APPENDIX J-3

Flat Creek Groundwater Report

UPDATED DRAFT

Groundwater Resources Investigation Report – Flat Creek Watershed Analysis Jacumba Community Services District Jacumba Hot Springs, San Diego County, California

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GLOSSARY OF TERMS AND ACRONYM

afy	Acre-Feet per Year
amsl	Above Mean Sea Level
APN	Assessor’s Parcel Number
bgs	below ground surface
CIMIS	California Irrigation Management Information System
County	County of San Diego
DG	decomposed granite
DWR	California Department of Water Resources
ET	Evapotranspiration
GMMP	Groundwater Monitoring and Mitigation Plan
gpd	gallons per day
gpd/ft	gallons per day/foot
gpm	gallons per minute
IFSAR	Interferometric Synthetic Aperture Radar
MCL	Maximum Contaminant Level
µg/L	Micrograms per Liter
SGMA	Sustainable Groundwater Management Act
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey

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EXECUTIVE SUMMARY

In accordance with San Diego County Planning guidance, Dudek has prepared this groundwater resources investigation report to examine the potential impact of the Jacumba Community Services District (JCSD) extracting additional water supply on groundwater resources of the Jacumba Valley alluvial aquifer within Jacumba Hot Springs, California. The groundwater extracted by JCSD would be used as a non-potable supply for the construction of off-site renewable energy projects.

JCSD is proposing the use of the Highland Center Well with backup water provided by the Park Well to serve as non-potable supply for the construction of proposed renewable energy projects. This analysis addresses potential impacts on Jacumba Valley alluvial aquifer groundwater resources based on the production from the Highland Center and Park wells of up to 290 acre-feet over a period of one year. In addition, this analysis includes evaluation of cumulative projects obtaining water supply from the Jacumba Valley alluvial aquifer. Reasonably foreseeable projects include the proposed JVR Energy Park, which is proposing to extract 112 acre-feet of groundwater for approximately one year of construction, 10 acre-feet per year (afy) for ongoing operations and maintenance and 50 acre-feet for decommissioning and dismantling from on-site groundwater wells. The significant results of the groundwater resource investigation report are as follows:

- The proposed non-potable groundwater extraction from the Highland Center Well with backup provided by the Park Well is 290 acre-feet or 95 million gallons (rounded). Operations and maintenance water supplied by the JCSD would be up to 9.28 acre-feet a year, 2 acre-feet of which is for a renewable energy project that has already been constructed (Jacumba Solar).
- The current maximum pumping rate for the Highland Center Well and the Park Well is 174 gallons per minute (gpm) and 40 gpm, respectively.
- The current groundwater storage in the Jacumba Valley alluvial aquifer, including the portion of the alluvial aquifer located in Mexico, is estimated to be 9,005 acre-feet based on updated groundwater level data and updated interpreted depth to bedrock using additional well logs.
- The volume of groundwater storage would not be reduced to 50% or less than the current groundwater storage in the aquifer as a result of additional pumping from the Highland Center with backup supply provided by the Park Well.
- The proposed non-potable groundwater extraction for construction is 14% of the estimated maximum historical groundwater extracted in one year from the Jacumba Valley alluvial aquifer. The maximum production from the Highland Center Well and the Park Well with all other known groundwater users is 16% of the estimated historical groundwater extracted from the Jacumba Valley alluvial aquifer in one year.

- Drawdown at the nearest off-site well and potential groundwater-dependent habitat was estimated under a 1- and 5-year scenario for the Highland Center Well and Park Well separately. The Highland Center 1-year scenario estimated drawdown based on the maximum production rate of the well of 280 acre-feet per year. The Park Well 1-year scenario estimated drawdown based on pumping the well at a production rate of 20 gpm for one year, equal to 32 acre-feet. The 5-year scenario estimates drawdown based on the rates for each well used in the 1-year scenario plus 4 years of O&M demand including contractually obligated JCSD non-potable supply (9.28 afy).
- The estimated drawdown at the nearest off-site well, Well Km, under the 1-year scenario is 3.17 feet from pumping the Highland Center Well and would be 0.36 feet from pumping the Park Well if used as a backup supply well. The estimated drawdown under the 5-year scenario would be 0.81 feet from pumping the Highland Center Well and 0.18 feet from pumping the Park Well if used as a backup supply well. To evaluate mutual well interference, the drawdown estimated for the Highland Center and Park wells were combined. Thus, under the 1-year scenario, the combined drawdown at Well Km is estimated at 3.53 feet and 0.99 feet under the 5-year scenario. Based on the County of San Diego well interference threshold guidance for alluvial wells, this drawdown is less than significant.
- The estimated drawdown at the nearest groundwater-dependent habitat, southern riparian forest, under the 1-year scenario is 3.10 feet from pumping the Highland Center Well and would be 0.36 feet from pumping the Park Well if used as a backup supply well. The estimated drawdown under the 5-years scenario is predicted to be 0.80 feet from pumping the Highland Center Well and 0.18 feet from pumping the Park Well if uses as a backup supply well. To evaluate mutual well interference, the drawdown estimated for the Highland Center and Park wells were combined. Thus, under the 1-year scenario the combined drawdown at the nearest groundwater-dependent habitat is estimated at 3.46 feet and 0.98 feet under the 5-year scenario. Based on the County of San Diego groundwater-dependent habitat threshold guidance for alluvial wells, drawdown would could be significant under the 1-year scenario but would be less than significant under the 5-year scenario.
- The Highland Center Well and the Park Well are a non-potable water source; therefore, no water quality analysis was performed for this report. Groundwater from the Highland Center Well and the Park Well is suitable for non-potable use, based on historical water quality testing.

An updated Groundwater Monitoring and Mitigation Plan (GMMP) will be prepared for the proposed groundwater extraction from the Highland Center with backup provided by the Park Well, which details thresholds for off-site well interference, groundwater in storage, and groundwater dependent habitat. The updated GMMP will provide recommendations for ongoing groundwater level monitoring and will establish groundwater thresholds for off-site well interference, groundwater in storage, and groundwater dependent habitat.

1 INTRODUCTION

1.1 Purpose of the Report

This groundwater resources investigation was prepared by Dudek for submittal to County of San Diego (County) Planning and Development Services to satisfy groundwater resource investigation scoping requirements outlined in Guidelines for Determining Significance and Report Format and Content Requirements: Groundwater Resources (County of San Diego 2007). This groundwater resource investigation evaluates the use of up to 290 acre-feet (rounded) of non-potable groundwater from the Jacumba Community Services District's (JCSD) Highland Center Well with backup water supplied by JCSD's Park Well. In accordance with County Guidelines, the evaluation includes a groundwater in storage analysis and a 1-year and 5-year drawdown analysis of off-site well interference and groundwater-dependent habitat.

The results of this investigation should only be relied upon for the Projects listed and not be used in any other groundwater proposal subject to County review in Jacumba Hot Springs, California.

1.2 Project Location

The JCSD is located in Jacumba Hot Springs on the international border with Mexico in southeastern San Diego County, California (Figure 1). The JCSD service area in approximately 422 acres located south of Interstate 8, immediately north of the U.S./Mexico Border, and within the town of Jacumba Hot Springs (Figure 2). The Highland Center Well and the Park Well are located within assessor's parcel number (APN) 660-140-07, located on the south side of Old Highway 80 between Heber Street and Campo Street, within Jacumba Community Park (Figure 2). JCSD owns the parcel and operates the wells.

1.2.1 Study Area

The study area for the purpose of discussions of groundwater storage is the Quaternary alluvium, referred to as the Jacumba Valley alluvial aquifer. The study area for the purpose of discussions of recharge is the Flat Creek watershed (which includes the Blue Angel Peak subwatershed, an unnamed subwatershed, and a modified version of the Walker-Carrizo Canyon subwatershed) (see Section 2.1). The study area for the purpose of well interference is the 0.5-mile radius around the Highland Center Well and the Park Well.

1.3 Project Description

JCSD is proposing the use of the Highland Center Well with potential backup supply provided by the Park Well to serve JCSD non-potable water to commercial customers. Based on foreseeable renewable energy projects, JCSD is proposing to extract up to 290 acre-feet of groundwater from the Highland Center and Park Wells for construction of five renewable energy projects. Construction groundwater extraction was analyzed over a period of 12-months in order to provide a conservative estimate of impacts as the timing of the five projects is uncertain. The JCSD is also proposing to supply a total of 9.28 acre-feet per year (afy) of operations and maintenance (O&M) water for these projects. Water demand for the proposed renewable energy projects and their proposed project construction duration is included in Table 1-1.

Table 1-1
Proposed Renewable Energy Projects Water Demand

Project Name[a]	Construction Water Demand (Acre-Feet)	Construction Water Demand (Million Gallons)	Project Construction Duration (Months)	O&M Demand (Acre-Feet per Year)
Boulder Brush[b]	50.03	16.3	9	0.00
Torrey Wind[c]	76.2	24.83	9	7.00
Campo Wind[d]	122.75	40	14	0.25
Rugged Solar[e]	36.50	11.89	9	0.00
Cameron Solar[f]	4.00	1.30	4[g]	0.03
TOTAL	**289.48**	**94.31**		**7.28**

O&M = Operations and maintenance.

a. The renewable energy projects listed in Table 1 are reasonably foreseeable though these projects are at different planning stages.
b. Boulder Brush is a component of the Campo Wind and Torrey Wind Projects. Boulder Brush would primarily source water for construction from JCSD with back-up water available from Padre Dam.
c. Torrey Wind is in an early planning stage and currently on hold but would primarily source water for construction from JCSD with back-up water available from Padre Dam. O&M water would be supplied from on-site well(s).
d. Campo Wind would primarily source water for construction from on-site wells. Back-up water supply would be available from JCSD and Padre Dam. O&M water would be supplied from on-site wells
e. Rugged Solar would primarily source water for construction from JCSD with back-up water available from Padre Dam. O&M water would be supplied form on-site well(s).
f. Cameron Solar would source construction water from JCSD or Padre Dam. O&M water for on-site water tanks used for fire suppression would be supplied from JCSD wells in the Flat Creek Watershed or others.
g. Construction duration of Cameron Solar project is estimated as a current project description is not currently available.

1.3.1 Groundwater Supply Wells

Both the Highland Center Well and the Park Well are non-potable supply wells screened in the Jacumba Valley alluvial aquifer. The Highland Center Well is completed to a depth of 124 feet below ground surface (bgs) with an 8.625 stainless steel casing and a screen interval of 75 to 115 feet bgs. It is estimated to have a production capacity of approximately 174 gpm based on aquifer test pumping. The Park well is completed to a depth of 124 bgs with a 4-inch PVC casing and a screened interval from 79 to 124 feet bgs. It is estimated to have a production capacity of approximately 80 gpm based on aquifer pump testing (Petra 2006, Dudek 2016c).

1.4 Applicable Groundwater Regulations

The County of San Diego Guidelines for Determining Significance and Report Format and Content Requirements: Groundwater Resources (County Guidelines) contain a series significance thresholds for groundwater quantity and groundwater quality (County of San Diego 2007). The County Guidelines contain the following guideline that, if met, would be considered a significant impact to local groundwater resources as a result of Project implementation.

To evaluate impacts to groundwater resources, a water balance analysis is typically required; the following guideline for determining significance is typically used (County of San Diego 2007):

> For proposed projects in fractured rock and sedimentary basins, groundwater impacts will be considered significant if a soil moisture balance, or equivalent analysis, conducted using a minimum of 30 years of precipitation data, including drought periods, concludes that at any time groundwater in storage is reduced to a level of 50% or less as a result of groundwater extraction.

To evaluate off-site well interference in alluvial wells as a result of this project, the following guideline for determining significance is typically used (County of San Diego 2007):

> As an initial screening tool, off-site well interference will be considered a significant impact if after a five year projection of drawdown, the results indicate a decrease in water level of 5 feet or more in the off-site wells. If site-specific data indicates alluvium or sedimentary rocks exist which substantiate a saturated thickness greater than 100 feet in off-site wells, a decrease in saturated thickness of 5% or more in the off-site wells would be considered a significant impact (County of San Diego 2007).

To evaluate groundwater quality impacts as a result of this project, the following guideline for determining significance is typically used (County of San Diego 2007):

> Groundwater resources for proposed projects requiring a potable water source must not exceed the Primary State or Federal Maximum Contaminant Levels (MCLs) for applicable contaminants. Proposed projects that cannot demonstrate compliance with applicable MCLs will be considered to have a significant impact. In general, projects will be required to sample water supply wells for nitrate, bacteria (fecal and total coliform), and radioactive elements. Projects may be required to sample other contaminants of potential concern depending on the geographical location within the County.

The Highland Center Well and the Park Well are a non-potable water source; therefore, the above guideline for determining significance for groundwater quality does not apply.

To evaluate impacts to groundwater-dependent habitat, the following guideline for determining significance is typically used (County of San Diego 2010a):

> The project would draw down the groundwater table to the detriment of groundwater-dependent habitat, typically a drop of 3 feet or more from historical low groundwater levels.[1]

The JCSD is a Water Service Agency regulated by the State Water Resources Control Board's Division of Drinking Water (formerly California Department of Public Health's Drinking Water Program). Thus, JCSD is not subject to the County's Groundwater Ordinance (County of San Diego, 2013).

The Jacumba alluvial aquifer is designated by the California Department of Water Resources (DWR) as the Jacumba Valley Groundwater Basin (7-047). The Sustainable Groundwater Management Act (SGMA) that was signed into law by Governor Brown in September 2014 requires sustainable management of all groundwater basins designated as medium- or high-priority by DWR. California's 515 groundwater basins are classified into one of four categories; high-, medium-, low-, or very low-priority based on components identified in the California Water Code Section 10933(b), including documented impacts on the groundwater within the basin. DWR assigned a very low-priority ranking to the Jacumba Valley Groundwater Basin. Very low-priority basins are currently not required to prepare a Groundwater Sustainability Plan under SGMA.

[1] Studies have found that groundwater elevation reductions adversely affect native plant species. Two of the referenced studies (Integrated Urban Forestry, 2001 and National Research Council, 2002) found that a permanent reduction in groundwater elevation of greater than three feet is enough to induce water stress in some riparian trees, particularly willow (*Salix* spp.), cottonwood (*Populus* spp.) and *Baccharis* species.

2 EXISTING CONDITIONS

2.1 Topographic and Hydrologic Setting

The Highland Center Well and Park Well are located within the Jacumba Valley in the southeastern corner of San Diego County which has an approximate elevation of 2,829 feet above mean sea level (amsl). The topography of the Jacumba Valley is generally flat and extends south across the border with Mexico. Adjacent mountains include Round Mountain (3,367 feet amsl) to the northwest and Grey Mountain (3,780 feet amsl) to the northeast. The Valley constricts to the north where it eventually terminates at Carrizo Canyon just north of Interstate 8. The elevations of the Highland Center Well and the Park Well are approximately 2,805 and 2,810 feet amsl, respectively.

The Jacumba Valley is located in the Upper Carrizo Creek Hydrologic Unit as defined by the USGS (Figure 3). The main contributing watershed to the Highland Center Well and Park Well is the Flat Creek watershed. The Flat Creek watershed does not include the Boundary Creek watershed, which is predominantly located in the United States. The Flat Creek watershed consists of approximately 52,405 acres, with 1,058 acres (2%) of the watershed located in the United States. The Flat Creek watershed ranges from 4,265 feet amsl at its headwaters along the Sierra Juarez Mountains to 2,777 feet amsl northeast of the Highland Center Well.

2.2 Climate

Jacumba experiences warm summer months and cool winters. Average temperatures vary greatly within the region. Mean maximum temperatures in the summer months reach the high-80s to low-90s (degrees Fahrenheit). Temperatures may fall below freezing in the winter, with snow levels occasionally below 2,500 feet (WRCC 2019).

Monthly precipitation records were obtained from the County of San Diego for a rain gauge previously located in Jacumba at 32°37' North latitude, 116°11' West longitude, and an elevation of 2,800 feet. The period of record available is from March 1963 until March 2011. Table 2-1 provides average monthly precipitation data, as well as the highest and lowest monthly precipitation for the Jacumba rain gauge (Allan 2013).

Table 2-1
Precipitation Data Recorded at Jacumba Rain Gauge

Month	Rainfall (inches) – 1963–2011		
	Average	*Highest/ Year*	*Lowest*[a]
January	1.45	5.79/ 1983	0
February	1.66	10.86/ 1993	0
March	1.82	6.76/ 1998	0
April	1.45	7.13/ 1991	0
May	0.50	2.38/ 1965	0
June	0.19	2.24/ 1981	0
July	0.06	0.96/ 1984	0
August	0.45	3.97/ 1984	0
September	0.50	3.48/ 1992	0
October	0.37	4.58/ 1976	0
November	0.60	4.37/ 2004	0
December	0.85	3.82/ 1965	0
Year	9.64	22.16/ 1982-83	2.26

Source: Allan 2013.
Notes: Jacumba rain gauge was located at N 32°37', W 116°11', at an elevation of 2,800 feet.
a. Jacumba rain gauge was active from 1963 to 2011.
b. Lowest monthly recorded precipitation data is not available due to data gaps.

For the period between 1963 through 2011, the average annual precipitation at the Jacumba rain gauge was approximately 9.64 inches with 85% of the precipitation occurring between October and April. Annual precipitation totals at the Jacumba rain gauge vary from a high of 22.16 inches in the 1982 – 1983 water year to a low of 2.26 inches in the 2001 – 2002 water year (Exhibit 2-A).

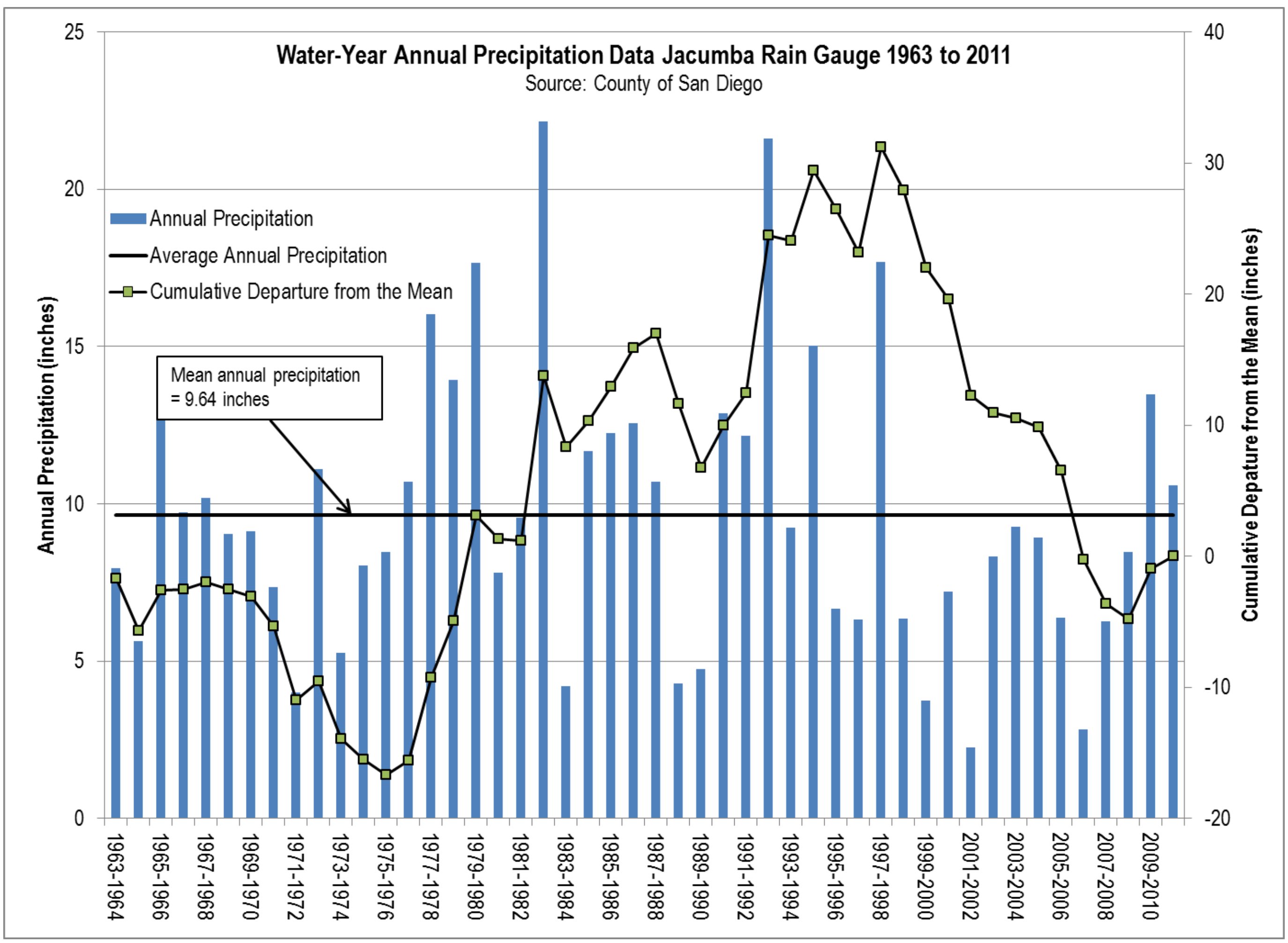
Precipitation records from four nearby rain gauges were reviewed in order to determine annual average rainfall within the vicinity of the Flat Creek watershed. The rain gauges are located in Boulevard (two stations), Tierra del Sol, and Jacumba. The location, elevation, years of operation, mean annual rainfall and source of data are provided in Table 2-2.

Table 2-2
Rain Gauges in Project Area

Station	Location	Elevation (feet amsl)	Years of Operation	Average Annual Rainfall (inches)	Source
Boulevard 1	N 32°40', W 116°17'	3,353	1924 to 1967	14.8	NOAA
Boulevard 2	N 32°40', W 116°18'	3,600	1969 to 1994	17.0	NOAA
Tierra del Sol	N 32°39', W 116°19'	4,000	1971 to 2017	10.8	County
Jacumba	N 32°37', W 116°11'	2,800	1963 to 2011	9.64	County

The isohyetal map of annual precipitation, developed by Swenson, shows that the majority of the Flat Creek watershed receives an average of 11 inches of precipitation per year (Figure 4). The lower elevations of the watershed receive an average of 9 inches of precipitation per year. This agrees with the average precipitation calculated for the Jacumba rain gauge between 1963 and 2011. The Jacumba rain gauge was located at the lowest elevation in the Flat Creek watershed. Mean annual precipitation, as determined from the County of San Diego map entitled "Groundwater Limitations Map" on file with the Clerk of the Board of Supervisors as Document No. 195172, indicates the Flat Creek watershed is located within a precipitation isohyetal of 9 to 14 inches (County of San Diego 2004). The County precipitation isohyetals roughly concur with those developed by Swenson (Figure 4).

Exhibit 2-A
Annual Precipitation Data Jacumba Rain Gauge 1963 to 2011



Notes: Station located at N 32°37', W 116°11' at an elevation of 2,800 feet and operated from 1963 through 2011.
Source: Allan, R. B., 2013.

According to the State of California Reference Evapotranspiration Map developed by the California Irrigation Management Information System (CIMIS), the JCSD is located in Evapotranspiration Zone 16, with an average of 62.5 inches of reference evapotranspiration (ETo) per year (CIMIS 1999). Table 2-3 presents ETo by month in CIMIS Zone 16. The annual 62.5 inches of ETo is based on potential evapotranspiration (ET) from turf grass/alfalfa crop, which assumes a continuous source of moisture and does not consider summer plant dormancy.

Table 2-3
California Irrigation Management Information System Zone 16 Reference Evapotranspiration

Month	ETo (inches)
January	1.55
February	2.52
March	4.03
April	5.7
May	7.75
June	8.7
July	9.3
August	8.37
September	6.3
October	4.34
November	2.4
December	1.55
Year	**62.51**

Source: CIMIS 1999

2.3 Land Use

According to the San Diego County General Plan, Jacumba Hot Springs is located within the Mountain Empire Subregional Plan area (County of San Diego 2011). Land use designations within a 0.5-mile radius of the Highland Center Well include: open space park or preserve, public services, communications and utilities, commercial retail, religious facility, single family residential, spaced rural residential, road right of way, and railroad right of way. Land Use designations within a 0.5-mile radius of the Park Well include: elementary school, open space park or preserve, public services, communications and utilities, commercial retail, religious facility, single family residential, spaced rural residential, road right of way, and railroad right of way (Figure 5). Adjacent current land uses are spaced rural residential, commercial retail, open space park or preserve, and single family residential. The parcel on which the Highland Center Well and Park Well are located is zoned as special purpose (S-80), with land use designation of public services, and is owned by JCSD.

Current land use within the Flat Creek watershed consists primarily of vacant, undeveloped land with the exception of the town of Jacume located south of the border in Mexico. The land outside Jacumba Hot Springs within the Flat Creek watershed is predominantly undeveloped land.

2.4 Water Demand

The current water demand for the Jacumba Valley alluvial aquifer includes potable demand for Jacumba Valley Ranch Water Company (formerly the Ketchum Ranch Water Company), and potable and non-potable demand from JCSD (Table 2-4).

The Jacumba Valley Ranch Water Company is classified as a transient non-community water system. According to County Department of Environmental Health Small Drinking Water System files, seven connections—three ranch homes, two gas stations, and two fire hydrants—are part of the Jacumba Valley Ranch water system (McCullough, pers. comm. 2015). Estimated water demands for the Jacumba Valley Ranch Water Company is 5 afy.

