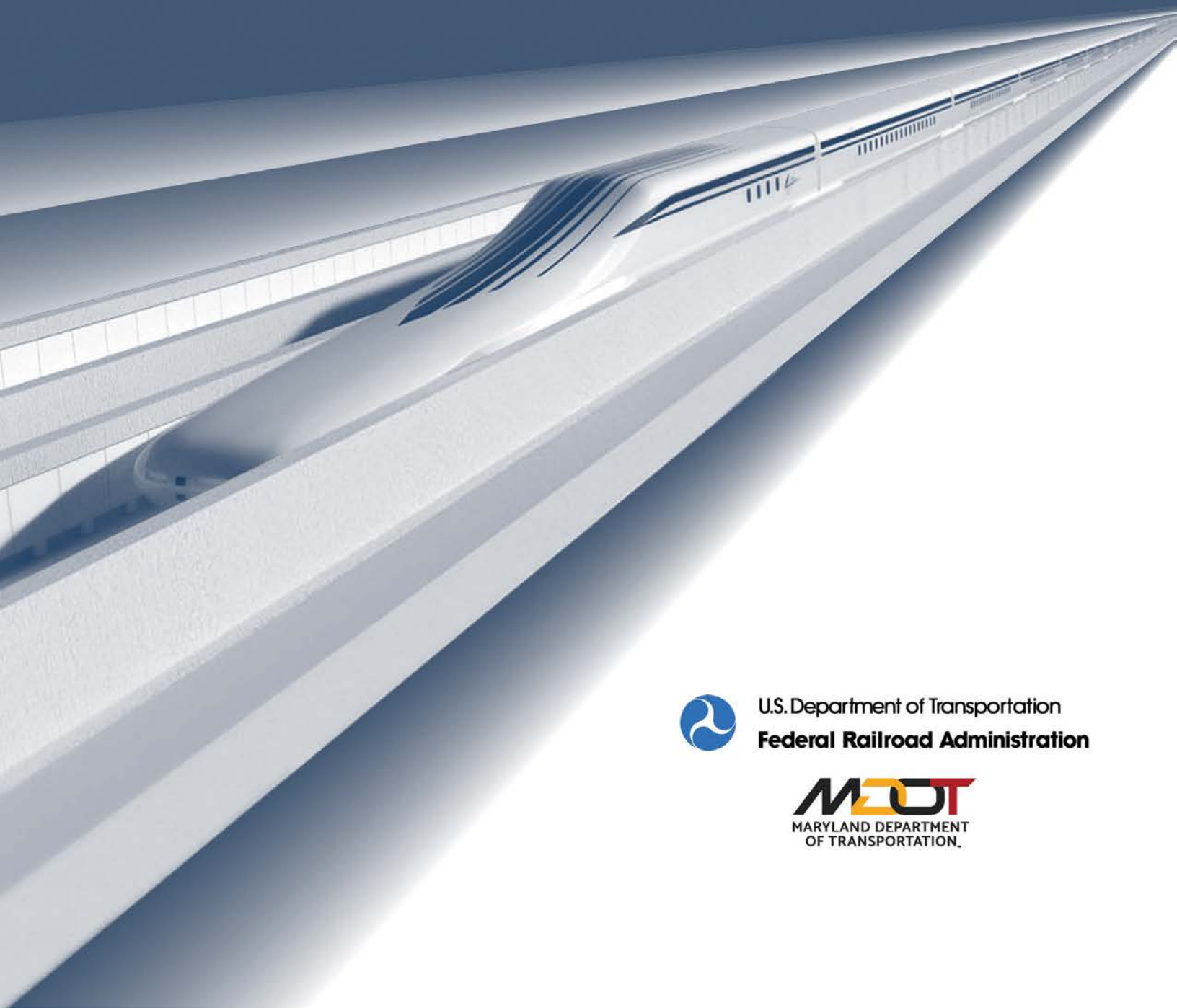
Section 4.18

Electromagnetic Fields and Interference

BALTIMORE-WASHINGTON SUPERCONDUCTING MAGLEV PROJECT

DRAFT ENVIRONMENTAL IMPACT STATEMENT AND SECTION 4(f) EVALUATION



U.S. Department of Transportation
Federal Railroad Administration

MARYLAND DEPARTMENT OF TRANSPORTATION

4.18 Electromagnetic Fields and Electromagnetic Interference (EMF/EMI)

4.18.1 Introduction

This section considers electromagnetic fields (EMFs) produced by the Superconducting Magnetic Levitation Project (SCMAGLEV Project) and identifies potentially sensitive receptors, those facilities with sensitive electronic equipment, that could be susceptible to electromagnetic interference (EMI). This section also considers other potential issues related to increased electric and magnetic fields associated with the operation of the SCMAGLEV system to include stray currents, broadband emissions, precipitation static, co-located devices, elevated EMFs, and magnetic malfunction.

