3.5 Electromagnetic Interference and Electromagnetic Fields

3.5.1 Introduction

This section describes the regulatory setting, affected environment, effects, and mitigation measures for electromagnetic interference (EMI) and electromagnetic field (EMF) impacts associated with the No Project Alternative and each of the six Build Alternatives within the resource study area (RSA). The analysis examines the impacts on EMI- and EMF-sensitive receptors from local sources of EMI and EMFs and the impact of high-speed rail (HSR) generated EMI/EMFs.

Electromagnetic Interference and Electromagnetic Fields

Electromagnetic interference occurs when electromagnetic fields produced by a source adversely affect operation of an electrical, magnetic, or electromagnetic device.

Electromagnetic fields consist of both electric fields and magnetic fields. Electric fields are forces that electric charges exert on other electric charges, while magnetic fields are forces that a magnetic object or moving electric charge exerts on other magnetic materials and electric charges.

The following resource sections in this Palmdale to Burbank Project Section Draft Environmental Impact Report /Environmental Impact Statement (EIR/EIS) provide additional information related to EMI/EMF:

- Section 3.2, Transportation, evaluates impacts of the Build Alternatives on other freight and passenger rail operations and roadways that use electricity and radio frequencies within adjacent transportation corridors.
- Section 3.6, Public Utilities and Energy, evaluates additional uses of electricity and radio frequency communication equipment, including high-voltage power lines, antennas, and electric transmission facilities.
- Section 3.9, Geology, Soils, Seismicity, and Paleontological Resources, evaluates operations changes caused by each of the six Build Alternatives related to local soil properties and the electrification system for each of the six Build Alternatives.
- Section 3.11, Safety and Security, evaluates community impacts of the Build Alternatives associated with radio frequency interference from local rail, air, and automobile routes.
- Section 3.18, Regional Growth, provides information regarding regional growth, construction- and operations-related employment, and each of the six Build Alternatives' potential to induce growth in existing communities.
- Section 3.19, Cumulative Impacts, identifies construction and operations changes caused by each of the six Build Alternatives related to EMI/EMF in combination with other past, present, and reasonably foreseeable future projects.

In addition, the following appendices in Volume 2 of this Draft EIR/EIS provide more detailed information:

- Appendix 2-D, Applicable Design Standards, contains the applicable design standards the California High-Speed Rail Authority (Authority) would use to address EMI/EMF impacts.
- Appendix 2-E, Impact Avoidance and Minimization Features, lists impact avoidance and minimization features (IAMFs) included as applicable in each of the Build Alternatives for purposes of the environmental impact analysis.
- Appendix 2-H, Regional and Local Policy Consistency Analysis, provides a Regional and Local Policy Consistency Table, which lists the EMI/EMF goals and policies applicable to the Palmdale to Burbank Project Section and notes the Build Alternatives' consistency or inconsistency with each.

- Appendix 3.1-B, United States Forest Service (USFS) Policy Consistency Analysis, provides an analysis of the consistency of the six Build Alternatives with these laws, regulations, policies, plans, and orders.
- Appendix 3.5-A, Pre-construction Electromagnetic Measurement Survey Summary, documents measurement results from the electromagnetic survey for the Palmdale to Burbank Project Section.
- Appendix 3.5-B, Electromagnetic Measurement Survey Summary Catalog, summarizes the results of the electromagnetic survey and describes methods employed in this survey.

During stakeholder outreach efforts, commenters expressed concern about impacts of EMI/EMF generated by the Palmdale to Burbank Project Section on adjacent land uses. These impacts are addressed in Section 3.5.6.3.

3.5.1.1 Definition of Resources

This section provides definitions related to EMI and EMF as analyzed in this Draft EIR/EIS.

- **EMF** consists of electric and magnetic fields. 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. EMFs are also created by the generation, transmission, and distribution of electricity; the use of everyday household electric appliances and communication systems; industrial processes; and scientific research.
- **Electric Fields** are forces that electric charges exert on other electric charges.

Definitions: Electromagnetic Wave and Spectrum

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. Electromagnetic waves have frequencies and wavelengths that directly relate to one another—as frequencies increase, wavelengths get shorter.

- **Magnetic Fields** are forces that a magnetic object or moving electric charge exerts on other magnetic materials and on electric charges.
- **EMI** is the interference that occurs when the EMF produced by a source adversely affects the operation of an electrical, magnetic, or electromagnetic device. EMI may be caused by a source that intentionally radiates EMFs (such as a television broadcast station) or one that does so incidentally (such as an electric motor).

The information presented in this section primarily concerns EMFs at the 60-Hertz (Hz) power frequency and radio frequency (RF) fields produced intentionally by communications or unintentionally by electric discharges. EMFs from operations of the Palmdale to Burbank Project Section would consist of the following:

- **Power-frequency electric and magnetic fields from the traction power system and electrical infrastructure—**Switching stations, paralleling stations, electrical lines, emergency generators that provide backup power to the stations in case of a power outage, and utility feeder lines—60-Hz electric fields would be produced by the 25-kilovolt (kV) operating voltage of the 2 x 25-kV HSR traction power system, and 60-Hz magnetic fields would be produced by the flow of currents providing power to the HSR vehicles. Along the tracks, magnetic fields would be produced by the flow of propulsion currents to the trains in the overhead contact system (OCS), negative feeder, and rails.

Unit Definitions and Conversions

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

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

- **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 kilohertz (kHz) range. Potential sources include power conversion units, switching power supplies, motor drives, and auxiliary power systems. Unlike the traction power system, these sources would be highly localized in the trains and would move along the track as the trains move.
- **Radio Frequency fields—**RF fields are any of the electromagnetic wave frequencies that lie in the range extending from around 3 kHz to 300 gigahertz (GHz), which include those frequencies used for communications or radar signals. The California HSR System would use a variety of communications, data transmission, and electronic monitoring systems—both on and off vehicles—that operate at radio frequencies. These wireless systems would meet the Federal Communications Commission (FCC) regulatory requirements for intentional emitters (47 Code of Federal Regulations [C.F.R.] 15 and *FCC Office of Engineering Technology Bulletin* No. 65 (FCC 1997), Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields).

3.5.1.2 Characteristics of Electromagnetic Radiation

The electromagnetic spectrum spans an enormous range of wavelengths or frequencies. The most energetic radiation consists of short-wavelength or high-frequency radiation and includes ultraviolet, X-ray, and gamma ray radiation. At longer wavelengths, electromagnetic radiation includes radio waves, microwaves, and infrared radiation. Visible light is the portion of the electromagnetic spectrum between the infrared and ultraviolet portions of the electromagnetic spectrum. Less energetic, longer-wavelength radiation, including visible light, infrared radiation, microwaves, and radio waves, is sometimes referred to as "non-ionizing radiation." This section addresses the possible impacts of electromagnetic radiation at wavelengths below those of visible light on human health and on sensitive electric and electronic equipment and facilities for each of the six Build Alternatives.

Non-ionizing electromagnetic radiation consists of waves characterized by variations in electric fields (measured in volts per meter, or V/m [1 meter is 3.28 feet, or 39.4 inches] and magnetic fields (measured in Tesla [T] or Gauss [G]). These periodic waves move through a medium, such as air, transferring energy from place to place as they go. The waves move at the speed of light and have dimensions of intensity or amplitude; wavelength, or the distance between two adjacent peaks of the wave; and number of cycles per second (Hz), or frequency. Table 3.5-1 shows wavelengths for a range of different frequencies. Table 3.5-2 shows the magnetic field strengths of electrical devices and facilities commonly found in urban areas.

Table 3.5-1 Relationship Between Typical Frequencies and Their Wavelengths

Frequency	Wavelength	Common Commercial Uses
60 Hz	3,105 miles	Electric power grid
10 kHz	18.6 miles	Radio navigation
10 MHz	98.4 feet	Shortwave radio
100 MHz	9.8 feet	FM radio
2000 MHz	6 inches	Cellular communications

Source: Authority, 2017
Hz = Hertz MHz = Megahertz
kHz = kilohertz

Table 3.5-2 Typical Magnetic Field Strengths

Electrical Source	Magnetic Field Strength (mG)
Dishwasher	30[1]
Hair Dryer	70[1]
Electric Shaver	100[1]
Vacuum Cleaner	200[1]
High-Voltage Power/Transmission Line (115 kV to 500 kV)	30–87[2]
Medium Voltage Power Distribution Line (4 kV to 24 kV)	10–70[2]

Source: National Institute of Environmental Health Sciences, 2002
1 = Measured 1 foot from appliance
2 = At ground level, directly beneath the lines
mG = milligauss kV = kilovolts

EMF Frequencies

EMFs are described in terms of both their intensity and their frequency, which is the number of cycles the EMF undergoes each second.[1] In the United States, the commercial electric power system operates at a frequency of 60 Hz, or cycles per second, meaning that the field completes one full cycle 60 times per second. Electric power substations are typical sources of electric and magnetic fields. These components include generating stations and power plants, traction power substations (TPSS), paralleling stations, and switching stations. Substations also require high-voltage transmission lines and electric distribution lines. Even in areas not adjacent to transmission lines, 60-Hz EMFs may be present due to electric power systems, common building wiring, electrical equipment, and appliances.

Natural and human-generated EMFs cover a broad-frequency spectrum. Direct current (DC) EMFs are nearly constant in time, whereas alternating current (AC) EMFs vary in time. AC EMFs are further characterized by their frequency range. Extremely low-frequency magnetic fields are typically defined as those having a lower limit of 3 to 30 Hz and an upper limit of 30 to 3,000 Hz. The California HSR System's OCS and power distribution system primarily would generate EMF 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 kHz) to 3 billion Hz (3 GHz). Typical RF sources of EMFs include (1) antennas associated with cell phone towers; (2) broadcast towers for radio and television; (3) airport radar, navigation, and communication systems; (4) high-frequency and very-high-frequency communication systems used by police and fire departments, emergency medical technicians, utilities, and governments; and (5) local wireless systems such as wireless fidelity (Wi-Fi) and cordless telephones. The strength of magnetic fields is often measured in milligauss (mG), G, T, or microtesla (μT). For comparison, the earth's ambient magnetic field ranges from approximately 500 to 700 mG DC (0.5 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). Moreover, the strength of EMFs rapidly decreases with distance from their sources; thus, EMFs that exceed background levels are usually found close to EMF sources. Table 3.5-3 shows the typical EMF levels from overhead electrical lines at varying distances. EMF levels at a distance of 200 feet from a 230-kV transmission line and a 115 kV power line are reduced by approximately 97 and 99 percent, respectively.

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

Table 3.5-3 Typical Electromagnetic Field Levels for Transmission/Power Lines

Voltage of Source	Field Strength at Specified Distances from Source				
	Directly under Lines	50 Feet	100 feet	200 feet	300 feet
230-kV Transmission Line Electric Field Strength (kV/m)	2.0	1.5	0.3	0.05	0.01
230-kV Transmission Line Mean Magnetic Field (mG)	57.5	19.5	7.1	1.8	0.8
115-kV Power Line Electric Field Strength (kV/m)	1.0	0.5	0.07	0.01	0.003
115-kV Power Line Mean Magnetic Field (mG)	29.7	6.5	1.7	0.4	0.2

Source: National Institute of Environmental Health Sciences, 2016
kV/m = kilovolts per meter
mG = milligauss

EMF Exposure and Health Effects

EMFs can cause EMI and can disrupt sensitive equipment (e.g., implanted medical devices), possibly triggering a malfunction. At sufficiently high exposure levels, EMFs also directly affect human health. Extensive research on EMFs has led the majority of scientists and health officials to conclude, however, that low-frequency EMFs have no adverse health effects at typical exposure levels. Objective scientific reviews of animal studies, from which some human health risks have been extrapolated, have also concluded that existing data are inadequate to indicate a potential risk of cancer, which is the primary human health concern associated with EMF exposure (World Health Organization 2007; International Agency for Research on Cancer 2002). However, EMFs remain a human health concern and is the subject of continuing research (World Health Organization 2007).

Electromagnetic Interference

General Considerations

EMI is an electromagnetic disturbance from an external source that interrupts or degrades the performance of an electrical device, circuit, or signal. Ambient EMI occurs when electromagnetic radiation intentionally or unintentionally jams, or blocks, another electromagnetic signal in free space. Hardware EMI occurs when electromagnetic radiation induces an unintended current in an electrical circuit. To interfere with a radio or microwave signal, the EMI must be at or near its frequency. Radio and other communications systems typically operate in the range of 500 kHz to 3 GHz.

Commercial standards developed for electromagnetic compatibility (EMC) both limit EMI generated by electrical devices and reduce susceptibility of electrical devices to external EMI. For example, the Federal Aviation Administration's (FAA) interim EMC commercial standards require aircraft systems to withstand EMF of up to 200 V/m (FAA 2014).

EMI and Radio Communications

Intentional radio signals exist in a sea of unwanted RF noise, so radio communications systems and devices are designed to operate in this environment. General frequency ranges are assigned for various types of radio signals, and specific radio frequencies and power output levels are assigned to individual users to minimize the potential for disruptions. Radio equipment is designed to separate the frequency of interest from background noise and to reject transient or unfocused signals.

EMI and Sensitive Equipment

Research equipment is generally designed to operate within the Earth's natural magnetic field and to compensate for fluctuations in that field of up to 10 mG (Field Management Services 2009). Industries associated with the use, assembly, calibration, or testing of sensitive or unshielded RF equipment, however, are still sensitive to EMI. In particular, fluctuations in the magnetic field can interfere with nuclear magnetic resonance, nuclear magnetic imaging, and other imaging equipment, such as electron microscopes. Computed tomography (CT) and computed axial tomography (CAT) scanning devices also are sensitive to EMI, as are some semiconductor, nanotechnology, and biotechnology operations. Nuclear magnetic resonance spectrometers are sensitive to time-varying DC magnetic fields of under 2 mG (Field Management Services 2009). For unshielded equipment that is sensitive to magnetic fields in the range of 1 to 3 mG, such as magnetic resonance imaging (MRI) systems, electromagnetic interference is possible at distances of up to 200 feet. An installation guide for nuclear magnetic resonance equipment recommends a separation distance of 330 feet from electric trains (Field Management Services 2009).

3.5.2 Laws, Regulations, and Orders

3.5.2.1 EMI/EMF Exposure Guidelines

Both governmental agencies and private organizations have developed guidelines for EMF exposure. These include state governments, the FCC, the Occupational Safety and Health Administration (OSHA), the Institute of Electrical and Electronics Engineers (IEEE), the American National Standards Institute (ANSI), and the American Conference of Governmental Industrial Hygienists (ACGIH). However, neither the State of California government nor the U.S. federal government has developed regulations limiting EMF exposure to residences.

EMF exposure guidelines and standards have also been adopted by the International Commission on Non-Ionizing Radiation Protection in the extremely low-frequency and RF bands applicable to HSR emissions. The International Commission on Non-Ionizing Radiation Protection and IEEE standards both address EMF exposure for the general public as well as for workers in occupational settings. Because the commission guidelines are widely used in the U.S. and abroad (they have been formally adopted by the European Union), the IEEE standards have been identified in the *Final Program EIR/EIS for the Proposed California High-Speed Train System* (Authority and the Federal Railroad Administration 2005) to assess the health and compatibility effects from anticipated emissions of the Build Alternatives. For occupational exposures, International Commission on Non-Ionizing Radiation Protection reference values are 1,000 µT for magnetic fields and 8.333 kV/m for electric fields.

