3.3 Groundwater

This section of the Final Environmental Impact Report (EIR) provides groundwater quality and supply data for the Chuckwalla Valley Groundwater Basin (Project vicinity) and the adjacent Orocopia Valley and Pinto Valley Groundwater Basins, including water bearing formations and hydraulic characteristics, and identification of springs, wells, and the Colorado River Aqueduct (CRA). Baseline groundwater levels, including direct flows, storage capacity, recharge sources, outflow and perennial yield are presented. The impact analysis section provides assessment of potential effects of using groundwater to supply the proposed Eagle Mountain Pumped Storage Project's (Project) needs, and of potential impacts on groundwater quality. A mitigation program is identified to reduce or avoid potential impacts, where applicable.

Please note: Surface water hydrology, drainage, and water quality are assessed separately in Section 3.2 Surface Water.

3.3.1 Regulatory Setting

The proposed Project will be constructed and operated in conformance with all applicable federal, state, and local laws, ordinances, regulations, and standards (LORS). The following LORS apply to the protection of groundwater.

3.3.1.1 Federal

Water Quality Certification (Section 401(a)(1) of the Federal Water Pollution Control Act (Clean Water Act), 33 U.S.C. Sec. 1341(c)(1)), or waiver of certification, is required for hydropower projects licensed by the Federal Energy Regulatory Commission (FERC). Under the California Code of Regulations, Water Quality Certifications for FERC-licensed projects are issued by the State Water Resources Control Board (State Water Board); (Title 23, Waters; Division 3, State Water Board and State of California, Regional Water Quality Control Boards (Regional Water Boards); Chapter 28 Certifications; Article 4, Water Quality Certification; Section 3855).

After review of the application, all relevant data, and any recommendations of the Regional Water Board, other state and federal agencies, and any interested person, the State Water Board's Executive Director, acting as the State Water Board's designee, shall issue certification or deny certification for any discharge resulting from a pertinent activity. Conditions shall be added to any certification if necessary to ensure that all activities will comply with applicable water quality standards and other appropriate requirements.

3.3.1.2 State

Porter-Cologne Water Quality Control Act of 1967 (Water Code Section 13000 et seq.) requires the State Water Board and the nine Regional Water Boards to adopt water quality standards to protect state waters. Those standards include the identification of beneficial uses, narrative and numerical water quality criteria, and implementation procedures. Water quality standards for the proposed Project area are contained in the *Water Quality Control Plan for the Colorado River Basin Region* (Basin Plan), which was adopted in 1994 and most recently amended in 2011. The Basin Plan sets numeric and/or narrative water quality criteria controlling the discharge of wastes to the state's waters and land.

Porter-Cologne Water Quality Control Act of 1967 *Section 13571.* Requires that anyone who constructs, alters, or destroys a water well, cathodic protection well, groundwater monitoring well, or geothermal heat exchange well, must file a well completion report with the California Department of Water Resources (DWR). With no nearby sources of surface water available and no existing water supply wells on the Project site that could serve the Project, water supply wells, extraction wells, and groundwater monitoring wells will be constructed to meet Project needs for supply, seepage recovery, and monitoring of water levels and water quality. A Well Completion Report will be filed with DWR for each well that is constructed. Measures will be undertaken to protect the groundwater wells (whether for water supply or for monitoring purposes) on the Project site through the use of physical barriers (e.g., fencing, traffic bollards, etc.). In the event that an existing well is altered or destroyed, a well completion report will be filed with the DWR.

California Code of Regulations Title 22, Article 3, Sections 64400.80 through 64445, requires monitoring for potable water wells, defined as non-transient, non-community water systems serving 25 people or more for more than six months.

State Water Resources Control Board Policies *(Resolution No. 88-63)* designates all groundwater and surface waters of the state as potential sources of drinking water, worthy of protection for current or future beneficial uses, except where: (a) the total dissolved solids (TDS) are greater than 3,000 milligrams per liter (mg/L), (b) the well yield is less than 200 gallons per day (gpd) from a single well, (c) the water is a geothermal resource, or in a water conveyance facility, or (d) the water cannot reasonably be treated for domestic use using either best management practices or best economically achievable treatment practices.

3.3.1.3 Local

Riverside County Ordinance Code, Title 13, Chapter 13.20 – Water Wells

> *Section 13-.20.160 Well Logs.* This section requires that a report of well excavation for all wells dug or bored for which a permit has been issued be submitted to the Riverside County Department of Environmental Health within 60 days after completion of drilling. DWR Form 188 shall satisfy this requirement as stipulated under California Water Code Section 13571.
>
> *Section 13.20.190 Water Quality Standards.* This section requires that water from wells that provide water for beneficial use shall be tested radiologically, bacteriologically and chemically as indicated by the Riverside County Department of Environmental Health. Laboratory testing must be performed by a state of California-certified laboratory. The results of the testing shall be provided to the Riverside County Department of Environmental Health within 90 days of pump installation.

Section 13.20.220 Well Abandonment. This section requires that all abandoned wells shall be destroyed in such a way that they will not produce water or act as a channel for the interchange of water, and will not present a hazard to the safety and well-being of people or animals. Destruction of any well shall follow requirements stipulated in DWR Bulletin No.74-81, provided that at a minimum the top 50 feet shall be sealed with concrete, or other approved sealing material. Applications for well destruction must be submitted 90 days following abandonment of the well and in accordance with Section 14.08.170.

Section 13.20.240 Declaration of Proposed Reuse. Requires that any well that has not been used for a period of one year shall be properly destroyed unless the owner has filed a Notice of Intent with the health officer declaring the well out of service and declaring their intention to use the well again.

Riverside County Title 15 Chapter 15.80 Regulating Flood Hazard Areas and Implementing the National Flood Insurance Program was developed to comply with Title 44 Code of Federal Regulations Part 65 regarding requirements for the identification and mapping of areas identified as Federal Emergency Management Agency (FEMA) Special Flood Hazard Areas. The ordinance is applicable to development within unincorporated areas of Riverside County and is integrated into the process of application for development permits under other county ordinances including, but not limited to, Ordinance Nos. 348, 369, 457, 460, and 555. When the information required, or procedures involved, in the processing of such applications is not sufficient to assure compliance with the requirements of Chapter 15.80, a separate application must be filed.

Flood insurance rate maps for the Project site or surrounding areas have not been prepared by FEMA. According to the Riverside County General Plan (Riverside County, 2000) the Project site and surrounding lands do not lay within a 100- or 500-year flood plain.

3.3.2 Environmental Setting

The Project site is located in the Eagle Mountains on a bedrock ridge along the northwestern margins of the Chuckwalla watershed which extends across portions of Riverside and Imperial counties. The central portions of the watershed contain the Palen and Chuckwalla valleys, with thick accumulations of alluvial sediments that comprise the Chuckwalla Valley Groundwater Basin (DWR, 2003). Most domestic and agricultural areas are located in the western portions of the basin near Desert Center, about six miles south of the Project site. This area has been historically referred to as the Upper Chuckwalla Valley. In the Lower Chuckwalla Valley, there is a large agricultural area of palm and citrus near the Corn Springs Exit off Interstate 10. The Chuckwalla Valley and Ironwood state prisons lie 30 miles east of Desert Center and south of Interstate 10.

There are five groundwater basins surrounding the Chuckwalla Valley Groundwater Basin. North of the Upper Chuckwalla Valley watershed is the Pinto Valley Groundwater Basin and north of the Palen Valley is the Cadiz Valley Groundwater Basin. To the west is the Orocopia Valley Groundwater Basin, which contains Hayfield Valley. About 45 to 50 miles east of the Project site are the Palo Verde Mesa and Palo Verde Valley Groundwater Basins. Figure 3.3-1 shows the locations of the groundwater basins.

Although the Cadiz Valley Groundwater Basin is adjacent to the Chuckwalla Valley Groundwater Basin, mountains along the edge of the basin provide complete enclosure around the Cadiz Valley so both surface flows and groundwater flows are internal or confined to the Cadiz Valley Groundwater Basin (B&V, 1998). Surface water and groundwater flows are from the edges of the basin toward Cadiz Lake (DWR, update 2003; B&V, 1998).

The western portion of the Orocopia Valley Groundwater Basin drains eastward into the Hayfield (dry) Lake and into the Upper Chuckwalla Valley Groundwater Basin. The Hayfield Valley is about 17 miles long. An artificial groundwater recharge site was constructed in the Hayfield Lake area of the basin, and Metropolitan Water District of Southern California (MWD) stored about 88,000 acre-feet of water in the basin in the late 1990s as part of a conjunctive water management and use program.

The Chuckwalla Valley Groundwater Basin receives both surface and groundwater inflow from the Pinto Valley Groundwater Basin. The water enters into the Chuckwalla Valley Groundwater Basin through a gap in the bedrock about six miles north of the Project site (B&V, 1998). A portion of Joshua Tree National Park (JTNP) overlies the Pinto Valley Groundwater Basin. JTNP also lies within 2 to 3 miles of the Project lands and extends into the bedrock areas of the Chuckwalla Valley watershed.

The Palo Verde Mesa and adjacent Palo Verde Valley Groundwater Basins are located east of the Chuckwalla Valley Groundwater Basin. A bedrock gap allows groundwater from the Chuckwalla Valley Groundwater Basin to flow into the Palo Verde Mesa Aquifer. Because there is no distinct physical groundwater divide, the groundwater is then connected to the Palo Verde Valley Groundwater Basin. The two groundwater basins are generally distinguished by water quality differences, with the Palo Verde Mesa aquifer having TDS levels of 1,000 to 2,000 mg/L or greater, and the Palo Verde Valley aquifer having TDS levels of about 800 mg/L, similar to the Colorado River, which forms the eastern edge of the Palo Verde Valley Groundwater Basin. This condition has resulted from many decades of irrigation on more than 100,000 acres of land in the Palo Verde Valley, which is constantly replenished and has raised the water table beneath the Valley.

3.3.2.1 Colorado River Aqueduct

The only aqueduct in the region is the CRA, owned and operated by MWD. The CRA was constructed in 1926 through the upper portions of the Chuckwalla Valley and Orocopia Valley Groundwater Basins. Portions of the CRA are constructed on and through the bedrock. MWD uses the CRA to supply water diverted from the Colorado River as a part of its water supply to approximately 18 million people in southern California. Figure 3.3-2 shows the CRA alignment.

3.3.2.2 Springs and Wells

Springs are present in the Eagle Mountains south of the Pinto Basin. Figure 3.3-1 shows the location of the springs.

The first high-capacity well was drilled in the Chuckwalla Valley Groundwater Basin in 1958 (Mann, 1984). There are now more than 60 wells in the Chuckwalla Valley Groundwater Basin (CH2M Hill, 1996). Existing wells in the area were located, to the extent possible, using driller's well logs obtained from the DWR and maps contained in various reports (CH2MHill, 1996). Figure 3.3-2 shows the locatable wells in and near the Chuckwalla Valley Groundwater Basin. Other agricultural or domestic wells may be present but could not be located because their locations are not well documented in the records, and some older wells – in some cases dating back to the early 1900s – may have been destroyed.

Wells in the Chuckwalla Valley Groundwater Basin range up to 2,000 feet in depth (B&V, 1998) and have pumping capacities up to 3,900 gallons per minute (gpm) (DWR, 2003). The average pumping rate is about 1,800 gpm. Groundwater wells in the Desert Center area range up to 900 feet deep. Two wells in this portion of the Chuckwalla Valley are capable of producing 2,300 gpm.

The National Park Service (NPS) owns one well in the Pinto Groundwater Basin (Pinto Well No. 2). Kaiser owns two additional wells near the NPS well in the southeastern portion of the Pinto Basin.

3.3.2.3 Water Bearing Formations

Water bearing units include quaternary alluvium and continental deposits. The maximum thickness of these deposits is about 1,200 feet in the central portions of the basin and up to 2,000 feet in the eastern portions of the basin (B&V, 1998), although DWR only considers there to be 1,200 feet of permeable sediments (DWR, 2003).

The alluvium (Qal) consists of fine to coarse sand interbedded with gravel, silt, and clay. The alluvium likely comprises the most substantial aquifer in the area (DWR, 1963). Locally windblown sand deposits (Qs) cover the alluvium.

The alluvium is underlain by Quaternary continental deposits (Qc) (Jennings, 1967). The continental deposits are exposed around the fringes of the basin, as shown on Figure 3.3-3. These deposits are composed of semi-consolidated coarse sand and gravel (fanglomerates), clay and some interbedded basalts.

Geologic profiles of the Chuckwalla Valley were developed to show the types of sediments and their distribution. The well logs did not distinguish between the Qal and Qc so all contacts are approximate. The profiles were developed based on available well logs. Figure 3.3-3 shows the location of the geologic profiles. Figure 3.3-4 shows the sediments along the east-west axis of the Chuckwalla Valley Groundwater Basin to have about 900 feet of sand and gravel with some thin clay and silt layers. The saturated sediments are about 600 feet thick near Desert Center. In the central portion of the Chuckwalla Valley, east of Desert Center, a relatively thick layer of clay has accumulated. Near the eastern portion of the Chuckwalla Valley the coarse sediment increases to up to 1,200 feet thick.

Figures 3.3-5 and 3.3-6 show the sediments in the Upper Chuckwalla Valley Groundwater Basin, from Desert Center north to the Pinto Basin, in the vicinity of the Project. The alluvial sediments were deposited on an irregular bedrock surface. Geophysical surveys suggest the bedrock surface is a large bowl opposite the Project site (GeoPentech, 2003). The southern edge of the bowl aligns with a narrow bedrock ridge that juts easterly into the basin.

The alluvium filling the Upper Chuckwalla Valley consists of about 300 feet of sand and gravel with a few discontinuous layers of silt and clay. About 150 feet of the alluvium is saturated. Underlying the coarse grained sediments are lake deposits consisting primarily of clay. The lakebed thickness varies and may be thinner near the margins of the basin and thicken towards the central portions of the basin based on geophysical surveys (gravity). However, no wells have fully penetrated the lakebeds to determine their actual thickness. One well (CW-1) penetrated over 900 feet of clayey lakebed deposits before being terminated. The coarse-grained sediments were deposited above the bowl rim and are in hydraulic continuity with the coarse grained sediments found near Desert Center, whereas the lakebed sediments are below the rim. The coarse grained sediments extend northward and connect with sediments in the Pinto Valley Groundwater Basin where inflow into the Chuckwalla Valley Groundwater Basin occurs. A basalt flow and several faults are present, as shown on Figure 3.3-5, but have an unknown effect on groundwater levels.

The lakebed deposits are potentially underlain by coarser sediments, based on geophysical surveys, but there are no wells to confirm the presence of this layer (GeoPentech, 2003). The sediments are likely to have a lower permeability than the coarse grained sediments above the lakebeds.

Geologic profile C-C’, Figure 3.3-6 shows the relationship of the sediments in the Chuckwalla Valley and Pinto Valley Groundwater Basins. A subsurface volcanic dike or flow is at a shallow depth and blocks some of the inflow from the Pinto Valley Basin into the Chuckwalla Valley Basin.

Outflow from the Chuckwalla Valley Groundwater Basin occurs through a gap in the bedrock at the southeastern edge of the basin and into the Palo Verde Mesa Groundwater Basin. Geophysical surveys showed the gap is filled with a rather thin section of recent alluvium that is connected to the Palo Verde Mesa Groundwater Basin aquifers. The recent alluvium pinches out just after crossing into the Chuckwalla Valley Groundwater Basin, and is underlain by the clayey Bouse Formation. Clays and silts of the lower part of the Bouse Formation are almost impermeable and can confine water in the underlying fanglomerate. The fanglomerate consists of moderately- to firmly-cemented continental sandy gravel (Wilson, 1994).

The fanglomerate has a low capacity to transmit water. The fanglomerate hydraulically connects the Chuckwalla Valley and Palo Verde Mesa groundwater sub-basins, but because it is confined, the Colorado River cannot recharge the aquifer. The Colorado River cannot recharge the

Chuckwalla Valley Groundwater Basin because the recent alluvium pinches out just after it enters into the Chuckwalla Valley Groundwater Basin and is isolated by the underlying almost impermeable Bouse Formation.

The profiles show that the coarse grained sediments are continuous throughout the Chuckwalla Valley Groundwater Basin and because they appear to be hydraulically connected, there is only one aquifer in the Chuckwalla Valley. Groundwater levels from 1963 and 1964 were plotted on the geologic profiles to show the saturated sediments. Based on the geology and the water levels the aquifer appears to be unconfined but within the central portion of the Chuckwalla Valley, where clays have accumulated, the aquifer may be semi-confined to confined.

3.3.2.4 Hydraulic Characteristics

Several terms are used to define the hydraulic characteristics of sediments and aquifers and their ability to store and transmit water. Hydraulic conductivity is the ability of the sediments to transmit water. Transmissivity, a term applied to aquifers, is the hydraulic conductivity multiplied by the thickness of the sediments capable of storing water. All sediments have some void space between the particles; this void space is reported as porosity. Water in the void spaces cannot be entirely removed. The storage coefficient is the percentage of water that can be removed from the pores by gravity drainage and is applied when describing unconfined aquifers. Storativity is similar to the storage coefficient, but is the percentage of water that can be released from the pores by a decrease in pressure. Storativity is used when referring to semi-confined or confined aquifers. The aquifers underlying the upper Chuckwalla Valley (generally the area beneath Desert Center area and to the north and west) are unconfined. The aquifers in the middle to lower portions of the Chuckwalla Valley (those portions of the valley east of Desert Center and in the central portions of the valley, connecting to the Palo Verde Aquifer) are semi-confined to confined.

Limited information is available on the hydraulic characteristics of the sediments in the Chuckwalla Valley Groundwater Basin. DWR estimated the average specific yield (specific yield is approximately equal to the storage coefficient for unconfined aquifers) to be 0.10 for the upper 220 feet of saturated sediments (DWR, 1979).

Figures 3.3-5 and 3.3-6 show that wells in the Upper Chuckwalla Valley obtain water from the alluvium and continental deposits. Table 3.3-1 summarizes the aquifer characteristics. Most tests were performed using only the pumping well which does not provide a storage coefficient or storativity for the aquifer and could result in a greater uncertainty in the aquifer characteristics.

The most representative hydraulic characteristics for the sediments near Desert Center where Project water supply wells will be constructed were determined from two long-term aquifer tests in which the drawdown was measured in observation wells. Table 3.3-1 summarizes hydraulic characteristics where storativities were within acceptable ranges, along with lower quality single well test results.

Table 3.3-1. Alluvial Aquifer Characteristics in Chuckwalla Groundwater Basin

Source of Test Data (Well Name)	State Well Log No.	Well Total Depth (feet)	Aquifer Test Storativity (unitless)	Assumed Storativity (unitless)	Flow Rate (gpm)	Drawdown (feet)	Saturated Aquifer Thickness (feet)	Distance from Well (feet)	Duration of Test (days)	Hydraulic Conductivity (ft/day)	Transmissivity (gpd/ft)
Upper Chuckwalla Valley											
CW-1		520		0.1	1,000	25	85	1	1.25	94	60,000
CW-2		535		0.1	2,400	78	166	1	1.25	36	45,000
CW-3		570		0.1	2,800	78	175	1	1.25	41	54,000
CW-4		500		0.1	1,150	32	150	1	1.25	48	54,000
MW-1		400					51			7.1	2,700
MW-2		455			33	37	65			0.02	10
							65			0.37	180
MW-5		245			20	25	30			2.01	450
							30			2.23	500
							30			7.13	1,600
4S/15E-11	395287	580		0.01-0.001	1,400	112	240	1	3.04	12 to 13	20,750-24,000
Desert Center Area											
Well 1				0.1	2,300	70.47	300	1	1.11	19	42,714
Well 3		789		0.1	2,350	46.91	300	1	1.99	32	71,902
OW-2			0.06		-	2.69	300	300	1.11	111	248,825
			0.06		-	2.69	300	300	1.11	118	264,002
			0.05		-	2.69	300	300	1.11	139	311,288
5S/15E-2	455508	800		0.01	1,200	40	220	1	0.33	22	36,000
5S/16E-5	069757	600		0.001	900	92	260	1	0.50	8	16,500
5S/16E-8F1		206		0.1	125	62	20	1	1.25	16	2,400
5S/16E-8K1		212		0.1	180	20	18	1	1.25	105	14,000
Lower Chuckwalla Valley											
6S/18E-29	217367	957		0.0001	600	120	380	1	1.38	3.5	10,000
6S/19E-32	353739	982		0.0001	450	175	50	1	3.00	12	4,500
7S/R20E-16M1	157672	1,200		0.0001	1,200	81	510	1	0.06	7	27,000
7S/R20-E17G1	15917	1,200		0.0001	1,200	75	510	1	1	9	34,000
7S/20E-17K1	15912	1,200		0.001	1,600	31	510	1	1	27	102,000
7S/20E-17L1	485765	1,200		0.0001	1,600	60	510	1	1	15	57,000
7S/20E-18A	27724	1,083		0.001	1,000	90	230	1	1	12	20,000
7S/20E-18K1	485768	1,200		0.0001	1,000	97	510	1	2	5	20,000
7S/20E-18R1	485766/485767	1,160		0.0001	1,500	90	450	1	5.42	12	39,000
7S/20E-20	157634	1,100		0.001	2,130	108	362	1	0.33	11	28,500
7S/18E-14	3645	960		0.0001	400	240	100	1	0.50	4	2,900
7S/18E-14	3647	1,000		0.0001	400	260	300	1	0.50	1	2,700
7S/19E-28	336234	1,100		0.01	2,000	3	400	1	0.08	434	1,300,000
7S/20E-17	218900	1,050		0.001	800	62	300	1	1	1	8,200

Unlocated Wells

Representative aquifer hydraulic characteristics for the upper portions of the Chuckwalla Valley Groundwater Basin, east of the Project site, were estimated from the Eagle Mountain iron mine water supply wells (CW-1 to CW-4). The characteristics were estimated from test results recorded on the well logs. The results show that the hydraulic conductivities are about half of those measured near Desert Center.

The alluvial aquifer near the Project site has lower hydraulic conductivities. Hydraulic characteristics of the sediments overlying the lakebeds were estimated during the investigation for the landfill. The hydraulic conductivity was estimated to be between 0.02 and 7.1 feet per day. Descriptions of the fanglomerate from monitoring well construction describe the sediments as ranging from boulders to coarse sand, and therefore the estimated hydraulic conductivities appear to be too low. Typical hydraulic conductivity values for well-sorted sand and gravel are from 3 to 180 feet per day (Fetter, 1988).

The bedrock portion of the Project site has a much lower hydraulic conductivity. In comparison to the alluvial aquifer, the bedrock is essentially impermeable. However, fracturing and faulting of the rock created secondary permeability. Groundwater movement in these formations is therefore associated with these faults, joints, and fractures.

3.3.2.5 Groundwater Levels

Groundwater levels are measured by the U. S. Geologic Survey (USGS) in 12 wells within the Chuckwalla Valley Groundwater Basin. DWR also reports groundwater levels for several other wells; however, there are only a few scattered measurements. A partial trend in groundwater levels can be developed by combining records from multiple wells. The status of the wells monitored is not fully known and the water level measurements may reflect local effects of well pumping. In the following paragraphs several wells are discussed. The status of the wells is briefly described below:

- Well 5S/16E-7P1 was active until well 5S/16E-7P2 was constructed. Both wells are located in the Chuckwalla Valley Groundwater Basin. Well 5S/16E-7P2 continues to be used by its owner.
- It is unknown whether wells 7S/20E-18H1, 7S/20E-28-C1, 7S/21E-15A1, located in the Palo Verde Mesa Groundwater Basin, were active wells.
- Well 3S/15E-4J1, Kaiser Well No. 2, is located in the Pinto Valley Groundwater Basin and was used between 1960 and 1984. After 1984 pumping of the well in the Pinto Valley Groundwater Basin was discontinued.

Well 5S/17E-33N1 is located in the central portion of the Chuckwalla Valley Groundwater Basin and was constructed to a depth of 768 feet below ground surface (bgs). It is one of the few wells in the area that have a long-term record that predates the heavy agricultural pumping and also has a current water level, taken in 2009. The difference in the water levels between April 1961 and April 2009 is minus 7 feet. The well is located west of Chuckwalla Valley Road where there is a large agricultural area and wells that could be affecting the water levels.

Note that from 1992 through 2009, water levels in well 7S/20E-28C1 have remained stable, varying not more than 3 feet, suggesting the basin has reached a new equilibrium.

Groundwater levels in the Desert Center area are represented by wells 5S/16E-7P1 and 5S/16E-7P2, which cover about a 50-year period. Figure 3.3-2 shows the locations of these wells. Figure 3.3-7 shows the water level measurements. There were few measurements between 1950 and 1981, but levels appear to have been relatively stable. Between 1981 and about 1986 thousands of acres were irrigated for the first time to produce jojoba and asparagus that ended in economic failure. During this period, the water levels declined at local wells by about 130 feet. The effects of the pumping were not as extreme at well 5S/15E-12N1, which is located about 1.5 miles to the west of well 5S/16E-7P1. This relationship suggests the drawdown in well 5S/16E-7P1 is the result of localized effects of pumping.

