APPENDIX E

Water Supply Assessment

Water Supply Assessment

Sapphire Solar Project

AUGUST 2024

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Executive Summary

EDF Renewables Development, Inc., on behalf of Sapphire Solar, LLC (Applicant), proposes to entitle, construct, operate, and maintain the Sapphire Solar Project (Project), in Riverside County, California. The Project would consist of approximately 1,192 acres, with approximately 1,082 acres on private lands and approximately 110 acres on Bureau of Land Management (BLM) administered lands. The Project would include up to 117 megawatts of photovoltaic solar generation and up to 117 megawatts of battery storage.

This Water Supply Assessment (WSA) has been prepared consistent with the requirements of Senate Bill 610. This WSA is needed to support preparation of the Environmental Impact Report and Environmental Assessment, and the discretionary land use decisions that will be undertaken by the Riverside County Board of Supervisors and BLM.

This WSA has estimated water demand for the Project to be 100 to 300 acre-feet for construction and 9 acre-feet per year for operation and maintenance (O&M). This WSA involved review of information on available water supplies, groundwater conditions, and nearby groundwater monitoring and mitigation plans, and analyzed the worst-case pumping scenario. Based on this work, this WSA has concluded that there are sufficient water supplies to serve the Project’s construction and operational water demands under normal-year, single-dry-year, and multiple-dry-year conditions over a 20-year period (as well as the Project’s 39-year Conditional Use Permit and Public Use Permit period), and has identified sufficient backup sources of water to give the Applicant the flexibility to respond to unanticipated events or constraints. Furthermore, the water demand of the Project can be served without having adverse impacts on groundwater resources, such as causing the water budget to go negative over the long term (i.e., 10 years) or causing groundwater levels to drop below the Colorado River Accounting Surface.

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Acronyms and Abbreviations

Acronym/Abbreviation	Definition
AF	acre-feet
AFY	acre-feet per year
amsl	above mean sea level
Applicant	Sapphire Solar, LLC
BESS	battery energy storage system
BLM	U.S. Bureau of Land Management
CEQA	California Environmental Quality Act
CSA 51	Riverside County Service Area 51
CVGB	Chuckwalla Valley Groundwater Basin
CWC	California Water Code
DWR	California Department of Water Resources
gen-tie	generation tie
gpm	gallons per minute
Linear Facility Routes	gen-tie line, access road, and collector line routes
MCL	maximum contaminant level
mg/L	milligrams per liter
MW	megawatt
NEPA	National Environmental Policy Act
O&M	operations and maintenance
Project	Sapphire Solar Project
PV	photovoltaic
SB	Senate Bill
TDS	total dissolved solids
UWMP	Urban Water Management Plan
WSA	Water Supply Assessment

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1 Introduction

1.1 Project Location and Description

EDF Renewables Development, Inc., on behalf of Sapphire Solar, LLC (Applicant), proposes to entitle, construct, operate, and maintain the Sapphire Solar Project (Project), in Riverside County, California. The Project would consist of approximately 1,192 acres, with approximately 1,082 acres on private lands and approximately 110 acres on U.S. Bureau of Land Management (BLM) administered lands. The Project would include up to 117 megawatts (MW) of photovoltaic (PV) solar generation and up to 117 MW of battery storage. The Project would primarily consist of PV panels; a single-axis tracker system; inverters; converters; transformers; electrical collection and communication lines; a 12-kilovolt distribution line for backup power; an on-site electrical substation; a battery energy storage system (BESS); a security fence; an operations and maintenance (O&M) facility, including a stand-alone spare parts storage building; up to three on-site groundwater wells; a meteorological station and albedometer weather station; a microwave/communication tower; and a supervisory control and data acquisition (SCADA) system, which would be on private lands.

The Project would also include up to three 230-kilovolt generation tie (gen-tie) line alignment options (only one of which would be constructed), access roads, and collector line routes, collectively referred to as "Linear Facility Routes," that would be on federal public lands administered by BLM and designed to support the Project, which would be on adjacent private lands. Table 1 provides a summary of the Project components that could be within the proposed Linear Facility Routes. The Project would interconnect with the Southern California Edison Red Bluff Substation via the existing Desert Harvest gen-tie line, located on lands administered by BLM.

Table 1. Project Components to Be Located Within Linear Facility Routes

Linear Facility Route	230 kV Gen-Tie Line	Access Road	Aboveground Electrical Lines, Spur Roads, Temporary Pulling and Tensioning Stations, Buried Fiber Optic Lines	Underground Collector Lines	12 kV Distribution Line
Linear Facility Route No. 1	●	●	●		●
Linear Facility Route No. 2	●	✓	●		●
Linear Facility Route No. 3		●		✓	

Notes: Linear Facility Route = gen-tie line, access road, and collector line; kV = kilovolt; gen-tie = generation tie; AG = aboveground.
✓ = Facilities that will be located in Linear Facility Route.
● = Facilities options that may be located in Linear Facility Route.

The Applicant is pursuing a Conditional Use Permit, Public Use Permit, and a Development Agreement from the County of Riverside for the private lands associated with the Project, and a right-of-way grant from BLM for the BLM-administered lands associated with the Project. As such, the County of Riverside will serve as the California Environmental Quality Act (CEQA) lead agency, and BLM will serve as the National Environmental Policy Act (NEPA) lead agency.

The Project site is in Riverside County, California, approximately 3 miles north of Desert Center, 40 miles west of the City of Blythe and approximately 3.5 miles north of Interstate 10. The Project site is bounded on the north, east, and west sides by BLM lands, and to the south by Belsby Avenue. Melon Street runs along the west side of the Project site, and Jojoba Street runs along the east side. The east side of the Project site is adjacent to California State Route 177/Rice Road (Figure 1, Project Location and Public Groundwater Sources). Table 2 includes the Township and Range sections, as well as the U.S. Geological Survey 7.5-minute quadrangles intersected by the Project site (Figure 1). Primary construction access would be from the main access road via Kaiser Road. A secondary access road for emergency services would be constructed within the Linear Facility Routes from either Kaiser Road (Linear Facility Route No. 1 and No. 2) or California State Route 177/Rice Road (exit 192) (Linear Facility Route No. 3). Two 24-foot-wide unpaved driveways with up to 5-foot-wide shoulders on either side would be constructed off this existing road to enter the Project site. The driveways would provide independent points of ingress to/egress from the Project site, as required by the Riverside County Fire Department.

Table 2. Project Site Information

Solar Site Boundary and Linear Facility Route Options	Linear Facility Route Options Only
Township and Range Sections	
Township 04 South, Range 15 East, Section 36	Township 05 South, Range 15 East, Section 3
Township 05 South, Range 15 East, Section 2	Township 05 South, Range 16 East, Section 5
Township 05 South, Range 15 East, Section 1	Township 04 South, Range 15 East, Section 34
Township 05 South, Range 16 East, Section 6	Township 04 South, Range 15 East, Section 35
USGS 7.5-Topographic Quadrangles	
Victory Pass	East of Victory Pass

Note: Linear Facility Routes = gen-tie line, access road, and collector line; USGS = U.S. Geological Survey.

Construction of the Project is anticipated to occur in two phases. The first phase would consist of construction of the gen-tie line, telecommunication line, 12-kilovolt distribution line, and access roads associated with the Linear Facility Routes, and the construction of fences, gates, and the on-site substation located on the private lands associated with the Project. The second phase would consist of installation and operation of the approximately 117 MW solar array, the approximately 117 MW BESS, and ancillary facilities. Construction is anticipated to commence in the third quarter of 2024, and the commercial operation date is anticipated to occur in December 2025. The Applicant is seeking a minimum 39-year Conditional Use Permit and Public Use Permit for the construction, operation, maintenance, and decommissioning of the proposed solar facility and gen-tie line.

1.2 Water Supply Assessment Applicability

Senate Bill (SB) 610 was passed on January 1, 2002, amending the California Water Code (CWC) Sections 10910–10915 to require detailed analysis of water supply availability for certain types of development projects. The primary purpose of SB 610 is to improve the linkage between water and land use planning by ensuring greater communication between water providers and local planning agencies, and to ensure that land use decisions for certain large development projects are fully informed as to whether sufficient water supplies are available to meet project demands. SB 610 requires the preparation of a Water Supply Assessment (WSA) for a project that is subject to CEQA and meets certain requirements.

The Project satisfies the statutory definition of a "project" for the purpose of determining SB 610 applicability because it is considered an industrial facility in excess of 40 acres in size, per CWC Section 10912(a)(5). Furthermore, because the Project site is not within the service area of a public water system, as defined in CWC Section 10912(c), the County of Riverside, as the CEQA lead agency, is responsible for the preparation of a WSA, which will be included for the consideration of the potential for significant environmental impacts on surface water and groundwater resources. In compliance with SB 610, this WSA examines the availability of the identified water supply under normal-year, single-dry-year, and multiple-dry-year conditions over a 20-year projection, accounting for the projected water demand of the Project plus other existing and planned future uses of the identified water supply.

The original intent of SB 610 was to address water supply sufficiency primarily for urban development projects and/or other projects that have large water demands. The water demand benchmark used in SB 610 for when a project is required to prepare a WSA is generally the amount of water used by a 500-unit residential development project. This amount varies from place to place throughout municipal areas in California, but for reference, would generally not be less than 100 acre-feet per year (AFY),[1] even for most modern and water-efficient residential development projects. The statute attempts to define size thresholds for commercial and industrial projects to approximate those that would have similarly large water demands. The threshold for an industrial facility is one that is greater than 40 acres in size, per CWC Section 10912(a)(5). Although SB 610 does not define an industrial facility, it appears, based on the purpose and intent of the statute, that it was contemplating typical urban industrial land uses rather than solar electric facilities. Given that the long-term O&M water demand of the Project would be much lower than a 500-unit residential development (see Chapter 2, Project Water Demand), an argument could be made that the requirements of SB 610 do not technically apply to the Project. Nevertheless, out of an abundance of caution and because analysis required by SB 610 is useful for the CEQA and NEPA processes, this WSA has been prepared for the Project in satisfaction of the requirements of SB 610.

The CWC, as amended by SB 610, requires that a WSA address the following questions:

- Is there a public water system that will service the project?
- Is there a current urban water management plan that accounts for the project demand?
- Is groundwater a component of the supplies for the project?
- Are there sufficient supplies to serve the project over the next 20 years?

Furthermore, the WSA is required to answer a primary question:

- Will the total projected water supplies available during normal, single-dry, and multiple-dry water years during a 20-year projection meet the projected water demand of the proposed project, in addition to existing and planned future uses of the identified water supplies, including agricultural and manufacturing uses?

The following sections address the SB 610 WSA questions as they relate to the Project, and Chapter 5, Water Supply Assessment, addresses the availability of water supplies.

1 This amount is for illustrative purposes only, and accounts for the indoor water use efficiency standard in the California Code of Regulations (23 CCR Section 697) of 55–75 gallons per capita per day and an average household size of three persons, and excludes outdoor (landscaping) water demands.

