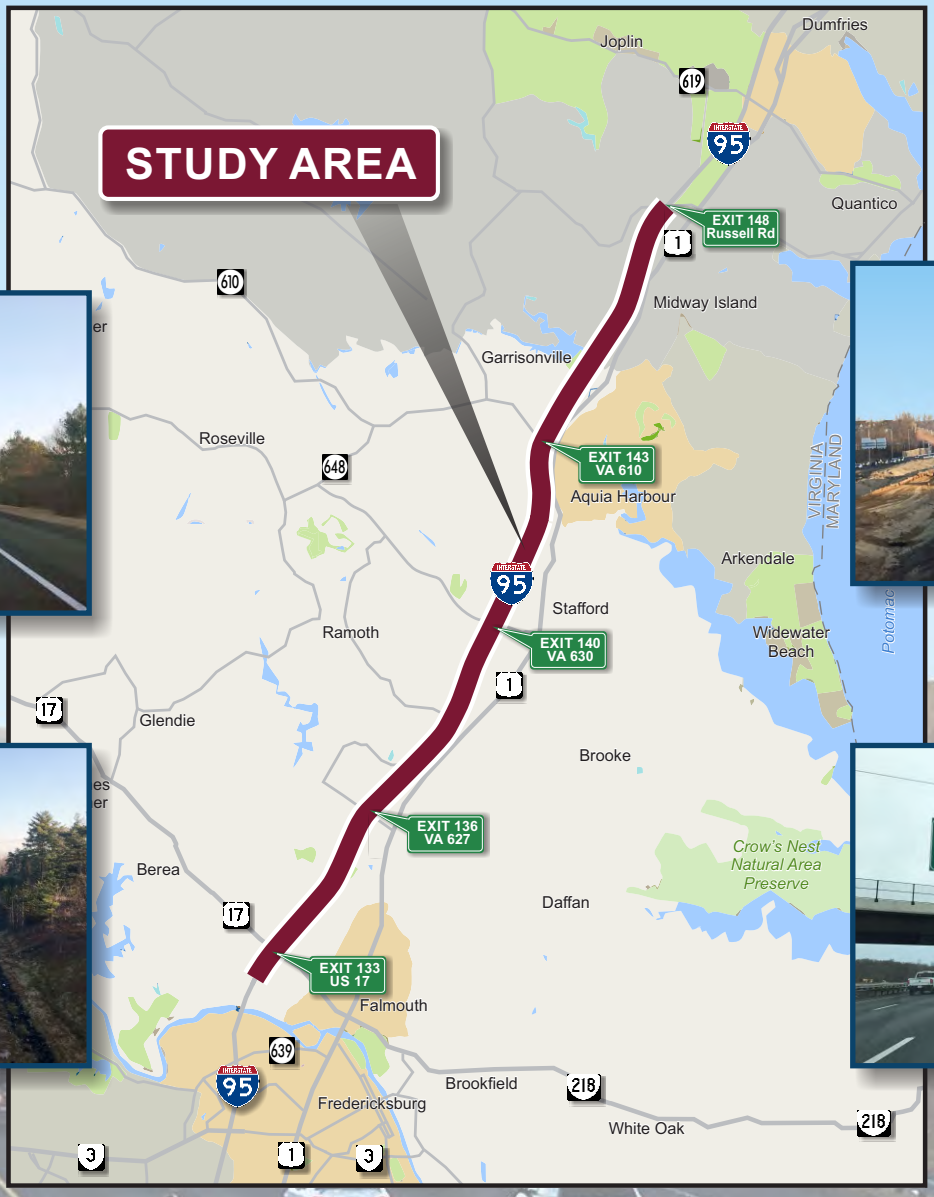
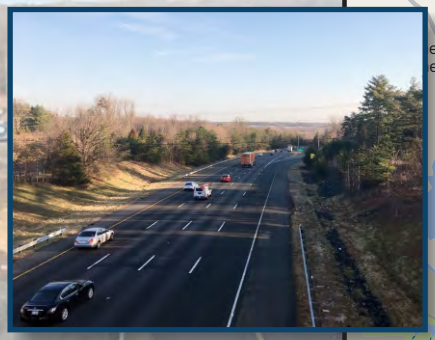
Interstate 95 Express Lanes
Fredericksburg Extension Study

INDIRECT AND CUMULATIVE EFFECTS TECHNICAL REPORT





VDOT Virginia Department of Transportation

U.S. Department of Transportation
Federal Highway Administration

AUGUST 2017

INDIRECT AND CUMULATIVE EFFECTS TECHNICAL REPORT

INTERSTATE 95 EXPRESS LANES FREDERICKSBURG EXTENSION STUDY

Prepared in support of the Revised Environmental Assessment

VDOT Project #: 0095-969-739

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LIST OF ACRONYMS

A-1	Agricultural Zoning Class
A-2	Rural Residential Zoning Class
ACS	American Community Survey
APE	Area of Potential Effects
ATTAINS	Assessment and Total Maximum Daily Load Tracking and Implementation System
B-1	Neighborhood Business Convenience Commercial Zoning Class
B-2	Convenience Business/Urban Commercial Zoning Class
B-3	Office Zoning Class
BMP	Best Management Practice
CD	Collector-Distributor
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CIP	Capital Improvement Plan
CLRP	Constrained Long-Range Plan
CS	Conservation Site
CWA	Clean Water Act
DO	Dissolved Oxygen
DoD	Department of Defense
DRPT	Department of Rail and Public Transportation
EA	Environmental Assessment
EB	Eastbound
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EJ	Environmental Justice
EO	Executive Order
EPA	Environmental Protection Agency
ESC	Erosion and Sediment Control
FAMPO	Fredericksburg Area Metropolitan Planning Organization
FE	Federally-Endangered
FED	Federal Zoning Class
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration

FIRM	Flood Insurance Rate Map
FONSI	Finding of No Significant Impact
FT	Federally-Threatened
FY	Fiscal Year
GIS	Geographic Information System
GP	General Purpose
HAPC	Habitat Area of Particular Concern
HHS	Department of Health and Human Services
HOT	High Occupancy Toll
HOV	High-Occupancy Vehicle
HUC	Hydrologic Unit Code
I-95	Interstate 95
ICE	Indirect and Cumulative Effects
IMR	Interchange Modification Report
IPaC	Information Planning and Consultation
LC	Life Care/Retirement Community Zoning Class
LOD	Limits of Disturbance
LOS	Levels of Service
M-1	Light Industrial Zoning Class
M-2	Heavy Industrial Zoning Class
MCB	Marine Corps Base
MCBQ	Marine Corps Base Quantico
MDE	Maryland's Department of the Environment
MDNR	Maryland Department of Natural Resources
MM	Mile Marker
MPO	Metropolitan Planning Organization
MWCOG	Metropolitan Washington Council of Governments
NB	Northbound
NCDOT	North Carolina Department of Transportation
NCHRP	National Cooperative Highway Research Program
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NHD	National Hydrography Dataset

NHPA	National Historic Preservation Act
NLCD	National Land Cover Dataset
NLEB	Northern Long-Eared Bat
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NVCT	Northern Virginia Conservation Trust
NVRC	Northern Virginia Regional Commission
NWI	National Wetlands Inventory
Pd	Pseudogymnoascus Destructans
PD-1	Planned Development 1 Zoning Class
PD-2	Planned Development 2 Zoning Class
PFA	Priority Focus Area
PIM	Public Information Meetings
PTND	Planned-Traditional Neighborhood Development Zoning Class
QMB	Marine Corps Base Quantico
R-1	Suburban Residential Zoning Class
R-2	Urban Residential Medium Zoning Class
R-3	Urban Residential High Zoning Class
R-4	Manufacture Home/Residential 4 Zoning Class
R-16	Residential 16 Zoning Class
RBC	Recreational Business Campus Zoning Class
ROW	Right-of-Way Zoning Class
RPA	Resource Protection Area
SAV	Submerged Aquatic Vegetation
SB	Southbound
SC	Suburban Commercial Zoning Class
SCU	Stream Conservation Unit
SE	State-Endangered
SGCN	Species of Greatest Conservation Need
SR	State Route
ST	State-Threatened

STIP	Statewide Transportation Improvement Program
SWM	Stormwater Management
SYIP	Six-Year Improvement Program
TAZ	Transportation Analysis Zone
TGA	Targeted Growth Area
TIP	Transportation Improvement Program
TMDL	Total Maximum Daily Load
TPB	Transportation Planning Board
TRB	Transportation Research Board
UD	Urban Development Zoning Class
US	United States
USACE	US Army Corps of Engineers
USDA	US Department of Agriculture
USDOT	US Department of Transportation
USEPA	US Environmental Protection Agency
USFS	US Forest Service
USFWS	US Fish and Wildlife Service
USGS	US Geological Survey
USNPS	US National Park Service
VAC	Virginia Administrative Code
VDACS	Virginia Department of Agriculture and Consumer Services
VCDR	Virginia Department of Conservation and Recreation
VDCR-DNH	Virginia Department of Conservation and Recreation Department of Natural Heritage
VDEQ	Virginia Department of Environmental Quality
VDGIF	Virginia Department of Game and Inland Fisheries
VDHR	Virginia Department of Historic Resources
VDOF	Virginia Department of Forestry
VDOT	Virginia Department of Transportation
VDRPT	Virginia Department of Rail and Public Transportation
VFWIS	Virginia Fish and Wildlife Information Service
VIM	Virginia Institute of Marine Science
VMRC	Virginia Marine Resources Commission
VOF	Virginia Outdoors Foundation

VRE	Virginia Railway Express
VSMP	Virginia Stormwater Management Program
WB	Westbound
WOUS	Waters of the United States

1. INTRODUCTION

1.1 PROJECT DESCRIPTION

The Virginia Department of Transportation (VDOT), in coordination with the Federal Highway Administration (FHWA) as the lead federal agency, is preparing a Revised Environmental Assessment (Revised EA) for the I-95 HOT Lanes Project, for which a Finding of No Significant Impact (FONSI) was issued by FHWA in 2011. The Revised EA, which is being completed for the Interstate 95 (I-95) Express Lanes Fredericksburg Extension Study (or the "Fredericksburg Extension Study"), presents improvements identified in a portion of the 2011 FONSI-selected Alternative, from the I-95 / US 17 North Interchange at Warrenton Road (Exit 133) to south of the I-95 / Russell Road interchange (Exit 148). The Revised EA also presents new access points along this portion of the 2011 FONSI-selected Alternative. As part of the study, environmental resources along the corridor were updated according to the latest available data and information.

The Fredericksburg Extension Study Revised EA is being prepared pursuant to the National Environmental Policy Act (NEPA) of 1969, as amended, and FHWA's regulations implementing NEPA (23 CFR §771.119). The Revised EA accounts for transportation projects that have been constructed in the original EA/FONSI study area since 2011 or which are currently under construction. In addition to the extension of Express Lanes, the Revised EA evaluates updated environmental data and existing conditions in the study area, as well as changes to access points along the Express Lanes considered, and not considered, in the 2011 EA, and those proposed in the study area by independent projects.

The 2011 EA included an analysis of potential indirect and cumulative effects (ICE) from the project following an agreed upon approach between VDOT and FHWA Virginia Division. At that time, the project was found to be consistent with local comprehensive planning regarding land use goals in the surrounding area and transportation in the project corridor. In addition, its effects were considered small when viewed in the context of impacts from other past, present, and reasonably foreseeable future actions and did not rise to a level that would cause significant cumulative impacts.

Since completion of the 2011 EA, VDOT and FHWA Virginia Division have refined their approach to conducting ICE analyses. The purpose of this ICE Technical Report is to identify and assess the ICE of the alternatives retained for analysis in the Revised EA in accordance with the guidelines published by VDOT in 2015 (VDOT, 2015). Information in this report, described below, would support discussions presented in the Revised EA. This document first provides an overview of the study with a description of the methods used to assess the ICE. This is followed by an indirect effects assessment and potential mitigation, and documentation of cumulative effects.

1.2 STUDY HISTORY

Completion of I-95 in Virginia occurred in sections and included portions constructed as part of the federally-funded highway system and portions of roadway incorporated into the system and reconstructed to urban interstate standards. The VA 350 Shirley Highway, incorporated into the interstate system in 1965, extended from US 1, just north of the Occoquan River near Woodbridge, to the 14th Street Bridge at the Potomac River. Reconstruction and upgrades occurred along this section between 1965 and 1975. Three final sections were completed and opened in 1964, extending 71 miles from Ashland to the section completed near Woodbridge. These final sections completed the continuous track of I-95 in Virginia (Kozel 2003).

Widening of I-95 in Stafford and Prince William Counties from four to six general purpose (GP) lanes occurred between 1983 and 1987 (Kozel 2003). In 1997, VDOT completed construction of two reversible

High-Occupancy Vehicle (HOV) lanes within the median of I-95, extending from their current terminus at the Capital Beltway to near VA 234 / Dumfries Road in Prince William County.

Studies completed between 1997 and 2002 evaluated transportation improvement options within the I-95 and I-395 corridors which are essential roadway facilities serving the National Capital Region. These studies included:

- *Outer Connector Study-Northwest Quadrant Draft Environmental Impact Statement* (VDOT, 1997);
- *I-95/I-395 HOV Restriction Study, Volume I: Summary Report* (VDOT, 1999);
- *Outer Connector Study-Northwest Quadrant Supplemental Draft Environmental Impact Statement* (VDOT, 2001); and
- *I-95 Collector-Distributor Access Feasibility Study* (BMI *et al*., 2002).

In 2007, the Metropolitan Washington Council of Governments (MWCOG) included funding in their Fiscal Year (FY) 2007-2012 Transportation Improvement Program (TIP) to develop environmental documents consistent with federal NEPA and state requirements, and to build and operate Express Lanes on I-95 and I-395 between Arlington County and the I-95 Massaponax exit (Spotsylvania County). In 2008, the MWCOG included funding in their FY 2008-2013 TIP to construct the portion of the Express Lanes extending from South Eads Street in Arlington County to VA 610 / Garrisonville Road (Exit 143) in Stafford County (MWCOG, 2008). Environmental and cultural resource documentation completed between 2007 and 2009 evaluated the potential effects of Express Lane expansion in the I-95 and I-395 corridors. These studies and reports included:

- *I-95/395 HOV/Bus/HOT Lanes Project Section 4(f) Applicability Analysis* (VDOT, 2007a)
- *Phase I Archaeological Investigations of the I-95/395 HOV/Bus/HOT Lanes Project Arlington, Fairfax, Prince William and Stafford Counties and the City of Alexandria, Virginia* (VDOT, 2007b)
- *Reconnaissance Architectural Survey for the I-95/I-395 HOV/Bus/HOT Lanes Project, Arlington, Fairfax, Prince William, and Stafford Counties, and the City of Alexandria, Virginia* (VDOT, 2007c)
- *I-95/395 Bus/HOV/HOT Lanes Environmental Document Study: Noise Analysis Technical Report* (VDOT, 2008a)
- *Air Quality Analysis: I-95/I-395 HOV/Bus/HOT Lanes Project: Arlington, Fairfax, Prince William, and Stafford Counties and City of Alexandria* (VDOT, 2008b)
- I-*95/395 HOV/Bus/HOT Lanes Project Existing Conditions Report* (VDOT, 2008c)
- *I-95/395 HOV/Bus/HOT Lanes Northern Section FHWA Categorical Exclusion* (FHWA, 2009)

In 2011, FHWA and VDOT prepared the *I-95 HOT Lanes Project Environmental Assessment* (FHWA and VDOT, 2011) to evaluate the environmental impacts of Express Lane expansion in the I-95 corridor. VDOT proposed to construct Express Lanes within the median of I-95 south of Dumfries and convert the existing HOV lanes to Express Lanes from Dumfries to the Capital Beltway (I-495). The I-95 HOT Lanes EA was supported by the following reports:

- *I-95 HOT Lanes Project Preliminary Noise Analysis Final Report* (VDOT, 2011a)
- *Interstate 95-HOT Lanes Project Air Quality Analysis Final Report* (VDOT, 2011b)

In December 2011, FHWA issued a Finding of No Significant Impact (FONSI) for the project, completing the NEPA process (FHWA, 2011). The project was divided into construction sections for implementation. In November 2012, VDOT received $300 million in Transportation Infrastructure Finance and Innovation Act credit assistance, using a Transportation Investment Generating Economic Recovery III grant award to fund the I-95 HOT Lanes Project (FHWA, 2014a). In April 2013, the Fredericksburg Area Metropolitan

Planning Organization (FAMPO) adopted their *2040 Long Range Transportation Plan*, which included funding for the project (VDOT, 2013).

Following receipt of funding, the existing HOV lanes were converted to Express Lanes and construction of the northern section of the Express Lanes from south of Dumfries Road to near Garrisonville Road was completed in December 2014 (Virginia Public-Private Partnerships, 2014) (**Figure 1-1**). Completion of this first section of Express Lanes provided continuous service for HOV and toll-paying users from central Stafford County to Washington, DC. VDOT planned to complete the subsequent sections of expanded Express Lanes as the department secured funding for construction.

To address issues regarding congestion near Garrisonville Road during peak use periods (**Figure 1-1**), VDOT is currently extending one reversible lane from the Express Lanes' southern terminus near Garrisonville Road, approximately 2.2 miles further south as part of the I-95 Express Lanes Southern Terminus Extension. When completed, this lane would split into northbound (NB) and southbound (SB) merge ramps and connect to the GP lanes in the area. VDOT examined the environmental impacts of the southern terminus extension in March 2016 with preparation of the *Reevaluation of 2011 Environmental Assessment (EA) for I-95 Express Lanes Southern Terminus Extension* (VDOT, 2016a) and determined that the *I-95 HOT Lanes Project Environmental Assessment* findings were still valid and no new NEPA document was required for the approximate 2.2-mile extension. Construction commenced in July 2016 with full completion anticipated in the summer of 2018 (VDOT, 2017a).

1.2.1 Purpose and Need

The purpose and need for the proposed improvements remains the same as presented in the 2011 I-95 HOT Lanes Project EA:

- Reduce daily congestion and accommodate travel demands more efficiently. Existing traffic volumes exceed available highway capacity and the forecasts prepared using the regional travel demand models show continuing traffic growth in the corridor, with much of the Fredericksburg region's workforce continuing to commute north.
- Provide higher reliability of travel times. People place a high value on reaching their destinations in a timely manner, and in recent years, I-95 has become so congested that the existing I-95 facilities cannot provide reliable travel times during the peak periods.
- Expand travel choices by increasing the attractiveness and utility of ridesharing and transit usage while also providing an option for single-occupant vehicles to bypass congested conditions.

1.2.2 Alternatives

The proposed Build Alternative and the No-Build Alternative are under consideration. The proposed limits of both alternatives extend along I-95 from southern Stafford County, near the United States (US) 17 (Warrenton Road) interchange, to Prince William County, north of Chopawamsic Creek and the Quantico interchange (Exit 148). This approximately 29-mile long study area is large enough to include continuous coverage of the I-95 corridor extending from the area of proposed Express Lane expansion in the south to proposed access improvements in the north. However, sections of the interstate where improvements are not proposed are included in the study area, including areas where Express Lanes were constructed following issuance of the 2011 FONSI. The sections of I-95 where improvements are not proposed were included in the study area to provide continuity to environmental resource evaluations. The proposed limits of the Build Alternative and areas identified for access improvements are shown on **Figure 1-2**. Additional information on the alternatives is included in the Alternatives technical report, and are summarized in the Revised EA.

Figure 1-1: Express Lane Status

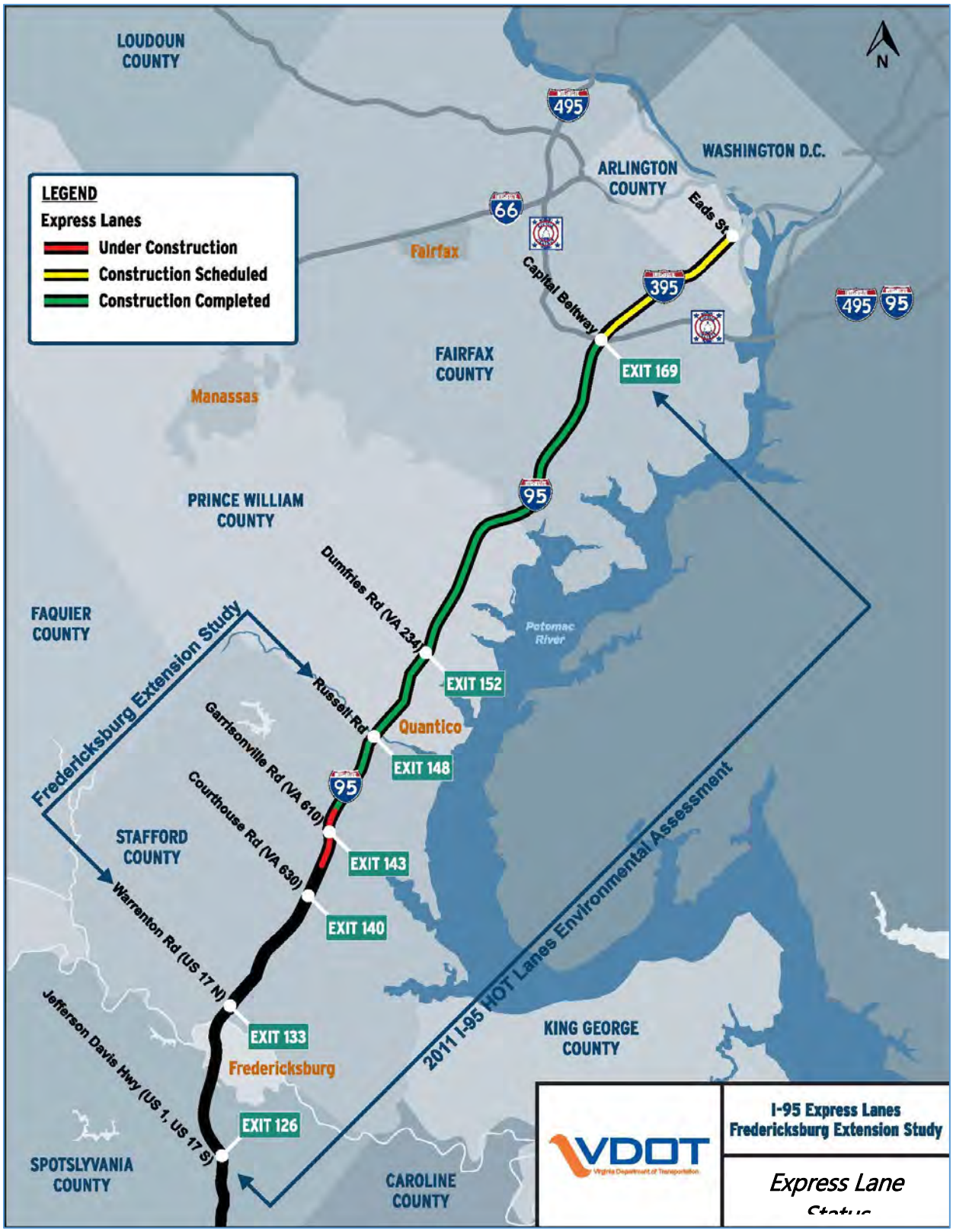
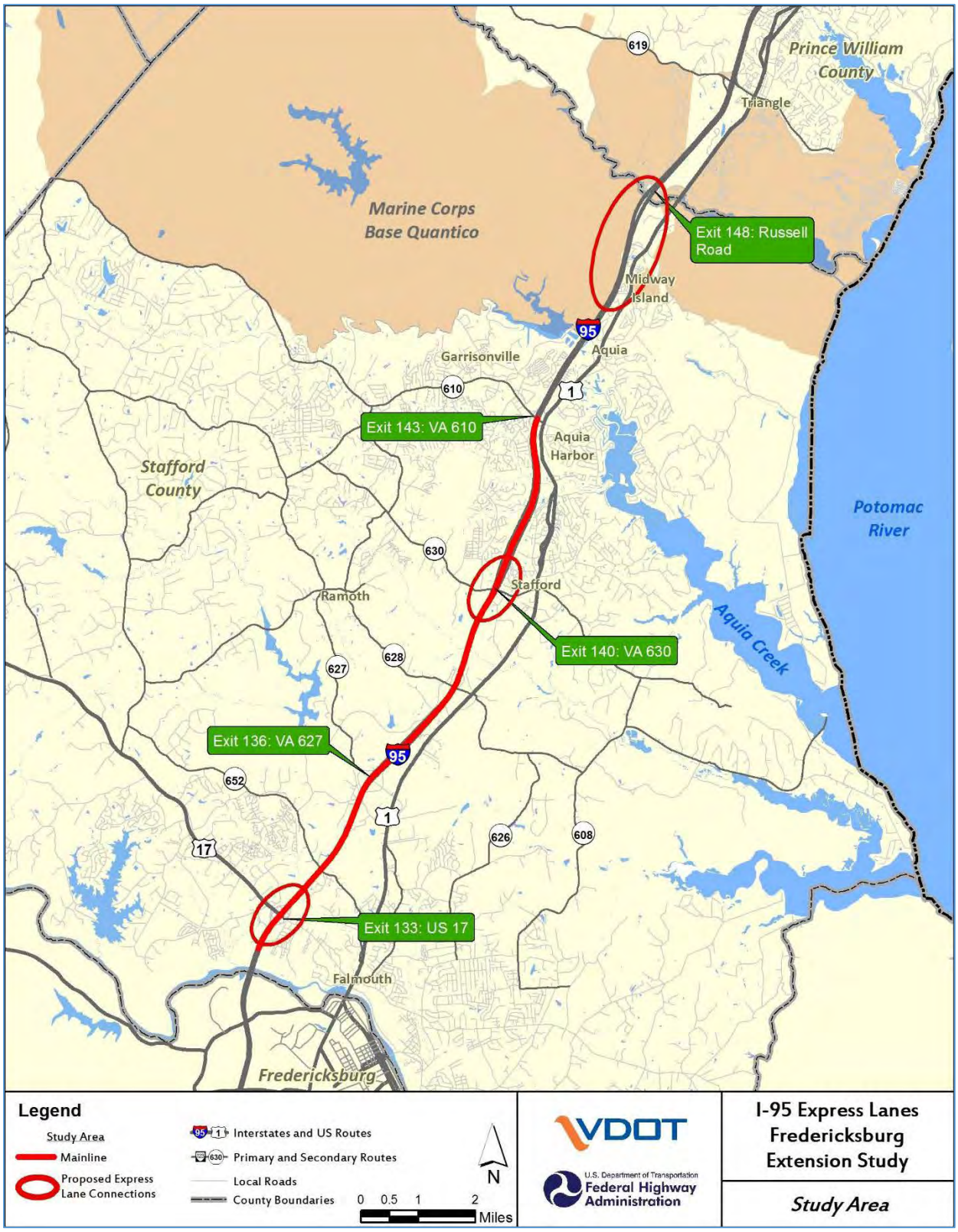


Figure 1-2: Study Area



The No-Build Alternative

In accordance with the implementing regulations for NEPA (40 CFR § 1502.14(d)), the No-Build Alternative has been retained for detailed study and serves as a benchmark for comparison with the Build Alternative. The No-Build Alternative would retain the existing configuration of I-95 through the study area except for those modifications to the roadway network programmed and approved for implementation by 2042 in the most recent long-range transportation plans or funded in capital improvement plans that cover the study area. However, transportation plans and population projections used in this analysis generally extend to 2040, the closest year to the design year of the study, and are noted as such. Transportation plan and improvement plans covering the study area include:

- *Financially Constrained Long-Range Transportation Plan 2016 Amendment* for the National Capital Region, prepared by the National Capital Region Transportation Planning Board (TPB), which is the designated Metropolitan Planning Organization (MPO) for the Washington, DC region under the MWCOG (TPB, 2016a);
- *MWCOG Transportation Improvement Program* (TPB, 2016b);
- *2040 Long Range Transportation Plan* produced by the George Washington Regional Commission and its designated MPO, FAMPO (FAMPO, 2013);
- FAMPO's *Fiscal Years 2015-2018 Transportation Improvement Program* (FAMPO, 2014);
- VDOT's *Six-Year Improvement Program* (SYIP) (VDOT, 2016b);
- MWCOG's *Draft National Capital Freight Plan* (TPB, 2016C);
- *Virginia Railway Express (VRE) System Plan 2040 Study Final Report* (VRE, 2014); and
- Capital Improvement Plans (CIPs) for Prince William and Stafford Counties (Prince William County, 2016; Stafford County, 2016a).

The regional planned and programmed transportation projects in close vicinity to the study area that could influence the improvements evaluated in the Revised EA are listed in **Appendix A** and include the following:

- I-95 Rest Area Access and Gordon Road Connector Road (Fredericksburg): includes construction of a new interchange at the rest area located along SB I-95, north of VA 369 / Fall Hill Avenue, and a new connector road from this new interchange to US 3 / Gordon Road (Exit 130). This project is in the preliminary engineering phase and received funding in FAMPO's TIP.
- I-95 Four Lane and Shoulder Widening: includes the addition of a fourth GP, SB, travel lane, and widening the shoulder between Route 8900 / Centreport Parkway (Exit 136) and VA 610 / Garrisonville Road (Exit 143) in Stafford County. This project is in the preliminary engineering phase and received funding in FAMPO's TIP.
- I-95 Rappahannock River Crossing Southbound Project: part of the Atlantic Gateway, a joint effort by VDOT and the Virginia Department of Rail and Public Transportation (DRPT) to reduce travel times, expand access to employment opportunities, enhance the ability to move people and freight, and alleviate some of the worst bottlenecks in the United States. The I-95 Rappahannock River Crossing Southbound Project would add two collector-distributor (CD) lanes parallel to I-95 SB between US 17 in Stafford County and US 3 in Fredericksburg. VDOT plans to build a new I-95 SB bridge over the Rappahannock River to carry the new CD lanes that would parallel the existing I-95 SB bridge at the river. VDOT also plans to modify the existing I-95 interchanges at US 17 and US 3, as well as ramps to the Safety Rest Area and Virginia Welcome Center. The project has received funding in FAMPO's TIP. Work on the project is to begin in 2017.

- I-95 and US 3 Safety Improvements: VDOT proposes several spot changes at the US 3 exit in Fredericksburg to enhance safety by reducing crashes, reducing the risk of injuries and fatalities, and to keep traffic moving locally and along the interstate. Work would involve interchange improvements to US 3 eastbound (EB) to I-95 NB, I-95 SB to US 3 westbound (WB) and I-95 NB to US 3 EB, pending funding. This project is in the preliminary engineering phase.
- I-95 Shoulder Running Lane Improvements: VDOT proposes to improve the inside shoulders of the I-95 GP lanes between mile markers (MM) 139 and 145 to be used as additional travel lanes during the peak periods. The project is in the preliminary engineering phase and is listed in FAMPO's *2040 Long Range Transportation Plan*. VDOT plans to complete the improvements in 2020.
- I-95 Express Lanes Southern Terminus Extension: VDOT is currently extending one reversible lane from the current Express Lane southern termination point near Garrisonville Road, approximately 2.2 miles further south as part of the I-95 Express Lanes Southern Extension. When completed in 2018, this lane would split into NB and SB merge ramps and connect to the GP lanes in the area.
- I-95 Southbound Hard / Dynamic Shoulder Running Project: VDOT proposes to improve the inside shoulders of the I-95 GP lanes between MM 133 and 140 to be used as additional travel lanes during the peak periods. The project is funded in VDOT's SYIP and VDOT plans to begin construction in FY 2020.
- I-395 Express Lanes Northern Extension: the I-395 Express Lanes Extension Project would extend the I-395 Express Lanes for approximately eight miles north from Turkeycock Run near Edsall Road to the vicinity of Eads Street in Arlington. Two existing HOV lanes would be converted to Express Lanes and a third lane would be added, providing three reversible Express Lanes. The improvements primarily would be built within the existing footprint of the I-395 HOV lanes. VDOT prepared the Interstate 395 Express Lanes Northern Extension Environmental Assessment (VDOT, 2016c) in September 2016 and completed the Interstate 395 Express Lanes Northern Extension Revised Environmental Assessment (VDOT, 2017b) in February 2017. Following completion of the Revised EA, FHWA issued a FONSI for the I-395 Express Lanes Northern Extension in February 2017 (FHWA, 2017). VDOT plans to begin construction in the summer of 2017 and anticipates that construction would be complete in 2019 (VDOT, 2017c).
- VA 630 / Courthouse Road (Exit 140) Interchange Relocation: VDOT plans to rebuild the Courthouse Road interchange as a diverging diamond interchange and relocate it slightly south of the existing interchange. The project would relocate the intersection of Courthouse Road and US 1 to the south to align with Hospital Center Boulevard. VDOT would widen Courthouse Road to four lanes between US 1 and I-95. West of I-95, VDOT would widen Courthouse Road to four lanes to a point just west of Route 628 / Ramoth Church Road and Winding Creek Road. Finally, VDOT would realign Ramoth Church Road and Winding Creek Road to intersect at a traffic signal. The project is funded in FAMPO's TIP and VDOT plans to complete the improvements in 2020.
- Arterial Road Capacity Improvements: VDOT, MPOs, County, and/or City plans include over 15 projects to provide additional capacity to principal arterial roads in the study area. These include, but are not limited to, widening US 1, US 17, Courthouse Road, and Garrisonville Road.
- Rail Service Improvements: the DRPT is currently evaluating improving rail service between Washington, DC and Richmond to deliver higher speed passenger service, improved conventional speed passenger rail service, expanded commuter rail, and growth of freight rail service in an efficient and reliable multimodal rail corridor. The Project extends 123 miles along an existing rail

corridor owned by CSX Transportation from Arlington to Chesterfield County, Virginia. DRPT is preparing a Tier II Environmental Impact Statement (EIS) to evaluate a range of alternatives. DRPT recommended alternatives include the addition of a third or fourth track through Prince William and Stafford Counties and the addition of a third track through Fredericksburg.

The Build Alternative

The Build Alternative would extend two Express Lanes in the median of I-95 from south of Exit 143 to south of the I-95 / US 17 North Interchange at Warrenton Road (Exit 133). This area of proposed Express Lane construction is consistent with the preferred alternative from the FONSI issued in 2011. The Build Alternative would also provide Express Lane access to independent projects proposed in the study area since completion of the 2011 EA. These projects include connecting Exit 133 to the I-95 Rappahannock River Crossing Southbound Project, and another at Exit 140 to connect with VA 630 / Courthouse Road Interchange Relocation Project. An additional connection not evaluated in the 2011 EA is proposed at the I-95 / Russell Road Interchange at Marine Corps Base Quantico (Exit 148).Although not included as part of the preferred alternative in 2011, this connection provides the same utility as the previously evaluated alternative, occurs in the same study area previously evaluated, and serves to meet the same purpose and need evaluated in 2011. The Build Alternative lane configuration is summarized in **Table 1-1**.

Table 1-1: Build Alternative Lane Configuration

Roadway Alignments	Existing Express Lanes	Proposed Express Lanes	Existing GP Lanes	Proposed GP Lanes
MM 132.8 to 145	0	2	3	3
MM 145 to 148	2	0	3	3

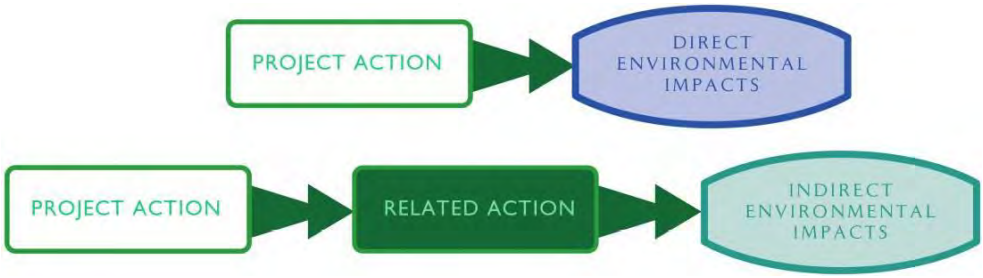
1.3 METHODOLOGY

1.3.1 Regulatory Context

The NEPA legislation does not mention indirect or cumulative impacts. The Council on Environmental Quality (CEQ) regulations for implementing NEPA, however, address federal agency responsibilities applicable to indirect and cumulative impacts considerations, analysis, and documentation (40 CFR § 1508.25) in the content requirements for the environmental consequences section of an EIS (40 CFR § 1502.16) (FHWA 2014).

CEQ defines indirect effects as "...effects which are caused by the action and are later in time or farther removed in distance, but are still 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(a)). These induced actions are those that would or could not occur without the implementation of the proposed project, as illustrated in **Figure 1-3**.

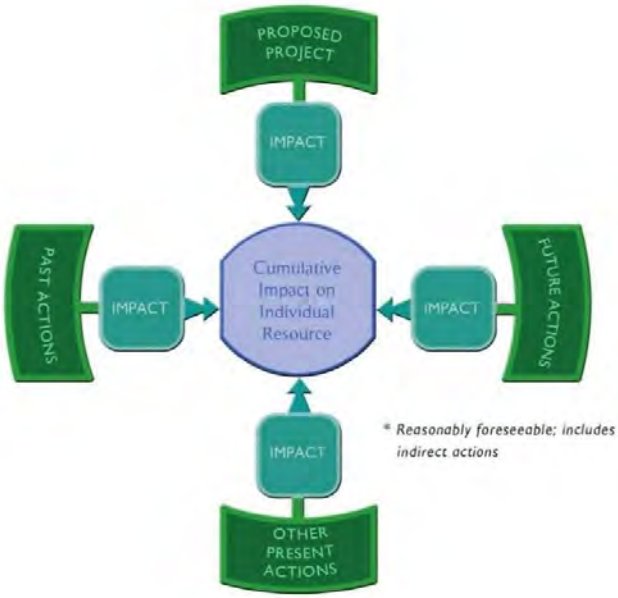
Figure 1-3: Direct vs. Indirect Environmental Impacts



Source: FHWA (2014).

CEQ defines cumulative effects (or impacts) as, "...the impact on the environment which 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" (40 CFR § 1508.7). Cumulative effects include the total of all impacts, direct and indirect, experienced by a particular resource that have occurred, are occurring, and would likely occur as a result of any action or influence, including effects of a federal activity (US Environmental Protection Agency [USEPA], 1999), as illustrated in **Figure 1-4**.

Figure 1-4: Cumulative Effects



Source: FHWA (2014).

Because indirect and cumulative effects may be influenced by actions including those taken by others outside of the immediate study area, assumptions must be made to estimate the result of these actions. The CEQ regulation cited above states that the analysis must include all the indirect effects that are known, and make a good faith effort to explain the impacts that are not known but which are "reasonably foreseeable." Court decisions on this topic indicate that indirect impact analysis should consider impacts that are sufficiently "likely" to occur and not those that only may be conceived or imagined (FHWA, 2014b). NEPA does not define what constitutes "reasonably foreseeable actions." CEQ has provided guidance on how to define reasonably foreseeable actions, based upon court opinions. CEQ makes it clear

that actions that are probable should be considered while actions that are merely possible, conceptual, or speculative in nature are not reasonably foreseeable and need not be considered in the context of cumulative impacts (CEQ 1981, FHWA 2014).

Therefore, while reasonably foreseeable events may be uncertain, they must still be probable. As such, those events that are considered possible, but not probable, may be excluded from NEPA analysis. There is an expectation in the CEQ guidance that judgments concerning the probability of future impacts would be informed, rather than based on speculation (FHWA, 2014b). This direction on identifying reasonably foreseeable actions is taken into account in both the analysis described in the following sections. Specific methodologies on how these analyses were conducted are presented for indirect and cumulative effects, respectively.

The means by which these regulations are applied to the ICE analysis are explained in the sections below.

1.3.2 Indirect Effects

This section presents an analysis of the potential indirect impacts related to the proposed alternatives described in **Section 1.2.2**. For the purposes of this Technical Report and the associated EA, the methodology followed for analyzing indirect effects are prescribed in the Transportation Research Board's (TRB) National Cooperative Highway Research Program (NCHRP) Report 466, *Desk Reference for Estimating the Indirect Effects of Proposed Transportation Projects* (TRB, 2002).

In NCHRP Report 466, TRB 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 study encroachment (physical, biological, socioeconomics) on the environment;
2) Induced Growth Impacts-Project – influenced development effects (land use); and
3) Impacts Related to Induced Growth – Effects related to project-influenced development effects (impacts of the change of land use on the human and natural environment).

