3.5 Electromagnetic Interference and Electromagnetic Fields

Since publication of the Draft Environmental Impact Report/Environmental Impact Statement (EIR/EIS), the following substantive changes have been made to this section:

- Revisions were made throughout the section to consolidate and clarify information on impacts and California Environmental Quality Act (CEQA) conclusions associated with the Fresno to Bakersfield Locally Generated Alternative (F-B LGA) alignment from the intersection of 34th Street and L Street to Oswell Street into Section 3.5.6.3. These conclusions were determined in the F-B LGA Final EIS (Authority 2019).
- A summary of the portion of the F-B LGA alignment from the intersection of 34th Street and L Street to Oswell Street pertaining to electromagnetic interference and electromagnetic fields (EMI/EMF) impacts was revised in Section 3.5.6.3 to clarify how the analysis addresses the F-B LGA alignment from the intersection of 34th Street and L Street to Oswell Street and for consistency with how this information is shown in other sections of the Final EIR/EIS.
- Revisions were made to Impact EMI/EMF #6, Electromagnetic Interference Effects on Schools, in Section 3.5.6.3 pertaining to schools within 500 feet of the Bakersfield to Palmdale Project Section (B-P) Build Alternatives where electromagnetic interference could affect the schools. These revisions were made to consolidate and clarify information on impacts associated with the F-B LGA alignment from the intersection of 34th Street and L Street to Oswell Street. Addresses of sensitive locations were added to Table 3.5-6 in the location column for consistency with how this information is shown in other sections of the Final EIR/EIS. The name of the Los Angeles County Sheriff's station in Lancaster was also corrected in Table 3.5-6.
- The existing sensitive receptors were reviewed and compared against the locations of the design refinements described in the Preface and Chapter 2. The refinements would not result in any changes to EMI or EMF affecting existing sensitive receptors. This has been noted in this section as applicable.

This section describes the regulatory setting and affected environment related to EMI/EMF for the Bakersfield to Palmdale Project Section of the California High-Speed Rail (HSR) System. This section includes analysis for the following components associated with the B-P Section:

- Bakersfield to Palmdale Build Alternatives 1, 2, 3, and 5 (B-P Build Alternatives)
- The César E. Chávez National Monument Design Option (CCNM Design Option)
- The Refined César E. Chávez National Monument Design Option (Refined CCNM Design Option)
- The portion of the F-B LGA from the intersection of 34th Street and L Street to Oswell Street[1]
- The Light Maintenance Facility/Maintenance of Way Facility/Maintenance of Infrastructure Siding Facility (LMF/MOWF/MOIS Facilities) in the B-P Project Section

> *Electromagnetic Interference*
>
> EMI (electromagnetic interference) is the disruption of operation of an electronic device when it is in the vicinity of an electromagnetic field in the radio frequency (RF) spectrum of another electronic device. The purpose of this analysis is to protect sensitive equipment near the proposed alignment and to inform the public with regard to any potential impacts from the project.

[1] The portion of the Fresno to Bakersfield Locally Generated Alternative (F-B LGA) alignment from the intersection of 34th Street and L Street to Oswell Street is analyzed and considered as part of the HSR Bakersfield to Palmdale Project Section under all of the Build Alternatives. The *Fresno to Bakersfield Section Final Supplemental Environmental Impact Report* (Authority 2018) approved the F-B LGA alignment from the City of Shafter through the Bakersfield F Street Station; however, the portion of the F-B LGA alignment from the intersection of 34th Street and L Street to Oswell Street has not been approved. As such, the approval of this portion of the alignment will take place through approval of the Bakersfield to Palmdale Project Section.

The impact analysis addresses the potential effects of these resources on the HSR project design, construction, and operation, as well as the effect the HSR project would have on existing EMI/EMF. The analysis considers a review and assessment of published maps, professional publications, and reports of the project vicinity, as well as consultation with subject matter experts and field surveys. Appendix 3.5-A, Pre-Construction Electromagnetic Measurement Survey along the Bakersfield to Palmdale Section, in Volume 2 of this Final EIR/EIS provides the electromagnetic measurements along the project alignment.

Summary of Results

The analysis indicates that implementation of each of the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, the portion of the F-B LGA from the intersection of 34th Street and L Street to Oswell Street, and the LMF/MOWF/MOIS Facilities would have similar effects related to EMI and EMFs. The populations and facilities close to the HSR system that could experience effects from exposure to HSR-related EMI and EMFs include medical laboratories, research and technology parks, dense housing developments, schools and colleges, employees, underground pipelines and cables, fences, and existing railroads. However, with incorporation of impact avoidance and minimization features (IAMF) and mitigation, impacts would be less than significant under CEQA.

With respect to radio frequency (RF) communications, HSR communication/control systems would meet Federal Communications Commission requirements regarding transmission of power and frequencies of operation and are not likely to present a hazard. The proposed HSR systems are all of similar power and use similar sections of the electromagnetic spectrum as do many other uses already existing in the region. These include RF sources such as cellular telecommunications; police, fire, and other municipal radio uses; amateur radio; and commercial broadcast radio. These uses would continue to occur along the Bakersfield to Palmdale Project Section without the HSR project. Under the No Project Alternative, future conditions would likely result in additional use of electricity and RF communications, consistent with that found in the urban and rural environments within the study area today.

3.5.1 Introduction

This introduction provides information about EMFs—what they are, how they are measured, and what governmental and industry standards exist to regulate these fields. For this EIR/EIS, the Authority undertook a measurement program to identify existing electromagnetic levels in each section of the California HSR System. This EIR/EIS section describes the measured levels, as well as the potential for EMI from operation of the HSR system for each of the B-P Build Alternatives. This section focuses on land uses that are particularly sensitive to EMF, such as businesses and institutions that use equipment that may be highly susceptible to EMI, or that engage in medical imaging or medical research activities that might experience effects from HSR-related EMFs.

Other sections of this EIR/EIS provide additional information about issues related to EMI/EMF, such as the presence and growth of population groups and locations of sensitive receptors. These sections include Section 3.12, Socioeconomics and Communities; Section 3.13, Station Planning, Land Use, and Development; Section 3.18, Regional Growth; and Chapter 5, Environmental Justice.

EMFs have both an electric and magnetic field component. Electric fields are forces that electric charges exert on other electric charges. Magnetic fields are forces that a magnetic object or moving electric charge exerts on other magnetic materials and electric charges. EMFs occur throughout the electromagnetic spectrum, are found in nature, and are generated both naturally and by human activity. Naturally occurring EMFs include the earth's magnetic field, static electricity, and lightning. The generation, transmission, and distribution of electricity; the

> *Electromagnetic Wave and Spectrum*
>
> An electromagnetic wave has a frequency and a wavelength that are each directly related to the other—the higher the frequency, the shorter the wavelength.
>
> The electromagnetic spectrum is the range of waves of electromagnetic energy. It includes static fields such as the earth's magnetic field, radio waves, microwaves, X-rays, and light.

use of everyday household electric appliances and communication systems; industrial processes; and scientific research also create EMFs.

EMI occurs when the EMFs produced by a source affect operation of an electrical, magnetic, or electromagnetic device. EMI may come from a source that intentionally radiates EMFs (such as a television broadcast station), or one that does so incidentally (such as an electric motor).

Unit Definitions and Conversions

Hertz (Hz) – Unit of frequency equal to one cycle per second:

- 1 kilohertz (kHz) = 1,000 Hz
- 1 gigahertz = 1 billion Hz

Gauss (G) – Unit of magnetic flux density (English units):

- 1 G = 1,000 milligauss (mG)

Tesla (T) – Unit of magnetic flux density (International units):

- 1 T = 1 million microtesla (µT)
- 1 G = 100 µT
- 1 mG = 0.1 µT

EMFs are described in terms of both their intensity and their frequency, which is the number of cycles the EMF undergoes each second.[2] In the U.S., the commercial electric power system operates at a frequency of 60 hertz (Hz), or cycles per second, meaning that the field completes one full cycle 60 times per second. Electric power system components are typical sources of electric and magnetic fields. These components include generating stations and power plants, substations, high-voltage transmission lines, and electric distribution lines. Even in areas not adjacent to transmission lines, 60 Hz EMFs are present from electric power systems and common building wiring, electrical equipment, and appliances.

Natural and human-generated EMFs cover a broad-frequency spectrum. EMFs that are nearly constant in time are called direct current (DC) EMFs. EMFs that vary in time are called alternating current (AC) EMFs. AC EMFs are further characterized by their frequency range. The Institute of Electrical and Electronic Engineers (IEEE) defines extremely low-frequency magnetic fields as those with a range of 3 to 3,000 Hz. The California HSR System's overhead contact system (OCS) and power distribution system would primarily generate extremely low frequency fields at 60 Hz and at harmonics (multiples) of 60 Hz.

Radio and other communications operate at much higher frequencies, often in the range of 500,000 Hz (500 kilohertz [kHz]) to 3 billion Hz (3 gigahertz). Typical RF sources of EMFs include antennas associated with cellular telephone towers; broadcast towers for radio and television; airport radar, navigation, and communication systems; high frequency and very high frequency communication systems used by police and fire departments, emergency medical technicians, utilities, and governments; and local wireless systems such as Wi-Fi or cordless telephones.

The strength of magnetic fields is typically measured in milligauss (mG), gauss (G), tesla (T), or microtesla (µT). For reference, the earth's geomagnetic field ranges from approximately 300 to 700 mG DC (0.3 to 0.7 G) (50 to 70 µT) at its surface. Average AC magnetic field levels within homes are approximately 1 mG (0.001 G) (0.1 µT), and measured AC values range from 9 to 20 mG (0.009 to 0.020 G) (0.9 to 2 µT) near appliances (Severson et al. 1988). The strength of EMFs decreases rapidly with distance from their sources; thus, EMFs higher than background levels are usually close to EMF sources.

The information presented in this section primarily concerns EMFs at the 60 Hz power frequency and at RFs produced intentionally by communications or unintentionally by electric discharges. EMFs from HSR project operation would consist of the following:

- Power-frequency electric and magnetic fields from the traction power system, traction power substations (TPSS), emergency generators that provide backup power to the stations in case of a power outage, and utility feeder lines. The 25-kilovolt (kV) operating voltage of the HSR traction system would produce 60 Hz electric fields, and the flow of currents providing power to the HSR vehicles would produce 60 Hz magnetic fields. Along the tracks, the flow of propulsion currents to the trains in the OCS and rails would produce magnetic fields.

[2] The period of the wave is the time it takes for an alternating field to complete one full cycle. Frequency is just the reciprocal of the period.

- Harmonic magnetic fields from vehicles. Depending on the design of power equipment in the HSR trains, power electronics would produce currents with frequency content in the kHz range. Potential sources include power conversion units, switching power supplies, motor drives, and auxiliary power systems. Unlike the traction power system, these sources are highly localized in the trains and move along the track as the trains move.
- RF fields. The HSR system would use a variety of communications, data transmission, and monitoring systems—both on and off vehicles—that operate at RFs. These wireless systems would meet the Federal Communications Commission (FCC) regulatory requirements for intentional emitters (Code of Federal Regulations [C.F.R.] Title 47, Part 15, and FCC Office of Engineering and Technology Bulletin No. 65, Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields).

Of these EMFs, the dominant effect is expected to be the 60 Hz AC magnetic fields from the propulsion currents flowing in the traction power system (i.e., the OCS and rails).

3.5.2 Laws, Regulations, and Orders

Several organizations have developed guidelines for EMF exposure, including individual states, the FCC, the Occupational Safety and Health Administration (OSHA), the IEEE, the American National Standards Institute (ANSI), and the American Conference of Governmental Industrial Hygienists (ACGIH). Neither the California government nor the U.S. government has regulations limiting power-frequency EMFs.

The International Commission on Non-Ionizing Radiation Protection has also adopted EMF exposure guidelines and standards in the extremely low frequency and RF frequency bands applicable to HSR emissions. The International Commission on Non-Ionizing Radiation Protection and IEEE standards both address EMF exposure by the general public and for workers in an occupational setting. While the International Commission on Non-Ionizing Radiation Protection guidelines are widely used within the U.S. and abroad, and have been formally adopted by the European Union, the *Final Program Environmental Impact Report/Environmental Impact Statement (EIR/EIS) for the Proposed California High-Speed Train System* (Statewide Program EIR/EIS) uses the IEEE standards to assess the potential for health effects from anticipated HSR emissions. For occupational exposure, International Commission on Non-Ionizing Radiation Protection reference values are 1,000 μT for magnetic fields and 8.333 kilovolts/meter (kV/m) for electric fields.

The IEEE Standard C95.6, IEEE Standard for Safety Levels with Respect to Human Exposure to Electromagnetic Fields, 0–3 kHz, which is often referenced in the U.S. and which the ANSI has formally adopted, specifies maximum permissible exposure (MPE) levels for the general public and for occupational exposure to EMFs from 0–3 kHz. The HSR electrification and traction systems would mainly generate 60 Hz EMFs, which this standard addresses. Table 3.5-1 and Table 3.5-2 show the IEEE Standard C95.6 exposure levels (IEEE 2002). Note that the IEEE exposure levels are recommendations only, not regulations.