Groundwater levels between 1986 and 2002 have recovered by over 100 feet near Desert Center. The recovery is due in part to a large decrease in agricultural pumping and potentially increased subsurface inflows (steeper gradients) from the Pinto Valley, Orocopia Valley (Hayfield Valley), and Cadiz Valley Groundwater Basins (Hanson, 1992). However, the Cadiz Valley Groundwater Basin is no longer considered to be a recharge source to the Chuckwalla Valley Groundwater

Basin (B&V, 1998). In 2007 groundwater levels were about 17 feet lower than the static water level in 1980, before the heavy agricultural pumping occurred. The lower groundwater level may be the result of drawdown created by pumping for current agriculture and domestic use, and possibly some from depletion of storage.

Groundwater levels in the eastern portion of the Chuckwalla Valley near the outflow to the Palo Verde Mesa Groundwater Basin are conflicting. Well 7S/20E-18H1 shows a similar trend as the wells near Desert Center, while well 7S/20E-28C1 shows the groundwater levels were recovering during the overdraft period. The conflicting results suggest the water levels may be affected by local use (7S/20E-18H1) and that the groundwater levels in this area of the Chuckwalla Valley were actually rising and were not affected by pumping near Desert Center. Figure 3.3-2 shows the locations of these wells. Figure 3.3-8 shows water level measurements in comparison to the water levels near Desert Center.

Groundwater levels in the Palo Verde Mesa Groundwater Basin are flat lying (7S/21E-15A1) and show little to no effects of pumping within the Upper Chuckwalla Valley Groundwater Basin. Figure 3.3-2 shows the location of this well. Figure 3.3-8 shows water level measurements in comparison to the Upper Chuckwalla Valley Groundwater Basin water levels.

Groundwater levels in the Pinto Valley Groundwater Basin remained stable up until about 1960. Pumping by Kaiser in the Pinto and Upper Chuckwalla Valley Groundwater Basins lowered water levels by about 15 feet between 1960 and 1981. Thereafter, groundwater levels recovered, potentially due to Kaiser's substantially reduced pumping, even though groundwater levels near Desert Center declined. A recent 2007 measurement shows that levels have continued to recover but are about 7 feet below the static water level recorded in 1960, likely due to pumping effects of existing users near Desert Center. Figure 3.3-9 shows the groundwater levels in both the Pinto Valley Basin and Desert Center area. These data show that groundwater levels in these two areas have different trends, suggesting that pumping in the Desert Center area does not have a significant effect on groundwater levels in the Pinto Valley Groundwater Basin.

3.3.2.6 Groundwater Flow Direction

Groundwater contours developed from 1974 groundwater level measurements for the Chuckwalla Valley Groundwater Basin show groundwater movement from the north and west toward the gap between the Mule and the McCoy Mountains at the southeastern end of the Chuckwalla Valley Groundwater Basin (DWR, 1979) and into the Palo Verde Mesa Groundwater Basin. Figure 3.3-10 shows the groundwater contours and flow directions.

Groundwater contours were also developed for portions of the Upper Chuckwalla Valley near the Project site (CH2M Hill, 1996). Bedrock groundwater contours show the water is moving both north and south from the Eagle Mountains towards Eagle Creek Canyon and then to the east until it intercepts the sediments in the groundwater basin. Groundwater levels in the sediments within the basin show the groundwater movement is from the northwest toward the southeast in the vicinity of the Project site. Figure 3.3.3-7 shows these groundwater contours.

3.3.2.7 Groundwater Storage

The total storage capacity of the Chuckwalla Valley Groundwater Basin was estimated to be about 9,100,000 acre-feet (DWR, 1975). A more recent analysis estimates that there are 15,000,000 acre-feet of recoverable water (DWR, 1979). The groundwater storage estimate for just the northwestern portion of the Upper Chuckwalla Valley, near the Project site is about 1,000,000 acre-feet. This is a very conservative estimate because only 100 feet of saturated sediments were considered in the calculation and there are about 800 feet of saturated sediments in the valley (Appendix C, Section 12.4, Figure 3).

Using the geologic profiles shown on Figures 3.3-4 through 3.3-6 to assess the saturated thickness, and assuming a storage coefficient of 0.10, the storage capacity of the Chuckwalla Valley Groundwater Basin is estimated to be about 10,000,000 acre-feet (similar to DWR's 1975 estimate). This is a very conservative estimate as it includes only the coarse grained sediments, and does not include water in the clay deposits nor does it account for additional water that may be present due to confining conditions in the central portion of the Chuckwalla Valley. The storage capacity of the Orocopia Valley Groundwater Basin is about 1,500,000 acre-feet (DWR, 1975). Because the Orocopia Valley Groundwater Basin was not subdivided, about half of this amount or 750,000 acre-feet is tributary to the Chuckwalla Valley Groundwater Basin. The saturated thickness is estimated to be between 200 to 400 feet thick, which indicates the specific yield of 0.04 to 0.09 was used for the calculations. The surface area of the Orocopia Valley Groundwater Basin is about 89,600 acres, but only about 45,000 acres east of Chiriaco Summit is tributary to the Chuckwalla Valley Groundwater Basin. The total storage capacity for the Pinto Valley Groundwater Basin is estimated to be about 230,000 acre-feet (DWR, 1975). This low estimate is due to the limited geologic knowledge of the Pinto Valley Groundwater Basin (four wells, Kaiser Pinto Basin wells, all clustered at the eastern end of the valley) and was based on an assumed saturated thickness of 100 feet and a specific yield of about 0.01. The total surface area of the Pinto Valley Groundwater Basin is 198,400 acres. This storage estimate appears to be very conservative based on the well logs from Kaiser and a geophysical survey by GeoPentec, which shows there are over 500 feet of saturated sediments at the eastern end of the valley and the Pinto Valley Groundwater Basin is four times the size of the Orocopia Valley Groundwater Basin.

3.3.2.8 Groundwater Pumping

The amount of groundwater historically pumped from the Chuckwalla Valley Groundwater Basin can be estimated from recordation data filed with the State Water Board or by the acres and types of crops grown multiplied by the evapotranspiration rates of the plants. Since the recorded pumping over the years has been erratic and may be incomplete, estimates using agricultural land usage were made (Mann, 1986).

The estimates were made by using water duties (evapotranspiration plus applied water losses) for crops and planted acreages measured using aerial photographs and field confirmation. Estimates were made for 1986 (Mann, 1986), 1992 (Hanson, 1992), 1996, 2005, and 2007 (GEI). Figures 3.3-12 through 3.3-16 show the crops grown in the Desert Center area in these years.

Table 3.3-2 summarizes the acreages and estimated volume of groundwater pumped. The highest pumping occurred in 1986, at about 20,778 acre-feet per year (AFY), mostly for jojoba and asparagus. Most of the jojoba and asparagus fields have since been abandoned and agricultural water usage has significantly decreased. Only about 25 percent of land continues to be farmed. More recent endeavors in palm farming have slightly increased groundwater use in the area from 1,758 AFY in 2005 to about 1,800 AFY in 2007. East of Desert Center the agricultural use increased rather significantly due to an expansion of a palm and citrus grower.

Table 3.3-2. Chuckwalla Valley Agricultural Water Use Summary

Crop	Applied Water Duty / Acre (Feet/Acre)	Area 1986 (Acres)	Area 1992 (Acres)	Area 1996 (Acres)	Area 2005 (Acres)	Area 2007 (Acres)	Water Use 1986 (A.F.)	Water Use 1992 (A.F.)	Water Use 1996 (A.F.)	Water Use 2005 (A.F.)	Water Use 2007 (A.F.)
Desert Center Area											
Jojoba	2.2	4,005	1,351	120	120	120	8,811	2,972	264	264	264
Jojoba/Asparagus	4.6	457	0	0	0	0	2,102	0	0	0	0
Asparagus	8.3	1,157	200	110	0	0	9,603	1,660	914	0	0
Citrus	4.5	14	5	23	23	23	63	23	104	102	102
Dates	8.0	14	25	12		0	112	200	96	0	
Dates/Palms[1]	6.7				188	188				1,260	1,260
Vines	4.5	5	5	33	9	9	23	23	147	39	39
Pasture	6.4	10	0	0	0	0	64	0	0	0	0
Peaches/Apples	4.5	0	80	0	0	0	0	360	0	0	0
Melons/Peppers	3.5	0	100	0	0	0	0	350	0	0	0
Greenhouses[2]	8.3				0	5				0	42
Row Crops[2]	8.3				11	11				94	94
SUBTOTAL (Desert Center)		5,662	1,766	298	351	355	20,778	5,587	1,525	1,758	1,800
Lower Chuckwalla Valley											
Citrus	4.5					207				0	931
Dates/Palms[1]	6.7			106	250	546			710	1,675	3,658
SUBTOTAL (Lower Chuckwalla)				106	250	753			710	1,675	4,589
TOTAL		**5,662**	**1,766**	**404**	**601**	**1,108**	**20,778**	**5,587**	**2,235**	**3,433**	**6,389**

Notes:

All water duties based on Mann, 1986 unless otherwise noted

[1] Water duty based on Kc of 0.95 (FAO, 1998), ETo of 6.0ft/yr (CIMIS 1999), and application efficiency of 0.85 (Jensen, 1980)

[2] Crop type unknown, so the largest possible water duty assumed

Other pumping in the Chuckwalla Valley Groundwater Basin occurs for domestic and industrial use. Domestic use in the area is estimated at 50 AFY in Desert Center[1] (Mann, 1986), and 1,090 AFY at the Lake Tamarisk development (average from State Recordation data filed with State Water Board between 2003 and 2008). Southern California Gas Company uses wells 5S/16E-7P1 and -7P2 to supply about 1 AFY to its natural gas pumping plant.

Further east in the Chuckwalla Valley Groundwater Basin are the Chuckwalla Valley and Ironwood state prisons that were opened in 1988 and 1994, respectively, and are located directly adjacent to each other about 30 miles east of Desert Center. The two prisons pumped 2,100 acre-feet of groundwater in 2007 and recharged about 800 acre-feet of treated wastewater (California Department of Public Health, pers. comm., with David Fairman, 2008). However, populations at the prisons are projected to be reduced to alleviate overcrowding, which would reduce their pumping to about 1,500 AFY. Water use at the prisons was projected to decline because California is being required to reduce its prison population. In January 2010, a three-judge panel ordered

[1] Although the information on domestic water use in Desert Center is dated, based on the current population of Desert Center (204 persons) 50 AFY is a reasonable estimate of current domestic water use (U.S. Census, 2010).

California to reduce its inmate population from 190 percent to 137.5 percent of the system's design capacity (Sacramento Bee, November 30, 2010). Inmate numbers have been declining since that time. The total inmate population in the two prisons in the Chuckwalla Valley has declined from 7,500 in 2009 to approximately 6,000 in 2012 (*see* following table, with data from the California Department of Corrections and Rehabilitation). Therefore, the assumed decrease in water use at the prisons is reasonable.

Prison	April 30, 2009	April 30, 2010	April 30, 2011	April 30, 2012
Chuckwalla Valley State Prison	3,506	3,491	3,157	2,561
Ironwood State Prison	3,997	4,065	4,065	3,464
Total Inmate Population	7,503	7,556	7,222	6,025

Groundwater production can affect local and regional groundwater levels. Figure 3.3-7 shows the plot of the groundwater levels versus estimates of groundwater pumping for agricultural, domestic, and industrial use. The figure shows that the decline of the water levels in the Desert Center area between 1981 and 1986 is due to groundwater pumping locally exceeding the perennial yield of the basin.

3.3.2.9 Recharge Sources and Volumes

The Chuckwalla Valley Groundwater Basin is recharged by percolation of runoff from the surrounding mountains and from precipitation to the Chuckwalla Valley floor (DWR, 1979). The Upper Chuckwalla Valley is also recharged by subsurface inflow from the north by the Pinto Valley Groundwater Basin and from the west from the Orocopia Valley Groundwater Basin. Subsurface inflow from the Pinto Valley Groundwater Basin occurs as outflow through an alluvium-filled gap at the east end of the Pinto Valley (Kunkle, 1963). Recent studies have indicated there is no groundwater outflow from Cadiz Valley Groundwater Basin (B&V, 1998). Therefore, the Pinto Valley and the Orocopia Valley Groundwater Basins are considered tributary to the Chuckwalla Valley Groundwater Basin.

One of the most difficult estimates in desert basins is natural recharge (FAO, 1981). Several authors have made estimates of the groundwater recharge to the Chuckwalla Valley Groundwater Basin varying from 10,000 to 20,000 AFY as shown in Table 3.3-3. In the Final License Application (FLA) submitted to the Federal Energy Regulatory Commission in June 2009, the Applicant reported these estimates and used what it considered to be a conservatively low value of 12,200 AFY (Hanson, 1992). The NPS suggested that the estimate used is too high and recommended re-evaluating the estimate of recharge (NPS 2009).

A baseline water balance was developed to estimate the amount of recharge to the Chuckwalla Valley Groundwater Basin between 1948 and 2009. The water balance was calibrated based on changes in groundwater levels. Only two wells, well 7S/20E-28C1 and 5S/17E-33N1, in the valley had groundwater levels that spanned at least portions of the time period used for the water balance. These wells are located east of Desert Center and represent average groundwater conditions in the valley. However, the groundwater level trends are not consistent. Well 5S/17E-33N1, which is located about the center of the Chuckwalla Valley, showed groundwater levels were 419 feet above mean sea level (msl) in April 1961 and 412 feet msl in August 2009, or a lowering of groundwater levels by about 7 feet. Well 7E/20S-28C1, which is located near the eastern end of the Chuckwalla Valley, had groundwater levels at 257 feet msl in 1982 and were 270 feet msl in 2009, or about 13 feet of rise in groundwater levels. Because of the long period of record, and that the record is after in the intense pumping by Kaiser and agriculture, any depletion of storage would have been distributed across the basin. The baseline water balance was developed and the average recharge was backed into based on these water level measurements. The recharge ranged from 7,000 AFY to 15,200 AFY. The estimates are conservative, as: well 5S/17E-33N1 is located in a portion of the valley where the aquifers are confined and therefore small changes in storage results in large changes in groundwater levels; and the water balance did not account for pumping by Kaiser in the Pinto Valley Groundwater Basin, near the outlet to the Chuckwalla Valley, where 137,000 AF of water was pumped which reduced recharge to the Chuckwalla Valley Groundwater Basin.

The Applicant conducted additional studies to estimate recharge to the Chuckwalla Valley Groundwater Basin. The area evaluated included the Chuckwalla Valley Groundwater Basin as well as the tributary Pinto Valley and Orocopia Valley Groundwater Basins. Because the Pinto Valley and Orocopia Valley Groundwater Basins are tributary to the Chuckwalla and have little-to-no pumping, deep percolation in these basins becomes recharge to the Chuckwalla Valley Groundwater Basin.

A literature search was conducted to find a representative method to estimate the deep percolation in the Chuckwalla Valley Groundwater Basin using existing information. The results of this literature search are described in more detail in Section 12.4, Attachment F. The literature search found recoverable water estimates have been developed for the Fenner Basin using a variety of methods. The Fenner Basin is located approximately 20 miles north of the Chuckwalla Valley Groundwater Basin and contains similar types of sediments as present in the Chuckwalla Valley Groundwater Basin. The aquifers are presumably unconfined (DWR, 2003). A groundwater model, a water balance, a chloride mass balance, the Crippen method, and the Maxey-Eakin method were used to develop annual recoverable water estimates in the Fenner Basin (URS, 1999). The estimates also included professional opinions of the recharge using simple estimates by a MWD Review Panel.

A fairly broad range of estimates resulted from these studies. The Applicant identified two of these methods that could be used to estimate the recharge in the Chuckwalla Valley Groundwater Basin using available data. Recharge was estimated using the Maxey-Eakin method (Maxey and Eakin, 1950) as well as using the methodology from the recommendations of the MWD Review Panel.

The Maxey-Eakin method was developed for large alluvial filled valleys that are surrounded by mountainous terrain with either shallow soils or exposed bedrock, similar to that present in the Chuckwalla Valley Groundwater Basin and its tributary basins. The method can be used where limited climatic and hydrogeologic information is available. This method uses average annual precipitation to classify areas of a basin into five recharge zones. The method has since been modified, using a continuous function to determine the fraction of recharge instead of the stepped function first proposed by Maxey-Eakin (Hevesi and Flint, 1998). The modified method was applied to the Fenner Basin and found to substantially underestimate the recharge in comparison to other, more exhaustive methods (USGS-WRD, 2000).

For the Chuckwalla Valley Groundwater Basin and its tributary basins, the surface area within the basins was measured from USGS topographic maps to determine the area at 820 foot (250 meter) intervals. Recharge was determined by using the continuous curve developed by Hevesi and Flint (1998). This produced a range of recharge values from 600 AFY to 3,100 AFY, much lower than other estimates of recharge developed by other studies.

The MWD Review Panel applied an empirical approach to recharge in the Fenner Basin. Based on its professional experience the MWD Review Panel predicted that somewhere between 3 percent and 7 percent of precipitation over the area of the basin would become groundwater recharge. These estimates came very close to those from more exhaustive methods such as a water balance model by Geoscience (URS, 1999).

This method was repeated for the Chuckwalla Valley Groundwater Basin and its tributary basins. However, only mountainous areas of the basin were considered, and valley floor areas were considered to contribute zero change. This conservative approach was used because the elevations of the basins are lower than in the Fenner Basin, and would receive less precipitation in the valley floors. Also, precipitation on the alluvial floor is much less likely to infiltrate and more likely to evaporate due to the presence of fine-grained silts and clays, especially in the dry lake beds. Precipitation was estimated using the local precipitation-elevation curve and the average elevation of the mountainous regions, 2,800 feet. Recharge using this approach is estimated to be between 7,600 and 17,700 AFY with a mean of 12,700 AFY (*see* Tables 3, 4, and 5 in Section 12.4 Attachment F).

Given the fact that an uncalibrated Maxey-Eakin method has been shown to substantially underestimate recharge, and that the MWD Review Panel's estimate of percentage of precipitation was in congruence with other estimates, a value of 12,700 AFY was used as the value for recharge in water balance calculations completed for this Final EIR. This value is in line with previous estimates available in the published literature (as cited in Table 3.3-3 below).

Table 3.3-3
Groundwater Basins Inflow Estimates in Acre-Feet/Year

Estimated Recharge to Chuckwalla Basin

Recharge Based on Precipitation Chuckwalla	Inflow from Pinto	Inflow from Orocopia (Hayfield)	Total
5,400 -5,600 [1]	2,500 [2]	1,700 [1]	9,600-9,800
	3,200 [5]		10,300-10,500

Recharge Based on Precipitation Chuckwalla	Subsurface Inflow Pinto + Orocopia	Total
5,400 -5,600 [1]	6,700 [4]	12,100-12,300

Independent Estimates of Total Inflow to Chuckwalla Basin:

Total
10,000-20,000 [2]
12,200 [3]
16,600 [6]
9,800 [7]

References

[1] LeRoy Crandall and Associates (LCA) 1981
[2] Mann 1986
[3] Hanson 1992
[4] CH2MHill 1996
[5] GEI 2009
[6] Greystone 1994
[7] NPS 2009 (total 10,631 AFY = natural recharge 9,800 AFY + wastewater recharge 831 AFY)

3.3.2.10 Outflow

Outflow is limited to the subsurface, as no surface waters leave the basin. Underflow from the Chuckwalla Valley Groundwater Basin discharges to the Palo Verde Mesa Groundwater Basin at an estimated rate of 400 AFY (Metzger et al., 1973). Additional geophysical surveys were performed to assess the outflow area (Wilson, 1994). Although the outflow area was found to be shallower, the length was larger resulting in no significant change.

3.3.2.11 Groundwater Quality

Table 3.3-4 lists results from water quality testing of wells in the Upper Chuckwalla Valley in bedrock and in alluvium, and in the Palen Valley, northeast of Desert Center (Figure 3.3-2).

The TDS content across the Chuckwalla Valley Groundwater Basin ranges from 274 mg/L to 12,300 mg/L (DWR, 1979). The best water quality is found in the western portion of the Chuckwalla Valley Groundwater Basin, where TDS concentrations range from 275 mg/L to 730 mg/L (DWR, 1979). In the northwest portions of the Chuckwalla Valley Groundwater Basin, arsenic concentrations have ranged from 9 micrograms per liter (ug/L) to 25 ug/L. Water quality in the Desert Center area and in the Upper Chuckwalla Valley has concentrations of nitrate, boron, fluoride, arsenic and TDS that are higher than recommended levels for drinking water use (DWR, 1975). High concentrations of boron impair groundwater for irrigation use (DWR, 1975).

Groundwater quality in the Palen Valley is of lower quality. TDS concentrations range from about 500 mg/L to 4,200 mg/L.

Miscellaneous water quality results are reported by the Department of Public Health and co-operators for 10 wells in the Chuckwalla Valley Groundwater Basin. Although the results from only one well were available, radiological, nitrate, pesticides, and volatile and synthetic organic chemicals have been below the maximum contaminant level (MCL) for drinking water (DWR, 2003).

The proposed Project would be located in eastern Riverside County, within the Colorado River Basin – Regional Water Quality Control Board7. The Basin Plan developed by Region 7 for the Colorado River Basin defines the beneficial uses that apply to groundwater resources in the Chuckwalla Hydrologic Unit (Table 3.3-5) (Regional Water Board, 2006 as amended 2011). By definition, all surface and groundwater is considered suitable or potentially suitable for municipal or domestic water supply, unless one or more of the following conditions applies (Regional Water Board, 2006 as amended 2011):

- TDS exceeds 3,000 mg/L and it is not reasonably expected by the Regional Water Board to supply a public water system
- Contamination exists either by natural processes or by human activity that cannot reasonably be treated
- The water source does not provide sufficient water to supply a single well capable of producing an average, sustained yield of 200 gpd
- The aquifer is regulated as a geothermal energy producing source

Historic groundwater quality TDS concentrations only occasionally exceed the 3,000 mg/L (Table 3.3-4) and none of the other exceptions would apply to the aquifer of the Chuckwalla Valley Groundwater Basin. Therefore the groundwater of the Chuckwalla Valley Groundwater Basin is considered 'potentially suitable source of drinking water' (Regional Water Board, 2006 as amended 2011).

