HYDROLOGY AND WATER QUALITY IMPACTS ANALYSIS

Pixley Groundwater Banking Project
Tulare County, California

Hydrology and Water Quality

February 1, 2017
Project FR1416066A

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ABBREVIATIONS

af	Acre-Feet
af/d	Acre-Feet per Day
af/y	Acre-Feet per Year
bgs	Below Ground Surface
BMP	Best Management Practices
CEQA	California Environmental Quality Act
cfs	Cubic Feet per Second
CVP	Central Valley Project
DWR	California Department of Water Resources
EPA	United States Environmental Protection Agency
FKC	Friant-Kern Canal
MCL	Maximum Containment Levels
mg/L	Milligrams per Liter
Project	Pixley Groundwater Banking Project
SGMA	California 2014 Sustainable Groundwater Management Act
SVWBA	South Valley Water Banking Authority
SWPPP	Stormwater Pollution Prevention Plan
SWRCB	State Water Resources Control Board
TDS	Total dissolved solids
µg/L	Micrograms per Liter
USBR	United States Bureau of Reclamation

1.0 INTRODUCTION AND OBJECTIVES

Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler), has prepared this report on behalf of the project proponent South Valley Water Banking Authority (SVWBA), to assess the impacts to hydrology and water quality conditions for the proposed Pixley Groundwater Banking Project in southern Tulare County, California (Figure 1).

The SVWBA, as the lead agency at the local level, is preparing a document pursuant to California Environmental Quality Act (CEQA) to examine the environmental impacts of the construction and operation/maintenance of the Project, which would include the following primary structures/features:

1. A Recharge Basins facility of 500 to 800 acres,
2. A wellfield of up to 16 Project groundwater recovery wells within the Recharge Basins facility's boundary,
3. A new 48-inch turnout from the west bank of the Friant-Kern Canal (FKC),
4. A 4.5-mile long, 48-inch diameter, bi-directional concrete pipeline from the new turnout to the in-lieu service area,
5. An approximately 2-acre pumping plant and regulating basin,
6. Approximately 14 acres of grower turnouts, related control facilities, connecting pipelines, and use of up to five Project groundwater recovery wells within an approximate 3,500-acre in-lieu service area,
7. A new 48-inch turnout to be built as an extension of the existing Deer Creek turnout structure,
8. Implementation of a groundwater monitoring program.
9. The creation of a Technical Committee charged with evaluating and monitoring Project recharge and recovery operations on behalf of the Authority for the purposes of assessing performance and reporting results to identified stakeholders.

This environmental compliance document will also examine the environmental effects of approval of a program of groundwater banking and recovery including necessary contracts and supporting actions to provide the ability to place into groundwater storage up to 30,000 acer-feet per year (af/y) of water. Ten percent of the water placed into storage would not be returnable and left to improve groundwater conditions in the area. Up to 90,000 acre-feet (af) of water could be stored at any one time. Up to 30,000 af of water could be returned to banking partners in any one year.

Potential banking partners include Friant Division CVP contractors, United States Bureau of Reclamation (USBR), CVP contractors within the Cross Valley, Delta-Mendota, San Luis Unit and Exchange Contractor service areas, the Kern County Water Agency and/or its member units, the Dudley Ridge Water District, the Tulare Lake Basin Water Storage District, and other water agencies, entities or individuals within the Friant Division of the CVP.

Pixley Irrigation District also intends to use the proposed facilities to deliver irrigation water from the FKC or from Deer Creek to the new service area (the in-lieu service area) and to direct recharge via the Recharge Basins facility at times when the proposed facilities are not obligated for use by banking partners.

The Project includes implementation of a groundwater monitoring program and creation of a Technical Committee. The program will employ standards for groundwater monitoring consistent with California Department of Water Resources (DWR) and others with respect to groundwater level and water quality measurements, locations, and frequency. In addition, the monitoring program will incorporate final Best Management Practices (BMPs) specified under the California 2014 Sustainable Groundwater Management Act (SGMA) for measurement of groundwater levels and other related parameters including recharge and extraction quantities (DWR, 2016). The program will be based on continuous data collection that integrates manual readings and pressure transducers with data loggers at key locations to identify direct pumping interference by recovery wells.

