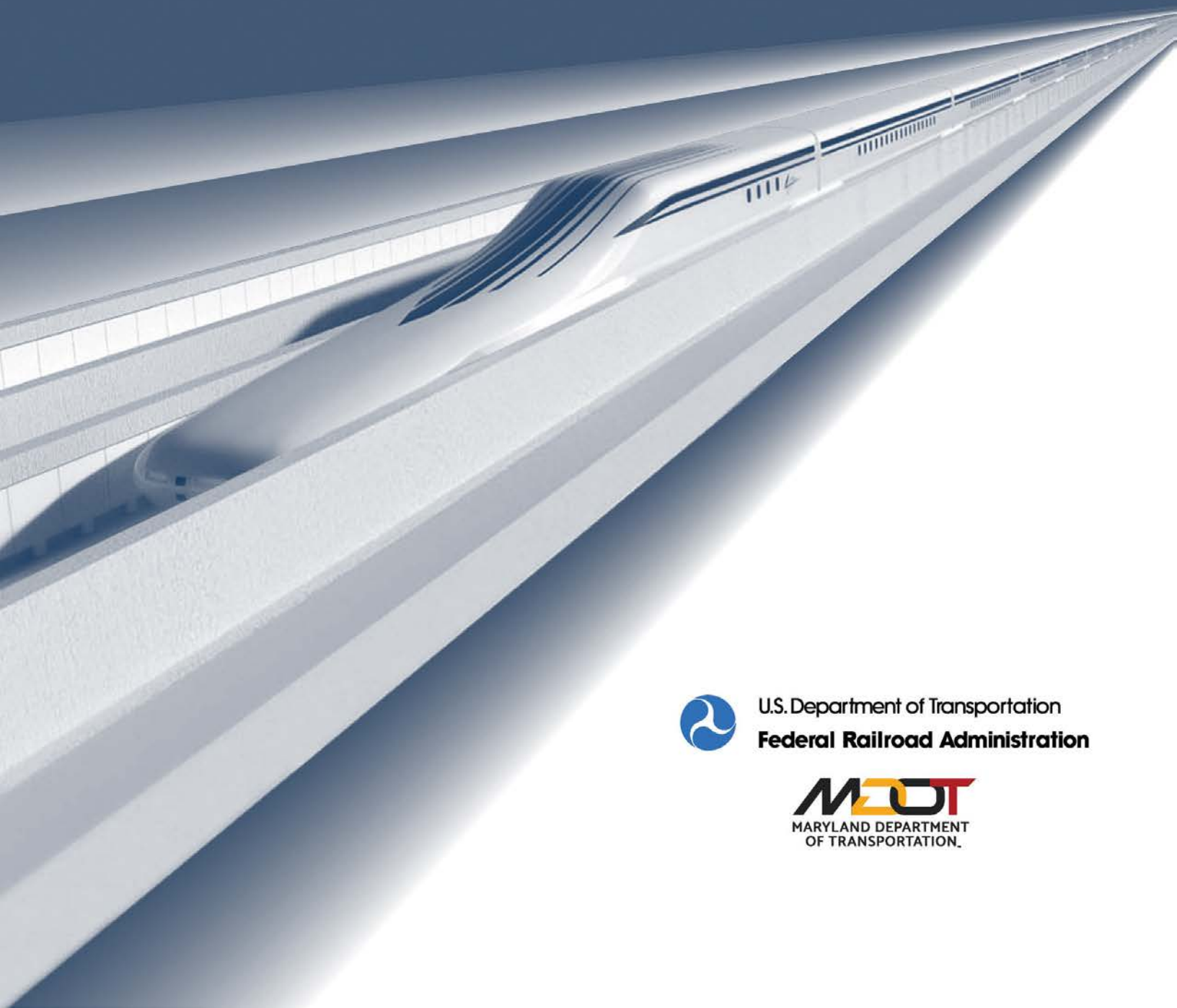
Section 4.13

Topography and Geology

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

4.13 Topography and Geology

4.13.1 Introduction

Topography relates to the shape and features of the earth; and a geologic resource can be described as a naturally occurring feature that has formed during evolution of the earth. Geologic resources, including fossilized flora and fauna (i.e., paleontological resources), fossil fuels, mineral resources, and rock formations, may provide value to the human and/or physical environment. Geologic hazards, such as earthquakes, sinkholes, and landslides, can be described as a naturally occurring feature that may result in a threat to the human or physical environment. This section evaluates how the Superconducting Magnetic Levitation Project (SCMAGLEV Project) would interact with and potentially impact regional topography, geologic resources and hazards, as well as the SCMAGLEV Project's location in relation to setting and features such as existing mines. Additional information about the geology of the area can be found in the Natural Environment Technical Report (Appendix D.10).

4.13.2 Regulatory Context and Methodology

4.13.2.1 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 the existing geologic conditions along the Build Alternatives to determine whether the SCMAGLEV Project would impact geologic resources. In addition, the following regulatory requirements are relevant should certain geologic resources or hazards be identified during final design and construction:

- 16 U.S. Code (U.S.C.) § 470aaa (Paleontological Resources Preservation Act)
- 29 U.S.C. § 651 et seq. (Occupational Safety and Health Act)
- 42 U.S.C. § 300f et seq. (Safe Drinking Water Act of 1974)
- Maryland Surface Mining Control and Reclamation Act (SMCRA)
- Code of Maryland Regulations: COMAR 26.20.30: Postmining Land Use

4.13.2.2 Methodology

