APPENDIX A: CALIFORNIA HIGH-SPEED RAIL IMPACT AVOIDANCE AND MINIMIZATION FEATURES FOR GEOLOGY, SOILS, AND SEISMICITY

GEO-IAMF#1: Geologic Resources

Prior to construction, the contractor shall prepare a Construction Management Plan (CMP) addressing how the contractor will address geologic constraints and minimize or avoid impacts to geologic resources during construction. The plan will be submitted to the Authority for review and approval. At a minimum, the plan will address the following geotechnical constraints/resources:

a. Groundwater Withdrawal. Controlling the amount of groundwater withdrawal from the project, by re-injecting groundwater at specific locations if necessary, or use alternate foundation designs to offset the potential for settlement. This control is important for locations with retained cuts in areas where high groundwater exists, and where existing buildings are located near the depressed track section.

   Ground settlement resulting from groundwater pumping is a problem in portions of the San Joaquin Valley. This feature would make sure that the HSR infrastructure will be designed to accommodate settlement and that the Central Valley Wye itself will not contribute to additional settlement.

b. Unstable Soils. Employing various methods to mitigate for the risk of ground failure from unstable soils. If soft or loose soils are encountered at shallow depths, they can be excavated and replaced with competent soils. To limit the excavation depth, replacement materials can also be strengthened using geosynthetics. Where unsuitable soils are deeper, ground improvement methods, such as stone columns, cement deep-soil-mixing (CDSM), or jet-grouting, can be used. Alternatively, if sufficient construction time is available, preloading—in combination with prefabricated vertical drains (wicks) and staged construction—can be used to gradually improve the strength of the soil without causing bearing-capacity failures.

   This feature would provide for a stable substrate on which to build the HSR infrastructure.

c. Subsidence. The Authority addresses subsidence in its design and construction processes. For the initial design, survey monuments were installed to establish a datum and set an initial track profile. In the construction phase, the design-build (DB) contractors for track bed preparation conduct topographic surveys for preparation of final design. Because subsidence could have occurred since the original benchmarks (survey monuments) were established, the DB contractor's topographic surveys will be used to help determine whether subsidence has occurred. The updated topographic surveys will also be used to establish the top of rail elevations for final design where the HSR system is outside established floodplain areas and above water surface elevations. Where the HSR system is in floodplain areas susceptible to flooding, consideration is being given to overbuild the height of the rail bed in anticipation of future subsidence.

   This feature would address the risk of ground failure from settlement in the engineering design. The design will include remediation for settlement-prone soils during construction. These activities would avoid the risk of settlement resulting from settlement-prone soils.

d. Water and Wind Erosion. The Contractor will implement erosion control methods as appropriate from the various erosion control methods documented in the Construction Storm Water Pollution Prevention Plan (SWPPP) (See HYD-IAMF#3), the Caltrans Construction Manuals, and the construction technical memorandum (see GEO-IAMF#6), and in coordination with other erosion, sediment, stormwater management and fugitive dust control efforts. Water and wind erosion control methods may include, but are not limited to, use of revegetation, stabilizers, mulches, and biodegradable geotextiles.

   Construction can contribute to air and water pollution if water and wind erosion occurs during construction. This measure would reduce the potential for erosion to occur by implementing specific actions to protect exposed soil, thereby reducing the potential for the Central Valley

Wye to contribute to air (dust) and water (sediment) pollution. This feature will complement the required stormwater pollution prevention plan.

e. Soils with Shrink-Swell Potential. In locations where shrink-swell potential is marginally unacceptable, soil additives will be mixed with existing soil to reduce the shrink-swell potential. Construction specifications will be based upon the decision whether to remove or treat the soil. This decision is based on the soils, specific shrink-swell characteristics, the additional costs for treatment versus excavation and replacement, as well as the long-term performance characteristics of the treated soil.

   This feature would avoid the risk of damage to HSR infrastructure from shrink-swell potential. The engineering design will include specific measures to remediate these soils during construction.

