3.9 Geology, Soils, Seismicity, and Paleontological Resources

This section identifies geologic, soil, and seismic conditions, and paleontological resources that could affect or be affected by the Fresno to Bakersfield Locally Generated Alternative (F-B LGA) to the Fresno to Bakersfield Section of the High-Speed Rail (HSR) System. The *Fresno to Bakersfield Section California High-Speed Train Final Project Environmental Impact Report/Environmental Impact Statement* (EIR/EIS) addressed geology, soils, and seismicity in Section 3.9, and paleontological resources in Section 3.17 (California High-Speed Rail Authority [Authority] and Federal Railroad Administration [FRA]). Paleontological resources analysis has been relocated in this document to match current Authority guidance regarding document organization. This section of the Draft Supplemental EIR/EIS also describes the regulatory setting, affected environment, impacts, and possible mitigation measures associated with the geology, soils, seismicity, and paleontological resources of the project area. The discussion of impacts presented in this section considers the consequences of the F-B LGA on geology, soils, seismicity, and paleontological resources as well as how geology, soils, and seismicity would affect the alignment.

This Draft Supplemental EIR/EIS compares the F-B LGA to the complementary portion of the Preferred Alternative that was identified in the Fresno to Bakersfield Section Final EIR/EIS. As discussed in Section 1.1.3 of this Draft Supplemental EIR/EIS, the complementary portion of the Preferred Alternative consists of the portion of the BNSF Alternative from Poplar Avenue to Hageman Road and the Bakersfield Hybrid from Hageman Road to Oswell Street (further referenced as the “May 2014 Project” in this Draft Supplemental EIR/EIS). Since the Fresno to Bakersfield Section Final EIR/EIS does not evaluate the May 2014 Project as a discrete subsection of the Fresno to Bakersfield Project (as it did for the Allensworth Bypass, for example), affected environment and impact summary discussion included in this section for the May 2014 Project has been extrapolated from the available information contained in the Fresno to Bakersfield Section Final EIR/EIS.

3.9.1 Regulatory Setting

This section identifies the regulations, laws, and orders that apply to geology, soils, seismicity, and paleontological resources, and that are relevant to the F-B LGA. As described in the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014: pages 3.9-2 through 3.9-6), the Authority and FRA would comply with all federal and state regulations. As with the May 2014 Project, the F-B LGA would also be compatible with local plans and policies.

3.9.1.1 Federal

Geology, Soils, and Seismicity

With the exception of the National Environmental Policy Act (NEPA), there are no federal laws or regulations applicable to geology, soils, and seismicity. No new federal regulations for geology, soils, or seismicity have been adopted since release of the Fresno to Bakersfield Section Final EIR/EIS.

Paleontological Resources

With the exception of NEPA, there are no federal laws or regulations applicable to paleontological resources. No new federal regulations for paleontological resources have been adopted since release of the Fresno to Bakersfield Section Final EIR/EIS.

3.9.1.2 State

Geology, Soils, and Seismicity

Please see Section 3.9.2.1 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: pages 3.9-2 and 3.9-3) for a discussion of applicable state regulations and Section 3.9.1.2 of this document for a discussion of the methodology used for evaluating effects under the California Environmental Quality Act (CEQA). Applicable state laws and regulations relevant to geology, soils, and seismicity include the following:

- Alquist-Priolo Earthquake Fault Zoning Act (Public Resources Code Section 2621 et seq.)
- Seismic Hazards Mapping Act (Public Resources Code Sections 2690 to 2699.6)
- Surface Mining and Reclamation Act (Public Resources Code Section 2710 et seq.)
- California Building Standards Code (California Code of Regulations Title 24)
- Public Resources Code Sections 3000-3473

No new state regulations for geology, soils, or seismicity have been adopted since release of the Fresno to Bakersfield Section Final EIR/EIS*.* As with the May 2014 Project, the F-B LGA would be compatible with applicable state plans and policies.

Paleontological Resources

With the exception of CEQA, there are no state laws or regulations applicable to paleontological resources.

3.9.1.3 Regional and Local

Geology, Soils, and Seismicity

Section 3.9.2.2 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: pages 3.9-3 through 3.9-6) provides a discussion of applicable regional and local regulations. Applicable state laws and regulations relevant to geology, soils, and seismicity include the following:

Kern County

- Kern County General Plan:
  - Chapter 1, Land Use, Open-Space, and Conservation Element: Goals 1.9.1 and 1.9.2, Policies 1.9.14 and 1.9.25, implementation measures 1.9.H and 1.9.K promote compatible uses on or next to mineral and oil and gas lands.
  - Chapter 4, Safety Element: Goals 4.3.1 and 4.3.2, Policy 4.3.1, and implementation measures 4.3.A through 4.3.L minimize damage and loss of life and protect from geological hazards.

City of Shafter

- City of Shafter General Plan
  - Chapter 6, Mineral Resources: Objective 6.5, Policies 6.5.1 through 6.5.4 protect and provide management for mineral resource areas.
  - Chapter 7, Geology and Seismicity: Objective 7.2, Policies 7.2.1 through 7.2.8 minimize the damage and loss of life from a geological event.

City of Bakersfield

- Metropolitan Bakersfield General Plan
  - Chapter 5, Conservation Element: Goals B.1 through B.4, Policies B.1 through B.16, and Implementation Measures B.1 through B.5 protect areas of significant resource potential for future use and avoid conflicts between the productive use of mineral and energy resource lands and urban growth.
  - Chapter 8, Safety Element: Goals A.1 through A.7, Policies A.1 through A.25, and Implementation Measures A.1 through A.36 reduce the level of death, injury, property damage, economic and social dislocation, and disruption of vital services that would result from earthquake damage.

No new regional or local regulations for geology, soils, or seismicity have been adopted since release of the Fresno to Bakersfield Section Final EIR/EIS*.* As with the May 2014 Project, the F-B LGA would be compatible with applicable local plans and policies.

Paleontological Resources

Section 3.17.2.3 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: pages 3.17-7 through 3.17-11) provides a discussion of regional and local regulations. There are no regional or local regulations applicable to paleontological resources. As with the May 2014 Project, the F-B LGA would be compatible with applicable plans and policies.

3.9.2 Methods for Evaluating Impacts

The methodology used to describe the affected environment and evaluate the potential environmental impacts of the alignment on geology, soils, and seismicity involved a review and assessment of published maps, professional publications, and reports pertaining to the geology, soils, and seismicity for the F-B LGA study area and surrounding region. The information included United States Geological Survey (USGS) topographic maps and California Geological Survey (CGS) geologic and landslide maps (Bartow 1984, 1986, 1991; Bartow and Pittman 1983; Bateman 1992, Dibblee 2008); Natural Resources Conservation Service soils maps (United States Department of Agriculture [USDA] 2006, 2015a, 2015b, 2015c, 2015d) ; CGS Seismic Hazard Zone maps (CGS 2011); USGS and CGS active fault maps (CGS 2010, USGS 2004); USGS and CGS ground-shaking maps (USGS 2013, 2015; CGS 2010); California Emergency Management Agency's dam inundation maps; USGS and state of California mineral commodity producer databases; and online databases for mineral resources, fossil fuels, and geothermal resources published by the California Division of Oil, Gas, and Geothermal Resources (DOGGR) (DOGGR 2002, 2016).

The impact analysis evaluates two risks:

- The potential to increase the risk of personal injury, loss of life, and damage to property, including planned new facilities, *as a result of* existing geologic, soils, and seismic conditions
- The potential to induce adverse effects *on* the existing geology, soils, and seismicity; for example, erosion of topsoil

The study area for geology, soils, and seismicity is discussed in Section 3.9.3.3 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: pages 3.9-6 through 3.9-8), and the study area for paleontological resources is discussed in Section 3.17.3.1 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: page 3.17-14). These discussions state that geologic hazards and seismic hazards, such as soil failures (e.g., adequacy of load-bearing soils), settlement, corrosivity, shrink-swell, erosion, and earthquake-induced liquefaction risks, directly affect the area immediately adjacent to the proposed alignment. For assessment of these risks, the study area includes the project footprint and up to 150 feet on either side of the footprint. The study area is a 0.5-mile radius for subsurface gas hazards, mineral resources, and oil and gas resources. The regional study area for geology, soils, and seismicity encompasses the San Joaquin Valley. Research for seismicity was conducted out to 62 miles (approximately 100 kilometers) from the project alignment, but regional seismic hazards are also considered for the proximity of the alignment to major faults and known or anticipated seismic activity on these faults, in order to fully capture and characterize potential impacts of the project.

For paleontological resources, the study area is a one-mile radius around the proposed HSR right-of-way and any potential facilities, including the Bakersfield passenger station. No specific guidance dictates the radius width used for paleontological resource studies, but a one-mile radius allows for the development of a complete context because paleontological resources tend to be distributed widely across the landscape.

3.9.2.1 Methods for Evaluating Effects under the National Environmental Policy Act

In the Fresno to Bakersfield Section Final EIR/EIS, analysts applied specified thresholds for each resource topic to assess whether the intensity of each impact is negligible, moderate, or substantial for the Build Alternatives, and provided a conclusion as to whether or not the impact was "significant." Since the Fresno to Bakersfield Section Final EIR/EIS does not evaluate the

May 2014 Project as a discrete subsection of the Fresno to Bakersfield Project (as it did for the Allensworth Bypass. for example), it does not provide conclusions using intensity thresholds for the May 2014 Project. Therefore, intensity thresholds are not used for the F-B LGA. Instead, the evaluation of impacts under NEPA in this Draft Supplemental EIR/EIS focuses on a comprehensive discussion of the project's potential impacts in terms of context, intensity, and duration and provides agency decision makers and the public with an apples-to-apples comparison between the May 2014 Project and the F-B LGA.

3.9.2.2 California Environmental Quality Act Significance Criteria

For the purposes of this report, the F-B LGA would result in a significant impact if it would expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving the following:

- Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the state geologist for the area, or based on other substantial evidence of a known fault
- Strong seismic ground shaking
- Seismically related ground failure, including but not limited to, liquefaction
- Seiche or tsunami hazard
- Dam failure inundation hazard
- Landslides, including seismically induced landslides

Impacts would also be potentially significant if they would do one or more of the following:

- Result in substantial soil erosion or the loss of topsoil
- Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, with the potential to result in onsite or offsite landslide, lateral spreading, subsidence, liquefaction, or collapse
- Be located on expansive soil, as defined in Table 18-1-B of the current Universal Building Code, creating substantial risks to life or property
- Be constructed on corrosive soils, creating substantial risks to life or property
- Result in the loss of availability of a known mineral, petroleum, or natural gas resource of regional or statewide value
- Result in the loss of availability of a locally important mineral resource recovery site
- Be located in an area of subsurface gas hazard, creating substantial risks to life or property

3.9.3 Affected Environment

The affected environment for geology, soils, seismicity, and paleontology includes physiography and regional geologic setting, characteristics of site soils, geologic hazards, primary seismic hazards, secondary seismic hazards, areas of difficult excavation, and mineral and energy resources. The defined affected environment is considered the context by which the evaluation would be made to evaluate impacts under CEQA.

3.9.3.1 Summary of the May 2014 Project Affected Environment

Geology, Soils, and Seismicity

Physiography and Regional Geologic Setting

The May 2014 Project is located in the central part of the San Joaquin Valley, south of the Sacramento-San Joaquin River Delta within the Central Valley of California. Discussion of the physiography, or physical geography, of this region is discussed in Section 3.9.4.1 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: page 3.9-10), along with overview of the regional geologic setting.

The thickness of sediments in this region ranges from thin veneers along the valley edges to greater than 40,000 feet in the central portion of the valley. These sedimentary deposits range in age from Jurassic (190 to 135 million years ago) to Holocene (0 to 0.01 million years ago), with the older deposits, Jurassic to Eocene (57.8 to 36.6 million years ago) comprising the marine sequence, and the younger deposits (Eocene to Holocene age) making up the continental (non-marine) sequence. The marine deposits were formed in offshore shallow ocean shelf and basin environments. Continental sediments were derived from mountain ranges surrounding the valley and were deposited in lacustrine, fluvial, and alluvial environments. (Norris and Webb 1990: 51–55)

Specific Geologic Setting/Context

Geology along the May 2014 Project is discussed as part of the Fresno to Bakersfield Section of the HSR system in Section 3.9.4.2 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: pages 3.9-10 through 3.9-12). Site soils along the May 2014 Project are characterized by alluvial fans and floodplains, low alluvial terraces, and basin areas (including saline-alkali basins), discussed in Section 3.9.4.3 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: pages 3.9-12 through 3.9-15). Table 3.9-5 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: page 3.9-15) provides a summary of the soil characteristics and soil associations along the Fresno to Bakersfield section of the HSR system, which includes the May 2014 Project. Applicable soil associations include Wasco-Kimberlina; Zerker-Premier-Delano-Chanac; Milham; Westhaven-Lerdo-Excelsior-Cajon; and Panoche-Milham-Kimberlina.

