

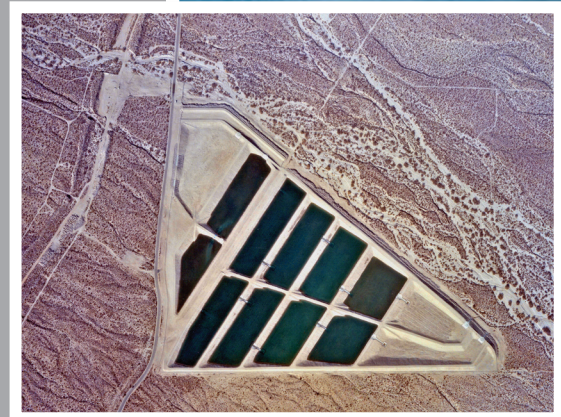


Coachella
Valley
Water
District

Engineer's Report on Water Supply and Replenishment Assessment

2016-2017

- Mission Creek Subbasin Area of Benefit
- West Whitewater River Subbasin Area of Benefit
- East Whitewater River Subbasin Area of Benefit



Prepared By:



KRIEGER & STEWART
Engineering Consultants

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COACHELLA VALLEY WATER DISTRICT
75-515 HOVLEY LANE EAST
PALM DESERT, CA 92211
(760) 398-2661

**COACHELLA VALLEY WATER DISTRICT
ENGINEER'S REPORT ON
WATER SUPPLY AND REPLENISHMENT ASSESSMENT
FOR THE
MISSION CREEK SUBBASIN AREA OF BENEFIT,
WEST WHITEWATER RIVER SUBBASIN AREA OF BENEFIT,
AND
EAST WHITEWATER RIVER SUBBASIN AREA OF BENEFIT
2016-2017**

APRIL 2016

Prepared by



KRIEGER & STEWART
Engineering Consultants

3602 University Avenue
Riverside, California 92501
(951) 684-6900



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MWH Americas, Inc.
618 Michillinda Avenue, Suite 200
Arcadia, California 91007
(626) 796-9141



David F. Scriven
R.C.E. No. 42922

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LIST OF ABBREVIATIONS

2010 Coachella Valley Water Management Plan Update	2010 CVWMP Update
2014 Status Report for the	
2010 Coachella Valley Water Management Plan Update	2014 Status Report
Acre Feet per Year	AF/Yr
Acre Foot, Acre Feet	AF
Area(s) of Benefit	AOB(s)
Bay Delta Conservation Plan	BDCP
California Department of Water Resources	CDWR
California State Groundwater Elevation Monitoring	CASGEM
California WaterFix Project	WaterFix Project
Coachella Branch of the All American Canal	Coachella Canal or Canal
Coachella Valley Water District Replenishment Fund	RAC Revenues
Coachella Valley Water District	CVWD
Coachella Valley Water Management Plan	CVWMP
Degrees Fahrenheit	°F
Desert Water Agency	DWA
Engineer's Report on Water Supply and Replenishment Assessment	Engineer's Report
Fiscal Year	FY
Groundwater Replenishment Program	GRP
Groundwater Sustainability Agencies, Groundwater Sustainability Agencies	GSA(s)
Groundwater Sustainability Plan(s)	GSP(s)
Imperial Irrigation District	IID
Integrated Regional Water Management Plan	IRWMP
Metropolitan Water District of Southern California	MWD
Mid-Valley Pipeline	MVP
Mission Springs Water District	MSWD
Quantification Settlement Agreement	QSA
Replenishment Assessment Charge	RAC
Rosedale Rio Bravo Water Storage District	Rosedale
State of California	State
State Water Project	SWP
State Water Resources Control Board	SWRCB
Sustainable Groundwater Management Act	SGMA
Thomas E. Levy Groundwater Replenishment Facility	TEL Replenishment Facility
Thousand Acre Foot	TAF
Turn-Back Water Pool Program	Pool A and Pool B
United States Department of the Interior, Geological Survey	USGS
Water Reclamation Plant(s)	WRP(s)

CHAPTER I

EXECUTIVE SUMMARY

CHAPTER I EXECUTIVE SUMMARY

The purpose of this report is to update Coachella Valley Water District's (CVWD's) Board of Directors and the public on the groundwater supply conditions and current Groundwater Replenishment Program (GRP), and to recommend Replenishment Assessment Charges (RACs) for CVWD's Mission Creek Subbasin, West Whitewater River Subbasin, and East Whitewater River Subbasin Areas of Benefit (AOBs) for the upcoming fiscal year.

In 1973, CVWD and Desert Water Agency (DWA) began replenishing groundwater within the West Whitewater River Subbasin Management Area of the Coachella Valley Groundwater Basin at the Whitewater River Groundwater Replenishment Facility, by importing Colorado River water exchanged for State Water Project (SWP) water allocations.

Since 1997, CVWD has been replenishing groundwater with Colorado River water in the East Whitewater River Subbasin Management Area, commencing with a pilot program at the Thomas E. Levy Groundwater Replenishment Facility (TEL Replenishment Facility). CVWD also operated the Martinez Canyon Pilot project in the East Whitewater River Subbasin Management Area from 2005 to 2013.

In 2002, CVWD expanded the GRP into the Mission Creek Subbasin Management Area at the Mission Creek Groundwater Replenishment Facility.

Groundwater replenishment is essential in the Coachella Valley Groundwater Basin. If groundwater replenishment with imported water is eliminated, groundwater overdraft will result. Increased overdraft results in declining water levels, increased pump lifts, and increased energy consumption to pump groundwater for irrigation and domestic use. Extreme overdraft has the potential to cause ground surface subsidence and to impact water quality and groundwater storage volume.

A. Mission Creek Subbasin Area of Benefit

CVWD's Mission Creek Subbasin AOB GRP is illustrated in **Figure III-1** and **Figures V-1 and V-2**. Costs associated with CVWD's GRP are recovered through a RAC applied to all non-exempted groundwater production within the AOB and through SWP Tax Revenues levied on all property within CVWD's boundary. Producers extracting groundwater from the Mission Creek Subbasin AOB at rates of 25 acre feet per year (AF/Yr) or less are specifically exempted from the GRP and RAC.

There was a negative change in groundwater in storage within the Mission Creek Subbasin in 2015 as shown in **Figure V-4**, due to minimal deliveries of imported water for replenishment as a result of reduced SWP deliveries due to California's drought. However, long-term overdraft in the Mission Creek Subbasin has been eliminated as evidenced by a positive ten-year average change in groundwater storage since 2009 due to artificial replenishment and other water management activities. As shown in **Figures V-1 through V-3**, groundwater replenishment has been effective in generally stabilizing water levels within the AOB. Continued groundwater replenishment is necessary to prevent long-term overdraft in the future.

In its efforts to maintain water supplies in the Coachella Valley, CVWD has requested its maximum 2016 Table A SWP allocation of 138,350 acre feet (AF) pursuant to the SWP

Contract. DWA also requested its maximum 2016 Table A water allocation, which is currently 55,750 AF. As of March 17, 2016, the California Department of Water Resources (CDWR) has allocated 45 percent of requested SWP allocations for 2016. In addition, CVWD will be implementing several water management projects outlined in the Mission Creek/Garnet Hill Water Management Plan (2013).

According to the *2016 RAC Rate Study Report*, the Mission Creek Replenishment Fund is underfunded, because the RAC Revenue is currently insufficient to cover the expenses associated with the GRP.

The Mission Creek Subbasin AOB RAC is recommended to be levied at \$123.20/AF (set forth in Proposition 218 proceedings), consistent with CVWD's recently completed 2016 Cost of Service Study, effective July 1, 2016. Based on the recommended RAC rate and Projected Revenue shown in **Table V-5**, the proposed RAC is projected to result in a decrease in the Cash Flow in fiscal year 2017 in the amount of \$1.4 million.

B. West Whitewater River Subbasin Area of Benefit

CVWD's West Whitewater River Subbasin AOB GRP is illustrated in **Figure III-1** and **Figures VI-1 and VI-2**. Costs associated with CVWD's GRP are recovered through the RAC applied to all non-exempted groundwater production within the AOB and through SWP Tax Revenues levied on all property within the CVWD boundary. Producers extracting groundwater from the West Whitewater River Subbasin AOB at rates of 25 AF/Yr or less are specifically exempted from the GRP and RAC.

There was a negative change in groundwater in storage within the West Whitewater River Subbasin Management Area in 2015 as shown in **Figure VI-4**. This is due, in part, to reduced deliveries of replenishment water to the Whitewater River Groundwater Replenishment Facility in 2015 as a result of reduced SWP deliveries due to California's drought.

Figure VI-4 illustrates that of the projects identified in the 2010 Coachella Valley Water Management Plan Update (2010 CVWMP Update) will improve the groundwater in storage. Continued groundwater replenishment will be necessary to eliminate or reduce long-term overdraft in the future.

In its efforts to maintain water supplies in the Coachella Valley, CVWD has requested its maximum 2016 Table A SWP allocation of 138,350 AF pursuant to the SWP Contract. DWA also requested its maximum 2016 Table A water allocation, which is currently 55,750 AF. As of March 17, 2016, CDWR has allocated 45 percent of requested SWP allocations for 2016.

According to the *2016 RAC Rate Study Report*, the West Whitewater River Replenishment Fund is currently underfunded, because the RAC and SWP Tax Revenues are insufficient to cover the expenses associated with the GRP.

The West Whitewater River Subbasin AOB RAC is recommended to be levied at \$145.60/AF (set forth in Proposition 218 proceedings), consistent with CVWD's recently completed 2016 Cost of Service Study, effective July 1, 2016. Based on the recommended RAC rate increase and Projected Revenue shown in **Table VI-5**, the proposed RAC is projected to result in a decrease in Cash Flow in fiscal year 2017 in the amount of \$27.4 million.

C. East Whitewater River Subbasin Area of Benefit

CVWD's East Whitewater River Subbasin AOB GRP is illustrated in **Figure III-1** and **Figures VII-1 and VII-2**. Costs associated with CVWD's GRP are recovered through the RAC applied to all non-exempted groundwater production within the AOB. Producers extracting groundwater from the East Whitewater River Subbasin AOB at rates of 25 AF/Yr or less are specifically exempted from the GRP and RAC.

Due to implementation of projects identified in the 2010 CVWMP Update, average groundwater levels in the East Whitewater River Subbasin Management Area are increasing. **Figure VII-4** illustrates total inflow to the subbasin exceeds total outflow, and the subbasin continues to experience a positive change in groundwater in storage. Continued artificial replenishment will be necessary to prevent overdraft in the future.

According to the *2016 RAC Rate Study Report*, the East Whitewater River Replenishment Fund is underfunded, because the RAC revenue is currently insufficient to cover the expenses associated with the GRP.

The East Whitewater River Subbasin AOB RAC is recommended to be levied at \$66/AF (set forth in Proposition 218 proceedings), consistent with CVWD's recently completed 2016 Cost of Service Study, effective July 1, 2016. Based on the recommended RAC rate and the projected revenue as shown in **Table VII-4**, the proposed RAC results in a projected decrease in Cash Flow in fiscal year 2017 in the amount of \$8.9 million.

CHAPTER II

INTRODUCTION

CHAPTER II INTRODUCTION

This 2016-2017 Engineer's Report on Water Supply and Replenishment Assessment (Engineer's Report) documents CVWD's GRP within the Mission Creek Subbasin, West Whitewater River Subbasin, and East Whitewater River Subbasin AOBs within the Coachella Valley Groundwater Basin. The purpose of this report is to update CVWD's Board of Directors and the public on the groundwater supply conditions and current GRP, and to recommend RACs for CVWD's Mission Creek Subbasin, West Whitewater River Subbasin, and East Whitewater River Subbasin AOBs for the upcoming fiscal year.

This report constitutes the 14th annual Engineer's Report for the Mission Creek Subbasin AOB, the 37th annual Engineer's Report for the West Whitewater River Subbasin AOB (formerly known as the Upper Whitewater River Subbasin AOB), and the 13th annual Engineer's Report for the East Whitewater River Subbasin AOB (formerly known as the Lower Whitewater River Subbasin AOB).

Groundwater replenishment within the Mission Creek Subbasin Management Area began in 2002 and has so far replenished the Mission Creek Subbasin Management Area with a cumulative total of approximately 150,313 AF of imported water. Imported water in the amount of 171 AF was delivered to the Mission Creek Groundwater Replenishment Facility during 2015.

Groundwater replenishment within the West Whitewater River Subbasin Management Area began in 1973, and has so far replenished the western portion of the Whitewater River Subbasin with a cumulative total of approximately 2,896,489 AF of imported water. Imported water in the amount of 865 AF was delivered to the Whitewater River Groundwater Replenishment Facility during 2015.

The GRP within the East Whitewater River Subbasin AOB began in the 2004-2005 fiscal year and has so far replenished the eastern portion of the Whitewater River Subbasin with a cumulative total of approximately 271,289 AF of imported water. Imported water in the amount of 37,262 AF was delivered to the TEL Replenishment Facility during 2015.

A. History and Legal Basis of the Groundwater Replenishment Program (GRP)

CVWD serves an area of approximately 1,000 square miles in the Coachella Valley within Riverside, Imperial, and San Diego Counties. The Coachella Valley is situated in the northwesterly portion of California's Colorado Desert. The Coachella Valley is bordered on the west and north by high mountains, which provide an effective barrier against coastal storms, and which greatly reduce the contribution of direct precipitation to replenish the Coachella Valley's groundwater. The bulk of natural groundwater replenishment comes from runoff from the adjacent mountains.

CVWD has been importing surface water from the Colorado River into the eastern portion of the Whitewater River Subbasin of the Coachella Valley since 1949, with the completion of the Coachella Branch of the All American Canal (Coachella Canal or Canal). Until the completion of the TEL Replenishment Facility in 2009, which permitted direct groundwater replenishment by percolation, groundwater replenishment in the East Whitewater River Subbasin AOB was accomplished only via "in-lieu replenishment", that is, by providing imported surface water to farmers for irrigation as a substitute for groundwater pumping.

In cooperation with DWA, CVWD has been providing groundwater replenishment in the West Whitewater River Subbasin Management Area since 1973 and in the Mission Creek Subbasin Management Area since 2002, via importation of Colorado River water for direct replenishment at the Whitewater River Groundwater Replenishment Facility and Mission Creek Groundwater Replenishment Facility, respectively. Colorado River water is obtained through an exchange agreement with the Metropolitan Water District of Southern California (MWD), wherein SWP water allocated to CVWD and DWA through contracts with CDWR are exchanged for Colorado River water from MWD's Colorado River Aqueduct. CVWD began providing groundwater replenishment with Colorado River water in the East Whitewater River Subbasin AOB via the TEL Replenishment Facility (and its predecessor, the Dike 4 Pilot Facility) and the Martinez Canyon Pilot Facility in 1997.

In 1967, CVWD initiated a water reclamation program, having identified reclaimed water as an alternative source of water that could allow groundwater to remain in storage and help to reduce overdraft. Today, CVWD operates six water reclamation plants (WRPs) in the Coachella Valley. Recycled water from three of these facilities (WRP 7, 9, and 10) has been used for golf course and greenbelt irrigation for many years, thereby reducing demand on the groundwater basin.

A detailed history of the GRP is included in **Chapter IV**.

Both CVWD and DWA are permitted by the State Water Code to replenish groundwater basins and to levy and collect water replenishment assessments from any non-exempt groundwater extractor or surface water diverter within their jurisdictions who benefits from replenishment of groundwater. CVWD began assessment of groundwater producers within the West Whitewater River Subbasin AOB in fiscal year 1980-1981, and DWA began its assessment program in fiscal year 1978-1979, thereby creating the GRP. The two agencies are not required to implement assessment procedures jointly or identically.

The State Water Code (Sections 31630-31639) requires completion of an Engineer's Report regarding the GRP before CVWD can levy and collect groundwater RACs. The report must include:

- The condition of groundwater supplies
- The need for groundwater replenishment
- The AOB boundaries
- Water production within each AOB
- RACs to be levied upon water production in the AOBs
- Recommendations regarding the GRP, including the sources and amounts of replenishment water and related costs

B. Definition of Overdraft and Critical Overdraft

The principal goal of the GRP is to arrest, reduce, and ultimately eliminate, groundwater overdraft. The following paragraphs provide a definition of overdraft and a description of its characteristics.

According to CDWR Bulletin 118-80 (Groundwater Basins in California):

"Overdraft is the condition of a groundwater basin in which the amount of water withdrawn by pumping over the long-term exceeds the amount of water that recharges the basin. Overdraft is characterized by groundwater levels that decline over a period of years and never fully recover, even in wet years. Overdraft can lead to increased extraction costs, land subsidence, water quality degradation, and environmental impacts."

CDWR Bulletin 118-80 states that overdraft conditions in a basin become "critical" when:

"...continuation of present water management practices would probably result in significant adverse overdraft-related environmental, social, or economic impacts."

CDWR Bulletin 160-93 (California Water Plan) expands on Bulletin 118-80's "period of years" as follows:

"Such a period of time must be long enough to produce a record that, when averaged, approximates the long-term average hydrologic conditions for the basin."

CDWR Bulletin 160-09 (2009 California Water Plan Update) synthesizes the definitions provided in Bulletins 118-80 and 160-93 as follows:

"Overdraft is defined as the condition of a groundwater basin in which the amount of water withdrawn by pumping exceeds the amount of water that recharges the basin over a period of years, during which the water supply conditions approximate average conditions."

The above is the definition of *overdraft* used herein. As noted in Bulletin 118-80, however, groundwater overdraft is characterized not only by a prolonged decline in quantities of groundwater in storage over long-term average hydrologic conditions, but also by secondary adverse effects including decreased well yields, increased groundwater extraction costs, water quality degradation, sea water intrusion, land subsidence, and environmental impacts. See below for information on how the Sustainable Groundwater Management Act (SGMA) deals with the concepts of "long-term overdraft" and "sustainable yield".

C. Changing Conditions

On January 17, 2014, Governor Jerry Brown, prompted by record dry conditions in California, proclaimed a drought state of emergency. On April 25, 2014, the Governor issued a proclamation of a continued state of emergency based on drought conditions. Subsequently, in July 2014, the Office of Administrative Law approved emergency regulations mandating water conservation measures set forth by the State Water Resources Control Board (SWRCB).

Drought conditions continued for a fourth consecutive year in 2015. On April 1, 2015, Governor Brown issued Executive Order B-29-15, finding that drought conditions persist and ordering that the SWRCB impose mandatory restrictions in order to achieve a statewide 25 percent reduction in potable urban water usage (as compared to usage in 2013) from June 2015 through February 2016.

In order to reach the statewide 25 percent reduction mandate, the SWRCB has assigned each urban water supplier a conservation standard that ranges between 4 percent and 36 percent, based on the supplier's residential gallons per capita per day water use for the months of July through September 2014. The SWRCB assigned CVWD to Tier 9 (based on a residential water use of 475 gallons per capita per day), which required that CVWD reduce potable urban water use within its service area by 36 percent, subsequently reduced to 32 percent. DWA was also tasked to reduce water use by 32 percent, Mission Springs Water District (MSWD) by 24 percent, City of Coachella by 20 percent, City of Indio by 28 percent, and Myoma Dunes Mutual Water Company by 32 percent.

The impacts of mandatory water use restrictions and conservation programs on the GRP are described in **Chapter IV**.

D. Sustainable Groundwater Management Act (SGMA)

In 2014, faced with declining groundwater levels (most notably in California's Central Valley), the California Legislature enacted the SGMA which was intended to provide a framework for the sustainable management of groundwater resources throughout California, primarily by local authorities. SGMA consisted of three bills, AB 1739 (Dickinson), SB 1168 (Pavley), and SB 1319 (Pavley), and was signed into law by Governor Brown on September 16, 2014.

The act requires local authorities to form local Groundwater Sustainability Agencies (GSAs) by June 30, 2017, which are required to evaluate conditions in their local water basins and adopt locally-based Groundwater Sustainability Plans (GSPs) tailored to their regional economic and environmental needs. The act allows a 20-year time frame for GSAs to implement their plans and achieve long-term groundwater sustainability. It protects existing water rights and does not affect current drought response measures.

SGMA provides local GSAs with tools and authority to:

- Monitor and manage groundwater levels and quality
- Monitor and manage land subsidence and changes in surface water flow and quality affecting groundwater levels or quality or caused by groundwater extraction
- Require registration of groundwater wells
- Require reporting of annual extractions
- Require reporting of surface water diversions to underground storage
- Impose limits on extractions from individual wells
- Assess fees to implement local GSPs
- Request revisions of basin boundaries, including establishing new subbasins

In accordance with SGMA, CDWR developed the California Statewide Groundwater Elevation Monitoring (CASGEM) program to track seasonal and long-term trends in groundwater elevations in California's groundwater basins. Through its CASGEM program, CDWR ranked the priority of each groundwater basin in California as either very low, low, medium, or high.

In addition, CDWR, as required by SGMA, identified the basins and subbasins that are in conditions of critical overdraft. Twenty-one basins and subbasins in California were identified as critically-overdrafted basins.

GSAs responsible for high-priority and medium-priority basins must adopt GSPs by January 31, 2020 for critically overdrafted basins, and by January 31, 2022 for high-priority and medium-priority basins not currently in overdraft. Agencies may adopt a single plan covering an entire basin or combine a number of plans created by multiple agencies. Sustainability must be achieved within 20 years after adoption of the GSP for all high-priority and medium-priority basins. Should a GSA elect to submit an Alternative GSP, rather than prepare a GSP in accordance with Water Code §10727 et seq., the Alternative GSP must be submitted to CDWR no later than January 1, 2017, and every five years thereafter.

The SWRCB is empowered to intervene if local agencies fail to form GSAs or fail to adopt their GSPs on schedule.

The Coachella Valley Groundwater Basin has been designated a medium-priority basin under SGMA, although none of the subbasins within the Coachella Valley have been designated as being in critical overdraft. On October 13, 2015, the CVWD Board of Directors adopted a resolution to become a GSA for portions of the Whitewater (Indio) Subbasin and the Mission Creek Subbasin within the boundaries of CVWD, and on November 6, 2015, CVWD submitted to CDWR a "Notice of Election to Become a Groundwater Sustainability Agency" for certain portions of the Whitewater (Indio) Subbasin and Mission Creek Subbasin that are within or surrounded by CVWD's statutory boundaries. DWA submitted a similar notice for portions of the Whitewater (Indio) Subbasin, Mission Creek Subbasin, and San Geronio Pass Subbasin that are within or surrounded by DWA's boundaries on November 24, 2015. The domestic water service areas of the Coachella Water Authority and Indio Water Authority were excluded from CVWD's requested GSA boundary because those agencies plan to form their own GSAs.

CVWD's current intent is to submit the Coachella Valley Water Management Plan (CVWMP) and Mission Creek/Garnet Hill Water Management Plan, with modifications and updates, as its alternative GSP.

SGMA relies on the definitions of "overdraft" and "critical overdraft" provided in previous CDWR documents (see above), but includes a consideration of groundwater management in its definition of "long-term overdraft" as follows:

"The condition of a groundwater basin where the average annual amount of water extracted for a long-term period, generally 10 years or more, exceeds the long-term average annual supply of water to the basin, plus any temporary surplus. Overdraft during a period of drought is not sufficient to establish a condition of long-term overdraft if extractions and recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods."

By eliminating long-term overdraft conditions, the goal of SGMA is to create statewide groundwater conditions that are "sustainable". SGMA defines the term "sustainable yield" as follows:

"The maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus that can be withdrawn annually from a groundwater supply without causing an undesirable result."

"Undesirable results" are defined in SGMA as:

1. *"Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods."*
2. *"Significant and unreasonable reduction of groundwater storage."*
3. *"Significant and unreasonable seawater (salt water) intrusion."*
4. *"Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies."*
5. *"Significant and unreasonable land subsidence that substantially interferes with surface land uses."*
6. *"Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water."*

CHAPTER III
COACHELLA VALLEY
GROUNDWATER BASIN

CHAPTER III COACHELLA VALLEY GROUNDWATER BASIN

A. The Coachella Valley and its Groundwater

1. Coachella Valley

The Coachella Valley is a desert valley in Riverside County, California. It extends approximately 45 miles southeast from the San Bernardino Mountains to the northern shore of the Salton Sea. Cities within the Coachella Valley include Cathedral City, Coachella, Desert Hot Springs, Indian Wells, Indio, La Quinta, Palm Desert, Palm Springs, and Rancho Mirage. The Coachella Valley is bordered on the north by Mount San Gorgonio in the San Bernardino Mountains, on the west by the San Jacinto and Santa Rosa Mountains, on the east by the Little San Bernardino Mountains, and on the south by the Salton Sea.

The Coachella Valley lies within the northwesterly portion of California's Colorado Desert, an extension of the Sonoran Desert. The San Bernardino, San Jacinto, and Santa Rosa Mountains provide an effective barrier against coastal storms, and greatly reduce the contribution of direct precipitation to replenish the Coachella Valley's groundwater, resulting in an arid climate. The bulk of natural groundwater replenishment comes from runoff from the adjacent mountains.

Climate in the Coachella Valley is characterized by low humidity, high summer temperatures, and mild dry winters. Average annual precipitation in the Coachella Valley varies from 4 inches on the Valley floor to more than 30 inches in the surrounding mountains (CDWR 1964). Most of the precipitation occurs during December through February (except for summer thundershowers).

Prevailing winds in the area are usually gentle, but occasionally increase to velocities as high as 30 miles per hour or more. Mid-summer temperatures commonly exceed 100 degrees Fahrenheit (°F), frequently reach 110°F, and periodically reach 120°F. The average winter temperature is approximately 60°F.

2. Coachella Valley Groundwater Basin

The Coachella Valley Groundwater Basin (**Figure III-1**), as described in CDWR Bulletins 108 and 118, is bounded on the north and east by non-water-bearing crystalline rocks of the San Bernardino and Little San Bernardino Mountains and on the south and west by the crystalline rocks of the Santa Rosa and San Jacinto Mountains. At the west end of the San Gorgonio Pass, between Beaumont and Banning, the basin boundary is defined by a surface drainage divide separating the Coachella Valley Groundwater Basin from the Beaumont Groundwater Basin of the Upper Santa Ana Drainage Area.

The southern boundary is formed primarily by the watershed of the Mecca Hills and by the northwest shoreline of the Salton Sea running between the Santa Rosa Mountains and Mortmar. Between the Salton Sea and Travertine Rock, at the base of the Santa Rosa Mountains, the southern boundary crosses slightly over the Riverside/Imperial County Line.

Southerly of the southern boundary, at Mortmar and at Travertine Rock, the subsurface materials are predominantly fine grained and low in permeability; although groundwater is present, it is not readily extractable. A zone of transition exists at these boundaries; to the north the subsurface materials are coarser and more readily yield groundwater.

Although there is interflow of groundwater throughout the groundwater basin, fault barriers, constrictions in the basin profile, and areas of low permeability limit and control movement of groundwater. Based on these factors, the groundwater basin has been divided into subbasins and subareas as described by CDWR in 1964 and the by United States Geological Survey (USGS) in 1971.

B. Subbasins and Subareas

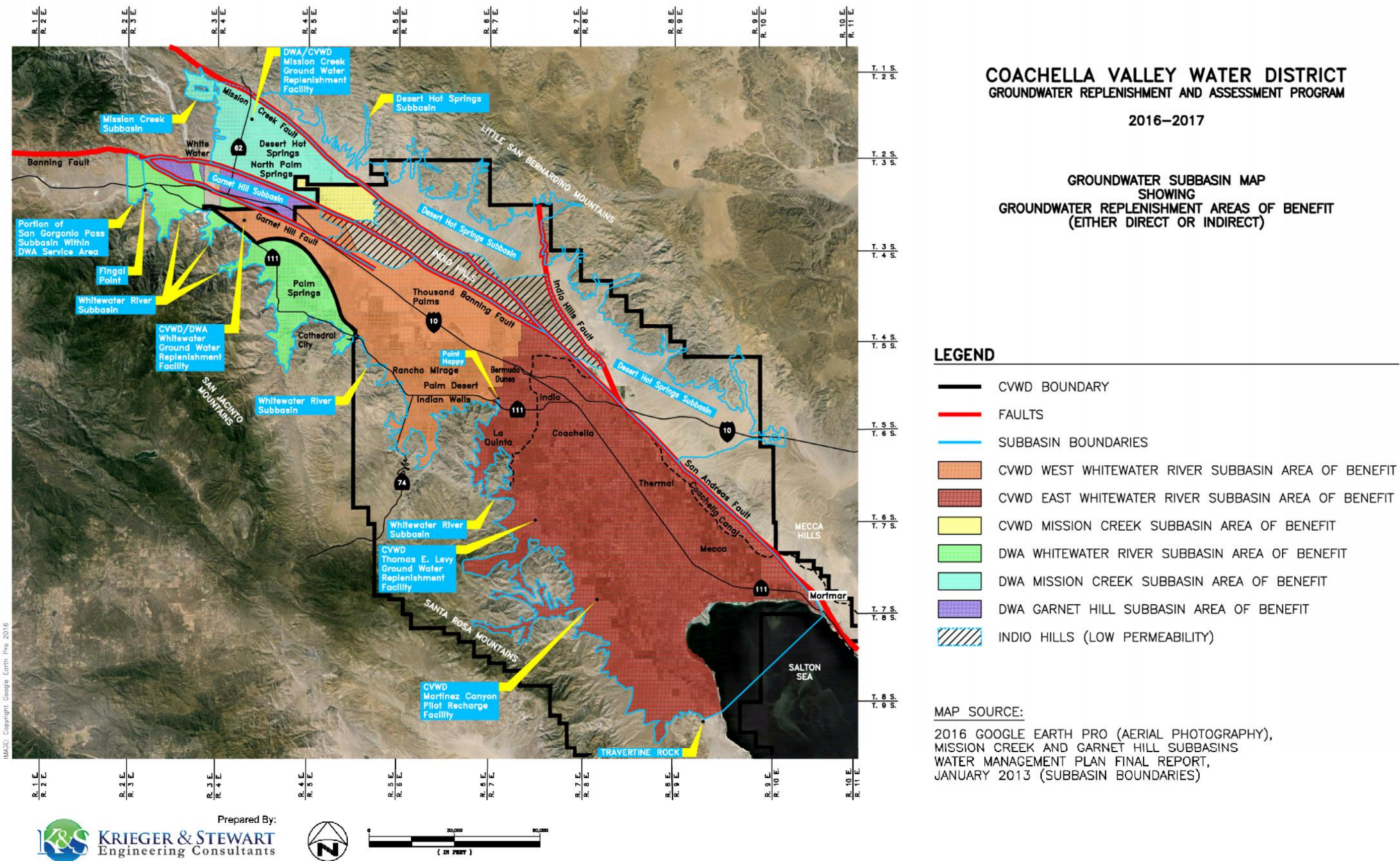
The subbasins of the Coachella Valley Groundwater Basin are the Mission Creek, Desert Hot Springs, Garnet Hill, San Gorgonio Pass, and Whitewater River (Indio) Subbasins. The subbasins, with their groundwater storage aquifers, are defined without regard to water quantity or quality. They delineate areas underlain by formations which readily yield stored groundwater through water wells and offer natural reservoirs for the regulation of water supplies.

The boundaries between subbasins within the groundwater basin are generally defined by faults that serve as effective barriers to the lateral movement of groundwater. Minor subareas have also been delineated, based on one or more of the following geologic or hydrologic characteristics: type of water-bearing formations, water quality, areas of confined groundwater, forebay areas, groundwater divides, and surface drainage divides.

The following is a list of the subbasins and associated subareas as designated by CDWR and USGS. The location of each subbasin is shown on **Figure III-1**.

- Mission Creek Subbasin (Subbasin 7-21.02 per CDWR Bulletin 118, 2003)
- Desert Hot Springs Subbasin (Subbasin 7-21.03 per CDWR Bulletin 118, 2003)
 - o Miracle Hill Subarea
 - o Sky Valley Subarea
 - o Fargo Canyon Subarea
- Garnet Hill Subbasin (considered a subarea of the Indio Subbasin in CDWR Bulletin 118, 2013; and a subbasin by USGS)
- San Gorgonio Pass Subbasin (Subbasin 7-21.04 per CDWR Bulletin 118, 2003)
- Whitewater River Subbasin (Subbasin 7-21.01 per CDWR Bulletin 118, 2003; referred to therein as the Indio Subbasin)
 - o Palm Springs Subarea
 - o Thermal Subarea
 - o Thousand Palms Subarea
 - o Oasis Subarea

Figure III-1
Coachella Valley Groundwater Basin



The boundaries (based on faults, barriers, constrictions in basin profile, and changes in permeability of water-bearing units), geology, hydrogeology, water supply, and groundwater storage of these subbasins are further described in the following sections.

1. Mission Creek Subbasin

Water-bearing materials underlying the Mission Creek upland comprise the Mission Creek Subbasin. This subbasin is designated Number 7-21.02 in CDWR's Bulletin 118 (2003). The subbasin is bounded on the south by the Banning Fault and on the north and east by the Mission Creek Fault. The subbasin is bordered on the west by relatively impermeable rocks of the San Bernardino Mountains. To the southeast of the subbasin are the Indio Hills, which consist of the semi-water-bearing Palm Springs Formation. The area within this boundary reflects the estimated geographic limit of effective storage within the subbasin (CDWR 1964).

Both the Mission Creek Fault and the Banning Fault are partially effective barriers to lateral groundwater movement, as evidenced by offset water levels, fault springs, and changes in vegetation. Water level differences across the Banning Fault, between the Mission Creek Subbasin and the Garnet Hill Subbasin, are on the order of 200 feet to 250 feet. Similar water level differences exist across the Mission Creek Fault between the Mission Creek and Desert Hot Springs Subbasins (MWH 2013).

This subbasin relies on the same imported SWP/Colorado River Exchange Water source for replenishment as does the Whitewater River Subbasin. CVWD, DWA, and MSWD jointly manage this subbasin under the terms of the 2004 Mission Creek Settlement Agreement. This agreement and the 2003 Mission Creek Groundwater Replenishment Agreement between CVWD and DWA specify that the available SWP water will be allocated between the Mission Creek and West Whitewater River Subbasin Management Areas in proportion to the amount of water produced or diverted from each subbasin during the preceding year.