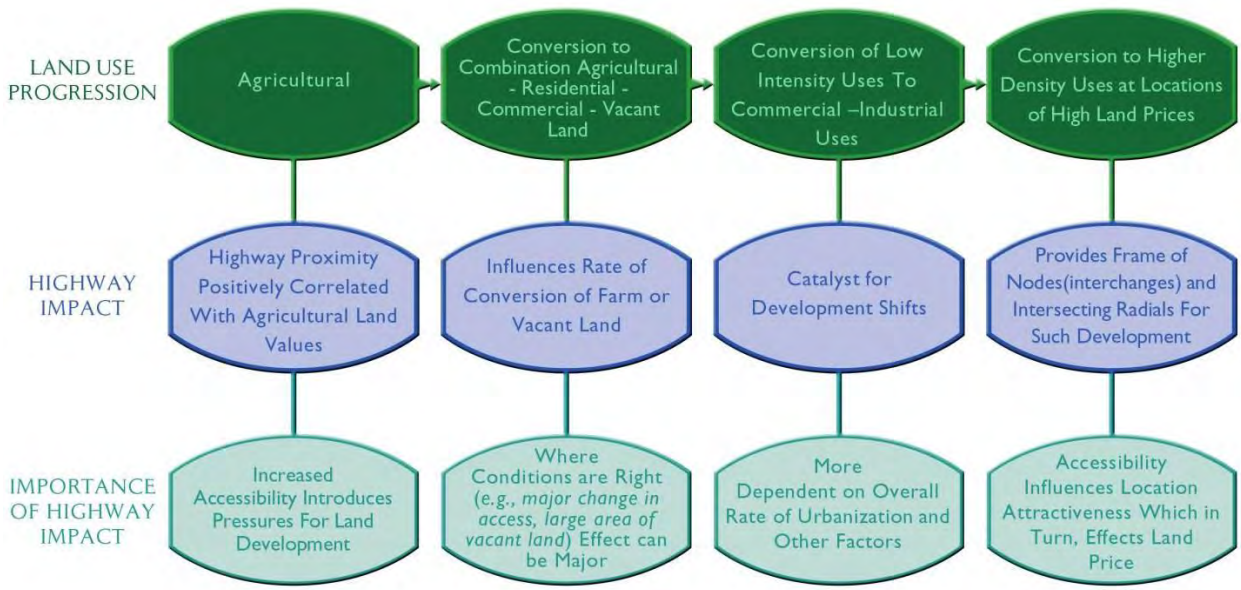
Transportation improvements often reduce time and cost of travel, as well as providing new access to properties, enhancing the attractiveness of surrounding land to developers and consumers. Development of vacant land, or conversion of the built environment to more intensive uses, is often a consequence of highway projects. Important characteristics for induced growth are described in North Carolina Department of Transportation's (NCDOT) *Guidance for Assessing Indirect and Cumulative Impacts of Transportation Projects in North Carolina, Vol. II: Practitioners Handbook* (NCDOT, 2001).These characteristics include existing land use conditions in the project area, increased accessibility that may result from new transportation improvements, local political and economic conditions, and the availability of other infrastructure and the rate of urbanization in the region. The NCDOT guidance illustrates the different stages of development and how a highway improvement project may influence development (**Figure 1-5**). The NCDOT guidance indicates induced growth impacts are most often found up to one mile around a freeway interchange and two to five miles along major feeder roads. Two principal factors influencing the likelihood of induced growth are the extent and maturity of the existing transportation infrastructure and land availability.

Interstate 95 and its existing interchanges have been in place for many decades, with most interchanges constructed between 1962 and 1964. Over the following decades, areas over one mile from existing interchanges in Berea, Falmouth, Stafford, Garrisonville, and Aquia Harbour in Stafford County, and Triangle, Dumfries, and Southbridge in Prince William County have been settled with well-established residential neighborhoods, commercial, and industrial areas. Since these areas are in an advanced land

use progression, it is more likely that the proposed transportation improvements could result in infill development rather than urban/suburban sprawl within the northern portion of the study area.

MCBQ straddles I-95 in the central portion of the Fredericksburg Extension study area within southern Prince William County and northern Stafford County. The MCBQ was established in 1917 (United States Marine Corps, No Date). The Base is owned by the United States Government and is restricted to Department of Defense (DoD) and US Government uses; therefore, it is limited in its potential for induced growth. In addition, no I-95 capacity improvements are proposed in this area. Proposed improvements are limited to the existing MCBQ interchange (Exit 148).

Figure 1-5: Highway Investment on Typical Progress of Urbanization



Source: NCDOT (2001).

Locust Shade Park and the National Museum of the Marine Corps are located east of I-95 and between the two sides of MCBQ. Locust Shade Park is a Prince William County park, and receives legal protection as a federal grant-assisted recreation site through Section 6(f)(3) of the Land and Water Conservation Fund Act. Development of the Park for other than recreational purposes would require federal approval, and property substituted for the converted land must be of at least equal fair market value and of reasonably equivalent usefulness and location. The Marine Corps University operates the National Museum of the Marine Corps on a 135-acre property owned by the US Government. The presence of Locust Shade Park and the Museum restricts land use progression and urbanization along I-95 between Exits 148 and 150. Land use progression and urbanization is also restricted to the north of the western side of MCBQ, as Prince William Forest Park, formerly the Chopawamsic Recreation Area, was established in 1936 along the northern boundary of the Base (US National Park Service, 2017). Today, the Park is located along the western side of I-95 between MM 150.8 and MM 152. The Park is almost entirely forested, and has been so since 1964 when the interstate in the Fredericksburg Extension study area was completed. The land is under US National Park Service (USNPS) control, is limited in its potential for urbanization, and occurs in a portion of the Fredericksburg Extension study area where no improvements are proposed.

Land between MM 136 and Stafford (east of I-95) and Garrisonville (west of I-95) to the north are in a less advanced state of urbanization when compared to the areas of Triangle, Dumfries, and Southbridge in

Prince William County. Access is proposed to connect to the independently relocated Courthouse Road in this section of the study area. However, as an interchange currently exists in that area, and no new interchanges are proposed which would connect to roadways not previously providing connections to the interstate, the greatest potential for induced growth would be along the existing interchanges, relocated interchange, and feeder roads in this area.

The stepwise process TRB recommends in NCHRP Report 466 for assessing indirect effects has been used as the structure for the analysis, and considers the following steps:

Step 1. Scoping

Step 2. Identify Study Area Direction and Goals

Step 3. Inventory Notable Features in the Study Area

Step 4. Identify Impact-Causing Activities of the Build Alternatives

Step 5. Identify Indirect Effects for Analysis

Step 6. Analyze Indirect Effects and Evaluate Analysis Results

Step 7. Assess Consequences and Develop Mitigation

To complete these steps, the required analyses rely on planning judgment that is described in the NCHRP 25-25 program, Task 22, *Forecasting Indirect Land Use Effects on Transportation Projects* (TRB, 2007). Planning judgment relies on experience and expertise of the study team combined with previously published reports and data. As stated in that report, "Planning judgment is a structured process for analyzing and forecasting land use change that relies on an understanding of the basics of transportation/land use interactions, basic data sources, asking the right questions, and using rules of thumb from research to make informed judgments." In this process, planners and technical experts make judgments about impacts rather than modeling to provide estimates of those impacts. The indirect effects analysis of wetlands and other natural resources, such as streams and wildlife habitat, is also based on an understanding of the proposed design, the natural resources in the study area, professional experience, and past scientific studies of the effects of similar projects.

1.3.3 Cumulative Effects

To document cumulative effects for this study, the analysis followed the five-part evaluation process outlined in Fritiofson v. Alexander, 772 F.2d 1225 (5th Cir., 1985), as described in FHWA's Guidance: *Questions and Answers Regarding the Consideration of Indirect and Cumulative Effects in the NEPA Process* (FHWA, 2014b):

1) What is the geographic area affected by the study?
2) What are the resources affected by the study?
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?

Each of these parts of the Cumulative effects evaluation process is discussed in **Section 3** of this technical report.

2. INDIRECT EFFECTS ANALYSIS

2.1 STEP 1: SCOPING

The first step in the indirect effects analysis includes scoping activities and the identification of the ICE study areas in order to set the stage for the remaining steps. As part of this scoping effort, input received during preparation of the *I-95 HOT Lanes Project Environmental Assessment* (FHWA and VDOT, 2011) is considered in the current analysis. In addition, a number of local and regional planning documents were reviewed. These include comprehensive and/or capital improvement plans for Fredericksburg, Prince William, Fauquier, Stafford, King George, and Spotsylvania Counties, and the town of Dumfries. The analysis also includes reviews of the long-range transportation plans for MWCOG and FAMPO. The following is a summary of how each document refers to the Fredericksburg Extension Study:

- *I-95 HOT Lanes Project Environmental Assessment* (FHWA and VDOT, 2011) examined environmental impacts for the project extending 46 miles from Spotsylvania County to Fairfax County. FHWA and VDOT conducted federal, state, and local agency coordination to obtain pertinent information and to identify key issues regarding potential environmental impacts. FHWA and VDOT completed review of the National Capital Region TPB's 2010 Financially Constrained Long Range Transportation Plan (CLRP) and FY 2011-2016 TIP, which were found to conform to the STIP. The southern portion of the project (south of the Prince William / Stafford County line) was included in the FAMPO's 2035 CLRP and FY 12-15 TIP, which were also found to conform to the STIP. Through review of these plans and other local and county planning documents, FHWA and VDOT determined that the project was consistent with local comprehensive planning regarding land use goals in the surrounding area and transportation in the project corridor.
- *Town of Dumfries Comprehensive Plan* (Town of Dumfries, 2014) has defined a policy that actively supports all improvements to I-95 that reduces through traffic in town. This policy includes: promoting VDOT and FHWA initiatives to construct additional capacity on I-95 without financially impacting town residents; promoting planning and construction of additional HOV lanes south of Exit 152 in order to relieve spillover traffic that clogs town roads when I-95 is congested; and promoting the use of HOV lanes, as well as carpooling and vanpooling, through incentives for destinations that accommodate ridesharing programs.
- *Prince William County 2008 Comprehensive Plan* (Prince William County, 2008) does not directly reference the Fredericksburg Extension Study, but it does recommend the addition of a fourth GP lane in both directions and the addition of a third Express Lane to assist in handling the increasing commuter traffic associated with adjacent jurisdictions to the north and south beginning at the Stafford and Prince William County lines. The County has an action strategy to work with VDOT and federal agencies to enhance the capacity of I-95 with these improvements.
- *Stafford County Comprehensive Plan 2016-2036* (Stafford County, 2016b) identifies that its transportation system currently experiences significant morning and afternoon traffic congestion, and the county anticipates that multiple road network improvements would be required based on their 20-year growth projection. The county's transportation plan identifies and supports the following improvements to I-95 in the study area:
    - Reconstruction/relocation of the Courthouse Road interchange
    - Extending Express Lanes from Garrisonville Road to Exit 126
    - Centreport Parkway ramp improvements

  - Inner shoulders to lane conversions
  - Rappahannock River Crossing Southbound Project
- *Fredericksburg Virginia Comprehensive Plan* (Fredericksburg, 2015) identifies transportation goals and initiatives that would guide transportation development in the City and outline the key steps for implementing the long-term goals for the City's transportation system. Goals include reducing congestion, improving transportation efficiency, and enhancing safety. The City would continue to seek transportation solutions through the regional planning process with FAMPO and other partnerships. The Plan recognizes VDOT's desire to extend the Express Lanes from Garrisonville Road to Exit 126.
- *Spotsylvania County Comprehensive Plan* (Spotsylvania County, 2016) recognizes the importance of I-95 as part of the Washington to North Carolina Corridor of Statewide Significance and lists strategies identified in Virginia's long-range multimodal policy plan (VTrans2035) to increase highway capacity through interchange improvements and modifications, interchange construction, and widening. The county's Transportation and Thoroughfare Plan identifies the following policies to provide direction for transportation-related decision-making in the county:
  - Maintain acceptable levels of service (LOS) on public roads;
  - Ensure that new development does not degrade LOS;
  - Promote alternative modes of transportation and multi-modal facilities;
  - Plan transportation facilities to minimize adverse effects on historic and environmental resources; and
  - Plan transportation facilities that are cost-effective and can be completed in a timely fashion.
- *2016 Amendment to the Constrained Long-Range Transportation Plan* (MWCOG, 2016) for the National Capital Region includes all major transportation projects reasonably expected to be completed in the region through 2040. The document defines major projects as those "which directly affect interstates, major arterials, and expressways or freeways with at-grade intersections, as well as dedicated transit facilities." The document includes planned improvements to US 1 in Prince William County, but it does not mention the Fredericksburg Extension Study or its components.
- *2040 Long Range Transportation Plan* (FAMPO, 2013) identifies highway needs through 2040 to address roadway performance "caused by deteriorated conditions, congestion, and the need for more efficiency and connectivity in the Regional surface transportation system." The organization's fiscally constrained highway plan includes 37 projects and 12 preliminary engineering studies funded for implementation or analysis in the study area. Interstate projects and studies include:
  - Reconstruction/relocation of the VA 630 / Courthouse Road interchange (Exit 140);
  - Extending Express Lanes from near VA 610 / Garrisonville Road (Exit 143) to Exit 126;
  - Constructing Inner shoulders to lane conversions for use during peak periods; and the
  - Rappahannock River Crossing Southbound Project.

More recently, as part of the Revised EA process, VDOT mailed scoping letters and questionnaires regarding ICE in November and December 2016 to the following state, federal, and local agencies and organizations to obtain pertinent information and data, as well as to identify key issues regarding the potential environmental impacts for this study:

- Caroline County
- City of Fairfax

- City of Fredericksburg
- DoD-Air Force District of Washington
- DoD-Office of Economic Adjustment
- DoD-Office of the General Council
- DoD-Office of the Secretary of Defense
- DoD-Washington Headquarters Service
- Fairfax County
- Fredericksburg Area Metropolitan Planning Organization
- MCBQ
- National Capital Region Transportation Planning Board
- National Oceanic and Atmospheric Administration (NOAA)-National Marine Fisheries Service (NMFS), Habitat Conservation Division
- Natural Resources Conservation Service (NRCS)
- Prince William County
- Spotsylvania County
- Stafford County
- Town of Dumfries
- Town of Occoquan
- Town of Quantico
- US Army Corps of Engineers (USACE)-Norfolk District
- US Department of Housing and Urban Development, Richmond Field Office
- US Department of Interior-Office of Environmental Policy and Compliance
- US Department of Transportation (USDOT)-Federal Railroad Administration
- US Department of Transportation-Federal Transit Administration
- US Environmental Protection Agency
- US Fish and Wildlife Service (USFWS)
- US Forest Service (USFS)
- USNPS
- Virginia Department of Agriculture and Consumer Services
- Virginia Department of Aviation
- Virginia Department of Conservation and Recreation (VDCR)-Department of Natural Heritage (VDCR-DNH)
- Virginia Department of Emergency Management-Region 7
- Virginia Department of Forestry (VDOF)
- Virginia Department of Environmental Quality (VDEQ)
- Virginia Department of Game and Inland Fisheries (VDGIF)-Environmental Services Section
- Virginia Department of Health, Office of Drinking Water
- Virginia Department of Historic Resources (VDHR)-Office of Review and Compliance
- Virginia Department of Housing and Community Development
- Virginia Department of Mines, Minerals, and Energy
- Virginia Department of Rail and Public Transportation (VDRPT)
- Virginia Economic Development Partnership
- Virginia Marine Resources Commission (VMRC)
- Virginia Outdoors Foundation (VOF)
- Virginia State Police Department

Survey questionnaires customized for various stakeholders or agencies requested input on the ICE study area boundaries, the impact methodology to be used for resources of interest to recipients, and any data helpful to the ICE analysis. Respondents provided information about other projects underway or in planning stages to be considered in the ICE and specific environmental resources to evaluate or consider. Only one respondent provided a comment specific to the ICE analysis. The USACE indicated in their response that use of the Hydrologic Unit Code (HUC) 12 digit boundary in the ICE might not be of sufficient size to address the indirect effects to aquatic resources that could extend downstream and beyond the limits of the HUC 12 digit boundary. Therefore, the boundaries used to examine the indirect effects of the study were expanded to include potential downstream impacts as discussed in **Section 2.2.1**.

On March 21, 2017, and March 22, 2017, VDOT held Public Information Meetings (PIM) to introduce the study to the public, share available information, and gather public input for consideration during study development. Twenty comments were received as a result of the PIMs but none concerned the ICE analysis.

2.2 STEP 2: IDENTIFY STUDY AREA DIRECTION AND GOALS

The ICE geographic study areas used for assessing indirect effects on particular resources are defined in this step. **Step 2** also provides the context for understanding changes and trends that have occurred over time resulting in current resource conditions in the ICE study areas, and identifies goals for the future as expressed in area plans.

2.2.1 Study Areas

As described in **Section 1.3.2**, the NCDOT guidance recommends induced growth impacts are most often found up to one mile around a freeway interchange and two to five miles along major feeder roads. These distances would capture induced growth around new and existing interchanges. The NCDOT guidance notes several factors that influence the likelihood of induced growth, including the extent and age of the existing transportation infrastructure, land availability, and regional economic conditions. As previously discussed, I-95 in the study corridor opened over 50 years ago, and the areas near interchanges in Prince William County and northern Stafford County are generally built-out or constrained by protections afforded by the National Park Service (Prince William Forest Park) or DoD (MCBQ). Induced growth effects from the proposed transportation improvements in this area would result from infilling and be subject to community planning requirements. Land in central and southern Stafford County is less urbanized when compared to northern Prince William County, and the Build Alternative may result in development shifts in these areas, in accordance with community planning and as favorable economic conditions permit.

The proposed I-95 Express Lanes would provide an alternative travel option, with improved reliability and reduced travel times compared to the existing I-95 GP lanes, for users of the existing interchanges and feeder roads within the study area. However, the I-95 Express Lanes would be dynamically priced to manage total demand, limiting the overall additional traffic demand that would be served. On a daily basis, by providing additional managed lane capacity, the Build Alternative is expected to increase throughput along the I-95 corridor by approximately six percent north of Exit 143 and eight to ten percent between Exits 133 and 143 when compared to the No-Build Alternative.

The proposed Build Alternative would provide access to the Interstate 95 corridor at the same locations where access is provided under the No-Build Alternative. One new direct (reversible) ramp connection from the I-95 Express Lanes is proposed to Old Courthouse Road; this ramp would serve a relocated park-and-ride facility and offer direct access to the Express Lanes from the Old Courthouse Road / Courthouse Road interchange (Exit 140) area. Since the direct ramp access is located in close proximity to the Exit 140 interchange, the proposed induced growth area (one mile around the interchange) would be appropriate at this location. The remaining connections would be between the I-95 Express Lanes and the I-95 GP Lanes; users would need to access I-95 GP lanes via the feeder roads at the other existing interchanges (Exit 133, Exit 136, Exit 143, and Exit 148) and then enter the Express Lanes via slip ramp or flyover ramp connections. Following the guidance, as these interchanges are existing, use of the one-mile buffer is also appropriate to define the Induced Growth study area.

Major feeder roads near locations of proposed ramps or access points to existing interchanges are included out to a distance of three miles from the interchange. Interchanges with a three-mile buffer include Exit 133, Exit 140, and Exit 148. The ICE study used the three-mile distance at these interchanges and ramp locations as the expanded Express Lane access from these interchanges may increase the

potential for induced growth near the interchange. Therefore, use of the larger study area in the ICE analysis would capture the existing land use and development conditions further afield of the interchange and allow for examination of induced growth affects. Feeder roads at the remaining interchanges in the study area (Exit 136 and Exit 143), are included in the Induced Growth Study area out to a distance of two miles from the interchange. No ramps or new connections are proposed at these interchanges; therefore, the potential for induced growth is less than at Exit 133, Exit 140, and Exit 148. Use of the two-mile distance is appropriate at these interchanges and within the range of the recommended guidance.

Along all the major interchange feeder roads included in the Induced Growth study area, a 1,000-foot buffer was applied to the roadway centerline. The 1,000-foot buffer is used because it represents a conservative estimate of the distance over which the influence of the study could be felt and is comparable to the areas of potential effect used for other impact assessments and resources. Based on the above principles, the indirect effects analysis focuses on the potential for ecological and socioeconomic impacts that could occur as a result of the proposed Build Alternative outside of the area of direct impact.

Figure 2-1 shows the Induced Growth study area. Portions of the Induced Growth study area are included within each of the specific resource study areas described below.

Specific ICE study areas were developed for each of the following resources:

- **Socioeconomic Resources**: The Socioeconomic Resources ICE study area was established to analyze indirect effects to land use, socioeconomics (including environmental justice), and parks/recreational resources/open space. The Socioeconomic Resources ICE study area includes those Census block groups that lie directly within or partially within the area of proposed improvements (**Figure 2-2**).
- **Natural Resources**: The Natural Resources ICE study area was established to analyze indirect effects to water resources, wildlife habitat, and threatened and endangered species. The Natural Resources ICE study area is based on VDCR Virginia HUC subwatersheds encompassing the Build Alternative's direct impact area, and in response to the scoping comment provided by the USACE, as described in **Section 2.1**, those HUC subwatersheds near and downstream of the study area corridor, including the Potomac River (**Figure 2-3**). No other responses received during scoping concerned the Natural Resources ICE study area boundary.
- **Historic Resources**: The Historic Resources ICE study area was established to analyze indirect effects to architectural and archaeological resources (**Figure 2-4**). The Historic Resources ICE study area includes the area of potential effects (APE) within which indirect effects to architectural historic properties could occur from visual, audible, and atmospheric elements that could diminish the integrity of historic properties. The Build Alternative's limit of disturbance (LOD) is the basis for definition of the APE. For potential effects to architectural historic properties beyond the LOD, the indirect effects APE for this undertaking includes tax parcels immediately adjacent to the LOD not already impacted by modern development and sound walls. The archaeological APE is defined as the Study's LOD. The effects of the undertaking on historic properties, including indirect effects, are considered under Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, and its implementing regulations (36 CFR Part 800), as reported in the *Interstate 95 Express Lanes Fredericksburg Extension Study Historic Resources Technical Report* (VDOT, 2017d). Indirect effects analyzed in this ICE document are those related to potential changes in access and induced growth.

Figure 2-1: Induced Growth Study Area

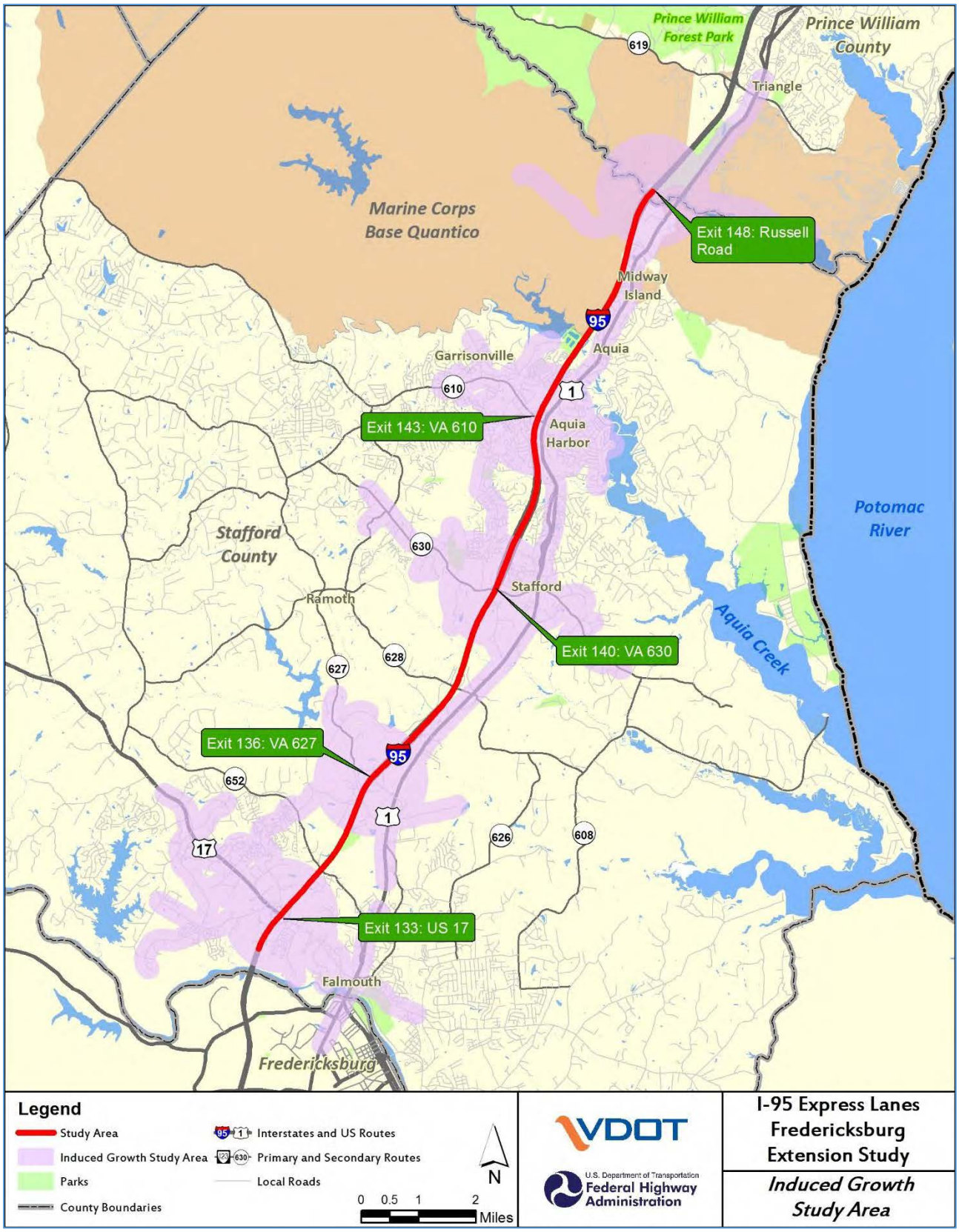


Figure 2-2: Socioeconomic Resources ICE Study Area

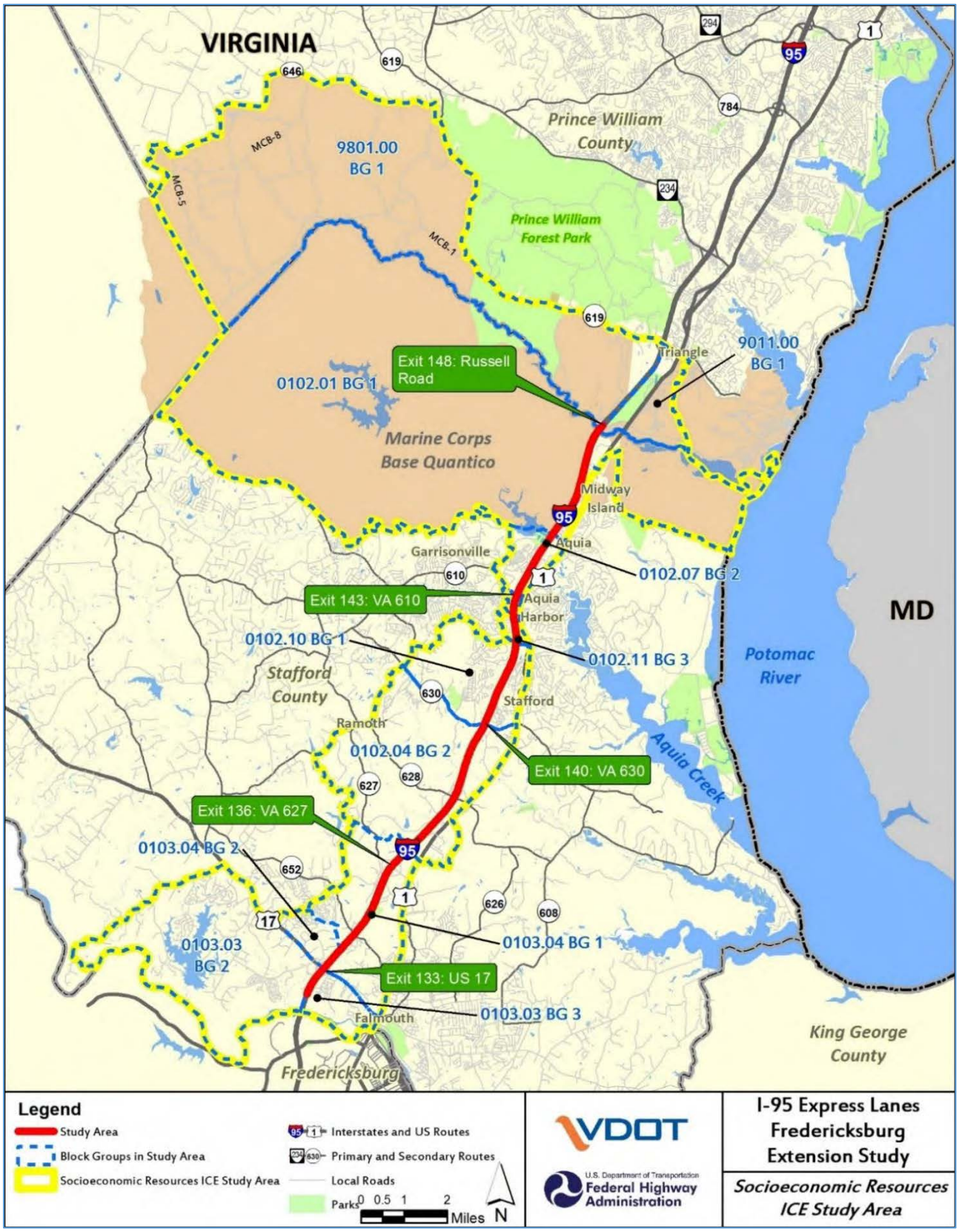
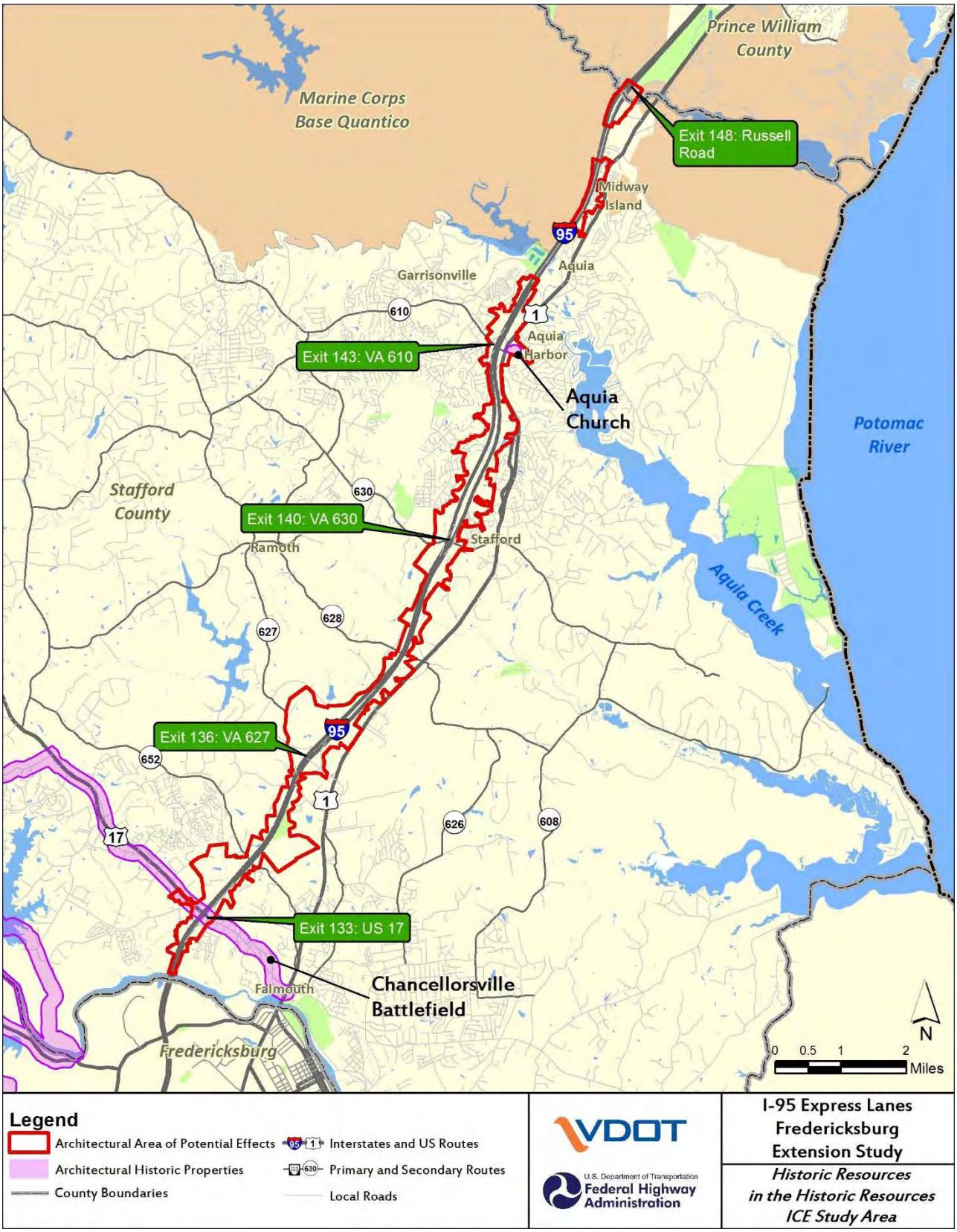


Figure 2-3: Natural Resources ICE Study Area

Figure 2-4: Historic Resources in the Historic Resources ICE Study Area



No ICE study areas for air quality or noise are defined. The air quality ICE of the Fredericksburg Extension Study alternatives are evaluated in the *Interstate 95 Fredericksburg Extension Study Air Quality Technical Report* (VDOT, 2017e) and take into account future air quality impacts for the region. Potential noise effects are evaluated for the study alternative's alignment in the *Interstate 95 Fredericksburg Extension Study Preliminary Noise Analysis Technical Report* (VDOT, 2017f) that incorporates the existing cumulative ambient noise environment with contributions from all sources including aircraft and railroads (regardless of where these sources are located). Mitigation for noise impacts is based on the forecasted noise levels in the design year.

2.2.2 Direction and Goals

The direction and goals considered for the analysis are independent of the transportation alternatives being evaluated in the Revised EA and include social, economic, growth-related, and natural and cultural resources-related issues. 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 a thorough knowledge of demographic, economic, and social trends is essential to understanding the potential for study-influenced changes. It is also important to understand the regional goals for consideration of potential indirect effects to the natural environment, and whether potential effects are in line with local goals as a determinant of impact significance and an indicator of effects that merit further analysis. The following sections describe the existing and planned land use, population/employment, and economic development trends in the Socioeconomic Resources ICE study area, presented in order to provide insight to the direction and goals for the Fredericksburg Extension study area corridor. In addition, environmental resource impact trends and protection goals within the Natural Resources ICE study area and Historic Resources ICE study area are discussed.

2.2.3 Historic Land Use

Early historical records show the area was inhabited by Native American tribes whose settlements clustered around waterways (Prince William County, 2012a). The first European contact occurred in the early 1600s when Captain John Smith first explored the Potomac River in 1608 (Prince William County, 2012a). At that time, the region was heavily wooded and the shoreline along the Potomac was in relatively "pristine" condition, with many more wetlands and wildlife than are present today.

The region was visited intermittently by explorers for the next several decades and one of the first permanent settlements appeared along Aquia Creek in 1647 (Stafford Historical Society, 2017). Further European settlement was established relatively quickly. As the Europeans settled the area, they took village sites and fields from the Native Americans. Stafford County was formally established in 1664 followed later by Spotsylvania County in 1721. Fredericksburg was formed from Spotsylvania County in 1728 (Spotsylvania County, 2017). King George County, named for King George I of England, was formed from Richmond County in 1720 (King George County, 2017). The Virginia General Assembly founded Prince William County in 1730 from which Fauquier County (1759) was later formed.

With its abundance of timber, sandstone, fish, iron ore, and waterpower, industry dominated Stafford County from the late 1600s until the Civil War (Stafford Historical Society, 2017). Land use in other areas was predominately based on agriculture, such as tobacco production (Sweig, 1995), with the town of Dumfries exporting more tonnage of tobacco than the entire colony of New York in 1763 (Prince William County, 2012a). The settlement and agricultural expansion resulted in changes to and loss of natural communities that were present when the area was in nearly pristine condition. In 1784, ferry service opened across the Rappahannock River, connecting Stafford County and Fredericksburg, allowing farmers

and plantation owners to transfer crops to waiting ships. The ferry service established Fredericksburg as a dominant and thriving port and commercial center (Fredericksburg, No Date a).

Land use continued to be predominately agricultural following the end of the Revolutionary War. However, in the early nineteenth century, portions of Virginia had made the shift from an exclusively agrarian society to a diverse landscape with well-developed towns and cities (Fredericksburg, No Date b). New roads were constructed through the region and the railroad era began in Virginia around 1811. The Richmond, Fredericksburg, and Potomac Railroad, chartered in 1834, connected Richmond to Fredericksburg in 1837 and then later to the Potomac River at Aquia Creek in 1842. In 1851, the railroad reached Manassas (Prince William County, 2012a).

The Antebellum Period (1812-1865) brought many internal improvements funded by the Virginia Board of Public Works including large-scale construction of railroads and turnpikes. Development also included construction of the Falmouth canal in Stafford County to power massive flour mills, and construction of a canal on the Rappahannock River began in 1829 (Stafford County, 2014). When completed in 1849, the canal extended 15 miles from the fall line at Fredericksburg to Waterloo in Fauquier County, and incorporated nearly 50 locks and 20 dams (VirginiaPlaces.org, No Date). The Fredericksburg Water Power Company purchased the canal and constructed an 18-foot high dam (Embrey Dam) at Fredericksburg in 1855 to turn waterwheels that powered machinery in nearby mills.

During the Civil War (1861-1865), many Union forts were constructed where thousands of troops were stationed throughout the region, and many battles were fought after the Commonwealth ratified succession on May 23, 1861. The Fredericksburg and Spotsylvania National Military Park is located within the study area. Major battlefield sites nearby include Spotsylvania Courthouse Battlefield, Chancellorsville Battlefield, Manassas National Battlefield, and the Ox Hill Battlefield.

Following the Civil War, economic growth struggled in the region during the Reconstruction period and this limited population growth in some areas (Fredericksburg, No Date c). Stafford County's population did not recover until the 1940s following World War I and the Depression (Stafford County, No Date). However, with vast increases in the size and scope of the federal government, the northern portion of the study area changed from an agrarian land use, to predominately residential, to intensive commercial and residential. This pattern continued through Prince William County, central and southern Stafford County, and Fredericksburg. The Prince William County and Fredericksburg populations expanded nearly 60 and 99 percent between 1900 and 1940, respectively (US Census Bureau, 1995).

As the federal government expanded, so did its land holdings. Marine barracks were established on the Quantico River in 1917, and the Marine Corps Base Quantico became an official training facility for the Navy in Prince William County. The town of Quantico, surrounded by the facility, was incorporated into the Base in 1927.

Commercial and residential development expanded and population growth increased exponentially following World War II. Along with the expanding population came increased automobile production and more and better roadways. State Route (SR) 1 (later US 1) was completed between Four Mile Fork in northern Spotsylvania County to Washington, DC in 1918. In 1964, I-95 was completed from Fredericksburg to the southern end of the Henry G. Shirley Highway. Passenger rail service was expanded in the study area with development of the VRE in 1992 that used tracks owned by Amtrak, Norfolk Southern, and CSX Transportation to connect Fredericksburg to Union Station in Washington, DC. A VRE station was opened in 2015, off US 17 and approximately five miles south of Fredericksburg, adding northern Spotsylvania County to the Fredericksburg service line.

As detailed in **Section 2.1**, the comprehensive plans for Dumfries, Fredericksburg, and Stafford and Spotsylvania Counties have been updated since completion of the original EA in 2011. The Fredericksburg,

Stafford County, and Spotsylvania County plans, have been updated following completion of the first section of Express Lanes extending south to Exit 143 in 2014. Each of these plans acknowledges the role that I-95 has played in historic, and current, land use patterns, and each supports improvements that would reduce congestion on local roadways. However, only Stafford County has indicated that it has adjusted its land use plans to accommodate anticipated growth resulting from the proposed construction of Express Lanes in the study area. As discussed further in **Section 2.2.4**, Stafford County would focus future residential growth and commercial development resulting from the Express Lane expansion into Target Growth Areas (TGAs) located near I-95.

Historic topographic maps and aerials most readily illustrate the pace and extent of growth in the region since the mid-Twentieth century. The maps and aerials also show the progression and extent of development impacts to the natural environment and historic properties. The US Geological Survey's (USGS) historical topographic maps for 1944 and aerials obtained from various sources for the years of 1960, 1971-1972, 1980, 1991, 2004, and 2015-2016 are available and are included in **Appendix B** for ease of reference. These maps and aerials were reviewed, and developments discussed, at a smaller scale as the study area is approximately 421 square miles in size and includes portions of five counties and one city. The development discussed captures the periods just before, during, and after construction of I-95 in the Fredericksburg Extension study area corridor and subsequent growth.

The following summarizes the review of historic topographic mapping and aerials in order by date.