4.18.2 Regulatory Context and Methodology

4.18.2.1 Regulatory Context

In accordance with the National Environmental Policy Act (NEPA), 42 U.S.C. § 4321 et seq., the Council on Environmental Quality (CEQ) regulations, 40 C.F.R. Parts 1500 - 1508, and the Federal Rail Administration's (FRA) Procedures for Considering Environmental Impacts, 64 Fed. Reg. 28545 (May 26, 1999), FRA assessed impacts from EMF/EMI. In addition, FRA also considered specific standards and regulations relating to EMF/EMI listed below.

The Federal Communications Commission (FCC) and the Occupational Safety and Health Administration (OSHA) have developed standards for EMF exposure for workers while at their workplace. OSHA has prescribed safety standards for occupational exposure to non-ionizing electromagnetic radiation in 29 C.F.R.§ 1910.97. However, neither the Federal government nor the State of Maryland has established standards for EMF exposure for residences. Under 47 C.F.R. Part 15, the FCC provides rules and regulations for licensed and unlicensed radio frequency transmissions.[1] Most telecommunications devices sold in the U.S., whether they radiate intentionally or unintentionally, must comply with Part 15. However, Part 15 does not govern any device used exclusively in a vehicle, including on High Speed Rail (HSR) trains. The International Commission on Non-Ionizing Radiation Protection (ICNIRP) and the World Health Organization (WHO) provide guidelines and technical specification on railways.[2] There will be a magnetic field generated by the SCMAGLEV Project. Shielding and other mitigation will be designed to fully comply with the ICNIRP and WHO guidelines and technical specifications.[3]

[1] *See* 47 C.F.R. § 15.103(a).

[2] ICNIRP - Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz). Health Physics, 1998, 74(4):494-522 and Guidelines for limiting exposure to time-varying electric and magnetic fields (1 Hz to 100 kHz). Health 932 Physics, 2010, 99(6):818-36.

[3] https://scmaglev.jr-central-global.com/faq/

4.18.2.2 Methodology

All sources of electricity produce both electric and magnetic fields. Electric fields result from the strength of the electric charge and magnetic fields are produced from the motion of the charge. Together, the combination of electric and magnetic fields is referred to as “electromagnetic fields.” EMFs are invisible, non-ionizing, low-frequency radiation. EMFs are commonly produced by both natural (for example thunderstorms) and man-made sources. EMI is a disturbance emitted by an external source, such as the SCMAGLEV Project technology, that may affect a sensitive electrical circuit in relatively close proximity via induction, coupling or conduction. The disturbance may diminish the quality of the circuit and/or lead to equipment malfunction.

FRA focused on identifying potentially sensitive receptors to EMF/EMI. FRA considered the No Build Alternative as a comparison to the Build Alternatives. FRA defined the SCMAGLEV Project Affected Environment for the EMF/EMI as 500 feet from the Limits of Disturbance (LOD) of the Build Alternatives, unless potential sensitive receptors (e.g. medical or institutional facilities) outside of this area expressed concerns based on sensitive electromagnetic equipment. Appendix D.11 has more information about the EMF regulatory guidelines.

EMF/EMI levels substantially decrease with increased distance from the source. Beyond the 500-foot distance, the EMF/EMI levels would be below existing ambient levels. Segments of the Build Alternatives would be located on an elevated aboveground structure (viaduct); however, the majority of the alignment would be located underground in deep tunnel. Tunnel segments are less likely to result in impacts from EMF/EMI, as EMFs dissipate quickly with distance. However, viaducts may pose a concern for multi-story buildings using sensitive electromagnetic equipment that are in close proximity to the guideway. FRA also considered the EMF/EMI impacts from passenger stations, train maintenance facilities, and ancillary facilities in proximity to potential receptors. FRA reviewed maps, surveys, and photographs to identify potentially sensitive receptors that could be susceptible to EMF/EMI produced by the Build Alternatives. FRA defined sensitive receptors to include Federal installations, universities/schools, medical institutions, high-tech businesses, airports and local governmental facilities (i.e., police and fire) that may use equipment that could be affected by new nearby sources of EMF/EMI. FRA identified an EMF/EMI concern calculating the distance of the receptor from the source and type of Build Alternative (viaduct or tunnel).