2. Desert Hot Springs Subbasin

The Desert Hot Springs Subbasin is designated Number 7-21.03 in CDWR's Bulletin 118 (2003). It is bounded on the north by the Little San Bernardino Mountains and on the southeast by the Mission Creek and San Andreas Faults. The Mission Creek Fault separates the Desert Hot Springs Subbasin from the Mission Creek Subbasin, and the San Andreas Fault separates the Desert Hot Springs Subbasin from the Whitewater River Subbasin. Both faults serve as effective barriers to lateral groundwater flow. The subbasin has been divided into three subareas: Miracle Hill, Sky Valley, and Fargo Canyon (CDWR 1964).

The Desert Hot Springs Subbasin is not extensively developed, except in the area of Desert Hot Springs. Relatively poor groundwater quality has limited the use of this subbasin for groundwater supply. The Miracle Hill Subarea underlies portions of the City of Desert Hot Springs and is characterized by hot mineralized groundwater, which supplies a number of spas in that area. The Fargo Canyon Subarea underlies a portion of the planning area along Dillon Road north of Interstate 10. This area is characterized by coarse alluvial fans and stream channels flowing out of Joshua Tree National Park. Based on limited

groundwater data for this area, flow is generally to the southeast. Water quality is relatively poor with salinities in the range of 700 milligrams per liter (mg/L) to over 1,000 mg/L (CDWR 1964).

3. Garnet Hill Subbasin

The area between the Garnet Hill Fault and the Banning Fault, named the Garnet Hill Subarea of the Indio Subbasin by CDWR (1964), was considered a distinct subbasin by the USGS because of the partially effective Banning and Garnet Hill Faults as barriers to lateral groundwater movement. This is demonstrated by a difference of 170 feet in groundwater level elevation in a horizontal distance of 3,200 feet across the Garnet Hill Fault, as measured in the spring of 1961. The Garnet Hill Fault does not reach the surface, and is probably effective as a barrier to lateral groundwater movement only below a depth of about 100 feet (MWH 2013).

The 2013 Mission Creek/Garnet Hill Subbasins Water Management Plan (Plan) states groundwater production is low in the Garnet Hill Subbasin and is not expected to increase significantly in the future due to relatively low well yields compared to those in the Mission Creek Subbasin. Water levels in the western and central portions of the subbasin show response to large replenishment quantities from the Whitewater River Groundwater Replenishment Facility, while levels are relatively flat in the eastern portion of the subbasin. The lack of wells in the subbasin limits the geologic understanding of how this subbasin operates relative to the Mission Creek Subbasin and Whitewater River Subbasin.

Although some natural replenishment to this subbasin may come from Mission Creek and other streams that pass through during periods of high flood flows, the chemical character of the groundwater (and its direction of movement) indicate that the main source of replenishment to the subbasin comes from the Whitewater River through the permeable deposits which underlie Whitewater Hill (MWH 2013).

This subbasin is considered part of the Whitewater River (Indio) Subbasin in CDWR's Bulletin 118 (2003) and therefore was not designated a separate number therein. There are no assessable groundwater pumpers within CVWD's portion of the Garnet Hill Subbasin, and CVWD considers the portion of the Garnet Hill Subbasin within its boundaries to be a part of the West Whitewater River Subbasin AOB. There are two assessable producers within DWA's portion of the Garnet Hill Subbasin, which together produced a total of 334 AF of groundwater from the subbasin in 2015. DWA considers the portion of the Garnet Hill Subbasin within its service area to be a separate AOB.

4. San Gorgonio Pass Subbasin

The San Gorgonio Pass Subbasin lies entirely within the San Gorgonio Pass, bounded by the San Bernardino Mountains on the north and the San Jacinto Mountains on the south (CDWR 2003). This subbasin is designated Number 7-21.04 in CDWR's Bulletin 118 (2003).

The San Gorgonio Pass Subbasin is hydrologically connected to the Whitewater River Subbasin on the east. Groundwater within the San Gorgonio Pass

Subbasin moves from west to east and spills out into the Whitewater River Subbasin over the suballuvial bedrock constriction at the east end of the pass (CDWR 1964).

CVWD's service area does not include any portion of the San Gorgonio Pass Subbasin.

5. Whitewater River (Indio) Subbasin

The Whitewater River Subbasin, designated the Indio Subbasin (Basin No. 7-21.01) in CDWR Bulletin No. 118 (2003), underlies the major portion of the Coachella Valley floor and encompasses approximately 400 square miles. Beginning approximately one mile west of the junction of State Highway 111 and Interstate 10, the Whitewater River Subbasin extends southeast approximately 70 miles to the Salton Sea.

The Subbasin is bordered on the southwest by the Santa Rosa and San Jacinto Mountains and is separated from the Garnet Hill, Mission Creek, and Desert Hot Springs Subbasins to the north and east by the Garnet Hill and San Andreas Faults (CDWR 1964). The Garnet Hill Fault, which extends southeasterly from the north side of San Gorgonio Pass to the Indio Hills, is a relatively effective barrier to lateral groundwater movement from the Garnet Hill Subbasin into the Whitewater River Subbasin, with some portions in the shallower zones more permeable. The San Andreas Fault, extending southeasterly from the junction of the Mission Creek and Banning Faults in the Indio Hills and continuing out of the basin on the east flank of the Salton Sea, is also an effective barrier to lateral groundwater movement from the northeast (CDWR 1964).

The subbasin underlies the cities of Palm Springs, Cathedral City, Rancho Mirage, Palm Desert, Indian Wells, La Quinta, Indio, and Coachella, and the unincorporated communities of Thousand Palms, Thermal, Bermuda Dunes, Oasis, and Mecca. From about Indio southeasterly to the Salton Sea, the subbasin contains increasingly thick layers of silt and clay, especially in the shallower portions of the subbasin. These silt and clay layers, which are remnants of ancient lake bed deposits, impede the percolation of water applied for irrigation and limit groundwater replenishment opportunities to the westerly fringe of the subbasin (CDWR 1964).

In 1964, CDWR estimated that the five subbasins that make up the Coachella Valley Groundwater Basin contained a total of approximately 39.2 million AF of water in the first 1,000 feet below the ground surface; much of this water originated as runoff from the adjacent mountains. Of this amount, approximately 28.8 million AF of water was stored in the Whitewater River Subbasin (CDWR 1964). However, the amount of water in the Whitewater River Subbasin has decreased over the years because it has developed to the point where significant groundwater production occurs (CVWD 2012). The natural supply of water to the northwestern part of the Coachella Valley is not keeping pace with the basin outflow, due mainly to large consumptive uses created by the resort-recreation economy and permanent resident population. Imported SWP water allocations are utilized for replenishment in the western portion of the Whitewater River Subbasin to replace consumptive uses created by the resort-recreation economy and permanent resident population.

The Whitewater River Subbasin is not adjudicated. From a management perspective, CVWD divides the portion of the subbasin within its service area into two AOBs designated the West Whitewater River Subbasin AOB and the East Whitewater River Subbasin AOB. The dividing line between these two areas is an irregular line trending northeast to southwest between the Indio Hills north of the City of Indio and Point Happy in La Quinta (see **Section 5.e.** for the history of this division). The West Whitewater River Subbasin AOB is jointly managed by CVWD and DWA under the terms of the 1976 Water Management Agreement. The East Whitewater River Subbasin AOB is managed by CVWD (CVWD 2012).

Hydrologically, the Whitewater River Subbasin is divided into four subareas: the Palm Springs, Thermal, Thousand Palms, and Oasis Subareas. The Palm Springs Subarea is the forebay or main area of replenishment to the subbasin, and the Thermal Subarea is the pressure or confined area within the basin. The other two subareas are peripheral areas having unconfined groundwater conditions.

a. Palm Springs Subarea

The triangular area between the Garnet Hill Fault and the east slope of the San Jacinto Mountains southeast to Cathedral City is designated the Palm Springs Subarea. Groundwater is unconfined in this area. The Coachella Valley fill materials within the Palm Springs Subarea are essentially heterogeneous alluvial fan deposits with little sorting and little fine grained material content. The thickness of these water-bearing materials is not known; however, it exceeds 1,000 feet. Although no lithologic distinction is apparent from well drillers' logs, the probable thickness of recent deposits suggests that Ocotillo conglomerate underlies recent fanglomerate in the subarea at depths ranging from 300 feet to 400 feet.

Natural replenishment to the aquifer in the Whitewater River Subbasin occurs primarily in the Palm Springs Subarea. The major natural sources include infiltration of stream runoff from the San Jacinto Mountains and the Whitewater River, and subsurface inflow from the San Gorgonio Pass and Garnet Hill Subbasins. Deep percolation of direct precipitation on the Palm Springs Subarea is considered negligible as it is consumed by evapotranspiration (CDWR 1964).

b. Thermal Subarea

Groundwater of the Palm Springs Subarea moves southeastward into the interbedded sands, silts, and clays underlying the central portion of the Coachella Valley. The division between the Palm Springs Subarea and the Thermal Subarea is near Cathedral City. The permeabilities parallel to the bedding of the deposits in the Thermal Subarea are several times the permeabilities perpendicular to the bedding and, therefore, movement of groundwater parallel to the bedding predominates. Confined or semi-confined groundwater conditions are present in the major portion of the Thermal Subarea. Movement of groundwater under these conditions is present in the major portion of the Thermal Subarea and is caused by

differences in piezometric (pressure) level or head. Unconfined or free water conditions are present in the alluvial fans at the base of the Santa Rosa Mountains, such as the fans at the mouth of Deep Canyon and in the La Quinta area.

Sand and gravel lenses underlying this subarea are discontinuous, and clay beds are not extensive. However, two aquifer zones separated by a zone of finer-grained materials were identified from well logs. The fine-grained materials within the intervening horizontal plane are not tight enough or persistent enough to completely restrict the vertical interflow of water, or to warrant the use of the term "aquiclude." Therefore, the term "aquitard" is used for this zone of less permeable material that separates the upper and lower aquifer zones in the southeastern part of the Valley.

The lower aquifer zone, composed of part of the Ocotillo conglomerate, consists of silty sands and gravels with interbeds of silt and clay. It contains the greatest quantity of stored groundwater in the Coachella Valley Groundwater Basin, but serves only that portion of the Valley easterly of Washington Street. The top of the lower aquifer zone is present at a depth ranging from 300 feet to 600 feet below the surface. The thickness of the zone is undetermined, as the deepest wells present in the Coachella Valley have not penetrated it in its entirety. The available data indicate that the zone is at least 500 feet thick and may be in excess of 1,000 feet thick.

The aquitard overlying the lower aquifer zone is generally 100 feet to 200 feet thick, although in small areas on the periphery of the Salton Sea it is more than 500 feet thick. North and west of Indio, in a curved zone approximately one mile wide, the aquitard is apparently lacking and no distinction is made between the upper and lower aquifer zones.

Capping the upper aquifer zone in the Thermal Subarea is a shallow fine-grained zone in which semi-perched groundwater is present (see **Figure III-2** at the end of this chapter). This zone consists of recent silts, clays, and fine sands and is relatively persistent southeast of Indio. It ranges from zero to 100 feet thick and is generally an effective barrier to deep percolation. However, north and west of Indio, the zone is composed mainly of clayey sands and silts, and its effect in retarding deep percolation is limited. The low permeability of the materials southeast of Indio has contributed to irrigation drainage problems in the area. Semi-perched groundwater has been maintained by irrigation water applied to agricultural lands south of Point Happy, necessitating the construction of an extensive subsurface tile drain system (CDWR 1964).

A generalized stratigraphic diagram of the geologic units and groundwater zones of the Thermal Subarea (CDWR 1964) is presented in **Figure III-3** at the end of this chapter.

The Thermal Subarea contains the division between CVWD's west and east AOBs of the Whitewater River (Indio) Subbasin. This division is discussed further in **Paragraph 5.e.**, below.

The imported Colorado River supply through the Coachella Canal is used mainly for irrigation in the eastern portion of the Whitewater River Subbasin. Annual deliveries of Colorado River water through the Coachella Canal of approximately 300,000 AF are a significant component of southeastern Coachella Valley hydrology. A smaller portion of the Coachella Canal water supply is used to offset groundwater pumping by golf courses in the west portion of the Whitewater River Subbasin.

CVWD recently completed a study to evaluate the entire groundwater basin. This led to the development and adoption of the 2010 CVWMP Update. Using state-of-the-art technology, CVWD developed and calibrated a peer-reviewed, three-dimensional groundwater model (Fogg 2000) that is based on data from over 2,500 wells, and includes an extensive database of well chemistry reports, well completion reports, electric logs, and specific capacity tests. This model improved on previous groundwater models, and incorporates the latest hydrological evaluations from previous studies conducted by CDWR and USGS to gain a better understanding of the hydrogeology in this subbasin and the benefits of water management practices identified in the CVWMP.

c. Thousand Palms Subarea

The small area along the southwest flank of the Indio Hills is named the Thousand Palms Subarea. The southwest boundary of the subarea was determined by tracing the limits of distinctive groundwater chemical characteristics. The major aquifers of the Whitewater River (Indio) Subbasin are characterized by calcium bicarbonate; but water in the Thousand Palms Subarea is characterized by sodium sulfate (CDWR 1964).

The differences in water quality suggest that replenishment to the Thousand Palms Subarea comes primarily from the Indio Hills and is limited in supply. The relatively sharp boundary between chemical characteristics of water derived from the Indio Hills and groundwater in the Thermal Subarea suggests there is little intermixing of the two waters.

The configuration of the water table north of the community of Thousand Palms is such that the generally uniform, southeasterly gradient in the Palm Springs Subarea diverges and steepens to the east along the base of Edom Hill. This steepened gradient suggests a barrier to the movement of groundwater: possibly a reduction in permeability of the water-bearing materials, or possibly a southeast extension of the Garnet Hill Fault. However, such an extension of the Garnet Hill Fault is unlikely. There is no surface expression of such a fault, and the gravity measurements taken during the 1964 CDWR investigation do not suggest a subsurface fault. The residual gravity profile across this area supports these observations. The sharp increase in gradient is therefore attributed to lower permeability of the materials to the east.

Most of the Thousand Palms Subarea is located within the western portion of the Whitewater River (Indio) Subbasin. Groundwater levels in

this area show similar patterns to those of the adjacent Thermal Subarea, suggesting a hydraulic connectivity (CDWR 1964).

d. Oasis Subarea

Another peripheral zone of unconfined groundwater that is different in chemical characteristics from water in the major aquifers of the Whitewater River (Indio) Subbasin is found underlying the Oasis Piedmont slope. This zone, named the Oasis Subarea, extends along the base of the Santa Rosa Mountains. Water-bearing materials underlying the subarea consist of highly permeable fan deposits. Although groundwater data suggest that the boundary between the Oasis and Thermal Subareas may be a buried fault extending from Travertine Rock to the community of Oasis, the remainder of the boundary is a lithologic change from the coarse fan deposits of the Oasis Subarea to the interbedded sands, gravel, and silts of the Thermal Subarea. Little information is available as to the thickness of the water-bearing materials, but it is estimated to be in excess of 1,000 feet. Groundwater levels in the Oasis Subarea have exhibited similar declines as elsewhere in the subbasin due to increased groundwater pumping to meet agricultural demands on the Oasis slope (CDWR 1964).

e. East/West Area of Benefit Division

The Thermal Subarea (see **Paragraph 5.b.**, above) contains the division between the westerly and easterly portions of the Whitewater River (Indio) Subbasin (CVWD's West Whitewater River Subbasin AOB and East Whitewater River Subbasin AOB), which constitutes the southern boundary of the management area governed by the Management Agreement between CVWD and DWA.

The boundary between these two AOBs extends from Point Happy (a promontory of the Santa Rosa Mountains between Indian Wells and La Quinta) northeasterly, generally along Washington Street, to a point on the San Andreas Fault intersecting the northerly prolongation of Jefferson Street in Indio.

The boundary was originally defined primarily on the basis of differing groundwater levels resulting from differences in groundwater use and management northerly and southerly of the boundary. Primarily due to the application of imported water from the Coachella Canal, and an attendant reduction in groundwater pumpage, the water levels in the area southeasterly from Point Happy (the East Whitewater River Subbasin AOB) rose until the early 1970s, while groundwater levels northwesterly from Point Happy (the West Whitewater River Subbasin AOB) were dropping due to continued development and pumping. This was stated by Tyley (USGS 1974) as follows:

"The south boundary is an imaginary line extending from Point Happy northeast to the Little San Bernardino Mountains and was chosen for the following reasons: (1) North of the boundary, water levels have been declining while south of the boundary, water

levels have been rising since 1949 and (2) north of the boundary, ground water is the major source of irrigation water while south of the boundary, imported water from the Colorado River is the major source of irrigation water."

In addition, according to CDWR (1964) and as discussed above, the eastern portion of the Thermal Subarea is distinguished from area north and west of Indio within the Thermal Subarea by the presence of several relatively impervious clay layers (aquitards) lying between the ground surface and the main groundwater aquifer, creating confined and semi-confined aquifer conditions (see **Figure III-2**). These conditions were characterized by Tyley as "artesian conditions" southerly of the south boundary.

Groundwater levels northerly of the boundary have been stable or increasing since the 1970s (per recorded measurements of USGS, DWA, and CVWD wells), except in the greater Palm Desert area, largely due to the commencement of replenishment activities at the Whitewater River Groundwater Replenishment Facility in 1973. Groundwater levels in the greater Palm Desert area continue to decline, but at a reduced rate as a result of the GRP. Differences between the East Whitewater River Subbasin AOB and West Whitewater River Subbasin AOB also persist in terms of management of the GRP and by groundwater usage (there is significantly more agricultural use in the East Whitewater River Subbasin AOB than in the West Whitewater River Subbasin AOB).

f. Summary

The Whitewater River (Indio) Subbasin consists of four subareas: the Palm Springs, Thermal, Thousand Palms, and Oasis Subareas. The Palm Springs Subarea is the forebay or main area of replenishment to the subbasin, and the Thermal Subarea includes the pressure or confined area within the basin. The Thousand Palms and Oasis Subareas are peripheral areas having unconfined groundwater conditions. From a management perspective, the Whitewater River (Indio) Subbasin is divided into a west and eastern portion, with the dividing line extending from Point Happy in La Quinta to the northeast, terminating at the San Andreas Fault and the Indio Hills at Jefferson Street.

Potable groundwater is not readily available within the following areas in the Coachella Valley: Indio Hills, Mecca Hills, Barton Canyon, Bombay Beach, and Salton City.

C. Groundwater Storage Capacity

In 1964, CDWR estimated that the subbasins in the Coachella Valley Groundwater Basin contained, in the first 1,000 feet below the ground surface, approximately 39,200,000 AF of water. The capacities of the subbasins are shown in **Table III-1**.

Table III-1
Coachella Valley Groundwater Basin
Groundwater Storage Capacity

Area	Storage (AF) ⁽¹⁾
Whitewater River Subbasin	
Palm Springs Subarea	4,600,000
Thousand Palms Subarea	1,800,000
Oasis Subarea	3,000,000
Thermal Subarea	19,400,000
Subtotal Whitewater River (Indio) Subbasin:	28,800,000
San Geronio Pass Subbasin	2,700,000
Mission Creek Subbasin	2,600,000
Desert Hot Springs Subbasin	4,100,000
Garnet Hill Subbasin	1,000,000
Total All Subbasins:	39,200,000

⁽¹⁾ First 1,000 feet below ground surface. CDWR estimate (CDWR, 1964).

D. Water Supply

1. Precipitation and Stream Flow

Average annual precipitation in the Coachella Valley varies from 4 inches on the Valley floor to more than 30 inches in the surrounding mountains (CDWR 1964). Precipitation predominantly occurs December through March, with occasional intense precipitation events during the summer months resulting from subtropical thunderstorms. The precipitation that occurs within the tributary watersheds either evaporates, is consumed by native vegetation, percolates into underlying alluvium and fractured rock, or becomes runoff, which can be captured by mountain-front debris basins and percolated into the aquifer. A portion of the flow percolating into the mountain watersheds eventually becomes subsurface inflow to the subbasins. The majority of the stream flow available for aquifer replenishment originates in the San Bernardino and San Jacinto Mountains, with lesser amounts from the Santa Rosa Mountains.

During 2015, the average annual rainfall was 3.62 inches throughout the Coachella Valley, as recorded by 12 rain gage stations located throughout the Valley, monitored by Riverside County Flood Control and Water Conservation District. This quantity is lower than the typical average annual rainfall for the area. Precipitation data for these stations in 2015 is presented in **Appendix A**.

Appendix A also includes 2015 stream flow data for gauged streams tributary to the Coachella Valley, as recorded by the USGS.

Table III-2 presents estimated long-term average annual replenishment from stream flows estimated by the USGS. It should be noted that stream flow is dependent on precipitation, and is, thus, highly variable from year to year.

Table III-2
Coachella Valley Groundwater Basin
Long-Term Annual Average Replenishment From Stream Flows

Stream	Estimated Long-Term Annual Average Stream Flow (AF)	Measurement Period
Snow Creek	6,958 ⁽¹⁾	1960-2009
Andreas Creek	2,047 ⁽¹⁾	1948-2009
Whitewater River	12,000 ⁽¹⁾	1948-1978
Tahquitz Creek	3,566 ⁽¹⁾	1948-2009
Palm Canyon Creek	3,314 ⁽¹⁾	1948-2009
San Gorgonio River (and underflow)	9,000 ⁽²⁾	N/A
Falls Creek	870 ⁽¹⁾	1995-2009
Chino Creek	525 ⁽¹⁾	1987-2009
Deep Creek	1,536 ⁽¹⁾	1963-2009
Mission Creek	1,975 ⁽¹⁾	1968-2015
Morongo Canyon	1,500 ⁽³⁾	N/A

⁽¹⁾ Based on readings from USGS stream gauges

⁽²⁾ Estimated, USGS, 1978

⁽³⁾ Estimated, USGS, 1974

A stream gauge will be constructed on Murray Canyon Creek later in 2016. Murray Canyon Creek stream flows will be included in future Engineer's Reports.

The 2010 CVWMP Update estimated that the average surface water available for groundwater replenishment is about 46,500 AF/Yr over the long-term.

2. Groundwater Underflow

Some of the stream flow that contributes to groundwater aquifer recharge is subsurface flow. In addition, boundaries between groundwater basins and subbasins are often semi-permeable, allowing subsurface flow from one area to another. The direction and quantity of flow is dependent on the hydraulic gradient across the boundary, which can be influenced by imported water deliveries. Under natural conditions, groundwater has flowed from the Mission Creek Subbasin into the Garnet Hill Subbasin, from the San Gorgonio Pass and Garnet Hill Subbasins into the Palm Springs Subarea of the Whitewater River Subbasin, and from the Palm Springs Subarea into the Thermal Subarea of the Whitewater River Subbasin.

However, during periods of significant groundwater level increases in the Palm Springs Subarea due to Advance Deliveries by MWD (see **Chapter IV**), groundwater has flowed from the Palm Springs Subarea of the Whitewater River Subbasin into the Garnet Hill Subbasin (MWH 2013).

Overdraft conditions can also cause reversals in groundwater flow patterns, which can create significant water quality issues where adjacent water bodies are saline. For this reason, it is important to avoid long-term overdraft conditions in the East Whitewater River Subbasin AOB, to prevent intrusion of saline water from the Salton Sea or perched aquifers.

Estimates of average groundwater underflows across subbasin and AOB boundaries are presented in **Table III-3**.

Table III-3
Coachella Valley Groundwater Basin
Estimated Average Underflows Across
Subbasin and Area of Benefit (AOB) Boundaries

Subbasin Boundary Transfer	Estimated Average Annual Underflow (AF)
Desert Hot Springs Subbasin to Mission Creek Subbasin	1,840 ⁽¹⁾
Mission Creek Subbasin to Garnet Hill Subbasin	4,000 ⁽¹⁾
Mission Creek Subbasin to West Whitewater River Subbasin AOB	1,100 ⁽¹⁾
Garnet Hill Subbasin to West Whitewater River Subbasin AOB	4,000 ⁽¹⁾
Desert Hot Springs Subbasin (Fargo Canyon) to East Whitewater River Subbasin AOB	170 ⁽²⁾
West Whitewater River Subbasin AOB to East Whitewater River Subbasin AOB	25,790 ⁽²⁾
East Whitewater River Subbasin AOB from Salton Sea	1,220 ⁽²⁾

⁽¹⁾ MWH 2013, Psomas 2013

⁽²⁾ MWH 2011, Fogg, et al. 2000

The underflows set forth in **Table III-3** are dependent on differential groundwater levels across the subbasin and AOB boundaries, which can change over time, especially in the vicinity of artificial replenishment activities. These changes will be more pronounced when the boundary is not defined by a hydrogeological barrier, as in the case of the boundary between the West Whitewater River Subbasin AOB and East Whitewater River Subbasin AOB. The figure of 25,790 AF shown in **Table III-3** above for underflow from the western portion to the eastern portion of the Whitewater River Subbasin is the result of MWH's groundwater modeling run (MWH 2011) for the year 2015.

Table III-4 shows how this figure is anticipated to decrease over time as groundwater levels in the East Whitewater River Subbasin AOB rise relative to those in the West Whitewater River Subbasin AOB.

Table III-4
Estimated Underflow from
West Whitewater River Subbasin Area of Benefit to
East Whitewater River Subbasin Area of Benefit (MWH 2011)

Year	Estimated Average Annual Underflow AF
2013	29,787 ⁽¹⁾
2014	27,836 ⁽¹⁾
2015	25,790 ⁽¹⁾
2016	24,148 ⁽¹⁾
2017	22,622 ⁽¹⁾
2018	21,198 ⁽¹⁾

⁽¹⁾ MWH 2011

The above figures are likely to be updated the next time the MWH model simulation is run with current data.

3. Non-Consumptive Return

Municipal and agricultural water uses are not 100 percent efficient. A portion of the water is used consumptively, and the remaining portion is either returned to the aquifer or exported from the area. While agricultural water users aim for high efficiency irrigation to minimize cost, 100 percent irrigation efficiency is not possible due to the potential for salt accumulation in the soil. In addition to the water consumptively used by evapotranspiration from crops and soil, irrigation must include a quantity of water that serves to flush salts from the soil to maintain crop production. Municipal use of water results in the generation of treated wastewater, which is either recycled for irrigation, percolated into the soil, or discharged into a water body such as the Coachella Valley Stormwater Channel. Overall, consumptive use (agricultural and municipal) in the Coachella Valley has been estimated to be approximately 65 percent of water production (USGS 1992).

Non-consumptive return water is the water that is returned to the aquifer after use (for example, irrigation water percolating beyond the root zone and treated wastewater discharged to percolation ponds or leach fields). Although non-consumptive return in the Whitewater River Subbasin has been estimated at approximately 40 percent (USGS 1974) and 35 percent (USGS 1992), non-consumptive return could decrease from 35 percent to approximately 30 percent through 2035 based on the effects of implementing water conservation measures such as turf removal, and more efficient irrigation practices (MWH 2011). According to MWH's Coachella Valley groundwater model (MWH 2011), the overall non-consumptive return for 2015 was approximately 33.5 percent, which has been rounded to 34 percent for use herein.

4. Artificial Replenishment

In addition to natural replenishment from precipitation and stream flow, the basin receives artificial replenishment from importation of surface water from the Colorado River and from water recycling. More information on these programs is provided in the following chapters.

E. Land Subsidence

Since 1996, CVWD and the USGS have cooperatively funded studies investigating land subsidence in the Coachella Valley. Global Positioning System (GPS) surveying and interferometric synthetic aperture radar (InSAR) methods are used to determine the location, extent, and magnitude of the vertical land-surface changes in the Coachella Valley.

A report was published by the USGS in 2007 entitled *Detection and Measurement of Land Subsidence Using Global Positioning System Surveying and Interferometric Synthetic Aperture Radar, Coachella Valley, California 1996-2005* (USGS 2007). The most recent phase of the investigation evaluated correlations between subsidence and recovery related to local geology and groundwater level changes during the period 1993 to 2010. The most recent in this series of reports was published by the USGS in 2014.

This report indicated that subsidence occurred in the East Whitewater River Subbasin AOB and portions of the West Whitewater River Subbasin AOB (primarily within the Palm Desert area). However, decreased rates of subsidence, or uplift, was observed in the La Quinta area in 2010. The uplift was attributed to the recovering water levels in the vicinity of the TEL Replenishment Facility (USGS 2014).

Figure III-2
Approximate Extent of Shallow, Semi-Perched Aquifer

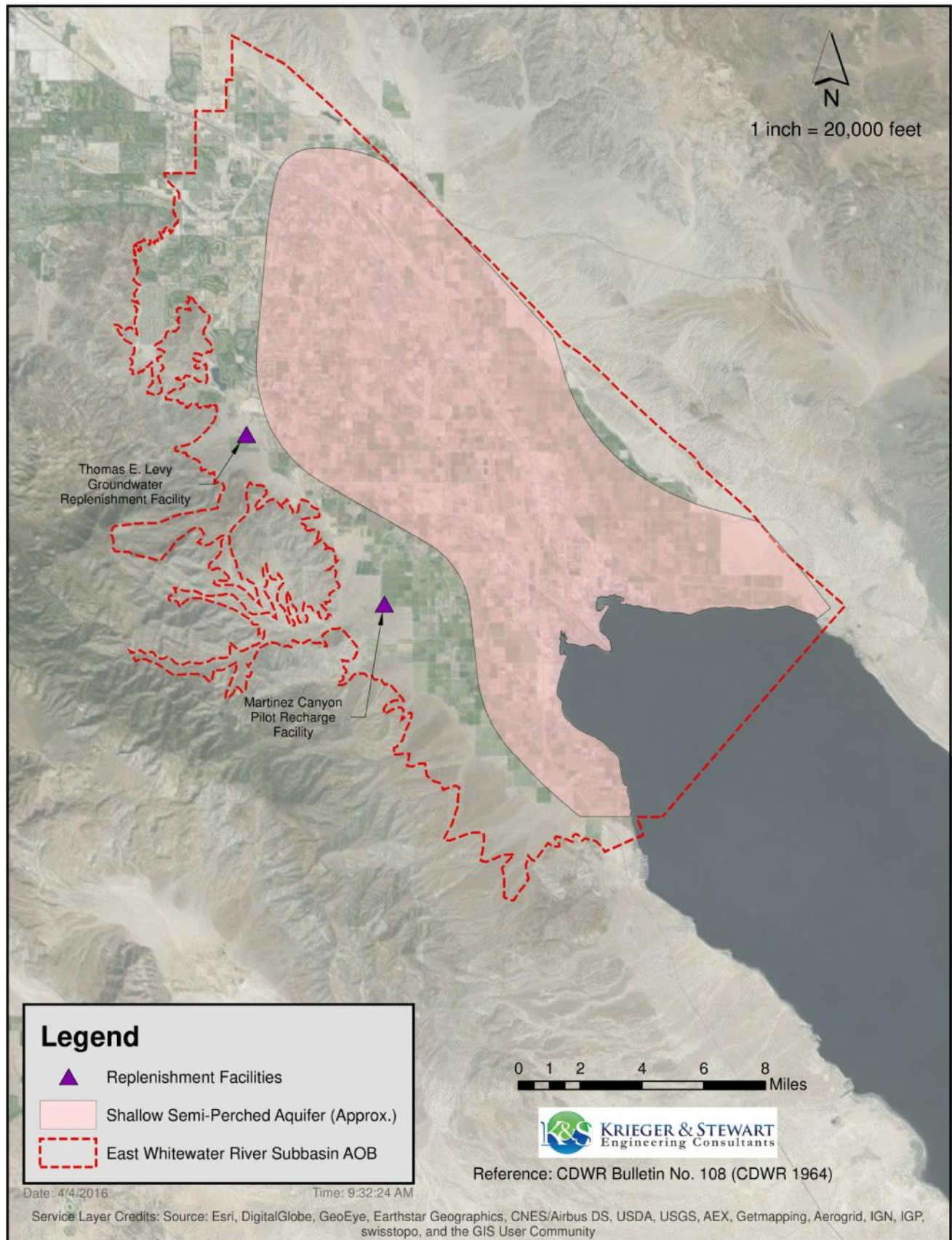
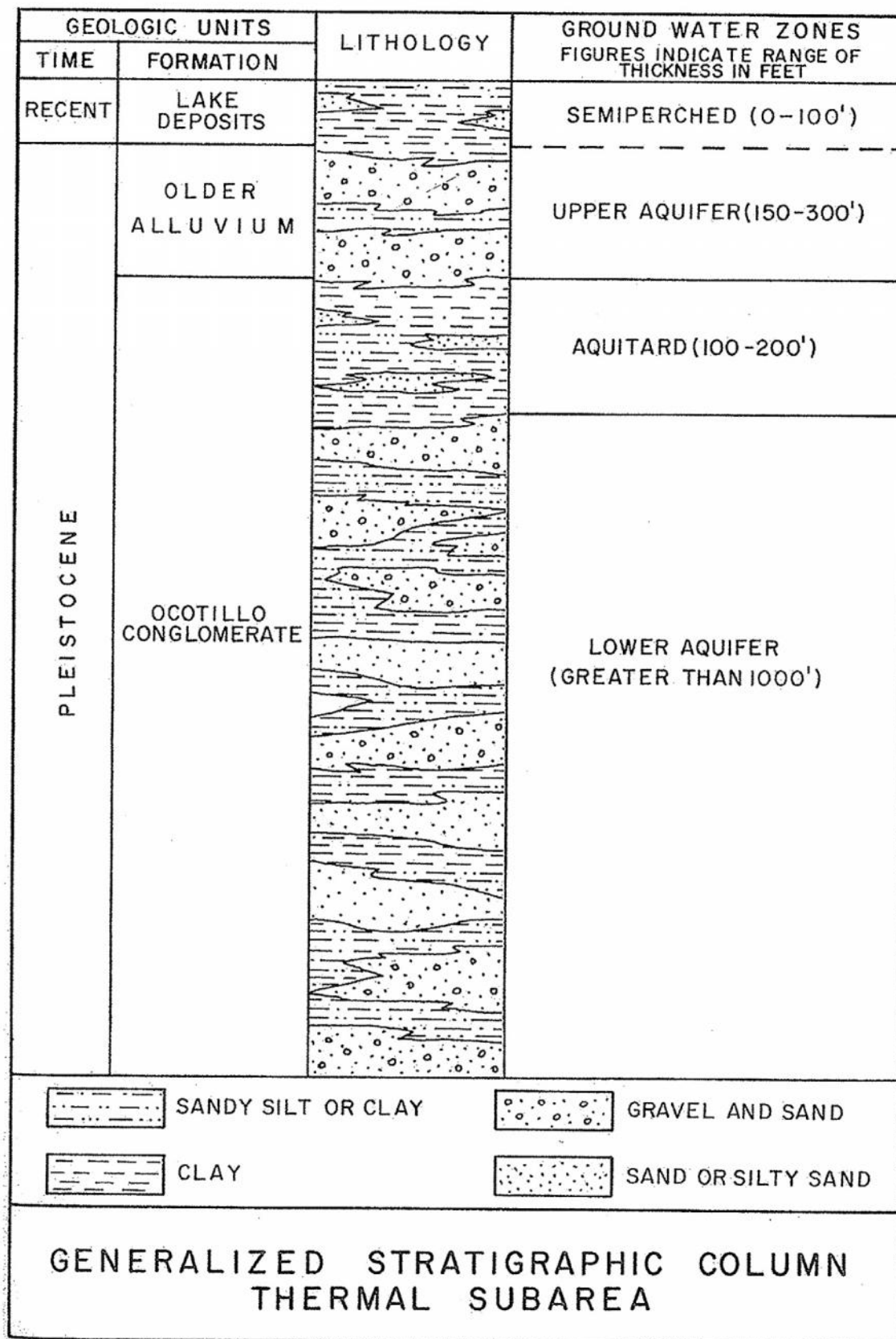


Figure III-3
Generalized Stratigraphic Column Thermal Subarea



Source: CDWR Bulletin No. 108 (CDWR 1964)

CHAPTER IV

**GROUNDWATER BASIN
REPLENISHMENT PROGRAM**

CHAPTER IV GROUNDWATER REPLENISHMENT PROGRAM

A. Summary

CVWD provides artificial replenishment of the Coachella Valley Groundwater Basin through its GRP. Groundwater replenishment is effected through two basic mechanisms: *direct replenishment*, in which imported surface water is percolated directly into the aquifer, and *in-lieu replenishment*, in which non-potable surface or reclaimed water is provided to groundwater pumpers for irrigation purposes, thus reducing or eliminating their use of pumped groundwater. In the future, delivery of treated surface water may be implemented to further offset groundwater pumping.