JCSD currently supplies potable water to 239 connections from JCSD Well #4 (Devine, pers. comm. 2019). JCSD's current water usage was not made available for this report, but historical water demand and water use calculations were used to estimate current demand. Based on available data from Barrett Consulting Group (Barrett 1996), JCSD produced between 86 and 146 acre-feet annually from 1991 to 1995, averaging 116 afy. More recent production data indicates that JCSD served 27.6 million gallons (85 acre-feet) of water from Well #4 in 2013 and 26.2 million gallons (80.4 acre-feet) from January 2014 through August 2014 to meet the water demands of the potable water system (Troutt, pers. comm. 2015). Based on the number of connections and an estimated 0.5 afy per connection, JCSD potable water demand is estimated to be 119.5 afy. This estimate roughly coincides with average historical water demand from 1991 to 1995, and conservatively overestimates production from more recent data received by the previous JCSD General Manager in 2014 (Troutt, pers. comm. 2015).

JCSD also supplies non-potable water for commercial sale. Historically, JCSD has supplied non-potable water from Well #6, a fractured rock well not screened in the Jacumba Valley alluvium. Beginning in 2016, JCSD began supplying non-potable water from the Highland Center Well and the Park Well, both screened in the Jacumba Valley alluvium. Non-potable water supply from JCSD varied based on customer demand. From February 2017 to February 2018, JCSD supplied 50.1 acre-feet from the Highland Center Well and 3.5 acre-feet from the Park Well. From February 2018 to January 2019, JCSD supplied 4 acre-feet from the Highland Center Well and 0 acre-feet from the Park Well. Maximum annual groundwater extraction from the Jacumba Valley alluvial aquifer by JCSD for non-potable water use is 53.6 afy.[2]

Based on the County Department of Environmental Health well completion report database, no additional active wells are located within the Jacumba Valley alluvium (County of San Diego 2018). Because there is the potential for active wells to exist without proper County Department of Environmental Health permitting, this report conservatively estimates six potential domestic wells that produce groundwater from the Jacumba Valley alluvial aquifer. Estimated water demands for the potential domestic wells is 3 afy, or 0.5 afy per well.

Agriculture located on the Jacumba Valley Ranch historically extracted the majority of groundwater from the Jacumba Valley alluvial aquifer. Currently no water is being extracted from the Jacumba Valley Ranch for these activities.

Table 2-4
Jacumba Valley Alluvial Aquifer Existing Water Demands

Groundwater Extraction Sources	Wells Names	Total Water Demand (acre-feet/year)
Jacumba Valley Ranch Water Co.	Well Km	5[a]
Jacumba Community Services District (JCSD) (potable)	Well 4	119.5[b,c]
JCSD (non-potable)	Highland Center Well, Park Well	53.6[d]
Potential Domestic Wells	Private Domestic Wells	3[e]
	Total Water Demand	**181.1**

a. Jacumba Valley Ranch Water Company has seven connections: three ranch homes, two gas stations, and two fire hydrants. No water demand was assigned to the fire hydrants. Water demand is estimated at approximately 1 acre-foot per connection.
b. Estimated based on 0.5 afy for 239 potable Jacumba Community Services District connections.
c. Beginning in late fall 2019, all potable groundwater production from Well 4 is expected to cease. Potable groundwater production will be sourced from Well 7 and 8, which are located in the fractured rock aquifer.
d. Maximum demand based on meter reads from February 2017 to February 2018.
e. Not all domestic wells are currently active or known; however, a consumptive water demand of 0.5 afy has been assigned to up to six potential domestic wells

2 Non-potable groundwater extraction from the Highland Center Well and the Park Well is based on totalizer readings collected during routine groundwater monitoring performed by Dudek staff as required for the Jacumba Solar Groundwater Monitoring and Mitigation Plan.

2.5 Geology and Soils

Geology

Jacumba Hot Springs is located on the eastern portion of the Peninsular Range geomorphic province, which consists of northwest-oriented mountain ranges separated by northwest trending fault-produced valleys, subparallel to faults branching from the San Andreas Fault. The regional geology of the Flat Creek watershed is depicted in Figure 6. Because much of the Project area is located south of the International Border, worldwide geologic data was used to depict geology south of the border (Garrity and Soller 2009).

The surface area of the Flat Creek watershed primarily consists of exposed Cretaceous plutonic rocks of the composite Peninsular Ranges Batholith. These plutonic rocks consist of the bedrock unit known as the tonalite of La Posta (also referred to as the La Posta Quartz Diorite) (USGS 2004). The Sierra Juarez Mountains, located on the southeastern side of the watershed in Mexico, consist of Mesozoic sedimentary rocks (Garrity and Soller 2009). Quaternary alluvium is present in low-lying areas in portions of the watershed including the Jacumba Valley (USGS 2004).

Jacumba Valley contains exposures of the Jacumba Volcanics and the Table Mountain Formation, overlain by Quaternary alluvium (Swenson 1981). Alluvial thickness in the center of Jacumba Valley is 100 to 150 feet, thinning towards the sides and ends of the valley (Swenson 1981). The Jacumba Volcanics are encountered below the Jacumba Valley alluvium as reported in numerous boring log reports (County of San Diego 2018; CRA 2012; Petra 2006). The Table Mountain Formation underlies the Jacumba Volcanics and is described as medium- to coarse-grained sandstone and conglomerate, and may reach up to 600 feet in thickness (Swenson 1981). The migmatitic schist and gneiss of the Stephenson Peak Formation outcrop just west of the valley (Swenson 1981; USGS 2004).

Soils

The type, areal extent, and key physical and hydrological characteristics of soils mapped on the United States side of the Flat Creek watershed were identified based on a review of soil surveys completed by the USDA, Natural Resources Conservation Service (NRCS 2018). Soil units are shown in Figure 7 and are described in Table 2-5. The permeability, specific retention, and active rooting depth of a given soil type control the percentage of precipitation that infiltrates the soil, satisfies the soil moisture deficit, and is available to recharge the groundwater aquifer.

Swenson (1981) provides a map and description of soil types on the Mexico side of the Flat Creek watershed based on representative soil samples and measurements of their porosity and specific retention.

Table 2-5
Soil Units within the Flat Creek Watershed

Map Unit, Soil Name	Acres (Percent of the Flat Creek Watershed)	Parent Material	Depth to restrictive layer (inches)	Hydrologic Groupa	Erosion Factor b
Soil Identification by USDA					
AcG, Acid Igneous Rock Land	0.4 (0.001%)	Acid igneous rock	0–4	D	—
CeC, Carrizo Very Gravelly Sand, 0-9% slope	1.9 (0.004%)	Alluvium derived from mixed igneous rocks		D	0.02
InA, Indio silt loam, 0-2% slope	63.1 (0.12%0	alluvium derived from igneous rock and mica schist		B	0.55
InB, Indio silt loam, 2-5% slope	79.1 (0.15%)	alluvium derived from igneous rock and mica schist		B	0.55
IoA, Indio silt loam, saline, 0-2% slope	14.9 (0.03%)	alluvium derived from igneous rock and mica schist		B	0.55
LcE2, La Posta Loamy Coarse Sand, 5-30% slope, eroded	43.9 (0.08%)	Residuum weathered from granodiorite	27	A	0.02
MnB, Mecca coarse sandy loam, 2 – 5% slopes	12.8 (0.02%)	alluvium derived from granite		A	0.20
RaC, Ramona sandy loam, 5-9% slopes	157.5 (0.30%)	alluvium derived from granite		C	0.32
RaD2, Ramona sandy loam, 9-15% slopes, eroded	6.5 (0.01%)	alluvium derived from granite		C	0.32
RkA, Reiff fine sandy loam, 0-2% slopes	171.4 (0.33%)	alluvium derived from granite		A	0.28
RsC, Rositas Loamy Coarse Sand, 2-9% slope	60.9 (0.12%)	Alluvium derived from granite		A	0.15
SrD, Sloping Gullied Land	126.3 (0.24%)			D	
SvE, Stony Land	320.4 (0.61%)	Mixed colluvium		D	
Subtotal	**1,059.1 (2.02%)**				

Table 2-5
Soil Units within the Flat Creek Watershed

Map Unit, Soil Name	Acres (Percent of the Flat Creek Watershed)	Parent Material	Depth to restrictive layer (inches)	Hydrologic Groupa	Erosion Factor b
Soil Identification by Swenson					
W, Sandy Alluvium	7,153.0 (13.65%)			B	
X, Metamorphic and Plutonic Residuum	43,555.9 (83.11%)	Metamorphic granitic rocks		D	
Y, Volcanic residuum and Fine sand alluvium	639.1 (1.22%)			A	
Subtotal	**51,348.0 (97.98%)**				
Total Acreage	**52,407.0**				

Notes:
[a] Hydrologic soil groups are used for estimating the runoff potential of soils on watersheds at the end of long-duration storms after a prior wetting and opportunity for swelling, and without the protective effect of vegetation. Soils are assigned to groups A through D in order of increasing runoff potential.
[b] Erosion factor Kw indicates the susceptibility of the whole soil to sheet and rill erosion by water (estimates are modified by the presence of rock fragments). The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and Ksat. Values of K range from 0.02 to 0.69. A range of values is given because map units are composed of several soil series.
Source: USDA 2015

2.6 Hydrogeologic Units

Boring logs were obtained for JCSD wells and select Jacumba Valley Ranch wells. The subsurface lithology within the vicinity of the Highland Center and Park Well consists of the following:

Alluvium: Alluvium up to a depth of 140 feet bgs was logged at JCSD Well 2 drilled approximately 2,200 feet east of the Park Well (Swenson 1981). The depth of alluvium at the Highland Center Well is 175 feet (Dudek 2016a). The depth of the alluvium at the Park Well is 124 feet (Petra 2006).

Jacumba Volcanics (Tv): Hard crystalline volcanic rocks form portions of the hills along the western and eastern sides of Jacumba Valley. Jacumba Volcanics have been encountered underlying the alluvium in boreholes drilled for JCSD Well 1 and the Park Well at depths of 124 feet bgs and 127 feet bgs, respectively. Jacumba Volcanics were encountered at a depth of 80 feet bgs in Chevron Service Station Well MW-9. The thickness of the Jacumba Volcanics is estimated to be up to 60 feet based on geophysical logs (Barrett 1996).

Decomposed Granite (DG): Decomposed granite (DG), ranging from 13 to 40 feet in thickness, was logged up to 80 feet bgs in JCSD Wells 6, 7 and 8 and in monitoring wells drilled approximately 1,200 feet west of the Park Well (CRA 2012).

Granitic Bedrock: The crystalline bedrock is predominantly composed of granodiorite with tonalite outcrops present throughout the Flat Creek watershed. Extensive fractures were logged up to a depth of 500 feet bgs while drilling JCSD Wells 7 and 8. Regional lineaments that trend both northwest–southeast and west–east as depicted on the interferometric synthetic aperture radar (IFSAR) digital ortho-photography (Figure 8) also indicate extensive fracturing.

2.7 Hydrogeologic Inventory and Groundwater Levels

Published well logs were reviewed to locate wells and refine the thickness of hydrologic units present within the Jacumba Valley alluvial aquifer. Table 2-6 provides a summary of the information available from driller well logs obtained to date. Well information has been updated based on field reconnaissance and/or historical data. Figure 9 includes the locations of select wells.

Table 2-6
Jacumba Valley Well Inventory

Well Number	Well Depth (feet bgs)/ (Year Drilled)	Depth to Water (feet btoc)/date	Approximate Production Capability (gpm)	Alluvium/ Residual Soil (feet bgs)	Bedrock Depth (feet bgs)/ (Type)
Jacumba Community Services District Wells					
JCSD 1[a]	124 (1956)	43.0; 10/1955	148	120	124 (volcanic)
JCSD 2	140 (1963)	72.13; 11/1979	-	140	-
JCSD 3	79	-	-	-	-
JCSD 3A	49	-	-	49	-
JCSD 4	39	20.66; 6/26/2018	175[b]	0-39[c]	-
JCSD 5	-	-	-	-	-
JCSD 6	465 (2003)	5.50; 6/26/2018	600+	-	-
JCSD 7	518 (2008)	31.20; 6/26/2018	300+	0-10	10-23 (granitic)
JCSD 8	518 (2009)	31.02; 6/26/2018	275+	0-42	42-55 (granitic)
MW-3	84.5 (2007)	28.0; 3/2009	Monitor well	0-30	30-80 (granitic)
Park Well	124 (2005)	59.74; 6/26/2018	80	0-127	127 (volcanic)
Highland Center Well	125 (2016)	56.98; 6/26/2018	174	0-175	182 (granitic)
Jacumba Valley Ranch Wells					
K	102+ (1960s)	-	-	-	-
K1	110 (1950s)	42.3; 9/6/1980	-	106	-
K2	103 (1950s)	41.0; 4/1958	-	103	-
K3	117 (1950s)	8.5; 2/1996	1,000	-	-
K4	109 (1950s)	9.9; 3/1994	908	-	-
Daley Well	150 (Unknown)	36.94; 10/2018	-	-	-
Well #1	124 (Unknown)[e]	59.99; 10/2018	148	120	124 (volcanic)
Well #2	114 (2007)[e]	46.56; 10/2018	2,000[d]	113	-

Table 2-6
Jacumba Valley Well Inventory

Well Number	Well Depth (feet bgs)/ (Year Drilled)	Depth to Water (feet btoc)/date	Approximate Production Capability (gpm)	Alluvium/ Residual Soil (feet bgs)	Bedrock Depth (feet bgs)/ (Type)
Well #3	100 (2005)[e]	38.96; 10/2018	2,000[d]	112	-
Central Irrigation Well	100 (Unknown)[e]	46.56; 10/2018	-	-	-
Mid Valley Well	90.7 (Unknown)[e]	48.72; 10/2018	-	-	-
Carrizo Gorge Well	-	80.22; 7/2018	-	-	-
Ketchum Ranch Water Co. Well	150 (130 silted)	51.62; 7/2018	33.7	-	-
Test Well 1 JVR	82 (1990)	2; 5/1990	225	75	-
P-1	-	-	Monitoring well	-	-
P-2	23.72[e]	Dry; 7/30/2018	Monitoring well	-	-
P-3	30.92[e]	Dry; 7/30/2018	Monitoring well	-	-
P-4	33.71[e]	Dry; 7/30/2018	Monitoring well	-	-
P-5	27.3[e]	Dry; 7/30/2018	Monitoring well	-	-
P-6	32.26[e]	Dry; 7/30/2018	Monitoring well	-	-
P-7	38.8[e]	Dry; 7/30/2018	Monitoring well	-	-
P-8	39.3[e]	Dry; 7/30/2018	Monitoring well	-	-
P-9	60.17[e]	Dry; 7/30/2018	Monitoring well	-	-
Other Wells					
R1	137	-	-	-	-
R2	400	-	-	-	-
(Abandoned Well near R2)	Abandoned (1979)	-	-	-	150-492 (Sandstone)
T5		-	-	-	-
T8	-	-	-	-	-
T1	-	-	-	-	-
RM	34	-	-	-	-
Spa Well	200 (1955)	-	-	-	-
Daley Construction Well	230 (NA)	-	-	-	-
Former Chevron Service Station 20-5934					
MW-8S	50 (2007)	-	-	81.5+	-
MW8-D	80 (2007)	-	-	81.5+	-
MW-9S	50 (2007)	-	-	80	80 (Volcanics)
MW-9D	80 (2007)	-	-	80	80 (Volcanics)
MW-10	57 (2007)	-	-	50+	-
MW-11	80 (2007)	-	-	80+	-

Table 2-6
Jacumba Valley Well Inventory

Well Number	Well Depth (feet bgs)/ (Year Drilled)	Depth to Water (feet btoc)/date	Approximate Production Capability (gpm)	Alluvium/ Residual Soil (feet bgs)	Bedrock Depth (feet bgs)/ (Type)
MW-12	80 (2012)	-	-	40	40 (DG to 80.5)
MW-13	80 (2012)	-	-	81+	-
MW-14	81 (2012)	-	-	80.5+	-
B-10	(2012)	-	-	55.5+	-
B-11	(2012)	-	-	66.5+	-
B-12	(2012)	-	-	57	57 (DG to 70)

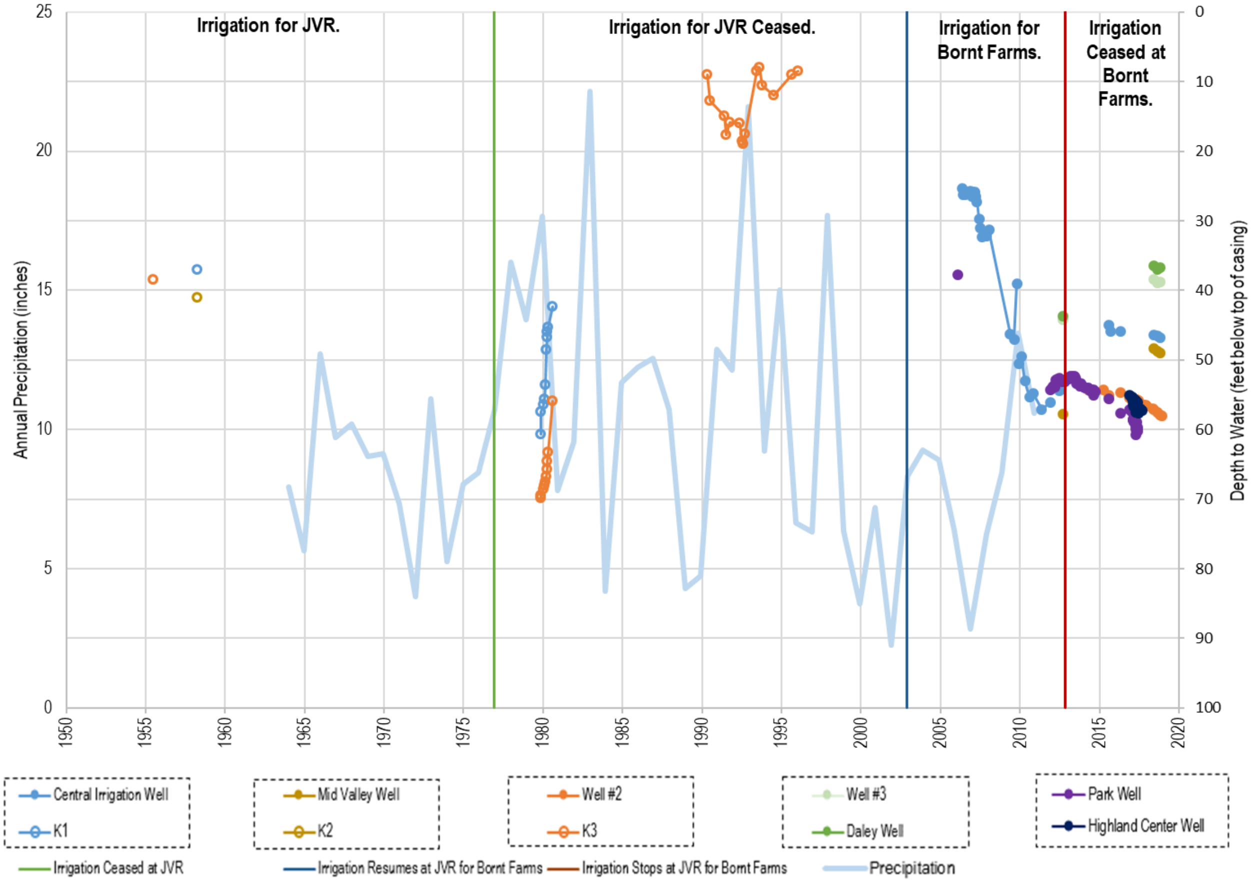
Sources: Barrett 1996; Pape 2015; Petra 2006; Swenson 1981; GRA 2012
bgs = below ground surface; btoc = below top of casing; gpm = gallons per minute; JCSD = Jacumba Community Services District; NA = not available; DG = decomposed granite

a. JCSD Well 1 is also referred to as JVR Well #1 and is included under both sub-headers in the table.
b. Reported pumping capacity provided by JCSD.
c. Alluvial depth based on total depth of Well #4.
d. Pumping rate based on airlifting by driller.
e. Based on field reconnaissance conducted in 2018 by Dudek staff.

Groundwater level data were obtained from JCSD from January 2012 through June 2018 (Devine, pers. comm. 2019; Troutt, pers. comm. 2015). Groundwater level data were also obtained from Barrett Consulting Group (1996), Peterson (2014), and Swenson (1981). Historical groundwater level data were available for Jacumba Valley as far back as 1955, but a continuous water level record was not available. Groundwater levels were recently measured by Dudek in July, October, and December 2018.

Fluctuations in groundwater levels in the Jacumba Valley alluvial aquifer result from both groundwater production and cycles of wet and dry climatic periods. Historical groundwater measurements from wells K1, K2, and K3 were used to represent trends associated with previous land use on the Project site (Exhibit 2-B). Wells K1, K2, and K3 have the closest geographical relationship to the Central Irrigation Well, Mid Valley Well, and Well #2, respectively.

Exhibit 2-B
Jacumba Valley Alluvial Aquifer Groundwater Level Data July 1955 to December 2019



Sources: Barrett 1996; Pape 2015; Peterson 2014; Swenson 1981.
Note: Boxes outlined by dashes represent wells in similar geographical locations.

Groundwater levels have fluctuated up to 61 feet in Well K3. When Well K3 was initially drilled in 1955, the groundwater level was 38.5 feet below ground surface (bgs). From 1932 to 1977, Jacumba Valley Ranch extracted on average 2,066 afy from the Jacumba Valley alluvial aquifer (Barrett 1996). Jacumba Valley Ranch pumping, in combination with lower than average precipitation in the late 1960s through the mid-1970s (see declining cumulative departure from mean precipitation in Exhibit 2-A), resulted in a groundwater level decline in the Jacumba Valley alluvial aquifer (Exhibit 2-B). Irrigation of agricultural lands ceased on Jacumba Valley Ranch in approximately 1977. In 1979, the groundwater level in Well K3 was 69.9 feet bgs (more than 30 feet lower than initial water level recorded in 1955). By 1990, groundwater levels had risen to near the surface in several Jacumba Valley alluvial aquifer wells (9 feet bgs in Well K3) because of higher recharge rates during a period of above-average precipitation in the late 1970s to mid-1980s (see ascending cumulative departure from mean precipitation in Exhibit 2-A) and low groundwater extraction during this time period.

Groundwater levels from the Central Irrigation Well declined from 2006 to 2011. This decline coincided with a lower than average rainfall period from 1999 to 2008 and the extraction of approximately 741 afy of groundwater by Bornt Farms. Groundwater levels began to rise after Bornt Farms ceased groundwater extraction in 2013. The current gradual declining trend in groundwater levels, shown in Well #2, can be attributed to lower than average rainfall years and recent extraction from JCSD non-potable wells. The groundwater level in Well #2 is currently 11.9 feet above the historic low groundwater level observed in Well K3, located near Well #2.

2.8 Water Quality

JCSD supplies non-potable water from the Highland Center Well and the Park Well, and potable water from Well #4. A water quality sample collected from the Highland Center Well in 2016 had a measured total dissolved solids concentration of 400 milligrams per liter. A wide range of constituents, including general minerals, inorganic minerals, and volatile organic compounds, were analyzed. Laboratory results indicated that no volatile organic compounds were detected and that groundwater produced from the Highland Center Well is suitable for construction water supply (Dudek 2016a). The Park Well was initially intended for use as a potable water well; however, low concentrations of volatile organic compounds were detected during drilling. Toluene was detected at concentrations of 291 micrograms per liter (µg/L), 199 µg/L, and 520 µg/L in water quality samples collected from the Park Well in 2006 (Petra 2006). A subsequent water quality sample was collected from the Park Well on November 5, 2015, by Dudek staff. Results from the sample collected on November 5, 2015, indicated no detections above the reporting limits for all constituents analyzed, including toluene, which was previously detected in the Park Well above the drinking water maximum contaminant level of 150 µg/L. It is possible that the toluene was introduced into the Park Well as a result of drilling or from chemicals (Scothchkote™) used in splicing the submersible cable for installation of the submersible pump and motor when the well was originally tested. Dudek has previously detected toluene in other water wells after the use of Scothchkote (EnviroMatrix Analytical 2015).

Since both the Highland Center Well and the Park Well are non-potable groundwater supply wells, water quality samples were not collected for this report.

3 WATER QUANTITY IMPACTS ANALYSIS

This section discusses the potential impacts on local groundwater resources in terms of the County Guidelines (County of San Diego 2007).

3.1 50% Reduction of Groundwater Storage

To apply the County methodology for determining a 50% reduction in groundwater storage to a given well, the area of the aquifer that can be accessed by a pumping well must be defined. For this analysis, the 2,061-acre extent and variable thickness of the alluvium underlying the Jacumba Valley as defined by Swenson (1981) was used to perform the 50% reduction in storage analysis (Figure 10).

3.1.1 Guidelines for Determination of Significance

The following requirement is set forth in the County Guidelines (County of San Diego 2007):

> For proposed projects in fractured rock and sedimentary basins, groundwater impacts will be considered significant if a soil moisture balance, or equivalent analysis, conducted using a minimum of 30 years of precipitation data, including drought periods, concludes that at any time groundwater in storage is reduced to a level of 50% or less as a result of groundwater extraction.

A Project-specific soil-moisture-based water balance was not performed for the Highland Center Well or the Park Well. Instead, an updated estimate of groundwater in storage was made based on previous work conducted by Roff and Fanzone (1994) and Swenson (1981). The estimate evaluated whether the water demands would maintain at least 50% groundwater in storage over the 2,061-acre Jacumba Valley alluvial aquifer (mapped by Swenson 1981). Additionally, a one-time extraction of up to 290 acre-feet over a 1-year period from JCSD non-potable wells was compared to historical groundwater extraction rates from the Jacumba Valley alluvial aquifer.