FRA did not conduct EMF/EMI calculations or simulations of the SCMAGLEV system as part of the DEIS. The Project Sponsor will coordinate with self-identified receptors to conduct appropriate analysis at site specific locations, as necessary. Additional coordination will be required with potentially impacted resources to identify impacts and develop appropriate mitigation strategies through the FEIS and final design process.

4.18.3 SCMAGLEV Project Affected Environment

FRA reviewed the SCMAGLEV Project Affected Environment for EMF/EMI sensitive receptors based on the Build Alternative relative proximity to the potential sensitive

receptor. **Table 4.18-1** summarizes the analysis of potential sensitive receptors near each Build Alternative and whether each sensitive receptor may present a concern for EMI.

4.18.4 Environmental Consequences

4.18.4.1 No Build Alternative

Under the No Build Alternative, the SCMAGLEV Project will not be built and therefore no impacts related to the construction or operation of a SCMAGLEV system will occur. However, other planned and funded transportation projects will continue to be implemented in the area and could result in EMF/EMI effects for the sensitive receptors identified in **Table 4.18-1**.

4.18.4.2 Build Alternatives

Unlike high voltage transmission lines, EMF/EMI exposure from the SCMAGLEV system would not be constant. EMF/EMI exposure would only occur as the train passes by the source, because exposure depends on the distance of the receptor from the source.

During operation, the Build Alternatives would generate EMF/EMI between 1 and 10 hertz (Hz) caused by the propulsion magnets, 60 Hz and harmonics for power, and radio frequencies for HSR signaling and communication equipment. Based on information reported by Central Japan Rail Central (JRC), EMF exposure levels within and outside the existing L0 Maglev trainsets[4] are below ICNIRP guidelines; the potential for EMF/EMI exposure is expected to be similar for the SCMAGLEV system. The SCMAGLEV system, including rolling stock as well as boarding bridges (passenger platforms for embarking/disembarking the train) have magnetic shields to limit magnetic exposure[5]. Passengers on the train, passengers waiting at the platform, or people beyond the external security fencing of the right-of-way (ROW), such as passers-by, would not be exposed to EMF levels above the ICNIRP guidelines. Examples of the magnetic shields are shown in **Figure 4.18-1**. Additionally, all equipment would comply with FCC requirements and would not adversely interfere with other electric or electronic equipment, such as radio or televisions. However, the generation of EMF/EMI from the SCMAGLEV system can result in induced currents in nearby metal structures. These currents can lead to shock hazards to humans and animals if the metal is ungrounded and touched. As planning for the Project progresses, more detailed analysis for potential shock hazards and associated risks may be considered.

[4] The L0 series is a Japanese Maglev train developed by the Central Japan Railway Company. https://www.maglev.net/worlds-fastest-train-l0-series

[5] Central Japan Railway Company, https://scmaglev.jr-central-global.com/about/magnetic/

Table 4.18-1: Identified EMF/EMI Sensitive Receptors

Name	Address	City/State Zip Code	Type	Distance from LOD (ft.)	Notes	EMI Concern?
Maryland Aviation Administration (BWI Marshall Airport)	7050 Friendship Rd	Baltimore, MD 21240	Airport	0	Tunnel. Surface features for human entry/exit to airport concourses	Self-identified possible: Airport equipment
Medmark Treatment Centers Cherry Hill	1801 Cherry Hill Rd	Baltimore, MD 21230	Health Center	0	Tunnel	No
Concentra Urgent Care - Baltimore Downtown	100 S Charles St Suite 150	Baltimore, MD 21201	Health Center	0	Tunnel	No
Linthicum Elementary School	101 School Ln	Linthicum Heights, MD 21090	School	380	Tunnel	No
Company 32 - Linthicum Volunteer Fire Company	South Camp Meade Road	Linthicum Heights, MD 21090	Fire Station	100	Tunnel	No
Baltimore Highlands Elementary School	4200 Annapolis Rd	Halethorpe, MD 21227	School	240	Tunnel	No
Beltsville Agricultural Research Center (BARC) Properties	Between NASA Goddard Space Flight Center and Patuxent Research Refuge	Beltsville, MD 20705	Government	0	Tunnel and a transition portal to viaduct and 2 possible sites for a TMF (BARC West and BARC Airstrip	Self-identified possible: sensitive instruments and research animals
Patuxent Wildlife Refuge	10901 Scarlet Tanager Loop	Laurel, MD 20708	Government	0	Viaduct and SCMAGLEV Systems	No
Lamont Elementary School	7101 Good Luck Rd	New Carrollton, MD 20784	School	0	Tunnel	No
Rogers Heights Elementary School	4301 58th Ave #1900	Bladensburg, MD 20710	School	0	Tunnel	No

