7.8 GEOLOGY, SOILS, AND MINERAL RESOURCES (NEW)

7.8 GEOLOGY, SOILS, AND MINERAL RESOURCES (NEW)

7.8.1 INTRODUCTION

7.8.1.1 Content

The proposed project analyzed in the Monterey Plus EIR was the Monterey Amendment and the Settlement Agreement. The Monterey Plus EIR considered five "elements" of the Monterey Amendment as follows:

- *Changes in the procedures for allocation of Table A water and surplus water among the SWP contractors;*
- *Approval to permanent transfers of 130,000 acre feet and retirement of 45,000 acre-feet of SWP long-term water supply contracts' Table A amounts;*
- *Transfer of property known as the "Kern Fan Element property" in Kern County;*
- *Water supply management practices; and*
- *Restructured water rates.*

This REIR has changed the description of the Kern Fan Element property transfer to be:

- *Transfer of property known as the "Kern Fan Element property" in Kern County and its development and continued use and operation as a locally owned and operated groundwater banking and recovery project.*

There are no revisions to the other elements of the Monterey Amendment or of the Settlement Agreement, and no changes have been made relating to them in this REIR. (See discussion in Introduction/Executive Summary.)

This REIR does not supersede the analysis of the Monterey Plus EIR but supplements the Monterey Plus EIR. The Monterey Plus EIR focused on the transfer of the KFE property, which was fully analyzed in the Monterey Plus EIR. This REIR did not identify any new impacts or changes to impacts caused by the transfer of the KFE property. Therefore, the Monterey Plus EIR fully disclosed all impacts caused by the transfer of the KFE property. Consequently, this REIR focuses on the development and continued use and operation of the KWB as a locally owned and operated groundwater banking and recovery project ("KWB activities").

The Monterey Plus DEIR Section 7.8 identified potential impacts to geology, soils, and mineral resources as a result of the transfer of the Kern Fan Element. Substantial new information is presented in this section, however, that replaces text from DEIR Section 7.8 that discusses KWB activities. All other text in DEIR Section 7.8 remains unchanged.

Table 7.8-1A identifies the potentially affected environmental resources from impacts of KWB activities on geology, soils, and mineral resources.

TABLE 7.8-1A

IMPACTS OF KWB ACTIVITIES ON GEOLOGY, SOILS, AND MINERAL RESOURCES

Proposed Project Element	Potentially Affected Environmental Resources	Impact Number
Transfer of Kern Fan Element lands, and KWB activities	Changes in soil erosion with changes in agricultural practices and construction activities, exposure of people and structures to risks from construction in unstable soils (liquefaction), potential for land subsidence from KWB operation, and contribution of subsidence from KWB operation to movement on regional faults	7.8-1, 7.8-2, 7.8-3

No comment letters related to geology, soils, or mineral resource impacts were received in response to the Notice of Preparation circulated for the Monterey Plus EIR.

7.8.1.2 Analytical Method

The analysis of potential geologic and soils impacts throughout the KWB Lands was based on *Geology of California*, Second Edition, by Robert M. Norris and Robert W. Webb, information from the Natural Resources Conservation Service (formerly the U.S. Soil Conservation Service), and a large variety of publicly available technical reports and maps. The information obtained from these sources was reviewed and summarized to establish existing conditions and to identify potential environmental effects, based on the standards of significance presented in this section. In determining the level of significance, the analysis assumes that the KWB activities would comply with relevant federal, State, and local regulations governing seismic safety, and hazards associated with unstable soils.

The analysis included a review of the environmental setting, impacts, and mitigation measures related to geology, soils, and mineral resources, to the extent they apply, presented in the 1997 Monterey Initial Study and Addendum (see Appendix 7-6a).

7.8.1.3 Standards of Significance

The following standards of significance are based on Appendix G of the California Environmental Quality Act (CEQA) Guidelines. For the purposes of this REIR, a significant impact related to geology and soils would occur if the KWB activities would:

- result in substantial soil erosion or the loss of topsoil; or
- be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in substantial on- or off-site landslides, lateral spreading, subsidence, liquefaction or collapse.

