identify trends in groundwater levels. The upgrades will also include refining the model's resolution to 1/8-mile square cells versus the previous model's 1/2 - mile cells, and creating 11 vertical layers to simulate groundwater flow in the various aquifers versus the previous model's 4 layers. The model has also been converted to the newest version of Modflow known as Unstructured Grids (USG), which allows better simulation of groundwater flow in the complex geology of the Central and West Coast Basins. New seismic reflection data purchased by WRD will also be incorporated into the model. Time frames for model calculation will improve from annual measurements to quarterly. All of these upgrades will lead to a much improved groundwater modeling simulator for the District's future management efforts. This model is a significant analytical tool utilized by WRD to determine basin benefits and impacts of changes proposed in the management of the Central Basin and West Coast Basin.

Hydrogeologic analysis is also needed for projects associated with groundwater quality concerns and specific cleanup projects. Staff work may include investigative surveys, data research, and oversight of specific project studies. Such efforts are used to relate water quality concerns with potential impact to basin resources. An example of this type of staff work is the District's Well Profiling Program. The District assists pumpers in evaluating drinking water supply well contamination.

Services may include existing data collection and review and field tasks such as spinner logging and depth-discrete sampling. WRD's evaluation helps pumpers to determine the best course of action; e.g., sealing off a particular screened interval of a well, wellhead treatment, or well destruction.

Salt / Nutrient Management Plans are a new State requirement for all groundwater basins throughout California. The Plans are required as part of the Recycled Water Policy issued by the State Water Resources Control Board ("SWRCB") and effective as of May 14, 2009. As stated in the Policy, its purpose is to "establish uniform requirements for recycled water use and to develop sustainable water supplies throughout the state". The SWRCB therefore "supports and encourages every region...to develop a Salt / Nutrient Management Plan by 2014". WRD has initiated the process with other stakeholders and the Regional Water Quality Control Board, has completed a work plan and will make considerable progress on the Salt / Nutrient Management Plan in the ensuing year.

Modeling of groundwater flow and movement of injected recycled water at the Alamitos and Dominguez Gap seawater barriers are also included in this program. These efforts are required under permits for the recycled water injection.

In 2013, WRD received a grant from MWD through WBMWD to perform groundwater tracer tests using noble gasses at the three seawater barrier systems. Use of noble gasses instead of other compounds, if found effective, will provide a cost-effective means to reliably follow the movement of injected water through the aquifers.

The Hydrogeology Program addresses both groundwater replenishment objectives and groundwater quality matters. The cost of the program is evenly split between the Replenishment and Clean Water Funds.

033 – Groundwater Reliability Improvement Program ("GRIP")

The WRD continues to pursue projects through its Water Independence Now ("WIN") program to develop local and sustainable sources of water for use in groundwater replenishment activities. This has become increasingly important in light of persistent drought conditions in the state and environmental and regulatory issues that limit delivery of imported water to the Los Angeles area.

To address these issues, WRD is seeking alternative sources of water to offset the imported water used for replenishment in the Montebello Forebay. This program is referred to as the Groundwater Reliability Improvement Program ("GRIP"). The goal of GRIP is to offset the current use of imported water by providing up to 21,000 AFY of recharge using reliable alternative supply sources (e.g., recycled water, storm water) for replenishment via the Montebello Forebay. The primary goals of GRIP are to:

- Provide a sustainable and reliable supply for replenishing the Basins;
- Protect groundwater quality;
- Minimize the environmental/energy footprint of any option or options selected;
- Comply with pertinent regulatory requirements employing an institutionally feasible approach;
- Minimize cost to agencies using ground water; and
- Engage stakeholders in the decision making process.

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The District is currently developing the 30% design for the Advanced Water Treatment facility and conveyance pipeline for providing 10,000 AFY of highly treated recycled water to the Montebello Forebay for groundwater recharge to better identify the design/operation parameters of GRIP. The additional 11,000 AFY of 21,000 AFY to be provided as part of the GRIP will come from tertiary treated recycled water from the SDLAC's San Jose Creek Water Reclamation Plant.

The District has recently completed the draft Environmental Impact Report ("EIR") for GRIP and is preparing to distribute the document for public review. Once public comments are incorporated in the document, the EIR will be presented to the WRD Board of Directors for adoption. Thereafter, full scale design and regulatory permitting efforts will commence to be followed by construction. Additional information related to GRIP may be found at www.wrd.org/grip.

GRIP efforts are part of WRD's capital improvement program and are funded primarily through bond proceeds.

035 - West Coast Seawater Barrier Monitoring Well Sampling Project

In a cooperative agreement with West Basin Municipal Water District ("WBMWD"), WRD has been contracted to sample eight West Coast Barrier monitoring wells to help satisfy WBMWD's permit compliance criteria for recycled water injection into the West Coast Barrier. WRD's hydrogeologists sample the eight wells quarterly and submit the samples to WBMWD's laboratory for analysis. Sampling of the eight monitoring wells is required by WBMWD's Regional Water Quality Control Board permit, which enforces the monitoring and testing of the recycled water that is injected into the West Coast Basin Barrier to prevent seawater intrusion. WBMWD is responsible for all the fees and expenses generated by each quarterly sampling, which therefore has no impact on WRD's replenishment assessment.

TABLES

Table 1
GROUNDWATER CONDITIONS AND REPLENISHMENT SUMMARY

	WATER YEAR		
	Oct 1 - Sep 30		
	<i>2012-2013</i>	<i>2013-2014^(a)</i>	<i>2014-2015^(a)</i>
Total Groundwater Production	238,678 AF	240,000 AF	242,000 AF
Annual Overdraft	(153,000) AF	(119,800) AF	(96,800) AF
Accumulated Overdraft	(757,500) AF	(780,700) AF	
Quantity Required for Artificial Replenishment for the Ensuing Year			
<u>Spreading</u>			
Imported for Spreading in Montebello Forebay			16,000 AF
Recycled for Spreading in Montebello Forebay			55,000
			71,000
<u>Injection</u>			
Alamitos Seawater Barrier Imported Water (WRD side only)			400
Alamitos Seawater Barrier Recycled Water (WRD side only)			3,700
Dominguez Gap Seawater Barrier Imported Water			3,500
Dominguez Barrier Seawater Barrer Recycled Water			3,500
West Coast Seawater Barrier Imported Water			0
West Coast Seawater Barrier Recycled Water			17,000
			28,100
<u>In-lieu^(b)</u>			
		Subtotal In-lieu	-
Total			99,100 AF

(a) *Estimated values*

(b) *In-Lieu Program currently not established for ensuing year*

Table 2

QUANTITY AND COST OF REPLENISHMENT WATER FOR THE ENSUING WATER YEAR

	Summary - All Water		Detailed Breakout of Water Costs and Surcharges to WRD						
	Item	Quantity (AF)	Total Cost	Quantity	Oct-Dec	Jan-Jun	Jul-Sep	Melded	Total
Summary - All Water	Spreading - Tier 1 Untreated Imported	16,000	\$ 12,226,100						
	Spreading - Recycled	55,000	\$ 3,285,000						
	Alamitos Barrier - Imported	400	\$ 473,998						
	Alamitos Barrier - Recycled	3,700	\$ 373,700						
	Dominguez Barrier - Imported	3,500	\$ 4,227,118						
	Dominguez Barrier - Recycled	3,500	\$ 3,083,500						
	West Coast Barrier - Imported	0	\$ 338,064						
	West Coast Barrier - Recycled	17,000	\$ 12,550,500						
	In-Lieu MWD Member	0	\$ -						
	In-Lieu WBMWD Customer	0	\$ -						
TOTAL	99,100	\$ 36,557,980							
Imported Water	CBMWD								
	MWD Untreated Tier 1 - Spreading (\$/af)	16,000	\$ 9,360,000	\$ 593	\$ 582	\$ 582	\$ 585	\$ 9,360,000	
	MWD RTS (\$/af)	16,000	\$ 976,000	\$ 60	\$ 60	\$ 62	\$ 61	\$ 976,000	
	CBMWD Administrative Surcharge (\$/af)	16,000	\$ 1,504,000	\$ 93	\$ 93	\$ 96	\$ 94	\$ 1,504,000	
	CBMWD Water Service Charge (\$/cfs/month)	450	\$ 386,100	\$ 71	\$ 71	\$ 73	\$ 72	\$ 386,100	
	Total to CBMWD		\$ 12,226,100					\$ 12,226,100	
	LBWD								
	MWD Treated Tier 1 - Alamitos Barrier (\$/af)	400	\$ 366,400	\$ 890	\$ 925	\$ 925	\$ 916	\$ 366,400	
	MWD Capacity Charge (\$/cfs/month)	6.8	\$ 59,998	\$ 717	\$ 742	\$ 742	\$ 736	\$ 59,998	
	LBWD RTS (\$/af)	400	\$ 45,600	\$ 113	\$ 113	\$ 117	\$ 114	\$ 45,600	
	LBWD Administrative Surcharge (\$/af)	400	\$ 2,000	\$ 5	\$ 5	\$ 5	\$ 5	\$ 2,000	
	Total to LBWD		\$ 473,998					\$ 473,998	
	WBMWD								
	MWD Treated Tier 1-DG/WC Barriers (\$/af)	3,500	\$ 3,206,000	\$ 890	\$ 925	\$ 925	\$ 916	\$ 3,206,000	
	MWD RTS (\$/af)	3,500	\$ 514,500	\$ 143	\$ 148	\$ 148	\$ 147	\$ 514,500	
	MWD Capacity Charge (\$/cfs/month)	46.8	\$ 316,742	\$ 550	\$ 569	\$ 569	\$ 564	\$ 316,742	
	WBMWD Administrative Surcharge (\$/af)	3,500	\$ 451,500	\$ 128	\$ 128	\$ 132	\$ 129	\$ 451,500	
	WBMWD Water Service Charge (\$/cfs/month)	130	\$ 76,440	\$ 48	\$ 48	\$ 50	\$ 49	\$ 76,440	
	Total to West Basin MWD		\$ 4,565,182					\$ 4,565,182	
	IN-LIEU								
	MWD Member Agency (\$/af)	0	No IL Program	-	-	-		No IL Program	
WBMWD Member Agency (\$/af)	0	No IL Program	-	-	-		No IL Program		
Total for In-Lieu Payments		\$ -					\$ -		
Recycled Water	LADWP								
	Recycled Water for Dominguez Barrier (\$/af)	3,500	\$ 3,083,500	\$ 875	\$ 875	\$ 900	\$ 881	\$ 3,083,500	
	Total to LADWP		\$ 3,083,500					\$ 3,083,500	
	SDLAC								
	Tertiary Water - WN, SJC, Pomona (\$/af) ≤50k	50,000	\$ 1,850,000	\$ 36	\$ 36	\$ 40	\$ 37	\$ 1,850,000	
	Tertiary Water - WN, SJC, Pomona (\$/af) >50k	5,000	\$ 1,435,000	\$ 284	\$ 284	\$ 294	\$ 287	\$ 1,435,000	
	Total to SDLAC		\$ 3,285,000					\$ 3,285,000	
	WBMWD								
	WBMWD Recycled Water Rate (\$/af) ≤4,500	4,500	\$ 5,013,000	\$ 1,103	\$ 1,103	\$ 1,145	\$ 1,114	\$ 5,013,000	
	WBMWD Recycled Water Rate (\$/af) 4,500+	12,500	\$ 7,537,500	\$ 598	\$ 598	\$ 619	\$ 603	\$ 7,537,500	
Total to WBMWD		\$ 12,550,500					\$ 12,550,500		
LBWD									
Source Water for Vander Lans Plant (\$/af)	3,700	\$ 373,700	\$ 100	\$ 100	\$ 104	\$ 101	\$ 373,700		
Total to WRD		\$ 373,700					\$ 373,700		
TOTAL	99,100	\$ 36,557,980					\$ 36,557,980		