3.1.2 Methodology

3.1.2.1 Groundwater Recharge

Groundwater recharge was not calculated for the Flat Creek watershed and Jacumba Valley alluvial aquifer.

3.1.2.2 Groundwater Demand

Historical Demand

The groundwater demands of the Jacumba Valley alluvial aquifer vary with time. Historically, Jacumba Valley Ranch was the primary user of groundwater from the aquifer. Jacumba Valley Ranch produced water for irrigation of agricultural lands. From 1932 through 1977, Jacumba Valley Ranch extracted on average 2,066 afy of groundwater (Barrett 1996). Irrigation ceased on Jacumba Valley Ranch and the agricultural lands were fallowed from about 1977 until 2002. From 2002 until 2013, Bornt Farms resumed irrigation at Jacumba Valley Ranch. The water demand of Bornt Farms was reported to be in excess of 1 million gallons per day (Pape, pers. comm. 2015). To determine the area of active irrigated agricultural land by year, historical aerial photographs were reviewed. Between 2002 and 2013, 187 to 465 acres of the Jacumba Valley Ranch was irrigated to grow predominantly lettuce and spinach (Google Earth 2015). Assuming a crop irrigation rate of 2.14 acre-feet per acre for lettuce, the maximum annual water demand of the lettuce crop at Bornt Farms would be 995 acre-feet (Barrett 1996; U.C. Davis 2011). Other estimates state that Bornt Farms extracted 7,413 acre-feet over the farm's lifetime, or an average of 741.3 afy.

Other groundwater users include the Jacumba Valley Ranch Water Company, which has historically extracted in excess of 242 afy (Barrett 1996). Groundwater extraction on the Mexican side of the border has historically been estimated to be 24 afy (Barrett 1996).

Since 1985, JCSD has extracted potable water from up to four groundwater wells within its approximately 423-acre boundary (LAFCO 2013). The water system includes storage of up to 638,000 gallons. As discussed in Section 2.4, Water Demand, historical potable water demand has been documented to be between 85 and 146 afy (Barret 1996; Trout, pers. comm. 2015).

As discussed in Section 2.4, JCSD has historically supplied non-potable water for commercial sale from Well #6 (a fractured rock well not screened in the Jacumba Valley alluvium) and the Highland Center Well and Park Well (both screened in the Jacumba Valley alluvium). Non-potable water supply from JCSD varies based on customer demand. Based on meter reads by Dudek staff, from February 2017 to February 2018, JCSD supplied 50.1 acre-feet from the Highland Center Well and 3.5 acre-feet from the Park Well. Maximum annual groundwater extraction from the Jacumba Valley alluvial aquifer by JCSD for non-potable water is 53.6 afy.

Current Demand

Current groundwater demand from the Jacumba Valley alluvial aquifer includes extraction by JCSD, Jacumba Valley Ranch Water Company, and a few potential domestic well owners. The

Jacumba Valley Ranch, which was historically produced an excess of 2,000 afy, no long extracts groundwater for agriculture but is in the process of obtaining a Major Use permit to construct a solar energy facility (JVR Energy Park). The Jacumba Valley Ranch Water Company, which has historically extracted in excess of 242 afy, currently supplies approximately 5 afy for three ranch homes, two gas stations, and two fire hydrants (Barrett 1996; McCullough, pers. comm. 2015).

JCSD continues to extract both potable and non-potable groundwater from the Jacumba Valley alluvial aquifer. As discussed in Section 2.6, JCSD is estimated to produce approximately 119.5 afy of potable water for 239 connections from Well #4, and 4 afy of non-potable water during 2018 from the Highland Center Well and Park Well (Devine, pers. comm. 2019).

There may be small volumes of groundwater (less than 3 afy) extracted from domestic wells located in the residential area in Jacumba Hot Springs.

Groundwater extraction is occurring from the fractured rock aquifer by JCSD, Jacumba Hot Springs Resort, and a few domestic well users on the outskirts of town. Since the Highland Center and Park Well extract groundwater from the Jacumba Valley alluvial aquifer, groundwater extraction from the fractured rock aquifer was not included in this analysis.

Future Demand

Future demand is expected to include JCSD potable and non-potable demand, Jacumba Valley Ranch Water Company, JVR Energy Park, and private domestic users. Potable groundwater use from JCSD, the Jacumba Valley Ranch Water Company, and private domestic users is expected to be similar to current conditions over the long-term.

Based on the current pump capacity of the Highland Center and Park Wells, maximum non-potable annual production from JCSD wells screened in the Jacumba Valley alluvial aquifer is 345 afy. This estimate is based on continuous pumping for 1 year at a maximum flow rate of 174 gpm and 40 gpm from the Highland Center Well and Park Well, respectively.

JCSD is currently completing a manganese water treatment system for Wells #7 and #8 that will ultimately serve all potable water demands for its customers (Dudek 2016b). This treatment system is expected to come online in November 2019. Once the treatment facility is operational, the JCSD water supply will be sourced from the fractured rock aquifer rather than the Jacumba Valley alluvial aquifer.

Jacumba Valley Ranch Water Company is expected to continue the estimated water use of 5 afy in the future.

The JVR Energy Park is proposing to extract 112 acre-feet for approximately 1 year during construction, 10 afy during operation, and 50 acre-feet for decommissioning once the project has reached its expected lifetime (i.e., approximately 38 years).

Potential water demands from proposed renewable energy projects are presented in Table 1-1. The proposed renewable energy projects have a construction demand of approximately 290 AF of water, with ongoing O&M water demand of approximately 7.28 afy once construction of all proposed projects is completed. In addition, the JCSD is currently committed to suppling the Jacumba Solar project with 2 afy of non-potable water for O&M.

Table 3-1 provides historical, current, and future water demand from the Jacumba Valley alluvial aquifer.

Table 3-1
Jacumba Valley Alluvial Aquifer Groundwater Demand

Land Use	Historical Water Demand (afy)	Current Water Demand (afy)	Future Demand for JCSD Non-potable Water (afy)	Future Maximum Demand (afy)	Future Demand During O&M (afy)
Jacumba Valley Ranch (Jacumba Valley Ranch; Bornt Farms; JVR Energy Park)	2,066; 741–995	0	112[a]	112	10
Jacumba Valley Ranch Water Company	242	5	5	5	5
Private Domestic[b]	3	3	3	3	3
JCSD (Potable)	80–146[c]	119.5	0[d]	119.5	0
JCSD (Non-Potable)	53.6	2[e]	290	345[f]	9.28[g]
Total Estimated Water Demand	**2,212[h]**	**129.5**	**410**	**584.5**	**27.28**

Source: Barrett 1996; Dudek 2015; Troutt, pers. comm. 2015;
afy = acre-feet per year; JCSD = Jacumba Community Services District

a. The JVR Energy Park is proposing to use 112 af for the construction of a solar energy facility. Although unlikely, groundwater extraction could occur for all proposed projects during the same time. O&M demand for JVR is proposed to be 10 afy.
b. Not all domestic wells are currently active or known; however, a consumptive water demand of 0.5 afy has been assigned to up to six potential domestic wells.
c. JCSD Wells #1 and #2 supplied all potable demands for the town of Jacumba Hot Springs until JCSD Wells #3 and #4 were drilled in the early 1970s.
d. Future JCSD potable water demand will be supplied from Wells #7 and #8, completed in the fractured rock aquifer.
e. Assumes current groundwater O&M demand based on metered data.
f. Assumes maximum groundwater extraction based on tested well yields from the Highland Center Well and the Park Well. This JCSD non-potable water use represents a one-time construction demand.
g. Total assumes 7 afy for Torrey Wind, 0.25 afy for Campo Wind, 2 afy for Jacumba Solar, and 0.03 afy for Cameron Solar.
h. Assumes maximum concurrent water demand from JCSD potable demand and Jacumba Valley Ranch.

Historically, groundwater demand from the Jacumba Valley alluvial aquifer has been estimated to be upwards of 2,066 afy. A drastic reduction in groundwater production has occurred since agriculture irrigation ceased on Jacumba Valley Ranch. The current groundwater demand from the Jacumba Valley alluvial aquifer is estimated to be 129.5 afy. A proposed future water demand of up to 290 acre-feet of water could be extracted from the Highland Center Well with back up provided by the Park Well for construction of renewable energy projects, with the total extraction potentially occurring within one year if all projects are constructed simultaneously. Additionally, the JVR Energy Park is proposing to extract 112 acre-feet for one year for construction, which, though unlikely, has the potential to occur at the same time as the proposed JCSD non-potable groundwater extraction. With all proposed uses, the proposed demand would result in a one-year extraction amount of 410 acre-feet from the Jacumba Valley alluvial aquifer.

Under the future maximum demand scenario, 112 acre-feet would be extracted for the proposed JVR Energy Park and the 345 acre-feet (the current maximum well capacity of the Highland Center and Park Well) would be extracted by JCSD for non-potable supply. This future maximum demand would result in a one-year extraction amount of 584.5 acre-feet from the aquifer, assuming other groundwater users continue their current estimated extraction amounts.

3.1.2.4 Groundwater in Storage

Groundwater in storage was calculated using estimates of the saturated aquifer thickness underlying the 2,060-acre area of the Jacumba Valley alluvial aquifer, as mapped by Swenson (1981). Aquifer thickness was updated from the Swenson groundwater storage compartments (A through E) with available well completion information. The estimated saturated thickness is based on recent groundwater levels measured in June and December 2018. The updated well completion information used to constrain aquifer thickness is provided in Table 3-2 and included in Appendix A, Well Completion Information. For compartments with multiple wells and groundwater level measurements, values were averaged to represent a non-uniform saturated aquifer thickness. In all cases, the average saturated thickness used to define groundwater in storage (Table 3-3) was less than the measured saturated thickness at each well (Table 3-2). For compartments in which no wells were located, groundwater levels were extrapolated from the nearest well (Table 3-3). Groundwater storage compartments and their representative wells are depicted in Figure 10. Specific yield was estimated based on historical and recent aquifer test analyses.

Table 3-2
Well Completion Information for Constraining Alluvial Saturated Thickness

Common Well Name	Source or County of San Diego Well Record Identification	Aquifer Thickness (feet)	Depth to Groundwater/ (feet below ground surface)	Depth to Groundwater Measurement Date	Saturated Thickness (feet)	Swenson Compartment (Swenson 1981)
JVR – Carrizo Creek	Lwell 6933	55	—	—	—	A
Leighton B-12	Leighton 1991a	20	—	—	—	A
Well #3	Lwel 16419	89	35.14	12/11/2018	50.26	C
Well #2	Lwel 1815	113	56.21	12/11/2018	55.27	C
Test Hole	Lwel 20450	100	—	—	—	C
Leighton B-2	Leighton 1991a	25	—	—	—	C
Central Irrigation Well	—	—	44.33	12/11/2018	—	C
Mid-Valley Well	—	—	47.42	12/11/2018	—	C
Well #1	—	124	57.87	12/11/2018	—	D
J2	Swenson 1981	120	—	—		D
Test Hole	Lwel 17922	108	—	—	—	D
Southwest Irrigation	Lwel 18031	86	—	—	—	D
Test Hole	Lwel 20411	150	—	—	—	D
Highland Center Well	Lwel 001506	175	56.98	6/26/2018	118.02	E
Park Well	—	—	59.74	6/26/2018	—	E
J3	Swenson 1981	60	—	—	—	E
J4	Swenson 1981	50	—	—	—	E

Notes: — = no information is available

Specific Yield (Storage Coefficient)

Previous estimates of specific yield for the Jacumaba Valley alluvial aquifer were made by Swenson (1981) and calculated from aquifer testing performed by Barrett (1996). The specific yield associated with the alluvium was conservatively estimated by Swenson (1981) to be between 5% and 10%. Barrett (1996) estimated specific yield to be 25% based on aquifer testing of Well K4, Test Well No. 1, and Well Km.

Storativity (storage coefficient) was recently calculated for two wells screened in the Jacumba Valley alluvial aquifer based on two constant-rate aquifer tests located on the Jacumba Valley Ranch (Dudek 2019a). The storage coefficient from one well (Well #2), located in compartment

D, ranged from 0.008 to 0.028. The storage coefficient from another well (Well #3), located in compartment C, was 0.2349 (Geosyntec 2012). Since the aquifer tests were conducted in the unconfined aquifer, the calculated storage coefficient is equivalent to the specific yield (Driscoll 1986). Values for the storage coefficient for unconfined aquifers range from 0.01 to 3 (Driscoll 1986). The calculated storage coefficients from the well located on the Jacumba Valley Ranch (Well #2 and Well #3) aquifer tests fall within this range.

Based on recent aquifer test analysis performed on wells on the Jacumba Valley Ranch within the Jacumba Valley alluvial aquifer, the specific yield ranges from 0.08% to 24%, with a mean value of 12% (Dudek 2019a, Geosyntec 2012). To provide a conservative estimate, a specific yield value of 10% was used for this analysis to calculate groundwater in storage.

Saturated thickness was calculated by subtracting the average alluvial thickness by recent depth to groundwater measurements recorded in 2018. Saturated thickness for each compartment was then multiplied by the compartments acreage and the 10% specific yield value to determine the groundwater in storage by compartment. Based on these calculations, the current groundwater in storage within the Jacumba Valley alluvial aquifer is estimated to be 9,005 acre-feet (Table 3-3).[3]

In comparison, groundwater in storage was estimated to range from 9,600 to 16,000 acre-feet by Roff and Fanzone (1994), and from 3,200 to 6,400 acre-feet by Swenson (1981).

Proposed groundwater production from the Highland Center Well with backup provided by the Park Well would be 290 acre-feet for approximately 1 year. Assuming no recharge to the aquifer, this would reduce groundwater in storage by 3.2%, which is substantially less than the 50% reduction in storage criteria. The estimated future demand from the aquifer with other groundwater users, including JCSD non-potable use from the Highland Center with backup provided by the Park Well, is 410 acre-feet, or a 4.6% reduction in estimated groundwater in storage. The estimated future maximum extraction by all known sources from the Jacumba Valley alluvial aquifer is 584.5 acre-feet, or a 6.5% reduction in estimated groundwater in storage.

[3] The estimate of 9,005 acre-feet of groundwater in storage in 2018 for the Jacumba Valley alluvial aquifer is an initial estimate based on available data, including well logs, water levels, and aquifer properties estimated by pump testing. The estimated storage in the Jacumba Valley alluvial aquifer may be revised as additional data is acquired.

Table 3-3
Jacumba Valley Alluvial Aquifer 2018 Groundwater in Storage Estimate

Alluvial Aquifer Compartments*	Area (acres)	Leighton Alluvial Thickness (1991) (feet)	Average Alluvial Thickness (feet)	Depth to Water 2018 (feet bgs)	Average Saturated Thickness (feet)	Specific Yield (unitless)	Storage (acre-feet)
A	240.94	50+	37.5	35.14	2.36	0.10	56.86
B	104.70	50+	50	35.14	14.86	0.10	155.58
C	439.40	120+	81.75	43.5	38.25	0.10	1,680.71
D	1,082.73	100+	117	57.87	59.13	0.10	6,402.18
E	193.61	80+	95.0	58.36	36.64	0.10	709.39
Total Groundwater in Storage (rounded acre-feet)							**9,005**

* **Compartment Details:**
A Aquifer thickness estimated from an average alluvial thickness observed in well log Lwel 6933 and B-12 (Leighton 1991a). Depth to water extrapolated from Well #3 (Lwel 16419)
B Aquifer thickness defined by Leighton 1991a. Depth to water extrapolated from Well #3 (Lwel 16419)
C Aquifer thickness estimated from Well #3 (Lwel 16419), Well #2 (Lwel 1814), Test Hole (L well 20450), and Leighton B-7 (Leighton 1991a). Depth to water averaged from Well #3 (Lwel 16419) and Well #2 (Lwel 1814).
D Aquifer thickness estimated from Well J2 (Swenson 1981), Test Holes (Lwell 17922 and 201411), and the Southwest Irrigation Well (Lwell 18031). Depth to water estimated from Well #1.
E Aquifer thickness estimated from the Highland Center Well (Lwell 001506), and Wells J3 and J4 (Swenson 1981). Depth to water estimated from an average of the Highland Center Well (Lwell 001506) and the Park Well

3.1.2.5 Long-Term Groundwater Availability (Sustainability)

Long-term groundwater availability was evaluated in context of the current available groundwater in storage, historical groundwater levels, and water demand. The volume of groundwater in storage varies depending on the rate of recharge and the volume of water pumped from storage (water demand). Sustainable groundwater availability is less than the historical average groundwater production rate of 2,066 afy from 1932 to 1977. This is observed during dry periods when the Jacumba Valley experienced groundwater overdraft, as indicated by declining groundwater levels in the alluvial aquifer wells (Exhibit 2-B). Pumping by Jacumba Valley Ranch between 2003 and 2013 also resulted in groundwater level declines in the alluvial aquifer. Bornt Farms grew lettuce and spinach on up to 465 acres, year-round, with an estimated maximum extraction rate of 995 acre-feet per year (Barrett 1996; UC Davis 2011). Due to Bornt Farms irrigation and below-average precipitation recorded in the contributing watersheds over the last decade, the water demands exceeded available recharge, resulting in groundwater level decline (Exhibit 2-B). Several years of drought and limited non-potable extraction by JCSD likely contributed to the current groundwater level decline.

The JCSD proposes to supply 290 acre-feet non-potable groundwater from the Highland Center Well with backup provided by the Park Well for 1 year. This one time use of groundwater for construction is approximately 14% of the estimated historical annual maximum groundwater extracted from the Jacumba Valley alluvial aquifer.

The future maximum groundwater extraction from all sources in the Jacumba Valley alluvial aquifer is estimated to be 584.5 acre-feet for one year, which is 28% of the estimated historical annual maximum groundwater extraction in the Jacumba Valley alluvial aquifer. This maximum groundwater extraction amount would be a one-time demand during the construction of various renewable energy projects.

3.1.3 Significance of Impacts Prior to Mitigation

The results of the analysis show that historical groundwater extraction rates of 995 to 2,066 afy resulted in groundwater overdraft during dry climatic periods such as those experienced from 1963 to 1976, and 1998 through 2008. Between 1955 and 1978, in conjunction with high pumping rates and low recharge rates, groundwater levels in the Jacumba Valley alluvial aquifer decreased by approximately 30 feet. The groundwater overdraft and storage reduction observed in the Jacumba Valley alluvial aquifer between 1938 and 1978 was alleviated, however, by 1993 when groundwater levels recovered to within 8 feet of land surface at Well K3 (Exhibit 2-B). This data shows that aquifer recharge is as important as groundwater withdrawal for maintaining adequate storage in the aquifer.

The groundwater extraction from the Highland Center Well with backup provided by the Park Well of 290 acre-feet for approximately one year is 14% of the total estimated maximum production from the entire Jacumba Valley alluvial aquifer. Assuming no recharge to the aquifer, this proposed groundwater extraction amount from the Highland Center Well and Park would reduce groundwater in storage by 3.2%. The estimated total maximum groundwater extraction from the Jacumba Valley alluvial aquifer is 584.5 acre-feet, or 6.5% of estimated groundwater in storage.

3.1.4 Mitigation Measures and Design Considerations

Actual conditions during groundwater extraction for the Highland Center Well with backup provided by the Park Well may vary from the above analysis. The existing Groundwater Monitoring and Mitigation Plan (GMMP) will be updated to ensure that pumping does not significantly impact existing well users. The updated GMMP will provide for monitoring the duration and rate of Project pumping to document the total volume of groundwater extracted. The updated GMMP will also provide for monitoring groundwater levels from Project pumping and monitoring wells.

3.1.5 Conclusions

The proposed Project would have a less-than-significant impact to groundwater in storage, as defined by the County Guidelines (County of San Diego 2007). The proposed groundwater extraction amount of 290 acre-feet for approximately one year from the Highland Center Well with backup provided from the Park Well would equate to a 3.2% reduction in estimated groundwater storage. This value is far less than the County’s significance criteria of 50%.

Total estimated groundwater extraction from the Jacumba Valley alluvial aquifer, including the maximum production from JCSD non-potable wells and all proposed projects would reduce estimated groundwater in storage by 6.5%, and would be 28% of the estimated historical maximum groundwater extraction.

3.2 Well Interference and Groundwater Dependent Habitat

3.2.1 Guidelines for Determination of Significance

3.2.1.1 Well Interference

The following significant impact requirements are set forth in the County of San Diego Guidelines (County of San Diego 2007):

> *Alluvial Well:* As an initial screening tool, off-site well interference will be considered a significant impact if after a five year projection of drawdown, the results indicate a

> decrease in water level of 5 feet or more in the off-site wells. If site-specific data indicates alluvium or sedimentary rocks exist which substantiate a saturated thickness greater than 100 feet in off-site wells, a decrease in saturated thickness of 5% or more in the off-site wells would be considered a significant impact.

According to the County Groundwater Geologist, the primary author of the County of San Diego Guidelines, the intent of the above guideline was to cover projects that have continual ongoing water uses that remain static over time (Bennett, pers. comm. 2015). Historically, this has been the case for the vast majority of groundwater-dependent projects processed by the County. The JCSD, however, proposes to use variable quantities of water, with intensive pumping over short periods. The intensive pumping during short periods may cause direct well interference impacts. Therefore, to evaluate potential impacts from short-term pumping of groundwater, the County Groundwater Geologist has requested a short-term drawdown analysis, in addition to the 5-year projection of drawdown, to evaluate the potential impacts from operating at the highest rate of pumping (Bennett, pers. comm. 2015).

Potential well interference impacts caused by groundwater extraction from the Highland Center Well with backup provided from the Park Well were evaluated over a 0.5-mile radius from the well. Table 3-4 lists off-site wells within 0.5-mile radius of the Highland Center and Park Well.

Table 3-4
Alluvial Aquifer Wells Within 0.5-Mile Radius of Extraction Wells

Well Name	Use	Distance from the Highland Center Well (feet)	Distance from the Park Well (feet)
Gas Station Well	Monitoring	966	505
Well Km	Small Water System	1,553	1,567
JVR Well 2	Private/Production	1,987	2,450
JCSD Well 4	Public/Potable	2,585	2,128
Border Patrol Well	Federal/Inactive	2,316	2,637

3.2.1.2 Groundwater-Dependent Habitat

Guideline 4.2.C from the County of San Diego Guidelines for Determining Significance and Report Format and Content Requirements: Biological Resources defines the following threshold for determining a significant impact to riparian habitat or a sensitive natural community (County of San Diego 2010a):

> The project would draw down the groundwater table to the detriment of groundwater-dependent habitat, typically a drop of 3 feet or more from historical low groundwater levels.[4]

Potential groundwater-dependent habitats present near the Highland Center Well and Park Well are depicted in Figure 11. The location and type of groundwater-dependent habitat was reviewed based on two sources; (1) the Ecological Vegetation Communities' data set, and (2) biological field surveys conducted by Dudek biologist for the JVR Energy Park project located adjacent to the Highland Center and Park Well (SanGIS 2017; Dudek 2019b). Both data sets were used to identify the nearest potential groundwater-dependent habitat to the Highland Center Well and Park Well (Table 3-5). The nearest groundwater-dependent habitat to the Highland Center Well and Park Well is southern riparian forest located 1,720 and 1,570 feet north, respectively.

Southern riparian forest is a broad description of riparian forest habitat that cannot be differentiated into a more distinct type of riparian forest habitat. These habitats are found along streams and river. The characteristic plant species are the California sycamore (*Platanus racemosa*), cottonwood (*Populus* spp.), and other wetland plants (Oberbauer 2008).

Table 3-5
Groundwater-Dependent Habitat Within 0.5-Mile Radius of Extraction Wells

Well Name	Source	Distance from the Highland Center Well (feet)	Distance from the Park Well (feet)
Southern Riparian Forest	SanGIS	1,720	1,570

SanGIS = San Diego Geographical Information Source.

3.2.2 Aquifer Testing Methodology

The following sections describe the procedures followed during the aquifer testing of the Highland Center Well. The purpose of the aquifer tests was to obtain an approximate long-term production rate for the well and to estimate aquifer properties for distance drawdown calculations.

4 Historical groundwater level hydrographs compiled by the Jacumba Community Sponsor Group –Town Center Well Hydrographs from 1990 to 2008 indicate up to 20 feet of groundwater level decline in one well during this period of measurement (Figure 2-58; County of San Diego 2010b). Historical groundwater level monitoring for JCSD Well 4 from 1990 to 2008 indicates up to 20 feet of groundwater level decline during the period of measurement.

3.2.2.1 Well Test Description

Highland Center Well

A 24-hour constant rate aquifer test was performed at the Highland Center Well by Fain Drilling and Pump Company on October 12, 2016 at an average pumping rate of 174.2 gpm.

3.2.2.2 Well Test Analysis

After 24-hours of continuous groundwater extraction, the observed groundwater level drawdown was 24.66 feet at the Highland Center Well (pumping well) and approximately 1.85 feet in the Park Well (observation well, located 483 feet away). Drawdown in the Highland Center Well and the Park Well are shown in Figures 12 and 13, respectively.