Geologic Hazards

Soil hazards include characteristics such as liquefaction potential, corrosivity, and shrink-swell potential, all of which may require special engineering considerations during design and construction. The two types of non-seismic geologic hazards applicable to the May 2014 Project include slides or slumps along steep slopes located next to rivers and creeks, and general land subsidence. These potential hazards are discussed in Section 3.9.4.4 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: page 3.9-16).

Primary Seismic Hazards

The primary seismic hazards assessed for the May 2014 Project include ground shaking and surface fault ruptures transecting the alignment; these hazards are discussed in Section 3.9.4.5 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: pages 3.9-16 through 3.9-19). Primary faults in the vicinity include the San Andreas Fault, the Kern Canyon Fault, the White Wolf Fault, and the Garlock Fault. Section 3.9.4.5 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: pages 3.9-16 through 3.6-19) provides discussion of the potential for surface fault rupture and ground shaking due to the proximity of faults and earthquake activity. As discussed in that document, the ground motions induced by a seismic event are characterized by a horizontal peak ground acceleration (PGA) value that is expressed as a percentage of the acceleration of gravity (g).

Secondary Seismic Hazards

See Section 3.9.4.6 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: pages 3.9-19 through 3.9-23) for an overview of secondary seismic hazards that could occur as a result of strong seismic shaking in the area, including liquefaction, seismically induced slides or slumps, and floods resulting from seismically induced dam failure. The first two of these hazards occur primarily where liquefiable soils exist or where steep slopes exist within the May 2014 Project.

In addition, as discussed in the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: pages 3.9-37 and 3.9-38), if the Isabella Dam fails due to a strong seismic event, subsequent flooding could inundate the area. The California Emergency Management Agency's dam inundation maps shows that the May 2014 Project crosses the potential inundation area around Bakersfield that would be affected by a potential failure of the Isabella Dam, which is owned and operated by the U.S. Army Corps of Engineers (USACE).

Furthermore, local groundwater conditions and soil types in combination with the estimated maximum PGA of 0.422 g is sufficient to warrant further detailed subsurface geotechnical investigations and geotechnical design evaluations to aid in final site-specific engineering design. These studies should be conducted during the final design phases. The primary consequences of secondary seismic hazards are discussed in Section 3.9.4.6 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: pages 3.9-19 through 3.9-23).

Areas of Difficult Excavation

Section 3.9.4.7 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: page 3.9-24) describes what constitutes areas of difficult excavation, or those areas where more than standard earth-moving equipment or special controls to enable the work would be required. Areas of difficult excavation along the May 2014 Project are not expected to be extensive because the alignment crosses predominantly uncemented Quaternary aged sediments in the San Joaquin Valley. There may exist, however some localized areas of difficult excavation, such as in areas adjacent to canal crossings and near the Kern River in the vicinity of Bakersfield due to localized shallow groundwater conditions. Further site-specific, subsurface geotechnical investigations and design evaluations should be conducted during the final design states to determine where difficult excavations may occur, and to plan for working with these sites during construction.

Mineral and Energy Resources

The following is an overview of mineral and energy resources specific to the May 2014 Project.

Mines

The May 2014 Project does not cross any active mines or known aggregate resources.

Oil and Gas Fields

The May 2014 Project is close to numerous oil and gas fields, and crosses through three mapped fields, including the North Shafter Oil Field, the Rosedale Ranch Oil Field, and the Seventh Standard Oil Field.

Locations of both active and abandoned oil wells were plotted from data obtained from the DOGGR California Geothermal Map (DOGGR 2002) database, which indicated a total of 28 active, idle, new, or plugged wells in the study area (project footprint plus a 150-foot buffer). Of these, nine are within the permanent footprint, including one active well and eight plugged or idle wells. Of the 19 wells located in the 150-foot buffer area, five are active wells, five are new, and nine are plugged. All of these wells are located in the northern portion of the May 2014 Project alignment, in and just south of Shafter.

Geothermal Resources

A review of the DOGGR indicates that the May 2014 Project would not cross a geothermal resource area as classified by the DOGGR, and there are no geothermal resource areas located in the project study area (project footprint plus a 150-foot buffer).

Paleontological Resources

The affected environment for paleontological resources is discussed in Section 3.17.4.4 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: pages 3.17-94 through 3.17-101). As described, paleontological resources are the fossilized remains or traces of animals and plants typically found in sedimentary rock units. The sensitivity of a sedimentary unit is determined by its past record and future potential to produce unique or scientifically significant fossils.

Paleontological resources may retain scientific importance by meeting one or more of the following criteria (Society of Vertebrate Paleontology [SVP] 2010):

- Significant Paleontological Resources are fossils and fossiliferous deposits, here defined as consisting of identifiable vertebrate fossils, large or small; uncommon invertebrate, plant, and trace fossils; and other data that provide taphonomic, taxonomic, phylogenetic, paleoecologic, stratigraphic, and/or biochronologic information.
- Paleontological resources are considered to be older than recorded human history and/or older than middle Holocene (i.e., older than about 5,000 radiocarbon years).[1]

The SVP describes sedimentary rock units as having a high, low, undetermined, or no potential for containing significant, nonrenewable, paleontological resources (SVP 2010). Table 3.17-8 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: page 3.17-95) defines paleontological sensitivity ratings. Five geologic units are mapped in the May 2014 Project study area: Quaternary stream channel deposits (Qsc); Quaternary fan deposits (Qf); Quaternary basin deposits (Qb); Pleistocene non-marine (Qc); and Miocene-Pleistocene Kern River Formation (Qp) (1964); with the exception of the Kern River Formation, all of these geologic units are described in Table 3.9-3 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: page 3.9-11). Paleontological sensitivity associated with these geologic units is discussed in Table 3.17-9 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: page 3.17-96); sensitivity ratings relevant to the May 2014 Project are provided below.

- **Quaternary stream channel deposits (Qsc).** Quaternary (Holocene) stream channel deposits are mapped in the portion of the Fresno to Bakersfield Section encompassed by the May 2014 Project north of Bakersfield. Paleontological sensitivity rating is No Potential.
- **Quaternary fan deposits (Qf).** Quaternary fan deposits (Holocene and Pleistocene) comprise the sediments over a large portion of the valley west of Bakersfield and the portion of the Fresno to Bakersfield Section encompassed by the May 2014 Project. Paleontological sensitivity rating is High.
- **Quaternary basin deposits (Qb).** Quaternary basin deposits are mapped at the surface along the alignment, just east of downtown Bakersfield, which includes a portion of the Fresno to Bakersfield Section encompassed by the May 2014 Project. Paleontological sensitivity rating is High.
- **Pleistocene non-marine (Qc).** Pleistocene non-marine alluvium is mapped at the surface under a majority of the middle portion of the project alignment. Paleontological sensitivity rating is High.
- **Miocene-Pleistocene Kern River Formation (Qp).** The Miocene-Pleistocene Kern River Formation does not outcrop at the surface in the project alignment, but underlies the geographic area. Paleontological sensitivity rating is High.

3.9.3.2 Fresno to Bakersfield Locally Generated Alternative

Geology, Soils, and Seismicity

Physiography and Regional Geologic Setting

The F-B LGA, like the May 2014 Project, is located in the central part of the San Joaquin Valley. Discussion of the physiography, or physical geography, of this region is provided in Section 3.9.4.1 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: page 3.9-10), and in Section 3.9.3.1 of this Draft Supplemental EIR/EIS.

Specific Geologic Setting/Context

Geology along the F-B LGA alignment, which includes the study area for the May 2014 Project, is discussed in Section 3.9.4.2 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and

[1] Radiocarbon years refer to geologic age-at-death dates derived from Carbon-14 dating. Radiocarbon years are typically converted to conventional years using an internationally accepted calibration curve.

FRA 2014a: pages 3.9-10 through 3.9-12) and in Section 3.9.3.1 of this Draft Supplemental EIR/EIS.

Figure 3.9-1 shows surficial geology characteristics along the F-B LGA, and Table 3.9-1 provides a summary of information on mapped surficial geology based on the California Division of Mines and Geology (CDMG) (1964) and CGS (2011) geologic maps.

As discussed in Section 3.9.3.1 for the May 2014 Project, applicable soil associations include the following: Wasco-Kimberlina; Zerker-Premier-Delano-Chanac; Milham; Westhaven-Lerdo-Excelsior-Cajon; and Panoche-Milham-Kimberlina. Figure 3.9-2 shows the locations and extent of these soil associations.

Table 3.9-1 Summary of Mapped Surficial Geologic Units

CDMG 1964 Map Symbol	CGS 2011 Map Symbol	Geologic Formation/Unit	Geologic Unit Type	Description
Qsc	Qw	Stream channel deposits in the Central Valley	Recent stream and wash deposits	Unconsolidated sandy and gravelly sediments deposited along recently active rivers and stream channels.
Qf	Qf/Qya/Qa	Fan deposits in the Central Valley	Recent alluvial fan deposits	Sediments of varying grain size deposited from highlands surrounding the Great Valley typically deposited in a fan shaped cone.
Qb	Qyl	Recent basin deposits in the Central Valley	Recent basin deposits	Sediments deposited during flood stages of major streams in areas between natural stream levees and fans; silts and clays.
Qc	Qof/Qyf	Pleistocene non-marine sedimentary deposits	Non-marine sedimentary deposits	Older alluvium, slightly consolidated and dissected fan deposits composed of sand, gravel, and cobbles.
Qp	Qvof/Qss	Kern River formation	Non-marine sedimentary deposits	Miocene-Pleistocene-age, poorly bedded, loosely to moderately consolidated gravel composed mainly of ill-sorted surrounded cobbles, and boulders of various rock types.

Sources: CDMG, 1964, Bakersfield Sheet 1:250,000; CGS, 2011, East Half of the Taft 30' X 60' Quadrangle 1:100,000
CDMG = California Division of Mines and Geology
CGS = California Geological Survey
Qb = Quaternary basin deposits
Qc = Pleistocene non-marine
Qf = Quaternary fan deposits
Qp = Miocene-Pleistocene Kern River Formation
Qsc = Quaternary stream channel deposits