Table 3.5-1 Institute of Electrical and Electronics Engineers C95.6 Magnetic Field Maximum Permissible Exposure Levels for the General Public

Body Part	Frequency Range (Hz)	B-Field (mG)
Head and Torso	20–759	9.04×10^3
	759–3,000	$6.87 \times 10^6/f$
	60	9.04×10^3
Arms or Legs	< 10.7	3.53×10^6
	10.7–3,000	$3.79 \times 10^7/f$
	60	6.32×10^5

Source: Institute of Electrical and Electronics Engineers, 2002
/f = divided by the frequency mG = milligauss
Hz = hertz

Table 3.5-2 Institute of Electrical and Electronics Engineers C95.6 Electric Field Maximum Permissible Exposure Levels for the General Public

Body Part	Frequency Range (Hz)	E Field (v/m)
Whole Body	1–368	5,000
	368–3,000	$1.84 \times 10^6/f$
	60	5,000

Source: Institute of Electrical and Electronics Engineers, 2002
/f = divided by the frequency v/m = volts per meter
Hz = hertz

In 2006, the ANSI adopted IEEE Standard C95.1 as its standard for safe human exposure to non-ionizing electromagnetic radiation (IEEE 2006). The HSR train control and communications systems would use radio signals within the range covered by this standard. The C95.1 Standard specifies MPE levels for whole and partial body exposure to electromagnetic energy. MPE exposure levels are lower at 100 to 300 megahertz (MHz) because the human body absorbs the greatest percentage of incident energy at these frequencies. The MPE standards become progressively higher at frequencies above 400 MHz because the human body absorbs less energy at these higher frequencies. The IEEE C95.1 Standard MPEs are based on RF levels averaged over a 30-minute exposure time for the general public. For occupational exposure, the averaging time varies with frequency, from 6 minutes at 450 MHz to 3.46 minutes at 5,000 MHz.

Both the IEEE C95.6 and C95.1 Standards specify safety levels for occupational and general-public exposure. For each, the exposure levels are frequency dependent. The general-public exposure safety levels are stricter because workers are assumed to have knowledge of occupational risks and are better equipped to protect themselves (e.g., through use of personal safety equipment). The general-public safety levels are intended to protect all members of the public (including pregnant women, infants, the unborn, and the infirm) from short-term exposure to EMFs. These safety levels are set at 10 to 50 times below the levels at which scientific research has shown harmful effects may occur, thus incorporating a large safety factor (IEEE 2006).

Title 29, Part 1910.97, of the C.F.R. contains the OSHA safety standards for occupational exposure to RF emissions. The OSHA safety levels do not vary with frequency and are less stringent than the equivalent IEEE standards and FCC MPEs, except for occupational exposure to fields with frequencies above 5,000 MHz, where the OSHA MPE is equal to the IEEE C95.1 MPE and is two times higher than the FCC MPE. The OSHA MPEs are based on a 6-minute averaging time.

The ACGIH limits state that power frequency (60 Hz) magnetic fields should not exceed 10 G (10,000 mG, or 1 millitesla). The ACGIH additionally recommends that workers with pacemakers not exceed 1 G (1,000 mG or 0.1 millitesla). The ACGIH 10 G guideline level is intended to prevent effects such as induced currents in cells or nerve stimulation. However, the ACGIH guidelines are for occupational exposure, not general-public exposure.

3.5.2.1 Federal

Federal Railroad Administration Procedures for Considering Environmental Impacts (64 Fed. Reg. 28545)

The Federal Railroad Administration *Procedures for Considering Environmental Impacts* states that “the EIS should identify any significant changes likely to occur in the natural environment and in the developed environment. The EIS should also discuss the consideration given to design quality, art, and architecture in project planning and development as required by U.S. Department of Transportation Order 5610.4” (FRA 1999, pg. 28555).

Other Federal Requirements

- FRA, 49 C.F.R. Parts 236.8, 238.225, and 236, Appendix C. These regulations provide rules, standards, and instructions regarding operating characteristics of electromagnetic, electronic, or electrical apparatus, and regarding safety standards for passenger equipment.

- U.S. Department of Commerce, FCC, 47 C.F.R. Part 15. Part 15 provides rules and regulations regarding licensed and unlicensed RF transmissions. Most telecommunications devices sold in the U.S., whether they radiate intentionally or unintentionally, must comply with Part 15. However, Part 15 does not govern any device used exclusively in a vehicle, including on HSR trains.
- U.S. Department of Commerce, FCC, Office of Engineering and Technology Bulletin 65, Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields. Office of Engineering and Technology Bulletin 65 provides assistance in evaluating whether proposed or existing transmitting facilities, operations, or devices comply with limits for human exposure to RF fields adopted by the FCC (1997).
- FCC Regulations at 47 C.F.R. Part 1.1310 are based on the 1992 version of the IEEE C95.1 safety standard. Table 3.5-3 shows MPEs contained in the IEEE C95.1 and FCC standards at frequencies of 450, 900, and 5,000 MHz, which covers the range of frequencies that may be used by HSR radio systems. FCC MPEs are based on an averaging time of 30 minutes for exposure of the general public and 30 minutes for occupational exposure. As shown in Table 3.5-3, the differences between the IEEE C95.1 and FCC MPEs are minor.
- U.S. Department of Labor, OSHA, 29 C.F.R. 1910.97 Non-Ionizing Radiation. These are safety standards for occupational exposure to RF emissions in the 10 MHz to 100 GHz range. Table 3.5-3 shows MPEs contained in the OSHA standards. The OSHA safety levels do not vary with frequency and are less stringent than the equivalent ANSI/IEEE and FCC MPEs, except for occupational exposure to fields with frequencies above 5,000 MHz, where the OSHA MPE is equal to the C95.1 MPE and is two times higher than the FCC MPE is. The OSHA MPEs are based on averaging over any 6-minute time interval.

Table 3.5-3 Radio Frequency Emissions Safety Levels Expressed as Maximum Permissible Exposure

Frequency	IEEE C95.1 MPE (mW/cm^2)		FCC MPE (mW/cm^2)		OSHA MPE (mW/cm^2)
	Occupational	General Public	Occupational	General Public	Occupational
450 MHz	1.5	0.225	1.5	0.3	10
900 MHz	3.0	0.45	3.0	0.6	10
5,000 MHz	10	1.0	5.0	1.0	10

Source: OSHA, 2011

cm = centimeter(s)
FCC = Federal Communications Commission
IEEE = Institute of Electrical and Electronics Engineers
MHz = megahertz
MPE = maximum permissible exposure
mW = milliwatt(s)
OSHA = Occupational Safety and Health Administration

3.5.2.2 State

- California Department of Education, California Code of Regulations, Title 5, Section 14010(c)—Sets minimum distances for siting school facilities from the edge of power line easements: 100 feet for 50- to-133 kV lines; 150 feet for 220- to 230-kV lines; and 350 feet for 500- to 550-kV lines.
- California Public Utilities Commission Decision D.93-11-013—The California Public Utilities Commission (CPUC) decision adopted a policy regarding EMFs from regulated utilities.
- CPUC Decision D.06-01-042—This CPUC decision updates the EMF policy originally defined in D.93-11-013.
- CPUC EMF Guidelines for Electrical Facilities—These CPUC guidelines, based on D.93-11-013 and D.06-01-042, establish priorities between land use classes for EMI mitigation.

  While the CPUC decisions, general orders, and guidelines do not directly apply to the HSR project, they are listed because:

  - The project would handle potential environmental impacts of the HSR system TPSS and associated electric power substations, station switches, and high-voltage transmission lines consistent with CPUC Decision D.93-11-013 and D.06-01-042.
  - Decision D.06-01-042 reaffirms the key elements of the updated EMF policy.
- General Order No. 176. Rules for Overhead 25-kV AC Railroad Electrification Systems:
  - The purpose of these rules is to establish uniform safety requirements governing the design, construction, operation, and maintenance of 25-kV AC railroad electrification OCSs. These rules promote the safety and security of the general public and of persons engaged in the construction, maintenance, and operation of a 25-kV electrified HSR project.
  - The rulemaking is for the 25-kV Electrification System, which includes new safety rules for only the construction and operation of HSR OCSs. The traction power system, which includes all power substations and required interconnections with utilities, would be constructed per existing safety rules (General Orders) and is not part of these proceedings. This rulemaking process is not related to the relocation of utilities that enable the construction of HSR infrastructure. All this work would be performed based on bilateral agreements with utilities and in accordance with existing regulations and design criteria.

3.5.2.3 Regional and Local

Some local and regional general plans and ordinances discuss EMI- and EMF-related topics, typically as guidance or policy. The EMI and EMF guidance in these plans and ordinances generally derives from the federal and state regulations listed above.

3.5.3 Regional and Local Policy Analysis

The HSR project is an undertaking of the Authority in its capacity as a state agency and representative of a federal agency. Therefore, the project is neither subject to the jurisdiction of local governments nor is it required to be consistent with local plans. Council on Environmental Quality and Authority regulations nonetheless call for the discussion of any inconsistency or conflict of a proposed action with regional or local plans and laws. Where inconsistencies or conflicts exist, the Council on Environmental Quality and the Authority require a description of the extent of reconciliation and the reason for proceeding if full reconciliation is not feasible (Code of Federal Regulations [C.F.R.] Title 40, Part 1506.2[d], and 64 *Federal Register* 28545, 14[n][15]).[3] The CEQA Guidelines also require that an EIR discuss the inconsistencies between the proposed project and applicable general plans, specific plans, and regional plans (CEQA Guidelines § 15125[d]). Section 3.16.3, Regional and Local Policy Analysis, and Appendix 2-H, Detailed Plan Consistency Analysis, of this EIR/EIS summarize the Bakersfield to Palmdale Project Section's consistency with regional and local plans and policies.

A review of municipal code and general plan documents for the Cities of Bakersfield, Tehachapi, Lancaster, and Palmdale identified local regulations pertaining to EMI or EMF exposure. With one exception, the review found no elements that would apply to EMI/EMF impacts from the HSR project.

The only direct reference to EMFs comes from the Safety Element of the City of Palmdale General Plan. The relevant section states:

> *Policy S2.6.1: if, in the future, conclusive evidence links electro-magnetic fields (EMF) associated with electrical distribution lines electrical distribution stations, or transformers with deleterious health effects, develop standards for*

[3] The Council on Environmental Quality (CEQ) issued new regulations, effective September 14, 2020, updating the NEPA implementing procedures at 40 CFR 1500-1508. However, because this project initiated the NEPA process before September 14, 2020, it is not subject to the new regulations. The Authority is relying on the regulations as they existed prior to September 14, 2020. Therefore, all citations to CEQ regulations in this environmental document refer to the 1978 regulations, pursuant to 40 CFR 1506.13 (2020) and the preamble at 85 Fed. Reg. 43340.

> *construction, building setbacks, and/or land use restrictions for those areas impacted by hazardous EMF fields.*

This does not set specific limits or standards regarding EMF exposure but simply reserves the right to develop standards in the future. As such, the HSR project is compatible with Policy S2.6.1 of the City of Palmdale General Plan.

3.5.4 Methods for Evaluating Impacts

3.5.4.1 Study Area for Analysis

The resource study area is the area in which all environmental investigations specific to EMI/EMFs are performed to determine the resource characteristics and potential impacts of the project section.

The boundaries of the resource study area for EMI/EMFs extend beyond the project footprint. The EMI/EMF impact analysis focuses on the effects of source EMI/EMFs on sensitive receivers. Sensitive EMI/EMF receivers are adjacent railroads and rail transit systems, airports, residential dwellings, schools, hospitals, clinics, medical facilities, commercial and industrial facilities, and agricultural operations (farms). The study area includes urban and developed areas in Bakersfield, Tehachapi, Lancaster, and Palmdale, from Oswell Street in Bakersfield to the section terminus at the Palmdale Station, located at the Palmdale Transportation Center. The Bakersfield F Street Station area to Oswell Street is included in the *Fresno to Bakersfield Section Draft Supplemental EIR/EIS* and *Final Supplemental EIR* for the F-B LGA (Authority and FRA 2017; Authority 2018), which are incorporated by reference into this analysis.

The study area for direct EMI/EMF impacts on sensitive receivers is the project footprint, as described in Chapter 2, Alternatives, plus:

- Two hundred feet on both sides of the proposed HSR right-of-way centerline (a 400-foot-wide strip centered on the proposed HSR alignment) for each B-P Build Alternative
- Two hundred feet on both sides of the proposed HSR right-of-way centerline (a 400-foot-wide strip) from the transmission lines supplying the TPSS for each B-P Build Alternative

Computer modeling predicts the EMF level would decay to a level below 2 mG at 200 feet from either side of the HSR right-of-way centerline.