Name	Address	City/State Zip Code	Type	Distance from LOD (ft.)	Notes	EMI Concern?
Port Towns Elementary School	4351 58th Ave	Bladensburg, MD 20710	School	10	Tunnel	No
Bladensburg High School	4200 57th Ave	Bladensburg, MD 20710	School	50	Tunnel	No
Bladensburg Community Center	4500 57th Ave	Bladensburg, MD 20710	Recreation Center	460	Tunnel	No
Elizabeth Seton High School	5715 Emerson St	Bladensburg, MD 20710	School	0	Tunnel	No
Fort George G. Meade	4409 Llewellyn Ave	Fort Meade, MD 20755	Government	0	Tunnel and transition portal to open cut and MD 198 TMF	Self-identified possible: military equipment
NSA	9800 Savage Rd	Fort Meade, MD 20755	Government	0	Tunnel and transition portal to open cut MD 198 TMF	Self-identified possible: intelligence equipment
Tipton Airport	7515 General Aviation Dr. #1	Fort Meade, MD 20755	Airport	800	MD 198 TMF	No
NASA Goddard Space Flight Center (GSFC) and the Goddard Geophysical and Astronomical Observatory (GGAO)	8800 Greenbelt Rd	Greenbelt, MD 20771	Government	0	Tunnel and transition portal to open cut and viaduct; BARC Airstrip TMF site is adjacent to the GGAO	Self-identified possible: experiments, scientific equipment, and satellite reference equipment
Montpelier Elementary School	9200 Muirkirk Rd	Laurel, MD 20708	School	320	Viaduct	No
Monarch Global Academy	430 Brock Bridge Rd	Laurel, MD 20724	School	470	Viaduct	No

Name	Address	City/State Zip Code	Type	Distance from LOD (ft.)	Notes	EMI Concern?
Beacon Heights Elementary School	6929 Furman Pkwy	Riverdale, MD 20737	School	90	Tunnel	No
Eleanor Roosevelt High School	7601 Hanover Pkwy	Greenbelt, MD 20770	School	280	Viaduct	No
USS Rowley Training Center	Powder Mill Rd	Laurel, MD 20708	Government	0	Viaduct or Tunnel	Self-identified possible: intelligence equipment
Salvation Army Harbor Light Center	2100 New York Ave NE	Washington, D.C. 20002	Hospital	200	Tunnel and Fresh Air/Emergency Egress	No
Mundo Verde Bilingual Public Charter School	30 P St NW	Washington, D.C. 20001	School	490	Tunnel	No
Metropolitan Police Department - Internal Affairs Division	64 New York Avenue Northeast	Washington, D.C. 20002	Police Station	300	Tunnel	No
The Children's Guild DC Public Charter School	2146 24th Pl NE	Washington, D.C. 20018	School	170	Tunnel and Fresh Air/Emergency Egress	No
Holy Redeemer School	206 New York Ave NW	Washington, D.C. 20001	School	160	Tunnel and Cut/Cover plus surface	No
Walker-Jones Education Campus	1125 New Jersey Ave NW	Washington, D.C. 20001	School	400	Tunnel and Cut/Cover plus surface	No
Dunbar High School	101 N Street NW	Washington, D.C. 20001	School	390	Tunnel	No