1944 Topographic Mapping

The 1944 topographic mapping depicts Fredericksburg as highly developed. Development outside the city is clustered around US 3, US 17, and US 1. The Virginia Electric Power Company canal, Embrey Dam, and the Richmond, Fredericksburg, and Potomac Railroad are shown on the map. The railroad runs to the east of US 1, which was the primary north to south highway through the region at the time, and through the southeast end of Fredericksburg. The green space depicted on the map represents forested areas. Little green space is located along the Rappahannock River, as the majority of this land has been cleared for agricultural use. The degree of development decreases north of Fredericksburg, along US 1, towards Stafford. The development that does exist is located along US 1, the railway, Courthouse Road, and VA 627 / Mountain View Road. Development along Aquia Creek is likely for residential uses and occurs at points along the creek and at the end of the peninsula created by Aquia Creek and the Potomac River. Development increases and forested land decreases along Garrisonville Road to the west of US 1.

Boundaries for the US Marine Corps Reservation (future MCBQ) are depicted on the mapping with its boundary being similar in location to its position today. Development within the Reservation is clustered along US 1, south of Chopawamsic Creek, and along the shoreline of the Potomac River. There is dense development along the Potomac, the railway, and in the town of Quantico. Telephone and powerline easements cross from south to north through the Reservation and east to west towards the town of Quantico. Development increases along the northern boundary of the Reservation in the towns of Triangle and Dumfries. The development is located near Route 689 (future Fuller Road), Route 626 (future Joplin Road), US 1, and along the alignment of future Dumfries Road.

1960 Aerials

The 1960 aerials depict an increase in development along US 1 in Fredericksburg and southern Stafford County; however, construction of I-95 has yet to commence. The amount of green space has been reduced to the east of the Richmond, Fredericksburg, and Potomac Railroad and the amount of land used for agricultural purposes has increased. There is evidence of increased residential development along County Road 607 (Deacon Road), County Road 606 (Ferry Road), and County Road 1004 (Kelley Road) in southern Stafford County. A cleared easement now connects to both sides of the Rappahannock River at the Embrey

Dam site. This is likely a transmission line easement and it travels roughly southwest to northeast and parallels US 1 to its east through Stafford and Prince Williams Counties. The easement connects to an additional easement located to the west of Occoquan and Woodbridge. A dam has been constructed on Beaverdam Run in Stafford County, creating Lunga Reservoir within MCBQ.

Increased development is evident around the towns of Stafford, Widewater, and Widewater Beach along Aquia Creek and the Potomac River in Stafford County. Residential subdivisions are now evident along US 1 near the location of future Allen Dent Road in Prince William County. Initial development of the Possum Point Power Station on Possum Point, located at the junction of Quantico Creek and the Potomac River, has been completed along with additional transmission easements that originate at the station.

1971-1972 Aerials

The NB and SB lanes of I-95 are complete throughout the study area and they cross the Rappahannock River to the west of the main developed area of Fredericksburg. Entry and exit ramps to US 3 in both the NB and SB directions are complete. The interchanges for Courthouse Road and Garrisonville Road are also complete. Land formerly used for agriculture in northern Spotsylvania County and southern Stafford County has been converted to residential developments. Roads and residential housing have been developed in a block format in Bel Air, near Deacon Road, and along Ferry Road in Stafford County. A dam has been constructed on Potomac Creek, west of I-95, creating Abel Lake, a drinking water reservoir for Stafford County. The roadways to the future Aquia Harbour development have been cleared and the Aquia Harbour yacht club building and boat slips are under construction.

The Smith Lake dam is complete along Beaverdam Run, prior to its connection with Aquia Creek, thus creating the Smith Lake Reservoir. Development has increased along Onville Road and within the Marine Corps Base. Land is cleared and buildings have been constructed along the MCB-2 and MCB-3 base roads. Development has also continued within the Base along the Potomac River with construction of Marine Corps Air Station, Quantico that was renamed to Marine Corps Air Facility, Quantico in 1976.

In Prince William County, the I-95 interchanges at Russell Road, Joplin Road, Dumfries Road, and Dale Boulevard are complete. Residential and commercial development has increased between US 1 and I-95 and to the east of US 1 in Triangle and Dumfries. Additional transmission line easements were cleared in the region and originate at the Possum Point Power Station.

1980 Aerials

The 1980 aerials depict an increase in development in Fredericksburg and southern Stafford County along US, 1, US 3, White Oak Road, and US 17. This development has converted former agricultural land to residential and commercial uses. Development has also increased along Courthouse Road and Garrisonville Road and within Aquia Harbour in Stafford County. The coal ash ponds at the Possum Point Power Station are visible in the imagery.

1991 Aerials

The 1991 aerial imagery indicates that development within Fredericksburg and Stafford County has progressed with additional residential and commercial areas evident along US 1, US 3, White Oak Road, and US 17. Development to the west of I-95 along Garrisonville Road has continued, and the land has been cleared for the Weapons Training Battalion and Federal Bureau of Investigation pistol, rifle, and shotgun ranges within MCBQ. In Prince William County, land has continued to develop at a faster pace. Residential areas have expanded on the main side of MCBQ, in Triangle, and Dumfries.

2004 Aerials

As in the previous decades, land used for residential and commercial development has increased along US 1, US 3, White Oak Road, and US 17. Construction has commenced at the Centreport Parkway interchange, approximately 2.9 miles north of the US 3 interchange in Stafford County. The Stafford Regional Airport, which opened for business in 2001, has been constructed west of I-95 in Stafford County (Stafford Regional Airport, 2017). In eastern Prince William County, development east and west of I-95 has increased substantially.

2015-2016 Aerials

Compared to the historic level of development experienced in Fredericksburg and Prince William County, development since 2004 within these localities was generally in the form of infill. In Stafford County, increased residential and commercial use has occurred along Garrisonville Road and US 3, and the Centreport Parkway interchange is complete. Residential development has expanded north and south of Courthouse Road to the east and west of I-95. Development in Stafford County has transitioned from rural and suburban residential between Garrisonville and Fredericksburg to centralized and planned residential communities with access to feeder roads to the I-95 interchanges.

Historic Aerials Review Conclusions

Prior to 1960, growth and development in the study area was tied to the previous development and growth of Fredericksburg and US 1 and government investments that occurred at MCBQ. The development of I-95 in the early 1960s has facilitated growth in this area providing increased capacity and connectivity extending from Fredericksburg to north of the study area and Washington, DC. The suburban growth in this area has occurred near I-95 interchanges. Substantial development occurred in the study area in Prince William County, north of MCBQ and Prince William Forest Park, east to the Potomac River and west to Hoadly Road. This development included suburban and urban residential developments, large commercial areas, and shopping centers. This rapid development followed completion of I-95 in the study area. Currently, the undeveloped lands within this section of Prince William County contain wetlands, streams, floodplains, and the associated protections each are provided.

2.2.4 Land Use Patterns and Local Plans

The following sections describe the local plans that guide the land use patterns and other development within the Socioeconomic ICE study area. Additional information is available in the *Interstate 95 Fredericksburg Extension Study Socioeconomics and Land Use Technical Report* (VDOT, 2017g). The town and county plans described below provide a general, overarching planning guide for community development with some plans including selective neighborhood or area-specific plans that focus on issues specific to that planning area. Transportation elements of the below plans that overlap with the Fredericksburg Extension Study are described under **Step 1** in **Section 2.1**.

Prince William County

Prince William County updated the *Long-Range Land Use Plan* section of their *2008 Comprehensive Plan* in July 2012 to provide planned guidance for long-range land use planning that would help create "sustainable transportation networks and encourage development that is environmentally and fiscally sound." Using nationally recognized smart growth principles the county plans to ensure that open space and cultural resources are preserved, economic development is supported and expanded, the county's fiscal health is strengthened, and its residents have an exceptional quality of life. The county details in the plan the goals, policies, and strategies it intends to use to meet these principles (Prince William County, 2012b).

The plan divides the county into two general geographic areas including the Rural Area and the Development Area. The Rural Area consists of areas considered to be sensitive resources including agricultural, open space, and forested land. The portion of the Socioeconomic ICE study area occurring in Prince William County is contained within MCBQ and inside of the county-designated Rural Area.

The Development Area consists of the portion of the county that is currently developed, or which would be developed at a residential density greater than that in the Rural Area as well as commercial, office, and industrial uses. The county intends to focus funds for future infrastructure improvements and public facilities in the Development Area. In the *Long-Range Land Use Plan,* the county also encourages "development that infills undeveloped portions of established stable neighborhoods in the Development Area, at a density, mass, height, and intensity that conforms with those neighborhoods-so long as the general *Long-Range Land Use Plan* designation of that neighborhood is upheld."

The 2008 Comprehensive Plan contains seven approved sector plans that provide the vision, goals, and community design plans for designated areas in the county (Prince William County, 2008a). In addition to designated areas in the County with design plans, the Socioeconomic ICE study area is comprised of MCBQ, Prince William Forest Park, Quantico National Cemetery, National Museum of the Marine Corps, Locust Shade Park, and Forest Greens Golf Club. These restricted access areas are outside of any approved sector plan areas.

Town of Dumfries

The town of Dumfries' Town Council adopted the *Town of Dumfries Comprehensive Plan* in July 2014. In the plan, the town acknowledges that use of US 1 is increasing as I-95 becomes more congested. It also recognizes the need for improvements to US 1, such as grade-separated interchanges, to compensate for increased congestion. Further, the plan contains the goals, policies, and strategies the town plans to implement to form future land use decisions and contains small area plans for the northern and southern gateways into town (Town of Dumfries, 2014). In regards to current land use, the town's dominant uses are residential (40 percent), commercial (12 percent), civic (10 percent), and non-conforming (10 percent). For future growth, the town indicates that its location along I-95, proximity to expanding military bases, affordable housing, and expanding metropolitan economy would foster future population growth (**Figure 2-5**). However, the amount of vacant land in the town is limited; therefore, the potential for infill growth is limited. For growth to occur, redevelopment must convert existing developed sites to higher densities (Town of Dumfries, 2014).

Stafford County

Stafford County's *2016-2036 Comprehensive Plan* specifies the goals, objectives, policies, and implementation tools with which the county plans to guide future development. Plan elements include Environmental Plans, a Land Use Plan, and Community Facility, and Infrastructure Plans (Stafford County, 2016b). The Land Use Plan was developed to assist the county in directing the location, type, and intensity of future land uses.

The Land Use Plan identifies Planning Areas within its Urban Services Area where the county plans to focus much of its infrastructure, facility planning, and growth and avoid distributed growth in agricultural/rural areas, which are considered sensitive resources. The Planning Areas include TGAs and economic development Priority Focus Areas (PFAs). The county would focus approximately 50 percent of future residential growth (2016 to 2036) in TGAs, to be combined with commercial land uses (Stafford County, 2016b). By focusing growth in the TGAs the county is appropriately planning to reduce unintended and negative impacts upon I-95 and commute times for Stafford County residents, as well as, planning for potential growth associated with the planned expansion of Express Lanes in the county. The TGAs have also been located to minimize encroachment effects on MCBQ and the Stafford Regional Airport.

The PFAs, including planned redevelopment areas, represent the areas where the county encourages future business development. There are five TGAs contained in the Land Use Plan, three of which are combined TGAs/PFAs and are within the Socioeconomic ICE study area (**Figure 2-5**). Four redevelopment areas are presented in the Plan, with three occurring in the Socioeconomic ICE study area.

The Courthouse TGA/PFA is the county's first choice for targeted growth based on the planned improvements to Courthouse Road and proposed Express Lane improvements along I-95 (Stafford County, 2016b; Stafford County, 2016c). The county has planned for growth in this area resulting from these improvements, in the near term, with development of vacant land, and in the mid-term with controlled redevelopment primarily focused on the intersection of Courthouse Road with US 1. The Plan states that additional streets should be developed around the Courthouse area to create a grid street pattern, and to establish this area as the center of Stafford County (Stafford County, 2016b).

The Central Stafford Business Area TGA/PFA includes land in close proximity to Stafford Regional Airport and is limited in utility infrastructure. The county plans to target future commercial growth in this area and intends that the area become the employment center for the county (Stafford County, 2016b). The area includes two mixed-use sections where residential dwelling units could be supported.

The Warrenton Road TGA/PFA has opportunities for near-term, mid-term, and long-term growth and is also TGA designed to accommodate growth anticipated with completion of Express Lanes in the study area. (Stafford County, 2016b; Stafford County, 2016c). In the near-term, the county plans to focus growth in this area within undeveloped land to support business along the US 17 corridor. In the mid and long-term, the county intends to redevelop the mix of highway commercial and industrial uses to align with the county's *Master Redevelopment Plan for the Southern Gateway (Volume V)* (Stafford County, 2011). The Southern Gateway Redevelopment Area contains the majority of the Warrenton Road TGA/PFA, and is generally defined as the area along US 17 from Berea Church Road to I-95 in the east to Celebrate Parkway in the west. It is a mix of low-density retail and commercial uses with several hotels near I-95. The county plans to redevelop the area with higher commercial and mixed-use densities.

The Boswell's Corner Planning Area is a PFA and redevelopment area planned for future economic development due to its location, road access, and the presence of the adjacent MCBQ. The area is recommended for primarily business and industry future land use with no additional dwelling units recommended.

The Aquia Town Center Planning Area is a PFA and is part of a private redevelopment project. Redevelopment in the area includes Class-A office space, residential space, and commercial retail uses.

The Historic Falmouth Village Planning Area is a PFA and redevelopment area currently developed with a mix of commercial uses intermixed with residential communities. The area is recommended for primarily mixed-use future land use with park land use designated on the Historic Port of Falmouth Park and the Belmont Estate.

2.2.5 Planning and Forecasting

Population Growth Trends

The US Decennial Census (2010) reported that the total resident population in Virginia, Prince William, and Stafford Counties was 8,001,024, 402,002, and 128,961 persons, respectively (US Census Bureau, 2010). The US Census Bureau's American Community Survey (ACS) 2011-2015 5-year dataset reports that the total resident population in 2015 in Virginia was 8,256,630 (a 3.2 percent increase from 2010), 437,271 in Prince William County (a 8.8 percent increase from 2010), and 137,145 in Stafford County (an 6.3 percent increase from 2010).

Figure 2-5: Proposed Development Areas within Stafford County

The MWCOG projects population per Transportation Analysis Zone (TAZ) from 2015 to 2040. The current MWCOG Round 9.0 projections indicate that by 2040, the resident population of the Socioeconomic Resources ICE study area TAZs would increase from 59,583 to 98,212; a 64.8 percent increase. In comparison, the MWCOG Round 9.0 projections anticipate the resident population of Prince William County would increase by 29.6 percent and Stafford County would increase by 68.6 percent over the same period (**Figure 2-6**).

The Weldon Cooper Center for Public Service projects the statewide resident population would increase from 8,382,993 in 2015 to 10,201,530 persons in 2040; a 21.7 percent increase (Weldon Cooper Center for Public Service, 2017).

Employment Trends

The Socioeconomic Resources ICE study area encompasses parts of Prince William and Stafford Counties that are home to major employers within the area. Besides local school districts and local government employers, top employers in the area include GEICO (Stafford County), Wal-Mart (Prince William County), and the US Government (Prince William and Stafford Counties) (Virginia Employment Commission, 2017a; Virginia Employment Commission, 2017b). In 2015, Marine Corps Base Quantico had a daytime population of 31,000 (National Capital Planning Commission, 2016). The daytime population is expected to increase on Base to 43,000 persons by 2035, an increase of approximately 39 percent. Future development is planned on Base to support the anticipated increase.

The MWCOG projects employment per TAZ from 2015 out to the year 2040 (**Figure 2-7**). The current Round 9.0 projections indicate that by 2040, employment in the TAZs in the Socioeconomic Resources ICE study area would increase from 38,163 to 54,660 (a 43.2 percent increase). In comparison, the MWCOG Round 9.0 projections indicate employment in Prince William County would increase by 48.5 percent and Stafford County would increase by 44.2 percent over the same period (**Figure 2-7**).

Between 2005 and 2015, the unemployment rates in Prince William County, Stafford County, and Virginia fluctuated due to the Great Recession (**Figure 2-8**). The Great Recession was a period of economic downturn during the late 2000s and early 2010s. At the height of the recession in 2010, Prince William County, Stafford County, and Virginia had unemployment rates of 6.1, 6.5, and 7.1 percent, respectively. Since 2010, unemployment rates have been decreasing. The 2015 unemployment rates for Prince William County (4.1 percent), Stafford County (4.5 percent), and Virginia (4.4 percent) are the lowest since 2008 (Virginia Employment Commission, 2017a; Virginia Employment Commission, 2017b).

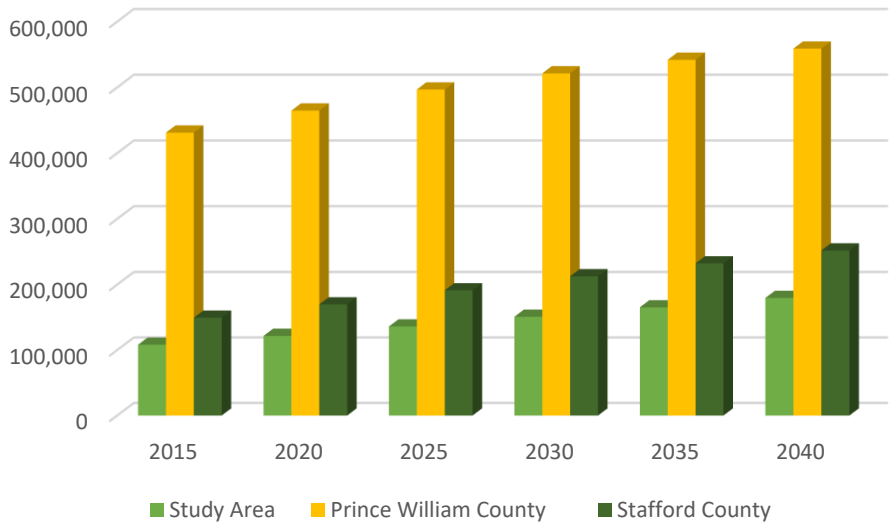
Economic Growth and Development Trends

I-95 extends along the eastern seaboard from southeast Florida to northeast Maine and serves major metropolitan areas including the cities of Baltimore, Boston, Jacksonville, Miami, Philadelphia, Richmond, Savannah, and Washington, D.C. The I-95 Corridor Coalition indicates that over its entire length, the average daily traffic on I-95 is over 72,000 vehicles, with peak daily traffic reaching over 300,000 vehicles. The areas directly along the I-95 corridor generate 40 percent of the US gross domestic product and 38 percent of US jobs, and are home to 37 percent of the US population (I-95 Corridor Coalition, No Date).

Nationally, the I-95 corridor is a vital conduit for commerce supporting the movement of freight/goods between major ports and manufacturing centers in the southeast including Miami, Jacksonville, Savannah, Charleston, Wilmington, Hampton Roads and the northeast consumer markets in Baltimore, New York and New Jersey. The segment of I-95 between Fredericksburg and Washington, D.C. carried 99 million tons of freight, valued at $155 billion, in 2012 (VDOT, 2016d). The value of these goods moved along this 50-mile section of I-95 represented nearly one percent of our nation's gross domestic product ($16.16

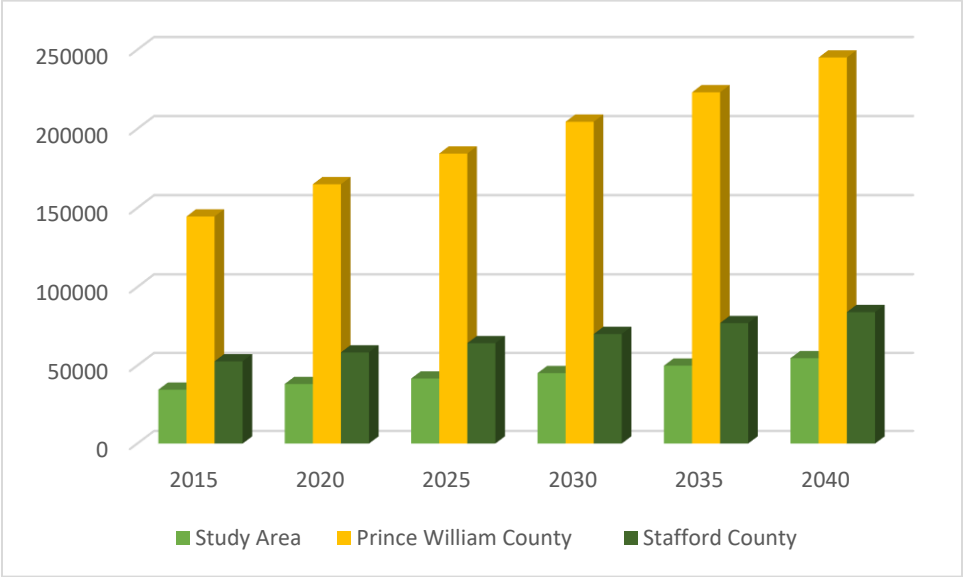
trillion) for that year (The World Bank Group, 2016). Growth in the regions north and south of the study area would produce increasing demand along I-95 in the study area for pass-through freight.

Figure 2-6: Study Area, Prince William, and Stafford County Population Projections (2015-2040)



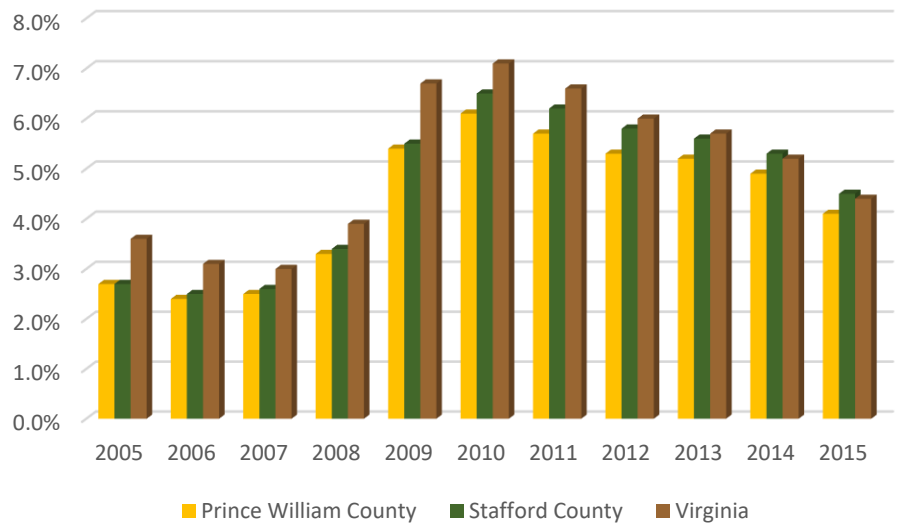
Source: MWCOG 2016.

Figure 2-7: Study Area, Prince William County, and Stafford County Employment Projections (2015-2040)



Source: MWCOG 2016.

Figure 2-8: Prince William County, Stafford County, and Virginia Unemployment Rates (2005-2015)



Source: Labor Market Information, 2016.

Regionally, I-95's importance stems from it being the only direct interstate connection from the south (i.e. Raleigh, Virginia Beach and Richmond) to north of the study area and Washington, D.C. This direct connection provides access for commuters travelling from their homes south of, and in the study area, to jobs located north of the study area. Employment centers of national significance are staffed by commuters using the corridor, including MCBQ, Fort Belvoir, the Pentagon, and the Naval Support Activity Washington. Collectively, I-95 in the study area provides access to over 100,000 direct employment opportunities and more than 400,000 people a day use the I-95 corridor between Richmond and Washington, D.C. (VDOT, 2016d).

Locally, I-95 is vitally important for the movement of freight/goods. Approximately 48 percent of the freight tonnage moving along the I-95 corridor locally is pass-through freight, but the majority, 52 percent, originates from, or reaches its final destination in, Virginia (VDOT, 2016d). In 2012, two of Virginia's top ten freight generating counties (Fairfax County at number three and Prince William County at number nine) were located in, or immediately adjacent to, the Fredericksburg Extension Study Area (Cambridge Systematics and Economic Development Research Group, 2015). I-95's many connections promote this movement of freight/goods, in, out, and within Virginia. These connections include several highway, rail, seaport, and airport facilities, including I-64, I-66, I-85, I-395, I-495, US 1, US 17, US 58, US 60, US 250, US 301, US 360, and US 460; Buckingham Branch, CSX, and Norfolk Southern rail lines; the Port of Richmond; and Dulles, Washington Reagan National, and Richmond Airports.

Federal spending has historically fueled economic and population growth in the region, which in turn has supported or induced the population growth that has occurred. According to data compiled by the Northern Virginia Regional Commission (NVRC), Virginia receives the most federal procurement dollars (defense and non-defense) of any state in the country, surpassing California in 2010 (NVRC, 2015). The NVRC reports that from 2010 to 2014, the US Government spent over $300 billion in Virginia purchasing products and services, and that the study area and surrounding region accounted for approximately 76 percent of that spending. Averaged annually, US Government procurement spending in Prince William and Stafford Counties was $2.4 billion and $0.2 billion, respectively, from 2010 to 2014 (NVRC, 2015).

Initiatives by study area localities foster economic growth at the local level as well. The Prince William and Stafford County Economic Development Authorities offer programs and incentives to help businesses to start, grow, and succeed. Prince William and Stafford County have programs offering incentives to businesses to locate and create jobs within Federal Historically Underutilized Business Zones. In addition, Prince William County may authorize the use of funds to attract and retain targeted industries and the funds may be used for infrastructure improvements, site preparation, work force services, and/or capital equipment purchases (Prince William County, 2017). Stafford County offers technology zone incentives that may include development fee and tax rebates, economic development grants, a waiver of certain construction fees, and tax rebates (Stafford County, 2017).

2.2.6 Land Use Trends

Prince William County

Excluding portions of the Socioeconomic ICE study area associated with I-95 and Chopawamsic Creek, almost the entire extent (approximately 99 percent) of the Socioeconomic ICE study area is undeveloped or is protected from development (**Figure 2-5**). These protections are afforded from the presence of MCBQ, Prince William Forest Park, Quantico National Cemetery, National Museum of the Marine Corps, Locust Shade Park, and Forest Greens Golf Club within the Socioeconomic ICE study area.

Stafford County

Current land use is indicative of the pattern of past growth in Stafford County. Approximately 69 percent of the county is currently under low density and military use. According to the Stafford County Comprehensive Plan, current land use is primarily agricultural/forestry (33.74 percent), followed by military (18.24 percent), rural residential (16.92 percent), suburban residential (6.81 percent), transportation and utilities (3.92 percent), and public facility (3.52 percent). Combined, commercial, construction, and industrial manufacturing uses account for less than seven percent. Urban residential land use in 2015 was 1.35 percent (Stafford County, 2016b).

As discussed in **Section 2.2.2**, the county recommends that future compact development occur in its designated Urban Services Area, which includes the county's TGAs and PFAs. Future facility and service upgrades, including public sewer, water, schools, community buildings, and transit services would be focused in these areas. Excluding land contained within MCBQ, the majority (approximately 68 percent) of the Socioeconomic ICE study area is contained within the Urban Services Area (**Figure 2-5**). Future development outside the Urban Services Area would not receive the priority focus for community services and facility expansion, limiting the attractiveness of these areas to developers.

2.2.7 Natural Resource Trends and Goals

Historical development in the region has resulted in loss of natural areas, wildlife, and wildlife habitat, as well as negative impacts to water quality. This trend has continued since completion of the EA in 2011. Today, the comprehensive plans from study area localities, define objectives, goals, or strategies to minimize destruction of environmental assets such as prime agricultural lands, environmentally sensitive soils, wetlands, streams, floodplains, and/or wildlife habitats as well as preservation of water quality (Stafford County, 2016b; Prince William County, 2012b; Town of Dumfries, 2014; Fredericksburg, 2015; Spotsylvania County, 2016).

Terrestrial Resources

As shown in the aerial imagery described in ***Section 2.2.3***, agricultural lands in the study area have historically been converted to residential and commercial uses. To counteract conversions of these valued natural and ecological resources, Virginia passed the Agricultural and Forestal Districts Act, in 1977, and

the Local Agricultural and Forestal Districts Act in 1982. These acts declare that it is the policy of Virginia to conserve, protect, and encourage the development and improvement of the state's agricultural and forestall products. To that end, the Virginia Code enables localities and landowners to conserve and protect valuable agricultural and forestal lands by mutually agreeing to form agricultural and forestal districts. Once a district is formed, landowners receive reduced tax rates for their land contained in the district and the land within the district is prohibited from being developed to a more intensive use for the duration of the district, which must be renewed every eight years.

Further protection of farmlands extends to protecting their important soils. In preparing its report on each major state project, as required in Article 2 (§ 10.1-1188 et seq.) of Chapter 11.1 of Title 10.1 of the Code of Virginia, each state agency shall demonstrate that it has considered the impact that a project would have on farm and forest lands as required in § 3.2-205, and has adequately considered alternatives and mitigating measures. The VDEQ, in conducting its review of each major state project, shall ensure that such considerations are demonstrated and shall incorporate its evaluation of the effects that the project would have on farm and forestlands. Farmlands to consider include that underlain by prime, unique, and important farmland soils.

Aquatic Resources and Habitat

In 1780, wetland coverage in the northeast region, including Virginia, was approximately seven percent. Since that time, at least 2.8 million acres (one quarter of the original extent) has been converted for development or for agricultural purposes (Anderson and Sheldon, 2011). Locally, the VDEQ summarizes historical impacts to wetlands in the state, reporting that Virginia had lost 42 percent of its wetlands to development from the 1780s to the mid-1980s, when permits began to be required for most impacts to wetlands (VDEQ, 2014). Agriculture, forestry, industrial and urban development, and recreation have resulted in draining, dredging, ditching, filling, diking, and damming of wetlands in Virginia such that an average annual loss of 3,870 acres occurred during this period (VDEQ, 2014). Statewide, from July 1, 2001 to June 30, 2013, impacts to 2,460 acres of wetlands and open water systems were permitted or authorized that were compensated for through creation, enhancement, restoration, or preservation of more than 10,000 acres of wetlands and in-lieu fee purchases (VDEQ, 2013).

A study conducted by Tiner and Foulis in 1994, including portions of the Natural Resources ICE study area in Fredericksburg and Spotsylvania County, examined wetland trends between 1980-1981 and 1988/1991. The study revealed that between the two analysis periods, over 127 acres of vegetated wetlands were converted to uplands (Tiner and Foulis, 1994). In addition, approximately 81 acres of vegetated wetlands were permanently converted to other wetland classes. Between the two impact types, approximately 175 acres of vegetated wetlands were lost. During the two periods of analysis, approximately 13 acres of vegetated wetlands and 125 acres of new ponds were created from uplands. However, the prevailing trend, as revealed in this study, was of wetland loss, with lesser gains of non-vegetated wetland acreage.

Permit database information was requested from the USACE for analysis of recent wetland impact trends in the region. Information is available from the VDEQ for state-permitted wetland and stream impacts in the region. The VDEQ Office of Wetlands and Stream Protection prepared a report titled, *Virginia Water Protection Permit Program Overview 2013*, in which they summarized permitting, compensation, and compliance activities throughout the state for activities requiring VDEQ permitting between July 1, 2001 and June 30, 2013. Although the period evaluated precedes completion of the first section of Express Lanes to Exit 143 in Stafford County in 2014, it does provide background on trends for permitted wetland and stream impacts in the region. During the period evaluated, the VDEQ authorized impacts to approximately 2,460 acres of wetlands and open water systems and to approximately 1.7 million linear

feet of streams (VDEQ, 2013). The cumulative wetland and open water impact acreage and stream impact length by locality is contained in **Table 2-1**.

Table 2-1: VDEQ-Permitted Wetland and Open Waters and Stream Impacts by Localities (2001-2013)

Locality	Wetland and Open Water Impacts (Acres)	Stream Impacts (Linear Feet)
Prince William County	126-200	175,001-310,000
Fauquier County	16-40	10,001-20,000
Stafford County	16-40	100,001-175,000
Fredericksburg	3-5	1,001-3,000
Spotsylvania County	6-15	10,001-20,000
King George County	3-5	3,001-10,000

Source: VDEQ, 2013.

Although development has continued, and accelerated since 1964 when I-95 was completed, as illustrated in the historic aerials discussed in **Section 2.2.3**, the net loss of wetland areas slowed following passage of the Clean Water and Coastal Zone Management Acts of 1972. In addition, subsequent modifications to Nationwide Permits administered by the USACE, passage of the Chesapeake Bay Preservation Act of 1988, statewide wetland regulation through the Virginia Water Protection Permit Program, greater enforcement, and new mitigation strategies have lessened development and agricultural impacts to wetlands. Federal grants have been awarded to state and local organizations in Virginia to develop wetland monitoring and assessment models, collect data, and manage data that contributes to wetland preservation (VDEQ, 2013). Virginia continues to develop a baseline data set, documenting current conditions and the general quality of wetlands throughout the state to determine whether existing wetland conditions affect wetland functions and values (VDEQ, 2016b).

Similar to wetlands, streams and rivers in the Natural Resources ICE Study Area have been impacted by the growth and development discussed in **Section 2.2.3**. Streams have been filled in, dammed, piped, realigned and channelized, dredged, lined with concrete associated with ditching, bridge and culvert construction, and stream banks hardened with riprap and other materials. For those streams affected, these impacts have eliminated or reduced stream functions and values including natural flood control, groundwater recharge, nutrient recycling, creation and maintenance of biological diversity, and sustaining the biological productivity of downstream rivers and estuaries. These values are important for streams provide habitat for plants, animals, and microbes such as shelter, food, protection from predators, spawning sites and nursery areas, and travel corridors (VDEQ, No Date a). Today, potential impacts to streams are regulated similar to wetlands on a federal, state, and local level. In fact, it is an objective of Stafford County, goal of Fredericksburg, and strategy of Prince William County, to protect and restore the ecological integrity of their streams (Stafford County, 2016b; Fredericksburg, 2015; Prince William County, 2012b). When impacts are unavoidable, they must be compensated through a combination of restoration, enhancement, and / or preservation of streambed or restoration of riparian buffers (VDEQ, 2013). Additional compensation may in the form of in-lieu fees.

Water quality in the Natural Resources ICE study area has diminished because of past population growth and development (Stafford County, 2016b). Extensive areas of impervious surface have increased the volume and speed of surface runoff entering nearby waters, where pollutants are lifted and deposited into nearby waters, causing erosion that increases sedimentation. Earth disturbance for development and

agriculture exposes soil to water erosion and reduces filtering vegetation, increasing sediment deposition into nearby waters. Agriculture uses fertilizers and pesticides and concentrates livestock offal that ends up in stormwater runoff. This causes algal blooms that rob water of oxygen and affect the survival of aquatic wildlife. Accidental fuel spills, vehicle emissions, and chemicals used for road maintenance impact stormwater runoff. Primary factors influencing the impact of pollutant loading within any surface water body include the type and size of the receiving water body, the potential for dispersion, the size of the catchment area, the biological diversity of the receiving water body, and relative effectiveness of proposed mitigation measures.

Commercial and industrial development in the Natural Resources ICE study area has also introduced pollutants to surface water at specific outfall points. Point discharge, damming, and loss of overhanging vegetation have altered water temperature, as well as light levels in water that affect wildlife. Loss of vegetation, wetlands, and riparian areas has reduced vegetation that filters pollutants from runoff. All of these past and present activities have contributed to waterbody impairment in the area, affecting the ability of water in the Natural Resources ICE study area to support human and wildlife uses. It is an objective of Stafford County, goal of Fredericksburg, and strategy of Prince William County, to protect and improve the water quality in their surface water resources (Stafford County, 2016b; Fredericksburg, 2015; Prince William County, 2012b).

In compliance with Sections 303(d), 305(b), and 314 of the Clean Water Act (CWA), as amended in 1977, and the Safe Drinking Water Act, VDEQ has developed a prioritized list of waterbodies that currently do not meet state standards. Section 305(b) requires the state to submit a biennial report to the USEPA describing the water quality of its surface waters. Virginia's water quality standards define the water quality needed to support each of these uses by establishing numeric physical and chemical criteria. If a waterbody fails to meet the water quality standards, it would not support one or more of its designated uses. These waters are considered impaired and placed on the 303(d) list as required by the CWA.

Once a waterbody has been identified as impaired due to human activities and placed on the 303(d) list, VDEQ is required to develop a Total Maximum Daily Load (TMDL) for the parameters that do not meet state water quality standards. The TMDL is a reduction plan that defines the limit of a pollutant(s) that a waterbody can receive and still meet water quality standards. A TMDL implementation plan, including waste load allocations, is developed by VDEQ once the TMDL is approved by USEPA. The ultimate goal of the TMDL Implementation Plan is to restore the impaired waterbody and maintain water quality for its designated uses.

To protect water quality and to reduce development that had historically impacted streams, Virginia enacted the Chesapeake Bay Preservation Act in 1988 designating sensitive lands within 100 feet of the shoreline or along the banks of streams or wetlands within the Bay watershed as Resource Protection Areas (RPA). Development within an RPA is restricted to water-dependent uses or redevelopment. Under the Chesapeake Bay Preservation Area Designation and Management Regulations (VDEQ, No Date b), public roads and their associated structures are conditionally exempt from RPA impact review provided they are constructed in accordance with the Erosion and Sediment Control Law (ESC) (§10.1- 560 et seq. of the Code of Virginia) and the Stormwater Management (SWM) Act (§10.1-603. 1 et seq of the Code of Virginia). In response to these regulations, VDOT's practice is generally to maintain both water quality and quantity post-development equal to or better than pre-development, as described in the current guidance, as well as in the Minimum Requirements for the Engineering, Plan Preparation, and Implementation of Post-Development SWM Plans (Instructional and Informational Memorandum Number: IIM-LD-195.8, VDOT-Location and Design Division).

Along with impacts to wetlands, streams, and water quality, past development discussed in **Section 2.2.3** has encroached on floodplains and modified floodplains such that severity of flooding (height, extent, and duration) and erosion may be increased. Increased impervious surfaces from development can increase surface runoff quantity and velocity that exacerbate flooding. Floodplains are important because they temporarily store flood waters, maintain water quality by filtering sediments and pollutants, preserve and recharge groundwater supply, provide fish and wildlife habitat, and offer recreation opportunities (National Wildlife Federation, 2016; VDCR, 2016a). Executive Order 11988: Floodplain Management, issued in 1977, requires federal agencies to avoid, to the extent possible, long- and short-term impacts to floodplains and avoid direct and indirect support of floodplain development wherever there is a practicable alternative. Floodplain impacts are also regulated at the state level (VDCR) and by local flood insurance programs administered by each locality under the National Flood Insurance Program (NFIP).

Wildlife and Habitat

Of all the development in Virginia that has occurred in the last 400 years, more than a quarter of it has taken place in the last 15 years (Council on Virginia's Future, 2017). Virginia lost over 79,500 acres of forest, farm, and other rural land to development between 2007 and 2010. The VDOF reports, since 2001, nearly a half-million acres of forested land in the state has been lost to land use changes of which approximately 64 percent was cleared for urban development, 30 percent for agriculture, and the balance to other land uses. However, this loss was partially offset by returning 354,381 acres to the forest land base (VDOF, 2017). The remaining wildlife habitat is fragmented by development. This fragmentation affects certain species that require larger areas of intact habitat to subsist, and interferes with migration and reproduction for many species. The VDOF reports that statewide, it is able to conserve approximately 3,000 acres of forestland for every 16,000 acres that is lost. Urbanization, development, and associated municipal infrastructure represent the greatest factors in this forestland deficit.

According to the Stafford County *Wildlife Habitat Protection Plan,* it is estimated that from 1985 to 2000 the County lost 20,200 acres of forestland (Stafford County, 2000). In addition, according to the *Urban Ecosystem Analysis for the George Washington Region (PD 16)*, Stafford County lost an additional 6.4 percent of its tree canopy area between 1996 and 2009 coupled with an approximately 48.9 percent increase in impervious surface area (George Washington Regional Commission, 2010). Between 1996 and 2009, King George County, Spotsylvania County, and Fredericksburg experienced a loss of approximately 2.4 percent, 5.1 percent, and 27.6 percent of their tree canopy, respectively. During the same period, the impervious surface area in King George County, Spotsylvania County, and Fredericksburg increased approximately 41.9 percent, 46.8 percent, and 25.2 percent, respectively.

Aquatic wildlife and habitat in the Natural Resources ICE study area has also been historically impacted, as discussed above for wetlands, streams, floodplains, and forested areas. These changes result from land disturbance and increases in impervious cover. According to Stafford County's *Wildlife Habitat Protection Plan* as of 1995, less than 50 percent of the Aquia Creek and Accokeek Creek watersheds were undisturbed, 50 to 70 percent of the Potomac Creek watershed was undisturbed, and 70 percent of the Widewater/Chopawamsic Creek watershed was undisturbed (Stafford County, 2000). The land disturbance has caused changes in water quality that have affected aquatic wildlife by disturbing migration and reproduction of certain species, increasing turbidity that affects light levels in water affecting wildlife, and reducing aquatic wildlife populations.

