HRCS SEIS

Hampton Roads Crossing Study SEIS

Indirect and Cumulative Effects Technical Report

Prepared in Support of the Supplemental Environmental Impact Statement

VDOT Virginia Department of Transportation

U.S. Department of Transportation Federal Highway Administration

July 2016

INDIRECT AND CUMULATIVE EFFECTS TECHNICAL REPORT

HRCS SEIS

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VDOT Project #: 0064-965-081, P101

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ACS	American Community Survey
ATI	Air Terminal Interchange
BMP	Best Management Practice
BRT	Bus Rapid Transit
CBBT	Chesapeake Bay Bridge Tunnel
CEQ	Council on Environmental Quality
CIDMMA	Craney Island Dredged Materials Management Area
CIM	Citizen Information Meeting
CIMT	Craney Island Marine Terminal
CLRP	Constrained long range plan
CSX	Chesapeake and Ohio Railroad
CTB	Commonwealth Transportation Board
DEIS	Draft Environmental Impact Statement
DoD	Department of Defense
DOF	Department of Forestry
DOT	Department of Transportation
EA	Environmental Assessment
EFH	Essential fish habitat
EIS	Environmental Impact Statement
EJ	Environmental Justice
EPA	US Environmental Protection Agency
ESA	Endangered Species Act
ESC	Erosion and Sediment Control
FE	Federally endangered
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FMP	Fishery management plans
FT	Federally threatened
HAPC	Habitat Area of Particular Concern
HHS	Health and Human Services
HOT	High Occupancy Toll
HOV	High Occupancy Vehicle
HRBT	Hampton Roads Bridge-Tunnel
HRCS	Hampton Roads Crossing Study
HRPDC	Hampton Roads Planning District Commission
HRTAC	Hampton Roads Transportation Accountability Commission
HRTPO	Hampton Roads Transportation Planning Organization
HUBZone	Historically Underutilized Business Zones
HUC	Hydrologic Unit Code
IC	Intermodal Connector
ICE	Indirect and Cumulative Effects
IJR	Interchange Justification Report
IMR	Interchange Modification Report
IPaC	Information for Planning and Conservation
LOD	Limits of disturbance
LRTP	Long Range Transportation Plan

MLK	Martin Luther King
MMMBT	Monitor-Merrimac Memorial Bridge-Tunnel
MPRSA	Marine Protection Research and Sanctuaries Act
MPO	Metropolitan Planning Organization
MS4	Municipal Separate Storm Sewer System
NALF	Naval Auxiliary Landing Field
NASA	National Aeronautics and Space Administration
NAVSTA	Naval Station
NCDOT	North Carolina Department of Transportation
NCHRP	National Cooperative Highway Research Program
NEPA	National Environmental Policy Act
NHD	National Hydrography Dataset
NHPA	National Historic Preservation Act
NHR	Natural Heritage Resource
NIT	Norfolk International Terminals
NLCD	National Land Cover Dataset
NLEB	Northern Long-eared Bat
NMFS	National Marine Fisheries Service
NNMT	Newport News Marine Terminal
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NRHP	National Register of Historic Places
NSA	Naval Support Activity
NWI	National Wetlands Inventory
ODU	Old Dominion University
OIS	Operationally Independent Section
PCB	Polychlorinated biphenyl
PMT	Portsmouth Marine Terminal
POV	Port of Virginia
ROD	Record of Decision
RPA	Resource Protection Area
RTE	Rare, Threatened, and Endangered Species
SAV	Submerged Aquatic Vegetation
SE	State Endangered
SEIS	Supplemental Environmental Impact Statement
SGCN	Species of Greatest Conservation Need
ST	State Threatened
SWM	Stormwater Management
SYIP	Six-Year Improvement Program
TMDL	Total Maximum Daily Load
TRB	Transportation Research Board
USACE	US Army Corps of Engineers
USDOT	US Department of Transportation
USFWS	US Fish and Wildlife Service
USGS	US Geological Survey
VDACS	Virginia Department of Agriculture and Consumer Services
VDCR	Virginia Department of Conservation and Recreation
VDCR-DNH	Virginia Department of Conservation and Recreation Division of Natural Heritage

VDEQ	Virginia Department of Environmental Quality
VDGIF	Virginia Department of Game and Inland Fisheries
VDOF	Virginia Department of Forestry
VDOT	Virginia Department of Transportation
VFWIS	Virginia Fish and Wildlife Information Service
VIG	Virginia International Gateway
VIMS	Virginia Institute of Marine Science
VMRC	Virginia Marine Resources Commission
VPDES	Virginia Pollution Discharge Elimination System
WetCAT	Wetland Condition Assessment Tool

1. INTRODUCTION

1.1 PROJECT DESCRIPTION

The Virginia Department of Transportation (VDOT), in cooperation with the Federal Highway Administration (FHWA) as the lead federal agency, is preparing a Supplemental Environmental Impact Statement (SEIS) for the Hampton Roads Crossing Study (HRCS) located in the cities of Chesapeake, Hampton, Newport News, Norfolk, Portsmouth, and Suffolk, Virginia. The SEIS re-evaluates the findings of the 2001 HRCS Final Environmental Impact Statement (FEIS) and Record of Decision (ROD). The three alternatives retained for analysis in the 2001 FEIS, as well as input received from the public during initial scoping for the SEIS, were used to establish the Study Area Corridors shown in **Figure 1-1**. The purpose and need of the SEIS is summarized below.

Pursuant to the National Environmental Policy Act (NEPA) of 1969, as amended, FHWA is preparing an SEIS because of the time that has lapsed since the 2001 FEIS and new information indicating significant environmental impacts not previously considered. The SEIS, prepared in accordance with the implementing regulations of NEPA (23 CFR §771.130), is intended to aid in ensuring sound decision-making moving forward by providing a comparative understanding of the potential effects of the various options.

The purpose of this *Indirect and Cumulative Effects (ICE) Technical Report* is to identify and assess the indirect and cumulative effects of the alternatives retained for analysis in the SEIS. Information in this report, described below, will support discussions presented in the SEIS. First, an overview of the study is provided with a description of the methods that were used to assess indirect and cumulative effects. The indirect effects are then assessed, followed by the assessment of cumulative effects.

1.1.1 Purpose and Need

The purpose of the HRCS is to relieve congestion at the I-64 Hampton Roads Bridge-Tunnel (HRBT) in a manner that improves accessibility, transit, emergency evacuation, and military and goods movement along the primary transportation corridors in the Hampton Roads region, including the I-64, I-664, I-564, and VA 164 corridors. The HRCS will address the following needs (in the order of presentation in Chapter 1 of the Draft SEIS):

- Accommodate travel demand – capacity is inadequate on the Study Area Corridors, contributing to congestion at the HRBT;
- Improve transit access – the lack of transit access across the Hampton Roads waterway;
- Increase regional accessibility – limited number of water crossings and inadequate highway capacity and severe congestion decrease accessibility;
- Address geometric deficiencies – insufficient vertical and horizontal clearance at the HRBT contribute to congestion;
- Enhance emergency evacuation capability – increase capacity for emergency evacuation, particularly at the HRBT;
- Improve strategic military connectivity – congestion impedes military movement missions; and
- Increase access to port facilities – inadequate access to interstate highway travel in the Study Area Corridors impacts regional commerce.

Figure 1-1: HRCS Study Area Corridors

1.1.2 Alternatives

Five alternatives, including the No-Build Alternative, are under consideration for the Draft SEIS and are assessed in this Technical Report. The proposed limits of the four Build Alternatives are shown on **Figure 1-2**. Each technical report and memorandum prepared in support of the Draft SEIS assesses existing conditions and environmental impacts along the Study Area Corridors (as shown on **Figure 1-1**) for each alternative. Each alternative is comprised of various roadway alignments, used to describe the alternatives and proposed improvements, shown on **Figure 1-3**.

1.1.2.1 The No-Build Alternative

This alternative includes continued routine maintenance and repairs of existing transportation infrastructure within the Study Area Corridors, but there would be no major improvements.

1.1.2.2 Alternative A

Alternative A begins at the I-64/I-664 interchange in the City of Hampton (Hampton) and creates a consistent six-lane facility by widening I-64 to the I-564 interchange in the City of Norfolk (Norfolk). A parallel bridge-tunnel would be constructed west of the existing I-64 HRBT. During the public review of the HRBT DEIS, there was a clear lack of public or political support for the level of impacts associated with any of the Build Alternatives. Specifically, potential impacts to the historic district at Hampton University, Hampton National Cemetery, and the high number of displacements were key issues identified by the public, elected officials, and University and Veterans Affairs officials. Given this public opposition, a Preferred Alternative was not identified and the study did not advance. On August 20, 2015, FHWA rescinded its Notice of Intent to prepare the HRBT DEIS, citing public and agency comments and concerns over the magnitude of potential environmental impacts to a variety of resources, such as impacts to historic resources as well as communities and neighborhoods. Consequently, VDOT and FHWA have committed that improvements proposed in the HRCS SEIS to the I-64 corridor would be largely confined to existing right-of-way. To meet this commitment, Alternative A considers a six-lane facility. Alternative A lane configurations are summarized in **Table 1-1**.

Table 1-1: Alternative A Lane Configurations

Roadway Alignments	Existing Lanes	Proposed Lanes
I-64 (Hampton)	4-6	6
I-64 (HRBT and Norfolk)	4	6

1.1.2.3 Alternative B

Alternative B includes all of the improvements included under Alternative A, and the existing I-564 corridor that extends from its intersection with I-64 west towards the Elizabeth River. I-564 would be extended to connect to a new bridge-tunnel across the Elizabeth River (I-564 Connector). A new roadway (VA 164 Connector) would extend south from the I-564 Connector, along the east side of the Craney Island Dredged Material Management Area (CIDMMA), and connect to existing VA 164. VA 164 would be widened from this intersection west to I-664. Alternative B lane configurations are summarized in **Table 1-2**.

Figure 1-2: Build Alternatives

Figure 1-3: Roadway Alignments

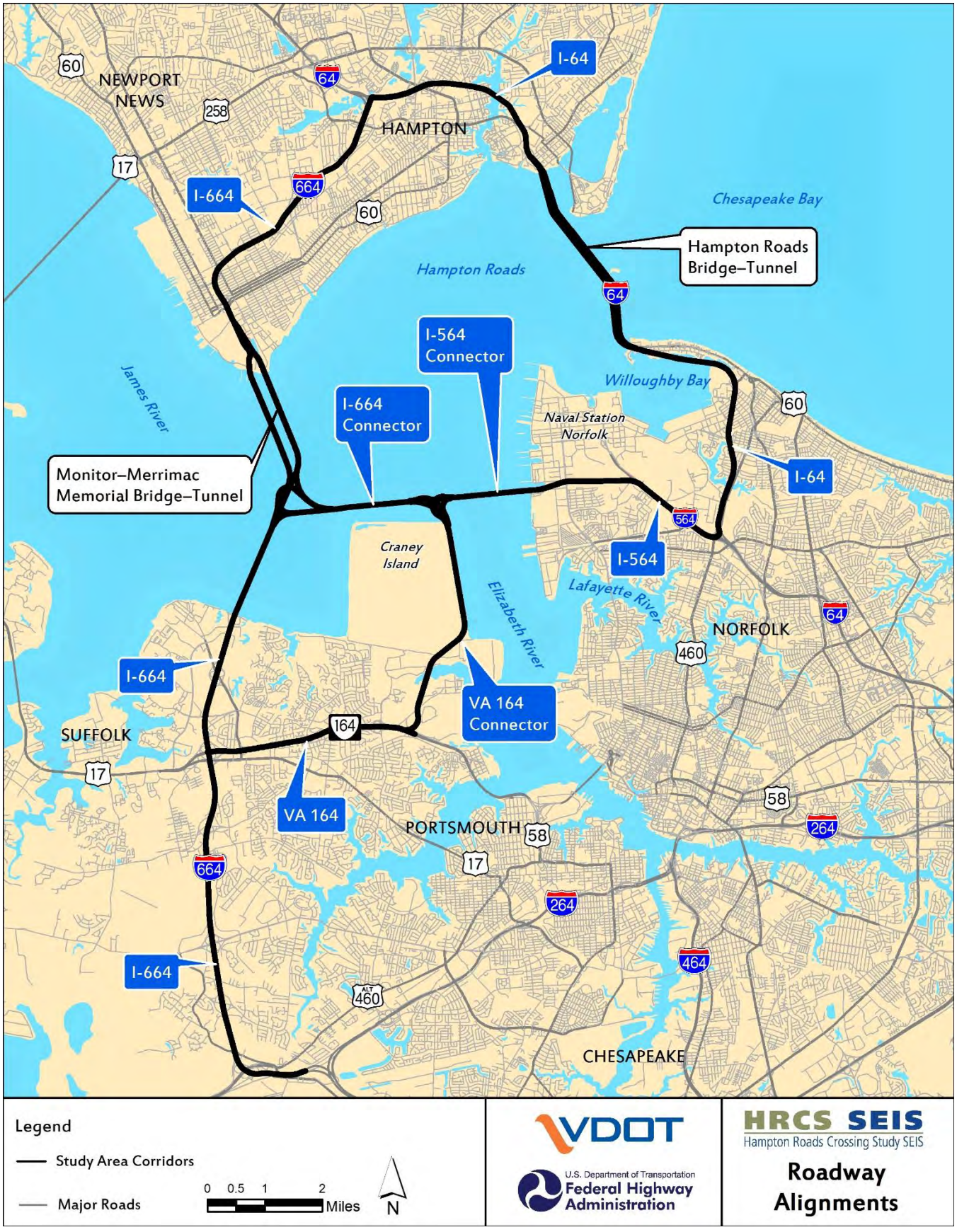


Table 1-2: Alternative B Lane Configurations

Roadway Alignments	Existing Lanes	Proposed Lanes
I-64 (Hampton)	4-6	6
I-64 (HRBT and Norfolk)	4	6
I-564	6	6
I-564 Connector	none	4
VA 164 Connector	none	4
VA 164	4	6

Note: The I-564 Intermodal Connector (IC) project is separate from HRCS that lies between the I-564 Connector and I-564. It would be constructed regardless of whether the HRCS improvements are made and therefore is included under the No-Build Alternative and is not listed with other proposed improvements.

1.1.2.4 Alternative C

Alternative C includes the same improvements along I-564, the I-564 Connector, and the VA 164 Connector that are considered in Alternative B. This alternative would not propose improvements to I-64 or VA 164 beyond the VA 164 Connector. Alternative C includes dedicated transit facilities in specific locations. DRPT completed a study in November 2015 that recommended high frequency bus rapid transit (BRT) service in a fixed guideway or in a shared high occupancy vehicle (HOV) or high occupancy toll (HOT) lanes (DRPT, 2015). Based on that recommendation, for the purposes of this Draft SEIS, transit assumes BRT. In the Final SEIS, transit could be redefined or these lanes may be used as managed lanes. Alternative C converts one existing HOV lane in each direction on I-564 in Norfolk to transit only. The I-564 Connector and the I-664 Connector would be constructed with transit only lanes. This alternative also includes widening along I-664 beginning at I-664/I-64 in Hampton and continuing south to the I-264 interchange in Chesapeake. One new transit lane is included along I-664 between I-664/I-64 in Hampton and the new interchange with the I-664 Connector. Alternative C lane configurations are summarized in **Table 1-3**.

Table 1-3: Alternative C Lane Configurations

Roadway Alignments	Existing Lanes	Proposed Lanes
I-664 (from I-64 to the proposed I-664 Connector)	4-6	8 + 2 Transit Only
I-664 (from the proposed I-664 Connector to VA 164)	4	8
I-664 (from VA 164 to I-264)	4	6
I-564	6	4 + 2 Transit Only
I-564 Connector	none	4 + 2 Transit Only
VA 164 Connector	none	4
I-664 Connector	none	4 + 2 Transit Only

Note: The I-564 IC project is separate from HRCS that lies between the I-564 Connector and I-564. It would be constructed regardless of whether the HRCS improvements are made and therefore is included under the No-Build Alternative and is not listed with other proposed improvements.

1.1.2.5 Alternative D

Alternative D is a combination of the sections that comprise Alternatives B and C. Alternative D lane configurations are summarized in **Table 1-4**.

Table 1-4: Alternative D Lane Configurations

Roadway Alignments	Existing Lanes	Proposed Lanes
I-64 (Hampton)	4-6	6
I-64 (HRBT and Norfolk)	4	6
I-664 (from I-64 to VA 164)	4-6	8
I-664 (from VA 164 to I-264)	4	6
I-664 Connector	None	4
I-564	6	6
I-564 Connector	none	4
VA 164 Connector	none	4
VA 164	4	6

Note: The I-564 IC project is separate from HRCS that lies between the I-564 Connector and I-564. It would be constructed regardless of whether the HRCS improvements are made and therefore is included under the No-Build Alternative and is not listed with other proposed improvements.

1.1.3 Operationally Independent Sections and Roadway Alignments

Given the magnitude and scope of the alternatives, it is expected that a Preferred Alternative would be constructed in stages or operationally independent sections (OIS). An OIS is a portion of an alternative that could be built and function as a viable transportation facility, even if other portions of the alternative are not advanced. The OIS are comprised of various roadway alignments and were developed by identifying sections of roadway improvements that if constructed, could function independently. In order to facilitate the identification of a Preferred Alternative, the alternative impacts have been quantified, as appropriate, based on roadway alignment sections and are presented in **Appendix A**.

1.2 METHODOLOGY

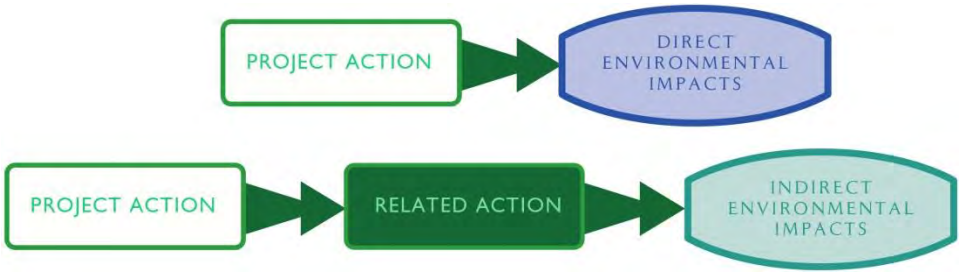
1.2.1 Regulatory Context

The NEPA legislation does not mention indirect or cumulative impacts; however, the Council on Environmental Quality (CEQ) regulations for implementing NEPA address federal agency responsibilities applicable to indirect and cumulative 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). In addition to CEQ's regulations, indirect and cumulative effects assessment is conducted in accordance with the requirements and processes outlined in 23 CFR Part 771, FHWA Interim Guidance: Indirect and Cumulative Impacts in NEPA (2003), FHWA Position Paper on Secondary and Cumulative Impact Assessment (1992), FHWA's Questions and Answers on Considering Indirect and Cumulative Impacts in the NEPA Process (2015), the Transportation Research Board's (TRB) National Cooperative Highway Research Program (NCHRP) Report 466: Desk Reference for Estimating the Indirect Effect of Proposed Transportation Projects (TRB, 2002), NCHRP Project 25-25 Task 22: Land Use Forecasting for Indirect Impacts Analysis (TRB, 2005), NCHRP Project 25-25 Task 11: Secondary/Indirect and Cumulative Effects Analysis (TRB, 2006), as well as CEQ's Considering Cumulative Effects under the National Environmental Policy Act (1997a) and Guidance on the Consideration of Past Actions in Cumulative Effects Analysis (2005).

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" (40 CFR 1508.8b)). Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems,

including ecosystems" (40 CFR 1508.8(b)). These induced actions are those that may or may not occur with the implementation of the proposed project, as illustrated in **Figure 1-4**.

Figure 1-4: Direct vs. Indirect Environmental Impact



Source: Questions and Answers Regarding the Consideration of Indirect and Cumulative Impacts in the NEPA Process, 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/or would likely occur as a result of any action or influence, including effects of a federal activity (US Environmental Protection Agency (EPA), 1999), as illustrated in **Figure 1-5**.

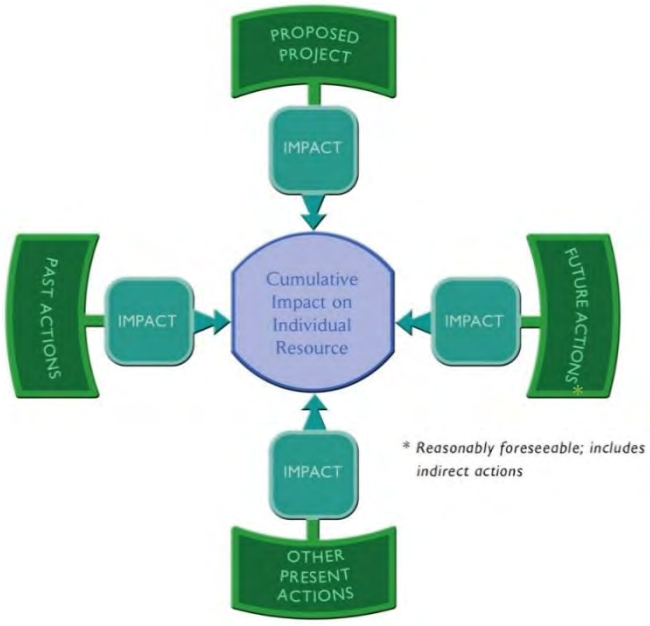
Because indirect and cumulative effects may be influenced by actions including those taken by others outside of the immediate study area, assumptions must be made to estimate the result of these actions. The CEQ regulation, cited above, states that the analysis must include all the indirect effects that are known, and make a good faith effort to explain the impacts that are not known but which are "reasonably foreseeable". NEPA does not define what constitutes "reasonably foreseeable actions". Court decisions on this topic indicate that indirect impact analyses should consider impacts that are sufficiently "likely" to occur (FHWA, 2014). 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 effects (CEQ, 1981; FHWA, 2014).

This direction on identifying reasonably foreseeable actions is taken into account in both indirect and cumulative effects analyses described in the following sections. Specific methodologies on how these analyses were conducted are presented below.

1.2.2 Indirect Effects

This section presents an analysis of the potential indirect impacts related to the alternatives described in **Section 1.1.2**. The methodology for this analysis differs from the less formal methods used for the original FEIS. The methods have been reviewed by the cooperating and participating agencies. Therefore, the ICE findings from the original FEIS are not presented, as they would not be comparative to this analysis. For the purposes of this technical report and the HRCS SEIS, the methodology followed for analyzing indirect effects is prescribed in the TRB's National Cooperative Highway Research Program (NCHRP) Report 466, *Desk Reference for Estimating the Indirect Effects of Proposed Transportation Projects* (TRB, 2002).

Figure 1-5: Cumulative Impacts



Source: Questions and Answers Regarding the Consideration of Indirect and Cumulative Impacts in the NEPA Process, FHWA, 2014.

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 project 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).

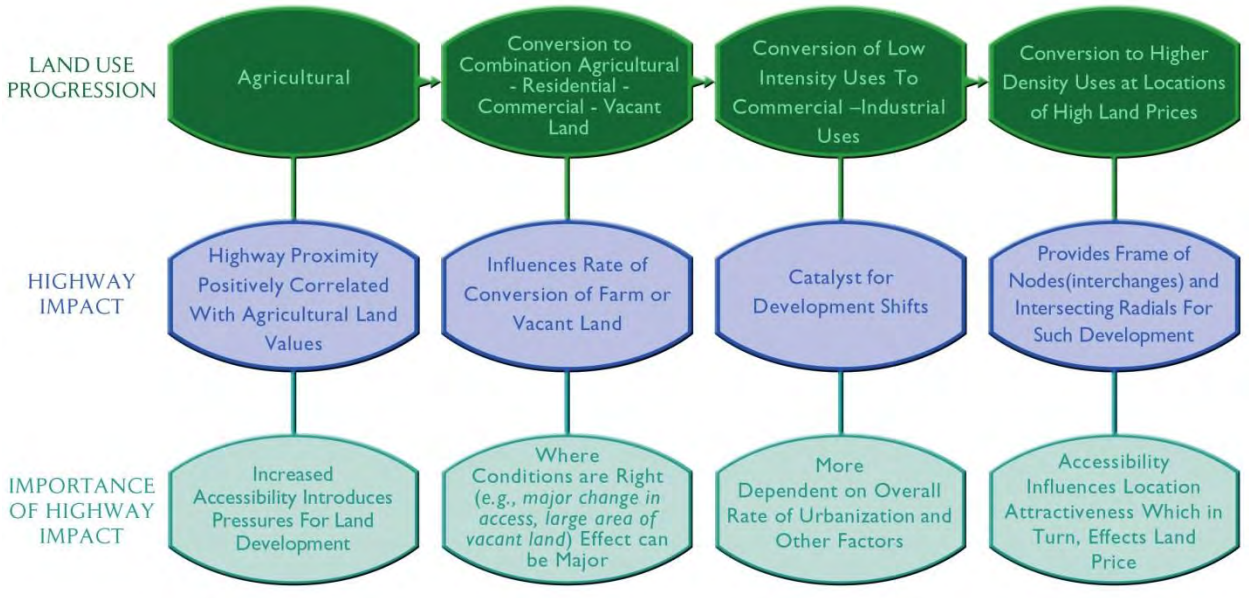
Transportation improvements often reduce time and cost of travel, as well as providing new access to properties, enhancing the attractiveness of surrounding land to developers and consumers. Development of vacant land, or conversion of the built environment to more intensive uses, is often a consequence 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 1-6**). The NCDOT guidance indicates induced growth impacts are most often found up to 1 mile around a freeway interchange and 2 to 5 miles along major feeder roads. Two principal factors influencing the likelihood of induced growth noted are the extent and maturity of the existing transportation infrastructure and land availability.

The HRCS SEIS study routes and existing interchanges have been in place for many decades; for example, I-64 was constructed in 1957, I-64 and the HRBT were expanded in the 1970s, I-564 was built from 1971 to 1977, the VA 164 Western Freeway was opened in 1992, and I-664 and the MMMBT were constructed in the early 1990s. Over the following decades, areas over 1-mile distant from the existing interchanges

in Norfolk, Hampton, City of Newport News (Newport News) and City of Portsmouth (Portsmouth) have been settled with well-established residential neighborhoods, commercial, and industrial areas; the induced growth effects from transportation improvements of the alternatives would not likely extend to these more distant locations. Because the Hampton Roads area is 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, particularly in the cities of Hampton, Newport News, Norfolk, and Portsmouth. Moreover, the HRCS alternatives that propose new interchanges have very limited potential for induced growth because they would be either over water or in areas with little available land for development due to large areas of government-owned and administered lands. The greatest potential for induced growth effects from the transportation improvements of the alternatives would therefore be infill in areas close to the existing interstates that would be adequately encompassed by the 1-mile boundary for analysis. As no mainline improvements or new interchanges are proposed by any of the Build Alternatives along I-64 in Hampton west of the Settler's Landing interchange, there is limited potential for induced growth adjacent to that part of the corridor. Thus, except for I-64 interchanges west of Settlers Landing Road in Hampton, this analysis evaluates the potential for induced growth within 1 mile of existing interchanges along the I-64 corridor in Hampton and Norfolk, and the I-564, I-664, and VA 164 corridors.

Along I-664 through the cities of Suffolk and Chesapeake, there is more undeveloped land near existing interchanges than other parts of the Study Area Corridors; however, much of this land is forested wetland or conservation areas. Several areas along I-664 on the Southside are in the process of converting from low intensity uses to commercial-industrial use. Therefore, certain Build Alternatives may result in development shifts in these areas, in accordance with community planning and as favorable economic conditions permit. Because of the greater potential for induced growth near existing I-664 interchanges in the cities of Suffolk and Chesapeake, in addition to examining all areas within 1 mile of interchanges, 2 miles along major feeder roads are assessed for induced growth effects at existing interchanges.

Figure 1-6: Highway Investment on Typical Progress of Urbanization



While this 2-mile distance is less than the maximum recommended by NCDOT guidance, it is within the range recommended by that guidance, and is appropriate because of the maturity of the existing transportation infrastructure in the area. Along the feeder roads, 1,000 feet from the edge-of-pavement

would be included in the analysis. The 1,000-foot buffer is used because it represents a conservative estimate of the distance over which the influence of the project 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 alternatives outside of the area of direct impact. The stepwise process TRB recommends in NCHRP Report 466 for assessing indirect effects has been used as the structure for this analysis, and consists of 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 project design, the natural resources in the study area, professional experience, and past scientific studies of the effects of similar projects.

1.2.3 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 Impacts in the NEPA Process* (FHWA, 2014):

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 are 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 EFFECT 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, a number of local and regional planning documents were reviewed. These include each local government's

comprehensive and/or capital improvement plans. Following is a summary of how each plan refers to the HRCS.

- *Moving Forward- Chesapeake 2035* (Chesapeake, 2014) does not directly reference the HRCS project. The document does envision I-664 and I-64 as eight-lane freeways. Pughsville Road would become a six-lane arterial and Route 191 extending west from the I-664 Portsmouth Boulevard interchange would become an eight-lane arterial. The plan acknowledges that planned improvements at area ports and the new planned terminal at the CIDMMA would contribute to congestion on city roads as the amount of cargo through the ports increases. Further, the widening of I-64 from I-464 to Bowers Hill I-664 / I-264 interchange is noted as a top priority project.
- *Hampton Community Plan: 2011 Update* (Hampton, 2012), states a general need to "1.) Support the development of new transportation options that address regional needs as well as those of Hampton businesses and citizens" and "2.) Reduce commute times within the region and the City of Hampton."
- *Framework for the Future 2030* (Newport News, 2008) calls for the City to develop attractive gateways at the north end of the Monitor-Merrimac Memorial Bridge-Tunnel (MMMBT) and along I-64. The plan states that the City plans to "support the implementation of the Hampton Roads *2030 Regional Transportation Plan*, and the six projects endorsed by [Metropolitan Planning Organization] MPO". The *Southeast Community Plan* (City of Newport News, 2011) states that I-664's right-of-way should be reserved for future widening in anticipation of the proposed "Third Crossing of Hampton Roads"[1]. Their plan prioritizes supporting light rail connections between Norfolk and the Peninsula via the "Third Crossing".
- *plaNorfolk 2030* (Norfolk, 2013) identifies construction of the I-564 Intermodal Connector followed by construction of the "Patriot's Crossing"[2] over Hampton Roads as the City's highest priorities. The plan indicates the key to Norfolk's economy is to improve and expand regional transportation linkages with bridge and tunnel infrastructure investments. The plan includes enhancing truck movements in the Willoughby area at the I-64 15th Street interchange by improving Bayville Street and the intersection of West Ocean View Avenue and 13th View Street. The plan identifies I-64 as severely congested that is expected to continue through the planning horizon of 2034. It is also important to the City to maintain the efficient connection between ports and the roadway/railway networks and to support economic development through transportation investments. Toward this end, the plan would extend light rail to Naval Station (NAVSTA) Norfolk and develop a high-speed ferry up the Elizabeth River with connections to Newport News, Hampton, and the north end of NAVSTA Norfolk as long-range goals.
- *Destination 2025: Setting a Bold New Course* (Portsmouth, 2005) lists the "Proposed Third Crossing" improvement with improvements to VA 164 (Western Freeway) as "critically important to maintaining mobility for the City's residences as well as Portsmouth's viability as an employment center." An immediate priority of the plan is to link the planned Virginia International Gateway Terminal (VIG) to the regional road network to reduce truck traffic in nearby

[1] "Third Crossing" refers to the preferred alternative of the 2001 FEIS. The preferred designation has been set aside as part of this SEIS and it is anticipated that local plans would be updated if a different preferred alternative is identified as a result of the current SEIS.

[2] "Patriot's Crossing" refers to a portion of the 2001 preferred alternative. The preferred designation has been set aside as part of this SEIS and it is anticipated that local plans would be updated if a different preferred alternative is identified as a result of the current SEIS.

neighborhoods. This has been partly addressed in the Study Area Corridors by constructing the Virginia International Gateway Boulevard interchange on VA 164. Another priority of the plan that has been accomplished was to build a rail corridor to VIG and the planned CIMT in the median of VA 164. Other traffic calming measures to reduce truck traffic through residential areas would be implemented.

- *Suffolk 2035: A Vision for the Future*, (City of Suffolk, 2015) does not specifically outline the need for another crossing, but it does state capacity to the I-664 segments that pass through Suffolk should be increased by widening to six lanes. The plan indicates I-664 is critical to the city's economic development because it enables access to regional markets. The plan also recommends VA 164 be widened from four to six lanes. On other roads in the Study Area Corridors, the addition of one lane in each direction is proposed for US Route 17 from the Chesapeake City line west. Further, College Drive from I-664 to the Hampton Roads Parkway is recommended for widening to four lanes in the foreseeable future.
- Finally, the *Hampton Roads 2034 Long Range Transportation Plan (LRTP)* (Hampton Roads Transportation Planning Organization [HRTPO], 2012) describes several of the elements under study in this SEIS as regionally important projects. Many of these elements were included in its original list of regionally funded projects. The document concludes that as a result of congestion, economic considerations from regional businesses and national security considerations from the military are emerging that deliberate whether to locate, expand, or even continue business Scoping also incorporates other previous efforts related to the HRCS that have been underway since the early 1990's. These scoping efforts were part of past studies that included the following: operations in the region. The HRTPO is currently developing the 2040 LRTP but it has not yet been approved and is therefore not described in the HRCS Draft SEIS or this document.
- I-64 Crossing Major Investment Study in 1997, HRCS Draft Environmental Impact Statement (DEIS) in 1999, HRCS FEIS and ROD issued in 2001, HRCS re-evaluation in 2003, HRCS revaluation and Environmental Assessment (EA) in 2011, the HRBT DEIS in 2012, and HRCS re-evaluation in 2013. Throughout the development of these studies, a variety of scoping and public involvement opportunities were provided to engage local, state, and federal agencies, and the public about the project; provide information and updates; and solicit input. These opportunities included but were not limited to a series of public hearings in the corridor when the HRCS DEIS was issued in 1999 and when the HRBT DEIS was issued in December 2012.

More recently, as part of the HRCS Draft SEIS process, VDOT mailed scoping letters and questionnaires regarding indirect and cumulative effects on June 19, 2015 to the following state, federal, and local agencies and organizations to obtain pertinent new information and data developed since the 2001 FEIS, as well as to identify key issues regarding the potential environmental impacts for this study:

- 733rd Mission Support Group and Army Support Activity
- Chesapeake Bay Foundation
- Chesapeake Bay Local Assistance
- City of Chesapeake
- City of Hampton
- City of Newport News
- City of Norfolk
- City of Portsmouth
- City of Suffolk (Suffolk)
- City of Virginia Beach
- US Department of Transportation - Federal Transit Administration
- US Environmental Protection Agency – Office of Environmental Programs
- US Fish and Wildlife Service
- Virginia Department of Agriculture and Consumer Services
- Virginia Department of Aviation
- Virginia Department of Conservation and Recreation – Department of Natural Heritage

- Commonwealth Transportation Board – Hampton Roads District
- Federal Emergency Management Agency
- Federal Railroad Administration
- Federal Transit Administration
- Great Dismal Swamp National Wildlife Refuge
- Hampton Roads Transit
- Hampton Roads Transportation Accountability Commission (HRTAC)
- Hampton Roads Transportation Planning Organization
- Hampton University
- Isle of Wight County
- Joint Base Langley-Eustis
- National Oceanic and Atmospheric Administration – National Marine Fisheries Service, Habitat Conservation Division
- National Park Service
- Natural Resources Conservation Service
- NAVSTA Norfolk
- The Elizabeth River Project
- The Nature Conservancy
- US Army Corps of Engineers – Norfolk District
- US Coast Guard – Fifth Coast Guard District, Sector Hampton Roads
- US Department of Housing and Urban Development, Richmond Field Office
- US Department of Interior - Office of Environmental Policy and Compliance
- Virginia Department of Emergency Management – Region 5Virginia Department of Forestry
- Virginia Department of Environmental Quality
- Virginia Department of Game and Inland Fisheries – Environmental Services Section
- Virginia Department of Health, Office of Drinking Water
- Virginia Department of Historic Resources – 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
- Virginia Economic Development Partnership
- Virginia Institute of Marine Science
- Virginia Marine Resources Commission
- Virginia Maritime Association
- Virginia Outdoors Foundation
- Virginia Pilot Association
- Virginia Port Authority
- Virginia State Police Department

The survey questionnaires requested input on the ICE study area boundaries, the impact methodology to be used, 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, specific resources to evaluate, as well as input on the geographic and temporal boundaries of the study. All comments received have been considered and included in the ICE methodology as warranted. Agency comments on a draft ICE Methodology Memorandum in August 2015 were solicited and the document was revised accordingly as described throughout this technical report.

On July 21, 2015, and July 22, 2015, VDOT held Citizen Information Meetings (CIM) to solicit input from the public on the purpose and need for the study, to solicit information helpful in developing preliminary alternatives, and to identify potentially affected resources. The CIM was held in an open house format. Display boards depicted general information including history, background, and purpose of the study. A video was also available presenting the same information. Comment sheets and informational handouts were provided at each meeting and were also made available on the study website. VDOT representatives were available to discuss the study and answer questions. A total of 30 citizens attended the CIM on July 21st and 35 citizens attended on July 22nd. Twenty-seven public comments were received at the CIMs and

36 comments were received during the 30-day comment period following the CIM. These comments informed the development of the Purpose and Need, alternatives, and other sections of the HRCS SEIS; however, they did not provide any input directly informing the ICE analysis.

On July 21, 2015, VDOT held an Agency Scoping Meeting that was attended by various local, state, and federal agencies and nongovernmental groups to introduce the Draft SEIS process; discuss the study process, schedule, and agency involvement; and identify any issues or constraints that should be considered in the study. No specific comments regarding the ICE analysis were offered at the scoping meeting.

On December 9 and 10, 2015, CIMs in an open house format were held for the public to comment on alternatives that could be retained for analysis as part of the HRCS. Several large boards displayed information on the Purpose and Need, each of four alternatives, and the Operationally Independent Sections. A narrated PowerPoint video was available for viewing. A total of 85 persons attended on December 9 and 53 on December 10. There were 215 comments submitted, none of which directly informed the ICE analysis.

2.2 STEP 2: IDENTIFY STUDY AREA DIRECTION AND GOALS

The ICE geographic study areas, which are appropriate 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

Input from cooperating and participating agencies and the public during the initiation of the SEIS was used to inform the Induced Growth ICE Study Area and the identification of resource-specific ICE Study Areas for this indirect effects analysis.

As described in **Section 1.2.2**, the NCDOT guidance recommends induced growth impacts are most often found up to 1 mile around a freeway interchange and 2 to 5 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 maturity of the existing transportation infrastructure, land availability, and regional economic conditions. As previously discussed, all of the HRCS Study Area Corridors were constructed over 20 years ago, and the areas near the interchanges are generally built-out or constrained by natural resources. Therefore, the greatest potential for induced growth effects from the proposed transportation improvements would be infill in areas close to the existing interstates, which would be adequately encompassed by the 2-mile boundary for analysis along major feeder roads.

At each existing interchange, the Induced Growth ICE Study Area encompasses the area within a one-mile radius of the given interchange, plus 2 miles along major feeder roads that lead to the interchanges. Along these feeder roads, a 1,000-foot buffer was applied to the edge of pavement. The 1,000-foot buffer is used because it represents a conservative estimate of the distance over which the influence of the project could be felt. The other two proposed interchanges are located over water and do not provide access to areas subject to induced growth, and have therefore not been included in this analysis.

Other things being equal, it is possible that if traffic capacity and reliability was sufficiently improved at the Hampton Roads crossings, some individuals will choose to relocate further away from the Study Area Corridors, increasing development pressure outside of the proposed Induced Growth ICE Study Area. The extent of this possible indirect effect is difficult to predict, but would be unlikely to cause substantial shifts in residential patterns in the Hampton Roads region. Given these uncertainties, it is appropriate to analyze the potential for induced growth in accordance with the NCDOT methodology.

The HRCS Induced Growth ICE Study Area is depicted in **Figure 2-1**. The Induced Growth ICE Study Area is 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, 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 direct impacts study area and the Induced Growth ICE Study Area (**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 the Virginia Department of Conservation and Recreation (VDCR) Virginia Hydrologic Unit Explorer subwatershed 12-digit Hydrologic Unit Code (HUC) within the direct impact area (**Figure 2-3**).
- **Historic Resources:** The Historic Resources ICE Study Area was established to analyze indirect effects to architectural and archaeological resources. The Historic Resources ICE Study Area includes the area within which indirect effects to historic properties could occur from altering the setting, feeling, and association contributing to the integrity of the historic property (**Figure 2-4**). Indirect effects such as altering the setting, feeling and association of archaeological and architectural historic properties are considered under Section 106 of the National Historic Preservation Act (NHPA) as reported in the *HRCS Archaeological Assessment* and *Architectural Survey: Management Summary* technical reports. Indirect effects analyzed in this ICE document are those related to potential changes in access and induced growth.

No ICE Study Areas for air quality or noise are defined. The indirect and cumulative effects of the HRCS alternatives are evaluated in the *HRCS Air Quality Technical Report* and take into account air quality impacts for a large part of the Hampton Roads region in the future. Potential noise effects are evaluated for the HRCS alternative's alignments in the *HRCS Noise Technical Report* that incorporates the existing cumulative ambient noise environment with contributions from all sources including aircraft, railroads, and ships (regardless of where these sources are located). Additionally, mitigation for noise impacts are based on the forecasted noise levels in the design year.

Figure 2-1: Induced Growth ICE Study Area

Figure 2-2: Socioeconomic Resources ICE Study Area

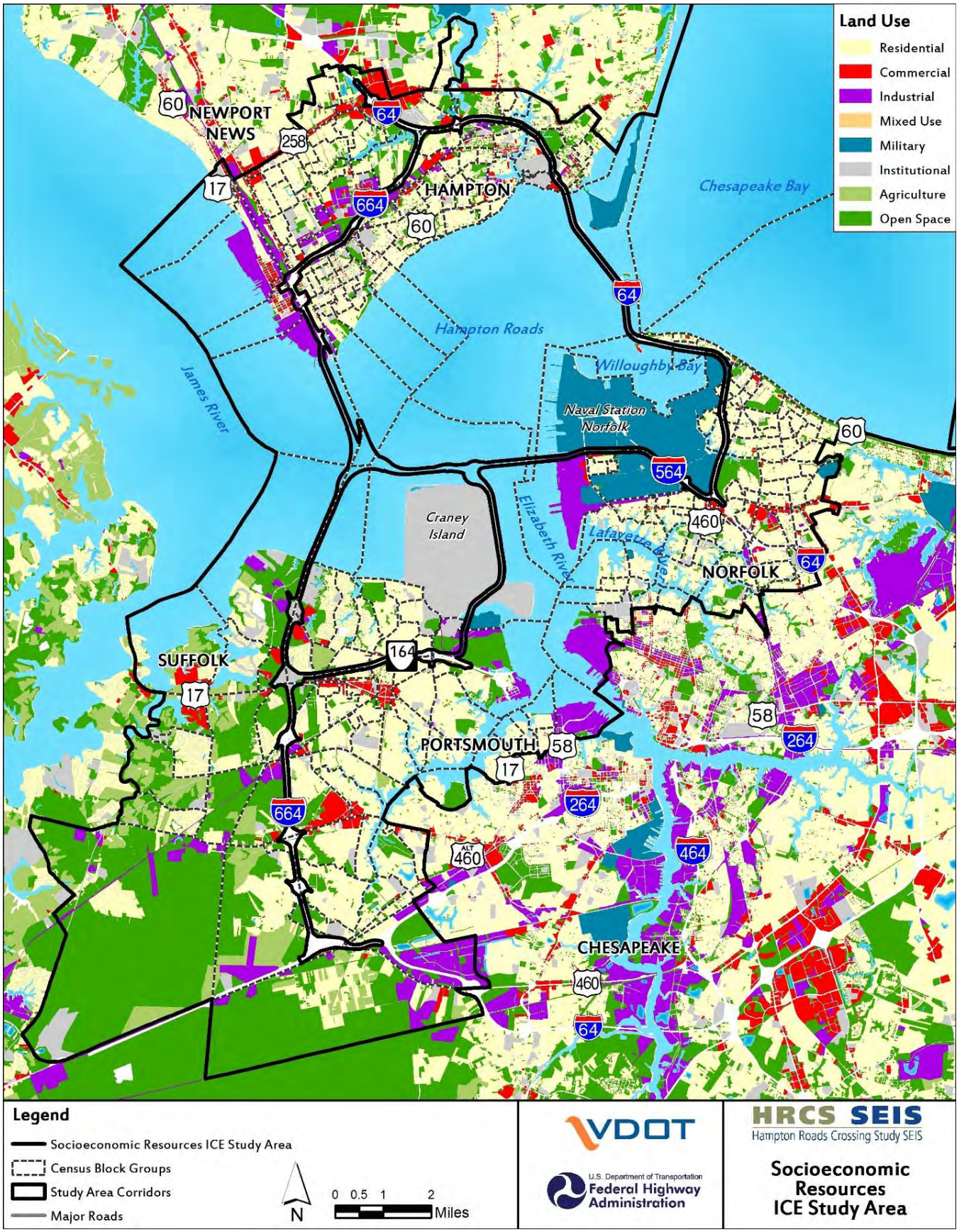


Figure 2-3: Natural Resources ICE Study Area

Figure 2-4: Historic Resources ICE Study Area

2.2.2 Directions and Goals

The direction and goals considered for the analysis are independent of the transportation alternatives being evaluated in the HRCS SEIS 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 in understanding the potential for project-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 in order to provide insight to the direction and goals for the Study Area Corridors. In addition, environmental resource impact trends and protection goals within the Natural Resources ICE Study Area and Historic Resources ICE Study Area are discussed.

2.2.2.1 Historic Land Use

Over the years, residential, commercial, and industrial development has resulted in a very densely developed region. Numerous roadways, bridges, and tunnels connect the communities within the region. "Hampton Roads" is the name of the water body that is located at the confluence of the James River, the Elizabeth River, the Nansemond River and the Chesapeake Bay. The shorelines along both the Peninsula (the area north of the James River/Hampton Roads) and the Southside (the area south of the James River/Hampton Roads) have been heavily developed and modified for an extensive period. The ICE Study Area is located within an area known as the Hampton Roads region.

Historical settlement in the Hampton Roads region is summarized in the *HRCS Archaeological Assessment*. Early historical records show the area was inhabited by Native American sedentary agriculturalists with several large villages at the time of first contact with Europeans in the early 1600s. At that time, the region was heavily wooded and the Hampton Roads region and shorelines were in relatively "pristine" condition, with many more wetlands and wildlife than are present today. European settlement in the region was established relatively quickly with Hampton (1610), the oldest continuously occupied community of English-speaking North America. The area encompassing modern Newport News was first settled in 1619. Settlement along the Elizabeth River in what is now Chesapeake began around then as well. Norfolk was founded in 1682 shortly after the establishment of Upper and Lower Norfolk Counties. Land around Portsmouth was recognized as suitable for shipbuilding and first patented in 1619, becoming a designated city in 1752. European settlement continued to expand westward along the James River, with the establishment of the Town of Suffolk in 1742. These developments resulted in changes to and loss of natural communities that were present when the area was in nearly "pristine" condition.

Both Norfolk and Portsmouth quickly evolved as important ports for the region. For several hundred years, the most feasible mode of travel into and out of the region was by boat. The Hampton Roads location at the mouth of the James River and Chesapeake Bay was naturally situated for sea-going commerce and facilitated the importing and exporting of goods that supported European expansion into the interior continent along the James River. Shorelines were therefore historically a focus for development. The Hampton Roads' geography also made the region strategically critical for the military of the nascent United States, leading to construction of defensive works and forts around the shoreline such as Fort Monroe and Fort Wool. Hampton Roads was also the site of battles during the Revolutionary War, the War of 1812, and the Civil War.

Development in the region expanded as numerous rail providers extended service to the port cities of Portsmouth, Norfolk, and Newport News during the 1800's. The outbreak of World War I spurred substantial military growth in the HRCS area. In 1917, the US Naval Operating Base and Training Station (NAVSTA Norfolk) was established in the City of Norfolk as well as dry docks and shipyards in Portsmouth. Development slowed after the war and through the Depression, but World War II once again brought thousands of workers into the area, leading to overcrowding in Hampton and Norfolk. After World War II, the base continued its role as "the home of the Atlantic Fleet" (NAVSTA Norfolk, 2016), firmly establishing the military as a major presence in the region. Suffolk and the area around Chesapeake remained primarily rural. However, beginning in the 1950s, substantial growth in the northern portion of what is Chesapeake today began and by 1962, Norfolk County and South Norfolk were merged into the new city of Chesapeake.

Historic topographic maps and aerials most readily illustrate the pace and extent of growth in the Hampton Roads 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. Topographic maps or aerials prior to 1955 are not widely available. However, the US Geological Survey's (USGS) historical topographic maps for the years 1955, 1964, 1965, 1973, 1986 and aerials for the years of 1963, 1982, 1983, 1990, 1991, 1994, 2002 and 2010 are available and are included in **Appendix A** for ease of reference. These maps and aerials are appropriate for analysis because they capture the periods just before, during, and after construction of the Study Area Corridors and subsequent growth. Aerial imagery from Google Earth was also reviewed to assess recent change in land use and development.

The following summarizes the review of historic mapping and aerials in order of dates.

1955 Topographic Mapping

The 1955 topographic maps depict the area north of the James River and Hampton Roads, known as the Peninsula, as highly developed along the shoreline with commercial and residential structures (shown in pink shading on the topographic maps). An extensive railroad system with numerous tracks clustered together is depicted in Newport News. Numerous docks are noted southwest and west of the Study Area Corridors and the mapping identifies land immediately south of the shoreline of Newport News and Hampton. Additionally, Newport News Creek, a dredged channel, is depicted west of Jefferson Avenue. Development is minimal north of where present day I-64 lies in Hampton. Bridges connect the Hampton mainland to Fort Monroe, but no bridge is indicated between Hampton and Norfolk.

This map also shows the extent of natural habitat and historic properties loss up to this point. Little green space is found along the Study Area Corridors or within downtown Hampton and Newport News, but extensive tracts are located north of Newmarket Creek and the mouth of the Hampton River. Earlier development in this area likely destroyed both prehistoric and historic properties.

On the 1955 mapping, the Southside has varying degrees of development. Norfolk has high levels of development, dominated by the NAVSTA Norfolk base to the north. Hampton Boulevard, with its bridge over the Lafayette River, connects the base with the rest of the city. Present day Craney Island is depicted as Disposal Area US Naval Supply Center on approximately the south third of the island, without the dredged material to the north as exists today. Portsmouth is depicted as having extensive development along the shoreline and inland, south of the Western Branch of the Elizabeth River. Portsmouth north of the Western Branch of the Elizabeth River is depicted as having shoreline development but there is little development inland (noted as green shading for the undeveloped areas, and no shading for rural areas that are starting to be developed). Suffolk is depicted as having some residential areas developed along the shoreline close to the south end of the present-day MMMBT. Portsmouth has extensive development north along the shoreline of the Western Branch of the Elizabeth River to the confluence with the Lafayette River. The Bowers Hill community is depicted on the northern edge of the Great Dismal Swamp, near the intersection of Routes 460, 58, and 13, as well as the railroad line. This is a low-density

development that has not experienced increased density to this day. Like the Peninsula, this mapping illustrates a substantial level of development had already occurred with consequent adverse impacts to natural and cultural resources in Norfolk and Portsmouth cities, but much less so in the vicinity of Chesapeake and Suffolk near the HRCS Study Area Corridors.