TABLE 3.3-4 UPPER CHUCKWALLA AND PALEN VALLEY GROUNDWATER QUALITY

WELL NAME	DATE SAMPLED	TDS (mg/L)	pH	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	CO3 (mg/L)	HCO3 (mg/L)	SO4 (mg/L)	Cl (mg/L)	NO3 as N (mg/L)	Ag mg/L	As mg/L	B mg/L	Ba mg/L	Cd mg/L	Cr mg/L	F mg/L	Pb mg/L	Hg mg/L	CaCO3 (mg/L)	Se (ug/L)
	MCLs [1]	500 [2]	6-8							250*	250*	10	0.1	0.01		1	0.005	0.05	2	0.015	0.002		50
Upper Chuckwalla Valley - Alluvium																							
4S/16E-30D1 (Well 1)	8-Mar-61	584	8.0	17	1	179	2.7	0	82	219	90	9.3			0.6				3.6				
4S/16E-30D1 (Well 1)	23-Sep-94	567	8.5	16.8	1.21	201	3.2	<1.0	74.3	240	87.7	0.65		0.009	0.6				10.9				<5
5S/16E-07M2 (Well 3)	11-Jul-61	413	8.7	6	0	143	1.6	12	55	106	89	1.9			0.3				6.9			15	
5S/16E-07M2 (Well 3) [3]	12-Sep-94	577	8.4	14.1	0.69	157	2.8	<1.0	74.3	112	116	4.1		0.025	0.6				7.62				<5
4S/16E-29R1	10-May-61	730	8.3		1	274	4.3	18	290	165	110	5.6			1.2				4.4			3	
4S/16E-31D1	6-Oct-61	626	8.0	16	0	201	2.7	0	134	212	96	5.6			0.6				9.5			40	
4S/16E-32D1	10-Jun-61	925	7.1	14	0	176	2	0	63	171	113	1.2			0.4				7.9			35	
4S/16E-32M1	10-Nov-61	532	8.2	12	0	16	16	0	43	162	124	3.7			0.7				7.4			30	
5S/15E-01L1	21-Mar-60	445	8.7	72	10	130	1.6	7	59	112	69	1.9			0.5				12			221	
5S/15E-12N1	18-May-61	424	7.9	14	0	129	2.7	0	88	115	74	8.7			0.3				8.7			35	
5S/15E-13B1	18-May-61	865	7.8	49	5	251	5.5	0	67	128	351	6.8			0.6				6.8			143	
5S/15E-27H1	18-May-60	2072		7.3				0	76		782								4			455	
5S/16E/18M1	11-Jul-61	459	8.6	5	0	158	0.8	12	67	122	85	9.9			0.4				8.9			13	
5S/16E-05B1	16-May-61	516	7.9	16	0	161	3.1	0	107	147	94	12			0.2				7			40	
5S/16E-05B2	17-May-61	400	7.5	9	0	129	1.6	0	79	108	74	10			0.4				8.7			23	
5S/16E-06N1	26-Sep-61	390		8.4	0.5	134	0	73	110	82	8.1	10			0.5				10			23	
5S/16E-07M1	10-Aug-61	418	8.2	12	0	134	2.3	0	79	105	82	14			0.3				6.8			30	
5S/16E-07P1	18-May-59	420	7.6	8	0.6	141	2.6	0	88	105	78	12			0.3				7.8			23	
5S/16E-08F1	16-May-57	481	8.0	8	2	156	2.1	0	409	140	82	3			0.6				8				
5S/16E-10Z1	17-Dec-17	3460		399	7.3	699	0	129	1950	286	8.8											1020	
5S/16E-22N1	9-Dec-61	1310	8.0	72	0	409	4.7	0	21	144	645	5.6			0.9				3.1			178	
Charpied Well	15-May-08	550	8.2	19	<1.0	160	2.6	<3.0	59	200	94	2.7		0.0058					6				<5
CW#3	30-Apr-91	1170	8.0	74	4	350	7	0	195	490	185	17		<0.010					5.4				<5
CW#4	30-Apr-91	635	8.2	21	1	215	4	0	177	215	100	3		<0.010					10				<5
Kaiser Well #4 Deep	5-May-93	685	8.2	19	1	216	4	0	162	230	100	4		0.01					10				<5
5S/15E-29F1	10-Nov-61	274		8	12	2	2.3	0	204	9	14	25			0.3				3.9			40	
5S/14E-24R1	31-Jan-33	987									398											82.5	
C-1	8-May-02	581	8.3	11	1.1	184	3.1			125	57	11.3	<0.010	0.0132	0.6	0.03	<0.0001	0.0108	7.6	0.001	<0.0002		7
C-1	28-Aug-02	578	8.3	12	1.4	181	3.1			124	54	11	<0.010	0.014	0.5	0.026	<0.0001	0.0095	6.6	<0.001	<0.0002		7.4
C-1	10-Dec-02	543	8.2	11	0.9	184	3			123	56	12	<0.010	0.014	0.6	0.026	<0.0001	0.01	7	<0.001	<0.0002		7
C-1	18-Mar-03	563	8.2	11	0.9	184	2.9			125	57	11	<0.010	0.0137	0.65	0.024	<0.0001	0.0091	7.4	<0.001	<0.0002		8
C-5	7-May-02	1163	7.7	77	3.6	284	5.5			486	122	<0.01	<0.010	0.021	1	0.039	0.0002	<0.001	6.2	0.003	<0.0002		<5
C-5	29-Aug-02	1066	7.8	63	3.1	264	5.2			419	111	<0.023	<0.010	0.023	0.8	0.021	<0.0001	<0.001	6.6	<0.001	<0.0002		<5
C-5	11-Dec-02	1030	7.8	59	2.7	268	5.2			410	115	<0.023	<0.010	0.024	0.9	0.021	0.0002	<0.001	6.5	<0.001	<0.0002		<5
C-5	19-Mar-03	1010	7.9	60	2.6	261	5.1			400	118	<0.023	<0.010	0.0247	0.96	0.019	0.0001	<0.001	6.8	0.001	<0.0002		<5
C-9	7-May-02	569	8.6	10	0.8	179	3.3			105	62	19	<0.010	0.021	0.6	0.031	<0.0002	0.013	8.8	0.002	<0.0002		<5
C-9	29-Aug-02	568	8.4	10	0.8	176	3			100	58	19	<0.010	0.019	0.5	0.014	<0.0001	0.012	6.1	<0.001	<0.0002		<5
C-9	10-Dec-02	569	8.4	10	0.8	183	3.3			106	63	20	<0.010	0.019	0.6	0.014	<0.0001	0.013	7.9	<0.001	<0.0002		<5
C-9	18-Mar-03	564	8.4	10	0.7	182	2.9			106	63	19	<0.010	0.0186	0.66	0.011	<0.0001	0.0123	8.6	<0.001	<0.0002		<5
C-10	8-May-02	942	7.8	79	6.1	224	4.9			432	99	0.02	<0.010	0.0036	0.9	0.049	0.0005	0.003	6.8	0.003	<0.0002		<5
C-10	28-Aug-02	936	7.8	79	6.1	211	4			407	94	<0.023	<0.010	0.003	0.8	0.021	<0.0001	<0.001	6.9	<0.001	<0.0002		<5
C-10	9-Dec-02	929	7.8	76	6.2	222	3.9			410	98	<0.023	<0.010	0.0032	0.8	0.022	0.0001	<0.001	6.8	<0.001	<0.0002		<5
C-10	19-Mar-03	926	7.8	79	6	219	3.9			410	99	<0.023	<0.010	0.0033	0.92	0.025	0.0001	<0.001	6.9	<0.001	<0.0002		<5

	DATE	TDS																					
	MCLs [1]	500 [2]	6-8							250*	250*	10	0.1	0.01		1	0.005	0.05	2	0.015	0.002		50
WELL NAME	DATE SAMPLED	TDS (mg/L)	pH	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	CO3 (mg/L)	HCO3 (mg/L)	SO4 (mg/L)	Cl (mg/L)	NO3 as N (mg/L)	Ag mg/L	As mg/L	B mg/L	Ba mg/L	Cd mg/L	Cr mg/L	F mg/L	Pb mg/L	Hg mg/L	CaCO3 (mg/L)	Se (ug/L)
Upper Chuckwalla Valley - Alluvium (continued from above)																							
MW-1	14-Jun-89	790	6.6	16	3	221				150	97	1.5											
MW-1	26-Sep-89	510	8.0	26	3	130				110	110	20											
MW-1	12-Dec-89	500	8.0	29	3	120				120	110	24											
MW-1	13-Mar-90	510	8.1	24	3	120				120	110	26											
MW-1	2-Aug-90	560	8.1	34	4	150				130	110	28											
MW-1	18-Sep-90	450	8.2	31	4	126				110	110	26							0.6				
MW-1	20-Dec-90	440	8.0	27	3	124				100	92	26		<0.01				0.02	0.6				
MW-1	19-Mar-91	430		31	4	122				4	96	5.6		<0.01				0.02		0.06			
MW-1	20-Jun-91	470	8.0	29	3	114				114	100	28		<0.01				0.02	0.6	0.01			
MW-1	30-Sep-91	460	7.8	30	4	124				120	100	0.3		<0.01				0.01	0.5				
MW-1	18-Dec-91	460	7.4	31	5	128				120	150	5.2		<0.01				0.02	0.8				
MW-1	9-Apr-92	445	8.0	28	4	116				110	100	5.5		<0.01				0.02	0.7				
MW-1	14-Jul-92	430	8.0	25	3	114				110	100	5.7		<0.01				0.02	0.7				
MW-2	17-Sep-90	885	8.6	95	13	178				390	130	29		<0.01				0.02	3.2	<0.05			
MW-2	19-Dec-90	905	7.8	98	12	184				400	130	29		<0.01				0.07	2.9				
MW-2	20-Mar-91	845		118	14	178				445	135	6.7		<0.01				0.05	3.2	0.29			
MW-2	20-Jun-91	920	8.5	104	12	170				460	140	29		<0.01				0.05	3.4	0.18			
MW-2	30-Sep-91	915	7.7	98	12	180				430	140	6.4		<0.01				0.02	2.8				
MW-2	18-Dec-91	920	8.0	111	20	182				410	130	6.6		<0.01				0.03	3.3				
MW-2	9-Apr-92	940	8.5	125	22	180				480	140	6.6		<0.01				0.05	3				
MW-2	13-Jul-92	940	8.0	97	13	177				460	140	7.2		<0.01					3.2				
MW-6	11-Apr-91	1430	7.7	215	48	180				740	160	30							2.1				
MW-6	21-Jun-91	1480	7.7	154	40	255				750	160	21		<0.01				0.03	2.7	0.04			
MW-6	1-Oct-91	1440	7.8	212	56	237				740	170	2		0.02				0.07	1.9				
MW-6	19-Dec-91	1420	7.7	185	53	225				720	160	4.3		0.02				0.06	2.1				
MW-6	10-Apr-92	1400	8.0	203	60	228				810	180	6.3		<0.01				0.04	2.5				
MW-6	13-Jul-92	1410	7.9	176	47	207				750	160	6.9		<0.01				0.03	1.8				
Upper Chuckwalla Valley - Bedrock (Beneath Project Site)																							
School Well	15-Jun-89	970	7.4	120	22	180				180	140	7.4											
School Well	27-Sep-89	1000	7.7	120	22	170				420	140	18											
School Well	13-Dec-89	960	7.6	120	19	160				390	140	16											
School Well	13-Mar-90	980	7.9	100	17	160				380	140	15											
School Well	18-Sep-90	865	8.1	102	20	170				380	130	15		<0.01				<0.01	1.8	<0.05			
School Well	20-Dec-90	855	7.7	101	19	158				370	130	16		<0.01				<0.01	1.9				
School Well	21-Mar-91	885		102	20	164				370	135	3.4		<0.01				0.02	2	0.03			
School Well	28-Jun-91	875	7.7	99	19	160				360	130	4		<0.01				<0.01	2	<0.005			
School Well	19-Dec-91	910	7.6	113	23	170				340	140	3.2		<0.01				<0.01	2.1				
School Well	10-Apr-92	900	8.2	109	22	164				370	140	3.6		<0.01				<0.01	2.8				
MW-4	9-Apr-91	1155	7.8	102	50	178				480	190	67							0.8				
MW-4	20-Jun-91	1090	8.0	104	50	165				460	180	74		<0.01				0.98	0.9	0.01			
MW-4	30-Sep-91	1070	7.9	94	46	170				440	170	16		<0.01				0.35	0.8				
MW-4	18-Dec-91	1080	7.8	107	57	114				480	180	16		<0.01				0.41	1				
MW-4	9-Apr-92	1050	8.0	105	51	177				480	180	16		<0.01				0.77	1.1				
MW-4	14-Jul-92	1110	8.0	98	47	171				460	170	18		<0.01				0.57	0.9				
MW-5	10-Apr-91	1115	8.1	134	16	190				490	160	55							0.8				
MW-5	20-Jun-91	1070	8.0	132	15	175				500	150	61		<0.01				0.02	0.8	<0.01			
MW-5	30-Sep-91	1070	7.7	138	23	186				490	150	14		<0.01				0.04	0.6				
MW-5	18-Dec-91	1170	8.0	133	21	189				610	150	13		<0.01				0.05	0.8				
MW-5	9-Apr-92	1090	8.0	135	21	195				520	160	14		<0.01				0.07	1				
MW-7	14-Jul-92	685	7.9	39	8	171				190	97	0.2		<0.01				0.43	5.1				

	MCLs [1]	500 [2]	6-8							250*	250*	10	0.1	0.01		1	0.005	0.05	2	0.015	0.002		50
WELL NAME	DATE SAMPLED	TDS (mg/L)	pH	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	CO3 (mg/L)	HCO3 (mg/L)	SO4 (mg/L)	Cl (mg/L)	NO3 as N (mg/L)	Ag mg/L	As mg/L	B mg/L	Ba mg/L	Cd mg/L	Cr mg/L	F mg/L	Pb mg/L	Hg mg/L	CaCO3 (mg/L)	Se (ug/L)
MW-1	14-Jun-89	790	6.6	16	3	221				150	97	1.5											
MW-1	26-Sep-89	510	8.0	26	3	130				110	110	20											
MW-1	12-Dec-89	500	8.0	29	3	120				120	110	24											
MW-1	13-Mar-90	510	8.1	24	3	120				120	110	26											
MW-1	2-Aug-90	560	8.1	34	4	150				130	110	28											
MW-1	18-Sep-90	450	8.2	31	4	126				110	110	26							0.6				
MW-1	20-Dec-90	440	8.0	27	3	124				100	92	26		<0.01				0.02	0.6				
MW-1	19-Mar-91	430		31	4	122				4	96	5.6		<0.01				0.02		0.06			
MW-1	20-Jun-91	470	8.0	29	3	114				114	100	28		<0.01				0.02	0.6	0.01			
MW-1	30-Sep-91	460	7.8	30	4	124				120	100	0.3		<0.01				0.01	0.5				
MW-1	18-Dec-91	460	7.4	31	5	128				120	150	5.2		<0.01				0.02	0.8				
MW-1	9-Apr-92	445	8.0	28	4	116				110	100	5.5		<0.01				0.02	0.7				
Palen Valley																							
4S/17E-06C1	10-Sep-61	4160	7.4	393	14	1130	18	0	49	442	2100	9.3			1.8				2.9			1040	
5S/16E-25F1	6-May-58	648	8.0	40		200		0	92	120	238	3.7			0.9								
5S/16E-36M1	9-Nov-59	524	8.3	20	2	159	4.3	6	116	113	131	6.2			0.7				5.2			60	
Hayfield Valley																							
5S/14E-33L	9-Feb-80	420	7.9									17							5.2			0.08	<1

Notes

[1] California Title 22 Drinking Water Maximum Contaminant Level (MCL), adopted by the Regional Water Board, Colorado River Basin Plan 2006 as amended 2011.

[2] Recommended MCL

[3] Iron exceeds MCL

Table 3.3-5. Beneficial Uses that Apply to Groundwater in Chuckwalla Hydrologic Unit (Regional Water Board, 2006 as amended 2011)

Category		Definition
MUN	Municipal and domestic supply	Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.
AGR	Agriculture supply	Uses of water for farming, horticulture, or ranching including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.
IND	Industrial service supply	Supply Uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, and oil well re-pressurization.

Historic water chemistry data for groundwater in the Chuckwalla Valley Groundwater Basin are variable, depending on the depth and location of the well (Table 3.3-4). Water quality in the aquifer occasionally exceeds the MCL for arsenic, fluoride, and lead. These results suggest treatment would be necessary for domestic water supplies to maintain water quality at levels below the MCLs.

The Basin Plan states that, “the Regional Board's goal is to maintain the existing water quality of all non-degraded groundwater basins. However, in most cases groundwater that is pumped generally returns to the basin after use with an increase in mineral concentrations such as total dissolved solids (TDS), nitrate, etc., that are picked up by water during its use. Under these circumstances, the Regional Board's objective is to minimize the quantities of contaminants reaching any groundwater basin… Until the Regional Board can complete investigations for the establishment of management practices, the objective will be to maintain the existing water quality where feasible.” (Regional Water Board, 2006 as amended 2011). Water quality objectives in the Basin Plan apply only to “controllable water quality factors.” Controllable water quality factors are those actions, conditions, or circumstances resulting from people’s activities which may influence the quality of the waters of the State which may feasibly be controlled. When other factors result in the degradation of water quality beyond the levels or limits established as water quality objectives, the controllable factors shall not cause further degradation of water quality. Therefore, those factors which contribute to water quality that are not controllable are not subject to the water quality objectives (Regional Water Board, 2012).

With respect to groundwater quality objectives, the Regional Water Board’s goal is to maintain the existing water quality of all non-degraded high quality groundwater basins. Therefore, the Regional Water Board’s objective is to maintain existing water quality in the Chuckwalla Valley Groundwater Basin (Regional Water Board, 2012).

3.3.3 Potential Environmental Impacts

3.3.3.1 Methodology

Evaluation of potential impacts is based upon literature review, review of state and private databases, aerial photo interpretation, and publicly available environmental documents for projects within and adjacent to the Project area.

3.3.3.2 Thresholds of Significance

The State Water Board concludes that the Project may have significant impacts on groundwater resources if it does any of the following:

(a) Violates any water quality standards or waste discharge requirements

(b) Substantially depletes groundwater supplies or interferes substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)

(c) Causes local groundwater level reductions that affect local residents and businesses dependent upon overlying wells, and/or

(d) Causes water table drawdown that depletes water in plant root zones on overlying lands

3.3.3.3 Environmental Impact Assessment

The Central Project Area facilities are located primarily on and within bedrock. Jointing and fracturing of the bedrock has locally increased the permeability of the rock. Groundwater in the joints and fractures may discharge to the sediments in the adjacent Upper Chuckwalla Valley Groundwater Basin. The Lower Reservoir is located on bedrock but the eastern wall of the pit exposed about 400 feet of alluvium that is part of the Chuckwalla Valley Groundwater Basin sediments. Residual seepage from the reservoirs could cause groundwater levels to rise in the sediments beneath the CRA and cause structural instability or subsidence.

The Project will require about 8,100 AFY for the four-year start-up period and 1,800 AFY of water for replenishment water. Groundwater pumped from wells in the Desert Center area is proposed to be used for the Project. The following sections analyze the potential effects of seepage from the Project reservoirs, and of Project pumping and existing water uses in the Chuckwalla Valley Groundwater Basin and interconnected groundwater basins.

3.3.3.3.1 *Seepage*

Seepage from the Project's reservoirs has the potential to transport pollutants down gradient resulting in degraded water quality of the aquifer. Estimates of seepage from the proposed Upper and Lower reservoirs were performed for the Project. Details of this analysis are found in Section 12.5. In addition, estimates of the potential effectiveness of seepage control blankets and other seepage control measures were also assessed. Geologic cross sections for seepage modeling were developed based on available geologic maps, surface exposures, and data from a total of ten borings located throughout the Project area. The Upper Reservoir is entirely incised in moderately fractured bedrock, consisting of granitic and metasedimentary rock units. The Lower Reservoir is divided into two geologic zones; the western three quarters which is underlain by slightly-to-moderately fractured bedrock, and the eastern quarter which is made up of alluvial deposits having relatively high horizontal permeability.

Based on the seepage analyses, and assuming that no reservoir seepage treatments are applied, the maximum average annual seepage volume from the Upper and Lower reservoirs is approximately 1,200 acre-feet, and 1,700 acre-feet, respectively. Under these conditions, the maximum groundwater elevations were estimated to be a minimum of about 50 feet below the existing ground surface.

If a seepage blanket and grouting of rock fractures are used at the Upper Reservoir, the average annual seepage volume could potentially be reduced to 700 acre-feet and the average groundwater elevations were estimated to be a minimum of approximately 125 feet below the existing ground surface. Similarly, if a seepage blanket, grouting of rock fractures and roller-compacted concrete (RCC) or soil cement treatment of the alluvium on the east wall are used at the Lower Reservoir, the average annual seepage volume could potentially be reduced to 900 acre-feet and the average groundwater elevations were estimated to be a minimum of approximately 265 feet below the existing ground surface.

The Applicant has proposed that water that may escape the engineered seepage solutions will be captured by groundwater wells that will be operated to mitigate above-normal hydrostatic pressures, and maintain groundwater levels with ±5 feet of the historic levels in the area. Based on inclusion of these proposed project design features (PDF) to minimize and collect seepage as part of Project approval, the potential for seepage to impact the surrounding facilities would be negligible. Water recovered by the seepage recovery groundwater wells would be returned to the reservoirs for reuse.

3.3.3.3.2 *Perennial Yield*

The proposed Project will rely on groundwater pumped from the Chuckwalla Valley Groundwater Basin to initially fill the reservoirs to operating levels and to supply make up water lost due to evaporation for the life of the Project. When pumping exceeds the annual recharge, groundwater levels will decline, and outflow from the basin may decrease over time. Over many decades, inflow from adjacent groundwater basins may increase, which could lead to a decrease in water levels in those basins.

Historically pumping exceeded the average annual yield of the Chuckwalla Valley Groundwater Basin between 1981 and 1986. During this five-year period the cumulative pumping exceeded the average annual yield, assumed to be a conservative 12,700 AFY, and resulted in a reduction in groundwater storage by a cumulative total of about 36,200 acre-feet. Table 3.3-6 shows these estimates. Figure 3.3-7 shows that the groundwater levels recovered to near historic water levels after pumping was reduced to below the average annual yield.

Table 3.3-6. Estimated Overdraft in Acre-Feet for 1981 to 1986 Chuckwalla Valley Groundwater Basin

Year	Eagle Mountain Mine [1]	Agricultural Pumping [1]	Aquaculture Pumping [2]	Sum of other Pumping [3]	Subsurface Outflow [4]	Subtotal Outflow	Average Inflow [5]	Inflow minus Outflow	Cumulative Change
1981	3,006	11,331	302	920	400	15,959	12,700	-3,259	-3,259
1982	1,574	13,220	302	920	400	16,416	12,700	-3,716	-6,975
1983	47	15,108	302	920	400	16,777	12,700	-4,077	-11,052
1984	790	16,997	302	920	400	19,409	12,700	-6,709	-17,761
1985	484	18,885	302	920	400	20,991	12,700	-8,291	-26,052
1986	450	20,774	302	920	400	22,846	12,700	-10,146	-36,198

Notes:

[1] From Greystone 1994.

[2] Pumping required to account for evaporation from open water bodies associated with fish ponds or tanks. Based on 1996 aerial photos.

[3] Includes domestic, Lake Tamarisk, and So Cal Gas.

[4] From Metzger, et al, 1973.

[5] From Section 12.7, Attachment F

A groundwater balance was developed to show the potential effects of groundwater pumping over the 50-year life of the Project, in combination with existing uses of groundwater. Table 3.3-7 shows a summary of the balance. At the time the analysis was prepared, the proposed Project was projected to start construction in 2012 with the initial fill of 8,100 AFY in about 2014, with replacement pumping of 1,800 AFY starting in 2018 and continuing through the 50-year life of the Project. (Subsequent delays have deferred the estimated start of construction to two years post licensing. Licensing is currently estimated at 2013.) Usage by the Chuckwalla and Ironwood state prisons is assumed to decrease by about 30 percent by 2011, in response to relief from overcrowding, as described above. Other than these exceptions, pumping rates are assumed to continue at the most recently recorded rate.

Some water will recharge the Chuckwalla Valley Groundwater Basin by recycling of the water through septic systems and could also occur from seepage from the reservoirs. Seepage from the reservoirs will be monitored and captured to prevent its return to the groundwater basin. The prisons are recycling about 800 AFY of treated wastewater through seepage ponds (Department of Public Health personnel comm., with David Fairman, 2008).

Using 2008 as the start of the water balance, recharge will exceed pumping until the start of the Project pumping in 2014 (date originally targeted by Applicant), at which time pumping will exceed recharge by about 4,800 AFY for four years. After 2018 (original date assuming pumping starts in 2014), recharge will exceed pumping by about 1,500 AFY and will continue for the remainder of the Project life. By 2060, at the end of the 50-year FERC Project license period, the aquifer storage (cumulative change) will have been increased by about 63,000 acre-feet.