GEO-IAMF#2 Slope Monitoring

During Operation and Maintenance, the Authority shall incorporate slope monitoring by a Registered Engineering Geologist into the Operation and Maintenance procedures. The procedures shall be implemented at sites identified in the CMP where a potential for long-term instability exists from gravity or seismic loading including but not limited to at-grade sections where slope failure could result in loss of track support, or where slope failure could result in additional earth loading to foundations supporting elevated structures.

There are no major slopes within the Central Valley Wye corridor. This feature would make sure that the Central Valley Wye design incorporates the necessary elements to avoid or mitigate small unstable slopes within the Central Valley Wye corridor.

GEO-IAMF#3: Evaluate and Design for Large Seismic Ground Shaking

Prior to Construction the Contractor shall document through preparation of a technical memorandum how all HSR components were evaluated and designed for large seismic ground shaking. Prior to final design, the Contractor will conduct additional seismic studies to establish up-to-date estimation of levels of ground motion. The most current Caltrans seismic design criteria at the time of design will be used in the design of any structures supported in or on the ground. These design procedures and features reduce to the greatest practical extent for potential movements, shear forces, and displacements that result from inertial response of the structure. In critical locations, pendulum base isolators may be used to reduce the levels of inertial forces. New composite materials may also be used to enhance seismic performance.

This feature would minimize the risk of seismic ground shaking to the Central Valley Wye. It would provide for engineering design to take full account of the potential for ground motion. Specific elements to accommodate the expected level of ground motion will be built into the Central Valley Wye design.

GEO-IAMF#4: Suspension of Operations during an Earthquake

Prior to Operation and Maintenance activities, the Contractor shall document in a technical memorandum how suspension of operations during or after an earthquake was addressed in project design. Motion-sensing instruments to provide ground motion data and a control system to shut down HSR operations temporarily during or after a potentially damaging earthquake will be incorporated into final design. Monitoring equipment will be installed at select locations where high ground motions could occur.

This operational feature is standard for HSR systems in seismically active areas. It has been highly successful in Japan, where earthquakes are common, and has contributed to the Japanese system's stellar safety record. Stopping operations greatly reduces the potential for derailment and the risks to passengers and nearby residents associated with infrastructure damage.

GEO-IAMF#5: Subsidence Monitoring

Prior to Operation and Maintenance, the Authority shall develop a stringent track monitoring program. Once tracks are operational, a remote monitoring program will be implemented to monitor the effects of ongoing subsidence. Track inspection systems will provide early warning of reduced track integrity. HSR train sets will be equipped with autonomous equipment for daily track surveys. This specification will be added to HSR train bid packages. If monitoring indicates that track tolerances are not met, trains would operate at reduced speed until track tolerances are restored. In addition, the contractor responsible for wayside maintenance will be required to implement a stringent program for track maintenance.

This feature would provide a safety mechanism during operations in case of ground movement detection to shut down operations until inspections and, if needed, repairs can be completed.

GEO-IAMF#6: Geology and Soils

Prior to construction, the contractor shall document through issuance of a technical memorandum how the following guidelines and standards have been incorporated into facility design and construction:

- 2010 American Association of State Highway and Transportation Officials (AASHTO) Load and Resistance Factor Bridge Design Specifications and the 2009 AASHTO Guide Specifications for Load and Resistance Factor Seismic Bridge Design, or their most recent versions. These documents provide guidance for characterization of soils, as well as methods to be used in the design of bridge foundations and structures, retaining walls, and buried structures. These design specifications will provide minimum specifications for evaluating the seismic response of the soil and structures.
- Federal Highway Administration (FHWA) Circulars and Reference Manuals: These documents provide detailed guidance on the characterization of geotechnical conditions at sites, methods for performing foundation design, and recommendations on foundation construction. These guidance documents include methods for designing retaining walls used for retained cuts and retained fills, foundations for elevated structures, and at-grade segments. Some of the documents include guidance on methods of mitigating geologic hazards that are encountered during design.
- American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual: These guidelines deal with rail systems. Although they cover many of the same general topics as AASHTO, they are more focused on best practices for rail systems. The manual includes principles, data, specifications, plans, and economics pertaining to the engineering, design, and construction of railways.
- California Building Code: The code is based on 2009 International Building Code (IBC). This code contains general building design and construction requirements relating to fire and life safety, structural safety, and access compliance.
- IBC and American Society of Civil Engineers (ASCE)-7: These codes and standards provide minimum design loads for buildings and other structures. They would be used for the design of the maintenance facilities and stations. Sections in IBC and ASCE-7 provide minimum requirements for geotechnical investigations, levels of earthquake ground shaking, minimum standards for structural design, and inspection and testing requirements.
- Caltrans Design Standards: Caltrans has specific minimum design and construction standards for all aspects of transportation system design, ranging from geotechnical explorations to construction practices. These amendments provide specific guidance for the design of deep foundations that are used to support elevated structures, for design of mechanically stabilized earth (MSE) walls used for retained fills, and for design of various types of cantilever (e.g., soldier pile, secant pile, and tangent pile) and tie-back walls used for retained cuts.

- Caltrans Construction Manuals: Caltrans has a number of manuals including Field Guide to Construction Dewatering, Caltrans Construction Site BMPs Manual and Construction Site BMP Field Manual and Troubleshooting Guide. These provide guidance and best management practices for dewatering options and management, erosion control and soil stabilization, non-storm water management, and waste management at construction sites.
- American Society for Testing and Materials (ASTM): ASTM has developed standards and guidelines for all types of material testing- from soil compaction testing to concrete-strength testing. The ASTM standards also include minimum performance requirements for materials.

This feature would identify many of the design standards that apply to the Central Valley Wye. These require construction to meet specific performance standards based on site conditions. As a result, the Central Valley Wye would be designed to be resistant to geologic hazards, including seismic damage and unstable soils.

BIO-IAMF#20: Dewatering and Water Diversion

Prior to any construction activities within open or flowing water, the Contractor will prepare a dewatering plan which will be submitted by the Contractor for review and approval by the resource agencies (USACE, SWRCB, NMFS, and CDFW) prior to any work in that area. The plan will incorporate appropriate construction measures that minimize turbidity and siltation as determined through review and approval by the designated resource agencies. The Project Biologist and/or Biological Monitor will provide regular monitoring of dewatering and diversion sites are conducted and water quality data will be collected (if applicable). Prior to dewatering or water diversion, pre-activity surveys would establish the presence or absence of special status wildlife species within the affected waterbody. In the event that special-status species are detected during pre-activity surveys, an agency approved Project Biologist would relocate the species (if allowable) to an approved location off-site.

This feature would specify characteristics of a dewatering plan so that resource agencies, including the SWRCB, would be able to determine any potential turbidity and siltation effects before approving the plan.

HYD-IAMF#3: Prepare and Implement a Construction Stormwater Pollution Prevention Plan

Prior to construction (any ground-disturbing activities), the contractor shall comply with the State Water Resources Control Board (SWRCB) Construction General Permit requiring preparation and implementation of a Stormwater Pollution Prevention Plan (SWPPP), providing best management practices (BMP) to minimize potential short-term increases in sediment transport caused by construction, including erosion control requirements, stormwater management, and channel dewatering for affected stream crossings. The Construction General Permit separates projects into Risk Levels 1, 2, or 3. Risk levels are determined during the planning and design phases, and are based on potential erosion and transport to receiving waters. Requirements apply according to the Risk Level determined. For example, a Risk Level 3 (highest risk) project would require compulsory storm water runoff pH and turbidity monitoring, and pre- and post-construction aquatic biological assessments during specified seasonal windows.

These BMPs will include measures to provide permeable surfaces where feasible and to retain or detain and treat stormwater on-site. Other BMPs will include strategies to manage the overall amount and quality of stormwater runoff. The Construction SWPPP will include measures to address, but are not limited to, the following:

- Hydromodification management to ensure maintenance of pre-project hydrology by emphasizing on-site retention of stormwater runoff using measures such as flow dispersion, infiltration, and evaporation, supplemented by detention where required. Additional flow control measures will be implemented where local regulations or drainage requirements dictate.