1.2.1 Is There a Public Water System that Will Service the Project?

A public water system refers to a system for the provision to the public of water for human consumption through pipes or other constructed conveyances that has 3,000 or more service connections (CWC 10912[c]). The Project site is in unincorporated Riverside County and would not be physically connected to a public water system. There are no public water systems, as defined by CWC 10912(c), within the Chuckwalla Valley. Water required for construction and operation of the Project would either be obtained from groundwater wells within the solar field on private lands and/or purchased from one or more nearby water systems (Figure 1).

1.2.2 Is There a Current Urban Water Management Plan that Accounts for the Project Demand?

Urban Water Management Plans (UWMPs) are prepared by California's urban water suppliers to support long-term resource planning and ensure adequate water supplies. Every urban water supplier that either delivers more than 3,000 AFY of water annually or serves more than 3,000 connections is required to assess the reliability of its water sources over a 20-year period under normal-year, dry-year, and multiple dry-year scenarios; these are the same requirements of a WSA, as specified by SB 610. UWMPs must be updated and submitted to the California Department of Water Resources (DWR) every 5 years for review and approval.

Because the Project site is not within an urban water supplier's service area, there is no UWMP that applies to the area or accounts for the Project's demand. Additionally, there is no integrated regional water management plan that covers the Chuckwalla Valley (DWR 2022).

1.2.3 Is Groundwater a Component of the Supplies for the Project?

Regardless of the location of the water source(s) ultimately used to supply the Project (i.e., on-site well or off-site water system), the water supplied would be groundwater from the Chuckwalla Valley Groundwater Basin (CVGB). The CVGB is an unadjudicated basin, meaning that owners of property overlying the CVGB have the right to pump groundwater from the basin for reasonable and beneficial use. Groundwater production in the CVGB is not managed by an entity, and there is no basin groundwater management plan (DWR 2022). Groundwater resources in the CVGB and water supply availability, including the reasonably available[2] information required under CWC 10910(f)(2)-(5), are described in greater detail in Section 4.2, Groundwater Resources, and Chapter 5, Water Supply Assessment.

Up to three on-site water wells are proposed to supply the Project with water. However, as shown in Figure 1, there are multiple other groundwater supply sources in proximity to the Project site: Chuckwalla Valley Raceway is located approximately 1.5 miles southeast, Green Acres Mobile Home Park is located approximately 1 mile south, and CSA-51 is located approximately 1.5 miles southwest (SWRCB 2022). Although on-site groundwater wells are identified as the primary water source for the Project, these other water sources could potentially serve as additional sources for the Project's water demand.

2 Detailed year-by-year groundwater production for water systems such those in the CVGB are not published or publicly available but have been estimated and included within the overall water budget of the CVGB, as discussed in Section 4.2.5 and Section 5.

1.2.4 Are There Sufficient Supplies to Serve the Project over the Next 20 Years?

As described in Chapter 2, Project Water Demand, and Chapter 5, Water Supply Assessment, adequate water is available at the Project site to meet Project construction and O&M demand, both over the next 20 years and for the operational or useful life of the Project.[3]

[3] As specified by SB 610, a project is required to assess the reliability of its water sources over a 20-year period, as discussed in Section 1.2.2. Although not required by SB 610, this Project is evaluated over a longer 39-year period, reflecting the projected life cycle of operation of the Project.

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2 Project Water Demand

It is anticipated that the Project would require up to 100 to 300 acre-feet (AF) of water during the construction phase of the Project, which is anticipated to occur over an approximately 1 year period.[4] Subsequent O&M of the Project would require approximately 9 AFY of water, primarily for solar PV module washing and for the O&M building. Table 3 provides the anticipated water demands for all phases of the Project, including an amortized water demand over the 39-year period encompassing both the construction and operational phases of the Project, and assuming the higher end of the construction water demand range. When amortized over all phases, the Project's water demand would average 16.5 AFY. Construction and O&M water demands are detailed in the subsequent sections.

Table 3. Project Water Demand

Project Phase	Water Demand	Uses/Source
Construction phase (1 year)[a]	300 AF	Soil compaction, dust control, and sanitary needs for construction workers
Operation and maintenance (38 years)	9 AFY	Once-yearly panel washing and O&M/sanitary needs
Total project water demand (39 Years)	**642 AF**	Source is anticipated to be on-site well(s), but could also be from another nearby local offsite water source.
20-year amortized water demand	**23.5 AFY**	
39-year amortized water demand	**16.5 AFY**	

Notes: Project = Sapphire Solar Project; AF = acre-feet; AFY = acre-feet per year; O&M = operations and maintenance.

a Although construction is anticipated to occur over a 14-month period, the phases of construction that will require regular dust control and grading are assumed to occur over a 12-month period. The initial mobilization and final testing and commissioning phases of construction do not typically require appreciable water use.

2.1 Construction Water Demand

The primary uses of water during the construction phase would be for soil compaction, dust control, and sanitary needs for construction workers. During construction, water would be pumped directly from one or more on-site groundwater well(s), or from an off-site source, into 2,000- to 4,000-gallon-tank water trucks, or water may be stored in temporary tanks to help ensure availability of water for trucks and expedient filling thereof.

Planning-level construction and operational water demand estimates for solar energy facilities have varied widely throughout the deserts of Southern California. The Palen Solar Project, which is south of Palen Dry lake, and the Desert Harvest Solar Project, which neighbors the Project site to the north of Big Wash, provide empirical water use data that can be used as proxies to estimate the Project's construction demand. Empirical (i.e., metered) records of water use from other projects of similar type and size in the same basin/climate provide the best available data regarding water use. Dudek staff monitored groundwater production on the Palen Solar Project site—a 457 MW solar facility (including a 50 MW BESS) on approximately 3,082 acres—throughout its 23-month construction period in 2020 and 2021. For the Palen Solar Project, on-site groundwater production totaled approximately 435 AF, which

4 Although construction is anticipated to commence in September 2024 and the commercial operation date is anticipated to occur in December 2025 (comprising a 16-month construction period), the phases of construction that will require regular dust control and grading are assumed to occur over a 12-month period (likely between October 2024 and October 2025).

equates to approximately 0.14 AF per acre (Dudek 2022a).[5] Dudek staff also monitored groundwater production on the Desert Harvest Solar Project site—a 150 MW solar facility (including a 35 MW BESS) on approximately 1,103 acres—throughout its 12-month construction period in 2020. Construction of the Desert Harvest Solar Project required approximately 91 AF of groundwater from an on-site well, which equates to a water use rate of 0.08 AF per acre (Dudek 2022b).[6] Therefore, applying a range of 0.08 to 0.14 AF per acre to the 1,192-acre Sapphire Solar Project, it is reasonable to expect the Project to require 98 AF to 168 AF for construction.[7,8] To ensure that the Project's environmental documents cover all potential contingencies, the construction water demand for the Project is assumed to be up to 300 AF (or 97,755,300 gallons).

Table 4 presents a water demand scenario for construction of the Project that reflects the pattern of use that occurred for the Desert Harvest Solar Project. Although this may not reflect the exact pattern of use that will occur for the Project, it is a useful way to recognize that certain construction phases have a disproportionately high demand for water, thereby providing a reasonable estimate of what yield, and pumping rate could be required during the months of construction with peak ground disturbance. The calculated water demand in gallons per day and gallons per minute (gpm) assumes the proposed groundwater source is pumped continuously 24 hours a day, as needed, to meet the monthly demand. As shown in Table 4, to meet peak monthly construction demands of the Project, one or more wells would be required to pump at combined rates of at least 362 gpm (the average pumping rate over the 12-month period would be 189 gpm).

Table 4. Construction Phase Water Demand Scenario

Month	Percent of Total Water Use on DHSP[a]	Total Gallons	Gallons per Construction Day[b]	Gallons Per Minute
Month 1	8%	8,167,590	272,253	189
Month 2	11%	10,626,394	354,213	246
Month 3	5%	4,426,890	147,563	102
Month 4	15%	14,749,961	491,665	341
Month 5	11%	10,282,543	342,751	238
Month 6	15%	14,761,039	492,035	342
Month 7	16%	15,622,946	520,765	362
Month 8	9%	8,791,723	293,057	204
Month 9	5%	4,935,371	164,512	114
Month 10	5%	4,791,059	159,702	111
Month 11	1%	599,783	19,993	14
Month 12	0%	0	0	0
Total	**100%**	**97,755,300 (300 AFY)[c]**	**271,543 (average)**	**189 (average)**

Notes: DHSP = Desert Harvest Solar Project; AFY = acre-feet per year.

a Dudek 2022b, Table 4-1.

b Assuming a 30-day period of construction water use.

c 1 acre-foot = 325,851 gallons

5 435 AF / 3,082 acres = 0.1411 AF per acre.

6 91 AF / 1,103 acres = 0.0825 AF per acre.

7 0.0825 AF per acre * 1,192 acres = 98.34 AF.

8 0.1411 AF per acre * 1,192 acres = 168.19 AF.

2.2 Operation and Maintenance Water Demand

According to the Plan of Development, operation of the Project would require up to eight employees, the use of an up to 3,600-square-foot O&M building, and annual panel washing. Operation is expected to begin in December 2025 and the operational life is assumed to be 39 years, with potential to extend. Following the construction period, PV panel washing is expected to be conducted once annually, although this could be less frequent depending on performance testing and weather and site conditions. The annual operational water usage for PV panel washing and for sanitary needs at the O&M facility is expected to be approximately 9 AFY. Potable water needs are expected to be minimal (i.e., drinking, bathrooms, and handwashing) and would be met using an on-site well (if treated to potable standards), an off-site municipal source, or a commercial bottled water supplier. Dudek staff monitored groundwater production during O&M for the Desert Harvest Solar Project and the Palen Solar Project and observed that there has been no pumping from the on-site well at the Desert Harvest Solar Project; pumping for the Palen Solar Project in the first 6 months of 2022 totaled 3.16 AF (Dudek 2022a, 2022b). Desert Harvest's O&M building is not on site, and instead is co-located with the O&M facility at Palen. Thus, the O&M water use recorded at the Palen Solar Project site is representative of the water needs for both site's O&M buildings. Because these facilities are new, the metered water use is not likely inclusive of panel washing events. Given that the Palen Solar Project (457 MW of PV and 50 MW BESS on 3,082 acres) is approximately three times the size of the Project and includes the O&M building water needs for the Desert Harvest Solar Project, an estimate of 9 AFY for the Project is both reasonable and conservative.

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3 Water Resources Plans and Programs

As discussed in Section 1.2.2, there are no UWMPs or integrated regional water management plans applicable to the Project, which means that the relevant water resource plans and programs are limited to well permitting and construction standards, which is described below. There is no Groundwater Sustainability Plan applicable to the CVGB because it has been determined to be a very low priority basin according to DWR (DWR 2019).

3.1 Groundwater Well Permitting and Construction Standards

Because on-site groundwater is proposed as a potential source of supply for the Project (the Applicant may install up to three new wells at the Project site), the Applicant would be required to obtain a permit from the Riverside County Department of Environmental Health for the construction and/or reconstruction of a groundwater well.