Due to the broad use of available habitat by terrestrial and aquatic wildlife, numerous federal and state agencies may be involved in the regulation of proposed habitat impacts. Federal and state agencies regulate and manage activities associated with terrestrial and aquatic wildlife and their habitats on conserved lands and through the enforcement of laws related to hunting and fishing as well as threatened

and endangered species. The USFWS and VDGIF act as consulting agencies under the United States Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), and provide environmental analysis of projects or permit applications coordinated through the Federal Energy Regulatory Commission, the USACE, and other state or federal agencies. Their role in these procedures is to determine likely impacts upon fish and wildlife resources and habitats, and to recommend appropriate measures to avoid, reduce, or compensate for those impacts (VDGIF, 2017a). The Threatened and Endangered Species section of this report contains regulatory specifics pertaining to threatened and endangered species.

Shallow water areas, featuring Submerged Aquatic Vegetation (SAV), provide protective aquatic habitat for many species. The SAV gives three-dimensional cover for juvenile and adult finfish and shellfish while filtering runoff and reducing wave energy and suspended sediment in the water. Its presence, or absence, can be indicative of water quality (NOAA, No Date). In 1985, the SAV program mapped approximately 125 acres of beds as occurring in the Natural Resources ICE study area (Orth *et al*., 1986).

The federal Magnuson-Steven Fisheries Conservation and Management Act of 1976, as amended, provides for the conservation and management of the nation's fishery resources through the preparation and implementation of fishery management plans. Federal agencies are required to consult with the NMFS on proposed actions that may affect Essential Fish Habitat (EFH); that is, waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. The Fish and Wildlife Coordination Act, as amended in 1964, requires that all federal agencies consult with NOAA Fisheries, USFWS, and state wildlife agencies when proposed actions might result in modification of a natural stream or body of water. Federal agencies must consider the impacts that these projects would have on fish and wildlife development and provide for improvement of these resources in the Natural Resources ICE study area.

Anadromous fish are born in freshwater, migrate to the ocean, and return to freshwater streams and rivers to spawn. Historical records indicate anadromous fish species such as herring and shad migrated through the fall zone into the upper reaches of all major drainages in Virginia (VDGIF, 2017b). Heavy fishing pressure, dams, canals, and other obstructions have substantially reduced anadromous fish populations so that by 1990, the American shad (*Alosa sapidissima*) harvest was only approximately six percent of the total harvest documented at the beginning of the 20th Century in Virginia. Today, the commercial harvest and recreational catch of anadromous fish such as the American and hickory shad (*Alosa mediocris*), blueback (*Alosa aestivalis*), and alewife herring (*Alosa pseudoharengus*) are prohibited within the Potomac River in the Natural Resources ICE study area (Potomac River Fisheries Commission, 2017 and 2016). The VDGIF affords additional protection to anadromous fish species by instituting a time-of-year-restriction (extending from February 15 to June 30 of each year) for in-stream work in anadromous fish use waters.

Invasive species have been affecting wildlife habitat since the discovery of the Americas by Europeans in the 16th Century. According to EO 13112, invasive species are non-native plant, animal, or microbial species that cause, or have the potential to cause, economic or ecological harm, or harm to human health. EO 13112 requires federal agencies to not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species in the United States, with certain exceptions.

State and local governments also regulate invasive plant and animal species in the Natural Resources ICE study area to prevent the spread of harmful wildlife species and noxious weeds and plants deemed to be detrimental to the human and natural environment. Common plant invasive species observed within Prince William, Fauquier, Stafford, Spotsylvania, and/or King George Counties, Virginia include the tree-

of-heaven (*Ailanthus altissima*), Japanese stilt grass (*Microstegium vimineum*), Japanese honeysuckle (*Lonicera japonica*), and ivy-leaved speedwell (*Veronica hederifolia*) (iMapInvasives, 2017). Terrestrial animal species include the emerald ash borer (*Agrilus planepennis*), observed in Prince William, Stafford and Spotsylvania Counties, and the wild boar (*Sus scrofa*), observed in Spotsylvania County. According to the Maryland Department of Natural Resources (MDNR), invasive aquatic animal species observed within the Potomac River include snakehead (*Channa argus*) and blue catfish (*Ictalurus furcatus*) (MDNR, 2016).

Threatened or Endangered Species

Past and present development and agriculture impacts to plant and wildlife habitat, overexploitation of plants and wildlife, and introduction of exotic invasive species have been the principal factors contributing to reducing certain species to extinction or levels of concern for their continued existence (Evans, 2013). All species of wildlife are important to the overall ecological health of natural systems (VDCR-DNH, 2016). The federal Endangered Species Act of 1973 and subsequent amendments and regulations define basic protections for federally-listed wildlife and plants that are considered threatened, endangered, or Species of Greatest Conservation Need (SGCN). The law also affords protection to prescriptive habitat critical for protected species' survival, and applies to all federal, state, and privately-authorized projects or actions in the Natural Resources ICE study area that potentially affect threatened and endangered species. The USFWS and the NMFS are responsible for listing, protecting, and managing federally-listed threatened and endangered species.

The VDGIF's *Virginia's 2015 Wildlife Action Plan* reports that of Virginia's 884 SGCN, 160 species are estimated to occur, or recently occurred, in the region of Virginia including the study area. Of these species, 69 SGCN are dependent upon habitats within the region (VDGIF, 2015). The Virginia Endangered Species Act of 1972 and the Endangered Plant and Insect Species Act of 1979 protect the species that are listed as threatened or endangered. VDGIF and the Virginia Department of Agriculture and Consumer Services (VDACS) are responsible for administering and enforcing the endangered species regulations. In addition, a cooperative agreement with the USFWS, signed in 1976, recognizes VDGIF as the designated state agency with regulatory and management authority over federally-listed animals and provides for federal/state cooperation regarding the protection and management of those species. VDACS holds authority to enforce regulations pertaining to plants and insects.

The VDCR-DNH conserves Virginia's natural and recreational resources through programs such as biological inventories, natural community inventory and classification, environmental review, and the creation of Natural Area Preserves. Through the environmental review program, VDCR-DNH provides natural heritage information in order to meet local, state, and federal regulatory needs. In addition to Natural Area Preserves, which there are none within the Natural Resources ICE study area, VDCR-DNH also identifies Conservation Sites (CSs), which represent key areas of the landscape worthy of protection and stewardship action because of the natural heritage resources and habitat they support. Terrestrial CSs are polygons built around one or more rare plant, animal, or natural community designed to include the element and, where possible, its associated habitat and buffer or other adjacent land thought necessary for the element's conservation (VDCR-DNH, 2017). The VDCR-DNH also designates stream reaches that contain aquatic natural heritage resources as designated Stream Conservation Units (SCUs). CSs and SCUs receive a biodiversity significance ranking based on the rarity, quality, and number of element occurrences they contain on a scale of B1-B5, with B1 being most significant (VDCR-DNH, 2017).

2.2.8 Historic Resources

European settlement in the region began in the 17th century, initiating population growth and intensifying settlement over the last 400 years. This growth and development has occurred in previously settled areas up to modern times, preserving some prehistoric and historic resources while destroying others along the

way. Historic resources may be found throughout the Historic Resources ICE study area. Historic resources are primarily protected under the federal NHPA of 1966 and the Virginia Antiquities Act (Code of Virginia § 10.1-2300), applicable to projects on federal or state lands or that are federally or state funded or permitted. The federal Native American Graves Protection and Repatriation Act of 1992 provides for the protection of such graves and associated cultural remains to be repatriated to affiliated tribes at their request. In addition, Prince William and Stafford Counties have zoning ordinances governing county-designated historic overlay districts. The ordinances require that they conduct historic architectural reviews of proposed new construction, renovation, or building alteration projects in historic districts (Prince William County, 2013; Stafford County, 2016d).

2.3 STEP 3: INVENTORY OF SENSITIVE RESOURCES IN THE STUDY AREA

Sensitive resources for this study that were considered to be particularly relevant for the analysis of impacts from a transportation prospective include socioeconomics (including land use, community facilities, parks, recreational facilities, and EJ); natural resources (including select terrestrial resources, streams, wetlands, water quality, floodplains, wildlife and wildlife habitat, and threatened or endangered species); and historic resources.

2.3.1 Socioeconomic Resources

Land Use

In the absence of a consistent source of current land use data in the study area localities, land use within the Socioeconomic Resources ICE study area was identified using Geographic Information System (GIS) zoning data from Prince William and Stafford counties; planning documents from these local jurisdictions; and aerial photography from Google Maps and Google Earth. However, the zoning categories defined by Prince William and Stafford Counties are not identical. Therefore, this study has reclassified the zoning categories of Prince William and Stafford Counties into eight land use categories. The following land use classifications are used in this analysis:

- Agricultural
- Commercial
- Federal
- Industrial
- Mixed
- Planned Development
- Residential
- Right-of-Way

Table 2-2 shows which county-defined land use classes were converted into the eight classifications above.

Table 2-2: Land Use Conversions

Prince William County		Stafford County	
County Zoning Class	**Converted Land Use Class**	**County Zoning Class**	**Converted Land Use Class**
Agricultural (A-1)	Agricultural	Agricultural (A-1)	Agricultural
Federal (FED)	Federal	Rural Residential (A-2)	Residential
Neighborhood Business (B-1)	Commercial	Convenience Commercial (B-1)	Commercial
Convenience Business (B-2)	Commercial	Urban Commercial (B-2)	Commercial
Residential 4 Dwellings per 1 acre (R-4)	Residential	Office (B-3)	Commercial
Residential 16 Dwellings per 1 acre (R-16)	Residential	Life Care/Retirement Community (LC)	Residential
Village	Mixed	Light Industrial (M1)	Industrial
		Heavy Industrial (M2)	Industrial
		Planned Development-1 (PD-1)	Planned Development
		Planned Development-2 (PD-2)	Planned Development
		Planned-Traditional Neighborhood Development (PTND)	Planned Development
		Marine Corps Base Quantico (QMB)	Federal
		Suburban Residential (R-1)	Residential
		Urban Residential-Medium (R-2)	Residential
		Urban Residential-High (R-3)	Residential
		Manufacture Home (R-4)	Residential
		Recreational Business Campus (RBC)	Commercial
		Right-of-way (ROW)	ROW
		Suburban Commercial (SC)	Commercial
		Urban Development (UD)	Planned Development

As reported in **Table 2-3** and shown in **Figure 2-9,** the land within the Socioeconomic Resources ICE study area is, for the most part, comprised of federal land encompassed by MCBQ and Prince William Forest Park. Agricultural land that is considered by Stafford and Prince William Counties as a sensitive resource accounts for approximately 13.5 percent (10,826 acres) of the study area.

Table 2-3: Land Use in the Socioeconomic Resources ICE Study Area

Land Use	Acreage	% of Socioeconomic Resources ICE Study Area
Agricultural	10,826	13.5%
Commercial	2,420	3.0%
Federal	54,192	67.4%
Industrial	2,661	3.3%
Planned Development	1,236	1.5%
Residential	6,695	8.3%
Right-of-Way	2,421	3.0%

Sources: Stafford County (2016d); Prince William County (2015).

Community Cohesion, Community Facilities, Parks, and Recreational Facilities

Transportation improvements have the potential to affect directly communities and their cohesion. Community cohesion is a sensitive resource and is a loosely defined concept of community identity potentially based on shared ethnicity; coherent design features in a community's layout and aesthetics; and spatial cohesion gained by accessibility to neighbors, community facilities, goods and services. The level of cohesion in communities may vary depending on how long residents have stayed or plan to stay in the area and the accessibility to services and community facilities. Communities in the Socioeconomic Resources ICE study area were identified, and their locations determined, through use of online mapping and local comprehensive plans.

Community facilities, parks, and recreational facilities are sensitive resources as they provide often determine the desirability of a community as a place to live, work and play. Community facilities, parks, and recreational facilities in the Socioeconomic Resources ICE study area were identified through a review of data from local government and resource agencies. Numerous neighborhood and community facilities occur throughout the Socioeconomic Resources ICE study area including: 15 places of worship, eight schools, nine parks/recreational facilities, four community centers, four hospitals/urgent care centers, four fire stations, one post office, and one cemetery (not associated with a place of worship) (**Figure 2-10**). The Socioeconomic Resources ICE study area also contains multiple county and non-county trails.

Environmental Justice

The *Interstate 95 Express Lanes Fredericksburg Extension Study Socioeconomics and Land Use Technical Report* (VDOT, 2017g) provides a detailed description of the regulatory basis and methodology used for the Environmental Justice (EJ) analysis of direct, indirect, and cumulative effects of the Build Alternative on sensitive populations such as minority and low-income populations. These populations are considered sensitive, as they have historically borne disproportionately high or adverse human health or environmental effects from infrastructure projects (USDOT, 2016).

Figure 2-9: Land Use in the Socioeconomic Resources ICE Study Area

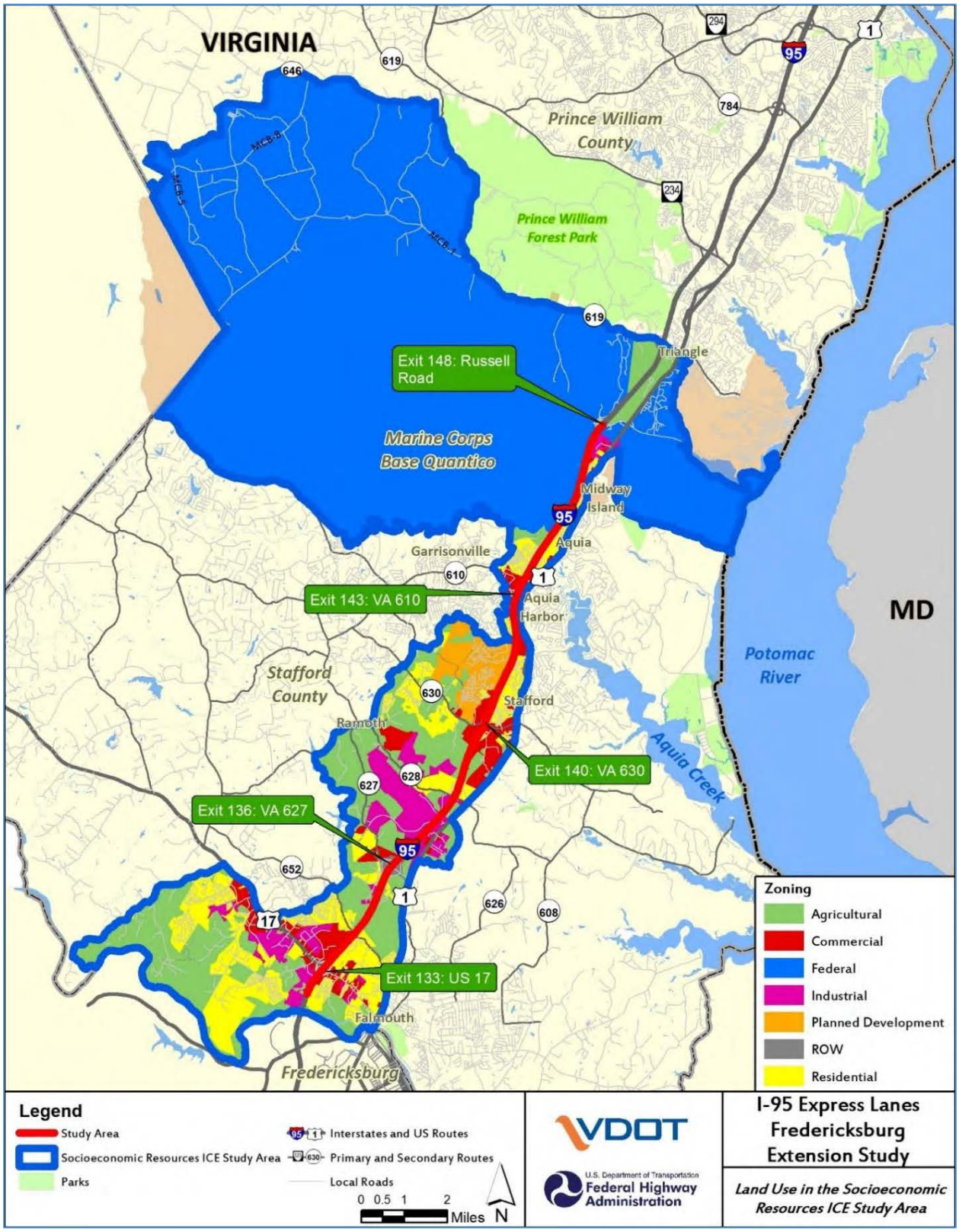
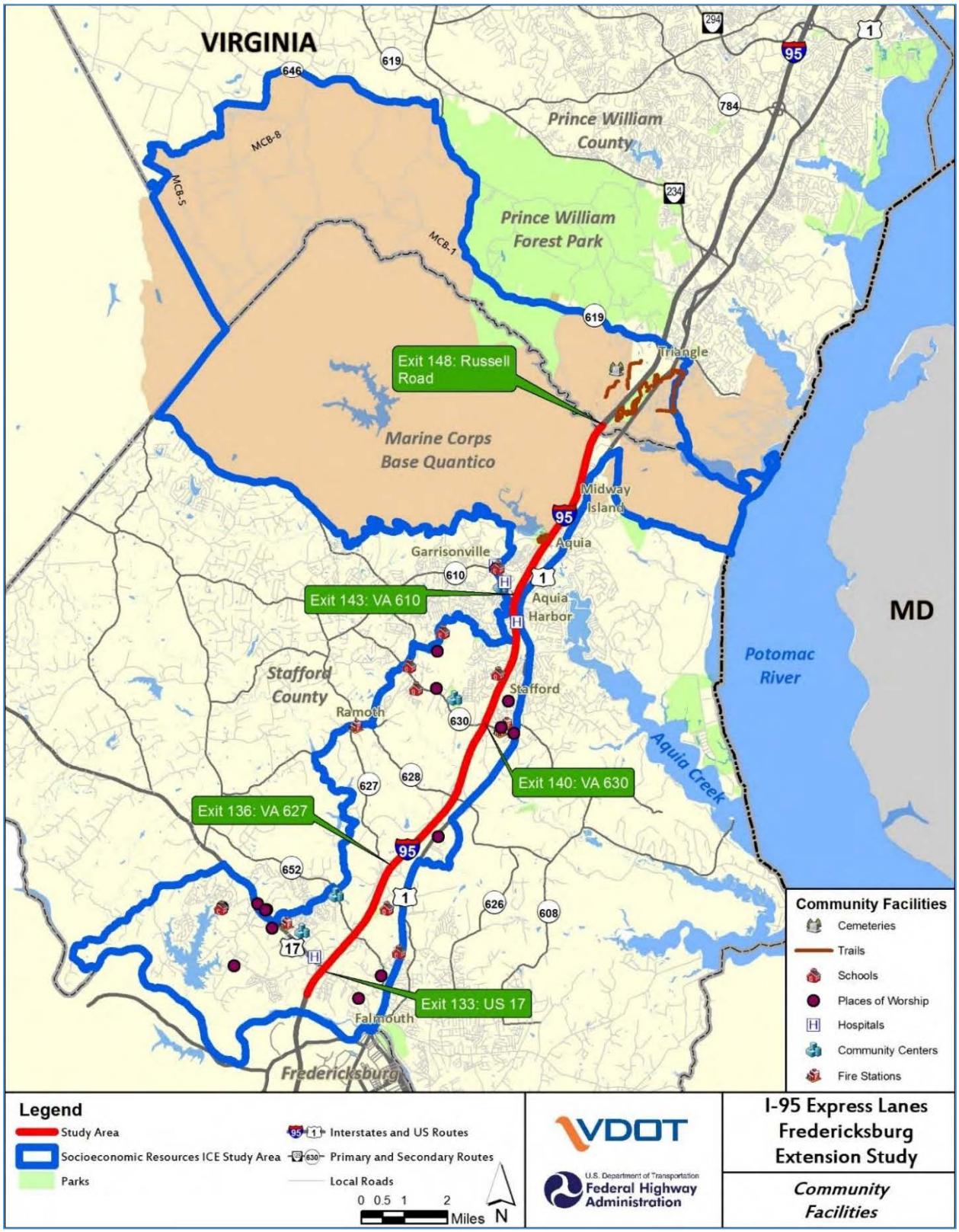


Figure 2-10: Community Facilities, Parks, and Recreational Facilities in the Socioeconomic ICE Study Area



Minority Populations

Minority Populations are any readily identifiable groups of minority persons who live in geographic proximity, and if circumstances warrant, geographically dispersed/transient persons (such as migrant workers or Native Americans) who would be similarly affected by a proposed USDOT/FHWA program, policy, or activity (USDOT and FHWA EJ Orders).

The Census block group containing the northern portion of MCBQ in Prince William County (9801-00 BG 1) had no reported resident population based on ACS 2011-2015 5-Year data (**Figure 2-11**). The resulting percent minority for this block group was zero percent. Based on the methodology described in the *Interstate 95 Express Lanes Fredericksburg Extension Study Socioeconomics and Land Use Technical Report* (VDOT, 2017g), the remaining 11 Census block groups in the Socioeconomic Resources ICE study area have minority populations based on minority racial data or Hispanic ethnicity.

Low-Income Populations

A low-income population is any readily identifiable group of low-income persons who live in geographic proximity, and, if circumstances warrant, geographically dispersed/transient persons (such as migrant workers or Native Americans) who would be similarly affected by a proposed USDOT/FHWA program, policy, or activity (USDOT/FHWA EJ Orders). In the EJ analysis, low-income populations are identified where the median household income for a study Census block group is at or below the Health and Human Services (HHS) poverty threshold. This analysis used the US Census Bureau's ACS 5-Year (2011-2015) Estimates, Median Income in the Past 12 Months (in 2015 Inflation-Adjusted Dollars) to generate median household income data at the Census block group level (2015). This analysis did not include Census block group 9801-00 BG 1 within MCBQ, as it had no reported income. In the Socioeconomic Resources ICE study area block groups, 2.85 persons on average occupy households based on the ACS 2011-2015 5-Year data. The ACS 2011-2015 Census block group margin of error for average household size averaged to 0.42 persons. Therefore, for this EJ analysis, low-income populations have been identified where the median household income for a Census block group within the study area is at, or below, the 2015 HHS poverty threshold for a family of four to be conservative and to account for the margin of error. The HHS poverty threshold was $24,250 for a family of four in 2015. No Census block groups with a resident population in the Socioeconomic Resources ICE study area have a median household income below the HHS poverty threshold.

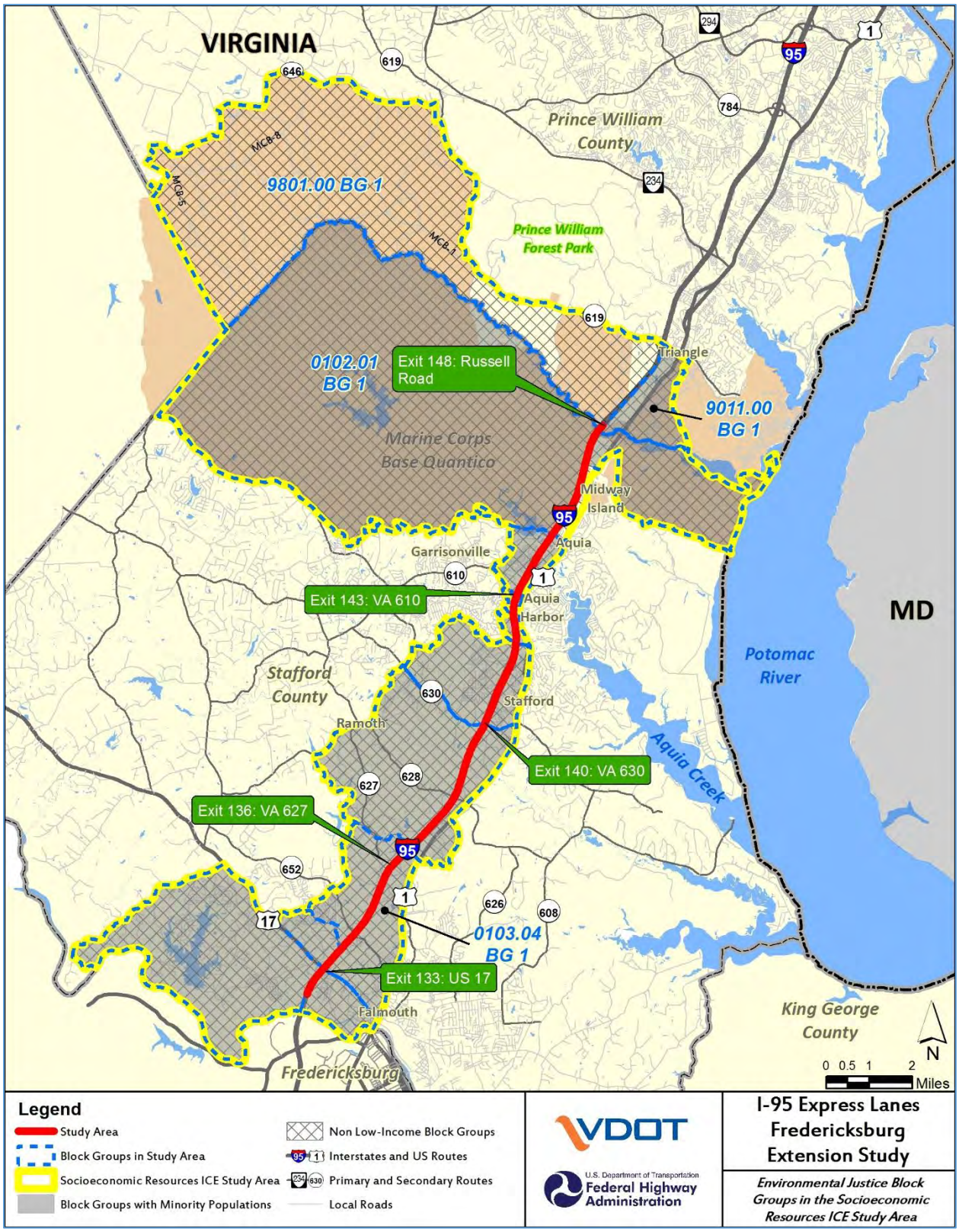
2.3.2 Natural Resources

Terrestrial Resources

As in the land use discussion of sensitive resources (**Section 2.3.1**), agricultural lands, including those protected in agricultural and forestal districts, and lands underlain with prime, unique, or important farmland soils are considered sensitive terrestrial resources. In addition, lands containing Quantico slate are a sensitive resource as the improper disturbance of these lands may cause impacts to surface water quality and aquatic life and contamination of groundwater.

Agricultural and forestal districts in the study area were identified through use of VDOT's Comprehensive Environmental Data and Reporting System GIS Database. Analysis of data contained in the database indicates that one agricultural and forestal district is contained in the Natural Resources ICE study area. The district is located in eastern Fauquier County and approximately 61 acres occurs in the Natural Resources ICE study area (**Figure 2-12**).

Figure 2-11: Environmental Justice Block Groups in the Socioeconomic Resources ICE Study Area



As the district is located approximately 11 miles from the Build Alternative's LOD, no encroachment effects are anticipated. Therefore, the district is not considered in the indirect or cumulative effects section of this report.

Soils data was acquired using the Natural Resources Conservation Service (NRCS) Web Soil Survey to identify prime, unique, or important farmland soils in the study area. Excluding lands designated as "urban areas" by the US Census Bureau, the Natural Resources ICE study area contains the acreages of prime and statewide important farmland provided in **Table 2-4**. **Figure 2-12** shows the extent of these lands in the Natural Resources ICE study area.

Table 2-4: Prime, Unique, or Important Farmland in the Natural Resources ICE Study Area

Soil	Acres
Prime Farmland	30,363
Prime Farmland (if drained)	1,884
Prime Farmland (if protected from flooding)	331
Unique Farmland	0
Farmland of Statewide Importance	48,293

Source: NRCS (2017).

A potential environmental concern identified by Stafford County's Interim County Administrator would be disturbance of Quantico slate, a rock formation in portions of Stafford County (Stafford County, 2016c). Road construction through this formation could result in acid rock drainage, which occurs when sulfide-bearing soil or rock is excavated and exposed to oxygen in the atmosphere and water. Problems associated with acid rock drainage include degradation of metal and concrete building materials (which accelerates the need for repairs and can compromise structural stability), weathering of fill material and precipitation of sulfates, damage to vegetation, impacts to surface water quality and aquatic life, and contamination of ground water. An example of this problem is evident in Stafford County along the west side of I-95 south of Chopawamsic Creek where there are several exposed areas on which it is difficult to grow stabilizing vegetation.

Areas of Quantico slate within, and adjacent to, the study area were identified with use of a GIS data representation of the Integrated Geologic Map Database for the United States: Delaware, Maryland, New York, Pennsylvania, and Virginia from the USGS. According to the data cited, approximately 9,421 acres of Quantico slate are located in the Natural Resources ICE study area (US Geological Survey, 2005). The majority of the slate areas are located west of I-95 and in southwest Stafford County and northern Spotsylvania County (**Figure 2-12**).

Aquatic Resources and Habitat

The USFWS National Wetlands Inventory (NWI) approximates 12,524 acres of freshwater, vegetated wetlands in the Natural Resources ICE study area (USFWS, 1990, 1991, 1994a, 1994b, 1994c, 1994d, 1994e, 2008, and 2009). Of these, approximately 84 percent are forested/shrub wetlands and 16 percent are emergent wetlands (**Figure 2-13**). An additional 42,888 acres are classified as unvegetated shorelines, unvegetated wetlands, freshwater ponds, lakes, and rivers, including the acreage associated with the Potomac River. (Note: It is acknowledged that the NWI is not the most accurate source of estimating

Figure 2-12: Terrestrial Resources in the Natural Resources ICE Study Area

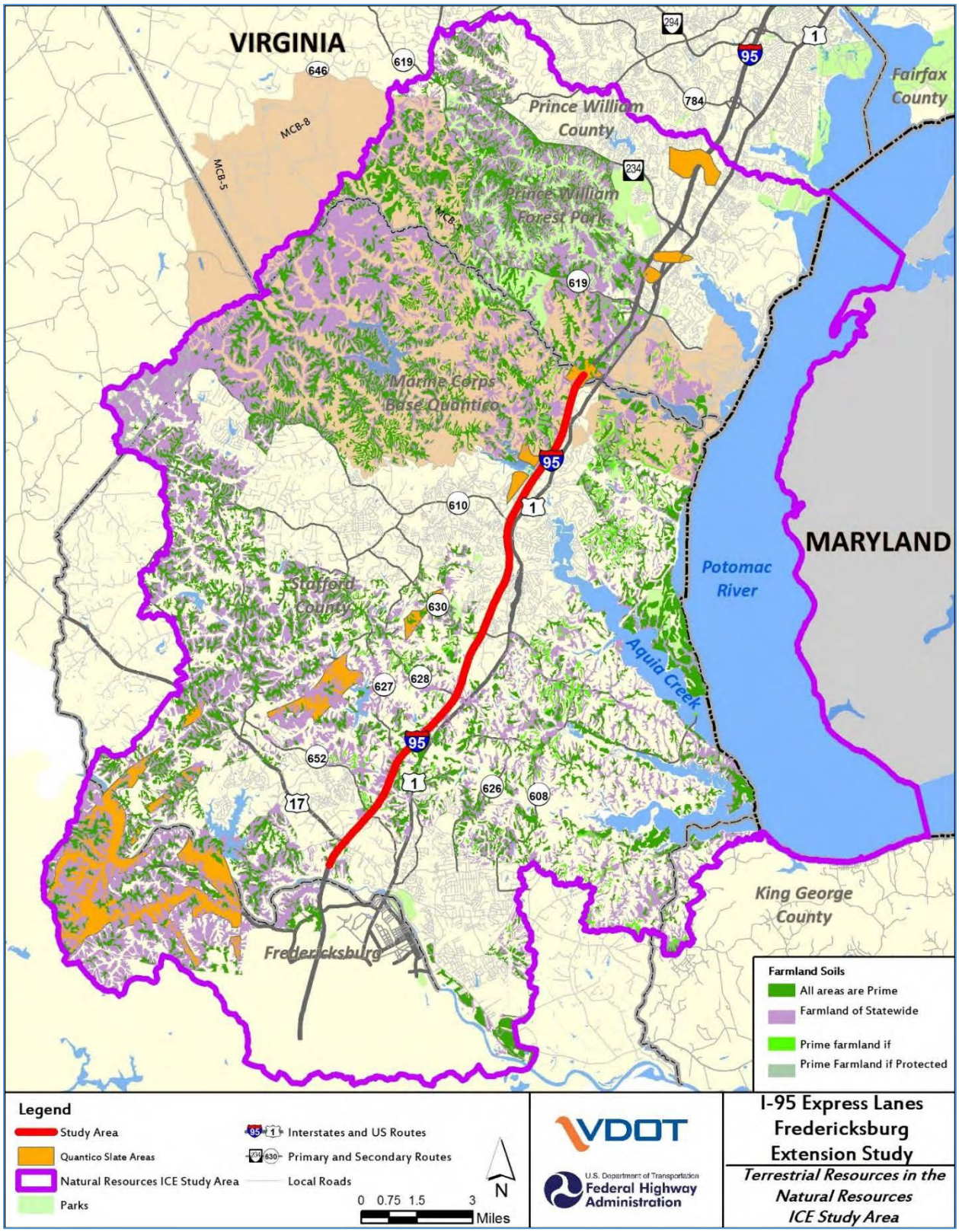
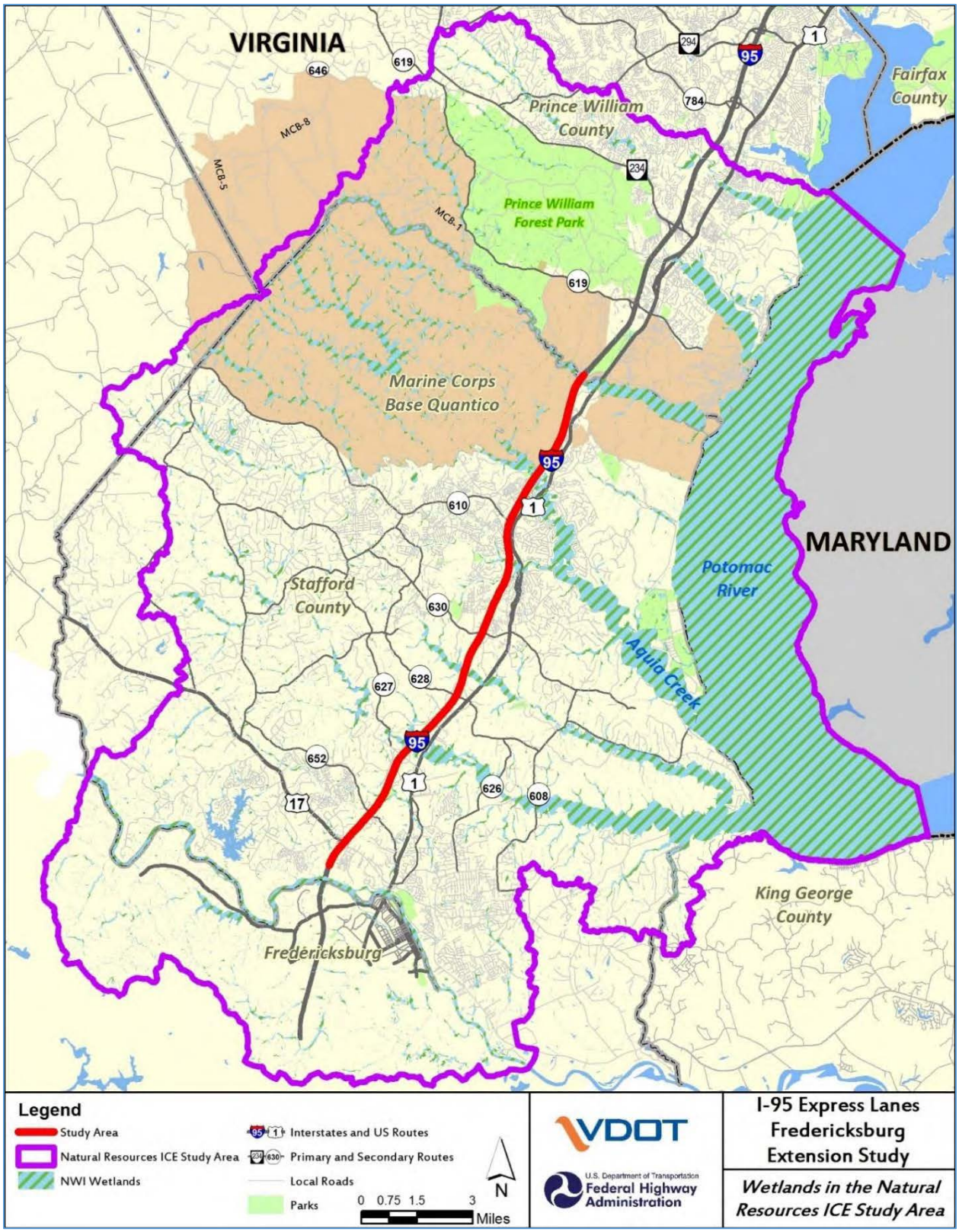


Figure 2-13: Wetlands in the Natural Resources ICE Study Area



wetlands and should not be compared to the field delineated wetland acreage for the study corridor discussed in the Revised EA or the *Interstate 95 Express Lanes Fredericksburg Extension Study Natural Resources Technical Report* (VDOT, 2017h). For the purposes of discussing indirect effects on the larger ICE study area, NWI data are incorporated into the study.)

The USGS National Hydrography Dataset (NHD) was used to estimate the extent of Natural Resources ICE study area streams. The estimated total length of listed NHD streams in the Natural Resources ICE study area is approximately 5.60 million linear feet (USGS, 2017a; 2017b). (Note: It is acknowledged that NHD is not the most accurate source of estimating streams in regards to ephemeral channels, which receive state-protection in Virginia, and should not be compared to the field delineated wetland acreage for the study corridor discussed in the Revised EA and the *Interstate 95 Express Lanes Fredericksburg Extension Study Natural Resources Technical Report* (VDOT, 2017h).)

Several permanent, perennial waterbodies and several reservoir-type bodies used for water storage are also located in the Natural Resources ICE study area. Navigable waters within the Natural Resources ICE study area consist of the Potomac River and portions of the Rappahannock River (**Figure 2-14**).

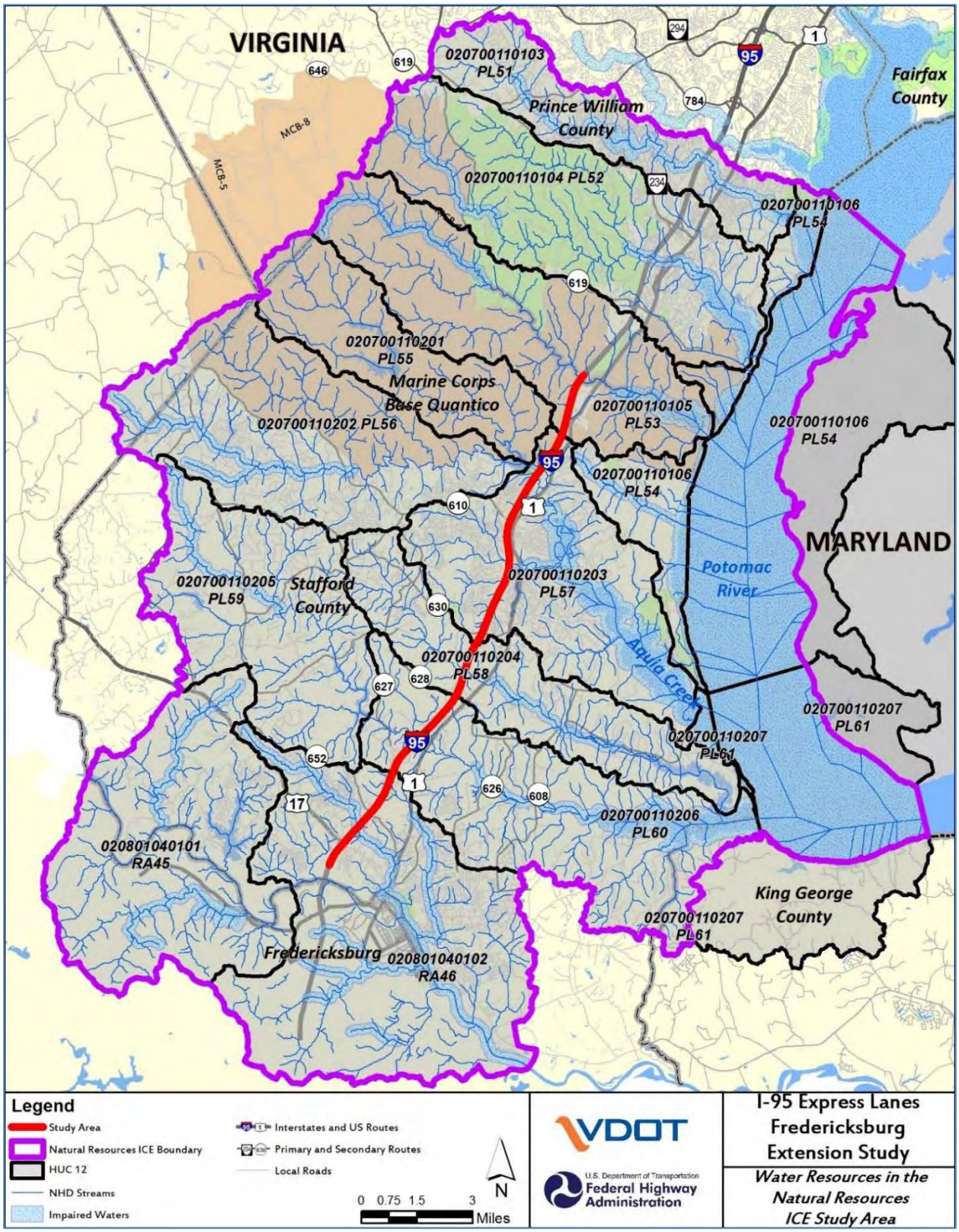
The water quality of some rivers/streams and waterbodies contained in the Natural Resources ICE study area were evaluated in the recent 303(d) and 305(b) integrated reports released by Virginia and Maryland, and the USEPA 303(d) Assessment and Total Maximum Daily Load Tracking and Implementation System (ATTAINS). The *Final 2014 305(b)/303(d) Water Quality Assessment Integrated Report* was released by VDEQ on June 13, 2016. The report summarizes water quality conditions in Virginia from January 1, 2007 through December 31, 2012. Data from this report is available as GIS shapefiles (VDEQ, 2016b). Maryland's Department of the Environment (MDE) *Draft 2016 Integrated Report of Surface Water Quality* is through the public comment period and supplants the Final 2014 Integrated Report identifying the impaired waters in the Natural Resources ICE study area (MDE, 2016).