The Technical Committee will develop reporting protocol to the SVWBA and regularly assess direct pumping influences by recovery wells, which this analysis has determined to be potentially significant without mitigation. Direct pumping influences have the potential to induce drawdown in neighboring wells and increase pumping lift, which may pose operational problems. The analysis presented in this appendix includes estimates of potential pumping influences, including magnitude and distribution, and has identified the thresholds and mitigation measures to be undertaken by the SVWBA.

2.0 LOCATION AND PHYSIOGRAPHY

The proposed Project is located within the Central Valley physiographic province of California. The Central Valley can be divided into the northern San Joaquin Basin that drains into the Sacramento Delta and the southern Tulare Basin, which is hydrologically closed. The proposed Project is located within Tulare Lake Hydrologic Region, within the Tule Groundwater Sub-Basin number 5-22.13 (Tule Basin) as defined by DWR Bulletin 118 (DWR, 2003) (Figure 2). The Tule Basin comprises approximately 467,000 acres and is bordered by Kern County to the south, Tulare Lake to the west, Kaweah River to the north, and the Sierra

Nevada foothills to the east. There are three major surface watersheds located within the boundary of the Tule Groundwater Basin: Tule River, Deer Creek, and White River.

3.0 CLIMATE AND PRECIPITATION

The climate of the proposed Project area is semi-arid with mild winters and hot, dry summers and is classified as a Mediterranean steppe climate (Köppen climate classification). The average rainfall received in the proposed Project is approximately 10.4 inches per year (Figure 3) (PRISM, 2014). The eastern edge of the Tule Basin along the foothills experiences higher amounts of rainfall, while the western edge of the Tule Basin is typically more arid and dry. Precipitation primarily occurs from November to March. From May through November, the area generally experiences dry summers where almost no rain occurs. A summary of the 1980-2010, 30-year average monthly temperatures and precipitation in the proposed Project are shown on Figure 3.

4.0 SURFACE WATER HYDROLOGY

There are only two surface waters of significance near the proposed Project: Deer Creek and the CVP FKC (Figure 4). Deer Creek is an intermittent stream extending from the Greenhorn Mountains in the Sierra Nevada and terminating in the Lakeland and Homeland Canals near the Tulare/Kings County border. Prior to diversion for agricultural purposes, Deer Creek ran into the former Tulare Lake bed. The United States Geological Survey operates a gauging station (#11200800) on Deer Creek near Fountain Springs where Deer Creek descends onto the valley floor. A chart of monthly Deer Creek flows from 1968 to present shows that Deer Creek has significant seasonal variability (Figure 5). Peak flows from 40 to 70 cubic feet per second (cfs) typically occur from January through May (Figure 5). The long-term average monthly discharge of Deer Creek is about 30 cfs (60.5 acre-feet per month).

The CVP FKC passes within one mile of the eastern edge of the proposed Project (Figure 4). The FKC is operated and maintained by the Friant Water Authority and is used to convey water from the San Joaquin River to Kern County. The canal originates at the Friant Dam, which is operated by the USBR. The FKC flows southeasterly along the western flank of the Sierra Nevada foothills through Fresno, Tulare, and Kern Counties. The FKC has a capacity of approximately 5,300 cfs (10,510 acre-feet per day [af/d]), which decreases to about 2,500 cfs (4,959 af/d) as demand decreases toward its end in the Kern River, near Bakersfield, California.

5.0 SURFACE WATER QUALITY

Surface water quality in the Tulare Lake Basin is generally good, with excellent quality exhibited by most eastside streams (RWQCB, 2004). Common water quality issues are a result of runoff from direct discharge from industrial and commercial activities, resource withdrawal, leaking sewer infrastructure, and illicit dumping during wet weather conditions. Further potential sources of polluted water within Tulare County include past waste disposal practices, agricultural chemicals, and fertilizers applied to landscaping. Characteristic water pollutant contaminants include: sediments, hydrocarbons and metals, pesticides, nutrients, bacteria, and trash.