The process of obtaining well permits within the CVGB is typically handled by registered well drillers with a C-57 license (on a list approved by the County of Riverside), who file appropriate applications with the Riverside County Department of Environmental Health designed to ensure compliance with the County of Riverside's well ordinance (Ordinance No. 682 [as amended through 682.6]). Well drillers must comply with the ordinance by applying appropriate statewide groundwater well construction standards contained in DWR Bulletin 74-81 and Bulletin 74-90, including subsequent modifications. Such standards include setback criteria from potential contaminant sources like septic tanks, proper sanitary sealing requirements, standards for materials, and well completion report requirements, among others. In addition to the permit requirement, construction of most groundwater wells requires an inspection to verify correct seal preparation and placement. The well ordinance requires, among other things, that domestic and agricultural wells be installed a minimum distance from potential pollution and contaminant sources, that water quality be tested for new and reconstructed wells, that an NSF 61 approved flowmeter be installed, and that the final well construction logs be inspected by County of Riverside staff. On-site inspections by County of Riverside staff are performed in certain circumstances, such as for a community well that is to be part of a public water system, for other wells that possess a high potential for contamination, as needed to determine that a well site meets minimum setback requirements, or in the event laboratory test results show the well water is not meeting water quality standards.

California Executive Order N-7-22(9)(a) requires review by the Groundwater Sustainability Agency for any new well or alteration to an existing well in basins subject to the Sustainable Groundwater Management Act and classified as medium- or high-priority. Before the permit can be approved, the Groundwater Sustainability Agency must verify that groundwater extraction by the proposed well would not be inconsistent with any sustainable groundwater management program established in any applicable Groundwater Sustainability Plan. This provision does not apply because the CVBG is a very low priority basin, as discussed in Section 4.2.1, Department of Water Resources 2019 Basin Prioritization.

Executive Order N-7-22(9)(b) also requires that any agency issuing a permit for a new well or an alteration to an existing well determine that extraction of groundwater from the proposed well is not likely to interfere with the production and functioning of existing nearby wells, and not likely to cause subsidence that would adversely impact or damage nearby infrastructure. If a new or altered on-site well is used as the source of supply for the Project, the

Riverside County Department of Environmental Health would be responsible for making this determination, in consideration of the information submitted on the well permit application. Given the amortized water demand and distance to nearest active well, it is unlikely that there would be well interference impacts, or appreciable pumping-induced subsidence.

4 Water Resources Inventory

The Project site is in the CVGB (Figure 2, Groundwater Basins and Hydrologic Areas). This chapter discusses the water resources on the Project site, including groundwater, surface water, imported water, and recycled water. The primary potential constraint on water resources in the region is lowering groundwater levels and the groundwater table's position relative to the Colorado River Accounting Surface (Accounting Surface). Any consumption that causes groundwater levels to decline below the Accounting Surface is considered subject to the Law of the River (Colorado River Compact of 1922 and amendments), which requires applicants to offset or otherwise mitigate the volume of water causing drawdown below the Accounting Surface.

4.1 Local Surface Water

The Project site is in the Palen Hydrologic Area (717.2), which encompasses an area of approximately 656 square miles (419,661 acres) draining the Eagle, Coxcomb, Granite, Palen, and Chuckwalla Mountains (Figure 2). Most of the precipitation that falls in the Palen Hydrologic Area evaporates, is transpired by plants, or infiltrates into the underlying groundwater basins, primarily the CVGB. Natural surface water features in the Project area are ephemeral, meaning that they only convey flows in direct response to precipitation events. Artificial surface water features in the area are limited to water storage ponds for agriculture and the Lake Tamarisk development. No surface water features that could be a source of Project water exist near the Project site.

4.2 Groundwater Resources

The CVGB, DWR Basin No. 7-5, covers an area of approximately 940 square miles, or 601,573 acres. The CVGB is bounded by consolidated rocks of the Mule and McCoy Mountains on the east; the Chuckwalla and Little Chuckwalla Mountains on the south; the Eagle Mountains on the west; and the Coxcomb, Granite, and Little Maria Mountains on the north (Figure 2). A topographic high point between the Chuckwalla Mountains and Palen Mountains creates an east/west surface-drainage divide (Figure 2).

The CVGB aquifer is composed of Pliocene- to Quaternary-age sediments divided into Pinto Formation, Bouse Formation, and Quaternary alluvium.[9,10] These deposits are upward of 1,200 feet thick and are largely considered unconfined to semi-confined (DWR 2004). The total storage capacity of the CVGB is estimated to be approximately 9.1 million AF (DWR 2004). Recharge to the CVGB occurs through percolation of precipitation runoff from the surrounding mountains; infiltration of precipitation that falls on the valley floor; irrigation and wastewater return flow; and groundwater inflow from the Orocopia Valley (DWR Basin No. 7-31), Pinto Valley (DWR Basin No. 7-6), and potentially the Cadiz Valley (DWR Basin No. 7-7) groundwater basins (DWR 2004). Groundwater in the CVGB generally follows the land surface topography and flows northwest to southeast toward the Lower Colorado River Valley. Historical groundwater extractions in the CVGB were a nominal 11 AF in 1952, but by 1966 had increased to 9,100 AF (DWR 2004). Current groundwater extraction in the CVGB is estimated to be approximately 10,810 AFY, with most groundwater pumping occurring in the western portion of the basin where the majority of groundwater wells are located (Figure 3, Groundwater Production and Monitoring Wells). Groundwater demands in the CVGB include water for solar facilities, the Lake Tamarisk development and golf course, Chuckwalla Valley

9 The Pliocene Epoch extends from approximately 5.33 million to 2.58 million years before present.
10 The Quaternary Period extends from approximately 2.58 million years ago to the present.

Raceway, Ironwood State Prison, Chuckwalla State Prison, agricultural irrigation, and domestic use. Existing and planned solar projects are shown in Figure 3.

4.2.1 Department of Water Resources 2019 Basin Prioritization

Basin prioritization is a technical process that uses the best available data and information to classify California's 515 groundwater basins into one of four categories: high, medium, low, or very low priority. The technical process is based on eight components that are identified in CWC Section 10933(b). The eight variously weighted components that are used to determine basin priority include factors such as existing population and anticipated population growth; groundwater well density; agricultural demands; and the historical and current documented impacts to water levels and storage, groundwater quality, subsidence, and groundwater-dependent ecosystems. DWR has designated the CVGB as a very-low-priority basin; therefore, development of a Groundwater Sustainability Plan is not currently required. This very-low-priority ranking is based on the lack of development or appreciable agriculture in the CVGB, a declining population, and a low density of groundwater wells (86 wells within the 940-square-mile basin). DWR estimated the average groundwater use at 9,023 AFY. The CVGB is not identified by DWR as a basin in a state of critical overdraft (DWR 2019).

Basin-wide, construction of multiple solar energy projects is resulting in a temporary increase in groundwater use for dust control and grading; however, groundwater use is expected to subsequently decrease because the O&M demands of solar projects are low, especially on a per-acre basis. DWR found in its basin prioritization process (completed in 2019) that the CVGB has an average per-acre groundwater use of less than 0.01 AFY. By comparison, once operational, the Project would have an average per-acre groundwater use of approximately 0.008 AFY.[11] Although the CVGB does not require a Groundwater Sustainability Plan, several groundwater monitoring and mitigation plans are being implemented throughout the basin to monitor for potential adverse impacts on adjacent water users, and if necessary, to mitigate for any impacts caused through water conservation or offset activities (e.g., curtailment/cessation of pumping and/or compensation for whatever equipment or well deepening is required to restore the yields of impacted wells). Thus far, no substantial adverse impacts have been detected through these monitoring programs (Dudek 2022a, 2022b, 2022c). As of June 9, 2022, the lowest groundwater levels detected in the CVGB (near the Palen Solar Project site) remain approximately 133 feet above the Accounting Surface of 234 feet above mean sea level (amsl) (Dudek 2022c). This indicates that a significant buffer remains before the Accounting Surface is reached. As solar projects complete construction in the area, their impacts on groundwater levels in the CVGB will decrease, and pumping will eventually return to near-historical averages.

4.2.2 Well Yields

As stated previously, the Applicant proposes to use on-site groundwater production wells to satisfy Project water demands. Based on a review of DWR well completion reports for groundwater production wells in the vicinity of the Project site, the average well yield is approximately 1,142 gpm, with a maximum yield of 1,500 gpm (Table 5) (SWRCB 2019).

Well yields not available from the DWR well completion report database have also been determined from pumping tests. For example, pumping tests conducted at the Desert Sunlight production well, Project Well 1, approximately 0.75 miles north of the Project site, verified that it could produce up to 600 gpm (West Yost 2012). For the purpose of this WSA, it is conservatively assumed that if the Project uses an on-site production well, it could produce up to

[11] 9 AFY / 1,192 acres = 0.008 AFY per acre.

400 gpm, which is much less than the reported yield for the Desert Sunlight production well and approximately one-third of the average well yield in this part of the CVGB. If pumped continuously at a rate of 400 gpm, the production well on the Project site could produce 645 AFY of groundwater, which is 345 AF more water than is assumed to be required for Project construction. Furthermore, it is more than is estimated to be required to meet the peak construction demands of the Project, determined to be 362 gpm (see Table 4 and Section 2.1, Construction Water Demand). Based on this analysis, a single on-site groundwater production well would be adequate to satisfy both the peak construction and the operational water demand of the Project.

Table 5. Well Completion Report Database Statistics for Production Wells Nearest the Project Site

Well Type	Well Log Number	Completion Depth (Feet)	Well Yield (Gallons per Minute)
Irrigation	455508	800	1,200[a]
Irrigation	1082702	1,005	1,500[b]
Domestic	E0149728	520	727[a]
Average	**N/A**	**828**	**1,142**

Source: SWRCB 2019.
Notes: N/A=not applicable.
[a] Well yield estimated via dedicated pump and motor.
[b] Well yield estimated via airlifting.

4.2.3 Groundwater Levels

Groundwater levels in the CVGB range from ground surface to approximately 400 feet below ground surface. Groundwater flow is generally from the northwest to the southeast. In general, well data shows stable long-term groundwater levels in the CVGB, with periods of localized water level depressions as a result of groundwater pumping (Aspen 2021; BLM 2017; DWR 2004; FERC 2013).

Groundwater level data collected as part of the Desert Sunlight Project monitoring program over a 6-year period from March 2012 to June 2018 indicated a stable trend in groundwater levels over the monitoring period, with maximum groundwater level fluctuations of approximately 1 foot (Northstar 2018). Similarly, groundwater level data collected as part of the Genesis Project monitoring program over a 10-year period from May 2009 to December 2019 indicate a stable trend in groundwater levels, with maximum groundwater level fluctuations of approximately 1 foot (Northstar 2019). Groundwater level data collected as a part of the Desert Harvest Solar Project and Palen Solar Project monitoring programs over a 3-year period from May 2019 to June 2022 showed a stable trend in groundwater levels in all wells in the monitoring network, with the exception of one well, identified as the Raceway Monitoring Well, where groundwater levels declined approximately 7 feet (Dudek 2022b). The observed decline in groundwater levels in the Raceway Monitoring Well suggests that groundwater extraction by various users in the vicinity have resulted in a local pumping depression in that area of the CVGB. Groundwater level data collected as part of the Arica Solar Project and Victory Pass Solar Project monitoring programs provide groundwater level data for one additional well, the project production well, not already included in the Desert Harvest and Palen monitoring networks which has shown a stable trend in groundwater levels over the monitoring period (Dudek 2023a, 2023b). It should be noted that the well has, however, been pumped frequently for project construction so groundwater levels are not representative of static conditions. Groundwater level data collected as part of the Oberon I Solar Project and Oberon II Solar Project monitoring programs provide groundwater level data for two project production wells (GSI 2023a, 2023b). However, the groundwater level data record for the wells is limited to two manual depth to water measurements at each well and the wells are pumped frequently for project construction so no conclusions regarding groundwater level trends can be made. No groundwater monitoring data are available for the Athos Renewable Energy Project (BLM pers. comm. 2023).