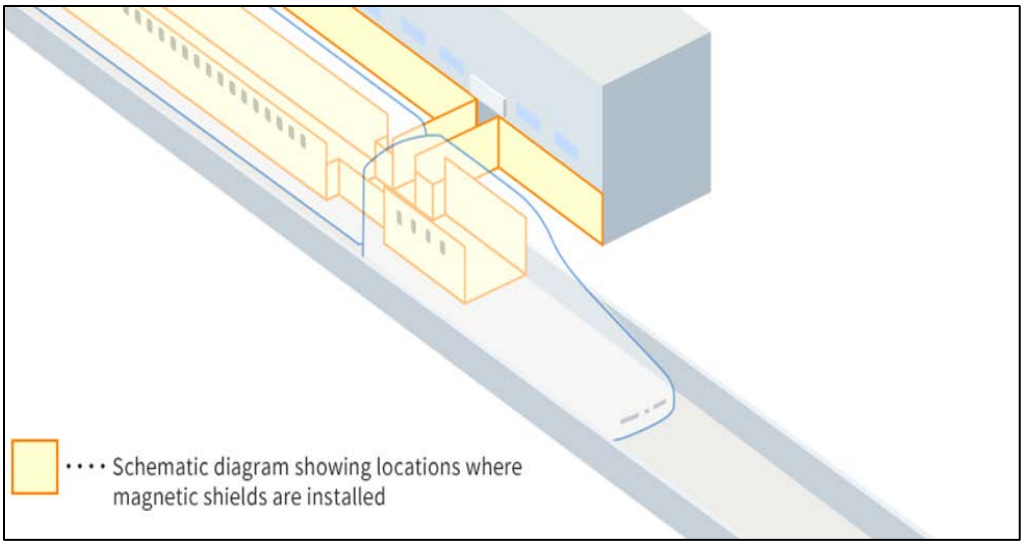
Source: SCMAGLEV Project Team Members 2020

Table 4.18-2: Identified EMF/EMI Sensitive Receptors near TMF's

Name	Address	City/State Zip Code	Type	Distance from Alignment (ft.)	Notes	EMI Concern?
Woodland Job Corps	3300 Fort Meade Road	Laurel MD 20724	School	0	MD 198 TMF	No
Thomas J.S. Waxters Children's Center	375 Red Clay Rd	Laurel, MD 20724	Correctional Facility	300	MD 198 TMF	No
Fort George G. Meade	4409 Llewellyn Ave	Fort Meade, MD 20755	Government	0	MD 198 TMF	Self-identified possible: military equipment
NSA	9800 Savage Rd	Fort Meade, MD 20755	Government	0	MD 198 TMF	Self-identified possible:
BARC Properties	Between NASA GSFC and Patuxent Research Refuge	Beltsville, MD 20705	Government	0	BARC Airstrip TMF BARC West TMF	Self-identified possible: sensitive instruments and research animals
USS Rowley Training Center	Powder Mill Rd	Laurel, MD 20708	Government	0	BARC Airstrip	Self-identified possible: intelligence equipment
NASA GGAO	8800 Greenbelt Rd	Greenbelt, MD 20771	Government	0	BARC Airstrip	Self-identified possible: experiments, scientific equipment, and satellite reference equipment
Patuxent Wildlife Refuge	10901 Scarlet Tanager Loop	Laurel, MD 20708	Government	0	BARC Airstrip 198 TMF	No

Source: SCMAGLEV Project Team Members 2020

Figure 4.18-1: Schematic of Magnetic Shields



Source: Central Japan Railway, https://scmaglev.jr-central-global.com/about/magnetic/

FRA did not identify any sensitive receptors within the SCMAGLEV Project Affected Environment that may be impacted from EMF/EMI. However, representatives from, Maryland Department of Transportation Maryland Aviation Administration (MDOT MAA), Baltimore-Washington International Thurgood Marshall Airport (BWI Marshall Airport), Federal Aviation Administration (FAA), National Security Agency (NSA), Fort George G. Meade, National Aeronautics and Space Administration (NASA), and the United States Secret Service (USSS) Rowley Training Center raised concerns regarding sensitive equipment on their properties that could be affected. When the SCMAGLEV system is in operation, the Build Alternatives J-01 through J-06 will be in closer proximity to some of these self-identified government properties and facilities. Additionally, Build Alternatives J-02, J-05, J1-02, and J1-05 have the potential to affect the NASA GSFC and GGAO due to proximity of the BARC Airstrip TMF. The agencies identified above have not disclosed if EMF/EMI levels within ICNIRP guidelines and compliant with FCC requirements will impact their facilities. Depending on the type and location of equipment housed within these resources, the facilities may be impacted by operation the SCMAGLEV system. Additional coordination will be required with these agencies to identify impacts and develop appropriate mitigation strategies.

Potential Issues Related to Increased Electric and Magnetic Fields

The SCMAGLEV Project has the potential to increase electric and magnetic fields as part of operations. Potential issues may exist from increased electric and magnetic fields associated with the operation of the SCMAGLEV system, including stray currents, broadband emissions, precipitation static, co-located devices, elevated EMFs, and magnetic malfunction. Each of these issues is discussed below. **Table 4.18-3** summarizes these potential issues and approaches to minimize related effects.