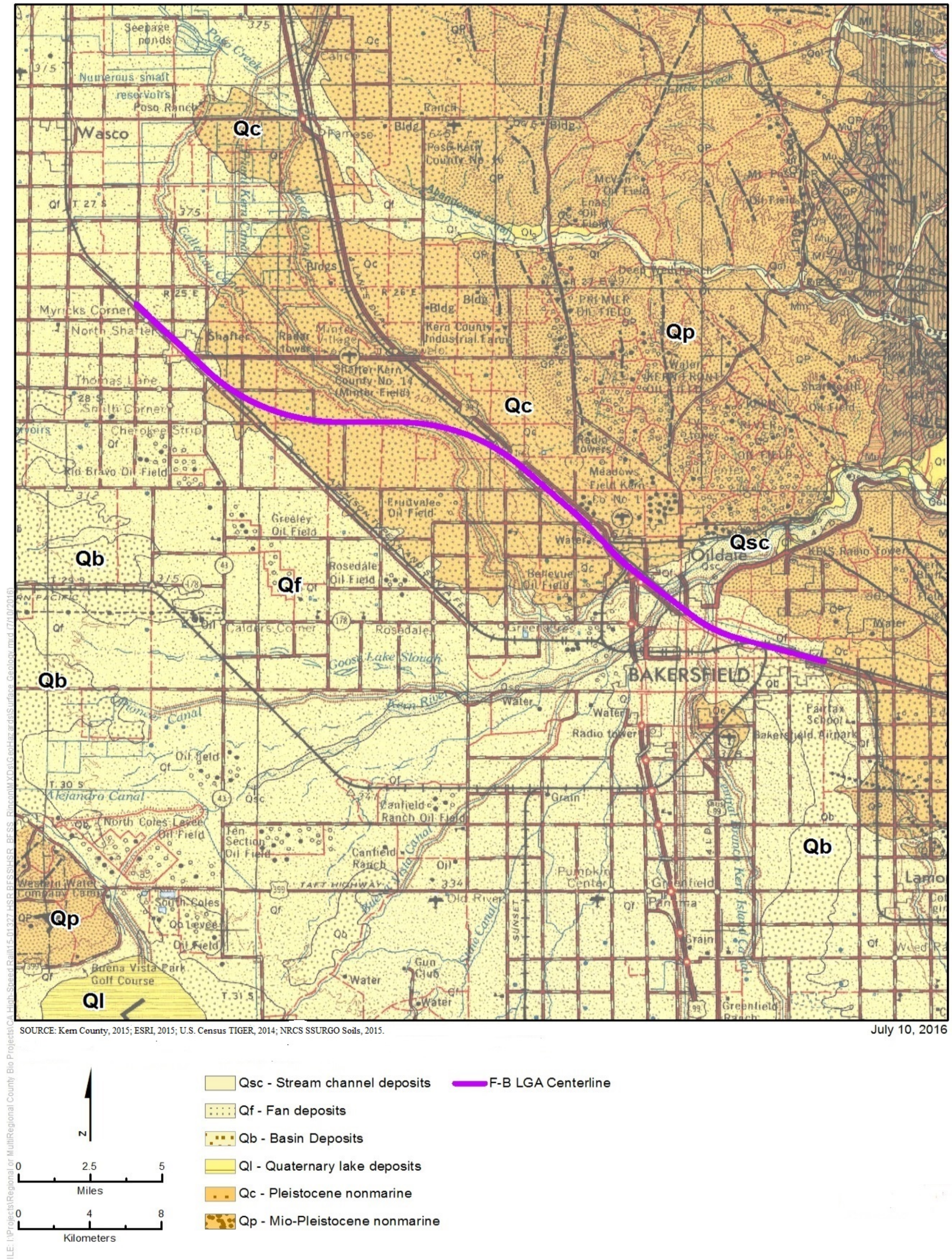
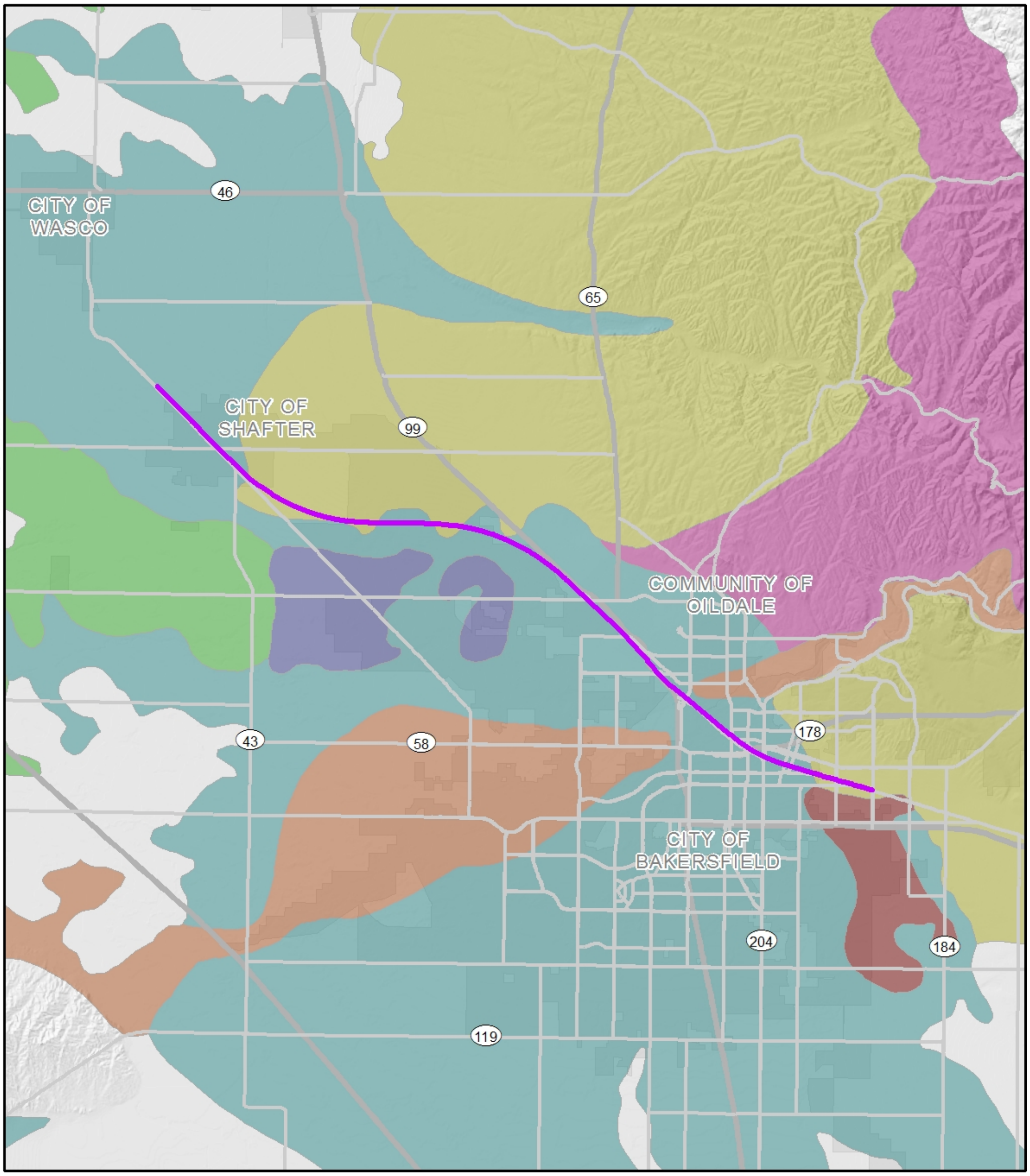
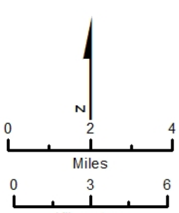


Figure 3.9-1 Surficial Geology for the F-B LGA



SOURCE: USGS 30m Hillshade, 2015; NRCS, 2006; ESRI, 2012; CHSRA, 2017.

January 17, 2017



F-B LGA Centerline
s774 - Panoche-Milham-Kimberlina
s775 - Wasco-Kimberlina
s779 - Panoche-Garces
s781 - Milham
s782 - Westhaven-Lerdo-Excelsior-Cajon
s783 - Zerker-Premier-Delano-Chanac
s809 - Torriorthents-Elkhills

Figure 3.9-2 Soil Associations in the Project Region

Geologic Hazards

Soil hazards applicable to the F-B LGA are the same as those described in Section 3.9.3.1 for the May 2014 Project, and include characteristics such as liquefaction potential, corrosivity, and shrink-swell potential. As with the May 2014 Project, the two types of non-seismic geologic hazards applicable to the F-B LGA include slides or slumps along steep slopes located next to rivers and creeks, and general land subsidence. These potential hazards are discussed in Section 3.9.4.4 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: page 3.9-16).

Primary Seismic Hazards

As with the May 2014 Project, the primary seismic hazards assessed for the F-B LGA include ground shaking and surface fault ruptures transecting the alignment. These hazards are discussed in Section 3.9.4.5 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: pages 3.9-16 through 3.9-19). Specific to the F-B LGA, Figure 3.9-3 shows hazardous and potentially hazardous faults in the study area for seismicity. As described in Section 3.9.2.1, this includes an area of 62 miles (approximately 100 kilometers) on either side of the project alignment. Figure 3.9-4 depicts a portion of a California fault map showing earthquake activity in this area. The figure indicates that the San Andreas Fault is approximately 34 miles to the southwest of the F-B LGA; the Kern Canyon Fault is approximately 40 miles to the northeast of the F-B LGA; and the White Wolf and Garlock faults are approximately 16 miles and 33 miles, respectively, to the southeast of the F-B LGA. In addition, Figure 3.9-5 presents the calculated PGA values for the F-B LGA, indicating that PGAs along the F-B LGA are estimated to range from about 0.406 g force in the Shafter area and increase southward to a maximum of about 0.422 g in the Bakersfield F Street Station area.

Secondary Seismic Hazards

Secondary seismic hazards applicable to the F-B LGA are the same as those described in Section 3.9.3.1 for the May 2014 Project, and in Section 3.9.4.6 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: pages 3.9-19 through 3.9-23). Figure 3.9-6 shows the Isabella Dam inundation areas relative to the F-B LGA.

Similar to the May 2014 Project, local groundwater conditions and soil types in combination with the estimated maximum PGA of 0.422 g (along the F-B LGA) is sufficient to warrant further detailed subsurface geotechnical investigations and geotechnical design evaluations to aid in final site-specific engineering design. These studies should be conducted during the final design phases. The primary consequences of secondary seismic hazards are discussed in Section 3.9.4.6 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: pages 3.9-19 through 3.9-23).

Areas of Difficult Excavation

Section 3.9.4.7 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: page 3.9-24) describes what constitutes areas of difficult excavation, or those areas where more than standard earth-moving equipment or special controls to enable the work would be required. As with the May 2014 Project, areas where difficult excavation could be required along the F-B LGA would not be extensive because the alignment crosses predominantly uncemented Quaternary aged sediments, although some localized areas of difficult excavation may occur.