KWB Lands contain known subsurface deposits of oil and natural gas. However, KWB activities would not interfere with the ability of any mine operator's rights to extract such resources or have any impact on mineral resources. Thus, there would be no impact related to loss of availability of known mineral resources, and therefore mineral resources were not addressed in the Monterey Plus EIR and are not addressed further in this REIR.

7.8.2 ENVIRONMENTAL SETTING

7.8.2.1 Physical Setting in 1995

The San Joaquin Valley basin is bordered to the south and east by the Sierra Nevada and Tehachapi mountains, which are composed of crystalline igneous and metamorphic rock. Exposed consolidated marine sedimentary rock from the Coast Range is evident in the layer of sediment above bedrock underlying the San Joaquin basin. The property underlying KWB Lands is a large, deep, and asymmetrical sedimentary basin located in the southern portion of the San Joaquin Valley.

The marine sedimentary rock is overlain by a thick series of continental rocks and semi-consolidated to unconsolidated sediments. These sediments are several thousand feet thick under KWB Lands and encapsulate the primary groundwater basin. The portion of this sediment that is usable for groundwater storage is located above the base of the fresh water in the basin. This area of the groundwater basin is dominated by the alluvial fan and lake material that comprise KWB Lands. Further, groundwater development is limited to the upper portions of the fresh water aquifer system in this basin.

The southern San Joaquin Valley, including KWB Lands, is dominated by the alluvial fan deposited by the Kern River, and consists of thick deposits of sand and gravel with extensive but discontinuous silt and clay beds.[1] The sand and gravel deposits are remnants of old streambed channels which generally occur in long, winding, and interconnecting stingers and sheets that are prevalent throughout the KWB Lands, but less evident along its borders. These sand and gravel deposits are highly permeable, but are imbedded with less permeable areas comprised of fine-grained silt and clay deposits. These silt and clay deposits are more extensive along the edges of the alluvial fan and in some areas may intersect with clay beds deposited in lakes. In general, the upper layers of the alluvial fan deposits form an unconfined to semi-confined aquifer system that provides a large amount of groundwater recharge area. For a geologic map and detailed description of the geologic formations present at KWB Lands, see Section 7.13, Cultural and Paleontological Resources.

Soils

Based on a review of U.S. Natural Resources Conservation Service (NRCS) soil survey data[2], soils at the KWB consist of silty, sandy, and clayey loams. These soils are moderately susceptible to water erosion and are highly to moderately susceptible to wind erosion. The sandy loam deposits are highly permeable, but are interbedded with lower permeability areas (i.e., a slower water infiltration rate) comprised of fine-grained silt and clay deposits. Soils that have a low infiltration rate also have a high water runoff potential.

Liquefaction

Soil liquefaction occurs when ground shaking from an earthquake causes a sediment layer saturated with groundwater to lose strength and become fluid, similar to quicksand. Factors determining liquefaction potential are type and consistency of soils, the level and duration of seismic ground motions, and the depth to groundwater. Loose sands and peat deposits, as well as uncompacted fill and other Holocene materials deposited by sedimentation in rivers and lakes (fluvial or alluvial deposits), as well as debris or eroded material (colluvial deposits), are more susceptible to liquefaction. Localities most susceptible to liquefaction-induced damage are underlain by loose, water-saturated, granular sediment within 40 feet of the ground surface. Liquefaction poses a hazard to engineered structures such as buildings, bridges, canals, and underground utility pipelines. The loss of soil strength can result in bearing capacity insufficient to support foundation loads, increased lateral pressure on retaining walls, and slope instability.