FRA performed a qualitative analysis based on readily and publicly available desktop information such as published and online reports and maps from the U.S. Geological Survey (USGS), Maryland Geological Survey (MGS), Maryland Department of the Environment (MDE), and site-specific studies. These sources provide information concerning the topographic and geologic setting and geologic formations. FRA reviewed existing data to document the presence or absence of geologic resources and hazards

within and surrounding the SCMAGLEV Project Affected Environment. FRA defined the geographic limits of the SCMAGLEV Project Affected Environment for geology as the proposed impact area, which includes the limits of operational/physical disturbance proposed as well as the construction-related impact area, which includes additional areas of temporary disturbance required for construction activities. These areas have been identified as an overall limit of disturbance (LOD) of the SCMAGLEV Project Build Alternatives. FRA identified relationships between project components and geologic resources/hazards at locations within the SCMAGLEV Project Affected Environment for proposed subsurface work such as tunnels, underground stations, and construction borings. As relevant, analyses extended beyond the SCMAGLEV Project LOD to describe the overall topographic setting as well as capture resources such as mines that could be close to the Build Alternatives. FRA considered mines within 300 feet of the LOD in this analysis. The following geologic resources and hazards were analyzed:

Geologic Resources

- **Mines** – mineral resources that can be extracted from the earth
- **Paleontological Resources** – physical evidence (e.g., fossils) of preexisting organisms
- **Unique Geological Features –** any unique or rare physical feature of the earth's surface, or of the rocks exposed at the surface, that is formed by a geologic process