The IEEE standard C95.6, IEEE Standard for Safety Levels with Respect to Human Exposure to Electromagnetic Fields, is 0 to 3 kHz. This standard, which is often referenced in the U.S. and has been formally adopted by ANSI, specifies maximum permissible exposure (MPE) levels for the general public and for occupational exposure to extremely low-frequency EMFs, which have frequencies of 0 to 3 kHz. All six Build Alternatives' electrification and traction systems would generate extremely low-frequency EMFs with frequencies of 60 Hz, which is in the range covered by this standard. Standard C95.6 exposure levels are presented in Table 3.5-4 and Table 3.5-5 (IEEE 2002). Note that the IEEE exposure levels are recommendations only; they are not governmental regulations.

Table 3.5-4 Institute of Electrical and Electronics Engineers Standard 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	6.87×10^6/f
	60	9.04×10^3
Arms or legs	< 10.7	3.53×10^6
	10.7–3,000	3.79×10^7/f
	60	6.32×10^5

Source: IEEE, 2002
/f = divided by the frequency
Hz = hertz
mG = milligauss

Table 3.5-5 Institute of Electrical and Electronics Engineers Standard 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	1.84×10^6/f
	60	5,000

Source: IEEE, 2002
/f = divided by the frequency
Hz = hertz
V/m = volts per meter

In 2006, ANSI adopted IEEE standard C95.1 as its standard for safe human exposure to non-ionizing electromagnetic radiation (IEEE 2006). For the California HSR System, the 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 more conservative in their allowances at 100 to 300 megahertz (MHz), because the human body absorbs the greatest percentage of incident energy at these frequencies. The MPE allowance 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 exposures, 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 (for example, through use of personal protective equipment). The general public safety levels are intended to protect members of the public (including pregnant women, infants, the unborn, and the infirm) from both short-term and long-term exposures to EMFs. The safety levels are also 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).

The OSHA safety standards for occupational exposure to RF emissions are found at 29 C.F.R. 1910.97. 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. The OSHA MPEs are based on a 6-minute averaging time.

The ACGIH states that occupational exposures should not exceed 10 G (10,000 mG or 1 millitesla). The ACGIH additionally recommends that exposure to workers with pacemakers or other electronic medical devices should not exceed 1 G (1,000 mG or 0.1 millitesla). The ACGIH 10-G guideline is intended to prevent effects such as induced currents in cells or nerve stimulation. However, the ACGIH guidelines apply to occupational exposures, not exposure to the general public.

3.5.2.2 Federal

Federal Railroad Administration, Procedures for Considering Environmental Impacts (64 Federal Register 28545)

The Federal Railroad Administration procedures state that an EIS should consider possible impacts from EMI/EMFs.

U.S. Department of Transportation, Federal Railroad Administration, 49 C.F.R. Part 236.8, 238.225, 229 Appendix F, and 236 Appendix C

These regulations provide rules, standards, and instructions regarding operating characteristics of electromagnetic, electronic, or electrical apparatus, as well as 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 United States, 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. This regulation would apply to stationary communications equipment required by the California HSR System.

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 the limits for human exposure to RF fields adopted by the FCC (FCC 1997). The FCC limits are partially based on the IEEE C95.1 standard (IEEE 2006).

U.S. Department of Commerce, FCC, 47 C.F.R. Part 1.1310, Radiofrequency Radiation Exposure Limits

FCC regulations at 47 C.F.R. Part 1.1310 are based on the 1992 version of the ANSI/IEEE C95.1 safety standard. Table 3.5-6 shows the MPEs of the ANSI/IEEE C95.1 and FCC standards at frequencies of 450,900, and 5,000 MHz, which covers the range of frequencies that could be used by the California HSR System's radio communications. 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 3.5-6, the differences between the ANSI/IEEE C95.1 and FCC MPEs are minor.

Table 3.5-6 Radio Frequency Emissions Safety Levels Expressed as Maximum Permissible Exposure

	ANSI / IEEE C95.1 MPE (mW/cm^2)		FCC MPE (mW/cm^2)		OSHA MPE (mW/cm^2)
Frequency	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: Authority, 2017
ANSI = American National Standards Institute
cm^2 = square centimeters
FCC = Federal Communications Commission
IEEE = Institute of Electrical and Electronics Engineers
MHz = megahertz
mW = milliwatts
MPE = maximum permissible exposure
OSHA = Occupational Safety and Health Administration

U.S. Environmental Protection Agency, Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks (April 21, 1997)

Executive Order 13045 directs federal agencies to make it a priority to identify and assess environmental health and safety risks that may disproportionally affect children and to ensure that policies, programs, activities, and standards address disproportionate risks to children, including risks from EMF exposure.

U.S. Department of Labor, Occupational Safety and Health Administration, 29 C.F.R. Part 1910.97, Nonionizing Radiation

Safety standards for occupational exposure to RF emissions in the 10-MHz to 100-GHz range are provided in 29 C.F.R. Part 1910.97. Table 3.5-6 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. The OSHA MPEs are based on averaging over any 6-minute time interval.

United States Forest Service Authorities

Sources of EMI/EMFs within the Angeles National Forest (ANF), including the San Gabriel Mountains National Monument (SGMNM), are governed by several federal laws and their implementing regulations, as well as policies, plans, and orders. The primary laws governing sources of EMI/EMFs are the Federal Land Policy and Management Act, the National Forest Management Act and the Antiquities Act of 1906 (for SGMNM). Appendix 3.1-B, USFS Policy Consistency Analysis, provides an analysis of the consistency of the six Build Alternatives with these laws, regulations, policies, plans, and orders.

3.5.2.3 State

California High-Speed Rail Authority—Electromagnetic Compatibility Program Plan

The Electromagnetic Compatibility Program Plan (EMCPP) defines the California HSR System's High-Speed Transit Protocol EMC objective, which would provide for electromagnetic compatibility of HSR equipment and facilities with themselves; with equipment and facilities of nearby land uses; and with passengers, workers, and neighbors of the HSR. The EMCPP also guides and coordinates the EMC design, analysis, testing, documentation, and certification activities among California HSR System management systems, as well as sections through the project phases; conforms to the EMC-related California HSR System requirements; and complies with applicable regulatory requirements, including EMC requirements in 49 C.F.R. 200–299 for the California HSR System and project sections (Authority 2010a). 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.
- The contractor would implement California HSR System standard corrosion protection measures to eliminate risk of corrosion of nearby metal objects.
- The Authority would work with the engineering departments of the Union Pacific Railroad, Metrolink, and Amtrak, where these railways parallel the HSR alignment, 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.

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 direct 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 contains the applicable design standards the Authority would use to address EMI/EMF impacts.

California Department of Education, California Code of Regulations, Title 5, Section 14010(c)

This regulation establishes minimum setback distances from school facilities for power line easements: 100 feet for a 50- to 133-kV line; 150 feet for a 220- to 230-kV line; and 350 feet for a 500- to 550-kV line.

California Public Utilities Commission

- **Decision D.93-11.013**—The California Public Utilities Commission (CPUC) decision adopted a policy regarding EMF from regulated utilities.
- **Decision D.66-01-042**—The August 2004 CPUC decision updates the EMF policy originally defined in Decision D.93-11-013. Decision D.66-01-042 reaffirmed D.93-11-013 in that health hazards from exposures to EMF have not been established and that state and federal public health regulatory agencies have determined that setting numeric exposure limits is not appropriate. The CPUC also reaffirmed the existing no-cost and low-cost precautionary-based EMF policy to be continued. D.06-01-042 ordered the utilities to convene a utility workshop, to develop standard approaches for design guidelines, including the development of a standard table showing EMF mitigation measures and costs.
- **California Public Utilities Commission Electromagnetic Field 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 EMF mitigation. While the CPUC decisions, general orders, and guidelines do not directly apply to the Palmdale to Burbank Project Section, they are listed because (1) all six Build Alternatives would handle the environmental impacts of the TPSSs, switching and paralleling stations, station switches, and high-voltage transmission lines in a manner consistent with CPUC decisions D.93-11-013 and D.06-01-042; and (2) CPUC decision D.06-01-042 reaffirms the key elements of the updated CPUC 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.

3.5.2.4 Regional and Local

EMF and EMI related topics are discussed in some county and municipal general plans and ordinances, typically as guidance or policy. The EMI and EMF policies in these plans and ordinances generally are derived from federal and state regulations. At the local level, within the jurisdictions traversed by the Palmdale to Burbank Project Section, only the cities of Palmdale and Burbank have policies or ordinances related to this topic, see Table 3.5-7 below. Appendix 2-H provides a Regional and Local Policy Consistency Table, which lists the EMI/EMF goals and policies applicable to the Palmdale to Burbank Project Section and consistency with the six Build Alternatives.

Table 3.5-7 Local Plans and Policies

Jurisdiction	Relevant Policy Documents
City of Palmdale	*Palmdale General Plan* (1993)
City of Burbank	Burbank Municipal Code

Sources: City of Palmdale 1993, City of Burbank 2013

3.5.3 Consistency with Plans and Laws

As indicated in Section 3.1.4.3, Consistency with Plans and Laws, California Environmental Quality Act (CEQA), and Council on Environmental Quality (CEQ) regulations require a discussion of inconsistencies or conflicts between a proposed undertaking and federal, state, regional, or local plans and laws. As such, this Draft EIR/EIS describes the inconsistencies between the six Build Alternatives with federal, state, regional, and local plans and laws to provide planning context.

The Authority, as the lead agency proposing to construct and operate the California HSR System, is required to comply with all federal and state laws and regulations and to secure all applicable federal and state permits prior to initiating construction on the selected Build Alternative. Therefore, there would be no inconsistencies between the six Build Alternatives and these federal and state laws and regulations.

The Authority is a state agency and therefore is not required to comply with local land use and zoning regulations; however, it has endeavored to design and construct the California HSR System so that it is consistent with local land use and zoning regulations. For example, the proposed Build Alternative would incorporate IAMFs that require the contractor to prepare an Implementation Stage Electromagnetic Compatibility Program Plan (ISEP) to identify construction BMPs that will minimize EMI/EMF effects and demonstrate how EMI/EMF will be maintained below applicable standards.

Appendix 2-H provides a Regional and Local Policy Consistency Table, which lists the EMI/EMF goals and policies applicable to the Palmdale to Burbank Project Section and notes the Build Alternatives' consistency or inconsistency with each.

3.5.4 Methods for Evaluating Impacts

The evaluation of impacts related to EMI/EMF is a requirement of the National Environmental Policy Act (NEPA) and CEQA. The following sections summarize the RSAs, and the methods used to analyze EMI/EMF impacts.

3.5.4.1 Definition of Resource Study Areas

As defined in Section 3.1, RSAs are the geographic boundaries in which the environmental investigations specific to each resource topic were conducted. The sensitive receiver and radio interference RSAs used to analyze EMI/EMF impacts include the rail alignments, station areas, and ancillary facilities capable of producing EMI/EMFs, including substations, power lines, and electrical interconnections.

The EMI/EMF impact analysis focuses on the effects of source EMI/EMFs on sensitive receivers. Sensitive EMI/EMF receivers include adjacent railroads and rail transit systems, airports, residential dwellings, schools, hospitals, clinics, medical facilities, commercial and industrial facilities, and agricultural operations (farming equipment and animals). The sensitive receiver and radio interference RSAs include urban and developed areas in Palmdale, Los Angeles, Burbank, and unincorporated portions of Los Angeles County that encompass the ANF. Computer modeling predicts that the EMF level would decay to less than 2 mG at 200 feet from either side of the HSR right-of-way centerline. However, to be conservative, a 500-foot buffer on either side of the HSR alignment centerline (a 1,000-foot-wide corridor) was used for the sensitive receiver RSA. The Authority determined the sensitive receiver RSA based on typical screening distances as defined in Section 2.5 of the Authority's *Technical Memorandum: EIR/EIS Assessment of California High-Speed Train Alignment EMF Footprint TM 300.07* (Footprint Report) and the unique characteristics of the elements of the Build Alternatives listed below. The Footprint Report provides estimates of EMI/EMF conditions in the vicinity of HSR infrastructure resulting from operations of the California HSR System. Sensitive receivers within the 500-foot screening distance of the alignment could be impacted by implementation of the Build Alternatives, whereas sensitive receivers outside of this area would be unlikely to experience effects (Authority 2010a). Thus, the sensitive receiver RSA includes the following:

- A 500-foot buffer from the proposed HSR right-of-way centerline (a 1,000-foot-wide strip centered on the proposed HSR alignment) for each Build Alternative
- A 500-foot buffer from the proposed HSR right-of-way centerline transmission lines supplying the TPSSs, switching stations, and paralleling stations for each Build Alternative

The radio interference RSA was also included on each side of the proposed HSR right-of-way centerline, as follows:

- 500 feet from the Build Alternative footprints, which includes all components and right-of-way needed to construct, operate, and maintain all permanent HSR features

3.5.4.2 Impact Avoidance and Minimization Features

IAMFs are project features the Authority has incorporated into each of the six Build Alternatives for purposes of the environmental impact analysis. The full text of the IAMFs that are applicable to the Palmdale to Burbank Project Section is provided in Volume 2, Appendix 2-E, Impact Avoidance and Minimization Features.

The following is a list of the IAMFs that were incorporated into the EMI/EMF analysis:

- **EMI/EMF-IAMF#1**: Preventing interference with adjacent railroads—This IAMF describes the Authority's commitment to requiring coordination with adjacent railroads per the Technical Manual 300.10 (ISEP). During design of the Preferred Alternative, the contractor will work with the engineering departments of railroads that operate parallel to the HSR in applying standard design practices to prevent interference with the electronic equipment operated by these railroads.

- **EMI/EMF-IAMF#2:** Controlling electromagnetic fields/electromagnetic interference—This IAMF describes the Authority's commitment to reducing potential exceedances to EMI/EMF standards by requiring the contractor to design the HSR to international guidelines and comply with federal and state laws and regulations related to EMI/EMF.

3.5.4.3 Methods for NEPA and CEQA Impact Analysis

Overview of Impact Analysis

This section describes the sources and methods the Authority used to analyze project impacts of each of the six Build Alternatives on EMI/EMFs. These methods apply to both NEPA and CEQA analyses unless otherwise indicated. Refer to Section 3.1.4.4, Methods for Evaluating Impacts, for a description of the general framework for evaluating impacts under NEPA and CEQA.