The study area sampled for RF interference was extended beyond 200 feet on each side of the proposed HSR right-of-way centerline as follows:

- Five hundred feet on both sides of the proposed HSR right-of-way centerline (a 1,000-foot-wide strip centered on the proposed HSR alignment) for each B-P Build Alternative

To be conservative as well as consistent with the HSR Environmental Methodology Guidelines, the 500-foot buffer on either side of the alignment was used for the resource study area in this EMI/EMF analysis. This study area has been determined based on typical screening distances as defined by the *Draft EIR/EIS Assessment of California High-Speed Train Alignment Electromagnetic Field Footprint* (Footprint Report) prepared in July 2010 (Authority 2012), Section 2.5, and project-specific features of the HSR project. Screening distances indicate whether any EMI/EMF-sensitive receivers are near enough to the proposed alignment for an EMI/EMF impact to be possible under typical conditions. If receivers are located farther than these screening distances, the Footprint Report has determined that impacts would be unlikely.

3.5.4.2 Impact Avoidance and Minimization Features

The Authority has pledged to implement programmatic IAMFs consistent with (1) the 2005 Statewide Program EIR/EIS, (2) the 2008 Bay Area to Central Valley Program EIR/EIS, and (3) the 2012 Partially Revised Final Program EIR into the HSR project. The Authority would implement these features during project design and construction, as relevant to the HSR project section, to avoid or reduce impacts.

The project design and construction would incorporate IAMFs that would avoid or minimize environmental or community impacts. Each IAMF is described below.

EMI/EMF-IAMF#1: Preventing Interference with Adjacent Railroads

Technical Memorandum 3.00.10. Implementation Stage Electromagnetic Compatibility Program Plan, requires coordination with adjacent railroads. During Project Design, the Contractor would work with the engineering departments of railroads that operate parallel to the HSR system to apply standard design practices to prevent interference with the electronic equipment operated by these railroads. Prior to Operation and Maintenance of each operating segment, the Contractor shall certify through issuance of a technical memorandum to the Authority that design provisions to prevent interference have been established and have been determined to be effective prior to the activation of potentially interfering systems of the HSR.

The contractor would work with the railroad engineering departments where these railways parallel the HSR to apply the standard design practices to prevent interference with the electronic equipment operated by these railroads. Design provisions to prevent interference would be put in place and determined to be adequately effective by a qualified electrical engineering professional prior to the HSR activation of potentially interfering systems. HSR Design Criteria Manual Chapter 26 summarizes the applicable EMI/EMF design standards that the Authority would use for the project.

EMI/EMF-IAMF#2: Controlling Electromagnetic Fields/Electromagnetic Interference

Prior to construction, the contractor would prepare an EMI/EMF technical memorandum for review and approval by the Authority. The California HSR Project shall adhere to international guidelines and comply with applicable federal and state laws and regulations. The HSR project design would follow Technical Memorandum 300.10, Implementation Stage Electromagnetic Compatibility Program Plan, the HSR Design Criteria Manual Chapter 26, which provides detailed electromagnetic compatibility (EMC) design criteria for the HSR systems and equipment, and HSR Design Criteria Manual Chapter 22, which addresses grounding requirements for third-party metallic structures, including fences and pipelines, which are parallel and adjacent to the California HSR System right-of-way. These documents describe the design practices to avoid EMI and to provide for HSR operational safety. Some measures of the ISEP include:

- During the planning stage through system design, the Authority would perform EMC/EMI safety analyses, which would include identification of existing nearby radio systems, design of systems to prevent EMI with identified neighboring uses, and incorporation of these design requirements into bid specifications used to procure radio systems.
- Pipelines and other linear metallic objects that are not sufficiently grounded through the direct contact with earth would be separately grounded in coordination with the affected owner or utility to avoid possible shock hazards. For cases where metallic fences are purposely electrified to inhibit livestock or wildlife from traversing the barrier, specific insulation design measures would be implemented.
- HSR standard corrosion protection measures would be implemented to eliminate risk of corrosion of nearby metal objects.

3.5.4.3 Method for NEPA and CEQA Impact Analysis

This section describes the sources and methods the Authority used to analyze potential impacts on EMI and EMFs from implementation of the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, the portion of the F-B LGA from the intersection of 34th Street and L Street to Oswell Street, and the LMF/MOWF/MOIS Facilities. These methods apply to both the National Environmental Policy Act (NEPA) and CEQA unless otherwise indicated. Refer to Section 3.1.3.4, Methods for Evaluating Impacts, for a description of the general framework for evaluating impacts under NEPA and CEQA.

The impact analysis included the following steps to identify representative land uses that could be affected by the EMFs resulting from HSR operations, and to predict HSR EMF levels for those land uses. The analysis used maps, surveys, photographs, and database searches to identify land uses in the Bakersfield to Palmdale Project Section that might be susceptible to the EMFs produced by an HSR system. Such uses include universities, medical institutions, high-tech businesses, and governmental facilities that use equipment that could be affected by new sources of EMFs. Baseline measurements of EMFs were made in accordance with technical guidance developed by the Authority at selected measurement locations to establish EMF levels representative of existing conditions along the Bakersfield to Palmdale Project Section (Authority 2010a). Using these targeted areas, the reconnaissance described above identified sensitive land uses. Appendix 3.5-A (*Pre-Construction Electromagnetic Measurement Survey along the Bakersfield to Palmdale Section*) describes the measurement sites and provides details of the existing EMF levels in these representative areas.

A mathematical model of the HSR traction electrical system was used to calculate the anticipated maximum 60 Hz magnetic fields that a single HSR train would produce. The model incorporates conservative assumptions for the potential EMF impacts of the HSR system. For example, the projected maximum magnetic fields would exist only for a short time and only in certain locations as the train moves along the track or changes its speed and acceleration. The magnetic field levels decline rapidly as lateral distance from the tracks increases. For most locations and most times, “exposure” to EMFs would not be as great as predicted by the model, which gives peak levels. The EMF model uses a 220-miles-per-hour speed assumption. The worst-case conditions for magnetic fields would be short term because the train current is not always at a peak level, depending on train speed and acceleration, and because currents split between two tracks, between contact wire and negative feeder, and between front and rear power stations as the train travels down the line. The model identifies how the projected maximum EMF levels vary with lateral distance from the centerline of the tracks. The Footprint Report (Authority 2012) describes the modeling methodology and discusses the modeling results for a single-train HSR system.

For the identified sensitive land uses from the field reconnaissance, maximum EMF levels emitted by the HSR system were predicted and compared to the measured, existing ambient conditions. Because magnetic fields are expected to be the dominant EMF effect from HSR operation,[4] these calculation results serve as the basis for the EMF impact analysis. Impacts were identified based on the difference between the predicted EMF levels and the existing conditions. Locations where the predicted magnetic fields are comparable to or lower than the typical levels were screened out. Where the predicted magnetic fields are higher than typical levels for exposure, then the potential for EMI is used to evaluate whether impacts could be expected.

3.5.4.4 Method for Determining Significance under CEQA

CEQA requires that an EIR identify the significant environmental impacts of a project (CEQA Guidelines § 15126). One of the primary differences between NEPA and CEQA is that CEQA requires a threshold-based analysis of the impacts (see Section 3.1.3.4, Methods for Evaluating Impacts, for further information). Accordingly, Section 3.5.9, CEQA Significance Conclusions, summarizes the significance of the environmental impacts related to EMI or EMFs for each of the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, the portion of the F-B LGA from the intersection of 34th Street and L Street to Oswell Street, and the LMF/MOWF/MOIS Facilities. The Authority is using the following thresholds to determine if a significant impact from EMI or EMFs would occur as a result of the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, the portion of the F-B LGA from the intersection of 34th Street and L Street to Oswell Street, and the LMF/MOWF/MOIS Facilities. A significant impact on the environment would occur if the HSR project exposes people to a documented EMF health risk, or if HSR operations interfere with implanted biomedical devices and unshielded sensitive equipment. For purposes of CEQA, the project would have a significant impact if it would:

[4] The HSR OCS and distribution systems primarily would have 60 Hz magnetic fields.

- Expose a person to an EMF health risk, including a field intensity over the limit of an applicable standard, an electric shock, or interference with an implanted biomedical device
- Disrupt agricultural activities near the HSR alignment
- Interfere with nearby sensitive equipment, including at hospitals, industrial and commercial facilities, railroads, rail transit systems, or airports

Human exposure and interference may be defined as follows:

- **Human Exposure**—As Table 3.5-1 shows, the MPE limit (IEEE Standard C95.6, Table 2) for 60 Hz magnetic fields for the instantaneous exposure of the general public is 9.04 G (904 μT or 9,040 mG); the MPE for controlled environments where only employees work is 27.12 G (2,712 μT). The MPE limit (IEEE Standard C95.6, Table 4) for 60 Hz electric fields for the general public is 5,000 volts per meter, or 5 kV/m (Table 3.5-2). The MPE is 20 kV/m for controlled environments in which only HSR employees would work. The IEEE Standard C95.6 was formally adopted by ANSI and is used regularly throughout the United States to analysis potential impacts related to EMF. The safety levels established by this standard are well below the levels at which scientific research has shown harmful effect may occur, thus incorporating a large safety factor (IEEE 2006). The HSR electrification and traction systems would mainly generate 60 Hz EMFs, which this standard addresses (https://www.ices-emfsafety.org/).
- **Interference**—The Footprint Report (Authority 2012) provides the typical interference levels for common types of sensitive equipment. This impact analysis uses these reported levels as the impact criteria. From the Footprint Report, 2 mG is used as a screening level for potential disturbance to unshielded sensitive equipment. The value of 2 mG also is the EMF level present at typical distances from working household appliances (Authority 2012).

3.5.5 Affected Environment

EMI can come from regional and local sources. Regional sources, such as television and radio transmissions, are present over a broad region and are captured in measurements taken at various measurement sites. Local sources are present only in measurements at the site nearest the source.

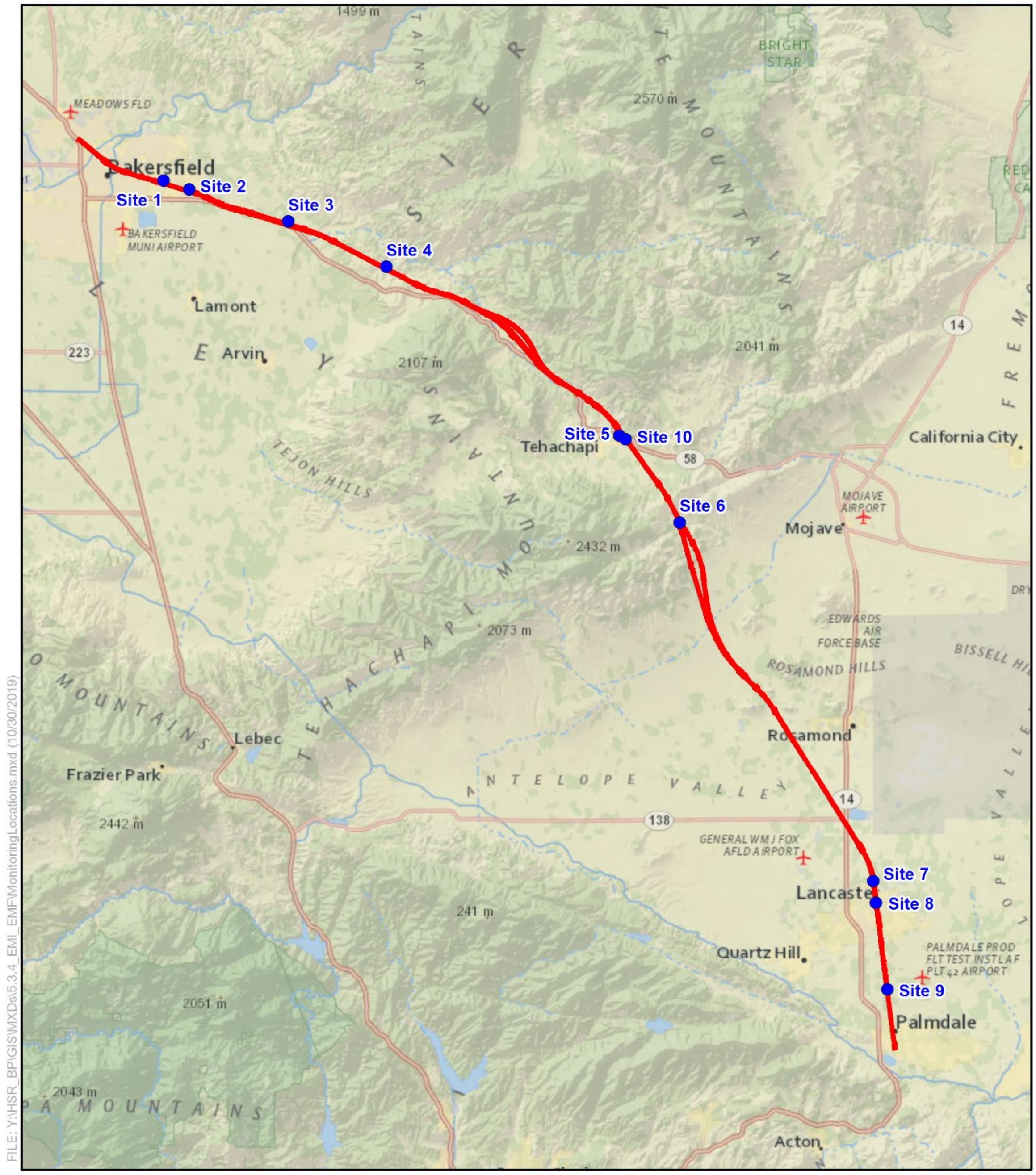
The measured regional sources along the HSR corridor included strong telecommunication transmitters that broadcast over a large area, including AM and FM radio stations and broadcast television stations. In addition, the project analysis identified a number of local sources, including land mobile base stations, police and fire transmitters, wind farm power generation, and cellular telephone antennas. Those local sources near the measurement locations that were visually identifiable were photographed (Appendix 3.5-A). Facilities that typically contain highly sensitive RF equipment were identified in the EMI study area defined in Section 3.5.4.1, Study Area for Analysis.