Table 3
WRD PROJECTS AND PROGRAMS

PROJECT / PROGRAM	DISTRICT FUNCTION	
	Replenishment	Clean Water
001 Leo J. Vander Lans Water Treatment Facility Project	100%	
002 Robert W. Goldsworthy Desalter Project		100%
004 Recycled Water Program	100%	
005 Groundwater Resources Planning Program	100%	
006 Groundwater Quality Program		100%
010 Geographic Information System	50%	50%
011 Regional Groundwater Monitoring Program	50%	50%
012 Safe Drinking Water Program		100%
018 Dominguez Gap Barrier Recycled Water Injection	100%	
023 Replenishment Operations (Spreading & Barriers)	100%	
025 Hydrogeology Program	50%	50%
033 Groundwater Resources Improvement Program (GRIP)	100%	0%
035 West Coast Seawater Barrier Monitoring Well Sampling	50%	50%

Table 4
**30-YEAR AVERAGE GROUNDWATER BALANCE
 FROM USGS AND WRD REGIONAL MODEL**

INFLOWS	Average AFY	OUTFLOWS	Average AFY
Natural Inflows:		Artificial Outflows:	
Local water conserved at spreading grounds ⁽¹⁾	48,825	Pumping	250,590
Interior and mountain front recharge	47,900		
Net underflow from adjacent basins ⁽²⁾	48,480		
Subtotal Natural Inflows:	145,205		
Artificial Inflows:			
Imported and recycled spreading ⁽³⁾	74,075		
Barrier injection water ⁽⁴⁾	34,600		
Subtotal Artificial Inflows:	108,675		
Total Inflows:	253,880	Total Outflows:	250,590

Average Annual Groundwater Deficiency (afy) = Natural Inflows - Total Outflows = (105,385)

⁽¹⁾ includes stormwater and base flow water captured and recharged at the spreading grounds

⁽²⁾ does not include average of 7,100 afy of seawater intrusion, which can not be considered as replenishment per the water code

⁽³⁾ includes all imported purchased, all recycled purchased, and Pomona Plant (free) recycled water.

⁽⁴⁾ includes all injected water at the three barrier systems, including all of Alamitos Barrier. Model value may differ slightly from actual purchases.

Description of the model can be found in USGS, 2003, Geohydrology, Geochemistry, and Ground-Water Simulation - Optimization of the Central and West Coast Basins, Los Angeles County, California; Water Resources Investigation Report 03-4065 by Reichard, E.G., Land, M., Crawford, S.M., Johnson, T., Everett, R.R., Kulshan, T.V., Ponti, D.J., Halford, K.J., Johnson, T.A., Paybins, K.S., and Nishikawa, T.

Table 5
Annual Rainfall in the WRD Service Area

Water Year	Inches	Water Year	Inches	Water Year	Inches	Water Year	Inches
1925-26	12.63	1950-51	8.27	1975-76	9.55	2000-01	14.98
1926-27	16.92	1951-52	24.68	1976-77	11.23	2001-02	2.52
1927-28	11.97	1952-53	10.53	1977-78	33.85	2002-03	19.89
1928-29	11.52	1953-54	12.33	1978-79	18.68	2003-04	7.73
1929-30	10.84	1954-55	11.84	1979-80	28.29	2004-05	23.43
1930-31	10.45	1955-56	13.97	1980-81	8.74	2005-06	11.36
1931-32	14.52	1956-57	9.89	1981-82	13.41	2006-07	1.95
1932-33	10.02	1957-58	24.65	1982-83	30.3	2007-08	17.11
1933-34	11.1	1958-59	6.68	1983-84	11.96	2008-09	9.49
1934-35	21.94	1959-60	9.84	1984-85	12.44	2009-10	13.02
1935-36	9.65	1960-61	4.3	1985-86	19.47	2010-11	17.73
1936-37	22.11	1961-62	18.46	1986-87	6.49	2011-12	8.84
1937-38	21.75	1962-63	10.9	1987-88	11.47	2012-13	6.19
1938-39	18.69	1963-64	6.86	1988-89	7.82		
1939-40	12.81	1964-65	13.27	1989-90	7.87		
1940-41	34.21	1965-66	17.02	1990-91	12.22		
1941-42	14.66	1966-67	17.78	1991-92	16.07		
1942-43	17.91	1967-68	11.46	1992-93	26.55		
1943-44	17.89	1968-69	22.33	1993-94	9.26		
1944-45	11.25	1969-70	7.52	1994-95	26.82		
1945-46	10.31	1970-71	11.45	1995-96	10.68		
1946-47	15.24	1971-72	6.4	1996-97	13.95		
1947-48	8.62	1972-73	18.57	1997-98	32.47		
1948-49	9.04	1973-74	14.51	1998-99	7.29		
1949-50	10.14	1974-75	15.01	1999-00	9.21		
Period of Record				88 years			
Running 88 Year Average				14.15 inches			
Minimum				1.95 inches			
Maximum				34.21 inches			

Table 6
ANNUAL OVERDRAFT CALCULATION
for Current and Ensuing Water Years (in acre-feet)*

Item	WATER YEAR	
	2013-2014	2014-2015
Average Annual Groundwater Deficiency (from Table 4)	(105,385)	(105,385)
Adjustments/Variances to AAGD		
(1) Local Water at Spreading Grounds ^(a)	(20,000) ^(d)	0 ^(d)
(2) Precipitation, mountain front recharge, applied water ^(a)	(5,000) ^(d)	0 ^(d)
(3) Subsurface inflow ^(b)	0 ^(d)	0 ^(d)
(4) Groundwater Extractions ^(c)	(10,600) ^(d)	(8,600) ^(d)
ANNUAL OVERDRAFT [AAGD+(1)+(2)+(3)-(4)]	(119,800)	(96,800)

* Previous Year Annual Overdraft is derived in Chapter III

(a) Difference between actual and model average. Positive value indicates increased recharge.

(b) Difference between annual model value and average model value. Positive value indicates increased inflow.

Does not include seawater intrusion inflow

(c) Difference between actual and model average. Positive value indicates increased pumpage.

(d) Estimated Values. A value of zero indicates average year was assumed.

Table 7

ACCUMULATED OVERDRAFT CALCULATION (in acre-feet)

Accumulated Overdraft at End of Previous Water Year	(757,500)
Estimated Annual Overdraft for Current Year	(119,800)
Subtotal without artificial replenishment	(877,300)
Planned Artificial Replenishment for Current Year	
Imported Water Purchased for Spreading	16,000
Recycled Water Purchased for Spreading	55,000
Imported and Recycled Water Purchased for Barrier Wells	25,600
Replenishment Subtotal	96,600
PROJECTED ACCUMULATED OVERDRAFT FOR CURRENT YEAR	(780,700)

**Table 8
CHANGES IN GROUNDWATER STORAGE**

WATER YEAR	ANNUAL CHANGE IN STORAGE (AF)	CUMULATIVE CHANGE IN STORAGE (AF)	WATER YEAR	ANNUAL CHANGE IN STORAGE (AF)	CUMULATIVE CHANGE IN STORAGE (AF)	WATER YEAR	ANNUAL CHANGE IN STORAGE (AF)	CUMULATIVE CHANGE IN STORAGE (AF)
1961-62	88,500	88,500	1985-86	10,600	238,200	2009-10	27,000	141,500
1962-63	(11,100)	77,400	1986-87	4,000	242,200	2010-11	110,000	251,500
1963-64	10,300	87,700	1987-88	(11,700)	230,500	2011-12	(73,200)	178,300
1964-65	35,200	122,900	1988-89	10,400	240,900	2012-13	(68,000)	110,300
1965-66	21,100	144,000	1989-90	13,600	254,500	2013-14	-	-
1966-67	21,400	165,400	1990-91	28,400	282,900	2014-15	-	-
1967-68	11,400	176,800	1991-92	1,600	284,500	2015-16	-	-
1968-69	(7,500)	169,300	1992-93	45,800	330,300	2016-17	-	-
1969-70	(800)	168,500	1993-94	(28,500)	301,800	2017-18	-	-
1970-71	(3,400)	165,100	1994-95	19,400	321,200	2018-19	-	-
1971-72	(50,600)	114,500	1995-96	12,500	333,700	2019-20	-	-
1972-73	34,800	149,300	1996-97	15,700	349,400	2020-21	-	-
1973-74	(2,400)	146,900	1997-98	16,700	366,100	2021-22	-	-
1974-75	(14,100)	132,800	1998-99	(80,200)	285,900	2022-23	-	-
1975-76	(40,200)	92,600	1999-00	(30,000)	255,900	2023-24	-	-
1976-77	(32,900)	59,700	2000-01	(400)	255,500	2024-25	-	-
1977-78	88,600	148,300	2001-02	(36,500)	219,000	2025-26	-	-
1978-79	30,100	178,400	2002-03	(10,500)	208,500	2026-27	-	-
1979-80	(1,100)	177,300	2003-04	(43,000)	165,500	2027-28	-	-
1980-81	17,100	194,400	2004-05	89,100	254,600	2028-29	-	-
1981-82	18,400	212,800	2005-06	12,000	266,600	2029-30	-	-
1982-83	46,800	259,600	2006-07	(59,000)	207,600	2030-31	-	-
1983-84	(22,400)	237,200	2007-08	(41,600)	166,000	2031-32	-	-
1984-85	(9,600)	227,600	2008-09	(51,500)	114,500	2032-33	-	-

Note: Numbers in parentheses represent negative values.