The USEPA ATTAINS information contains GIS shapefile data listing impaired waterways as of May 1, 2015. The review indicates that 28 303(d)-listed river/stream, river/stream segments, or waterbodies occur in the Natural Resources ICE study area (USEPA, 2015). The listed river/stream, river/stream segments, or waterbodies are shown in **Figure 2-14** and listed in **Appendix C**. The MDE has designated the Potomac River as Tidal Use II, supporting estuarine and marine aquatic life and shellfish harvesting (MDE, 2014). In Virginia, all waters are designated for recreational use, habitat for indigenous aquatic life and wildlife, and the production of edible and marketable natural resources (VDEQ, 2016a).

Causes of impairment of these sensitive river/stream or waterbodies are largely due to low DO, contaminants in fish and invertebrate tissue, and fecal coliform bacteria (*Escherichia coli*). The major suspected sources of the impairments are nonpoint sources (including wastes from pets, waterfowl, and wildlife), sewer overflows, atmospheric deposition, and unknown sources. Pollutant or pollutant categories causing impairment TMDLs to some of the listed river/stream or river/stream segments have been established and approved by the USEPA (Appendix D). In addition, Virginia Administrative Code (VAC) 9VAC25-260-310 identifies special water quality standards for the Potomac River, its tidal embayments, and their tidal and non-tidal tributaries.

Certain river segments within the Natural Resources ICE study area are designated as public water supply waters, making them sensitive resources, and are subject to water special quality standards that have been calculated to protect human health from toxic effects through drinking water and fish consumption. The river or river segments designated as public water supply waters in the Natural Resources ICE study area include:

Figure 2-14: Water Resources in the Natural Resources ICE Study Area



- Potomac Creek and its tributaries from the Stafford County water supply dam (Able Lake Reservoir) to their headwaters;
- Chopawamsic Creek and its tributaries above the MCBQ water supply intakes at the Gray and Breckenridge Reservoirs to their headwaters;
- Aquia Creek from the Aquia Sanitary District Water Impoundment, and other tributaries into the impoundment, including Beaverdam Run and the Lunga Reservoir upstream to their headwaters; and
- The Rappahannock River and its tributaries from Spotsylvania County's raw water intake near Golin Run to points five miles upstream (excluding Motts Run and tributaries).

Virginia's surface water quality standards also include criteria for man-made lakes and reservoirs to protect aquatic life and recreational designated uses from the impacts of nutrients. These standards regulate the amount of chlorophyll and total phosphorous permitted in the following lakes and reservoirs in the Natural Resources ICE study area: Abel Lake, Aquia Reservoir, Lake Curtis, and Motts Run Reservoir.

Digital floodplain data from the National Flood Hazard Layer was obtained from the FEMA GeoPlatform and plotted in the study area to determine the location and extent of floodplain areas. **Figure 2-15** shows the 100-year and 500-year floodplains in the Natural Resources ICE study area. Based on the data compiled, the Natural Resources ICE study area includes an estimated 25,387 acres of 100-year floodplains and 1,548 acres of 500-year floodplains (FEMA, 2017). Floodplains are sensitive resources, as development within these areas can have a negative effect on stream hydraulics. Floodplain encroachment can increase upstream flooding by narrowing the width of the channel and increasing the channel's resistance to flow (Konrad, 2003). To limit the effects of development in floodplains, each locality in the Natural Resources ICE study area restricts development to certain activities, such as private and public utilities, SWM facilities, road crossings, and work on existing structures.

Wildlife and Habitat

The Natural Resources ICE study area contains several different land covers from the 2011 National Land Cover Dataset (NLCD), including forested lands, agricultural lands, pasture, grasslands, scrub/shrub, open water, wetlands, and developed lands (**Table 2-5**). The composition of land cover directly affects the natural communities, wildlife, and biodiversity found within a given environment; therefore, lands with natural cover such as forested land, scrub/shrub/grasslands, and wetlands are considered sensitive resources. Sensitive wetland areas are discussed in **Section 2.3.2**.

In 2011, terrestrial lands with natural cover including forests, and scrub/shrub/grassland areas, accounted for approximately 52 percent of the Natural Resources ICE study area. These resources are located predominately away from I-95, and those within the median of I-95 occur within an area already greatly impacted, or are designated for transportation use. The largest category with natural cover, forested lands, comprised approximately 48 percent of the Natural Resources ICE study area (**Figure 2-16**). The three main terrestrial forest types identified were: 1) deciduous forest, 2) evergreen forest, and 3) mixed evergreen/deciduous forest (Homer *et al*., 2015).

Of the forested areas, approximately 84 percent were deciduous forest, eight percent were evergreen forest, and seven percent were mixed evergreen/deciduous forest. The largest sections of forested land occur along the west side of MCBQ and within Prince William Forest Park.

Forested land also dominated the land cover east of I-95 in Stafford County between the Potomac River tributaries, including Chopawamsic Creek; Aquia Creek; and Potomac Creek; and bounding the

Figure 2-15: Floodplains in the Natural Resources ICE Study Area

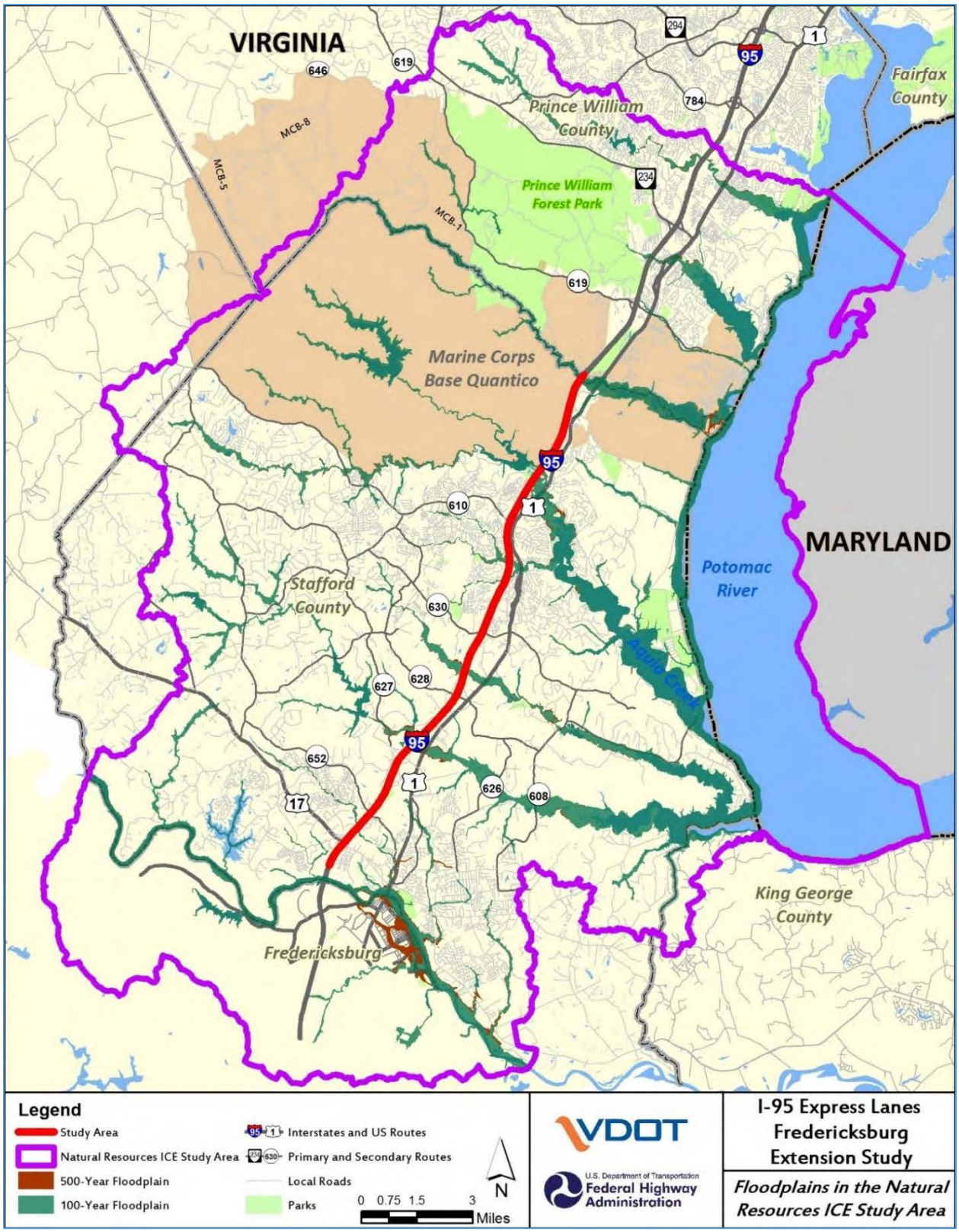
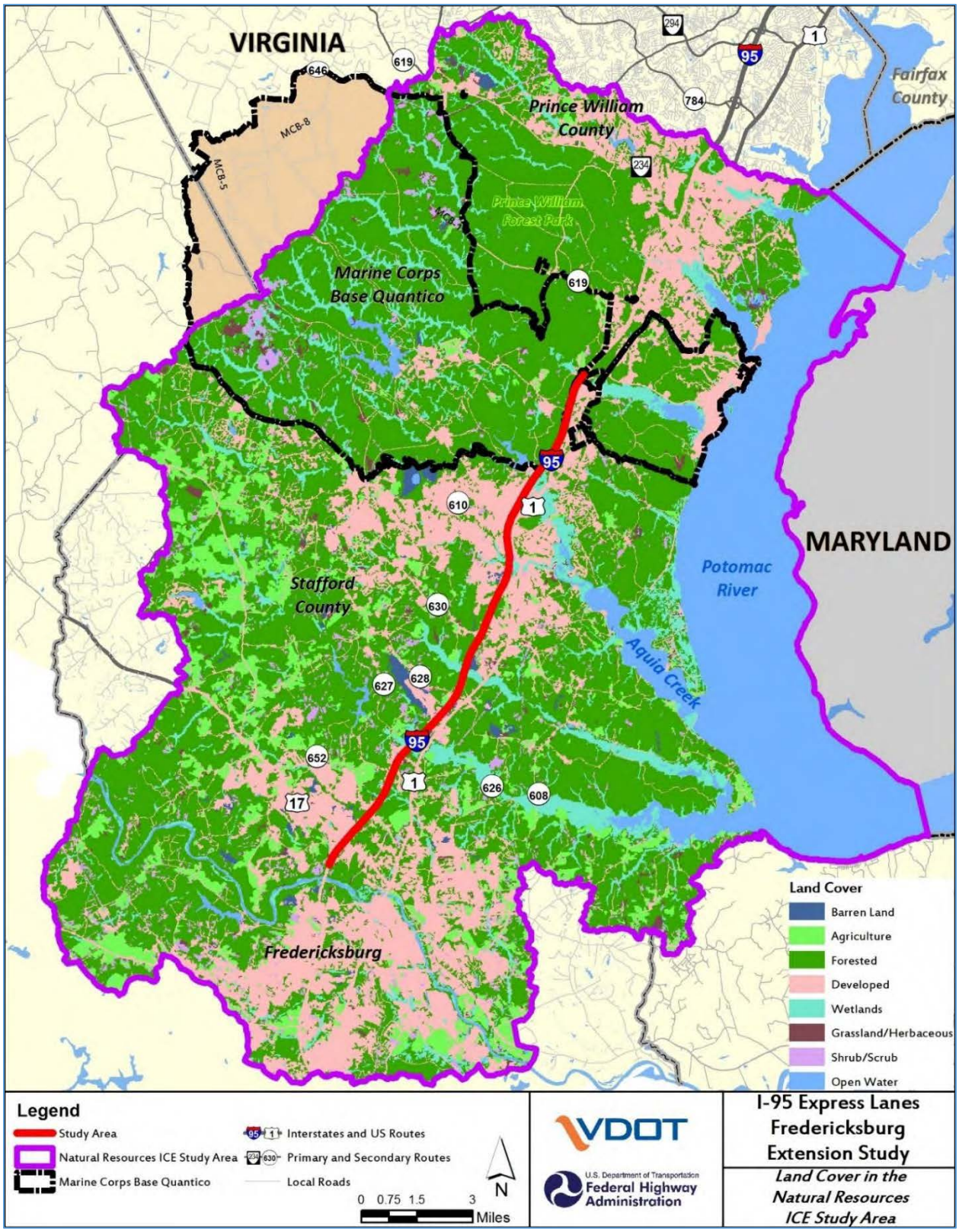


Figure 2-16: Land Cover in the Natural Resources ICE Study Area



Rappahannock River, west of Fredericksburg, in Stafford and Spotsylvania Counties. Within the remainder of the Natural Resources ICE study area, forested land provided connected corridors along waterways, wetlands, and between areas used for hay and agricultural production such as in Stafford, Fauquier, Spotsylvania, and King George Counties. These large areas of unbroken forested land, riparian-forested areas, and forested corridors support a diverse array of species and ecosystem functions.

Table 2-5: Land Cover in the Natural Resources ICE Study Area

Land Cover	Acres in Natural Resources ICE Study Area	% of Natural Resources ICE Study Area
Developed (Low, Medium, and High Intensity)	26,180	9.7%
Developed Open Space	30,064	11.1%
Barren Land	1,526	0.6%
Forest	130,429	48.3%
Agriculture	16,356	6.1%
Shrub/Scrub/Grassland	9,012	3.3%
Wetland	17,086	6.3%
Open Water	39,196	14.5%

Source: Homer et al. (2015).

The forested areas in the Natural Resources ICE study area provide habitat for many of the typical terrestrial urban wildlife species inhabiting this region. Larger terrestrial species found include mammals such as whitetail deer (*Odocoileus virginianus*), common gray fox (*Urocyon cinereoargenteus cinereoargenteus*), coyote (*Canis latrans*), and red fox (*Vulpes vulpes*). Medium and smaller mammals include the Virginia opossum (*Didelphis virginiana*), raccoon (*Procyon lotor lotor*), shrew (*Blarina* sp.), mice (*Peromyscus* sp.), and common eastern chipmunk (*Tamias striatus striatus*) (VDGIF, 2017c).

Reptiles and amphibians known to inhabit the Natural Resources ICE study area include the woodland box turtle (*Terrapene carolina carolina*), and eastern ratsnake (*Pantherophis alleghaniensis*), American toad (*Anaxyrus americanus americanus*), wood frog (*Lithobates sylvaticus*), and long-tailed salamander (*Eurycea longicauda longicauda*) (VDGIF, 2017c).

Insects tracked by the VDGIF and known to occur in the Natural Resources ICE study area include the field cricket (*Gryllus pennsylvanicus*), eastern tiger swallowtail butterfly (*Papilio glaucus*), blue-fronted dancer damselfly (*Argia apicalis*), and Japanese beetle (*Popillia japonica*) (VDGIF, 2017c).

Common forest bird species known to occur in the Natural Resources ICE study area include the yellow-billed cuckoo (*Coccyzus americanus*), gray catbird (*Dumetella carolinensis*), northern flicker (*Colaptes auratus*), and northern cardinal (*Cardinalis cardinalis*) (VDGIF, 2017c). These, as well as other bird species confirmed in the study area are protected under the Migratory Bird Treaty Act of 1918. The roadway bridges in the study area may provide nesting habitat for species such as the Canada goose, barn swallow (*Hirundo rustica*), and peregrine falcon (*Falco peregrinus*) as well as for owls, cormorants, and gulls. The flat decks under roadway bridges, vertical structures, structural cavities, and pier footings provide locations for nest building or egg laying. The eggs and nests of these species are protected under the Migratory Bird Treaty Act and take is prohibited without a federal permit.

Terrestrial lands without natural cover, including developed lands, developed open space, barren, and planted/cultivated areas, are not considered sensitive resources, and account for nearly 28 percent of the total land cover in the Natural Resources ICE study area. The highest prevalence of developed land occurs in eastern Prince William County and south along the I-95 and US 1 corridors into Garrisonville and Aquia Harbour, Falmouth, Berea, Fredericksburg, and northern Spotsylvania County.

The lands developed with impervious cover result in highly fragmented, patchy natural wildlife habitat. Although the developed open space areas are not a form of natural cover, a number of species of wildlife have adapted to developed areas, using fragments of forests within the suburban lawns and school and recreational area properties. However, the habitat fragmentation interferes with some species' feeding, breeding, spawning/nursery, and migration sites. Some urban wildlife confirmed in the Natural Resources ICE study area include the Virginia white-tailed deer, red fox, common gray fox, raccoon, Virginia opossum, groundhog, eastern cottontail rabbit, eastern gray squirrel, and coyote (VDGIF, 2017c).

The barren lands in the Natural Resources ICE study area are devoid of natural cover and do not provide suitable habitat. Wildlife habitat associated with agricultural lands is comparatively limited due to the lack of plant diversity, the relatively high frequency of disturbance (i.e., plowing, planting, fertilizing, grazing, and routine maintenance), and fragmentation into non-continuous patches. Despite these factors, agricultural lands are used by wildlife on a limited basis.

The Potomac River constitutes the eastern boundary of the Natural Resources ICE study area. Combined with the river embayments, rivers, streams, wetlands, and reservoirs within the boundary, open water and saturated lands accounted for approximately 21 percent of the total land cover in 2011 (Homer *et al*., 2015). As with terrestrial habitat, the condition of aquatic and wetland habitat is important for the species living in the Natural Resources ICE study area. These areas provide opportunity for a large numbers of species to live and thrive. The presence of SAV improves aquatic habitat for fish and shellfish species in shallow waters and improves water quality. The Virginia Institute of Marine Science (VIMS) SAV program recorded approximately 3,260 acres of SAV in the Natural Resources ICE study area during their 2015 survey. The majority were located along the western bank of the Potomac River and within its tidal embayments.

Fish species recorded in the Natural Resources ICE study area have included the American eel (*Anguilla rostrate*), common carp (*Cyprinus carpio*), longnose dace (*Rhinichthys cataractae*), striped killifish (*Fundulus majalis*), white perch (*Morone americana*), largemouth bass (*Micropterus salmoides*), and striped bass (*Morone saxatilis*) (VDGIF 2017b; 2017c). Two invasive species now commonly found in the Natural Resources ICE study area are negatively affecting native species in the ecosystem. The northern snakehead (*Channa argus*) and blue catfish (*Ictalurus furcatus*) abundance are being monitored by the MDNR and VDGIF as the presence of both species has been shown to cause a decrease in native fish populations due to direct and indirect competition of forage fish (MDNR, No Date; VDGIF, 2017e)

A review of data obtained from the NMFS indicates that EFH exists in the Natural Resources ICE study area for adult and juvenile summer flounder (*Paralichthys dentatus*), scup (*Stenotomus chrysops*), black sea bass (*Centropristis striata*), and bluefish (*Pomatomus saltatrix*) (NOAA, 2017) (**Figure 2-17**). No Habitat Areas of Particular Concern (HAPC) are located within the Natural Resources ICE study area.

Other aquatic species have been observed within the Natural Resources ICE study area including the northern river otter (*Lontra canadensis lataxina*), dwarf wedgemussel (*Alasmidonta heterodon*), brook

floater (*Alasmidonta varicosa*), green floater (*Lasmigona subviridis*), triangle floater mussel (*Alasmidonta undulata*), and yellow lance (*Elliptio lanceolata)* (VDGIF 2017c). The VDGIF lists the Rappahannock River and Aquia Creek as threatened and endangered species waters for the Dwarf Wedgemussel (**Figure 2-17**).

In Virginia, the VDGIF has designated the entire portion of the Potomac River in the Natural Resources ICE study area as a confirmed anadromous fish use area. **Figure 2-17** shows other confirmed anadromous fish use areas in the Natural Resources ICE study area. Anadromous fish confirmed within the Natural Resources ICE study area include the alewife herring, blueback herring, yellow perch, American shad, hickory shad, and golden shiner (VDGIF, 2017c). However, fish passage is restricted at multiple locations along waters in the Natural Resources ICE study area. Impediments that terminate the upstream movement of fish within the confirmed anadromous fish use water segments include the Aquia Creek Dam (Stafford County), and raised culverts and other impediments on Little Falls Run (Stafford County), Deep Run (Spotsylvania County), and Hazel Run (Fredericksburg) (VDGIF, 2017c).

Over 45 parks are located within the Natural Resources ICE study area (**Figure 2-18**) (VDCR, 2017; VDOT, 2016e). These include local, county, regional, state, and national parks. The Natural Resources ICE study area also contains 65 conservation easements and holdings, and one forestal district. MCBQ also contains lands that are restricted from general development. Cumulatively, MCBQ accounts for approximately 17 percent (46,807 acres) of the Natural Resources ICE study area. These conservation lands and parks contain undeveloped land which may be utilized by wildlife and contribute to wildlife corridors, linking isolated areas of natural habitat and allowing for wildlife migration.

RPAs are sensitive resources as they preserve water quality by removing excess sediment, nutrients, and potentially harmful substances from groundwater and surface water prior to their entrance into the Chesapeake Bay watershed. According to available data, there are approximately 29,569 acres of RPA lands within the Natural Resources ICE study area (**Figure 2-19**). This acreage includes the Potomac River embayments and waterways designated as RPAs by each respective county or city in the Natural Resources ICE study area.

Figure 2-17: Protected Species and Habitat in the Natural Resources ICE Study Area

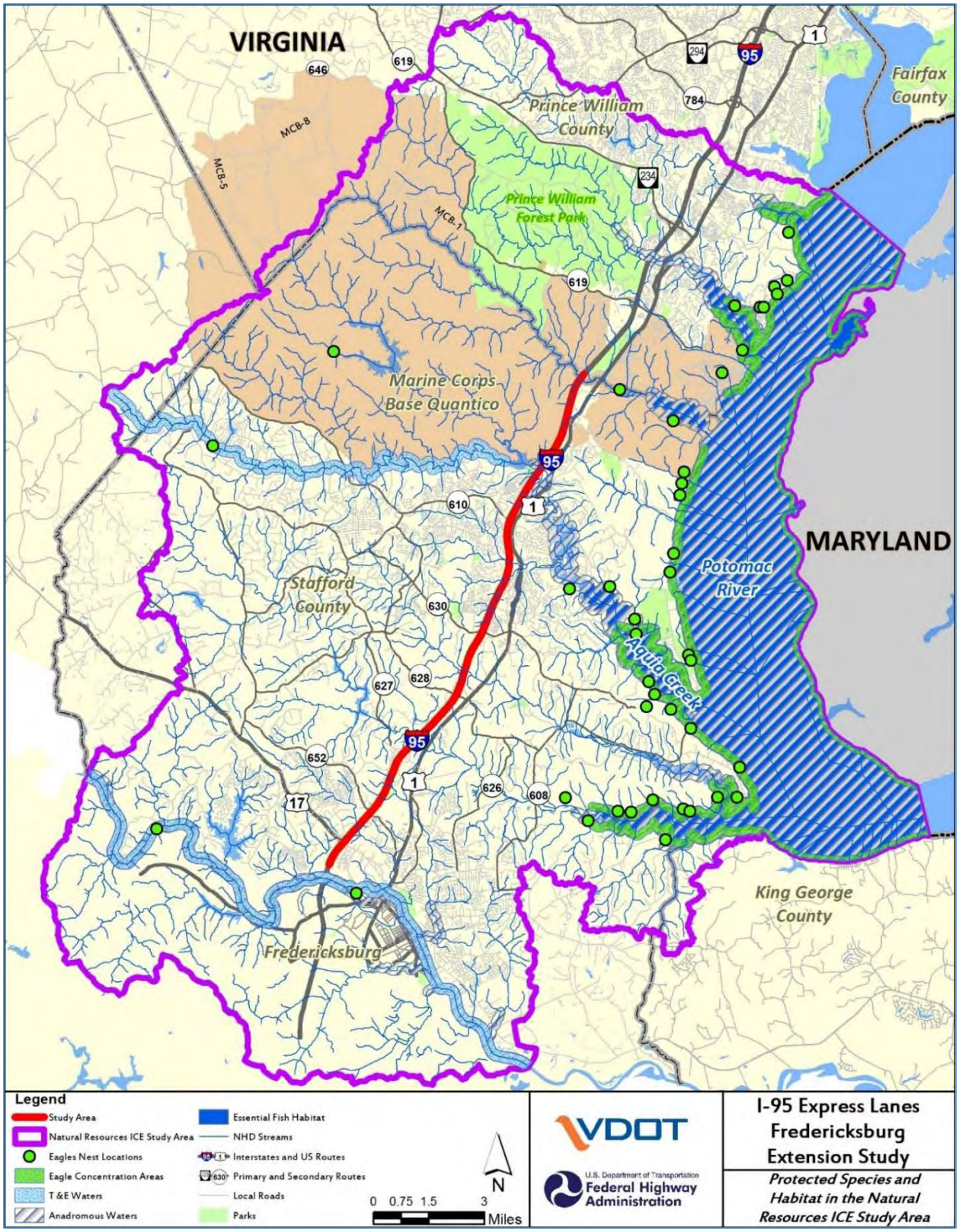


Figure 2-18: Protected and Conservation Areas in the Natural Resources ICE Study Area

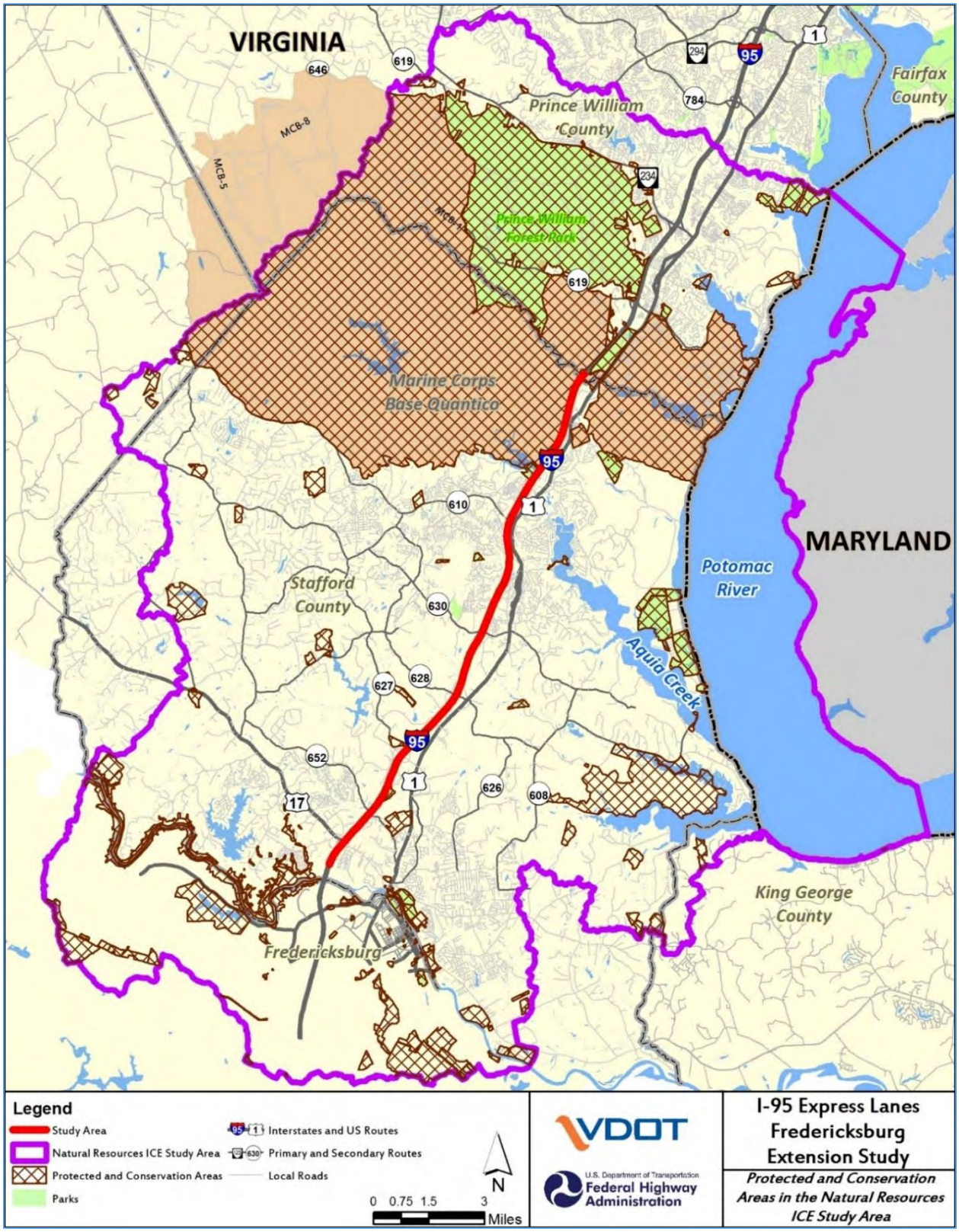
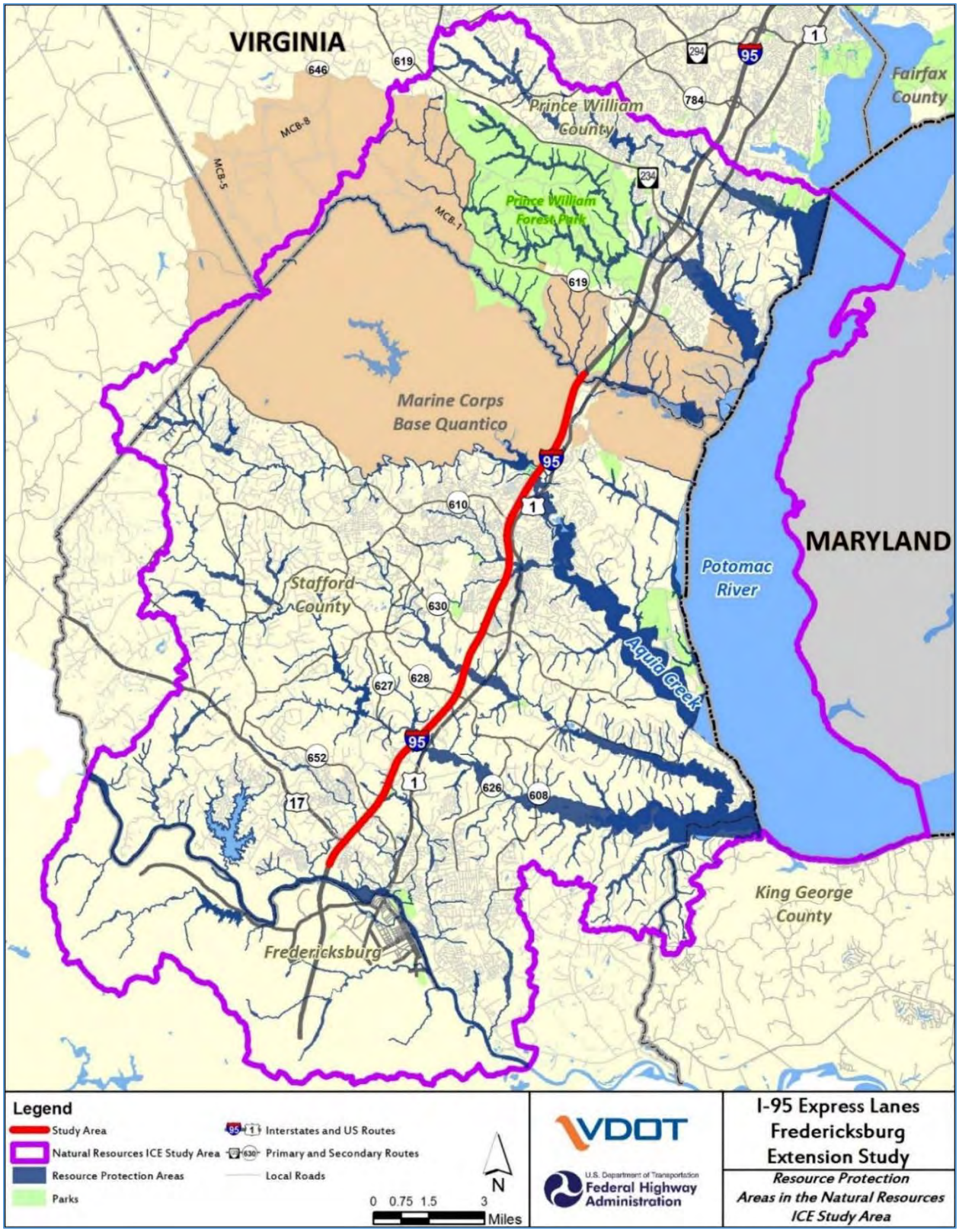


Figure 2-19: Resource Protection Areas in the Natural Resources ICE Study Area



Threatened or Endangered Species

State- and federally-listed threatened and endangered species reported to occur or potentially occur in the Natural Resources ICE study area are considered sensitive resources, and they were identified through a study area review conducted by the MDNR Wildlife and Heritage Service and review of the USFWS Information Planning and Consultation (IPaC), Virginia Fish and Wildlife Information Service (VFWIS), and VDCR-DNH databases. The MDNR review indicates that there are no threatened or endangered species occurring within the Potomac River that constitutes the eastern edge of the Natural Resources ICE study area. **Table 2-6** lists the protected species potentially inhabiting, or confirmed, within the Natural Resources ICE study area. No critical habitats, fish hatcheries, or national wildlife refuges were identified in the Natural Resources ICE study area through the USFWS IPaC review.

Table 2-6: Listed Species Database Search Results for Natural Resources ICE Study Area

Species	Status
Dwarf Wedgemussel (*Alasmidonta heterodon*)	FESE
Harperella (*Ptilimnium nodosum*)	FESE
Shortnose Sturgeon (*Acipenser brevirostrum*)	FESE
Small Whorled Pogonia (*Isotria medeoloides*)	FTSE
Sensitive Joint-Vetch (*Aeschynomene virginica*)	FTST
Northern Long-Eared Bat (*Myotis septentrionalis*)	FTST
Yellow Lance (*Elliptio lanceolata*)	FT[1]
Black Rail (*Laterallus jamaicensis*)	SE
Brook Floater (*Alasmidonta varicosa*)	SE
Virginia Piedmont Water Boatman (*Sigara depressa*)	SE
Green Floater (*Lasmigona subviridis*)	ST
Peregrine Falcon (*Falco peregrinus*)	ST
Henslow's Sparrow (*Ammodramus henslowii*)	ST

Note: 1=Proposed as a federally-threatened species on April 5, 2017.
Sources: USFWS (2017); VDCR (2017); VDGIF (2017c).

The *Interstate 95 Express Lanes Fredericksburg Extension Study Natural Resources Technical Report* (VDOT, 2017h) discusses those species with confirmed habitat in the direct impacts area including the northern long-eared bat, small whorled pogonia, brook floater, dwarf wedgemussel, green floater, yellow lance, and harperella. Those species potentially inhabiting, or confirmed, within the Natural Resources ICE study area, which are not discussed in the natural resources technical report, that may experience indirect effects resulting from induced growth or encroachment, are included below.

The sensitive joint-vetch (*Aeschynomene virginica*) is a member of the pea family (*Fabaceae*) and it was listed as FT on May 20, 1992. It is listed in the IPaC official species list and VDCR-DNH database search results for the Natural Resources ICE study area. The plant grows in the intertidal zone of coastal marshes and tidal rivers where the area receives flooding twice daily. It can also be found in roadside ditches, which often have connection to nearby brackish marshes. Threats to its existence include habitat destruction, dredging/filling activities within the coastal area, sedimentation, competition with invasive species, and water impoundment, or diversion activities (USFWS, 2011).

The Virginia piedmont water boatman (*Sigara depressa*) is a SE and endemic aquatic insect species (Hobson *et al*., 1998). Historical and recent collections of the species were made in deep pools found in streams featuring a riffle/run/pool sequence. Adult individuals overwinter in backwater pools of small streams (VDGIF, 2005). Threats to the species include habitat destruction due to alteration of stream hydrology and direct impacts due to stream channel modification.

The peregrine falcon (*Falco peregrinus*) is included in the VDGIF VFWIS search results as a state-threatened (ST) bird for the Natural Resources ICE study area. Federally, the species was delisted on August 25, 1999 due to an increase in population size. It has the most extensive natural distribution of any bird in the world and is found on all continents except Antarctica. The bird feeds primarily on other birds and nests on ledges and in small shallow caves located high on cliff walls (USFWS, 2013). Threats to its survival include the illegal take of adults through shooting, taking of eggs and young, habitat destruction, and poisoning. The VDGIF institutes a time-of-year-restriction for certain activities between February 15 and July 15 when they occur within 600 feet of a nest.

The Henslow's sparrow (*Ammodramus henslowii*) is listed as ST in the VDGIF VFWIS search results for the Natural Resources ICE study area. The sparrow is grassland bird species that breeds in dense herbaceous vegetation in the north and eastern US and winters in the southeast US. The breeding habitat includes prairies, hayfields, pastures, wet meadows, and old fields. Its wintering habitat includes tall dense groundcover dominated by grasses. Threats to its existence include habitat loss and degradation (USFWS, 1997). The VDGIF institutes a time-of-year-restriction for certain activities between April 1 and August 31.

In addition to these listed species found in database searches, a few other species were identified as having the potential to occur within the Natural Resources ICE study area. The VDGIF VFWIS database results indicate that the shortnose sturgeon (*Acipenser brevirostrum*) and black rail (*Laterallus jamaicensis*) might be present or have the potential to occur within the Natural Resources ICE study area. The shortnose sturgeon is a FE and SE anadromous fish species which was included in the VDGIF VFWIS search results for the Natural Resources ICE study area. The species lives mainly in slow moving riverine waters, or nearshore marine waters, and moves into faster moving fresh water areas to spawn. Threats to its survival include construction of dams, pollution, dredging, or disposal in rivers, and habitat alterations from discharges (NOAA, 2015). The black rail bird is listed as ST in Virginia and is under review for federal listing. It inhabits salt and freshwater marshes (Cornell Lab of Ornithology, 2015). The VDGIF institutes a time-of-year-restriction for certain activities between April 1 and August 31.

Although bald eagles (*Haliaeetus leucocephalus*) are no longer federally or state listed, bald eagles currently are protected under the Bald and Golden Eagle Protection Act. The bald eagle can forage in the river and large water body-type habitats of the Natural Resources ICE study area. Nesting sites are commonly located in large forested areas adjacent to marshes, on farmland, or in seed tree cutover areas. Threats to the bald eagle include habitat destruction, electrocution, poisoning, wind farms, and pesticides. Mapping obtained from the USFWS Virginia Field Office indicates that most of the Potomac River shoreline in the Natural Resources ICE study area is considered a bald eagle concentration area for the yearly periods extending May 15th to August 31st and December 15th to March 15th (**Figure 2-17**). These dates represent the time-of-year-restrictions for activities within the mapped concentration areas. For projects that have blasting or other loud noise components, the buffer distance from the concentration area is 2,640 feet or up to 5,280 feet in open areas. For projects with activities within areas with noise buffers extending into concentration areas, an Eagle Act permit from the USFWS may be necessary.

The Center for Conservation Biology VA Eagle Nest Locator was used to identify and map known eagle nest locations within the Natural Resources ICE study area. Results from this service indicate that there are 42 known nest locations in the study area (**Figure 2-17**) (Center for Conservation Biology, 2017). The nests are located predominately along the shoreline of the Potomac River and its embayments. For projects that have blasting or other loud noise components, the buffer distance around eagle nests is 2,640 feet or up to 5,280 feet in open areas. For projects without blasting or other loud noise components, the buffer distance around nests is 660 feet. Given the separation distance from I-95 and known nest locations, bald eagle nests are not considered a sensitive resource for this study and are not considered further in the indirect and cumulative impacts sections of this report.

