PORTSMOUTH & CHESAPEAKE

JOINT LAND USE STUDY

Hampton Roads Planning District Commission

Final Report
August 2021

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Report Format

This report is designed as an interactive PDF and is optimized for viewing on-screen. The report includes hyperlinks and other buttons to support document navigation. Embedded hyperlinks to websites are recognizable by underlined text. To access a website, hover over and click on the link to open a separate browser window. In addition, several button features are provided to support navigation, including a fully hyperlinked table of contents and table of contents navigation buttons on the perimeter of each page. Some maps are also enabled with an "Expand" button at the top of the map that when clicked opens up a larger map image. In addition, the flood scenario and travel demand maps in Chapter 4 are presented in a layered, or stacked, method with buttons above each map that allow navigation through the scenarios while remaining on the same page. Maps that are presented in a layered format in the Draft Report are also provided in a separate JLUS Map Booklet that can be used to print individual maps.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS

BFE	base flood elevation
BRIC	Building Resilient Infrastructure and Communities
BRT	bus rapid transit
Business PREP	Business Preparedness and Resiliency Program
CDBG	Community Development Block Grant
CIA	Controlled Industrial Area
CIDMMA	Craney Island Dredged Material Management Area
CIP	Capital Improvement Plan
CWSRF	Clean Water State Revolving Fund
CPLO	Community Plans and Liaison Officer
CRO	Chief Resilience Officer
CTP	Cooperating Technical Partner
DAR	Defense Access Road
DCIP	Defense Community Infrastructure Program
DCR	(Virginia) Department of Conservation and Recreation
DEM	Digital Elevation Model
DEP	(NYC) Department of Environmental Protection
DEQ	(Virginia) Department of Environmental Quality
DoD	U.S. Department of Defense
DRPT	Virginia Department of Rail and Public Transportation
DSCA	Defense Support to Civil Authorities
DWSRF	Drinking Water State Revolving Fund
EA	Environmental Assessment
EDA	U.S. Economic Development Administration
EMS	emergency medical services
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EUL	Enhanced Use Lease
FAQ	Frequently Asked Question
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FTA	Federal Transit Administration
FY	fiscal year
GIS	geographic information system
HRGEO	Hampton Roads Geospatial Exchange Online
HRMFFA	Hampton Roads Military and Federal Facilities Alliance
HRPDC	Hampton Roads Planning District Commission
HRSD	Hampton Roads Sanitation District
HRT	Hampton Road Transit
HRTPO	Hampton Roads Transportation Planning Organization
HVAC	heating, ventilation, and air conditioning
ICC	Increased Cost of Compliance
IN	Industrial (zoning)
INFRA	Infrastructure for Rebuilding America
JLUS	Joint Land Use Study
LEED	Leadership in Energy and Environmental Design
LUC	land use controls
MAX	Metro Area Express
MHHW	mean higher high water
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MW	megawatt
NAVD88	North American Vertical Datum of 1988
NAVFAC	Naval Facilities Engineering Systems Command
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NFWF	National Fish and Wildlife Foundation
NMCP	Naval Medical Center Portsmouth
NNSY	Norfolk Naval Shipyard
NOAA	National Oceanic and Atmospheric Administration
NPB	Norfolk & Portsmouth Belt Line Railroad
NSA	Naval Support Activity
NYC	New York City
OLDCC	Office of Local Defense Community Cooperation
PDM	Pre-Disaster Mitigation
PMMAC	Portsmouth Mayor's Military Affairs Committee

ACRONYMS

PMT	Portsmouth Marine Terminal
POC	point of contact
PPV	Public-Private Venture
RCS	Regional Connectors Study
REPI	Readiness and Environmental Protection Integration Program
RFP	Request for Proposal
RGGI	Regional Greenhouse Gas Initiative
SACAP	Special Assistant to the Governor for Coastal Adaptation and Protection
SERDP	Strategic Environmental Research and Development Program
SFHA	Special Flood Hazard Area
SIOP	Shipyard Infrastructure Optimization Plan
SLR	sea level rise
SSPD	Southside Parking District
STRAHNET	Strategic Highway Network
TDM	Traffic Demand Management
TIP	Transportation Improvement Program
TPOF	Transportation Partnership Opportunity Fund
ULI	Urban Land Institute
USACE	U.S. Army Corps of Engineers
USC	United States Code
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
VA DEQ	Virginia Department of Environmental Quality
VaUSBC	Virginia Uniform Statewide Building Code
V/C	volume to capacity
VCWRLF	Virginia Clean Water Revolving Loan Fund
VDEM	Virginia Department of Environmental Management
VDOT	Virginia Department of Transportation
VIG	Virginia International Gateway
VPA	Virginia Port Authority
WIFIA	Water Infrastructure Finance and Innovation Act

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EXECUTIVE SUMMARY

Purpose

This **Joint Land Use Study (JLUS)** addresses several challenges and opportunities that currently affect or could affect in the future the cities of Portsmouth and Chesapeake in southeastern Virginia and several Navy installations in those communities. While both cities and the Navy have a commendable history of cooperation and support, the potential for new threats from sea level rise and flooding, combined with the anticipated growth of the Navy mission, will present new risks and challenges in the coming years.

Overall, the Department of Defense (DoD) is a major part of the local and regional economies. It is also the largest employer in Portsmouth.[1] The close proximity of the installations to the surrounding neighborhoods and the high degree of interdependency among the localities and the Navy serve as critical reminders of the importance of coordinated planning and alignment of priorities to support the long-term success of the Navy and the economic resilience of both cities.

The JLUS defines 36 Actions that relate to a specific task or project aimed at addressing the primary challenges and goals identified in the study. In many instances, the Actions define the first steps toward more technical planning, engineering analysis, and coordination that will be needed before an appropriate and site-specific design solution can be defined. In other instances, and where appropriate, Actions suggest potential infrastructure upgrades that could improve conditions.

Summary of Challenges

The JLUS stands apart from other local planning processes because it brings together the military and the communities in a process focused on issues of mutual concern as well as opportunities that could offer benefits to the partners. The following primary challenges were identified and influenced the analysis and strategy development for the JLUS:

The Portsmouth and Chesapeake JLUS is a cooperative planning process among the Cities of Portsmouth and Chesapeake, the Commonwealth of Virginia, and the following:

- Naval Station Norfolk – Navy Supply Systems Command Fleet Logistics Center Norfolk, Craney Island Fuel Depot (referred to hereafter as Craney Island Fuel Depot)
- Naval Support Activity (NSA) Hampton Roads – Portsmouth Annex (Naval Medical Center Portsmouth)
- Norfolk Naval Shipyard (NNSY) and associated properties, including:
  - St. Juliens Creek Annex
  - South Gate Annex
  - Scott Center Annex
  - The Village at New Gosport
  - Stanley Court
  - Paradise Creek Annex

The Hampton Roads Planning District Commission (HRPDC) is the primary project sponsor.

- **Access.** Military installations rely upon the local and regional transportation networks on a daily basis to carry thousands of personnel along regional and local corridors to installation gates. Congestion within close proximity of the installation gates can create neighborhood-level access impacts that is expected to increase with additional population and employment growth at Norfolk Naval Shipyard in particular. A coordinated approach is needed when considering changes to existing entry control points or modifications to existing local roadways so that impacts related to gate volumes, congestion, neighborhood safety, redevelopment, and future flooding are considered.
- **Roadway Flooding.** Flooding on roadways can disrupt or limit access to military installations and prevent military personnel from getting to work, which impacts mission readiness. Localized flooding impacts already occur in certain areas around NNSY and

1 Virginia Employment Commission, Portsmouth City Community Profile, Updated 5/20/21. https://virginiaworks.com/Portals/200/Local%20Area%20Profiles/5104000740.pdf Accessed 6/1/2021

reduce the functionality of certain gates. Future rainfall intensity and sea level rise will increase the extent and depth of flooding, further compounding installation access and congestion, as well as affecting access to community facilities that the military relies upon.

Eight scenarios were used to assess potential flood impacts on the roadway network and to simulate how flood impacts could affect congestion. The analysis showed that multiple corridors will be simultaneously affected with conditions lasting from a few hours to a day or more, and alternate routes used today to avoid tidal or storm-based flooding will not provide the necessary relief in the future because those routes will also be affected by flooding. Nearly all of the streets connecting NNSY to I-264, the Downtown Tunnel, and the Naval Medical Center Portsmouth area will be flooded to some degree in four of the eight flood scenarios evaluated, limiting installation access and the ability to travel to and both between NNSY and Naval Medical Center Portsmouth. In addition, the only access to Craney Island Fuel Depot will be impacted in isolated and relatively shallow flooding.

This analysis led to the identification of six priority corridors within the network that play an important role in military readiness, installation resilience, and overall effectiveness of the regional transportation network: Effingham Street, Portsmouth Boulevard, Victory Boulevard, Frederick Boulevard, George Washington Highway, and Cedar Lane. If these routes are impacted by flooding or otherwise impeded, operational inefficiencies and lost work time for the Navy will likely occur. Flooding will also affect emergency response activities and access to community services, limit or constrain neighborhood access, and limit or disrupt commerce and economic development in Downtown Portsmouth. A coordinated and comprehensive flood mitigation and stormwater management strategy is needed for each corridor that combines different infrastructure improvements and options for addressing long-term potential flood impacts.

- **Redevelopment Opportunities.** The Navy installations contribute to the industrialized nature of the Elizabeth River corridor. Both Portsmouth and Chesapeake view the river corridor south of NNSY as an important priority for economic development and tax revenue. Opportunities for redevelopment along the river corridor include potential Enhanced Use Lease opportunities on underutilized land at South Gate Annex and St. Juliens Creek Annex (including extension of utilities to adjacent vacant land) and potential reuse opportunities at the Navy-owned Paradise Creek Annex. In addition, opportunities for compatible, mixed-use development, including restaurants or other services on underutilized or vacant land near the NNSY and Naval Medical Center Portsmouth gates, could help diversify land use around the installations, offer military personnel and visitors more options for meeting day-to-day errands, and support local economic development objectives.

  Redevelopment can also present opportunities to improve safety, mitigate access conflicts, and expand connectivity between the cities and the installations along key corridors. Careful and coordinated management of growth and redevelopment on and adjacent to the installations will be needed between the Navy and cities to ensure that any changes or impacts associated with land use changes are jointly understood and any negative impacts mitigated.

JLUS Goals

The goals for the JLUS focus on reducing flood impacts to the transportation network, expanding access opportunities for getting to the installations, reducing impacts on neighborhoods, promoting compatible and managed growth and redevelopment that also benefits the local tax base, and fostering improved coordination among JLUS partners. There are seven goals:

- Future flooding impacts to the transportation network are mitigated.
- Military installation resilience is strengthened.
- Access to Navy installations is maintained and mobility options are expanded.
- Neighborhoods surrounding the installations are enhanced.
- Redevelopment and reuse of land improves the local economy.
- Policies and regulations manage growth and prevent conflicts.
- Navy and locality relationships are strengthened.

- **A Lack of Mobility Options.** There is currently a limited number of alternative transportation options for traveling to and from Navy facilities in the region as a whole, and bus ridership of Navy personnel is low. Bus service does exist in the study area; however, routes are long, transfers are challenging, and the hours of operation do not align with shipyard work shifts. Buses are not permitted to enter the installations, and there are no dedicated regional or express routes that serve the installations in either Portsmouth or Chesapeake. Bicycle and pedestrian infrastructure improvements both on and around the installations are also needed to provide additional safe options and to promote and encourage other modes of access to and onto the installations. Expanded transit options and improved bicycle and pedestrian infrastructure around the installations will also serve to enhance connectivity to local neighborhoods.
- **Managing Parking.** Convenient parking on NNSY and at the Naval Medical Center Portsmouth fills up quickly, especially parking lots that are located within a reasonable walking distance to large work centers. However, remote lots on the main shipyard and in nearby South Gate Annex typically remain underutilized. As a result, parking spills into surrounding neighborhoods, which offer a more proximate parking location for employees than other lots, creating congestion and enforcement challenges for Portsmouth in and around the South Side Parking District. A block-by-block evaluation of parking trends in the South Side Parking District revealed that approximately 250 vehicles associated with NNSY were parking illegally daily in the district. The analysis also showed that redevelopment at the shipyard would result in a reduction of at least 1,500 parking spaces, which will potentially increase or double the number of employees parking in the South Side Parking District. Management of parking will require a multi-pronged approach that anticipates the impacts of mission growth, reduces parking-related impacts on neighborhoods, better optimizes and connects existing parking on the installations, and considers remote parking alternatives across the study area that are efficient and directly connect onto the installations.

Recommendations

The JLUS recommends 36 Actions and 36 Practices and Policies. The Actions are organized into six types as shown in Table ES.1.

Table ES.1 Types of Actions

Type		Description
	Parking	Parking strategies focus on managing parking both internal and external to the installations, including improving parking utilization and connectivity and pursuing remote parking alternatives in an effort to reduce impacts on adjacent neighborhoods.
	Multimodal	Multimodal strategies focus on expanding and improving transit to align with military personnel schedules and improving bicycle and pedestrian access in and around the installations.
	Flood Mitigation	Flood mitigation strategies identify approaches that could help mitigate flooding along corridors identified as critical for accessing the installations and providing important network functionality.
	Land Use and Development	Land use and development strategies target specific areas adjacent to the installations and recommend joint planning efforts to manage compatible growth, reuse, and redevelopment that considers both local and federal lands.
	Access	Access strategies focus on improving installation access points and enhancing directional signage and information to assist commuters and visitors.
	Utilities	Utility strategies focus on improving utility resiliency for the installations and local economic development opportunities.

Priority Actions

Evaluation criteria were established to assess the overall importance of each action by defining how well each action addresses the JLUS goals and reduces risk to or improves military readiness. The criteria consider DoD Mission and Personnel Readiness, Transportation Network Connectivity, Community Benefits, and Economic Resiliency. A stronger emphasis was placed on Mission and Personnel Readiness and Economic Resiliency criteria by giving each criterion in those categories a weighted multiplier of 2, while all other criteria were unweighted.

Based on the evaluation criteria, scores ranged from 5 to 17 points. All 36 Actions are presented by overall score in the report. To help clarify level of priority within the large list of Actions and provide direction for implementation, the actions were further assigned into Tiers, as shown in Table ES.2.

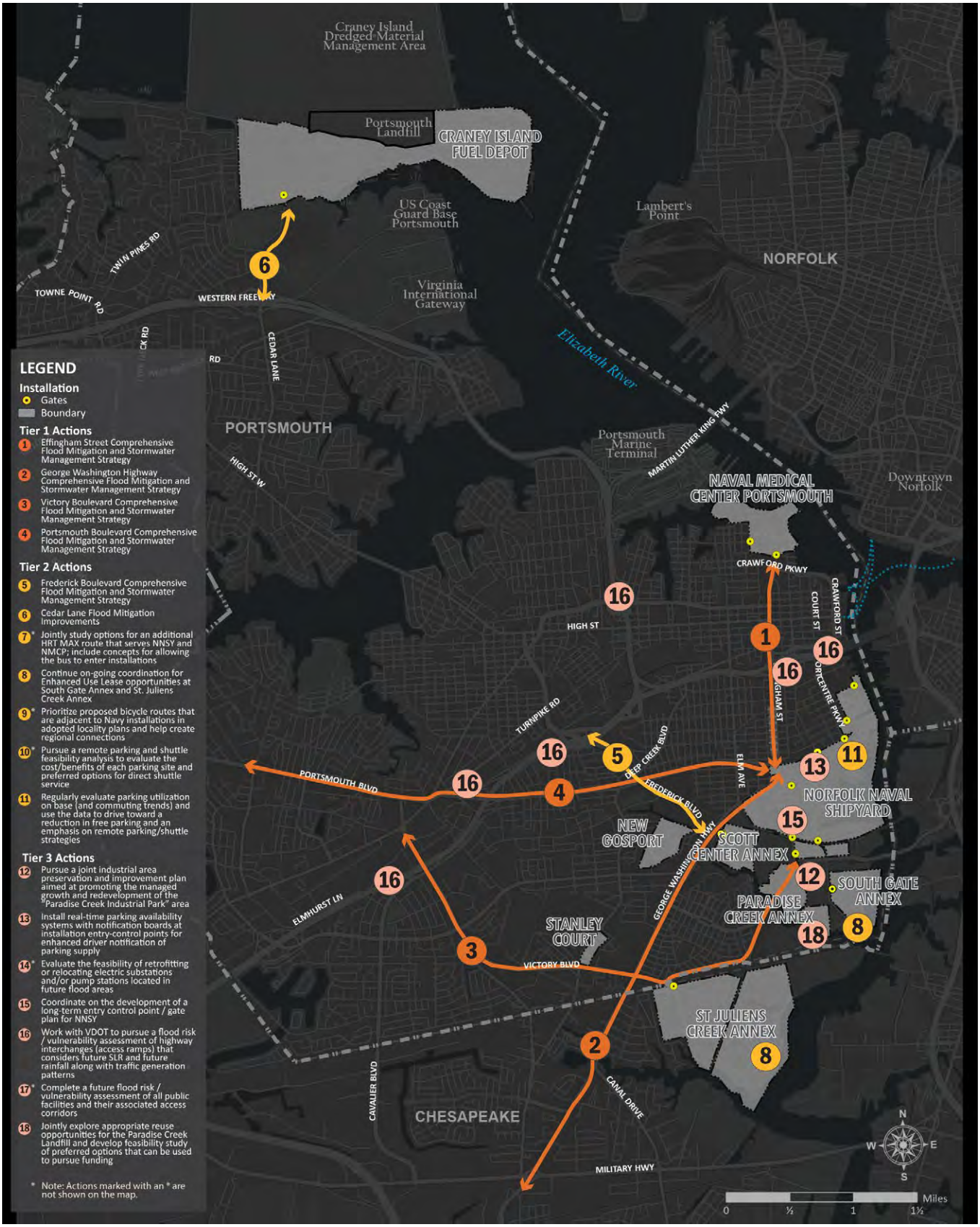
The four highest-scoring JLUS Actions (Tier 1) are comprehensive flood mitigation and stormwater management strategies for Effingham Street, George Washington Highway, Victory Boulevard, and Portsmouth Boulevard. Figure ES.1 maps the locations of the Tier 1 through 3 Actions. (Tier 4 strategies are not mapped). Actions within Tiers 1 through 3 are described in more detail in the report and include information about lead and supporting partners, potential funding sources, timeframe, and estimated cost.

The overall scores reflect the relative importance of each Action in meeting the JLUS goals. However, prioritizing actions for implementation will require the consideration of other factors such as, but not limited to, estimated project cost, funding availability, and the level of required coordination. These factors affect the level of effort that could be required to move a strategy forward at any given time. Some strategies will be more costly and complex than others and will, therefore, require more time to implement, while other strategies may be advanced more swiftly as a result of lower costs and availability of existing resources. In addition, funding availability may shift how strategies are prioritized, in order to take advantage of special opportunities, such as federal or state grant programs.

Table ES.2 Recommended JLUS Strategies by Tier

	Priority Ranking	Score Range	# of Actions	Ranking Color
Tier 1	High	15–17	4	
Tier 2	Medium	12–14	7	
Tier 3	Low	10–11	7	
Tier 4		< 10	18	(Not mapped)

Figure ES.1 Tier 1-3 JLUS Actions



Policies and Practices

The 36 recommended policies or practices included in the JLUS aim to improve collaboration, coordination, and project execution and are not limited to one geographic area. A number of practices are already in place that support coordination among Portsmouth, Chesapeake, and the Navy that can serve as a foundation for partnering on issues of mutual concern in the future or could be expanded and strengthened to address other priority issues or opportunities. The policies and practices, as shown in Table ES.3, are intended to improve collaboration among JLUS partners, advocate for the advancement of local and regional priorities, strengthen policies and regulations for long-term community resilience, and leverage technology and data sharing to support decision-making.

A few sample strategies from the Policy and Practices recommendations are included below. The full list of policies and practices is available in the report.

- Adopt a Memorandum of Understanding (MOU) among JLUS partners to commit to working together to advance and implement JLUS priorities.
- Develop guidance for multijurisdictional projects that would define a formal coordination mechanism to ensure all affected parties are sufficiently engaged and consulted in the project.
- Continue to explore and pursue funding opportunities through the DoD Defense Community Infrastructure Program (DCIP) and Defense Access Road (DAR) Program.
- Develop regional guidance for integrating tidal and rainfall scenarios into local and regional transportation planning so that the information can be used in future scenario planning.
- Incorporate future climate conditions (rainfall, SLR) into locality comprehensive plan updates and area plans so that land use policy, growth management strategies, and siting of public facilities (schools, fire, police) consider future conditions for flooding.
- Consider the formation of a regional industrial lands task force to support the development of guidance for reducing risk along the Southern Branch of the Elizabeth River.
- Define geographic information system (GIS) data-sharing protocols, requirements, and points of contact at the cities and the Navy to support cross-jurisdictional technical studies, analyses, and project execution.

The planning horizon for the JLUS is approximately 50 years. The recommended actions, polices, and practices are intended to provide a roadmap for action that can begin today and focuses on the next 10 to 15 years. The implementation steps defined for each of the Tier 1 through 3 strategies provide direction for the JLUS partners on how to begin. The recommended actions, policies, and programs should serve as an implementation framework for the study partners. The JLUS process has aimed to establish an ongoing dialogue that should continue after the study is completed to help with implementation and continue to address ongoing and emerging issues.

Table ES.3 Types of Policies and Practices

Type		Description
	Planning Coordination and Outreach Strategies	Coordination and outreach strategies are largely targeted at strengthening and formalizing coordination and communication between the JLUS partners, other regional stakeholders, and the public.
	Advocacy	The advocacy strategies are aimed at influencing state, federal, and regional actions in support of JLUS priorities.
	Policy and Development Regulations	Land use policies and development regulations are important tools for managing long-term compatible growth and development of a community.
	Technology and Data	Data sharing and technology can support decision-making and cross-jurisdictional coordination.

1.0 INTRODUCTION

1.1 Introduction

A Joint Land Use Study (JLUS) is a type of cooperative planning effort that brings together military installations and their surrounding communities to jointly identify shared challenges and strategies typically related to land use compatibility and development that currently affect, or could affect, the military mission. The JLUS Program falls under the U.S. Department of Defense's (DoD's) Office of Local Defense Community Cooperation (OLDCC) and is now part of the OLDCC's broader Military Installation Sustainability Program. The Military Installation Sustainability program provides technical and financial assistance to states and local governments to analyze and implement actions necessary to foster, protect, and enhance military installation sustainability. "This program is designed to help communities make informed decisions by enabling states and communities to partner with local commands to respond to, address, and mitigate activities that are either impairing or likely to impair the use of the installation. When done successfully, it increases military value of the installation by preserving the military mission."[1]

1.1.1 Purpose of the JLUS

This JLUS focuses on a range of issues that are currently affecting or could affect the cities of Portsmouth and Chesapeake, Virginia and the Navy military assets located therein.

The issues are a blend of challenges related to tidal flooding, rainfall, and sea level rise (SLR) as well land use patterns and development compatibility related to mission growth that could affect the continued operational utility of the installations and/or generate impacts on the nearby neighborhoods.

The Norfolk Naval Shipyard (NNSY) and the Naval Medical Center Portsmouth are major employers in Portsmouth, attracting thousands of employees and visitors daily that utilize the regional and local transportation network to reach the installations. Increased risk of future flooding due to tidal flooding, future SLR, and increased rainfall amounts will exacerbate congestion issues along critical routes through the study area, including those used to reach the installations, and will significantly restrict access to the installations. Similarly, all of the installations rely upon many of the same services and resources as the community. Utilities, such as natural gas, electric, water, and wastewater, and the roads that provide access to local streets and regional highways, are critical to enabling the operations at each installation. Increased risks to these services and resources from future flooding can result in short-term or prolonged loss of access, structure loss, infrastructure damage, and other serious consequences. The high degree of interdependency between the Navy, Portsmouth, and Chesapeake around major infrastructure elements underscores the importance of these entities working together and defining a path toward a regional set of priorities.

The Portsmouth and Chesapeake JLUS is a cooperative planning process among the Cities of Portsmouth and Chesapeake, the Commonwealth of Virginia, and the following:

- Naval Station Norfolk – Navy Supply Systems Command Fleet Logistics Center Norfolk, Craney Island Fuel Depot (referred to hereafter as Craney Island Fuel Depot)
- Naval Support Activity (NSA) Hampton Roads – Portsmouth Annex (Naval Medical Center Portsmouth)
- Norfolk Naval Shipyard (NNSY) and associated properties, including:
  - St. Juliens Creek Annex
  - South Gate Annex
  - Scott Center Annex
  - The Village at New Gosport
  - Stanley Court
  - Paradise Creek Annex

The Hampton Roads Planning District Commission (HRPDC) is the primary project sponsor. The JLUS is sponsored by a grant from the OLDCC and from local match contributions from the participating jurisdictions and the HRPDC.

1 U.S. Department of Defense, The Office of Local Defense Community Cooperation. 2021. "Military Installation Sustainability." https://www.oea.gov/our-programs/military-installation-sustainability. Accessed 2/25/2021.

Concentrated primarily along the Elizabeth River waterfront, the installations contribute to the area's industrialized nature. They also share boundaries with urban and suburban neighborhoods, including mature historic districts and commercial and business districts. Anticipated growth within the installations themselves and a desire for more private industrial redevelopment on under-utilized land south of NNSY are identified as opportunities for both the cities and the Navy. This growth can provide benefits to the cities through additional jobs and tax revenue and could lead to the development of more support services for the neighborhoods nearby.

In contrast, because the installations are situated within the urban fabric of the cities, installation personnel trying to get to or from work sometimes travel through neighborhood streets or park in adjacent neighborhoods, and traffic trying to get onto the installations can back up onto city streets near entry control points (installation gates) creating congestion and delay. Redevelopment could place increased pressure on the roadway networks and could result in new land use patterns through areas that are already congested and disconnected. However, redevelopment activity can also present opportunities to improve safety, mitigate access conflicts, and expand connectivity between the cities and the installations along key corridors while also addressing issues related to future flooding. Careful and coordinated management of growth and redevelopment on and adjacent to the installations will be needed between the Navy and cities to ensure that any impacts are jointly understood and mitigated, current and future gate access is safely

The Economic Impact of the Navy in Hampton Roads

According to the fiscal year (FY) 2019 *Navy Region Mid Atlantic Economic Impact Report*, the Navy spent more than $15.4 billion in Hampton Roads during FY2019. Annual military, civilian, and contractor payroll associated with Navy operations increased from $11.7 billion in FY2018 to $12.2 billion in FY2019. The overall economic impact of the installations included in the JLUS in FY2019 was over $9 billion, as shown in Table 1.1. Data is aggregated at the installation level.

The operational footprint of each installation varies, depending upon its mission. Table 1.2 identifies the total personnel (including military, civilian, and contractors) at each installation. Norfolk Naval Shipyard has the largest number of personnel among the JLUS installations. A brief summary of each installation mission follows.

Table 1.1 Overall Aggregated Economic Impact of Installations (FY2019)

Installation	Military and Civilian Annual Total Payroll	Annual Procurement and Travel	Overall Economic Impact
Norfolk Naval Shipyard	$1,115,062,431	$1,183,839,606	$2,298,902,037
Naval Station Norfolk	$4,942,748,037	$1,151,613,322	$6,094,361,359
Naval Support Activity Hampton Roads	$ 968,154,192	$ 409,955,016	$1,378,109,208

Note: Data provided by Navy Region Mid-Atlantic, June 2021. Economic data is aggregated at the installation level. Norfolk Naval Shipyard numbers include installation Annexes; Naval Station Norfolk data includes Craney Island Fuel Depot; Naval Support Activity Hampton Roads data includes Naval Medical Center Portsmouth.

Table 1.2 Total Personnel

Installation	Total Personnel (includes military, civilian, and contractors)
Norfolk Naval Shipyard	14,577
Craney Island Fuel Depot	64
Naval Medical Center Portsmouth	5,182

Note: Craney Island Fuel Depot personnel numbers provided by Norfolk Naval Station, March 3, 2021; Norfolk Naval Shipyard personnel numbers, including St. Juliens Creek Annex, were derived from Navy Region Mid Atlantic Press Release 20-12 and are for FY19. Naval Medical Center Portsmouth personnel numbers were provided by the NSA Hampton Roads Public Affairs Officer on March 9, 2021.

managed, and future redevelopment and access improvements incorporate strategies to mitigate the potential for future flooding.

While operations at NNSY are primarily contained on site, the close proximity can sometimes result in impacts extending into the surrounding communities. For example, employee and visitor parking extends into the adjacent Southside neighborhood. Although Portsmouth has defined a parking district to manage the activity, its use is difficult to enforce. The issue of parking is a key focus of this JLUS because of the current impacts it places on the adjacent neighborhood, the management challenge it presents for Portsmouth, and the potential for increased impacts in the future as parking supply on the installation decreases.

The JLUS identifies 36 Actions to address primary issues and 36 strategies to enhance policies, planning, and coordination and partnering among the JLUS partners. In many instances, the Actions refer to areas in need of more technical planning and engineering analysis and coordination across jurisdictions to define appropriate and site-sensitive design solutions. In other instances, and where appropriate, Actions suggest potential infrastructure upgrades that could improve conditions.

1.2 Goals of this JLUS

The goals for the JLUS focus on reducing flood impacts to the transportation network, expanding access opportunities for getting to the installations, reducing impacts on neighborhoods related to congestion and parking, promoting compatible and managed growth and redevelopment that also benefits the local tax base, and fostering improved coordination among JLUS partners to advance regional priorities. They respond directly to the issues defined in the analysis described later in Chapters 2 through 4. The goals are as follows:

Future flooding impacts to the transportation network are mitigated. Protecting the transportation network from future flooding is essential for DoD mission readiness because it ensures that military commuters, goods, and services can access the Navy installations. It is also essential for economic activity. A flood-resilient transportation network also enables the provision of protective services, such as fire and police, by ensuring unrestricted movement. Local and regional improvements to the network aimed at addressing congestion and access management related to commuter traffic and freight activity should also proactively mitigate against future flood conditions as part of design development.

Military installation resilience is strengthened. The resilience of the Navy installations and their operations depends upon outside sources and partners providing power, water, wastewater, and other services that support the day-to-day mission. A shared understanding of the interdependencies among the cities, Navy, and service providers fosters coordinated investments and an alignment of policy and spending priorities that promote military resilience. Infrastructure and critical systems that deliver resources and services from off the installation to the Navy are protected, and critical assets mission capabilities are sustained.

Access to Navy installations is maintained and mobility options are expanded. More mobility options that consider the needs of military commuters are needed. Currently, bus service is limited, inconvenient, and, therefore, not well-utilized. Options that are convenient, efficient, and operated to align with work shifts could encourage more workers to use transit and help reduce congestion over time. Improved infrastructure for walking and biking near the installations and internal installation shuttles that connect work centers on base with parking and transit options can improve and expand overall mobility.

Neighborhoods surrounding the installations are enhanced. Impacts from military operational activities on the surrounding neighborhood currently center mostly around transportation issues, including illegal and legal parking and roadway congestion along local roadways that affects neighborhood access. These impacts could increase as installation growth and development occurs. In addition, a limited number of convenient options exist for the community or military personnel to eat lunch or run an errand before or after work shifts, and gaps in the pedestrian network that are a deterrent to walkability. Opportunities exist to reduce or mitigate operational impacts on the neighborhoods while also enhancing the public realm so that there is a positive impact on the surrounding communities' health, safety, and welfare.

Figure 1.1 JLUS Study Area

Redevelopment and reuse of land improves the local economy. The redevelopment and reuse of underutilized Navy land should benefit and strengthen the local economy. Reinvestment and infill development can enhance the local tax base, improve the value of the surrounding area, and potentially diversify land uses near the installations to benefit the installations and nearby neighborhoods.

Policies and regulations manage growth and prevent conflicts. Land use policies and development regulations set forth a guide for new development so that land is organized and developed in a way that benefits the localities and does not create adverse effects for the installations. Future updates to policies and regulations serve to reduce risk and consider the long-term threat of flooding and SLR by promoting alignment with regional standards and guidelines.

Navy and locality relationships are strengthened. Portsmouth, Chesapeake, and the Navy already have some formal and informal coordination mechanisms and processes in place. However, opportunities exist to strengthen procedures and add new mechanisms to address broader issues of concern, such as regional transportation projects and utility expansion projects. Formalized protocols can facilitate faster responses and withstand regular leadership changes at the installations and provide a platform for addressing new and emerging issues.

1.3 JLUS Study Area

The JLUS study area includes the City of Portsmouth and a portion of the City of Chesapeake (roughly the area north of I-64 and east of I-264). Installations in this study include Norfolk Naval Shipyard, including St. Juliens Creek Annex, South Gate Annex, Scott Center Annex, as well as the family housing areas of Stanley Court and the Village at New Gosport, NSA Hampton Roads – Portsmouth Annex (Naval Medical Center Portsmouth), and Naval Station Norfolk – Navy Supply Systems Command Fleet Logistics Center Norfolk, Craney Island Fuel Depot. Figure 1.1 identifies the JLUS study area, and each installation is described below.

Norfolk Naval Shipyard originally began shipbuilding operations in 1767 and is considered the oldest shipyard in the United States. Originally charged with building sailing and conventionally powered ships, it now specializes in the repair, overhaul, and modernization of all types of Navy ships and submarines. With several noncontiguous areas totaling approximately 1,275 acres, the NNSY is one of the largest shipyards in the world. The shipyard's main site, approximately 470 acres located on the Elizabeth River, supports the repair and modernization mission.

Typical operations at NNSY include maintenance on one aircraft carrier and one submarine, which results in a daily workforce between 16,000 and 17,000 people. Mission growth could bring one or two additional carriers to NNSY, in the near term which would bring an associated increase in personnel and personnel support requirements. The Navy is in the midst of a modernization effort to optimize and improve the functionality and through-put of the nation's four Navy shipyards, including Norfolk Naval Shipyard. The program will identify specific and required investments to support new optimized production processes.

The shipyard includes several special areas—noncontiguous land areas that support the shipyard mission:

- **St. Juliens Creek Annex**, located just across the Chesapeake border, provides administrative offices, light industrial shops, research and development labs, warehousing, and radar testing capabilities for the Navy and tenant commands. At approximately 498 acres, St. Juliens Creek Annex has the largest land mass of the special areas and is characterized as potentially under-utilized, although much of the site is constrained by environmental issues and/or flooding. Part of the site contains ball fields used by City of Portsmouth sports teams and a regional fire response facility used by multiple localities. Located at the confluence of St. Juliens Creek and the Elizabeth River, St. Juliens Creek Annex can only be accessed from the City of Portsmouth. The area around St. Juliens Creek Annex has built up over time and includes surrounding residential uses.
- **Scott Center Annex** is the Sailor and Family Readiness hub, a recreational complex that spans approximately 60 acres and supports Norfolk Naval Shipyard personnel and their families. Support services include the commissary, Navy Exchange, bowling alley, swimming pool, and officer's club.
- **South Gate Annex** is used primarily for storage and safe haven for barges during storms. It encompasses approximately 92 acres south of the Shipyard's main site in an area

characterized by existing former industrial sites. The site includes five piers (A through E), some of which are being explored for potential reuse opportunities.

- **Paradise Creek Annex** is a 91-acre former industrial landfill used by NNSY for solid waste disposal and petroleum reclamation.
- **New Gosport and the Stanley Court** are both Navy housing areas operated by Lincoln Military Housing. According to the Navy, both housing developments are at 100 percent occupancy.

Naval Medical Center Portsmouth is the oldest continuously running hospital in the Navy's medical system and has a mission to maintain the health readiness of the U.S. armed forces by providing healthcare services to nearly 180,000 beneficiaries, including military members, their families, and retirees. More than 5,100 employees are based at Naval Medical Center Portsmouth, and approximately 5,000 patients are seen daily at the facility.

Craney Island Fuel Depot. The Craney Island Fuel Depot is the Navy's largest fuel facility in the United States and supports fuel storage for DoD operations along the East Coast via piping, pump and dispensing systems, and pier-side fueling. The depot operates 24/7 and encompasses more than 1,000 acres that support above-ground and underground fuel storage tanks. Fuels arrive at Craney Island in several ways, including by tanker along the federal shipping channel and via the Colonial Pipeline that runs from Texas to New Jersey. The area around the depot is less densely developed than other Navy facilities, and adjacent land uses and wetlands limit the expansion potential of the property. U.S. Coast Guard Base Portsmouth is located south of the depot across Craney Island Creek. Additional fuel tanks are needed and are planned to be constructed at the site to meet growing demand.

1.4 JLUS Partners

In addition to the primary project partners, several other entities have contributed to the development of the JLUS, including the Hampton Roads Transportation Planning Organization (HRTPO), the Port of Virginia, the U.S. Army Corps of Engineers (USACE), the U.S. Coast Guard (USCG), and the Hampton Roads Sanitation District (HRSD). These partners play critical roles in contributing to the economic vitality of both cities, protecting and enhancing their physical infrastructure, and safeguarding their residents' health, safety, and welfare. Other state and local agencies, institutions of higher learning, and not-for-profit organizations such as the Hampton Roads Military and Federal Facilities Alliance (HRMFFA), were consulted as part of the stakeholder process and could provide valuable support for implementing projects.

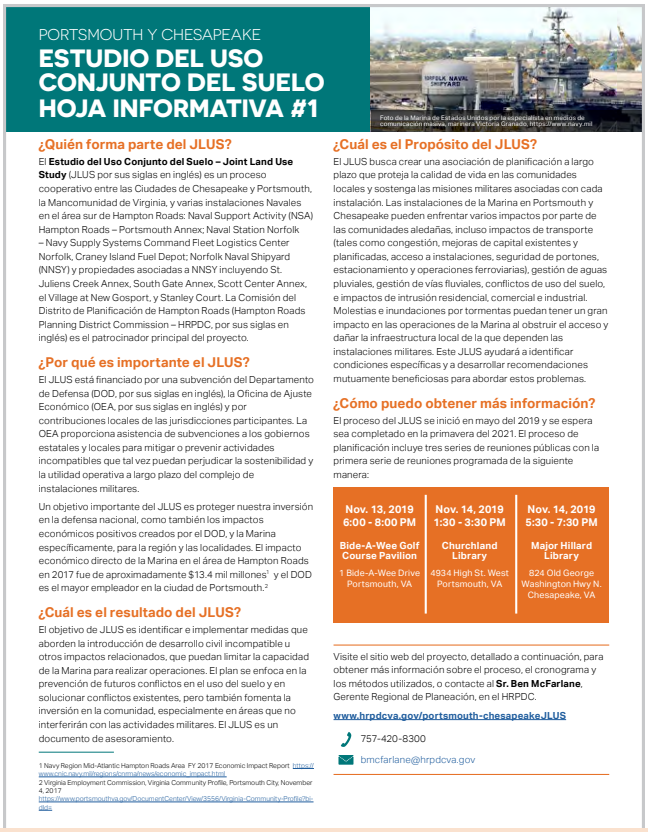
The JLUS has been overseen by two committees that have each played distinct roles in guiding the process. The Technical Committee helped define the focus areas of the study and provided feedback on the technical analyses and development of recommendations. The Policy Committee provided overall oversight of the effort. In addition, the process was informed by a robust stakeholder involvement process and input from the public at key milestones.

1.4.1 Technical Committee

The primary role of the Technical Committee is to guide the technical analysis, provide supporting information and data, and review and provide comments on materials prepared by the consultant team. The Technical Committee advises the Policy Committee. The Technical Committee includes city department heads and department staff, Community Plans and Liaison Officers (CPLOs) from each Navy installation, and staff from the HRPDC and HRTPO.

1.4.2 Policy Committee

The role of the JLUS Policy Committee is to oversee the JLUS process, review and validate the work of the Technical Committee, and ensure that the interests of the primary study partners and stakeholders are adequately represented. The members of the JLUS Policy Committee include local elected and appointed officials from the cities of Portsmouth and Chesapeake (e.g., mayors, city managers). The non-voting members of the Policy Committee include the HRPDC's Executive Director, senior active duty representatives from Navy Region Mid-Atlantic and the participating installations, and leadership representatives from the USACE.



PORTSMOUTH Y CHESAPEAKE

ESTUDIO DEL USO CONJUNTO DEL SUELO HOJA INFORMATIVA #1

Foto de la Marina de Estados Unidos por la especialista en medios de comunicación masiva, marinera Victoria Granado. https://www.navy.mil

¿Quién forma parte del JLUS?

El **Estudio del Uso Conjunto del Suelo – Joint Land Use Study** (JLUS por sus siglas en inglés) es un proceso cooperativo entre las Ciudades de Chesapeake y Portsmouth, la Mancomunidad de Virginia, y varias instalaciones Navales en el área sur de Hampton Roads: Naval Support Activity (NSA) Hampton Roads – Portsmouth Annex; Naval Station Norfolk – Navy Supply Systems Command Fleet Logistics Center Norfolk, Craney Island Fuel Depot; Norfolk Naval Shipyard (NNSY) y propiedades asociadas a NNSY incluyendo St. Juliens Creek Annex, South Gate Annex, Scott Center Annex, el Village at New Gosport, y Stanley Court. La Comisión del Distrito de Planificación de Hampton Roads (Hampton Roads Planning District Commission – HRPDC, por sus siglas en inglés) es el patrocinador principal del proyecto.