Geologic Hazards

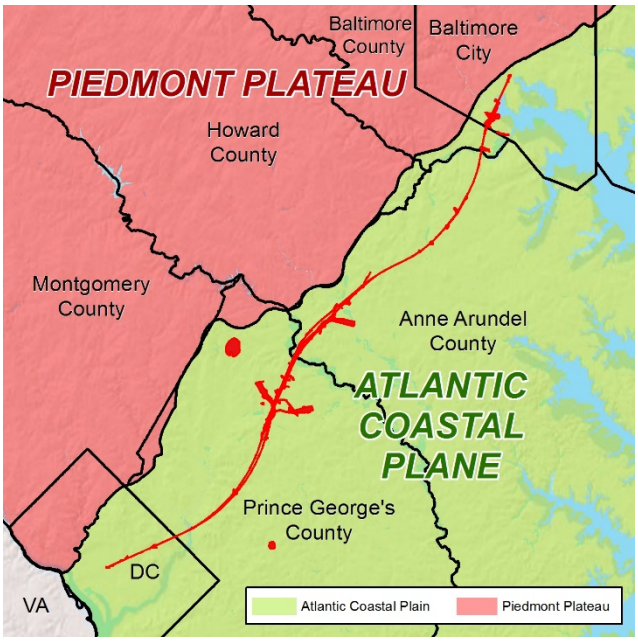
- **Seismic Hazards/Faulting (Seismicity)** – the frequency and severity of earthquakes. Seismic hazards are typically associated with a geologic fault or fracture and areas requiring tunnels or bridges may be especially susceptible to potential damage.
- **Naturally Occurring Asbestos** – United States Environmental Protection Agency (USEPA) regulated asbestiform minerals, as a natural component of soil or rock. Excavating in areas with naturally occurring asbestos typically requires engineering controls, site monitoring, and regulatory interaction and reporting.
- **Radon Gas** – a common radioactive gas that results from the natural breakdown of uranium in soil, rock, and water. USEPA recommends reducing concentrations of radon gas that may accumulate in the air in poorly ventilated enclosed spaces.
- **Landslide Prone Soils** – the susceptibility for rock or landslides (debris, mudflows, rock fall). Construction and tunneling in areas that contain landslide prone soils require engineering/design considerations to minimize hazards to workers during construction and the future utilization of the corridor.
- **Acid Producing Soils** – soils with low pH. These soils may contain enough acidity to degrade concrete and steel structures, requiring additional consideration during design.

- **Karst Topography** - dissolution of a soluble layer or layers of bedrock. These areas are susceptible to sinkholes, groundwater contamination, and erosion.

4.13.3 SCMAGLEV Project Affected Environment

Topography surrounding the SCMAGLEV Project ranges from approximately 5 feet above sea level to over 200 feet above sea level, spanning a broadly undulating landscape with relative topographic highs within Anne Arundel and Prince George's Counties, and relative lows near Washington, D.C. and Baltimore City. The SCMAGLEV Project falls entirely within the Atlantic Coastal Plain physiographic province, located just south and east of the Fall Zone separating it from the Piedmont Plateau Physiographic Province as seen in **Figure 4.13-1**. A physiographic province is a geographic area in which the geology (including lithology[1] and structure) and climate history have resulted in landforms that are distinctly different from adjacent areas. The Atlantic Coastal Plain represents the easternmost contact with crystalline bedrock to the shorelines of major estuaries or the Atlantic Ocean. Sediments across the province include gravel, sand, silt, and clay of both terrigenous and marine origin. The geologic hazards and resources known to occur within the SCMAGLEV Project Affected Environment are summarized below.

Figure 4.13-1: Physiographic Provinces



Seismicity - The SCMAGLEV Project is in an area of the U.S. with a low probability of seismic activity. The USGS identifies the eastern U.S. as a "Stable Continental Region" because of its location in the center of a tectonic plate. According to the MGS, strong earthquakes are unusual in Maryland, although the state occasionally experiences perceptible earthquakes. In 2011, a 5.8 magnitude quake occurred 35 miles north of Richmond, Virginia, and registered as a 2.2 magnitude quake in Anne Arundel County. In 2010, a 3.6 magnitude quake occurred in nearby Montgomery County, Maryland. The latest quake occurred in Maryland on November 11, 2017, classified as a 1.5 magnitude.

Naturally Occurring Asbestos - Given the composition of bedrock throughout the region, there is the potential for the SCMAGLEV Project to encounter naturally occurring asbestos within the bedrock. The USGS Mineral Resources Data System (MRDS) lists multiple occurrences of naturally occurring asbestos to the northwest of Washington, D.C., one occurrence in Baltimore City, and multiple occurrences to the northwest of

[1] Lithology – the study of the general physical characteristics of rocks.

Baltimore. Although these known occurrences do not fall within the SCMAGLEV Project Affected Environment, they indicate the potential for naturally occurring asbestos within the regional bedrock formations that do extend into the SCMAGLEV Project Affected Environment beneath the unconsolidated surficial strata. The presence of asbestos-containing rock will be further determined during the next phase of geotechnical investigations.