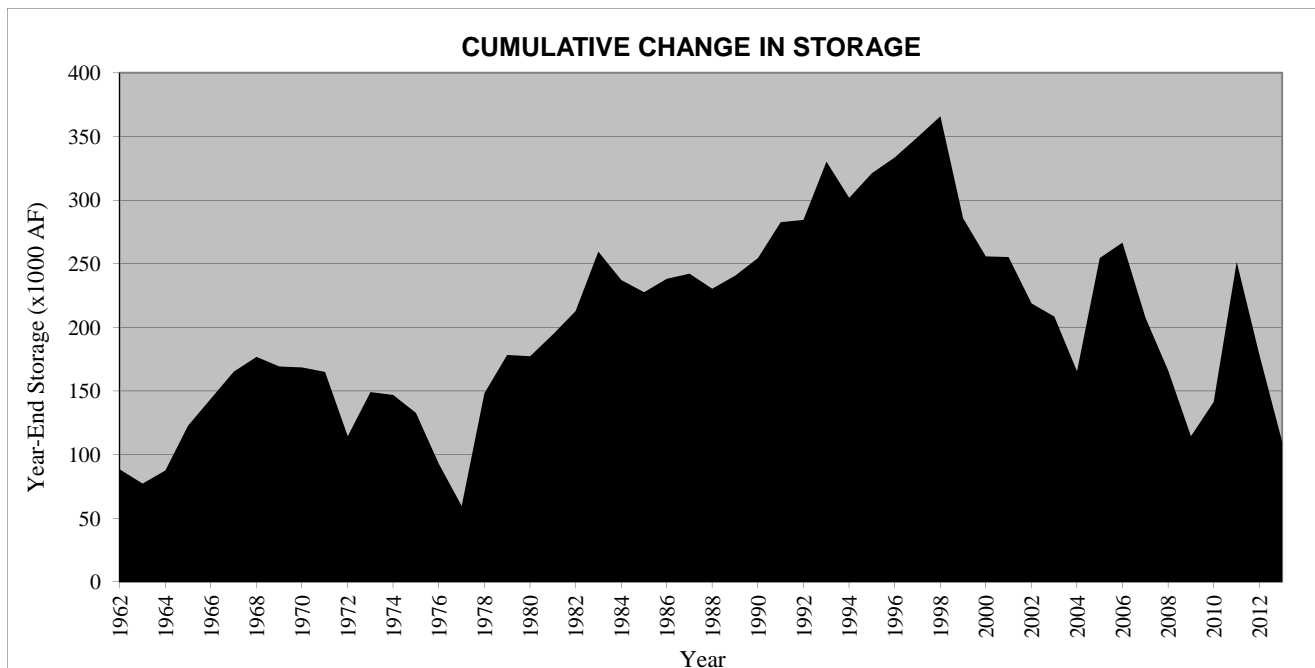


Table 9
QUANTITY OF WATER REQUIRED FOR ARTIFICIAL REPLENISHMENT

WATER TYPE	AMOUNT (AF)
Long Term Average for Imported Spreading (updated, see below)*	16,000
Recycled Water for Spreading (WRD Purchases)	55,000
Total Spreading	71,000
West Coast Barrier - Imported	0
West Coast Barrier - Recycled	17,000
Dominguez Gap - Imported	3,500
Dominguez Gap - Recycled	3,500
Alamitos Barrier - Imported - WRD portion only	400
Alamitos Barrier - Recycled - WRD portion only	3,700
Total Barriers	28,100
In-Lieu Central Basin	0
In-Lieu West Coast Basin	0
Total In-Lieu	0
Total Water Purchase Estimate for Ensuing Year	99,100
Less Other Actions	0
Total Water Purchase Estimate for Ensuing Year	99,100

* - Derivation of new Long Term Imported Spreading Requirement is possible due to new projects that will capture more storm/recycled water for conservation, and thus less imported needs:

1. Long Term Average of 27,600 af defined in 2003 ESR
2. Minus 3,000 afy for increasing Whittier Narrows Conservation Pool
3. Minus 3,600 afy for two new rubber dams on San Gabriel River
4. Minus 5,000 afy of imported due to 5,000 afy increase in recycled based on new averaging period effective 2013
5. Equals new Long Term Average of 16,000 afy imported spreading

**HISTORICAL AMOUNTS OF WATER RECHARGED IN
THE MONTEBELLO FOREBAY SPREADING GROUNDS^{(a) (g)}**

(in acre-feet)

WATER YEAR	Imported Water			Recycled Water				Local Water	Make-up Water			TOTAL
	LACFCD or Other	WRD	TOTAL	Whittier WRP	San Jose Creek WRP	Pomona WRP	TOTAL	Stormwater and River Baseflow	USGVMWD & SGVMWD	CBMWD	TOTAL	
1959-60	80,900		80,900				-	20,064			-	100,964
1960-61	80,800	67,000	147,800				-	9,118			-	156,918
1961-62	39,500	168,622	208,122	1,178			1,178	39,548			-	248,848
1962-63	4,800	75,790	80,590	12,405			12,405	14,565			-	107,560
1963-64	-	104,900	104,900	13,258			13,258	9,992			-	128,150
1964-65	75,500	84,670	160,170	14,528			14,528	13,097			-	187,795
1965-66	67,800	53,900	121,700	15,056			15,056	45,754	6,500		6,500	189,010
1966-67	74,100	10,200	84,300	16,223			16,223	59,820	-		-	160,343
1967-68	66,600	28,800	95,400	18,275			18,275	39,760	-		-	153,435
1968-69	12,500	5,300	17,800	13,877			13,877	119,395	-		-	151,072
1969-70	25,800	43,100	68,900	17,158			17,158	52,917	-		-	138,975
1970-71	46,700	25,400	72,100	19,494		3,232	22,726	44,757	-		-	139,583
1971-72	-	34,400	34,400	17,543		4,456	21,999	17,688	-		-	74,087
1972-73	-	71,947	71,947	13,622	8,327	5,937	27,886	45,077	-	20,000	20,000	164,910
1973-74	-	68,237	68,237	13,385	7,064	3,003	23,452	29,171	-	23,921	23,921	144,781
1974-75	-	71,900	71,900	14,650	6,549	5,592	26,791	29,665	-	-	-	128,356
1975-76	-	50,800	50,800	12,394	9,062	6,231	27,687	22,073	-	-	-	100,560
1976-77	-	9,300	9,300	10,158	12,705	6,496	29,359	19,252	14,500	6,900	21,400	79,311
1977-78	-	39,900	39,900	13,104	5,997	6,621	25,722	147,317	7,800	-	7,800	220,739
1978-79	-	65,300	65,300	10,716	11,741	6,403	28,860	68,859	-	-	-	163,019
1979-80	-	10,200	10,200	14,568	9,815	5,023	29,406	106,820	10,900	-	10,900	157,326
1980-81	3,300	28,700	32,000	11,464	14,645	5,613	31,722	50,590	31,500	-	31,500	145,812
1981-82	-	4,600	4,600	14,133	15,285	4,634	34,052	47,930	30,900	-	30,900	117,482
1982-83	-	2,000	2,000	12,818	4,217	5,735	22,770	126,076	8,900	-	8,900	159,746
1983-84	-	1,500	1,500	13,194	14,590	4,457	32,241	60,710	20,800	-	20,800	115,251
1984-85	-	40,600	40,600	12,905	14,093	4,380	31,378	39,099	-	-	-	111,077
1985-86	-	21,500	21,500	13,827	11,487	3,965	29,279	66,966	-	-	-	117,745
1986-87	-	49,200	49,200	15,280	20,041	2,655	37,976	27,613	-	6,500	6,500	121,289
1987-88	-	23,300	23,300	14,585	27,182	1,582	43,349	50,068	5,800	-	5,800	122,517
1988-89	-	50,300	50,300	13,830	33,327	2,616	49,773	17,096	6,500	-	6,500	123,669
1989-90	-	52,700	52,700	15,043	33,498	1,568	50,109	9,388	13,600	-	13,600	125,797
1990-91	-	56,300	56,300	13,841	38,603	1,420	53,864	35,717	100	-	100	145,981
1991-92	-	43,100	43,100	12,620	31,326	2,957	46,903	136,357	-	-	-	226,360
1992-93	-	16,561	16,561	11,026	29,811	8,027	48,864	147,699	-	-	-	213,124
1993-94	-	20,411	20,411	10,249	40,768	2,965	53,981	55,896	-	-	-	130,288
1994-95	-	21,837	21,837	10,642	18,431	4,228	33,300	100,578	-	-	-	155,715
1995-96	-	18,012	18,012	9,971	40,922	2,969	53,862	62,920	-	-	-	134,794
1996-97	-	22,738	22,738	9,850	36,977	3,132	49,959	58,262	-	-	-	130,959
1997-98	-	952	952	8,378	26,483	2,156	37,017	96,706	-	-	-	134,675
1998-99	-	-	-	10,968	34,782	1,451	47,201	32,013	-	-	-	79,214
1999-00	-	45,037	45,037	8,950	30,481	3,839	43,270	20,607	-	-	-	108,914
2000-01	-	23,451	23,451	8,253	35,165	2,925	46,343	39,725	-	-	-	109,519
2001-02	-	42,875	42,875 ^(c)	8,474	50,194	1,928	60,596	17,000	-	-	-	120,471
2002-03	-	22,366	22,366 ^(d)	5,156	35,320	2,320	42,796	58,202	-	-	-	123,364
2003-04	-	27,520	27,520 ^(e)	8,195	34,033	2,697	44,925	30,467	-	-	-	102,912
2004-05	-	25,296	25,296 ^(e)	6,741	20,547	2,215	29,503	148,674	-	-	-	203,473
2005-06	-	33,229	33,229	8,868	30,180	2,973	42,022	60,377	-	-	-	135,628
2006-07	-	40,214	40,214	7,334	34,823	2,882	45,039	11,495	-	-	-	96,748
2007-08	1,510	-	1,510 ^(b)	6,212	29,131	4,424	39,767	54,518	-	-	-	95,795
2008-09	-	-	-	5,202	29,999	4,410	39,611	35,348	-	-	-	74,959
2009-10	-	26,286	26,286	5,431	45,538	4,762	55,731	35,398	-	-	-	117,415
2010-11	-	37,315	37,315	7,576	24,323	5,231	37,131	113,295	-	-	-	187,741
2011-12	-	-	-	7,558	43,479	4,760	55,797	35,806	-	-	-	91,603
2012-13	2	-	2	7,004	47,107	4,933	59,044	5,696	-	-	-	64,742
TOTAL	579,812	1,887,565	2,467,377	597,170	1,048,048	169,799	1,815,017	2,843,002	157,800	57,321	215,121	7,340,517

(a) Imported and Recycled are purchased, local and Pomona WRP are incidental recharge. Purchased water may have losses to Main Basin before reaching the Spreading Grounds

(b) CBMWD purchased 1,510 af of imported water for spreading for Downey, Lakewood, and Cerritos.

(c) Includes 1,607 af of EPA extracted groundwater from Whittier Narrows considered imported water to WRD. Paid for in 2003.

(d) Includes 5,069 af of EPA extracted groundwater from W.N. considered imported water to WRD. Paid for in June 2005.

(e) Includes 13,000 af of water banked by Long Beach under a storage agreement with WRD (792 af 02/03, 12,210 af 3/04).

(g) Includes the Rio Hondo Spreading Grounds, Whittier Narrows Conservation Pool, San Gabriel Spreading Grounds and unlined San Gabriel River.