1963-1965 Topographic Mapping and Aerials

The 1963 aerials and 1964 and 1965 topographic maps depict an increase in residential, commercial, and industrial development in Newport News and Hampton compared to 1955. The shoreline is completely developed with numerous docks extending into the Hampton Roads waterway south and southwest of Newport News. The images and mapping now depict the shoreline between the present-day MMMBT and HRBT as tidal flats replacing the previous sand designation, and with development occurring the full length of the shoreline. The 1963 aerials show I-64 under construction through Hampton and the HRBT as a two-lane, single bridge complex. South of Newmarket Creek through Hampton and Newport News has large tracts of open land. Large tracts of open land are also around the Hampton University area and north of Mallory Street in Hampton. The tip of the Peninsula in Newport News is heavily developed with port facilities.

The Southside shows a significant increase in residential, commercial, and industrial development in Norfolk. Norfolk Naval Base is depicted as having increased the number of docks along the Hampton Roads shoreline, in addition to filling in aquatic habitat to extend the Base west. The Base is almost completely developed with major infrastructure including rail lines, docks, highway and major roads, and an airport. Willoughby Spit is fully developed with numerous residential structures. Although the topographic maps do not show the full extent of I-64, the highway as well as the two lanes of the HRBT are constructed by this time, connecting Hampton with Norfolk (both opened to traffic in 1957). I-64 is the only interstate into and out of the Hampton Roads region. The shorelines throughout Norfolk, including along Mason Creek, the Lafayette River, the Elizabeth River Eastern Branch, and Wayne Creek, have all been fully developed with residential and commercial structures.

Chesapeake, Suffolk, and Portsmouth remain largely unchanged from the decade before. The 1963 aerials show the Pig Point Depot in north Suffolk is deforested where the MMMBT now lands on the South Side. The area from north Suffolk east through Portsmouth to the Elizabeth River is primarily agricultural fields. CIDMMA is depicted as being more filled in trending towards the western boundary but still less than one-third of its present size. Progressing south along where I-664 will be eventually built through Suffolk and Chesapeake, land use is largely agricultural open fields with large blocks of forest east, south and west of Pughsville. Although Pughsville is subdivided it still has large areas of open land.

1973 Topographic Mapping

The 1973 topographic maps depict an increase in development along the shorelines and inland. On the Peninsula, growth has extended further north with interchanges on I-64 in the approximate present-day locations. The second set of lanes for the HRBT are depicted as being under construction. Fort Wool has been expanded and filled in westward.

On the Southside, the 1973 mapping shows some residential development on the east side of Chesapeake close to the Portsmouth City limits. New development within Suffolk is generally confined to the shoreline residential development that has spread east along major roads such as College Drive (Route 135) and Harbor View Boulevard (Route 624). Additionally, CIDMMA is depicted as completely filled in to present day boundaries.

1982-1985 Topographic Mapping and Aerials

On the Peninsula, 1982 aerials show I-64 constructed through Newport News and Hampton. Construction of I-664 is underway through Newport News. The area south of Newmarket Creek in Hampton and

Newport News is nearly completely developed. A 1983 aerial and 1985 topographic map show development filling in around Hampton University and the HRBT widened to four lanes with an additional two-lane trestle bridge (opened in 1976). Hampton and Newport News are depicted as almost entirely developed with residential, commercial, and industrial areas.

On the Southside, Norfolk is depicted as almost entirely developed with residential, commercial, and industrial areas. A 1982 aerial shows completion of the second set of lanes to the HRBT and I-64 through Norfolk. A 1983 aerial and 1985 mapping shows the addition of the US Coast Guard Base Portsmouth, just south of CIDMMA. New residential development is noted throughout Chesapeake and Suffolk, with development immediately south of Route 17 and along the shore of Drum Point Creek and the Western Branch of the Elizabeth River. Major roads are noted in Chesapeake and Suffolk such as Route 17 and the Mills E. Goodwin Jr. Bridge, the intersection of I-64 at Bowers Hill with I-264, Dock Landing Road, Jolliff Road, Portsmouth Boulevard (Route 337), and Taylor Road. The portion of Portsmouth south of the Western Branch of the Elizabeth River is almost entirely developed with minimal vacant land occurring west of Twin Pines Road. The area shown on 1983 aerials that will become I-664 through Suffolk and Chesapeake is still primarily agricultural.

1990-2002 Aerials

On the Peninsula, a 1991 aerial shows I-664 and the MMMBT under construction through Newport News that is completed on the 2002 aerial. A 1994 aerial shows increased development in the area around Hampton University to essentially what exists today. This image also shows the area southeast of the I-64/I-664 interchange as still undeveloped.

On the Southside, a 1991 aerial of northern Suffolk and Portsmouth shows the MMMBT, I-664, and VA 164 Western Freeway under construction. Nearly all of the area north of VA 164 through Portsmouth is developed. Pig Point in Suffolk and south through Chesapeake where I-664 was built still has large areas of open, undeveloped land. Chesapeake mall is constructed and neighborhoods developed around Western Branch.

Recent Aerial Mapping

Compared to the historic level of development experienced in the region, development within Newport News, Hampton, and Norfolk was limited between 2000 and 2015. There was no substantial change in land use, density, or development over the 25-year period. While the majority of the undeveloped area are wetlands, floodplains, or parks or open space, no apparent change in density, such as the replacement of single-family with multi-family residences, or increasing office/commercial densities, has occurred.

There was, however, substantial development during the same period west and north of the Western Branch of the Elizabeth River (see the 2010 aerial). This development has been attributed to the completion of I-664 (sections opening between 1989 and 1993) and construction of the MMMBT (opened in 1992). The areas both east and west of I-664 experienced residential, commercial, and industrial development, schools and a hospital on most of the available developable parcels (this area has numerous streams and associated wetlands and floodplains, thus limiting development). Similarly, the area surrounding VA 164 in Portsmouth experienced residential development south of the highway (opened in 1992, extended to Midtown Tunnel by 2006) as well as the construction of a new private port, the APM Terminals (now under new ownership as VIG), which opened in 2007, just south of the US Coast Guard Base in Portsmouth.

Map Review Conclusions

Prior to 1955, growth and development in the Hampton Roads region was historically driven by European colonialism, river transportation and shipping, development of the railroad system, and military investments. The development of highways and the bridges and tunnels in the late 1950s through 1990s

linked residential areas to commercial, industrial, and military activity centers. The suburban growth occurred near the newer highway interchanges. As described below, the once rural landscape has been transformed to residential neighborhoods, shopping centers, port facilities, military and industrial facilities, and business parks by years of rapid development following the construction of I-64, I-564, I-664, and VA 164. Other important transportation events for growth in the region (Kozel, 2007) included:

- completion of the Downtown Tunnel in 1952 that was expanded to four lanes in 1989;
- opening the Midtown tunnel on US 58 in 1962;
- the High Rise Bridge opening in 1969 and construction of I-64 through Chesapeake to Bowers Hill by 1969;
- opening I-264 in 1972 with additional connections to the Downtown Tunnel and Berkley Bridge in 1991; and
- replacement of the 1928 two-lane James River Bridge on US 17 with a four-lane bridge in 1982.

2.2.2.2 Land Use Patterns and Local Plans

The following sections describe the local plans that guide the land use patterns and other development in each city within the ICE Socioeconomic Study Area. Additional information is available in the *HRCS Socioeconomics and Land Use Technical Report*. Each city has a general, overarching plan guiding community development and some cities have selective neighborhood-specific plans that focus on issues specific to that neighborhood. Transportation elements of the below plans that overlap with the HRCS are described under Step 1.

Chesapeake

Chesapeake is in a historically rural and agricultural area that experienced a large population boom at the turn of the century, and continues to be one of the fastest growing cities in the Hampton Roads region. The city was established in 1962 by the merging of Norfolk County and the community of South Norfolk (Chesapeake, 2015). Factors affecting land use and development in the City include approximately 40 percent of its land area is comprised of wetlands and 30 percent as conservation areas (Chesapeake, 2014). Chesapeake's dramatic growth since 1963 has been spurred by the improvement of major transportation corridors such as I-664, I-64, and VA 164. Chesapeake's Comprehensive Plan *Moving Forward Chesapeake 2035* establishes a development pattern map for the year 2050 in which the areas within the Socioeconomic ICE Study Area along the I-664 corridor are designated as "dispersed suburban development areas", where the purpose is to provide a transition area between the urban areas of the City and the outlying rural area (Chesapeake, 2014). This area is also within the Suburban Overlay District where mixed use and infill development are authorized by City design guidelines. Further growth and development may occur in designated Major Activity Centers and lands zoned commercial and industrial.

Hampton

The City of Hampton is located at the southern tip of the Peninsula and is divided into several planning districts, and, within them, smaller communities and neighborhoods (Hampton, 2012). Seven large districts (Coliseum Central, Downtown, Aberdeen Gardens, West Hampton, Wythe, Briarfield and Phoebus) and several smaller neighborhoods fall within the Socioeconomic Resources ICE Study Area. Coliseum Central is located in the central part of the city, Hampton's economic hub, and includes the Hampton Coliseum, Peninsula Town Center, and other business, residential, and recreational areas. Downtown Hampton is located just south of I-64 and is the core of the city comprised of government offices, historic neighborhoods, and the historic waterfront (Hampton, 2006). Selective strategic master plans for Coliseum Central, Downtown Hampton, Phoebus, and Kecaughton have been prepared by Hampton and are integrated into the current comprehensive plan, the *City of Hampton Community Plan*

(Hampton, 2012). Phoebus has a distinct identity rooted in its origins as a city separate from Hampton. Phoebus's access to the waterfront and its own historic core are key elements of its identity (Hampton, 2012). Hampton is noted as a "mature, fully developed community" and the population in the community is expected to remain stable (Hampton, 2012). The plan indicates the City is largely built-out and provides guidance to redevelopment – replacing older existing development with new development – that is most consistent with community priorities and shifting markets. Hampton also has designated Urban Enterprise Zones that provide incentives for development.

Newport News

Similar to Hampton, Newport News is located at the tip of the Peninsula. Newport News is in the process of updating its Comprehensive Plan (Newport News, 2015) to address opportunities to better integrate land use and transportation to provide citizens with affordable, efficient and safe transportation choices. Under the *Framework for the Future 2030* plan (Newport News, 2008), the city is divided into different planning districts of which District 1 (South District) and the communities of Historic Downtown and Southeast Community are located within the Socioeconomic Resources ICE Study Area. I-664 and the railroad buffer the residential neighborhoods to the north from the industrial area/ports to the south before entering the north portal of the MMMBT.

The portion of Newport News within the Socioeconomic Resources ICE Study Area is an older, developed City; therefore, revitalization and redevelopment are used to encourage improvement to its neighborhoods and community facilities. Current neighborhood plans include the *Southeast Community Plan* (2011), *Jefferson Avenue Corridor Study* (Newport News, 2009), and the *Southeast Community Urban Waterfront Design Study* (2007). These plans focus on eliminating blight in the Southeast Community, promoting mixed-income housing development and job creation, and attracting commercial services that are accessible to the whole community. The plans also include improvements to overall circulation and waterfront access and better pedestrian connections and enhancements to open spaces. Newport News has several Urban Enterprise Zones that provide incentives for development. *Framework for the Future 2030* acknowledges the City is primarily built-out with less than eight percent vacant lands; as a result, the plan identifies a need to ensure that any plans for infill development remain compatible with the existing development in that region.

Norfolk

Norfolk has a strong military presence and is home to the world's largest naval base, NAVSTA Norfolk; as much as 15.6 percent of its land is devoted to military installations (Norfolk, 2013). The communities of Ocean View, Northside, Wards Corner, Willoughby Spit, NAVSTA Norfolk, Central Hampton Boulevard, and Colonial Place-Riverview are within the Socioeconomic Resources ICE Study Area. The Study Area Corridors fall within Norfolk's Suburban District: primarily developed after World War II with more curvilinear streets, larger blocks and lot sizes, and greater separation of uses. Recently the City amended their general plan to include the Coastal Character District that encompasses the City coast along the Chesapeake Bay, including the communities of Willoughby Spit and Ocean View in the I-64 Study Area Corridors. Design standards and review would require development in this area to be consistent with the coastal character of these communities. Selective neighborhood plans relating to specific neighborhoods within the City are included in the *plaNorfolk 2030* comprehensive plan (Norfolk, 2013). *plaNorfolk 2030* states that new development is not a viable option as only 3.1 percent of the City is vacant, making redevelopment and infill the only means for further developing the City (Norfolk, 2013). The Greater Wards Corner Comprehensive Plan calls for the establishment of a new retail district that would transform the current area to a mid-box retail district with a hotel, new apartments, and townhomes, as well as the redevelopment of current strip shopping centers as mid-rise apartments with retail on the ground floor (Greater Wards Corner Comprehensive Plan; Norfolk, 2004). This area is also with an Urban Enterprise Zone that provides incentives for development. Willoughby Spit and West Ocean View are also within

designated redevelopment neighborhoods. Downtown Ocean View and Wards Corner are identified as strategic economic development areas in city plans. Because NAVSTA Norfolk's Chambers Field airstrip is located near the I-564 and I-64 Study Area Corridors, land use is strictly regulated in potential noise and accident zones that extend into these corridors. This regulation aims to minimize impacts to operations at the airfield and provides for the safety of those living and working in these zones. The City also plans to work with the Navy to evaluate potential reuse opportunities of federally owned land at the I-64 and 4th View Street interchange area. Land use along Norfolk's shoreline near the HRCS corridors is primarily military and industrial because of the Norfolk International Terminals (NIT) port.

Portsmouth

Portsmouth is an older, largely built-out city with established neighborhoods and a mature housing stock. Portsmouth is the smallest city in the Hampton Roads region at 34 square miles and is almost entirely developed. Because of the small area, limited vacant land, barriers to annexing new land, and high proportion of tax-exempt government and conservation land inform the City's plan is oriented to achieving the highest and best use of each parcel. US government-owned properties at the CIDMMA, the Craney Island US Naval Supply Center, the US Coast Guard – Portsmouth Station and VIG Terminals limit access to the northeastern parts of the City because of gated entrances and off-limits areas protected by fences. Land use surrounding the VA 164 Study Area Corridor is planned to remain primarily residential with industrial uses concentrated north and east of the Cedar Lane interchange. Commercial uses would be clustered on both sides of VA 164 at the western City boundary. Strategic growth areas identified by the City include the eastern portion of CIDMMA, VIG, and the MAST Center at Hampton Roads Crossing north of VA 164 at the Suffolk City boundary. The only Urban Enterprise Zone in this area of Portsmouth is in the West Norfolk industrial area. Future Community Activity Centers identified in the comprehensive plan, *Destination 2025 Setting a Bold New Course,* are located in the High Street/Tyre Neck Road and the Churchland High School areas. Areas that show some evidence of decline in stability are termed "transitional. Within the Study Area Corridors, these "transitional" areas are located adjacent to the VA 164 Towne Point interchange. The remaining areas along VA 164 in Portsmouth are identified as residential neighborhoods. According to Portsmouth's comprehensive plan, *Destination 2025 Setting a Bold New Course*, growth has not been similar to the surrounding Hampton Roads Region localities due to the extent of development and lack of open space. It goes on to state that "key indicators such as the percentage of public schools accredited, per capita income, and median housing value rank below other Hampton Roads communities", making improvements a top priority of the City. Infill development and redevelopment are stated as the only possible methods for future growth (Portsmouth, 2005).

Suffolk

Unlike other communities evaluated in this study, Suffolk land use is primarily agricultural and working forests followed by residential use (Suffolk, 2015). Like Chesapeake, Suffolk is historically a rural and agricultural city that has experienced rapid suburban growth in the past 50 years due to a burgeoning population, greater accessibility, and suburban sprawl. Development occurring in this area of Suffolk has been spurred by the greater access provided by construction of I-664 and the MMMBT. Suffolk is still a predominantly rural area with two major centers of development: the historic downtown core located in central Suffolk and the more recently developed northern core that surrounds I-664 (Suffolk, 2015). The two major centers of development or "Growth Areas" are the focus to guide development and protect the rural community character and agricultural resources in Suffolk. The *2035 Suffolk Comprehensive Plan* describes the City's study of potential for future growth. The study found there is sufficient capacity in the Growth Areas to accommodate more than the forecasted non-residential development, but forecasted residential development would require all designated residential lands by 2031. This potential is constrained by environmental resources such as marshes and wetlands, especially by the Great Dismal Swamp that dominates the southeastern half of the City. The 2035 plan therefore provides for future

forecasted growth by expanding designated Growth Areas capable of supporting more intensive land use. The Northern Growth Area near the Study Area Corridors is comprised of the Mixed Use Core District along I-664 that still has substantial greenfield development opportunities to build on existing high technology businesses in the area. North of the Pughsville area is designated as a Core Support District and is intended to provide residential and ancillary retail activity to support the Mixed Use Core. While some vacant land is available, infill development is likely to occur in the northeastern regions of Suffolk close to I-664 and around the downtown region of Suffolk (Central Growth Area) where residential and commercial development is established and land is feasible for construction.

2.2.2.3 Planning and Forecasting

Population Growth Trends

The HRTPO reported that population in the Hampton Roads region has increased approximately 51 percent from 1,077,049 residents in 1970 to 1,632,100 residents in 2010 (HRTPO, 2013a). The estimated 2009 population within the Socioeconomic Resources ICE Study Area was 280,640 (**Table 2-1**). Between 2000 and 2009, population in the Socioeconomic Resources ICE Study Area grew approximately five percent, with changes ranging from negative 39 percent in the Newport News portion to 209 percent in the Portsmouth portion. Population within the Socioeconomic Resources ICE Study Area is projected to increase to 303,699 by 2040, an increase of eight percent over the 31–year period (HRTPO, 2013b). The portions of the Socioeconomic Resources ICE Study Area within Suffolk and Chesapeake are expected to increase the greatest, at 50 percent and 136 percent, respectively. However, population within the Socioeconomic Resources ICE Study Area is expected to decrease in the other four cities, with Norfolk sustaining the greatest loss at 13 percent. Additional information is available in the *HRCS Socioeconomics and Land Use Technical Report*.

Table 2-1: Population Trends and Forecasts, 1990, 2010, and 2040

Location	Estimated 2000 Population	Estimated 2009 Population	% Increase (2000 to 2009)	Projected 2040 Population	% Increase (2009 to 2040)
Socioeconomic Resources ICE Study Area	267,455	280,640	5%	303,699	8%
Chesapeake	19,768	33,392	69%	50,228	50%
Hampton	37,645	48,123	28%	44,736	-7%
Newport News	56,054	33,951	-39%	32,534	-4%
Norfolk	114,524	105,127	-8%	91,434	-13%
Portsmouth	12,800	39,568	209%	36,340	-8%
Suffolk	26,664	20,479	-23%	48,427	136%

Source: HRTPO (2013a,b)

Employment Trends

The Socioeconomic Resources ICE Study Area encompasses several downtowns and city centers, a large naval base (NAVSTA Norfolk), three ports, two universities, and office parks. Major employers in the Socioeconomic Resources ICE Study Area include NAVSTA Norfolk (approximately 45,000 military and 12,000 civilian employees), Newport News Shipbuilding (24,000 employees), the Port of Virginia that directly and indirectly supports 40,000 jobs in the region, Old Dominion University (4,000 employees) and Hampton University (1,000 employees) (Hampton Roads Economic Development Alliance, 2015). Each of the cities within the ICE Study Area are also major area employers. Regionally, other large employers include several additional military installations with approximately 100,000 personnel, Sentara Healthcare (20,000 employees), Riverside Health System (7,050), NASA Langley Research Center (4,000), and Bank of America (3,600 employees) (Hampton Roads Economic Development Alliance, 2015).

Table 2-2 presents American Community Survey (ACS) 5-year (2009-2013) labor force and employment data for the cities within the Socioeconomic Resources ICE Study Area compared to Virginia.

Table 2-2: 2013 Labor Force, Employment, and Unemployment

Location	Residents in Labor Force[1]	Residents Employed[2]	% Employed
Virginia	4,304,562	3,885,077	90%
Chesapeake	119,988	105,099	88%
Hampton	71,736	59,981	84%
Newport News	99,688	82,481	83%
Norfolk	138,948	102,424	74%
Portsmouth	48,822	40,950	84%
Suffolk	43,637	38,150	87%

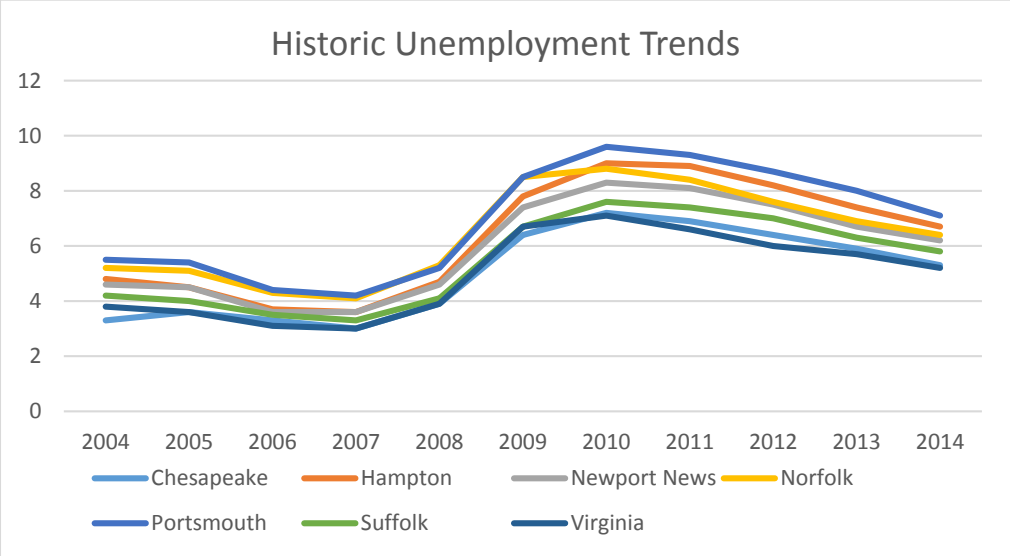
Source: ACS 5-year 2009-2013
[1]Residents in labor force are persons 16 years of age or older; [2]Residents employed are persons 16 years of age or older

Between 2004 and 2014, unemployment in the six cities along the Study Area Corridors and statewide was initially, relatively low at less than 6.0 percent, but rose to a height of 9.6 percent during the recent recession in 2010 (**Figure 2-5**) (Virginia Employment Commission, 2015). The unemployed are over 16 years of age and not currently working but actively looking for work, and generally available to work. Employment in the larger Hampton Roads region is expected to increase by over 500,000 positions between 2012 and 2022, representing a 13.5 percent increase in employment (Virginia Labor Market Information, 2015a-f). Improved access and mobility provided by the proposed improvements would accommodate continued economic growth and planned development within and beyond the Socioeconomic Resources ICE Study Area.

Economic Growth and Development

There is a large military presence in the Socioeconomic Resources ICE Study Area that has a large impact on the area economy. Old Dominion University (ODU) reports approximately 39 percent of economic activity in the Hampton Roads region is directly or indirectly related to defense spending (ODU, 2016a). Direct spending means spending on military installations and personnel and defense-related contracts with private companies, such as with area shipyards. Indirect spending includes expenditures for things such as military personnel and employee payments for rent, food, gas and the like. In 2000, direct DoD spending in Hampton Roads region has been estimated at $10 billion, with an annual average increase of 5.65 percent up to $19.33 billion in 2012 (Argawal, 2016). In 2016, it is forecasted to be approximately 2.8 percent lower than its peak in 2012. All six cities in the HRCS Socioeconomic Resources ICE Study Area

Figure 2-5: 2004-2014 Unemployment Trends in Study Localities and Statewide



Source: Virginia Employment Commission (2015)

benefit from DoD spending. A noted trend is that higher military spending on technology assets has resulted in reductions of active-duty personnel, which is expected to continue in the Hampton Roads region (ODU, 2015).

During the recent Great Recession, the Port of Virginia (POV) in Hampton Roads region experienced a 16.4 percent decline in general cargo tonnage (ODU, 2016a). Area ports began to rebound strongly in 2012 and are now operating at a profit. The ports at NIT, Newport News, and VIG are currently thriving, continually increasing their capacity. The POV plans to increase capacity at area ports and construct a new port at CIDMMA (POV, 2015). The number and size of the vessels coming to the POV keeps growing and is expected to continue to grow. In Fiscal Year 2015, $961 million was invested or reinvested in port-related economic development projects (POV, 2015). Factors that contribute to port growth include larger ships, its access to deep water, and the expected opening (approximately 2022) of the expanded and refurbished Panama Canal.

The Hampton Roads Economic Development Alliance, as well as each of the six cities in the Socioeconomic Resources ICE Study Area, continue their effort in recruiting new businesses to the area and helping existing businesses expand. All of the cities have programs offering incentives to businesses to establish offices and create jobs within specific areas of the cities, such as Historically Underutilized Business Zones (HUBZone), Enterprise Zones, Technology Zones, and Foreign Trade Zones. Many cities also have specific neighborhood incentive programs, such as the Downtown Hampton and Phoebus Retail Incentive, which encourages retail establishment to locate in Downtown Hampton and Phoebus (Hampton, 2016a).

Land Use Trends

Regional planners have forecasted future land use in the Hampton Roads region to the year 2034 (HRTPO, 2011). Forecasted land use estimates future socioeconomic factors based on trends in employment, population, foreseeable transportation improvements, and local comprehensive plans. **Figure 2-6** shows the distribution of forecasted land use in the Socioeconomic Resources and Induced Growth ICE Study Area. This data set is not directly comparable to the 2011 HRTPO existing land use data as the geometry (larger area) and the land use categories are slightly different. However, reclassifying the resource conservation and parks categories to open space, the distribution of forecasted land use is as shown in **Table 2 -3**.

Table 2-3: 2034 Forecasted Land Use

Land Cover	Acres	Land Cover	Acres
Agriculture	1,738	Military	5,107
Commercial	4,349	Mixed Use	5,771
Industrial	8,407	Open Space	20,870
Institutional	4,466	Residential	25,495
Total	76,202		

Source: HRTPO (2011)

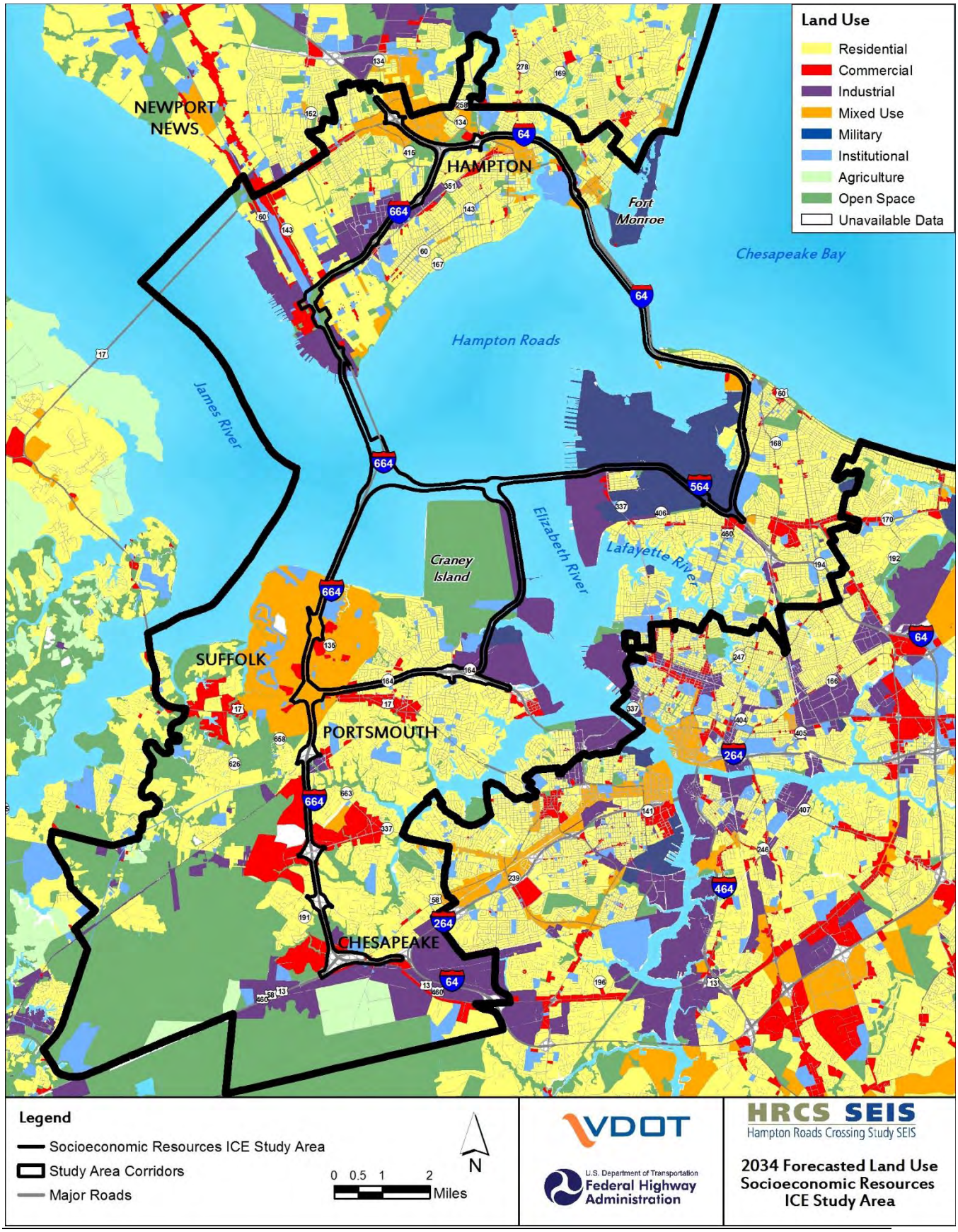
Natural Resource Trends and Goals

As noted previously, historical development in the Hampton Roads region has resulted in significant loss of natural areas, wildlife, and wildlife habitat, as well as negative impacts to water quality. The Natural Resources ICE Study Area encompasses numerous ecosystems including the Chesapeake Bay, the northern tip of the Great Dismal Swamp National Wildlife Refuge, and river/tributary/wetland ecosystems. Hampton Roads is the receiving waters for the entire James River Basin watershed of 10,000 square miles, and the mouth of the Chesapeake Bay that drains 64,000 square miles is in the eastern Natural Resources ICE Study Area (James River Association, 2016; Chesapeake Bay Program, 2016) (**Figure 2-3**).

Water Quality

Water quality in the Natural Resources ICE Study Area has diminished because of past population growth and development. Extensive areas of impervious surfaces has increased the volume and speed of surface runoff entering nearby waters, causing erosion that increases sedimentation, and picks up pollutants and deposits them into nearby waters. 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 effect of pollutant loading within any particular 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. The Virginia Institute of Marine Science (VIMS) has estimated non-tidal wetland quality in the Natural Resources ICE Study Area as a function of habitat and water quality parameters using the Wetland Condition Assessment Tool (WetCAT). WetCAT allows users to overlay data such as previously permitted impacts and impaired waters and run various geoprocessing tools to visualize cumulative impacts. Modal water quality scored 0.10, indicating water quality is severely stressed in the study area (VIMS, 2016).

Figure 2-6: 2034 Forecasted Land Use in the Socioeconomic Resources ICE Study Area



Dredging in Waters of the US is regulated by Section 404 of the Clean Water Act and work within navigable waterbodies is federally regulated under Section 10 of the Rivers and Harbors Act of 1899, as amended. Permits to impact subaqueous bottom are administered by the Virginia Marine Resources Commission (VMRC). VMRC, in conjunction with Virginia's local wetlands boards (where established) also has jurisdiction over subaqueous bottoms or bottomlands, tidal wetlands, beaches and coastal primary sand dunes and regulates any dredge material disposal in those locations. Dredging spoil may be used for construction fill, or be disposed of in other waters or on land. Ocean placement of dredged materials is regulated under Section 103 of the Marine Protection Research and Sanctuaries Act (MPRSA) (Public Law 92-532) to minimize adverse environmental impacts. The *HRCS Natural Resources Technical Report* discusses in detail potential dredge material disposal sites in the Hampton Roads region. The suitability of dredge material for alternative use and disposal is contingent on the sediment properties and chemical composition of the dredged materials, including potential toxic contaminants.

Dredging in the Natural Resources ICE Study Area is routinely done to maintain navigation channels. Sometimes, it is for special purposes such as deepening navigation tunnels, laying utilities, or remediating contaminated water-bottom sediments. During the dredging process, effects may arise due to the excavation of sediments at the bed, loss of material during transport to the surface, overflow from the dredger during loading, and loss of material from the dredger and/or pipelines during transport. This results in resuspension of sediments and an increase in turbidity that decreases light in the photic zone. It can also result in resuspension of contaminants and release of nutrients that increase fertilization of waters. The latter increases biological oxygen demand and subsequent reduction of dissolved oxygen in the water column. The turbidity associated with the dredging operations lasts only as long as the dredging. The resuspension of adsorbed contaminants on the particulates and release of contaminants to the water column is a function of the total area of disturbed sediment and the characteristics of the sediment (sediment quality) in the areas of disturbance. These maintenance-dredging activities result in relatively small increases in siltation away from the immediate dredging area resulting in short term temporary impacts to the water quality. The indirect impact of dredged material disposal largely depends on the nature of the material (inorganic, organically enriched, or contaminated) and the characteristics of the disposal area being utilized. However, the disposal options are operating under existing water quality permits that include conditions to minimize impacts to water quality and wildlife habitat at specific locations.

Commercial and industrial development in the Natural Resources ICE Study Area have also introduced pollutants to surface water at specific outfall points. Projects to control flooding or store water impact water quality. Point discharge, damming, and loss of overhanging vegetation have altered water temperature and light levels in water that affects wildlife. Loss of vegetation, wetlands, and riparian areas have reduced vegetation that filters pollutants from runoff. All of these past and present activities have impaired the ability of some water reaches to support both human and wildlife uses in the Natural Resources ICE Study Area.

Water quality is regulated by Sections 303(d), 305(b), and 314 of the Federal Clean Water Act and the Safe Drinking Water Act. These laws have led to implementation of state programs to monitor water quality, identify sources of impairments, and establish Total Maximum Daily Load (TMDL) levels of pollutants for impaired waters. The programs benefit water quality in the Natural Resources ICE Study Area. The Chesapeake Bay Preservation Act of 1988 also designates 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. The majority of undeveloped land within the Natural Resources ICE Study Area is designated as either wetlands or RPAs. Under the Chesapeake Bay Preservation Area Designation and Management Regulations, public roads and their associated structures are conditionally exempt from review provided they are constructed in accordance with the Erosion and Sediment Control Law (§10.1-560 et seq. of the Code of Virginia) and the

Stormwater Management 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, *Minimum Requirements for the Engineering, Plan Preparation and Implementation of Post Development Stormwater Management Plans* (Instructional and Informational Memorandum Number: IIM-LD-195.8, VDOT – Location and Design Division).

Virginia's strategy to meet the Chesapeake Bay TMDL and reduce bacterial impairment relies on the implementation of the recently revised stormwater criteria to achieve no net increase of nutrients from new development. In order to achieve the additional reductions in the urban sector, local governments would need to treat existing development with new Best Management Practices (BMPs) or retrofit existing BMPs to increase performance. Redevelopment projects would have to reduce the total nutrient load on the site by either 20 percent (for projects greater than or equal to 1 acre) or 10 percent (for projects less than 1 acre) from the previous development.

More recently, managing discharges from municipal separate storm sewer systems as point discharges has become regulated under the Virginia Stormwater Management Act. This Act established the Municipal Separate Storm Sewer System (MS4) permitting system. The MS4 permitting system established Individual and General Permits for entities of various sizes aimed at ensuring a collective series of programs are enacted to reduce the discharge of pollutants from the given storm sewer system to the maximum extent practicable in a manner that protects the water quality of nearby streams, rivers, wetlands, and bays. The program also collects fees for annual permit maintenance (Virginia Department of Environmental Quality [VDEQ], 2016). VDOT facilities operate under the General Permit system for small municipal separate storm sewer systems. Managing soil erosion and runoff from construction sites is also administered by the State under the Virginia Erosion and Sediment Control Law that requires construction activities that would disturb certain acreage thresholds to acquire permits and implement BMPs to control erosion and runoff. These include measures like using silt fencing, erosion control blankets, temporary vegetative covers, and placing check dams and drainage inlet protection. Federal, state, and local laws also regulate agriculture through land conservation measures to minimize water erosion, restrict the amount and timing of fertilizer and pesticide applications, and regulate concentrated feed operations.

The Federal Coastal Zone Management Act and the Virginia Coastal Zone Management Program require federally licensed, permitted, or assisted activities that have reasonably foreseeable coastal impacts to be consistent with the enforceable policies of the Virginia Coastal Zone Management Programs. The Virginia Coastal Zone Enforceable Regulatory Programs enhance water quality in the Natural Resources ICE Study Area by regulating subaqueous lands management, wetlands management, nonpoint source pollution control, point source pollution control, shoreline sanitation, air pollution control, and coastal lands management.

Water quality planning and protection is also being addressed at the regional level by the Hampton Roads Planning District Commission (HRPDC). HRPDC has compared the efficiencies of various commonly used BMPs in the Coastal Plain for retention of phosphorous, copper, lead, zinc and nitrogen, with canopy interception, soil infiltration, rainfall harvesting and engineered infiltration being the most effective in runoff reduction for phosphorous, heavy metals, and sediments (HRPDC, 2013a). They have subsequently also considered how Coastal Plain factors, such as soil type, low elevations, impaired waters, and high water table, impact the efficacy of water quality BMPs, and identified the most cost effective and appropriate BMPs for roadway and development projects, given these constraints. The recommended BMPs included both nonstructural practices (such as grading the site to promote sheet flow from impervious to pervious areas, soil amendments) and structural practices (such as vegetated roofs and permeable pavements) (HRPDC, 2013b). A positive trend in water quality could be expected as practices and technologies improve, and implemented for a larger area over a longer period of time.

Wetlands and Streams

The VDEQ summarizes historical impacts to wetlands in the State (VDEQ, 2014a), reporting that Virginia has 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. 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, 2014a). Statewide, from July 1, 2001 to June 30, 2013, impacts to 2,460 acres of wetlands and open water 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 fees (VDEQ, 2013). Wetland trends for the Norfolk/Hampton region of Virginia indicate a loss of about 4,800 acres of vegetated wetlands between 1982 and 1989-90 (Tiner and Foulis, 1994). According to US Army Corps of Engineers (USACE) data for the lower James River from March 28, 2006 to March 28, 2016, the USACE Norfolk District has permitted the following:

- Permits issued: 1,723
- Authorized fill acres: 149.3
- Acres of permanent loss: 44.3
- Authorized dredge removal acres: 1,030.3
- Required mitigation acres: 137.3

VDOT records also provide some insight into impacts to wetlands and streams. Since 2007, VDOT has received permits for the following impacts[3]:

- Streams
  - 3,157 cubic yards of dredge material
  - 4,231 cubic yards of permanent fill
  - 6,635 linear feet of permanent fill
- Wetlands
  - 7.6 acres of dredge
  - 29.7 acres of fill

Waters of the US including wetlands in the Natural Resources ICE Study Area are regulated by the EPA, the USACE, the State Water Control Board, and the VDEQ according to the Water Pollution Control Act of 1972 (Clean Water Act), the Water Quality Act of 1987, and the Resource Conservation and Recovery Act as amended in 1984. Additionally, as mentioned above, Virginia Coastal Zone Enforceable Regulatory Programs under the Federal Coastal Zone Management Act and the Virginia Coastal Zone Management Program apply to wetlands management.

A high wetland to upland ratio characterizes the Coastal Plain of Southeastern Virginia that increases the likelihood for wetland impacts with increasing population growth (Tiner et al., 2005). Most wetland in the area is converted to upland habitat or estuarine deep water habitat. Net loss of wetland areas has slowed since 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

[3] Data as of March 23, 2016

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, 2014b).

Streams and rivers in the Natural Resources ICE Study Area have been impacted by growth and development similar to wetlands. 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. Stream functions and values include natural flood control, groundwater recharge, nutrient recycling, creation and maintenance of biological diversity, and sustaining the biological productivity of downstream rivers and estuaries. 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). Potential impacts to streams are regulated similar to wetlands on a federal, state, and local level. From July 1, 2001 to June 30, 2013, impacts to 1.7 million linear feet of streams were permitted or authorized in Virginia. These impacts were compensated through a combination of restoration, enhancement and / or preservation of 1.9 million linear feet of streambed and restoration of 4,300 acres of riparian buffers (VDEQ, 2013). Additional compensation was in the form of in-lieu fees. Nongovernmental organizations such as the Chesapeake Bay Foundation, the James River Association, the Elizabeth River Project, and Nansemond River Preservation Alliance also assist with stream conservation by installing forested buffers along streams and rivers and restoring living shorelines.

Floodplains

Past development in the Natural Resources ICE Study Area 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; Virginia Department of Conservation and Recreation [VDCR], No Date). 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 and local level in Virginia.

Wildlife and Wildlife Habitat

Historically, the majority of the Hampton Roads region land base was forested. Of all the development in Virginia that has occurred in the last 400 years, more than a quarter of it has taken place just in the last 15 years (Council on Virginia's Future, 2016). Virginia lost over 79,500 acres of forest, farm, and other rural land to development between 2007 and 2010. The Virginia Department of Forestry (VDOF) reports, since 2001, nearly a half million acres of forested land in the state has been lost to land use changes of which 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, No Date). The remaining wildlife habitat is fragmented by development. This fragmentation impacts 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 (VDOF, personal communication).

In the Natural Resources ICE Study Area, approximately 25 percent of land cover is natural areas, 23 percent is lawn/parkland/recreation areas, and four percent is agricultural (National Land Cover Dataset [NLCD], 2011). Population growth and development forecasts previously discussed indicate the most growth, in the six study cities encompassing the HRCS, is expected to occur in the cities of Suffolk and

Chesapeake (HRTPO, 2013b). These cities have land use policies in place that would concentrate growth with the goal of preserving the natural and agricultural character of their communities, and thereby, preserve wildlife habitat.

Aquatic wildlife and habitat in the Natural Resources ICE Study Area has also been historically impacted, as discussed above for wetlands, streams and floodplains. In addition, the construction of bridges and tunnels, waterfront development, and navigation improvements as well as commercial and recreational fishing have impacted aquatic wildlife, water birds, and habitat. In the ICE Study Area, navigation improvements to shipping channels by dredging have increased their width and depth to accommodate increasing ship size, and these areas require periodic maintenance dredging. Dredge spoil has been used to create more land, or has been disposed of in aquatic settings such as the Atlantic Ocean. Dredging and placement of bridges and tunnels can alter hydrodynamics of flowing water that can adversely affect aquatic wildlife and erode streambanks and shorelines. Changes in water quality as discussed above have impacted aquatic wildlife and vegetation. These activities together have altered the proportion of deepwater habitat; reduced Submerged Aquatic Vegetation (SAV) important as food, cover, and spawning for certain species; disturbed migration and reproduction of certain species; increase turbidity that impacts light levels in water affecting wildlife and SAV; and reduced aquatic wildlife populations. Dredging results in elimination of benthic populations within the dredging zone; deposition of dredge-induced suspended sediment on benthic populations downstream of the dredging zone; capture and killing of fish by dredge equipment; disruption of normal foraging or spawning behaviors; and gill injury from exposure to local increases in turbidity.

Impacts to aquatic habitat in the Natural Resources ICE Study Area are regulated at the federal, state, and local level that aims to minimize and mitigate adverse effects through design modifications, BMPs, restoration and enhancements. 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 (FMPs). The Magnuson-Steven Act calls for National Oceanic and Atmospheric Administration (NOAA) Fisheries to work with regional Fishery Management Councils to develop FMPs for each fishery under their jurisdiction. Federal agencies are required to consult with the National Marine Fisheries Service (NMFS) on proposed actions that may impact Essential Fish Habitat (EFH); that is, waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. The Magnuson-Steven Fishery Conservation and Management Reauthorization Act of 2006 authorized the Community-based Restoration Program administered by NOAA to implement and support the restoration of fishery and coastal habitats by providing federal financial and technical assistance for local restoration and to promote stewardship and conservation values.

The Fish and Wildlife Coordination Act, as amended in 1964, requires that all federal agencies consult with NOAA Fisheries, US Fish and Wildlife Service (USFWS), and state wildlife agencies when proposed actions might result in modification of a natural stream or body of water. Federal agencies must consider effects 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. Archaeological evidence and historical records indicate anadromous fish species such as herring and shad migrated into the upper reaches of all major drainages in Virginia, including the James, Elizabeth, and Nansemond Rivers that meet in Hampton Roads (Virginia Department of Game and Inland Fisheries (VDGIF), 2016). Heavy fishing pressure, dams, canals, and other obstructions have substantially reduced anadromous fish populations so that by 1990, the shad harvest was only approximately six percent of the total harvest documented at the beginning of the 20th Century. The importance of migratory fish species was recognized in the Chesapeake Bay Agreement of 1987 that was later reaffirmed in the Chesapeake 2000 agreement. Several protected species are also anadromous and are regulated

under the federal and Virginia Endangered Species Acts. Any project with the potential to prevent passage of anadromous fish in the Natural Resources ICE Study Area must take into account measures to ensure fish passage is not diminished.

Potential impacts to SAV in the Natural Resources ICE Study Area are regulated according to Regulation 4 VAC 20-337-10 et seq. Submerged Aquatic Vegetation Transplantation Guidelines. Under the authority of the Code of Virginia §§28.2-103 and 28.2-1203, any removal of SAV from State bottom would require prior approval by the VRMC (VMRC, 2000).

Marine mammals such as dolphins (*Tursiops truncates* and *Delphinus delphis*), porpoises (*Phocoena phocoena*) and less frequently manatees (*Trichechus manatus)*, seals (*var. sp.*), and whales (*var. sp.*) ply the Chesapeake Bay, Hampton Roads, and the James and Elizabeth Rivers. The population of these animals has been historically reduced by collisions with boats and mortality associated with commercial fishing, loss of habitat, habitat fragmentation, reduced water quality, and harassment in the form of noise or vibrations. Marine mammals are protected under the Marine Mammal Protection Act of 1972. The taking or harassment of marine mammals within the Natural Resources ICE Study Area is prohibited under federal law.

According to Executive Order 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. Invasive species have been affecting wildlife habitat since the discovery of the Americas by Europeans in the 16th Century. Federal, State and local governments 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. Some widespread invasive species in the Hampton Roads region include the emerald ash borer (*Agrilus planepennis*), rapa whelk (*Rapana venosa*), fire ant (*Solenosis invicta*), tree of heaven (*Ailanthus altissima*), and phragmites (*Phragmites austrails*) (Virginia Invasive Species Working Group, No Date). EO 13112, issued in 1999, 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. The State of Virginia has many invasive species laws and regulations, of which some deal with individual pests (Virginia Invasive Species Council, 2016).

Rare, Threatened and 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 (Virginia Division of Natural Heritage [VDCR-DNH], No Date). The Virginia Endangered Species Act of 1972 and the federal Endangered Species Act of 1973 and subsequent amendments and regulations define basic protections for state and federally listed wildlife and plants that are considered rare, threatened, endangered or Species of Greatest Conservation Need (SGCN). These laws also afford protection to prescriptive habitat critical for protected species' survival, and apply to all federally, state, and privately authorized projects or actions in the Natural Resources ICE Study Area that potentially affect rare, threatened, and endangered species. The USFWS and the NMFS are responsible for listing, protecting, and managing federally listed threatened and endangered species. The VDGIF and the Virginia Department of Agriculture and Consumer Services (VDACS) are responsible for administering and enforcing Virginia's endangered species regulations. 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 Department of Conservation and Recreation's Division of Natural Heritage (VDCR-DNH) is responsible for the

identification, protection, and stewardship of Virginia's natural heritage resources. Natural heritage resources (NHRs) are defined as the habitat of rare, threatened, or endangered plant and animal species; rare or state significant natural communities or geologic sites; and similar features of scientific interest.

The State's Wildlife Action Plan provides a summary for the Hampton Roads region, including information regarding priority SGCN, the habitats those species require, threats impacting species and / or habitats, and actions that can be taken to address those threats (VDGIF, 2015). Whenever possible, particular habitat types have been identified as being a priority either for conservation or for restoration. Of Virginia's 884 SGCN, 139 are estimated to occur or recently occurred in the Hampton Roads region. Of these 139 species, 120 SGCN are dependent upon habitats within the Hampton Roads region. As described above, the most remaining terrestrial wildlife habitat in the Natural Resources ICE Study Area is found in the cities of Suffolk and Chesapeake, where the greatest future population growth up to the year 2040 is also forecasted to occur. The greatest amount of conserved lands near the Study Area Corridors are on NAVSTA Norfolk and the CIDMAA, and in the Natural Resources ICE Study Area as a whole, the Dismal Swamp National Wildlife Refuge (VDGIF, 2015).

Other threats to protected species being studied include climate change and rising sea levels. A growing body of evidence has linked accelerating climate change with observed changes in fish and wildlife, their populations, and their habitats (USFWS, 2012). Climate change has the potential to cause abrupt ecosystem changes and increased species extinctions (EPA, 2016). The Hampton Roads region is particularly susceptible to rising sea levels due to its geography, land subsidence and a rise of 14 inches in sea level since 1930 (ODU Center for Sea Level Rise, 2016a and b). These latter phenomena are expected to worsen into the future. The Endangered Species Act and other laws to protect imperiled species do not address climate change effects to protected species. However, federal, state, and local agencies active in the Hampton Roads region are taking climate change and sea level rise into consideration. They are collaborating to collect and analyze data to predict wildlife habitat changes and impacts, as well as implement coordinated management strategies.

Historic Resources

The Hampton Roads region archaeological record documents human use spanning thousands of years (see the *HRCS Archaeological Assessment*). As discussed previously, 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, many communities in the Hampton Roads region have either city ordinances or historic overlay zones that require them to maintain a register of locally important historic sites, to conduct historic architectural reviews of proposed projects and modifications in historic districts, and award grants for preservation projects.

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 project include socioeconomics and land use (including communities, community facilities and parks, EJ, and economics); natural resources (including streams, wetlands, water quality, floodplains, wildlife habitat, and threatened and endangered species); and historic resources.

2.3.1 Socioeconomic Resources

2.3.1.1 Land Use

The land within the Socioeconomic Resources ICE Study Area is, for the most part, comprised of well-established communities and commercial and industrial areas. The portions of the Socioeconomic Resources ICE Study Area within the cities of Hampton, Newport News, Norfolk, and Portsmouth are more densely built-out, while the cities of Chesapeake and Suffolk have more recent suburban-style development and large areas of agricultural lands. As shown in **Figure 2-2** and **Table 2-4**, current land use in the Socioeconomic Resources ICE Study Area is primarily residential and open space, however, much of the open space is associated with wetlands (HRTPO, 2011).

Table 2-4: 2011 Land Use within the Socioeconomic Resources ICE Study Area

Land Cover	Land Use Acreage	% of Socioeconomic Resources ICE Study Area
Residential	25,315	32%
Open Space	24,758	31%
Institutional	8,965	11%
Industrial	7,579	10%
Military	5,032	6%
Agriculture	3,994	5%
Commercial	3,438	4%
Mixed Use	28	< 1%
Total	79,109	100%

Source: HRTPO (2011)

2.3.1.2 Community Facilities, Parks, Recreational Facilities, Open Space

Community facilities in the Socioeconomic Resources ICE Study Area were identified through a review of data from local government and resource agencies, as well as discussions with their staff members. Numerous neighborhood and community facilities occur throughout the Socioeconomic Resources ICE Study Area. Community facilities have been grouped into four categories: schools/universities, places of worship, parks and recreation, and cemeteries. Included among the categories are 67 schools and universities, 205 places of worship, 92 parks and recreation areas, and 14 cemeteries, for a total of 378 community facilities.