3.5.5.1 Fresno to Bakersfield Locally Generated Alternative from the Intersection of 34th Street and L Street to Oswell Street

The EMI/EMF affected environment for the portion of the F-B LGA alignment from the intersection of 34th Street and L Street to Oswell Street is included in Section 3.5.3 of the *Fresno to Bakersfield Section Final Supplemental EIR* (Authority 2018). However, the affected environment discussions included in Sections 3.5.5.2 through 3.5.5.4 below also reflect this portion of the F-B LGA alignment between the intersection of 34th Street and L Street to Oswell Street.

3.5.5.2 Local Conditions

Figure 3.5-1 shows the field measurement site locations. Magnetic fields were measured from 0 Hz (DC) to 1,000 Hz. The measurement site locations selected are representative of each B-P Build Alternative under consideration because no substantive change in rural or urban land use occurs between alternatives near the measurement sites. Rural and urban EMI and EMF study areas have the following differences:



SOURCE: National Geographic (2013); CHSRA (4/2016, 8/2018, 10/2019); CARB (2018)

October 30, 2019

N

HSR Alignments under Consideration

Measurement Locations

0 5 10
Miles

0 8 16
Kilometers

Figure 3.5-1 EMI/EMF Measurement Site Locations

- The rural EMI/EMF study areas typically have only a few sparsely distributed residences. These areas may have underground pipelines, underground cables, and fencing associated with agricultural operations, including irrigation systems.
- The urban EMI/EMF study areas include more densely spaced residential housing, high-voltage overhead power lines, industrial parks that include laboratories that operate sensitive medical devices, and associated urban infrastructure.

The field survey also involved measurements of radiated electric field strengths (RF levels) from 10 kHz to 6 gigahertz. This frequency range encompasses many different applications, including broadcast radio and digital television signals, communications, cellular telephones, and radar and navigation systems. In general, the highest RF electric field levels, especially at the broadcast frequencies, occur in the Bakersfield, Lancaster, and Palmdale urban areas. The survey also quantified typical power-frequency magnetic field levels along the project section to characterize typical DC and extremely low frequency (up to 1,000 Hz) sources such as high-voltage transmission lines, electrical distribution lines, and electrical substations or generating equipment. The maximum or peak 60 Hz magnetic fields recorded in this survey ranged from 0.5 mG to 14.3 mG, depending primarily on the measurement locations' proximity to local distribution and transmission power lines.

Table 3.5-4 provides a comparison by listing of the measured and calculated 60 Hz magnetic fields at the distances of each of the nine sites from the centerline of the proposed HSR right-of-way. The calculated magnetic fields include those for a single HSR train passing, as modeled in the Footprint Report (Authority 2012). The calculated fields take into consideration the magnetic fields from the return currents flowing in the running rails, and the negative feeder partially cancelling the magnetic fields from the supply current flowing in the messenger wire and the contact.

Table 3.5-4 Comparison of Measured and Project Calculated 60-Hertz Magnetic Fields

Measurement Location	Distance from Right-of-Way Centerline (feet)[1]	Existing Measured AC Magnetic Field Level[2] (mG)	Project Modeled 60 Hz Field at Measurement Location (Single Train) (mG)[3,4]
1. Oswell St and Laguna Seca Way, Bakersfield	140	6.29	3.20
2. Mills Dr, Southern California Edison Substation, Bakersfield	580	10.93	0.19
3. Towerline Rd, Edison	130	13.31	3.70
4. Bena Rd, Ilmon	50	1.24	25.00
5. Alan Ave and Lois St, Tehachapi	1,000	0.55	0.06
6. Tehachapi Willow Springs Rd, near Oak Creek Ln, Tehachapi	35	14.30	51.00
7. Ave H and Sierra Hwy, Lancaster	200	0.94	1.60
8. Lancaster Blvd and Sierra Hwy, Lancaster	100	1.96	6.20
9. Ave O and Sierra Hwy, Palmdale	40	0.46	39.00
10. Anatase Products	50[5]	0.55	53

Source: California High-Speed Rail Authority, 2012

[1] Approximate distance of measurement location from centerline of right-of-way.

[2] Maximum measured AC magnetic field of two sensors approximately 40 feet apart at each site.

[3] Calculated magnetic fields for single-train HSR passing the measurement location.

[4] Estimated from Figure E-1b of *Draft Environmental Impact Report/Environmental Impact Statement Assessment of California High-Speed Train Alignment Electromagnetic Field Footprint* (California High-Speed Rail Authority 2012)

[5] Vertical distance from building to track electrical conductor directly above. The HSR alignment would traverses the Anatase Products parcel on a viaduct directly above the property. The California High-Speed Rail Authority would acquire this parcel, which would require relocation of the Anatase Products facility. Once relocated, Anatase Products would not be affected by magnetic fields generated by the HSR alignment.

AC = alternating current Hz = hertz mG = milligauss

3.5.5.3 Receivers Susceptible to Electromagnetic Interference/Electromagnetic Fields/Radio Frequency Interference Effects

The considered alignments include urban and developed areas, particularly in the Cities of Bakersfield and Lancaster. Sensitive human receptors, such as hospitals, medical centers, schools, and colleges, are concentrated in urban areas. In some cases, these locations may be associated with the use, assembly, calibration, or testing of sensitive and unshielded RF equipment. For unshielded equipment that is sensitive to magnetic field strengths in the range of 1 to 3 mG (e.g., magnetic resonance imaging [MRI] systems), interference is possible at distances of up to approximately 200 feet from the centerline of the HSR right-of-way. For the most-sensitive electron-beam microscopes, which are sensitive to magnetic field strengths in the range of 0.1 to 0.3 mG, interference would be possible to approximately 700 feet from the centerline of the HSR right-of-way. From a practical standpoint, local 60 Hz magnetic field sources would be dominant well before this distance, as evidenced by the range of median magnetic field levels measured along the alignment during the baseline survey (the median 60 Hz AC magnetic field levels ranged from 0.02 to 12.4 mG).

A review of land uses along the alignment identified a total of seven potentially sensitive receptors within the 500-foot screening distance of the proposed HSR alignments. These potentially sensitive facilities, along with the closest distance to the alignment centerline, were:

1. Edison Middle School, 721 Edison Road, Bakersfield (460 feet)
2. Antelope Valley Enrichment Services, 506 W Jackman Street, Lancaster (320 feet)
3. Lancaster Sheriff Station, 501 W Lancaster Boulevard, Lancaster (375 feet)
4. Family Urgent Care, 412 W Avenue J, Lancaster (150 feet)
5. University of Antelope Valley, 44055 Sierra Highway, Lancaster (330 feet)
6. North Valley Veterinary Clinic, 43619 Sierra Highway, Lancaster (190 feet)
7. Charter College, 43141 Business Center Parkway, Lancaster (490 feet)

The Adventist Health Bakersfield Medical Center Campus is approximately 560 feet from the portion of the F-B LGA from the intersection of 34th Street and L Street to Oswell Street. The nearest building on the Adventist Health Bakersfield Medical Center Campus with equipment sensitive to EMI/EMFs is the Quest Imaging building at 2700 Chester Avenue, approximately 820 feet from the portion of the F-B LGA alignment from the intersection of 34th Street and L Street to Oswell Street.

The various alternative track alignments pass within 500 feet of three schools. The closest of these is the University of Antelope Valley (Lancaster), which at its closest point is 330 feet from the alignment centerlines. Only one medical facility fell within the screening distance (Family Urgent Care in Lancaster).

Radio communications systems (e.g., wireless local area networks and internet connections) are assumed to be in use at all of these facilities. FCC spectrum frequency allocations allow Wi-Fi systems to operate in their frequency blocks at 2.4, 3.6, and 4.9/5.0 gigahertz; each is divided into channels to allow multiple systems to operate without interfering with each other. Wireless networks used by schools and colleges operate at relatively low power levels and have a limited range of 100 to 300 feet (FCC 2015); therefore, EMI with distant uses is generally not a concern.

All other potentially sensitive sites identified (e.g., Antelope Valley Hospital, the Lockheed Martin facilities in Palmdale) were well outside of the 500-foot screening distance.

In the Bakersfield to Palmdale Project Section, the HSR alignment passes through a wind turbine farm south of Tehachapi. The alternative alignments at the wind farm are mostly in tunnels, but there are portions that are at grade and elevated on a viaduct. The wind farm consists of multiple towers, each with a large three-blade turbine, an electric generator, associated controls, power electronics, and a step-up transformer. Medium-voltage circuits form the collector system, running from each wind turbine back to a substation. The collector substation increases the voltage again and serves as the interface to the AC transmission system.

3.5.5.4 Railroad/Transportation Equipment Susceptible to Electromagnetic Interference/Electromagnetic Fields/Radio-Frequency Interference Effects from Airports, Military, or Other Commercial Transmitters along the High-Speed Rail Right-of-Way

The analysis did not identify any ground-based aviation, military, or commercial emitters (e.g., air traffic control radars or broadcast stations) that would present potential EMI/EMF/RF interference problems for the HSR system or supporting infrastructure.

Along the Bakersfield to Palmdale Project Section, portions of the HSR alignment pass through areas that are routinely overflown by military aircraft operating out of Edwards Air Force Base, as well as other nearby military training and testing facilities. These facilities conduct flight activities in controlled and restricted airspace. The activities encompass a wide range of operations, including low-altitude flight, training, and test activities (including those employing electronic countermeasures).

One facility of note is U.S. Air Force Plant 42 at Palmdale Regional Airport. This is a government-owned, contractor-operated Air Force facility that is host to a number of private contractors. There are a number of RF emitters associated with this facility and the airport, including radars, very high frequency Omni-Directional Radio Range and Non-Directional Beacon Navaids, National Radar Cross-Section Test Facilities, and aircraft communications.

3.5.6 Environmental Consequences

This section describes the environmental consequences of EMI/EMFs for the proposed B-P Build Alternatives. This section lists the magnetic field levels used to evaluate whether an impact would occur and discusses measures to reduce impacts.

3.5.6.1 Overview

This section evaluates how the No Project Alternative and the B-P Build Alternatives could affect EMI/EMF levels. The impacts of the B-P Build Alternatives are described and organized as follows:

- **Construction Impacts**
  - Impact EMI/EMF #1: Impacts During Construction
- **Operations Impacts**
  - Impact EMI/EMF #2: General Human Exposure to Electromagnetic Fields
  - Impact EMI/EMF #3: People with Implanted Medical Devices and Exposure to Electromagnetic Fields
  - Impact EMI/EMF #4: Livestock and Poultry Exposure
  - Impact EMI/EMF #5: Effects on Sensitive Equipment from Electromagnetic Interference
  - Impact EMI/EMF #6: Electromagnetic Interference Effects on Schools
  - Impact EMI/EMF #7: Potential Corrosion of Underground Pipelines and Cables and Adjoining Rail
  - Impact EMI/EMF #8: Potential for Nuisance Shocks
  - Impact EMI/EMF #9: Effects on Adjacent Existing Rail Lines
  - Impact EMI/EMF #10: Wind Farm Electromagnetic Interference Effects
  - Impact EMI/EMF #11: Electromagnetic Interference Concerns Related to Edwards Air Force Base Flight Operations

The B-P Build Alternatives alignments are located between the Cities of Bakersfield and Palmdale, which include rural areas in unincorporated Kern and Los Angeles Counties, as well as urban areas in Bakersfield, Tehachapi, Lancaster, and Palmdale. Electrical and RF communication equipment, including high-voltage electric power lines and directional and nondirectional (cellular and broadcast) antennas that emit EMI and EMFs exist within these areas. The B-P Build Alternatives could potentially result in exposure of populations and facilities close to the HSR system to increased levels of EMI and EMFs, although impacts would be minimized through project design.