Table 3.3-7. Chuckwalla Valley Groundwater Basin
Groundwater Balance for Existing and Project Pumping Effects on Groundwater Storage (AF)

Year	Subtotal Outflow	Subtotal Inflow	Inflow minus Outflow	Cumulative Change	Basinwide Change in Water Level (Feet)
2008	10,640	13,531	2,891	2,891	0.19
2009	10,640	13,531	2,891	5,781	0.39
2010	10,640	13,531	2,891	8,672	0.58
2011	10,040	13,300	3,260	11,932	0.80
2012	10,348	13,300	2,952	14,884	0.99
2013	10,348	13,300	2,952	17,836	1.19
2014	19,734	14,928	-4,806	13,030	0.87
2015	19,734	14,928	-4,806	8,224	0.55
2016	19,734	14,928	-4,806	3,418	0.23
2017	19,734	14,928	-4,806	-1,387	-0.09
2018	14,356	14,928	572	-815	-0.05
2019	13,435	14,928	1,493	678	0.05
2020	13,431	14,928	1,497	2,175	0.14
2021	13,431	14,928	1,497	3,672	0.24
2022	13,431	14,928	1,497	5,169	0.34
2023	13,431	14,928	1,497	6,666	0.44
2024	13,431	14,928	1,497	8,163	0.54
2025	13,431	14,928	1,497	9,660	0.64
2026	13,431	14,928	1,497	11,157	0.74
2027	13,431	14,928	1,497	12,655	0.84
2028	13,431	14,928	1,497	14,152	0.94
2029	13,431	14,928	1,497	15,649	1.04
2030	13,431	14,928	1,497	17,146	1.14
2031	13,431	14,928	1,497	18,643	1.24
2032	13,431	14,928	1,497	20,140	1.34
2033	13,431	14,928	1,497	21,637	1.44
2034	13,431	14,928	1,497	23,134	1.54
2035	13,431	14,928	1,497	24,631	1.64
2036	13,431	14,928	1,497	26,128	1.74
2037	13,431	14,928	1,497	27,625	1.84
2038	13,431	14,928	1,497	29,123	1.94
2039	13,431	14,928	1,497	30,620	2.04
2040	13,431	14,928	1,497	32,117	2.14
2041	13,431	14,928	1,497	33,614	2.24
2042	13,431	14,928	1,497	35,111	2.34
2043	13,431	14,928	1,497	36,608	2.44
2044	13,431	14,928	1,497	38,105	2.54
2045	13,431	14,928	1,497	39,602	2.64
2046	13,431	14,928	1,497	41,099	2.74
2047	13,431	14,928	1,497	42,596	2.84
2048	13,431	14,928	1,497	44,093	2.94
2049	13,431	14,928	1,497	45,591	3.04
2050	13,431	14,928	1,497	47,088	3.14
2051	13,431	14,928	1,497	48,585	3.24
2052	13,431	14,928	1,497	50,082	3.34
2053	13,431	14,928	1,497	51,579	3.44
2054	13,431	14,928	1,497	53,076	3.54
2055	13,431	14,928	1,497	54,573	3.64
2056	13,431	14,928	1,497	56,070	3.74
2057	13,431	14,928	1,497	57,567	3.84
2058	13,431	14,928	1,497	59,064	3.94
2059	13,431	14,928	1,497	60,561	4.04

Year	Subtotal Outflow	Subtotal Inflow	Inflow minus Outflow	Cumulative Change	Basinwide Change in Water Level (Feet)
2060	13,431	14,928	1,497	62,059	4.14
2061	10,040	13,300	3,260	65,319	4.35
2062	10,040	13,300	3,260	68,579	4.57
2063	10,040	13,300	3,260	71,839	4.79
2064	10,040	13,300	3,260	75,099	5.01
2065	10,040	13,300	3,260	78,359	5.22
2066	10,040	13,300	3,260	81,619	5.44
2067	10,040	13,300	3,260	84,879	5.66
2068	10,040	13,300	3,260	88,139	5.88
2069	10,040	13,300	3,260	91,399	6.09
2070	10,040	13,300	3,260	94,660	6.31
2071	10,040	13,300	3,260	97,920	6.53
2072	10,040	13,300	3,260	101,180	6.75
2073	10,040	13,300	3,260	104,440	6.96
2074	10,040	13,300	3,260	107,700	7.18
2075	10,040	13,300	3,260	110,960	7.40
2076	10,040	13,300	3,260	114,220	7.61
2077	10,040	13,300	3,260	117,480	7.83
2078	10,040	13,300	3,260	120,740	8.05
2079	10,040	13,300	3,260	124,000	8.27
2080	10,040	13,300	3,260	127,260	8.48
2081	10,040	13,300	3,260	130,521	8.70
2082	10,040	13,300	3,260	133,781	8.92
2083	10,040	13,300	3,260	137,041	9.14
2084	10,040	13,300	3,260	140,301	9.35
2085	10,040	13,300	3,260	143,561	9.57
2086	10,040	13,300	3,260	146,821	9.79
2087	10,040	13,300	3,260	150,081	10.01
2088	10,040	13,300	3,260	153,341	10.22
2089	10,040	13,300	3,260	156,601	10.44
2090	10,040	13,300	3,260	159,861	10.66
2091	10,040	13,300	3,260	163,121	10.87
2092	10,040	13,300	3,260	166,382	11.09
2093	10,040	13,300	3,260	169,642	11.31
2094	10,040	13,300	3,260	172,902	11.53
2095	10,040	13,300	3,260	176,162	11.74
2096	10,040	13,300	3,260	179,422	11.96
2097	10,040	13,300	3,260	182,682	12.18
2098	10,040	13,300	3,260	185,942	12.40
2099	10,040	13,300	3,260	189,202	12.61
2100	10,040	13,300	3,260	192,462	12.83

3.3.3.3.3 *Regional Groundwater Level Effects*

The water balance shows a positive change in storage from the start of the Project to the end indicating that groundwater levels will continue to rise, but not by very much. There are about 9.1 to 15 million acre-feet of water in storage in the Chuckwalla Valley Groundwater Basin. Assuming the low estimate of 9.1 million acre-feet and a conservative average saturated thickness of 600 feet, there is about 15,000 acre-feet per foot of saturated aquifer. Table 3.3-7 shows a net increase in groundwater in storage by about 74,000 acre-feet at the end of the Project's 50-year license. This would result in a net increase in water level of about five feet. During the initial fill between 2014 and 2017, groundwater use will exceed recharge by approximately 4,800 acre-feet each year, so groundwater levels are expected to decrease during this period.

3.3.3.3.4 *Colorado River Effects*

The Colorado River is located about 60 miles east of the central Project site and 50 miles east of the proposed water supply wells. At the request of the United States Bureau of Reclamation

(Bureau of Reclamation), the USGS developed a method to identify wells that pump water that is replaced by water drawn from the lower Colorado River. The Colorado River "accounting-surface" method was first developed in the 1990s by USGS, in cooperation with the Bureau of Reclamation (Water-Resources Investigations Report 94-4005, USGS, 1994). In 2008, USGS updated the "accounting surface" method (USGS Scientific Investigations Report 2008–5113, 2008). A proposed policy for using this method for determining well impacts to the Colorado River was published in the Federal Register for the Department of the Interior on July 16, 2008, but has not been acted upon and is not a current policy of the Department of Interior.

The accounting surface method was intended to identify wells which require an entitlement for diversion of water from the Colorado River and need to be included in accounting for consumptive use of Colorado River water. The USGS method assumes that the Chuckwalla Valley Groundwater Basin is hydraulically connected to the Colorado River.

In order to assess any potential impacts that groundwater extraction in the Chuckwalla Valley Groundwater Basin may have on the Colorado River, the 2008 USGS accounting surface methodology was applied to proposed Project wells. If static water levels in wells are equal to or below the accounting surface, it is assumed that this water would ultimately be replaced by Colorado River water. The accounting surface in the Chuckwalla Valley Groundwater Basin was determined to be between 238 and 240 feet msl (Scientific Investigations Report 2008-5113, USGS 2008). As shown in Figure 3.3-10, groundwater levels in the area of the Project's wells are approximately 500 feet msl, hundreds of feet above the contemplated accounting surface elevation. On that basis, it is concluded that the Project will not use groundwater that could ultimately be replaced by the Colorado River, and the Project's groundwater use would have no impact on the contemplated Colorado River Accounting Surface.

More recently, USGS published another method for assessing whether wells deplete groundwater that would otherwise recharge the Colorado River Aquifer. This superposition model is intended to simulate the percentage of water that could ultimately (over 100-years of constant pumping) be depleted from the river (Scientific Investigations Report 2008-5189, USGS 2008). The assumption is that when a well is initially pumped, virtually all the water comes from groundwater storage, but over time as the cone of depression grows, the percentage of water from the Colorado River or other recharge sources increases. For the Desert Center area where Project pumping would occur, this depletion from the Colorado River was determined by the USGS to be less than one percent after 100 years, and concluded to be negligible and undetectable. The USGS method for assessing impacts to the Colorado River was applied to the groundwater supply wells for the proposed Project. Using this method, it was concluded that potential impacts of Project pumping on the Colorado River, nearly 50 miles to the east of the well field, are negligible and undetectable.

3.3.3.3.5 *Local Groundwater Level Effects*

Historically, groundwater pumping occurred in the Upper Chuckwalla Valley, near Desert Center. Given the constraint of available hydraulic data and groundwater level measurements needed to calibrate a numeric groundwater model (i.e., Modflow or equivalent), it was determined that numeric modeling would not provide a more precise estimate of the pumping effects than analytical modeling. Therefore an analytical model was selected to assess water supply pumping effects which uses methods to estimate the effects of drawdown by pumping wells (i.e., Theis).

The local effects of pumping the Project's wells were modeled to estimate the amount of drawdown at varying distances from the wells (Section 12.4). A transmissivity of 280,000 gpd-per-foot with a storage coefficient of 0.05 was used. It was assumed that each Project water supply well would pump at 2,000 gpm for the first four years of the Project and that the wells would be spaced a sufficient distance away from each other (about one mile) to minimize well interference.

Historic pumping produced drawdown in the Chuckwalla, Pinto, and Orocopia groundwater basins. The maximum historic drawdown for each basin was determined by measured groundwater levels or by modeled estimations using the analytical model, with the following results: 137 feet of measured drawdown in the Chuckwalla Valley Groundwater Basin as a localized condition near Desert Center (1980 to 1986); about 15 feet in the Upper Chuckwalla Valley, near the CRA; about 15 feet at the mouth of the Pinto Valley Groundwater Basin (1960 to 1981); and as projected, about 10 feet for the Orocopia Valley Groundwater Basin (1981 to 1986) (Appendix C, Section 12.4, Figures 6, 8 and 10).

The modeling predicts Project water supply pumping alone will cause drawdown of the groundwater levels in the Chuckwalla Valley Groundwater Basin and at the mouths of the Orocopia Valley and Pinto Valley Groundwater Basins. During the initial fill about 50 feet of drawdown will be created in the Chuckwalla Valley Groundwater Basin in the immediate vicinity of the Project's pumping wells (a cone of depression) for about four years. Thereafter when pumping is reduced to annual makeup water only, the drawdown at the pumping wells will be reduced to about 14 feet. At distances of one mile from the pumping wells the drawdown will be about six feet. After 50 years of pumping, the drawdown created by Project pumping will be about 3.5 to 4.3 feet near the CRA in the Upper Chuckwalla and Orocopia valleys (Figure 3.3-20). Groundwater levels could be lowered by about 3.3 feet at the mouth of the Pinto Basin. Project pumping by itself would not exceed the maximum historic drawdown that occurred in the late 1970s through mid-1980s.

Existing pumping is causing variable baseline conditions. Projections show the groundwater levels near Desert Center are declining by about 0.1 foot per year due to local pumping. The existing pumping is lowering groundwater levels and would, even without the Project, exceed the maximum historic drawdown in the Orocopia Valley by the end of the Project in 2060 (Appendix C, Section 12.4, Figure 22, blue line).

The modeling predicts that both Project and existing pumping would not exceed maximum historic drawdown in Desert Center or at the mouth of the Pinto Valley, but would exceed the maximum historic drawdown beneath the CRA by three feet in the Upper Chuckwalla Valley and by four feet in the Orocopia Valley (Appendix C, Section 12.4, Figures 21 through 24, pink line). Although drawdown of groundwater levels in the Orocopia Valley Groundwater Basin will exceed historic levels it is not considered significant as there is about 700 feet of saturated sediments (B&V, 1998) and the drawdown would only result in a temporary depletion of less than one percent of the total saturated section.

The effects of Project pumping alone on inflow from the Pinto Valley Groundwater Basin were evaluated using the model. The inflow is based on estimates of the hydraulic conductivity, the area that water can flow through, and the groundwater gradient. The potential effects of the Project showed groundwater levels would be lowered by less than four feet at the mouth of the Pinto Valley Groundwater Basin. The gradient was adjusted based on the drawdown produced by the pumping. The inflow area (height) was reduced by four feet to simulate the affects after 50 years of pumping. A hydraulic conductivity of 50 feet per day was used to simulate flow for sediments above the basalt layer. The hydraulic conductivity was reduced to 25 feet per day to conservatively simulate groundwater flow below the basalt layer where the sediments may be more consolidated, weathered, or cemented. It is likely that the hydraulic conductivities are higher which would result in higher estimates of subsurface inflow that would be consistent with the revised recharge estimates.

The results of the calculations show inflow from the Pinto Valley Groundwater Basin prior to Project pumping is about 3,173 AFY. After 50 years of Project pumping the inflow would decrease to about 3,143 AFY, a reduction of about 30 AFY. The results show that Project pumping will have little effect on the groundwater gradient, changing it from 0.00576 to 0.00579, which is beyond detection (beyond the accuracy of the measurements). The decrease in the inflow area has a greater effect on the inflow from the Pinto Valley Groundwater Basin to the Chuckwalla Valley Groundwater Basin, and is producing the reduction of groundwater subsurface inflow in the calculations.

Project pumping is not likely to have any effects on springs in the Eagle Mountains. Based on available water resource information, it appears unlikely that these springs are hydrologically connected to the Pinto Valley or Chuckwalla Valley Groundwater Basins aquifers since they are located in the mountains above the Pinto Valley and Chuckwalla Valley Groundwater Basins. Rather, they appear to be fed by local groundwater systems that would be unaffected by withdrawals from the proposed Project (NPS, 1994).

Note that the cumulative effects of Project pumping combined with existing and proposed projects are discussed in Section 5.5.3.

3.3.3.3.6 *Groundwater Flow Direct Effects*

The groundwater flow is generally from the west and north and flows towards the south and east (DWR, 1979). The modeling and groundwater levels show existing pumping near Desert Center has created a localized pumping depression. The Project pumping will temporarily deepen the pumping depression during the initial fill which thereafter creates a cone of depression of about 14 feet of drawdown near the pumping wells. Overall the short- and long-term pumping effects of the Project will not significantly change regional groundwater flow directions.

3.3.3.3.7 *Subsidence Potential*

The potential of drawdown associated with well pumping to cause subsidence is typically associated with the lowering of confined aquifer groundwater levels below historic low levels. The aquifer in the Upper Chuckwalla Valley Groundwater Basin is unconfined and there is no reported evidence of subsidence in the area as a result of historic or present pumping.

Groundwater levels beneath the CRA in the Upper Chuckwalla Valley fluctuated by 1 to 15 feet between 1965 and 1986 as a result of historic pumping for mine operations and irrigated farming. Because the water levels have been lowered over multiple years, inelastic subsidence – to the extent it would occur – should have already occurred, without affecting the tight tolerance of ¼-inch of drop per 200 linear feet of the CRA (MWD, 2008).

Over a 50-year period, projected effects of existing and Project pumping could lower water levels by about four feet below the maximum historic drawdown beneath the CRA in the Upper Chuckwalla Valley and Orocopia Valley Groundwater Basins (Appendix C, Section 12.4, Figures 21 and 22, magenta line) . The geologic conditions favorable for subsidence related to groundwater extraction are not prevalent in the area. Historic pumping effects have not resulted in subsidence. It is unlikely that lowering of water levels below their historic lows by up to an additional four feet will have a significant effect. Nonetheless, subsidence monitoring should be implemented to confirm that drawdown effects remain within the projected drawdown levels and that significant inelastic subsidence is not induced.

The maximum drawdown due to existing and Project water supply pumping at the mouth of the Pinto Valley Groundwater Basin will be approximately five feet (Appendix C, Section 12.4, Figure 23, magenta line). The amount of drawdown will be less than this in the interior of the Pinto Valley Groundwater Basin, which is located at greater distance from the Project's wells. Because of the small amount of drawdown and the coarse-grained sediments in the Pinto Valley Groundwater Basin, the potential for subsidence is low to non-existent as a result of the Project's water supply pumping.

The potential for drawdown under the cumulative effects scenario (including Kaiser's water use for the proposed landfill, water use for multiple proposed solar projects, and water use for the prisons), is larger than the drawdown for the Project pumping alone (nine feet). With a total saturated depth of 600 feet or greater, subsidence potential in the Chuckwalla Valley Groundwater Basin remains low under this scenario.

3.3.3.3.8 *Hydrocompaction Potential*

The sediments around the fringes of the Chuckwalla Valley Groundwater Basin were deposited as alluvial debris flows. These types of sediments are susceptible to settling and compaction leading to subsidence if wetted from above or below. The CRA is constructed on these sediments at the base of the Eagle Mountains. Seepage from the reservoir or brine ponds could raise groundwater levels and consolidate the sediments leading to subsidence. Direct contact of the seeped water with the CRA is unlikely because groundwater levels are about 150 feet below ground surface.

The results of MODFLOW modeling for the Lower Reservoir area indicate that groundwater levels beneath the reservoir would rise by about 4 to 12 feet if not controlled by pumping. In the vicinity of the CRA, groundwater levels would increase by 3 to 6 feet (*see* Section 12.8). Seepage monitoring and pump-back recovery is planned to prevent the potential for hydrocompaction.

A seepage recovery well array was designed to capture the average seepage volume from the Lower Reservoir. The design consists of six wells, each pumping 92 gpm, resulting in capture of seepage from the Lower Reservoir, with groundwater elevations being reduced beneath the CRA by about three feet. Although the seeped water could be allowed to flow unimpeded to offset drawdown related to water supply pumping, this does not allow for unanticipated conditions. Therefore, seepage recovery wells will be installed. Once the reservoirs are at full capacity and the actual operating conditions are observed, groundwater management actions may be altered (i.e., reduced pump back recovery) to further minimize groundwater level changes beneath the CRA, if approved by the State Water Board and assuming seepage does not cause degradation of groundwater quality.

Seepage from the Upper Reservoir will be along joints, fractures, and faults that cross beneath the reservoir. This seepage may cause water levels to rise and be transmitted into the alluvial aquifer of the Upper Chuckwalla Valley. Seven seepage control wells will be needed to control the seepage losses, assuming they will each pump about 70 gpm. Additional seepage recovery wells will be constructed along the axis of the Eagle Creek Canyon to provide secondary control and to prevent groundwater levels from rising beneath this area of the proposed landfill (27 CCR Section 20240, subdivision (c).

3.3.3.3.9 *Potential Impacts to Groundwater Quality*

Limited groundwater quality analyses have been performed in the Chuckwalla Valley Groundwater Basin. Samples were collected in 1960 at various locations throughout the Chuckwalla Valley Groundwater Basin. Samples were also collected in 1994 during pilot testing of groundwater wells for use by the Project. These wells are the same or in close proximity to the previously sampled wells so a comparison of historic to present water quality can be made. Table 3.3-4 presents these analyses.

The water quality analyses show conflicting patterns. Wells 4S/16E-32M and 4S/16E-30D1 show there has been very little change even though the Chuckwalla Valley Groundwater Basin experienced overdraft during 1981 through 1991. However, wells 5S/16E-7P1 and 5S/16E-7M2 show TDS increased by about 160 mg/L. The increase appears to be related to irrigation return water. Nitrate concentrations increased by about 2 mg/L over the same time, presumably due to the use of fertilizers and other aquaculture practices, and to a lesser degree, the use of septic systems in the areas.

Although pumping for the Project and by existing wells will cause temporary overdraft, groundwater levels for the most part will be within the range of drawdown that has occurred in the past when little to no change in water quality occurred. For that reason, projected Project pumping is not expected to adversely affect the water quality in the Chuckwalla Valley Groundwater Basin.

The bedrock, and to a limited extent the tailing piles, contain metal ore that could be mobilized by water seepage from the reservoirs. Water in contact with the bedrock could migrate into sediments of the Chuckwalla Valley Groundwater Basin and could affect water quality. The geochemical analysis indicates that metals present in the underlying rock are not likely to produce acid leachate, however, it is possible that metals in seepage water could be transported into the Chuckwalla Valley Groundwater Basin.

Seepage from the reservoirs is estimated to be 1,800 AFY. Unchecked, this seepage water would mix with down-gradient groundwater. Seepage will be recovered and returned to the reservoirs unless long term monitoring demonstrates that no adverse effects of contaminant transport are occurring. Thereafter, seepage may be managed to offset water supply pumping drawdown effects.

Salt and metal laden water could seep through the brine disposal ponds and degrade the groundwater quality in the basin. As required by state law, the brine ponds will be double-lined to prevent seepage and a detection groundwater monitoring network will be constructed to confirm that seepage is not occurring.

Based upon data from existing wells in the Chuckwalla Valley Groundwater Basin, the water table is measured to be approximately 110 to more than 150 feet below ground surface. At this depth, the underlying aquifer does not support any vegetation on the overlying desert floor. For this reason, it is concluded that water table drawdown from groundwater pumping does not have any potential to alter or deplete water that is a source for any overlying plant root zones.

<u>Environmental Impact Assessment Summary</u>:

(a) *Would the project violate any water quality standards or waste discharge requirements?* No. Seepage water would migrate into the Chuckwalla Valley Groundwater Basin and could affect water quality. While it is not likely that metals in the bedrock will be mobilized or produce acid leachate, it is possible that metals could be transported into the Chuckwalla Valley Groundwater Basin. This impact is potentially significant and subject to mitigation (PDF GW-1 and PDF GW-2).

(b) *Would the project substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?* Pumping in the Chuckwalla Valley Groundwater Basin is projected to exceed recharge for approximately four years of the 50-year Project life. During the remaining years, recharge is projected to exceed pumping. By 2065, at the end of the 50-year FERC Project license period, the aquifer storage (cumulative change) is project to increase by about 74,000 acre-feet. This potential impact for the Chuckwalla Valley Groundwater Basin is therefore considered to be *less than significant.* Potential local effects on nearby wells are addressed in (c) below. (However, *see* the analysis of cumulative effects in Section 5.0. In combination with pumping for all reasonably foreseeable projects, basin overdraft of about nine feet could occur over the life of the Project, in which case, this Project would contribute to a *significant adverse cumulative effect*.)

(c) *Would the project cause local groundwater level reductions that affect local residents and businesses dependent upon overlying wells?* During the initial fill period, groundwater use would exceed recharge, so groundwater levels will decrease during this period. This impact is considered *potentially significant* and subject to mitigation. Mitigation measures (MM) MM GW-1 through MM GW-7 are identified to reduce or offset this potential impact. Over the life of the Project, for existing and Project pumping only, groundwater levels will increase by about five feet over the Chuckwalla Valley Groundwater Basin as a whole, which does not cause any net depletion of regional groundwater supplies. (However, *see* the analysis of cumulative effects in Section 5.0. In combination with pumping for all reasonably foreseeable projects, a Chuckwalla Valley Groundwater Basin overdraft of about nine feet could occur over the life of the Project, in which case, this Project would contribute to a *significant adverse cumulative effect*.)

(d) *Would the project cause water table drawdown that depletes water in plant root zones on overlying lands?* Groundwater level reductions will have no impact on plant root zones, as the groundwater level from which Project pumping would occur is currently more than 110 feet below the root zone of plants.

Impact 3.3-1 Perennial Yield and Regional Groundwater Level Effects. Pumping will exceed recharge for approximately four years of the 50-year Project life. During the remaining years, recharge will exceed pumping. By 2065, at the end of the 50-year FERC project license period, the aquifer storage (cumulative change) is projected to increase by about 74,000 acre-feet. This will not result in depletion of groundwater supplies. Therefore, this potential impact is *less than significant*. (However, *see* the analysis of cumulative effects in Section 5.0. In combination with pumping for all reasonably foreseeable projects, a Chuckwalla Valley Groundwater Basin overdraft of about nine feet could occur over the life of the Project, in which case, this Project would contribute to a *significant adverse cumulative effect*.)

Impact 3.3-2 Local Groundwater Level Effects. Although not significant basin-wide, the modeling predicts the Project water supply pumping will cause drawdown of the groundwater levels in the Chuckwalla Valley, Pinto Valley and Orocopia Valley Groundwater Basins. During the initial fill, in the vicinity of the Project's wells, about 50 feet of drawdown will be created at the pumping wells for about four years, but thereafter the drawdown will be reduced to about 14 feet. At distances of one mile from the pumping wells the drawdown will be about six feet. The greatest drawdown will occur near the Project's wells after the first four years of pumping. The greatest drawdown created by just Project pumping elsewhere in the basins will be at the end of the Project pumping with approximately 3.5 to 4.3 feet near the CRA in the Upper Chuckwalla and Orocopia valleys. Project pumping by itself would not exceed the maximum historic drawdown, and this impact is not considered a substantial decrease of the local groundwater level. Local drawdown effects do have the potential to interfere with pumping costs and yields from nearby neighboring wells. This impact is considered *potentially significant and subject to mitigation* (MM GW-1 and MM GW-2).

Impact 3.3-3 Groundwater Flow Direction Effects. The short- and long-term pumping effects will not significantly change groundwater flow directions. The groundwater flow is generally from the west and north and flows towards the south and east (DWR, 1979). The modeling and groundwater levels show existing pumping near Desert Center has created a localized pumping depression. The Project pumping will temporarily deepen the pumping depression during the initial fill in the first four years of pumping, and thereafter will create a cone of depression drawdown of about 14 feet at the pumping wells. Due to the size of the Chuckwalla Valley Groundwater Basin (more than 45 miles across), the total volume of water in storage (9.1 to 15 million acre-feet), and the volume of water to be pumped in the first four years (approximately 32,000 acre-feet), it is concluded that Project pumping does not have potential to substantially alter flow throughout the Chuckwalla Valley Groundwater Basin or other basins, and this potential impact is considered to be *less than significant*.

Impact 3.3-4 Subsidence and Hydrocompaction Potential. Lowering of groundwater levels below their historic lows could cause subsidence and potential impacts to the CRA. Increases of groundwater levels could result in hydrocompaction, resulting in impacts to the CRA. It is unlikely that lowering of water levels below their historic lows by up to an additional five feet at the CRA will cause subsidence. Although unlikely, the impact is deemed *potentially significant and subject to mitigation* (MM GW-3, MM GW-4, and MM GW-5). Because of the small amount of drawdown and the coarse-grained sediments in the Pinto Valley Groundwater Basin, the potential for subsidence in the Pinto Valley Groundwater Basin is low to non-existent as a result of Project water supply pumping. The potential for drawdown under the cumulative effects scenario (including Kaiser's water use for the proposed landfill, water use for the proposed solar projects, and water use for the prisons), is larger than the drawdown for the Project pumping alone (estimated total of nine feet). Subsidence potential remains low under this scenario.