Irrigated agriculture accounts for most water used in the Tulare Lake Basin. Agricultural drainage, depending on management and location, carries varying amounts of salts, nutrients, pesticides, trace elements, sediments, and other by-products to surface and groundwater (RWQCB, 2004).

The State Water Resources Control Board (SWRCB), in compliance with the Clean Water Act, Section 303(d) (RWQCB, 2011), prepared a list of impaired water bodies in the State of California. The list was approved by the U.S. Environmental Protection Agency (EPA) in 2011. Deer Creek is listed as a Category 5 water body, impaired by an unknown toxicity (303(d) 2011) (RWQCB, 2011). Category 5 criteria indicate a water segment where standards are not met and a Total Maximum Daily Load is required, but not yet completed (RWQCB, 2011).

The water from the San Joaquin River that is delivered via the FKC is considered of excellent quality. The USBR maintains guidelines for the quality of any water to be introduced into the FKC that doesn’t originate from the San Joaquin River (USBR, 2008). These guidelines specify that any water introduced into the FKC must meet Title 22 State drinking water quality standards (the Domestic Water Quality and Monitoring Regulations specified by the State of California, Health and Safety Code (Sections 4010-4037), and Administrative Code (Sections 64401 et seq.), as amended). There is allowance in the guidelines for the introduction of water that may exceed these standards for certain constituents (typically inorganic constituents) but they do not allow any impairment that rises to the level of limiting any beneficial use of the water in the FKC.

6.0 GROUNDWATER HYDROLOGY

The sediments that comprise the Tule Basin’s aquifer are continental deposits of Tertiary and Quaternary age (Pliocene to Holocene). These deposits include flood-basin deposits, younger alluvium, older alluvium, the Tulare Formation, and undifferentiated continental deposits.

The flood-basin deposits consist of relatively impermeable silt and clay interbedded with some moderately to poorly permeable sand layers that interfinger with the younger alluvium. These deposits are likely not important as a source of water to wells, but may yield sufficient supplies for domestic and stock use.

The younger alluvium is a complex of interstratified and discontinuous beds of unsorted to fairly well sorted clay, silt, sand, and gravel, comprising the materials beneath the alluvial fans in the valley and stream channels. Where saturated, the younger alluvium is very permeable. However, this unit is largely unsaturated and likely not important as a source of water to wells. The older alluvium consists of poorly sorted deposits of clay, silt, sand, and gravel. This unit is moderately to highly permeable and is a major source of water to wells.

The Tulare Formation is composed of poorly sorted deposits of clay, silt, sand, and gravel, the origin of which is the Coast Ranges (DWR, 2003). The Tulare Formation contains the Corcoran Clay Member, the major confining bed in the western portion of the Tule Basin. This unit separates a confined and unconfined aquifer where it occurs. The Tulare Formation is moderately to highly permeable and yields moderate to large quantities of water to wells (DWR, 2003). Approximately two miles southwest of the proposed Project area, the Corcoran Clay occurs between depths of 200 to 300 feet below ground surface (bgs) (Figure 6; USGS, 2009). The undifferentiated continental deposits contain poorly sorted lenticular deposits of clay, silt, sand, and gravel derived from the Sierra Nevada (DWR, 2003). The unit is moderately to highly permeable and is a major source of ground water in the Tule Basin (DWR, 2003). A detailed discussion of geology and stratigraphy derived from well logs are presented in Section H2 of this appendix.