3.5.6.2 No Project Alternative

As discussed in Chapter 1, Project Purpose, Need, and Objectives, and Section 3.18, Regional Growth, the population in the project vicinity is growing, and this growth is projected to continue. Section 3.19, Cumulative Impacts, provides foreseeable future projects, which include shopping centers, industrial parks, transportation projects, and residential developments. These development and transportation infrastructure projects are planned or approved to accommodate the growth projections in the area. The use of electricity and RF communication equipment, including high-voltage power lines and directional and nondirectional (cellular and broadcast) antennas that result in EMFs and resulting EMI occurs and would continue to occur along the Bakersfield to Palmdale Project Section. Under the No Project Alternative, future conditions would likely result in additional use of electricity and RF communications, consistent with that found in the urban and rural environments in the study area today. It is reasonable to assume that by 2040, the use of electricity and RF communications would increase because of increased development, greater use of electrical devices, and technological advances in wireless transmission (such as wireless data communication). As a result, generation of EMI and EMFs that might affect people and sensitive receptors would continue in the area.

3.5.6.3 Fresno to Bakersfield Locally Generated Alternative from the Intersection of 34th Street and L Street to Oswell Street

The EMI/EMF impacts for the portion of the F-B LGA alignment from the intersection of 34th Street and L Street to Oswell Street are addressed in Section 3.5.4 of the *Fresno to Bakersfield Section Final Supplemental EIR* (Authority 2018). There are no EMI/EMF sensitive receptors along the portion of the F-B LGA alignment from the intersection of 34th Street and L Street to Oswell Street. Two schools are within 500 feet of the portion of the F-B LGA from the intersection of 34th Street and L Street to Oswell Street; however, because the HSR radio system would use dedicated frequency blocks and all HSR equipment would meet the regulations for EMI, this portion of the project would not generate EMI impacts on the two schools. This portion of the alignment is not included in the qualitative EMI/EMF analysis below. No adverse impacts were identified for the portion of the F-B LGA alignment from the intersection of 34th Street and L Street to Oswell Street.

3.5.6.4 Bakersfield to Palmdale Project Section Build Alternatives

The populations and facilities close to the HSR system that could experience effects from exposure to HSR-related EMI and EMFs include medical laboratories, research and technology parks, dense housing developments, schools and colleges, employees, underground pipelines and cables, fences, and existing railroads. The impacts of the HSR project related to EMI/EMFs are similar for all of the B-P Build Alternatives (including the CCNM Design Option), stations, maintenance facilities, TPSSs, and electrical upgrades (if necessary). Therefore, for the purposes of this analysis, the impacts would be the same for each B-P Build Alternative.

This section evaluates direct and indirect impacts associated with EMI/EMFs that would result from construction and operation of the Bakersfield to Palmdale Project Section. For CEQA, the analysis assesses impacts after consideration of the IAMFs identified in Section 3.5.4.2, but before consideration of the project mitigation measures identified in Section 3.5.7. For NEPA, impacts are assessed after consideration of both the IAMFs and mitigation measures.

Construction Impacts

Impact EMI/EMF #1—Impacts During Construction

Construction of the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, the LMF/MOWF/MOIS Facilities, and electrical upgrades (if necessary) would require use of heavy equipment, trucks, and light vehicles, which, like all motor vehicles, generate EMFs. Additionally, many types of construction equipment contain electric motors that also generate EMFs. Movement of large construction vehicles could result in transient changes to the static (DC) magnetic field. While such changes could interfere with some equipment, construction vehicles must be both very large and operate very closely to the equipment in question to cause interference. As an example, articulated buses (approximately 50,000 pounds) produce magnetic field shifts of approximately 0.5 mG at a distance of 70 feet (Electric Research & Management 2007). For a construction vehicle with twice the mass of an articulated bus, the magnetic field shift would be 1 mG at 70 feet or 2 mG at 50 feet. Because the magnitude of this disturbance would decrease with distance, construction vehicles would pose no reasonable interference risk to magnetically sensitive equipment at pass-by distances greater than 50 feet because any magnetic shift at this distance would be below 2 mG. As described in Section 3.5.4.3, the Footprint Report (Authority 2012) uses 2 mG as a screening level for potential disturbance to unshielded sensitive equipment. In general, all receptors that would be likely to operate sensitive equipment subject to potential interference by large construction equipment would be located more than 50 feet from receptors. An exception would occur at Anatase Products (see Table 3.5-6 in the Operations Impacts section below); however, this property would be acquired by the Authority, and Anatase Products would be relocated to a new area where HSR-generated EMFs would not affect this facility's operation. Project design would include EMI/EMF-IAMF#2. Implementation of this IAMF would avoid or minimize effects related to EMI during construction.

Construction crews would also use communication equipment that would generate RF fields, such as mobile telephones and radios. Communications equipment would include off-the-shelf products that comply with FCC regulations designed to prevent EMI with other equipment or hazards to people. The EMFs generated during project construction would be similar in strength to the EMFs produced at nonproject construction sites and, with compliance with FCC regulations, would be unlikely to cause EMI with nearby land uses or hazards to workers.

EMI could be generated during construction from occasional licensed radio transmissions between construction vehicles. This is not considerably different from the number of radio transmissions that occur under existing conditions. As indicated in Section 3.5.2.1, the HSR project would adhere to 47 C.F.R. Part 15 and its general provision that devices may not cause interference, must accept interference from other sources, and must prohibit the operation of devices once the operator is notified by the FCC that the device is causing interference. Adherence to these provisions would control the generation of EMI from communication equipment during construction activities.

As discussed further under Impact EMI/EMF #5 with respect to project operation, sensitive equipment could potentially be disrupted by HSR-generated EMFs. Any impacts would be addressed through Mitigation Measure EMI/EMF-MM#2 (described in more detail in Section 3.5.7), which would include any additional necessary suitable design provisions to prevent EMI.

CEQA Conclusion

Even with implementation of EMI/EMF-IAMF#2, as described above, sensitive equipment that could potentially be disrupted by construction activities associated with the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, and the LMF/MOWF/MOIS Facilities would not be reduced; therefore, this impact is considered significant under CEQA, and CEQA requires mitigation. Mitigation Measure EMI/EMF-MM#1 would be needed and is described in more detail in Section 3.5.7. EMI/EMF-MM#1 would require the Authority to contact relevant entities regarding the potential impacts of both HSR–related EMF RF and low-frequency EMI on imaging equipment prior to completion of final design, and requires that the final design include suitable design provisions to prevent interference. With the implementation of EMI/EMF-MM#1, the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, and the

LMF/MOWF/MOIS Facilities would not interfere with nearby sensitive equipment, including at hospitals, industrial and commercial facilities, railroads, rail transit systems, or airports. Therefore, impacts from EMI with sensitive equipment during construction of the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, and the LMF/MOWF/MOIS Facilities and electrical upgrades (if necessary) would be less than significant under CEQA.

Operations Impacts

The operation of any of the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, and the LMF/MOWF/MOIS Facilities would result in some additional exposure to EMFs. IAMFs would avoid or minimize the environmental or community impacts. The following section discusses different types of potential EMI/EMF effects associated with project operations.

Impact EMI/EMF #2—General Human Exposure to Electromagnetic Fields

Operation of the HSR system would generate 60 Hz electric and magnetic fields on and adjacent to trains, including in passenger station areas. Table 3.5-5 presents the HSR project model results that apply to the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, and the LMF/MOWF/MOIS Facilities.

Table 3.5-5 Summary of High-Speed Rail EMF Modeling Results

EMF Analysis	Platform: 16 Feet from HSR Alignment Centerline	Fence Line: 30 Feet from HSR Alignment Centerline	350 Feet from HSR Alignment Centerline
Magnetic Field (mG) Single-Train HSR	720	177	Less than 1

Source: California High-Speed Rail Authority, 2020
EMF = electromagnetic field HSR = high-speed rail
mG = milligauss

Magnetic field measurements have been made in the passenger compartments onboard other HSR systems such as the Acela Express (119 mG) and the French *Train à Grande Vitesse* (TGV) A (165 mG), as well as in the operator's cab of the Acela Express (58 mG) and the French TGV A (367 mG) (FRA 2006). The HSR system would employ a 2x25-kV supply that includes a negative feeder wire running parallel to the contact wire. This arrangement differs in some cases from those employed by the Acela Express and TGV systems, and in general would be expected to produce magnetic fields equal to or lower than the quoted values. For example, the Acela Express' electrified Northeast Corridor is not strictly 2x25 kV; some sections are 1x12.5 kV or 11.5 kV. Magnetic fields in these sections without the negative return feeder would be higher than in the sections with the typical 2x25-kV traction system arrangement. The modeled levels of EMF generation in Table 3.5-5 are very close to the measured existing conditions provided in Table 3.5-4, and measurements on other existing HSR systems are below the MPE limits of 5 kV/m and 9,040 mG for the public.

The HSR EMF analyses indicate that the EMFs generated at the light maintenance facility would be less than along the mainline because HSR trains would operate at much lower speeds and would have much lower acceleration rates at the light maintenance facility, whether entering or exiting the site, or during maintenance and testing. When the trains operate at low speeds and have low acceleration rates, they draw much less current through the OCS and thus produce correspondingly lower magnetic fields. EMFs generated by establishing electric connections to existing substation and the new TPSSs, switching stations, and paralleling stations are not anticipated to be more than what would be generated from HSR operations. As such, exposure of people to EMFs generated by the connection of such features would be nominal and below the human exposure threshold limits.

EMF impacts on people at nearby schools[5], hospitals, businesses, colleges, and residences would be below the IEEE Standard C95.6 (IEEE 2002) MPE limit of 9,040 mG for the public because even within the mainline right-of-way, HSR operation would not reach these levels.

CEQA Conclusion

The modeled levels of EMF exposure are below the MPE limits of 5 kV/m and 9,040 mG for the public; therefore, the health risk impact associated with the operation of the HSR system would be less than significant under CEQA. CEQA does not require mitigation.

Impact EMI/EMF #3—People with Implanted Medical Devices and Exposure to Electromagnetic Fields

Magnetic fields of 1,000 to 12,000 mG (1 to 12 G) may interfere with implanted medical devices (Electric Power Research Institute 2004). The ACGIH has recommended magnetic and electric field exposure limits of 1,000 mG and 1 kV/m, respectively, for people with pacemakers (ACGIH 1996). These levels would occur only inside traction power facilities, which are unmanned and inaccessible to the general public.

The Bakersfield to Palmdale Project Section would have emergency standby generators at passenger stations and at the TPSS facilities. EMFs would occur due to electrical devices, such as transformers and distribution bus lines common to an electrical substation. EMFs would occur primarily within the immediate, secure work area, except where power lines enter and exit the facility, and would rapidly decrease with distance from the source located within the study area.

EMF levels above the recommended limits for employees with implanted medical devices could exist inside traction power facilities and emergency power generator rooms. Traction power facilities and emergency power generator room sites would be unmanned, and workers would enter them only periodically (e.g., to perform routine maintenance). Project design would include EMI/EMF-IAMF#2. Implementation of this IAMF would avoid or minimize effects related to people with implanted medical devices. This IAMF would reduce potential impacts resulting from exposure to EMFs.

CEQA Conclusion

With implementation of EMI/EMF-IAMF#1, as described above, during operation of the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, and the LMF/MOWF/MOIS Facilities, the health risk impact to people with implanted medical devices and exposure to EMFs would be less than significant under CEQA. Therefore, CEQA does not require mitigation.

Impact EMI/EMF #4—Livestock and Poultry Exposure

With regard to dairy production, McGill University conducted a study (2006) that exposed cows in pens to controlled EMF levels of 300 mG and 10 kV/m, the projected magnetic and electric fields that occur at ground level under a 735-kV line at full load. The researchers measured the following: melatonin levels, prolactin levels, milk production, milk-fat content, dry-matter intake by cows, and reproductive outcomes. While the study found a few statistically significant changes in these factors, none of the changes was outside the normal range for cows (Exponent 2014). The study concluded that the EMF exposure did not harm the cows or reduce milk productivity. Various studies that other researchers cite regarding EMFs and wildlife suggest a range of effects similar to livestock, from nonexistent to relatively small to positive. One study suggests a beneficial application for extremely low frequency EMFs in broiler chickens to fight a common parasitic infection called coccidiosis (Golder Associates 2009).

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[5] The California Department of Education, per the California Public Utility Commission's Decision 06-01-042, uses setback criteria in the siting of schools near aboveground and belowground power lines that generate EMFs. The guidelines indicate that schools must be set back 100 feet for 50- to 133-kV overhead power lines; 150 feet for 220- to 230-kV overhead power lines; 350 feet for 500- to 550-kV overhead power lines; 25 feet for 30- to 133-kV underground power lines; 37.5 feet for 220- to 230-kV underground power lines; and, 87.5 feet for 500- to 550-kV underground power lines.

CEQA Conclusion

Based on the studies described above, the impact to livestock and poultry from EMF exposure would be less than significant under CEQA. Therefore, CEQA does not require mitigation.