The methods used to establish EMF and EMI baseline conditions and to determine impacts associated with construction and operations of each of the six Build Alternatives combine data collection, EMF survey, and mathematical modeling to predict EMF levels. For the analysis of EMI/EMF effects, the Authority assessed:

- The magnitude of the change between the existing and modeled EMF levels
- The potential to which each of the six Build Alternatives could exceed applicable standards, including impacts on public health through exposure of people to EMF health risks in exceedance of applicable standards, exposing people to electric shock, or interfering with implanted biomedical devices
- The potential for each of the six Build Alternatives to affect public safety by interfering with the operation of nearby railroads, rail transit systems, airports, or other businesses

To identify regional and local sources of EMF and EMI, the analysis relied upon aerial imagery, surveys, photographs, and FCC databases, as well as observations of existing conditions obtained during a pre-construction electromagnetic survey in the RSA, described below.

Local Conditions

As part of this evaluation, a baseline conditions electromagnetic survey was performed within the sensitive receptor RSA. The measurement sites are identified in Table 3.5-8 and Figure 3.5-1. The purpose of the survey was to (1) provide a baseline characterization of the existing electromagnetic environment, (2) permit comparisons with the expected electromagnetic footprint from each of the six Build Alternatives, and (3) provide guidance for EMC requirements by defining the typical electromagnetic environment that each of the six Build Alternatives must operate in without interference.

Table 3.5-8 Measurement Locations

Location / Community	Nearest Cross Streets	Distance to Right-of-Way Centerline (feet)	Build Alternatives
1 – Palmdale	6th Street East / Transportation Center	75	All
2 – Palmdale	6th Street East / Palmdale Blvd	52	All
3 – Acton	Foreston Drive / Angeles Forest Highway	252	E1, E1A, E2, and E2A
4 – Acton	Aliso Canyon Road	239	E1, E1A, E2, and E2A
5 – Acton	Sierra Highway / Red Rover Mine Road	62	Refined SR14
6 – Agua Dulce	Soledad Canyon Road	144	Refined SR14 and SR14A
7 – Pacoima	Filmore Street / Cornelia Avenue	49	Refined SR14, SR14A, E1, and E1A
8 – Sun Valley	San Fernando Road / Sheldon Street	72	Refined SR14, SR14A, E1, and E1A
9 – Shadow Hills	Wentworth Street / McBroom Street	111	E2 and E2A
10 – Burbank	San Fernando Road / Lockheed Drive	75	All

Source: Vibro-Acoustic Consultants 2016

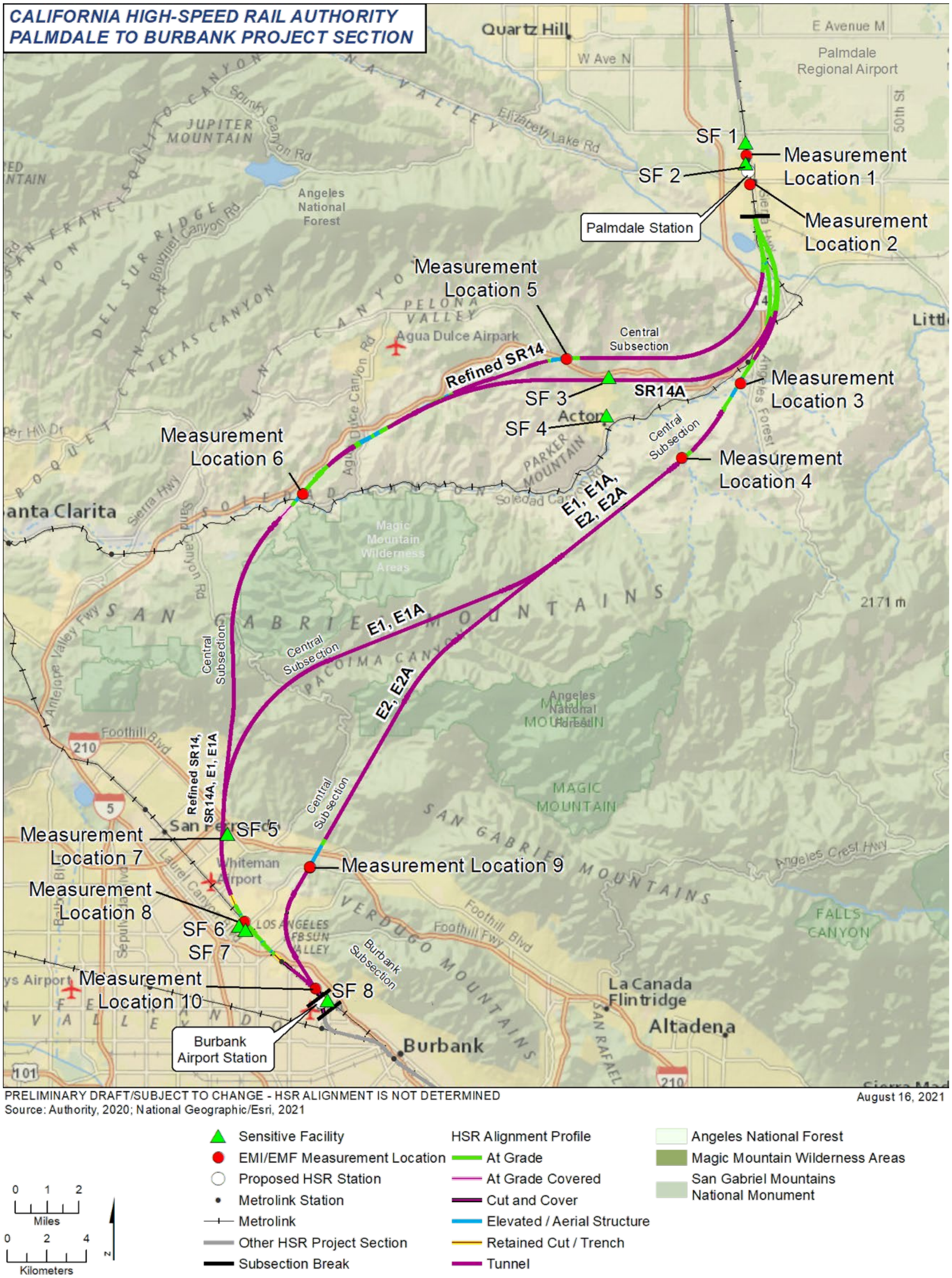

Figure 3.5-1 EMI/EMF Measurement Locations

The Authority reviewed existing facilities and uses within the RSA with respect to the electromagnetic environment, and 10 measurement locations were selected to establish the range of different EMI baseline conditions based on the presence of typical emitters such as power lines, antenna towers, and potentially sensitive facilities. Consistent with the Authority's guidance on EMI/EMF measurement contained in *Technical Memorandum: Measurement Procedure for Assessment of California High-Speed Train Alignment EMI Footprint,* measurement locations capture a range of typical conditions along all six of the Build Alternative alignments, including areas with numerous emitters and more undeveloped areas (Authority 2010b). Selection of measurement locations also focused on areas where each of the six Build Alternatives would require aboveground footprint and at-grade or elevated alignment. Intervening soil would prevent subsurface infrastructure required for each of the six Build Alternatives from resulting in surface EMI/EMF impacts where such infrastructure would be constructed in deep tunnels. As shown in Figure 3.5-1, urban sites were selected for measurement locations in Palmdale, Los Angeles County, and Burbank, while locations in less developed areas were selected to capture more rural conditions at tunnel portal sites between the major urban centers of the Palmdale to Burbank Project Section. By measuring a variety of locations, conditions across large areas of each of the six Build Alternative alignments could be estimated. Table 3.5-8 summarizes the locations where EMI measurements were performed. To note, information regarding facilities and receptors in the Palmdale and Maintenance Facility Subsection, such as Measurement Location 1 and Measurement Location 2, are provided in this section for context; however, effects regarding sensitive receivers within the Palmdale Subsection and Maintenance Facility are discussed in the Bakersfield to Palmdale Project Section EIR/EIS.

The RF and magnetic field measurements and identification of sensitive receptors for the Palmdale to Burbank Project Section were performed between August 22 and 26, 2016. Since the survey was conducted, additional review of aerial imagery and database searches conducted in November 2020 confirmed that land uses have not changed substantially since 2016, and that no new uses susceptible to EMI/EMF impacts are present within the sensitive receptor RSA (Los Angeles County 2018).

Two types of measurements were performed at each of the 6 locations for the E1, E1A, E2, and E2A Build Alternatives. For the Refined SR14 and SR14A Build Alternatives, only 6 and 5 locations were measured, respectively. The first type of measurement involved radiated electric fields from 10 kHz to 6 GHz, meant to characterize the RF environment. These electric field strengths were measured using an RF spectrum analyzer and calibrated antennas. Expected sources of RF signals included the following:

- Cell towers (cellular telephone signals)
- Broadcast towers (radio and television broadcasts)
- Airport radars and aircraft communications equipment
- General high-frequency and very-high-frequency fixed and mobile communications systems (police, fire, emergency medical technician, utilities, and government)
- Local wireless (Wi-Fi and Worldwide Interoperability for Microwave Access)

The second type of measurement assessed background DC and power frequency magnetic fields along the alignment. These magnetic fields were recorded using a three-axis fluxgate sensor with a waveform recording data acquisition system. Expected sources of DC and low-frequency magnetic fields include the following:

- The geomagnetic field[2]
- Utility high-voltage transmission/power lines
- Utility electric distribution lines

[2] The geomagnetic field is produced naturally by electric currents flowing in the Earth's metallic core. At the Earth's surface, this field varies in strength from approximately 0.3 to 0.6 mG.

- Utility substations
- Utility switching stations
- Utility electrical generation facilities
- Geomagnetic perturbations due to passing vehicles and trains on nonelectrified lines

Sensitive Facilities

The impact analysis focused on identifying impacts on sensitive receptors, which consist of land uses and facilities susceptible to EMFs and EMI that would be produced by the Build Alternatives. These receptors include adjacent railroads and rail transit systems, airports, residential dwellings, schools, preschools and daycare facilities, hospitals, agricultural facilities, and commercial and industrial facilities. These land uses have communications systems, sensitive equipment, or other electronic devices that EMFs could disrupt. Residences are considered to be EMF sensitive because people residing in the residences could be exposed to EMFs.

EMF and EMI Levels

To predict EMF levels from operation of the six Build Alternatives, the following assessment approach was implemented:

- EMF-sensitive land uses were identified through a review of aerial imagery, county parcel data, and local planning documents
- Baseline EMF levels were measured at each of the 10 locations representing typical land use character along the Build Alternatives as described above and in Appendices 3.5-A and 3.5-B.
- The Magnetic Field Calculation Model, a mathematical model of the California HSR System traction electrical system, was then used to calculate the anticipated maximum 60 Hz magnetic fields that a single HSR train would produce.

The model incorporates conservative assumptions for the EMF impacts of each of the six Build Alternatives. For example, the projected maximum magnetic fields would exist only for a short period and only in certain locations as the fast-moving train travels along the track or changes its speed and acceleration. The magnetic field levels would decline rapidly as the lateral distance from the tracks increases. For most locations and most times, exposure to EMFs would not be as high as predicted by the model, which predicts peak EMF levels.

The model also identifies how the projected maximum EMF levels would vary with the lateral distance from the centerline of the tracks. For sensitive land uses identified, the maximum EMF levels that each of the six Build Alternatives would emit were predicted and compared to measured ambient conditions at the 10 locations. Because magnetic fields are expected to be the dominant EMF impact from operations of each of the six Build Alternatives, these results are a key element in the EMF impact analysis.

Predicted EMF levels on sensitive receptors associated with the new/modified electrical infrastructure are based on the distance between the receptor and the nearest source. EMFs are also produced by electric substations, but due to the spacing of electrical equipment, measured field strengths are generally low and below recommended standards outside the fence line of the substation. Electrical fields near substations are mainly produced by the entering and exiting power lines (Western Area Power Administration n.d.).

EMF impacts on sensitive land uses were identified based on the differences between predicted EMF levels and existing conditions. The data from the 10 measurement locations were generalized to represent the entire sensitive receptor RSA for each of the Build Alternatives. Where the predicted maximum magnetic fields would be comparable to or lower than the typical existing levels, no adverse effect would occur, and these locations were screened out. Where the predicted magnetic fields would be higher than typical existing levels for exposure, the potential for EMI was used to evaluate whether adverse effects could be expected at the sensitive land uses.

3.5.4.4 Methods for Evaluating Impacts under NEPA

CEQ NEPA regulations (40 C.F.R. Parts 1500–1508) provide the basis for evaluating NEPA effects (Section 3.1.4.4). As described in Section 1508.27 of these regulations, the criteria of context and intensity are considered together when determining the severity of the change introduced by the Palmdale to Burbank Project Section. “Context” is defined as the affected environment in which a proposed project occurs. “Intensity” refers to the severity of the effect, which is examined in terms of the type, quality, and sensitivity of the resource involved; the location and the extent of the effect; duration of the effect (short- or long-term); and other considerations of context. Beneficial effects are also considered. When no measurable effect exists, no impact is found to occur. For the purposes of NEPA compliance, the same methods used to identify and evaluate impacts under CEQA are applied here.

3.5.4.5 Methods for Determining Significance under CEQA

CEQA requires that an EIR identify the significant environmental impacts of a project (CEQA Guidelines Section 15126). One of the primary differences between NEPA and CEQA is that CEQA requires a significance determination for each impact using a threshold-based analysis (see Section 3.5.4.3 for further information). Accordingly, Section 3.5.9, CEQA Significance Conclusions, summarizes the significance of the environmental impacts from EMFs and EMI for each of the six Build alternatives.

The Authority is using the following thresholds to determine if a significant impact from EMFs or EMI would result from each of the six Build Alternatives. The significance thresholds are based on relevant research and documentation on potential EMF and EMI safety levels, such as the ANSI/IEEE, FCC, and OSHA safety levels presented in Section 3.5.2. A significant impact is one that would:

- Expose a person to a documented 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 through EMF exposure near the HSR
- 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 shown in Table 3.5-4, 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), and the MPE for controlled environments that only contains workers is 27.12 G (2,712 μT). The MPE limit (IEEE standard C95.6, Table 4) for 60-Hz electric fields for the public is 5,000 V/m (5 kV/m) (Table 3.5-4). The MPE is 20 kV/m for controlled environments that could contain only HSR employees. IEEE standard C95.6 was formally adopted by the ANSI and is used regularly throughout the United States to analyze impacts related to EMFs. The safety levels established by this standard are well below the levels at which scientific research has shown harmful effects 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 (www.ices-emfsafety.org/).
- **Interference**—The Footprint Report provides typical interference levels for common types of sensitive equipment. These reported levels are used as the significance criteria for the interference impact analysis. Based on the Footprint Report, 2 mG is used as a screening level for potential disturbance to unshielded sensitive equipment. In addition, early epidemiological studies have shown that 2 mG is the highest level of chronic, long-term magnetic field exposure with no statistical association with a disease outcome (Savitz et al. 1988; Severson et al. 1988). The value of 2 mG is also a typical EMF level emitted from household appliances (Authority 2010a).

3.5.5 Affected Environment

This section discusses the affected environment related to EMI/EMF frequencies in the RSAs for the Build Alternatives. The following four sections describe the sources of EMF, EMI, and radio interference in the RSA; local conditions based on the measurements at the 10 measurement sites; the sensitive receptors in the Central Subsection; and the sensitive receptors in the Burbank Subsection.