Recreation on the water is a major activity in the region, including boating, fishing, and swimming, particularly near the HRBT and MMMBT, and along numerous beaches in the Socioeconomic Resources ICE Study Area. One boat ramp (Willoughby Boat Ramp) is within the ICE Study Area, along the Willoughby Bay, south of the HRBT. In addition, the Captain John Smith Chesapeake National Historic Trail, the US's first national water trail created in 2006 run by the National Park Service, provides the general public with a historic water route that was used to map the Chesapeake Bay. This trail also has driving components, for those who do not want to take the water trail, with one of the suggested routes going through the Eastern Shore, Hampton, Norfolk, and Virginia Beach.

2.3.1.3 Environmental Justice

The ICE Methodology Technical Memorandum and the *Socioeconomic and Land Use Technical Report* provide 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 Alternatives on sensitive populations.

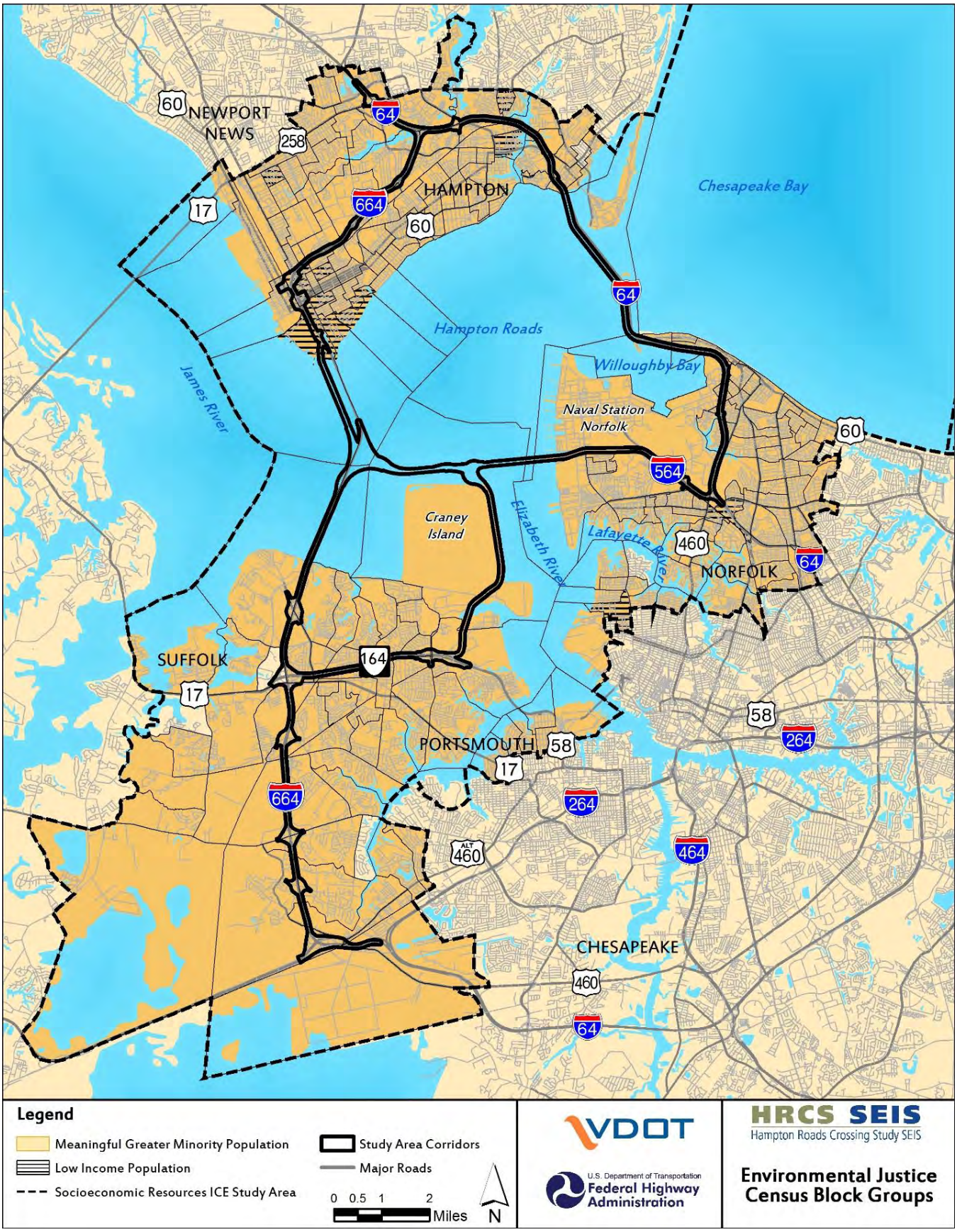
Minority Populations

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 US Department of Transportation (USDOT)/FHWA program, policy, or activity (USDOT and FHWA EJ Orders). For the purposes of this analysis, a minority population is present when: (a) the minority population of the affected area exceeds 50 percent of total population, or (b) the minority population percentage in the affected area is "meaningfully greater" than the minority population percentage in the general population or other appropriate unit of geographical analysis (CEQ, 1997b). For the purposes of this study, the minority population for a study Census block group will be found to be "meaningfully greater" than surrounding study Census block groups if its minority population is greater than the value of the block group with the lowest percentage of minority population within the study Census block groups, plus an additional ten percent of that value. This methodology has been agreed upon by the EPA, FHWA, and VDOT as appropriate for the identification of minority populations for discussion in NEPA documents. The lowest percentage (above zero percent) of minority population in any Census block group was 1.3 percent. Therefore, the meaningfully greater threshold is 1.4 percent for the purposes of this analysis. **Figure 2-7** depicts the Census block groups with meaningful greater percentages of minority population. Based on this definition, a total of 207 out of 215 Census block groups in the Socioeconomic Resources ICE Study Area have a minority population. Of the eight Census block groups not considered a minority population, seven are located over water or in other nonresidential areas.

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. The Census Bureau's ACS 5-year (2009-2013) Estimates, *Median Income in the Past 12 Months (in 2012 Inflation-Adjusted Dollars)*, was used to generate median household income data at the Census block group level (2013). An area is identified as containing a low-income population when the median household income for the Census block group is below the HHS poverty threshold, which was $23,550 for a family of four in 2013. Thirteen Census block groups with a resident population in the Socioeconomic Resources ICE Study Area have a median household income below the HHS poverty threshold as shown on **Figure 2-7**.

Figure 2-7: Environmental Justice Census Block Groups



2.3.2 Natural Resources

Water Resources

Streams, Wetlands, and Water Quality

The Natural Resources ICE Study Area is within the James River and Chesapeake Bay watersheds. It contains a large number of named and unnamed perennial and intermittent streams. Of these, the James River is the most prominent and longest stream course. The National Hydrography Dataset (NHD) was used to estimate the extent of Natural Resources ICE Study Area streams. The total is approximately 1.97 million linear feet. Navigable waters within the Natural Resources Study Area consist of Chesapeake Bay, Hampton Roads, Willoughby Bay, and the following rivers and their tributaries:

- Elizabeth River and the following tributaries - Lafayette River, the Western and Eastern Branches of the Elizabeth River, Craney Island Creek, Lilly Creek, Sterns Creek, Baines Creek, Bailey's Creek, Drum Point Creek, Scott Creek, Southern Branch (the Intracoastal Waterway), Paradise Creek, Jones Creek, Gilligan Creek, St. Julian Creek, Milldam Creek, Newton Creek, Deep Creek, and Wayne Creek.
- James River and the following tributaries - Batten Bay/Ragged Island Creek
- Hampton River and the following tributaries - Sunset Creek, Salters Creek, Newport News Creek, and Mill Creek
- Nansemond River and the following tributaries – Bennett Creek, West Creek, Knotts Creek, Bleakhorn Creek, Campbell Creek, Oyster House Creek, and Western Branch.
- Masons Creek is a hydrologically altered historically tidal tributary of Willoughby Bay/Hampton Roads.
- Southwest Branch of the Back River, and its tributary Newmarket Creek.
- Hampton Roads tributaries - Hofflers Creek, Streeter Creek, and West Creek
- Lower Chesapeake Bay's tributary - Little Creek

The National Wetlands Inventory (NWI) approximates 26,000 acres of tidal and non-tidal wetlands are in the Natural Resources ICE Study Area (**Figure 2-3** in **Section 2.2.1**). Approximately 37 percent are estuarine wetlands (emergent, scrub-shrub, and forested) and 63 percent are palustrine wetlands (emergent, scrub-shrub, and forested). An additional 764,000 acres are classified as open water and include freshwater ponds, lakes, riverine, and estuarine and marine deepwater (including the acreage associated with Chesapeake Bay). [Note: It is acknowledged that NWI is not the most accurate source of estimating wetlands and should not be compared to the photo interpreted estimated acreage for the Study Area Corridors discussed in the SEIS or the *HRCS Natural Resources Technical Report*. For the purposes of discussing indirect effects on the larger ICE study area, NWI data are incorporated into the study]. In the Hampton Roads region area of Virginia, these natural communities are interspersed within industrial, commercial, and residential areas and are frequently remnants of larger ecosystems within the floodplains. Often, wetlands and other special aquatic sites directly abut the impervious and semi-impervious developed surfaces within the floodplain with no buffer.

Using WetCAT, VIMS has determined NWI wetlands yielded a mean habitat score of 0.57, indicating the mapped NWI wetlands are somewhat severely stressed, and as previously discussed, water quality is severely stressed in the Natural Resources ICE Study Area (VIMS, 2016).

Some surface waters in the Natural Resources ICE Study Area fail to meet water quality standards and are designated as "impaired waters" under Section 303(d) of the Clean Water Act. Approximately 760,700 acres of streams and other surface waters, listed on the Virginia 303(d) Priority List of Impaired Waters, fall within the Natural Resources ICE Study Area (VDEQ, 2014b; USGS, 2016). Appendix B lists the 111 impaired waterbodies in the Natural Resources ICE Study Area and the causes of their impairment. Causes

of impairment of these streams and surface waters are largely due to dissolved oxygen, estuarine bioassessments, fecal coliform, polychlorinated biphenyl (PCB) in fish tissue, and enterococcus. The major suspected sources of the impairments are nonpoint sources, atmospheric deposition, sediment, loss of riparian habitat, municipal and industrial point source discharges, non-point sources, and unknown sources.

Floodplains

Based on the Federal Emergency Management Agency's (FEMA, 2015) Flood Insurance Rate Maps, the Natural Resources ICE Study Area includes an estimated 300 acres of floodways (associated with Newmarket Creek), 55,000 acres of 100-year floodplains (of which approximately 19,000 acres are classified as zone VE – velocity hazard caused by wave action), and 8,000 acres of 500-year floodplains (**Figure 2-8**). Longstanding development in the Hampton Roads region associated with residential settlement, industry, commerce, and recreation has developed a higher proportion of historic coastal floodplains than floodplains further inland.

Wildlife Habitat

The Natural Resources ICE Study Area contains several different kinds of land cover including, but not limited to, forested lands, agricultural lands, pasture, grasslands, scrub/shrub, open water, unconsolidated shore, beaches, and developed lands. The composition of land cover directly influences the natural communities, wildlife, and biodiversity found within a given environment. **Table 2-5** and **Figure 2-9** show the acreage and percentage of each land cover within the Natural Resources ICE Study Area.

Three main terrestrial forest types have been identified in the Natural Resources ICE Study Area: 1) deciduous forest, 2) evergreen forest, and 3) mixed evergreen/deciduous forest (NLCD, 2011). Terrestrial forest types comprise approximately five percent of the Natural Resources ICE Study Area. Of this forested total, 42 percent is deciduous forest, 42 percent is evergreen forest, and 16 percent is mixed evergreen/deciduous forest. There are two larger forested areas in the Natural Resources ICE Study Area – the coast north of the James River Bridge has several lakes with connecting forest corridors among the residential neighborhoods, and the area west of the Nansemond River has forest corridors interspersed along the wetlands and farmlands. Riparian-forested corridors such as these support a diverse array of species and ecosystem functions.

Within the Natural Resources ICE Study Area, 47 percent of the land cover is developed land. This has resulted in highly fragmented, patchy natural wildlife habitat as discussed in **Section 2.2.2.3 Natural Resource Trends and Goals**. A number of species of wildlife are adapted to developed areas and utilize fragments of forests within developed areas, including suburban lawns, school and recreational properties. Some urban wildlife in the Hampton Roads region include the Virginia white-tailed deer (*Odocoileus virginianus*), red fox (*Vulpes vulpes*), raccoon (*Procyon lotor lotor*), Virginia opossum (*Didelphis virginiana*), cottontail rabbit (*Sylvilagus floridanus*), gray squirrel (*Sciurus carolinensis carolinensis*), and occasional coyote (*Canis latrans*) (City of Hampton, 2016b). The land portions of the Natural Resources ICE Study Area that include the cities of Hampton, Newport News, and Norfolk are almost entirely developed along the interstate corridor. Much of the areas around the HRCS interstates and VA 164 in Portsmouth are developed. Additionally, these urban and suburban portions of the Natural Resources ICE Study Area include interstates and state routes flanked by noise walls, which isolate some wildlife populations.

Figure 2-8: Floodplains within the Natural Resources ICE Study Area

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

Land Cover	Acres within Natural Resources Study Area	% of Natural Resources ICE Study Area
Developed	76,620	47%
Lawn/Parkland/Recreation Areas	37,019	23%
Barren Land	2,483	2%
Forest	8,322	5%
Agriculture	6,620	4%
Shrub/Scrub/Grasslands	3,800	2%
Wetlands	14,827	18%

Source: NLCD (2011)

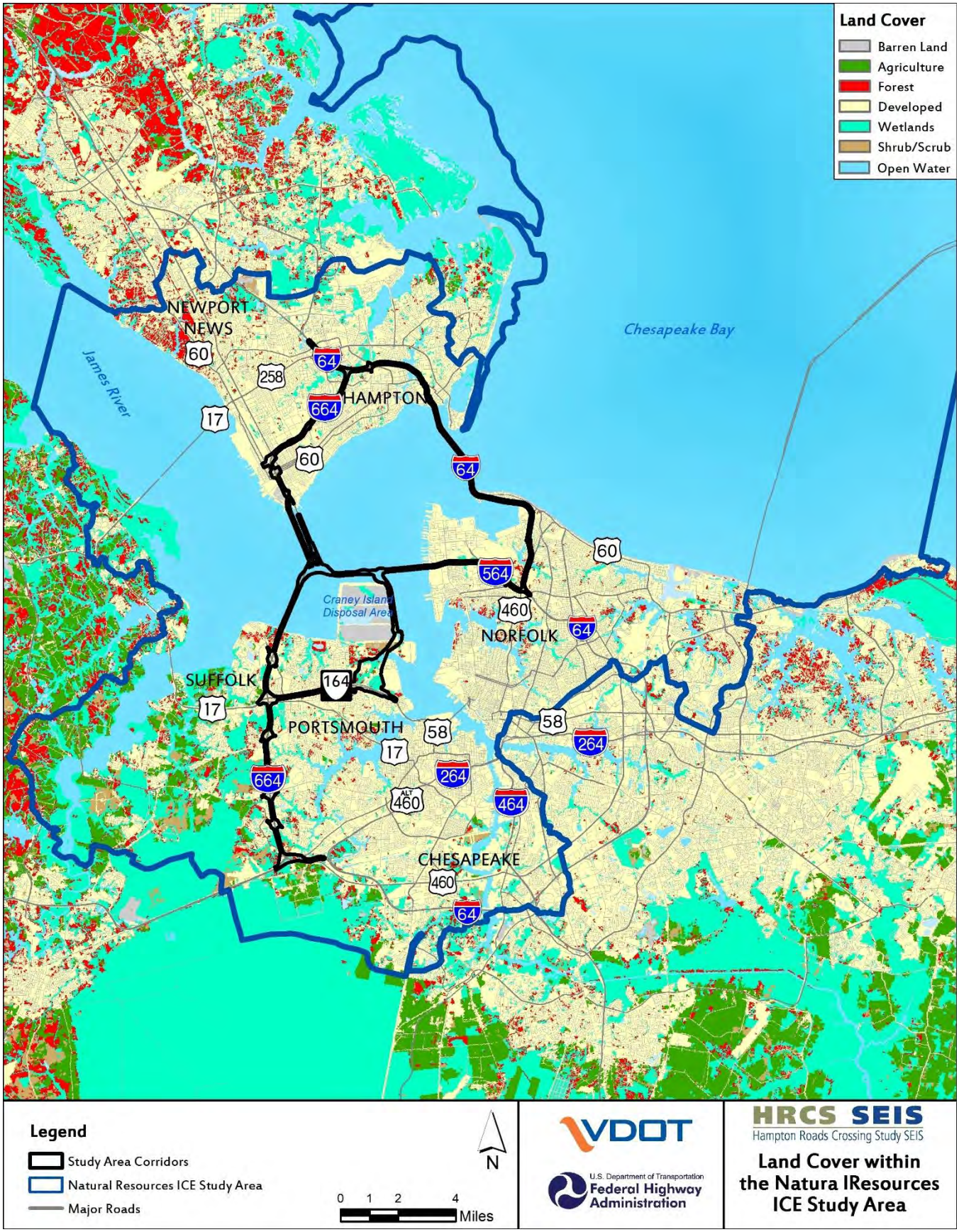
The southernmost portion of the Natural Resources ICE Study Area contains some agricultural lands. Agricultural lands are limited to the area east and west of the Nansemond River, and north of the Great Dismal Swamp National Refuge, bounded to the east and north by I-664/I-64. Smaller agricultural parcels are intermixed with wetlands. The existing fragmentation favors edge dwelling species at the expense of species needing larger patches of continuous habitat. Some of these edge dwelling species include raccoon, Virginia opossum, Virginia white tailed deer, turkey (*Meleagris gallopavo*), American robin, red-tailed hawk (*Buteo jamaicensis*), and bobwhite quail (*Colinus virginianus*). Wildlife habitat associated with agricultural lands is comparatively limited due to the lack of plant diversity and the relatively high frequency of disturbance (i.e., plowing, planting, fertilizing, grazing, and routine maintenance), and fragmentation into non-continuous patches (Graham, 2002). Despite these factors, agricultural lands are used by wildlife on a limited basis, with the species composition often depending on the type of crop being cultivated, the time of year, and the methods of harvesting.

Open water and unconsolidated shore dominates the Natural Resources ICE Study Area, covering more than one million acres. The Natural Resources ICE Study Area and HRCS SEIS Study Area Corridors include crossings of these vast bodies of water constituting most of the consolidated waters of Hampton Roads. I-64/HRBT crosses Hampton Roads and the Chesapeake Bay. Open water and unconsolidated shore are utilized by a variety of species including estuarine organisms and nesting species, even with existing boat traffic and other human interactions. Benthic species are organisms that live on, in or attached to the sea floor and include 98 percent of all marine species (Kudela, 2007). Marine mammals such as dolphins, porpoises and less frequently manatees, seals, and whales ply the Chesapeake Bay, Hampton Roads, and the Lower James and Elizabeth rivers. I-64/HRBT crosses Hampton Roads and the Chesapeake Bay. I-664/MMMBT crosses the James River and Hampton Roads, whereas, other HRCS Study Corridors on new alignment would cross the James River, Hampton Roads, and the Elizabeth River. A component of tidal waterbodies is shallow water, generally 6.6 feet or less in depth. Shallow water habitat provides forage, refuge, spawning and rearing habitat for fish, their prey, shellfish, and benthos.

Soils on the Coastal Plain are generally fertile, and wetlands, both tidally influenced and fresh water, are relatively abundant. They are a highly valuable resource, as they provide a vital link in the food chain for most marine organisms. The marsh areas provide shelter and breeding grounds for marine organisms, waterfowl, shorebirds, several reptile species and some mammals.

The beach habitat in the Willoughby Bay section of Norfolk is bordered by a narrow strip of sea rocket (*Cakile edentula*), beach panic grass (*Panicum amarum),* and American beach grass (*Ammophila breviligulata*). The vegetation grows on the high dune area, ranging from 15 to 50 feet above high water. These plants are sustained by irregular inundation and salt spray. Interstitial invertebrates, including nematode worms and crustaceans live among the sand grains.

Figure 2-9: Land Cover within the Natural Resources ICE Study Area



The tidal tributaries are contiguous with a large, though declining network of nontidal perennial streams and non-perennial streams (also known as "headwaters") which are regulated by the USACE and the VDEQ. These streams support a large variety of invertebrates within their banks and provide flood storage capacity. They also support wildlife and provide riparian corridors for wildlife to aid in movement and limited migration to other areas for securing food and reproductive success.

Several species of finfish have been identified as possessing EFH for specific life stages (spawning, breeding, feeding, or growing to maturity) within the Natural Resources ICE Study Area. These include windowpane flounder (*Scopthalmus aquosus*), bluefish (*Pomatomus saltatrix*), Atlantic butterfish (*Peprilus triacanthus*), summer flounder (*Paralichthys dentatus*), black sea bass (*Centropristis striata*), king mackerel (*Scomberomorus cavalla*), Spanish mackerel (*Scomberomorus maculates*), cobia (*Rachycentron canadum*), red drum, Atlantic cod (*Gadus morhua*), scalloped hammerhead shark (*Sphyma lewini*) dusky shark (*Carcharhinus obscurus*), and sandbar shark (*Carcharhinus plumbeus*). The Natural Resources ICE Study Area is also a designated Habitat Area of Particular Concern (HAPC) for the sandbar shark (NOAA, 2015).

A significant commercial fishery industry exists in the Natural Resources ICE Study Area and HRCS Study Area Corridors with the menhaden (*Brevoortia tyrannus*) fishery being the largest of the commercial fisheries, as well as the speckled trout (*Cynoscion nebulosus*) and red drum (*Sciaenops ocellatus*) fisheries. The spawning and hatchery grounds for commercial shellfish and fish are within the lower James River/Hampton Roads/Elizabeth River. The Hampton Roads/Elizabeth River is also a fertile spawning and hatchery area for noncommercial invertebrates depended heavily upon by the commercial species above and is a spawning and hatchery area for recreational (bait) species. SAV in the Natural Resources ICE Study Area provide food for the estuarine community in the area's tidal waterways.

The American oyster (*Crassostrea virginica*) is declining in Hampton Roads and is the focus of many restoration efforts to increase its numbers. Oysters are cultivated by private parties in leased grounds as well as public Baylor grounds in the lower James River / Hampton Roads. Baylor grounds flank CIDMMA to the north, west, and east. The Baines Creek Oyster Reef in Baines Creek, Portsmouth, was completed in May 2014 by the USACE as Phase II of a larger multiple site reef mitigation for the CIDMMA Eastern Expansion Project.

There are no areas within the Natural Resources ICE Study Area designated as Natural Area Preserves or Agricultural and Forestal Districts (VDCR, 2014 and VDOF, 2015). However, VDCR conservation lands and easements are present. A total of 77 conservation lands (most are local parks with public access; 12 are military installations which require arrangement with the landowner for access) and ten easements (none of which have public access) are present in the Natural Resources ICE Study Area (VDCR, 2015). Sandy Bottom Nature Park, CIDMMA, Langley Air Force Base, Naval Station Norfolk, and the Great Dismal Swamp are some of the larger conservation lands in the Natural Resources ICE Study Area. These lands contain sizable tracts of undeveloped land, which may be utilized by wildlife and contribute to wildlife corridors, linking isolated areas of natural habitat and allowing for wildlife migration. Other than these lands, no wildlife habitat cores or core support areas were found in the Natural Heritage Data Explorer.

Additionally, the Hoffler Creek Nature Preserve, owned by Portsmouth and maintained by private citizens, is located to the southwest of Craney Island. It is a sanctuary for buffleheads (*Bucephalia albeola),* ruddy ducks (*Oxyura jamaicensis*), great horned owls (*Bubo virginianus*), red tailed hawks (*Buteo jamaicensis*) and the occasional visiting bald eagle (*Haliaeetus leucocephalus*) (Hoffler Creek Wildlife Foundation, 2013).

Threatened and Endangered Species

USFWS's Information for Planning and Conservation (IPaC) (USFWS, 2014a), the Virginia Fish and Wildlife Information Service (VFWIS, 2015), and the Virginia Department of Conservation and Recreation Division

of Natural Heritage (VDCR-DNH, 2015) databases were queried to identify any documented threatened, endangered, or special status species within the Natural Resources ICE Study Area, as well as those species that have potential habitat in the Study Area (**Table 2-6**). No critical habitat has been designated within the Natural Resources ICE Study Area.

Following is a description of each of the identified federal threatened, endangered, and special status species.

The piping plover was listed as a federally threatened species by the USFWS on December 11, 1985. The species breeds on coastal beaches, sandflats, and sparsely vegetated sand dunes from Newfoundland and southeastern Quebec to North Carolina. Piping plovers are uncommon breeders on the west side of the lower Chesapeake Bay and have been absent from typical nesting sites within the Hampton Roads vicinity (i.e., CIDMMA in Portsmouth and Grandview Beach in Hampton) for over a decade (Cairns and McLaren, 1980; VDOT, 2001; USACE,2006; Hampton, 2013). These areas are believed to be no longer suitable for nesting piping plovers due to the presence of predators and human disturbance (Boettcher et al., 2007).

Federally listed as threatened on December 14, 2014, the red knot is a master of long-distance aviation. Red knots fly more than 9,300 miles from south (South America) to north (Arctic) every spring and repeat the trip in reverse every autumn, making this bird one of the longest-distance migrants in the animal kingdom. The birds' spring migration is timed with the release of horseshoe crab eggs, the perfect food for a traveling red knot. Major staging areas along the migratory route for the red knot are Delaware Bay and Cape May on the US Atlantic coast (USFWS, 2005).

The northern long-eared bat (NLEB) was listed as a federally threatened species by the USFWS on April 2, 2015. Suitable summer habitat exists throughout the Natural Resources ICE Study Area and consists of a wide variety of forested/wooded habitats where they roost, forage, and travel, and may include some adjacent and interspersed non-forested habitats such as emergent wetlands and adjacent edges of agricultural fields, old fields, and pastures. NLEBs also have been occasionally found roosting in structures like barns and sheds (particularly when suitable tree roosts are unavailable). NLEBs typically occupy their summer habitat from mid-May through mid-August each year and the species may arrive or leave some time before or after this period (USFWS, 2014b).

The loggerhead sea turtle was listed by USFWS as a federally threatened species on July 23, 1978. They occur throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans. Loggerhead sea turtles occupy three different ecosystems throughout their lifecycle: beaches, water, and nearshore coastal areas. Beaches are used for nesting, juveniles live in open water, and adults inhabit nearshore coastal areas, such as the habitat found in the Natural Resources ICE Study Area. Current threats to logger head turtles include beach development, accidental capture as bycatch, pollution, and disorientation of hatchlings by beachfront lighting.

Breeding colonies of the green sea turtle were federally listed as endangered and the species as threatened everywhere else on July 28, 1978. The green sea turtle has a worldwide distribution in tropical and subtropical waters, and along the US southeast Atlantic coast. They nest as far north as North Carolina. Hatchling green turtles eat a variety of plants and animals, but adults feed almost exclusively on seagrasses and marine algae. Green turtles are generally found in shallow waters (except when migrating) inside reefs, bays, and inlets. The turtles are attracted to lagoons and shoals with an abundance of marine grass and algae (USFWS, 2015a).

The Kemp's ridley sea turtle, the most endangered of the sea turtles, was federally listed as endangered on December 2, 1970. This turtle is a shallow water benthic feeder with a diet consisting primarily of crabs. Its range includes the Gulf coasts of Mexico and the U.S., and the Atlantic coast of North America as far north as Nova Scotia and Newfoundland. Nesting is essentially limited to the beaches of the western Gulf of Mexico and occurs regularly in Texas and infrequently in a few other states (USFWS, 2015b).

The leatherback sea turtle was federally listed as endangered on June 2, 1970. The leatherback is the largest, deepest diving, and most migratory and wide ranging of all sea turtles. The leatherback turtle is distributed worldwide in tropical and temperate waters of the Atlantic, Pacific, and Indian Oceans. Jellyfish are the main staple of its diet, but it is also known to feed on sea urchins, squid, crustaceans, tunicates, fish, blue-green algae, and floating seaweed. In the U.S., nesting occurs from about March to July, with their preferred nesting beaches having proximity to deep water and generally rough seas (USFWS, 2015c).

The Atlantic sturgeon was listed by the USFWS as endangered on February 6, 2012. It is an anadromous fish, living in saltwater and requiring freshwater to spawn. The Atlantic sturgeon's range is from Florida to Labrador, Canada, and appropriate to this study, includes the lower Chesapeake Bay. The current threat to the Atlantic sturgeon is water pollution.

Although bald eagles are no longer federally or state listed, bald eagles currently are protected under the Bald and Golden Eagle Protection Act. The bald eagle is a common summer and winter visitor in the Chesapeake Bay region and nearby counties. The bald eagle forages the types of habitat characteristic of the Natural Resource ICE Study Area, such as coastal areas, rivers, and large bodies of water. 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. Although critical habitat for the bald eagle does not exist within the Natural Resources ICE Study Area, bald eagle nests have been recorded within the Natural Resources ICE Study Area. One documented eagle nest is located approximately 2 miles west of Harbour View Boulevard in Suffolk, a historical nest was noted at the Hoffler Creek Nature Preserve (within the past five years) and a bald eagle roost is located approximately 2 miles south of I-564 in Norfolk (Center for Conservation Biology, 2015).

State threatened species believed to occur or that have the potential to occur within the Natural Resources ICE Study Area include the gull-billed tern, Mabee's salamander, and peregrine falcon. State endangered species believed to occur or that have the potential to occur within the Natural Resources ICE Study Area include the Wilson's plover, canebrake rattlesnake, little brown bat, and the tri-colored bat.

In addition to these listed species found in database searches, a few other species were identified in scoping letter responses as being present or having the potential to occur within the Natural Resources ICE Study Area. The Elizabeth River Project mentioned shortnosed sturgeon (*Acipenser brevirostrum*, FE, SE) might be present or have the potential to occur within the Natural Resources ICE Study Area. Although not federally or state listed, DCR also noted several other Virginia very rare or rare species might be present in the Natural Resources ICE Study Area: black skimmer (*Rynchops niger*), royal tern (*Thalasseus maximus*), sandwich tern (*Thalasseus sandvicensis*), least tern (*Sterna antillarum*), black-necked stilt (*Himantopus mexicanus*), and northern harrier (*Circus cyaneus*). These birds either utilize the open salt and brackish water of the ICE Study Area for foraging, or in the case of the terns, use the narrow coastal interface between land and sea for foraging and nesting. In addition, Elliott's aster (*Symphyotrichum elliottii*) may be found in bogs, swamps, and marshes as well as roadside ditches (NatureServe Explorer, 2016).

2.3.3 Historic Resources

The NHPA (54 USC. 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 listed in the NRHP. See the *HRCS Archaeological Assessment* and *Architectural Survey: Management Summary* reports for a detailed description of NRHP eligibility criteria.

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

Common Name	Scientific Name	Status	IPaC	VFWIS	VDCR-DNH
Piping Plover	*Charadrius melodus*	FT, ST	X	X	X
Northern Long-Eared Bat	*Myotis septentrionalis*	FT, ST	X		
Loggerhead Sea Turtle	*Caretta*	FT, ST		X	
Red Knot	*Calidris canutus rufa*	FT		X	
Atlantic Sturgeon	*Acipenser oxyrinchus*	FE, SE		X	X
Kemp's Ridley Sea Turtle	*Lepidochelys kempii*	FE, SE		X	
Leatherback Sea Turtle	*Dermochelys coriacea*	FE, SE		X	
Green Sea Turtle	*Chelonia mydas*	FT, ST		X	
Bald Eagle	*Haliaeetus leucocephalus*	Protected under the Bald and Golden Eagle Protection Act		X	
Gull-Billed Tern	*Gelochelidon nilotica*	ST			X
Mabee's Salamander	*Ambystoma mabeei*	ST			X
Peregrine Falcon	*Falco peregrinus*	ST			X
Wilson's Plover	*Charadrius wilsonia*	SE			X
Canebrake Rattlesnake	*Crotalus horridus*	SE			X
Little Brown Bat	*Myotis lucifigus*	SE		X	
Tri-colored Bat	*Perimyotis subflavus*	SE		X	

Source: IPaC, VFWIS, and VDRC-DNH
Notes: FE = federally endangered, FT= federally threatened, SE = state endangered, ST = state threatened

Portsmouth, Hampton, Norfolk, Newport News, and Suffolk are the oldest cities in the Historic Resources ICE Study Area and have experienced heavy development since the early 1700's, resulting in hundreds of buildings being designated as historic resources, as well as several historic districts within the Historic Resources ICE Study Area. A total of 820 architectural/historic sites are located in the Historic Resources ICE Study Area. Twenty-four of the architectural/historic sites have either been previously determined NRHP-eligible, are listed on the NRHP, or are recommended NRHP-eligible. Two National Historic Landmarks in the ICE Study Area are Fort Monroe and the Hampton Institute Historic District. Nineteen other individual historic architectural sites and districts are currently listed on the NRHP. The NRHP eligibility of a few additional sites is yet to be determined in further consultation with SHPO. Not all of the Historic Resources ICE Study Area has been intensively surveyed for archaeological sites. However, 50 archaeological sites have been previously recorded within the Historic Resources ICE Study Area. Of these, the NRHP eligibility of 40 are unevaluated, 4 are potentially eligible, 1 is listed on the NRHP, and 5 have been determined not eligible. **Figure 2-4** in **Section 2.2.1** shows the historic resources within the Historic Resources ICE Study Area.

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

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** and/or impact the resources identified in **Step 3**. The NCHRP Report 466 includes groups of actions associated with transportation projects that are known to

trigger indirect effects. NCHRP and HRCS-specific examples of these impact-causing activities include alteration of drainage, channelization, noise and vibration, excavation and fill for roadways, tunnels and tunnel islands, barriers, erosion and sediment control, landscaping, and alteration of travel time/cost. These activities potentially result in the estimated impacts documented in **Table 2-7**. Whether hydrodynamic changes would occur due to pile installation and interchange construction in Hampton Roads will be determined in studies by VIMS for inclusion in the Final SEIS. Effects can be either long term or short term, with long-term effects potentially having the most severe impacts. Comparing these actions to regional directions and goals and the resources in the ICE study areas enables the identification of resources that could be indirectly affected. The findings of this identification process are presented in **Step 5**.

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 impacts. The indirect effects analysis focuses on the potential for socioeconomic and ecological impacts that could occur outside of the area of direct impact as a result of the alternatives. In NCHRP Report 466, 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 project encroachment (physical, biological, socioeconomics) on the environment;
  Induced Growth Impacts – Project-influenced development effects (land use); and,
- **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).

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 along feeder roads a distance of 1 mile from existing interchanges on all study corridors and a 1,000 foot buffer either side of the feeder roads along major feeder roads. The exception is I-64 interchanges west of Settlers Landing interchange in Hampton where there is limited potential for induced development because no mainline improvements area proposed there. With respect to I-664 on the Southside, induced growth effects have been considered up to 2 miles from existing interchanges along feeder roads with a 1,000 foot buffer along either side of the feeder road (as described in **Section 1.2.1** and shown on **Figure 2-1**). 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 1.2.1**, the lands adjacent to existing interchanges along I-64 through Norfolk, I-564, I-664 north of the MMMBT and VA 164 are in an advanced stage of land development, and the cities of Hampton, Newport News, Norfolk, and Portsmouth are largely built-out. It is therefore expected the greatest potential for induced growth in these areas would be in the form of infill or redevelopment where the natural environment has

Table 2-7: Direct Impacts of the Alternatives

Resource	No-Build Alternative	Alternative A	Alternative B	Alternative C	Alternative D
Right-of-Way Number of properties (acres)	**0**	**86 (10.3)**	**130 (248.9)**	**201 (340.6)**	**248 (319.6)**
Residential	0	24 (0.5)	29 (0.6)	58 (1.9)	69 (2.1)
Commercial	0	6 (1.3)	10 (2.7)	23 (4.7)	23 (5.5)
Industrial	0	6 (0.9)	14 (54.8)	35 (104.2)	33 (94.1)
Institutional	0	9 (2.8)	14 (113.3)	15 (117.7)	20 (120.1)
Military	0	4 (0.6)	7 (22.5)	3 (23.2)	7 (22.5)
Open Space	0	14 (1.1)	27 (23.9)	59 (44.1)	66 (44.0)
Other	0	23 (3.1)	29 (31.2)	8 (44.9)	30 (31.2)
Potential Residential Relocations	**0**	**9**	**9**	**11**	**20**
Potential Commercial Relocations	**0**	**0**	**0**	**5**	**4**
Other Relocations*	**0**	**2**	**4**	**8**	**9**
Military Facilities # (acres)	**0**	**1 (22.4)**	**4 (162.9)**	**4 (168.1)**	**4 (163.7)**
Number of Census Block Groups with Environmental Justice Populations Present	**0**	**8**	**17**	**25**	**35**
Community Facilities (#)	**0**	**2**	**3**	**4**	**5**
Parks & Recreation	0	1	2	2	3
Place of Worship	0	0	0	1	0
Cemetery	0	0	0	0	0
School / University	0	1	1	1	2
Land Use (acres)	**0**	**27.8**	**260.4**	**333.0**	**335.9**
Residential	0	0.5	0.6	2.6	2.7
Commercial	0	1.8	3.2	6.3	7.5
Industrial	0	0.7	72.1	119.9	112.1
Institutional	0	2.8	113.3	117.4	119.8
Military	0	20.8	47.4	40.4	47.4
Open Space	0	1.2	23.9	46.4	46. 4
Section 4(f) Properties (#)	**0**	**6**	**7**	**5**	**9**
Farmland	**0**	**0**	**0**	**0**	**0**
Stream Impacts (linear feet)	**0**	**0**	**0**	**547. 9**	**547. 9**
Navigable Waters (acres)	**0**	**147.3**	**215.6**	**369.9**	**480.9**
Maintained Navigable Channels	**0**	**12.3**	**24.4**	**57.1**	**62.3**
Wetlands (acres)	**0**	**7.8**	**72.6**	**111.5**	**119.9**
Resource Protection Areas (acres)	**0**	**1.1**	**16.0**	**139.8**	**127.1**
Floodplains (acres)	**0**	**112.6**	**213.3**	**213.3**	**313.3**
Hampton Roads Aquatic Habitat (acres)	**0**	**155.7**	**201.2**	**572.6**	**660.7**
Benthic Communities	**0**	**153.9**	**240.7**	**664.7**	**741.5**

Resource	No-Build Alternative	Alternative A	Alternative B	Alternative C	Alternative D
Essential Fish Habitat, Habitat Areas of Particular Concern, and Anadromous Fish Use Areas (acres)	0	138.4	214.3	565.4	636.3
Threatened & Endangered Species Habitat (acres)	0	1.0	111.9	163.9	153.7
Submerged Aquatic Vegetation (acres)	0	1.8	1.8	0	1.8
Terrestrial Habitat (Forested Area) (acres)	0	14.9	73.1	179.5	177.6
Water Quality	No impact	Short-term and minor, beneficial long-term impacts			
Historic Architecture Resources (#)	0	6	11	10	16
Archaeology Resources (#)	0	6	10	26	33
Noise Impacts (#)	0	953	1,987	1,014	2,548
Air Quality	No impact	Minor Short-term Impacts	Minor Short-term Impacts	Minor Short-term Impacts	Minor Short-term Impacts
Potential Hazardous Materials Sites	0	27	70	194	232
Visual Impacts	No impact	Minor to moderate			
Energy Requirements and Conservation Potential	No impact	Minor energy requirements			

Notes: Right-of-Way data was gathered from each of the localities. Land use data was gathered from HRTPO.

already been degraded. Lands along I-664 on the Southside are at a slightly lower level of land use intensity and development, resulting in more undeveloped lands in the vicinity of existing I-664 interchanges. Growth along major feeder roads to these interchanges would still be largely infill but potentially could occur slightly further out (up to two miles) from existing I-664 interchanges. Using these limits to identify the location of potential induced development and associated indirect effects is an attempt to identify where those indirect effects are most probable and could occur because of the project. It does not mean that indirect effects from the project 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. As described in **Section 1.1.2**, each Build Alternative includes multiple elements. While each alternative has operationally independent sections, comprised of one or more elements, the assessment of indirect effects has been prepared for the full alternative. Therefore, the potential total indirect effects may not be realized until all operationally independent sections of an alternative are implemented. Potential indirect effects that may occur by the year 2040 are considered for all alternatives, including the No-Build Alternative. The specific minimization and mitigation measures that would reduce adverse indirect effects to socioeconomic and environmental resources are presented in **Section 2.7**.

2.6.1 No-Build Alternative

2.6.1.1 Encroachment Effects

Socioeconomic Resources

Continued and increasing traffic delays and traffic unreliability along and beyond the Study Area Corridors could cause some individuals or businesses to leave the area and locate elsewhere to reduce transportation-related costs. Increasing congestion and travel unreliability impedes the delivery of and access to goods and services and results in lost economic productivity due to workers being delayed in traffic and increased fuel consumption from increased idling. A recent study of congestion at the HRBT by the Transportation Research Institute at ODU reports congestion and delays are costing the traveling public approximately 1.13 million vehicle hours or $33.2 million annually in lost productivity, vehicle operation cost, and lost fuel (based on 2013 data) (Cetin et al., 2015). Given increasing gridlock in the Socioeconomic Resources ICE Study Area, it is uncertain whether individuals or businesses could be attracted to the area to replace those that may move away. Increased gridlock would cause more visual, noise, and air impacts that could reduce community cohesion and reduce access to community facilities and recreation areas.

The indirect effects to transportation on the Study Area Corridors under the No-Build Alternative are examined in the *HRCS Transportation and Traffic Technical Report*. Under the No-Build Alternative, increased congestion on the larger regional transportation network would occur, leading drivers that would otherwise use the severely congested HRBT crossing to use other Hampton Roads crossings and/or other routes around the region to avoid congestion while trying to reach their destinations.

Natural Resources

The No-Build Alternative would not improve the existing HRCS Study Area Corridors. Although stormwater management along the Study Area Corridors has been updated over the past 25 years with retrofitted and more modern systems as improvements have been made, there are still sections where there are not any stormwater management features or the features are outdated that would not be improved under the No-Build Alternative. Existing indirect effects associated with untreated or poorly treated stormwater runoff would continue.

Under the No-Build Alternative, the existing fragmented and limited wildlife habitat existing within and adjacent to the Study Area Corridors would continue to degrade.

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 the Hampton National Cemetery, Emancipation Tree, and Fort Monroe, making them less attractive to visit.

2.6.1.2 Induced Growth

No induced growth is expected under the No-Build Alternative, as no changes would be made to the Study Area Corridors. Land near existing interchanges may become less desirable due to continued traffic congestion and diminishing travel reliability.

2.6.2 Alternative A

2.6.2.1 Encroachment Effects

Socioeconomic Resources

Direct residential relocations under Alternative A would be relatively few (nine), and no commercial, industrial or community facilities would be relocated. Alternative A would widen I-64 by adding a lane in the eastbound direction for a short distance. Therefore, the residential relocations would be located along the edge of communities that border the I-64 Study Area Corridor. Consequently, Alternative A would have minor indirect effects on community cohesion in the cities of Norfolk and Hampton. The relocation assistance process does not require that a relocated resident locate in a certain area or to a specific structure; however, community cohesion impacts are generally minimized when there is sufficient replacement housing available and displaced residents are able to relocate and remain within or in close proximity to their existing communities. Under Alternative A, the effects to community cohesion would be minor as relatively few relocations would occur and comparable adequate replacement housing exists.

Widening I-64 in the Study Area Corridors would require relocating some residences, exposing "second row" homes that were previously "buffered" from the interstate. This could cause some residents or businesses in the new "first row" closest to the interstate to leave the area. However, given the limited improvements to regional connectivity and reduction in congestion, others may be attracted to the area, resulting in minimal effects to community cohesion. Widening I-64 would also marginally increase the separation distance between communities located on either side, but because the relationship between the interstate and adjoining communities has been established for nearly 60 years and all local road crossings would be maintained, indirect effects to community cohesion would be minor.

Improvements to I-64 under Alternative A would marginally improve access to transportation while reducing congestion along a relatively short corridor. This would benefit people and businesses by reducing lost productivity from sitting in congested traffic. An improved corridor 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 new improvements.

Generally, when capacity is added, traffic volumes will increase on that facility as it becomes more attractive for travelers. Parallel facilities such as the MMMBT would see traffic divert to the roadway with newly added capacity. Under Alternative A, traffic volumes on the HRBT would increase and traffic volumes on the MMMBT would decrease. Regional traffic patterns would change in concert with the shift in traffic between the HRBT and MMMBT. Additionally, local roadways that parallel the improved I-64 Study Area Corridor could see traffic volume reductions, as drivers divert from existing surface streets to the improved corridor where they would find better travel conditions. Tolling could also influence the diversion of traffic. While the indirect effects of tolling on traffic cannot be reliably determined at this time because of a number of unknowns (e.g. which facilities would be tolled, the toll rate, etc.), the *HRCS Traffic and Transportation Technical Report* included a basic toll diversion analysis. The toll diversion analysis is intended to determine whether traffic diversions associated with tolls could possibly lead to system failure at a Hampton Roads crossing. Tolling scenarios are based on those developed by the HRTAC (HRTAC, 2015). See the *HRCS Traffic and Transportation Technical Report* for details on the assumptions used for the toll diversion analysis. For Alternative A, one toll scenario was considered, and that scenario involved the implementation of managed lanes (i.e. HOT lanes) on the HRBT; no toll was placed on any other crossing such as the MMMBT that would not be improved as part of the alternative. **Table 2-8** presents the assumed toll-per-mile rates for HOT lanes. The results indicate a slight overall reduction in traffic volumes on the HRBT, with some of the traffic shifting to the MMMBT.

Table 2-8: Modeled HOT Toll Rates (in dollars per mile)

Passenger Car		Commercial Vehicles (3+ axles)	
Peak	Off Peak	Peak	Off Peak
0.33	0.15	1.32	0.45

During construction, short-term road closures, detours and loss of parking would indirectly affect residents, businesses, and the local economy by potentially increasing commute times, emergency vehicle response times, and limiting or restricting access to neighborhoods, community facilities, or businesses. These effects would be short-term, ending once construction was completed. Conversely, hiring for construction could increase local employment and the money spent by workers could benefit local businesses over the short-term.

Natural Resources

Alternative A would widen an existing interstate in a highly urbanized area. Alternative A would cause some habitat loss (**Table 2-7**); particularly near water crossings which tend to have greater integrity than the land areas along either side of the I-64 Study Area Corridor that have fewer legal protections. Habitat fragmentation is associated with habitat loss. As described in **Section 2.2**, habitat fragmentation can have wide-ranging indirect effects to wildlife, resulting in species shifts associated with greater edge habitat and less interior habitat (smaller patch size); lower diversity due to smaller habitat patches; potential isolation of populations; increased vulnerability of species to external competition and predation; potential decreased flow of genetic material through the landscape; restricting wildlife movements that disrupt foraging, breeding/nesting and migration; increased risk of invasive species establishment; and generally, reduced biological diversity. Roadway noise can 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 most intact habitat within the Study Area Corridor tends to be riparian corridors. Widening of existing bridges and lengthening culverts under Alternative A could indirectly restrict wildlife movement through the riparian corridors crossed by these structures and alter up and downstream hydrologic flow. Direct effects 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 systems is important because they are a major pathway for energy flow and dissipation in the Coastal Plain, an area of flat, low-lying land with many rivers, marshes, and swamplands.

Some of the potential effects that may occur because of changes to natural processes in the wetlands of the ICE Natural Resources ICE Study Area include changes to floodwater storage capacity and retention times, vegetative community composition and structure, nutrient cycling, and aquatic life movement. These indirect effects can alter wetland functions such as habitat, plant community, and carbon cycling as described in the *HRCS Natural Resources Technical Report*. For example, an increase in sunlight in riparian areas due to a new roadway removing forest canopy can alter vegetation community composition (introduction of invasive species, changes in light regime which favor full-sun plants) and water chemistry (decrease in dissolved oxygen and increase in temperature, both which impact nutrient cycling and aquatic life). The obverse could occur as widening existing or constructing new bridges and overpasses can shadow wetlands, altering the plant community, wildlife habitat, and carbon cycling.

Direct impacts from cut/fill would result in loss of all wetland functions within the immediate footprint of the impact and indirectly contribute to habitat fragmentation effects described above. The magnitude of the effects to wetland functions directly and indirectly impacted from conversion and hydrologic

alteration/isolation is generally less than effects from cut/fill. However, hydraulic alteration can remove all wetland function if the site is converted to an upland. Filling floodplains would also result in loss of floodplain functions. Floodplain encroachment could alter the hydrology of the floodplain that could indirectly result in more severe flooding in terms of flood height, duration and erosion (FEMA, 2016). Approximately 113 acres of floodplain would be directly impacted by Alternative A.

The indirect impacts of Alternative A to hydrology associated with any given stream, wetland, floodplain or open water crossing would be limited as this alternative is confined to widening an existing corridor. Existing culverts would be extended or resized where appropriate, and bridges widened or replaced in accordance with design standards. Mitigation efforts discussed later in this document would offset much of this potential impact.

The increased impervious surface of the widened interstate could indirectly increase the amount and velocity of runoff, 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 runoff enters waters that are already impaired, the impacts are cumulative and can result in accelerated changes in the macrobenthic community structure and composition, which in turn can affect the fish and amphibian populations that rely on them as a food source, as well as the birds and aquatic mammals that prey on the fish and amphibians. The effects 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.

Threatened and endangered species habitat within the I-64 Study Area Corridor includes the Hampton Roads Bridge-Tunnel Island Conservation Site that is habitat for federally listed shorebirds. As described earlier in this chapter and the HRCS *Natural Resources Technical Report*, this habitat is already fragmented by the existing HRBT and surrounding development. Further, the widespread occurrence of common reed has rendered much of this habitat unsuitable for shorebird foraging. The majority of these estuarine areas would be bridged under Alternative A, limiting the direct loss of habitat, and thereby, indirect effects associated with additional habitat fragmentation. Due to the presence of higher quality foraging habitat outside the Study Area Corridors but in the vicinity of Alternative A, disruption during construction activities should have little to no impact on the shorebird species. Additionally, summer roosting habitat has been confirmed for bat species within Alternative A (NLEB, Little brown bat, Tri-colored bat), and forested habitat is very fragmented. Alternative A would not further degrade the quality of this habitat. Furthermore, no confirmed maternity roosts or hibernacula are located within a 2-mile radius of the I-64 Study Area Corridor, further limiting the potential indirect effects on the species from encroachment.