Impact EMI/EMF #5—Effects on Sensitive Equipment from Electromagnetic Interference

As Table 3.5-6 shows, three medical facilities were identified in the 500-foot resource study area as potentially sensitive sites. These are labeled as numbered sites 2, 4, and 6. As indicated above, 2 mG is used as a screening level for potential disturbance to unshielded sensitive equipment. This condition is anticipated at Family Urgent Care, North Valley Veterinary Clinic, and Anatase Products. The HSR alignment would traverse the Anatase Products property on a viaduct over the parcel, and it is anticipated that this property would be acquired and Anatase Products would be relocated. Therefore, the Family Urgent Care facility (Site 4) is the only receptor that would be sensitive to HSR-generated EMFs.

Table 3.5-6 Potentially Sensitive Facilities

Site		Location	Distance to Right-of-Way Centerline (feet)[1]	Estimated Ambient 60 Hz Field Strength, (mG)[2]	Modeled 60 Hz Field at Measurement Location (Single Train) (mG)[3,4]
1	Edison Middle School	721 Edison Rd, Bakersfield	460	0.68	0.30
2	Antelope Valley Enrichment Services	506 W. Jackman St, Lancaster	320	0.86	0.61
3	Los Angeles County Sheriff Lancaster Station[5]	501 W Lancaster Blvd, Lancaster	375	0.86	0.44
4	Family Urgent Care	412 W Ave J, Lancaster	150	0.86	2.80
5	University of Antelope Valley	44055 Sierra Hwy, Lancaster	330	0.56	0.57
6	North Valley Veterinary Clinic	43619 Sierra Hwy, Lancaster	190	0.56	1.70
7	Charter College	43141 Business Center Pkwy, Lancaster	490	0.56	0.26
8	Anatase Products	1314 Goodrick Dr, Tehachapi	50[6]	0.55	53.00

Source: California High-Speed Rail Authority, 2019

[1] Approximate distance of the facility from the centerline of right-of-way.

[2] Median measured AC magnetic field of two sensors, taken from the closest measurement site.

[3] Calculated magnetic fields for single-train HSR passing the facility location.

[4] Estimated from Figure E-1b of *Draft Environmental Impact Report/Environmental Impact Statement Assessment of California High-Speed Train Alignment Electromagnetic Field Footprint* (California High-Speed Rail Authority, 2012)

[5] The Los Angeles County Sheriff Lancaster Station property would be acquired by the California High-Speed Rail Authority under Alternative 5. Vertical distance from building to track electrical conductor directly above. The HSR alignment would traverse the Anatase Products parcel on a viaduct directly above the property. The California High-Speed Rail Authority would acquire this parcel, which would require relocation of the Anatase Products facility. Once relocated, Anatase Products would not be affected by electromagnetic fields generated by the HSR alignment.

[6] Vertical distance from building to track electrical conductor directly above. The HSR alignment would traverse the Anatase Products parcel on a viaduct directly above the property. The California High-Speed Rail Authority would acquire this parcel, which would require relocation of the Anatase Products facility.

AC = alternating current mG = milligauss

Hz = hertz

However, none of these facilities operate magnetically sensitive imaging equipment (MRI or e-beam CT scanners), but provide X-ray and lab work services only (which are not sensitive to magnetic fields). The baseline survey, EMF measurements, and evaluation of adjacent uses revealed no sensitive sites requiring mitigation. Project design would include EMI/EMF-IAMF#2. Implementation of this IAMF would avoid or minimize effects related to EMI with sensitive equipment. This IAMF would reduce potential impacts resulting from EMI.

The Quest Imaging Building is the closest facility containing sensitive equipment and is located approximately 820 feet from the portion of the F-B LGA alignment from the intersection of 34th Street and L Street to Oswell Street. As this facility is outside of the EMI/EMF/RF interference study area, the equipment in this facility is not anticipated to be affected.

Any remaining impacts, after implementation of EMI/EMF-IAMF#2, would be addressed through Mitigation Measure EMI/EMF-MM#1 (described in more detail in Section 3.5.7), which would include any additional necessary suitable design provisions to prevent interference.

None of the design refinements would result in changes in EMI/EMF emissions that would affect the identified sensitive facilities.

CEQA Conclusion

Although no sensitive sites were identified, EMI/EMF-IAMF#2, as described above, would address interference with any sensitive equipment during operation of the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, and the LMF/MOWF/MOIS Facilities. Even with the IAMF, a significant impact may occur under CEQA if sensitive equipment that could potentially be disrupted by HSR EMFs is identified. Therefore, CEQA requires mitigation. Mitigation Measure EMI/EMF-MM#1 would be needed and is described in more detail in Section EMI/EMF-MM#1 would require the Authority to contact relevant entities regarding potential impacts of both HSR-related EMF RF and low-frequency EMI on imaging equipment prior to completion of final design, and requires that the final design include suitable design provisions to prevent interference. With the implementation of EMI/EMF-MM#1, impacts from EMI with sensitive equipment during operation of the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, and the LMF/MOWF/MOIS Facilities would be less than significant under CEQA.

Impact EMI/EMF #6—Electromagnetic Interference Effects on Schools

The analysis identified seven schools within the 500-foot study area of the B-P Project Section. The HSR system would use radio systems for the enhanced automatic train control, data transfer, and communications systems, raising the concern that HSR operations would result in EMI with the radio systems in use at nearby schools and colleges. HSR radio systems would transmit radio signals from antennas located at stations and along the track alignment, and on locomotives and train cars. In 2016, the Authority acquired exclusive rights to the radio spectrum needed to operate future communications systems for its trains. The Authority would utilize 44 frequencies for the development of secure and reliable train communication systems. The radio spectrum is a 700 MHz A Block spectrum with a clear signal. It would not be susceptible to interference and would not be shared with other users. As only authorized parties will have access to these frequencies, they are ideal for secure communication among trains, Authority facilities, and public safety agencies. Since the block spectrum would be dedicated for HSR use, EMI with other users would be unlikely. Communications systems at stations may operate at Wi- Fi frequencies to connect to stationary trains; channels would be selected to avoid EMI with other users, including Wi-Fi systems in use at nearby schools (Authority 2011b, 2011c). Project design would include EMI/EMF-IAMF#2. Implementation of this IAMF would avoid or minimize effects related to EMI effects on schools. This IAMF would reduce potential impacts resulting from EMI.

Additionally, the Authority would implement an Electromagnetic Compatibility Program Plan (EMCPP) during project planning and implementation to ensure EMC with radio systems operated by neighboring uses, including schools and colleges. The EMCPP would comply with applicable regulatory requirements, including EMC requirements in 49 C.F.R. 200–299 for HSR systems and sections (Authority 2010b). During the planning stage through system design, the Authority would perform EMC/EMI safety analyses, which would include identification of existing nearby radio systems, design of systems to prevent EMI with identified neighboring uses, and incorporation of these design requirements into bid specifications used to procure radio systems. The implementation stage would include monitoring and evaluation of system performance. Most radio systems procured for HSR use would be commercial off-the-shelf systems conforming to the FCC regulations at 47 C.F.R. Part 15, which contain emissions requirements designed to ensure EMC among users and systems. The Authority would require all noncommercial off-the-shelf systems procured for HSR use to be certified in conformity with the FCC regulations for Part 15, Sub-Part B, Class A devices. HSR radio systems would additionally meet emissions and immunity requirements designed to ensure EMC with other radio users that are contained in the European Committee for Electrotechnical Standardization EN 50121-4 Standard for railway signaling and telecommunications operations (Committee for Electrotechnical Standardization 2006).

None of the design refinements would result in changes in EMI/EMF emissions that would affect schools.

CEQA Conclusion

With implementation of EMI/EMF-IAMF#2, as described above, and because during operation, the HSR radio system would use dedicated frequency blocks and all HSR equipment would meet FCC regulations (47 C.F.R. Part 15) for EMI, the impact of EMI on schools would be less than significant under CEQA. Therefore, CEQA does not require mitigation

Impact EMI/EMF #7—Potential for Corrosion of Underground Pipelines and Cables and Adjoining Rail

TPSSs located every 30 miles would deliver AC current to the HSR trains through the OCS, with return current flowing from the trains back to the TPSSs through the steel rails and static wires. At paralleling stations, which would be positioned approximately every 5 miles along the right-of-way and at regularly spaced bonding locations, some of the return current to the TPSSs would transfer from the rails to the static wires. The HSR rails and the static wire would carry most return current back to the TPSSs, but some return current would find a path through rail connections to the ground and through leakage into the ground from the rails via the track ballast.

Soils in the project vicinity tend to be sandy and dry (except where irrigated), so they have higher electrical resistivity and lower ability to carry electrical current than soils with more clay and moisture content (Section 3.9, Geology, Soils, Seismicity, and Paleontological Resources). Nevertheless, other linear metallic objects such as buried pipelines or cables, or adjoining rails, could carry some AC ground current. AC ground currents have a much lower propensity to cause corrosion in parallel conductors than the DC currents that rail transit lines such as Bay Area Rapid Transit or the Los Angeles County Metropolitan Transportation Authority use. Nonetheless, such stray AC currents might cause corrosion by galvanic action (an action when two electrochemically dissimilar metals are in contact and a conductive path occurs for electrons and ions to move from one metal to the other). Project design would include EMI/EMF-IAMF#2. Implementation of this IAMF would avoid or minimize impacts to underground pipelines and cables and adjoining rail. This IAMF would reduce potential impacts resulting from potential corrosion.

Establishing connections to existing substations and the new TPSSs, switching stations, and paralleling stations may require the upgrade of the substations, the upgrade of existing transmission lines, or the construction of new overhead lines. New facilities and upgrades to existing facilities have the potential to induce stray current corrosion to buried pipelines in the vicinity. The details of the specific equipment and location of these additional utility actions have not been designed. When electrification of the system is engineered, Pacific Gas and Electric Company would assess the need to alter the existing transmission lines. Implementation of EMI/EMF-IAMF#2 would avoid or minimize impacts to underground pipelines and cables that may be affected by stray current corrosion.

If necessary, the HSR project would avoid the potential for corrosion from ground currents through installation of supplemental grounding or insulation of sections in continuous metallic objects in accordance with standard HSR designs.

CEQA Conclusion
With implementation of EMI/EMF-IAMF#2, as described above, during operation of the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, and the LMF/MOWF/MOIS Facilities, the potential impact for corrosion of underground pipelines and cables from ground currents would be less than significant under CEQA. Therefore, CEQA does not require mitigation.

Impact EMI/EMF #8—Potential for Nuisance Shocks

EMFs from the voltage on and currents running through the OCS have the potential to induce voltage and current in nearby conductors such as ungrounded metal fences and ungrounded metal irrigation systems alongside the HSR alignment. This effect would be more likely where long (1 mile or more), ungrounded fences or irrigation systems run parallel to the HSR and are electrically continuous throughout that distance. Such voltages could potentially cause a nuisance shock to anyone who touches such a fence or irrigation system. A center pivot system on rubber tires is an example of an ungrounded metal irrigation system that is potentially subject to induced current. By contrast, the Vermeer-type metal irrigation system is grounded by its metal wheels and therefore offers less shock hazard, because any surface pipe metal irrigation system is grounded through its contact with the ground. Long, ungrounded fences and metal irrigation systems are more common in rural areas than urban areas. Adjacent metal structures are much shorter in length compared to long fences and should already be properly grounded using National Electrical Code guidelines at Article 250 for building and electrical system safety and lightning protections. Project design would include EMI/EMF-IAMF#2 and would implement this IAMF to avoid or minimize impacts to nuisance shocks. This IAMF would reduce potential impacts resulting from potential nuisance shocks.

CEQA Conclusion
With implementation of EMI/EMF-IAMF#2, as described above, during operation of the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, and the LMF/MOWF/MOIS Facilities, the potential impact from nuisance shocks would be less than significant under CEQA. Therefore, CEQA does not require mitigation.

Impact EMI/EMF #9—Effects on Adjacent Existing Rail Lines

Signal systems control the movement of trains on the existing Union Pacific Railroad tracks, including those sections that run parallel to the HSR track alignment. These signal systems serve three general purposes:

- To warn drivers of street vehicles that a train is approaching. The rail signal system turns on flashing lights and warning bells; some crossings lower barricades to stop traffic.
- To warn train engineers of other train activity on the same track a short distance ahead, and advise the engineer that the train should either slow or stop. This is done by using changing, colored (green, yellow, or red) trackside signals.
- To show railroad dispatchers in a central control center where trains are located on the railway so that train movements can be controlled centrally for safety and efficiency.

Railroad signal systems operate in several ways but are generally based on the principle that the railcar metal wheels and axles electrically connect the two running rails. The rail-to-rail connection of the metal wheel-axle sets of a train would short out (i.e., reduce to a low voltage) an AC or DC voltage applied between the rails by a signal system. The signal system detects and interprets this low-voltage condition to indicate the presence of a train on that portion of track.