B. History

The need to enhance the Coachella Valley's water supply has been recognized for many years. The formation of CVWD in 1918 was a direct result of the concern of residents over a plan to export water from the Whitewater River to the Imperial Valley. Early residents of the Coachella Valley also recognized action was needed to stem the decline of the water table resulting from groundwater extractions. Their concern led CVWD to enter into an agreement in 1934 for construction of the Coachella Branch of the All American Canal (Coachella Canal or Canal) to bring Colorado River water to the Coachella Valley. Since 1949, the Coachella Canal has been providing water for irrigation use in the eastern Coachella Valley.

After establishing a supplemental water importation program in the eastern part of the Coachella Valley and with the onset of recreational development in the western part of the Coachella Valley, the need for a supplemental water importation program in the northwestern part of the Valley was recognized. As a result, CVWD and DWA entered into separate contracts with the State of California (State) in 1963 and 1962, respectively, to purchase water from the SWP. A direct connection from the SWP to the Coachella Valley does not currently exist. Therefore, CVWD and DWA entered into an agreement with the MWD to exchange water from MWD's Colorado River Aqueduct, which crosses the western portion of the Coachella Valley near Whitewater, for CVWD and DWA allocations of SWP water. Since 1973, CVWD and DWA have been releasing Colorado River Exchange Water near Whitewater to replenish groundwater in the western portion of the Whitewater River Subbasin of the Coachella Valley, and since 2002 to replenish groundwater in the Mission Creek Subbasin of the Coachella Valley.

CVWD and DWA entered into Water Management Agreements for the cooperative management of the Colorado River water received from MWD for replenishment of the western portion of the Whitewater River Subbasin, and the sharing of costs associated therewith, on July 1, 1976 and December 15, 1992. On July 15, 2014, they executed the Whitewater Water Management Agreement intended to update and replace the previous two Water Management Agreements.

On June 28, 1984, MWD, CVWD, and DWA entered into an Advance Delivery Agreement that allowed MWD to pre-deliver up to 600,000 AF of SWP Exchange Water into the Coachella Valley. MWD then had the option of delivering CVWD's and DWA's SWP allocations either from the Colorado River Aqueduct or from water previously

stored in the basin under the Advance Delivery Agreement. This agreement was subsequently amended to increase the maximum pre-delivery quantity to 800,000 AF.

Between October 1984 and December 1986, MWD initially recharged the Whitewater River Subbasin with about 466,000 AF of Advance Delivered Water for future exchange with CVWD and DWA. This initial quantity of Advance Delivered Water has been augmented several times since then, and the total quantity of Advance Delivered Water is currently 907,516 AF. During drought conditions, MWD has periodically met exchange delivery obligations with water from its Advance Delivery Account. By December 2015, MWD had converted approximately 708,309 AF of Advance Delivered Water to Exchange Water deliveries, leaving a balance of approximately 200,161 AF in MWD's Advance Delivery Account

Both CVWD and DWA are permitted by the State Water Code to replenish groundwater basins and to levy and collect water replenishment assessments from any non-exempt groundwater extractor or surface water diverter within their jurisdictions who benefits from replenishment of groundwater. CVWD began assessment of groundwater producers within the West Whitewater River Subbasin AOB in fiscal year 1980-1981, and DWA began its assessment program in fiscal year 1978-1979, thereby creating the GRP. The two agencies are not required to implement assessment procedures jointly or identically.

The State Water Code (Sections 31630-31639) requires completion of an Engineer's Report regarding the GRP before CVWD can levy and collect groundwater RACs. The report must include the condition of groundwater supplies, the need for groundwater replenishment, the AOB boundaries, water production within each AOB, and the RACs to be levied upon water production in the AOBs. It must also contain recommendations regarding the GRP, including the sources and amounts of replenishment water and related costs. The first Engineer's Report for the West Whitewater River Subbasin AOB was completed in April 1980; the first Engineer's Report for the Mission Creek Subbasin AOB was completed in April 2003; and the first Engineer's Report for the East Whitewater River Subbasin AOB was completed in April 2004.

In 1967, CVWD began a water reclamation program, having identified reclaimed water as an alternative source of water that could allow groundwater to remain in storage and help to reduce overdraft. Today, CVWD operates six WRPs in the Coachella Valley. Recycled water from three of these facilities (WRP 7, 9, and 10) has been used for golf course and greenbelt irrigation for many years, thereby reducing demand on the groundwater basin. CVWD is planning to continue expanding recycled water use throughout the mid-Valley.

Due to overdraft conditions in the Mission Creek Subbasin, located northerly of the Whitewater River Subbasin, CVWD and DWA began constructing facilities to replenish the Mission Creek Subbasin in October 2001, in accordance with applicable law. Facilities were completed in June 2002 and, DWA and CVWD began replenishment activities in the Mission Creek Subbasin in December 2002.

On April 8, 2003, CVWD and DWA recognized that management of the Mission Creek Subbasin extended across agency boundaries, and entered into the Mission Creek Groundwater Replenishment Agreement for the cooperative management of the Colorado River water received from MWD for replenishment of the Mission Creek Subbasin, and the sharing of costs associated therewith. This agreement acknowledged

the need to operate the Mission Creek Subbasin as a complete unit rather than as individual segments delineated by agency boundaries.

The agreement was developed following numerous investigations regarding the groundwater supply within the Coachella Valley. Those investigations are addressed in previous reports (Engineer's Reports on Water Supply and Replenishment Assessment for CVWD, 1980-1981 through 2002-2003).

On December 7, 2004, CVWD, DWA, and MSWD entered into an addendum ("Settlement Agreement") to the 2003 Mission Creek Groundwater Replenishment Agreement. On July 15, 2014, CVWD and DWA executed a Mission Creek Water Management Agreement intended to update and replace the previous Mission Creek Groundwater Management Agreement.

The Mission Creek Water Management Agreement calls for the maximum importation of water for replenishment of groundwater basins within a defined management area. The agreement also requires collection of data necessary for sound management of all water resources within the same management area.

The Mission Creek/Garnet Hill Subbasins Water Management Plan (Plan) Final Report was completed in January 2013 as a collaborative effort between DWA, MSWD, and CVWD. The purpose of the Mission Creek/Garnet Hill Subbasins Water Management Plan is to manage the water resources to meet demands reliably and protect water quality in a sustainable and cost-effective manner. Mission Creek/Garnet Hill Subbasins Water Management Plan provides the status of the subbasins, current issues, and water management goals. As recommended by Mission Creek/Garnet Hill Subbasins Water Management Plan, additional information such as annual precipitation and groundwater levels have been included in herein to more thoroughly describe the condition of the subbasin.

In the eastern portion of the Whitewater River Subbasin, groundwater levels had been declining since about 1980. In response, CVWD implemented a GRP to replenish the subbasin at two sites in the eastern Coachella Valley. Groundwater replenishment began in 1997 using pilot groundwater replenishment facilities.

The Dike 4 Pilot project began in 1997, and became the fully operational TEL Replenishment Facility in June 2009, with a full-scale capacity of 40,000 AF/Yr. The Martinez Canyon Pilot project, designed for 4,000 AF/Yr, began in 2004 to determine if water conditions at the site were beneficial for groundwater replenishment. Although there were zero deliveries to the Martinez Canyon Replenishment Facilities in 2015, CVWD continues to monitor and evaluate the need and feasibility of replenishment in the Martinez Canyon alluvial fan. As of the end of 2015, the combined cumulative total replenishment at the two sites was 271,289 AF.

In 2002, the CVWD Board of Directors adopted the CVWMP. The CVWMP was updated in 2010 (2010 CVWMP Update), and a status report was issued in 2014 (2014 Status Update). The goal of the 2010 CVWMP Update is to reliably meet current and future water demands in a cost effective and sustainable manner through water conservation, increased surface water supplies, substitution of surface water supplies to replace groundwater (source substitution), groundwater replenishment, and monitoring. The 2010 CVWMP Update can be found on CVWD's website at www.cvwd.org.

C. Replenishment Water Source(s)

1. Coachella Canal and Colorado River Water

a. Coachella Canal

The 122-mile long Coachella Branch of the All-American Canal (Coachella Canal or Canal) was completed in 1948, and began operating in 1949. Water delivered to the Coachella Valley via the Coachella Canal is diverted from the Imperial Dam 18 miles upstream of Yuma, Arizona into the All-American Canal. It is then diverted into the Coachella Canal at "Drop 1" of the All-American Canal, approximately 20 miles west of Yuma. It conveys water northward into the eastern Coachella Valley along the east bank of the Salton Sea, continuing northerly past Mecca and Thermal to Indio, where it bends westerly, then continues southerly and southwesterly to La Quinta, where it discharges into Lake Cahuilla (constructed by CVWD in 1968 to provide recreational and operational storage for Colorado River water). Along its route, it distributes water for irrigation to approximately 73,000 acres of agricultural land in the eastern Coachella Valley through nearly 500 miles of buried delivery laterals (IRWMP 2010). The capacity of the Coachella Canal is approximately 1,500 cfs (CVWD 2002).

b. Colorado River Water Allocations

Distribution of water from the Colorado River to the seven Colorado River Basin states is governed by the Law of the River, a collection of interstate compacts, federal and state legislation, agreements and contracts, and international treaty, a U.S. Supreme Court decree, and federal and state administrative actions (CVWD 2002).

California's apportionment of Colorado River water is allocated by the 1931 Seven Party Agreement, which allocates 5,362,000 AF/Yr between nine categories of users with different priorities. CVWD was included in a group of California agricultural agencies under Priority 3(a), which was collectively allocated 3.85 million AF/Yr (CVWD 2002).

In 1934, a contract was signed between CVWD and the U.S. Department of the Interior which designates a portion of CVWD's service area (Improvement District 1 or ID-1) as eligible to receive Colorado River water under the *Boulder Canyon Project Act* of 1928 (CVWD 2002).

In 2003, the Quantification Settlement Agreement (QSA) between CVWD, the Imperial Irrigation District (IID), and MWD, supplementing the 1931 agreement was signed. The QSA provided CVWD with an initial base allotment of 330,000 AF/Yr, adjusted to 301,000 AF/Yr (to account for canal lining and miscellaneous water rights claims). In accordance with the QSA, CVWD has entered into water transfer agreements with MWD and IID that increase CVWD supplies by an additional 158,000 AF/Yr, which will be effective 2026 (CVWD 2012).

Replenishment water for the East Whitewater River Subbasin AOB GRP comes primarily from CVWD's Colorado River water contract and the QSA. Colorado River water available for groundwater replenishment includes the following block amounts:

Base Allotment	301, 000 AF
1988 MWD/IID Approval Agreement	20,000 AF
IID to CVWD-First Transfer	50,000 AF
IID to CVWD-Second Transfer	53,000 AF
Total:	424,000 AF

Groundwater replenishment water is priced at CVWD's Canal Water Class 3 Rate plus Quagga Mussel and Gate Charges.

The QSA also provided CVWD a transfer of SWP water from MWD in the amount of 35,000 AF/Yr (35 TAF/Yr). This SWP water is exchanged for Colorado River water and can be delivered at Imperial Dam for delivery via the Coachella Canal to the eastern portion of the Whitewater River Subbasin or can be delivered via the Colorado River Aqueduct for delivery to the western portion of the Whitewater River Subbasin.

c. Quagga Mussel

In 2007, quagga mussels (an invasive species of mussel, *Dreissena bugensis*) were discovered at Imperial Dam, through which Colorado River water passes shortly before diversion into the All American and Coachella Canals. As a result of the discovery, CVWD constructed a sodium hypochlorite dosing facility (chlorination facility) to deliver chlorine to the Coachella Canal downstream of its turnout from the All American Canal (i.e. Drop One) to prevent the mussels from infesting and colonizing the Canal or Canal water conveyance and storage facilities.

2. State Water Project

a. Table A Amounts

The SWP includes 660 miles of aqueduct and conveyance facilities from Lake Oroville in the north to Lake Perris in the south. The SWP has contracts to deliver 4.1 million AF/Yr to 29 contracting agencies. CVWD's original 1963 Table A Amount was 23,100 AF/Yr and DWA's original 1962 Table A Amount was 38,100 AF/Yr for a combined Table A Amount of 61,200 AF/Yr.

In 2003, CVWD and DWA executed a Delivery and Exchange Agreement with MWD in which the two agencies acquired 100,000 AF/Yr of MWD's SWP Table A water as a permanent transfer, with CVWD receiving 88,100 AF/Yr and DWA receiving 11,900 AF/Yr. However, MWD retained the option to call-back or recall the assigned annual Table A water allocations, in accordance with specific conditions, in any year. In implementing the 2003 Exchange Agreement, MWD advised CVWD and

DWA that it would probably recall the 100,000 AF assigned to the two Coachella Valley agencies from 2005 through 2009. In fact, MWD did recall 100,000 AF in 2005 but has not recalled any water since then. According to communications with MWD staff, it is unlikely that MWD will recall any water in 2016.

In 2004, CVWD purchased 9,900 AF/Yr of SWP Table A water from the Tulare Lake Basin Water Storage District.

In 2007, CVWD and DWA completed negotiations for two water transfers. The first transfer to CVWD and DWA for 12,000 AF/Yr and 4,000 AF/Yr, respectively, from Berrenda Mesa Water District for a total Table A Amount of 16,000 AF/Yr. The second transfer to CVWD and DWA for 5,250 AF/Yr and 1,750 AF/Yr, respectively, from Tulare Lake Basin Water Storage District for a total of 7,000 AF/Yr. The transfers were completed in 2007 but did not take effect until January 1, 2010, when deliveries under these two transfers first began. These Table A Amount transfers increased the total combined Table A Amount for CVWD and DWA to 194,100 AF/Yr with CVWD's portion equal to 138,350 AF/Yr and DWA's portion equal to 55,750 AF/Yr.

b. SWP Supplemental Water

CVWD and DWA also purchase interruptible water, as available, from the SWP on the spot market including Turn-Back Water Pool Program (Pool A and Pool B) water.

In 2008, CVWD and DWA executed agreements to augment SWP water supplies. CVWD and DWA executed separate agreements to acquire SWP supplemental water from the CDWR for a Water Supply and Conveyance Under a Dry Year Water Purchase Program. CDWR initiated this Dry Year Water Purchase Program to augment water supplies in anticipation of decreased water availability to SWP Contractors resulting from dry hydrologic conditions and/or regulatory constraints.

CDWR will make the water available for purchase from its Yuba Agreement. The amount of water available for purchase will be based on CDWR's determination of the Water Year Classification. It is estimated that CVWD and DWA may be able to purchase up to 4 percent or 5,600 AF/Yr, and 1.3 percent or 1,820 AF/Yr, respectively. These agreements provide for the exchange of these supplies with MWD for Colorado River water in accordance with existing exchange agreements.

c. Metropolitan Water District Exchange: State Water Project for Colorado River Water

CVWD and DWA cannot directly receive SWP water. CVWD and DWA have existing exchange agreements (signed in 1972 and amended in 1983) with MWD for delivery to the Whitewater River Subbasin. These agreements provide for CVWD and DWA to exchange their SWP water deliveries with MWD for Colorado River water. The 1984 Advance

Delivery Agreement between CVWD, DWA and MWD (as amended) allows MWD to store up to 800,000 AF water in the Coachella Valley Groundwater Basin. Subsequent to such Advance Deliveries, MWD has the option of delivering CVWD's and DWA's SWP allocations either from the Colorado River Aqueduct or from water previously stored in the basin under the Advance Delivery Agreement.

As mentioned in **Paragraph 1.b.** above, CVWD and MWD executed a SWP water transfer agreement during the QSA negotiations that was intended to provide 35,000 AF (35 TAF) of Colorado River water per year to the Coachella Valley via the Coachella Canal, and would not be subject to SWP reliability concerns or applied to the Advance Delivery account. A delivery of 10,000 AF of this water was made to the Whitewater River Groundwater Replenishment Facility in 2010, and two supplements to the 2003 Delivery and Exchange Agreement for the delivery of the 35,000 AF/Yr were then negotiated. Under the "First Supplement" (2011), MWD agreed to pre-deliver 105,000 AF of Exchange Water to the Whitewater River Groundwater Replenishment Facility, satisfying MWD's delivery obligation for 2011, 2012, and 2013. Under the "Second Supplement" (2013), MWD would pre-deliver 2,508 AF of Exchange Water to the Whitewater River Groundwater Replenishment Facility in 2013 as part of MWD's obligation for 2014. MWD was unable to meet its obligation in 2014, but was able to deliver 3,533 AF to the Whitewater River Groundwater Replenishment Facility, and to credit 16 AF from the Advance Delivery Account. In 2015, MWD delivered 865 AF to the Whitewater River Groundwater Replenishment Facility under this account.

d. State Water Project Reliability

Continuous availability of SWP allocations will require complete development of the SWP, which currently has only about half of the water supply capacity needed to meet maximum Table A Amount obligations during droughts; available water supplies are being further threatened by new and increasing constraints on the development of new water supply facilities and on the operation of existing facilities.

In particular, the Wanger decisions regarding protection of the Delta smelt, concerns about reliability of the Delta levees, and other concerns led the CDWR to issue a revision in June 2012 of *The SWP Reliability Report 2009*, dated August 2010, wherein the long-term reliability of SWP supplies was reduced to approximately 60 percent of maximum allocations (later reduced to 58 percent). Without the construction of additional Sacramento-San Joaquin Delta facilities and certain water storage reservoirs, the water supply capability of the SWP will remain limited and SWP Contractors will have to share reduced quantities of available supplies, especially during droughts.

With continued progress in the completion of California WaterFix (formerly known as the Bay Delta Conservation Plan (BDCP)), the balance between more reliable SWP water supplies and ecosystem restoration will be increased.

The BDCP was a long-term conservation strategy designed to set forth actions required for a healthy Delta that would have been implemented over the next 50 years, with an estimated cost of about \$20 billion. California WaterFix is a refinement of the BDCP that involves a shorter term of implementation and incidental take authorization, and a narrowing of scope: the principal habitat restoration effort of the BDCP has been isolated as a separate program called "California EcoRestore".

California WaterFix itself involves the construction and operation of new water diversion facilities near Courtland to convey water from the Sacramento River through two tunnels to the existing state and federal pumping facilities near Tracy. In addition to other federal, state, and local approvals, California WaterFix requires changes to the water rights permits for the SWP and the federal Central Valley Project to authorize the proposed new points of water diversion and rediversion.

Currently, the cost of California WaterFix is estimated at about \$15 billion. Eventually, SWP water supply reliability, quality, and delivered quantities and the overall health of the Delta may improve; however, it is unlikely that the costs for Delta improvements will be allocated to the SWP Contractors before 2020.

In addition to the existing restrictions on water supplies from the SWP, California is in its fourth consecutive year of severe drought. Beginning in 2012, the State has experienced the driest three years on record. In response to another dry winter in 2014/2015, the Governor of California issued an executive order on April 1, 2015, mandating water restrictions on urban water use statewide, and demanding 25 percent reduction in water use. As of the date of this report, the effect this executive order will have on water deliveries from the SWP is uncertain.

The *2013 SWP Final Reliability Report*, dated December 2014, estimated the long-term reliability of SWP supplies at 58 percent of maximum Table A Amounts through 2033. Last year, CDWR issued the *2015 SWP Deliverability Capability Report*, dated July 2015. Said report estimated the median deliverability of SWP supplies at approximately 64 percent, and long-term deliverability (82-year average value) at 62 percent of maximum Table A Amounts 50 percent of the time over the historic long-term. However, said report's estimates are qualified as being based on existing and historical conditions, and are not intended as future projections. Furthermore, the extremely dry sequence from the beginning of January 2013 through the end of 2014 was one of the driest two-year periods in historical record, and resulted in a low SWP supply allocation in 2013 (35 percent of SWP Table A Amounts), and an extremely low SWP water supply allocation in 2014 (5 percent of Table A Amounts). The dry hydrologic conditions that led to the low 2014 SWP water supply allocation were extremely unusual, and to date have not been included in the SWP delivery estimates presented in CDWR's *2015 Delivery Capability Report*. It is anticipated that the hydrologic record used in the CDWR model will be extended to include the period through 2014 during the next update of the model, which is expected to be completed prior to

issuance of the next update to the biennial SWP *Delivery Capability Report*. Given these factors, the older, more conservative 58 percent reliability figure has been used for future projections in this report.

The low reliability of the SWP requires the placement of increased emphasis on other sources of replenishment water, such as Colorado River water and recycled water.

3. Non-State Water Project Supplemental Water

In 2003, CVWD and MWD entered into a one-time agreement for MWD to return 32,000 AF of Colorado River water received as a result of water conservation measures taken by CVWD in Palo Verde prior to execution of the QSA. Per the agreement with MWD, MWD delivered half of the 32,000 AF (16,000 AF) to CVWD in 2007 at the Whitewater River Groundwater Replenishment Facility. In 2008, 8,008 AF were delivered, and the remaining 7,992 AF were delivered to CVWD in 2009 at the Whitewater Groundwater Replenishment Facility.

In 2008, CVWD executed an Agreement with Rosedale Rio Bravo Water Storage District (Rosedale) for a one-time transfer of 10,000 AF of banked Kern River flood water that is exportable to CVWD. Deliveries to CVWD began in 2008 when 3,000 AF were delivered and 3,000 AF were delivered in 2009. There were no deliveries in 2010 or 2011. The 4,000 AF remaining balance was delivered in 2012. CVWD entered into an Assignment Agreement with the Glorious Lands Company effective July 10, 2012 which transferred the existing Amended Water Supply Agreement between Glorious Lands Company and Rosedale to CVWD. CVWD will receive up to 9,500 AF/Yr of Rosedale water through 2035. In 2014, 5,000 AF were delivered to MWD on behalf of CVWD, and 9,500 AF were delivered to MWD on behalf of CVWD in 2015. These quantities of water have not yet been delivered to CVWD.

In 2008, DWA and MWD executed an Exchange Agreement for delivery of non-SWP supplemental water purchased by DWA from MWD to replenish water extracted by CPV-Sentinel Energy, Inc. MWD will exchange these supplies with Colorado River water in accordance with existing exchange agreements. DWA plans to acquire up to 36,000 AF of non-SWP supplemental water during the period from 2008 through 2015 from entities in Kern County. MWD delivered 754 AF, 1,743 AF, 5,350 AF, and 134 AF to the Mission Creek Subbasin from 2009, to 2012, pursuant to this agreement.

In 2010, CVWD executed an agreement with DMB Pacific, Inc. for the one-time transfer of 8,393 AF of "Nickel" water made available through Kern County Water Agency's Kern River Restoration and Water Supply Program. Per the agreement, CVWD received the full transfer amount in 2010.

4. Recycled Water

CVWD began producing recycled (reclaimed) water in 1967. Recycled water is a significant potential local resource that can be used to help reduce overdraft. Although treated wastewater is not yet suitable for direct potable use, wastewater that has been treated to State standards can be reused for landscape irrigation

and other purposes. Recycled wastewater has historically been used for irrigation of golf courses and municipal landscaping in the Coachella Valley.

CVWD operates six WRPs in the Coachella Valley. Recycled water from two of these facilities (WRP 9 and WRP 10) has been used for golf course and greenbelt irrigation in the Palm Desert area for many years, thereby reducing demand on the groundwater basin. A third facility (WRP 7), located north of Indio, began providing recycled water for golf course and greenbelt irrigation in 1997. CVWD is currently planning to expand non-potable water (imported water and recycled water) use within the central portion of the Coachella Valley (mid-Valley).

5. Non-Potable in Lieu Replenishment (Source Substitution)

The term *in-lieu replenishment* refers to a reduction of demands on the aquifer by providing an alternative source of water to pumpers; thus, allowing them to reduce their extraction of groundwater from the aquifer. CVWD accomplishes in-lieu replenishment by providing non-potable, imported surface water from the Coachella Canal, recycled water, or a blend of Coachella Canal water and recycled water to golf courses, agricultural operations, and other irrigation water users, thus reducing or eliminating their use of pumped groundwater. When a golf course or other irrigation water user switches from pumped groundwater to non-potable supplies, it is referred to as "source substitution." Several source substitution projects were identified in the 2010 CVWMP Update and are currently being implemented.

D. Replenishment Assessment

1. Authority (State Water Code)

Sections 31630 through 31639 of the State Water Code authorize to levy and collect water replenishment assessments for the purpose of replenishing groundwater supplies within CVWD boundaries. CVWD began assessment of groundwater producers within the West Whitewater River Subbasin AOB in fiscal year 1980-1981, thereby creating the GRP. The State Water Code defines production, producer, and minimal pumper for replenishment purposes as follows:

- a. **"Production" or "to produce"** means the extraction of ground water by pumping or any other method within the boundaries of the district or the diversion within the district of surface supplies which naturally replenish the ground water supplies within the district and are used therein.
- b. **"Producer"** means any individual, partnership, association or group of individuals, lessee, firm, private corporation, or any public agency or public corporation, including, but not limited to, the CVWD.
- c. **"Minimal pumper"** means any producer who produces 25 or fewer AF in any year. Production by minimal pumpers is exempt from assessment.

The State Water Code states that assessments may be levied upon all water production within an AOB (other than that produced by minimal pumpers), provided the assessment charge is uniform throughout said AOB.

2. Replenishment Program Accounting and Replenishment Assessment Development

a. Replenishment Assessment Charge (RAC)

The RAC is a monetary charge per AF of groundwater extracted, authorized by the State Water Code and uniformly applied to extractions of groundwater within certain specified geographic boundaries of CVWD for payments of an imported or recycled (reclaimed) water supply purchased to supplement naturally existing water supplies. Charges for the water supply are limited to certain specified costs.

The RAC for each AOB is based on groundwater production within the AOB.

In the initial 12 years of operation of the West Whitewater River Subbasin AOB GRP, only the Variable Operation, Maintenance, Power and Replacement component of the Transportation Charge and the Delta Water Charge for the SWP could be included in the calculation. However, in 1991, the Legislature passed and the Governor signed into law AB 1070. This bill continues to limit the charges assessable against production, but includes an additional component of the Transportation Charge, the Off-Aqueduct Power component. CVWD has also been allowed, under the State Water Code, to include in its calculations surplus or excess water charges, payments to DWA for similar payments by DWA to the State, the cost of importing and recharging water from sources other than the SWP and the cost of treating and distributing recycled water. The RACs considered in this report are based on the most recent and reliable information available with respect to applicable costs or charges.

b. Coachella Valley Water District State Water Project Tax

In 1959, the voters of California approved and adopted the Burns-Porter Act (CDWR Bond Act-Water Code Section 12930) and in so doing, approved the use of local taxes when a local agency's board of directors determines such use to be necessary to fund that agency's water contract obligations. CVWD's Board of Directors determined that such a tax was necessary to carry out those obligations, which were incurred pursuant to CVWD's long-term plan to eliminate groundwater overdraft through replenishment basins that would benefit the entire Coachella Valley. This property tax has been levied on all property within the CVWD boundary since 1967. On March 12, 2013, the CVWD Board of Directors approved an increase in the property tax from \$0.08/\$100 of assessed valuation to \$0.10/\$100 of assessed valuation which became effective July 1, 2013.

The CVWD SWP Tax Revenues are presently being used to fund the GRPs in the Mission Creek Subbasin AOB, West Whitewater River Subbasin AOB, and East Whitewater River Subbasin AOB.

3. Methods for Determining Production

In accordance with Section 31638.5 of the California Water Code, producers who extract greater than 25 AF/Yr, including artesian flowing groundwater, are required to have water-measuring devices installed on all wells or other water producing facilities and report the total amount produced from all wells to CVWD on a monthly basis. Minimal pumpers are exempt from this provision.

Producers submit a water production statement on a CVWD approved form with their RAC payment each month or enter into a Water Production Metering Agreement with CVWD to have CVWD staff measure and report groundwater production.

If no statement of production is furnished, CVWD calculates production based on energy consumption records (in kilowatt-hours) and the results of well pump tests indicating unit energy consumption per AF of production (in kilowatt-hours per AF).

If no energy consumption records are available, CVWD computes the groundwater pumping based on consumptive use of water. Consumptive use is computed by multiplying the irrigated acreage for each crop type using CVWD's crop report (conducted semi-annually) by a water consumption factor for each crop. The water consumption factor is based on published crop evapotranspiration requirements, an allowance for leaching, and an irrigation efficiency of 70 percent. Other water consumption factors are used to compute production not used for irrigation. Production is computed by subtracting any metered deliveries of Canal water or recycled water.

If the total metered, estimated, or computed annual amount of production for any producer is 25 AF or less, that entity is designated a minimal pumper and will be exempt from the RAC for that year. Minimal pumpers are re-evaluated as necessary.

4. Impacts of Conservation

Water conservation may also become an important driver for future RAC rates. Reduced groundwater production associated with water conservation benefits the groundwater basin and is an important element of the 2010 CVWMP Update. The cost of this benefit is reflected in rising RAC rates that result from ongoing GRP costs that must be divided by lower groundwater production amounts.

Governor Brown's executive order dated April 1, 2015 responds to drought conditions in California and mandates a 25 percent reduction in water used by public water systems in California. To achieve this mandate, CVWD is tasked with reducing water use by 32 percent, as are several other local public water systems. In addition, the Governor is recommending golf courses using groundwater reduce their water use by 25 percent. Together, these changes would equate to approximately a 20 percent reduction in groundwater production

throughout the CVWD service area. Such reductions will require increases in the RAC in future years to continue funding ongoing GRP expenses, as described in the three Rate Study Reports comprising the 2016 Cost of Service Study.

5. 2016 Cost of Service Study

In late 2015, the CVWD Finance Department, along with Hawksley Consulting, conducted a Cost of Service Study to develop fair and equitable rates and recommendations for potential rate adjustments that will be necessary to cover operating cost increases and critical investment in CVWD's infrastructure. The Cost of Service Study resulted in three 2016 RAC Rate Study Reports, one for each AOB, which were completed in March 2016. The RACs set forth herein are compatible with the recommendations of said 2016 Rate Study Reports.

CHAPTER V
MISSION CREEK SUBBASIN
AREA OF BENEFIT

CHAPTER V

MISSION CREEK SUBBASIN AREA OF BENEFIT

A. Management Area and Area of Benefit

1. Mission Creek Subbasin Management Area

The Mission Creek Subbasin AOB is defined as the portion of the Mission Creek Subbasin (bounded on the north by the Mission Creek Fault, on the south by the Banning Fault, the low-permeability Indio Hills to the southeast, and the San Bernardino Mountains to the west) that lies within CVWD's service area.

CVWD and DWA have recognized the need to manage the Mission Creek Subbasin as a complete unit rather than as individual segments underlying the individual agency's boundaries. This management area consists of the entire Mission Creek Subbasin.

2. Mission Creek Subbasin Area of Benefit Boundary

Figures V-1 and V-2 at the end of this chapter show CVWD's Mission Creek Subbasin AOB. This boundary is defined as follows:

That portion of the Mission Creek Subbasin within the boundaries of CVWD, bounded on the east beginning approximately one-eighth mile west of the center of Section 10, Township 3 South, Range 5 East, San Bernardino Base and Meridian; thence southeasterly along the trace of the Mission Creek Fault to the base of Edom Hill; thence curving westerly along the base of the Indio Hills following along the southern San Andreas Fault to the intersection of Avenue 20 and Palm Drive; thence north along Palm Drive to Avenue 18; thence west along Avenue 18 to Little Morongo Road; thence north along the west section line of Section 12, Township 3 South, Range 4 East, to Avenue 16; thence east along the north section line of said Section 12 to the northeast corner of the section; thence south along the east section line of said Section 12 to the east-west midsection line, which is Dillon Road; thence east along Dillon Road to the point of beginning.

B. Water Supply and Use

1. Natural Replenishment (Precipitation and Stream Flow)

Precipitation in the surrounding mountains is included in the natural inflow estimates found in the water balance calculated in **Table V-4** of this report. The natural inflow estimates are based on long-term average rates provided by Reichard (USGS 1992), and the 2010 CVWMP Update.