The designs for the tunnels would substantially affect the amount of dredging and fill needed which in turn, could affect aquatic species, cause habitat loss, and degrade water quality. As Alternative A would construct one additional bridge-tunnel at the HRBT, it would have fewer dredging indirect effects to natural resources and water quality than the other Build Alternatives. The potential indirect effects of Alternative A to hydrodynamics are being evaluated by VIMS and will be provided in the Final SEIS. It is estimated Alternative A would generate approximately 1.2 million cubic yards of dredge material requiring disposal. Alternative A would also have fewer indirect effects to regional dredge material capacity than the other Build Alternatives. As discussed in **Section 2.2**, several options are available to dispose of dredge material that requires testing to evaluate its suitability for various alternative uses and disposal sites. Therefore, the exact effects of dredge material disposal to natural resources and the regional capacity for dredge material disposal is not known at this time. However, with the exception of the initial impacts to benthic communities at the disposal site, the potential for other indirect effects to possibly occur as a result from disposal operations will be site-specific, depending on the characteristics of the dredged material, whether disposal is on land or in water, and the hydrodynamic conditions at the disposal site. These include indirect impacts from increased or decreased light penetration and potential

release of toxicants that may alter feeding, breeding, and nursery habitat as well as affect the life and health of nearby wildlife. These potential effects at the disposal site are minimized as part of the USACE permitting process for the disposal site approval. Construction and post-construction discharges of stormwater, as well as dredging, potentially contribute to minor, localized increases in the pollutants and nutrients causing impairment as measured by dissolved oxygen, benthic invertebrate communities, aquatic plants, and chlorophyll-a. Drainage design for the new proposed bridge structures would be developed in later design phases and would be designed in conformance with current stormwater regulations to minimize downstream effects to natural resources and water quality. Alternative A is not expected to disturb soils with Enterococcus or fecal coliform, which impair several waterbodies in the area. Therefore, Alternative A is not expected to substantially contribute to the further impairment of any impaired waterbodies from these sources.

Construction can increase the presence of invasive plant species enabled by earth disturbance and spreading from contaminated vehicles, clothing, and shoes. The spread of invasive species will be minimized by following provisions in VDOT's Road and Bridge Specifications as described in **Section 2.7**. While the Study Area Corridors 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.

Historic Resources

All effects to archaeological and historic architectural properties, including indirect effects, have been considered under Section 106 of the NHPA as described in the *HRCS Archaeological Assessment* and *Architectural Survey: Management Summary*. Portions of the Area of Potential Effects with a high potential for archaeological remains that have not been previously intensively inventoried will be intensively surveyed in later phases of the project. It is not expected that any archeological sites identified from later intensive survey would embody characteristics important for preservation in place.

Potentially easier access to historic properties within Norfolk and Hampton from an improved I-64 under Alternative A could foster increased visitation to historic properties. 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. Major historic property attractions in the Historic Resources ICE Study Area close to I-64 include Fort Monroe, Fort Wool, the Emancipation Tree at the Hampton University campus, and the Hampton National Cemetery. Access to Fort Monroe, a National Historic Monument, is controlled. Visitation to Fort Wool is naturally limited as its only access is by water. The Emancipation Tree is fenced but otherwise access is not controlled. Access to Hampton National Cemetery is controlled by gates and fencing.

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.

2.6.2.2 Induced Growth Impacts

Induced growth could occur under Alternative A 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 1.2.2**, induced growth would most likely occur around existing interchanges along I-64 through Hampton and Norfolk. **Figure 2-10** presents the interchanges within the Induced Growth ICE Study Area of Alternative A and **Table 2-9** presents the list of interchanges keyed to match the figure.

Figure 2-10: Interchanges and Induced Growth ICE Study Area under Alternative A

Table 2-9: Alternative A Induced Growth ICE Study Area Interchange Map Key

Key #	Interchange Description	Key #	Interchange Description	Key #	Interchange Description
1	Exit 267 - US Route 60/VA143 Settlers Landing Road & Woodland Road	**5**	Exit 274 - West Bay Avenue to I-64 East/I-64 to Westbound West Ocean View Avenue	**9**	I-64/I-564
2	Exit 268 - VA 169 South Mallory Street	**6**	I-64 WB Entrance Ramp from Granby Street/ Norfolk Naval Station Gate 22/Forest Lawn Cemetery	**10**	VA 165/VA 170 Little Creek Road
3	Exit 272 - West Ocean View Avenue/ Willoughby Spit	**7**	Exit 276 - I-564 & Granby Street/VA 460	**11**	VA 406/Terminal Boulevard to Hampton Boulevard
4	Exit 273 - Route 60 4th View Street	**8**	I-64 EB Entrance Ramp from Norfolk Naval Station Gate 22		

Consideration of induced growth in Hampton along the I-64 Study Area Corridor focused on the Mallory and Settlers Landing interchanges, since under Alternative A, improvements to I-64 would be limited to the Settlers Landing Interchange. From there westward, I-64 would not be improved.

Under Alternative A, the potential for induced growth is limited by the restricted availability of undeveloped land in both Hampton and Norfolk that are virtually built-out, the amount of protected lands present (e.g., RPAs, wetlands, parks), and inaccessible land within military installations like NAVSTA Norfolk, which is controlled by the federal government. In addition, west of the I-64 Study Area Corridor in Norfolk, is Chambers Field on NAVSTA Norfolk. It includes runway approaches and clear zones outside the boundary of the installation, where the type of development is specifically regulated in the Induced Growth ICE Study Area. **Figure 2-11** shows the extent of developed land within Norfolk and Hampton based on the NLCD. Lands classified as developed or undeveloped in the NLCD could include military or other inaccessible government-controlled lands. Approximately 93 percent of lands are developed within the Induced Growth ICE Study Area of Alternative A. With the lack of undeveloped land, induced growth in built-out areas would therefore be in the form of infill or redevelopment.

Alternative A improvements to I-64 would most likely lead to growth in the Induced Growth Study Area based on the factors discussed in **Section 1.2.2**. One of these factors is local land use policies and guidance. Therefore, areas designated by Hampton and Norfolk as suitable for such growth within the Induced Growth ICE Study Area would likely experience the most growth. **Figure 2-12** shows the designated growth areas, redevelopment areas, and Urban Enterprise Zones in Hampton and Norfolk, and **Figure 2-13** depicts the designated commercial, industrial and mixed use areas in both cities.

The Induced Growth ICE Study Area also extends outside of designated growth areas. **Table 2-10** summarizes characteristics by land use category of the Induced Growth ICE Study Area for Alternative A that extends beyond designated growth areas. Land use is based on HRTPO 2011 regional data.

Figure 2-11: Developed Lands in the Induced Growth ICE Study Area

Figure 2-12: Designated Growth Areas in the Induced Growth ICE Study Area

Figure 2-13: Designated Industrial, Commercial, and Mixed-use Areas

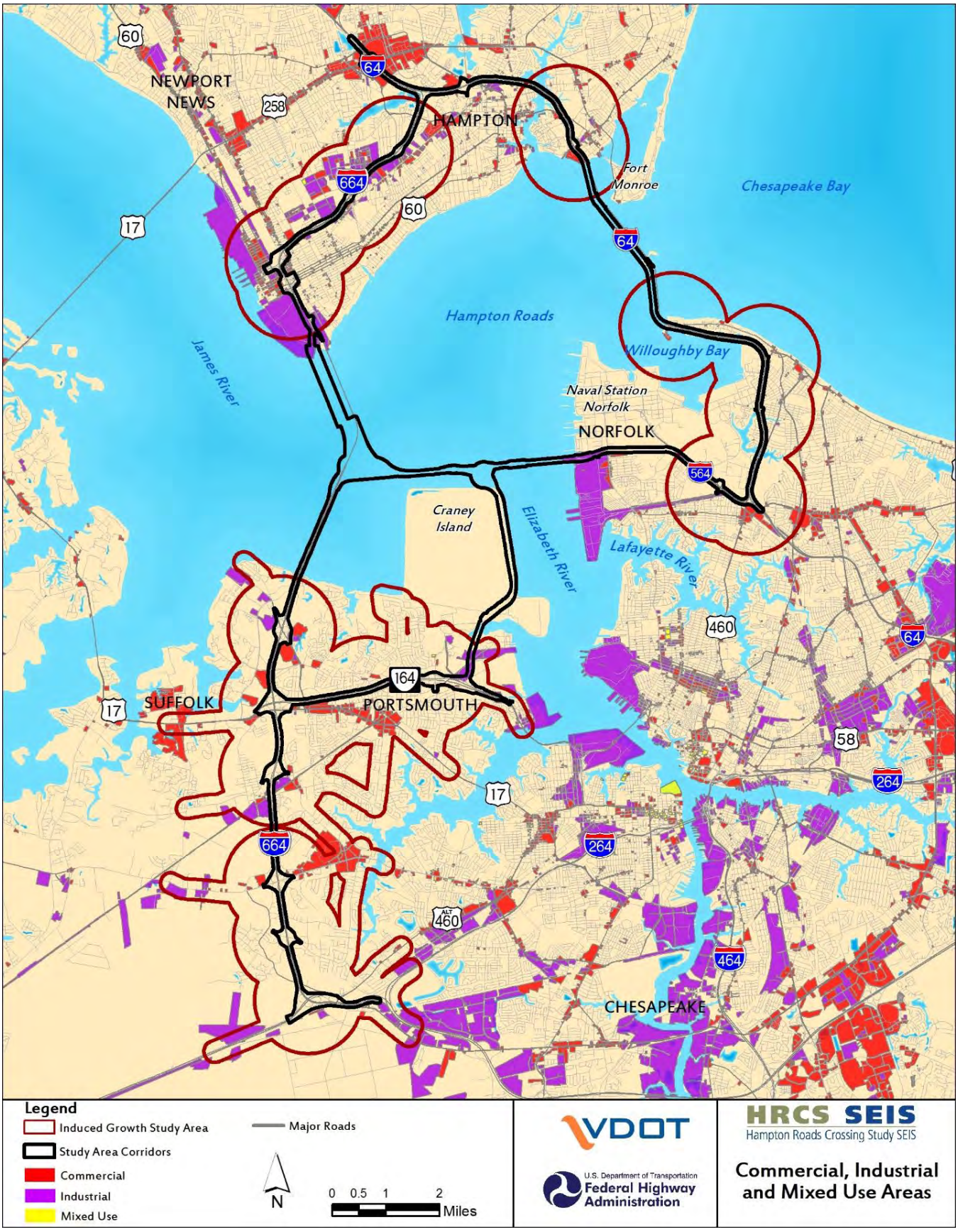


Table 2-10: Alternative A Induced Growth ICE Study Area Outside Designated Growth Areas

Land Use Category	Induced Growth ICE Study Area Outside Designated Growth Areas (Acres)	Percent
Residential	1,500	36%
Commercial	105	3%
Industrial	41	1%
Mixed Use	0	0%
Military	1,612	38%
Institutional	383	9%
Agriculture	0	0%
Open Space	551	13%
Total	**4,193**	**100%**
Total Alternative A Induced Growth ICE Study Area Acres	**10,412**	

Approximately 40 percent (4,193 acres) of the total Induced Growth Ice Study Area acres extend beyond designated growth areas in Hampton and Norfolk, including areas over water. Of the total acres outside of designated growth areas, the majority are military (38 percent) and residential (36 percent). Induced growth associated with Alternative A is not expected on military lands or areas over water.

Induced growth associated with Alternative A could create pressure on city councils and boards of supervisors 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 Hampton Roads crossings have been studied for several decades. Area planning (such as comprehensive plans for Norfolk) have considered potential crossing improvements or widening of I-64 (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 Alternative A outside of designated growth areas is in residential areas where infill would be expected to increase density. The extent of induced residential, commercial, industrial and mixed use growth that could occur under Alternative A 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, impacting human use and ecosystem functions as discussed above in **Section 2.2.2** and the natural resources indirect effects

assessment of Alternative A. 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 ICE Study Area could impact wetlands, streams, and floodplain areas. **Table 2-11** presents an estimate of wetland acres[4], linear feet of streams and floodplain acres throughout the Induced Growth ICE Study Area of Alternative A. The potential effects of induced growth to wetlands, streams, and floodplains under Alternative A cannot be quantified as the exact impacts of a specific development are unknown at this time. However, should future induced growth and development in the vicinity of Alternative A interchanges impact regulated waters, wetlands, streams, or floodplains, that 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 already 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, Stream, and Floodplains in Alternative A Induced Growth ICE Study Area

Resource	Quantity
Wetlands (acres)	31
Streams (linear feet)	63,192
Floodplains (acres)	3,090

Source: USFWS (2011), NHD

Impacts of induced growth under Alternative A 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 and SGCN. Because the induced growth area of Alternative A is largely built-out, it is highly disturbed, thus, the potential adverse effects to wildlife and wildlife habitat from induced growth development would 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 shorelines and wetlands would be federally and state regulated as well, reducing potential adverse effects of induced growth to wildlife and wildlife habitat.

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

- demolition, excavation, or vibration effects; changing the design, materials, or workmanship
- 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, both the cities of Hampton and Norfolk have historic architectural preservation committees that 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 constructing Alternative A.

[4] Approximate based on NWI: some wetlands may have been already impacted.

2.6.3 Alternative B

2.6.3.1 Encroachment Effects

Socioeconomic Resources

Alternative B includes all of the improvements considered under Alternative A. The types of indirect effects on socioeconomic resources therefore would be similar to those described for Alternative A along the I-64 Study Area Corridor. The area along the I-564 and VA 164 Connector Study Area Corridors is largely controlled by the military and POV. While these agencies would realize the benefits related to reduced congestion, increased port access, and improved travel reliability, it is unlikely that there would be a potential for changes in land use or ownership as there is for the private properties described under Alternative A. Alternative B would result in nine residential relocations and no commercial relocations of properties bordering I-64, I-564, the I-564 and VA 164 Connectors, and VA 164. Along VA 164, the type of encroachment effects to socioeconomic resources would be similar to those described under Alternative A, as the existing facility is primarily bordered by private properties. Although indirect effects would occur over a larger area than Alternative A, those effects would be distributed along a narrow corridor along existing transportation infrastructure through several different communities, limiting adverse effects to community cohesion in an individual neighborhood or city.

Alternative B indirect effects on the larger regional transportation network would consist of decreases in congestion and improved travel reliability. The alternative would also offer a new crossing of the Elizabeth River and a more direct connection between the HRBT and the MMMBT, further improving travel reliability and connectivity in the region. Under Alternative B, traffic volumes on the HRBT would increase and traffic volumes on the MMMBT would decrease. Congestion at peak travel times at the Hampton Roads crossings would still occur. Regional traffic patterns would shift as described for Alternative A, because increased capacity of the widened Study Area Corridors would reduce excess travel demand on parallel local streets, resulting in traffic volume reductions on those roads. Tolling could also influence the diversion of traffic. While the indirect effects of tolling on traffic cannot be reliably determined at this time because of a number of unknowns (e.g. which facilities would be tolled, the toll rate, etc.), the *HRCS Traffic and Transportation Technical Report* includes a basic toll diversion analysis. Two toll scenarios were considered for Alternative B. Tolling scenarios are based on those developed by the HRTAC (HRTAC, 2015). See the *HRCS Traffic and Transportation Technical Report* for details on the assumptions used for the toll diversion analysis. Under the first scenario, a toll was placed on the new Elizabeth River crossings (i.e. the I-564 and VA 164 Connectors). Under the Elizabeth River toll-only scenario, a fixed toll of $1 was coded on the I-564 and VA 164 connectors. However, because vehicles would always need to travel on at least two of these connectors to cross the Elizabeth River, the effective toll on the crossing is $2. The results indicate that volumes on the HRBT and MMMBT may increase slightly, as tolls on the new Elizabeth River connectors improve the attractiveness of the HRBT and MMMBT to drivers. A slight shift in traffic to the James River Bridge is indicated as well. Volumes on the I-564 and VA 164 Connectors would decline substantially, indicating that the additional cost of a toll may not outweigh travel-time savings provided by these new connections. Under the second scenario, a managed lane scenario (i.e. HOT Lanes) was considered where widening occurs; the fixed toll on the Elizabeth River crossing was retained as well. Under this scenario for Alternative B, the volume reduction on the HRBT would be slightly larger, with almost the entire volume shift being absorbed by the MMMBT. Traffic volumes on the I-564 and VA 164 Connectors would be essentially unchanged from the volumes under the first scenario.

Alternative B construction would occur over a larger area than Alternative A. Much of the additional work under this alternative would occur over water or within or around lands managed by government agencies. Therefore, indirect effects to socioeconomic resources during construction would be short-term and are not expected to be much greater than Alternative A.

Natural Resources

Along existing I-64, I-564, and VA 164, Alternative B would have similar types of indirect effects to natural resources as described for Alternative A. However, Alternative B also would construct on new alignment the I-564 and VA 164 Connectors. The I-564 Connector would involve constructing a tunnel extending from the Norfolk shoreline across the mouth of the Elizabeth River, a tunnel portal island north of CIDMMA, and trestle bridges. The hydrodynamic indirect effects related to the new tunnel are being evaluated by VIMS and will be presented in the Final SEIS. The designs for the tunnels will substantially influence the amount of dredging and fill needed which, in turn, could affect aquatic species, cause habitat loss and degrade water quality from sedimentation, resuspension of sediment in the water column (turbidity), and potential release of toxicants from water bottom disturbance. As Alternative B would construct two new tunnels (alongside HRBT and the I-564 Connector), it would have more dredging indirect effects to natural resources and raise regional dredge material disposal capacity issues more than Alternative A, but less than Alternatives C and D. It is estimated Alternative B would generate approximately 4.1 million cubic yards of dredge material requiring disposal. As discussed in **Section 2.2**, several options are available to dispose of dredge material. The material requires testing to evaluate its suitability for various alternative uses and disposal sites. Therefore, the exact effects of dredge material disposal to natural resources and the regional capacity for disposal is not known at this time. However, with the exception of impacts to benthic communities at the disposal site, the potential for other effects to possibly occur as a result from disposal operations will be site-specific, depending on the characteristics of the dredged material, whether disposal is on land or in water, and the hydrodynamic conditions at the disposal site. These include impacts from increased or decreased light penetration and potential release of toxicants that may alter feeding, breeding, and nursery habitat as well as affect the life and health of nearby wildlife. These potential effects at the disposal site are minimized as part of the USACE permitting process for the disposal site approval.

Unlike the I-564 Connector, the VA 164 Connector would be constructed on new alignment, but it is being proposed that it not be on structure and over water. The potential for the VA 164 Connector to be placed on structure was not considered for the ICE analysis, but if included in the Preferred Alternative, the possibility would be evaluated, if needed, to accommodate US Navy and US Coast Guard security requirements.

In the absence of an elevated facility, the VA 164 Connector under Alternative B could result in habitat loss and fragmentation. The *HRCS Natural Resources Technical Report* describes the habitat, species diversity, protected species, and wetland functions found in this area. Habitat loss resulting in habitat fragmentation may have wide-ranging effects to wildlife and biological diversity as described under Alternative A. The Craney Island Conservation Site is also habitat for federally protected shorebirds (Piping plover, Gull-billed tern, Wilson's plover, and Red knot). The VA 164 Connector would be constructed on the eastern edge of the CIDMMA with more suitable habitat to the west. Therefore, the potential indirect effects of habitat fragmentation to wildlife and protected shorebird species is expected to be minimal near the VA 164 Connector. However, the alignment south of the island through government-controlled lands to its connection with VA 164 would have more severe indirect effects on wildlife because of habitat fragmentation. Summer roosting habitat for federally protected bats occurs and, although some larger tracts of forest do exist in the Study Area Corridor along Coast Guard Boulevard north of VA 164, the potential indirect effects of Alternative B to bat roosting and foraging habitat would be similar to the types described for Alternative A. Canebrake rattlesnake habitat is located in forest habitat on the Coast Guard property, however, the habitat area is isolated and it is believed that the area is not able to support a viable population of the species long term. This area of the VA 164 Connector was also clearcut in the 1990s that likely eliminated any Canebrake rattlesnake population at that time. Therefore, Alternative B is not expected to have any indirect effects to the Canebrake rattlesnake.

Palustrine wetlands within CIDMMA are routinely disturbed. Those along the proposed VA 164 Connector south of CIDMMA are generally in better condition but still altered. A large palustrine wetland north and south of Coast Guard Boulevard on the Station would be fragmented by Alternative B, disconnecting the northern portion from estuarine wetlands, and substantially reducing the overall function of the wetland, especially plant communities. Under Alternative B, a large palustrine wetland would be fragmented on the Station south of Coast Guard Boulevard, resulting in a small western fragment with substantially reduced plant community function. These direct effects would reduce and fragment wetland habitat that indirectly impacts wetland-dependent species.

Alternative B would directly impact 213 acres of floodplains. Similar to Alternative A, potential indirect effects such as increasing flooding severity should be reduced by building bridges and placing correctly sized culverts that maintain floodplain functions.

Alternative B could increase impacts to water quality from highway runoff and increased impervious surfaces. Replacing outdated stormwater and drainage systems and constructing new facilities designed to achieve minimal increases in stormwater runoff should reduce adverse indirect effects to water quality under Alternative B.

Historic Resources

Similar to Alternative A, improved access to historic properties open to the public could occur as a result of the Alternative B improvements, with similar benefits and impacts as discussed under Alternative A. In addition to those historic properties mentioned under Alternative A, the Norfolk Naval Base Historic District, the Battle of Craney Island, the Battle of Sewell's Point, the Captain John Smith Chesapeake National Historic Trail, and the Washington Rochambeau Revolutionary Route National Historic Trail are found along the I-564 and the I-564 and VA 164 Connectors portions of Alternative B.

Temporary indirect effects from the construction of Alternative B would be similar to those discussed for Alternative A, namely, access to historic properties could be temporarily impacted. These impacts would be short term and therefore minor.

2.6.3.2 Induced Growth

Figure 2-14 shows the Induced Growth ICE Study Area for Alternative B and the interchanges around which potential induced growth could occur. **Table 2-12** presents the interchange map key for **Figure 2-14**. Alternative B would have the same type of induced growth effects along I-64 as described under Alternative A.

Induced growth of Alternative B would be constrained along I-564 by the extent of military lands and crash and noise zones associated with Chambers Field. Induced growth would be further constrained through CIDMMA, the US Naval Supply Center, Coast Guard Station, and the VIG that are under government control. **Figure 2-11** shows the extent of developed land within the Induced Growth ICE Study Area of Alternative B. Lands classified as developed or undeveloped in the NLCD could include military or other inaccessible government-controlled lands. Approximately 87 percent of lands are developed within the Induced Growth ICE Study Area of Alternative B. With the lack of undeveloped land, induced growth in built-out areas would more likely be in the form of infill or redevelopment.

Alternative B improvements to VA 164 would most likely lead to growth in the Induced Growth Study Area based on the factors discussed in **Section 1.2.2**. For the reasons discussed for Alternative A, areas designated by Hampton, Norfolk, and Portsmouth as suitable for such growth within the Induced Growth ICE Study Area would likely experience the most growth. **Figure 2-12** shows the designated growth areas, redevelopment areas, and Urban Enterprise Zones in these cities, and **Figure 2-13** depicts the designated commercial, industrial and mixed use areas.

Figure 2-14: Interchanges and Induced Growth ICE Study Area under Alternative B

The Induced Growth ICE Study Area of Alternative B also extends outside of designated growth areas. **Table 2-13** summarizes characteristics by land use category of the Induced Growth ICE Study Area for

Alternative B that extends beyond designated growth areas. Land use is based on HRTPO 2011 regional data. Approximately 38 percent (6,896 acres) of the total Induced Growth Ice Study Area acres extend beyond designated growth areas in Hampton and Norfolk, including areas over water. Of these, the majority are residential (47 percent) and military lands (24 percent). As seen in **Figure 2-11**, much of the open space in the Induced Growth ICE Study Area of Alternative B is on military and other government-controlled lands such as CIDMMA. Induced growth associated with Alternative B is not expected on military or government lands, nor areas over water. Similar to Alternative A, transportation improvements of Alternative B may increase pressure on city councils and boards of supervisors to make changes to their land use plans to allow development in areas not currently authorized for it or to allow greater development densities. Similar to Alternative A, most of the Induced Growth ICE Study Area outside of designated growth areas are within residential areas. Induced growth in these residential areas would most likely be infill or redevelopment that increases residential density. However, the extent of induced residential, commercial, industrial and mixed use growth that could occur under Alternative B is also uncertain, as many factors other than transportation accessibility affect the decision to develop. Land use policies and guidelines are set by local government and Code of Virginia § 15.2-2223 requires updating comprehensive plans for the physical development of land within their jurisdiction every five years. Comprehensive plans are developed in consultation with stakeholders and citizens. These processes reduce the potential for unwanted growth.

Alternative B would not provide a new crossing over the entire Hampton Roads as would occur under Alternatives C and D. Therefore, it would have fewer beneficial indirect socioeconomic effects from induced growth than Alternatives C and D. The planned Craney Island Marine Terminal on eastern CIDMMA would connect to the VA 164 Connector that is proposed under Alternative B. Plans for the development of the new port terminal have been ongoing for some time. The facility is not dependent upon implementing Alternative B; rather, it is contingent on funding that is projected to be available in the 2030/2040 timeframe. While plans for this expansion have set aside right–of-way for the alignment of the VA 164 Connector, Alternative B does not propose an interchange at the potential future port site, and that expansion is not considered induced growth of Alternative B.

Table 2-12: Alternative B Induced Growth ICE Study Area Interchange Map Key

Key #	Interchange Description	Key #	Interchange Description	Key #	Interchange Description
1	Exit 267 - US Route 60/VA143 Settlers Landing Road & Woodland Road	**8**	I-64 EB Entrance Ramp from Norfolk Naval Station Gate 22	**15**	Cedar Lane
2	Exit 268 - VA 169 South Mallory Street	**9**	I-64/I-564	**16**	Towne Point Road
3	Exit 272 - West Ocean View Avenue/ Willoughby Spit	**10**	VA 165/VA 170 Little Creek Road	**17**	VA 135/College Drive
4	Exit 273 - Route 60 4th View Street	**11**	VA 406/Terminal Boulevard to Hampton Boulevard	**18**	Exit 9A - US Route 17 North/Bridge Road/ James River Bridge

Key #	Interchange Description	Key #	Interchange Description	Key #	Interchange Description
5	Exit 274 - West Bay Ave to I-64 East/ I-64 to WB West Ocean View Avenue	**12**	I-564 Connector	**19**	I-664/VA164 Interchange
6	I-64 WB Entrance Ramp from Granby Street/Norfolk Naval Station Gate 22/ Forest Lawn Cemetery	**13**	VA-164 Connector	**20**	Exit 9B - VA 164 East/US Route 17 South/Portsmouth
7	Exit 276 - I-564 & Granby Street/VA 460	**14**	Virginia International Gateway Boulevard		

Table 2-13: Alternative B Induced Growth ICE Study Area Outside Designated Growth Areas

Land Use Category	Induced Growth ICE Study Area Outside Designated Growth Areas (Acres)	Percent
Residential	3,247	47%
Commercial	122	2%
Industrial	181	3%
Mixed Use	0	0%
Military	1,675	24%
Institutional	665	10%
Agriculture	1	<1%
Open Space	978	14%
Total	**6,869**	**100%**
Total Alternative B Induced Growth ICE Study Area Acres	**18,083**	

Table 2-14 presents the wetland acreage, linear feet of streams, and acres of floodplain throughout the Induced Growth ICE Study Area of Alternative B. Although induced growth associated with Alternative B could potentially adversely affect more aquatic resources than Alternative A, this potential should be minimized over much of the corridor by the government-controlled land use along I-564 and the proposed VA 164 Connector, as well as water regulations that apply to private land. Induced growth along VA 164 would primarily be in developed neighborhoods, which reduces the potential adverse effects to wildlife and wildlife habitat.

Table 2-14: Wetland, Stream, and Floodplains in Alternative B Induced Growth ICE Study Area

Resource	Quantity
Wetlands (acres)	370
Streams (linear feet)	98,932
Floodplains (acres)	3,656

Source: USFWS (2011) NHD

The types of potential effects to historic properties from induced growth associated with Alternative B would be similar to those described under Alternative A. In addition, no city-designated historic districts are within the Portsmouth portion of the Induced Growth ICE Study Area of Alternative B. Therefore, no City regulation of development's impact to historic properties from induced growth under Alternative B would apply there. However, regulation of potential impacts to historic properties as applies to federal and state undertakings would still apply.

Both the potential beneficial and adverse effects of induced growth as described above would be greater under Alternative B than Alternative A because the construction of Alternative B would occur over a larger area. Similarly, because the potential induced growth area of Alternative B is smaller than either Alternative C or D, the relative potential indirect effects to land use, socioeconomic resources, natural resources, and historic properties from induced growth would be fewer under Alternative B than those alternatives.

2.6.4 Alternative C

2.6.4.1 Encroachment Effects

Socioeconomic Resources

The types of indirect effects on socioeconomic resources under Alternative C would be similar to those described for Alternatives A and B. The type of indirect impacts along I-664 through Hampton and Newport News would be similar to those described along I-64 under Alternative A. Up to 12 residential and four commercial relocations would occur in areas adjacent to the Alternative C corridor. In some locations, the I-664 corridor on land is not as developed and mature as the I-64 corridor. Therefore, impacts to community cohesion may be less of a concern and the factors that influence individuals leaving or coming to the area may be different. The socioeconomic impacts along the I-664, I-564, and VA 164 Connectors would be similar to those described for the connectors under Alternative B.

The increased capacity with the associated reduction in congestion and increase in the reliability of the regional transportation system achieved under Alternative C would have similar types of indirect effects and benefits to socioeconomic resources as described for Alternatives A and B. However, because construction would occur over a larger area relative to Alternatives A and B, these effects would be experienced over a larger area, impacting more socioeconomic resources. Increased transit capacity and the competitive travel time advantage achieved through the transit-only lanes included in Alternative C relative to the other Build Alternatives, would benefit transit-dependent populations more than Alternative A and B.

Alternative C effects on the larger regional transportation network would consist of decreases in congestion and improved travel reliability. This alternative would also include a new crossing over the entire Hampton Roads and a more direct connection between the HRBT and the MMMBT, further improving travel reliability and connectivity in the region. Traffic would increase on the MMMBT and decrease on the HRBT under this alternative. Congestion at Hampton Roads crossing at peak travel times would still occur. Regional traffic patterns would shift as described for Alternative A, because increased

capacity of the widened Study Area Corridors would reduce excess travel demand on other parallel local streets, resulting in traffic volume reductions on those roads. Tolling could also influence the diversion of traffic. While the indirect effects of tolling on traffic cannot be reliably determined at this time because of a number of unknowns (e.g. which facilities would be tolled, the toll rate, etc.), the *HRCS Traffic and Transportation Technical Report* included a basic toll diversion analysis. Two toll scenarios were considered for Alternative C. Tolling scenarios are based on those developed by the HRTAC (HRTAC, 2015). Under the first scenario, a toll was placed on the new Elizabeth River crossings (i.e. the I-564, I-664, and VA 164 Connectors). A fixed toll of $1 was coded on the I-564, I-664 and VA 164 connectors. However, because vehicles would always need to travel on at least two of these connectors to cross the Elizabeth River, the effective toll on the crossing is $2. See the *HRCS Traffic and Transportation Technical Report* for details on the assumptions used for the toll diversion analysis. The results indicate that traffic volumes on the MMMBT would decline slightly while traffic volumes on the HRBT would increase. This pattern occurs despite the relatively larger capacity increase on the MMMBT. This indicates that the HRBT is the preferred means of crossing Hampton Roads, in particular when the trip between the Peninsula and the Norfolk area via the HRBT remains toll-free compared to a trip travelling via the MMMBT that would involve the (tolled) I-664 and I-564 Connectors. Traffic volumes on the VA 164 Connector would likely see the largest decline with the implementation of a toll, indicating that travelers using the VA 164 Connector would find alternate, lower cost routes to and from the Norfolk area from areas to the south. Under the second scenario, a managed lane scenario (i.e. HOT Lanes) was considered where widening occurs; the fixed toll on the Elizabeth River crossing was retained as well. HOT lanes would cause volumes on the MMMBT to be substantially less under Alternative C. This is likely due to the longer distance that drivers would experience traveling between the Peninsula and Norfolk and the higher toll cost they would incur. It is also an indication that congestion on the MMMBT is projected to be lower under Alternative C because the toll scenario assumes that four general purpose lanes would remain, and the fifth lane would be converted from a transit-only lane to a HOT lane. When congestion in the general purposes lanes is relatively low, there is little incentive for drivers to pay for a trip using the HOT lanes.

Temporary indirect effects to socioeconomic resources from the construction of Alternative C would be similar to those described for Alternative A. However, they would be experienced over a larger area and in more communities than for Alternatives A and B. Conversely, as Alternative C is shorter than Alternative D, it would have fewer temporary indirect effects to socioeconomic resources than Alternative D.

Natural Resources

Alternative C would be constructed in the highly urbanized area of Norfolk along I-564 and in highly urbanized and industrialized portions of Hampton and Newport News. Areas along I-664 in Suffolk and Chesapeake (the Southside), however, are less developed. Indirect effects to natural resources along I-664 in Hampton and Newport News would be similar to the types of impacts along I-64 under Alternative A. Impacts from widening the MMMBT and building the I-564 and the VA 164 Connectors over water and on CIDMMA would be similar to the types of impacts described under Alternative B.

Much of the undeveloped land to either side of I-664 on the Southside is forested wetland, swamps, and marshes. South of the VA 164 interchange, a rail line enters the median of I-664 and continues south to the end of the Study Area Corridor. Alternative C would widen I-664 on the Southside from four to six lanes. This alternative would improve existing I-664 where habitat has been fragmented from previous road and rail infrastructure. It would impact the edge of the forested habitat bordering the interstate right-of-way and thus would have limited habitat fragmentation effects in this area. These impacts would be greater than experienced under Alternative A, as some of the areas surrounding I-664 on the Southside are less developed. However, as I-664 is an existing interstate facility with a rail line partly running through the median, the impacts would not be as great as described under Alternative B for the VA 164 Connector south of CIDMMA.

Alternative C would have similar indirect effects to protected shorebirds along I-664 as described for I-64 / HRBT under Alternative A. It would also have similar effects to threatened and endangered species as Alternative B near the VA 164 Connector. Alternative C would have increased habitat fragmentation effects to Mabees salamander habitat present on either side of I-664 on the Southside, from reduction of forested buffers, and alteration of a pond that is habitat for this species. This would result in indirect effects to light and temperatures from forest loss. An impact to the Mabees salamander would not occur if two consecutive years of survey document the species was not present. Although more summer roosting bat habitat is present in the Alternative C Study Area Corridors, potential indirect effects on bat roosting and foraging habitat would be similar to those described for Alternative B. Canebrake rattlesnake habitat to either side of I-664 on the Southside would not likely experience increased fragmentation as no habitat corridors currently connect these areas. Peregrine falcons have no documented use of the Alternative C Study Area Corridor for breeding, thus this alternative would have no indirect effects on this species.

Alternative C is estimated to require disposal of approximately 7.1 million cubic yards of dredge material. This amount would be more than all the other Build Alternatives, thus Alternative C would have the most indirect dredging effects to natural resources and raise the greatest regional dredge material disposal capacity issues. As discussed in **Section 2.2**, several options are available to dispose of dredge material that require testing to evaluate its suitability for various alternative uses and disposal sites. Therefore, the exact effects of dredge material disposal on natural resources and the regional capacity for dredge material disposal is not known at this time. However, with the exception of the initial impacts to benthic communities at the disposal site, the potential for other effects to possibly occur as a result from disposal operations will be site specific, depending on the characteristics of the dredged material, whether disposal is on land or in water, and the hydrodynamic conditions at the disposal site. These include impacts from increased or decreased light penetration and potential release of toxicants that may alter feeding, breeding, and nursery habitat as well as affect the life and health of nearby wildlife. These potential effects at the disposal site are minimized as part of the USACE permitting process for the disposal site approval.

Alternative C would also construct the I-664 Connector comprised of trestle bridges over the open waters of Hampton Roads north of CIDMMA, between the I-564 Connector and the MMMBT. The indirect effects to aquatic resources related to this over-water structure are being addressed in the hydrodynamic study being completed by VIMS and will be included in the final SEIS.

Indirect effects of Alternative C to wetlands would be the same as Alternatives A and B where they overlap. Wetland habitat would not be substantially altered along I-664 in Hampton and Newport News because the few wetlands present have been previously altered or fragmented. Thus, indirect effects to wildlife and wildlife habitat in these areas would be reduced. More unaltered wetlands are present in the Suffolk portion of the I-664 corridor, but because direct effects would occur to a narrow fringe along existing right-of-way, limited indirect impacts to wetland habitat would occur there to accommodate the proposed widening of the interstate. Indirect effects to estuarine wetlands would be similar as described for Alternative A and B.

Historic Resources

Alternative C would improve access to historic properties better than Alternatives A or B. As discussed for Alternative A, greater access may benefit historic properties by increasing visitation that supports historic preservation. In addition to the historic properties noted under Alternative B in the I-564, I-564 and VA 164 Connectors areas, the St. Vincent de Paul Catholic Church, the Noland Company Building, Brown Manufacturing Coca-Cola Bottling Works-Daily Press Building, and Sunray Agricultural Historic District are located within the Historic Resources ICE Study Area along I-664 through Newport News and the Southside.

2.6.4.2 Induced Growth

The interchanges and Induced Growth ICE Study Area boundaries of Alternative C are shown in **Figure 2-15**. **Table 2-15** presents the interchange map key for **Figure 2-15**. **Figure 2-11** shows the extent of developed lands (79 percent) in the Induced Growth ICE Study Area of Alternative C. Lands classified as developed or undeveloped in the NLCD could include military or other inaccessible government-controlled lands. Induced growth is not expected along I-564 or the I-664, I-564, or VA 164 Connectors because these areas are either primarily under government control or over water. **Figure 2-13** depicts the designated commercial, industrial and mixed use areas.

The Induced Growth ICE Study Area of Alternative C extends beyond planned growth areas as identified by the planning documents of the cities of Chesapeake, Hampton, Newport News, Norfolk, Portsmouth and Suffolk (see **Figure 2-12**). **Table 2-16** provides a breakdown of Induced Growth ICE Study Area acreage outside designated growth areas by land use category. Approximately 27 percent (7,343 acres) of the total Induced Growth Ice Study Area acres extend beyond designated growth areas in the cities crossed by Alternative C, including areas over water. Of the land uses, the majority are residential (51 percent), open space (18 percent), and military lands (14 percent). As seen in **Figure 2-12**, the Induced Growth ICE Study Area of Alternative C in Suffolk and Chesapeake is mostly within designated growth areas, which also includes more open space than in either Hampton, Newport News, Norfolk or Portsmouth. However, much of this open space is within wetlands and the Great Dismal Swamp that are more difficult and costly to develop because of protective regulations. The Induced Growth ICE Study Area boundaries of Alternative C in Hampton, Newport News and Norfolk includes more acreage outside designated growth areas than elsewhere. Because these cities are largely built-out, induced growth associated with Alternative C is expected to occur more as redevelopment and infill in these communities. As discussed for Alternatives A and B, induced growth of Alternative C is anticipated to occur in areas designated for such growth, but pressure to change land use or increase density beyond what is currently planned may occur in the future, primarily in residential areas. It is difficult to predict the extent of the induced growth associated with Alternative C as transportation is but one of many factors that influence growth and development. As discussed for Alternative A, land use policies and guidelines are set by local governments and are required by the Code of Virginia § 15.2-2223 to be updated every five years. This process reduces the potential for unwanted growth or unplanned land use.

Because induced growth could potentially take place over a larger area under Alternative C compared to Alternatives A and B, the related effects of induced growth would have more widespread potential benefits to socioeconomic resources and adverse effects to natural and historic resources than Alternatives A and B. The types of indirect effects to these resources in the Peninsula portion of the I-664 corridor under Alternative C would be similar to those discussed for Alternative A along I-64. On the Southside, more benefits to socioeconomic resources along I-664 are expected under Alternative C from more extensive induced growth than on the Peninsula because more undeveloped land could potentially be developed. It follows that adverse impacts to natural resources could be greater on the Southside than on the Peninsula also because more undeveloped land could potentially be developed. Again, most of this development would be in areas designated for such growth.

Figure 2-15: Interchanges and Induced Growth ICE Study Area under Alternative C

Table 2-15: Alternative C Induced Growth ICE Area Interchange Map Key

Key #	Interchange Description	Key #	Interchange Description	Key #	Interchange Description
6	I-64 WB Entrance Ramp from Granby Street/Norfolk Naval Station Gate 22/ Forest Lawn Cemetery	**21**	I-664 Connector	**32**	Exit 10 - VA 659 Pughsville Road
7	Exit 276 - I-564 & Granby Street/VA 460	**22**	Exit 1A - Williamsburg/Richmond	**33**	Exit 11A - VA 337 West/Portsmouth Boulevard
8	I-64 EB Entrance Ramp from Norfolk Naval Station Gate 22	**23**	Exit 1B - Downtown Hampton/Norfolk/Virginia Beach	**34**	Exit 12 - VA 663/ Dock Landing Road
9	I-64/I-564	**24**	Exit 2 - Power Plant Parkway/ Powhatan Parkway	**35**	Exit 13A - US Route 13 South/ US Route 58 West/ US Route 460 West/ Suffolk
10	VA 165/VA 170 Little Creek Road	**25**	Exit 3 - Aberdeen Road	**36**	Exit 13B - US Route 58 East to US Route 13 North/ US Route 460 Alt/ US Route 460 East/Bowers Hill Military Highway
11	VA 406/Terminal Boulevard to Hampton Boulevard	**26**	Exit 4 - Chestnut Avenue	**37**	Exit 15B - I-64/ Chesapeake/Virginia Beach
12	I-564 Connector	**27**	Exit 5 - 35th Street	**38**	Exit 15A - I-264 East/ Portsmouth/Norfolk
13	VA-164 Connector	**28**	Exit 7 - Terminal Avenue	**39**	Exit 14 - US Route 13 North/ US Route 460 East/ Military Highway
15	Cedar Lane	**29**	Exit 6 - 26th St/ 27th Street	**40**	Exit 11B - VA 337 East/ Portsmouth Boulevard
16	Towne Point Road	**30**	Exit 8B - VA 135 South/ College Drive/Churchland	**41**	Exit 8A - VA 135 North /College Drive
17	VA 135/College Drive	**31**	Exit 9 - US Route 17 North/ Bridge Road		

Table 2-16: Alternative C Induced Growth ICE Study Area Outside of Designated Growth Areas

Land Use Category	Induced Growth ICE Study Area Outside Designated Growth Areas (Acres)	Percent
Residential	3,742	51%
Commercial	135	2%
Industrial	353	5%
Mixed Use	1	<1%
Military	1,011	14%
Institutional	706	10%
Agriculture	39	<1%
Open Space	1,356	18%
Total	7,343	**100%**
Total Alternative C Induced Growth ICE Study Area Acres	**27,557**	

Table 2-17 presents the wetland acres, linear feet of streams, and floodplain acres throughout the Induced Growth ICE Study Area of Alternative C. The federal and state regulations protecting water resources as discussed under Alternatives A and B, as well as the previously discussed government-controlled land use along I-564 and the proposed VA 164 Connector, would apply to development in the Alternative C Induced Growth ICE Study Area. Modern stormwater measures would replace older stormwater systems under this alternative, neutralizing potential indirect impacts to water quality by treating runoff. As previously discussed, VIMS' WetCAT analysis found water quality in the Natural Resources ICE Study Area is severely stressed (VIMS, 2016), and Hampton Roads is currently listed as impaired on the 303(d) list. More induced growth under Alternative C could have greater adverse impact to wildlife, wildlife habitat, and protected species as described under Alternatives A and B, but less than Alternative D. This potential should still be minimized as the type of induced growth is expected to be infill or redevelopment within primarily previously disturbed areas designated in regional and local planning for such type of development. State and local governments have identified priority areas for preservation of wildlife habitat and implemented land use policies to preserve many of these areas.

Table 2-17: Wetland, Stream, and Floodplains in Alternative C Induced Growth ICE Study Area

Resource	Quantity
Wetlands (acres)	490
Streams (linear feet)	167,048
Floodplains (acres)	3,454

Source: USFWS (2011), NHD

Because induced growth under Alternative C would occur over a larger area than Alternatives A and B, potential adverse effects to historic properties from that development would be more widespread. These effects should be similarly minimized by regulations as described under Alternatives A and B. In addition, Chesapeake has a historic preservation commission that maintains and updates a list of historic sites and

reviews architectural projects in historic and cultural preservation overlay districts, including the Sunray Historic District south of the I-664 Bowers Hill interchange area. Newport News has a historic architectural review board that reviews proposed projects in the North End / Huntington Heights Historic District southwest of I-664 and northeast of the Newport News Shipbuilding shipyard. Suffolk has a Historic Landmarks Commission but no Historic Overlay District in the Induced Growth ICE Study Area of Alternative C.

2.6.5 Alternative D

2.6.5.1 Encroachment Effects

Socioeconomic Resources

Alternative D would combine elements of the other Build Alternatives and would have indirect effects similar to those facilities described above. This alternative would have a narrower footprint along I-664 than Alternative C, but with little difference in indirect effects to socioeconomic resources. This alternative would not offer the competitive travel time advantage for transit that the dedicated transit lanes in Alternative C provide. Therefore, Alternative D would have fewer benefits for transit –dependent populations.

Because Alternative D includes all the other Build Alternatives, it would provide the greatest benefits when it comes to reducing congestion and increasing regional travel reliability and connectivity. Under Alternative D, which includes widening on both the HRBT and the MMMBT, the overall increase in traffic volumes would be balanced between the two bridge-tunnels. Congestion would still occur during peak hour travel times at the Hampton Roads crossings. Regional traffic patterns would shift as described for Alternative A, because increased capacity of the widened Study Area Corridors would reduce excess travel demand on parallel local streets, resulting in traffic volume reductions on those roads. Tolling could also influence the diversion of traffic. While the indirect effects of tolling on traffic cannot be reliably determined at this time because of a number of unknowns (e.g. which facilities would be tolled, the toll rate, etc.), the HRCS *Traffic and Transportation Technical Report* includes a basic toll diversion analysis. Two toll scenarios were considered for Alternative D. Tolling scenarios are based on those developed by the HRTAC (HRTAC, 2015). Under the first scenario, a toll was placed on the new Elizabeth River crossings (i.e. the I-564, I-664, and VA 164 Connectors). A fixed toll of $1 was coded on the I-564, I-664 and VA 164 connectors. However, because vehicles would always need to travel on at least two of these connectors to cross the Elizabeth River, the effective toll on the crossing is $2. See the *HRCS Traffic and Transportation Technical Report* for details on the assumptions used for the toll diversion analysis. The results indicate that traffic volumes on the MMMBT would decline slightly while traffic volumes on the HRBT would increase. This pattern occurs despite the relatively larger capacity increase on the MMMBT. This indicates that the HRBT is the preferred means of crossing Hampton Roads, in particular when the trip between the Peninsula and the Norfolk area via the HRBT remains toll-free compared to a trip travelling the MMMBT that would involve the (tolled) I-664 and I-564 Connectors. Traffic volumes on the VA 164 Connector would likely see the largest decline with the implementation of a toll, indicating that travelers using the VA 164 Connector would find alternate, lower cost routes to and from the Norfolk area from areas to the south. Under the second scenario, a managed lane scenario (i.e. HOT Lanes) was considered. HOT lanes would cause volumes on the MMMBT to be substantially less under Alternative D. This is due to the longer distance drivers would experience traveling between the Peninsula and Norfolk, as well as the higher toll cost they would incur.

Temporary indirect effects to socioeconomic resources during construction would be similar to those described for Alternative A, but would occur over a larger area than the other Build Alternatives. These effects would end once construction is completed and therefore are considered minor.

Natural Resources

Alternative D would combine elements of the other Build Alternatives and would have indirect impacts similar to those facilities described above. This alternative would have a narrower footprint along I-664 than Alternative C. This reduction in footprint, however, would not substantially decrease the indirect effects to natural resources relative to Alternative C.

Alternative D would potentially generate approximately 6.1 million cubic yards of dredge material requiring disposal, fewer relative to Alternative C, but more than the other Build Alternatives. For the same reasons cited for the other alternatives, the exact indirect dredging effects to natural resources and regional disposal capacity are not known at this time. However, with the exception of the initial impacts to benthic communities at the disposal site, the potential for other effects to possibly occur as a result from disposal operations would be site specific, depending on the characteristics of the dredged material, whether disposal is on land or in water, and the hydrodynamic conditions at the disposal site. These include impacts from increased or decreased light penetration and potential release of toxicants that may alter feeding, breeding, and nursery habitat as well as affect the life and health of nearby wildlife. These potential effects at the disposal site are minimized as part of the USACE permitting process for the disposal site approval.

Historic Resources

As Alternative D would construct improvements over a larger area, it would have the most indirect benefits and adverse indirect effects to historic properties among the Build Alternatives. Compared to the other Build Alternatives, Alternative D would increase capacity and regional accessibility the most, and therefore would make historic properties in the Historic Resources ICE Study Area more accessible. This could increase historic tourism the most relative to the other alternatives, but also may have greater adverse effects to historic properties that do not limit access, as discussed under Alternative A.

2.6.5.2 Induced Growth

Alternative D would combine elements of the other Build Alternatives and would have induced growth effects similar to those described for those alternatives. However, Alternative D would not include an additional dedicated transit lane as proposed by Alternative C. **Figure 2-16** shows the existing and proposed interchanges and Induced Growth ICE Study Area of Alternative D. **Table 2-18** presents the interchange key for the **Figure 2-16** map. Because Alternative D would improve all the Study Area Corridors, potential for induced growth effects would be over a larger area than all of the other Build Alternatives.

Developed lands within the Induced Growth ICE Study Area for Alternative D are shown in **Figure 2-11**. Lands classified as developed or undeveloped in the NLCD could include military or other inaccessible government-controlled lands. **Figure 2-13** depicts the designated commercial, industrial and mixed use areas. Approximately 81 percent of the Induced Growth ICE Study Area of Alternative D on land is developed.

