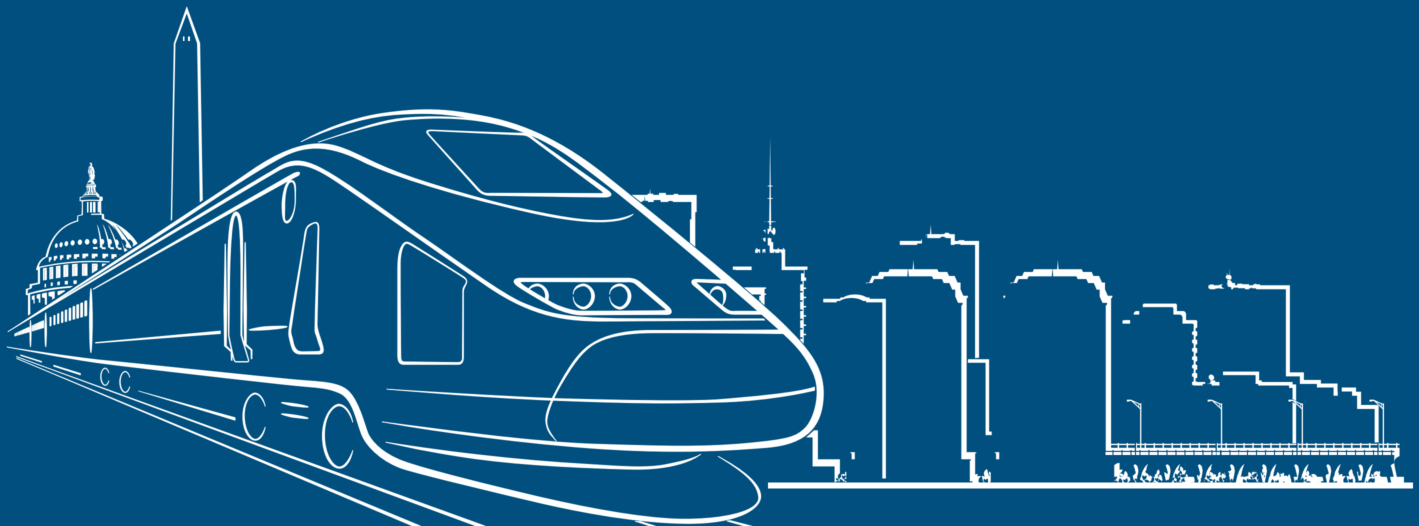
DC TO RICHMOND
SOUTHEAST HIGH SPEED RAIL

4 ENVIRONMENTAL CONSEQUENCES



4 ENVIRONMENTAL CONSEQUENCES

The discussion on environmental consequences summarizes potential effects on the human, physical, and natural environments that may result from construction and operation of the Washington, D.C. to Richmond Southeast High Speed Rail Project (DC2RVA Project). The existing environment within the study area was described in Chapter 3. The effects presented in this chapter are based on the conceptual engineering developed for the Build Alternatives. Effects are identified for each alternative within the six areas defined for the Project in detail in Chapter 2 and summarized below in Table 4.0-1.

Table 4.0-1: Summary of Build Alternatives

Alternative Area	Alternative	Description
Area 1: Arlington (Long Bridge Approach)	1A	Add Two Tracks on the East
	1B	Add Two Tracks on the West
	1C	Add One Track East and One Track West
Area 2: Northern Virginia (Long Bridge to Dahlgren Spur)	2A	Add One Track/Improve Existing Track
Area 3: Fredericksburg (Dahlgren Spur to Crossroads)	3A	Maintain Two Tracks Through Town
	3B	Add One Track East of Existing
	3C	Add Two-Track Bypass East
Area 4: Central Virginia (Crossroads to Doswell)	4A	Add One Track/Improve Existing Track
Area 5: Ashland (Doswell to I-295)	5A	Maintain Two Tracks Through Town
	5A–Ashcake	Maintain Two Tracks Through Town (Relocate Station to Ashcake)
	5B	Add One Track East of Existing
	5B–Ashcake	Add One Track East of Existing (Relocate Station to Ashcake)
	5C	Add Two-Track West Bypass
	5C–Ashcake	Add Two-Track West Bypass (Relocate Station to Ashcake)
	5D–Ashcake	Three Tracks Centered Through Town (Add One Track, Relocate Station to Ashcake)
Area 6: Richmond (I-295 to Centralia)	6A	Staples Mill Road Station Only
	6B–A-Line	Boulevard Station Only, A-Line
	6B–S-Line	Boulevard Station Only, S-Line
	6C	Broad Street Station Only
	6D	Main Street Station Only
	6E	Split Service, Staples Mill Road/Main Street Stations
	6F	Full Service, Staples Mill Road/Main Street Stations
	6G	Shared Service, Staples Mill Road/Main Street Stations

For this Environmental Impact Statement (EIS), the Federal Railroad Administration (FRA) and the Virginia Department of Rail and Public Transportation (DRPT) established two important planning dates. The first planning date is 2025, which is FRA and DRPT's current best estimate of when construction of the DC2RVA infrastructure could be completed and the new DC2RVA service would be placed in operation. FRA and DRPT's estimate of the year 2025 as the "opening day" is dependent on many factors, not the least of which is finalizing the EIS and Record of Decision. The date also assumes that federal funding in addition to other funding sources will be available at the level required to build all of the proposed infrastructure improvements and acquire the necessary equipment and trainsets. DRPT based this date on an aggressive but potentially achievable schedule assumption that all necessary permits, approvals, agreements, and funding could be finalized by 2020, final design would take one year (2021), right-of-way acquisition (if needed) would take one year (2022), and construction would take three years (2023–2025). FRA and DRPT also used 2025 as the date when the physical impacts associated with DC2RVA Project construction would take place. Thus, all of the physical impact analyses within this Draft EIS on human and natural resources are estimated for 2025, and compared to the No Build Alternative conditions projected for 2025.

The second key planning date established by FRA and DRPT is the planning horizon date of 2045, 20 years after the projected implementation of the new intercity passenger rail service in 2025. Both the Passenger Rail Investment and Improvement Act (PRIIA) and FRA guidance require that DRPT demonstrate that the proposed project is sufficient to deliver the proposed passenger rail benefits and an efficient and reliable multimodal rail corridor over a 20-year time horizon following the completion of the passenger project. DRPT uses operational simulations analysis, as discussed in Section 2.6, to test the proposed alternatives to determine if the rail capacity is adequate for both the opening day (2025) levels of projected freight, commuter, and passenger rail traffic and to determine if the infrastructure remains adequate over the 20-year planning horizon or until 2045. DRPT also used the 2045 planning horizon date to estimate some of the longer term effects of the proposed service, such as ridership, energy use, and effects on air quality, as well as indirect and cumulative effects.

Proposed mitigation is identified throughout this chapter as a way to avoid, minimize, reduce, or eliminate potential effects of the Project. As part of the identified mitigation, applicable best management practices (BMPs) are also identified. BMPs are existing practices and measures required by law, regulation, or policy that reduce the environmental impacts of designated activities, functions, or processes. Although BMPs mitigate potential impacts by avoiding, minimizing, or reducing/eliminating impacts, BMPs are distinguished from mitigation measures because BMPs are inherently part of the Project and are not additional mitigation measures proposed because of this environmental review process. Examples of typical BMPs include permanent seeding, use of native vegetation, sediment and erosion control, silt fences, check dams, and sediment basins. DRPT will refine the mitigation measures during final design and ensure that they are incorporated into the DC2RVA Project.

4.1 WATER RESOURCES

Several federal laws protect water resources, which include the Clean Water Act (CWA), Safe Drinking Water Act (SDWA), and the Rivers and Harbors Act (RHA). These laws protect water resources from pollutants, discharges, fill materials, dredging, and encroachments. Water resources are regulated by the United States Environmental Protection Agency (EPA), the United

States Army Corps of Engineers (USACE), United States Coast Guard (USCG), and state departments of environment.

Under the No Build Alternative, CSX Transportation (CSXT) would continue maintenance and repairs of the existing infrastructure, and infrastructure improvements that are already planned for the DC2RVA corridor, as defined in Section 2.5.1.1, would move forward. Anticipated effects of the No Build Alternative are discussed below in comparison with the Build Alternatives, including potential permits required. Existing factors that affect water quality, such as impervious surfaces and pollutants washed from the existing surfaces into receiving water bodies, would continue with the No Build Alternative. No changes to floodplains or hydraulic conditions are anticipated with the No Build Alternative.

Due to the linear nature and length of the DC2RVA corridor, each Build Alternative would include unavoidable effects to water resources. Effects were calculated in Geographic Information System (GIS) based on the limits of disturbance (LOD) developed for each Build Alternative. Permanent effects include all areas where infrastructure would physically replace existing conditions. Temporary effects are areas required for construction of the Build Alternatives, such as for movement, access, or storage of equipment, that would be regraded and seeded with an approved seed mixture by the contractor and allowed to renaturalize after completion of the Project. Water resources potentially affected by the Build Alternatives are shown in the *Natural Resources Technical Report* (Appendix M).

4.1.1 Surface Waters, Rivers, Streams, and Floodplains

Effects to surface waters resulting from construction of the proposed improvements are similar between the Build Alternatives. Typical effects would include:

Temporary

- Increased erosion from disturbed areas, resulting in increased sedimentation and decreased water clarity
- Disturbance of in-stream habitat and aquatic species from in-stream construction

Long-Term Temporary

- Clearing and grubbing of stream banks, resulting in increased erosion, decreased bank stabilization, and potential slope failure
- Removal of riparian canopy, resulting in increased water temperatures

Permanent

- Decreased groundwater recharge due to increased impervious surfaces
- Increased nutrient loading from increased runoff and fertilizer application during the replanting process
- Increased potential for toxic compounds entering the water system from construction equipment, increased train traffic, application of snow and ice removal chemicals, and application of herbicides to keep tracks clear of vegetation
- Altered stream locations (including intentional stream relocations), flow patterns, and morphology
- Use of resource (culverted streams and filled wetlands) for infrastructure placement

The extent of effects is generally related to the length or area of the resource affected. The extent of potentially permanent and temporary encroachments on the water resources identified in Chapter 3 are listed in Table 4.1-1. The more severe impacts are associated with new or rehabilitated structures spanning major waterways. These types of crossings would require several spans and new piers or substructure to be constructed in the waterway itself. For smaller waterway crossings, single-span bridges or bottomless or properly embedded culverts are recommended. In most cases, the short-term or temporary nature of the effects caused by construction would allow renaturalization of the resource. The locations of all water crossings and the approximate LOD associated with each are presented in detail the *Natural Resources Technical Report* (Appendix M). Depending on the combination of Build Alternatives, between 152 and 191 streams would be permanently affected by the proposed improvements. Linear and parallel encroachments to these streams are estimated between 26,377 and 35,422 linear feet.

Table 4.1-1: Stream Resource Effects

Alternative Area	Alternative	Number of Streams	Stream Length (Linear Feet)	Navigable Waters (Linear Feet)	State Scenic Rivers (Linear Feet)	Nationwide Rivers Inventory (Linear Feet)	Chesapeake Bay RPA (Acres)	Floodplains (Acres)
Area 1: Arlington (Long Bridge Approach)	1A	–	–	–	–	–	P: 4.0 T: 1.2	P: 0.3 T: 1.0
	1B	–	–	–	–	–	P: 4.8 T: 1.5	P: 0.1 T: 0.3
	1C	–	–	–	–	–	P: 6.0 T: 0.6	P: 0.1 T: 0.4
Area 2: Northern Virginia (Long Bridge to Dahlgren Spur)	2A	P: 52 T: 68	P: 7,198 T: 4,022	P: 205.7 T: 232.9	P: 44.4 T: 50.2	–	P: 67.9 T: 50.2	P: 15.1 T: 18.1
Area 3: Fredericksburg (Dahlgren Spur to Crossroads)	3A	P: 16 T: 21	P: 1,101 T: 1,771	–	–	–	P: 36.9 T: 17.7	P: 7.7 T: 5.7
	3B	P: 20 T: 26	P: 1,506 T: 1,894	P: 45.0 T: 50.1	P: 45.0 T: 50.1	–	P: 41.0 T: 17.9	P: 10.5 T: 6.4
	3C	P: 43 T: 45	P: 4,597 T: 1,693	P: 44.5 T: 102.7	P: 44.5 T: 102.7	–	P: 57.9 T: 18.6	P: 8.0 T: 3.8
Area 4: Central Virginia (Crossroads to Doswell)	4A	P: 32 T: 43	P: 3,627 T: 2,798	P: 64.8 T: 265.9	P: 40.5 T: 20.8	P: 40.5 T: 20.8	P: 69.7 T: 31.9	P:17.2 T: 17.3
Area 5: Ashland (Doswell to I-295)	5A	P: 23 T: 25	P: 6,928 T: 1,623	–	P: 40.1 T: 15.7	P: 40.1 T: 15.7	P: 16.6 T: 12.9	P: 5.9 T: 2.5
	5A–Ashcake	P: 22 T: 25	P: 6,928 T: 1,623	–	P: 40.1 T: 15.7	P: 40.1 T: 15.7	P: 17.7 T: 12.8	P: 7.1 T: 2.4
	5B	P: 24 T: 27	P: 9,114 T: 2,151	–	P: 40.1 T: 15.7	P: 40.1 T: 15.7	P: 19.4 T: 14.4	P: 6.5 T: 3.3

▶ *Continued (see end of table for detailed notes.)*

Table 4.1-1: Stream Resource Effects

Alternative Area	Alternative	Number of Streams	Stream Length (Linear Feet)	Navigable Waters (Linear Feet)	State Scenic Rivers (Linear Feet)	Nationwide Rivers Inventory (Linear Feet)	Chesapeake Bay RPA (Acres)	Floodplains (Acres)
Area 5: Ashland (Doswell to I-295)	5B–Ashcake	P: 23 T: 28	P: 9,101 T: 2,132	–	P: 40.1 T: 15.7	P: 40.1 T: 15.7	P: 23.4 T: 14.7	P: 10.7 T: 3.8
	5C	P: 26 T: 26	P: 9,005 T: 1,410	–	P: 40.1 T: 15.7	P: 40.1 T: 15.7	P: 31.6 T: 13.9	P: 9.2 T: 2.4
	5C–Ashcake	P: 26 T: 26	P: 9,005 T: 1,410	–	P: 40.1 T: 15.7	P: 40.1 T: 15.7	P: 32.6 T: 13.9	P: 10.4 T: 2.4
	5D–Ashcake	P: 28 T: 31	P: 8,163 T: 2,958	–	P: 40.1 T: 15.7	P: 40.1 T: 15.7	P: 25.7 T: 15.4	P: 11.5 T: 4.0
Area 6: Richmond (I-295 to Centralia)	6A	P: 30 T: 30	P: 7,523 T: 3,384	–	–	–	P: 53.5 T: 15.5	P: 8.1 T: 3.5
	6B–A-Line	P: 34 T: 34	P: 9,650 T: 3,609	–	–	–	P: 59.3 T: 17.4	P: 11.3 T: 6.1
	6B–S-Line	P: 36 T: 30	P: 8,819 T: 2,333	P: 31.7 T: 49.5	P: 31.7 T: 49.7	–	P: 55.1 T: 11.5	P: 48.6 T: 12.4
Area 6: Richmond (I-295 to Centralia)	6C	P: 35 T: 34	P:10,886 T: 3,349	–	–	–	P: 63.3 T: 17.0	P: 16.1 T: 5.8
	6D	P: 36 T: 30	P: 8,819 T: 2,333	P: 31.7 T: 49.5	P: 31.7 T: 49.5	–	P: 55.0 T: 11.5	P: 51.9 T: 13.0
	6E	P: 30 T: 30	P: 7,952 T: 3,169	–	–	–	P: 55.3 T: 15.4	P: 22.2 T:20.2
	6F	P: 36 T: 31	P: 8,869 T: 2,333	P: 29.2 T: 51.9	P: 29.2 T: 51.9	–	P: 57.2 T: 11.3	P: 50.7 T: 13.1
	6G	P: 34 T: 29	P: 8,235 T: 2,288	P: 29.2 T: 51.9	P: 29.2 T: 51.2	–	P: 57.8 T: 11.1	P: 48.1 T: 13.1

Notes: P = Permanent Effect; T=Temporary Effect.

4.1.1.1 Designated Waters

Navigable Waters

Although construction of the proposed project would not have any effect on this designation, work in navigable waters requires special consideration under Section 9 and Section 10 of the Rivers and Harbors Act (see Permits 4.1.5). Depending on the Build Alternative, the LOD would cross five to seven of the eight Coast Guard regulated navigable waters within the study area:

- Occoquan River
- Neabsco Creek
- Powells Creek
- Aquia Creek
- Rappahannock River
- Mattaponi River
- James River

State Scenic Rivers and Nationwide Rivers Inventory

The existing rail corridor was in place long before much of the surrounding development in the DC2RVA corridor; as such, new construction would be consistent with existing land uses and controlling regulations for designated waters. The most notable changes due to the proposed improvements would be the construction of new bridges built adjacent to and/or replacing existing bridges. However, the new bridges would generally reflect the horizontal and vertical profiles of existing structures; therefore, DRPT anticipates that the landscape and viewsheds from designated waters will be similar in context to existing conditions. The Fredericksburg Bypass (Build Alternative 3C) would require a new bridge over the Rappahannock River in a new location; however, the new bridge would not be in an area where the Rappahannock River is designated a State Scenic River. The State Scenic River designation ends north of the proposed bypass near Ferry Farm. Consistent with the guidelines for protecting designated waters, the use of BMPs would ensure the preservation of the ecological resources within the waterways and their local watersheds. The DC2RVA Project is not expected to affect river designations.

Chesapeake Bay Preservation Act (CBPA)

Transportation projects, including rail lines, are conditionally exempt from the Chesapeake Bay Preservation Area Designation and Management Regulations. By constructing improvements in accordance with the Virginia Erosion and Sediment Control Law (§10.1-560 *et seq.* of the Code of Virginia), the *Stormwater Management Act* (§10.1-603. 1 *et seq*. of the Code of Virginia), and the terms and conditions of water quality permits required by USACE, Virginia Department of Environmental Quality (Virginia DEQ), and Virginia Marines Resources Commission (VMRC), and an erosion and sediment control plan and a stormwater management plan approved by Virginia DEQ, all of the Build Alternatives would be consistent with the CBPA and its implementing regulations.

Virginia Coastal Zone Management Act (CZMA)

Each Build Alternative would be consistent with the established Virginia Coastal Zone Enforceable Policies as related to fisheries management, subaqueous lands management, wetlands management, dunes management, nonpoint source pollution control, point source pollution control, shoreline sanitation, air pollution control, and coastal lands management. The FRA would submit a Federal Consistency Determination for the recommended Preferred Alternative that analyzes the coastal effects of the Project in light of the enforceable policies of the Virginia CZMA program and provides commitment to comply with those policies. The recommended Preferred Alternative would be designed and constructed in accordance with the Virginia Erosion and Sediment Control Law and the terms and conditions of water quality permits required by USACE, Virginia DEQ, and VMRC, and an erosion and sediment control plan and a stormwater management plan approved by Virginia DEQ. Implementation of proposed mitigation measures and any required permits would ensure consistency with the enforceable policies of the Virginia CZMA program.

4.1.1.2 Floodplains and Floodways

As indicated in Table 4.1-1, each Build Alternative would potentially affect Federal Emergency Management Agency (FEMA) 100-year floodplains. There is considerable variation in the acres of encroachments (both longitudinal and parallel) among the various combinations of the Build Alternatives – ranging from 62.4 to 124.8 acres. None of the floodplain encroachments would represent a "significant encroachment" (as defined in 23 *Code of Federal Regulations* [CFR] 650.105[q]) because of the following reasons:

- It would pose no significant potential for interruption or termination of a transportation facility that is needed for emergency vehicles or provides a community's only evacuation route. These rail lines are not considered the only emergency evacuation route, nor do they support emergency vehicles.
- It would not pose a significant flooding risk. The Build Alternatives would be designed consistent with procedures for the location and hydraulic design on floodplains contained in 23 CFR 650 Subpart A. Accordingly, the Build Alternatives are not expected to increase flood height elevations, the probability of flooding, or the potential for property loss and hazard to life.
- It would not have significant adverse effects on natural and beneficial floodplain values. Avoidance and minimization efforts, including spanning floodplains where practicable and minimizing wetland impacts, would be made during design to avoid or minimize impacts on natural and beneficial floodplain values.

Portions of the study area are also vulnerable to tidal flooding from major storms, such as hurricanes and northeasters. Both types of storms produce winds that push large volumes of water against the shore. Hurricanes, with their high winds and heavy rainfall, are the most severe storms to which the study area is subjected and can produce local to widespread flooding in the study area. The study area also contains tidally influenced waters that are subject to tidal flooding in their lower reaches and fluvial flooding on the upper reaches.

Each Build Alternative is consistent with the transportation elements of local comprehensive use plans and are not projected to either encourage or accelerate any growth or changes in land use that are not already expected. The Project would not encourage, induce, allow, serve, support, or otherwise facilitate incompatible base floodplain development.

4.1.1.3 Stormwater/Drainage

Increased stormwater runoff from construction of the Project improvements can impact receiving streams and associated land surfaces in two forms: long-term impacts caused by runoff from increased impervious surfaces and short-term impacts caused by land disturbance during construction. Stormwater from railroad corridors can potentially carry increased quantities of silt; heavy metals; petroleum products from railroad equipment; chemicals associated with snow and ice removal; herbicides associated with vegetation maintenance; and other chemicals associated with railroad cars and machinery. The proposed Build Alternatives would increase impervious surfaces by constructing additional rail bed and track, as well as ancillary facilities associated with stations, grade crossings, and bridges. The increase in stormwater runoff could increase erosion, silt, and chemicals entering the waterways. These materials can potentially degrade water quality and aquatic habitat integrity. The effects on water quality depend on the size of the receiving waterways crossed and the number of such crossings (see Table 4.1-1). Streams with low flow are more severely affected because they have less volume to dilute the runoff.

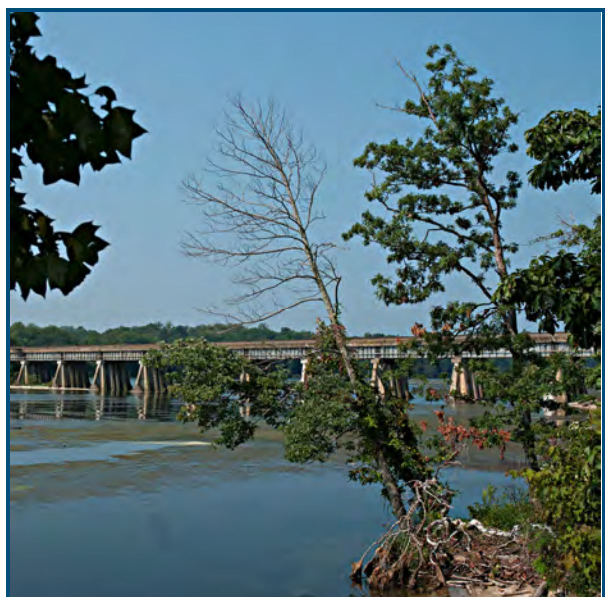
Additional runoff as a result of the Build Alternatives would be minimal because the increases in impervious surface are small. Stormwater runoff from railways is generally less pronounced than that from roadways because much of the rail bed is permeable to rainfall (i.e., ballast and side slopes). Impervious surfaces have a runoff coefficient of 0.80, or about 80 percent runoff and about 20 percent infiltration. Roadways have runoff coefficients of 0.85 to 0.95, while the runoff coefficient for ballasted track is calculated between 0.50 to 0.55. Although ballast is considered to be permeable, some runoff would collect in adjacent drainage ditches and may carry similar pollutants to and have similar effects to surface waters as runoff associated with paved roadways.

Short-term adverse impacts on water quality within the study area may result from soil erosion and sedimentation because of land-disturbing activities during construction. Land-disturbing activities include construction of the rail bed, tracks, bridges, signal and communication facilities, and other related structures and facilities of the railroad, including grade crossings, clearing of right-of-way, staging areas, access roads, and borrow/spoil areas. Construction-related effects are likely to be similar for road and rail (see Section 4.19 for descriptions of construction activities). Uncontrolled erosion and sedimentation can affect aquatic algae and submerged aquatic vegetation, benthic macroinvertebrate habitat, and fish spawning habitat, and it can remove food resources for some stream species.

The recommended Preferred Alternative would be designed and constructed in accordance with the Virginia Erosion and Sediment Control Law (§10.1-560 *et seq.* of the Code of Virginia), the *Stormwater Management Act* (§10.1-603. 1 *et seq.* of the Code of Virginia), and the terms and conditions of water quality permits required by USACE, Virginia DEQ, and VMRC. By upgrading older stormwater facilities along the DC2RVA corridor, the Project could improve drainage in the study area.

4.1.2 Wetlands

As noted in Chapter 3, various wetland systems are located along extensive stretches throughout the 123-mile railroad corridor. Many of these systems pre-date the rail corridor and are bisected by the rail line itself. Existing drainage facilities beneath the rail bed have maintained hydraulic connections between the systems and, in many cases, allowed the persistence of these systems on both sides of the rail line. Preliminary designs to widen the rail bed attempted to minimize encroachments on these resources by widening on sides opposite of wetlands when practicable. However, complete avoidance could not be achieved, and DRPT anticipates permanent impacts to wetlands with any of the Build Alternatives. Permanent impacts resulting from such encroachments range from 22.14 to 49.64 acres depending on the combination of Build Alternatives (see Table 4.1-2). Temporary impacts during construction would be similar between the Build Alternatives, ranging from 25.25 to 30.86 acres. The most measurable difference in effects among the alternatives is found in the effects associated with construction of the Fredericksburg and Ashland bypasses on greenfield alignments that cross rural areas less altered by human activities (Alternatives 3C and 5C, respectively). The approximate limits of disturbance and locations of potential wetlands effects for each alternative are shown in detail in the *Natural Resources Technical Report* (Appendix M).



Powells Creek Crossing

Table 4.1-2: Wetland Effects (acres)

Alternative Area	Alternative	PEM[1]	PEM/ PSS	PEM/ PFO	PEM/ PSS/ PFO	PSS[2]	PSS/ PFO	PFO[3]	Total
Area 1: Arlington (Long Bridge Approach)	1A	–	–	–	–	P: 0.02 T: 0.67	–	–	P: 0.02 T: 0.67
	1B	–	–	–	–	P: — T:0.01	–	–	P: — T: 0.01
	1C	–	–	–	–	P: 0.01 T: 0.11	–	–	P: 0.01 T: 0.11
Area 2: Northern Virginia (Long Bridge to Dahlgren Spur)	2A	P: 1.36 T: 0.62	P: 0.15 T: 0.19	P: 1.71 T: 1.53	P: 0.67 T: 0.37	–	–	P: 1.31 T: 0.83	P: 5.19 T: 3.54
Area 3: Fredericksburg (Dahlgren Spur to Crossroads)	3A	P: 1.57 T: 1.11	P: 0.42 T: 0.21	P: 2.40 T: 1.30	–	P: 0.13 T: 0.34	P: 0.04 T: —	P: 0.70 T: 1.49	P: 5.24 T: 4.45
	3B	P: 1.61 T: 1.16	P: 0.42 T: 0.21	P: 2.39 T: 1.29	–	P: 0.13 T: 0.34	P: 0.04 T: —	P: 0.71 T: 1.52	P: 5.29 T: 4.52
	3C	P: 1.92 T: 0.92	P: 0.54 T: 0.10	P: 3.92 T: 0.90	–	P: 0.42 T: 0.36	–	P: 17.03 T: 4.24	P: 23.82 T: 6.53
Area 4: Central Virginia (Crossroads to Doswell)	4A	P: 2.51 T: 1.66	P: 0.78 T: 0.17	P: 2.67 T: 7.55	P: 0.71 T: 1.15	P: 0.04 –	P: 0.25 T: 0.90	P: 1.43 T: 3.31	P: 8.39 T: 14.74
Area 5: Ashland (Doswell to I-295)Z	5A	P: 0.16 T: 0.08	–	P: 0.21 T: 0.46	–	–	P: — T: 0.08	P: 0.04 T: 0.86	P: 0.41 T: 1.48
	5A–Ashcake	P: 0.16 T: 0.08	–	P: 0.21 T: 0.46	–	–	P: — T: 0.08	P: 0.04 T: 0.86	P: 0.41 T: 1.48
	5B	P: 0.16 T: 0.08	–	P: 0.21 T: 0.51	–	–	P: — T: 0.08	P: 0.04 T: 0.86	P: 0.41 T: 1.53
	5B–Ashcake	P: 0.20 T: 0.05	–	P: 0.21 T: 0.51	–	–	P: — T: 0.08	P: 0.04 T: 0.86	P: 0.45 T: 1.50
	5C	P: 2.66 T: 0.78	–	P: 2.10 T: 0.92	–	–	P: — T: 0.08	P: 3.69 T: 1.70	P: 8.44 T: 3.47
	5C–Ashcake	P: 2.70 T: 0.78	–	P: 2.10 T: 0.92	–	–	P: — T: 0.08	P: 3.69 T: 1.70	P: 8.48 T: 3.47
	5D–Ashcake	P: 0.20 T: 0.05	–	P: 0.21 T: 0.46	–	–	P: — T: 0.08	P: 0.04 T: 0.93	P: 0.45 T: 1.51
Area 6: Richmond (I-295 to Centralia	6A	P: 1.59 T: 0.29	–	P: 1.07 T: 0.33	P: 0.36 T: 0.10	P: 0.01 T: 0.40	–	P: 0.18 T: 0.77	P: 3.21 T: 1.89
	6B–A-Line	P: 1.30 T: 0.31	–	P: 1.07 T: 0.33	P: 0.36 T: 0.10	P: 0.01 T: 0.40	–	P: 0.18 T: 0.77	P: 2.91 T: 1.91
	6B–S-Line	P: 2.48 T: 0.64	P: 0.20 T: 0.01	P: 0.28 T: 0.05	P: 0.13 T: 0.06	P: 0.08 T: 0.05	–	P: 0.30 T: 0.22	P: 3.47 T: 1.03

▶ *Continued (see end of table for detailed notes.)*

Table 4.1-2: Wetland Effects (acres)

Alternative Area	Alternative	PEM[1]	PEM/ PSS	PEM/ PFO	PEM/ PSS/ PFO	PSS[2]	PSS/ PFO	PFO[3]	Total
Area 6: Richmond (I-295 to Centralia	6C	P: 1.37 T: 0.30	–	P: 1.07 T: 0.33	P: 0.36 T: 0.10	P: 0.01 T: 0.40	–	P: 0.18 T: 0.77	P: 2.99 T: 1.90
	6D	P: 2.48 T: 0.64	P: 0.20 T: 0.01	P: 0.28 T: 0.05	P: 0.13 T: 0.06	P: 0.08 T: 0.05	–	P: 0.30 T: 0.22	P: 3.47 T: 1.03
	6E	P: 1.59 T: 0.29	–	P: 1.18 T: 0.33	P: 0.36 T: 0.10	P: 0.01 T: 0.40	–	P: 0.18 T: 0.77	P: 3.31 T: 1.89
	6F	P: 2.53 T: 0.64	P: 0.20 T: 0.01	P: 0.28 T: 0.05	P: 0.13 T: 0.06	P: 0.08 T: 0.05	–	P: 0.30 T: 0.22	P: 3.52 T: 1.03
	6G	P: 2.75 T: 0.64	P: 0.20 T: 0.01	P: 0.28 T: 0.05	P: 0.13 T: 0.06	P: 0.08 T: 0.05	–	P: 0.30 T: 0.22	P: 3.74 T: 1.03

Notes: 1. PEM=Palustrine Emergent (freshwater emergent wetland); 2. PSS=Palustrine Scrub-Shrub (freshwater shrub wetland); 3. PFO = Palustrine Forested (freshwater forested wetland); P = Permanent Effect, T=Temporary Effect.

Typical impacts to wetlands from construction projects such as this include:

Temporary

- Increased erosion from disturbed areas, resulting in increased sedimentation and decreased water filtering abilities
- Increased nutrient loading from increased runoff and fertilizer application (during the replanting process)
- Disturbance of habitat and aquatic species

Long-term temporary

- Clearing and grubbing of vegetated wetland buffers
- Introduction of invasive species
- Decreased groundwater recharge due to increased impervious surfaces
- Increased potential for toxic compounds entering the wetland system from construction equipment, increased train traffic, application of snow and ice removal chemicals, and application of herbicides to keep tracks clear of vegetation
- Altered hydrologic patterns

A small portion of the wetlands in the northern section of the alignment are tidally influenced. These wetlands mostly occur along larger waterways. Impacts to these waters would be minimized by designing water crossings to span waterways, placing as little infrastructure in the waters as practicable. All tidal wetlands crossed in the DC2RVA corridor are along Build Alternatives 1 and 2A.

4.1.3 Water Quality

Under the CWA, a permit is necessary to discharge any pollutant from a point source into Waters of the U.S. through EPA's National Pollutant Discharge Elimination System (NPDES) program, including pollutants carried by stormwater discharges. The permits contain industry-specific, technology-based, and/or water quality-based limits and establish pollutant monitoring and reporting requirements. Water quality-based limits and monitoring and reporting requirements could be stricter for those streams that do not meet water quality standards (on the Section 303[d] list) and already have regulated total maximum daily loads (TMDLs) of pollutants. Impaired waters crossed by the DC2RVA Project are listed in the *Natural Resources Technical Report* (Table 3-9 in Appendix M).

4.1.3.1 Temporary Effects

Despite protective measures, the Project could potentially result in short-term effects, such as increased sedimentation; increase in turbidity from in-stream work; increased likelihood of potential spills; and non-point source pollutants entering groundwater or surface water from stormwater runoff. Construction activities that could affect stormwater runoff include excavation to widen 'cut' sections and to remove unsuitable (organic) material from 'fill' sections; filling and placing ballast to support new track; relocating access roads; relocating or creating new trackside swales; and any substructure work required for the signal and communication equipment foundations, bridge or culvert installation, or station improvements. Construction-phase staging areas and haul roads, if needed, could also disturb the ground, potentially causing erosion and sedimentation.

4.1.3.2 Long-Term Effects

All Build Alternatives cross impaired waters, and DRPT assumes that the Project would have some effect on water quality. Minor long-term water quality impacts could occur as a result of increases in impervious surfaces and consequent increases in pollutants washed from the railroad surface into receiving water bodies; leaking fluids from trains; and an increase in non-point source pollutants from infrastructure, grease, oil, metals, maintenance chemicals, vegetation management chemicals, and suspended solids and other elements associated with railways. The greatest effect would occur with the Fredericksburg and Ashland bypasses, which would convert green space to railroad facilities in locations where none currently exist. The remaining alternatives would be located adjacent to existing facilities and incorporate BMPs and improved stormwater facilities, which would mitigate new conditions and may improve existing conditions.

4.1.3.3 Impaired Waters

The DC2RVA corridor includes 51 water crossings that have been assessed and found to have more contamination than allowed to support one or more of its designated uses. Most Build Alternatives cross the same water bodies; however, the Fredericksburg Bypass (Build Alternative 3C) would cross two fewer impaired water bodies than Build Alternatives 3A or 3B which pass through town. In the Richmond area, the S-Line crosses two more impaired water bodies than the A-Line. The *Natural Resources Technical Report* (Appendix M) provides a list of impairments, probable causes, and the potential for the DC2RVA Project to add to these impairments. The potential for additional contaminants is similar for all waters; however, waters that are already impaired may have additional restrictions in the form of TMDLs in an effort to restore designated uses.

4.1.4 Drinking Water/Aquifers/Water Supply

Contamination of groundwater resources occurs when man-made chemicals such as gasoline, oil, and road salts enter aquifers and render their water unsafe and unfit for human use. Some of the major sources of these contaminants include storage tanks, septic systems, hazardous waste sites, landfills, and the widespread use of road salts and chemicals. Release of chemicals during construction, release of transported chemicals, salts and chemicals used for snow and ice removal, and chemicals used for the maintenance of vegetation are the main sources of contamination to public water supplies along rail lines. These chemicals can leach through the soil and into the water table from which public water supplies are drawn.

In accordance with 1996 *Safe Drinking Water Act* (SDWA) amendments, Virginia adopted a protection zone around all groundwater public sources. Virginia Department of Health (VDH) recommends private wells not be located within 100 feet of known contamination sources such as, but not limited to, sewage disposal systems, dump stations, abandoned wells, pesticide treated soils, underground storage tanks (USTs), and other sources of physical, chemical, or biological contamination; and any potential contamination sources within 200 feet should be investigated (VDH, 2012). The LOD for the Build Alternatives fall within the following prescribed protection zones:

- Zone 1 (5-mile radius) of 3 public surface water supply intakes: Fairfax County Water Authority, Hanover County Suburban Water System, and City of Richmond. Fairfax County Water Authority and City of Richmond water supplies are located upstream of the existing tracks.
- Zone 2 (1-mile wellhead protection zone) of 14 public groundwater sources.
- Zone 1 (1,000-foot radius in which land use activities should be assessed for their potential to contaminate water supplies) of three public groundwater sources.
- Within 100 feet of 14 private wells.

Although the existing railroad facilities that fall within the wellhead protection zones are exempt, work required for the DC2RVA Project would include new permanent and temporary impacts within the wellhead protection zones for public and private wells. Construction of the new facilities and subsequent operation within these protection zones have the potential to introduce contamination to existing wells. Before construction, DRPT will evaluate the potential for contamination. The area of each Build Alternative within these drinking water protection zones is shown in Table 4.1-3.

4.1.5 Permits

Wetland and water quality permits would be required for construction of any of the Build Alternatives. The controlling regulations and permits required at the local, state, and federal level are addressed below.

Table 4.1-3: Estimated Area within Drinking Water Protection Zones

Alternative Area	Alternative	Public Surface Water Zone 1[1] (acres)			Public Groundwater Sources (acres)		Private Wells (square feet)	
		Fairfax County*[2]	Hanover County[2]	City of Richmond*[2]	Zone 1[3]	Zone 2[4]	100-foot radius (31,416 square feet)	200-foot radius (125,664 square feet)
Area 1: Arlington (Long Bridge Approach)	1A	–	–	–	–	–	–	–
	1B	–	–	–	–	–	–	–
	1C	–	–	–	–	–	–	–
Area 2: Northern Virginia (Long Bridge to Dahlgren Spur)	2A	P: 32.75 T: 31.05	–	–	–	P: 26.37 T: 15.94	P: 7,822 T: 8,726	P: 72,243 T: 23,146
Area 3: Fredericksburg (Dahlgren Spur to Crossroads)	3A	–	–	–	–	P: 16.91 T: 6.39	P: 3,343 T: 6,406	P: 57,106 T: 13,279
	3B	–	–	–	–	P: 16.91 T: 6.39	P: 16,365 T: 8,397	P:105,610 T: 16,996
	3C	–	–	–	–	P: 13.98 T: 9.72	P: 279 T: 414	P: 41,238 T: 3,762
Area 4: Central Virginia (Crossroads to Doswell)	4A	–	P: 42.48 T: 23.36	–	P: 0.81 T: 1.07	P: 37.55 T: 27.73	P: 4,117 T: 25,446	P: 18,088 T: 45,750
Area 5: Ashland (Doswell to I-295)	5A	–	P: 8.36 T: 6.08	–	–	P: 9.25 T: 5.52	–	P: 13,688 T: —
	5A–Ashcake	–	P: 8.36 T: 6.08	–	–	P: 11.59 T: 5.32	–	–
	5B	–	P: 8.36 T: 6.08	–	–	P: 9.33 T: 6.04	P: 609 –	P: 26,018 T: 138
	5B–Ashcake	–	P: 8.36 T: 6.08	–	–	P: 15.21 T: 6.65	P: 609 –	P: 15,411 T: 2,727
	5C	–	P: 31.06 T: 9.59	–	P: 4.70 T: 1.51	P: 44.09 T: 11.24	P: 4,205 T: 1,693	P: 19,098 T: 2,181
	5C–Ashcake	–	P: 31.06 T: 9.59	–	P: 4.70 T: 1.51	P: 46.53 T: 11.24	P: 4,205 T: 1,693	P: 5,410 T: 2,181
	5D–Ashcake	–	P: 8.36 T: 6.08	–	–	P: 16.12 T: 7.07	–	P: 17,321 T: 251

▶ *Continued (see end of table for detailed notes.)*

Table 4.1-3: Estimated Area within Drinking Water Protection Zones

Alternative Area	Alternative	Public Surface Water Zone 1[1] (acres)			Public Groundwater Sources (acres)		Private Wells (square feet)	
		Fairfax County*[2]	Hanover County[2]	City of Richmond*[2]	Zone 1[3]	Zone 2[4]	100-foot radius (31,416 square feet)	200-foot radius (125,664 square feet)
Area 6: Richmond (I-295 to Centralia)	6A	–	–	P: 51.70 T: 17.53	–	–	–	P: 21,701 T: 3,275
	6B–A-Line	–	–	P: 121.10 T: 46.69	–	–	–	P: 16,364 T: 2,932
	6B–S-Line	–	–	P: 125.26 T: 31.24	–	–	P: 3.73 T: —	P: 28,214 T: 10,324
	6C	–	–	P: 153.22 T: 47.50	–	–	P: 23,773 T: 1,938	P: 55,761 T: 7,887
	6D	–	–	P: 119.50 T: 31.96	–	–	P: 3.73 –	P: 28,214 T: 10,324
	6E	–	–	P: 80.04 T: 40.18	–	–	–	P: 21,701 T: 3,275
	6F	–	–	P: 129.47 T: 32.53	–	–	P: 3.73 –	P: 28,214 T: 10,324
	6G	–	–	P: 129.84 T: 30.76	–	–	–	P: 31,558 T: 13,595

Source: VDOT-CEDAR, 2014; DMME, 2016.

Notes: *These public water supplies are located upstream from the study area; 1. 5-mile radius; 2. Fairfax County Water Authority, Hanover Suburban Water System, and City of Richmond; 3. Zone 1 includes a 1,000-foot radius (~72 acres) in which land use activities should be assessed for their potential to contaminate water supplies; 4. Zone 2 Virginia adopted a 1-mile wellhead protection zone around all groundwater public sources. P = Permanent Effect, T=Temporary Effect.

4.1.5.1 Section 401– Certification (Water Quality Certification [WQC])

Section 401 of the CWA states that "any activity including, but not limited to, the construction or operation of facilities, which may result in any discharge into the navigable waters, shall provide the licensing or permitting agency a certification from the state in which the discharge originates or will originate, or, if appropriate, from the interstate water pollution control agency having jurisdiction over the navigable waters at the point where the discharge originates or will originate." Section 401 of the CWA requires any applicant for a federal license or permit for any activity that may result in a discharge into waters to obtain a certification that discharge will not adversely affect water quality from the state in which the discharge will occur. Section 401 requires certification by Virginia that prospective permits comply with the state's applicable effluent limitations and water quality standards. Impacts to water resources would require a Joint Permit Application (JPA) to regulatory agencies. The JPA is submitted to VMRC who then distributes it to USACE, Virginia DEQ, and Local Wetlands Boards.

4.1.5.2 Section 402–-National Pollution Discharge Elimination System (NPDES)

Permits for the discharge of any pollutant or combination of pollutants into navigable waters are regulated by Virginia DEQ.

4.1.5.3 Section 404–Dredge and Fill Materials

Section 404 of the CWA regulates activities that may affect the chemical, physical, or biological integrity of Waters of the U.S. Permits for activities that result in the discharge of dredged materials or fill into jurisdictional waters are administered by USACE. Permits issued under Section 404 of the CWA must comply with the Section 404(b)(1) Guidelines developed by EPA.

4.1.5.4 Subaqueous Stream Bed Bottom

Subaqueous land is defined in Virginia as ungranted beds of the bays, rivers, creeks, and shores of the sea owned by the state. Through this regulatory framework, activities requiring permits include building, dumping, or otherwise trespassing upon or over, encroach upon, take or use any material from the beds of the bays, oceans, and jurisdictional rivers, streams, or creeks. VMRC issues permits for activities in, on, or over subaqueous lands in Virginia (Code of Virginia Chapter 2, Title 62.1).

4.1.5.5 Section 9–United States Coast Guard

Section 9 of the *Rivers and Harbors Act* prohibits construction of any dam, dike, bridge, or causeway across navigable waters without approval of the USCG.

4.1.5.6 Section 10–USACE

Section 10 of the *Rivers and Harbors Act* regulates dredging and filling activities related to construction of any structure or type of obstruction in navigable waters of the United States. Permits for these activities are administrated by USACE.

4.1.5.7 Virginia Water Protection Permit

The Virginia Water Protection Permit Program was designed to protect surface waters, including tidal and non-tidal water bodies and wetlands. Virginia DEQ has regulatory authority over most activities affecting these waters. Virginia's authority to protect water resources is independent of other state and federal regulatory agencies.

4.1.5.8 MS4 Permit–Small Municipal Separate Storm Sewer Systems

Discharges from municipal separate storm sewer systems (MS4s) are regulated under the Virginia *Stormwater Management Act,* the Virginia Stormwater Management Program (VSMP) Permit regulations, and the CWA as point source discharges. MS4 programs must be designed and implemented to control the discharge of pollutants from their storm sewer system to the maximum extent practicable in a manner that protects the water quality in nearby streams, rivers, wetlands, and bays. MS4 permits are administrated by Virginia DEQ.

4.1.5.9 Joint Permit Application–USACE, VMRC, Virginia DEQ, Local Wetlands Board

In Virginia, for permitting involving water, wetlands, and dune/beach resources where fill, flooding, or alteration of flow occurs, USACE, VMRC, Virginia DEQ, and Local Wetlands Boards (LWB) use a joint permitting process. Non-tidal resources use a Standard Joint Permit Application (JPA) form, while a Tidewater JPA form is used for most projects involving tidal waters, tidal wetlands, and coastal primary sand dunes and beaches.

4.1.5.10 Chesapeake Bay Preservation Act

Projects located within "Tidewater Virginia" are subject to requirements of the CBPA. Land disturbance or vegetation removal in Resource Protection Areas (RPAs) require approval from local government and completion of Appendix C in the JPA. Individual localities are responsible for enforcing CBPA requirements. Local permits are not issued through the JPA process.

Transportation projects, including rail lines, are conditionally exempt from the Chesapeake Bay Preservation Area Designation and Management Regulations.

4.1.6 Avoidance, Minimization, and Mitigation Evaluation

4.1.6.1 Wetlands, Streams, and Water Resources

Efforts have been made throughout the planning and preliminary design process, and they will continue to be made in later designs to further avoid and minimize impacts to the extent practicable. Avoidance of impacts to water resources will be accomplished by selecting the alternative that best avoids such impacts and/or by routing a selected alignment around wetlands or by completely spanning streams rather than building through them. These measures will be made while also balancing potential impacts to other resources, such as residences and businesses. General minimization measures incorporated into the preliminary designs for the Build Alternatives include:

- Minor alignment shifts to avoid or minimize impacts
- Reduction of construction footprint to the extent practicable in areas with water resources
- Construction of bridges over wetland areas, substantially reducing impacts in comparison to causeways with culverts
- Use of bridges and open bottom culverts designed to the proper hydraulic opening to maintain stream morphology and integrity and that are wide enough to carry baseflow without altering stream depth, facilitate passage of wildlife and aquatic species, and decrease erosion
- The use of stabilized side slopes and retaining walls to minimize encroachment
- Temporary and permanent stormwater management measures
- Use of natural stream design for unavoidable stream relocations, which means that the channel would mimic the characteristics of an appropriate reference stream
- Prompt revegetation of disturbed area, in particular stream banks, immediately after construction to stabilize soil and reduce erosion

Impacts to water resources would require submittal of a JPA to USACE, Virginia DEQ, and VMRC. Mitigation for unavoidable impacts would be developed in coordination with these agencies during the permitting process and incorporated into final design for both temporary and permanent impacts. Permanent impacts to wetlands and streams from construction activities will require compensatory mitigation. Guidance for compensatory mitigation from the regulatory agencies can be found in the July 2004 Joint USACE and Virginia DEQ Recommendations for Wetland Compensatory Mitigation: Including Site Design, Permit Conditions, Performance Criteria, and Monitoring Criteria and associated Mitigation Checklist; the March 2008 Off-Site Mitigation Location Guidelines; and the USACE and EPA jointly issued Compensatory Mitigation for Losses of Aquatic Resources; Final Rule from June 2008. The mitigation rule indicates the agencies' preferred hierarchy for mitigation options as follows:

1. Purchase of compensatory mitigation bank credits.
2. Purchase of an approved in-lieu fee fund's credits.
3. Watershed approach-based mitigation by the permittee.
4. Onsite mitigation/in-kind mitigation by the permittee.
5. Offsite mitigation/out-of-kind mitigation by the permittee.

Virginia DEQ has also adopted this preferred sequence. Factors to be considered in deviating from the preference for banks include the likelihood for ecological success and sustainability, the location of the compensation site(s) relative to the impact site and their significance within the watershed, and the costs of the compensatory mitigation project. The final compensatory mitigation plan will be determined during the permitting process, in coordination with the regulatory agencies, and will likely include a combination of types of mitigation. Wetland mitigation requirements vary by wetland type. Typical replacement ratios of area disturbed are Palustrine Emergency Wetlands (PEM) (1:1), Palustrine Scrub-Shrub Wetlands (PSS) (1.5:1), and Palustrine Forested Wetlands (PFO) (2:1). Compensation is approved on a case-by-case basis, and requirements may vary.

Compensatory mitigation for unavoidable stream impacts would be based on the Unified Stream Methodology (USM) form. Impacts greater than 300 linear feet typically require compensation; however, for projects with multiple stream impacts, compensation for all impacts is often required regardless of the length of individual crossings. Although compensatory mitigation is generally not required for impacts to jurisdictional ditches or open waters, impacts will be reviewed on a case-by-case basis, and compensation will be determined during the permitting process.

4.1.6.2 Floodplains and Stormwater/Drainage

The design of this Project would include the use of stormwater management practices to address issues such as post-development storm flows and downstream channel capacity. The Project would be constructed in accordance with Executive Order (EO) 11988–Floodplain Management, the Virginia Erosion and Sediment Control Regulations, and the Virginia Stormwater Management Law and regulations and include an erosion and sediment control plan and a stormwater management plan approved by the Virginia DEQ, or local water quality protection criteria at least as stringent as the above state requirements.

Existing stormwater facilities would be upgraded and new stormwater facilities would be implemented to capture and treat run-off. Stormwater management measures, including detention basins, would be installed to reduce or detain discharge volumes, to compensate for increased impervious surfaces. Major bridge crossings built to accommodate the additional rail line are designed to match horizontal clearances of existing bridges and will be built in parallel to avoid altering hydraulics. Storm surge protection measures will be taken in areas along the Potomac River where practicable. During final design, a detailed hydraulic survey and study would evaluate specific impacts on stormwater discharges. This evaluation would adhere to the aforementioned specifications ensuring that no substantial increases to flooding would occur.

4.1.6.3 Water Quality

Minor long-term water quality impacts could occur as a result of increases in impervious surfaces, increases in train traffic, and consequent increases in pollutants washed from the railroad and bridges into receiving water bodies. Stormwater management measures, including detention basins, vegetative controls, and other measures, would be implemented to minimize water quality impacts. These measures would reduce or detain discharge volumes and remove pollutants, thus avoiding substantial further degradation of impaired water bodies in the study area vicinity.

Appropriate erosion and sediment control practices would be implemented in accordance with the Virginia Erosion and Sediment Control Regulations and the Virginia Stormwater Management Law and regulations. Virginia's Erosion and Sediment Control Law requires soil-disturbing projects to be designed to reduce soil erosion during and after construction. Implementation of BMPs would minimize increases in turbidity of waters downstream of construction activities. Preconstruction sediment quality assessments and water quality monitoring during construction may be conducted to address potential resuspension of contaminants and nutrients into overlying water. Further efforts to avoid and/or minimize water quality impacts would be made during final design.

Such efforts to prevent impacts could include:

- Designing the project to minimize the LOD and subsequent impacts to water resources
- Silt fencing and measures to prevent soil erosion from earthwork entering water bodies
- Temporary and permanent stormwater management measures
- Conducting stream work in the dry
- Native revegetation of disturbed areas
- Taking practicable measures to prevent spills of fuels, lubricants, or other pollutants into water bodies
- Elimination of weep hole devices that allow runoff to drip directly into waterways from bridges
- Use of vegetated buffers and vegetated swales to intercept runoff
- Use of holding basins to reduce pollution content, temperature, and intensity of runoff entering the water supply

These laws have specifications that also prohibit contractors from discharging any contaminant that may impact water quality. If accidental spills occur, the contractor is required to immediately notify all appropriate local, state, and federal agencies and to take immediate action to contain and remove the contaminant. Additionally, the requirements and special conditions of any required permits for work in and around surface waters would be incorporated into construction contract documents, so that the contractor would be required to comply with such conditions. The number, locations, and abatement capacities of stormwater management facilities will be determined during later phases of Project design. Pollutant removal efficiencies will be used as a factor in determining the location and design of stormwater management facilities.

Impaired Waters

DRPT will ensure that BMPs and other stormwater techniques would be employed to minimize further impacts on impaired waters. Construction techniques designed to reduce water quality impacts will be employed. Clearing practices should be limited to the greatest extent practicable around impaired waters to limit further degradation. The DC2RVA Project will adhere to additional restrictions in accordance with any TMDLs developed for impaired waters.

4.1.6.4 Drinking Water/Aquifers/Water Supply

Efforts would be made throughout the final design process to avoid and minimize impacts to drinking waters to the extent practicable. Minimization measures could involve modifications, such as further alignment shifts to avoid or minimize impacts; the use of BMPs; the use of retaining walls; and temporary and permanent stormwater management measures to reduce transportation of chemicals by stormwater, and they should include limited or avoidance of snow removal and vegetation maintenance chemicals near Source Protection Areas and well locations.

4.2 TOPOGRAPHY, GEOLOGY, AND SOILS

The No Build Alternative would not affect topography, geology, or soils in the DC2RVA corridor. Most of the proposed improvements associated with the Build Alternatives are located adjacent to existing railroad tracks in areas where the land has already been disturbed. There is little difference between the Build Alternatives for these resources, and aside from the proposed bypasses, the Build Alternatives are not anticipated to affect local topography or geology. The proposed Fredericksburg and Ashland bypasses would be new greenfield alignments and would involve the use of a greater portion of previously undisturbed areas.

4.2.1 Topography

Small localized changes in topography would occur with the Build Alternatives in the form of excavation and fill for tracks to have a smooth and gradual change in elevation in areas where local topographic changes are sudden. These proposed localized changes are not expected to have an effect on area topography.

4.2.2 Geology

Geology includes the underlying material (rock) the local earth is composed of and the process by which it was created and continues to change. DRPT does not anticipate that the Build Alternatives would affect area geology, aside from minor excavation, and would not affect the processes exerting change on area geology.

4.2.3 Soils

Most of the land within the LOD of the Build Alternatives was previously disturbed with construction and maintenance of the existing railroad. Soils with construction-limiting qualities within the proposed LOD are listed in Table 4.2-1. The Natural Resources Conservation Service (NRCS) provides the soils classifications listed in Table 4.2-1 as defined in Chapter 3, Section 3.2.3.

Table 4.2-1: Construction-Limiting Soils within Build Alternatives (acres)

Alternative Area	Alternative	Suitability for Building Local Roads and Streets				Hydric Soils			
		Not Rated	Not Limited[1]	Somewhat Limited[2]	Very Limited[3]	Unknown	Not Hydric	Partially Hydric	100% Hydric
Area 1: Arlington (Long Bridge Approach)	1A	P: 5.1 T: 2.2	–	–	–	P: 5.1 T: 2.2	–	–	–
	1B	P: 8.9 T: 3.2	–	–	–	P: 8.9 T: 3.2	–	–	–
	1C	P: 9.1 T: 2.1	–	–	–	P: 9.1 T: 20.1	–	–	–
Area 2: Northern Virginia (Long Bridge to Dahlgren Spur)	2A	P:87.2 T: 73.5	P: 2.2 T: 1.6	P: 37.8 T: 31.7	P: 107.4 T: 111.7	P: 87.6 T: 73.9	P: 120.2 T: 117.1	P: 12.9 T:12.4	P: 13.8 T: 15.1
Area 3: Fredericksburg (Dahlgren Spur to Crossroads)	3A	P: 9.1 T: 10.5	P: 4.6 T: 2.3	P: 22.6 T: 13.4	P: 66.9 T: 32.3	P: 8.8 T: 10.3	P: 45.0 T: 24.7	P: 37.2 T: 19.3	P: 12.2 T: 4.3
	3B	P: 16.2 T: 9.3	P: 6.7 T: 2.5	P: 28.3 T: 14.4	P: 77.2 T: 38.1	P: 15.6 T: 8.6	P: 53.2 T: 27.7	P: 46.4 T: 23.7	P: 13.2 T: 4.4
	3C	P: 9.5 T: 6.7	P: 16.1 T: 5.6	P: 79.9 T: 22.8	P: 146.8 T: 45.9	P: 9.5 T: 6.7	P: 141.2 T: 44.6	P: 73.7 T: 21.5	P: 27.9 T: 8.3
Area 4: Central Virginia (Crossroads to Doswell)	4A	P: 3.2 T: 3.3	P: 20.7 T: 10.4	P: 58.7 T: 34.6	P: 75.4 T: 47.6	P: 0.7 T: 0.2	P: 56.4 T: 33.0	P: 51.8 T: 28.6	P: 49.2 T: 34.0
Area 5: Ashland (Doswell to I-295)	5A	–	P: 1.9 T: 1.8	P: 25.5 T: 15.5	P: 24.3 T: 12.0	–	P: 21.4 T: 12.8	P: 25.3 T: 12.1	P: 5.0 T: 4.3
	5A–Ashcake	P: 0.5 T: –	P: 1.9 T: 1.8	P: 23.8 T: 13.3	P: 25.0 T: 12.0	–	P: 22.1 T: 12.7	P: 25.6 T: 12.1	P: 3.5 T: 4.3
	5B	–	P: 1.9 T: 1.8	P: 33.1 T: 16.6	P: 27.3 T: 13.6	–	P: 25.7 T: 14.2	P: 30.3 T: 13.2	P: 6.3 T: 4.7
	5B–Ashcake	P: 0.5 T: –	P: 1.9 T: 1.8	P: 33.2 T: 17.3	P: 30.0 T: 13.9	–	P: 29.0 T: 14.6	P: 30.9 T: 13.5	P: 5.7 T: 5.0

▶ *Continued (see end of table for detailed notes.)*

Table 4.2-1: Construction-Limiting Soils within Build Alternatives (acres)

Alternative Area	Alternative	Suitability for Building Local Roads and Streets				Hydric Soils			
		Not Rated	Not Limited[1]	Somewhat Limited[2]	Very Limited[3]	Unknown	Not Hydric	Partially Hydric	100% Hydric
Area 5: Ashland (Doswell to I-295)	5C	P: 1.5 T: 0.3	P: 36.3 T: 8.2	P: 58.3 T: 19.3	P: 62.8 T: 20.4	–	P: 33.4 T: 13.6	P: 114.4 T: 28.3	P: 11.1 T: 6.3
	5C–Ashcake	P: 2.1 T: 0.3	P: 36.3 T: 8.2	P: 56.7 T: 19.3	P: 63.5 T: 20.4	–	P: 24.1 T: 13.6	P: 114.8 T: 28.3	P: 9.7 T: 6.3
	5D–Ashcake	P: 0.5 T: –	P: 1.9 T: 1.8	P: 44.8 T: 17.4	P: 32.2 T: 14.3	–	P: 33.8 T: 15.0	P: 37.7 T: 13.6	P: 8.0 T: 4.8
Area 6: Richmond (I-295 to Centralia)	6A	P: 9.3 T: 1.8	P: 5.9 T: 1.6	P: 35.2 T: 17.9	P: 117.6 T: 55.8	P: 5.7 T: 3.9	P: 95.8 T: 45.0	P: 28.7 T: 12.5	P: 37.7 T: 15.7
	6B–A-Line	P: 29.9 T: 11.3	P: 7.3 T: 1.8	P: 40.5 T: 19.9	P: 161.8 T: 74.5	P: 8.4 T: 4.9	P: 126.8 T: 60.0	P: 73.0 T: 25.8	P: 31.3 T: 15.9
	6B–S-Line	P: 24.6 T: 10.5	P: 5.9 T: 1.3	P: 16.5 T: 3.5	P: 173.7 T: 41.8	P: 0.0 –	P: 154.1 T: 43.5	P: 44.2 T: 8.0	P: 22.4 T: 5.7
	6C	P: 30.8 T: 10.9	P: 7.3 T: 1.8	P: 41.6 T: 19.0	P: 192.0 T: 75.7	P: 9.6 T: 4.4	P: 131.6 T: 60.0	P: 98.8 T: 27.3	P: 31.7 T: 15.8
	6D	P: 24.6 T: 10.5	P: 5.9 T: 1.4	P: 16.5 T: 3.6	P: 168.0 T: 48.9	P: 0.1 –	P: 154.1 T: 46.8	P: 38.5 T: 11.9	P: 22.4 T: 5.7
	6E	P: 9.3 T: 1.8	P: 5.9 T: 1.6	P: 35.2 T: 18.6	P: 145.9 T: 77.7	P: 5.7 T: 4.6	P: 121.3 T: 67.0	P: 30.7 T: 12.5	P: 38.5 T: 15.6
	6F	P: 25.6 T:10.6	P: 5.8 T: 1.5	P: 16.8 T: 3.6	P: 176.7 T: 49.3	P: 0.1 –	P: 158.3 T: 47.2	P: 36.7 T: 12.0	P: 29.9 T: 5.7
	6G	P: 26.3 T: 9.9	P: 6.0 T: 1.5	P: 17.1 T: 3.7	P: 175.6 T: 48.2	P: 0.1 –	P: 160.7 T: 45.6	P: 34.3 T: 12.0	P: 30.1 T: 5.6

Source: CEDAR, 2015.

Notes: 1. Not Limited–Soil works well for specified use, good performance/low maintenance required; 2. Limitations can be overcome/ minimized through planning, design, and installation, fair performance/moderate maintenance; 3. Limitations may require major soil reclamation, special design, or expensive installation procedures to be overcome, poor performance/high maintenance.

P=Permanent Effect; T=Temporary Effect.

4.2.4 Avoidance, Minimization, and Mitigation Evaluation

Before the acquisition of right-of-way and construction associated with any of the Build Alternatives, thorough site investigations would be conducted to determine if mitigation would be required for limiting soil characteristics. A geologic hazard assessment will be made to establish potential impacts of soil characteristics to bridges, walls, trackbed, and roadway subgrades, and geotechnical engineering parameters will be developed for soil conditions along the corridor. Bridge, wall, trackbed, and roadway recommendations will be developed according to the specific conditions of each site. Preliminary geotechnical engineering recommendations and a more detailed analysis can be found in the DC2RVA Geotechnical Engineering Report.

Compensation for soil, geologic, and topographic limitations could include:

- The use of cut or fill to compensate for topographic changes
- The use of retaining walls to stabilize soils
- Removal or encapsulation of unsuitable soils
- Blending neutralizing material into acidic soils
- Engineering structures to compensate for limiting conditions adjustment of slope ratios, design heights, and depth of embedment
- Use of stabilizing materials

4.3 AGRICULTURAL LANDS

4.3.1 Farmland Soils

The No Build Alternative requires no right-of-way acquisition; therefore, it requires no land use conversion and has no direct effects to farmland soils.

The Build Alternatives require permanent right-of-way acquisition that contains prime farmland and statewide and locally important soils (Table 4.3-1). The transition of these soils to transportation use is a direct effect of the Project. No unique farmland soils occur within the LODs of the Build Alternatives.

Within Alternative Area 3 (Fredericksburg), the Fredericksburg Bypass (Build Alternative 3C) converts the most prime and the most statewide/locally important soils of the three alternatives.

Within Alternative Area 5 (Ashland), the Ashland Bypass (Build Alternatives 5C and 5C–Ashcake) converts the most prime and the most statewide/locally important soils of the seven alternatives.

Within Alternative Area 6 (Richmond), the Build Alternatives along the CSXT A-Line (Build Alternatives 6A, 6B–A-Line, 6C, and 6E) convert similar amounts of prime and statewide/locally important soils and almost twice as much of these soils than the Build Alternatives along the CSXT S-Line (Build Alternatives 6B–S-Line, 6D, 6F, and 6G).

As required by the *Farmland Protection Policy Act of 1981* (FPPA), Form CPA-106, Farmland Conversion Impact Rating for Corridor Type Projects, is being completed for the DC2RVA alternatives, and the first round of submissions to the NRCS is complete. Representatives of NRCS completed the required agency portions of the forms. The final corridor assessment for each Build Alternative is also complete; the forms appear in Appendix N. The corridor assessment is based on the types of farmland soils present in the Build Alternatives, the existing agricultural uses in an individual jurisdiction, the existing agricultural uses adjacent to and within the Build Alternatives, and other criteria such as farm support services.

Alternative Area 1 (Arlington): The land affected by Build Alternatives 1A, 1B, and 1C has been committed to urban use, which results in a Corridor Assessment Score of 0.

Table 4.3-1: Farmland Soils Converted within Build Alternatives and Farmland Corridor Assessment Score

Alternative Area	Alternative	Prime Farmland Soils (Acres)	Statewide and Locally Important Soils (Acres)	Total (Acres)	Corridor Assessment Score
Area 1: Arlington (Long Bridge Approach)	1A	0.00	0.00	0.00	0
	1B	0.00	0.00	0.00	0
	1C	0.00	0.00	0.00	0
Area 2: Northern Virginia (Long Bridge to Dahlgren Spur)	2A	53.56	52.37	105.93	66
Area 3: Fredericksburg (Dahlgren Spur to Crossroads)	3A	26.84	17.83	44.67	80
	3B	34.01	20.62	54.63	80
	3C	69.05	84.17	153.22	118
Area 4: Central Virginia (Crossroads to Doswell)	4A	99.17	49.91	149.08	93
Area 5: Ashland (Doswell to I-295)	5A	27.18	24.83	52.01	51
	5A–Ashcake	28.04	23.57	51.61	46
	5B	31.20	28.30	59.50	51
	5B–Ashcake	33.82	28.02	61.84	51
	5C	89.83	35.10	124.93	171
	5C–Ashcake	90.88	33.82	124.70	171
	5D–Ashcake	39.38	32.28	71.66	52
Area 6: Richmond (I-295 to Centralia)	6A	45.20	7.22	52.42	29
	6B–A-Line	49.04	10.06	59.10	23
	6B–S-Line	30.79	4.59	35.38	22
	6C	49.93	10.62	60.55	22
	6D	30.93	4.59	35.52	22
	6E	45.20	14.22	59.42	24
	6F	31.78	4.65	36.43	19
	6G	32.48	4.81	37.29	19

Source: VDOT; Forms NRCS-CPA-106. No Unique Farmland Soils occur within the Build Alternatives.

Alternative Area 2 (Northern Virginia): There is a wide variety of land uses within and adjacent to Build Alternative 2A. There are farmland soils present within the Build Alternative, but the score is 66 due to the urban uses of land within the Build Alternative and the amount of agricultural activity within the Build Alternative.

Alternative Area 3 (Fredericksburg): Build Alternatives 3A and 3B that pass through Fredericksburg have Corridor Assessment Scores of 80. The Fredericksburg Bypass (Build Alternative 3C) has a score of 118 due to the presence of multiple farms within the alternative.

Alternative Area 4 (Central Virginia): Build Alternative 4A has a score of 93.

Alternative Area 5 (Ashland): Build Alternative 5A–Ashcake has the lowest score of 46, Build Alternatives 5A, 5B, and 5B–Ashcake have scores of 51, and Build Alternative 5D–Ashcake has a score of 52. These are all fairly low scores due to the alternatives' locations along the existing

CSXT rail line. The Ashland Bypass (Build Alternatives 5C and 5C–Ashcake) has scores of 171 due to the existing farms and the Stanley Agricultural District within both alternatives.

Alternative Area 6 (Richmond): The Build Alternatives in Area 6 have lower scores than in other areas due to the high amount of land already committed to urban use. The full service and shared service Build Alternatives that use both existing Staples Mill and Main Street stations—Build Alternative 6F (full service) and Build Alternative 6G (shared service)—have the lowest scores of 19. The single-station Build Alternatives at Boulevard (Build Alternatives 6B–S-Line), Broad Street (Build Alternative 6C), and Main Street (Build Alternative 6D) have scores of 22. Similarly, the single-station Build Alternative at Boulevard (Build Alternative 6B–A-Line) has a score of 23. The two-station alternative serving both Staples Mill and Main Street stations (Build Alternative 6E) has a slightly higher score of 24. Build Alternative 6A that serves Staples Mill only via the A-Line has the highest score of 29.

Table 4.3-1 lists the Corridor Assessment Scores for each of the Build Alternatives. The NRCS recommends selecting the Build Alternatives with the lowest score within each alternative area as part of the recommended Preferred Alternative. The alternatives with the lowest scores within each alternative area are the Build Alternatives that primarily utilize the existing railroad right-of-way (Build Alternatives 1A/1B/1C, 2A, 3A/3B, 4A, and 5A–Ashcake) and the two-station alternatives in Richmond using both the existing Staples Mill and Main Street stations—Build Alternative 6F (full service) and Build Alternative 6G (shared service).

4.3.2 Agricultural and Forestal Districts

The No Build Alternative requires no right-of-way acquisition; therefore, it requires no land use conversion and has no direct effects to agricultural and forestal districts.

There is one agricultural/forestal district, the Stanley District in Hanover County, within a Build Alternative. Originally approved in 1978, the Stanley District is made up of seven parcels, owned by multiple landowners, and totals 713 acres. The district was renewed by the Hanover County Planning Commission in July 2015. The transition of 73.7 acres of this agricultural/ forestal district to a transportation use is a direct effect of the Ashland Bypass (Build Alternatives 5C and 5C–Ashcake) (Figure 4.3-1). A previous preliminary design for these Build Alternatives affected a greater acreage of the Stanley District. The design was shifted east to minimize the impacts to the district. One farm within the Stanley District, White Oak Farm, is also a Century Farm, as designated by the Virginia Department of Agriculture and Consumer Services. This designation provides no formal protection at the state level but is a recognition of continuous farming for 100 years at a particular farm. There are two other Century Farms within the Ashland Bypass (Build Alternatives 5C and 5C–Ashcake), but they are not within the Stanley Agricultural District.

The state regulations detail a process for land acquisition or construction within a designated district, including coordination with landowners and the locality. Notice to landowners and the locality includes a report detailing the proposed action (this Draft EIS). The agricultural/forestal district advisory committee, county board of supervisors, and local planning commission review the report and the effects the Project would have on an individual district. If the locality determines that the Project "might have an unreasonably adverse effect on either state or local policy", the locality can issue an order to direct the DRPT not to take the proposed action for a period of 150 days and then hold a public hearing. Before the end of the 150 days, the locality must issue a final order on the action, based on a majority vote of the members.

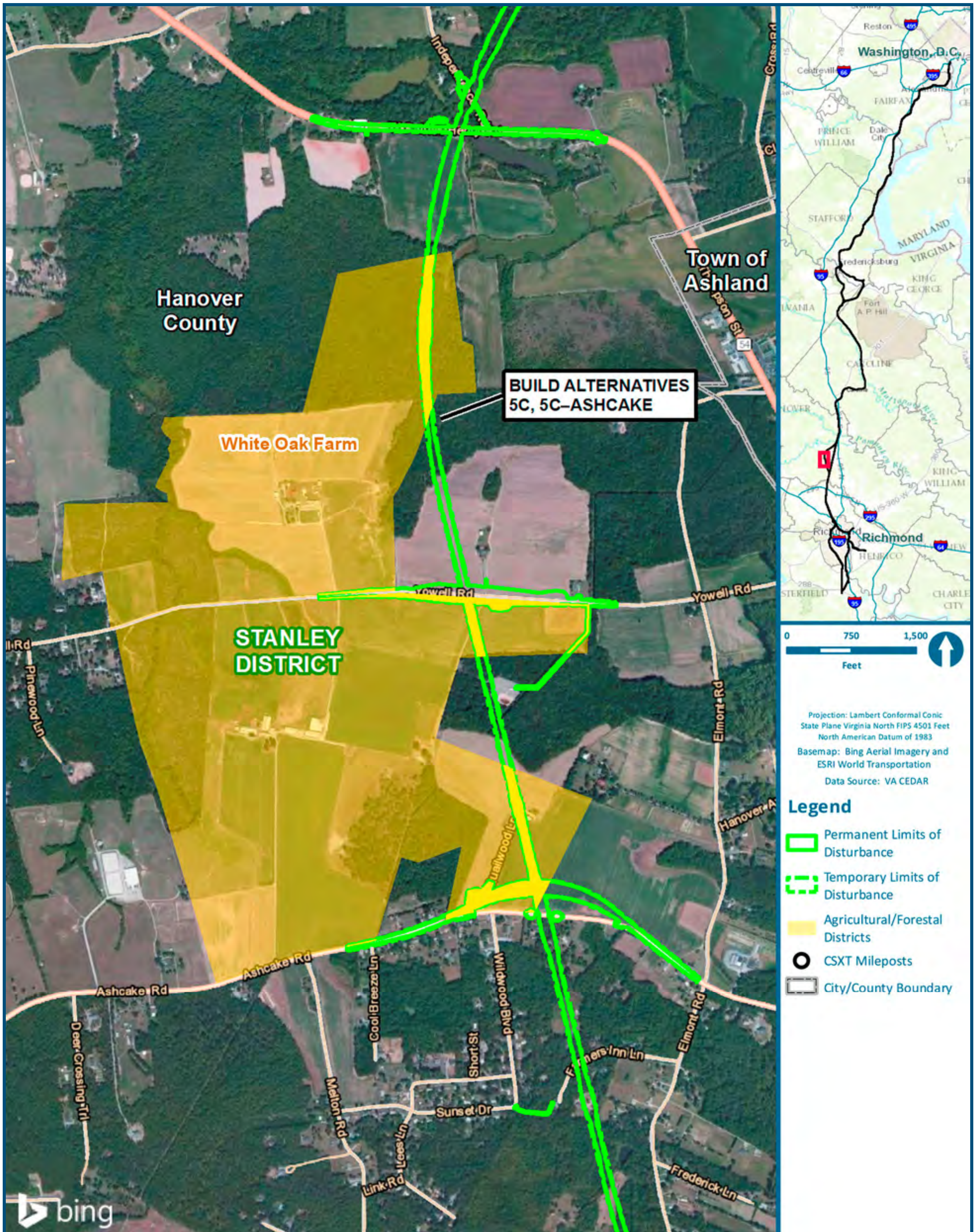


Figure 4.3-1: Agricultural/Forestal Districts Impacts – Build Alternatives 5C, 5C–Ashcake

4.4 MINERAL RESOURCES

4.4.1 Effects

According to information available from the Virginia Department of Mines, Minerals, and Energy (DMME), several active and inactive mines and mineral resources are located in the DC2RVA corridor. Mines could be affected by direct use of the area for railroad construction or any other construction activity associated with the Build Alternatives, such as new grade separations. DRPT has determined that no mines located in the study area would be affected by the No Build Alternative or Build Alternatives because they are outside of the LOD.

One known mineral resource is crossed by the Fredericksburg Bypass (Build Alternative 3C). This site—Massaponax S. & G. (VA DMM permit 08288AA)—is a former sand and gravel pit. It appears to have been subdivided and sold for residential use. One parcel had a residence added in 2004 (Figure 4.4-1).

4.4.2 Avoidance, Minimization, and Mitigation Evaluation

Although the potentially affected mineral resource located along the Fredericksburg Bypass (Build Alternative 3C) is no longer in use, DRPT will ensure that additional efforts will be made, to the extent practicable, throughout the final design process to avoid and minimize impacts to the potential reuse of this resource. Minor alignment shifts or reducing the LOD could minimize or avoid impacts to this resource.

4.5 SOLID WASTES AND HAZARDOUS MATERIAL

4.5.1 Effects

Under the No Build Alternative, CSXT would continue maintenance and repairs of the existing infrastructure, and infrastructure improvements that are already planned for the DC2RVA corridor, as defined in Section 2.5.1.1, would move forward. DRPT anticipates that the No Build Alternative would not affect hazardous material sites. Anticipated effects of the Build Alternatives are presented in Table 4.5-1 and Figure 4.5-1. The estimated number of sites affected by the Build Alternatives is based on the number of sites mapped within the LOD (permanent and temporary) that may contain hazardous materials or wastes. Contaminated sites may affect the Project by:

- Affecting the environment during construction
- Creating significant construction impacts
- Incurring cleanup liability to Project owners

Additionally, areas of contaminated soil are likely to exist along the DC2RVA corridor. Contamination is generally due to residual contamination that can be found along any part of the DC2RVA corridor or contamination associated with adjacent industrial uses. The greatest potential of contaminated soils being disturbed is during excavation. Areas requiring fill are unlikely to unearth unknown contaminants. Earthwork along the DC2RVA corridor has the potential of encountering the following contaminants:

- Railroad ties, usually treated with chemicals such as creosote
- Coal ash and cinder containing lead (Pb) and arsenic

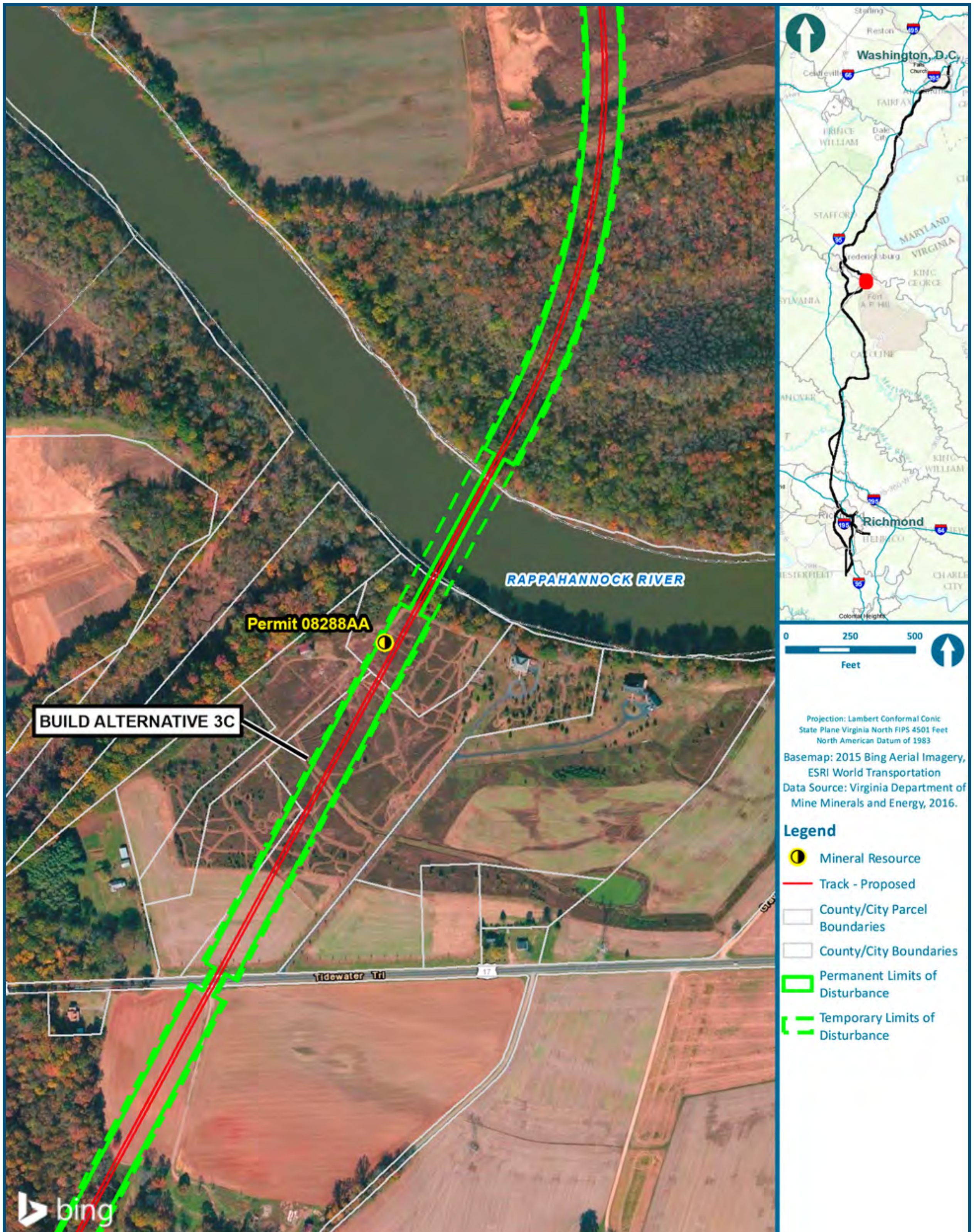


Figure 4.4-1: Mineral Resource Impact – Build Alternative 3C

Table 4.5-1: Hazardous Materials Sites within Build Alternatives

Alternative Area	Alternative	Superfund/ CERCLA/ SEMS/NPL[1]	Known HAZMAT Release[2]	Potential HAZMAT Contamination[3]	Petroleum Release[4]	HAZMAT Facility[5]	Petroleum Storage Tanks[6]
Area 1: Arlington (Long Bridge Approach)	1A	–	n/a	–	–	–	–
	1B	–	n/a	–	2	–	–
	1C	–	n/a	–	2	–	–
Area 2: Northern Virginia (Long Bridge to Dahlgren Spur)	2A	–	–	8	4	2	1
Area 3: Fredericksburg (Dahlgren Spur to Crossroads)	3A	1	–	5	2	–	–
	3B	–	–	7	3	4	3
	3C	–	–	8	3	1	1
Area 4: Central Virginia (Crossroads to Doswell)	4A	1	n/a	–	–	–	–
Area 5: Ashland (Doswell to I-295)	5A	n/a	n/a	1	4	–	1
	5A–Ashcake	n/a	n/a	1	4	–	1
	5B	n/a	n/a	1	4	1	3
	5B–Ashcake	n/a	n/a	1	4	1	3
	5C	n/a	n/a	2	3	–	2
	5C–Ashcake	n/a	n/a	2	3	–	2
	5D–Ashcake	n/a	n/a	1	7	1	5
Area 6: Richmond (I-295 to Centralia)	6A	–	–	5	8	4	7
	6B–A-Line	–	–	8	15	4	14
	6B–S-Line	–	1	16	22	7	8
	6C	–	–	9	18	6	16
	6D	1	1	16	23	6	6
	6E	1	1	6	10	6	7
	6F	1	1	14	23	6	5
	6G	1	1	14	23	6	5

Source: VDOT GIS database, 2014.

Notes: 1. Sites proposed or already on the National Priority List. Sites in the United States eligible for long-term remedial action (cleanup) financed under the federal Superfund program. 2. Area known to be contaminated by HAZMAT or has had a toxic release of unlisted chemical. 3. Area with history of use for HAZMAT or has had a release that has been closed or remediated. These areas may be okay for their current use; however, there could be potential for uncovering contamination through construction. 4. Area where a petroleum product is known to have been released. The case may be closed; however, there is the potential for uncovering contaminated soil through construction. 5. Facilities that generate, transport, treat, store, and/or dispose of hazardous waste. 6. Facilities with above ground and underground storage tanks that store petroleum or hazardous substances, the vast majority store petroleum products. n/a – No records found in study area.