This page is left intentionally blank

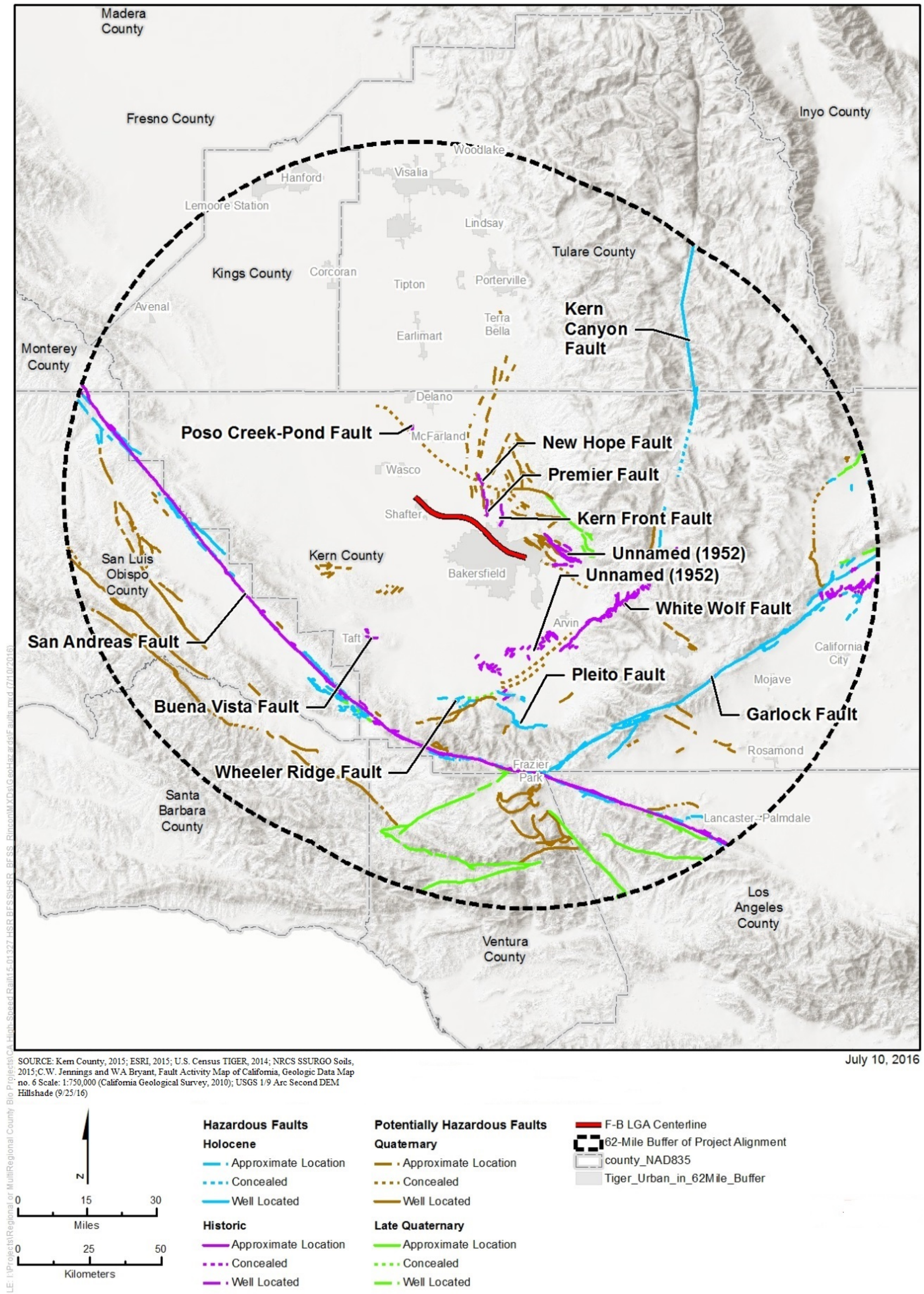


Figure 3.9-3 Hazardous and Potentially Hazardous Faults near the Alignment

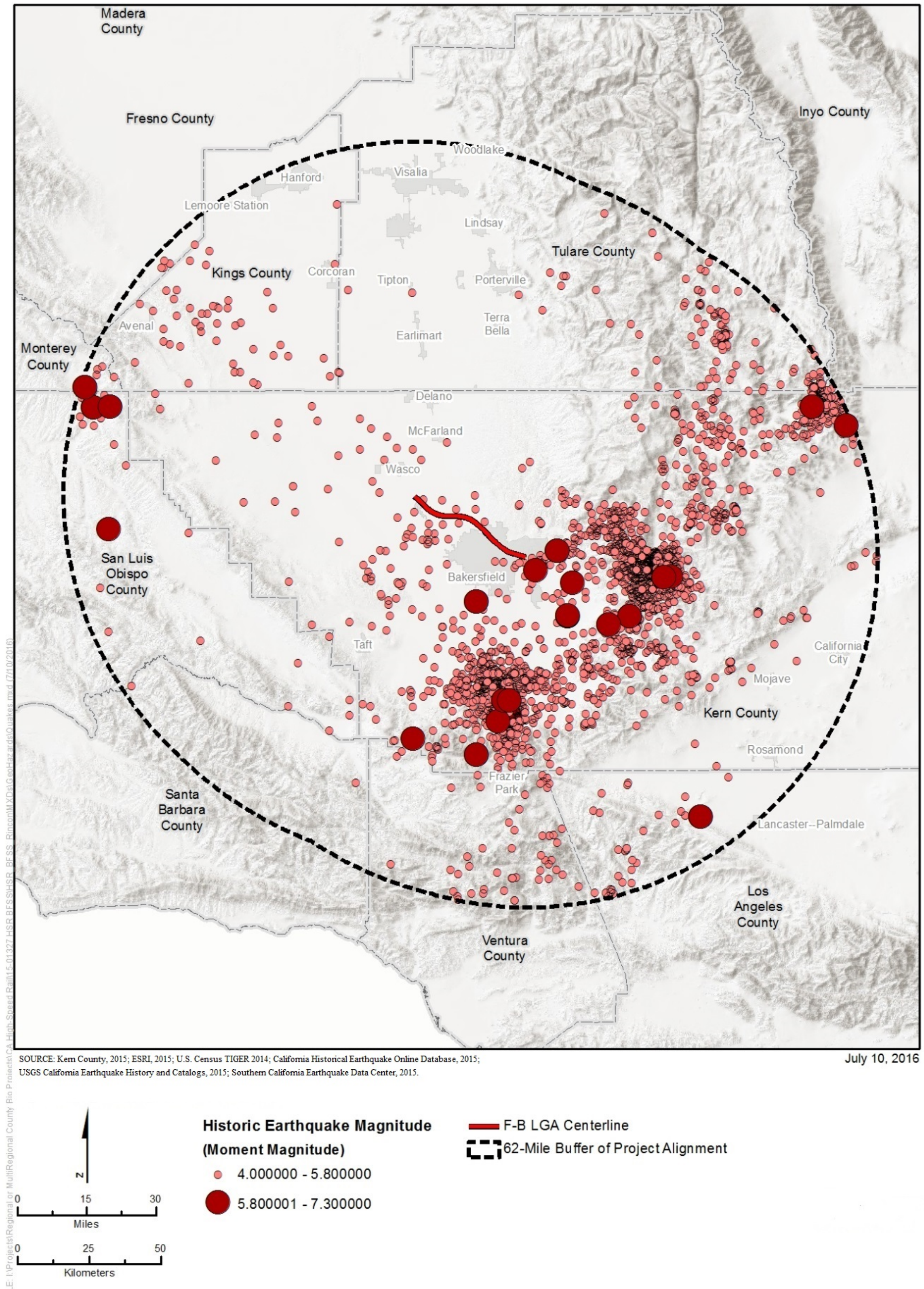


Figure 3.9-4 Earthquake Activity in the Region

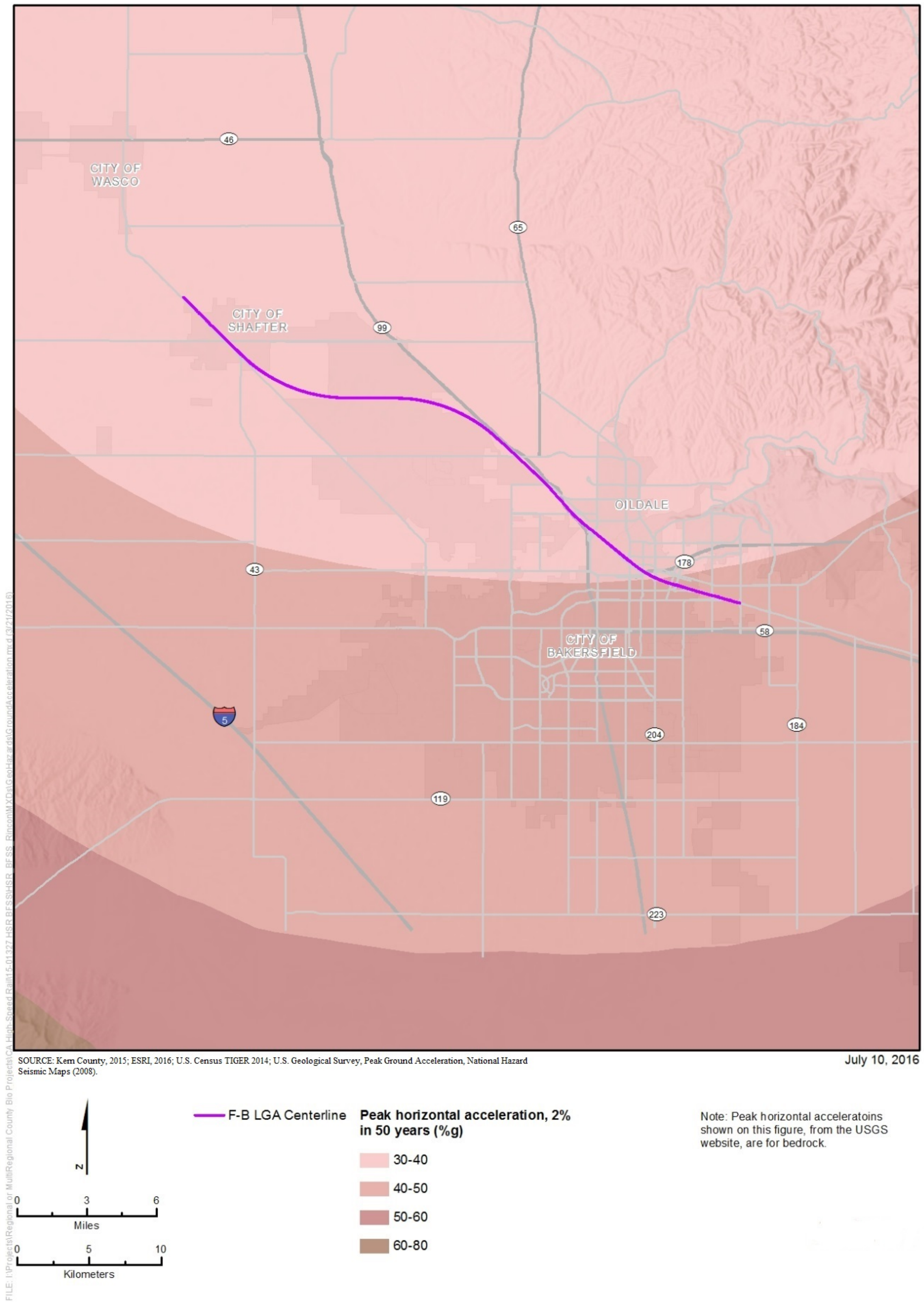


Figure 3.9-5 Calculated Peak Ground Acceleration Values for the F-B LGA

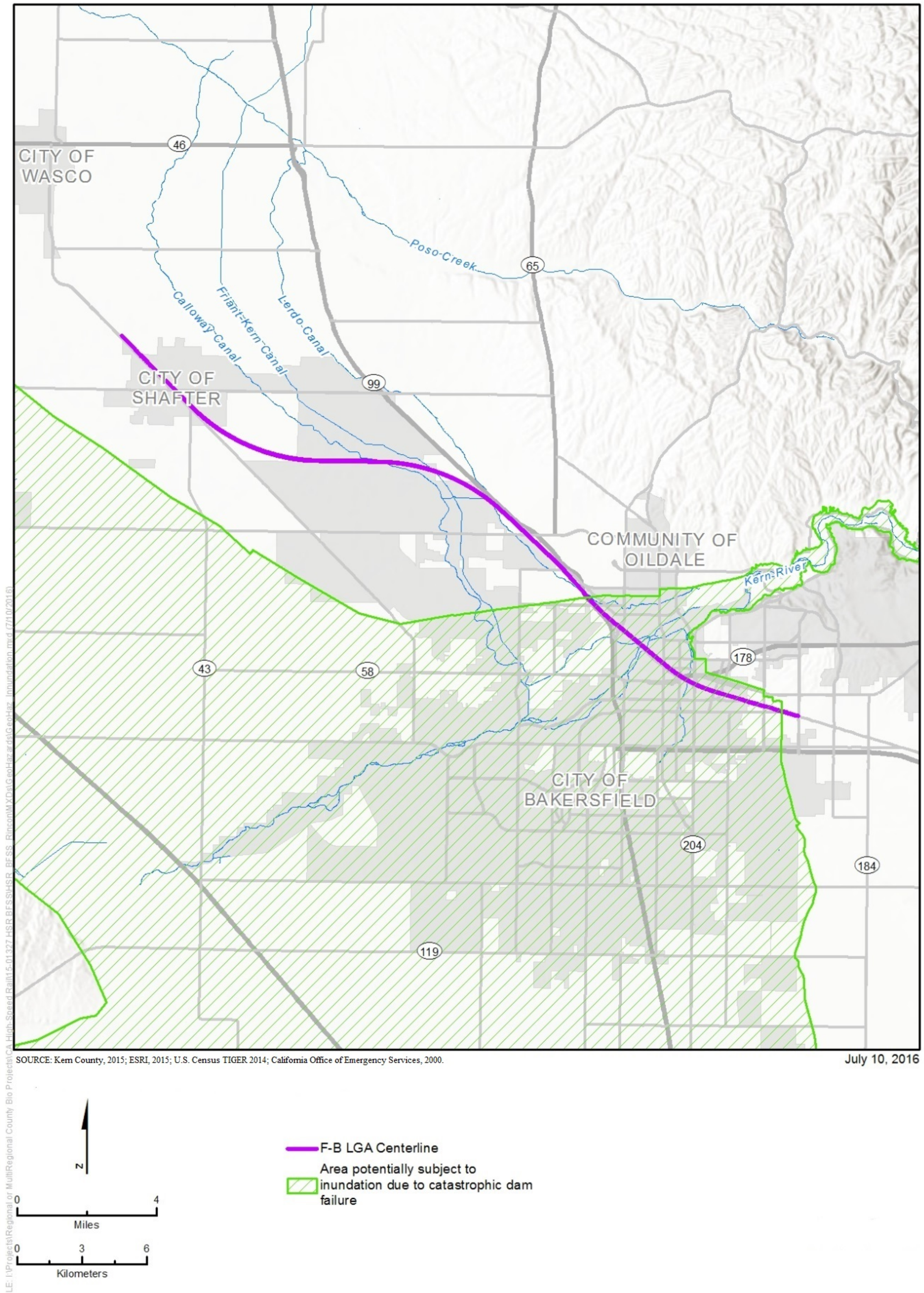


Figure 3.9-6 Inundation Areas

Mineral and Energy Resources

The following is an overview of mineral and energy resources specific to the F-B LGA.

Mines

The F-B LGA does not cross any active mines or known aggregate resources.

Oil and Gas Fields

The F-B LGA is close to numerous oil and gas fields, and crosses through four mapped fields shown in Figure 3.9-7:

- **Fruitvale Oil Field:** Approximately 1.88 miles
- **Kern Front Oil Field:** Approximately 0.74 mile
- **Rosedale Oil Field:** Approximately 0.63 mile
- **North Shafter Oil Field:** Approximately 1.1 miles

Locations of both active and abandoned oil wells were plotted from data obtained from the DOGGR database, which indicated a total of 11 wells in the study area (including the project footprint plus a 150-foot-wide buffer around the project footprint). Of these, three are located within the permanent footprint, all of which are plugged. There are no active wells in the permanent footprint. Of the eight wells within the 150-foot buffer area, six are classified as plugged and two are new. Seven of the wells in the F-B LGA study area are located between Shafter and Oildale, with one well situated just north of Bakersfield.

Geothermal Resources

A review of the DOGGR indicates that the F-B LGA would not cross a geothermal resource area as classified by the DOGGR, and there are no geothermal resource areas located in the project study area (project footprint plus a 150-foot-wide buffer around the project footprint).

Paleontological Resources

The affected environment for paleontological resources applicable to the F-B LGA is the same as described for the May 2014 Project and is discussed in Section 3.17.4.4 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: pages 3.17-94 through 3.17-101).

3.9.4 Environmental Consequences

This section summarizes the Fresno to Bakersfield Section Final EIR/EIS analysis of the May 2014 Project, then describes the construction and project impacts associated with the F-B LGA as they relate to geology, soils, and seismicity, as well as paleontological resources.

3.9.4.1 Summary of Analysis for the May 2014 Project

Geology, Soils, and Seismicity

Construction and operation of the May 2014 Project would avoid potential impacts associated with geology, soils, and seismicity risks through inclusion of conventional foundation design methods for elevated structure, retained-fill, at-grade, and retained-cut facilities as part of the project. These methods are included in American Association of State Highway and Transportation, American Railway Engineering and Maintenance-of-Way Association, California Department of Transportation (Caltrans), and International Building Code standards and guidelines, which are included as Project Design Features in the May 2014 Project, as described in Section 3.9.6 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: pages 3.9-38 through 3.9-41).