- Implementing practices to minimize the contact of construction materials, equipment, and maintenance supplies with stormwater.
- Limiting fueling and other activities using hazardous materials to areas distant from surface water, providing drip pans under equipment, and daily checks for vehicle condition.
- Implementing practices to reduce erosion of exposed soil, including soil stabilization, watering for dust control, perimeter silt fences, and sediment basins.
- Implementing practices to maintain current water quality including silt fences, stabilized construction entrances, grass buffer strips, ponding areas, organic mulch layers, inlet protection, and storage tanks and sediment traps to settle sediment.
- Implementing practices to capture and provide proper off-site disposal of concrete wash water, including isolation of runoff from fresh concrete during curing to prevent it from reaching the local drainage system, and possible treatment with dry ice or other acceptable means to reduce the alkaline character of the runoff (high pH) that typically results from new concrete.
- Developing and implementing a spill prevention and emergency response plan to handle potential fuel or other spills.
- Using diversion ditches to intercept surface runoff from offsite.
- Where feasible, avoiding areas that may have substantial erosion risk, including areas with erosive soils and steep slopes.
- Where feasible, limiting construction to dry periods when flows in water bodies are low or absent.

Implementation of a SWPPP will be performed by the construction contractor's as directed by the contractor's Qualified SWPPP Practitioner or designee. As part of that responsibility, the effectiveness of construction BMPs must be monitored before and after storm events. Records of these inspections and monitoring results are submitted to the SWRCB/Regional Water Quality Control Board (RWQCB) as part of the annual report required by the Statewide Construction General Permit. The reports are available to the public online. The SWRCB and RWQCB have the opportunity to review these documents.

This feature would limit erosion potential as a result of construction activities.

SS-IAMF#2: Safety and Security Management Plan

Sixty days after receiving from the Authority a construction notice-to-proceed, the Contractor shall provide the Authority with a technical memorandum documenting how the following requirements, plan, programs and guidelines were considered in design, construction and eventual operation to protect the safety and security of construction workers and users of the HSR. The Contractor shall be responsible for implementing all construction-related safety and security plans and the Authority shall be responsible for implementing all safety and security plans related to HSR operation.

- Workplace worker safety is generally governed by the Occupational Health and Safety Act of 1970, which established the OSHA. OSHA establishes standards and oversees compliance with workplace safety and reporting of injuries and illnesses of employed workers. In California, OSHA enforcement of workplace requirements is performed by California Occupational Safety and Health Administration (Cal OSHA). Under Cal OSHA regulations, as of July 1, 1991, every employer must establish, implement, and maintain an injury and illness prevention program.
- The Authority has adopted a Safety and Security Management Plan to guide the safety and security activities, processes, and responsibilities during design, construction and implementation phases of the project to protect the safety and security of construction workers and the public. A Systems Safety Program Plan (SSPP) and a System Security Plan

will be implemented prior to the start of revenue service to guide the safety and security of the operation of the high-speed rail system.