HISTORICAL AMOUNTS OF WATER PURCHASED FOR INJECTION

(in acre-feet)

Water Year	West Coast Barrier (a)			Dominguez Gap Barrier (b)			Alamitos Barrier						TOTAL	
							WRD			OCWD				Total
	Imported	Recycled	Total	Imported	Recycled	Total	Imported	Recycled	Total	Imported	Recycled	Total		
1959-60	3,700		3,700											3,700
1960-61	4,420		4,420											4,420
1961-62	4,460		4,460											4,460
1962-63	4,150		4,150											4,150
1963-64	10,450		10,450											10,450
1964-65	33,020		33,020				2,760		2,760	200		200	2,960	35,980
1965-66	44,390		44,390				3,370		3,370	350		350	3,720	48,110
1966-67	43,060		43,060				3,390		3,390	490		490	3,880	46,940
1967-68	39,580		39,580				4,210		4,210	740		740	4,950	44,530
1968-69	36,420		36,420				4,310		4,310	950		950	5,260	41,680
1969-70	29,460		29,460				3,760		3,760	720		720	4,480	33,940
1970-71	29,870		29,870	2,200		2,200	3,310		3,310	822		822	4,132	36,202
1971-72	26,490		26,490	9,550		9,550	4,060		4,060	936		936	4,996	41,036
1972-73	28,150		28,150	8,470		8,470	4,300		4,300	883		883	5,183	41,803
1973-74	27,540		27,540	7,830		7,830	6,140		6,140	1,148		1,148	7,288	42,658
1974-75	26,430		26,430	5,160		5,160	4,440		4,440	716		716	5,156	36,746
1975-76	35,220		35,220	4,940		4,940	4,090		4,090	565		565	4,655	44,815
1976-77	34,260		34,260	9,280		9,280	4,890		4,890	885		885	5,775	49,315
1977-78	29,640		29,640	5,740		5,740	4,020		4,020	831		831	4,851	40,231
1978-79	23,720		23,720	5,660		5,660	4,220		4,220	898		898	5,118	34,498
1979-80	28,630		28,630	4,470		4,470	3,560		3,560	575		575	4,135	37,235
1980-81	26,350		26,350	3,550		3,550	3,940		3,940	524		524	4,464	34,364
1981-82	24,640		24,640	4,720		4,720	4,540		4,540	394		394	4,934	34,294
1982-83	33,950		33,950	6,020		6,020	3,270		3,270	1,943		1,943	5,213	45,183
1983-84	28,000		28,000	7,640		7,640	2,440		2,440	1,402		1,402	3,842	39,482
1984-85	25,210		25,210	7,470		7,470	3,400		3,400	1,446		1,446	4,846	37,526
1985-86	20,260		20,260	6,160		6,160	3,410		3,410	1,863		1,863	5,273	31,693
1986-87	26,030		26,030	6,230		6,230	4,170		4,170	2,754		2,754	6,924	39,184
1987-88	24,270		24,270	7,050		7,050	3,990		3,990	2,173		2,173	6,163	37,483
1988-89	22,740		22,740	5,220		5,220	3,900		3,900	2,173		2,173	6,073	34,033
1989-90	20,279		20,279	5,736		5,736	4,110		4,110	1,929		1,929	6,039	32,054
1990-91	16,039		16,039	7,756		7,756	4,096		4,096	1,799		1,799	5,895	29,690
1991-92	22,180		22,180	6,894		6,894	4,172		4,172	1,552		1,552	5,724	34,798
1992-93	21,516		21,516	4,910		4,910	3,350		3,350	1,565		1,565	4,915	31,341
1993-94	15,482		15,482	5,524		5,524	2,794		2,794	1,309		1,309	4,103	25,109
1994-95	14,237	1,480	15,717	4,989		4,989	2,883		2,883	890		890	3,773	24,479
1995-96	12,426	4,170	16,596	5,107		5,107	3,760		3,760	2,010		2,010	5,770	27,473
1996-97	11,372	6,241	17,613	5,886		5,886	3,854		3,854	1,750		1,750	5,604	29,103
1997-98	8,173	8,306	16,479	3,771		3,771	3,677		3,677	1,504		1,504	5,181	25,431
1998-99	10,125	6,973	17,097	4,483		4,483	4,012		4,012	1,689		1,689	5,700	27,280
1999-00	11,172	7,460	18,632	6,010		6,010	4,028		4,028	1,707		1,707	5,735	30,377
2000-01	13,988	6,838	20,826	3,923		3,923	3,710		3,710	1,964		1,964	5,674	30,423
2001-02	12,724	7,276	20,000	5,459		5,459	3,961		3,961	2,232		2,232	6,193	31,652
2002-03	10,419	6,192	16,611	8,056		8,056	3,445		3,445	1,197		1,197	4,642	29,309
2003-04	9,304	3,669	12,973	6,089		6,089	3,876		3,876	2,092		2,092	5,968	25,030
2004-05	4,548	3,920	8,468	8,557		8,557	2,870		2,870	1,685		1,685	4,555	21,580
2005-06	5,997	4,249	10,246	7,259	1,450	8,709	1,042	921	1,963	330	254	584	2,547	21,502
2006-07	4,373	10,960	15,333	5,510	1,733	7,243	1,568	219	1,787	543	165	708	2,495	25,071
2007-08	3,662	10,954	14,616	4,468	2,452	6,920	3,467	1,284	4,751	1,283	475	1,758	6,509	28,045
2008-09	7,178	6,434	13,612	4,550	2,414	6,964	4,145	1,275	5,420	1,518	535	2,053	7,473	28,049
2009-10	9,661	7,620	17,281	5,495	2,037	7,532	2,596	1,775	4,371	659	470	1,129	5,500	30,313
2010-11	7,466	7,440	14,906	3,929	2,363	6,292	1,968	1,482	3,450	638	875	1,513	4,963	26,161
2011-12	3,651	6,682	10,333	4,646	103	4,749	1,785	1,527	3,312	814	678	1,492	4,804	19,886
2012-13	9,095	7,761	16,856	2,973	2,170	5,143	2,639	1,309	3,948	1,145	537	1,683	5,631	27,630
TOTAL	1,039,577	124,624	1,164,201	249,340	14,722	264,062	175,698	9,792	185,490	60,185	3,989	64,175	249,664	1,677,927

(a) Prior to 10/1/71, water was purchased by the State, West Basin Water Association, local water interests, Zone II of the LA County Flood Control District and WRD. After 10/1/71, all purchases have been by WRD
 (b) In 1970-71, purchases were shared by WRD and Zone II. After 10/1/71, all purchases have been by WRD

HISTORICAL AMOUNTS OF THE IN-LIEU PROGRAM

(in acre-feet)

WATER YEAR	CENTRAL BASIN	WEST COAST BASIN	TOTAL
1965-66	-	745	745
1966-67	-	851	851
1967-68	-	850	850
1968-69	-	850	850
1969-70	-	900	900
1970-71	-	881	881
1971-72	-	756	756
1972-73	-	901	901
1973-74	-	901	901
1974-75	-	400	400
1975-76	-	400	400
1976-77	-	400	400
1977-78	11,316	4,815	16,131
1978-79	9,723	8,655	18,378
1979-80	10,628	4,333	14,961
FISCAL YEAR			
1980-81	17,617	6,206	23,823
1981-82	14,050	4,833	18,883
1982-83	13,813	5,939	19,752
1983-84	29,216	12,524	41,740
1984-85	23,246	13,594	36,840
1985-86	15,505	10,627	26,132
1986-87	16,205	12,997	29,202
1987-88	15,518	12,893	28,411
1988-89	11,356	14,069	25,425
1989-90	16,858	12,293	29,151
1990-91	11,886	10,153	22,039
1991-92	13,000	6,104	19,104
1992-93	37,652	15,654	53,306
1993-94	83,488	26,093	109,581
1994-95	32,904	17,994	50,898
1995-96	37,517	13,816	51,333
1996-97	34,547	4,847	39,394
1997-98	22,995	7,335	30,330
1998-99	13,213	10,303	23,516
1999-00	18,799	3,479	22,278
2000-01	18,364	2,817	21,181
2001-02	11,931	8,789	20,720
2002-03	6,866	4,339	11,205
2003-04	-	-	-
2004-05	6,000	1,804	7,804
2005-06	7,475	2,414	9,889
2006-07	5,779	3,485	9,264
2007-08	-	-	-
2008-09	-	-	-
2009-10	-	-	-
2010-11	6,724	-	6,724
2011-12	7,815	-	7,815
2012-13	2,180	-	2,180
TOTAL	584,187	272,040	856,227

HISTORICAL AMOUNTS OF REPLENISHMENT WATER

(in acre-feet)

WATER YEAR	MONTEBELLO FOREBAY SPREADING WATER					INJECTION WATER*			IN-LIEU	TOTAL
	IMPORTED WATER	RECYCLED WATER	LOCAL WATER	MAKEUP WATER	TOTAL	IMPORTED WATER	RECYCLED WATER	TOTAL	TOTAL	
1959-60	80,900	-	20,064	-	100,964	3,700	-	3,700		104,664
1960-61	147,800	-	9,118	-	156,918	4,420	-	4,420		161,338
1961-62	208,122	1,178	39,548	-	248,848	4,460	-	4,460		253,308
1962-63	80,590	12,405	14,565	-	107,560	4,150	-	4,150		111,710
1963-64	104,900	13,258	9,992	-	128,150	10,450	-	10,450		138,600
1964-65	160,170	14,528	13,097	-	187,795	35,980	-	35,980		223,775
1965-66	121,700	15,056	45,754	6,500	189,010	48,110	-	48,110	745	237,865
1966-67	84,300	16,223	59,820	-	160,343	46,940	-	46,940	851	208,134
1967-68	95,400	18,275	39,760	-	153,435	44,530	-	44,530	850	198,815
1968-69	17,800	13,877	119,395	-	151,072	41,680	-	41,680	850	193,602
1969-70	68,900	17,158	52,917	-	138,975	33,940	-	33,940	900	173,815
1970-71	72,100	22,726	44,757	-	139,583	36,202	-	36,202	881	176,666
1971-72	34,400	21,999	17,688	-	74,087	41,036	-	41,036	756	115,879
1972-73	71,947	27,886	45,077	20,000	164,910	41,803	-	41,803	901	207,614
1973-74	68,237	23,452	29,171	23,921	144,781	42,658	-	42,658	901	188,340
1974-75	71,900	26,791	29,665	-	128,356	36,746	-	36,746	400	165,502
1975-76	50,800	27,687	22,073	-	100,560	44,815	-	44,815	400	145,775
1976-77	9,300	29,359	19,252	21,400	79,311	49,315	-	49,315	400	129,026
1977-78	39,900	25,722	147,317	7,800	220,739	40,231	-	40,231	16,131	277,101
1978-79	65,300	28,860	68,859	-	163,019	34,498	-	34,498	18,378	215,895
1979-80	10,200	29,406	106,820	10,900	157,326	37,235	-	37,235	14,961	209,522
1980-81	32,000	31,722	50,590	31,500	145,812	34,364	-	34,364	23,823	203,999
1981-82	4,600	34,052	47,930	30,900	117,482	34,294	-	34,294	18,883	170,659
1982-83	2,000	22,770	126,076	8,900	159,746	45,183	-	45,183	19,752	224,681
1983-84	1,500	32,241	60,710	20,800	115,251	39,482	-	39,482	41,740	196,473
1984-85	40,600	31,378	39,099	-	111,077	37,526	-	37,526	36,840	185,443
1985-86	21,500	29,279	66,966	-	117,745	31,693	-	31,693	26,132	175,570
1986-87	49,200	37,976	27,613	6,500	121,289	39,184	-	39,184	29,202	189,675
1987-88	23,300	43,349	50,068	5,800	122,517	37,483	-	37,483	28,411	188,411
1988-89	50,300	49,773	17,096	6,500	123,669	34,033	-	34,033	25,425	183,127
1989-90	52,700	50,109	9,388	13,600	125,797	32,054	-	32,054	29,151	187,002
1990-91	56,300	53,864	35,717	100	145,981	29,690	-	29,690	22,039	197,710
1991-92	43,100	46,903	136,357	-	226,360	34,798	-	34,798	19,104	280,262
1992-93	16,561	48,864	147,699	-	213,124	31,341	-	31,341	53,306	297,771
1993-94	20,411	53,981	55,896	-	130,288	25,109	-	25,109	109,581	264,978
1994-95	21,837	33,300	100,578	-	155,715	22,999	1,480	24,479	50,898	231,092
1995-96	18,012	53,862	62,920	-	134,794	23,304	4,170	27,473	51,333	213,600
1996-97	22,738	49,959	58,262	-	130,959	22,862	6,241	29,103	39,394	199,456
1997-98	952	37,017	96,706	-	134,675	17,125	8,306	25,431	30,330	190,436
1998-99	-	47,201	32,013	-	79,214	20,308	6,973	27,280	23,516	130,010
1999-00	45,037	43,270	20,607	-	108,914	22,917	7,460	30,377	22,278	161,569
2000-01	23,451	46,343	39,725	-	109,519	23,585	6,838	30,423	21,181	161,123
2001-02	42,875	60,596	17,000	-	120,471	24,376	7,276	31,652	20,720	172,843
2002-03	22,366	42,796	58,202	-	123,364	23,117	6,192	29,309	11,205	163,878
2003-04	27,520	44,925	30,467	-	102,912	21,361	3,669	25,030	-	127,942
2004-05	25,296	29,503	148,674	-	203,473	17,660	3,920	21,580	7,804	232,857
2005-06	33,229	42,022	60,377	-	135,628	14,628	6,874	21,502	9,889	167,019
2006-07	40,214	45,039	11,495	-	96,748	11,994	13,077	25,071	9,264	131,083
2007-08	1,510	39,767	54,518	-	95,795	12,880	15,165	28,045	-	123,840
2008-09	-	39,611	35,348	-	74,959	17,391	10,658	28,049	-	103,008
2009-10	26,286	55,731	35,398	-	117,415	18,411	11,902	30,313	-	147,728
2010-11	37,315	37,131	113,295	-	187,741	14,001	12,160	26,161	6,724	220,626
2011-12	-	55,797	35,806	-	91,603	10,896	8,990	19,886	7,815	119,304
2012-13	2	59,044	5,696	-	64,742	15,852	11,777	27,630	2,180	94,552
TOTAL	2,467,377	1,815,017	2,843,002	215,121	7,340,517	1,524,799	153,127	1,677,927	856,227	9,874,671