The Induced Growth ICE Study Area for this alternative extends beyond areas designated for growth by the cities transected by Alternative D. **Table 2-19** presents the land use category of the Induced Growth ICE Study Area extending out of designated growth areas under Alternative D. Approximately 27 percent (9,453 acres) of the total Induced Growth Ice Study Area acres extend beyond designated growth areas in the cities crossed by Alternative D, including areas over water. Of these, the majority are residential (48 percent), military (18 percent), and open space (17 percent). It is not expected that induced growth would

Figure 2-16: Interchanges and Induced Growth ICE Study Area under Alternative D

Table 2-18: Alternative D Induced Growth ICE Study Area Interchange Map Key

Key #	Interchange Description	Key #	Interchange Description	Key #	Interchange Description
1	Exit 267 - US Route 60/VA143 Settlers Landing Road & Woodland Road	**16**	Towne Point Road	**31**	Exit 9 - US Route 17 North/ Bridge Road
2	Exit 268 - VA 169 South Mallory Street	**17**	VA 135/College Drive	**32**	Exit 10 - VA 659 Pughsville Road
3	Exit 272 - West Ocean View Avenue/ Willoughby Spit	**18**	Exit 9A - US Route 17 North/Bridge Road/ James River Bridge	**33**	Exit 11A - VA 337 West/ Portsmouth Boulevard
4	Exit 273 - Route 60 4th View Street	**19**	I-664/VA164 Interchange	**34**	Exit 12 - VA 663/ Dock Landing Road
5	Exit 274 - West Bay Avenue to I-64 East/ I-64 to WB West Ocean View Avenue	**20**	Exit 9B - VA 164 East/US Route 17 South/Portsmouth	**35**	Exit 13A - US Route 13 South/US Route 58 West/US Route 460 West/Suffolk
6	I-64 WB Entrance Ramp from Granby Street/ Norfolk Naval Station Gate 22/Forest Lawn Cemetery	**21**	I-664 Connector	**36**	Exit 13B - US Route 58 East to US Route 13 North/US Route 460 Alt/US Route 460 East/Bowers Hill Military Highway
7	Exit 276 - I-564 & Granby Street/VA 460	**22**	Exit 1A - Williamsburg/Richmond	**37**	Exit 15B - I-64/ Chesapeake/Virginia Beach
8	I-64 EB Entrance Ramp from Norfolk Naval Station Gate 22	**23**	Exit 1B – Downtown Hampton/Norfolk/Virginia Beach	**38**	Exit 15A - I-264 East/ Portsmouth/Norfolk
9	I-64/I-564	**24**	Exit 2 – Power Plant Parkway/ Powhatan Parkway	**39**	Exit 14 - US Route 13 North/US Route 460 East/Military Highway
10	VA 165/VA 170 Little Creek Road	**25**	Exit 3 - Aberdeen Road	**40**	Exit 11B - VA 337 East/ Portsmouth Boulevard
11	VA 406/Terminal Boulevard to Hampton Boulevard	**26**	Exit 4 - Chestnut Avenue	**41**	Exit 8A - VA 135 North/College Drive
12	I-564 Connector	**27**	Exit 5 - 35th Street	**42**	Exit 264 - I-664
13	VA-164 Connector	**28**	Exit 7 - Terminal Avenue	**43**	Exit 263B - VA 258 North/VA 134 South/Mercury

Key #	Interchange Description	Key #	Interchange Description	Key #	Interchange Description
					Boulevard/Hampton Coliseum
14	Virginia International Gateway Boulevard	**29**	Exit 6 - 26th Street/27th Street	**44**	Exit 263 - Mercury Boulevard/VA 258 South James River Bridge/ VA 258 North/ VA 134 South Coliseum
15	Cedar Lane	**30**	Exit 8B - VA 135 South/ College Drive/Churchland	**45**	Exit 265 - VA 167/VA 134 - LaSalle Avenue/ North Armistead Avenue & Rip Rap Road

Table 2-19: Alternative D Induced Growth ICE Study Area Outside of Designated Growth Areas

Land Use Category	Induced Growth ICE Study Area Outside Designated Growth Areas (Acres)	Percent
Residential	4,541	48%
Commercial	187	2%
Industrial	357	4%
Mixed Use	1	<1%
Military	1,675	18%
Institutional	1,033	11%
Agriculture	39	<1%
Open Space	1,620	17%
Total	9,453	
Total Alternative D Induced Growth ICE Study Area Acres	**35,177**	**100%**

occur on military lands or areas over water. As discussed for the other Build Alternatives, induced growth in the largely built-out cities of Hampton, Newport News, Norfolk and Portsmouth would occur as infill or redevelopment most likely within areas designated for such growth. However, some induced growth associated with Alternative D could occur outside of designated growth areas, especially in Hampton, Newport News, Norfolk and Portsmouth. This could occur primarily on residential lands. In these areas, induced growth associated with Alternative D could increase pressure to increase density or change land

use classification. Induced growth in Suffolk and Chesapeake associated with Alternative D would occur almost entirely within designated growth areas (**Figure 2-12**). This may change existing land use, but in accordance with comprehensive plans. Besides transportation accessibility, other factors affect the decision to develop; hence, the extent of induced growth associated with Alternative D is uncertain. As discussed for Alternative A, land use policies and guidelines are set by local governments and are required by the Code of Virginia § 15.2-2223 to be updated every five years. This process reduces the potential for unwanted growth or unplanned land use.

The extent of wetlands, streams, and floodplains throughout the Induced Growth ICE Study Area of Alternative D is shown in **Table 2-20**. Alternative D would have the greatest potential to adversely affect these resources. Modernized stormwater management systems and implementation of BMPs such as limiting increases in permeable surfaces to previously developed areas could reduce the impacts to water resources. Aside from induced development associated with Alternative D occurring as infill and redevelopment in primarily previously disturbed areas, federal, state, and local regulations should minimize the potential adverse effects to these aquatic resources as described for the other alternatives.

Table 2-20: Wetland, Stream, and Floodplains in Alternative D Induced Growth ICE Study Area

Resource	Quantity
Wetlands (acres)	511
Streams (linear feet)	211,837
Floodplains (acres)	6,058

Source: USFWS (2011), NHD

Alternative D would also have the greatest potential to adversely affect wildlife, wildlife habitat, and protected species compared to the other Build Alternatives because it has the potential to induce growth over the largest area. As described under the other Build Alternatives, this potential would be minimized because expected growth would occur in mostly in previously developed areas and some development would be subject to federal, state, or local regulations that require minimizing or mitigating impacts.

The potential effects of Alternative D's induced growth to historic properties would include all those discussed for the other Build Alternatives because Alternative D includes elements of all the other Build Alternatives.

2.7 STEP 7: ASSESS CONSEQUENCES AND DEVELOP MITIGATION

2.7.1 No-Build Alternative

Under the No-Build Alternative, no improvements to the Study Area Corridors would occur other than routine maintenance to existing facilities. This would result in increasing traffic congestion and associated lost productivity that could cause some individuals or businesses to leave the Hampton Roads region. This could result in impacts to community cohesion and loss of business and employment in the Socioeconomic Resources ICE Study Area. As no improvements would be made, no indirect effects to historic properties would occur under this alternative. Growth could occur in the Induced Growth ICE Study Area under the No-Build Alternative, but it would not be related to maintenance of existing Study Area Corridors. Routine maintenance does not hold potential for induced growth. As this alternative is the baseline against which the Build Alternatives are compared to assess environmental effects, no mitigation measures are proposed for the No-Build Alternative.

2.7.2 Alternative A

2.7.2.1 Encroachment Effects

Socioeconomic Resources

Alternative A would improve traffic congestion on the I-64 Study Area Corridor that would result in moderate reductions in lost productivity due to congestion, and increased business and employment due to increased regional transportation accessibility. Alternative A would benefit economics and employment.

Alternative A would result in some residential and community facility relocations. The full right-of-way and relocation effects cannot be understood until the property impacts are identified during final design. In accordance with the Uniform Relocation Assistance and Real Property Policies Act of 1970, as amended, relocated residents would be fairly compensated and relocation resources made available to all qualified relocated residents. Relocated property owners would be provided relocation assistance advisory services together with the assurance of the availability of decent, safe, and sanitary housing. Relocation resources would be made available to all relocated residents without discrimination. The relocation assistance process does not require that a relocated resident locate in a certain area or to a specific structure; however, community cohesion impacts are generally minimized when there is sufficient replacement housing available and relocated residents, businesses, farms, and non-profit organizations are able to relocate and remain within or in close proximity to their existing communities.

Due to the preliminary nature of this study, individual households were not contacted regarding potential relocated residents; therefore, it is not feasible to determine the specific relocation needs of each potential relocated resident. Potentially impacted properties were not inspected and property owners were not contacted to determine such factors as population per household, minority status, owner/renter status, or income level. Relatively few relocations would occur and those affected residents would be fairly compensated, and adequate similar replacement housing space is available in the affected communities. Therefore, relocation effects to community cohesion should be limited under Alternative A. Alternative A should have minor indirect effects to community cohesion, and housing in the Socioeconomic Resources ICE Study Area.

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 and businesses in advance of when such circumstances would occur, and working with individuals and the community to potentially adjust schedules and identify alternative access.

Natural Resources

Water Resources

Potential indirect effects to water resources have been estimated for water resources both in the Natural Resources ICE Study Area and in the Induced Growth ICE Study Area. Implementation of strict erosion and sediment control measures during construction would reduce temporary indirect impacts to surface waters. Modern temporary and permanent stormwater management measures, including stormwater management 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 would reduce or detain discharge volumes and remove many pollutants before discharging into receiving bodies of water. All VDOT projects on state-owned lands must comply with the Virginia Erosion & Sediment Control (ESC) Law and Regulations, the Virginia Stormwater Management (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. During construction, a water quality monitoring program could be implemented to evaluate real-time effects to water quality and

provide swift treatment if adverse effects are identified. During dredging, a waterbottom toxicity screening program could reduce effects to water quality and aquatic wildlife.

VDOT's practice is generally to maintain both water quality and quantity post-development equal to or better than pre-development, as described in current guidance, Minimum Requirements for the Engineering, Plan Preparation and Implementation of Post Development Stormwater Management Plans (Instructional and Informational Memorandum Number: IIM-LD-195.8, VDOT – Location and Design Division). Long-term impacts to water quality from contaminant loadings would 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). Development in any induced growth areas could be subject to the same erosion and sediment control as described above.

All roadway crossings would utilize structures designed to adequately pass design floods and accommodate passage of aquatic organisms. Re-alignment, re-sizing, and replacement of existing culverts can reduce overall current stream quality degradation by improving crossing locations, such as properly sized culverts. Design and construction techniques that reduce water quality impacts and protect aquatic species, as described in the Virginia Stormwater Management BMP Clearinghouse, would be incorporated into construction and maintenance of Alternative A. Drainage design for the new bridge-tunnel as proposed by Alternative A would be developed in later design phases, if this alternative were selected. The design would aim to minimize the indirect effects to water quality from drainage of the new bridges. Potential tanker spills would be handled using established hazardous material spill guidelines. Design modifications to eliminate or minimize floodplain encroachments to the extent practicable are required by Executive Order 11988: Floodplain Management.

Potential indirect effects to wetlands, streams, and floodplains would be minimized by regulations governing construction impacts to Waters of the US. These regulations require avoidance, minimization, and compensatory mitigation. Restricting the location of staging areas and temporary construction causeways in wetlands would reduce indirect effects. Implementation of strict erosion and sediment control measures during construction should minimize temporary impacts to wetlands. Additionally, various control measures would be incorporated into the roadway design and maintenance plans to reduce impacts to wetland hydrology and water quality, including stormwater BMPs as a means of mitigating expected impacts to water quality. BMPs also slow the release of stormwater, reducing erosion of wetlands and floodplains. Development in any induced growth areas could be subject to the same regulations.

Indirect effects to water quality from dredging can include reduced water quality during the activity and disposal of dredge material at land and water sites. These effects could occur as suspended sediments, release of toxicants, and soil erosion at landward disposal sites. Short-term increases in the level of suspended sediment can give rise to changes in water quality that can effect marine flora and fauna, both favorably and unfavorably, such as increased turbidity and the possible release of organic matter, nutrients and or contaminants, depending upon the nature of the material in the dredging area. This potential should be reduced by implementing BMPs to reduce turbidity and soil erosion as described above, and implementation of a water toxicity screening program during construction.

The potential indirect effects of Alternative A on water quality and Waters of the US should be reduced with the implementation of BMPs, minimization and mitigation measures.

Wildlife Habitat

The indirect effects to wildlife from habitat loss, fragmentation, and degradation due to reduced water quality or altered hydrology under Alternative A should be minimized and mitigated by the measures discussed above for water resources. Design modifications to culverts and bridges, mindful of maintaining

natural stream bottoms and natural shoreline preservation would be incorporated to reduce adverse indirect effects to aquatic wildlife. Restoration of SAV, wetland and riparian vegetation would reduce potential indirect effects to aquatic and terrestrial wildlife from loss of habitat, habitat fragmentation, and potentially reduced water quality. While dredging, a toxicity screening program could be implemented in areas with anticipated high contamination to identify any cause-effect release of toxic materials, and if a relationship were established, corrective action and mitigation would occur.

Habitat restoration and species restoration (such as oysters) in response to direct impacts would reduce indirect effects to wildlife from habitat loss, fragmentation, and degradation. 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.

Invasive plant species management techniques, as previously described, would minimize the indirect effects to wildlife and wildlife habitat from the introduction and spread of invasive species posed by construction of Alternative A and induced growth under Alternative A. VDOT's Roadside Development Specification 244 and Roadside Vegetation Management Policy includes 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.

Additionally, some indirect effects of Alternative A to wildlife can be reduced through use of design measures, such as bridging, countersinking culverts, and reducing the roadway footprint and median width. Using bridges for crossings of streams and associated riparian corridors serves to maintain some existing wildlife movement pathways, while fill with cross-pipes provides a deterrent to movement of certain wildlife species. Preliminary designs at this stage of the study do not incorporate details regarding these bridges and pipe culverts. These measures would be fully considered during design/permitting of Alternative A. Temporary construction impacts to fish and macroinvertebrates would be reduced through appropriate use of temporary stream crossing structures and strict adherence to erosion and sedimentation controls.

Rare, Threatened and Endangered Species

The potential indirect effects to threatened and endangered species under Alternative A could be reduced using the same measures as discussed above for wildlife habitat. Mitigation measures would be further developed following additional coordination with VDGIF and USFWS prior to construction. Through the consultation process under the Endangered Species Act, indirect effects are taken into account and appropriate mitigation measures identified. Consultation would occur before the permit decision, as any mitigation measures, conditions, or restrictions determined necessary by the USFWS would be conditions of any permit issued. Mitigation measures 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. Surveys for species may be required if potential habitat is identified. While many of these mitigation actions would be incorporated to offset direct impacts, they also would mitigate indirect effects outside of the area of direct impact.

Historic Resources

Mitigation for adverse effects to historic properties would be developed through the Section 106 process in later phases of the project.

2.7.2.2 Induced Growth

Alternative A has the potential to induce growth around the existing interchanges and major feeder roads along the I-64 Study Area Corridor between the I-564 interchange in Norfolk to the Settlers Landing interchange in Hampton. An Interchange Modification Report (IMR) for any existing interchanges

proposed for modification under Alternative A 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 cultural resources would not be substantial. No mitigation measures are proposed. 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 Ecological Effects and Historic Resources Effects sections above.

2.7.3 Alternative B

2.7.3.1 Encroachment Effects

Socioeconomic Resources

Indirect effects and minimization and mitigation measures to socioeconomic resources under Alternative B would be similar to those described for Alternative A; however, because construction would occur over a larger area, more beneficial and adverse indirect effects would occur to more communities under Alternative B than Alternative A. Although more relocations would occur under Alternative B than Alternative A, the narrow right-of-way width over a longer area would disperse indirect effects among different affected communities. Therefore, alternative housing or commercial space within the affected property owner's community would still be readily available. Conversely, Alternative B's smaller footprint in comparison to Alternative C and D would result in fewer indirect benefits and adverse effects to socioeconomic resources.

Temporary construction indirect effects to socioeconomic resources under Alternative B would be similar to those described under Alternative A and similarly minimized to a minor level.

Natural Resources

Alternative B would have similar indirect effects to natural resources as described for Alternative A, but on a larger scale. The same BMPs, minimization, and mitigation measures as described for Alternative A would reduce adverse indirect effects of Alternative B to natural resources. In addition, construction of the VA 164 Connector on structure could reduce its footprint and leave corridors open for wildlife movement. The DoD, Homeland Security, and POV would be coordinated with to provide access for mitigation to natural resources under their jurisdictions.

Historic Resources

Mitigation for adverse effects to historic properties would be developed through the Section 106 process in later phases of the project.

2.7.3.2 Induced Growth

Induced growth effects to socioeconomic resources, land use, natural resources, and historic resources under Alternative B would be the same as described for Alternative A, but on a larger scale. Because the I-564 Connector and VA 164 Connector interchange would be over water, there is no potential for induced growth there. As the majority of land along the VA 164 Connector is under government ownership, there is little potential for induced growth around the proposed VA 164 Connector / VA 164 interchange.

In addition to the IMR as described under Alternative A, VDOT would prepare an Interchange Justification Report (IJR) for any new interchanges if Alternative B were implemented to assess and mitigate potential land use change, adding additional identification of potential effects beyond those provided under NEPA.

As discussed for Alternative A, Alternative B would most likely result in infill or redevelopment in highly urbanized communities, reducing potential effects to socioeconomic, natural and cultural resources. As local governments guide where and what type of growth will occur, no mitigation measures are proposed.

2.7.4 Alternative C

2.7.4.1 Encroachment Effects

Socioeconomic Resources

The types of indirect construction and operation effects to socioeconomic resources of Alternative C would be similar to those described for Alternatives A and B, however, because they would occur over a larger area, it would have beneficial and adverse impacts to more communities than these latter Build Alternatives. The exception is Alternative C would not improve the I-64 Study Area Corridor and thus would have fewer beneficial and adverse impacts to that area of Norfolk and Hampton. The effects of Alternative C from relocations, and therefore to housing and community cohesion would be similar to those described for Alternative B, but on a larger scale. Similarly, because of the linear nature of the right-of-way required, impacts would be distributed among many communities. Adequate replacement housing and commercial or other space should be available for relocated residents.

This alternative would also be more beneficial to business and individual productivity than the other Build Alternatives, as it would construct a new crossing extending across the entire Hampton Roads, providing another viable diversion route during traffic incidents at other crossings. It would also have more indirect benefits to transit-dependent populations than the other alternatives by including dedicated transit lanes in addition to providing more general-purpose lanes.

Minimization and mitigation measures of adverse indirect effects to socioeconomic resources under Alternative C would be similar to those described under Alternative A.

Natural Resources

Alternative C would have indirect effects to natural resources similar to Alternative A and B but on a larger scale. Potential BMPs, minimization, and mitigation measures would be as described for Alternative A.

Historic Resources

Mitigation for adverse effects to historic properties would be developed through the Section 106 process in later phases of the project.

2.7.4.2 Induced Growth

Alternative C may induce growth near existing interchanges along I-564 and I-664 and feeder roads in the Induced Growth ICE Study Area. The greatest potential for induced growth to change existing land use would be along I-664 on the Southside, as less developed land occurs there within the Induced Growth ICE Study Area. However, most of the induced growth associated with Alternative C on the Southside is anticipated to occur in designated growth areas. Anticipated induced growth under this alternative along I-664 in Hampton and Newport News would be infill and redevelopment in highly urbanized settings. Some of the anticipated induced growth could occur outside designated growth areas. As described for Alternative A, land use is guided by local governments that frequently update their land use plans. The comprehensive planning process serves to reduce the potential for growth in unwanted areas.

Similar to Alternative B, Alternative C would not likely induce growth around the I-564 Connector / VA 164 Connector interchange as it is over water. Similarly, induced growth is not expected along I-564 or the VA 164 connector because they are predominately bordered by government lands. An additional new interchange proposed under Alternative C would be over water at the MMMBT and I-664 Connector, and

therefore would have no induced growth potential in that area. The types of potential induced growth impacts to socioeconomic, natural and cultural resources under Alternative C would be similar to those described for the other alternatives. For the reasons outlined for Alternatives A and B, no minimization or mitigation measures to socioeconomic, natural, or historic resources for induced growth effects are proposed.

2.7.5 Alternative D

2.7.5.1 Encroachment Effects

Socioeconomic Resources

As Alternative D would improve all the Study Area Corridors, it would have the most beneficial and adverse effects to socioeconomic resources compared to the other Build Alternatives. The direct effects of Alternative D to housing and therefore community cohesion would be similar to that described for Alternative C, although on a larger scale; this would still be a minor indirect effect to communities due to the limited number of relocated residents and the distribution of relocation effects over small areas within many communities. Minimization and mitigation measures of indirect effects to socioeconomic resources under Alternative D would be similar to those described for the other Build Alternatives.

Natural Resources

Alternative D includes elements of all the other Build Alternatives and would therefore have the most indirect effects to natural resources as previously described. Measures to minimize and mitigate adverse indirect effects to natural resources would be the same as described for the other Build Alternatives.

Historic Resources

Mitigation for adverse effects to historic properties would be developed through the Section 106 process in later phases of the project.

2.7.5.2 Induced Growth

Alternative D includes elements of all of the other Build Alternatives, and so would have similar types of induced growth effects to land use, socioeconomics, natural and historic resources as described for those alternatives. For the same reasons as discussed for the other Build Alternatives, no minimization or mitigation measures for the indirect effects of induced growth are proposed.

3. CUMULATIVE EFFECTS

As noted in **Section 2.2** the cumulative effects analysis is based on the 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 Impacts in the NEPA Process (FHWA, 2014). The following sections follow this direction.

3.1 STUDY AREA AND GEOGRAPHIC SCOPE

Figure 3-1 shows the geographic limits of the Cumulative Effects Study Area. It corresponds to the Natural Resource ICE Study Area boundary that encompasses natural, socioeconomic, cultural and induced growth ICE Study Areas described in **Section 2.2.1** of this report.

Figure 3-1: Cumulative Effects Study Boundary

3.2 WHAT ARE THE TEMPORAL BOUNDARIES FOR THE STUDY?

The analysis of cumulative effects must consider past, present, and reasonably foreseeable future actions. The temporal boundary used to establish the timeframe for this cumulative effects assessment spans from 1955, when construction of I-64 within the Study Area Corridors began, to 2040, which is the modeled design year used for the Build Alternatives in the HRCS SEIS.

3.3 WHAT ARE THE RESOURCES AFFECTED BY THE STUDY?

The resources affected by the Build Alternatives would be the same as those resources identified in Step 3 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 that is largely built-out in the Cumulative Effects Study Area. As discussed in detail in **Section 2.2**, continual land use intensification in the Hampton Roads 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 Cumulative Effects Study Area. The extent of impaired waters in the Cumulative Effects Study Area are the best available measure of the magnitude of cumulative effects to Waters of the US. 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 (EPA, 2016).

The following identifies specific past actions since 1955 that have contributed to existing conditions within the Cumulative Effects Study Area. The following past transportation, major development, military and port activities are focused upon as the most relevant to understanding the potential cumulative impacts of the HRCS alternatives. Permit data is not available for many of these projects; however, some of these developments are clearly visible in the historic mapping and aerials included in **Appendix C**.

Given the age of most of these improvements, permitted impacts are not available. The major roadway projects include:

- I-64, with the initial section in the Hampton Roads region opened in 1957. The section in Newport News and Hampton was widened from four to six lanes in two projects between 1979 and 1988 (Roads to the Future, 2016). I-64 is the only interstate into and out of the Hampton Roads region.
- I-264 was originally located between two interchanges with I-64 between Bowers Hill in Chesapeake and the junction in Norfolk, and was designated in the late 1950s. The stretch of I-264 to the east, now known as the Virginia Beach Expressway, was originally built in 1967 as a toll road with four lanes, and was widened to six lanes in the 1980s and to eight lanes in the early 1990s. I-264 connects Portsmouth and Norfolk through the Downtown Tunnel and Berkley Bridge that were constructed in 1952.
- I-464 connects I-64 in Chesapeake to I-264 in downtown Norfolk at the Berkley Bridge and Downtown Tunnel, just outside the Natural Resources ICE Study Area boundary. Opened between I-64 and US 13(Military Highway) in 1967 and extended north in 1987, I-464 connects directly to

the Virginia 168 Chesapeake Expressway, which comprises a limited access facility southward to the North Carolina State Line for travelers headed to the Outer Banks.

- I-564 connects NAVSTA Norfolk to the east to I-64 for a total of approximately 3 miles. I-564 was completed in the early 1970s and is also known as Admiral Taussig Boulevard.
- I-664 starts at the junction of I-64 and I-264 at Bowers Hill in Chesapeake and continues north for approximately 21 miles to I-64 in Hampton. I-664 crosses Hampton Roads on the MMMBT, which was completed in 1992. The roadway between I-64 and Aberdeen Road in Hampton was first completed in 1971, while the section south of Aberdeen Road was completed in 1989 prior to construction of the MMMBT. The roadway south of the MMMBT was partially completed in 1990 and connected with Bowers Hill in 1993.
- VA 164 known as the Western Freeway is approximately 7 miles long and connects I-664 and Route 17 in Suffolk with US 58 in Portsmouth. This roadway includes a crossing of the Western Branch of the Elizabeth River on the West Norfolk Bridge. The West Norfolk Bridge was part of the first section of the Western Freeway to be completed in 1979 in order to replace an outdated bridge originally built in the 1920s. The last part of the roadway, west of the bridge, was completed in 1992.
- US 17 James River Bridge was originally completed as a two-lane bridge in 1928, later replaced with a new four-lane bridge in 1982. The bridge connects Newport News across the James River with Isle of Wight County.

Five large bridge tunnels have been constructed within the Cumulative Effects Study Area since 1955 that have served to connect the Hampton Roads region. Given the age of most of these improvements, permitted impacts are not available. These projects include:

- The 3.5-mile long HRBT opened with the first set of lanes in 1957; the second set of lanes was opened in 1976.
- The Chesapeake Bay Bridge Tunnel (CBBT) constructed in 1964 connecting Northampton County on the Eastern Shore to Virginia Beach
- The 4.6-mile long MMMBT opened in 1992 connecting Chesapeake with Newport News.
- The Midtown Tunnel opened in 1962, connecting Portsmouth with Norfolk via Route 58. A second set of lanes and parallel tunnel is currently under construction.
- The Downtown Tunnel opened in 1952, connecting Portsmouth with Norfolk via I-264, and expanded to four lanes in 1989. Traffic can continue north over the Eastern Branch of the Elizabeth River using the Berkley Bridge into Norfolk, or can turn south and travel on I-464 towards Chesapeake. The existing Berkeley Bridge was completed in 1952 along with the Downtown Tunnel and subsequently widened in 1989.

Recently completed transportation projects within the Cumulative Effects Study Area are listed in **Table 3-1.**

Table 3-1: Recently Completed Transportation Projects

Project
Gilmerton Bridge replacement and additional channel clearance to limit bridge openings, larger bridge deck to accommodate future widening of Military Highway, Chesapeake
South Norfolk Jordan Bridge replacement with a higher, fixed span bridge, Chesapeake
Wesleyan Drive, widen to 4 lanes from Northampton Boulevard to Baker Road, Norfolk to Virginia Beach
Hampton Boulevard Railroad Grade Separation - Hampton Blvd in Norfolk was lowered below the existing railroad tracks, thus eliminating interruptions to vehicular traffic

Several military facilities are located within the Cumulative Effects Study Area that were constructed or expanded since 1955. They include:

- NAVSTA Norfolk – 4 miles of waterfront space and 7 miles of pier and wharf space of the Hampton Roads peninsula known as Sewell's Point. Established in 1917, by the end of World War II, the base became much more industrial in nature, including becoming a major supplier of aircraft parts and a rework plant. The Naval Aviation Depot Norfolk plant was closed in 1996 as part of the Congressional Base Realignment and Closure Act.
- Naval Support Activity (NSA) Hampton Roads – Located east of NAVSTA Norfolk and north of Terminal Boulevard, NSA Hampton Roads hosts fleet headquarters administrative and communication facilities with 6,000 personnel and several major tenant commands. It is located where the Atlantic Fleet Headquarters Support Activity was established in 1977, and reorganized in 2000 to Naval Support Activity Norfolk, which subsequently changed its name to NSA Hampton Roads in 2011.
- Mid-Atlantic Military Family Housing – Located south of Little Creek in Norfolk near the Joint Expeditionary Little Creek-Fort Story Base is a small area of military housing across from Tarralton Elementary School.
- Craney Island US Naval Supply Center – Depicted as a US Naval Reservation on the 1955 historical topographic map near the mouth of the Elizabeth River opposite Lambert's Point. By 1964, construction of the US Army Disposal Center had begun to the north of what was now depicted as the US Naval Supply Center. The northern portion of CIDMMA was completed using dredged materials sometime before 1973. The Craney Island Fuel Terminal located at the southeastern corner of the island, possesses 1,100 acres of above- and below- ground fuel storage tanks providing fuel, lubricants and fuel related service to approximately 256 fleet ships. Facilities include 60 storage tanks and over 100 miles of pipeline.
- US Coast Guard Base Portsmouth – Land was purchased in 1974 south of the Craney Island Naval Supply Center along the coast of the Elizabeth River and construction underway in 1983.
- Joint Staff Suffolk Complex – Newly assembled after dissolution of the Joint Forces Command in 2011, the Joint Staff Suffolk Complex replaced the Joint Warfighting Center in North Suffolk near the I-664 and College Drive interchange. It contains elements of Navy Cyber Forces, Navy Cyber Defense Operations Command, and Naval Network Warfare Command.

Listed below are state-run and private ports in the Cumulative Effects Study Area, major shipyards, a dredged material management area, and Hampton Roads:

- Hampton Roads – The Norfolk Harbor and Channels, Virginia project is a long-term effort in partnership with USACE and the Virginia Port Authority initiated in 1986. It is a network of federally managed navigation channels that has been constructed in separable elements including the Outbound Element completed in 1989; the 50-foot Anchorage in 1999, and 50-Foot Inbound Element in 2007 (USACE, 2015). All federal navigation channels are continually maintained by dredging. The USACE is currently conducting a study to determine if a number of these channels should be dredged to meet or exceed their congressionally authorized depths.
- Portsmouth Marine Terminal (PMT) – 287 acres of land located on the west bank of the Elizabeth River, the terminal was largely built upon reclaimed land from dredged material from construction of the Midtown Tunnel that was completed in 1962.
- Norfolk International Terminals (NIT) – Located south of NAVSTA Norfolk in Hampton Roads on 567 acres along the Elizabeth and Lafayette Rivers, NIT is the POV's largest terminal. The land was originally a military site that Norfolk purchased in 1965. The terminal originally had one berth and

one crane but was upgraded starting in the early 1970s with a second container berth and two more cranes. The terminal continued to expand until 2008 when the three newest and largest cranes were installed. Thousands of trucks are processed through the existing 17 interchange lanes. The port has plans for expansion of up to 26 interchange lanes.

- Virginia International Gateway (VIG) – Opened in 2007, VIG is the largest privately owned container terminal in the US at 576 acres. It is leased by the POV. The port has plans to add approximately 60 additional acres of space to the terminal.
- Newport News Marine Terminal (NNMT) – The NNMT has 165 acres of land on the north bank of the James River, just off I-664 in downtown Newport News, with easy access to I-64. The port was established in the late 1880's. Expansion of the terminal facilities included a second pier in the late 1960s, a third pier in 1972, and additional expansions in the 1990s and 2011.
- Major Private Ports – Kinder Morgan, Dominion Terminal Associates, and CSX (Chesapeake and Ohio Railroad) all hold port facilities southeast of NNMT at the southernmost tip of the Peninsula, directly southwest of I-664. Kinder Morgan and Dominion are coal port facilities.
- Major Private Shipyards – Newport News Shipbuilding/Huntington Ingalls is the nation's sole-industrial designer, builder, and re-fueler of nuclear-powered aircraft carriers located at the tip of the Peninsula just south of I-664. Established for 130 years but with changing ownership, the shipyard is a major employer in Hampton Roads region.
- Craney Island Dredged Material Management Area (CIDMMA) – Completed in 1957, the USACE used dikes to create an area to accept dredging material from the Elizabeth River and Hampton Roads to maintain the shipping channels. When funding becomes available, planned expansion of the CIDMMA would extend eastward. The POV plans to construct a new Craney Island Marine Terminal on top of the expanded CIDMMA, increasing the ports capacity by 20 percent (Virginia Places, 2016).

A recent major improvement project in the Cumulative Effects study area was the US Navy dredging of the Elizabeth River Channel from Lambert's Point to Norfolk Naval Shipyard in 2011 that established a 600-foot wide channel, deepening it from 40 feet to between 47 to 50 feet deep. The potential environmental effects of this action were evaluated in an EIS concluding with the ROD issued in 2009 [74 FR 46583, September 9, 2009].

Many residential developments were built following the construction of I-64 through Hampton, I-664 through Hampton, Newport News, Suffolk, and Chesapeake, and VA 164 through Portsmouth and Suffolk (see **Section 2.2.2.1** discussion of historic land use and **Appendix C** aerials). Other major developments in the Cumulative Effects Study Area since 1955 include:

- Hampton Coliseum: The first large multi-purpose arena in the Hampton Roads region and the state of Virginia, the Hampton Coliseum opened in 1970.
- Chesapeake Square: Anchored by the Chesapeake Square Mall that opened in 1989, the Chesapeake Square area is a mixed commercial and residential development in north Chesapeake.
- Harborview: Located in north Suffolk near the I-664/US Route 17 interchange, Harborview is a mixed development of retail, medical services, and residential development designed in concert with development of I-664 in the early 1990s.
- Hampton Roads Crossing: On the border of Suffolk and Portsmouth in the area northeast of the I-664/VA 164 interchange, Hampton Roads Crossing is a mixed use development of housing, commercial uses, and the MAST Center, a regional technology campus that opened in 2007.

- Peninsula Town Center: Officially opened in 2010 on the former Coliseum Mall location in Hampton, Peninsula Town Center features specialty retailers, restaurants, a movie theater and bowling alley.

One commercial airport and one military airfield are located in the Socioeconomic Resources ICE Study Area that were constructed before 1950, but continue to be updated and expanded:

- Hampton Roads Executive Airport – A public use, privately owned airport that is located near the intersection of I-64, I-664, I-264 and Route 58 in Chesapeake. A runway expansion project was completed in 2014.
- NAVSTA Norfolk Chambers Field – Located along the north side of I-564 on NAVSTA Norfolk, aircraft operating out of Chambers Field also utilize other Navy installations in the Hampton Roads region of southeastern Virginia, including Naval Auxiliary Landing Field (NALF) Fentress in Chesapeake, Virginia. Recently, City of Norfolk and NAVSTA Norfolk have been addressing incompatible development surrounding Chambers Field.

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 Hampton Roads Crossing under consideration in this SEIS, there are numerous VDOT actions planned within the Cumulative Effects Study Area, as identified in VDOT's Six-Year Improvement Program (SYIP). In addition, the HRTPO CLRP, *2034 Long-Range Transportation Plan* (HRTPO, 2012)[5] lists regional projects that add capacity to the transportation network. The 2034 (LRTP) is the currently approved plan. The 2034 LRTP lists committed projects (which are currently in VDOT's SYIP) and regionally funded construction projects (which evolved through a prioritization process). Projects on these lists 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. **Table 3-2** lists all of the present and reasonably foreseeable future transportation projects that would add capacity within the Cumulative Effects Study Area and notes the status of each project. These projects would all contribute to cumulative impacts related to socioeconomic, natural and historic resources.

The I-564 IC shares similar footprint and limits of disturbance (LOD) as portions of the improvements proposed under Alternatives B, C, and D. At this stage, it is not appropriate to make decisions on which areas are shared impacts, as the I-564 IC may have permit modifications and this study is based on limited engineering. It is worth noting, however, that some of the impacts assumed under Alternatives B, C, and D may occur under the I-564 IC.

When conducting cumulative effects analysis, FHWA and VDOT consider "Reasonably Foreseeable Future Actions" to be those actions that are fiscally constrained in the region's LRTP. At this time, efforts are underway to finalize and adopt the region's 2040 LRTP. This action has the potential to modify the reasonably foreseeable future projects considered in this document. One potential project not funded in the 2034 LRTP but proposed for funding in the 2040 LRTP is the Air Terminal Interchange (ATI) on the I-564 IC. The ATI would represent a new interchange on the proposed I-564 IC to service NAVSTA Norfolk, NSA Hampton Roads, and the public. As this project has not been funded in the current LRTP and an IJR has not been completed to confirm its location and layout, it is not considered in the cumulative effects analysis. However, given its proximity to Study Area Corridors, it is noted in this document.

[5] The 2040 LRTP has not yet been approved at the time of the preparation of this report.

Table 3-2: Present and Reasonably Foreseeable Future HRTPO Transportation Projects within the Cumulative Effects Study Area

Project	Status
Elizabeth River Tunnels Project – addition of a new two-lane tunnel adjacent to the existing Midtown Tunnel, maintenance and safety improvements to the existing Midtown and Downtown tunnels, extension of the Martin Luther King (MLK) Freeway from London Boulevard to I-264, and interchange modifications at Brambleton Avenue and Hampton Boulevard	Under Construction
I-564 IC – Extends I-564 to connect to Norfolk Naval Base and Norfolk International Terminals, Norfolk	Under Construction
Portsmouth Boulevard improvements widen to 4 lanes between Jolliff Road and Suffolk City line, Chesapeake	In Design
I-64 Widening Segment 1 from Jefferson Avenue Exit 255 to Yorktown Road Exit 247	Under Construction
Conventional Passenger Rail Service from Norfolk to Richmond/Northeast Corridor, along existing Norfolk Southern and CSX tracks, Norfolk	In Design
I-64 Interchange at LaSalle Avenue ramp widening to allow dual left turn lanes and right turn lane, Hampton	In Design
Military Highway widening from Robin Hood Road to Lowery Road, Norfolk	In Design
Turnpike Road widening from 0.13 miles east of Frederick Boulevard to Constitution Avenue, Portsmouth	Under Construction
I-64 Widening and High Rise Bridge Replacement	NEPA Study
Nansemond Parkway widening from Chesapeake City Line to Norfolk Southern Railroad, Suffolk	In Design
Chesapeake Bay Bridge-Tunnel Parallel Thimble Shoal Tunnel – addition of a new 2-lane tunnel, Virginia Beach to Northampton	In Design

Source: HRTPO 2034 Long Range Transportation Plan; VDOT Six-Year Improvement Program.

Numerous studies are being conducted in the Hampton Roads region to further develop transportation in the region. In 2014 the I-64 / High Rise Bridge Corridor Study culminated in an EA. This study looks to relieve traffic conditions by expanding 8 miles of I-64 between the I-464 interchange and the I-664 / I-264 interchanges at Bowers Hill including the G.A. Treakle Memorial Bridge (High Rise Bridge). Hampton Roads Transit is studying the expansion of light rail to NAVSTA Norfolk and ODU in Norfolk, and rapid transit on the Peninsula (Peninsula Fixed Guideway Corridor Study).

Other local non-transportation projects being studied by other state and federal agencies and private developments have been identified by examining local and regional plans and capital improvement project lists, described in **Table 3-3**. These projects would all contribute to cumulative impacts related to socioeconomics, natural and historic resources.

Table 3-3: Present and Reasonably Foreseeable Future Non-Transportation Projects within the Cumulative Effects Study Area

Project Name	Project Type	Project Description
Chesapeake		
Stormwater & Drainage	Stormwater & Drainage	Various Stormwater and drainage projects – Citywide

Project Name	Project Type	Project Description
Oceaneering International	Energy Facility	An oilfield engineered services and products provider primarily to offshore oil and gas industry will expand to a new 150,000 square foot facility in Greenbrier North Commerce Park
Kroger Marketplace	Retail Development	Located at South Military Highway and I-64, will include four retail stores
Lidl Grocer	Retail Development	36,000 square foot development in Chesapeake Square
Hoffman Beverage	Commercial Development	195,000 square foot warehouse expansion at 4105 South Military Highway
Sonny Merryman Inc.	Commercial Bus Facility	37,000 square foot bus service facility in Cavalier Industrial Park
Hampton		
Multi-Use Trails	Recreation	Trail construction of Newmarket Creek Trail & Pine Chapel Road Trail
Waterway Projects	Stormwater, Drainage & TMDL	Improvements to and maintenance of the waterways in Hampton, including the City's compliance with the Chesapeake Bay TMDL requirement – Citywide
Coliseum Crossing	Commercial Development	8,225 square foot expansion on Coliseum Drive
Riverpointe Shopping Center	Commercial Development	Overhaul of old Riverdale Plaza to include a 123,000 square foot Kroger Marketplace and 91,000 square foot At Home
Isle of Wight		
Eagle Harbor Apartments	Residential Development	New apartments and detached garages on 15.93 acre site off US Route 17
Newport News		
Downtown Initiatives	Community Development	Waterfront redevelopment and enhancements to Historic Downtown
Southeast Community Development	Community Development	General urban developments which include survey of existing buildings, acquisition, demolition, relocation, infrastructure to improve the overall quality of life for citizens and revitalize the community
32nd Street Drainage Improvements	Stormwater Drainage	Rehab or replacement of drainage system to ensure the efficiency to the entire drainage network –less resources will be needed to respond and repair to recurring sinkholes
River Road Shoreline Stabilization	Stormwater Drainage	Reduce erosion of the existing embankments, loss of shoreline and protection of the City's roadway and underground utilities
Watershed Protection Improvements	Stormwater, Drainage	Citywide project will design and construct regional wet detention ponds to improve water quality of runoff into the reservoirs
Upper Newmarket Creek Drainage Improvements	Stormwater, Drainage	Project to reduce the flooding during the 10-year and 50-year storm events along the upper section of the watershed

Project Name	Project Type	Project Description
Huntington Ingalls Industries	Commercial Development	Adding a 22,000 square foot health center at Newport News Shipbuilding
Printpack	Commercial Development	50,000 square foot warehouse facility expansion to 10.7 acres in Oakland Industrial Park
Newport News Shipbuilding	Commercial Development	52,000 square foot headquarters expansion at 4104 Washington Avenue
Brooks Crossing	Mixed use Development	Redevelopment area along Jefferson Avenue between 14th and 35th Street constructing Jim's Local Market and the completed South Police Precinct facility
Norfolk		
Citywide Stormwater Quality Initiative	Stormwater, Drainage	Citywide effort to continue best practice used to reduce storm water related pollutants entering local waterways, rivers and the Chesapeake Bay
Develop Bicycle, Pedestrian Greenways, Sharrows and Complete Street	Recreation	Develop citywide transportation connectivity initiatives. Construction of new bike and pedestrian trails and curb improvements
Stormwater Waterfront Facilities	Stormwater	Citywide effort to initiate non-routine inspections, repair, rehabilitation and replacement of deteriorated bulkheads
Improve Downtown Corridor Streetscaping	Community Development	Streetscaping and corridor improvements in the Central Business District. Curb installation, sidewalks and paths to encourage pedestrian friendly environment
Norfolk Premium Outlet Mall	Retail Development	350,000 square foot retail outlet mall near Northampton Boulevard and I-64
Ikea	Retail Development	331,000 square foot store on 19 acres at the northwestern corner of I-64 and Northampton Boulevard. Will involve interchange modification on I-64
Waterside	Retail Development	Overhaul of Waterside District in downtown
Automatic Data Processing Inc.	Office Development	New headquarters near downtown Waterside expected to bring 1,800 jobs
Sentara Norfolk General Hospital	Institutional Development	Revamping and adding three floors to existing structures dating from 1950s to 2006
The Main	Commercial Development	A new mixed use entertainment, meeting, dining and hotel destination at the corner of Main and Granby
Movement Mortgage	Commercial/ Office Development	Moving to Military Circle and overhauling the former JC Penney site
The Railyard	Retail/Office Development	New retail and office center on 13 acres at Lambert's Point
Portsmouth		
Citywide Stormwater Drainage Improvements	Utilities	Upgrade existing facilities and install new infrastructure

Project Name	Project Type	Project Description
Multi-purpose Recreation Field/Facility at Greenland Road (Former Stump Dump)	Community Development	Converting the former "stump dump" facility on Greenland Road into a multi-purpose regulation-sized outdoor recreation field with artificial turf and include parking and trail access for the Hampton Branch Trail System
Dredging of Lakes/Ponds	Stormwater	Enhance water quality by re-establishing original lake/pond depths by removing organic materials and sediment by dredging
Closing Craney Island Landfill	Utility	This facility will be at capacity by 2017 and is planned to be closed by 2018.
InterChange Group, Inc.	Industrial Development	New industrial site on 12.5 acres at 2175 Elmhurst Lane
ZPMC	Industrial Development	7,500 square foot facility at 4018 Seaboard Court in the Greenwood/Elmhurst Industrial Corridor
PER Properties	Industrial Development	New concrete facility on 16 acres along the Elizabeth River
Vane Brothers Company	Office Development	Expansion of waterfront facility at 4565 Burtons Point Road
Bon Secours Maryview	Institutional Development	Located in Midtown, plans include 60,000 square foot expansion
MAST Center Office Park	Institutional/Retail/Office/ Residential Development	Technology park on the Portsmouth/Suffolk boundary off College Drive
Suffolk		
Water Source Development and Water Treatment Expansion – Suffolk	Utilities	Improvements to water supply infrastructure and G. Robert House treatment plant
Sanitary Sewer System Upgrades – Suffolk	Utilities	Improvements and upgrades to City's sanitary sewer system and including drainage facilities
Hampton Roads Crossing	Retail/Office/ Residential Development	148 acre mixed use development off College Drive
Tidewater Community College Real Estate Foundation	Mixed Use Development	Planning for best use of the historic Pig Point Depot now owned by Tidewater Community College
Harbour View	Mixed Use	Continuing mixed use development in retail and residential areas such as Riverfront and Harbour View Golf community

Project Name	Project Type	Project Description
Others		
The Norfolk Harbor and Channels Deepening Project Environmental Assessment – (USACE and POV)	Facilities	A 3-year feasibility study and Environmental Assessment for the deepening of the federal navigation channels extending from the Atlantic Ocean through the Chesapeake Bay into the Port of Hampton Roads. The study is anticipated to include an evaluation of a range of Norfolk Harbor Channels' dimensions
The Elizabeth River Project	Environmental Restoration	Various steps to restore the Elizabeth River through a series of projects that include the Money Point Revitalization, Paradise Creek Restoration, and the Lafayette River Project
USACE CIDMMA Eastward Expansion (partnered with the POV)	Facilities	Dredge material placement; future Craney Island Marine Terminal
Expansion of the NIT and VIG Terminals	Facilities	The POV requested $350 million from Virginia to expand the NIT and VIG Terminals in Norfolk and at CIDMMA in order to handle growing volume.
Intergovernmental Planning Pilot Project (Old Dominion University)	Plan	Develop a regional “whole of government” and “whole of community” approach to sea level rise preparedness and resilience planning in Hampton Roads region
National Disaster Resilience, US Department of Housing and Urban Development	Environmental Restoration / Facilities	Hampton Roads area will be receiving more than $120.5 million as part of the National Disaster Resilience Competition to help prepare for the effects of climate change, sea level rise, flooding and storms. Includes combination of natural infrastructure and integration with traditional resilience and storm hazard reduction strategies

3.5 WHAT WERE THOSE IMPACTS?

Cumulative impacts consist of the direct and indirect impacts of the alternatives under consideration in the HRCS SEIS in combination with the impacts of past, present, and reasonably foreseeable actions. Past, present, and reasonably foreseeable actions have already impacted or have the potential to impact land use and socioeconomic, natural, or historic resources, as does the proposed project. 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 such as society as a whole, an affected region, affected interests, and 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 impacts

- 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 3-4**). 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 3-4: 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 (Hampton Roads) 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

Past and present actions 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. Some past and present developments have resulted in large-scale residential, community facility, and business relocations that adversely affected community cohesion, such as construction of the interstate system and other major freeways. Transportation facilities such as I-64, I-664, and VA 164 have divided and isolated communities, reducing access to neighbors and services. As seen on historic aerials in **Appendix C**, I-64 was constructed through the previously established neighborhoods of Willoughby Spit, West Ocean View, and Northside through Norfolk. In Hampton, construction of I-64 separated Kings Square from Olde Hampton, and I-664 was built through the Hampton Terrace, Azalea Gardens, Powhatan Park and Park Place neighborhoods. In Newport News, I-664 construction impacted the Newsome Park, Huntington, Jefferson Park, Marshall, and Tucker Creek neighborhoods. In Portsmouth, construction of VA 164 separated Ebony Heights (a historically African American community) and Edgewood Park from Merrifields and Pepperwood in Churchland. I-664 is on the edge of Suffolk and Chesapeake, and therefore its construction did not substantially divide neighborhoods at that time, but as development has increased to either side of I-664, access has been limited to few interchanges and roads that cross under or over the interstate. Minority and low-income populations have historically been adversely affected by past interstate construction (Karas, 2015). Future actions that lead to growth and development are expected to be beneficial for some, but not for others. For example, growth could increase employment opportunities, but require relocations to accommodate. Current federal regulations require that adverse effects of federal actions consider and incorporate mitigation into decisions that adversely affect communities.

Past growth and development has also led to widespread land use change as the region transitioned from a largely dispersed agricultural society to intensified commercial, residential, industrial, and other land uses in the modern urbanized area of the Hampton Roads region. Since 1955 when the HRBT was built, this has led to four of the six cities in the Socioeconomic Resources ICE Study Area to be largely built-out, with future growth expected to occur as infill or redevelopment. Chesapeake and Suffolk are at a slightly

less intensive growth progression than the other cities, with future growth constrained by wetlands and conservation lands.

3.5.1.1 No-Build Alternative

The No-Build Alternative would not improve the HRCS Study Area Corridors and therefore would not result in any incremental effect to community cohesion, community facilities and recreation resources, land use, local economies, or environmental justice populations in the Cumulative Effects Study Area.

3.5.1.2 Alternative A

Past and present growth and development has resulted in largely built-out cities of Hampton and Norfolk along the I-64 Study Area Corridor comprising Alternative A. Growth of these cities has resulted in a loss of natural ecosystems and previously maintained agricultural land uses. Alternative A would improve an existing interstate, limiting the effects of converting other land uses to transportation compared to improvements on new alignment. The Induced Growth ICE Study Area of Alternative A is 93 percent built-out. Induced growth associated with Alternative A is expected to be limited to infill and redevelopment, primarily within urban areas designated by Hampton and Norfolk as suitable for such development. However, induced growth associated with Alternative A could also occur in areas outside of designated growth areas in Norfolk and Hampton that are primarily residential. This would likely lead to increased density rather than changes to land use type. Because transportation is only one element that can contribute to growth, it is difficult to predict the extent of induced growth associated with Alternative A. Code of Virginia § 15.2-2223 requires local land use planning to be updated every five years, limiting the potential for adverse effects to land use from induced growth.

Reasonably foreseeable transportation and other development projects are expected to convert more land use to future transportation and other uses in the Induced Growth ICE Study Area. The incremental contribution of Alternative A to cumulative land use changes would be minor as limited right-of-way would be required along an existing facility, and potential induced growth would be limited to infill and redevelopment in built-out cities.

Past and present growth and development has positively contributed to community cohesion in the cities of Norfolk and Hampton traversed by the I-64 Study Area Corridor by improving the standard of living for these communities. However, original construction of I-64 and the expansion of controlled access facilities such as military installations like NAVSTA Norfolk have separated neighboring communities. Future growth and development is expected to continue, benefiting community cohesion from increased productivity and services. Widening I-64 would marginally increase the separation distance between communities located on either side, but because the relationship between the interstate and adjoining communities has been established for nearly 60 years and all local road crossings would be maintained, indirect effects to community cohesion would be minor. Alternative A would also relocate some residences that border the I-64 right-of-way, however, the number of affected residences would be low (nine) and dispersed among the Willoughby Spit and Commodore Park neighborhoods on the edge of these communities. Relocated residents would receive relocation assistance and comparable replacement housing is available in the affected communities, therefore, limited community cohesion effects should result. Future transportation and redevelopment projects could potentially result in residential relocations within the Socioeconomic Resources ICE Study Area. The incremental contribution of Alternative A to cumulative effects to community cohesion would be minor because the direct and indirect effects would be minor.

Past growth and development also led to the provision of community facilities and recreational resources, and benefited local economies and long-term employment from increased access to markets and business customers. Both Hampton and Norfolk comprehensive planning provide for recreational opportunities in their communities. Past and present transportation improvements benefit community facilities and

recreational resources by increasing access. Existing severe congestion reduces access to these facilities and recreation areas. Future transportation projects and development would continue to increase access to community facilities and recreational resources while potentially displacing others. Alternative A would improve an existing interstate, minimizing potential effects to community facilities and recreational areas, while improving their accessibility. Construction of Alternative A would result in minor right-of-way acquisition near Hampton University and less than 0.1 acre at the Willoughby Boat Ramp. The access and functions of these community and recreation facilities would be unchanged. Other potential short-term, temporary construction effects could occur to community facilities from detours and loss of parking. Overall, the incremental contribution of Alternative A to cumulative effects to community facilities and recreational resources would be minor because the direct and indirect effects would be minor. Past, present and future actions would continue to have both positive and adverse cumulative effects to community facilities and recreation.