The HSR OCS would carry 60 Hz AC electric currents of up to 750 amperes per train. Interference between the HSR 60 Hz currents and a nearby freight railroad signal system could occur under the following conditions:

- The high electrical currents flowing in the OCS and the return currents in the overhead negative feeder, HSR rails, and ground could induce 60 Hz voltages and currents in existing parallel railroad tracks. If an adjoining freight railroad track parallels the HSR tracks for a long enough distance (i.e., several miles), the induced voltage and current in the adjoining freight railroad tracks could interfere with the normal operation of the signal system so that it indicates there is no freight train present when in fact one is (or so that it indicates the presence of a freight train when in fact none is there).

- Higher-frequency EMI from several HSR sources (electrical noise from the contact on the pantograph sliding along the contact conductor, from electrical equipment onboard the train, or from the cab radio communication system) could cause electrical interaction with the adjoining freight railroad signal or communication systems.

There are standard design and operational practices that a nonelectric railroad must use to avoid EMI effects on the signal and communication system when an electric railroad or electric power lines operate adjacent to its tracks. These standard design and operational practices prevent the possible effects that HSR operation might otherwise cause: disruption of the safe and dependable operation of the adjacent railroad signal system, resulting in train delays or hazards, or disruption of the road crossing signals, stopping road traffic from crossing the tracks when no train is there (Electric Power Research Institute 2006).

B-P Build Alternative 5 would include implementation of improvements and realignment of the adjacent Union Pacific Railroad line in Lancaster and Palmdale. Operation of the HSR system could affect the signaling systems along these existing track lengths. The proposed project includes relocation of and improvements to the adjacent Union Pacific Railroad facilities, which would reduce EMI exposure to sensitive Union Pacific Railroad signal and communications systems.

Interference from HSR currents could result in a nuisance or reduction in operational efficiency by interrupting road and rail traffic. Project design would include EMI/EMF-IAMF#1. Implementation of this IAMF would avoid or minimize impacts to adjacent existing rail lines. This IAMF would reduce potential impacts to adjacent rail lines.

Design provisions may include replacement of specific track circuit types on the adjoining rail lines with other types developed for operation on or near electric railways or adjacent to parallel utility power lines, providing filters for sensitive communication equipment, and potentially relocating or reorienting radio antennas. These design provisions would be put in place and determined to be adequately effective prior to the activation of potentially interfering systems of the HSR system.

None of the design refinements would result in changes in EMI/EMF emissions that would affect railroads in the project vicinity.

CEQA Conclusion
With implementation of EMI/EMF-IAMF#1, as described above, during operation of the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, and the LMF/MOWF/MOIS Facilities, the impact on adjacent existing rail lines would be less than significant under CEQA. Therefore, CEQA does not require mitigation.

Impact EMI/EMF #10—Wind Farm Electromagnetic Interference Effects

In terms of impact to the HSR system from the wind farm, the wind turbine generators, power collector circuits, and substation produce power-frequency magnetic fields with significant harmonics near the power electronics used to create the constant 60 Hz AC necessary for connection to the grid. These magnetic fields would be proportional to the power the generators produce. Power-frequency electric fields are not significant because the generator voltages are low and the conductors are inside enclosures or shielded cables. Substantial electric fields would only exist at the collector substation, on the high-voltage side, where overhead lines connect to the transmission system. As an EMF source, the wind farm, collector system, and associated substation connections to the AC power system are similar to general AC power system infrastructure[6] typically found along the proposed alignment. Harmonics associated with the power-conversion electronics would be the main difference compared to the typical AC electric system, but magnetic fields at the harmonic frequencies would be extremely localized at each wind turbine and are typically managed with line filters to maintain acceptable human exposure levels. Magnetic field levels at the base of turbines under “high wind” and “low wind” conditions are typically low (0.9 mG) when compared to acceptable human exposure levels, and rapidly diminish with distance, becoming undistinguishable from background levels within 6 feet of the turbine base (Knopper et al. 2014).

In terms of HSR-related impacts to the wind farm, the two main considerations are interference with the wind turbine control systems and interference with the wind farm communications system. The power-frequency magnetic fields from the HSR AC traction currents powering the trains would be the predominant source of EMFs. Because the wind farm is, as described above, comparable to AC power system infrastructure, the control system electronics must already operate in an EMF environment adjacent to generators, power conversion, and collector circuits. With respect to RF communications, both the wind farm systems and any HSR communication/control systems would meet FCC requirements regarding transmission of power and frequencies of operation. With details of the spectrum use from each side (HSR versus wind farm), one can quickly determine whether there is any overlap and potential for interference. Project design would include EMI/EMF-IAMF#2. Implementation of this IAMF would avoid or minimize impacts from wind farm EMI.

None of the design refinements would result in changes in EMI/EMF emissions that would affect the wind farms in the project vicinity.

CEQA Conclusion

With implementation of EMI/EMF-IAMF#2, as described above, during operation of the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, and the LMF/MOWF/MOIS Facilities, the impact from wind farm EMI would be less than significant under CEQA. Therefore, CEQA does not require mitigation.

Impact EMI/EMF#11—Electromagnetic Interference Concerns Related to Edwards Air Force Base Facilities and Operations

Along the Bakersfield to Palmdale Project Section, portions of the HSR alignment pass through areas that are routinely overflown by military aircraft operating out of Edwards Air Force Base as well as other nearby military training and testing facilities. These facilities conduct flight activities in controlled and restricted airspace. The activities encompass a wide range of operations, including low-altitude flight, training, and test activities (including those employing electronic countermeasures).

The airspace involved consists of a number of Military Training Routes, Military Operating Areas, and overlying Air Traffic Control Assigned Airspace, collectively referred to as the R-2508 Complex. Two of these, the Bakersfield and Isabella Military Operating Areas, lie above segments of the HSR alignment and extend from FL180 (18,000 feet) down to as low as 200 feet above ground level.

[6] The AC power system infrastructure consists of the following features: (1) traction power substations, which draw power off the grid and have transformers, switchgear, and a control room placed about every 30 miles along the HSR route; (2) switching stations that switch power from one grid power source to another (they also have transformers, switchgear, and control rooms, which are placed every 15 miles along the HSR); (3) paralleling stations are placed approximately every 5 miles along the HSR alignment and act as a booster between switching stations and also have transformers, switchgear, and a control room; (4) overhead contact systems that run along the entire length of the HSR tracks for both directions (they are suspended on poles about every 100 feet and hang over the center of the track/train); and (5) gantries that feed power to the overhead contact systems from the traction power substations, switching stations, and paralleling stations (gantries are typically overhead, but sometimes they are underground, depending on the distance from the power supply).

There are two principal concerns with respect to the HSR system:

1. Aviation hazards to low-flying aircraft that elevated HSR structures such as OCS supports, signal bridges, or ground masts and antennas present.
2. EMI hazards either to aircraft from the TPSSs or communications and control systems, or EMI from aircraft that might impact HSR RF communications.

Elevated HSR structures such as the OCS supports do not represent a particularly unique hazard, as they are of similar or lower height than existing power distribution and communications infrastructure that exists throughout the area. The Authority would follow up with the appropriate range personnel during final design to determine whether specific HSR structures somehow present a particular risk.

The HSR TPSSs would generate EMFs that are similar in magnitude to fields routinely encountered throughout the area from the existing power distribution and transmission infrastructure. The aircraft in question routinely and safely operate in this environment.

Similarly, RF emissions from HSR communications or control systems are not likely to present EMI risks to overflying aircraft. The proposed systems are all of similar power and utilize similar sections of the electromagnetic spectrum as many other uses already existing in the region. These include RF sources such as cellular telecommunications; police, fire, and other municipal radio uses; amateur radio; and commercial broadcast radio.

U.S. Air Force Plant 42, located at Palmdale Regional Airport, utilizes a number of RF emitters associated with this facility and the airport, including radars, very-high-frequency Omni-Directional Radio Range and Non-Directional Beacon Navaids, National Radar Cross-Section Test Facilities, and aircraft communications. The EIR/EIS analysis conducted for the Bakersfield to Palmdale Project Section did not identify any clear EMI/EMF impacts to U.S. Air Force Plant 42.

The only plausible EMI risks to HSR communications or control systems would be from range activities employing electronic countermeasures close to the HSR alignment. An environment employing military electronic countermeasures would be a potential problem only if it operates at the same frequencies as the train systems. Given the lack of overlap between frequencies used for typical airborne radar and weapons control systems and those proposed for HSR system use, this risk is unlikely. Project design would include EMI/EMF-IAMF#2. Implementation of this IAMF would avoid or minimize impacts related to Edwards Air Force Base facilities and operations.

None of the design refinements would result in changes in EMI/EMF emissions that would affect the Edwards Air Force Base.

CEQA Conclusion

With implementation of EMI/EMF-IAMF#2, as described above, the impact from EMI related to Edwards Air Force Base facilities and operations would be less than significant under CEQA. Therefore, CEQA does not require mitigation.

3.5.7 Mitigation Measures

The *Fresno to Bakersfield Section Final Supplemental EIR* (Authority 2018) and the *Final Supplemental EIS* (Authority 2019) did not identify significant EMI/EMF impacts requiring mitigation measures; therefore, no EMI/EMF-related mitigation measures apply to the portion of the F-B LGA from 34th Street and L Street to Oswell Street.

The mitigation strategies detailed in the *Final Program Environmental Impact Report/ Environmental Impact Statement (EIR/EIS) for the Proposed California High-Speed Train System* (Statewide Program EIR/EIS) (Authority and FRA 2005) have been refined and adapted for this project EIR/EIS. The baseline survey, EMF measurements, and evaluation of adjacent uses revealed no sensitive sites requiring mitigation. However, if sensitive equipment vulnerable to disruption by HSR EMFs were identified, this would have a significant impact under CEQA. Thus, if required, the project would utilize the following approach to protect sensitive equipment.

EMI/EMF-MM#1: Protect Sensitive Equipment

The Authority would contact entities where sensitive equipment is located to evaluate the potential impacts of both HSR Project–related EMF RF and EMI on imaging equipment prior to completion of final design. Where necessary to avoid interference, the final design would include suitable design provisions to prevent EMI. These design provisions may include establishing magnetic field shielding walls around sensitive equipment or installing RF filters into sensitive equipment.

HSR-related EMI may affect highly susceptible, unshielded sensitive RF equipment such as older MRI systems and other measuring devices common to medical and research laboratories. Most of the devices manufactured today have adequate shielding from all potential EMI sources; however, the potential exists for older devices to be affected and require shielding.

A shielded enclosure is very effective at preventing external EMI. Metallic materials are used for shielding (specifically high-conductivity metals for high-frequency interference, such as from HSR operation), and high-permeability metals are used for low-frequency interference. Often either the housing of the affected device is coated with a conductive layer or the housing itself is made conductive. In some situations, it may be necessary to reduce EMI for a suite of devices by creating a shielded room or rooms.

Attenuation, or the effectiveness of EMI shielding, is the difference between an electromagnetic signal's intensity before and after shielding. Attenuation is the ratio between field strength with and without the presence of a protective medium measured in decibels (dB). This decibel range changes on a logarithmic scale, so an attenuation rating of 50 dB indicates a shielding strength 10 times that of 40 dB. In general, a shielding range between 60 dB and 90 dB represents a high level of protection, while 90 dB to 120 dB is exceptional.

3.5.7.1 Impacts from Implementing Mitigation Measures

Implementation of EMI/EMF-MM#1 would mitigate effects related to EMI. This mitigation measure would reduce potential impacts to sensitive equipment through the following mechanisms:

- EMI/EMF-MM#1: Protect Sensitive Equipment—The Authority would contact relevant entities regarding the potential impacts of both HSR–related EMF RF and low-frequency EMI on imaging equipment prior to completion of final design. Where necessary to avoid interference, the final design would include suitable design provisions to prevent interference.

With implementation of EMI/EMF-MM#1, the impact of EMI on sensitive equipment would have a less than significant impact under CEQA. Additionally, no secondary environmental impacts would result from implementation of any EMI/EMF-MM#1 measures because the shields and filters would be installed inside the building or on the sensitive equipment.

3.5.7.2 Additional Considerations

The HSR project would adhere to international guidelines and comply with applicable federal and state laws and regulations. Similarly, project design would follow the EMCPP to avoid EMI and to ensure HSR operational safety. Some features of the EMCPP include:

- During the planning stage through the system design stage, the Authority would conduct EMC/EMI safety analyses, which would include the identification of existing nearby radio systems, the design of systems to prevent EMI with identified neighboring uses, and the incorporation of these design requirements into bid specifications used to procure radio systems.
- Pipelines and other linear metallic objects that are not sufficiently grounded through direct contact with earth would be separately grounded in coordination with the affected owner or utility to avoid possible shock hazards. For cases where metallic fences are purposely electrified to inhibit livestock or wildlife from traversing the barrier, the contractor would implement specific insulation design measures.

- The contractor would implement HSR standard corrosion protection measures to eliminate risk of corrosion of nearby metal objects.
- The Authority would work with the engineering departments of the BNSF Railway and the Union Pacific Railroad, where these railways parallel the HSR system, to apply the standard design practices to prevent EMI with the electronic equipment these railroads operate. Design provisions to prevent EMI would be put in place and determined to be adequately effective prior to the activation of potentially interfering systems of the HSR system.