¿Por qué es importante el JLUS?

El JLUS está financiado por una subvención del Departamento de Defensa (DOD, por sus siglas en inglés), la Oficina de Ajuste Económico (OEA, por sus siglas en inglés) y por contribuciones locales de las jurisdicciones participantes. La OEA proporciona asistencia de subvenciones a los gobiernos estatales y locales para mitigar o prevenir actividades incompatibles que tal vez puedan perjudicar la sostenibilidad y la utilidad operativa a largo plazo del complejo de instalaciones militares.

Un objetivo importante del JLUS es proteger nuestra inversión en la defensa nacional, como también los impactos económicos positivos creados por el DOD, y la Marina específicamente, para la región y las localidades. El impacto económico directo de la Marina en el área de Hampton Roads en 2017 fue de aproximadamente $13.4 mil millones[1] y el DOD es el mayor empleador en la ciudad de Portsmouth.[2]

¿Cuál es el resultado del JLUS?

El objetivo de JLUS es identificar e implementar medidas que aborden la introducción de desarrollo civil incompatible u otros impactos relacionados, que puedan limitar la capacidad de la Marina para realizar operaciones. El plan se enfoca en la prevención de futuros conflictos en el uso del suelo y en solucionar conflictos existentes, pero también fomenta la inversión en la comunidad, especialmente en áreas que no interferirán con las actividades militares. El JLUS es un documento de asesoramiento.

1 Navy Region Mid-Atlantic Hampton Roads Area FY 2017 Economic Impact Report https://www.navy.mil/region/promain/navaleconomic_impact.html

2 Virginia Employment Commission, Virginia Community Profile, Portsmouth City, November 4, 2017 https://www.portsmouthva.gov/DocumentCenter/View/3556/Virginia-Community-Profile?bidId=

¿Cuál es el Propósito del JLUS?

El JLUS busca crear una asociación de planificación a largo plazo que proteja la calidad de vida en las comunidades locales y sostenga las misiones militares asociadas con cada instalación. Las instalaciones de la Marina en Portsmouth y Chesapeake pueden enfrentar varios impactos por parte de las comunidades aledañas, incluso impactos de transporte (tales como congestión, mejoras de capital existentes y planificadas, acceso a instalaciones, seguridad de portones, estacionamiento y operaciones ferroviarias), gestión de aguas pluviales, gestión de vías fluviales, conflictos de uso del suelo, e impactos de intrusión residencial, comercial e industrial. Molestias e inundaciones por tormentas puedan tener un gran impacto en las operaciones de la Marina al obstruir el acceso y dañar la infraestructura local de la que dependen las instalaciones militares. Este JLUS ayudará a identificar condiciones específicas y a desarrollar recomendaciones mutuamente beneficiosas para abordar estos problemas.

¿Cómo puedo obtener más información?

El proceso del JLUS se inició en mayo del 2019 y se espera sea completado en la primavera del 2021. El proceso de planificación incluye tres series de reuniones públicas con la primera serie de reuniones programada de la siguiente manera:

Nov. 13, 2019 6:00 - 8:00 PM	Nov. 14, 2019 1:30 - 3:30 PM	Nov. 14, 2019 5:30 - 7:30 PM
Bide-A-Wee Golf Course Pavilion	**Churchland Library**	**Major Hillard Library**
1 Bide-A-Wee Drive Portsmouth, VA	4934 High St. West Portsmouth, VA	824 Old George Washington Hwy N. Chesapeake, VA

Visite el sitio web del proyecto, detallado a continuación, para obtener más información sobre el proceso, el cronograma y los métodos utilizados, o contacte al **Sr. Ben McFarlane**, Gerente Regional de Planeación, en el HRPDC.

www.hrpdcva.gov/portsmouth-chesapeakeJLUS

757-420-8300

bmcfarlane@hrpdcva.gov

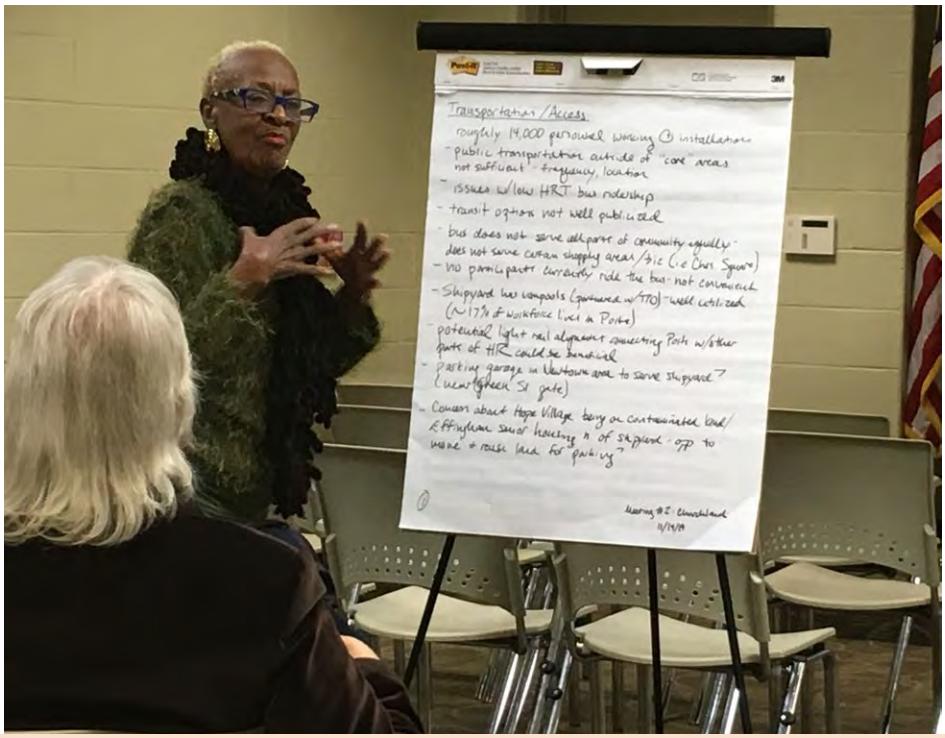
JLUS Fact Sheet prepared to support public meetings, November 2019.

1.4.3 Community Participation and Stakeholder Input

Members of the consultant team met with more than 50 different stakeholders between June and September of 2019 as part of an effort to identify issues and priorities of common concern. In addition, the team held five public meetings during the JLUS planning process to obtain community input. The first three public meetings were held in November 2019 as a series. The meetings were held in three different locations to collect public input on a broad set of issues that emerged during the stakeholder interview process. Fact sheets and a questionnaire were developed in English and Spanish and made available online and at the meeting as an alternate way to learn more and provide input. The number one issue identified by survey respondents was traffic congestion. Presentation materials, posters, and other materials from the first public meeting series can be found at this link: https://www.hrpdcva.gov/departments/joint-land-use-studies/portsmouth-chesapeake-joint-land-use-study/

View materials from public meetings

Public meeting at Bide-A-Wee Golf Course, November 2019. Source: AECOM



Public meeting at Churchland Library, November 2019. Source: AECOM

In response to COVID-19, the traditional in-person public outreach strategy was modified after the first series of meetings to a virtual program. The first virtual town hall was held on March 2, 2021, via Zoom. The meeting had 38 attendees and included a presentation of findings related to flood impacts and congestion, parking, land use, transit, and coordination. Supporting materials, including a fact sheet and Power Point presentations were made available on the project website. Participants submitted comments or questions during the live event that were compiled into a Frequently Asked Questions (FAQs) list that was posted on the project website. In addition, a comment form was made available on the website. A recording of the meeting and supplemental background information was posted on the project website after the meeting.

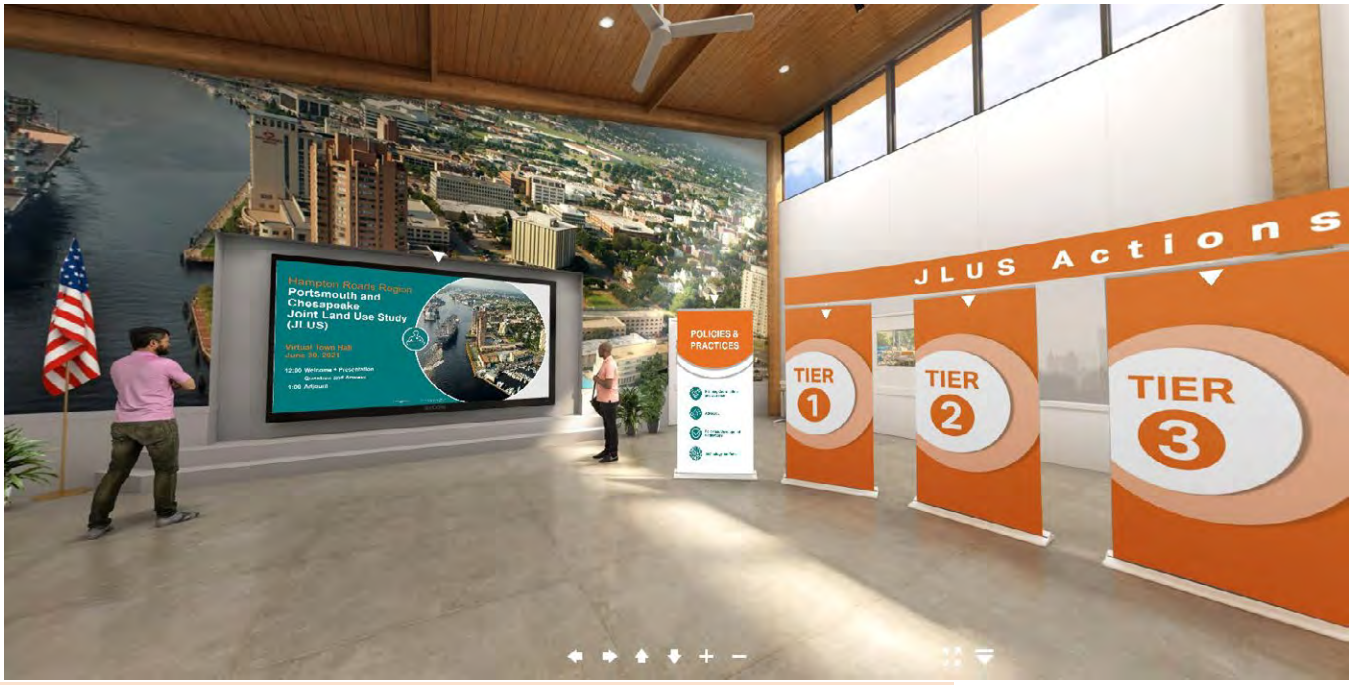
A second virtual town hall was held June, 30 2021 to present highlights from the Draft JLUS. An online virtual room was created to provide participants a way to explore meeting materials and project resources in an easy-to-navigate setting. The Draft was posted in the virtual room and was also made available on the HPRDC website for public comment from June 18 through July 16, 2021. Comments were reviewed and final revisions were incorporated into the Final JLUS.

1.5 Current Federal, State, and Regional Initiatives

Several recent developments at the federal, state, and regional levels are aimed at addressing resiliency and, more specifically, flooding and SLR challenges facing local communities and the military. These new programs and initiatives could be targeted for funding to implement JLUS priorities. Relevant initiatives or programs are described briefly below.

Military Installation Resilience Projects

Section 315 of the 2021 National Defense Authorization Act amended Title 10 of the United States Code (U.S.C.) Section 2185 pertaining to the authority to carry out military installation resilience projects. A new subsection was added to address the location of projects, which includes on a military installation, on a facility used by DoD that is owned and operated by a state, or outside a military installation or facility if the Secretary determines that the project would preserve or enhance the resilience of a military installation, a facility used by the DoD, or community infrastructure determined to be necessary to maintain, improve, or rapidly reestablish installation mission assurance and



Screenshot of online Virtual Room created for the JLUS. Source: AECOM

mission-essential functions. In addition, a section on alternative funding was added stating that the project may use funding available for operations and maintenance of the military department concerned if the associated Secretary submits a notification to the congressional defense committees of the decision and addresses other notification requirements.[2]

Community Economic Adjustment Assistance for Responding to Threats to the Resilience of a Military Installation

Through the OLDCC, technical grant assistance is available to state and local governments to review existing capabilities to support military installations and develop strategies to protect the resources that are necessary to enhance the resilience of military installations in their communities. The state and/or local government partners with the military installation to plan and carry out strategies promoting protection of critical resources adjacent to installations, ranges, and military flight corridors that are vital to military installation resilience. The review includes a strategic plan with specific implementation actions to ensure military installation resilience is compatible with, and supportive of, vital training, testing, and other military missions. Funded projects in FY20 and FY21 have included $14.8 million for Military Installation Resilience Reviews for 28 installations.[3]

Defense Access Road Program (DAR) Amendment

The DAR is a cooperative program between the DoD and the Federal Highway Administration (FHWA) that provides a means for the military to pay its share of the cost of public highway improvements necessary to mitigate an unusual impact of a defense activity.[4] The program is jointly administered by the FHWA and the Military Surface Deployment and Distribution Command.

The 2019 National Defense Authorization Act included a program amendment to the DAR, which is now part of 23 U.S.C. Section 210, which allows funds to pay the costs of repairing damage caused to, and for any infrastructure to mitigate the risks posed to, highways by recurrent flooding and sea level fluctuation if the Secretary of Defense determines that continued access to a military installation has been impacted by past flooding and mean sea level fluctuation.[5]

Defense Community Infrastructure Pilot Program

Public Law 115-232 Section 2816 authorized a defense community infrastructure pilot program that allows the Secretary of Defense to make grants, conclude cooperative agreements, and supplement funds available under other federal programs to address deficiencies in community infrastructure in order to enhance the military family quality of life, resilience, or military value.[6] The program, administered by the Office of Local Defense Community Cooperation, awarded approximately $50 million in funding in FY2020.

Readiness and Environmental Protection Integration (REPI) Program

The REPI Program is managed by the Under Secretary of Defense for Acquisition, Technology, and Logistics and encourages the military services and installations to enter into cost-sharing agreements with conservation organizations and state and local governments to promote compatible land use and preserve habitats around military installations.[7] In 2019, REPI's authority was expanded to address military installation resilience. REPI projects may engage in activities that protect, restore, and support off-base natural infrastructure.[8] Military resilience is defined as the capability of a military installation to avoid, prepare for, minimize the effect of, adapt to, and recover from extreme weather events, or from anticipated or unanticipated changes in environmental conditions that have the potential

2 National Defense Authorization Act for Fiscal Year 2021, 116th Congress (2019-2020). https://www.congress.gov/bill/116th-congress/house-bill/6395/text. Accessed 3/3/21.
3 Department of Defense, Office of Economic Adjustment. 2021. "Community Economic Adjustment Assistance for Responding to Threats to the Resilience of a Military Installation." https://beta.sam.gov/fal/1ca4fc7cfb8c4e2e9f1a0b2a81a0d1db/view?keywords=12.003&sort=-relevance&index=&is_active=true&page=1. Accessed 3/9/2021.
4 U.S. Department of Transportation, Federal Highway Administration. 2020. "Defense Access Road Program (DAR)." https://highways.dot.gov/federal-lands/programs/defense. Accessed 3/3/21.
5 23 U.S. Code § 210 - Defense access roads, https://www.law.cornell.edu/uscode/text/23/210. Accessed 3/3/21.
6 U.S. Department of Defense, Office of Local Defense Community Cooperation. 2021. "Community Investment." https://oldcc.gov/our-programs/community-investment. Accessed 3/3/21.
7 U.S. Governmental Accountability Office. 2016. Defense Infrastructure: DOD Efforts to Prevent and Mitigate Encroachment at Installations, GAO-17-86. November 14, 2016. https://www.gao.gov/products/gao-17-86?source=ra.
8 U.S. Department of Defense. 2020. "How REPI Can Enhance Installation Resilience." https://www.repi.mil/Resilience/. Accessed 3/3/21.

to adversely affect the military installation or essential transportation, logistical, or other necessary resources outside of the installation that are necessary to maintain, improve, or rapidly reestablish mission assurance and mission-essential functions.[9] A key component of the REPI Program is the use of encroachment management partnerships, referred to as REPI projects, among the military services, private conservation groups, and state and local governments, to include agreements that enhance or improve military installation resilience.

Building Resilient Infrastructure and Communities (BRIC)

The Federal Emergency Management Agency (FEMA) launched the BRIC grant program in FY20, replacing the Pre-Disaster Mitigation (PDM) program, as authorized under the Disaster Recovery Reform Act of 2018 legislation. The FY20 BRIC priorities are to incentivize the following:

- Public infrastructure projects
- Projects that mitigate risk to one or more community lifelines
- Projects that incorporate nature-based solutions
- Adoption and enforcement of modern building codes

In FY20, FEMA allocated $500 million to be distributed by a States/Territory Allocation ($33.6 million, up to $600,000 per applicant), Tribal Set-Aside ($20 million), and National Competition for Mitigation Projects (estimated $446.4 million) and the program requires a 10 to 25 percent cost share from the applicant.[10] The Virginia Department of Emergency Management (VDEM) is the agency that is tasked with selecting Virginia applicants that will compete nationally for the BRIC grant funding by developing priorities, scoring criteria, and collecting and evaluating applications. VDEM has defined key funding priorities as follows:[11]

- Reducing the long-term risk from future disasters
- Equity – supporting vulnerable populations and communities disproportionately impacted by disasters
- Sustaining community lifelines

The BRIC grant program is designed to provide financial assistance to applicants to implement cost-effective mitigation projects designed to increase resilience and public safety, reduce injuries and loss of life, and reduce damage and destruction to property, critical services, facilities, and infrastructure. VDEM also requires that localities applying for funding have a FEMA-approved and locally adopted hazard mitigation plan by January 1, 2021, and the proposed mitigation project must be included in that plan. Hampton Roads localities could apply for future BRIC grant funding to directly support the implementation of flood risk management projects and strategies that are recommended by this JLUS, as long as these projects are included in the 2017 Hampton Roads Hazard Mitigation Plan or the 2022 update that is currently under development.

America's Water Infrastructure Act

The America's Water Infrastructure Act of 2018 authorized a USACE feasibility study for coastal Virginia to address flood risk management, ecosystem restoration, and navigation. This study would likely be implemented through a USACE "3x3x3" study, which lasts no more than 3 years, has a maximum cost of $3 million, and offers vertical team integration at three levels of command. The authorization and future study could directly support the advancement of some of the multi-jurisdictional flood risk management actions and strategies recommended by this JLUS.

9 U.S. Department of Defense. 2018. The Department of Defense's Readiness and Environmental Protection Integration (REPI) Program: A Guide for State, Local and Private Partners. March 2018. http://repiprimers.org/#&ui-state=dialog. Accessed 3/3/21.

10 Federal Emergency Management Agency. 2020. Notice of Funding Opportunity for Hazard Mitigation Assistance Grants. August 2020. https://www.fema.gov/sites/default/files/2020-09/fema_bric_fy-2020_nofo_fact-sheet.pdf. Accessed 3/8/2021.

11 Virginia Department of Emergency Management. 2020. Building Resilient Infrastructure and Communities (BRIC). https://www.scribd.com/document/478911167/BRIC-Hazard-Mitigation-Layout-Updated#fullscreen&from_embed. Accessed 3/8/2021.

Commonwealth of Virginia Executive Order (EO) 24

EO 24 was signed by Governor Ralph Northam on November 2, 2018. The EO identifies a series of actions aimed at increasing resilience to natural hazards and extreme weather statewide. The EO designates the Secretary of Natural Resources as a Chief Resilience Officer (CRO) and identifies a number of actions to assess the Commonwealth's current resilience status, including the development of a Virginia Coastal Resilience Master Plan and creation of publications and guidance for projecting SLR for local governments. The EO defines a position of Special Assistant to the Governor for Coastal Adaptation and Protection (SACAP) to consult with local governments, relevant state agencies and bodies, regional planning district commissions, and federal partners.

Virginia Coastal Resilience Master Plan

In October 2020, pursuant to EO 24, Governor Northam released the Virginia Coastal Master Planning Framework, which lays out the core principles of the Commonwealth's approach to coastal adaptation and the process that will be followed to begin development of the first Coastal Resilience Master Plan by the end of 2021. The goals of the Virginia Coastal Resilience Master Planning Framework[12] are as follows:

1. Identification of priority projects to increase the resilience of coastal communities, including both built and natural assets at risk due to SLR and flooding
2. Establishment of a financing strategy, informed by regional differences and equity considerations, to support execution of the plan
3. Effective incorporation of climate change projections into all of the Commonwealth's programs addressing coastal built and natural infrastructure at risk due to SLR and flooding
4. Coordination of all state, federal, regional, and local coastal adaptation and protection efforts in accordance with the guiding principles of the Framework

The goals of the Virginia Coastal Master Planning Framework closely align with the purpose of the JLUS in that it will involve coordination between the DoD and the surrounding communities to identify critical natural and built infrastructure, define vulnerabilities to coastal threats, and develop a prioritized list of adaptation projects and strategies to protect critical infrastructure. Many of the strategies recommended in this JLUS could be incorporated into the Virginia Coastal Resilience Master Plan.

Hampton Roads Planning District Commission

In October 2018, the HRPDC adopted a resolution that recommends local governments adopt policies to incorporate SLR into planning and engineering decisions. The resolution recommends using 1.5 feet of relative SLR above current mean higher high water (MHHW) (based on the current National Tidal Datum Epoch of 1983-2001) for near-term (2018–2050) planning, 3 feet of relative SLR above current MHHW for mid-term (2050 –2080) planning, and 4.5 feet of relative SLR above current MHHW for long-term (2080–2100) planning. These planning thresholds are consistent with those used in this JLUS. In addition, the policy also recommends performing individual SLR assessments during project design, which would account for the unique needs and circumstances of specific projects, such as expected lifespan or criticality. The regional policy is a step forward in achieving consistency across multiple jurisdictions on how to integrate SLR into planning.

12 Office of Governor Ralph S. Northam, Commonwealth of Virginia. 2020. Virginia Coastal Resilience Master Planning Framework: Principles and Strategies for Coastal Flood Protection and Adaptation. https://www.governor.virginia.gov/media/governorvirginiagov/governor-of-virginia/pdf/Virginia-Coastal-Resilience-Master-Planning-Framework-October-2020.pdf, Accessed 3/8/2021.

Hampton Roads Transportation Planning Organization

The HRTPO is working in partnership with the HRPDC, USDOT, and Volpe to incorporate resilience and adaptation into decision-making about long-range transportation investments. Volpe's Resilience and Disaster Recovery (RDR) Metamodel enables scenario planning and comparisons of resilience investment return[13] of projects that can inform project prioritization and performance. The goal of this collaboration is to develop a tool that can be used to assess the impacts of stressors such as flooding on the performance of the transportation system. In doing so, the model will generate the expected resilience benefits of transportation projects in terms of avoided costs or losses, which can be used to inform benefit-cost calculations for transportation planning or programming efforts.

National Fish and Wildlife Foundation (NFWF) National Coastal Resilience Fund

The NFWF and National Oceanic and Atmospheric Administration (NOAA) manage a competitive grant program designed to fund projects that are helping coastal communities and ecosystems prepare for and recover from extreme weather events, climate hazards, and changing ocean conditions. Projects funded have included natural and nature-based infrastructure, post-disaster recovery, and vulnerability and risk assessments. In the 2020 round of grant-making from the fund, NFWF and NOAA were joined by partners Shell, TransRe, the U.S. Environmental Protection Agency, and AT&T with additional funding from DoD.[14] The National Coastal Resilience Fund could be considered a potential funding source for coastal resilience strategies identified in this JLUS.

Virginia Clean Energy and Community Flood Preparedness Act

In March 2020, the Virginia General Assembly passed the Clean Energy and Community Flood Preparedness Act, and in July 2020, the Commonwealth joined the Regional Greenhouse Gas Initiative (RGGI), a regional cap-and trade-program designed to reduce climate pollution from fossil fuel power plants. Virginia will use proceeds generated from the RGGI auction for community flood preparedness, coastal resilience, and energy efficiency programs. A portion of the auction funds will be directed to a newly created "Community Flood Preparedness Fund." Virginia is currently developing the program guidelines and grant manual that will determine how the fund is administered. The Department of Housing and Community Development, in coordination with the Department of Mines, Minerals, and Energy will administer just over half of the proceeds to energy efficiency programs benefiting low-income Virginians. Approximately 45 percent of the proceeds will be invested in community flood prevention and coastal resilience programs, and 3 percent will be used by the Virginia Department of Environmental Quality (VA DEQ) to further statewide climate planning efforts.[15] The first distribution of funds generated from RGGI auctions is anticipated to be distributed in 2021.

13 https://www.hrtpo.org/uploads/docs/P9-HRTPO-IntegratingResilience-LRTP-10.07.20.pdf. Accessed 3/16/21.

14 National Fish and Wildlife Foundation. 2020. "National Coastal Resilience Fund," 2020 Grant Slate. https://www.nfwf.org/sites/default/files/2020-11/national-coastal-resilience-fund-2020-grant-slate.pdf. Accessed 3/9/2021.

15 Office of Governor Ralph S. Northam, Commonwealth of Virginia. 2020. "Virginia Becomes First Southern State to Join Regional Greenhouse Gas Initiative." Press Release. July 8, 2020. https://www.governor.virginia.gov/newsroom/all-releases/2020/july/headline-859128-en.html#:~:text=RICHMOND%E2%80%94Governor%20Ralph%20Northam%20today,emissions%20from%20the%20power%20sector%2C. Accessed 3/9/2021.

2.0 PARKING

The majority of employees at Norfolk Naval Shipyard (NNSY), Naval Medical Center Portsmouth, and Craney Island Fuel Depot commute to work by car. Parking-related behaviors and associated parking trends create localized issues, particularly when it comes to parking in and around the shipyard and hospital complexes. The primary issues related to parking include the following:

- **Perception.** Shipyard employees perceive that parking capacity is inadequate at NNSY. Similarly, at Naval Medical Center Portsmouth, the multi-story parking structure for staff and patients fills up, and users are not often aware of alternative parking options.
- **Proximity.** At both NNSY and Naval Medical Center Portsmouth, the most convenient parking areas close to work centers are usually fully occupied. Less convenient parking areas are sometimes under-utilized.
- **Illegal Parking.** Employee and visitor parking overflows into the neighborhoods adjacent to NNSY. This results in illegal parking in Portsmouth's Southside Parking District (SSPD), which has a direct impact on residents.
- **Mission Growth.** The mission and workload tempo are expected to increase at NNSY, and redevelopment on the installation will reduce the existing parking supply. This could lead to more parking impacts on the adjacent neighborhoods.

2.1 Parking Conditions at NNSY

Norfolk Naval Shipyard provides parking for personnel and contractors who work on the site. The installation is highly developed, leaving few open areas across the installation. Parking is at a premium, especially in those spaces nearest the waterfront and near buildings with high occupancy.

A 2017 parking study[1] for NNSY inventoried 14,650 parking spaces within the installation fence line, including a combination of surface parking lots and on-street parking spaces. Another 200 on-street parking spaces were identified along Portsmouth Boulevard just north of the installation, and approximately 2,500 parking spaces are located in three remote lots south of the installation.

1 Jacobs. 2017. *Norfolk Naval Shipyard Parking Study.*

To help employees move around the installation, an internal circulator shuttle operates on weekdays from 0500 to 1700. The shuttle route takes approximately 30 minutes to complete a full loop and includes 21 stops at key buildings throughout the installation. The shuttle route spans the non-industrial part of the installation outside of the Controlled Industrial Area (CIA), as shown in Figure 2.1. Funding restrictions require the shuttle to stop only at buildings, not parking lots, which limits the potential of the route to serve commuters. In addition, the shuttle cannot exit the installation, so it cannot provide a connection to the remote parking areas outside of the installation. Per the 2017 study, shuttle ridership numbers were relatively low (approximately 300 riders per day), which is likely attributable to the length of route and total number of stops.[2] The stops are primarily clustered in the northern part of NNSY. Although the shuttle is a very useful service for traveling between workplaces, it is less effective as a means to travel between parking areas and work centers.

2 Jacobs. 2017. Norfolk Naval Shipyard Parking Study.

Figure 2.1 Existing Parking Facilities at Norfolk Naval Shipyard

Currently, there are no real-time parking availability systems in place at the shipyard or near entry control points to inform drivers of parking availability. Such systems could help to optimize parking resources if combined with other strategies such as centralizing parking permits based on work zones and eliminating individually reserved spaces that are often vacant. The 2017 Parking Study[3] tracked parking lot occupancy and found that spaces closest to the densest employment areas (closest to the piers and dry docks) are routinely full, which leads to a perception that there is not enough parking. However, less desirable parking lots do have capacity. About 20 percent of the available parking supply is located in remote areas or outside the installation. Walking from remote parking lots to the waterfront employment areas adds considerable time to an employee's daily commute, making it a less desirable option. Lack of shuttle service to the remote lots likely contributes to these areas being less desirable.

As noted in the 2017 Parking Study and communicated through stakeholder interviews, convenience plays a significant role in commuter behavior and parking lot utilization. There is a clear preference for parking in proximity to an area in which a person works. These conditions influence behavior and lead some employees to park within the adjacent neighborhood of Southside, which results in a shorter total trip time to the northern section of the installation than other available parking alternatives. A more detailed analysis of the Southside Parking District (SSPD) is discussed later in this chapter.

2.1.1 Walkability to Parking and Employment Centers

A walkability analysis was performed as part of the JLUS to understand how distance and proximity can influence parking behavior and trends. In addition to validating the observed parking behaviors, the walkability analysis helped to focus attention on the importance of proximity, convenience, and connectivity as key components of any parking strategy. The analysis was used to inform concepts for siting new parking or shuttle routes that better optimize parking resources and can reduce parking impacts in adjacent neighborhoods. The SSPD as shown in Figure 2.2 is included as a parking location (facility) in the walkability analysis to understand how it relates to other parking resources and employment areas on the installation.

3 The parking study was completed with one carrier and one submarine in production at the Shipyard.

Figure 2.2 Location of Southside Parking District

As shown in Figure 2.3, much of the Norfolk Naval Shipyard main site (outside of the CIA) is accessible within a 5-minute walk from the identified parking areas, as indicated in purple. The northernmost end of the shipyard has a higher degree of walkability, largely because of the proximity of Lot 9 and the SSPD. Within the CIA, buildings closest to the access gates are also accessible. However, many of the larger production buildings and most of the waterfront are beyond a 5-minute walk from primary parking lots and are sometimes outside of a 10-minute walk. Although there are no public parking lots within 1 mile of the shipyard, on-street parking is permitted in some areas outside of the SSPD.

On its surface, the analysis appears to show adequate coverage for most of the installation; many areas are within a reasonable walking distance. However, when parking occupancy and/or availability is considered, walk times would likely increase as employees search for less convenient parking. This factor needs to be considered when assessing overall walkability, as parking supply and work location are driving factors that influence behavior. Walk times from less-convenient parking helps to explain why the SSPD may be seen as a viable option for some employees who cannot find a comparable on-installation parking spot.

Recognizing the importance of work location as a factor in parking preference, an analysis was also performed to assess walkability to parking locations from five high-population facilities. The analysis shown in Figure 2.4 illustrates the impact of the CIA fence line on personnel who work at the industrial facility alongside the piers and dry docks. The fence line affects walkability in a pronounced way because employees must funnel through access points to reach parking or shuttle stops.

The analysis confirms the findings of previous studies: the parking lots that are within a 5-minute walk zone tend to be the most desirable parking locations on the installation, as evidenced by the highest occupancy rates. However, at the southern end of the installation, few parking areas are located within a tolerable walking distance of work centers.

Walkability Analysis Perspectives

The walkability analysis was completed from two perspectives to measure and understand how the location of parking may affect behavior. The analysis defines pedestrian tolerances for walking equivalent to a 5- or 10-minute walk from parking lots or work centers, which is roughly equivalent to a ¼-mile and ½-mile walking distance when using a walking speed of 3 miles per hour. The analysis resulted in two types of maps that illustrate:

- Walkability from major parking lots
- Walkability from work centers

The analysis modeled walking routes using existing sidewalks and streets where possible and routing around internal fence lines, access control points, buildings, and other barriers in other cases. The models assumed a typical walking speed and factored in a short delay at access control points to best represent realistic conditions.

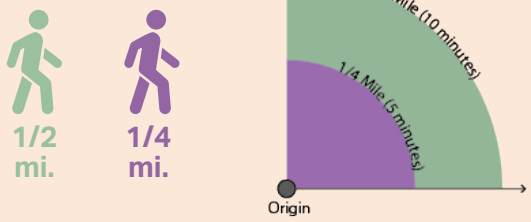


Figure 2.3 Walkability from Parking Areas - Norfolk Naval Shipyard

Figure 2.4 Walkability from Employment Centers - Norfolk Naval Shipyard

Parking Activity in the South Side Parking District

The SSPD was implemented to regulate parking operations and reduce traffic impacts within the residential neighborhoods adjacent to NNSY. The SSPD includes 2- and 4-hour parking zones that are identified by signage; however, the signage is inconsistent. The Portsmouth Police Department is responsible for enforcement of the restrictions, and in 2018, the department responded to approximately 200 parking-related calls within the SSPD, representing approximately 10 percent of the total annual parking calls made within the city. Enforcement is a challenge because the city currently lacks an efficient parking management system to document, track, and enforce restrictions.

A parking evaluation of the SSPD area was performed in January 2020 as part of the JLUS to assess and quantify the impacts that existing employee parking was having within the parking district. A block-by-block evaluation of vehicle occupancy before and during peak hours indicated that 250 vehicles associated with the Shipyard (employees or contractors) were parked illegally in the neighborhood. As illustrated in Figure 2.5 and Figure 2.6, the highest parking demand occurred within one block of the NNSY fence line, with negligible employee parking demand observed further than three blocks from an installation gate.

Source: AECOM

Although final destinations for people who parked in the neighborhood could not be accurately determined, stakeholder input indicated that most pedestrians are likely destined to areas east and south of Port Centre Parkway. Employees parking in the SSPD would have an approximate 10-minute total walk time between their vehicle in the neighborhood and their employment destination, which is quicker than parking in remote lots on the installation. This finding aligns with the walkability analysis, which suggests that convenience and proximity to work centers is a factor that influences parking behavior in the neighborhood.

Decreases in parking supply on the installation and increases in parking demand are anticipated as a result of redevelopment on the installation. New infrastructure under construction or proposed within four existing surface parking lots (Lots 28, 35, 41, and 43) is estimated to result in a reduction of at least 1,500 parking spaces. These changes will increase parking occupancy on base and will potentially increase the number of employees parking in the SSPD. Neighborhood impacts could be expected to double as a result of these changes, and impacts could extend across Effingham Street into additional neighborhoods.

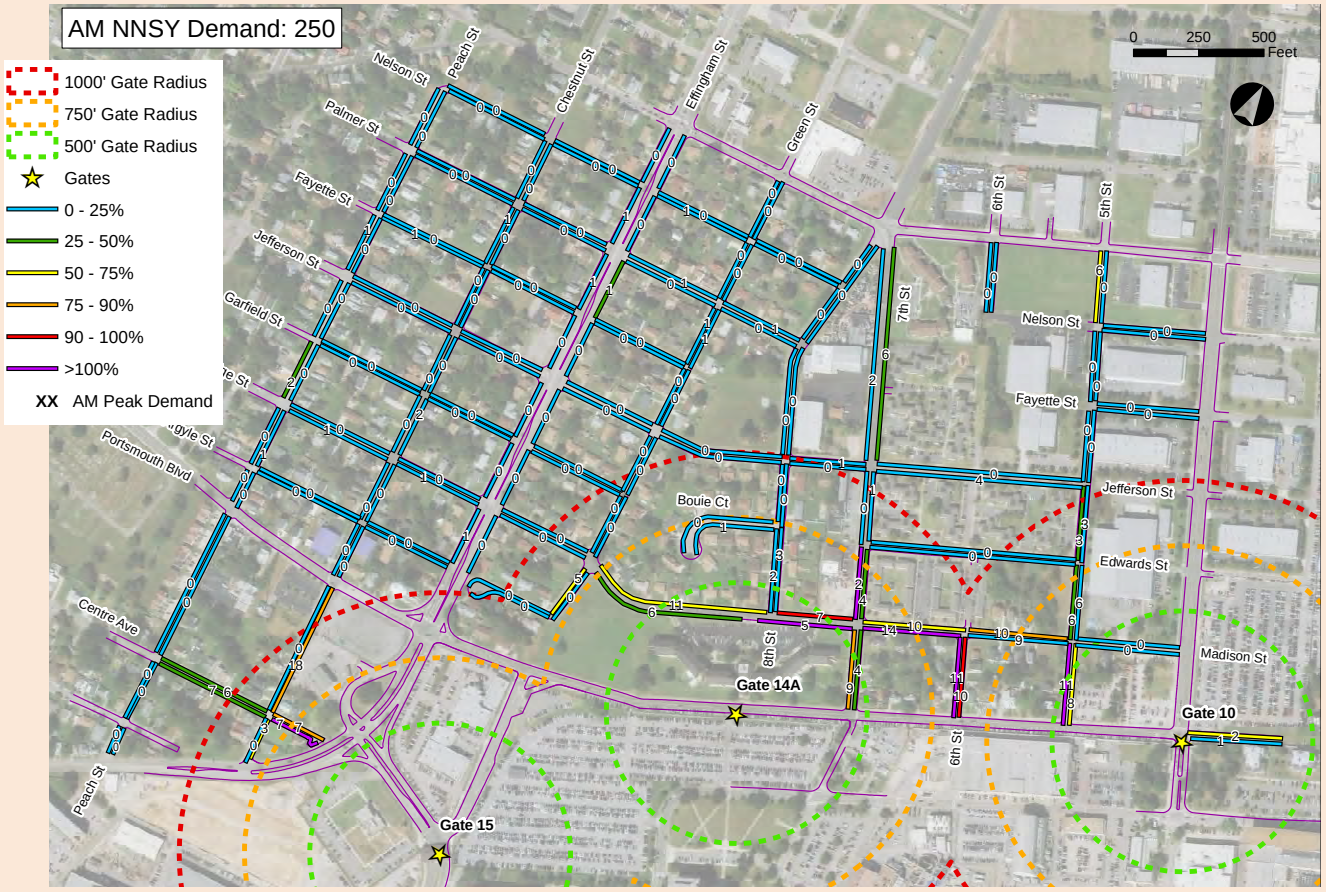


Figure 2.5 Current Parking Demand in the Southside Parking District

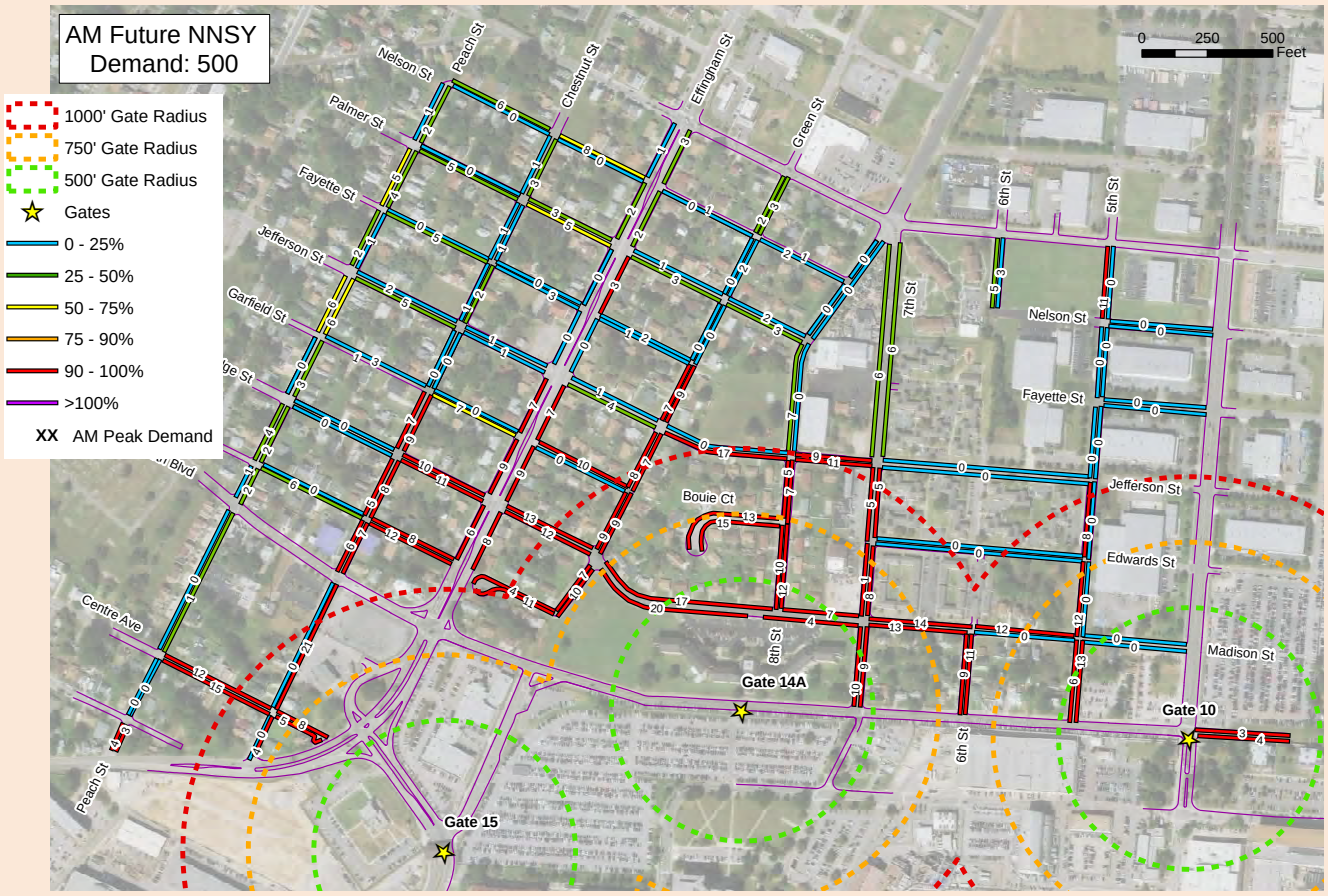


Figure 2.6 Future Parking Demand in Southside Parking District

The 5-minute walk zone extends outside of NNSY in two areas. One of these areas is within the SSPD, suggesting this location is within a tolerable walking distance of major work centers. The other area is east of Gate 10 at Port Centre Parkway, where the 5-minute walk zone, as modeled, intersects with Hampton Road Transit (HRT) existing bus route 41.[4]

At the southern and western ends of the shipyard, there are few parking areas located within a tolerable walking distance of work centers. The lots in these areas have historically lower utilization. Even with the operation of the installation shuttle, commuter time from these areas exceeds the 10-minute "tolerance" threshold for commuting. An efficient and reliable internal transportation option is needed to encourage future use of these parking lots as well as remote lots outside of the installation.