7.0 GROUNDWATER OCCURRENCE

The sediments described above comprise a regional aquifer system serving domestic, agricultural, and industrial uses. In a 1984 report, Poland and Lofgren define the aquifer in the Tule Basin as unconfined or confined based on the absence or presence of the Corcoran Clay (Poland and Lofgren, 1984). In parts of the Tule Basin, the Corcoran Clay separates aquifers with distinctly different water chemistries (USGS, 1959; 1989, 2009). Differences in hydraulic head and water chemistry above and below the Corcoran Clay support the hypothesis that the Corcoran Clay separates the aquifer system into unconfined or semi-confined zones (above the clay) and a confined zone (below the clay). However, in some areas of the Tule Basin, the fine-grained lenses have a combined thickness of several hundred feet. Also, many wells have been perforated above and below the Corcoran Clay, allowing flow through the well casings and gravel packs. In the vicinity of these wells, hydraulic head is equalized. In the eastern areas of the Tule Basin where the Project site occurs and where the Corcoran Clay is absent, head differences between shallow and deeper wells result from restriction of vertical movement by intervening and discontinuous clay layers (USGS, 1989).

The heterogeneous composition of alluvial deposits in central San Joaquin Valley exhibit classic examples of unconfined and confined aquifers (USGS, 1968). Aquifers in which the heads rises and falls with the water table are defined as unconfined. Aquifers which exhibit a rapid pressure response that do not equilibrate with the water table are defined as confined. Aquifers that respond to changes in pressure over short periods of time, but in which heads adjusts to equilibrium with the water table over long, low stress periods of time, are defined as be semi-confined (USGS, 1968). Beneath most of the proposed Project, the aquifer is unconfined or semi-confined by lenses of fine-grained material. Where the Corcoran Clay is present in the western portion of the Tule Basin, the shallow overlying aquifer is unconfined or semi-confined while the aquifer beneath the Corcoran Clay is confined.

8.0 GROUNDWATER LEVELS

Groundwater levels near the proposed Project have been measured on a semi-annual basis by the DWR and cooperating agencies. Long-term hydrographs for wells in the vicinity of the proposed project show that groundwater levels have decreased as much as 100 feet since the 1940s (Figure 7). The regional groundwater decline was somewhat arrested by the availability of CVP water starting in the 1960s; however, CVP water is not available in the immediate vicinity of the proposed Project. Groundwater levels continue to decrease in Pixley Irrigation District.

9.0 GROUNDWATER QUALITY

In the northern portion of the Tule Subbasin, groundwater is characterized as calcium bicarbonate (USGS, 1968), while the southern portion is sodium bicarbonate (USGS, 1963). Concentrations of total dissolved solids (TDS) typically range from 200 to 600 milligrams per liter (mg/L), which is satisfactory for a wide range of agricultural uses. TDS values of shallow groundwater in poorly drained areas are as high as 30,000 mg/L (USGS, 1995), exceeding all beneficial uses. The California Department of Drinking Water, which monitors Title 22 water quality standards for domestic uses, reports TDS values in 65 wells ranging from 20 to 490 mg/L, with an average value of 256 mg/L. The eastern side of the Tule Subbasin, including areas near the Project location, have occurrences of elevated nitrate.

The groundwater quality characteristics of the Deer Creek/White River Watershed vary from east to west. In general, water quality on the east side of the valley floor in this area may be of poor quality where nitrate, phenols, and salts are present in varying concentrations and locales. On the westerly side of the watershed, groundwater quality may also have unfavorable characteristics including elevated arsenic concentrations exceeding the Title 22 Maximum Containment Level (MCL) (10 micrograms per liter [µg/L]). Arsenic is naturally occurring and commonly found in drinking water sources in California. More groundwater sources exceeded the Title 22 MCL after the state raised the standard from 50 to 10 µg/L in 2008.

Samples of groundwater taken from existing wells in the area of the proposed Project were obtained and analyzed for quality constituents of concern and compared against Title 22 drinking water quality standards (RWQCB, 2016). Of twelve wells initially screened and sampled, two contained measurable arsenic and one contained measurable lead that exceeded MCL allowed by Title 22 (see Table 1). No other constituents tested in the balance of the wells exceeded MCLs. Construction information, including depth and screened intervals, was not available for the initial water quality screening.