Hydrographs for wells with recent groundwater level data are shown in Figure 4, Groundwater Level Hydrographs, and the location of the wells are shown in Figure 3. The location where groundwater is at its lowest elevation is the Palen Solar Project production well. In this location, pumping water levels quickly rebounded by more than 100 feet once construction-related pumping in that well ceased in November 2021. This indicates that pumping-related depressions during construction phases are temporary, and that low-level water use for O&M tends not to have a significant or long-term impact on groundwater levels.

Hydrographs for wells with a long-term, static groundwater level record are shown in Figure 6, Chuckwalla Valley Groundwater Basin Groundwater Level Trends. The hydrographs indicate that groundwater levels are stable across the CVGB and have remained so even during periods of below-average precipitation such as the 2014 to 2016 water years, with the exception of the Raceway Monitoring Well where groundwater levels locally declined as a result of pumping by groundwater users in the vicinity, but recently have started to recover (Figure 5). Furthermore, static groundwater levels across the western portion of the CVGB, as measured from monitored wells, generally remain 100 to 250 feet above the Accounting Surface (Dudek 2022a, 2022b).

4.2.4 Groundwater Quality

Groundwater quality in the CVGB is characterized by elevated concentrations of total dissolved solids (TDS), chloride, fluoride, sulfate, sodium, and boron (USGS 2013). These constituents can impair groundwater for domestic and/or irrigation use. TDS concentrations in the basin range from 274 to 12,300 milligrams per liter (mg/L), with the lowest concentrations observed in the western portion of the basin (BLM 2012). In general, groundwater in the CVGB is sodium chloride to sodium sulfate-chloride in character (DWR 2004).

Groundwater quality data are available for several wells in the Project area including Well 05S/16E-07M001S, Desert Sunlight Project Well 1, and Raceway Monitoring Well (Table 6). Concentrations that exceed State of California primary or secondary MCLs for drinking water are denoted with an asterisk (*) in Table 6. As shown in Table 6, groundwater from Well 05S/16E-07M001S exceeds the drinking water MCL for fluoride; groundwater from Desert Sunlight Project Well 1 exceeds the MCLs for pH, TDS, fluoride, and arsenic; and groundwater from Raceway Monitoring Well exceeds the MCLs for fluoride and pH.

Based on the potential for certain constituents, such as TDS, arsenic, and fluoride, to exceed primary MCLs, on-site groundwater is likely to require treatment to meet Title 22 drinking water standards, if it is to be used for potable/sanitary purposes. To avoid the need for additional treatment, it is recommended that potable water for construction workers and/or maintenance workers either be purchased from a commercial bottling company or obtained from an existing local source of potable water. Despite elevated levels of certain constituents discussed above, on-site groundwater would be of suitable quality for use as a means of solar panel cleaning, soil compaction, dust control, and/or grading.

Table 6. Groundwater Quality Data for Wells in the Project Vicinity

Analyte	Units	MCL[a]	Well 05S/16E-07M001S[b]	Desert Sunlight Project Well 1[c]	Raceway Monitoring Well[d]
Specific conductance	µ℧/cm	900	—	790	830
pH	pH units	6.5–8.5	8.2	8.6*	8.9*
Total dissolved solids	mg/L	500	387	1,200*	470
Bicarbonate	mg/L as $CaCO_3$	N/A	—	160	68
Chloride	mg/L	250	78	89	140
Fluoride	mg/L	2	8.0*	7.5*	8.2*
Sulfate	mg/L	250	108	130	96
Calcium	mg/L	N/A	—	—	9.6
Magnesium	mg/L	N/A	0.7	—	1.1
Potassium	mg/L	N/A	2.0	—	4.0
Sodium	mg/L	N/A	—	—	160
Arsenic	µg/L	10	—	26*	6.6
Perchlorate	µg/L	6	—	—	ND

Sources: Dudek 2022c; SWRCB 2022; West Yost 2012.
Notes: MCL = maximum contaminant level; µ℧/cm = micromhos per centimeter; N/A = not applicable; — = not available; * = value exceeds the applicable primary or secondary MCL for California drinking water standards; mg/L = milligrams per liter; $CaCO_3$ = calcium carbonate; µg/L = micrograms per liter; ND = not detected above the laboratory reporting limit.
[a] Denotes primary or secondary MCL for California drinking water standards.
[b] Sample collected February 1, 1967.
[c] Sample collected October 19, 2011.
[d] Sample collected November 3, 2021.

4.2.5 Groundwater Storage, Inflow, and Outflow

4.2.5.1 Groundwater Storage

DWR reports that the total storage capacity of the CVGB is estimated at 9,100,000 AF (DWR 2004). The upper 100 feet of saturated sediments in the basin are estimated to have 900,000 AF of groundwater in storage (DWR 2004).

4.2.5.2 Groundwater Inflow

The Chuckwalla Valley watershed receives between 258,000 AFY and 315,000 AFY total precipitation (Aspen 2021; BLM 2012). Groundwater recharge from precipitation is estimated as a percentage of total precipitation in the Chuckwalla Valley, and in previous studies has ranged from 2% to 10%, with 3% of the total average precipitation being considered a reasonable conservative estimate of recharge for a normal (average water year) based on previous studies and the most commonly used estimate in other reports (Aspen 2021; BLM 2012; USGS 2007). There have been substantial differences in reported estimates of the amount of infiltration recharge to the CVGB by precipitation, in part due to a lack of reliable data (Fang et al. 2019, 2021; Shen et al. 2017). Precipitation-related recharge estimates have ranged from 2,060 AFY to 9,448 AFY (Aspen 2021; BLM 2012). Table 7 shows the range of estimates for precipitation recharge and subsurface inflow for the CVGB based on previous studies. For the purpose of this WSA, natural recharge from precipitation is assumed to be 8,588 AFY for a normal water year (about 3% of average total precipitation), 6,441 AFY for a single-dry water year (75% of normal water year), 7,300 AFY for the first year of a multiple-dry water year (85% of normal water year), 6,012 AFY for the second year of a multiple-dry water year (70% of normal water year), and 4,723 AFY for the third year of a multiple-dry water year (55% of normal water year) (BLM 2012). However, the actual amount of groundwater recharge from precipitation for normal, single-dry, and multiple-dry water years is uncertain because precipitation-related recharge depends on local geology and the volume of mountain-front runoff.

Infiltration of irrigation water applied to crops within the CVGB is estimated to contribute approximately 800 AFY of recharge to the basin, and wastewater return flow that originates from the Chuckwalla and Ironwood State Prisons and the Lake Tamarisk development is estimated to contribute approximately 831 AFY to the regional aquifer (Worley Parsons 2009). Combined, infiltration of irrigation water and wastewater account for 1,631 AFY of CVGB aquifer recharge.

Multiple studies have estimated and summarized the total subsurface inflow to the CVGB (i.e., Argonne 2013; BLM 2012; Fang et al. 2019, 2021; Shen et al. 2017). However, there has been significant variation in expert opinion, and, thus, high uncertainty regarding the amount of recharge the CVGB receives from adjacent groundwater basins; with estimates ranging from 953 AFY to 6,700 AFY (BLM 2012; FERC 2013). This uncertainty is in part due to a lack of long-term consistent groundwater level monitoring data and the simplifying assumptions inherent to the groundwater models used. For the purpose of this WSA, subsurface inflow to the CVGB is assumed to be 3,500 AFY, which is approximately in the midrange of estimates reported in previous studies, and is the value most commonly used in CVGB water budget analyses (Table 7).

Table 7. Reported Precipitation Recharge and Subsurface Inflow Estimates for the Chuckwalla Valley Groundwater Basin

Inflow Component	Range (AFY)	Baseline Value Adopted for This Study (AFY)	Reason for Adoption
Recharge from Precipitation	2,060 to 20,038	8,588	Approximately 3% of average total annual precipitation and most commonly used value in other reports
Subsurface Inflow	953 to 6,575	3,500	Approximate middle of range and most commonly used value in other reports

Source: Aspen 2021; BLM 2012; Fang et al. 2019; FERC 2013; USGS 2007.
Note: AFY = acre-feet per year.

4.2.5.3 Groundwater Outflow

Groundwater outflow from the CVGB occurs through subsurface flow to the Palo Verde Mesa Groundwater Basin (DWR 7-39), evapotranspiration from Palen Dry Lake, and groundwater extraction.

Estimates of subsurface outflow from the CVGB to the Palo Verde Mesa Groundwater Basin have ranged from zero outflow (Argonne 2013) to 1,162 AFY (Aspen 2018), with 400 AFY being the estimate most often used in CVGB water budget analyses and the value used for the purpose of this WSA.

Historical groundwater extraction in the CVGB was estimated at a nominal 11 AF in 1952. By 1966, pumping rates dramatically increased to 9,100 AF (DWR 2004). Current groundwater extraction in the CVGB is estimated to be approximately 2,605 AFY in the eastern portion of the basin, and 7,900 AFY in the western portion of the basin, where the majority of groundwater wells are located, for a total of 10,505 AFY of groundwater extracted (BLM 2012).

However, total pumping estimates have ranged from 4,700 AFY to 10,579 AFY, with limited information on groundwater usage by entity to support the estimates (Aspen 2018). Groundwater demands in the CVGB include water for several solar farms, the Lake Tamarisk development and golf course, agricultural irrigation, domestic use, and the Ironwood and Chuckwalla State Prisons. For the purpose of this WSA, total groundwater extraction is estimated to be 10,810 AFY (see Chapter 5). This conservative estimate (higher range of estimated pumping) considers that the groundwater demand of solar PV projects is often a one-time construction use with significantly less water required thereafter for O&M.

Evapotranspiration at Palen Dry Lake is believed to occur through capillary action and transpiration by phreatophytic vegetation along the margins and at the northwestern corner of the dry lake, where depth to groundwater has been reported to be approximately 8 to 25 feet below ground surface based on nearby well groundwater levels and soil borings (BLM 2012). The rate of groundwater evaporation has been estimated to be 0.0583 feet of water per acre for 3 months of the year across an area of 2,000 acres, which equates to approximately 350 AFY of evapotranspiration (BLM 2012).

4.3 Imported Water

Imported water is currently not available in the vicinity of the Project site.