Transmissivity

Aquifer transmissivity (the rate at which water flows through a vertical strip of the aquifer 1-foot wide and extending through the full saturated thickness, under a hydraulic gradient of 1 or 100%) is calculated using the Cooper–Jacob approximation to the Theis equation (Cooper and Jacob 1953) as follows:

$$T = \frac{2.303Q}{4\pi\Delta s}$$

Where:

T = transmissivity (feet^2/day) [multiply by 7.48 to get units of gpd/foot]
Q = average pumping rate (feet^3/day) [multiply gpm by 192.5]
π = pi (3.14)
Δs = difference in drawdown over one log cycle (feet)

The transmissivity (T) calculated by performing the Cooper-Jacob approximation to the Theis equation, using data collected in the pumping well, is 748 square feet per day (ft^2/day) or 5,599 gpd/ft (Figure 12). The transmissivity calculated by performing the Cooper-Jacob approximation to the Theis equation, using data collected in the observation well is 10,242.8 ft^2/day or 76,616.1 gpd/ft (Figure 13).

Storativity

The aquifer coefficient of storage (also called storativity) is the volume of water released from storage per unit decline in hydraulic head in the aquifer per unit area of the aquifer. Due to well loses and inefficiency of the pumping well, an observation well is required to calculate the coefficient of storage. The coefficient of storage from the aquifer test was estimated using the Cooper-Jacob approximation to the Theis non-equilibrium flow equation (Cooper and Jacob 1953) as follows:

$$S = \frac{2.25Tt_0}{r^2}$$

Where:

S = Coefficient of Storage (dimensionless)
T = transmissivity (feet^2/day)
t_o = intercept with x-axis, time (days)
r = distance to observation well (feet)

The coefficient of storage calculated at Park Well was 0.0000185 (1.85×10^{-5}) (Figure 13).

AQTESOLV Analysis

Aquifer properties were also calculated using AQTESOLV. The transmissivity values obtained from the Cooper-Jacob and Theis equations using data from 60 to 600 minutes since the start of pumping are 11,060 ft^2/day and 8,598.9 ft^2/day in the Park Well. These values were obtained using an aquifer saturated thickness (b) equivalent to 40 feet (the saturated thickness of the screened interval of the Highland Center Well). The hydraulic conductivity values calculated by dividing transmissivity by aquifer thickness (K=T/b) ranged from 276.5 ft/day to 215 ft/day. The storativity values estimated using data collected in the Park Well ranged from 0.00001959 (1.959×10^{-5}) using Cooper-Jacob method and 0.00007532 (7.532×10^{-5}) using the Theis method. Table 3-6 shows the range of aquifer properties and residual statistics obtained from the AQTESOLV curve matching of drawdown data at the Park Well from the Highland Center Well aquifer test. AQTESOLV results are included in Appendix A.

Table 3-6
Highland Center Aquifer Test – Estimated Aquifer Hydraulic Properties

Solution Method	Estimated Aquifer Hydraulic Estimates			Residual Statistics
	Transmissivity (feet^2/day)	*Hydraulic Conductivity (feet/day)*	*Storativity (dimensionless)*	*Sum of Squares (feet^2)*
Park Well (Observation Well)				
Cooper-Jacob (Manual)	10,242.80	256	0.0000185	-
Cooper-Jacob (AQTESOLV)	11,060	276.5	0.00001959	0.2048
Theis (AQTESOLV)	8,598.9	215	0.00007532	2.093
Average (AQTESOLV)	**9,829**	**245.75**	**0.00004745**	**-**

Note: Dash (-) = Data not available or not applicable.

An estimated transmissivity of 10,242.80 and storativity of 0.0000185 (1.85×10^{-5}) were used for distance drawdown calculations. Data were verified by computing transmissivity and storativity in AQTESOLV. The average transmissivity and storativity values estimated by fitting the Cooper-Jacob and Theis methods to the drawdown data in the Park Well using AQTESOLV are 9,829 ft^2/day and 0.00004745 (4.745×10^{-5}), respectively.

Distance Drawdown

Manually estimated aquifer hydraulic properties (transmissivity and storativity) calculated by using the Cooper-Jacob approximation of the Theis equation were used for distance drawdown calculations. An estimate of groundwater drawdown at the nearest off-site wells and groundwater-dependent habitat, induced by pumping after 1 year and 5 years, was estimated using the Cooper-Jacob method (USGS 1962):

$$s = \frac{264Q}{T} \log_{10} \frac{0.3Tt}{r^2 S}$$

Where:

s = predicted drawdown (feet)
Q = average pumping rate (feet^3/day)
T = transmissivity (feet^2/day)
t = time (days)
r = distance from pumping well (feet)
S = coefficient of storage (dimensionless)

The solution assumes that the aquifer is infinite and that no recharge occurs during the forecast period.

Distance drawdown calculations were performed separately at select distances from the Highland Center Well and the Park Wells. Calculations assume that the wells will not be pumped together during the same time. The Highland Center Well is capable of suppling 280 acre-feet of groundwater assuming constant pumping of 174 gpm for one year.

For the Highland Center, drawdown at the nearest off-site well and potential groundwater-dependent habitat was estimated after 1 year and 5 year scenarios. The 1-year scenario estimates drawdown based on the construction water demand of 280-acre feet for one year. The 5-year scenario estimates drawdown based on the combined total of construction water demand (280 acre-feet) and 4 years of O&M demand for the Projects and other contractually obligated JCSD non-potable supply (9.28 afy). The total 5-year demand would be 317.12 acre-feet spread out over 5-years, equal to 63.42 acre-feet per year or a continuous 39.2 gpm.

For the Park Well, drawdown at the nearest off-site well and potential groundwater-dependent habitat was estimated after 1 year and 5 year scenarios. The 1-year scenario estimates drawdown based pumping 32 acre-feet, which is a rate of 20 gpm assuming constant pumping. The 5-year scenario estimates drawdown based on pumping (32 acre-feet) and 4 years of O&M demand for the Projects and other contractually obligated JCSD non-potable supply (9.28 afy). The total 5-year demand would be 69.12 acre-feet spread out over 5-years, equal to 13.82 acre-feet per year or a continuous 8.6 gpm.

Highland Center Well Drawdown

The closest active off-site well to the Highland Center Well is Well Km, owned by the Jacumba Valley Ranch Water Company, located 1,553 feet to the north (Figure 11). Projected drawdown at Well Km after 1 year of construction groundwater extraction at a constant rate of 174 gpm is 3.15 feet. The total estimated drawdown at Well Km for the 5-years scenario is predicted to be 0.81 feet.

The closest groundwater-dependent habitat to the Highland Center Well is southern riparian forest located 1,720 feet to the north (Figure 11). Projected drawdown at the nearest groundwater-dependent habitat after 1 year of construction groundwater extraction at a constant rate of 174 gpm is 3.10 feet. The total estimated drawdown at the southern riparian forest for the 5-years scenario is predicted to be 0.80 feet.

Table 3-7 summarizes projected drawdown at select distances from the Highland Center Well.

Table 3-7
Highland Center Well Distance Drawdown Calculations

Nearest Off-site Well or Groundwater-Dependent Habitat	Distance from Pumping Well (feet)	End Year 1 Drawdown[a] (feet)	u[b]	End Year 5 Drawdown[a] (feet)	u[b]
-	25	5.29	0.000000001	1.29	0.0000000002
-	50	4.93	0.000000003	1.21	0.0000000006
-	60	4.84	0.000000004	1.19	0.0000000009
-	100	4.57	0.000000012	1.13	0.0000000025
-	250	4.10	0.000000077	1.02	0.0000000155
Park Well	460	3.78	0.000000262	0.95	0.0000000524
-	500	3.74	0.000000309	0.94	0.0000000619
Gas Station	966	3.40	0.000001154	0.86	0.0000002309
-	1,000	3.38	0.000001237	0.86	0.0000002474
-	1,495	3.17	0.000002765	0.81	0.0000005530
Well Km	1,553	3.15	0.000002984	0.81	0.0000005967
Southern Riparian Forest	1,720	3.10	0.000003660	0.80	0.0000007320
JVR Well 2	1,987	3.02	0.000004884	0.78	0.0000009768
-	2,000	3.02	0.000004948	0.78	0.0000009897
Border Patrol Well	2,316	2.94	0.000006636	0.76	0.0000013271
JCSD Well 4	2,585	2.89	0.000008266	0.75	0.0000016533

Notes: Dash (-) = Data not available or not applicable.

a. Amortized 1-year and 5-year production rates 174 gpm and 39.2 gpm, respectively
b. u valid if sufficiently small ($u<0.05$)

Park Well

The closest off-site well to the Park Well is Well Km, owned by the Jacumba Valley Ranch Water Company, located 1,567 feet to the north (Figure 11). Projected drawdown at Well Km after 1 year of construction groundwater extraction at a constant rate of 20 gpm is 0.36 feet. The total estimated drawdown at Well Km for the 5-years scenario is predicted to be 0.18 feet.

The closest groundwater-dependent habitat to the Park Well is southern riparian forest located 1,570 feet to the north (Figure 11). Projected drawdown at the nearest groundwater-dependent habitat after 1 year of construction groundwater extraction at a constant rate of 20 gpm is 0.36 feet. The total estimated drawdown at southern riparian forest for the 5-years scenario is predicted to be 0.18 feet.

Table 3-8
Park Well Distance Drawdown Calculations

Nearest Off-site Well or Groundwater Dependent Habitat	Distance from Pumping Well (feet)	*End Year 1 Drawdown (feet)*	*u*	*End Year 5 Drawdown (feet)*	*u*
-	25	0.60	0.000000001	0.28	0.0000000002
-	50	0.56	0.000000003	0.26	0.0000000006
-	60	0.55	0.000000004	0.26	0.0000000009
-	100	0.52	0.000000012	0.25	0.0000000025
-	250	0.47	0.000000077	0.22	0.0000000155
-	500	0.43	0.000000309	0.21	0.0000000619
Gas Station Well	505	0.43	0.000000315	0.20	0.0000000631
-	1,000	0.39	0.000001237	0.19	0.0000002474
-	1,500	0.36	0.000002783	0.18	0.0000005567
Well Km	1,567	0.36	0.000003038	0.18	0.0000006075
Southern Riparian Forest	1,570	0.36	0.000003049	0.18	0.0000006099
JVR Well 4	2,128	0.34	0.000005602	0.17	0.0000011204
JVR Well 2	2,450	0.33	0.000007426	0.16	0.0000014851
Border Patrol Well	2,637	0.33	0.000008602	0.16	0.0000017205

Notes: Dash (-) = Data not available or not applicable.
a. Amortized 1-year and 5-year production rates 20 gpm and 9 gpm, respectively
b. u valid if sufficiently small ($u<0.05$)

3.2.3 Significance of Impacts Prior to Mitigation

Drawdown at the nearest off-site well and potential groundwater-dependent habitat was estimated under 1-year and 5-year scenarios for the Highland Center Well and Park Well separately. The Highland Center 1-year scenario estimated drawdown based on demand of 280 acre-feet extracted from the Highland Center Well for one year. The Park Well 1-year scenario estimated drawdown based on continuous pumping at a rate of 20 gpm for one year (32 acre-feet). The 5-year scenario, used for both the Highland Center Well and Park Well, estimates drawdown based on the 1-year scenario plus 4 years of O&M demand with other contractually obligated JCSD non-potable supply (9.28 afy).

To assess the potential for groundwater extraction to draw down the groundwater table to the detriment of nearby groundwater-dependent habitat, or to cause well interference, projected drawdown within a 0.5-mile radius of the Highland Center Well and the Park Well was estimated using the Cooper-Jacob equations. Pumping scenarios of 1 year and 5 years were used to calculate the potential long-term impacts to nearby groundwater-dependent habitats and off-site production wells.

Drawdown at the closest off-site groundwater well to the Highland Center Well under the 1-year 5-year scenario is predicted to be 3.17 feet and 0.81 feet, respectively. Projected drawdown at the closest groundwater-dependent habitat to Highland Center Well, southern riparian forest, located approximately 1,720 feet to the north, under the 1-year and 5-year scenario is predicted to be 3.10 feet and 0.80 feet, respectively.

Drawdown at the closest off-site groundwater well to the Park Well under the 1-year and 5-years scenarios is predicted to be 0.36 feet and 0.18 feet, respectively. Projected drawdown at the closest groundwater-dependent habitat to Park Well, located approximately 1,570 feet to the north, under the 1- and 5-years scenarios is predicted to be 1.36 feet and 0.18 feet, respectively.

To evaluate mutual well interference, the drawdown estimated for the Highland Center and Park wells were combined. Thus, under the 1-year scenario, the combined drawdown at Well Km is estimated at 3.53 feet and 0.99 feet under the 5-year scenario.

The primary source of supply for the JVR Energy Park is Jacumba Valley Ranch (JVR) Well #3 located in the northern portion of the JVR property. No groundwater wells are located within a 0.5-mile radius of Well #3. The nearest off-site well, Well Km, is located 3,548 feet from Well #3. Estimated drawdown for JVR construction was based on maximum groundwater production for the construction phase from either Well #2 or Well #3 at rates of 69 gpm and 14 gpm for 1 year and 5 years. These adjusted production rates equal 112 acre-feet for each time period. The estimated groundwater level drawdown at Well Km is predicted to be 0.03 feet and 0.01 feet after 1 year and 5 years (Dudek 2019a). If JVR Well #3 is used as the sole source of supply for construction of the JVR Energy Project, mutual well interference is expected to be practically undetectable after 1 year and 5 years of pumping at the nearest off-site wells. The nearest off-site well to JVR Well #2 is the Highland Center Well, located 1,817 feet to the west. The estimated groundwater level drawdown at the Highland Center Well is predicted to be 0.27 feet and 0.07 feet after 1 year and 5 years (Dudek 2019a). If all pumping for the JVR Energy Project occurred from

JVR #2, and this project occurred concurrently with non-potable supply by JCSD, the mutual well interference is expected to result in an additional 0.24 feet of drawdown at Well Km. The combined 1-year mutual well interference from pumping JVR Well #2, High land Center Well and Park Well is 3.75 feet (JVR#2 [0.24 feet] + Highland Center Well [3.15 feet] + Park Well [0.36 feet]). This is less than the County threshold of significance of a decrease in groundwater level of 5 feet or more for an alluvial well.

The estimated drawdown from combined pumping of the Highland Center Well and the Park Well at the groundwater-dependent habitat, southern riparian forest, under the 1-year scenario is estimated at 3.46 feet and 0.98 feet under the 5-year scenario. Based on the County of San Diego groundwater-dependent habitat threshold guidance for alluvial wells, drawdown would could exceed the County threshold of significance of a decrease in groundwater level of 3 feet below the historical low under the 1-year scenario.

3.2.4 Mitigation Measures and Design Considerations

As the above analysis is based on limited site data and well testing, monitoring will be conducted to verify that groundwater levels remain stable at accessible off-site wells. An updated GMMP, which details updated establishment of groundwater thresholds for off-site well interference and groundwater-dependent habitat, will be prepared for off-site water supply.

3.2.5 Conclusions

The analysis above indicates that proposed groundwater extraction from the Highland Center Well with backup provided by the Park Well to is anticipated to be less-than-significant for well interference but potentially significant for groundwater-dependent habitat. This analysis is made based on combined drawdown for the Highland Center Well, Park Well and JVR Energy Park groundwater extraction concurrently over a one year period. For safe measure, groundwater-level monitoring will be performed in several wells to record groundwater levels during groundwater extraction. An updated GMMP detailing groundwater thresholds for off-site well interference and groundwater-dependent habitat will be prepared. Annual review of groundwater-level data would be conducted by a Professional Geologist or Engineer licensed in the State of California to evaluate long-term impacts.

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4 WATER QUALITY IMPACT ANALYSIS

The JCSD does not propose to supply groundwater as a potable water source; therefore, no water quality impact analysis was conducted.

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5 SUMMARY OF PROJECT IMPACTS AND MITIGATION

5.1 50% Reduction in Groundwater Storage

As discussed in Section 3.1, a soil moisture-based water balance was not performed for the Highland Center Well or the Park Well. Instead, a 1-year non-potable extraction volume of up to 290 acre-feet was compared to historical, ongoing, and future estimated groundwater extraction rates from the Jacumba Valley alluvial aquifer and updated estimates of groundwater in storage originally made by Roff and Franzone (1994) and Swenson (1981).

The analysis evaluates whether the proposed water demands alone and with maximum estimated groundwater use from other users in the aquifer would maintain at least 50% groundwater in storage over the 2,060-acre Jacumba Valley alluvial aquifer. The proposed groundwater extraction amount of 290 acre-feet for approximately one year from the Highland Center Well with backup provided from the Park Well would equate to a 3.2% reduction in estimated groundwater storage, and would be 14% of the estimated historical maximum groundwater extraction. Total estimated groundwater extraction from the Jacumba Valley alluvial aquifer, including the maximum production from JCSD non-potable wells and all proposed projects, would reduce estimated groundwater in storage by 6.5%, and would be 28% of the estimated historical maximum groundwater extraction.

The analysis indicates that the volume of groundwater in storage remains above the 50% significance threshold. Since JCSD groundwater extraction will not exceed the 50% reduction in groundwater storage threshold and other cumulative groundwater demands will be met, groundwater impacts to storage will be less than significant.

5.2 Well Interference

As presented in Section 3.2, the nearest off-site well to the Highland Center Well and the Park well is Well Km. Well interference was estimated under 1-year and 5-year scenarios for each well. The Highland Center Well 1-year scenario estimated drawdown based on the pumping capacity of 174 gpm for the well over one year (280 acre-feet). The Park Well 1-year scenario estimated drawdown based on a pumping rate of 20 gpm over one year, equal to 32 acre-feet. The 5-year scenario, used for both the Highland Center Well and Park Well, estimates drawdown based on the 1-year scenario plus 4 years of O&M demand with other contractually obligated JCSD non-potable supply (9.28 afy).

Based on the Cooper-Jacob approximation of the Theis non-equilibrium flow equation analysis, projected drawdown at Well Km under the 1-year scenario is estimated to be is 3.17 feet from pumping the Highland Center Well and 0.36 feet from pumping the Park Well. The total estimated drawdown under the 5-year scenario for the Highland Center Well and the Park Well is 0.81 and 0.18 feet, respectively.

To evaluate mutual well interference, the drawdown estimated for the Highland Center and Park wells were combined. Thus, under the 1-year scenario, the combined drawdown at Well Km is estimated at 3.53 feet and 0.99 feet under the 5-year scenario.

The primary source of supply for the JVR Energy Park is Jacumba Valley Ranch (JVR) Well #3 located in the northern portion of the JVR property. No groundwater wells are located within a 0.5-mile radius of Well #3. The nearest off-site well, Well Km, is located 3,548 feet from Well #3. Estimated drawdown for JVR construction was based on estimated groundwater production for the construction phase from either Well #2 or Well #3 at rates of 69 gpm and 14 gpm for 1 year and 5 years. These adjusted production rates equal 112 acre-feet for each time period. The estimated groundwater level drawdown at Well Km is predicted to be 0.03 feet and 0.01 feet after 1 year and 5 years (Dudek 2019a). If JVR Well #3 is used as the sole source of supply for construction of the JVR Energy Project, mutual well interference is expected to be practically undetectable after 1 year and 5 years of pumping at the nearest off-site wells. The nearest off-site well to JVR Well #2 is the Highland Center Well, located 1,817 feet to the west. If JVR Well #2 is used as the sole source of supply for construction of the JVR Energy Project, the estimated groundwater level drawdown at the Highland Center Well is predicted to be 0.27 feet and 0.07 feet after 1 year and 5 years (Dudek 2019a). If all pumping for the JVR Energy Project occurred from JVR #2, and this project occurred concurrently with non-potable supply by JCSD, the mutual well interference is expected to result in an additional 0.24 feet of drawdown at Well Km. The combined 1-year mutual well interference from pumping JVR Well #2, High land Center Well and Park Well is 3.77 feet (JVR#2 [0.24 feet] + Highland Center Well [3.17 feet] + Park Well [0.36 feet]). This is less than the County threshold of significance of a decrease in groundwater level of 5 feet or more for an alluvial well.

These results indicate that drawdown is not predicted to exceed the County well interference threshold of significance of a decrease in groundwater level of 5 feet or more in off-site alluvial wells (County of San Diego 2007).

5.3 Groundwater-Dependent Habitat

As presented in Section 3.2, potential groundwater-dependent habitat includes southern riparian forest located approximately 1,720 feet north of the Highland Center Well and 1,570 feet north of the Park Well.

Drawdown at potential groundwater-dependent habitat was estimated under a 1- and 5-year scenario for each well. The Highland Center Well 1-year scenario estimated drawdown based on the construction water demand of 280 acre-feet extracted from the Highland Center Well for one year. The Park Well 1-year scenario estimated drawdown based on a pumping rate of 20 gpm over one year, equal to 32 acre-feet. The 5-year scenario, used for both the Highland Center Well and Park Well, estimates drawdown based on the 1-year scenario plus 4 years of O&M demand with other contractually obligated JCSD non-potable supply (9.28 afy).

Based on the Cooper-Jacob approximation of the Theis non-equilibrium flow equation analysis, projected drawdown the southern riparian forest under the 1-year scenario is 3.10 feet from pumping the Highland Center Well and 0.36 feet from pumping the Park Well. The total estimated drawdown under the 5-years scenario is predicted to be 0.80 feet from pumping the Highland Center Well and 0.18 feet from pumping the Park Well.

The estimated drawdown from combined pumping of the Highland Center Well and the Park Well at the groundwater-dependent habitat, southern riparian forest, under the 1-year scenario is estimated at 3.46 feet and 0.98 feet under the 5-year scenario. Based on the County of San Diego groundwater-dependent habitat threshold guidance for alluvial wells, drawdown could exceed the County threshold of significance of a decrease in groundwater level of 3 feet below the historical low under the 1-year scenario (County of San Diego 2010a). However, the historical low groundwater level in the vicinity of the groundwater-dependent habitat is not known.

5.4 Water Quality

The JCSD does not propose to supply groundwater as a potable water source; therefore, no water quality impact analysis was conducted.

5.5 Mitigation Measures

Monitoring will be in place during production from the Highland Center and the Park Well to verify that impacts to groundwater storage, well interference, and groundwater-dependent habitat do not occur. An updated GMMP detailing groundwater thresholds for off-site well interference and groundwater dependent habitat will be prepared.

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7 LIST OF PREPARERS AND PERSONS AND ORGANIZATIONS CONTACTED

This report was prepared by Dudek Hydrogeologist Trey Driscoll, PG, CHG, and County-approved hydrogeologist, and Dudek Hydrogeologist Hugh McManus. Graphics were provided by Devin Pritchard-Peterson and Hugh McManus. Debby Troutt, former General Manger, Jacumba Community Services District assisted with background information and data for the original version of this report dated April 2014.