Expanded screening was performed on two nearby agricultural supply wells with known construction features. As shown in Table 1 (see Mouw 1 and 2), test results indicate that groundwater quality in these wells meet Title 22 MCLs for the constituents tested. The completion intervals for these wells are consistent with the targeted completion zones for Project recovery wells. Although groundwater quality from these wells are considered most representative of water to be recovered from the water bank, the Project development phase incorporates measures such as zone sampling during well construction to ensure that recovery wells meet Title 22 requirements including the MCL for arsenic (which was encountered in two of the initial screening wells of unknown construction). Recovery well design and blending of return water before introduction into the FKC, as incorporated into the Project mitigation measures, will further reduce the potential that Project discharges would violate water quality standards.

Table 1
Summary of Lab Results – Key Constituents

				Well Number													
Constituent	**Units**	**Maximum Contaminant**	**Secondary Standard**	**BP No. 2**	**BP No. 4**	**BP No. 5**	**BP No. 6**	**BP No. 7**	**BP No. 8**	**BP No. 11**	**BP No. 12**	**BP No. 14**	**BP No. 16**	**BP No. 17**	**BP No. 18**	**Mouw 1**	**Mouw 2**
Aluminum	mg/L	1.0	0.20	0.01	ND	ND	0.02	0.01	0.05	0.15	0.02	0.03	0.02	0.02	0.02	ND	0.1
Arsenic	ug/L	10	-	3	2	2	2	2	**13**	10	4	ND	5	5	3	6	8
Fluoride	mg/L	2.0	-	0	0	0	ND	ND	0.2	0.4	ND	ND	0.1	0.1	ND	0.2	0.4
Iron	ug/L	-	300	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lead	ug/L	15	-	ND	ND	1	1	ND	3	3	ND	**21**	ND	2	ND	ND	ND
Manganese	ug/L	-	50	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nitrate	mg/L	45	-	18	18	15	12	23	3	1	27	34	12	34	13	-	-
Nitrate as N	mg/L	10	-	-	-	-	-	-	-	-	-	-	-	-	-	1	ND
Sodium Absorption Ratio	-	-	-	2	1	1	2	1	7	16	3	1	3	2	3	-	-
Electrical Conductivity	umhos/cm	-	900 - 1,600	250	269	268	246	332	233	346	390	414	286	426	261	240	300
pH	units	-	-	8.2	8.1	8.0	8.2	8.1	9.3	9.2	8.4	8.0	8.9	8.3	8.7	8.9	9.2
Total Dissolved Solids	mg/L	-	500 - 1,100	150	160	170	140	200	130	200	210	260	170	280	160	150	200
DBCP	ug/L	0.20	-	ND	ND	ND	0.05	ND	ND	ND	ND	0.03	0.02	ND	ND	ND	ND

				Well Number													
Constituent	Units	Maximum Contaminant	Secondary Standard	BP No. 2	BP No. 4	BP No. 5	BP No. 6	BP No. 7	BP No. 8	BP No. 11	BP No. 12	BP No. 14	BP No. 16	BP No. 17	BP No. 18	Mouw 1	Mouw 2
EDB	ug/L	0.05	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3 - Trichloropropane	ug/L		-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	.0009	ND
Gross Alpha	pCi/L	15	-	0	0	2	0	3	0	2	0	3	1	4	1	4	4

Notes: Well Mouw 1 is perforated from 490 feet to 1,050 feet.
Well Mouw 2 is perforated from 570 feet to 1,090 feet.

10.0 GROUNDWATER IMPAIRMENTS

Over pumping of groundwater and chronic water level declines in the Tule Basin and in other parts of the San Joaquin Valley have induced land subsidence due to deep compaction of fine-grained lithologies. Areas most vulnerable to subsidence are where pumping occurs beneath the Corcoran Clay west of the Project area. Land subsidence beneath portions of the Tule Basin of 12 to 16 feet from 1926 to 1970 has been reported (USGS, 1984). More recently between 2007 and 2011, an additional 0.5 to 1 foot of subsidence occurred in the Project area (LSCE, 2014). This is attributed to reduced availability of surface water supplies and reliance on groundwater to meet water demands.