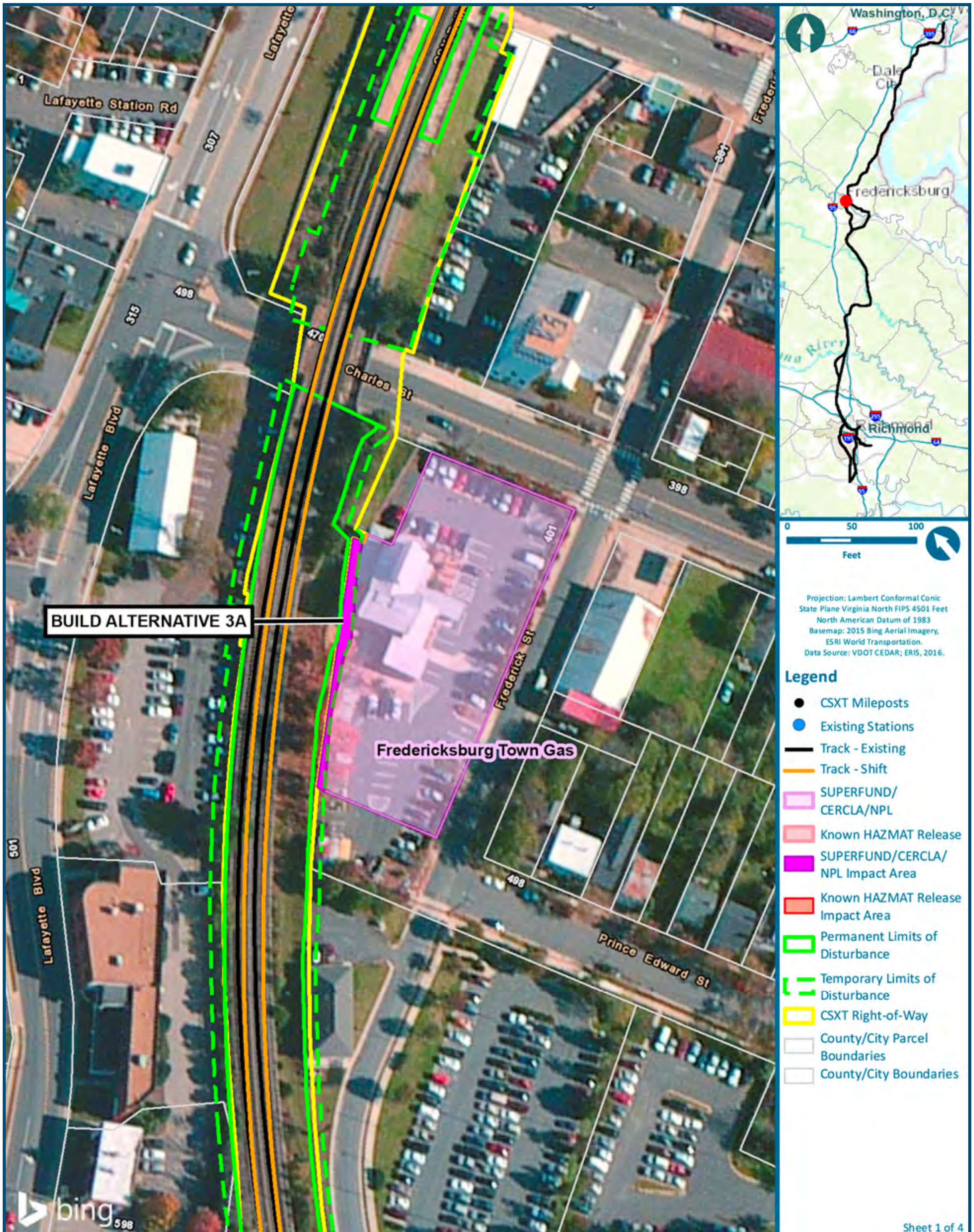


Figure 4.5-1: Critical Hazardous Materials Impacts – Build Alternative 3A

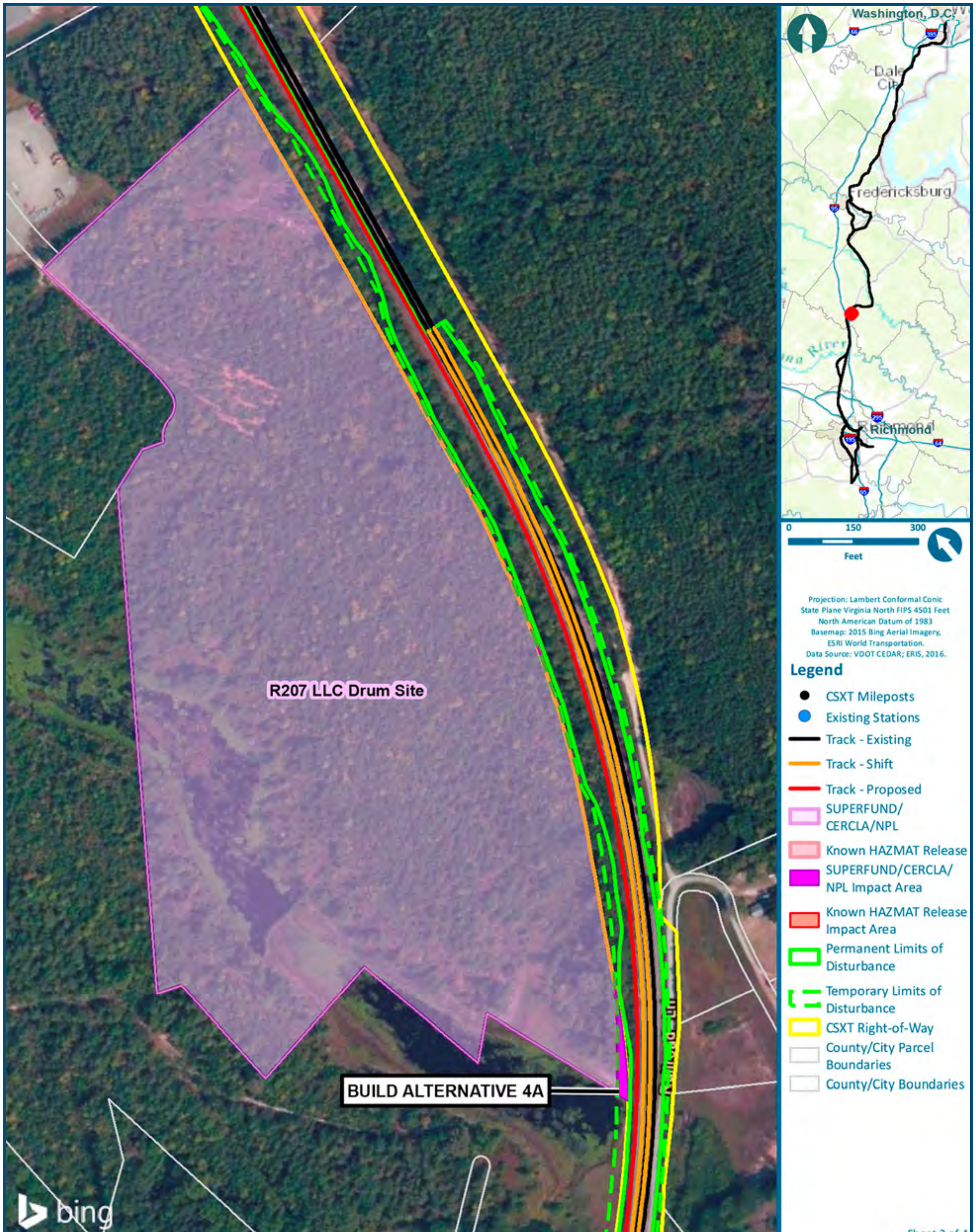


Figure 4.5-1: Critical Hazardous Materials Impacts – Build Alternative 4A

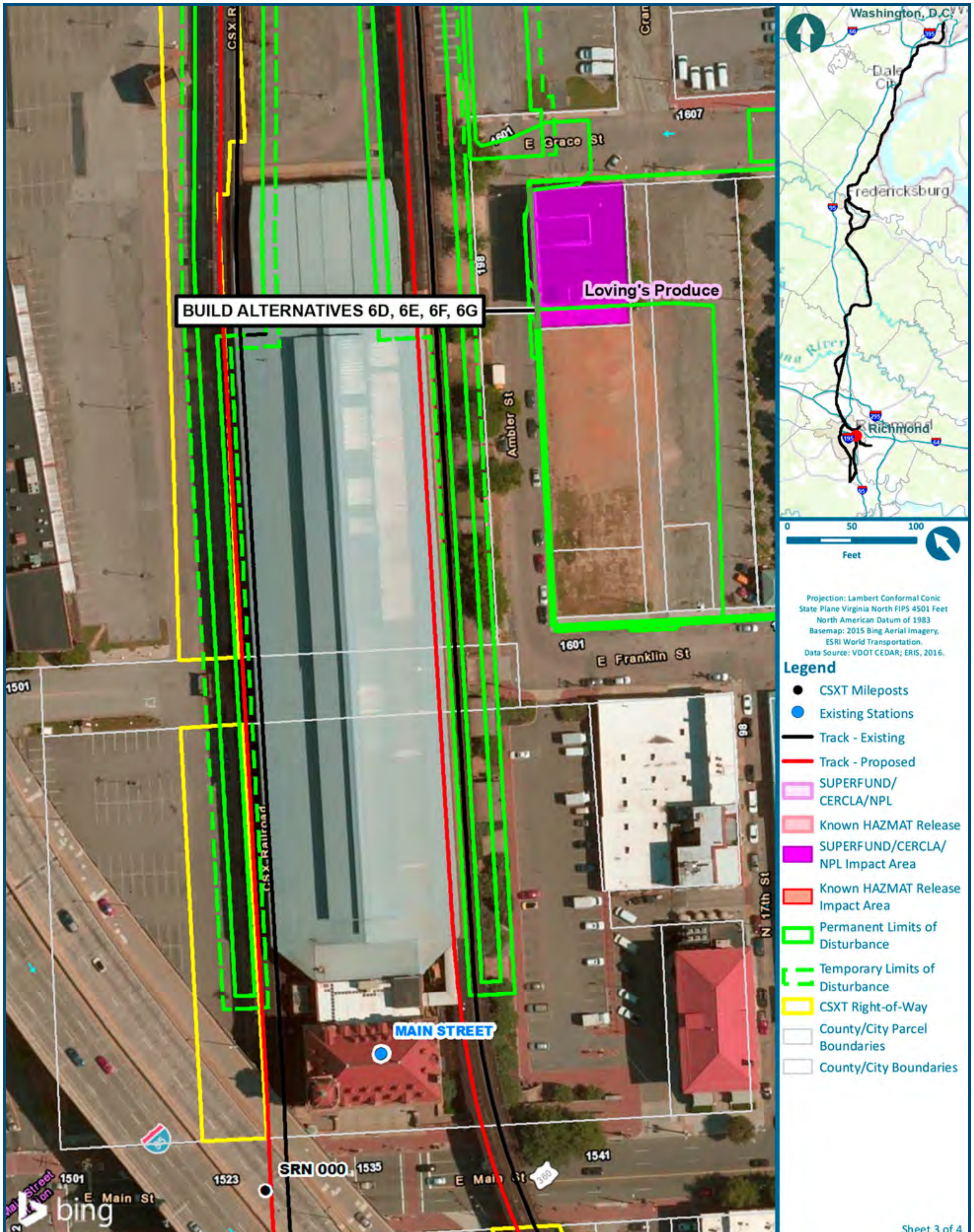


Figure 4.5-1: Critical Hazardous Materials Impacts – Build Alternatives 6D, 6E, 6F, 6G

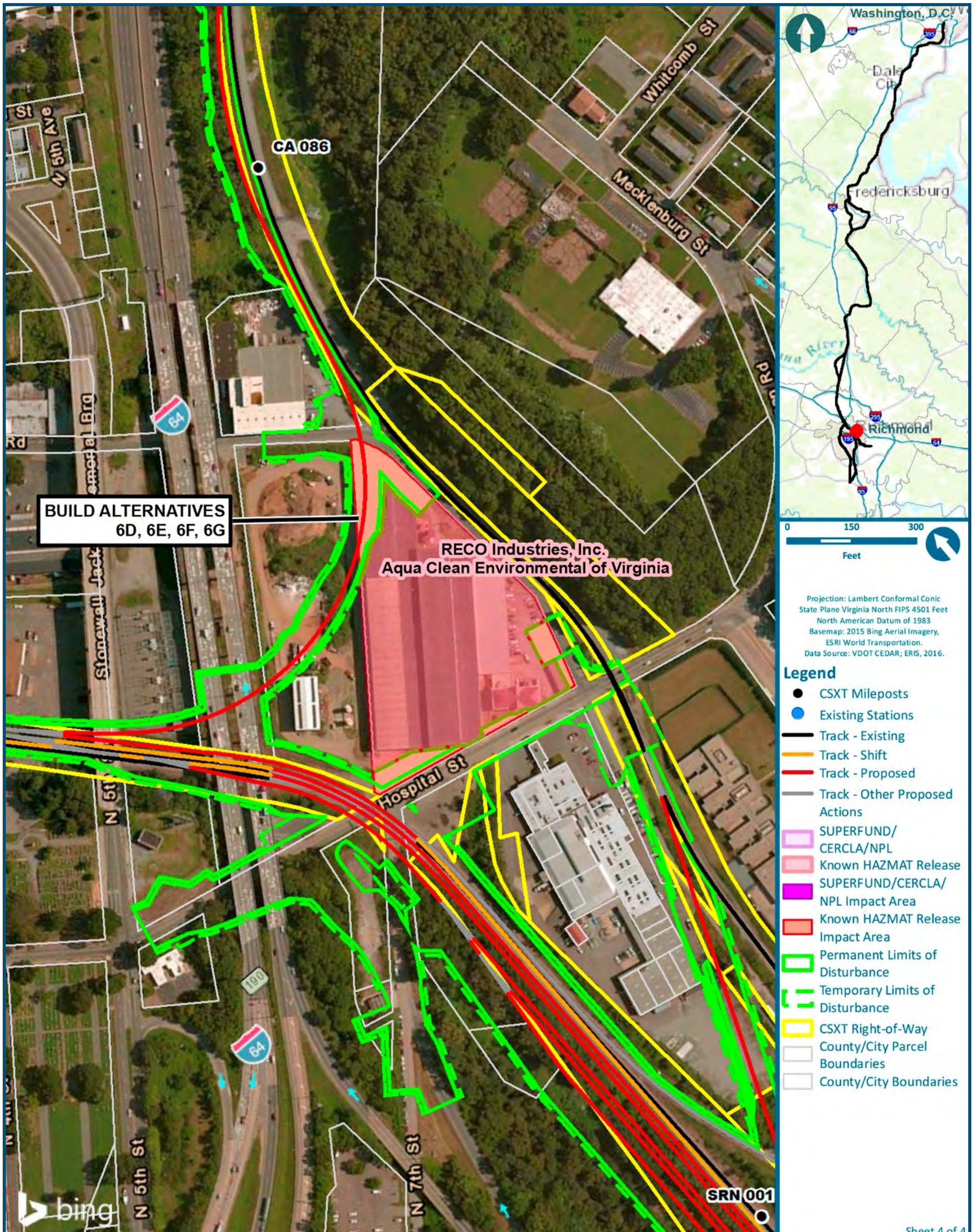


Figure 4.5-1: Critical Hazardous Materials Impacts – Build Alternatives 6D, 6E, 6F, 6G

- Spilled or leaked liquids such as oil, gasoline, and cleaning solvents
- Herbicides
- Fossil fuel combustion products (polycyclic aromatic hydrocarbons [PAHs])
- Roofing shingles (asbestos)
- Transformers and capacitors containing polychlorinated biphenyls (PCBs)
- Heavy metals such as lead, cadmium, copper, zinc, mercury, iron, cobalt, chromium, and molybdenum

It is the responsibility of the owner to determine if any of the waste created meets the criteria of a 'hazardous waste' and must be managed as such. All hazardous waste or solid waste should be tested and removed in accordance with Virginia Solid Waste Management Regulations (VSWMR) (9 *Virginia Administrative Code* [VAC] 20 - 60) and or (9 VAC 20 - 80). Asbestos, lead, or contaminated residues generated must be handled and disposed of in accordance with VSWMR or Virginia Hazardous Waste Management Regulations (VHWMR), as applicable.

Figure 4.5-1 depicts sites along the corridor that have the greatest chance of requiring costly mitigation or causing project delays if a hazardous material is located within the LOD. Appendix O includes a list of all recorded sites within the LOD.

4.5.2 Avoidance, Minimization, and Mitigation Evaluation

Before the acquisition of right-of-way and construction, thorough site investigations would be conducted to determine whether any of the sites are actually contaminated, and, if so, the nature and extent of that contamination. All solid waste material resulting from clearing and grubbing, demolition, or other construction operations will be removed and disposed of according to regulations. Any additional hazardous materials discovered during construction of a Build Alternative or demolition of existing structures will be removed and disposed of in compliance with all applicable federal, state, and local regulations. All necessary remediation would be conducted in compliance with applicable federal, state, and local environmental laws and would be coordinated with EPA, Virginia DEQ, and other federal or state agencies as necessary.

Types of remediation could include:

- **Excavation or dredging**–Removal of contamination generally to a regulated landfill, but also to be treated (commonly used for petroleum contamination, which is the most likely form of contamination to be found in a project such as this)
- **Thermal desorption**–Use of a chemical to vaporize contamination which is them collected or destroyed in an off-gas treatment system
- **Surfactant enhanced aquifer remediation (SEAR)**–Use of chemicals to decrease water surface tension to allow the contamination to de-absorb and be removed from the medium
- **Pump and treat**–Pumping out contaminated groundwater and passing it through a filtration system designed to absorb contamination from the groundwater
- **Solidification and stabilization**–Using a binder and soil to stop, prevent, or reduce the mobility of contaminants that are left in place

- **In situ oxidation**–Injection of oxygen or air to promote the growth of aerobic bacteria and accelerate natural destruction of organic contaminants
- **Soil vapor extraction**–Treatment of the off-gas volatile organic compounds (VOCs) generated after vacuum removal of air and vapors (and VOCs) from the subsurface
- **Nanoremediation**–Use of nano-sized reactive agents to degrade or immobilize contaminants
- **Bioremediation**–Use of biological methods, such as seeding the site with specific plants, fungus (mycelia), or bacteria, to remove contamination

4.6 AIR QUALITY

This section analyzes criteria pollutant air emissions associated with the proposed Project. Additionally, while mobile source air toxics (MSATs) and greenhouse gases (GHGs) are not criteria pollutants nor subject to conformity requirements, they are also considered in this section in accordance with EPA guidance. Potential air quality effects of the proposed DC2RVA Project include:

- Changes in rail-related emissions due to an increase in train operations each day and a change in equipment.
- Changes in the overall regional emissions due to travelers shifting from one mode of transportation to another.
- Changes in local (microscale) emissions, including changes at various crossings that could handle additional traffic due to nearby highway-railroad crossing closures, experience additional delay due to an increase in train operations, and changes in vehicular delay around stations due to increased traffic resulting from increased ridership.

4.6.1 Locomotive Operations–NO_x, VOC, and PM

EPA established a comprehensive program to dramatically reduce emissions from locomotives, including line-haul, switch, and passenger engines (40 CFR Part 1033). The program establishes emission standards with applicability dependent on the date a locomotive is first manufactured. The first set of standards (Tier 0) applies to most locomotives originally manufactured before 2001. The most stringent set of standards (Tier 4) applies to locomotives manufactured in 2015 and later. Additional intercity passenger locomotives operating under the DC2RVA Project will, at a minimum, meet the emissions standards set by EPA. EPA has published expected fleet average pollutant emission rates in their *Technical Highlights: Emission Factors for Locomotives USEPA-420-F-09-025* (EPA, 2009).

The DC2RVA Project is subject to federal air quality general conformity regulations (40 CFR Part 93, Subpart B). These regulations require that an evaluation of Project-generated emissions within the study area's nonattainment and maintenance areas be conducted to assess potential air quality effects. Annual pollutant emissions were calculated for the one nonattainment area in the study area (i.e., the Washington, D.C.-Maryland-Virginia ozone nonattainment area). The emissions were calculated using the expected EPA emission rates, along with projected locomotive fuel consumption, which was developed as part of the rail operations modeling conducted for this Project (Table 4.6-1). The emissions inventory listed in Table 4.6-1 represents the expected Project-generated emissions under the Build Alternatives (i.e., emissions generated from the additional intercity passenger trains from this Project). Fuel consumption in the nonattainment and maintenance areas would not be substantially different among the different Build Alternatives.

Table 4.6-1: Predicted Build Alternative Project-Generated Locomotive Emissions

Metropolitan Planning Organization	Annual Emissions (tons/year)	
	NO_x	VOC
Washington, D.C.-Maryland-Virginia[1]	13.7	0.3
De minimis (allowable) levels in the nonattainment/maintenance areas according to 40 CFR 51.853	100	50

Notes: 1. Predicted emissions listed are for those generated from the additional intercity passenger trains from this Project.

Table 4.6-1 shows that Project-generated predicted annual pollutant emissions, from the Southeast High Speed Rail (SEHSR) trains added by this Project, in nonattainment and maintenance areas, are all below general conformity *de minimis* threshold values. Pursuant to the General Conformity Rule, EPA considers project-generated emissions below these *de minimis* values to be minimal. Such projects do not require formal conformity determinations. These numbers are considered conservatively high because they do not account for any reduction in automobile emissions related to travelers diverting from auto to rail travel.

4.6.2 Mobile Source Air Toxics

Currently, FRA does not have any guidelines related to MSAT analysis, including hot-spot analyses. A hot-spot analysis is known as a "microscale" analysis because it focuses on a relatively small geographic area. In the absence of FRA MSAT guidelines, regional MSAT effects associated with the Project are discussed qualitatively. The qualitative assessment presented below is based on the Federal Highway Administration's (FHWA) *Interim Guidance Update on Air Toxic Analysis in NEPA Documents,* released December 6, 2012, and in part from a study conducted by FHWA entitled *A Methodology for Evaluating Mobile Source Air Toxic Emissions among Transportation Project Alternatives* (FHWA, 2010). It is provided as a basis for identifying and comparing the potential differences in MSAT emissions, if any, among the alternatives.

4.6.2.1 Regional MSAT Effects

MSAT emissions would be similar among the Build Alternatives because the regional change in vehicle emissions would be similar. This analysis qualitatively compares the Build Alternatives to the No Build Alternative. In 2045, the Build Alternatives are projected to have up to 1.12 million more rail passenger trips annually (compared to the No Build Alternative). By shifting this travel to rail, it is expected that up to 2,700 vehicles per day (VPD) and 322,000 vehicle miles would be removed from the parallel roads of I-95 and U.S. Route 1 in the 123-mile Project corridor in the year 2045. Assuming an average fuel efficiency of 22 miles per gallon, this equates to a reduction of approximately 5.3 million gallons of fuel per year. In comparison, the additional intercity passenger trains that would operate as a result of this project are estimated to consume approximately 2.3 million gallons of fuel per year. Therefore, overall fuel consumption would be reduced in the DC2RVA corridor. The Build Alternatives would also result in a reduction in passenger miles of travel by air and bus, which could ultimately lead to a reduction in vehicle miles from these two modes; however, the ridership forecasting completed for this Project does not include projections related to reduced vehicle trips for air or bus travel.

Beginning in 2025, through 2045, and beyond, the Build Alternatives would decrease regional vehicle miles traveled (VMT) and MSAT emissions compared to the No Build Alternative. The availability of improved intercity passenger rail service would reduce the number of vehicle trips on a regional basis. Because the Build Alternatives would not substantially change the regional traffic mix, the amount of MSATs emitted from highways and other roadways within the study area would be proportional to the VMT. Because the regional VMT estimated for the Build Alternatives would be less than the No Build Alternative in 2045, MSAT emissions from regional vehicle traffic would be less for the Build Alternatives compared to the No Build Alternative in 2045. Regardless of the Build Alternatives, emissions would also likely be lower than present levels in 2045 because of EPA's national control programs that are projected to reduce annual priority MSAT emissions by 83 percent between 2010 and 2050 even if VMT increases by 102 percent over that same period.

Local conditions may differ from these national projections in terms of fleet mix and turnover, VMT growth rates, and local control measures; however, the magnitude of the EPA-projected reductions is so great (even after accounting for VMT growth) that MSAT emissions in the study area are likely to be lower in nearly all cases. Further information on highway vehicle MSATs is included in Appendix T.

4.6.2.2 Local MSAT Effects

The potential MSAT emission sources directly related to Project operation would be from trains operating along the DC2RVA corridor, vehicles used at maintenance facilities, passenger vehicles traveling to and from the train stations, and passenger vehicles delayed at grade crossings. Localized increases in MSAT emissions would occur as a result of all of these activities.

DRPT expects that the differences in local MSAT effects amongst the Build Alternatives would be minor. The Fredericksburg Bypass (Build Alternative 3C) and the Ashland Bypass (Build Alternative 5C and 5C–Ashcake) would shift freight trains and some intercity passenger trains outside of those towns, through less populated areas. While there would be fewer local MSAT emissions through town under the bypass alternatives, there would be greater local MSAT emissions along the bypasses themselves.

In Ashland, Build Alternatives 5A–Ashcake, 5B–Ashcake, and 5D–Ashcake would relocate the rail passenger station south of town in a less populated area. Passengers driving to and from the new station would result in a reduction in local MSAT emissions in downtown Ashland, and an increase in local MSAT emissions in the area surrounding the Ashcake Station.

In Richmond, local MSAT emissions will vary based on the route used (i.e., A-Line or S-Line) and station location. Nonetheless, DRPT does not anticipate a noticeable difference in local MSAT emissions between the Build Alternatives.

The localized increases in MSAT emissions would likely be most pronounced at maintenance facilities, where in-yard diesel-fueled switch locomotives would be used to pull in or pull out the trainsets for maintenance. The only maintenance facility along the DC2RVA corridor is proposed at Brown Street, north of Main Street Station in Richmond. Local MSAT emissions around this maintenance facility would increase with additional DC2RVA trains. There is no residential development or other sensitive land uses directly adjacent to the proposed maintenance facility. Therefore, DRPT expects any local MSAT effects to be minor.

Localized Project-related emissions would be substantially reduced due to implementation of EPA's vehicle and fuel regulations. The Build Alternatives would decrease regional MSAT emissions compared to the No Build Alternative.

4.6.3 Highway Vehicle Operations–CO

Carbon monoxide (CO) emissions are associated with large volumes of slow-moving traffic, such as highly congested intersections. Areas experiencing high levels of CO are referred to as CO "hot spots." The purpose of a CO hot-spot analysis is to determine if CO emissions generated by a proposed project would cause or contribute to an exceedance of the air quality standard for CO as promulgated by EPA.

The Build Alternatives would result in an increase in vehicular delay at grade crossings because more trains would be operating over these crossings; however, given the relatively short length and rapid passages of intercity passenger trains and modest predicted increases in the rates of train service, it is unlikely that these delays would result in any substantial effect on air quality levels. Additionally, at the locations where highway-rail grade separations are proposed, vehicles would no longer have to stop to wait for trains to pass, and CO emissions would be reduced. Proposed grade separation locations are identified in Section 4.15.2.

Additionally, the Build Alternatives are anticipated to increase vehicular traffic near station locations; however, while the Project would enhance passenger train travel speeds over an extended route, the frequency of service would be relatively modest. This would tend to reduce the temporal concentration of motor vehicles associated with trips to and from train stations along the DC2RVA corridor. Many stations also have direct connections to local and regional transit. Particularly, all intercity passenger rail stations in Northern Virginia share service with Virginia Railway Express (VRE). Other stations in Northern Virginia have convenient or direct connection to the Washington Metro Area Transit Authority (WMATA), including Franconia-Springfield, Alexandria, Crystal City, L'Enfant Plaza, and Washington Union Station. In Richmond, Main Street Station has multiple local and regional bus services, and the Greater Richmond Transit Company (GRTC) has plans for a 7.6-mile bus rapid transit (BRT) system along Broad Street and Main Street. These multimodal connections can help offset vehicular traffic at these stations.

The federal ambient air quality standards for CO are 35 parts per million (ppm) (1-hour) and 9 ppm (8-hour). DRPT ran a computer model to determine the CO concentrations at the worst-case grade crossings along the DC2RVA corridor. DRPT selected these locations because the locations have the highest projected amount of traffic and/or the greatest amount of delay. Based on traffic operations analysis conducted for this Project (see Section 4.15), the following worst-case traffic locations were selected:

- England Street/Thompson Street–where all intercity passenger and freight train traffic would continue to operate through town, which would contribute to the worst-case traffic conditions in Ashland (Build Alternatives 5A and 5B)
- Jahnke Road–where most intercity passenger and freight train traffic would use the CSXT A-Line between ACCA Yard and Centralia, which would contribute to the worst-case traffic conditions on the A-Line in Richmond (Build Alternatives 6A, 6B–A-Line, 6C, and 6E)
- Hermitage Road–where most intercity passenger train traffic would use all or a portion of the CSXT S-Line between Main Street Station and Centralia, which would contribute to the worst-case traffic conditions on the S-Line in Richmond (Build Alternatives 6C, 6D, 6F, and 6G)

The CO hot-spot analysis compared the 2015 Existing (Base), 2025 Interim (Opening) Build and No Build, and 2045 Design Year Build and No Build scenarios. DRPT used CAL3QHC, which is a standard EPA dispersion model, to estimate CO concentrations. Model input parameters included MOVES2014 emissions factors, CO background levels, persistence factors, peak-hour volumes, free-flow speeds, and estimated gate down time. Simulated meteorological conditions designed to yield worst-case concentrations were used in the analysis.

The results of the analyses indicated that the 1-hour and 8-hour concentrations at the locations analyzed in any scenario were well below the National Ambient Air Quality Standards (NAAQS). Based on these results, no mitigation is required, and no additional analysis is recommended (Table 4.6-2).

Table 4.6-2: Predicted CO Concentrations (including background)

Worst-Case Intersection/Crossing	Analysis Scenario									
	2015 Existing		2025 No Build		2025 Build		2045 No Build		2045 Build	
	1-hour	8-hour	1-hour	8-hour	1-hour	8-hour	1-hour	8-hour	1-hour	8-hour
England Street/Thompson Street	4.2	2.9	3.4	2.4	3.6	2.5	3.1	2.2	3.2	2.2
Jahnke Road	4.1	2.9	3.3	2.3	3.3	2.3	2.9	2.0	2.9	2.0
Hermitage Road	3.6	2.5	2.9	2.0	2.9	2.0	2.4	1.7	2.4	1.7

Note: NAAQS: 35 ppm (1-hour) and 9 ppm (8-hour).

4.6.4 Greenhouse Gas Emissions

Carbon dioxide (CO_2) is the primary GHG associated with the combustion of transportation fuels, accounting for more than 95 percent of transportation GHG emissions based on global warming potential. CO_2 is emitted in direct proportion to fuel consumption, with different emission levels associated with different fuel types. Other notable GHGs include methane (CH_4) and nitrous oxide (N_2O), which together account for 2 percent of transportation GHG emissions, and hydrofluorocarbons (HFCs), which comprise approximately 3 percent of transportation GHG emissions. N_2O and CH_4 are not directly related to fuel consumption, but instead are dependent on engine operating conditions (i.e., vehicle speeds) and emissions control technologies. HFCs are also emitted from vehicle air conditioners and refrigeration used in some freight shipments; these emissions do not come from the tailpipe and depend on factors such as the age of the vehicle and how often air conditioners are used. Given the relatively small percentage of these gases in comparison to CO_2, CH_4, N_2O, and HFC, emissions were not calculated for this Project.

The projected change in 2045 CO_2 emissions for the Build Alternatives relative to the No Build Alternative is shown in Table 4.6-3 by mode of passenger travel. These emission values were derived from mass emission rates per passenger mile published in a report prepared for the American Bus Association (Bradley, 2014) and projected changes in annual passenger miles of travel from Table 4.8-1 of this Draft EIS.

Increases in CO_2 emissions associated with additional intercity passenger rail service are expected to be more than offset by reductions in CO_2 emissions due to reduced use of other transportation modes, as shown in Table 4.6-3. The results in Table 4.6-3 are presented by the Build Alternatives in Richmond but reflect the projected changes through the entire DC2RVA corridor. DRPT derived the CO_2 emissions from the passenger ridership estimates for the entire DC2RVA corridor. The ridership forecasts for the Build Alternatives only differ based on which station option is used in Richmond.

Table 4.6-3: Change in Projected CO_2 Emissions in the DC2RVA Corridor by Mode Compared to the No Build Alternative (tons per year)–Year 2045

Build Alternative	Rail	Automobile	Bus	Air	Total
6A (Staples Mill Road Station Only)	64,552	-43,206	-10,527	-17,516	-6,696
6B–A-Line (Boulevard Station Only, A-Line)	58,536	-39,281	-9,715	-15,543	-6,003
6B–S-Line (Boulevard Station Only, S-Line)	58,536	-39,281	-9,715	-15,543	-6,003
6C (Broad Street Station Only)	56,711	-37,568	-9,310	-15,496	-5,663
6D (Main Street Station Only)	58,975	-39,752	-9,677	-15,493	-5,947
6E (Split Service, Staples Mill Road/Main Street Stations)	60,496	-40,475	-9,693	-16,379	-6,051
6F (Full Service, Staples Mill Road/Main Street Stations)	60,155	-41,187	-9,854	-15,632	-6,518
6G (Shared Service, Staples Mill Road/Main Street Stations)	60,597	-41,658	-9,995	-15,813	-6,869

Note: Results in this table are for the entire DC2RVA corridor. The results for the entire DC2RVA corridor only differ by which Build Alternative station option is considered in Richmond.

4.6.5 Construction Effects

Demolition and construction activities can result in short-term increases in fugitive dust and equipment-related particulate emissions in and around the study area. (Equipment-related particulate emissions can be minimized if the equipment is well maintained.) The potential air quality effects would be short-term, occurring only while demolition and construction work is in progress and local conditions are appropriate. The potential for fugitive dust emissions typically is associated with building demolition, ground clearing, site preparation, grading, stockpiling of materials, onsite movement of equipment, and transportation of materials. The potential is greatest during dry periods, periods of intense construction activity, and high wind conditions. There is not enough information regarding construction activity, equipment, and duration to estimate emissions from construction in this Draft EIS. If required, DRPT will perform this analysis during final design to demonstrate general conformity. DRPT will also identify the appropriate BMPs to minimize air quality effects during construction.

GHG emissions would also be generated during the construction phase of the program; however, these emissions are likely to be relatively minor given the nature and size of the program and the limited duration of the construction activities.

4.6.6 Conclusion

The Project-generated net increases in predicted annual pollutant emissions, from new SEHSR passenger service, in nonattainment areas would all be below general conformity *de minimis* threshold values. Pursuant to the General Conformity Rule, EPA considers project-generated emissions below these *de minimis* values to be minimal. Such projects do not require formal conformity determinations. With regard to GHG emissions, the Build Alternatives would reduce CO_2 emissions versus the No Build Alternative. As a result, DRPT anticipates that the DC2RVA Project will not result in significant adverse effects to public health related to air pollutants and air toxics or contributions to GHG emissions.

4.6.7 Mitigation

DRPT will identify the appropriate BMPs to minimize air quality effects during construction. Air quality mitigation is discussed in Section 4.19.2.3 in the Construction Impacts section.

4.7 NOISE AND VIBRATION

This section describes potential Project-related noise and vibration effects and identifies mitigation measures to offset Project-related impacts. These analyses only evaluated noise and vibration from the additional intercity passenger trains proposed under this project, except where noted.

Noise and vibration effects were assessed based on the methods and criteria included in FRA's *High Speed Ground Transportation Noise and Vibration Impact Assessment* guidance manual (September 2012) for sections of the study corridor where passenger train speeds can reach 90 miles per hour (mph). On sections where all train speeds are below 90 mph, this assessment used the noise and vibration impact assessment methods published in the Federal Transit Administration (FTA) *Transit Noise and Vibration Impact Assessment* (May 2006) manual per FRA guidance. The assessment addresses both operational and construction effects from the proposed alternatives.

The noise and vibration study area consists of lands adjacent to the project corridor; it was not defined by the FTA/FRA screening methods. Rather, the noise and vibration analyses conservatively determined the distances at which noise and vibration impacts would no longer occur. Noise and vibration-sensitive land uses within the study area were categorized for analysis purposes according to FRA and FTA land use categories. Land use was identified from GIS databases, digital aerial photographs, field surveys, and information on planned development from local planning departments where publicly available and reasonably obtainable.

4.7.1 Noise

4.7.1.1 Noise Impact Criteria

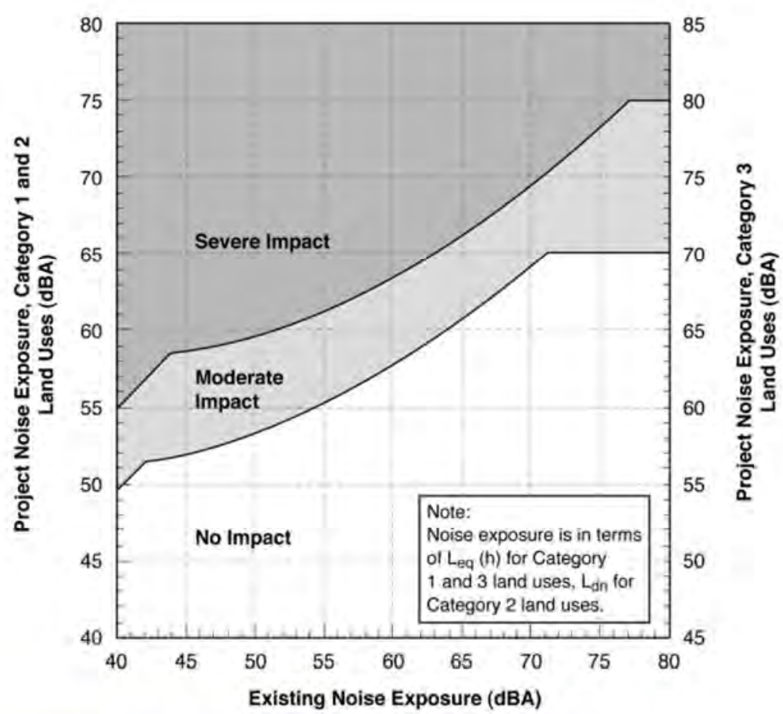
According to FRA and FTA, noise-sensitive land uses are divided into one of three categories.

- **Category 1**: Land where quiet is an essential element (e.g., amphitheaters and concert pavilions). This category includes lands set aside for serenity and quiet, and such land uses as outdoor amphitheaters and concert pavilions, as well as National Historic Landmarks (NHLs) with significant outdoor use.
- **Category 2**: Residences and buildings where people sleep. This category includes homes, hospitals, and hotels where a nighttime sensitivity to noise is assumed to be of utmost importance.
- **Category 3**: Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, and churches where it is important to avoid interference with such activities as speech, meditation, and concentration on reading material. Buildings with interior spaces where quiet is important, such as medical offices, conference rooms, recording studios, and concert halls, fall into this category. Places for meditation or study associated with cemeteries, monuments, and museums. Certain historical sites, parks, and recreational facilities are also included.

Category 1 and 3 receptors are evaluated using the equivalent-average sound level (L_{eq}) from the noisiest hour of train-related activity during hours of noise sensitivity. The L_{eq} represents a constant sound that, over the hour, has the same acoustic energy as the time-varying signal. Category 2 receptors are evaluated using the day-night sound level (L_{dn}), because Category 2 receptors are sensitive to noise during all hours of the 24-hour day. The L_{dn} describes a receiver's cumulative noise exposure from all events over a full 24 hours, with events between 10:00 p.m. and 7:00 a.m. penalized by adding an additional 10 decibels (dB) to account for greater nighttime sensitivity to noise.

This analysis followed the FTA/FRA noise impact assessment methodology in which measurements of existing noise levels are used to determine the noise impact threshold. Project-related noise is then calculated using FTA and FRA methods, and the resulting noise levels are compared with the FTA/FRA noise impact criteria to determine if noise impacts are expected to occur.

Figure 4.7-1 from the FTA guidance manual shows the noise impact criteria used by both FTA and FRA, which are based on the land use category and the existing noise exposure in the area. No impact indicates Project noise levels are unlikely to cause annoyance. A moderate noise impact is a noise level increase that is noticeable to most people, yet generally not enough to cause adverse reactions. A severe noise impact is a noise level increase that could cause annoyance to a significant percentage of people. FTA guidance requires consideration and adoption of noise mitigation measures for moderate and severe noise impacts when noise mitigation is feasible and reasonable.



Source: Federal Transit Administration, https://www.transit.dot.gov/regulations-and-guidance/environmental-programs/fta-noise-and-vibration-impact-assessment

DC2RVA_083

Figure 4.7-1: FTA/FRA Noise Impact Criteria for Transit Projects

4.7.1.2 Noise Prediction Methodology

Sound Exposure Level (SEL) is an acoustical descriptor that contains all acoustical energy associated with a single event such as the passby of a locomotive, railcar, or a locomotive horn use event. SEL values are used as the noise emissions terms in the train noise models; they are expressed in units of dBA (A-weighted decibel). Actual noise levels from passenger trains between Poughkeepsie and Albany, New York (the Empire Line) that are similar to the trains proposed on this Project were measured to calculate projected noise levels on the DC2RVA corridor. Noise measurements were performed in areas where Empire Line trains were expected to reach speeds of 90 mph. Due to track maintenance and other unknown factors, none of the Empire Line trains were traveling at or above 90 mph during measurements of passby noise; therefore, SEL values measured along the Empire Line were used to calculate noise from all other passenger trains (at speeds below 90 mph). The SEL values for freight locomotives and railcars were obtained from FRA's *CREATE Noise and Vibration Assessment Manual* (FRA, 2013). The SEL for CSXT locomotive horns was obtained from the *Final EIS for the Acquisition of Conrail by Norfolk Southern Railroad and CSX Railroad* (United States Surface Transportation Board, 1998). Noise from freight trains on the proposed bypasses and passenger trains traveling at speeds below 90 mph were modeled using FTA's general noise assessment methods. SEL values for proposed intercity passenger trains traveling at 90 mph were obtained from Appendix E of the FRA guidance manual. This analysis used the maximum allowable speed on each rail section to calculate train noise. Characteristics of the SEHSR passenger trains that were used in the noise analysis are shown in Table 4.7-1. Figure 2.2-3 in Chapter 2 of this Draft EIS provides additional information about the proposed increases in intercity passenger rail service in the DC2RVA corridor.

Table 4.7-1: Intercity Passenger Train Characteristics used in the Noise Assessment

Characteristics	Proposed DC2RVA Train
Train speed (mph)[1]	90
Train Length (feet)	665
Number of locomotives per train	2
Number of railcars per train	8
Throttle setting	8
Locomotive length (feet)	70
Length of train railcars (feet)	85

Notes: 1. Maximum train speed varies by rail section; the maximum allowable speed per section was modeled.

Growth in the passenger (non-SEHSR) and freight trains that currently use the corridor will occur independently from the proposed Project; therefore, the noise analysis only modeled the proposed additional intercity passenger trains on most rail sections in the study area. The exceptions to this are the Fredericksburg Bypass (Build Alternative 3C) and the Ashland Bypass (Build Alternatives 5C and 5C–Ashcake). In these areas, the distribution of freight and/or passenger (non-SEHSR) trains that currently use the corridor may change and was, therefore, modeled.

The proposed bypasses in Fredericksburg and Ashland are expected to have unique combinations of freight and intercity passenger trains and were modeled based on the way trains are proposed to use the bypasses. In Fredericksburg, only freight trains are expected to use the proposed bypass alignment (Build Alternative 3C); therefore, noise from freight trains was evaluated on that bypass alignment. The proposed additional intercity passenger trains that will bypass downtown

Fredericksburg were also modeled on the existing alignment under the Fredericksburg Bypass alternative. In Ashland, under the bypass alternatives (Build Alternatives 5C and 5C–Ashcake), freight trains and intercity passenger trains that do not stop in Ashland are expected to use the bypass alignment while other passenger trains would use the existing alignment. This results in a net reduction in train noise on the existing alignment and is considered a benefit of the proposed Project. Noise from freight trains was not evaluated in areas other than on the proposed bypass alignments because freight train traffic would continue to operate and expand on the existing corridor in the Build Alternatives as it would in the No Build Alternative.

Trains operate on five different rail sections in each of the eight Richmond Build Alternatives. In addition to operating on different sections, sometimes passenger train length increases under different Richmond alternatives; therefore, each alternative was evaluated individually, and noise from all trains on all five sections was calculated for each alternative. Noise from freight trains was not included in the evaluation of Project-related noise under each Richmond alternative because freight trains currently operate on those lines (unlike the proposed bypass alternatives), and changes in freight train volume and size will occur based on market forces and in a manner that is unrelated to the proposed Project.

Table 4.7-2 shows other train characteristics used to evaluate noise from trains on the proposed bypasses in Fredericksburg (Build Alternative 3C) and Ashland (Build Alternatives 5C and 5C–Ashcake) and on the eight Richmond Build Alternatives.

Table 4.7-2: Characteristics of Existing Trains Analyzed in the Noise Assessment

	Amtrak Auto Train	Amtrak Long Distance	Amtrak Interstate Corridor Carolinian	Interstate Corridor (SEHSR) and Regional (Virginia and SEHSR)	Freight Train[1]
SEL for locomotive at 50 feet[2, 3]	97	97	97	97	97[4]
SEL for railcar at 50 feet[2, 3]	82	82	82	82	100[4]
SEL for locomotive horn at 50 feet[2, 3]	108	108	108	108	110[5]
Maximum train speed (mph)[6]	90	90	90	90	60[7]
Train length (feet)	4390	1075	750	992	7083
Number of locomotives per train	2	2	1	2	2
Number of railcars per train	50	11	8	10	73[8]
Throttle setting	8	8	8	8	8
Locomotive length (feet)	70	70	70	70	74
Length of train railcars (feet)	85	85	85	85	95

Notes: 1. Freight trains were only modeled on the proposed bypasses. 2. Source: HDR Engineering, Inc. 3. SEL for 90 mph trains from FRA (September 2012). 4. Source: FRA CREATE. 5. Source: United States Surface Transportation Board, 1998. 6. Varies by rail section; the maximum allowable speed per section was modeled. 7. Maximum freight train speed is 60 mph. 8. Based on an average of cars on intermodal trains and coal and merchandise trains.

Under FRA safety rules, locomotive horns are required to be used at public at-grade crossings. CSXT operating rules also require locomotive horns to be used when trains:

- Approach public crossings
- Approach tunnels, yards, or locations where railroad employees may be working
- Approach roadway workers
- Approach standing trains
- Approach passenger stations
- When warning people or animals near the track

This analysis utilized FRA methods to evaluate locomotive horn noise at public at-grade crossings, yards, and near passenger stations. FRA has studied locomotive horn noise and had determined that horn noise contours exhibit the general cone-like shape shown in Figure 4.7-2. Locomotive horn use increases as trains approach the crossing, and therefore, the noise contour flares outward at the crossing. The locomotive horn contours created during this noise analysis exhibit a similar shape; refer to the noise contour figures in *Noise and Vibration Technical Report* (Appendix P).

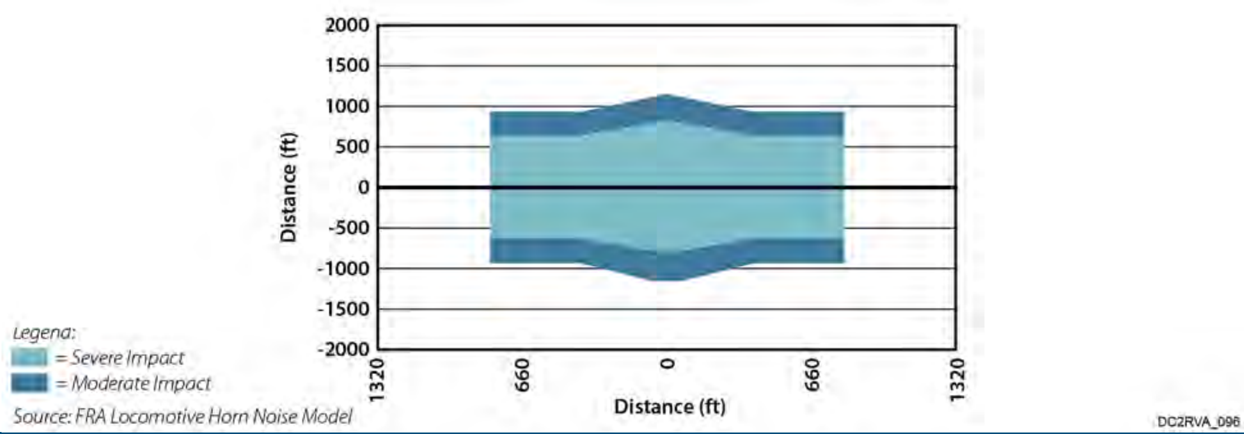


Figure 4.7-2: FRA Sample Train Noise Contour

4.7.1.3 Predicted Noise Levels

Using the information in Tables 4.7-1 and 4.7-2, train noise levels under the Build Alternatives were calculated throughout the study area. These calculations accounted for project-related wayside noise (locomotive and wheel-rail noise) and locomotive horn use at public at-grade crossings. Existing locomotive horn use is incorporated into the noise analysis via the existing noise measurements. FRA locomotive horn use rules do not require locomotive horn use at private at-grade crossings. The analysis assumed that freight trains would use the Fredericksburg Bypass (Build Alternative 3C), and the Ashland Bypass (Build Alternatives 5C and 5C–Ashcake) would be used by freight trains and passenger trains that do not stop in Ashland. Analysis results were used to determine the distance from the tracks at which train noise levels equal the noise impact thresholds for moderate and severe noise impacts at Category 1, 2, and 3 land uses. Noise impacts are identified at the noise-sensitive land uses within those distances to the track.

4.7.1.4 Noise Impact Assessment

This section presents the results of the assessment of Project-related noise during operation and construction. The *Noise and Vibration Technical Report* (Appendix P) includes figures that show the noise impact contours.

Operational Noise Impacts

The noise impact assessment results are presented in Table 4.7-3; this includes both locomotive horn and wayside horn noise. The values shown in the table represent the number of noise-sensitive land use receptors projected to experience noise impacts under the Build Alternatives. Category 1, Category 2, and Category 3 refer to land use categories evaluated in the noise assessment, as explained previously. The noise analysis did not account for terrain or buildings that block train noise from reaching noise-sensitive parcels; therefore, the results are considered to be conservatively high, over-estimating the number of likely train noise impacts.

The proposed project has potential to reduce existing horn noise through new grade separations and crossing closures. Closing an at-grade crossing reduces locomotive horn noise. Adding new at-grade crossings where locomotive horns must be used increases outdoor noise levels near the new crossing. Section 4.15.2 provides the recommended grade crossing treatments for all of the alternatives.

Increases in intercity passenger trains results in a corresponding increase in locomotive horn use in most portions of the project corridor. Exceptions to this include the proposed bypasses of Fredericksburg (Build Alternative 3C) and Ashland (Build Alternatives 5C and 5C–Ashcake) where train volumes will decrease on the exising alignment. Horn noise impacts are distinguishable from wayside noise impacts on the noise impact contour figures shown in the *Noise and Vibration Technical Report*, Appendix P.

Build Alternatives 1A, 1B, and 1C (Arlington). DRPT does not anticipate that Build Alternatives 1A, 1B, and 1C will cause any noise impacts.

Build Alternative 2A (Northern Virginia). Build Alternative 2A would result in noise impacts at 775 sensitive receptors. The most severe impacts generally occur at residences located immediately adjacent to the DC2RVA corridor, including a trailer park just south of Woodbridge Station and several other residential neighborhoods in Prince William County.

Build Alternatives 3A, 3B, and 3C (Fredericksburg). Build Alternatives 3A and 3B that pass through town would impact 75 and 76 sensitive receptors, respectively. Projected noise impacts along the Fredericksburg Bypass (Build Alternative 3C) are substantially higher due to noise from freight trains on the bypass, which would run through areas that currently have no train traffic.

Build Alternative 4A (Central Virginia). Build Alternative 4A is projected to cause noise impacts at 70 sensitive receptors.

Build Alternatives 5A through 5D (Ashland). Projected noise impacts are similar among Build Alternatives that pass through town (Build Alternatives 5A, 5A–Ashcake, 5B, 5B–Ashcake, and 5D–Ashcake), ranging from 154 to 159 sensitive receptors. The Ashland Bypass (Build Alternatives 5C and 5C–Ashcake), would impact 329 sensitive receptors. The higher number of impacts is due to the addition of freight train noise along the proposed bypass, which runs through areas that do not have trains under existing conditions.

One of the severe Category 3 impacts is at the Ashland Library, located adjacent to the tracks; however, the proximity of the nearby station means that intercity passenger and freight trains would actually be traveling slower than modeled. This is one example where use of the highest train speed on each section results in conservatively high analysis results.

The impacts identified with the Ashland area alternatives assume that passenger trains would operate at 90 mph through the Town of Ashland. In reality, the trains would slow down through town, even if they are not stopping at the station. Any reduction in speed would reduce the noise impacts from the Project. As a result, the noise analysis results are conservative.

Build Alternatives 6A through 6G (Richmond). Projected noise impacts through Richmond range from 313 to 439 sensitive receptors under Build Alternatives 6A through 6G.

Table 4.7-3: Operational Noise Impact Summary by Alternative

Alternative Area	Alternative	Operational Noise Impacts						
		Category 1		Category 2		Category 3		
		Moderate	Severe	Moderate	Severe	Moderate	Severe	Total
Area 1: Arlington (Long Bridge Approach)	1A	0	0	0	0	0	0	0
	1B	0	0	0	0	0	0	0
	1C	0	0	0	0	0	0	0
Area 2: Northern Virginia (Long Bridge to Dahlgren Spur)	2A	0	0	670	99	6	0	775
Area 3: Fredericksburg (Dahlgren Spur to Crossroads)	3A	0	0	66	8	1	0	75
	3B	0	0	67	8	1	0	76
	3C	2	1	2,392	1,524	8	5	3,932
Area 4: Central Virginia (Crossroads to Doswell)	4A	0	0	51	18	1	0	70
Area 5: Ashland (Doswell to I-295)	5A	0	0	135	14	1	4	154
	5A–Ashcake	0	0	135	14	1	4	154
	5B	1	0	133	20	1	4	159
	5B–Ashcake	1	0	133	20	1	4	159
	5C	0	0	272	51	2	4	329
	5C–Ashcake	0	0	272	51	2	4	329
	5D–Ashcake	1	0	135	18	1	4	159
Area 6: Richmond (I-295 to Centralia)	6A	0	0	366	8	6	0	380
	6B–A-Line	0	0	386	9	6	0	401
	6B–S-Line	1	0	416	15	7	0	439
	6C	0	0	387	9	7	0	403
	6D	1	0	416	15	7	0	439
	6E	0	0	379	9	6	0	394
	6F	1	0	416	15	7	0	439
	6G	1	0	298	10	4	0	313

The noise impact locations are shown in the Noise and Vibration Technical Report (Appendix P).

Construction Noise Impacts

Construction of the Build Alternatives would result in a temporary increase in noise levels. Equipment used to move soil and other earthen materials is often the loudest construction noise source. FTA and FRA both recommend construction noise limits of 90 dBA (daytime) and 80 dBA (nighttime) on a 1-hour L_{eq} basis in residential areas.

Typical equipment used for different phases of railroad construction with typical noise levels, quantities, and estimated utilizations for each type of equipment used are presented in Table 4.7-4. The table shows the calculated construction noise sound pressure levels (SPL) at different distances. These are estimates of construction noise at different distances from the center of a construction site.

Table 4.7-4: Estimated Construction Equipment Noise Levels

Construction Phase	Equipment	Number	Hours/day	Utilization	SWL/unit	Total SWL	SPL (dBA) at distance (feet)		
							100	500	1,000
Clearing	Off-Highway Trucks	4	6	50%	124	127	108	94	88
	Rubber Tired Dozers	3	8	67%	122	125	106	92	86
	Rubber Tired Loaders	2	6	50%	121	121	102	88	82
	Tractors/Loaders/Backhoes	3	5	42%	118	119	100	86	80
	Trenchers	2	4	33%	117	115	96	82	76
Utility Relocation	Cranes	1	6	50%	121	118	100	86	80
	Dumper/Tender	2	4	33%	110	108	89	75	69
	Off-Highway Trucks	2	6	50%	124	124	105	91	85
	Rubber Tired Dozers	3	8	67%	122	125	106	92	86
	Rubber Tired Loaders	2	6	50%	121	121	102	88	82
	Tractors/Loaders/Backhoes	3	5	42%	118	119	100	86	80
	Trenchers	2	6	50%	117	117	98	84	78
	Welders	3	6	50%	114	116	97	83	77
Earthwork	Excavators	2	8	67%	120	121	102	88	82
	Graders	1	8	67%	120	118	100	86	80
	Off-Highway Trucks	4	8	67%	124	128	109	95	89
	Off-Highway Trucks	1	4	33%	123	118	100	86	80
	Rollers	2	6	50%	117	117	98	84	78
	Rubber Tired Dozers	1	8	67%	122	120	101	87	81
	Rubber Tired Loaders	2	6	50%	121	121	102	88	82
	Scrapers	2	8	67%	123	125	106	92	86
	Signal Boards	3	8	67%	106	109	90	76	70
	Tractors/Loaders/Backhoes	3	6	50%	118	119	101	87	81

▶ *Continued*

Table 4.7-4: Estimated Construction Equipment Noise Levels

Construction Phase	Equipment	Number	Hours/day	Utilization	SWL/unit	Total SWL	SPL (dBA) at distance (feet)		
							100	500	1,000
Bridge Construction for Overpasses	Cranes	1	7	58%	121	119	100	86	80
	Excavators	2	8	67%	120	121	102	88	82
	Forklifts	3	8	67%	117	120	102	88	82
	Generator Sets	1	8	67%	117	115	97	83	77
	Graders	1	8	67%	120	118	100	86	80
	Impact Pile Driver	1	6	50	n/a	n/a	95	81	75
	Pavers	2	8	67%	119	120	101	87	81
	Paving Equipment	2	8	67%	119	120	101	87	81
	Rollers	2	8	67%	117	118	99	85	79
	Rubber Tired Dozers	1	8	67%	122	120	101	87	81
	Scrapers	2	8	67%	123	125	106	92	86
	Tractors/Loaders/Backhoes	2	8	67%	118	119	100	86	80
	Welders	1	8	67%	114	113	94	80	74
Retaining Walls	Excavators	2	8	67%	120	121	102	88	82
	Forklifts	3	8	67%	117	120	102	88	82
	Generator Sets	1	8	67%	117	115	97	83	77
	Graders	1	8	67%	120	118	100	86	80
	Impact Pile Driver	1	6	50	n/a	n/a	95	81	75
	Rubber Tired Dozers	1	8	67%	122	120	101	87	81
	Rubber Tired Loaders	2	7	58%	121	121	103	89	83
	Scrapers	2	8	67%	123	125	106	92	86
	Tractors/Loaders/Backhoes	3	7	58%	118	120	101	87	81
Signals	Cranes	1	7	58%	121	119	100	86	80
	Forklifts	3	8	67%	117	120	102	88	82
	Generator Sets	1	8	67%	117	115	97	83	77
	Tractors/Loaders/Backhoes	2	8	67%	118	119	100	86	80
	Welders	1	8	67%	114	113	94	80	74

▶ *Continued*

Table 4.7-4: Estimated Construction Equipment Noise Levels

Construction Phase	Equipment	Number	Hours/day	Utilization	SWL/unit	Total SWL	SPL (dBA) at distance (feet)		
							100	500	1,000
Track Installation	Air Compressors	1	6	50%	117	114	95	81	75
	Cranes	1	7	58%	121	119	100	86	80
	Forklifts	3	8	67%	117	120	102	88	82
	Generator Sets	1	8	67%	117	115	97	83	77
	Track Laying Machine	1	8	67%	129	128	109	95	89
	Track Tamper	1	8	67%	121	119	100	86	80
	Track Stabilizer	1	8	67%	126	124	106	92	86
	Tractors/Loaders/Backhoes	2	8	67%	118	119	100	86	80
	Welders	1	8	67%	114	113	94	80	74
Demolish Existing Bridge	Concrete/Industrial Saws	1	8	67%	117	115	96	82	76
	Excavators	2	8	67%	120	121	102	88	82
	Graders	1	8	67%	120	118	100	86	80
	Rubber Tired Dozers	1	8	67%	122	120	101	87	81
	Scrapers	2	8	67%	123	125	106	92	86
	Tractors/Loaders/Backhoes	2	8	67%	118	119	100	86	80
Signal Work	Cranes	1	7	58%	121	119	100	86	80
	Forklifts	3	8	67%	117	120	102	88	82
	Generator Sets	1	8	67%	117	115	97	83	77
	Tractors/Loaders/Backhoes	2	8	67%	118	119	100	86	80
	Welders	1	8	67%	114	113	94	80	74
Install Track and Subballast over Bridge	Air Compressors	1	6	50%	117	114	95	81	75
	Cranes	1	7	58%	121	119	100	86	80
	Forklifts	3	8	67%	117	120	102	88	82
	Generator Sets	1	8	67%	117	115	97	83	77
	Track Laying Machine	1	8	67%	129	128	109	95	89
	Track Tamper	1	8	67%	121	119	100	86	80
	Track Stabilizer	1	8	67%	126	124	106	92	86
	Ballast Regulator	1	8	67%	119	118	99	85	79
	Tractors/Loaders/Backhoes	2	8	67%	118	119	100	86	80
	Welders	1	8	67%	114	113	94	80	74
Final Cut-Over and Removal of Turnouts	Cranes	1	7	58%	121	119	100	86	80
	Forklifts	3	8	67%	117	120	102	88	82
	Generator Sets	1	8	67%	117	115	97	83	77
	Tractors/Loaders/Backhoes	3	7	58%	118	120	101	87	81
	Welders	1	8	67%	114	113	94	80	74

The results presented in Table 4.7-4 conservatively overestimate actual expected construction noise levels by assuming that all equipment (i.e., all dump trucks or all pickup trucks) operate at the same location. Typically, construction equipment is spread throughout the construction work zone. Given the linear nature of the Project and relatively confined width of the railroad right-of-way, it is reasonable to assume that all equipment would not operate next to each other in the same (stationary) location for 1 hour. On this basis, construction noise levels in Table 4.7-4 somewhat overestimate noise levels for construction phases that would use more than one piece of equipment at a particular location. In all other cases, the results are assumed to be within 3 dBA of likely construction noise levels, if the equipment has been properly maintained and the mufflers are in good condition.

Construction noise analysis results shown in Table 4.7-4 indicate the total combined noise for all equipment types and construction phases never exceeds the FTA/FRA recommended limit of a 1-hour L_{eq} of 90 dBA at 200 feet, even using a conservative approach to the evaluation. Because the conservatively calculated construction noise is not anticipated to exceed 90 dBA at 200 feet, construction noise is not expected to be adverse in most locations; however, DRPT will ensure that construction noise mitigation measures will be evaluated when an analysis of construction noise based on the actual construction plan can be completed. At the preliminary design phase, construction noise mitigation measures are not recommended due to the overly conservative nature of these calculation results.

FRA and FTA do not have standardized criteria for construction; however, FTA suggests reasonable criteria that can be used for assessment purposes. The criteria for residential land uses are 1-hour L_{eq} of 90 dBA during the day and 80 dBA during the night; therefore, it would be prudent to limit construction to daytime hours whenever feasible.

4.7.1.5 Noise Mitigation Measures

Potential noise mitigation measures are broadly categorized as applied at the source, in the pathway (the path that sound travels), or at the receiver. The source of most train noise is the interaction of steel wheels and the steel rail; this is called wayside noise. In addition to wayside noise, railcars (particularly, freight cars) sometimes rattle and produce noticeable amounts of noise. Locomotives also emit noise from the engine casing and from the cooling and exhaust vents. Maintaining wheels and rails is an effective way to manage and reduce wayside noise. Use of continuously welded rail (CWR or rail with no joints) also minimizes wayside noise (joints and gaps in the rail produce noise when trains roll over them). As part of the Build Alternatives, DRPT assumes that all track will be CWR.

Locomotive horns are another loud source of train noise; however, their use is mostly limited to at-grade crossings and other areas required by CSXT operating rules where they are used to warn people that trains are approaching. Locomotive horn use at public at-grade crossings is required under FRA safety regulations. FRA does not require locomotive horn use at private at-grade crossings. Grade crossing closure, grade separations, and installation of wayside horns (stationary horns located where trains cross public at-grade crossings, whose use eliminates the use of locomotive horns) are potential measures to mitigate locomotive horn use. These have been evaluated and are incorporated into the Project to the extent deemed reasonable and appropriate within the design, operating, and financial constraints of the Project. FRA regulations also allow the creation of quiet zones, where locomotive horn use at public at-grade crossings is not required due to the installation of supplemental safety measures. Under those regulations, municipalities can coordinate the design and development of quiet zones. Section 4.15.2.2 (Relevance of Build Alternatives on Quiet Zones) provides additional information on quiet zones.

Noise barriers, while not commonly used on rail projects, can block train noise and reduce noise levels in areas behind them. To be effective, noise barriers must block the line of sight between the noise source and the receiver. Raising the height of the noise barrier above that line of sight increases the amount of noise reduction the noise barrier provides, but the cost of a noise barrier is directly related to the size of the noise barrier. Cost effectiveness is sometimes used to evaluate whether the noise reduction provided by a noise barrier justifies the expense of designing, constructing, and maintaining the barrier. This type of evaluation also considers the number of noise-sensitive land uses expected to experience a noise reduction due to the noise barrier. FRA does not have criteria for evaluating cost effectiveness of noise barriers. VDOT does, however, and their criteria could be useful for evaluating the cost effectiveness of noise barriers on this Project. At this early phase of Project development (Draft EIS and preliminary design), it is premature to discuss specific details of potential noise mitigation options before a recommended Preferred Alternative is selected.

Receiver-based mitigation is rarely implemented on rail projects because it is not cost effective to treat multiple individual locations across large areas.

Noise mitigation during construction is discussed in Section 4.19.2.4 in the Construction Impacts section.

4.7.2 Vibration

This section describes potential Project-related vibration effects and identifies mitigation measures to offset projected impacts. Vibration effects were assessed based on the methods and criteria included in FRA's *High Speed Ground Transportation Noise and Vibration Impact Assessment* guidance manual (September 2012) as well as those included in FTA's *Transit Noise and Vibration Impact Assessment* (May 2006) manual, where applicable.

4.7.2.1 Vibration Impact Criteria

The FRA and FTA vibration impact criteria are identical and are used to predict future vibration impacts from train operations. There are separate criteria for both ground-borne vibration (GBV) and ground-borne noise (GBN). GBN is a rumble sound created by GBV and is often masked by airborne-noise; therefore, GBN criteria are primarily applied to subway operations in which airborne noise is negligible. The basis for evaluating rail vibration impact thresholds is the highest expected root mean square (RMS) vibration levels for repeated vibration events from the same source. As presented in Table 4.7-5, the thresholds are differentiated between vibration-sensitive land uses and the frequency of the events.

The Category 1 vibration impact threshold is acceptable for most moderately sensitive equipment; other highly sensitive equipment would require a detailed analysis to determine the acceptable vibration levels and the effect of the Project on the equipment. There are no GBN impact thresholds for Category 1 land uses because equipment sensitive to GBV is generally not sensitive to GBN; however, other special Category 1 land uses, such as concert halls, television and recording studios, and theaters, can be very sensitive to GBV and GBN. FTA has developed special vibration impact thresholds for these Category 1 land uses, but these land uses were not encountered within the vibration impact contour distances. Category 2 and 3 land uses exist within the vibration impact distances discussed below.

Table 4.7-5: Ground-Borne Vibration (GBV) and Ground-Borne Noise (GBN) Impact Criteria for General Assessment

Land Use Category	GBV Impact Levels (VdB re 1 µin/s)			GBN Impact Levels (dBA re 20 µPa)		
	Frequent Events [1]	Occasional Events [2]	Infrequent Events [3]	Frequent Events [1]	Occasional Events [2]	Infrequent Events [3]
Category 1: Buildings where vibration would interfere with interior operations.	65 VdB [4]	65 VdB [4]	65 VdB [4]	n/a [5]	n/a [5]	n/a [5]
Category 2: Residences and buildings where people normally sleep.	72 VdB	75 VdB	80 VdB	35 dBA	38 dBA	43 dBA
Category 3: Institutional land uses with primarily daytime use.	75 VdB	78 VdB	83 VdB	40 dBA	43 dBA	48 dBA

Source: FRA, 2012.

Notes: 1. Frequent Events is defined as more than 70 vibration events of the same kind per day; 2. Occasional Events is defined as between 30 and 70 vibration events of the same kind per day; 3. Infrequent Events is defined as fewer than 30 vibration events of the same kind per day; 4. This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration-sensitive manufacturing or research would require detailed evaluation to define the acceptable vibration levels. Ensuring lower vibration levels in a building often requires special design of the heating, ventilation, and air conditioning (HVAC) systems and stiffened floors; 5. Vibration-sensitive equipment is not sensitive to GBN.

4.7.2.2 Vibration Prediction Methodology

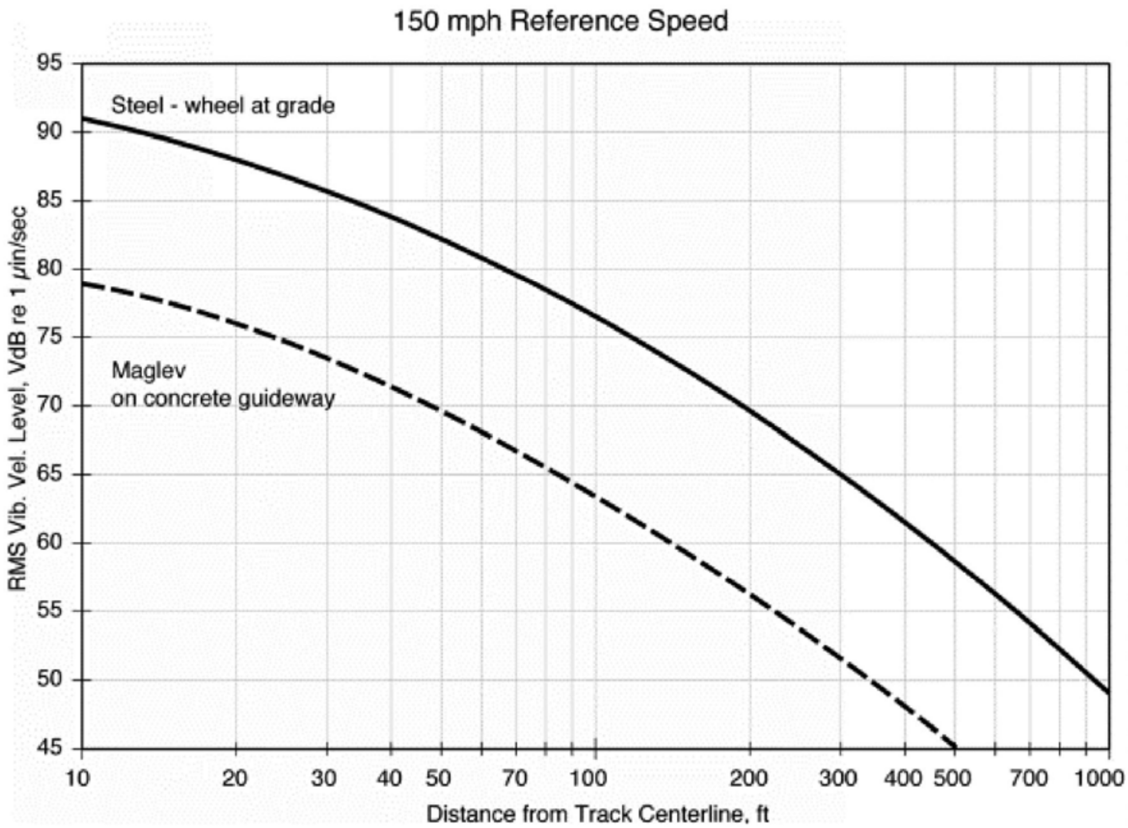
The vibration assessment consists of the following general steps:

1. Establish the study area and identify vibration-sensitive land uses. The FTA/FRA vibration screening assessment was not performed. Rather, the lands adjacent to the rail line were considered part of the study area, and the vibration study conducted for this Project identified the distance from the rail line at which vibration impacts would no longer occur. The *Noise and Vibration Technical Report* (Appendix P) provides additional detail regarding the vibration study conducted.
2. Evaluate the railroad traffic conditions and set corresponding impact thresholds.
3. Select the base generalized vibration curve, and then apply appropriate adjustments for factors such as speed.
4. Determine the propagation from Project-related vibration sources to the impact thresholds.
5. Identify receptors anticipated to experience vibration impacts.

The FRA and FTA General Assessment methodologies are nearly identical and are intended to predict approximate magnitude of impact, and those with the highest magnitude of impact may merit a more-detailed assessment during subsequent engineering phases. Noise and vibration-sensitive land uses within the study area were identified according to FRA categories. Land use was identified from GIS databases, field surveys, and information on planned development from local planning departments.

The vibration prediction begins with selection of a generalized base curve, depending on the mode considered. These curves represent typical ground-surface vibration as a function of distance from the source, based on many GBV measurements of numerous transit sources.

The generalized ground surface vibration curves suitable for assessing the high speed passenger trains (not the existing passenger or freight) are shown in Figure 4.7-3. They represent the upper range of the measurement data from equipment in good condition and were adjusted to account for projected operating speeds as described below.



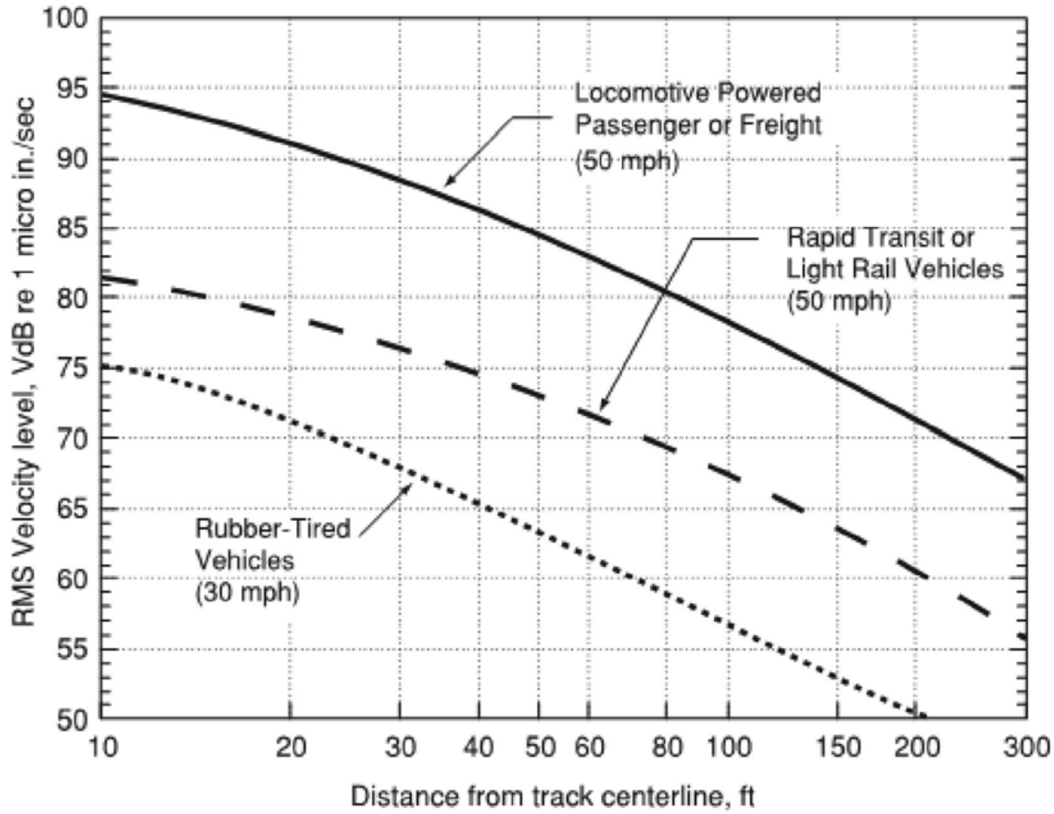
Source: FRA, 2012.

DC2RVA_088

Figure 4.7-3: FRA Generalized Ground Surface Vibration Curves

The generalized ground surface vibration curves suitable for assessing existing intercity passenger and freight trains (for the segments on which they are modeled) are shown in Figure 4.7-4. These curves similarly represent the upper range of the measurement data from equipment in good condition. The top curve represents trains that are powered by diesel-electric locomotives, and the middle curve represents fixed-guideway steel-wheel transit vehicles such as light-rail vehicles and streetcars.

The base curves must then be adjusted to account for Project-specific vibration factors that differ from the conditions of the base curve. Adjustment parameters are given in the FRA and FTA guidance and include train speed, wheel and rail type and condition, and type of track support system, among other adjustments. The adjustment parameters are based on typical vibration spectra and are given as generalized single numbers to be applied to the base curve.



Source: FTA, 2006.

DC2RVA_089

Figure 4.7-4: FRA Generalized Ground Surface Vibration Curves Suitable for Assessing Transit and Freight Trains

The adjustments are arithmetically added to the reference vibration curve, and the resulting levels are compared to the impact thresholds. This is algebraically equivalent to subtracting the same adjustments from the impact threshold and comparing it to the unadjusted reference curve. In this way, the graphical curves shown in Figures 4.7-3 and 4.7-4 can be used to find the distance to vibration impact. For this assessment, the distance to vibration impact was determined by looking up the level of the adjusted criterion curve on the y-axis and then finding the distance on the x-axis from the generalized vibration curve.

Computation Assumptions and Input Data

The vibration assessment used the same passenger and freight rail data as the noise assessment (Tables 4.7-1 and 4.7-2). The FRA generalized vibration curve "Steel-wheel at-grade" was used as the base curve for the impact assessment of the proposed additional intercity passenger trains (Figure 4.7-3). Freight trains already run through the DC2RVA corridor and are not modeled for any of the track in the existing corridor; however, where freight trains are being introduced, such as on the proposed bypass sections, the FTA generalized vibration curve "Locomotive powered passenger and freight" (Figure 4.7-4) was used as the base curve for the impact assessment of freight trains.

Specific modeling considerations for each Build Alternative are provided in Table 4.7-6.

Table 4.7-6: Vibration Analysis Modeling Assumptions

Alternative Area	Alternative	Modeling Assumption
Area 1: Arlington (Long Bridge Approach)	1A, 1B, and 1C	There are three alternatives, but no vibration-sensitive receptors within 500 feet of the Project; therefore, no vibration assessment was completed for Build Alternatives 1A, 1B, and 1C.
Area 2: Northern Virginia (Long Bridge to Dahlgren Spur)	2A	There is only one alternative along the existing passenger rail corridor. The additional intercity passenger trains were modeled using the FRA generalized vibration curve for steel-wheel at-grade high speed trains.
Area 3: Fredericksburg (Dahlgren Spur to Crossroads)	3A and 3B	Build Alternatives 3A and 3B would route Project-related trains through the existing passenger rail corridor. The additional intercity passenger trains were modeled using the FRA generalized vibration curve for steel-wheel at-grade high speed trains.
	3C	The Fredericksburg Bypass (Build Alternative 3C) would route freight trains and potentially some of the passenger trains along a new alignment that bypasses Fredericksburg. The additional intercity passenger trains were modeled through the existing corridor using the FRA generalized vibration curve for steel-wheel at-grade high speed trains. Even at a lower speed, the freight trains generate more vibration than the passenger trains; therefore, the freight trains were modeled in the bypass corridor using the FTA generalized vibration curve for locomotive-powered passenger or freight trains.
Area 4: Central Virginia (Crossroads to Doswell)	4A	There is only one alternative along the existing passenger rail corridor. The additional intercity passenger trains were modeled using the FRA generalized vibration curve for steel-wheel at-grade high speed trains.
Area 5: Ashland (Doswell to I-295)	5A, 5A–Ashcake, 5B, 5B–Ashcake, and 5D–Ashcake	Build Alternatives 5A, 5A–Ashcake, 5B, 5B–Ashcake, and 5D–Ashcake would route Project-related trains through the existing passenger rail corridor. The additional intercity passenger trains are modeled using the FRA generalized vibration curve for steel-wheel at-grade high speed trains.
	5C and 5C–Ashcake	Build Alternatives 5C and 5C–Ashcake would route the through passenger trains and the freight trains along a new alignment that bypasses the Town of Ashland, while passenger trains that stop in Ashland would use the bypassed area of the existing corridor. Even at a lower speed, the freight trains generate more vibration than the passenger trains; therefore, the freight trains were modeled in the bypass corridor using the FTA generalized vibration curve for locomotive-powered passenger or freight trains. The planned number of future passenger trains is the same as the number of passenger trains that currently use this portion of the DC2RVA corridor, and the planned future trains are on average shorter than the average length of existing trains, plus there would be no freight traffic. These changes represent a benefit to vibration effects; therefore, vibration contours were not calculated for the bypassed area of the existing corridor.
Area 6: Richmond (I-295 to Centralia)	6A, 6B–A-Line, 6C, and 6E	Alternatives 6A, 6B–A-Line, 6C, and 6E would route Project-related trains via the current CSXT North End Subdivision (sometimes referred to as the A-line) between West Acca Yard in Richmond and Centralia, VA. The CSXT Bellwood Subdivision (sometimes referred to as the S-line) between Control Point Hermitage in Richmond and Centralia, VA, would not see any increase in passenger train traffic, so the trains were not modeled as a consequence of this Project on that section. The additional intercity passenger trains are modeled using the FRA generalized vibration curve for steel-wheel at-grade high speed trains.
	6B–S-Line, 6D, 6F, and 6G	Alternatives 6B–S-Line, 6D, 6F, and 6G would route Project-related trains via the current S-line. The A-line would see a reduction in passenger trains, which represents a Project benefit, so the trains are not modeled as a consequence of this Project on that section. The additional intercity passenger trains were modeled using the FRA generalized vibration curve for steel-wheel at-grade high speed trains.

4.7.2.3 Predicted Vibration Levels

Estimates of Project-related, train-induced GBV were developed based on the methodology described above. The predicted vibration levels were used to develop distance-to-vibration-impact contours.

4.7.2.4 Vibration Impact Assessment

This section presents the results of the vibration impact assessment during operation and construction.

Operational Vibration Impacts

Using site-specific and project-specific data as explained above, DRPT conducted the vibration assessment by calculating the distance from the rail line at which train-induced vibration levels equal the FRA ground-borne vibration impact thresholds. Vibration impact contour lines were then overlaid upon digital aerial photographs (refer to Appendix P) to delineate the areas projected to experience vibration impacts. (See the *Noise and Vibration Technical Report*, Appendix P.) Vibration-sensitive land uses inside the vibration contours are projected to experience vibration impacts as defined by FRA. Table 4.7-7 shows the number of receptors anticipated to experience vibration impacts associated with each Build Alternative.

Table 4.7-7: Vibration Impact Summary by Alternative

Alternative Area	Alternative	Vibration Impacts			
		Category 1	Category 2	Category 3	Total
Area 1: Arlington (Long Bridge Approach)	1A	0	0	0	0
	1B	0	0	0	0
	1C	0	0	0	0
Area 2: Northern Virginia	2A	0	15	0	15
Area 3: Fredericksburg (Dahlgren Spur to Crossroads)	3A	0	0	0	0
	3B	0	0	0	0
	3C	0	43	0	43
Area 4: Central Virginia (Crossroads to Doswell)	4A	0	2	0	2
Area 5: Ashland (Doswell to I-295)	5A	0	25	1	26
	5A–Ashcake	0	25	1	26
	5B	0	30	1	31
	5B–Ashcake	0	30	1	31
	5C	0	35	1	36
	5C–Ashcake	0	35	1	36
	5D–Ashcake	0	30	1	31
Area 6: Richmond (I-295 to Centralia)	6A	0	8	0	8
	6B–A-Line	0	8	0	8
	6B–S-Line	0	8	0	8
	6C	0	8	0	8
	6D	0	8	0	8
	6E	0	8	0	8
	6F	0	8	0	8
	6G	0	8	0	8

Build Alternatives 1A, 1B, and 1C (Arlington). There are no vibration-sensitive receptors within 500 feet of Build Alternatives 1A, 1B, or 1C; therefore, vibration impact contours were not calculated, and there are no receptors anticipated to experience vibration impacts for these Build Alternatives.

Build Alternative 2A (Northern Virginia). Under Build Alternative 2A, 15 receptors are projected to experience vibration impacts. Additionally, there is a structure on National Register of Historic Places (NRHP)—the historic Alexandria Union Station—which is within all vibration impact contours; however, this structure was designed to stand next to rail transportation. Furthermore, the vibration levels are currently being compared to human-comfort criteria, which is much lower than vibration levels necessary to cause damage to even old, fragile structures. Therefore, while this structure is within the vibration impact contours, it is not considered an impact and is not included in Table 4.7-7.

Build Alternatives 3A, 3B, and 3C (Fredericksburg). No receptors are projected to experience vibration impacts under Build Alternatives 3A or 3B that pass through town. Under the Fredericksburg Bypass (Build Alternative 3C), 43 receptors are projected to experience vibration impacts as a result of freight trains operating along new alignment.

Build Alternative 4A (Central Virginia). Under Build Alternative 4A, two residential receptors are projected to experience vibration impacts.

Build Alternatives 5A through 5D (Ashland). Under the Build Alternatives in the Ashland area, 26 to 36 receptors are projected to experience vibration impacts. These impacts, including the Category 3 impact at the Ashland Library, are based on the assumption that passenger trains are operating at 90 mph through Ashland. In reality, trains would slow down through town, even if they are not stopping at the station. At this point, the tabulation of vibration impacts is considered a conservative overestimate. The addition of freight traffic on the proposed bypass alignment is the primary source of vibration impacts for Build Alternatives 5C and 5C–Ashcake.

Build Alternatives 6A through 6G (Richmond). Projected vibration impacts in the Richmond area are the same for all Build Alternatives. Vibration impacts are projected in areas where all trains operate on the same alignment. Refer to the *Noise and Vibration Technical Report* (Appendix P) for figures showing the locations of these impacts.

Construction Vibration Impacts

Construction activity can result in varying degrees of ground vibration, depending on the equipment and methods employed. Operation of construction equipment causes ground vibrations that spread through the ground and diminish in strength with distance. Buildings near construction can respond to these vibrations, with varying results ranging from no perceptible effects at the lowest levels; low rumbling sounds and perceptible vibrations at moderate levels; and slight damage at the highest levels.

Ground vibrations from construction activities do not often reach the levels that can damage structures, but they can reach the range of perceptible vibration or audible sound in buildings very close to the site. A possible exception is the case of fragile buildings where special care must be taken to avoid damage. The construction vibration criteria include special consideration for fragile buildings. The damage criteria published by FTA, using units of peak particle velocity (PPV) expressed in inches per second, are presented in Table 4.7-8.

Table 4.7-8: Construction Vibration Damage Criteria

Building Category	Description	Damage Criteria, PPV (in./sec.)
I	Reinforced concrete, steel, or timber (no plaster)	0.5
II	Engineered concrete and masonry (no plaster)	0.3
III	Non-engineered timber and masonry buildings	0.2
IV	Buildings extremely susceptible to vibration damage	0.12

Ground vibrations from construction activities can be audible and perceptible in buildings near the construction limits. Some buildings are more sensitive to vibration than others; they might have recording or broadcast facilities or vibration-sensitive equipment in them. FRA advocates a separate set of vibration criteria for buildings with vibration-sensitive uses or equipment inside of them. The criteria used for vibration-sensitive equipment is presented in Table 4.7-9.

Table 4.7-9: Construction Vibration Damage Criteria–Vibration-Sensitive Equipment

Type of Building or Room	Max Lv, VdB [1]
TV Studios	65
Recording Studios	65
Theaters	65
Vibration-Sensitive Lab	48

Notes: 1. RMS velocity in decibels (VdB) re 1 micro-inch/second.

PPVs associated with typical construction equipment, as published by FTA, are presented in Table 4.7-10. These vibration emission levels and factors represent a conservatively high usage because it is not anticipated that all this machinery is to be used at any one particular location at the same time.

Table 4.7-10: Construction Equipment PPV

Equipment		PPV at 25 ft (in./sec.)	Approx. Lv[1] at 25 ft.
Pile Driver (impact)	Upper range	1.518	112
	Typical	0.644	104
Pile Driver (sonic)	Upper range	0.734	105
	Typical	0.17	93
Clam shovel drop		0.202	94
Hydromill	In soil	0.008	66
	In rock	0.017	75
Vibratory Roller		0.21	94
Hoe Ram		0.089	87
Large bulldozer		0.089	87
Caisson drilling		0.089	87
Loaded trucks		0.076	86
Jackhammer		0.035	79
Small bulldozer		0.003	58

Source: FTA, May 2006.

Notes: 1. RMS velocity in decibels (VdB) re 1 micro-inch/second.

4.7.2.5 Vibration Mitigation

Vibration mitigation options are limited due to the presence of freight trains in the DC2RVA corridor. Mitigation strategies, such as floating slabs, are not feasible options for tracks that also carry freight. Where freight trains operate, the only feasible options for mitigation of the trains are track and wheel maintenance measures, strategic location of special trackwork, and buffer zones between the tracks and the receptors. DRPT has no control over the implementation of these mitigation measures by the freight railroads. Passenger train maintenance can also be implemented to reduce ground-borne vibration; modification of the passenger rail vehicle suspension is also a potential mitigation option. DRPT will identify the necessary mitigation measures during the final design process.

- **Track and wheel maintenance:** Maintenance procedures reduce vibration effects through regularly scheduled rail grinding, wheel truing programs, vehicle reconditioning programs, and implementation of flat-wheel detectors. These maintenance procedures minimize the vibration sources before they can affect vibration-sensitive receptors.
- **Location of special trackwork:** Effects of special trackwork has not been evaluated in this assessment because the locations are likely to change as Project design progresses. It is crucial that vibration effects on sensitive receptors are evaluated when locating special trackwork.
- **Vehicle suspension:** Changing the vehicle suspension of the passenger trains is normally an option only when creating a new fleet of passenger trains. It is not feasible for the freight train traffic, and it is unlikely that the existing passenger train fleet will modify their suspension.

Construction-related vibration mitigation measures include BMP's such as equipment selection, finding alternatives to traditional impact pile driving, and limiting the hours of operation and locations where sources of construction-related vibration will occur. DRPT will develop the details of these BMPs during the final design process.

4.8 ENERGY

4.8.1 Energy Consumption during Operation

DRPT evaluated the Build Alternatives in terms of their potential to realize savings in energy consumed by all major modes of transportation in the DC2RVA corridor compared to the No Build Alternative. As noted in Section 3.8, travel by rail is the most energy-efficient mode of transportation. As a result, any substantial increase in rail ridership associated with any of the Build Alternatives that would shift ridership from the other less-efficient modes of transportation would result in conservation of travel-related energy.

The estimated change in intercity passenger miles of travel of the Build Alternatives relative to the No Build Alternative are shown in Table 4.8-1 by mode of travel. The results in Table 4.8-1 represent the benefit to other modes only from intercity passenger ridership accommodated by the DC2RVA project. Auto, bus, and air travel will continue to grow under the No Build Alternative and Build Alternatives, however, at a lesser rate under the Build Alternatives.

When comparing the Build Alternatives with the No Build Alternative, there would be an increase in intercity passenger rail miles, while the other three modes of transportation would experience a decrease, as shown in Table 4.8-1. This can be attributed to a shift in ridership from the other three modes to rail.

DRPT estimated the future energy use of all modes in the DC2RVA corridor by calculating the total passenger miles of travel projected for 2045 by mode for the No Build Alternative and Build Alternatives and then applying the energy consumption rates by mode that are presented in Section 3.8. The estimated change in annual energy consumption of the Build Alternatives compared to the No Build Alternative is summarized in Table 4.8-2 by mode of travel.

The results in Table 4.8-2 show that the total energy consumption from intercity passenger travel under the No Build Alternative would be higher than the Build Alternatives. By expanding intercity passenger rail service, the Build Alternatives would result in an increase in energy consumption compared to the No Build Alternative with regard to rail transportation; however, the other three modes would experience a decrease, which would result in an overall net decrease in energy consumption. As previously mentioned, this can be attributed to a shift in ridership from the other three less energy-efficient modes to rail.

Table 4.8-1: Change in Annual Passenger Miles of Travel Compared to the No Build Alternative (millions)–Year 2045

Build Alternative	Rail	Automobile	Bus	Air	Total
6A (Staples Mill Road Station Only)	315	-164	-31	-68	52
6B–A-Line (Boulevard Station Only, A-Line)	286	-149	-29	-60	48
6B–S-Line (Boulevard Station Only, S-Line)	286	-149	-29	-60	48
6C (Broad Street Station Only)	277	-143	-27	-60	47
6D (Main Street Station Only)	288	-151	-29	-60	48
6E (Split Service, Staples Mill Road/Main Street Stations)	295	-154	-29	-63	49
6F (Full Service, Staples Mill Road/Main Street Stations)	293	-156	-29	-61	47
6G (Shared Service, Staples Mill Road/Main Street Stations)	296	-158	-29	-61	47

Note: The results reflected in this table represent all passenger travel to, from, and within the DC2RVA corridor. Corridor-wide ridership forecasts for the Build Alternatives only differ based on which station option is used in Richmond (*Ridership Technical Report*, Appendix J).

Table 4.8-2: Change in Annual Energy Consumption Compared to the No Build Alternative (billions of BTUs)–Year 2045

Build Alternative	Rail	Automobile	Bus	Air	Total
6A (Staples Mill Road Station Only)	513	-636	-26	-158	-307
6B–A-Line (Boulevard Station Only, A-Line)	465	-578	-24	-140	-277
6B–S-Line (Boulevard Station Only, S-Line)	465	-578	-24	-140	-277
6C (Broad Street Station Only)	451	-553	-23	-140	-265
6D (Main Street Station Only)	469	-585	-23	-140	-280
6E (Split Service, Staples Mill Road/Main Street Stations)	481	-596	-23	-148	-286
6F (Full Service, Staples Mill Road/Main Street Stations)	478	-606	-24	-141	-293
6G (Shared Service, Staples Mill Road/Main Street Stations)	481	-613	-24	-143	-299

Note: The results reflected in this table represent all passenger travel to, from, and within the DC2RVA corridor. Corridor-wide ridership forecasts for the Build Alternatives only differ based on which station option is used in Richmond (*Ridership Technical Report*, Appendix J).

When comparing the Build Alternatives with the No Build Alternative, there would be an increase in intercity passenger rail miles, while the other three modes of transportation would experience a decrease, as shown in Table 4.8-1. This can be attributed to a shift in ridership from the other three modes to rail.

DRPT estimated the future energy use of all modes in the DC2RVA corridor by calculating the total passenger miles of travel projected for 2045 by mode for the No Build Alternative and Build Alternatives and then applying the energy consumption rates by mode that are presented in Section 3.8. The estimated change in annual energy consumption of the Build Alternatives compared to the No Build Alternative is summarized in Table 4.8-2 by mode of travel.