Aggregate resources are the only mineral resources within the study area for the May 2014 Project. Although aggregate mining occurs near Fresno, no mineral resources are known to exist within the footprint of the May 2014 Project, and no loss of availability of minerals of statewide significance or hazards associated with encountering such surface or sub surface deposits of such minerals would occur.

This page is left intentionally blank

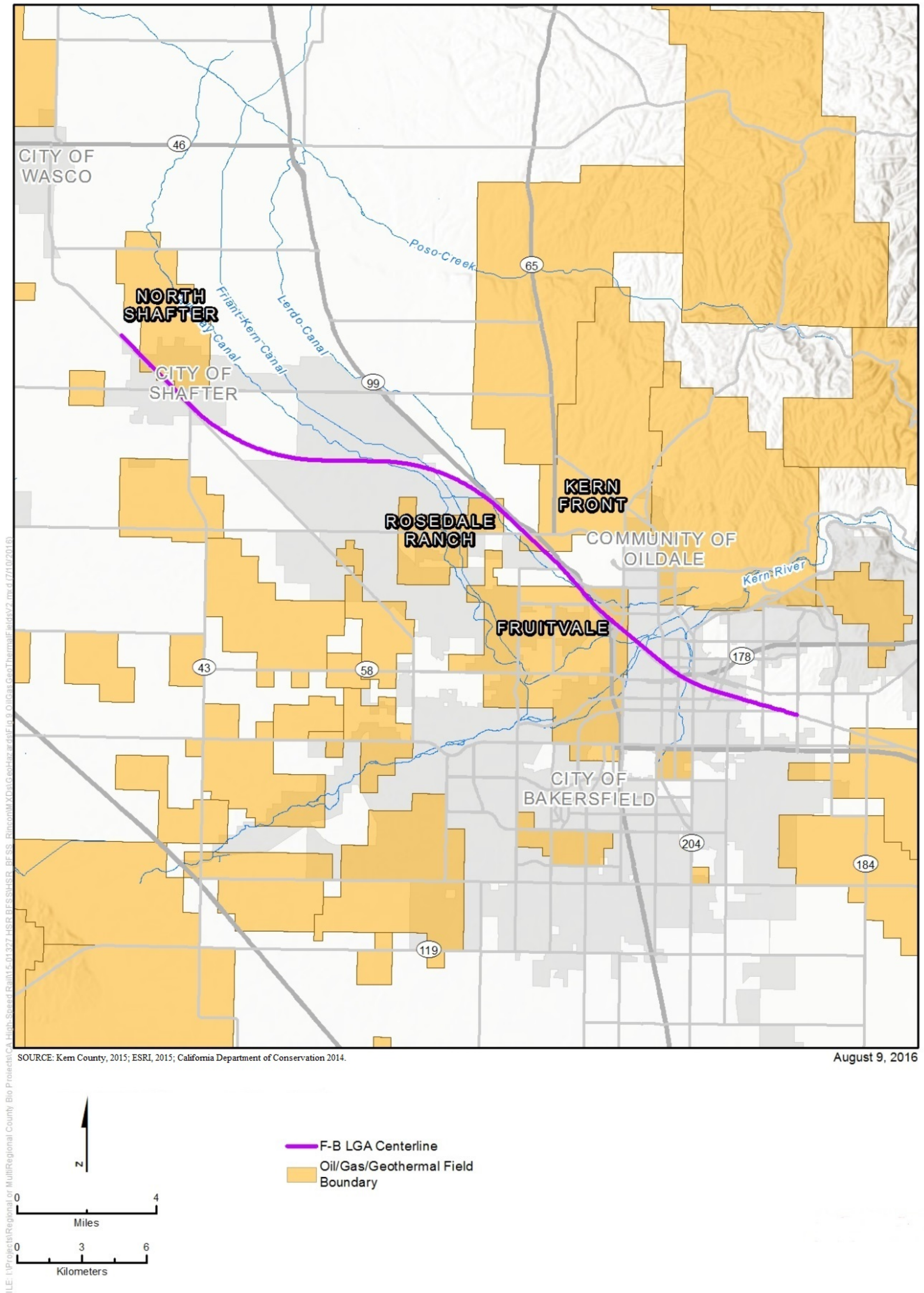


Figure 3.9-7 Oil and Gas Fields near the F-B LGA

This page is left intentionally blank

Geologic risks that would be considered during design and construction of the May 2014 Project include unstable soils and settlement, which present a low risk to existing infrastructure such as roadways, bridges, buildings, and residential structures, due to the use of standard engineering design features. With incorporation of standard engineering design features, geologic risks to facilities included under the May 2014 Project would also be low; these facilities include elevated, retained-fill, at-grade, and retained-cut segments of the alignment. The severity of geologic risks is limited because the geology along the May 2014 Project alignment and underlying the associated facilities is generally very competent, with only localized areas of potentially loose or compressible soils. Where geologic hazards exist, well-proven methods to address these hazards are outlined in standard guidance and engineering standards. Due to the incorporation of appropriate construction Best Management Practices (BMP) and standard engineering design measures, risks to the May 2014 Project facilities from unstable soils, settlement, and erosion would result in less than significant impacts under CEQA.

Potential operational impacts associated with the May 2014 Project include low soil-bearing strength, soil settlement, shrink-swell behavior and corrosive soils, slope failures, ground shaking, and secondary seismic hazards such as liquefaction, liquefaction-related slope movement, and liquefaction-related settlement. Engineering design of the May 2014 Project would incorporate guidelines issued by the American Association of State Highway and Transportation, the American Railway Engineering and Maintenance-of-Way Association, Caltrans, and the International Building Code (as described in Section 3.9.6 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: pages 3.9-38 through 3.9-41). With proper incorporation of these guidelines and construction standards, the severity of operational impacts to elevated, retained-fill, at-grade, and retained-cut segments of the alignment would be limited. Collectively, these design measures would reduce the effects from geologic and seismic hazards to a less than significant impact under CEQA.

Paleontological Resources

Construction of the May 2014 Project would occur in both urbanized areas and sparsely populated, undeveloped land outside of regional centers; there would be potential to disturb paleontological resources in rural areas due to the general lack of existing development. As discussed in Section 3.9.2.1, the study area for paleontological resources includes a one-mile radius around the proposed HSR right-of-way and any potential facilities, including the Bakersfield passenger station. No specific paleontological resources have been recorded in the study area for the May 2014 Project, but five geologic formations that intersect the study area are considered highly sensitive for potentially significant, yet unidentified, paleontological resources. The potential for the May 2014 Project to affect paleontological resources would depend upon the required depth of ground disturbances during construction. Therefore, mitigation measures would be implemented to require monitoring during construction, and to halt ground-disturbing activities should paleontological resources be encountered. Incorporation of mitigation measures identified in the *Mitigation Monitoring and Enforcement Plan* for the May 2014 Project would ensure construction monitoring by a paleontological resources specialist (CUL-MM#16), the preparation and implementation of a Paleontological Resource Monitoring and Mitigation Plan (CUL-MM#17), and halting of construction activities when paleontological resources are identified (CUL-MM#18). Therefore, potential impacts to paleontological resources during construction and operation of the May 2014 Project would be less than significant under CEQA, after mitigation.

3.9.4.2 Fresno to Bakersfield Locally Generated Alternative

Impact GSSP #1 – Encountering Unstable Soils during Construction

Based on review of the regional geologic reports, the F-B LGA appears to be situated where there are competent soils near the ground surface, but there exists the possibility for encountering unstable soils in specific areas, particularly near river and stream crossings. The potential for impacts associated with the encounter of unstable soils during construction of the F-B LGA would occur in the same way as described in Section 3.9.5.3 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: pages 3.9-28 through 3.9-38).

Construction of the alignment on soft or loose soils could result in onsite or offsite slumps, small slope failures at stream crossings, instability of cut-and-fill slopes required for the tracks, and collapse of retaining structures used for retained fills. These potential slumps and slope failures could endanger people or onsite or offsite properties if not addressed. While the risk of slumps and slope failures is greater if a large seismic event occurs, the likelihood of correspondence between construction and a high magnitude earthquake is low because the construction period is short (i.e., up to five years) and the earthquake occurrence infrequent. If a large earthquake were to occur during construction, effects could range from no effect to the potential for partially built structures or slopes to fail. This would vary based on the magnitude of the earthquake and the specific state of construction of various features at the moment the earthquake occurred. With implementation of appropriate design standards, such as Section 1805.3 of the International Building Code, which includes specifications for the placement of buildings and structures with respect to slope stability and safety associated with soils and foundations and standard safety practices during construction, these risks would be less than significant under CEQA.

Construction impacts associated with unstable soils would be the same across the alignment of the F-B LGA. The project would minimize impacts from potentially unstable soils through foundation design for site-specific conditions, such as the use of deep foundations or piles, based on site-specific, geotechnical investigations.

Impact GSSP #2 – Soil Settlement at Structures or along Trackway during Construction

Soil settlement could occur during project construction if induced loads cause compression of the underlying materials. Soil settlement occurs over time and is most problematic at locations where soft deposits exist (e.g., silt or clay soils) that have not previously been consolidated or compacted by loads of the same force as would be imposed by new construction. Such loads could occur at approach fills for elevated guideways or from embankments built to support track structural sections (e.g., ballast and sub-ballast placed to meet track grade requirements).

Soils along the F-B LGA are generally competent (medium-dense, stiff, or better), although localized deposits of soft or loose soils could occur at various locations, particularly at water crossings where these types of soils tend to be more prevalent. Geotechnical explorations conducted prior to final design and before construction begins, would identify the locations with the potential for settlement. In locations where subsurface conditions may not be capable of supporting the additional loading induced by added fill material, engineering design features that address soft deposits of silt or clay soils would be incorporated. These would include preloading to accelerate settlement or adding wick drains if applicable. Potential impacts associated with soil settlement at structures or along trackway during construction of the F-B LGA would be the same as described for the May 2014 Project, under Impact GSS #2 in Section 3.9.5.3 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: page 3.9-29). Application of the engineering design features would reduce the potential for soil settlement to a less-than-significant impact under CEQA.

In some locations, settlement associated with project construction could affect nearby existing structures or buried utilities located close to the area of construction. These effects would result from either new structures or earth fills (including retained fills) being placed in areas underlain by settlement-prone (loose or soft) soils, or from dewatering excavations for below-grade sections of track where shallow groundwater occurs and soils are loose or soft. Industry-standard construction manuals, such as the *Field Guide to Construction Dewatering* (Caltrans 2001), describe BMPs that can mitigate this type of hazard. The implementation of standard construction and engineering design standards and practices, like sheet piling to prevent lowering the groundwater table in sensitive areas, would make the effects of F-B LGA improvements on existing structures or utilities have a less-than-significant impact under CEQA.

Impact GSSP #3 – Soil Erosion during Construction

Soils that have a high potential for wind or water erosion were identified along the F-B LGA (Section 3.9.3, Affected Environment), and areas with high potential for soil erosion are shown on Figure 3.9-8. Potential impacts associated with accelerated soil erosion, including loss of topsoil, during construction of the F-B LGA would be the same as described for the May 2014 Project under Impact GSS #3 in Section 3.9.5.3 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: pages 3.9-29 and 3.9-30).

Areas with high potential for soil erosion have been identified in the southeastern portion of Bakersfield, and are shown in Figure 3.9-7. The potential for increased surface water runoff exists during construction when existing vegetation is removed and the disturbed soils are exposed to both wind and water erosion. Increased surface water runoff could also result from the construction of temporary, impermeable work surfaces. If exposed soils are not protected from wind or water erosion, such as when work areas are cleared of vegetation and materials stockpiled, both the exposed work area and any stockpiles could erode and cause indirect impacts on air and water quality. The potential for erosion from water increases slightly from west to east. Standard construction practices, such as those listed in the *Caltrans Construction Site Best Management Practices (BMP) Manual* (Caltrans 2003a), the *Construction Site Best Management Practice (BMP) Field Manual and Troubleshooting Guide* (Caltrans 2003b), and the *California Stormwater Quality Association BMP Handbook* (California Stormwater Quality Association 2015) will be implemented to reduce the potential for erosion. These handbooks describe standard engineering and design practices to ensure safe building approaches. Such measures could include but are not limited to soil stabilization, watering for dust control, perimeter silt fences, and sediment basins. Because these standard practices would be implemented during, the design phase impacts under CEQA would be less than significant.