* - Including Orange County side of Alamitos Barrier

HISTORICAL AMOUNTS OF GROUNDWATER PRODUCTION*

(in acre-feet)

WATER YEAR	CENTRAL BASIN	WEST COAST	TOTAL
1959-60	245,400	66,600	312,000
1960-61	292,500	61,900	354,400
1961-62	275,800	59,100	334,900
1962-63	225,400	59,100	284,500
1963-64	219,100	61,300	280,400
1964-65	211,600	59,800	271,400
1965-66	222,800	60,800	283,600
1966-67	206,700	62,300	269,000
1967-68	220,100	61,600	281,700
1968-69	213,800	61,600	275,400
1969-70	222,200	62,600	284,800
1970-71	211,600	60,900	272,500
1971-72	216,100	64,800	280,900
1972-73	205,600	60,300	265,900
1973-74	211,300	55,000	266,300
1974-75	213,100	56,700	269,800
1975-76	215,300	59,400	274,700
1976-77	211,500	59,800	271,300
1977-78	196,600	58,300	254,900
1978-79	207,000	58,000	265,000
1979-80	209,500	57,100	266,600
1980-81	211,915	57,711	269,626
1981-82	202,587	61,874	264,461
1982-83	194,548	57,542	252,090
1983-84	196,660	51,930	248,590
1984-85	193,085	52,746	245,831
1985-86	195,972	53,362	249,334
1986-87	196,660	48,026	244,686
1987-88	194,704	43,837	238,541
1988-89	200,207	44,323	244,530
1989-90	197,621	48,047	245,668
1990-91	187,040	53,660	240,700
1991-92	196,400	56,318	252,718
1992-93	150,495	40,241	190,736
1993-94	156,565	41,826	198,392
1994-95	180,269	41,729	221,998
1995-96	182,413	52,222	234,636
1996-97	187,561	52,576	240,137
1997-98	188,305	51,859	240,164
1998-99	204,441	51,926	256,367
1999-00	198,483	53,599	252,082
2000-01	195,361	53,870	249,231
2001-02	200,168	50,063	250,231
2002-03	190,268	51,946	242,214
2003-04	200,365	48,013	248,378
2004-05	188,783	41,297	230,079
2005-06	191,123	36,808	227,931
2006-07	198,249	37,659	235,908
2007-08	206,297	38,472	244,768
2008-09	197,663	45,538	243,201
2009-10	197,390	44,013	241,403
2010-11	170,630	44,480	215,109
2011-12	195,820	45,597	241,417
2012-13	196,414	42,263	238,678
TOTAL	10,997,461	2,862,373	13,859,834

* Numbers sometimes updated when pumping adjustments are required

**HISTORICAL AMOUNTS OF WATER USE
IN THE WRD SERVICE AREA***

(in acre-feet)

WATER YEAR	GROUNDWATER PRODUCTION	IMPORTED WATER FOR DIRECT USE*	RECLAIMED WATER FOR DIRECT USE*	TOTAL
1960-61	312,000	196,800		508,800
1961-62	334,900	178,784		513,684
1962-63	284,500	222,131		506,631
1963-64	280,400	257,725		538,125
1964-65	271,400	313,766		585,166
1965-66	283,600	308,043		591,643
1966-67	269,000	352,787		621,787
1967-68	281,700	374,526		656,226
1968-69	275,400	365,528		640,928
1969-70	284,800	398,149		682,949
1970-71	272,500	397,122		669,622
1971-72	280,900	428,713		709,613
1972-73	265,900	400,785		666,685
1973-74	266,300	410,546		676,846
1974-75	269,800	380,228		650,028
1975-76	274,700	404,958		679,658
1976-77	271,300	355,896		627,196
1977-78	254,900	373,116		628,016
1978-79	265,000	380,101	100 ^(a)	645,201
1979-80	266,600	397,213	200	664,013
1980-81	269,626	294,730	300	564,656
1981-82	264,461	391,734	300	656,495
1982-83	252,090	408,543	400	661,033
1983-84	248,590	441,151	1,800	691,541
1984-85	245,831	451,549	2,000	699,380
1985-86	249,334	427,860	2,400	679,594
1986-87	244,686	478,744	2,300	725,730
1987-88	238,541	479,318	3,500	721,359
1988-89	244,530	466,166	5,300	715,996
1989-90	245,668	448,285	5,900	699,853
1990-91	240,700	485,109	5,000	730,809
1991-92	252,718	395,191	4,900	652,809
1992-93	190,736	388,949	824	580,509
1993-94	198,392	483,287	3,413	685,092
1994-95	221,998	437,191	6,143	665,332
1995-96	234,636	426,699	19,804	681,139
1996-97	240,137	436,569	25,046	701,752
1997-98	240,164	375,738	27,075	642,976
1998-99	256,367	396,655	30,510	683,532
1999-00	252,082	395,681	33,589	681,352
2000-01	249,231	395,024	32,589	676,845
2001-02	250,231	395,799	38,694	684,723
2002-03	242,214	381,148	38,839	662,202
2003-04	248,378	389,233	36,626	674,237
2004-05	230,079	402,660	33,988	666,727
2005-06	227,931	366,815	35,301	630,047
2006-07	235,908	376,492	41,899	654,299
2007-08	244,768	346,035	45,120	635,923
2008-09	243,201	320,711	43,153	607,065
2009-10	241,403	278,857	43,547	563,808
2010-11	215,109	286,448	39,418	540,975
2011-12	241,417	282,746	42,138	566,301
2012-13	238,678	280,561	45,377	564,616
TOTAL	13,505,434	19,908,595	697,494	34,111,523

(a) Los Coyotes on-line in 1979; Long Beach on-line in 1980

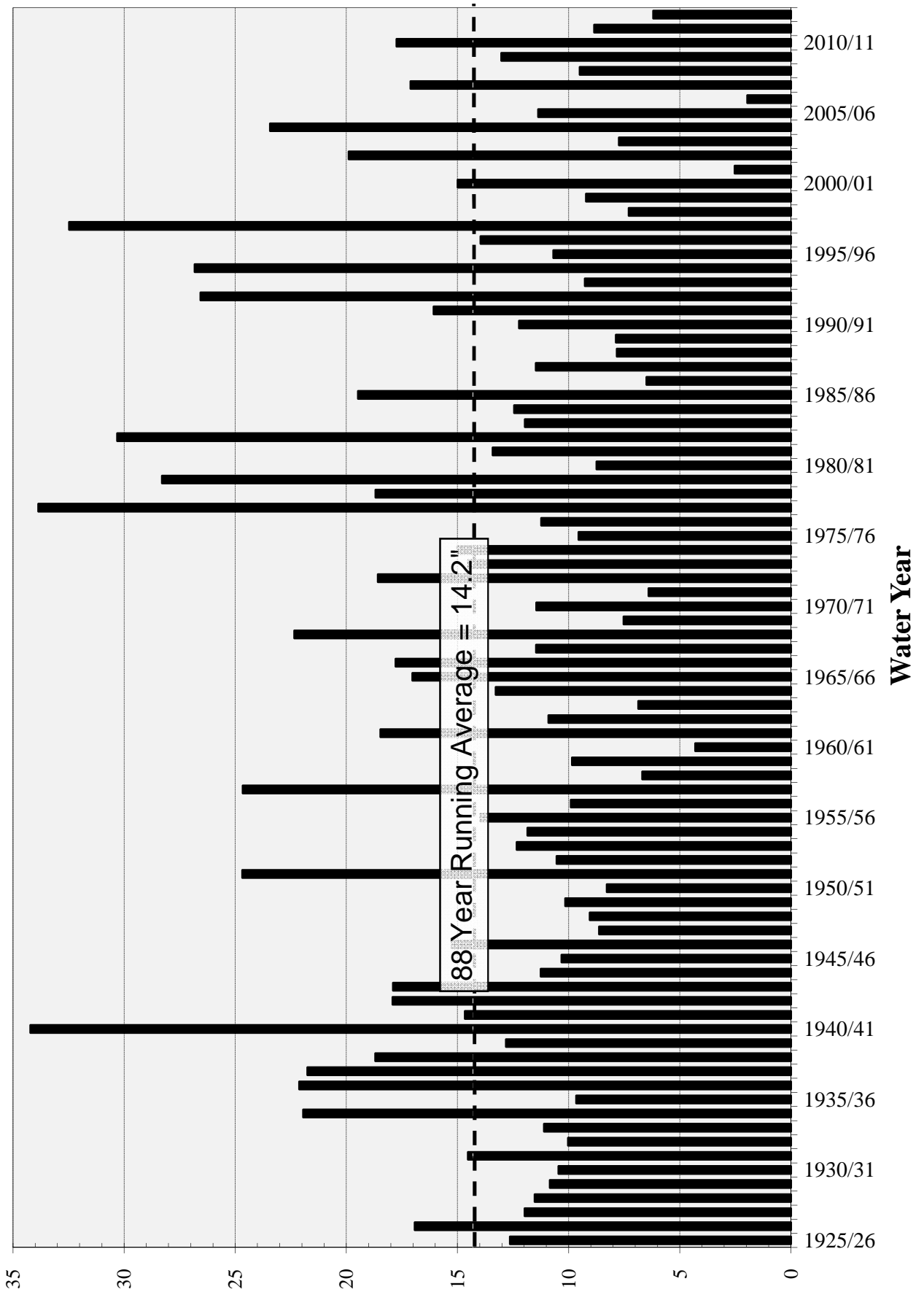
* - Includes imported & recycled at seawater barriers, but not spreading grounds.