The results in Table 4.8-2 show that the total energy consumption from intercity passenger travel under the No Build Alternative would be higher than the Build Alternatives. By expanding intercity passenger rail service, the Build Alternatives would result in an increase in energy consumption compared to the No Build Alternative with regard to rail transportation; however, the other three modes would experience a decrease, which would result in an overall net decrease in energy consumption. As previously mentioned, this can be attributed to a shift in ridership from the other three less energy-efficient modes to rail.

4.8.2 Energy Consumption during Construction

The No Build Alternative would not require any construction; therefore, no changes in energy consumption are expected. During construction of the Build Alternatives, additional energy would be expended beyond what would be used for normal rail operations. This additional energy would be consumed on a short-term basis by construction of improvements required to implement the Project and by construction-related delays to existing rail service in the DC2RVA corridor; however, once the Project is complete and additional improved passenger rail service is provided, long-term energy savings would be realized.

4.9 AESTHETIC AND VISUAL ENVIRONMENT

4.9.1 Effects

This section addresses the visual effects of the proposed Build Alternatives. To assess potential changes to the visual environment, a qualitative visual impact rating system was used that considers those changes from the perspective of viewers from the rail corridor (e.g., train passengers), as well as viewers looking toward the rail corridor.

In accordance with FRA's *Procedures for Considering Environmental Impacts* (FRA, 1999), DRPT identified major changes likely to occur in the natural landscape and in the developed environment as a result of this Project. The assessment considers the visual changes associated with the Build Alternatives, such as track improvements, bridges, grade crossings/separations, roadway improvements, stations and maintenance facilities, and other permanent improvements associated with the Project.

The level of visual impact was assessed by combining the severity of the change in visual quality with the degree to which people are sensitive to the change.

Visual quality considers landscape qualities related to natural and/or man-made features, specifically:

- Natural features, including topography, water courses, rock outcrops, and natural vegetation;
- The positive and negative effects of man-made alterations to the environment and built structures on visual quality; and
- Visual composition, including an assessment of the complexity and vividness of patterns that exist in the landscape.

Visual sensitivity is based on the number and types of users, viewers, or sensitive receptors typically found in the study area. Generally, viewers in parks and residential areas are assumed to be the most sensitive to visual and aesthetic changes, and viewers in industrial areas would be the least sensitive.

For each visual assessment unit, a High, Moderate, or Low Visual Impacts rating was assigned for the No Build Alternative and Build Alternatives. These ratings are described below:

- **Low Visual Impacts:** The alternative is consistent with the existing visual elements in the landscape, such as line, form, texture, and color, and the alternative blends with the existing visual character. Viewers are generally not very sensitive to these changes.
- **Moderate Visual Impacts:** The project is notably visible in the landscape but does not dominate or detract from the existing visual features. Viewers may notice these changes, but the changes are generally not seen as negative.
- **High Visual Impacts:** The project elements are obvious and dominate the landscape detracting from the existing landscape characteristics or scenic qualities. Viewers are sensitive to these changes and may perceive them negatively.

The following sections describe the visual changes associated with the Build Alternatives by the Visual Assessment Units (VAU). The No Build Alternative would not have visual effects associated with the DC2RVA Project. The Build Alternatives were described in detail in Chapter 2. The existing conditions within each VAU were described in Section 3.9. A summary of effects within each VAU by alternative are provided in Table 4.9-1.

4.9.1.1 Arlington: Build Alternatives 1A, 1B, and 1C

VAU 1-1 (CFP 110 to CFP 109.3)—Long Bridge Approach. There are two existing tracks throughout this VAU with up to four tracks in some areas. The addition of one to two tracks on either side of the existing tracks would not result in major visual changes within this VAU. The existing tracks are already part of the landscape. Additionally, changes to the views from the train would be minimal. The visual impact rating is low for Build Alternatives 1A, 1B, and 1C.

4.9.1.2 Northern Virginia: Build Alternative 2A

VAU 2-1 (CFP 109.3 to CFP 100)—Crystal City through Franconia. Within this VAU, the number of tracks is generally three along the main line with up to ten or more in the Norfolk Southern (NS) Yard area south of Alexandria. The addition of one track on one side of the existing tracks, with the side varying, would not result in major changes within this VAU. Additionally, changes to the views from the train would be minimal. The visual impact rating is low for Build Alternative 2A.

VAU 2-2 (CFP 100 to CFP 92)—Franconia through Lorton. The northern half of this VAU consists primarily of three tracks, with another two WMATA tracks located immediately to the west. The southern half transitions down to two tracks. The addition of one track on one side of the existing tracks, with the side varying, would not result in major changes within this VAU. Additionally, changes to the views from the train would be minimal. The visual impact rating is low for Build Alternative 2A.

VAU 2-3 (CFP 92 to CFP 85)—Lorton through Neabsco Creek. There are two tracks through most of this VAU. The Occoquan River Railroad Bridge is the most notable rail visual feature within this VAU. Build Alternative 2A adds one track on one side of the existing tracks, with the side varying. It would also add a bridge on the east side of the existing Occoquan River Railroad Bridge that would generally reflect the horizontal and vertical profiles of the existing bridge to minimize the visual impacts. The views from the train would only differ slightly. The visual impact rating is moderate for Build Alternative 2A.

VAU 2-4 (CFP 85 to CFP 62)—Neabsco Creek through north of Fredericksburg. The rail corridor includes two tracks throughout most of this VAU. Notable rail features are the numerous bridges in this section, including Neabsco Creek, Powells Creek, Quantico Creek, and Aquia Creek. Build Alternative 2A adds one track on one side of the existing tracks, with the side varying. It would also add bridges at each creek crossing except Quantico Creek, where two bridges currently carry three tracks at this location. The new bridges would generally reflect the horizontal and vertical profiles of the existing bridges to minimize the visual impacts. The views from the train would only differ slightly. The visual impact rating is moderate for Build Alternative 2A.

4.9.1.3 Fredericksburg: Build Alternatives 3A, 3B, and 3C

VAU 3-1 (CFP 62 to CFP 48)—through Fredericksburg. This section primarily consists of two tracks, though it broadens out to up to six tracks at the Fredericksburg rail yard on the south side of Fredericksburg. The most notable visible feature of the railroad is the Rappahannock River Bridge and station platforms. There would be a new raised station platform, parking deck, and station building for all Build Alternatives. These facilities would generally reflect the horizontal and vertical profiles of the existing facilities to minimize the visual impacts. Build Alternative 3A has a low visual impact rating because it does not add any track. Build Alternative 3B has a high visual impact rating because it adds one additional track to the east and an additional bridge over the Rappahannock River. The new bridge would be constructed with one additional track and include width for two tracks. Additionally, the new bridge would generally reflect the horizontal and vertical profiles of the existing bridge to minimize the visual impacts. Build Alternative 3B also includes a new grade separation at Landsdowne Road. The Fredericksburg Bypass (Build Alternative 3C) is not within this VAU but is listed in VAU 3-2.

VAU 3-2 (CFP 62 to CFP 48)—Fredericksburg Bypass. This VAU shares common areas on the north end and south end with VAU 3-1. Near CFP 61, it turns east and follows the existing single-rail track Dahlgren Spur. The Fredericksburg Bypass (Build Alternative 3C) would cross the Rappahannock River on new alignment and is on new alignment until reconnecting with the existing tracks near CFP 52. Much of the Fredericksburg Bypass (Build Alternative 3C) is on new alignment, except where following the Dahlgren Spur rail feature and where it ties into the CSXT main line at the north and south ends. Most passenger trains would still use the alignment through Fredericksburg, so views from the train would not be greatly altered. Only certain intercity passenger trains not serving Fredericksburg would use the bypass. The new bridge over the Rappahannock River would generally reflect the horizontal and vertical profiles of the existing upstream railroad bridge in downtown Fredericksburg to minimize the visual impacts. Given the new bridge over the Rappahannock River and the two tracks on new alignment, Build Alternative 3C has a high visual impact rating in this VAU. Four new highway-rail grade separations are also included along the new alignment section of Fredericksburg Bypass (Build Alternative 3C). The Build Alternatives that pass through town (Build Alternatives 3A and 3B) are not within this VAU but are listed in VAU 3-1.

4.9.1.4 Central Virginia: Build Alternative 4A

VAU 4-1 (CFP 48 to CFP 19)—South of Fredericksburg through Doswell. There are primarily two tracks within this VAU. The new bridges over the Mattaponi River and North Anna River would generally reflect the horizontal and vertical profiles of the existing bridges to minimize the visual impacts and are in areas where the number of viewers of the bridge structures are low. The addition of one track on one side of the existing tracks, with the side varying, and the new bridges would not result in major changes within this VAU. No new highway-rail grade separations are included with Build Alternative 4A. Additionally, changes to the views from the train would be minimal. The visual impact rating is low for Build Alternative 4A.

4.9.1.5 Ashland: Build Alternatives 5A, 5A–Ashcake, 5B, 5B–Ashcake, 5C, 5C–Ashcake, and 5D–Ashcake

VAU 5-1 (CFP 19 to CFP 9)—through Ashland. There are primarily two existing tracks throughout this VAU. The tracks are in the middle of the main downtown area in Ashland along Railroad Avenue (also called Center Street) and are a dominant feature of the landscape with the town buildings and roadways developed around the tracks. The Build Alternatives that pass through town (Build Alternatives 5A, 5A–Ashcake, 5B, 5B–Ashcake, and 5D–Ashcake) would include new grade separations at Ashcake Road and Vaughan Road; however, these grade separations would be located outside of downtown Ashland. Build Alternative 5A would not add track, but it would have a visual change to the landscape due to the grade separations and would therefore have a moderate visual impact rating. Similarly, Build Alternative 5A–Ashcake would include the visual intrusion of a new station south of Ashcake Road but would still have a moderate visual impact rating. Build Alternatives 5B and 5B–Ashcake would add a single track adjacent to the existing tracks in a sensitive visual area through town and would have moderate visual impact. The visual impact of Build Alternative 5B–Ashcake would be slightly greater than Build Alternative 5B due to the station relocation at Ashcake but would still have a moderate visual impact rating. Similar to

Build Alternative 5B–Ashcake, Build Alternative 5D–Ashcake would add a third track through downtown Ashland, which is a sensitive visual area. The impacts would be slightly less than Build Alternative 5B–Ashcake as the existing two tracks and the added third track would be centered through town; however, there would be the visual intrusion of a new station at Ashcake Road resulting in a moderate visual impact rating. The Ashland Bypass (Build Alternatives 5C and 5C–Ashcake) are not within this VAU but are listed in VAU 5-2.

VAU 5-2 (CFP 19 to CFP 9)—Ashland Bypass. This VAU shares a northern terminus and southern terminus with VAU 5-1. The remainder of the section is on new alignment, where there are no existing rail features. The Ashland Bypass (Build Alternatives 5C and 5C–Ashcake) would add two tracks on a new alignment in this VAU. This would be a major change in the visual landscape, and the six proposed highway-rail grade separations would be highly visible. Build Alternative 5C–Ashcake would also have the visual intrusion of a new station facility south of Ashcake Road. There are no sensitive resources, but several residences would experience major changes in their viewshed with Build Alternatives 5C and 5C–Ashcake, resulting in a high visual impact. Views from the long distance trains would be altered by no longer traveling through the Town of Ashland. The Build Alternatives that pass through town (Build Alternatives 5A, 5A–Ashcake, 5B, 5B–Ashcake, and 5D–Ashcake) are not within this VAU but are listed in VAU 5-1.

4.9.1.6 Richmond: Build Alternatives 6A, 6B–A-Line, 6B–S-Line, 6C, 6D, 6E, 6F, and 6G

VAU 6-1 (CFP 9 to CFP 2)—South of Ashland through ACCA Yard. This VAU has two existing tracks on the north end with an increasing number of tracks approaching the Acca Yard. A new highway-rail grade separation at Hungary Road, located in a primarily suburban residential setting, would be included with all the Richmond Build Alternatives (Build Alternatives 6A through 6G) in this VAU. Some visual changes to views from the train would also occur. Staples Mill Station is located within this VAU. Build Alternatives 6A, 6E, 6F, and 6G would include a new two story station at Staples Mill and a new pedestrian bridge across the tracks to access the platforms. These alternatives would have a moderate visual impact rating based on these visual changes associated with the station. Build Alternatives 6B–A-Line, 6B–S-Line, 6C, and 6D would close the existing Staples Mill Station. These alternatives would have a low visual impact rating within this VAU because the visual changes to and from the train are minimal.

VAU 6-2 (CFP 2 to SRN 0)—Acca Yard through Main Street along the S-Line. This approximately 4-mile long VAU begins in the Acca Yard area with a large expanse of tracks. It tapers down to two existing tracks at the southern terminus near Main Street Station in downtown Richmond. The historic rail viaduct is an integral part of the scenic views. There are several notable rail visual features in the section, including Main Street Station and the Triple Crossing. New highway-rail grade separations would be included at Hermitage Road under Build Alternative 6B–S-Line and at Hospital Street/North 7th Street under Build Alternatives 6B–S-Line, 6D, 6F, and 6G. Three of the DC2RVA intercity passenger rail route and station alternatives utilize the CSXT S-Line (Build Alternatives 6D, 6F, and 6G) and would involve the restoration of intercity passenger service on the west side of Main Street Station, and require the construction of one to two multistory parking garages within the viewshed of the main station building and also require alterations to historic platforms, thus diminishing the integrity of design, setting, materials, workmanship, feeling, and association. Build Alternative 6B–S-Line would also utilize the CSXT S-Line adjacent to Main Street Station but would bypass the station and result in a disuse of the station for intercity passenger rail purposes. Build Alternative 6E would maintain and slightly expand intercity passenger rail service at Main Street Station with the expansion of and alteration to the historic platforms. The single-station alternatives at Boulevard (Build Alternatives 6B–A-Line and 6B–S-Line) would also include a new station building and pedestrian overpass at Boulevard Station. The single-station alternative at Broad Street (Build Alternative 6C) would include a new station building and pedestrian overpass at Broad Street Station. Four single-station alternatives (Build Alternatives 6A, 6B–A-Line, 6B–S-Line, and 6C) would close Main Street Station to passenger rail service, but there would be no major visual changes to the station building itself. Each of the Richmond Build Alternatives (6A through 6G) would have an impact within this VAU. Some visual changes to views from the train would occur. Build Alternative 6A would have a moderate visual impact rating within this VAU. Build Alternatives 6B–A-Line, 6B–S-Line, 6C, 6D, 6E, 6F, and 6G would have a high visual impact rating within this VAU because there is extensive trackwork coupled with sensitive resources.

VAU 6-3 (SRN 0 to A 11)—Main Street through Centralia via the S-Line. Build Alternatives that route intercity passenger trains via the S-Line between Main Street Station and Centralia operate through this VAU, each of which consists of adding a single track to the existing James River crossing. Most of the section south of the James River consists of two tracks with some limited areas widening out to as many as eight tracks. A new highway-rail grade separation would be included with Build Alternatives 6B–S-Line, 6D, 6F, and 6G. The most notable rail visual feature is the James River crossing. Some visual changes to views from the train would occur. The new bridge on the James River S-line would generally reflect the horizontal and vertical profiles of the existing bridge to minimize the visual impacts. Build Alternatives 6B–S-Line, 6D, 6F, and 6G would have a high visual impact rating due to the additional bridge across the James River.

VAU 6-4 (CFP 2 to A 11)—Acca Yard through Centralia via the A-Line. The Build Alternatives that route intercity passenger trains via the A-Line between Acca Yard and Centralia (Build Alternatives 6A, 6B–A-Line, 6C, and 6E) operate through this VAU, which primarily consists of two existing tracks. New highway-rail grade separations would be included at Broad Rock Boulevard and Walmsley Boulevard under Build Alternatives 6A, 6B–A-Line, 6C, and 6E. The most notable feature in this VAU is the scenic railroad bridge over the James River on the A-line. This bridge is visible from many nearby parks and residential areas, as well as from the river itself, which is highly used for recreational purposes; no change is proposed to the existing bridge. Some visual changes to views from the train would occur. All Build Alternatives would have a low visual impact rating because minimal track work and no additional bridge across the James River are proposed in this VAU.

VAU 6-5 (SRN 0 to CA 87)—Main Street Station through Hospital Wye. There is a single track within this VAU. There are no notable rail visual features. The Build Alternatives do not involve any track work within this VAU. There would be no effect on views to or from the railroad. All Build Alternatives have a low visual impact rating within this VAU.

VAU 6-6 (SRN 0 to CA 80)—Main Street Station through Fulton Yard/Eastern Henrico County. This VAU includes two existing tracks where it parallels the James River, expanding to more than ten tracks to the east of Richmond. The most notable rail feature is the raised rail bridge that is parallel to the James River. The Build Alternatives do not involve any track work within this VAU. There would be no effect on views to or from the railroad. All Build Alternatives have a low visual impact rating within this VAU.

The High, Moderate, or Low Visual ratings for each VAU and each Build Alternative are provided in Table 4.9-1.

Table 4.9-1: Visual Impact Rating by Visual Assessment Unit

Alternative Area	Alternative	Visual Assessment Unit (VAU)															
		1-1	2-1	2-2	2-3	2-4	3-1	3-2	4-1	5-1	5-2	6-1	6-2	6-3	6-4	6-5	6-6
Area 1: Arlington (Long Bridge Approach)	1A	L	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	1B	L	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	1C	L	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Area 2: Northern Virginia (Long Bridge to Dahlgren Spur)	2A	–	L	L	M	M	–	–	–	–	–	–	–	–	–	–	–
Area 3: Fredericksburg (Dahlgren Spur to Crossroads)	3A	–	–	–	–	–	L	–	–	–	–	–	–	–	–	–	–
	3B	–	–	–	–	–	H	–	–	–	–	–	–	–	–	–	–
	3C	–	–	–	–	–	–	H	–	–	–	–	–	–	–	–	–
Area 4: Central Virginia (Crossroads to Doswell)	4A	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Area 5: Ashland (Doswell to I-295)	5A	–	–	–	–	–	–	–	–	M	–	–	–	–	–	–	–
	5A–Ashcake	–	–	–	–	–	–	–	–	M	–	–	–	–	–	–	–
	5B	–	–	–	–	–	–	–	–	M	–	–	–	–	–	–	–
	5B–Ashcake	–	–	–	–	–	–	–	–	M	–	–	–	–	–	–	–
	5C	–	–	–	–	–	–	–	–	–	H	–	–	–	–	–	–
	5C–Ashcake	–	–	–	–	–	–	–	–	–	H	–	–	–	–	–	–
	5D–Ashcake	–	–	–	–	–	–	–	–	M	–	–	–	–	–	–	–
Area 6: Richmond (I-295 to Centralia)	6A	–	–	–	–	–	–	–	–	–	–	M	M	L	L	L	L
	6B–A-Line	–	–	–	–	–	–	–	–	–	–	L	H	L	L	L	L
	6B–S-Line	–	–	–	–	–	–	–	–	–	–	L	H	H	L	L	L
	6C	–	–	–	–	–	–	–	–	–	–	L	H	L	L	L	L
	6D	–	–	–	–	–	–	–	–	–	–	L	H	H	L	L	L
	6E	–	–	–	–	–	–	–	–	–	–	M	H	L	L	L	L
	6F	–	–	–	–	–	–	–	–	–	–	M	H	H	L	L	L
	6G	–	–	–	–	–	–	–	–	–	–	M	H	H	L	L	L

L = Low Visual Impact; M = Moderate Visual Impact; H = High Visual Impact

4.9.2 Mitigation Evaluation

DRPT will work with affected communities during the final design process to obtain public review and comment on the nature and style of design for new physical structures, such as major waterway crossings, highway-rail grade separations, and station improvements. DRPT anticipates that new bridges and buildings would generally reflect the horizontal and vertical profiles of existing bridges and building in their environs to minimize the visual impact.

Constructing tracks adjacent to the existing tracks would also minimize visual impacts and would occur for the Build Alternatives through most of the DC2RVA corridor, except for the Fredericksburg Bypass (Build Alternative 3C) and Ashland Bypass (Build Alternatives 5C and 5C–Ashcake). These Build Alternatives would construct a railroad with highway-rail grade separations along new alignment. With these strategies, DRPT has determined that most of the Build Alternatives have low to moderate visual impact ratings.

Other visual impact mitigation strategies that DRPT will consider during the final design process include:

- Incorporating landscaping to screen undesirable features
- Using other screening techniques for undesirable features
- Adding architectural design features in character with existing visual environs
- Minimizing tree and shrub removal
- Enhancing or creating visually pleasing designs

4.10 BIOLOGICAL RESOURCES

Under the No Build Alternative, CSXT would continue maintenance and repairs of the existing infrastructure, and infrastructure improvements that are already planned for the DC2RVA corridor, as defined in Section 2.5.1.1, would move forward. Anticipated effects of the No Build Alternative are discussed below in comparison with the Build Alternatives. All practicable measures would be taken to avoid and minimize impacts; however, due to the length and linear nature of the DC2RVA Project, impacts to habitats would be unavoidable. For this EIS, estimated impacts to habitats and natural communities are calculated using a conservative assumption and are categorized as permanent or temporary.

4.10.1 Habitat and Natural Communities

Construction of any of the Build Alternatives would result in effects to the general ecology of its surroundings. The Build Alternatives would affect terrestrial natural communities and associated wildlife habitat through conversion of existing land coverage to railroad structures and maintained right-of-way. Depending on the combination of Build Alternatives, between 31 and 264 acres of habitat are estimated to be permanently converted by the proposed improvements within and outside of the existing railroad right-of-way. This conversion would result in the loss of wildlife habitat. Permanent (converted to use by the railroad) and temporary (able to renaturalize after construction completion) impacts to general habitat types within the LOD of each Build Alternative are summarized in Table 4.10-1. Most of the area affected by the Build Alternatives, aside from the bypasses, is already developed. Habitats that would be affected are directly adjacent to the existing rail line and are already altered by local activities, including operation of the railroad, with the exception of the bypass alternatives (i.e., Build Alternatives 3B and 5C). Disturbance or loss of these upland habitats adjacent to the existing railroad would not result in substantial impacts to wildlife due to their location and widespread availability of such habitats within the study area and the region.

Table 4.10-1: Habitat Impacts (acres)

Alternative Area	Alternative	Agriculture (pasture/row crop/ grassland)	Aqueous Habitat (wetlands/streams/ open water)	Upland Forest	Crosses Internal Forest Habitat*	Shrub Area/Old Field	Riparian/Bottomland Forest/PFO	Urban/Developed Lands	Total
Area 1: Arlington (Long Bridge Approach)	1A	–	–	–	No	–	–	P: — T: 0.6	P: — T: 0.6
	1B	–	–	–	No	–	–	P: 1.5 T: 0.9	P: 1.5 T: 0.9
	1C	–	–	–	No	–	–	P: 0.4 T: 0.7	P: 0.4 T: 0.7
Area 2: Northern Virginia (Long Bridge to Dahlgren Spur)	2A	P: 2.1 T: 1.6	P: 1.1 T: 2.0	P: 15.0 T: 7.2	No	P: 0.2 T: 0.1	P: 1.3 T: 0.9	P: 13.2 T: 11.8	P: 32.9 T: 23.6
Area 3: Fredericksburg (Dahlgren Spur to Crossroads)	3A	P: 0.1 T: 1.1	P: 0.1 T: 0.4	P: 0.4 T: 3.2	No	–	P: 0.1 T: 1.4	P: 1.5 T: 3.4	P: 2.2 T: 9.5
	3B	P: 2.3 T: 1.4	P: 1.9 T: 0.9	P: 2.1 T: 3.5	No	–	P: 0.1 T: 1.4	P: 13.4 T: 5.2	P: 19.8 T: 12.4
	3C	P: 32.7 T: 8.2	P: 8.5 T: 3.1	P: 66.9 T:17.4	Yes	–	P: 13.2 T: 4.0	P: 19.3 T: 5.4	P: 140.6 T: 38.1
Area 4: Central Virginia (Crossroads to Doswell)	4A	P: 0.9 T: 7.4	P: 0.3 T: 5.1	P: 0.5 T:10.1	No	P: 0.1 T: 1.0	P: 0.1 T: 9.4	P: 0.7 T: 7.6	P: 2.6 T: 40.6
Area 5: Ashland (Doswell to I-295)	5A	P: 1.2 T: 0.5	P: — T: 0.2	P: 2.4 T: 4.7	No	P: — T: 0.2	P: 0.2 T: 0.6	P: 18.1 T: 6.7	P: 21.9 T: 12.9
	5A–Ashcake	P: 1.2 T: 0.5	P: — T: 0.2	P: 2.4 T: 4.7	No	P: — T: 0.2	P: 0.2 T: 0.6	P: 16.4 T: 6.7	P: 20.2 T: 12.9
	5B	P: 1.2 T: 0.5	P: — T: 0.2	P: 2.4 T: 4.7	No	P: — T: 0.2	P: 0.6 T: 0.9	P: 25.6 T: 7.6	P: 29.4 T: 14.1
	5B–Ashcake	P: 1.2 T: 0.5	P: — T: 0.2	P: 2.4 T: 4.8	No	P: — T: 0.2	P: 0.6 T: 0.9	P: 25.9 T: 8.7	P: 29.7 T: 15.3
	5C	P: 29.3 T: 5.7	P: 2.3 T: 0.3	P: 64.0 T:20.7	Yes	P:11.0 T: 2.4	P: 4.7 T: 0.9	P: 36.5 T: 8.9	P: 147.8 T: 38.9
	5C–Ashcake	P: 29.3 T: 5.7	P: 2.3 T: 0.3	P: 64.0 T:20.7	Yes	P:11.0 T: 2.4	P: 4.7 T: 0.9	P: 34.8 T: 8.9	P: 146.1 T: 38.9
	5D–Ashcake	P: 1.2 T: 0.5	P: — T: 0.2	P: 2.0 T: 4.9	No	P: — T: 0.2	P: 0.2 T: 0.9	P: 32.3 T: 9.1	P: 36.1 T: 15.8

▶ *Continued (see end of table for detailed notes.)*

Table 4.10-1: Habitat Impacts (acres)

Alternative Area	Alternative	Agriculture (pasture/row crop/ grassland)	Aqueous Habitat (wetlands/streams/ open water)	Upland Forest	Crosses Internal Forest Habitat*	Shrub Area/Old Field	Riparian/Bottomland Forest/PFO	Urban/Developed Lands	Total
Area 6: Richmond (I-295 to Centralia)	6A	–	–	P: 3.7 T: 2.7	No	–	P: 1.5 T: 0.7	P: 70.8 T: 35.5	P: 76.0 T: 38.9
	6B–A-Line	–	–	P: 3.9 T: 2.8	No	–	P: 1.5 T: 0.7	P: 95.6 T: 48.3	P: 101.0 T: 51.8
	6B–S-Line	–	P: 0.7 T: 0.7	P: 6.5 T: 3.3	No	–	P: 2.5 T: 0.6	P: 68.9 T: 17.6	P: 78.6 T: 22.2
	6C	–	–	P: 4.4 T: 2.8	No	–	P: 1.5 T: 0.7	P: 122.1 T: 48.6	P: 128.0 T: 52.1
	6D	–	P: 0.7 T: 0.7	P: 6.5 T: 3.3	No	–	P: 2.5 T: 0.6	P: 63.9 T: 17.7	P: 73.6 T: 22.3
	6E	–	–	P: 6.4 T: 3.5	No	–	P: 2.2 T: 0.8	P: 80.5 T: 57.1	P: 89.1 T: 61.4
	6F	–	P: 0.6 T: 0.7	P: 6.7 T: 3.3	No	–	P: 2.5 T: 0.6	P: 73.1 T: 18.3	P: 82.9 T: 22.9
	6G	–	P: 0.6 T: 0.7	P: 6.3 T: 3.3	No	–	P: 2.5 T: 0.6	P: 71.5 T: 17.6	P: 80.9 T: 22.2

P = Permanent Impact, T=Temporary Impact.
*Areas of internal forest that are a minimum of 300 feet from the edge of the forested area.

Due to the new area crossed by the Build Alternatives that includes new bypasses, more habitat not already affected by human activities would be affected. A greater amount of all habitat types would be permanently converted, and larger areas of intact forested habitat would be bisected, removing a large portion of interior forest and fragmenting habitat. Interior forest habitats are located 300 feet or farther from the forest edge and are commonly composed of mature trees. These areas are important to forest interior dwelling species (FIDS), especially Neotropical migrant songbirds that utilize these habitats for foraging, breeding, and nesting. FIDS can also include certain mammals, especially certain species of bats, reptiles, and amphibians that prefer unbroken forested tracts.

The Fredericksburg Bypass (Build Alternative 3C) crosses an area of 1,200+ acres of continuous forest southwest of the Rappahannock. This area includes Virginia Outdoors Fund Easements and the Alexander Berger Memorial Sanctuary, discussed in Section 4.10.1.1. This area also includes at least 750 acres of interior habitat defined as 'high' by the VDCR Ecological Core model that is connected to a very large area of 'outstanding' habitat associated with Fort A. P. Hill. The Virginia Outdoors Fund Easements and the Alexander Berger Memorial Sanctuary, including the majority of the forest mentioned above, would be cut off from the Fort A. P. Hill habitat by the construction of the Fredericksburg Bypass (Build Alternative 3C), and a large portion of the interior habitat would be lost and/or degraded due to the introduction of the railroad through the habitat.

The Ashland Bypass (Build Alternatives 5C and 5C–Ashcake) cross several smaller wildlife corridors associated with waterways, and three larger tracts of forested habitats (approximately 140, 380, and 180 acres) with interior habitat that would be bisected by the proposed alignment resulting in a decrease of interior habitat.

Station upgrades would occur in urban areas. Although the LODs are wider in these locations, only small additional amounts of urban tree canopy would be affected.

4.10.1.1 Conservation Areas

DRPT have made efforts, to the extent practicable, to avoid impacts to existing conservation areas (federal and state) and priority conservation areas (areas of habitat designated as worthy of conservation). Aside from temporary impacts to Mattaponi Wildlife Management Area, the alternatives avoid existing conservation areas. Due to the linear nature of the Project and the location of the existing tracks through rural areas, some of the habitat areas adjacent to the DC2RVA corridor have been determined worthy of conservation for a variety of qualities. Unavoidable impacts to these areas are outlined below (Table 4.10-2). As previously mentioned, impacts listed are the total area of predicted temporary and permanent impacts within the proposed LOD, unless otherwise noted. A more detailed discussion of conservation area impacts can be found in the *Natural Resources Technical Report* (Appendix M).

State Wildlife Lands

DRPT anticipates that Build Alternatives 4A would result in unavoidable temporary impacts to Mattaponi State Wildlife Management Area. Approximately 2.54 acres adjacent to existing railroad right-of-way would be disturbed for construction and then replanted and encouraged to renaturalize. Coordination with the Virginia Department of Game and Inland Fisheries (VDGIF) would be necessary.

County Wildlife Lands

DRPT anticipates that Build Alternative 2A would result in approximately 0.55 acre of temporary impacts to Pohick Seeps Conservation Area. The site is located on parcels owned by Fairfax County that have a Permanent Wildlife Conservation Easement. Depending on the type of impacts proposed, temporary impacts could potentially be considered permanent for the rare habitat located there. Proposed work in this area will require coordination with Fairfax County.

Private Wildlife Lands

Two parcels containing open-space easements managed by the Virginia Outdoors Foundation (VOF) are crossed by the Fredericksburg Bypass (Build Alternative 3C). DRPT anticipates that VOF conservation area CLN-VOF-3804 would have 1.22 acres of permanent impacts and 0.32 acre of temporary impacts, and area CLN-VOF-03850 would have 21.09 acres of permanent impact and 5.37 acres of temporary impact. The Fredericksburg Bypass (Build Alternative 3C) would bisect intact interior forested habitat in these locations. Coordination with VOF may be necessary.

Table 4.10-2: Conservation Area Impacts (acres)

Alternative Area	Alternative	USFWS National Wildlife Refuges	State Wildlife Lands	County Wildlife Lands	Private Wildlife Lands	Priority Conservation Areas
Area 1: Arlington (Long Bridge Approach)	1A	–	n/a	n/a	n/a	n/a
	1B	–	n/a	n/a	n/a	n/a
	1C	–	n/a	n/a	n/a	n/a
Area 2: Northern Virginia (Long Bridge to Dahlgren Spur)	2A	–	–	P: —— T: 0.55	n/a	P: 0.01 T: 0.78
Area 3: Fredericksburg (Dahlgren Spur to Crossroads)	3A	n/a	n/a	n/a	–	P: 0.03 T: 1.52
	3B	n/a	n/a	n/a	–	P: 0.10 T: 1.61
	3C	n/a	n/a	n/a	P: 22.31 T: 5.69	P: 83.36 T: 18.63
Area 4: Central Virginia (Crossroads to Doswell)	4A	n/a	P: —— T: 2.54	n/a	n/a	P: —— T: 2.48
Area 5: Ashland (Doswell to I-295)	5A	n/a	n/a	n/a	n/a	P: 0.59 T: 0.01
	5A–Ashcake	n/a	n/a	n/a	n/a	P: 0.59 T: 0.01
	5B	n/a	n/a	n/a	n/a	P: 0.59 T: 0.01
	5B–Ashcake	n/a	n/a	n/a	n/a	P: 0.59 T: 0.01
	5C	n/a	n/a	n/a	n/a	P: 4.80 T: 21.13
	5C–Ashcake	n/a	n/a	n/a	n/a	P: 4.80 T: 21.13
	5D–Ashcake	n/a	n/a	n/a	n/a	P: 0.59 T: 0.01
Area 6: Richmond (I-295 to Centralia)	6A	n/a	n/a	n/a	n/a	P: 0.15 T: 0.05
	6B–A-Line	n/a	n/a	n/a	n/a	P: 0.15 T: 0.05
	6B–S-Line	n/a	n/a	n/a	n/a	P: 0.15 T: 0.05
	6C	n/a	n/a	n/a	n/a	P: 0.15 T: 0.05
	6D	n/a	n/a	n/a	n/a	P: 0.15 T: 0.05
	6E	n/a	n/a	n/a	n/a	P: 0.15 T: 0.05
	6F	n/a	n/a	n/a	n/a	P: 0.15 T: 0.05
	6G	n/a	n/a	n/a	n/a	P: 0.15 T: 0.05

Source: VDOT-CEDAR, 2015.

P = Permanent Impact, T=Temporary Impact, n/a = no resources located in that Area

Priority Conservation Areas including Wildlife Corridors

Details about unavoidable impacts to Priority Conservation Areas are described in the *Natural Resources Technical Report* (Appendix M). These areas are recommended for preservation. Temporary impacts may be permanent depending on the type of impact and the potential to disrupt sensitive resources that may not have the ability to recover (e.g., clearing and grubbing of an area with a rare plant community).

Aside from the proposed Fredericksburg Bypass (Build Alternative 3C), which bisects a large forested area and wildlife corridor, all impacts to wildlife corridors would result from widening the existing railroad. In some of these areas, wildlife are able to use areas under bridges that span waterways and dry culverts. Larger animals may be able to successfully cross existing tracks if no fencing or other additional barriers exist; however, an increased track area and increased train traffic would result in a decreased ability for wildlife to cross and increased mortality rates. Figure 3.10-2 in Chapter 3 identifies the existing wildlife corridors. Overall, DRPT does not anticipate a substantial amount of wildlife crossing.

4.10.1.2 Invasive Species

The Build Alternatives could increase the spread of invasive species. Construction equipment used could carry seeds or propagative plant parts from other construction projects or infested areas. Removal of sediment and soil to offsite locations could spread invasive species, and placement of fill from borrow sites could introduce invasive species to the study area. Exposed soil also allows invasive species to spread, which could contribute to encroachment of invasive species on vegetation communities adjacent to the LOD.

In accordance with EO 13112, Invasive Species, the potential for the establishment of invasive plant species during construction of any Build Alternative would be minimized by prompt seeding of disturbed areas with seeds that are tested in accordance with the Virginia Seed Law to ensure that seed mixes are free of noxious species. To prevent the introduction of new invasive species and to prevent the spread of existing populations, BMPs would also be followed and could include washing machinery before it enters the area, minimizing ground disturbance, and reseeding disturbed areas. While the LOD is vulnerable to colonization by invasive plant species from adjacent properties, implementation of the stated provisions would reduce the potential for the establishment and proliferation of invasive species.

4.10.1.3 Submerged Aquatic Vegetation

Due to the need to expand existing bridge crossings of major waterways where submerged aquatic vegetation (SAV) exists, the proposed Project would have unavoidable impacts on these plant species. Permanent impacts would include areas converted for the use of piers or infrastructure, while temporary impacts would include disturbed areas with the ability to support SAV again after construction completion. Impacts to SAV are only anticipated to occur with Build Alternative 2A. No SAV beds occur in the DC2RVA corridor south of Aquia Creek, and proposed improvements included with Build Alternatives 1A, 1B, and 1C would not require work in waters containing SAV. Estimated acres of impacts to SAV are presented in Table 4.10-3 (Figure 4.10-1). A request to remove SAV from or plant SAV on state-administered benthic surfaces would be submitted with a JPA to VMRC. In determining whether to grant approval for SAV removal or planting, VMRC shall be guided by §28.2-1205 of the Code of Virginia and the SAV Transplantation Guidelines, or any new and improved methodologies as approved by VMRC (VMRC, 2000).

Table 4.10-3: Submerged Aquatic Vegetation Impacts (acres)

Alternative Area	Alternative	Existing	Historic	Total
Area 1: Arlington (Long Bridge Approach)	1A	P: —— T: 0.03	–	P: —— T: 0.03
	1B	P: —— T: 0.01	–	P: —— T: 0.01
	1C	–	–	–
Area 2: Northern Virginia (Long Bridge to Dahlgren Spur)	2A	P: 1.33 T: 1.91	P: 0.37 T: 0.35	P: 1.70 T: 2.26

P = Permanent Impact, T=Temporary Impact.

There is no SAV south of Aquia Creek; therefore, there are no impacts listed for the Build Alternatives in Alternative Areas 3, 4, 5, and 6.

4.10.1.4 Avoidance, Minimization, and Mitigation Evaluation

Minimization measures to protect natural habitats and communities could involve modifications to later designs such as:

- Minor alignment shifts to avoid or minimize impacts
- Minimizing clearing and grubbing, in particular in riparian areas
- Development of a mitigation plan that includes landscaping and planting detail for onsite replacement of any trees removed
- Native revegetation, including native shrub plantings and native reseeding of disturbed areas to prevent the spread of invasive species, and additional erosion during storm events due to exposed soil
- Using bridges or open bottom culverts in streams to minimize the disruption of natural stream bottoms

Invasive Species

To avoid the introduction of new invasive species and prevent the spread of existing populations, BMPs should be followed, including washing machinery before it enters the area to prevent the spread of seeds and minimizing ground disturbance. Prompt seeding of disturbed areas with native seeds or seeds that are tested in accordance with the Virginia Seed Law to ensure that seed mixes are free of noxious species will decrease the ability for invasive species to take root and outcompete native species.

Submerged Aquatic Vegetation

Mitigation for areas of temporary disturbance to SAV would be coordinated with VMRC. The following procedures are suggested by the Chesapeake Bay Program (Chesapeake Bay Program, 1995) for the protection of SAV areas:

- Protect existing, historic, and potential SAV areas from physical disruption
- Avoid or minimize dredging within SAV areas
- Avoid nearby construction activities that create additional turbidity
- Avoid reduction in Secchi depths (measure of water clarity) compared to predisturbance levels

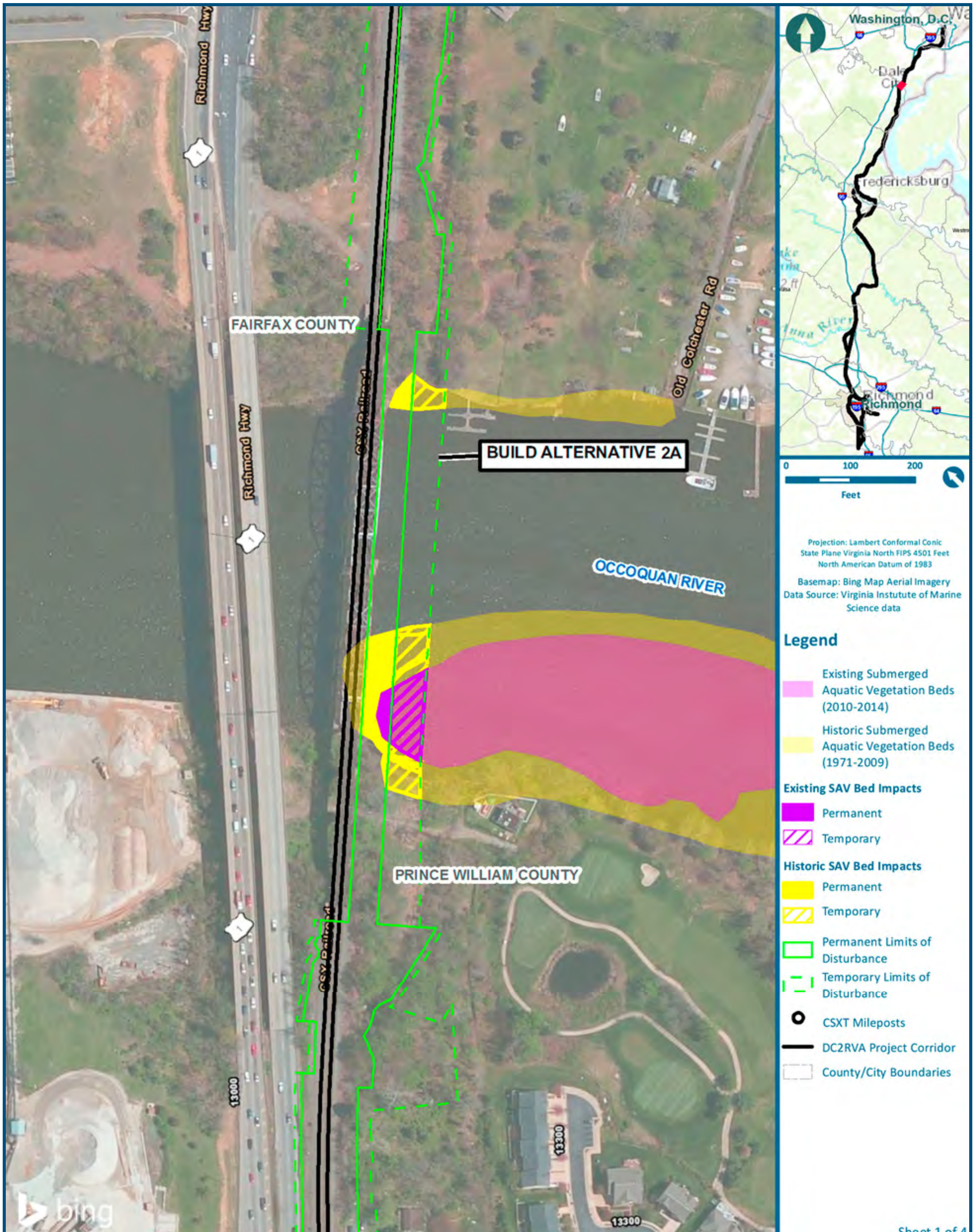


Figure 4.10-1: Submerged Aquatic Vegetation Impacts – Build Alternative 2A

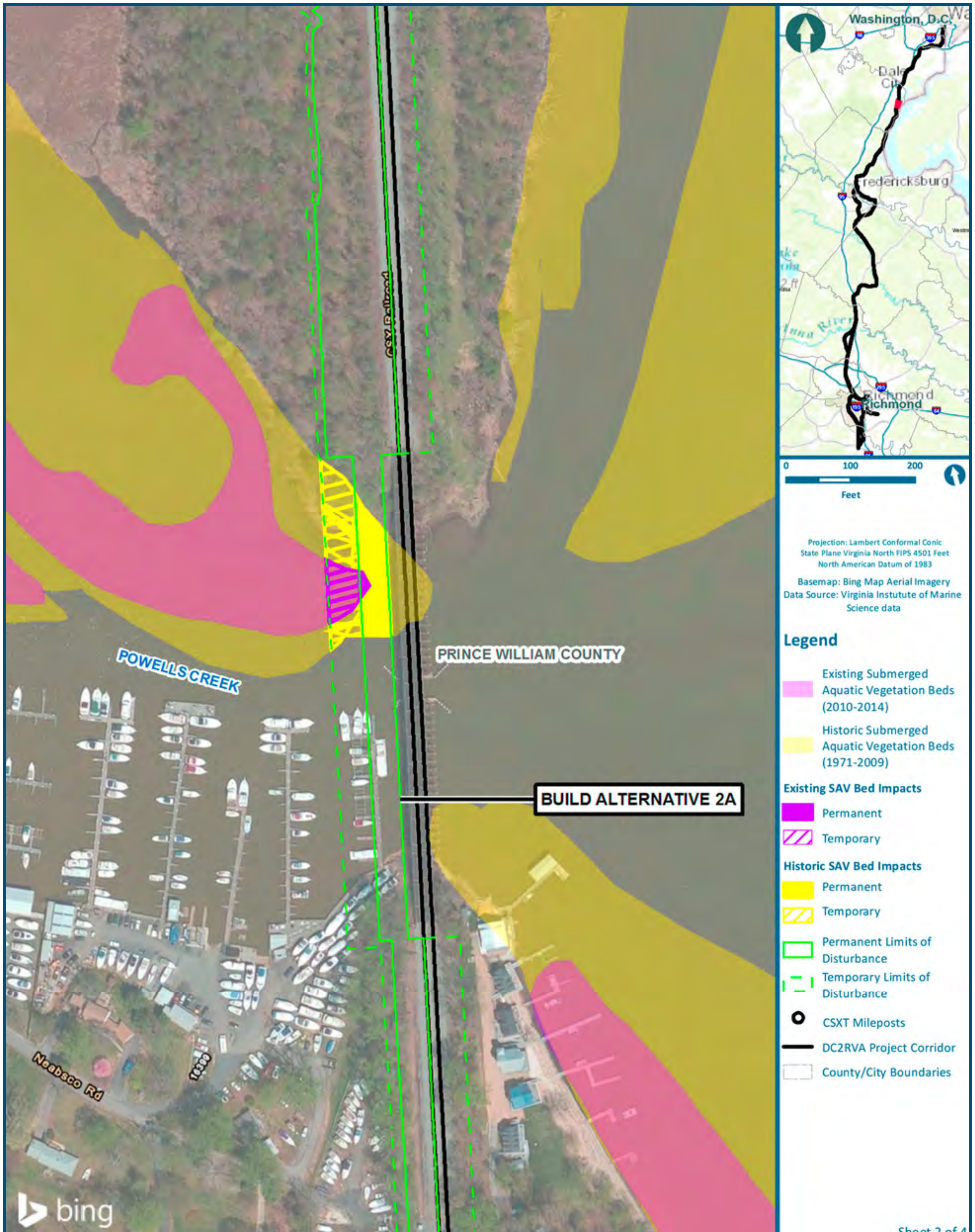


Figure 4.10-1: Submerged Aquatic Vegetation Impacts – Build Alternative 2A

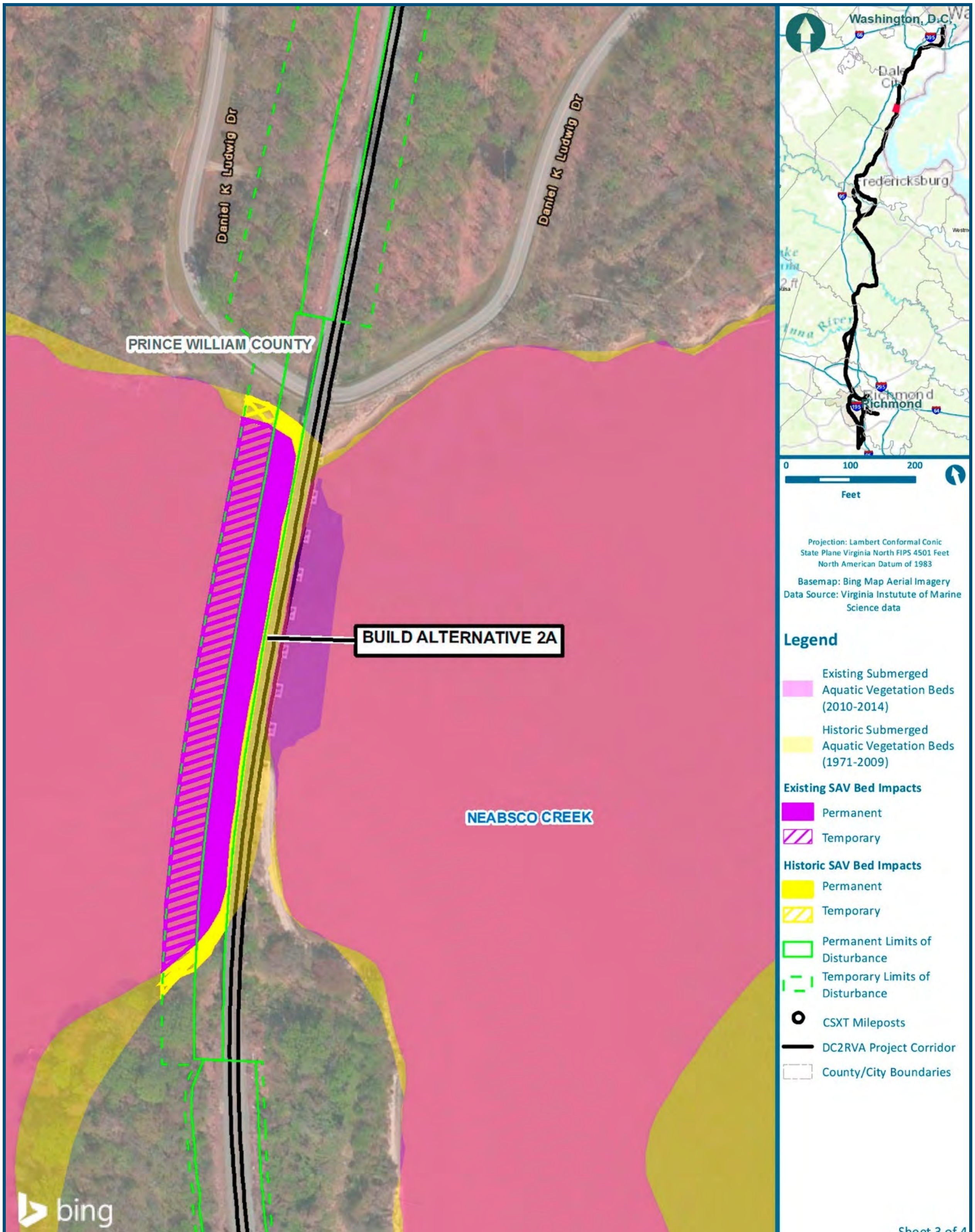


Figure 4.10-1: Submerged Aquatic Vegetation Impacts – Build Alternative 2A

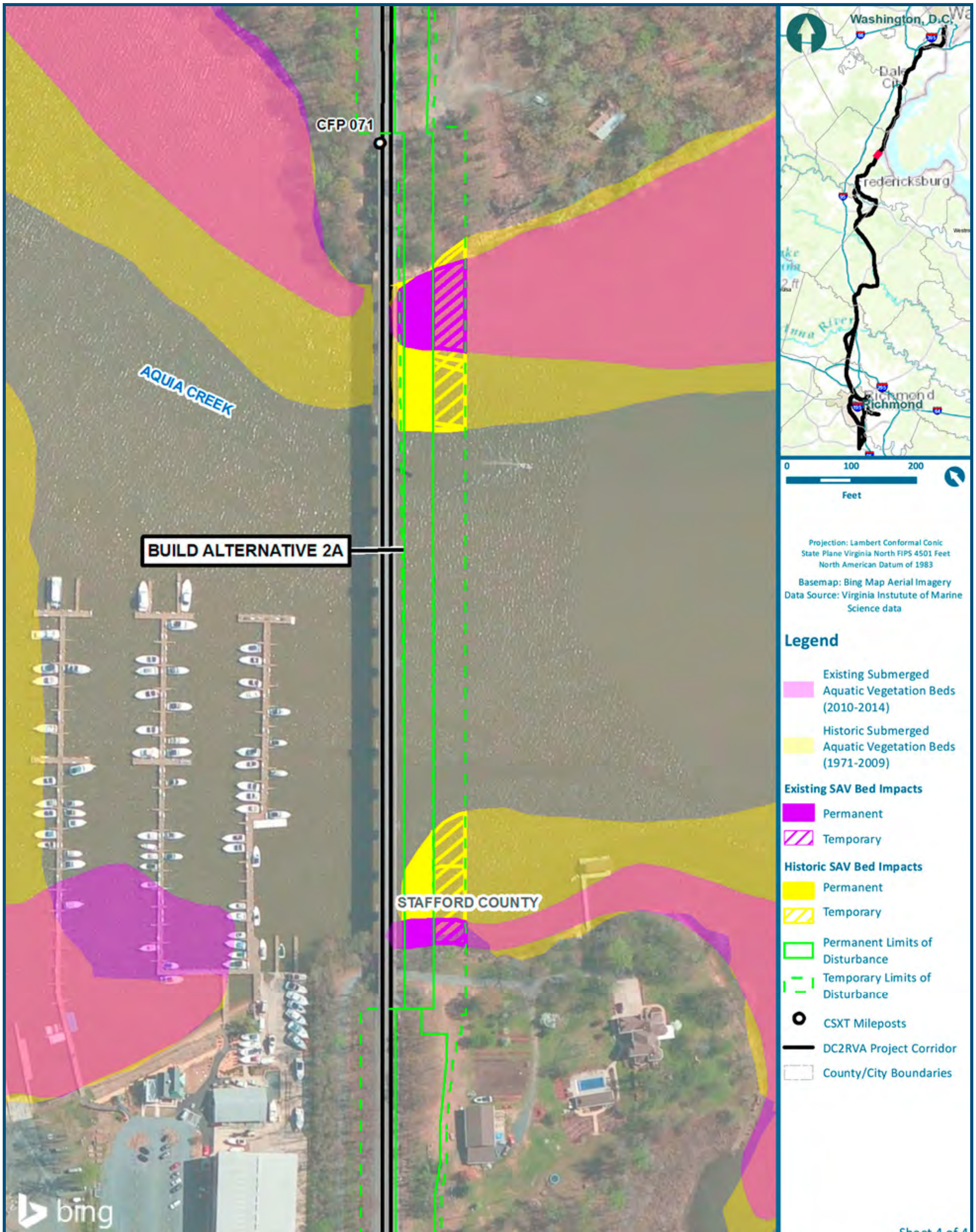


Figure 4.10-1: Submerged Aquatic Vegetation Impacts – Build Alternative 2A

- Establish an undisturbed buffer around SAV beds
- If construction must occur near or in beds, avoid activities during the growing season (April–October for most species)
- Preserve natural shorelines through stabilization with marsh plantings

Further efforts to avoid and/or minimize disturbance and removal of SAV would be made during final design as part of obtaining the VMRC permit. Erosion and sediment control measures would minimize potential impacts to water quality within adjacent SAV areas. Construction within or adjacent to SAV areas would avoid the growing season for representative plant species to the extent practicable. Mitigation for SAV loss would be developed in coordination with VMRC and may include enhancement (increase aerial coverage of SAV beds or improvement in habitat quality) or restoration (return SAV to unvegetated bottom, which historically supported SAV) of SAV beds.

4.10.2 Wildlife

Construction activities associated with the build alternatives, including clearing and grubbing and direct use of adjacent habitat, could result in the disturbance of local wildlife species such as birds, reptiles and amphibians, deer, foxes, squirrels, rabbits, raccoons, groundhogs, and other common mammals associated with these areas. Mobile species, such as adult birds, mammals, and some reptiles, would be displaced during construction. Loss of less mobile animals may result from construction. These species would return and repopulate the area once construction has been completed.

Additional loss of wildlife may occur due to mortality from collisions with trains, increased habitat fragmentation (discussed further in Section 4.10.1, Habitat and Natural Communities), impacts to aqueous habitats due to decreased water quality (discussed further in Section 4.1.3, Water Quality), and habitat loss through the introduction of invasive species (discussed further in Section 4.10.1.2, Invasive Species). As noted in Section 4.10.1, DRPT does not anticipate a substantial amount of wildlife crossing.

4.10.2.1 Colonial Waterbirds

All mapped colonial waterbird colonies are located more than 1 mile from the proposed Project. Due to the distance of the rail corridor from known colonies, DRPT does not anticipate that any activities associated with the build alternatives would have any impact on colonial waterbirds.

4.10.2.2 Migratory Birds

The migratory birds of primary concern in the study area are migratory songbirds, commonly referred to as Neotropical migrants. Short-term adverse impacts from construction noise and disturbance may mask territorial vocalizations of birds and breeding calls, and they may temporarily disturb breeding pairs. Important stopover habitat for migratory songbirds includes forested areas with dense undergrowth that provides cover from predators. Migratory birds could be affected through habitat degradation and loss associated with this Project. Most of the lost habitat associated with this Project, aside from proposed bypasses, would be directly adjacent to the existing rail line and is lower quality edge habitat already impacted by local activities. Nearby conservation areas, such as federal, state, and private wildlife lands, are more likely to provide optimal habitat for these species.

The proposed Fredericksburg Bypass (Build Alternative 3C) and Ashland Bypass (Build Alternatives 5C and 5C–Ashcake) would use larger areas of habitat, each affecting approximately 80 acres of forested areas, and would bisect a large area of interior forested habitat (located 300 feet or farther from the forest edge and commonly composed of mature trees). These areas provide important habitat to many migratory species and protect them from predators that prefer the forest edge. The Fredericksburg Bypass would cut through two VOF easements, a large forested area including wildlife corridors, and may represent important sites for FIDS, which need large, relatively unfragmented tracts of hardwood or mixed hardwood forest to successfully breed and maintain viable populations. FIDS prefer tracts in excess of 100 acres or they require large contiguous linear tracts of hardwood or mixed hardwood forest that are a minimum of 600 feet wide, as many of these species prefer nest sites to be located greater than 300 feet from the forest edge. This diverse group includes Neotropical migrant songbirds such as tanagers, warblers, and vireos that breed in North America and winter in the Caribbean, Central America, and South America, as well as residents and short-distance migrants such as woodpeckers, some raptors, and owls (Jones, *et. al.*, 2001). Songbirds using these areas may be displaced and would disperse to nearby areas with suitable habitat, which may create greater competition.

4.10.2.3 Aquatic and Marine Life

Due to the number and type of water crossings involved, direct disturbance of aquatic communities would be unavoidable. In-stream work and use of wetland areas would result in the elimination of some aqueous habitat and species that would be unable to relocate. Additional impacts to aqueous habitats due to decreased water quality (discussed further in Section 4.1.3, Water Quality) and habitat loss through the introduction of invasive species could occur (discussed further in Section 4.10.1.2, Invasive Species).

Fisheries, Anadromous Fish, and Trout Waters

Cook Lake in Cameron Run Regional Park, the only mapped trout water in the Project vicinity (VDGIF, 2015b), is not located near the LOD and is not expected to be affected. Anticipated impacts to waters containing anadromous fish are dependent on the size of the water body and the type of crossing required. Depending on the combination of build alternatives selected, DRPT estimates there would be between 8,235 and 14,420 linear feet of permanent impacts to anadromous fish waters. Temporary and permanent impacts are detailed in Table 4.10-4.

Table 4.10-4: Confirmed Anadromous Fish Use Waters

Water	Alternative	Confirmed Species	Anticipated Impacts (Linear Feet)
Four Mile Run	2A	Striped Bass, Yellow Perch	P: 189 T: 692
Occoquan River	2A	Alewife, American Shad, Blueback Herring, Hickory Shad, Striped Bass, Yellow Perch	P: 1,161 T: 1,275
Neabsco Creek	2A	Striped Bass	P: 1,201 T: 1,332
Powells Creek	2A	Striped Bass, Yellow Perch	P: 1,592 T: 1,908

▶ *Continued (see end of table for detailed notes.)*

Table 4.10-4: Confirmed Anadromous Fish Use Waters

Water	Alternative	Confirmed Species	Anticipated Impacts (Linear Feet)
Aquia Creek	2A	American Shad, Blueback Herring, Striped Bass, Yellow Perch	P: 2,085 T: 3,641
Claiborne Run	3A	Potential anadromous fish use waters	P: 227 T: 318
	3B		P: 1,231 T: 682
	3C		P: 362 T: 507
Rappahannock River	3B	Alewife, American Shad, Blueback Herring, Hickory Shad, Striped Bass, Yellow Perch	P: 914 T: 922
	3C		P: 1,034 T: 2,094
Mattaponi River	4A	American Shad, Blueback Herring, Striped Bass, Yellow Perch	P: 715 T: 1,167
North Anna River	4A	American Shad, Blueback Herring, Hickory Shad, Striped Bass, Yellow Perch	P: 252 T: 386
Little River	4A	Yellow Perch	P: 179 T: 228
South Anna River	5A, 5A–Ashcake, 5B, 5B–Ashcake, 5C, 5C–Ashcake, 5D–Ashcake	Alewife, American Shad, Blueback Herring, Hickory Shad, Striped Bass	P: 230 T: 329
James River	6B–S-Line	American Shad, Blueback Herring, Striped Bass, Yellow Perch	P: 2,940 T: 6,162
	6D		P: 2,940 T: 6,162
	6F		P: 3,905 T: 5,197
	6G		P: 3,905 T: 5,197
Falling Creek	6A	Potential anadromous fish use waters	P: 242 T: 174
	6B–A-Line		P: 242 T: 174
	6C		P: 242 T: 174
	6E		P: 242 T: 174

P = Permanent Impact, T=Temporary Impact.

4.10.2.4 Avoidance, Minimization, and Mitigation Evaluation

Wildlife

DRPT will evaluate further minimization of impacts to wildlife during the final design process by decreasing LOD in habitat areas. This will include considering conservative use of staging areas and limiting access roads to reduce habitat loss. Wildlife passage can be facilitated through wildlife crossings. Wildlife crossings are man-made structures that allow animals to safely cross barriers. These crossings allow the connection or reconnection between habitats mitigating the impacts of habitat fragmentation, allow greater access to resources, and avoid wildlife/train collisions. DRPT will evaluate providing oversized culverts and extended bridges in areas where habitat fragmentation would occur. If pipes are used, they should be countersunk a minimum of 3 inches for pipes under 24 inches and a minimum of 6 inches for pipes 24 inches or greater.

Migratory Birds

General time-of-year (TOY) restrictions on construction activities to avoid impacts on migratory and resident songbirds in Virginia are from mid-March through mid-August and for migrant passerines and non-passerines from the beginning of May through the end of July (VDGIF, 2016). To the maximum extent practicable, DRPT will avoid grading and construction during the breeding season. If construction is necessary during the breeding season, DRPT will conduct nest surveys, if necessary, and will avoid activities within 100 feet of active nests, where possible. DRPT will not plant food sources within the right-of-way, which will make the right-of-way less attractive to birds decreasing the likelihood of collisions with trains.

Aquatic and Marine Life

DRPT will work with VDGIF, National Marine Fisheries Service (NMFS), and United States Fish and Wildlife Service (USFWS) during the design process to develop specific measures for avoidance, minimization, and mitigation of impacts to aquatic wildlife. DRPT will implement BMPs, including use of silt curtains and limiting overflow from dredging equipment, which will minimize increases in turbidity of waters downstream of in-water activities. Erosion and sediment control measures will also minimize potential impacts to water quality during construction.

Bottomless culverts and single-span bridges will be considered at smaller streams to maintain fish passage and channel morphology and to avoid instream work to the extent practicable. If pipes are used, they should be countersunk a minimum of 3 inches for pipes under 24 inches and a minimum of 6 inches for pipes 24 inches or greater. Preconstruction sediment quality assessments and water quality monitoring during construction will be considered to address potential resuspension of contaminants and nutrients into overlying waters.

TOY restrictions will be considered to avoid or minimize impacts on fish during early life stages. VDGIF typically recommends restrictions on all in-stream work within Anadromous Fish Use Areas and their tributaries between February 15 and June 30. Exact restrictions will vary depending on the species, type of work, and location and will be developed with VDGIF. Stormwater management measures, including detention basins, vegetative controls, and other measures, will be implemented to minimize water quality impacts, if necessary. These measures will reduce or detain discharge volumes and remove pollutants, thus avoiding substantial further degradation of impaired water bodies in and downstream of the study area. With implementation of these BMPs, DRPT anticipates the proposed Project will not adversely affect downstream species.

4.10.3 Threatened and Endangered Species

Potential impacts to federal- or state-listed threatened or endangered species that may be present within the study area could occur for the build alternatives where planned improvements affect areas where species or their habitat may be found.

Based on research through regulatory agency online databases, agency input regarding threatened and endangered species that may be present within the study area, and field surveys of potentially suitable habitat, DRPT determined that the build alternatives could potentially impact seven federally endangered and/or threatened species and eight state-listed endangered and/or threatened species (Table 4.10-5 and 4.10-6). Potential impacts depend on the species and range, including, but not limited to, elimination of the species from the area, removal or alteration of habitat, elimination of access to important life stage areas, disruption of breeding season, or disturbance resulting in a species leaving the area. The build alternatives for the Fredericksburg Bypass (Build Alternative 3C) and Ashland Bypass (Build Alternatives 5C and 5C–Ashcake), which would bisect forested habitat, wildlife corridors, and use rural areas with far less alteration, would have the greatest chance of impacting wildlife, including threatened and endangered species. All other alternatives would be in mostly urban or already disturbed, although in some cases naturalized, areas adjacent to the existing tracks.

Coordination with USFWS and NMFS pursuant to Section 7 of the *Endangered Species Act of 1973* (ESA), as amended, for potential impacts to federally listed species would be conducted where required after the Draft EIS is published. Preliminary coordination with USFWS has consisted of obtaining the current list of federally listed threatened and endangered species that could potentially be found in the study area. DRPT anticipates that future coordination will cover the need for additional field surveys and discussion regarding the potential Project effects.

Table 4.10-5: Potential for Federally Listed Species to be Affected by Project

Species/ Resource Name	Status*	Conclusion	Notes
Alternatives 1A, 1B, and 1C			
No species indicated; however, the tidal wetland in the waterfowl sanctuary may provide suitable habitat for sensitive joint-vetch and is recommended for future surveys, if impacted by a build alternative.			
Alternative 2A			
Dwarf Wedgemussel *(Alasmidonta heterodon)*	FE	Potential habitat present, and no current survey conducted; may affect	Known or likely to occur within the Lower Aquia Creek subwatershed (VDGIF, 2014)
Harperella *(Ptilimnium nodosum)*	FE	Potential habitat does not appear to be present, and no suitable habitat was identified during field surveys; not likely to adversely affect.	Known or likely to occur only in Stafford County (USFWS, 2014a) in the Lower Potomac (02070011) watershed (NatureServe, 2014)
Northern Long-eared Bat *(Myotis septentrionalis)*	FT	Potential habitat present, and no current survey conducted; may affect	It is generally agreed by the regulatory agencies that this species can be found throughout Virginia
Sensitive Joint-vetch *(Aeschynome virginica)*	FT	Habitat present, and no current survey conducted; may affect	Habitat recorded during field surveys
Small Whorled Pogonia *(Isotria medeoloides)*	FT	Habitat present, and no current survey conducted; may affect	Habitat recorded during field surveys

▶ *Continued (see end of table for detailed notes.)*

Table 4.10-5: Potential for Federally Listed Species to be Affected by Project

Species/ Resource Name	Status*	Conclusion	Notes
Alternatives 3A, 3B, and 3C			
Dwarf Wedgemussel *(Alasmidonta heterodon)*	FE	Potential habitat present, and no current survey conducted; may affect	Existing populations in the Lower Rappahannock (02080104) watershed (NatureServe, 2014)
Indiana bat *(Myotis sodalis)*	FE	Potential habitat present, and no current survey conducted; may affect	Known or likely to occur in Caroline County (USFWS-ECOS, 2016)
Northern Long-eared Bat *(Myotis septentrionalis)*	FT	Potential habitat present, and no current survey conducted; may affect	It is generally agreed by the regulatory agencies that this species can be found throughout Virginia
Small Whorled Pogonia *(Isotria medeoloides)*	FT	Habitat present, and no current survey conducted; may affect	Habitat recorded during field surveys
Alternative 4A			
Dwarf Wedgemussel *(Alasmidonta heterodon)*	FE	Species present; may affect	Existing populations in the Mattaponi (02080105) watershed (NatureServe, 2014); Po River, upstream of this Project, has been listed by VDGIF as endangered waters for the dwarf wedgemussel; this species is known or likely to occur within the Poni River subwatershed (VDGIF, 2014); this species is known or likely to occur within the South Anna River–Cedar Creek subwatershed (VDGIF, 2014 and VDCR, 2014)
Indiana bat *(Myotis sodalis)*	FE	Species potentially present, and no current survey conducted; may affect	Known or likely to occur in Caroline County (USFWS-ECOS, 2016)
Northern Long-eared Bat *(Myotis septentrionalis)*	FT	Potential bat habitat present, and no current survey conducted; may affect	It is generally agreed by the regulatory agencies that this species can be found throughout Virginia
Swamp-pink *(Helonias bullata)*	FT	Potential habitat present, and no current survey conducted; may affect	There are historic records of the potential of this species occurring in the Campbell Creek-Mattaponi River subwatershed (VDCR, 2014) in Caroline County (USFWS, 2014a) crossed by this alternative area
Alternatives 5A, 5A–Ashcake, 5B, 5B–Ashcake, 5C, 5C–Ashcake, and 5D–Ashcake			
Dwarf Wedgemussel *(Alasmidonta heterodon)*	FE	Species present; may affect	South Anna River has been listed by VDGIF as endangered waters for the dwarf wedgemussel; this species is known or likely to occur within the South Anna River–Cedar Creek subwatershed (VDGIF, 2014 and VDCR, 2014)
Northern Long-eared Bat *(Myotis septentrionalis)*	FT	Potential bat habitat present, and no current survey conducted; may affect	Bat habitat was noted during field surveys in Carter Park; it is generally agreed by the regulatory agencies that this species can be found throughout Virginia
Alternatives 6A, 6B–A-Line, 6B–S-Line, 6C, 6D, 6E, 6F, and 6G			
Northern Long-eared Bat *(Myotis septentrionalis)*	FT	Species potentially present, and no current survey conducted; may affect	It is generally agreed by the regulatory agencies that this species can be found throughout Virginia
Sensitive Joint-vetch *(Aeschynome virginica)*	FT	Species unlikely to be present in the project area	It is generally agreed by the regulatory agencies that this species can be found throughout Virginia, but no habitat in in the Richmond area would be affected

*FE – Federal Endangered; FT – Federal Threatened; SE – State Endangered; ST – State Threatened.

Table 4.10-6: Potential for State-Listed Species to be Affected by Project

Species/ Resource Name	Status*	Conclusion	Notes
Alternatives 1A, 1B, and 1C			
No species indicated; however, the tidal wetland in the waterfowl sanctuary may provide suitable habitat for sensitive joint-vetch and is recommended for future surveys, if impacted by a build alternative.			
Alternative 2A			
Peregrine Falcon *(Falco peregrinus)*	ST	Species potentially present; and no current survey conducted; may affect	This species has been recorded in Huntly Meadows Park (CEDER-VDGIF); the Project is separated from Huntly Meadows Park by more than 1.5 miles of urban development
Sensitive Joint-vetch *(Aeschynome virginica)*	ST	Habitat present, and no current survey conducted; may affect.	Four wetlands recommended for further sensitive joint-vetch survey
Small Whorled Pogonia *(Isotria medeoloides)*	SE	Habitat present, and no current survey conducted; may affect.	Habitat recorded during field surveys
Wood Turtle *(Glyptemys insculpta)*	ST	Species potentially present; and no current survey conducted; may affect	Known or likely to occur in the Cameron Run (VDGIF, 2014b) subwatershed and the Accotink Creek-Gunston Cove subwatershed (VDGIF, 2014b and VDCR-NHD, 2014)
Alternatives 3A, 3B, and 3C			
Green Floater *(Lasmigona subviridis)*	ST	Species present; may affect; coordination with VDGIF required	The Rappahannock River has been listed by VDGIF as endangered waters for the green floater; coordination with VDGIF is required
New Jersey Rush *(Juncus caesariensis)*	ST	Potential habitat present, and no current survey conducted; may affect	There are historic records of the potential of this species occurring in the Poni River subwatershed (VDCR, 2014) in Caroline County (USFWS, 2014a and NatureServe, 2014) and the Lower Rappahannock (02080104) and Mattaponi (02080105) watersheds (NatureServe, 2014)
Small Whorled Pogonia (*Isotria medeoloides*)	SE	Habitat present, and no current survey conducted; may affect	Habitat recorded during field surveys
Alternative 4A			
New Jersey Rush *(Juncus caesariensis)*	ST	Potential habitat present, and no current survey conducted; may affect	There are historic records of the potential of this species occurring in the Poni River and Campbell Creek-Mattaponi River, Reedy Creek, and Polecat Creek subwatersheds (VDCR, 2014) in Caroline County (USFWS, 2014a and NatureServe, 2014) within the Mattaponi (02080105) watershed and the Lower Rappahannock (02080104) watershed (NatureServe, 2014)
Swamp-pink *(Helonias bullata)*	FT	Potential habitat present, and no current survey conducted; may affect	There are historic records of the potential of this species occurring in the Campbell Creek-Mattaponi River subwatershed (VDCR, 2014) in Caroline County (USFWS, 2014a) crossed by this alternative area
Alternatives 5A, 5A–Ashcake, 5B, 5B–Ashcake, 5C, 5C–Ashcake, and 5D–Ashcake			
No species indicated			
Alternatives 6A, 6B–A-Line, 6B–S-Line, 6C, 6D, 6E, 6F, and 6G			
Barking Treefrog *(Hyla gratiosa)*	ST	Potential habitat present, and no current survey conducted; may affect	This species is known or likely to occur in the Falling Creek (VDCR, 2014 and VDGIF, 2014b) and Proctors Creek-James River (VDGIF, 2014b) subwatersheds in Chesterfield County (NatureServe, 2014)
Peregrine Falcon *(Falco peregrinus)*	ST	Species present; may affect; coordination with VDGIF required	Several active nests were recorded in 2009 within 3 miles of this alternative area near River Front Plaza in Richmond
Sensitive Joint-vetch *(Aeschynome virginica)*	ST	Species unlikely to be present in the project area	It is generally agreed by the different regulatory agencies that this species can be found throughout Virginia, but no habitat in in the Richmond area would be affected

*ST – State Threatened.

4.10.3.1 Bald Eagle and Golden Eagle Protection Act

Bald eagle (Haliaeetus leucocephalus) is listed under Tier II of the Virginia Wildlife Action Plan for "Very High Conservation Need." The Bald eagle is no longer listed as threatened, but this discussion was left in this section since it is still protected under some laws. Table 4.10-7 lists bald eagle nests that would have their buffer zones encroached on by construction of the Build Alternatives (Figure 4.10-2). Disturbance of nesting bald eagles is unlikely to occur if the following guidelines are followed:

- Clearing, grubbing, and construction activities within 660 feet, but outside 330 feet, can be restricted to outside of the breeding season (mid-December to June), even if these activities are occurring within railroad right-of-way
- A buffer of at least 660 feet can be maintained between all activities and the nest (including active and alternate nests)
  - If a similar activity is closer than 660 feet, then a distance buffer as close to the nest as the existing tolerated activity may be maintained
- A buffer of at least 0.5 mile, or 1 mile in open areas, can be maintained for blasting and other activities that produce extremely loud noises, or restricted to outside the breeding season (USFWS, 2007)
- Construction activities in Bald Eagle Concentration Areas may also negatively affect bald eagles. Bald eagles congregate in these locations for feeding and sheltering (roosting) because of their proximity to food sources. Construction activities may prevent bald eagles from foraging and roosting in these locations, resulting in disturbance that may stress or relocate the species to less optimal habitat. Permanent alterations at these sites can eliminate or reduce essential feeding and sheltering habitat. Bald Eagle Concentration Areas are intersected near Aquia Creek, Potomac River, Quantico Creek, Powells Creek, Neabsco Creek, and Occoquan River. TOY restrictions are listed in Table 4.10-8.

Nesting Bald Eagles

Table 4.10-7: Number of Bald Eagle Nests within Buffer Zones

Alternative Area	Alternative	2,640 feet or up to 5,280 feet in open areas[1]	660 feet[2]	330 feet[3]
Area 2: Northern Virginia (Long Bridge to Dahlgren Spur)	2A	18	8	4
Area 6: Richmond (I-295 to Centralia)	6A	1	–	–
	6B–A-Line	1	–	–
	6B–S-Line	1	–	–
	6C	1	–	–
	6D	–	–	–
	6E	1	–	–
	6F	–	–	–
	6G	1	–	–

Source: CCB, 2016.

Notes; 1. For projects that have blasting or other loud noise components. 2. Clearing, external construction, and landscaping between 330 and 660 feet should be done outside breeding season. 3. 330 feet, or as close as existing tolerated activity of similar scope.

None of the Build Alternatives are within bald eagle nest buffer zones in Alternative Areas 1, 3, 4, or 5.

Table 4.10-8: Listed Time-of-Year Restrictions for Threatened and Endangered Species with Potential to Occur in the DC2RVA Corridor

Species	Status	Recommended Time-of-Year Restrictions
Dwarf Wedgemussel (*Alasmidonta heterodon*)	FE	March 15–May 31; August 15–October 15
Indiana bat (*Myotis sodalis*)	FE	The standard TOY restrictions are June 1–July 31 for the "pup season," April 15–September 15 outside of the 5.5-mile-radius buffer for hibernacula, and April 1–November 15 within a hibernaculum buffer
Northern Long-eared Bat (*Myotis septentrionalis*)	FT	Compliance with the USFWS ESA 4(d) rule. VDGIF's standard recommendations are to prohibit tree removal within 150 feet of a documented maternity roost from June 1–July 31 and to prohibit tree removal within 0.25 mile of a documented hibernaculum
Bald Eagle (*Haliaeetus leucocephalus*)	ST	Nest Sites: December 15–July 15; Concentration Areas and Roost Sites: Summer: May 15–August 31; Winter: December 15–March 15
Barking Treefrog (*Hyla gratiosa*)	ST	None listed
Green Floater (*Lasmigona subviridis*)	ST	April 15–June 15 (release of glochidia); August 15–September 30 (spawning)
Peregrine Falcon (*Falco peregrinus*)	ST	February 15–July 15 for activities within 600 feet of nest
Wood Turtle (*Glyptemys insculpta*)	ST	For instream work: October 1–March 31; For work within 900 feet of stream (zone of concern): April 1–September 30. Maintain undisturbed naturally vegetated buffer of at least 300 feet (preferably larger) on stream

Source: VDGIF, 2016.