4.4 Recycled/Reclaimed Water

Recycled water infrastructure does not exist in the vicinity of the Project site and is not anticipated to be a potential source of Project water supply. The Project is not anticipated to use recycled water during project construction or O&M.

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5 Water Supply Assessment

5.1 Groundwater Budget

Groundwater extracted from the CVGB has been identified as the only source of water to satisfy the Project construction and O&M demand of 642 AF over 39 years (up to 300 AF for construction and 9 AFY for O&M). As indicated in Section 4.2, Groundwater Resources, wells within the western part of the CVGB have sufficient yield to supply the water demand of the Project, meaning there is no physical limitation that would indicate supply cannot meet demand over the next 20 years (the statutory planning period required by SB 610) or over the estimated/ minimum 39-year life of the Project. However, because of the presence of multiple solar energy projects, their associated pumping demands, and the fact that recharge is limited in the CVGB (a dry desert basin), an analysis of the impact of the Project on groundwater resources for normal, single-dry, and multiple-dry water years is warranted. SB 610 requires consideration of other planned projects over a 20-year period; therefore, water demands for the other known completed and planned solar projects in the western CVGB are included in this analysis.

There has been a notable trend of solar projects in the desert southwest using less water than estimated for both construction and O&M. Table 8 lists recent local examples of water demand estimates that were substantially higher than actual metered water use for construction and operation. Earlier analyses of water budgets associated with solar energy development in the CVGB assumed very high water demands for projects that have not pumped nearly the anticipated amounts, as well as water demands for projects that have not been built, such as the Eagle Mountain Pumped Storage Project. The proposed Eagle Mountain Pumped Storage Project has by far the single highest groundwater demand of any project in the CVGB, requiring an estimated 8,100 AFY for construction and 1,800 AFY for operation (BLM 2017; FERC 2012, 2013). This single project water demand is almost as much water as the total existing estimated groundwater extraction of 10,505 AFY for domestic and agricultural uses in the CVGB. The Eagle Mountain Pumped Storage Project drove the water balance presented in many of the WSAs previously completed in the CVGB. As a result, many of the previously completed WSAs in the CVGB have overestimated the potential cumulative effects of solar development more broadly. Although the Eagle Mountain Pumped Storage Project is still under consideration, the likelihood of it commencing construction in the foreseeable future is very low, as FERC recently stayed Eagle Mountain Pumped Storage Project's commencement of construction and completion of construction deadlines to 2028 and 2031, respectively, and legal challenges remain pending before the Interior Board of Land Appeals and the United States District Court for the Eastern District of California.

Table 8. Comparison of Planning Estimates Versus Metered Water Use for Existing Solar Projects

Project	Construction Planning Estimate (AF)	Construction Updated and/or Metered Use (AF)	Difference (AF)	O&M Planning Estimate (AFY)	O&M Updated and/or Metered Use (AFY)	Difference (AFY)
Genesis Solar Project	1,368[a]	N/A	N/A	202[b]	114[c]	-88
Desert Sunlight Solar Farm	1,500[a]	N/A	N/A	2.3[a]	0.2[d]	-2.1

Table 8. Comparison of Planning Estimates Versus Metered Water Use for Existing Solar Projects

Project	Construction Planning Estimate (AF)	Construction Updated and/or Metered Use (AF)	Difference (AF)	O&M Planning Estimate (AFY)	O&M Updated and/or Metered Use (AFY)	Difference (AFY)
Palen Solar Project	1,750[e]	435[f]	-1,315	41[e]	2[g]	-39
Desert Harvest Solar Project	204[h]	91[e]	-113	20[h]	0[f]	-20

Sources: Aspen 2018; BLM 2017; Dudek 2019, 2022a, 2022b; Northstar 2018, 2019.
Notes: AF = acre-feet; AFY = acre-feet per year; N/A = not available.

a BLM 2017.
b Northstar 2019.
c Value represents metered use (Northstar 2019).
d Value represents metered use (Northstar 2018).
e Aspen 2018.
f Value represents metered use (Dudek 2022a, 2022b).
g Value represents metered use during year with no panel washing (Dudek 2022a, 2022b). Water use would be higher in years when panels are washed.
h Dudek 2019.

The CVGB groundwater inflow and outflow estimates used in this WSA to determine the availability of groundwater resources for Project construction and O&M were adopted from previous studies. As discussed in Section 4.2.5, Groundwater Storage, Inflow, and Outflow, a wide range of estimates of current groundwater extraction in the CVGB has been reported. For the purpose of estimating the baseline water budget for the CVGB under various climatic scenarios, existing groundwater extraction in the CVGB is assumed to be 10,505 AFY (domestic and agricultural pumping), plus the operational water planning use estimates of the solar projects that are currently in operation: Desert Sunlight Solar Farm (2.3 AFY), Palen Solar Project (41 AFY), Desert Harvest Solar Project (20 AFY), and Genesis Solar Energy Project (202 AFY), and Athos Renewable Energy Project (40 AFY) (Aspen 2018, 2019; Dudek 2019; Northstar 2018, 2019).[12] Adding the estimated domestic and agricultural extraction with the operational water demand of the above solar projects results in a total baseline groundwater extraction of approximately 10,810 AFY. Table 9 provides a summary of the estimated baseline water budget for the CVGB for normal, single-dry, and multiple-dry water years.

Table 9. Estimated Baseline Water Budget for the Chuckwalla Valley Groundwater Basin

Budget Component	Normal (Average) Year	Single-Dry Year	Multiple-Dry (Year 1)	Multiple-Dry (Year 2)	Multiple-Dry (Year 3)
Inflow					
Recharge from precipitation[a]	+8,588	+6,441	+7,300	+6,012	+4,723
Irrigation/wastewater return flow	+1,631	+1,631	+1,631	+1,631	+1,631
Underflow from Pinto and Orocopia Valley Groundwater Basins	+3,500	+3,500	+3,500	+3,500	+3,500
Total inflow	**+13,719**	**+11,572**	**+12,431**	**+11,143**	**+9,854**

12 Although metered water use is available for several of these projects, the planning estimates are used because water use varies from year to year. The planning estimates are conservatively high estimates of operational water demands.

Table 9. Estimated Baseline Water Budget for the Chuckwalla Valley Groundwater Basin

Budget Component	Normal (Average) Year	Single-Dry Year	Multiple-Dry (Year 1)	Multiple-Dry (Year 2)	Multiple-Dry (Year 3)
Outflow					
Underflow to Palo Verde Mesa Groundwater Basin	−400	−400	−400	−400	−400
Groundwater extraction	−10,810	−10,810	−10,810	−10,810	−10,810
Evapotranspiration at Palen Dry Lake	−350	−350	−350	−350	−350
Total outflow	**−11,560**	**−11,560**	**−11,560**	**−11,560**	**−11,560**
Inflow−Outflow					
Budget Balance	**+2,159**	**+12**	**+871**	**−417**	**−1,706**
Percentage of Total Groundwater in Storage	**+0.0237%**	**+0.0001%**	**+0.0096%**	**−0.0046%**	**−0.0187%**

Sources: Aspen 2018, 2019; BLM 2012; Northstar 2018, 2019; Worley Parsons 2009.

Notes: All values are in acre-feet per year (AFY) unless otherwise noted; plus sign (+) indicates inflow or surplus; negative sign (−) indicates outflow or deficit; total Chuckwalla Valley Groundwater Basin groundwater in storage is estimated to be 9,100,000 acre-feet.

[a] As discussed in Section 4.2.5.2, Groundwater Inflow, natural recharge from precipitation is assumed to be 8,588 AFY for a normal water year (3% of average total precipitation), 6,441 AFY for a single-dry water year (75% of normal water year), 7,300 AFY for the first year of a multiple-dry water year (85% of normal water year), 6,012 AFY for the second year of a multiple-dry water year (70% of normal water year), and 4,723 AFY for the third year of a multiple-dry water year (55% of normal water year).

As shown in the baseline water budget for the CVGB (Table 9), for normal-year, single-dry-year, and for year one of a multiple-dry-year condition, there is an estimated groundwater surplus of 2,159 AFY, 12 AFY, and 871 AFY, respectively. However, for the second and third years of a multiple-dry-year condition, there is an estimated groundwater deficit of -417 AFY, and -1,706 AFY, respectively.

For the purpose of estimating the future water budget for the CVGB under various climatic scenarios, future groundwater extraction in the CVGB is assumed to include the existing domestic, agricultural, and solar project pumping, plus the estimated 20-year amortized construction and O&M water demand of proposed projects and projects currently under construction. Projects that are currently under construction include the Oberon, Arica, and Victory Pass solar projects. Projects that are being proposed include the Eagle Mountain Pumped Storage Project and Easley Renewable Energy Project. The estimated construction, O&M, and 20-year amortized water demand of the above projects is provided in Table 10. The 20-year amortized water demands assume a construction period of two years for the solar projects and four years for the Eagle Mountain Pumped Storage Project (Aspen 2021; BLM 2017, 2021a, 2021b; County of Riverside 2022b; FERC 2013).

Table 10. Estimated Water Demand of Proposed Projects and Projects Currently Under Construction within the Chuckwalla Valley Groundwater Basin

Project	Construction Water Demand (AF)	O&M Water Demand (AFY)	20-Year Amortized Water Demand (AFY)
Oberon Renewable Energy Project	700	40	71
Arica Solar Project	650	25	55
Victory Pass Solar Project	650	25	55
Easley Renewable Energy Project	1,000	50	95

Table 10. Estimated Water Demand of Proposed Projects and Projects Currently Under Construction within the Chuckwalla Valley Groundwater Basin

Project	Construction Water Demand (AF)	O&M Water Demand (AFY)	20-Year Amortized Water Demand (AFY)
Eagle Mountain Pumped Storage Project	32,400[a]	1,800	3,060
		Total	**3,336**

Source: Aspen 2021; BLM 2017, 2021a, 2021b; County of Riverside 2022b; FERC 2012, 2013.
Notes: AF = acre-feet; AFY = acre-feet per year; O&M = operations and maintenance.
[a] The Eagle Mountain Pumped Storage Project is estimated to require 8,100 AFY over a construction period of four years (FERC 2012, 2013).

Adding the estimated baseline groundwater extraction (10,810 AFY) with the 20-year amortized total groundwater extraction of proposed projects and projects currently under construction (3,336 AFY), plus the 20-year amortized demand of the Project (23.5 AFY), results in a total future groundwater extraction of approximately 14,170 AFY. Without the Eagle Mountain Pumped Storage Project, total future groundwater extraction is estimated to be approximately 11,110 AFY. Table 11 provides a summary of the estimated future water budget for the CVGB for normal, single-dry, and multiple-dry water years.