Impact GSSP #4 – Difficult Excavations due to Hardpan Soil and Shallow Groundwater

There are areas along the F-B LGA that may result in difficult investigations due to the presence of hardpan soil or shallow groundwater. Excavations in these types of soils are relatively common, and qualified contractors are familiar with methods to handle excavations in hardpan. Excavations in loose, cohesionless deposits that extend below groundwater could also result in difficult excavations. At these locations, hydrostatic pressures can result in instabilities of the excavation side-slopes or heave of the excavation base, leading to loss of ground support. These conditions can be encountered in localized areas like river crossings. Design issues associated with these conditions are routinely handled during construction through the use of dewatering with groundwater wells and well points that lower the water level; the use of sheet pile wall systems to stabilize the soil; or techniques such as jet grouting and deep soil mixing that add cement to the soil and provide a cement-soil mix that resists hydrostatic forces. Alternatively, excavations can be avoided by using deep foundations that can be driven or drilled into the loose, water-saturated soil. This potential effect of the F-B LGA would be the same as described for the May 2014 Project under Impact GSS #4 in Section 3.9.5.3 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: pages 3.9-30 and 3.9-31).

Locations where retained-cut segments are planned would be most affected by hardpan and shallow groundwater conditions. Both retained fill and at-grade designs would usually involve a limited need to excavate the hardpan or work below the groundwater level, and deep foundations for elevated structures are conventionally built into rock and below the groundwater. Construction and design methods are provided in detail by Caltrans, in the *Caltrans Construction Site BMP Manual* (Caltrans 2003a) and the *Construction Site BMP Field Manual and Troubleshooting Guide* (Caltrans 2003b), which specify commonly practiced construction techniques associated with excavation methods. Such techniques include but are not limited to pre-drilling with rock bits for drilled piers/piles and the use of backhoe-mounted hydraulic impact hammers for shallow excavations, as applicable. The specific excavation methods selected will be determined by the construction contractor, based on site-specific conditions. With the implementation of these design and construction measures to ensure successful excavations in areas with hardpan soil and/or shallow groundwater, potential impacts would be less than significant under CEQA.

This page is left intentionally blank

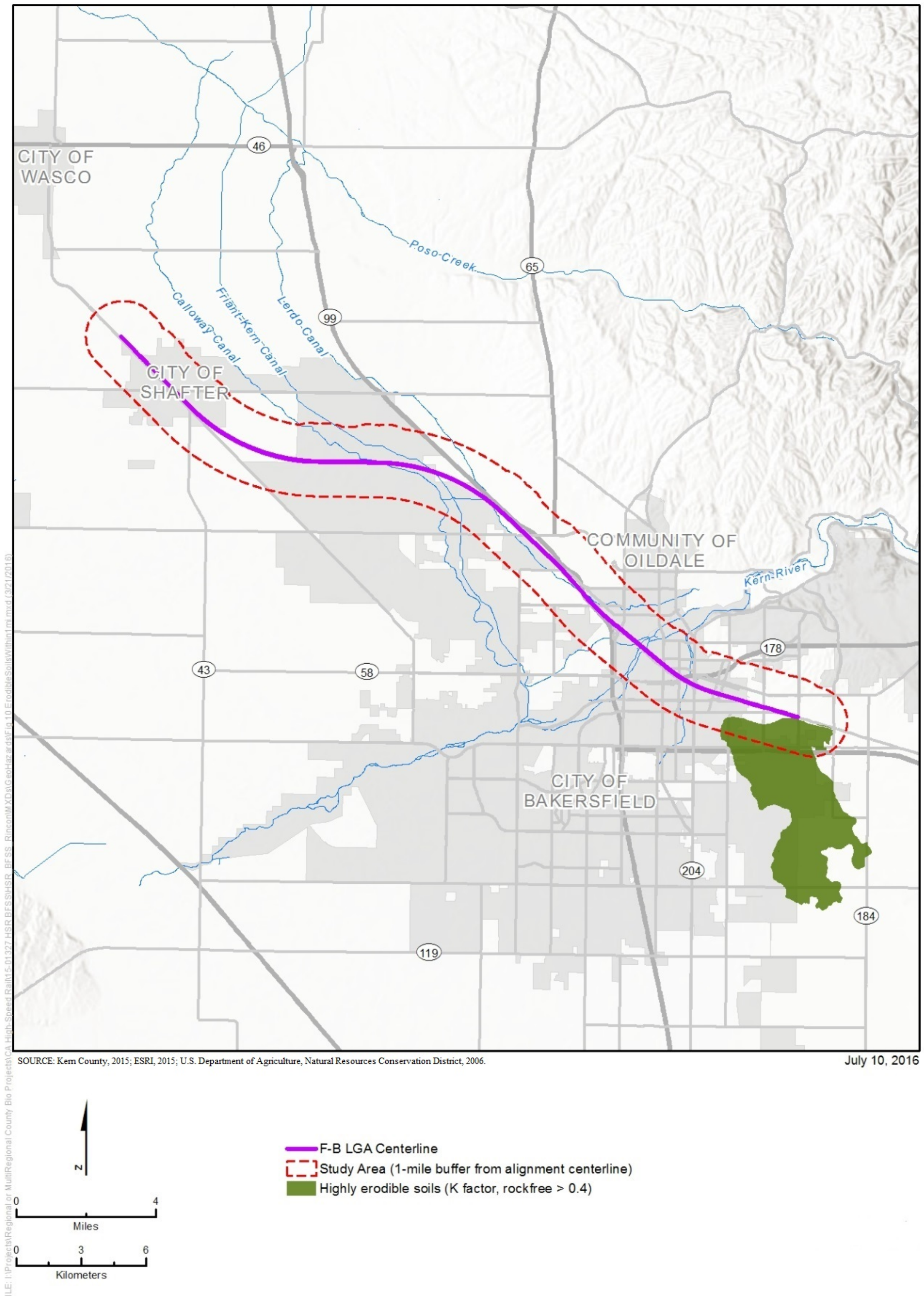


Figure 3.9-8 Soil Erosion in Southeastern Bakersfield

This page is left intentionally blank

Impact GSSP #5 – Encountering Mineral and Energy Resources during Construction and Loss of Availability of Known Mineral or Energy Resources of Statewide or Regional Significance

No loss in the availability of minerals of statewide significance or hazards associated with encountering surface or sub-surface deposits of such minerals are anticipated as a result of the F-B LGA. No impact under CEQA would occur in relation to minerals of statewide significance.

The F-B LGA would not cross any areas of known geothermal resources and no impact under CEQA would occur in relation to geothermal resources.

Potential impacts related to conflicts with oil or gas fields, including specific wells, would occur in the same way as described for the May 2014 Project under Impact GSS #5 in Section 3.9.5.3 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: pages 3.9-32 and 3.9-33), with the exception of site-specific locations of existing wells and oil fields that occur in the project footprint and within the 150-foot buffer area. Figure 3.9-7 shows the oil and gas fields in the project vicinity. The relative distances of these fields to the F-B LGA are described in Section 3.9.3.7.

In addition, as described in Section 3.9.3.2 (Mineral and Energy Resources), there are a total of 11 new or plugged wells in the project footprint and within the 150-foot buffer area. Of these, three are located in the permanent footprint, all of which are plugged. No active wells are located in the permanent footprint or 150-foot buffer area. In comparison, as described in Chapter 8 of this Draft Supplemental EIR/EIS, there are 28 plugged, idle, active, or new wells in the May 2014 Project study area (project footprint plus a 150-foot buffer around the footprint), including one active well in the permanent footprint area, and five active wells within the 150-foot buffer area.

Active wells would be properly abandoned or relocated to nearby sites using directional drilling techniques, if feasible. Related facilities such as pipelines would also potentially need to be relocated if they fall within the permanent footprint area. Data collected from exploration activities are used to optimize the entrance to the target zone when drilling and developing a well, and wells are originally placed for optimal production. Capping an existing well and re-drilling into the target zone from a nearby location, therefore, may not result in the same level of production from the new well. The production rate from a new well cannot be estimated before it is installed. Consequently, it is not certain that a new well will be as productive as the existing well and the replacement well may result in a reduction in the rate of production compared to the old well. However, because all of the wells located in the study area for the F-B LGA are currently plugged, there would be no effect related to loss of production associated with well relocation.

Although a small number of individual wells (three) are located in the permanent project footprint for the F-B LGA, none of these are active, and the project would not result in damage to the geologic horizons containing the oil or gas due to the depth of the oil and gas reserves. The F-B LGA would not, therefore, result in a loss of access to oil and gas resources.

As a standard safety practice, the construction contractor(s) would retain a civil engineer to determine if explosion hazards exist along the project study area, and would test for gases regularly. Because of these precautionary measures, impacts from construction in areas with subsurface gas or oil would be less than significant under CEQA.

Impact GSSP #6 – Effects of Unstable Soils on Operations

During project operation, the presence of unstable soils could introduce potential for creep- or groundwater-related soil failures increases. This potential effect of the F-B LGA would be the same as described for the May 2014 Project under Impact GSS #6 in Section 3.9.5.3 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: page 3.9-33). Adverse impacts from soft or loose soils would affect some design types more than others. For instance, unstable soils would represent a greater risk to locations where retained fills are planned than they would to at-grade segments of the alignment because retained fills impose a much greater load on the unstable soil. Typically, elevated structures supported on deep foundations are specifically designed to handle soft and near-surface soils and can be designed to accommodate soft-soil conditions. The severity of the risk increases where soft-soil conditions combine with the potential for small slumps and slope failures. In these locations, the potential impact of loss in bearing or additional soil loads associated with the slump or slope failure would be considered during the design process.

The F-B LGA engineering design would incorporate methods that consider the short- and long-term impacts of unstable soils on the rail line and nearby facilities. Where appropriate, engineered ground improvements, including groundwater controls, would be implemented to avoid long-term impacts from unstable soils. Implementation of these measures during final design would meet standards of design and building code requirements to provide either sufficient bearing capacity and slope stability, or to implement measures that protect the facility from loads associated with unstable soils. With implementation of these design measures, loose and unstable soils would be improved or foundations would be designed to avoid impacts to structures from these conditions, and therefore, the impacts would be less than significant under CEQA.

Impact GSSP #7 – Effects of Soil Settlement on Operations

Soil settlement could occur during operation of the train because of regional subsidence, which is common in the San Joaquin Valley. Soil subsidence could also occur in specific locations where soft deposits of silty or clayey soils are subjected to new earth loads, as might occur with approach fills for elevated guideways, retained fill, or for track subgrade and ballast materials that are placed to meet track grade requirements. This potential effect of the F-B LGA would be the same as described for the May 2014 Project under Impact GSS #7 in Section 3.9.5.3 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: page 3.9-34).

A number of locations along the project alignment would require new earth fills. Some of these areas are potentially underlain by settlement-prone (loose or soft) soils. These specific locations would be identified during preconstruction and construction geotechnical investigations and engineered solutions would be implemented for site-specific conditions. The potential consequence of excessive settlement represents a high risk to train travel if unaddressed. Regional subsidence and localized settlement are typically slow processes that, with periodic maintenance, can be remedied by dressing and or ballasting where required to maintain a safe track profile.

The project design incorporates ground improvements and foundations that are resistant to settlement and would meet building code requirements. Additional fill material from other sources would be imported as necessary. Because of this, the potential risk of excessive ground settlement would be minimal and would result in less than significant impacts under CEQA.

Impact GSSP #8 – Effects of Moderate to High Shrink-Swell Potential on Operations

Soils located in the upper five feet of the soil profile along the F-B LGA are generally characterized as expansive, or as having moderate to high shrink-swell potential. Soils with high shrink-swell potential shrink during dry conditions and expand when soaked. If unchecked, the shrink-swell potential represents a risk to the operation of the track system and the track right-of-way for long-term operations. Soils with high shrink-swell potential have been identified in the southeastern part of Bakersfield. This potential effect of the F-B LGA would be the same as described for the May 2014 Project under Impact GSS #8 in Section 3.9.5.3 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: page 3.9-34).

Shrink-swell impacts are more critical to locations with at-grade segments than to elevated structures on deep foundations or retained fill. The earth loads associated with at-grade segments of the project may not be sufficient to overcome swell potential, and this swell would likely be variable along the alignment, leading to differential movement of the track system. The project design reduces the risk from shrink-swell soils through minimization of moisture content changes, design of surcharge loads to offset swell pressures, or soil improvement, and by removal of the upper five feet of soils that exhibit high shrink-swell potential, and replacement of the excavated soils with those that do not exhibit these characteristics. Implementing these engineering design measures would reduce risks from shrink-swell soils and result in less than significant impacts under CEQA.

Impact GSSP #9 – Effects of Moderately to Highly Corrosive Soils on Operations

Soils along the F-B LGA generally have moderate to high corrosivity to uncoated steel and concrete in some locations. The potential for corrosion to uncoated steel and concrete represents a risk to the operation of the track system and the track right-of-way for long-term operations. Consequences of corrosion could include eventual loss in the structural capacity of buried steel or concrete components. This potential effect of the F-B LGA would be the same as described for the May 2014 Project under Impact GSS #9 in Section 3.9.5.3 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: pages 3.9-34 and 3.9-35).