During 2015, the average annual rainfall was 4.27 inches throughout the Mission Creek Subbasin Management Area and West Whitewater River Subbasin Management Area, as recorded by nine rain gage stations located in the Mission Creek Subbasin Management Area and West Whitewater River Subbasin Management Area monitored by Riverside County Flood Control and Water

Conservation District. This quantity is less than the typical average annual rainfall for the Upper Coachella Valley. 2015 precipitation data for these stations is presented in **Appendix A**.

2. Non-Potable Water

At this time, within CVWD's Mission Creek Subbasin AOB, there is one golf course extracting groundwater for irrigation purposes; however, access to recycled water supplies is currently unavailable for source substitution within the Mission Creek Subbasin.

MSWD operates two wastewater treatment facilities having a combined capacity of 2.2 million gallons per day, but the treated effluent is currently percolated for disposal into the Mission Creek Subbasin (MWH 2013). However, as development progresses and additional infrastructure is constructed within the Mission Creek Subbasin Management Area, opportunities for recycled water use may arise.

Developing recycled water use in the Mission Creek Subbasin would offset groundwater pumping for irrigation purposes and improve groundwater quality by removing nitrates that are otherwise percolated into the subbasin from MSWD's existing wastewater treatment facilities; however, it would not substantially lessen the need for artificial replenishment. This program was anticipated to be implemented within five years from the 2013 Mission Creek/Garnet Hill Subbasins Water Management Plan by MWH, but no progress has been made, to date, in developing the necessary additional wastewater treatment and recycled water distribution system in the Mission Creek Subbasin. According to MWH (2013), the total estimated cost to develop recycled water for the single golf course within DWA's Mission Creek Subbasin AOB would be approximately \$4.7 million. Additional costs for developing recycled water supplies for other potential recycled water users, including one golf course within CVWD's AOB, may be prepared in the future.

3. Production, Non-Consumptive Return, and Conservation

a. Groundwater Production

Table V-1 presents historical groundwater production in the Mission Creek Subbasin Management Area, including groundwater production for both CVWD's and DWA's AOBs. Production in 2015 totaled 12,670 AF. Production has declined from a high of 17,365 AF/Yr in 2006.

b. Non-Consumptive Return

The 35 percent non-consumptive return estimated for the Whitewater River Subbasin (USGS 1992) has also been applied in other parts of the Coachella Valley, including the Mission Creek Subbasin. However, based on MWH's groundwater model projections (MWH 2011), a current non-consumptive return of 34 percent is used herein, and is applied to groundwater produced locally for irrigation and municipal use.

c. Conservation

As discussed in **Chapter IV**, water conservation may also become an important driver for future RAC rates. Under Governor Brown's executive order dated April 1, 2015, CVWD is tasked with reducing water use by 32 percent and MSWD by 24 percent. In addition, the Governor is recommending golf courses using groundwater reduce their water use by 25 percent. Together, these changes would equate to approximately a 20 percent reduction in groundwater production in the Mission Creek Subbasin AOB.

Table V-1
Production within the Mission Creek Subbasin Management Area in Acre Feet

Year	Production within CVWD AOB	Production within DWA AOB ⁽¹⁾	Total ⁽²⁾	Annual Change ⁽³⁾	CVWD Percentage of Total Production	DWA Percentage of Total Production
1978	854	1,399	2,253	---	37.91	62.09
1979	1,001	2,564	3,565	1,312	28.08	71.92
1980	1,107	2,914	4,021	456	27.53	72.47
1981	1,421	2,878	4,299	278	33.05	66.95
1982	1,302	2,630	3,932	-367	33.11	66.89
1983	1,442	2,979	4,421	489	32.62	67.38
1984	1,915	3,740	5,655	1,234	33.86	66.14
1985	2,148	3,559	5,707	52	37.64	62.36
1986	2,159	4,278	6,437	730	33.54	66.46
1987	2,234	4,483	6,717	280	33.26	66.74
1988	2,302	4,834	7,136	419	32.26	67.74
1989	2,606	5,690	8,296	1,160	31.41	68.59
1990	2,512	5,790	8,302	6	30.26	69.74
1991	2,292	5,486	7,778	-524	29.47	70.53
1992	2,188	6,187	8,375	597	26.13	73.87
1993	2,528	6,333	8,861	486	28.53	71.47
1994	2,863	6,813	9,676	815	29.59	70.41
1995	2,865	7,237	10,102	426	28.36	71.64
1996	2,838	7,724	10,562	460	26.87	73.13
1997	2,104	7,795	9,899	-663	21.25	78.75
1998	2,757	7,534	10,291	392	26.79	73.21
1999	3,004	7,970	10,974	683	27.37	72.63
2000	3,433	8,405	11,838	864	29.00	71.00
2001	3,929	8,421	12,350	512	31.81	68.19
2002	4,371	9,597	13,968	1,618	31.29	68.71
2003	4,425	10,073	14,498	530	30.52	69.48
2004	4,628	11,920	16,548	2,050	27.97	72.03
2005	4,247	12,080	16,327	-221	26.01	73.99
2006	4,757	12,608	17,365	1,038	27.39	72.61
2007	4,547	11,862	16,409	-956	27.71	72.29
2008	4,543	11,232	15,775	-634	28.80	71.20
2009	4,813	10,295	15,108	-667	31.86	68.14
2010	4,484	9,820	14,304	-804	31.35	68.65
2011	4,653	9,550	14,203	-101	32.76	67.24
2012	4,582	9,493	14,075	-127	32.55	67.45
2013	4,415	10,080	14,495	420	30.46	69.54
2014	4,154	9,680	13,834	-661	30.02	69.97
2015	4,090	8,580	12,670	-1,164	32.28	67.72

Average Annual Change = 322

- ⁽¹⁾ Production within DWA AOB, per Krieger & Stewart.
⁽²⁾ Sum of production within CVWD's and DWA's AOBs.
⁽³⁾ Current year total minus previous year total

C. Groundwater Replenishment

1. Mission Creek Groundwater Replenishment Facility

The Mission Creek Groundwater Replenishment Facility consists of a series of 13 basins with a combined surface area of 57 acres, located at the upper (northerly) end of the Mission Creek Subbasin, westerly of Desert Hot Springs, near the intersection of Highway 62 and North Indian Canyon Drive. DWA and CVWD completed construction of the Mission Creek Groundwater Replenishment Facility in June 2002, and recharge activities commenced in November 2002. Since then, 141,428 AF of water has been replenished at the Mission Creek Groundwater Replenishment Facility.

2. Current Replenishment Activities

Alleviation of overdraft in the Mission Creek Subbasin was initiated in 2002 by CVWD and DWA using SWP water exchanged for Colorado River water.

In 2015, a total of 48,813 AF were delivered via the SWP to MWD on behalf of CVWD and DWA for replenishment at the Whitewater River Groundwater Replenishment Facility and the Mission Creek Groundwater Replenishment Facility as shown in **Table V-2**.

Table V-2
State Water Project Exchange Delivery to
Metropolitan Water District in 2015

Description	CVWD (AF)	DWA (AF)	Total (AF)
Table A	27,670	11,150	38,820
Article 21	0	0	0
Turnback Pool A and B	0	0	0
Multi-Year Pool	0	67	67
Dry Year (Yuba)	426	0	0
Rosedale	9,500	0	0
Article 56 (c) "Carryover"	0	0	0
Total Delivered to MWD	37,596	11,217	48,813

During 2015, MWD delivered 1,036 AF of Colorado River Exchange Water for replenishment to the Mission Creek Subbasin and the western portion of the Whitewater River Subbasin. The Colorado River Exchange Water includes all SWP deliveries except Article 56 (c) "Carryover" and MWD Advance Delivery. Article 56 (c) "Carryover" is water requested under Article 56 (c) of the Water Supply Contracts. SWP Contractors can carry over a portion of their allocated water approved for delivery in the current year for delivery during the next year. There were no carryover deliveries in 2015.

The amount of water that MWD has previously stored in the Coachella Valley Groundwater Basin through the Advance Delivery Agreement was 248,804 AF at the beginning of 2015 and was decreased by 48,643 AF to 200,161 AF at the end of 2015.

Of the total amount of Colorado River Exchange Water, on average, 90 percent is delivered to the West Whitewater River Subbasin Management Area, and 10 percent is delivered to the Mission Creek Subbasin Management Area. However, in 2015, the total amount of water delivered for replenishment within the West Whitewater River Subbasin Management Area was 865 AF, while the Mission Creek Subbasin Management Area received 171 AF, as shown in **Tables V-3 and VI-3**.

Table V-3
Colorado River Exchange Water
Delivered to Mission Creek Groundwater Replenishment Facility⁽¹⁾

Year	AF
2002	4,733
2003	59
2004	5,564
2005	24,723
2006	19,901
2007	1,011
2008	503 ⁽²⁾
2009	4,090 ⁽²⁾
2010	33,210 ⁽²⁾
2011	26,238 ⁽²⁾
2012	23,406
2013	2,379
2014	4,325
2015	171
Total	150,313

⁽¹⁾ Delivered water quantities vary as a result of drought conditions and Advance Deliveries associated with the Exchange Agreement.

⁽²⁾ Includes deliveries of DWA's non-SWP supplemental water purchased from entities in Kern County for the CPV Sentinel Energy Power Plant.

3. Future Replenishment Activities

CVWD and DWA request their full Table A Amounts each year for a combined total of 194,100 AF.

Since water demand and groundwater extraction are expected to increase in the future, the current GRP will need to be continued and increased in the future to eliminate long-term overdraft (MWH 2013).

There may be limitations on the replenishment program such as supply availability (see **Chapter IV** regarding SWP reliability) and replenishment basin capacity, however, the 2004 Mission Creek Settlement Agreement Addendum states CVWD and DWA will replenish available water. CVWD and DWA are both committed to acquiring additional water supplies for the Coachella Valley.

4. Other Replenishment Activities

DWA, MSWD, and CVWD completed the Mission Creek/Garnet Hill Subbasins Water Management Plan in January 2013. The purpose of the Mission Creek/Garnet Hill Subbasins Water Management Plan is to manage the water resources to meet demands reliably and protect water quality in a sustainable and cost-effective manner. Mission Creek/Garnet Hill Subbasins Water Management Plan provides the status of the subbasins, current issues, and water management goals.

D. Aquifer Conditions

1. Groundwater Inflows and Outflows

Total inflow and outflow to the Mission Creek Subbasin Management Area in 2015 is summarized in **Table V-4**. The Mission Creek/Garnet Hill Subbasins Water Management Plan (MWH 2013) and Psomas Groundwater Model (Psomas 2013) provide updated estimates of natural replenishment and subsurface flows.

The long-term estimated natural inflow of 9,300 AF/Yr includes estimated average mountain-front precipitation and runoff (7,500 AF/Yr) and flow across subbasin boundaries into the Mission Creek Subbasin (1,840 AF/Yr). The non-consumptive return of applied water is estimated at 4,500 AF, which is 34 percent of the estimated reported groundwater production of 12,670 AF/Yr and an assumed production of approximately 500 AF/Yr from minimal pumpers (see **Section B** above for a more detailed explanation). The total inflow includes the natural inflow, the non-consumptive return, and the 171 AF of water replenished at the Mission Creek Groundwater Replenishment Facility.

The total outflow is the estimated groundwater production plus 6,000 AF/Yr of estimated natural outflow. Estimated natural outflows include 4,000 AF/Yr of subsurface outflow into the Garnet Hill Subbasin, 1,100 AF/Yr of subsurface outflow to the western portion of the Whitewater River Subbasin, and 900 AF/Yr of evapotranspiration by native vegetation (MWH 2013).

Table V-4
2015 Water Balance in the
Mission Creek Subbasin Management Area

Item	Annual Calculation (AF)
<u>2015 Groundwater Production</u>	
Reported Production	-12,670
Assumed Approximate Production by Exempt Minimal Pumpers	-500
Total Estimated Production (Rounded)	<u>-13,200</u>
Non-Consumptive Return ⁽¹⁾	4,500
<u>Natural Inflow</u>	
Natural Replenishment ⁽²⁾	7,500
Subsurface Inflow across Mission Creek Fault ⁽²⁾	1,840
Total Natural Inflow (Rounded)	<u>9,300</u>
<u>Natural Outflow</u>	
Subsurface Outflow Across Banning Fault ⁽²⁾	-4,000
Subsurface Outflow to Southeast ⁽²⁾	-1,100
Evapotranspiration ⁽²⁾	-900
Total Natural Outflow (Rounded)	<u>-6,000</u>
Artificial Replenishment ⁽³⁾	171
Annual Balance	-5,229
Annual Balance (Rounded)⁽⁴⁾	-5,200

⁽¹⁾ Based on 34 percent of production (13,200 AF x 0.34 = 4,488 AF), rounded.

⁽²⁾ MWH 2013

⁽³⁾ Water delivered to the Mission Creek Groundwater Replenishment Facility.

⁽⁴⁾ This was a decrease in stored groundwater equal to 0.2 percent of the subbasin's storage capacity of 2,600,000 AF in 2015.

The annual balance is the total inflow less the total outflow, for a loss of approximately 5,200 AF of water in storage in the subbasin in 2015. This was primarily due to reduced replenishment deliveries due to the on-going drought.

2. Change in Groundwater Storage

In 2015, the change in groundwater in storage in the Mission Creek Subbasin was negative. Imported water may offset annual changes in the groundwater in storage in a particular year. However, on a long-term basis, water requirements are likely to continue to place demands on groundwater in storage. The 2010 CVWMP Update outlined a plan to address long-term overdraft in the Coachella Valley. The 2014 Status Report for the CVWMP Update (2014 Status Plan) illustrates that storing imported water supplies is beneficial to the future of the groundwater basin.

Without artificial replenishment, the annual reduction in stored groundwater within the Mission Creek Subbasin in 2015 would have been approximately -5,400 AF, compared to the annual balance of -5,200 AF as

shown in **Table V-4**. Continued groundwater replenishment is necessary to prevent long-term overdraft in the future.

Figure V-4 at the end of this chapter shows the historic and projected change of groundwater in storage based on total inflows and outflows. The GRP has eliminated overdraft in the management area. As shown by the ten-year average change in storage, evidenced by the positive average since 2009.

The total historic outflow shown in **Figure V-4** consists of groundwater production and natural outflows as shown in **Table V-4** of this Engineer's Report and past Engineer's Reports.

The total historical inflow shown in **Figure V-4** consists of artificial replenishment, natural inflows, and non-consumptive return (34 percent of total groundwater production) as shown in **Table V-4** of this Engineer's Report and past Engineer's Reports.

Projected groundwater production was obtained from MWH as prepared for the Mission Creek/Garnet Hill Subbasins Water Management Plan, which accounts for population growth within the management area as forecast by Coachella Valley Association of Governments in 2010. Groundwater production and population projections have not been reassessed by MWH since the water management plan was published in 2013.

Projections for groundwater replenishment are based on anticipated SWP deliveries as reported by the CDWR annually (as available) for 2015, and thereafter according to the *2013 SWP Final Reliability Report* long-term average delivery estimate of 58 percent.

In accordance with the Mission Creek Groundwater Replenishment Agreement, dated April 8, 2003, each year DWA and CVWD calculate the total groundwater production and surface water diversion from the Mission Creek Subbasin Management Area and West Whitewater River Subbasin Management Area in order to determine the quantity of SWP water to be delivered to each subbasin in the current year as a portion of the previous year's total production or diversion. Typically, the Mission Creek Subbasin Management Area has accounted for approximately 7 percent of the total production within both management areas, but based on current production projections, relative production in the management area will increase to a range of 12 percent to 19 percent through 2035. The percentage of proportionate delivery is projected to increase due to assumptions made in the Mission Creek/Garnet Hill Subbasins Water Management Plan that population will increase in the Mission Creek Subbasin Management Area and groundwater production will decrease in the West Whitewater River Subbasin Management Area due to conservation and source substitution.

As of March 17, 2016, CDWR expects to deliver 45 percent of its total allocations to SWP Contractors in 2015. Of that 45 percent expected to be delivered to both DWA and CVWD, 8 percent (per 2015 production) is projected for delivery to the Mission Creek Groundwater Replenishment Facility.

Projections of groundwater replenishment during the period 2016 through 2035 are based on a 58 percent long-term average of total allocations and projected groundwater production for both the Mission Creek Subbasin Management Area and West Whitewater River Subbasin Management Area in the absence of the California WaterFix.

3. Groundwater Levels

Historical water level declines and conditions producing those declines in the Coachella Valley Groundwater Basin have been extensively described by the USGS and CDWR.

Although groundwater levels in the Mission Creek Subbasin rose slightly between 1938 and 1952, they declined steadily since 1952 until replenishment began in 2002. The historical declining water table in the Mission Creek Subbasin Management Area led to the determination that a management program was necessary to stabilize water levels and to prevent adverse effects such as water quality degradation and land subsidence. After commencement of groundwater replenishment activities in 2002, a reduction in the decline of water levels was observed.

Figure V-1 at the end of this chapter depicts the change in average groundwater levels from 2014 to 2015 in the Mission Creek Subbasin and in CVWD's Mission Creek Subbasin AOB. The Mission Creek Subbasin AOB boundary and location of the Mission Creek Groundwater Replenishment Facility are also shown.

The average change observed in the six wells monitored from 2014 to 2015 within CVWD's Mission Creek Subbasin AOB was an increase of 2.8 feet. The average change observed in the 17 wells monitored from 2014 to 2015 within the overall Mission Creek Subbasin Management Area was a decline of 1.4 feet. One monitoring well and one production well are located near the Mission Creek Groundwater Replenishment Facility, and experience dramatic fluctuations in water levels throughout the year in response to water deliveries. In 2015, water levels in these wells declined approximately 19 to 20 feet due to such fluctuations.

Figure V-2 at the end of this chapter depicts the change in average groundwater levels from 2005 to 2015 in the Mission Creek Subbasin Management Area and in CVWD's Mission Creek Subbasin AOB. The Mission Creek Subbasin AOB boundary and location of the Mission Creek Groundwater Replenishment Facility are also shown.

The average change observed in the five wells monitored from 2005 to 2015 within CVWD's Mission Creek Subbasin AOB was an increase of 4.9 feet (one of the wells monitored for the one-year comparison had no data in 2005). The average change observed in the 14 wells monitored from 2005 to 2015 within the overall Mission Creek Subbasin Management Area was an increase of 18.8 feet. Note that, in contrast with the decrease in water levels shown near the replenishment facility from 2014 to 2015, the water levels near the replenishment facility increased by over 70 feet from 2005 to 2015.

Figure V-3 at the end of this chapter illustrates the response of water levels in the Mission Creek Subbasin to groundwater replenishment. Wells located nearest the Mission Creek Groundwater Replenishment Facility (Mission Creek Monitoring Well and MSWD 34) experienced more dramatic changes in water level than those further away, as with the wells located in CVWD's AOB (CVWD 3405 and CVWD 3518). Despite the physical distance from the replenishment facility, wells within CVWD's AOB are, in fact, benefiting from groundwater replenishment, as evidenced by the stabilization of water levels since the program commenced in 2002.

4. Assessment of Overdraft Conditions

There was a negative change in groundwater in storage within the Mission Creek Subbasin in 2015 as shown in **Figure V-4**. However, long-term overdraft in the Mission Creek Subbasin has essentially been eliminated as evidenced by a positive ten-year average change in groundwater storage since 2009 due to artificial replenishment and other water management activities. As shown in **Figures V-1 through V-3**, groundwater replenishment has been effective in stabilizing water levels within the AOB, and continued groundwater replenishment is necessary to prevent long-term overdraft in the future.

E. **Replenishment Assessment**

1. Replenishment Water Costs

In the initial 12 years of operation of the West Whitewater River Subbasin AOB GRP, only the Variable Operation, Maintenance, Power and Replacement component of the Transportation Charge and the Delta Water Charge for the SWP could be included in the calculation. However, in 1991, prior to construction of the Mission Creek Groundwater Replenishment Facility, the Legislature passed and the Governor signed into law AB 1070. This bill continues to limit the charges assessable against production, but includes an additional component of the Transportation Charge, the Off-Aqueduct Power component. CVWD has also been allowed, under the State Water Code, to include in its calculations surplus or excess water charges, payments to DWA for similar payments by DWA to the State, the cost of importing and recharging water from sources other than the SWP and the cost of treating and distributing recycled water. The RACs considered in this report are based on the most recent and reliable information available with respect to applicable costs or charges.

CVWD has incurred additional costs associated with the GRP which include continuing engineering studies, well meter reading and maintenance, and groundwater monitoring. These costs have now also been included as a portion of the RAC. Although the law allows inclusion of the cost of treating and distributing reclaimed water, these costs have not been included.

2. Replenishment Program Accounting and Replenishment Assessment Development

a. Minimal Pumpers

There are approximately 10 to 20 exempt minimal pumpers within the Mission Creek Subbasin Management Area. These are predominantly small wells used for domestic or limited irrigation purposes. Maximum pumpage by the minimal pumpers in the management area is assumed to be less than approximately 500 AF/Yr, or less than 5 percent of annual groundwater production within the management area.

b. Income Statement

Table V-5 presents an income statement showing Actual Fiscal Year 2015, Projected Fiscal Year 2016, and Projected Fiscal Year 2017 Revenues, Expenses, and Cash Flow. **Table V-5** shows that without increasing the RAC rate, existing reserves are insufficient to support expenditures. Therefore, an increase to the Mission Creek Subbasin RAC is proposed for fiscal year 2017 to \$123.20/AF.

c. Replenishment Assessment Charge (RAC)

GRP costs continue to increase. CVWD has analyzed projected expenses, revenues, and reserves over the next five years and determined that the RAC should be increased to \$123.20/AF, effective July 1, 2016.

Based on Projected Revenue as shown in **Table V-5**, the proposed RAC increase results in a projected decrease in Cash Flow in fiscal year 2017 in the amount of \$1.4 million.

Table V-5
Coachella Valley Water District
Mission Creek Subbasin Area of Benefit
Groundwater Replenishment Program Income Statement

Description	Actual Fiscal Year (FY) 2015 (\$1,000)	Projected FY 2016 (\$1,000)	Projected FY 2017 (\$1,000)
Revenues			
RAC Rate ⁽¹⁾	419	481	469
SWP Tax Revenue ⁽²⁾	1,990	1,990	1,990
Other Revenue ⁽³⁾	39	33	37
Total Revenues	2,448	2,504	2,496
Expenses			
Total O&M Costs	86	133	126
Administrative Costs ⁽⁴⁾	138	151	155
State Water Project Costs			
SWP Table A Amount Costs ⁽⁵⁾	510	917	1,188
Supplemental SWP Water Costs ⁽⁶⁾	101	112	370
Other SWP Costs ⁽⁷⁾	1,416	1,558	1,597
Total SWP Costs	2,028	2,587	3,155
Supplemental Non SWP Water Costs ⁽⁸⁾	57	179	508
Depreciation	1	1	1
Capital Improvement Budget			
Transfer to (from) Other Funds ⁽⁹⁾	648		
Total Expenses	2,958	3,051	3,945
Increase (Decrease) in Cash Flow - Replenishment	177	36	(303)
Increase (Decrease) in Cash Flow - SWP	(686)	(582)	(1,145)
Net Increase (Decrease) in Cash Flow	(509)	(546)	(1,448)
Ending Unrestricted Reserves	1,798	1,834	1,531
Ending Restricted Reserves	2,366	1,784	639
Ending Reserves	4,164	3,618	2,170

(1) RAC for FY 2015 = \$98.73/AF, for FY 2016 = \$112.00/AF, and for FY 2017 = \$123.20. The FY 2017 rate is the recommended rate from the cost of service study. Revenues based on FY actual or budgeted production estimates.

(2) SWP revenues collected from \$.08 tax levy.

(3) Other Revenues include investment income.

(4) Includes personnel, meter reading, billing, groundwater monitoring and report preparation.

(5) SWP Table A costs that can be paid for by the RAC.

(6) SWP Turnback Water Pool A & B, Pool A & B Water, and Yuba Dry Year that can be paid for by the RAC.

(7) SWP costs that cannot be paid for by the RAC.

(8) Mission Creek Funds prorated amount of non SWP water costs.

(9) The \$648,000 transfer out is comprised of a transfer to the East Whitewater Fund for redevelopment revenues that were incorrectly receipted to the SWP reserves in prior years.

F. Conclusions and Recommendations

Because groundwater production from the Mission Creek Subbasin AOB continues to exceed natural inflow, the GRP must continue importing water for groundwater replenishment.

The GRP has proven to be effective in improving groundwater storage and eliminating groundwater overdraft, and should be continued. However, GRP costs continue to increase. CVWD has analyzed projected expenses, revenues, and reserves over the next five years and determined that the RAC should be increased in fiscal year 2016 to reduce the decrease in Cash Flow in the Mission Creek Replenishment Fund.

Accordingly, it is recommended that the RAC of \$123.20/AF be levied upon all producers within the Mission Creek Subbasin AOB in accordance with the State Water Code, effective July 1, 2016.

Figure V-1
Groundwater Level Changes in Mission Creek Subbasin Management Area: 2014 to 2015

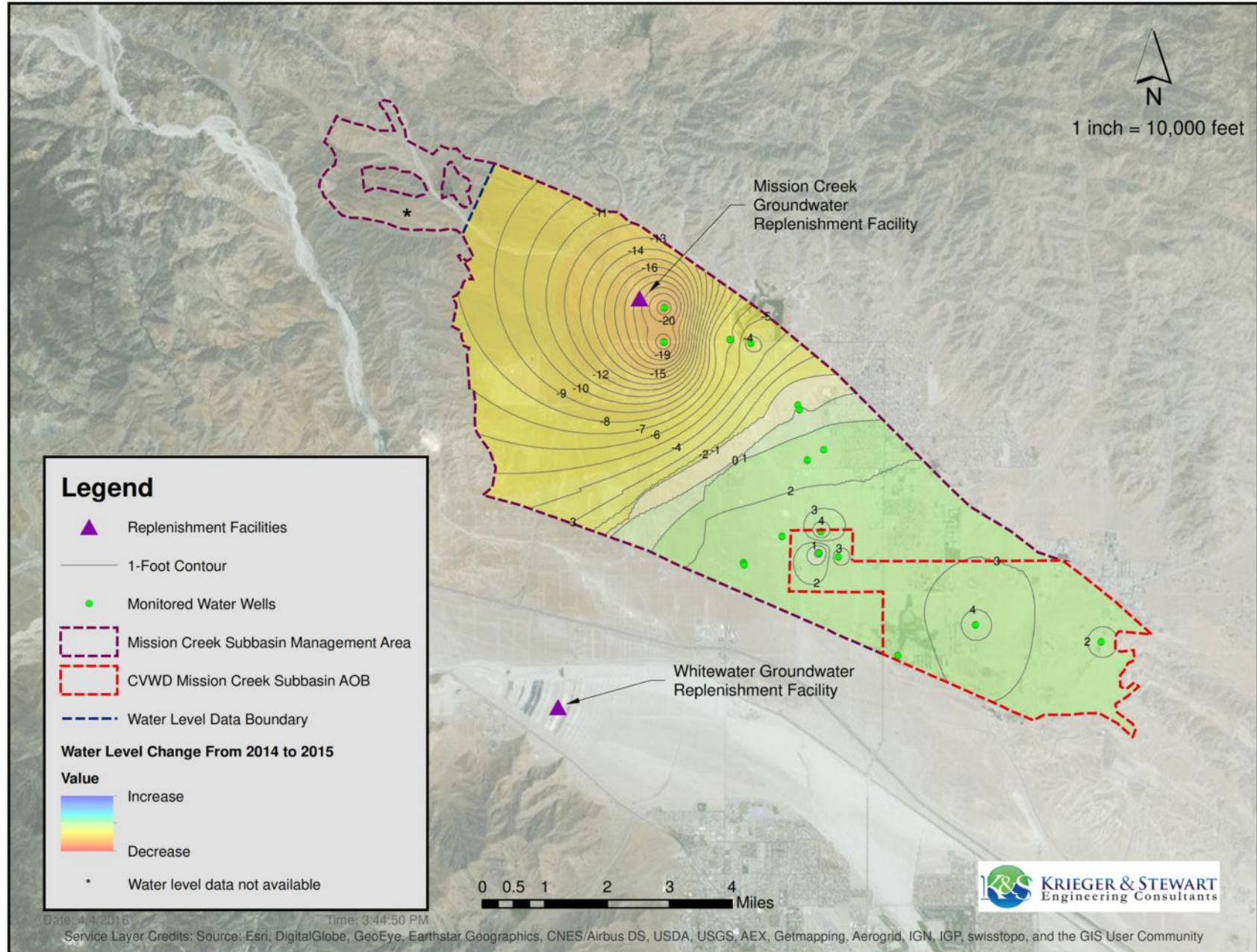


Figure V-2
Groundwater Level Changes in Mission Creek Subbasin Management Area: 2005 to 2015

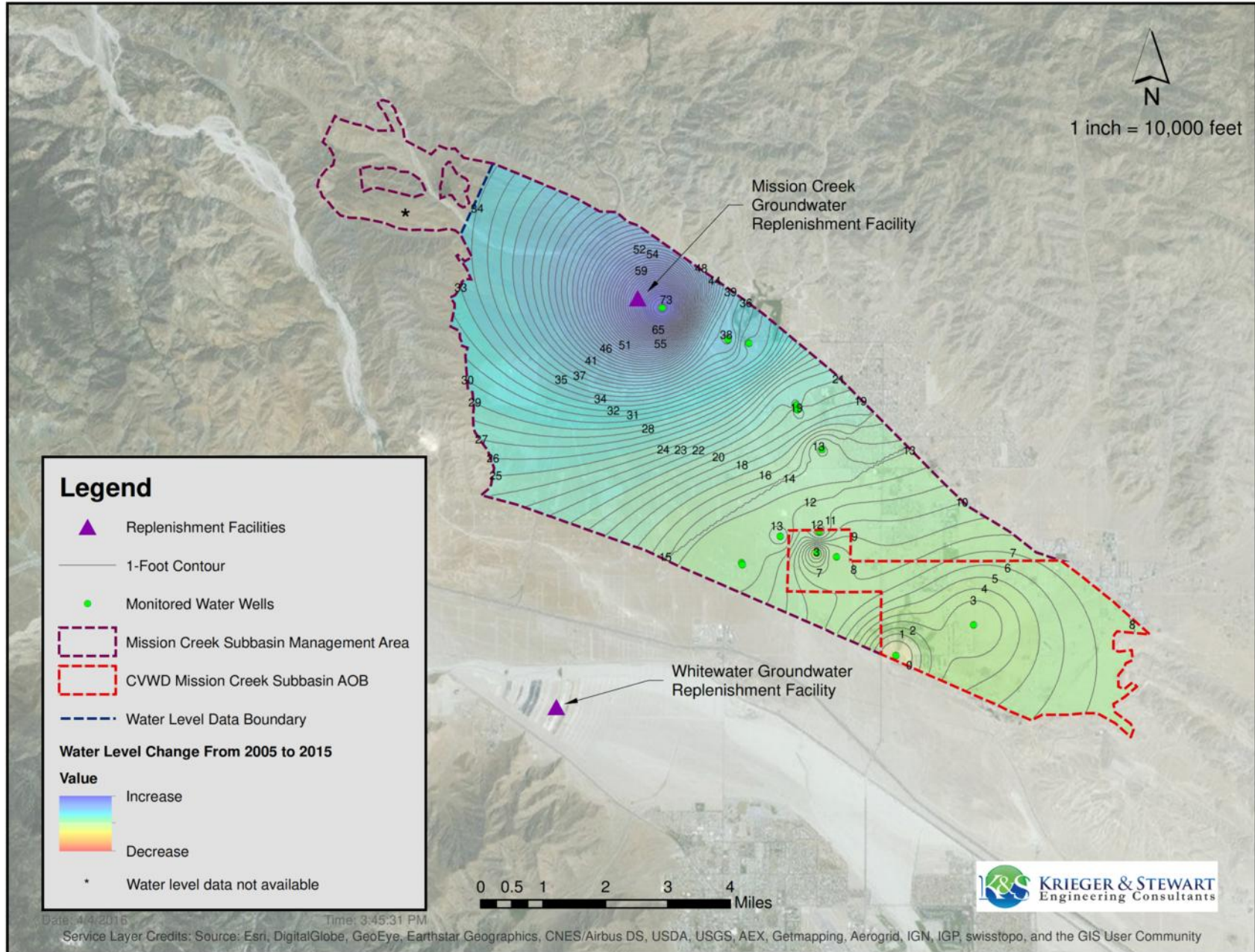


Figure V-3
Mission Creek Subbasin Management Area
Artificial Replenishment Quantities and Groundwater Level Hydrograph