With regard to hydrocompaction, direct contact of seepage water with the CRA is unlikely because groundwater levels are about 135 feet below ground surface at the CRA. Therefore, no direct impact to MWD's infrastructure is anticipated. The results of MODFLOW modeling for the Lower Reservoir area indicate that groundwater levels beneath the Lower Reservoir would rise by about 4 to 12 feet if not controlled by pumping. In the vicinity of the CRA groundwater levels could increase by 3 to 6 feet if not controlled by pumping to minimize seepage losses. This impact is considered *potentially significant and subject to mitigation* (MM GW-3, MM GW-4, and MM GW-5).

Impact 3.3-5 Groundwater Quality. Seepage water could migrate into the Chuckwalla Valley Groundwater Basin and could affect water quality in the aquifer. This impact *is potentially significant and subject to mitigation* (MM GW-6, PDF GW-1 and PDF GW-2). Metals in the bedrock are not likely to be mobilized or produce acid leachate, but it is possible that contaminants could be transported into the Chuckwalla Valley Groundwater Basin.

Without water quality treatment, the water in the reservoirs would change over time due to evaporation, resulting in increasing levels of TDS. In order to maintain TDS at a level consistent with existing groundwater quality, a water treatment plant using reverse osmosis (RO) is proposed as a part of the Project to maintain reservoir water quality at the existing quality of the source groundwater. This consists primarily of an RO desalination facility and brine disposal ponds to remove salts and metals from reservoir water and maintain TDS concentrations equivalent to the source water quality (PDF GW-2).

In addition, a groundwater quality monitoring program will be implemented to collect the data necessary to assess and maintain groundwater effects at less than significant levels. Water quality sampling will be done within the reservoirs, production wells, and in wells up gradient and down gradient of the reservoirs and brine disposal lagoon consistent with applicable portions of California Code of Regulations Title 27 (MM GW-6). Monitoring will be done on a quarterly basis for the first four years and may be modified to biannually thereafter based on initial results.

Compliance with state Title 27 requirements will prevent salt and metal-laden water from seeping through the brine disposal ponds, and thereby preventing degradation of groundwater quality from this source.

Impact 3.3-6 Colorado River Effects. The Colorado River "accounting surface" policy contemplated by the Bureau of Reclamation would apply to groundwater in the Chuckwalla Valley Groundwater Basin between 238 and 240 feet msl. The Project will have *no impact* on the Colorado River or this potential future policy because groundwater levels in the area are around 500 feet msl, and will not deplete groundwater levels in a manner that could encounter the proposed accounting surface elevations.

Impact 3.3-7 Loss of Existing Wells. This impact is *considered potentially significant and subject to mitigation* (MM GW-7). Existing wells within the central and eastern mining pits would be destroyed by development of the Project reservoirs.

3.3.4 Mitigation Program

The mitigation program includes PDFs and mitigation measures MMs. PDFs are design elements inherent to the Project that reduce or eliminate potential impacts. MMs are provided to reduce impacts from the proposed Project to below a level of significance, where applicable. As appropriate, performance standards have been built into MMs.

As mentioned under Regulatory Settings, LORS are based on local, state, or federal regulations or laws that are frequently required independent of the California Environmental Quality Act review, yet also serve to offset or prevent certain impacts. The proposed Project will be constructed and operated in conformance with all applicable federal, state, and local LORS.

This section lists mitigation for lower groundwater level, higher groundwater level, groundwater quality, and loss of well facilities.

3.3.4.1 Mitigation Pertaining to Potential Impacts of Changed Groundwater Levels

Groundwater levels near the Project's water supply wells will decline during Project pumping. Local decline of groundwater levels within the cone of depression could affect nearby wells. Project wells have been intentionally sited so that they are approximately one mile or more from each other to prevent overlapping cones of depression and increasing this potential impact.

MM GW-1. **Groundwater Level Monitoring.** A groundwater level monitoring network will be installed to confirm that Project pumping is maintained at levels that are in the range of historic pumping. The monitoring network will consist of both existing and new monitoring wells to assess changes in groundwater levels beneath the CRA, and the Pinto Basin, as well as in areas east of the Project water supply wells. Table 3.3-8 lists the proposed monitoring network and Figure 3.3-17 shows its proposed locations. In addition to the proposed monitoring wells, groundwater levels, water quality, and production will be recorded at the Project pumping wells. The Project will report the static water levels beneath each of the Project's production wells annually along with a reference either to the accounting surface as proposed by USGS in 2008 or to a valid accounting surface methodology set forth in future legislation, rule-making or applicable judicial determination. A "static water level" shall be when the well has been idle for an equal time that it has been pumping or the measurement taken after the longest period of Project non-pumping.

If monitoring indicates that groundwater is being draw down at greater levels and faster rates than expected (exceeding the "Maximum Allowable Changes" identified in Table 3.3-8), pumping rates for the initial fill will be reduced to a level that meets the levels specified in Table 3.3-8. The initial fill period would therefore be extended to a maximum of 4.5 to 6 years.

Table 3.3-8. Mitigation Monitoring Network and Maximum Allowable Changes

Existing Monitoring Wells	New Monitoring Wells Well	Maximum Allowable Drawdown (feet)
3S/15E-4J1 (OW18)		10
C-9		11
	MW-109 (near OW03)	14
	MW-110 (near OW13)	12
	MW-112 (near OW15)	9
	MW-111 (CRA in Palen Valley) [2]	Unknown
5S/6E-25F1 (OW17) [2]		13

Existing Water Supply Well	New Water Supply Well	Maximum Allowable Drawdown (feet)
	WS-1	51
	WS-2	51
	WS-3	51

Existing Extensometers	New Extensometers	Maximum Subsidence (feet)
	E-1	0.125
	E-2	0.125

Notes:
[1] Maximum allowable drawdown may be revised upon completion of project aquifer testing
[2] Boring shall be drilled to bedrock or first water. If saturated alluvium is encounter construct a monitoring well.
[3] Drawdown could be greater depending upon the confinement of the aquifers in the eastern portion of the valley and pumping by solar facilities

MM GW-2. **Well Monitoring.** Wells on neighboring properties whose water production may be impaired by Project groundwater pumping will be monitored quarterly at a minimum during the initial fill pumping period and for at least 4 years following the initial fill. Monitoring will be semi-annual, at a minimum, for the remainder of the Project. If it is determined that Project pumping is lowering static water levels in those wells by 5 feet or more, the Project will replace or lower the pumps, deepen the existing well, construct a new well, and/or compensate the well owner for increased pumping costs to maintain water supply to those neighboring properties.

3.3.4.2 Mitigation Pertaining to Seepage, Hydrocompaction and Subsidence

PDF GW-1. **Groundwater Seepage.** The Licensee will limit seepage from the Project reservoirs to the extent feasible using specified grouting, seepage blankets, and roller-compacted concrete (RCC) or soil cement treatments. This includes the Upper Reservoir, Lower Reservoir, and the brine disposal ponds that will be part of the water quality management system for the Project. Final design for seepage control will be approved by the State Water Board and FERC prior to construction. Seepage control from the Project reservoirs will be accomplished using systematic procedures that will include the following:

During final engineering design, a detailed reconnaissance of the reservoir basins and pond areas will be conducted to identify zones where leakage and seepage would be expected to occur. These areas will include faults, fissures and cracks in the bedrock, and zones that may have direct connection to the alluvial deposits of the Chuckwalla Valley. During the reconnaissance, the effectiveness of various methods for seepage and leakage control to mitigate the effects of these particular features will be evaluated, including grouting, seepage blankets, and RCC or soil cement treatments, and other methods if needed.

Methods for seepage and leakage control will include curtain grouting of the foundation beneath the dam footprint and around the reservoir rim, as needed; backfill concrete placement and/or slush grouting of faults, fissures, and cracks detected in the field reconnaissance; placement of low permeability materials over zones too large to be grouted and over areas of alluvium within the Lower Reservoir; seepage and leakage collection systems positioned based upon the results of the hydrogeologic analyses; and clay or membrane lining of the brine ponds associated with the Project's water quality management system. The collection systems would recycle water into the Project reservoirs or the reverse osmosis (RO) system.

Design and construction of a Comprehensive Monitoring Program, consisting of observation wells and piezometers that will be used to assess the effectiveness of the seepage and leakage control measures.

Based on monitoring results, additional actions may be taken to further control leakage and seepage from the reservoirs and ponds. Such measures may include curtain grouting and the expansion of seepage and leakage collection systems.

Other measures, such as use of stepped RCC or soil cement overlay on the eastern portion of the Lower Reservoir, may also be used depending on results of final engineering design analyses.

In addition, portions of the tunnels and shaft of the Project will experience very high water pressures; whereas, current plans are based on lining of the tunnels with concrete, and in some locations steel liners will be installed. These liners will also effectively block seepage from occurring.

MM GW-3. **Extensometers.** Two extensometers shall be constructed to measure potential inelastic subsidence that could affect operation of the CRA; one in the upper Chuckwalla Valley near OW-3 and the other in the Orocopia Valley near OW-15. Figures 3.3-17 and 18 show the locations of the extensometers.

In the unlikely event that the data show inelastic subsidence is occurring due to Project groundwater pumping the Project will eliminate inelastic subsidence by:

Redistributing pumping by constructing additional wells and modifying the pumping rates to reduce drawdown.

Reducing pumping or by artificially increasing recharge in order to better match the net annual groundwater withdrawal to the net annual recharge.

If structures are impacted, they will be mitigated to pre-subsidence condition through engineered solutions that may consist of re-leveling, placement of compacted fill, soil-cement, pressure grouting, installation of piles and grade-beams, or steel-reinforcement. As necessary, portions or all of the impacted structure will be repaired or replaced in consultation with the Metropolitan Water District of Southern California (MWD).

MM GW-4. **Lower Reservoir Seepage Recovery Wells.** Seepage from the Lower Reservoir will be extracted through seepage recovery wells. The proposed recovery well locations are shown on Figure 3.3-18. Seepage from the Lower Reservoir will be maintained to prevent a significant rise in water levels beneath the CRA or a rise in groundwater that could potentially impact the liner of the proposed landfill. Target water levels have been assigned to the monitoring wells as shown in Table 3.3-9. Aquifer tests will be performed during final engineering design to confirm the seepage recovery well pumping rates and aquifer characteristics. The tests will be performed by constructing one of the seepage recovery wells and pumping the well while observing the drawdown in at least two seepage recovery or monitoring wells. Upon completion of this testing, the model will be re-run and the optimal locations of the remainder of the seepage recovery wells will be determined to effectively capture water from the Lower Reservoir and maintain groundwater level changes at less than significant levels beneath the CRA and the liner of the proposed landfill. Groundwater monitoring will be performed on a quarterly basis for the first 4 years of Project pumping. This program may be modified to bi-annually or annually depending on the findings. Annual reports will be prepared and distributed to interested parties.

If needed based upon monitoring results, and acceptable based upon water quality monitoring results, as an adaptive management measure Project pumping drawdown can be mitigated by allowing seepage from the reservoirs to occur without pump-back recovery. If seepage from the reservoirs is unimpeded, groundwater levels could rise beneath the CRA by up to 3 feet.

Performance Standard: Seepage from the Lower Reservoir will be maintained to prevent a significant rise in water levels beneath the CRA or a rise in groundwater that could potentially impact the liner of the proposed landfill. Seepage from the Lower Reservoir will be managed to maintain groundwater levels at least five feet below the bottom elevation of the liner of the proposed landfill so that the landfill can comply with title 27 CCR Section 20240, subdivision (c) requirements. Target levels have been assigned to the monitoring wells as shown in Table 3.3-9.

MM GW-5. **Upper Reservoir Seepage Recovery Wells.** Seepage from the Upper Reservoir will be controlled through a separate set of seepage recovery wells, locations of which are shown on Figure 3.3-18. Seepage from the Upper Reservoir will be maintained at least five feet below the bottom elevation of the proposed landfill project liner. Target levels have been assigned to the monitoring wells as shown in Table 3.3-9. A testing program will also be employed for seepage recovery wells for the Upper Reservoir to assess the interconnectedness of the joints and fractures and the pumping extraction rate. Drawdown observations will be made in nearby observation wells to support final engineering design. Groundwater monitoring will be performed on a quarterly basis for the first four years of Project pumping. This program may be modified to bi-annually or annually depending on the findings. Annual reports will be prepared and distributed to interested parties.

Based upon testing for final design, or if indicated by groundwater level monitoring, additional seepage extraction wells may be constructed to meet target groundwater levels listed in Table 3.3-9. PDF GW-1 would also apply should water levels approach target levels listed in Table 3.3-9. Based upon testing for final design, or if indicated by groundwater level monitoring, additional seepage extraction wells may be constructed.

Performance Standard: Seepage from the Upper Reservoir will be managed to maintain groundwater levels at least five feet below the bottom elevation of the liner of the proposed landfill so that the landfill can comply with title 27 CCR Section 20240, subdivision (c) requirements. Target levels have been assigned to the monitoring wells as shown in Table 3.3-9.

Table 3.3-9. Proposed Mitigation Well Network and Maximum Allowable Changes from Seepage Recovery Pumping[1]

Existing Monitoring Wells or Piezometer

Well No./Name	Aquifer Material	Monitoring Purpose	Total Borehole Depth (feet)	Borehole Diameter (inches)	Casing Diameter (inches)	Screen Interval (feet bgs)		Maximum Allowable Drawdown (feet)	Maximum Allowable Water Elevation (feet msl)
						Top	Bottom		
Existing Monitoring Wells to be Replaced									
P-1R	Alluvium	Lower Reservoir Pumping Contol	550	10	4	490	540	6	
MW-4R	Bedrock	Background Lower Reservoir	774	10	4	704	764		
MW-5R	Alluvium	Lower Reservoir Pumping Contol	418	10	4	348	408	6	
MW-10R	Bedrock	Background Upper Reservoir	1,672	10	4	1,558	1,662		1,464
New Monitoring Wells to be Constructed									
MW-101A	Alluvium	Brine Pond Downgradient	110	10	4	60	100	dry	
MW-101B	Bedrock	Brine Pond Downgradient	599	10	4	549	589		
MW-102A	Alluvium	Brine Pond Downgradient	110	10	4	60	100	dry	
MW-102B	Bedrock	Brine Pond Downgradient	658	10	4	608	648		
MW-103A	Alluvium	Brine Pond Downgradient	200	10	4	150	190	dry	
MW-103B	Bedrock	Brine Pond Downgradient	658	10	4	608	648		
MW-104	Alluvium	Lower Reservoir Pumping Contol	575	10	4	525	565	6	
MW-105	Alluvium	Lower Reservoir Seepage	552	10	4	502	542	4	
MW-106	Alluvium	Lower Reservoir Seepage	383	10	4	333	373	4	
MW-107	Alluvium	Lower Reservoir Seepage	353	10	4	303	343	4	
MW-108	Alluvium	CRA	318	10	4	268	308	2	
MW-109	Alluvium	CRA	497	10	4	447	487	3	

Seepage Recovery Wells to be Constructed

Well No./Name	Aquifer Material	Purpose	Total Borehole Depth (feet)	Borehole Diameter (inches)	Casing Diameter (inches)	Screen Interval (feet bgs)		Maximum Allowable Drawdown (feet)	Maximum Allowable Water Elevation (feet msl)
						Top	Bottom		
SRW-01	Bedrock	Upper Reservoir Seepage Recovery	1,477	10	6	1,353	1,467		2,540
SRW-02	Bedrock	Upper Reservoir Seepage Recovery	1,421	10	6	1,297	1,411		586
SRW-03	Bedrock	Upper Reservoir Seepage Recovery	1,359	10	6	1,235	1,349		586
SRW-04	Bedrock	Upper Reservoir Seepage Recovery	1,297	10	6	1,173	1,287		586
SRW-05	Bedrock	Upper Reservoir Seepage Recovery	1,522	10	6	1,398	1,512		586
SRW-06	Bedrock	Upper Reservoir Seepage Recovery	696	10	6	614	686		940
SRW-07	Bedrock	Upper Reservoir Seepage Recovery	1,043	10	6	969	1,033		2,060
SRW-08	Alluvium	Lower Reservoir Seepage Recovery	650	18	12	493	640	7	
SRW-09	Alluvium	Lower Reservoir Seepage Recovery	495	18	12	328	485	7	
SRW-10	Alluvium	Lower Reservoir Seepage Recovery	645	18	12	463	635	7	1,560
SRW-11	Alluvium	Lower Reservoir Seepage Recovery	575	18	12	385	565	7	
SRW-12	Alluvium	Lower Reservoir Seepage Recovery	640	18	12	453	630	7	
SRW-13	Alluvium	Lower Reservoir Seepage Recovery	695	18	12	513	685	7	

Footnote: [1] Drawdown projections soley due to Seepage Recovery Pumping

3.3.4.3 Mitigation Pertaining to Groundwater Quality

Without treatment, water quality of the water in the reservoirs would change over time due to evaporation, resulting in increasing concentrations of TDS. In order to maintain TDS at a level consistent with existing groundwater quality, a water treatment plant using RO for TDS removal is proposed as a PDF (PDF GW-2 below).

Specific MMs and PDFs include:

PDF GW-2. **Water Treatment Facility.** In order to maintain TDS at a level consistent with existing groundwater quality, a water treatment plant using a RO desalination system and brine disposal lagoon will be constructed as a part of the Project to remove salts and metals from reservoir water and maintain TDS concentrations equivalent to the source groundwater.

Treated water will be returned to the Lower Reservoir while the concentrated brine from the RO process will be directed to brine ponds. In addition to removing salts from the water supply, other contaminants, nutrients, and minerals, if present, would be removed, preventing eutrophication from occurring.

Salts from the brine disposal lagoon will be removed and disposed of at an approved facility when the lagoons become full, approximately every 10 years. The lagoons will be maintained in a wetted condition, to maintain air quality in the Project area.

MM GW-6. **Water Quality Sampling.** Water quality sampling will be done at the source wells, and within the reservoirs, and in monitoring wells up-gradient and down-gradient of the reservoirs and brine disposal lagoon consistent with applicable portions of California Code of Regulations Title 27. Figure 3.3-18 shows the proposed locations of these wells. The Licensee shall prepare and implement a site-specific monitoring and reporting plan for groundwater and surface waters which will specify the location and timing of water quality monitoring, and constituents to be monitored. Monitoring will be done on a quarterly basis for the first four years and may be reduced to biannually thereafter based on initial results. Results of the sampling will be used to adjust water treatment volume, and to add or adjust treatment modules for TDS and other potential contaminants as needed to maintain groundwater quality under the direction of the State Water Board and FERC. Groundwater quality monitoring results will be made available to the MWD upon request.

Performance Standard: As a performance standard, the proposed Project: 1) must not cause or contribute to the degradation of background water quality; and 2) water quality in the reservoirs will be maintained at the existing quality of the source groundwater.

MM GW-7. **Replacement Wells.** Existing wells within the central and eastern mining pits which are to be developed as Project reservoirs, will be replaced at locations outside of the reservoirs as shown on Figure 3.3-18. Table 3.3-9 lists those wells scheduled for replacement.

3.3.5 Level of Significance after Implementation of Mitigation Program

Impact 3.3-1 Perennial Yield and Regional Groundwater Level Effects. As noted above, on an individual project-basis, this potential impact is *less than significant, and no mitigation is required*. As discussed in Section 5, over its 50-year Project life, this Project would contribute to a *significant adverse cumulative effect* in combination with pumping for all other currently proposed projects in the Chuckwalla Basin.

Impact 3.3-2 Local Groundwater Level Effects. With full implementation of the mitigation measures identified (MM GW-1 and MM GW-2), *potentially significant adverse effects on local groundwater levels will be reduced to a level that is less than significant*.

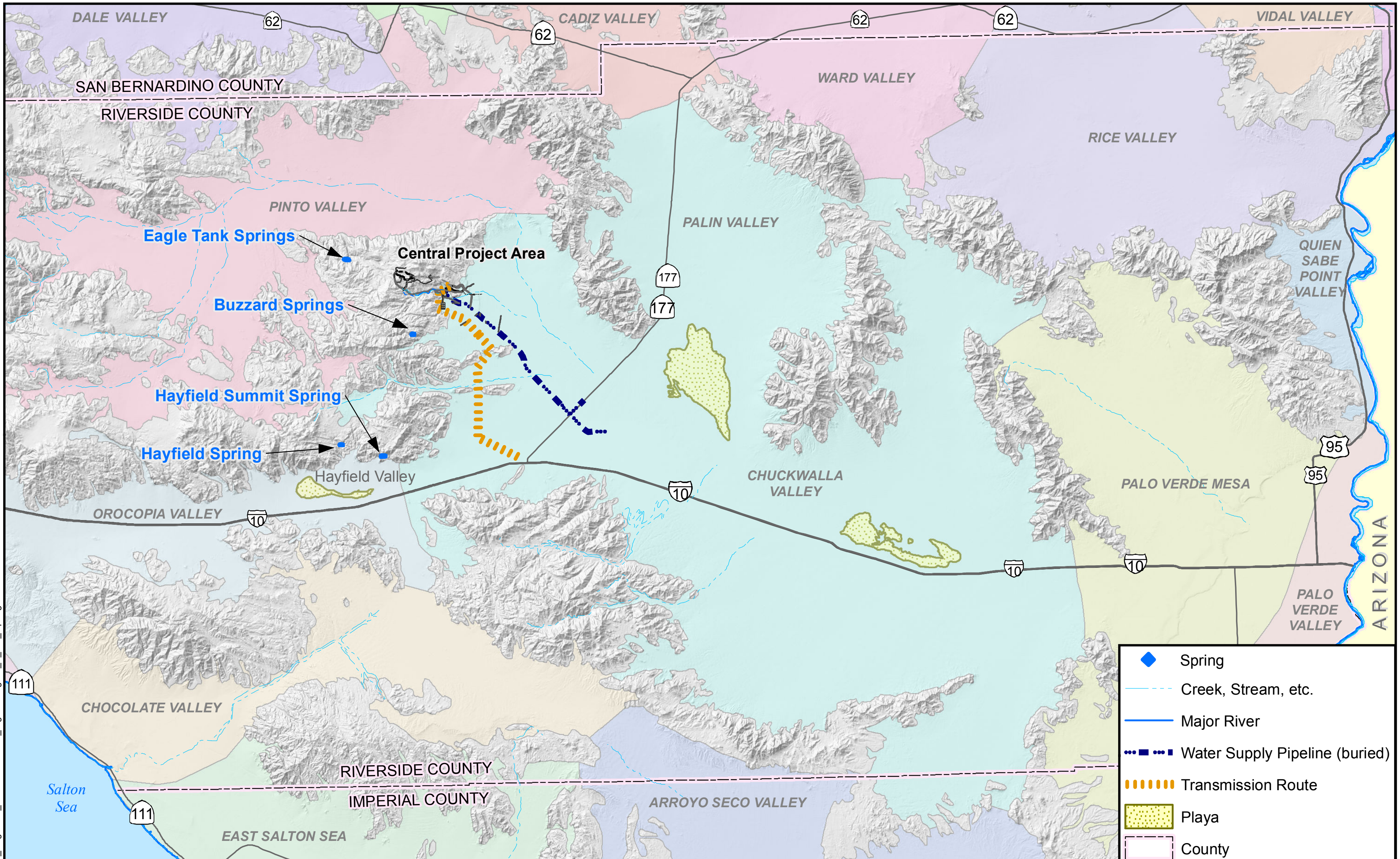
Impact 3.3-3 Groundwater Flow Direction Effects. As noted above, on an individual project-basis, this potential impact is *less than significant, and no mitigation is required*.

Impact 3.3-4 Subsidence and Hydrocompaction Potential. With full implementation of the mitigation measures identified (MM GW-3, MM GW-4, and MM GW-5), *potentially significant adverse effects of subsidence and hydrocompaction will be reduced to a level that is less than significant*.

Impact 3.3-5 Groundwater Quality. With full implementation of the mitigation measures identified (MM GW-6, PDF GW-1 and PDF GW-2) *potentially significant adverse effects on groundwater quality will be reduced to a level that is less than significant.*

Impact 3.3-6 Colorado River Effects. The Project will have *no impact* on the Colorado River or the potential future “accounting surface” policy because groundwater levels will not be depleted that could possibly encounter the accounting surface elevations.

Impact 3.3-7 Existing Wells. With adherence to MM GW-7, potential impacts to the existing wells (as noted on Figure 3.3-18) will be *less than significant*.



SOURCE: Groundwater Basins from CA Department of Water Resources, Bulleting 118, v. 3 (date).