The project design reduces potential risks associated with corrosive soils through soil improvement or removal of the upper five feet of soils that exhibit high-corrosivity characteristics, and through replacement of the excavated soils with those that do not exhibit these characteristics in areas where there would be buried, uncoated steel. Active and passive protection systems could also protect embedded and exposed steel structures from corrosion. As necessary, final designs would include epoxy-coated steel or double corrosion-protection ground anchors to avoid long-term corrosion issues.

Standard engineering and design features would be implemented to reduce risks from corrosive soils. This could include importing non-corrosive soils or using coated or corrosion resistant steel or concrete materials. Implementing these engineering design measures would reduce risks associated with corrosive soils and result in less than significant impacts under CEQA.

Impact GSSP #10 – Effects of Slope Failure on Operations

Slopes along some rivers and streams could fail in the F-B LGA, either from additional earth loads at the top of the slope, undercutting by stream erosion at the toe of the slope, or additional forces during a seismic event. This potential effect of the F-B LGA would be the same as described for the May 2014 Project under Impact GSS #10 in Section 3.9.5.3 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: page 3.9-35), due to the flat regional topography traversed by both alignments. Loss in bearing support would affect at-grade and retained fill segments more than elevated structures supported on deep foundations. These failures could endanger people as well as on-site and off-site structures if the track were damaged.

The project design addresses slope stability by incorporating International Building Code and other commonly practiced engineering standards and criteria. Detailed slope stability evaluations would be conducted and impact avoidance measures, such as structural solutions (e.g., tie backs, soil nails, or retaining walls), or geotechnical solutions (e.g., ground improvement or regrading of slopes), would be implemented, as appropriate, to reduce the potential for future slumps and slope failures. Structural solutions would physically hold cuts in slopes in place with walls or other physical structures, while geotechnical solutions would improve the soils to increase stability or reduce slopes to eliminate slope failure. In the case of elevated structures, the location of the foundation would be sited during final design to avoid the area of slope failure. Because standard engineering and design measures would be implemented, impacts under CEQA would be less than significant.

Impact GSSP #11 – Effects of Seismicity on Operations

Earthquakes could produce hazards to the HSR system, including both primary and secondary seismic hazards, discussed in this document (Sections 3.9.3.4 and 3.9.3.5, respectively).

Seismic-Induced Ground Shaking

The faults and fault systems that exist to the east, west, and south of the F-B LGA are known to produce seismic events capable of causing ground shaking of moderate intensity, with estimated PGA at the ground surface of 0.406 g to 0.422 g. The level of ground shaking could vary along the alignment, depending on the amount of ground motion amplification or de-amplification within specific soil layers, but the likely level of seismically induced ground motion is sufficient to cause substantial damage regardless of the location. Potential impacts of the F-B LGA associated with seismic-induced ground shaking would be the same as described for the May 2014 Project under Impact GSS #11 in Section 3.9.5.3 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: pages 3.9-35 through 3.9-38), and discussed below.

The level of ground shaking stated above represents a critical hazard to all design types. Elevated structures supported on deep foundations can be designed for moments and shear forces associated with the ground shaking, and the retaining walls for retained earth structures can be designed for the inertial response of the retained soil.[2]

A key consideration is the response of the operating train if a seismic event shakes the track, because movement of the track bed would be transferred into the train. The train cars, the spring system for the train cars, and the track design would be appropriately configured to resist the resulting inertial response of the train while it is traveling at a high speed. Available information for other HSR systems in seismically active areas, such as Japan and Taiwan, suggests that the California HSR would be able to satisfy life-safety requirements in the design to mitigate hazards posed by earthquakes.

The engineering design would address seismically induced ground shaking by specifying minimum seismic loading requirements for any elevated structures, and for the train's performance while operating. These would include specific evaluations of the response of the track system, including elevated structures, and confirmation that the soil provides sufficient support to the track. Detailed seismic response evaluations would be conducted, and measures such as enhanced structural detailing, more system redundancy, or special ground motion isolation systems would be implemented, as appropriate, to reduce the potential for failures from inertial forces resulting from the ground motions. In addition, a network of instruments would be installed to provide ground motion data that would be used with the operational instruments and controls system to temporarily shut down train operations in the event of an earthquake. Therefore, design of the project would render seismically induced ground shaking a less than significant impact under CEQA.

Surface Fault Rupture

Figure 3.9-3 indicates that some faults near the F-B LGA have experienced surface rupture, including the Premier, New Hope, and Poso Creek-Pond Faults. There are no mapped faults that cross the F-B LGA alignment. Potential impacts of the F-B LGA associated with surface fault rupture would be the same as described for the May 2014 Project under Impact GSS #11 in Section 3.9.5.3 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: pages 3.9-35 through 3.9-38).

As discussed on page 3.9-36 of the Fresno to Bakersfield Section Final EIR/EIS, studies have shown that historical fault movements have occurred on the exposed or mapped portion of the Pond Fault. These movements have been periodic or creep-type rather than single abrupt rupture. If damage from fault creep were to occur along the proposed F-B LGA alignment, it would be repaired with routine maintenance that could include repaving or minor track realignment. Therefore, the exposure of people or structures to potential effects from surface fault rupture would have a less than significant impact under CEQA.

[2] Moments and shear forces are engineering terms that refer to forces that develop in structures during seismic loading. During an earthquake, inertial forces often develop above the ground surface, when the mass of the structure accelerates from earthquake shaking. The combination of force and distance above the ground results in a moment above the ground, as would occur for an elevated track supported on a cast-in-drill-hole foundation. Shear develops from the horizontal application of this force to the column. Strict engineering standards must be met so that moments and shear forces are within design values.

Secondary Seismic Hazards

Secondary seismic hazards include liquefaction, slope stability, and potential hazards associated with dam inundation. Potential impacts of the F-B LGA associated with secondary seismic hazards would be the same as described for the May 2014 Project under Impact GSS #11 in Section 3.9.5.3 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: pages 3.9-35 through 3.9-38).

As discussed in Section 3.9.3.5, one of the consequences of strong ground shaking could be liquefaction of saturated, loose, cohesionless soils. The soil types in the area and groundwater conditions are generally not conducive to liquefaction because of the depth to groundwater and the coarse soil textures typical of the eastern portion of the San Joaquin Valley. Liquefaction potential can increase in areas where groundwater is less than 50 feet below the surface, such as near river and stream crossings or in areas where perched shallow groundwater occurs. The F-B LGA would be built on relatively flat terrain and lateral spreading in response to the liquefaction of subsurface soil caused by gravitational forces is not likely. Therefore, potential impacts associated with liquefaction would be less than significant under CEQA.

Detailed slope stability evaluations would be conducted as part of the final engineering and design phase, and site-specific engineering measures like ground improvement, use of retaining walls, or regrading of slopes would be implemented as appropriate, to reduce the potential for seismically-induced slope failures. Localized instabilities that may occur would be addressed as a part of routine maintenance. These measures would render the risk of seismically-induced slope failures a less than significant impact under CEQA.

The potential failure of Isabella Dam could result in the inundation of the downstream flat-lying areas and could potentially affect the alignment (see Figure 3.9-6 for a map of inundation areas). Isabella Dam is located approximately 37 miles to the northeast of Bakersfield. The 2008 USACE flood maps for Isabella Dam show that an approximately 6.5-mile section of the F-B LGA alignment could be inundated by as much as 20 feet of water (ESRI StreetMaps USA 2005a, ESRI StreetMaps USA 2005b). It would take an estimated six to eight hours for escaped water to reach a flooding depth of one foot at the F-B LGA (Kern County 2008). In the unlikely event that Isabella Dam did fail, this should allow time to evacuate HSR facilities and tracks.

At the time this document was prepared, Isabella Dam was being operated at a lowered pool elevation to reduce the risk of flooding should the dam breach in response to a large storm or seismic event, and to prepare for improvements to the existing dam facility. Operating the dam at a lowered pool elevation means that less water is entrained in the reservoir, and it is therefore less likely that the dam would breach and result in a flooding event. It is not unusual for a dam to be operated at a lowered pool elevation for these reasons and in response to a general shortage in water supply often associated with drought. In addition, improvements that will be implemented under the Isabella Lake Dam Safety Modification Project include the following:

- A full height filter and drain (with an approximately 16-foot crest raise)
- Improvements to the existing spillway
- A new emergency spillway
- An 80-foot downstream buttress at the Auxiliary Dam with a 16-foot crest raise
- Shallow foundation treatment at the downstream toe of the Auxiliary Dam
- Realignment of the Borel Canal conduit through the right abutment of the Auxiliary Dam
- Relocations of California State Route 178 and Lake Isabella Boulevard
- A gate closure structure along California State Route 155 to accommodate the 16-foot crest raise (USACE 2012)

The lowered pool elevation will be maintained throughout implementation of these improvements to facilitate work on the dam structure and associated facilities. The pool elevation may be increased after the safety improvements are implemented, depending on water supply. The USACE plans to implement improvements included under the Isabella Lake Dam Safety Modification Project between 2017 and 2022.

As is typical of flood control / safety structures, Isabella Dam was designed, engineered, and constructed to withstand seismic events. A seismically-induced dam failure could occur in the event of a very large earthquake with sufficient magnitude to cause catastrophic damage to the dam structure. The exact magnitude of an earthquake that could cause catastrophic damage to the Isabella Dam depends upon a variety of factors, including but not limited to the structural integrity of the dam and associated facilities, the elevation of water entrained by the dam, groundwater levels, and the location and type of the earthquake.

The predicted strength loss of the Isabella Dam foundation and embankment materials during a maximum credible earthquake may result in failure of the dam and lead to a release of the lake pool. The maximum credible earthquake determined for Isabella Dam is a moment 7.0 magnitude on the Kern Canyon Fault, which runs beneath the dam's right abutment. Through field studies concluded in 2010, the USACE determined that the Kern Canyon Fault is active and assessed it to be capable of a 7.5 magnitude earthquake. The amount of water currently stored in Lake Isabella is reduced, therefore, to ensure dam safety under current loading conditions, including but not limited to the potential for the Kern County Fault to result in a maximum credible earthquake event (USACE 2012).

In the event of a structural failure at Isabella Dam resulting from a catastrophic seismic event, the amount of time that would pass prior to inundation of the proposed alignment would be on the order of several hours, allowing for evacuation of people from the potentially affected area. Therefore, impacts associated with exposing people or structures along the F-B LGA to inundation hazards resulting from seismically induced dam failure would be less than significant under CEQA.

Paleontological Resources

There would be potential for impacts to occur to paleontological resources during the construction phase for the F-B LGA, due to ground-disturbing activities. Operation of the project would not involve ground-disturbing activities, and therefore, no impacts to paleontological resources would occur during the operational phase. Impact GSSP #12 characterizes potential construction-phase impacts to paleontological resources.

Impact GSSP #12 – Sensitive Paleontological Resources

No exposures of bedrock geology were observed during field surveys for the F-B LGA, and no fossils were discovered. As discussed in Section 3.9.3.8, there are multiple geologic units along the F-B LGA that have been identified as having high paleontological sensitivity because of their presumed early Holocene and Pleistocene age. Potential impacts of the F-B LGA resulting from ground-disturbing activities in areas with high paleontological sensitivity would be the same as described for the May 2014 Project, under Impact CUL #3 in Section 3.17.5.3 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA 2014a: pages 3.17-126 and 3.17-127).

Early Holocene- and Pleistocene-age units could potentially yield scientifically significant paleontological resources during project-related construction activities. Early Holocene and Pleistocene sediments occur at the surface along most of the project alignment. In addition, alluvial sediments that are at least Holocene in age (some of those sediments mapped as Qf could be very young), though not themselves sensitive, overlay older deposits, at unknown depths, that are sensitive. For example, Pleistocene aged sediments (Qc) may be present beneath latest Holocene aged deposits, wherever these occur. Pleistocene non-marine alluvium and fan deposits, including terraces, have a record of abundant and diverse vertebrate fauna throughout California and are generally considered to have high paleontological sensitivity, wherever they occur.

As a result of these potential sensitivities, all ground disturbance associated with construction of the F-B LGA has the potential to directly disturb geologic units with high paleontological sensitivity. Pleistocene and early Holocene alluvium mapped at the surface and late Holocene alluvium that may directly overlie older units could be disturbed by construction activities. Due to the presence of areas with high paleontological sensitivity, construction of the F-B LGA could result in potentially significant impacts under CEQA. Therefore, Mitigation Measures CUL-MM#16, CUL-MM#17, and CUL-MM#18 would also be applicable here.

These measures are presented in the *Fresno to Bakersfield Mitigation Monitoring and Enforcement Plan* (2014b), pages 1-57 through 1-60. As discussed in Section 3.9.6, these measures would require the development and implementation of a Paleontological Resource Monitoring and Mitigation Plan (PRMMP) and designation of a paleontological resources specialist (PRS) and paleontological resources monitors (PRM). Ground-disturbing activities would cease should unanticipated resources be encountered. These requirements would minimize or avoid impacts to paleontological resources by protecting known resources, avoiding the disturbance of unanticipated resources, and properly recovering and handling resources should they be encountered. Therefore, with implementation of these mitigation measures, impacts associated with sensitive paleontological resources would be reduced to less than significant under CEQA.