The KWB Lands are located in a seismically active area. A series of earthquakes occurred in 1952 in the area of the White Wolf fault and subsequently in an area east of Bakersfield. On July 21, 1952, a magnitude 7.3 earthquake was recorded along the White Wolf fault south of Arvin; numerous aftershocks continued on July 21, six of which were magnitude 5.0 and above. On July 28, 1952, a magnitude 6.1 shock and several smaller aftershocks occurred east of Bakersfield. On August 22, 1952, a magnitude 5.8 earthquake also occurred east of Bakersfield. Aftershocks of magnitude 4.0 and higher were recorded in the area through September 26, 1952. These earthquakes resulted in surface fault rupture along the White Wolf fault and along several unnamed faults east of Bakersfield. The magnitude 7.3 earthquake resulted in 12 deaths and approximately $60 million in property damage. Railways lines were offset, highways were cracked, older unreinforced buildings collapsed or were substantially damaged, and some newer reinforced concrete buildings were damaged. The magnitude 7.3 earthquake was felt over most of California, as well as parts of western Arizona and western Nevada. It was the largest earthquake since the 1906 San Francisco event (which occurred along the San Andreas fault). [3,10]

The 1857 Fort Tejon earthquake caused surface fault rupture along the Cholame-Chorizo section of the San Andreas fault from Parkfield (in the Cholame Valley) south to Wrightwood, a distance of approximately 186 miles. The earthquake magnitude is estimated to have been 7.9. Property loss and destruction of buildings occurred at Fort Tejon, and seismic seiching, fissuring, sandblows, and hydrologic changes were reported from Sacramento to the Colorado River delta.[4] The KWB is approximately 21 miles east of the Cholame-Chorizo section.

Although the KWB is located in a seismically active area and the surficial deposits consist of Holocene sediments, the depth to groundwater is approximately 50 feet or greater below the ground surface and the potential for liquefaction or lateral spreading is minimal.[5]

Subsidence

Subsidence of the land surface can be induced by both natural and human phenomena. Subsidence caused by natural phenomena can result from tectonic deformations and seismically induced settlements; from consolidation, hydrocompaction, or rapid sedimentation; from oxidation or dewatering of organic-rich soils; and from subsurface cavities. Subsidence related to human activity can result from withdrawal of subsurface fluids or sediment. The potential for failure from subsidence is highest in areas where the groundwater table is high and where relatively soft and recent alluvial deposits are present.

<u>Effects Related to Groundwater Extraction</u>

In Kern County, subsidence is caused primarily by the dewatering and subsequent compaction of unconsolidated clay and silt deposits within the groundwater aquifer, and oil and natural gas extraction.[6] Between 1926 and 1970, subsidence within Kern County ranged from 4 to 28 feet (depending on location).[7] Areas close to the Kern River and KWB Lands have historically experienced less subsidence than other areas in the San Joaquin Valley because local surface water supplies (rather than groundwater) have been used for irrigation, and because of aquifer recharge.[8]

Subsidence in the San Joaquin Valley has resulted in damage to the California Aqueduct along with various canals, roads, bridges, buildings, and well casings. Subsidence-related damages and repairs have included the loss of canal capacity to convey and deliver water or remove floodwaters; realignment of canals when their constant gradient becomes variable; raising of infrastructure such as canal check stations; and releveling of furrowed fields for maximum irrigation efficiency. The California Aqueduct, Delta-Mendota Canal, Outside Canal, Friant-Kern Canal, San Luis Canal, State Route 198, and other infrastructure in the San Joaquin Valley have all undergone repairs and modifications.[9,10]

The benchmark network in the San Joaquin Valley is only periodically surveyed by the National Geodetic Survey. Control benchmarks are concentrated in the three major areas of known subsidence (Los Banos–Kettleman, Tulare-Wasco, and Arvin-Maricopa), with roughly 12 stable bedrock reference benchmarks around the perimeter of the valley.[11] As early as 1950, the California Department of Water Resources (Department) began installing and monitoring borehole extensometers (i.e., compaction recorders) in wells throughout the San Joaquin Valley to monitor subsidence.[12] By the end of the 1960s, the subsidence monitoring network consisted of 31 extensometers operating at 21 sites, but was reduced to 26 extensometers at 18 sites by the 1980s. Periodic measurements of 28 benchmarks distributed throughout KWB Lands have been used to monitor the land surface elevations.[13] Since June 1994, the Department has independently maintained and monitored one extensometer and three transducers in well T30S/R25E-16L on KWB Lands, adjacent to a triple completion monitoring well (multiple completion wells allow for more sampling locations in an aquifer). Monitoring began before groundwater recovery operations began, thus allowing the tracking of subsequent land-surface elevation recovery and subsidence.