Minority and low-income populations have historically been adversely affected by large infrastructure projects such as interstate construction. Since 1994, federal regulations require federal actions to avoid disproportionate and highly adverse effects to minority and low-income populations. 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. Federal regulations would continue to avoid disproportionate and highly adverse effects of their authorized actions to minority and low-income populations whenever possible. Minority or low-income populations reside all along Alternative A through Hampton and Norfolk. Beneficial effects to minority or low-income populations as well as other travelers would be realized from reduced congestion and improved access to transportation under Alternative A. Residential relocations would occur within some of these areas designated as minority or low-income populations, however, it is not known at this time whether affected individuals could be minorities or low-income. Approximately 74 percent and 69 percent of the resident population in the two Census Block Groups where relocations would occur under Alternative A identified themselves as non-minorities. Relocated households (nine) would receive relocation assistance and similar replacement housing exists in the potentially affected areas. It is possible the potential effects to minority and low-income populations would be reduced with refined design in advanced phases of the project, and that relocations would not impact individual minority or low-income residents, reducing the potential for disproportionate impacts in the Alternative A corridor. Temporary, short-term construction effects of increased noise, dust, and visual changes would not be high and adverse to the affected EJ community. Future federal infrastructure and development projects may have effects to protected EJ populations; however, EO 12898 should continue to minimize adverse effects. Alternative A would have incremental effects to minority and low-income populations resulting in cumulative effects. Past, present and foreseeable future actions would continue to have both beneficial and adverse cumulative effects to minority and low-income populations.

Increased commerce and employment from past and present growth and development, including original construction of I-64, has benefited economic resources in Hampton and Norfolk along the Alternative A Study Area Corridor. Existing severe congestion reduces access to markets and customers, thereby reducing commerce and employment that could otherwise occur. Continued growth and development is expected to have a positive impact to local economies from increased customer demand and long-term employment opportunities. Alternative A would result in moderate improvements to transportation accessibility and reduced congestion providing greater capacity for efficient movement of more goods and people that benefits productivity and local economies in Hampton and Norfolk. Few residential and no commercial relocations would result under this alternative. Short-term construction effects to businesses from temporary detours and lost parking could occur that could cause some customer losses and make deliveries more difficult, but these effects would be temporary and minimized by advance notice of closures and directional signing, resulting in minor effects. Alternative A would have minor adverse and moderately positive incremental effects to local economies. Past, present and future growth

and development in Hampton and Norfolk is expected to result in positive cumulative effects to commerce and employment.

3.5.1.3 Alternative B

For largely the same reasons as described for Alternative A, Alternative B would have minor incremental effects to cumulative land use impacts. In addition to I-64, Alternative B would continue along I-564 in Norfolk, the I-564 Connector across the Elizabeth River, and the VA 164 Connector and VA 164 freeway in Portsmouth. These latter areas are also largely built-out from prior developments and induced growth associated with Alternative B could occur as infill and redevelopment. Much of the land along I-564 is owned by the military and the VA 164 Connector traverses CIDMMA and other military and state controlled lands. It is expected that no land use change from induced growth potentially related to Alternative B would occur in these latter locations.

Alternative B would also have moderate incremental effects to community cohesion. Its direct and indirect effects along I-64 would be similar to those described for Alternative A. Improvements along I-564 and VA 164 would be to existing roadway facilities where communities have been previously separated by their original construction, or later grew around them. Improvements to these corridors would be at the periphery of established communities and would not bisect residential areas or create new impediments to travel through communities. The I-564 Connector proposed under Alternative B would be over water and the VA 164 Connector would be primarily across government-controlled lands with little potential for community cohesion direct or indirect effects. Up to nine residential relocations (the same as Alternative A) and no commercial relocations would occur under Alternative B. The majority of the residential relocations would occur in the Willoughby Spit neighborhood of Norfolk, a minority population area. Similar to Alternative A, the race and/or ethnicity of potentially relocated persons is not known at this time. These relocations would occur on the edge of these communities near the existing roadway facilities. As stated in the Socioeconomic Resources section, the estimated right-of-way needed for Alternative B is conservative, and would be refined in more advanced design that may reduce relocation effects. Relocated residents would receive relocation assistance and comparable replacement housing is available in the affected communities. The incremental effects of Alternative B to community cohesion in Norfolk would be minor based on the number of relocations. Past, present, and future transportation projects and other actions are expected to have both positive and adverse cumulative effects to community cohesion.

Alternative B direct effects to community facilities and recreation resources would consist of minor right-of-way acquisitions (less than 12 acres) from six facilities including parks and recreation facilities, and a cemetery in Portsmouth, however, without affecting their access or functions. The majority of the impacts would occur at Fleet Park on NAVSTA Norfolk. No community facility relocations would occur under Alternative B. Other indirect temporary construction effects similar to those described for Alternative A could occur to community and recreational facilities and would be minor. The I-564 IC project currently in design would impact Fleet Park on NAVSTA Norfolk. Future actions are expected to provide additional recreational facilities while potentially displacing others. The incremental contribution of impacts of Alternative B to community facility and recreation resources cumulative effects would be minor because the direct and indirect effects of this alternative would be minor.

I-64, I-564, and VA 164 encompassed by Alternative B were originally constructed prior to 1994 when EO 12898 became effective. Similar to Alternative A, minority or low-income populations reside all along I-64 through Hampton and Norfolk, thus Alternative B would have similar direct and indirect effects in these areas. Additionally, minority populations reside along VA 164 through Portsmouth. These communities would benefit from the proposed transportation improvements under Alternative B that increases access to transportation. Relocated households (nine) (the same as Alternative A) would receive relocation assistance and similar replacement housing exists in the potentially affected areas. Although all

relocations under Alternative B would occur in Census Block Groups that meet the threshold for an EJ population, the minority or low-income status of potential relocated residents is not known at this time. Approximately 74 percent to 69 percent non-minority residents live in the two Census Block Groups with potential relocations. It is possible the potential effects to minority and low-income populations would be reduced with refined design in advanced phases of the project, and that relocations would not impact individual minority or low-income residents, reducing the potential for disproportionate impacts under Alternative B. Temporary construction effects of increased noise, dust, and visual changes would not be high and adverse to the affected EJ community. Future federal infrastructure and development projects may have effects to protected EJ populations; however, EO 12898 would continue to minimize adverse effects. Alternative B could contribute incremental effects to cumulative effects on minority and low-income populations in the Cumulative Effects Study Area.

Alternative B would result in moderate improvements to transportation accessibility and reduced congestion providing greater capacity for efficient movement of more goods and people that benefits productivity, long-term employment and local economies. No commercial relocations would result under this alternative. Short-term construction effects to businesses from temporary detours and lost parking could occur that could cause some customer losses and make deliveries more difficult, but these effects would be temporary and minimized by advance notice of closures and directional signing. Temporary job increases associated with construction of Alternative B would occur that would benefit the local economies of Hampton, Norfolk, and Portsmouth. Alternative B would have minor adverse and moderate positive incremental effects to local economies. Past, present and future transportation and other development actions are anticipated to have primarily positive cumulative effects to the economy of the Hampton Roads region.

3.5.1.4 Alternative C

Alternative C would be constructed through the cities of Hampton, Suffolk, Chesapeake, Portsmouth, and Norfolk. Because improvements would be made primarily along existing roadways, right-of-way requirements would consist of narrow corridors along existing facilities with less potential conversions of existing land use to transportation. Hampton, Portsmouth, and Norfolk are largely built-out, thus, any indirect induced growth associated with Alternative C construction could occur as infill or redevelopment in these cities. For the same reasons as discussed for Alternative B, no substantial land use change is expected to occur from implementation of Alternative C along I-564, and the proposed I-564 and VA 164 Connectors surrounded principally by government-controlled lands or over water. The area along I-664 through Suffolk and Chesapeake is less developed, but much of the undeveloped land bordering the interstate interchanges and feeder roads is within wetlands and conservation lands that would pose challenges to development. Nevertheless, induced growth pressures in these areas would likely be greater under Alternative C. Population growth is forecasted to increase approximately 136 percent in Suffolk and 50 percent in Chesapeake from 2009 levels to the year 2040 (HRTPO, 2013b). Further, almost all of the Induced Growth Study Area through Suffolk and Chesapeake is within designated areas for growth. Current land use in Suffolk and Chesapeake may change that is in part due to construction of Alternative C, but for the reasons discussed in **Section 1.2.2**, would be limited to within a few miles of I-664 interchanges, and would not conflict with local comprehensive land use planning. The incremental contribution of Alternative C to cumulative land use change in the Cumulative Effects Study Area would therefore be moderate.

Alternative C would primarily widen along existing transportation corridors and therefore would not further bisect residential areas or create new impediments to travel through communities. The only proposed new alignment on land is through the CIDMMA and southward along the VA 164 Connector, the majority of which is government land. Alternative C would result in ten residential relocations in the Hampton Terrace community of Hampton (near the I-64/I-664 interchange) and one relocation each in

Park Place in Hampton and Newsome Park, Newport News. Relocated households would receive relocation assistance and similar replacement housing exists in the potentially affected areas. In addition, four commercial relocations would occur. Future transportation and redevelopment projects could potentially result in residential and commercial relocations within the Cumulative Effects Study Area. Alternative C would have moderate incremental contributions to cumulative effects on community cohesion.

Alternative C direct effects to community facilities and recreation resources would consist of minor right-of-way acquisitions (10 acres) from four facilities including one religious facility, one school, and two park and recreation facilities. All but 1 acre of these effects would be at Fleet Park on NAVSTA Norfolk. This property would also be impacted by the I-564 IC currently in design. Other direct effects of Alternative C to community facilities and recreation resources include potential temporary construction impacts from detours and reduced parking. Based on the limited direct and indirect effects of Alternative C to community facilities and recreation resources, the incremental contribution of Alternative C to cumulative effects on these resources would be minor. As described for Alternative A, past, present and reasonably foreseeable transportation and other actions would continue to have both positive and negative cumulative effects to community facilities and recreation resources.

I-564, I-664, and VA 164 encompassed by Alternative C were originally constructed prior to 1994 when EO 12898 became effective. Similar to the other Build Alternatives, minority populations reside all along the Alternative C alignment, with some low-income population Census Block Groups located in Newport News and Norfolk portions of the Socioeconomic ICE Study Area. Several of the low-income Census Block Groups in Newport News are adjacent to I-664 at the tip of the Peninsula. These communities would benefit from the proposed transportation improvements under Alternative C that increases access to transportation. Under Alternative C, residential relocations (11) would occur in minority population areas, primarily in the Hampton Terrace area of Hampton as described above. Although all relocations under Alternative C would occur in Census Block Groups that meet the thresholds for an EJ population, the minority status of potentially relocated residents is not known at this time. Approximately 0 to 33 percent of residents in the affected three Census Block Groups are non-minority. It is possible the potential effects to minority populations would be reduced with refined design in advanced phases of the project, and that relocations would not impact individual minority residents, reducing the potential for disproportionate impacts in the Alternative C corridor. Temporary, short-term construction effects of increased noise, dust, and visual changes would not be high and adverse to the affected EJ community. Future federal infrastructure and development projects may have effects to protected minority and low-income populations, however, EO 12898 would continue to minimize adverse effects. Alternative C would have incremental effects contributing to cumulative effects to minority and low-income populations in the Cumulative Effects Study Area.

Alternative C would result in moderate improvements to transportation accessibility and reduced congestion, providing greater capacity for efficient movement of more goods and people that benefits productivity, long-term employment, and local economies. Five commercial relocations could result from this alternative, but affected businesses would receive relocation assistance. Short-term construction effects to businesses from temporary detours and lost parking could occur that could cause some customer losses and make deliveries more difficult, but these effects would be temporary and minimized by advance notice of closures and directional signing. Temporary job increases associated with construction of Alternative C would occur that would benefit the local economies of Chesapeake, Newport News, Norfolk, Portsmouth, and Suffolk. Alternative C would have moderate incremental contributions to positive cumulative effects on local economies because the benefits would be moderate and adverse direct and indirect effects of this alternative would be minor.

3.5.1.5 Alternative D

Alternative D would include elements of all the other Build Alternatives, except it would not include additional dedicated transit lanes as proposed under Alternative C. As such, Alternative D would have similar incremental contributions to cumulative effects on land use, community cohesion, community facilities, recreation resources, environmental justice populations, and local economies as described for the other individual Build Alternatives.

3.5.2 Natural Resources

Past, present, and reasonably foreseeable future growth and development actions in the Cumulative Effects Study Area have been primarily adverse to natural resources. Intensification of land use in the Hampton Roads region since 1955 has resulted in reduced water quality with many waters impaired for human and wildlife use; loss of wetlands, streams, and floodplains; substantial 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 Hampton Roads region. Hampton Roads is the receiving waters for the entire James River basin and is impaired for chlorophyll-a, enterococcus, nutrient/eutrophication biological indicators, and PCB in fish tissue.

All of these past and present 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 effects to natural resources. Past and present private conservation efforts have also positively contributed to natural resources in the region, such as the Hoffler Creek Nature Preserve in Portsmouth, the Chesapeake Bay Foundation, the James River Association, the Elizabeth River Project, and Nansemond River Preservation Alliance. Future growth and development in the Natural Resources ICE Study Area is limited because of the lack of developable land and land use policies that aim to concentrate growth while preserving natural lands. The effects of growth and development would also be limited because its effects would be primarily within previously disturbed areas.

3.5.2.1 No-Build Alternative

The No-Build Alternative would not improve the existing HRCS Study Area Corridors. Although stormwater management along the Study Area Corridors has been updated over the past 25 years with retrofitted and more modern systems as improvements have been made, there are still sections where there are not any stormwater management features or the features are outdated that would not be improved under the No-Build Alternative. Existing indirect effects associated with untreated or poorly treated stormwater runoff would continue. Under the No-Build Alternative, the existing fragmented and limited wildlife habitat existing within and adjacent to the Study Area Corridors would continue to degrade.

3.5.2.2 Alternative A

As previously discussed, past growth and development has diminished natural resources within the Natural Resources ICE Study Area encompassing Alternative A. However, current federal, state, and local regulations and non-governmental conservation efforts lessen the effects of such development.

Alternative A would widen an existing interstate in a highly urbanized area that has been previously disturbed. Alternative A would directly impact approximately8 acres of wetlands, 113 acres of floodplain, 147 acres of navigable waters, 12 acres of maintained navigable channels, and 1 acre of RPA. This

alternative would not directly impact known streams. Indirect effects to these resources could include reduced water quality as discussed below, as well as changes to floodwater storage capacity and retention times, vegetative community composition and structure (which affects wetland functions), and nutrient cycling. These direct and indirect effects should be minimized by implementation of best management practices and potentially compensatory mitigation as discussed in the Natural Resources direct effects section of the SEIS. With mitigation, the incremental contribution of Alternative A to adverse cumulative effects on wetlands and RPA should be minor, with moderate incremental effects to floodplains and navigable waters.

Under Alternative A, construction and post-construction discharges of stormwater, as well as dredging, would potentially contribute to minor, localized increases in the pollutants and nutrients causing impairment as measured by dissolved oxygen, benthic invertebrate communities, aquatic plants, and chlorophyll-a. Drainage design for the new proposed bridge structures would be developed in later design phases and is expected to be in conformance with current stormwater regulations in order to minimize downstream effects to natural resources and water quality. Alternative A is not expected to disturb soils with Enterococcus or fecal coliform, which impair several waterbodies in the area. Further, because Alternative A would upgrade existing systems that pre-date more stringent stormwater management regulations, impacts to water quality from highway runoff could be reduced compared to current roadway conditions. The James River at Hampton Roads is on the 303(d) list of impaired waters, and WetCAT analysis by VIMS indicate water quality in the Cumulative Effects Study Area is severely stressed (VIMS, 2016). Alternative A is not expected to substantially contribute to the further impairment of any impaired waterbodies. Ongoing present actions that could impact water quality include maintenance dredging of navigable channels in the Chesapeake Bay and Hampton Roads, and watershed protection and stormwater and drainage projects completed by cities in the Hampton Roads region (**Table 3-2**). Near future impacts could occur from the Norfolk Harbor and Channels Deepening Project administered by the USACE and POV. The adverse incremental effects of Alternative A to cumulative impaired water quality is anticipated to be moderate.

Dredging under Alternative A would be conducted to place the new tunnel for the HRBT. The new tunnel and bridges could potentially alter hydrodynamics, possibly directly and indirectly affecting aquatic habitat and navigation. The potential indirect effects of Alternative A to hydrodynamics are being evaluated by VIMS and will be presented in the Final SEIS. Dredging under Alternative A would generate approximately 1.2 million cubic yards of dredge material requiring disposal. Alternative A would have fewer indirect effects to regional dredge material capacity than the other Build Alternatives.

Several options are available to dispose of dredge material that require testing to evaluate suitability for various alternative uses and disposal sites. Therefore, the exact effects of dredge material disposal to natural resources and the regional capacity for dredge material disposal is not known at this time but would be determined upon advancing a Preferred Alternative. Ongoing, routine maintenance of navigable channels in the Chesapeake Bay and Hampton Roads, as well as future projects such as the Norfolk Harbor and Channels Deepening Project would continue to potentially impact hydrodynamics and regional dredging capacity in the Natural Resources ICE Study Area near the Alternative A alignment. Therefore, it can be anticipated short-term increases in the level of suspended sediment can give rise to changes in water quality that can affect marine flora and fauna, both favorably and unfavorably, such as increased turbidity and the possible release of organic matter, nutrients and or contaminants, depending upon the nature of the material in the dredging area. Generally, sediments settle within the vicinity of the dredged area, where they are likely to have little effect on the recently disturbed communities, particularly in areas where dredging is a well-established activity which has occurred within Hampton Roads for decades. These potential effects should be minimized by adherence to federal and state regulations. Although the exact effects of Alternative A to hydrodynamics and regional dredge material capacity are unknown at this time, it is expected this alternative would not have substantial incremental contributions to

cumulative effects on hydrodynamics and regional dredge material capacity due to the limited proposed tunnel footprint.

Past development and original construction of I-64 through Hampton and Norfolk has led to little remaining intact terrestrial wildlife habitat in the Alternative A Study Area Corridor and the Natural Resources ICE Study Area as a whole. Remaining habitat is highly fragmented along I-64 that is associated with habitat loss. Alternative A would cause some habitat loss, particularly near water crossings that tend to have greater integrity than areas on land along either side of the I-64 Study Area Corridor that have fewer legal protections. Alternative A would impact approximately 15 acres of forested terrestrial habitat. Habitat fragmentation can have wide-ranging indirect effects to wildlife, possibly resulting in: species shifts associated with greater edge habitat and less interior habitat (smaller patch size); lower diversity due to smaller habitat patches; potential isolation of populations; increased vulnerability of species to external competition and predation; potential decreased flow of genetic material through the landscape; restricting wildlife movements that disrupt foraging, breeding/nesting and migration; increased risk of invasive species establishment; and generally, reduced biological diversity. Roadway noise can 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. Widening of existing bridges and lengthening culverts under Alternative A could indirectly restrict wildlife movement through the riparian corridors crossed by these structures and alter upstream and downstream hydrologic flow. Direct effects 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 systems is important because they are a major pathway for energy flow and dissipation in the Coastal Plain, an area of flat, low-lying land with many rivers, marshes, and swamplands. All of these effects to terrestrial wildlife habitat can be reduced with appropriate mitigation and minimization measures as discussed in the Natural Resources direct effects section of this document. Continued growth and development would potentially reduce and degrade terrestrial habitat. Federal, state, and local regulations would continue for the foreseeable future to require minimization, mitigation, and compensation for terrestrial habitat direct and indirect impacts. The direct and indirect incremental contribution to cumulative effects of Alternative A to terrestrial habitat would be moderate.

Construction can increase the presence of invasive plant species enabled by earth disturbance and spreading from contaminated vehicles, clothing, and shoes. The spread of invasive species would be minimized by following provisions in VDOT's Road and Bridge Specifications. 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. While the Study Area Corridors 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. Future development actions could spread invasive species, and accidental releases of invasive species could occur. Adherence to the VDOT specifications under Alternative A would result in minor contributions to cumulative effects on habitat from invasive species.

Past development along the shoreline, bridges and tunnels, as well as navigation improvements and commercial and recreational fishing have impacted aquatic habitat. Impaired water quality associated with point and non-point pollution, and upstream obstructions along the James River have impacted aquatic wildlife and habitat in the vicinity of Alternative A. For example, archaeological evidence and historical records indicate anadromous fish species such as herring and shad migrated into the upper reaches of all major drainages in Virginia, including the James, Elizabeth, and Nansemond Rivers that meet in Hampton Roads (VDGIF, 2016). Heavy fishing pressure, dams, canals, and other obstructions have

substantially reduced anadromous fish populations. By 1990, the shad harvest was only approximately six percent of the total harvest documented at the beginning of the 20th Century.

Alternative A would impact 156 acres of aquatic habitat, 43 acres of shallow tidal water habitat, 154 acres of benthic habitat, 138 acres of EFH, HAPC and Anadromous Fish Use Areas, and 2 acres of SAV. In addition, any construction activity under Alternative A on the HRBT islands that generates noise or sediment could impact waterbird colonies. However, the colonies have demonstrated the ability to persist at this location amid disturbances from cars, boats, airplanes, constant shipping traffic, as well as coastal storms. Strict adherence to time-of-year restrictions and erosion and sediment control measures would minimize (to the maximum extent practicable) impacts to waterbird colonies. Surveys to locate existing waterbird colonies could also be required. While beach disturbance during construction may temporarily make areas inadequate for nesting waterbirds, Alternative A could ultimately augment the existing beach habitat, providing an opportunity for increased suitable nesting habitat along the I-64 corridor. Loss of habitat and direct impacts to any existing benthic communities could result from dredging associated with the tunnels, installation of bridge foundations, and the enlargement of the portal islands. Runoff from roadways could contain heavy metals, salt and associated materials, organic compounds, and nutrients. When runoff enters waters that are already impaired, the impacts are cumulative and can result in accelerated changes in the macrobenthic community structure and composition. In turn, this can affect the fish and amphibian populations that rely on them as a food source, as well as the birds and aquatic mammals that prey on the fish and amphibians. The effects 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. In addition, existing SAV beds occur along the eastern side of the north island of the HRBT, just west of Fort Monroe, as well as along the north shore of Hampton Roads between I-64 and I-664. SAV can be indirectly impacted by reduced water quality from stormwater runoff, and increased sedimentation and photic zone impacts from turbidity associated with dredging. Stormwater runoff treatment along I-64 would be improved under Alternative A, potentially neutralizing adverse effects of roadway runoff.

The adverse effects of Alternative A to aquatic habitat and wildlife would be minimized, mitigated, and possibly compensated as described in the Natural Resources direct effects section of the HRCS SEIS. Ongoing dredging associated with navigation maintenance in Hampton Roads would continue to affect aquatic wildlife and habitat in the vicinity of Alternative A, as would the proposed Norfolk Harbor and Channels Deepening Project. The relatively small increases in siltation away from the immediate dredging area of Alternative A are generally considered unlikely to have long-term adverse effects on benthic populations in areas that are routinely dredged. Based upon the direct and indirect effects of Alternative A, this alternative would have moderate incremental contributions to adverse cumulative effects to aquatic wildlife habitat occurring from past, present and future actions.

Past development and harvesting of wildlife has led to the very existence of some wildlife species to be threatened and endangered. Passage of the Virginia Endangered Species Act in 1972 and the federal Endangered Species Act in 1973 required state and federal agencies to avoid and minimize potential effects to designated rare, threatened, and endangered species and their critical habitat. Threatened and endangered species habitat within the I-64 Study Area Corridor includes the Hampton Roads Bridge-Tunnel Island Conservation Site that is habitat for federally listed shorebirds. As previously described, this habitat is already fragmented by the existing HRBT and surrounding development. Further, the widespread occurrence of common reed has rendered much of this habitat unsuitable for shorebird foraging. The majority of these estuarine areas would be bridged under Alternative A, limiting the direct loss of habitat, and thereby, limiting indirect effects associated with additional habitat fragmentation. Due to the presence of higher quality foraging habitat outside the Study Area Corridor but in the vicinity of Alternative A, disruption during construction activities should have little to no impact on the shorebird species. Additionally, summer roosting habitat has been confirmed for bat species within Alternative A (NLEB, Little brown bat, Tri-colored bat), and forested habitat is very fragmented. Alternative A would not

further degrade the quality of this habitat. Moreover, no confirmed maternity roosts or hibernacula are located within a 2-mile radius of the I-64 Study Area Corridor, further limiting the potential indirect effects on the species from encroachment. Future growth and development would occur in the Natural Resources ICE Study Area that could degrade threatened and endangered species habitat. State and federal regulations would continue to require their actions to avoid and minimize effects to threatened and endangered species. Based on the limited direct and indirect effects of Alternative A to protected species, the incremental contribution of Alternative A to cumulative effects on threatened and endangered species would be moderate.

3.5.2.3 Alternative B

Along existing I-64, Alternative B would have similar incremental effects to natural resources as described for Alternative A. However, Alternative B would also improve I-564, construct the I-564 and VA 164 Connectors on new alignment, and widen VA 164.

Alternative B would directly impact approximately 73 acres of wetland, 213 acres of floodplain, 215 acres of navigable waters, 24 acres of maintained navigable channels, and 16.0 acres of RPA. No impacts to known streams would result under Alternative B. The type of cumulative impacts to these water resources would be similar as described under Alternative A. Past development along the Norfolk shoreline has impacted water resources from the construction of the NAVSTA Norfolk docks and NIT. Water resources were also substantially impacted by decades of expansion of Craney Island using disposed dredge material (see **Appendix C** historic aerials). Continual maintenance of the CIDMMA affects wetlands along the shore of Craney Island. Future projects such as the Norfolk Harbor and Channels Deepening Project and the planned expansion of CIDMMA to the east, development of the CIMT, and expansion of VIG and the NIT Terminals would also continue to impact wetlands and navigable waters. The incremental contribution of Alternative B to adverse cumulative effects on wetlands, floodplains, navigable waters, and RPA would be moderate.

The I-564 Connector would involve constructing a tunnel extending from the Norfolk shoreline across the mouth of the Elizabeth River, a tunnel portal island north of CIDMMA, and trestle bridges. This area has been previously impacted by dredging and maintenance of the Norfolk Harbor Channel up the Elizabeth River, as well as expansion of CIDMMA to the east, and development along the Norfolk shoreline. The designs for the new HRBT and I-564 Connector tunnels would substantially influence the amount of dredging and fill needed, which in turn, could affect aquatic habitat, benthic species, EFH, HAPC and Anadromous Fish Use Areas, SAV, and threatened and endangered species. Together with improvements at the HRBT, Alternative B could impact 241 acres of benthic habitat and 214 acres of EFH, HAPC and Anadromous Fish Use Areas. No SAV is present along the I-564 Connector, so the effects of Alternative B to SAV (2 acres) would be the same as Alternative A. This alternative could result in direct aquatic habitat loss (201 acres), shallow water habitat (59 acres), and indirect degraded water quality from sedimentation, resuspension of sediment in the water column (turbidity), and potential release of toxicants from water bottom disturbance by dredging for the new tunnel and bridge facilities along the I-564 Connector. However, potential direct and indirect effects to aquatic habitat and wildlife would be minimized and mitigated as described in the Natural Resources direct effects section. Future expansion of CIDMMA further to the east, construction of the CIMT, expansion of the VIG and NIT, and the Norfolk Harbor and Channels Deepening Project would continue to impact aquatic habitat. The incremental contribution of Alternative B to adverse cumulative effects on aquatic habitat and wildlife would be moderate.

It is estimated Alternative B would generate approximately 4.1 million cubic yards of dredge material requiring disposal. As discussed for Alternative A, several options are available to dispose of dredge material that requires testing to evaluate its suitability for various alternative uses and disposal sites. Therefore, the exact direct and indirect effects of dredge material disposal to natural resources and the

regional capacity for dredge material disposal is not known at this time, hence, the incremental addition of this alternative to cumulative effects is unknown. However, we can anticipate short-term increases in the level of suspended sediment that can give rise to changes in water quality that affects marine flora and fauna, both favorably and unfavorably, such as increased turbidity and the possible release of organic matter, nutrients and or contaminants, depending upon the nature of the material in the dredging area. Generally, sediments settle within the vicinity of the dredged area, where they are likely to have little effect on the recently disturbed communities, particularly in areas where dredging is a well-established activity which has occurred within Hampton Roads for decades.

Alternative B incremental effects to terrestrial wildlife and habitat along I-64 would be the same as described for Alternative A. The area along I-564 is highly developed with highly fragmented habitat. Alternative B is estimated to impact 73 acres of forested habitat and 112 acres of threatened and endangered species habitat. Unlike the I-564 Connector, the VA 164 Connector would be constructed on new alignment, but it is being proposed for construction on land, not on structure and over water. The potential for the VA 164 Connector to be placed on structure was not considered for the ICE analysis, but if it is included in the Preferred Alternative, the possibility would be evaluated (if needed) to accommodate US Navy and US Coast Guard security requirements. In the absence of an elevated facility, the VA 164 Connector under Alternative B could result in habitat loss and fragmentation. Habitat loss resulting in habitat fragmentation may have wide-ranging effects to wildlife and biological diversity as described under Alternative A. The Craney Island Conservation Site is also habitat for federally protected shorebirds (Piping plover, gull-billed tern, Wilson's plover, and Red knot) potentially impacted by Alternative B. Because the VA 164 Connector would be constructed on the eastern edge of the CIDMMA with more suitable habitat to the west, the potential indirect effects of habitat fragmentation to wildlife and protected shorebird species is expected to be minimal in the vicinity of the VA 164 Connector. However, the alignment south of the island through government-controlled lands to its connection with VA 164 would have more severe habitat fragmentation indirect effects to wildlife. Summer roosting habitat for federally protected bats occurs along I-64 as described for Alternative A, and although some larger tracts of forest do exist in the Study Area Corridor along Coast Guard Boulevard north of VA 164, the potential indirect effects of Alternative B to bat roosting and foraging habitat would be similar to the types described for Alternative A. Canebrake rattlesnake habitat is located in forest habitat on the Coast Guard property, however, the habitat area is isolated and it is believed that the area is not able to support a viable population of the species long term. This area of the VA 164 Connector was also clear cut in the 1990s that likely eliminated any Canebrake rattlesnake population at that time. Therefore, Alternative B is not expected to have any direct or indirect effects to the Canebrake rattlesnake.

Future projects such as the I-564 IC currently in design, the expansion of CIDMMA and construction of the CIMT, and expansion of VIG would continue to impact terrestrial wildlife habitat within the Alternative B Study Area Corridor, as would other future development in the Cumulative Effects Study Area. In combination with past, present, and future actions, Alternative B would have moderate incremental contributions to cumulative impacts to terrestrial wildlife. It is anticipated further consultation with USFWS would result in measures to reduce effects of Alternative B to protected species.

3.5.2.4 Alternative C

As Alternative C would be the same width along I-564 and the VA 164 Connector as Alternative B, it would have the same cumulative effects to natural resources in these areas. With the addition of two dedicated transit lanes, Alternative C cumulative impacts to natural resources along the I-564 Connector would be the same type as described for Alternative B, but over a larger area. Alternative C would also widen the entire length of I-664, construct an additional tunnel alongside the MMMBT, and construct the I-664 Connector. No improvements would be made to the I-64 corridor and improvements to VA 164 would only include tying in the VA 164 Connector.

Past development and construction of the I-664 and the MMMBT as well as navigation improvements have impacted water resources in the Alternative C Study Area Corridor. Water quality has been impaired by previous and ongoing point and non-point pollution. The types of cumulative effects of Alternative C to wetlands, floodplains, navigation channels and RPA's would be the same as described for Alternative A and B, but would occur on a larger scale. Alternative C is estimated to directly impact 112 acres of wetlands, 370 acres of navigable waters, 57 acres of maintained navigable channels, and 127 acres of RPA. In addition, it could impact 548 linear feet of streams along I-664. Alternative C would impact 213 acres of floodplains. The types of indirect effects to these water resources under Alternative C would be similar to the type of indirect effects identified for Alternatives A and B. Minimization, mitigation, and possibly compensatory measures as described in the Natural Resources direct effects section of this SEIS would lessen adverse effects to water resources. Future effects to water resources could occur from the planned expansion of CIDMMA further to the east, construction of the CIMT, expansion of the VIG and NIT, and the Norfolk Harbor and Channels Deepening Project. Federal, state, and local regulations protecting water resources would continue in the foreseeable future. With mitigation, the incremental contribution of direct and indirect effects of Alternative C to adverse cumulative effects on water resources would be moderate.

Alternative C is estimated to require disposal of approximately 7.1 million cubic yards of dredge material. As discussed for the other Build Alternatives, the exact direct and indirect effects to regional dredge material disposal capacity is unknown at this time, therefore, the incremental cumulative effects are unknown. However, we can anticipate short-term increases in the level of suspended sediment can give rise to changes in water quality that can affect marine flora and fauna, both favorably and unfavorably, such as increased turbidity and the possible release of organic matter, nutrients and or contaminants, depending upon the nature of the material in the dredging area. Generally, sediments settle within the vicinity of the dredged area, where they are likely to have little effect on the recently disturbed communities, particularly in areas where dredging is a well-established activity that has occurred within Hampton Roads for decades. In addition to the I-564 Connector, Alternative C would construct another tunnel alongside the MMMBT and the I-664 Connector on structure over water. This alternative is estimated to impact approximately 573 acres of aquatic habitat, 29 acres of shallow tidal water habitat, 665 acres of benthic habitat, and 565 acres of EFH, HAPC, and Anadromous Fish Use Areas. No known existing or historic SAV areas occur within the Alternative C Study Area Corridor. The types of indirect effects to these resources by construction of Alternative C would be similar to the effects described for Alternatives A and B, but would occur on a larger scale. Minimization, mitigation, and possibly compensatory measures would lessen direct and indirect adverse effects to aquatic wildlife and habitat from Alternative C. Future projects as described in the above paragraph could further impact aquatic habitat, but federal, state, and local regulations should minimize the negative effects of these actions. The incremental contribution of Alternative C's effects to cumulative effects on aquatic wildlife and habitat would be moderate when combined with past, present, and future actions.

Direct and indirect impacts to terrestrial wildlife and wildlife habitat along I-564 and the VA 164 Connector would be the same as described for Alternative B, as the footprint of Alternative C would be the same in these areas. Alternative C would widen the entire length of I-664 and thus could have additional terrestrial wildlife habitat effects. Past development in Hampton and the Newport News along I-664 has resulted in very little intact natural habitat in these portions of the Natural Resources ICE Study Area. Habitat along I-664 has also been fragmented from previous construction of I-664 and the rail line in the median. As land use is slightly less intensive along the I-664 Study Area Corridor on the Southside, more intact natural habitat is present in this area. Alternative C would impact 180 acres of terrestrial wildlife habitat and 164 acres of threatened and endangered species habitat. Habitat fragmentation along I-664 on the Southside would occur on the edge of the forested habitat bordering the interstate right-of-way; consequently, although the interstate corridor would be wider, it would not substantially change the fragmented

condition of wildlife habitat in this area. The incremental contribution of Alternative C to cumulative effects on wildlife and wildlife habitat would be moderate.

Alternative C would have similar types of direct and indirect effects to protected shorebirds along the VA 164 Connector and the MMMBT as described for I-64 under Alternative A. It would also have similar effects to threatened and endangered species as Alternative B near the VA 164 Connector. Alternative C would have increased habitat fragmentation effects to Mabees salamander habitat present on either side of I-664 on the Southside from reduction of forested buffers, and alteration of a pond that is habitat for this species, resulting in indirect effects to light and temperatures from forest loss. An impact to the Mabees salamander would not occur if two consecutive years of survey document the species was not present. Although more summer roosting bat habitat is present in the Alternative C Study Area Corridor, potential indirect effects on bat roosting and foraging habitat would be similar to that described for Alternative B. Canebrake rattlesnake habitat to either side of I-664 on the Southside would not likely experience increased fragmentation as no habitat corridors currently connect these areas. Peregrine falcons have no documented use of the Alternative C Study Area Corridor for breeding, thus this alternative would have no indirect effects on this species. Impacts to protected species would be avoided, minimized, and mitigated as described in the Natural Resources direct effects section of this SEIS. The incremental contribution of Alternative C to cumulative effects on threatened and endangered species is anticipated to be reduced to a moderate level in consultation with USFWS.

The Norfolk Harbor and Channel Deepening Project, expansion of CIDMMA, NIT, and VIG, and construction of the CIMT within and near the Alternative C Study Area Corridor could also have adverse direct and indirect effects to terrestrial wildlife and protected species. Federal, state, and local laws and regulations would require these actions to avoid, minimize, and mitigate their effects to terrestrial wildlife and protected species, which would continue into the foreseeable future. With mitigation, Alternative C would have moderate incremental contributions to cumulative effects on these resources.

3.5.2.5 Alternative D

Alternative D includes elements of all the other Build Alternatives except it would not include additional dedicated transit lanes as proposed under Alternative C; Table 2-7 presents the direct effects of Alternative D to environmental resources. Alternative D would generate 6.1 million cubic yards of dredge material, fewer than Alternative C, but more than the other Build Alternatives. Alternative D would have similar incremental and cumulative effects to natural resources as the other Build Alternatives.

3.5.3 Historic Resources

With human occupation of the Hampton Roads 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. This has occurred more extensively since 1955 in the growing Hampton Roads region that is expected to continue to grow in 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 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, some of the six cities 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.

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.

3.5.3.1 Build Alternatives

All direct and indirect effects to archaeological and historic architectural properties have been considered under Section 106 of the NHPA as described in the archaeological and historic architectural sections of the SEIS. Portions of the Area of Potential Effects with a high potential for archaeological remains that have not been previously intensively inventoried will be intensively surveyed in later phases of the project. It is not expected that any archeological sites identified from later intensive survey would embody characteristics important for preservation in place.

Past and present development actions have directly and indirectly impacted archaeological and historic architectural historic properties. Mitigation measures for adverse effects to historic properties under each Build Alternative would be developed in consultation with the SHPO and ACHP and stipulated in a Programmatic Agreement. Future actions in the Historic Resources ICE Study Area such as redevelopment projects conducted by local governments, the I-564 IC, expansion of NIT and VIG, and various transportation and other present and reasonably foreseeable projects could have adverse effects to historic properties. Federal, state, and local regulations would continue to minimize potential adverse effects to historic properties from their actions. Section 4(f) requires federal DOT agencies to avoid adversely impacting architectural historic properties important for preservation in place and authorizes adverse effects only if there is no other prudent and feasible alternative. The incremental contribution of the Build Alternatives to cumulative effects on historic properties would be moderately adverse.

3.5.4 Summary of Cumulative Effects

Table 3-5 summarizes the potential incremental contribution of the Build Alternatives to cumulative effects on the resources evaluated. As previously discussed for each Build Alternative, the racial or ethnic status of potentially relocated households is not presently known, although all the potential relocations for the Build Alternatives would occur in minority population areas. The more relocations an alternative would have, the greater the potential incremental effect to minority populations. A determination will be made in the Final SEIS as to whether a disproportionate impact would occur and if mitigation would be required. As such, **Table 3-66** presents the number of relocations in minority population Census Block Groups per alternative.

The NRHP eligibility of a few historic architectural resources is yet to be determined and complete archaeological investigations are awaiting selection of a Preferred Alternative and more advanced preliminary design. Therefore, only the potential indirect effects to access and induced growth impacts are addressed in this cumulative effects analysis. Incremental effects of the alternatives contributing to cumulative socioeconomic, natural and historic resources would range from none to moderately adverse.

Table 3-5: Summary of Build Alternative Incremental Contribution to Cumulative Effects

Resource	Alternative A	Alternative B	Alternative C	Alternative D	Cumulative Effect
Land Use	Minor	Minor	Moderate	Moderate	Adverse
Community Cohesion	Minor	Moderate	Moderate	Moderate	Adverse
Community Facilities and Recreation Resources	Minor	Minor	Moderate	Moderate	Adverse

Resource	Alternative A	Alternative B	Alternative C	Alternative D	Cumulative Effect
Environmental Justice	9 relocations	9 relocations	11 relocations	20 relocations	Adverse
Local Economy	Minor	Minor	Moderate	Moderate	Positive
Wetlands	Minor	Moderate	Moderate	Moderate	Adverse
Floodplains	Moderate	Moderate	Moderate	Moderate	Adverse
Streams	0	0	Moderate	Moderate	Adverse
Navigable waters	Moderate	Moderate	Moderate	Moderate	Adverse
Resource Protection Areas	Minor	Moderate	Moderate	Moderate	Adverse
Water Quality	Moderate	Moderate	Moderate	Moderate	Adverse
Hydrodynamics/Regional Dredge Material Disposal Capacity	Moderate	Moderate	Moderate	Moderate	Adverse
Hampton Roads Aquatic Habitat	Moderate	Moderate	Moderate	Moderate	Adverse
Benthic Communities	Moderate	Moderate	Moderate	Moderate	Adverse
EFH, HAPC, & Anadromous Fish Use Areas	Moderate	Moderate	Moderate	Moderate	Adverse
SAV	Moderate	Moderate	0	Moderate	Adverse
Terrestrial Habitat	Minor	Moderate	Moderate	Moderate	Adverse
Threatened & Endangered Species	Moderate	Moderate	Moderate	Moderate	Adverse
Historic Architecture	Moderate	Moderate	Moderate	Moderate	Adverse
Archaeological Resources	Moderate	Moderate	Moderate	Moderate	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 Cumulative Effects Study Area. These actions have been both beneficial and adverse to land use, socioeconomic, natural, and historic resources within the Cumulative Effects Study Area. 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 Alternatives would be both beneficial and moderately adverse to socioeconomic resources. Overall cumulative effects of the Build Alternatives in combination with past, present and foreseeable future actions to natural and historic resources would be primarily adverse.

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APPENDIX A:

ALIGNMENT SEGMENTS &

OPERATIONALLY INDEPENDENT SECTIONS

ALIGNMENT SEGMENTS & OPERATIONALLY INDEPENDENT SECTIONS

Given the magnitude and scope of the alternatives, it is expected that a Preferred Alternative would be constructed in stages or operationally independent sections (OIS). An OIS is a portion of an alternative that could be built and function as a viable transportation facility even if other portions of the alternative are not advanced (FHWA, 2007). The OISs are comprised of various roadway alignments and were developed by identifying sections of roadway improvements that if constructed, could function independently. Additionally, different sections within an OIS also could be replaced with another.

Following the release of the Draft SEIS and an opportunity for public review and comment, the independent sections could ultimately be combined to form "hybrid" alternatives. The OIS strategy allows for the identification of a "hybrid" alternative in addition to the alternatives described in this Draft SEIS that could reduce impacts and costs while achieving purpose and need. Depending on the nature of a hybrid alternative, if selected, public involvement opportunities may be offered to solicit additional public comment.

If a hybrid is identified as the Preferred Alternative, it would be fully documented in the Final SEIS; however, this OIS strategy allows impacts and costs to be summarized in this Draft SEIS.

The alignment segments that make up each Build Alternative are shown on **Figure A-1** and summarized in **Table A-1. Figures A-2 through A-5** show each Build Alternative broken down by alignment segment. For the alignment segments that are included under two or more alternatives, **Figure A-1** lists the letter of the corresponding alternatives with the numbered segment. The OISs are shown on **Figure A-6**. Environmental impacts have been quantified by roadway alignment segment and are presented in detail in **Table A-2**.

Table A-1: Alternative Alignment Segments

Segment	Roadway Segment Description
Alternative A	
8	I-64 north of HRBT
9	I-64 from HRBT to I-564
Alternative B	
8	I-64 north of HRBT
9	I-64 from HRBT to I-564
10	I-564 and I-564 Connector
12	I-564 Connector and VA 164 Connector Interchange
13	VA 164 Connector
14	VA 164
3	I-664 and VA 164 Interchange
Alternative C	
7	I-664 from I-64 to and including Terminal Avenue Interchange. Proposed design includes 8 lanes plus 2 transit only lanes
6	Terminal Avenue Interchange. Proposed interchange to connect with I-664 design that includes 8 lanes plus 2 transit only lanes
5	I-664 from Terminal Avenue Interchange to I-664 Connector. Proposed design includes 8 lanes plus 2 transit only lanes

Segment	Roadway Segment Description
11	I-664 Connector including I-664 interchange. Proposed interchange to connect with I-664 design that includes 8 lanes plus 2 transit only lanes
4	I-664 from I-664 Connector to VA 164
3	I-664 and VA 164 Interchange
2	I-664 from VA 164 to US 58 (Bowers Hill)
1	I-664 from US 58 (Bowers Hill) to I-264
13	VA 164 Connector
12	I-564 Connector, I-664 Connector, and VA 164 Connector Interchange. Proposed interchange to connect with I-564 design that includes 4 lanes plus 2 transit only lanes
10	I-564 and I-564 Connector. Proposed design includes 8 lanes plus 2 transit only lanes
Alternative D	
8	I-64 north of HRBT
9	I-64 from HRBT to I-564
7	I-664 from I-64 to and including Terminal Avenue Interchange. Proposed design includes 8 lanes
6	Terminal Avenue Interchange. Proposed interchange to connect with I-664 design that includes 8 lanes
5	I-664 from Terminal Avenue Interchange to I-664 Connector. Proposed design includes 8 lanes
11	I-664 Connector including I-664 interchange. Proposed interchange to connect with I-664 design that includes 8 lanes
4	I-664 from I-664 Connector to VA 164
3	I-664 and VA 164 Interchange
2	I-664 from VA 164 to US 58 (Bowers Hill)
1	I-664 from US 58 (Bowers Hill) to I-264
14	VA 164
13	VA 164 Connector
12	I-564 Connector, I-664 Connector, and VA 164 Connector Interchange. Proposed interchange to connect with I-564 design that includes 4 lanes
10	I-564 and I-564 Connector. Proposed design includes 8 lanes

Figure A-1: Alignment Segments

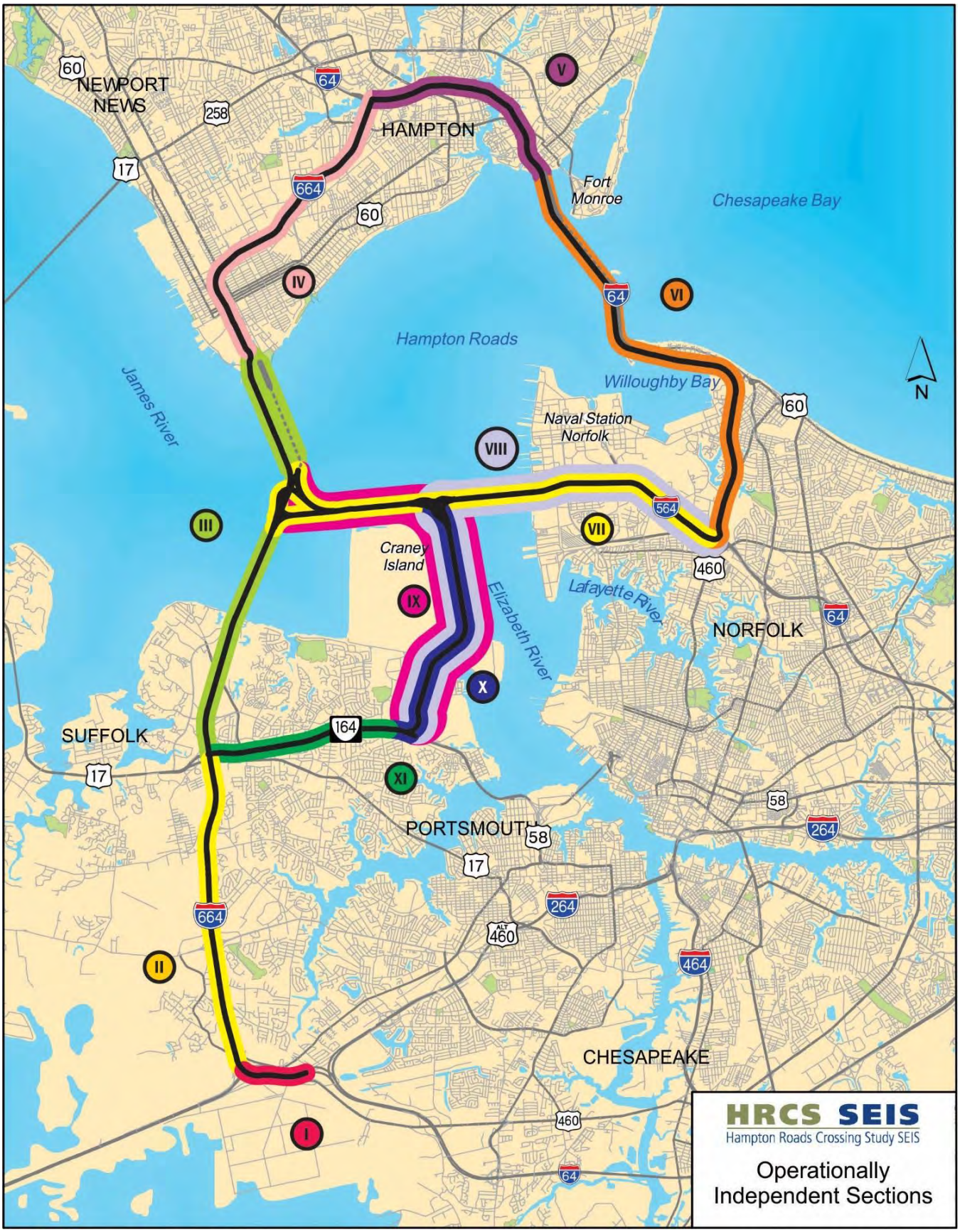
Figure A-2: Alternative A Segments

Figure A-3: Alternative B Segments

Figure A-4: Alternative C Segments

Figure A-5: Alternative D Segments

Figure A-6: Operationally Independent Sections



Resource	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5C	Segment 5D	Segment 6C	Segment 6D	Segment 7C	Segment 7D	Segment 8	Segment 9	Segment 10BD	Segment 10C	Segment 11C	Segment 11D	Segment 12B	Segment 12C	Segment 12D	Segment 13	Segment 14
Right-of-Way (# / acres)	**8 (0.9)**	**20 (2.7)**	**1 (0.4)**	**8 (13.2)**	**3 (21.1)**	**2 (21.0)**	**5 (16.0)**	**4 (12.7)**	**111 (22.3)**	**75 (18.9)**	**20 (2.8)**	**66 (7.5)**	**7 (65.0)**	**8 (89.4)**	**0**	**0**	**1 (6.7)**	**1 (7.5)**	**1 (7.5)**	**36 (167.0)**	**0**
Residential	2 (<0.1)	9 (0.2)	0	0	0	0	0	0	42 (1.7)	29 (1.3)	1 (0.1)	23 (0.5)	0	0	0	0	0	0	0	5 (0.1)	0
Commercial	1 (<0.1)	0	0	1 (<0.1)	0	0	0	0	17 (3.3)	11 (2.8)	2 (0.1)	4 (1.2)	0	0	0	0	0	0	0	4 (1.4)	0
Industrial	0	3 (0.3)	0	0	3 (21.1)	2 (21.0)	4 (15.8)	4 (12.7)	16 (6.7)	10 (5.4)	0	6 (0.9)	1 (28.5)	2 (34.9)	0	0	0	0	0	7 (25.4)	0
Institutional	0	1 (<0.1)	0	1 (0.3)	0	0	1 (0.2)	0	7 (6.0)	4 (5.7)	8 (1.9)	1 (0.9)	0	0	0	0	1 (6.7)	1 (7.5)	1 (7.5)	4 (103.8)	0
Military	0	0	0	0	0	0	0	0	0	0	0	4 (0.6)	2 (10.2)	2 (11.4)	0	0	0	0	0	1 (11.7)	0
Open Space	5 (0.9)	7 (2.2)	1 (0.4)	6 (12.9)	0	0	0	0	27 (4.8)	20 (3.7)	3 (0.1)	11 (0.9)	2 (0.3)	2 (0.3)	0	0	0	0	0	11 (22.5)	0
Other	0	0	0	0	0	0	0	0	2 (<0.1)	1 (<0.1)	6 (0.7)	17 (2.4)	2 (26.0)	2 (42.7)	0	0	0	0	0	4 (2.1)	0
Potential Residential Displacements	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**11**	**11**	**0**	**9**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Potential Commercial Displacements	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**4**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Potential Other* Displacements	**0**	**0**	**0**	**1**	**0**	**0**	**2**	**2**	**3**	**2**	**2**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**0**
Military Facilities (#/acres)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1 (22.4)**	**1 (14.7)**	**1 (41.5)**	**0**	**0**	**1 (6.7)**	**1 (7.5)**	**1 (7.5)**	**3 (119.1)**	**0**
Community Facilities	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**2**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Park & Recreation	0	0	0	0	0	0	0	0	1	1	0	1	1	1	0	0	0	0	0	0	0
Place of Worship	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Cemetery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
School / University	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0
Land Use*	**0.9**	**3.1**	**0.7**	**16.4**	**21.8**	**21.6**	**16.1**	**12.8**	**22.6**	**19.0**	**2.6**	**25.2**	**61.1**	**79.1**	**0**	**0**	**6.7**	**7.5**	**7.5**	**164.8**	**0**
Residential	0	0.6	0	0	0	0	0	0	2.0	1.5	0.1	0.5	0	0	0	0	0	0	0	0.1	0
Commercial	0	0	0	1.3	0	0	0	0	3.6	3.0	0.5	1.2	0	0	0	0	0	0	0	1.4	0
Industrial	0	0.2	0	0.2	21.8	21.6	15.9	12.8	6.2	5.0	0	0.7	46.0	50.2	0	0	0	0	0	25.3	0
Institutional	0	0	0	0	0	0	0.2	0	5.9	5.7	1.9	0.9	0	0	0	0	6.7	7.5	7.5	103.8	0
Military	0	0	0	0	0	0	0	0	0	0	0	20.8	14.8	28.6	0	0	0	0	0	11.7	0
Open Space	0.9	2.3	0.7	14.9	0	0	0	0	4.9	3.7	0.1	1.1	0.3	0.3	0	0	0	0	0	22.5	0
Section 4(f) Properties (# / acres)	**0**	**0**	**0**	**1 (27.0)**	**1 (254.2)**	**1 (233.8)**	**1 (0.3)**	**1 (0.4)**	**3 (1.6)**	**3 (1.5)**	**2 (1.8)**	**4 (304.6)**	**2 (48.7)**	**2 (98.3)**	**1 (151.7)**	**1 (123.5)**	**1 (25.6)**	**1 (69.8)**	**1 (64.0)**	**1 (6.7)**	**0**
Farmland	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Resource	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5C	Segment 5D	Segment 6C	Segment 6D	Segment 7C	Segment 7D	Segment 8	Segment 9	Segment 10BD	Segment 10C	Segment 11C	Segment 11D	Segment 12B	Segment 12C	Segment 12D	Segment 13	Segment 14
Stream Impacts (linear feet)	292.7	143.0	0	112.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Navigable Waters (acres)	0	0.6	0	26.7	97.2	97.2	0.2	0.2	0	0	0.1	147.3	44.4	53.9	116.8	95.7	20.5	71.3	65.6	3.4	0
Wetlands (acres)	23.6	5.8	4.8	7.8	0	0	0	0	5.7	5.3	0.6	7.2	0.2	1.9	0	0	0	0	0	61.6	3.0
Resource Protection Areas (acres)	17.8	13.6	0	27.3	0	0	0	0	0	0	0	0	0	0	64.8	52.1	1.0	1.3	1.3	15.0	0
Floodplains (acres)	0	3.5	0	4.0	23.6	25.0	5.6	4.5	0.4	0.4	3.3	109.3	25.4	31.1	43.5	38.7	10.3	36.8	34.4	64.9	0
Hampton Roads Aquatic Habitat (acres)	0	0	0	27.4	249.0	227.8	2.5	2.4	0	0	0	155.7	45.5	57.8	151.7	123.5	30.7	79.9	74.1	4.4	0
Benthic Communities	0	0	0	15.1	0	0	0	0	0	0	0	0	0	0	180.0	149.0	5.4	50.0	44.2	0	0
Essential Fish Habitat, Habitat Areas of Particular Concern, and Anadromous Fish Use Areas (acres)	0	0	0	26.1	247.7	226.4	2.9	2.7	0	0	0	138.4	45.4	57.4	151.7	123.5	30.5	79.7	73.9	0	0
Threatened & Endangered Species Habitat (acres)	22.2	4.2	1.2	13.5	0	0	0.4	0.0	0.6	0.6	0	1.0	3.0	14.1	0	0	6.3	7.0	7.0	101.7	0
Submerged Aquatic Vegetation (acres)	0	0	0	0	0	0	0	0	0	0	0	1.8	0	0	0	0	0	0	0	0	0
Terrestrial Habitat (Forested Area) (acres)	54.6	12.3	6.6	13.6	0	0	0	0	18.2	17.3	0	14.9	7.2	23.1	0	0	0	0	0	51.0	0
Water Quality	Short-term and minor, beneficial long-term impacts																				
Historic Architecture Resources	0	0	0	1	1	1	1	1	1	1	3	3	2	2	1	1	1	1	1	2	0
Archaeology Resources	8	12	2	1	0	0	0	0	0	0	4	2	0	0	0	0	0	0	0	3	1
Visual Impacts	Minor to moderate impacts																				
Energy Requirements and Conservation Potential	Minor energy requirements																				