Although they do not show the exact location of rare plant, animal or natural communities, the VDCR-DNH designated CSs represent key areas of the landscape worthy of protection and are built around one or more rare plant, animal, or natural community. The VDCR-DNH also designates stream reaches that contain aquatic natural heritage resources as designated SCUs. Designated conservation sites and SCUs within the Natural Resources ICE study area may contain sensitive resources. The conservation sites and SCUs occurring in the study area are provided in **Table 2-7**.

Table 2-7: Conservation Sites and Units in the Natural Resources ICE Study Area

Site	Biodiversity Rank	Location
Chopawamsic Creek CS	B5	MCBQ
Pipeline-Little Union Slopes CS	B2	Prince William Forest Park
Powell's Creek CS	B3	Along Powells Creek east of US 1
Mount West CS	B3	MCBQ
Russell Road Slopes CS	B2	MCBQ
Smith Lake West Slopes CS	B4	MCBQ
Breckenridge Reservoir Ravine CS	B2	MCBQ
Carters Day Camp CS	B5	Prince William Forest Park
Chopawamsic CS	B3	MCBQ
Hotpatch Slopes CS	B3	MCBQ
Oldpark Headquarters NW Slopes CS	B3	Prince William Forest Park
Quantico Creek CS	B3	Prince William Forest Park
River Oaks Elementary CS	B3	Near River Oaks Elementary School in Prince William County
Falls Run at Rt. 17 SCU	B3	Riparian reaches along Falls Run in Stafford County
Aquia Creek-Rt. 1-Government Landing SCU	B2	Riparian reaches along Aquia Creek in Stafford County
Chopawamsic Creek Upstream Russell Road SCU	B2	Riparian reaches along Chopawamsic Creek upstream of Russell Road and US 1 in MCBQ

Notes: CS represents conservation sites; SCU represents stream conservation units.
Sources: VDCR-DNH (2017).

2.3.3 Historic Resources

The NHPA (54 U.S.C. 300101 et seq.) defines a historic property as any "prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion on, the National Register of Historic Places (NRHP), including artifacts, records, and material remains related to such a property or resource." For the purpose of this analysis, historic properties are architectural resources and archaeological sites eligible for listing or already listed in the NRHP. See the *Interstate 95 Express Lanes Fredericksburg Extension Study Historic Resources Technical Report* (VDOT, 2017d) for a detailed description of NRHP eligibility criteria for these sensitive resources.

As noted in **Section 2.2.2** the study area localities have experienced continuous Euro-American development since the 1600s, resulting in many buildings being designated as historic resources. **Figure 2-4a** through **Figure 2-f** shows the previously recorded architectural resources in the Historic Resources ICE study area. Two architectural historic properties are located in the Historic Resources ICE study area. The Chancellorsville Battlefield (VDHR ID 088-5180) was determined eligible for listing on the NRHP on March 22, 2000 and Aquia Church (VDHR ID 089-0008) is currently listed on the NRHP. The NRHP eligibility of additional sites is unevaluated.

Not all of the Historic Resources ICE study area has been intensively surveyed for archaeological sites. However, 18 archaeological sites have been previously recorded within the Historic Resources ICE study area. Of these, the NRHP eligibility of three are unevaluated (VDHR IDs 44ST0908, 44ST0909, and 44ST0910) and the remainder are documented as not eligible. **Figure 2-4** does not show the archaeological resources so as to protect their integrity.

2.4 STEP 4: IDENTIFY IMPACT CAUSING ACTIVITIES OF THE BUILD ALTERNATIVE

The objective of this step is to identify direct impacts that could have indirect effects that conflict with the regional direction and goals discussed in **Step 2 (Section 2.2)** and/or affect the resources identified in **Step 3 (Section 2.3)**. The NCHRP Report 466 includes groups of actions associated with transportation projects that are known to trigger indirect effects. NCHRP and project-specific examples of these impact-causing activities include: alteration of drainage, channelization, noise and vibration; excavation and fill for roadways; barriers; erosion and sediment control; landscaping; and alteration of travel time/cost. These activities potentially result in the estimated impacts documented in **Table 2-8.** These impacts are a subset of those impacts reported in the *I-95 HOT Lanes Project Environmental Assessment* (FHWA and VDOT, 2011) for the Express Lane expansion that was completed in the I-95 corridor in 2014. See the *I-95 HOT Lanes Project Environmental Assessment* for a summary of those impacts. Comparing these actions to regional directions and goals and the resources in the study areas enables the identification of potential indirect effects. The findings of this identification process are presented in **Step 5 (Section 2.5)**.

Table 2-8: Direct Impacts of the Alternatives

Environmental Resource	Potential Impacts	
	No-Build Alternative	Build Alternative
Total area (acres)	0	375.8
Additional required right-of-way (acres)	0	37.8
Land use conversions (acres)	0	37.8
Agricultural to transportation	0	12.5
Commercial to transportation	0	15.4
Residential to transportation	0	4.7
Industrial to transportation	0	5.2
Homes displaced (no.)	0	0
Businesses displaced (no.)	0	0
Farms displaced (no.)	0	0
Schools displaced (no.)	0	0
Churches displaced (no.)	0	0
Other community facilities displaced (rescue squads, fire stations, etc.) (no.)	0	0
Historic properties affected (no.)	0	0
Agricultural and forestal district land used (acres)	0	0
Prime, unique, or statewide-important farmland converted outside of existing right-of-way (acres)	0	4.6
Acid rock/soil disturbance (acres)	0	3.9
Length of streams disturbed (linear feet)	0	8,521
Wetlands displaced (acres)	0	3.2
Floodplains crossed (acres)	0	20.6
Woodland displaced (acres)	0	82.6
Resource protection area crossed (acres)	0	24.5
Anadromous fish use waters crossed (no.)	0	0
Proposed or listed threatened or endangered species impacted (no.)	0	7

2.5 STEP 5: IDENTIFY INDIRECT EFFECTS FOR ANALYSIS

The objective of this step is to assess whether direct impacts identified above would cause indirect effects. The indirect effects analysis focuses on the potential for socioeconomic and ecological impacts that could occur outside of the area of direct impact because of the alternatives. In NCHRP Report 466, the TRB states that indirect effects can occur in three broad categories:

- **Encroachment-Alteration Impacts**: Alteration of the behavior and functioning of the affected environment caused by study encroachment (physical, biological, socioeconomics) on the environment;
- **Induced Growth Impacts**: Study-influenced development effects (land use); and,
- **Impacts Related to Induced Growth**: Effects related to study-influenced development effects (impacts of the change of land use on the human and natural environment).

Induced growth impacts and the impacts to other resources related to induced growth are discussed together in the following sections.

When the term "induced growth effects" is used in this document, it is specifically referring to potential growth within one mile of all I-95 interchanges within the study area, including those at locations were capacity improvements are not proposed. Major feeder roads at all interchanges are also included to determine the study's induced growth effects. These feeder roads are included out to a minimum distance of two miles from the interchanges. The feeder roads at interchanges nearest to newly proposed or reengineered entry/exit ramps to the GP lanes (Exits 133 and 148), and the VA 610 / Courthouse Road interchange (Exit 140) where Express Lane access is proposed, are analyzed for induced growth effects out to a distance of three miles from the interchange. The induced growth study includes a 1,000-foot buffer on either side of the centerline for all analyzed feeder roads.

In general, with regard to induced growth, transportation improvements often reduce time and cost of travel, as well as provide new or improved access to properties, enhancing the attractiveness of surrounding land to developers and consumers. As previously discussed in **Section 1.3.2**, I-95 and its interchanges have been in place for many decades. Most of the lands within one mile of the existing interchanges in Berea, Falmouth, Stafford, Garrisonville, and Aquia Harbour in Stafford County have been settled with well-established residential neighborhoods, commercial, and industrial areas. Induced growth resulting from the proposed transportation improvements could include of infill rather than urban/suburban sprawl. Induced growth is limited by restricted access areas in the northern portion of the study area due to the presence of MCBQ and Prince William Forest Park. The portion of the study area north of the suburban areas of Berea and Falmouth, and south of Garrisonville, Aquia Harbour, and Stafford, is in a less advanced state of land use progression. However, as described in **Section 1.3.2**, the greatest potential for urbanization in this area occurs along the existing feeder roads and interchanges included within the Induced Growth study area boundary. Therefore, using the limits described above and in **Section 1.3.2**, this analysis attempts to identify where indirect effects are most probable and could occur because of the Study. It does not mean that indirect effects from the Study would not occur elsewhere; rather, it means that those effects are less reasonably foreseeable.

2.6 STEP 6: ANALYZE INDIRECT EFFECTS AND EVALUATE ANALYSIS RESULTS

Using planning judgement, this step analyzes indirect and induced growth effects potentially resulting from each alternative. Potential indirect effects that may occur by the year 2042 (the design year) are considered for all alternatives, including the No-Build Alternative. The specific minimization and

mitigation measures that would reduce adverse indirect effects to socioeconomic, natural, and historic resources are presented in **Section 2.7**.

2.6.1 No-Build Alternative

Encroachment Effects

Socioeconomic Resources

Continued and increasing traffic delays and traffic unreliability along I-95 and beyond the study corridor could cause some individuals or businesses to leave the area and locate elsewhere to reduce transportation-related costs. Given the importance of the I-95 corridor in connecting destinations within the study area, region, and nation, increasing congestion and travel unreliability would likely continue to impede the delivery of goods and services, restrict access to tourism and commercial activities, and result in lost economic productivity due to workers being delayed in traffic and increased fuel consumption from increased idling. Additional information on the socioeconomic effects to commuters entering or leaving the study area for work is available in the *Interstate 95 Fredericksburg Extension Study Socioeconomics and Land Use Technical Report* (VDOT, 2017g).

A recent study by the Texas A and M Transportation Institute reports that the Washington, DC-Virginia-Maryland urban area, when compared to areas in the nation with over three million in population, lead the US in yearly delay and excess fuel use per automobile commuter and congestion cost per mile (Texas A and M Transportation Institute, 2015). Given increasing congestion in the Socioeconomic Resources ICE study area, it is uncertain whether the area would remain attractive to individuals and businesses. Increased congestion would also result in more visual, noise, and air impacts that could reduce community cohesion and reduce access to community facilities and recreation areas.

Natural Resources

Although stormwater management along the I-95 corridor has been updated during the past with retrofitted and more modern systems as improvements have been made, there are still sections without any stormwater management features or outdated features that would not be improved under the No-Build Alternative. Existing indirect effects associated with untreated or poorly treated stormwater runoff containing contaminants from vehicle spills, and non-point source pollutants (asphalt, grease, oil, metals, nutrients, nitrogen, and deicing salts) would continue.

Historic Resources

Increasing traffic congestion under the No-Build Alternative could make access to certain historic properties that are open to public visitation more difficult, such as Aquia Church and the Chancellorsville Battlefield, making them less attractive to visit.

Induced Growth

No induced growth is expected under the No-Build Alternative by not implementing the Build Alternative. Land near existing interchanges may become less desirable under the No-Build Alternative due to continued traffic congestion and diminishing travel reliability.

2.6.2 Build Alternative

Encroachment Effects

Socioeconomic Resources

There would be no residential, commercial, industrial, or community facility relocations under the Build Alternative. The Build Alternative would add capacity to I-95 by adding two Express Lanes within the

median of the interstate for approximately ten miles. The temporary and permanent right-of-way requirements would be limited primarily to narrow strips adjacent to existing I-95 in the Fredericksburg Extension Study corridor. As the potentially impacted properties already border I-95, they are on the edge of adjacent communities. Therefore, proposed right-of-way acquisition would not change overall land use in the area. Consequently, the Build Alternative would have minimal indirect effects on land use.

Transportation impacts to community cohesion "may be beneficial or adverse, and may include splitting neighborhoods, isolating a portion of a neighborhood or an ethnic group or separating residents from community facilities" (FHWA, 1987). Construction and expansion of existing transportation corridors can disrupt community cohesion by changing connectivity between residential neighborhoods (i.e., physically dividing communities), displacing residents, disrupting access to community facilities either on a temporary or permanent basis, and introducing noise and visual elements incompatible with existing surrounding conditions (FHWA, 1996; FHWA, 1998). However, adding two additional Express Lanes to I-95 would not increase the separation distance between communities located on either side because the lanes would be constructed in the median; therefore, any indirect effects to community cohesion would be minor.

No relocations would occur and therefore no direct impact to EJ populations would occur. Indirect effects of increased noise, dust, or visual disturbance may occur during construction of the Build Alternative. Transportation benefits would be borne by all users of I-95. The improved transportation mobility and reduced congestion would include the Census block groups containing EJ populations.

Improvements to I-95 under the Build Alternative would reduce congestion along the study area corridor, improving travel reliability. As a result, transit services that use I-95 in the Socioeconomic Resources ICE study area would also be improved. This would benefit people and businesses by reducing lost productivity from sitting in congested traffic. The proposed improvements may make the area more attractive for new businesses or make it more conducive for existing businesses to expand, increasing employment opportunities in the Socioeconomic Resources ICE study area. Additionally, increases in job opportunities could be expected due to short-term construction hiring and long-term operation and maintenance of the new improvements.

Generally, when capacity is added, traffic volumes would increase on that facility as it becomes more attractive for travelers. Local roadways that parallel the improved I-95 study area could see traffic volume reductions, as drivers divert from existing surface streets to the improved corridor where they would find better travel conditions.

Natural Resources

Some of the potential impacts that may occur because of changes to natural processes in the Natural Resources ICE study area include changes to vegetative community composition and structure (riparian and forestland impacts), water quality, floodwater storage and movement, and aquatic life movement. An increase in sunlight in the riparian areas adjacent to Falls Run, Claiborne Run, Potomac Creek, Accokeek Creek, Austin Run, Aquia Creek, and Chopawamsic Creek due to roadway expansion, resulting in removing riparian canopy, could alter vegetation community composition. The removal of existing vegetation could introduce invasive species, which may favor full-sun conditions over native plants. Construction can also indirectly increase the presence of invasive plant species enabled by earth disturbance and spreading from contaminated vehicles, clothing, and shoes. These changes to community composition, and competition with invasive species, could reduce the amount of habitat preferred by protected plant species if they occur in the study area. The spread of invasive species can be minimized by following provisions in the most recent versions of VDOT's *Road and Bridge Specifications*. These provisions require prompt seeding of disturbed areas with mixes that are tested to ensure that seed mixes are free of noxious species. While

areas with active land disturbance would be vulnerable to the colonization of invasive plant species from adjacent properties, implementation of the stated provisions would reduce the potential for the establishment and proliferation of invasive species.

Reduction in riparian canopy cover could indirectly affect water chemistry (decrease in DO and increase in temperature, both which impact nutrient cycling and aquatic life) in Falls Run, Claiborne Run, Potomac Creek, Accokeek Creek, Austin Run, Aquia Creek, and Chopawamsic Creek. In addition, the obverse could occur as widening or constructing new bridges at the existing bridge crossings of Potomac Creek, Aquia Creek, and Chopawamsic Creek could shadow wetlands, and indirectly alter the plant community and wildlife habitat in these areas.

Although, the Build Alternative is located primarily within the median of I-95, it would cause some habitat loss (**Table 2-8**) along the corridor because of vegetation removal. Areas of potential vegetation removal occur mainly in the median of the divided interstate south of Aquia Creek and in lesser amounts along the outside edges of the existing lanes near the Warrenton Road interchange and in areas where stormwater management facilities are proposed. The removal of tree species could indirectly affect the NLEB through the elimination of suitable forage and summer roost habitat.

Habitat fragmentation is indirectly associated with habitat loss. As described in **Section 2.2.2**, habitat fragmentation can have wide-ranging indirect effects to wildlife including:

- Species shifts associated with less interior habitat (smaller patch size), lower diversity due to smaller habitat patches, and potential isolation of populations which may result from vegetation removal within the median of the interstate;
- Potential decreased flow of genetic material through the landscape due to lengthening of culverts and removal of vegetation in the median;
- Restricting wildlife movements that disrupt foraging, breeding/nesting, and migration;
- Increased risk of invasive species establishment; and
- Generally, reduced biological diversity.

Roadway noise can also result in altered habitat utilization, strained communication, and heightened metabolic rates on wildlife, especially avian communities, indirectly causing wildlife abandonment of the area, increased predation, reduced foraging success, decreased breeding success, and decreased wildlife health.

The increased impervious surface of the additional travel lanes could indirectly increase the amount and velocity of runoff in streams located in, and downstream of the LOD, amplifying the severity of flooding and erosion. Runoff would also pick up more sediment from disturbed soils and contaminants that could be deposited downstream, reducing water quality that impairs both human and wildlife uses. Runoff from roadways could contain heavy metals, salt, and associated materials, organic compounds, and nutrients. When contaminated runoff enters waters that are already impaired, such as Falls Run in the Build Alternative's LOD, the impacts are cumulative and can result in accelerated changes in the macrobenthic community (those organisms larger than 0.04 inch in size) structure and composition. These changes in turn can affect the fish and amphibian populations that rely on them as a food source, as well as the birds, aquatic mammals, and reptiles that prey on the fish, amphibians, and invertebrates. The impacts can result in changes in community structure at a local level, but may also extend further to include changes in ecosystem structure and function in the absence of proper mitigation. Through adherence to approved best management practices (BMPs) the potential adverse impacts on aquatic habitat and wildlife should be neutralized.

The Build Alternative would directly affect approximately 20.6 acres of floodplain in seven anticipated crossings of the Falls Run, Potomac Creek, Accokeek Creek, Austin Run, and Aquia Creek floodplains. Floodplain encroachment could alter the hydrology of the floodplain indirectly leading to more severe flooding in terms of flood height, duration, and erosion (FEMA, 2016). These potentially adverse indirect effects to floodplains can be minimized through proper crossing design as discussed in **Section 2.7.2**.

Widening of existing bridges or lengthening culverts under the Build Alternative at Falls Run, Claiborne Run, Potomac Creek, Accokeek Creek, Austin Run, and Aquia Creek could indirectly restrict wildlife movement through the riparian corridors crossed by these structures and alter up and downstream hydrologic flow. Direct impacts to wetlands, streams, and floodplains may indirectly change hydrologic flow dynamics through adjacent natural communities up or downstream, which sometimes alters these dynamics at the ecosystem level such that the ability of the system to maintain itself is altered. Preserving the hydrodynamic flow through the stream systems in the study area is important because reduced flow reduces the ability to move sediment and material downstream, clogging streams and altering the natural riffle, pool, run sequence and reducing habitat quality.

Habitat and water quality may also be indirectly affected by disturbance of acid rock such as Quantico slate near the proposed ramp at Russel Road. Problems associated with acid rock drainage include degradation of metal and concrete building materials (which accelerates the need for repairs and can compromise structural stability), weathering of fill material and precipitation of sulfates, damage to vegetation, impacts to the surface water quality and aquatic life in Chopawamsic Creek, and contamination of groundwater.

The water quality and habitat indirect effects resulting from increased impervious surface area has the potential to affect negatively the designated threatened and endangered species waters and anadromous fish use waters occurring in the Natural Resources ICE study area. If present, mussel species in Aquia Creek, Austin Run, and Chopawamsic Creek, and anadromous fish in Aquia Creek, downstream of the direct impacts area, could be indirectly impacted through sedimentation and prey reduction due to reduced water quality, respectively. Further, activities that could affect the location or abundance of prey (insects, small fish, worms, and small crustaceans), such as removal of canopy cover and hardening of the channel (culverting), may affect the distribution of anadromous fish.

Historic Resources

Quicker and more reliable access to historic sites in the study area such as the Chancellorsville Battlefield, and those accessed by I-95 north and south of the study area (Fredericksburg and Spotsylvania National Military Park, Manassas National Battlefield Park, and Spotsylvania Court House Battlefield) could potentially foster increased visitation. This would be beneficial if access to historic properties is controlled, as increasing historic tourism provides incentives and means for preservation. While not expected, uncontrolled increased visitation may result in overuse to the point of adversely affecting their integrity.

During construction, access to historic properties could be temporarily impacted by temporary road closures, detours, and loss of parking, potentially affecting visitation. These construction effects would be short term and therefore minor.

Induced Growth

Induced growth could occur under the Build Alternative because it would increase capacity and reduce congestion, making it more attractive for users and increasing access to surrounding land. It would also improve regional accessibility for customers as well as the delivery of goods and services that facilitates growth. As previously discussed in **Section 1.3.2**, induced growth would most likely occur around existing interchanges along the Fredericksburg Extension Study corridor. However, it is not expected to exceed

the growth anticipated and planned for regionally. The potential growth areas are presented in **Figure 2-1** as the Induced Growth study area and the interchanges of the Build Alternative.

Under the Build Alternative, the potential for induced growth is limited by the restricted availability of undeveloped land in the Induced Growth study area that is virtually built-out, the amount of protected lands present (e.g., RPAs, wetlands, parks), and inaccessible land within a military installation. Approximately 15 percent of the Induced Growth study area is protected parkland or under the protection of the US Government (MCBQ, Quantico National Cemetery, and National Museum of the Marine Corps). Excluding areas protected from development, approximately 9,829 acres (approximately 55 percent) are within the Induced Growth study area. Lands classified as developed for this analysis include developed open space, and low-, medium-, and high-intensity developed lands as contained in the 2011 NLCD (**Figure 2-20**). Growth in these developed areas would likely be in the form of infill or redevelopment. The remaining approximately 45 percent (8,056 acres) of the Induced Growth study area is undeveloped and is not currently protected as park or government land.

The Build Alternative improvements to I-95 would most likely lead to growth in the Induced Growth study area based on the factors discussed in **Section 1.3.2**. One of these factors is local land use policies and guidance. The Induced Growth study area is outside of designated growth or redevelopment areas in Prince William County. Areas designated as growth areas in Stafford County include the Courthouse, Central Stafford Business Area, and Warrenton Road TGA/PFAs and the Boswells' Corner, Aquia Town Center, and Historic Falmouth redevelopment areas. Stafford County has determined that these areas are suitable for growth and these areas would likely experience the highest level of growth in the Induced Growth study area. As the feeder roads accessing I-95 at Exit 133 extend from the interchange into the city of Fredericksburg, the induced growth effects along US 1 in northeast Fredericksburg are considered. As such, and to match the zoning/land use conversions developed to access land use in the Socioeconomic ICE study area, Fredericksburg zoning GIS data was utilized and paired with the categories presented in **Table 2-2**. The *Fredericksburg Virginia Comprehensive Plan* (2015) designates the entire city as a Strategic Growth Area within the region. Therefore, the entire portion of the Induced Growth study area in Fredericksburg is included as a growth area in this analysis. **Figure 2-20** shows the designated growth areas in Stafford County and Fredericksburg. Combined, these areas are determined to be suitable for growth account for approximately 38 percent (8,146 acres) of the Induced Growth study area.

The Induced Growth study area also extends outside of designated growth areas. **Table 2-9** summarizes characteristics by land use category of the Induced Growth study area for the Build Alternative that extends beyond designated growth areas. Land use is based on Stafford County, Prince William County, and Fredericksburg data.

Approximately 62 percent (13,141 acres) of the total Induced Growth study area acres extend beyond designated growth areas, including areas over water. Of the total acres outside of designated growth areas, the majority are residential (31.9 percent), agricultural (20.5 percent), and federal lands (19.9 percent). Induced growth associated with the Build Alternative could create pressure on Stafford County, Prince William County, and Fredericksburg to make changes to their land use plans to allow types of development in areas not currently approved for it or to allow greater development densities, primarily the latter. This is anticipated to occur at limited levels for several reasons. Improvements to I-95 have been studied for several decades. Area planning has considered potential improvements to I-95 (see **Section 2.1**), and developed their land use policies with these improvements in mind. Further, the largest acreage of potential induced growth associated with the Build Alternative outside of designated growth areas is in residential areas where infill would be expected to increase density.

Figure 2-20: Developed Lands in the Induced Growth ICE Study Area

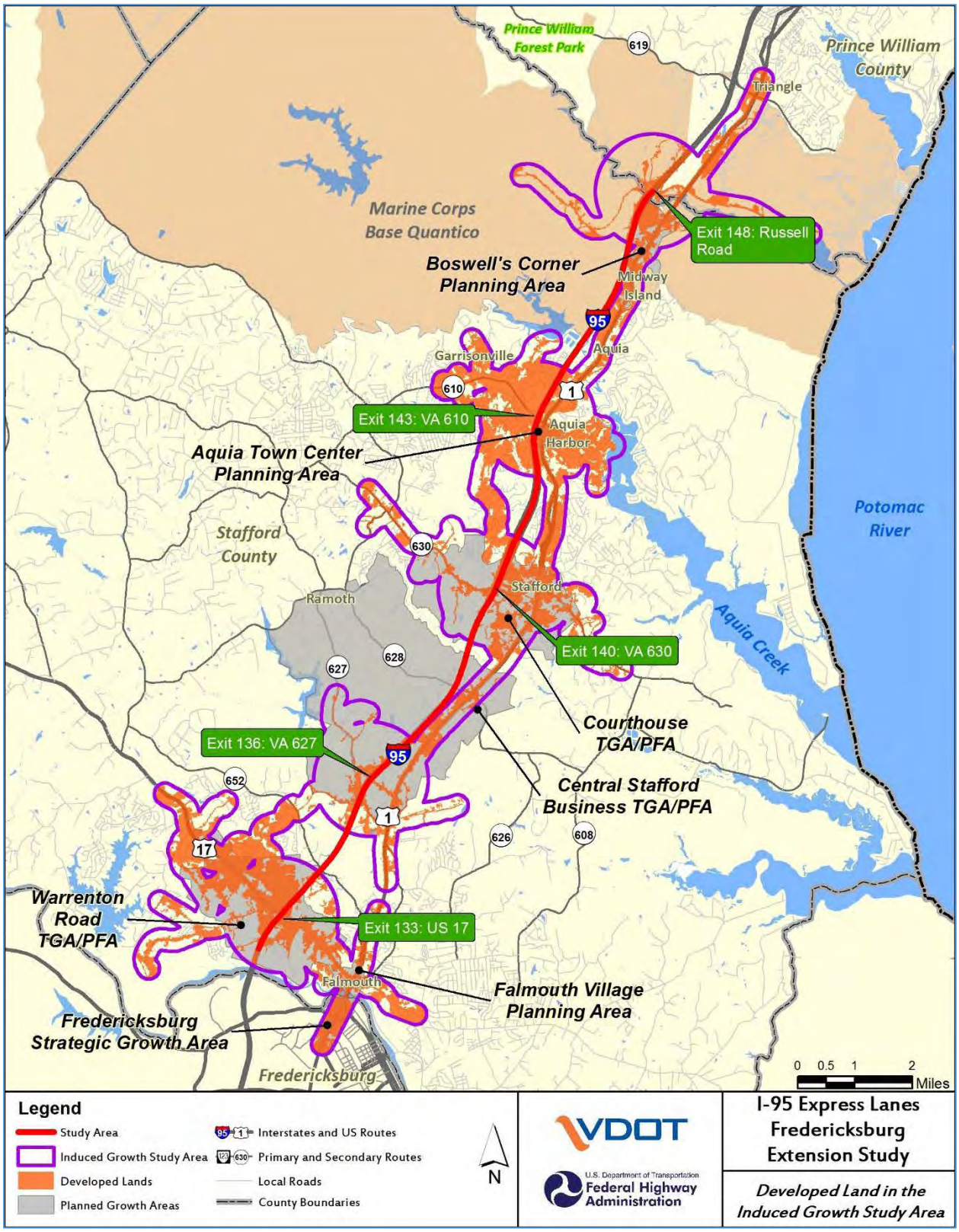


Table 2-9: Build Alternative Induced Growth Study Area Outside of Designated Growth Areas

Land Use Category	Induced Growth Study Area Outside of Designated Growth Areas (Acres)	Percent
Agricultural	2,698	20.5%
Commercial	1,720	13.1%
Federal	2,620	19.9%
Industrial	167	1.3%
Planned Development	397	3.0%
Residential	4,194	31.9%
Right-of-Way	1,345	10.2%

Sources: Stafford County (2016d); Prince William County (2015).

As of 2011, the combined cover of developed lands in the Induced Growth study area exceeded the combined cover of all other lands with natural cover including forests, wetlands, grasslands, scrub/shrub lands, and open water (**Table 2-10**). Of the total land within the Induced Growth study area, approximately 14.7 percent is protected from development by the presence of MCBQ and county parks including Locust Shade Park. Excluding these protected areas, approximately 53.3 percent of the Induced Growth study area was developed in 2011.

Table 2-10: Land Cover in the Build Alternative Induced Growth Study Area

Land Use Category	Induced Growth Study Area Outside of Designated Growth Areas (Acres)	Percent
Forests, Wetlands, Grasslands, Scrub/Shrub, and Open Water	9,760	46.2%
Barren Land	144	0.7%
Agricultural Land	944	4.5%
Developed Land	10,267	48.6%

Sources: Homer et al. (2015).

The extent of induced residential, commercial, industrial, and mixed-use growth that could occur under the Build Alternative is uncertain because many factors other than transportation accessibility affect the decision to develop, such as local development policies and incentives, favorable economic conditions, and ease of financing.

Induced growth could benefit socioeconomic resources by increasing business and service providers that lead to increased long-term employment. It could also be negative for others. For example, induced growth could be both beneficial and adverse to low-income populations. New employment opportunities could occur but gentrification associated with induced growth and development could increase property values and reduce available low-income housing stock.

Development associated with induced growth can adversely affect water quality, affecting human use and ecosystem functions, as discussed above in **Section 2.2.2**, and the natural resources indirect effects assessment of the No-Build Alternative. However, federal, state, and local regulations addressing stormwater runoff and protecting water quality could reduce potential adverse impacts.

Development associated with induced growth in the Induced Growth study area could affect wetlands, streams, and floodplain areas. **Table 2-11** presents an estimate of wetland acres, linear feet of streams and floodplain acres throughout the Induced Growth study area of the Build Alternative. Should future induced growth and development in the vicinity of the Build Alternative interchanges and feeder roads impact regulated waters, wetlands, streams, or floodplains, individual development could be subject to review, approval, and/or permits from local, state, or federal agencies (including the USACE) before any impacts would occur. New development in previously developed areas could be required to replace outdated stormwater control and drainage systems and replace impervious surfaces with more permeable surfaces, lessening impacts to water quality that may otherwise occur.

Table 2-11: Wetlands, Streams, and Floodplains in the Build Alternative's Induced Growth Study Area

Resource	Quantity
Wetlands	1,572 acres
Streams	440,517 linear feet
Floodplains	1,991 acres

Sources: USFWS (1990, 1991, 1994a, 1994b, 1994c, 1994d, 1994e, 2008, 2009); USGS (2017a, 2017b); FEMA (2017)

Impacts of induced growth under the Build Alternative to terrestrial and aquatic wildlife and wildlife habitat can include wildlife loss; habitat loss, fragmentation and degradation; disruption of resting, feeding, movement, breeding, and nursery sites; changes in wildlife population density and species richness; alterations of hydrology and species interaction; and imperil protected species. Because the induced growth area of the Build Alternative is largely preserved through protection as federal or park land, the potential adverse impacts to wildlife and wildlife habitat from induced growth development could still occur, but may be reduced. Any federal or state-sponsored development or development on federal or state land would be regulated to minimize potential impacts to protected wildlife and wildlife habitat. Potential impacts to federally-protected species on private property are also regulated as previously described. Proposed modifications to wetlands would be federally- and state-regulated as well, reducing potential adverse impacts of induced growth to wildlife and wildlife habitat.

New construction or rehabilitation associated with induced growth has the potential to affect adversely archaeological and architectural historic properties. This could occur by:

- Demolition, excavation, or vibration effects;
- Changing the design, materials, or workmanship; and/or
- Altering the setting, feeling, and association of historic properties.

Development projects funded, permitted, or on lands controlled by federal and state agencies must take into account effects on historic properties by complying with Section 106 of the NHPA and the Virginia Antiquities Act and Burial Law, respectively. Additionally, Stafford County's Architectural Review Board, Prince William County's Historic Preservation Division, and Fredericksburg's Architectural Review Board review and approve individual development projects within historic districts or historic overlay zones under their jurisdictions that apply to private property. These processes would reduce the potential adverse effects to historic properties from induced growth associated with the Build Alternative.

2.7 STEP 7: ASSESS CONSEQUENCES AND DEVELOP MITIGATION

2.7.1 No-Build Alternative

Under the No-Build Alternative, routine maintenance to existing facilities, and the planned and programmed improvements listed in **Section 1.2.2** may occur. The environmental impacts associated with implementing these planned and programed actions would be considered in the environmental review process for each. Selection of the No-Build Alternative of the Fredericksburg Extension Study would result in increasing traffic congestion and associated lost productivity that could cause some individuals or businesses to leave the Socioeconomics ICE study area. This could result in impacts to community cohesion and loss of business and employment in the Socioeconomic Resources ICE study area. Under the No-Build Alternative, no indirect effects to natural resources or historic properties would occur by not implementing the Fredericksburg Extension Study. Growth could occur in the Induced Growth study area under the No-Build Alternative, but it would not be related to failing to implement the Build Alternative. As this alternative is the baseline against which the Build Alternative is compared to assess environmental effects, no mitigation measures are proposed for the No-Build Alternative.

2.7.2 Build Alternative

Encroachment Effects

Socioeconomic Resources

The Build Alternative would result in the conversion of study area land to transportation land use. Because most Build Alternative construction would occur in existing transportation right-of-way, these impacts would be generally limited to slivers of land bordering I-95. Therefore, the Build Alternative would not change the overall existing and planned land use pattern in the study area or Prince William and Stafford counties. Mitigation in compliance with the Uniform Act of 1970 would compensate individual landowners for property converted to transportation use.

As the Build Alternative would be completed largely within existing right-of-way, and no bicycle paths, recreational trails, or community facilities are located in the LOD, no direct impact to these resources would occur. Temporary indirect effects to socioeconomic resources from temporary road closures, detours, and loss of parking during construction would be minimized by informing the affected communities in advance of when such circumstances would occur, and working with individuals and the community to potentially adjust schedules and identify alternative access.

The Build Alternative would improve traffic congestion along the Fredericksburg Extension Study corridor that would result in moderate reductions in lost productivity due to congestion. The Build Alternative would not result in residential or business relocations as the improvements would predominately be within the existing median of I-95. Therefore, indirect effects to community cohesion under the Build Alternative should be minor.

Finally, as the Build Alternative stays predominately within the existing right-of-way, and no residential relocations would be required from the construction of the Build Alternative, minimal potential direct and indirect effects to the minority population living in the study area would occur. Potential indirect effects such as the temporary and short-term construction effects of increased noise, dust, and visual changes would not be major and adverse to the affected EJ community.

Natural Resources

Potential indirect effects to wetlands, streams, floodplains, water quality, wildlife habitat, and threatened or endangered species are not anticipated to be significant and may result from temporary construction

impacts and increased stormwater runoff due to increases in impervious surface area. Potential indirect effects to wetlands, streams, and floodplains would be minimized by local, state, and federal regulations governing construction impacts in these areas. These regulations require avoidance, minimization, and compensatory mitigation. Implementation of strict ESC measures during construction should minimize temporary, indirect effects to wetlands and waters. Impacts to floodplains should be reduced by utilizing proper design consistent with procedures for the location and hydraulic design of highway encroachments on floodplains contained in 23 CFR §650 Subpart A Location and Hydraulic Design of Encroachments on Flood Plains. In addition, the Build Alternative would be designed in accordance with Sections 107 Legal Responsibilities and 303 Earthwork of VDOT's Road and Bridge specifications.

Indirect impacts to water quality and aquatic habitat may result from disturbance of acid rock in the LOD near exit 148. Potential problems associated with disturbance of the acid rock can be mitigated by several possible methods:

- Neutralize the acid by applying pulverized agricultural lime or soda ash;
- Encapsulate the materials to segregate them from exposure to air; and/or
- Remove and dispose at another location.

The appropriate method of dealing with potential acid drainage problems would be identified during the design process, part of which would include acquisition of geotechnical borings to identify potential problem areas for use in design of foundations and road substructure. Special provisions would be developed as needed for inclusion in the construction plans.

Modern temporary and permanent SWM measures, including SWM ponds, sediment basins, vegetative controls, and other measures would be implemented to minimize potential degradation of water quality due to increased impervious surface, drainage alteration, and soil disturbance. These measures, the use and location of which would be determined during design/permitting, would reduce or detain discharge volumes and remove many pollutants before discharging into receiving bodies of water separated from the direct impacts project area. Removal of these pollutants would prevent indirect water quality impacts downstream in the watershed protecting areas of SAV and EFH located in the Potomac River and its embayments. In addition, the implementation of these measures would reduce the potential for downstream effects to threatened and endangered species and anadromous fish waters. To this end, all VDOT projects must comply with the Virginia ESC Law and Regulations, the Virginia SWM Law and Regulations, the most current version of the VDOT Annual ESC and SWM Specifications and Standards, and the project-specific ESC and SWM plans.

Indirect impacts to water quality from contaminant loadings would also be reduced through highway design that incorporates runoff pre-treatment, including vegetated medians and swales, stormwater BMPs, and forebays (basins designed to detain the runoff for initial settling of coarse particulates). Indirect impacts to water quality during construction may be reduced from use of: non-erodible cofferdams to isolate the construction area; stockpiling excavated material in a manner that prevents reentry into the stream; re-vegetating barren areas with native vegetation; and implementing strict erosion and sediment control measures. Measures such as culvert inlet and outlet protection, rock check dams, dewatering structures, and sediment traps and basins would help to prevent sedimentation of the waterbodies.

The indirect effects of the Build Alternative to hydrology associated with the eight anticipated floodplain crossings would be limited as this alternative is mainly confined to the interstate's median in an existing corridor. The crossings would be designed to adequately pass design floods and existing culverts would be extended or resized, where appropriate, and bridges widened or replaced in accordance with design standards.

All roadway crossings would utilize structures designed to accommodate passage of aquatic organisms. Using bridges for crossings of streams and associated riparian corridors serves to maintain some existing wildlife movement pathways; in contrast, fill with cross-pipes deters movement of certain wildlife species. The design would also be mindful of maintaining natural stream bottoms and natural shoreline preservation beneficial to wildlife. Re-alignment, re-sizing, and replacement of existing culverts can reduce overall current stream quality degradation upstream and downstream of the direct impacts area. These measures would be fully considered during design/permitting of the Build Alternative.

Restoration of wetland and riparian vegetation within the median and on the edges of the right-of-way, would reduce potential indirect effects to aquatic and terrestrial wildlife from loss of habitat, habitat fragmentation, and potentially reduced water quality. Restricting the timing and duration of some construction activities relative to specific species needs would also minimize potential indirect effects to wildlife and protected species feeding, migration, breeding, nesting, and spawning.

Forest clearing along the edge of the existing ROW would result in minimal reduction in forested cover and quality of forested habitat. Clearing of forests within interchanges and smaller fragmented forested areas within the median could indirectly result in the removal of sub-optimal habitat that has a low potential for roosting and generally does not provide suitable commuting and foraging corridors for bats. Larger tracts of contiguous forest within the median provide suitable summer roosting habitat and foraging in areas. However, these area are still disconnected from the surrounding landscape by a three lane heavily trafficked interstate. Clearing of these forested areas would not result in the removal of optimal habitat for NLEB. No confirmed maternity roosts or hibernacula are located within a two-mile radius of the LOD, further limiting the potential effects on the species.

Invasive plant species management techniques would minimize the indirect effects to wildlife, wildlife habitat, and protected plant species from the introduction and spread of invasive species posed by construction of the Build Alternative. VDOT's *Roadside Development Specification 244* and Roadside Vegetation Management Policy include these and other measures to manage invasive plant species. These provisions require prompt seeding of disturbed areas with mixes that are tested in accordance with the Virginia Seed Law and VDOT's standards and specifications to ensure that seed mixes are free of noxious species.

Due to the potential presence of listed species in the study area, close regulatory coordination would be required during the permitting process. At that time, the agencies may require surveys be completed to confirm the presence, or absence of, listed species in the study area. If required, these surveys must be conducted by an approved surveyor, and often are only acceptable if completed during certain periods of the year. If presence of a listed species is confirmed, the agencies may recommend a time-of-year restriction for activities within occupied habitat and these restrictions would be determined as part of the permitting process. Additional potential mitigation measures may include use of contractor training in recognizing and avoiding threatened and endangered species and their habitats, and restoration of habitat. While many of these mitigation actions would be incorporated to offset direct impacts, they also could mitigate indirect effects outside of the area of direct impact.

Historic Resources

VDOT is committed to further coordination with VDHR as the study progresses and additional information is known about the Build Alternative design and anticipated impacts. Although no adverse indirect effects are currently anticipated, mitigation for adverse effects to historic properties would be developed through the Section 106 process if additional effects were identified in later phases of the study.