Effects Related to Fault Creep

Several researchers have indicated that historic fault creep along the Buena Vista, Premier, New Hope, and Kern Front faults, as well as historic-period fault breaks along the Garlock fault zone (in the Fremont Valley), are the result of subsurface withdrawal of oil, natural gas, and/or groundwater.[14,15,16,17]

KWB Lands are not, however, within the immediate vicinity of these areas, and there is no evidence of fault creep that could affect or be affected by KWB activities.

7.8.2.2 Changes in Physical Setting between 1996 and 2014

Geological and soil conditions generally do not change within a short period of time and, therefore, the environmental setting described under 1994 conditions for the southern San Joaquin Valley portion of Kern County (including KWB Lands) are generally the same under 2014 conditions. However, text is added in the impact analysis to provide site-specific characteristics based on current soil survey data.

7.8.2.3 Regulatory Setting in 1995

Regulations related to geologic hazards and soil erosion relevant to KWB activities are described below.

Federal

There are no applicable federal regulations pertaining to seismic hazards or soil erosion applicable to KWB activities.

State

Major State regulations include the California Code of Regulations (CCR), Title 24, Part 2, the California Building Standards Code (CBC); and California Public Resources (CPR) Code, Division 2, Chapter 7.8, the Seismic Hazards Mapping Act. Both these regulations apply to public buildings and a large percentage of private buildings intended for human occupancy. The CBC is based on the Uniform Building Code (UBC), which is used widely throughout United States (adopted on a state-by-state or district-by-district basis) and has been modified for California conditions with numerous more detailed and/or more stringent regulations.

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act (Alquist-Priolo Act) (California Public Resources Code [PRC] Sections 2621–2630) was passed in 1972 to mitigate the hazard of surface faulting to structures designed for human occupancy. The main purpose of the law is to prevent the construction of buildings used for human occupancy on the surface trace of active faults. The law addresses only the hazard of surface fault rupture and is not directed toward other earthquake hazards. The Alquist-Priolo Act requires the State Geologist to establish regulatory zones known as Earthquake Fault Zones around the surface traces of active faults and to issue appropriate maps. The maps are distributed to all affected cities, counties, and state agencies for their use in planning efforts. Before a project can be permitted in a designated Alquist-Priolo Earthquake Fault Zone, cities and counties must require a geologic investigation to demonstrate that proposed buildings would not be constructed across active faults.

Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act of 1990 (CPR Sections 2690–2699.6) addresses earthquake hazards from nonsurface fault rupture, including liquefaction and seismically induced landslides. The act established a mapping program for areas that have the potential for liquefaction, landslide, strong ground shaking, or other earthquake and geologic hazards. The act also specifies that the lead agency for a project may withhold development permits until geologic or soils investigations are conducted for specific sites and mitigation measures are incorporated into plans to reduce hazards associated with seismicity and unstable soils.

National Pollutant Discharge Elimination System Permit

In California, the State Water Resources Control Board (SWRCB) administers regulations promulgated by the United States Environmental Protection Agency (40 CFR Part 122) requiring the permitting of stormwater-generated pollution under the National Pollutant Discharge Elimination System (NPDES). In turn, the SWRCB's jurisdiction is administered through nine regional water quality control boards. Under these regulations, an operator must obtain a general permit through the NPDES Stormwater Program for all construction activities with ground disturbance of 1 acre or more. The general permit requires the implementation of Best Management Practices (BMPs) to reduce sedimentation into surface waters and to control erosion. One element of compliance with the NPDES permit is preparation of a Stormwater Pollution Prevention Plan (SWPPP) that addresses control of water pollution, including sediment, and the sources of runoff during construction.