Table 11. Estimated Future Water Budget for the Chuckwalla Valley Groundwater Basin

Budget Component	Normal (Average) Year	Single-Dry Year	Multiple-Dry (Year 1)	Multiple-Dry (Year 2)	Multiple-Dry (Year 3)
Inflow					
Recharge from precipitation[a]	+8,588	+6,441	+7,300	+6,012	+4,723
Irrigation/wastewater return flow	+1,631	+1,631	+1,631	+1,631	+1,631
Underflow from Pinto and Orocopia Valley Groundwater Basins	+3,500	+3,500	+3,500	+3,500	+3,500
Total inflow	*+13,719*	*+11,572*	*+12,431*	*+11,143*	*+9,854*
Outflow					
Outflow with Eagle Mountain Pumped Storage Project					
Underflow to Palo Verde Mesa Groundwater Basin	−400	−400	−400	−400	−400
Groundwater extraction	−14,170	−14,170	−14,170	−14,170	−14,170
Evapotranspiration at Palen Dry Lake	−350	−350	−350	−350	−350
Total outflow	*−14,920*	*−14,920*	*−14,920*	*−14,920*	*−14,920*
Outflow without Eagle Mountain Pumped Storage Project					
Underflow to Palo Verde Mesa Groundwater Basin	−400	−400	−400	−400	−400
Groundwater extraction	−11,110	−11,110	−11,110	−11,110	−11,110

Table 11. Estimated Future Water Budget for the Chuckwalla Valley Groundwater Basin

Budget Component	Normal (Average) Year	Single-Dry Year	Multiple-Dry (Year 1)	Multiple-Dry (Year 2)	Multiple-Dry (Year 3)
Evapotranspiration at Palen Dry Lake	−350	−350	−350	−350	−350
Total outflow	*−11,860*	*−11,860*	*−11,860*	*−11,860*	*−11,860*
Inflow−Outflow					
Inflow−Outflow with Eagle Mountain Pumped Storage Project					
Budget Balance	**−1,201**	**−3,348**	**−2,489**	**−3,777**	**−5,066**
Percentage of Total Groundwater in Storage	**−0.0132%**	**−0.0368%**	**−0.0274%**	**−0.0415%**	**−0.0557%**
Inflow−Outflow without Eagle Mountain Pumped Storage Project					
Budget Balance	**+1,859**	**−288**	**+571**	**−717**	**−2,006**
Percentage of Total Groundwater in Storage	**+0.0204%**	**−0.0032%**	**+0.0063%**	**−0.0079%**	**−0.0220%**

Sources: Aspen 2021; BLM 2017, 2021a, 2021b; County of Riverside 2022b; FERC 2012, 2013.

Notes: All values are in acre-feet per year (AFY) unless otherwise noted; plus sign (+) indicates inflow or surplus; negative sign (−) indicates outflow or deficit; total Chuckwalla Valley Groundwater Basin groundwater in storage is estimated to be 9,100,000 acre-feet.

[a] As discussed in Section 4.2.5.2, Groundwater Inflow, natural recharge from precipitation is assumed to be 8,588 AFY for a normal water year (3% of average total precipitation), 6,441 AFY for a single-dry water year (75% of normal water year), 7,300 AFY for the first year of a multiple-dry water year (85% of normal water year), 6,012 AFY for the second year of a multiple-dry water year (70% of normal water year), and 4,723 AFY for the third year of a multiple-dry water year (55% of normal water year).

As shown in the future water budget for the CVGB (Table 11), there is a groundwater deficit of -1,201 AFY (normal-year) to -5,066 AFY (third year of multiple-dry-year) when the water demand of all proposed projects and projects currently under construction, including the Eagle Mountain Pumped Storage Project, are included. When the water demand of the Eagle Mountain Pumped Storage Project is excluded from the future water budget, there is an estimated groundwater surplus of 1,859 AFY and 571 AFY for normal-year and year one of a multiple-dry-year condition, respectively. However, for a single-dry-year and for the second and third years of a multiple-dry- year condition, there is an estimated groundwater deficit of -288 AFY, -717 AFY, and -2,006 AFY under this scenario. The deficits experienced in the CVGB during drought years would be made up by surplus during normal and above-normal years (above-normal and wet years are not included in the table but would have higher surpluses). This means that it is not expected that the CVGB would have a long-term overdraft condition even if every project in this cumulative scenario (excluding the Eagle Mountain Pumped Storage Project) were completed and the conservative water demand estimates were borne out. In year three of a multiple-dry-year condition in the CVGB, the Project's water demand would contribute approximately 1% or less to the total yearly deficit of -2,006 AF.

The 39-year amortized water demand of the Project of 16.5 AFY and the 20-year amortized demand of 23.5 AFY (see Table 3) would have a negligible impact on the water budget. Even when considering the construction of forthcoming solar energy projects, such as Oberon Renewable Energy Project, Victory Pass Solar Project, Arica Solar Project, Easley Renewable Energy Project, and others (Table 10 and Figure 3), the additional contributions of their amortized water demands would not result in a negative average water budget. As discussed earlier, construction-related pumping could result in temporary and localized cones of depression, which quickly rebound when intensive pumping ceases. Groundwater levels remain 100 to 250 feet above the Accounting Surface, and with an average inflow of 1,859 AFY (budget balance during normal-year), approaching the Accounting Surface should not occur over the next 20-years or 39 years.

5.2 Groundwater Level Drawdown and Change in Storage Analysis

5.2.1 Groundwater Level Drawdown

The following provides an estimate of groundwater level drawdown induced by Project pumping at various distances from the Project production well.

When water is extracted from a well, groundwater levels around the well decline, creating a cone of depression. The cone of depression is deepest at the pumping well and extends radially to a distance away from the pumping well to eventually reach a point where water-level decline (or drawdown) is effectively zero. To evaluate the impact of Project pumping on local groundwater levels, an analytical approach to estimate drawdown induced by well extraction at various distances from the Project production well was employed. The following estimate of groundwater drawdown at various distances from the Project production well relies on the Cooper-Jacob approximation of the Theis non-equilibrium flow equation (Cooper and Jacob 1946):

$$s = \frac{2.3Q}{4\pi T} log_{10} \frac{2.25Tt}{r^2 S}$$

Where:

s = predicted drawdown (feet)
Q = average pumping rate (cubic feet per day)
T = transmissivity (square feet per day)
t = time since pumping started
r = distance from pumping well (feet)
S = coefficient of storage (dimensionless)

The Cooper-Jacob method was verified by validating that the dimensionless time (u) is sufficiently small (u <0.05) using the equation as follows:

$$u = \frac{r^2 S}{4Tt}$$

Where:

u = time (dimensionless)
r = distance from pumping well (feet)
S = coefficient of storage (dimensionless)
T = transmissivity (square feet per day)
t = time since pumping started

During a constant rate aquifer test, drawdown data plot on a straight line except at large values of u, or small values of 1/u. At values of u less than approximately 0.05, the Cooper-Jacob approximation is valid (Driscoll 1986). When the value of u exceeded 0.05, the Theis solution was used to calculate drawdown.

Values for aquifer transmissivity and storativity used in the calculations were obtained from results of field pumping tests conducted at wells in the Project area (AECOM 2010; FERC 2013). A transmissivity value of 20,000 square feet per day and storativity value of 0.05 were used in the calculations.

Assuming the Project production well is pumped continuously for one year at 189 gpm in order to satisfy construction water demands (see Table 4), groundwater level drawdown at a distance of 1,000 feet from the well is estimated to be approximately 0.84 feet and at 1-mile is estimated to be approximately 0.36 feet (Table 12). Assuming the Project production well is pumped continuously for three months at a peak demand of 362 gpm in order to satisfy construction water demands (see Table 4), groundwater level drawdown at a distance of 1,000 feet from the well is estimated to be approximately 1.22 feet and at 1-mile is approximately 0.70 feet (Table 12). The closest off-site municipal supply well is located approximately 0.75-miles south of the southern boundary of the Project site along State Route 177 (Figure 3). Estimated drawdown at the closest off-site municipal supply well after one year of Project pumping at 189 gpm is estimated to be approximately 0.44 feet, and after three months at a peak demand of 362 gpm is approximately 0.85 feet. This is assuming that the Project production well is located along the southern boundary of the Project site. If the Project production well is located elsewhere within the Project site, such as along the northern boundary, groundwater level drawdown impacts at off-site wells would be less.

Table 12. Estimated Groundwater Level Drawdown

Distance from Project Production Well (feet)	Groundwater Level Drawdown (feet) When Project Pumping at 189 gpm for One Year	Groundwater Level Drawdown (feet) When Project Pumping at 362 gpm for Three Months
500	1.04	1.60
750	0.92	1.38
1,000	0.84	1.22
2,640	0.56	1.07
3,960	0.44	0.85
5,280	0.36	0.70
10,560	0.18	0.35

Notes: gpm = gallons per minute.

Based on the above analysis, groundwater level drawdown at off-site wells is predicted to be less than significant because drawdown of one foot or less is not anticipated to cause a reduction in well yield or other type of significant well interference impacts. Well interference that results in well performance impacts typically occurs when groundwater levels drop below the screened interval of a well causing aeration, which is not anticipated to occur with a drawdown of one foot or less. It should be noted that the drawdown calculations rely on a number of simplifying assumptions including that the aquifer is homogenous and isotropic, the aquifer has infinite areal extent, and others (Cooper and Jacob 1946). Additionally, the calculations do not take into account the influence of groundwater recharge and aquifer boundary conditions on the magnitude of drawdown, and the transmissivity and storativity values used in the calculations are estimates based on previous field studies and actual values may be higher or lower.

5.2.2 Change in Storage

To evaluate the potential impacts of Project pumping on groundwater in storage, the following equation was used to calculate the available aquifer storage beneath the Project Site assuming a new on-site well is drilled and used to satisfy Project water demands:

$$Storage\ Capacity = Area\ of\ Property\ x\ Aquifer\ Thickness\ x\ Aquifer\ Specific\ Yield$$

Where:

Area of Property = size of contiguous owned property where well is located (acres)
Aquifer Thickness = saturated thickness of aquifer (feet)
Aquifer Specific Yield = volume of water released from storage per unit surface area of aquifer per unit decline of the water table (dimensionless)

Using the Project Site area of 1,192 acres, an aquifer saturated thickness of 500 feet, and an aquifer specific yield of 0.1, the calculated volume of groundwater in storage beneath the Project Site is approximately 59,600 AF.[13] The groundwater storage reduction after one year of Project pumping at 300 AF, as a percentage of total groundwater in storage beneath the Project Site, is approximately 0.5%. The groundwater storage reduction after 20 years of Project pumping at an amortized rate of approximately 23.5 AFY (471 AF total), as a percentage of total groundwater in storage beneath the Project Site, is approximately 0.8%. The groundwater storage reduction after 39 years of Project pumping at approximately 16.5 AFY (642 AF total), as a percentage of total groundwater in storage beneath the Project Site, is approximately 1.1%. This is a conservative estimate (i.e., worst-case scenario) because it assumes the Project will use the upper limit of the estimated water demand for the Project, and because the calculation does not take into account the influence of groundwater recharge on the volume of groundwater in storage.

13 An aquifer saturated thickness of 500 feet and specific yield of 0.1 are representative of the sediments that underlie the Project site based on published information (DWR 2004).