Parking conditions at St. Juliens Creek Annex were not identified as an area of concern and, therefore, were not analyzed as part of this study.

2.2 Parking Conditions at Naval Medical Center Portsmouth

Naval Medical Center Portsmouth provides parking for both installation employees and patients that visit the hospital for services. An on-site parking structure provides more than 2,500 parking spaces, of which more than 1,000 are reserved for patients and visitors.[5] The garage employs sensors to indicate space availability, and staff are directed to park in the back and top of the garage to allow patients to access spaces closer to the building. An additional 475 surface parking spaces are available throughout the installation, as shown in Figure 2.7.

A lack of available parking has been cited by stakeholders primarily in proximity to Buildings 1, 2, and 3, which have the highest density of workers.

Several parking garages in downtown offer parking opportunities but are largely unused by installation personnel.

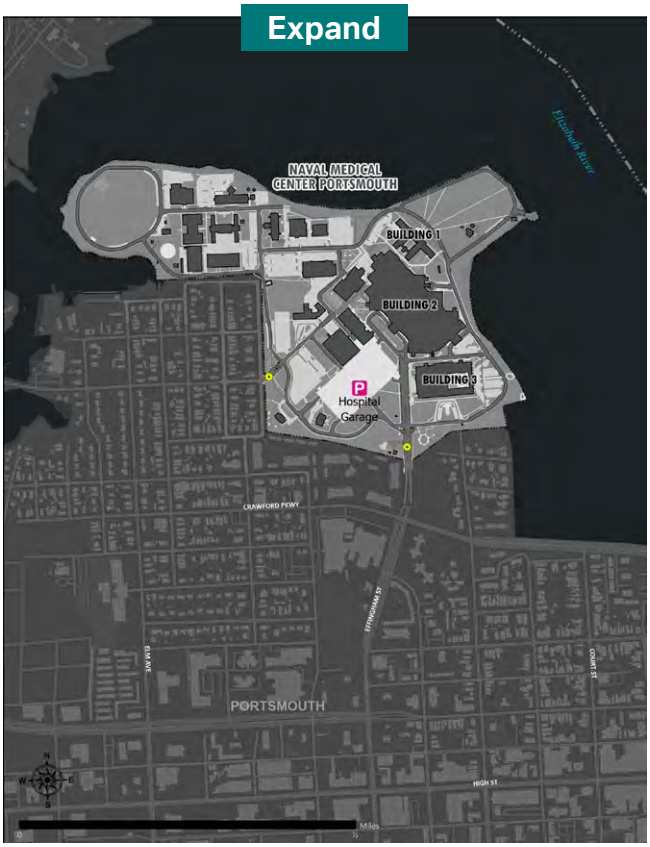


Figure 2.7 Existing Parking Facilities at Naval Medical Center Portsmouth

2.2.1 Walkability to Parking and Work Centers

The walkability to parking and work centers for Naval Medical Center Portsmouth is shown in Figure 2.8 and Figure 2.9. Approximately half of the installation is accessible within a 5-minute walk of the installation's parking garage (not accounting for travel within the garage itself). Most of the northern areas of the installation are accessible within a 10-minute walk from the garage, though, employees working in these areas would likely choose to park in smaller nearby surface lots. Employees who choose to park in Harbor Court Garage (the closest garage to Naval Medical Center Portsmouth) could either walk 0.8 mile to the installation or ride HRT bus route 43 to a point near the installation gate. The estimated walk time from the Harbor Court Garage is greater than 15 minutes. Route 43 provides service throughout Downtown Portsmouth, including along County Street and near several parking garages. Other downtown garages are equally distant or are further away, making daily use by installation personnel or visitors unlikely.

4 This is the only location where a bus route is captured within the installation's 5-minute walkshed. Route 45, which has higher frequency and a connection to Norfolk, is barely within the 10-minute walkshed from Building 1500 and is significantly farther from high-concentration areas at the north end and waterfront.

5 Naval Medical Center Portsmouth. n.d. "Visitor Guidelines." https://www.med.navy.mil/sites/nmcp/SitePages/Welcome/Parking.aspx.

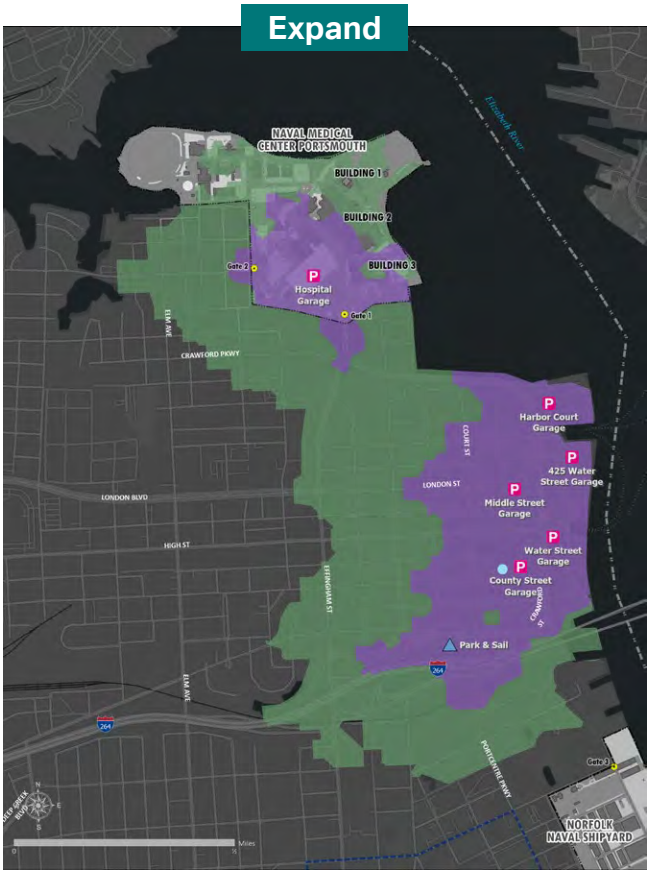


Figure 2.8 Walkability from Parking Areas - Naval Medical Center Portsmouth

Figure 2.9 Walkability from Employment Centers - Naval Medical Center Portsmouth

Within the installation boundary, Naval Medical Center Portsmouth is highly walkable. As shown in Figure 2.8, a large portion of the site and many of the parking lots are within the 5-minute walk zone from the main hospital building, providing convenient (though not highly visible) parking opportunities in proximity to major work centers. Access to HRT's bus route 43 is available at the edge of the 5-minute walk zone and is well within the 10-minute walk zone.

2.3 Parking Conditions at Craney Island Fuel Depot

Compared with other installations, the relative parking demand at Craney Island Fuel Depot is small. However, a lack of transit alternatives and the remote location of the site means that employees must drive and park to reach the installation. Modestly sized parking lots exist in proximity to administrative buildings and fueling piers. While sized appropriately to meet the current demand, the parking lot nearest the fueling piers floods regularly.

Parking lots at Craney Island Fuel Depot

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3.0 LAND USE AND DEVELOPMENT

Managing growth and development around military installations is the responsibility of state and local governments that have land use management authority. Local land use policies and regulations guide local development and set priorities for investment. In the case of Portsmouth and Chesapeake, the areas around the Navy installations are already highly urbanized. Land uses around each military installation range from established medium-density residential neighborhoods to institutional and industrial uses. Changes in land use would come about as localized redevelopment occurs or as regional projects are implemented.

This chapter discusses land use and development issues that are already occurring or have the potential to occur and lead to land use incompatibilities that impact military readiness as well as opportunities for compatible growth that could complement the military installations and provide an economic or community benefit to the localities. The primary issues and opportunities that could impact military readiness discussed and evaluated include the following:

- Expansion of the Craney Island Dredged Material Management Area (CIDMMA) and development of the future Craney Island Marine Terminal
- Redevelopment of underutilized industrial land
- Land use policies and zoning near the installations that support compatible growth and redevelopment
- Strengthening the resilience of utility systems serving the installations

3.1 Craney Island Eastern Expansion and Future Craney Island Marine Terminal

The 2,500- acre CIDMMA disposal site operated and maintained by the USACE provides a long-term disposal area for material dredged from the channels and ports in the Hampton Roads area. Originally designed for a 20-year life span, the USACE and Virginia Port Authority have been working to increase capacity of the management area, which is currently projected to reach capacity around 2045.[1] Expansion of the CIDMMA would provide an area to construct the fourth marine terminal for the Port of Virginia, the Craney Island Marine Terminal. Other expansion projects by the Virginia Port Authority, including at the Virginia International Gateway site, have forestalled the immediate requirement for the Craney Island Marine Terminal.[2] This pause presents an opportunity to re-evaluate alignment options that consider all federal, state, regional, and local interests.

The CIDMMA Rehandling Basin is located just north of the Craney Island Fuel Depot, and access to the new terminal site has been identified as a major concern by the Navy and City of Portsmouth due to the potential impact on the Craney Island Fuel Depot and the City Landfill located west of the Fuel Depot and south of the CIDMMA. See Figure 3.1. The Craney Island Fuel Depot, which is the highest volume DoD fuel complex, provides an important service to all services and operates on a 24/7 basis. Recent mission growth has included

1 Email correspondence from Michael Anderson, P.E., U.S. Army Corps of Engineers, June 15, 2021.

2 Stakeholder Interview, Kit Chope, Virginia Port Authority, July 2020.

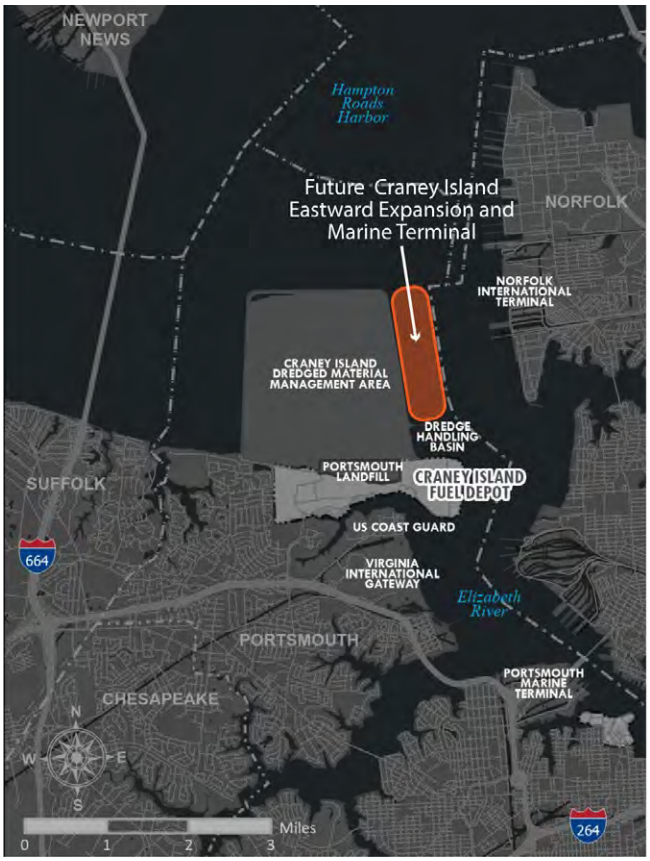


Figure 3.1 Location of Future Craney Island Marine Terminal

the planning and execution of projects to address fuel storage needs on the western end of the property, adjacent to the City Landfill.

An important component of the proposed Craney Island Marine Terminal is accessibility for vessels, freight rail, trucks, and vehicles. The approach to providing access has been studied in various transportation and environmental reviews and is currently being studied as part of the HRTPO's Regional Connectors Study.

The Regional Connector Study Working Group has recommended eight DRAFT conceptual access alternatives, as shown in Figure 3.2 for further study. Not all eight draft RCS alternatives will provide direct access to Craney Island Marine Terminal/CIDMMA. Pending approval by the study's Steering Committee, the alternatives will undergo more detailed evaluation and preliminary engineering analysis. The development of the draft alternatives should be closely monitored as the process advances to ensure there are no negative impacts to the Navy mission, or to the City Landfill.

Expand

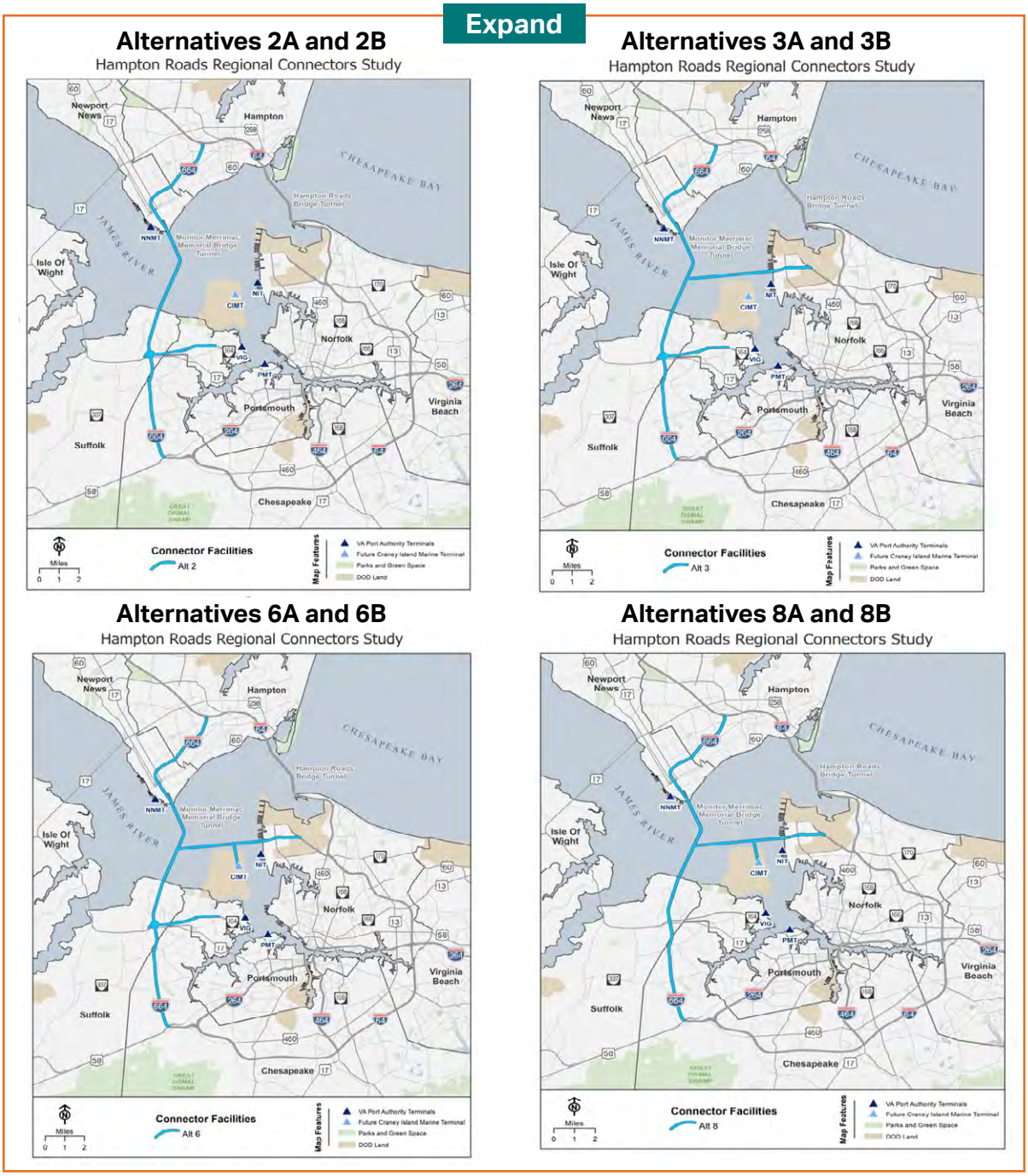


Figure 3.2 DRAFT Regional Connector Study Conceptual Access Alternatives

Note:"A" alternatives assume 6 general purpose lanes and 2 managed lanes, whereas "B" alternatives assume 4 general purpose lanes and 4 managed lanes

Source: HRTPO Regional Connector Study, Working Group Presentation, 5/25/2021.

The Hampton Roads 2045 Long-Range Transportation Plan also includes a recommendation for a Craney Island Access Road Study to evaluate accessibility to the Craney Island Marine Terminal. The 2045 LRTP Project Information Guide summarizes the project as reducing travel time to port facilities, improving reliability of truck travel, and reducing conflicts between modes of transportation. This effort should be coordinated with the Navy and Portsmouth as major stakeholders.

Currently, the Fuel Depot is served by one access route off of Cedar Lane. Segments of this route located outside the installation will be impacted by flooding, which is discussed in more detail in Chapter 4. However, the flood vulnerabilities extend inside the installation and will likely create more significant challenges in the long term. A secondary or alternate access route and/or gate for the Fuel Depot that is not impacted by flooding would improve resiliency and mission readiness by creating a redundant route to the installation that is located outside of future flood areas.

Options for a secondary access route should be pursued in coordination with Portsmouth so that the route does not impact the City Landfill. An opportunity also exists to integrate access considerations to the fuel depot into the Craney Island Access Road Study.

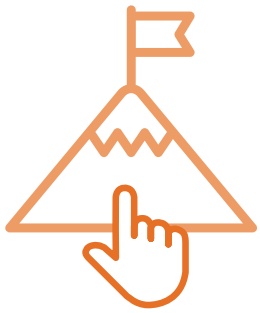
Other activities related to the expansion of the federal channel are discussed in Chapter 6, Regional Coordination.

3.2 Underutilized Land and Redevelopment Opportunities

The Southern Branch of the Elizabeth River has been the location of various industrial and military activities over time, and the river corridor remains largely industrialized, offering unique deep-water access. Both Portsmouth and Chesapeake view the river corridor south of the Shipyard as an important priority for economic development and tax revenue. Figure 3.3 shows the properties currently zoned as industrial along the river.

The land area east of Victory Boulevard and north of St. Juliens Creek Annex to the NNSY fence line is generally referred to as the Paradise Creek Industrial area. Navy-owned parcels in this area include Scott Center Annex, South Gate Annex, and Paradise Creek Annex within Portsmouth and St. Juliens Creek Annex in Chesapeake. Recent discussions about underutilized portions of South Gate Annex and St. Juliens Creek Annex have identified potential reuse opportunities.

What is an EUL?



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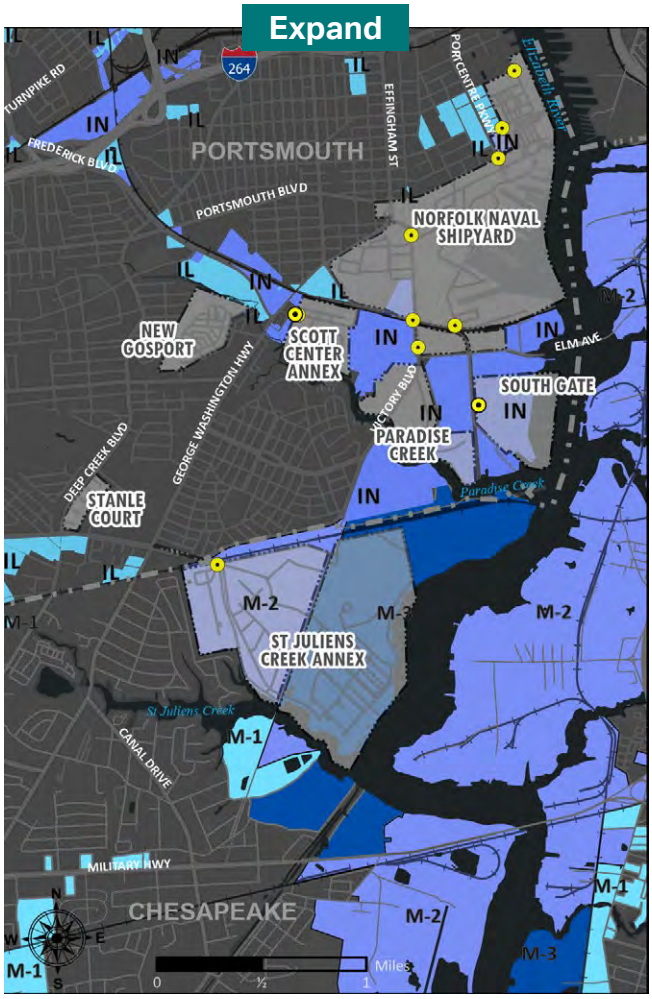

Figure 3.3 Properties Under Industrial Zoning

3.2.1 South Gate Annex

In 2002, South Gate Annex's Piers A and B were declared excess by the Commander, Navy Region Mid-Atlantic and are currently used for berthing barge storage, overflow berthing, and heavy weather mooring. The north part of the site is used for long-term Norfolk Naval Shipyard parking. The Navy is advancing efforts for an Enhanced Use Lease (EUL) or Public-Private Venture (PPV) for about 16 acres of the South Gate Annex, to include Piers D, E, and F and some of the upland area as shown in Figure 3.4. An Environmental Condition of Property assessment and survey work has been funded, and a request for industry input is being developed to understand potential interest in the site.

South Gate Annex is accessed by Burtons Point Road. The proposed EUL area includes existing shipyard overflow parking that would be impacted by any redevelopment of the site. The Navy's need for offsite parking in South Gate Annex could grow in the future as the number of carriers or submarines in production at one time increases.

There is not a formal street hierarchy in this area, and the number of parcels, landowners, railroad right-of-way, and at-grade crossings contribute to access challenges overall in the Paradise Creek Industrial Area. The Portsmouth FY 2019–2023 Capital Improvement Program (CIP) includes a project for reconstructing Burtons Point Road from Elm Avenue to the industrial area to improve safety, drainage, and pedestrian accommodations, which should help address some of these issues. However, concept plans for improved access to and through the area should be re-envisioned as part of a joint industrial area preservation and improvement plan among the Navy and both cities. The plan should be aimed at promoting the managed growth and future redevelopment of the Paradise Creek Industrial Park area. The effort should evaluate vehicle, bicycle, and pedestrian access and safety improvements from George Washington Highway to the Jordon Bridge; establish land use compatibility guidelines; and develop an integrated stormwater management and flood mitigation strategy that considers future flood impacts. This study should integrate the long-term access and parking needs for Navy facilities in this area, including the NNSY main site, Scott Center Annex, South Gate Annex, and St. Juliens Creek Annex. Chapter 2 discusses parking in more detail.

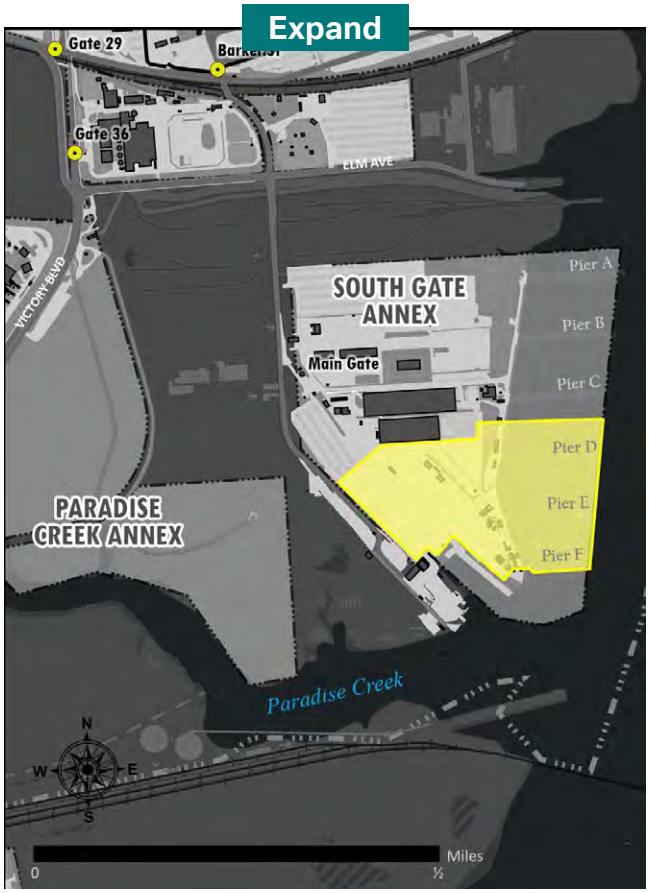

Figure 3.4 Potential Site of South Gate Annex EUL

3.2.2 St. Juliens Creek Annex

St. Juliens Creek Annex is about 490 acres and sits at the confluence of St. Juliens Creek and the Southern Branch of the Elizabeth River. The site maintains an active mission, but activity has decreased over the years. In 2000, the site was listed as a National Priorities List site by the U.S. Environmental Protection Agency (USEPA), and an Environmental Restoration Program is underway.

The potential redevelopment and reuse of St. Juliens Creek Annex was assessed in an Urban Land Institute study in 2001. The study panel recommended the creation of a regional manufacturing and distribution center at St. Juliens Creek Annex and extending northward to the shipyard and westward to George Washington Highway. Proposed redevelopment included revitalization of the Victory Boulevard corridor and George Washington Highway.[3] The study cited access to a deep-water shipping channel, utilities, adjacency to industrial activities, and the cooperation between Portsmouth and Chesapeake as strengths. The lack of direct interstate access, compatibility with nearby neighborhoods, and uncertainty about the

3 Urban Land Institute, 2001. *St. Juliens Creek Naval Annex, Chesapeake, Virginia, A Redevelopment and Reuse Strategy,* February 2001.

Navy's disposition of the property were noted as weaknesses.[4]

St. Juliens Creek Annex has one entrance point off of Victory Boulevard and is flanked by established residential neighborhoods to the west, south, and north across Victory Boulevard. A portion of the installation supports community uses, including the Southside Regional Fire Academy, which supports fire response training activities for multiple cities, and several baseball fields that are maintained by Portsmouth in exchange for their use. Chesapeake has expressed an interest in expanding public waterfront recreational access to St. Juliens Creek from the installation to give the public additional recreational options. The feasibility for public waterfront access could be studied jointly with the Navy to identify potential access alternatives and associated security concerns or requirements that would be needed. The Navy is currently evaluating two EUL opportunities at St. Juliens Creek Annex on the western and eastern portions of the property. The western site currently provides a location for regional fire training and community recreation as well as storage. The eastern site includes riparian areas and port-related functions.

An undeveloped parcel northeast of St. Juliens Creek Annex in Chesapeake as shown in Figure 3.5 has potential for redevelopment, but it is only accessible via an unimproved road. Lack of roadway access, wetlands, and limited utilities on the site are limiting factors to development. Chesapeake is interested in extending water service to this site. The site is bounded to the north by a Norfolk Southern railroad. Any redevelopment on the site should involve consultation with the Navy to address land use compatibility concerns, security, access, and environmental considerations and with Portsmouth to comprehensively address transportation and access requirements.

4 Ibid.

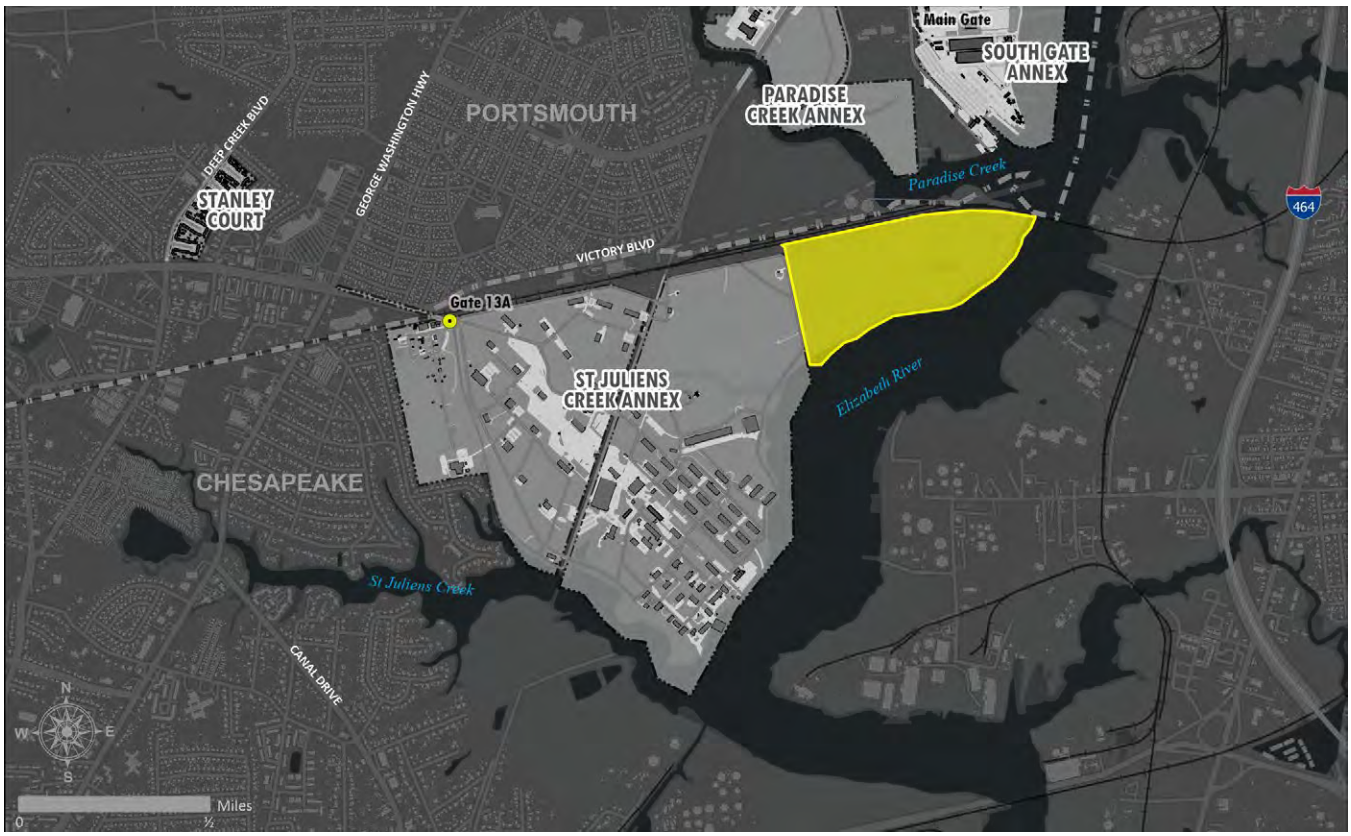

Figure 3.5 Undeveloped Parcel Northeast of St. Juliens Creek Annex

3.2.3 Paradise Creek Annex

Paradise Creek Annex is adjacent to Paradise Creek and is owned by the Navy as shown in Figure 3.6. The site was formerly used for landfilling, solid waste disposal, and petroleum reclamation. The site is bounded to the northwest, across Victory Boulevard, by a refuse-derived fuel processing plant operated by the Southeastern Public Service Authority; to the east by Atlantic Wood Industries, Inc. (a former wood-treatment facility currently on the USEPA Region III NPL), the Portsmouth School Board vehicle maintenance and refueling yard, and the Vane Brothers Marine Terminal property formerly used for petroleum bulk-storage; and to the south and southwest by Paradise Creek, a tributary to the Southern Branch of the Elizabeth River.[5]

A soil cover was installed in 2010 over the entire Paradise Creek landfill boundary, and low-lying areas have been restored to tidal wetland areas or have stabilized slopes along Paradise Creek.[6] Land use controls are in place on the site, and the Navy conducts regular inspections in accordance with the USEPA and the VA DEQ requirements. Reuse opportunities or changes in land use would be guided by any restriction of use governing the site. The JLUS stakeholders expressed interest in additional passive recreational uses on the site. Given the close proximity to Paradise Creek Nature Park, a 40-acre park with trails, forest, and restored wetlands located directly south of the site, an opportunity could exist to integrate some or all of the site into an expanded park and trail network, including providing a connection to the Jordon Bridge multi-use trial.

5 CH2M. 2016. *Final Second Five-Year Review, Norfolk Naval Shipyard*, Contract Task Order, WE58, August 2016. https://semspub.epa.gov/work/03/2237900.pdf Accessed 3/9/21.

6 Ibid.

3.2.3.1 Other Areas

Several parcels at the intersection of Port Centre Parkway and Portsmouth Boulevard within the SSPD are also identified as underutilized. These parcels are primarily used for surface parking. Vacant and underutilized land near NNSY presents opportunities for infill redevelopment such as retail, food services, business or other support services that can help to revitalize the area and strengthen connections between the community and installation.

Other areas that have significant inventories of underutilized or vacant land are Churchland Shopping Center, Turnpike Road, Portsmouth Boulevard, Victory Boulevard, the Midtown area near the intersection of High Street and Airline Boulevard, the Scotts Creek waterfront on the Portsmouth Marine Terminal, and areas around Downtown.[7] These areas could also be studied for possible remote parking strategies in concert with redevelopment.

7 Portsmouth Planning Commission. 2018. *Build One Portsmouth,* https://portsmouthva.gov/396/Comprehensive-Plan.

Figure 3.6 Paradise Creek Annex

Industrial Development Best Practices

Industrial development within the floodplain can present unique challenges that are different from other types of land uses. The proximity to water and maritime access is an advantage but also presents potential flood risk to physical infrastructure and operational procedures. The Appendix includes a review of several case studies from cities working to improve the resiliency of their working industrial waterfronts. The case studies identify several strategies related to physical infrastructure, design principles, policies, preparedness planning, and coordination that could be considered not only in Portsmouth and Chesapeake, but in the broader region. While the JLUS was not focused on developing strategies for privately held industrial lands, the case studies do offer important considerations for future planning and coordination across a broader range of stakeholders. For this reason, the formation of an industrial lands task force is suggested and discussed in Chapter 6.

3.3 Land Use and Zoning Policies

Previous planning studies completed in both cities were reviewed to determine relevance to the JLUS planning effort and to identify the applicable policies that will shape conditions in and around the Navy installations. The purpose of the review was three-fold: 1) to understand if current regulations might be contributing to a lack of food service or convenience-type retail near the installations – both of which were identified by stakeholders as desirous to support NNSY and Naval Medical Center workers and visitors specifically; 2) to understand where parking is an allowable use; and 3) to identify any potential concerns with land use compatibility near the installations. Portsmouth and Chesapeake City codes require that installation commanders be notified in writing and invited to submit comments and/or recommendations for all zoning requests or use permit applications within 3,000 feet of a military installation.

3.3.1 Portsmouth

Land use policies in Portsmouth focus on revitalizing the downtown area through redevelopment and investment in public infrastructure that strengthens the city's connection to the waterfront. Build One Portsmouth, the city's comprehensive plan, sets forth guiding principles, a vision, goals, and strategies for the city, including a future land use plan and priority actions for future investment. Other planning studies focus on certain areas or corridors of the city and set forth specific recommendations related to development, revitalization, connectivity, and land use.

Build One Portsmouth defines the Norfolk Naval Shipyard, Naval Medical Center Portsmouth, and the Craney Island Fuel Depot as campus/special districts and recognizes the importance of transitions from these areas to surrounding blocks.

Craney Island Fuel Depot Area. The area around Craney Island Fuel Depot includes a mix of residential uses, including the Merrifield neighborhood, as well as townhome and multifamily development along its western edge. Maintaining a buffer along the western edge of the fuel depot will help reduce conflicts with the adjacent residential neighborhood. Industrial (IN) zoning covers a large area that is home to Virginia International Gateway and other industrial operations. These uses are consistent with the allowable heavy manufacturing, fabrication, processing, distribution, storage, and research and development uses permitted by the Industrial (IN) zoning district and supported by the Build One Portsmouth plan.

Figure 3.7 Crawford Corridor

Source: Crawford Corridor Revitalization Study, Final Submission, September 2019.

Naval Medical Center Portsmouth Area. Zoning around Naval Medical Center Portsmouth aligns with the recommendations of the Build One Portsmouth and Downtown Master Plans by supporting walkable, higher-density housing, retail, restaurants, and mixed-use development. Zoning districts in this area help form the character of development along Effingham Street leading to the main gate of the Naval Medical Center Portsmouth property. These districts allow the types of restaurant and services that could support hospital employees. The Crawford Corridor Revitalization Study recommends the transformation of the Crawford Street corridor, which connects Effingham Street in front of the Naval Medical Center Portsmouth to downtown, into a multi-modal, complete corridor that includes a mix of new housing, shops, restaurants, and mixed-use development. The plan does not specifically recognize the Naval Medical Center Portsmouth, which is located at the north end of the corridor just outside the study area boundary. Other adjacent activities underway by Portsmouth promote the redevelopment of downtown, including reconfiguration of County

Street between Court Street and Crawford Street, redevelopment of the City Jail Complex into a future mixed-use development, development of a stormwater park on the Civic Center Lot, and extension of King Street to the waterfront. These actions will facilitate the redevelopment of downtown.

Norfolk Naval Shipyard Area. The area between Effingham Street and Port Centre Parkway, adjacent to NNSY, is defined as a mixed district redevelopment area, and guidelines focus on targeted public infrastructure investments and promoting economic development and business retention. The SSPD, discussed in Chapter 2, is located in part of this district, as are several underutilized parcels that are currently surface parking.

The proximity of this area to shipyard workers and gates 3, 8, and 10, as shown in Figure 3.8, could present mixed-use redevelopment opportunities in the future as the area is within a 10-minute walk zone of primary work centers on the Shipyard.

This proximity means it may be more feasible for shipyard workers to reach the area, grab lunch, and return within the 30 minutes allotted for lunch. One restaurant located just outside Gate 10 is the only restaurant outside the installation within walking distance. Additional options could be provided by reprogramming underutilized parking areas to support a food truck zone near Gate 10, for example. The zoning in the area contains a mixture of light industrial, general mixed use, and multi-family urban residential high-density uses.[8] Restaurants are a permitted use in both the General Mixed and Light Industrial districts as are parking facilities and business support services (retail and services). Additional mixed-use zoning areas are found near the NNSY main gate at Effingham Street (Gate 15); however, these zones are beyond the 10-minute walk zone from primary work centers at the shipyard.

8 Information was derived from City of Portsmouth GIS Viewer online and Portsmouth Zoning Ordinance, 2021. Online viewer: https://www2.portsmouthva.gov/portsmap/. Accessed 3/12/21.

Figure 3.8 Potential Redevelopment Area Near Norfolk Naval Shipyard Gate 10

George Washington Highway, Effingham Street, Portsmouth Boulevard, and the South Norfolk Jordan Bridge/Victory Boulevard are defined as major gateway corridors, and Cedar Lane and Elm Avenue are defined as local gateway corridors in Build One Portsmouth. Gateways and corridors are locations or roadways that serve as critical entryways or landmarks and are the locations where Portsmouth's identity should be celebrated and displayed.9 A large area outside the shipyard between Elm Avenue, George Washington Highway, and the Norfolk Portsmouth Beltline Railroad comprising convenience retail, restaurant, and light industrial development could present opportunities for compatible redevelopment and infill in the future given its proximity to housing development on the shipyard. This area is shown in Figure 3.9. Comprising multiple parcels, the predominant zoning is light industrial. Additional access to the installation, such as a pedestrian gate, could be considered as a future redevelopment concept. Any improvements in this area along George Washington Highway should also address the need for additional sidewalks and pedestrian infrastructure to improve safety. Additional considerations related to flooding along the corridor are discussed in Chapter 5.