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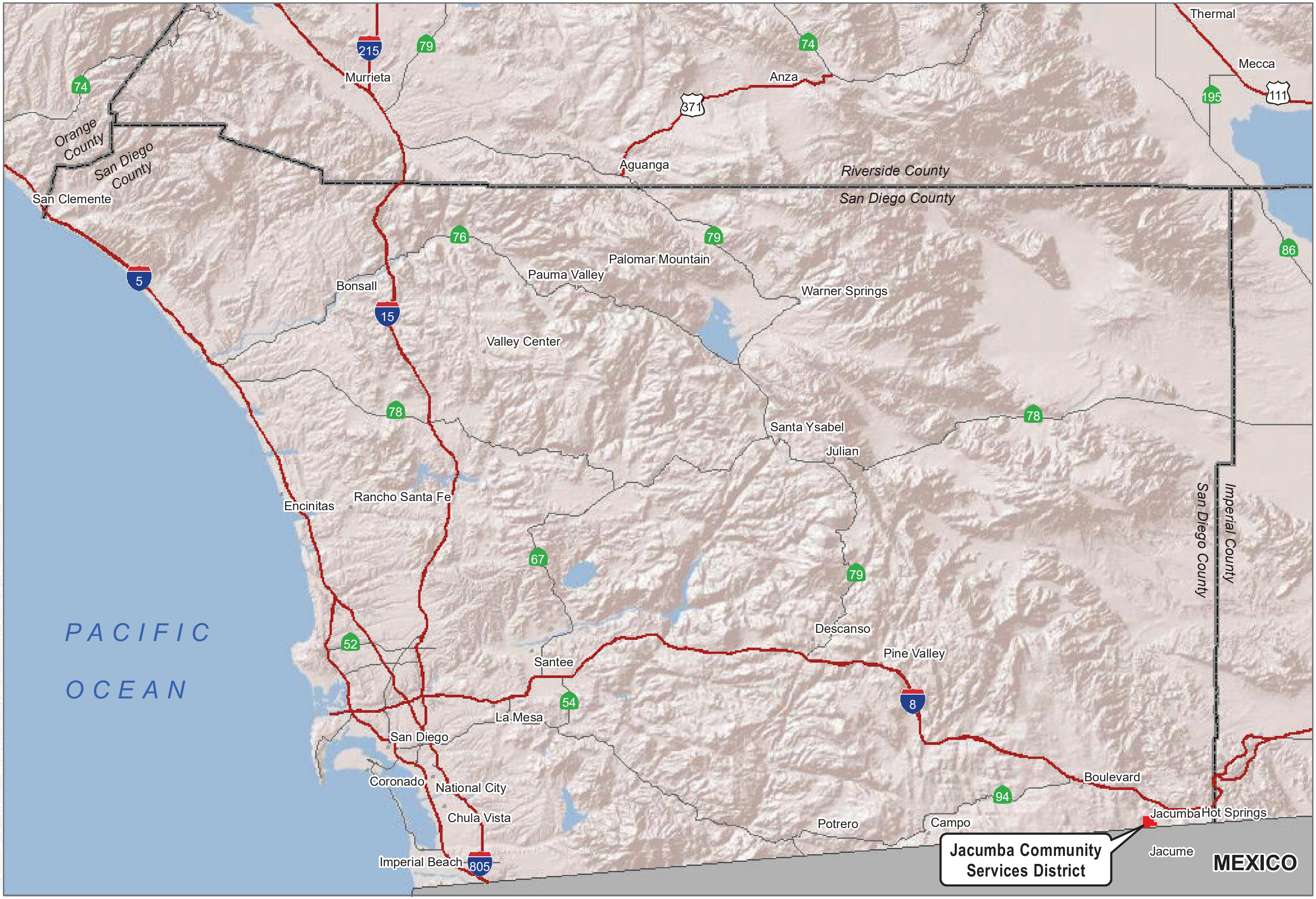

SOURCE: ESRI

DUDEK

FIGURE 1

Regional Location

Updated Groundwater Resources Investigation Report - Flat Creek Watershed Analysis

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SOURCE: Bing Maps

DUDEK

0 0.25 0.5 Miles

FIGURE 2

Vicinity Map

Updated Groundwater Resources Investigation Report - Flat Creek Watershed Analysis

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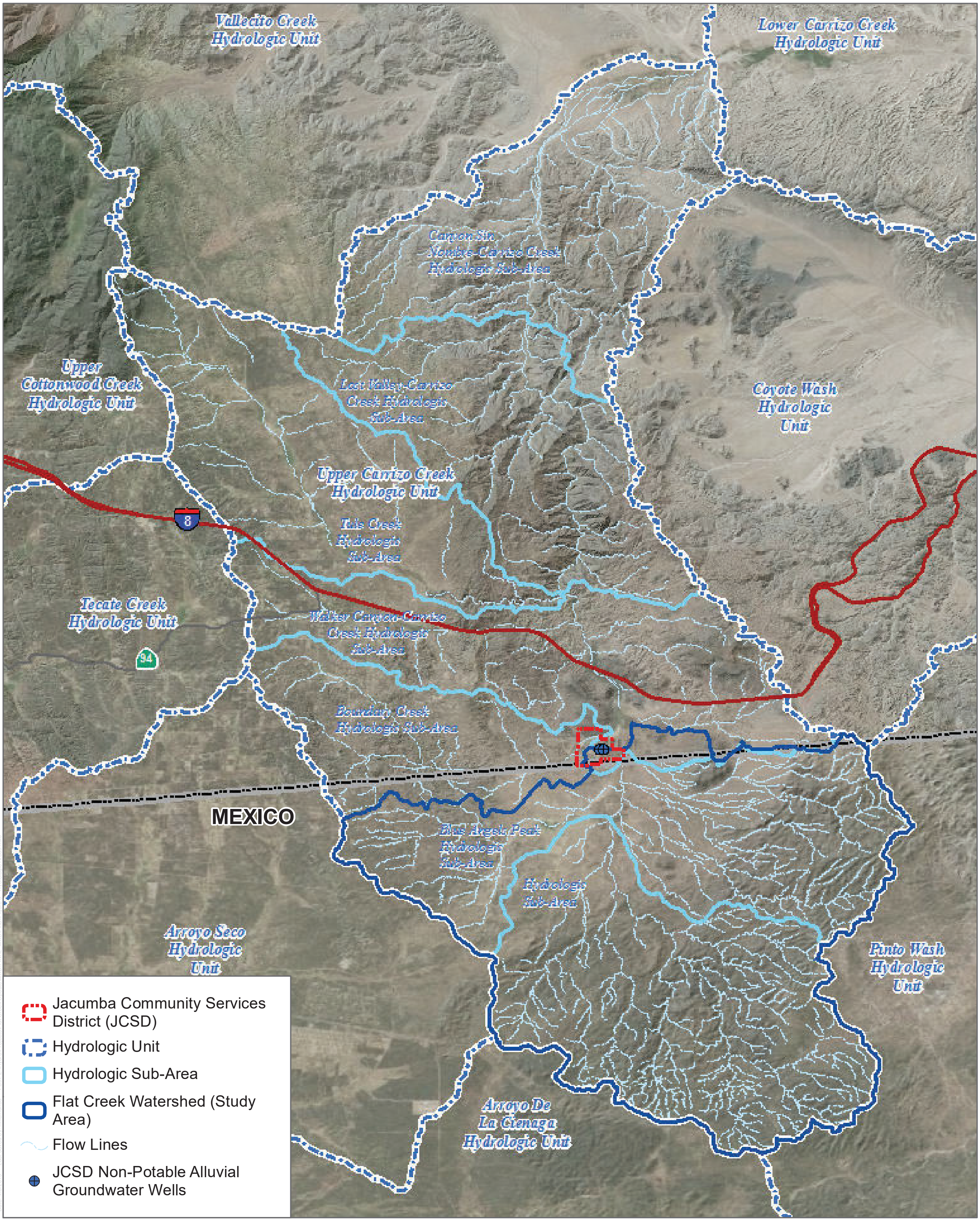

SOURCE: Bing Maps; USGS

DUDEK

0 2.5 5 Miles

FIGURE 3

Hydrologic Areas

Updated Groundwater Resources Investigation Report - Flat Creek Watershed Analysis

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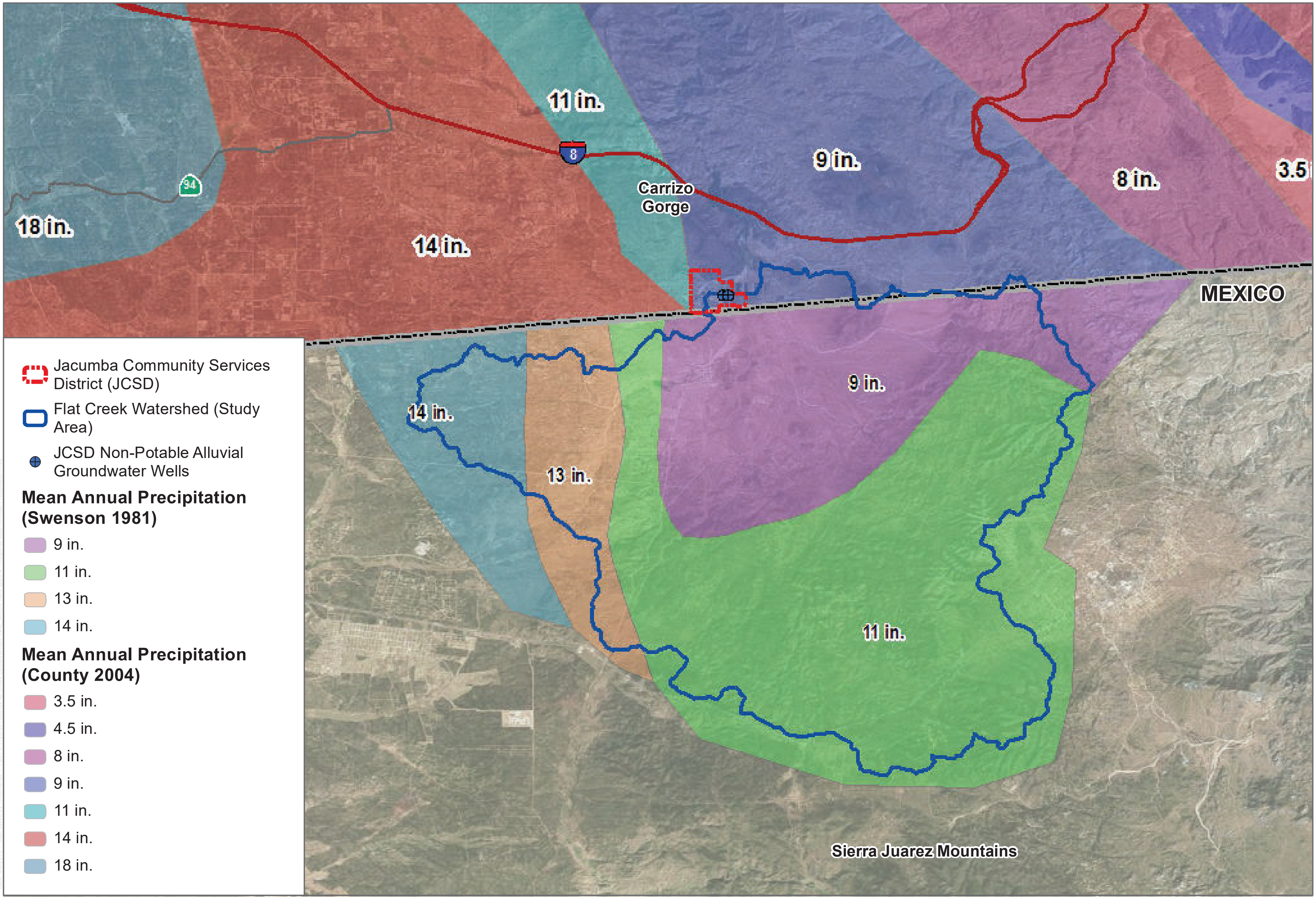

SOURCE: NOAA; SanGIS; Swenson, 1981

DUDEK

0 2.5 5 Miles

FIGURE 4

Regional Mean Annual Precipitation

Updated Groundwater Resources Investigation Report - Flat Creek Watershed Analysis

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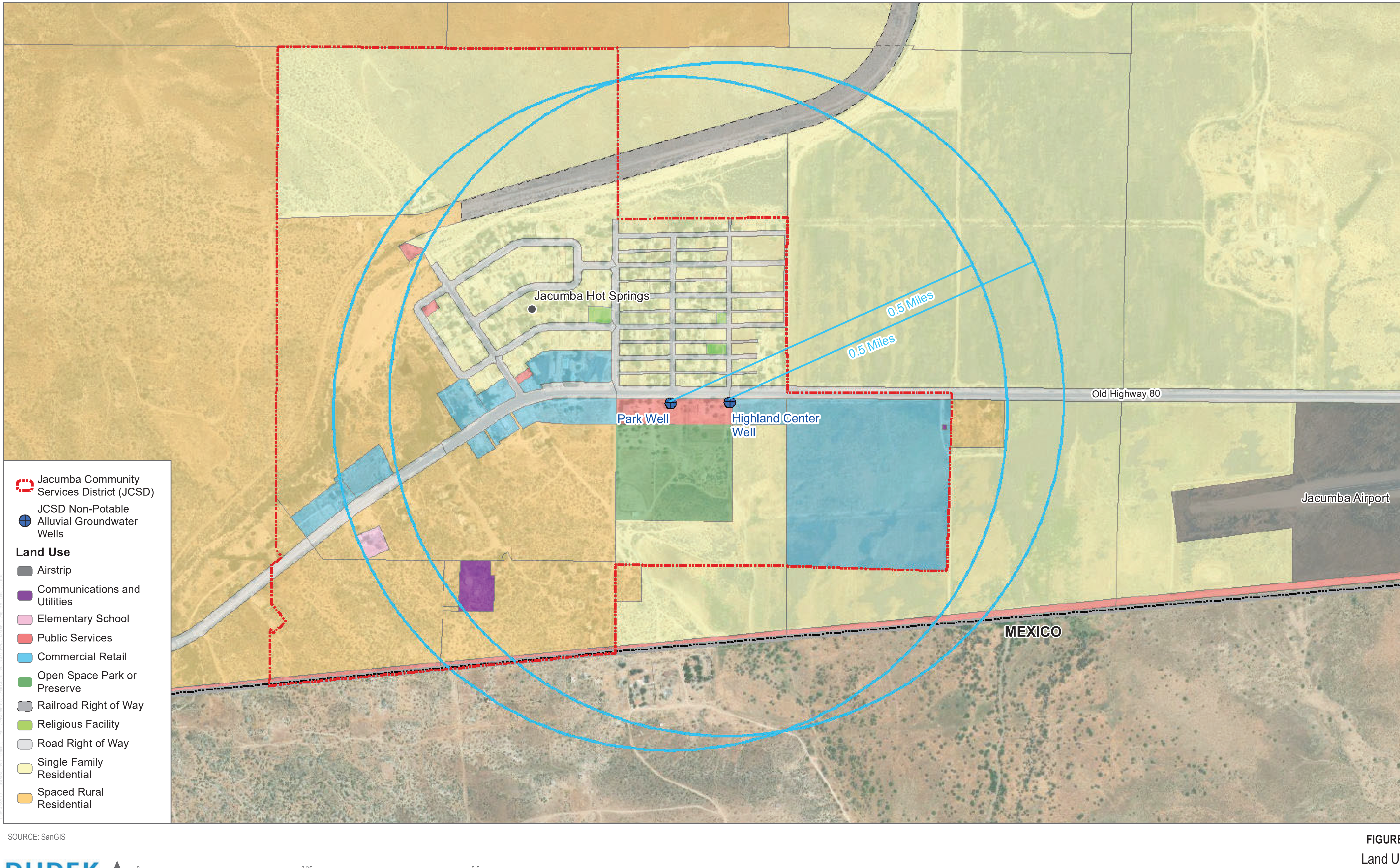

SOURCE: SanGIS

DUDEK

FIGURE 5

Land Use

Updated Groundwater Resources Investigation Report - Flat Creek Watershed Analysis

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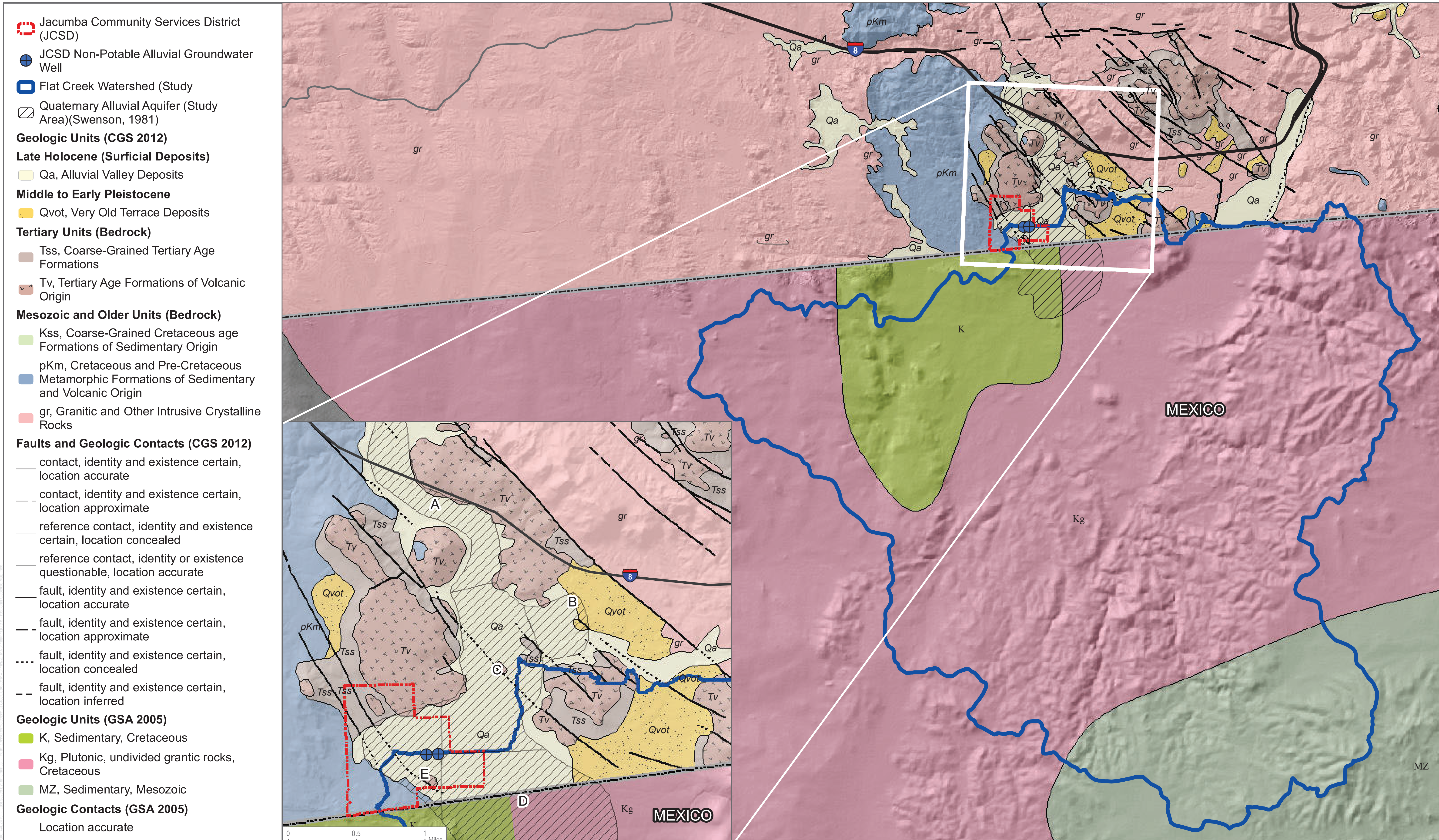

SOURCE: USGS; GSA; Swenson, 1981

DUDEK

FIGURE 6

Regional Geologic Map

Updated Groundwater Resources Investigation - Flat Creek Watershed Analysis

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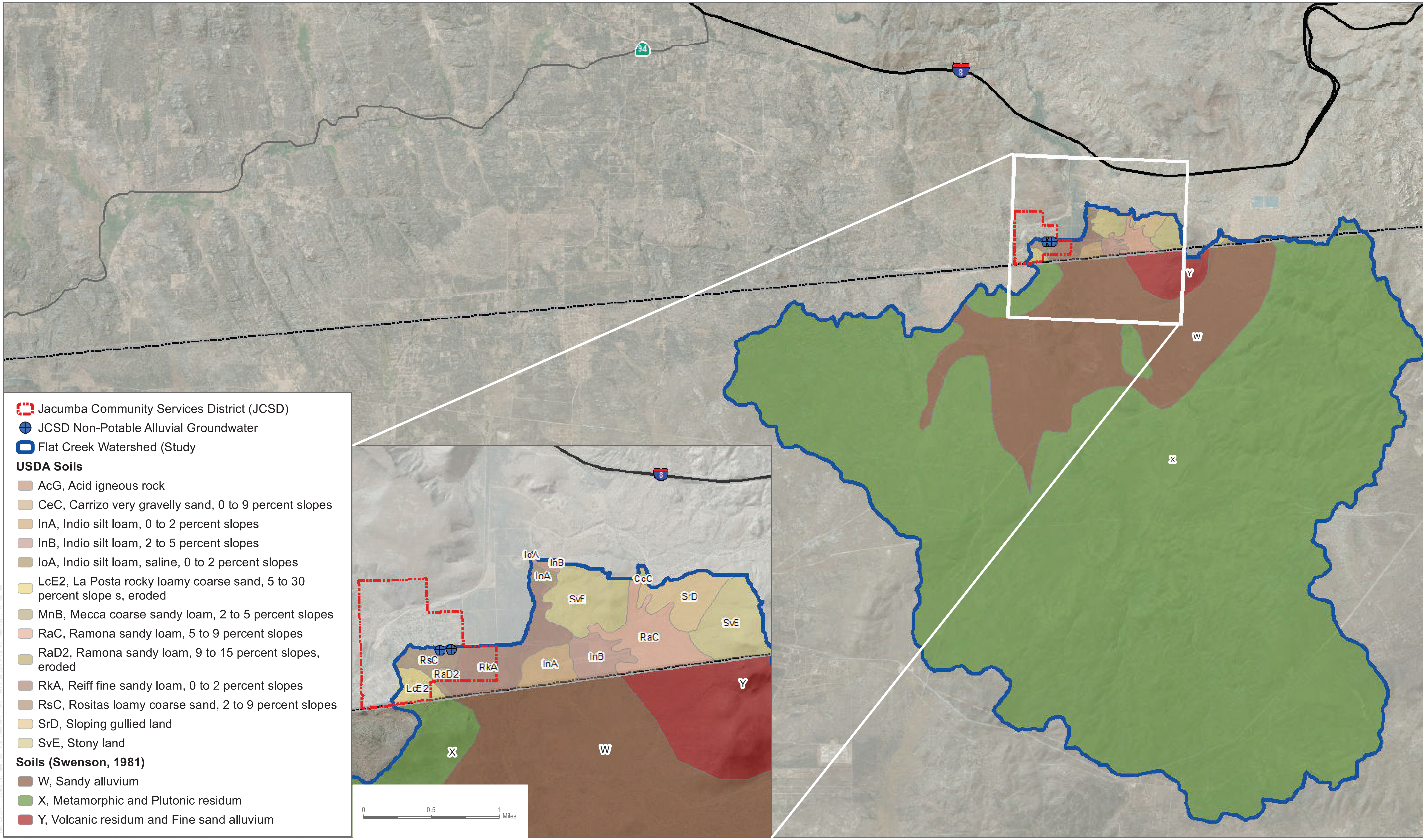

SOURCE: Bing Maps; USDA; USGS; Swenson, 1981

DUDEK

0 1 2 Miles

FIGURE 7

Soils Map

Updated Groundwater Resources Investigation - Flat Creek Watershed Analysis

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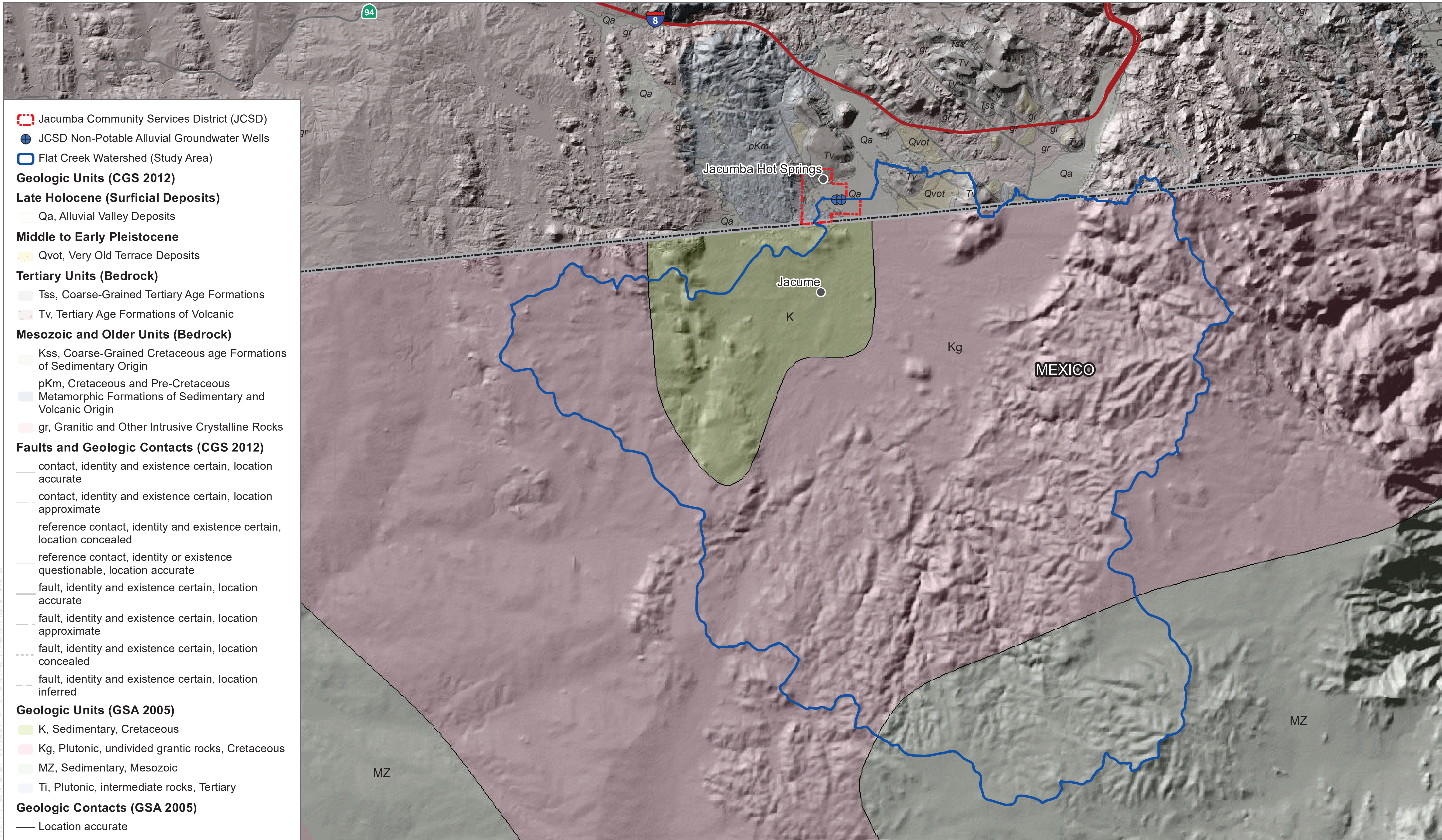

SOURCE: CSA, 2012; GSA, 2005; USGS

DUDEK

0 2 4 Miles

FIGURE 8

Digital Elevation Model

Updated Groundwater Resources Investigation Report - Flat Ceek Watershed Analysis