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Springs Near Project Area

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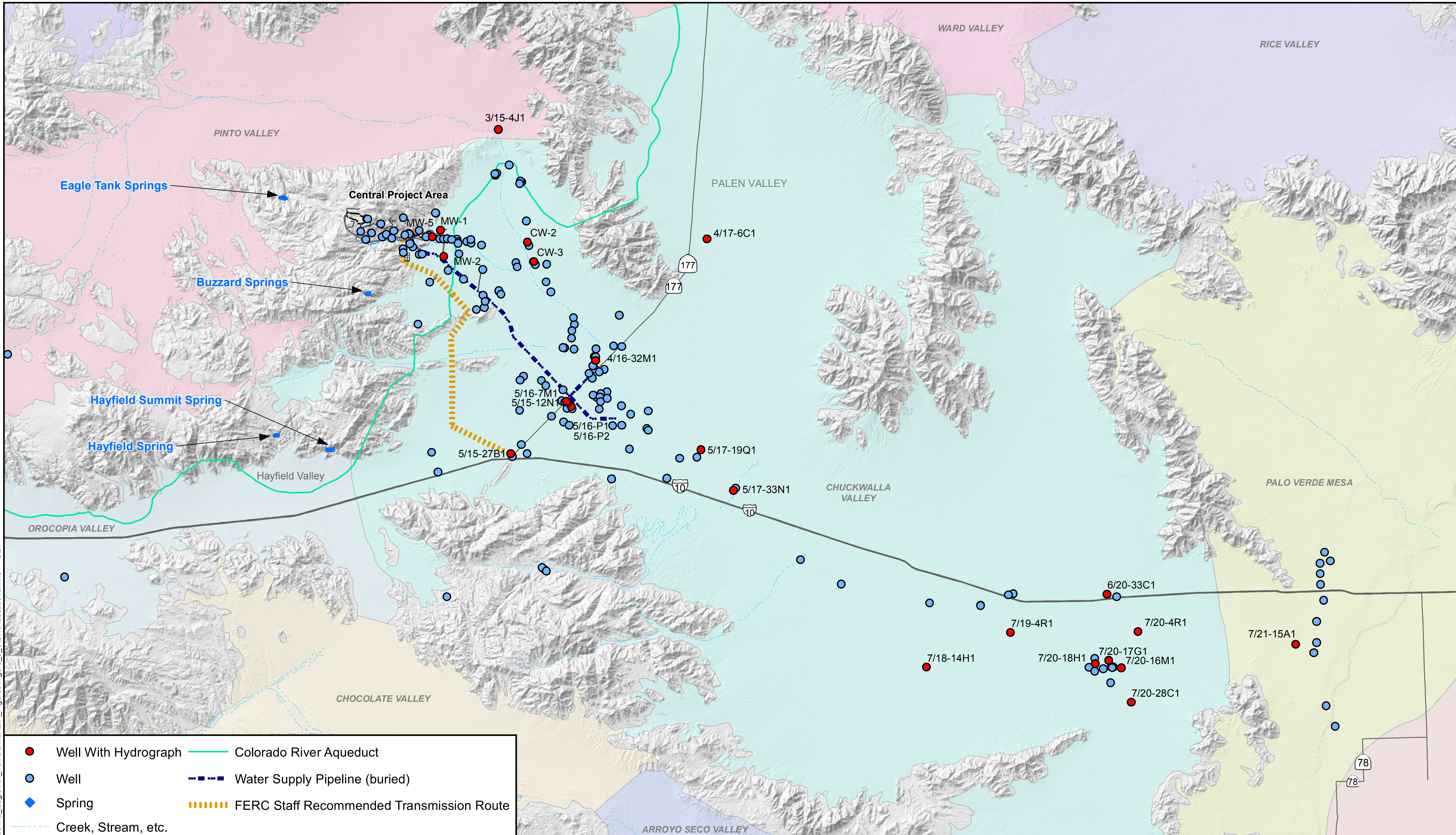
Figure 3.3-1

25-Jan-2012 Z:\Projects\080472_EagleMtn_fromDenvenEIR_Figures\Figure_3_3-1_Springs.mxd SET



0 5 10 Miles

N

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WELL LOCATIONS

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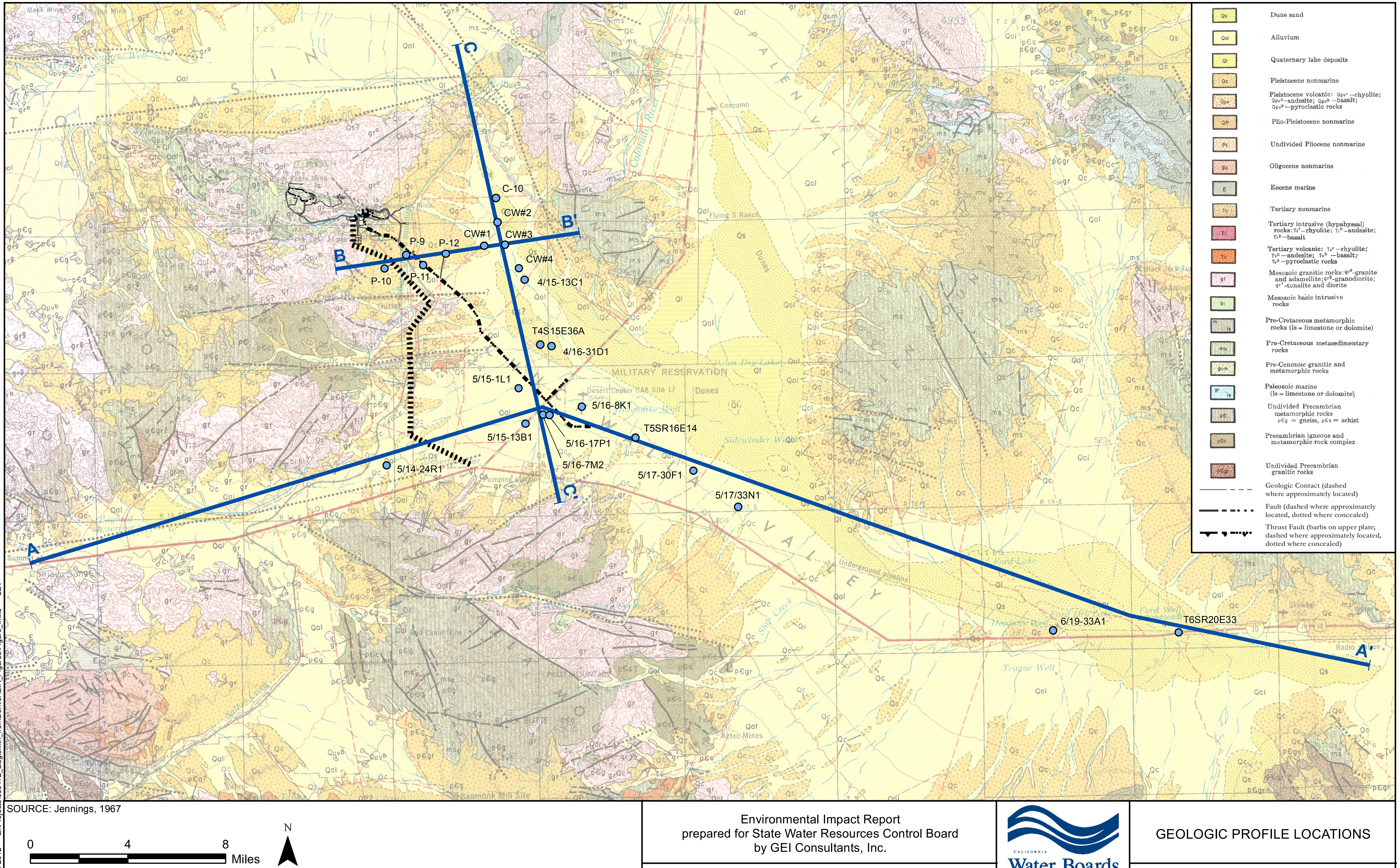
Figure 3.3-2

25-Jan-2012 Z:\Projects\080472_EagleMtn_fromDenver\EIR_Figures\Figure_3_3-2WellLocations.mxd SET



SOURCE: Jennings, 1967

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GEOLOGIC PROFILE LOCATIONS

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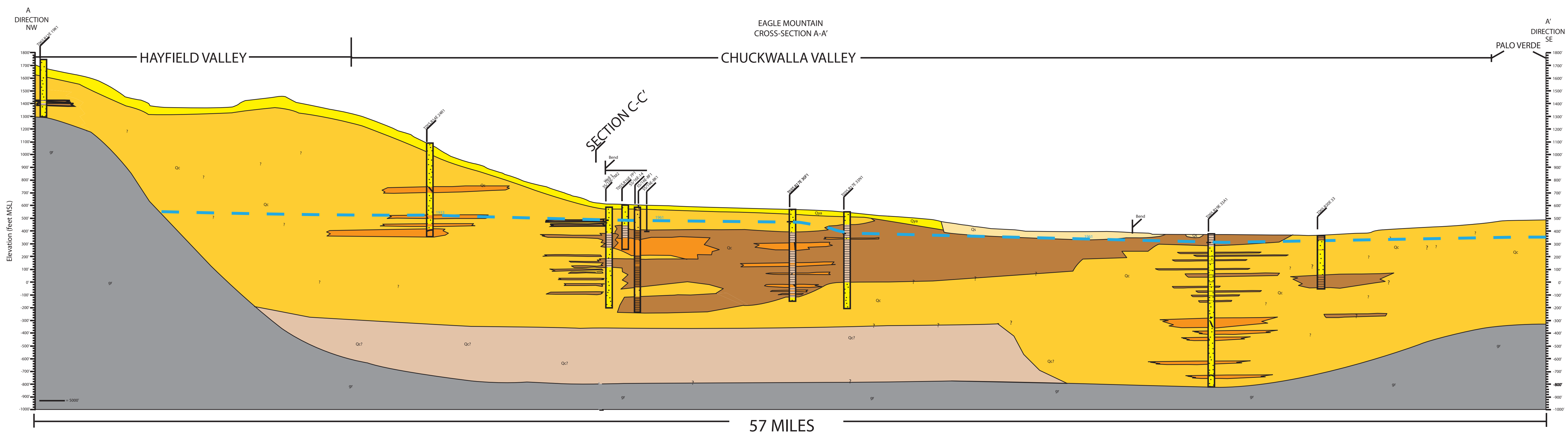
Figure 3.3-3

25-Jan-2012 Z:\Projects\080472_EagleMtn_fromDenverEIR_Figures\Figure_.mxd SET



LEGEND

- GRAVELS
- SANDS
- SILT OR CLAY
- VOLCANICS
- BASEMENT

Qc = Pleistocene nonmarine
Qc = Quaternary Alluvium
Ql = Quaternary Lake Deposits
Qs = Dune Sand
Qpv b = Pleistocene Volcanic
gr = Mesozoic Granitic rocks
ms = Pre-Cretaceous Metamorphic Rocks

Water level

Vertical Scale
= 200'

Horizontal Scale
= 5000'

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CROSS-SECTION A-A'

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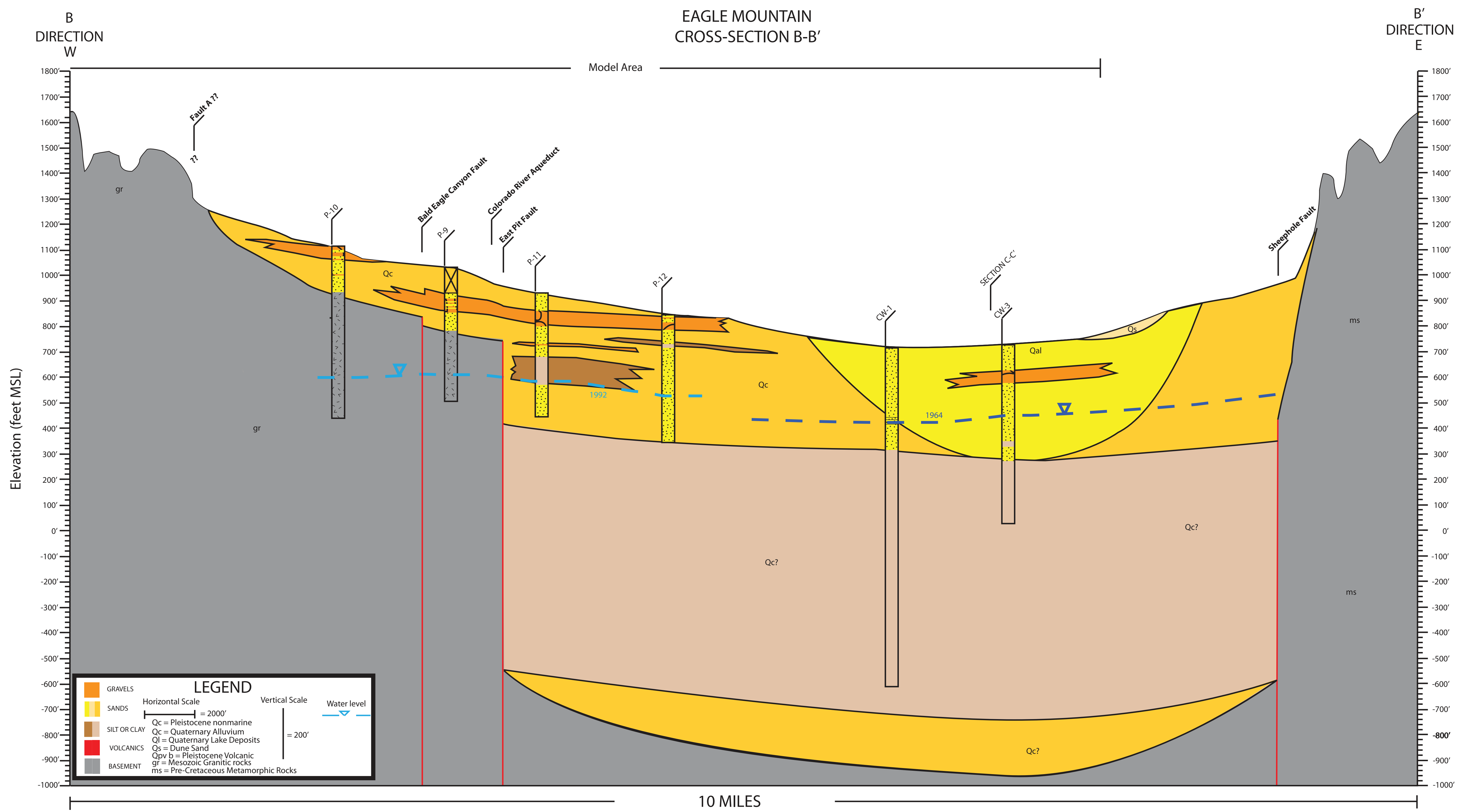
Figure 3.3-4



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CROSS-SECTION B-B'

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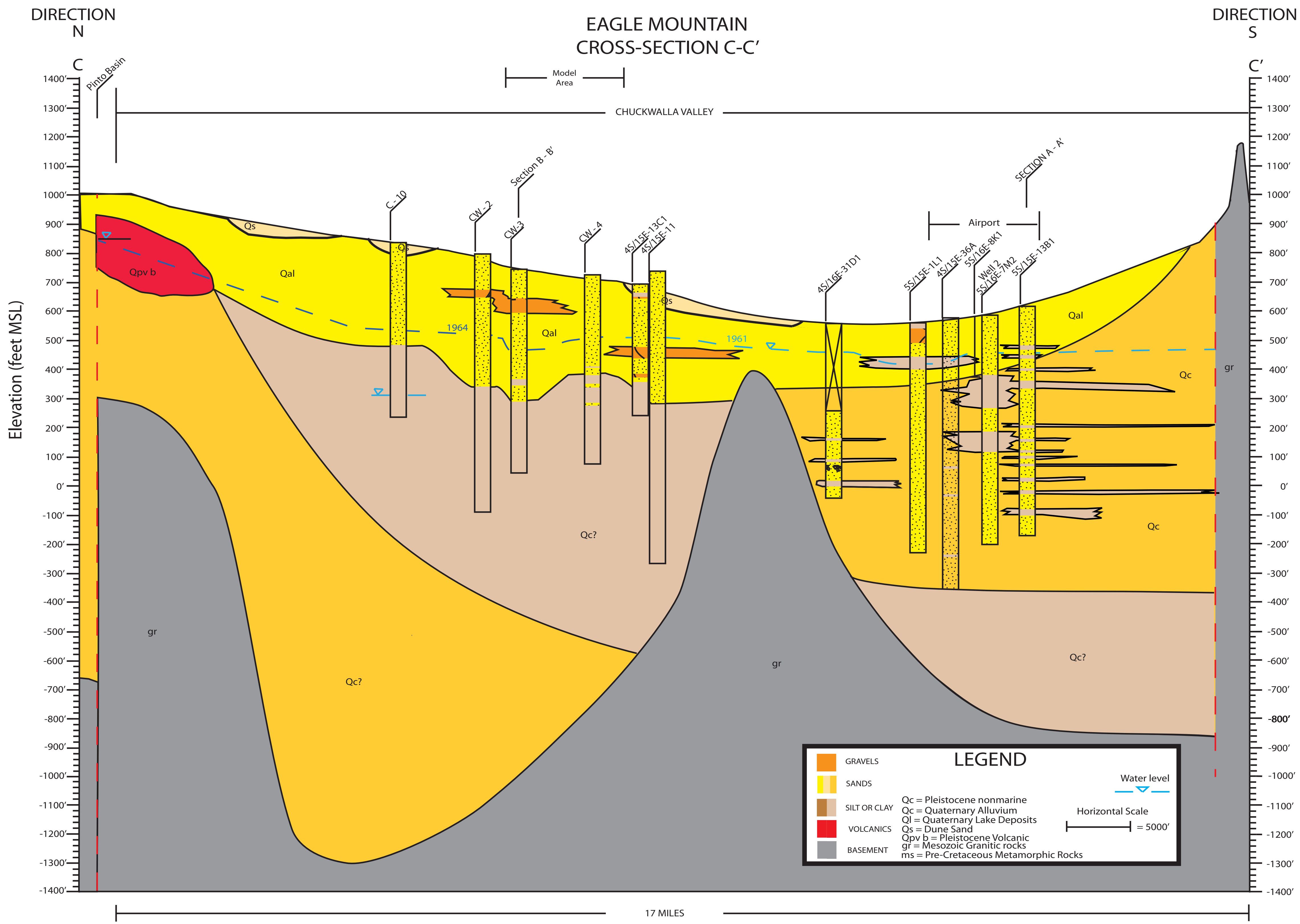
Figure 3.3-5



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CROSS-SECTION C-C'