Although the primary purpose of these regulations and standards is the protection of surface water resources from the effects of land development (such as turbidity caused by sedimentation), measures included in such regulations and standards also reduce the potential for erosion and soil loss resulting from construction activities. Such regulations include, but are not limited to, the NPDES program for management of construction and municipal stormwater runoff, which is part of the federal Clean Water Act and is implemented at the State and local level through issuance of permits and preparation of site-specific pollution protection plans. Sections 1600 through 1607 of the California Fish and Game Code regulates activities that would alter stream characteristics, including sedimentation caused by erosion.

Other Geotechnical Considerations

Chapter 18 of the CBC regulates the excavation of foundations and retaining walls, and Appendix Chapter 33 regulates grading activities, including drainage and erosion control, and construction on expansive soils. Construction activities are subject to occupational safety standards for excavation,

shoring, and trenching as specified in the California Division of Occupational Safety and Health (Cal-OSHA) regulations (Title 8 of the CCR) and in Section A33 of the CBC.

Local

The *Kern County General Plan* contains goals and policies to address potential hazards associated with geologic and soil constraints. Based on the impact analyses presented below, there are no aspects of the KWB activities that would be considered inconsistent with general plan policies pertaining to geotechnical hazards or safety.

7.8.2.4 Changes in Regulatory Setting between 1996 and 2014

Local

Metropolitan Bakersfield General Plan

The *Metropolitan Bakersfield General Plan,*[18] adopted in 2007, suggests that land use and grading practices should be designed to prevent soil erosion while protecting existing watercourses. The plan also contains policies designed to reduce the level of death, injury, property damage, economic and social dislocation and disruption of vital services that would result from earthquake damage.

7.8.3 IMPACTS AND MITIGATION MEASURES

7.8-1 Rates of erosion could potentially be affected by KWB activities.

1996 — 2014

Prior to 1996, approximately 3,034 acres of shallow recharge ponds existed in the Kern Fan Element. The KWB facilities currently include approximately 7,200 acres of recharge ponds, 85 recovery wells, an extensive network of monitoring wells, 36 miles of pipeline, and the 6-mile-long KWB Canal. The ponds consist of low earthen berms that pond water to depths of a few feet. The ponded water infiltrates into the alluvial fan for recharge into the aquifer. Water flows between the ponds in small channels; Kern Water Bank Authority (KWBA) operators control the flow with small weir boxes. The recovery wells average about 750 feet deep and produce as much as 5,000 gallons per minute of water. They are distributed throughout KWB Lands and are spaced approximately one-third mile apart. The 16- to 20-inch-diameter wells are powered with electric motors. Small diameter (15- to 36-inch-diameter) PVC pipelines transport water recovered from wells to existing canals or, in some cases, to large diameter (> 36-inch-diameter) pipelines. Approximately 31 miles of small-diameter and 5 miles of large-diameter pipeline have been constructed.

The KWB Canal was constructed to convey water both to the water bank ponds for recharge purposes and from the water bank wells for recovery purposes. The canal extends 6 miles from the Kern River on the east to the California Aqueduct on the west. Associated structures include headworks at the Kern River, a 100 cubic feet per second (cfs) pump station serving the Kern River area, a crossing under Enos Lane, a check structure, a 545 cfs pump station serving the eastern portions of the KWB, and diversion facilities at the California Aqueduct.