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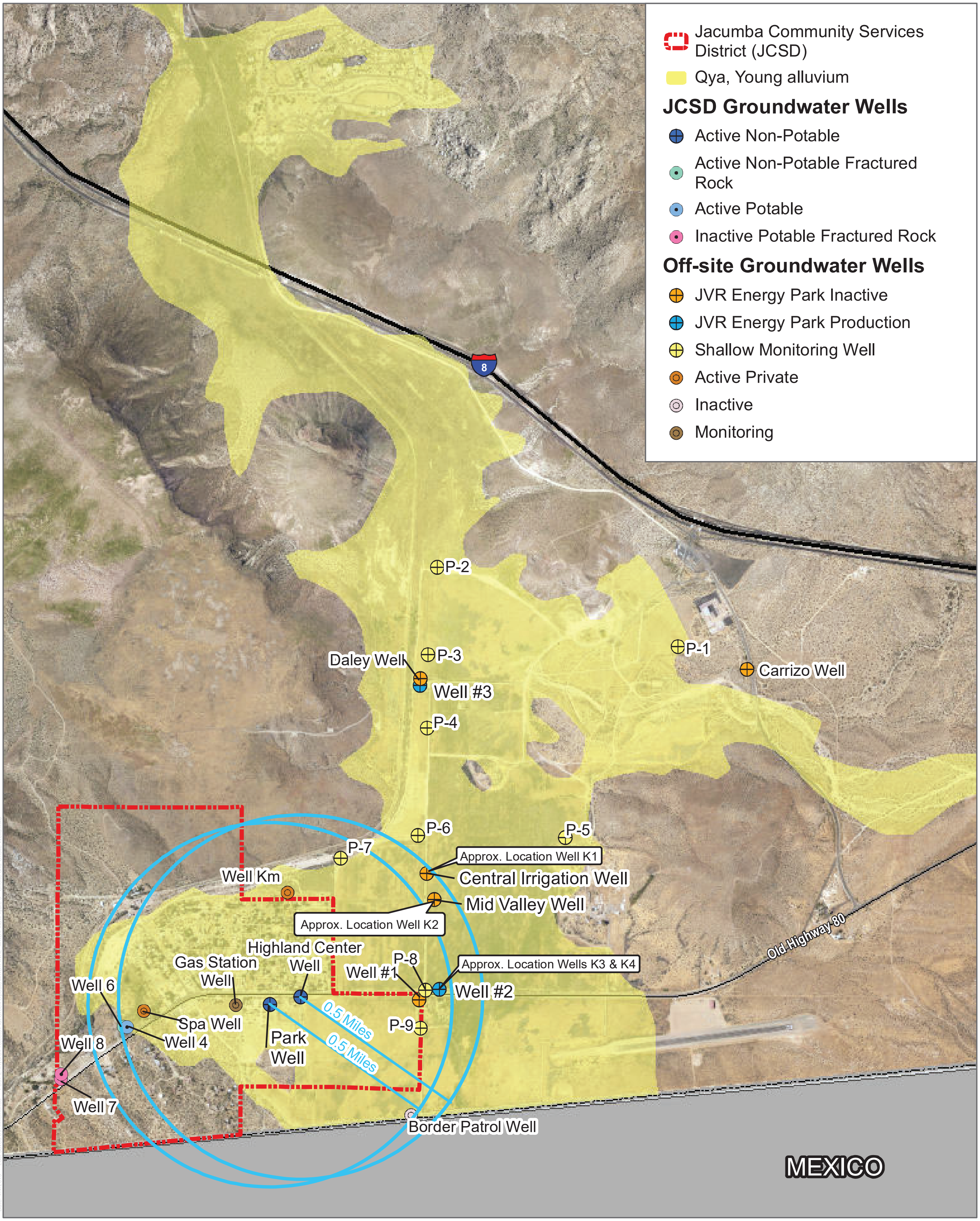

SOURCE: JCSD; JVR; SanGIS

FIGURE 9

Well Map

DUDEK

0 0.25 0.5 Miles

Updated Groundwater Resources Investigation - Flat Creek Watershed Analysis

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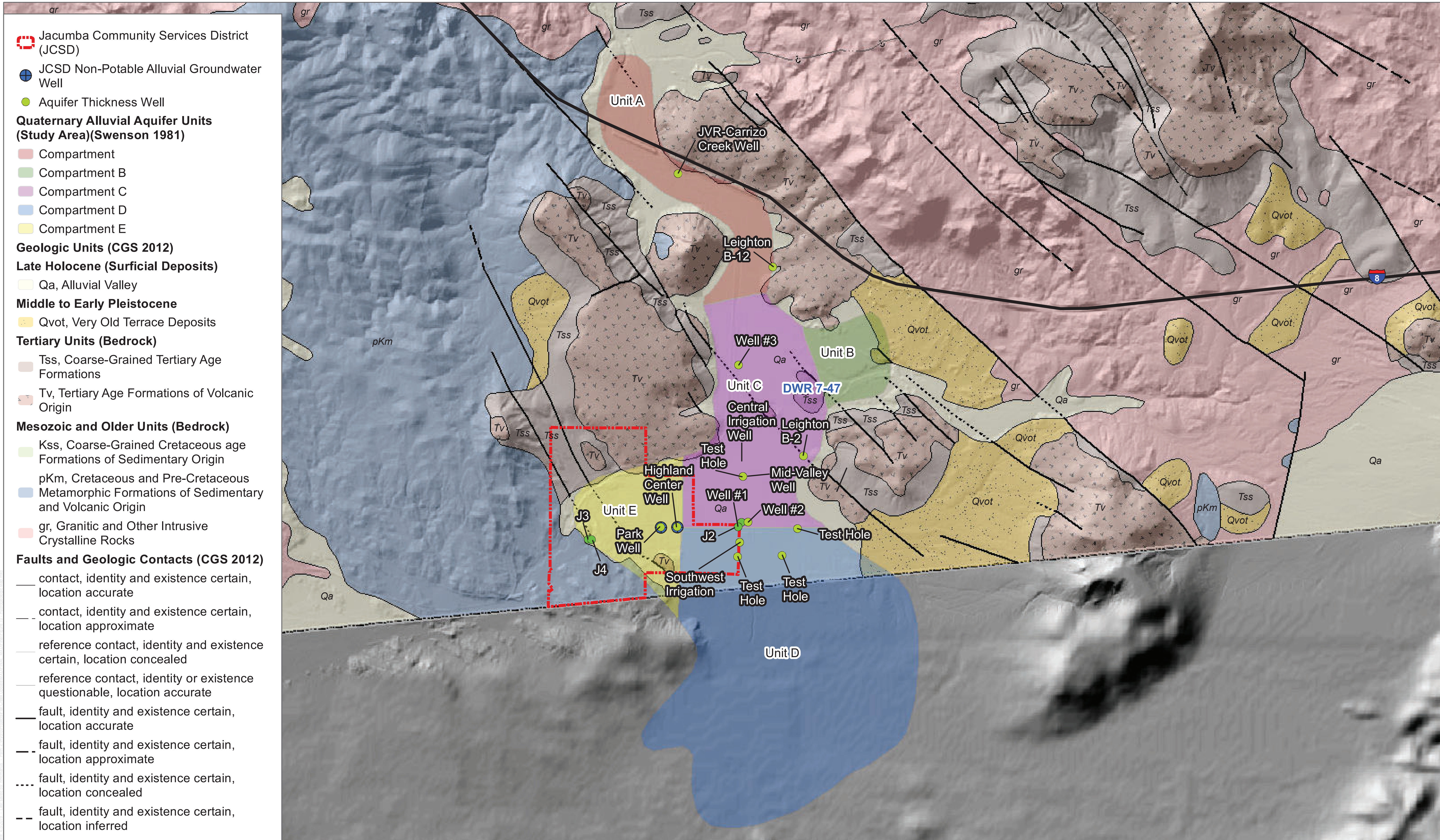

SOURCE: Swenson, 1981; DWR; CGS 2012

*Note: Aquifer thickness wells include Swenson, 1981 study wells and wells with available completion information

DUDEK

0 0.5 1 Miles

FIGURE 10

Hydrogeologic Units

Updated Groundwater Resources Investigation - Flat Creek Watershed Analysis

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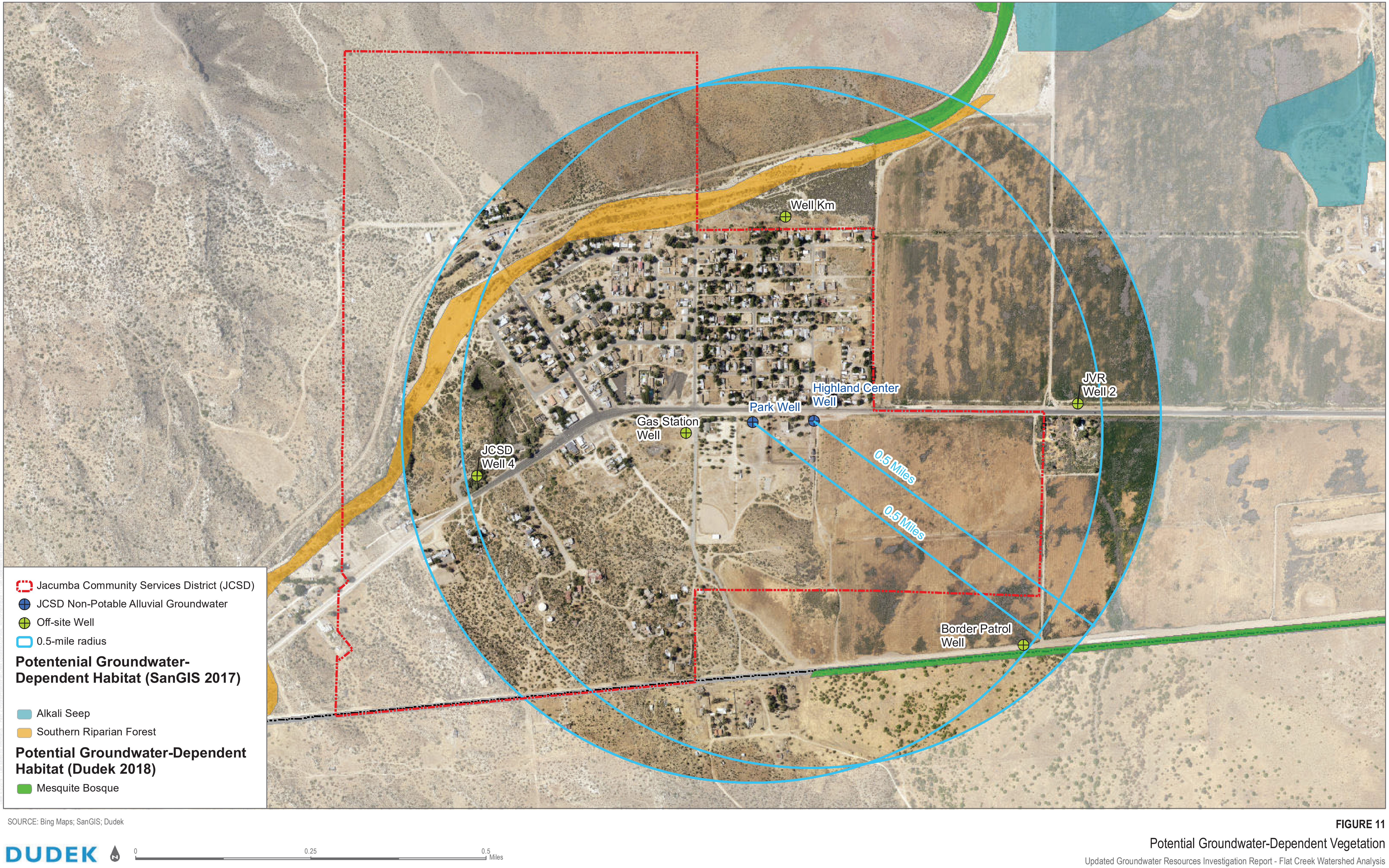

SOURCE: Bing Maps; SanGIS; Dudek

FIGURE 11

Potential Groundwater-Dependent Vegetation

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Figure 12. Highland Center Well Constant Rate 24-Hour Test - Highland Center Well Analysis

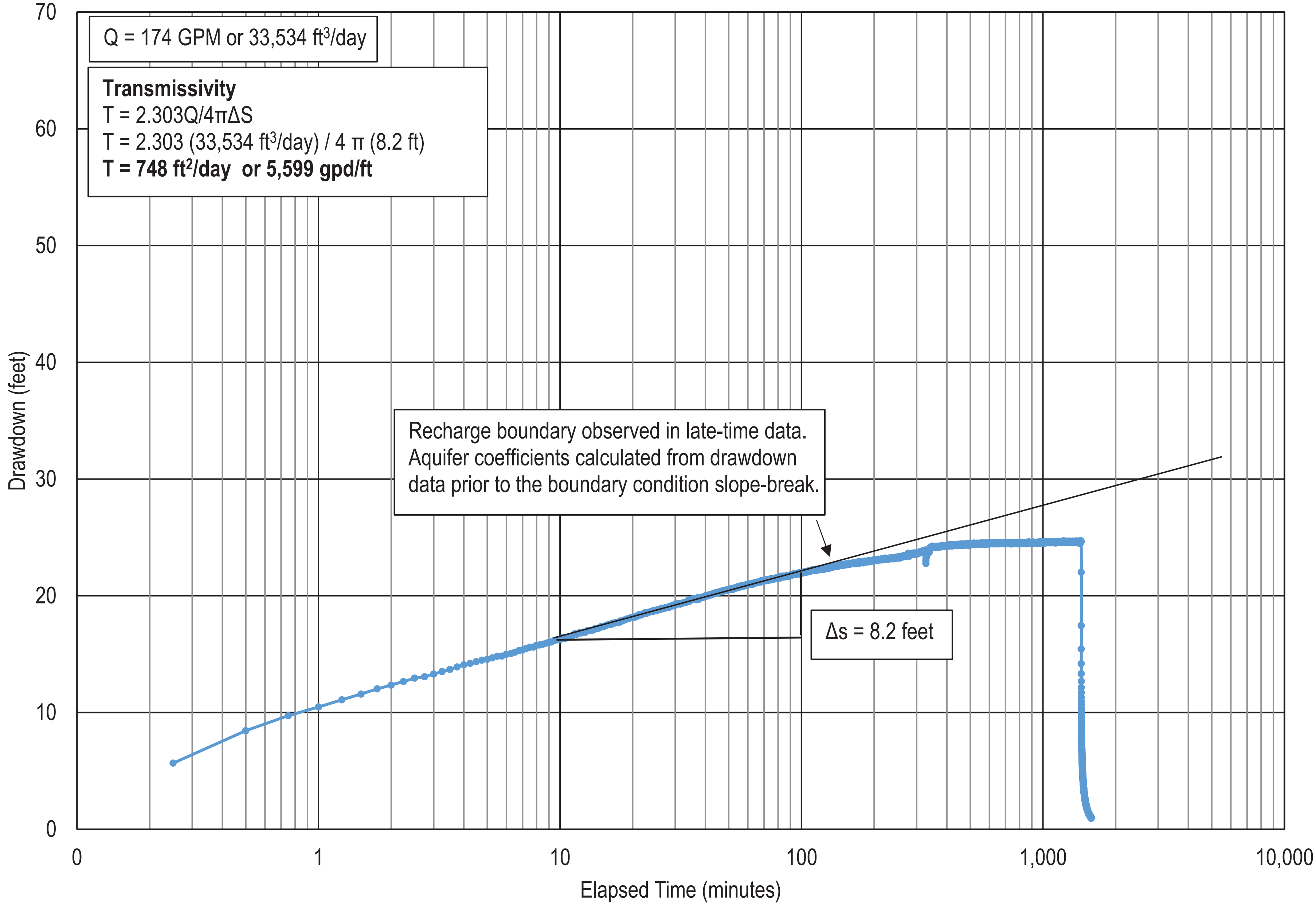

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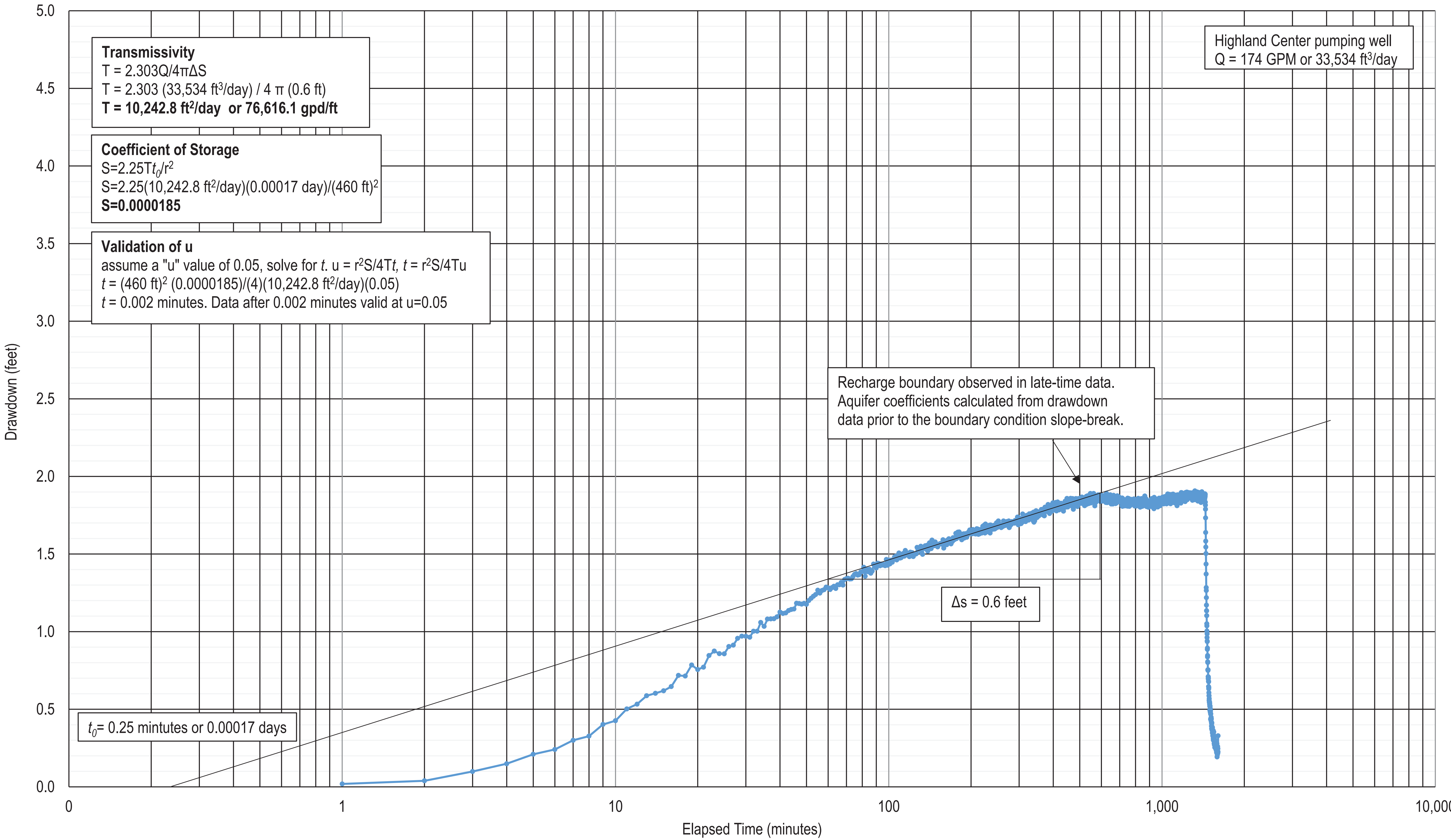
Figure 13. Highland Center Well Constant Rate 24-hr Test - Park Well Analysis



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APPENDIX A

Park Well AQTESOLV Results from Highland Center Well Pump Test

APPENDIX A

Park Well AQTESOLV Results from Highland Center Well Pump Test

Diagnostic Statistics

Estimation complete! Parameter change criterion (ETOL) reached.

Aquifer Model: Confined
Solution Method: Cooper-Jacob

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
T	1.106E+4	66.33	+/- 130.3	166.7	ft^2/day
S	1.959E-5	7.151E-7	+/- 1.405E-6	27.4	

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

K = T/b = 276.4 ft/day (0.09751 cm/sec)
Ss = S/b = 4.899E-7 1/ft

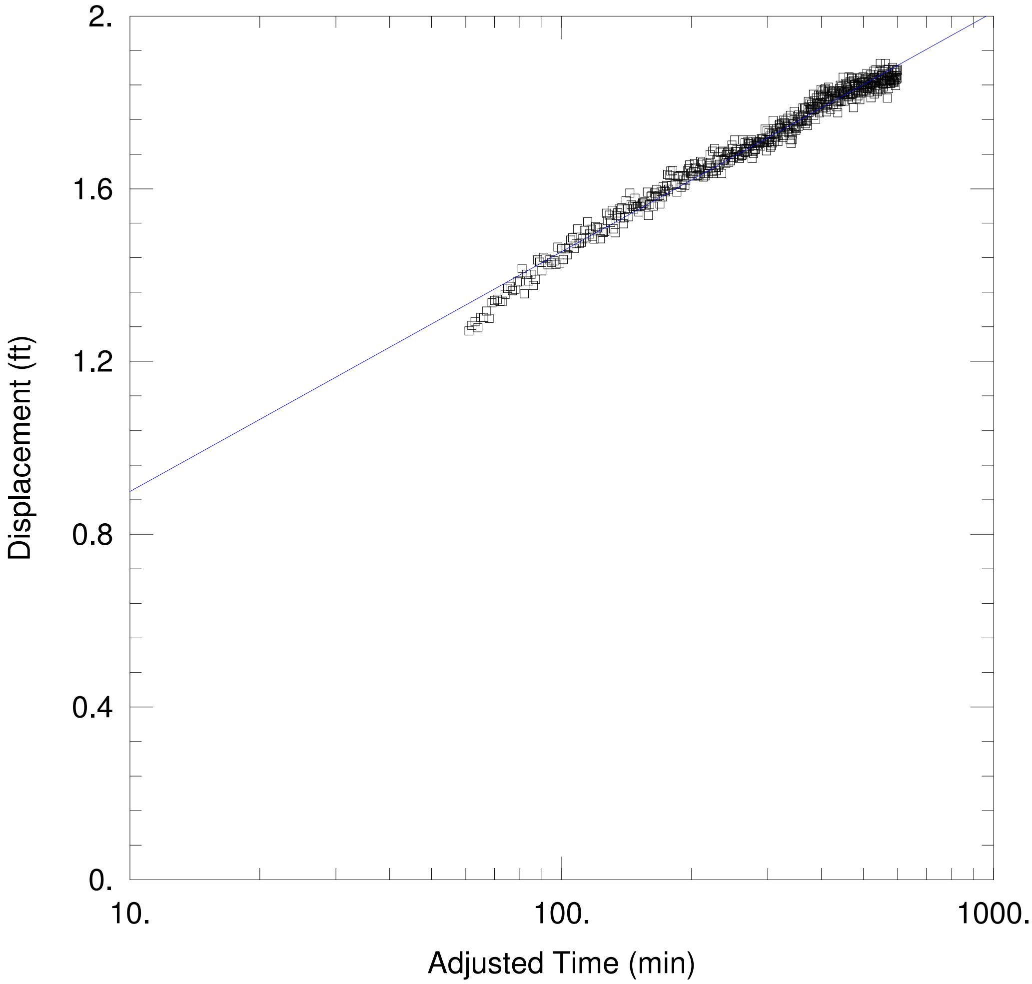
Parameter Correlations

	T	S
T	1.00	-1.00
S	-1.00	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . . 0.2048 ft^2
Variance . . . . 0.0003807 ft^2
Std. Deviation . . . . 0.01951 ft
Mean . . . . -2.135E-8 ft
No. of Residuals 540
No. of Estimates 2



WELL TEST ANALYSIS

Data Set:
Date: 11/14/16

Time: 12:13:38

PROJECT INFORMATION

Company: Dudek
Client: JCSD
Project: 9286
Location: Jacumba
Test Well: Higland Center Well
Test Date: 10/11/2016

AQUIFER DATA

Saturated Thickness: 40. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Highland Center Well	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ Park Monitoring Well	460	0

SOLUTION

Aquifer Model: Confined

Solution Method: Cooper-Jacob

T = 1.106E+4 ft^2/day

S = 1.959E-5

Diagnostic Statistics

Estimation complete! RSS criterion (RTOL) reached.