The eastern side of the Tule Basin, including areas near the proposed Project location, have localized nitrate pollution, likely as a result of agricultural fertilizers.

11.0 WATER BALANCE

Overdraft for the Tulare Lake Hydrologic Region has been projected at 820,000 af/y (Tulare County, 2012). The Tule Subbasin is one of six major subbasins in this hydrologic region. The Tule Subbasin has also has been identified by DWR as a basin in critical condition of overdraft. As defined in SGMA, a basin is identified as in critical overdraft "when continuation of present water management practices would probably result in significant adverse overdraft-related environmental, social, or economic impacts." As a consequence, the Tule Subbasin will be required to be managed under a groundwater sustainability plan, or coordinated plans, by January 31, 2020.

The estimated irrigation demand for the Delano-Earlimart Irrigation District is approximately 177,000 af/y. To meet agricultural demand, it is estimated that between 35,000 and 40,000 af is pumped by private landowner wells (P&P, 2008). Pixley Irrigation District has a total irrigated demand of 157,600 af/y, while the District's total water sold to growers averages only 21,600 af/y. The 136,000 af/y deficit is assumed to be pumped from private groundwater wells.

12.0 FLOODING

Portions of the proposed project area are located within the 100-year flood plain of Deer Creek (Figure 8). The 100-year flood is defined as a flood flow that has a 1 percent chance of being equaled or exceeded in any given year (FEMA, 2009). 100-year flood zones are located throughout southern Tulare County from a number of waterways, including the White and Tule Rivers, Deer Creek, and the FKC (FEMA, 2009). A portion of the proposed project area is within the 100-year flood plain of Deer Creek. A turnout will be constructed as part of the Project that will allow water from Deer Creek to be routed into the recharge basins. Although not a Project purpose, some flood water can be diverted into the Recharge Basins providing an increment of additional protection for areas further down-stream from inundation.

13.0 PROJECT IMPACTS

The proposed Project would begin a program of long-term groundwater banking where up to 30,000 af/y of surface water is recharged to groundwater. The Project would provide opportunities for partners to bank water during wet years and recover water in normal and dry years. The proposed Project would operate on a 10 percent “leave behind” fraction, where water recovered would not exceed more than 90 percent of the previously recharged water; thus creating a minimum net benefit of at least 10 percent of the banked groundwater. The Project seeks participants to actively use the bank so that the 10-percent leave-behind benefit is maximized. This minimum net benefit is a direct addition of a new source of water to the Project area.

a. Would the project violate any water quality standards or waste discharge requirements?

Impact: The proposed Project could result in temporary adverse impacts to groundwater quality. (Less than significant)

Surface water applied to the recharge basins and in-lieu lands would be delivered via Deer Creek and the FKC. The water quality of these deliveries, because of their similar tributary origins, would be comparable to historic water qualities that have naturally recharged the underlying groundwater. Hence no long-term negative impact on groundwater quality would be expected.

However, residual concentrations of nitrates and other agricultural related chemicals (if present) could be mobilized beneath the recharge basins with initial water applications. This would result in short-term impacts to groundwater quality. Assuming a 20 foot thick zone of impacted soils, with soils possessing 15 percent void space, and 30,000 af/y of applied water, the 20 foot zone would be flushed more than 16 times in the first year of recharge, significantly diluting potential impacts to groundwater. Additionally, water quality sampling before the Project, and continued sampling during the first year of operation, would be conducted to verify lack of impacts by this mechanism.

Likewise, care should be taken when recharging the first runoff waters from Deer Creek each season. Allowing the initial flows of Deer Creek to continue past the proposed Project until the water appears clear before beginning recharge operations would mitigate the unwanted application of higher chemical concentrations (if present) and the introduction of silts that will likely reduce basin infiltration.