Table 4.18-3: Potential Issues Related to Increased Electric and Magnetic Fields

Potential Issue	Concern	Effect	Mitigation Strategies
Stray Currents	Induced by passing trains Generated by leakage from within the electrical system	Shock hazards to living beings Corrosion to metal structures[6] Arcing (causing broadband emissions to affect nearby receivers) Grounding issues for some sensitive receptors	Select substation locations to minimize interference Provide a continuous grounding system (electrical continuity) Verify return currents are given a low impedance return path Electrical segregation Isolation of structural elements Drainage bonds A routine testing and inspection program
Broadband Emissions	Broadband electrical noise from the switching power supplies	Raise the noise floor of nearby EMF receivers Limits range of electrical equipment, such as cell phones Nuisance issues from increased noise on two-way radios Interference with electric devices currently under development, such as self-driving automobiles	SCMAGLEV equipment uses radiation shielding cooled with liquid nitrogen, which lowers EMF/EMI levels to below the ICNIRP.
Precipitation Static (p-static)[7]	SCMAGLEV trains moving at speeds sufficient to generate p-static	Interference with internal communications equipment, such as handheld radios used by onboard crew, radio communication between the train and the control center	Equip SCMAGLEV train with a static dissipater and an electrical grounding system
Co-located Devices	Passengers operating multiple types and/or pieces of electronic equipment simultaneously (i.e., wireless, blue tooth, cell phones)	Results in combined emissions that may exceed the specifications and cause interference issues	All equipment used on the SCMAGLEV system will comply with FCC regulations to minimize interference

[6] Morrow, C. “Design of Reinforced Concrete Civil Structures to Mitigate Against Stray Current Corrosion with a Rail Corridor." 8th Australian Small Bridges Conference, November 28, 2017.

[7] Precipitation static (p-static) is generally experienced on airplanes and is caused by the exterior of the aircraft experiencing triboelectric charging due to friction, which is caused by the impact of snow, rain, or dust particles on the front surface of the craft. (Thornell, J., "Precipitation-Static (P-Static) Overview of Composite Aircraft," SAE Technical Paper 2001-01-2933, 2001, https://doi.org/10.4271/2001-01-2933.)

Potential Issue	Concern	Effect	Mitigation Strategies
Elevated EMFs	Powerful magnets used by the SCMAGLEV system can emit strong electric and magnetic fields	Interference/disruption with other electric and electronic devices near the magnet.	Provide shielding equipment to minimize the EMI below ICNIRP recommended levels for public exposure. Design boarding bridge and seal arrangement to minimize aerodynamic pressure and magnetic field exposure to passengers/crew
Magnetic Malfunction	System malfunction	If the magnet malfunctions, then the magnet ceases to operate, in which case, no EMI would be present Magnets cannot emit more EMI than they already do while operating	Address general, emergency procedures as part of the system technical familiarization process

4.18.4.3 Short-term Construction Effects

Construction of the Build Alternatives would result in periodic increases in EMF/EMI during the use of electric and electronic construction equipment, such as two-way communication radios and power equipment. This standard equipment is regulated by the FCC and associated EMFs would be within the FCC regulatory limits. Typical construction equipment would not interfere with the operation of other nearby electric and electronic equipment; therefore, the impacts from construction activities of the Build Alternatives would be minimal. As part of the construction phase, equipment used on the SCMAGLEV system would be tested, and coordinated with adjacent Federal landowners. Short-term construction effects would be the same as those described for the Build Alternatives in Section 4.18.4.2.

4.18.4.4 Potential Mitigation Strategies

The SCMAGLEV Project design features, such as high-performance magnetic shields on the trainsets, will be implemented to avoid and minimize impacts to the human and physical environment. Based on information reported by JRC, EMF exposure levels within and outside the existing L0 Maglev trainsets[8] are below ICNIRP guidelines; the potential for EMF exposure is expected to be similar for the SCMAGLEV system. As part of the general operation and maintenance of the SCMAGLEV system, the Project Sponsor would routinely inspect and replace as necessary the external fencing and any other grounded metallic objects within the system. This will avoid or minimize any corrosion.

[8] The L0 series is a Japanese Maglev train developed by the Central Japan Railway Company. https://www.maglev.net/worlds-fastest-train-l0-series

Design will include mitigation measures, such as proper grounding of nearby metal structures, to minimize shock hazards.

All construction equipment will meet standard operating conditions. Some equipment may result in periodic increases in EMF/EMI while being used; however, it is not expected that adverse impacts would occur to sensitive receptors during construction activities.