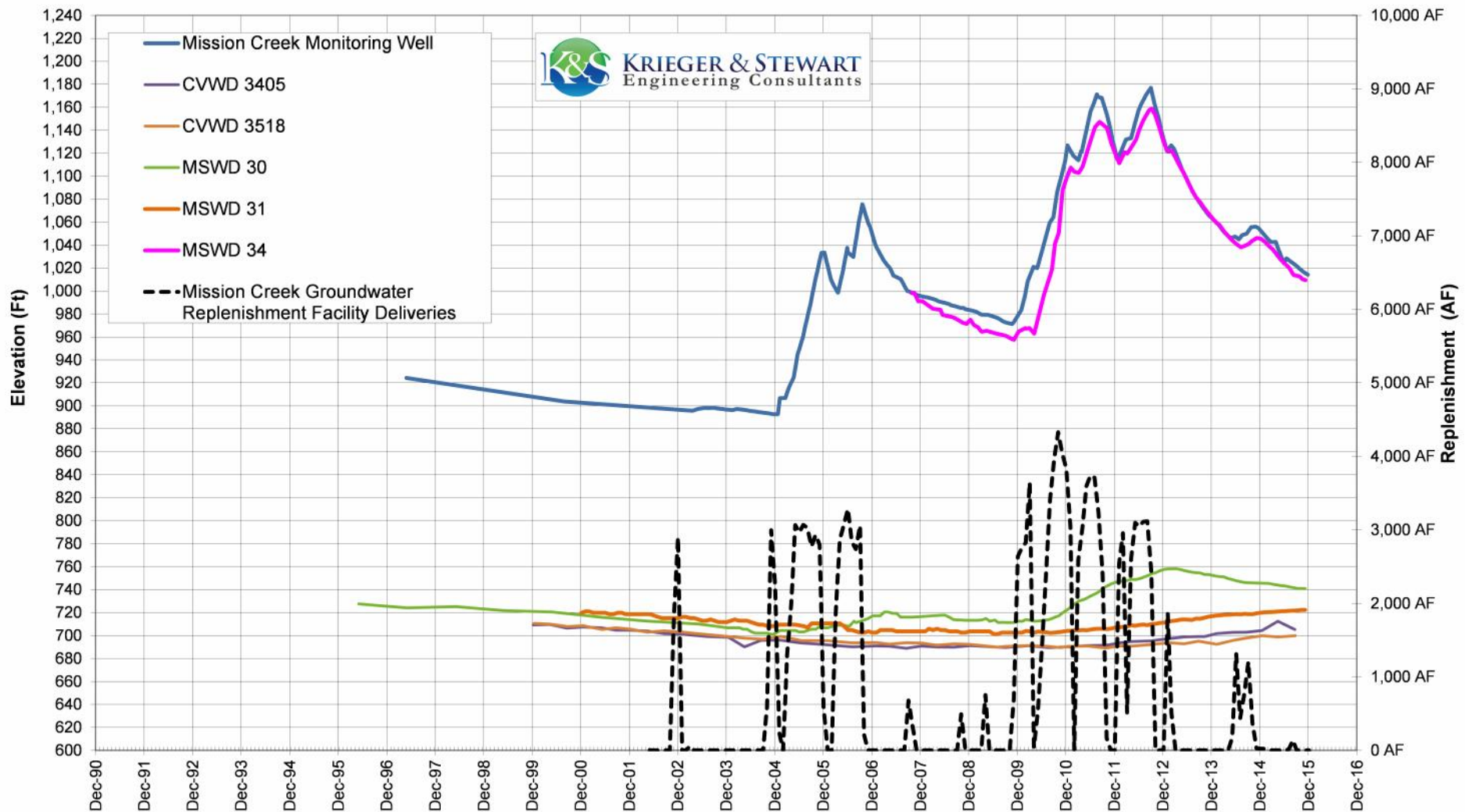
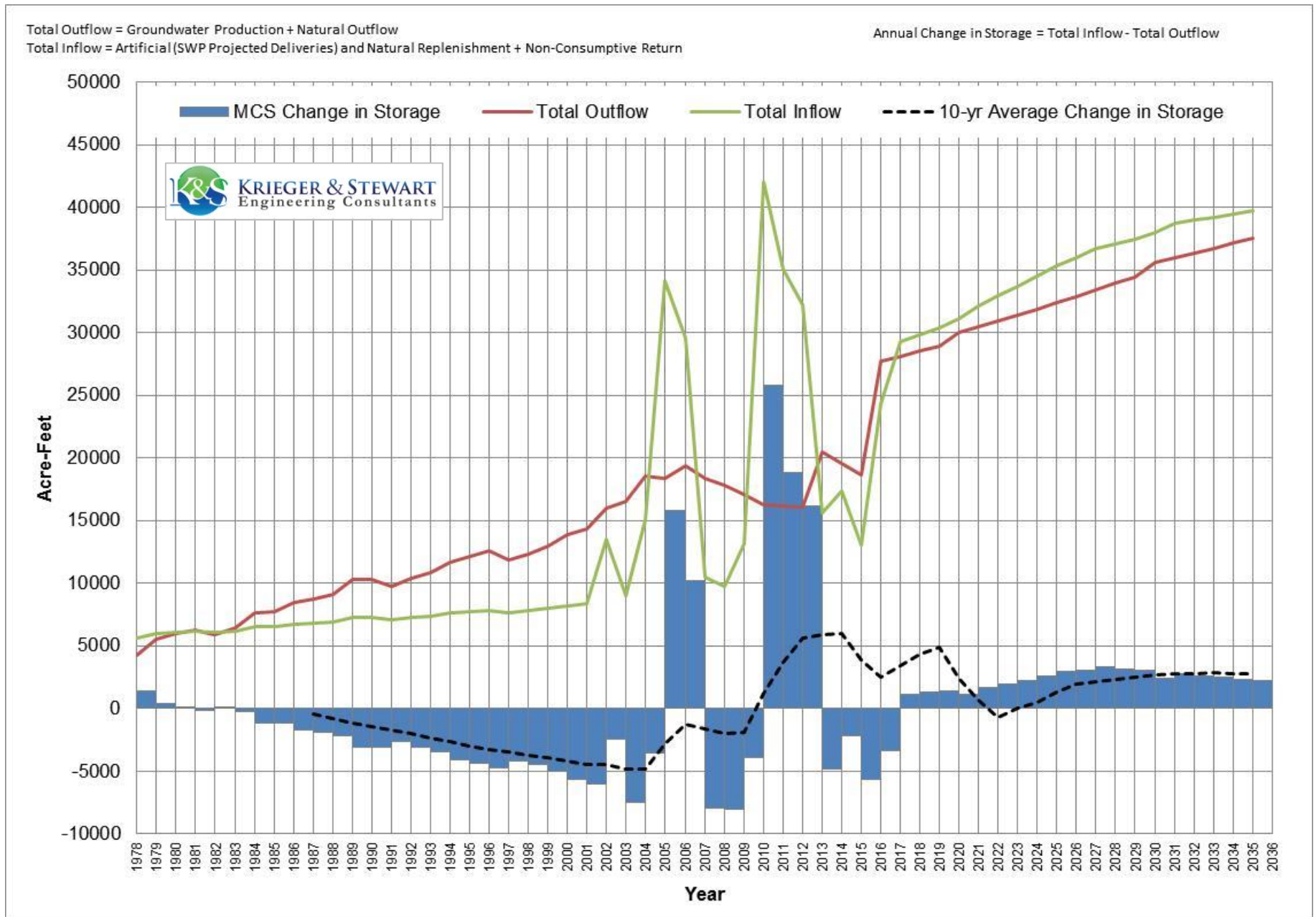


Figure V-4
Mission Creek Subbasin Management Area Change in Groundwater in Storage



CHAPTER VI
WEST WHITEWATER RIVER SUBBASIN
AREA OF BENEFIT

CHAPTER VI WEST WHITEWATER RIVER SUBBASIN AREA OF BENEFIT

A. Management Area and Area of Benefit

1. West Whitewater River Subbasin Management Area

The Whitewater River Subbasin is bounded on the southwest by the Santa Rosa and San Jacinto Mountains, on the north and east by the Banning and San Andreas Faults, on the south by the Salton Sea, and on the northwest by a suballuvial bedrock construction at the east end of the San Geronio Pass.

CVWD and DWA have recognized the need to manage the western portion of the Whitewater River Subbasin as a complete unit rather than as individual segments underlying the individual agencies' boundaries. This management area consists of the Palm Springs and Thousand Palms Subareas and the western portion of the Thermal Subarea experiencing a significantly declining water table. The management area was established to encompass the area of groundwater overdraft as evidenced by declining water table conditions, and includes areas within both CVWD and DWA boundaries.

CVWD's service area within the Whitewater River Subbasin is divided into two AOBs, the West Whitewater River Subbasin AOB and the East Whitewater River Subbasin AOB. The boundary between these two AOBs extends from Point Happy (a promontory of the Santa Rosa Mountains between Indian Wells and La Quinta) northeasterly, generally along Washington Street, to a point on the San Andreas Fault intersecting the northerly prolongation of Jefferson Street in Indio.

2. West Whitewater River Subbasin Area of Benefit Boundary

Figures VI-1 and VI-2 at the end of this chapter present the boundary of CVWD's West Whitewater River Subbasin AOB. This boundary is defined as follows:

That western portion of the Whitewater River Subbasin within the boundaries of CVWD, bounded on the east beginning at the north end of Jefferson Street, south to Avenue 40, west to Adams Street, south along the north-south township line to Fred Waring Drive (Avenue 44), west to Washington Street, south to the Santa Rosa Mountains near Highway 111. The area's southern boundary continues westerly along the foothills of the Santa Rosa and San Jacinto Mountains to the western boundary at Whitewater. The northern boundary continues from Whitewater easterly to the San Andreas Fault and across the Indio Hills to the point of beginning.

The general area includes the cities of Indian Wells, Palm Desert, Rancho Mirage, the northern portion of Cathedral City and the unincorporated areas of Riverside County northerly of these cities.

B. Water Supply and Use

1. Natural Replenishment (Precipitation and Stream Flow)

Precipitation in the surrounding mountains is included in the natural inflow estimates found in the water balance calculated in **Table VI-4** of this report. The natural inflow estimates are based on the Coachella Valley Groundwater Flow Model data (prepared by MWH and others), which was utilized for the 2010 CVWMP Update and 2014 Status Report.

During 2015, the average annual rainfall was 4.27 inches throughout the Mission Creek Subbasin Management Area and West Whitewater River Subbasin Management Area, as recorded by nine rain gage stations located in the Mission Creek Subbasin Management Area and West Whitewater River Subbasin Management Area monitored by Riverside County Flood Control and Water Conservation District. This quantity is less than the typical average annual rainfall for the Upper Coachella Valley. 2015 precipitation data for these stations is presented in **Appendix A**.

2. Non-Potable Water

CVWD operates six WRPs in the Whitewater River (Indio) Subbasin. Recycled water from two of these facilities (WRP 9 and WRP 10) has been used for golf course and greenbelt irrigation in the Palm Desert area for many years, thereby reducing demand on the groundwater basin. A third facility (WRP 7), located north of Indio, began providing recycled water for golf course and greenbelt irrigation in 1997. Colorado River water is also available for golf course source substitution projects via the Mid-Valley Pipeline (MVP) from the Coachella Canal. DWA also operates one water recycling plant in the City of Palm Springs, delivering recycled water for golf course and park irrigation.

3. Groundwater Production, Non-Consumptive Return, and Conservation

a. Groundwater Production

Table VI-1 sets forth historical groundwater production in the western portion of the Whitewater River Subbasin, including surface water and groundwater production for both CVWD's and DWA's AOBs. Production totaled 147,459 AF in 2015.

Table VI-1
Production within the West Whitewater River Subbasin Management Area⁽¹⁾

Year	Groundwater		Surface Water ⁽²⁾ (AF)	Total (AF)
	CVWD Area of Benefit (AF)	DWA Area of Benefit (AF)		
1977	67,696	18,661	7,000	93,357
1978	61,172	28,100	8,530	97,802
1979	72,733	29,393	7,801	109,927
1980	84,142	32,092	7,303	123,537
1981	86,973	33,660	7,822	128,455
1982	83,050	33,382	6,512	122,944
1983	84,770	33,279	6,467	124,516
1984	104,477	38,121	7,603	150,201
1985	111,635	39,732	7,143	158,510
1986	115,185	40,965	6,704	162,854
1987	125,229	44,800	5,644	175,673
1988	125,122	47,593	5,246	177,961
1989	129,957	47,125	5,936	183,018
1990	136,869	45,396	5,213	187,478
1991	126,360	42,729	4,917	174,006
1992	128,390	42,493	4,712	175,595
1993	131,314	41,188	6,363	178,865
1994	134,223	42,115	5,831	182,169
1995	134,583	41,728	5,809	182,117
1996	137,410	45,342	5,865	188,617
1997	137,406	43,658	5,626	186,690
1998	142,620	41,385	7,545	191,550
1999	157,148	44,350	6,941	208,439
2000	161,834	44,458	6,297	212,589
2001	159,767	44,112	4,928	208,807
2002	163,185	46,004	4,221	213,410
2003	156,185	43,463	4,627	204,275
2004	159,849	48,093	4,758	212,700
2005	153,462	46,080	4,799	204,341
2006	160,239	48,967	4,644	213,805
2007	157,487	50,037	3,490	211,014
2008	161,695	45,405	3,593	210,693
2009	155,793	41,913	1,443	199,149
2010	141,481	39,352	1,582	182,415
2011	141,028	40,071	1,724	182,823
2012	141,379	39,507	2,222	183,108
2013	143,108	37,730	1,802	182,640
2014	136,027	36,372	1,787	174,187
2015	115,588	30,332	1,539	147,459

⁽¹⁾ Calendar year production in AF.

⁽²⁾ Whitewater Mutual Water Company, Chino Creek, Snow Creek, and Falls Creek (DWA AOB).

b. Non-Consumptive Return

Based on MWH's groundwater model projections (MWH 2011), a current non-consumptive return of 34 percent is used herein and is applied to groundwater produced locally for irrigation and municipal use.

c. Conservation

As discussed in **Chapter IV**, Water conservation may also become an important driver for future RAC rates. Under Governor Brown's executive order dated April 1, 2015, CVWD is tasked with reducing water use by 32 percent. In addition, the Governor is recommending golf courses using groundwater reduce their water use by 25 percent. Together, these changes would equate to approximately a 30 percent reduction in groundwater production in the West Whitewater River Subbasin AOB.

C. Groundwater Replenishment

1. Replenishment Facilities

a. Whitewater River Groundwater Replenishment Facility

The Whitewater River Groundwater Replenishment Facility consists of approximately 700 acres of percolation ponds constructed at the upper (easterly) end of the Whitewater River Subbasin during the early 1970s adjacent to Highway 111 near the community of Palm Oasis. The Facility is situated in the west-to-east flow path of the Whitewater River. Recharge activities commenced in 1973. Since then, 2,896,489 AF (see **Table VI-3**) of water has been replenished at the Whitewater River Groundwater Replenishment Facility.

b. Mid-Valley Pipeline (MVP) Project

The MVP is a key element of "In-lieu" replenishment designed to help eliminate overdraft in the Whitewater River Subbasin. This source substitution project is currently being implemented to reduce groundwater pumping by supplying non-potable Colorado River water via the Coachella Canal and CVWD recycled water for irrigation. The initial portion of the MVP was completed in 2009. CVWD staff and GEI Consultants are currently preparing a master plan for completion of the MVP. When completed the MVP will deliver about 52,000 AF/Yr of recycled water and Coachella Canal water to golf courses.

2. Current Replenishment Activities

Alleviation of overdraft in the western portion of the Whitewater River Subbasin was initiated in 1973 by CVWD and DWA when the two agencies contracted with the State to purchase SWP water (Table A Amount) to exchange for Colorado River water.

In 2015, a total of 48,813 AF were delivered via the SWP to MWD on behalf of CVWD and DWA for replenishment at the Whitewater River Groundwater Replenishment Facility and the Mission Creek Groundwater Replenishment Facility as shown in **Table VI-2**.

**Table VI-2
State Water Project Exchange Delivery to
Metropolitan Water District in 2015**

Description	CVWD (AF)	DWA (AF)	Total (AF)
Table A	27,670	11,150	38,820
Article 21	0	0	0
Turnback Pool A and B	0	0	0
Multi-Year Pool	0	67	67
Dry Year (Yuba)	426	0	0
Rosedale	9,500	0	0
Article 56 (c) "Carryover"	0	0	0
Total Delivered to MWD	37,596	11,217	48,813

During 2015, MWD delivered 1,036 AF of Colorado River Exchange Water for replenishment to the Mission Creek Subbasin and the western portion of the Whitewater River Subbasin. The Colorado River Exchange Water includes all deliveries except Article 56 (c) "Carryover" and MWD Advance Delivery. Article 56 (c) "Carryover" is water requested under Article 56 (c) of the Water Supply Contracts. SWP Contractors can carry over a portion of their allocated water approved for delivery in the current year for delivery during the next year. There were no carryover deliveries in 2015.

The amount of water that MWD has previously stored in the Coachella Valley Groundwater Basin through the Advance Delivery Agreement was 248,804 AF at the beginning of 2015 and was decreased by 48,643 AF to 200,161 AF at the end of 2015.

In 2015, MWD's delivery to the Whitewater River Groundwater Replenishment Facility consisted of 865 AF of water under CVWD's "35 TAF" Agreement.

Of the total amount of Colorado River Exchange Water, on average, 90 percent is delivered to the West Whitewater River Subbasin Management Area, and 10 percent is delivered to the Mission Creek Subbasin Management Area. However, in 2015, the total amount of water delivered for replenishment within the West Whitewater River Subbasin Management Area was 865 AF, while the Mission Creek Subbasin Management Area received 171 AF as shown in **Tables V-3 and VI-3**.

In addition to direct replenishment activities at the Whitewater River Groundwater Replenishment Facility, CVWD has implemented a program of

non-potable in-lieu replenishment via source substitution. In 2010, CVWD developed a new non-potable water use agreement requiring golf courses with access to Canal or recycled water to meet a minimum of 80 percent of irrigation demand from those sources. To date, there are 20 water users within the West Whitewater River Subbasin AOB which have been converted from groundwater extraction to non-potable Canal or recycled water for irrigation water use. Three of these 20 golf courses were converted in early 2015, and an additional three golf courses in the West Whitewater River Subbasin AOB are proposed for conversion by the end of fiscal year 2016.

Table VI-3
Colorado River Exchange Water Delivered to
Whitewater River Groundwater Replenishment Facility⁽¹⁾

Year	AF
1973	7,475
1974	15,396
1975	20,126
1976	13,206
1977	0
1978	0
1979	25,192
1980	26,341
1981	35,251
1982	27,020
1983	53,732
1984	83,708
1985	251,994
1986	298,201
1987	104,334
1988	1,096
1989	12,478
1990	31,721
1991	14
1992	40,870
1993	60,153
1994	36,763
1995	61,318
1996	138,266
1997	113,677
1998	132,455
1999	90,601
2000	72,450
2001	707
2002	33,435
2003	902

Table VI-3
Colorado River Exchange Water Delivered to
Whitewater River Groundwater Replenishment Facility⁽¹⁾

Year	AF
2004	13,224
2005	165,554
2006	98,959
2007	16,009
2008	8,008
2009	57,024
2010	228,330
2011	232,214
2012	257,267
2013	26,620
2014	3,533
2015	865
Total	2,896,489

⁽¹⁾ Delivered water quantities vary as a result of drought conditions and Advance Deliveries associated with the Exchange Agreement.

3. Future Replenishment Activities

CVWD and DWA will request their full Table A Amounts each year for a combined total of 194,100 AF and continue to exchange their SWP water for Colorado River water for replenishment at the Whitewater River Groundwater Replenishment Facility.

Extensive computer modeling of the Whitewater River Subbasin was conducted during the course of preparation of the CVWMP, the 2010 CVWMP Update, and their associated Program Environmental Impact Reports. The groundwater model allowed CVWD to gain a better understanding of water conditions in this subbasin and the benefits of water management activities identified in the 2010 CVWMP Update.

The projected change in groundwater levels in 2009 and 2045 during implementation of the 2010 CVWMP Update project is presented in **Chapter VII** (see **Figure VII-5**). Implementation of the project results in water levels that are 20 feet to 40 feet higher in the Palm Springs area, and stabilized in the Thousand Palms area.

CVWD continues to work with golf courses to expand non-potable water (imported water and recycled water) use throughout the mid-Valley area of the Whitewater River (Indio) Subbasin.

As shown in **Figure VI-2** at the end of this chapter, groundwater levels in the mid-Valley area have historically experienced significant declines in comparison to the west Valley area where the Whitewater River Groundwater Replenishment Facility is located, and display a need for source substitution in the mid-Valley,

mainly for golf course irrigation. Currently, the quantity of recycled and Colorado River water that can be delivered is limited, since the remainder of the MVP project has not yet been completed (CVWD 2012).

The benefits of completing the project include improvement in groundwater water quality, preserving potable water supplies, and reducing land subsidence. With increased recycled water delivered for "in-lieu" use, the quantity of wastewater disposal and future water treatment costs would be reduced. Offsetting groundwater pumping with delivery of Colorado River water and recycled water, together known as "non-potable water", also reduces the decline in groundwater levels (stabilization) which may reduce overdraft and the effects of land subsidence experienced in the mid-Valley in addition to maintaining groundwater supplies.

CVWD's recycled water supply (by itself and when blended with Colorado River water delivered through the Coachella Canal) is more reliable than SWP water (exchanged for Colorado River water) as a source of irrigation water. As mentioned in **Chapter IV**, the SWP's long-term estimated delivery reliability for future projections is 58 percent of its total allocations, according to the final *2013 Final SWP Delivery Reliability Report*, dated December 2014. CDWR currently (as of March 17, 2016) anticipates it will deliver 45 percent of its total allocations to SWP Contractors in 2016. In addition, the current California drought contributes to lower deliveries, but it also presents further uncertainty to the deliverability of SWP water to the Coachella Valley in future years.

As stated in the 2010 CVWMP Update, there were approximately 51 identified proposed connections for the MVP project, with an estimated reduction in groundwater pumping of approximately 52,000 AF/Yr, 37,000 AF/Yr from Canal water and 15,000 AF/Yr from recycled water supplies. That quantity of source substitution accounts for approximately 23 percent of the total production in both the East and West Whitewater River Subbasin AOBs (229,294 AF) recorded in 2015.

As demonstrated in the 2015-2016 Engineer's Report, the MVP project represents the most cost effective program to replenish the West Whitewater River Subbasin AOB. However, in addition to the MVP, CVWD is exploring options for direct groundwater replenishment (surface spreading) in the mid-Valley area.

With the uncertainty of the future SWP deliveries, golf course source substitution should be prioritized for implementation in the mid-Valley area to reduce the use of groundwater in storage for irrigation, and put MVP investments to maximum use.

Several of the completed golf course conversion projects have been partly financed using California Proposition 84 grant funds, but grant funding is far too limited to complete the MVP project. Future conversions are proposed to be accelerated using funding from the CVWD Replenishment Fund (RAC Revenues).

D. Aquifer Conditions

1. Groundwater Inflows and Outflows

Total inflows and outflows to the western portion of the Whitewater River Subbasin in 2015 are summarized in **Table VI-4**.

The estimated natural inflow of 52,100 AF/Yr includes natural replenishment and subsurface inflow across subbasin boundaries. The non-consumptive return of applied water is estimated at 52,700 AF, which is 34 percent of the reported production of 147,459 AF/Yr plus an assumed production of approximately 500 AF/Yr by minimal pumpers (see **Section B** above for a more detailed explanation). The total inflow includes the natural inflow, the non-consumptive return, and the 865 AF of water replenished.

The total outflow is the reported groundwater production plus an estimated 25,790 AF/Yr of natural subsurface outflow to the eastern portion of the Whitewater River Subbasin and 2 percent losses from groundwater replenishment due to evaporation (17 AF).

Table VI-4
2015 Water Balance in the
West Whitewater River Subbasin Management Area

Item	Annual Calculation (AF)
<u>2015 Groundwater Production</u>	
Reported Production	-147,459
Assumed Approximate Production by Exempt Minimal Pumpers	-500
Total Estimated Production (Rounded)	-148,000
<u>Non-Consumptive Return</u>	
From Production ⁽¹⁾	50,300
From Applied Colorado River Water ⁽²⁾	2,400
Total Non-Consumptive Return (Rounded)	52,700
<u>Natural Inflow</u>	
Natural Replenishment ⁽³⁾	40,823
Subsurface Inflow from San Gorgonio Pass and Garnet Hill ⁽³⁾	11,235
Total Natural Inflow (Rounded)	52,100
<u>Natural Outflow</u>	
Subsurface Outflow to East Whitewater River Subbasin AOB ⁽³⁾	-25,790
Evapotranspiration ⁽⁴⁾	-17
Total Natural Outflow (Rounded)	-25,800
Artificial Replenishment ⁽⁵⁾	865
Annual Balance	-68,135
Annual Balance (Rounded)⁽⁶⁾	-68,100

⁽¹⁾ 34 percent of production (148,000 AF x 0.34 = 50,300 AF), rounded.

⁽²⁾ 34 percent of Colorado River water applied for irrigation in the AOB ((7,100) x 0.34 = 2,414), rounded.

⁽³⁾ MWH 2011

⁽⁴⁾ Two percent loss from groundwater replenishment due to evaporation (0.02 x 865 = 17 AF) (MWH 2011)

⁽⁵⁾ Water delivered to the Whitewater River Groundwater Replenishment Facility.

⁽⁶⁾ This was a decrease in stored groundwater equal to 0.24 percent of the Whitewater River Subbasin's storage capacity of 28,800,000 AF in 2015.

The annual balance is the total inflow less the total outflow for a loss of approximately 68,100 AF of water in storage in the management area in 2015.

2. Change in Groundwater Storage

In 2015, the change in groundwater in storage in the West Whitewater River Subbasin Management Area was negative. Imported water may offset annual changes in the groundwater in storage in a particular year. However, on a long-term basis, water requirements are likely to continue to place demands on groundwater storage. The 2010 CVWMP Update outlined a plan to address long-term overdraft in the Coachella Valley. The 2014 Status Report illustrates

that storing imported water supplies is beneficial to the future of the groundwater basin.

Figure VI-4 at the end of this chapter shows the changes in groundwater in storage, the quantities of artificial replenishment, and the historic and projected inflow and outflow. The projected changes in groundwater in storage are based on the implementation of the 2010 CVWMP Update to reduce pumpage and the continued replenishment of the groundwater basin with imported water.

Without artificial replenishment, the annual reduction in stored groundwater within the West Whitewater River Subbasin Management Area in 2015 would have been approximately -69,000 AF, compared to the annual balance of -68,100 AF as shown in **Table VI-4**. Continued groundwater replenishment is necessary to either eliminate or reduce long-term overdraft in the future.

The total historic outflow shown in **Figure VI-4** consists of the total groundwater production and natural outflow to the East Whitewater River Subbasin AOB as shown in **Table VI-4** within this Engineer's Report and past Engineer's Reports.

The total historic inflow shown on **Figure VI-4** consists of artificial replenishment, natural inflow, and non-consumptive return (approximately 34 percent of the total groundwater production) as shown on **Table VI-4** of this Engineer's Report and past Engineer's Reports.

Projected groundwater production figures were obtained from MWH (2010 CVWMP Update and the 2014 Status Report, with additional, updated information provided by MWH). Projections consider population growth forecasts along with a reduction in the total groundwater produced as future projects such as the MVP, irrigation source substitution with non-potable water, and water conservation programs continue to be implemented.

Projections for groundwater replenishment are based on anticipated SWP deliveries as reported by the CDWR annually (as available) and according to the *2013 Final SWP Reliability Report* the long-term projected average delivery estimate is 58 percent.

In accordance with the Mission Creek Groundwater Replenishment Agreement, dated April 8, 2003, each year DWA and CVWD calculate the total groundwater production and surface water diversion from the Mission Creek Subbasin Management Area and West Whitewater River Subbasin Management Area in order to determine the quantity of SWP water to be delivered to each subbasin in the current year as a proportion of the previous year's total production or diversion. In past years, the West Whitewater River Subbasin Management Area has accounted for approximately 93 percent of the total production within both subbasins, but based on current production projections, production will decrease to a range of 88 percent down to 81 percent through 2035.

Based on the 2010 CVWMP Update and 2014 Status Report assumptions that population will increase in the Mission Creek Subbasin Management Area and groundwater production will decrease in the West Whitewater River Subbasin Management Area due to conservation and source substitution, the percentage of proportionate delivery to the Mission Creek Subbasin is projected to increase.

As of March 17, 2016, CDWR expects to deliver 45 percent of its total allocations to SWP Contractors in 2016. Of that 45 percent expected to be delivered to both DWA and CVWD, 92 percent (per 2015 production) is projected for delivery to the Whitewater River Groundwater Replenishment Facility as a proportion of the total projected groundwater production in the West Whitewater River Subbasin Management Area and Mission Creek Subbasin Management Area in 2015.

Projections of groundwater replenishment during the period 2016 through 2035 are based on a 58 percent long-term average of total allocations and projected groundwater production for both the Mission Creek Subbasin and West Whitewater River Subbasin Management Areas.

Projected natural inflows were obtained from MWH (2011) and include: projected subsurface flows from the West Whitewater River Subbasin AOB and Desert Hot Springs Subbasin; projected surface flows based on stream gauging and precipitation records; and projected non-consumptive return.

Future non-consumptive return is expected to decrease from approximately 35 percent to 30 percent through 2035, based on the effects of implementation of water conservation measures such as turf removal, and more efficient irrigation practices. As shown in **Table VI-4**, the estimated percentage of non-consumptive return for 2015 is approximately 34 percent (MWH 2011).

3. Groundwater Levels

Historical water level declines in the Coachella Valley Groundwater Basin and conditions producing those declines have been extensively described by the USGS and CDWR, and are documented in the 2010 CVWMP Update and 2014 Status Report. The 2014 Status Report demonstrates that the programs set forth in the 2010 CVWMP Update are effectively reducing overdraft within the groundwater basin based on the increase in groundwater elevations. Such programs include replenishment, source substitution, expansion of Canal water and recycled water use, and various other conservation programs.

Comparison of the water level for the 37-year period (1936-1973) prior to initiation of full-scale replenishment indicates that water levels declined more than 100 feet in parts of the Palm Springs Subarea and more than 70 feet in parts of Palm Desert.

In the past ten years, inflows to the basin have exceeded outflows; increasing groundwater storage (CVWD 2014). Conservation measures and source substitution implementation are the main cause of this improvement in the basin's condition, as well as increased replenishment quantities of advance and surplus deliveries from the Colorado River Aqueduct.

Water surface elevations in the northwestern area of the Coachella Valley are highest at the northwest end of each Subbasin, indicating that groundwater typically flows from the northwest to the southeast in the Coachella Valley.

Figure VI-1 at the end of this chapter depicts the change in average groundwater levels from 2014 to 2015 in the West Whitewater River Subbasin Management

Area. The West Whitewater River Subbasin AOB boundary and the location of the Whitewater River Groundwater Replenishment Facility are also shown.

The colored contours in **Figure VI-1** represent water level changes from 2014 to 2015 for 111 wells in the West Whitewater River Subbasin AOB monitored by CVWD staff and for 29 additional wells outside the AOB monitored by DWA and MSWD staff. The average annual change in water levels observed in the monitored wells from 2014 to 2015 within the AOB was a decline of 1.9 feet. The average change observed in the 140 wells monitored from 2014 to 2015 within the overall West Whitewater River Subbasin Management Area and Garnet Hill Subbasin was a decline of 3.2 feet. **Figure VI-1** includes eight monitoring wells located at the Whitewater Groundwater Replenishment Facility, which experienced dramatic fluctuations in water levels throughout the year in response to water deliveries. In 2015, water levels in those eight monitoring wells declined approximately 45 feet due to reduced replenishment deliveries, which thereby skewed water level changes observed in the remaining 103 wells that are representative of CVWD's West Whitewater River Subbasin AOB. Excluding those eight monitoring wells, the average change in groundwater levels from 2014 to 2015 within CVWD's West Whitewater River Subbasin AOB was an increase of 1.4 feet. **Figure VII-6** depicts the same information for the West and East Whitewater River Subbasin Management Areas combined.

Figure VI-2 depicts the change in average groundwater levels from 2005 to 2015 in the western portion of the Whitewater River Subbasin based on CVWD's groundwater level monitoring well data. The West Whitewater River Subbasin AOB boundary and the location of the Whitewater River Groundwater Replenishment Facility are also shown.

The colored contours in **Figure VI-2** represent water level changes for 101 wells monitored by CVWD staff in the West Whitewater River Subbasin AOB (10 of the wells monitored for the one-year comparison had no data in 2005) and for 27 additional wells outside the AOB monitored by DWA and MSWD staff. The average annual change in water levels observed in the monitored wells from 2005 to 2015 within the AOB was a decline of 8.5 feet. The average change observed in the 128 wells monitored from 2014 to 2015 within the overall West Whitewater River Subbasin Management Area and Garnet Hill Subbasin was a decline of 1.3 feet. Excluding the eight monitoring wells near the replenishment facility, the average change in groundwater levels from 2005 to 2015 within CVWD's West Whitewater River Subbasin AOB was a decline of 8.4 feet. The analysis of the water levels observed at the monitoring wells emphasizes the benefit and effectiveness of the replenishment program in improving groundwater storage conditions; without replenishment, greater declines in water levels would have been observed during this period. **Figure VII-7** depicts the same information for the West and East Whitewater River Subbasin Management Areas combined.

Figure VI-3 at the end of this chapter illustrates the response of groundwater levels in the vicinity of the Whitewater River Groundwater Replenishment Facility in the West Whitewater River Subbasin Management Area to groundwater replenishment. Wells located nearest to the Whitewater River Groundwater Replenishment Facility, such as monitoring Well 03S04E29R1, experience more dramatic changes in water levels than those located further away in the mid-

Valley area. In comparison with the color contours shown in **Figure VI-1**, the hydrograph in **Figure VI-3** shows the decline of water levels at the groundwater monitoring wells nearest the replenishment facility coincide with reduced quantities of groundwater replenishment in the management area and also demonstrates the GRP is successful in managing water supplies when adequate replenishment occurs.

4. Assessment of Overdraft Conditions

There was a negative change in groundwater in storage within the West Whitewater River Subbasin Management Area in 2015 as shown in **Figure VI-4**. This is due, in part, to reduced deliveries of replenishment water to the Whitewater River Groundwater Replenishment Facility over the past three years.

Figure VI-4 illustrates that continued implementation of the projects identified in the 2010 CVWMP Update will improve the groundwater in storage. However, continued groundwater replenishment is necessary to either eliminate or reduce long-term overdraft in the future.

E. **Replenishment Assessment**

1. Replenishment Water Costs

In the initial 12 years of operation of the West Whitewater River Subbasin AOB GRP, only the Variable Operation, Maintenance, Power and Replacement component of the Transportation Charge and the Delta Water Charge for the SWP could be included in the calculation. However, in 1991 the Legislature passed and the Governor signed into law AB 1070. This bill continues to limit the charges assessable against production, but includes an additional component of the Transportation Charge, the Off-Aqueduct Power component. CVWD has also been allowed, under the State Water Code, to include in its calculations surplus or excess water charges, payments to DWA for similar payments by DWA to the State, the cost of importing and recharging water from sources other than the SWP and the cost of treating and distributing recycled water. The RACs considered in this report are based on the most recent and reliable information available with respect to applicable costs or charges.

In the West Whitewater River Subbasin AOB, replenishment water costs are also incurred for Colorado River water conveyed via the MVP for source substitution projects, and for recycled water produced by CVWD's water recycling plants.

CVWD has incurred additional costs associated with the GRP which include continuing engineering studies, well meter reading and maintenance, and groundwater monitoring. These costs have now also been included as a portion of the RAC. Although the law allows inclusion of the cost of treating and distributing reclaimed water, these costs have not been included.