9 Portsmouth Planning Commission. 2018. Build One Portsmouth. https://portsmouthva.gov/396/Comprehensive-Plan.

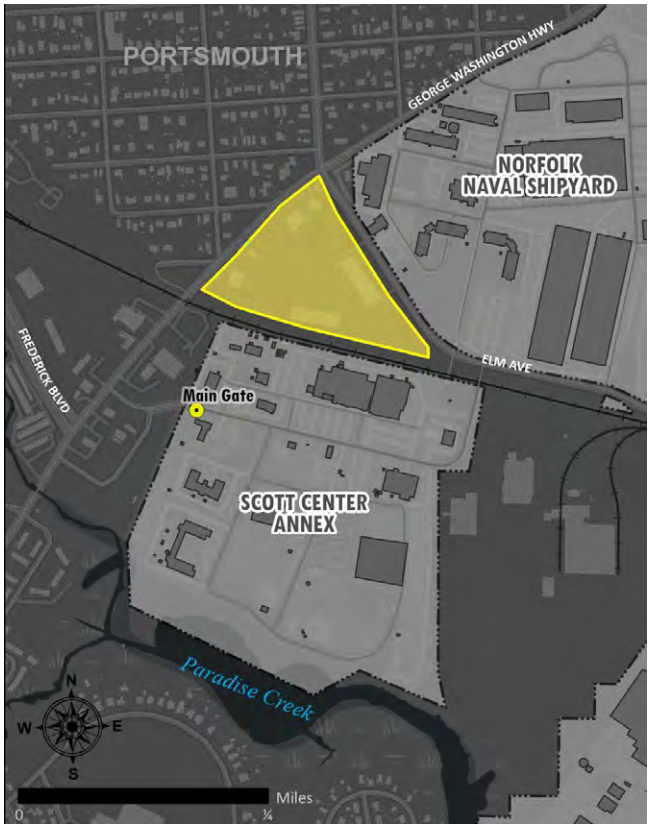

Figure 3.9 Potential Redevelopment Area Near Norfolk Naval Shipyard and Scott Center Annex

South of Norfolk Naval Shipyard, the George Washington Highway corridor supports mixed use, commercial, and industrial land uses and transitions to urban residential approaching the historic Cradock neighborhood before returning to mixed use near the entrance to St. Juliens Creek Annex. The Paradise Creek industrial area is zoned almost entirely industrial and accommodates heavy manufacturing, fabrication, processing, distribution, storage, research and development, and other more intense industrial uses that might have adverse environmental or create visual impacts. Victory Boulevard provides an important edge and buffer between the industrial area and the greater Cradock neighborhood. The Industrial district allows for a wide range of activities, including the manufacture, use, storage, shipping, or disposal of chemicals or substances that are hazardous. Hazardous materials include explosives or blasting agents, flammable and combustible liquids, and other materials that could create significant safety and operational concerns if sited in close proximity to military operations. Portsmouth's Zoning Ordinance requires a Use Permit for industrial hazardous uses, which allows the City and adjacent owners to comment on proposed plans and uses.

The establishment of a special compatible use overlay district or zone around each installation could prevent future land use conflicts and could better inform and guide development opportunities in both localities. As part of this concept, a compatibility checklist could be added into the existing mandatory application process to assess any application for rezoning, special use, or variances within the district.

3.3.2 Chesapeake

Moving Forward Chesapeake 2035, Chesapeake's comprehensive plan, serves as a policy guide for the city's responsible growth and physical development. St. Juliens Creek Annex falls within the Urban Overlay of the plan, which is a broader area intended to provide opportunities for infill. The plan is preparing to undergo an update, and several additional plans function as supporting elements to the plan. In August of 2018, the Mayor of Chesapeake's Advisory Committee on Comprehensive Plan Strategies identified the need for a special area study for the industrial waterfront and for gateways/entryways in order to define specific land use and strategic planning

recommendations.[10] St. Juliens Creek Annex would be eligible for inclusion in both types of studies because of its waterfront location and proximity to major corridors such as George Washington Highway/Route 17.

Chesapeake's South Military Highway Corridor Study makes recommendations for improved circulation and a redeveloped waterfront to the south of St. Juliens Creek Annex. It also encourages the concentration of industrial uses near the interstate, where neighborhood impacts due to truck and through-traffic will be minimized. New industrial development is also encouraged along St. Juliens Creek, although the Navy's property is not specifically mentioned.[11]

Zoning in Chesapeake along George Washington Highway, Canal Drive, and Military Highway is predominantly neighborhood business and general business, which allow a variety of retail and service businesses that support both the neighborhoods and the broader community. Several fast food and convenience stores are located at the intersection of Victory Boulevard and George Washington Highway. The Brentwood neighborhood adjacent to St. Juliens Creek Annex is a single-family residential zone. Recreational ball fields, fire training, and open space on the installation provide a buffer between the neighborhood and the research and development and industrial nature of military operations on the installation.

Chesapeake has adopted the Fentress Airfield Overlay District as part of the zoning ordinance to address incompatible land development and encroachment around the installation. The City proactively coordinates with the Navy in regard to Naval Auxiliary Landing Field Fentress. A similar process could be considered for St. Juliens Creek Annex as potential reuse concepts are explored.

10 Chesapeake Planning Department. 2018. *Mayor's Advisory Committee on Comprehensive Plan Strategies: Final Report and Recommendations.* https://www.cityofchesapeake.net/Assets/documents/departments/planning/2035compplan/MACCPS+Final+Report.pdf. Accessed 3/12/21.

11 City of Chesapeake Department of Planning. 2005. *South Military Highway Corridor Study; Chesapeake, Virginia.* December 21, 2005. https://www.cityofchesapeake.net/government/city-departments/departments/Planning-Department/Planning-Library/plans_studies/south_military_study.htm. Accessed 3/12/21.

3.4 Utilities

Reliable utility infrastructure is critical to the DoD for maintaining normal operations. Utility infrastructure interdependencies among the installations, the cities, and other providers are high. In general, the provision and reliability of utilities has not been identified as a major concern by the DoD or the localities as it relates to the JLUS. However, interruption or loss of service could lead to mission impacts and loss of productivity.

Many of the installations have redundancy measures in place for electric and water. Redundancy ensures that when a primary infrastructure link breaks, there is no disruption or loss in productivity for the installation, and downtimes are reduced or eliminated. The missions at the Norfolk Naval Shipyard and the Naval Medical Center Portsmouth require a reliable source of power at all times. Although power outages have occurred, the loss of water and wastewater service was not identified as a concern for any of the installations, based on input received during interviews.

3.4.1 Electric

Power supply is provided by Dominion Energy for all Navy installations in the study area. Dominion's energy production portfolio includes coal, nuclear, natural gas, oil, and renewables.[12] Power is transferred from high-voltage transmission lines to substations that serve the installations. The substations "step down" the power to a voltage that can be delivered directly to the installations via mainline feeders and overhead or underground tap lines.

The electric distribution system at NNSY is old, and maintenance remains a challenge due to the highly developed nature of the shipyard and the need to maintain operations during service calls. Two substations provide power and offer redundant power feeds, and diesel-powered generators provide emergency backup power to critical facilities. Generators require regular refueling and maintenance to ensure operability. Adequate and accessible fuel storage for generators is critical should roadways to the installation become impassable.

12 Dominion Energy. 2020. "Making Energy." https://www.dominionenergy.com/our-company/making-energy. Accessed 3/11/21.

Efforts are underway to upgrade backup generation capability at Craney Island Fuel Depot. Power requirements at the Naval Medical Center Portsmouth are 24/7 and 365 days per year. The site has experienced some power disruption in the past. In addition to generator backup on critical facilities, the hospital does have a secondary power feed.

Power supply and reliability was not identified as a specific concern at the other installations.

3.4.2 Natural Gas

Columbia Gas is the natural gas service provider in the JLUS study area[13] and provides natural gas service to the Navy installations. No specific natural gas concerns were identified during the planning process. Columbia Gas and Naval Medical Center Portsmouth recently signed a Memorandum of Understanding (MOU) that codifies a process whereby the Navy alerts Columbia Gas whenever any projects are proposed that could affect natural gas infrastructure in the vicinity. The agreement helps to streamline communication between the Navy and the utility.

3.4.3 Potable Water and Wastewater

Potable water is supplied to NNSY, Naval Medical Center Portsmouth, and Craney Island Fuel Depot by the City of Portsmouth, and wastewater generated at these facilities is collected in the Navy-owned collection system and discharged to the HRSD system. The Hampton Roads Sanitation District is also in the process of upgrading wastewater pump stations, and new stations are being designed with backup power generation to improve resiliency.

Both NNSY and the Naval Medical Center Portsmouth have redundant water feeds. At Craney Island Fuel Depot, potable water is provided by Portsmouth, and fire suppression is provided by Norfolk via a direct connection to its raw water main.

Portsmouth is continuing comprehensive efforts to replace and upgrade its potable water infrastructure through its capital improvements program, including upgrades to water pump stations and improving the pressurization of the system. Water supply for Portsmouth is sourced from supply lakes and wells in Suffolk, and multiple feeds connect to the supplies to provide redundant service. St. Juliens Creek Annex in Chesapeake is served by the same source and Portsmouth water supply lines, but

Chesapeake purchases water from Portsmouth and then sells it to St. Juliens. Chesapeake is in the process of installing a new water meter on the St. Juliens Annex side of the railroad tracks. Other approaches to serving St. Juliens Annex have been discussed because of the Navy's low water usage on site, including potentially extending water lines further east toward the Elizabeth River. Extension of the system is not currently included in any CIPs but is covered under the city's public utilities franchise area and would help facilitate the redevelopment of an undeveloped parcel northeast of St. Juliens Creek Annex in Chesapeake, as discussed in Section 3.3.1. Interconnecting the water service and extending it would require coordination among the Navy and both cities.

3.4.4 Stormwater

Each locality owns its stormwater infrastructure, which is managed and maintained by the cities' public works departments. Similarly, the Navy manages and maintains the stormwater infrastructure inside its fence line. In general, the stormwater systems generally do not interconnect. A few exceptions exist around the perimeter of Norfolk Naval Shipyard, where Portsmouth storm drainage flows into NNSY storm drains, with the combined flow discharging through a shipyard outfall to the river. In addition, Portsmouth has a drainage easement on the Craney Island Fuel Depot property that the city regularly cleans, mows, and maintains.

Stormwater system capacity issues can create localized flooding today in the study area, and these issues will be exacerbated with increased rainfall and future SLR. Maintenance routines on federal, city-owned, and private property can vary and contribute to flooding issues both on and off base. As part of an ongoing capital investment, Portsmouth is installing tide gates and other types of backflow preventers in stormwater outfalls to help reduce tidally influenced flooding. The city has also implemented a network of flood sensors that will provide data to the public in an app-based tool about real-time flood conditions. The city plans to expand the network over time. The sensor locations do not include Navy facilities at this time; cyber security concerns would need to be addressed to expand onto federal properties.

13 A Virginia natural gas easement crosses the northeast side of Craney Island Fuel Depot and provides service to Norfolk.

3.4.5 Emergency Response Support

The Navy and the localities are already coordinating on emergency response activities. Mutual aid agreements define the level of bi-directional support for law enforcement, fire response, and emergency management services for the Navy and cities.

The Norfolk Naval Shipyard and Portsmouth have an MOU for sharing emergency management equipment, whereby the shipyard sends a single fire engine to support structure fires within a defined zone and Portsmouth supports the Shipyard in its emergency training for submarines by providing staff for drills. In the past, Portsmouth has also provided rehabilitation support (assessing vital signs, etc.) for NNSY staff in submarine fire response training; however, the rehabilitation unit has been out of service for a year. The Craney Island Fuel Depot relies on Portsmouth for fire response, with NNSY providing a secondary response team. Portsmouth also does some spill response training and coordination at Craney Island Fuel Depot.

Portsmouth and the Naval Medical Center Portsmouth also have a good working relationship on emergency response; both parties are renegotiating a Memorandum of Agreement (MOA) for law enforcement support. The use of three different emergency notification systems among Portsmouth, Naval Medical Center Portsmouth, and Naval Support Activity Hampton Roads presents a challenge to coordination and can lead to confusion. Stakeholders identified a need for more coordination and consistency regarding emergency evacuation protocols for city and federal employees, especially those working in downtown Portsmouth. The Southside Regional Fire Academy at St. Juliens Creek Annex is a multi-agency joint venture training facility used for fire/emergency medical services (EMS) training by several localities in the region

Both Chesapeake and Portsmouth desire a Class A burn building and associated land for the facility, and Chesapeake is in the process of conducting a public safety study. JLUS partners are interested in developing a First Responder Academy, including an emergency vehicle operations course. According to the Navy, this project is in the concept development phase and a team is working to identify the size and scope of all components. The Navy indicated that it is possible that some of the administrative functions could be at St. Juliens Creek Annex. The location for a burn facility would need to consider smoke and noise impacts, as well as access requirements.

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4.0 TRANSPORTATION AND ACCESS

The Hampton Roads region includes a large number of military facilities that contribute significantly to the economy. A reliable regional and local transportation network is paramount to enabling the military mission through the movement of personnel, goods, and services. Challenges impacting the transportation network and mobility of military personnel include congestion and delays, lack of transit alternatives, gaps within the pedestrian and bicycle infrastructure, and threats from current and future flooding. This chapter explores these transportation and access issues and provides an understanding of how they can affect access in and around the Navy installations, creating challenges for military readiness and for those who live, work, and travel throughout the study area.

4.1 Critical Corridors Serving the Navy

Several corridors were identified as providing critical and direct access to the installations included in the JLUS. These routes are used by employees to travel between home and the installations, and they support the movement of goods and services the installations need to perform various mission functions. The 2018 HRTPO *Hampton Roads Military Transportation Needs Study*[1] identifies the Strategic Highway Network (STRAHNET), as defined by the DoD, as well as other roadways that serve military sites and intermodal facilities not included in the STRAHNET. The STRAHNET corridors are defined by the DoD as the "minimum public highway infrastructure…needed to fulfill its mission and ensure defense readiness capability."[2]

This report helped to identify 13 critical corridors within the JLUS study area. The corridors were identified based on their proximity and connectivity to the installations and their ability to support the movement of various transportation users (i.e., local, commuter, military, and heavy vehicle traffic) within the localities. Of the 13, two roadways (Route 164 Western Freeway and Effingham Street) are identified in the STRAHNET system. Although the remaining corridors are not included within STRAHNET, they still provide critical connections between other STRAHNET facilities and military sites and have been identified as significantly important corridors by the HRTPO. The Hampton Roads Military Transportation Needs Study identifies the following roadways as critical corridors serving the military: London Boulevard, Effingham Street, Port Centre Parkway, Portsmouth Boulevard, Elm Avenue, George Washington Highway, Frederick Boulevard, Martin Luther King Freeway, and Victory Boulevard. Five of the roadways are also designated as evacuation routes by VDOT and Portsmouth. Table 4.1 provides a list of the critical corridors and their operational characteristics. The corridors are also illustrated in Figure 4.1.

According to the HRTPO, between 2000 and 2017, traffic volumes in Hampton Roads grew nearly 12 percent, and in 2016 the region ranked 6th highest among 37 other metropolitan areas in terms of congested hours, or the length of time of congested conditions.[3] Based on data from VDOT, six corridors have sections experiencing "severe" congestion levels during one or both peak periods.

1 HTRPO. 2018. *Hampton Roads Military Transportation Needs Study* 2018 Update. July. https://www.hrtpo.org/news/article/july/24/2018/hrtpo-releases-hampton-roads-military-transportation-needs-study/. Accessed 3/24/21.

2 Ibid.

3 HTRPO. 2018. *The State of Transportation in Hampton Roads. November*. https://www.hrtpo.org/uploads/docs/State%20of%20Transportation%202018%20-%20Final%20Report.pdf. Accessed 3/24/21.

How is congestion defined?

Table 4.1 Critical Corridors

Critical Corridor	Segment (Orientation)	Primary Typical Section	Functional Classification	Posted Speed Limit (mph)[1]	Average Daily Traffic (vpd)[2]	Direct Connection to Installation	Gates Served	Congestion Level	Railroad Crossings
Cedar Lane	CINSC to Western Freeway (N-S)	4-lane, divided	Major Collector	25	8,700	Yes (CINSC)	Craney Island Fuel Depot Main Gate	Low - Moderate	N/A
Western Freeway	Cedar Lane to Martin Luther King Freeway (E-W)	4-lane, divided	Freeway	60	56,000 – 63,000	No	N/A	Severe	N/A
Martin Luther King Freeway	I-264 to Western Freeway (N-S)	4-lane, divided	Freeway	45	29,000 - 56,000	No	N/A	Low-Moderate	N/A
London Boulevard	High Street to Effingham Street (E-W)	6-lane, divided	Principal Arterial	45	18,000 – 56,000	No	N/A	Low - Moderate	1 (At Virginia Avenue)
High Street	Cedar Lane to Frederick Boulevard (E-W)	4-lane, undivided	Principal Arterial	20 – 35	4,800 – 25,000	No	N/A	Low - Moderate	1 (At Virginia Avenue)
County Street	Constitution Avenue to Crawford Street (E-W)	2-lane, undivided	Major Collector	30	1,500 – 4,200	No	N/A	Low	N/A
Portsmouth Boulevard	Hodges Ferry Road to Port Centre Parkway (E-W)	4-lane, undivided	Minor Arterial	35	7,500 – 21,000	Yes (NNSY)	NNSY Gate 10 NNSY Gate 14A	Severe	1 (At Frederick Boulevard) 1 (At I-264)
Elm Avenue	Victory Boulevard to Jefferson Street (N-S)	4-lane, undivided	Minor Arterial	25 – 35	5,400 – 6,700	Yes (NNSY)	NNSY Gate 29 NNSY Gate 36	Low - Moderate	1 (At I-264) 1 (At Dale Street)
Effingham Street	London Boulevard to Portsmouth Boulevard (N-S)	4-lane, undivided	Principal Arterial	25 – 35	18,000	Yes (NMCP and NNSY)	NMCP Gate 1 NNSY Main 15	Severe	1 (At I-264)
Frederick Boulevard	High Street to George Washington Highway (E-W)	4-lane, divided	Principal Arterial	35 – 40	15,000 – 36,000	No	N/A	Low - Moderate	1 (At I-264)
George Washington Highway	Chesapeake City Limits to Portsmouth Boulevard (N-S)	4-lane, undivided	Principal Arterial	35	12,000 – 33,000	No	N/A	Severe	1 (At Andrews Street) 1 (At Battery Park Road)
Victory Boulevard	Portsmouth Boulevard to Elm Avenue (E-W)	4-lane, undivided	Principal Arterial	35 – 40	6,100 – 22,000	Yes (NNSY and St. Juliens Annex)	NNSY Gate 36 St. Juliens Main Gate	Severe	1 (At Airline Boulevard)
Port Centre Parkway	Portsmouth Boulevard to Lincoln Street (N-S)	4-lane, undivided	Minor Arterial	30	6,400	Yes (NNSY)	NNSY Gate 10	Severe	1 (At Pavilion Drive)

NMCP = Naval Medical Center Portsmouth; NNSY = Norfolk Naval Shipyard

1 Miles per hour (mph)

2 Vehicles per day (vpd) – 2019 Virginia Department of Transportation (VDOT) Daily Traffic Volume Estimates Including Vehicle Classification Estimates

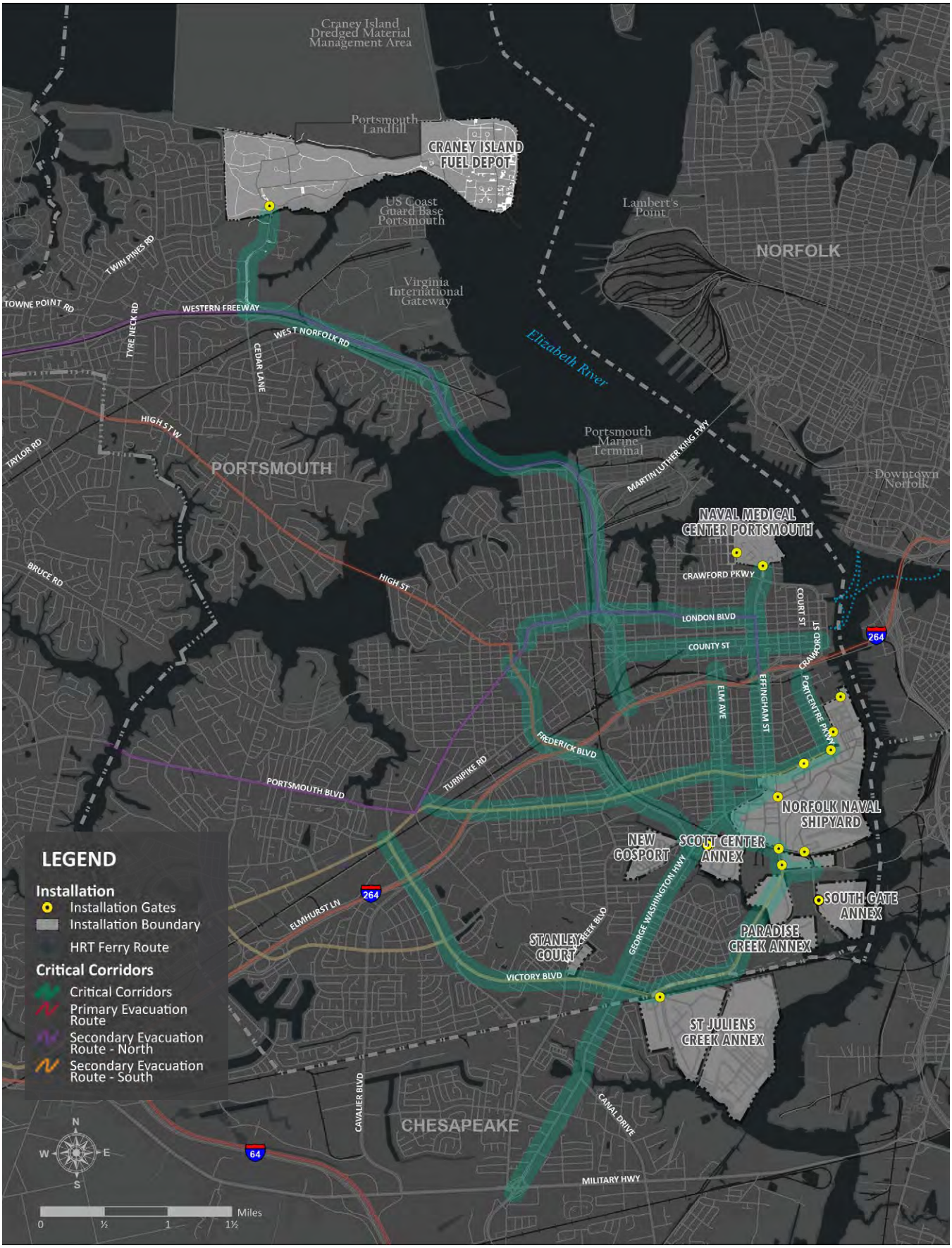


Figure 4.1 Critical Corridors

Of the six corridors experiencing severe congestion, the following four sections are within 1 mile of a Navy installation.

- Effingham Street between Crawford Parkway and Portsmouth Boulevard
- George Washington Highway between Victory Boulevard and the Chesapeake-Portsmouth city line
- Portsmouth Boulevard between Effingham Street and Port Centre Parkway
- Port Centre Parkway between I-264 and Portsmouth Boulevard

Congestion within close proximity of the installations impacts both mobility to and accessibility into the Naval Medical Center Portsmouth and NNSY. Furthermore, the existing congestion classifications in Figure 4.2 demonstrate that some of the observed congestion during the morning peak period can be attributed to gate operations and not solely a lack of capacity on the surrounding roadway network. In other words, it sometimes takes longer getting into the installation than getting to the installation. Flooding due to rainfall or future SLR along the corridors will exacerbate congestion conditions, making it more difficult to access the installations. Additional analyses related to flooding are discussed in Section 4.6.

Click the buttons below to see different congestion levels during peak periods.

AM Congestion Levels **PM Congestion Levels**

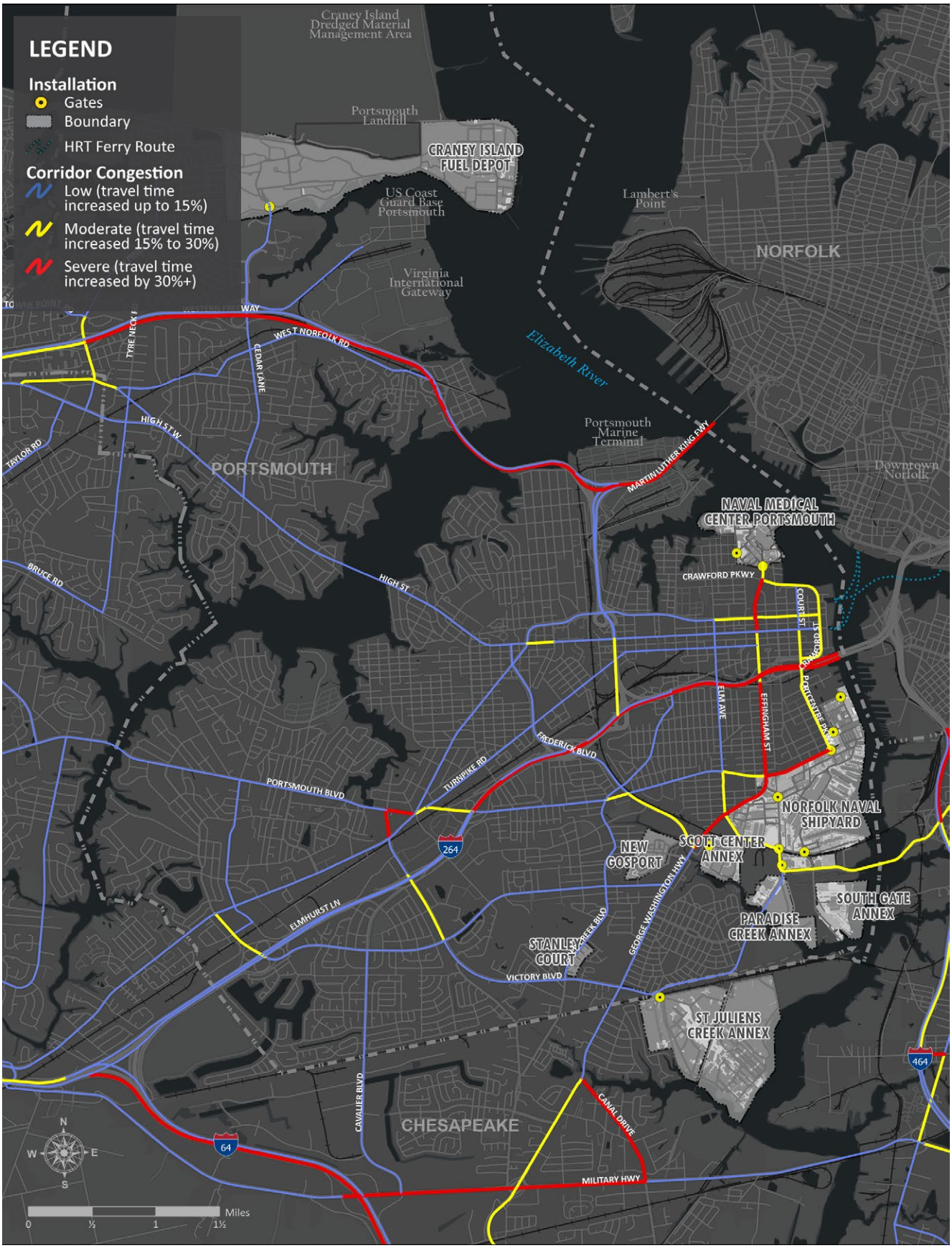


Figure 4.2 Corridor Congestion Levels During AM and PM Peak Period

4.2 Entry Control Points (Gates)

The Navy installations are accessed through entry control points or gates, either by vehicle, bicycle, or on foot. Commuter arrival times based on work shifts, gate operating hours, and traffic conditions of the adjacent roadway network influence which gates commuters choose to use and the overall gate utilization. The number of vehicles (gate volume), gate operational procedures, and processing capacity can impact congestion on nearby roadways and cause lengthy vehicle queuing that creates neighborhood-level impacts for residents attempting to leave or return home.

Norfolk Naval Shipyard

There are eight vehicle gates at NNSY as shown in Figure 4.3 and Table 4.1. Gate 15 is the main entry control point for NNSY. It operates 24/7 and provides access from the pass office and the commercial vehicle inspection station. The other shipyard gates are open between 0500 and 1700 (or 1800) or only operate to support incoming morning rush hour and outbound afternoon rush hour traffic.

Expand

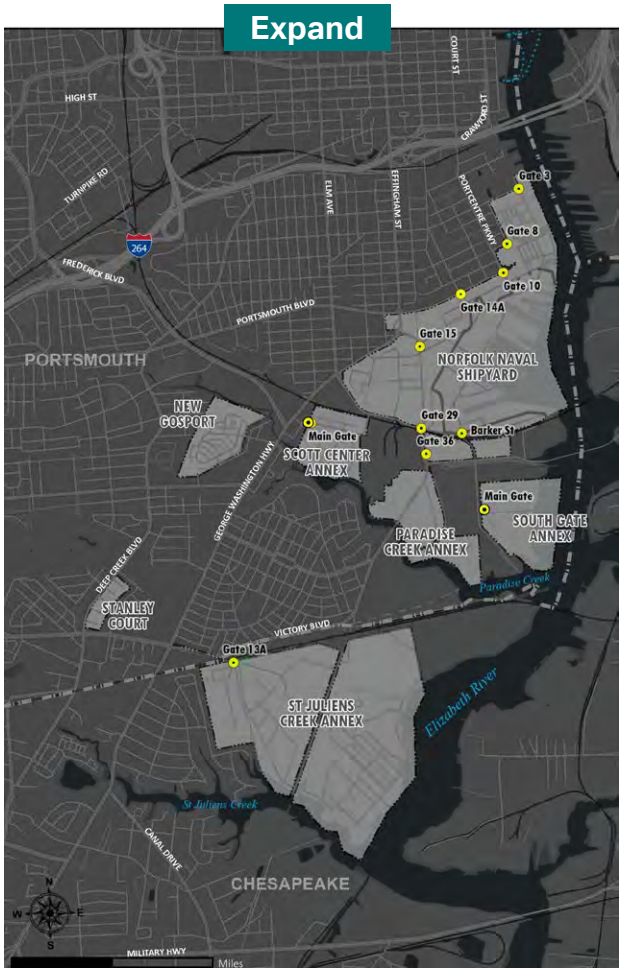


Figure 4.3 Norfolk Naval Shipyard Gates and St. Juliens Creek Annex Gate

Access to Scott Center Annex is located off of George Washington Highway. Scott Center Annex is busiest during the midday period (i.e., 1100 – 1400), and congestion is compounded at this location by the railroad crossing across George Washington Highway between Andrews Street and Elm Avenue. Rail crossings can cause 45-minute closures along George Washington Highway and cause severe congestion that leads to vehicle diversions through adjacent streets around Scott Center Annex.

St. Juliens Creek Annex has one gate off of Victory Boulevard that operates 24/7, as shown in Figure 4.3. The approach to the main gate shares an entrance with the Southside Regional Fire Academy and the Cradock Little League baseball fields. This gate does not experience significant congestion, and future traffic conditions are anticipated to be stable.

Existing congestion impacts at the gates and along the adjacent roadway network are expected to increase as additional population and employment growth occur at the Shipyard and in the surrounding communities. Anticipated congestion is expected to spread to adjacent and connected roadways, some of which will be affected by increasing amounts of rainfall and future SLR, as discussed in Section 4.6. Future flood conditions may also result in a shift in gate utilization as drivers seek roadways and gates that are not impacted by flooding. A coordinated approach by the Navy and Portsmouth is needed when considering changes to existing entry control points so that impacts related to congestion, neighborhood safety, redevelopment, and future flooding are considered. Opportunities for integrating transit into gate design and connectivity to remote parking should also be considered.

Naval Medical Center Portsmouth

Naval Medical Center Portsmouth is served by two gates, as shown in Figure 4.4. Gate 1 on Effingham Street is operational 24 hours a day and supports visitor processing and commercial vehicle inspection. Gate 1 was recently upgraded to four inbound lanes with one lane dedicated to commercial vehicle inspections and one "flex" lane that can process commercial vehicles or personal vehicles. Gate 2 is accessed from Spratley Street within the Park View neighborhood and operates only during peak traffic periods; the gate is closed during all other times of the day.

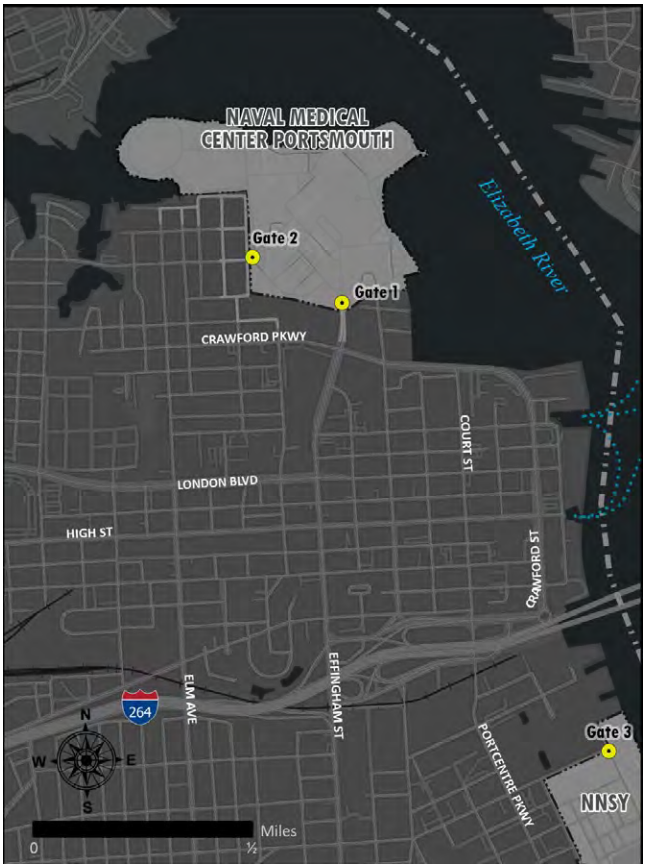


Figure 4.4 Naval Medical Center Portsmouth Gates

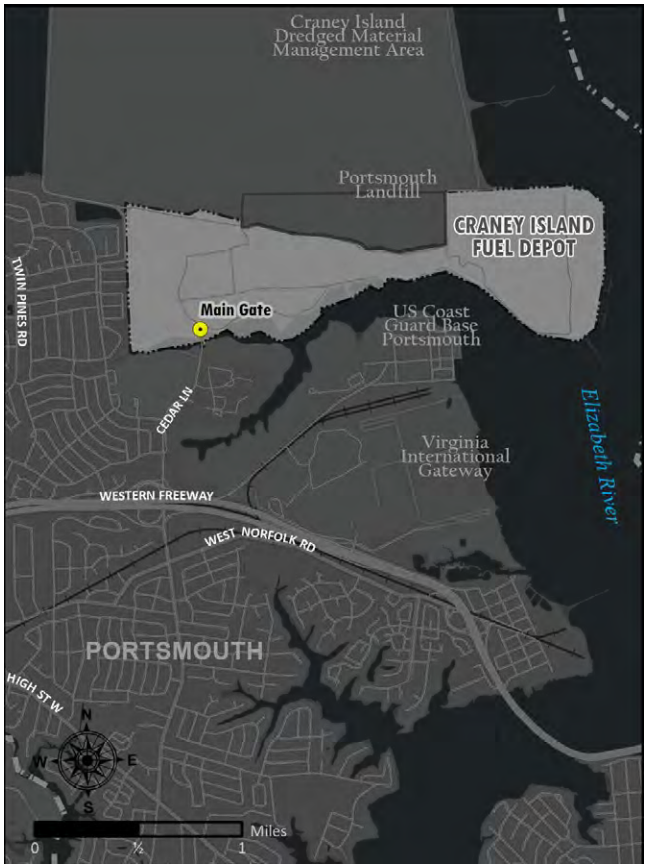


Figure 4.5 Craney Island Fuel Depot Gate

Effingham Street experiences significant congestion at Gate 1 that extends to London Boulevard in the morning peak period. In response to the high levels of congestion, drivers sometimes try to bypass the line at Crawford Parkway or divert through the Park View neighborhood to access Gate 2. The neighborhood has raised concerns about cut-through traffic and vehicle parking associated with vehicles and personnel trying to enter the installation. The Navy should consider modifying Gate 2 to serve only specific users to help reduce impacts on the surrounding neighborhood.

Craney Island Fuel Depot

Craney Island Fuel Depot is served by one 24-hour gate located at the terminus of Cedar Lane, as shown in Figure 4.5. Three schools are located off of Cedar Lane in the vicinity of the main gate – Churchland High School, Churchland Middle School, and Churchland Preschool Center, which are the primary drivers for potential congestion along Cedar Lane.

4.3 Freight Activity

The network of rail and highway corridors in the study area enables the movement of goods and services that support the three major industries in the Hampton Roads economy: the military, port facilities and container terminals, and tourism. Significant investments have been made in regional transportation infrastructure to support the growth of these industries and the region as a whole. However, the presence of different rail lines and operators and the movement of freight within the study area also brings challenges that affect the JLUS partners and presents opportunities for partnering.

4.3.1 Rail

According to the Virginia Statewide Rail Plan completed in 2017 by the Virginia Department of Rail and Public Transportation (DRPT), there are six existing rail freight lines within Hampton Roads, as shown in Figure 4.6. Together, these rail lines serve the Port of Virginia and other industrial facilities, including those along the Southern Branch of the Elizabeth River. The network of railroad tracks has multiple owners and operators, which can complicate communication and maintenance.

For example, Norfolk and Portsmouth Beltline is jointly owned by CSX Transportation and Norfolk Southern.[4]

The Port of Virginia provides direct and dedicated service to and from Virginia with connections to over 200 countries worldwide. In 2019, the Port moved 63 percent of its cargo by truck and 34 percent of its cargo by rail, demonstrating the importance of direct highway access and a reliable transport network.[5] The Port of Virginia owns and operates the Portsmouth Marine Terminal (PMT) near Naval Medical Center Portsmouth, Virginia International Gateway (VIG) near Craney Island Fuel Depot, and the Norfolk International Terminals in Norfolk.

Together, these facilities move approximately 600,000 containers per year by rail with the potential to grow to more than 1 million containers by 2040.[6] To support this growth, the Port of Virginia has identified several infrastructure improvements that would include associated improvements and extensions to rail capacity.

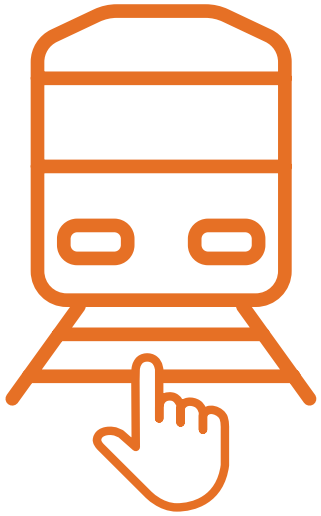
These improvements could include extension of the Commonwealth Railway to the Craney Island area to support the development of the Craney Island Marine Terminal.

The rail network includes more than 200 railroad crossings (at-grade) within the vicinity of the installations and along critical corridors, as shown in Figure 4.6. Rail crossings are a unique component of the transportation network, as they involve the only locations where all potential landside traffic modes conflict. Table 4.1 identifies those crossings that are located near the installations along important corridors.

At-grade crossings can halt vehicular and pedestrian traffic for extended periods of time, impacting both mobility and accessibility to an installation. As both vehicular and rail traffic grow, the impacts at critical crossings not only increase, but compound with other impacts (e.g., roadway congestion, mobility, gate operations, neighborhood impacts).

Activity is expected to increase along the Norfolk & Portsmouth Belt Line Railroad (NPB) that extends along a portion of the southern boundary of NNSY before crossing Elm Avenue and passing Scott Center Annex near George Washington Highway. Based on a stakeholder interview with NPB,[7] the rail line has plans to upgrade tracks to allow double stacking from the Shipyard to the interchange area of I-264 when funding becomes available. This would allow trains to go in both directions and could increase conflicts near at-grade crossings in this area. In addition, per NPB, trains have increased in car length over time to approximately 120 cars for a typical train. Increased coordination between the Navy, cities, and NPB is needed to understand future growth plans and to mitigate impacts. Coordination strategies are discussed in Chapter 6.

Train Schedules and Warnings



Portsmouth has applied and been approved for SmartScale funding to place advanced warning signage at four intersections with at-grade crossings (High Street, Elm Avenue, Frederick Boulevard, and George Washington Highway) that will inform motorists when trains will be crossing to help them reroute to reduce or avoid delays. Portsmouth should coordinate with the Navy to prioritize the specific locations for and implementation of the funded signage and consider future locations for additional signage to expand the program.