3.5.5.1 Sources of EMF, EMI, and Radio Frequency Interference

Electromagnetic emissions are generated by regional and local sources. Regional sources such as television and radio that exist over large areas, extending tens to hundreds of miles from the broadcast antennas, were captured in measurements taken at the various measurement locations.

Local sources such as cell phone signals typically extend only a few miles from the transmitting antenna. Due to the spacing of the 10 measurement locations, these sources were observed above background just at the measurement location nearest the source.

The measured regional sources along the sensitive receiver and radio interference RSAs include stronger telecommunication transmitters that broadcast over a large area, radars and navigational aids, and electrical TPSSs. These sources include AM and FM radio stations, time signal transmitters, maritime and land mobile radio transmitters, air-to-ground transceivers, cell phone antennas, microwave communication links, and television station transmissions. Sources that were visually identified as near or in the line-of-sight of the measurement locations were photographed (see Appendix 3.5-B). Photographs taken at measurement locations along the proposed corridor show many sources, including police and fire department and FM radio transmitters. One regional airport is located within the radio interference RSA, the Hollywood Burbank Airport, where sources of EMF, EMI, and radio frequency interference occur. Local sources and facilities that typically contain highly sensitive RF equipment were not identified in the sensitive receiver RSA. Measurements for EMF and RF signal strength were taken within 1.5 miles of the proposed Maintenance Facility site. The sensitive receptors associated with these locations do not include RF transmission equipment; they are primarily underground pipelines.

3.5.5.2 Local Conditions

Existing local conditions were determined by measuring EMF levels at 10 representative locations within the RSA. Table 3.5-8 summarizes the 10 field measurement locations where EMI measurements were performed. These locations were selected by considering the geographic extent of the subsections and each Build Alternative, expected high- and low-emission areas, and land uses (including locations of potentially sensitive receptors). Moreover, these 10 monitoring locations provide a representative sampling of each Build Alternative under consideration. This is, in part, because there would be no substantive change in EMI/EMF levels in rural or urban land use areas between Build Alternatives in the vicinity of the measurement locations.

The survey of baseline conditions included measurements of radiated electric field strengths (RF levels) from 10 kHz to 6 GHz. This frequency range encompasses many different applications, including broadcast radio and digital television signals, communications, cell phones, and radar and navigation systems. In general, the highest RF electric field levels, especially at the broadcast frequencies, occur in the Palmdale and Burbank urban areas. The survey also quantified typical power-frequency magnetic field levels along the 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 TPSSs or generating equipment. The maximum or peak 60-Hz magnetic fields recorded in this survey ranged from 0.1 mG to 20.8 mG, depending primarily on the measurement locations' proximity to local distribution and transmission power lines.

3.5.5.3 Central Subsection

The Central Subsection extends from Spruce Court in Palmdale to Lockheed Drive in Burbank. Measurements were made at eight sites within the Central Subsection. A majority of the Central Subsection is within tunnels where the possibility of EMI with surrounding sensitive land uses are negligible due to the depth of the tunneled portions. As described in Section 3.5.4.3, the measurement locations were concentrated in areas where the track is at grade or elevated: Measurement Locations 3 and 4 along the E1, E1A, E2, and E2 Build Alternatives; Measurement Location 5 along the Refined SR14 Build Alternative; Measurement Location 6 along the Refined SR14 and SR14A Build Alternatives; Measurement Locations 7 and 8 along the E1, E1A, Refined SR14, and SR14A Build Alternatives; Measurement Location 9 along the E2 and E2A Build Alternatives; and Measurement Location 10 along all six Build Alternatives. With the exception of Measurement Location 5, which is not along the SR14A Build Alternative alignment, the measurement sites in the Central Subsection are in identical locations along the SR14A, E1A, and E2A Build Alternative alignments compared to the Refined SR14, E1, and E2 Build Alternative alignments, respectively.

Five potentially sensitive receptors were identified within the 500-foot buffer in the Central Subsection: Hillery T. Broadous Elementary School near Fillmore Street in Pacoima; Pacifica Hospital in Sun Valley; the Acton-Agua Dulce Unified School District campus (which is used by the Learn4Life and SCALE Leadership Academy) in Acton; High Desert School in Acton; the Serra Medical Group in Sun Valley; and Hollywood Burbank Airport at San Fernando Boulevard in Burbank. Each of these sensitive receptors is marked with a green triangle on Figure 3.5-2. Distances to potentially sensitive receptors are listed in Table 3.5-9 below. No other sensitive receptors were identified within the 500-foot buffer within this subsection.

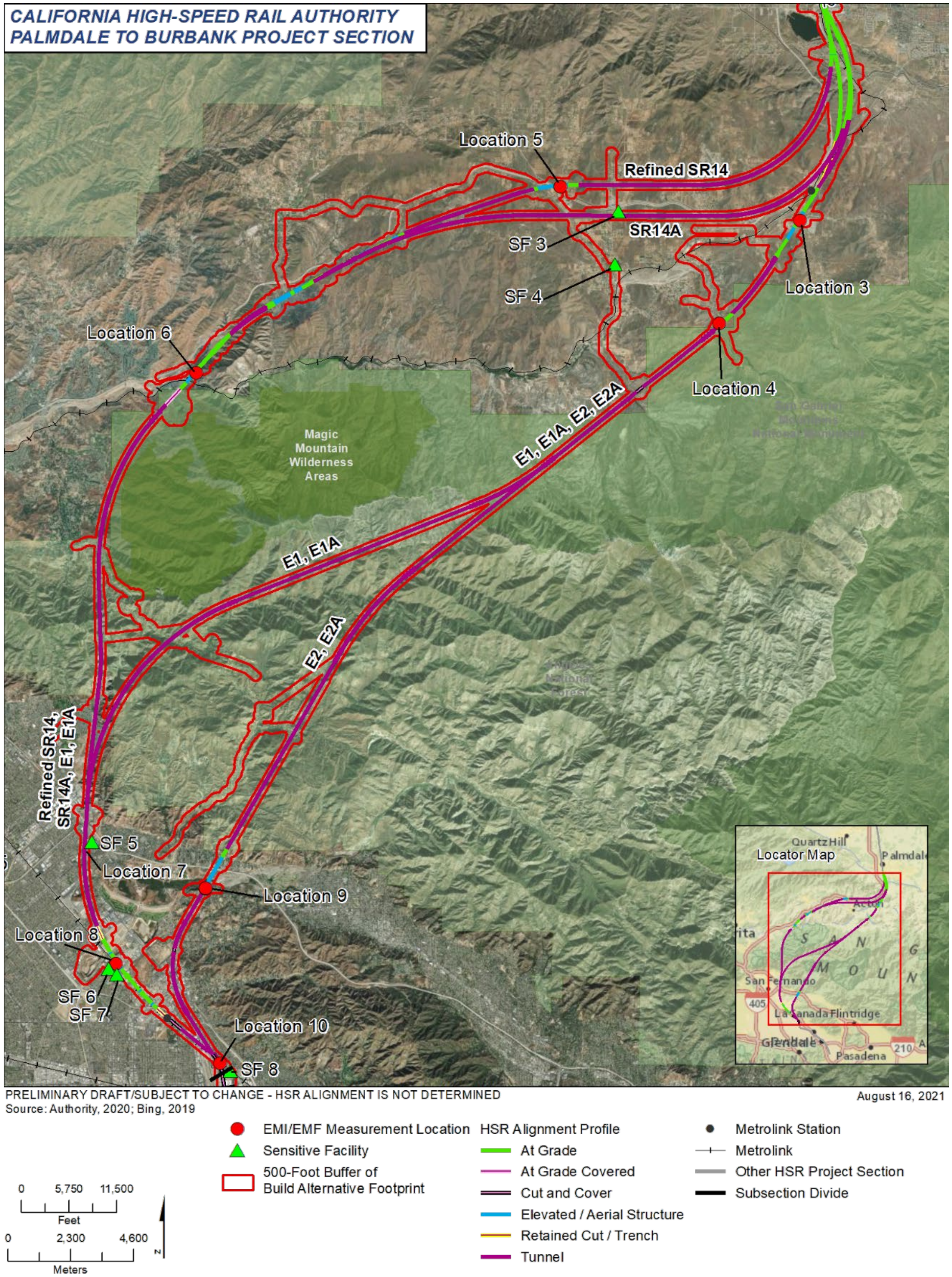

Figure 3.5-2 Central Subsection Measurement Locations

Table 3.5-9 Potentially Sensitive Facilities

Site	Location	Build Alternative Distance to Right-of-Way Centerline (feet)[1]	Estimated Ambient 60 Hz Field Strength, (mG)[2]	Map Label
Palmdale Subsection				
R. Rex Parris High School	Clock Tower Plaza Drive, Palmdale	120	0.05	SF 1
Embry-Riddle Aeronautical University	Sierra Highway, Palmdale	200	0.05	SF 2
Central Subsection				
High Desert School	3620 Antelope Woods Road, Acton	30[3] (SR14A only)	0.05	SF 3
Acton-Agua Dulce Unified School District/ Learn4Life/SCALE Leadership Academy	32248 Crown Valley Road, Acton	5,658[4]	0.05	SF4
Hillery T. Broadous Elementary School	Filmore Street, Pacoima	100 (Refined SR14, SR14A, E1, and E1A only)	0.44	SF 5
Pacifica Hospital	San Fernando Road, Sun Valley	270 (Refined SR14, SR14A, E1, and E1A only)	0.05	SF 6
Serra Medical Group	San Fernando Road, Sun Valley	110 (Refined SR14, SR14A, E1, and E1A only)	0.05	SF 7
Burbank Subsection				
Hollywood Burbank Airport	San Fernando Boulevard, Burbank	500 (closest point)	0.27	SF 8

Source: Authority, 2017
[1] Approximate distance of the facility from the right-of-way centerline.
[2] Median measured alternating current magnetic field of two sensors, taken from the closest measurement location.
[3] The SR14A Build Alternative alignment would pass underneath the High Desert School via a tunnel; in this case a nominal distance of 30 feet has been included.
[4] This facility would be in the vicinity of a water utility line required for each of the six Build Alternatives. The distance to the closest alignment centerline (SR14A Build Alternative) is provided here.
Hz = hertz
mG = milligauss
SF = sensitive facility
USAF = U.S. Air Force

3.5.5.4 Burbank Subsection

The Burbank Subsection extends from Lockheed Drive to Winona Avenue in Burbank (Figure 3.5-3). Portions of Hollywood Burbank Airport (formerly known as Bob Hope Airport) are within the Burbank Subsection sensitive receiver and radio interference RSAs. The Hollywood Burbank Airport is listed as the only potentially sensitive receptor within this subsection. This airport is included as a sensitive receptor because of the safety-critical nature of the airport's radio-based systems. Location 10 was selected within the Central Subsection to establish existing conditions within the Central and Burbank Subsections. Measured electric and magnetic fields were below regulatory limits (Table 3.5-9). No other sensitive receptors were identified.

Figure 3.5-3 Burbank Subsection Measurement Locations

3.5.6 Environmental Consequences

This section describes the environmental consequences of EMI/EMFs for the proposed six Build Alternatives and discusses measures to reduce impacts.

3.5.6.1 Overview

This assessment describes the impacts of the Build Alternatives with incorporation of avoidance and minimization features or other refinements discussed in Chapter 2, Alternatives, for the No Project and Build Alternatives. All six Build Alternatives would generally result in similar impacts (listed below), but would vary in the degree of effect, likelihood, and extent of the impacts. Section 3.5.6.2 discusses anticipated impacts in the absence of constructing and operating the Palmdale to Burbank Project Section. Section 3.5.6.3 address construction-period and operations impacts separately for the Build Alternatives as follows:

- **Construction Impacts**
  - Impact EMI/EMF#1: Temporary Impacts from Use of Heavy Construction Equipment.
  - Impact EMI/EMF#2: Temporary Impacts from Communications Equipment.
  - Impact EMI/EMF#3:Temporary Impacts from Operation of Electrical Equipment.
- **Operations Impacts**
  - Impact EMI/EMF#4: Permanent Human Exposure to EMF.
  - Impact EMI/EMF#5: People with Implanted Medical Devices and Exposure to EMF.
  - Impact EMI/EMF#6: Exposure of Livestock, Poultry, Domestic Animals, and Wildlife to EMF.
  - Impact EMI/EMF#7: EMI with Sensitive Equipment.
  - Impact EMI/EMF#8: EMI Effects on Schools
  - Impact EMI/EMF#9: Potential for Corrosion of Underground Pipelines, Cables, and Adjoining Rail.
  - Impact EMI/EMF#10: Potential for Nuisance Shocks.
  - Impact EMI/EMF#11: Effects on Adjacent Existing Rail Lines.
  - Impact EMI/EMF#12: Effects Related to Adjacent Airports.

Table 3.5-10 below, shows the modeled EMF strength estimated during operations at potentially sensitive facilities near alignments of each of the six Build Alternatives.

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 radio interference and sensitive receiver RSAs is increasing, and this growth is projected to continue. Various growth policies have been developed to limit the additional spread of low-density growth. Planned urban development and transportation infrastructure projects would accommodate the growth projections throughout the region. Under the No Project Alternative, these future conditions would likely result in additional use of electricity and RF communication equipment, including high-voltage power lines and antennas, that would generate EMI/EMF primarily within the urbanized portions of the Antelope Valley and San Fernando Valley. Smaller communities between these urban centers would also experience future development that would generate EMI/EMF at levels proportional to the rural character of this area. Land use restrictions within the ANF, including the SGMNM, would generally preclude development from taking place in currently undeveloped areas within the ANF.

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 EMFs and EMI that might affect people and sensitive receptors would continue in the area due to the potential increase of population growth.

3.5.6.3 Build Alternatives

As noted in Section 3.5.4.3, information regarding facilities and receptors in the Palmdale Subsection and Maintenance Facility area are provided in this section for context; however, effects regarding sensitive receptors of the Palmdale Subsection and Maintenance Facility are discussed in the Bakersfield to Palmdale Project Section EIR/EIS.

Construction Impacts

Impact EMI/EMF#1: Temporary Impacts from Use of Heavy Construction Equipment.

Implementation of all six Build Alternatives would require construction of shared features, including trackway, stations, TPSSs, and electrical upgrades that necessitate the use of heavy equipment, trucks, and light vehicles. Like other motor vehicles, construction vehicles generate low levels of EMI and EMFs. Movement of large construction vehicles would result in transient changes to the static DC magnetic field. In this context, “transient changes” refer to intermittent EMI/EMF fluctuations associated with the proximity to active equipment moving around a construction site. EMFs generated by motor vehicles, however, consist of highly localized fields and would attenuate within a few feet of each vehicle (Ferrari, Mariscotti, Motta, and Pozzobon 2001). Although such changes can interfere with some equipment, construction vehicles must be both very large and operate very closely to the sensitive equipment to cause interference. For example, articulated buses (approximately 50,000 pounds) produce magnetic field shifts of approximately 0.5 mG at a distance of 70 feet (ERM 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. A vehicle with half the mass of the articulated bus would need to be within 25 feet to generate the same field shift. Because the magnitude of this disturbance would decrease with distance, construction vehicles that weigh less than 1,000 pounds would pose no reasonable interference risk to magnetically sensitive equipment at pass-by distances greater than 50 feet because magnetic shifts at this distance would be below the interference threshold of 2 mG. The use of construction vehicles that weigh more than 100,000 pounds could also result in EMI/EMFs at sensitive receptors more than 50 feet from the Build Alternative footprint. However, EMI/EMF fluctuations resulting from construction equipment would not exceed MPE limits for humans or interfere with medical implants.