Samples of groundwater taken from existing wells in the area of the proposed Project area indicate the potential for exceeding drinking water MCLs for arsenic. It is anticipated that all other standards will be discharge requirements for the FKC. Recovery well design and blending return water to the FKC before introduction into the FKC further will reduce the potential that Project discharges would violate FKC standards.

Mitigation Measure: Impact would be less than significant after mitigation.

WAT-1: Project recovery wells will be designed to meet water quality criteria by USBR. During the construction phase, zone sampling will be performed at prospective well locations and observation wells will be used to evaluate water quality characteristics of aquifer units underlying the Project area. Based on water quality from each recovery well, a blending protocol will be implemented to meet USBR requirements for deliveries via the FKC under WAT-2.

WAT-2: Well water returned to the FKC will be commingled in the 48-inch turnout before being discharged into the FKC. Based on the water quality characteristics of individual wells, a protocol will be developed to ensure that blending and mixing through the 4.5-mile long, 48-inch diameter conveyance to the FKC meets USBR's then-current water quality requirements. Ongoing sampling in accordance with USBR's then-current water quality requirements will also be performed to ensure compliance.

b. Would the Project substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level?

Impact: The proposed Project would have short-term impacts to groundwater levels during recharge and recovery operations. (Less than Significant with Mitigation)

Mitigation Measure: Impact would be less than significant after mitigation.

WAT-3: A monitoring program will be implemented to evaluate recovery pumping impacts on neighboring wells. Thresholds of significance requiring mitigation have been quantified with measures to be employed by the SVWBA through recommendations by a Technical Committee:

Threshold	Discussion	Mitigation
< 10 feet induced drawdown	This degree of influence is considered reliably detectable, but generally not a significant impact for the Project setting.	No action. Continue monitoring to determine whether Project influences may induce drawdown to next threshold level.
>10 feet induced drawdown	This degree of influence may cause significant added cost in operating high capacity wells over an irrigation season.	Authority shall compensate well owner for added lift. A protocol for claims shall be developed and managed by the water bank Technical Committee
>20 feet induced drawdown	This degree of influence may pose operational problems by reducing the margin between pumping levels and pump setting depths.	Authority shall compensate for added lift. Authority shall compensate well owner to lower pump if induced drawdown by Project recovery wells results in inadequate suction head to operate well pump.

The SVWBA may employ other measures to mitigate an adverse impact attributed to Project recovery pumping. Such measures may include, but are not limited to the following:

1. Reducing or shutting off recovery wells to reduce impacts to nearby wells;
2. Supply well owner's parcel with a different source of water;
3. Lower or replace a well pump; and
4. Replace a well.

c. Would the Project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on-or off-site?

Impact: The proposed Project would not significantly alter the existing drainage pattern of the site in a manner which would result in substantial erosion or siltation on or off site. (Less than Significant)

The proposed Project would construct 4 to 5 foot deep recharge basins with 1- to 2-foot tall berms over an approximate 500 to 800 acre area. The construction of the basins would alter the existing drainage pattern and could increase the rate of erosion at the site during construction. Erosion and sediment control measures, if properly prescribed, implemented, and maintained, including a Stormwater Pollution Prevention Plan (SWPPP) in accordance with the Clean Water Act are expected to reduce erosion rates during and after construction to less than significant levels.

Mitigation Measure: No Mitigation is required.

d. Would the Project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the amount of surface runoff in a manner which would result in flooding on-or off-site?

Impact: Outside of typical groundwater banking operations, the proposed Project would not significantly alter the site's existing drainage pattern in a manner which would result in flooding on or off-site. (Less than Significant with Mitigation)

The proposed Project would construct 4 to 5 foot deep recharge basins with 1- to 2-foot tall berms over an approximate 532 acre area. Unregulated water from Deer Creek, when available and acceptable, will be captured and recharged to basins. The capture of this water will temporally divert water from Deer Creek without permanently altering the course of the creek. The impacts of surface runoff to result in flooding on or off site are less than significant.