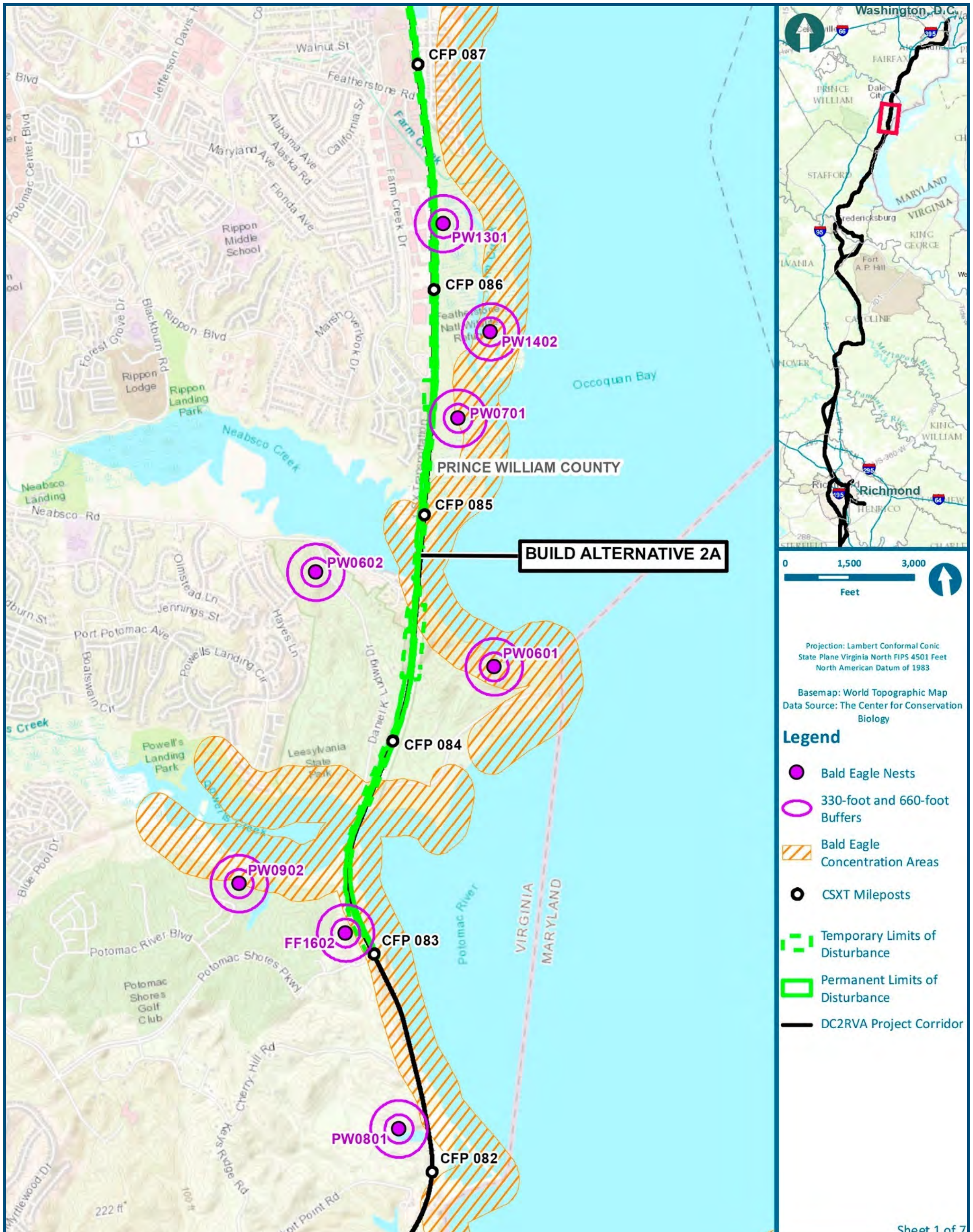


Figure 4.10-2: Bald Eagle Nest Impacts – Build Alternative 2A

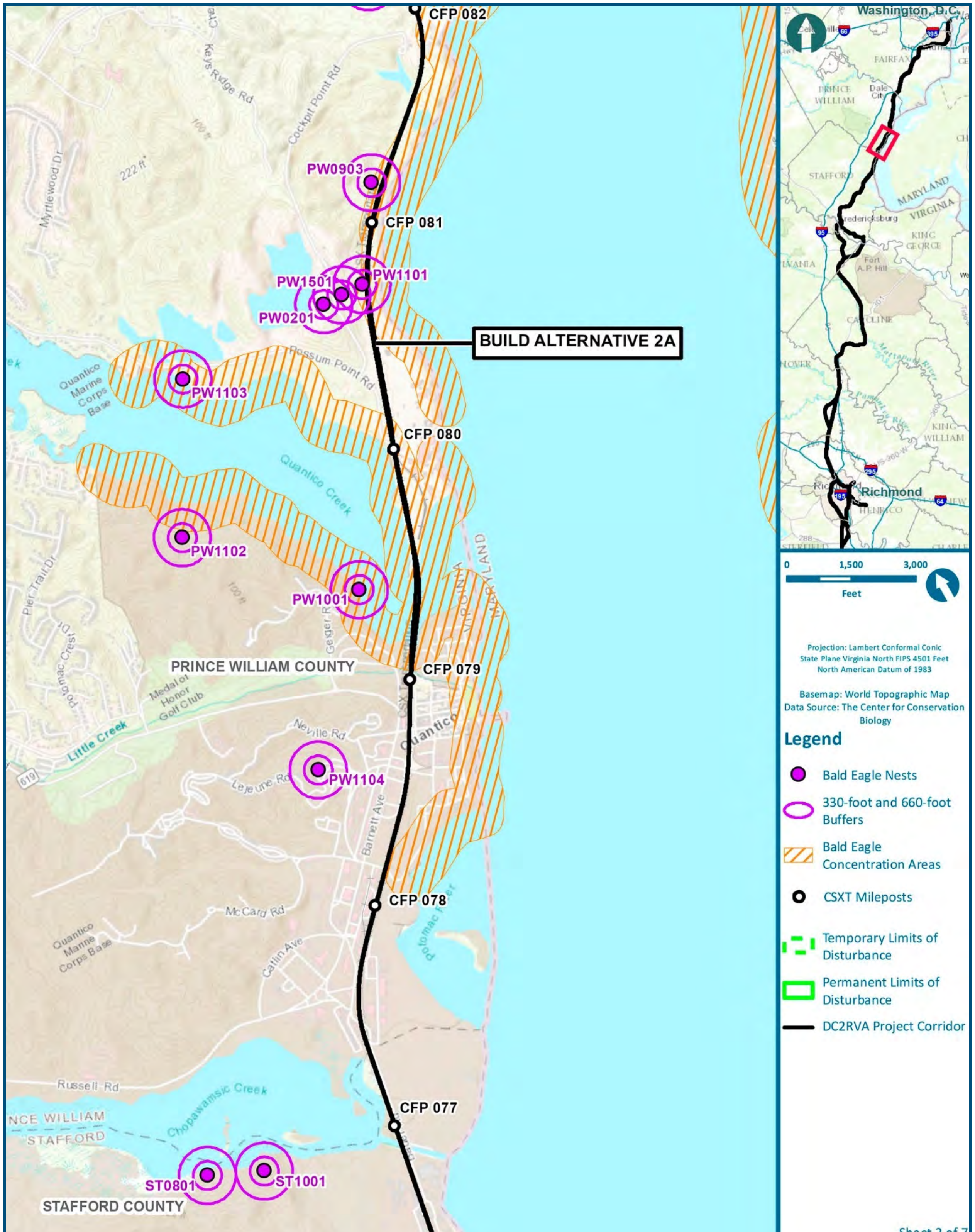


Figure 4.10-2: Bald Eagle Nest Impacts – Build Alternative 2A

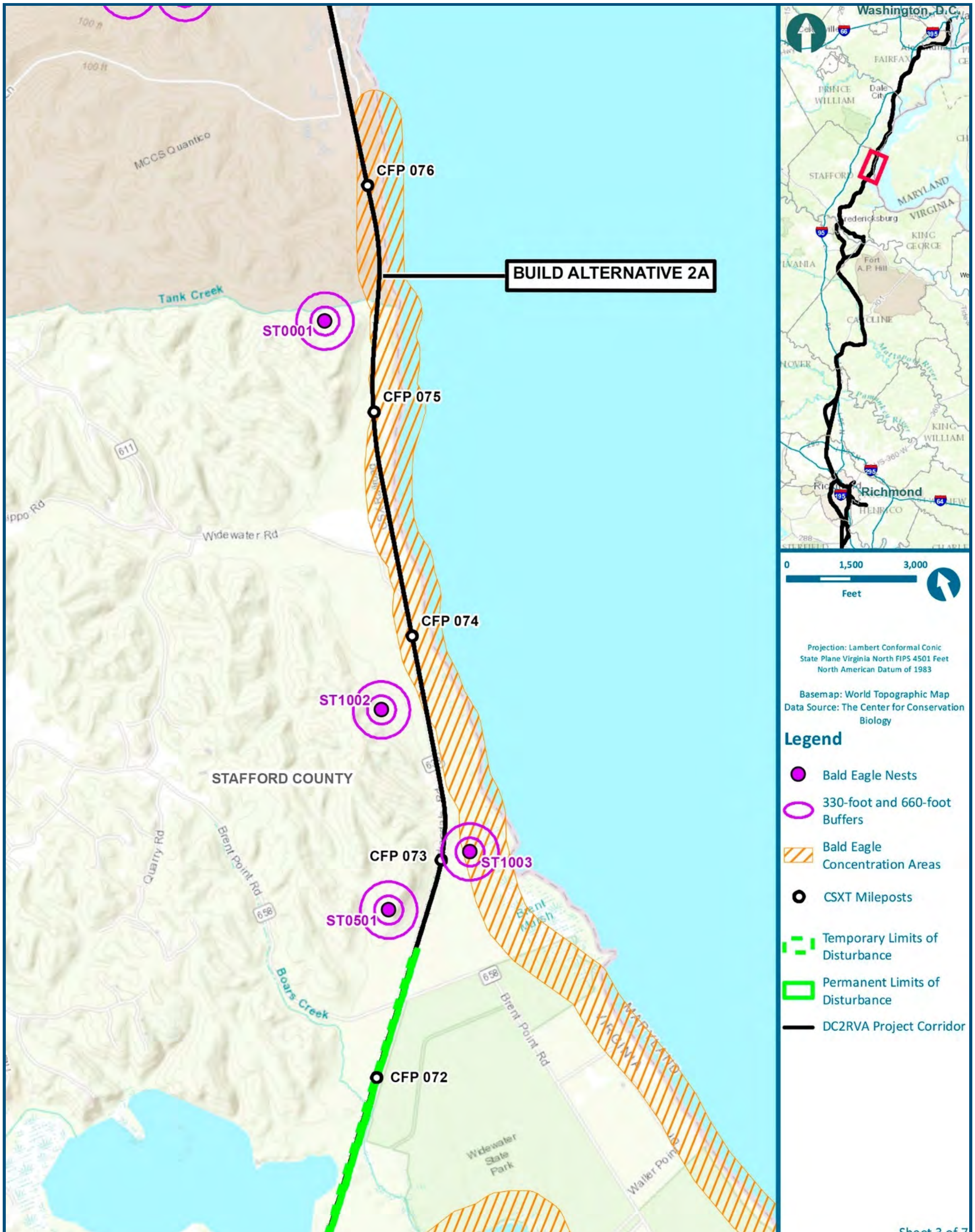


Figure 4.10-2: Bald Eagle Nest Impacts – Build Alternative 2A

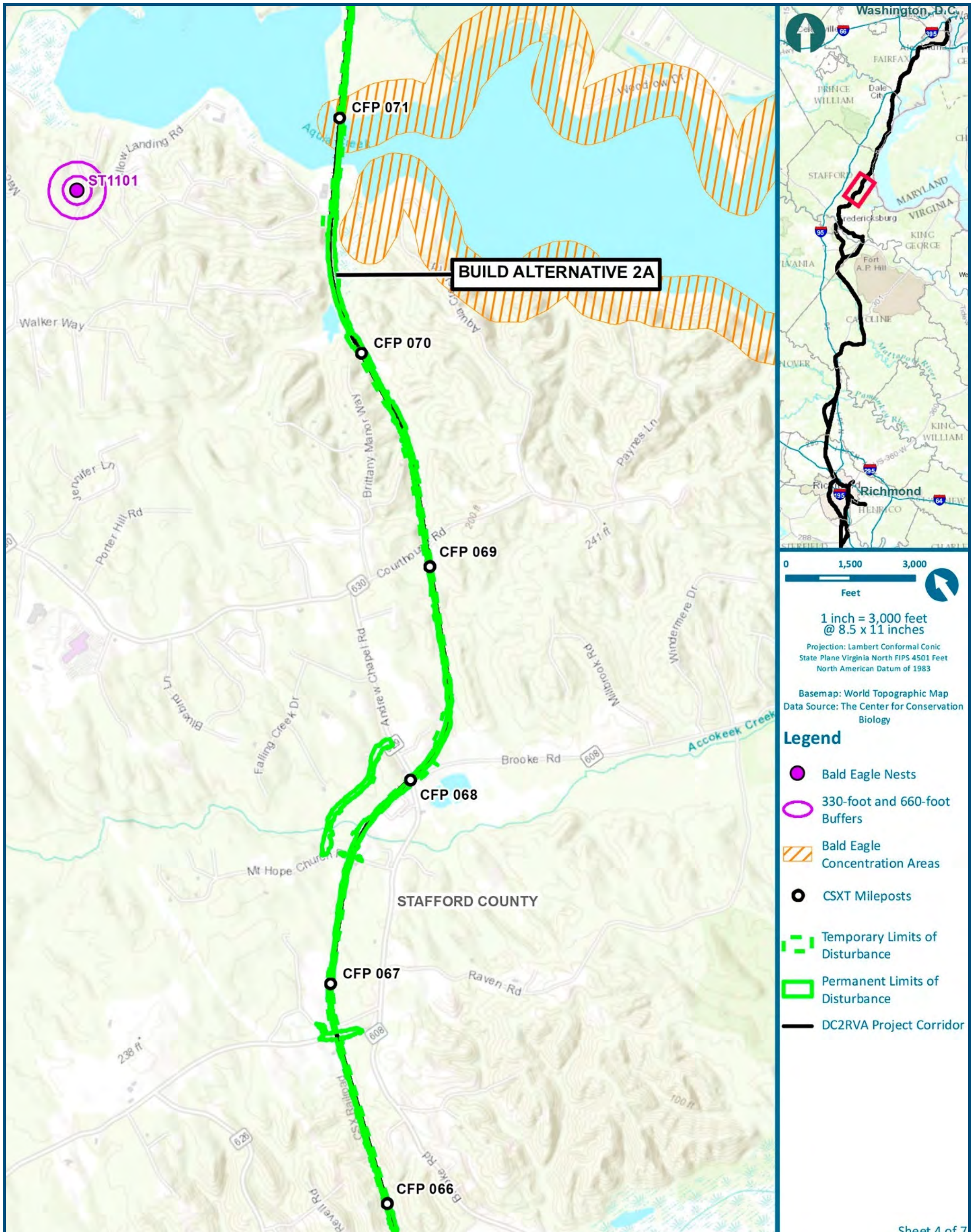


Figure 4.10-2: Bald Eagle Nest Impacts – Build Alternative 2A

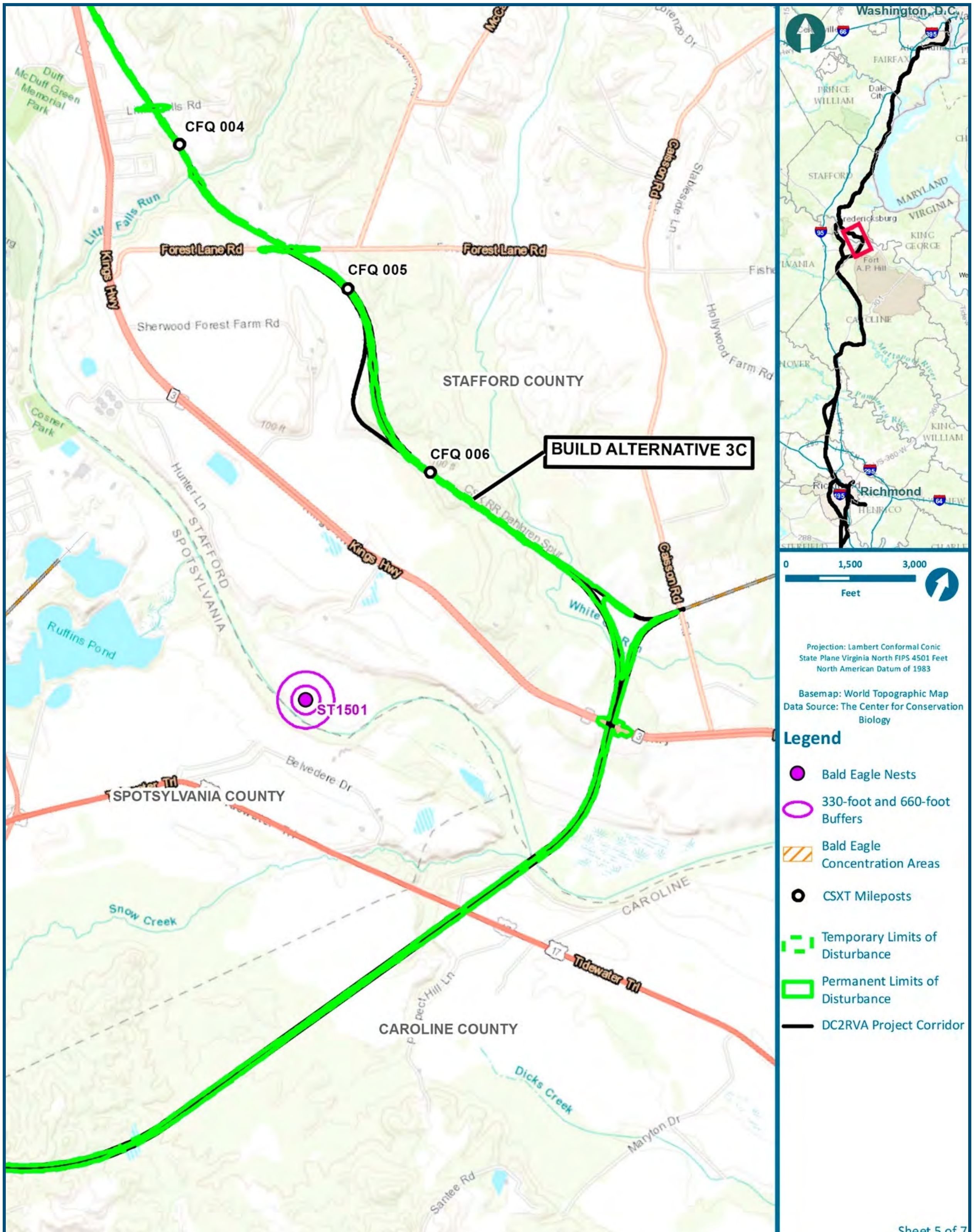


Figure 4.10-2: Bald Eagle Nest Impacts – Build Alternative 3C

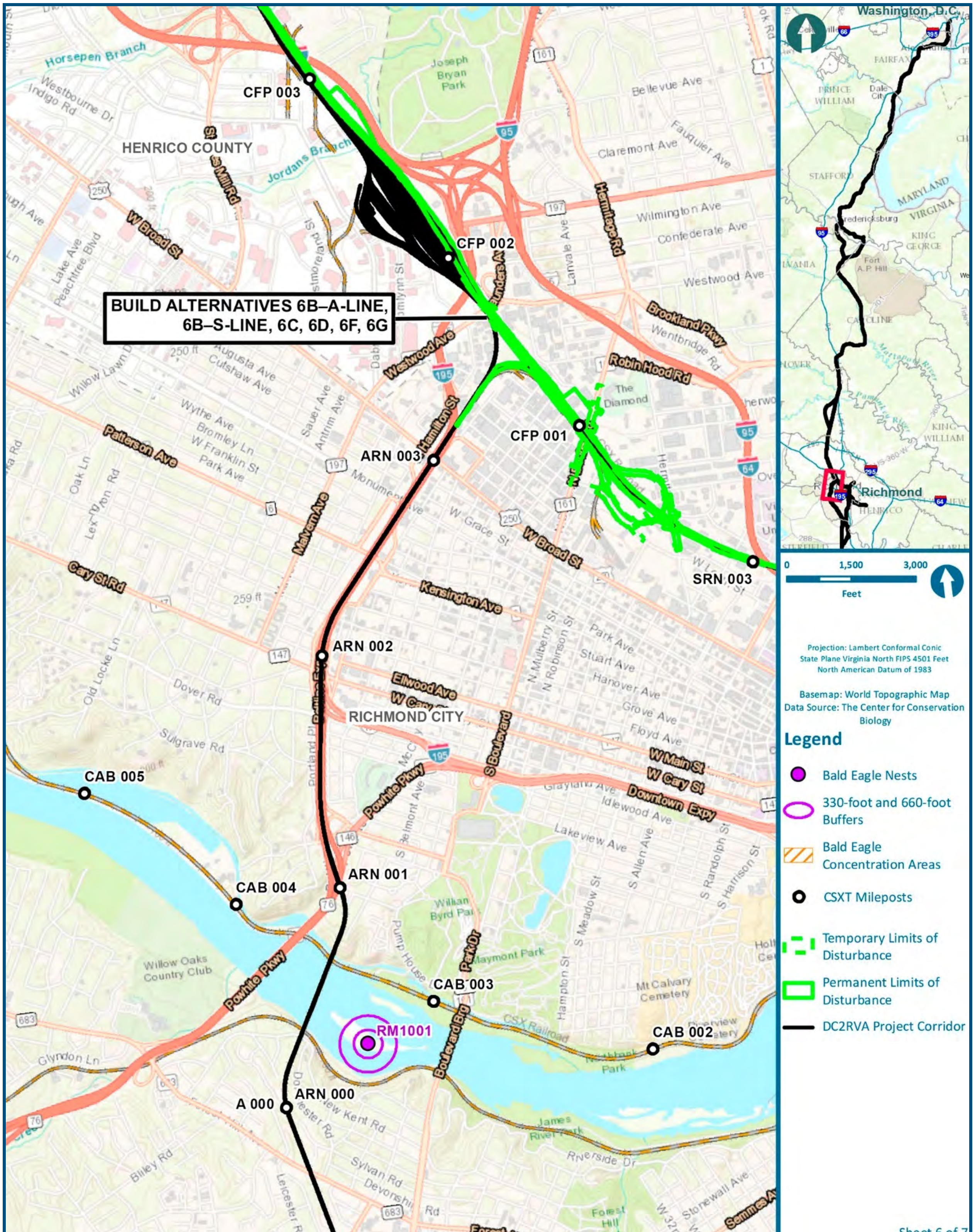


Figure 4.10-2: Bald Eagle Nest Impacts – Build Alternatives 6B–A-Line, 6B–S-Line, 6D, 6F, 6G

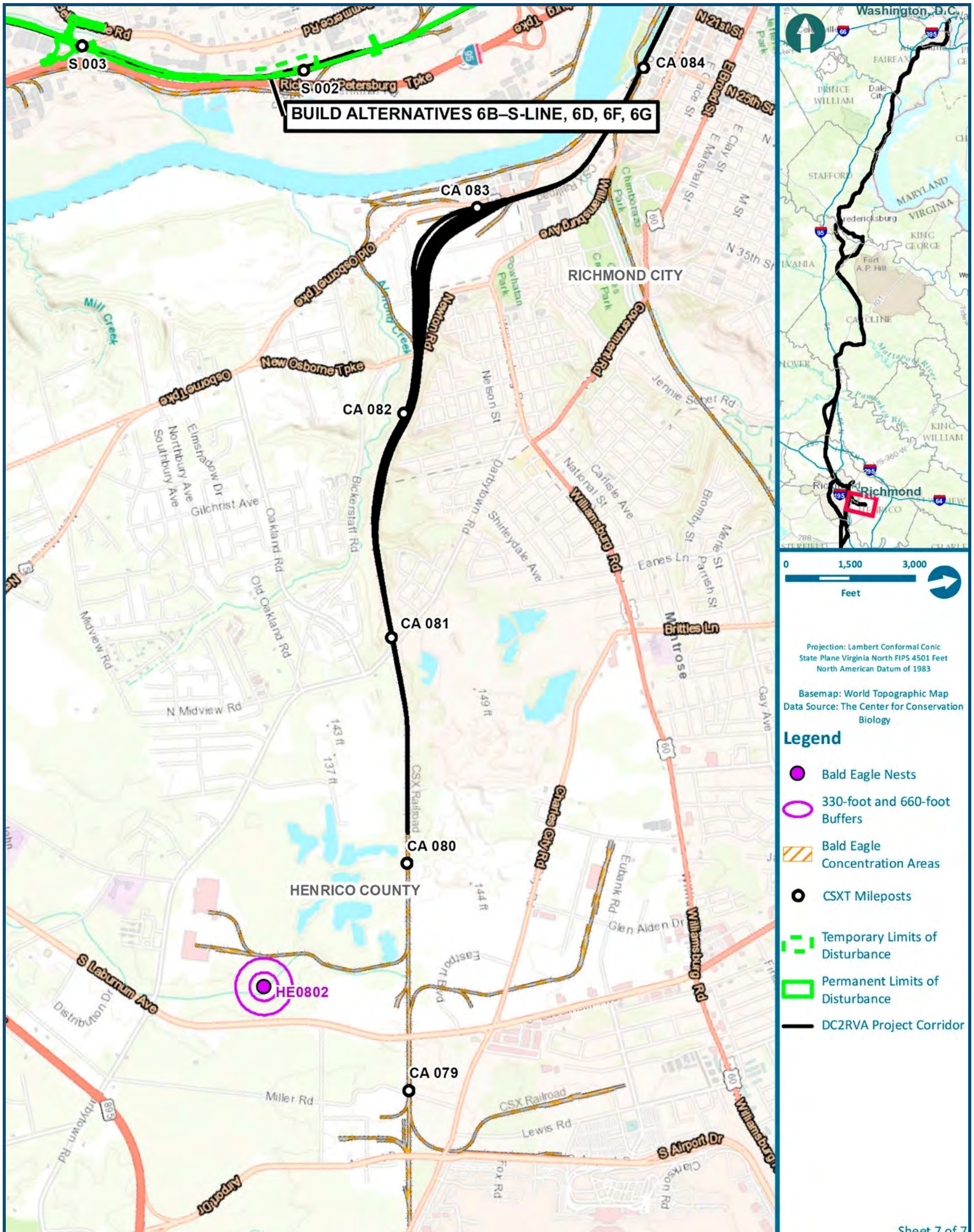


Figure 4.10-2: Bald Eagle Nest Impacts – Build Alternatives 6B–S-Line, 6D, 6F, 6G

4.10.3.2 Avoidance, Minimization, and Mitigation Evaluation

DRPT will coordinate with USFWS, EPA, VDCR, VDGIF, and other regulatory agencies regarding habitat and wildlife—rare, threatened, and endangered species, bald eagles, migratory birds, anadromous fish, and SAV in particular—to ensure impacts are avoided to the extent practicable through the final design process and appropriate mitigation is developed where impacts are unavoidable. DRPT will reduce the likelihood of adverse effects through use of these measures:

- Minimizing the LOD through design
- Following appropriate BMPs for sediment and erosion control during construction
- Using infiltration stormwater management
- Minimizing clearing and grubbing
- Prompt reseeding of disturbed areas with native vegetation
- TOY restrictions (Table 4.10-8)

Bald Eagle

According to the USFWS National Bald Eagle Management Guidelines to minimize disturbance, activities should be conducted outside of the breeding season, if possible, and kept as far away from nests as possible. Loud and disruptive activities should be limited to periods when eagles are not nesting, and activity between the nest and nearest foraging area should be avoided. General guidance for Category A activities, such as constructing roads and other linear facilities, and Category H, such as blasting and other loud, intermittent noises, is outlined in Table 4.10-9 (USFWS, 2007). It may be necessary to also obtain a permit issued under the *Bald and Golden Eagle Act* (16 United States Code [U.S.C.] 668-668c, 54 Stat. 250), as amended, for activities located in Bald Eagle Concentration Areas. This would be determined during the design process. Specific avoidance, minimization, and mitigation would be developed in coordination with USFWS and VDGIF and may require development of an eagle conservation plan.

Table 4.10-9: Bald Eagle Management Guidelines

		If there is no similar activity within 1 mile of the nest	If there is similar activity closer than 1 mile from the nest
Category A activities, such as constructing roads and other linear facilities	If the activity will be visible from the nest	660 feet. Landscape buffers are recommended.	660 feet, or as close as existing tolerated activity of similar scope. Landscape buffers are recommended.
	If the activity will not be visible from the nest	330 feet. Clearing, external construction, and landscaping between 330 and 660 feet should be done outside breeding season.	330 feet, or as close as existing tolerated activity of similar scope. Clearing, external construction, and landscaping within 660 feet should be done outside breeding season.
Category H, such as blasting and other loud, intermittent noises	Avoid blasting and other activities that produce extremely loud noises within 0.5 mile of active nests (or within l mile in open areas), unless greater tolerance to the activity (or similar activity) has been demonstrated by the eagles in the nesting area.		

Source: USFWS, 2007.

4.11 COMMUNITY RESOURCES

4.11.1 Economic Effects

The Build Alternatives would have direct effects on economic activity through business/ commercial relocations, as shown in Table 4.11-1.

Table 4.11-1: Commercial Relocations by Build Alternative

Alternative Area	Alternative	Stafford County		Hanover County	Henrico County	City of Richmond				Total
		O	GC	GC	GC	GC	S/W	M/A	O	
Area 3: Fredericksburg (Dahlgren Spur to Crossroads)	3B	–	–	–	–	–	–	–	–	1
	3C	–	–	–	–	–	–	–	–	1
Area 5: Ashland (Doswell to I-295)	5A	–	–	1	–	–	–	–	–	1
	5A–Ashcake	–	–	1	–	–	–	–	–	1
	5B	–	–	1	–	–	–	–	–	1
	5B–Ashcake	–	–	1	–	–	–	–	–	1
	5C	–	–	1	–	–	–	–	–	1
	5C–Ashcake	–	–	1	–	–	–	–	–	1
	5D–Ashcake	–	–	1	–	–	–	–	–	1
Area 6: Richmond (I-295 to Centralia)	6A	–	–	–	5	1	0	4	0	10
	6B–A-Line	–	–	–	5	2	4	7	0	18
	6B–S-Line	–	–	–	5	0	2	2	1	10
	6C	–	–	–	5	1	1	5	3	15
	6D	–	–	–	5	0	2	2	1	10
	6E	–	–	–	5	1	0	4	0	10
	6F	–	–	–	5	0	2	2	1	10
	6G	–	–	–	5	0	2	2	1	10

This table includes only the Build Alternatives with commercial relocations.
O=Other; GC=General Commercial; S/W=Storage/Warehousing; M/A=Manufacturing/Auto Repair

The nonresidential relocations were broken down into types of businesses with similar relocation/ structural needs: general commercial, storage and warehousing, manufacturing, and other. The category "Other" includes an apartment building as well as a variety of government properties (city, county, or university-owned). The government properties include a Department of Motor Vehicles, Commonwealth of Virginia Workers' Compensation Department, and City of Richmond Department of Public Works properties. The general commercial businesses within the Build Alternatives include technical services and entertainment services. The warehousing and storage facilities include food and container storage. The manufacturing facilities include auto service and repair, and electrical manufacturing and repair. In Alternative Area 5, the Town of Ashland could be adversely affected economically by Build Alternatives 5A, 5A–Ashcake, 5B, 5B–Ashcake, and 5D–Ashcake. There are few business relocations, due to these Build Alternatives, but the short-term effects of construction within town, particularly central downtown along Railroad Avenue and Center Street, could cause local businesses to suffer loss of commerce and, potentially, closure. In addition to the short-term effects of construction, Build Alternatives 5B, 5B–Ashcake, and 5D–Ashcake could close South Center Street between England Street and Maiden Street. Access to the businesses and residences would still be provided from other public rights-of-way. However, the long-term effects of the closure and change in access could also cause loss of commerce and potential closure of businesses. This in turn could cause negative effects on the economic vitality of downtown Ashland.

Based on the number of nonresidential relocations and the types of businesses potentially being relocated, adequate replacement properties would be available for relocation purposes. The acquisition of right-of-way and the relocation of displaced persons and businesses would be conducted in accordance with the *Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970,* as amended, and 24 VAC 30 - 41. DRPT assures that relocation resources would be available to all displaced businesses and nonprofit entities without discrimination.

4.11.2 Neighborhood and Community Effects

4.11.2.1 Community Effects

DRPT assessed impacts to communities based on potential right-of-way acquisition of residences and community facilities, partial acquisitions of parcels, potential changes in community cohesion, changes in access to community facilities, and changes in access for emergency services.

More-detailed information on right-of-way acquisition and relocation can be found in Section 4.12, Title VI and Environmental Justice. Effects based on changes to the transportation network are summarized in the next section, discussed in the Transportation Section (Section 4.15), and discussed in more detail in the *Transportation Technical Report* (Appendix S).

The No Build Alternative would not require any right-of-way acquisition or result in any neighborhood and community effects.

In Alternative Area 1 (Arlington), DRPT does not expect direct effects to communities from relocations and right-of-way acquisition. There are no relocations, and none of the Build Alternatives require more than 1.5 acres of right-of-way. There are no adverse effects to community facilities, access to these facilities, or access for emergency services.

In Alternative Area 2 (Northern Virginia), Build Alternative 2A would require two residential relocations in part of the Belmont Bay community along Railroad Avenue (Prince William County). Access to this community is currently through the condominiums at Belmont Bay and would not change under the Build Alternative 2A. DRPT has determined that there would be no adverse effects to community facilities, access to these facilities, or access for emergency services.

The community of Brooke (Stafford County) would be affected by Build Alternative 2A. Partial acquisition of residential property would occur due to an additional roadway connection north of and parallel to the CSXT line to continue to provide access to the street network for residents via Brooke Road and Andrew Chapel Road. DRPT has determined that access to and from the area for emergency services, school transportation, and religious facilities on Andrew Chapel Road would not be adversely affected by Build Alternative 2A. Additional effects to this community include partial acquisition of residential property around the Eskimo Hill Road crossing of the CSXT line.

In Alternative Area 3 (Fredericksburg), Build Alternatives 3A and 3B that pass through town would not require residential relocations, and only partial acquisition of primarily residential parcels would be required in the communities in this area. DRPT has determined that the Fredericksburg Bypass (Build Alternative 3C) would adversely affect the community of Little Falls (Stafford County). The adverse effects would be due to partial acquisition of residential parcels on Little Falls Road and Forest Lane Road, as well as an increase in the frequency of trains along the existing Dahlgren Spur. There are currently very few train movements on this line (one per day). Additional freight trains would use the bypass as part of future train operations. Existing crossings of these roads would be improved with median treatments to provide additional safety measures for residents.

The communities that would be affected by the Fredericksburg Bypass (Build Alternative 3C) include the residential development along Sandy Lane Drive, Swan Lane, Thornton Rolling Road, and Patriot Lane and the community of Summit (Spotsylvania County). As rural communities, they may not be as well defined as urban or suburban communities, but they would still be adversely affected by residential relocations. The Fredericksburg Bypass (Build Alternative 3C) would bisect the residential development along Thornton Rolling Road and Patriot Lane. Community cohesion could be adversely affected by this alternative. None of these communities are currently on a rail line, and the introduction of a rail line and freight rail traffic would undoubtedly result in an adverse effect on this currently rural area. DRPT does not, however, anticipate adverse effects to community facilities, access to these facilities, or access for emergency services since roadway crossings along the new alignment bypass would be grade-separated.

In Alternative Area 4 (Central Virginia), to the east and south of Carmel Church and Patersons Corner, access to the residential development along Railroad Lane (Caroline County) would not be affected by Build Alternative 4A since only one low-volume roadway (Colemans Mill Road) would be closed. DRPT has determined that there would be no adverse effects to community facilities, access to these facilities, or access for emergency services.

In Alternative Area 5 (Ashland), within the Town of Ashland, the proximity of the community to the existing CSXT rail line makes adverse effects to the community difficult to avoid. The Build Alternatives that pass through town (Build Alternatives 5A, 5A–Ashcake, 5B, 5B–Ashcake, and 5D–Ashcake) would have similar effects on the community. There would be no residential relocations, one commercial relocation, and partial acquisitions of parcels. The communities affected include downtown Ashland, southern Ashland, Gwathmey, and Elmont.

The Ashland Bypass (Build Alternatives 5C and 5C–Ashcake) would result in 20 residential relocations, 1 community facility relocation (Calvary Pentecostal Tabernacle and camp), 2 commercial relocations, and partial acquisition of more than 50 parcels. The communities affected include Blunts Bridge Road, Independence Road, Ashcake Road and Wildwood Boulevard, and Elmont. As noted above, one community facility would be adversely affected, but DRPT does not expect any other adverse effects to community facilities, access to community facilities, or access for emergency services since roadway crossings along the new alignment bypass would be grade-separated.

Within Alternative Area 6 (Richmond), direct effects to communities from residential relocations would occur in Laurel Park in Henrico County and in McGuire in the City of Richmond. The Build Alternatives that use the A-Line between Acca Yard and Centralia (Build Alternatives 6A, 6B–A-Line, 6C, and 6E) would affect both communities through these residential relocations and the relocation of a church, the Rock Christian Center. The Build Alternatives that use the S-Line between Main Street Station and Centralia (Build Alternatives 6B–S-Line, 6D, 6F, and 6G) would only affect the community of Laurel Park. One community facility would be adversely affected, but no other adverse effects to community facilities, access to these facilities, or access for emergency services are expected.

More-detailed information on community effects can be found in the *Community Impact Assessment Technical Report* (Appendix Q).

4.11.2.2 Effects from Changes to the Transportation Network

Effects on communities from changes to the transportation network have been assessed based on physical changes to the roadway network and increased intercity passenger rail service in the DC2RVA corridor. The methodology used to determine the proposed crossing improvements at each at-grade crossing is provided in the *Transportation Technical Report* (Appendix S). Types of crossing treatments were identified at each at-grade highway-rail crossing to improve safety and road and rail traffic flow (see Section 4.15.2.1). Most existing public at-grade crossings are proposed to remain at-grade with the addition of four-quadrant gates or gates with center median treatment; there are fewer locations with proposed grade separations and closures. New grade separations would reduce vehicular delay at those locations. DRPT evaluated all crossing improvement effects on connectivity and accessibility (see Section 4.15.2.2) and completed a crossing closure diversion analysis (see Section 4.15.2.3) to determine the effects the proposed roadway closures would have on traffic operations. Crossings proposed to be closed are typically lower volume roadways with nearby alternate new or existing access across the rail corridor, or were determined due to safety concerns and/or the requirements of the physical or operational infrastructure of the Project. All new crossings of roads as part of the Build Alternatives would be grade-separated, except for two new at-grade roadway crossings that are proposed as part of the station improvement designs for Build Alternative 6C. Additionally, some existing public at-grade crossings would be grade-separated which would reduce vehicular delay at those locations.

In Alternative Area 1 (Arlington), DRPT does not expect direct effects to the local transportation network as a result of construction of the proposed Project because there are no at-grade crossings in this alternative area.

In Alternative Area 2 (Northern Virginia), Build Alternative 2A would not change access to the communities of Harbor View and Colchester (Fairfax County), via Furnace Road, and would therefore not adversely affect these communities. The community of Brooke (Stafford County) would be affected by Build Alternative 2A. Mount Hope Church Road would be closed at the CSXT rail line, and an additional roadway connection would be added north of and parallel to the CSXT line to provide access to the street network for residents via Brooke Road and Andrew Chapel Road. More detail appears in the *Transportation Technical Report* (Appendix S). DRPT has determined that access to and from the area for emergency services, school transportation, and the religious facilities in Brooke would not be adversely affected by Build Alternative 2A.

In Alternative Area 3 (Fredericksburg), DRPT expects that the Project will result in direct effects to the transportation network. The improved station at Fredericksburg would provide better access to the transportation network with a larger station building, additional parking, and improved handicapped parking, which are all positive effects. The end of Patriot Lane (Spotsylvania County) would also be acquired as part of right-of-way acquisition for the Fredericksburg Bypass (Build Alternative 3C). The roadway would terminate at the new wye junction required for joining the bypass to the main line.

In Alternative Area 4 (Central Virginia), the Colemans Mill Road (Caroline County) crossing of the CSXT rail line would be closed under Build Alternative 4A. DRPT does not expect adverse effects to access for emergency response, school transportation, or the roadway network as a result of this road closure. The north side of Colemans Mill Road would continue to be accessed by Rogers Clark Boulevard. The south side would maintain access through Dry Bridge Road to Colemans Mill Road. Access to the eastern section of Railroad Lane (Caroline County) would remain in place under Build Alternative 4A.

In Alternative Area 5 (Ashland), closure of College Avenue/Henry Clay Street would occur under Build Alternatives 5A, 5B, and 5C if the existing platforms at the Ashland Station were extended. DRPT expects that there would be no adverse effects to access to community facilities or for emergency response, school transportation, or access to the roadway network as a result of this road closure. West Vaughan Road would provide an alternative for emergency medical services and would be improved with a grade separation under the Build Alternatives that pass through town (Build Alternatives 5A, 5A–Ashcake, 5B, 5B–Ashcake, and 5D–Ashcake). This would improve safety and emergency response time. The Volunteer Rescue Squad on Duncan Street would still have access to both sides of the rail line, as would the Ashland Police Department on England Street. Closure of Independence Road at West Patrick Henry Road would occur under the Ashland Bypass (Build Alternatives 5C and 5C–Ashcake). An alternate alignment that uses existing West Patrick Henry Road and Blanton Road would be less than 1 mile.

DRPT does, however, expect adverse effects due to road closure in Ashland. Closure of the northbound portion of South Railroad Avenue between England Street and Maiden Lane, due to the addition of a third track, under Build Alternatives 5B, 5B–Ashcake, and 5D–Ashcake, would adversely affect the community of Ashland and, in particular, the community cohesion of the area of town south of England Street.

In Alternative Area 6 (Richmond), direct effects to the transportation network are expected as a result of construction of the Build Alternatives. The station improvements at Staples Mill would provide expanded mobility and better access to the transportation network with an expanded building, additional parking, and a designated pick-up and drop-off area, which would all be positive effects of the Project. Some at-grade roadway crossings would also be closed under the Build Alternatives, which are summarized in the following paragraphs.

The Boulevard single-station alternative (Build Alternative 6B–S-Line) includes the closure of the Ownby Lane/Hermitage Road intersection in the Diamond/Newtowne West area to accommodate the Hermitage Road grade separation. The area is generally in commercial and industrial uses. Access to Ownby Lane would still be available via Overbrook Road and Botetourt Street.

The Build Alternatives that use the A-Line between Acca Yard and Centralia (Build Alternatives 6A, 6B–A-Line, 6C, and 6E) include the closure of Bassett Avenue in Westover . Access to the east side of this crossing would still be available via Westover Hills Boulevard. Access to the west side of the crossing would still be available through Jahnke Road, which would be improved with four-quadrant gates to increase safety at the crossing.

The Build Alternatives that use the A-Line between Acca Yard and Centralia (Build Alternatives 6A, 6B–A-Line, 6C, and 6E) include the closure of the Terminal Avenue at-grade crossing in Hickory Hill. Access on the eastern side of Terminal Avenue is available via Belt Boulevard. Access on the western side of Terminal Avenue is available via Hopkins Road. A signal study of the intersection of Terminal Avenue and Hopkins Road would also occur under these alternatives.

The Build Alternatives that use the A-Line between Acca Yard and Centralia (Build Alternatives 6A, 6B–A-Line, 6C, and 6E) include the closure of Thurston Road in the community of Chimney Corner. Access to the western side of Thurston Road would still be available via Hopkins Road. Access to the eastern side of Thurston Road would still be available via Dorsey Road. Access to and from the community for emergency services and school transportation would not be adversely affected by the alternatives.

The Build Alternatives that use the S-Line between Main Street Station and Centralia (Build Alternatives 6B–S-Line, 6D, 6F, and 6G) include the closure of St James Street and North Second Street/Valley Road between the communities of Gilpin and Southern Barton Heights. Based on the proximity to and connections to the existing roadway network via North First Street and North Fifth Street, access to and from the communities for emergency services and school transportation would not be adversely affected by the alternatives.

The Build Alternatives that use the S-Line between Main Street Station and Centralia (Build Alternatives 6B–S-Line, 6D, 6F, and 6G) include the closure of the at-grade crossing at Dale Avenue/Trenton Avenue in the community of Ampthill Heights. It primarily provides access to the DuPont plant, and alternate access is available.

The Build Alternatives that use the S-Line between Main Street Station and Centralia (Build Alternatives 6B–S-Line, 6D, 6F, and 6G) include the closure of Brinkley Road in Chimney Corner. Access to Brinkley Road would still be available via Dorsey Road and Thurston Road via Hopkins Road.

Old Lane in the community of Centralia would be closed under all Build Alternatives. Access to and from the community for school transportation would not be adversely affected by the alternatives. An increase in response time for emergency services could occur if the response were from Fire Station 17 in Centralia, but it would be less than a 5-minute increase. If the response were from Fire Station 1, there would be no difference in response time.

4.11.3 Community Facilities and Services

The No Build Alternative would have no direct effects on community facilities.

In Alternative Areas 1 through 4, the Build Alternatives would have no direct effects on community facilities.

In Alternative Area 5 (Ashland), one community facility, the Calvary Pentecostal Tabernacle camp in Hanover County, would be relocated due to Build Alternatives 5C and 5C–Ashcake. The facility would be relocated in a manner that would enable access to remain similar to the existing access.

Build Alternatives 5A, 5A–Ashcake, 5B, and 5B–Ashcake would require a minor temporary easement of two parcels from the Gwathmey Baptist Church. The temporary easement would not affect activities at the church, and DRPT does not expect the temporary easement to have adverse effects to the church.

All Build Alternative would require a temporary easement from Patrick Henry Branch of the YMCA in Ashland due to alignment changes along Ashcake Road. DRPT does not expect the temporary easement to have adverse effects to the facility.

In Alternative Area 6 (Richmond), the Build Alternatives that use the A-Line between Acca Yard and Centralia (Build Alternatives 6A, 6B–A-Line, 6C, and 6E) would require the relocation of the Rock Christian Center as a part of the grade separation of the intersection of Broad Rock Boulevard and the CSXT rail line. The facility would be relocated in a manner that would enable access to remain similar to the existing access. In addition, partial acquisition of the parcel containing Hunter Holmes McGuire Veterans Affairs Medical Center would also occur in this location. The partial acquisition of this parcel is minor in nature (0.10 acre) and would not affect the functioning of the center.

4.11.4 Right-of-Way and Relocations

The acquisition of right-of-way and the relocation of displacees would take place in accordance with the *Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970,* as amended (42 U.S.C. 4601). Data and information were collected on social demographics and potential relocations, including individual tax parcel data, within the Build Alternatives. This information was compiled from city/county tax parcel databases, United States Geological Survey (USGS) mapping, aerial photos, the United States Census website, GIS databases, conceptual drawings/engineering, and field inspections. All field inspections were conducted from within public right-of-way. Given that potential property effects are only being estimated at this time, local citizens/property owners were not contacted for any data to determine family size, household size, property value, owner/renter status, or any other demographic information. Similarly, individual businesses potentially subject to relocation were not contacted to determine their number of employees. These data were estimated using the sources noted above.

Potential relocations were determined based on overlaying the estimated LOD of the Build Alternatives on county/city tax parcel digital data through the use of GIS. The individual parcel data were then compiled, and the area that may be acquired with implementation of a Build Alternative was computed. Potential relocations were identified as residential (individuals/families), community facilities, and commercial. The relocations can be classified as total acquisitions or partial acquisitions:

- **Total Acquisition:** This occurs when the primary improvement (house, business, nonprofit, or farm) is within the right-of-way or access to the parcel is removed and cannot be restored. The owner is compensated for the fair market value of the entire parcel and provided relocation assistance.
- **Partial Acquisition:** This occurs when a portion of a parcel is acquired and that portion does not include a primary improvement. The owner is compensated for the fair market value of the portion of their parcel and minor improvements that would be acquired.

This document represents a preliminary examination of the potential relocations; therefore, direct contact with individual residents, landowners, and business owners did not occur. Coordination with affected property owners will begin with the Public Hearing and continue into the final design process. Social and economic characteristics of the displaced population are based on United States Census data from the 2009 - 2013 American Community Survey (ACS) and from the National Center for Education Statistics.

Residential relocations by Build Alternative are detailed in Table 4.11-2. The No Build Alternative requires no residential relocations. Specific communities within which these relocations occur were discussed in Section 4.11.2.1.

In Alternative Area 1 (Arlington) Build Alternatives 1A, 1B, and 1C would have no residential relocations.

In Alternative Area 2 (Northern Virginia), the single Build Alternative 2A would have two residential relocations.

In Alternative Area 3 (Fredericksburg), the Fredericksburg Bypass (Build Alternative 3C) would have 19 residential relocations.

In Alternative Area 4 (Central Virginia), the single Build Alternative 4A would have no residential relocations.

In Alternative Area 5 (Ashland), the Ashland Bypass (Build Alternatives 5C and 5C–Ashcake) would have 21 residential relocations. These alternatives would relocate one community facility, the Calvary Pentecostal Tabernacle camp in Hanover County. This facility would be relocated due to severing the parcel and lack of access to the remaining part of the parcel.

In Alternative Area 6 (Richmond), residential relocations would occur under all Build Alternatives. The Build Alternatives that use the A-Line between Acca Yard and Centralia (Build Alternatives 6A, 6B–A-Line, and 6E would have 12 relocations. Build Alternative 6C, which also uses the A-Line, has 12 single-family residence relocations and an apartment building relocation with 100 units. The Build Alternatives that use the S-Line between Main Street Station and Centralia (Build Alternatives 6B–S-Line, 6D, 6F, and 6G) would have seven relocations.

Right-of-way acquisitions may be further minimized as design progresses. Easements may be used in lieu of acquiring new right-of-way for some properties. Temporary easements may also be needed on adjacent property to gain access to the existing rail line and right-of-way during construction activities and for construction staging. If necessary, these temporary easements could be obtained for a short duration, and the land would be returned to its original condition before easement lease termination.

DRPT has the ability and, if necessary, is willing to provide housing of last resort, including the purchase of land or dwellings; repair of existing dwellings to meet decent, safe, and sanitary conditions; relocation or remodeling of dwellings purchased by DRPT; or construction of new dwellings. DRPT assures that all displaced families and individuals would be relocated to suitable replacement housing, and that all replacement housing would be fair housing available to all persons without regard to race, color, religion, sex, or national origin and would be within the financial means of the displacees. Each person would be given enough time to negotiate for and obtain possession of replacement housing. No residential occupants would be required to move from property needed for the Build Alternatives until comparable decent, safe, and sanitary replacement dwellings have been made available to them.

Table 4.11-2: Residential Relocations by Build Alternative

Alternative Area	Alternative	City/County												
		Arlington County	City of Alexandria	Fairfax County	Prince William County	Stafford County	City of Fredericksburg	Spotsylvania County	Caroline County	Hanover County	Henrico County	City of Richmond	Chesterfield County	Total
Area 1: Arlington (Long Bridge Approach)	1A	0	–	–	–	–	–	–	–	–	–	–	–	0
	1B	0	–	–	–	–	–	–	–	–	–	–	–	0
	1C	0	–	–	–	–	–	–	–	–	–	–	–	0
Area 2: Northern Virginia (Long Bridge to Dahlgren Spur)	2A	–	0	0	2	0	–	–	–	–	–	–	–	2
Area 3: Fredericksburg (Dahlgren Spur to Crossroads)	3A	–	–	–	–	0	0	0	–	–	–	–	–	0
	3B	–	–	–	–	0	0	0	–	–	–	–	–	0
	3C	–	–	–	–	—	—	18	0	–	–	–	–	19
Area 4: Central Virginia (Crossroads to Doswell)	4A	–	–	–	–	–	–	–	–	–	–	–	–	0
Area 5: Ashland (Doswell to I-295)	5A	–	–	–	–	–	–	–	–	–	–	–	–	0
	5A–Ashcake	–	–	–	–	–	–	–	–	–	–	–	–	0
	5B	–	–	–	–	–	–	–	–	–	–	–	–	0
	5B–Ashcake	–	–	–	–	–	–	–	–	–	–	–	–	0
	5C	–	–	–	–	–	–	–	–	–	–	–	–	21
	5C–Ashcake	–	–	–	–	–	–	–	–	–	–	–	–	21
	5D–Ashcake	–	–	–	–	–	–	–	–	–	–	–	–	0
Area 6: Richmond (I-295 to Centralia)	6A	–	–	–	–	–	–	–	–	–	7	5	0	12
	6B–A-Line	–	–	–	–	–	–	–	–	–	7	5	0	12
	6B–S-Line	–	–	–	–	–	–	–	–	–	7	0	0	7
	6C	–	–	–	–	–	–	–	–	–	7	105	0	112
	6D	–	–	–	–	–	–	–	–	–	7	0	0	7
	6E	–	–	–	–	–	–	–	–	–	7	5	0	12
	6F	–	–	–	–	–	–	–	–	–	7	0	0	7
	6G	–	–	–	–	–	–	–	–	–	7	0	0	7

The acquisition of right-of-way and the relocation of displacees would be in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended. Assurance is given that relocation resources would be available to all residential, business, farm, and nonprofit displacees without discrimination.

4.11.5 Land Use Planning

4.11.5.1 Changes in Land Use

The No Build Alternative requires no right-of-way acquisition; therefore, it requires no land use conversion and has no direct impacts to land use.

The Build Alternatives require different amounts of right-of-way acquisition (Table 4.11-3). The transition of these land uses to transportation use is a direct effect, but it is an extension of the existing adjacent transportation land use and is not out of character with the area.

In Alternative Area 1 (Arlington), the only land use in transition to a transportation use is currently vacant. The transition of this land to a transportation use would not be incompatible with the current use.

In Alternative Area 2 (Northern Virginia), the greatest amount of land use transition to a transportation use is from residential uses. The transition of residential use to a transportation use would be incompatible; however, it is an extension of the existing adjacent transportation land use and is not out of character with the area.

In Alternative Area 3 (Fredericksburg), Build Alternatives 3A and 3B pass through town and involve transition from commercial/office and residential uses to a transportation land use. This conversion is not incompatible with the current land use. The Fredericksburg Bypass (Build Alternative 3C) bypasses the City of Fredericksburg to the east. It begins in Stafford County and is along the Dahlgren Spur, an existing rail line that is surrounded by commercial land uses at the junction with the main rail line. At Ferry Farm, the land use along Build Alternative 3C transitions to residential uses, and then rural residential and rural uses, with some commercial uses near the former Renaissance Faire. Build Alternative 3C turns south and crosses the Rappahannock River at the Spotsylvania County/Caroline County line. The land use in both counties along this alternative is predominantly agricultural, forested, and rural residential. Stafford County comprehensive planning is focusing growth within the urban service areas and does not recommend “increasing land use intensity” in other areas (Stafford County, 2014). Build Alternative 3C is not in one of the urban service areas. The Caroline County comprehensive plan states that agricultural and forested uses are “the primary land uses to be protected” (Caroline County, 2010). The Spotsylvania County comprehensive plan fosters “the preservation of agricultural and forestal land” and states that “the primary goal of the Future Land Use Element in the rural portion of the County is the preservation of farms, forestland, and open space” (Spotsylvania County, 2013). Based on the current land use planning within these counties, conversion of the existing land uses along Build Alternative 3C to a transportation land use is not compatible with the adjacent land uses.

In Alternative Area 4 (Central Virginia), the greatest amount of land use transitioning to transportation use is currently in agricultural use. The transition of this land to a transportation use would be incompatible with the current use.

Table 4.11-3: Land Use Acreage within Build Alternatives

Alternative Area	Alternative	Agricultural	Commercial/Office	Industrial	Institutional	Transportation	Preserved Open Space	Residential	Vacant
Area 1: Arlington (Long Bridge Approach)	1A	–	–	–	–	–	–	–	0
	1B	–	–	–	–	–	–	–	1.5
	1C	–	–	–	–	–	–	–	0.4
Area 2: Northern Virginia (Long Bridge to Dahlgren Spur)	2A	4.3	1.9	0.63	1.96	–	10.2	12.1	0.1
Area 3: Fredericksburg (Dahlgren Spur to Crossroads)	3A	0.2	0.3	–	1.9	–	0.05	0.4	–
	3B	0.2	10.7	–	2.0	–	3.4	12.6	–
	3C	66.4	22.0	–	1.9	–	5.6	75.2	–
Area 4: Central Virginia (Crossroads to Doswell)	4A	0.9	0.1	–	0.1	0.3	–	0.1	–
Area 5: Ashland (Doswell to I-295)	5A	4.2	0.5	2.7	0.5	11.2	–	3.6	–
	5A–Ashcake	4.2	–	3.8	–	9.7	–	3.6	–
	5B	4.2	0.5	2.7	2.2	15.2	–	5.5	–
	5B–Ashcake	4.2	0.1	3.8	1.9	15.3	–	5.5	–
	5C	150.8	0.5	6.5	0.5	37.3	–	0.6	–
	5C–Ashcake	150.8	–	7.6	–	35.8	–	0.5	–
	5D–Ashcake	4.2	0.4	3.9	1.4	21.1	–	6.3	–
Area 6: Richmond (I-295 to Centralia)	6A	–	8.5	17.1	0.2	–	0.2	19.5	6.8
	6B–A-Line	–	16.0	25.7	0.2	–	0.2	19.5	7.6
	6B–S-Line	–	8.7	22.5	0.2	–	0.01	4.8	12.7
	6C	–	38.6	18.4	7.1	–	0.4	21.3	7.3
	6D	–	9.5	17.7	0.2	–	0.01	4.6	13.0
	6E	–	9.2	19.9	0.2	–	0.4	19.5	9.4
	6F	–	12.4	23.1	0.2	–	0.01	4.6	14.1
	6G	–	11.8	22.2	0.2	–	0.01	4.6	13.6

Source: City and County Land Use GIS databases.

In Alternative Area 5 (Ashland), the greatest amount of land use transitioning to a transportation use for Build Alternatives 5A, 5A–Ashcake, 5B, 5B–Ashcake, and 5D–Ashcake is from land already in transportation use, such as the additional right-of-way required along Railroad Avenue. The transition of this land to a transportation use would not be incompatible with the current use. The Ashland Bypass (Build Alternatives 5C and 5C–Ashcake) to the west of the Town of Ashland lies completely within Hanover County. The Ashland Bypass alternatives begin north of town and turn southwest and then southeast to return to the main rail line south of Gwathmey. The land use along the bypass alternatives is currently in agricultural use. The Hanover County comprehensive plan states that in the existing agricultural land use category, such as along the Ashland Bypass (Build Alternatives 5C and 5C–Ashcake), "appropriate uses would be farming, forestry, Agricultural Forestal Districts, public or semi-public uses that serve the community," or rural residential uses. Based on the current land use planning within the county, conversion of existing land uses along the Ashland Bypass to a transportation land use is not compatible with the adjacent land uses. An existing Agricultural/Forestal District, the Stanley District, is also within Build Alternatives 5C and 5C–Ashcake and is adversely affected by those alternatives (see Section 4.3, Agricultural Lands).

In Alternative Area 6 (Richmond), the greatest amount of land use transitioning to transportation use for most of the Build Alternatives is currently in commercial and industrial use. The transition of this land to a transportation use would not be incompatible with the current use. The single-station Broad Street alternative (Build Alternative 6C) involves transition of almost 40 acres of commercial/office land use to a transportation use. This is primarily near the historic Broad Street Station.

4.11.5.2 Compatibility with Future Land Use

Many of the local jurisdictions have directly addressed the importance of rail service, and in some cases this particular Project, to local and regional mobility in their respective comprehensive planning processes. In Alternative Area 1 (Arlington), future land use adjacent to the Build Alternatives is expected to remain in a similar use to current uses.

In Alternative Area 2 (Northern Virginia), in Prince William County, future land use is projected to intensify within the Development Area (where development has already occurred) and remain similar to existing land uses within the Rural Area. The single Build Alternative 2A is compatible with these land uses. Within Stafford County, future land use is expected to stay similar to existing land use, with development intensifying in the Urban Service Areas.

In Alternative Area 3 (Fredericksburg), Build Alternatives 3A and 3B, which pass through Fredericksburg, are compatible with future land uses. In the City of Fredericksburg, future land use is expected to remain similar to existing land use, due to the city's developed nature. Build Alternatives 3A and 3B are compatible with these land uses. In Spotsylvania and Caroline counties, future land use within Build Alternatives 3A and 3B is expected to remain similar to the existing rural residential and agricultural/forested uses. In both counties, I-95 and the CSXT rail line are acknowledged as important transportation corridors. The Fredericksburg Bypass (Build Alternative 3C) is also compatible with future land uses for those sections along existing rail. The 7.1-mile new alignment portion of this bypass alternative is inconsistent with the future rural land use planned for that area. However, DRPT does not expect Build Alternative 3C to affect future land use outside of the Project right-of-way.,

In Alternative Area 4 (Central Virginia), future land use in Caroline County is discussed in Alternative Area 3. In Hanover County, future land use is projected to remain similar to existing land uses, while providing "orderly growth" (Hanover County, 2012).

In Alternative Area 5 (Ashland), the Build Alternatives, other than the Ashland Bypass (Build Alternative 5C and Build Alternative C–Ashcake), are compatible with future land uses.

In Alternative Area 6 (Richmond), existing land uses surrounding the Build Alternatives are expected to remain similar. The Build Alternatives are compatible with these uses.

4.11.5.3 Compatibility with Multimodal Transportation Planning

Many of the intercity passenger stations along the DC2RVA corridor have direct connections to local and regional transit. Particularly, all intercity passenger rail stations in Northern Virginia share service with VRE. Other stations in Northern Virginia have convenient or direct connection to the WMATA, including Franconia-Springfield, Alexandria, Crystal City, L'Enfant Plaza and Washington Union Station. In Richmond, Main Street Station has multiple local and regional bus services and the planned Broad Street bus rapid transit system. These multimodal connections can help offset vehicular traffic at these stations.

Many of the jurisdictions have recognized the importance of rail and multimodal transportation options within their transportation networks to residents, local businesses, regional connections, and economic vitality. In several of the jurisdictions, improved passenger rail and planning for it is specifically mentioned (Fairfax County, Stafford County, the City of Fredericksburg, Caroline County, the Town of Ashland, the City of Richmond, and Chesterfield County). Within the counties that have existing rail stations, focusing new development, particularly transit-oriented, in these areas is a priority.

Nevertheless, two entities, the Fredericksburg Area Metropolitan Planning Organization (MPO) and the Hanover County Board of Supervisors, have expressed opposition to the Fredericksburg Bypass (Build Alternative 3C) and Ashland Bypass (Build Alternatives 5C and 5C–Ashcake), respectively. Because these alternatives are not supported by specific government-entity resolutions, they are not compatible with planning in these areas.

4.12 TITLE VI AND ENVIRONMENTAL JUSTICE

The environmental justice analysis is based on whether the percentage of minority or low-income populations within a census tract impacted by an alternative is greater than the percentage of minority or low-income populations within that census tract's county. For example, Fairfax County has a minority population of 46.11 percent. If the percentage of minority population in a census tract in Fairfax County is higher than 46.11 percent, the tract has the potential to contain an environmental justice population. Instead of a regional population across the entire corridor, this method provides a more accurate representation of potential environmental justice populations in diverse areas such as the DC2RVA corridor. Data and information from other sources, such as free and reduced school lunch programs and the public involvement process, have also been used to refine the identification of potential environmental justice communities not identified by United States Census data. The number of relocations, changes in community cohesion, relocations of community facilities, changes of access to these facilities, changes in response times for emergency services, and noise and vibration effects are all examined to assess effects. The trigger for an environmental justice effect is defined as "disproportionately high and adverse human health or environmental effects" (EO 12898). These effects are then compared to impacts in those census tracts that do not meet the thresholds for environmental justice populations.

The U.S. DOT definition of Adverse Effects is "the totality of significant individual or cumulative human health or environmental effects, including interrelated social and economic effects, which may include, but are not limited to: bodily impairment, infirmity, illness or death; air, noise, and water pollution and soil contamination; destruction or disruption of man-made or natural resources; destruction or diminution of aesthetic values; destruction or disruption of community cohesion or a community's economic vitality; destruction or disruption of the availability of public and private facilities and services; vibration; adverse employment effects; displacement of persons, businesses, farms, or nonprofit organizations; increased traffic congestion, isolation, exclusion or separation of minority or low-income individuals within a given community or from the broader community; and the denial of, reduction in, or significant delay in the receipt of, benefits of DOT programs, policies, or activities" (U.S. DOT, 5610.2[a]).

The U.S. DOT definition of disproportionately high and adverse effect on minority and low-income populations is an Adverse Effect that:

1. "is predominately borne by a minority population and/or a low-income population, or
2. will be suffered by the minority population and/or low-income population and is appreciably more severe or greater in magnitude than the adverse effect that will be suffered by the non-minority population and/or non-low-income population" (U.S. DOT, 5610.2[a]).

4.12.1 Corridor-Wide Impacts

The No Build Alternative requires no right-of-way acquisition; therefore, it requires no relocations and has no direct adverse impacts to Title VI or environmental justice populations. Under the No Build Alternative, beneficial impacts also would not be realized. Congestion and lack of mobility would continue to affect individuals and communities. These problems also would continue to impact businesses and economic activity along the DC2RVA corridor, which would, in turn, result in additional impacts to individuals and communities.

Under all Build Alternatives, more-frequent and more-reliable intercity passenger rail service in the DC2RVA corridor would provide better access and mobility to all communities and populations, including environmental justice populations. Access to a wider geographic area for educational, medical, and employment opportunities would be improved as well.

4.12.2 Community-Level Impacts

United States Census information and preliminary relocation data was supplemented with information from public involvement activities for this Project and from federal education statistical information, and regional and local agency planning information on communities.

4.12.2.1 Relocations and Displacements

Seven of the Build Alternatives that significantly alter the natural or railroad operating environments on the Fredericksburg Bypass (Build Alternative 3C), Ashland Bypass (Build Alternatives 5C and 5C–Ashcake), or CSXT A-Line in the City of Richmond (Build Alternatives 6A, 6B–A-Line, 6C, and 6E) have the potential to impact six census tracts with low-income and minority populations, out of a total of 10 census tracts with residential relocations (Table 4.12-1 and Figure 4.12-1). Implementation of a Build Alternative would impact communities with environmental justice populations by requiring the acquisition of right-of-way and the displacement of residences. DRPT considers displacements to be adverse effects.

In Alternative Area 3 (Fredericksburg), the Fredericksburg Bypass (Build Alternative 3C) has the potential for disproportionately high and adverse effects on potential environmental justice populations. All 19 residential relocations would occur in census tracts that have low-income populations, and 18 would occur in a census tract with low-income and minority populations. In the latter tract, in Spotsylvania County, the elementary school that students in the area are zoned for, Cedar Forest, is also a Title 1 school based on the high percentage of students that receive free and reduced-price lunches.

In Alternative Area 5 (Ashland), the Ashland Bypass (Build Alternatives 5C and 5C–Ashcake) does not have the potential for disproportionately high and adverse effects on potential environmental justice populations. Of the 21 residential relocations, only five would occur in a census tract that has high low-income and minority populations.

In Alternative Area 6 (Richmond), three of the four Build Alternatives that use the A-Line between Acca Yard and Centralia (Build Alternatives 6A, 6B–A-Line, and 6E) would have five residential relocations that occur in census tracts with high minority populations (Table 4.12-1). However, this is not disproportionate since seven potential residential relocations would also occur with these alternatives in census tracts with lower proportions of the population that are low-income or minority. The fourth Build Alternative that uses the A-Line (Build Alternative 6C) would have 112 relocations, 105 of which would be in census tracts with high minority or low-income populations. DRPT has, therefore, determined that Build Alternative 6C has the potential for disproportionately high and adverse effects on potential environmental justice populations. The Build Alternative 6C relocations include a 100-unit apartment building.

The potential impacts to environmental justice populations could be avoided and/or minimized by using a Build Alternative that does not have relocations occurring in a census tract with high percentages of low-income and minority populations.

4.12.2.2 Noise and Vibration

The Build Alternatives were also analyzed to determine any disproportionate and adverse noise and vibration effects to environmental justice populations. The potential noise receptors that were assessed for this analysis were residential receptors and other places for sleeping (Category 2) and were those receptors with moderate and severe impacts. A full discussion of noise impacts appears in Section 4.7, Noise and Vibration.

In Alternative Area 1 (Arlington), there are no affected noise receptors.

In Alternative Area 2 (Northern Virginia), there are more than 700 noise receptors affected by the single Build Alternative 2A. Fifty-five (55) percent of these noise receptors occur in census tracts with a high proportion of minority and low-income populations in the communities of Springfield Forest, Lorton, Colchester, Marumsco Acres, Marumsco Woods, and Leeland. This Build Alternative would not have a disproportionately high and adverse effect on potential environmental justice populations in these communities.

In Alternative Area 3 (Fredericksburg), there are less than 100 noise receptors affected by Build Alternatives 3A and 3B; however, 88 percent of these occur in census tracts with a high proportion of minority and low-income populations. These occur in the communities of Mayfield, Hazel Hill, Patriot Lane, Summit, and Claiborne Crossing. This would be a disproportionately high and adverse effect on potential environmental justice populations in these communities. There are almost 4,000 noise receptors affected by the Fredericksburg Bypass (Build Alternative 3C), primarily due to the addition of freight trains along the new bypass. Forty-five (45) percent of these noise receptors occur in census tracts with a high proportion of minority and low-income populations. The affected receptors occur throughout the entire bypass, not just clustered in one community. This alternative would not have a disproportionate effect on environmental justice populations. Mitigation for these effects could include noise barriers for affected receptors. Additional information regarding noise mitigation is provided in Section 4.7.1.5, Noise Mitigation Measures; however, detailed recommendations for noise mitigation will be developed during the final design process.

Table 4.12-1: Residential Relocations by Environmental Justice Census Tracts

Alternative Area	Alternative	City/County										
		Prince William County	Stafford County	Spotsylvania County	Hanover County		Henrico County		City of Richmond			Total
		Tract 9001	Tract 105.04	Tract 202.05	Tract 3205	Tract 3204	Tract 2005.03	Tract 2009.06	Tract 402	Tract 706.02	Tract 710.02	
Area 2: Northern Virginia (Long Bridge to Dahlgren Spur)	2A	2	–	–	–	–	–	–	–	–	–	2
Area 3: Fredericksburg (Dahlgren Spur to Crossroads)	3C	–	1	18	–	–	–	–	–	–	–	19
Area 5: Ashland (Doswell to I-295)	5C	–	–	–	16	5	–	–	–	–	–	21
	5C–Ashcake	–	–	–	16	5	–	–	–	–	–	21
Area 6: Richmond (I-295 to Centralia)	6A	–	–	–	–	–	3	4	0	4	1	12
	6B–A-Line	–	–	–	–	–	3	4	0	4	1	12
	6B–S-Line	–	–	–	–	–	3	4	0	0	0	7
	6C	–	–	–	–	–	3	4	100*	4	1	112
	6D	–	–	–	–	–	3	4	0	0	0	7
	6E	–	–	–	–	–	3	4	0	4	1	12
	6F	–	–	–	–	–	3	4	0	0	0	7
	6G	–	–	–	–	–	3	4	0	0	0	7
% Minorities in City/County		52	33	28	15		44		61			–
% Minorities in Census Tract		42	9	36	7	17	20	25	50	84	83	–
% Low-Income in City/County		6	5	8	5		11		26			–
% Low-Income in Census Tract		5	10	9	2	10	10	6	46	14	21	–

Above 50%; Greater than respective jurisdiction. *This is an apartment building with 100 units.

Build Alternatives 1A, 1B, 1C, 3A, 3B, 4A, 5A, 5A–Ashcake, 5B, 5B–Ashcake, and 5D–Ashcake, have no residential relocations; therefore, they do not appear in this table.

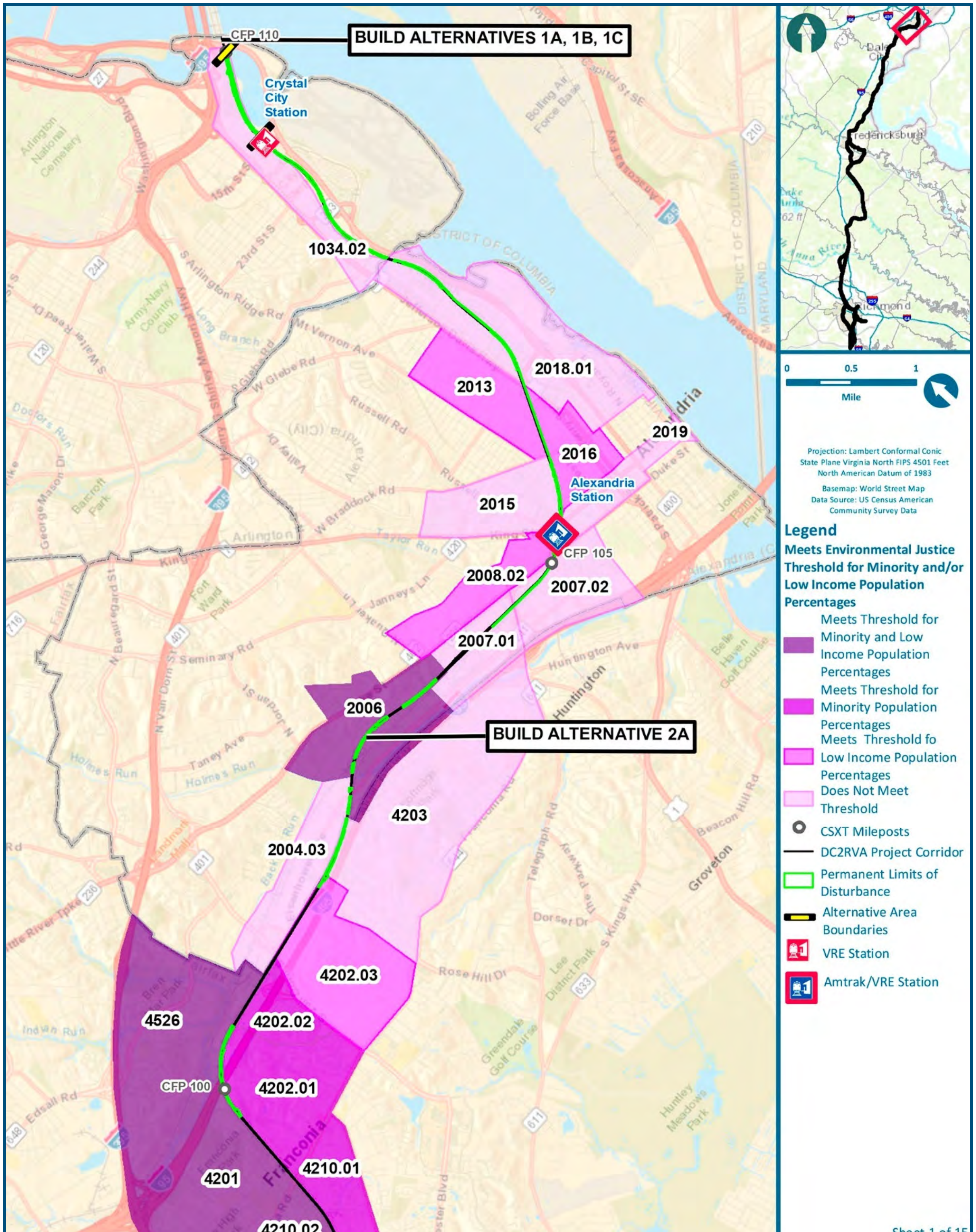


Figure 4.12-1: Environmental Justice Census Tract Impacts – Build Alternatives 1A, 1B, 1C, 2A

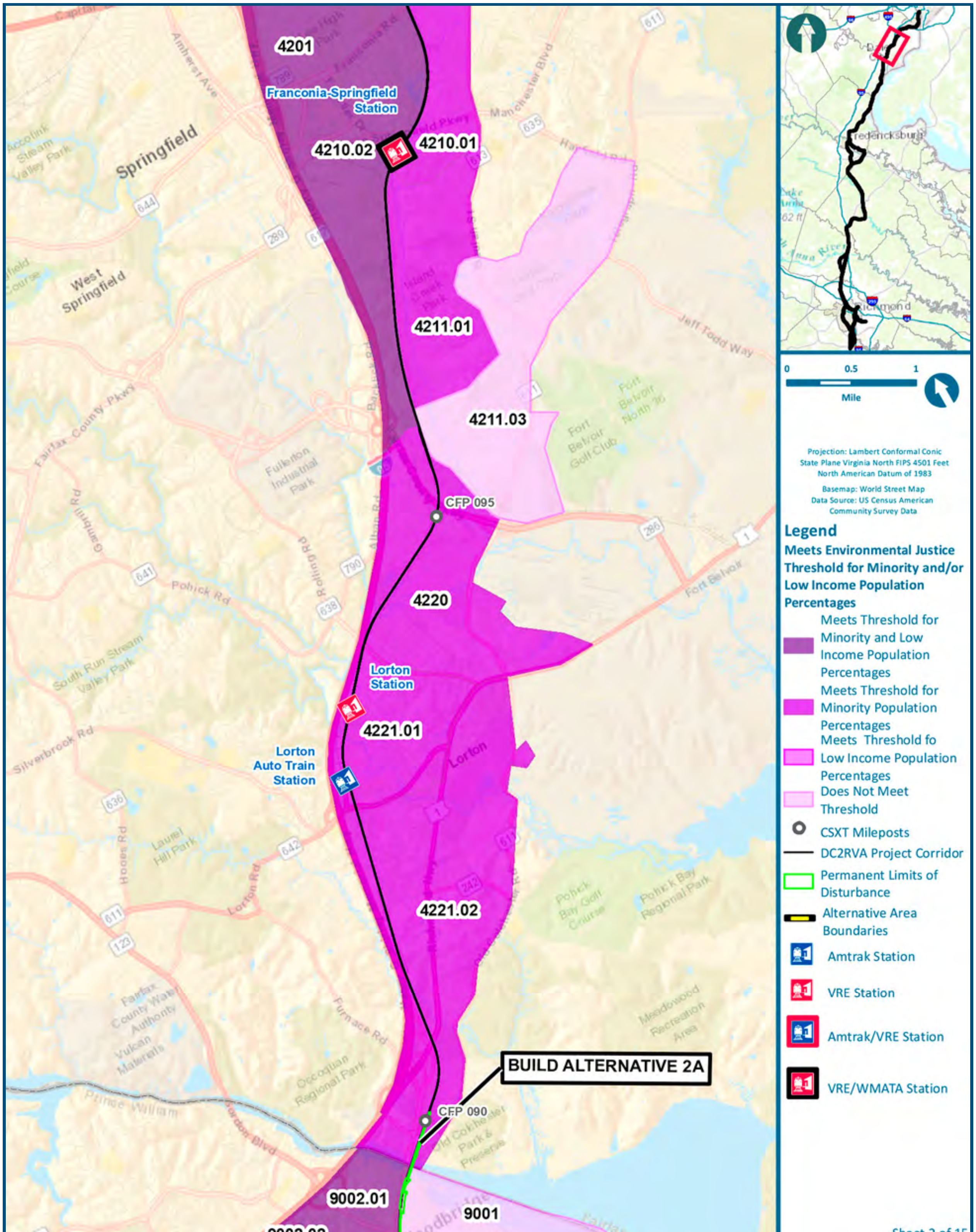


Figure 4.12-1: Environmental Justice Census Tract Impacts – Build Alternative 2A

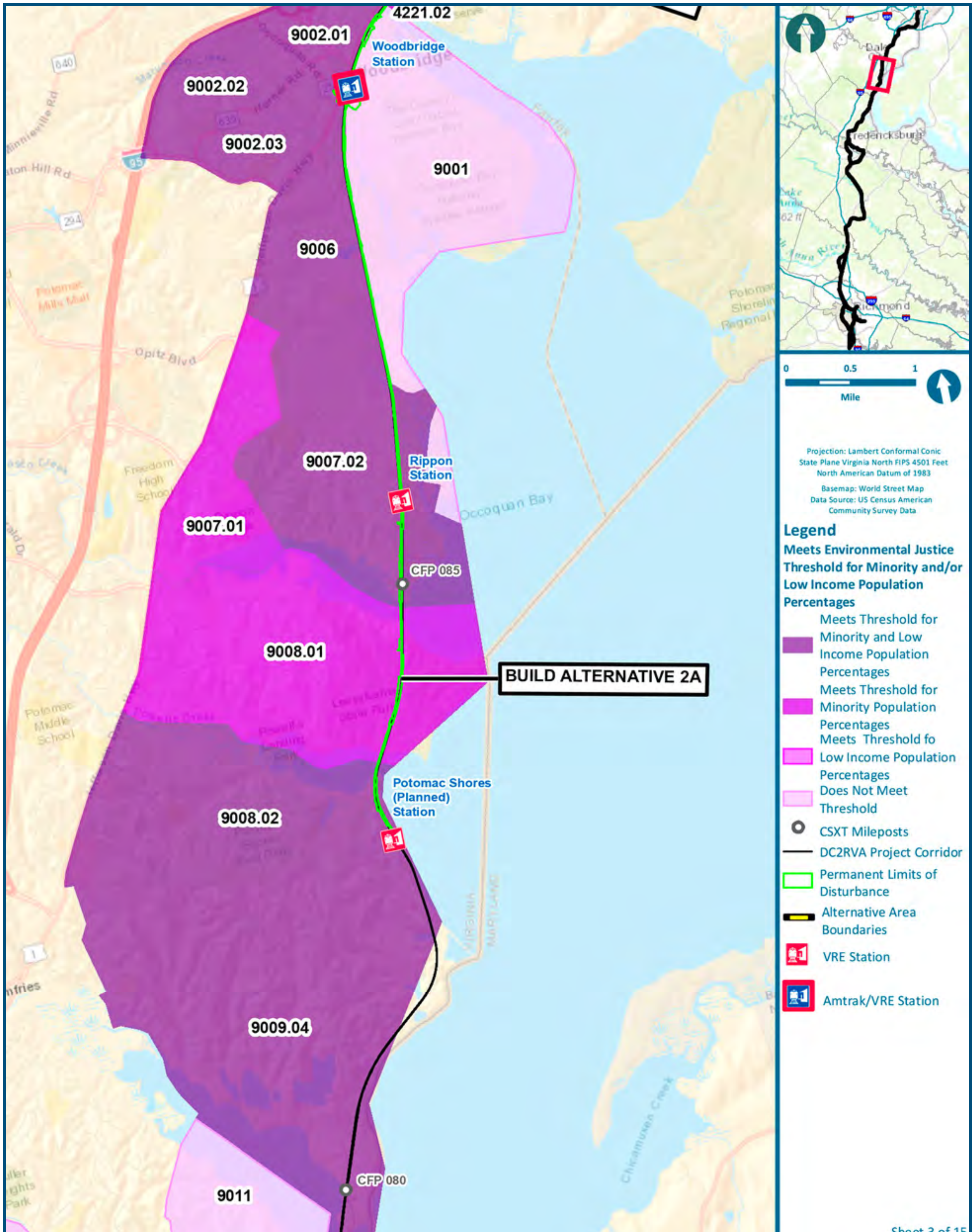


Figure 4.12-1: Environmental Justice Census Tract Impacts – Build Alternative 2A

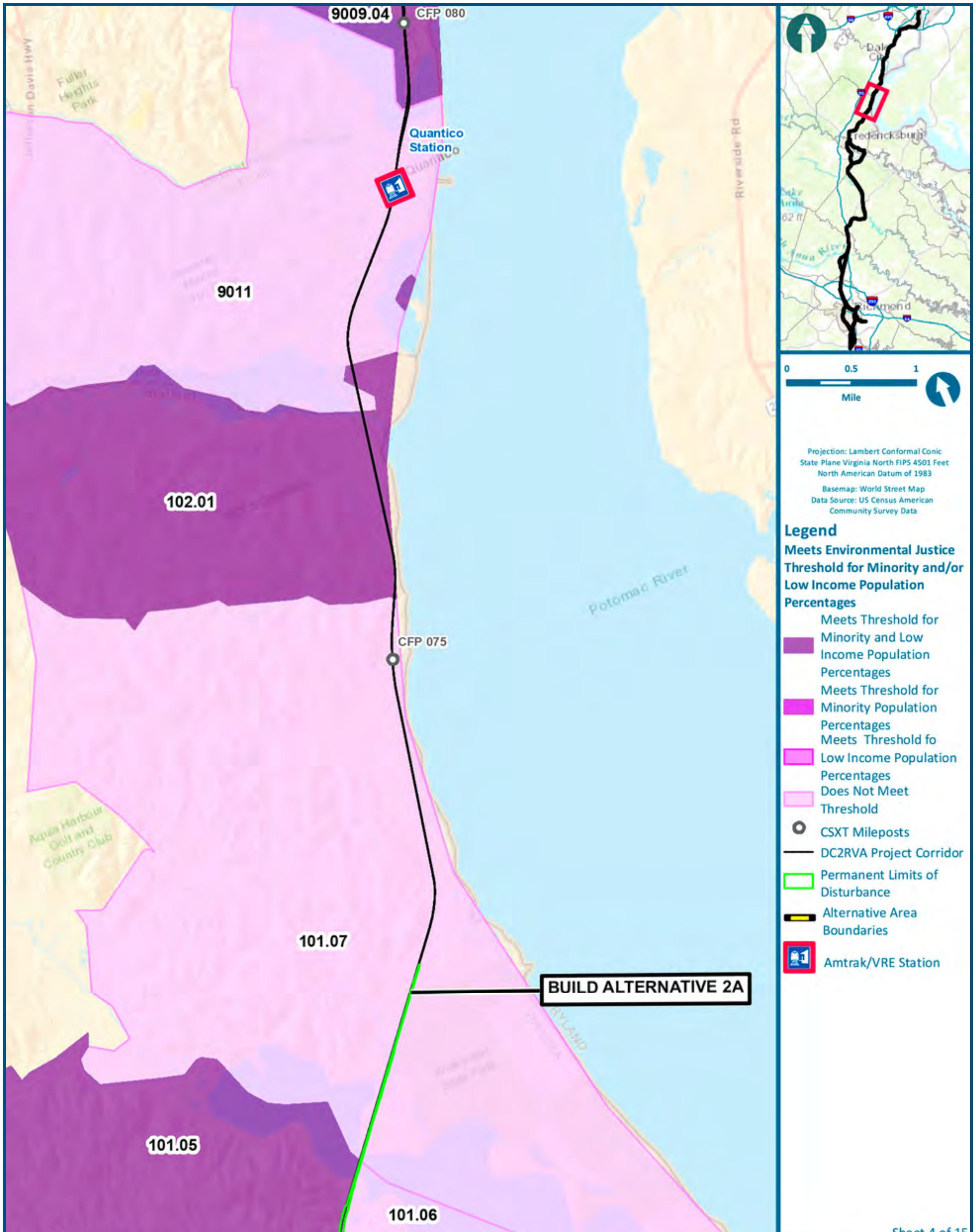


Figure 4.12-1: Environmental Justice Census Tract Impacts – Build Alternative 2A

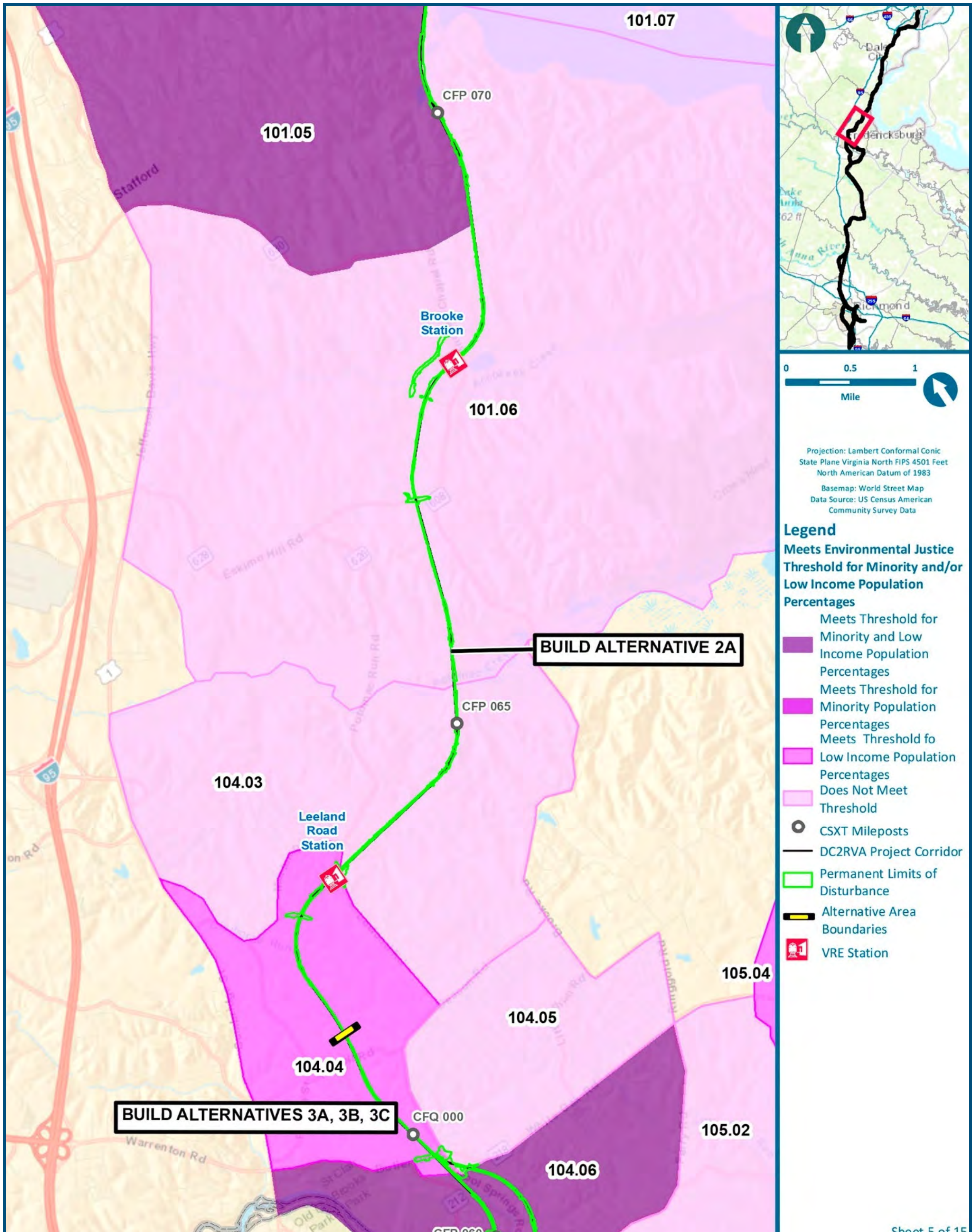


Figure 4.12-1: Environmental Justice Census Tract Impacts – Build Alternatives 2A, 3A, 3B, 3C

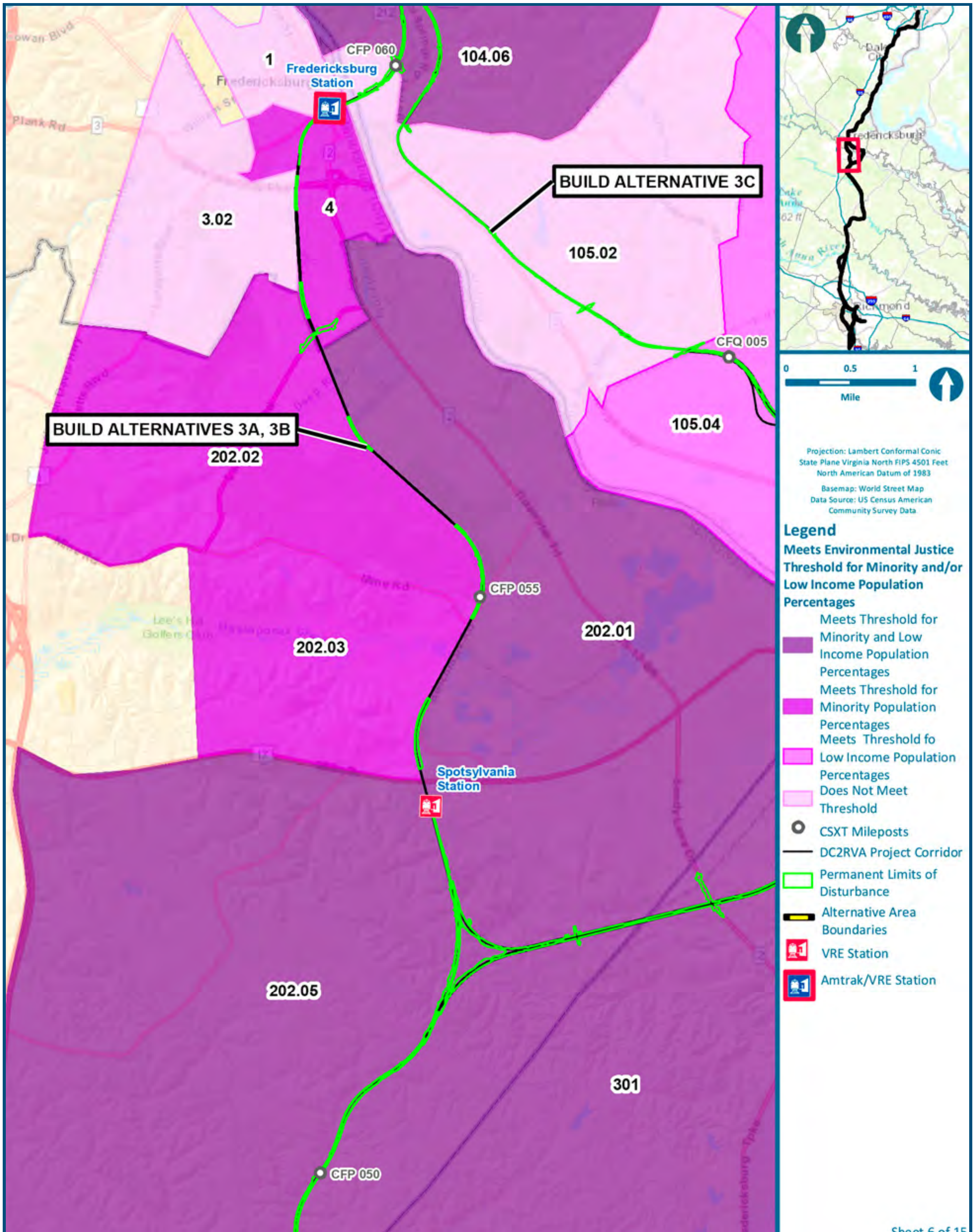


Figure 4.12-1: Environmental Justice Census Tract Impacts – Build Alternatives 3A, 3B, 3C

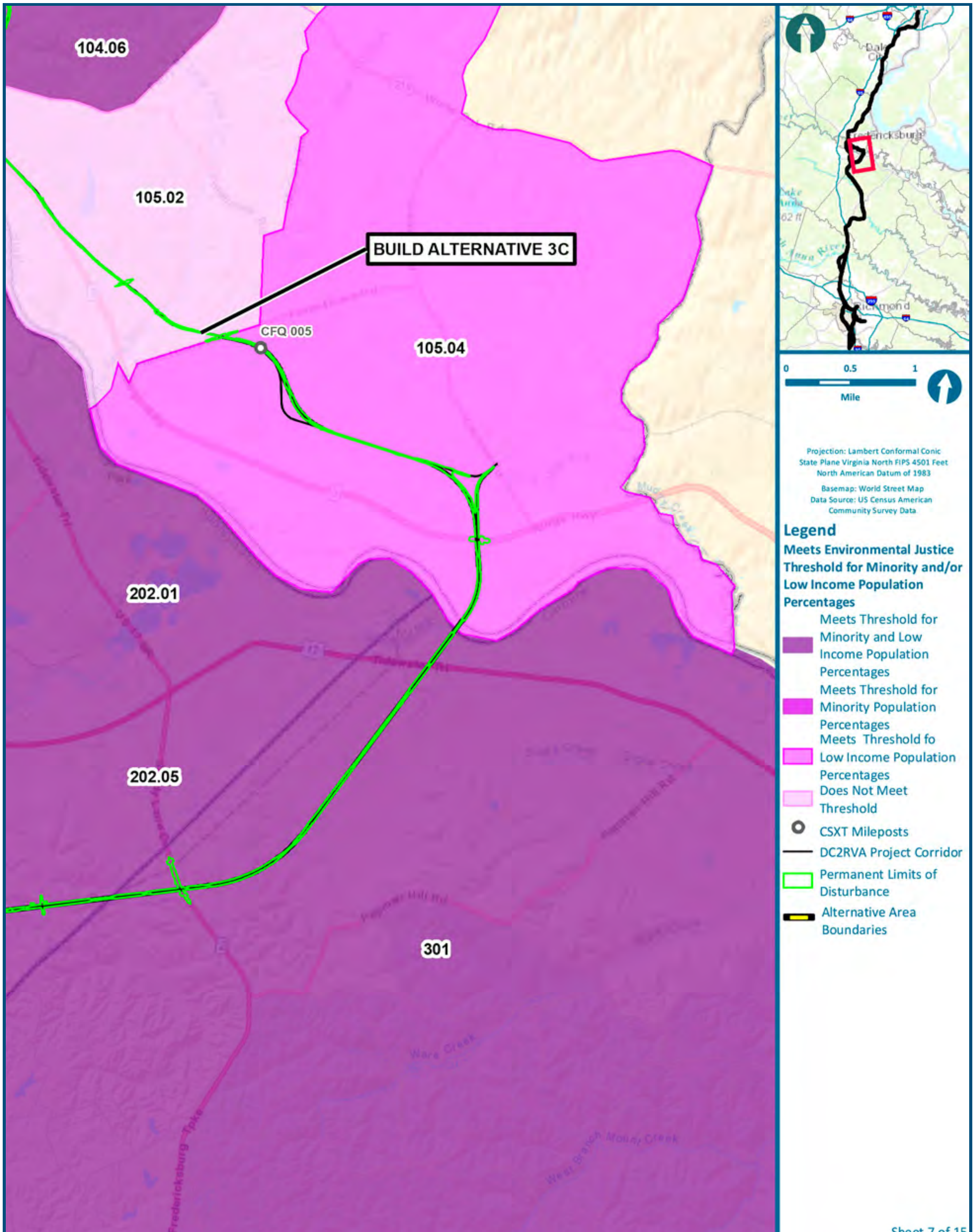


Figure 4.12-1: Environmental Justice Census Tract Impacts – Build Alternative 3C

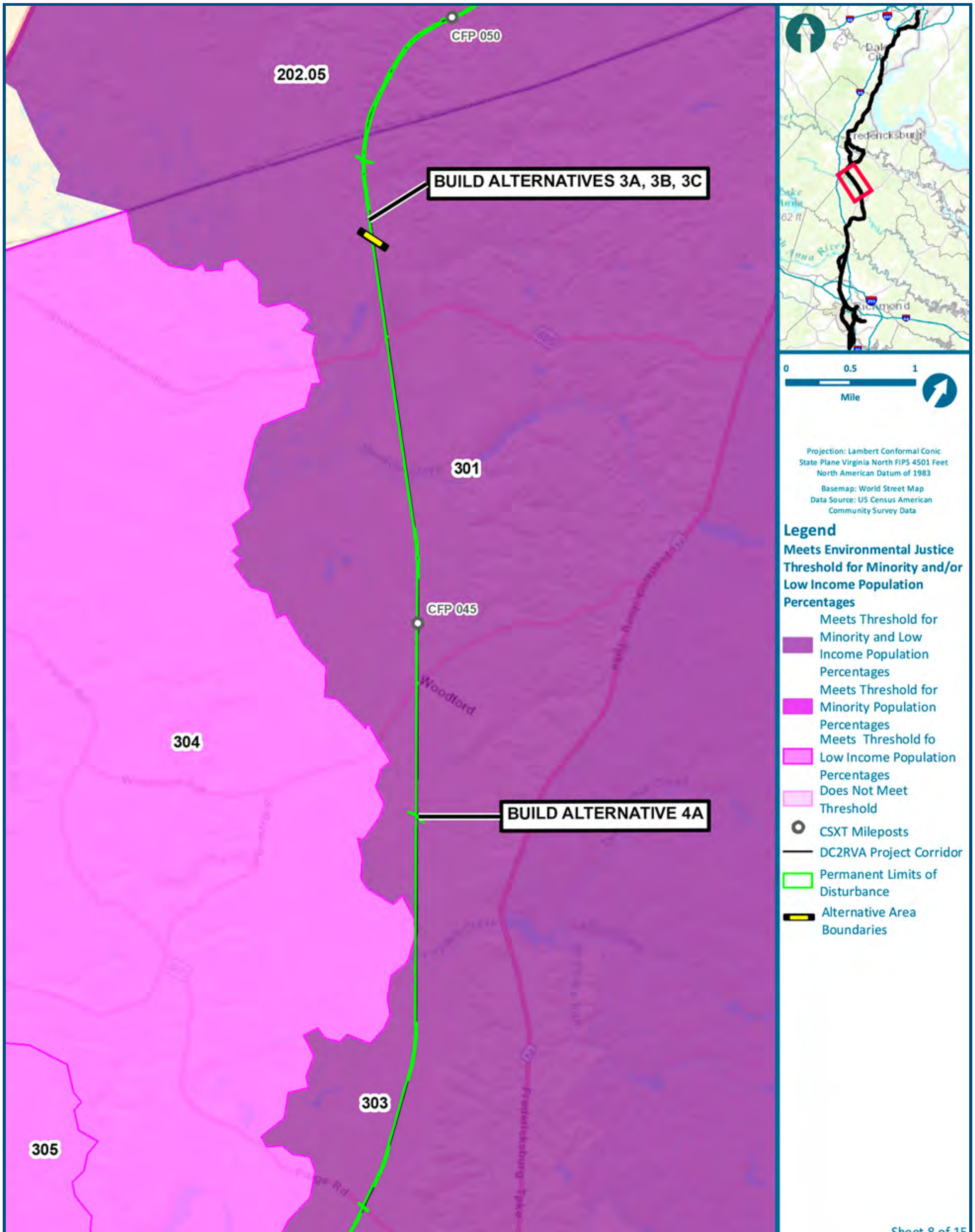


Figure 4.12-1: Environmental Justice Census Tract Impacts – Build Alternatives 3A, 3B, 3C, 4A