Aquifer Model: Confined
Solution Method: Theis

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
T	8598.9	76.94	+/- 151.1	111.8	ft^2/day
S	7.532E-5	2.94E-6	+/- 5.775E-6	25.62	
Kz/Kr	1.	not estimated			
b	40.	not estimated			ft

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

K = T/b = 215. ft/day (0.07584 cm/sec)
Ss = S/b = 1.883E-6 1/ft

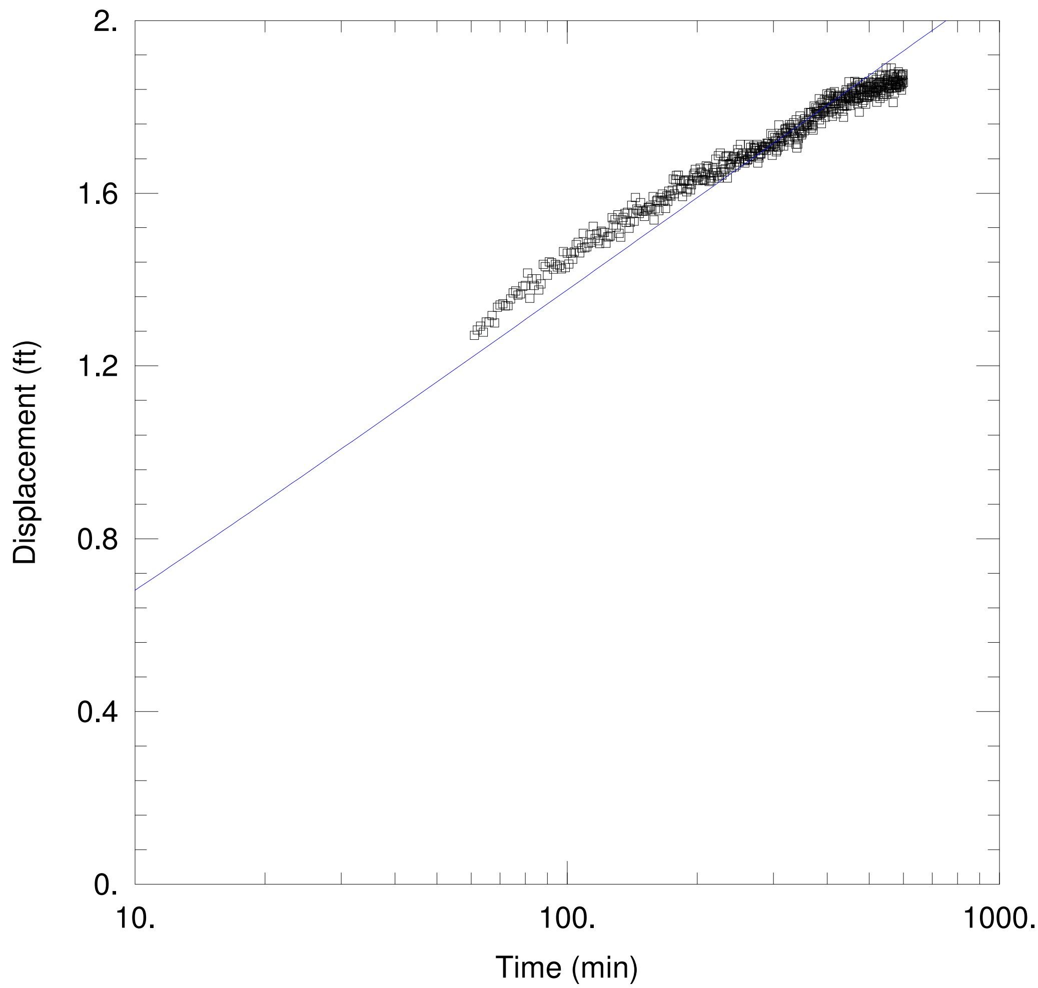
Parameter Correlations

	T	S
T	1.00	-0.98
S	-0.98	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . . 2.093 ft^2
Variance . . . . 0.003501 ft^2
Std. Deviation . . . . 0.05917 ft
Mean . . . . -0.0006454 ft
No. of Residuals 600
No. of Estimates 2



WELL TEST ANALYSIS

Data Set:
Date: 11/14/16 Time: 12:11:38

PROJECT INFORMATION

Company: Dudek
Client: JCSD
Project: 9286
Location: Jacumba
Test Well: Higland Center Well
Test Date: 10/11/2016

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Highland Center Well	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ Park Monitoring Well	460	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis

T = 8598.9 ft^2/day S = 7.532E-5
Kz/Kr = 1. b = 40. ft

UPDATED DRAFT

Groundwater Monitoring and Mitigation Plan – Flat Creek Watershed Analysis Jacumba Community Services District Jacumba Hot Springs, San Diego County, California

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County of San Diego
Planning and Development Services
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Contact: Susan Harris

Project Proponent:

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NOVEMBER 2019

Update to Report dated April 2015

Printed on 30% post-consumer recycled material.

Updated Draft Groundwater Monitoring and Mitigation Plan – Flat Creek Watershed Analysis Jacumba Community Services District

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APPENDIX

FIGURE

TABLES

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1 INTRODUCTION

Jacumba Community Services District (JCSD) is proposing the use of the Highland Center Well and the Park Well as sources of non-potable groundwater to serve JCSD commercial customers (the Project). This Groundwater Monitoring and Mitigation Plan (GMMP) is an update to a previous GMMP prepared by Dudek (Dudek 2015). Dudek prepared this GMMP to provide protection of nearby groundwater-dependent habitat and limit groundwater level decline in off-site groundwater wells caused by groundwater extraction for the Project.

As described in the Updated Draft Groundwater Resources Investigation Report – Flat Creek Watershed for the JCSD (Investigation) (Dudek 2019), JCSD is proposing to extract 290 acre-feet of groundwater over an approximate 1 year period for construction use and up to 9.28 acre-feet per year for operations and maintenance. Non-potable groundwater will be supplied from the Highland Center Well with backup provided by the Park Well.

The Highland Center Well and Park Well are located within Assessor's Parcel Number 660-140-07, on the south side of Old Highway 80 between Heber Street and Campo Street, within Jacumba Community Park (Figure 1).

The Investigation assumed that the Highland Center Well and Park Well would supply up to 290 acre-feet for 1 year and 9.28 acre-feet per year of ongoing groundwater use for operations and maintenance. The Investigation indicates that short-term pumping of the Highland Center Well with backup provided by the Park Well would result in a less-than-significant impact to groundwater storage.

Drawdown at the nearest off-site well and potential groundwater-dependent habitat was estimated under a 1- and 5-year scenario for the Highland Center Well and Park Well separately. The Highland Center 1-year scenario estimated drawdown based on the maximum production rate of the well of 280 acre-feet per year. The Park Well 1-year scenario estimated drawdown based on pumping the well at a production rate of 20 gpm for one year, equal to 32 acre-feet. The 5-year scenario estimates drawdown based on the rates for each well used in the 1-year scenario plus 4 years of O&M demand including contractually obligated JCSD non-potable supply (9.28 afy).

The estimated drawdown at the nearest off-site well, Well Km, under the 1-year scenario is 3.17 feet from pumping the Highland Center Well and would be 0.36 feet from pumping the Park Well if used as a backup supply well. The estimated drawdown under the 5-year scenario would be 0.81 feet from pumping the Highland Center Well and 0.18 feet from pumping the Park Well if used as a backup supply well. To evaluate mutual well interference, the drawdown estimated for the

Highland Center and Park wells were combined. Thus, under the 1-year scenario, the combined drawdown at Well Km is estimated at 3.53 feet and 0.99 feet under the 5-year scenario. Based on the County of San Diego well interference threshold guidance for alluvial wells, this drawdown is less than significant.

The estimated drawdown at the nearest groundwater-dependent habitat, southern riparian forest, under the 1-year scenario is 3.10 feet from pumping the Highland Center Well and would be 0.36 feet from pumping the Park Well if used as a backup supply well. The estimated drawdown under the 5-years scenario is predicted to be 0.80 feet from pumping the Highland Center Well and 0.18 feet from pumping the Park Well if uses as a backup supply well. To evaluate mutual well interference, the drawdown estimated for the Highland Center and Park wells were combined. Thus, under the 1-year scenario the combined drawdown at the nearest groundwater-dependent habitat is estimated at 3.46 feet and 0.98 feet under the 5-year scenario. Based on the County of San Diego groundwater-dependent habitat threshold guidance for alluvial wells, drawdown would could be significant under the 1-year scenario but would be less than significant under the 5-year scenario.

This GMMP has been prepared because actual conditions during groundwater extraction for the Projects may vary from conditions assumed in the Investigation. This GMMP establishes protective groundwater drawdown thresholds for off-site well interference and groundwater-dependent habitat. This GMMP also describes the monitoring, mitigation, and reporting procedures by which the County of San Diego Planning and Development Services (PDS) can validate that the conditions and criteria for the Project’s groundwater extraction activities are continually being upheld. A 5-year monitoring period is proposed to assess the impact of groundwater extractions.

2 ESTABLISHMENT OF GROUNDWATER THRESHOLDS

According to the County of San Diego Guidelines for Determining Significance and Report Format Content Requirements: Groundwater Resources (County Guidelines), Project-related groundwater extraction would incur a significant well interference impact if after a 5-year projection of drawdown, the results indicate a decrease in water level of 5 feet or more in the off-site wells (County of San Diego 2007). If site-specific data indicates alluvium or sedimentary rocks exist, which substantiate a saturated thickness greater than 100 feet in off-site wells, a decrease in saturated thickness of 5% or more in the off-site wells would be considered a significant impact (County of San Diego 2007). The County's Guidelines for Determining Significance and Report Format and Content Requirements: Biological Resources defines a project-related drawdown of 3 feet below historical low groundwater levels as causing a significant impact to riparian habitat of a groundwater-sensitive natural community (County of San Diego 2010). The thresholds established below incorporate these guidelines and represent a basis for monitoring and mitigating potential groundwater impacts related to the Project.

2.1 Potential Off-Site Well Interference

As described in the Investigation, wells identified near the Highland Center Well and Park Well include the Gas Station Well, Well Km, Jacumba Valley Ranch (JVR) Well 2, JCSD Well 4, and the Border Patrol Well (Figure 1). All of these wells except Well Km and the Border Patrol Well are already included in an existing groundwater-monitoring network and are equipped with pressure transducers. Well Km and the Border Patrol Well are not monitored due to lack of access. The pressure transducers record the groundwater level in the wells at sub-daily, 15-minute intervals; the level is confirmed periodically through manual groundwater level measurements recorded with an electric sounder. Groundwater level hydrographs for the wells monitored are provided in Appendix A.

Well Km is operated by the Jacumba Valley Ranch Water Company (California Small Drinking Water System CA3701588), which operates as a transient non-community water system overseen by the San Diego County Department of Environmental Health.[1] The Border Patrol Well, an inactive well with unknown condition, is enclosed in a locked pump house. Access has not been provided by the well owners for monitoring of groundwater levels.

1 The San Diego County Department of Environmental Health has an agreement with the State Water Resources Control Board, Division of Drinking Water for administration and enforcement of the federal and state statutes and regulations for any water systems under 200 service connections.

Groundwater wells within a 0.5-mile radius and their distance to the Highland Center Well and Park Well are indicated in Table 1 and depicted in Figure 1.

Table 1
Alluvial Aquifer Wells Within 0.5-Mile Radius of Extraction Wells

Well Name	Owner/Use	Distance from the Highland Center Well (feet)	Distance from the Park Well (feet)
Gas Station Well	Private/Monitoring	966	505
Well Km[a]	Small Water System/Active Production	1,553	1,567
JVR Well 2	Private/Active Production	1,987	2,450
JCSD Well 4	Public/Active Production	2,585	2,128
Border Patrol Well[a]	Federal/Inactive Production	2,316	2,637

Notes: JVR = Jacumba Valley Ranch; JCSD = Jacumba Community Services District.
a Well Km and the Border Patrol Well are privately owned wells that will need access granted by their respective well owners before monitoring can occur.

The pre-construction baseline conditions were determined on January 18, 2017 for the Jacumba Solar Project, which consisted of measuring manual groundwater levels and installing new In-situ pressure transducers into monitoring network wells. The County PDS has requested that these baseline conditions be carried over to future projects. Baseline conditions from January 2017, groundwater level threshold and current groundwater levels are presented in Table 2.

Table 2
Baseline Conditions, Groundwater Level Threshold and Current Groundwater Levels

Well ID	Baseline Groundwater Level Measurement (feet btoc) [a]	Threshold Condition (drawdown, feet)	Groundwater Level Threshold (feet btoc)	Current Groundwater Level Measurement (feet btoc/ date)
JCSD Well 4	12.94	3.93[b]	16.87	14.12[c]/ 9/23/2019
Highland Center Well	55.05	N/A	N/A	56.59/ 9/23/2019
Park Monitoring Well	57.71	N/A	N/A	59.15/ 9/23/2019
Gas Station well	64.25	5.39	69.64	66.48 1/23/2019
JVR Well 2	55.40	N/A	N/A	58.49/ 7/30/2019

Source: Dudek, 2019b
Notes:
MUP Established Threshold Conditions per MUP PDS2014-MUP-14-041 Sec. 15, 29, and 30
BTOC : Below Top of Casing
N/A: Not applicable; no water level thresholds identified in the MUP
a. Measured on January 18, 2017
b. Threshold condition determined per MUP PDS2014-MUP-14-041 Sec. 30 due to lack of access to JVR Well Km.
c. Only a manual measurement was taken. May be recovering groundwater level.

To protect off-site well users and comply with County Guidelines, a maximum drawdown of 5 feet below the baseline groundwater levels will be allowed in accessible production wells.[2] The nearest off-site production well is Well Km. If Well Km is not accessible for groundwater level monitoring, a maximum drawdown of 5.39 feet at the Gas Station Well, below the water level baseline will be allowed.

Results of the off-site well interference analysis detailed in the Investigation conclude that well interference is not anticipated to result in a significant impact. The existing groundwater monitoring program will be continued in order to characterize change in groundwater levels due to JCSD's non-potable water supply.

2.2 Groundwater-Dependent Habitat

Groundwater-dependent vegetation communities mapped approximately 1,720 feet from the Highland Center and 1,570 feet from the Park Well include southern riparian forest associated with Boundary Creek (Figure 1). According to the Investigation, the estimated drawdown at the nearest groundwater-dependent habitat under the 1-year scenario is 3.46 feet from pumping the Highland Center Well and Park Well. Based on this analysis, the Project could potentially draw down the groundwater table to the detriment of groundwater-dependent habitat, which would typically require a drop of 3 feet or more from historical low groundwater levels.

Since historical groundwater level measurements are available for JCSD Well 4, monitoring of the groundwater-dependent habitat would be required in the event that water levels in JCSD Well 4 drop 3 feet below historical low groundwater levels, which were recorded at 23 feet below ground surface. Biological monitoring procedures are described in Section 3.2, Groundwater-Dependent Habitat.

2 The proposed Jacumba Valley Ranch (JVR) Energy Park project is planning to use JVR Well 2 as a source of construction water supply for a solar energy facility. If JVR Well 2 is used for JVR Energy Park, the static groundwater level threshold in this well should not apply to the Project.

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3 MONITORING PROCEDURES AND MITIGATION CRITERIA

The groundwater level monitoring, and if necessary biological monitoring, procedures and mitigation criteria are outlined below and will be followed during pumping at the Highland Center Well and Park Well. The groundwater monitoring program defined herein will be carried out under the direction of a professional geologist or professional engineer licensed in the State of California.

3.1 Groundwater Production and Groundwater Level Monitoring

Pressure transducers will be maintained in a network of three groundwater wells (the Gas Station Well, JVR Well 2, and JCSD Well 4) as well as both production wells, the Highland Center Well and Park Well. Additionally, Well Km and the Border Patrol Well will be included if property access is granted. The pressure transducers will be programed to record the water level sub-daily at 15-minute intervals. In addition, ambient barometric pressure and temperature will be recorded at 15-minute intervals with a barometric logger. Manual groundwater level measurements may be required for Well Km and the Border Patrol well if pressure transducers cannot be fitted in the wells due to lack of appropriately sized port or sounding tube.

Transducer data will be downloaded at all the instrumented wells 1 month prior to the onset of Project-related groundwater extraction. Transducer data will also be downloaded monthly during periods of pumping for non-potable construction water supply to the Project. Cumulative groundwater usage will be monitored at the Highland Center Well and Park Well using an instantaneous flow meter. Flow rate and volume measurements will be recorded daily during pumping for the Project.

3.2 Groundwater-Dependent Habitat Monitoring

The following monitoring program will be carried out for groundwater-dependent habitat if water levels in JCSD Well 4 drop below the established threshold. The goal would be to determine if the Project's use of groundwater is impacting groundwater-dependent habitat.

3.2.1 Monitoring

Baseline data will be collected within a 0.5-mile radius of the Highland Center Well and Park Well and confined to groundwater-dependent habitat, specifically the southern riparian habitat associated with Boundary Creek (study area) (Figure 1). Potentially affected native trees within the study area would be evaluated for overall physical condition and attributes. The trees would be inventoried by an International Society of Arboriculture–Certified Arborist or Registered Professional Forester with specific experience evaluating riparian dominant species.

The baseline monitoring evaluations would include the following:

- Establishment of 18 equidistant plots or transects within the riparian and bottomland habitat within 0.5 miles of the Highland Center Well and Park Well. Sample plots/transects would include the range of existing habitat conditions, including elevation, slope and aspect, and proximity to roads and other land uses.
- Tagging of trees and recording species, tag number, trunk diameter at breast height (inches), height (feet), and dominance (i.e., whether the tree is under the canopy of another tree or forms the uppermost canopy). Slope, aspect, and elevation of each tree location, existing understory species (including proportion of natives to exotics); presence of debris and litter; and soil type, depth, and parent material will be noted for each tree or plot/transect.
- Assessment of tree status, including documentation of:
  - Diameter at breast height measured at 4.5 feet aboveground (according to standard practices)
  - Number of stems
  - Overall tree height (based on ocular estimates)
  - Tree crown spread (measurement in each cardinal direction, based on ocular estimate)
  - Overall tree health condition (good, fair, poor, dead)
  - Overall tree structural condition (good, fair, poor, dead)
  - Pest presence (type, extent—minimal, moderate, high)
  - Disease presence (type, extent—minimal, moderate, high)
  - Other specific comments
- Assessment of seedling establishment and sapling tree densities and conditions.
- The data collection procedure will include full data collection at each plot/transect so that consistency is maintained among sampling plots.
- Creation of database using GIS or similar application.

3.3 Groundwater Mitigation Criteria

The following mitigation criteria will be established to protect groundwater resources and groundwater-dependent habitat in the Project area:

- If the groundwater level in Well Km drops 5 feet below the baseline groundwater level, groundwater extraction at the Highland Center and Park Well will cease for Project water supply until the groundwater level at the well that experienced the threshold exceedance has increased above the threshold and remained there for at least 30 continuous days. Additionally, written permission from PDS must be obtained before production for the Project may be resumed. If Well Km is not accessible, then the well interference threshold will be 5.39 feet at the Gas Station Well in order to not exceed the maximum drawdown of 5 feet at Well Km.
- If groundwater levels at JCSD Well 4 drop more than 23 feet below ground surface, than monitoring of the groundwater-dependent habitat would be triggered.
- If the groundwater levels exceed 3 feet below historical low groundwater levels in JCSD Well 4 (lowest recorded static groundwater level in JCSD Well 4 is 23 feet below ground surface) and the Arborist or Forester finds evidence of deteriorating riparian habitat health, there may be a temporary or permanent cessation of pumping at the Highland Center Well and Park Well.

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4 REPORTING REQUIREMENTS

A groundwater monitoring report will be completed by a professional geologist or engineer licensed in the State of California and will be submitted to PDS annually no later than 28 days following the end of the calendar year. Groundwater monitoring reports should be submitted for 5 years after Project construction has commenced. After 5 years, PDS should determine if continuous reporting is required based on the effects of groundwater extraction from the previous 5 years. The annual reports will include the following information:

- Groundwater level hydrographs and tabulated groundwater level data for each accessible well in the groundwater-monitoring network.
- Tabulated groundwater production volumes from the Highland Center Well and Park Well.
- Documentation of any changes in well pumping or groundwater well conditions for wells in the groundwater-monitoring network.
- Documentation of groundwater dependent habitat monitoring, if necessary, as described in Section 3.2.

If the baseline groundwater levels at the wells included in the groundwater-monitoring network decline by 5 feet, PDS will be notified via letter and electronic mail within 1 working day of the exceedance. Additionally, if groundwater level thresholds at the off-site wells are exceeded by their respective thresholds, pumping of the Highland Center Well and Park Well shall cease and PDS shall be notified via letter and electronic mail within 1 working day.

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5 REFERENCES

County of San Diego. 2007. *County of San Diego, Guidelines for Determining Significance and Report Format and Content Requirements: Groundwater Resources*. Land Use and Environment Group, Department of Planning and Land Use, Department of Public Works. March 19, 2007.

County of San Diego. 2010. *County of San Diego, Guidelines for Determining Significance: Biological Resources*. Land Use and Environment Group, Department of Planning and Land Use, Department of Public Works. Fourth Revision. September 15, 2010.

Dudek. 2015. *Groundwater Monitoring and Mitigation Plan – Flat Creek Watershed.* Prepared for Jacumba Community Services District. April 2015.

Dudek. 2019*. Updated Groundwater Resources Investigation Report – Flat Creek Watershed Analysis.* Prepared for the Jacumba Community Services District. November 2019.

Dudek 2019b. *Jacumba Solar 2018 Annual Groundwater Monitoring Report.* Prepared for AEP Renewables. March 2019.

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6 LIST OF PREPARERS

This GMMP was prepared Dudek Hydrogeologist Trey Driscoll, PG, CHG, a County-approved hydrogeologist, and Dudek Hydrogeologist Hugh McManus. Dudek Arborist Michael S. Huff prepared the monitoring program for the groundwater-dependent habitat.

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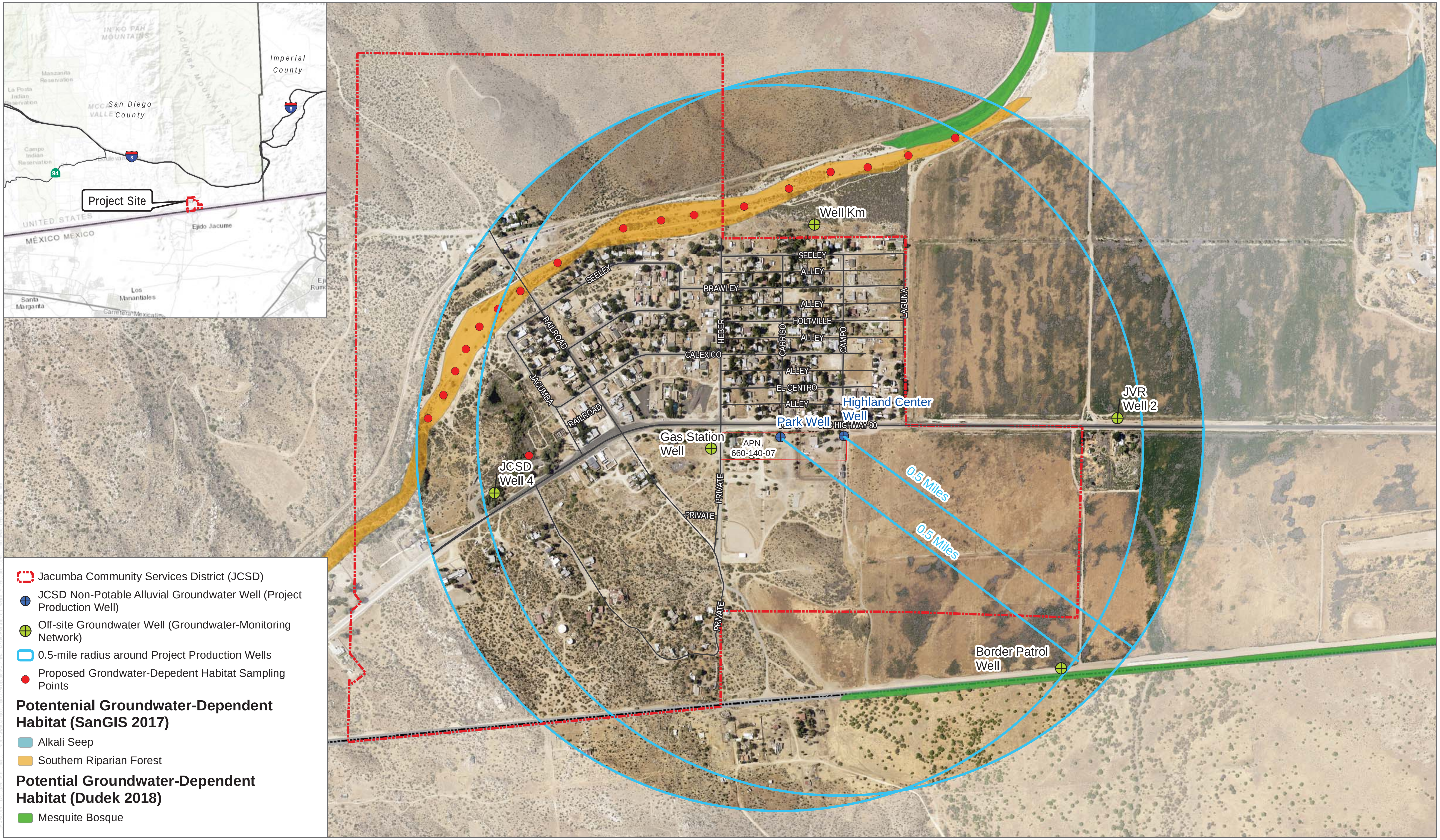

SOURCE: Bing Maps; SanGIS; Dudek

DUDEK

0 0.25 0.5 Miles

FIGURE 1

Well Interference and Potential Groundwater-Depedent Habitat

Updated Groundwater Monitoring and Mitigation Plan - Flat Creek Watershed Analysis