Induced Growth

The Build Alternative has the potential to induce growth around the existing interchanges and major feeder roads along the Fredericksburg Extension Study corridor. An Interchange Modification Report (IMR) for any existing interchanges proposed for modification under the Build Alternative would be prepared to evaluate specific effects on land use and appropriate mitigation measures to be developed. Because induced growth is anticipated to occur as infill or redevelopment around existing interchanges in previously developed areas, and such growth would occur primarily in areas allowing that type of development as identified in planning and zoning, it is anticipated that the indirect effects of induced growth to socioeconomic, natural, and historic resources would not be substantial. Further, as discussed in **Section 2.2.4**, according to scoping responses received to date, Stafford County has updated their comprehensive plan to incorporate the potential induced growth effects of the Build Alternative and have updated their future land use plan with designated TGAs to accommodate the potential growth. Therefore, no mitigation measures are proposed for induced growth effects. However, applicable federal, state, and local regulations would minimize the potential adverse effects of potential induced growth to natural and cultural resources and may require mitigation and compensatory measures for a specific development as described in the Natural Resources Effects and Historic Resources Effects sections above.

3. CUMULATIVE EFFECTS

3.1 STUDY AREA AND GEOGRAPHIC SCOPE

The geographic boundaries for the cumulative effects analysis are the same as the individual study areas described in **Section 2.2.1** and include the following components:

- The full environmental study area for the resource inventory and alternatives analysis;
- The natural resources study area for indirect effects; and
- The socioeconomic and historic resources study areas for indirect effects.

3.2 WHAT ARE THE TEMPORAL BOUNDARIES FOR THE STUDY?

The temporal boundary established for the I-95 Express Lanes Fredericksburg Extension Study ICE analysis began in 1964 and extends to 2042. The past timeframe was selected based on the completion date of I-95 in the study corridor. The future time bracket was selected because it encompasses the 2042 design year for the study and the analysis uses existing regional plans and projections that are forecasted generally through 2040.

3.3 WHAT ARE THE RESOURCES AFFECTED BY THE STUDY?

The resources affected by the Build Alternative would be the same as those resources identified in **Step 3** and discussed in **Section 2.3** of the indirect effects analysis.

3.4 WHAT ARE OTHER PAST, PRESENT, AND REASONABLY FORESEEABLE ACTIONS THAT HAVE IMPACTED OR MAY IMPACT THESE RESOURCES?

3.4.1 Past Actions

Many of the past actions that have broadly contributed to the baseline for this analysis occurred as part of the development described in **Section 2.2**. This development transformed a rural landscape into an urban/suburban environment in many parts of the ICE study areas. As discussed in detail in **Section 2.2**, continual land use intensification in the region has contributed to increased benefits to society from expanding communities with burgeoning employment and increased standards of living but also a steady decline in natural and historic resource conditions in the respective study areas. The extent of impaired

waters in the Natural Resources ICE study area is the best available measure of the magnitude of cumulative effects to WOUS. Ecosystem functioning has declined due to impairments to water quality; wetland, stream, and floodplain loss; terrestrial and aquatic wildlife and wildlife habitat loss; alteration of habitat that affects the survival of wildlife; increasingly imperiling rare, threatened, and endangered plant and wildlife species; and destroying historic properties. More recently, climate change and sea level rise has the potential to cause abrupt ecosystem changes and increased species extinctions (USEPA, 2016).

The following identifies specific past actions since 1964 that have contributed to existing conditions within the Natural Resources ICE study area. The following past transportation and major development activities are focused upon as relevant to understanding the potential cumulative effects of the Interstate 95 Express Lanes Fredericksburg Extension Study alternatives. These past actions are provided in **Table 3-1**. Permit data is not available for many of these projects; however, some of these developments are clearly visible in the historic mapping and aerials (**Appendix B**) and include I-95, Aquia Harbour, Smith Lake Reservoir, Celebrate Virginia North and South development, construction of the Centreport Parkway interchange, and forming of the Rocky Pen Run reservoir. Beginning in the 1960s and extending to today, many individual development projects also transformed portions of the Natural Resources ICE study area to the developed areas that exists today. Growth in these areas is discussed in **Section 2.2.1** and they can be viewed in the aerials contained in **Appendix B**.

Table 3-1: Past Projects in the Natural Resources ICE Study Area

Project Description	Approximate Date	Approximate Location
Construction of two Express Lanes within the median of I-95	2014	North of Exits 143 to near Exit 152
Dam completed forming Rocky Pen Run Reservoir	2014	Constructed along Rocky Pen Run in Stafford County
Construction completed of Centreport Parkway interchange	2007	Exit 136
Celebrate Virginia South development	2003	West of I-95, south of the Rappahannock River, and north of Fall Hill Avenue
Stafford Regional Airport opens for business	2001	North of Exit 136
Celebrate Virginia North development	2000	West of I-95, south of US 17, and north of the Rappahannock River
Construction of two HOV lanes within the median of I-95	1997	From I-495 to near Exit 152
Smith lake dam rehabilitated increasing the normal pool elevation from 70 to 90 feet	1996	MCBQ in Stafford County
Fredericksburg Regional Transit opens for service	1996	Providing public transportation services to Fredericksburg, Spotsylvania and Stafford Counties
Central Park Commerce Center opens first section	1995	Intersection of I-95 and US 3 in Fredericksburg

Project Description	Approximate Date	Approximate Location
Virginia Railway Express begins passenger service	1992	Manassas to Fredericksburg
Widening I-95 from four to six lanes	1983-1987	Throughout study area
Dam completed forming Smith Lake Reservoir	1968	Constructed along Aquia Creek in MCBQ
Aquia Harbour Community Development	1968	East of US 1 along Aquia Creek
Dam completed forming Abel Lake	1965	Constructed along Potomac Creek in Stafford County
Completion of I-95 with four lanes	1964	Through study area

3.4.2 Present and Reasonably Foreseeable Future Actions

A number of development actions are occurring and/or are planned to occur that could contribute to cumulative effects on resources affected by the alternatives. In addition to the Fredericksburg Extension Study under consideration in the Revised EA, there are numerous VDOT and local actions planned within the respective study areas. These actions were identified through the review of the following documents, plans, or lists:

- CLRP 2016 Amendment for the National Capital Region, prepared by the National Capital Region TPB (TPB, 2016a);
- MWCOG TIP (TPB, 2016b);
- 2040 Long-Range Transportation Plan produced by the George Washington Regional Commission and FAMPO (FAMPO, 2013);
- FAMPO's Fiscal Years 2015-2018 Transportation Improvement Program (FAMPO, 2014);
- VDOT's Six-Year Improvement Program (SYIP) (VDOT, 2016b);
- VDOT's Statewide Transportation Improvement Program (STIP) – Fredericksburg District (VDOT, 2014);
- MWCOG's Draft National Capital Freight Plan (TPB, 2016C);
- VRE System Plan 2040 Study Final Report (VDOT, 2014); and
- CIPs or budgets for Fredericksburg, and Prince William, Stafford, and Spotsylvania Counties (Fredericksburg, 2017; Prince William County, 2016; Stafford County, 2016a; and Spotsylvania County, 2016).

These documents, plans, or lists detail the current or planned transportation projects and separate the projects by type (Interstate, primary road, secondary road, multimodal, bicycle, transit, pedestrian, multiuse, or shared-use path). The MWCOG CLRP and FAMPO Long-Range Transportation Plan identify the significant capital improvement projects for the region's highway, transit, and active transportation systems that transportation agencies expect to be able to fund over the next 20-plus years. The MWCOG FY 2015-2020 TIP represents the currently approved program listing the federal funds used to supplement state or local projects. The MWCOG FY 2017-2022 TIP and FAMPO FY 2015-2018 TIP lists projects that are reasonably foreseeable for future implementation. VDOT's SYIP details the anticipated expenditure of funds for capital improvements to transportation facilities or services in the state. The VDOT STIPs identify the transportation projects (highway, passenger rail, freight, public transit, bicycle, and pedestrian) that

would utilize federal transportation funding or require approval from either the FHWA or the Federal Transit Administration.

When conducting cumulative effects analyses, FHWA and VDOT consider "Reasonably Foreseeable Future Actions" to be those actions that are fiscally constrained in the region's transportation plans. Projects included in the documents, plans, or lists provided above are treated as reasonably foreseeable actions because future construction funds have been set aside for them in the planning process. Due to scarce financial resources, projects that do not have identified funding may not be constructed, and are therefore not reasonably foreseeable. **Appendix A** lists all of the present and reasonably foreseeable future transportation projects that would add capacity within the respective study areas and notes the status of each project. These projects would all contribute to cumulative effects related to socioeconomic, natural, and historic resources.

Local non-transportation projects being studied by other state, federal agency, or private entities have been identified by examining the local and regional plans and capital improvement project lists provided above. **Appendix E** contains a list of these current and future non-transportation projects. These projects, along with those listed above, are considered in the discussion and analysis below.

3.5 WHAT ARE THOSE IMPACTS?

Cumulative effects consist of the direct and indirect effects of the given alternative in combination with the impacts of past, present, and reasonably foreseeable actions. Past, present, and reasonably foreseeable actions have already affected or have the potential to impact land use and socioeconomic, natural, or historic resources, as does the proposed improvements. This analysis relies on CEQ guidance to assess the severity of an impact based on context and intensity. Context may be geographic at multiple scales, including society as a whole, an affected region, affected interests, and or specific localities. Intensity, as defined by CEQ, is the severity of impact with regard to multiple factors, including:

- Impacts both beneficial and adverse;
- Degree of public health and safety impacted;
- Unique characteristics of the geographic area;
- Degree of controversy surrounding that action and the effect;
- Potential to set precedent for future actions;
- Cumulative effects, which may be significant, even though the action itself would not create significant effects; and
- Whether there is a violation of federal, state, or local law or requirements meant to protect the environment.

Impacts with respect to each of the intensity criteria can be described in various levels of severity (**Table 3-2**). The significance or importance of impacts is determined by evaluating the proposed action against existing environmental standards, thresholds, guidelines, or objectives established by federal, state, and local agencies. These impact significance factors are applied to all resource areas.

Table 3-2: General Effects Determination Matrix

Severity	Extent	Duration	Likelihood
Major	Large	Long	Probable
Moderate	Medium	Medium	Possible
Minor	Small	Short	Unlikely

A large extent would be statewide, medium would be regional and small would be local. For most resources, a long duration corresponds to over five years, a medium duration would be one to five years, and a short duration would be less than one year. These potential effects are taken into consideration in the following discussions of cumulative effects of the alternatives to different resources. The following briefly discusses the cumulative effects to land use, socioeconomic, natural, and historic resources.

3.5.1 Socioeconomic Resources and Land Use

Many of the past and present actions included in **Table 3-1** have contributed to the development discussed in **Section 2.2.3** and have been both beneficial and adverse to socioeconomic resources and land use, and it is expected reasonably foreseeable future actions could as well. Past and present growth and development has increased the standards of living for communities that benefited community cohesion, and provided community facilities and recreational resources. Such growth and development has benefited local economies by improving access to markets and customers as well as facilitated the existing population growth and income levels observed today in the study area.

No-Build Alternative

The No-Build Alternative would not improve the Fredericksburg Extension Study corridor and therefore would not contribute to cumulative effects related to community cohesion, community facilities, recreational resources, land use, local economies, or EJ populations in the Socioeconomic Resources ICE study area. Existing congestion along the interstate would likely increase associated with the anticipated population growth in study area localities (**Figure 2-6**).

Build Alternative

Past growth and development has resulted in largely built-out sections of Prince William and Stafford Counties along the I-95 corridor. This growth has positively contributed to community cohesion in Prince William and Stafford Counties by improving the standard of living for these communities. Present actions would provide additional housing and work options for the study area population, and in-commuters (**Appendix C).**

Past growth and development has led to the provision of community facilities and recreational resources. These community facilities and recreational resources benefit from past and present (**Appendix A**) transportation improvements through increased access; however, the increased access is hindered by severe congestion.

Increased commerce and employment from past and present growth and development, including the original construction of I-95 completed in 1964, has benefited economic resources in Prince William and Stafford Counties in the Socioeconomic Resources ICE study area. The construction of I-95 itself has benefited local economies and long-term employment from increased access to markets, business customers, and jobs. However, existing congestion reduces access to markets and customers, and opportunities that could otherwise occur.

Future growth and development is expected to have a positive impact to local economies from increased customer demand and long-term employment opportunities. The Build Alternative is anticipated to support this growth by reducing daily congestion and accommodating travel demand more efficiently, providing higher reliability of travel times, and expanding travel choices by increasing the attractiveness and utility of ridesharing and transit usage while also providing an option for SOVs to bypass congested conditions.

The anticipated growth and development in turn would benefit community cohesion from increased productivity and services. As no residential or business relocations are required under the Build Alternative, it would not contribute negatively to the cumulative effects for community cohesion in the

study area. It is anticipated that the Build Alternative would positively contribute to community cohesion by alleviating congestion that negatively affects user's experience on the interstate.

Future transportation projects and development would continue to increase access to community facilities and recreational resources while potentially displacing others. The Build Alternative would provide additional Express Lanes in the median of an existing interstate, with no direct impacts to community facilities. The access, function, and amenities of those facilities adjacent to the study area would remain unchanged. Overall, the Build Alternative's contribution to cumulative effects for community facilities and recreational resources would be minor because the direct and indirect effects would be minor.

Future federal and non-federal development would continue to have potential disproportionate and highly adverse impacts to minority and low-income populations, as well as benefits. However, federal regulations would continue to avoid these disproportionate and highly adverse effects for their authorized actions to minority and low-income populations whenever possible. The Build Alternative would provide beneficial effects to minority populations, low-income populations, and other travelers through reduced congestion and additional travel choice in the study area.

3.5.2 Natural Resources

Past growth and development actions in the Natural Resources ICE study area have been primarily adverse to natural resources. Intensification of land use in the region has resulted in reduced water quality with many waters impaired for human and wildlife use; loss of wetlands, streams, and floodplains; wildlife population loss from overexploitation and loss of habitat; fragmented habitat; and degraded habitat quality. Impacts that occurred early in the development of the region had a greater impact than more recent projects, given the lack of previous development and absence of environmental regulations. The best indicator for the degree of cumulative effects to water resources is the extent of impaired waters in the region. There are 35 303(d)-listed river/stream, river/stream segments, or waterbodies that occur in the Natural Resources ICE study area.

These past actions have limited and/or degraded the quality of habitat for existing species. This has led to some species becoming threatened and endangered with extinction. Federal, state, and local regulations enacted over the last 50 years have done much to slow the loss of remaining wildlife and wildlife habitat, improve wildlife habitat and water quality, and recover protected species. These regulations require consideration of avoidance, minimization, and mitigation of adverse impacts to natural resources. Conservation efforts have also positively contributed to natural resources in the region, such as the protection of lands within VOF, Central Virginia Battlefield Trust, Civil War Trust, The Nature Conservancy, NVCT, VDOF, VDHR, USNPS, and Ducks Unlimited easements and holdings in the Natural Resources ICE study area. Future growth and development in the Natural Resources ICE study area would be subject to the land use policies of each jurisdiction that aim to concentrate growth while preserving natural lands.

No-Build Alternative

Past actions contributing to cumulative effects in the Natural Resources ICE study area are included in **Table 3-2**. These include the completion of I-95 in the study area in 1964 and the widening of the interstate to six lanes occurring between 1983 and 1987. Under the No-Build Alternative, cumulative affects to natural resources would occur due to present and future actions, including those presented in **Section 1.2.2, Appendix A**, and **Appendix E**, but they would not occur because of the Fredericksburg Extension Study. Under the No-Build Alternative, the existing wildlife habitat within, and adjacent to, the study corridor would be subject to impacts from these actions.

Build Alternative

As previously discussed, past growth and development has diminished natural resources within the Natural Resources ICE study area. This development has affected terrestrial and aquatic habitat and impaired water quality. The prevailing trend has been habitat loss in regards to wetlands and streams (Tiner and Foulis, 1994 and VDEQ, 2013) and forestland (Council on Virginia's Future, 2016; VDOF, 2017). Aquatic impacts have included stream piping, relocation, channelization, and flow alteration. Further aquatic impacts causing impediments to fish passage have included construction of the Smith Lake, Rocky Pen Run, Lunga Reservoir, and Breckenridge Reservoir dams, as well as the raised culverts and other impediments on Little Falls Run, Deep Run, and Hazel Run. Consequences of aquatic habit loss has included an approximate 93 percent decrease in historic anadromous fish catches in Virginia (VDGIF, 2016b), and threatened existence of vulnerable aquatic species (USFWS, 1993; Pennsylvania Natural Heritage Program, No Date a; and Pennsylvania Natural Heritage Program, No Date b). Losses in terrestrial habitat also affect vulnerable species (USFWS, 2011; USFWS, 2015; and USFWS, 2016a).

Many major waterways, including the Potomac River, within the Natural Resources ICE study area are designated as impaired for one or more uses (VDEQ, 2016b and MDE, 2016). Pollutants include fecal coliform bacteria and contaminants in fish and shellfish tissue. Impaired water quality parameters include elevated pH and low DO levels. These impairments result from point and non-point source pollution, can be exacerbated by poor construction practices during development, and are a consequence of poor pollution control from past developments.

Past development and harvesting of wildlife has led to some wildlife species to be threatened and endangered. However, passage of the Virginia Endangered Species Act and the federal Endangered Species Act requires state and federal agencies to avoid and minimize potential impacts to designated threatened and endangered species and their critical habitat. Through adherence to these Acts, direct and cumulative effects to threatened and endangered species from current and future projects should be mitigated.

Present, private conservation efforts have positively contributed to natural resources in the region, such as the NVCT, The Nature Conservancy, Ducks Unlimited, and VOF conservation easements established in the Natural Resources ICE study area. As shown in **Appendix E**, public entities are also completing or planning projects that would improve water quality, and therefore habitat, in the Natural Resources ICE study area. The following projects would temporarily affect, yet ultimately improve water quality in the study area for the long-term:

- Stream Restoration Projects (Powells Creek and Quantico Creek Watersheds) in Prince William County;
- Wastewater System Proposed Improvements in Stafford County;
- Sewer Collection, Transfer, and Pump Station Projects in Fredericksburg; and
- Sewer Collection, Transfer, and Pump Station Projects in Spotsylvania County.

Future growth and development could possibly further reduce and degrade terrestrial and aquatic habitat for the long term. However, federal, state, and local regulations would continue for the foreseeable future and would continue to require minimization, mitigation, and compensation for terrestrial and aquatic habitat direct and indirect effects.

The Build Alternative could result in short-term reduced water quality, as well as changes to floodwater storage capacity and retention times (floodplain impacts) and vegetative community composition and structure (forestland and wetland impacts). The construction and post-construction discharges of stormwater could possibly contribute to minor, localized (small extent) increases in the pollutants and nutrients causing impairments. However, drainage design for waterway crossing structures is expected to

be in conformance with current stormwater regulations in order to minimize downstream impacts to natural resources and water quality. The Build Alternative is unlikely to disturb soils with Enterococcus or fecal coliform bacteria, which impair several waterbodies in the area as detailed in the Virginia 303(d) list (VDEQ, 2016b). The cumulative effects should further be minimized by implementation of local and state-mandated BMPs. Therefore, the Build Alternative is unlikely to substantially contribute to the further impairment of any impaired waterbody.

Adherence to VDOT specifications would minimize the Build Alternative's contribution to cumulative effects (either direct or indirect) on habitat and protected species from the introduction of invasive species. As the direct effects of the Build Alternative to protected species would be minor, the Build Alternative's contribution to cumulative effects of past, present, and foreseeable projects would be minor.

As discussed, the Build Alternative's cumulative effect on protected species and their habitat would be mitigated through coordination with VDGIF, VDCR-DNH, USFWS, and NMFS during the permitting/design process. The mitigation measures used would be determined during the coordination and may include use of time-of-year restrictions on construction, contractor training in recognizing and avoiding threatened and endangered species and their habitats, and restoration of habitat. Through use of these measures, it is anticipated that the Build Alternative would have a minor cumulative contribution to negative affects to protected species in the study area.

3.5.3 Historic Resources

With human occupation of the region extending thousands of years into the past and ongoing today, archaeological and architectural historic properties have been continuously created and destroyed by succeeding developments over time in the Historic Resources ICE study area. Since 1964, this pattern has occurred more extensively and is expected to continue into the future. Transportation improvements and other actions potentially adversely affect archaeological and architectural historic properties by destruction or altering the integrity of their historically important characteristics. Federal and state laws requiring agencies to take into account effects to historic properties have slowed the loss of historic properties. Section 4(f) of the Department of Transportation (DOT) Act of 1966 affords some protection to historic properties by requiring DOT agencies to avoid adversely affecting archaeological and architectural historic properties important for preservation in place, and only authorizing adverse effects if there is no prudent and feasible alternative. Further, the two counties in the Historic Resources ICE study area regulate potential effects to historic properties by creating historic overlay zones and districts within which proposed projects are reviewed by committees and boards to minimize adverse effects to historic resources. Finally, all effects to archaeological and historic architectural properties, including indirect effects, have been considered under Section 106 of the NHPA, as described in the *I-95 Express Lanes Fredericksburg Extension Study Historic Resources Technical Report* (VDOT, 2017d).

Transportation improvements can also increase visitation to historic properties open to the public, sustaining historic resources tourism and providing incentives for preservation. Other incentives for historic preservation are offered by federal, state, and local governments in the form of grants and tax breaks.

3.5.4 Summary of Cumulative Effects

Table 3-3 summarizes the Build Alternative's potential contribution to cumulative effects on the resources evaluated. Incremental effects of the alternatives contributing to cumulative socioeconomic, natural, and historic resources would range from none to adverse.

Table 3-3: Summary of Build Alternative's Contribution to Cumulative Effects

Resource	Build Alternative	Cumulative Effect
Land Use	Minor	Adverse
Community Cohesion	Minor	Adverse
Community Facilities and Recreation Resources	Minor	Adverse
Environmental Justice	Minor	Adverse
Local Economy	Minor	Beneficial
Wetlands	Minor	Adverse
Floodplains	Minor	Adverse
Streams	Minor	Adverse
Resource Protection Areas	Minor	Adverse
Water Quality	Minor	Adverse
Aquatic Habitat	Minor	Adverse
Benthic Communities	Minor	Adverse
EFH, HAPC, and Anadromous Fish Use Areas	0	Adverse
SAV	0	Adverse
Terrestrial Habitat	Minor	Adverse
Threatened and Endangered Species	Minor	Adverse
Historic Architecture	Minor	Adverse
Archaeological Resources	0	Adverse

3.6 WHAT IS THE OVERALL IMPACT ON THESE VARIOUS RESOURCES FROM THE ACCUMULATION OF THE ACTIONS?

Past and present actions have shaped the current state of land use and socioeconomic, natural, and historic resources within the respective ICE study areas. These actions have been both beneficial and adverse to land use, socioeconomic, natural, and historic resources. Future actions would be both beneficial and adverse to socioeconomic resources and land use, and primarily adverse to natural and historic resources. Coupled with past, present, and future actions, the overall cumulative effects of the Build Alternative should be beneficial to socioeconomic resources. Overall, cumulative effects of the Build Alternative in combination with past, present, and foreseeable future actions to natural and historic resources would be primarily adverse. However, adherence to current and future regulatory requirements and planning practices would minimize the adverse cumulative effects of the Build Alternative , and other present and future projects, on natural and historic resources in the study area.

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Appendix A:

Present and Reasonably Foreseeable Future Transportation Projects in the Natural Resources ICE Study Area

Project	State or Regional Identification Number	Source	Jurisdiction	Status
Interstate				
Harrison Road Interchange Construction	N/A	FAMPO's I-95 Corridor Study-Phase 1	Spotsylvania County	PE/Studies
I-95 Rest Area Access and US 3 Connector Road (Rest area to intersection of US 3 and Gordon Rd)	UPC 101557	FAMPO's TIP, and Fredericksburg Area Congestion Relief Study Recommendations	Fredericksburg	PE/Studies
I-95 Four Lane and Shoulder Widening (Exit 143 to 136)	UPC 104924	FAMPO'S TIP and I-95 Corridor Study-Phase 1	Stafford County	PE/Studies
I-95 Rappahannock River Crossing Southbound Project (MM 130 to 133)	UPC 101595	FAMPO's TIP, Fredericksburg Area Congestion Relief Study Recommendations, and I-95 Corridor Study-Phase 1	Fredericksburg and Stafford County	PE/Studies
I-95 and US 3 Safety Improvements (Exit 130)	N/A	VDOT Fredericksburg District's Project List, FAMPO's I-95 Corridor Study-Phase 1	Fredericksburg	PE/Studies
I-95 ICM Program Improvements (ITS) (MM 126 to 145)	N/A	FAMPO'S LRP	Fredericksburg, Spotsylvania and Stafford County	Year of Expenditure: 2016-2020
I-95 Corridor Study-Phase 2	N/A	FAMPO Project's List	Fredericksburg and Stafford and Spotsylvania Counties	Recommended implementation: FY2017
I-95 Bridge Rehabilitation (Potomac Creek Bridges at MM 137)	N/A	VDOT Fredericksburg District's Project List	Stafford County	Expected completion: 2018
I-95 Bridge Rehabilitation (Aquia Creek Bridges at MM 145)	N/A	VDOT Fredericksburg District's Project List	Stafford County	Expected completion: 2018
I-95 Express Lanes Southern Extension (Approximate two-mile extension from current southern terminus)	UPC 108315; State Project 0095-969720, C501	VDOT Fredericksburg District's Project List, FAMPO's I-95 Corridor Study-Phase 1	Stafford County	Expected completion: 2018
I-95 Shoulder Running Lane Improvements (MM 139 to 145)	N/A	FAMPO'S LRP	Stafford County	Expected Completion: 2020

Project	State or Regional Identification Number	Source	Jurisdiction	Status
I-95 Southbound Hard / Dynamic Shoulder Running Project (MM 133 to 140)	UPC 108587	VDOT's SYIP	Stafford County	Expected Completion: 2020
I-95 Safety Improvements (US 3 to Cowan Blvd)	UPC 107715	VDOT's SYIP	Fredericksburg	Expected Completion: 2020
Courthouse Road Interchange	UPC 13558	FAMPO's TIP, LRP, and I-95 Corridor Study-Phase 1	Stafford County	Year of Expenditure: 2021-2025
Principal Arterial				
Route 3 Corridor Transportation Plan (Gordon Rd to Orange County Line)	N/A	VDOT Fredericksburg District Project List	Spotsylvania County	PE/Studies
Lafayette Boulevard Improvements/Widening (Blue and Gray Pkwy to US 1)	N/A	FAMPO's LRP	Fredericksburg	PE/Studies
Berea Parkway Construction (Centreport Pkwy to US 17)	N/A	FAMPO's LRP and Fredericksburg Area Congestion Relief Study Recommendations	Stafford County	PE/Studies
US 17 Widening (McLane Dr to Stafford Lakes Pkwy)	UPC 71774	FAMPO's TIP and LRP	Stafford County	Year of Expenditure: 2016-2020
Fall Hill Avenue Widening (Car D. Silver Pkwy to US 1)	N/A	Fredericksburg's CIP	Fredericksburg	Expected completion: 2017
Courthouse Road Widening (Cedar Ln to Winding Creek Rd)	N/A	Stafford County's CIP	Stafford County	Expected completion: 2019
US 1 Safety Improvements (Woodstock Ln and Telegraph Rd)	N/A	Stafford County's CIP	Stafford County	Expected completion: 2020
US 1 Bridge Replacement over the Rappahannock Canal	N/A	Fredericksburg's CIP	Fredericksburg	Expected completion: 2021
US 1/VA 630 Corridor Improvements (Near Courthouse Rd)	UPC 103085	VDOT's Six-Year IP	Stafford County	Expected Completion: 2021
US 1 Bridge Replacement over Potomac Creek	UPC 102936	VDOT's Six-Year IP	Stafford County	Expected Completion: 2021
US 1 Widening (Telegraph Road to Prince William County Line)	UPC 100456	FAMPO's TIP and LRP	Stafford County	Year of Expenditure: 2021-2025

Project	State or Regional Identification Number	Source	Jurisdiction	Status
Garrisonville Road Widening (Eustace Rd to Shelton Shop Rd)	N/A	Stafford County's CIP	Stafford County	Expected completion: 2022
Courthouse Road Widening (Winding Creek Rd to Shelton Shop Rd)	N/A	Stafford County's CIP	Stafford County	Expected completion: 2024
VA 234 Interchange Bypass (At Dumfries Rd)	CLRP 3178	MWCOG's CLRP	Prince William County	Expected completion: 2025
US 1 Widening (Brady's Hill Rd to Neabsco Mills Rd)	CLRP 2594	MWCOG's CLRP	Prince William County	Expected Completion: 2025
US 1 Rappahannock River Bridge Replacement	UPC 105533	VDOT's Six-Year IP	Stafford County	Expected Completion: 2025
Butler Road Widening (US 1 to Chatham Heights Rd)	UPC 105911	VDOT's Six-Year IP	Stafford County	Expected Completion: 2026
William Street Widening (Gateway Blvd. to William St.)	N/A	FAMPO's LRP	Fredericksburg	Year of Expenditure: 2026-2030
US 17 Widening (I-95 to Caroline County Line)	N/A	FAMPO'S LRP	Fredericksburg and Spotsylvania County	Year of Expenditure: 2026-2030
Courthouse Road Widening (US 1 to Smith Station Rd)	N/A	FAMPO's LRP	Fredericksburg	Year of Expenditure: 2036-2040
US 17 Widening (Stafford Lakes Pkwy to Hartwood Rd)	N/A	FAMPO's LRP	Stafford County	Year of Expenditure: 2036-2040
US 1 Bridge Replacement over US 3	N/A	Fredericksburg's CIP	Fredericksburg	Expected completion: TBD
Harrison Road Widening (US 1 to Smith Station Rd)	N/A	Spotsylvania County	Spotsylvania County Thoroughfare Plan	Expected completion: TBD
Tidewater Trail Widening (Benchmark Rd to Lansdowne Rd)	N/A	Spotsylvania County	Spotsylvania County Thoroughfare Plan	Expected completion: TBD
Rail				
Southeast High Speed Rail Project (Washington, DC to Richmond)	N/A	Virginia Department of Rail and Public Transportation, MWCOG National Capital Freight Plan 2016	Fredericksburg, Prince William, Stafford and Spotsylvania Counties	Draft EIS due Late 2016

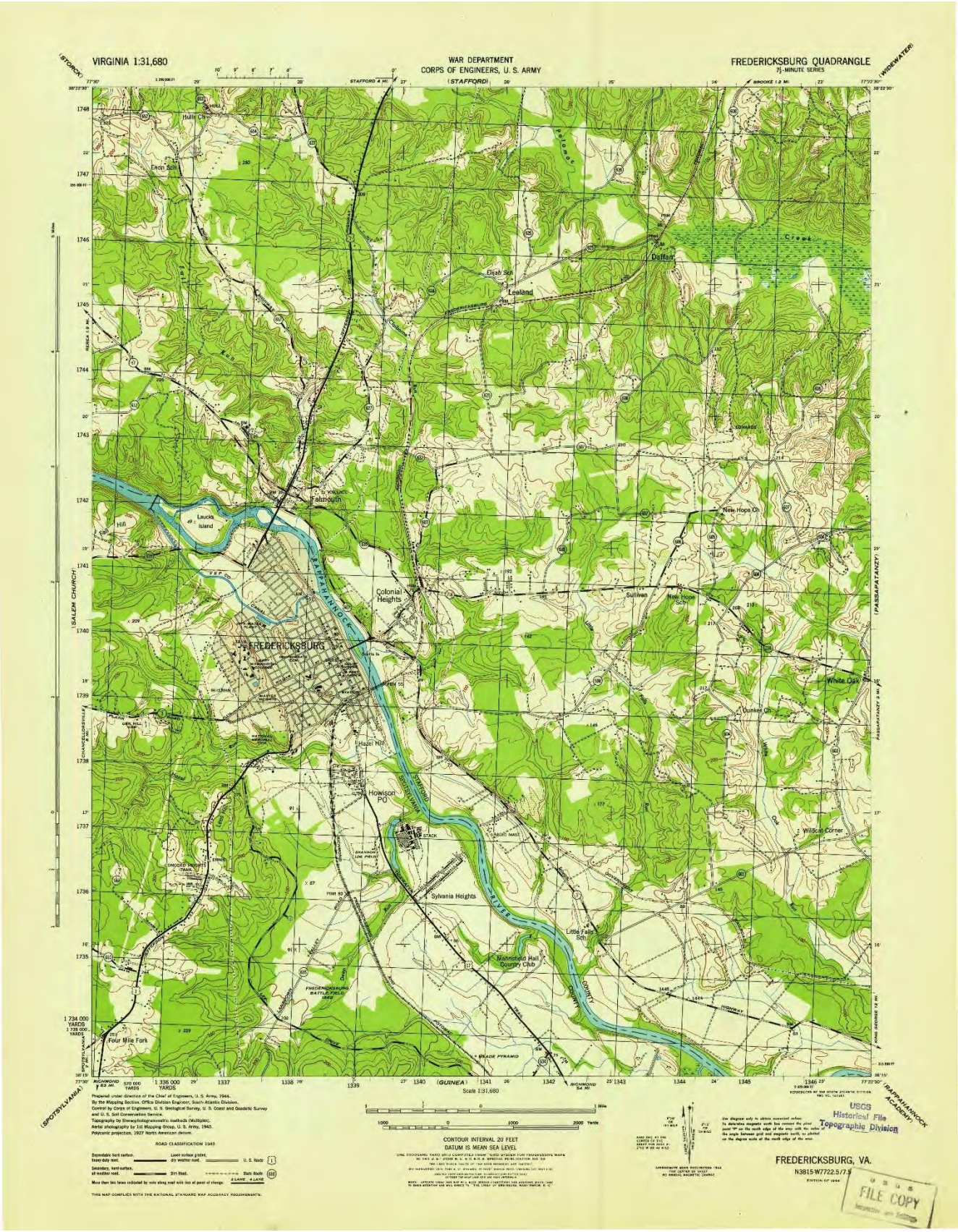
Project	State or Regional Identification Number	Source	Jurisdiction	Status
I-95 Transit Enhancement and Travel Demand Management Services	N/A	Virginia Department of Rail and Public Transportation	Fredericksburg, Prince William, Stafford and Spotsylvania Counties	Transit study due early 2017
Southeast High Speed Rail Project Third Track Construction (Arkendale to Powell's Creek)	N/A	Virginia Department of Rail and Public Transportation, MWCOG National Capital Freight Plan 2016	Prince William and Stafford Counties	Expected completion: 2017
VRE Potomac Shores Station Construction	N/A	VRE System Plan 2040	Prince William County	Expected completion: 2017
VA Railway Express-Reduce headways along the Manassas and Fredericksburg Lines	N/A	MWCOG's CLRP	Prince William and Stafford Counties	Expected completion: 2020
US 1 Multimodal Improvements (Woodbridge to the I-95/I-495 Beltway)	N/A	Prince William County, VDOT, and the Office of Intermodal Planning and Investment	Prince William County	Metrorail extension construction completed 2040
Trails and Walkways				
Virginia Central Railway Trail Bridge over North Hazel Run	UPC T17463	VDOT's Six-Year IP	Fredericksburg	Expected Completion: 2020

Appendix B:

Historical Topographic Maps and Aerials

The following historical topographic maps and aerial imagery illustrate the changes in land use that have occurred over time within the Socioeconomic Resources ICE study area. This appendix includes historic topographic maps and aerial imagery from 1944, 1960, 1971-1972, 1980, 1991, 2004, and 2015-2016.