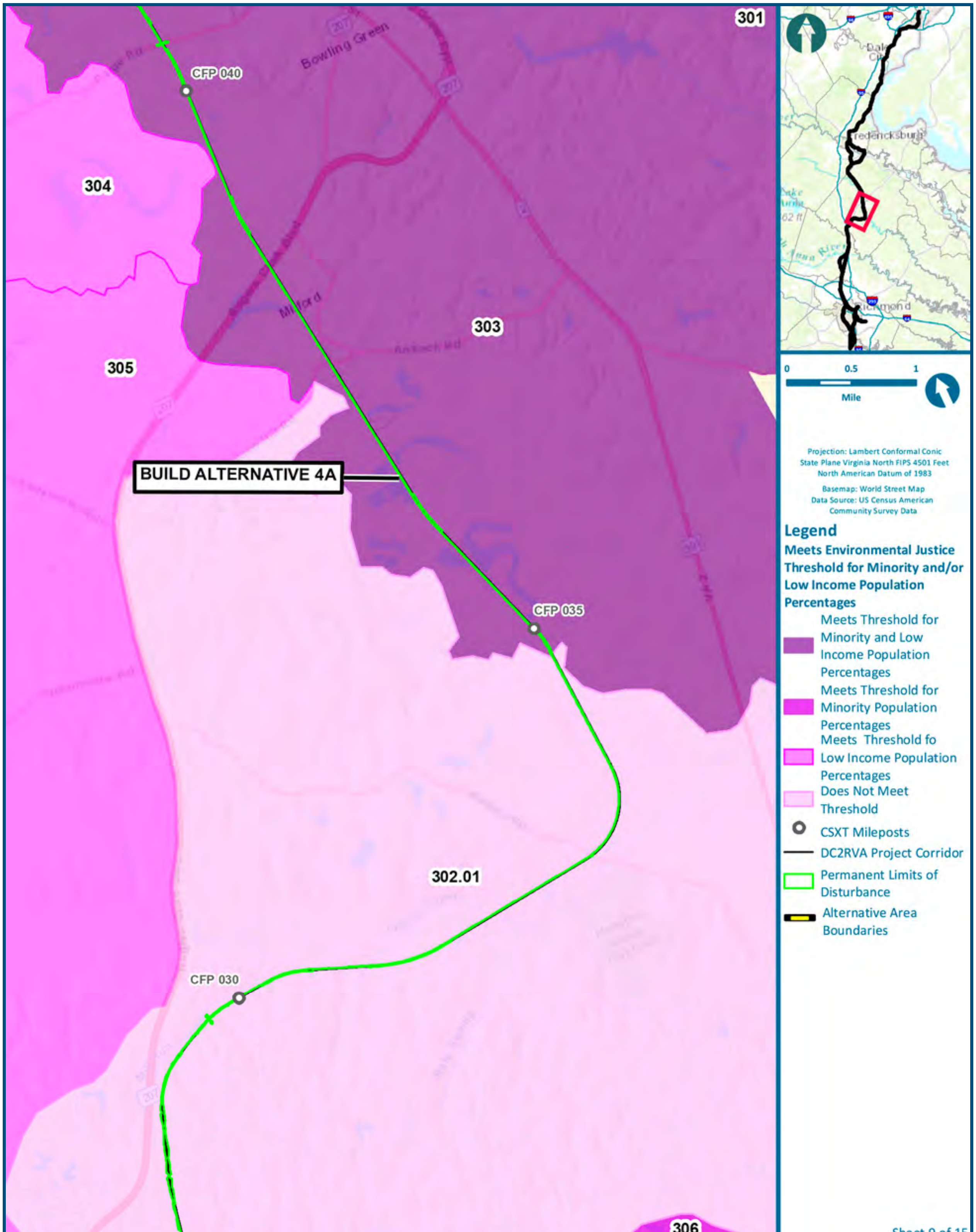


Figure 4.12-1: Environmental Justice Census Tract Impacts – Build Alternative 4A

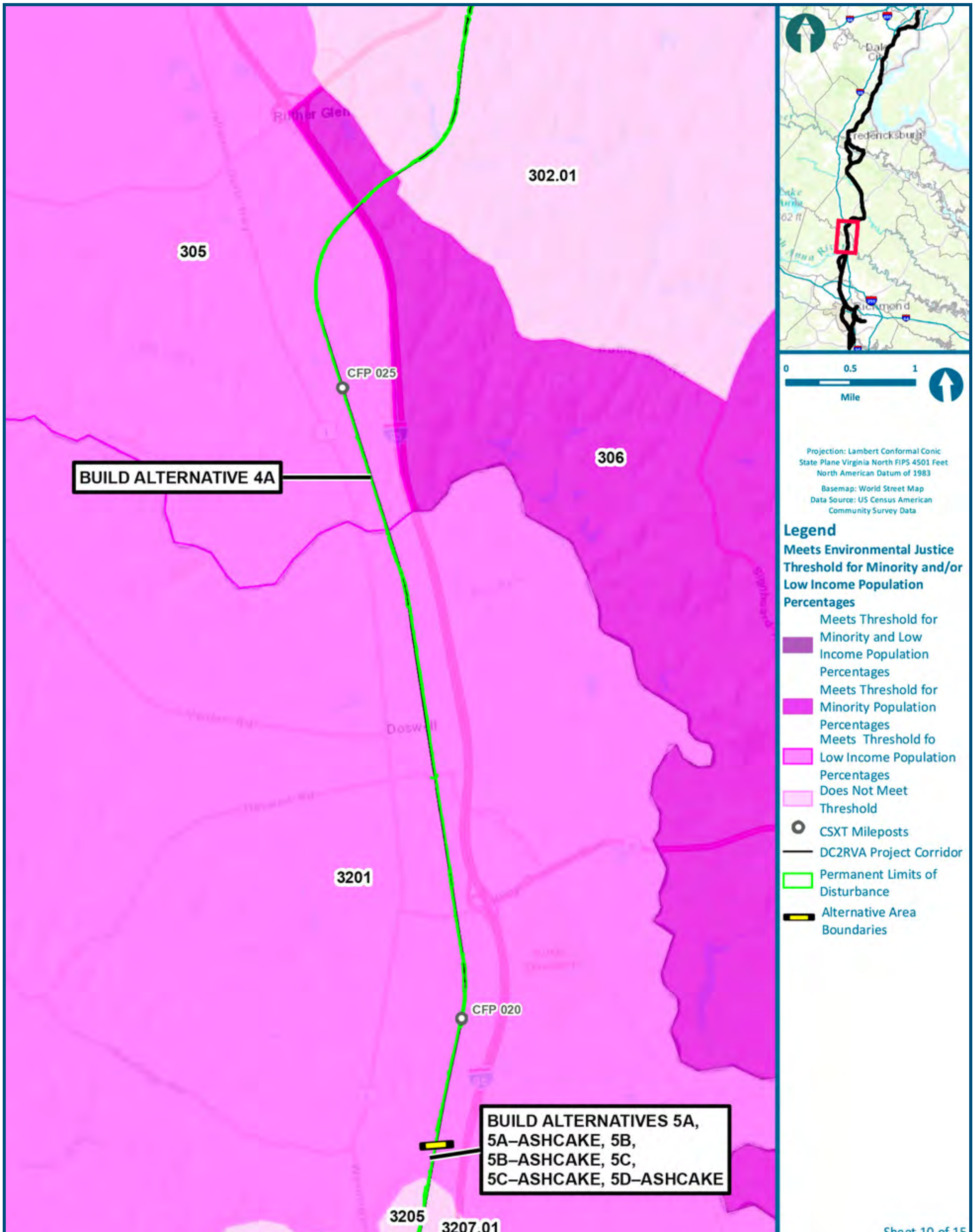


Figure 4.12-1: Environmental Justice Census Tract Impacts – Build Alternatives 4A, 5A, 5A–Ashcake, 5C, 5C–Ashcake, 5D–Ashcake

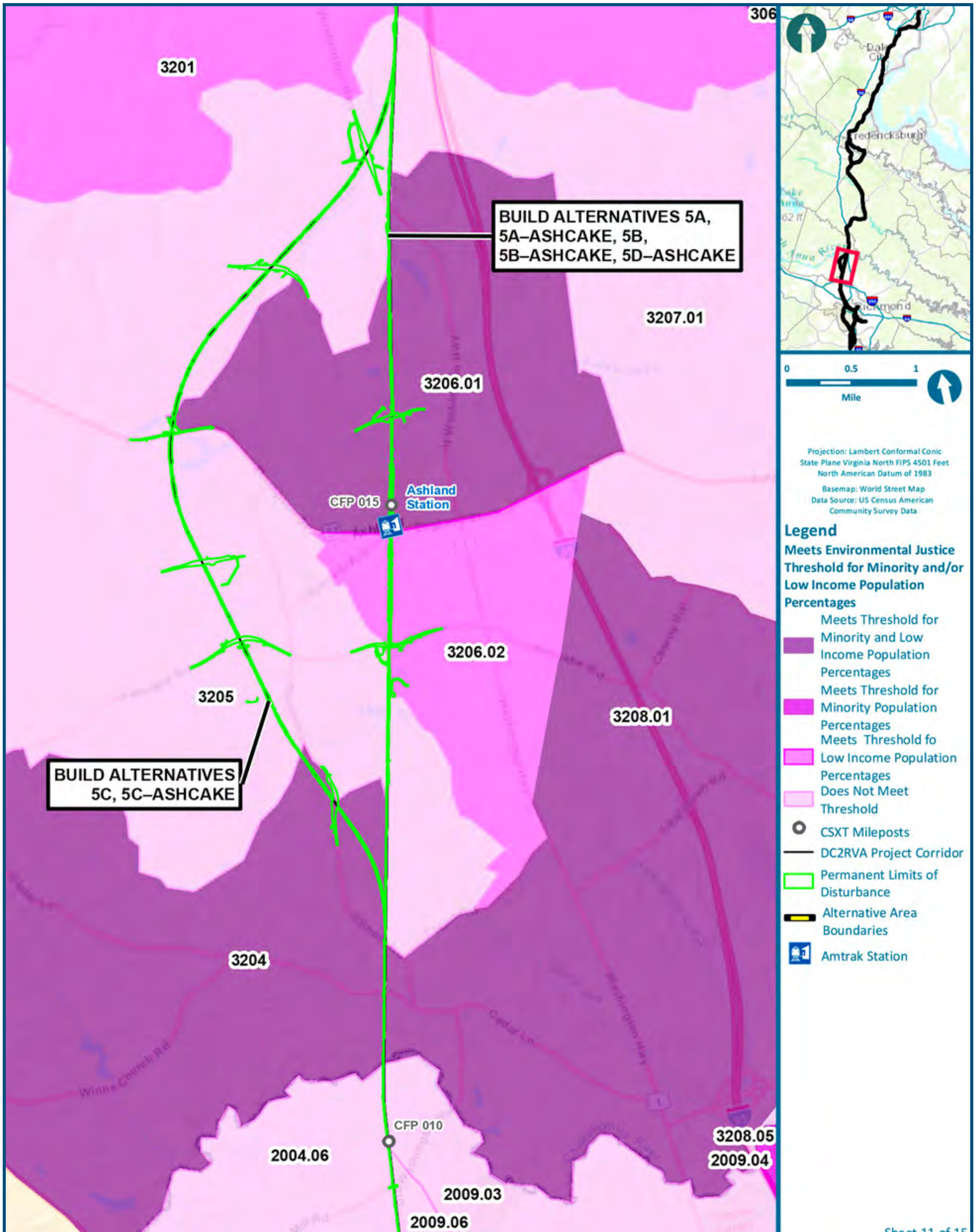


Figure 4.12-1: Environmental Justice Census Tract Impacts – Build Alternatives 5A, 5A–Ashcake, 5B, 5B–Ashcake, 5C, 5C–Ashcake, 5D–Ashcake

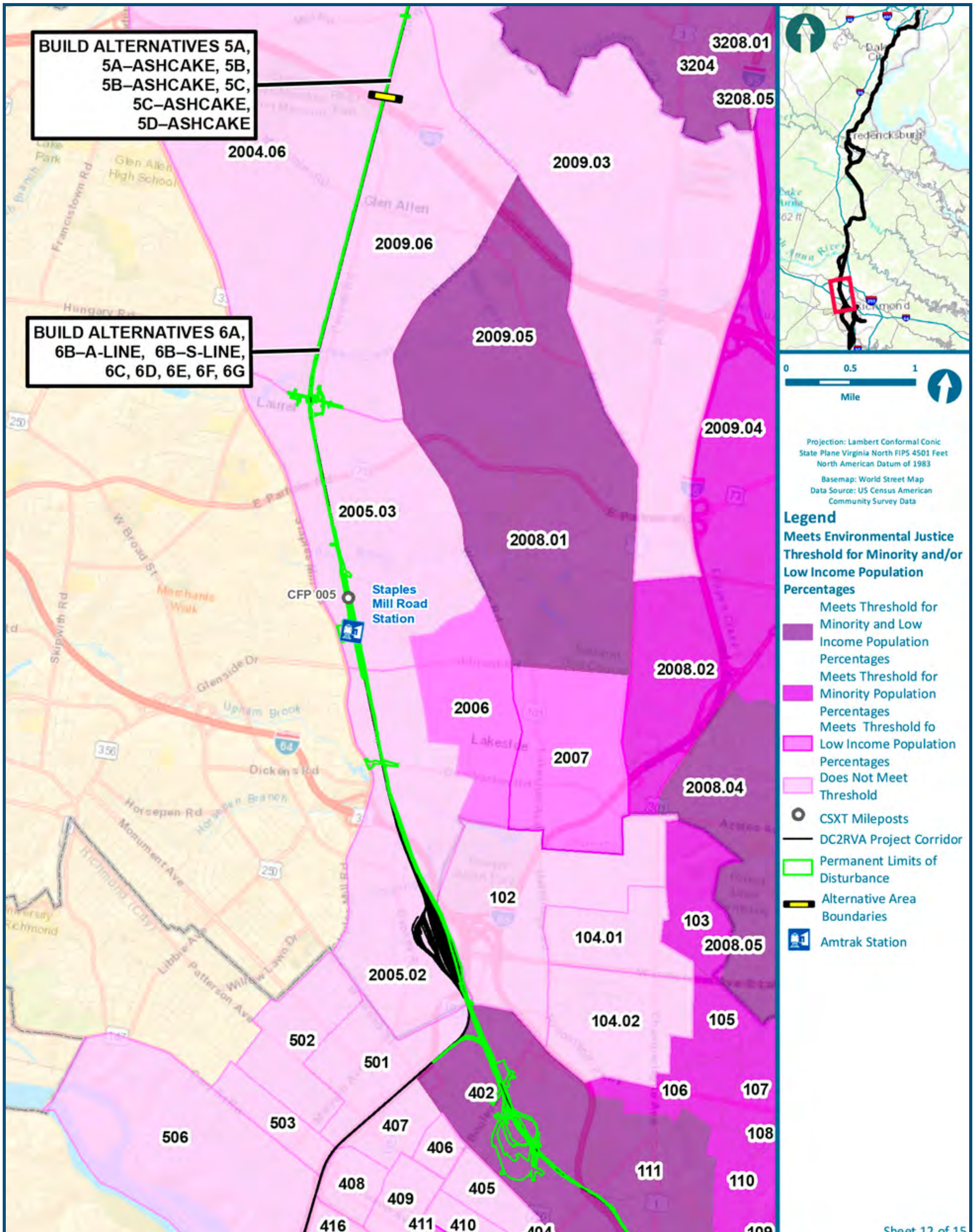


Figure 4.12-1: Environmental Justice Census Tract Impacts – Build Alternatives 5A, 5A–Ashcake, 5B, 5B–Ashcake, 5C, 5C–Ashcake, 5D–Ashcake, 6A, 6B–A-Line, 6B–S-Line, 6C, 6D, 6E, 6F, 6G

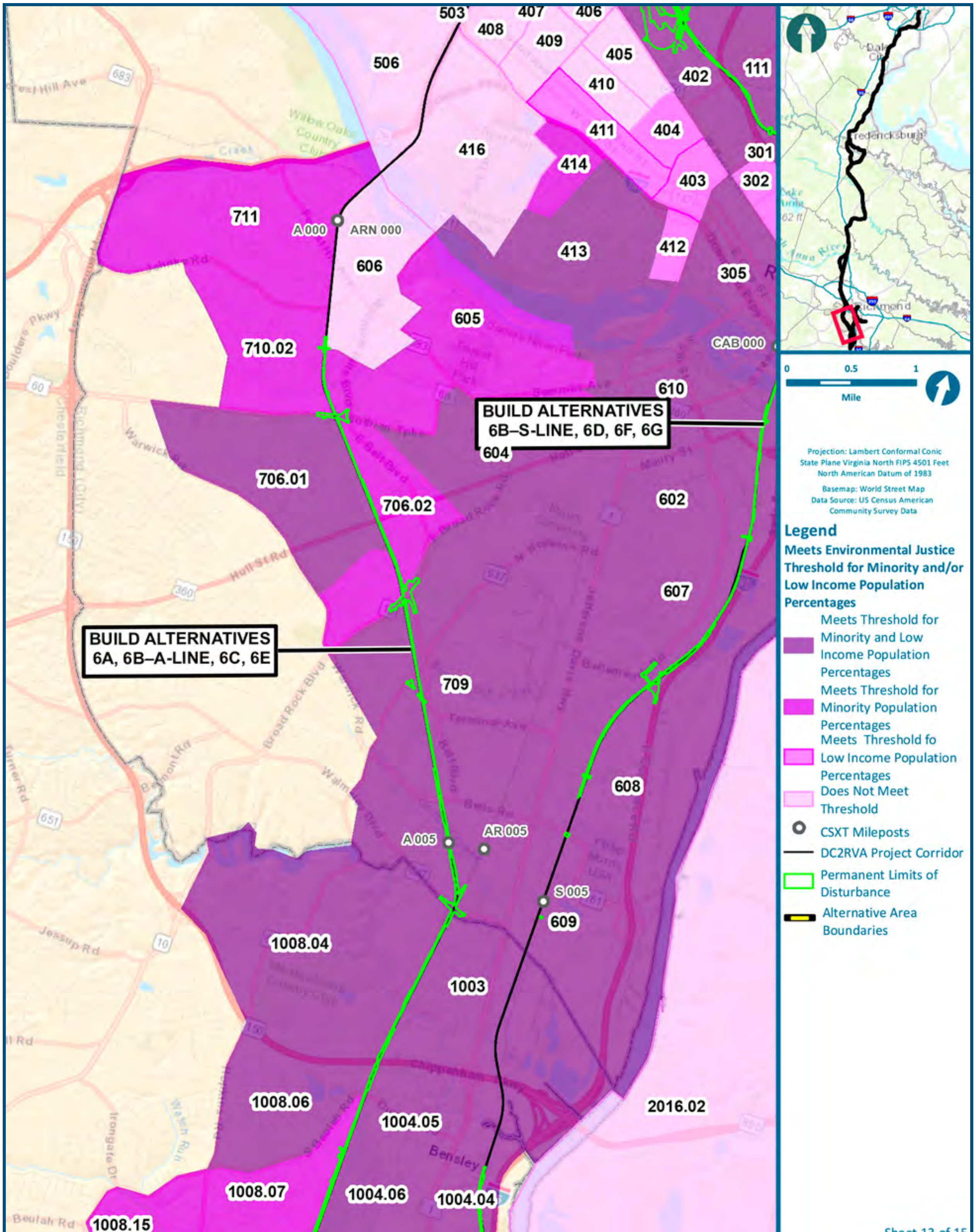


Figure 4.12-1: Environmental Justice Census Tract Impacts – Build Alternatives 6A, 6B–A-Line, 6B–S-Line, 6C, 6D, 6E, 6F, 6G

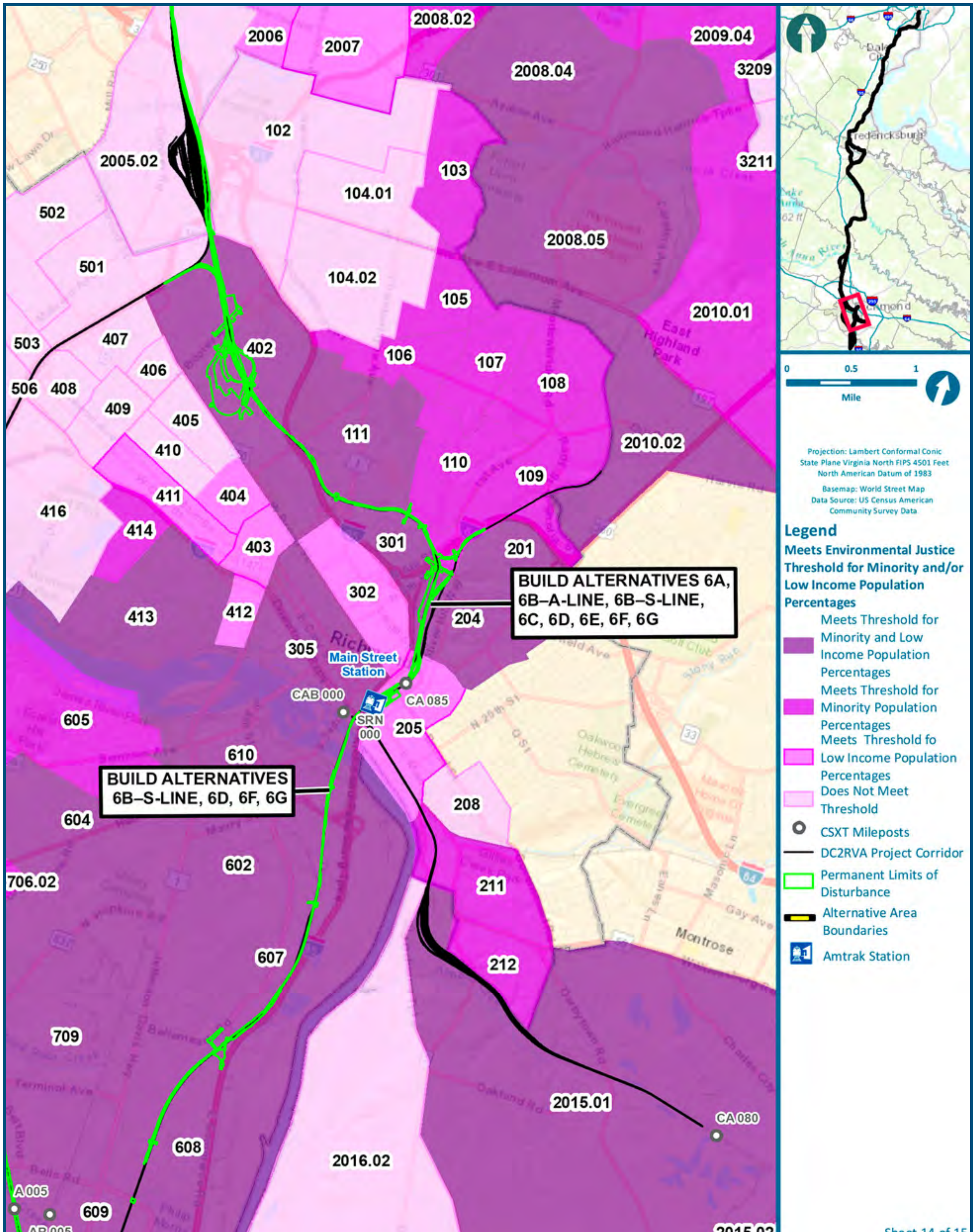


Figure 4.12-1: Environmental Justice Census Tract Impacts – Build Alternatives 6A, 6B–A-Line, 6B–S-Line, 6C, 6D, 6E, 6F, 6G

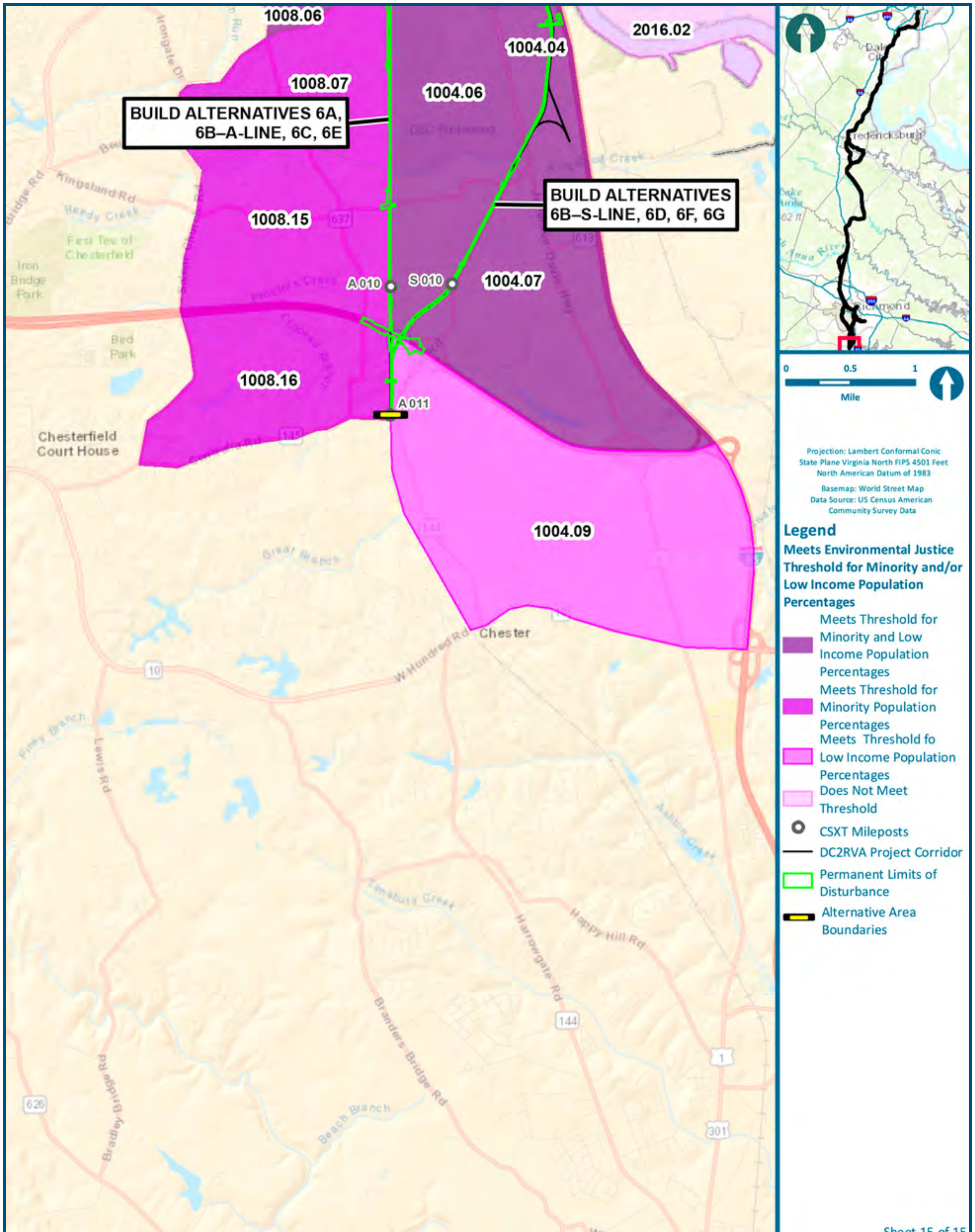


Figure 4.12-1: Environmental Justice Census Tract Impacts – Build Alternatives 6A, 6B–A-Line, 6B–S-Line, 6C, 6D, 6E, 6F, 6G

In Alternative Area 4 (Central Virginia), there are less than 100 noise receptors affected by the single Build Alternative 4A. Seventy-nine (79) percent of these occur in census tracts with a high proportion of minority and low-income populations in the communities of Claiborne, Woodford, Milford, Penola, and Doswell. This would be a disproportionately high and adverse effect on potential environmental justice populations in these communities.

In Alternative Area 5 (Ashland), there are almost 160 noise receptors affected by Build Alternatives that pass through town (Build Alternatives 5A, 5A–Ashcake, 5B, 5B–Ashcake, and 5D–Ashcake); however, 80 percent of these occur in census tracts with a high proportion of minority and low-income populations. These occur in the communities of downtown Ashland, Gwathmey, and Elmont. There are more than 300 noise receptors affected by the Ashland Bypass (Build Alternatives 5C and 5C–Ashcake). Forty-six (46) percent of these occur in census tracts with a high proportion of minority and low-income populations; therefore, the Ashland Bypass (Build Alternatives 5C and 5C–Ashcake) would not have a disproportionately high and adverse impact on potential environmental justice populations. The Build Alternatives that pass through town (Build Alternatives 5A, 5A–Ashcake, 5B, 5B–Ashcake, and 5D–Ashcake) would have a disproportionately high and adverse effect on potential environmental justice populations in these communities.

In Alternative Area 6 (Richmond), noise receptors affected by the Build Alternatives range from approximately 310 to 440. The Build Alternatives that use the A-Line between Acca Yard and Centralia (Build Alternatives 6A, 6B–A-Line, 6C, and 6E) affect approximately 400 noise receptors on the A-line; 30 percent of these occur in census tracts with a high proportion of minority and low-income populations in the communities of Cedarhurst, Forest View, Belt Center, and Chimney Corner. Three of the four Build Alternatives that use the S-Line between Main Street Station and Centralia (Build Alternatives 6B–S-Line, 6D, and 6F) affect approximately 440 noise receptors on the S-line; 54 percent of these occur in census tracts with a high proportion of minority and low-income populations in the communities of Newtowne West, Chamberlayne, Gilpin, Davee Gardens, and Bellwood. The fourth Build Alternative that uses the S-Line (Build Alternative 6G) affects approximately 310 noise receptors. Thirty-five (35) percent of these occur in census tracts with a high proportion of minority and low-income populations, and they occur in the communities previously listed for both the A-Line and the S-Line. None of the Build Alternatives in Alternative Area 6 would have a disproportionately high and adverse effect on potential environmental justice populations in these communities.

Additional information on the environmental justice analysis can be found in the *Community Impact Assessment Technical Report* (Appendix Q).

4.13 ARCHAEOLOGICAL AND ABOVEGROUND CULTURAL AND HISTORIC RESOURCES

Section 106 of the *National Historic Preservation Act of 1966,* as amended (54 U.S.C. 306108) (Section 106), and implementing regulations (36 CFR Part 800) require federal agencies to consider the effects of their actions on historic properties and to afford the Advisory Council on Historic Preservation (ACHP) an opportunity to comment if the action would result in an adverse effect on any property listed in or eligible for the NRHP. Eligibility criteria for the NRHP are summarized in Section 3.13. The Section 106 process is summarized below:

- **Initiate Section 106 process–**The responsible federal agency first determines whether it has an undertaking that is a type of activity that could affect historic properties. Historic properties are properties that are included in the NRHP or that meet the criteria for the NRHP. If so, it must identify the appropriate State Historic Preservation Officer/Tribal Historic Preservation Officer (SHPO/THPO) to consult with during the process. It should also plan to involve the public, and identify other potential consulting parties. If it determines that it has no undertaking, or that its undertaking is a type of activity that has no potential to affect historic properties, the agency has no further Section 106 obligations.
- **Identify historic properties–**If the agency's undertaking could affect historic properties, the agency determines the scope of appropriate identification efforts and then proceeds to identify historic properties in the area of potential effects. The agency reviews background information, consults with the SHPO/THPO and others, seeks information from knowledgeable parties, and conducts additional studies as necessary. Districts, sites, buildings, structures, and objects listed in the NRHP are considered; unlisted properties are evaluated against the National Park Service's published criteria, in consultation with the SHPO/THPO and any Indian tribe or Native Hawaiian organization that may attach religious or cultural importance to them.

  If questions arise about the eligibility of a given property, the agency may seek a formal determination of eligibility from the National Park Service. Section 106 review gives equal consideration to properties that have already been included in the NRHP as well as those that have not been so included, but that meet NRHP criteria.

  If the agency finds that no historic properties are present or affected, it provides documentation to the SHPO/THPO and, barring any objection, proceeds with its undertaking.

  If the agency finds that historic properties are present, it proceeds to assess possible adverse effects.
- **Assess adverse effects–**The agency, in consultation with the SHPO/THPO, makes an assessment of adverse effects on the identified historic properties based on criteria found in ACHP's regulations.

  If they agree that there will be no adverse effect, the agency proceeds with the undertaking and any agreed-upon conditions.

  If they find that there is an adverse effect, or if the parties cannot agree and ACHP determines that there is an adverse effect, the agency begins consultation to seek ways to avoid, minimize, or mitigate the adverse effects.
- **Resolve adverse effects–**The agency consults to resolve adverse effects with the SHPO/THPO and others, who may include Indian tribes and Native Hawaiian organizations, local governments, permit or license applicants, and members of the public. ACHP may participate in consultation when there are substantial impacts to important historic properties, when a case presents important questions of policy or interpretation, when there is a potential for procedural problems, or when there are issues of concern to Indian tribes or Native Hawaiian organizations.

  Consultation usually results in a Memorandum of Agreement (MOA), which outlines agreed-upon measures that the agency will take to avoid, minimize, or mitigate the adverse effects. In some cases, the consulting parties may agree that no such measures are possible, but that the adverse effects must be accepted in the public interest.

- **Implementation–**If an MOA is executed, the agency proceeds with its undertaking under the terms of the MOA.
- **Failure to resolve adverse effects–**If consultation proves unproductive, the agency or the SHPO/THPO, or ACHP itself, may terminate consultation. If a SHPO terminates consultation, the agency and ACHP may conclude an MOA without SHPO involvement. However, if a THPO terminates consultation and the undertaking is on or affecting historic properties on tribal lands, ACHP must provide its comments. The agency must submit appropriate documentation to ACHP and request ACHP's written comments. The agency head must take into account ACHP's written comments in deciding how to proceed.
- **Indian Tribes and Native Hawaiian Organizations–**The regulations also place major emphasis on consultation with Indian tribes and Native Hawaiian organizations, in keeping with the 1992 amendments to NHPA. Consultation with an Indian tribe must respect tribal sovereignty and the government-to-government relationship between the Federal Government and Indian tribes. Even if an Indian tribe has not been certified by NPS to have a Tribal Historic Preservation Officer who can act for the SHPO on its lands, it must be consulted about undertakings on or affecting its lands on the same basis and in addition to the SHPO.
- **Public Involvement–**Public involvement is a key ingredient in successful Section 106 consultation, and the views of the public should be solicited and considered throughout the process.

FRA and DRPT initiated the Section 106 process and invited consulting parties, such as the National Park Service (NPS), local historical societies, and property owners, to participate in the Fall of 2014. Table 5.7-1 in Chapter 5 lists the consulting parties for this Project, as well as those who were invited to be a consulting party but did not respond.

DRPT defined an Area of Potential Effect after the Section 106 process was initiated. The Virginia Department of Historic Resources (DHR), the SHPO for the Commonwealth of Virginia, concurred on the Area of Potential Effect in early 2015. DRPT evaluated the resources in the APE and identified 158 historic properties within the Area of Potential Effect (APE): 9 archaeological sites, 135 above ground resources, 3 resources with an above ground and below ground component, and 11 battlefields. See the *Cultural Resources Reports* (Appendix R) for technical reports and mapping related to cultural resource studies and historic properties. DHR has reviewed and commented on these technical reports. After DHR review, FRA and DRPT distributes them to the consulting parties for review and comment. Section 5.7 provides a summary of the Section 106 coordination completed for this Project.

FRA has completed a preliminary evaluation of potential effect of the Project on archaeological and historic architectural resources in accordance with Section 106. According to the criteria for Effect and Adverse Effect developed by ACHP (36 CFR Section 800.5), potential effect is determined based on the following:

- **No Effect–**There would be no effect, neither adverse nor beneficial, on historic properties.

- **No Adverse Effect–**There would be an effect, but the effect would not compromise those characteristics that qualify the property for listing on the NRHP. Archaeological sites may be "adversely affected" when they are threatened with unavoidable physical destruction or damage.
- **Adverse Effect–**There would be an effect that would compromise the physical and/or historic integrity of the resource.

4.13.1 Archaeological Resources

As described in Section 3.13, archaeological studies have been completed along all Project alternatives with the exception of the Fredericksburg and Ashland bypasses and on roadway modification areas. In accordance with 36 CFR 800.4(b)(2), a phased approach for archaeological studies such as this are allowed where alternatives under consideration consist of corridors or large land areas. DHR has agreed with this approach for this Project. Additional Phase I survey will be completed through these unsurveyed areas once a Preferred Alternative is selected. Any ensuing Phase II archaeological evaluation testing will be included as a stipulation in the PA that will be completed as part of the environmental process.

Two (2) NRHP and 10 NRHP-eligible archaeological sites are located in the APE, including 9 archaeological sites and 3 resources that have both an archaeological and an architectural component. One of these sites—Ferry Farm/George Washington's Boyhood Home (44ST0084/089-0016)—is a National Historic Landmark (NHL). FRA's preliminary determinations of effect for archaeological resources in Virginia are listed in Tables 4.13-1 and 4.13-2. Coordination of these determinations is ongoing with DHR and consulting parties. The resources are listed in the order they appear in the study area from north to south. Only the sites with a preliminary determination of an adverse effect on the resource are described below.

Site 44SP0187 comprises a set of cut stone piers that are now located under the waters of the Rappahannock River. They may be associated with earlier railroad structures or nearby mills that are no longer extant. It is eligible under Criteria A and D for its association with the development of Fredericksburg and its information potential. Construction of a new bridge across the Rappahannock River to accommodate a third track for Build Alternative 3B would impact the subsurface archaeological deposits in this area, thus diminishing the data potential of this site. FRA's preliminary determination is that Build Alternative 3B would have an adverse effect to this historic property.

Sites 44HE1098, 44HE1097, and 44HE1095 are all archaeological sites located in downtown Richmond. They are potentially eligible for the NRHP under Criteria A and D for their association with the development of Richmond and their data potential. They were recorded based on the appearance of warehouses and other urban buildings on historic maps in this area. Today, these sites are paved parking lots. Often, parking lot developers truncate once-extant buildings and leave foundations and other deposits in place, sealing them with asphalt. As such, the potential for notable archaeological deposits within these recorded sites is high. Current plans for Build Alternatives 6B–S-Line, 6D, 6F, and 6G include the installation of new piers to support expanded tracks near Main Street Station. The installation of the piers would result in subsurface disturbances within these three recorded archaeological sites. As such, FRA's preliminary determination is that Build Alternatives 6B–S-Line, 6D, 6F, and 6G would have an adverse effect on these three archaeological sites.

Table 4.13-1: Summary of Preliminary Effect Determinations on Archaeological Sites

Alternative Area	Alternative	Potential Effect (Number of Resources		
		Adverse	No Adverse	No Effect
Area 1: Arlington (Long Bridge Approach)	1A	0	0	0
	1B	0	0	0
	1C	0	0	0
Area 2: Northern Virginia (Long Bridge to Dahlgren Spur)	2A	0	0	0
Area 3: Fredericksburg (Dahlgren Spur to Crossroads)	3A	0	0	3
	3B	1	1	1
	3C*	0	1	0
Area 4: Central Virginia (Crossroads to Doswell)	4A	0	0	0
Area 5: Ashland (Doswell to I-295)	5A	0	0	0
	5A–Ashcake	0	0	0
	5B	0	0	0
	5B–Ashcake	0	0	0
	5C*	0	0	0
	5C–Ashcake	0	0	0
	5D–Ashcake	0	0	0
Area 6: Richmond (I-295 to Centralia)	6A	0	5	4
	6B–A-Line	0	5	4
	6B–S-Line	3	4	2
	6C	0	5	4
	6D	3	4	2
	6E	0	7	2
	6F	3	4	2
	6G	3	4	2

* Partial Data; Only Phase IA reconnaissance studies were completed on the bypass options. As such, this count only includes previously recorded resources.

Table 4.13-2: Details of Project Preliminary Effect on Archaeological Sites

DHR ID	Name/Description	Build Alternative																						
		1A	1B	1C	2A	3A	3B	3C	4A	5A	5A–Ashcake	5B	5B–Ashcake	5C	5C–Ashcake	5D–Ashcake	6A	6B–A-Line	6B–S-Line	6C	6D	6E	6F	6G
089-0016/ 44ST0084	Ferry Farm	–	–	–	–	No Effect	No Adverse	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
44SP0187	Stone Piers; Bridge or Building	–	–	–	–	No Effect	Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
44SP0468-extension	Earthwork/ Jackson's Earthwork	–	–	–	–	No Effect	No Effect	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
44CF0680	Fort Darling/ Battlefield, Earthworks, Fort	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse
44HE1098	Main Street Station Parking Lot/Railroad	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	Adverse	No Adverse	Adverse	No Adverse	Adverse	Adverse
44HE1097	Railroad, Warehouse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	Adverse	No Adverse	Adverse	No Adverse	Adverse	Adverse
44HE1092	Warehouse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect
44HE1094	Warehouse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect
44HE1095	Storage Facility	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	Adverse	No Adverse	Adverse	No Adverse	Adverse	Adverse
127-6245/ 44CF0724	Williams Bridge Company, Emergency Fleet Corporation Factory, 700 East 4th Street	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Effect	No Effect	No Adverse	No Effect	No Adverse	No Adverse	No Adverse	No Adverse
020-0063	Falling Creek Ironworks Archaeological Site	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Effect	No Effect	No Adverse	No Effect	No Adverse	No Adverse	No Adverse	No Adverse
020-0022/ 44CF0680	Centralia Earthworks	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse

4.13.2 Historical Resources

One-hundred thirty-eight (138) eligible or listed buildings, districts, structures, and objects are located within the APE of the DC2RVA Project—135 above ground resources and 3 that have an above ground and below ground component. They range from single-family rural dwellings to significant historic districts along the rail corridor. One above ground property is an NHL—Main Street Station in Richmond (127-0172). FRA's preliminary determinations of effect for historic resources in the Project APE are listed in Tables 4.13-3 and 4.13-4. Coordination of these determinations is ongoing with DHR and relevant consulting parties. The resources are listed in the order they appear in the study area from north to south. Only the buildings, districts, structures, and objects with a preliminary determination of an adverse effect on the resource are described below; these historic properties are also shown on Figure 4.13-1.

Table 4.13-3: Summary of Preliminary Effect Determinations on Buildings, Districts, Structures, and Objects

Alternative Area	Alternative	Potential Effect (Number of Resources)		
		Adverse	No Adverse	No Effect
Area 1: Arlington (Long Bridge Approach)	1A	1	2	0
	1B	1	2	0
	1C	1	2	0
Area 2: Northern Virginia (Long Bridge to Dahlgren Spur)	2A	1	10	4
Area 3: Fredericksburg (Dahlgren Spur to Crossroads)	3A	1	0	15
	3B	4	11	1
	3C*	1	5	0
Area 4: Central Virginia (Crossroads to Doswell)	4A	3	12	4
Area 5: Ashland (Doswell to I-295)	5A	0	0	0
	5A–Ashcake	0	3	16
	5B	7	10	2
	5B–Ashcake	7	10	2
	5C*	1	4	2
	5C–Ashcake*	1	4	2
	5D–Ashcake	7	10	2
Area 6: Richmond (I-295 to Centralia)	6A	8	50	11
	6B–A-Line	16	42	11
	6B–S-Line	13	45	11
	6C	16	42	11
	6D	7	52	10
	6E	7	60	2
	6F	7	52	10
	6G	10	57	2

*Partial Data; Only Phase IA reconnaissance studies were completed on the bypass options. As such, this count only includes previously recorded resources.

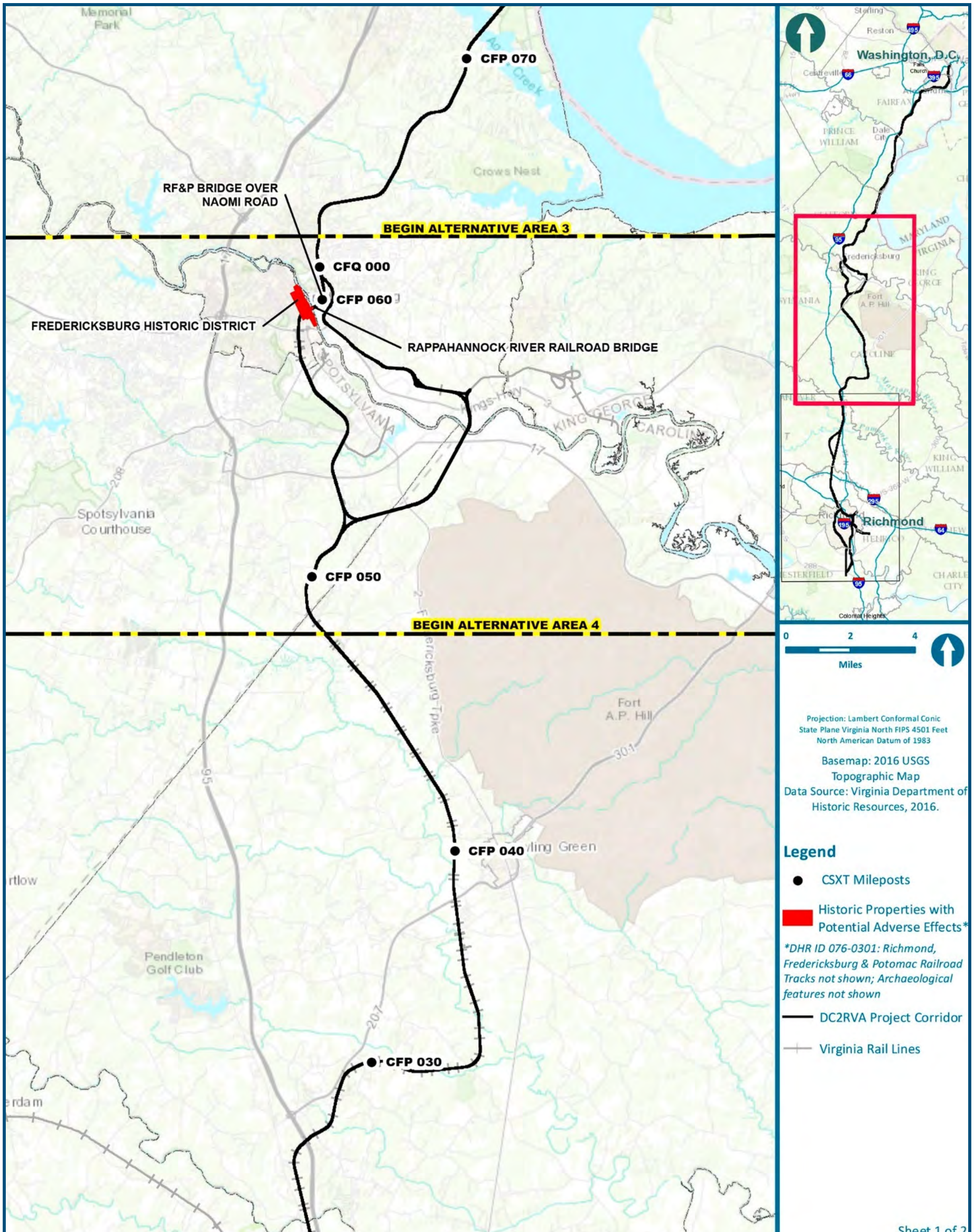


Figure 4.13-1: Historic Properties with Potential Adverse Effects

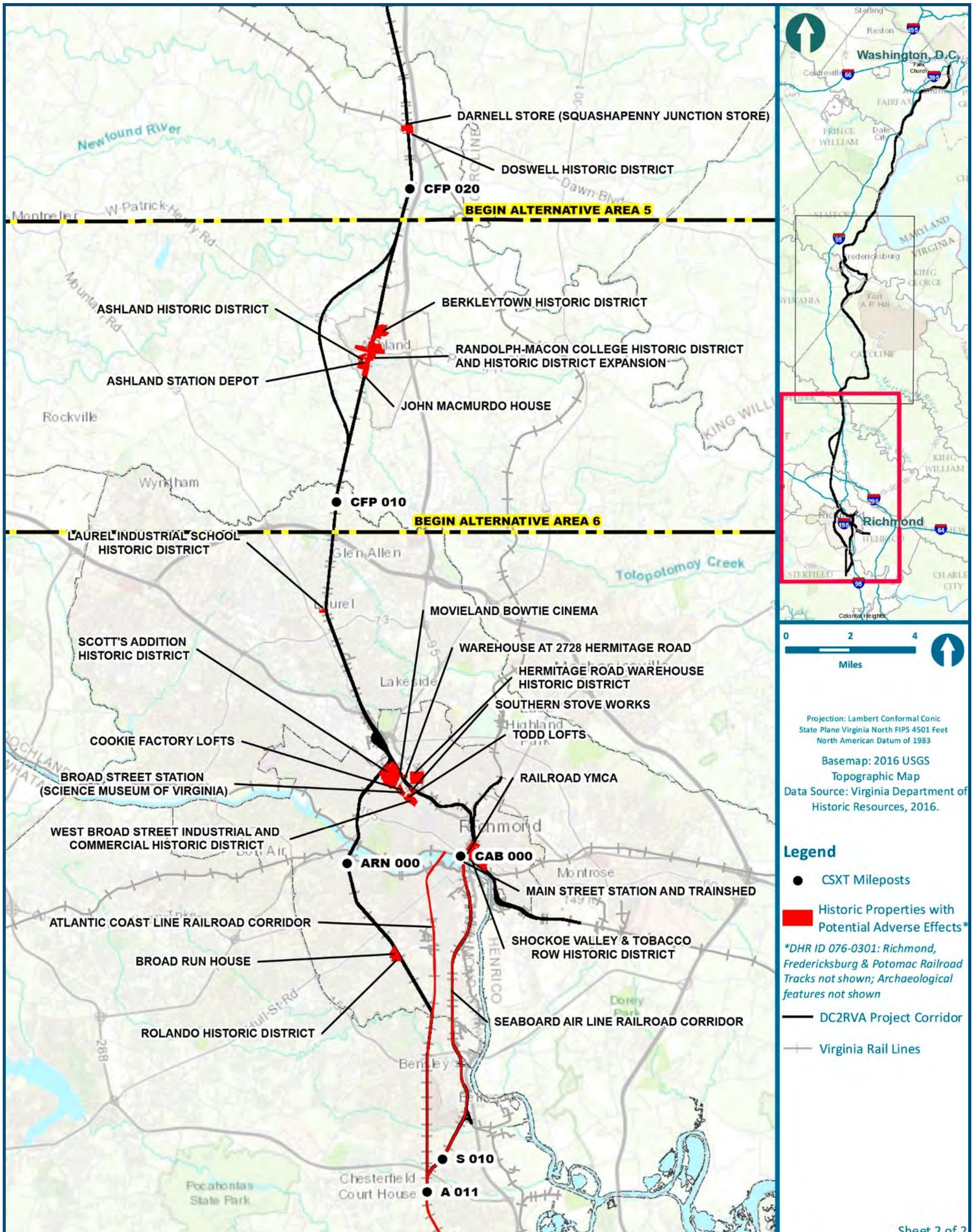


Figure 4.13-1: Historic Properties with Potential Adverse Effects

Table 4.13-4: Details of Project Preliminary Effect on Buildings, Structures, Objects, and Districts

DHR ID	Name/Description	Build Alternative																						
		1A	1B	1C	2A	3A	3B	3C	4A	5A	5A–Ashcake	5B	5B–Ashcake	5C	5C–Ashcake	5D–Ashcake	6A	6B–A-Line	6B–S-Line	6C	6D	6E	6F	6G
029-0218	Mount Vernon Memorial Highway (8.5-mile section of the George Washington Memorial Parkway from Fairfax County to the southern boundary of Alexandria)	No Adverse	No Adverse	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
000-0045	Washington National Airport (Reagan National Airport) (1 Aviation Circle, Arlington)	No Adverse	No Adverse	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
100-0160	George Washington Junior High School, (1005 Mt. Vernon Avenue)	–	–	–	No Effect	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
100-0133	Parker-Gray Historic District/Uptown (northwestern quadrant of Old Town Alexandria)	–	–	–	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
100-0137	Rosemont Historic District (northwest of Old Town Alexandria)	–	–	–	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
100-0124	Alexandria Depot (110 Callahan Drive, Alexandria)	–	–	–	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
100-0128	George Washington National Masonic Memorial (101 Callahan Drive, Alexandria)	–	–	–	No Effect	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
100-0277	Phoenix Mill (3642 Wheeler Avenue, Alexandria)	–	–	–	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
TBD	RF&P Bridge over Holmes Run (Cameron Run Park, Alexandria)	–	–	–	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
029-0953	Old Colchester Road, Potomac Path, King's Highway (Occoquan River to Route 1, Fairfax County)	–	–	–	No Effect	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
029-5741	Hannah P. Clark House/Enyedi House (10605 Furnace Road, Fairfax County)	–	–	–	No Effect	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
029-0043	Colchester Arms, Fairfax Arms (10712 Old Colchester Road, Fairfax County)	–	–	–	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
TBD	RF&P Bridge over Occoquan River (Occoquan River at Town of Occoquan, Prince William County)	–	–	–	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

▶ *Continued*

Table 4.13-4: Details of Project Preliminary Effect on Buildings, Structures, Objects, and Districts

DHR ID	Name/Description	Build Alternative																						
		1A	1B	1C	2A	3A	3B	3C	4A	5A	5A–Ashcake	5B	5B–Ashcake	5C	5C–Ashcake	5D–Ashcake	6A	6B–A-Line	6B–S-Line	6C	6D	6E	6F	6G
287-0010	Marine Corps Base Quantico, Quantico Marine Corps Base Historic District (East of town of Quantico, Prince William and Stafford counties)	–	–	–	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
287-5147	Town of Quantico, Town of Quantico Historic District (Southern Prince William County, east of Route 1)	–	–	–	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
089-0019	Richland/Richlands (945 Widewater Road, Stafford County)	–	–	–	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
089-0045	RF&P Bridge over Potomac Creek at Leland Road (Leland Road east of Route 1, Stafford County)	–	–	–	–	No Effect	No Adverse	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
089-0080	RF&P Bridge over Naomi Road (Naomi Road north of Rappahannock, Stafford County)	–	–	–	–	No Effect	Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
111-0147	Fredericksburg & Spotsylvania Co. Battlefields National Military Park & Cemetery (Lee Drive, Fredericksburg and Spotsylvania County)	–	–	–	–	No Effect	No Adverse	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
089-0016/ 44ST0084	Ferry Farm (268 Kings Highway, Stafford County)	–	–	–	–	No Effect	No Adverse	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
089-0014	Sherwood Forest (Sherwood Forest Farm Road, Stafford County)	–	–	–	–	–	–	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
111-0132-00 25	Rappahannock River Railroad Bridge (Railroad at Rappahannock River north of Fredericksburg)	–	–	–	–	No Effect	Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
111-0132-0704	Fredericksburg Train Station (200 Lafayette Boulevard, Fredericksburg)	–	–	–	–	No Effect	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
111-0132	Fredericksburg Historic District (downtown Fredericksburg, east of Route 1)	–	–	–	–	Adverse	Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
111-0132-0020	Purina Tower (401 Charles Street, Fredericksburg)	–	–	–	–	No Effect	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

▶ *Continued*

Table 4.13-4: Details of Project Preliminary Effect on Buildings, Structures, Objects, and Districts

DHR ID	Name/Description	Build Alternative																						
		1A	1B	1C	2A	3A	3B	3C	4A	5A	5A–Ashcake	5B	5B–Ashcake	5C	5C–Ashcake	5D–Ashcake	6A	6B–A-Line	6B–S-Line	6C	6D	6E	6F	6G
111-0132-0522	House, 314–316 Frederick Street (314–316 Frederick Street, Fredericksburg)	–	–	–	–	No Effect	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
111-0009-0795	Pulliam's Service Station (411 Lafayette Boulevard, Fredericksburg)	–	–	–	–	No Effect	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
111-0009	Fredericksburg Historic District Extension (west of historic district, Fredericksburg)	–	–	–	–	No Effect	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
088-5364	Fredericksburg & Gordonsville Railroad Bed District (Virginia Central Railroad) (38 miles long; Fredericksburg to Orange)	–	–	–	–	No Effect	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
111-0145	Fredericksburg Gun Manufactory (210 Ferdinand Street, Fredericksburg)	–	–	–	–	No Effect	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
088-0254	Slaughter Pen Farm (11232 Tidewater Trail, Spotsylvania County)	–	–	–	–	No Effect	No Effect	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
088-0039	LaVue (3232 LaVue Lane, Spotsylvania County)	–	–	–	–	No Effect	No Adverse	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
016-0092	Fairfield Plantation Office, Jackson Shrine (12019 Stonewall Jackson Road, Caroline County)	–	–	–	–	–	–	–	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
016-0208	House (12096 Guinea Drive, Caroline County)	–	–	–	–	–	–	–	No Effect	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
016-5165	Excelsior Industry of Caroline County MPD (numerous properties throughout Caroline County)	–	–	–	–	–	–	–	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
016-5129	Woodford Historic District (central Caroline County)	–	–	–	–	–	–	–	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
016-0223	Woodford Excelsior Company Office (Lake Farm Road, Caroline County)	–	–	–	–	–	–	–	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
016-0222	Woodford Freight & Passenger Depot (Woodford Road, Caroline County)	–	–	–	–	–	–	–	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
016-0224	Glenwood House (11102 Woodford Road, Caroline County)	–	–	–	–	–	–	–	No Effect	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

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Table 4.13-4: Details of Project Preliminary Effect on Buildings, Structures, Objects, and Districts

DHR ID	Name/Description	Build Alternative																						
		1A	1B	1C	2A	3A	3B	3C	4A	5A	5A–Ashcake	5B	5B–Ashcake	5C	5C–Ashcake	5D–Ashcake	6A	6B–A-Line	6B–S-Line	6C	6D	6E	6F	6G
016-0220	Carolina Mansion (11146 Woodford Road, Caroline County)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
016-0270	Milford State Bank (15461 Antioch Road, Caroline County)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
016-5136	Milford Historic District (east-central Caroline County)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
016-0286	Coleman's Store (22275 Penola Road/16095 Polecat Lane, Caroline County)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
042-5448	Doswell Historic District (northern Hanover County, east of Route 1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
042-0470	House/Squashapenny Store (10570 Doswell Road, Hanover County)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
042-0469	Tri-County Bank, Doswell Branch (part of Squashapenny Antiques) (10561 Doswell Road, Hanover County)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
042-0093	Doswell Depot and Tower (10577 Doswell Road, Hanover County)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
042-5307	Taylorsville Road Historic District (southern Hanover County)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
TBD	RF&P Bridge over Little River (Little River at RF&P, Hanover County)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
042-0836	Earthworks, Little River (south side of Little River, Hanover County)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
042-0557	Dry Bridge (10411 Old Bridge Road, Hanover County)	–	–	–	–	–	–	–	–	–	No Effect	No Adverse	No Adverse	–	–	No Adverse	–	–	–	–	–	–	–	–
042-0392	Montevideo (Hanover County west of Route 1, north of Ashland)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
166-5073	Berkleytown Historic District (north of Ashland, Hanover County)	–	–	–	–	–	–	–	–	–	No Effect	Adverse	Adverse	–	–	Adverse	–	–	–	–	–	–	–	–
166-5073-0010	House, Dabney Funeral Home (600 B Street, Ashland)	–	–	–	–	–	–	–	–	–	No Effect	No Adverse	No Adverse	–	–	No Adverse	–	–	–	–	–	–	–	–
166-0001	Ashland Historic District (downtown Ashland west of I-95)	–	–	–	–	–	–	–	–	–	No Adverse	Adverse	Adverse	–	–	Adverse	–	–	–	–	–	–	–	–

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Table 4.13-4: Details of Project Preliminary Effect on Buildings, Structures, Objects, and Districts

DHR ID	Name/Description	Build Alternative																						
		1A	1B	1C	2A	3A	3B	3C	4A	5A	5A–Ashcake	5B	5B–Ashcake	5C	5C–Ashcake	5D–Ashcake	6A	6B–A-Line	6B–S-Line	6C	6D	6E	6F	6G
166-0001-0015	Business Office, Randolph-Macon (310 N. Center Street, Ashland)	–	–	–	–	–	–	–	–	–	No Effect	No Adverse	No Adverse	–	–	No Adverse	–	–	–	–	–	–	–	–
166-5072	Randolph-Macon College Historic District Expansion (east of original district, Ashland)	–	–	–	–	–	–	–	–	–	No Effect	Adverse	Adverse	–	–	Adverse	–	–	–	–	–	–	–	–
166-0002	Randolph-Macon College Historic District (east of RF&P, Ashland)	–	–	–	–	–	–	–	–	–	No Effect	Adverse	Adverse	–	–	Adverse	–	–	–	–	–	–	–	–
166-0001-0008	Ashland Station Depot (112 N. Railroad Avenue, Ashland)	–	–	–	–	–	–	–	–	–	No Adverse	Adverse	Adverse	–	–	Adverse	–	–	–	–	–	–	–	–
166-5041	Priddy House (107 Stebbins Street, Ashland)	–	–	–	–	–	–	–	–	–	No Effect	No Effect	No Effect	–	–	No Effect	–	–	–	–	–	–	–	–
166-0001-0055	House (704 S. Center Street, Ashland)	–	–	–	–	–	–	–	–	–	No Effect	No Adverse	No Adverse	–	–	No Adverse	–	–	–	–	–	–	–	–
166-0001-0060	House (708 S. Center Street, Ashland)	–	–	–	–	–	–	–	–	–	No Effect	No Adverse	No Adverse	–	–	No Adverse	–	–	–	–	–	–	–	–
166-0036	MacMurdo House (713 S. Center Street, Ashland)	–	–	–	–	–	–	–	–	–	No Effect	Adverse	Adverse	–	–	Adverse	–	–	–	–	–	–	–	–
166-0037	Hugo House (11208 Gwathmey Church Road, Ashland)	–	–	–	–	–	–	–	–	–	No Effect	No Adverse	No Adverse	–	–	No Adverse	–	–	–	–	–	–	–	–
166-0001-0077	House (1005 S. Center Street, Ashland)	–	–	–	–	–	–	–	–	–	No Effect	No Adverse	No Adverse	–	–	No Adverse	–	–	–	–	–	–	–	–
042-5048	Elmont Historic District (southern Hanover County)	–	–	–	–	–	–	–	–	–	No Effect	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	–	–	–	–	–	–	–	–
043-0693	Mill Road Historic District (northern Henrico County)	–	–	–	–	–	–	–	–	–	No Effect	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	–	–	–	–	–	–	–	–
043-0694	Hunton Treasures (11701 Greenwood Road, Henrico County)	–	–	–	–	–	–	–	–	–	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	–	–	–	–	–	–	–	–
043-5646	House (11501 Old Washington Highway, Henrico County)	–	–	–	–	–	–	–	–	–	No Effect	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	–	–	–	–	–	–	–	–
043-5657	Darling Smokestack (Old Washington Highway, Henrico County)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse
043-0690	Lewis-McLeod House (2945 Mountain Road, Henrico County)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect
043-0292	Laurel Industrial School Historic District (Hungary Road, Henrico County)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse

▸ *Continued*

Table 4.13-4: Details of Project Preliminary Effect on Buildings, Structures, Objects, and Districts

DHR ID	Name/Description	Build Alternative																						
		1A	1B	1C	2A	3A	3B	3C	4A	5A	5A–Ashcake	5B	5B–Ashcake	5C	5C–Ashcake	5D–Ashcake	6A	6B–A-Line	6B–S-Line	6C	6D	6E	6F	6G
043-0292-0001	Main Building/Robert Stiles Building/Bluford Office Building (2900 Hungary Road, Henrico County)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse
043-5636	Integrated Power Sources of Virginia (2260 Dabney Road, Henrico County)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse
127-6136	Scott's Addition Historic District (northwest Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Adverse	Adverse	Adverse	Adverse	No Adverse	Adverse	No Adverse	Adverse
127-6569	Central National Bank (3501 W. Broad Street, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Effect	No Adverse	No Effect	No Adverse	No Effect	No Adverse
127-6514	Kent Road Village (905 Kent Road, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect
127-0742	West of Boulevard Historic District (west Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Effect	No Adverse	No Effect	No Adverse	No Effect	No Adverse
127-6756	Carillon Neighborhood Historic District (northwest Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Effect	No Adverse	No Effect	No Adverse	No Effect	No Adverse
127-0171	James River and Kanawha Canal Historic District (north of James River, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse
127-6792	Southern Railway (north of James River, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse
127-6629	Cedarhurst Neighborhood Historic District (northwest Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Effect	No Adverse	No Effect	No Adverse	No Effect	No Adverse
Temp 402	House (351 W. 49th Street, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Effect	No Adverse	No Effect	No Adverse	No Effect	No Adverse
127-6757	Woodstock Historic District (west Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Effect	No Adverse	No Effect	No Adverse	No Effect	No Adverse
Temp R	Rolando Historic District (southwest Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Adverse	Adverse	No Effect	Adverse	No Effect	Adverse	No Effect	Adverse
Temp 268	Broad Run House (2011 S. Kinsley Avenue, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Adverse	Adverse	No Effect	Adverse	No Effect	Adverse	No Effect	Adverse
020-5351	Richmond & Petersburg Electric Railway (along Route 1 between Richmond and Chesterfield County)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse

▶ *Continued*

Table 4.13-4: Details of Project Preliminary Effect on Buildings, Structures, Objects, and Districts

DHR ID	Name/Description	Build Alternative																						
		1A	1B	1C	2A	3A	3B	3C	4A	5A	5A–Ashcake	5B	5B–Ashcake	5C	5C–Ashcake	5D–Ashcake	6A	6B–A-Line	6B–S-Line	6C	6D	6E	6F	6G
020-5336	The Bellwood-Richmond Quartermaster Depot Historic District, United States Department of Defense Supply Center Historic District (north central Chesterfield County)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse
127-6188	Movieland Bowtie Cinema (1331 North Boulevard, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	Adverse	Adverse	Adverse	No Adverse	No Adverse	No Adverse	No Adverse
127-6840	Warehouse (2728 Hermitage Road, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	Adverse	Adverse	Adverse	No Adverse	No Adverse	No Adverse	No Adverse
127-6730	Hermitage Road Warehouse Historic District (north central Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	Adverse	Adverse	Adverse	No Adverse	No Adverse	No Adverse	No Adverse
127-6165	Cookie Factory Lofts (900 Terminal Place, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	Adverse	Adverse	Adverse	No Adverse	No Adverse	No Adverse	No Adverse
127-0226	Science Museum of Virginia (2500 Broad Street, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	Adverse	Adverse	Adverse	No Adverse	No Adverse	No Adverse	No Adverse
127-5978	Todd Lofts (1128 Hermitage Road, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	Adverse	Adverse	Adverse	No Adverse	No Adverse	No Adverse	No Adverse
127-6145	Southern Stove Works (1215 Hermitage Road, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	Adverse	Adverse	Adverse	No Adverse	No Adverse	No Adverse	No Adverse
127-6570	West Broad Street Industrial and Commercial Historic District (north of Broad Street, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	Adverse	Adverse	Adverse	No Adverse	No Adverse	No Adverse	No Adverse
127-0414	Governor's School (1000 North Lombardy Street, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse
127-0354	Virginia Union University Historic District (1500 North Lombardy Street, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse
127-0428	George W. Carver Elementary School (1110 West Leigh Street, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse
127-0822	Carver Residential Historic District (northeast Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse
127-6171	Richmond and Chesapeake Bay Railway Barn), Richmond-Ashland Railway Company Car Barn (northeast Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse

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Table 4.13-4: Details of Project Preliminary Effect on Buildings, Structures, Objects, and Districts

DHR ID	Name/Description	Build Alternative																						
		1A	1B	1C	2A	3A	3B	3C	4A	5A	5A–Ashcake	5B	5B–Ashcake	5C	5C–Ashcake	5D–Ashcake	6A	6B–A-Line	6B–S-Line	6C	6D	6E	6F	6G
127-5679	Barton Heights Cemetery (1600 Lamb Avenue, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse
127-0353	Richmond Nursing Home (210 Hospital Street, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse
127-6166	Hebrew Cemetery (320 Hospital Street, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse
127-0343	Chestnut Hill/ Plateau Historic District (northwest Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Effect	No Effect	No Effect	No Effect	No Adverse	No Adverse	No Adverse	No Adverse
127-0344	Shockoe Valley & Tobacco Row Historic District (north of James River, downtown Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	Adverse	No Adverse	Adverse	Adverse
127-6129	Winfree Cottage (East Main Street, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse
127-0172	Main Street Station and Trainshed, New Union Station, Seaboard Airline & Chesapeake & Ohio Railroad Depot (Main Street, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Adverse	Adverse	No Adverse	Adverse	Adverse	No Adverse	Adverse	Adverse
127-0344-0123	Railroad Y.M.C.A. (1552 East Main Street, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	Adverse	No Adverse	Adverse	Adverse
127-0219	Shockoe Slip Historic District and Expansions (north of James River, downtown Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse
127-6793	C&O Railroad (downtown Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse
127-5809	Bridge #1857, North 14th Street; Mayo Bridge North (14th Street, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse
127-5808	Bridge #1857, South 14th Street; Mayo Bridge South (14th Street, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse
127-0197	Philip Morris Leaf Storage Warehouse (1717–1721 East Cary Street, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse
127-0282	Henrico County Courthouse (2127 Main Street East, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse
127-0192	St. John's Church Historic District (downtown Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse

▸ *Continued*

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		1A	1B	1C	2A	3A	3B	3C	4A	5A	5A–Ashcake	5B	5B–Ashcake	5C	5C–Ashcake	5D–Ashcake	6A	6B–A-Line	6B–S-Line	6C	6D	6E	6F	6G
127-0192-0322	Libby Hill Park and Park House (2801 East Franklin Street, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse
127-0854	Bridge #1850 (E. Main Street, spanning Southern Railway, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse
127-0119	John Woodward House (3017 Williamsburg Avenue, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse
127-6693	Armitage Manufacturing Company (3200 Williamsburg Avenue, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse
127-6255	Fulton Gas Works (Williamsburg Avenue, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse
127-0257	Bridge #8067 (east of downtown Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse
043-5313	James River Steam Brewery Cellars (4920 Old Main Street, Henrico County))	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse
043-0439	Aviation General Supply Depot (508 Bickerstaff Road, Henrico County)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse
127-0457	Manchester Warehouse Historic District (south of James River, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Effect	No Effect	No Adverse	No Effect	No Adverse	No Adverse	No Adverse	No Adverse
127-6193	J.P. Taylor Leaf Tobacco, Southern Stove Works (516 Dinwiddie Avenue, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Effect	No Effect	No Adverse	No Effect	No Adverse	No Adverse	No Adverse	No Adverse
127-6245/ 44CF0724	Williams Bridge Company, Emergency Fleet Corporation Factory (700 East 4th Street, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Effect	No Effect	No Adverse	No Effect	No Adverse	No Adverse	No Adverse	No Adverse
127-6248	Pure Oil Company, Transmontaigne(1314 Commerce Street, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Effect	No Effect	No Adverse	No Effect	No Adverse	No Adverse	No Adverse	No Adverse
127-6213	Davee Gardens Historic District (east of Route 1, Richmond)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Effect	No Effect	No Adverse	No Effect	No Adverse	No Adverse	No Adverse	No Adverse
020-5474	DuPont Spruance (north Chesterfield County)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Effect	No Effect	No Adverse	No Effect	No Adverse	No Adverse	No Adverse	No Adverse

▸ Continued

Table 4.13-4: Details of Project Preliminary Effect on Buildings, Structures, Objects, and Districts

DHR ID	Name/Description	Build Alternative																						
		1A	1B	1C	2A	3A	3B	3C	4A	5A	5A–Ashcake	5B	5B–Ashcake	5C	5C–Ashcake	5D–Ashcake	6A	6B–A-Line	6B–S-Line	6C	6D	6E	6F	6G
020-0007	Bellwood, Sheffields, Auburn Chase, Building 42, Defense Supply Center Richmond (8000 Jefferson Davis Highway, Chesterfield County)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Effect	No Effect	No Adverse	No Effect	No Adverse	No Adverse	No Adverse	No Adverse
020-0013	House (3619 Thurston Road, Chesterfield County)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Effect	No Effect	No Adverse	No Effect	No Adverse	No Adverse	No Adverse	No Adverse
020-5378	VEPCo Power Transmission Line (west of Route 1, Chesterfield County)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse
020-0140	Circle Oaks (4510 Centralia Road, Chesterfield County)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse
020-0552	Centralia Post Office (Centralia Road, Chesterfield County)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse
076-0301	Richmond, Fredericksburg, and Potomac Railroad (rail corridor between Washington, D.C. and Main Street Station in Richmond)	Adverse	Adverse	Adverse	Adverse	No Effect	Adverse	Adverse	Adverse	–	No Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse
127-6251	Atlantic Coast Line Railroad Corridor, Richmond, and Petersburg Railroad (A-Line rail corridor between Main Street Station and Centralia)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse
127-6271	Seaboard Air Line Railroad Corridor (S-Line rail corridor between Main Street Station and Centralia)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse

The **RF&P Bridge over Naomi Road (089-0080**) is a double-vault arched structure rumored to be the oldest documented and identified reinforced concrete bridge in the Commonwealth. It is potentially eligible for the NRHP under Criterion C for its architectural merit. It is also a contributing element to the Richmond, Fredericksburg & Potomac (RF&P) Railroad (076-0301). Construction of Build Alternative 3B would result in removal of the existing bridge and construction of a new structure. Demolition would remove all character-defining features of this resource. FRA's preliminary determination is that Build Alternative 3B would have an adverse effect on this structure.

The **Rappahannock River Railroad Bridge (111-0132-0025)** is a multiple-span, open-spandrel, concrete-arch bridge and is an excellent and rare surviving example of a reinforced-concrete arch railroad bridge within this region of Virginia. It was erected when the station and tracks were elevated for automobile traffic pass through on surface streets in downtown Fredericksburg. The bridge is both individually eligible (Criterion C for its architectural merit) and eligible as a contributing element to the Fredericksburg Historic District (111-0132) and the RF&P Railroad (076-0301). Addition of a third track to the east of the existing alignment as part of Build Alternative 3B would require construction of a new bridge adjacent to the old structure, thus diminishing its integrity of design, setting, feeling, and association and affecting its architectural character. FRA's preliminary determination is that Build Alternative 3B would have an adverse effect on this resource.

The 200-acre **Fredericksburg Historic District (111-0132)** comprises the city's downtown commercial area, adjacent industrial area, and some of the surrounding residential blocks. This part of Fredericksburg boasts a wide variety of infrastructure that ranges in date from the early eighteenth century throughout the late twentieth century. It is listed in the NRHP under Criterion C for its architectural merit. Although Build Alternative 3A does not require installation of new tracks, plans call for construction of a multi-story parking deck to the east (south) of the tracks in an existing parking lot. Installation of the third track associated with Build Alternative 3B also entails building the multi-story parking deck. This new structure would impact the viewshed of the district and its integrity of setting, feeling, and association by adding a large, non-conforming, visual element to the distinct area skyline. The new parking structure would also add a new physical element within the district boundaries. FRA's preliminary determination is that Build Alternatives 3A and 3B would have an adverse effect on this historic property.

The **Doswell Historic District (042-5448)** encompasses a rural community that was once a center of major activity along road and rail networks. Nearly a dozen historic properties are located within the district's boundaries. It is potentially eligible for the NRHP under Criteria A for its association with railroad history and C for its architectural integrity. Although the community was founded along the rail lines, Build Alternative 4A would adversely affect one contributing element to the district, the Squashapenny Junction Store (042-0470), as listed below. This includes potentially removing the main building and associated outbuildings and taking land from the parcel, thus diminishing the characteristics that render it eligible for the NRHP. FRA's preliminary determination is that because of the potential physical adverse effects to a contributing element, Build Alternative 4A would likely have an adverse effect on the district.

Located at 10570 Doswell Road, the **Squashapenny Junction Store (042-0470)** is a two-and-a-half-story, three-bay, vernacular commercial building. Located adjacent to the tracks, the store was a commercial hub for the Doswell community. It is potentially eligible for the NRHP under Criterion C for its architectural style. The building is also a contributing element to the Doswell

Historic District (042-5448). The building is located immediately east of the rail tracks. Build Alternative 4A requires acquisition of land from the parcel and would bring the tracks even closer to the dwelling, potentially requiring removal of the main building or one or more contributing outbuildings on the property, thus compromising its integrity of design, setting, materials, workmanship, feeling, and association. FRA's preliminary determination is that Build Alternative 4A would have an adverse effect on this resource.

The **Berkleytown Historic District (166-5073)** is typical of many small-town, twentieth-century, African American neighborhoods in that it was relatively isolated from the formal downtown core and is dotted by small vernacular dwellings. It is potentially eligible under Criteria A for its association with African-American history in this area and C for its architectural merit. Construction of an overpass carrying Vaughan Road over the rail tracks associated with Build Alternatives 5B, 5B–Ashcake, and 5D–Ashcake would require alterations to the historic road pattern within the district and require a new bridge structure within the viewshed of the district and several contributing elements. Due to these disturbances to the setting, feeling, and design of the district, FRA's preliminary determination is that Build Alternatives 5B, 5B–Ashcake, and 5D–Ashcake would have an adverse effect.

The **Ashland Historic District (166-0001)**, with its large collection of late-Victorian and Edwardian frame dwellings and its brick commercial core, all set among hundreds of trees, survives as a fine example of a railroad and streetcar suburb preserving much of its turn-of-the-century character. It is listed in the NRHP under Criteria A for its association with railroad history and C for its architectural character. Build Alternatives 5B, 5B–Ashcake, and 5D–Ashcake, expanding the existing rail corridor through town, would result in modified roadways, sidewalks, and viewsheds in the district, thus impacting character-defining features. Moreover, FRA's preliminary determination is that these alternatives would have an adverse effect to several contributing resources to the district (as described below), including the Ashland Station Depot (166-0001-0008) and the MacMurdo House (166-0036). As such, FRA's preliminary determination is that Build Alternatives 5B, 5B–Ashcake, and 5D–Ashcake would have an adverse effect on the Ashland Historic District.

The **Randolph-Macon College Historic District Expansion (166-5072)** highlights a significant part of campus that developed between the early-twentieth century and the mid-1960s when a substantial building boom occurred. The expansion was determined to be eligible for the NRHP as part of the current survey. Build Alternatives 5B, 5B–Ashcake, and 5D–Ashcake, expanding the existing rail corridor through town, would result in modified roadways, sidewalks, and viewsheds in the district, thus impacting character-defining features. Thus, FRA's preliminary determination is that Build Alternatives 5B, 5B–Ashcake, and 5D–Ashcake would have an adverse effect on the district.

The 85-acre **Randolph-Macon College Historic District (166-0002)** includes the college campus and all associated buildings, structures and landscape features. This is the oldest Methodist-related college in the United States still in operation. The original district was listed in the NRHP under Criteria A as one of the oldest Methodist colleges in the United States and C for its architectural merit. As with the Randolph-Macon Historic District Expansion listed above, Build Alternatives 5B, 5B–Ashcake, and 5D–Ashcake would result in modifications that would diminish character-defining features of the district through roadway realignments, sidewalk modifications, and viewshed changes. Some contributing elements may also be required to be relocated. FRA's preliminary determination is that Build Alternatives 5B, 5B–Ashcake, and 5D–Ashcake would have an adverse effect on this historic property.

The one-story, five-bay, brick **Ashland Station Depot (166-0001-0008)** is said to have been designed by W. P. Lee to replace a previous circa-1890 station that burned down. Although the building is no longer used as a station (with its interior turned over for other purposes), the building appears little altered and is a good example of a Colonial Revival-styled depot potentially eligible for the NRHP under Criteria A for its association with area development and C for its architectural character. The building is also a contributing element to the Ashland Historic District (166-0001) and the RF&P Railroad (076-0301). Build Alternatives 5B, 5B–Ashcake, and 5D–Ashcake require track changes and alterations to the station. Build Alternative 5D–Ashcake includes demolition of the historic station and construction of a new station. These modifications, and the potential demolition, would diminish the characteristics that render this resource eligible for the NRHP. Removal of the historic, and continued, use of these contributing elements would remove character-defining attributes of the property—namely its use as a rail stop. FRA's preliminary determination is that Build Alternatives 5B, 5B–Ashcake, and 5D–Ashcake would have an adverse effect on this resource.

The **MacMurdo House (166-0036)** is a two-story, three-bay, Greek Revival, single-family dwelling. It is one of the few buildings of its style in Ashland, and it has excellent historic integrity. As such, it is potentially eligible for the NRHP under Criterion C for its architectural merit. The building is also a contributing element to the Ashland Historic District (166-0001) as it dates to the period of significance and reflects the developmental history of the district. Build Alternatives 5B, 5B–Ashcake, and 5D–Ashcake, expanding the existing rail corridor through town, would result in moving the existing sidewalks and roadways closer to the historic dwelling and onto the parcel boundaries, thus impacting the resource's integrity of design, setting, feeling, and association and modifying key visual elements of the building. FRA's preliminary determination is that Build Alternatives 5B, 5B–Ashcake, and 5D–Ashcake would have an adverse effect on this property.

The **Laurel Industrial School Historic District (043-0292)** consists of a complex of buildings that was part of a school founded under the patronage of the Prison Association of Virginia, a group of private citizens who sought to reform the state's penal system by establishing a self-supporting model industrial reformatory for boys. It is listed in the NRHP under Criteria A for its association with prison reform and C for its architectural character. All Build Alternatives in Area 6 (6A through 6G) would require construction of a bridge to carry traffic on Hungary Road over the rail tracks, as well as notable associated secondary road changes. These modifications would impact the district through the introduction of a large visual element (the new overpass) and modified roadway plans. Some contributing elements may also be required to be relocated. As such, FRA's preliminary determination is that Build Alternatives 6A through 6G would have an adverse effect on this historic district.

The **Scott's Addition Historic District (127-6136)** is a 152-acre industrial and commercial district in Richmond featuring 287 contributing resources built primarily between 1900 and 1956 in the Colonial Revival, Classical Revival, Mission, Moderne, International, and Art Deco styles. The district is located immediately southeast of the intersection of the A-line and the S-line in Richmond. It is listed in the NRHP under Criteria A for its association with Richmond development and C for its architectural fabric. Construction of Build Alternatives 6A, 6B–A-Line, 6B–S-Line, 6C, 6E, and 6G would require notable changes to this area, including new tracks outside of the existing right-of-way, erecting superstructures to support rail facilities, and construction of multi-story parking facilities. These changes would diminish character-defining features of the district. FRA's preliminary determination is that Build Alternatives 6A, 6B–A-Line, 6B–S-Line, 6C, 6E, and 6G would have an adverse effect on the historic district.

Containing approximately 142 parcels, the **Rolando Historic District (Temp R)** is a post-World War II-era, suburban neighborhood. The dwellings were constructed in the Minimal Traditional style. The neighborhood and contributing dwellings have been generally unchanged since its subdivision in 1946. It is potentially eligible for the NRHP under Criterion C for its styling as a post-war neighborhood. Plans associated with Build Alternatives 6A, 6B–A-Line, 6C, 6E, and 6G include construction of a new overpass carrying Broad Rock Boulevard over the tracks and associated roadway modifications. Some of the impacted roadways are located within the footprint of the district, and the new overpass would be a notable new visual element to the viewshed of the neighborhood. These changes would diminish the district's integrity of design, setting, feeling, and association. FRA's preliminary determination is that Build Alternatives 6A, 6B–A-Line, 6C, 6E, and 6G would have an adverse effect on this district.

The two-story, Federal-style, frame **Broad Run House (Temp 268)** was constructed with a central-passage plan. It is a rare and exceptional, surviving example of a late-eighteenth century dwelling in this area of Richmond. Although it is located within the Rolando Historic District, the resource is a noncontributing element to the district as it dates outside of its period of significance. The house is located within the northeastern section of the Rolando Historic District listed above. It is potentially eligible for the NRHP under Criterion C for its architectural style and as a unique example of extant eighteenth-century architecture in this part of Richmond. The new overpass and roadway changes along Broad Rock Boulevard would have the same impacts on this individual resource. Given this, FRA's preliminary determination is that Build Alternatives 6A, 6B–A-Line, 6C, 6E, and 6G would have an adverse effect on this historic property.

The **Movieland Bowtie Cinema (127-6188)**, previously known as the Richmond Locomotive & Machine Works, the American Locomotive Company, and Richmond Works, is an industrial complex with two buildings—the brass foundry and the iron foundry—that are both steel-framed resources with masonry walls. It is listed in the NRHP under Criteria A for its association with Richmond industrial history and C for its architectural merit. Construction of Build Alternatives 6B–A-Line, 6B–S-Line, and 6C require development of new rail corridors and large-scale structures to accommodate the train movement in this part of Richmond, as well as associated road modifications and new parking structures. Some of these changes border, or are actually located on, the Movieland Bowtie Cinema parcel. Modifications would diminish the characteristics that render this resource eligible for the NRHP. As such, FRA's preliminary determination is that Build Alternatives 6B–A-Line, 6B–S-Line, and 6C would have an adverse effect on this resource.

Access to the **Warehouse at 2728 Hermitage Road (127-6840)** was not granted during the Phase I-level survey. As such, little is known about the structure; however, the changes noted above associated with the Movieland Bowtie Cinema would also result in notable changes to the viewshed and nearby roadways related to this warehouse. FRA's preliminary determination is that Build Alternatives 6B–A-Line, 6B–S-Line, and 6C would have an adverse effect on this resource.

The industrial **Hermitage Road Warehouse Historic District (127-6730)** is characterized by roughly a dozen medium- to large-scale one-story warehouse buildings set on a gridded block pattern. Most of the buildings have large footprints that occupy most of the block on which they sit. The buildings are typically one-story, clad in brick, and covered with flat roofs. It is listed in the NRHP under Criterion A for its association with twentieth-century Richmond development and Criterion C for its architectural styling. Located north of the tracks, Build Alternatives 6B–A-Line, 6B–S-Line, and 6C would require road work along Hermitage Road, which forms the western boundary of the district, and also include construction of a rail superstructure to aid in train movement. This new superstructure would be visible from the district. Because of these modifications, FRA's preliminary determination is that Build Alternatives 6B–A-Line, 6B–S-Line, and 6C would have an adverse effect on this district.

The **Cookie Factory Lofts (127-6165)**, previously known as Southern Biscuit Company, Interbake Foods, and Famous Foods of Virginia, is a six-story, multi-bay, industrial building with a water tower on the roof that was constructed with Colonial Revival attributes. It is listed in the NRHP under Criterion A for its association with the development of this section of Richmond and Criterion C for its architectural merit. The resource is also a contributing element to the West Broad Street Industrial and Commercial Historic District (127-6570) listed below. The same aforementioned changes associated with Build Alternatives 6B–A-Line, 6B–S-Line, and 6C would affect the setting, feeling, and association of the Cookie Factory Lofts due to construction of new rail lines and road changes in the area. FRA's preliminary determination is that Build Alternatives 6B–A-Line, 6B–S-Line, and 6C would have an adverse effect on this historic property.