Notes: Right-of-Way data was gathered from each of the localities. Land use data was gathered from HRTPO.
**Other includes Military, Institutional, and Industrial zoning classifications.*

Appendix B:
Impaired Waters in the Cumulative Effects Study Area

2012 List of Impaired Waters in the Cumulative Effects Study Area

Water Name	Impairment Cause	Category[1]
Bailey Creek, Western Branch Elizabeth R.	Dissolved Oxygen, PCB[2] in Fish Tissue	5D
Ballard Creek & Bay- James R. South Shore Tributary	Dissolved Oxygen, Fecal Coliform, PCB in Fish Tissue	5D
Bennett Creek - Tributary to Nansemond R. [No TMDL]	Enterococcus, Dissolved Oxygen, Fecal Coliform, PCB in Fish Tissue	5D
Bleakhorn Creek - Tributary to Nansemond R. Mouth	Dissolved Oxygen, Fecal Coliform, PCB in Fish Tissue	5D
Buckroe Beaches	PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
Chesapeake Bay - CBP Segment CB8PH	PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
Chesapeake Bay - CBP Segment MOBPH	Dissolved Oxygen, PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
Chesapeake Bay - Northern portion of CBP Segment CB7PH	Estuarine Bioassessments, Dissolved Oxygen, PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
Chesapeake Bay - Off Little Creek BSS #068-017, Areas A & B	PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
Chesapeake Bay - Off Little Creek BSS #068-017, Section C.	PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
Chesapeake Bay - S. Thimble Island BSS Condemnation #163	PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
Chesapeake Bay - Southern portion of CBP Segment CB6PH	Dissolved Oxygen, PCB in Fish Tissue	5D
Chesapeake Bay - Southern portion of CBP Segment CB7PH	Estuarine Bioassessments, Dissolved Oxygen, PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
Chesapeake Bay - Northern portion of CBP Segment CB6PH	Dissolved Oxygen, PCB in Fish Tissue	5D
Chesapeake Bay - VA portion of CBP Segment CB5MH	Dissolved Oxygen, PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
Chesapeake Bay - VA portion of CBP Segment TANMH	Dissolved Oxygen, PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
Chesapeake Bay Beaches	PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
Cockrell Creek	PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
Deep Creek, Southern Br. Elizabeth R.	Dioxin (including 2,3,7,8-TCDD[3]), Dissolved Oxygen, PCB in Fish Tissue	5D

Water Name	Impairment Cause	Category[1]
Dividing Creek	PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
Drum Point Creek - Western Branch, Elizabeth R.	Estuarine Bioassessments, Dissolved Oxygen, PCB in Fish Tissue	5D
DSS Inlet #1 - Unnamed Inlet at Mouth of SW Branch	Dissolved Oxygen, Fecal Coliform, PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
DSS Inlet #2 - Unnamed Inlet S. Shore of SW Br. Back River	Dissolved Oxygen, PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
Dymer Creek	PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
Dymer Creek	Dissolved Oxygen, PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
Eastern Branch, Elizabeth R. - Lower	Estuarine Bioassessments, Dissolved Oxygen, PCB in Fish Tissue	5D
Elizabeth River Mainstem - Middle	Estuarine Bioassessments, Dissolved Oxygen, PCB in Fish Tissue	5D
Elizabeth River Mainstem - Mouth	Estuarine Bioassessments, Dissolved Oxygen, PCB in Fish Tissue	5D
Elizabeth River Mainstem - Upper	Enterococcus, Estuarine Bioassessments, Dissolved Oxygen, PCB in Fish Tissue	5D
Fleets Bay	Dissolved Oxygen, PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
Fort Monroe Beaches	PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
Gilligan Cr - Lower, trib to SB Eliz R	Dioxin (including 2,3,7,8-TCDD), Dissolved Oxygen, PCB in Fish Tissue	5D
Gilligan Cr - Upper, trib to SB Eliz R	Dioxin (including 2,3,7,8-TCDD), Dissolved Oxygen, PCB in Fish Tissue	5D
Goose Creek - Western Branch, Elizabeth R.	Dissolved Oxygen, PCB in Fish Tissue	5D
Great Wicomico River	Dissolved Oxygen, PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
Hampton River [Less Mill Point Creek Beach Area]	Enterococcus, Dissolved Oxygen, PCB in Fish Tissue	5D
Hoffler Creek	Enterococcus, Dissolved Oxygen, PCB in Fish Tissue	5D
Indian Creek	Dissolved Oxygen, PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
James River - Along Lower North Shore	Chlorophyll-a, Dissolved Oxygen, PCB in Fish Tissue	5D

Water Name	Impairment Cause	Category[1]
James River - Anderson Park Beach Area	Chlorophyll-a, Enterococcus, Nutrient/Eutrophication Biological Indicators, PCB in Fish Tissue	5D
James River - Ballard Swamp Area	Chlorophyll-a, Dissolved Oxygen, PCB in Fish Tissue	5D
James River - Hilton Beach Area	Chlorophyll-a, Enterococcus, Dissolved Oxygen, PCB in Fish Tissue	5D
James River - Hilton Village to Craney Island	Chlorophyll-a, Dissolved Oxygen, PCB in Fish Tissue	5D
James River - Huntington Beach Area	Chlorophyll-a, Dissolved Oxygen, PCB in Fish Tissue	5D
James River - Jail Point to Hilton Village	Chlorophyll-a, Dissolved Oxygen, PCB in Fish Tissue	5D
James River - King/Lincoln Park Beach Area	Chlorophyll-a, Enterococcus, Nutrient/Eutrophication Biological Indicators, PCB in Fish Tissue	5D
James River - Newport News Point to NW Corner Craney Isl.	Chlorophyll-a, Dissolved Oxygen, PCB in Fish Tissue	5D
James River - Outside Chuckatuck Creek	Chlorophyll-a, Dissolved Oxygen, PCB in Fish Tissue	5D
James River - Outside Mouth Streeter & Hoffler Creeks	Chlorophyll-a, Dissolved Oxygen, PCB in Fish Tissue	5D
James River at Hampton Roads Harbor	Chlorophyll-a, Nutrient/Eutrophication Biological Indicators, PCB in Fish Tissue	5D
Jones Cr - Lower, trib to SB Eliz R	Dioxin (including 2,3,7,8-TCDD), Dissolved Oxygen, PCB in Fish Tissue	5D
Jones Cr - Upper, trib to SB Eliz R	Dioxin (including 2,3,7,8-TCDD), Dissolved Oxygen, PCB in Fish Tissue	5D
Kings Creek & Bay - James R. South Shore Tributary	Dissolved Oxygen, Fecal Coliform, PCB in Fish Tissue	5D
Knitting Mill Creek	Enterococcus, Dissolved Oxygen, PCB in Fish Tissue	5D
Knotts Creek - Tributary to E. shore Nansemond R.	Dissolved Oxygen, Fecal Coliform, PCB in Fish Tissue	5D
Lafayette River - Lower	Dissolved Oxygen, PCB in Fish Tissue	5D
Lafayette River - Upper	Enterococcus, Dissolved Oxygen, PCB in Fish Tissue	5D
Lake Smith (PWS)	Chlorophyll-a, Dissolved Oxygen, Phosphorus (Total)	5A

Water Name	Impairment Cause	Category[1]
Lake Whitehurst (PWS)	Chlorophyll-a, Dissolved Oxygen, Phosphorus (Total), Mercury in Fish Tissue, PCB in Fish Tissue	5A
Little Bay	PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
Little Creek & Harbor	PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
Little Creek Reservoir - (PWS)	Chlorophyll-a, Dissolved Oxygen, Phosphorus (Total), PCB in Fish Tissue	5A
Lynnhaven River & Bay - Mainstem	Estuarine Bioassessments, Dissolved Oxygen	5D
Mainstem Back River	Dissolved Oxygen, PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
Mill Creek	Dissolved Oxygen, PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
Mill Creek	PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
Mill Creek, Trib to Hampton Roads Harbor	PCB in Fish Tissue	5D
Mill Point Creek - Beach Area, Hampton River	Dissolved Oxygen, PCB in Fish Tissue	5D
Milldam Cr trib S. Br. Elizabeth R.	Dioxin (including 2,3,7,8-TCDD), Dissolved Oxygen, PCB in Fish Tissue	5D
Nansemond River - Lower [No TMDL]	Dissolved Oxygen, PCB in Fish Tissue	5D
Nansemond River - Lower DSS Condemned at Knotts Cr	Dissolved Oxygen, Fecal Coliform, PCB in Fish Tissue	5D
Nansemond River - Lower Middle	Dissolved Oxygen, Fecal Coliform, PCB in Fish Tissue	5D
Nansemond River - Upper Lower [TMDL]	Dissolved Oxygen, PCB in Fish Tissue	5D
Newmarket Creek - Lower	Enterococcus, Dissolved Oxygen, Fecal Coliform, PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
Newmarket Creek - Lower Riverine	Oxygen, Dissolved, Fecal Coliform	5D
Newmarket Creek - Upper	Enterococcus, Dissolved Oxygen, Fecal Coliform, PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
Newton Cr trib to SB Eliz R	Dioxin (including 2,3,7,8-TCDD), Dissolved Oxygen, PCB in Fish Tissue	5D

Water Name	Impairment Cause	Category[1]
Paradise Creek - Lower, trib. to S. Br. Elizabeth R.	Dioxin (including 2,3,7,8-TCDD), Enterococcus, Dissolved Oxygen, PCB in Fish Tissue	5D
Paradise Creek - Upper, trib. to S. Br. Elizabeth R.	Dioxin (including 2,3,7,8-TCDD), Enterococcus, Dissolved Oxygen, PCB in Fish Tissue	5D
Piankatank River	Dissolved Oxygen, PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
Poquoson River - Mouth	Dissolved Oxygen, PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
Pungoteague Creek - Lower	Dissolved Oxygen, PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
Ragged Island Creek	Dissolved Oxygen, PCB in Fish Tissue	5D
Rappahannock River	Estuarine Bioassessments, Dissolved Oxygen, PCB in Fish Tissue	5D
Saint Julian Creek	Dioxin (including 2,3,7,8-TCDD), Dissolved Oxygen, PCB in Fish Tissue	5D
Scott Creek	Dissolved Oxygen, PCB in Fish Tissue	5D
Southern Branch, Elizabeth R. - Lower	Dioxin (including 2,3,7,8-TCDD), Enterococcus, Dissolved Oxygen, PCB in Fish Tissue	5D
Southern Branch, Elizabeth R. - Middle	Dioxin (including 2,3,7,8-TCDD), Dissolved Oxygen, PCB in Fish Tissue	5D
Southern Branch, Elizabeth R. - Upper	Dioxin (including 2,3,7,8-TCDD), Dissolved Oxygen, PCB in Fish Tissue	5D
Southwest Br. Back River - Mouth [DSS OPEN - No TMDL]	Dissolved Oxygen, Fecal Coliform, PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
Star & Oyster House Creeks - Tributary to Nansemond R.	Dissolved Oxygen, Fecal Coliform, PCB in Fish Tissue	5D
Streeter Creek	Dissolved Oxygen, PCB in Fish Tissue	5D
SW Br Back R - DSS OPEN [TMDL]	Dissolved Oxygen, Fecal Coliform, PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
SW Br Back River - Incl Tides Mill Cr [TMDL area]	Dissolved Oxygen, Fecal Coliform, PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
SW Br Back River - Outside DSS Inlet #1 & #2 [TMDL area]	Dissolved Oxygen, Fecal Coliform, PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
Tabbs Creek	Dissolved Oxygen, PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D

Water Name	Impairment Cause	Category[1]
Unsegmented estuaries - James R. Tribs	Dissolved Oxygen, PCB in Fish Tissue	5D
Unsegmented Estuaries - Lower Nansemond R.	Dissolved Oxygen, PCB in Fish Tissue	5D
Unsegmented Estuaries - Upper Nansemond R.	Dissolved Oxygen, Fecal Coliform, PCB in Fish Tissue	5D
Unsegmented estuaries in Back River - DSS	Dissolved Oxygen, Fecal Coliform, PCB in Fish Tissue, Aquatic Plants (Macrophytes)	5D
Unsegmented estuaries in Hampton Roads Harbor	PCB in Fish Tissue	5D
Unsegmented estuaries in SBEMH	Dioxin (including 2,3,7,8-TCDD), Dissolved Oxygen, PCB in Fish Tissue	5D
Unsegmented estuaries in WBEMH	Estuarine Bioassessments, Dissolved Oxygen, PCB in Fish Tissue	5D
Unsegmented rivers in K39R	Mercury in Fish Tissue	5A
Warwick River - Lower Tidal Portion	Dissolved Oxygen, PCB in Fish Tissue	5D
Western Branch - Tributary to Nansemond R.	Dissolved Oxygen, Fecal Coliform, PCB in Fish Tissue	5D
Western Branch, Elizabeth R. - Lower	Estuarine Bioassessments, Dissolved Oxygen, PCB in Fish Tissue	5D
Western Branch, Elizabeth R. - Upper	Enterococcus, Estuarine Bioassessments, Dissolved Oxygen, PCB in Fish Tissue	5D
Willis Cover , Nansemond River - Lower Middle	Dissolved Oxygen, Fecal Coliform, PCB in Fish Tissue	5D
Willoughby Bay - Beach Area	PCB in Fish Tissue	5D
Willoughby Bay [Less Beach Area]	PCB in Fish Tissue	5D

[1]**EPA Category 5**: Waters are impaired or threatened and a TMDL is needed. VA Cat. **5A**: the water quality standard is not attained. The AU is impaired or threatened for one or more designated uses by a pollutant(s) and requires a TMDL (303d list). VA Cat. **5D**: the water quality standard is not attained where TMDLs for a pollutant(s) have been developed but one or more pollutants remain requiring TMDL development.

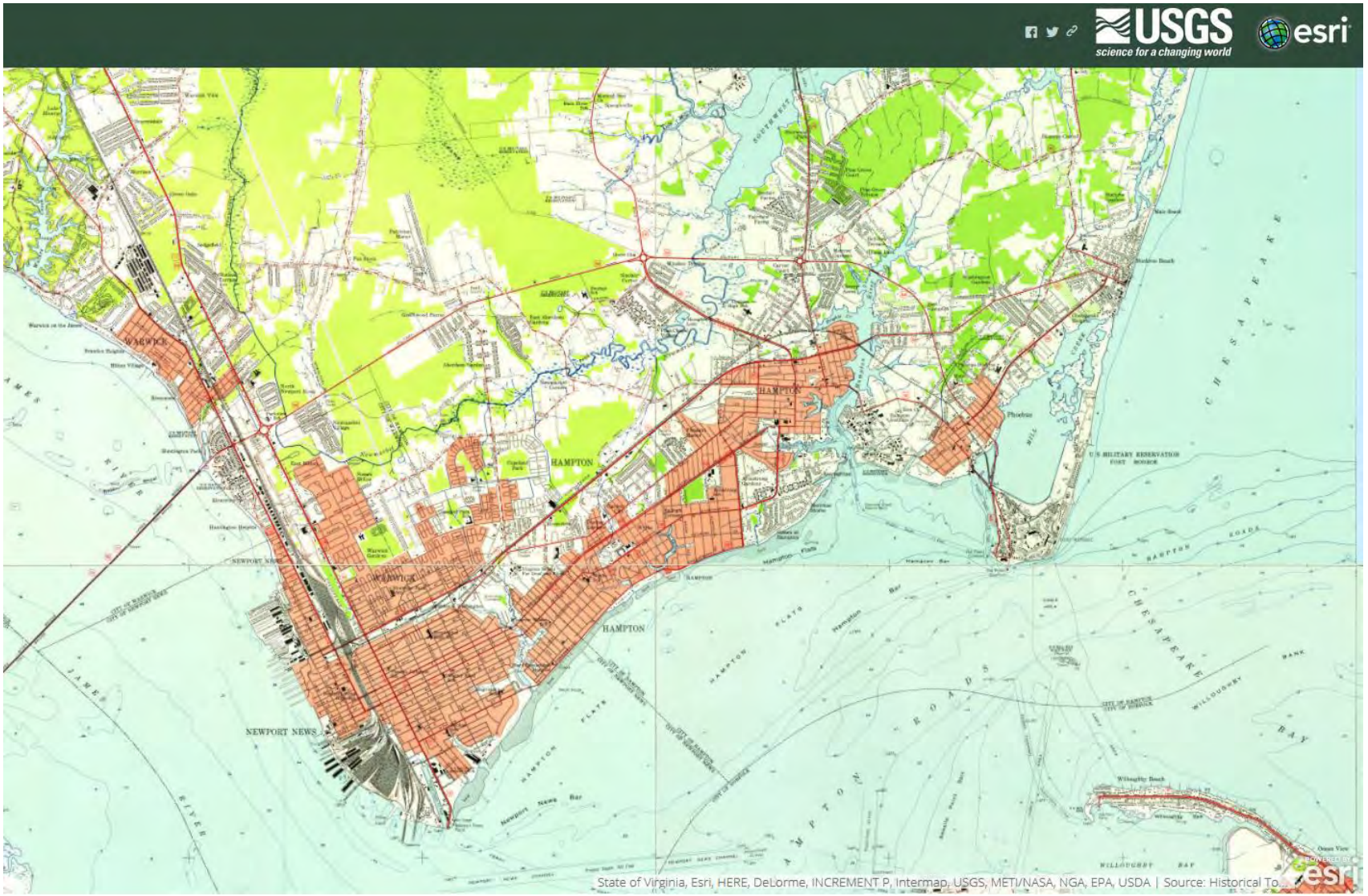
[2]PCB: polychlorinated biphenyl

[3]2,3,7,8-TCDD: 2,3,7,8-tetrachlorodibenzo-p-dioxin

Appendix C:
Historical Topographic Maps and Aerials

The following historical topographic mapping and aerial photographs illustrate the changes in land use that have occurred in the Hampton Roads region over time within the Socioeconomic Resources Indirect and Cumulative Effects Study Area. This appendix includes historic topographic mapping from 1955, 1964, 1965, 1973, and 1986 and aerial photos from 1963, 1982, 1983, 1990, 1991, 1994, 2002, and 2010.

Figure C1: 1955 Historical Topographic Maps (Hampton / Newport News)

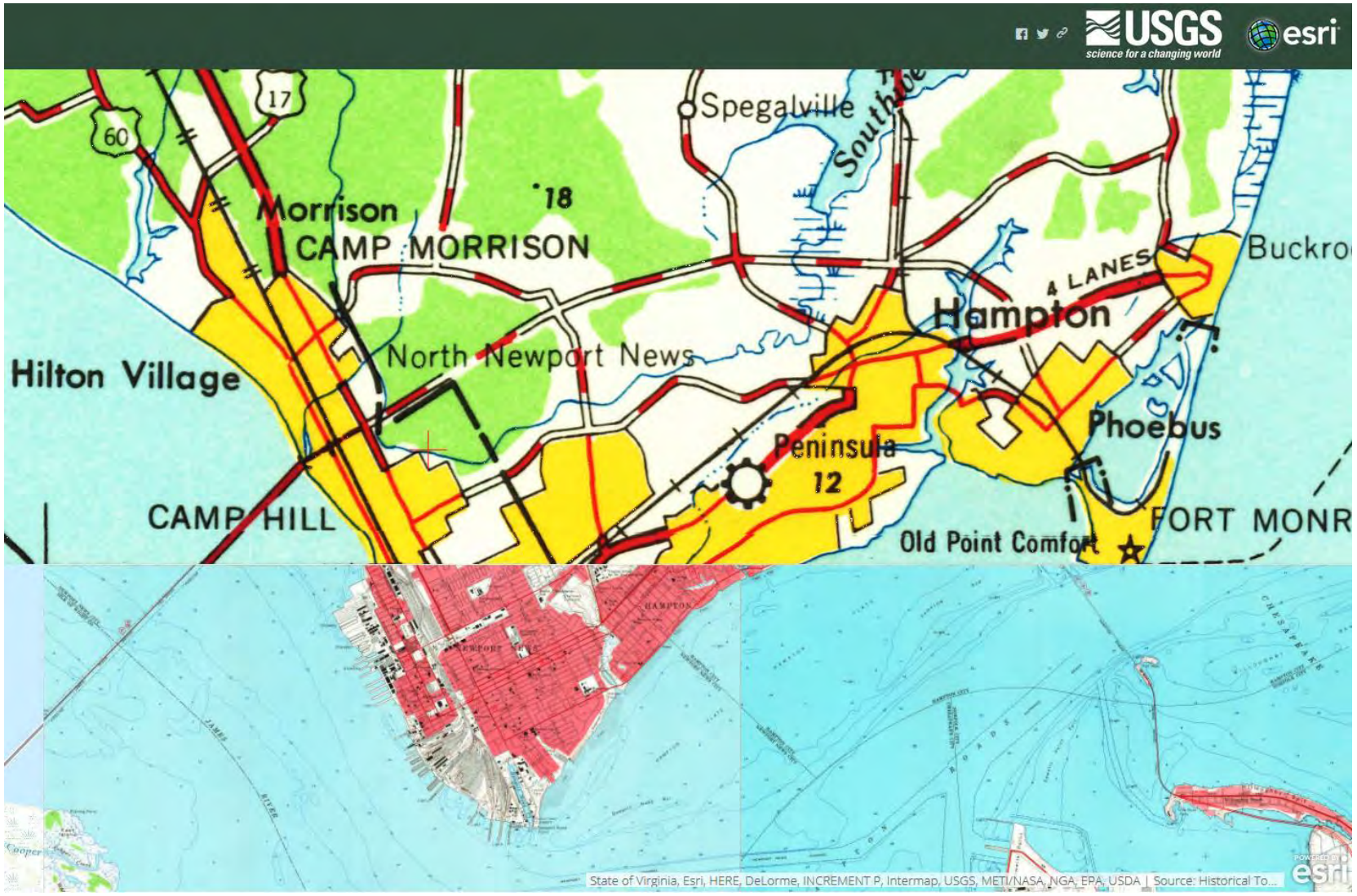


Quadrants: Morrison, Newport News, Hampton, Norfolk North, and Ocean View

Figure C2: 1963 Aerial of Newport News and Hampton (USGS, 1963)

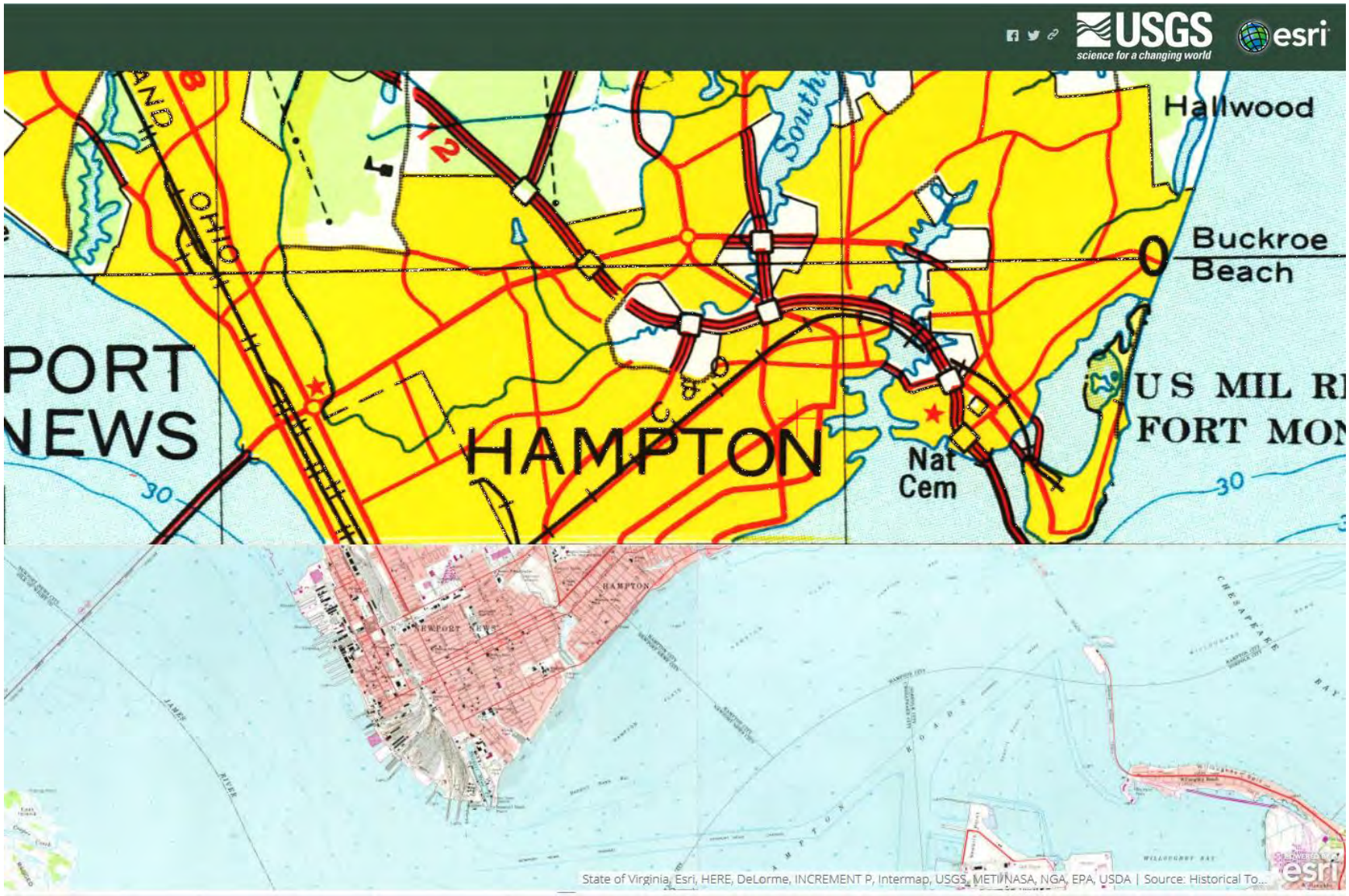
Figure C3: 1963 Aerial of Hampton (USGS, 1963)

Figure C4: 1964 and 1965 Historical Topographic Maps (Hampton /Newport News)



Quadrants: Richmond, Norfolk North, and Newport News South

Figure C5: 1973 Historical Topographic Maps (Hampton /Newport News)



Quadrants: Richmond, Newport News South, and Norfolk North

Figure C6: 1982 Aerial of Newport News (USGS, 1982)

Figure C7: 1983 Aerial of Hampton and Norfolk (USGS, 1983)

Figure C8: 1986 Historical Topographic Maps (Hampton /Newport News)

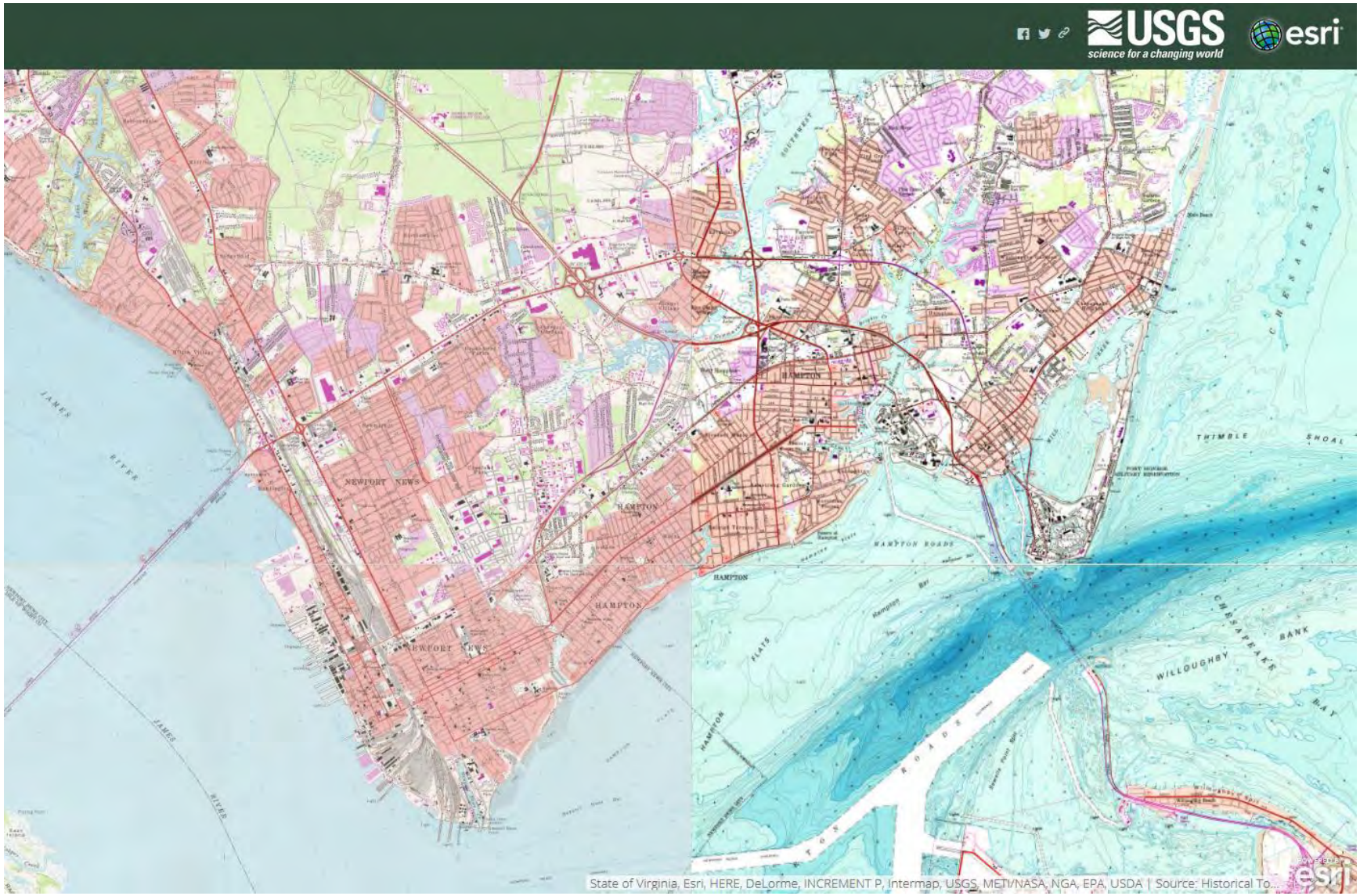


Figure C9: 1991 Aerial of Newport News (USGS, 1991)

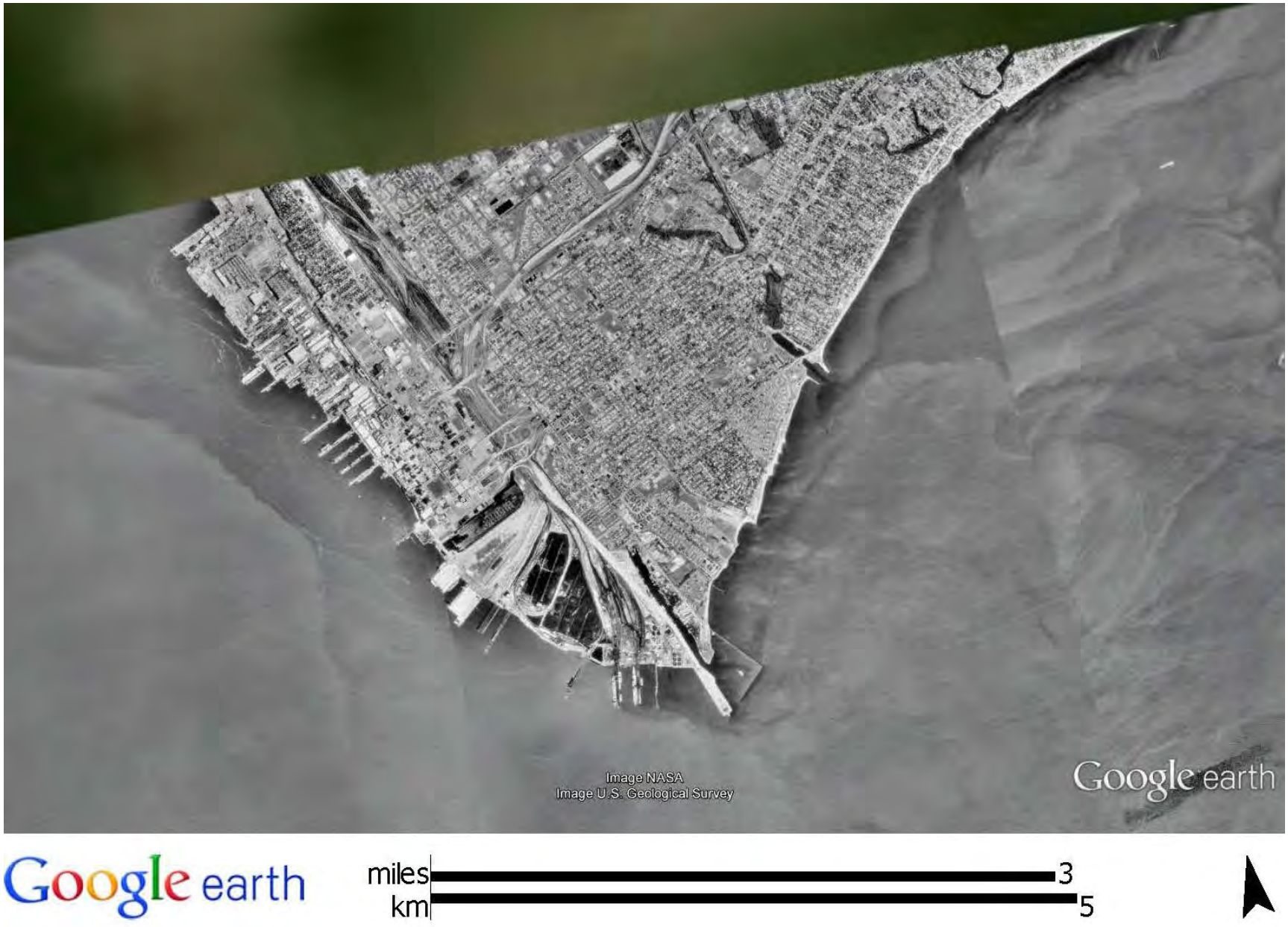


Figure C10: 1994 Aerial of Hampton (USGS, 1994)

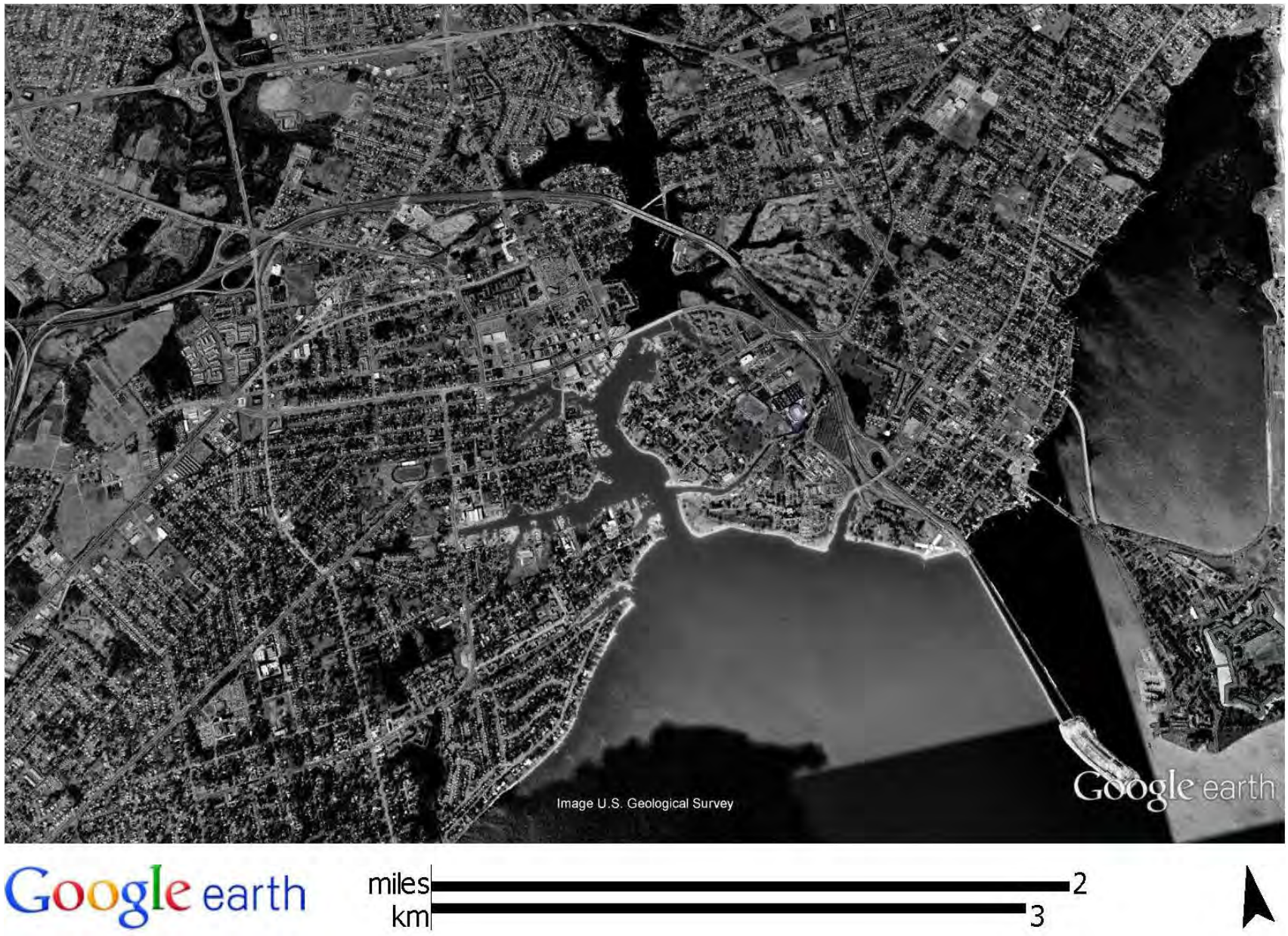


Figure C11: 2002 Aerial of Newport News and Hampton

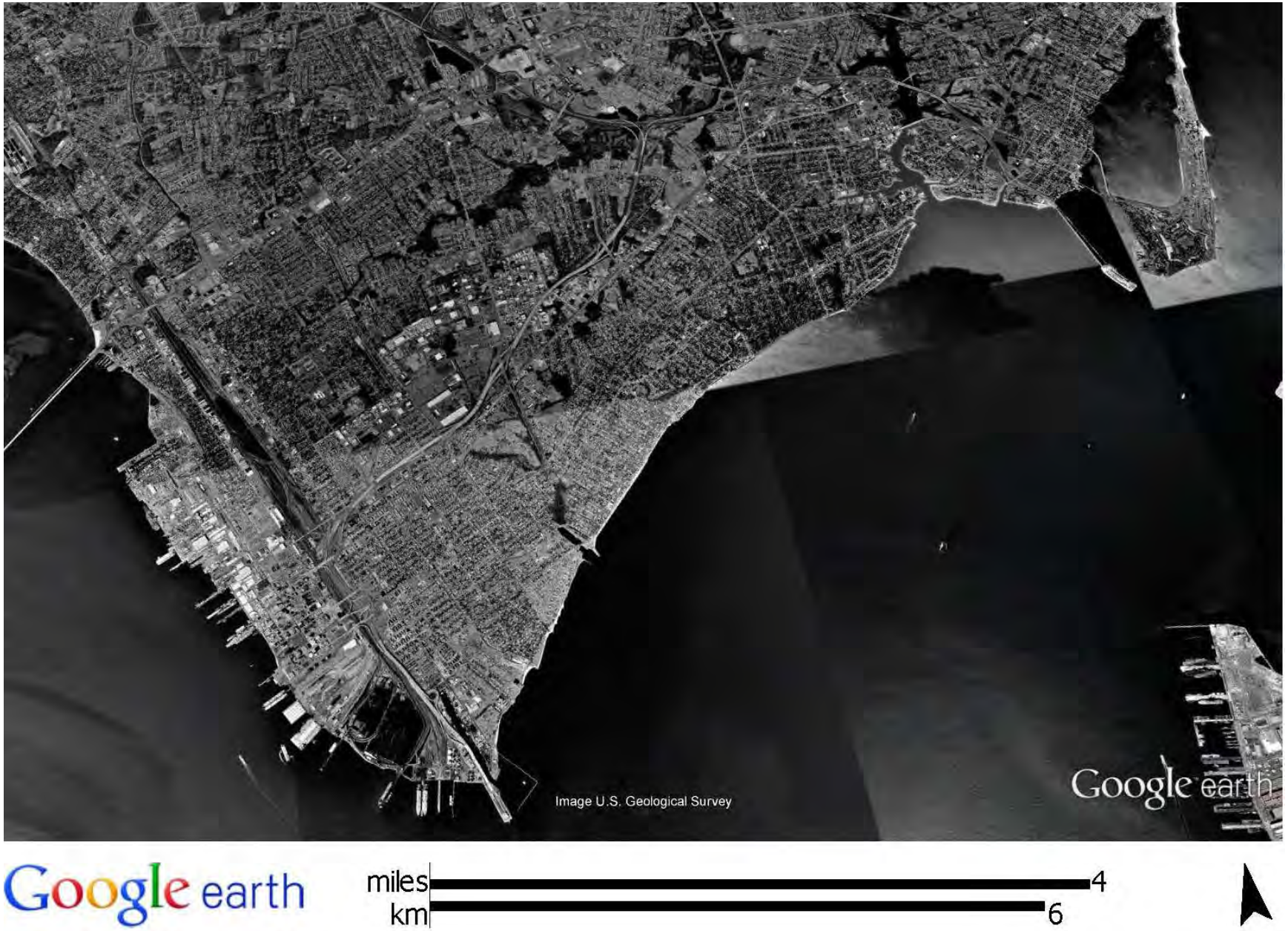
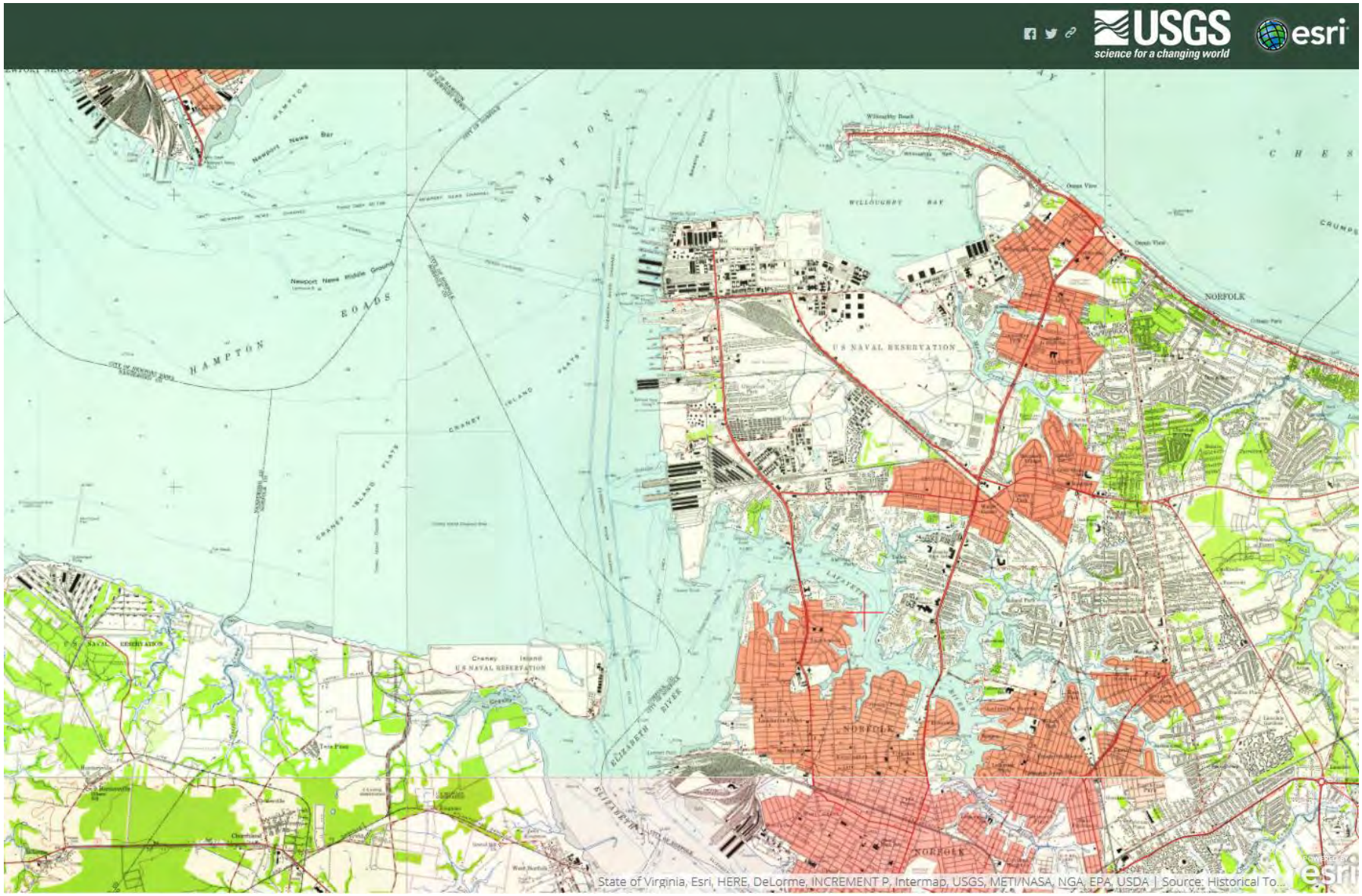