2. Replenishment Program Accounting and Replenishment Assessment Development

a. Minimal Pumpers

There are approximately 30 to 40 exempt minimal pumpers within the West Whitewater River Subbasin Management Area. These are predominantly small wells used for domestic or limited irrigation purposes. Maximum pumpage by the minimal pumpers in the management area is assumed to be approximately 500 AF/Yr.

b. Income Statement

Table VI-5 presents an income statement showing Actual Fiscal Year 2015, Projected Fiscal Year 2016, and Projected Fiscal Year 2017 Revenues, Expenses, and Cash Flow. **Table VI-5** shows that even by increasing the RAC rate, existing reserves would not be sufficient to support expenditures. An increase to the West Whitewater River Subbasin AOB RAC is proposed for fiscal year 2017.

c. Replenishment Assessment Charge (RAC)

The California Water Code Section 31633 permits revenue from the RAC to be used to fund the "in-lieu" programs providing incentives to use recycled water or Colorado River water in place of groundwater. To address decreasing water levels in the mid-Valley area observed in **Figure VI-2**, it is recommended that the MVP project be accelerated utilizing the Replenishment Fund to finance the project.

GRP costs continue to increase. **Table VI-5** reflects projected increases in operating costs, SWP costs, and supplemental water costs during fiscal year 2017. Based on projected expenses, revenues, and reserves, CVWD has determined that the RAC should be increased to \$145.60/AF beginning July 1, 2016. Even with this proposed RAC increase, there is a projected decrease in Cash Flow in fiscal year 2017 in the amount of \$27.4 million.

Table VI-5 includes \$3,919,000 for in-lieu replenishment costs to fund non-potable water connections to the MVP project during fiscal year 2017. As demonstrated in the 2015-2016 Engineer's Report, these connections are the most cost effective replenishment approach to benefit the mid-Valley area of the West Whitewater River Subbasin AOB. Funding for additional non-potable water connections needed to complete the MVP project is included in the financial strategy for the current year through 2024 as set forth in the 2016 Cost of Service Study.

Table VI-5
Coachella Valley Water District
West Whitewater River Subbasin Area of Benefit
Groundwater Replenishment Program Income Statement

Description	Actual Fiscal Year (FY) 2015 (\$1,000)	Projected FY 2016 (\$1,000)	Projected FY 2017 (\$1,000)
Revenues			
RAC Rate ⁽¹⁾	14,428	14,442	14,549
SWP Tax Revenue ⁽²⁾	42,775	37,801	37,801
Other Revenue ⁽³⁾	631	709	798
Reimbursement of Shared Facility Costs ⁽⁴⁾	1,697		
Total Revenues	59,531	52,952	53,148
Expenses			
Total O&M Costs	1,850	1,752	1,791
Power Costs	22	22	24
Administrative Costs ⁽⁵⁾	1,016	1,057	1,089
State Water Project Costs			
SWP Table A Amount Costs ⁽⁶⁾	9,698	17,417	22,575
Supplemental SWP Water Costs ⁽⁷⁾	1,907	2,136	7,011
Other SWP Costs ⁽⁸⁾	26,908	29,607	30,355
Total SWP Costs	38,513	49,160	59,941
Supplemental Non SWP Water Costs ⁽⁹⁾	1,088	3,417	9,645
QSA Mitigation Costs		2,764	4,091
In-lieu Replenishment Costs ⁽¹⁰⁾		3,515	3,919
Capital Improvement Budget	653	152	64
Depreciation	43	43	43
Debt Service ⁽¹¹⁾	2,714	3,346	
Transfer to (from) Other Funds ⁽¹²⁾	12,159		
Total Expenses	58,058	65,228	80,607
Increase (Decrease) in Cash Flow - Replenishment	9,268	(1,323)	(5,850)
Increase (Decrease) in Cash Flow - SWP	(7,751)	(10,910)	(21,566)
Net Increase (Decrease) in Cash Flow	1,517	(12,233)	(27,416)
Ending Unrestricted Reserves	26,805	25,482	19,632
Ending Restricted Reserves	61,870	50,960	29,394
Ending Reserves	88,675	76,442	49,026

⁽¹⁾ RAC for FY 2015 = \$110.26/AF, for FY 2016 = \$112.00/AF, and for FY 2017 = \$145.60. The FY 2017 rate is the recommended rate from the cost of service study. Revenues based on FY actual or budgeted production estimates.

⁽²⁾ SWP revenues for FY 2015 were collected from the \$.08 and \$.01 tax levies. Beginning in FY 2016, the SWP Tax Revenues will be collected from the \$.08 tax levy.

⁽³⁾ Other Revenues include investment income and revenues received from Whitewater Hydro leases.

⁽⁴⁾ The reimbursement of shared facility costs is derived from an agreement with DWA to share in the maintenance costs of the Whitewater River Groundwater Replenishment Facility.

⁽⁵⁾ Cost to administer the replenishment assessment program includes personnel, meter reading, billing, groundwater monitoring and report preparation.

⁽⁶⁾ SWP Table A costs that can be paid for by the RAC.

⁽⁷⁾ SWP Turnback Water Pool A & B, Pool A & B Water and Yuba Dry Year that can be paid for by the RAC.

⁽⁸⁾ SWP costs that cannot be paid for by the RAC.

⁽⁹⁾ Non SWP water purchases from the Glorious Land Company and MWD.

⁽¹⁰⁾ Costs for projects providing recycled water or Colorado River water in place of groundwater.

⁽¹¹⁾ Debt Service is a CWWD five-year Interfund loan for the payment of 105,000 AF of water purchased from MWD. The loan was paid in full in FY 2016.

⁽¹²⁾ The FY 2015 transfer of \$12,159,000 is comprised primarily of a transfer to the East Whitewater Fund for redevelopment revenues that were incorrectly receipted to the SWP reserves in prior years.

F. Conclusions and Recommendations

Because groundwater production from the West Whitewater River Subbasin AOB continues to exceed natural inflow, the GRP must continue importing water for groundwater replenishment. In addition, CVWD's non-potable water program represents a cost effective in-lieu groundwater replenishment option for improving declining groundwater conditions in the mid-Valley area.

The GRP has proven to be effective in improving groundwater storage and reducing overdraft. However, GRP costs continue to increase. CVWD has analyzed projected expenses, revenues, and reserves over the next five years and determined that the RAC should be increased in fiscal year 2017 to reduce the decrease in cash flow in the West Whitewater River Replenishment Fund.

Accordingly, it is recommended that the RAC of \$145.60/AF be levied upon all producers within the West Whitewater River Subbasin AOB in accordance with the State Water Code, effective July 1, 2016.

In future years, it is recommended that the Replenishment Fund be utilized to fund the completion of the MVP In-Lieu Recharge project within the West Whitewater River Subbasin AOB. The RAC should be assessed considering projected and scheduled connections and as approved by the CVWD Board of Directors, to cover the in-lieu replenishment program costs each fiscal year. In utilizing the RAC and other available funding sources, the MVP can be fully implemented and the previous investments made in managing water supplies within the West Whitewater River Subbasin AOB will come into full effect.

Figure VI-1
Groundwater Level Changes in
West Whitewater River Subbasin Management Area: 2014 to 2015

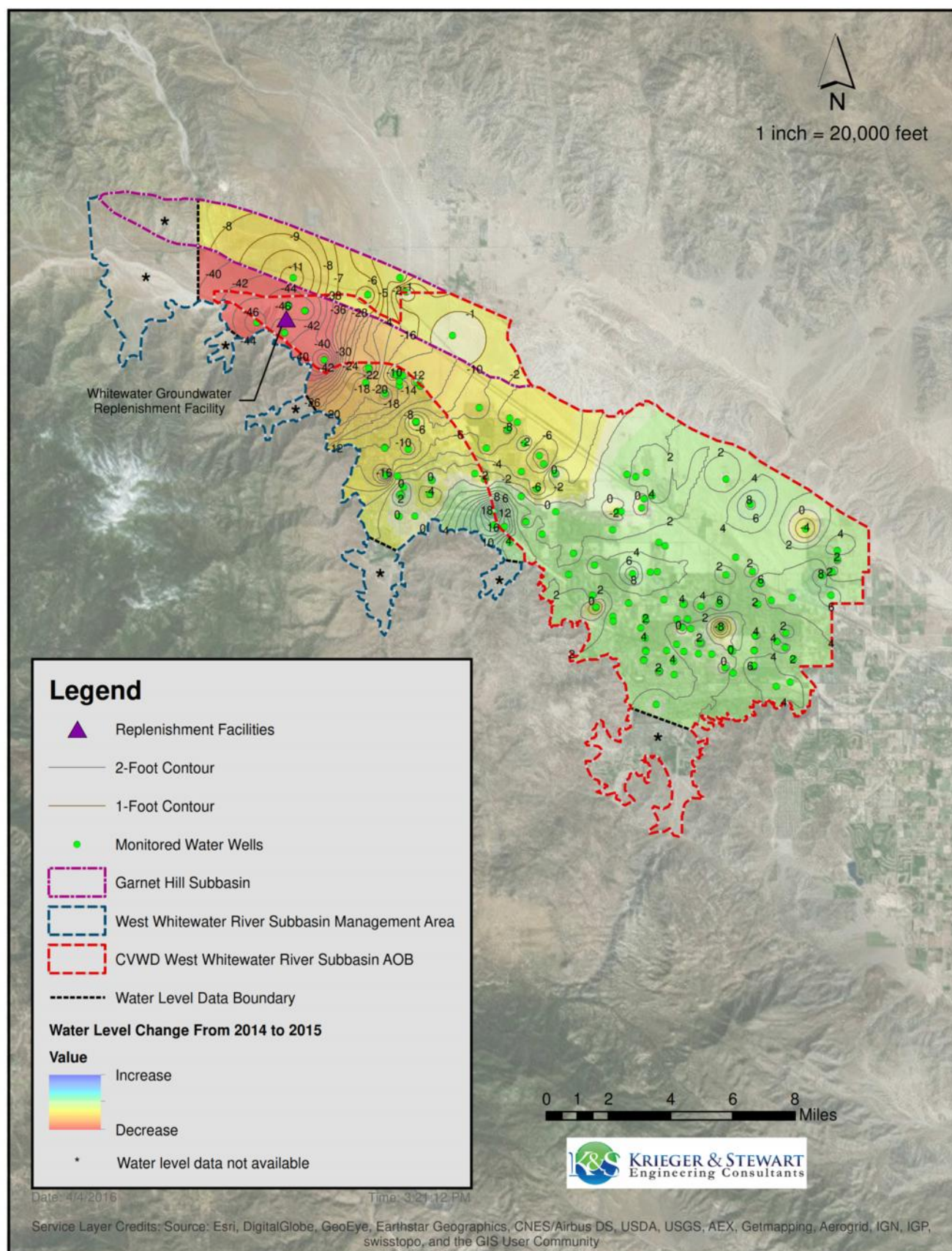


Figure VI-2
Groundwater Level Changes in
West Whitewater River Subbasin Management Area: 2005 to 2015

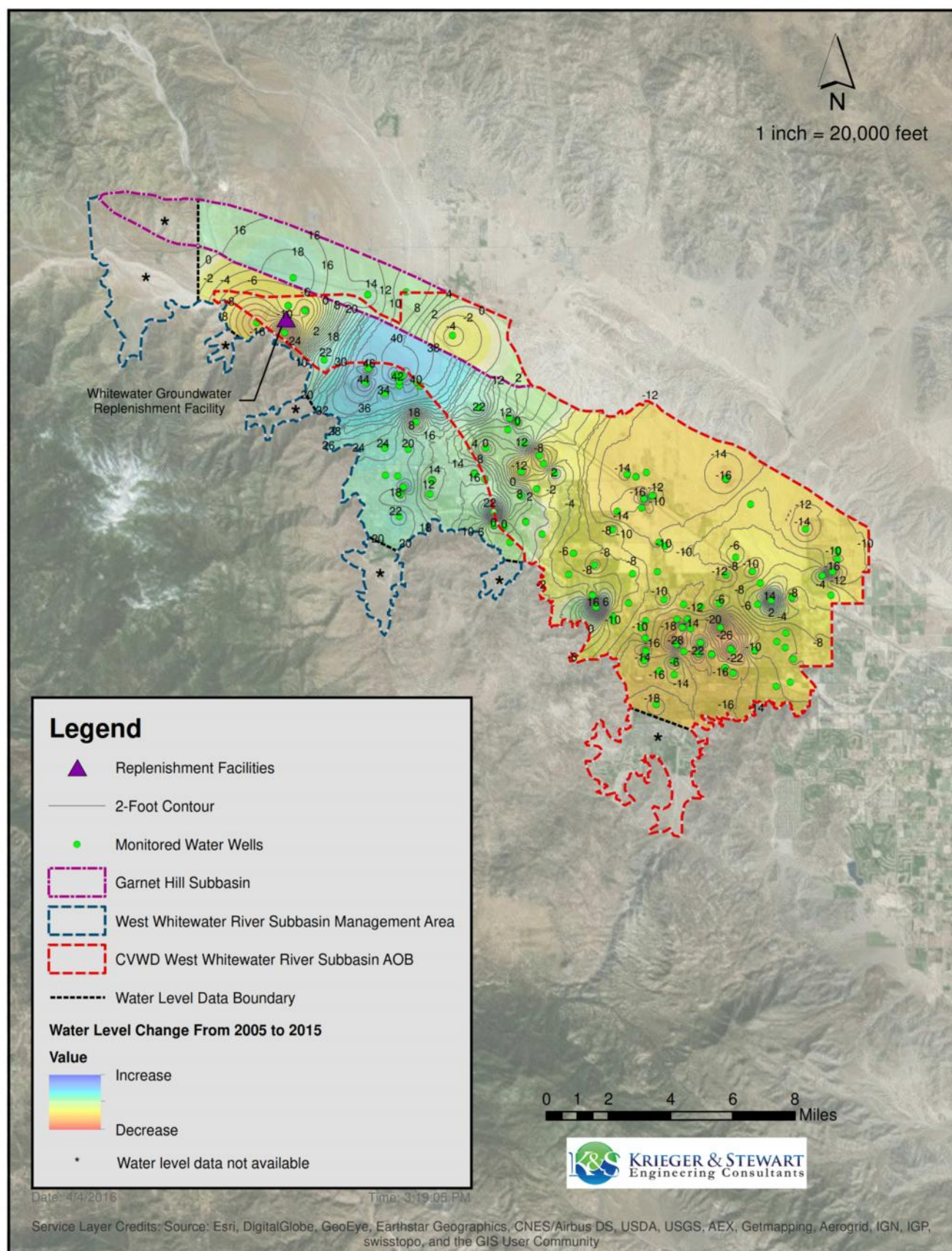


Figure VI-3
West Whitewater River Subbasin Management Area
Artificial Replenishment Quantities and Groundwater Level Hydrograph

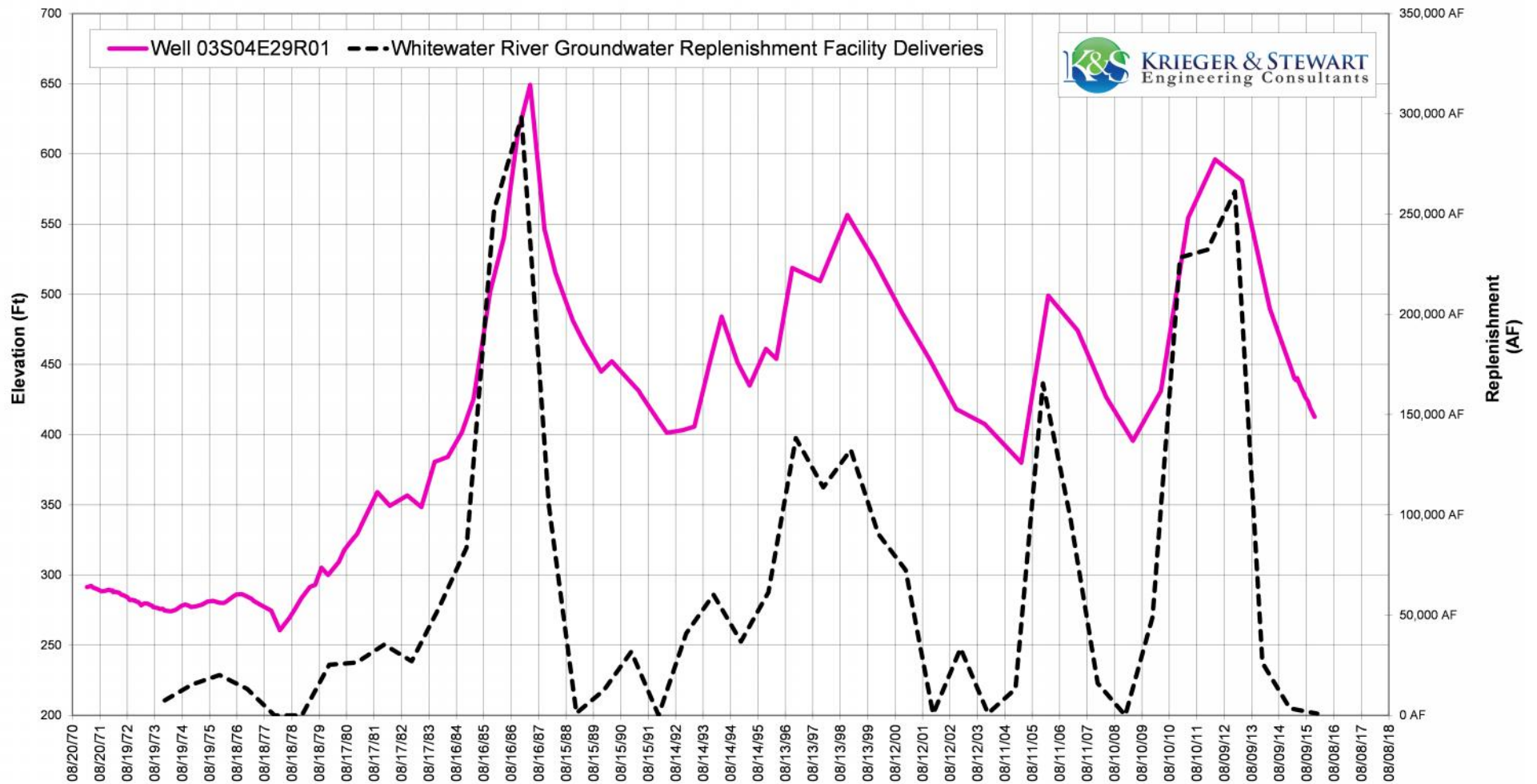
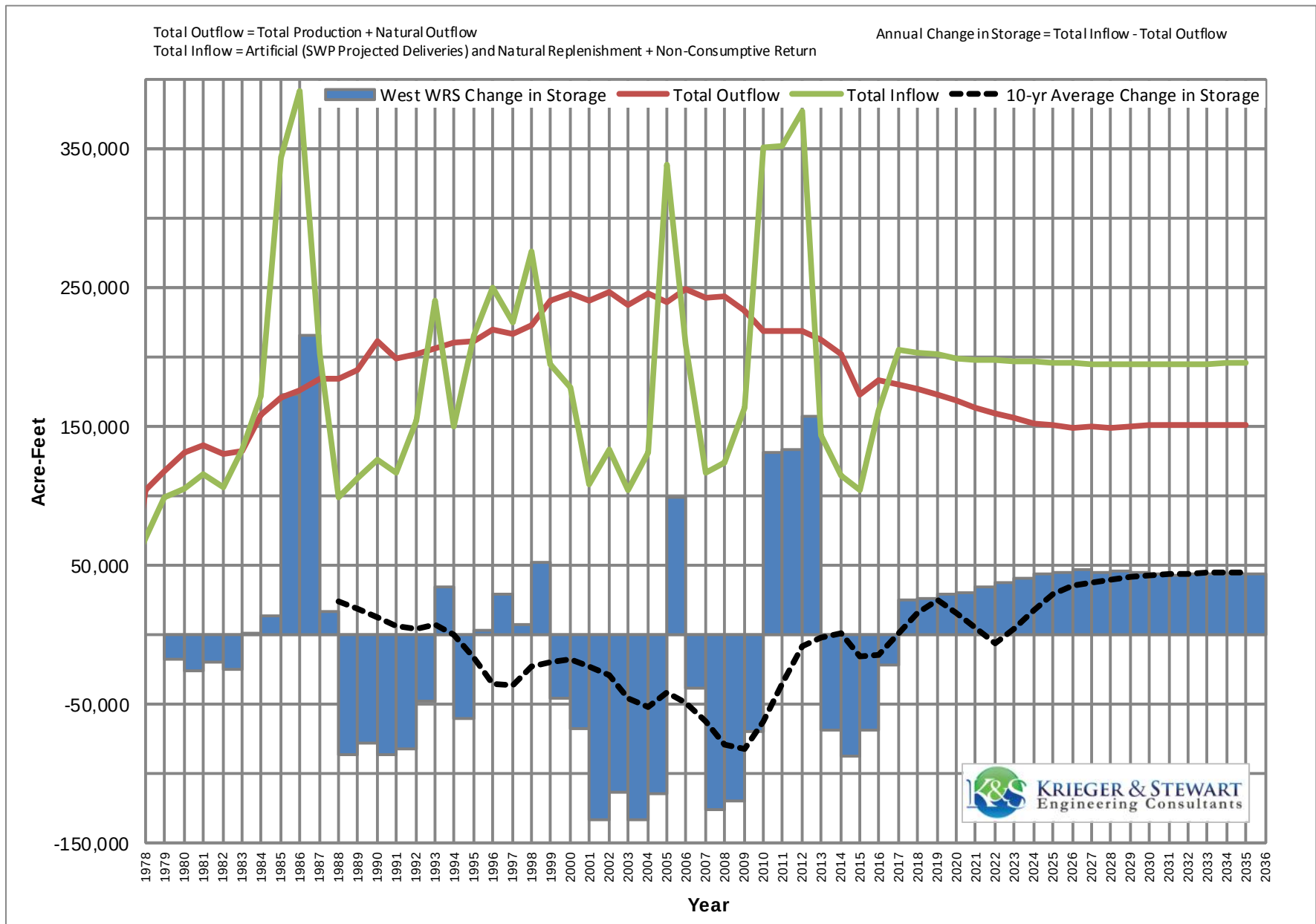


Figure VI-4
West Whitewater River Subbasin Management Area: Change in Groundwater in Storage



CHAPTER VII
EAST WHITEWATER RIVER SUBBASIN
AREA OF BENEFIT

CHAPTER VII EAST WHITEWATER RIVER SUBBASIN AREA OF BENEFIT

A. Management Area and Area of Benefit

1. East Whitewater River Subbasin Management Area

The Whitewater River Subbasin is bounded on the southwest by the Santa Rosa and San Jacinto Mountains, on the north and east by the Banning and San Andreas Faults, on the south by the Salton Sea, and on the northwest by a suballuvial bedrock construction at the east end of the San Geronio Pass.

CVWD manages groundwater in the eastern portion of the Whitewater River Subbasin as a separate unit from the western portion of the Whitewater River Subbasin (**Chapter III**). This management area was created in 2004 and consists of the southerly portion of the Thermal Subarea and the Oasis Subarea that were experiencing declining groundwater levels. The AOB for this management program coincides with the management area.

2. East Whitewater River Subbasin Area of Benefit Boundary

Figures VII-1 and VII-2 at the end of this chapter present the boundary of the East Whitewater River Subbasin AOB. This boundary is defined as follows:

That eastern portion of the Whitewater River Subbasin within the boundaries of CVWD, beginning at the northerly extension of Jefferson Street located on the San Andreas Fault, south to Avenue 40, west to Adams Street, south to Fred Waring Drive (Avenue 44), west to Washington Street, south to the Santa Rosa Mountains near Point Happy. The area's western boundary continues south along the foothills of the Santa Rosa Mountains to the southwest corner of Section 25, Township 7 South, Range 7 East, thence to the southwest corner Of Section 36, Township 8 South, Range 8 East, which is approximately three miles due west of Travertine Rock.

The boundary continues east along the Riverside County line to the southeast corner Of Section 34, Township 8 South, Range 9 East, which is inundated by the Salton Sea. The boundary continues northeasterly across the Salton Sea to the northeast corner of Section 34, Township 7 South, Range 10 East, thence northwesterly along the San Andreas Fault to the point of beginning.

B. Water Supply and Use

1. Natural Replenishment (Precipitation and Stream Flow)

Precipitation in the surrounding mountains is included in the natural inflow estimates found in the water balance calculated in **Table VII-3** of this report. The natural inflow estimates are based on the Coachella Valley Groundwater Flow Model data (prepared by MWH and others), which was utilized for the 2010 CVWMP Update and 2014 Status Report.

The average annual rainfall within the East Whitewater River Subbasin Management Area is approximately 3 inches, as reported by the Western Regional Climate Center station located at the Thermal FAA airport, in Thermal California.

During 2015, the annual average rainfall recorded by rain gauge stations at Thermal FAA Airport, Mecca Landfill, and Oasis as monitored by Riverside County Flood Control and Water Conservation District within the eastern portion of the Whitewater River Subbasin was approximately 1.65 inches, more than the previous year, but still much less than the typical average annual rainfall for the area (see **Appendix A**).

2. Non-Potable Water

CVWD continues to work with groundwater users such as farmers, golf courses and others to encourage the use of non-potable water. Urban irrigation is also expected to use non-potable water as development progresses within this subbasin. This program will be implemented over the next 30 years and is expected to reduce groundwater production from the Whitewater River Subbasin.

There are approximately 37 golf courses in the East Whitewater River Subbasin AOB per the 2010 CVWMP Update. CVWD developed a new non-potable water use agreement in 2010 requiring golf courses with access to Canal or recycled water to meet a minimum of 80 percent of irrigation demand from those sources. To date, 28 18-hole golf courses and one 9-hole golf course are existing Coachella Canal customers. There are approximately five additional golf courses proposed for conversion from irrigation with groundwater to irrigation with non-potable water by the end of fiscal year 2016. Conversions are an important element in the continuing efforts to reduce the quantity of groundwater extracted from the basin, contributing to the reduction of overdraft within the East Whitewater River Subbasin AOB.

The Oasis Area Irrigation Project is an "in-lieu" replenishment project, located strictly within the East Whitewater River Subbasin AOB, which is designed to help eliminate overdraft. The project is estimated to reduce groundwater production by approximately 32,000 AF/Yr by providing Canal water for irrigation as described in the 2010 CVWMP Update. Construction of the Oasis Area Irrigation Project is anticipated to begin in October 2016. The project will be funded, in part, through an assessment district.

The benefits of completing these projects within the East Whitewater River Subbasin Management Area, as shown in **Figure VII-4** at the end of this chapter, include preserving groundwater supplies and reducing land subsidence. Offsetting groundwater pumping with delivery of non-potable water for irrigation use also reduces the decline in groundwater levels (stabilization), the decline of groundwater in storage, and the effects of land subsidence.

3. Groundwater Production, Non-Consumptive Return, and Conservation

a. Groundwater Production

As presented in the 2010 CVWMP Update, groundwater production within the East Whitewater River Subbasin AOB was estimated to be 168,300 AF/Yr during 1999. **Table VII-1** presents the estimated groundwater production in the East Whitewater River Subbasin Management Area from 1999 through 2015.

When the replenishment assessment was adopted in June 2004, the CVWD Board of Directors required groundwater producers to report their groundwater production. The reported production for 2015 was 113,706 AF.

Table VII-1
Production within the
East Whitewater River Subbasin Management Area

Year	AF ⁽¹⁾
1999	168,300
2002	166,700
2003	199,800
2004	172,300
2005	172,000
2006	172,000
2007	172,000
2008	172,000
2009	160,000
2010	150,000
2011	145,000
2012	120,064
2013	119,194
2014	123,465
2015	113,706

⁽¹⁾ The 1999 production value is from the CVWMP, Table 3-2, Summary of Historical Water Supplies in 1936 and 1999. The CVWMP did not include production values for 2000 and 2001. Production values for the years 2002 through 2012 were estimated from reported and projected unreported groundwater production. The production values for 2012 through 2015 are equal to the reported groundwater production during those calendar years.

b. Non-Consumptive Return

Based on MWH's groundwater model projections (MWH 2011), a current non-consumptive return of 34 percent is used herein, and is applied to both groundwater produced locally for irrigation and municipal use, and to imported Colorado River water applied locally for irrigation.

Treated wastewater discharged to the Coachella Valley Stormwater Channel, such as that discharged from CVWD's WRP 4, the Valley Sanitary District (Indio), and the Coachella Sanitary District (Coachella) does not result in any non-consumptive return and is excluded from the non-consumptive return calculations.

c. Conservation

As discussed in **Chapter IV**, water conservation may also become an important driver for future RAC rates. Under Governor Brown's executive order dated April 1, 2015, CVWD is tasked with reducing water use by 32 percent. In addition, the Governor is recommending golf courses using groundwater reduce their water use by 25 percent. Together, these changes would equate to approximately a 10 percent reduction in groundwater production in the East Whitewater River Subbasin AOB.

C. Groundwater Replenishment

1. Replenishment Facilities

a. Thomas E. Levy Groundwater Replenishment Facility

The TEL Replenishment Facility is located just south of Lake Cahuilla at Dike 4, a major flood control dike, near Avenue 62 and Madison Street. This location is ideally suited for large-scale replenishment in the Thermal Subarea, given its proximity to Lake Cahuilla and the relative absence of aquitards that would retard infiltration (see **Figure III-2**). The TEL Replenishment Facility went online in June, 2009. Since then, 271,289 AF of water has been replenished at the TEL Replenishment Facility. The 2010 CVWMP Update recommends a goal of 40,000 AF/Yr at this facility.

b. Martinez Canyon Replenishment Facility

CVWD completed construction of a pilot replenishment facility and several monitoring wells on the Martinez Canyon alluvial fan in March 2005. This pilot facility was designed to replenish approximately 4,000 AF/Yr, but the results from the Martinez Canyon Pilot project indicate the site may not be ideally suited for groundwater replenishment. CVWD continues to monitor and evaluate the need and feasibility of a replenishment facility on the Martinez Canyon alluvial fan. If needed, CVWD plans to evaluate alternate locations for replenishment in the East Whitewater River Subbasin Management Area.

2. Current Replenishment Activities

a. Direct Replenishment at TEL Replenishment Facility

In 2015, CVWD replenished 37,262 AF/Yr at the TEL Replenishment Facility. At this time, water deliveries to the Martinez Canyon site have been discontinued, and received no water in 2014 or 2015. CVWD continues to monitor groundwater in the Martinez Canyon area to assess any changes in water quality or supply conditions that would support groundwater replenishment at this site in the future.

The annual amounts of water delivered for replenishment at the TEL Replenishment Facility and Martinez Canyon Pilot Replenishment Facility are shown in **Table VII-2**.

Table VII-2
Colorado River Water Delivered to
East Whitewater River Subbasin
Management Area Replenishment Facilities

Year	Replenishment Delivery (AF/Yr)
1997	415
1998	1,364
1999	2,802
2000	1,813
2001	3,572
2002	2,360
2003	1,671
2004	3,450
2005	4,743
2006	2,648
2007	5,775
2008	7,473
2009	21,735
2010	37,401
2011	32,417
2012	33,166
2013	35,192
2014	36,030
2015	37,262
Total	271,289

Reference: CVWD billing records

b. Non-Potable In-Lieu Replenishment (Source Substitution)

In addition to the direct replenishment activities described above, CVWD plans to provide non-potable water (imported water and recycled water) to replace groundwater pumping as identified in the 2010 CVWMP Update. CVWD continues to work with groundwater users such as farmers, golf courses and other users to encourage the use of non-potable water. Currently, five additional golf courses are scheduled for conversion to non-potable supply during fiscal year 2016.

3. Future Replenishment Activities and Replenishment Model Projections

Direct replenishment at the TEL Replenishment Facility is expected to continue, as will source substitution efforts.

Extensive computer modeling of the Whitewater River Subbasin was conducted during the course of preparation of the 2010 CVWMP Update and its associated Program Environmental Impact Report. The groundwater model allowed CVWD to gain a better understanding of water conditions in this subbasin and the benefits of water management activities identified in the 2010 CVWMP Update.

Figure VII-5 at the end of this chapter presents projected groundwater levels in 2045 during implementation of the 2010 CVWMP Update projects (80,000 AF/Yr in the East Whitewater River Subbasin AOB) compared to groundwater levels in 2009. Implementation of the project results in water levels that are 40 feet to 60 feet higher in the La Quinta area, and about 90 feet higher in the Oasis area.

Construction of a canal water distribution system in the Oasis area is a source substitution project identified in the 2010 CVWMP Update. This project will convert agricultural irrigation from groundwater to Colorado River water on the Oasis slope. This project will conserve groundwater, utilize available Colorado River water, and help reduce aquifer overdraft. To date, a preliminary project design and theory of operations have been developed, and public outreach to landowners and operators has been completed. Preliminary locations and sizes have been approved for major facilities, such as reservoirs, pump stations, and pipelines. Construction is anticipated to begin in October 2016.

D. Aquifer Conditions

1. Groundwater Inflows and Outflows

Total inflows and outflows to the East Whitewater River Subbasin Management Area in 2015 are summarized in **Table VII-3**.

The estimated natural inflow of 32,300 AF/Yr includes natural replenishment and subsurface inflow across subbasin boundaries. The non-consumptive return of applied water is estimated at 129,500 AF, which is the sum of 34 percent of the estimated annual groundwater production (excluding wastewater discharges) and 34 percent of Colorado River water applied for irrigation within the management area during 2015 (see **Section B** above and **Figure VII-8** for a more detailed explanation). Wastewater discharges are excluded from this figure because they flow to the Salton Sea without an opportunity to percolate into the groundwater

basin. The total inflow includes the natural inflow of 32,300 AF, the non-consumptive return, and the 37,262 AF of water replenished by CVWD at the replenishment facilities.

The total outflow is the groundwater production estimate plus 57,500 AF/Yr (subsurface drainage excluding wastewater discharges and canal regulatory flows), evapotranspiration by native vegetation, evaporation losses, and net subsurface outflow to the Salton Sea. Wastewater is subtracted from the outflow because it was already included as outflow in the total production quantity, and canal regulatory flows were subtracted from outflow because these flows do not leave the management area.

The annual balance is the total inflow less the total outflow for a gain of 26,900 AF of water in storage in the subbasin in 2015.