The **Science Museum of Virginia (127-0226)** is a 3-story, 11-bay, monumental Neoclassical style train station that now houses the Science Museum of Virginia. This resource was designed by architect John Russell Pope and is constructed of dressed ashlar with a large, central, copper dome. It is listed on the NRHP under Criteria A for its association with transportation history and C for its architectural characteristics. The resource is also a contributing element to the West Broad Street Industrial and Commercial Historic District (127-6570) listed below. While construction of Build Alternative 6C would restore the historic usage of this property, many of the rail-related features originally part of this property were removed when the structure was converted into a museum. Work associated with Build Alternatives 6B–A-Line, 6B–S-Line, and 6C would result in new construction to the north and east of the historic building, such as raised tracks and installation of new structures, as well as roadway modifications. This work would diminish the integrity of design, setting, materials, workmanship, feeling, and association of this historic property. As such, FRA's preliminary determination is that Build Alternatives 6B–A-Line, 6B–S-Line, and 6C would have an adverse effect on the Science Museum of Virginia.

The five-story, multi-bay **Todd Lofts (127-5978)** building was originally built as the Richmond Brewery. The E.M. Todd Company bought the building in 1919 and expanded it into a meat production facility. Until 1998, this resource housed the county's oldest meat processor in continuous business. This property is located along Hermitage Road. It is listed on the NRHP under Criterion A for its association with industrial development in this part of Richmond. Build Alternatives 6B–A-Line, 6B–S-Line, and 6C would require road work along Hermitage Road, and Build Alternatives 6B–A-Line and 6B–S-Line include construction of a rail superstructure to aid in train movement. This new superstructure would be visible from the property. Because of these modifications, FRA's preliminary determination is that Build Alternatives 6B–A-Line, 6B–S-Line, and 6C would have an adverse effect on this resource.

The **Southern Stove Works (127-6145)** is an industrial complex of four brick buildings and a water tower built during the time of rapid industrialization in Richmond. Southern Stove Works was one of the two largest and most important stove making plants in Richmond and the South. It is listed on the NRHP under Criteria A for its association with Richmond industrialization and C for its architectural merit. This resource is located just east across Hermitage Road from Todd Lofts, listed above. The same modifications stated above are applicable to this resource, including roadway changes and construction of new rail structures. FRA's preliminary determination is that Build Alternatives 6B–A-Line, 6B–S-Line, and 6C would have an adverse effect on this historic property.

The 40-acre **West Broad Street Industrial and Commercial Historic District (127-6570)** reflects development of the industrial capabilities of Richmond, and the allied development of commercial resources, culminating in the embrace of large-scale consumer economy by the middle of the twentieth century. It is listed in the NRHP under Criteria A for its association with industrial history in this area and C for its architectural characteristics. The district is located on both sides of Broad Street and extends northeast past Marshall Street. Changes associated with the new rail system and associated roads related to Build Alternatives 6B–A-Line, 6B–S-Line, and 6C would diminish character-defining features of this district, as well as at least two contributing resources—the Cookie Factory Lofts (127-6165) and the Science Museum of Virginia (127-0226). FRA's preliminary determination is that Build Alternatives 6B–A-Line, 6B–S-Line, and 6C would have an adverse effect on this historic district.

The **Shockoe Valley & Tobacco Row Historic District (127-0344**) encompasses the area of Richmond's earliest residential, commercial, and manufacturing activity. It is listed in the NRHP under Criteria A for its association with early Richmond developmental history and C for its architectural merit. The district is located east of the S-line corridor and north of the James River in downtown Richmond. Construction associated with Build Alternatives 6D, 6F, and 6G would include one to two multistory parking garages and the addition of long, linear platforms within the district boundaries, thus resulting in a modified building stock and the addition of large visual elements to the district. These elements have the potential to diminish the characteristics that render this resource eligible for the NRHP. FRA's preliminary determination is that Build Alternatives 6D, 6F, and 6G would have an adverse effect on this resource.

Main Street Station and Trainshed (127-0172), also known as New Union Station and Seaboard Airline & Chesapeake & Ohio Railroad Depot, symbolizes the importance of the rail terminal as an entrance gateway to Richmond and is an example of the influence of the French Ecole des Beaux Arts on American building. The building is a National Historic Landmark (NHL), listed in the NRHP under Criteria A and C, and is also a contributing element to both RF&P Railroad (076-0301) and the Seaboard Air Line Railroad (127-6271), both listed below. Three of the four Build Alternatives that use the A-Line between Acca Yard and Centralia (Build Alternatives 6A, 6B–A-Line, and 6C) include disuse of the current station and construction of a new station elsewhere. Removal of the historic, and continued, use of this significant rail station would remove character-defining attributes of the building—namely its use as a rail depot. This is especially notable as this property is an NHL due to its association with local, state, and national rail history. Three of the four Build Alternatives that use the S-Line between Main Street Station and Centralia (Build Alternatives 6D, 6F, and 6G) would involve the restoration of intercity passenger service on the west side of Main Street Station and would include the construction of one to two multistory parking garages within the viewshed of the main station building and also require alterations to historic platforms, thus diminishing the integrity of design, setting, materials, workmanship, feeling, and association. FRA's preliminary determination is that Build Alternatives 6A, 6B–A-Line, 6C, 6D, 6F, and 6G would have an adverse effect on this resource.

The French Renaissance Revival-styled **Railroad Y.M.C.A. (127-0344-0123)** is notable for its architectural characteristics and for its importance as a community center to provide recreational space for railroad workers and their families in the area. It is eligible for the NRHP under Criterion A for its importance to the early recreational and social history of this section of Richmond and under Criterion C for its architectural styling. Work associated with Build Alternatives 6D, 6F, and 6G involves the construction of one to two multistory parking decks and platform modifications, both of which would add a notable visual element within the viewshed of this resource. The parking garages and modified platforms have the potential to diminish the characteristics that render this resource eligible for the NRHP. FRA's preliminary determination is that Build Alternatives 6D, 6F, and 6G would have an adverse effect on this resource.

The **Richmond, Fredericksburg, & Potomac Railroad (076-0301)** opened in 1836 and eventually spanned from the Potomac River to Richmond. It is eligible for the NRHP under Criterion A for its association with rail development in northern and central Virginia. The DC2RVA corridor includes the main rail line, spurs, and associated elements such as station houses, bridges, and other structures. Construction associated with several alternatives would result in removal or large-scale modifications to several contributing elements to the railroad district, including Main Street Station listed above and several bridges. The exact roster of bridges is under consideration but, at a minimum, this includes the Naomi Road Bridge and the Rappahannock River Bridge in Fredericksburg, the North Anna Bridge near Doswell, and several bridges and other rail structures in Richmond. FRA's preliminary determination is that the Build Alternatives 1A through 1C, 2A, 3B, 3C, 4A, 5B through 5D–Ashcake, and 6A through 6G that include improvements on or expansion to the rail line, bridges, or structures between Arlington and Acca Yard in Richmond would have an adverse effect on this property.

The historic **Atlantic Coast Line Railroad Corridor (127-6251)** merged from several railroads in the early 1890s and represents the origins and growth of the railroad industry in the Richmond to Petersburg corridor., The historic predecessor of the CSXT A-Line, the line ran roughly parallel along what is today I-95, transporting rail travelers between Richmond and Florida. It is eligible for the NRHP under Criterion A for its association with area transportation history. Like the RF&P listed above, construction of any one of the Build Alternatives in the Richmond area would result in modifications or reconstruction of several contributing elements to this railroad district. The exact list is pending, but this includes the CSXT A-Line bridge over the James River and potential contributing resources in the Centralia area. FRA's preliminary determination is that portions of the CSXT A-Line improvements between Acca Yard and Centralia (Build Alternatives 6A, 6B–A-Line, 6C, and 6E), including the connection with the CSXT S-Line at Centralia (Build Alternatives 6B–S-Line, 6D, 6F, and 6G) would have an adverse effect on this resource.

Also representing the post-Civil War trend of merging smaller operations, the **Seaboard Air Line Railroad Corridor (127-6271)** was founded in 1900. The historic predecessor to the CSXT S-Line from Main Street Station to Centralia, it roughly paralleled what is today I-85 from Richmond to Florida. It is also eligible for the NRHP under Criterion A for its association with area transportation history. Similar to the Atlantic Coast Line Railroad, work associated with improvements to the S-Line would include modifications to contributing elements to this resource such as Main Street Staton, the S-Line bridge over the James River, and other road and rail structures south of Richmond. FRA's preliminary determination is that improvements between Main Street Station and Centralia (Build Alternatives 6B–S-Line, 6D, 6F, and 6G), including the connection with the CSXT A-Line at Centralia (Build Alternatives 6A, 6B–A-Line, 6C, and 6E) would have an adverse effect on this resource.

4.13.3 Battlefields

Due to their expansive nature and multi-resourced nature, battlefields have been pulled from the list of above ground properties as mentioned above and are outlined here in a separate narrative. The resources were defined and mapped based on the American Battlefield Protection Program (ABPP)-defined Potential National Register (PotNR) boundaries, as determined in 2009. If PotNR boundaries were not available, DHR boundaries were used. In February 2016, DHR agreed to use these boundaries in the current analysis (Appendix R).

There are 11 battlefields located in the APE. All 11 are associated with Civil War activities located in areas that were the site of numerous troop engagements during the war, notably Fredericksburg and surrounding counties, Hanover County, Henrico County, the City of Richmond, and Chesterfield County.

FRA's preliminary determinations of effect for historic resources in Virginia are listed in Tables 4.13-5 and 4.13-6.

Table 4.13-5: Summary of Preliminary Effect Determinations on Battlefields

Alternative Area	Alternative	Potential Effect (Number of Resources)		
		Adverse	No Adverse	No Effect
Area 1: Arlington (Long Bridge Approach)	1A	0	0	0
	1B	0	0	0
	1C	0	0	0
Area 2: Northern Virginia (Long Bridge to Dahlgren Spur)	2A	0	0	0
Area 3: Fredericksburg (Dahlgren Spur to Crossroads)	3A	0	0	3
	3B	0	3	0
	3C*	0	0	0
Area 4: Central Virginia (Crossroads to Doswell)	4A	0	1	0
Area 5: Ashland (Doswell to I-295)	5A	0	0	0
	5A–Ashcake	0	0	0
	5B	0	0	0
	5B–Ashcake	0	0	0
	5C*	0	0	0
	5C–Ashcake	0	0	0
	5D–Ashcake	0	0	0
Area 6: Richmond (I-295 to Centralia)	6A	0	4	2
	6B–A-Line	0	4	2
	6B–S-Line	0	6	0
	6C	0	4	2
	6D	0	6	0
	6E	0	6	0
	6F	0	6	0
	6G	0	6	0

* Partial Data; Only Phase IA reconnaissance studies were completed on the bypass options. As such, this count only includes previously recorded resources.

Table 4.13-6: Details of Project Preliminary Effect on Battlefields

DHR ID	Name/Description	Build Alternative																							
		1A	1B	1C	2A	3A	3B		3C	4A	5A	5A–Ashcake	5B	5B–Ashcake	5C	5C–Ashcake	5D–Ashcake	6A	6B–A-Line	6B–S-Line	6C	6D	6E	6F	6G
111-5295	Battle of Fredericksburg I	–	–	–	–	No Effect	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
111-5296	Battle of Fredericksburg II	–	–	–	–	No Effect	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
088-5181	Salem Church Battlefield (Banks Ford Battlefield)	–	–	–	–	No Effect	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
042-0123	North Anna Battlefield	–	–	–	–	–	–	–	No Adverse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
043-5108	Yellow Tavern Battlefield	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	
020-5320	Proctor's Creek Battlefield	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	
043-0307	Battle of Chaffin's Farm (New Market Heights Battlefield), New Market Road	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	
043-5071	Darbytown & New Market Roads Battlefield, Route 5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	No Adverse	
020-0147	Drewry's Bluff Battlefield (Fort Darling, Fort Drewry), Fort Darling Road	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Effect	No Effect	No Adverse	No Effect	No Adverse	No Adverse	No Adverse	No Adverse	
123-5025	Assault on Petersburg (Petersburg Battlefield II), Bermuda Hundred Road (Alt Route 697)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No Effect	No Effect	No Adverse	No Effect	No Adverse	No Adverse	No Adverse	No Adverse	

Coordination of these determinations is ongoing with DHR and relevant consulting parties. Based on preliminary dialogues with DHR, the Project would have No Adverse Effect on any of the 11 battlefields within the APE. As Project plans are confirmed, the work would be evaluated to assure that character-defining features of the battlefields in general, and contributing elements specifically, are not altered or diminished during the Project. Because FRA's preliminary determination is that there would be no adverse effects to these battlefields, narratives are not presented below. See Section 3.13 for descriptions of these resources.

4.13.4 Summary and Mitigation

In summary, FRA's preliminary determination is that 33 historic properties would be adversely affected by 1 or more of the Build Alternatives (Figure 4.13-1). Figures in the *Cultural Resources Reports* (Appendix R) show the potential impacts to these historic properties. FRA's preliminary determination is that the remaining 125 historic properties in the APE would have no effect or no adverse effect resulting from any of the Build Alternatives.

Where FRA determines that the Project will have an adverse effect on historic resources, efforts will be undertaken to avoid, minimize, or mitigate the adverse effects. Efforts have been made by DRPT to identify Project alternatives that avoid adverse effects to Section 106 resources identified in this section. Where avoidance is not possible, FRA will identify measures to minimize and mitigate for impacts. Chapter 5 outlines measures to minimize harm to historic resources. Chapter 6 describes the coordination that has taken place between DRPT and state historic preservation offices, resource owners, historic societies, and other consulting parties.

A Programmatic Agreement was executed for the SEHSR project. Due to the nature of the DC2RVA Project, a Programmatic Agreement (PA) is underway to outline: (1) studies still required once a recommended Preferred Alternative has been selected (namely, additional Phase I and Phase II archaeological studies on the main corridor and road improvement areas and full cultural resource studies on the bypasses, if selected); and (2) tasks that would be undertaken to mitigate adverse effects.

4.14 PARKLANDS, RECREATIONAL AREAS, AND REFUGES

4.14.1 Effects

Effects to parklands, recreational areas, and wildlife refuges, collectively referred to as parkland resources, were determined through overlay of the parkland boundaries with the permanent and temporary limits of disturbance for the Build Alternatives. Section 3.14 in Chapter 3 identifies all the parklands, recreational areas, and wildlife refuges identified in the study area. DRPT assumed that the proposed right-of-way would match the permanent limits of disturbance, and these areas would be permanently removed from use as a park, recreational area, or wildlife refuge. Seventeen (17) parkland and trail resources could potentially be impacted by the Build Alternatives. Six of the 17 facilities would have permanent impacts while the remainder would only have temporary impacts. Table 4.14-1 identifies the permanent and temporary impacts to parkland resources by Build Alternative. Figure 4.14-1 depicts the permanent impact areas. The No Build Alternative would have no impacts to parkland resources.

Section 3.14 in Chapter 3 also identifies Section 4(f) recreational resources and Section 6(f) resources. These designations apply to some of the public parks, recreation areas, and wildlife refuges in the study area and afford additional protection to these resources. See Chapter 5 for the Section 4(f) Evaluation and discussion of Section 4(f) impacts and mitigation. Section 6(f) impacts are discussed below.

The permanent impacts associated with each of the Build Alternatives are discussed below.

In Alternative Area 1 (Arlington), Build Alternatives 1B and 1C would impact Long Bridge Park. Permanent impacts range from 0.36 to 1.45 acres. Build Alternative 1B would have the greatest impact to this resource.

In Alternative Area 2 (Northern Virginia), the single Build Alternative 2A would have a 0.04-acre permanent impact to the Dog Run Park at Carlyle.

In Alternative Area 3 (Fredericksburg), none of the alternatives through or around Fredericksburg (Build Alternatives 3A, 3B, and 3C) would have permanent impacts to parkland resources.

In Alternative Area 4 (Central Virginia), the single Build Alternative 4A would not have permanent impacts to parkland resources.

In Alternative Area 5 (Ashland), permanent impacts to parkland resources are minimal. The four alternatives that include a new intercity passenger rail station at Ashcake Road (Build Alternatives 5A–Ashcake, 5B–Ashcake, 5C–Ashcake, and 5D–Ashcake) would have a 0.01-acre permanent impact to Ashland Trolley Line. The alternatives that would add a third track, primarily on the east side of the right-of-way, through town (Build Alternatives 5B and 5B–Ashcake) would have a 0.03-acre permanent impact to Carter Park.

In Alternative Area 6 (Richmond), permanent impacts to parkland resources are minimal. Build Alternatives that use the A-Line between Acca Yard and Centralia (Build Alternatives 6A, 6B–A-Line, 6C, and 6E) would have the slightly higher permanent impact of 0.19 acre and would only impact Gates Mill Park. Build Alternatives that use the S-Line between Main Street Station and Centralia (Build Alternatives 6B–S-Line, 6D, 6F, and 6G) would have a 0.17-acre permanent impact to Walker's Creek Retention Basin Park.

Section 6(f) directs the United States Department of Interior (DOI) to assure that replacement lands of equal value, location, and usefulness are provided as conditions to such conversions. Consequently, where conversions of Section 6(f) lands are proposed for transportation projects, replacement lands would be necessary. There are no permanent impacts to Section 6(f) lands. George Washington Memorial Parkway, Fredericksburg and Spotsylvania National Military Park, and Pierson/Slaughter Pen Farm are Section 6(f) resources but would only have temporary impacts during construction and replacement lands would not be required.

4.14.2 Mitigation

Impacts to parkland, recreational areas, and wildlife refuges were avoided and minimized to the maximum extent possible. All potential impacts consist of minor amounts of additional right-of-way required for track construction that would not impact park functions. DRPT will coordinate these impacts with the park owners. Temporary impacts were also avoided and minimized to the greatest extent feasible. DRPT will make all efforts to return temporary easements back to pre-construction conditions and to avoid impacting the essential park functions during construction.

Table 4.14-1: Permanent and Temporary Impacts to Parkland Resources by Build Alternative (acres)

Alternative Area	Alternative	Long Bridge Park	Crystal City Water Park	Old Town Greens Homeowners Association	Dog Run Park at Carlyle	George Washington Memorial Parkway	Veterans Memorial Park	Mount Vernon Trail	Pierson/Slaughter Pen Farm	Fredericksburg and Spotsylvania National Military Park	Mattaponi Wildlife Management Area	North Ashland Park	Railside Park	Carter Park	Ashland Trolley Line	Maggie Walker Governor's School Fields	Walkers Creek Retention Basin Park	Gates Mill Park
Area 1: Arlington (Long Bridge Approach)	1A	P: 0.00 T: 0.51	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	1B	P: 1.45 T: 0.88	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	1C	P: 0.36 T: 0.65	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Area 2: Northern Virginia (Long Bridge to Dahlgren Spur)	2A	–	P: 0.00 T: 0.11	P: 0.00 T: 0.08	P: 0.04 T: 0.14	P: 0.00 T: 1.04	P: 0.00 T: 0.05	P: 0 feet T: 20 feet	–	–	–	–	–	–	–	–	–	–
Area 3: Fredericksburg (Dahlgren Spur to Crossroads)	3A	–	–	–	–	–	–	–	P: 0.00 T: 0.17	P: 0.00 T: 0.02	–	–	–	–	–	–	–	–
	3B	–	–	–	–	–	–	–	P: 0.00 T: 0.17	P: 0.00 T: 0.02	–	–	–	–	–	–	–	–
	3C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Area 4: Central Virginia (Crossroads to Doswell)	4A	–	–	–	–	–	–	–	–	P: 0.00 T: 1.09	P: 0.00 T: 2.54	–	–	–	–	–	–	–
Area 5: Ashland (Doswell to I-295)	5A	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	5A–Ashcake	–	–	–	–	–	–	–	–	–	–	—	—	—	P: 0.01 T: 0.00	–	–	–
	5B	–	–	–	–	–	–	–	–	–	–	—	—	P: 0.03 T: 0.00	—	–	–	–
	5B–Ashcake	–	–	–	–	–	–	–	–	–	–	—	—	P: 0.03 T: 0.00	P: 0.01 T: 0.00	–	–	–
	5C	–	–	–	–	–	–	–	–	–	–	–	–	–	—	–	–	–
	5C–Ashcake	–	–	–	–	–	–	–	–	–	–	–	–	–	P: 0.01 T: 0.00	–	–	–
	5D–Ashcake	–	–	–	–	–	–	–	–	–	–	–	–	–	P: 0.01 T: 0.00	–	–	–
Area 6: Richmond (I-295 to Centralia)	6A	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	P: 0.19 T: 0.22
	6B–A-Line	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	P: 0.19 T: 0.22
	6B–S-Line	–	–	–	–	–	–	–	–	–	–	–	–	–	–	P: 0.00 T: 0.01	P: 0.17 T: 0.23	–
	6C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	P: 0.19 T: 0.22
	6D	–	–	–	–	–	–	–	–	–	–	–	–	–	–	P: 0.00 T: 0.01	P: 0.17 T: 0.23	–
	6E	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	P: 0.19 T: 0.22
	6F	–	–	–	–	–	–	–	–	–	–	–	–	–	–	P: 0.00 T: 0.01	P: 0.17 T: 0.23	–
	6G	–	–	–	–	–	–	–	–	–	–	–	–	–	–	P: 0.00 T: 0.01	P: 0.17 T: 0.23	–

P: Permanent Impacts in Acres; T: Temporary Impacts in Acres

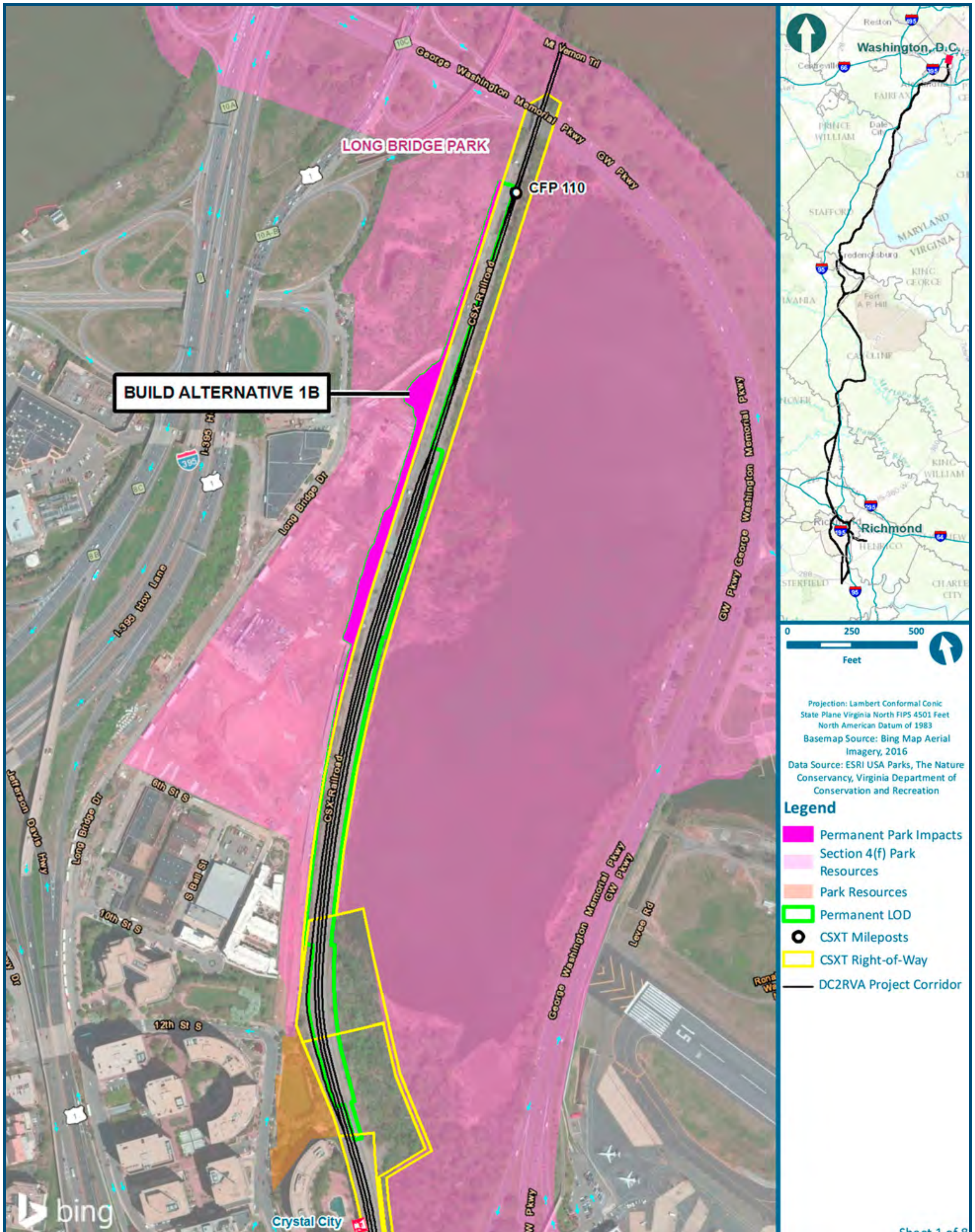

Figure 4.14-1: Permanent Park Impacts – Build Alternative 1B

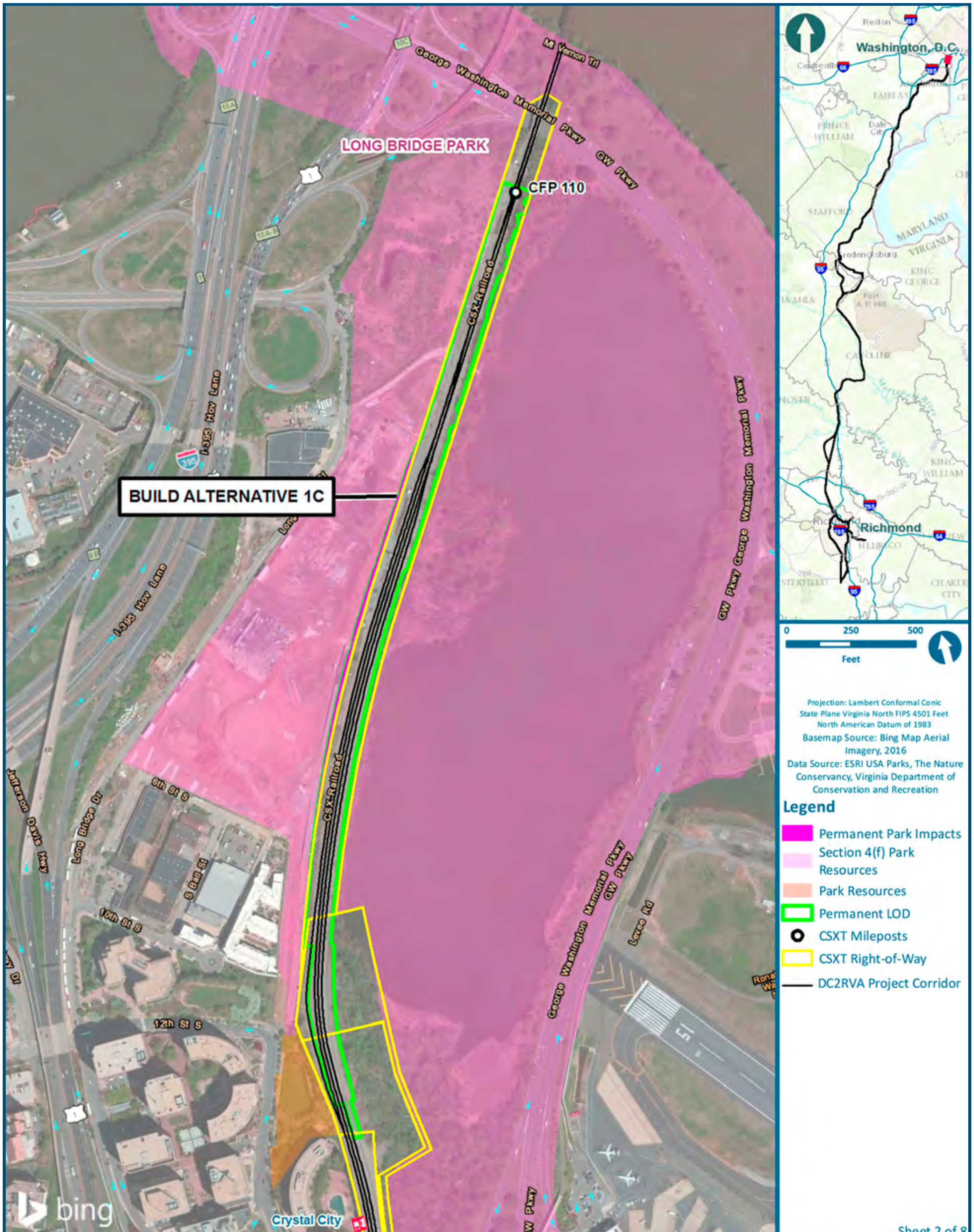

Figure 4.14-1: Permanent Park Impacts – Build Alternative 1C

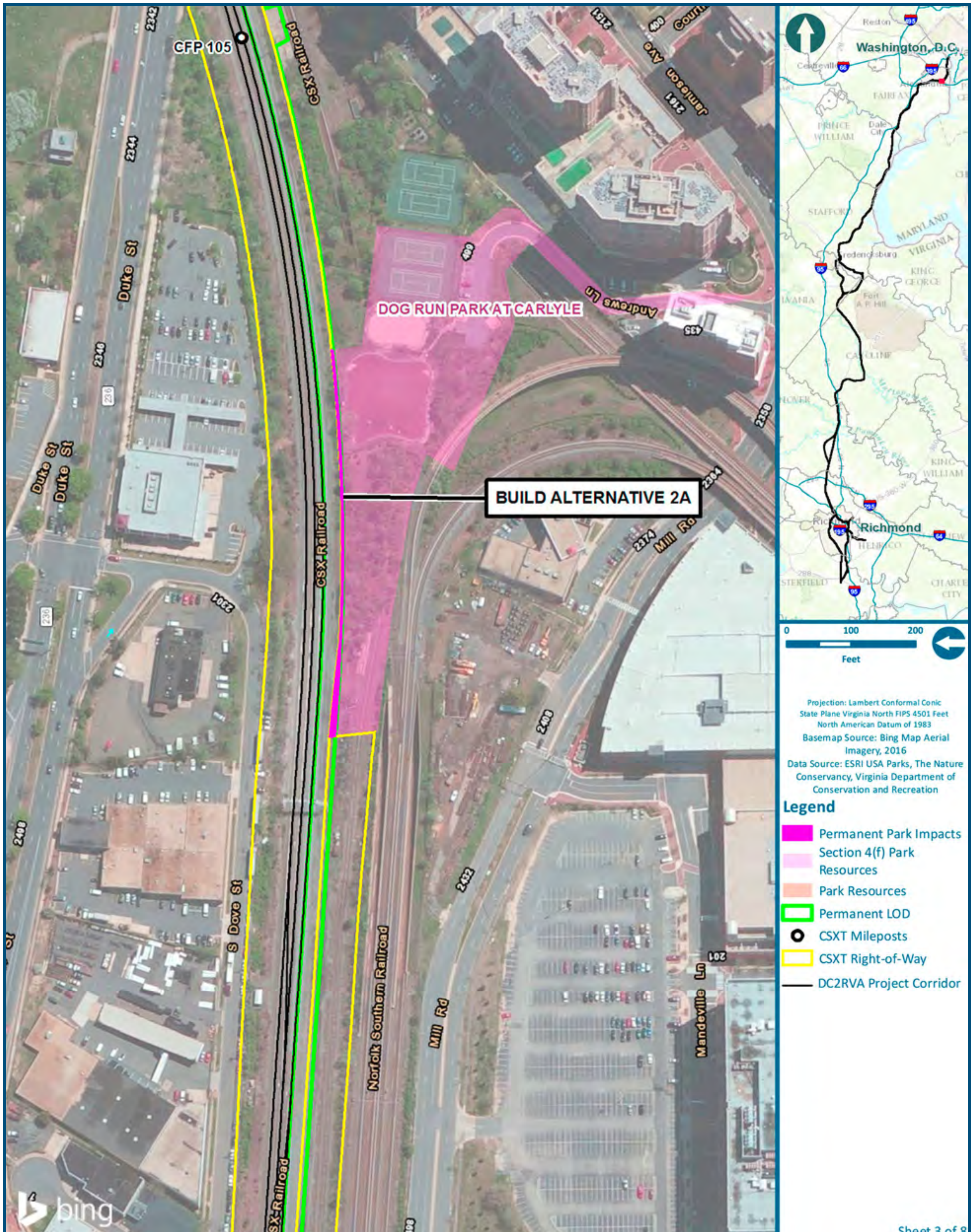

Figure 4.14-1: Permanent Park Impacts – Build Alternative 2A

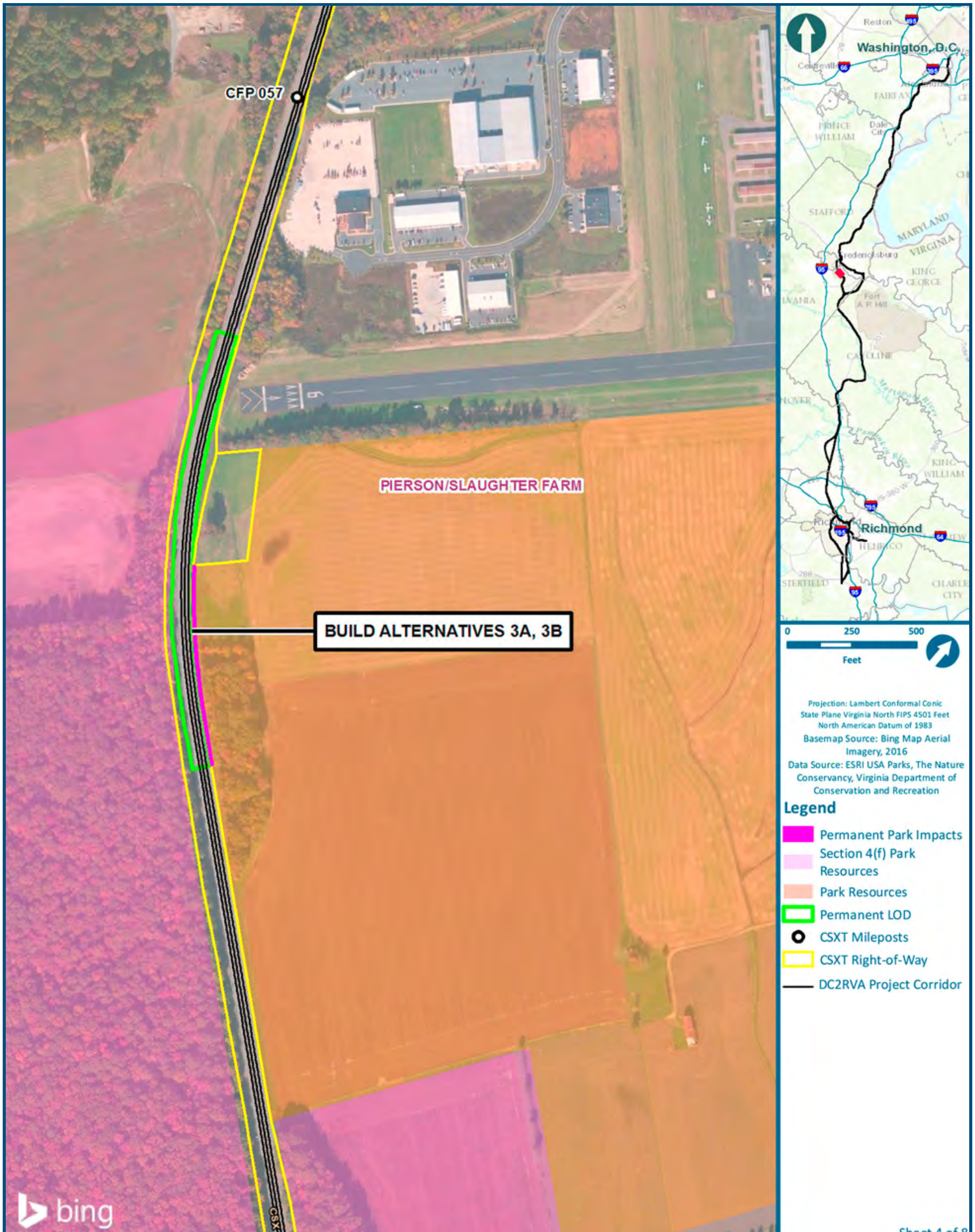

Figure 4.14-1: Permanent Park Impacts – Build Alternatives 3A, 3B

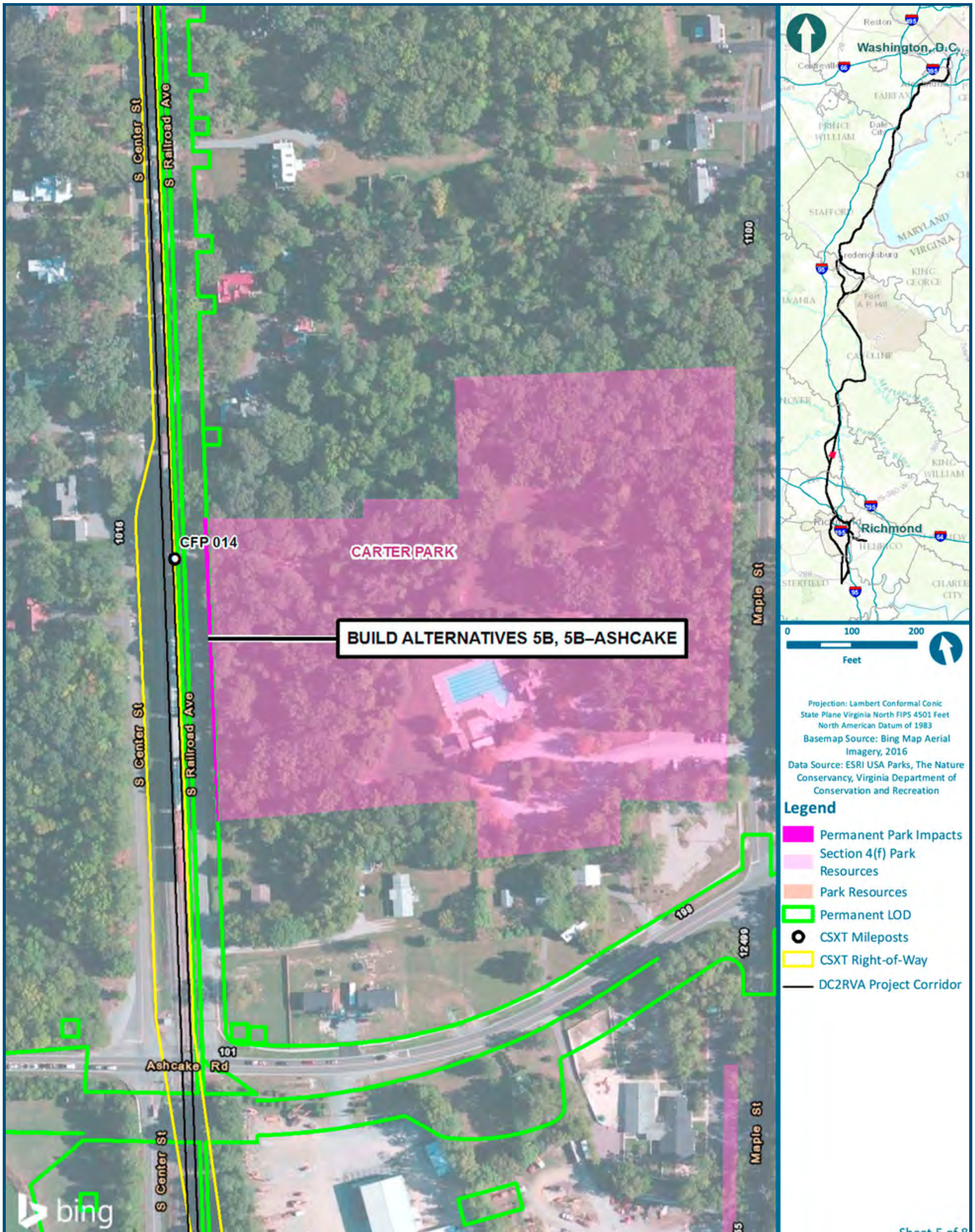

Figure 4.14-1: Permanent Park Impacts – Build Alternatives 5B, 5B–Ashcake

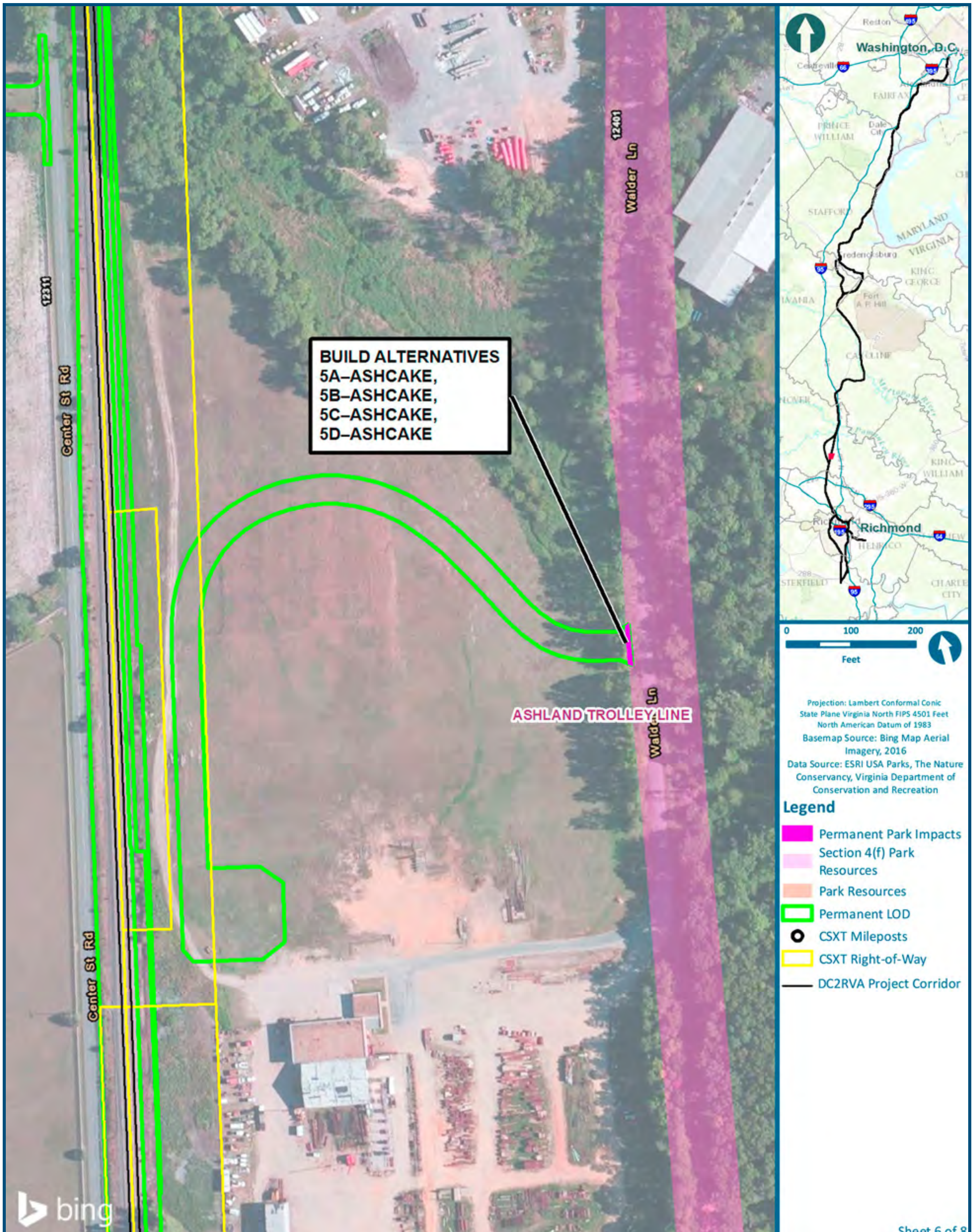

Figure 4.14-1: Permanent Park Impacts – Build Alternatives 5A–Ashcake, 5B–Ashcake, 5C–Ashcake, 5D–Ashcake

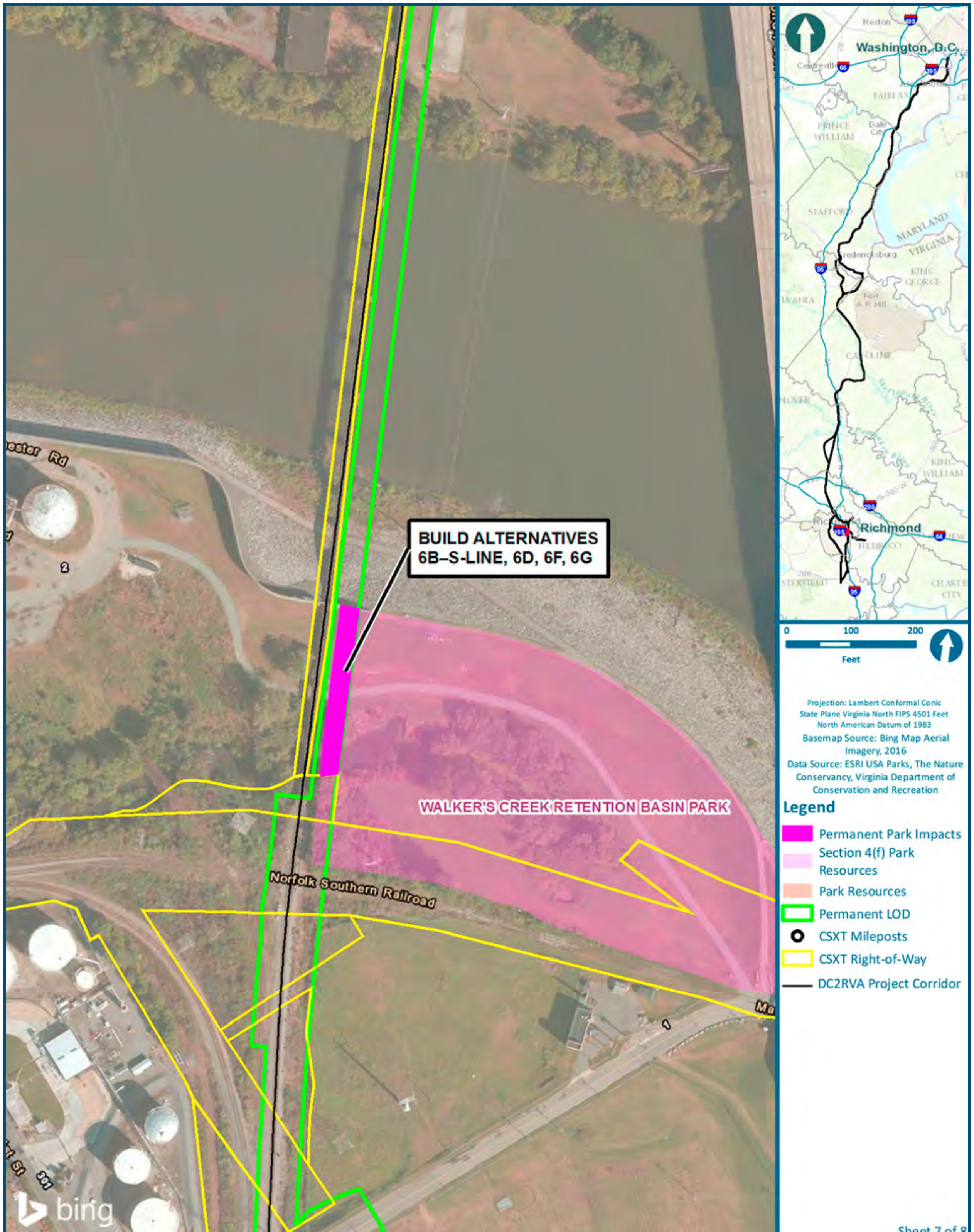

Figure 4.14-1: Permanent Park Impacts – Build Alternatives 6B–S-Line, 6D, 6F, 6G

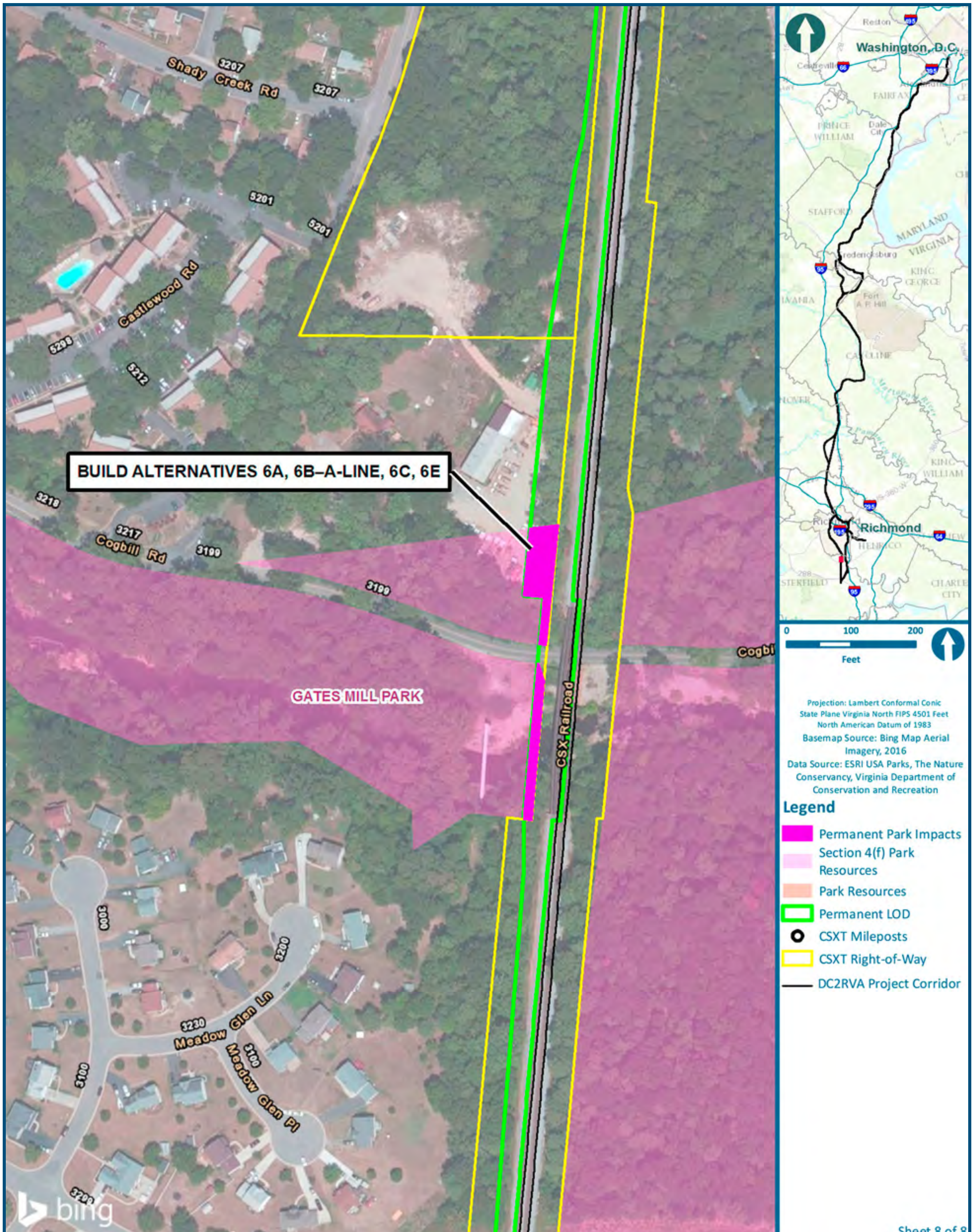

Figure 4.14-1: Permanent Park Impacts – Build Alternatives 6A, 6B–A-Line, 6C, 6E

4.15 TRANSPORTATION FACILITIES

This section summarizes the anticipated effects on the DC2RVA Project area transportation network and is presented at the same two scales as the Affected Environment Transportation Facilities section: Regional Scale and Corridor Scale.

The Regional Scale Environmental Consequences include the following (in order of presentation):

- DC2RVA train service through the corridor, including the type and number of increases in daily trips through the DC2RVA corridor, and associated ridership projections.
- Effects due to increases in DC2RVA ridership along the corridor:
  - Effects on the regional roadway network from the DC2RVA Project, including the number of vehicles anticipated to be removed from the transportation network due to DC2RVA ridership.
  - Effects on adjacent roadways to the Amtrak stations that are being served by the DC2RVA intercity passenger trains.
  - Effects on parking needs at the Amtrak stations that are being served by the DC2RVA intercity passenger trains.

The Corridor Scale Environmental Consequences include the following (in order of presentation):

- Crossing improvements that are proposed at each roadway crossing as part of the DC2RVA Project, including presentation of:
  - Descriptions of the types of crossing treatments.
  - Crossing improvements at existing public and private at-grade crossings.
  - Crossing improvements at existing grade-separated crossings.
  - Build alternative improvements to other public roadways.
  - Summary of all proposed public roadway closures and grade separations.
- Crossing improvement effects (qualitative) on connectivity and accessibility, including:
  - Effects of improvements at public at-grade crossings
  - Effects of improvements at private at-grade crossings
  - Effects of improvements at grade-separated crossings.
  - Relevance of Build Alternatives to existing quiet zones.
  - Effects on bicycle and pedestrian connectivity.
- Quantitative traffic operational analysis (changes in volumes and level of service along roadways and through the intersections) to determine the effects of the public roadway closures that are proposed as part of the DC2RVA Project.
- Quantitative analysis of the crossing improvement effects on vehicles at the public at-grade crossings (total daily vehicle delay).

It is the intent of this section to provide a high-level overview of the transportation analysis and resulting effects that were conducted to support the decisions to be made for the DC2RVA Project. The *Transportation Technical Report* (Appendix S) contains a full inventory of all methodology, data, and analyses summarized herein. In accordance with Project planning dates for physical impacts, analyses of transportation facilities are estimated for 2025; refer to Section 2.1.2 for details.

4.15.1 Regional Scale

This section presents the future year 2025 conditions of the DC2RVA train service and associated increased ridership from a regional level, and the analysis of how those improvements are anticipated to affect the greater roadway network. Year 2025 is the current best estimate of when construction of the DC2RVA infrastructure could be completed and the new DC2RVA service would be placed in operation.

4.15.1.1 DC2RVA Train Service and Ridership

Under 2025 Build conditions, intercity passenger rail ridership is projected to increase due to increased train frequency, availability, and reliability, as well as trends in general population growth. The future year increases in ridership from the DC2RVA Project could affect the regional roadway network[1] in the following ways:

- Decreases in vehicles using the roadway network (i.e., mainly I-95) between Washington, D.C. and Richmond. *Refer to Section 4.15.1.2 for this analysis.*
- Increases in vehicles using the roadway network directly adjacent to the train station(s) that provide service, as well as increases in parking needs at those stations. *Refer to Section 4.15.1.3 and 4.15.1.4 for these analyses.*

The DC2RVA Project would add nine new passenger rail round trips for 2025 Build conditions (refer to Chapter 2 for full details):

- Four new interstate corridor (NC) passenger trains, with stops at the following stations within the DC2RVA corridor:
  - Alexandria
  - Fredericksburg
  - Richmond (station location within the city varies by Build Alternative)
- Five new Northeast Regional passenger (VA) trains, with stops at the following stations within the DC2RVA corridor:
  - Alexandria
  - Woodbridge
  - Quantico
  - Fredericksburg
  - Ashland (station location within town varies by Build Alternative)
  - Richmond (station location within the city varies by Build Alternative)

Table 4.15-1 presents the annual ridership at each station, represented as a total number of boardings and alightings (i.e., a total number of train passengers getting on and off of the train) for 2015, 2025 No Build, and 2025 Build conditions, by Build Alternative. As the station alternatives in Richmond drive the differences in ridership for Build conditions throughout the DC2RVA corridor, the annual ridership is presented by the seven station alternatives in the Richmond area. Ridership is the same for Build Alternatives 6B–A-Line and 6B–S-Line, so they are presented as a single Build Alternative 6B. The table also compares each of the Build

[1] Changes in the number and operating characteristics (i.e., type, speed, and length) of trains can have a direct effect on individual at-grade highway-rail crossings in terms of delay experienced while trains are traversing the crossing. These analyses are provided on the Corridor Scale, which are included in Section 4.15.2.

Table 4.15-1: Annual DC2RVA Ridership[1] at Station in Project Area (boardings and alightings[2])

Alternative	Station									Total Corridor Stations
	Alexandria	Woodbridge	Quantico	Fredericksburg	Ashland Station	Staples Mill Road	Boulevard Road	Broad Street	Main Street	
Existing–2015	174,238	23,836	34,574	127,535	28,013	351,156	–	–	46,849	1,028,488
No Build–2025	208,496	31,191	37,945	168,627	32,694	407,119	–	–	50,846	1,248,848
Build Alternatives–2025: Annual Ridership (% Change Compared to 2025 No Build Alternative)										
6A (Staples Mill Road Station Only)	233,602 (12%)	82,694 (165%)	45,313 (19%)	305,177 (81%)	47,368 (45%)	714,795 (76%)	–	–	–	1,929,413 (54%)
6B[3] (Boulevard Station Only)	227,706 (9%)	82,304 (164%)	44,943 (18%)	311,500 (85%)	50,437 (54%)	–	700,152 (new)	–	–	1,895,121 (52%)
6C (Broad Street Station Only)	224,571 (8%)	81,140 (160%)	44,278 (17%)	311,761 (85%)	54,002 (65%)	–	–	677,667 (new)	–	1,849,827 (48%)
6D (Main Street Station Only)	228,278 (9%)	82,521 (165%)	45,118 (19%)	314,017 (86%)	55,771 (71%)	–	–	–	725,586 (1,327%)	1,910,001 (53%)
6E (Split Service, Staples Mill Road/Main Street Stations)	230,896 (11%)	82,171 (163%)	45,398 (20%)	301,810 (79%)	45,701 (40%)	588,610 (45%)	–	–	107,090 (111%)	1,879,581 (51%)
6F (Full Service, Staples Mill Road/Main Street Stations)	230,840 (11%)	83,057 (166%)	45,257 (19%)	303,303 (80%)	44,165 (35%)	417,774 (3%)	–	–	370,238 (628%)	1,951,631 (56%)
6G (Shared Service, Staples Mill Road/Main Street Stations)	233,030 (12%)	83,467 (168%)	45,527 (20%)	303,120 (80%)	44,388 (36%)	514,975 (26%)	–	–	254,728 (401%)	1,941,560 (55%)

[1] The annual ridership represents the DC2RVA Project. It excludes passengers on VRE, the Auto Train, and the long distance trains to Georgia/Florida. Ridership forecasts for the Build Alternatives only differ based on which station option is used in Richmond.

[2] Boardings and alightings represent train passengers getting on and off of the train, respectively.

[3] The DC2RVA passenger train ridership is the same for Build Alternatives 6B–A-Line and 6B–S-Line, so they are presented in this table as a single Build Alternative 6B.

conditions to the No Build, as a percentage of total ridership. The total DC2RVA ridership throughout the corridor is anticipated to increase approximately 50 percent by 2025 for all Build Alternatives (ranging from a low of 48 percent for Build Alternative 6C Broad Street Station Only, to a high of 56 percent for Build Alternative 6F, Full Service at Staples Mill and Main Street Stations).

4.15.1.2 Ridership Effects on Regional Roadways

The purpose of this analysis is to determine the effects of increased DC2RVA ridership on the number of vehicles that use the regional roadway system each day.

Future year roadway traffic volumes for the No Build condition were developed by applying a two percent growth rate (linear growth, non-compounded) to existing traffic volumes. Refer to the *Transportation Technical Report* (Appendix S) for details of the methodology of determining the growth rate, which was based on examining growth trends in historical traffic volume data, and of determining the associated future year regional roadway network Build conditions.

Table 4.15-2 summarizes the estimated traffic on the regional roadway for 2025 No Build conditions, as well as existing conditions (2015) for reference. The data indicate an overall increase of 20 percent in total VMT[2] by 2025, without the DC2RVA rail improvements. The I-95 facility represents approximately 280 directional roadway miles (including I-395) of the total regional roadway miles between Washington, D.C. and Richmond within the DC2RVA corridor. I-95 is projected to carry approximately 45.4 million vehicle miles annually by 2025, which represents almost 50 percent of the total vehicles miles in the regional area.

Table 4.15-2: Regional Roadway Network, No Build Conditions

	Directional Measure	Interstate and U.S. Routes	State Primary Route	State Secondary Route	Urban Routes	Total
2015 Total (Regional Scale)	ADT	47,856,880	14,744,998	5,748,709	1,029,843	69,380,430
	Length	895.0	530.7	422.2	70.8	1,918.7
	VMT	60,815,804	13,903,153	3,658,472	618,849	78,996,278
2025 No Build Total (Regional Scale)	ADT	57,240,582	17,636,174	6,875,907	1,231,773	82,984,436
	Length	895.0	530.7	422.2	70.8	1,918.7
	VMT	72,740,471	16,629,261	4,375,819	740,192	94,485,743

The DC2RVA improvements are expected to result in an increase of up to 854,000 annual rail passenger trips[3] (compared to No Build conditions). By shifting this travel to rail, DRPT anticipates that up to 2,050 VPD and 250,000 daily vehicle miles would be removed from the parallel roads of I-95 and U.S. Route 1 in the 123-mile Project corridor – annually, this equates to

[2] A vehicle mile is a measure of total travel on a particular roadway or within an overall area; it is calculated by multiplying the number of vehicles traveling on a particular roadway by the total length of that roadway.

[3] This value represents trips going to, from, and through the study corridor.

removing 656,000 vehicles per year and 80 million annual vehicle miles from the system[4]. This represents a reduction in vehicle miles both annually and daily of approximately 0.6 percent.

4.15.1.3 Ridership Effects on Roadway Network at Amtrak Stations

The purpose of this evaluation is to assess the effects on major roadways that are located adjacent to the Amtrak stations that are served by the DC2RVA passenger trains. To complete this assessment, the annual DC2RVA passenger train ridership (as presented in Table 4.15-1) was used to estimate daily trips by mode, and the resulting motor vehicle trips were compared to the daily volumes of the adjacent roadways[5] to determine the percent change in traffic due to increases in DC2RVA ridership. The *Transportation Technical Report* (Appendix S) includes estimates of the daily number of passengers and associated daily number of motor vehicle trips, as well as associated changes in daily traffic at every station for each Build Alternative.

A summary of the ridership effects on the station roadway network is presented in Table 4.15-3. The results indicate the following overall corridor-wide results.

- For each Build Alternative, the DC2RVA ridership equates to over 2,000 new daily motor vehicle trips at each station (for each single-station alternative) or combination of stations (for each two-station alternative).
- Most adjacent roadways to the stations will experience nominal increases in traffic[6] (under 1 percent increase in total daily traffic) for most Build conditions. In general, the adjacent roadways at the stations are multiple lane facilities with high carrying capacity that could accommodate increases in vehicular trips due to the DC2RVA Project.
- Overall, the highest increases in daily traffic on adjacent roadways due to the DC2RVA ridership are anticipated at the Fredericksburg station where traffic is projected to increase approximately 7 to 8 percent on the adjacent roadways of Princess Anne Street and Caroline Street for all Build Alternatives. These facilities carry some of the lowest existing and future daily volumes on adjacent roadways to stations for the project.
- Within Ashland, the location of the station has minimal effect on the results. Increases to traffic are nominal (less than 1 percent change in daily traffic) for both the existing station location and the station relocation to Ashcake Road.
- For the single station Build Alternatives in Richmond, the greatest increases in traffic on adjacent roadways are anticipated for the two stations that are not currently served by any passenger trains (Boulevard and Broad Street stations), which are projected to increase approximately 5 percent. Traffic increases adjacent to the Main Street Station and Staples Mill Station are projected to increase approximately 4 percent and 2 percent, respectively.

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[4] Average daily to annual equivalence based on assumed ratio of 320.

[5] Adjacent roadway(s) at stations were defined as those that vehicles (including personal motor vehicle, transit, or drop-off service such as taxis) could use to access the station. The starting adjacent roadway values were based on the DC2RVA Project not being build, i.e. the No Build.

[6] While increases in DC2RVA ridership would cause increases in traffic adjacent to DC2RVA stations, the levels of increase in ridership do not directly correlate to the same increases in traffic.

- For the two-station Build Alternatives in Richmond, the traffic increases vary by station; however, all projected traffic increases are anticipated to be under 2 percent at both Staples Mill Road and Main Street stations for all Build conditions.
- Reductions in traffic due to the DC2RVA ridership are anticipated at stations that are being served in the No Build condition but are not being served in the Build condition.

4.15.1.4 Ridership Effects on Parking Needs at Stations

DRPT used an Amtrak-approved method to determine the parking demand at each Amtrak station in the DC2RVA corridor[7]. Parking factors vary by the type and location of station. There are three types of Amtrak stations within the DC2RVA corridor: Large (fully staffed, multiple transit services and amenities, multiple tracks and platforms); Medium (lower levels of staff, supporting transit services); and Caretaker (enclosed waiting areas, limited amenities, not fully staffed). Additionally, stations were categorized as city center (high density urban) or suburban (medium density)[8]. The analysis approach takes into account the different characteristics of regional, state corridor, or long distance passenger train riders and includes average duration of trip. Refer to the *Transportation Technical Report* (Appendix S) for detailed assumptions, as well as results for each station alternative.

Alexandria Depot

[7] Amtrak recommends that parking capacities at its stations should be based on at least a twenty-year projection of ridership growth. Accordingly, DRPT determined it appropriate to conduct the DC2RVA parking analysis based on projections for the year 2045.

[8] It was assumed that a suburban station requires more parking than in a city center.

Table 4.15-3: Summary of Ridership Impacts on Station Roadways, % Change[1] in Traffic on Adjacent Roadways[2] due to DC2RVA Intercity Passenger Trains

2025 Build Alternatives	Station								
	Alexandria	Woodbridge	Quantico	Fredericksburg	Ashland Station	Staples Mill Road	Boulevard Road	Broad Street	Main Street
6A (Staples Mill Road Station Only)	0.2%	0.4%	0.8%	7.7%	0.3%	2.2%	0.0%	0.0%	-0.4%
6B[3] (Boulevard Station Only)	0.1%	0.3%	0.4%	8.1%	0.3%	-3.0%	5.2%	0.0%	-0.4%
6C (Broad Street Station Only)	0.1%	0.3%	0.4%	8.1%	0.3%	-3.0%	0.0%	5.3%	-0.4%
6D (Main Street Station Only)	0.1%	0.3%	0.4%	8.1%	0.3%	-3.0%	0.0%	0.0%	3.9%
6E (Split Service, Staples Mill Road/Main Street Stations)	0.1%	0.3%	0.8%	7.3%	0.3%	1.3%	0.0%	0.0%	0.3%
6F (Full Service, Staples Mill Road/Main Street Stations)	0.1%	0.4%	0.8%	7.3%	0.1%	0.1%	0.0%	0.0%	1.8%
6G (Shared Service, Staples Mill Road/Main Street Stations)	0.1%	0.4%	0.8%	7.3%	0.1%	0.7%	0.0%	0.0%	1.1%

[1] The % changes shown in this table compare the 2025 Build to the 2025 No Build conditions. For details of each Build Alternative, refer to the *Transportation Technical Report.* The information is presented by the Richmond area alternatives, because the ridership forecasts developed for this Project only differ based on which station option is used in Richmond.

[2] Adjacent roadway(s) at stations were defined as those that vehicles (including personal motor vehicle, transit, or drop-off service such as taxis) could use to access the station.

[3] The DC2RVA passenger train ridership is the same for Build Alternatives 6B–A-Line and 6B–S-Line, so they are presented in this table as a single Build Alternative 6B.

Note that the station(s) served within Richmond for each Build Alternatives are highlighted for ease of reference.

DRPT calculated a range of daily parking space demand (a high and low range) based on projected DC2RVA ridership. A summary of the results is provided in Table 4-15.4.

Table 4-15.4: Summary of Daily Parking Space Demand by Station

Station	Station Size / Type	Daily Parking Space Demand: Low	Daily Parking Space Demand: High
Alexandria	Medium / Suburban	140	190
Woodbridge	Caretaker / Suburban	35	47
Fredericksburg	Medium / Suburban	142	191
Ashland	Caretaker / Suburban	29	39
Boulevard Road	Large / Suburban	459	620
Broad Street	Large / Suburban	446	603
Staples Mill:			
Build Alternative 6A	Large / Suburban	467	632
Build Alternative 6E	Large / Suburban	411	556
Build Alternative 6F	Large / Suburban	301	406
Build Alternative 6G	Large / Suburban	344	465
Main Street:			
Build Alternative 6D	Large / City Center	193	261
Build Alternative 6E	Medium / Suburban	49	66
Build Alternative 6F	Large / Suburban	199	269
Build Alternative 6G	Medium / Suburban	120	163

The results indicate the following overall corridor-wide results.

- The daily parking space demand does not vary by Build Alternative for the stations with a single location (Alexandria; Woodbridge; Fredericksburg; Ashland; Boulevard Road; and Broad Street).
- At Staples Mill Road Station, sizing and type do not vary. Build Alternative 6A would require the highest daily parking space demand at 632 spaces (high demand), which is a 56 percent increase over the Build Alternative 6F which requires 406 spaces (high demand).
- At Main Street Station, the station size and type varies by Build Alternative. Build Alternatives 6D and 6E, in which it is defined as a large station, would require the most daily parking (260 to 270 spaces, high demand), while Build Alternative 6E, in which Main Street is defined as a medium station, requires the least amount of parking (66 spaces, high demand).

The conceptual layouts based on these parking needs are shown in Chapter 2. These conceptual layouts for each station were based on the physical characteristics of the station site, the DC2RVA basis of design, and the functional requirements of Amtrak. In general, the high end of the range of the daily parking space demand was used (with rounding) when developing the parking layouts; however, for the Alexandria station, the conceptual layout reflects the existing property constraints and not the calculated parking space demand.

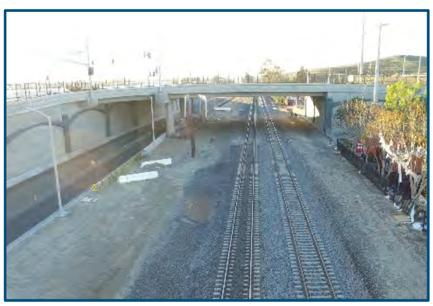
4.15.2 Corridor Scale

This section presents the potential effects of the DC2RVA Project on the highway-rail crossings and connecting roadway network. It includes descriptions of the improvements proposed at each crossing as well as analysis of the effects of those improvements on vehicles using the crossings and on connectivity to the transportation network. All analyses in this section are for the permanent Build condition; for temporary construction-related effects, refer to Section 4.19.

4.15.2.1 DC2RVA Build Alternative Crossing Improvements

Types of Crossing Treatments

The following five types of crossing treatments are included within the DC2RVA Build Alternatives; these were based on FRA guidelines, life-cycle cost efficiency, and safety needs of the geometry of parallel/intersecting crossing roadways and operating conditions within the DC2RVA corridor. Other site improvements (i.e., geometric and/or safety improvements) to improve overall roadway and/or railroad safety, as part of or in addition to these treatments, are not precluded from the design of any of these treatments. It is anticipated that changes to crossing treatments that could occur during final design would have limited effects compared to the treatment types developed and analyzed in this Draft EIS. In the unanticipated event that substantive changes are developed as part of final design efforts, the impacts of these changes would be assessed at that time.



Grade Separation.

A highway-rail crossing that occurs at two different vertical levels (i.e., the roadway pavement and the railroad tracks do not intersect). Per FHWA[9], "the decision to grade separate at [an existing] highway-rail crossing is primarily a matter of economics" as a long-term investment. Benefits of grade-separated crossings (compared to at-grade crossings) include reduction in collisions, vehicle and rail delay, and maintenance costs.

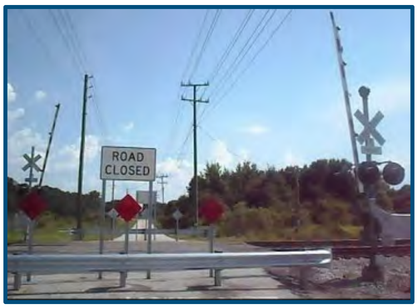
Four-Quadrant Gates.

A system of gates (entrance and exit gates on all roadway approaches) designed to provide full closure of the crossing when a train is approaching or occupying the crossing, thus eliminating the opportunity for vehicles to navigate around a single lowered gate. Design can include detection inside the gates to ensure that vehicles do not get "trapped" inside lowered gates.

[9] Quoted from FHWA's *Railroad-Highway Grade Crossing Handbook* (Revised Second Edition August 2007)

Median Treatment with Gates.

A system of physical improvements designed to impede the movement of vehicles into the opposing traffic lane and around the single lowered gate (two-quadrant gate). Treatments include barrier wall systems, wide raised medians, and mountable raised curb systems with vertical median separators. Considerations include cost-benefit (median treatments are generally less expensive to install than four-quadrant gate systems) and absence/distance of nearby intersections and driveways.



Closure.

Per FHWA[10], "closure of [an existing at-grade] crossing to highway traffic should always be considered as an alternative." Benefits include reduction in collisions, vehicle and rail delay, and rail maintenance costs. Considerations include elimination of redundant crossings, convenience/travel cost of vehicles using an adjacent crossing, and effects on adjacent crossings and connecting roadway network due to diversion of vehicles.

Locking Gate (private crossings only).

This term refers to a moveable barrier gate that is engaged (i.e., closed) and only opens on demand, and would be implemented in accordance with FRA's 2009 *High Speed Passenger Rail Safety Strategy* guidelines[11]. The locking gate could be manual (requiring property owners to exit their vehicle to manually interact with the gate) or more automated (e.g., key card access to open and close the gate), the details of which would be determined during final design.

No Action.

Considered at crossings where the existing crossing treatment is sufficient to accommodate the DC2RVA Project.

The example images above are representative of a typical application; they are included for illustrative purposes only.

[10] Quoted from FHWA's *Railroad-Highway Grade Crossing Handbook* (Revised Second Edition August 2007)

[11] FRA's 2009 High Speed Passenger Rail Safety Strategy guidance states for track speeds between 80mph and 110mph, private highway-rail grade crossings should be treated with "automated warning or locked gate with signal interlock". Other types of private gates were considered during the alternatives development process, but from a safety standpoint, the locked gate treatment was considered to be the better candidate by restricting access to the crossing to the private crossing owner and allowing access only for a specific set of conditions as opposed to being open 24 hours a day excluding train events.

Virginia state code[12] restricts the creation of new at-grade crossings; this means that any new crossings of existing roadways due to the DC2RVA Project should be grade-separated, with potential roadway realignment and/or closure. As part of any Build Alternative for the DC2RVA Project, every existing or new at-grade crossing should be grade-separated, closed, or have appropriate crossing treatment that is connected into the train detection circuitry[13] and physically impedes vehicles from accessing the tracks when a train is approaching or occupying the crossing.

Existing or future year roadway capacity improvements, other than those that are directly due to actions of this Project, are under the purview of VDOT and/or local governments and are excluded from the DC2RVA analyses. For example, if a Build Alternative of the DC2RVA Project consolidates two adjacent crossings, assessing if roadway improvements that are directly related to that traffic diversion are required is part of this Project and would be evaluated as part of the environmental consequences; however, assessing if roadway improvements are needed due to increases in overall traffic due to regional growth (i.e., No Build conditions) is outside the purview of this Project.

Crossing Improvements at Existing Public and Private At-Grade Crossings

Decisions regarding whether an existing at-grade public or private roadway crossing should be eliminated (grade-separated or closed) or improved through installation of new or additional crossing treatments depended on several factors, including FHWA crossing elimination guidance criteria for public roadways[14], as well as the identification and analysis of site-specific conditions by the DRPT team[15]:

- Traffic Data and Traffic Operations
- Train Data and Rail Operations
- Safety/Geometric Deficiencies
- Environmental Resources
- Engineering Feasibility
- Adjacent Property Uses.
- Preliminary Cost-Benefit
- Accessibility
- Connectivity to Adjacent Crossings
- Special Uses at Crossings

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12 The applicable state law can be found at: https://vacode.org/56-363/.

13 The design and construction of crossings will comply with all applicable safety standards, including positive train control. Positive train control is a new system being designed to automatically stop a train before certain types of accidents occur. Specifically, positive train control, as mandated by Congress in the Rail Safety Improvement Act of 2008 (RSIA), is being designed to prevent train-to-train collisions; derailments caused by excessive speed; unauthorized incursions by trains onto sections of track where maintenance activities are taking place; and movement of a train through a track switch left in the wrong position.

14 FHWA's *Railroad-Highway Grade Crossing Handbook – Revised Second Edition* provides guidance criteria and details physical and operational improvements for highway-rail at-grade crossings to enhance safety and operation of roadway and rail traffic through the crossings. Specifically, the handbook outlines analysis methodologies for consideration of traffic control devices or other measures at every public roadway-rail at-grade crossing and sets forth 11 conditions for which public at-grade crossings "should be considered for grade separation or otherwise eliminated" if any one or more of the set thresholds are met or exceeded. FHWA Rail-Roadway Crossing Handbook can be found here: http://safety.fhwa.dot.gov/xings/com_roaduser/07010/07010.pdf.

15 Site-specific condition evaluation was based on project site visits, aerial and/or street-view photography, and VDOT and FRA online databases. The level of detail documented for the site-specific conditions was intended to support identification of feasibility considerations for each proposed action at the crossing location.

The methodology to determine the crossing treatment at new crossings followed a similar site-specific process as described above, with an emphasis on roadway network connectivity and accessibility to adjacent crossings and land uses.

Based on the above, DRPT developed a crossing improvement recommendation for each crossing[16] for the Draft EIS, which can vary by Build Alternative. It is anticipated that, during final design, additional crossing diagnostics would be performed based on the standards of practice at that time.

Summary tables of total type of crossing improvement for each Build Alternative for public and private crossings are provided in Tables 4.15-5 and 4.15-6, respectively.

At-Grade Crossing at Vaughan Road in Ashland, VA

[16] The proposed crossing improvements that DRPT developed were based on the Build condition of adding one additional track throughout the DC2RVA corridor. It was intended that the primary proposed actions resulting from the evaluation could be altered for other Build condition scenarios based on detailed engineering analyses and design considerations. For example, for Hermitage Road (S-Line crossing), DRPT initially recommended additional median treatment; however, during the design of Build Alternative 6B–S-Line, it was determined that the potential for risk to motorists at this crossing increases significantly with passenger trains accelerating and decelerating toward the proposed Boulevard Station. Accordingly, the Hermitage Road crossing was proposed to be grade-separated as part of this build alternative.

Table 4.15-5: Public At-Grade Crossing Improvements, Summary by Build Alternative

Alternative Area	Alternative	Description	Proposed Crossing Improvements[1]					New[2]	Total
			Grade Separation	Crossing Closure	Four-Quadrant Gates	Median Treatment	No Action		
Area 1: Arlington (Long Bridge Approach)	1A, 1B, and 1C	RO 2-Track East Alignment, RO 2-Track West Alignment, and RO 1 Track East & West	0	0	0	0	0	0	0
Area 2: Northern Virginia (Long Bridge to Dahlgren Spur)	2A[3]	Add 1 Track East or West	0	1	2	0	1	0	4
Area 3: Fredericksburg (Dahlgren Spur to Crossroads)	3A	No Additional Track	0	0	3	1	0	0	4
	3B	Add Main Track East of Existing	1	0	2	1	0	0	4
	3C	2-Track Bypass (East)	0	0	5	4	0	5	14
Area 4: Central Virginia (Crossroads to Doswell)	4A	Add 1 Track East or West	0	1	4	2	0	0	7
Area 5: Ashland (Doswell to I-295)	5A and 5B	No Additional Track; and Add 1 Track East	2	1	7	1	0	0	11
	5A–Ashcake, 5B–Ashcake, and 5D–Ashcake,	No Additional Track (Relocate Station); Add 1 Track East (Relocate Station); and Add Main Track and Center Existing;	2	0	8	1	0	0	11
	5C	2-Track West Bypass	0	1	9	1	0	8	19
	5C–Ashcake	2-Track West Bypass (Relocate Station)	0	0	10	1	0	8	19
Area 6: Richmond (I-295 to Centralia)	6A, 6B–A-Line, and 6E	Staples Mill Road Station Only; Boulevard Station Only (A-Line); and Split Service Main Street/Staples Mill	3	4	2	1	1	0	11
	6B–S-Line	Boulevard Station Only (S-Line)	4	5	4	3	1	0	17
	6C	Broad Street Station Only	3	4	2	2	1	2	14
	6D, 6F, and 6G	Main Street Station Only; Full Service. Main Street/Staples Mill; and Shared Service, Main Street/Staples Mill	3	5	4	4	1	0	17

[1] "Crossing Closure" can include construction of a new roadway connector to provide access. "Median Treatment" can include raised medians (new or extension of existing raised medians) or mountable raised curbs with vertical median tubes, with gates. "No action required" includes existing crossings with existing treatment that meets the DC2RVA criteria; existing crossings that are not affected by the Build Alternative (bypass alignments only); or new crossings of public roadways that do not require an action due to property acquisition (bypass alignments).

[2] "New" public crossings are provided as a summary total for reference and include crossings that would be grade-separated, closed/consolidated with adjacent crossings or due to property acquisitions; or realigned. The exception is for Build Alternative 6C (Broad Street Station), which includes two new at-grade public roadway crossings as part of the station improvements.

[3] Build Alternative 2A includes the proposed improvement of four-quadrant gates at Potomac Avenue, if not installed by others as part of the Powells Creek–Arkendale improvements.

Note that all crossings may require minor safety and/or geometric improvements related to construction of the Build Alternative (i.e., moving existing gates to accommodate the proposed track).

This table does not include potential effects to other non-crossing roadways that may be required as part of the Build Alternative.

Table 4.15-6: Private At-Grade Crossing Improvements, Summary by Build Alternative

Alternative Area	Alternative	Description	Proposed Crossing Improvement				New Private Crossings[2]	Total
			Crossing Closure	Four-Quadrant Gates	Locking Gate	No Action Required[1]		
Area 1: Arlington (Long Bridge Approach)	1A, 1B, and 1C	RO 2-Track East Alignment; RO 2-Track West Alignment; and RO 1 Track East & West	0	0	0	0	0	0
Area 2: Northern Virginia (Long Bridge to Dahlgren Spur)	2A	Add 1 Track East or West	0	3	1	1	0	5
Area 3: Fredericksburg (Dahlgren Spur to Crossroads)	3A and 3B	No Additional Track; and Add Main Track East of Existing	0	0	0	0	0	0
	3C	2-Track East Bypass	1	0	4	0	4	9
Area 4: Central Virginia (Crossroads to Doswell)	4A	Add 1 Track East or West	0	0	10	0	0	10
Area 5: Ashland (Doswell to I-295)	5A, 5A–Ashcake, 5B, 5B–Ashcake, and 5D–Ashcake	No Additional Track; Add 1 Track East of Existing; Add Main Track / Center Existing	0	0	0	0	0	0
	5C and 5C–Ashcake	2-Track West Bypass	0	0	0	0	7	7
Area 6: Richmond (I-295 to Centralia)	6A, 6B–A-Line, 6C, and 6E	Staples Mill Road Station Only; Boulevard Station Only (A-Line); Broad Street Station Only; and Split Service, Main Street/Staples Mill	0	0	0	0	0	0
	6B–S-Line, 6D, 6F, and 6G	Boulevard Station Only (S-Line); Main Street Station Only; Full Service, Main Street/Staples Mill; and Shared Service, Main Street/Staples Mill	0	2	2	0	0	4

[1] "No action required" in the above table includes existing crossings with existing treatment that meets the DC2RVA criteria; or new crossings of public roadways that do not require an action due to property acquisition or alternate access (bypass alignments).

[2] "New Private Crossings" in the above table are provided as a summary total for reference, and include crossings that would be closed/consolidated with adjacent crossings or due to property acquisitions; or realigned.

Note that all crossings may require minor safety and/or geometric improvements related to construction of the Build Alternative (i.e., moving existing gates to accommodate the proposed track).

As shown by the summary at-grade crossing improvement data:

- DRPT proposes that most of the existing at-grade public roadways remain at grade with the addition of four-quadrant gates or gates with median treatment as appropriate to provide a corridor with increased safety for the DC2RVA Project.
- DRPRT proposes that most of the existing private at-grade crossings have locking gates in all Build Alternatives, unless the property is acquired or alternate access can be provided. Four-quadrant gates are proposed at private crossing locations where site-specific safety, geometric, and/or operating conditions were determined to preclude use of locking gates. See the *Transportation Technical Report* (Appendix S) for details.
- Most new crossings occur in Build Alternative 3C (Fredericksburg Bypass) and Build Alternatives 5C and 5C–Ashcake (Ashland Bypass).
- Build Alternative 6C (Broad Street Station Only) includes two new at-grade public roadway crossings on West Leigh Street as part of the station improvement design, which would require a variance of Virginia State Code and/or coordination with VDOT.

Each proposed crossing improvement for public at-grade roadways is presented in Figures 4.15-1 through 4.15-13. Additionally, a list of each public roadway closure and grade separation is provided at the end of this section.

Full methodology of the crossing improvement evaluation process, as well as detailed lists of the crossing roadways and figures showing the proposed crossing improvements at private crossings, are provided in the *Transportation Technical Report* (Appendix S)**.**

Crossing Improvements at Existing Grade-Separated Crossings

All existing grade-separated crossings (both public and private) in the rail corridor would be maintained as part of all Build Alternative designs. The proposed crossing improvements at the existing grade-separated crossings consist of one of the following:

- No action required (i.e., the existing structure is sufficient to accommodate the DC2RVA Project)
- Extend the existing structure (i.e., widen either roadway structure for roadway overpasses or rail structure for roadway underpasses)
- Build a new structure

These three types of crossing improvements are functionally equivalent because the existing operations of the crossing roadway (i.e., the number and type of lanes) are not modified as part of the Build Alternative.

Build Alternative Improvements to other Roadways

In addition to the highway-rail crossing roadways, two public roadways that run parallel to and generally adjacent to the railroad tracks are included in the Build Alternative improvements, as follows.