Construction of all six Build Alternatives could require active construction vehicles within 50 feet of the sensitive facilities listed in Table 3.5-9. These sensitive facilities include the R. Rex Parris High School, Embry-Riddle Aeronautical University, and Hollywood Burbank Airport for the Refined SR14, E1, and E2 Build Alternatives. Additionally, construction of the Refined SR14 and E1 Build Alternatives could require active construction vehicles within 50 feet of the Hillery T. Broadous Elementary School, Serra Medical Group, Pacifica Hospital, and the Acton-Agua Dulce Unified School District campus. Of these sensitive facilities, Pacifica Hospital and Serra Medical Group in Sun Valley, could house EMI-sensitive equipment. Both facilities currently operate magnetically sensitive imaging equipment such as MRI (Serra Medical Group 2021, Pacifica Hospital of the Valley 2021). However, both facilities could support or acquire equipment that would be sensitive to EMI. The SR14A, E1A, and E2A Build Alternatives would also require operation of construction vehicles near sensitive facilities. With one exception, such impacts would be identical to those resulting from implementation of the Refined SR14, E1, and E2 Build Alternatives, respectively. The SR14A Build Alternative could require operation of construction vehicles within 50 feet of the High Desert School, because it would require tunnel construction directly beneath the High Desert School.

In accordance with EMI/EMF-IAMF#2, the design of the Preferred Alternative would minimize conflict with sensitive receptors through pre-construction review and design that will avoid potential interference with neighboring land uses in accordance with federal and state laws requiring avoidance of EMI. EMI/EMF-IAMF#2 will ensure the preparation of an EMI/EMF technical memorandum demonstrating project compliance with applicable federal and state laws. This measure would also ensure the completion of safety analyses and the grounding of metallic objects that could be potentially affected by the Build Alternative's EMI/EMFs. Any remaining impacts would be further reduced by implementing EMI/EMF-MM#1 (described in more detail in Section 3.5.7). Although EMI/EMF-IAMF#2 will reduce EMI/EMF impacts and these impacts would be temporary, use of heavy construction equipment required for the Refined SR14, SR14A, E1, and E1A Build Alternatives could still result in exceedances of the 2 mG numerical threshold at Serra Medical Group and Pacifica Hospital, where sensitive medical equipment could exist. The E2 and E2A Build Alternatives would not be constructed within 500 feet of the Serra Medical Group or Pacifica Hospital.

CEQA Conclusion

Each of the six Build Alternatives would require the use of heavy construction equipment capable of generating EMI/EMFs in the vicinity of sensitive receptors. Heavy construction equipment would not expose workers or the members of the public to a documented EMF health risk. EMI/EMF-IAMF#2 will minimize conflict with sensitive receptors through pre-construction review and design. However, use of heavy construction equipment required for the Refined SR14, SR14A, E1, and E1A Build Alternatives could still result in exceedances of the 2 mG numerical threshold. This represents a significant impact for the Refined SR14, SR14A, E1, and E1A Build Alternatives. EMI/EMF-MM#1 will reduce these impacts. The Authority would implement EMI/EMF-MM#1 by contacting affected third parties to explore the possibility of either relocating or shielding the affected equipment, and the Authority would implement measures to eliminate interference. With implementation of EMI/EMF-MM#1, temporary construction impacts on sensitive equipment would be less than significant under CEQA for the Refined SR14, SR14A, E1, and E1A Build Alternatives, because actions such as relocating or shielding affected equipment would eliminate the potential for interference with nearby sensitive equipment.

The E2 and E2A Build Alternatives are not located within 500 feet of EMI-/EMF-sensitive facilities and thus the use of heavy construction equipment would not interfere with nearby sensitive equipment at such facilities. This impact would be less than significant for the E2 and E2A Build Alternatives. Therefore, CEQA does not require any mitigation.

Impact EMI/EMF#2: Temporary Impacts from Communications Equipment.

Communication equipment used by construction crews would include mobile phones and radios that generate RF fields. Communication equipment would include off-the-shelf products that comply with FCC regulations at 47 C.F.R. 15 designed to prevent EMI with other equipment or hazards to persons. The EMFs generated during construction of all six Build Alternatives would be similar in strength to the EMFs produced at construction sites of other projects and would be unlikely to cause EMI with nearby land uses or hazards to workers or members of the public.

CEQA Conclusion

Complying with 47 C.F.R. 15, EMF generated by communications equipment during construction of all six of the Build Alternatives would not exceed the thresholds identified in Section 3.5.4.5, and it would not expose workers or members of the public to a documented EMF health risk or interfere with nearby sensitive equipment. The impact under CEQA would be less than significant for the Refined SR14, SR14A, E1, E1A, E2, and E2A Build Alternatives. Therefore, CEQA does not require mitigation.

Impact EMI/EMF#3: Temporary Impacts from Operation of Electrical Equipment.

Many types of construction equipment required for all six Build Alternatives contain generators or electric motors that generate EMFs. Despite variations in each of the Build Alternative footprints, these sources of EMFs are not anticipated to generate substantial EMI beyond the footprint of the six Build Alternatives and would not present a health risk to workers or members of the public. Electric welding equipment is perhaps the one instance where substantial EMFs could be generated. Welders with implanted medical devices and using high welding currents (greater than 225 amperes) should work with caution (Fetter 1996). EMF strengths from large electric welders could be in the range of 1 to 5 mG at 50 feet, so intermittent interference with magnetically sensitive equipment would be possible. But other construction workers, including those with implanted medical devices, would not be at risk operating other types of construction equipment.

Regarding sensitive equipment, magnetic field strengths from large electric welders could be in the range of 1 to 5 mG at a distance of 50 feet, so transient interference with magnetically sensitive equipment is possible. EMI/EMF-IAMF#2 will be employed for all of the Build Alternatives and would minimize impacts. As part of the ISEP, the Authority would monitor field conditions to determine if such EMC issues arise and provide the necessary coordination with affected third parties and the construction contractor to resolve any interference. Although EMI/EMF-IAMF#2 will reduce EMI/EMF impacts and impacts would be temporary, use of construction electrical equipment required for the Refined SR14, SR14A, E1, and E1A Build Alternatives could still result in exceedances of the 2 mG numerical threshold at the Serra Medical Group and Pacifica Hospital where sensitive medical equipment could exist within 50 feet of construction activities. The E2 and E2A Build Alternatives would not be constructed within 500 feet of the Serra Medical Group or Pacifica Hospital. Any remaining impacts would then be addressed by implementing EMI/EMF-MM#1, which will require the Authority to contact the affected third parties and determine how best to protect sensitive equipment, either through relocation or shielding in place.

CEQA Conclusion

Each of the six Build Alternatives would require the use of electrical equipment capable of generating EMF near sensitive receptors. This equipment would expose people to a documented EMF health risk and, in the case of the Refined SR14, SR14A, E1, and E1A Build Alternatives, could interfere with sensitive equipment at Serra Medical Group. This represents a significant impact for the Refined SR14, SR14A, E1, and E1A Build Alternatives. EMI/EMF-IAMF#2 will reduce temporary impacts from the operation of high-current electrical welding equipment during construction; however, the impact under CEQA could still be significant and exceed 2 mG. Therefore, CEQA requires mitigation. To reduce these environmental impacts, the Authority would implement EMI/EMF-MM#1, which requires affected third parties to be contacted to explore the possibility of either relocating or shielding affected equipment in order to eliminate the interference. With the implementation of EMI/EMF-MM#1, temporary impacts from the operation of electrical welding equipment during construction would be less than significant under CEQA because actions such as relocating or shielding affected equipment would eliminate the potential for interference with nearby sensitive equipment.

The E2 and E2A Build Alternatives would not be within 500 feet of EMI/EMF sensitive facilities and thus would not interfere with nearby sensitive equipment at such facilities. This impact would be less than significant for the E2 and E2A Build Alternatives. Therefore, CEQA does not require any mitigation.

Operations Impacts

Impact EMI/EMF#4: Permanent Human Exposure to EMF.

Given that all six of the Build Alternatives would employ the same trains, operations of all six Build Alternatives would generate 60 Hz electric and magnetic fields on and adjacent to trains, including in passenger station areas. Table 3.5-10 presents the model results for the Build Alternatives. Detailed information about reconductoring upgrades, interconnection facilities, and other electrical facilities can be found in Chapter 2, Alternatives.

Table 3.5-10 Summary of Electromagnetic Field Modeling Results

EMF Analysis	Platform: 16 feet from Centerline	Fence Line: 30 feet from Centerline	Resource Study Area: 500 feet from Centerline
Magnetic Field (mG) Single-Train HSR[1]	720	177	Less than 1
Electric Field (V/m) Typical 2-track OCS geometry[2]	810	110	Less than 1

[1] Source: Authority, 2011a
[2] Source: Authority, 2017
HSR = high-speed rail
mG = milligauss
OCS = overhead contact system
V/m = volts per meter

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 A (165 mG), as well as in the operator's cab of the Acela Express (58 mG) and Train à Grande Vitesse A (367 mG) (Federal Railroad Administration 2006). It should be noted that the California 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 the design employed by the Acela Express and Train à Grande Vitesse A systems, and in general would be expected to produce magnetic fields that are equal to or lower than the quoted values. For example, the electrified Northeast Corridor used by the Acela Express 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 exposure on other existing HSR systems are below the MPE limits of 5 kV/m and 9,040 mG for the public.

During operations of the Palmdale to Burbank Project Section, all six Build Alternatives would generate EMI/EMFs below the applicable MPE standards for humans in uncontrolled (open) environments. The HSR-generated EMI/EMF levels to which employees working in traction power facilities and emergency backup generator rooms would be exposed are expected to be lower than the applicable California HSR System MPE standards for human exposure in controlled environments.

CEQA Conclusion
Operations of all six Build Alternatives could expose passengers and workers to EMFs. EMF exposure resulting from operations of the Build Alternatives would be below the IEEE standard limit of 9,040 mG for the public. Therefore, the six Build Alternatives would not expose persons to a documented EMF health risk This impact would be less than significant for the Refined SR14, SR14A, E1, E1A, E2, and E2A. Build Alternatives. Therefore, CEQA does not require any mitigation.

Impact EMI/EMF#5: People with Implanted Medical Devices and Exposure to EMF.

Magnetic fields of 1,000 to 12,000 mG (1 to 12 G) may interfere with implanted medical devices (EPRI 2004). The ACGIH recommends that 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 public. EMI/EMF conditions at these facilities would not differ between Build Alternatives.

For all six Build Alternatives, emergency standby generators would be placed at passenger stations and at the TPSS facilities. Electrical devices, such as transformers and distribution lines common to an electrical TPSS, could generate EMFs within the immediate secure work area, except where power lines enter and exit the facility, and would rapidly decrease with distance from the source within the substation. The emergency power generator room would not be accessible to the public. Only the immediate area would be a risk for workers, not passengers or other members of the public.

Traction power facilities and emergency power generator room sites would be unmanned, and workers would enter them only periodically (for example, to perform routine maintenance). However, EMF levels above the recommended limits for employees with implanted medical devices could exist inside traction power facilities and emergency power generator rooms. EMI/EMF-IAMF#2, described in Section 3.5.4.2, would require the Authority to implement a safety program that includes disclosure of health risks to employees, particularly those who have implanted medical devices, as it would require adherence to the HSR Design Criteria Manual. To protect their health and safety, the safety program would preclude workers with implanted medical devices from entering facilities with electrical equipment that could endanger them. For passengers, as noted in Impact EMI/EMF#3 above, the EMI and EMF exposure levels would be below the MPE and not interfere with an implanted medical device. Additionally, passengers and members of the public would not have access to traction power facilities or emergency generator rooms.

CEQA Conclusion

All six Build Alternatives could expose workers with implanted medical devices to EMF in traction power facilities and emergency power generator rooms; however, EMI/EMF-IAMF#2 will require implementation of a safety program that would preclude these workers from entering facilities with electrical equipment that could endanger them. Signs would be posted to alert employees to avoid the potentially hazardous conditions; thus, there would be no human health risk for employees. For passengers and members of the public, the EMI and EMF exposure levels would be below the MPE and would not interfere with an implanted medical device. Additionally, passengers and members of the public would not have access to traction power facilities or emergency generator rooms. Thus, operations of the six Build Alternatives would not expose persons to a documented EMF health risk. This impact would be less than significant for the Refined SR14, SR14A, E1, E1A, E2, and E2A Build Alternatives. Therefore, CEQA does not require any mitigation.

Impact EMI/EMF#6: Exposure of Livestock, Poultry, Domestic Animals, and Wildlife to EMF.

Livestock

Livestock is defined as animals, such as cows, sheep, and goats, that are used for agricultural practices. For the purpose of analysis, only dairy cows are discussed because sheep and goats are not known to exist in the RSA. Each of the six Build Alternatives would be near agricultural farms that have livestock present. Studies have been conducted regarding exposure of EMFs on dairy cows. To establish the impact of EMFs on dairy production, McGill University conducted a study 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 melatonin levels, prolactin levels, milk production, milk-fat content, dry-matter intake by cows, and reproductive outcomes. Although a few statistically significant changes in these factors were found, none of the changes was outside the normal range for cows (Exponent 2008). The study concluded that the EMF exposure did not harm the cows or reduce milk productivity.

Poultry

Poultry is defined as domesticated avian species that can be raise for eggs, meat and feathers. As described in Section 3.14, Agricultural Farmland and Forest Land, agricultural use around each of the six Build Alternatives is limited to grazing land. Confined poultry is not known to exist in the RSA.

Domestic Animals

Domestic animals are defined as animals that have been tamed and kept by humans as a work animal or pet. Each of the six Build Alternative alignments would be near public equestrian facilities at the following locations:

- Pacific Crest Trail (Refined SR14 Build Alternative only)
- Vasquez Rocks Natural Area Park (Refined SR14 and SR14A Build Alternatives only)
- Hansen Dam Recreation Area (E2 and E2A Build Alternatives only)
- Stonehurst Park and Recreation Center (E2 and E2A Build Alternatives only)

Additionally, there are private equestrian facilities in the Palmdale to Burbank Project Section, particularly near the Southern California Edison's Vincent Substation and in the Shadow Hills area.

For the Pacific Crest Trail, the Refined SR14 Build Alternative would pass over the trail via viaduct at two points and would affect 0.7 miles of the trail. During operations of the project, the effects of EMF levels would be minimal to horses, as the train would pass over via viaduct, and would be passing at high speeds for a minimal duration. The Vasquez Rocks Natural Area Park is 1,000 feet from the centerline of the Refined SR14 and SR14A Build Alternatives, which is outside of the sensitive receptors RSA.