Radon Gas - Radon gas is a colorless, odorless, radioactive gas. It forms naturally from the decay of radioactive elements, such as uranium, which are found in different amounts in soil and rock throughout the world. Radon gas in soil and rock can move into the air and into underground water and surface water. Generally, the USEPA recommends mitigating structures where radon gas concentrations exceed 4 picocuries per liter (pCi/L).[2] According to the Maryland Department of Health, the SCMAGLEV Project Affected Environment includes only one ZIP Code designation where radon gas concentrations exceed 4 pCi/L[3], and this part of the alignment is on elevated track. In Washington, D.C., no radon gas tests near the alignment exceeded 3.1 pCi/L.[4]

Landslide Prone Soils - Regional topography, precipitation, and past events are taken into account when developing a landslide susceptibility percentage for a region. According to information obtained from the USGS, FRA has identified much of the SCMAGLEV Project within a "High Landslide Incidence Area," which means that over 15 percent of the area is prone to land sliding. Within the SCMAGLEV Project Affected Environment, the clay layers of the Arundel Formation (from deposits of the Potomac Group), as previously described in Section 4.10.3.3, act as the confining unit between aquifers, and are known to cause stability issues and create a landslide risk.[5] Reports of rockslides in the coastal plain are rare. Given the flat topography and deep sandy soils generally found in this physiographic region, rockslides are not considered an exceptional risk.

Acid Producing Soils - Atlantic Coastal Plain sediments have the potential to contain acid producing sediments considered a geologic hazard. Such sediments are known to exist in Virginia and New Jersey in the Atlantic Coastal Plain region and are likely to occur in Atlantic Coastal Plain sediments of Maryland, and potentially the SCMAGLEV Project Affected Environment. FRA did not identify published Maryland- and Washington, D.C.- specific information available for review. The presence of iron ore mines in the vicinity of the SCMAGLEV Project however, as discussed below, indicates the likely presence of acid producing soils.[6]

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[2] Environmental Protection Agency. Accessed July 2020. https://www.epa.gov/radon/what-epas-action-level-radon-and-what-does-it-mean#:~:text=EPA%20recommends%20homes%20be%20fixed,L%20and%204%20pCi%2FL.

[3] Maryland Department of Health. *Maryland: 2005-2016 Average Radon Measurements by ZIP Code*. Accessed July 2020. https://maps.health.maryland.gov/phpa/eh/radon/

[4] District Department of the Environment. *District of Columbia Radon Map 2010-2012*. Accessed July 2020. https://doee.dc.gov/node/22322

[5] Pomeroy, J.S. (1988). Map showing landslide susceptibility in Maryland. United States Geological Survey. Retrieved from *https://pubs.er.usgs.gov/publication/mf2048*

[6] Acidic Soil, Metal in Soils and Acid Rock Drainage. Virginia Division of Geology and Mineral Resources. Accessed January 2019. Retrieved from *https://www.dmme.virginia.gov/DGMR/acidicsoils.shtml*

Karst Topography - According to the MGS, karst areas do not occur in the unconsolidated sediments of the Atlantic Coastal Plain; therefore, FRA has not further evaluated this geologic resource.

Mines - Nine mining locations, identified as "past producers" are present within 300 feet of the SCMAGLEV Project LOD[7]**.** The locations listed are locations where sand, gravel, and iron ore have historically been mined, including six iron ore and three sand/gravel mines. One mine located near the tunnel laydown area for the Camden Station also mined heavy metals. These mines are currently inactive, and the potential for modern mining of resources in these areas is limited due to land development and economic feasibility. Because details such as the extent and type of backfill at the former open quarries and the extent of mine reclamation activities is not available, additional coordination with state sources is necessary. Although sand and gravel mines in this area are typically mined from the surface, the type of iron ore mine can vary depending on the type of iron being mined. The acquisition and reclamation of abandoned mines may require coordination under the Maryland SMCRA.