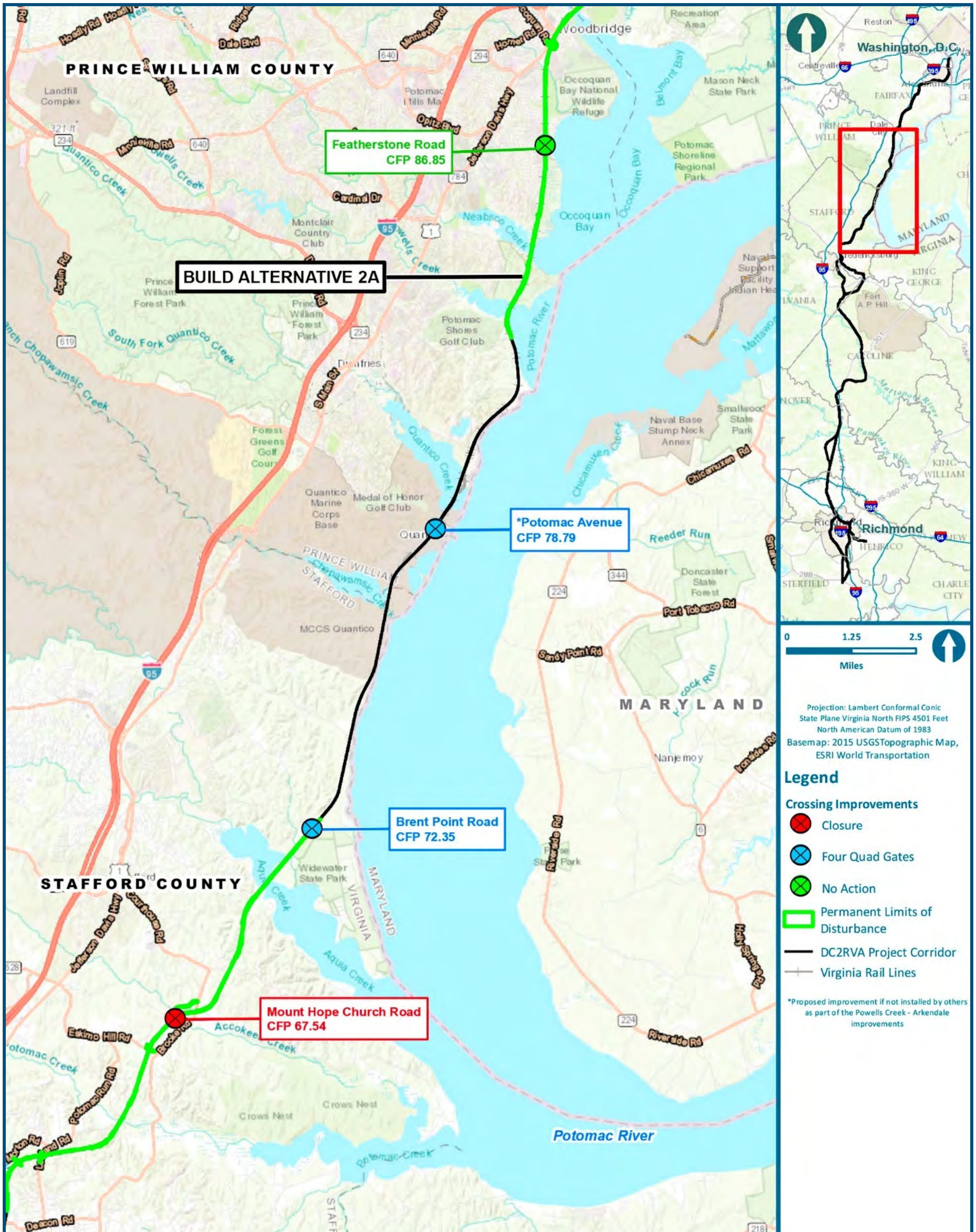

Figure 4.15-1: Public At-Grade Crossing Improvements – Build Alternative 2A

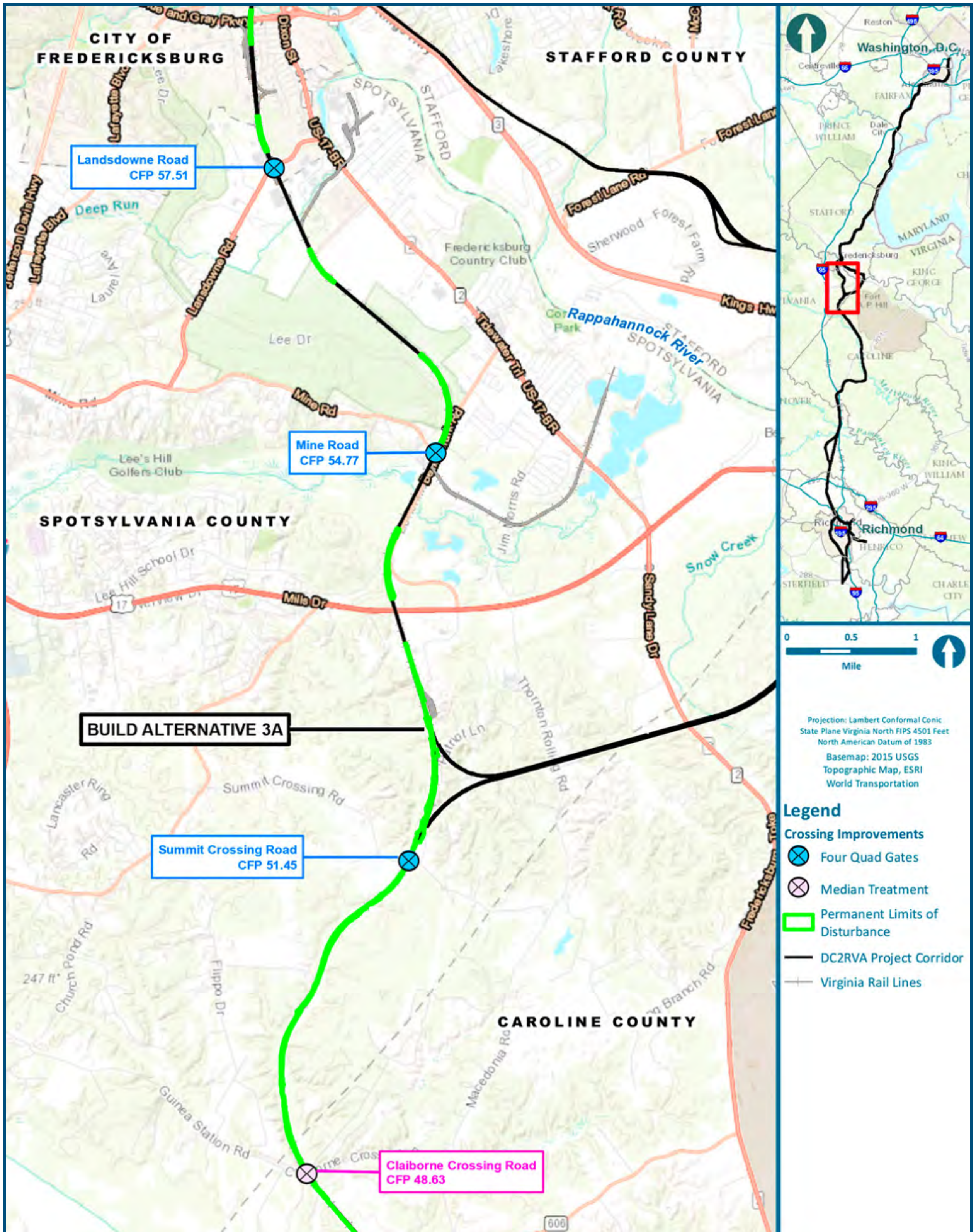

Figure 4.15-2: Public At-Grade Crossing Improvements – Build Alternative 3A

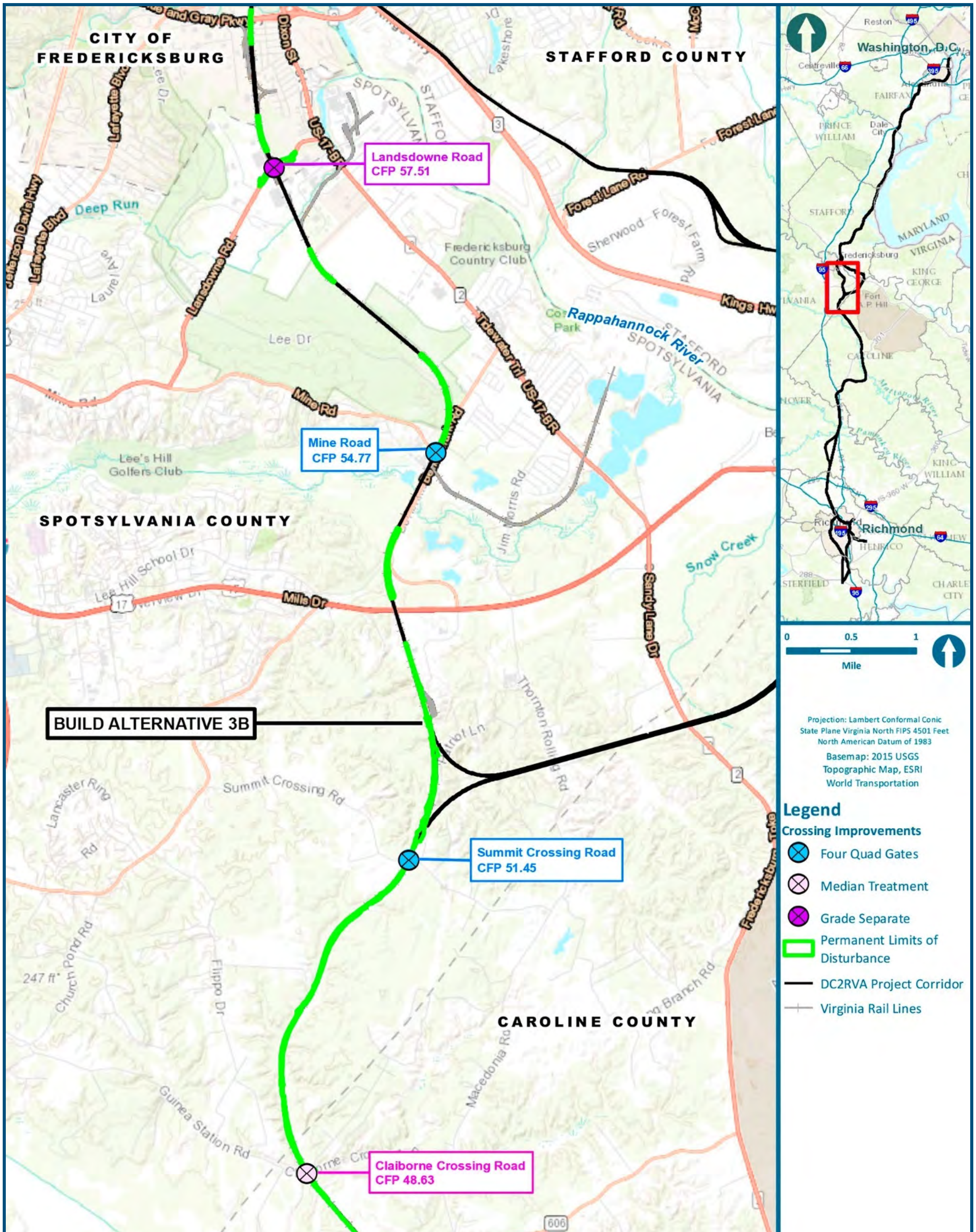

Figure 4.15-3: Public At-Grade Crossing Improvements – Build Alternative 3B

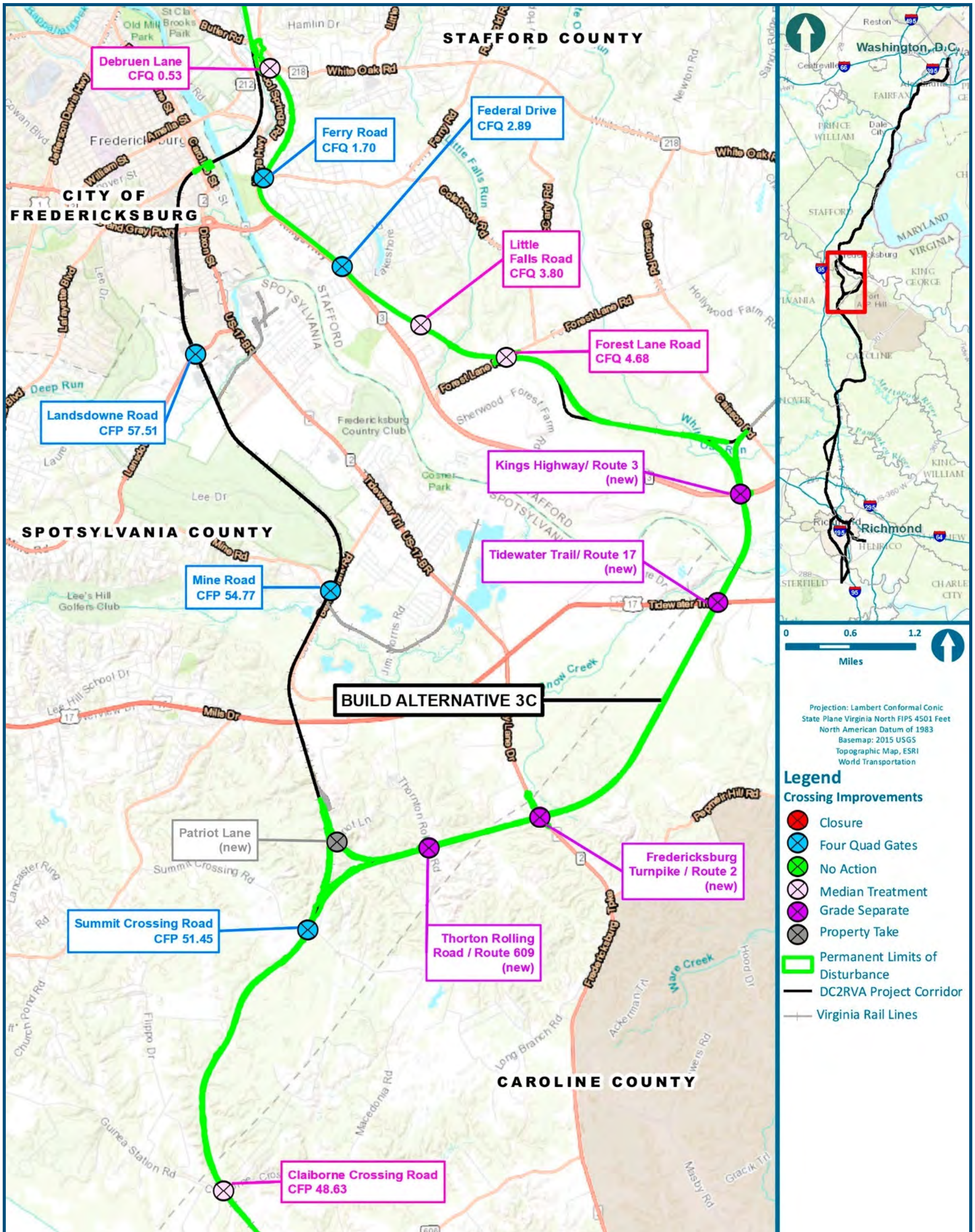

Figure 4.15-4: Public At-Grade Crossing Improvements – Build Alternative 3C

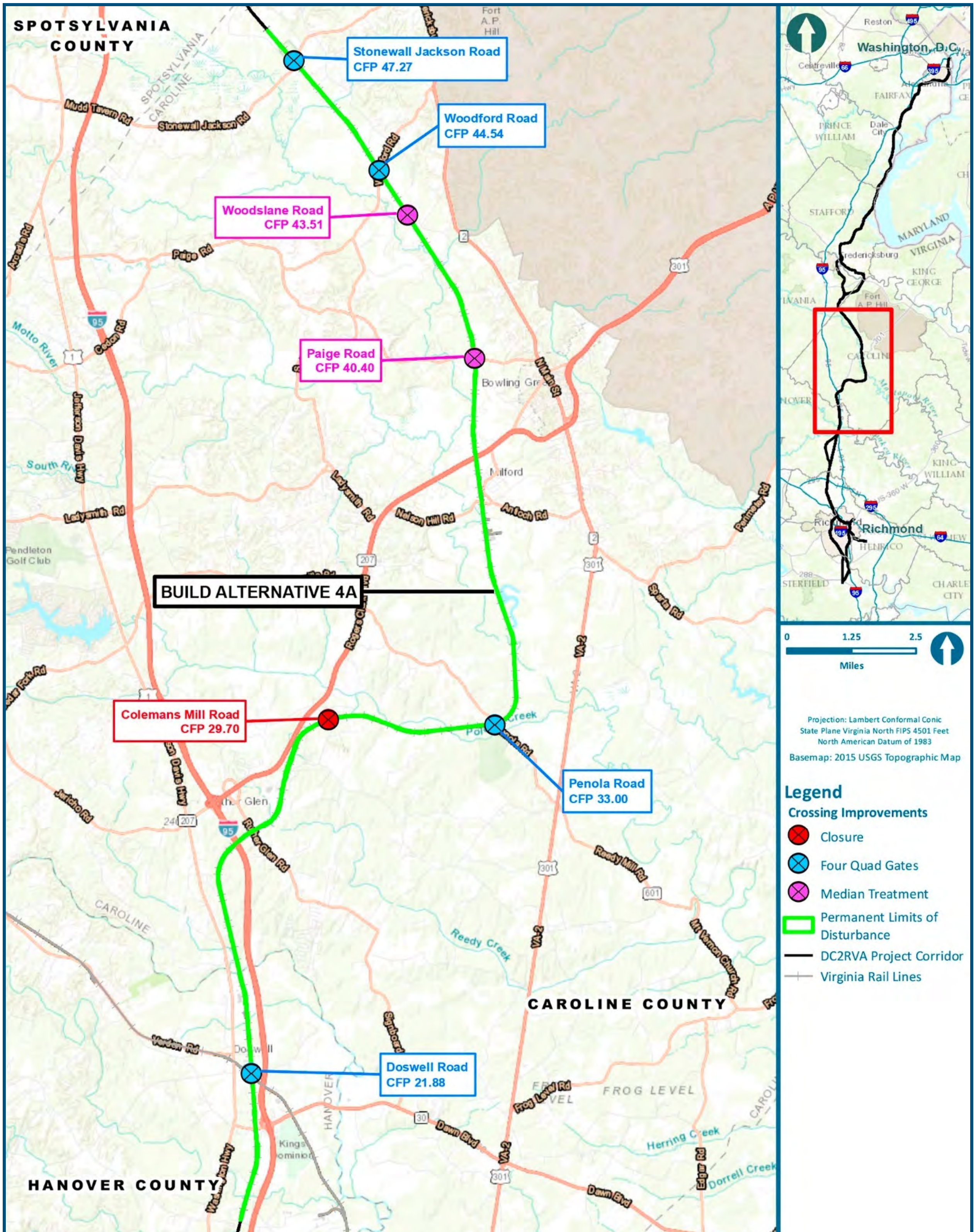

Figure 4.15-5: Public At-Grade Crossing Improvements – Build Alternative 4A

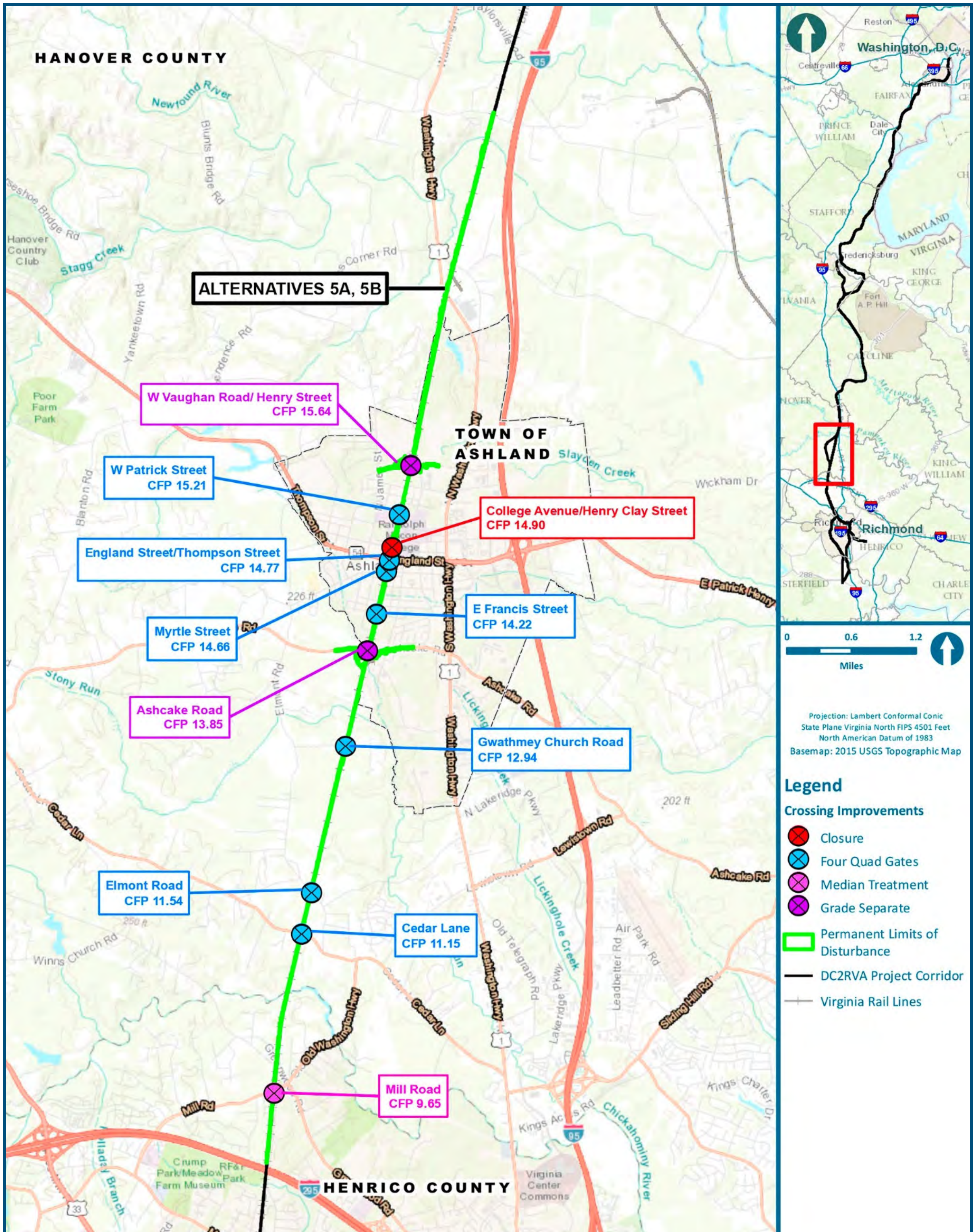

Figure 4.15-6: Public At-Grade Crossing Improvements – Build Alternative 5A, 5B

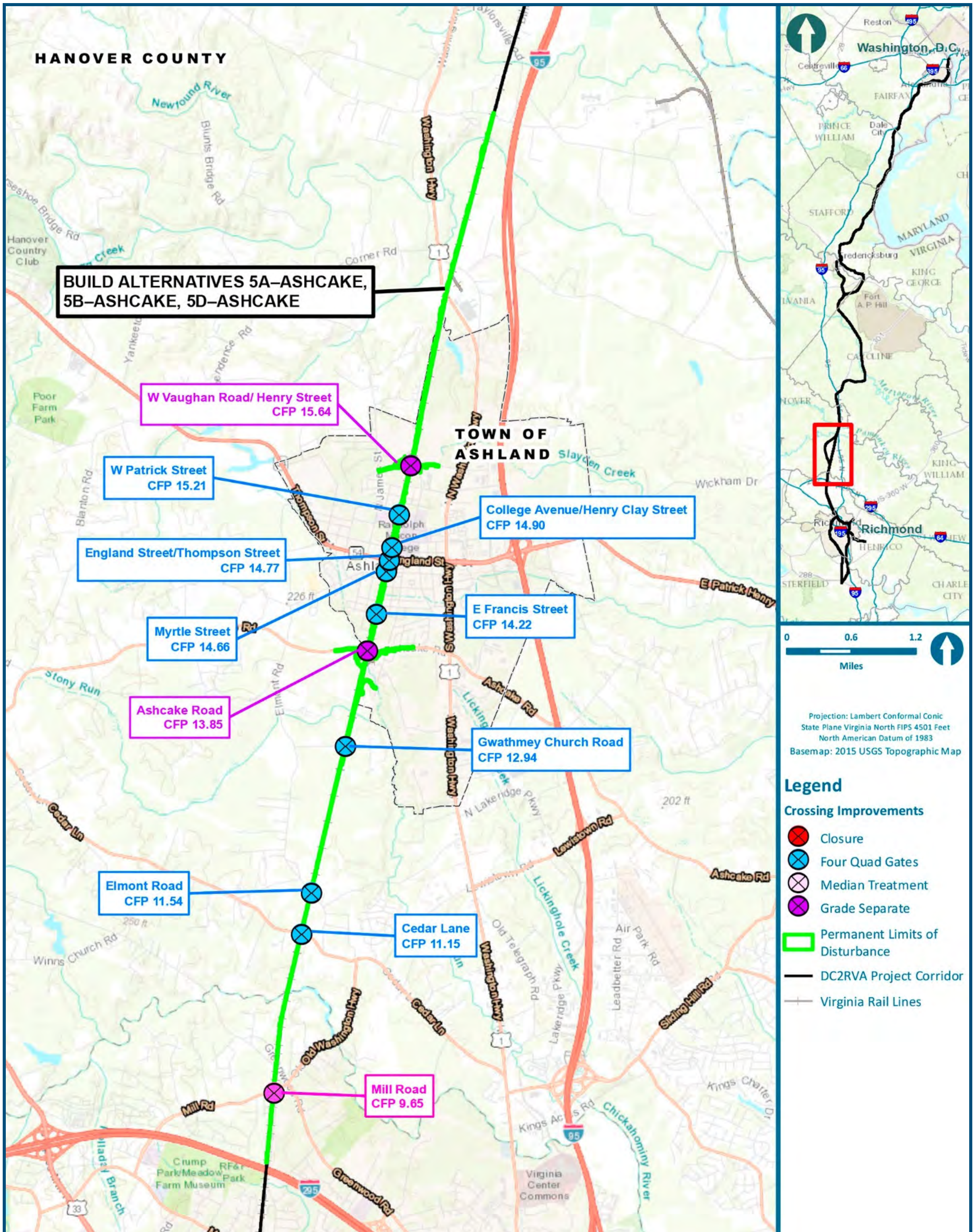

Figure 4.15-7: Public At-Grade Crossing Improvements – Build Alternatives 5A–Ashcake, 5B–Ashcake, 5D–Ashcake

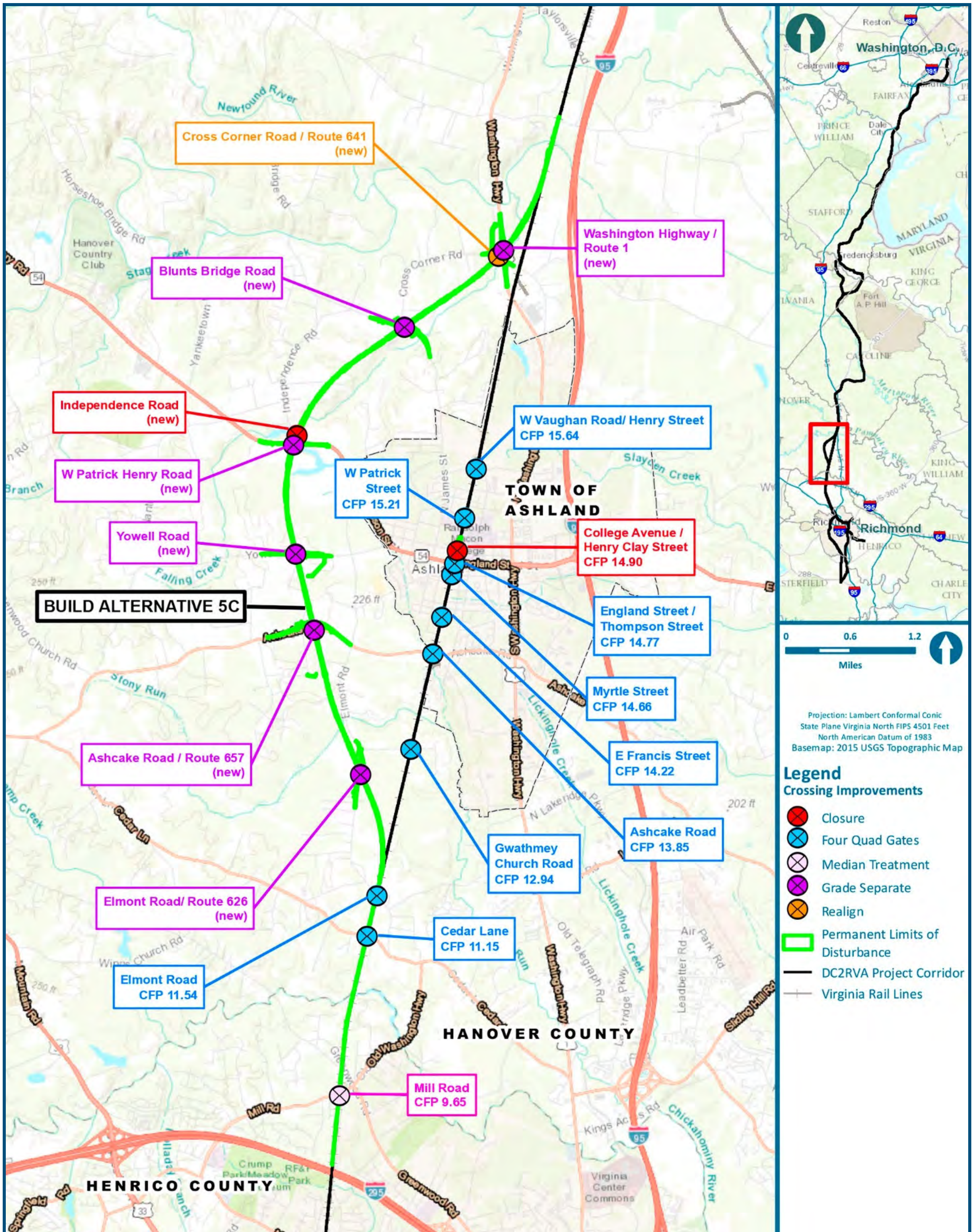

Figure 4.15-8: Public At-Grade Crossing Improvements – Build Alternative 5C

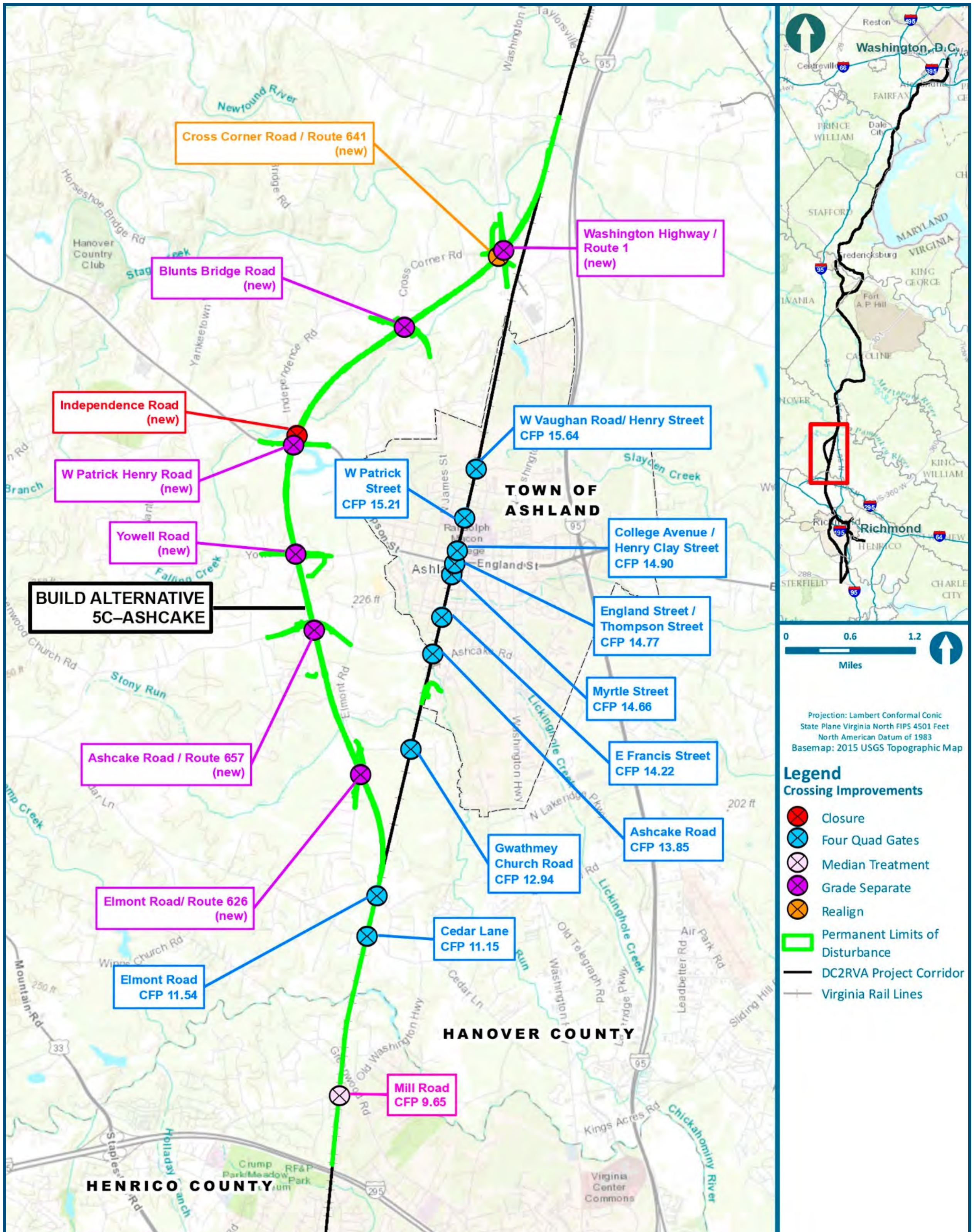

Figure 4.15-9: Public At-Grade Crossing Improvements – Build Alternative 5C–Ashcake

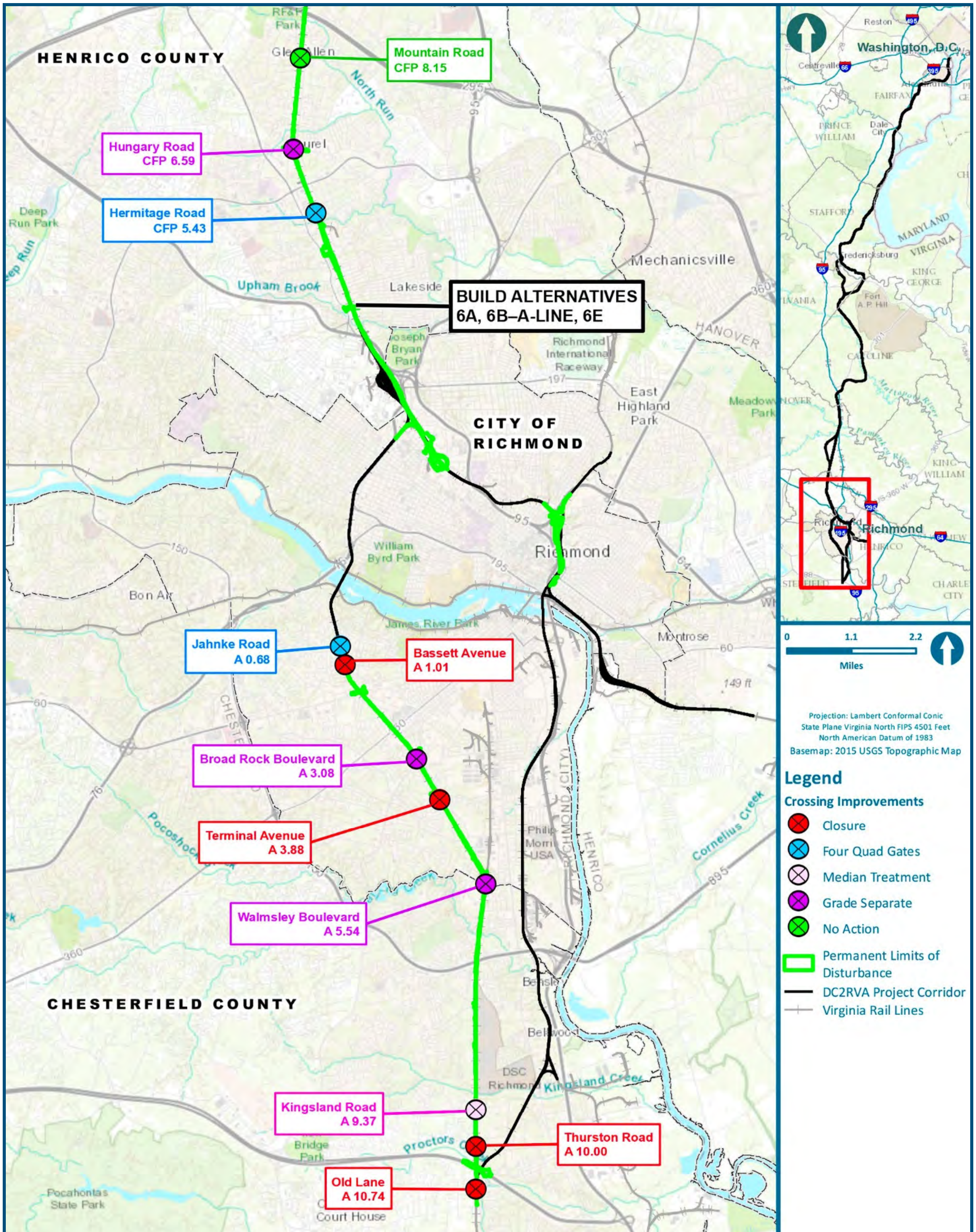

Figure 4.15-10: Public At-Grade Crossing Improvements – Build Alternatives 6A, 6B–A-Line, 6E

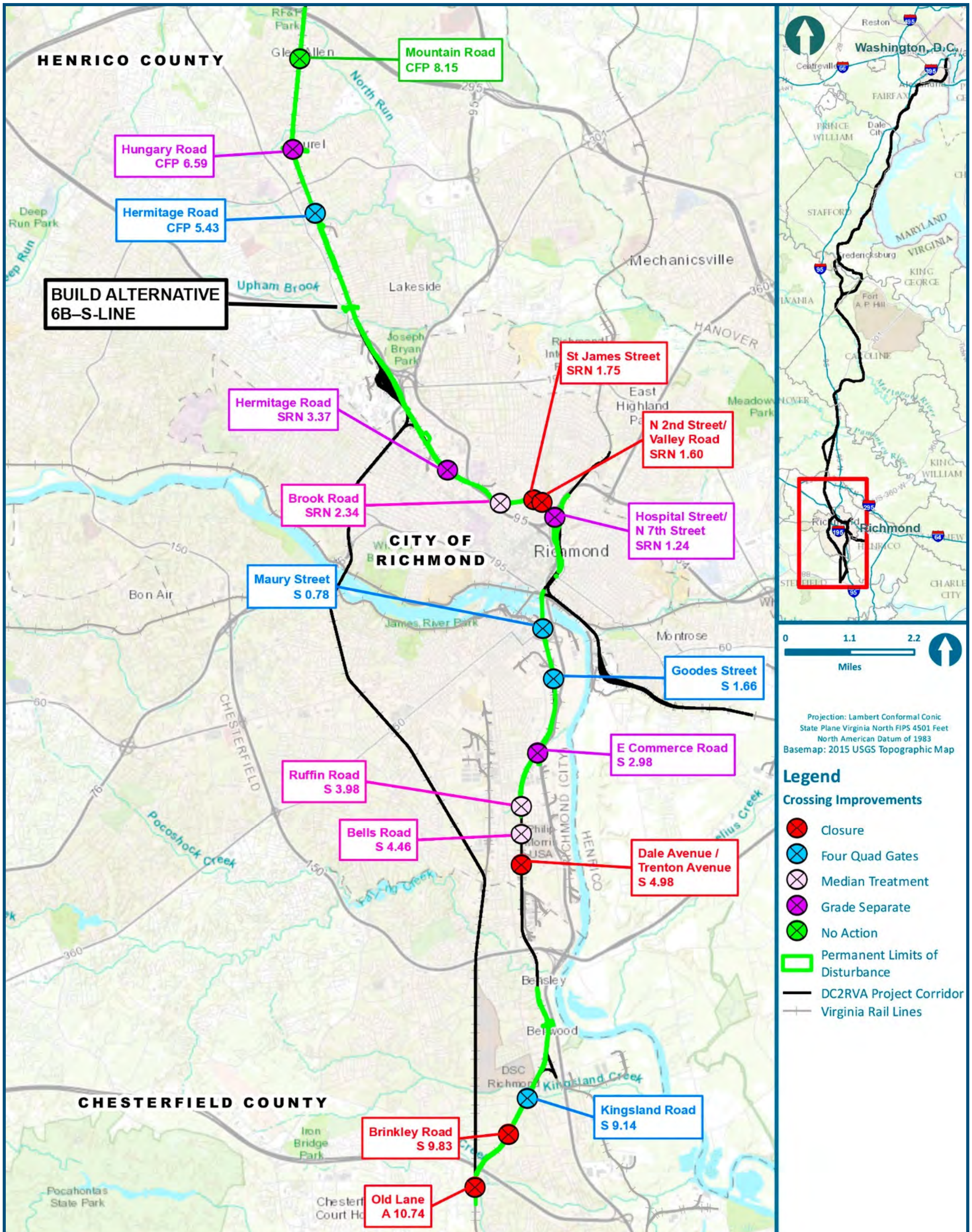

Figure 4.15-11: Public At-Grade Crossing Improvements – Build Alternative 6B–S-Line

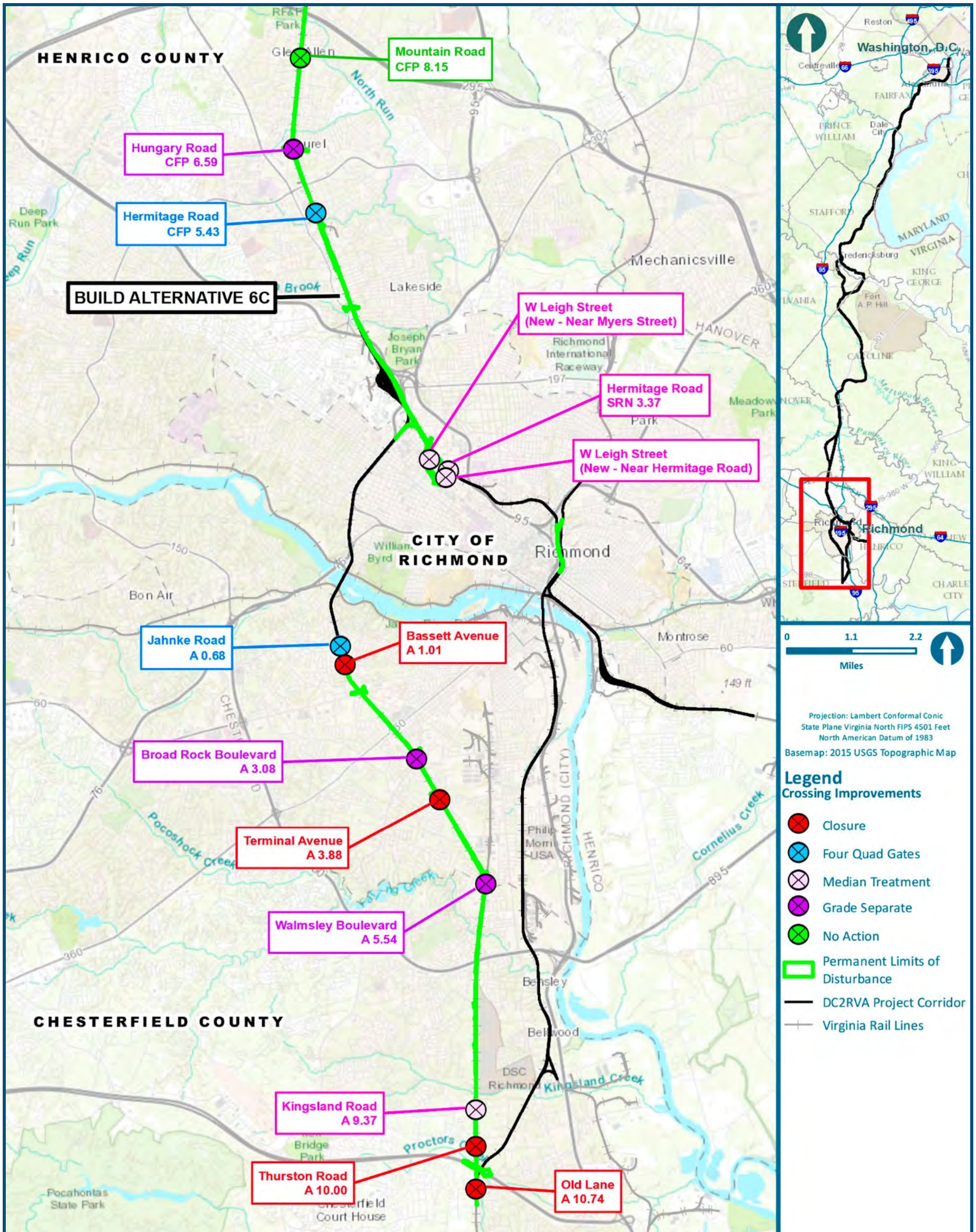

Figure 4.15-12: Public At-Grade Crossing Improvements – Build Alternative 6C

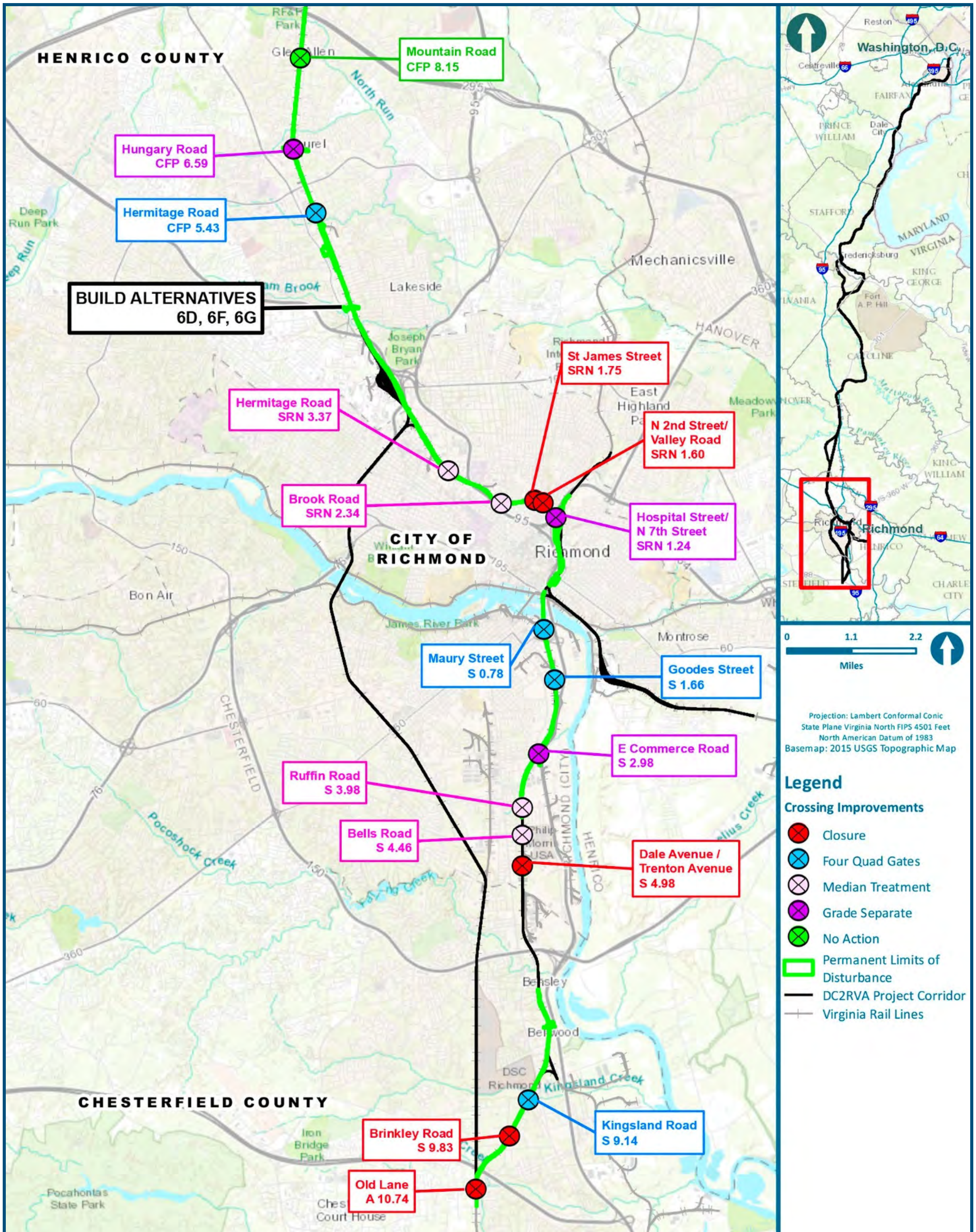

Figure 4.15-13: Public At-Grade Crossing Improvements – Build Alternatives 6D, 6F, 6G

- The Build Alternatives that include the addition of a third track through town (Build Alternatives 5B, 5B–Ashcake, and 5D–Ashcake) require the closure of the eastern section of Railroad Avenue / Center Street between England / Thompson Street and Maiden Lane. At this location Railroad Avenue / Center Street[17] runs adjacent and parallel to the railroad tracks within the Town of Ashland. The portion of Railroad Avenue / Center Street on the eastern side of the rail corridor between England / Thompson Street and Maiden Lane conflicts with the addition of the third track. All other portions of Railroad Avenue / Center Street, on either side of the rail corridor within the Town of Ashland, would be realigned, as required, to accommodate the design of the Build conditions and remain open to traffic after completion of construction.
- The proposed additional track through the Richmond Area conflicts with one public roadway that is located adjacent and parallel to the railroad tracks. Dalebrook Drive from Bellbluff Drive to southern terminus of Dalebrook Drive would be required to be realigned without change to existing operations as part of all Build Alternatives.

Summary of All Proposed Public Roadway Closures and Grade Separations

For ease of reference, a summary of the public roadway improvements that are proposed as part of each Build Alternative is provided here. Unless specified below, all other public roadway crossings would either maintain the existing at-grade condition with crossing improvements of either four-quadrant gates or median treatment with gates, or do not require any action.

Alternative Area 1 (Arlington): There are no public roadway closures or grade separations within Area 1 as part of any Build Alternative.

Alternative Area 2 (Northern Virginia): There are no grade separations proposed within the single Build Alternative 2A. One closure is proposed at Mount Hope Church Road crossing.

Alternative Area 3 (Fredericksburg): As shown in Table 4.15-7, there are no proposed public roadway closures through Fredericksburg. One grade separation is proposed at Landsdowne Road in Build Alternative 3B only. Four grade separations are proposed along the new alignment portion of the Fredericksburg Bypass (Build Alternative 3C).

Table 4.15-7: Public Roadway Closures and Grade Separations in Fredericksburg Area

Alternative Area	Alternative	Grade Separate Landsdowne Road
Area 3: Fredericksburg (Dahlgren Spur to Crossroads)	3A	
	3B	✓
	3C	

This table only shows the proposed improvements of grade separation and closure for public roadways.

[17] Railroad Avenue / Center Street operates as two one-way roadways (one on each side of the rail line) through the Town of Ashland. Based on inventory of physical street signage, the Railroad Avenue designation is generally used closest to the center of town (near England Street) and the Center Street designation is used elsewhere. For ease of reference, these roadways will be designated as "Railroad Avenue / Center Street" with callouts to the appropriate side of the tracks, as necessary, as well as to/from limits, in place of any "N" or "S" designation in the transportation analysis for the Draft EIS.

Alternative Area 4 (Central Virginia): There are no proposed grade separations within the single Build Alternative 4A. One closure is proposed at Colemans Mill Road crossing.

Alternative Area 5 (Ashland): As shown in Table 4.15-8, each Build Alternative in Ashland contains some combination of the following closures and separations:

- All Build Alternatives except for the Ashland Bypass (Build Alternatives 5C and 5C–Ashcake) will require two grade separations as part of this project: W. Vaughan Road crossing and Ashcake Road crossing.
- All Build Alternatives that include station platform improvements at the existing station location within town require one roadway crossing closure at College Avenue crossing to accommodate the platform improvements at the existing station.
- The Build Alternatives that include the addition of a third track through town (Build Alternatives 5B, 5B–Ashcake, and 5D–Ashcake) require the closure of the eastern section of Center Street / Railroad Avenue between England / Thompson Street and Maiden Lane.
- The Ashland Bypass (Build Alternatives 5C and 5C–Ashcake) will require one roadway closure at Independence Road and six grade separations along the Ashland Bypass (Build Alternatives 5C and 5C–Ashcake) (not listed in Table 4.15-8).

Table 4.15-8: Public Roadway Closures and Grade Separations in Ashland Area

Area	Alternative	Grade Separate West Vaughan Crossing	Grade Separate Ashcake Crossing	Close College Avenue Crossing	Close Center Street, South of England Street to Maiden Lane
Area 5: Ashland (Doswell to I-295)	5A	✓	✓	✓	
	5A–Ashcake	✓	✓		
	5B	✓	✓	✓	✓
	5B–Ashcake	✓	✓		✓
	5C			✓	
	5C–Ashcake				
	5D–Ashcake	✓	✓		✓

This table only shows the proposed improvements of grade separation and closure for public roadways.

Alternative Area 6 (Richmond): As shown in Table 4.15-9, each Build Alternative in Richmond contains some combination of the following closures and grade separations, the need for which is driven by the at-grade crossing evaluation that was completed by DRPT as part of this project:

- All Build Alternatives grade separate Hungary Road near Staples Mill Road Station and close Old Lane near the junction of the CSXT A-Line and S-Line at Centralia.
- All Build Alternatives that use the A-Line close Bassett Avenue, Terminal Avenue, and Thurston Road, and grade separate Broad Rock Boulevard and Walmsley Boulevard.
- All Build Alternatives that use the S-Line close St James Street, N 2nd Street/Valley Road, Dale/Trenton Avenue, and Brinkley Road, and grade separate Hospital Street and E Commerce Drive.
- Build Alternative 6B–S-Line grade separates the S-Line crossing of Hermitage Road, which is proposed for safety considerations due to proximity of trains decelerating and accelerating to the new Boulevard Road Station.

Table 4.15-9: Public Roadway Closures and Grade Separations in Richmond Area

Alternative	Grade Separate Hungary Road	Close Bassett Avenue	Grade Separate Broad Rock Boulevard	Close Terminal Avenue	Grade Separate Walmsley Boulevard	Close Thurston Road	Close Old Lane	Grade Separate Hermitage Road (S-Line Crossing)	Close St James Street	Close N 2nd Street/ Valley Road	Grade Separate Hospital Street	Grade Separate E Commerce Road	Close Dale / Trenton Avenue	Close Brinkley Road
6A	✓	✓	✓	✓	✓	✓	✓							
6B–A-Line	✓	✓	✓	✓	✓	✓	✓							
6B–S-Line	✓						✓	✓	✓	✓	✓	✓	✓	✓
6C	✓	✓	✓	✓	✓	✓	✓							
6D	✓						✓		✓	✓	✓	✓	✓	✓
6E	✓	✓	✓	✓	✓	✓	✓							
6F	✓						✓		✓	✓	✓	✓	✓	✓
6G	✓						✓		✓	✓	✓	✓	✓	✓

This table only shows the proposed improvements of grade separation and closure for public roadways.

4.15.2.2 DC2RVA Crossing Improvement Effects on Connectivity and Accessibility

The purpose of this analysis is to qualitatively identify locations where existing accessibility and connectivity of the roadway network may be affected by the DC2RVA Project as compared to the No Build condition. These locations will be moved forward for further quantitative analysis (refer to Section 4.15.2.4.).

Accessibility and connectivity to public roadways and private property driveways and access were considered. The identification was conducted at each highway-rail crossing; however, both the crossing roadway and adjacent connecting roadway network within the limits of disturbance were evaluated. The determination of "no effect"[18] is defined as maintaining existing capacity and connectivity to the roadway network, as follows:

- No increases or decreases to carrying capacity of public roadways.
- All existing movements on the crossing roadway are maintained.

All existing parcel access is maintained, unless the design requires a full property acquisition. The results of this process are summarized by type of crossing in the sections below. Refer to the *Transportation Technical Report* (Appendix S) for full details of the process and results of the evaluation.

[18] "No effect" does not preclude minor changes to location of any access points within the same property, if needed, to facilitate design and construction of the project. For properties with existing access to the crossing roadway, if at least one access to that property area is maintained or the parcel was a full property acquisition, the "no effect" is considered reasonable.

Effects of Improvements at Public At-Grade Crossings and Adjacent Public Roadways

Closure Effects. The crossing improvements that are anticipated to have the greatest effect on the existing accessibility and connectivity of the transportation network are related to either closures of existing public at-grade highway–rail crossings or closures of public roadways located adjacent and parallel to the railroad tracks that are required due to engineering of other improvements. Closing an existing traffic movement requires a permanent detour of vehicular traffic. This permanent detour not only affects the vehicles that are making the detour, but also the traffic operations and vehicles along the alternate route to some degree and therefore warrants further analysis.

Fourteen (14) public roadway closures within the different Build Alternatives were identified to be analyzed further (see Section 4.15.2.3); these include:

- Mount Hope Church Road crossing, Stafford County: Build Alternative 2A
- Colemans Mill Road crossing, Caroline County: Build Alternative 4A
- College Avenue/Henry Clay Road crossing, Town of Ashland: Build Alternatives 5A, 5B, and 5C
- Railroad Avenue/Center Street between England Street and Maiden Lane, Town of Ashland: Build Alternatives 5B, 5B–Ashcake, and 5D–Ashcake
- Independence Road intersection with West Patrick Henry Road, Hanover County: Build Alternatives 5C and 5C–Ashcake
- Bassett Avenue crossing, City of Richmond: Build Alternatives 6A, 6B–A-Line, 6C, and 6E
- Terminal Avenue crossing, City of Richmond: Build Alternatives 6A, 6B–A-Line, 6C, and 6E
- Thurston Road crossing, Chesterfield County: Build Alternatives 6A, 6B–A-Line, 6C, and 6E
- Brinkley Road crossing, Chesterfield County: Build Alternatives 6B–S-Line, 6D, 6F, and 6G
- Old Lane crossing, Chesterfield County: all Richmond Area Build Alternatives
- Ownby Lane intersection with Hermitage Road, City of Richmond: Build Alternative 6B–S-Line
- St James Street crossing, City of Richmond: Build Alternatives 6B–S-Line, 6D, 6F, and 6G
- N 2nd Street/Valley Road crossing, City of Richmond: Build Alternatives 6B–S-Line, 6D, 6F, and 6G
- Dale Avenue/Trenton Avenue crossing, City of Richmond: Build Alternatives 6B–S-Line, 6D, 6F, and 6G

The closure locations are included on Figures 4.15-1 through 4.15-13. Refer to Section 4.15.2.3 of this Draft EIS for details on the closure diversion analysis that was completed for each location.

Grade Separation and Median Treatment Effects. After review of all highway-rail crossings[19], the proposed crossing improvements of grade separation and crossing treatment improvements (including both median treatment with gates and four-quadrant gates) are expected to have minimal effect on existing accessibility and connectivity of the transportation network as part of any Build Alternative of the DC2RVA Project. The designs of all proposed grade separations and crossing treatment improvements of existing at-grade crossings maintain the existing functional characteristics of the crossing roadway, including number and type of roadway lanes. Improvements associated with the Build Alternatives sought to address potential adverse effects on traffic through implementation of grade separations.

Effects of Improvements at Private At-Grade Crossings

After review of all private at-grade highway-rail crossings, DRPT does not anticipate that any of the private crossing improvements included as an element of any DC2RVA Build Alternative would have an effect on the overall connectivity and accessibility of the transportation network; therefore, they do not warrant further detailed traffic operations analysis.

This outcome is supported by the fact that these crossings are all private and are, by definition, exclusive of the public roadway network. Regardless of the private classification, however, the crossing improvements at all private at-grade crossing locations were designed to maintain existing accessibility and connectivity to the private land parcels. All Build Alternatives as part of the DC2RVA Project maintain private property access, with the exception of where full property acquisitions are required by the design.

Effects of Improvements at Grade-Separated Crossings

After review of all public and private grade-separated highway-rail crossings, DRPT does not anticipate any of the proposed modifications to existing grade-separated crossings would have an effect on the overall connectivity and accessibility of the transportation network for any Build Alternative of the DC2RVA Project. The crossing modifications, if required, at existing grade-separated crossings include two types: extension of the existing crossing structure or construction of a new separate parallel grade-separated crossing structure. All modifications were designed to maintain existing functional characteristics of the crossing roadway, including number and type of roadway lanes, as part of each Build Alternative; therefore, the proposed actions of the existing grade-separated public and private crossings do not warrant further detailed traffic operations analysis.

Relevance of Build Alternatives on Quiet Zones (Public At-Grade Crossings)

As discussed in Section 3.15.2.2, a Quiet Zone is a section of rail line that contains one or more consecutive at-grade public crossings at which locomotive horns are not routinely sounded[20]. FHWA defines highway-rail Supplemental and Alternative Safety Measures (SSMs) as

[19] The impact to the two new W. Leigh Street at-grade crossings is identified as "no effect" to the connectivity of the transportation network because all existing movements are maintained in the design. This is not intended to indicate that there would be no effects to vehicles if a new crossing is implemented; refer to Section 14.15.2.2 of this Draft EIS for the daily vehicle delay analysis.

[20] FRA's regulatations mandate that a horn be sounded at every public at-grade crossing (i.e., horns are not required to be sounded at public crossings that re grade-separated or private crossings). See the *Transportation Technical Report* (Appendix S) for details.

engineering improvements that compensate for the absence of the train horn safety requirement at at-grade crossings. SSMs include the following:

- Closure of a highway-rail at-grade crossing. *Note that closure of an at-grade crossing indicates, in this instance, closure of the at-grade condition, which would include grade separation of the crossing or permanently closing the crossing to vehicular traffic.*
- Four-quadrant gates.
- Gates with traffic channelization arrangements (e.g., non-mountable curb or mountable curb with delineators).

In accordance with FHWA's *Railroad-Highway Grade Crossing Handbook* (Revised Second Edition August 2007), if SSMs are "employed at every highway-rail grade crossing in the quiet zone, they automatically qualify the quiet zone (subject to reporting requirements)." The DC2RVA Build Alternatives include SSMs at all public existing at-grade crossings; therefore, because the proposed actions for existing at-grade highway-rail crossings for the DC2RVA Project fully align with the definition of SSMs, the DC2RVA Project would not negatively affect the ability of local public authorities to obtain Quiet Zones within their jurisdictions. Because local jurisdictions must initiate and manage the process for implementing Quiet Zones, the noise reduction benefits that derive from removing the requirement for trains to routinely sound horns are dependent on locality actions; the DC2RVA Project would support local jurisdictions should they seek to establish Quiet Zones. FRA Office of Safety authorizes quiet zones on a site-specific basis, which are voluntary by the operating railroad.

Furthermore, DRPT does not anticipate that the DC2RVA Project will adversely affect the existing Quiet Zone designations because safety improvements that qualify as SSMs are proposed at all existing public at-grade crossings, including those with existing Quiet Zone designations that are based on the "grandfather" provision in the regulations. Refer to the *Transportation Technical Report* (Appendix S) for full assessment details.

Effects on Bicycle and Pedestrian Connectivity

All existing bicycle and pedestrian facilities would be maintained (provided in-kind) as part of all DC2RVA Build Alternatives and would be designed to current safety standards. This includes the existing at-grade pedestrian crossings through the Town of Ashland. The 11 at-grade pedestrian crossings in Ashland consist of 3-foot-wide walkways at top of rail, with steps at each end. The pedestrian crossings do not have any train warning protection (e.g., no flashing lights or gates). In addition, the current at-grade pedestrian crossings do not meet *Americans with Disabilities Act* (ADA) requirements. Most of the pedestrian crossings also lack a designated crosswalk leading across Center Street/Railroad Avenue. DC2RVA Build Alternatives that add a track through town would extend existing pedestrian crossings across the new track alignment, as necessary.

Opportunities for additional bicycle and pedestrian accessibility improvements, including updates to ADA facilities, would be incorporated during final design in coordination with FRA after the Draft EIS.

4.15.2.3 DC2RVA Crossing Closure Diversion Analysis (Traffic Operations)

Roadway closures can affect more than the closed roadway itself. Closing an existing traffic movement requires vehicles to divert to a different route. This not only affects the vehicles that are diverting, but it also affects traffic operations and vehicles along the diversion route to some degree. It is the purpose of this analysis to evaluate the effect of each closure along the diversion route. There are fourteen roadways that are anticipated to be closed by the DC2RVA Build Alternatives; these are presented in Table 4.15-10.

Table 4.15-10: Existing and 2025 No Build Data for Closure Diversion Analysis

Alternative Area[1]	Alternative	Closure Roadway Name	Existing/ New	Roadway Type	Crossing Milepost	Daily Volumes[2]	
						2015	2025 No Build
Area 2: Northern Virginia (Long Bridge to Dahlgren Spur)	2A	Mount Hope Church Road	Existing	Crossing	CFP 67.54	214	256
Area 4: Central Virginia (Crossroads to Doswell)	4A	Colemans Mill Road	Existing	Crossing	CFP 29.70	449	537
Area 5: Ashland (Doswell to I-295)[3]	5A, 5B, and 5C	College Avenue / Henry Clay Road	Existing	Crossing	CFP 14.90	1,326	1,586
	5B, 5B–Ashcake, and 5D–Ashcake	Railroad Avenue / Center Street	Existing	Adjacent	n/a	1,000	1,200
	5C and 5C–Ashcake	Independence Road	New	Crossing	New	949	1,135
Area 6: Richmond (I-295 to Centralia)	6A, 6B–A-Line, 6C, 6E	Bassett Avenue	Existing	Crossing	A 1.01	1,399	1,674
	6A, 6B–A-Line, 6C, 6E	Terminal Avenue	Existing	Crossing	A 3.88	683	817
	6A, 6B–A-Line, 6C, 6E	Thurston Road	Existing	Crossing	A 10.00	459	549
	6B–S-Line, 6D, 6F, 6G	Brinkley Road	Existing	Crossing	S 9.83	1,836	2,196
	6A through G	Old Lane	Existing	Crossing	A 10.74	4,896	5,856
	6B–S-Line	Ownby Lane	Existing	Adjacent	n/a	n/a	n/a
	6B–S-Line, 6D, 6F, 6G	St James Street	Existing	Crossing	SRN 1.75	1,000	1,196
	6B–S-Line, 6D, 6F, 6G	N 2nd Street/ Valley Road	Existing	Crossing	SRN 1.60	2,142	2,562
	6B–S-Line, 6D, 6F, 6G	Dale Avenue/ Trenton Avenue	Existing	Crossing	S 4.98	0	0

[1] No closure diversion analysis in Alternative Areas 1 or 3.

[2] The source for all traffic volumes for transportation analyses is the VDOT GIS online database for AADT with Vehicle Classification for 2014 (accessed January 2016). ADT grown to future years; refer to Section 4.15.1.2 of this Draft EIS. Note that the Dale Avenue/Trenton Avenue crossing is not open to public traffic in existing conditions.

[3] Within Ashland, Build Alternative 5A–Ashcake does not include any closures of public roadways.

The analysis was performed at a level of detail commensurate with size and varied conditions of the project's geographic scale, and with the relatively low traffic volumes on the majority of roadways that have the potential for being closed. The closure diversion analysis included two evaluations for each closure:

1. Effects on the roadway traffic along the diversion route(s), including changes in daily volumes and associated facility level of service (LOS)[21] operations.
2. Effects on intersection capacity and operations along the diversion route(s). DRPT considered three threshold criteria: under capacity, near capacity, and over capacity, where intersections may be approaching but not yet exceeding capacity. The intersection capacity analyses are intended to generally correspond to LOS as follows:
    a) Under capacity represents LOS A/B conditions
    b) Near capacity represents LOS C/D conditions
    c) Over capacity represents LOS E/F conditions

For this analysis, DRPT assumed that diverted vehicles would travel beginning at the location of the crossing and then utilize the closest adjacent crossing(s) using the shortest roadway path (determined based on roadway speeds and distances and engineering judgment). Diversions on both sides of the crossing (i.e., east and west of the tracks) were included, as well as upstream and downstream adjacent crossings, as applicable. The diversion analysis was conducted separately for each roadway closure, except within Ashland. For the Ashland alternatives, the analysis was completed for each Build Alternative to evaluate all of the proposed roadway closures together on the affected roadway network within the town[22].

Refer to the *Transportation Technical Report* (Appendix S) for full details on the process and assumptions, as well as detailed results, including maps of roadways and intersection, by closure location.

The results of the roadway and intersection diversion analysis are summarized in two tables:

- Table 4.15-11 summarizes the analysis as it was conducted: by closure location.
- Table 4.15-12 compiles the results by Build Alternative.

As shown by the results in Table 4.15-11, the majority of the roadway closures are anticipated to have minimal effect on both roadway and intersection operations. "Minimal effect" is defined as the Build condition LOS on all roadway segments and through all intersections as being equivalent to the No Build condition.

There are four closures that DRPT anticipates will have an effect on roadway and/or intersection operations, which are shaded for ease of reference in the table and described in further detail below.

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[21] Level of service (LOS) is a measure of traffic operating conditions based generally on a comparison of traffic volumes to available capacity. LOS is described in terms of letter grades from A to F; LOS A represents free-flowing traffic conditions, while LOS F represents a breakdown in traffic flows, with stop-and-go conditions. Generally, LOS C is considered acceptable in rural areas, whereas LOS D is considered acceptable in urban areas.

[22] Within the Town of Ashland, a small traffic assignment model was developed to analyze the closure diversions. While the model used the same general process as the other roadway closures, the advantage of using a computerized model is to enable the consideration of a greater number of and more varied detour routes.

Table 4.15-11: Summary of Closure Diversion Analysis Results, by Closure

Alternative Area[1]	Alternative	Closure Roadway Name	# Roadway Segments / Effect on Roadway Volumes & LOS	# Intersections / Effect on Intersection Capacity
Area 2: Northern Virginia (Long Bridge to Dahlgren Spur)	2A	Mount Hope Church Road	4 / Minimal Effect	4 / Minimal Effect
Area 4: Central Virginia (Crossroads to Doswell)	4A	Colemans Mill Road	4 / Minimal Effect	7 / Minimal Effect
Area 5: Ashland[2] (Doswell to I-295)	5A and 5C	Ashland: Close College Avenue Crossing	24 / Decreased LOS one segment	24 / Decreased capacity through one intersection
	5B–Ashcake and 5D–Ashcake	Ashland: Close Center Street (South of England / Thompson Street to Maiden Lane)	24 / Minimal Effect	24 / Minimal Effect
	5B	Ashland: Close College Avenue Crossing & Close Center Street (South of England / Thompson Street to Maiden Lane)	24 / Decreased LOS on one segment	24 / Decreased capacity through one intersection
	5C and 5C–Ashcake	Independence Road	3 / Minimal Effect	3 / Minimal Effect
Area 6: Richmond (I-295 to Centralia)	6A, 6B–A-Line, 6C, 6E	Bassett Avenue	8 / Minimal Effect	10 / Minimal Effect
	6A, 6B–A-Line, 6C, 6E	Terminal Avenue	Qualitative / Minimal Effect	Qualitative / Minimal Effect
	6A, 6B–A-Line, 6C, 6E	Thurston Road	4 / Minimal Effect	6 / Minimal Effect
	6B–S-Line, 6D, 6F, 6G	Brinkley Road	4 / Decreased LOS on one segment	6 / Minimal Effect
	6A - G	Old Lane	4 / Decreased LOS on two segments	6 / Decreased capacity through one intersection
	6B–S-Line	Ownby Lane	Qualitative / Minimal Effect	Qualitative / Minimal Effect
	6B–S-Line, 6D, 6F, 6G	St James Street	4 / Minimal Effect	6 / Minimal Effect
	6B–S-Line, 6D, 6F, 6G	N 2nd Street/ Valley Road	Qualitative / Minimal Effect	Qualitative / Minimal Effect
	6B–S-Line, 6D, 6F, 6G	Dale Avenue/ Trenton Avenue	Qualitative / Minimal Effect	Qualitative / Minimal Effect

[1] No closure diversion analysis in Alternative Areas 1 or 3.

[2] Within the Town of Ashland, the closure diversion analysis was performed as a set for the concurrent closures by Build Alternative. Build Alternative 5A–Ashcake does not include any public roadway closures.

Shaded rows represent closures that are anticipated to have an effect on roadway and/or intersection operations.

Effects of Closure of College Avenue Crossing, Town of Ashland

This closure is required by the station improvements at the existing station location (i.e., the extension of the platform across College Avenue/Henry Clay Road) in Build Alternatives 5A and 5C. Diverted vehicles could use a variety of alternate routes through the grid street network in the Town of Ashland.

- **Roadway Operations.** Thompson Street, between N James Street and N Center Street, is projected to drop from operating at LOS D (with 14,600 daily vehicles) in 2025 No Build to LOS E (with 15,400 daily vehicles) 2025 Build.
- **Intersection Operations.** Thompson/England Street at Center Street, which is the primary intersection in the center of the Town of Ashland, is projected to operate near capacity (generally equivalent to LOS C/D) during Build conditions, compared to under capacity (generally equivalent to LOS A/B) during 2025 No Build conditions.

Effects of Closure of College Avenue Crossing and Closure of Center Street (South of England/Thompson Street to Maiden Lane), Town of Ashland

These concurrent closures are required due to conflicts with the station platform improvements (closure of College Avenue crossing) and conflicts with the addition of the third track (closure of Railroad Avenue/Center Street (on the east side of the tracks, between England/Thompson Street and Maiden Lane) that are part of Build Alternative 5B. Diverted vehicles could use a variety of alternate routes through the grid street network in the Town of Ashland.

Roadway Operations. Thompson Street, between N James Street and N Center Street, is projected to drop from operating at LOS D (with 14,600 daily vehicles) in 2025 No Build to LOS E (with 15,300 daily vehicles) in 2025 Build.

- **Intersection Operations.** Thompson/England Street at Center Street, which is the primary intersection in the center of the Town of Ashland, is projected to operate near capacity (generally equivalent to LOS C/D) during Build conditions, compared to under capacity (generally equivalent to LOS A/B) during 2025 No Build conditions.

Effects of Closure of Brinkley Road, Chesterfield County

The Kingsland Road crossing is located just over approximately ½ mile north of the Brinkley Road crossing. For 2025 Build conditions as part of Build Alternatives 6B–S-Line, 6D, 6F, and 6G, diverted vehicles would access this crossing by using Dorsey Road to the west of the rail corridor and Chester Road to the east.

- **Roadway Operations.** Kingsland Road, between Dorsey Road and Chester Road is projected to drop from operating at LOS A (with 2,100 daily vehicles) in the 2025 No Build conditions to LOS B (with 4,200 daily vehicles) in the 2025 Build conditions.
- **Intersection Operations.** Minimal effect.

Effects of Closure of Old Lane, Chesterfield County

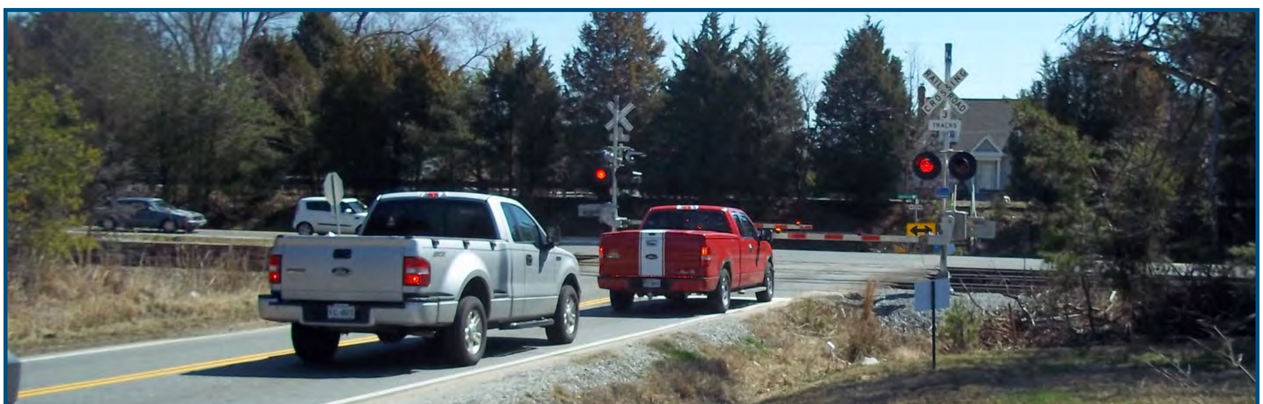
The Centralia Road crossing, which is proposed to be grade-separated as a part of the Richmond-to-Raleigh (R2R) project, is located approximately ½ mile south of the Old Lane crossing. For 2025 Build conditions in all Richmond Build Alternatives (6A through 6G), diverted vehicles would access this crossing by using Hopkins Road to the west of the rail corridor and Chester Road to the east.

- **Roadway Operations.** The following two roadway segments are affected by the closure:
  - Centralia Road, between Hopkins Road and Chester Road, is projected to drop from operating at LOS B (with 10,500 daily vehicles) in the 2025 No Build conditions to LOS E (with 16,300 daily vehicles) in the 2025 Build conditions. Centralia Road near this segment would be redesigned and reconstructed (including the grade separation) to accommodate these future volumes.
  - Hopkins Road, between Old Lane and Centralia Road, is projected to drop from operating at LOS B (with 4,100 daily vehicles) in the 2025 No Build conditions to LOS C (with 8,000 daily vehicles) in the 2025 Build conditions.
- **Intersection Operations.** Centralia Road at Chester Road is projected to operate near capacity (generally equivalent to LOS C/D) during Build conditions, compared to under capacity (generally equivalent to LOS A/B) during 2025 No Build conditions.

The results of the crossing diversion analyses compiled by Build Alternative are presented in Table 4.15-12.

4.15.2.4 DC2RVA Crossing Improvement Effects on Total Daily Vehicle Delay

The total vehicle delay per day is the amount of time that vehicles spend queuing at an at-grade crossing over the course of a day (24 hours) based on the number of trains that are expected to pass through the crossing. The purpose of the daily delay calculations as part of the DC2RVA transportation analysis is to quantify the delay experienced by vehicles due to the number and type of trains traveling through the public at-grade highway-rail crossings for existing, No Build, and Build conditions. This daily vehicle delay calculation applies only to the at-grade public crossings themselves in the DC2RVA corridor[23]. Any combination of more trains, slower trains, and more motor vehicles would result in increases in resulting daily vehicle delay. Refer to the *Transportation Technical Report* (Appendix S) for full details on the daily delay calculation and source data, as well as the results summarized below.



At-Grade Crossing at Mine Road

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[23] While private vehicles may experience additional delay due to either train service improvements or crossing improvements as part of the DC2RVA Project, it is not quantified as part of this analysis.

[24] The increase of 1 hour of total daily delay for Build Alternative 3A is due to a combination of maintaining existing crossing conditions and increases in train frequency.

Table 4.15-12: Summary of Closure Diversion Analysis Results, by Build Alternative

Alternative Area[1]	Alternative	Closure Diversion Roadway(s) Analyzed	Effects on Roadway Traffic Volumes and Associated LOS	Effects on Intersection Capacity
Area 2: Northern Virginia (Long Bridge to Dahlgren Spur)	2A	Mount Hope Church Road	Minimal Effect	Minimal Effect
Area 4: Central Virginia (Crossroads to Doswell)	4A	Colemans Mill Road	Minimal Effect	Minimal Effect
Area 5: Ashland (Doswell to I-295)	5A	College Avenue/Henry Clay Road	Thompson Street: *14,600 vehicles / LOS D, No Build* *15,400 vehicles / LOS E, Build* All other locations minimal effect.	England/Thompson Street at Center Street: *Under Capacity, No Build* *Near Capacity, Build* All other locations minimal effect.
	5A–Ashcake	*No Closures for this Build Alternative*	*n/a*	*n/a*
	5B	College Avenue / Henry Clay Road; Railroad Avenue / Center Street	Thompson Street: *14,600 vehicles / LOS D, No Build* *15,300 vehicles / LOS E, Build* All other locations minimal effect.	England/Thompson Street at Center Street: *Under Capacity, No Build* *Near Capacity, Build* All other locations minimal effect.
	5B–Ashcake	*Same as 5D–Ashcake*	*Same as 5D–Ashcake*	*Same as 5D–Ashcake*
	5C	College Avenue / Henry Clay Road; Independence Road	Thompson Street: *14,600 vehicles / LOS D, No Build* *15,400 vehicles / LOS E, Build* All other locations minimal effect.	England/Thompson Street at Center Street: *Under Capacity, No Build* *Near Capacity, Build* All other locations minimal effect.
	5C–Ashcake	Independence Road	Minimal Effect	Minimal Effect
	5D–Ashcake	Railroad Avenue / Center Street	Minimal Effect	Minimal Effect

▶ *Continued (see end of table for detailed notes.)*

Table 4.15-12: Summary of Closure Diversion Analysis Results, by Build Alternative

Alternative Area[1]	Alternative	Closure Diversion Roadway(s) Analyzed	Effects on Roadway Traffic Volumes and Associated LOS	Effects on Intersection Capacity
Area 6: Richmond (I-295 to Centralia)	6A	Bassett Avenue; Terminal Avenue; Thurston Road; Old Lane	Centralia Road: *10,500 vehicles / LOS B, No Build* *16,300 vehicles / LOS E, Build* Hopkins Road: *4,100 vehicles / LOS B, No Build* *8,000 vehicles / LOS C, Build* All other locations minimal effect.	Centralia Road at Chester Road: *Under Capacity, No Build* *Near Capacity, Build* All other locations minimal effect.
	6B–A-Line	*Same as 6A*	*Same as 6A*	*Same as 6A*
	6B–S-Line	St James Street; N 2nd Street/Valley Road; Dale Avenue/Trenton Avenue; Brinkley Road; Old Lane	*Same as 6A* Kingsland Road: *2,100 vehicles / LOS A, No Build* *4,200 vehicles / LOS B, Build* All other locations minimal effect.	*Same as 6A*
	6C	*Same as 6A*	*Same as 6A*	*Same as 6A*
	6D	*Same as 6B–S-Line*	*Same as 6B–S-Line*	*Same as 6B–S-Line*
	6E	*Same as 6A*	*Same as 6A*	*Same as 6A*
	6F	*Same as 6B–S-Line*	*Same as 6B–S-Line*	*Same as 6B–S-Line*
	6G	*Same as 6B–S-Line*	*Same as 6B–S-Line*	*Same as 6B–S-Line*

[1] No closure diversion analysis locations in Alternative Areas 1 or 3.

Effects of Types of Crossing Treatments on Daily Vehicle Delay

Different crossing treatments that are proposed as part of the DC2RVA Build Alternatives would have different effects on the total daily delay. The type of crossing improvement that can have the largest effect on the daily delay calculation is crossing elimination, as it fully removes the delay condition of vehicles queueing at an at-grade crossing. Crossing elimination is defined as either grade-separation or crossing closure:

- Grade separation eliminates the vehicle delay by physically separating the train traffic from the roadway vehicles, though all vehicles use the crossing in the same travel patterns as the existing condition. This would affect the daily delay calculation by "zeroing out" the daily delay at the grade-separated crossing in the Build condition. For the DC2RVA Project, the following proposed crossing closure locations would divert vehicular traffic to adjacent crossing(s) that are grade-separated, as previously presented in Section 4.15.2.3, and therefore do not require diverted vehicles to be accounted for in the analysis of delay.
  - Mount Hope Church Road, Build Alternative 2A, Stafford County
  - Colemans Mill Road, Build Alternative 4A, Caroline County
  - Independence Road, Build Alternative 5C, Hanover County
  - Old Lane, all Richmond Build Alternatives, Chesterfield County
  - St James Street, Build Alternative 6B–S-Line, 6D, 6F, and 6G, Richmond
  - Terminal Avenue, Build Alternative 6A, 6B–A-Line, 6C, and 6E, Richmond
  - N 2nd Street/Valley Road, Build Alternative 6B–S-Line, 6D, 6F, and 6G, Richmond
  - Dale Avenue/Trenton Avenue is not considered an existing public crossing and therefore has no effect on the delay analyses.
- Crossing closure eliminates the vehicle delay by physically removing the ability of roadway vehicles to cross the rail corridor at an existing location; these vehicles would be accommodated via a permanent detour of vehicular traffic to adjacent crossing(s) as presented in Section 4.15.2.3. This would affect the daily delay in two ways in the Build conditions: (1) it would "zero out" the daily delay at the location of the crossing closure, and (2) it would increase the delay at any adjacent at-grade crossing(s) that the detoured vehicles use. If the adjacent crossing used by detoured vehicles is a grade-separated crossing(s), there is no effect on the grade-separated crossing because, as noted above, there is no interaction between motor vehicles and rail traffic. Otherwise, proposed crossing closures would require detouring vehicles to adjacent at-grade crossing(s), and therefore, would require inclusion of diverted vehicles on those adjacent crossing(s) as part of the Build condition. For the total daily delay analyses, vehicles were diverted per the closure diversion analysis methodology as presented in Section 4.15.2.3 above.

Table 4.15-13 presents the summary of the total daily delay results for the above conditions. The results indicate the following overall corridor-wide results.

Effect of the DC2RVA Project on the 40-hour FHWA Daily Delay Threshold

Daily vehicle delay is one of FHWA's 11 criteria for which grade separation of at-grade crossings should be considered; the criteria threshold set by FHWA is 40 total vehicle hours of delay per day, which is the cumulative time all vehicles are delayed at a crossing per day.

- The 40-hour FHWA threshold for total daily delay at an individual at-grade crossing is not met or exceeded under existing or No Build conditions.

- The 40-hour FHWA threshold for total daily delay at an individual at-grade crossing is not met or exceeded by the crossing conditions for any Build Alternative as part of the DC2RVA Project with the exception of one crossing. The England Street/Thompson Street crossing exceeds the 40-hour FHWA threshold in two of the build alternatives that pass through the Town of Ashland (Build Alternatives 5A and 5B with 41.85 total daily hours). The total daily delay at this crossing is 37.37 hours under No Build conditions.

Effect of the DC2RVA Project on Total Daily Vehicle Delay

The results shown in Table 4.15-13 are the sum total of all crossings within each Build Alternative. Negative values in the "% change" column represent decreases in delay in the Build condition.

- DRPT anticipates that the DC2RVA Project will reduce vehicle delay for each Build Alternative with the exception of Build Alternative 3A, which maintains existing crossing conditions[24]. This reduction in delay indicates that the overall proposed grade separations and operating conditions that reduce delay (i.e., improved train speeds) outweigh the proposed changes that would increase delay (i.e., number of daily vehicles and trains, length of train). While vehicles at crossing closures will divert to adjacent crossings, the majority of diverted vehicles would utilize adjacent grade-separated crossings (thus removing the daily delay of those vehicles) and/or are relatively not high volumes of vehicles that are detoured.
- Corridor-wide, the Build Alternatives with the greatest reductions in total vehicle delay hours are represented by the areas with the most at-grade crossing eliminations (i.e., grade separation or crossing closure) or those with service changes (i.e., the bypass alignments that reduce the daily number of trains through existing at-grade crossings or service line changes on the A- and S-Lines in Richmond).
- Within Build Alternative 2A, there is one crossing elimination at Mount Hope Church Road (of four total at-grade crossings), which represents a 1 percent reduction in daily delay compared to No Build.
- Within Fredericksburg, the only Build Alternative that includes a crossing elimination is 3B, which includes one grade separation at Landsdowne Road (of four total at-grade crossings) and has the fewest total number of at-grade crossings. 3B represents a 60 percent reduction in daily delay compared to No Build.
- Within Build Alternative 4A, there is one crossing elimination at Colemans Mill Road (of seven total at-grade crossings), which represents a 6 percent reduction in daily delay compared to No Build.
- Within Ashland, the Build Alternatives with the greatest reductions in daily delay occur for the bypass alignments (5C and 5C–Ashcake), which represent approximately 90 percent reductions in daily delay through the existing at-grade crossings in town. The bypass alignments remove freight and long-distance passenger trains from traveling through the at-grade crossings in the town. For all other Build Alternatives, which vary in the total number and location of crossing elimination, there is a reduction of approximately 25 percent in daily delay compared to No Build.
- The A-Line Build Alternatives in Richmond include seven crossing eliminations (out of eleven total at-grade crossings), which represents a 70 percent reduction in daily delay

[24] The increase of 1 hour of total daily delay for Build Alternative 3A is due to a combination of maintaining existing crossing conditions and increases in train frequency.

compared to No Build. The exception is 6C, which includes two new at-grade crossings at the Broad Street Station and therefore would experience higher total delay.

- The S-Line Build Alternatives in Richmond include seven crossing eliminations (of a total of seventeen at-grade crossings), which represents a 60 percent reduction in daily delay compared to No Build. The exception is 6B–S-Line, which includes an additional crossing elimination in proximity to the Boulevard Station. By eliminating the most at-grade crossings in the Build condition, it is projected to experience the greatest decreases in delay.
- For crossings that remain at-grade and experience increases in delay in the Build condition, the change in total daily delay is less than 8 percent for most crossings. Less than ten individual crossings that are located within Fredericksburg, Ashland, and Richmond will experience higher total daily delay. Refer to the *Transportation Technical Report* (Appendix S) for these details.

Total Daily Delay due to Types of Trains

Table 4.15-13 also shows the Intercity Passenger, VRE Passenger, and Freight percentage of total daily delay.

- The delay due to intercity passenger trains increases compared to No Build conditions for the majority of the corridor and continues to represent a relatively small fraction of the total daily vehicle delay experienced at at-grade crossings in 2025 Build conditions.
- The majority of the total delay experienced throughout all alternative areas would continue to be from freight trains, which represents almost 90 percent of the total delay corridor-wide in 2025[25].

4.16 UTILITIES

Utility impacts for the Build Alternatives vary widely throughout the length of the Project. Table 4.16-1 summarizes the estimated utility impacts and costs for the Build Alternatives. The No Build Alternative would not require any utility relocations.

4.17 SAFETY AND SECURITY

FRA’s Track Safety Standards (49 CFR 213) are based on classifications of track that determine maximum operating speed limits, inspection frequencies, and standards of maintenance, among other issues. Higher track classes require more-stringent maintenance standards to support higher allowable maximum operating speed. Between Fredericksburg and Staples Mill Station in Richmond, the proposed maximum speed is 90 mph, or FRA Class 5. Outside of this area, the proposed maximum speed is 79 mph, or FRA Class 4. The proposed improvements described in Chapter 2 would bring rail infrastructure in the selected corridor into compliance with the appropriate FRA standards. FRA will require the preparation of a System Safety Plan upon the completion of the EIS and prior to authorization to implement the infrastructure and service improvements proposed under the DC2RVA Project. Refer to the *Basis of Design Technical Report* (Appendix B).

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[25] The exception to this is Build Alternative 5C and 5C-Ashcake, which shift all freight trains onto the bypass. Accordingly, the existing at-grade intersections through the Town of Ashland would therefore have reduced daily delay due to freight trains for the bypass alternatives.