4 Virginia Places. n.d. Norfolk and Portsmouth Belt Line. http://www.virginiaplaces.org/rail/norfolkportsmouth.html.

5 add source

6 HRTPO. 2017. *Hampton Roads Regional Freight Study* 2017 Update. July. https://www.hrtpo.org/uploads/docs/Regional%20Freight%20Study%20Update%202017%20Update%20-%20FINAL%28new%29.pdf.

7 Stakeholder Interview with Donna Coleman, Norfolk & Portsmouth Belt Line Railroad, August 13, 2019.

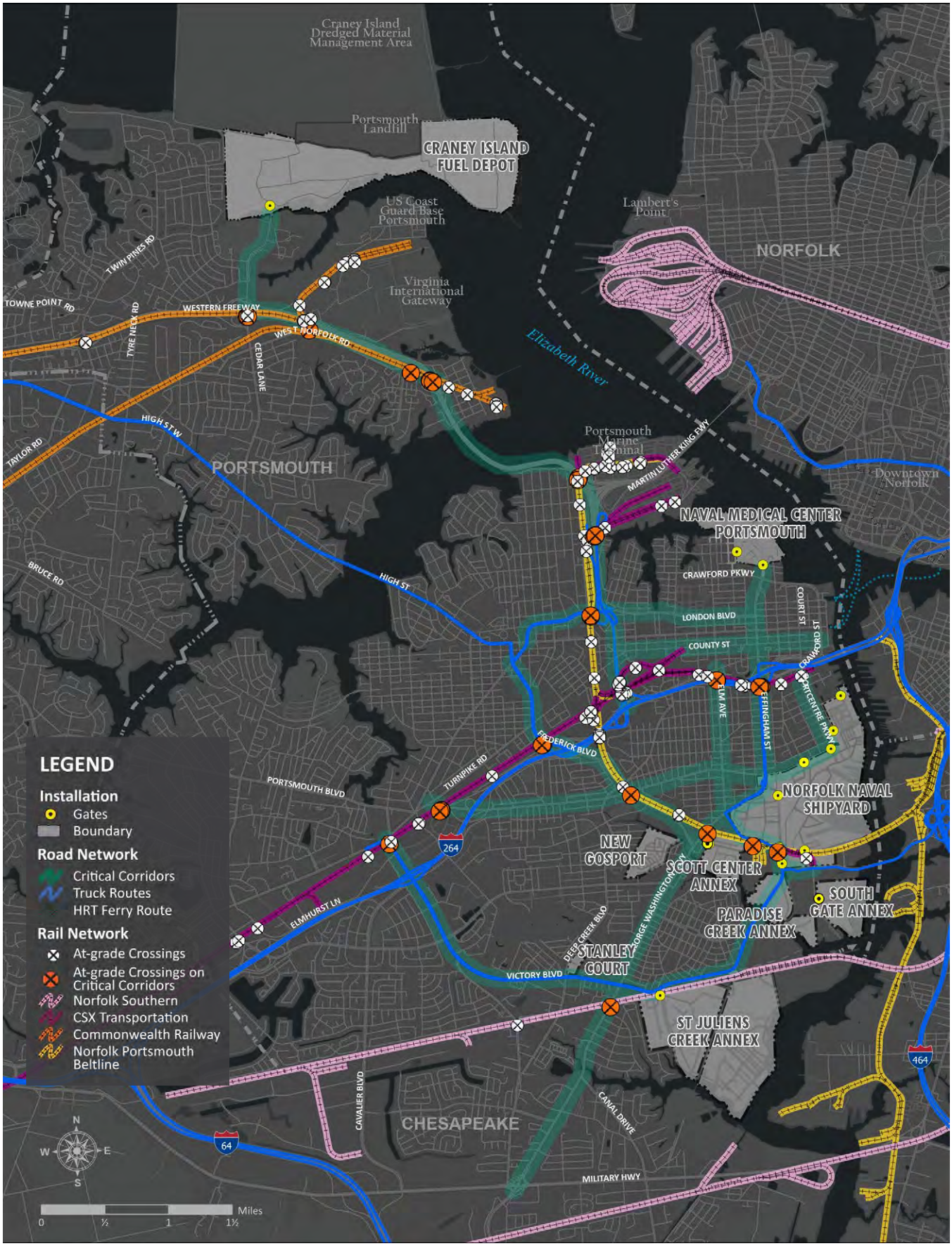


Figure 4.6 Existing Freight Rail Lines and Truck Routes

4.3.2 Truck

Several designated truck routes occur in the JLUS study area, primarily along the interstate system, as shown in Figure 4.6. Trucks are allowed on several other major roadways, including Effingham Street, Elm Avenue, Victory Boulevard, Frederick Boulevard, and High Street. These same corridors already experience congestion, and JLUS stakeholders specifically identified truck traffic on local roadways and around installation gates as a concern. For example, participants in the JLUS public meetings stated that PMT truck traffic backs up on Virginia Avenue and creates a barrier for residents in the Port Norfolk neighborhood. In other cases, trucks make incorrect turns and end up on local streets or arrive at the wrong installation and affect gate operations and efficiency. Additional directional signage to the installations located along key corridors and truck routes could help reduce confusion for drivers and conflicts in neighborhoods and at entry control points.

Similar to the freight trends, container movements by truck are anticipated to increase with the development of industrial, warehouse, and manufacturing sites throughout the region. The total tonnage moved by truck in Hampton Roads is anticipated to double from approximately 75 to 150 million tons by 2040.[8] Therefore, improving the highways, railways, and rail crossings is imperative to accommodate the anticipated regional freight growth. Localities will need to anticipate these changes to minimize negative impacts to installations and communities. A coordinated planning process could help identify specific local improvements to help manage projected impacts.

4.4 Transit

Alternative transportation options in the region are provided by HRT, which offers light rail, bus, passenger ferry, and demand response transit services. Within the JLUS study area, bus service and passenger ferry service are available but are not well utilized by installation personnel. The location, availability, efficiency, and quality of transportation alternatives can influence commuting decisions, ultimately impacting traffic, congestion, and parking patterns in and around the installations.

8 HRTPO. 2017. *Hampton Roads Regional Freight Study 2017 Update.* July. https://www.hrtpo.org/uploads/docs/Regional%20Freight%20Study%20Update%202017%20Update%20-%20FINAL%28new%29.pdf. Accessed 3/24/21.

4.4.1 Light Rail

HRT operates the Tide, a 7.4-mile light rail line in Norfolk that extends from the Fort Norfolk Station near historic Ghent to the Newtown Road Park & Ride Station at the Norfolk / Virginia Beach city line. It has 11 stops and connects Eastern Virginia Medical School, Downtown Norfolk, Harbor Park, Norfolk State University, and Newtown Road. Although light rail does not directly serve Portsmouth, it connects riders to bus routes that can provide a connection across the Elizabeth River, including Bus Route 45, which delivers passengers to Portsmouth.

The service area for the Tide is limited. Extension of light rail into Portsmouth is not practical in the near term; however, several stakeholders supported the idea of extending the Tide across the river to serve Portsmouth and Chesapeake.

4.4.2 Ferry Service

Hampton Roads Transit contracts with Norfolk-by-Boat to provide daily ferry service on the Elizabeth River between Downtown Norfolk and Downtown Portsmouth using three 150-passenger ferries. Two ferry landings in Downtown Portsmouth at North Landing and High Street provide daily service every 30 minutes during operating hours. Portsmouth is interested in expanded ferry service, including higher frequency of service and direct connection to the Tide. Figure 4.7 shows the existing ferry service routes. Peak ridership occurs during the summer and on weekends. During peak ridership months, service frequency increases to 15 minutes.[9] Hampton Roads Transit reports that some U.S. Coast Guard employees utilize the ferry to commute to the Coast Guard Base in Downtown Portsmouth.[10]

Naval Medical Center Portsmouth has expressed an interest in ferry access that could allow visitors to utilize the ferry and avoid the need to drive and park on site. An existing dock is located on the hospital property, but it is not in use. Opportunities to reuse the dock for ferry access should be studied. Any studies would need to address access and security requirements of the installation. Chesapeake has also expressed interest in expanded ferry service.

9 Olde Town Business Association. 2020. Elizabeth River Ferry. https://oldetowneportsmouth.com/listings/elizabeth-river-ferry/. Accessed May 24, 2020.

10 Stakeholder interview with Sam Sink, HRT, June 18, 2019.

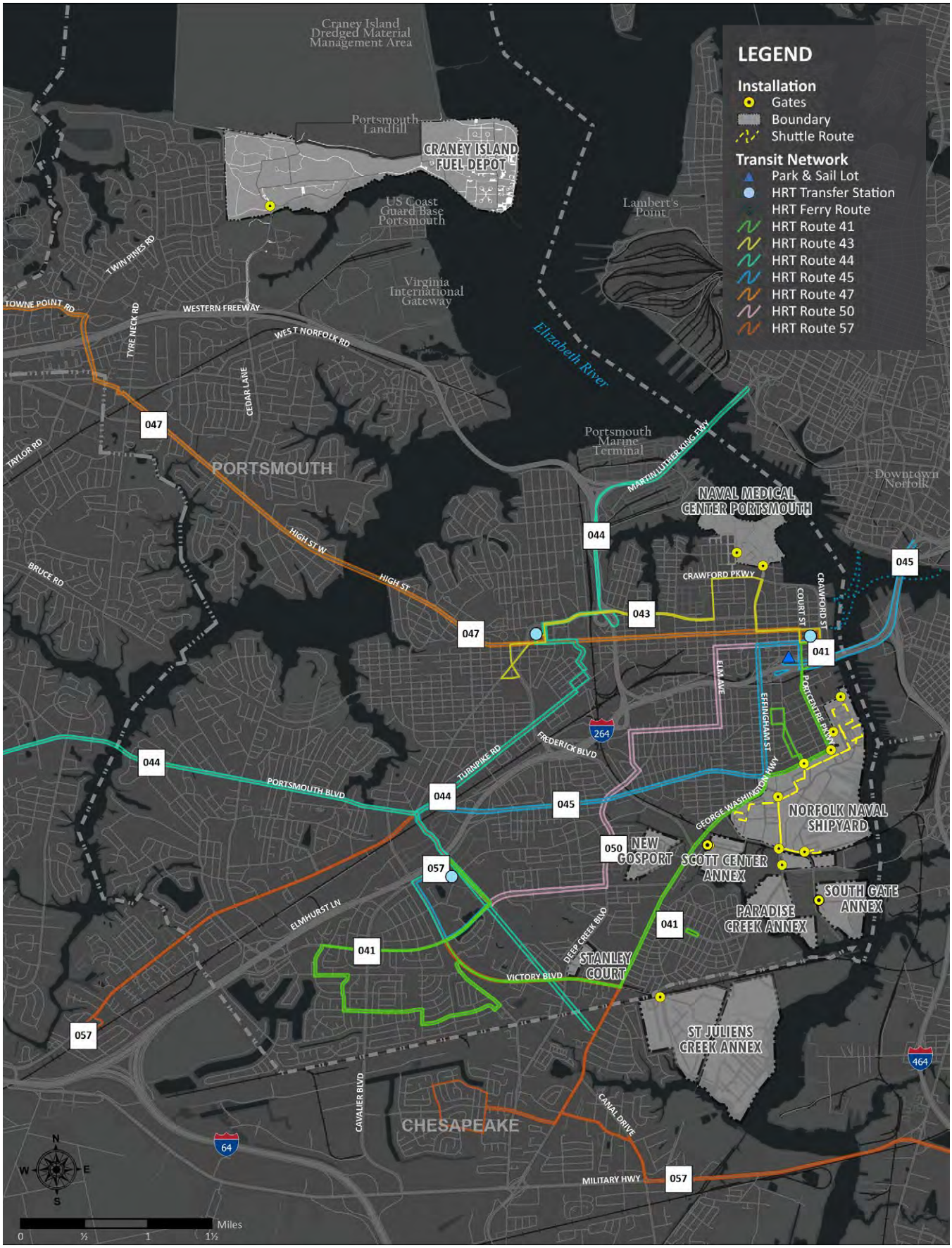


Figure 4.7 Existing HRT Bus and Ferry Service Routes

4.4.3 Fixed Bus Routes

HRT currently operates 53 local bus fixed-routes across the region; 33 routes are located on the Southside, and 20 routes are located on the Peninsula.[11] Four of these routes serve one or more of the installations in this study, as noted in Table 4.2 and Figure 4.7: Route 41, Route 43, Route 45, and Route 57.

Table 4.2 Existing HRT Fixed Bus Routes with Stops Within 1/2 Mile of a Navy Installation

HRT Routes: Portsmouth	
Route 41	Downtown Portsmouth / Cradock
Route 43	Downtown Portsmouth / Bart Street
Route 45	Downtown Norfolk Transit Center / Portsmouth
Route 50	Downtown Portsmouth / Victory Crossing
Route 57	Robert Hall Boulevard / Airline Boulevard
HRT Routes: Chesapeake	
Route 57	Robert Hall Boulevard / Airline Boulevard

Although HRT offers bus service to NNSY and Naval Medical Center Portsmouth (Craney Island Fuel Depot is not served by bus), the convenience and proximity of bus routes could be contributing to low bus-ridership by military personnel. According to the 2012 Hampton Roads Military Transportation Needs Survey, 90 percent of survey respondents drive alone to work, and the mean travel time to work/home of survey participants working at NNSY and Naval Medical Center Portsmouth was around 33 minutes.[12] A large number of military commuters leave for work early in the morning, between 0500 and 0600 according to the survey. Based on stakeholder interviews with NNSY personnel, shipyard employees begin arriving around 0545. Although some individual bus routes arrive at or near the installations by the typical shift start times, because 83 percent of shipyard employees live outside of Portsmouth, a bus transfer is likely required, and riders would need to utilize two or more routes to reach NNSY.

To be a practical alternative for military commuters, bus service must be accessible, convenient, and compatible with work shift start and end times. Some bus routes currently service stops every 60 minutes, which is likely a deterrent to use since missing a bus would have a significant impact on commute times. A brief summary of each route serving the installations is provided below.

- **Route 41** provides service to NNSY and St. Juliens Creek Annex. It circulates between Downtown Portsmouth and Victory Crossing beginning at 0600; its first stop at NNSY is at approximately 0615, and there is a 60-minute wait time between busses.
- **Route 43** circulates between Downtown Portsmouth and Midtown; it provides service to Naval Medical Center Portsmouth at Crawford Parkway. Service in Downtown begins at 0700, and there is a 60-minute wait time between buses.
- **Route 45** provides service to the NNSY Gate 15 (Main Gate). It connects Portsmouth's Victory Crossing area to the Downtown Norfolk Transit Center via the Downtown Tunnel. This route provides early service beginning at 0439 in Portsmouth and 0515 in Norfolk. Route 45 has a 30-minute wait time during the day and a 60-minute wait time after 7pm.
- **Route 57** provides service to St. Juliens Creek Annex. It connects South Norfolk to the Chesapeake Crossing Shopping Center via the Gilmerton Bridge. The service begins at approximately 0620 and operates every 60 minutes.

The *HRT Transit Strategic Plan (FY2021–2030)* outlines proposed service planning, operations, and phased improvements for the overall system, including transit route profiles. The improvements are designed to increase service efficiency by providing more high-frequency service, more consistent hours of service, and greater route directness to help increase overall transit trip speed. The Transit Transformation Project also considered concepts to improve transfers between services at convenient locations in order to increase system-wide accessibility.

The following specific recommendations, described in the Transit Strategic Plan, impact the study installations.[13] Additional detail is available online at: https://gohrt.com/tsp/HRT-TSP-Chapter-6.pdf.

11 HRT. 2020. *Transit Strategic Plan FY 2021-2030*. Chapter 1. June. https://gohrt.com/tsp/HRT-TSP-Chapter-1.pdf. Accessed 3/24/21.

12 HRPTO. 2012. *Hampton Roads Military Transportation Needs Study: Military Commuter Survey*. https://www.hrtpo.org/library/view/252/t12_11-hampton-roads-military-transportation-needs-study_-military-commuter-survey/.

13 HRT. 2020. *Transit Strategic Plan FY 2021-2030*. Chapter 3. June. https://gohrt.com/tsp/HRT-TSP-Chapter-3.pdf, Accessed 3/16/21.

- **Elimination of Route 43.** The service area of Route 43 will be covered by realignment of Routes 50 and 47. Route 50 will maintain a stop outside of Naval Medical Center Portsmouth and will offer an improved span of service compared with current operations.
- **Realignment of Route 41.** Route 41 will no longer serve Port Centre Parkway, 7th Street, Lincoln Street, 8th Street, and Portsmouth Boulevard east of Effingham Street. Instead, it will continue straight onto County Street and then turn left on Effingham to continue onto George Washington Highway (following a portion of existing Route 45). The route will continue onto Victory Boulevard, turning right onto Greenwood Drive and continuing to Victory Crossing. Service along Portsmouth Boulevard and Port Centre Parkway will be replaced with the realigned Route 45. In the long term, weekday service will be extended to operate between 0500 and 1100, with half hour service through most of the service day. Ridership on this route is forecast to increase by 61 percent.
- **Realignment of Route 45.** Route 45 will operate via Port Centre Parkway and Portsmouth Boulevard instead of via Effingham Street and Court Street (service along these corridors will be replaced with the realigned Route 41) to improve route directness and decrease travel time. Route 45 will be a Regional Backbone service that will operate on weekdays between 0439 and 0100 between Victory Crossing, Downtown Portsmouth, and Norfolk. In the long term, it will provide 15-minute service between Victory Crossing and Downtown Norfolk during AM and PM peak periods, with non-peak period (except late night) service being offered at half hour intervals within Portsmouth and to Norfolk.
- **Realignment of Route 57.** Route 57 will be extended to Greenbrier Mall and Victory Crossing. Weekday service will begin earlier, and service intervals will remain at 60 minutes.

In addition, HRT is currently conducting a survey targeted at NNSY employees to better understand mode choice; commute patterns; work schedules; desired services, including convenient park and ride locations; and interest in MAX service or other transit programs.

A New Law Providing Dedicated Funding for Hampton Roads Transit

Metro Area Express

HRT offers Metro Area Express (MAX) routes connecting major employment destinations in the region, but it does not currently provide service to NNSY, Naval Medical Center Portsmouth, or other installations in the JLUS. The routes are designed for commuters and offer limited-stop express service between major destinations in the region.

The Transit Strategic Plan identifies a new MAX Route 970 as one option for future expansion of MAX service, as shown in Figure 4.8. The route would offer service between Downtown Portsmouth and Newport News with four trips in the morning and afternoon peak periods. The route would begin at County Street and Court Street and would end at the Newport News Transit Center and Shipyard. The route is focused on the Newport News Shipyard; the plan recognizes that other routes will be explored by HRT, including connecting Chesapeake to NNSY.

Future MAX routes that provide connectivity to NNSY and Naval Medical Center Portsmouth, including access onto the installations, should be explored. In addition, HRT, HRTPO, and the Navy should consider conducting a detailed study to assess the workforce transit needs of installation personnel. The results could be used to inform modifications to bus routes and stops.

Figure 4.8 Proposed MAX Route 970
Source: HRT Transit Strategic Plan, 2020.

4.4.4 Walkability to Bus Service

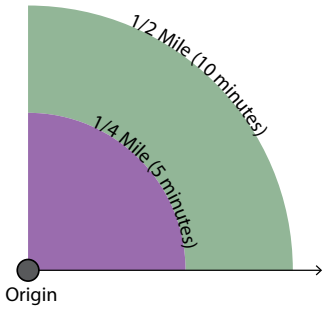
All transit trips start or end with a walking trip.[14] Although HRT can deliver passengers at or near the main gate, none of the HRT routes are permitted onto an installation, and commuters must complete the last part of their journey on foot. This is referred to as the "first/last mile connection," although the actual distance may vary.[15] On average, people generally tolerate a 5- to 10-minute walk (equivalent to ¼ to ½ mile) to a transit stop.[16] Transit stops within a quarter mile of a destination are shown to have significantly higher rates of use than stops that are between ¼ and ½ mile from a destination.[17]

The "last-mile" transit trip for a military commuter requires entrance through an entry control point or gate and walking to the workplace or building. Depending on the entry point and destination, the last mile could add between 5 and 20 minutes to a trip. The willingness to complete the last mile connection is affected by a number of factors, including the presence of sidewalks, cross walks, and lighting; the built environment; perceived safety; and distance. In addition to limitations in transit service, gaps in the pedestrian network can contribute to the disuse of transit overall.

The distance between bus stops located outside the installation and primary work centers (buildings) located inside the installation was evaluated to understand the relationship between bus stops and walkability at both NNSY and Naval Medical Center Portsmouth.

14 The City of Portsmouth. 2020. *Portsmouth Bicycle and Pedestrian Plan*. June. https://www.portsmouthva.gov/DocumentCenter/View/8831/PortsmouthBikePedPlan_FINAL_optimized?bidId=. Accessed 3/25/21.
15 Federal Highway Administration. 2019. *Integrating Shared Mobility into Multimodal Transportation Planning: Metropolitan Area Case Studies.* May. Report Number FHWA-HEP-19-036. https://www.planning.dot.gov/documents/regional_shared_mobility_planning_caseStudies.pdf. Accessed 3/25/21.
16 Federal Highway Administration. 2008. *Pedestrian Safety Guide for Transit Agencies.* Chapter 4. February. https://safety.fhwa.dot.gov/ped_bike/ped_transit/ped_transguide/ch4.cfm. Accessed 3/25/21.
17 Dittmar, H. and Ohland, G. 2004. *The New Transit Town: Best Practices in Transit-Oriented Development.* Island Press: Washington, DC.

Figure 4.9 and Figure 4.10 show the walking distance from bus stops at NNSY and Naval Medical Portsmouth. The analysis uses a widely accepted planning metric for walkability that assumes people will generally tolerate a 5- to-10-minute walk when infrastructure is present. Using an average speed of 3 mph, this translates roughly to a ¼-mile to a ½-mile walking radius or distance. The analysis accounts for and assumes a preference for walking along streets and sidewalks and adds a 1-minute delay at installation gates to account for additional time for gate processing and security screening. Buildings and fences were treated as barriers that cannot be crossed. The shaded zones represent the areas that could be reached within a 5-or 10-minute walk.



Norfolk Naval Shipyard

Bus Route 41 operates along Port Centre Parkway and Portsmouth Boulevard and includes bus stops near NNSY Gate 10 and the pedestrian gate on Portsmouth Boulevard. The 5-minute walk zone from the bus stops extends into NNSY and encompasses some of the buildings along the shipyard's primary east-west roadway, as shown in Figure 4.9. The 10-minute walk zone from bus stops extends further into NNSY, encompassing most of the north end and some large production facilities within the industrial waterfront area; however, most of the shipyard waterfront and main production areas are more than 10 minutes from the nearest bus stop.

Route 41 also extends southward along George Washington Highway towards St. Juliens Creek Annex. Although there are stops along George Washington Highway near the St. Juliens Creek access road, only the gate facility itself is within a 10-minute walkshed of a bus stop. Route 45 provides a higher frequency service north of NNSY along Effingham Street and Portsmouth Boulevard and has one bus stop near Gate 15. Commuters on this bus route would likely enter through Gate 15, which is within a 5-minute walk. However, most workers are likely destined for the industrial waterfront area, which is closer to a 10-minute walk or more.

Naval Medical Center Portsmouth

Route 43 provides bus service along Effingham Street to Crawford Parkway and has a stop near Naval Medical Center Portsmouth. From this stop, passengers can reach Building 3 within a 5-minute walk and can reach Building 2 (the main hospital) and other facilities within a 10-minute walk. Figure 4.10 illustrates walkability from transit to Naval Medical Center Portsmouth.

Norfolk Naval Shipyard Shuttle

An internal shuttle at NNSY provides circulation within the installation boundary, stopping at 21 buildings as shown in Figure 4.9. The shuttle operates weekdays from 0500 to 1700 on 15-minute intervals; a complete loop takes 30 minutes. Ridership numbers are relatively low (approximately 300 riders per day), which is likely attributable to the length of the route and total number of stops.[1]

With some adjustment to the stops and schedule to make the route more efficient, this shuttle has the potential to enhance pedestrian circulation at NNSY by linking bus stops with work centers, thereby shortening the last-mile commute for transit riders. The shuttle could also serve designated remote parking areas to incentivize the use of remote lots and reduce parking impacts on nearby neighborhoods.

1 Jacbos, 2017. Norfolk Naval Shipyard Parking Study. January.

Park and Ride

HRT operates several Park and Ride lots regionally that connect the road network to the bus and light rail networks. In Portsmouth, VDOT operates a Park & Sail lot at the intersection of Court and Crawford Streets in Downtown, just off I-264. This lot provides convenient and accessible parking in Portsmouth where commuters can board HRT Routes 41, 45, and 50. Development along County Street may necessitate relocation of the downtown transit station; Portsmouth is evaluating the Park and Sail area as a potential location for this hub.

Chesapeake has proposed construction of a parking structure across the Jordan Bridge at Poindexter (municipal building) that could also be used as a Park and Ride lot.

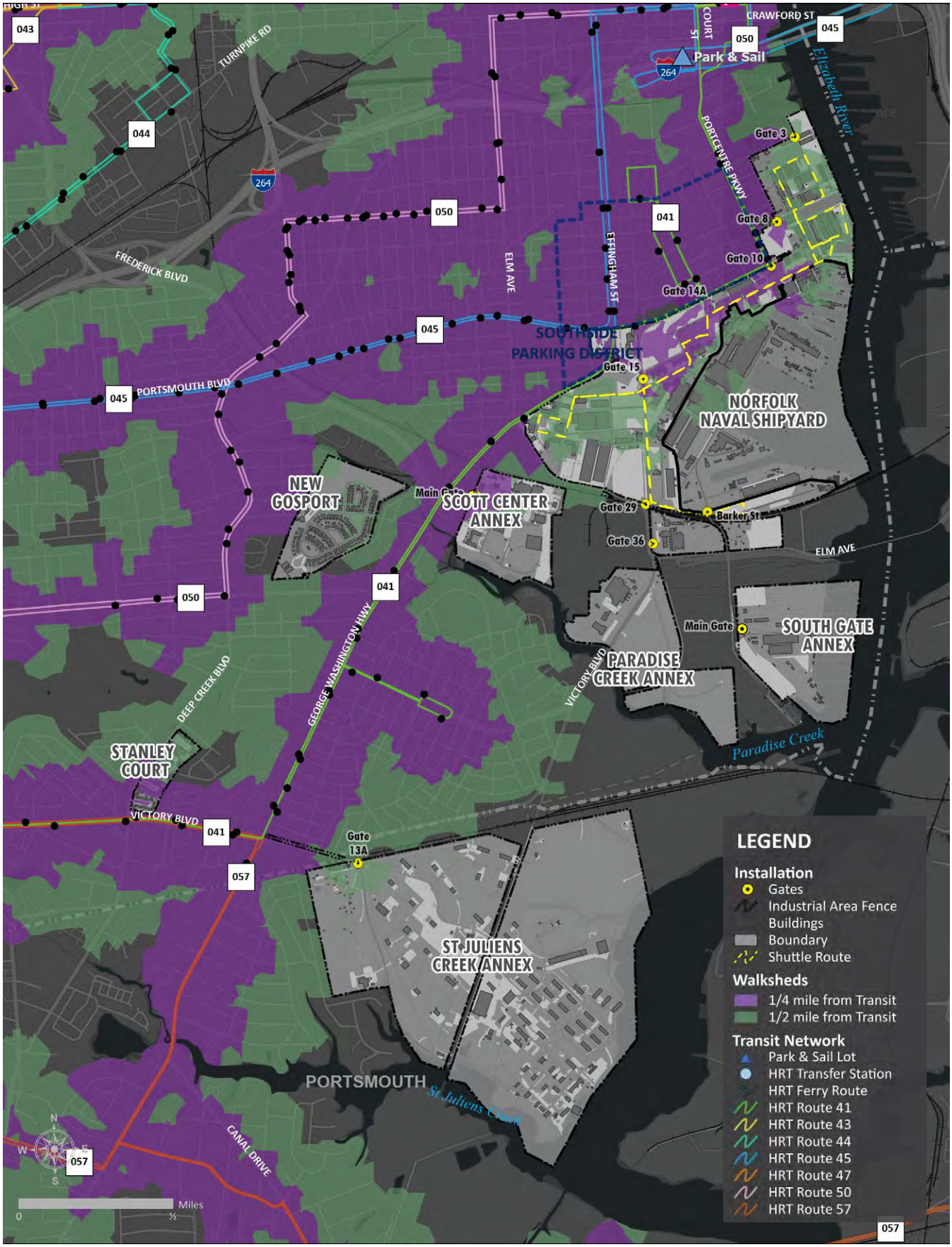


Figure 4.9 Norfolk Naval Shipyard Walkability to Transit

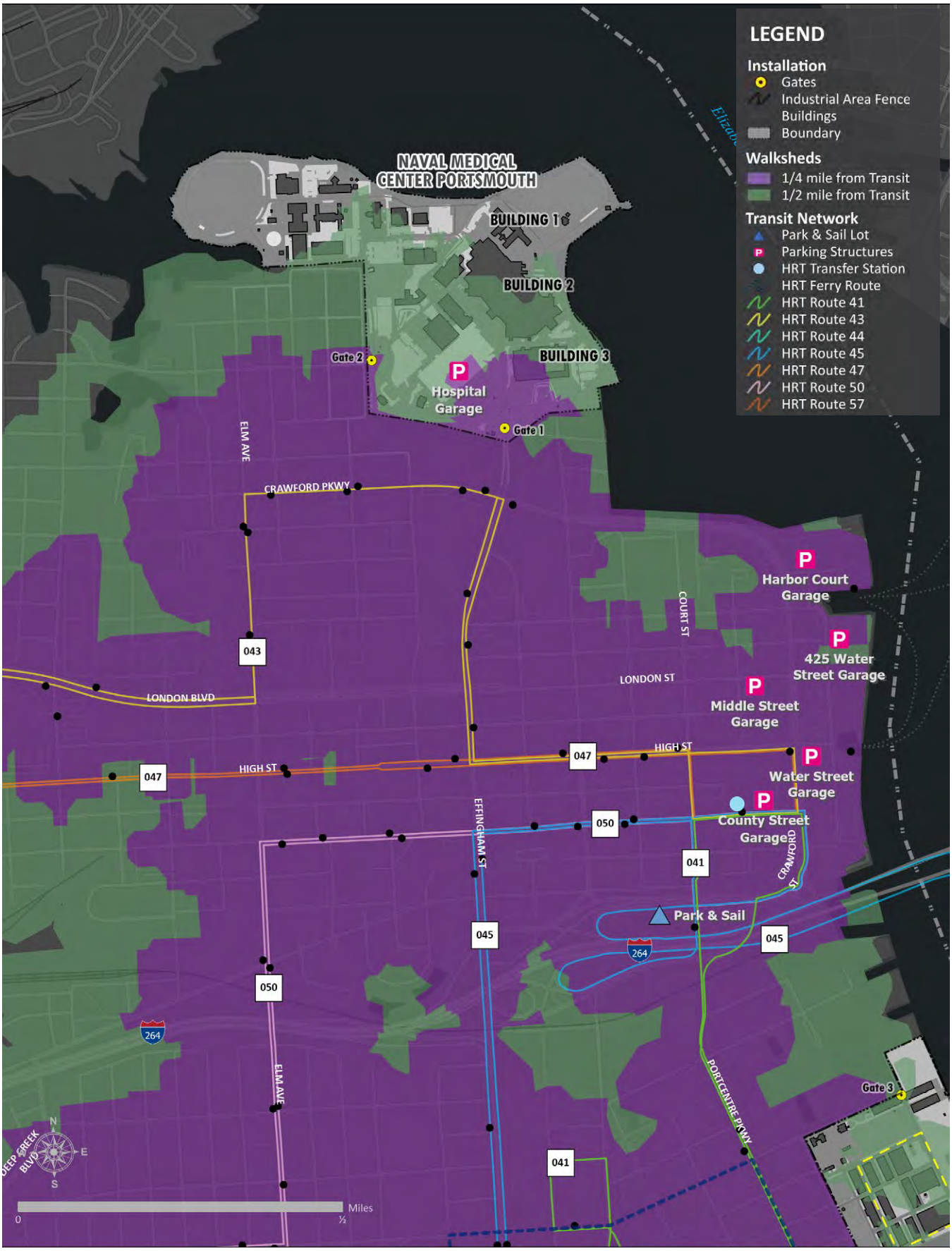


Figure 4.10 Naval Medical Center Portsmouth Walkability to Transit

4.4.5 TRAFFIX

Established in 1995 as Hampton Roads' regional Transportation Demand Management (TDM) agency, TRAFFIX supports commuter ridesharing, reduced vehicle trips and parking needs, and multi-modal options by providing and facilitating access to vanpools, carpools, and telework options for commuters. The TRAFFIX program increases transit reliability by guaranteeing a reliable ride back to a rider's point of origin in case of an emergency.

At NNSY, employees have coordinated to form approximately 50 vanpools under the TRAFFIX program. Participants are permitted to park in a special vanpool parking area on the installation.

TRAFFIX is funded by Virginia's Department of Rail and Public Transportation (DRPT); the funding is administered through the Transportation District Commission of Hampton Roads. Program grants are directed through HRT's TRAFFIX division, which oversees the administration of the program.

4.5 Bicycle and Pedestrian Infrastructure

A safe and connected pedestrian and bicycling network improves accessibility and mobility and provides safety, health, and environmental benefits. An assessment of the linear sidewalk condition and pedestrian crossings at major intersections was completed as part of the JLUS, focusing on the sidewalks near NNSY and Naval Medical Center Portsmouth.

Of the sidewalks inventoried, the majority (44 percent) were rated in good condition, while almost a third (28 percent) were defined as missing or nonexistent. Sidewalks are missing along Parkview Avenue, portions of George Washington Highway, Portsmouth Boulevard, Elm Avenue, and Victory Boulevard. Shipyard staff have indicated that sidewalk improvements along George Washington Highway are especially desirable, as this roadway is the main pedestrian connection to Scott Center Annex when the pedestrian bridge from NNSY over Elm Avenue to the Annex is closed.[18] In most locations, if sidewalk is missing on one side of the corridor, it is provided on the other side, with the exceptions of Elm Avenue and Victory Boulevard.

18 The City of Portsmouth. 2020. *Portsmouth Bicycle and Pedestrian Plan.* June. https://www.portsmouthva.gov/DocumentCenter/View/8831/PortsmouthBikePedPlan_FINAL_optimized?bidId= Accessed 3/25/21.

The *Portsmouth Bicycle and Pedestrian Plan* includes a pilot pedestrian crossing inventory that identifies "comfort ratings" for intersections based on a qualitative assessment of accessibility, land use, quality of infrastructure, buffers, lighting, and street characteristics for 17 intersections along Effingham Street between NNSY and Naval Medical Center Portsmouth.[19] See Figure 4.11. Of the 17 intersections, only 6 intersections were rated as moderately "comfortable." This pilot program should be expanded to include other

19 Ibid.

Expand

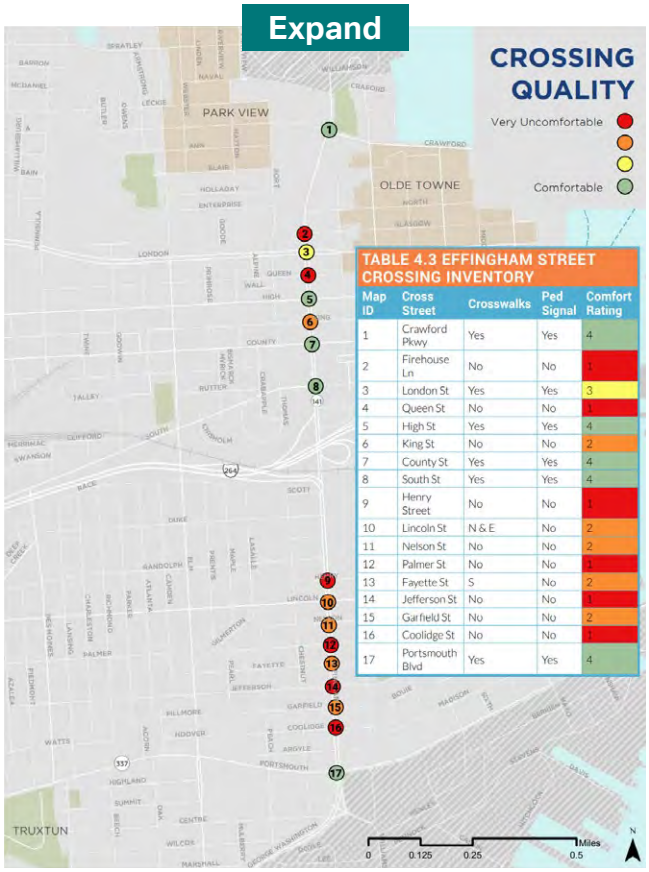


TABLE 4.3 EFFINGHAM STREET CROSSING INVENTORY

Map ID	Cross Street	Crosswalks	Ped Signal	Comfort Rating
1	Crawford Pkwy	Yes	Yes	4
2	Firehouse Ln	No	No	1
3	London St	Yes	Yes	3
4	Queen St	No	No	1
5	High St	Yes	Yes	4
6	King St	No	No	2
7	County St	Yes	Yes	4
8	South St	Yes	Yes	4
9	Henry Street	No	No	1
10	Lincoln St	N & E	No	2
11	Nelson St	No	No	2
12	Palmer St	No	No	1
13	Fayette St	S	No	2
14	Jefferson St	No	No	1
15	Garfield St	No	No	2
16	Coolidge St	No	No	1
17	Portsmouth Blvd	Yes	Yes	4

Figure 4.11 Pedestrian Crossing Quality
Portsmouth Bicycle and Pedestrian Plan. June. 2020.

roadways, including George Washington Highway between Portsmouth Boulevard and Canal; Elm Avenue between George Washington Highway and Victory Boulevard; and Victory Boulevard between Elm Avenue and George Washington Highway. The program could also be adapted to evaluate existing lighting and provide specific lighting recommendations.

The Portsmouth Bicycle and Pedestrian Plan recommends an 82-mile network of shared use paths, on-street bike facilities, and neighborhood bikeways[20] as shown in Figure 4.12. In addition, Chesapeake adopted a 2050 Trails Plan in 2016 that defines future multi-use and roadway trails as shown in Figure 4.13. Together the plans provide an opportunity to connect the Navy installations with local and regional bike networks and to provide a safe, alternative option for accessing the installations.

The JLUS recommends prioritizing routes that promote regional connections and are adjacent to Navy installations, including the following:

- Jordan Bridge: A shared use path connecting the Jordon Bridge to Victory Boulevard, Elm Avenue, and George Washington Highway. This connection would link NNSY with St. Juliens Creek Annex in Chesapeake and provide a connection to the Paradise Creek Nature Preserve along Victory Boulevard.
- Elm Avenue: A bike route along Elm Avenue to connect NNSY to Naval Medical Center Portsmouth.
- Crawford Street: An additional on-street bicycle facility within the vicinity of Gates 1 and 2 at Naval Medical Center Portsmouth, including a neighborhood greenway throughout Park View.
- A neighborhood greenway from Des Moines Avenue to NNSY Gate 3 that includes shared use lanes east of Effingham Street.
- George Washington Highway and Portsmouth Boulevard: Shared use paths along Portsmouth Boulevard and George Washington Highway and bordering NNSY, extending south past Scott Center Annex. These routes would connect to the future proposed multiuse path in Chesapeake as depicted on the 2050 Trails Plan.[21]
- Cedar Lane: A shared roadway (sharrow) bikeway exists along Cedar Lane that connects to Churchland Park and the U.S. Coast Guard Base. The plan proposes this route be modified to a on-street facility. An opportunity exists to connect this further north along Cedar Lane to the Craney Island Fuel Depot.
- South Hampton Roads Trail: Portsmouth is participating in the Rails to Trails initiative via implementation of the South Hampton Roads Trail, a planned 41-mile multi-purpose trail from downtown Suffolk to the City of Virginia Beach resort area. A section of the trail has been funded through a Transportation Alternative grant by VDOT.[22] The project includes a barrier-separated multi-use path between the Chesapeake-Portsmouth city line and Old Coast Guard Boulevard, known as the Portsmouth Seaboard Coastline Trail.

The Build One Portsmouth Comprehensive Plan[23] includes several implementation strategies to improve bike infrastructure in the city, including requiring bike parking and sidewalk connections in employment and retail centers to support connections to surrounding neighborhoods.

Bicycles are permitted on the installations when certain safety criteria are met; however, there are no dedicated bike lanes on the installations to separate bicyclists from traffic. Bicyclists are required to enter through the standard vehicle gates. Future gate modifications should consider the inclusion of bicycle lanes, including Gate 2 at the Naval Medical Center Portsmouth, to separate cyclists from vehicles.

In general, infrastructure improvements are needed on all the installations to provide safe options for bicycling and to promote and encourage bicycle use as a viable commuting option.