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Figure 3.3-6

FIGURE 3.3-7
DESERT CENTER GROUND WATER LEVELS

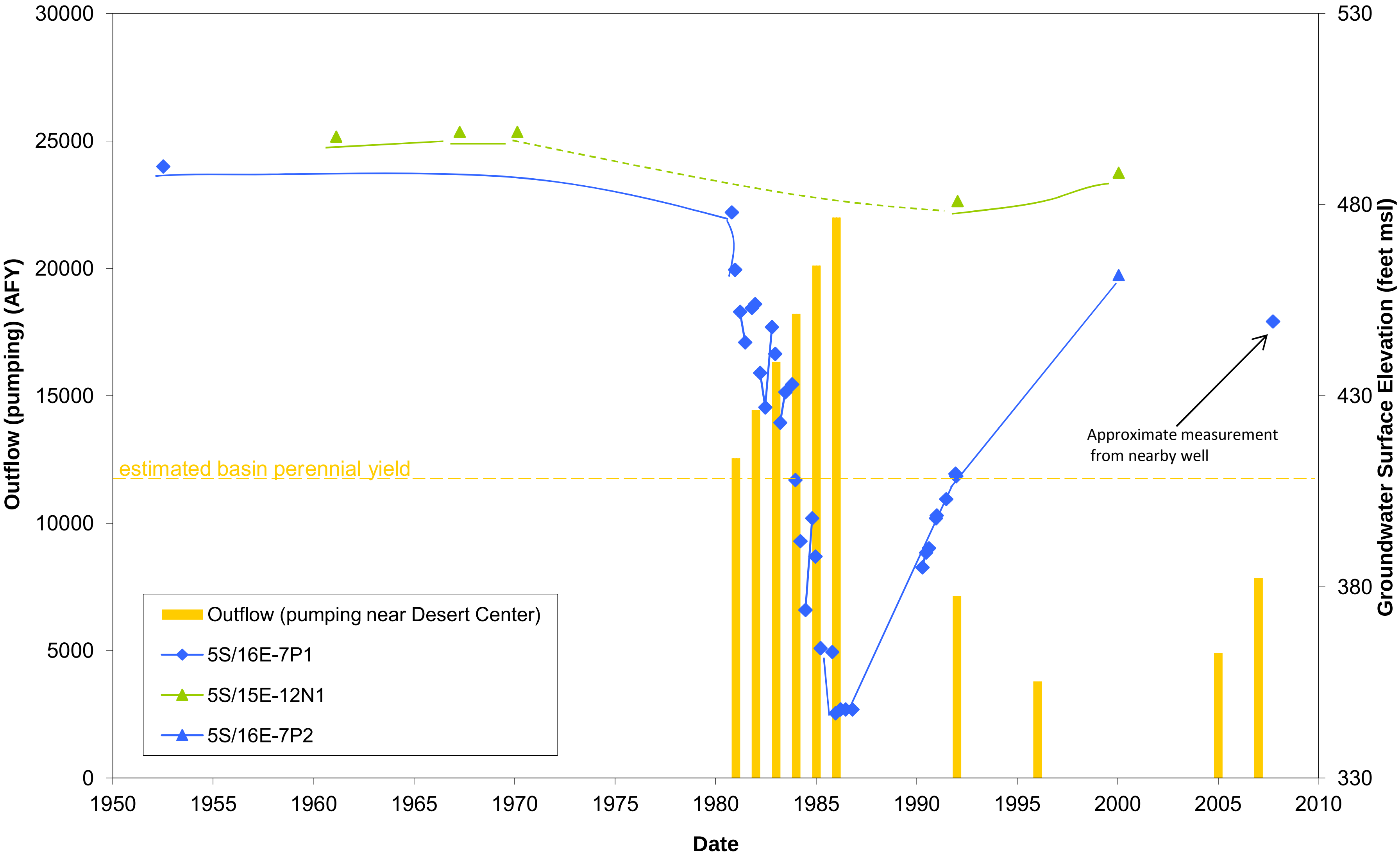


FIGURE 3.3-8
UPPER CHUCKWALLA VALLEY AND PALO VERDE MESA GROUND WATER LEVELS

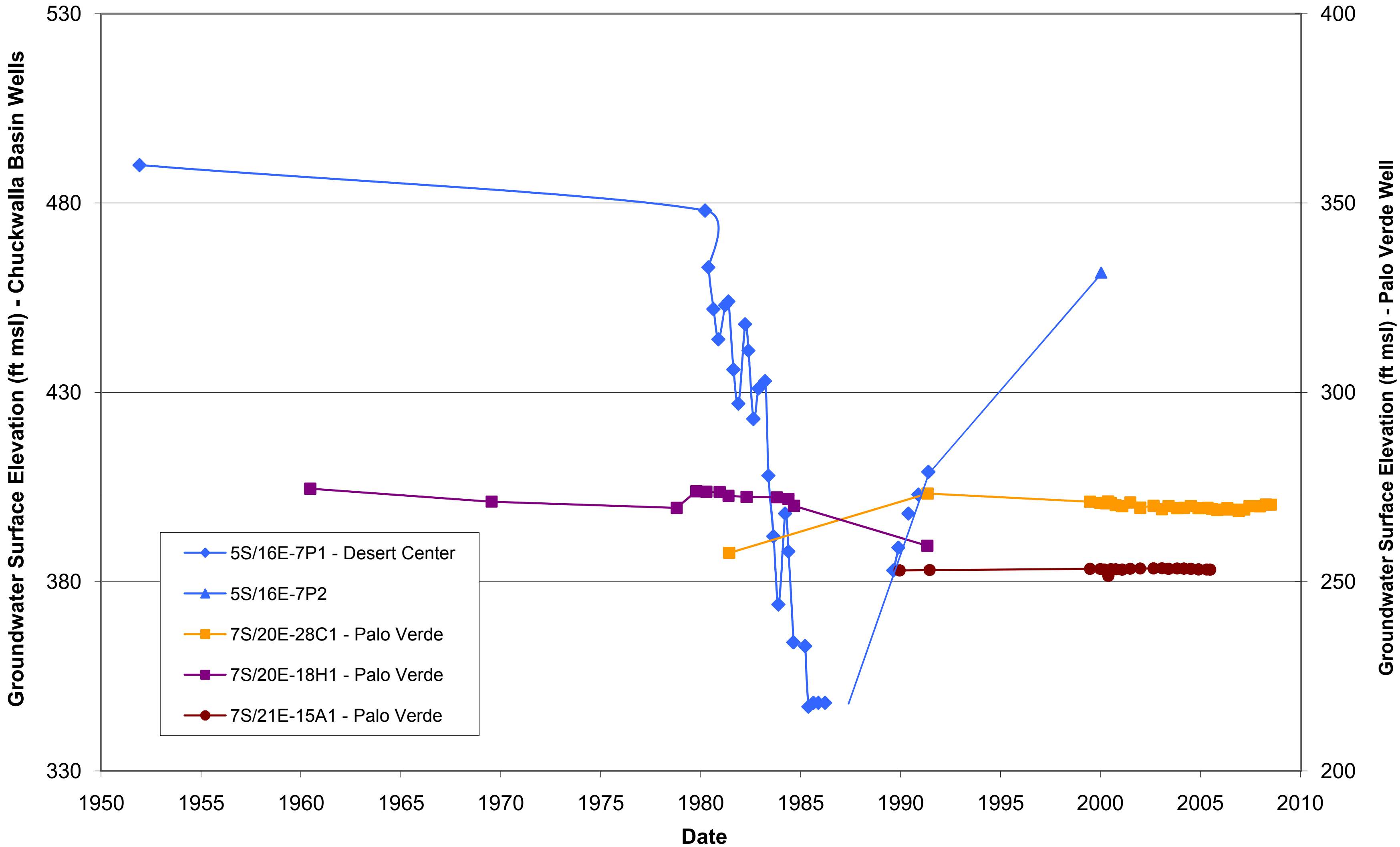
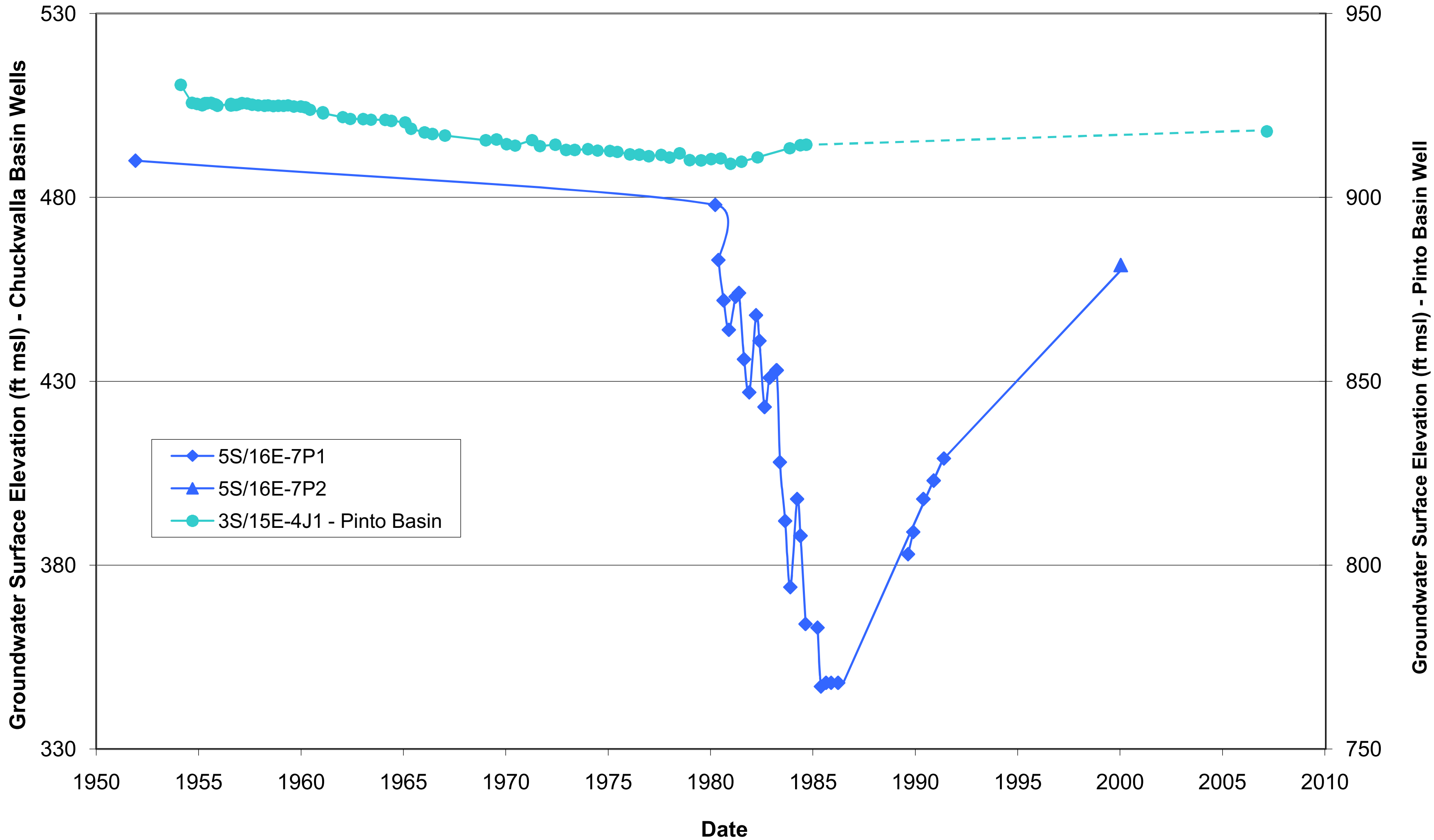
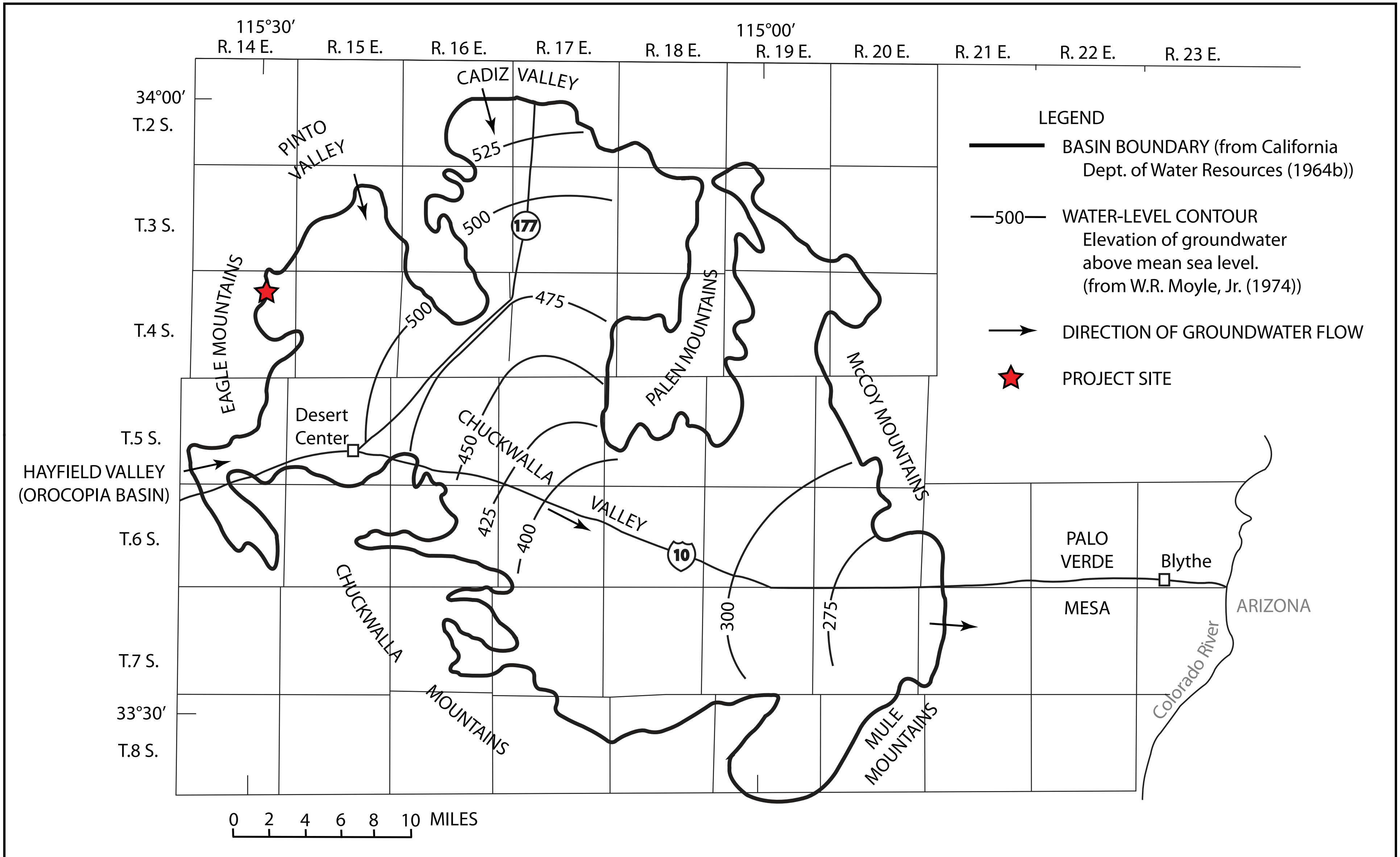


FIGURE 3.3-9
DESERT CENTER AREA AND PINTO VALLEY GROUND WATER LEVELS





SOURCE: Modified from California Department of Water Resources Bulletin 91-27, Figure 7 (1979)

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1974 GROUNDWATER CONTOURS USED TO IDENTIFY REGIONAL FLOW DIRECTION

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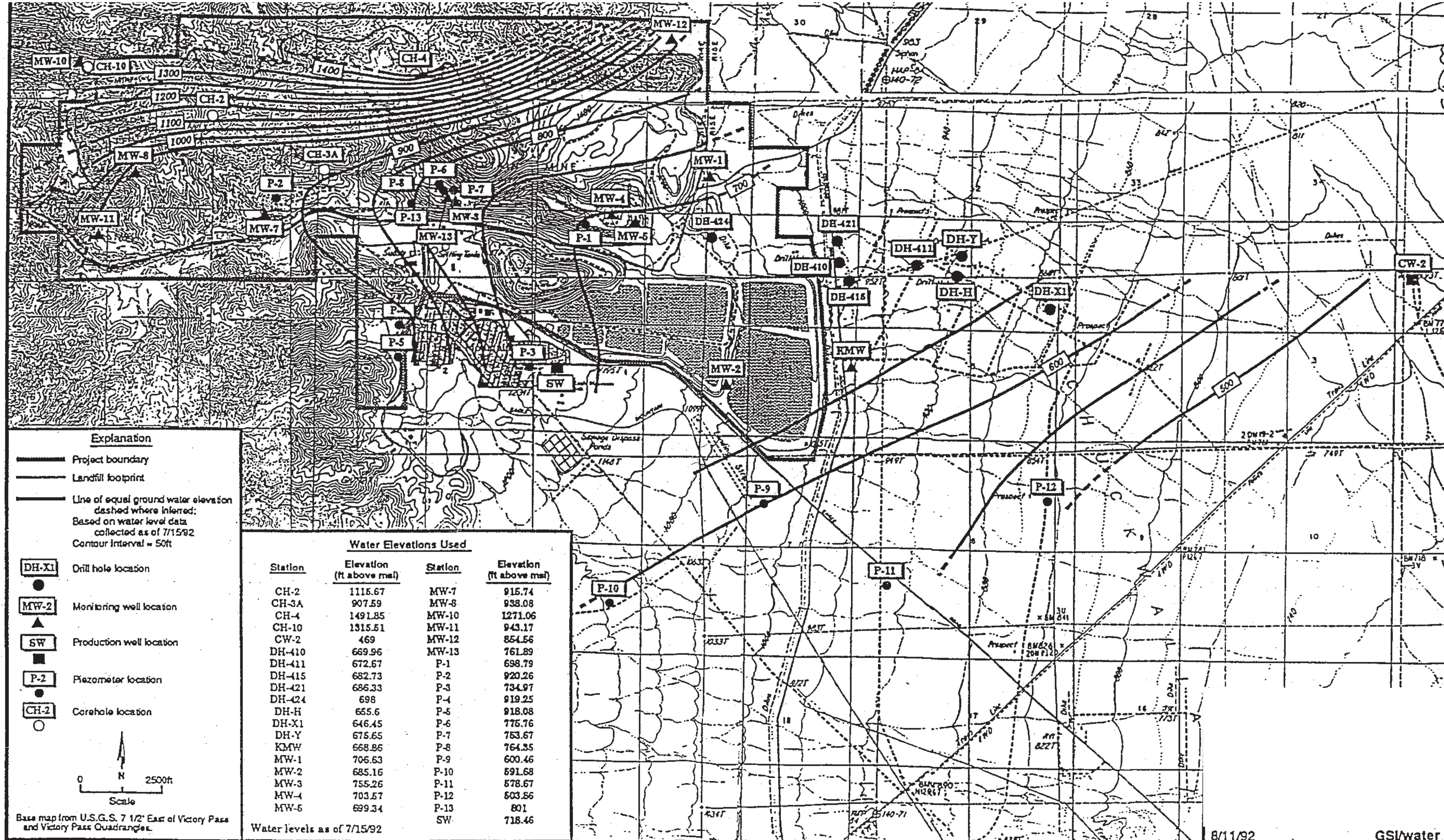
Figure 3.3-10



Water Elevations Used

Station	Elevation (ft above msl)	Station	Elevation (ft above msl)
CH-2	1115.67	MW-7	915.74
CH-3A	907.59	MW-8	938.08
CH-4	1491.85	MW-10	1271.06
CH-10	1315.51	MW-11	943.17
CW-2	469	MW-12	854.56
DH-410	669.96	MW-13	761.89
DH-411	672.67	P-1	698.79
DH-415	682.73	P-2	920.26
DH-421	686.33	P-3	734.97
DH-424	698	P-4	919.25
DH-H	655.6	P-5	918.08
DH-X1	646.45	P-6	775.76
DH-Y	675.65	P-7	753.67
KMW	668.86	P-8	764.35
MW-1	706.63	P-9	600.46
MW-2	685.16	P-10	591.68
MW-3	755.26	P-11	578.67
MW-4	703.57	P-12	603.56
MW-5	699.34	P-13	801
		SW	718.46

Water levels as of 7/15/92

SOURCE: GSI/Water (1992) from GeoSyntec (1992)

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GROUNDWATER CONTOURS NEAR PROJECT SITE

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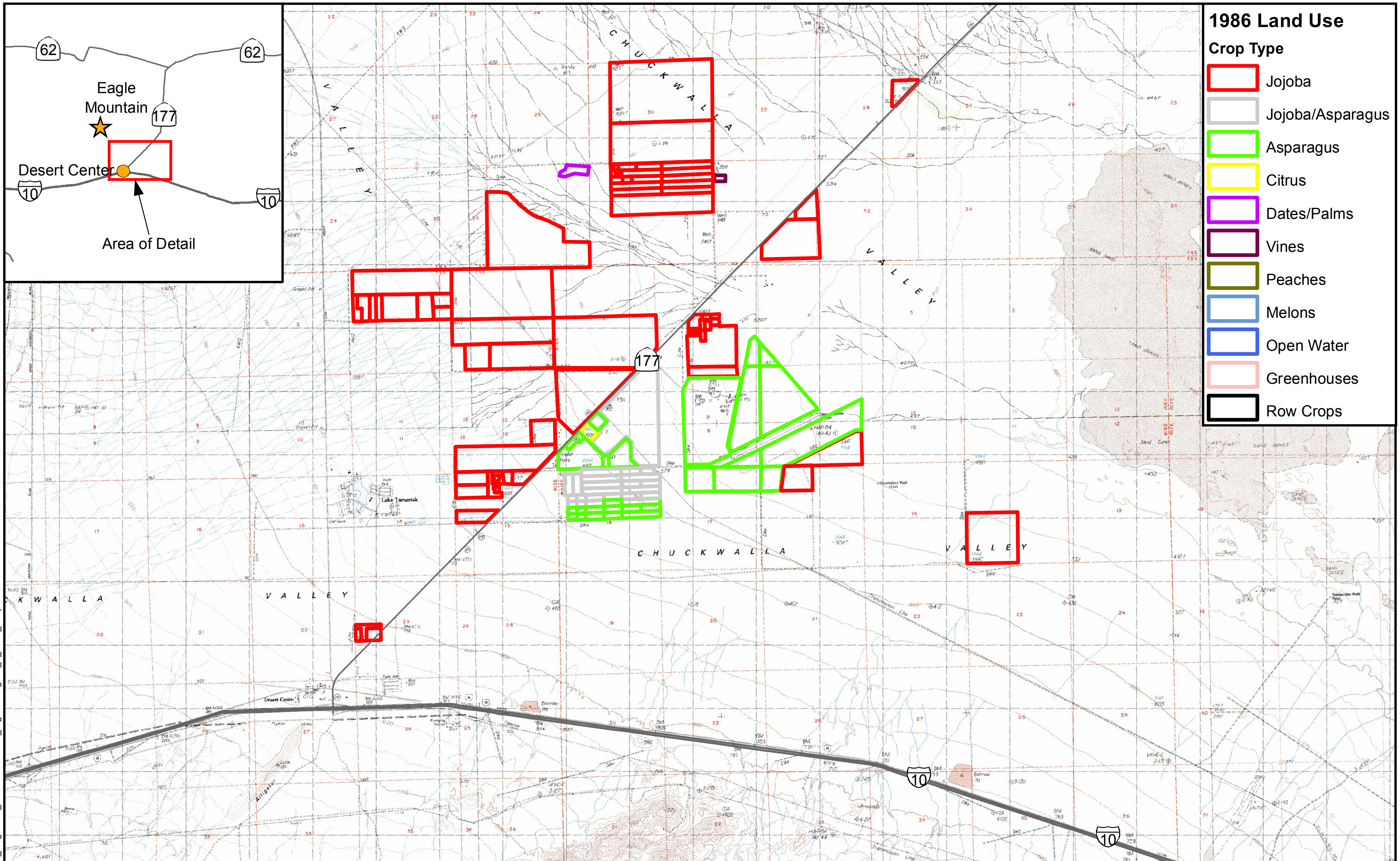
Figure 3.3-11



0 1 2 Miles

N

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1986 CROP LAND USE
NEAR DESERT CENTER

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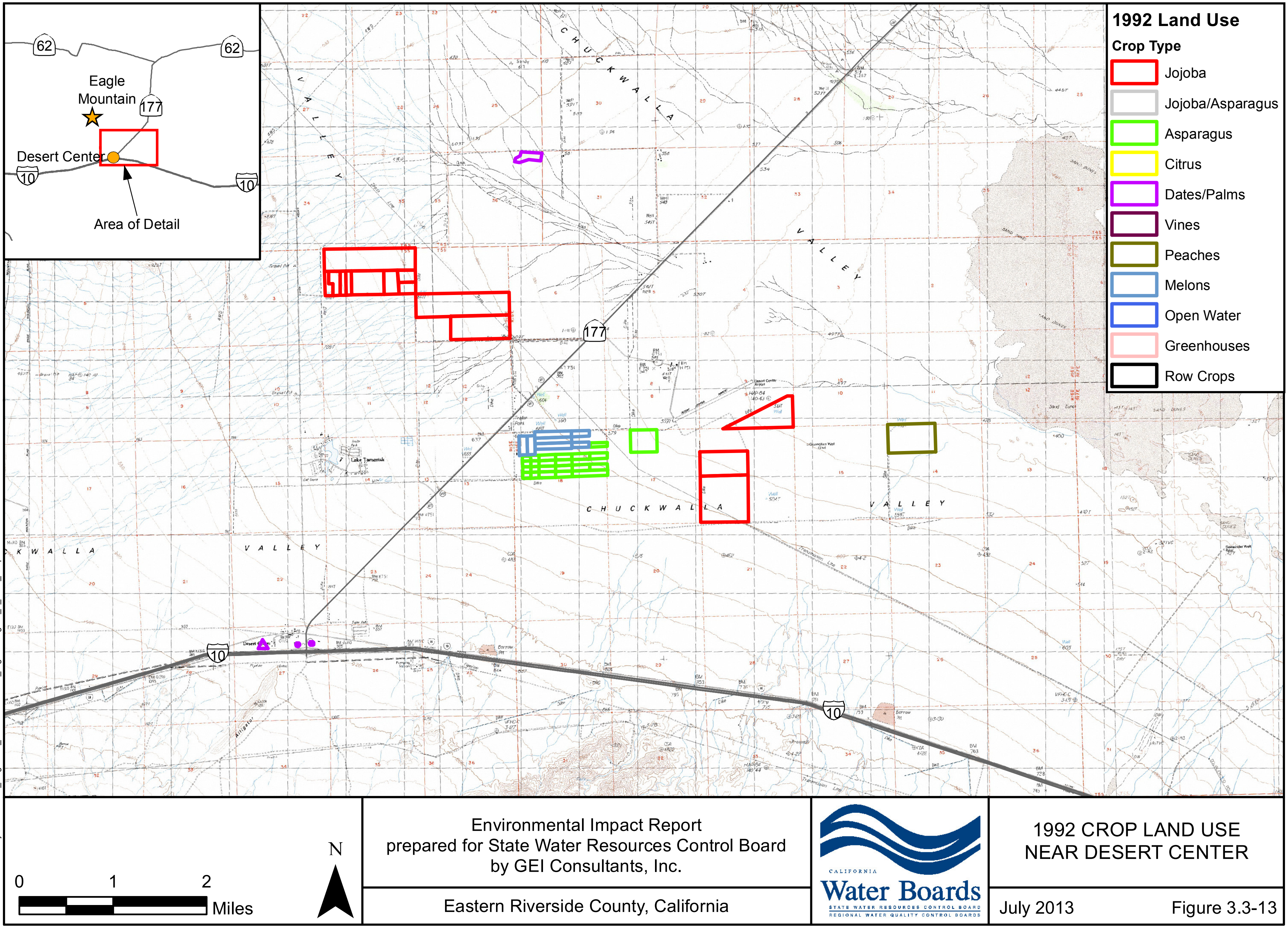
25-Jan-2012 Z:\Projects\080472_EagleMtn_fromDenverEIR_Figures\Figure_3_3-12_Crops1986.mxd SET



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1992 CROP LAND USE NEAR DESERT CENTER

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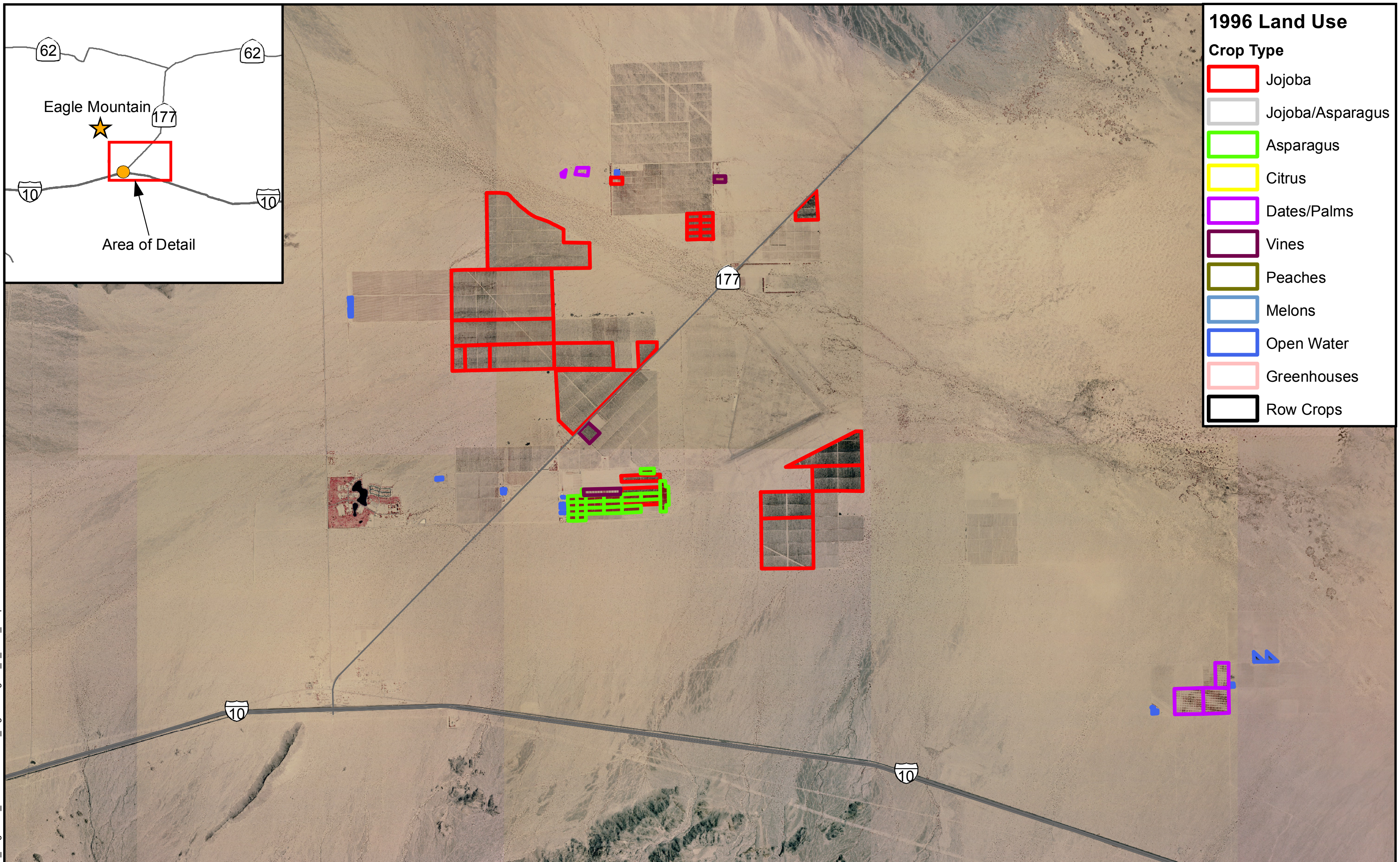
25-Jan-2012 Z:\Projects\080472_EagleMtn_fromDenver\EIR_Figures\Figure_3_3-13_Crops1992.mxd SET



SOURCE: USGS DOQQ, 1996.