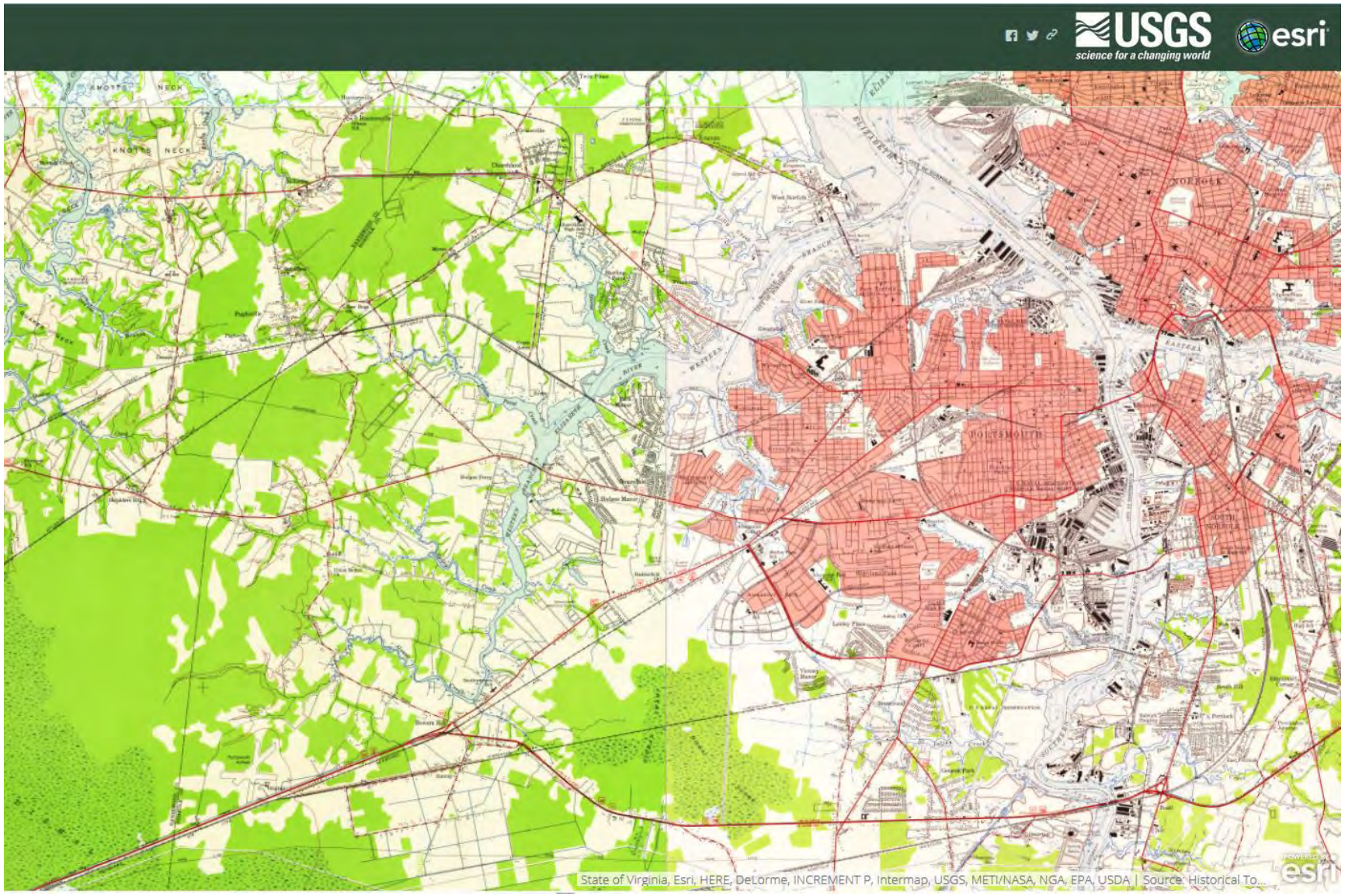
Figure C12: 2010 Aerial of Newport News and Hampton (Google Earth, 2010)

Figure C13: 1955 Historical Topographic Maps (Norfolk / Portsmouth / Suffolk)



Quadrants: Norfolk North, Ocean View, Newport News, Bowers Hill, Norfolk South, and Kempsville

Figure C14: 1955 Historical Topographic Maps (Suffolk / Portsmouth / Chesapeake)



Quadrants: Bowers Hill, Norfolk South, and Kempsville

Figure C15: 1963 Aerial of Norfolk (USGS, 1963)

Figure C16: 1963 Aerial of Suffolk, Portsmouth, Chesapeake to Bowers Hill (USGS, 1963)

Figure C17: 1963 Aerial of Craney Island and Portsmouth (USGS, 1963)

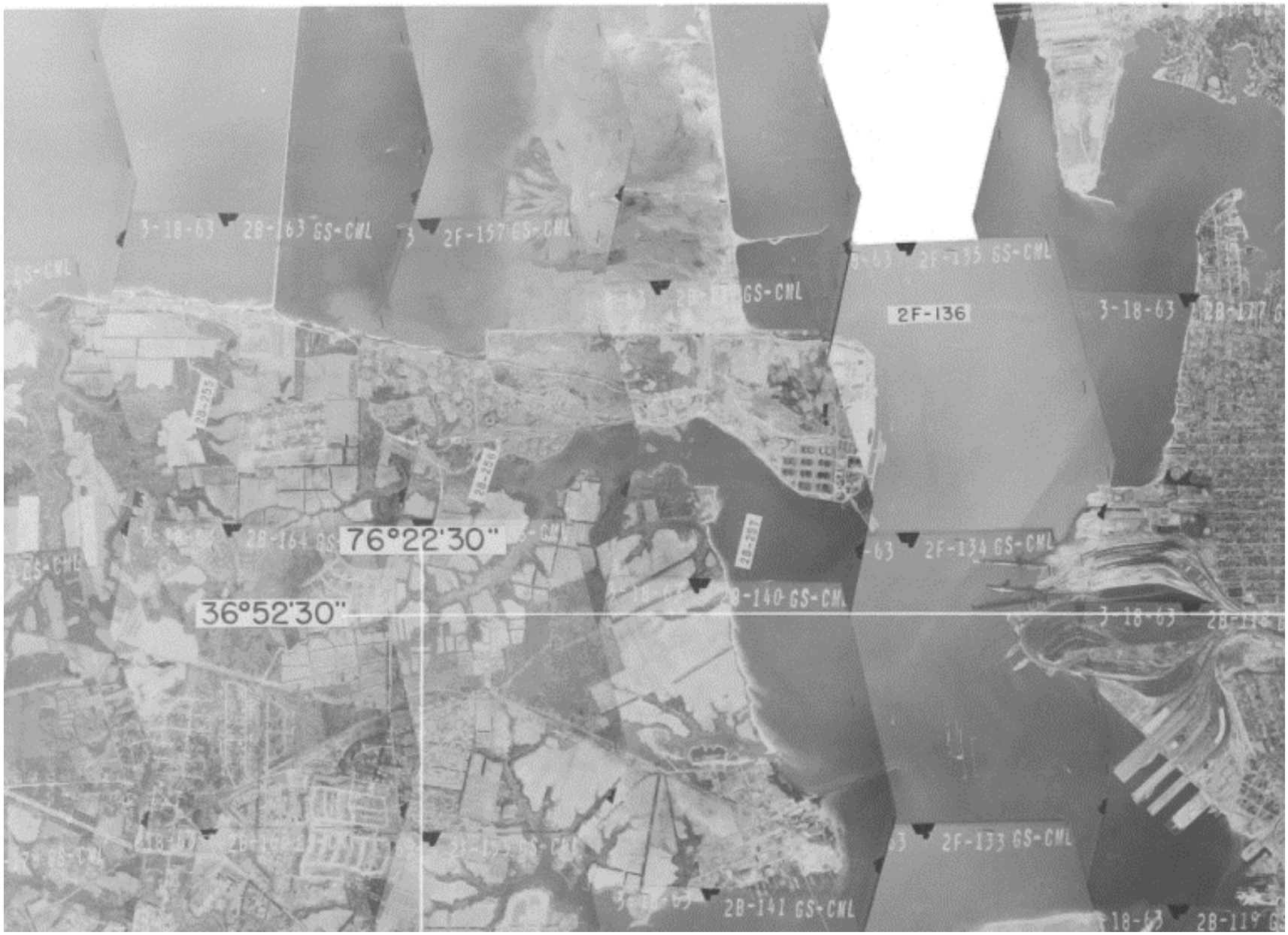
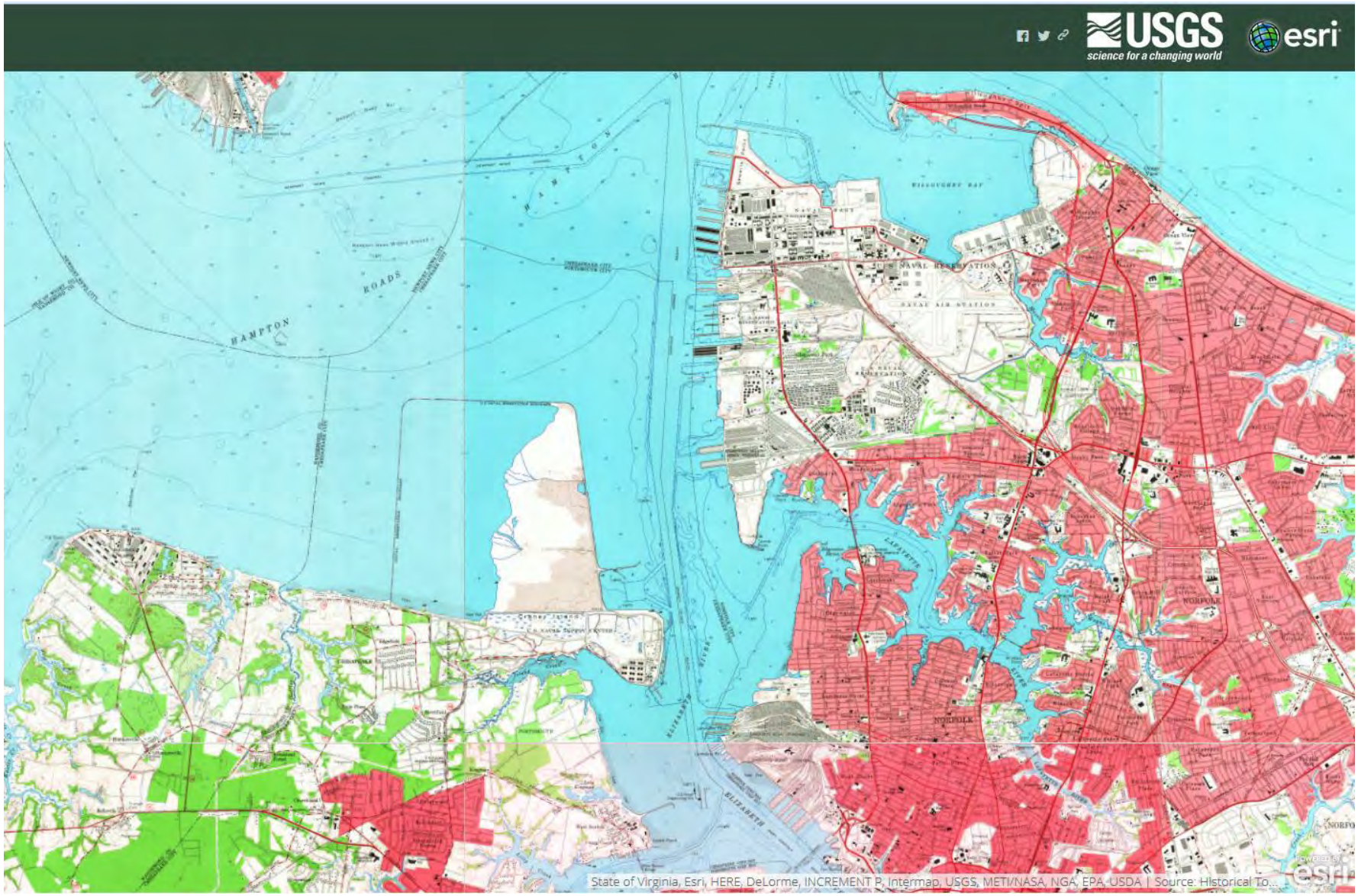
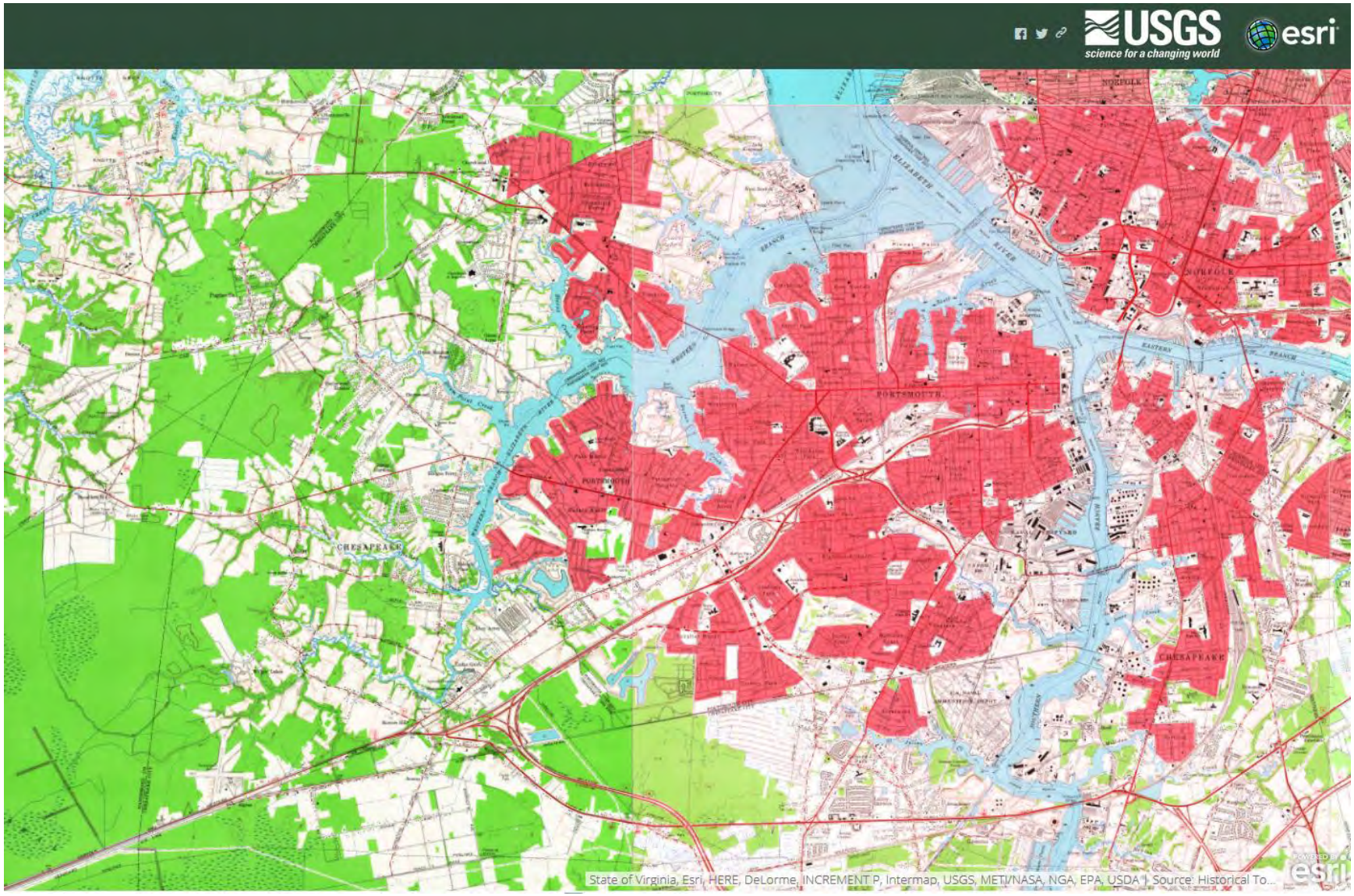


Figure C18: 1964 and 1965 Historical Topographic Maps (Norfolk / Portsmouth / Suffolk)



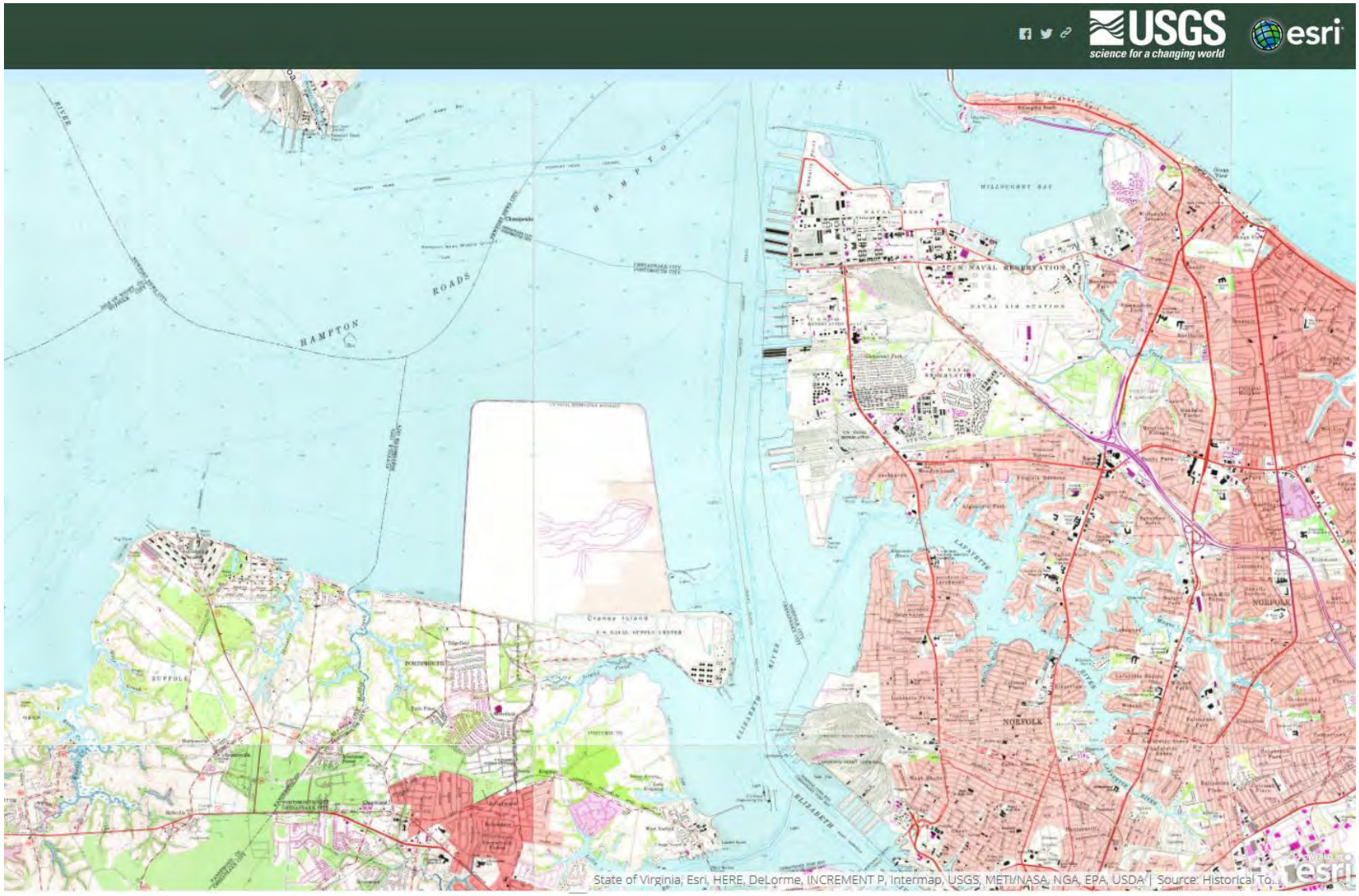
Quadrants: Newport News South, Norfolk North, Little Creek, Bowers Hill, Norfolk South, and Little Creek

Figure C19: 1964 and 1965 Historical Topographic Maps (Suffolk / Portsmouth / Chesapeake)



Quadrants: Bowers Hill, Norfolk South, and Kempsville

Figure C20: 1973 Historical Topographic Maps (Norfolk / Portsmouth / Suffolk)



Quadrants: Newport News South, Norfolk North, Little Creek, Bowers Hill (1970), Norfolk South, and Kempsville

Figure C21: 1982 Aerial of Norfolk and Portsmouth (USGS, 1982)

Figure C22: 1990 Aerial of Norfolk (Google Earth, 1990)

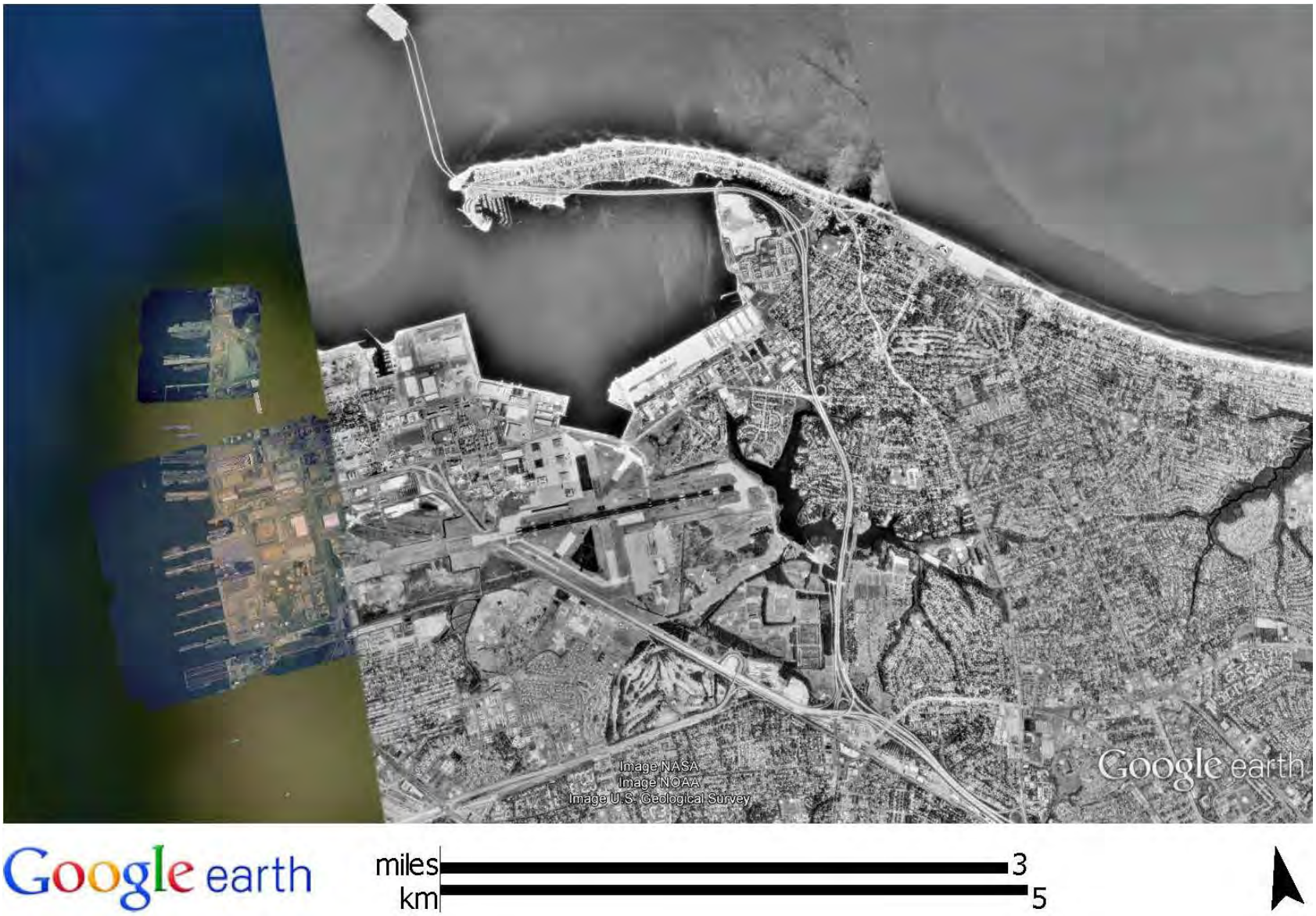
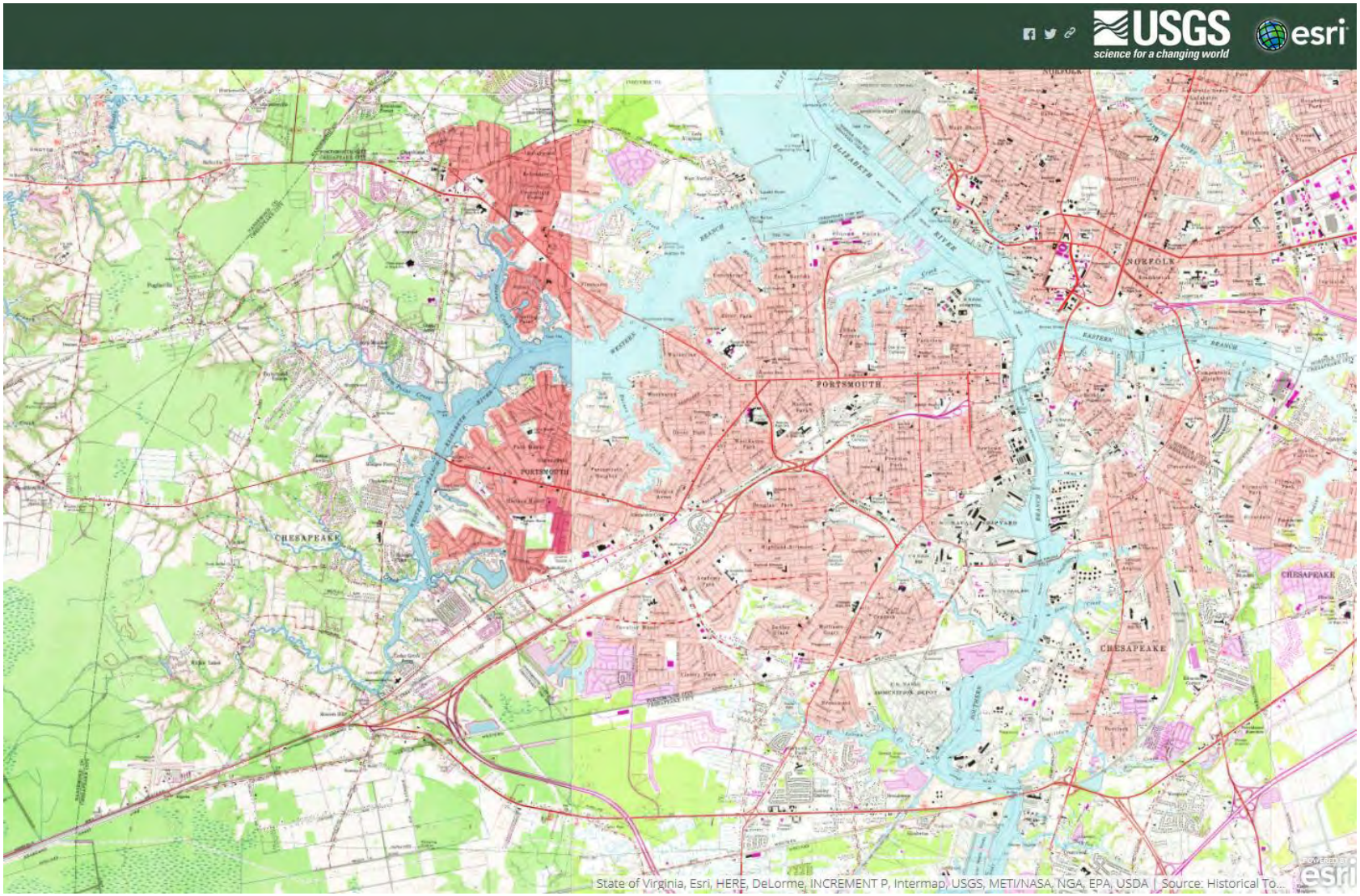


Figure C23: 2010 Aerial of Norfolk (Google Earth, 2020)

Figure C24: 1973 Historical Topographic Maps (Suffolk / Portsmouth / Chesapeake)

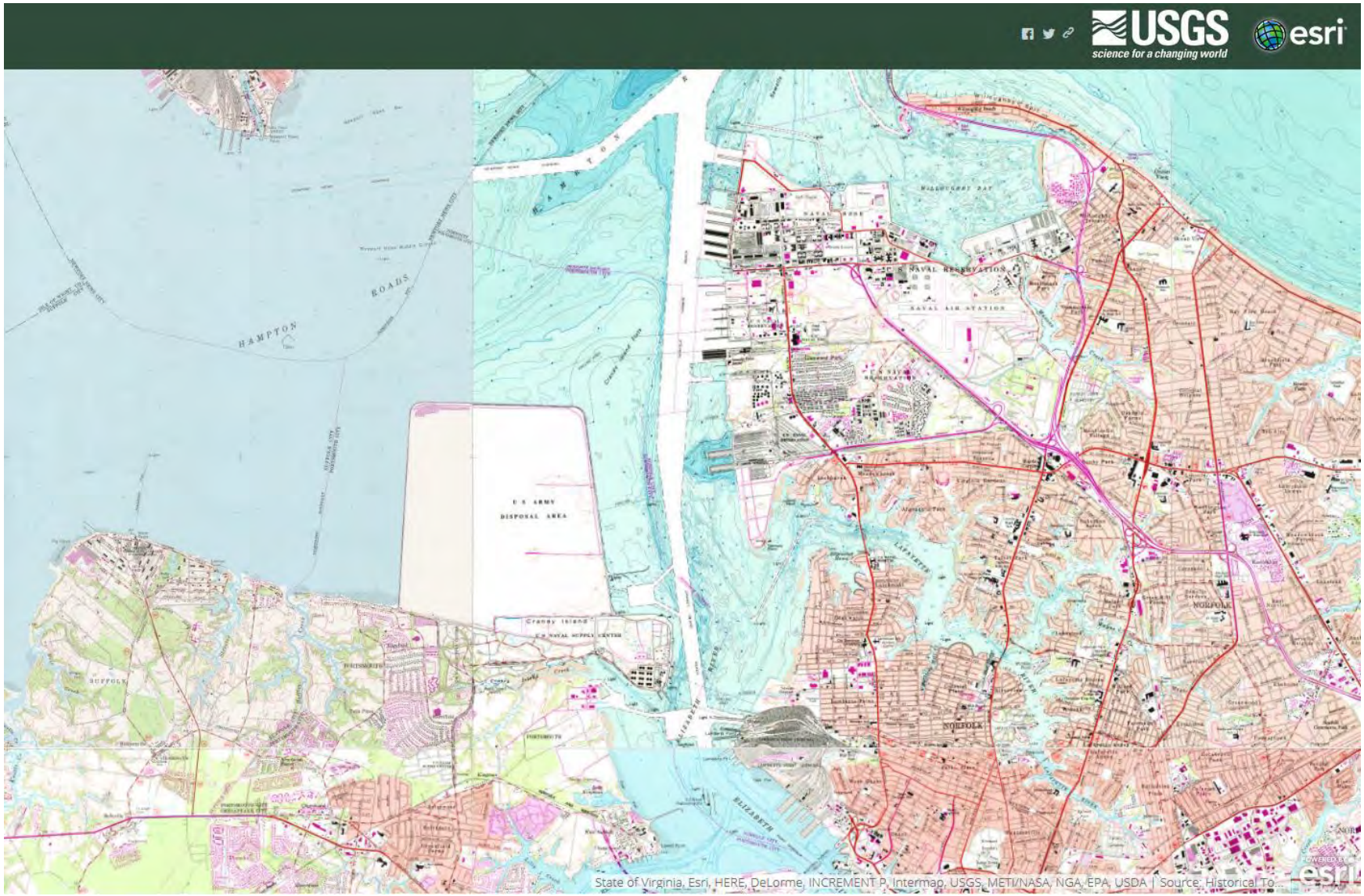


Quadrants: Bowers Hill (1970), Norfolk South, and Kempsville

Figure C25: 1983 Aerial of Suffolk, Portsmouth and Chesapeake to Bowers Hill (USGS, 1983)

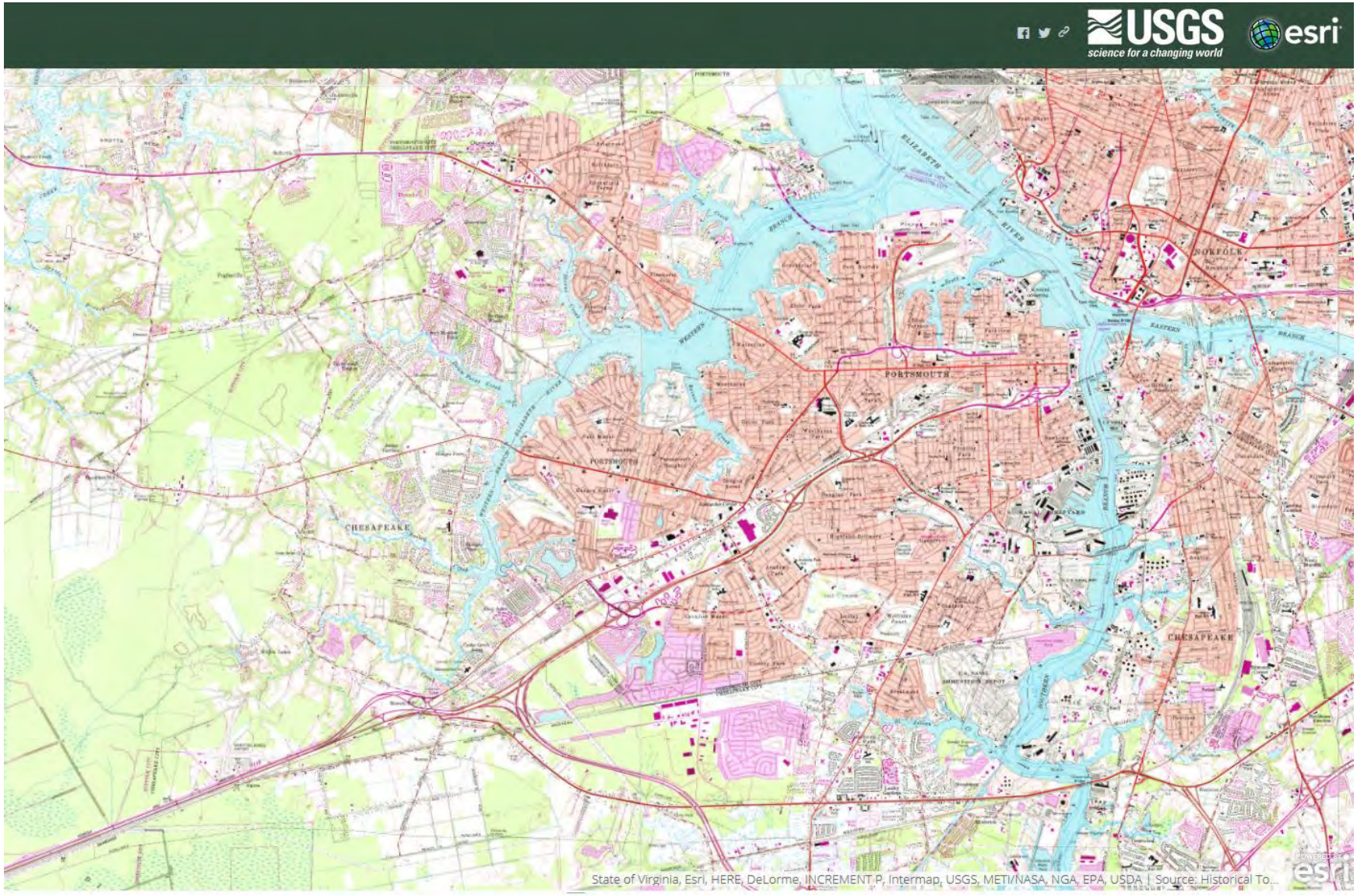
Figure C26: 1983 Aerial of Suffolk, Portsmouth and Chesapeake (USGS, 1983)

Figure C27: 1986 Historical Topographic Maps (Norfolk / Portsmouth / Suffolk)



Quadrants: Newport News South, Norfolk North, Little Creek, Bowers Hill, Norfolk South, and Kempsville

Figure C28: 1986 Historical Topographic Maps (Suffolk / Portsmouth / Chesapeake)



Quadrants: Bowers Hill, Norfolk South, and Kempsville

Figure C29: 1991 Aerial of Portsmouth and Suffolk (Google Earth, 1991)

Figure C30: 1991 Aerial of Suffolk, Portsmouth and Chesapeake to Bowers Hill (Google Earth, 1991)

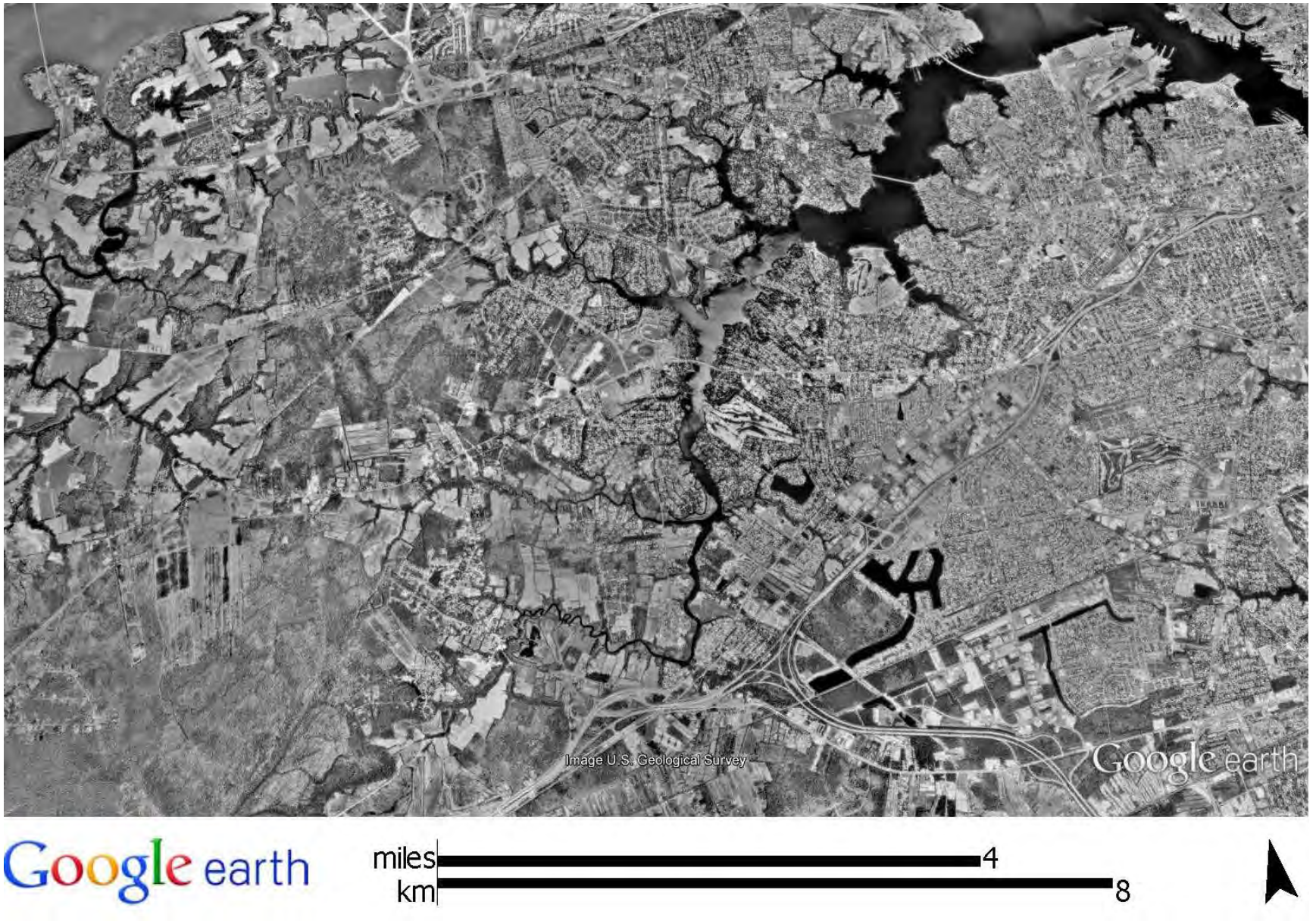


Figure C31: 2002 Aerial of Suffolk and Portsmouth (Google Earth, 2002)

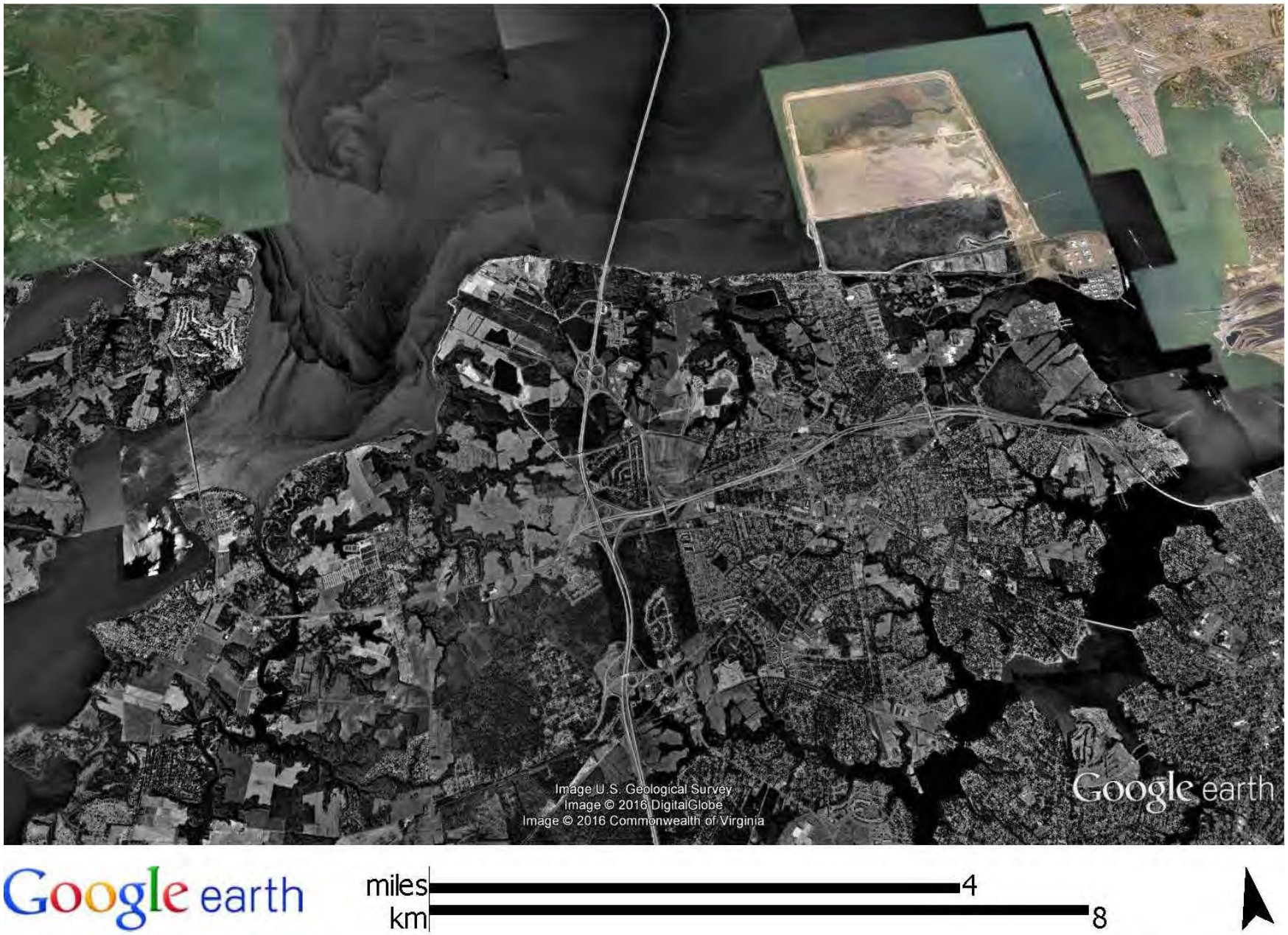


Figure C32: 2002 Suffolk, Portsmouth and Chesapeake to Bowers Hill (Google Earth, 2002)

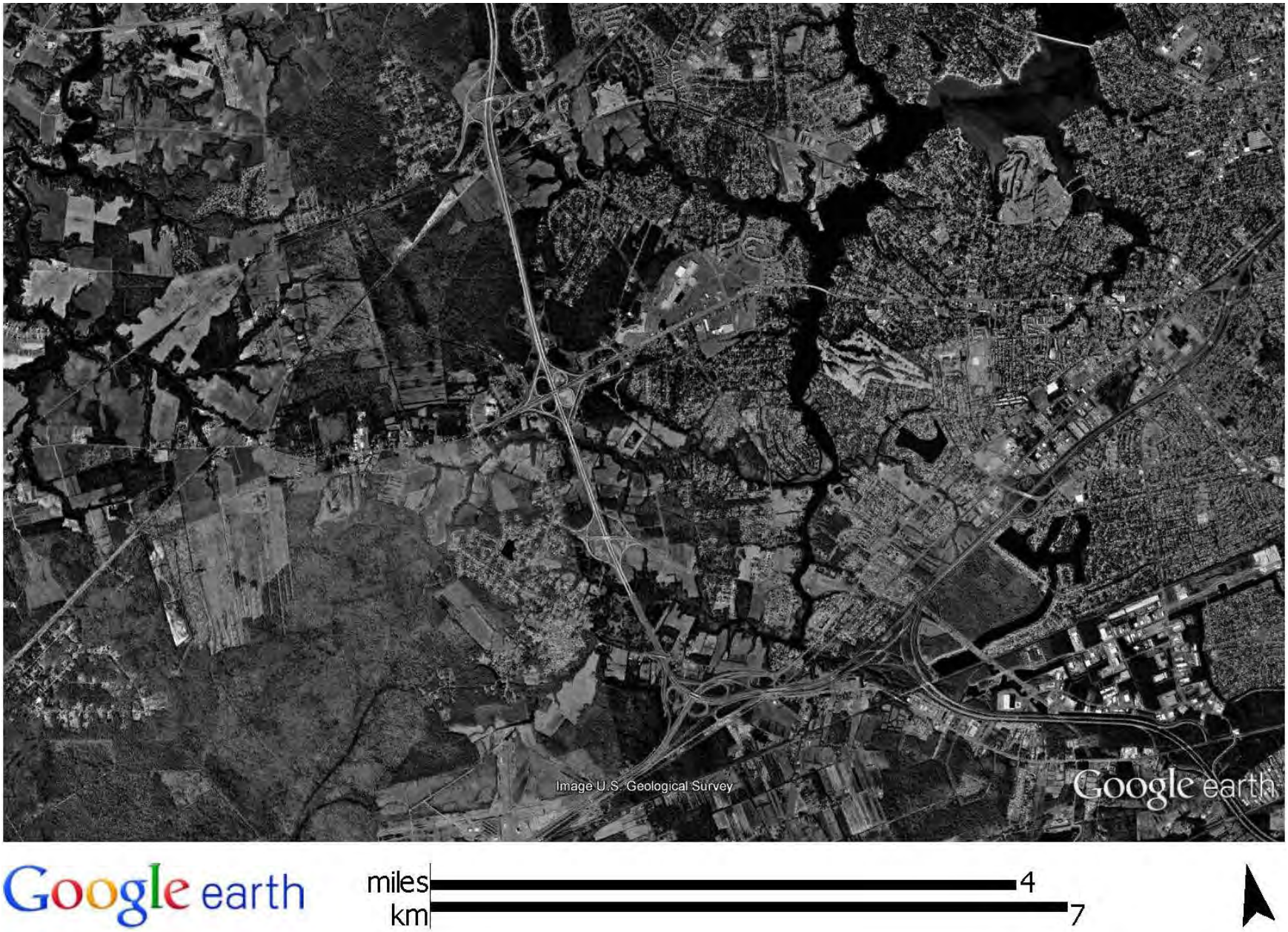


Figure C33: 2010 Aerial of Suffolk, Portsmouth and Chesapeake (Google Earth, 2010)

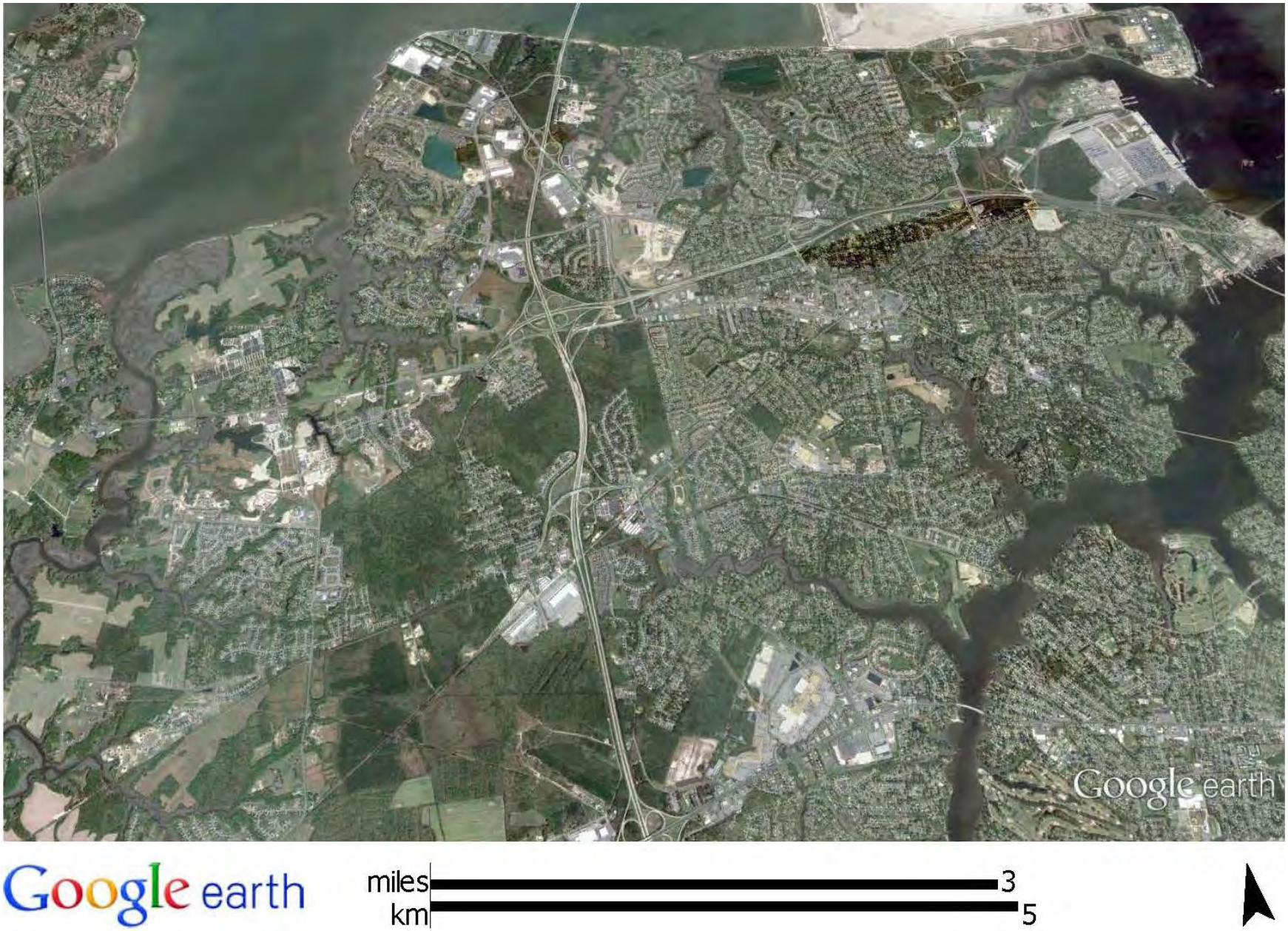


Figure C34: 2010 Aerial of Suffolk, Portsmouth and Chesapeake to Bowers Hill (Google Earth, 2010)