20 Ibid.
21 City of Chesapeake, Virginia. 2016. *2050 Trails Plan.* https://www.cityofchesapeake.net/Assets/documents/departments/planning/2035compplan/Trails_Adopted111516.pdf. Accessed 3/25/21.
22 Portsmouth Planning Commission. 2018. *Build One Portsmouth,* https://portsmouthva.gov/396/Comprehensive-Plan.
23 Ibid.

Figure 4.12 Bikeway Prioritization Defined in Portsmouth Bicycle and Pedestrian Plan

Source: Portsmouth Bicycle and Pedestrian Plan. June. 2020.

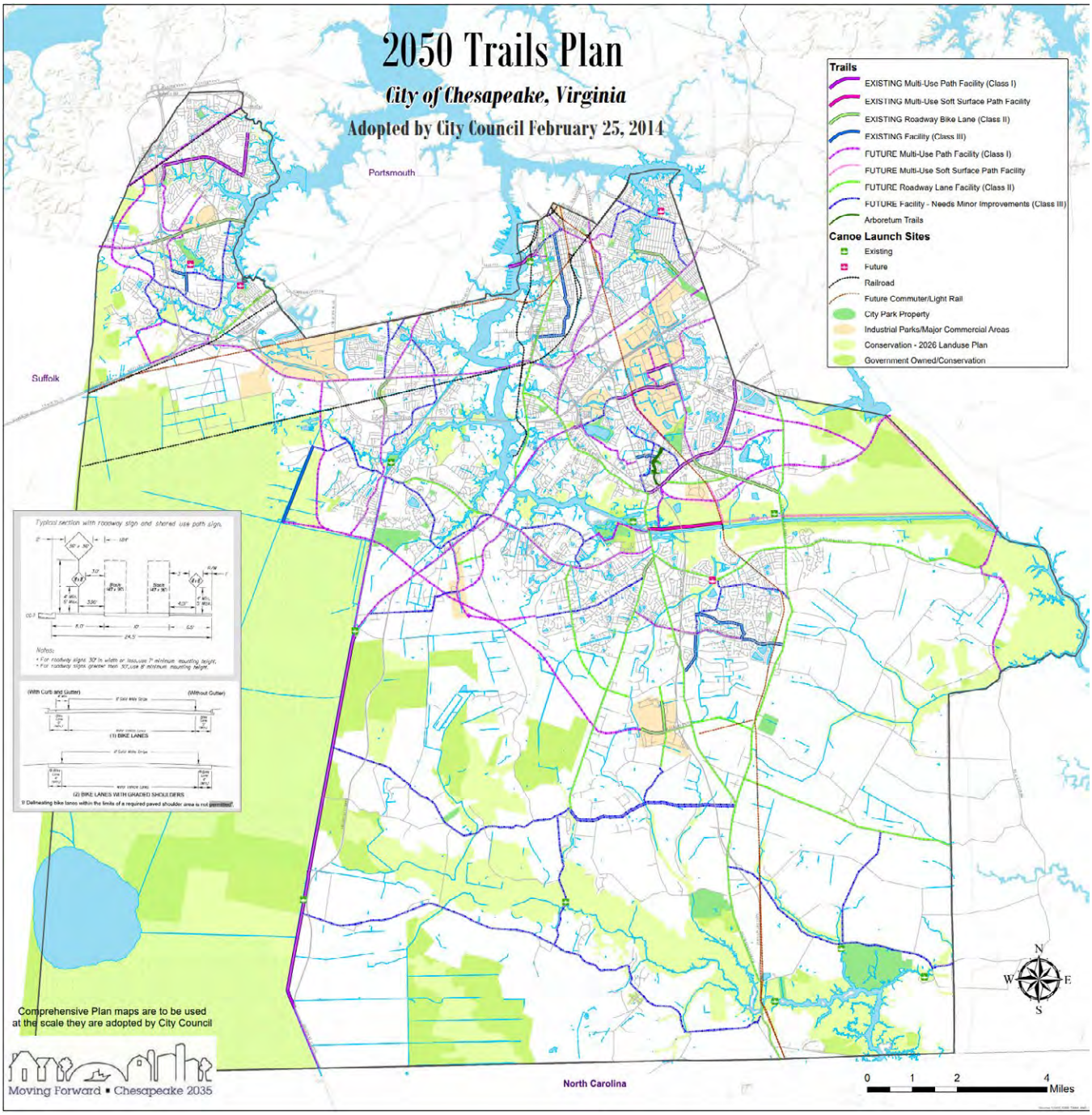


Figure 4.13 Chesapeake 2050 Trails Plan
Source: City of Chesapeake, 2050 Trails Plan.

Bicycle racks are available for use in some locations at NNSY, but they generally are not prevalent. Additional secure parking areas for bicycles are needed at all installations, including the gate areas. NNSY has a shared bicycle program that could be expanded and piloted at the Naval Medical Center Portsmouth. Shipyard personnel indicated that the distance between the shipyard and key destinations outside the shipyard is the biggest barrier to walking and biking.[24] Shared bikes could offer shipyard and hospital employees a faster option than walking to run errands or grab lunch during the day. In addition, Portsmouth is exploring a bikeshare/scooter program in the downtown area. Bikeshare or scooter stations located near NNSY and Naval Medical Center Portsmouth gates could offer more mobility options for employees.

24 The City of Portsmouth. 2020. *Portsmouth Bicycle and Pedestrian Plan*. June. https://www.portsmouthva.gov/DocumentCenter/View/8831/PortsmouthBikePedPlan_FINAL_optimized?bidId= Accessed 3/25/21.

4.6 Flooding Impacts on Roadways

Corridors and facilities within the JLUS study area are vulnerable to flooding from extreme high astronomical tides, more frequent "minor" storm surges, intense rainfall that exceeds the capacity of the storm drain system, or a combination of tidal or storm surge flooding with intense rainfall. Projected sea level rise and increasing rainfall intensities will increase the frequency, extent, and duration of flooding in the JLUS study area. Flooding impacts on roadways can disrupt or limit access to military installations and prevent military personnel from getting to work, which impacts mission readiness. Flooding impacts can reduce or block access to installation gates and disrupt emergency response activities in and around the installations.

A roadway flood exposure analysis was performed to 1) estimate flooding impacts on the roadway network and community facilities that the DoD may rely upon, and 2) simulate how the flood impacts could affect congestion and function of the roadway network using the regional travel demand model (TDM). This section defines the flood scenarios used in the analysis, describes the potential impacts in proximity to the installations under the flooding scenarios, and discusses potential implications of the flood scenarios to the regional transportation network and along the critical corridors identified in Section 4.1.

4.6.1 JLUS Flood Scenarios and Methodology

Several flood scenarios were defined to estimate flooding extents. The scenarios include a combination of high tidal water levels, rainfall conditions, and sea level change, as shown in Table 4.3. The scenarios cover a range of tidal and rainfall events that would cause varying degrees of flooding today and in the future.

Tidal Flooding: Scenarios 1 through 3 represent tidal flooding from high river levels in the absence of significant rainfall. River levels in these scenarios are based on the 1-year-return-period (RP)[25] value of 2.8 feet NAVD88 (North American Vertical Datum of 1988) as derived from the Sewells Point NOAA tide station. For simplicity and for additional consistency with the Norfolk and Virginia Beach JLUS, the value has been rounded up to 3.0 feet NAVD88 for this study. A 1-year-RP event has a high likelihood of occurring in any given year.

Sea Level Rise: Sea level rise projections are available for the study area from various sources, based on varying underlying assumptions and climate models. An October 18, 2018, resolution by the HRPDC localities recommended three different SLR scenario values for planning purposes, each with an associated future planning horizon, as summarized below. The JLUS utilized the near- and mid-term SLR values consistent with the HRPDC guidance.

- 1. 5 feet of SLR for near-term planning, represented by the timeframe 2018–2050
- 3.0 feet of SLR for medium-term planning, represented by the timeframe 2050–2080
- 4.5 feet of SLR for long-term planning relevant to timeframes beyond year 2080

Present-day Rainfall: Three flooding scenarios consider the potential for additional flooding from intense rainfall concurrent with tidal flooding. This type of combined flooding occurs when high river levels cause backups in the stormwater pipes or otherwise impede flow through the stormwater outfalls. To evaluate the effect of rainfall and stormwater flooding, a combination of high river levels with present-day rainfall was defined. The 10-year RP (10-percent-annual-chance), 24-hour rainfall total with a Type II distribution was chosen for consistency with the current stormwater infrastructure design standards used by Portsmouth and Chesapeake. Staff from both cities acknowledged local efforts by Virginia Beach that shows present-day rainfall intensities at a given RP are actually higher than the values published in NOAA's Atlas 14 for the same RP.[26] Thus, a present-day 24-hour rainfall total of 6.2 inches was selected based on Table VIII-1 (Section 8.3.) of the City of Virginia Beach, Department of Public Works *Design Standards Manual*, adopted June 2020.

25 A return period is an estimate of the likelihood of an event to occur. It is a statistical measurement typically based on historical data denoting the average recurrence interval over an extended period of time.

26 City of Virginia Beach, Department of Public Works. 2020. *Design Standards Manual*, June 2020.

Table 4.3 JLUS Flood Scenario Descriptions

#	Scenario	Scenario Description	River Level (ft NAVD88)	24-Hour Rainfall (inches)
Tidal Flooding In Absence of Rainfall				
1	No rain, no SLR	Present-day 1-year-return-period (RP) river level, with no rainfall, no SLR	3.0	0
2	No rain, 1.5′ SLR	Present-day 1-year-RP river level, with no rainfall, plus 1.5 feet of future SLR	4.5	0
3	No rain, 3.0′ SLR	Present-day 1-year-RP river level, with no rainfall, plus 3.0 feet of future SLR	6.0	0
Combined Tidal and Present Day Rainfall Flooding				
4	Present day 10 year rainfall, no SLR	Present-day 1-year-RP river level and present-day 10-year-RP rainfall, no SLR	3.0	6.2
5	Present day 10 year rainfall, 1.5′ SLR	Present-day 1-year-RP river level and present-day 10-year-RP rainfall with 1.5 feet of SLR	4.5	6.2
6	Present day 10 year rain, 3.0′ SLR	Present-day 1-year-RP river level and present-day 10-year-RP rainfall with 3.0 feet of SLR	6.0	6.2
Combined Tidal and Future Rainfall Flooding				
7	Future 10 year rain, 1.5′ SLR	Present-day 1-year-RP river level and future (2050-2080) 10-year-RP rainfall with 1.5 feet of SLR	4.5	6.8
8	Future 10 year rain, 3.0′ SLR	Present-day 1-year-RP river level and future (2050-2080) 10-year-RP rainfall with 3.0 feet SLR	6.0	6.8

Future Rainfall: The impact of future, increased rainfall intensity was included in two of the flood scenarios by increasing future rainfall totals, as projected in the Fourth National Climate Assessment.[27] The Virginia Beach *Design Standards Manual* concluded that present-day rainfall values should be increased by approximately 10 percent for evaluating future rainfall effects. A future 24-hour rainfall total of 6.8 inches was selected that was also based on Table VIII-1 (Section 8.3.) of the Virginia Beach *Design Standards Manual*.

Present-day rainfall values were increased by approximately 10 percent for evaluating future rainfall effects, which results in a 24-hour future rainfall total of 6.8 inches.

Methodology

For Scenarios 1 through 3, identified as tidal flooding and no significant rainfall, the flooding extents were evaluated by applying the 1-year-RP river levels, at present day and with 1.5 feet and 3.0 feet of SLR, respectively, to the study area's topographic elevations sourced from the HRPDC Digital Elevation Model (DEM). In general, in areas where the DEM elevations are lower, the tidal flood levels are identified as flooded. For Scenarios 4 through 8, the extents of flooding for the combination of high river levels and intense rainfall were determined using the results of hydrologic and hydraulic models of the cities' stormwater collection and drainage systems and modeling performed by the JLUS team and others.

27 Melillo, Jerry M., Terese (T.C.) Richmond, and Gary W. Yohe, Eds. 2014. *Climate Change Impacts in the United States: The Third National Climate Assessment*. U.S. Global Change Research Program, 841 pp. doi:10.7930/J0Z31WJ2. https://nca2014.globalchange.gov/report. Accessed June 3, 2020.

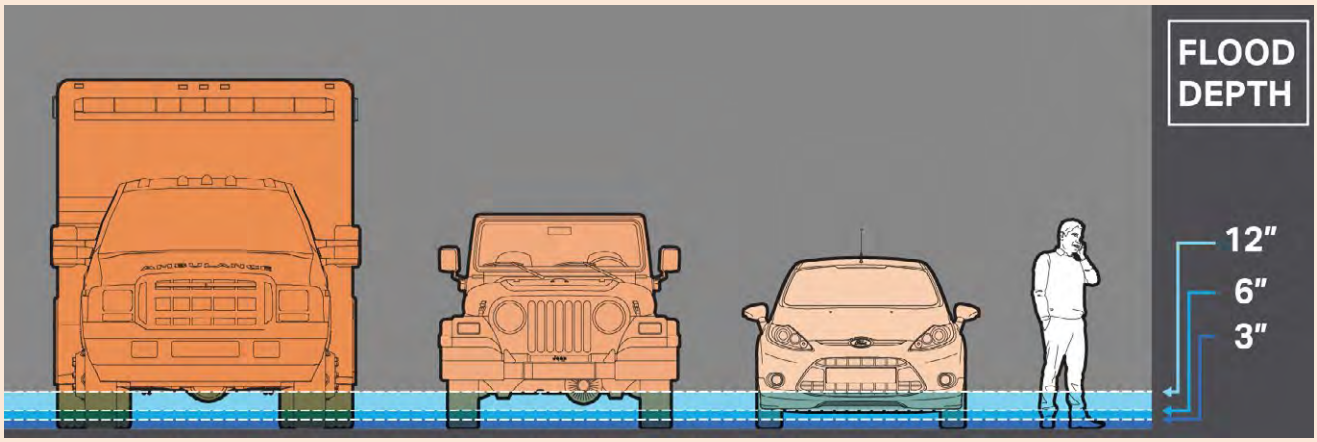


Figure 4.14 Conceptual Illustration Comparing Flood Depths and Vehicle Types

Sea Level Rise Projections

Building on a previous evaluation of SLR projections for the Norfolk-Virginia Beach JLUS, the JLUS considered NOAA[1] and the DoD's Strategic Environmental Research and Development Program (SERDP)[2] projections to be the most relevant data sets. Both the NOAA (2017) and the SERDP (2016) projections are based on scenarios documented in the U.S. Third National Climate Assessment,[3] and both provide regional and local adjustments that make these sets of curves specifically relevant to the study area.

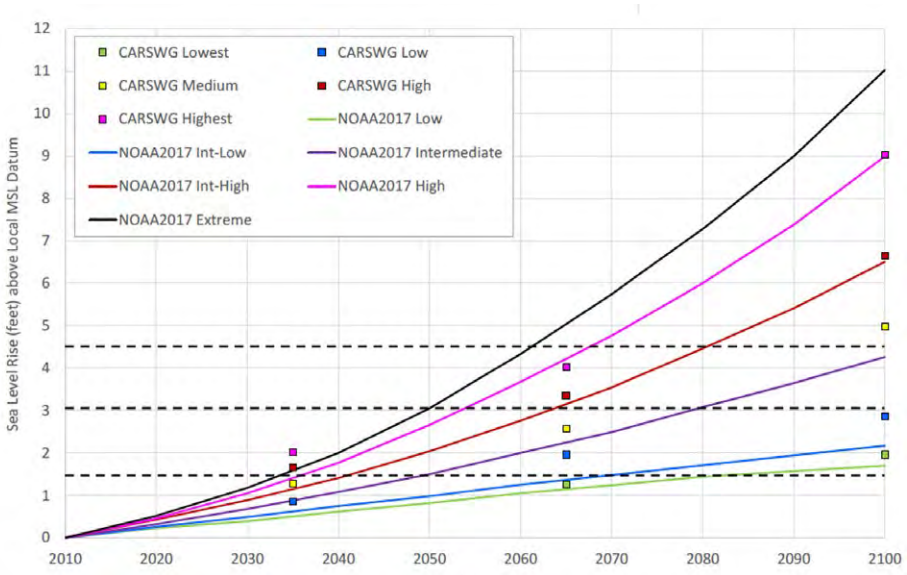
The figure below charts the projected SLR values in feet above present-day tide levels, with Year 2010 as the base year. The NOAA (2017) projections are shown as curves and the Coastal Assessment Regional Scenario Working Group database's SERDP projections for the DoD sites in the study area are shown as shaded markers. Three dashed black horizontal lines mark the HRPDC adopted SLR intervals of 1.5, 3.0, and 4.5 feet. The SLR scenarios of 1.5 and 3.0 feet offer an acceptable planning horizon for the JLUS (approximately 2065–2070).

Sources:

1 Sweet et al., 2017. Global and Regional Sea Level Rise Scenarios for the United States. NOAA Technical Report NOS CO-OPS 083. January.

2 Hall et al., 2016. Regional Sea Level Scenarios for Coastal Risk Management: Managing the Uncertainty of Future Sea Level Change and Extreme Water Levels for Department of Defense Coastal Sites World-wide. Strategic Environmental Research and Development Program.

3 Parris et al., 2012. Global Sea Level Rise Scenarios for the United States National Climate Assessment. NOAA Technical Memo OAR CPO-1. December.



Following completion of the modeling simulations, flood extents for Scenarios 4 through 8 were estimated using geographic information systems (GIS), evaluating depths of flooding at all stormwater structures, and then coding the outputs by flood depth. The model-indicated flooding at structures (points) was translated to depict potential flooding on surface streets using centerlines and 250-foot-long segments. Flood depths were assigned into one of four categories:

- Less than 3 inches
- 3 to 6 inches
- 6 to 12 inches
- Greater than 12 inches

Figure 4.14 shows a conceptual illustration of the assigned flood depths up to 12 inches and how they could impact certain vehicle types. The roadway flood exposure analysis results are presented and described from north to south across the study area. The eight flood scenarios are represented in figures that are stacked to allow a visual progression of flooding from one scenario to the next through the use of buttons at the top of each map series. Figure 4.15 provides an orientation of the maps and explanation of how to read them.

4.6.2 Overall Flood Impacts

Flooding results represent peak flood extents for tidal flooding in Scenarios 1 through 3 and peak flood depths over the ground and road surface for combined rainfall and tidal flooding in Scenarios 4 through 8. In actual flood events, the peak depth and extent of the flooded area is associated with tidal flooding from the Elizabeth River that is likely to be on the order of several hours to a day. More extreme tidal events may cause flooding for multiple days (such as the November 2009 "Nor'Ida" nor'easter event). In contrast, near-peak flooding durations are likely to be shorter, on the order of a half hour to a few hours, in areas that are primarily affected by rainfall flooding.

In much of the JLUS study area from Naval Medical Center Portsmouth to St. Juliens Creek Annex, tidal effects hamper drainage of the intense rainfall, producing a combined flooding with near-peak durations on the order of several hours in each event. Although the most intense rainfall may occur over a relatively short amount of time, the tidal back pressure prevents the stormwater system from draining water that ponds on the surface, and the flooding persists until the tide ebbs.

Future Flooding Will Directly Impact Installation Access

Localized flooding impacts already occur in certain areas around NNSY and reduce the functionality of certain gates. Future rainfall intensity and SLR will increase the extent and depth of flooding and will further compound installation access and congestion. The roadway flooding analysis undertaken as part of the JLUS identified the following:

- Multiple routes will be simultaneously affected with conditions lasting from a few hours to a day or more.
- Alternate routes used today to avoid tidal or storm-based flooding will not provide the necessary relief in future conditions because those routes will also be affected by flooding.
- Nearly all of the streets connecting NNSY to I-264, the Downtown Tunnel, and the Naval Medical Center Portsmouth area will be flooded to some degree in Scenarios 4 through 8, limiting installation access.
- The ability to travel between NNSY and Naval Medical Center Portsmouth will be impacted by flooding, making it more difficult to provide reciprocal services between the installations and creating challenges for emergency response at the locality and installation level.

Craney Island Fuel Depot Area. The roadway flood exposure analysis near the Craney Island Fuel Depot considers roadway flooding potential between the Western Freeway interchange with Cedar Lane, along Cedar Lane to the main entrance to the Fuel Depot, and in areas adjacent to the Cedar Lane corridor. Overall, potential roadway flooding was limited to two short segments of shallow flooding along Cedar Lane between Western Freeway and the Depot entry control point.

It appears that the roadway is vulnerable to tidal flooding in the three tidal-flooding-only scenarios (1 through 3) where Cedar Lane crosses into the Craney Island Fuel Depot. A short segment of Cedar Lane just north of Greenbrook Drive may also be vulnerable to tidal flooding in Scenarios 2 and 3. In addition, a short segment of Cedar Lane just north of River Shore Road is vulnerable to combined rainfall and tidal flooding in Scenarios 4 through 8. Figure 4.16 illustrates the flooding scenarios for Cedar Lane and the area around Craney Island Fuel Depot.

Greater extents and depths of flooding, from combined rainfall and tidal effects, are indicated on neighborhood streets west of Cedar Lane. In addition, internal roadways within the Fuel Depot's boundary would likely be affected by flooding in all of the flooding scenarios. Those effects were not quantified, as the roadway flood exposure analysis did not specifically evaluate surface roads within the depot (or nearby U.S. Coast Guard Base Portsmouth), and stormwater model results were not available within the installations.

How to Read the Flood Scenario Maps

The results of the roadway flood exposure analysis are shown for each flood scenario and can be viewed by clicking on the buttons located above each map. Each map represents a different flooding scenario.

Tidal flooding extents (Scenarios 1 through 3) use blue shading over land areas as these scenarios do not directly depict roadway flooding lines.

The combined rainfall and tidal flooding (Scenarios 4-8) is depicted by colored road segments based on estimated flood depths. In general, the progression of colors through blue, green, yellow and red indicates progressively greater flood depths on the roads.

The extent of road segment and the depth of flooding along the segments can change from one scenario to the next.

The legend for each map remains consistent.

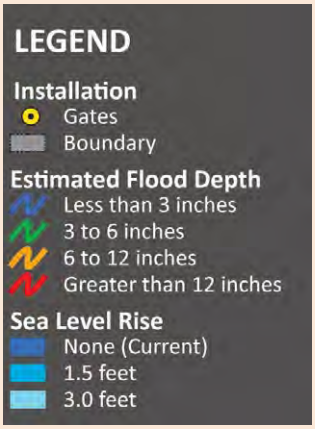


Figure 4.15 How to Read the Flood Scenario Maps

Click the buttons below to see different examples of Craney Island Fuel Depot flooding scenarios.

1 No rain, no SLR | **2** No rain, 1.5′ SLR | **3** No rain, 3.0′ SLR | **4** Present day 10 year rainfall, no SLR

5 Present day 10 year rainfall, 1.5′ SLR | **6** Present day 10 year rain, 3.0′ SLR | **7** Future 10 year rain, 1.5′ SLR | **8** Future 10 year rain, 3.0′ SLR

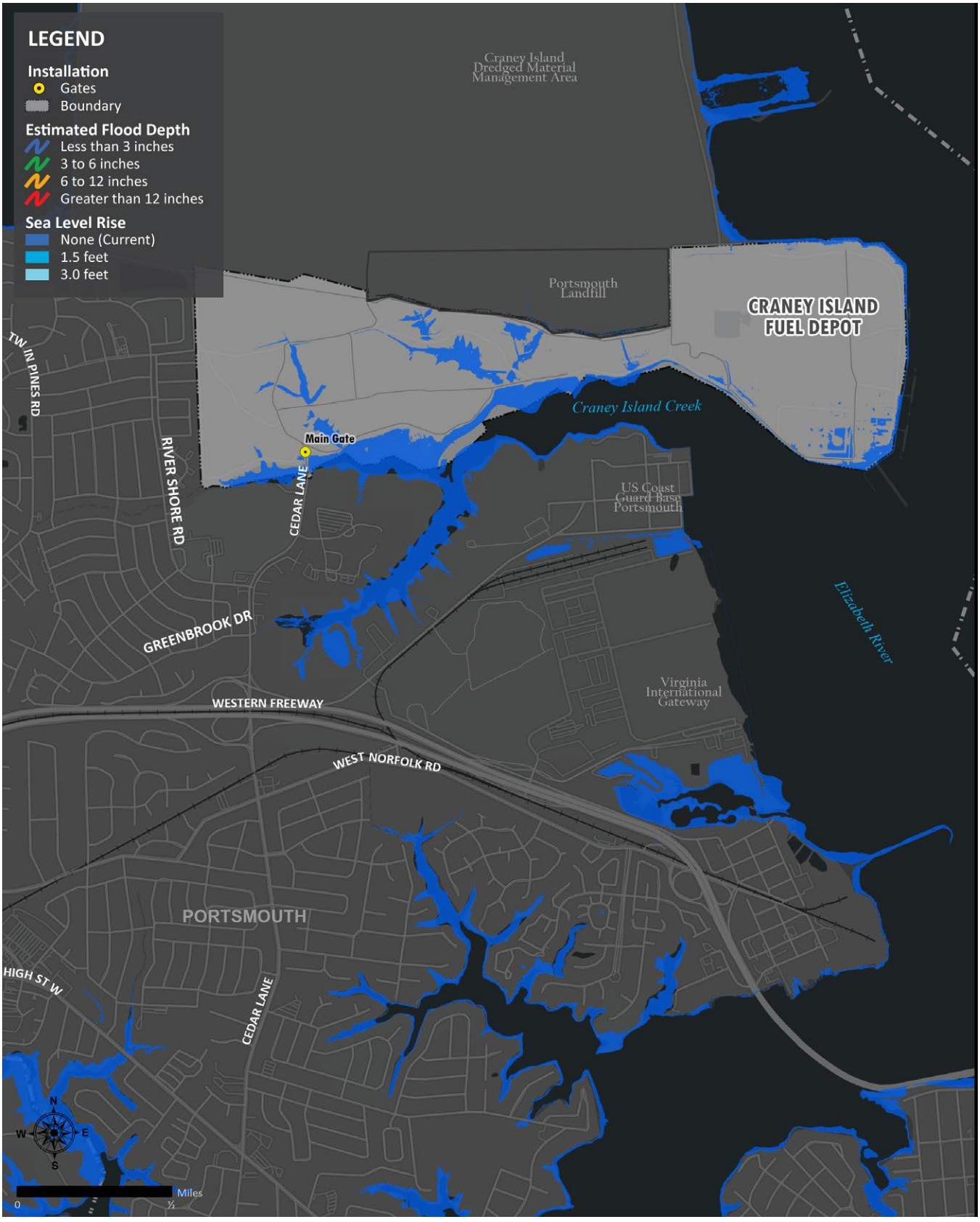


Figure 4.16 Craney Island Fuel Depot Area - Flood Scenarios

Naval Medical Center Portsmouth Area. The roadway flood exposure analysis evaluated the streets serving Naval Medical Center Portsmouth and the adjacent neighborhoods, from I-264 north to the medical center and from the MLK Freeway east to the Southern Branch Elizabeth River. Significant portions of this area are vulnerable to tidal flooding in the 1.5 feet and 3.0 feet SLR scenarios (Scenarios 2 and 3) including streets providing access to the Naval Medical Center Portsmouth entry control points and approaches to I-264.

In the absence of rainfall, tidal flooding is most pronounced along and to the east of Effingham Street, between London Street and Crawford Parkway. The streets in the neighborhood adjacent to Gate 2 at Naval Medical Center Portsmouth are indicated as flooded in Scenario 3 (tidal flooding with 3.0 feet of SLR). That neighborhood street flooding effects access to Gate 2.

In a combined rainfall and tidal flooding event, at both present and future sea levels, the majority of Effingham Street and the adjacent surface streets in Olde Towne are subject to flooding depths of greater than 3 inches. Scenario 4 (present-day rainfall without SLR), indicates flooding depths of 12 inches or more along a large portion of Effingham Street between I-264 and Naval Medical Center Portsmouth, effectively cutting off access to the main gate at Naval Medical Center Portsmouth. Flooding depths increase in Scenario 5 (present day rainfall with 1.5 feet of SLR) and Scenario 6 (present day rainfall with 3.0 feet of SLR) where most of Effingham Street between NNSY and the Naval Medical Center Portsmouth is flooded by 12 inches or greater. Future SLR and future increased rainfall intensities in Scenario 7 and Scenario 8 are expected to increase both the depth and frequency of flooding in this area.

West of Effingham Street, between I-264 and London Boulevard, tidal flooding in the absence of rainfall is not indicated as a significant concern. However, when rainfall is a contributing factor, this area is subject to significant extents and depths of flooding in all combined rainfall and tidal flooding scenarios (Scenarios 4 through 8). Flooding in these areas impacts access to Naval Medical Center Portsmouth from the west.

Access between the Naval Medical Center Portsmouth and NNSY and from Naval Medical Center Portsmouth to the regional highway network (such as I-264 and the MLK Expressway and Western Freeway) is also heavily impacted by flooding along Effingham Street and Port Centre Parkway/Court Street corridor. Effingham Street is a direct corridor connecting the two installations. The Port Centre Parkway/Court Street corridor also connects NNSY Gate 10 to Naval Medical Center Portsmouth via Crawford Parkway. Both the Effingham and Port Centre Parkway/ Court Street corridor are affected by flooding in Scenarios 2 through 8.

Elm Avenue could serve as an alternate route between Naval Medical Center Portsmouth and NNSY. However, Elm Avenue is also affected by flooding in Scenarios 3 through 8 (and to a minor extent in Scenario 2).

During flood events, the peak flooding depths and durations are likely to occur at approximately the same time on both Elm Avenue and Effingham Street, thereby eliminating the ability to use of one of these roads as an alternate route. Improvements to mitigate this flooding to provide highway access may include upgrades to the drainage network and the existing Olde Towne stormwater pumping station, the addition of backflow preventers on stormwater outfalls, and/ or raising the roadway surface of one or more of these critical streets.

Portsmouth has installed some backflow preventers in the area between Naval Medical Center Portsmouth and NNSY, but they are not yet installed on all of the storm drain outfalls in this area.

Click the buttons below to see different examples of Naval Medical Center Portsmouth flooding scenarios.

1 No rain, no SLR | **2** No rain, 1.5′ SLR | **3** No rain, 3.0′ SLR | **4** Present day 10 year rainfall, no SLR

5 Present day 10 year rainfall, 1.5′ SLR | **6** Present day 10 year rain, 3.0′ SLR | **7** Future 10 year rain, 1.5′ SLR | **8** Future 10 year rain, 3.0′ SLR

Figure 4.17 Naval Medical Center Portsmouth Area - Flood Scenarios

Norfolk Naval Shipyard Area. This area surrounds NNSY, from I-264 north of NNSY to the intersection of George Washington Highway and Frederick Boulevard west of NNSY. In Scenario 1 (tidal flooding with no SLR and no rainfall), relatively small patches of flooding potential are indicated north of NNSY and near the NNSY main gate at Effingham Street. The area vulnerable to tidal flooding increases significantly with 1.5 feet and 3.0 feet of SLR in Scenarios 2 and 3, extending from Gate 10 at the eastern end of Portsmouth Boulevard west to approximately Peach Street and including the NNSY main gate area. This condition would cause impacts to gate access for NNSY and all vehicles attempting to pass through this area. Figure 4.18 illustrates the eight flooding scenarios around NNSY.

Similar to conditions noted in the Naval Medical Center Portsmouth area, much of the area north of Wilcox Avenue and east of Elm Avenue is subject to flooding in Scenarios 4 through 8. The depths and durations of flooding would increase as SLR and future rainfall intensity increase in Scenarios 7 and 8.

Tidal flooding is generally not indicated to the west of Peach Street in this area, except for potential flooding on Elm Avenue near I-264 and the Frederick Boulevard and George Washington Highway intersection in Scenario 3 (3.0 feet SLR). However, rainfall combined with tidal flooding has a much greater impact on access as shown in Scenarios 4 through 8. Much of the area north of Frederick Boulevard, as well as segments of George Washington Highway and Frederick Boulevard, are subject to flooding depths of greater than 3 inches in Scenarios 4 through 8. Flooding also affects neighborhoods, including Southside.

Access between NNSY and I-264 is limited because routes that drivers would typically use are affected by flooding. Flood mitigation options to maintain access to the highway from Effingham Street, Portsmouth Boulevard, and George Washington Highway/Frederick Boulevard would require additional study but could potentially include raising lanes of one or more of the streets, making improvements to the drainage network, and providing stormwater pumping capacity. Further analysis of the potential difference in timing and duration of flooding along these routes could be considered when evaluating solutions in greater detail. In addition, because of the potential impact of flooding on primary routes used to reach NNSY, long-term plans and improvements for entry control points should evaluate the need for alternate entry points to NNSY along the south side of the installation where potential flood impacts may be less severe in both flood depths and extents.

The western approach to the South Norfolk Jordan Bridge is not impacted by flooding in any of the scenarios evaluated. The elevated road surface of the bridge begins west of Burton's Point Road. The bridge can be accessed from Victory Boulevard; flooding potential on Victory Boulevard is discussed in the next section. A short segment of Elm Avenue near its intersection with Victory Boulevard is indicated as flooded in Scenarios 6 and 8. Flooding on this segment of Elm Avenue would affect access to the Jordan Bridge from areas north and west of that intersection, including the NNSY main gate.

Click the buttons below to see different examples of Norfolk Naval Shipyard flooding scenarios.

1 No rain, no SLR	**2** No rain, 1.5′ SLR	**3** No rain, 3.0′ SLR	**4** Present day 10 year rainfall, no SLR
5 Present day 10 year rainfall, 1.5′ SLR	**6** Present day 10 year rain, 3.0′ SLR	**7** Future 10 year rain, 1.5′ SLR	**8** Future 10 year rain, 3.0′ SLR

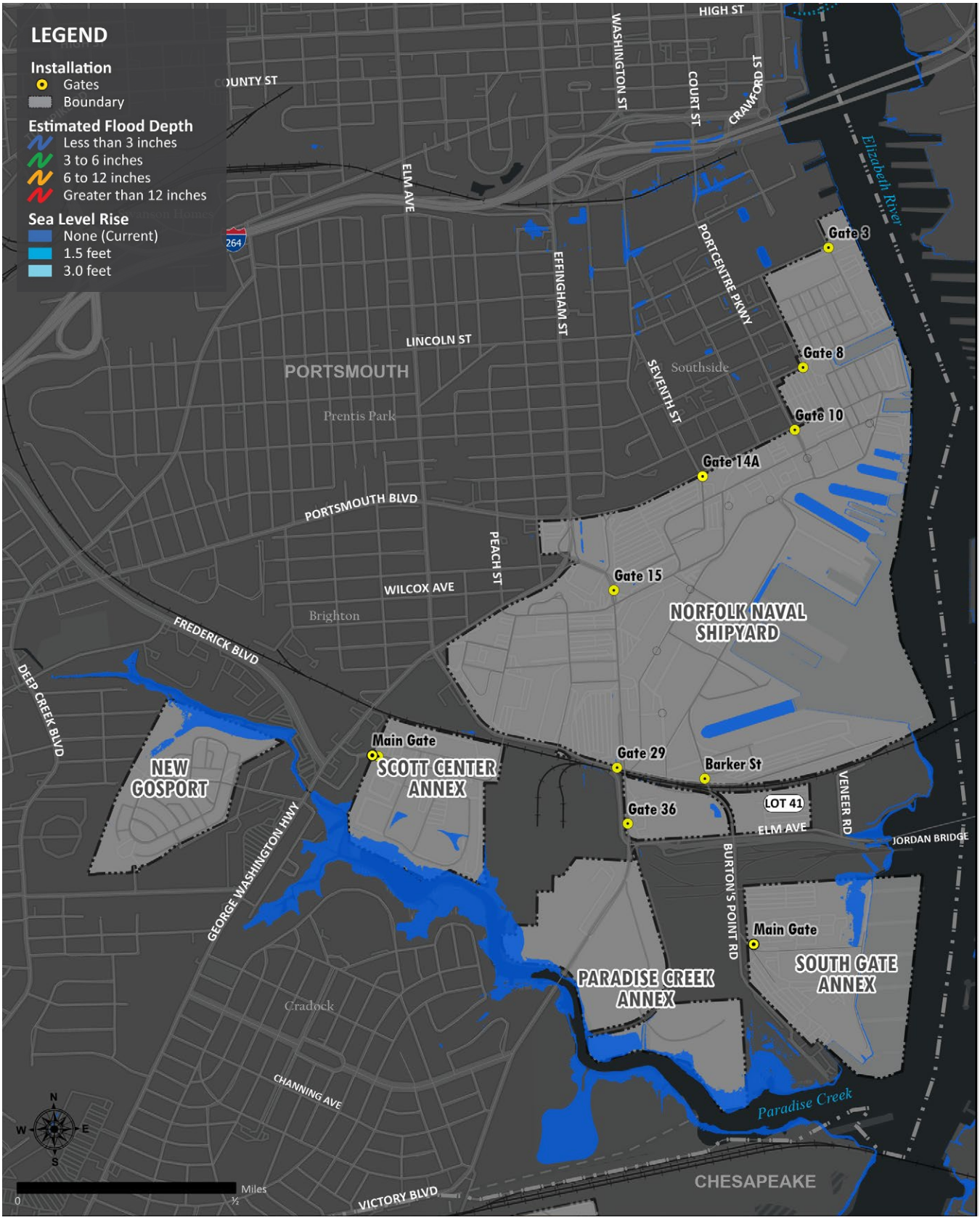


Figure 4.18 Norfolk Naval Shipyard Area - Flood Scenarios

South of Norfolk Naval Shipyard Area. Flooding effects on roadways and community facilities south of NNSY are significantly less than those described for areas around and between NNSY and Naval Medical Center Portsmouth. Figure 4.19 illustrates the eight flooding scenarios for the area South of NNSY, including around St Juliens Creek Annex.

Tidal flooding in the 1.5 feet and 3.0 feet SLR scenarios (Scenario 2 and Scenario 3) has the potential to impact two George Washington Highway bridge crossings over Paradise Creek and near its crossing of St. Juliens Creek at Canal Drive, and could flood parts of the Cradock Historic District near Paradise Creek and St. Juliens Creek Annex in Chesapeake. Tidal flooding from St. Juliens Creek and Deep Creek would affect the Deep Creek area both north and south of Military Highway, as well as the Woodland Terrace and Geneva Park neighborhoods closer to St. Juliens Creek Annex. Some of these areas in Chesapeake already appear to be affected at present sea level (Scenario 1) and the extent of the area affected would expand with 1.5 feet and 3.0 feet of SLR.

When rainfall, tidal flooding, and present and future sea levels are considered, flooding exposure is apparent on several segments of George Washington Highway, particularly north of Victory Boulevard and on multiple segments of roadways within the Navy's New Gosport family housing area. Adding future SLR (Scenarios 5 and 6) and future increased rainfall (Scenarios 7 and 8), causes the flooding extents and depths along the roadways to increase. The intersection of George Washington Highway and Frederick Boulevard would be flooded to a depth of 12 inches or greater in Scenario 5, and the length of the corridor flooding under Scenario 6 would directly impact the entrance to Scott Center Annex. Access to Scott Center Annex and the New Gosport Family Housing area would be significantly impacted.

Victory Boulevard is generally clear of flooding in Scenarios 1 through 3 except for a short segment at the intersection with Elm Avenue near the NNSY southern boundary. Combined rainfall and tidal flooding impacts could affect segments of Victory Boulevard east of St. Juliens Creek Annex.

West of St. Juliens Creek Annex, Victory Boulevard is impacted by flooding by as much as 12 inches (or greater) at the I-264 westbound interchange ramps in Scenario 4 (present-day rainfall without SLR) and by 6 to 12 inches over a segment just north of the interstate ramps. One segment of Victory Boulevard south of I-264 is flooded by 12 inches or greater in the present-day rainfall Scenarios 5 and 6, and two segments are flooded by less than 3 inches between I-264 and St. Juliens Creek Annex.

The addition of SLR to the present-day rainfall scenarios does not appear to increase the flooding extents or depths for Frederick Boulevard, which is consistent with the segment not being directly impacted by tidal flooding. Increased flood depths and slight increases in the length of flooded segments along this reach of Victory Boulevard would be expected with future rainfall under Scenarios 7 and 8.

Immediately south of NNSY, Elm Avenue east of George Washington Highway may be affected by tidal flooding in Scenarios 1 through 3; ground elevations in the Digital Elevation Model indicate that tidal flooding with 1.5 feet and 3.0 feet SLR would closely approach the road surface. In Scenarios 4 through 8, segments of Elm Avenue east of Burton's Point Road near the NNSY Parking Lot #41 appear as flooded between 0 to 3 inches and 3 to 6 inches in depth. Increased flooding depths are indicated further east as Elm Avenue joins Veneer Road. This corridor provides access to NNSY parking and is the proposed site for the NNSY Combined Heat Plant. Additional flooding of 6 to 12 inches occurs near the intersection of Elm Avenue and Burtons Point Road, which travels under the South Norfolk Jordon Bridge. This corridor provides the primary access between NNSY, South Gate Annex, and the Paradise Creek Industrial Corridor.

While flooding effects on roadway segments are less in this area than other parts of the study area, the analysis shows a significant increase of flood risk within the St. Juliens Creek Annex installation over time.