Grading was required to construct the recharge ponds. However, construction of the ponds and associated berms occurred on topography that is relatively flat and required only minor grading and compaction of soils. Soils in the KWB Lands can generally be characterized as being moderately to highly erodible. –

KWBA would have been required to comply with NPDES permit requirements, which include preparation of a site-specific SWPPP and implementation of BMPs specifically designed to control erosion and reduce the transport of sediment and other pollutants. The KWB Habitat Conservation Plan and Natural Community Conservation Plan (KWB HCP/NCCP) Vegetation Management Plan (see Appendix 7-7c) also includes standard measures to address potential topsoil loss and erosion. In addition, Mitigation Measure E-1 of the 1997 Monterey IS and Addendum (see Appendix 7-6a) requires a watering truck to be used to minimize fugitive dust generated during grading when conditions require, such as on dry, windy days. KWBA was required to comply with these requirements, which are specific enforceable performance standards.

Therefore, the impact of KWB construction activities from 1996 to 2014 with regard to soil erosion or topsoil loss was ***less than significant***.

Mitigation Measures

None required.

2015 — 2030

Near-term future KWB activities include construction of approximately 190 acres of recharge ponds and three wells under the ongoing Integrated Regional Water Management (IRWM) program (Kern Water Bank Recharge and Recovery Project). Longer-term future construction of approximately 862 acres of additional recharge ponds and associated facilities is anticipated as part of full build-out. In addition to the new recharge ponds, wells, and associated facilities, other potential ground-disturbing activities could include: fencing, constructing replacement recovery wells, installing and replacing pipeline, and installing weir boxes. Maintenance of existing basins, wells, and ancillary facilities would also take place. The IRWM program ponds have been sited. The locations of additional ponds are approximate but will be consistent with KWB HCP/NCCP requirements; final locations and areas will be determined as these facilities are designed. No new water conveyance facilities to convey KWB-recovered water are anticipated to be constructed by KWB participants; KWB participants already have facilities in place to convey and exchange recovered water. Conveyance of KWB-recovered water used beyond KWB Lands is not anticipated to cause any substantial impacts to geologic and soil resources.

KWBA manages KWB Lands in accordance with the KWB HCP/NCCP approved by the U.S. Fish and Wildlife Service and California Department of Fish and Game in 1997. The KWB HCP/NCCP allows developed uses on about 4,000 acres of KWB Lands (see Appendix 7-7a). Approximately 490 acres of land adjacent to Interstate 5 are designated for possible commercial use. Between 1995 and 2003, no development occurred on the 490-acre parcel. After 2003, development of this parcel was prohibited by the Settlement Agreement.

Grading would be required to construct the proposed facilities, including the recharge ponds. Construction of the ponds and other improvements would occur on topography that is relatively flat and that would require only minor grading and compaction of soils. Soils on KWB Lands can generally be characterized as being moderately to highly erodible. Construction activities, however, have the potential to cause erosion if not conducted properly

The impact of KWB activities from 2015 to 2030 with regard to soil erosion or topsoil loss could be ***potentially significant.***

Mitigation Measures

Mitigation Measure 7.8-1 would reduce Impacts of KWB activities with regard to soil erosion or topsoil loss to less than significant. KWBA is subject to legal requirements regarding NPDES permits (see Section 7.0.4.1.1 covering NPDES permits) in subsection a) below and is obligated to carry out the measures (see Section 7.0.4.2.1 covering HCP Incidental Take Permits and Section 7.0.4.3.1 covering the 1997 Monterey IS and Addendum) in subsections b) and c) below. Therefore, KWB activities from 2015 to 2030 with regard to soil erosion or topsoil loss would be ***less than significant, with mitigation.***