Portions of the proposed Project area, including portions of the recharge basins, fall within a 100-year flood zone. The 100-year flood is defined as a flood flow that has a 1 percent chance of being equaled or exceeded in any given year (FEMA, 2009). Special consideration should be taken in the engineering and construction of the berms such that the recharge basins are constructed in a way to capture flows to the extent that the basins are capable, thereby reducing inundation off-site, and in a manner that protect the berms from failure from a 100-year flood.

Mitigation Measure: Impact would be less than significant after mitigation.

WAT-4: Special engineering consideration shall be incorporated in the design of the berms to protect the recharge basins from 100-year flood related failure.

e. Would the Project create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?

Impact: The Project will not create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff. (Less than Significant)

The Project would capture and recharge surface water up to 30,000 af/y. Additionally, rain that falls within the proposed recharge basins will be captured and recharged to groundwater. The capture of unregulated water to Deer Creek, and capture of direct rainfall will produce a net reduction in runoff water as a result of the proposed Project. The basins will be constructed using materials, including existing topsoil, which will not provide substantial additional sources of polluted runoff. Therefore, the impacts of the Project are considered less than significant.

Mitigation Measure: No Mitigation is required.

f. Would the Project Otherwise substantially degrade water quality?

Impact: The proposed Project would not substantially degrade water quality. (Less than significant with Mitigation.)

Surface water applied to the recharge basins and in-lieu lands would be delivered via Deer Creek and the FKC. The water quality of these deliveries, because of their similar tributary origins, would be comparable to historic water qualities that have naturally recharged the underlying groundwater.

Mitigation Measure: Impact would be less than significant after mitigation.

See WAT-1 and WAT-2.

Impacts of the Project to substantially degrade water quality are considered less than significant.

Mitigation Measure: No Mitigation is required.

g. Would the Project place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?

Impact: None.

The proposed Project will not place or construct any housing.

Mitigation Measure: No Mitigation is required.

h. Place within a 100-year flood hazard area structures which would impede or redirect flood flows?

Impact: The proposed Project would construct recharge basins within a 100-year flood hazard area which would redirect flood flows. (Less than Significant with Mitigation)

Portions of the proposed Project area, including portions of the recharge basins, fall within a 100-year flood zone. The 100-year flood is defined as a flood flow that has a 1 percent chance of being equaled or exceeded in any given year (FEMA, 2009). Recharge basins, which consist of 3 to 4-foot deep excavations with 1- to 2-foot tall berms, will be constructed. These structures would be constructed for the purpose of capturing surface water deliveries. The redirection of flood flows into the basins would reduce downstream inundation. Special consideration should be taken in the engineering and construction of the berms such that the recharge basins are constructed to capture flows to the extent that the basins are capable, and in a manner that protect the berms from failure from a 100-year flood.

Mitigation Measure: Impact would be less than significant after mitigation.

See WAT-4.

i. Would the Project expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee or dam?

Impact: The proposed Project would not expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result or the failure of a levee or dam. (Less than significant)

According to a dam failure inundation map of Tulare County, prepared by the Tulare County Office of Emergency Services, the Project site is not located within an inundation area (Tulare County, 2011). As such, the Project would not expose people or structures to a significant risk of loss, injury, or death involving flooding. Furthermore, water levels within the excavated recharge ponds will be kept at or below grade, reducing the potential for flooding.

Mitigation Measure: No Mitigation is required.

j) Would the Project expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of involving inundation by seiche, tsunami, or mudflow?

Impact: The proposed Project would not expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result or the failure of inundation by seiche, tsunami, or mudflow. (Less than significant)

The proposed Project area is located on nearly flat topography, with no nearby bodies of water, and is separated from the Pacific Ocean by the Coast Range and approximately 100 miles. Therefore, inundation by seiche, tsunami, or mudflow are not significant hazards to the site.

Mitigation Measure: No Mitigation is required.

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