The E2 and E2A Build Alternative alignments would cross the eastern edge of the Hansen Dam Open Space, while the majority of open space amenities are on the western side. Additionally, only a small portion of the park would be affected by operations of the E2 and E2A Build Alternatives. Similar to the Pacific Crest Trail, during operations of the project, the effects of EMF levels would be minimal to horses, as the train would pass over via viaduct, and would be passing at high speeds for a minimal duration. For the E2 and E2A Build Alternatives, Stonehurst Park and Recreation Center would be 900 feet from the centerline, however the portion of the alignments would be underground bored tunnel, which would have no surface effects. As there would be no surface effects, no EMF exposure to livestock would occur. Similar to the effects of the Stonehurst Park, all private equestrian facilities in the Shadow Hills area and near the Southern California Edison's Vincent Substation would be in proximity to a portion of the E2 and E2A Build Alternatives that is underground bored tunnels, with no surface effects. Additionally, the equestrian facilities are outside of the 500 foot buffer, and therefore would not have impacts associated with EMF exposure to livestock.

Wildlife

For purposes of this discussion, wildlife is defined as undomesticated, roaming animals that can be found in the wild. Various studies cited by other researchers regarding EMFs and wildlife suggest a range of effects similar to livestock, from nonexistent, to relatively small, to positive risks. Right-of-way fencing would prevent larger wildlife from traveling in proximity to harmful EMF levels. For smaller wildlife traveling near the Build Alternative alignments, the effects would be minimal as the wildlife would be exposed in short durations of time, therefore limiting the effects of EMF levels. Due to the fencing, it is unlikely that wildlife would be exposed to high levels of EMF for an extended period of time.

CEQA Conclusion

The six Build Alternatives would not expose livestock, poultry, domestic animals, and wildlife to harmful EMF levels because the right-of-way fencing would maintain a sufficient distance from proposed EMI/EMF sources at between the livestock, domestic animals, and wildlife to prevent exposure to harmful EMF levels. This impact would be less than significant for the Refined SR14, SR14A, E1, E1A, E2, and E2A Build Alternatives. Therefore, CEQA does not require any mitigation.

Impact EMI/EMF#7: EMI with 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 potential EMI sources;

however, the potential exists to affect older devices, and those may require shielding. Sensitive facilities within the sensitive receiver RSA which may have sensitive equipment that could be exposed to EMI are shown in Table 3.5-11. EMI/EMF-MM#1 requires the Authority to contact relevant entities regarding the impacts of HSR–related interference on imaging equipment before completion of final design.

Table 3.5-11 Impacts on Potentially Sensitive Facilities within the Build Alternative Resource Study Areas

Site	Location	Build Alternative Distance to Right-of-Way Centerline (feet)[1]	MPE for the General Public (mG)	Interference Threshold (mG)	Modeled 60-Hz Field at Measurement Location (Single Train) (mG)[2,3]	Estimated Ambient 60-Hz Field Strength, (mG)[4]	Map Label
Palmdale Subsection							
R. Rex Parris High School	Clock Tower Plaza Drive, Palmdale	120	9,040	2	8.9	0.05	SF 1
Embry-Riddle Aeronautical University	Sierra Highway, Palmdale	200	9,040	2	3.2	0.05	SF 2
Central Subsection							
High Desert School	3620 Antelope Woods Road, Acton	30 [5] (SR14A only)	9,040	2	148	0.05	SF 3
Acton-Agua Dulce Unified School District/ Learn4Life/ SCALE Leadership Academy	32248 Crown Valley Road, Acton	5,658[6]	9,040	2	Less than 0.01	0.05	SF 4
Hillery T Broadous Elementary School	Filmore Street, Pacoima	100 (Refined SR14, SR14A, E1A, and E1 only)	9,040	2	12.9	0.44	SF 5
Pacifica Hospital	San Fernando Road, Sun Valley	270 (Refined SR14, SR14A, E1A, and E1 only)	9,040	2	1.7	0.05	SF 6

Site	Location	Build Alternative Distance to Right-of-Way Centerline (feet)[1]	MPE for the General Public (mG)	Interference Threshold (mG)	Modeled 60-Hz Field at Measurement Location (Single Train) (mG)[2,3]	Estimated Ambient 60-Hz Field Strength, (mG)[4]	Map Label
Serra Medical Group	San Fernando Boulevard, Sun Valley	110 (Refined SR14, SR14A, E1A, and E1 only)	9,040	2	10.6	0.05	SF 7
Burbank Subsection							
Hollywood Burbank Airport	San Fernando Boulevard, Burbank	500 (closest point)	9,040	2	12.9	.27	SF 8

Source: Authority, 2017
[1] Approximate distance of the facility from centerline of right-of-way.
[2] Calculated magnetic fields for single-train high-speed rail passing the facility location.
[3] Estimated from Figure E-1b of the Footprint Report (Authority 2010a).
[4] Median measured alternating current magnetic field of two sensors, taken from the closest measurement location.
[5] The SR14A Build Alternative alignment would pass underneath the High Desert School via a tunnel; in this case a nominal distance of 30 feet has been included.
[6] This facility would be in the vicinity of a water utility line required for each of the six Build Alternatives. The distance to the closest alignment centerline (SR14A Build Alternative) is provided here.
Hz = hertz
mG = milligauss
MPE = maximum permissible exposure
SF = sensitive facility
USAF = U.S. Air Force

No sensitive medical facilities are within 500 feet of the E2 Build Alternative. As shown in Table 3.5-11, two medical facilities, Pacifica Hospital and Serra Medical Group in Sun Valley, were identified within 500 feet of the Refined SR14, SR14A, E1, and E1A Build Alternatives. As described under Impact EMI/EMF#1, both facilities could support or acquire equipment that would be sensitive to EMI. Modeled EMFs at Pacifica Hospital would be less than the 2-mG threshold for interference with implementation of either the Refined SR14, SR14A, E1, and E1A Build Alternatives. Such impacts would be identical to those resulting from implementation of the Refined SR14, SR14A, E1, and E1A Build Alternatives, respectively.

CEQA Conclusion

The Refined SR14, SR14A, E1, and E1A Build Alternatives could expose sensitive medical equipment to EMI, which would be a significant impact, and CEQA requires mitigation. Where necessary, the final design of the selected alternative would include suitable design provisions to prevent interference. With implementation of EMI/EMF-MM#1, this impact would be less than significant for the Refined SR14, SR14A, E1, and E1A Build Alternatives.

The E2 and E2A Build Alternatives would not be located within 500 feet of EMI-/EMF-sensitive facilities and thus would not interfere with nearby sensitive equipment at such facilities. No impact would occur for these Build Alternatives. Therefore, CEQA does not require any mitigation.

Impact EMI/EMF#8: EMI Effects on Schools.

Several schools are within the sensitive receiver RSA of one or more of the six Build Alternatives. Three schools—R. Rex Parris High School and Embry-Riddle Aeronautical University in Palmdale and Hillery T. Broadous Elementary School in Pacoima—were identified within 500 feet of the Refined SR14, SR14A, E1, E1A, E2, and E1A Build Alternative footprints. However, the R. Rex Parris High School would be displaced by the Build Alternatives and relocated, and therefore would not be affected by EMI. The SR14A Build Alternative footprint would be within 500 feet of the High Desert School.

The Acton-Agua Dulce Unified School District campus was identified within 500 feet of the Refined SR14, SR14A, E1, E1A, E2, and E2A Build Alternative footprints. With one exception, such impacts on schools would be identical to those resulting from implementation of the Refined SR14, E1, and E2 Build Alternatives, respectively. Additionally, the Acton-Agua Dulce Unified School District campus has the Learn4Life center for K-12 students would be within 500 feet of the Refined SR14, SR14A, E1, E1A, E2, and E2A Build Alternative footprints.

All six Build Alternatives would use radio systems for the enhanced automatic train control, data transfer, and communications systems, raising the concern that HSR operations could result in EMI with the radio systems in use at the nearby schools. Palmdale to Burbank Project Section radio systems would transmit radio signals from antennas at stations and along the track alignment, and on locomotives and train cars. The Authority has acquired 44 dedicated frequencies in the 700-MHz A Block spectrum for use by the California HSR System (Authority 2016). As only authorized parties would 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 will avoid or minimize EMI effects on schools.

Additionally, the Authority would implement an 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, designs of systems to prevent EMI with identified neighboring uses, and incorporation of these design requirements into bio specifications used to procure radio systems.

CEQA Conclusion

Operations of all six Build Alternatives would expose schools to EMF. However, the Build Alternatives' radio system would use dedicated frequencies and HSR equipment would meet FCC regulations (47 C.F.R. 15), which would avoid interference with sensitive communications equipment, such as Wi-Fi and radio systems, at nearby schools. This impact would be less than significant for the Refined SR14, SR14A, E1, E1A, E2, and E2A Build Alternatives. Therefore, CEQA does not require any mitigation.

Impact EMI/EMF#9: Potential for Corrosion of Underground Pipelines, Cables, and Adjoining Rail.

Operation of the Build Alternatives could result in corrosion of underground pipelines, cables, and adjoining rail from stray AC ground currents. TPSSs located approximately every 30 miles along each of the six Build Alternative alignments would deliver AC current to the HSR trains through the OCS, with return current flowing from the trains back to the TPSS 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 locations, some of the return current to the TPSSs would be transferred from the rails to the static wires. Most return current would be carried by the HSR rails and the static wire back to the TPSS, but some return current could 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 sensitive receiver RSAs 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. Nevertheless, linear metallic objects, such as buried pipelines, cables, or adjoining rails, could carry some AC ground current resulting from operations of each of the six Build Alternatives. AC ground currents have a much lower propensity to cause corrosion in parallel conductors than do the DC currents used by rail transit lines such as Bay Area Rapid Transit or Los Angeles County Metropolitan Transportation Authority. Nonetheless, stray AC currents could 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). Corrosion of underground pipe and cable could occur along all six Build Alternatives' surface alignments, depending on soil conductivity and the presence of ungrounded metal objects. EMI/EMF-IAMF#2 requires the identification and grounding of susceptible pipelines and other linear metallic objects along the project alignment. This effort will occur in coordination with the affected owner or utility as part of the construction of the Build Alternatives. Alternatively, insulating joints or couplings could be installed in continuous metallic pipes to prevent current flow, such that corrosion would be minor.

The Authority would implement and follow the ISEP (Authority 2014a) to help avoid and minimize possible impacts on underground pipelines and cables, including the grounding of pipelines. If adjacent pipelines and other linear metallic structures are not sufficiently grounded through the direct contact with earth, the Authority would include additional grounding of pipelines and other linear metallic objects, in coordination with the affected owner or utility, as part of the construction of the HSR Build Alternative. The contractor would follow the procedures set out in the ISEP to help avoid and minimize the potential for impacts on underground pipelines and cables, including the grounding of pipelines. Alternatively, insulating joints or couplings may be installed in continuous metallic pipes to prevent current flow. Specific measures for avoiding stray current corrosion are discussed in the Chapter 23 of the *Design Criteria Manual* (Authority 2014c). Measures such as applying (or repairing) structure coatings and providing cathodic protection are standardized practices that prevent corrosion. As a result of these steps, the potential for corrosion from ground currents resulting from operation of the HSR Build Alternative would be avoided.

CEQA Conclusion

Operations of the Build Alternatives could result in stray current that could cause corrosion of nearby pipelines, cables, or adjoining rails. EMI/EMF-IAMF#2 will avoid the potential for corrosion from ground currents by installing supplemental grounding or by insulating sections in continuous metallic objects in accordance with measures called for in Chapter 23 of the *Design Criteria*

Manual (Authority 2014c). With implementation of EMI/EMF-IAMF#2, operations of the Build Alternatives would not subject underground pipelines, cables, and adjoining rail to corrosion. This impact would be less than significant for the Refined SR14, SR14A, E1, E1A, E2, and E2A Build Alternatives, because project features would minimize corrosion risks by arranging for the grounding of nearby underground linear metal structures or insulating metallic pipes to prevent current flow. Therefore, CEQA does not require any mitigation.

Impact EMI/EMF#10: Potential for Nuisance Shocks.

EMFs from the voltage on and currents running through the OCS could induce current in nearby conductors, such as ungrounded metal fences, utility pipelines, and ungrounded metal irrigation[3] systems alongside the HSR alignment, which could cause a nuisance shock to anyone who touches these conductors. This effect would be most likely where long (1 mile or more) ungrounded fences or irrigation systems run parallel to the HSR and are electrically continuous throughout that distance. Metal structures could also produce nuisance shocks but should already be properly grounded consistent with the National Electrical Code guidelines in Article 250 for building and electrical system safety and lightning protections.

EMI/EMF-IAMF#2 will reduce these potential shock hazards by grounding HSR fences, non-HSR metal fences, and metal irrigation systems that parallel the Build Alternative alignments. In addition, insulating sections would be installed in fences to prevent current flow and would be coordinated with owners of the metal objects. For cases where such fences are purposely electrified to inhibit livestock or wildlife from traversing the fences, the contractor would implement specific insulation design measures per the Authority's standard design manual.

CEQA Conclusion
Operations of all six Build Alternatives could expose a person to an EMF-related nuisance shock. EMI/EMF-IAMF#2 will reduce nuisance shock hazards by grounding susceptible facilities, thereby avoiding exposure of persons to a documented EMF health risk. With implementation of EMI/EMF-IAMF#2, this impact would be less than significant for the Refined SR14, SR14A, E1, E1A, E2, and E2A Build Alternatives. Therefore, CEQA does not require any mitigation.

Impact EMI/EMF#11: Effects on Adjacent Existing Rail Lines.

Operations of the Build Alternatives is not anticipated to result in effects on adjacent existing rail lines. Signal systems control the movement of trains on existing railroad tracks, including those sections that run parallel to the HSR alignment (such as Metrolink and Union Pacific Railroad in the Burbank Subsection). These signal systems serve three general purposes, as follows:

- To warn vehicle drivers on cross streets 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 to 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 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. An AC or DC voltage applied between the rails by a signal system is reduced to a low voltage by the rail-to-rail connection of the metal wheel-axle sets of a train. This low-voltage condition is detected and interpreted by the signal system to indicate the presence of a train on that portion of track.

[3] An example of an ungrounded metal irrigation system is a center pivot system on rubber tires. By contrast, systems employing metal wheels would be grounded by these wheels, and therefore these systems' pipes offer less shock hazard.

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 or passenger 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 were to parallel the HSR tracks for a long enough distance (that is, several miles), the induced voltage and current in the adjoining freight railroad tracks could interfere with the normal operations of the track signal system such that it could indicate no presence of a freight train when in fact one is present (or vice versa, that it indicates the presence of a freight train when none is there).
- Higher-frequency EMI from several HSR sources (electrical noise from 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.

Operations of all six Build Alternatives could affect signaling systems where the HSR alignments are adjacent to existing rail lines. The Build Alternatives would be adjacent to 13.6 miles (Refined SR14), 14.1 miles (SR14A), 16.0 miles (E1), 15.2 miles (E1A), 12.4 miles (E2), and 11.6 miles (E2A) of existing rail alignments (Metrolink and Union Pacific Railroad).