Paleontological Resources - Mesozoic Era rock found within northern Prince George's and Anne Arundel Counties is called the Potomac Group which consists of three subgroups: the Patuxent Formation, the oldest and westernmost subgroup that abuts the Fall Zone; the Arundel Formation; and the Patapsco Formation, the youngest deposits of the Group. The Potomac Group is believed to be up to 1,000 feet thick within and surrounding the SCMAGLEV Project Affected Environment. During the late 19th century, dinosaur teeth and bones were found in sedimentary iron mines that intersected the Potomac Group rock layer[8]. In 2012, exceptionally preserved fossilized reptile and mammal tracks from the Cretaceous Patuxent Formation were discovered at NASA's Goddard Space Flight Center (GSFC) about one-half mile from the proposed SCMAGLEV project. The finding contains the largest number of dinosaur-era mammal tracks on a single slab and the largest sized mammal track known from the age of dinosaurs. The finding is considered one of the most important dinosaur-era mammal track fossils ever discovered.[9] The Patuxent formation is found along the entire LOD and may be present as surface rock outcroppings or overlain by the Arundel Formation.[10] Given the SCMAGLEV Project's location within the Potomac Group sediments, there is the possibility for prehistoric animal and plant fossils to be present in the subsurface, specifically within the Patuxent Formation and Arundel Clay, however fossils are expected to be especially scarce in Washington, D.C. and parts of Prince George's County, where the Arundel Clay is thinner and discontinuous.

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[7] Mineral Resource Data System by common geographic areas. United States Geological Survey. Mineral Resource Data System. KML files. Washington, D.C. and Maryland. Retrieved from *https://mrdata.usgs.gov/mrds/geo-inventory.php*

[8] Kranz, Peter M., 1989, Dinosaurs in Maryland: Maryland Geological Survey, Educational Series No. 6, 34 p.

[9] Stanford, R., Lockley, M.G., Tucker, C. et al. A diverse mammal-dominated, footprint assemblage from wetland deposits in the Lower Cretaceous of Maryland. Sci Rep 8, 741 (2018). https://doi.org/10.1038/s41598-017-18619-w

[10] Stanford, R., Lockley, M.G., Tucker, C. et al. A Diverse Mammal-Dominated, Footprint Assemblage from Wetland Deposits in the Lower Cretaceous of Maryland. Sci Rep **8,** 741 (2018)

Unique Geological Features - Exposed bedrock in the Atlantic Coastal Plain is rare. MGS does not identify any geologic features of particular interest near the proposed alignment. The geologic features near the proposed alignment are similar to those found along the fall zone along the eastern coast of North America. Perhaps the most notable geologic features are the fossil containing beds discussed above.

4.13.4 Environmental Consequences

Geologic hazards exist throughout the SCMAGLEV Project Affected Environment and affect the types and placement of infrastructure where such hazards exist. FRA identified areas where the Build Alternatives intersect known geologic resources or hazards. Given the proximity of the Build Alternatives, they generally have the same potential to encounter geologic features and hazards. FRA determined that the greatest impacts would occur in areas where the SCMAGLEV Project proposes tunnel or subsurface features.

4.13.4.1 No Build Alternative

Under the No Build Alternative, the SCMAGLEV Project would not be built and therefore no impacts to site topography and geology related to the construction or operation of a SCMAGLEV system would occur. However, other planned and funded transportation projects would continue to be implemented in the area in and surrounding the LOD and could result in alterations to geologic conditions.

4.13.4.2 Build Alternatives

Construction of the Build Alternatives J1-01 through J1-06 would require more subsurface activity than construction of Build Alternatives J-01 through J-06; therefore, Build Alternatives J1 may inherently result in greater potential to encounter geologic hazards.

Permanent topographical changes would occur from grading or filling landscape to accommodate appropriate structure stability requirements for surface features (i.e., viaduct piers, stations, TMF) and are similar for Build Alternatives J and J1. The landscape would continue to undulate above or below the viaduct as it exists now. Some modifications may be required in areas of access needed for maintenance to the viaduct but would remain largely unchanged. Groundwater pumping could result in topographic subsidence and ground compaction which has the potential to affect sensitive instrumentation at GSFC. The Project Sponsor will continue to coordinate with NASA to determine the potential risk of topographic subsidence. Other long-term changes are consistent with many transportation projects and would not be considered an adverse effect, nor induce indirect effects.