WRD GROUNDWATER BANKING PROGRAMS
(in acre-feet)

WATER YEAR	CITY OF LONG BEACH MWD Program			LONG BEACH/ALAMITOS BARRIER Seasonal Water			LONG BEACH/ALAMITOS BARRIER Tier 1 Water			TOTAL		
	Banked	Called	Balance	Banked	Called	Balance	Banked	Called	Balance	Banked	Called	Balance
2002-03	4,864	-	4,864	-	-	-	-	-	-	4,864	-	4,864
2003-04	8,136	-	13,000	-	-	-	-	-	-	8,136	-	13,000
2004-05	-	-	13,000	3,652	-	3,652	-	-	-	3,652	-	16,652
2005-06	-	-	13,000	1,324	56	4,919	-	-	-	1,324	56	17,919
2006-07	-	-	13,000	300	1,561	3,658	-	-	-	300	1,561	16,658
2007-08	-	2,416	10,584	-	1,498	2,160	-	-	-	-	3,914	12,744
2008-09	-	4,182	6,402	-	-	2,160	2,000	-	2,000	2,000	4,182	10,562
2009-10	-	-	6,402	-	-	2,160	-	2,000	-	-	2,000	8,562
2010-11	-	-	6,402	-	-	2,160	-	-	-	-	-	8,562
2011-12	-	-	6,402	-	-	2,160	-	-	-	-	-	8,562
2012-13	-	-	6,402	-	-	2,160	-	-	-	-	-	8,562
TOTAL	13,000	6,598		5,275	3,115		2,000	2,000		20,275	11,713	

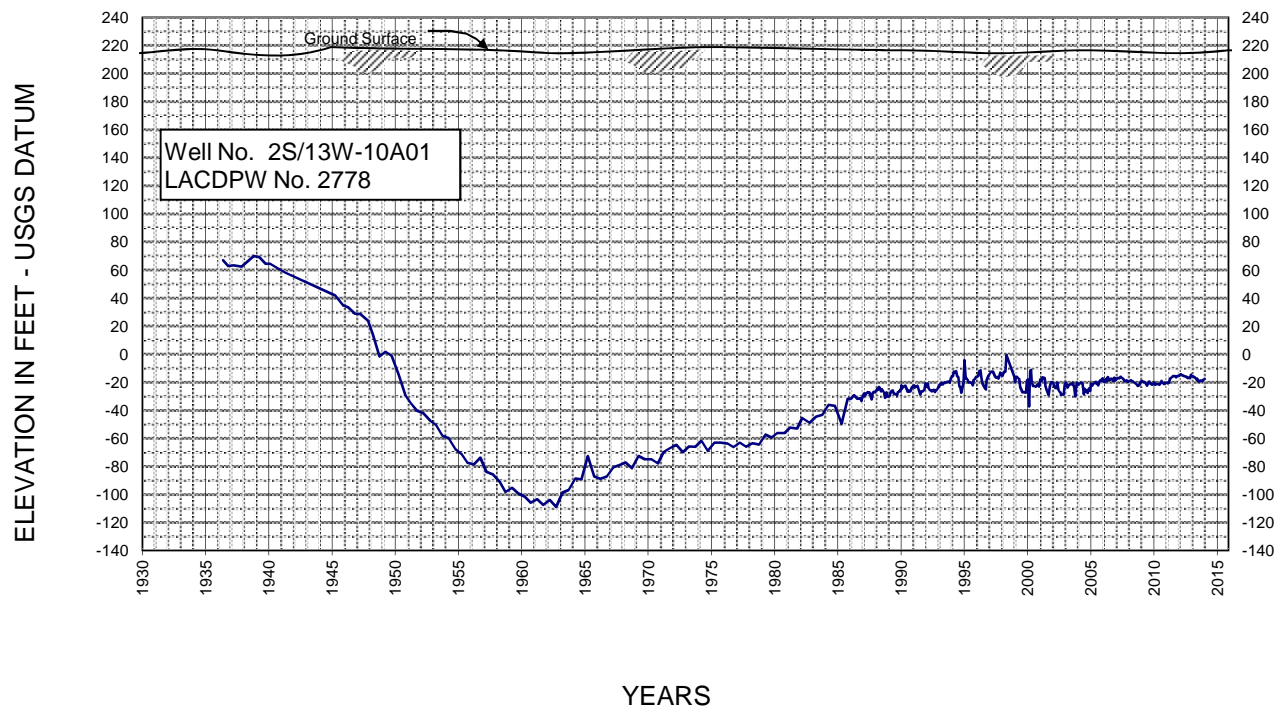
FIGURES

Annual Rainfall in WRD Service Area



Rainfall (inches)

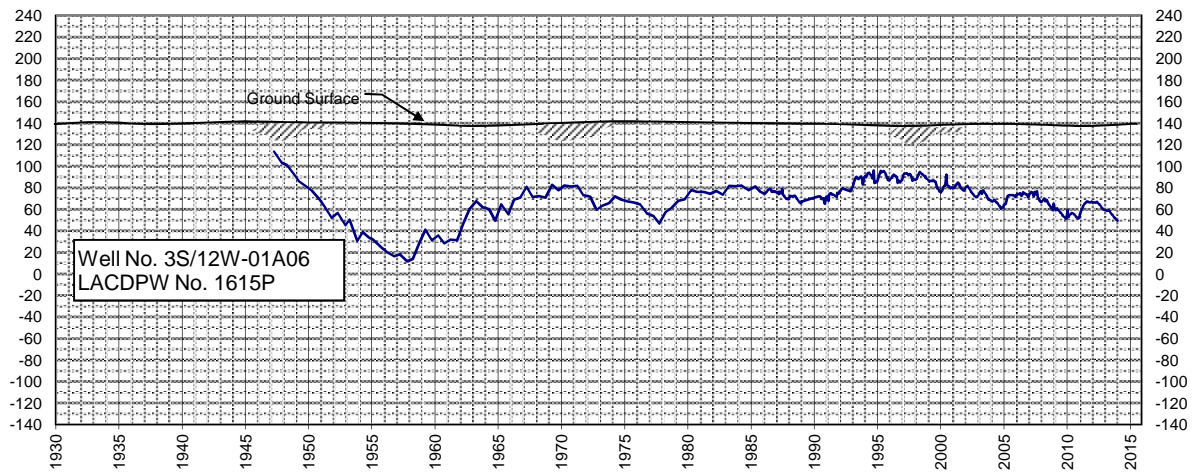
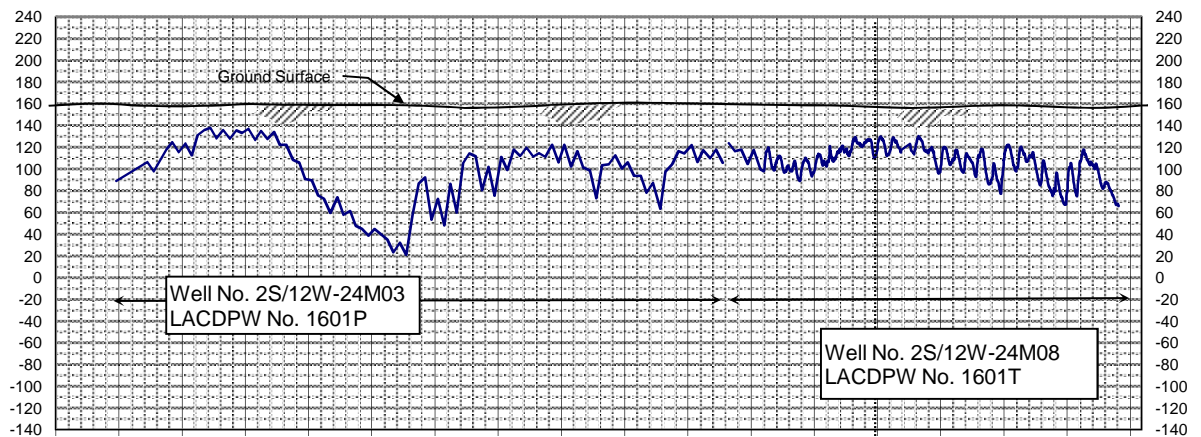
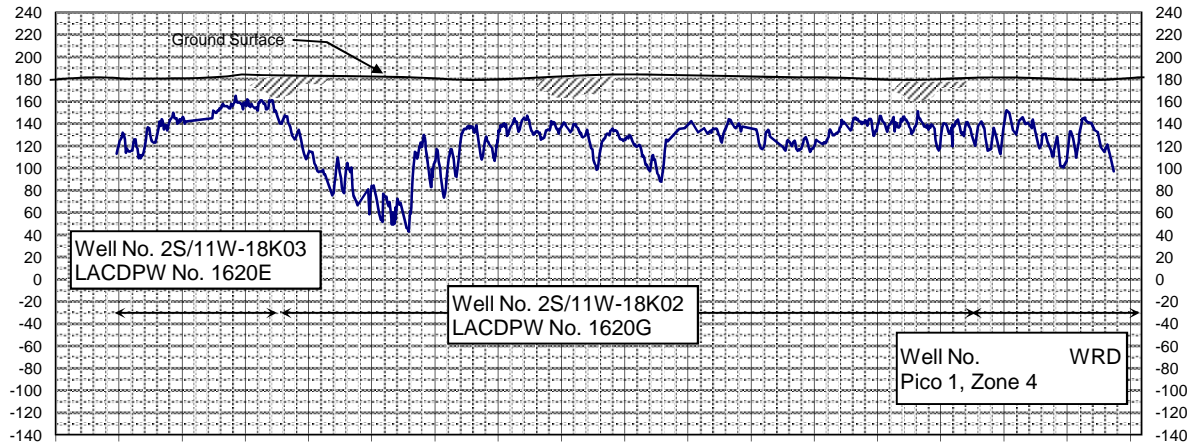
Figure A