Implementation of EMI/EMF-IAMF#1 will avoid EMI effects on the signal and communication system when an electric railroad or electric power lines are installed adjacent to their respective tracks. The IAMF will prevent disruptions to the adjacent railroad signal system, which otherwise could result in train delays or hazards, or disruption of the road crossing signals, stopping road traffic from crossing the tracks when no train is there (EPRI 2006). EMI/EMF-IAMF#1 will also include replacement of specific track circuit types on the adjoining and parallel rail lines with other types developed for operations 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.

Interference from HSR currents could result in a nuisance or reduction in operations efficiency by interrupting road and rail traffic. To preclude this possibility, the Authority and the HSR contractor would work with the engineering departments of freight railroads that parallel the HSR line to apply the standard design practices that a nonelectric railroad must use when an electric railroad or electric power liners are installed next to its tracks. The Authority would also implement procedures called for under EMI/EMF-IAMF#1, which include working with the engineering departments of freight and passenger railroads that parallel the HSR line to apply the standard design practices that a nonelectric railroad must use when an electric railroad or electric power lines are installed adjacent to its tracks.

CEQA Conclusion

Operations of the six Build Alternatives could affect adjacent rail lines, but EMI/EMF-IAMF#1 requires the Authority to coordinate with adjacent railroads and implement design provisions to prevent EMI/EMF interference prior to operations. EMI/EMF-IAMF#1 requires design provisions to prevent interference with adjacent railroads (Metrolink and Union Pacific Railroad). With implementation of EMI/EMF-IAMF#1, this impact would be less than significant for the Refined SR14, SR14A, E1, E1A, E2, and E2A Build Alternatives. Therefore, CEQA does not require any mitigation.

Impact EMI/EMF#12: Effects Related to Adjacent Airports.

Operations of the six Build Alternatives is not anticipated to cause effects on adjacent airport equipment or operations. Airports operate radio and other electronic systems that are potentially susceptible to EMI from other radio systems. The California HSR System would use radio systems for the enhanced automatic train control, data transfer, and communications systems. This raises the concern that operations of all six Build Alternatives could result in EMI with the radio systems in use at Hollywood Burbank Airport. The estimated ambient 60-Hz field strength for the Hollywood Burbank Airport can be found in Table 3.5-10.

Aviation systems such as marker beacons, distance-measuring equipment, traffic-alert and collision-avoidance systems, microwave-landing systems, and global positioning systems operate across a wide range of radio frequencies. Thus, EMI is an ongoing concern for airports and aircraft operators. Historically, EMI from sources such as radars and broadcast transmitters resulted in numerous aviation accidents and, as a result, such sources are now carefully considered in almost all aspects of design and certification of modern avionics. The radio spectrum for aeronautical services has been carefully coordinated and protected by federal law to minimize the potential of EMI from other radio services. With one minor exception,[4] communications, instrument landing systems, and navigation services for aircraft in the United States operate in frequency bands exclusively reserved for those purposes. In complying with existing FCC requirements, HSR-related radio services would avoid these frequency bands.

Palmdale to Burbank Project Section radio systems would transmit radio signals from antennas at stations, along the track alignment, on locomotives, and train cars. The Authority has acquired 44 frequencies in the Upper 700 MHz A Block spectrum. Interference with other users, including airports, would not occur, because these frequencies are not shared with other users (Authority 2016).

There are three main sources of potential interference from the HSR Build Alternatives: the onboard and wayside communication systems, the train traction power systems, and intermittent arcing between the train pantograph and the OCS. RF emissions due to arcing are believed to be the most consequential source in terms of interference at the frequencies used by airport communications and navigation systems. However, at Hollywood Burbank Airport, the potential for such interference is greatly reduced by two considerations. First is the substantial shielding effect provided by the HSR tunnel itself, which extends approximately 1 mile north and 1.5 miles south of the airport property. The second is that all radio-navigation aids at the Hollywood Burbank Airport are well-removed from the HSR tracks, the closest more than 4,000 feet from the tunnel. The closest section of unshielded OCS is 7,500 feet from the nearest navigation aid and 9,000 feet to the nearest instrument landing system aircraft flight path.

To minimize interference from HSR communication systems, the HSR Build Alternatives will employ dedicated, exclusive-use radio bands (Authority 2016). In addition to the use of frequency bands dedicated to the California HSR System, the Authority requires that communications equipment procured for HSR use, including commercial and non-commercial off-the-shelf products, comply with FCC regulations designed to prevent EMI with other equipment. The Authority would comply with an EMCPP, as described Section 3.5.2.3, during planning and implementation of the Build Alternatives to ensure compatibility with radio systems operated the Hollywood Burbank Airport (Authority 2010b). Effects would also be avoided through EMI/EMF-IAMF#2, which provides the necessary third-party coordination through the Electromagnetic Compatibility Program Plan and ISEP. During the planning stage through system design, the Authority would perform additional EMC/EMI safety analyses, including the following:

- Coordination with the Federal Aviation Administration's spectrum engineering office and airport staff.
- Identification of existing airport radio systems.
- Selection of systems to prevent EMI with identified airport uses, and incorporation of these requirements into bid specifications used to procure radio systems.

The ISEP and EMCPP would further include monitoring and evaluation of system performance to ensure compatibility with airport systems (FAA 2014a). The implementation stage of the EMCPP would include monitoring and evaluation of system performance for compatibility with airport systems. This would include verifying that airport radio navigation aids are free of interference from pantograph arcing.

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[4] Primary air surveillance radars operate in shared-use bands. Even here, however, these shared uses are federally licensed and managed to avoid mutual interference.

CEQA Conclusion

With implementation of the EMCPP, EMI/EMF-IAMF#2, and associated measures contained in the ISEP, and use of a dedicated frequency for HSR communications, operations of all six Build Alternatives would not result in interference with nearby sensitive equipment required for airport communications, navigation, or surveillance systems. This impact would be less than significant for the Refined SR14, SR14A, E1, E1A, E2, and E2A Build Alternatives. Therefore, CEQA does not require any mitigation.

3.5.7 Mitigation Measures

The Authority will implement the following mitigation measure to further reduce the EMF and EMI impacts of each of the six Build Alternatives, as identified in Section 3.5.6.3.

EMI/EMF-MM#1: Protect Sensitive Equipment

The Authority will contact entities where sensitive equipment is located and evaluate impacts of HSR-related EMFs, RF, and low-frequency EMI on medical equipment before completion of final design. Where necessary to avoid interference, the final design would include suitable design provisions, which 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 significantly reduce EMI for a suite of devices by creating a shielded room or rooms.

Attenuation (i.e., 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 dB 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 and 90 dB may be considered a high level of protection, while 90 to 120 dB is exceptional.

3.5.7.1 Impacts from Implementing Mitigation Measures EMI/EMF-MM#1

EMI/EMF-MM#1 will mitigate effects on sensitive equipment adjacent to the HSR right-of-way and could consist of installation of barriers or construction of rooms to enclose sensitive equipment. Construction of these improvements would likely entail minor improvements within existing facilities but could include expansion of structures outside of the Build Alternative right-of-way. Depending on the location and extent of facility expansion, this mitigation measure could result in temporary emissions and fugitive dust from construction equipment as well as construction-related noise. However, new facility expansion would likely be minor, only requiring the construction of rooms to house equipment rather than the construction of whole new facilities. Thus, these effects would be minimal, would occur over short durations, and would be less than significant.

3.5.8 NEPA Impacts Summary

This section summarizes impacts from EMI/EMF associated with all six Build Alternatives and compares them to the No Project Alternative impacts. EMF impacts generated by the California HSR System fall into one of two types for both human effects and equipment interference:

- Low-Frequency—The magnetic and electric fields generated by the traction power system and associated effects such as induced voltages and ground currents.

- High-Frequency—Impacts resulting from fixed and mobile wireless communications by the HSR system.

Table 3.5-12 compares the impacts of each of the Build Alternatives. Measurements of EMF along representative portions of the HSR alignment for the Palmdale to Burbank Project Section indicate that background levels for both magnetic and electric fields are below accepted thresholds applied for the California HSR System relative to human health and interference with other equipment and systems.

Table 3.5-12 Comparison of High-Speed Rail Build Alternative Impacts for EMI and EMF

Impacts	Build Alternative						NEPA Conclusion before Mitigation	Mitigation	NEPA Conclusion post Mitigation
	Refined SR14	SR14A	E1	E1A	E2	E2A			
Construction Impacts									
Impact EMI/EMF#1: Temporary Impacts from Use of Heavy Construction Equipment.							**Refined SR14, SR14A, E1, and E1A:** Adverse Effect **E2 and E2A:** No Adverse Effect	EMI/EMF-MM#1	**Refined SR14, SR14A, E1, and E1A**: No Adverse Effect **E2 and E2A**: N/A See Section 3.5.8
Number of facilities within the sensitive receiver RSA where heavy construction equipment use could temporarily expose magnetically sensitive equipment to EMI exceeding applicable mG thresholds.	2	2	2	2	0	0			
Impact EMI/EMF#2: Temporary Impacts from Communications Equipment Communications equipment used during construction of the Refined SR14, SR14A, E1, E1A, E2, and E2A Build Alternatives would comply with 47 C.F.R. 15 and would not expose people to a documented EMF health risk or interfere with nearby sensitive equipment.							No Adverse Effect	No mitigation needed	N/A See Section 3.5.8
Impact EMI/EMF#3: Temporary Impacts from Operation of Electrical Equipment							**Refined SR14, SR14A, E1, and E1A**: Adverse Effect **E2 and E2A**: No Adverse Effect	EMI/EMF-MM#1	**Refined SR14, SR14A, E1, and E1A**: No Longer Adverse **E2 and E2A:** N/A See Section 3.5.8
Number of facilities within the sensitive receiver RSA where temporary use of construction equipment could expose sensitive receptors to EMI exceeding applicable mG thresholds.	2	2	2	2	0	0			

Impacts	Build Alternative						NEPA Conclusion before Mitigation	Mitigation	NEPA Conclusion post Mitigation
	Refined SR14	SR14A	E1	E1A	E2	E2A			
Operations Impacts									
Impact EMI/EMF#4: Permanent Human Exposure to EMF. EMFs generated during operations of the Refined SR14, SR14A, E1, E1A, E2, and E2A Build Alternatives would not exceed applicable safety thresholds on trains, at passenger station areas, or at nearby sensitive receptors (identical for all of the Build Alternatives).							No Adverse Effect	No mitigation needed	N/A See Section 3.5.8
Impact EMI/EMF#5: People with Implanted Medical Devices and Exposure to EMF EMFs generated during operations of the Build Alternatives is not anticipated to pose hazards to maintenance workers or members of the public with implanted medical devices for the Refined SR14, SR14A, E1, E1A, E2, and E2A Build Alternatives.							No Adverse Effect	No mitigation needed	N/A See Section 3.5.8
Impact EMI/EMF#6: Exposure of Livestock, Poultry, Domestic Animals, and Wildlife to EMF. EMFs generated during operations of the Refined SR14, SR14A, E1, E1A, E2, and E2A Build Alternatives is not anticipated to endanger livestock, poultry, domestic animals, or wildlife.							No Adverse Effect	No mitigation needed	N/A See Section 3.5.8
Impact EMI/EMF#7: EMI with Sensitive Equipment.							**Refined SR14, SR14A, E1, and E1A**: Adverse Effect **E2 and E2A**: No Adverse Effect	EMI/EMF-MM#1	**Refined SR14, SR14A, E1, and E1A**: No Adverse Effect **E2 and E2A**: N/A See Section 3.5.8
Number of facilities within the sensitive receiver RSA where operations of the Palmdale to Burbank Project Section could expose sensitive equipment to EMI exceeding applicable mG thresholds.	1	1	1	1	0	0			

Impacts	Build Alternative						NEPA Conclusion before Mitigation	Mitigation	NEPA Conclusion post Mitigation
	Refined SR14	SR14A	E1	E1A	E2	E2A			
Impact EMI/EMF#8: EMI Effects on Schools Communications equipment used during operation of the Refined SR14, SR14A, E1, E1A, E2, and E2A Build Alternatives would comply with 47 C.F.R. 15, and would not expose schools to a documented EMF health risk or interfere with nearby sensitive equipment.							No Adverse Effect	No mitigation needed	N/A See Section 3.5.8
Impact EMI/EMF#9: Potential for Corrosion of Underground Pipelines, Cables, and Adjoining Rail. EMFs generated during operations of the Refined SR14, SR14A, E1, E1A, E2, and E2A Build Alternatives are not anticipated to cause corrosion of underground pipes, cables, and adjoining rail.							No Adverse Effect	No mitigation needed	N/A See Section 3.5.8
Impact EMI/EMF#10: Potential for Nuisance Shocks. EMFs generated during operations of the Refined SR14, SR14A, E1, E1A, E2, and E2A Build Alternatives are not anticipated to cause nuisance shocks.							No Adverse Effect	No mitigation needed	N/A See Section 3.5.8
Impact EMI/EMF#11: Effects on Adjacent Existing Rail Lines. EMFs generated during operations of the Build Alternatives is not anticipated to effect existing rail line tracks within the sensitive receiver RSA for the Refined SR14, SR14A, E1, E1A, E2, and E2A Build Alternatives.							No Adverse Effect	No mitigation needed	N/A See Section 3.5.8
Impact EMI/EMF#12: Effects Related to Adjacent Airports. There are airports within the sensitive receiver and radio interference RSAs however with implementation of the EMCPP and associated measures contained in the ISEP operation of any of the Build Alternatives would not result in interference with nearby sensitive equipment required for airport communications, navigation, or surveillance systems.							No Adverse Effect	No mitigation needed	N/A See Section 3.5.8

EMF = electromagnetic field
EMI = electromagnetic interference
HSR = high-speed rail
RSA = resource study area

Construction of the Palmdale to Burbank rail, stations, TPSSs, and electrical upgrades would require the use of heavy equipment, trucks, light vehicles, and electrical equipment which generate EMFs. Communication equipment used by construction crews would include mobile phones and radios that would generate RF fields. The EMFs generated during construction of all six Build Alternatives would be unlikely to cause EMI with nearby land uses, hazards to workers, or nearby members of the public, with the exception of potential EMI with sensitive equipment that could occur at Serra Medical Group and Pacifica Hospital under the Refined SR14, SR14A, E1, and E1A Build Alternatives. No such effects would occur under the E2 and E2A Build Alternatives from the use of heavy construction equipment during construction, and temporary impacts associated with the operation of electrical equipment during construction. EMI/EMF-IAMF#2 will require the preparation of an EMI/EMF technical memorandum to assess the potential EMF interference during construction at nearby sensitive receptors. EMI/EMF-MM#1 includes further design provisions to prevent interference at facilities containing sensitive equipment. Thus, construction EMI/EMF impacts would be minimal for the Refined SR14, SR14A, E1, and E1A Build Alternatives. There would be no construction EMI/EMF impacts associated with the E2 and E2A Build Alternatives, as neither Build Alternative would be located within 500 feet of EMI/EMF sensitive facilities.