Although the SCMAGLEV Project is located in an area considered low potential for seismic hazards, there have been earthquakes in Maryland as identified Section 4.13.3. Continuing ground investigations and geotechnical studies for the SCMAGLEV Project will be analyzed and the Project Sponsor will consider seismic risk, safety factors, and potential mitigation measures should an event occur that affects the structures and/or

surrounding infrastructure and population. At this time the need for blasting is not identified. Future studies will also consider the possibility for construction of the tunnels to result in any micro-seismic activity and the Project Sponsor will evaluate the need for and specific type of micro-seismic monitoring.

Alignment

Both Build Alternative alignments have similar potential to encounter naturally occurring asbestos, radon gas, landslide prone soils, acid producing soils, mines and fossils during construction of subsurface features. All open trench type soil excavations and a majority of the tunneling activity would be conducted within the Patapsco Formation. Given that Potomac Group sediments of this Formation lie close to the surface and are believed to run as deep as 1,000 feet beneath the surface, there is potential for an adverse impact to the fossil record.

Geologic hazards of greatest concern during operation and potential to incur long-term and indirect impacts include landslide prone soils and acid producing soils. These are considered of greater risk due to their widespread occurrence either documented within the SCMAGLEV Project Affected Environment (landslide) or in areas near the SCMAGLEV Project Affected Environment (acid producing soil). The risk of landslides after completion of construction could present a concern, as areas of tunneling and excavation would be particularly vulnerable to these occurrences. This would be consistent for impact with any alignment. Future geotechnical investigations would determine whether accounting for rockslides in the project design is recommended.

Similarly, risks from acid producing soil hazards are also present and certain unconsolidated soils and sediments in the Atlantic Coastal Plain could contain minerals that produce enough acidity to degrade concrete and steel structures to the point of failure.[11]

Potential indirect effects would also include potential worker health concerns associated with airborne asbestiform particles, should naturally occurring asbestos be encountered, as well as radioactive particles from radon gas. These are discussed further in Section 4.21 Public Health and Safety. Surface water run-off containing acidic discharges from soils could also degrade the environment, as previously noted in Section 4.10 Water Resources, which has the potential to indirectly affect water quality and aquatic species.

Stations

All stations have the potential to encounter naturally occurring asbestos, landslide prone soils, and acid producing soils. The Baltimore-Washington International Thurgood Marshall Airport Station (BWI Marshall Airport Station) (associated with all Build Alternatives) and Camden Yards Station (Build Alternatives J-04 through J-06 and
J1-04 through J1-06) have a greater potential to encounter fossil deposits as they are in

[11] Federal Railroad Administration. December 2016. *A Rail Investment Plan for the Northeast Corridor. Tier 1 Final Environmental Impact Statement*. Section 7.7 Geologic Resources.

the Patapsco Formation. The Cherry Hill and Camden Yards Stations are within 300 feet of a recorded mine, therefore affecting all Build Alternatives.

TMF

The BARC Airstrip, BARC West, and MD 198 TMFs have the potential to encounter landslide prone soils and acid producing soils. There is a mine within 300 feet of the MD 198 TMF, associated with Build Alternatives J-01, J-04, J1-01 and J1-04. All the TMFs are located in the Patapsco Formation, which is known to contain fossil deposits. Construction of the BARC TMFs and the viaduct in this area could have the potential to impact paleontological and archeological resources, such as the recent finds of dinosaur-era footprint fossil records.

4.13.4.3 Short-term Construction Effects

Geologic conditions and hazards have the greatest potential to be impacted during short-term construction activities of subsurface features. Where construction will intersect bedrock, most notably in Washington, D.C. and Baltimore City, (Mount Vernon Square East Station and Camden Yards Station, respectively) naturally occurring asbestos would be of concern.

Future geotechnical investigations completed for the preferred alternative and determinations of final construction methods necessary based on subsurface materials will provide a better assessment of potential disruption to BWI Marshall Airport and its daily operations, as well as Tipton Airport operations.

Natural factors considered to most directly contribute to landslide potential are precipitation, slope, and the nature of the geologic unit (or lithology). During construction activities and the exposure of soils, creation of exposed slopes, and removal of vegetation that help to stabilize these features, areas are more susceptible to landslide.