**FLUCTUATION OF WATER LEVELS IN THE
LOS ANGELES FOREBAY**

Figure B

ELEVATION IN FEET - USGS DATUM

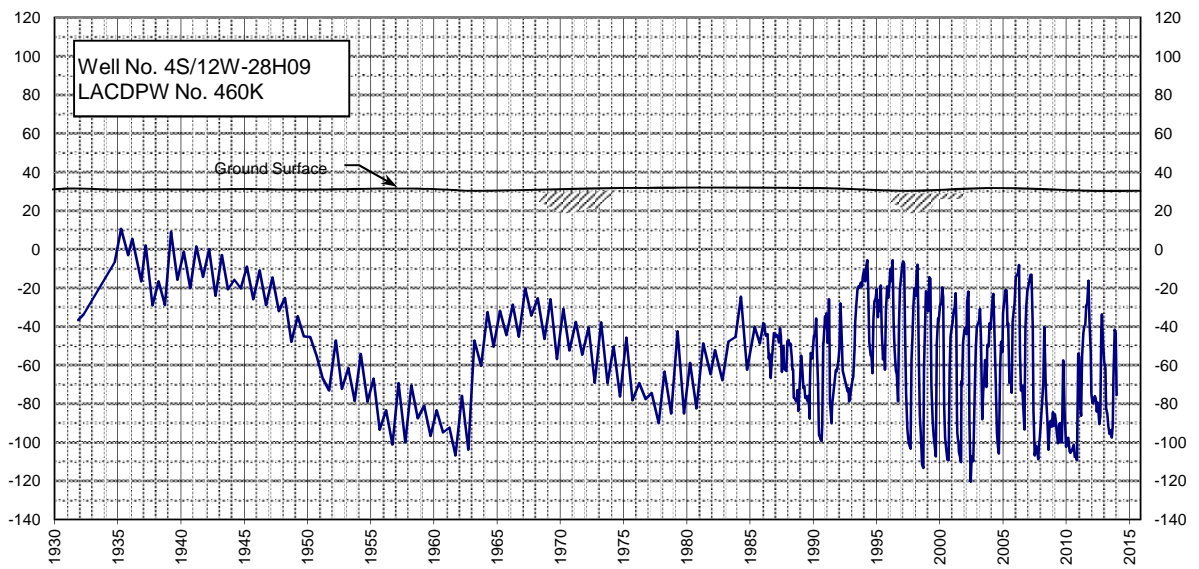
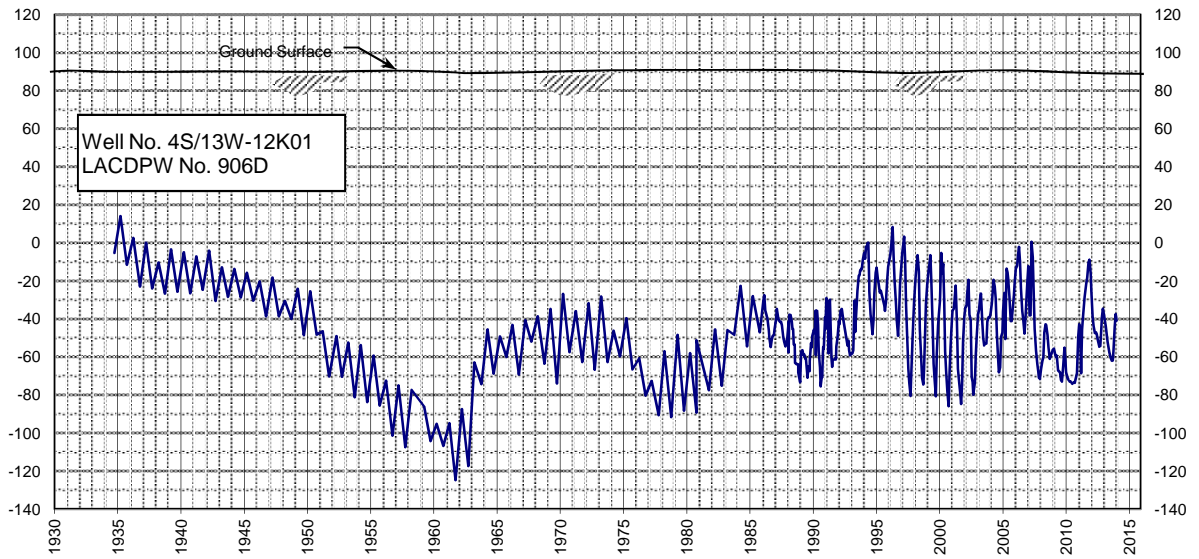


YEARS

FLUCTUATION OF WATER LEVELS IN THE MONTEBELLO FOREBAY

Figure C

ELEVATION IN FEET - USGS DATUM

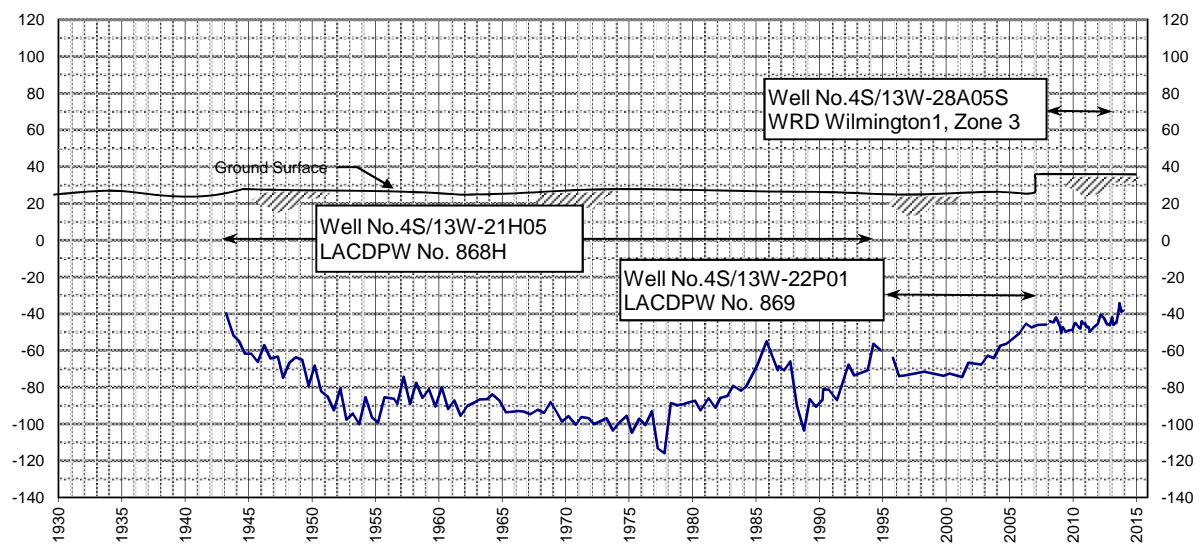
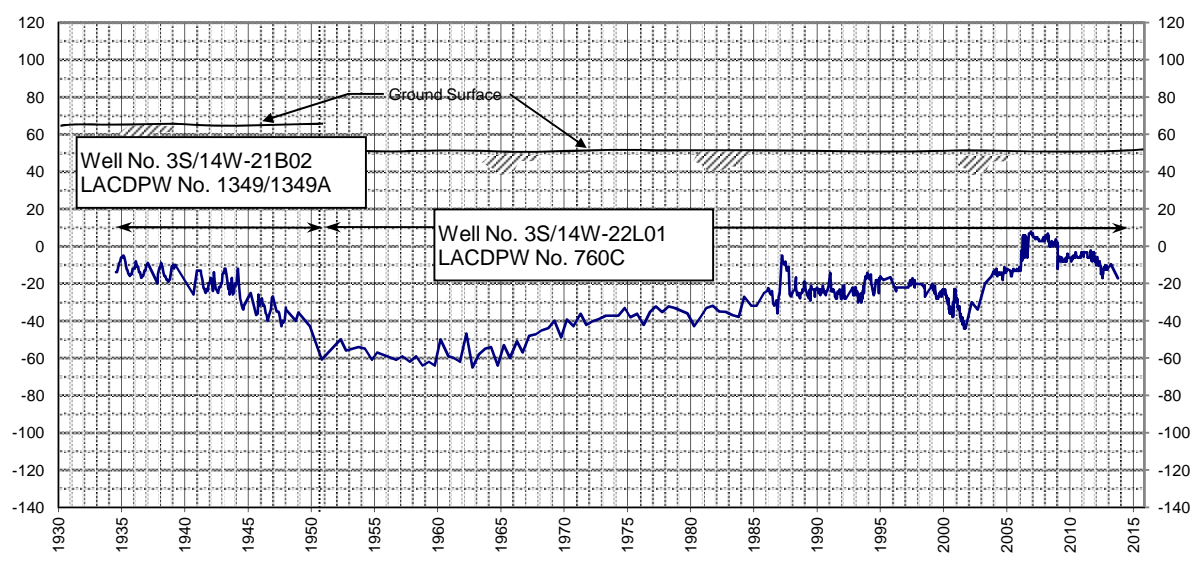


YEARS

**FLUCTUATION OF WATER LEVELS IN THE
CENTRAL BASIN PRESSURE AREA**

Figure D

ELEVATION IN FEET - USGS DATUM



YEARS

FLUCTUATION OF WATER LEVELS IN THE WEST COAST BASIN

Figure E


PLATES


PLATE 1
GROUNDWATER PRODUCTION
WATER YEAR
2012 - 2013


LEGEND

Groundwater Production (AF/Yr)