7.8-1 *KWBA will implement the following measures:*

a) *Comply with NPDES permit requirements, which include preparation of a site-specific SWPPP and implementation of BMPs specifically designed to control erosion and reduce the transport of sediment and other pollutants (see Section 7.0.4.1.1).*

b) *Comply with measures in the KWB HCP/NCCP Vegetation Management Plan, including the following specified for sediment removal and erosion control (see Appendix 7-7c):*

i. Sediment build up in canals and recharge basins must be removed to maintain adequate flow and water capacity in canals and to maintain good percolation in recharge basin. Sediment is typically removed mechanically with an excavator. To minimize transport costs of disposal, the loose soil sediments are typically placed on or near levees and canals. When feasible, islands in the recharge basis will be constructed from the spoil of the removal process. If this practice is to continue, then newly placed soils will be compacted onto the levee side slopes and tops where appropriate in areas that are not known to support kit fox dens, Tipton kangaroo rat burrows, blunt-nosed leopard lizards or burrowing owl holes. Hay mulch may be applied to the bare slopes and seed would occur at the proper time of year as appropriate. The elimination of bare soil conditions will decrease erosion. In addition, establishing marsh vegetation at the head of stream flow patterns will filter water and reduce sediment transport through the system.

ii. Water conveyance structures and control devices require periodic erosion control protection measures. Concrete riprap is typically used near the structures to prevent excessive erosion. Sidebank blowouts near conveyance structures shall be refilled and revegetated where appropriate.

c) *Use a watering truck to minimize fugitive dust generated during grading when conditions require, such as on dry, windy days (1997 Monterey IS and Addendum, Measure E-1)(see Appendix 7-6a).*

7.8-2 KWB activities could potentially expose people and structures to risks from unstable soils (liquefaction).

1996 — 2014

The White Wolf and San Andreas faults, which are considered to be active and are known to have produced large magnitude earthquakes, are located approximately 18 and 21 miles from the KWB, respectively. Although the KWB is located in a seismically active area and the surficial deposits consist of unconsolidated Holocene sediments (which are more susceptible to liquefaction), the depth to groundwater is approximately 50 feet or greater below the ground surface and the liquefaction potential is low.

Therefore, the impact of KWB activities from 1996 to 2014 as related to liquefaction was ***less than significant.***

Mitigation Measures

None required.

2015 — 2030

The White Wolf and San Andreas faults, which are considered to be active and are known to have produced large magnitude earthquakes, are located approximately 18 and 21 miles from the KWB, respectively. Although the KWB is located in a seismically active area and the surficial deposits consist of unconsolidated Holocene sediments (which are more susceptible to liquefaction), the depth to groundwater is approximately 50 feet or greater below the ground surface and the liquefaction potential is low.

Therefore, the impact of KWB activities from 2015 to 2030 as related to liquefaction would be ***less than significant.***

Mitigation Measures

None required.

7.8-3 KWB activities could potentially cause or contribute to subsidence as a result of groundwater extraction.

1996 — 2014

Land subsidence in the San Joaquin Valley is caused by compaction of the interbedded layers of clay and silt within the aquifer system resulting from groundwater level changes. The KWB on-site extensometer showed little compaction occurring on KWB Lands, only several hundredths of a foot, through the early 1990s. From 1994 to May 2013, KWB Lands experienced a net rise in the land surface elevation of approximately three-quarters of a foot (Figure 7.8-1).[19]

During the 1970s, before artificial recharge activities, groundwater levels throughout the San Joaquin Valley and in areas of Kern County had reached historical lows. However, from June 1994 (just before the start of recharge operations at the KWB) to May 2013, there was an overall net rise in the land surface elevation and an increase in groundwater levels. Therefore, subsidence was measured during periods of drought and high groundwater withdrawals, but was offset during periods of groundwater recharge when soil expansion occurred within the aquifer.