6 Conclusion

Based on the analysis presented herein, there is sufficient on-site groundwater availability to satisfy the Project construction and O&M water demand over the operational lifetime of the Project. By extension, water supplies are also adequate for the 20-year planning period specified in SB 610 (300 AF for construction and 9 AFY for O&M). “Overdraft” is defined as the condition of a groundwater basin where the average annual amount of water extracted over at least a 10-year period exceeds the average annual inflow of water to the basin (CWC Section 10735[a]). According to this definition of “overdraft,” the CVGB is not currently in overdraft, considering that observed groundwater levels are relatively stable across the CVGB and have remained so even during periods of below-average precipitation, such as the 2014 to 2016 water years, as discussed in Section 4.2.5. In addition, based on the updated water demands for already constructed projects and reasonably foreseeable projects, the CVGB is not forecast to be in overdraft for at least the next 20 years, according to the estimated water budget. Although a reduction in groundwater in storage is predicted to occur during the second and third years of multiple-dry-year conditions, the deficit would be small (≤0.02%) compared to the total volume of groundwater in storage, and the deficit is predicted to be erased during normal and above-normal water years. Overdraft of the CVGB would only occur after 10 years of groundwater outflow exceeding inflow, either as a consequence of 10 years of below-average precipitation (i.e., a 10-year drought) or if groundwater extraction in the CVGB were to increase significantly, such as for construction and operation of the Eagle Mountain Pumped Storage Project, neither of which are likely to occur at this time.

Based on a review of available water supplies versus groundwater conditions, this WSA concludes the following:

- A time-series visualization of all publicly available, long-term, static groundwater level monitoring well data (Figure 5) suggests the CVGB is in a non-overdraft and generally balanced condition.
- The Project has enough water through use of on-site groundwater (or other nearby water systems), and/or a commercial water hauler to support both the construction and O&M demands of the Project over the next 20 years, even in multiple-dry-year conditions.
- Existing and planned solar projects will not have water demands sufficient to cause an overdraft condition and/or cause the groundwater level in the CVGB to reach or exceed the Colorado River Accounting Surface.
- Groundwater level drawdown at nearby off-site wells due to Project pumping is predicted to be less than significant
- Change in groundwater in storage beneath the Project site due to Project pumping is predicted to be less than significant

For the purposes of CEQA and NEPA, this WSA supports a conclusion of less-than-significant impacts with regard to water supply availability and impacts to groundwater resources. The array of water supply options (on-site groundwater, off-site groundwater, and/or commercial hauler) allows the Applicant to adapt to the unknowns regarding whether on-site groundwater is suitable for various uses.

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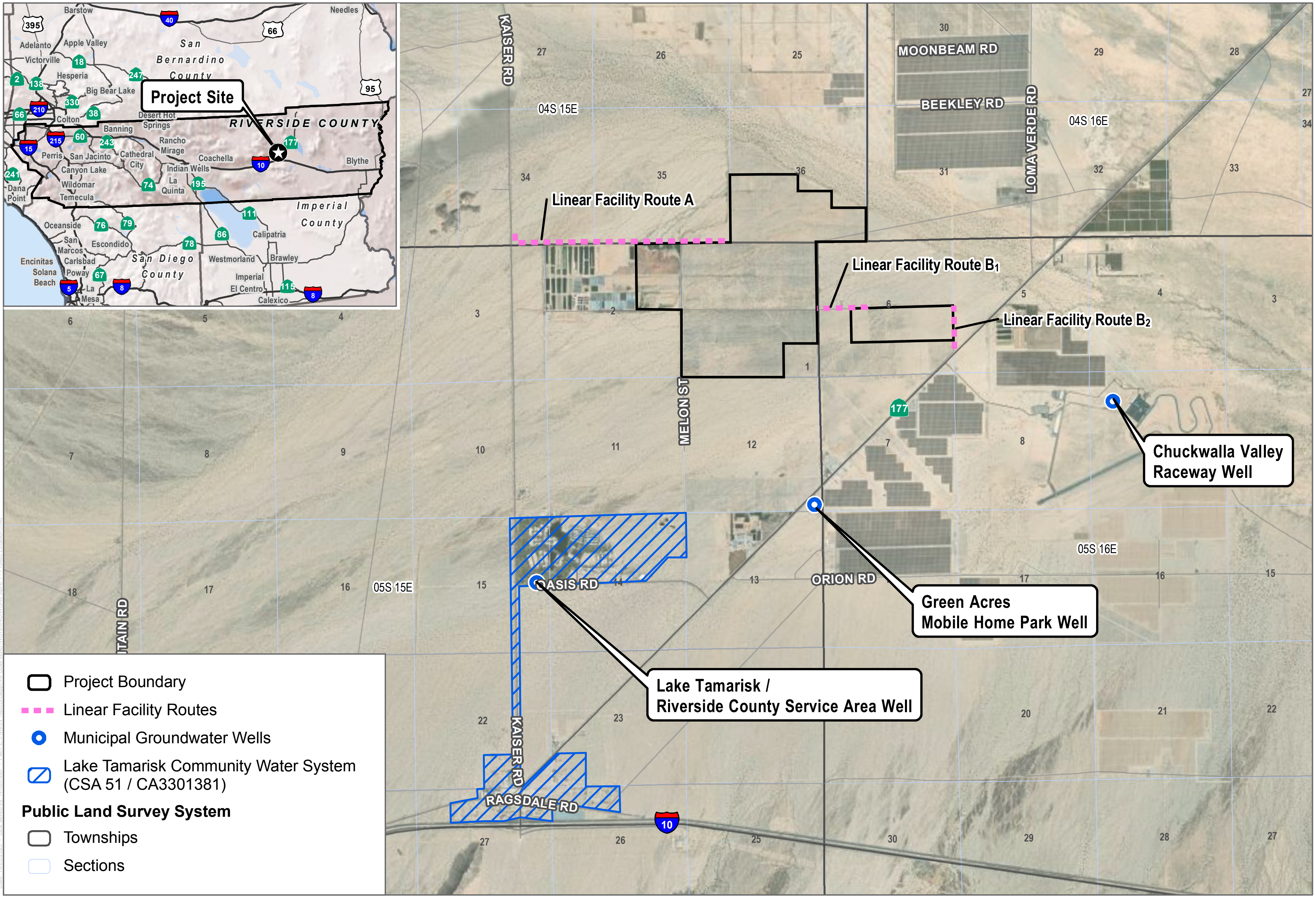

SOURCE: Esri World Imagery Basemap (accessed 2022); County of Riverside 2022; SWRCB 2022

DUDEK

0 0.5 1 Miles

FIGURE 1

Project Location and Public Groundwater Sources

Sapphire Solar Project

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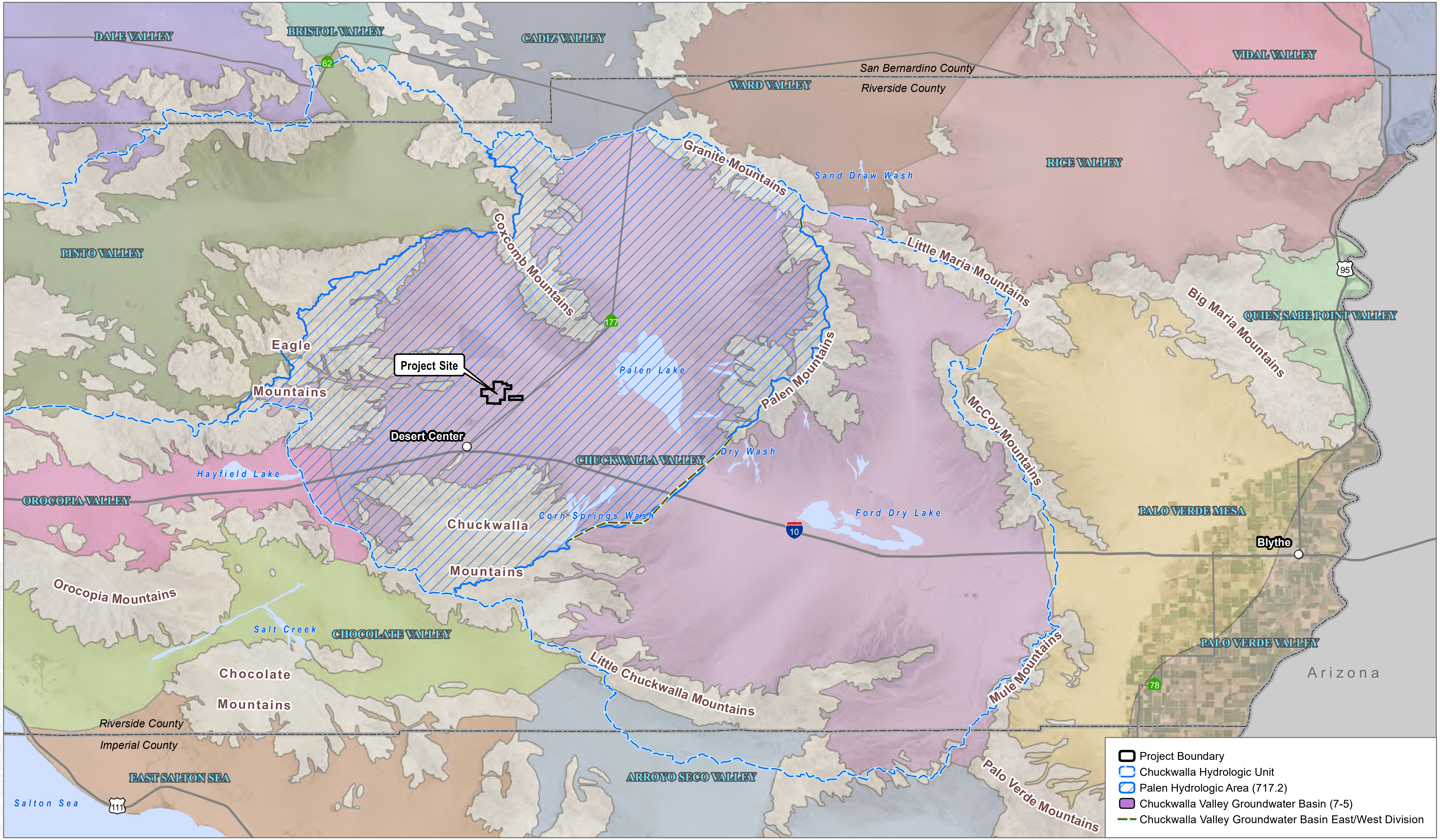