Click the buttons below to see different examples of South Norfolk Naval Shipyard flooding scenarios.

1 No rain, no SLR	**2** No rain, 1.5′ SLR	**3** No rain, 3.0′ SLR	**4** Present day 10 year rainfall, no SLR
5 Present day 10 year rainfall, 1.5′ SLR	**6** Present day 10 year rain, 3.0′ SLR	**7** Future 10 year rain, 1.5′ SLR	**8** Future 10 year rain, 3.0′ SLR

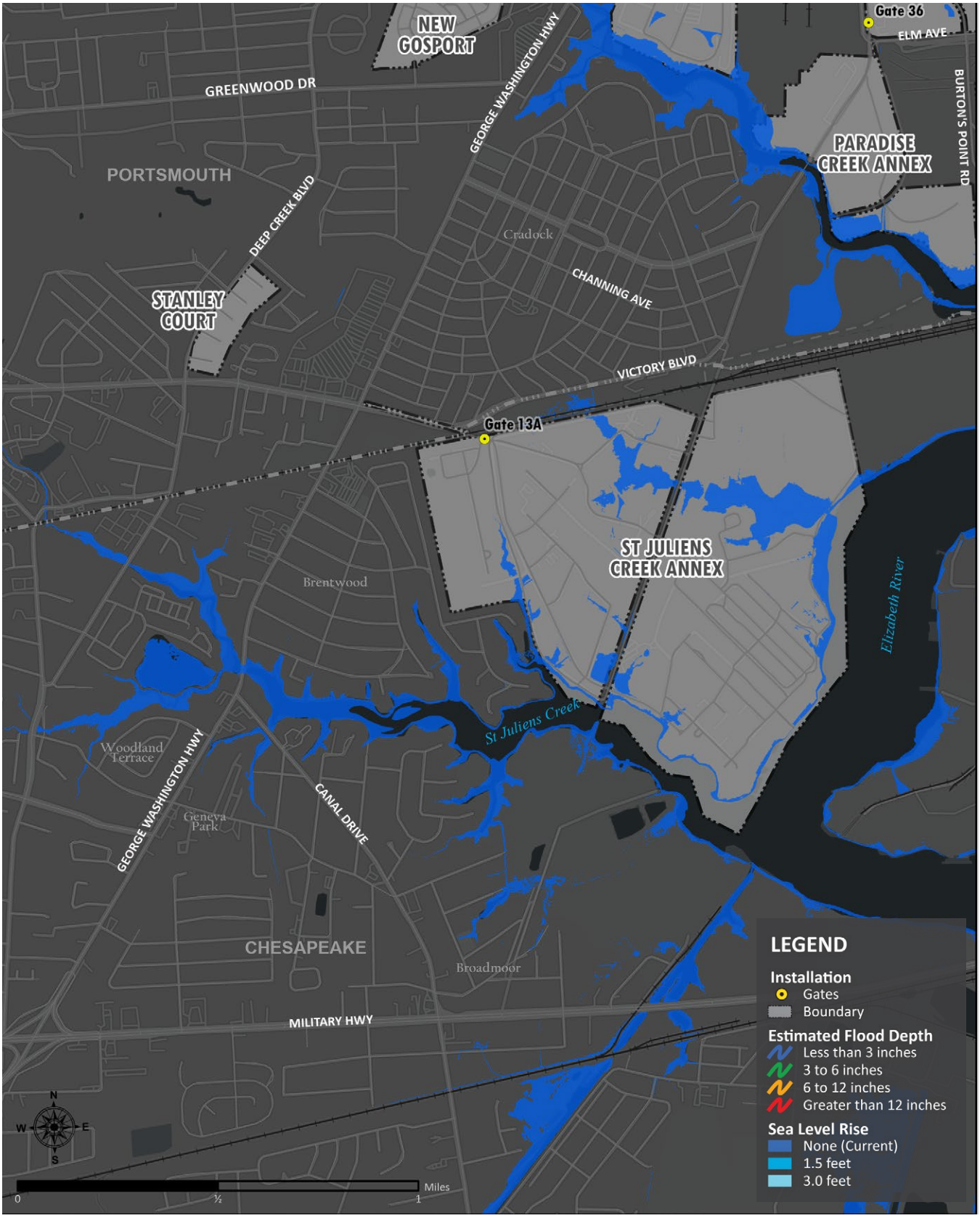


Figure 4.19 South of Norfolk Naval Shipyard Area - Flood Scenarios

4.6.3 Impacts of Flooding on Travel Demand

Roadway operations are impacted by two fundamental components: roadway capacity and traffic volume. Insufficient roadway capacity or excessive traffic volume has the potential to create delays, cause congestion, and inconvenience all road users. While there are many sources that could impact a roadway's capacity and its resulting operations, roadway flooding can be a significant contributor. The JLUS explored the relationship between flooding and roadway operations to provide an understanding of how the transportation network responds when certain roadways are flooded and to help identify critical corridors that should be considered for recommended improvements and future study. A technical memorandum describing the TDM methodology and results in more detail is included in the Appendix.

4.6.3.1 TDM Methodology

Using a subset of the flood scenarios and their estimated roadway flood depths described in Section 4.6.1, potential roadway operational impacts due to flooding were assessed using the 2045 Hampton Roads Long Range Travel Demand Model (TDM). The TDM is a regional model and tool used by the HRTPO and other planning agencies and stakeholders to forecast the amount of traffic (i.e., traffic demand) anticipated on a particular roadway segment. The TDM is a powerful tool because it can be used to identify a roadway segment that may be forecasted to have more traffic demand than physical roadway capacity (i.e., lanes and throughput). The TDM can divert traffic to alternate routes with available roadway capacity that are less congested. Combined, these strengths of the TDM allowed the JLUS team to recognize both localized and systemwide operational impacts due to potential roadway flooding. The subarea of the TDM used in the analysis is shown in Figure 4.20 and focuses on roadways in Portsmouth and Chesapeake that are critical to military operations and mobility. The TDM does not include local streets but does include freeways, arterials, and collectors.

Four of the flood scenarios described in Section 4.6.1 were used in the analysis and redefined as TDM scenarios as follows:

- Scenario 2: No rainfall, 1.5 feet SLR – "TDM Scenario 1"
- Scenario 3: No rainfall, 3.0 feet SLR – "TDM Scenario 2"
- Scenario 7: Future rainfall, 1.5 feet SLR – "TDM Scenario 3"
- Scenario 8: Future rainfall, 3.0 feet SLR – "TDM Scenario 4"

Each TDM scenario was adjusted to simulate operational impacts from various flood depths by reducing actual roadway capacity and/or travel speeds, as shown in Table 4.4. The adjustment creates a "burden" that a driver would expect to encounter due to the flooding conditions on the roadway.

Table 4.4 Operational Impacts Applied to Simulate Flooding in Model Analysis

Anticipated flood depth of 0.00 inches	No adjustments to capacity or speed
Anticipated flood depth of 0.0 – 3.0 inches	Reduction of speed to 25 MPH only
Anticipated flood depth of 3.01 – 6.0 inches	Reduction of speed to 25 MPH and reduction in capacity by 50%
Anticipated flood depth of 6.01 inches or more	Reduction in capacity by 100% (i.e., not traversable)

Source: Virginia Pilot

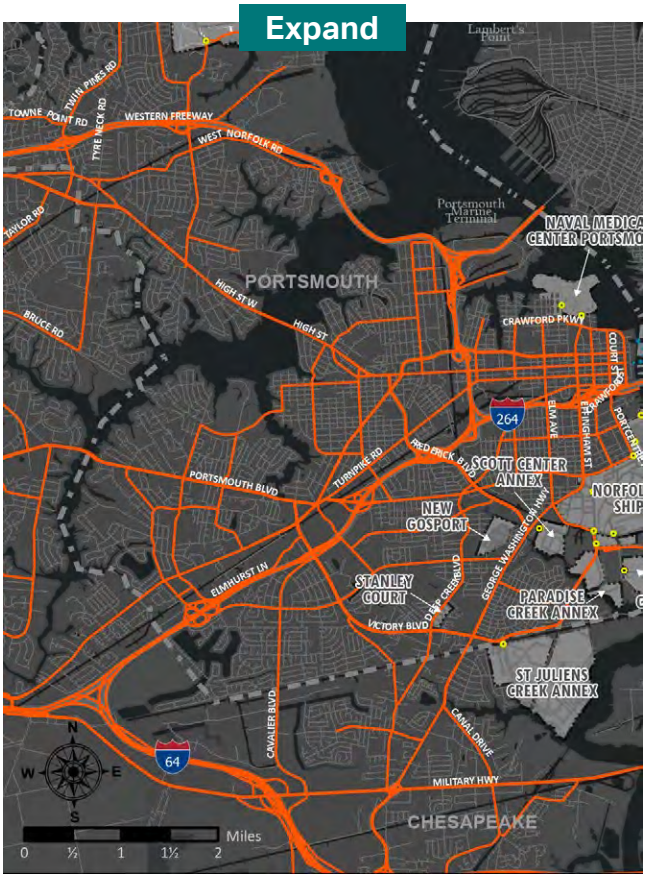
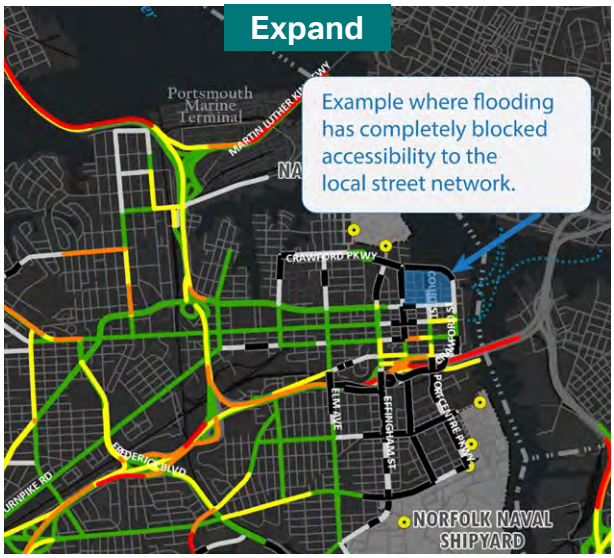


Figure 4.20 Travel Demand Model Analysis Study Area

Modeled Metrics

- Traffic Volume – Amount of traffic (i.e., able to load onto the network) traversing each roadway segment. Maps depicting volume can also show how traffic is diverted to other routes when roads are flooded.
- Volume-to-Capacity (V/C) Ratio – Ratio of traffic volume traversing a segment to the available roadway capacity (i.e., traffic that is able to access the roadway network and roadway capacity still available after flooding adjustments were made). A V/C score of 0 indicates volume is below or near capacity, whereas a score of greater than 1 indicates that volume exceeds capacity.
- Unmet Demand – Traffic demand that is not able to enter the roadway network from residential neighborhoods or employment centers because all possible roadway connections are completely blocked (i.e., anticipated flood depth of 6.01 inches or greater).



The figure above illustrates the difference in forecasted traffic demand from a less severe flooding scenario to that of a more severe flooding scenario. All roadway segments generate traffic in normal non-flood conditions, which is depicted in red, orange, yellow, or green colors that are associated with a specific metric, such as volume. However, when roadway segments are flooded, traffic is blocked (black lines) and is unable to load onto the network. This condition can affect multiple roadway segments or areas as illustrated.

4.6.3.2 Preliminary Findings

The 2045 TDM model was rerun for each TDM scenario using the model adjustments to illustrate the impacts of flooding. Three primary metrics were evaluated and compared across the TDM scenarios to assess the impacts of flooding: unmet demand, traffic volume, and V/C.

In TDM Scenario 1, flooding does not prohibit network trips, so TDM Scenario 1 served as the baseline for comparing the other scenarios. In general, flooding on road segments will cause traffic volume to shift elsewhere in the network and for the V/C ratio on some segments to reach or exceed 1.0, indicating that volume exceeds roadway capacity. Figure 4.21 illustrates the impacts on traffic volume for each of the TDM scenarios. Figure 4.22 illustrates the impacts on V/C.

Increased levels of flooding also cause the amount of unmet demand to increase significantly, as shown in Table 4.5, as vehicle trips are unable to load onto the network due to flooded roadway segments.

In TDM Scenario 1, traffic volume is spread relatively evenly throughout the study area. A few streets primarily in the downtown area, including Washington Street, Court Street, Port Centre Parkway, Seventh Avenue, and Lincoln Street, are unable to support any traffic volume because of the depth of flooding. While flooding in these areas does not prevent access to any of the study installations, it does require traffic to find alternative routes, thereby causing volume increases along alternate routes.

Table 4.5 Unmet Demand (trips) for each TDM Scenario

TDM Scenario	Total AM and PM Peak Period* Unmet Demand (Trips)	Flood Scenario Reference
TDM Scenario 1	0 (Baseline)	Scenario 2: No rainfall, 1.5 feet SLR
TDM Scenario 2	52,300	Scenario 3: No rainfall, 3.0 feet SLR
TDM Scenario 3	80,800	Scenario 7: Future rainfall, 1.5 feet SLR
TDM Scenario 4	116,600	Scenario 8: Future rainfall, 3.0 feet SLR

*Peak period is 0600-0900 and 1500-1800.

In TDM Scenario 2, much of the downtown Portsmouth street network is unable to carry any traffic volume because of the flooding increase over TDM Scenario 1, and this contributes to unmet demand. Flooding of Effingham Street, Crawford Parkway, Port Centre Parkway, and flooding on portions of George Washington Highway, Portsmouth Boulevard, and Frederick Boulevard cause traffic to seek alternate routes. Victory Boulevard experiences an increase in volume, which begins to exceed capacity in multiple areas.

In TDM Scenarios 3 and 4, several roads are unable to load trips. Nearly all of the streets between Naval Medical Center Portsmouth and NNSY are unable to carry traffic, and, in many cases, there are no accessible alternate routes to reach Naval Medical Center Portsmouth or NNSY. Increased congestion occurs on Victory Boulevard as well as on Military Highway.

Consistent with the findings in Section 4.6.2, roadway flooding significantly impedes accessibility to military installation gates, as shown in Table 4.6. Anticipated impacts could occur in the near term (today–2050) with increased rainfall intensity and 1.5 feet of SLR, which would result in a significant impact on military readiness and emergency response activities. These findings underscore the importance and necessity of coordinated mitigation solutions for roadway and installation gate infrastructure that addressed both near-term and mid-term planning horizons.

Given the significant impacts associated with unmet demand observed throughout the network, an investigation was undertaken to understand how sensitive unmet demand is to localized roadway flooding. This investigation was accomplished by removing the flooding from certain targeted roadways and resetting conditions to normal along those segments. This approach hypothetically assumes an undefined flood mitigation measure would be employed to remove the flooding and return traffic to the network.

Click the buttons below to see different examples of traffic volume with select future flooding scenarios.

TDM Scenario 1: No rainfall, 1.5ft SLR | **TDM Scenario 2:** No rainfall, 3.0ft SLR | **TDM Scenario 3:** Future rainfall, 1.5ft SLR | **TDM Scenario 4:** Future rainfall, 3.0ft SLR

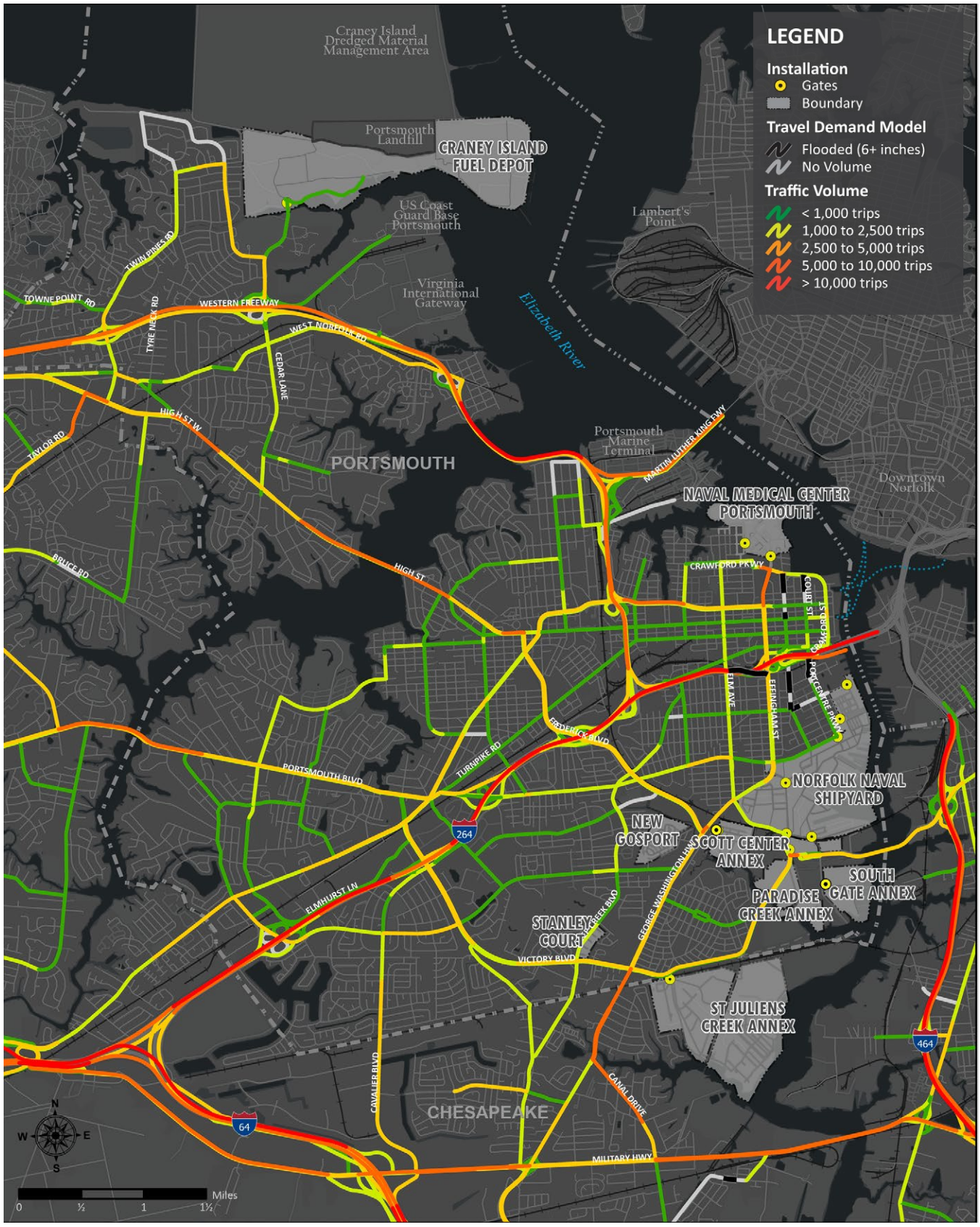


Figure 4.21 Traffic Volume Impacts with Future Flooding

Click the buttons below to see different examples of volume to capacity with select future flooding scenarios.

TDM Scenario 1: No rainfall, 1.5ft SLR | **TDM Scenario 2:** No rainfall, 3.0ft SLR | **TDM Scenario 3:** Future rainfall, 1.5ft SLR | **TDM Scenario 4:** Future rainfall, 3.0ft SLR

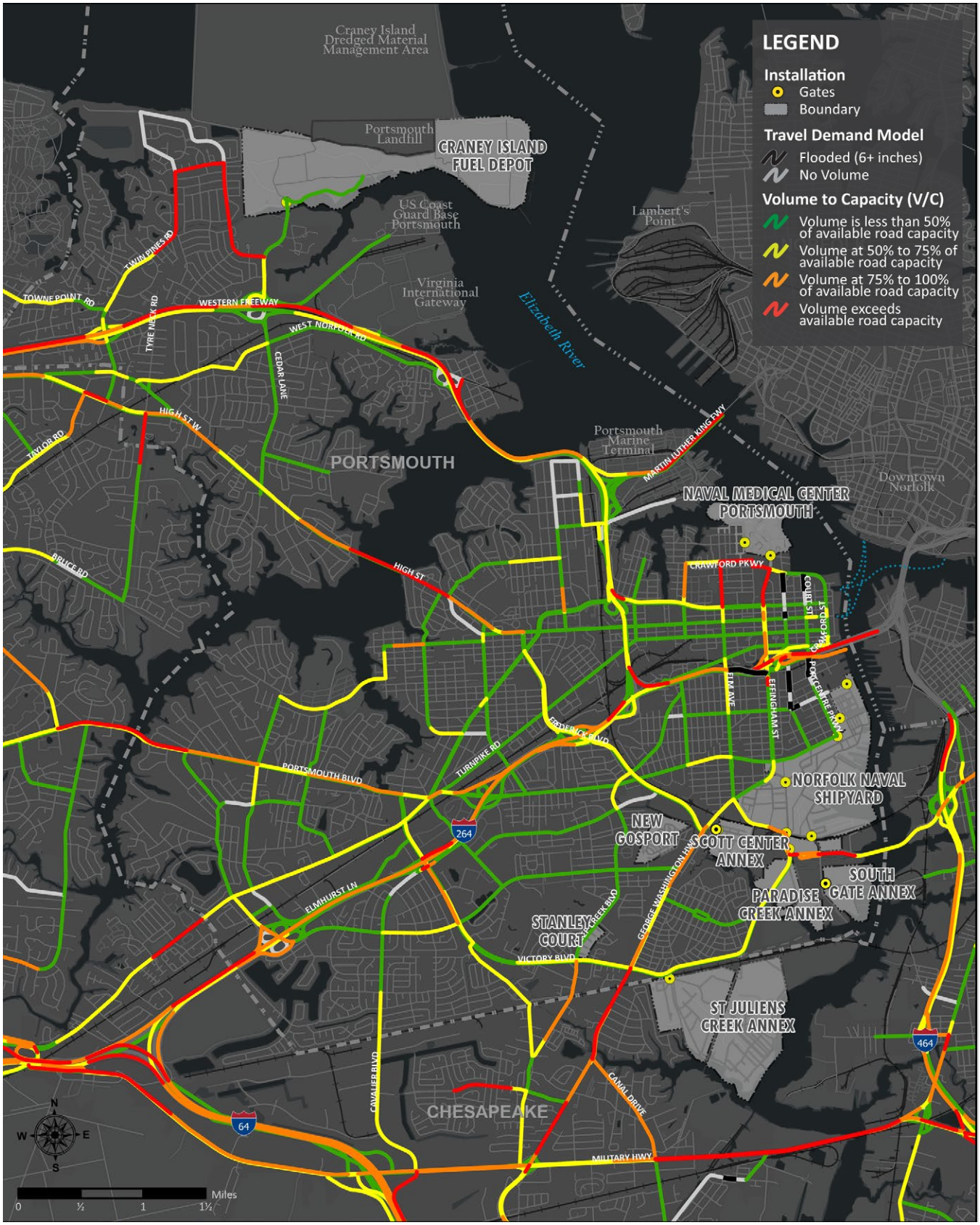


Figure 4.22 Volume to Capacity Impacts with Future Flooding

Table 4.6 Flooding Impacts on Installation Gates Associated with TDM Scenarios

Facility	Location	Scenario 2: No rainfall, 1.5 fee SLR	Scenario 3: No rainfall, 3.0 feet SLR	Scenario 7: Future rainfall, 1.5 feet SLR	Scenario 8: Future rainfall, 3.0 feet SLR
		TDM Scenario 1	TDM Scenario 2	TDM Scenario 3	TDM Scenario 4
		"X" = Impacted by Flooding			
Naval Medical Center Portsmouth	Gates 1 & 2		X	X	X
NNSY	North Gates (3, 10B, 10, & 14A)		X	X	X
	Main Gate (15)		X		X
	South Gates (29 & 36)		X		X
	Scott Center Gate			X	X
	St. Juliens Creek Annex Gate				
Craney Island Fuel Depot	Main Gate - Cedar Lane		X		X

This approach helped to identify the extent or "how much" flooding improvement (i.e., removal/prevention of flooding) would need to be implemented to have a measurable effect on returning traffic to the network. For example, whether a reduction in unmet demand can be expected by improving one intersection, one corridor, or an entire area within the study area. Only Flood Scenario 8 / TDM Scenario 4 (3.0 feet of SLR with future rainfall) was used in the sensitivity analysis. Findings from this investigation include the following:

- When flooding adjacent to Naval Medical Center Portsmouth was removed, approximately 58,000 trips (50 percent of unmet demand) were added back to the overall network.
- When flooding adjacent to NNSY was removed, approximately 21,600 trips (19 percent of unmet demand) were added back to the overall network.
- When flooding along Frederick Boulevard and George Washington Highway (adjacent to NNSY and Scott Center Annex) was removed, approximately 13,100 trips (11 percent of unmet demand) were added back to the overall network.
- When flooding adjacent to the Portsmouth Boulevard and Victory Boulevard interchanges, as well as surrounding roadways was removed, approximately 16,800 trips (14 percent of unmet demand) were added back to the overall network.
- When flooding adjacent to the Victory Boulevard interchange and along Victory Boulevard and George Washington Highway (adjacent to NNSY, Scott Center Annex, and St. Juliens Creek Annex) was removed, approximately 18,900 trips (16 percent of unmet demand) were added back to the overall network.
- Craney Island Fuel Depot area results did not differ, because the flooding impacts along Cedar lane are minimal and do not block access. As discussed in Section 4.5.2, flooding is primarily localized within the Craney Island Fuel Depot (i.e., the Craney Island Fuel Depot Main Gate is accessible in each scenario).

In addition to the unmet demand findings, preliminary results revealed a significant issue with access to military installations. Summarized in Table 4.6, the TDM Scenario results illustrate that as roadway flooding increases, accessibility to multiple installation gates at NMCP, NNSY, and Craney Island is significantly impeded. With the exception of the St. Juliens Creek Annex gate, every gate is impacted by flooding in at least two of the modeled scenarios.

4.6.4 Priority Corridors

The roadway flood exposure analysis of roadways and the associated impacts that flooding has on the regional traffic network led to the identification of priority corridors that play an important role in both military readiness and the overall effectiveness of the regional transportation network. These priority corridors, listed in Table 4.7, are reflected in the initial and more comprehensive list of critical corridors defined early in the JLUS planning process and described in Chapter 3. The priority corridors are addressed in Chapter 5, Recommended Strategies.

- Effingham Street is a primary north-south arterial roadway in Portsmouth and is one of the most direct routes between NNSY and Naval Medical Center Portsmouth, providing direct access to main gates at each installation. Prioritizing Effingham Street allows for increased accessibility and mobility to the installations and I-264, including efficient access for emergency response activities. Effingham Street north of I-264 is also identified as a secondary north evacuation route by Portsmouth.
- Portsmouth Boulevard provides direct east/west access to NNSY and I-264. Flooding near Portsmouth Boulevard's intersection with Effingham Street would also impact accessibility to NNSY's main gate (Gate 15) as well as Gates 3 and 10 when approaching from the west. Portsmouth Boulevard is identified as a secondary south evacuation route by Portsmouth.
- Victory Boulevard provides direct access to NNSY, the Jordan Bridge, St. Juliens Creek Annex, and I-264. When other major roadways are impacted by flooding, traffic becomes dependent on Victory Boulevard. Removal of flooding along Victory Boulevard and George Washington Highway is expected to result in the third largest impact to unmet demand in terms of the number of trips added back to the network. Victory Boulevard is identified as a secondary south evacuation route by Portsmouth.
- Frederick Boulevard provides a critical east/west connection within Portsmouth to George Washington Highway, Portsmouth Boulevard, and Victory Boulevard. It also provides access to NNSY and St. Juliens Creek Annex. Flooding at the Frederick Boulevard and George Washington Highway intersection impacts the ability of traffic to access points north, including the NNSY Gate 15 and Naval Medical Center Portsmouth, when approaching from the south. Although removal of flooding impacts on Frederick Boulevard, including its interchange with I-264 and its eastern connection with George Washington Highway, did not significantly reduce unmet demand, this roadway is a critical connection between other major roadways in the city that have notable benefits in the reduction of unmet demand and provide access to NNSY and St. Juliens Creek Annex. Frederick Boulevard north of I-264 is identified as a primary VDOT evacuation route.
- George Washington Highway provides direct access to NNSY and St. Juliens Creek Annex from the City of Chesapeake. Removal of flood impacts along George Washington Highway reestablishes a direct connection from NNSY to I-64 and the regional transportation network. The flooding impacts on George Washington Highway are not widespread; however, the impacts could disrupt access to Scott Center Annex and New Gosport Family Housing. George Washington Highway can experience severe congestion due to high traffic volumes and at-grade railroad crossings; this congestion would be expected to worsen with increased flooding.
- Cedar Lane provides the only roadway connection to Craney Island Fuel Depot and, therefore, is critical for access and mission continuity. The roadway flood exposure analysis identified isolated and relatively shallow flooding along Cedar Lane. However, internal access is anticipated to experience additional impacts, and a secondary access route to the depot should be explored in coordination with Portsmouth.

Table 4.7 Critical Corridor Evaluation Matrix - Based on Scenario 8, Future Rainfall, 3.0 feet SLR (TDM Scenario 4)

Critical Corridor	Segment (From/To)	Length (Feet)	Percent Flooded	Direct Access to Gate	Direct Access to I-264	V/C > 1.0	Existing Transit Corridor	Potential Direct Access to Remote Parking
Effingham St	NMCP Gate 1 to I-264	4,100	81%	X	X	X	X	
Effingham St	I-264 to NNSY Gate 15	5,315	98%	X	X		X	
London Blvd	Crawford Pkwy to US 58	8,170	45%				X	
Port Centre Pkwy	Bart St to NNSY Gate 10	4,450	85%	X			X	X
Portsmouth Blvd	NNSY Gate 10 to Peach St	4,075	81%	X	X		X	X
Portsmouth Blvd	Victory Blvd to Rodham Ave	5,655	60%		X		X	X
Frederick Blvd	I-264 to George Washington Hwy	7,450	63%		X	X		X
George Washington Hwy	NNSY Gate 15 to City Line	14,005	27%	X		X	X	X
Victory Blvd	Portsmouth Blvd to Greenwood Dr	6,055	36%		X		X	X
Cedar Lane	Western Freeway to Craney Island Main Gate	5,800	0%	X				

NMCP = Naval Medical Center Portsmouth
NNSY = Norfolk Naval Shipyard

4.6.5 Community Facilities and Utilities Flood Exposure and Access Analysis

In addition to evaluating flood impacts to specific corridors, the flood exposure analysis included an assessment of flood impacts to a specific set of community facilities. The selected facilities align with the facilities identified as "essential" in the *Hampton Roads Hazard Mitigation Plan*[28] and include primarily life-safety facilities that directly serve the Navy installations and/or military service members, as well as the broader community. The following facility types and the number of each type are included:

- Hospitals (2)
- Police stations (10)
- Fire stations (25)
- Emergency shelters (33)[29]
- Schools (75)
- Emergency operations centers (1)[30]
- Portsmouth City Hall (1)

Hospitals, police stations, and fire stations provide vital services and need access 24 hours a day, 7 days a week. Police, fire fighters, first responders, and hospital staff who live in the communities all need the ability to reach these facilities along with the general public. Similarly, Emergency Operations Centers and emergency shelters provide essential services during major storm events or other natural (or man-made) disasters; therefore, access to and from these facilities is essential in the event of an emergency situation. While not included in the exposure analysis, during the COVID-19 pandemic other facilities such the Portsmouth Health Center and Portsmouth Sportplex were utilized as vaccination centers and could serve other emergency purposes in the future.

A total of 113 facilities were evaluated across Portsmouth and Chesapeake based on the facility types listed above. Figure 4.23 identifies 59 of the evaluated facilities within the JLUS study area. In addition, electrical substations and wastewater pump stations in proximity to the installations were reviewed; however, because of concerns with security, these facilities are not mapped. The evaluation included two parts:

- Identify facilities exposed to tidal flooding and future SLR
- Identify impacts to community facility access due to flooding

Exposure to flooding was based on the depth of water estimated to occur at the lowest adjacent grade to the building, as estimated from the HRPDC LiDAR-based DEM and the MHHW elevation grids. Elevations were assigned to each building footprint for both the HRPDC DEM ground elevations and the tidal flooding elevations associated with Scenarios 1 through 3 (tidal flooding only). Because a comprehensive and accurate dataset of key elevations for the structures themselves, such as elevations of first floors and mechanical equipment, is not available, any depth of tidal flooding resulted in the facility being considered impacted.

Based on the methodology, none of the community facilities evaluated are impacted directly in Scenarios 1 or 2. A handful of facilities, identified in Table 4.8, are impacted under Scenario 3 that should be investigated further to fully evaluate facility risks and vulnerabilities more comprehensively. Portsmouth is evaluating plans to relocate the Emergency Operations Center on County Street to a different location.

Table 4.8 Community Facilities Exposed to Tidal Flooding and Future SLR (Scenario 3)

Facility	Location
Portsmouth City Hall	801 Crawford Street, Portsmouth
Emergency Operations Center/ 911 Center	307 County Street, Portsmouth
Navy Medical Center Portsmouth	620 John Paul Jones Circle, Portsmouth
Westhaven Elementary School	3701 Clifford Street, Portsmouth
Fire Station #8	209 George Washington Highway, Chesapeake
Edwin Chittum Elementary School	2008 Dock Landing Road, Chesapeake

28 HRPDC. 2017. *Hampton Road Mitigation Plan*. https://www.hrpdcva.gov/uploads/docs/2017%20Hampton%20 Roads%20Hazard%20Mitigation%20Plan%20Update%20FINAL.pdf. Accessed June 10, 2020.

29 All emergency shelters are located at schools; they are not counted twice in the total. Shelters are designed as primary or secondary.

30 The Portsmouth EOC is counted as a police station in the total.

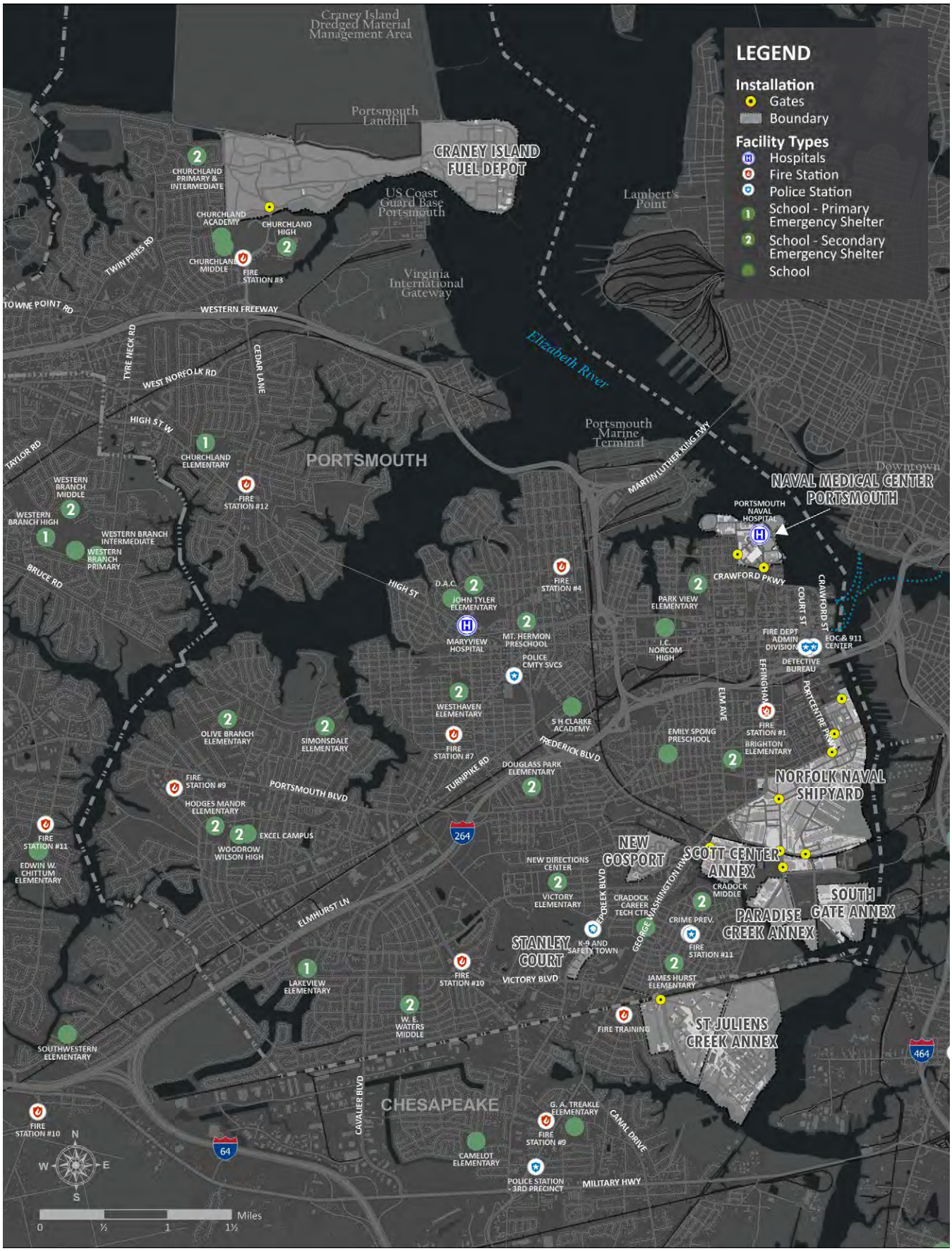


Figure 4.23 Community Facilities

Exposure of electrical substations was based on data sourced from the U.S. Department of Homeland Security.

- Two electrical substations serving NNSY from the south, located just inside the fence line, do not appear to be impacted by Scenario 2 (no rain, 1.5-foot SLR), but tidal flooding is indicated in proximity to the substations in Scenario 3 (no rain, 3.0-foot SLR), which could affect access to the buildings. Stormwater modeling inside the fence line would need to be pursued to confirm impacts from rainfall inside the fence line.
- A substation on the north shoreline of Craney Island Fuel Depot is impacted by tidal flooding and SLR in Scenarios 2 and 3.
- Two electrical substations serving St. Juliens Creek Annex appear to be impacted by tidal flooding under Scenario 3 (3.0-foot SLR). The location of both of these substations, along Craddock Street, is not covered by the stormwater modeling, so they could also be affected by the combined rainfall and tidal flooding scenarios with less than 3.0 feet of SLR.
- Seven substations located south of St. Juliens Creek Annex, east of Willis Street on either side of S. Military Highway, could experience impacts from flooding. Three of the substations have low adjacent ground elevations close to the tidal flooding elevation in Scenario 1 (no SLR) and would be impacted either directly or by having limited accessibility in Scenarios 1, 2, and 3. Although those substation sites were not directly included in the stormwater modeling, because they are affected in all three of the tidal flooding only scenarios, they would also be impacted by flooding in all of the combined rainfall and tidal flooding scenarios. Two other substations in that same area, located on the south side of Vepco Street, near the Chesapeake Energy Center, appear to have ground elevations above the Scenario 1, 2, and 3 tidal flooding levels; however, tidal flooding approaches those substations' positions in all three of the tidal flooding scenarios.

The JLUS did not evaluate the ownership of each substation or specific substation components to know the criticality of each substation or its service area. Rather, the proximity of the substation to the installation was used as a condition of analysis to assess potential impact.

More investigation is needed to confirm impacts and determine whether any mitigation measures have been implemented to address future flood impacts.

A review of sanitary pump station locations in proximity to the installations indicated that none would be impacted by flooding under Scenarios 1 through 3. However, based on adjacent ground elevation, combined rainfall and future SLR would impact the pump stations, and access to the pumps would be restricted due to roadway flooding.

4.6.5.1 Community Facility Access Analysis

Section 4.6 described the impacts that flooding could have on roadways and access to the installations. Access to community facilities may also be impacted by combined rainfall and tidal flooding that affects surrounding streets and limits access to and from a community facility. To identify the effects of combined rainfall and tidal flooding on roadway access to community facilities, fire stations, police stations, hospitals, and primary and secondary emergency shelters were further evaluated to consider the proximity and severity of flooding based on the stormwater model results. This process was completed using a network analysis tool in GIS that measured the distance that could be driven from a community facility today without flooding (unconstrained conditions), versus under conditions of Scenario 8 (Future 10-year rain, 3.0-foot SLR). Flooding depths of 6 inches or greater were used in the analysis.

Driving distances (drivesheds) of 0.5 mile, 1 mile, and 2 miles were mapped from each community facility based on the existing road networks; an additional distance of 4 miles was included for hospitals, as shown in Figure 4.24. The drivesheds illustrate the accessibility of traffic to and from a facility under flooded (constrained) and unconstrained scenarios.