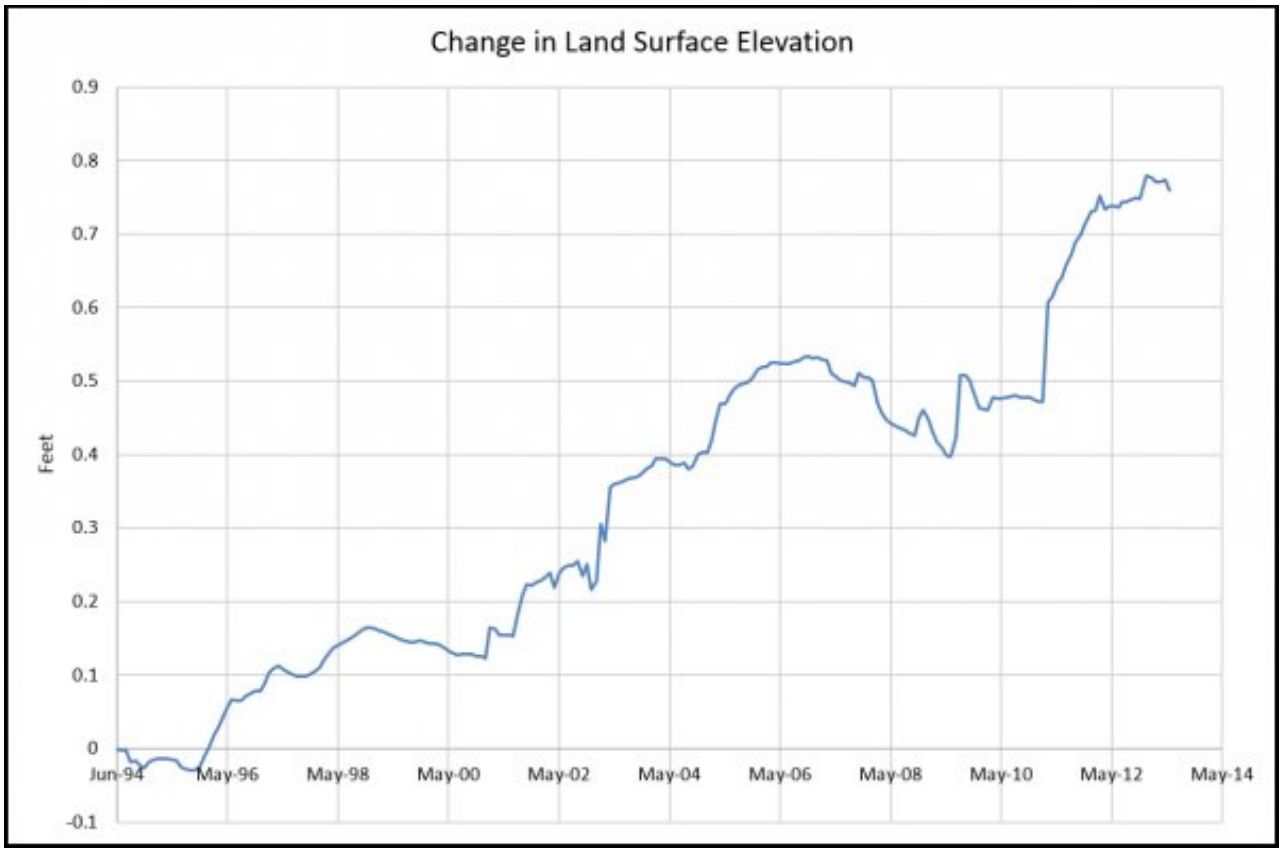
The KWB aquifer contains a substantial amount of sand, with lesser amounts of gravel, silt, and clay.[20] Aquifers with higher volumes of sand and gravel are not as susceptible to compaction as aquifers with

higher volumes of clays and fine silts. A continuous reading extensometer located in KWB has shown little response to changes in water level changes during recharge or recovery operations.

Therefore, the impact of KWB activities from 1996 to 2014 on land subsidence was ***less than significant***.

Mitigation Measures

None required.



Source: Adapted by KWBA in 2014 with data provided by DWR Water Data Library in 2014.

Figure 7.8-1. Land Surface Elevation at Well T30S/R25E-16L1 between June 1994 and May 2013

2015 — 2030

The Department has an on-site subsidence monitoring program that has been effective in monitoring subsidence throughout KWB Lands and none has been observed. The program allows for identifying and tracking the development and progression of potential land subsidence.

Therefore, the impact of KWB activities from 2015 to 2030 on land subsidence would be ***less than significant***.

Mitigation Measures

None required.

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