SOURCE: ESRI; County of Riverside; DWR

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FIGURE 2

Groundwater Basins and Hydrologic Areas

Sapphire Solar Project

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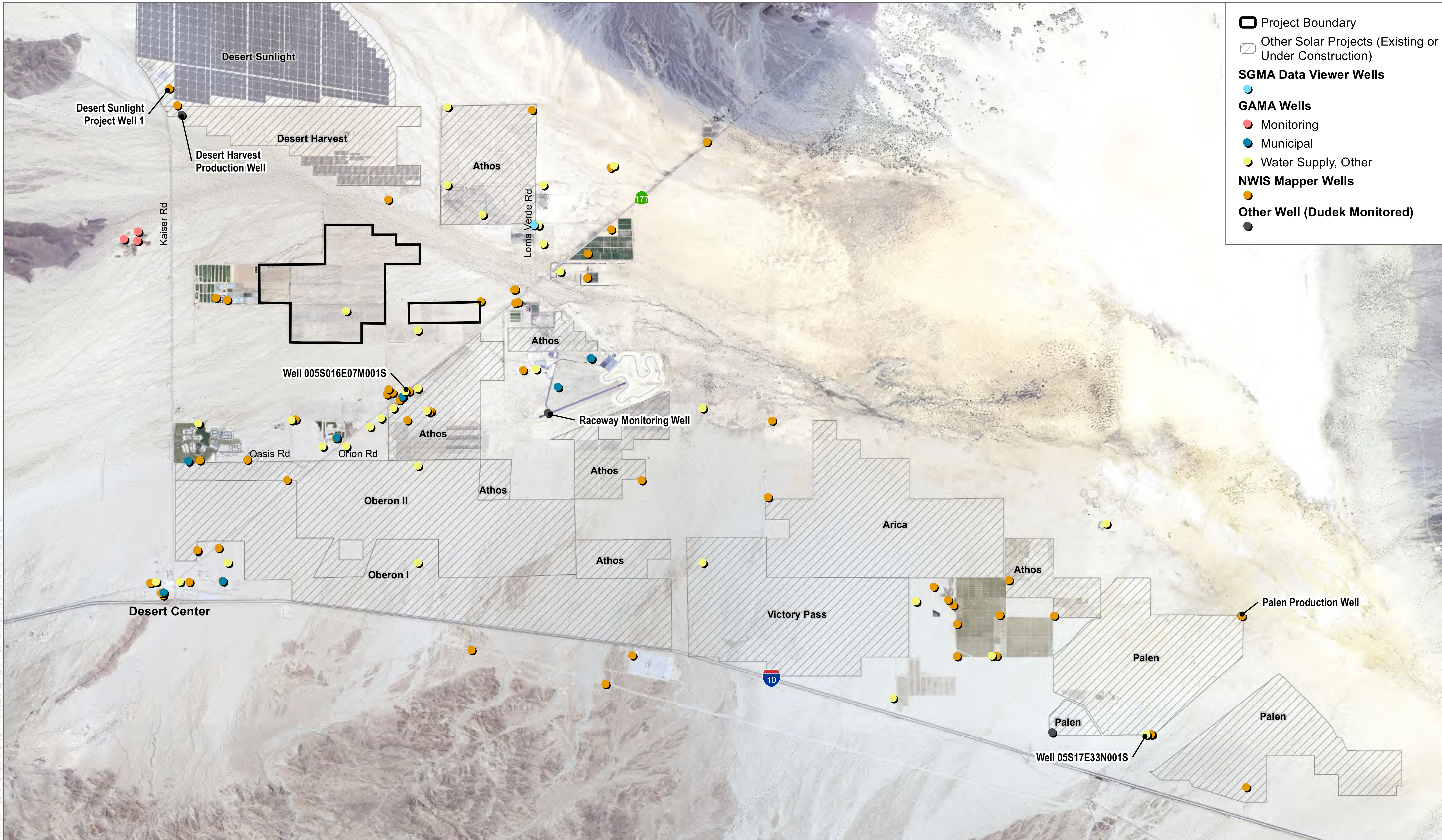

SOURCE: County of Riverside, USGS, DWR; SWRCB

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FIGURE 3

Groundwater Production and Monitoring Wells

Sapphire Solar Project

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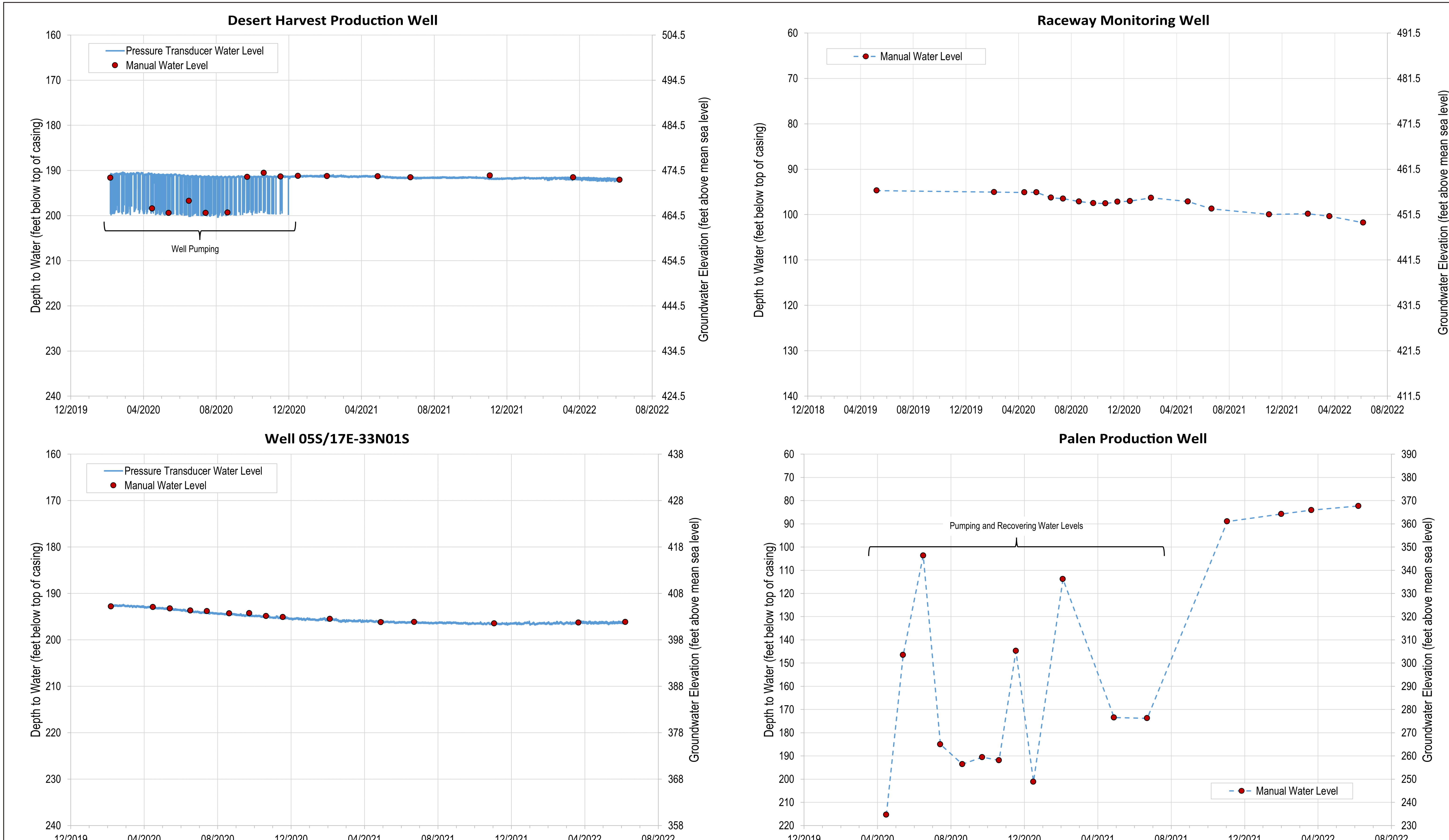

FIGURE 4

Groundwater Level Hydrographs

Sapphire Solar Project

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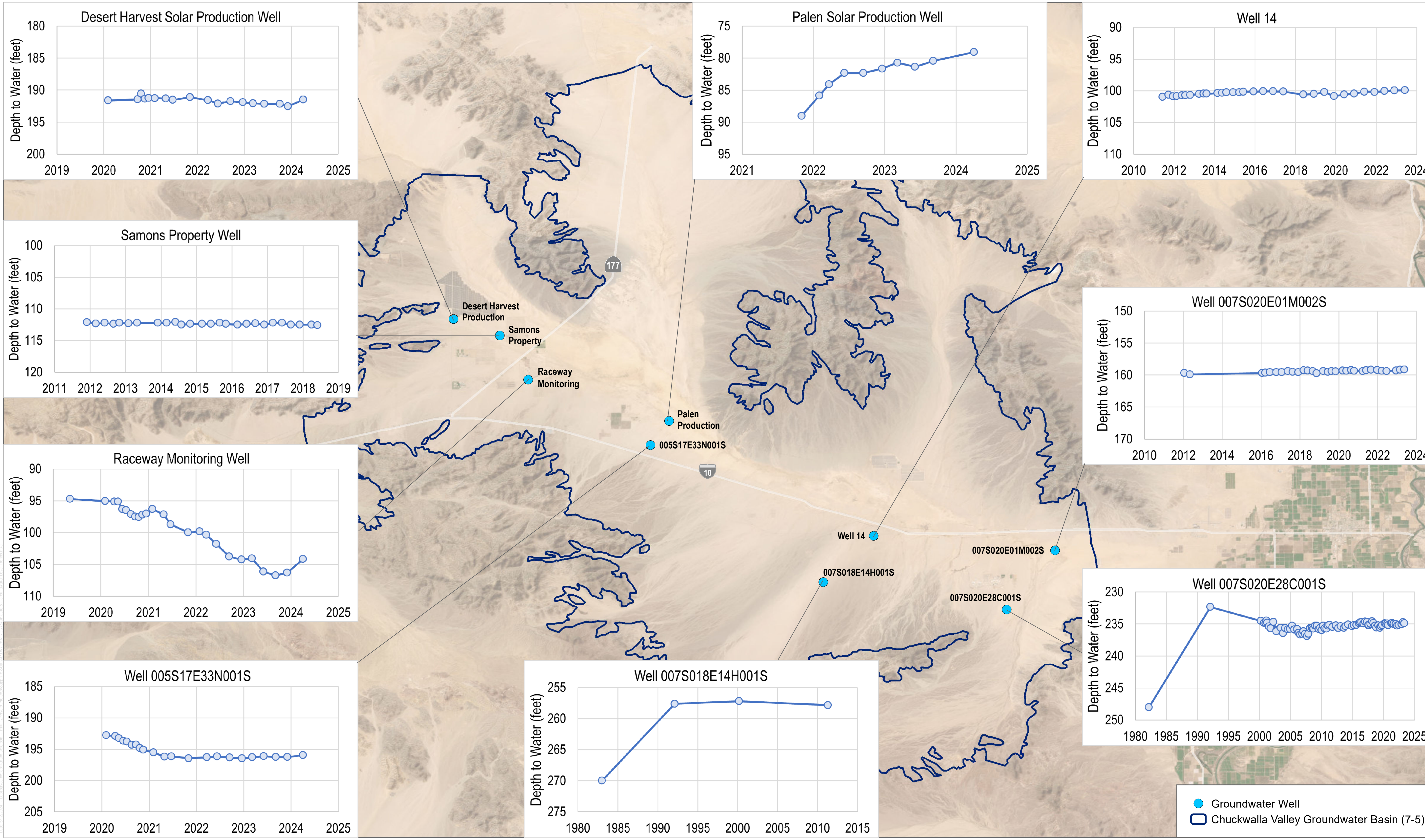

SOURCE: ESRI; DWR; USGS; Dudek; Northstar

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0 5 10 Miles

FIGURE 5

Chuckwalla Valley Groundwater Basin Groundwater Level Trends

Sapphire Solar Project

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