- < 500 Acre Ft/Yr
- 500 - 2,000 Acre Ft/Yr
- >2,000 Acre Ft/Yr

Barrier Injection Wells 

WRD Boundary 

Forebay 

Data Source: WRD Production Database

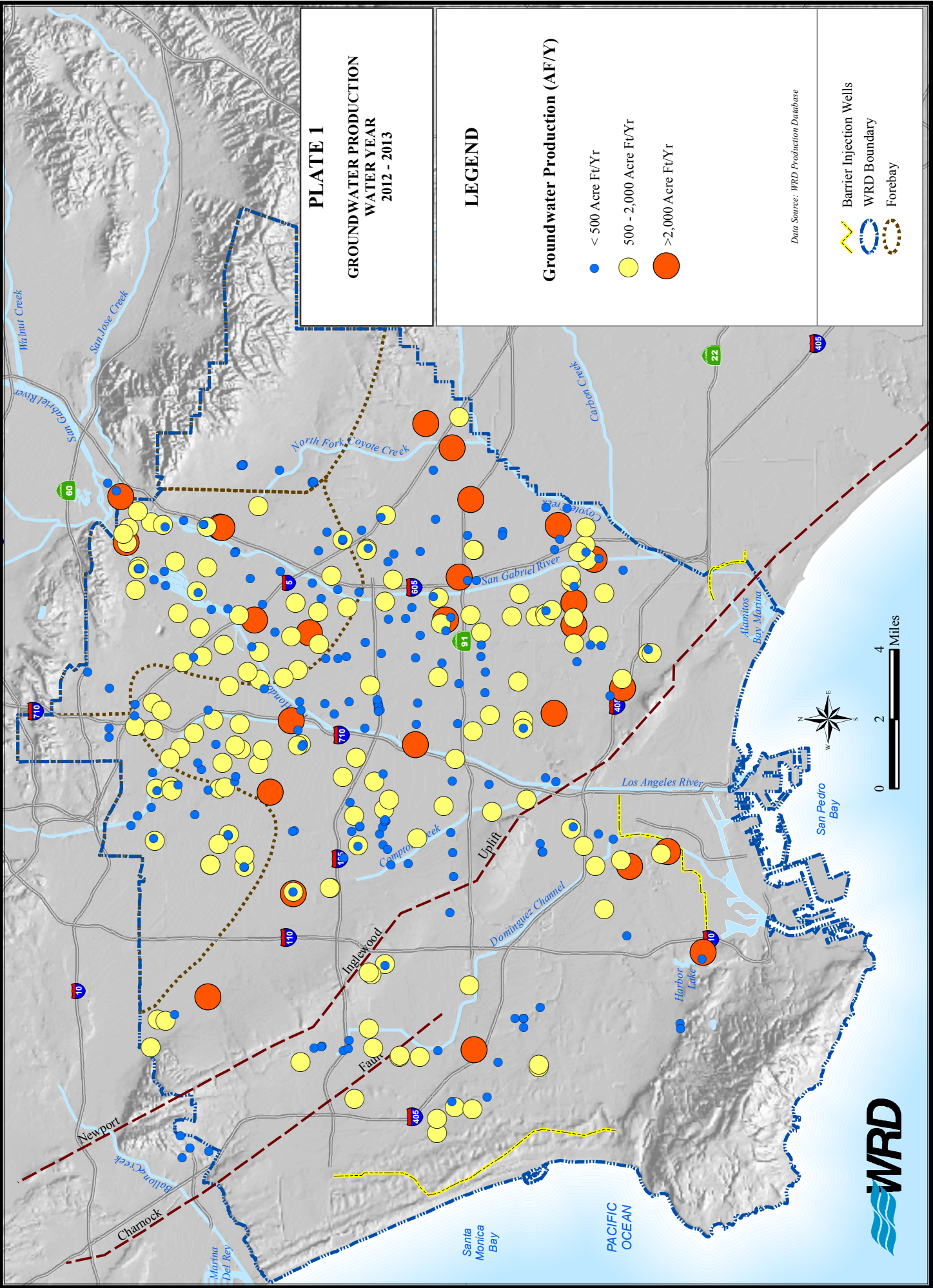


PLATE 2 GROUNDWATER ELEVATION CONTOURS FALL 2013

LEGEND

Groundwater Elevation Contours 10 ft. intervals




-  Above Sea Level
-  Below Sea Level

 Key wells used for hydrographs
(Figures B - E)

Wells used for contouring:

-  Other Wells
-  WRD Nested Wells

Water Level Data Source: Courtesy of Los Angeles Department of Public Works and WRD Regional Groundwater Monitoring Program.

-  Barrier Injection Wells
-  WRD Boundary
-  Forebay

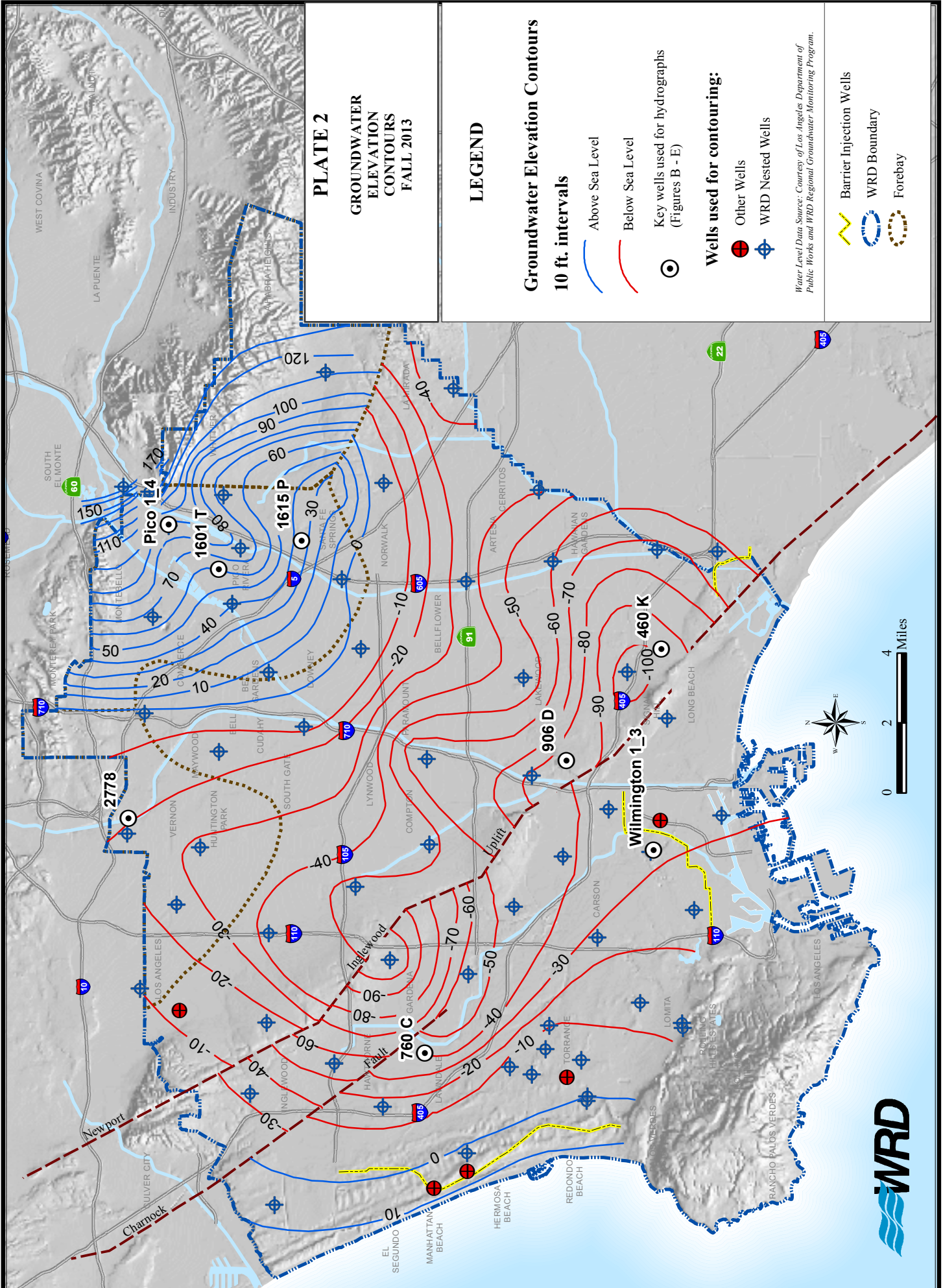


PLATE 3
CHANGES IN
GROUNDWATER LEVELS
FALL 2012 TO FALL 2013
(Upper San Pedro Formation Aquifers)

LEGEND

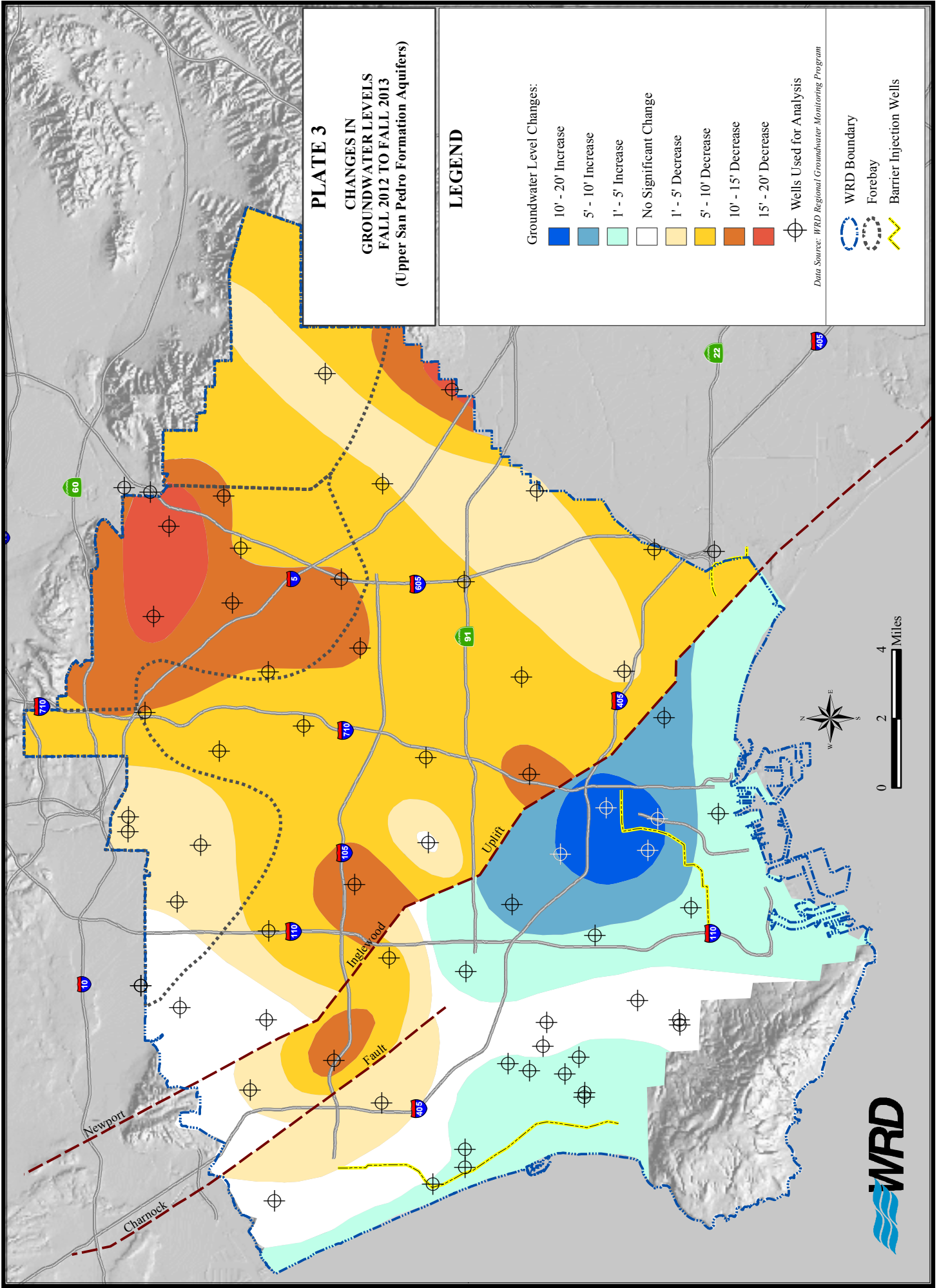
Groundwater Level Changes:

- 10' - 20' Increase
- 5' - 10' Increase
- 1' - 5' Increase
- No Significant Change
- 1' - 5' Decrease
- 5' - 10' Decrease
- 10' - 15' Decrease
- 15' - 20' Decrease

⊕ Wells Used for Analysis

Data Source: WRD Regional Groundwater Monitoring Program

WRD Boundary
 Forebay
 Barrier Injection Wells



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