- Prior to construction, the Contractor shall provide the Authority with a Safety and Security Management Plan documenting how they will implement the Authority's safety and security requirements within their project scope.
- Implement site-specific health and safety plans and site-specific security plans to establish minimum safety and security guidelines for contractors of, and visitors to, construction projects. Contractors will be required to develop and implement site-specific measures that address regulatory requirements to protect human health and property at construction sites.
- Preparation of a Valley Fever action plan that includes: A) information on causes, preventative measures, symptoms, and treatments for Valley Fever to individuals who could potentially be exposed through construction activities (i.e., construction workers, monitors, managers, and support personnel); B) continued outreach and coordination with California Department of Public Health; C) coordination with county departments of public health to ensure that the above referenced information concerning Valley Fever is readily available to nearby residents, schools, and businesses and to obtain area information about Valley Fever outbreaks and hotspots; and D) provide a qualified person dedicated to overseeing implementation of the Valley Fever prevention measures to encourage a culture of safety of the contractors and subcontractors. The Valley Fever Health and Safety (VFHS) designee shall coordinate with the county Public Health Officer and oversee and manage the implementation of Valley Fever control measures. The VFHS designee is responsible for ensuring the implementation of measures in coordination with the county Public Health Officer. Medical information will be maintained following applicable and appropriate confidentiality protections. The VFHS in coordination with the county Public Health Officer will determine what measures will be added to the requirements for the Safety and Security Management Plan regarding preventive measures to avoid Valley Fever exposure. Measures shall include, but are not limited to the following: A) train workers and supervisors on how to recognize symptoms of illness and ways to minimize exposure, such as washing hands at the end of shifts; B) provide washing facilities nearby for washing at the end of shifts; C) provide vehicles with enclosed, air conditioned cabs and make sure workers keep the windows closed; D) equip heavy equipment cabs with high efficiency particulate air (HEPA) filters; and E) make NIOSH approved respiratory protection with particulate filters as recommended by the CDPH available to workers who request them.
- System safety program plans incorporate FRA requirements and are implemented upon FRA approval. FRA's SSPPs requirements will be determined in FRA's new System Safety Regulation (49 CFR 270).
- Rail systems must comply with FRA requirements for tracks, equipment, railroad operating rules and practices, passenger safety, emergency response, and passenger equipment safety standards found in 49 CFR Parts 200-299.
- The HSR *Urban Design Guidelines* (Authority 2011) require implementing the principles of crime prevention through environmental design. The contractor shall consider four basic principles of crime prevention through environmental design during station design and site planning: territoriality (design physical elements that express ownership of the station or site); natural surveillance (arrange physical features to maximize visibility); improved sightlines (provide clear views of surrounding areas); and access control (provide physical guidance for people coming and going from a space). The HSR design includes emergency access to the rail right-of-way, and elevated HSR structure design includes emergency egress points.
- Implement fire/life safety and security programs that promote fire and life safety and security in system design, construction, and implementation. The fire and life safety program is coordinated with local emergency response organizations to provide them with an understanding of the rail system, facilities, and operations, and to obtain their input for modifications to emergency response operations and facilities, such as evacuation routes.

The Authority will establish fire/life safety and security committees throughout the HSR section.

- Implement system security plans that address design features intended to maintain security at the stations within the track right-of-way, at stations, and onboard trains. A dedicated police force will ensure that the security needs of the HSR system are met.
- The design standards and guidelines require emergency walkways on both sides of the tracks for both elevated and at-grade sections and the provision of appropriate space as defined by fire and safety codes along at-grade sections of the alignment to allow for emergency response access.
- Implement standard operating procedures and emergency operating procedures, such as the FRA-mandated Roadway Worker Protection Program to address the day-to-day operation and emergency situations that will maintain the safety of employees, passengers, and the public.

This feature would provide plans for safe construction conditions as well as safe operation conditions in areas of potential geologic hazard, including in areas of subsurface gas and oil wells.

SS-IAMF#4: Oil and Gas Wells

Prior to ground disturbing activities, the Contractor shall identify and inspect all active and abandoned oil and gas wells within 200 feet of the HSR tracks. Any active wells will be abandoned and relocated by the Contractor in accordance with the California Department of Conservation, Division of Oil, and Gas and Geothermal Resources (DOGGR) standards in coordination with the well owners. In the event that relocated wells do not attain the current production rates of the now-abandoned active wells, the Authority will be responsible for compensating the well owner for lost production. All abandoned wells within 200 feet of the HS tracks will be inspected and re-abandoned, as necessary, in accordance with DOGGR standards and in coordination with the well owner. The Contractor will provide the Authority with documentation that the identification and inspection of the wells has occurred prior to construction.

This feature would provide for compensation to well owners for lost production for any active oil wells that must be relocated.

References

California High-Speed Rail Authority (Authority). 2011. *California High-Speed Train Project Urban Design Guidelines*. March 2011.