Subsurface excavation and construction also have the potential for permanent impacts to paleontological resources to be caught in the transport and movement of earth and soil during construction activities, that is not always captured by the contractor or inspector on site and thus going unnoticed. Measures to avoid such impacts are discussed below. During subsequent phases of SCMAGLEV Project development, subsurface geotechnical testing and documentation would be undertaken to confirm locations of geologic hazards and recommend structural materials that will mitigate for such hazards during construction.

4.13.5 Potential Minimization and Mitigation Strategies

4.13.5.1 Minimization

The Project Sponsor will minimize construction impacts to geologic resources using specifically identified Best Management Practices (BMPs) and construction techniques within SCMAGLEV erosion and sediment design plans and geotechnical investigations.

Such measures utilized to minimize risk of landslides, exposure to naturally occurring asbestos and acid producing soils includes, but is not limited to the following:

- Use of a “one-pass tunnel lining system” and a “pressurized closed-face tunnel boring machine (TBM),” further described in Section 4.11 Wetlands and Waterways, to reduce the amount of subsurface soils and groundwater dewatering required by tunneling activities and to minimize the amount of geologic material disturbed.

- In areas of excavation of ground surface not utilizing TBM techniques, BMPs include the use of sheeting and shoring methods in order to minimize the amount of subsurface soils disturbed and removed during excavation.

- Other possible measures include soldier pile and lagging, tangent piles, and secant pile walls as potential excavation support systems to be used during excavation.

- Additional details regarding piers/pilings as well as cofferdams that may be used surrounding in-stream piers can be found in Section 4.11 Waters of the U.S. including Wetlands.

The Project Sponsor will minimize exposure to geologic hazards during construction by adhering to appropriate building codes, Occupational Safety and Health Administration (OSHA) regulations, and engineering controls. In construction areas where potential naturally occurring asbestos is encountered in bedrock, implementation of proper protection and engineering controls to protect and educate workers on handling and monitoring would be necessary and would be described in a Health and Safety Plan prepared for the SCMAGLEV Project during the design-build phase. The use of a TBM, a water-tight segmental lining, and constant ventilation helps ensure that there is no accumulation of radon during construction and during the post-construction lifespan of the structures. Radon gas will be monitored in tunnels during construction and, if necessary, additional ventilation or personal protective equipment will be used to minimize health risk. Additional evaluation of radon content of sediments and groundwater will also be conducted at later design phase. Tests will also include the presence of other gases such as methane and hydrogen sulfide.

The Project Sponsor will monitor for paleontological resources in excavated soil and TBM spoils. These may be more likely found in areas around Camden Yards and BWI Marshall Airport Stations. Methods to minimize impacts to these geologic resources include, but are not limited to:

- Identification of those locations of the selected Build Alternatives where subsurface activities will disturb previously undisturbed strata in rock units considered to have a higher paleontological sensitivity.
- Conduct ground penetrating radar surveys of areas proposed for surface disturbance to determine the presence of large, potentially fossil-rich rocks.

- Retaining a certified paleontologist to supervise monitoring of construction excavations.
- Conducting visual surveys of ground disturbance areas before construction.
- Training provided to personnel running ground disturbing equipment.
- If paleontological materials are found during construction qualified paleontological resource staff would be contacted, and construction would be suspended, as appropriate.

4.13.5.2 Mitigation

The Project Sponsor will further evaluate subsurface structures and construction methods in order to mitigate potential effects and will design soil staging and removal practices to mitigate potential acidic surface water runoff. Recognition and appropriate soil amendments for burial, removal, or disposal of acid producing soils would mitigate the amount of potential acidic material produced.[12]

The Project Sponsor will identify and document former mine locations within the LOD on final site plans. For cases in which the guideway tunnel would pass below a former mine without intersecting it, reclamation documentation may not be necessary.

The Project Sponsor will consider seismic risk and adopt appropriate criteria in design of SCMAGLEV elements during later design and continued study.

[12] New Jersey Department of Agriculture-State Soil Conservation Committee. May 2012. *The Standards for Soil Erosion and Sediment Control in New Jersey*.