0 1 2 Miles

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1996 CROP LAND USE
NEAR DESERT CENTER

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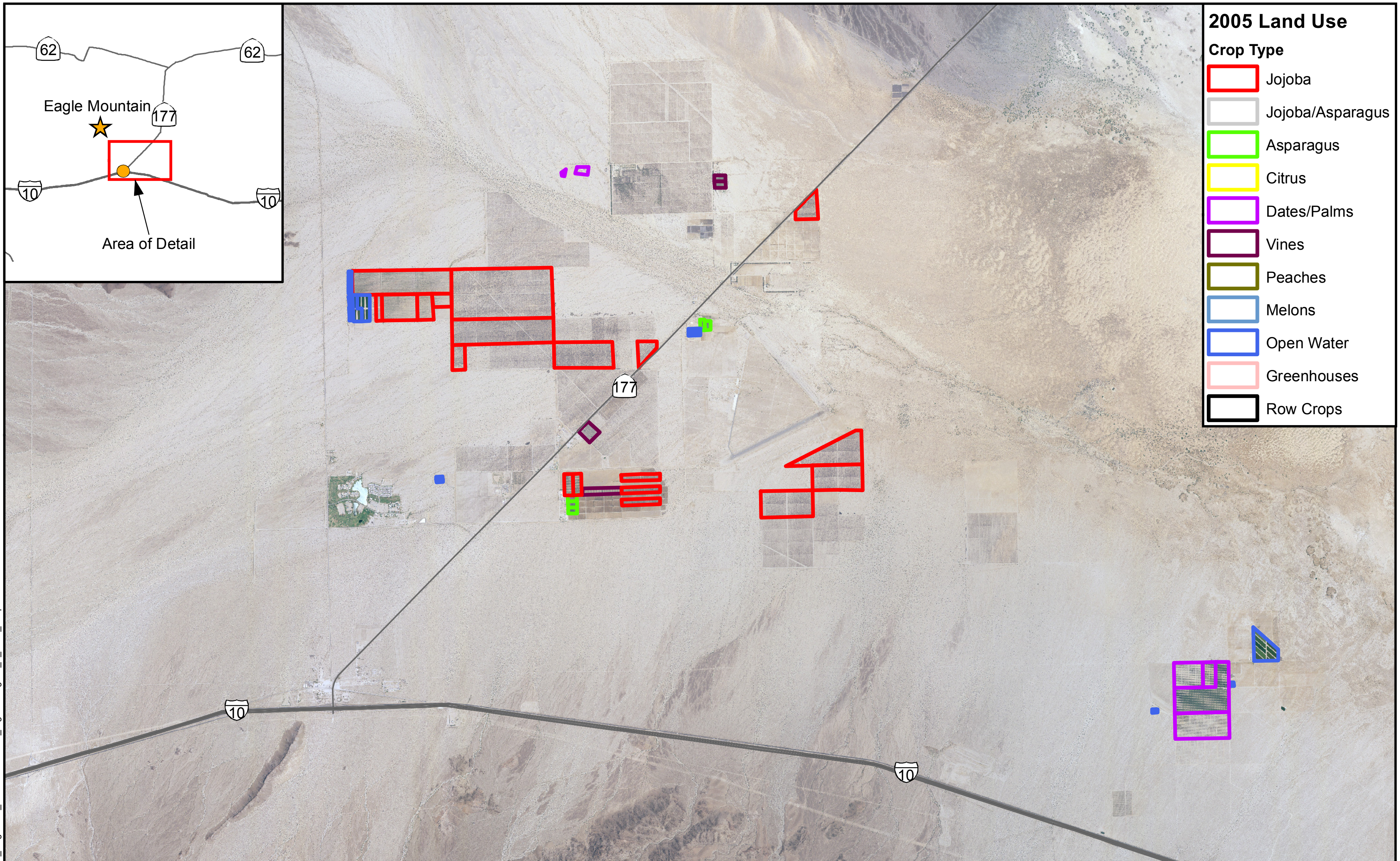
Figure 3.3-14

02-Jun-2010 Z:\Projects\080472_EagleMtn_fromDenver\EIR_Figures\Figure_3_3-14_Crops1996.mxd SEW



SOURCE: USDA NAIP Aerial Photo, 2005.

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2005 CROP LAND USE
NEAR DESERT CENTER

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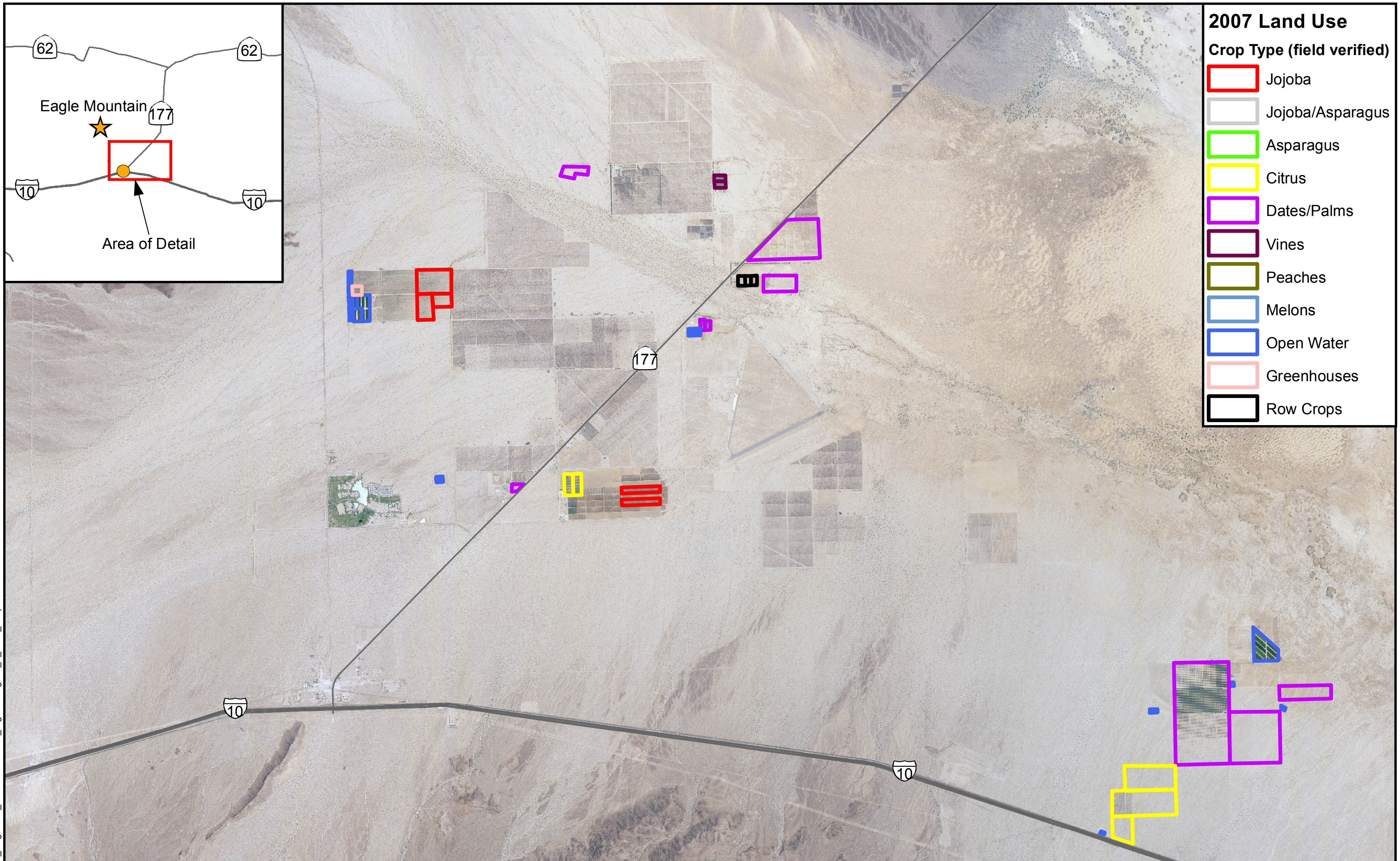
Figure 3.3-15

25-Jan-2012 Z:\Projects\080472_EagleMtn_fromDenver\EIR_Figures\Figure_3_3-15_Crops2005.mxd SET



SOURCE: USDA NAIP Aerial Photo, 2005.

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2007 CROP LAND USE
NEAR DESERT CENTER

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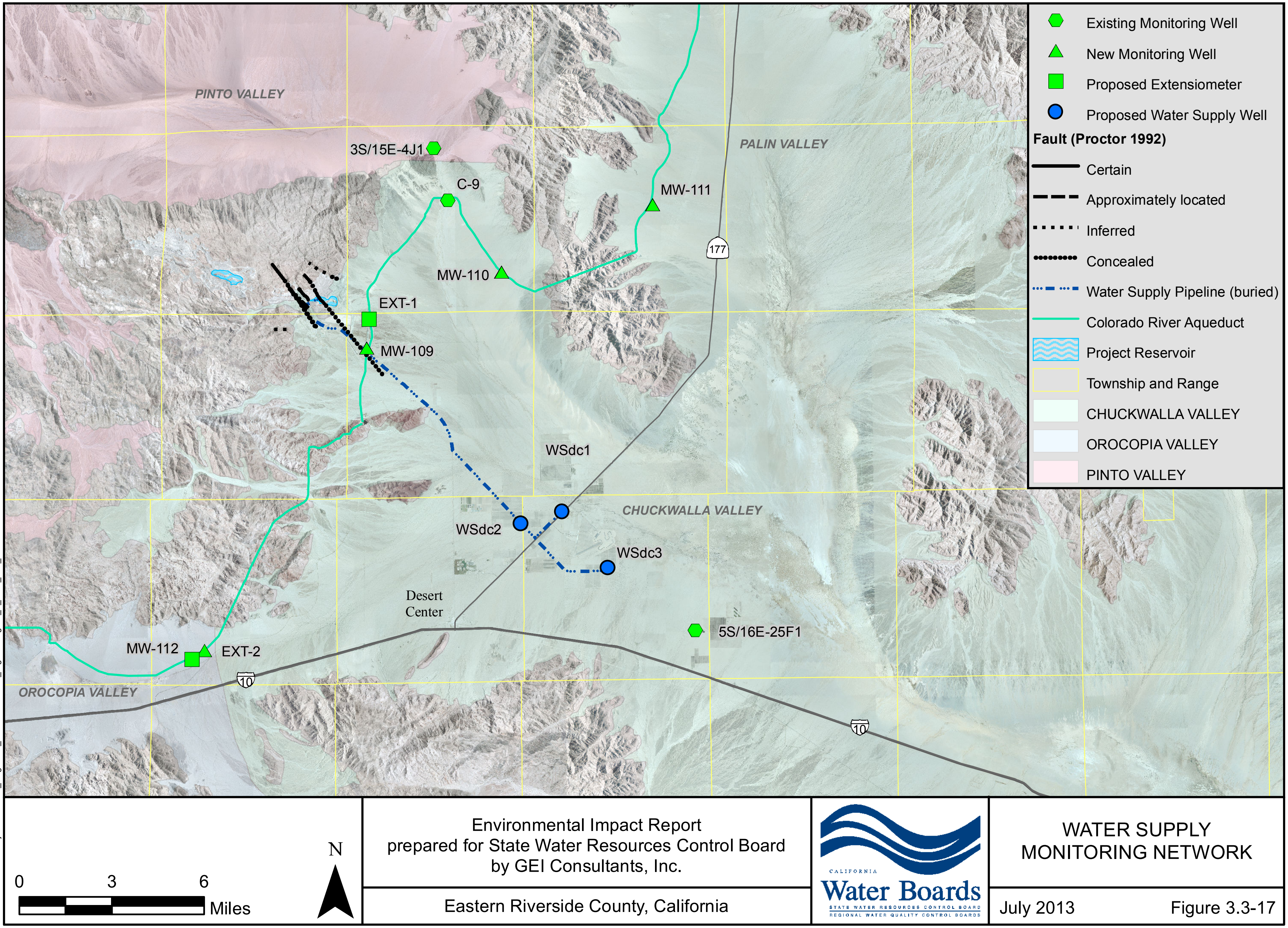
Figure 3.3-16

25-Jan-2012 Z:\Projects\080472_EagleMtn_fromDenver\EIR_Figures\Figure_3_3-16_Crops2007.mxd SET



25-Jan-2012 Z:\Projects\080472_EagleMtn_fromDenver\EIR_Figures\Figure_3_3-17_WS_Monitor.mxd SET

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WATER SUPPLY MONITORING NETWORK

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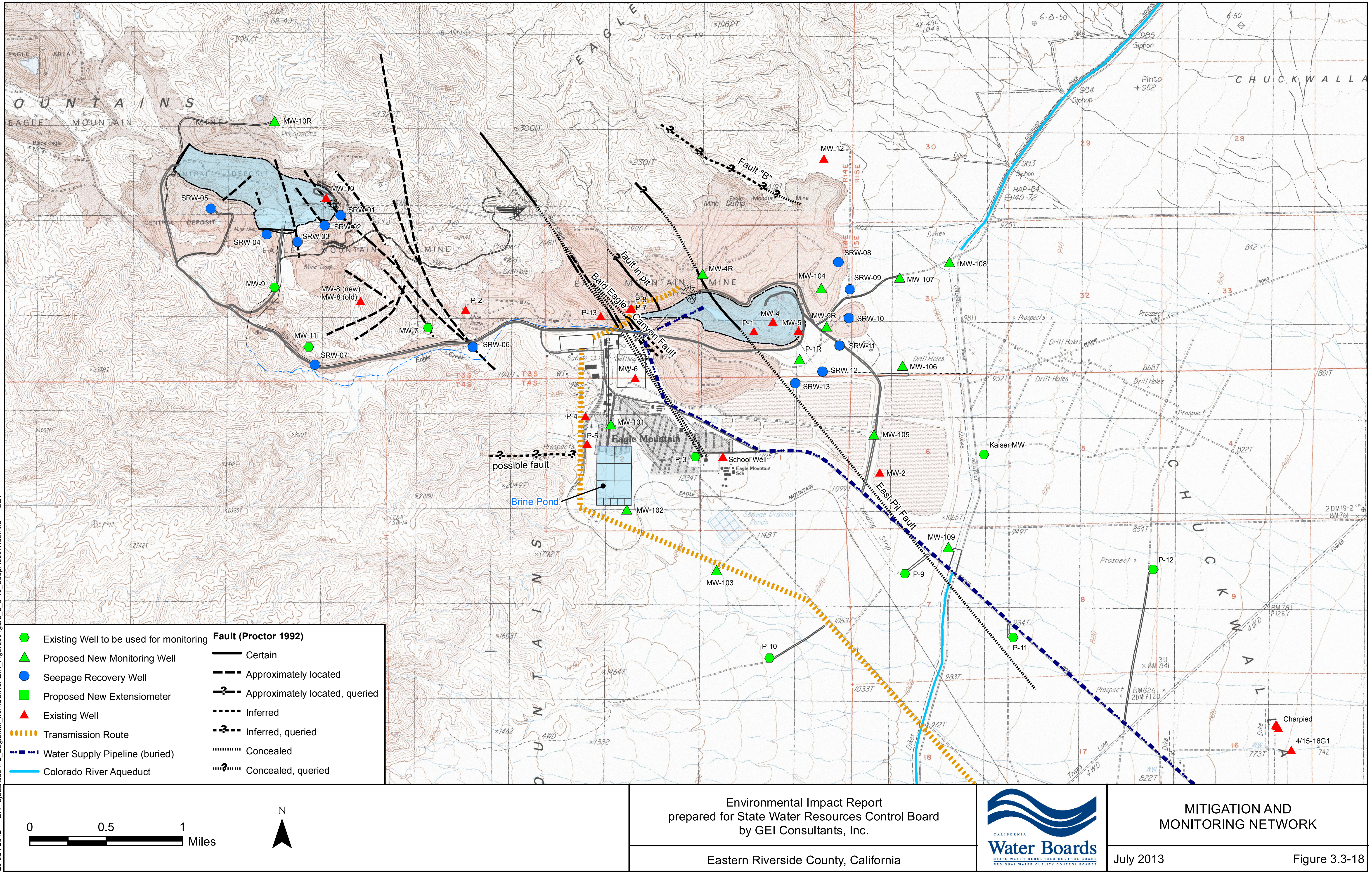
Figure 3.3-17



Z:\Projects\080472_EagleMtn_fromDenverEIR_Figures\Figure_3_3-18_SeepRecovNet.mxd SET 25-Jan-2012

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MITIGATION AND MONITORING NETWORK

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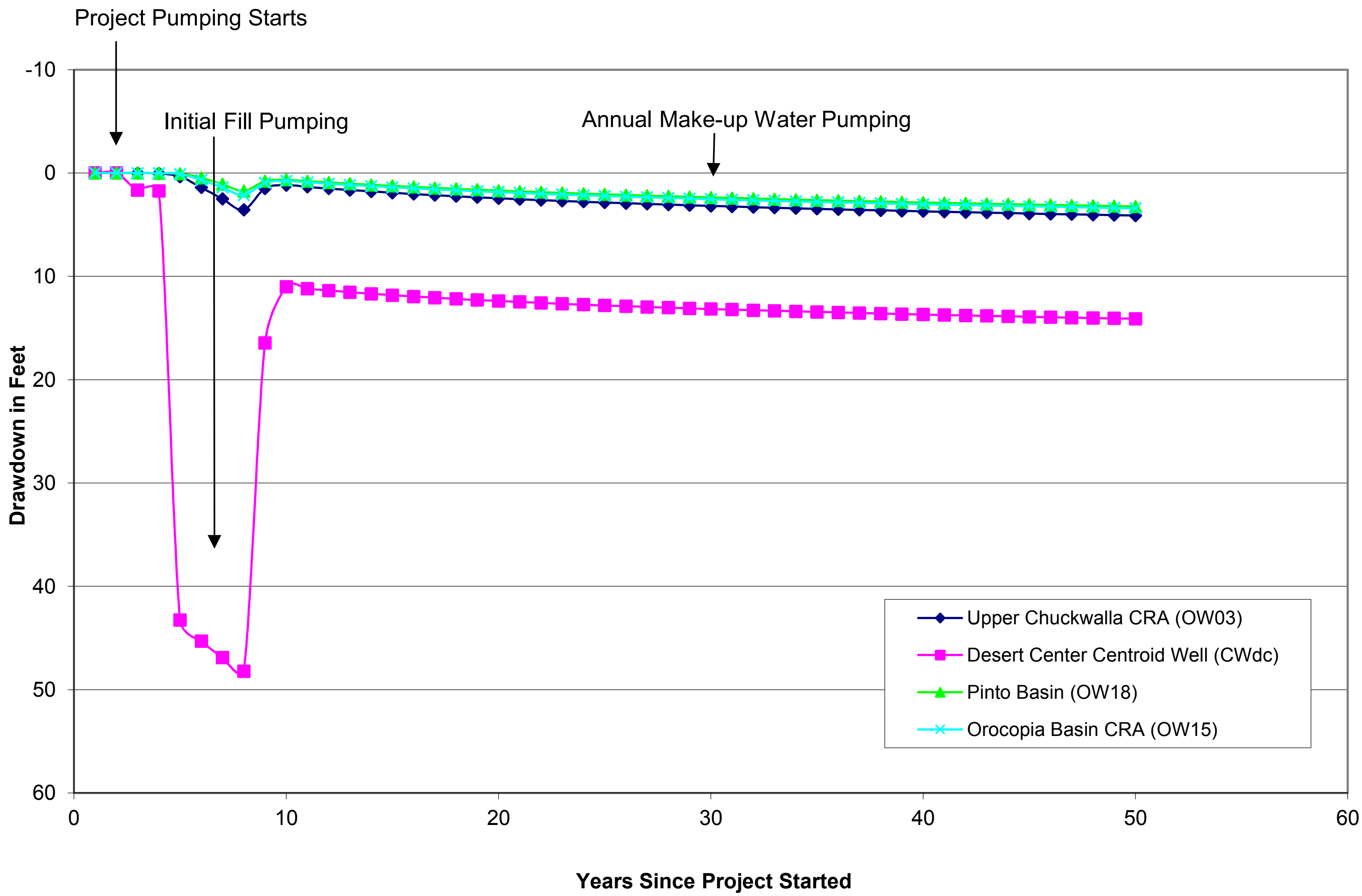
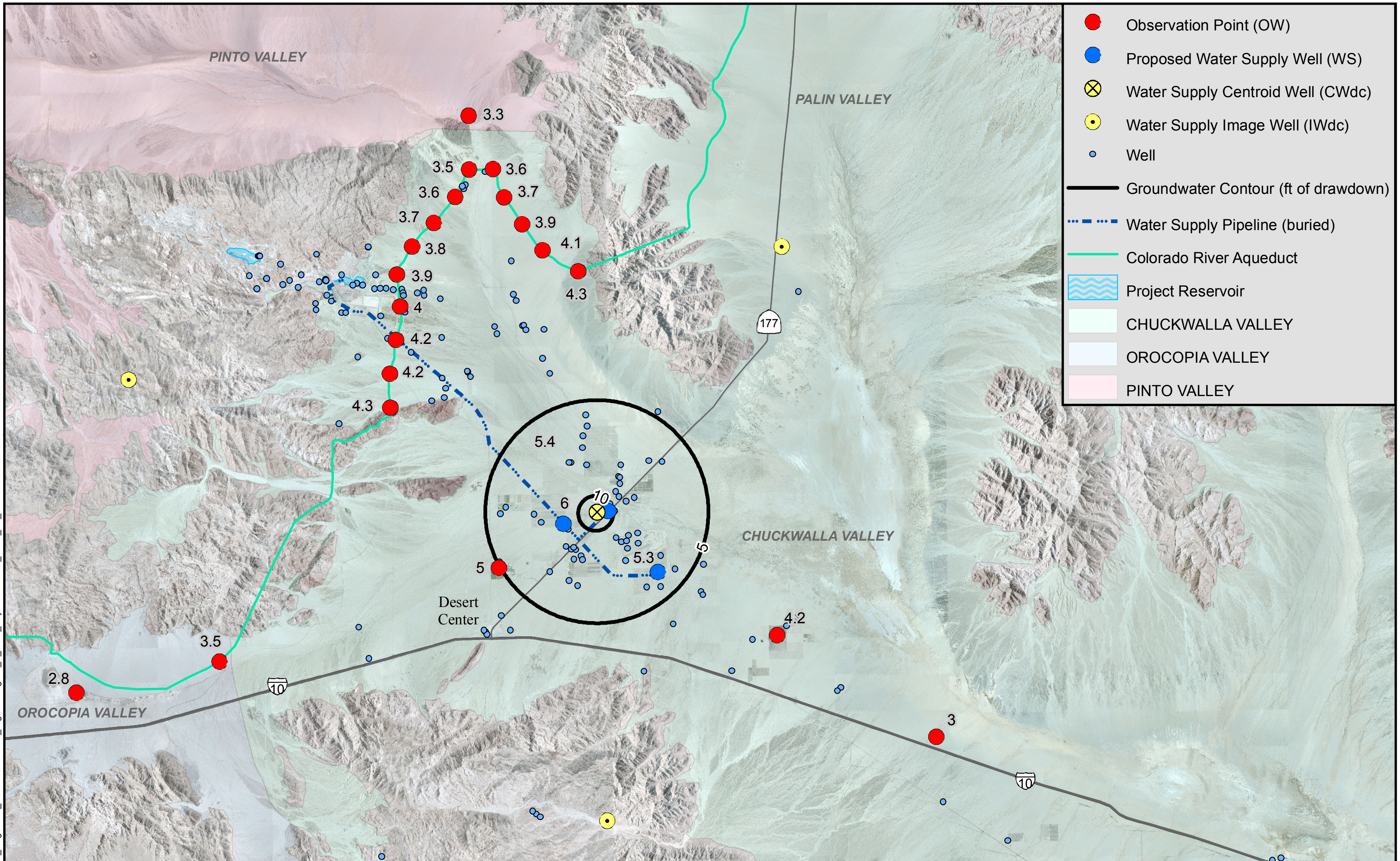
Figure 3.3-18

FIGURE 3.3-19
50-YEAR PROJECT PUMPING EFFECTS





0 3 6 Miles

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DRAWDOWN AFTER 50 YEARS OF PROJECT OPERATION - PROJECT PUMPING ONLY

July 2013 Figure 3.3-20

06-Dec-2012 Z:\Projects\080472_EagleMtn_fromDenverEIR_Figures\Figure_3_3-20_50yrDrawdown_2012_12_06.mxd SET