The Authority would include EMC requirements and design provisions in the Systems Bid Specifications and Construction Bid Specifications for all system and construction procurements that raise EMC issues. The Bid Specification Electromagnetic Compatibility Requirements require each affected supplier and contractor to develop, deliver, and follow an EMC plan; use and document appropriate EMC design guidelines, criteria, and methods in equipment and construction; perform required EMC analysis and reporting; and perform required EMC testing.

Appendix 2-D, Table 2-D-4, contains the applicable design standards the project would use for addressing EMI/EMF impacts.

3.5.8 NEPA Impact Summary

This section summarizes and compares the impacts of the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, the LMF/MOWF/MOIS Facilities, and the No Project Alternative. The NEPA process takes into account the potential impacts to EMI and EMFs in conjunction with potential impacts to all resources to determine the effects of each B-P Build Alternative, the CCNM Design Option, the Refined CCNM Design Option, and the LMF/MOWF/MOIS Facilities. The No Project Alternative provides a benchmark for resource impacts.

Under the No Project Alternative, existing development trends are likely to continue. The use of electricity and RF communication equipment, including high-voltage power lines and directional and nondirectional (cellular and broadcast) antennas that review in EMFs and resulting EMI, occurs and would continue to occur along the Bakersfield to Palmdale Project Section. Under the No Project Alternative, future conditions would likely result in additional use of electricity and RF communications, consistent with that found in the urban and rural environments in the study area today. As a result, generation of EMI and EMFs that might affect people and sensitive receptors would continue in the area. Therefore, the No Project Alternative could result in similar EMI and EMF impacts as the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, and the LMF/MOWF/MOIS Facilities. Under the No Project Alternative, there would be more facilities potentially producing EMFs. Based on the nature of these sources, and existing regulations, there would be no effect.

With the project, HSR facilities would also produce EMFs. Levels would be well below established public exposure thresholds and effects on sensitive equipment would be addressed through IAMFs/mitigation measures.

Table 3.5-7 provides a comparison of the impacts of the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, and the LMF/MOWF/MOIS Facilities associated with EMI and EMFs. Data from this table and the information summarized below are described in detail in Section 3.5.6. None of the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, or the LMF/MOWF/MOIS Facilities would generate EMI or EMFs during construction that would result in hazards to people. The B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, and the LMF/MOWF/MOIS Facilities incorporate IAMFs that would avoid or minimize impacts associated with EMI and EMFs during operation. These IAMFs would avoid or minimize effects to populations and facilities during operation from exposure to HSR-related EMI and EMFs, including the general population, people with implanted medical devices, sensitive equipment, schools, underground pipelines, cables and adjoining rail, existing adjacent rail lines, wind farms, and Edwards Air Force Base. Additionally, to prevent interference with sensitive equipment, mitigation would be applied.

Table 3.5-7 Comparison of Bakersfield to Palmdale Project Section Build Alternative Impacts for EMI/EMF

Impact	Alternative 1	Alternative 2	Alternative 3	Alternative 5	CCNM Design Option	Refined CCNM Design Option	LMF/MOWF/ MOIS Facilities
Construction							
Impact EMI/EMF #1—Impacts During Construction	None of the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, or the LMF/MOWF/MOIS Facilities would generate EMI or EMFs during construction that would result in hazards to people or result in EMI to sensitive equipment.						
Operations							
Impact EMI/EMF #2—General Human Exposure to Electromagnetic Fields	None of the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, or the LMF/MOWF/MOIS Facilities would result in EMF exposure above the MPE limits of 5 kV/m and 9,040 mG for the public.						
Impact EMI/EMF #3—People with Implanted Medical Devices and Exposure to Electromagnetic Fields	None of the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, or the LMF/MOWF/MOIS Facilities would result in EMF exposure above the magnetic and electric field exposure limits for people with implanted medical devices.						
Impact EMI/EMF #4—Livestock and Poultry Exposure	None of the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, or the LMF/MOWF/MOIS Facilities would result in EMF exposure that would impact livestock or poultry because there is no documented evidence that EMFs harm livestock or poultry.						
Impact EMI/EMF #5—Effects on Sensitive Equipment from Electromagnetic Interference	None of the B-P Build Alternatives, the CCNM Design Option, or the LMF/MOWF/MOIS Facilities would result in EMI to sensitive equipment.						
Impact EMI/EMF #6—Electromagnetic Interference Effects on Schools	None of the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option or the LMF/MOWF/MOIS Facilities would result in EMI to school communications systems.						
Impact EMI/EMF #7—Potential for Corrosion of Underground Pipelines and Cables and Adjoining Rail	None of the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, or the LMF/MOWF/MOIS Facilities would result in corrosion of underground pipelines, cables or adjoining rail.						
Impact EMI/EMF #8—Potential for Nuisance Shocks	All of the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, and the LMF/MOWF/MOIS Facilities would avoid or minimize impacts from potential nuisance shocks.						
Impact EMI/EMF #9—Effects on Adjacent Existing Rail Lines	None of the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, or the LMF/MOWF/MOIS Facilities would result in EMI to adjacent existing rail lines.						

Impact	Alternative 1	Alternative 2	Alternative 3	Alternative 5	CCNM Design Option	Refined CCNM Design Option	LMF/MOWF/MOIS Facilities
Impact EMI/EMF #10—Wind Farm Electromagnetic Interference Effects	EMI would not occur between the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, or the LMF/MOWF/MOIS Facilities and wind farms.						
Impact EMI/EMF #11—Electromagnetic Interference Concerns Related to Edwards Air Force Base Facilities and Operations	EMI would not occur between the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, or the LMF/MOWF/MOIS Facilities and Edwards Air Force Base.						

Source: California High-Speed Rail Authority, 2020
B-P = Bakersfield to Palmdale Project Section
CCNM = César E. Chávez National Monument
EMF = electromagnetic fields
EMI = electromagnetic interference
F-B LGA = Fresno to Bakersfield Locally Generated Alternative
kV/m = kilovolts/meter
LMF/MOWF/MOIS Facilities = light maintenance facility/maintenance of way facility/maintenance of infrastructure siding facility
mG = milligauss
MPE = maximum permissible exposure

Construction activities would generate EMFs using powered construction equipment and radio communications. These emissions would be temporary, occurring only during construction, and would not exceed relevant exposure thresholds or present a public health risk. Occasional licensed radio transmissions between construction vehicles would not generate off-site EMI because the radio equipment would operate on licensed frequencies and would comply with FCC regulations. Construction impacts would be the same for all of the B-P Build Alternatives.

During operation of the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, and the LMF/MOWF/MOIS Facilities, EMFs would be below MPE levels for the public but would reach levels that may interfere with implanted medical devices. However, these levels would occur only inside traction power facilities, which are unmanned and inaccessible to the general public. EMF levels above the recommended limits for employees with implanted medical devices could exist inside traction power facilities and emergency power generator rooms. Traction power facilities and emergency power generator room sites would be unmanned, and workers would enter them only periodically (e.g., to perform routine maintenance). Project design would include EMI/EMF-IAMF#2, which would require disclosure of health risks to employees who have implanted medical devices and would preclude workers with implanted medical devices from entering any traction power facilities with levels above the recommended limits. Multiple studies have concluded that EMF exposure does not harm livestock or poultry. No facilities within a 500-foot study area were identified that operate sensitive equipment that could potentially be affected by EMFs during operation. However, HSR project design would include EMI/EMF-IAMF#2, which would require the project to adhere to international guidelines and comply with applicable federal and state laws and regulations. Additionally, EMI/EMF-MM#1 would ensure that if sensitive equipment were identified, suitable design provisions would be included where necessary to prevent EMI.

Operation of the HSR system would use radio systems, raising the concern that HSR operations would result in EMI with the radio systems in use at nearby schools and colleges. The HSR project plans to acquire two dedicated frequency blocks, making EMI with other users unlikely. Channels would also be selected to avoid EMI with other users. HSR project design would include EMI/EMF-IAMF#1, which would require the project to adhere to international guidelines and comply with applicable federal and state laws and regulations. Additionally, the Authority would implement an EMCPP, perform EMC/EMI safety analyses, monitor and evaluate system performance, comply with FCC regulations, and meet the previously identified international emissions and immunity requirements.

Operation of the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, and the LMF/MOWF/MOIS Facilities could cause corrosion. However, project design would include EMI/EMF-IAMF#2, which would implement standard corrosion protection measures to eliminate risk of corrosion of nearby metal objects.

Operation of the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, and the LMF/MOWF/MOIS Facilities could potentially cause a nuisance shock to anyone who touches ungrounded metal fences and ungrounded metal irrigation systems. Project design would include EMI/EMF-IAMF#2, which would avoid possible shock hazards through grounding or insulation of HSR fences and of non-HSR parallel metal fences and parallel metal irrigation systems within a to-be-determined, specified lateral distance of the HSR alignment.

Operation of the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, and the LMF/MOWF/MOIS Facilities could affect the signaling systems along 8 miles (13 kilometers) of existing track in the project study area. These signal systems warn drivers of street vehicles that a train is approaching, warn train engineers of other train activity on the same track a short distance ahead, advise the engineer that the train should either slow or stop, and show railroad dispatchers in a central control center where trains are located on the railway so that train movements can be controlled centrally for safety and efficiency. Project design would include EMI/EMF-IAMF#1, which would require application of suitable design provisions on the adjoining rail lines to prevent EMI.

With respect to RF communications, both the wind farm systems and any HSR communication/control systems would meet FCC requirements regarding transmission of power and frequencies of operation. Project design would include EMI/EMF-IAMF#2, which would perform tests to check for compatibility and adjust as required to avoid any conflicts.

There are two principal concerns with respect to the HSR system and Edwards Air Force Base: (1) aviation hazards from elevated HSR structures to low-flying aircraft, and (2) EMI hazards either to aircraft from the TPSSs or communications and control systems, or EMI from aircraft that might impact HSR RF communications. Elevated HSR structures do not represent a unique hazard, as they are of similar or lower height than existing power distribution and communications infrastructure that exists throughout the area. The Authority intends to follow up with the appropriate range personnel to determine whether specific HSR structures somehow present a particular risk. The HSR TPSSs would generate EMFs that are similar in magnitude to fields routinely encountered throughout the area from the existing power distribution and transmission infrastructure. The aircraft in question routinely and safely operate in this environment. Similarly, RF emissions from HSR communications or control systems are not likely to present EMI risks to overflying aircraft. The proposed systems are all of similar power and utilize similar sections of the electromagnetic spectrum as many other uses already existing in the region. Additionally, given the lack of overlap between frequencies used for typical airborne radar and weapons control systems and those proposed for HSR system use, EMI risk is unlikely. Project design would include EMI/EMF-IAMF#2, which would require preparation of an EMI/EMF technical report to guide design of the HSR system to avoid EMI with identified neighboring uses.

3.5.9 CEQA Significance Conclusions

Table 3.5-8 summarizes the CEQA determination of significance for all construction and operations impacts discussed in Section 3.5.6. The CEQA level of significance before and after mitigation for each impact in this table is the same for all of the B-P Build Alternatives, the CCNM Design Option, the Refined CCNM Design Option, and the LMF/MOWF/MOIS Facilities. Table 3.5-8 does not summarize the portion of the F-B LGA from the intersection of 34th Street and L Street to Oswell Street, because all impacts were determined to be less than significant and no mitigation measures were warranted.

Table 3.5-8 Summary of CEQA Significance Conclusions and Mitigation Measures for EMI/EMF

Impact	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
Construction			
EMI/EMF #1: Impacts During Construction	Significant	EMI/EMF-MM#1: Protect Sensitive Equipment	Less than Significant
Operations			
EMI/EMF #2: General Human Exposure to Electromagnetic Fields	Less than Significant	N/A	N/A
EMI/EMF #3: People with Implanted Medical Devices and Exposure to Electromagnetic Fields	Less than Significant	N/A	N/A
EMI/EMF #4: Livestock and Poultry Exposure	Less than Significant	N/A	N/A
EMI/EMF #5: Effects on Sensitive Equipment from Electromagnetic Interference	Significant	EMI/EMF-MM#1: Protect Sensitive Equipment	Less than Significant
EMI/EMF #6: Electromagnetic Interference Effects on Schools	Less than Significant	N/A	N/A
EMI/EMF #7: Potential for Corrosion of Underground Pipelines and Cables and Adjoining Rail	Less than Significant	N/A	N/A
EMI/EMF #8: Potential for Nuisance Shocks	Less than Significant	N/A	N/A
EMI/EMF #9: Effects on Adjacent Existing Rail Lines	Less than Significant	N/A	N/A
EMI/EMF #10: Wind Farm Electromagnetic Interference Effects	Less than Significant	N/A	N/A
EMI/EMF #11: Electromagnetic Interference Concerns Related to Edwards Air Force Base Facilities and Operations	Less than Significant	N/A	N/A

Source: California High-Speed Rail Authority, 2020
EMF = electromagnetic fields
EMI = electromagnetic interference
N/A = not applicable