Table 4.15-13: Summary of Total Daily Delay[1] Results, 2025 Build Conditions, By Build Alternative

Alternative Area[2]	Alternative	Crossings that Exceed FWHA 40-hour Daily Delay Threshold		Total Daily Vehicle Delay Results						Change in Daily Delay Build to No Build	
		No Build	Build	No Build (Hours)	At-Grade Crossings Removed[3] as part of project	Build (Hours)	Intercity Percent of Total Delay	VRE Percent of Total Delay	Freight Percent of Total Delay	Hours	% Change
Area 2: Northern Virginia (Long Bridge to Dahlgren Spur)	2A	0	0	23.28	1	23.01	13%	5%	82%	-0.26	-1%
Area 3: Fredericksburg (Dahlgren Spur to Crossroads)	3A	0	0	16.61	0	17.61	13%	5%	81%	0.99	6%
	3B	0	0	16.61	1	6.59	13%	5%	82%	-10.03	-60%
	3C	0	0	36.37	0	32.79	9%	0%	91%	-3.58	-10%
Area 4: Central Virginia (Crossroads to Doswell)	4A	0	0	3.58	1	3.35	13%	0%	87%	-0.23	-6%
Area 5: Ashland (Doswell to I-295)	5A	0	1	73.94	3	56.28	11%	0%	89%	-17.66	-24%
	5A–Ashcake	0	0	73.94	2	56.33	11%	0%	89%	-17.61	-24%
	5B	0	1	73.94	3	55.01	11%	0%	89%	-18.93	-26%
	5B–Ashcake and 5D–Ashcake	0	0	73.94	2	55.06	11%	0%	89%	-18.88	-26%
	5C	0	0	73.94	1	9.76	42%	0%	58%	-64.18	-87%
	5C–Ashcake	0	0	73.94	0	9.77	42%	0%	58%	-64.17	-87%
Area 6: Richmond (I-295 to Centralia)	6A, 6B–A-Line, and 6E	0	0	78.70	7	26.48	12%	0%	88%	-52.22	-66%
	6B–S-Line	0	0	168.36	9	40.37	11%	0%	89%	-127.99	-76%
	6C[4]	0	0	104.90	7	64.95	24%	0%	76%	-39.95	-38%
	6D and 6F	0	0	168.36	8	68.55	10%	0%	90%	-99.81	-59%
	6G	0	0	168.36	8	67.20	8%	0%	92%	-101.17	-60%

[1] Delay represents the Total Daily Vehicle Delay for all train types. It is the cumulative delay for all at-grade crossings.

[2] Note that there are no public at-grade crossings located within Alternative Area 1 (Arlington).

[3] Removal of the At-Grade Highway-Rail Crossing Condition includes the proposed improvements of Grade Separation and Crossing Closure.

[4] Build Alternative 6C includes the delay associated with the two new at-grade crossings in all calculations excluding the No Build condition.

Table 4.16-1: Estimated Utility Relocations and Costs

Alternative Area	Alternative	Relocations (in feet, except Major Facility)							Cost $2016
		Fiber	Water	Sanitary Sewer	Electric Dist.	Electric Trans.	Gas	Major Facility	
Area 1: Arlington (Long Bridge Approach)	1A	–	–	–	–	–	–	–	$0
	1B	–	–	–	400	–	–	–	$118,800
	1C	–	–	–	400	–	–	–	$118,800
Area 2: Northern Virginia (Long Bridge to Dahlgren Spur)	2A	3,000	–	–	2,000	–	45,000	–	$34,485,000
Area 3: Fredericksburg (Dahlgren Spur to Crossroads)	3A	1,500	–	–	–	–	3,500	–	$2,695,500
	3B	1,500	–	–	–	–	3,500	–	$2,695,500
	3C	1,500	–	–	–	–	4,000	–	$3,070,500
Area 4: Central Virginia (Crossroads to Doswell)	4A	153,000	1,160	–	1,875	–	7,275	–	$13,506,885
Area 5: Ashland (Doswell to I-295)	5A	61,776	–	–	400	–	600	–	$3,472,272
	5A–Ashcake	61,776	–	–	400	–	600	–	$3,472,272
	5B	90,288	5,000	600	2,825	–	2,800	–	$8,724,561
	5B–Ashcake	90,288	5,000	600	2,825	–	2,800	–	$8,724,561
	5C	30,096	1,667	200	942	–	933	–	$2,908,123
	5C–Ashcake	30,096	1,667	200	942	–	933	–	$2,908,123
	5D–Ashcake	90,288	5,000	600	2,825	–	2,800	–	$8,724,561
Area 6: Richmond (I-295 to Centralia)	6A	24,345	2,170	1,175	9,510	3,700	6,915	1	$28,935,430
	6B–A-Line	104,855	2,575	1,220	20,920	5,200	7,200	1	$43,945,400
	6B–S-Line	196,175	1,658	1,215	23,020	14,700	7,325	2	$96,463,578
	6C	104,900	2,665	1,220	20,920	5,700	7,200	1	$46,471,005
	6D	196,175	1,658	1,215	23,020	14,700	7,325	2	$96,463,578
	6E	91,630	2,350	1,220	11,040	3,700	7,140	2	$33,035,740
	6F	196,175	1,658	1,215	23,020	14,700	7,325	2	$96,463,578
	6G	196,175	1,658	1,215	23,705	14,700	7,475	2	$96,779,523

Note: Cost estimates do not include engineering costs or contingency. Major utility facility relocations are provided by number, not feet.

Each at-grade highway-rail crossing was analyzed to determine which safety mechanisms or treatments would be proposed as part of the Build Alternatives. These treatments include grade separation, closure/consolidation, four-quadrant gates, median treatment, other treatment, or no action. All roadways that would be retained across the Fredericksburg Bypass (Build Alternative 3C) and the Ashland Bypass (Build Alternatives 5C and 5C–Ashcake) would be grade-separated.

There would be two new at-grade crossings under the single-station alternative in Richmond at Broad Street (Build Alternative 6C). The Project would improve safety of the private at-grade crossings with either locking gates or signalized four-quadrant gates and would improve safety at the pedestrian at-grade crossings.

Safety of the existing public at-grade crossings in the DC2RVA corridor would be improved as part of the Build Alternatives (Appendix S, *Transportation Technical Report).*

4.18 PUBLIC HEALTH AND SAFETY

Most of the rail lines in the United States, including the DC2RVA corridor, are used for transportation of various freight, including hazardous materials. All Class I railroads are required to maintain a safety plan for transporting such materials. FRA and The United States Department of Homeland Security (DHS) regulate the transportation of materials on railroads.

The Transportation Security Administration (TSA) of DHS determines the routes for shipment of certain hazardous materials. For security reasons, TSA does not share this information outside specific agencies and freight rail carriers; however, freight rail carriers regularly communicate with emergency management agencies and DHS about materials of concern.

The Build Alternatives would add nine additional round trips of intercity passenger trains on the DC2RVA corridor. The Project would not add any hazardous materials trains on the DC2RVA corridor. The Build Alternatives are designed in accordance with FRA regulations, industry standards, and CSXT requirements. DRPT expects that the proposed upgrades to facilities and added rail capacity associated with the Build Alternatives will increase safety of all train traffic through the DC2RVA corridor by decreasing congestion, maintaining the rail line to current standards in locations where work is being conducted and replacing older infrastructure. The modern infrastructure and new technologies that would be applied would provide a greater level of safety for all rail traffic, including transportation of hazardous materials.

4.19 CONSTRUCTION IMPACTS

Construction impacts associated with a transportation project are those impacts that are temporary or short term and that occur only during construction. They can involve temporary changes in land use and access, air quality, noise levels, water quality, and wildlife habitat. The following provides an overview of the types and extent of potential construction impacts that may occur if a Build Alternative is advanced. BMPs and other measures that can be used as appropriate to mitigate any temporary construction impacts are also presented. Construction impacts would be similar amongst the different Build Alternatives in each alternative area, with the exception of Alternative Area 3 (Fredericksburg) and Alternative Area 5 (Ashland). In these areas, more construction would occur with the Fredericksburg Bypass (Build Alternative 3C) and the Ashland Bypass (Build Alternatives 5C and 5C–Ashcake) than the Build Alternatives that go through town (Build Alternatives 3A, 3B, 5A, 5A–Ashcake, 5B, 5B–Ashcake, and 5D–Ashcake). However, the Build Alternatives that go through town and add an additional track (Build Alternatives 3B, 5B, 5B–Ashcake, and 5D–Ashcake) would require construction through a built up urban environment where space is more confined and where construction activities are more likely to impact activities of area residents. Refer to the *Constructability Technical Report* (Appendix L) for addition information regarding the construction of each Build Alternative.

4.19.1 Impacts

4.19.1.1 Rail

Track closures and shifts can have major effects on rail operations. New stations and station alterations can also have effects on transit users. Construction of the additional track, infrastructure additions and modification to control points, station infrastructure with additional platforms, and speed increases requires a phased construction approach.

4.19.1.2 Land Use and Access

Construction activities for all Build Alternatives could result in temporary and localized detours, modifications to access, and increases in truck traffic. Access to businesses and homes could be temporarily disrupted due to temporary detours that are necessary to allow ample space for equipment staging and construction.

4.19.1.3 Air Quality

Demolition and construction activities can result in short-term increases in fugitive dust and equipment-related particulate emissions in and around the study area. The potential air quality effects would be short term, occurring only while demolition and construction work is in progress and local conditions are appropriate. The potential for fugitive dust emissions typically is associated with building demolition, ground clearing, site preparation, grading, stockpiling of materials, onsite movement of equipment, and transportation of materials. The potential is greatest during dry periods, periods of intense construction activity, and during high wind conditions.

GHG emissions would also be generated during construction; however, these emissions are likely to be relatively minor given the nature and size of the Project and the limited duration of construction activities.

4.19.1.4 Noise

Noise levels would not be substantially altered by construction, which includes noise generated by heavy equipment during construction activities. The potential for noise impacts during construction is correlated to the proximity of sensitive noise receptors to the proposed construction activity. The potential for noise impacts during construction typically increases in urban and suburban areas because of the higher population densities found in those areas; however, noise in urban areas might be less noticeable than in rural areas because ambient noise levels are higher in urban areas. Construction noise impacts are temporary and, typically, progress linearly along transportation corridor construction projects. As construction approaches an area, noise impacts to receptors in that area would begin to increase over a period of time, reach a peak, and then dissipate as construction moves past the area. Section 4.7.1.4 provides additional information regarding construction noise.

4.19.1.5 Water Resources

Construction could potentially result in short-term effects such as increased sedimentation, increase in turbidity from in-stream work, and possible spills, or non-point source pollutants entering groundwater or surface water from stormwater runoff. Construction activities that could affect stormwater runoff include excavation to widen 'cut' sections and to remove unsuitable (organic) material from 'fill' sections; filling and placing ballasts to support new track; relocating access roads; relocating or creating new trackside swales; and any substructure work required for bridge or culvert installation, or station improvements. Construction staging areas and haul roads, if needed, could also disturb the ground, potentially causing erosion and sedimentation. Additionally, culvert installation may require pump-around methods, resulting in a temporary cessation of flow through stream sections.

4.19.1.6 Wildlife and Habitat

Human presence during construction and the associated construction noise, such as from passing equipment, piling emplacement, and blasting of bedrock, may temporarily displace some species of wildlife. The noises associated with construction may also mask territorial vocalizations of birds, interfering temporarily with breeding. Amphibians, which breed more commonly at dusk or night, are less likely to be affected. Construction in forested areas may result in mortality of amphibians, reptiles, and small mammals within the work zone and the loss of nesting birds if construction is initiated during nesting season. The clearing of terrestrial and aquatic vegetated cover within the construction footprint would temporarily displace certain habitat areas, and the mechanical removal of cover would cause animal migration away from the disturbance, resulting in a temporary decrease in available habitat and increased competition for remaining habitat. Water quality and therefore aquatic species may be affected temporarily by runoff from construction areas and permanently through runoff from increased impervious surfaces. Anadromous fish movements could be interrupted during construction. Opportunistic or invasive plant species may have a competitive advantage in colonizing disturbed areas during early construction activities. Many of these effects can be offset through application of BMPs.

4.19.2 Mitigation

4.19.2.1 Rail

During construction, the goal will be to maintain two main tracks in operation wherever possible; however, there will be some track outages and service disruptions during construction. DRPT will prepare a Service Development Plan (SDP) for the DC2RVA Project. The SDP will define the phased implementation of improvements relative to the incremental expansion of service. Preliminary engineering and final design plans will include a construction staging plan to minimize track outages during construction. Station improvements for platform additions and pedestrian access will be constructed early to support the new track when placed in operation.

4.19.2.2 Land Use and Access

Temporary disruptions to driving patterns and access are often unavoidable but would be minimized to the extent possible by carefully planning for maintenance of traffic during the construction process. The SDP will define the phased implementation of improvements relative to the incremental expansion of service. Preliminary engineering and final design plans will include a construction staging plan to minimize roadway outages during construction. Safety concerns due to the presence of heavy construction equipment during Project construction will be mitigated using appropriate signage and fencing to separate pedestrians and vehicles from construction areas and equipment. All land use temporarily affected by construction activities would be returned to its original use after construction is complete. All temporary access for construction vehicles would be removed and returned to its original land use.

4.19.2.3 Air Quality

DRPT will identify the appropriate BMPs to minimize air quality effects during construction. The VDOT Road and Bridge Specifications include provisions on fugitive dust control. Under these provisions, dust and airborne dirt generated by construction activities will be controlled through dust control procedures or a specific dust control plan, when warranted. The contractor and DRPT will meet to review the nature and extent of dust-generating activities and will cooperatively develop specific types of control techniques appropriate to the specific situation. Techniques that may warrant consideration include measures such as minimizing track-out of soil onto nearby publicly traveled roads, reducing speed on unpaved roads, covering haul vehicles, and applying chemical dust suppressants or water to exposed surfaces, particularly those on which construction vehicles travel. With the application of appropriate measures to limit dust emissions during construction, this Project will not cause any significant, short-term particulate matter air quality impacts.

4.19.2.4 Noise

Practices to minimize the effects of construction noise would be in accordance with Section 107.14(c)(3) of VDOT's Road and Bridge Specifications.

While construction noise is unavoidable in most cases, steps can be taken to minimize the impact, such as the following:

- Keep all equipment well maintained, tuned, and properly lubricated to minimize at-source noise production;
- Use sound attenuation devices on exhaust ports;
- Substitute the use of flag persons to control construction vehicle movements, instead of using audible back-up alarms for vehicles;
- Minimize unnecessary idling of heavy equipment and machinery, especially diesel engines and generators, when not actively in use; and
- Prohibit construction during sensitive nighttime, early evening, and early morning hours.

DRPT will evaluate construction noise mitigation measures in more detail when an analysis of construction noise based on an actual construction plan can be completed and will ensure that all appropriate mitigation measures are employed by including these measures in the contractors' contracts.

4.19.2.5 Water Resources

All temporary and permanent impacts to wetlands and water resources associated with construction activities are regulated by USACE and Virginia DEQ through Sections 404 and 401 of the CWA, as well as by the Virginia Water Protection Program. DRPT will be responsible for ensuring that all Section 404 and 401 permit requirements are met by the Project contractors.

Stormwater discharges to jurisdictional wetlands and waterways, such as discharges from construction sites, are regulated through the National Pollutant Discharge Elimination System (NPDES) Stormwater program. An NPDES Construction permit would be required for any construction site that disturbs more than 1 acre (including sites that are smaller than 1 acre but are included as part of a larger project or development). Through issuance of an NPDES

Stormwater permit, the regulating agency would ensure that enough erosion and sediment control measures are specified for the activity and that impacts are further reduced by using construction BMPs.

Erosion and sedimentation control plans for highway and rail improvements, including staging areas, would be required for work that would include ground disturbance, and they would describe the measures to be employed as erosion control, sedimentation control, temporary stormwater management measures, and dust control. Erosion control plans would also address in-water work at stream crossing locations. These plans must be approved before site construction could proceed and would be developed in accordance with regulations set forth by VDCR. Implementation of the Project-specific plan would be expected to minimize impacts of erosion and sedimentation during construction. Erosion and sediment control measures would be implemented throughout the construction period to minimize water quality impacts from increased levels of sedimentation and turbidity. Control measures may include berms, dikes, sediment basins, fiber mats, straw silt barriers, netting, mulch, temporary and permanent seeding, and other methods. Construction impacts to in-stream aquatic habitats would be minimized to the extent practicable by avoiding stream relocations and by crossing streams at right angles where possible. To the extent possible, construction equipment would be restricted from fording and otherwise disrupting in-stream habitats. Staging areas for heavy equipment, material storage, and short-term field offices would be chosen carefully and situated away from sensitive areas.

4.19.2.6 Wildlife and Habitat

DRPT anticipates that construction would be monitored to adhere to a strict schedule with possible time of year restrictions to avoid disrupting the critical life cycles of both aquatic and terrestrial wildlife, in particular, threatened and endangered species. The spread of invasive plant species would be minimized during construction through cleaning of equipment and machinery between sites to reduce transport of undesirable plant species and prompt revegetation of disturbed areas. Temporary and permanent revegetation establishment, in accordance with VDOT's Road and Bridge Specifications, would minimize the extent and duration of undesirable plant growth and reduce sediment runoff. Work in streams and wetlands would also be minimized to the extent practicable, and necessary in-stream work would be done in the dry or with the use of sediment curtains and other measures to minimize impacts to aquatic species. Aquatic and terrestrial habitat would be restored in temporary construction areas as the native vegetation reestablishes over time.

4.20 INDIRECT AND CUMULATIVE EFFECTS

4.20.1 Indirect Effects

Indirect effects are those that are caused by an action and are later in time or farther removed in distance, but still are reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems (40 CFR 1508.8(a)). The analysis of indirect effects followed a seven-step process described below based on National Cooperative Highway Research Program (NCHRP) Report 466, *Desk Reference for Estimating the Indirect Effects of Proposed Transportation Projects* (TRB, 2002). This process is consistent with Council on Environmental Quality (CEQ) and FHWA regulations for implementing the *National Environmental Policy Act of 1969* (NEPA) and with applicable CEQ and FHWA guidance.

NCHRP Report 466 states that indirect effects can occur in three broad categories:

1. Encroachment-alteration impacts – Alteration of the behavior and functioning of the affected environment caused by project encroachment (physical, biological, socioeconomic) on the environment
2. Induced growth impacts – Project-influenced development effects (land use)
3. Impacts related to induced growth – effects related to Project-influenced development effects (impacts of changed land uses on the human and natural environment)

4.20.1.1 Step 1: Scoping

Scoping entails collaboration with the public, agencies, and other stakeholders to identify the significant issues that should be studied in the indirect effects analysis. The study team coordinated extensively with local, state, and federal agencies and jurisdictions and the public throughout the study. Early outreach included an agency scoping meeting, four public scoping meetings, e-mail distributions, press releases, website announcements, and letters to elected officials. Additional details on the coordination can be found in Chapter 6.

Commenters identified several resources of concern, including:

- Socioeconomics (land use, parks and recreational areas, public lands, minority and low-income populations, and right-of-way and displacements);
- Natural resources (surface waters and wetlands, floodplains, biological resources, and air quality);
- Historic properties (building sites, districts, and objects listed in or eligible for listing in the NRHP).

4.20.1.2 Step 2: Identify Study Area Direction and Goals

As described in Chapter 1, Purpose and Need, and Chapter 2, Alternatives, the proposed improvements would be largely limited to the existing rail corridor, with the exception of several local realignment options at the City of Fredericksburg and the Town of Ashland. Accordingly, the general study areas for the Project are centered on the existing rail facilities, as illustrated in Figure 1.2-1 in Chapter 1. The preceding sections of this chapter describe the direct environmental impacts of the proposed improvements along these corridors.

Indirect effects can occur in areas beyond the direct footprint of the constructed improvements. Moreover, the areas within which indirect effects may materialize vary by resource type. Therefore, each resource-specific study area includes additional lands that contain resources that are in some way connected to the area of direct effects of the Project. The following study areas have been defined for the indirect and cumulative effects analyses.

Socioeconomics

The study area for indirect and cumulative effects on socioeconomic resources encompasses an area defined by Census tracts that lie directly within or partially within the direct impacts area. Topics included under socioeconomics include land use, demographics, environmental justice, parks and recreational resources, and public lands. The Project corridor traverses parts of 153 census tracts in

Arlington County (2), the City of Alexandria (10), Fairfax County (13), Prince William County (11), Stafford County (10), the City of Fredericksburg (3), Spotsylvania County (4), Caroline County (6), Hanover County (12), Henrico County (19), the City of Richmond (52), and Chesterfield County (11). The data associated with these tracts are presented in Table 3.12-2 and Figure 3.12-1 in Chapter 3. While the census tracts encompass areas where indirect socioeconomic effects may occur, the locations where induced growth might occur is focused near the stations where access to improved intercity passenger rail services would be provided. Inducement of growth requires access to the rail services at the station locations in the same manner as highway interchanges provide access to the interstate highway system. Major passenger transport stations for intercity passenger rail work best in existing regional centers (FRA, 2011). Accordingly, station locations proposed for one or more alternatives include the following, which are all in urban or suburban areas:

- Alexandria Union Station
- Woodbridge Station
- Quantico Station
- Fredericksburg Station
- Ashland Station
- Staples Mill Road Station
- Boulevard Station
- Broad Street Station
- Main Street Station

In a station area planning reference document for high speed and intercity rail, FRA (2011) suggests defining the station area in terms of 0.25- and 0.5-mile radii of the station. Accordingly, the study area for analysis of potential induced development is defined as the areas within a 0.5-mile radius of the station locations.

Also included for the indirect effects analysis for socioeconomics is Union Station in downtown Washington, D.C. Although Washington's Union Station is beyond the limits of the Project, it serves as an existing hub for Amtrak services and an important origin and destination for potential passenger travel on the Washington, D.C. to Richmond line. Union Station is located near many government and commercial buildings and residential areas.

Natural Resources

The study area for indirect and cumulative effects to natural resources includes the seven eight-digit hydrologic unit code (HUC) watershed boundaries that encompass the Project limits. Chapter 3, Affected Environment, Section 3.1.1, provides descriptions of these watersheds, and Figure 3.1-1 in Chapter 3 shows their locations.

- Middle Potomac-Anacostia-Occoquan (HUC 02070010)
- Lower Potomac (HUC 02070011)
- Lower Rappahannock (HUC 02080104)
- Mattaponi (HUC 02080105)
- Pamunkey (HUC 02080106)
- Middle James-Willis (HUC 02080205)
- Lower James (HUC 02080206)

These watersheds represent the area within which there is potential for indirect and/or cumulative effects on waters and related resources (wetlands and floodplains) upstream and downstream of the study area. It also is a suitable area for consideration of the potential effects of habitat loss on the availability and connectivity of wildlife habitats.

Historic Properties

The study area for indirect and cumulative effects to historic properties is the same as the Section 106 APE for architectural and archaeological resources as defined in the historic properties analysis. The APE extends 500 feet on either side of the DC2RVA corridor center line in those areas where the proposed corridor would follow the existing rail line; however, in town or urban settings, the APE is reduced to one city block because dense modern development would often limit the effect of the proposed rail Project on historic resources. The APE was expanded to 1,000 feet in areas where DRPT recommends highway-rail grade separations and also expanded as needed in areas of new roadways to capture potential viewshed impacts (areas where alterations to a resource's setting and feeling could occur). This APE was approved by DHR in March 2015.

Direction and goals pertain to past trends and future expectations regarding social, economic, natural resource, and historic property conditions. Past actions regarding land use and development, including exploitation of natural resources, are reflected in the current conditions of the environment, as described in Chapter 3. Future conditions depend in part on the policies and planning activities of local and regional planners with respect to land use types and densities. Local comprehensive plans generally contain sections regarding visions or goals for desired patterns of development, as well as protection and preservation of sensitive environmental resources. Evidence indicates that transportation investments result in land use changes only in the presence of other factors. These factors include supportive local land use policies, local development incentives, availability of developable land, and a favorable investment climate (TRB, 2002). An understanding of local goals, combined with knowledge of demographic, economic, and social trends, contributes to understanding the potential for Project-influenced changes. Moreover, understanding goals permits consideration of the extent to which potential indirect effects align with those goals as a partial determinant of impact significance and an indicator of effects that merit further analysis. In Chapter 3, Section 3.11.3.2, Status of Local Planning/Development Trends, provides an overview of direction and goals.

4.20.1.3 Step 3: Inventory Notable Features in the Study Area

The objective of this step is to identify specific environmental issues within the indirect effects study areas against which the Project may be assessed. This is accomplished through conducting an inventory of notable features for each resource of concern. Notable features include specific valued, vulnerable, or unique elements of the environment. More-specific information regarding notable features for each resource is provided throughout Chapter 3, Affected Environment.

4.20.1.4 Step 4: Identify Impact-Causing Activities of the Proposed Alternatives

Step 4 identifies the impact-causing activities of the Project so that they may be compared with the goals and trends identified in Step Two and the notable features identified in Step Three to assess whether a potential for indirect effects exists (Step Five). General types of Project impact-causing activities include earthwork for track and station construction (clearing, excavation, and filling), landscaping, erosion control, remediation, changes in travel patterns, and changes in access. These activities have been considered in the analysis of direct effects for each resource in this chapter. Direct effects that may result from the Project can potentially trigger indirect effects through encroachment and alteration of the environment farther in distance or time.

In addition to indirect effects that can be triggered by Project encroachment, indirect effects can also occur as a result of induced changes in land use patterns, population density, or growth rate that would otherwise not be expected without implementation of a proposed Project. General circumstances influencing the likelihood of induced development include:

- Extent and maturity of existing transportation infrastructure
- Accessibility
- Location attractiveness
- State of the regional economy
- Land availability and value
- Availability of utilities
- Area vacancy rates
- Local political/regulatory conditions
- Land use controls

For this Project, the potential for induced growth effects is focused on station locations. The existing railway passenger stations on the DC2RVA corridor require facilities and infrastructure improvements. The site preparation for station construction may include clearing and grubbing, grading for new or expanded platforms and trackage, utility service installation and relocations, and drainage installations. Other potential impact-causing activities at station locations may include provision of intermodal connectivity for local transit, pedestrian, and bicycle travel; passenger pickup and drop offs; parking as either parking decks or paved parking areas; and ancillary retail and other amenities. The relevant station locations are as listed previously in Step 2.

4.20.1.5 Step 5: Identify Indirect Effects for Analysis

The objective of this step is to assess whether notable features identified in Step 3 would be indirectly affected by the proposed alternatives, taking into consideration the impact-causing activities and direct effects in Step 4. The following subjects were determined to potentially experience indirect effects from the Build Alternatives and were thus selected to move forward to the analysis of indirect effects in Step 6:

- Socioeconomics and land use
- Parks and recreation areas
- Historic properties
- Water resources
- Floodplains
- Wildlife and habitat

4.20.1.6 Step 6: Analyze Indirect Effects and Evaluate Analysis Results

Socioeconomics and Land Use

Under the No Build Alternative, the population along or near the rail corridor is expected to continue to grow. The Washington/Northern Virginia, Fredericksburg, and Richmond urban areas would continue to function as hubs of residential and commercial activities. In-fill development and denser development would be expected in these areas. Less-developed lands between these hubs also would be expected to continue to experience development as people seek more space that is still within reasonable commuting distance of job opportunities.

All existing rail station locations are in urban and suburban locations where considerable development already exists; however, under the Build Alternatives, further intensification of development densities could occur at these locations in response to demand for residential space and commercial services in areas convenient to the stations, generally within a 0.5-mile radius from the station. Government agencies and other entities often prepare planning documents to anticipate and guide the form and density of such development. For example, Amtrak prepared a Master Plan for Washington, D.C.'s Union Station (Amtrak, 2012). The Master Plan provides for relieving existing and future passenger rail congestion and accommodating triple the current number of passengers and double the current number of trains (including the new SEHSR trains) within the existing station footprint. This would be accomplished by improving existing facilities and constructing new facilities under and over the existing facilities, including air rights development of retail, hotel, commercial, and residential spaces. Construction would be phased over a 15- to 20-year period. Phase 4 of the Master Plan provides further expanded tracks and platforms on a lower level and creation of a new Amtrak lower-level concourse, which would accommodate increased intercity passenger rail service south to Virginia and the Southeastern United States. Aside from the facilities that would specifically be built to serve increased intercity passenger rail services, it is difficult to determine specific increments of other types of development that could be attributed to actual implementation of the services. The variety of other passenger rail services at the station (e.g., Northeast Corridor [NEC], VRE, Metrorail), as well as the dense and dynamic existing and planned residential and commercial activities, also contribute to the overall development status of the station area and surrounding lands. Similarly, the City of Richmond's Downtown Master Plan (2009) calls for Main Street Station to be a multimodal transportation hub for downtown Richmond. Recent and ongoing construction at the Main Street Station is aimed at rehabilitating the condition of the facilities, furthering the multimodal functions of the station, and promoting retail and social activities within and around the station.

Other stations in the DC2RVA corridor that would be served by the additional intercity passenger trains may also experience some increment of increased development to take advantage of the transportation benefits provided; however, such development would be consistent with the urban or suburban patterns already existing and would be consistent with local land use planning and goals. Moreover, such development would only enhance the utilization and effectiveness of the passenger rail services.

Except for the Fredericksburg Bypass (Build Alternative 3C) and Ashland Bypass (Build Alternatives 5C and 5C–Ashcake), the Project involves improvements to an existing rail facility. As such, the Project would not divide or segment existing communities or interfere with community cohesion. Existing communities adjacent to the rail corridor are accustomed to the presence of the rail facility, the train traffic on it, and the noise and visual effects associated with it. However, in sections where parallel track would be added, the rail facility would be in incrementally closer proximity to residences and businesses, which may increase noise levels and/or remove visual buffers. It is possible that some residents or businesses may leave the area because of such increased proximity effects. It is also possible, however, that some people may be attracted to communities adjacent to the rail stations because of the improved travel times and access.

The Fredericksburg Bypass (Build Alternative 3C) would bisect residential development along two local roads (Thornton Rolling Road and Patriot Lane), which would adversely affect community cohesion by separating adjacent neighbors and introducing a rail line where one does not currently exist. The introduction of a rail line and rail traffic would alter the rural setting of the area and may make nearby lands less attractive for residential use. Likewise, the Ashland Bypass (Build Alternatives 5C or 5C–Ashcake) would cross rural lands designated in Hanover County's Comprehensive Plan for agricultural and forestry uses, including the locally designated Stanley Agricultural and Forestal District. In addition to displacing homes, this alternative would adversely affect community cohesion by separating adjacent neighbors and introducing a rail line where one does not currently exist. The introduction of a rail line and rail traffic would alter the rural setting of the area. The effects on community cohesion are mitigated, to some extent, through the provision of highway-rail grade at most of the roadways that cross the bypass alignments.

The Project could contribute positively to economic activity along the DC2RVA corridor in the short term by providing jobs during Project design and construction and in the long term by reducing congestion, improving intercity travel time and reliability, and improving accessibility to employment at other location within the region by rail.

Parks and Recreation Areas

Many publicly owned parks and recreation areas exist immediately adjacent to the rail corridor. The No Build Alternative would have no induced development effects on these properties. None of these properties are at station locations where new or modified access would be provided to accommodate intercity passenger rail services. Accordingly, none of the Build Alternatives would result in induced growth effects on parks or recreation areas; however, these properties could potentially experience encroachment-alteration indirect effects under the Build Alternatives due to ongoing proximity effects over time, such as air quality, noise, and visual impacts from the railroad and trains operating on it. However, these are expected to be minor and would not differ substantially from the No Build Alternative. There would be direct effects of the Project on publicly owned parks and recreational areas by one or more of the Build Alternatives (see Section 4.14 of this chapter). Land at up to six parks would be directly used by the Project. None of these impacts would affect park activities, and the amount of right-of-way required would generally be below 0.4 acre. The exception is at Long Bridge Park, where Build Alternative 1B would impact 1.45 acres. Impacts at the other parks would be temporary and would not result in incorporation of parkland into the railroad right-of-way. Noise levels under the Build Alternatives would generally be higher than existing noise levels or No Build Alternative noise levels; however, such noise levels would not rise to a level as to render the parklands unsuitable for their designated public recreational uses.

Historic Properties

The No Build Alternative would have no induced development effects on historic properties, except to the extent that station modifications are being planned and constructed to address other needs while also accommodating future increases in intercity passenger train services. For example, the City of Richmond's Main Street Station and Trainshed (NRHP and NHL) is currently undergoing renovations that include retrofitting, upgrading, and expanding existing platforms to accommodate more trains; replacing the roof of the train shed; restoring pedestrian and bicycle travel through the train shed between Franklin Street and the farmer's market; providing 80,000 square feet of retail space; and providing facilities and amenities to promote the site as an alternative transportation hub for transit, bicycles, and other alternative vehicles (City of Richmond Department of Economic & Community Development, 2016). These improvements also would support use of the station as a multimodal transportation hub for downtown Richmond (City of Richmond, 2009). While these improvements anticipate use of the station for both the Washington-to-Richmond and Richmond-to-Raleigh sections of the SEHSR corridor, additional improvements at the station would be needed to fully implement the increased intercity train services.

Several of the Build Alternatives could have induced development effects on historic properties based on the different stations associated with the alternatives:

- Build Alternative 2A in the Northern Virginia Area includes Alexandria Union Station (NRHP). Two other NRHP-listed historic properties are near the station – the George Washington National Masonic Memorial and the Rosemont Historic District. Although the Project involves no physical changes to the station, the increased train service could incrementally enhance the attractiveness of adjacent lands for more or denser development. However, the City of Alexandria's Master Plan sets goals of encouraging quality, high-density mixed-use development near the King Street Metro Station, which is adjacent to the Alexandria Union Station. The major proposed changes involve phasing out industrial uses and replacing them with higher-density mixed-use development and moderate density office spaces. Accordingly, any increment of development induced by the Project at this location would be fully consistent with local planning for land use. Evaluation of effects on historic properties at this location pursuant to Section 106 of the NHPA is not complete. FRA's preliminary conclusion is there will be no adverse effect, but this is subject to further consultation with DHR and the Section 106 consulting parties.
- Build Alternatives 3A, 3B, and 3C in the Fredericksburg Area involve the Fredericksburg Amtrak/VRE Station. The historic station building (potentially eligible for NRHP) is not actually used for the station but is occupied by a restaurant. Passengers use the nearby platforms that have canopies to provide some protection from the weather. The station building is within the Fredericksburg Historic District (NRHP), which straddles the rail corridor. The historic station building would not be physically impacted. Instead, the platforms would be widened and lengthened, a new station building would be constructed, and a parking garage would be constructed. A tunnel would be constructed to connect the new station building with the parking garage. The increased train service could incrementally enhance the attractiveness of adjacent lands for more or denser development; however, the City of Fredericksburg's Comprehensive Plan contains provisions aimed at protecting the city's historic properties while also allowing compatible development through building rehabilitation, infill on vacant parcels, and replacement of noncontributing resources (City of Fredericksburg, 2010). Evaluation of effects on historic properties pursuant to Section 106 of the NHPA is not complete. FRA's preliminary conclusion is there will be no adverse effect on the historic train station building and an adverse effect on the Fredericksburg Historic District under Build Alternatives 3A and 3B, but this is subject to further consultation with DHR and the Section 106 consulting parties.

- Build Alternatives 5B, 5B–Ashcake, and 5D–Ashcake through the town of Ashland would involve the Ashland Station Depot. Although the building is no longer used as a station (with its interior turned over for other purposes), it is potentially eligible for NRHP. Increased train service at this station under Build Alternatives 5A, 5B, and 5D could incrementally enhance the attractiveness of adjacent lands for more or denser development. Evaluation of effects on the historic station for these alternatives pursuant to Section 106 of the NHPA is not complete. FRA's preliminary conclusion is there will be an adverse effect under Build Alternatives 5B, 5B–Ashcake, and 5D–Ashcake, but this is subject to further consultation with DHR and the Section 106 consulting parties.
- The Build Alternatives that use the S-Line between Main Street Station and Centralia (Build Alternatives 6B–S-Line, 6D, 6F, and 6G) and one of the Build Alternatives that uses the A-Line between Acca Yard and Centralia (Build Alternative 6E) would involve the Main Street Station (NRHP and NHL) in downtown Richmond. Increased train service at this station could incrementally enhance the attractiveness of adjacent lands for more or denser development; however, development around the station is relatively dense, and ongoing planning and construction at the station are taking into account more intensive utilization of the station and its environs as a multimodal transportation hub, increased commercial uses, and increased social activities. Evaluation of effects on the historic station for these alternatives pursuant to Section 106 of the NHPA is not complete. FRA's preliminary conclusion is there will be no adverse effect under Build Alternatives 6B–S-Line and 6E and an adverse effect under Build Alternatives 6D, 6F, and 6G. Build Alternatives 6A, 6B–A-Line, and 6C would involve disuse of the Main Street Station, which would be an adverse effect. This preliminary conclusion is subject to further consultation with DHR and the Section 106 consulting parties.

DRPT does not expect either the No Build Alternative or the Build Alternatives to have notable indirect encroachment-alteration effects on historic properties.

Water Resources

The No Build Alternative would have no induced development effects on water resources. The Build Alternatives may have incremental induced development effects on water resources near station areas; however, given the urban and suburban locations of these stations, land cover is relatively impervious, and the potential for increased runoff and diminished water quality is less than it would be if the induced development were to occur in more naturalized land cover types (e.g., forest).

Under the No Build Alternative, stormwater runoff from the existing rail and station facilities would continue to transport sediments and roadway contaminants to local water bodies, including impaired streams.

All the Build Alternatives involve direct loss of streams and wetlands as a result of track additions and modification, with the exception of Build Alternatives 1A, 1B, and 1C where there would be no stream impacts. Potential temporary indirect impacts of the Build Alternatives during Project construction include increased downstream sedimentation and turbidity from in-stream work, and possible spills or non-point source pollutants entering groundwater or surface water from storm runoff. Each Build Alternative would incrementally increase the amount of impervious surface, resulting in increased stormwater runoff flows from affected surfaces. If untreated, increased flows would incrementally increase the transport of sediments and roadway contaminants to streams crossed by or adjacent to the rail corridor. These pollutants can then be transported farther downstream and into wetland areas. Pollutant levels in runoff and the extent of downstream impacts are very difficult to quantify because there are many variables surrounding land use and stream dynamics. Given that a meaningful projection of the extent of pollutant loads from each alternative cannot be made without extensive analysis, the best predictor of relative degree of impacts would then be the amount of increase in impervious surfaces and the number of stream crossings for each alternative. Specific quantities of additional impervious surfaces for each Build Alternative are not yet known, but they are expected to be similar among the alternatives given the substantial overlap of the alternatives.

Floodplains

The No Build Alternative would have no induced development effects on floodplains. Likewise, the Build Alternatives would not have induced development impacts on floodplains because none of the locations where induced development might occur are in floodplains. With respect to encroachment-alteration indirect effects, the existing rail tracks displaced 100-year floodplains by placing bridges and culverts at stream crossings within the floodplains. The Build Alternatives would require new or modified bridges and extensions of culverts, which could potentially cause indirect effects with respect to changes in flood flow elevations and changes in floodplain configurations. While floodplain encroachments are likely, Project design under any of the alternatives would be consistent with federal policies and procedures for the location and hydraulic design of encroachments on floodplains. Therefore, DRPT does not expect that the Project would cause notable increases in flood levels, increase the probability of flooding, or increase the potential for property loss and hazard to life. Furthermore, the Project would not be expected to have substantial indirect effects on natural and beneficial floodplain values.

Wildlife and Habitat

The No Build Alternative would have no induced development effects on wildlife and habitat. DRPT does not expect the Build Alternatives to have notable induced development impacts on wildlife and habitat because all locations of potential induced development are in urban and suburban areas where available natural habitat is very limited. With respect to encroachment-alteration indirect effects of the Build Alternatives, wildlife habitat along the rail corridor is highly variable. In some areas, development has entirely displaced or at least fragmented forested habitat. In other areas, sizable blocks of forested habitat remain, though in many cases it is fragmented by agricultural activities. While the No Build Alternative would not result in further fragmentation of wildlife habitats due to rail construction, present and planned future development and transportation projects would continue to reduce habitat areas. Under the No Build Alternative, wildlife that occupies habitats adjacent to the rail corridor would continue to experience disturbance from noise, habitat degradation from soil erosion and sedimentation, introduction of invasive plants, and risk of collision with vehicles and trains. Stream hydrology and water quality within aquatic habitats downstream of the rail corridor are currently affected by erosive stormwater velocities and transport of sediment and roadway contaminants in stormwater runoff. The Build Alternatives may incrementally increase ongoing habitat impacts due to expansion of the rail facilities. Adjacent habitats would be further fragmented by removal of habitat for construction of the proposed improvements. Such habitat disturbances and losses could incrementally increase competition for resources in diminished habitats by displaced populations.

The indirect impacts to water quality discussed earlier would potentially affect habitat quality for aquatic species living in streams and wetlands downstream of the rail corridor. Sediments and pollutants in runoff may contribute to changes in macrobenthic community structure and composition, affecting fish and amphibian populations that rely on them as a food source, as well as birds and mammals higher on the food chain.

4.20.1.7 Step 7: Assess Consequences and Develop Mitigation

Various indirect effects for the Project are identified in Step 6. While planning judgment allows the identification of potential indirect effects, insufficient data exist to fully assess the consequences of these indirect effects. For example, while it is reasonable to predict that direct impacts to water quality may occur at stream crossings by the railroad, there is not enough information to determine how far downstream such impacts would persist. Despite the lack of detailed data, DRPT expects that the consequences of the indirect effects would be limited because:

- The proposed improvements would modify an existing rail facility within which the locations of potential induced development are limited to station areas where development already is prevalent.
- Any induced development that may occur would be largely compatible with existing development and would actually be desirable in the context of promoting more compact development patterns consistent with rail mass transit, multimodal transportation hubs, and facilitation of intercity travel that does not rely on the automobile.
- Any induced development would be consistent with local planning goals and land use plans.
- The narrow linear nature of the Project presents a limited footprint of direct impacts and, therefore, a limited potential for expansive indirect impacts attributable to encroachment and alteration.
- Impacts of the Project can be minimized and mitigated in many ways, including:
  - Implementation of temporary and permanent stormwater management features and erosion and sediment controls.
  - Compensation for unavoidable stream and wetland impacts.
  - Resolution of adverse effects on historic properties through design changes and other measures developed in consultation with DHR and other Section 106 consulting parties.

4.20.2 Cumulative Effects

Cumulative effects are defined as the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time. The cumulative effects analysis uses a five-part evaluation process based on FHWA guidance:

1. What is the geographic area affected by the Project?
2. What are the resources affected by the Project?
3. What are the other past, present, and reasonably foreseeable actions that have impacted these resources?
4. What were those impacts?
5. What is the overall impact on these various resources from the accumulation of the actions?

4.20.2.1 Geographic Area and Time Span

The geographic limits of the resource-specific study areas used for the cumulative effects analysis are the same as those used for the indirect effects analysis. The time span for the analysis is from the mid-1950s (when highways and automobile use were rapidly expanding and rail passenger travel was declining) to 2045, which is the design year for the Project (the horizon year for traffic analysis and Project design). Notwithstanding, a general synopsis of human activities before the mid-1950s is provided as background.

4.20.2.2 Affected Resources

The resources that would potentially experience cumulative effects are the same as those that would experience direct and/or indirect effects.

4.20.2.3 Past, Present, and Reasonably Foreseeable Actions

Past Actions

General Past Development. The current condition of the affected environment reflects the impacts of thousands of years of prehistoric occupations and four centuries of historic occupation. In the Northern Virginia, Fredericksburg, and Richmond portions of the DC2RVA corridor, many of the past actions that have broadly contributed to the baseline for this analysis occurred as part of a general development progression advancing from subsistence hunting and gathering to agricultural uses to increasingly dense urban/suburban occupations. This incremental land use intensification in portions of the DC2RVA corridor has contributed to increased benefits to society from expanding communities with growing employment and increasing standards of living, but also a decline in natural resource conditions. Other portions of the DC2RVA corridor remain largely in agricultural or rural residential uses, with a correspondingly greater portion of remaining natural resources. These stages of progressively more intensive utilization of the environment by humans encompass a multitude of past actions that cannot be reasonably enumerated; however, the cumulative impact of these actions is represented in the current state or condition of environmental resources.

Existing Rail. In 1834, RF&P was formed, connecting Richmond to Washington, D.C. via Fredericksburg. The railroad served as a bridge line between other railroads to the north and south to facilitate movement of freight and passengers. Its strategic location allowed it to connect with virtually every major northeastern and southeastern railroad. By the 1930s, the line was accommodating many passenger rail services, including extensive long-distance interstate travel between New York and Florida. During the 1960s through the 1980s, several railroads merged and consolidated, and RF&P eventually became part of CSXT. Rail passenger travel declined through the 1960s and 1970s as the interstate highway system made automobile travel more convenient, and air travel diverted most long-distance travelers. In 1971, Amtrak took over passenger services on the RF&P line. As highways became more congested, rail travel again became attractive, particularly in urban areas such as Northern Virginia. Establishment of VRE in 1992 provided a new alternative to commuting on congested highways between Fredericksburg and Washington, D.C. Amtrak trains using the line include regional services connecting to the NEC services that run from Washington to New York and Boston, as well as some long-distance service. Amtrak has expanded service in the corridor since 1992, adding Northeast Regional (Virginia) and Interstate Corridor (Carolinian) trains.

Road Development. The 1918 Virginia General Assembly approved establishment of the first state highway system, a network of 4,002 miles for which construction and maintenance would be the direct responsibility of the highway commissioner and his staff. Among the roads to be included was the Richmond-Washington Highway, the predecessor of U.S. Route 1 and I-95. A fully paved Route 1 was not completed until 1927 (VDOT, 2006).

In the *Federal Aid Highway Act of 1944,* Congress called for designation of a national system of interstate highways that was "so located as to connect by routes, as direct as practicable, the principal metropolitan areas, cities, and industrial centers, to serve the national defense, and to connect at suitable border points with routes of continental importance." However, it was not until passage of the *Federal-Aid Highway Act of 1956* that enough funding was provided for development of the system. In Virginia, early emphasis was on the I-95 corridor because it was to parallel U.S. Route 1, which by the mid-1950s had become the most heavily traveled through road in Virginia and one of the nation's busiest highways. I-95 had lower crash rates than conventional roads; reduced travel times; stimulated commercial, industrial, and residential growth; and provided broader tax bases for local governments related to the associated economic development (VDOT, 2006).

Development of an arterial network to supplement the interstate system was authorized by the 1964 Virginia General Assembly.

Present and Reasonably Foreseeable Future Actions

As described in Chapter 1, Purpose and Need, population in the DC2RVA corridor and adjacent urban regions continues to grow, increasing demand for reliable and safe travel options. With population growth comes increased development, consumption, and freight movement. Construction of homes, businesses, community facilities, and supporting infrastructure will continue into the future throughout the DC2RVA corridor; however, those developments are too numerous and unspecific to enumerate here. Illustrative of the types of infrastructure other than transportation facilities needed to support ongoing development is a 340-megawatt electrical power generating plant at Doswell approved by the State Corporation Commission (SCC) (SCC, 2016). Section 3.11.3.2 outlines expected future land use and planned growth and development as envisioned by local jurisdictions and regional planning organizations.

The following rail and transit projects have been identified within the indirect and cumulative effects study area.

- Washington Union Station Capacity upgrade
- Virginia Avenue Tunnel expansion (under construction)
- VRE 4th Track: CP Virginia – Long Bridge
- Long Bridge Project
- RF&P Franconia-Featherstone improvements (CSXT "Fast Track agreement")
- RF&P Powells Creek – Arkendale improvements
- Main Line Relocation Project at Acca Yard and Crossovers South of the James River
- Richmond-Petersburg section improvements for service expansion to Norfolk
- DC2RVA Franconia – Occoquan Improvements
- VRE Broad Run/Crossroads Yard expansion

- VRE Gainesville/Haymarket Extension
- VRE Station Platform Expansion Program
- VRE Potomac Shores Station
- GRTC Pulse Bus Rapid Transit (BRT) Implementation (The Pulse BRT)
- WMATA Silver Line Phase II Implementation (under construction)
- Crystal City BRT/Streetcar Corridor

The *Financially Constrained Long-Range Transportation Plan* for the National Capital Region contains projects to add nearly 1,200 new lane miles of roadway throughout the Washington Metropolitan Area. Notable projects in the Virginia portion of the region include the following:

- I-395 express lanes between the Capital Beltway and the Pentagon
- I-66 corridor improvements from U.S. 15 to Capital Beltway
- I-66 express lanes inside the beltway
- I-66 eastbound widening inside the Beltway
- U.S. 1, Richmond Highway BRT
- U.S. 1 widening

The *2040 Long Range Transportation Plan* for the Fredericksburg region contains 37 projects to increase roadway capacity, replace or expand aging bridges, enhance safety and operations, improve intersections, increase commuter parking options, and provide enhanced accommodations for bicyclists and pedestrians. Notable projects include:

- Extension of I-95 express lanes
- Reconstruction of I-95/Route 630 interchange at Stafford
- Replacement of Falmouth bridge on U.S. 1
- Widening of U.S. 17 in Spotsylvania and Stafford counties

The Richmond Regional Transportation Planning Organization's draft *Plan 2040* includes many highway improvement projects on I-95, I-295, I-64, US 1, US 301, and others.

4.20.2.4 Impacts

Socioeconomics and Land Use

Impact from Proposed Project. Except for the Fredericksburg Bypass (Build Alternative 3C) and the Ashland Bypass (Build Alternatives 5C and 5C–Ashcake), the land use and relocations impacts are relatively modest compared to the length of the Project. Including the bypass alternatives, the total number of residential relocations would range from approximately 10 to 150, depending on the specific combination of alternatives within each area. Of the larger number, just over 40 would be within the 2 bypass sections. The lower number reflects the ability to contain much of the Build Alternative improvements within the existing rail corridor for large portions of its length. Acquisition of properties and relocations of families, businesses, farms, and nonprofit organizations would occur in accordance with standards of the *Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970* (as amended, 1987). Any individual displaced as a result of the acquisition of real property, in whole or in part, would be eligible to receive reimbursement for the fair market value of the property acquired, as well as moving costs. Displaced property owners would be provided relocation assistance and advisory services together with the assurance of the availability of decent, safe, and sanitary housing. Relocation resources would be made available to all relocatees without discrimination.

The Build Alternatives would reduce congestion and improve travel time and reliability within the rail corridor. These improvements to mobility would generally contribute positively to the quality of life for local communities and support the anticipated continued economic growth; however, the two sections of potential bypasses would convert lands largely in rural residential and agricultural uses to transportation use. These conversions would be inconsistent with local comprehensive plans and would result in some divisions of rural communities. Notwithstanding, the bypasses still would provide transportation benefits and would incrementally decrease some impacts along sections of the existing rail line through the City of Fredericksburg and the Town of Ashland.

The Build Alternatives could induce more or denser development at station locations as a result of the improved transportation services; however, such development generally would be desirable to enhance the effectiveness of passenger rail services. Furthermore, because the station locations are in already urbanized areas, such development would be consistent with local plans, policies, and goals.

Impacts from Past and Present Actions. Past and present actions have changed the landscape dramatically and have resulted in the conversion of forest land to agricultural lands to residential, commercial, and industrial land uses as the populations and economies of localities along the DC2RVA corridor grew. It is presumed that in prehistoric times forests once covered the entirety of the area surrounding the rail corridor. Those forests were displaced by agriculture and development long before modern times. Therefore, tree cover that exists today is due to multiple regenerations of tree growth. Agriculture, particularly tobacco farming, depleted the soil, and much of the soil that was not depleted washed away due to erosion of unprotected soil surfaces. Livestock waste contributed to water pollution. By the mid-1950s, development accelerated sharply in Northern Virginia, largely as a result of a growing federal government sector and post-World War II prosperity. Housing booms in counties bordering Washington D.C. were fed by postwar affluence and the desire of people to own their own homes and land. The *Interstate Highway Act* authorized construction of high speed roads that made living farther from work a possibility. By the time I-95 was completed between Richmond and Washington, D.C., several residential subdivisions had already been built in jurisdictions along the DC2RVA corridor. In recent times, the City of Fredericksburg and portions of the surrounding Stafford and Spotsylvania counties have become bedroom communities to the metropolitan Washington region, as well as becoming economic activity centers themselves. The City of Richmond and surrounding counties collectively have become the third largest metropolitan area in Virginia ranked by population. The urbanization of these areas has created neighborhoods, facilitated social interaction, provided business and employment opportunities, facilitated economies of scale in community services such as education and public safety, and provided connectivity through robust multimodal transportation systems.

Potential Impact on Resources from Potential Future Actions. Under the No Build Alternative, the socioeconomic and land use impacts of the Build Alternatives would not occur and would not contribute to overall cumulative impacts. The foreseeable future projects noted above may have various socioeconomic and land use impacts throughout the study area; however, there is not enough information to reasonably quantify them. The foreseeable transportation projects listed above are all along existing transportation facilities. As such, disruptive socioeconomic and land use effects could be largely limited by containing construction within existing rights-of-way to the extent possible. Furthermore, these projects also would be subject to NEPA and other regulatory processes that are designed to help avoid substantial impacts to communities. Future projects also would be guided by local comprehensive plans, which identify areas for compatible planned growth while accommodating future planned transportation improvements.

Cumulative Effect. Except for the Fredericksburg Bypass (Build Alternative 3C) and the Ashland Bypass (Build Alternatives 5C and 5C–Ashcake), the nature and magnitude of the direct and indirect effects among the Build Alternatives are very similar. While there are some differences in the extent of impacts associated with each alternative, these differences as well as the overall impacts are small in the context of the effects of past, present, and reasonably foreseeable future actions. Build Alternatives 3C, 5C, and 5C–Ashcake would have greater socioeconomic and land use impacts than the other Build Alternatives. Nevertheless, at a corridor-wide scale, these impacts are relatively small; however, at local scales, these impacts would be felt more acutely.

Parks and Recreation Areas

Impact from Proposed Project. There would be direct effects of the Project on publicly owned parks and recreational areas by one or more of the Build Alternatives (see Section 4.14 of this chapter). Land at up to six parks would be directly used by the Project. None of these impacts would affect park activities, and the amount of right-of-way required would generally be below 0.4 acre. The exception is at Long Bridge Park, where Build Alternative 1B would impact 1.45 acres. Impacts at the other parks would be temporary and would not result in incorporation of parkland into the railroad right-of-way. Noise levels under the Build Alternatives would be higher than existing noise levels or No Build Alternative noise levels; however, such noise levels would not rise to a level as to render the parklands unsuitable for their designated public recreational uses.

Impacts from Past and Present Actions. Past actions have preserved notable acreages of land throughout the study area for conservation and recreational uses. At the same time, some past actions may have had direct physical encroachment impacts on some parks and recreation areas. Population increases and associated traffic increases may have caused higher levels of traffic noise within parks and placed greater wear and tear on park facilities due to greater use. Development adjacent to parks may have contributed to visual impacts to parks and increased volumes of stormwater flow to streams running through parks.

Potential Impact on Resources from Potential Future Actions. Under the No Build Alternative, the parks and recreation area impacts of the Build Alternatives would not occur and would not contribute to overall cumulative impacts to parks and recreation areas. Some of the foreseeable future projects noted above may have various park and recreational area impacts throughout the study area; however, there is not enough information to reasonably quantify them. Notwithstanding, the projects that would be subject to federal transportation agency approvals also would be subject to Section 4(f) provisions that require avoidance and minimization of uses of land from publicly owned public parks and recreation areas.

Cumulative Effect. The Build Alternatives would have only minor impacts to parks and recreation areas. Additionally, the legal protections afforded parks and recreation areas by Section 4(f) for federal-aid transportation projects and the plan review processes by local jurisdictions for other projects greatly limit the potential for impacts by future projects.

Accordingly, no substantial adverse cumulative impacts to parks and recreation areas by the Project are anticipated.

Historic Properties

Impact from Proposed Project. The APE encompasses 158 historic properties. A preliminary determination of effects has concluded that 33 historic properties could experience adverse effects from 1 or more of the alternatives, as outlined in Section 4.13. A formal effects determination would be coordinated with DHR once a recommended Preferred Alternative is selected. Where FRA determines that the Project will have an adverse effect on historic resources, Section 106 requires that efforts be undertaken to avoid, minimize, or mitigate the adverse effects. As part of this process, FRA and DRPT have initiated consultation with DHR and other "consulting parties," such as the National Park Service (NPS), local historical societies, and property owners. Due to the nature of the this Project, a Programmatic Agreement (PA) is underway to outline: (1) studies still required once a recommended Preferred Alternative has been selected (namely, additional Phase I and Phase II archaeological studies on the main corridor and road improvement areas and full cultural resource studies on the bypasses, if selected); and (2) tasks that would be undertaken to mitigate adverse effects.

Impacts from Past and Present Actions. Damage to or loss of historic resources was far more prevalent from past actions that occurred before the NHPA. The NHPA and the establishment of historic resource protection objectives at the local planning level have reduced the rate of impacts to historic resources.

Potential Impact on Resources from Potential Future Actions. Notwithstanding the protections now afforded, conflicts between protection of historic properties and development and transportation projects are expected to continue under the No Build Alternative, especially because non-federal actions, such as private developments, are not subject to the NHPA. Potential effects include permanent loss and proximity effects (noise and visual impacts) from present and planned future development and transportation projects.

Cumulative Effect. The Build Alternatives would adversely affect historic properties and contribute to the cumulative degradation of historic properties. However, feasible and prudent avoidance alternatives and measures to minimize harm to historic properties would be incorporated into the Project.

Water Resources

Impact from Proposed Project. The Project corridor crosses more than 350 rivers and streams, 51 of which are characterized as impaired on Virginia's Section 303(d) list (see Section 3.1.6 in Chapter 3, Affected Environment, for details). As shown in Figure 3.1-1, the following boundaries of watersheds are crossed by the Project:

- The Middle Potomac-Anacostia-Occoquan Watershed encompasses approximately 831,483 acres, with roughly 45 percent of the watershed forested.
- The Lower Potomac River Watershed encompasses approximately 1,160,160 acres, most of which is forested.
- The Pamunkey Watershed encompasses approximately 941,032 acres, most of which is forested.
- The Lower Rappahannock Watershed encompasses approximately 738,446 acres. Half of the area is forested, with the remainder consisting largely of agricultural and developed land.

- The Mattaponi Watershed encompasses approximately 582,426 acres of which approximately 70 percent is forested.
- The Middle James-Willis Watershed encompasses approximately 615,449 acres.
- The Lower James Watershed encompasses approximately 1,135,000 acres, approximately 48 percent of which is in urban and suburban uses.

Details on the impacts of the alternatives are provided in Section 4.1. Unavoidable impacts to streams and wetlands would be mitigated.

Impacts from Past and Present Actions. Past and present actions within the affected watersheds have impacted an unknown quantity of streams and wetlands; however, the water quality effects of these actions are reflected in impairment designations and establishment of TMDLs of pollutants in certain waters, including the Chesapeake Bay, into which most of the affected watersheds drain.

Potential Impact on Resources from Potential Future Actions. Under the No Build Alternative, the water resources impacts of the Build Alternatives would not occur and would not contribute to overall cumulative impacts; however, the other reasonably foreseeable projects noted earlier would have incremental effects on water resources. Before implementation, these projects would be required to undergo analysis of alternatives that avoid and minimize water resources impacts to the extent practicable, and project proponents would have to obtain any required permits. Compensatory mitigation of unavoidable impacts also would be required.

Cumulative Effect. While the impacts of the Project and the multiple other reasonably foreseeable transportation projects and other likely development would be additive, these impacts would not all be occurring simultaneously due to the phasing of construction over a period of years. Additionally, the impacts would be largely disbursed over many streams and multiple watersheds. Furthermore, the direct impact of the Project at each stream would be localized and the reach of the Project's indirect impacts is not expected to be extensive. Stormwater generated through new impervious surfaces would be treated through improved or new stormwater management facilities. Implementation of compensatory mitigation, both for the Project and other foreseeable actions would offset the adverse direct and indirect impacts. Moreover, local jurisdictions have established preservation and conservation programs that serve to improve water quality by protecting streams and controlling development. For example, Fairfax County's Environmental Quality Corridor (EQC) system protects the county's stream valleys by incorporating them into a system of connected parklands and trail systems. The EQC system provides buffer lands that separate streams from land uses and development activities that have the potential to degrade the ecological quality of streams (Fairfax County, 2013). Prince William County's Comprehensive Plan limits development within the designated "Rural Area" and includes various rural preservation goals and policies that serve to protect water quality through careful land use planning (Prince William County, 2008). Both counties also prepare watershed management plans or studies that assess, monitor, and evaluate water quality and identify priorities and BMPs for improving water quality. Other counties and cities encompassed by the watersheds have similar policies and programs in place to protect water resources.

Floodplains

Impact from Proposed Project. As noted in Section 4.1.1.2 of this chapter, none of the floodplain encroachments by the Build Alternatives would represent a significant encroachment. The Project would be designed to not encourage, induce, allow, serve, support, or otherwise facilitate incompatible base floodplain development.

Impacts from Past and Present Actions. The cumulative extent of impacts to floodplains from past and present actions is not known; however, it can be assumed that the degree of impacts was greater before federal initiatives to avoid and minimize floodplain impacts (e.g., EO 11988 in 1977). State and local initiatives also now protect floodplains and reduce floodplain encroachments by development (Virginia's *Chesapeake Bay Preservation Act* enabled localities to establish resource protection areas along streams draining to the Chesapeake Bay).

Potential Impact on Resources from Potential Future Actions. Under the No Build Alternative, the floodplain impacts of the Build Alternatives would not occur and would not contribute to overall cumulative impacts. Reasonably foreseeable future public or private actions could potentially impact floodplains; however, these actions would also be subject to federal and local floodplain protections that would minimize potential impacts.

Cumulative Effect. Because the floodplain encroachments by the Project do not represent significant encroachments, and because federal and local initiatives would continue to exert floodplain protections, adverse cumulative effects of the Project to floodplains are expected to be negligible.

Wildlife and Habitat

Impact from Proposed Project. Most of the habitat within the LOD for all Build Alternatives includes either developed lands or aquatic habitats. A limited amount of forested and other upland habitat would be disturbed by the Build Alternatives, with the exception of the Fredericksburg Bypass (Build Alternative 3C) and the Ashland Bypass (Build Alternatives 5C and 5C–Ashcake). Disturbance or loss of these upland habitats would not result in substantial impacts to wildlife due to the widespread availability of such habitats within the study area. In general, habitats that would be impacted are directly adjacent to the existing rail line and are already altered by local activities, including operation of the railroad.

Impacts from Past and Present Actions. As outlined above under cumulative socioeconomic and land use impacts, past and present actions have changed the landscape dramatically and converted natural habitats to human uses. These changes have resulted in considerable fragmentation and loss of habitat throughout the study area.

Potential Impact on Resources from Potential Future Actions. Under the No Build Alternative, the wildlife and habitat impacts of the Build Alternative would not occur and would not contribute to overall cumulative impacts; however, the other reasonably foreseeable actions noted above would be expected to contribute to further fragmentation and losses of habitat over time.

Cumulative Effect. Adverse effects on wildlife habitats are expected to continue to accrue with anticipated population growth in the study area, even in the absence of the Project. The relative contribution of the Build Alternatives to the effects of terrestrial and aquatic habitat losses is small given the existing fragmented condition of affected habitat areas along the existing rail corridor. The contribution of the Build Alternatives to degradation of water quality within aquatic habitats is also minimal given that the proposed improvements are being made to an existing rail facility and stormwater management measures would be implemented in accordance with federal, state, and local regulations to minimize onsite and downstream water quality impacts. Project proponents would be responsible for coordination with applicable federal and state agencies.

4.20.2.5 Overall Cumulative Effects

Overall, the No Build Alternative reflects the absence of the incremental direct and indirect impacts of the Build Alternatives relative to accumulation of adverse effects; however, adverse environmental effects, though offset to some degree by mitigation and compensation measures, would continue to accumulate due to ongoing implementation of other reasonably foreseeable projects and development in general. Furthermore, cities along the rail corridor would also not benefit from the transportation improvements that would accompany the Build Alternatives.

While providing transportation benefits, the Build Alternatives would incrementally increase environmental effects. Where these effects would occur along the existing rail corridor, they are relatively small in the context of the entire corridor as well as the localized impact sites. In contrast, impacts with the Fredericksburg Bypass (Build Alternative 3C) and the Ashland Bypass (Build Alternatives 5C and 5C–Ashcake) would be correspondingly greater because of the size of new right-of-way required; therefore, on a proportionate basis, these bypass alternatives would contribute more to cumulative effects than comparable lengths of corridor on existing rail alignment.

In summary, considerable adverse impacts to sensitive and vulnerable resources have occurred over time, first due to agricultural uses of the land and then to residential, commercial, industrial, institutional, and public infrastructure development; however, current regulatory requirements and planning practices are helping avoid or minimize the contribution of present and future actions to adverse cumulative effects. With the exception of the bypass alternatives, when considered in the context of the Project setting, the magnitude and intensity of the impacts of the Build Alternatives generally would not have substantial cumulative effects, particularly considering the efforts to minimize adverse impacts of the Project and other mitigation measures to be implemented. The Fredericksburg Bypass (Build Alternative 3C) and the Ashland Bypass (Build Alternatives 5C and 5C–Ashcake) may be perceived as having a more substantial cumulative effect, at least at the local level where the impacts would be most felt.

4.21 RELATIONSHIP BETWEEN SHORT-TERM IMPACTS AND LONG-TERM BENEFITS

This section addresses in general terms the proposed Project's relationship between local short-term impacts/use of resources and the maintenance and enhancement of long-term productivity. Build alternatives were developed based on sound planning for local, regional, and statewide transportation needs within the context of present and possible future traffic requirements and land use patterns. Coupled with the environmentally sensitive design of the proposed Project and BMPs, this helps to ensure that the short-term use of resources related to construction would be outweighed by the long-term benefits of implementing the proposed Project.

The most disruptive local short-term impacts associated with the Build Alternatives would occur during land acquisition and Project construction. The short-term use of the environment and of human, socioeconomic, cultural, and natural resources contributes to the long-term productivity of the DC2RVA corridor. Most short-term, construction-related impacts would occur within or near the proposed right-of-way.

Some existing homes, farms, and businesses would be displaced under the Build Alternatives; however, adequate replacement housing, land, and space are available for homeowners, tenants, and business owners. Residential displacements would range from approximately 10 to 150 over the entire DC2RVA corridor, with the highest number of displacements associated with the

Fredericksburg Bypass (Build Alternative 3C), the Ashland Bypass (Build Alternatives 5C and 5C–Ashcake), and the single-station alternative at Broad Street in Richmond (Build Alternative 6C). DRPT estimates that these alternatives would result in 21, 21, and 112 residential displacements, respectively. Business displacements would range from approximately 10 to 20 over the entire DC2RVA corridor and most would occur in Alternative Area 6 (Richmond). Improved access to intercity travel within the DC2RVA corridor would contribute to long-term residential and business growth.

Construction activities would create short-term air quality impacts, such as dust due to earthwork, road and rail improvements, and exhaust from construction vehicles. Short-term noise impacts would be unavoidable due to use of heavy equipment. Air and noise abatement measures, discussed in Sections 4.6 and 4.7, would be used to minimize these short-term impacts during construction. Short-term visual impacts would occur near the construction corridor. Mitigation measures, such as reducing slope cuts outside necessary road widths, reducing vegetation removal, leaving native vegetation screens in place, and minimizing the alteration of scenic viewsheds, would be used to reduce long-term visual resource impacts.

Implementation of BMPs for protection of surface waters would minimize potential water quality impacts. A short-term impact from construction would be removal of biotic communities and wildlife within the proposed right-of-way and construction staging areas Overall, the Build Alternatives would have minimal short-term impacts relative to the long-term benefits of increased intercity passenger rail service in the DC2RVA corridor, and the ultimate extension of the SEHSR corridor along the East Coast. The elimination of some of the existing at-grade rail crossings and construction of grade-separated crossings would also improve the safety of rail crossings and reduce roadway delay. Construction-related activities would be localized and temporary. Short-term gains to the local economy should be recognized as a result of hiring local firms and labor, as well as purchasing local services and supplies to construct the proposed Project. Once completed, the benefits of long-term productivity in terms of improved mobility and safety would be realized. Implementation of the Project would enhance the existing transportation network between Washington, D.C. and Richmond, VA, and provide a viable travel alternative for residents and users. This is consistent with the purpose of the proposed Project. Based on the significant contribution to the long-term objectives of regional and local plans for development, the proposed Project is consistent with the maintenance and enhancement of the long-term productivity at the local, regional, state, and national levels. Benefits of the Project are described in more detail in Chapter 1.

4.22 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Construction of one of the Build Alternatives would require certain irreversible and irretrievable commitments of natural resources, energy (which would include fossil fuels), manpower, materials, and fiscal resources. Because most of the Project would be constructed within existing railroad right-of-way, land acquisition for construction of the proposed Project would be minimized; however, there would be an irreversible conversion of land to a transportation use in areas of new alignment and in areas where the existing road network would be modified to accommodate rail crossing closures and consolidations and to avoid historic resources. If a greater need for the use of the land were to arise or if the transportation facility were no longer needed, it could be converted to another use. There is no reason to believe such a conversion would be necessary or desirable.

The acquisition of new right-of-way and new construction within the existing right-of-way may result in short-term and long-term losses and alterations to the natural resources in the area. Upland and aquatic biotic communities, as well as agricultural land, may be committed to rail service where new right-of-way is required. The most apparent impact may be loss of aquatic or terrestrial habitat productivity and connectivity; therefore, wildlife abundance may decline in the area as a result of habitat destruction. Increased noise associated with the Project may be intolerable to some wildlife species. Forested areas may be cleared in some locations, and wetlands and other surface waters may be filled to accommodate new bridges and underpasses. Riprap may be placed along stream banks at bridge crossings, reducing habitat within riparian zone. After construction, some habitat types may be restored within the construction limits, although their value to wildlife is unlikely to equate to that which was lost. If wetlands are filled for new construction, mitigation of impacts would likely involve restoration of degraded wetlands within the same watershed. In the long term, this would offset the loss of wetland habitats within the Project construction limits. The commitment of natural resources within existing and new right-of-way is a permanent loss of productive wildlife habitat.

Construction of the Fredericksburg Bypass (Build Alternative 3C) or the Ashland Bypass (Build Alternatives 5C and 5C–Ashcake) would also increase habitat fragmentation within the DC2RVA corridor. As described in Section 4.10, habitat fragmentation can increase the risk of predation or displacement of native species by invasive, exotic species. Loss of habitat, mortality due to collisions, barrier effect, and reduction in habitat quality are the main impacts of habitat fragmentation by railroads. On a local scale, trains may affect wildlife habitats through the introduction of exotic plant species (e.g., seeds), emission of toxic contaminants (e.g., heavy metals), or right-of-way management (e.g., herbicide application). Section-specific habitat fragmentation effects are discussed in Section 4.10. Fossil fuels, labor, and construction materials would be expended in the fabrication and preparation of construction materials, as well as during construction of the Project. While these materials are generally not retrievable, they are not in short supply, and their use would not have an adverse effect on the continued availability of these resources. The steel rails required for the Project could be recycled should an alternate use of the property be selected. Any construction would also require a substantial, one-time expenditure of state and federal funds, which are not retrievable and could be used instead on other projects within the local community or in other parts of the country.

Specific natural resource impacts for the Build Alternatives have been previously detailed in this chapter. When reviewed in the overall context of the Project and taken in total, they are proportionately small compared to the benefits of the Project.

4.23 SUMMARY OF IMPACTS

The following table (Table 4.23-1) provides a summary of the potential impacts of each of the Build Alternatives upon the built and natural environments. It is the intent of this table to summarize the key results that differentiate the Build Alternatives and assist in the decisions to be made. All impacts shown are permanent impacts (i.e., not temporary disturbances due to construction activities). Any "Change" shown is consistent with how that resource was evaluated in this chapter (i.e., "change" in the transportation resource compares 2025 Build Alternatives to 2025 No Build conditions; "change" in the air quality and energy resources compares 2045 Build Alternatives to 2045 No Build conditions).

As noted earlier in this chapter, DRPT uses two future planning years for analysis of the DC2RVA Project. Year 2025 is the current best estimate of when construction of the DC2RVA infrastructure could be completed and the new DC2RVA service would be placed in operation. All the physical impact analyses within this Draft EIS on human and natural resources are estimated for 2025, and compared to the No Build Alternative conditions projected for 2025. Year 2045 is used by DRPT to demonstrate that the proposed project is sufficient to deliver the proposed passenger rail benefits and an efficient and reliable multimodal rail corridor over a 20-year time horizon following the completion of the passenger project. DRPT also used the 2045 planning horizon date to estimate some of the longer term effects of the proposed service such as ridership, energy use, and effects on air quality, as well as indirect and cumulative effects.

Table 4.23-1: Summary of Impacts

					Natural Resources				Geologic Resources				Hazardous Materials				Air Quality
Area #	Area Name and CSXT Milepost Limits	Alternative	Description	Additional ROW (Acres)	Wetlands (Acres)	Floodplains (Acres)	Stream & River Crossings (linear feet)	Threatened & Endangered Species and Habitat	Construction-Limiting Soils	Prime Farmland: Prime Soils (Acres)	Prime Farmland: NRCS Form 106 Score (Points)	Agricultural & Forestal Districts (Acres)	Superfund / CERCLA Sites	Recorded Release & Potential Contamination Sites	HAZMAT Facilities	Petroleum Storage Tanks	CO_2 Emissions (Tons per Year) Change Compared to No Build
1	Arlington (Long Bridge Approach) CFP 110 – 109.3	1A	Add Two Tracks on the East	0.0	0.02	0.3	0	No	Unknown / Not Rated	0	0	0	0	0	0	0	n/a
		1B	Add Two Tracks on the West	1.5	0.00	0.1	0	No	Unknown / Not Rated	0	0	0	0	2	0	0	n/a
		1C	Add One Track East and One Track West	0.4	0.01	0.1	0	No	Unknown / Not Rated	0	0	0	0	2	0	0	n/a
2	Northern Virginia CFP 109.3 – 62	2A	Add One Track/Improve Existing Track	33.0	5.19	15.1	7, 198	Yes	Yes	53.56	66	0	0	12	2	1	n/a
3	Fredericksburg (Dahlgren Spur to Crossroads) CFP 62 – 48	3A	Maintain Two Tracks Through Town	2.2	5.24	7.7	1,101	Yes	Yes	26.84	80	0	1	7	0	0	n/a
		3B	Add One Track East of Existing	19.8	5.29	10.5	1,506	Yes	Yes	34.01	80	0	0	10	4	3	n/a
		3C	Add Two-Track Bypass East	140.5	23.82	8.0	4,597	Yes	Yes	69.05	118	0	0	11	1	1	n/a
4	Central Virginia (Crossroads to Doswell) CFP 48 – 19	4A	Add One Track/Improve Existing Track	2.4	8.39	17.2	3,627	Yes	Yes	99.17	93	0	1	0	0	0	n/a
5	Ashland (Doswell to I-295) CFP 19 – 9	5A	Maintain Two Tracks Through Town	21.9	0.41	5.9	6,928	Yes	Yes	27.18	51	0	0	5	0	1	n/a
		5A–Ashcake	Maintain Two Tracks Through Town (Relocate Station to Ashcake)	20.5	0.41	7.1	6,928	Yes	Yes	28.04	46	0	0	5	0	1	n/a
		5B	Add One Track East of Existing	29.4	0.41	6.5	9,114	Yes	Yes	31.2	51	0	0	5	1	3	n/a
		5B–Ashcake	Add One Track East of Existing (Relocate Station to Ashcake)	29.9	0.45	10.7	9,101	Yes	Yes	33.82	51	0	0	5	1	3	n/a
		5C	Add Two-Track West Bypass	147.8	8.44	9.2	9,005	Yes	Yes	89.83	171	73.7	0	5	0	2	n/a
		5C–Ashcake	Add Two-Track West Bypass (Relocate Station to Ashcake)	146.4	8.48	10.4	9,005	Yes	Yes	90.88	171	73.7	0	5	0	2	n/a
		5D–Ashcake	Three Tracks Centered Through Town (Add One Track, Relocate Station to Ashcake)	36.4	0.45	11.5	8,163	Yes	Yes	39.38	52	0	0	8	1	5	n/a
6	Richmond (I-295 to Centralia) CFP 9 – A 011	6A	Staples Mill Road Station Only	76.0	3.21	8.1	7,523	Yes	Yes	45.20	29	0	0	13	4	7	-6,696
		6B–A-Line	Boulevard Station Only, A-Line	101.0	2.91	11.3	9,650	Yes	Yes	49.04	23	0	0	23	4	14	-6,003
		6B–S-Line	Boulevard Station Only, S-Line	78.7	3.47	48.6	8,819	Yes	Yes	30.79	22	0	0	39	7	8	-6,003
		6C	Broad Street Station Only	128.1	2.99	16.1	10,886	Yes	Yes	49.93	22	0	0	27	6	16	-5,663
		6D	Main Street Station Only	73.7	3.47	51.9	8,819	Yes	Yes	30.93	22	0	1	40	6	6	-5,947
		6E	Split Service, Staples Mill Road/ Main Street Stations	89.1	3.31	22.2	7,952	Yes	Yes	45.20	24	0	1	17	6	7	-6,051
		6F	Full Service, Staples Mill Road/ Main Street Stations	83.0	3.52	50.7	8,869	Yes	Yes	31.78	19	0	1	38	6	5	-6,518
		6G	Shared Service, Staples Mill Road/ Main Street Stations	81.0	3.74	48.1	8,235	Yes	Yes	32.48	19	0	1	38	6	5	-6,869

Notes: All impacts shown are permanent impacts (i.e., not temporary disturbances due to construction activities). Any "Change" shown compares 2045 Build Alternatives to 2045 No Build conditions. Air Quality is analyzed corridor-wide with differences only related to the station alternatives in Richmond.

▶ *Continued*

Table 4.23-1: Summary of Impacts

Area #	Area Name and CSXT Milepost Limits	Alternative	Description	Noise							Vibration				Energy	Aesthetics & Visual Environment	Community & Environmental Justice			
				Impacted Noise Receptors							Impacted Vibration Receptors									
				Category 1 Moderate	Category 1 Severe	Category 2 Moderate	Category 2 Severe	Category 3 Moderate	Category 3 Severe	Total	Category 1	Category 2	Category 3	Total	Energy Consumption (Billions of BTUs) Change Compared to No Build	Visual Impact Rating (Low, Medium, or High)	Commercial Relocations	Residential Relocations	Compatible with Comprehensive Land Use Plans (Yes / No)	Environmental Justice Census Tracts with Residential Relocations
1	Arlington (Long Bridge Approach) CFP 110 – 109.3	1A	Add Two Tracks on the East	0	0	0	0	0	0	0	0	0	0	0	n/a	Low	0	0	Yes	0
		1B	Add Two Tracks on the West	0	0	0	0	0	0	0	0	0	0	0	n/a	Low	0	0	Yes	0
		1C	Add One Track East and One Track West	0	0	0	0	0	0	0	0	0	0	0	n/a	Low	0	0	Yes	0
2	Northern Virginia CFP 109.3 – 62	2A	Add One Track/Improve Existing Track	0	0	670	99	6	0	775	0	15	0	15	n/a	Low – Medium	0	2	Yes	0
3	Fredericksburg (Dahlgren Spur to Crossroads) CFP 62 – 48	3A	Maintain Two Tracks Through Town	0	0	66	8	1	0	75	0	0	0	0	n/a	Low	0	0	Yes	0
		3B	Add One Track East of Existing	0	0	67	8	1	0	76	0	0	0	0	n/a	High	1	0	Yes	0
		3C	Add Two-Track Bypass East	2	1	2392	1524	8	5	3932	0	43	0	43	n/a	High	1	19	No	2
4	Central Virginia (Crossroads to Doswell) CFP 48 – 19	4A	Add One Track/Improve Existing Track	0	0	51	18	1	0	70	0	2	0	2	n/a	Low	0	0	Yes	0
5	Ashland (Doswell to I-295) CFP 19 – 9	5A	Maintain Two Tracks Through Town	0	0	135	14	1	4	154	0	25	1	26	n/a	Medium	1	0	Yes	0
		5A–Ashcake	Maintain Two Tracks Through Town (Relocate Station to Ashcake)	0	0	135	14	1	4	154	0	25	1	26	n/a	Medium	1	0	Yes	0
		5B	Add One Track East of Existing	1	0	133	20	1	4	159	0	30	1	31	n/a	Medium	1	0	Yes	0
		5B–Ashcake	Add One Track East of Existing (Relocate Station to Ashcake)	1	0	133	20	1	4	159	0	30	1	31	n/a	Medium	1	0	Yes	0
		5C	Add Two-Track West Bypass	0	0	272	51	2	4	329	0	35	1	36	n/a	High	1	21	No	1
		5C–Ashcake	Add Two-Track West Bypass (Relocate Station to Ashcake)	0	0	272	51	2	4	329	0	35	1	36	n/a	High	1	21	No	1
		5D–Ashcake	Three Tracks Centered Through Town (Add One Track, Relocate Station to Ashcake)	1	0	135	18	1	4	159	0	30	1	31	n/a	Medium	1	0	Yes	0
6	Richmond (I-295 to Centralia) CFP 9 – A 011	6A	Staples Mill Road Station Only	0	0	366	8	6	0	380	0	8	0	8	-307	Low – Medium	10	12	Yes	2
		6B–A-Line	Boulevard Station Only, A-Line	0	0	386	9	6	0	401	0	8	0	8	-277	Low – High	18	12	Yes	2
		6B–S-Line	Boulevard Station Only, S-Line	1	0	416	15	7	0	439	0	8	0	8	-277	Low – High	10	7	Yes	0
		6C	Broad Street Station Only	0	0	387	9	7	0	403	0	8	0	8	-265	Low – High	15	112	Yes	3
		6D	Main Street Station Only	1	0	416	15	7	0	439	0	8	0	8	-280	Low – High	10	7	Yes	0
		6E	Split Service, Staples Mill Road/ Main Street Stations	0	0	379	9	6	0	394	0	8	0	8	-286	Low – High	10	12	Yes	2
		6F	Full Service, Staples Mill Road/ Main Street Stations	1	0	416	15	7	0	439	0	8	0	8	-293	Low – High	10	7	Yes	0
		6G	Shared Service, Staples Mill Road/ Main Street Stations	1	0	298	10	4	0	313	0	8	0	8	-299	Low – High	10	7	Yes	0

Notes: All impacts shown are permanent impacts (i.e., not temporary disturbances due to construction activities). Any "Change" shown compares 2045 Build Alternatives to 2045 No Build conditions. Noise and Vibration categories defined in Section 4.7. Energy is analyzed corridor-wide with differences only related to the station alternatives in Richmond.

▸ *Continued*

Table 4.23-1: Summary of Impacts

Area #	Area Name and CSXT Milepost Limits	Alternative	Description	Park Resources	Cultural Resources								
					Effects on Archaeological Sites			Effects on Buildings, Districts, Structures, & Objects			Effects on Battlefields		
				Number / Acres	Adverse Effect	No Adverse Effect	No Effect	Adverse Effect	No Adverse Effect	No Effect	Adverse Effect	No Adverse Effect	No Effect
1	Arlington (Long Bridge Approach) CFP 110 – 109.3	1A	Add Two Tracks on the East	0 / 0	0	0	0	1	2	0	0	0	0
		1B	Add Two Tracks on the West	1 / 1.45	0	0	0	1	2	0	0	0	0
		1C	Add One Track East and One Track West	1 / 0.36	0	0	0	1	2	0	0	0	0
2	Northern Virginia CFP 109.3 – 62	2A	Add One Track/Improve Existing Track	1 / 0.04	0	0	0	1	10	4	0	0	0
3	Fredericksburg (Dahlgren Spur to Crossroads) CFP 62 – 48	3A	Maintain Two Tracks Through Town	0 / 0	0	0	3	1	0	15	0	0	3
		3B	Add One Track East of Existing	0 / 0	1	1	1	4	11	1	0	3	0
		3C	Add Two-Track Bypass East	0 / 0	0	1	0	1	5	0	0	0	0
4	Central Virginia (Crossroads to Doswell) CFP 48 – 19	4A	Add One Track/Improve Existing Track	0 / 0	0	0	0	3	12	4	0	1	0
5	Ashland (Doswell to I-295) CFP 19 – 9	5A	Maintain Two Tracks Through Town	0 / 0	0	0	0	0	0	0	0	0	0
		5A–Ashcake	Maintain Two Tracks Through Town (Relocate Station to Ashcake)	1 / 0.01	0	0	0	0	3	16	0	0	0
		5B	Add One Track East of Existing	1 / 0.03	0	0	0	7	10	2	0	0	0
		5B–Ashcake	Add One Track East of Existing (Relocate Station to Ashcake)	2 / 0.04	0	0	0	7	10	2	0	0	0
		5C	Add Two-Track West Bypass	0 / 0	0	0	0	1	4	2	0	0	0
		5C–Ashcake	Add Two-Track West Bypass (Relocate Station to Ashcake)	1/ 0.01	0	0	0	1	4	2	0	0	0
		5D–Ashcake	Three Tracks Centered Through Town (Add One Track, Relocate Station to Ashcake)	1 / 0.01	0	0	0	7	10	2	0	0	0
6	Richmond (I-295 to Centralia) CFP 9 – A 011	6A	Staples Mill Road Station Only	1 / 0.19	0	5	4	8	50	11	0	4	2
		6B–A-Line	Boulevard Station Only, A-Line	1 / 0.19	0	5	4	16	42	11	0	4	2
		6B–S-Line	Boulevard Station Only, S-Line	1 / 0.17	3	4	2	13	45	11	0	6	0
		6C	Broad Street Station Only	1 / 0.19	0	5	4	16	42	11	0	4	2
		6D	Main Street Station Only	1 / 0.17	3	4	2	7	52	10	0	6	0
		6E	Split Service, Staples Mill Road/ Main Street Stations	1 / 0.19	0	7	2	7	60	2	0	6	0
		6F	Full Service, Staples Mill Road/ Main Street Stations	1 / 0.17	3	4	2	7	52	10	0	6	0
		6G	Shared Service, Staples Mill Road/ Main Street Stations	1 / 0.17	3	4	2	10	57	2	0	6	0

Notes: All impacts shown are permanent impacts (i.e., not temporary disturbances due to construction activities).

► *Continued*

Table 4.23-1: Summary of Impacts

Area #	Area Name and CSXT Milepost Limits	Alternative	Description	Transportation												
				Proposed Crossing Improvements: Public At-Grade Crossings					New Public Crossings	Proposed Crossing Improvements: Private At-Grade Crossings				New Private Crossings	Roadway Travel Patterns: % Change in Daily Traffic, Adjacent Roadways at Stations	At-Grade Crossings: Total Daily Delay, % Change
				Grade Separate	Closure	Four-Quad Gates	Median Treatment	No Action		Closure	Four-Quad Gates	Locking Gate	No Action			
1	Arlington (Long Bridge Approach) CFP 110 – 109.3	1A	Add Two Tracks on the East	0	0	0	0	0	0	0	0	0	0	0	n/a	n/a
		1B	Add Two Tracks on the West	0	0	0	0	0	0	0	0	0	0	0	n/a	n/a
		1C	Add One Track East and One Track West	0	0	0	0	0	0	0	0	0	0	0	n/a	n/a
2	Northern Virginia CFP 109.3 – 62	2A	Add One Track/Improve Existing Track	0	1	2	0	1	0	0	3	1	1	0	<1%	-1%
3	Fredericksburg (Dahlgren Spur to Crossroads) CFP 62 – 48	3A	Maintain Two Tracks Through Town	0	0	3	1	0	0	0	0	0	0	0	7-8%	6%
		3B	Add One Track East of Existing	1	0	2	1	0	0	0	0	0	0	0		-60%
		3C	Add Two-Track Bypass East	0	0	5	4	0	5	1	0	4	0	4		-10%
4	Central Virginia (Crossroads to Doswell) CFP 48 – 19	4A	Add One Track/Improve Existing Track	0	1	4	2	0	0	0	0	10	0	0	n/a	-6%
5	Ashland (Doswell to I-295) CFP 19 – 9	5A	Maintain Two Tracks Through Town	2	1	7	1	0	0	0	0	0	0	0	<1%	-24%
		5A–Ashcake	Maintain Two Tracks Through Town (Relocate Station to Ashcake)	2	0	8	1	0	0	0	0	0	0	0		-24%
		5B	Add One Track East of Existing	2	1	7	1	0	0	0	0	0	0	0		-26%
		5B–Ashcake	Add One Track East of Existing (Relocate Station to Ashcake)	2	0	8	1	0	0	0	0	0	0	0		-26%
		5C	Add Two-Track West Bypass	0	1	9	1	0	8	0	0	0	0	7		-87%
		5C–Ashcake	Add Two-Track West Bypass (Relocate Station to Ashcake)	0	0	10	1	0	8	0	0	0	0	7		-87%
		5D–Ashcake	Three Tracks Centered Through Town (Add One Track, Relocate Station to Ashcake)	2	0	8	1	0	0	0	0	0	0	0		-26%
6	Richmond (I-295 to Centralia) CFP 9 – A 011	6A	Staples Mill Road Station Only	3	4	2	1	1	0	0	0	0	0	0	2%	-66%
		6B–A-Line	Boulevard Station Only, A-Line	3	4	2	1	1	0	0	0	0	0	0	5%	-66%
		6B–S-Line	Boulevard Station Only, S-Line	4	5	4	3	1	0	0	2	2	0	0		-76%
		6C	Broad Street Station Only	3	4	2	2	1	2	0	0	0	0	0	5%	-38%
		6D	Main Street Station Only	3	5	4	4	1	0	0	2	2	0	0	4%	-59%
		6E	Split Service, Staples Mill Road/ Main Street Stations	3	4	2	1	1	0	0	0	0	0	0	1-2%	-66%
		6F	Full Service, Staples Mill Road/ Main Street Stations	3	5	4	4	1	0	0	2	2	0	0	1-2%	-59%
		6G	Shared Service, Staples Mill Road/ Main Street Stations	3	5	4	4	1	0	0	2	2	0	0	1-2%	-60%

Notes: All impacts shown are permanent impacts (i.e., not temporary disturbances due to construction activities). Any "Change" shown compares 2025 Build Alternatives to 2025 No Build conditions.