The overall water balance in the East Whitewater River Subbasin Management Area is schematically depicted in **Figure VII-8** at the end of this chapter. A simplified water balance for crop irrigation is schematically depicted in **Figure VII-9** at the end of this chapter, and a simplified water balance for landscape irrigation is schematically depicted in **Figure VII-10** at the end of this chapter.

2. Change in Groundwater Storage

In 2015, the annual water balance for the East Whitewater River Subbasin AOB was positive, providing an increase in the total groundwater in storage. Imported water may offset annual changes in the groundwater in storage in a particular year. However, on a long-term basis, water requirements are likely to continue to place demands on groundwater storage. The 2010 CVWMP Update outlines a plan to address long-term overdraft in the Coachella Valley.

Based on the water balance information presented in **Table VII-3**, the East Whitewater River Subbasin Management Area experienced a gain of 26,900 AF of water storage during 2015. Without artificial replenishment, however, the stored groundwater within the East Whitewater River Subbasin Management Area would have decreased by approximately 10,400 AF. Continued groundwater replenishment is necessary to prevent overdraft in the future.

It should be noted that overdrafting the groundwater basin may allow poor quality water from the semi-perched aquifer and the Salton Sea to replace fresh water storage. An ongoing GRP is necessary to continue to reduce declining groundwater levels and to avoid any detrimental water quality conditions that might otherwise occur.

Figure VII-4 at the end of this chapter shows the historical and projected change in the groundwater in storage based on the total outflow and total inflow estimated for the East Whitewater River Subbasin Management Area through 2035, as reported in past Engineer's Reports and projected by MWH (2011).

The total historical outflow consists of the total groundwater produced from the subbasin, subsurface drainage outflow, and natural outflow as shown in **Table VII-3** within this Engineer's Report and past Engineer's Reports.

Table VII-3
2015 Water Balance in the
East Whitewater River Subbasin Management Area

Item	Annual Calculation (AF)
<u>2015 Groundwater Production</u>	
Reported Production	-113,706
Assumed Approximate Production by Exempt Minimal Pumps	-1,000
Total Estimated Production (Rounded)	-114,706
<u>Non-Consumptive Return</u>	
From Production (Minus Wastewater) ⁽¹⁾	34,400
From Applied Colorado River Water ⁽²⁾	95,064
Total Non-Consumptive Return (Rounded)	129,500
<u>Natural Inflow</u>	
Natural Replenishment ⁽³⁾	5,130
Subsurface Inflow from West Whitewater River Subbasin AOB ⁽³⁾	25,790
Subsurface Inflow from Fargo Canyon Subarea (DHS Subbasin) ⁽³⁾	170
Net Subsurface Inflow from Salton Sea ⁽³⁾	1,220
Total Natural Inflow (Rounded)	32,300
<u>Natural Outflow</u>	
Subsurface Drainage Outflow ⁽⁴⁾	-51,895
Evapotranspiration ^(3,5)	-5,602
Total Natural Outflow (Rounded)	-57,500
Artificial Replenishment ⁽⁶⁾	37,262
Annual Balance	26,862
Annual Balance (Rounded)⁽⁷⁾	26,900

(1) 34 percent of production excluding wastewater discharges ((113,706 AF + 1,000-13,500) x 0.34 = 34,410 AF), rounded

(2) 34 percent of Colorado River water applied for irrigation in the AOB ((279,600) x 0.34 = 95,064)

(3) MWH 2011

(4) Total subsurface drainage outflow excluding wastewater discharges and regulatory Canal water discharges (70,979 AF – 13,500 AF – 5,584 AF = 51,895)

(5) Evapotranspiration (4,857 AF) and two percent losses from groundwater replenishment due to evaporation (0.02 x 37,262 = 745 AF)

(6) TEL Replenishment Facility received 37,262 AF and the Martinez Canyon Facility received 0 AF.

(7) This was an increase in stored groundwater equal to 0.09 percent of the Whitewater River Subbasin's storage capacity of 28,800,000 AF in 2015.

The total historical inflow consists of artificial groundwater replenishment, natural inflow, and non-consumptive return (34 percent of the total groundwater extractions and Canal water use), as shown on **Table VII-3** within this Engineer's Report and past Engineer's Reports.

Projected groundwater production figures were obtained from groundwater model simulations (MWH 2011) for the 2010 CVWMP Update and the 2014 Status Report. These projections consider population growth forecasts along with a reduction in the total groundwater produced as future projects such as the Oasis Irrigation Project, source substitution with non-potable water, and water conservation programs continue to be implemented.

Projections for artificial groundwater replenishment are based on the capacity of the TEL Replenishment Facility (40,000 AF/Yr), 10,000 AF/Yr to be replenished by the City of Indio, and 4,000 AF/Yr to 20,000 AF/Yr additional replenishment within the East Whitewater River Subbasin AOB after 2025. Plans for the future extent of replenishment activities at the Martinez Canyon Pilot Facility and in the City of Indio are actively being evaluated.

Projected natural inflow obtained from MWH include: projected subsurface flows from the West Whitewater River Subbasin AOB and Desert Hot Springs Subbasin; projected surface flows based on stream gauging and precipitation records; and projected non-consumptive return.

Future non-consumptive return is expected to decrease from approximately 34 percent to 30 percent through 2035 based on the effects of implementation of water conservation measures such as turf removal, more efficient irrigation practices, and increased drain flows leaving the subbasin. As shown in **Table VII-3**, the estimated percentage of non-consumptive return for 2015 is approximately 34 percent (MWH 2011).

3. Groundwater Levels

a. Local Effects of Direct Replenishment

Early benefits of replenishment from the TEL Replenishment Facility to the lower aquifer are observed in measurements collected from monitoring wells near the facility. The 18 monitoring wells located at the TEL Replenishment Facility provide representative monitoring of the effects of the replenishment efforts. The nine original monitoring wells at the TEL Replenishment Facility show an average water level increase of 5.0 feet during 2015. The nine new monitoring wells installed in mid-2009 show an average water level increase of 60.2 feet from the time of installation through January 2016, and a 5.0 feet average increase in 2015. The average rise in water levels between 2014 and 2015 observed in the 141 East Whitewater River Subbasin AOB monitoring wells was 3.9 feet. One of the nine new monitoring wells installed in 2009 (Monitoring Well #25) was installed into the upper perched aquifer. Water levels observed in this well increased approximately 1.75 feet in 2015.

b. Effects throughout the Management Area

Historical water level declines in the Coachella Valley Groundwater Basin and conditions producing those declines have been extensively described by the USGS and CDWR, and are documented in the 2010 CVWMP Update and 2014 Status Report. The 2014 Status Report demonstrates that the programs set forth in the 2010 CVWMP Update are effectively

reducing overdraft within the groundwater basin based on the increase in water levels. Such programs include replenishment, source substitution (golf course conversions), expansion of Coachella Canal water and recycled water use, and various other conservation programs.

Although groundwater levels have been declining throughout most of the subbasins since 1945, water levels in the eastern portion of the Coachella Valley had risen until the early 1970s due to importation of water from the Coachella Canal and the resulting decreased pumpage in that area. However, groundwater levels began to decline again in the 1980s due to increasing urbanization and increased groundwater use by domestic water purveyors, local farmers, golf courses, and fish farms.

The historical declining water table in the eastern portion of the Whitewater River Subbasin led to the determination that a management program was required to stabilize water levels and prevent other adverse effects such as water quality degradation and land subsidence. CVWD's East Whitewater River Subbasin AOB GRP was developed to serve this need and became effective in 2005. Since then, groundwater levels in wells throughout most of the eastern portion of the Whitewater River Subbasin have stabilized or are rising.

Water surface elevations in the Valley are highest at the northwest end of each Subbasin, indicating that regional groundwater flow is typically from the northwest to the southeast in the center of the Coachella Valley.

Figure VII-1 at the end of this chapter depicts the change in average groundwater levels from 2014 to 2015 in the East Whitewater River Subbasin Management Area based on CVWD's groundwater level monitoring well data. The East Whitewater River Subbasin AOB boundary and the locations of the TEL Replenishment Facility and Martinez Canyon Pilot Replenishment Facility are also shown in **Figure VII-1**.

The colored contours in **Figure VII-1** represent water level changes for 141 wells in the East Whitewater River Subbasin Management Area monitored by CVWD staff. The average rise in water levels observed in these monitored wells from 2014 to 2015 was 3.9 feet. **Figure VII-1** includes data from 18 monitoring wells located at the TEL Replenishment Facility, which experienced dramatic fluctuations in water levels throughout the year in response to water deliveries to the facility. In 2015, water levels in those 18 monitoring wells increased approximately 5.0 feet, which increased the annual average water level within the East Whitewater River Subbasin Management Area. Excluding the monitoring wells, the annual average change in groundwater levels in the management area is an increase of 3.8 feet. **Figure VII-6** at the end of this chapter depicts the same information for the West and East Whitewater River Subbasin Management Areas combined.

Figure VII-2 at the end of this chapter depicts the change in average groundwater levels from 2005 to 2015 in the East Whitewater River

Subbasin Management Area based on CVWD's groundwater level monitoring well data.

The colored contours in **Figure VII-2** represent water level changes for 114 wells in the East Whitewater River Subbasin Management Area monitored by CVWD staff (nine of the wells used for the one-year comparison were not constructed in 2005, and data were not available in both years of the comparison for 18 of the wells). The average change in water levels observed in these monitored wells from 2005 to 2015 was an increase of 24.1 feet. **Figure VII-7** at the end of this chapter depicts the same information for the West and East Whitewater River Subbasin Management Areas combined.

The annual average change in groundwater levels from 2005 to 2015, excluding the monitoring wells near the TEL Replenishment Facility, was an increase of 19.7 feet. The analysis of the groundwater levels observed at the monitoring wells emphasizes the benefit and effectiveness of the replenishment program in sustaining the water supplies. Without replenishment, water levels and supplies would likely decline, but with sufficient replenishment and other water management programs, water levels will stabilize.

4. Assessment of Overdraft Conditions

Due to implementation of projects identified in the 2010 CVWMP Update, average groundwater levels in the East Whitewater River Subbasin Management Area are increasing. **Figure VII-4** at the end of this chapter illustrates total inflow to the subbasin exceeds total outflow, and the subbasin continues to experience a positive change in groundwater in storage. However, continued artificial replenishment is necessary to prevent overdraft in the future.

5. Artesian Conditions

Historically, the eastern portion of the Whitewater River Subbasin experienced confined aquifer artesian conditions with sufficient pressure to cause groundwater levels in wells to rise above the ground surface. Artesian flowing wells attracted early settlers to farm in this area. Artesian conditions declined in the late 1930s when increased groundwater pumping caused declining groundwater water levels. The completion of the Coachella Canal by the U.S. Bureau of Reclamation in 1949 brought Colorado River water to the eastern Coachella Valley for agricultural irrigation purposes. Artesian conditions returned in the early 1960s through the 1980s as imported Colorado River water was substituted for groundwater production. Beginning in the late 1980s, groundwater use again increased, resulting in declining water levels and a loss of artesian conditions.

The East Whitewater River Subbasin AOB GRP combined with other water management elements, including source substitution and water conservation, are helping to control groundwater overdraft, restore water levels, and return artesian conditions within the eastern portion of the Whitewater River Subbasin. This results in reduced groundwater pumping costs and water quality protection of the confined aquifer.

As artesian conditions return, water pressure in the lower confined aquifer increases and can cause uncontrolled flows in wells that are not properly constructed and/or poorly maintained. The Coachella Valley Mosquito and Vector Control District and CVWD are cooperating in an effort to notify well owners of their responsibility to control artesian wells in accordance with state regulations, and offering artesian well owners who properly control artesian flows the opportunity to apply for a \$3,000/well rebate to offset their costs. California Health and Safety Code, Section 2000-2007 states that flooding caused by artesian wells is a public nuisance which poses a risk to public health, safety, and welfare. In addition, Section 305 of the California Water Code requires artesian wells to be capped or equipped with a mechanical appliance which will readily and effectively arrest and prevent the flow of water.

In accordance with Section 31638.5 of the California Water Code, producers who extract greater than 25 AF/Yr (including artesian flowing groundwater) are required to have water-measuring devices installed on all wells or other water producing facilities, and to report the total amount produced from all wells to CVWD on a monthly basis. Minimal pumpers are exempt from this provision. **Figure VII-3** at the end of this chapter depicts the current annual average artesian conditions within the East Whitewater River Subbasin AOB; specifically, the water pressure equivalent elevation above ground surface. In 2015, water levels above ground surface were measured in 10 wells, with an average annual increase in water levels of approximately one foot.

6. Water Quality (Saline Water Intrusion)

Nine monitoring wells were installed near the TEL Replenishment Facility in 1995 and are monitored quarterly for water quality and changes in water table elevation. Of these nine wells, four are shallow (176 to 315 feet), five are deep (543 feet to 740 feet), and they are all located either up-gradient or down-gradient of the original Thomas E. Levy pilot replenishment facility ponds along Avenue 62.

Nine additional monitoring wells were installed near the TEL Replenishment Facility in 2009. Six wells are nested together in groups of two (one shallow and one deep) down-gradient of the facility, parallel to Dike 4. Three shallow monitoring wells are located down-gradient of the facility at existing CVWD sites. These additional monitoring wells are used to evaluate water quality and depth to water table, along with the original monitoring wells.

Monitoring wells at the Martinez Canyon Pilot Replenishment Facility were installed in 2001-2002 and are used to monitor water quality and water table elevation data. These wells range from a depth of 380 feet to 420 feet and are located down-gradient of the Martinez Canyon Pilot ponds along Avenue 72.

Monitoring wells are also used to evaluate saline water intrusion from the Salton Sea into the fresh water aquifer. CVWD has been studying this potential problem since 1996 using a multiple zone monitoring well near Lincoln Street on the northwest end of the Salton Sea. This well allows the evaluation of water level and quality at four different depths below the ground surface. During 2002, CVWD completed construction of two additional multiple zone monitoring wells

near Avenue 78 on the west side of the Salton Sea. Each monitoring well allows measurements from two aquifer zones in the Oasis area. Monitoring data for these wells from 2004 indicated water levels in the shallower aquifers ranged from 25 feet to 70 feet below the elevation of the Salton Sea. Current monitoring data shows water levels in these wells are under artesian pressure and range from 17 feet below to 19 feet above the current elevation of the Salton Sea.

Data from these monitoring wells also show that the water levels in the primary production aquifers are increasing. The depth to water in 2004 in the primary production aquifer was 40 feet to 100 feet below the ground surface. Current water levels at the multiple-zone monitoring well near Lincoln Street range from 12 feet below ground surface to 19 feet above ground surface.

Many areas of the East Whitewater River Subbasin Management Area have shallow semi-perched groundwater conditions. Because groundwater levels in this perched aquifer are typically 8 feet to 10 feet below ground surface (controlled by subsurface tile drains), there can be a downward vertical gradient between the perched aquifer and the primary production zone. Salts that accumulate in the semi-perched zone from irrigation use can migrate slowly through the aquitard into the deeper aquifers thereby degrading the water quality. Rising water levels in the primary production aquifer, displayed in recent data collected at the multiple zone monitoring wells, reduces the likelihood of salt water intrusion into the fresh water aquifer.

E. Replenishment Assessment

1. Replenishment Water Costs

Replenishment water for the East Whitewater River Subbasin AOB GRP comes primarily from CVWD's Colorado River water contract and the QSA. Groundwater replenishment water is priced at CVWD's Canal Water Class 3 Rate plus Quagga Mussel and Gate Charges.

2. Replenishment Program Accounting and Replenishment Assessment Development

a. Minimal Pumpers

The number of exempt minimal pumpers in the East Whitewater River Subbasin AOB is currently unknown. CVWD has an ongoing program to conduct a thorough field investigation of the use of all wells. Minimal pumpers predominantly pump water from small wells that are used for domestic or limited irrigation purposes. Maximum pumpage by the minimal pumpers in the management area is assumed to be less than approximately 1,000 AF/Yr.

b. Debt Consolidation

The East Whitewater Replenishment Fund received a loan from CVWD's Domestic Water Fund to construct the TEL Replenishment Facility in the amount of \$49.2 million. Beginning in 2013, this capital debt is now consolidated with the Uncollected RAC First Four Years and Assessed vs

Assessable Amortizations from prior years to form one debt service amount and such debt will be paid back each year to the Domestic Water Fund.

c. Income Statement

Table VII-4 presents the items identified above into an income statement showing Actual Fiscal Year 2015, Projected Fiscal Year 2016 and Projected Fiscal Year 2017 Revenues, Expenses, and Cash Flow. **Table VII-4** shows that even with the proposed \$7/AF RAC increase previously recommended, the reserve balance declines.

The SWP Tax Revenues and debt service payments in the Income Statement were presented in a multi-year forecast at the Joint Water Policy Advisory Committee meeting on March 17, 2016 for the East Whitewater River Subbasin AOB.

d. Replenishment Assessment Charge (RAC)

The Joint Water Policy Advisory Committee has previously recommended a RAC increase of \$7/AF per year for successive fiscal years beginning July 1, 2009. This would increase the RAC from the current \$59/AF to \$66/AF effective July 1, 2016 for a 12 percent increase.

Based on projected revenue as shown on **Table VII-4**, the proposed RAC increase results in a projected decrease in Cash Flow in fiscal year 2017 in the amount of \$8.9 million.

Table VII-4
Coachella Valley Water District
East Whitewater River Subbasin Area of Benefit
Groundwater Replenishment Program Income Statement

Description	Actual Fiscal Year (FY) 2015 (\$1,000)	Projected FY 2016 (\$1,000)	Projected FY 2017 (\$1,000)
Revenues			
Replenishment Assessment Charge Revenue ⁽¹⁾	6,446	6,782	6,202
State Water Project Tax Revenue ⁽²⁾	10,683	17,770	20,072
Other Revenue ⁽³⁾	24	6,559	152
Total Revenues	17,153	31,111	26,426
Expenses			
Total O&M Costs ⁽⁴⁾	1,008	1,232	1,239
Power Costs ⁽⁵⁾	985	1,122	1,200
Colorado River Water ⁽⁶⁾	3,316	3,468	3,425
QSA Mitigation Costs		2,508	3,713
Administrative Costs ⁽⁷⁾	1,030	1,222	1,259
Depreciation (7)	397	461	523
In-lieu Replenishment Costs ⁽⁹⁾	1,332	4,126	20,232
Capital Improvement		336	4
Debt Service ⁽¹⁰⁾	4,459	4,292	4,292
Transfer (from) To Other Funds ⁽¹¹⁾	(13,116)	5,331	-
Total Expenses	(589)	24,098	35,887
Increase (Decrease) in Cash Flow - Replenishment	(\$5,684)	(\$10,455)	(\$29,162)
Increase (Decrease) in Cash Flow - SWP	\$23,823	\$17,929	\$20,224
Net Increase (Decrease) in Cash Flow	18,139	7,474	(8,938)
Ending Unrestricted Reserves	(17,883)	(28,338)	(57,500)
Ending Restricted Reserves	30,146	48,075	68,299
Ending Reserves	12,263	19,737	10,799

⁽¹⁾ RAC for FY 2015 = \$52/AF, for FY 2016 = \$59/AF, and for FY 2017 = \$66/AF. Revenues based on FY actual or budgeted production estimates.

⁽²⁾ SWP revenues collected in FY 2015 from \$.01 tax levy. In FY 2016 the tax levy was increase to \$.02. The additional \$.01 was moved from the West Whitewater Fund to the East Whitewater Fund.

⁽³⁾ Other Revenues include investment income and a one-time allocation of property tax revenue.

⁽⁴⁾ Operations and Maintenance (O&M) costs include labor, equipment, and materials for the replenishment facilities.

⁽⁵⁾ Power costs are the actual power and utility charges for the recharge facilities for FY 2015.

⁽⁶⁾ Colorado River water costs for FY 2015 were based on the delivered volume of 37,262 AF. FYs 2016 and 2017 water costs are based on an estimated 38,000 AF. The calculated rate per AF is comprised of CVWD's Class 3 Rate plus Quagga and Gate Charges.

⁽⁷⁾ Annual cost to administer the GRP includes personnel, meter reading, investigation, report preparation, and billing.

⁽⁸⁾ Depreciation is the annual depreciation expense for the TEL Replenishment Facility.

⁽⁹⁾ Costs for projects providing recycled water or Colorado River water in place of groundwater.

⁽¹⁰⁾ Debt Service - 15 year variable debt instrument payable to CVWD's Domestic Water Fund in the amount of \$60,285,179. This note payable reimburses the Domestic Water Fund for the land and construction costs of the replenishment facilities within this AOB.

⁽¹¹⁾ The FY 2015 transfer is primarily from CVWD's West Whitewater and Mission Creek Funds for redevelopment revenues that were incorrectly receipted to the SWP reserves. The FY 2016 transfer is for reimbursement of costs paid by the Canal Fund to restore conveyance capacity of the canal that had been negatively impacted by subsidence due to groundwater pumping.

F. Conclusions and Recommendations

Because groundwater production from the East Whitewater River Subbasin AOB continues to exceed natural inflow, the GRP must continue importing water for groundwater replenishment.

The GRP has proven to be effective in reducing groundwater overdraft and the program should continue. However, GRP costs continue to increase. CVWD has analyzed projected expenses, revenues, and reserves over the next five years and determined that the RAC set forth herein is needed to sustain the GRP.

Accordingly, it is recommended that the RAC of \$66/AF be levied upon all producers within the East Whitewater River Subbasin AOB in accordance with the State Water Code, effective July 1, 2016.

Figure VII-1
Groundwater Level Changes in
East Whitewater River Subbasin Management Area: 2014 to 2015

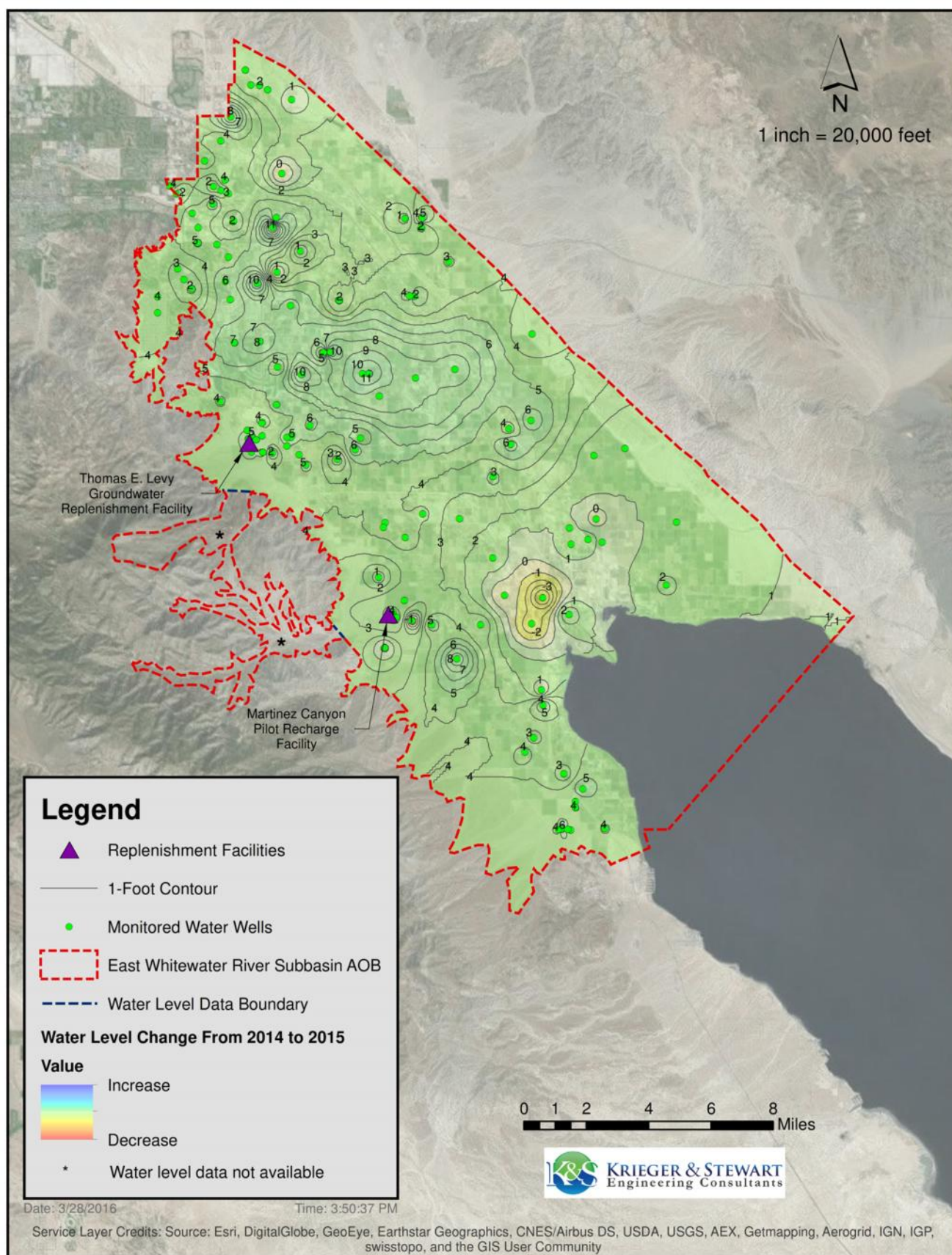


Figure VII-2
Groundwater Level Changes in
East Whitewater River Subbasin Management Area: 2005 to 2015

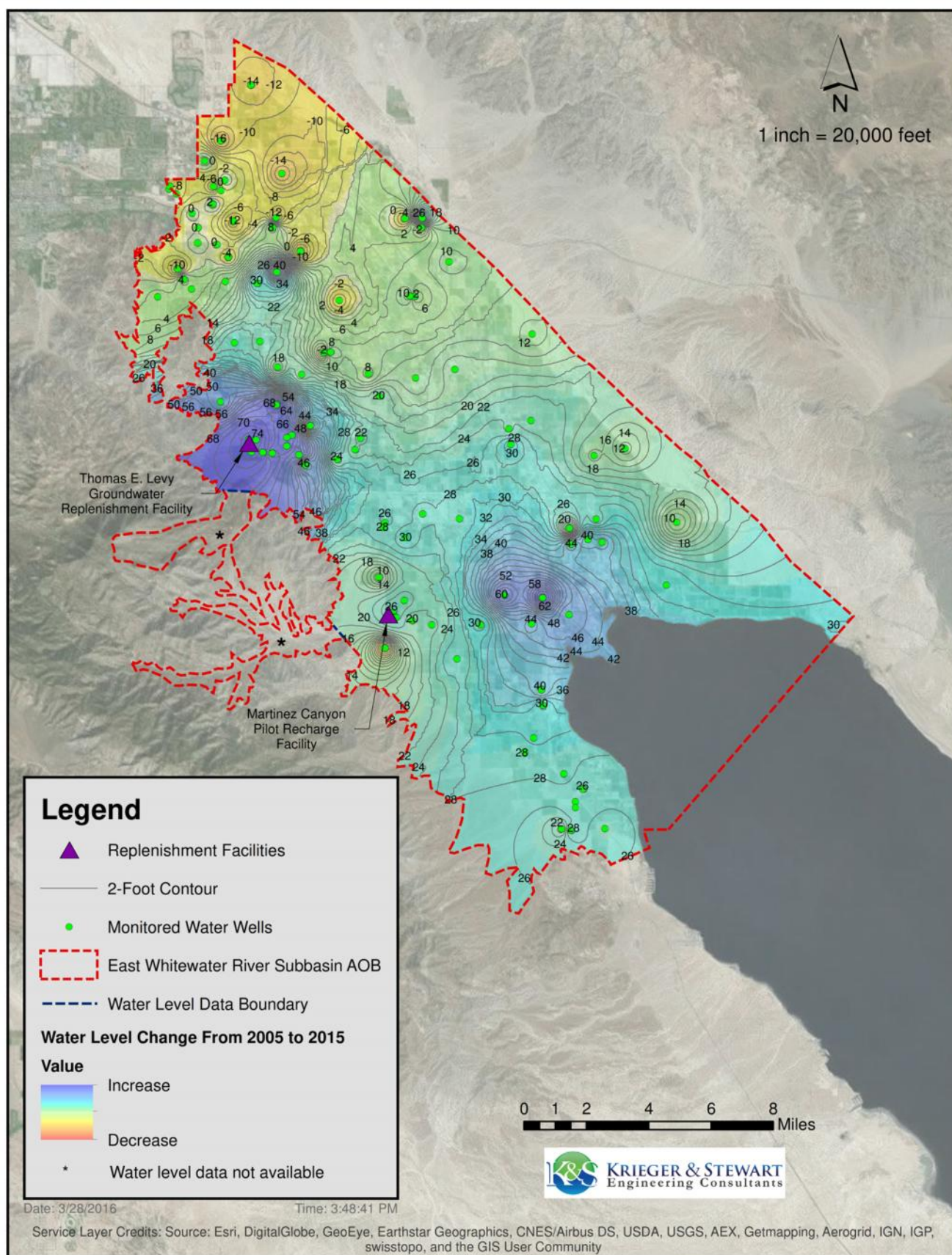


Figure VII-3
2015 Artesian Conditions (Elevations Above Ground Surface) in the
East Whitewater River Subbasin Area of Benefit

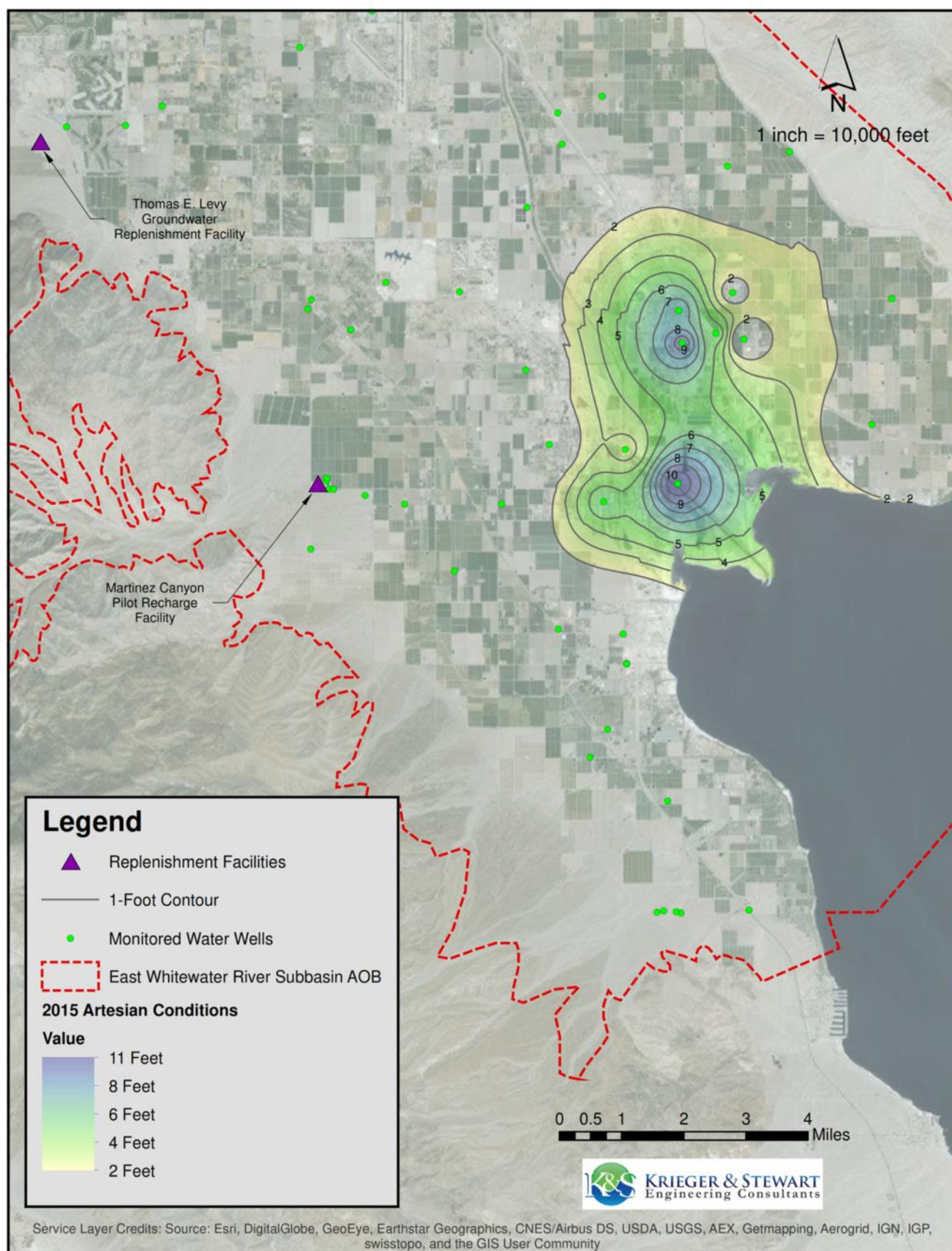


Figure VII-4
East Whitewater River Subbasin Management Area: Change in Groundwater in Storage