Operations of the Palmdale to Burbank Project Section would generate 60 Hz electric and magnetic fields resulting from trains, including through passenger station areas. The modeled levels of EMF exposure are estimated to be below the MPE limits of 5 kV/m and 9,040 mG for the public. EMF impacts on people at nearby schools, hospitals, businesses, universities, and residences would be below the IEEE standard limit of 9,040 mG for the public. Even within the mainline right-of-way, these levels would not be reached. This impact would be identical for the Refined SR14, SR14A, E1, E1A, E2, and E2A Build Alternatives.

Magnetic fields of 1,000 to 12,000 mG (1 to 12 G) could occur inside traction power facilities and emergency generator rooms, which could interfere with implanted medical devices. Traction power facilities and emergency power generator room sites would be closed to the public and unmanned, with workers entering periodically (for example, to perform routine maintenance). EMI/EMF-IAMF#2 will preclude workers with implanted medical devices from entering facilities with electrical equipment that could endanger them. This impact would be identical for the Refined SR14, SR14A, E1, E1A, E2, and E2A Build Alternatives.

EMFs generated by the Refined SR14, SR14A, E1, E1A, E2, and E2A would not affect livestock, poultry, domestic animals, or wildlife within the sensitive receiver RSA.

Two medical facilities within 500 feet of the centerline of the Refined SR14 and E1 Build Alternatives could be sensitive to EMI generated by the Build Alternatives. Furthermore, EMI/EMF-MM#1 includes design provisions to prevent interference at medical facilities containing sensitive equipment. There are no sensitive facilities within the E2 Build Alternative sensitive receiver RSA. The SR14A, E1A, and E2A Build Alternatives could also interfere with sensitive equipment within the sensitive receiver RSA, due to the proximity of the two medical facilities. Such impacts would be identical to those resulting from implementation of the Refined SR14, E1, and E2 Build Alternatives, respectively.

Radio-based systems used by all six Build Alternatives are not anticipated to result in EMI with the radio systems in use at nearby schools and airports. The six Build Alternatives’ radio system would use dedicated frequencies and HSR equipment would meet FCC regulations (47 C.F.R. 15). Interference with other users, including schools and airports, would not occur since these frequencies are not shared with other users and only authorized parties would have access.

Stray AC current from operations of the HSR system is not anticipated to cause corrosion by galvanic action to adjacent pipelines or other linear metallic structures that are not sufficiently grounded. Implementation of EMI/EMF-IAMF#2 will avoid the potential for corrosion from ground currents by requiring the installation of supplemental grounding or insulating sections in continuous metallic objects in accordance with standard California HSR System designs.

EMFs from the voltage on and currents running through the OCS are not anticipated to induce voltage and current in nearby conductors, such as ungrounded metal fences and ungrounded metal irrigation systems alongside the HSR alignment. Such voltages could cause a nuisance shock to anyone who touches such a fence or irrigation system. Implementation of EMI/EMF-IAMF#2 will reduce potential shock hazards by grounding HSR fences, non-HSR metal fences, and metal irrigation systems that parallel the HSR alignment.

EMI generated by operations of all six Build Alternatives is not anticipated to affect nearby railroad signal systems. The E1 Build Alternative would encounter the most existing railroad track that could be affected by EMI (16.0 miles) relative to the Refined SR14 (13.6 miles), SR14A (14.1 miles), E1A (15.2 miles), E2 (12.4 miles), and E2A (11.6 miles). EMI/EMF-IAMF#1 will avoid EMI effects on the signal and communication system of these nearby railroad signal systems. Implementation of EMI/EMF-IAMF#1 and the EMCPP will prevent disruption of the safe and dependable operation of the adjacent railroad signal systems. This impact would be identical for all six Build Alternatives.

Operations of the six Build Alternatives is not anticipated to cause effects on adjacent airport equipment or operations. The Authority would comply with an EMCPP, as described in Section 3.5.2.3, during planning and implementation of any of the Build Alternatives to ensure compatibility with radio systems operated the Hollywood Burbank Airport (Authority 2010b). Effects would also be avoided through EMI/EMF-IAMF#2, which provides the necessary third-party coordination through the Electromagnetic Compatibility Program Plan and ISEP. With implementation of the EMCPP, EMI/EMF-IAMF#2, and associated measures contained in the ISEP, and use of a dedicated frequency for HSR communications, operations of any of the six Build Alternatives would not result in interference with nearby sensitive equipment required for airport communications, navigation, or surveillance systems.

3.5.9 CEQA Significance Conclusions

Table 3.5-13 summarizes impacts, the level of significance before mitigation, mitigation measures, and the level of CEQA significance after mitigation for all six Build Alternatives. With application of EMI/EMF-MM#1, the Refined SR14, SR14A, E1, E1A, E2, and E2A Build Alternatives would result in all less than significant EMI/EMF impacts.

Table 3.5-13 Summary of CEQA Significance Conclusions and Mitigation Measures for EMI/EMF

Impact	Level of CEQA Significance before Mitigation						Mitigation Measure	Level of CEQA Significance after Mitigation					
	Refined SR14	SR14A	E1	E1A	E2	E2A		Refined SR14	SR14A	E1	E1A	E2	E2A
Construction Impacts													
Impact EMI/EMF#1: Temporary Impacts from Use of Heavy Construction Equipment	S	S	S	S	LTS	LTS	EMI/EMF-MM#1 for Build Alternatives Refined SR14, SR14A, E1, and E1A.	LTS	LTS	LTS	LTS	N/A	N/A
Impact EMI/EMF#2: Temporary Impacts from Communications Equipment	LTS	LTS	LTS	LTS	LTS	LTS	No mitigation measures are required.	N/A	N/A	N/A	N/A	N/A	N/A
Impact EMI/EMF#3: Temporary Impacts from Operation of Electrical Equipment	S	S	S	S	LTS	LTS	EMI/EMF-MM#1 for Build Alternatives Refined SR14, SR14A, E1, and E1A.	LTS	LTS	LTS	LTS	N/A	N/A
Operations Impacts													
Impact EMI/EMF#4: Permanent Human Exposure to EMF	LTS	LTS	LTS	LTS	LTS	LTS	No mitigation measures are required.	N/A	N/A	N/A	N/A	N/A	N/A

Impact	Level of CEQA Significance before Mitigation						Mitigation Measure	Level of CEQA Significance after Mitigation					
	Refined SR14	SR14A	E1	E1A	E2	E2A		Refined SR14	SR14A	E1	E1A	E2	E2A
Impact EMI/EMF#5: People with Implanted Medical Devices and Exposure to EMF	LTS	LTS	LTS	LTS	LTS	LTS	No mitigation measures are required.	N/A	N/A	N/A	N/A	N/A	N/A
Impact EMI/EMF#6:Exposure of Livestock, Poultry, Domestic Animals, and Wildlife to EMF	LTS	LTS	LTS	LTS	LTS	LTS	No mitigation measures are required.	N/A	N/A	N/A	N/A	N/A	N/A
Impact EMI/EMF#7: EMI with Sensitive Equipment.	S	S	S	S	No Impact	No Impact	EMI/EMF-MM#1 for Build Alternatives Refined SR14, SR14A, E1, and E1A.	LTS	LTS	LTS	LTS	N/A	N/A
Impact EMI/EMF#8: EMI Effects on Schools	LTS	LTS	LTS	LTS	LTS	LTS	No mitigation measures are required.	N/A	N/A	N/A	N/A	N/A	N/A
Impact EMI/EMF#9: Potential for Corrosion of Underground Pipelines, Cables, and Adjoining Rail.	LTS	LTS	LTS	LTS	LTS	LTS	No mitigation measures are required.	N/A	N/A	N/A	N/A	N/A	N/A

Impact	Level of CEQA Significance before Mitigation						Mitigation Measure	Level of CEQA Significance after Mitigation					
	Refined SR14	SR14A	E1	E1A	E2	E2A		Refined SR14	SR14A	E1	E1A	E2	E2A
Impact EMI/EMF#10: Potential for Nuisance Shocks.	LTS	LTS	LTS	LTS	LTS	LTS	No mitigation measures are required.	N/A	N/A	N/A	N/A	N/A	N/A
Impact EMI/EMF#11: Effects on Adjacent Existing Rail Lines	LTS	LTS	LTS	LTS	LTS	LTS	No mitigation measures are required.	N/A	N/A	N/A	N/A	N/A	N/A
Impact EMI/EMF#12: Effects Related to Adjacent Airports.	LTS	LTS	LTS	LTS	LTS	LTS	No mitigation measures are required.	N/A	N/A	N/A	N/A	N/A	N/A

CEQA = California Environmental Quality Act
EMF = electromagnetic field
EMI = electromagnetic interference
N/A = not applicable
LTS = less than significant
S = significant.

3.5.10 United States Forest Service Impact Analysis

This section summarizes the analysis of EMI/EMF-related effects associated with the six Build Alternatives on the ANF, including lands within the ANF that are part of the SGMNM.

3.5.10.1 Consistency with Applicable United States Forest Service Regulations

As mentioned in Section 3.5.2.2, the primary laws governing the ANF are the Federal Land Policy and Management Act, National Forest Management Act, and the Antiquities Act of 1906. Appendix 3.1-B, USFS Policy Consistency Analysis, contains a comprehensive evaluation of relevant laws, regulations, plans, and policies relative to areas within the ANF, including the SGMNM. Policies in the Angeles National Forest Management Plan do not specifically address EMI/EMF, and as described under Impact EMI/EMF#6, none of the Build Alternatives would result in substantial impacts on wildlife, including wildlife with protected status within USFS lands. Additionally, each of the six Build Alternatives include EMI/EMF-IAMF#2, which will ensure that impacts related to EMI/EMF do not interfere with U.S. Forest Service policies or the U.S. Forest Service's ability to meet planned goals. As such, all six Build Alternatives are considered consistent with the policies in the ANF, including the SGMNM.

3.5.10.2 United States Forest Service Resource Analysis

Construction Effects

There are no EMI/EMF-sensitive receptors—such as schools, hospitals, or airports—within the ANF including SGMNM. While human activity occurs and recreational facilities are located within the ANF including SGMNM, the Build Alternative alignments would be constructed primarily below ground through the ANF in tunnels. As discussed in Section 3.5.5.3 and Section 3.5.5.4, all six Build Alternative alignments present a low possibility of EMF interference with surrounding equipment in underground tunneled alignment areas. In contrast, construction of aboveground elements of each of the six Build Alternatives could result in EMI/EMF impacts on the ANF, including the SGMNM.

Aboveground features within the ANF and outside of the SGMNM would be limited to the adit sites, as well as ancillary power utility lines associated with the adits. Electrical utilities extended to adits within the ANF would generally follow existing utility corridors. In addition, the Build Alternatives would be aboveground in three areas immediately adjacent to the ANF's borders: Vulcan Mine (Refined SR14), Aliso Canyon (E1/E2), and the Lake View Terrace Neighborhood (E2). Portals (entrances/exits of tunnels) and HSR support facilities would be placed in these areas. The proximity of these facilities to the ANF could result in EMF exposure areas just inside the ANF perimeter from construction equipment and vehicles. The SR14A, E1A, and E2A Build Alternatives would also require aboveground facilities within and adjacent to the ANF, including the SGMNM. EMF impacts from these facilities would be identical to those resulting from surface facilities associated with the Refined SR14, E1, and E2 Build Alternatives, respectively.

As discussed in Impact EMI/EMF#2, construction of each of the six Build Alternatives would require the use of communications equipment, including mobile phones and radios that generate RF fields. Communications equipment would include off-the-shelf products that comply with FCC regulations at 47 C.F.R. 15 designed to prevent EMI with other equipment or hazards to persons within the ANF including SGMNM.

As discussed in Impact EMI/EMF#1, construction activities would require the use of heavy equipment, trucks, and light vehicles, which, like other motor vehicles, generate low levels of EMI/EMFs. Electrical equipment, including large welders would also produce EMI/EMFs, as established in Impact EMI/EMF#3. Construction activities requiring the use of heavy equipment and electrical equipment would take place within and adjacent to the ANF including SGMNM at four areas: Vulcan Mine (Refined SR14), Aliso Canyon (E1/E2), Arrastre Canyon (E1/E2), and the Lake View Terrace Neighborhood (E2). Construction activities would also take place at the adit locations and associated access and utility corridors within the ANF. However, as outlined in Impact EMI/EMF#1 and Impact EMI/EMF#3, these EMF sources would not generate substantial EMI and would not present a health risk to construction workers or the general public.

Furthermore, design criteria implemented as part of EMI/EMF-IAMF#2, described in Section 3.5.4.2, will identify sensitive receptors, ground metallic objects, and use corrosion protection measures during construction. With implementation of EMI/EMF-IAMF#2, construction of the Refined SR14, E1, and E2 Build Alternatives will not expose a person to an EMF health risk or interfere with nearby equipment on U.S. Forest Service lands. The SR14A, E1A, and E2A Build Alternatives would also require operation of construction equipment capable of generating low levels of EMI/EMFs. Such EMI/EMF impacts would be identical to those resulting from the use of equipment associated with the Refined SR14, E1, and E2 Build Alternatives, respectively. See Section 3.5.6.3 for additional information regarding construction period impacts.

Operations Effects

As discussed in Impact EMI/EMF#5, EMF levels inside all six Build Alternatives' traction power facilities and emergency power generator rooms would be above the recommended limits for employees with implanted medical devices. Traction power facilities would be located within the ANF including SGMNM but would be within the tunnel below the ground surface. These facilities would not be accessible to the general public or U.S. Forest Service employees. EMI/EMF-IAMF#2 will require the Authority to implement a safety program that includes disclosure of health risks to HSR employees with implanted medical devices. To protect their health and safety, the safety program would preclude HSR workers with implanted medical devices from entering facilities with electrical equipment that could endanger them. With implementation of EMI/EMF-IAMF#2, the Refined SR14, SR14A, E1, E1A, E2, and E2A Build Alternatives would not result in EMI/EMF health risks on U.S. Forest Service lands.

As discussed in Impact EMI/EMF#6, operations of each of the six Build Alternatives could expose livestock, poultry, domestic animals, and wildlife to EMFs. Within the ANF, the Build Alternatives could expose wildlife to EMF at aboveground TPSSs. However, research indicates EMF impacts on animals is negligible, as animals exposed to additional EMF levels are typically within normal ranges (Exponent 2008). Therefore, each of the six Build Alternatives would not result in substantial impacts on wildlife within the ANF, including the SGMNM.

EMI/EMF exposure could corrode metallic objects such as underground pipelines and cables within the exposure area. As discussed in Impact EMI/EMF#9, EMI/EMF-IAMF#2 will avoid the potential for corrosion from ground currents in these areas by installing supplemental grounding or by insulating sections in continuous metallic objects in accordance with California HSR System design standards. With implementation of EMI/EMF-IAMF#2, operations of the Build Alternatives would minimize EMF exposure within the ANF; thus, the potential corrosion of metallic objects that could be within the ANF exposure areas would be minimized. See Section 3.5.6.3 for additional information regarding operations impacts.