1944 Historical Topographic Map for Fredericksburg (USGS, 1944)



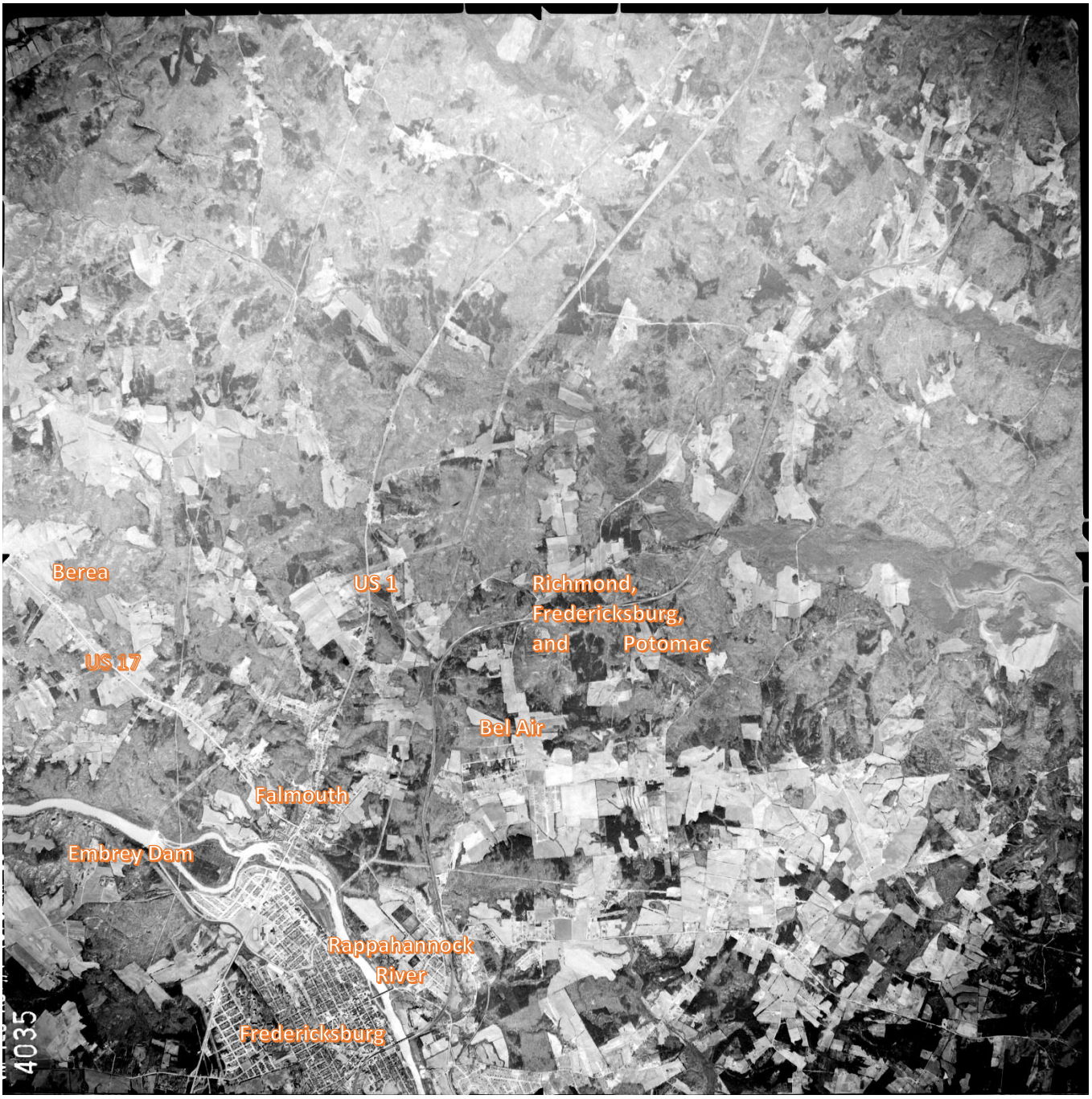
1944 Historical Topographic Map for Stafford (USGS, 1944)

1944 Historical Topographic Map for Quantico (USGS, 1944)

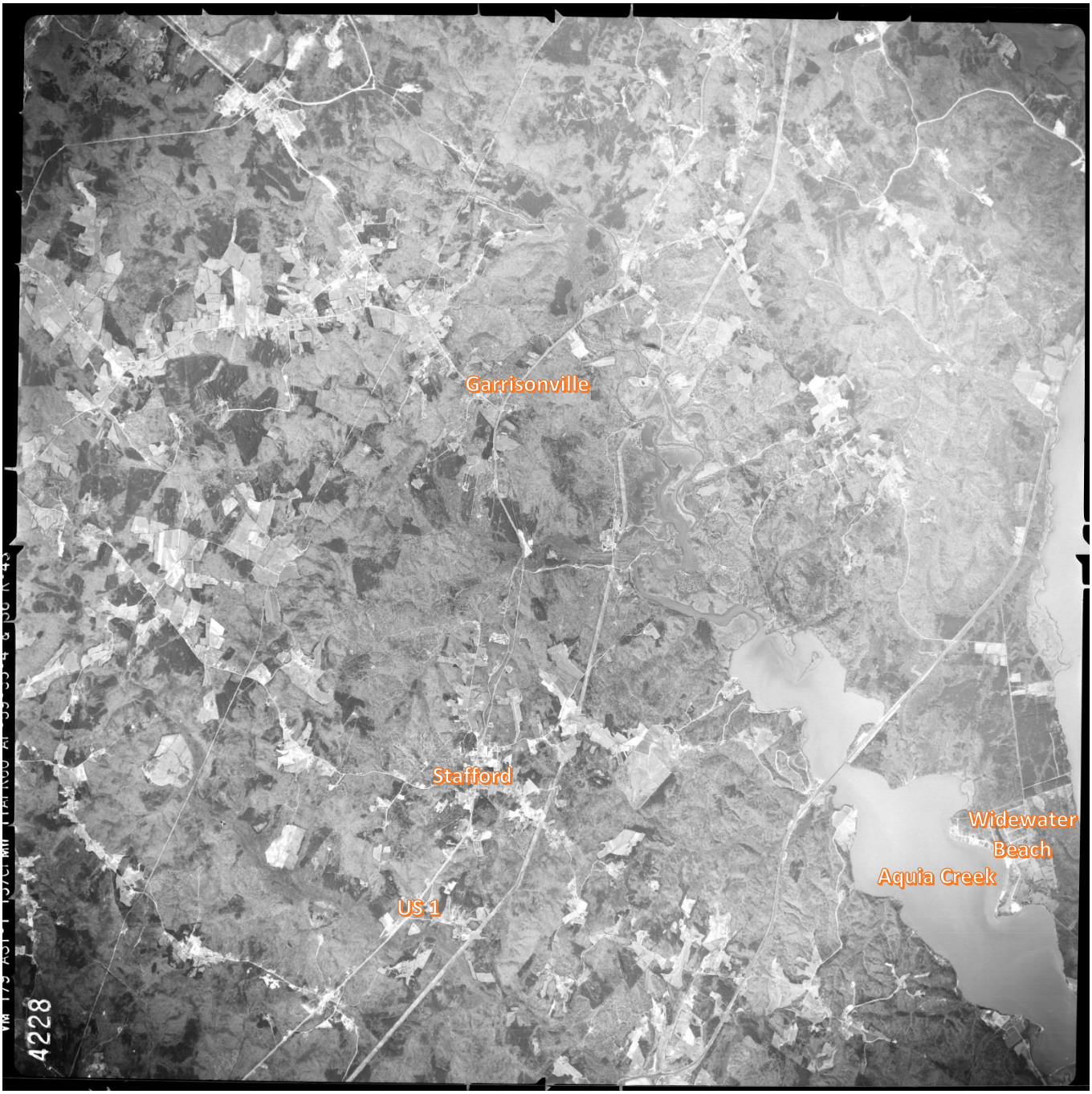
1944 Historical Topographic Map for Widewater (USGS, 1944)

1944 Historical Topographic Map for Indian Head (USGS, 1944)

1960 Aerial of Fredericksburg and Stafford County (USGS, 1960)



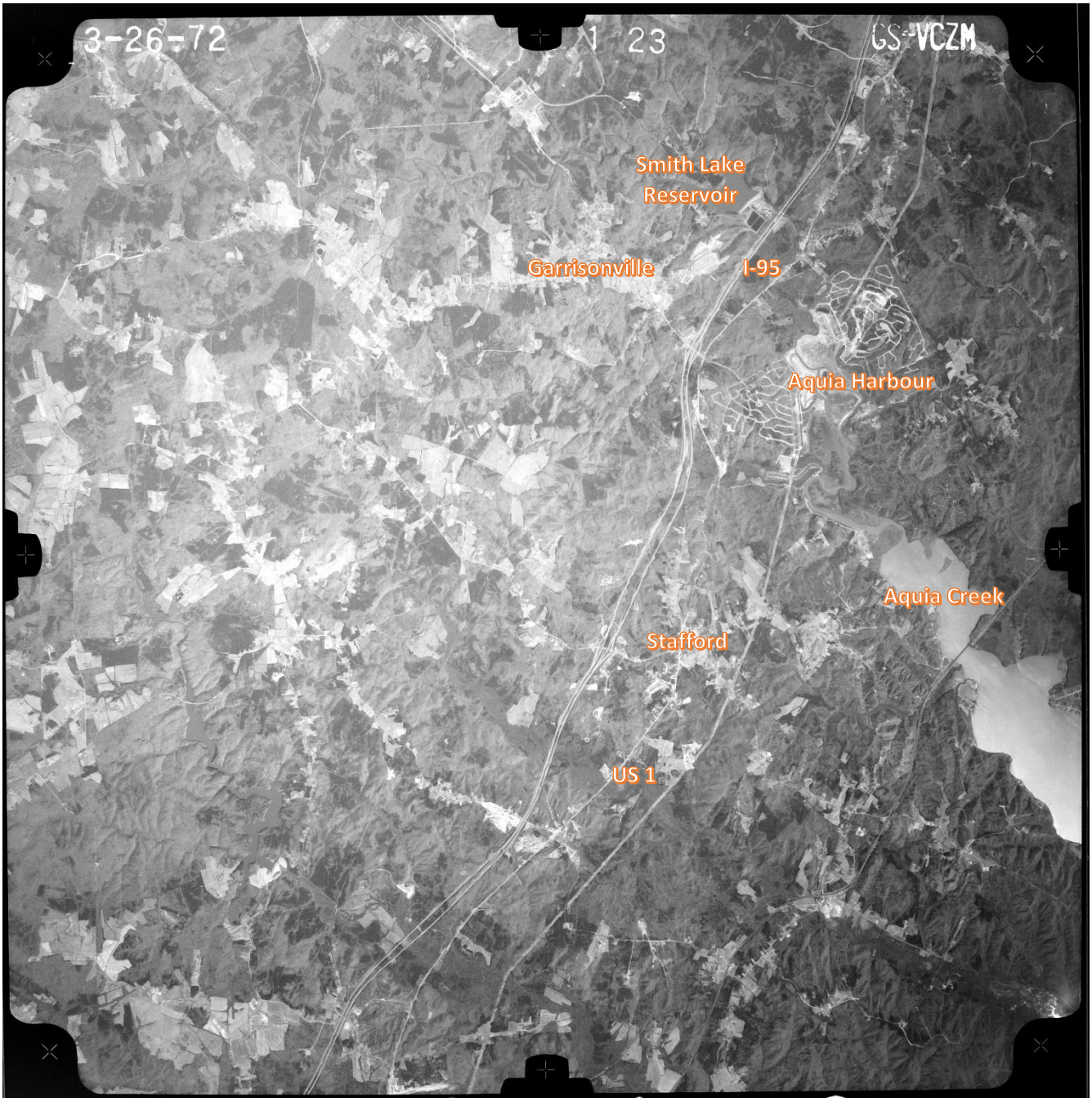
1960 Aerial of Stafford, Aquia Harbour, and Garrisonville (USGS, 1960)



1960 Aerial of Quantico, Southbridge, and Triangle (USGS, 1960)

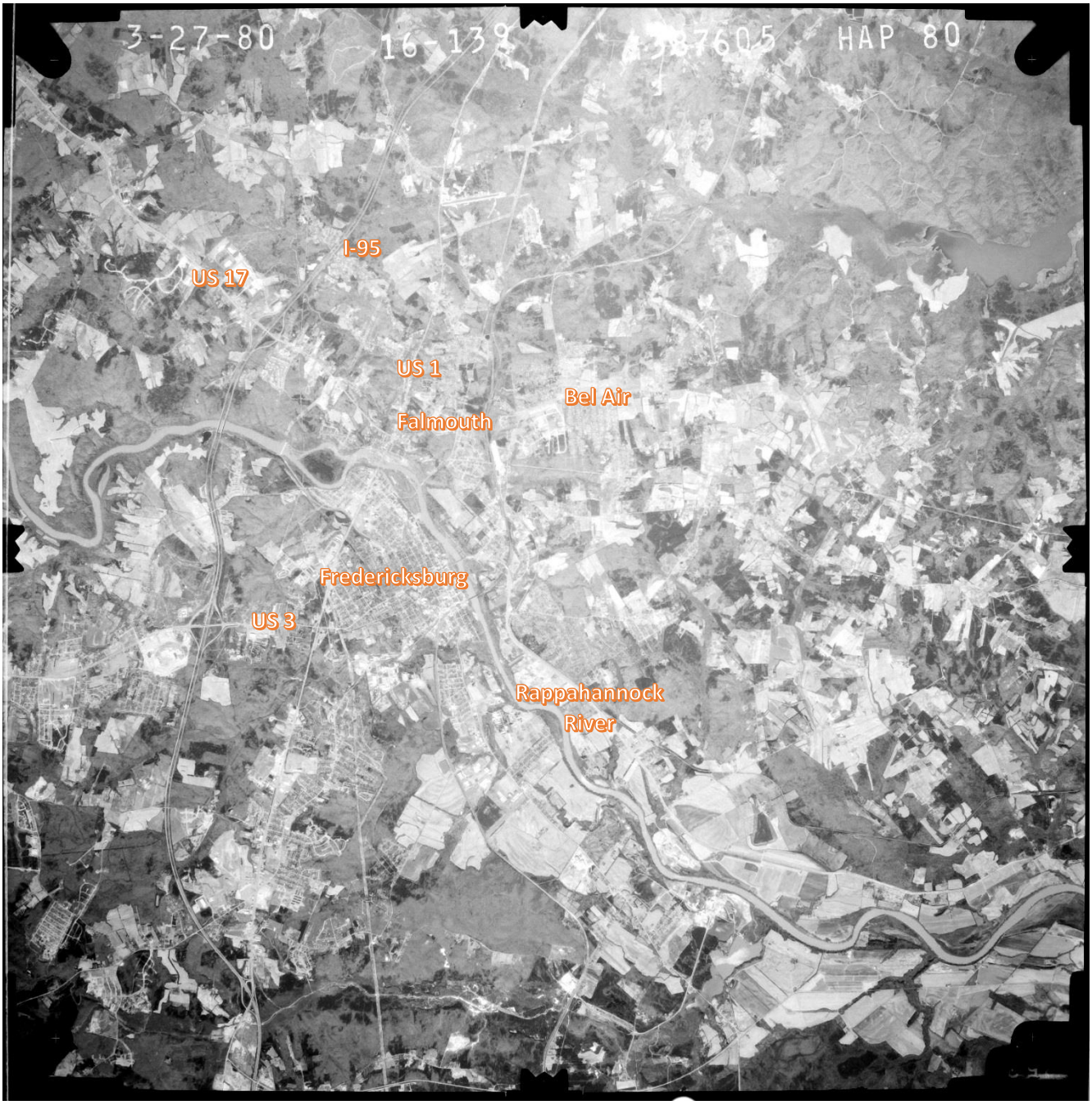
1972 Aerial for Fredericksburg and Stafford County (USGS, 1972)

1972 Aerial of Stafford, Aquia Harbour, and Garrisonville (USGS, 1972)

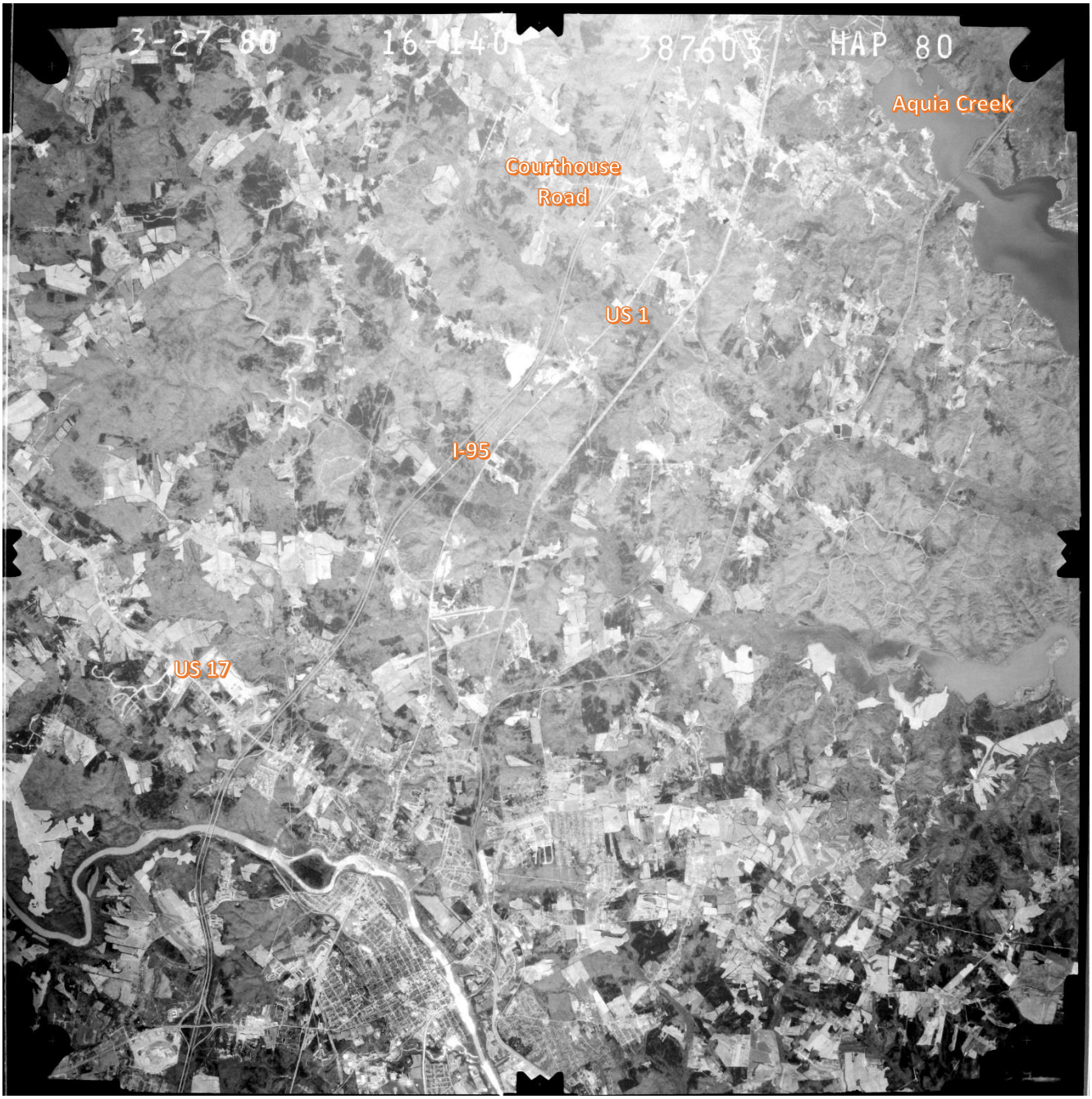


1971 Aerial of Quantico, Southbridge, and Triangle (USGS, 1971)

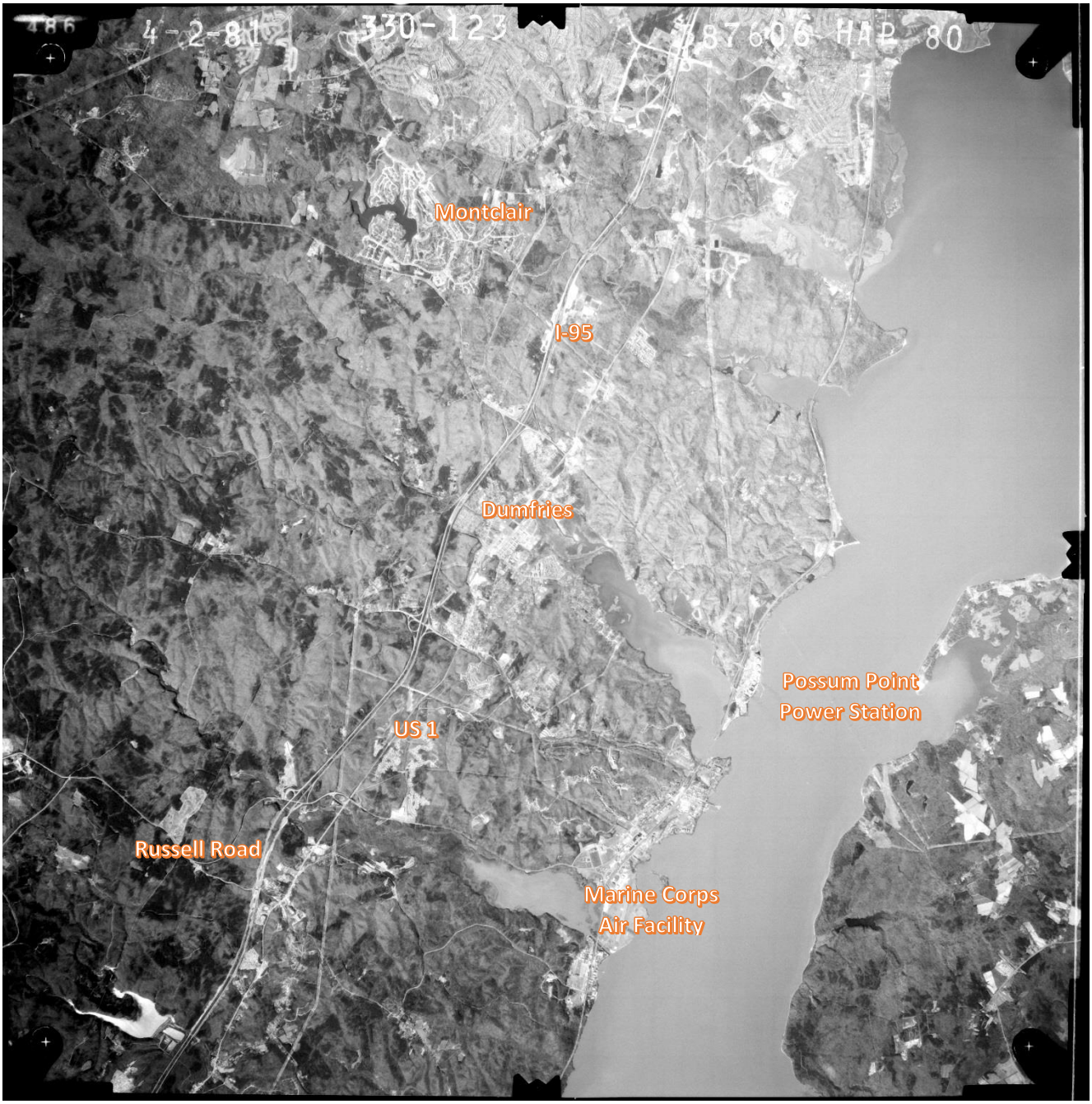
1980 Aerial of Fredericksburg and Stafford County (USGS, 1980)



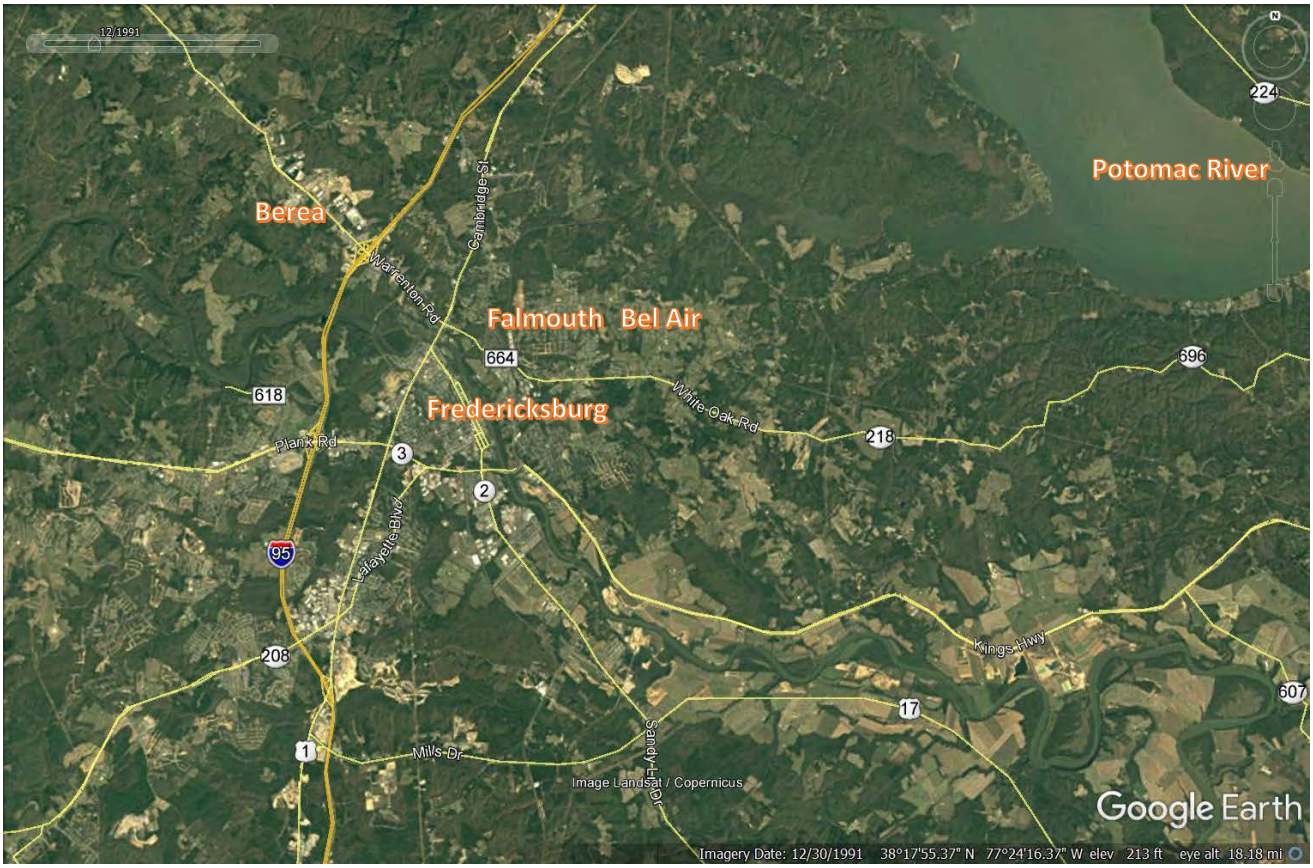
1980 Aerial Stafford County (USGS, 1980)



1980 Aerial of Quantico, Southbridge, and Triangle (USGS, 1980)



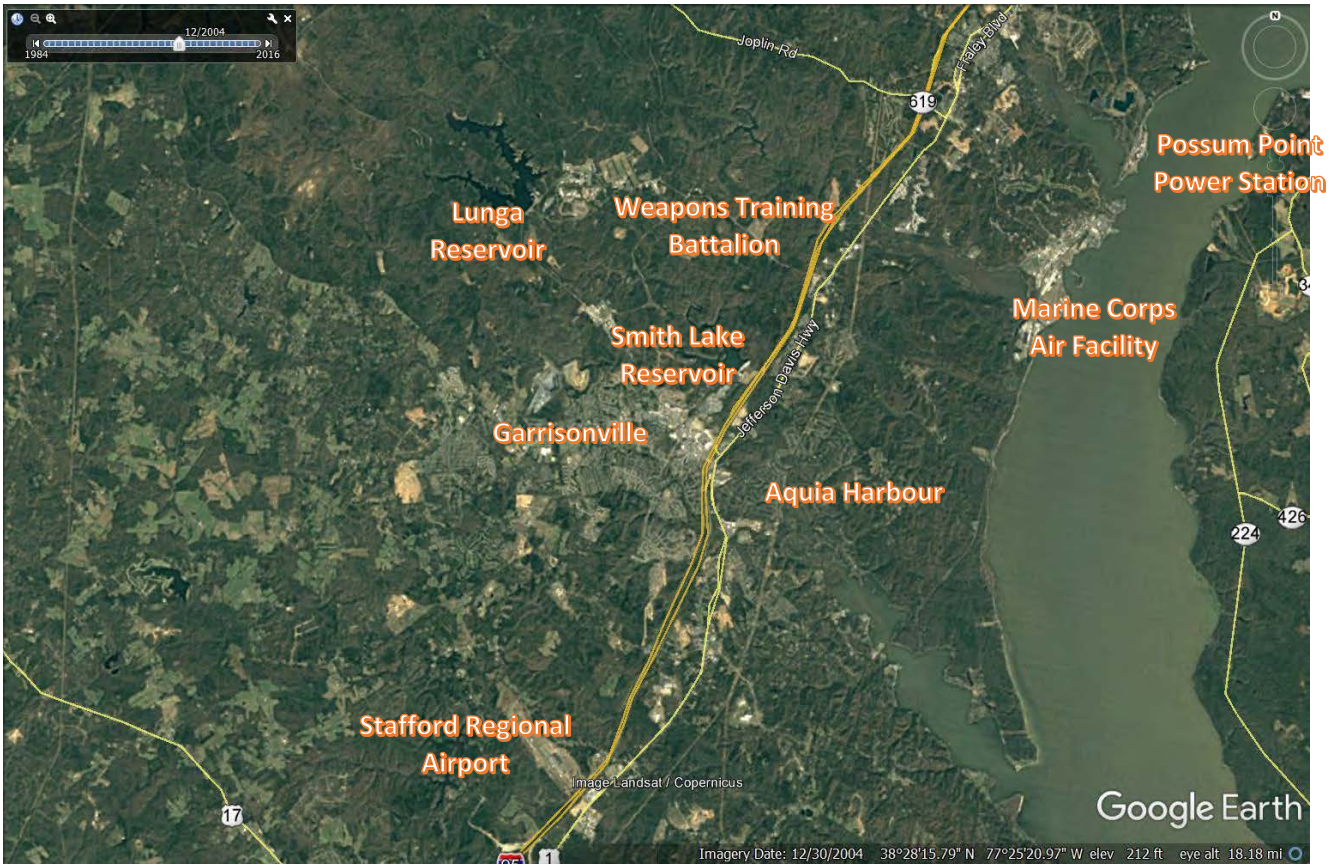
1991 Aerial of Fredericksburg and Stafford County (Landsat/Copernicus, 1991)



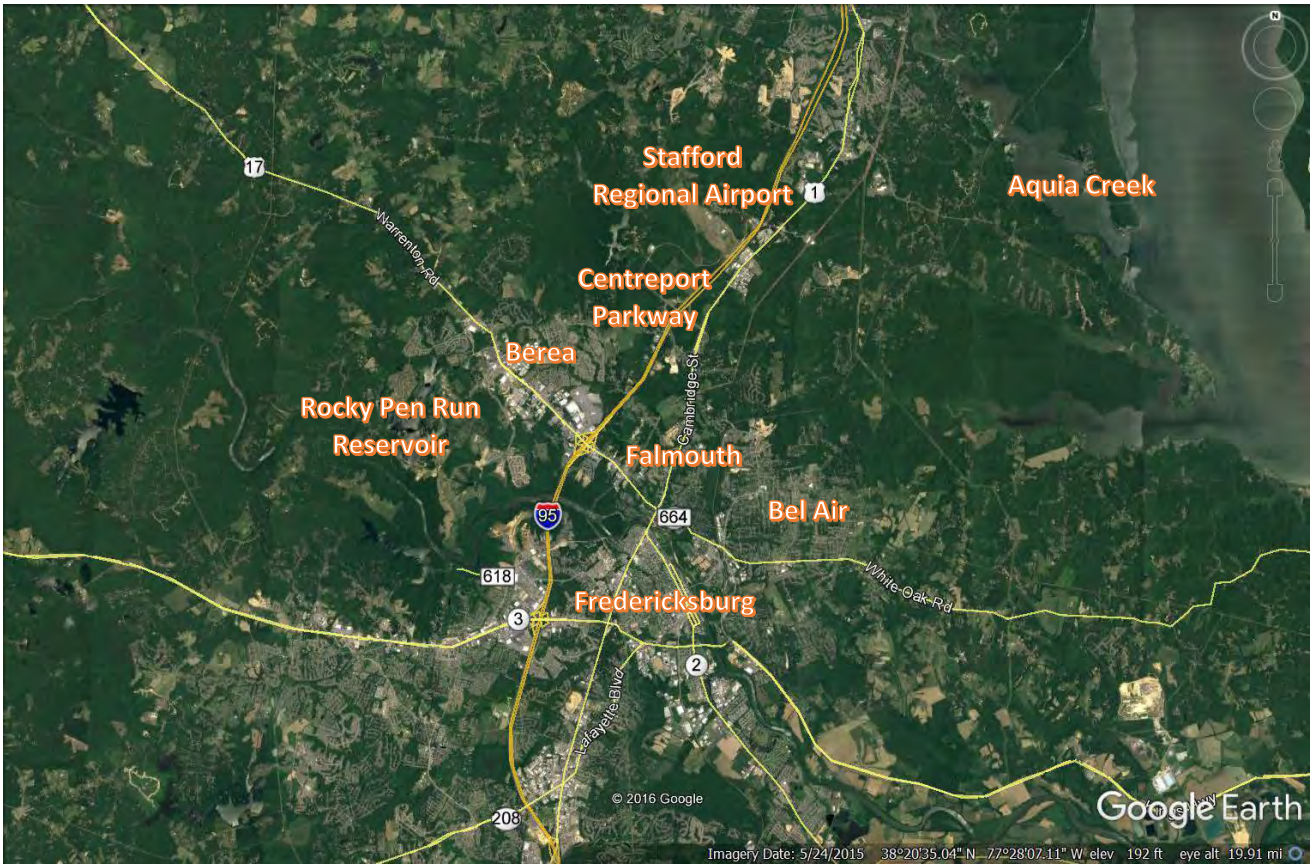
1991 Aerial of Stafford, Aquia Harbour, and Garrisonville (Landsat/Copernicus, 1991)

2004 Aerial of Fredericksburg and Stafford County (Landsat/Copernicus, 2004)

2004 Aerial of Stafford, Aquia Harbour, and Garrisonville (Landsat/Copernicus, 2004)



2015 Aerial of Fredericksburg and Stafford County (Google Earth, 2015)



2016 Aerial Quantico, Triangle, and Garrisonville (Google Earth, 2016)

Appendix C:

Impaired Waters in the Natural Resources ICE Study Area

Locality	Assessed Water Unit	Impairment	Pollutant
Prince William County	Cedar Run	Recreation	*Escherichia coli*
	Cedar Run	Recreation	*Escherichia coli*
	Lake Montclair	Fish Consumption	Mercury in Fish Tissue, PCB in Fish Tissue
	Lucky Run	Aquatic Life	Benthic-Macroinvertebrate Bioassessments
	Powells Creek-Estuarine	Aquatic Life, Fish Consumption, Open Water	Low DO, PCB in Fish Tissue, Low DO
	Powells Creek-Estuarine	Aquatic Life, Fish Consumption, Open Water	Low DO, Benzo[k]fluoranthene/PCB in Fish Tissue, Low DO
	Powells Creek-Riverine	Recreation	*Escherichia coli*
	Potomac Creek	Recreation	*Escherichia coli*
	Quantico Creek-Estuarine	Aquatic Life, Fish Consumption, Open Water	Low DO, PCB in Fish Tissue, Low DO
	Quantico Creek-Estuarine	Aquatic Life, Fish Consumption, Open Water	Estuarine Bioassessments/Sediment Bioassays for Estuarine and Marine Waters, PCB in Fish Tissue, Low DO
	Quantico Creek-Riverine	Recreation	*Escherichia coli*
	South Fork Quantico Creek	Recreation	*Escherichia coli*
Stafford County	North Branch Chopawamsic Creek	Recreation	*Escherichia coli*
	Aquia Creek-Estuarine	Fish Consumption	PCB in Fish Tissue
	Aquia Creek-Riverine	Recreation	*Escherichia coli*
	Unnamed Tributary to Aquia Creek	Aquatic Life	Low DO
	Unnamed Tributary to Potomac River	Recreation	*Escherichia coli*/pH
	Austin Run	Recreation	*Escherichia coli*
	Potomac Run	Aquatic Life, Recreation	Low DO, *Escherichia coli*
	Horsepen Run	Recreation	*Escherichia coli*
	Accokeek Creek	Recreation	*Escherichia coli*
	Potomac Creek-Estuarine	Fish Consumption	PCB in Fish Tissue

Locality	Assessed Water Unit	Impairment	Pollutant
	Potomac Creek-Estuarine	Aquatic Life, Fish Consumption	pH, PCB in Fish Tissue
	Potomac Creek-Riverine	Recreation	*Escherichia coli*
	Falls Run	Aquatic Life	Benthic-Macroinvertebrate Bioassessments
	Claiborne Run	Fish Consumption, Recreation	PCB in Fish Tissue, *Escherichia coli*
	Rappahannock River-Estuarine	Aquatic Life, Fish Consumption, Recreation	Low DO, PCB in Fish Tissue, *Escherichia coli*
Fredericksburg	Unnamed Tributary to Hazel Run	Recreation	*Escherichia coli*
	Unnamed Tributary to Hazel Run	Recreation	*Escherichia coli*
	Hazel Run	Aquatic Life, Fish Consumption, Recreation	Benthic-Macroinvertebrate Bioassessments, PCB in Fish Tissue, *Escherichia coli*
Spotsylvania County	Mine Run	Recreation	*Escherichia coli*
	Motts Run Reservoir	Recreation	Mercury in Fish Tissue
	Deep Run	Aquatic Life	pH
Charles County, MD	Lower Potomac River-Tidal Fresh	Aquatic Life, Open Water	Low DO, Low DO
	Lower Potomac River-Oligohaline	Aquatic Life, Open Water	Low DO, Low DO

Source: MDE, 2016; VDEQ, 2016b.

Appendix D:

Established TMDLs for Impaired Waters in the Natural Resources ICE Study Area

Locality	Assessed Water Unit	Pollutant(s) Categories Causing Impairment	TMDL Establishment Date
Prince William County	Cedar Run	*Escherichia coli*	2020
	Cedar Run	*Escherichia coli*	2024
	Lake Montclair	Mercury in Fish Tissue, PCB in Fish Tissue	2022, 2022
	Lucky Run	Benthic-Macroinvertebrate Bioassessments	2020
	Hooes Run	*Escherichia coli*	2024
	Marumsco Creek	*Escherichia coli*	2024
	Neabsco Creek-Riverine	*Escherichia coli*	2016
	Powells Creek-Estuarine	Benzo[k]fluoranthene	2014
	Powells Creek-Riverine	*Escherichia coli*	2014, 2026[1]
	Quantico Creek-Estuarine	Estuarine Bioassessments, Sediment Bioassays for Estuarine and Marine Waters	2018, 2018
	Quantico Creek-Riverine	*Escherichia coli*	2016
	South Fork Quantico Creek	*Escherichia coli*	2016
Stafford County	North Branch Chopawamsic Creek	*Escherichia coli*	2016
	Aquia Creek-Riverine	*Escherichia coli*	2024
	Unnamed Tributary to Aquia Creek	Low DO	2022
	Unnamed Tributary to Potomac River	*Escherichia coli*, pH	2022, 2026
	Austin Run	*Escherichia coli*	2016, 2026[1]
	Potomac Run	Low DO, *Escherichia coli*	2026, 2018
	Horsepen Run	*Escherichia coli*	2026
	Accokeek Creek	*Escherichia coli*	2014
	Potomac Creek-Estuarine	pH	2026
	Potomac Creek-Riverine	*Escherichia coli*	2016, 2026[1]
	Falls Run	Benthic-Macroinvertebrate Bioassessments	2024
	Claiborne Run	*Escherichia coli*	2016

Locality	Assessed Water Unit	Pollutant(s) Categories Causing Impairment	TMDL Establishment Date
	Rappahannock River-Estuarine	*Escherichia coli*	2010
Fredericksburg	Unnamed Tributary to Hazel Run	*Escherichia coli*	2026
	Hazel Run	Benthic-Macroinvertebrate Bioassessments, *Escherichia coli*	2024, 2016/2024[1]
Spotsylvania County	Mine Run	*Escherichia coli*	2005
	Motts Run Reservoir	Mercury in Fish Tissue	2020
Charles County, MD	Lower Potomac River-Tidal Fresh	Low DO, Low DO	2012, 2012
	Lower Potomac River-Oligohaline	Low DO, Low DO	2012, 2012

[1]TMDL established data differs between assessed sections of water unit.
Sources: MDE, 2016; VDEQ 2016.

Appendix E:

Present and Reasonably Foreseeable Future Non-Transportation Projects in the Natural Resources ICE Study Area

Project	Source	Project Type	Status
Prince William County			
Marine Corps Base Quantico Development and Employee Growth	Marine Corps Base Quantico 2015 Final Master Plan Update	Facility Development	Marine Corps Base Quantico plans that future development on installation is needed to accommodate a potential increase in daytime population from 31,000 to 43,000 by 2035, an approximately 39% increase.
Stream Restoration Projects (Powells Creek and Quantico Creek Watersheds)	Prince William County FY2017-2022 CIP	Water Quality Project	The county plans to fund $23,697,000 in stream restoration projects out to FY2022.
Ali Krieger Sports Complex (2400 River Heritage Blvd)	Prince William County FY2017-2022 CIP	Facilities	Construction of five fields (one softball and four rectangular) with a comfort station in FY17; one artificial turf field and one tot lot in FY20; two rectangular fields and two Little League fields in FY23.
Water Supply, Storage and Transmission Projects (County-wide)	Prince William County Service Authority CIP, FY2017-2021	Utilities	The county plans to replace, improve, and /or modify pump stations, wells, suction mains, and transmission pipelines throughout the county.
Sewer Collection, Pump Station, and Water Reclamation Projects (County-wide)	Prince William County Service Authority CIP, FY2017-2021	Utilities	The county plans to replace, improve, and /or modify pump stations, sewer collection facilities, pipelines, and reclamation facilities throughout the county.
Potomac Shores Elementary School (River Heritage Boulevard)	Prince William County Development Services ePortal	Capital Improvement Project	Approved project to provide a 101,246-square-foot elementary school in the Potomac Shores community.
Subdivisions Approved or Submitted between April 1 and December 31, 2016	Prince William County Development Services ePortal	Private Development	Approved or planned projects to provide 2,004 residential units.
Stafford County			
Marine Corps Base Quantico Development and Employee Growth	Marine Corps Base Quantico 2015 Final Master Plan Update	Facility Development	Marine Corps Base Quantico plans that future development on installation is needed to accommodate a potential increase in daytime population from 31,000 to 43,000 by 2035, an approximately 39% increase.
Water System Proposed Improvements and Service Area Expansion (County-wide)	Stafford County Master Plan	Utilities	The county plans to complete water system improvements and expand the utility service area outside of existing growth areas.

Project	Source	Project Type	Status
Wastewater System Proposed Improvements and Service Area Expansion (County-wide)	Stafford County Master Plan	Utilities	The county plans to complete water system improvements and expand the utility service area outside of existing growth areas.
Moncure Elementary School (Juggins Road)	Stafford County Integrated Response System	Capital Improvement Project	Planned project to construct a new elementary school on site.
Subdivisions Approved or Submitted between April 1 and December 31, 2016	Stafford County Integrated Response System	Private Development	Approved or planned projects to provide 3,048 residential units.
Town Center at Aquia (Garrisonville Road)	Stafford County Integrated Response System	Private Development	Planned project to construct 167,575 square feet of retail and commercial space.
Celebrate Virginia Silver Collection Apartments (Celebrate Virginia Parkway)	Stafford County Integrated Response System	Private Development	Planned project to build 16 apartment buildings in the area.
Austin Ridge Commerce Center (Austin Ridge Drive)	Stafford County Integrated Response System	Private Development	Planned project to construct a shopping center with retail and restaurants on site.
Fredericksburg			
Riverfront Park Development	Fredericksburg 2017 CIP	Capital Improvement Project	The City plans to develop a park along Sophia Street on the Rappahannock River between Hanover Street and just south of Charlotte Street.
Dixon Park Community Center	Fredericksburg 2017 CIP	Capital Improvement Project	The City plans to develop a center that would provide space for various community activities with the construction of community rooms as well as a gymnasium
New Elementary School (Idlewild School Site)	Fredericksburg 2017 CIP	Capital Improvement Project	The City plans to construct a new 95,000 square foot elementary school for 750 students in FY2021.
Water System Replacement, Rehabilitation and Reinvestment Program (County-wide)	Fredericksburg 2017 CIP	Utilities	The City plans to carry out the necessary renovation and improvements that would permit the entire system to function at a high level of efficiency.
Sewer Collection, Transfer, and Pump Station Projects	Fredericksburg 2017 CIP	Utilities	The City plans to replace, improve, and /or modify pump stations, sewer collection facilities, and pipelines throughout the City.

Project	Source	Project Type	Status
Spotsylvania County			
Water System Replacement, Rehabilitation and Reinvestment Program (County-wide)	Spotsylvania County FY 2017-2021 Capital Improvement Plan	Utilities	The county plans to carry out the necessary renovation and improvements that would permit the entire system to function at a high level of efficiency.
Sewer Collection, Transfer, and Pump Station Projects (County-wide)	Spotsylvania County FY 2017-2021 Capital Improvement Plan	Utilities	The county plans to replace, improve, and /or modify pump stations, sewer collection facilities, and pipelines throughout the county.
Subdivision Approved between April 1 and December 31, 2016	Spotsylvania County Permit Tracker	Private Development	Approved site plan for development of 98 residential units on site.