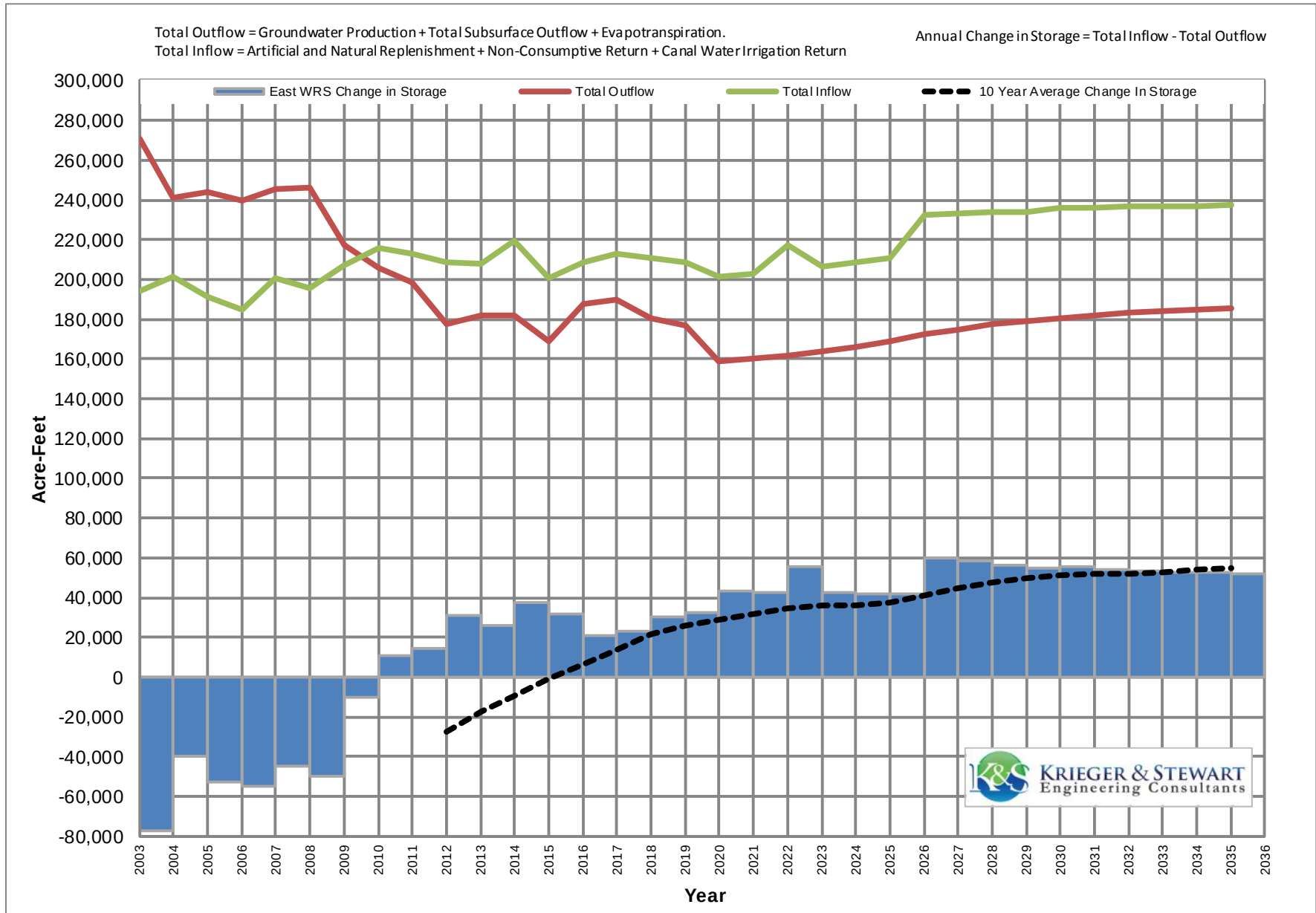
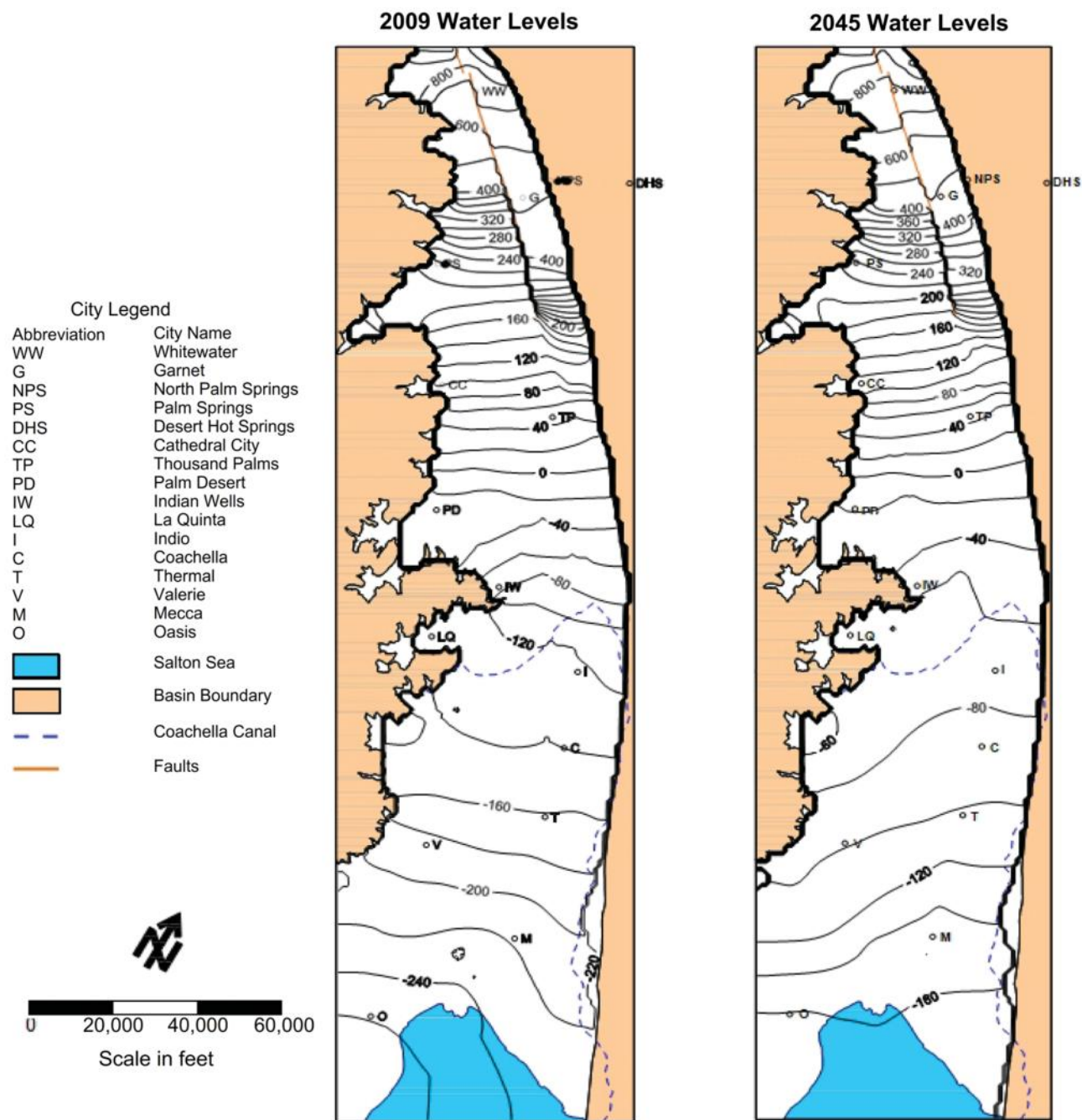


Figure VII-5
Whitewater River Subbasin
Change in Water Levels: 2009 to 2045



Contours represent feet above MSL

Figure VII-6
Groundwater Level Changes in Combined East and West Whitewater River Subbasin Management Areas: 2014 to 2015

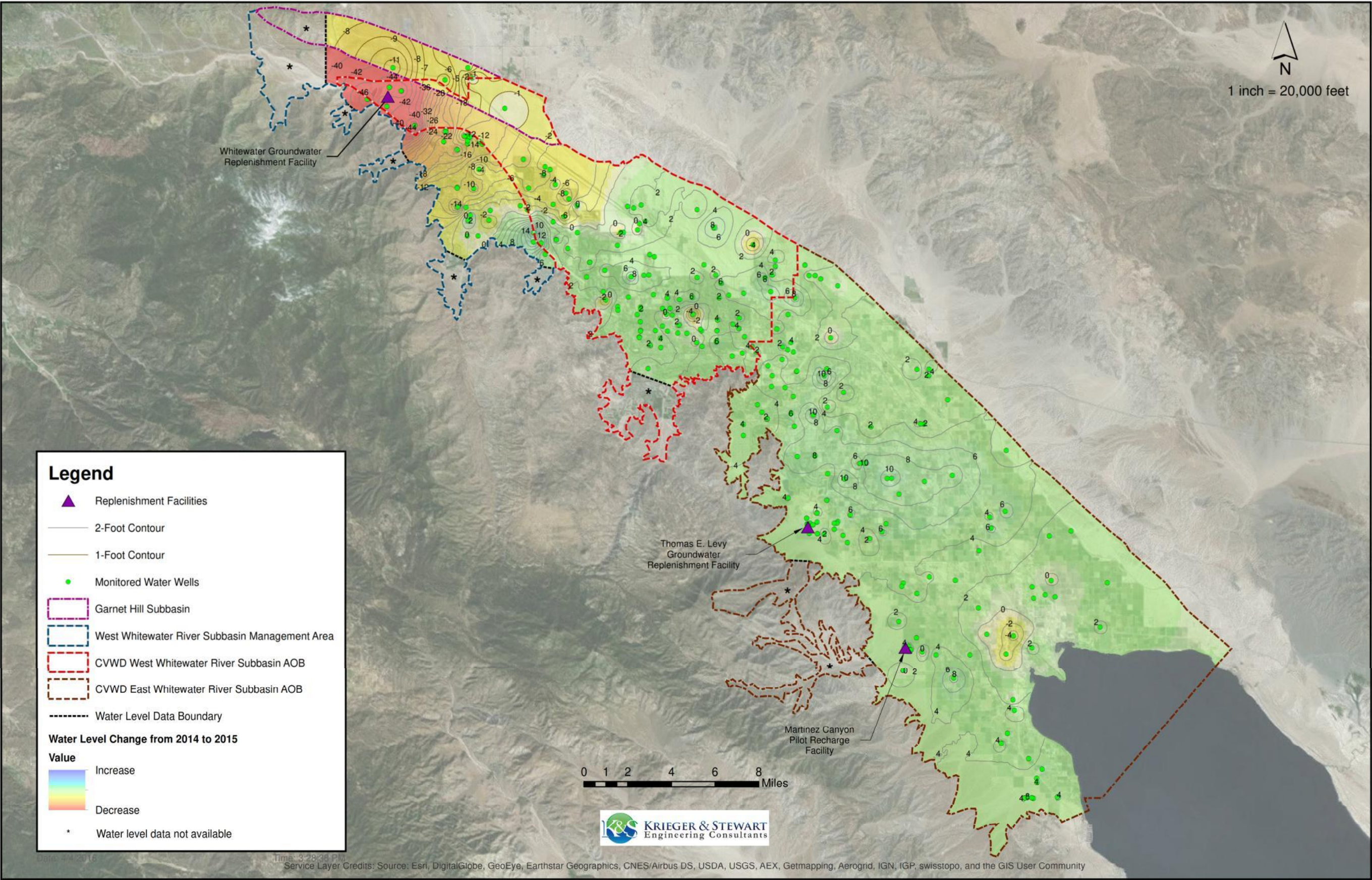


Figure VII-7
Groundwater Level Changes in Combined East and West Whitewater River Subbasin Management Areas: 2005 to 2015

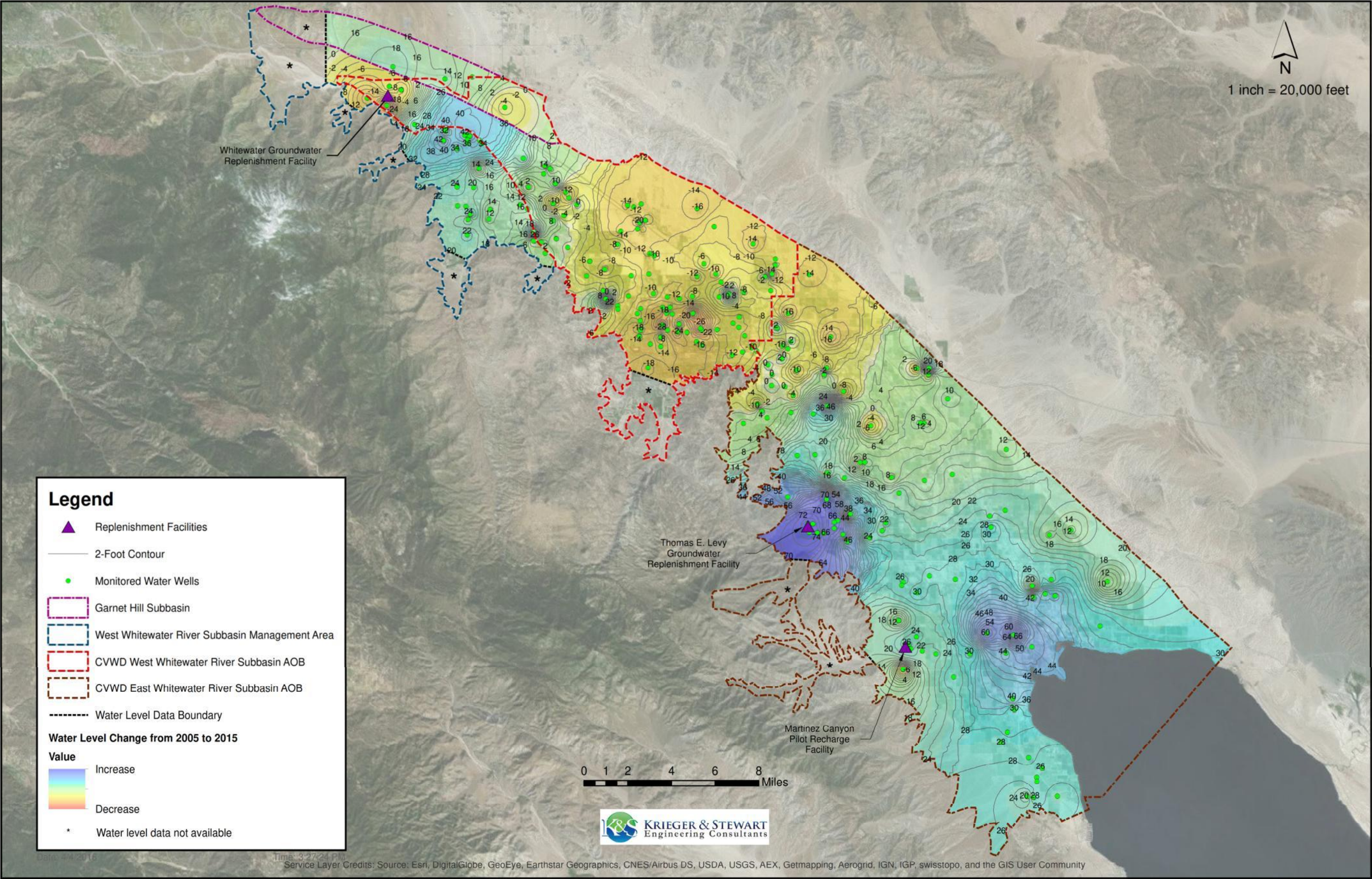


Figure VII-8
East Whitewater River Subbasin Area of Benefit:
Water Balance Schematic Diagram

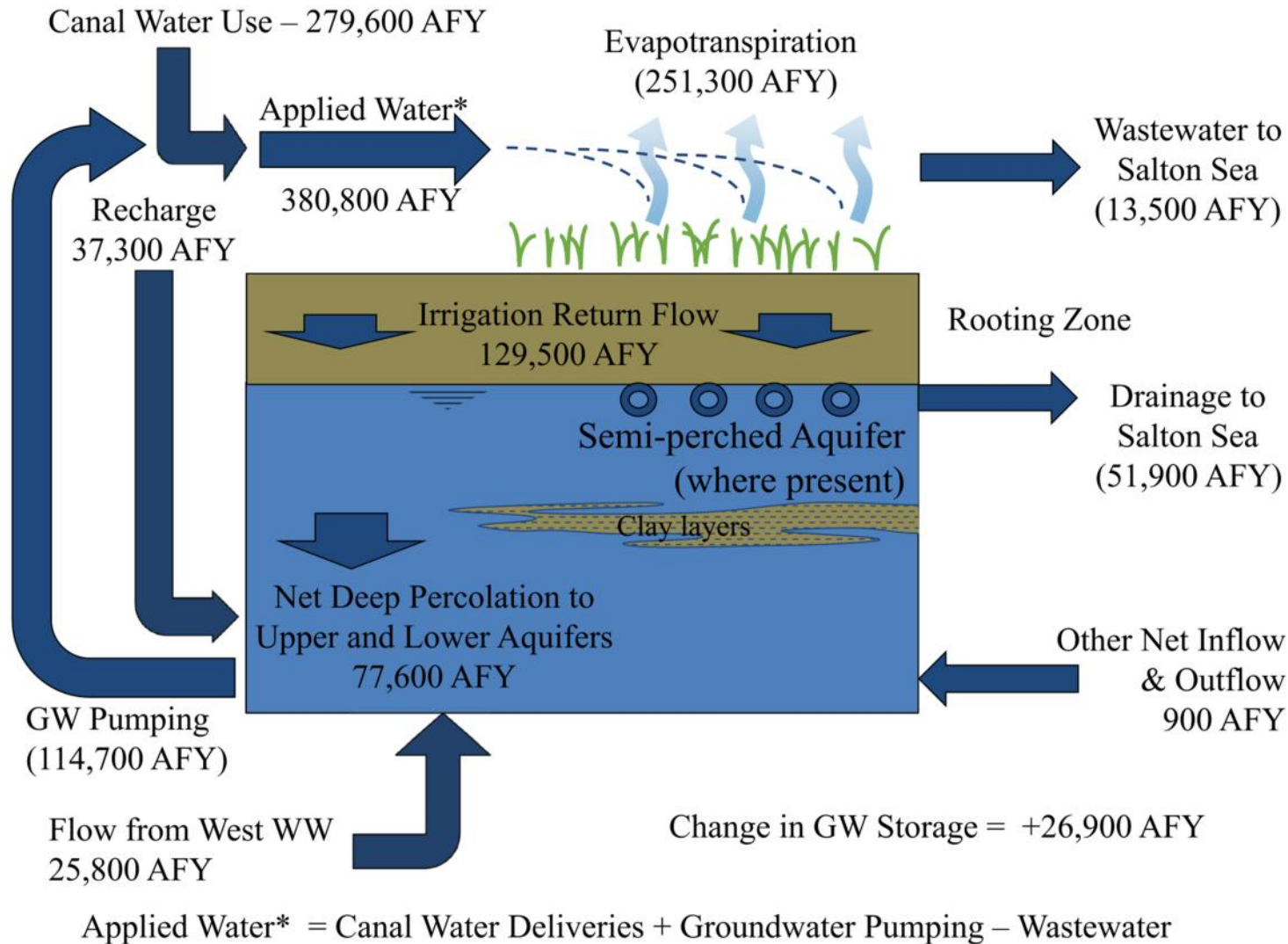
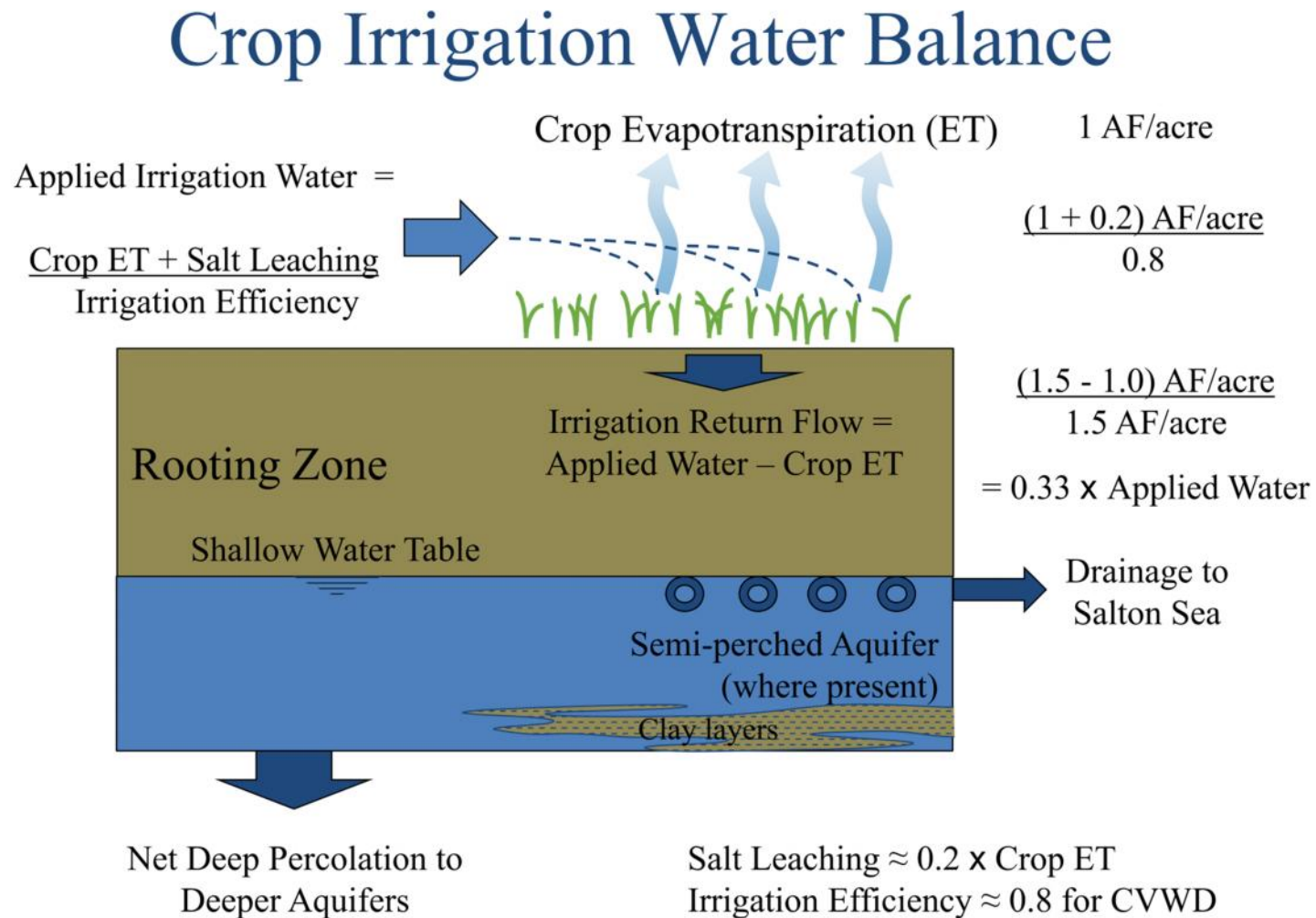


Figure VII-9
East Whitewater River Subbasin Area of Benefit:
Crop Irrigation Water Balance Schematic Diagram



CHAPTER VIII

BIBLIOGRAPHY

CHAPTER VIII BIBLIOGRAPHY

The following is a partial bibliography of material related to the water supply in the Coachella Valley that was used in preparing this report.

Coachella Valley Regional Water Management Group; *Final Integrated Regional Water Management Plan*, December 2010

Coachella Valley Water District, *Comprehensive Water Resources Management Plan*, prepared by Bechtel Corporation, March 1967

Coachella Valley Water District, *Coachella Valley Water Management Plan*, September 2002

Coachella Valley Water District, *Final Program Environmental Impact Report for the Coachella Valley Water Management Plan and State Water Project Entitlement Transfer*, prepared by MWH, 2002

Coachella Valley Water District, *Engineer's Report on Water Supply and Replenishment Assessment Lower Whitewater River Subbasin Area of Benefit, 2005-2006*, prepared by MWH. 2005

Coachella Valley Water District, *Coachella Valley Water Management Plan 2010 Update*, prepared by MWH, January 2012

Coachella Valley Water District, *Urban Water Management Plan 2010, Final Report*, July 2011

Coachella Valley Water District, *Engineers Report on Water Supply and Replenishment Assessment Lower Whitewater River Subbasin Area of Benefit, 2013-2014*, April 2013

Coachella Valley Water District, *2014 Status Report for the 2010 Coachella Valley Water Management Plan Update*, prepared by MWH, 2014

Coachella Valley Water District, *Engineer's Report on Water Supply and Replenishment Assessment, East Whitewater River Subbasin Area of Benefit, 2015-2016*, April 2015

Coachella Valley Water District, *Engineer's Report on Water Supply and Groundwater Replenishment Assessment, Mission Creek Subbasin Area of Benefit 2015-2016*, April 2015

Coachella Valley Water District, *Engineer's Report on Water Supply and Groundwater Replenishment Assessment, West Whitewater River Subbasin Area of Benefit 2015-2016*, April 2015

Coachella Valley Water District, *2016 Rate Study Report: Mission Creek Sub-basin Replenishment Fund*, prepared by Hawksley Consultants, March 2016

Coachella Valley Water District, *2016 Rate Study Report: West Whitewater River Sub-basin Replenishment Fund*, prepared by Hawksley Consultants, March 2016

Coachella Valley Water District, *2016 Rate Study Report: East Whitewater River Sub-basin Replenishment Fund*, prepared by Hawksley Consultants, March 2016

- Desert Water Agency, *Engineer's Report on Basin Water Supply and Water Replenishment Program*, Prepared by Krieger & Stewart, May 1978, Revised June 1978
- Desert Water Agency, *Ground Water Recharge Potential within Mission Creek Subbasin*, Prepared by Krieger & Stewart, November 1980
- Desert Water Agency, *Domestic Water System General Plan, 1998*, Prepared by Krieger & Stewart, January 1999
- Desert Water Agency, Engineer's Report, *Groundwater Replenishment and Assessment Program for the Whitewater River Subbasin 2015/2016*, prepared by Krieger & Stewart, April 2015
- Desert Water Agency, *Engineer's Report, Groundwater Replenishment and Assessment Program for the Mission Creek Subbasin 2015/2016*, prepared by Krieger & Stewart, April 2015
- Desert Water Agency, *Engineer's Report, Groundwater Replenishment and Assessment Program for the Garnet Hill Subbasin 2015/2016*, prepared by Krieger & Stewart, April 2015
- Fogg, Graham E., Gerald T. O'Neill, Eric M. LaBolle, David J. Ringel, *Groundwater Flow Model of Coachella Valley, California: An Overview*. November 2002
- Geotechnical Consultants, Inc., *Hydrogeologic Investigation of Ground Water Basin Serving Palm Springs*, 1978
- Geotechnical Consultants, Inc., *Hydrogeologic Investigation: Mission Creek Subbasin Within the Desert Hot Springs County Water District*, prepared for Desert Water Agency, November 1979
- Huberty, M.R. and A.F. Pillsbury, *Hydrologic Studies in Coachella Valley, California*, University of California, Berkeley 1948
- Krieger & Stewart, *Coachella Valley Groundwater Management Plan for the Coachella Valley Planning Area of the West Colorado River Basin*, 1979
- Krieger & Stewart, *Groundwater Recharge Potential within Mission Creek Subbasin*, 1980
- Mayer, Alex S. and Wesley L. May, Michigan Technological University, Department of Geological Engineering and Sciences, *Mathematical Modeling of Proposed Artificial Recharge for the Mission Creek Subbasin*, Prepared for Mission Springs Water District, March 1998
- Mission Springs Water District, *Hydrogeologic Conditions Near Mission Springs Water District Well Nos. 25 and 26, Cabazon Area, Riverside County*, prepared by Richard C. Slade and Associates, LLC, September 2001
- MWH, *Groundwater Model Simulations for Coachella Valley Water Management Plan Update*, for Draft Subsequent Program Environmental Impact Report, July 2011
- MWH, *Mission Creek/Garnet Hill Subbasins Water Management Plan, Final Report*, January 2013

- Psomas, *Groundwater Flow Model of the Mission Creek and Garnet Hill Subbasins and Palm Springs Subarea, Riverside, California*, January 2013
- Richard C. Slade and Associates, LLC, *Final Hydrogeologic Evaluation, Well Siting, And Recharge Potential Feasibility Study Mission Creek Groundwater Subbasin, Riverside County, California*, May 2000
- San Geronio Pass Water Agency, *Water Resources Investigation – Groundwater Dependable Yield*, prepared by Boyle Engineering Corporation, 1998
- State of California, The Resources Agency, Department of Conservation, Division of Mines and Geology, *Geologic Map of California, Santa Ana Sheet*, 1966
- State of California, The Resources Agency, Department of Water Resources, *Bulletin No. 108, Coachella Valley Investigation*, July 1964
- State of California, The Resources Agency, Department of Water Resources, *Coachella Valley Area Well Standards Investigation*, 1979
- State of California, The Resources Agency, Department of Water Resources, *Management of the California State Water Project, Bulletin 132-92*, September 1992
- State of California, The Resources Agency, Department of Water Resources, *California's Groundwater, Bulletin 118*. October 2003
- State of California, The Resources Agency, Department of Water Resources, *California Water Plan Update 2009, Bulletin No. 160-0*, Chapter 4, California Water Today. March 2010
- State of California, The Resources Agency, Department of Water Resources; *State Water Project Final Reliability Report 2013*, December 2014
- State of California, The Resources Agency, Department of Water Resources; *2015 State Water Project Deliverability Capability Report*, July 2015
- United States Department of the Interior, Geological Survey; *Artificial Recharge in the Whitewater River Area, Palm Springs, California*, 1973
- United States Department of the Interior, Geological Survey; *Water-Supply Paper 2027, Analog Model Study of the Ground- Water Basin of the Upper Coachella Valley, California*, 1974
- United States Department of the Interior, Geological Survey; *Water Resources Investigation 77-29: Predicted Water-Level and Water-Quality Effects of Artificial Recharge in the Upper Coachella Valley, California, Using a Finite-Element Digital Model*, April 1978
- United States Department of the Interior, Geological Survey; *Water Resources Investigation 91-4142: Evaluation of a Ground-Water Flow and Transport Model of the Upper Coachella Valley, California*, 1992
- United States Department of the Interior, Geological Survey; *Scientific Investigations Report 2007-5251, Detection and Measurement of Land subsidence Using Global Positioning System Surveying and Interferometric Synthetic Aperture Radar, Coachella Valley, California 1996-2005*, 2007

United States Department of the Interior, Geological Survey; *Land Subsidence, Groundwater Levels, and Geology in the Coachella Valley, California, 1993-2010, 2014*

APPENDIX A
2015 COACHELLA VALLEY
PRECIPITATION DATA &
STREAM FLOW DATA

**APPENDIX A
UPPER COACHELLA VALLEY
PRECIPITATION AND STREAM FLOW DATA
MONTHLY AND ANNUAL RECORDED PRECIPITATION
(INCHES)
2015**

STATION NAME	WHITewater NORTH	SNOW CREEK	DESERT HOT SPRINGS	TACHEVAH DAM	TRAM VALLEY	CATHEDRAL CITY	THOUSAND PALMS	PALM SPRINGS SUNRISE	EDOM HILL	OASIS	MECCA LANDFILL III	THERMAL AIRPORT
STATION NUMBER	233	207	57	216	224	34	222	442	436	431	432	443
JANUARY	0.66	0.50	0.36	0.15	1.14	0.19	0.22	0.20	0.29	0.15	0.22	0.27
FEBRUARY	1.14	1.16	0.14	0.19	0.76	0.09	1.35	0.17	0.12	0.00	0.00	0.03
MARCH	0.72	1.18	0.48	0.46	1.05	0.57	0.50	0.57	0.45	0.30	0.29	0.34
APRIL	0.52	0.32	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MAY	0.62	1.30	0.11	0.10	0.39	0.11	0.12	0.17	0.09	0.25	0.20	0.06
JUNE	0.01	0.00	0.18	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
JULY	1.20	1.80	0.48	0.38	0.92	0.44	0.42	0.50	0.54	0.17	0.09	0.91
AUGUST	0.00	0.02	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.28	0.01	0.00
SEPTEMBER	1.31	1.09	0.33	0.20	0.58	0.06	0.07	0.16	0.17	0.08	0.11	0.03
OCTOBER	0.69	0.54	0.23	0.08	0.55	0.15	0.32	0.22	0.18	0.28	0.39	0.42
NOVEMBER	0.65	1.23	0.02	0.00	0.03	0.00	0.00	0.02	0.00	0.06	0.00	0.00
DECEMBER	1.52	1.53	0.29	0.02	0.46	0.02	0.04	0.07	0.04	0.00	0.00	0.02
TOTAL	9.04	10.67	2.62	1.58	5.91	1.63	3.05	2.08	1.88	1.57	1.31	2.08

NOTE: DATA SHOWN HEREIN WAS PROVIDED BY RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT.

APPENDIX A
UPPER COACHELLA VALLEY
PRECIPITATION AND STREAM FLOW DATA
MONTHLY AND ANNUAL RECORDED PRECIPITATION
(SQUARE FEET)
2015

2015 Stream Flows for Streams Tributary to Coachella Valley Groundwater Basin Measured by U.S. Geological Survey

Site	Average Measured Stream Flow (cfs)													Total AF/Yr
	January	February	March	April	May	June	July	August	September	October ⁽¹⁾	November ⁽¹⁾	December ⁽¹⁾	Total ⁽³⁾	
Mission Creek Near Desert Hot Springs	0.025	0.254	0.273	0.238	0.156	0.025	0.16	0.034	0.003	0.239	0	0	1.407	1,018
Snow Creek near White Water	2.26	2.64	1.98	1.36	2.09	1.38	2.29	1.97	2.68	1.929	1.765	2.929	25.273	18,288
Falls Creek near White Water	0.334	0.281	0.247	0.151	0.21	0.116	0.085	0.068	0.065	0.111	0.24	0.345	2.253	1,630
Whitewater River at Windy Point Overflow Channel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chino Canyon Creek Below Tramway Near Palm Springs	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tahquitz Creek Near Palm Springs ⁽²⁾	0.9	0.821	1.24	0.668	0.632	0.154	0.008	0	0	**	**	**	4.423	3,201
Andreas Creek Near Palm Springs	1.43	1.31	1.31	1.06	0.922	0.475	0.483	0.451	0.827	0.957	1.017	1.348	11.59	8,387
Palm Canyon Creek Near Palm Springs	0.088	0.25	0.157	0.003	0	0	0	0	0	0	0	0	0.498	360
Palm Canyon Wash Near Cathedral City	0	0	0	0.033	0	0	0	0	0	0	0	0	0.033	24
Whitewater River At Rancho Mirage	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Whitewater River At Indio	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Deep Creek Near Palm Desert	0	0	0.001	0.034	0	0	0.539	0.027	0.011	0.009	0	0	0.621	449

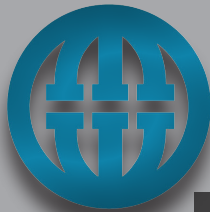
⁽¹⁾ October, November, and December data is provisional as of 3/2/2016.

⁽²⁾ No station data available after 10/7/2015.

⁽³⁾ Calculated annual average stream flow (cfs).



3602 University Avenue
Riverside, California 92501
951 • 684 • 6900
www.kriegerandstewart.com



MWH®

300 North Lake Avenue, Suite 400
Pasadena, California 91101
1 • 626 • 796 • 9141
www.mwhglobal.com