Potential impacts to sensitive paleontological resources are tied to ground-disturbing activities and would not occur during operation and maintenance of the F-B LGA (also as described under Impact CUL #6 in Section 3.17.5.3 of the Fresno to Bakersfield Section Final EIR/EIS [Authority and FRA 2014a: page 3.17-127]).

3.9.5 Avoidance and Minimization Measures

All of the Avoidance and Minimization Measures in the Fresno to Bakersfield Section Final EIR/EIS (therein referred to as project design features [Sections 3.9.6 and 3.17]) (Authority and FRA 2014b) are applicable to the F-B LGA. The list is provided in Technical Appendix 2-G Mitigation Monitoring and Enforcement Plan. Technical Appendix 2-H describes how implementation of these measures would reduce adverse effects related to geology, soils, and seismicity, as well as paleontological resources.

Geology, Soils, and Seismicity

The following Avoidance and Minimization Measures would be applicable to the May 2014 Project as well as the F-B LGA, as relevant to geology, soils, and seismicity.

- **GEO-IAMM #1: General Guidelines to be Followed**
  - 2010 American Association of State Highway and Transportation Officials (AASHTO) *Load and Resistance Factor Design Bridge Design Specifications* and the 2009 *AASHTO Guide Specifications for Load and Resistance Factor Design Seismic Bridge Design*: These documents provide guidance for characterization of soils, as well as methods to be used in the design of bridge foundations and structures, retaining walls, and buried structures. These design specifications will provide minimum specifications for evaluating the seismic response of the soil and structures.
  - Federal Highway Administration Circulars and Reference Manuals: These documents provide detailed guidance on the characterization of geotechnical conditions at sites, methods for performing foundation design, and recommendations on foundation construction. These guidance documents include methods for designing retaining walls used for retained cuts and retained fills, foundations for elevated structures, and at-grade segments. Some of the documents include guidance on methods of mitigating geologic hazards that are encountered during design.
  - American Railway Engineering and Maintenance-of-Way Association Manual: These guidelines deal with rail systems. Although they cover many of the same general topics as AASHTO, they are more focused on best practices for rail systems. The manual includes principles, data, specifications, plans, and economics pertaining to the engineering, design, and construction of railways.

- California Building Code: The code is based on 2009 International Building Code (IBC). This code contains general building design and construction requirements relating to fire and life safety, structural safety, and access compliance.
- IBC and American Society of Civil Engineers (ASCE)-7: These codes and standards provide minimum design loads for buildings and other structures. They would be used for the design of the maintenance facilities and stations. Sections in IBC and ASCE-7 provide minimum requirements for geotechnical investigations, levels of earthquake ground shaking, minimum standards for structural design, and inspection and testing requirements.
- Caltrans Design Standards: Caltrans has specific minimum design and construction standards for all aspects of transportation system design, ranging from geotechnical explorations to construction practices. These amendments provide specific guidance for the design of deep foundations that are used to support elevated structures, for design of mechanically stabilized earth walls used for retained fills, and for design of various types of cantilever (e.g., soldier pile, secant pile, and tangent pile) and tie-back walls used for retained cuts.
- Caltrans Construction Manuals: Caltrans has a number of manuals including *Field Guide to Construction Dewatering, Caltrans Construction Site Best Management Practices (BMPs) Manual* and *Construction Site Best Management Practice (BMP) Field Manual and Troubleshooting Guide* that provide guidance and Best Management Practices for dewatering options and management, erosion control and soil stabilization, non-storm water management, and waste management at construction sites.
- American Society for Testing and Materials (ASTM): ASTM has developed standards and guidelines for all types of material testing- from soil compaction testing to concrete-strength testing. The ASTM standards also include minimum performance requirements for materials. Most of the guidelines and standards cited above use ASTM or a corresponding series of standards from AASHTO to assure that quality is achieved in the constructed project.

- **GEO-IAMM#2: Groundwater Withdrawal.** This measure reduces potential impacts on geologic resources by requiring the Contractor to prepare a Construction Management Plan (CMP) that would address groundwater withdrawal. The CMP outlines how HSR engineering design appropriately addresses these geologic constraints.
- **GEO-IAMM#3: Monitor Slopes.** The measure calls for slope monitoring that will reduce potential impacts from geologic conditions by establishing an operation and maintenance procedure for locations identified in the CMP where potential for long-term instability exists. Such instability could result in loss of track support or slope failure could bring about additional earth loading to foundations supporting elevated structures. The monitoring program will provide a mechanism for early detection of potential slope instability.
- **GEO-IAMM#4: Geotechnical Inspections**. Prior to and throughout construction, conduct geotechnical inspections to verify that no new, unanticipated conditions are encountered, and to determine the locations of unstable soils in need of improvement.
- **GEO-IAMM#5: Improve Unstable Soils**. The CMP would address unstable soils as it outlines how HSR engineering design appropriately addresses these geologic constraints. This measure reduces impacts to geologic resources by requiring the Contractor to incorporate established engineering design guidelines and standards during the HSR design phase so facilities are constructed according to accepted engineering standards. .
- **GEO-IAMM#6: Improve Settlement-Prone Soils**. The CMP would address subsidence as it outlines how HSR engineering design appropriately addresses these particular geologic constraints. This measure provides for subsidence monitoring as part of HSR design and will reduce potential impacts resulting from geologic conditions by providing a remote monitoring program. Trains with autonomous equipment for daily track surveys will monitor and detect

reduced track tolerance resulting in changed operations until track tolerances are restored to design specifications.

- **GEO-IAMM#7: Prevent Water and Wind Erosion.** The CMP would address water and wind as it outlines how HSR engineering design appropriately addresses these geologic constraints.
- **GEO-IAMM#8: Modify or Remove and Replace Soils with Shrink-Swell Potential and Corrosion Characteristics.** The CMP would address soils with shrink-swell potential as it outlines how HSR engineering design appropriately addresses these particular geologic constraints.
- **GEO-IAMM#9: Evaluate and Design for Large Seismic Ground Shaking.** This measure reduces impacts from geologic conditions by requiring evaluation and design for large seismic ground shaking in the engineering of all HSR components.
- **GEO-IAMM#10: Secondary Seismic Hazards.** As discussed above, various ground improvement methods can be implemented to mitigate the potential for liquefaction, liquefaction-induced lateral spreading, or flow of slopes, or post-earthquake settlement. Ground improvement around Cast-in-Drilled-Hole piles improves the lateral capacity of the Cast-in-Drilled-Hole during seismic loading. Cement deep soil mixing, stone columns, earthquake drains, or jet-grouting develop resistance to lateral flow or spreading of liquefied soils.
- **GEO-IAMM#11: Suspend Operations During or After an Earthquake.** This commitment requires motion-sensing instruments be part of HSR design and will reduce potential impacts resulting from geologic conditions by providing a control system to shut down HSR operations temporarily during or after a potentially damaging earthquake.

Paleontological Resources

There are no Avoidance and Minimization Measures applicable to paleontological resources identified in the Fresno to Bakersfield Section Final EIR/EIS. As described in the Fresno to Bakersfield Section Final EIR/EIS, in this Draft Supplemental EIR/EIS under Impact GSSP #12 (Sensitive Paleontological Resources), and in Section 3.9.6.2, mitigation measures would be implemented to reduce potential impacts to paleontological resources.

3.9.6 Mitigation Measures

3.9.6.1 Mitigation Measures Identified in the Fresno to Bakersfield Section Final EIR/EIS

Geology, Soils, and Seismicity

Standard engineering design measures and BMPs are incorporated into the project, including through the implementation of Avoidance and Minimization Measures provided in Section 3.9.5, that would ensure potential impacts related to geology, soils, and seismicity on elevated structures, retained cuts, retained fills, and at-grade segments of each alternative would be less than significant. Therefore, additional mitigation measures are not required.

Paleontological Resources

During project design and construction, the Authority and FRA would implement measures to reduce impacts associated with paleontological resources. The mitigation detailed in Table 3.9-2 was approved under the *Fresno to Bakersfield Section Mitigation and Monitoring Enforcement Program* (Authority and FRA 2014b) and is applicable to the F-B LGA.

Table 3.9-2 Mitigation Measures Applicable to the F-B LGA

Number	Description
CUL-MM#16	**Engage a Paleontological Resources Specialist to Direct Monitoring during Construction.** A paleontological resources specialist (PRS) will be designated for the project who will be responsible for determining where and when paleontological resources monitoring should be conducted. Paleontological resources monitors (PRM) will be selected by the PRS based on their qualifications, and the scope and nature of their monitoring will be determined and directed based on the Paleontological Resource Monitoring and Mitigation Plan (PRMMP). The PRS will be responsible for developing Worker Environmental Awareness Program (WEAP) training. All management and supervisory personnel and construction workers involved with ground-disturbing activities will be required to take this training before beginning work on the project and will be provided with the necessary resources for responding in case paleontological resources are found during construction. The PRS will document any discoveries, as needed, evaluate the potential resource, and assess the significance of the find under the criteria set forth in California Environmental Quality Act (CEQA) Guidelines Section 15064.5.
CUL-MM#17	**Prepare and Implement a Paleontological Resource Monitoring and Mitigation Plan.** Paleontological monitoring and mitigation measures are restricted to those construction-related activities that will result in the disturbance of paleontologically sensitive sediments. The PRMMP will include a description of when and where construction monitoring will be required; emergency discovery procedures; sampling and data recovery procedures; procedures for the preparation, identification, analysis, and curation of fossil specimens and data recovered; and procedures for reporting the results of the monitoring and mitigation program. The monitoring program will be designed to accommodate site-specific construction of the selected option. The PRMMP will be consistent with Society of Vertebrate Paleontology (SVP 1995) guidelines for the mitigation of construction impacts on paleontological resources. The PRMMP will also be consistent with the SVP (1995) conditions for receivership of paleontological collections and any specific requirements of the designated repository for any fossils collected.
CUL-MM#18	**Halt Construction When Paleontological Resources are Found.** If fossil or fossil-bearing deposits are discovered during construction, regardless of the individual making a paleontological discovery, construction activity in the immediate vicinity of the discovery will cease. This requirement will be spelled out in both the PRMMP and the WEAP. Construction activity may continue elsewhere provided that it continues to be monitored as appropriate. If the discovery is made by someone other than a PRM or the PRS, a PRM or the PRS will immediately be notified.

Mitigation Measure CUL-MM#16 requires that a PRS and PRMs be identified to implement the PRMMP required per Mitigation Measure CUL-MM#17. The PRS will determine when and where monitoring is necessary, while the PRM will ensure that all project workers involved with ground-disturbing activities receive WEAP training. These actions will minimize the potential to encounter unanticipated paleontological resources, and will ensure that if such resources are unexpectedly encountered during construction, they will be appropriately handled to avoid damage. These precautionary measures would not increase the potential for project-related activities to result in adverse physical impacts on the environment. Therefore, implementation of Mitigation Measure CUL-MM#16 would not result in impacts under CEQA.

Mitigation Measure CUL-MM#17 requires the development and implementation of a PRMMP, to be carried out by the PRS and PRMs identified in Mitigation Measure CUL-MM#16. This PRMMP will be designed to accommodate site-specific construction of the selected option, and would specify precautionary measures as discussed above. The PRMMP would not increase the potential for project-related activities to result in adverse physical impacts on the environment; therefore, implementation of Mitigation Measure CUL-MM#17 would not result in impacts under CEQA.

Mitigation Measure CUL-MM#18 would require the cessation of construction activities, should unanticipated paleontological resources be discovered during project-related ground-disturbing activities, consistent with the PRMMP and WEAP identified in Mitigation Measures CUL-MM#16 and CUL-MM#17. Construction activities may continue in areas other than the resource discovery, and construction activities may resume at the site of the discovery after the resource is removed. This measure ensures effective implementation of Mitigation Measures CUL-MM#16 and CUL-MM#17, and would not result in impacts under CEQA.

No impact would occur as a result of mitigation measures identified for paleontological resources.

3.9.6.2 Mitigation Measures Specific to the F-B LGA

Geology, Soils, and Seismicity

No additional mitigation measures are applicable to address geology, soils, and seismicity impacts resulting specifically from the F-B LGA.

Paleontological Resources

With the implementation of Mitigation Measures CUL-MM #16 through CUL-MM #18, and discussed in the preceding impact analysis, adverse effects associated with disturbance of paleontological resources during project construction would be mitigated by ensuring appropriate monitoring and cessation of ground-disturbing activities, as needed. These mitigation measures identify responsible parties for each project phase (pre-construction, and construction) to ensure that the requirements are appropriately implemented. There are no further applicable mitigation measures for impacts to paleontological resources resulting specifically from the F-B LGA.

This page is left intentionally blank