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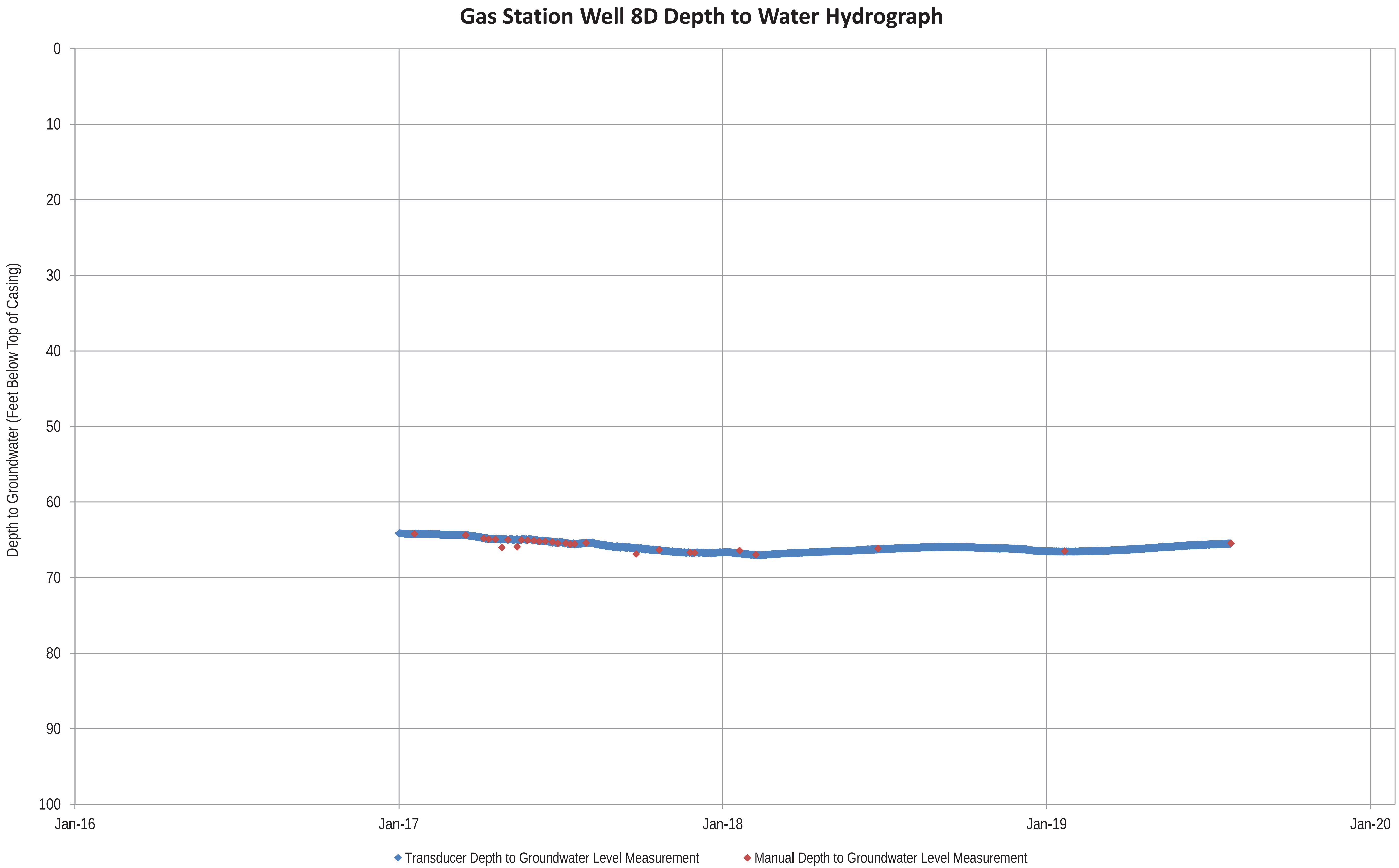
APPENDIX A

Groundwater Level Hydrographs

Jacumba Community Services District Groundwater Level Monitoring



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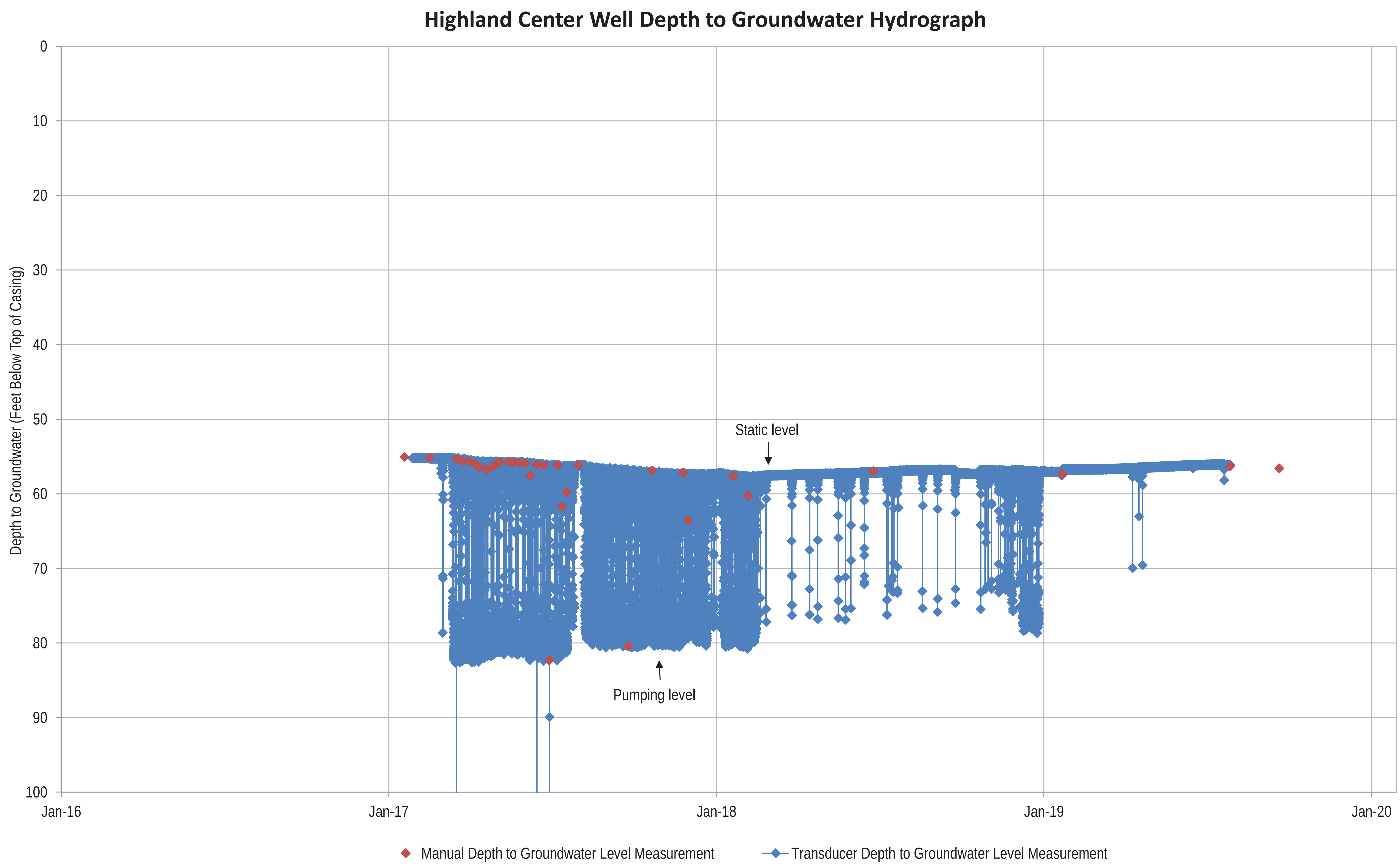
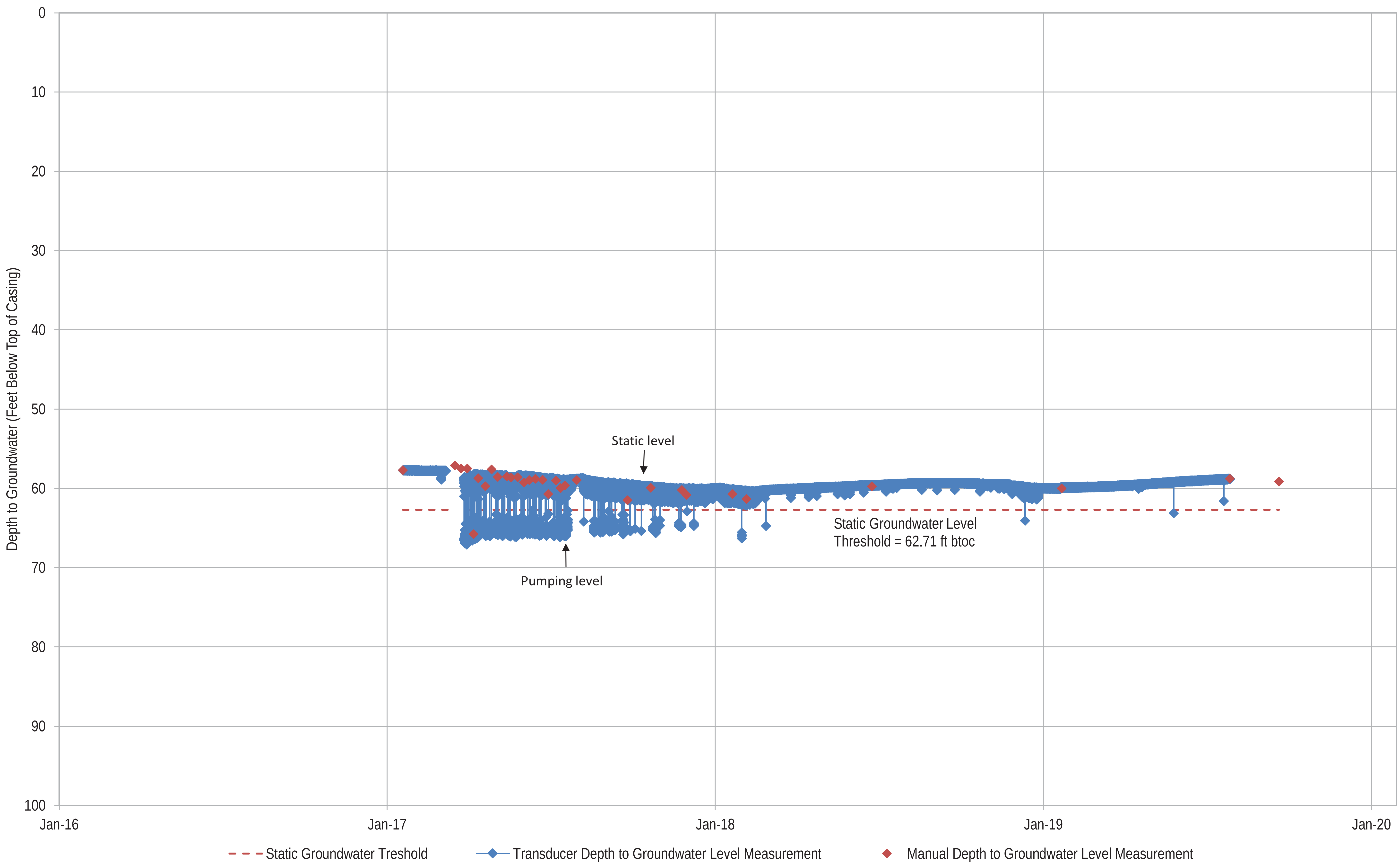
November 2019

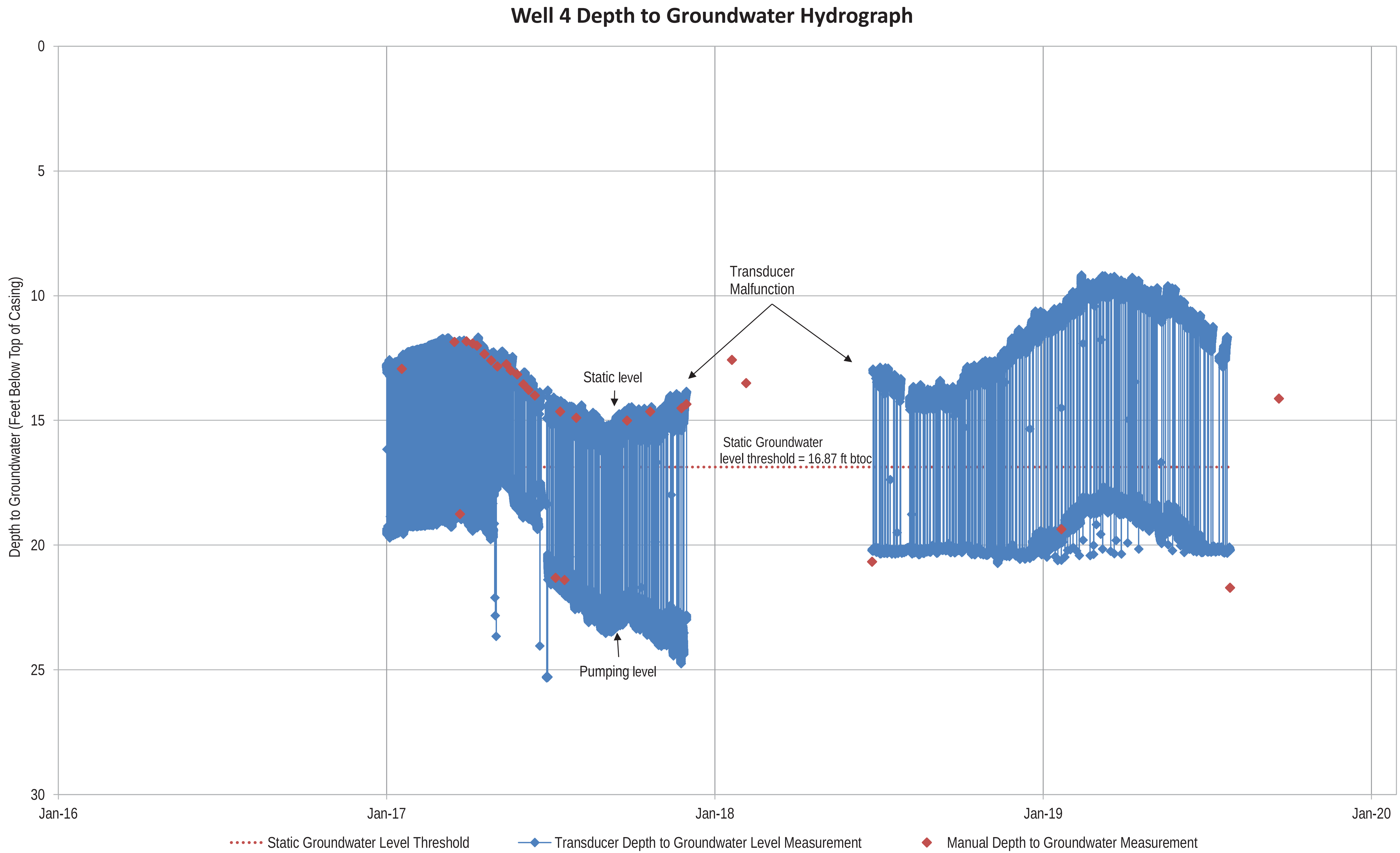
Jacumba Community Services District Groundwater Level Monitoring



Jacumba Community Services District During-Construction Groundwater Level Monitoring



Jacumba Community Services District Groundwater Level Monitoring



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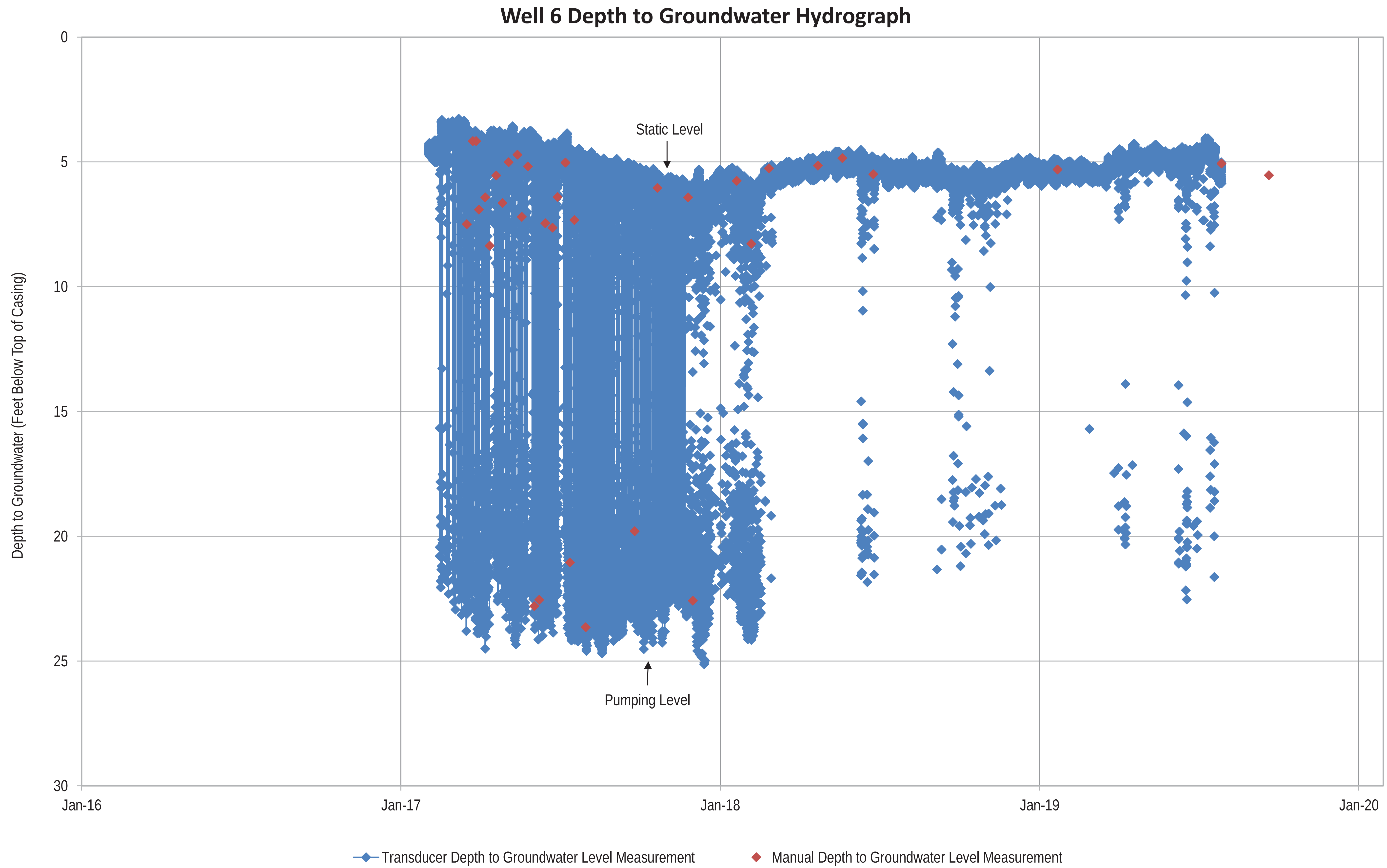
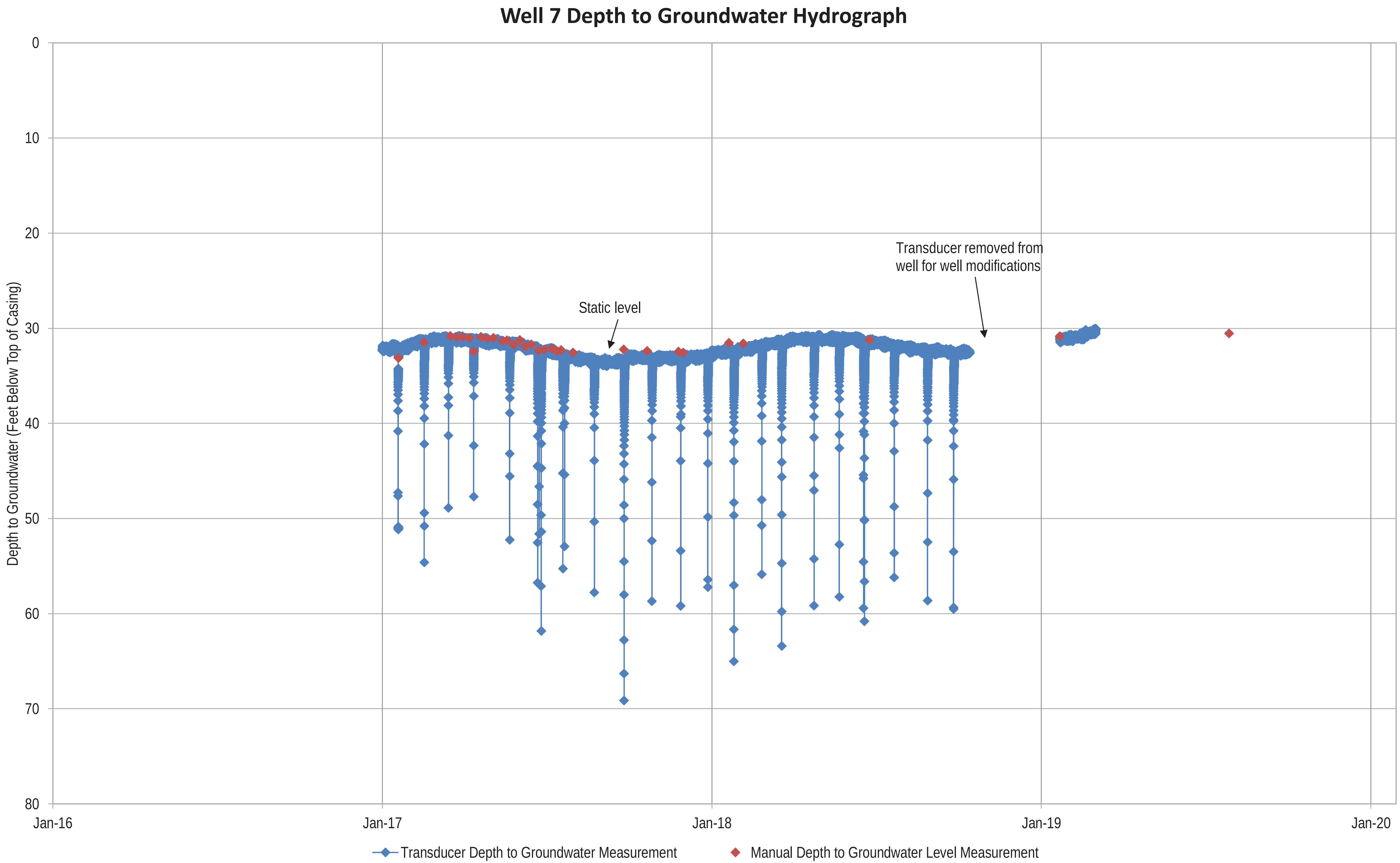
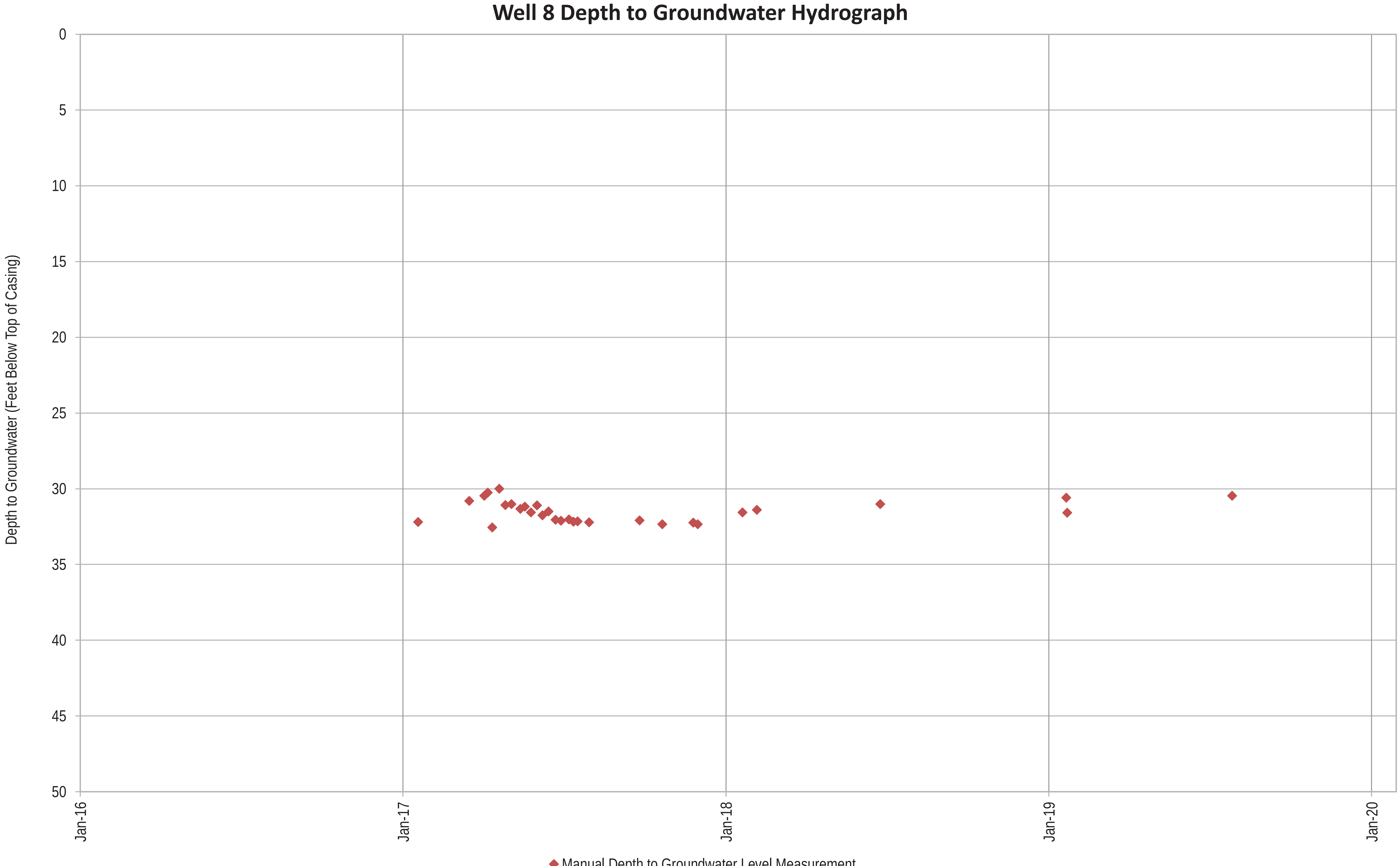
Jacumba Community Services District Groundwater Level Monitoring





Well 7 Depth to Groundwater Hydrograph
Depth to Groundwater (Feet Below Top of Casing)
0
10
20
30
40
50
60
70
80
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Static level
Transducer removed from well for well modifications
Transducer Depth to Groundwater Measurement
Manual Depth to Groundwater Level Measurement

Jacumba Community Services Groundwater Level Monitoring



Note:
No working transducer installed in Well 8.

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November 2019