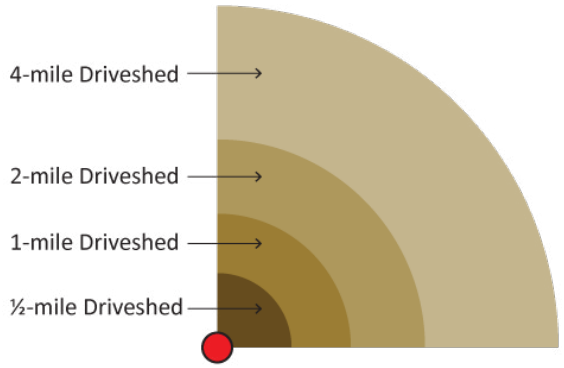


Figure 4.24 Driveshed Analysis Zones

The analysis helped to identify areas of the community that might experience a reduced level of accessibility and service in the future and can be used by the localities to ensure roadway improvement projects also consider future conditions and solutions for maintaining accessibility and service delivery, including emergency response services. Build One Portsmouth recognizes the need for ensuring that primary corridors and evacuation routes remain open during storm and flooding events. Plan tactics recommend partnering with regional agencies to model flooding on corridors and evacuation routes; modifying roadway design on flood prone routes; creating access to or from city safety services designated shelter locations, and related facilities; and evaluating sites for new or relocated public facilities to ensure they are out of significant hazard areas.[31]

Figures 4.25 through 4.30 illustrate the impacts that flooding has on facilities and their accessible service areas.

31 Portsmouth Planning Commission. 2018. Build One Portsmouth, https://portsmouthva.gov/396/Comprehensive-Plan.

Figure 4.25 illustrates the impact that future flooding could have on access to and from Naval Medical Center Portsmouth and Maryview Hospital. Without flooding, the driveshed areas extend past NNSY to Chesapeake and across the Elizabeth river to Norfolk. However, in flood Scenario 8 (Future 10-year rain, 3.0-foot SLR), significant impacts are observed in Downtown Portsmouth, whereby multiple access routes from Naval Medical Center Portsmouth are unavailable and the connection to NNSY is eliminated. Fewer impacts are observed immediately around Maryview Hospital; however, significant access impacts are observed for areas south of I-264 as distances exceed 2 miles from the hospital.

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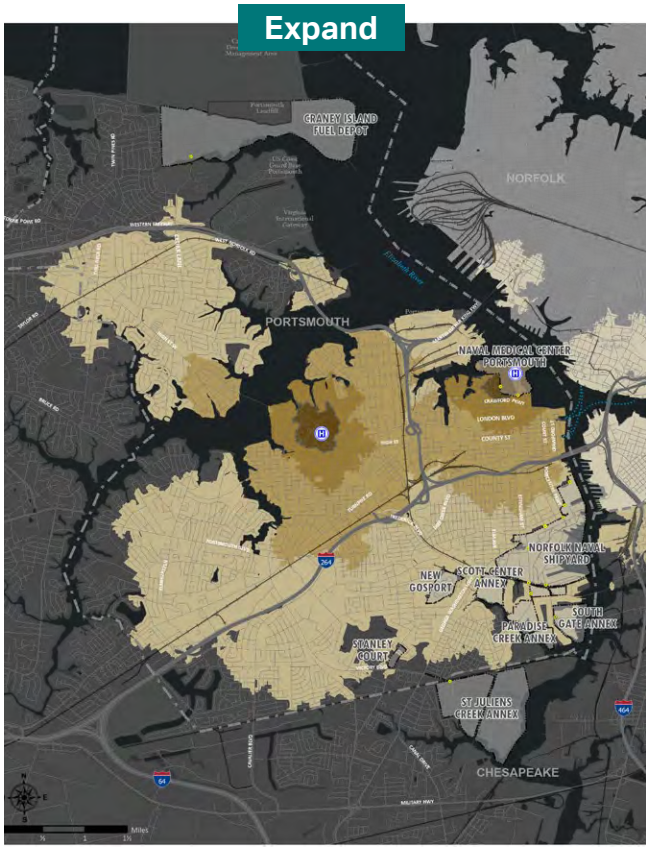

Figure 4.25 Hospital Drivesheds Unconstrained

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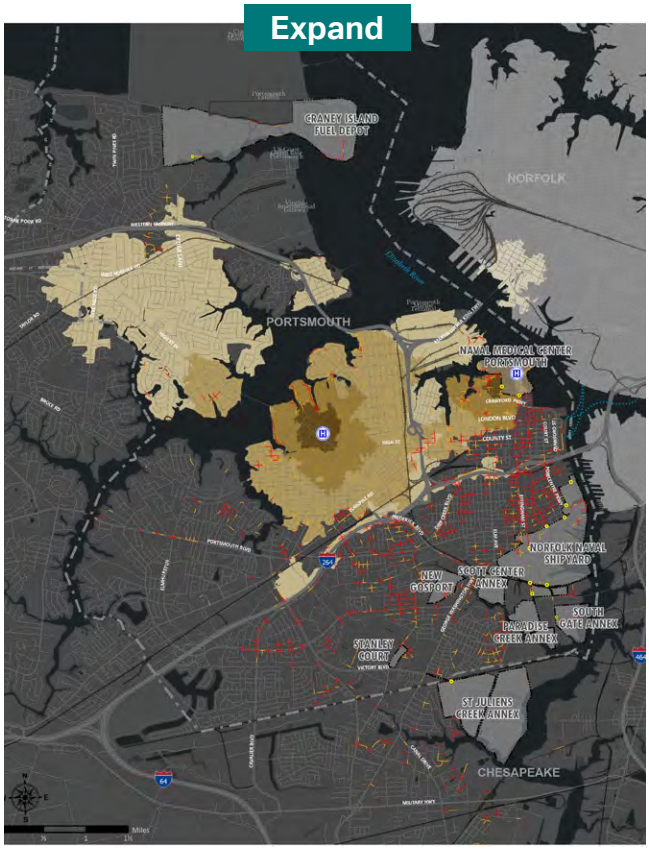
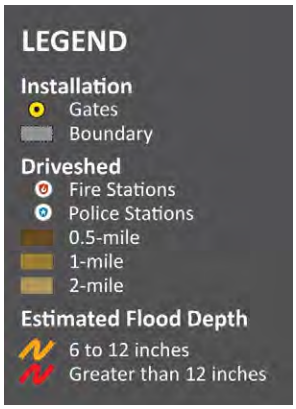


Figure 4.26 Hospital Drivesheds Constrained

Fire and Police Stations

Without flooding, fire and police driveshed areas cover a majority of the study area, as shown in Figure 4.27. Coverage reduces significantly under Scenario 8, as large parts of Downtown Portsmouth are impacted, including neighborhoods around NNSY and Navy family housing. Fire Station #1 in Portsmouth, Portsmouth City Hall, the Emergency Operations Center, and the Fire Department Administration facility would be severely constrained. Without mitigation, flooding conditions would be expected to impact emergency response times, limit the routes available to emergency responders, and restrict the ability of the localities and Navy to offer mutual aid support in times of need.



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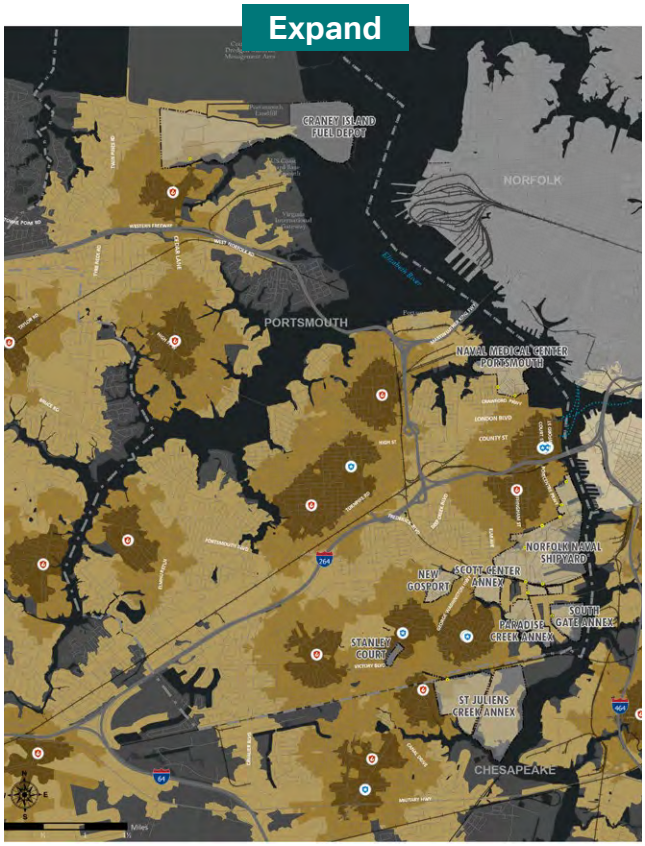

Figure 4.27 Fire/Police Drivesheds Unconstrained

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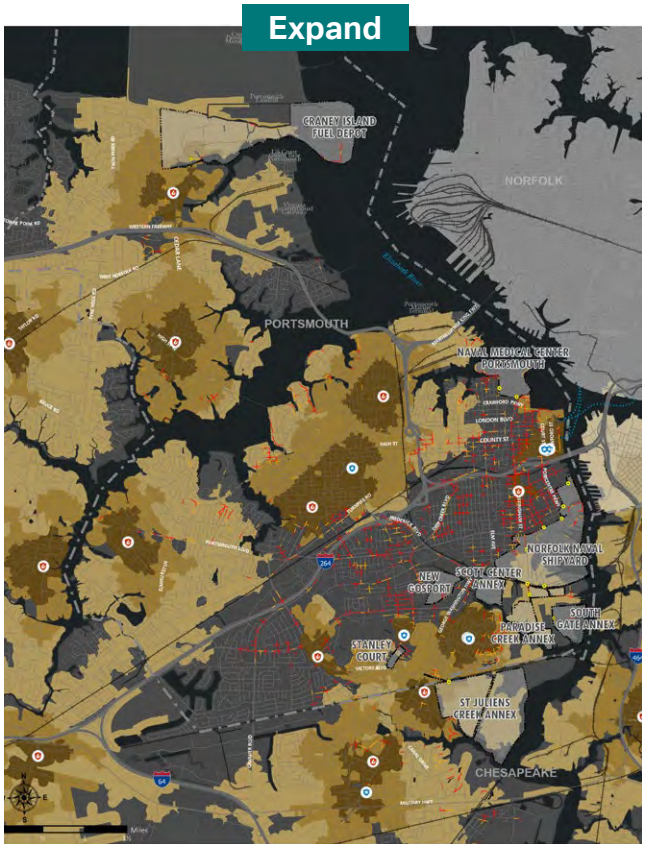
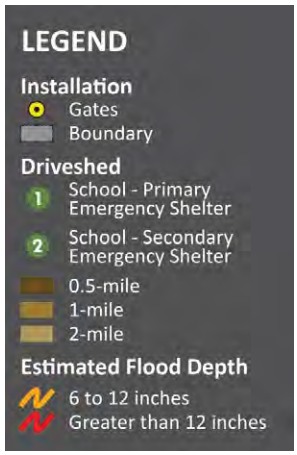


Figure 4.28 Fire/Police Drivesheds Constrained

Emergency Shelters

Primary and secondary emergency shelters are located in school buildings and provide an important function for the community. Not all shelters may be in use at one time, and access constraints could be a primary consideration in which shelters are able to provide service. As shown in Figure 4.29, shelters are widely distributed across the localities. Under Scenario 8 flooding conditions, access would be severely constrained for the Victory Elementary and Douglas Park Elementary School shelters.



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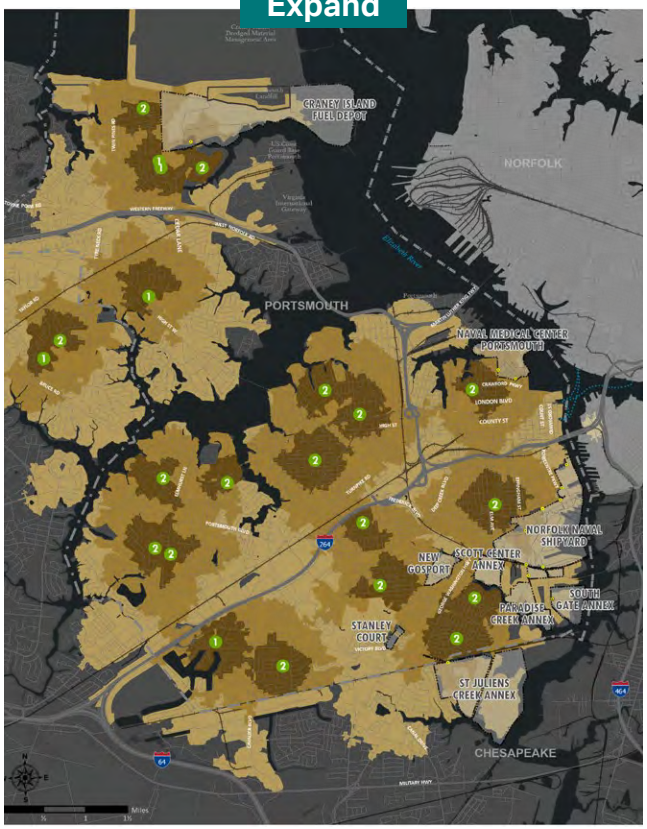

Figure 4.29 Shelter Drivesheds Unconstrained

Expand

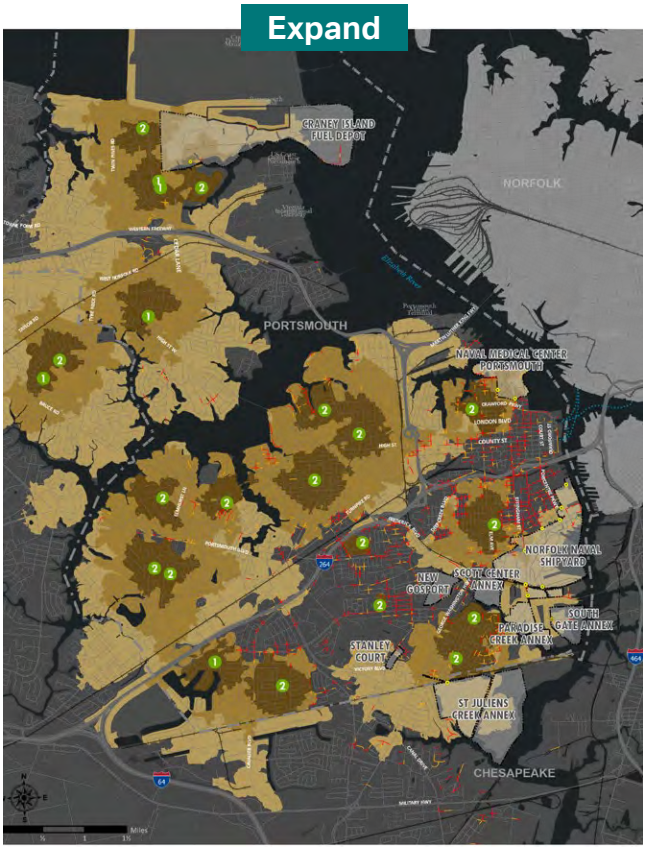

Figure 4.30 Shelter Drivesheds Constrained

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5.0 RECOMMENDATIONS

The recommendations identified as part of the JLUS are divided into two categories: Actions and Policies and Practices. Actions are strategies that incorporate a specific task or project. Policies and practices refer to new regulations, coordination activities, or processes. Each recommendation embodies one or more of the JLUS goals and attempts to comprehensively address as many of the challenges identified during the planning process as possible. This chapter discusses 36 recommended actions, which are further organized by type based on the issues that each strategy addresses. Recommended policies and practices are discussed in Chapter 6.

Actions (36 Actions)


Parking (3)


Multi-modal (11)


Flood Mitigation (8)


Land Use and Development (9)


Access (3)


Utilities (2)

5.1 Action Types

- **Parking.** These strategies focus on managing parking both internal and external to the installations, including improving parking utilization and connectivity and pursuing remote parking alternatives in an effort to reduce impacts on adjacent neighborhoods.
- **Multi-modal.** These strategies focus on expanding and improving transit to align with military personnel schedules and improving bicycle and pedestrian access in and around the installations.
- **Flood Mitigation.** These strategies identify approaches that could be considered to mitigate flooding along corridors identified as critical for accessing the installations and providing important network functionality.
- **Land Use and Development.** These strategies target specific areas adjacent to the installations and recommend joint planning efforts to manage compatible growth, reuse, and redevelopment that considers both local and federal lands in the process.
- **Access.** These strategies focus on improving installation access points and enhancing directional signage and information to assist commuters.
- **Utilities.** These strategies focus on improving utility resiliency for the installations and local economic development opportunities.

5.2 Evaluation Criteria and Scoring

A set of 14 criteria was established to assess the overall importance of each recommended action by defining how well each addresses the JLUS goals and reduces risk to or improves military readiness. The criteria are organized into four categories: DoD Mission and Personnel Readiness, Transportation Network Connectivity, Community Benefits, and Economic Resiliency. The recommended policies and practices presented in Chapter 6 are not scored, based on an understanding that each strategy is of similar importance and priority.

The criteria were developed and refined in consultation with the Technical Committee. The committee placed a stronger emphasis on Mission and Personnel Readiness and Economic Resiliency criteria by giving each criteria in those categories a weighted multiplier of 2. All other criteria were unweighted. This approach prioritizes those actions that could potentially have a more direct benefit to the military and local economic development goals. The following descriptions explain the four main criteria categories shown in Table 5.1:

DOD Mission and Personnel Readiness: Criteria in this category consider the impacts on strategic corridors and access routes that are essential for getting people and goods to the installations. Criteria also consider the importance of ensuring gate access as a factor for readiness and for minimizing any land use conflicts that could impact operations or nearby neighborhoods. This category includes a weighting to emphasize installation readiness as a top priority. A total of 10 points is available in this category (2 points per criterion) based on the applied weighting.

Transportation Network Connectivity: Criteria in this category consider how a strategy supports both regional and local transportation connectivity and the overall efficiency of the network. Criteria also consider alternative transportation modes as a component of the network. A total of 3 points is available in this category.

Community Benefits: Criteria in this category consider potential benefits to the community, including safety, walkability, health, recreation, and opportunities to benefit underserved communities. Criteria also consider services and assets that could serve both military installations and the community. A total of 4 points is available in this category.

Table 5.1 JLUS Evaluation Criteria

DOD Mission and Personnel Readiness	Reduces future flood risk along a DoD strategic corridor or to an asset the DoD relies upon
	Improves travel efficiency for military personnel trying to get to work
	Benefits more than one DoD installation or site
	Benefits gate access areas
	Reduces land use conflicts near installations (including parking impacts)
Transportation Network Connectivity	Improves regional transportation connectivity (interstate, transit, etc.)
	Improves circulation and efficiency of the local transportation network
	Improves or expands alternative options for mobility
Community Benefits	Benefits one or more community assets (police, fire, hospital, etc.)
	Improves overall quality of life and provides community benefits
	Reduces flood risk to the community
	Benefits at-risk or underserved communities
Economic Resilience	Supports reuse and redevelopment of underutilized lands
	Contributes to local economic development goals

Economic Resilience: Criteria in this category recognize how a strategy could support local economic development goals and opportunities to increase tax revenues and provide other economic benefits. This category includes weighting to emphasize local economic development opportunities as a priority. A total of 4 points is available in this category (2 points per criterion) based on the applied weighting.

Scoring Breakdown

Table 5.2 provides a list of the 36 actions sorted by weighted score. Actions can receive a maximum of 21 potential points based on the value assigned to each criterion and weighting. The actions with the higher overall scores are those strategies that most directly address three or more mission and personnel readiness criteria and also have positive impacts on transportation network connectivity. The top five actions are comprehensive flood mitigation and stormwater management strategies for corridors that the DoD relies upon and that play a role in both local and regional transportation network connectivity. These strategies would also benefit gate access and efficiency of the network overall.

Using the selected weighting system, scores ranged between a low of 5 points and a high of 17 points. To aid with plan clarity and to provide a compass for prioritizing implementation, the recommended actions were grouped into Tiers as follows:

- **Tier 1:** Actions that score 15 points or higher
- **Tier 2:** Actions that score 12 through 14 points
- **Tier 3:** Actions that score 10 or 11 points
- **Tier 4:** Actions that score below 10 points

Scores are the primary indicator of overall benefit based upon the criteria used in the evaluation; however, prioritizing actions for implementation will require considering other information. Implementation factors, such as estimated project cost and the level of required coordination, inform the level of effort that could be required to move a strategy forward. Some strategies will be more costly and complex than others and will, therefore, require more time to implement, while other strategies may be advanced more swiftly as a result of lower costs and availability of existing resources. In addition, funding availability may shift how strategies are prioritized, in order to take advantage of special opportunities, such as federal or state grant programs. Implementation factors are discussed in Chapter 7.

5.3 JLUS Actions

Each of the actions in Tiers 1 through 3 is described in more detail beginning in Section 5.3.1. The actions are presented in order by reference number that correlates to score. Figure 5.1 shows the actions for Tiers 1 through 3. The proposed rationale and implementation steps are described for each strategy, along with goal alignment and project ranking. The goal alignment for each action is shown on a pie chart; shaded wedges on the pie chart indicate the action supports the goal. Hovering over each wedge will reveal the goal language, as illustrated below.

In addition, the recommended lead responsible party to initiate each action is identified. Supporting partners and a list of potential funding sources are identified for Tier 1 through 3 actions. Each action also includes a suggested timeframe and estimated cost range.

Providing a useful cost estimate for implementation is difficult at the early stages of planning. Estimated rough-order-of-magnitude (ROM) costs for each action have been defined in general terms to reflect the potential cost for more detailed study, design, and construction of a solution, where applicable. The ranges are as follows:

$	Up to $100K
$$	$100K – $1M
$$$	>$1M

Tier 4 actions are each briefly summarized beginning in Section 5.3.19.

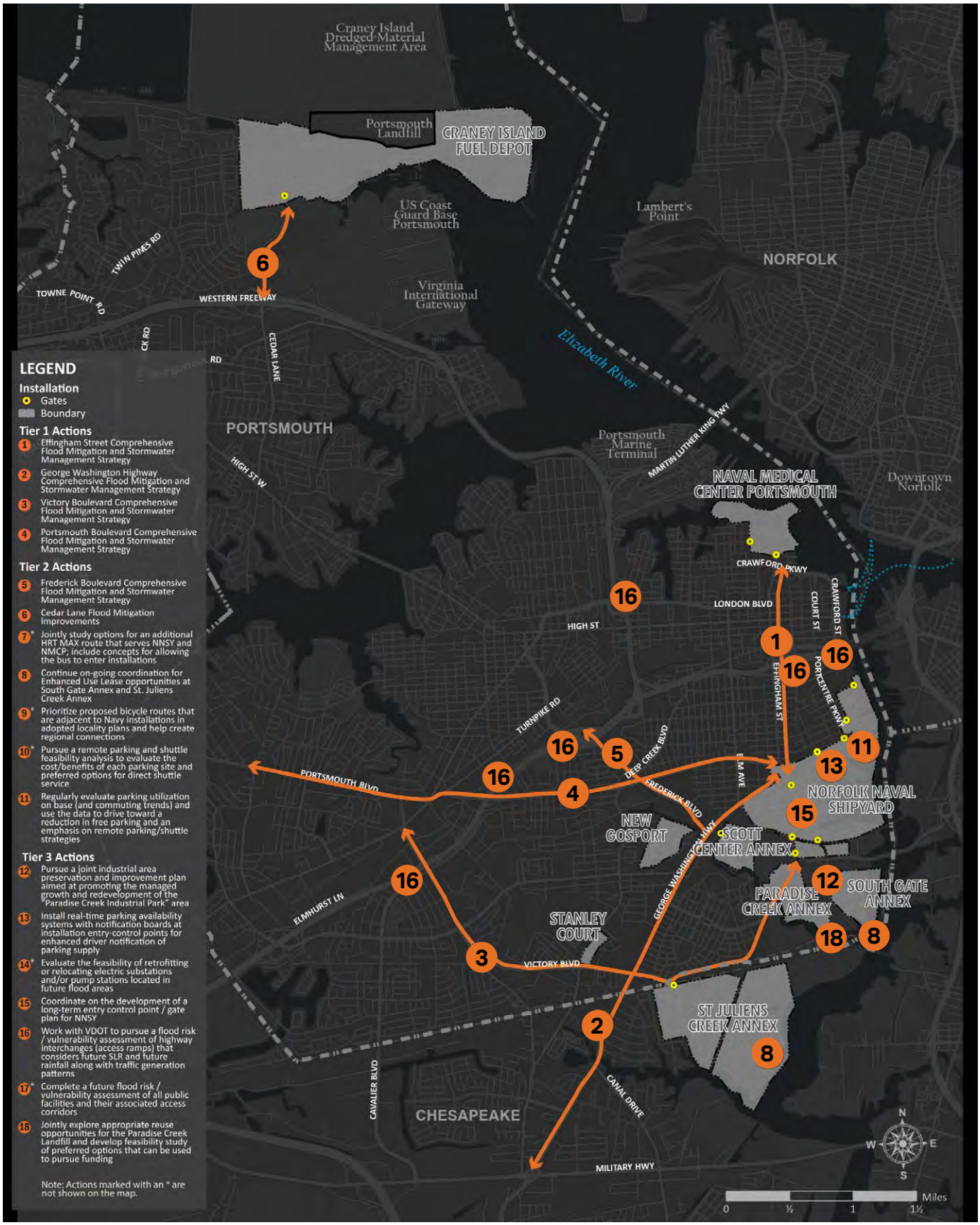


Figure 5.1 Priority Actions (Tier 1-3)

Table 5.2 JLUS Actions (Tiers 1-4)

No.	Action	Total Score	Tier #	Locality	Installation Areas Served
1	Effingham Street Comprehensive Flood Mitigation and Stormwater Management Strategy.	17	Tier 1	Portsmouth	NNSY, NMCP
2	George Washington Highway Comprehensive Flood Mitigation and Stormwater Management Strategy.	16	Tier 1	Portsmouth	NNSY, Scott Center Annex, New Gosport
3	Victory Boulevard Comprehensive Flood Mitigation and Stormwater Management Strategy.	15	Tier 1	Portsmouth, Chesapeake	NNSY, St. Juliens Creek Annex
4	Portsmouth Boulevard Comprehensive Flood Mitigation and Stormwater Management Strategy.	15	Tier 1	Portsmouth	NNSY
5	Frederick Boulevard Comprehensive Flood Mitigation and Stormwater Management Strategy.	14	Tier 2	Portsmouth	NNSY, Scott Center Annex, New Gosport
6	Cedar Lane Flood Mitigation Improvements	14	Tier 2	Portsmouth	Craney Island Fuel Depot
7	Jointly study options for an additional HRT pilot MAX route that serves NNSY and NMCP and include concepts for allowing the bus to enter the installations.	13	Tier 2	Portsmouth	NNSY, NMCP
8	Continue on-going coordination for Enhanced Use Lease opportunities at South Gate Annex and St. Juliens Creek Annex.	13	Tier 2	Portsmouth, Chesapeake	NNSY, South Gate Annex, St. Juliens Creek Annex
9	Prioritize proposed bicycle routes that are adjacent to Navy installations in adopted locality plans and help create regional connections.	13	Tier 2	Portsmouth, Chesapeake	NNSY, Scott Center Annex, New Gosport, St. Juliens Creek Annex, NMCP
10	Pursue a remote parking and shuttle feasibility analysis to evaluate the cost/benefits of each parking site and preferred options for direct shuttle service.	12	Tier 2	Portsmouth	NNSY
11	Regularly evaluate parking utilization on base (and commuting trends) and use the data to drive toward a reduction in free parking and an emphasis on remote parking/shuttle strategies.	12	Tier 2	Portsmouth	NNSY, NMCP
12	Pursue a joint industrial area preservation and improvement plan aimed at promoting the managed growth and redevelopment of the "Paradise Creek Industrial Park" area.	11	Tier 3	Portsmouth, Chesapeake	NNSY, Scott Center Annex, St. Juliens Creek Annex
13	Install real-time parking availability systems with notification boards at installation entry-control points for enhanced driver notification of parking supply.	11	Tier 3	Portsmouth	NNSY
14	Evaluate the feasibility of retrofitting or relocating electric substations and/or pump stations located in future flood areas.	11	Tier 3	Portsmouth	Craney Island Fuel Depot, NMCP, NNSY, St. Juliens Creek Annex
15	Coordinate on the development of a long-term entry control point/gate plan for NNSY.	11	Tier 3	Portsmouth	NNSY

No.	Action	Total Score	Tier #	Locality	Installation Areas Served
16	Work with VDOT to pursue a flood risk/ vulnerability assessment of highway interchanges (access ramps) that considers future SLR and future rainfall along with traffic generation patterns.	10	Tier 3	Portsmouth, Chesapeake	All Installations
17	Complete a future flood risk/vulnerability assessment of all public facilities and their associated access corridors.	10	Tier 3	Portsmouth, Chesapeake	All installations
18	Jointly explore appropriate reuse opportunities for the Paradise Creek Landfill and develop feasibility study of preferred options that can be used to pursue funding.	10	Tier 3	Portsmouth	NNSY, Paradise Creek Annex
19	Conduct a joint HRT/NAVY study that targets DOD needs and details workforce points of origin to inform revisions to the stops and frequency of HRT Routes 41, 45, and 43.	9	Tier 4	Portsmouth, Chesapeake	NMCP, NNSY
20	Perform a study to prioritize changeable message sign location and integration based on anticipated diversion route operations.	9	Tier 4	Portsmouth	NNSY
21	Explore the use of automated vehicles and/or shuttles to carry people from downtown garages to NMCP.	9	Tier 4	Portsmouth	NMCP
22	Jointly study options for a secondary access road to Craney Island Fuel Depot that does not impact the city landfill.	9	Tier 4	Portsmouth	Craney Island Fuel Depot
23	Consider adding bicycle lanes at Gate 2 at NMCP and evaluate options for upgrading bicycle infrastructure at all installations.	9	Tier 4	Portsmouth	NMCP
24	Jointly identify appropriate locations for secure bicycle parking external to the installations and near the gates.	9	Tier 4	Portsmouth	NNSY, NMCP
25	Consider modifying NMCP Gate 2 to serve specific users only to help reduce neighborhood impacts.	8	Tier 4	Portsmouth	NMCP
26	Study options for mixed use development in the vicinity of NNSY Gate 10.	8	Tier 4	Portsmouth	NNSY
27	Pursue a joint planning and feasibility study for the siting of a regional First Responder Academy, Class A burn building, and emergency vehicle operations course to support multiple jurisdictions and the Navy.	8	Tier 4	Portsmouth, Chesapeake	All Installations
28	Establish a food truck zone adjacent to Gate 10 outside NNSY and pursue development of a food truck program at NMCP similar to the one at NNSY.	8	Tier 4	Portsmouth	NNSY
29	Pursue a joint planning study of St. Juliens Creek corridor and/or Blows Creek corridor to explore options for expanded public recreational access to the water around St. Juliens Creek Annex.	8	Tier 4	Chesapeake	St. Juliens Creek Annex

No.	Action	Total Score	Tier #	Locality	Installation Areas Served
30	Jointly study options for interconnecting water service to St. Juliens Creek Annex and evaluate alternatives for extending water and sewer service eastward toward the Elizabeth River to support future redevelopment.	7	Tier 4	Chesapeake	St. Juliens Creek Annex
31	Re-evaluate the zoning classification for the area between the rail line and Elm Avenue, east of George Washington Highway.	7	Tier 4	Portsmouth	NNSY, Scott Center Annex
32	Study options for expanded ferry service to Naval Medical Center Portsmouth.	7	Tier 4	Portsmouth	NMCP
33	Refine the NNSY internal shuttle route to be more direct and efficient (connect to parking and explore off-site option).	5	Tier 4	Portsmouth	NNSY
34	Expand the shared bicycle program on NNSY and establish a similar program at Naval Medical Center Portsmouth.	5	Tier 4	Portsmouth	NNSY, NMCP
35	Expand the comfort rating analysis used in the Portsmouth Bike and Pedestrian Plan and consider adding lighting adequacy into the analysis.	5	Tier 4	Portsmouth	NNSY, NMCP
36	Install additional installation directional signage along key corridors to direct employees and visitors to installations.	5	Tier 4	Portsmouth, Chesapeake	All Installations

NMCP = Naval Medical Center Portsmouth
NNSY = Norfolk Naval Shipyard

1 5.3.1 Effingham Street Comprehensive Flood Mitigation and Stormwater Management Strategy

Flood Mitigation

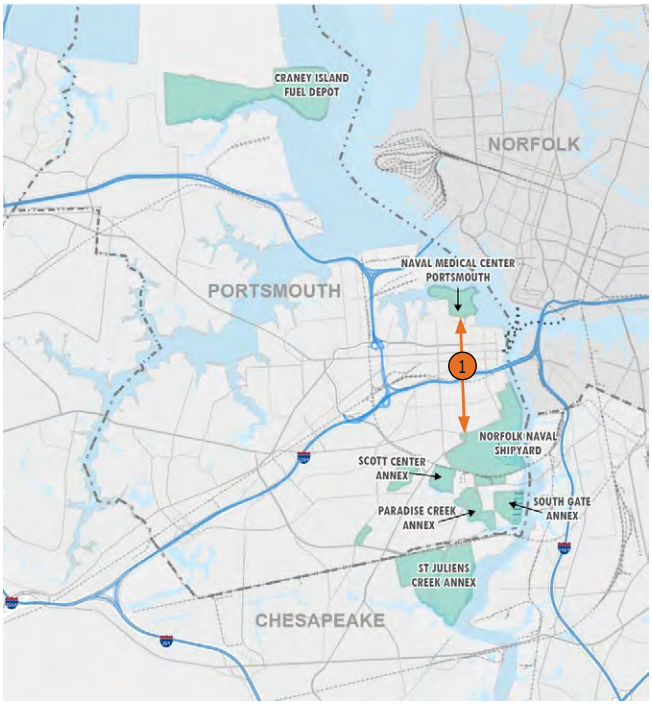
Effingham Street provides a direct connection between the NNSY main gate and Gate 1 at Naval Medical Center Portsmouth, and it is the most direct route between the two installations. The corridor carries approximately 18,000 vehicles per day and provides one of the most direct connections from NNSY and Naval Medical Center Portsmouth to I-264 and the regional expressway network. In addition to serving these DoD installations, Effingham Street provides access to Portsmouth's Olde Towne district and the neighborhoods between Elm Street and the Elizabeth River waterfront, and the segment north of I-264 functions as a secondary evaluation route. Effingham Street experiences severe congestion levels during morning and peak travel periods.

The Need for Action

The exposure analysis, described in Section 4.6 showed that Effingham Street is vulnerable to significant levels of flooding in Scenario 2 (no rainfall and 1.5 feet of SLR) and Scenario 3 (no rainfall and 3.0 feet of SLR), and most of the length of Effingham Street is vulnerable to flooding in all of the combined rainfall and tidal flooding Scenarios 4 through 8.

A comprehensive strategy is needed to manage current and future flooding along Effingham Street, from Gate 1 of Naval Medical Center Portsmouth to the NNSY pass and ID office, including the ramps connecting Effingham to I-264. A long-term solution to mitigate flooding on Effingham Street will require a combination of infrastructure improvements, including backflow prevention on stormwater outfalls, increased capacity in stormwater pipe and/or storage capacity, increased stormwater pumping capacity, and elevation of portions of the street surface above current elevations.

Although Effingham Street is not vulnerable to direct tidal flooding in Scenario 1 (with no rainfall and no sea level rise), it is vulnerable to frequent and widespread flooding in all of the evaluated combined rainfall and tidal flooding scenarios. This indicates that the street's flooding vulnerability is largely the result of reduced capacity of the stormwater drainage system during a 1-year return period (and higher) tidal event, when the high tidal tailwater in the Elizabeth River inhibits the ability of the stormwater infrastructure to drain the roadway. The resulting flooding significantly impacts the ability to travel the length of Effingham Street.



Goal Alignment

DOD Mission & Personnel Readiness	●●●●● ●●●●●
Transportation Network Connectivity	●●●
Community Benefits	●●●●
Economic Resilience	●●○○

Strategy Total Score

Estimated ROM Cost:

$$$

Timeframe

SHORT	MID	LONG
0-3 yrs	3-10 yrs	+10 yrs

Back to Priority Actions Map

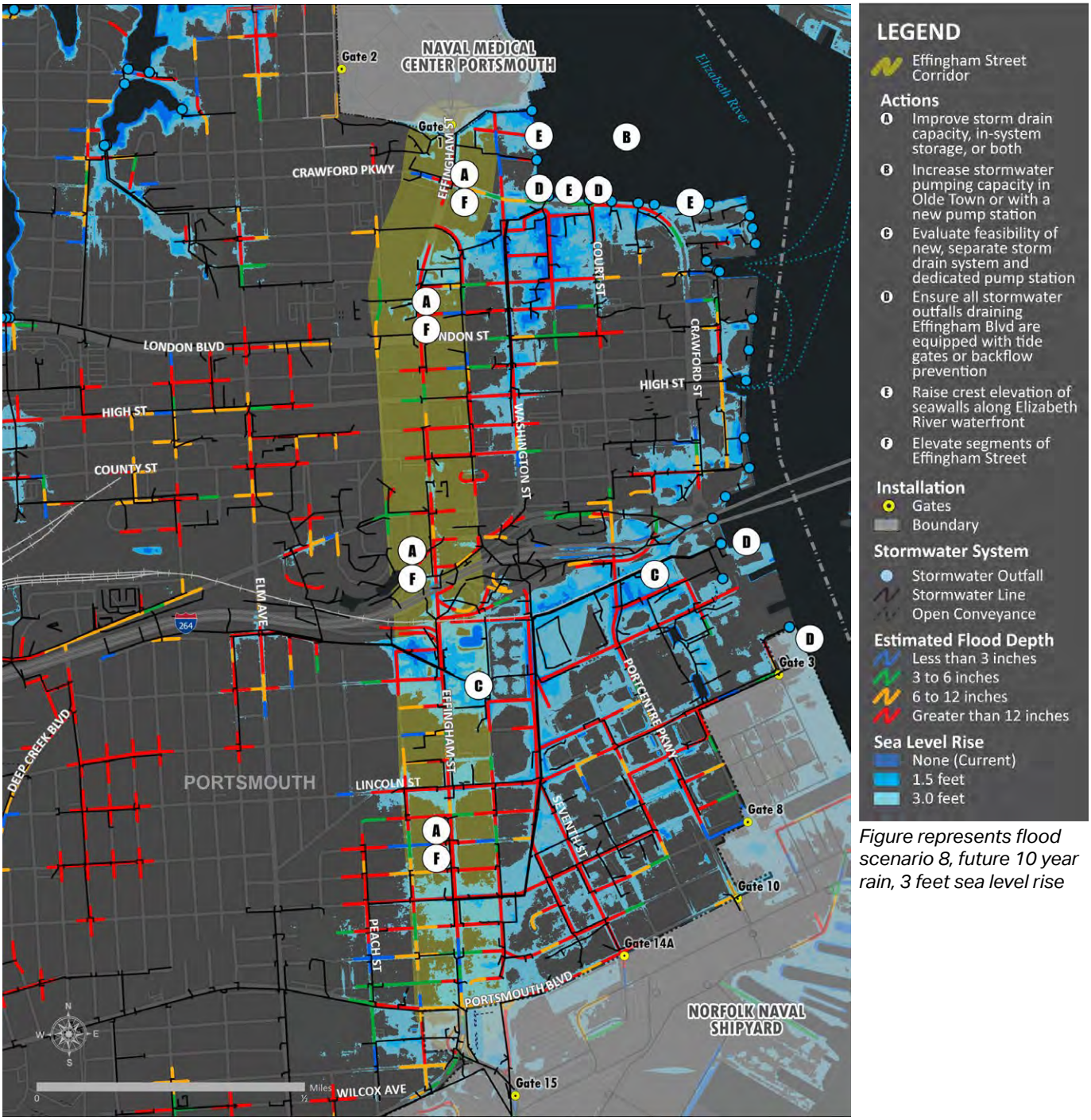


Figure represents flood scenario 8, future 10 year rain, 3 feet sea level rise

Figure 5.2 Effingham Street Potential Flood Mitigation Improvements

In the absence of rainfall but considering future SLR effects on tidal flooding, 3.0 feet of SLR (Scenario 3) will lead to flooding at the Naval Medical Center Portsmouth Gate 1, between London Street and Crawford Parkway, in an expanded area south of I-264, and on either side of Portsmouth Boulevard north of the NNSY main gate.

In Scenario 4, with current rainfall and no SLR, much of the length of Effingham Street between I-264 and Naval Medical Center Portsmouth will be flooded by 12 inches or more, and segments between I-264 and NNSY will be flooded to a depth of several inches. The flooding depths increase as sea levels rise, such that with 3.0 feet of SLR, most of the length of Effingham Street between NNSY and Naval Medical Center Portsmouth will be flooded to depths of 12 inches or greater. Expected increases in future rainfall intensity (illustrated in Scenario 7 and Scenario 8) will add to the depth and duration of flooding along this corridor.

Future flooding of Effingham Street both north and south of I-264 will significantly impact the ability of DoD personnel to access NNSY and Naval Medical Center Portsmouth, which in turn affects the operational readiness of the installations. Flooding will limit access to routine and emergency medical services at the Naval Medical Center Portsmouth, will create challenges for emergency response activities in general, and will limit or disrupt commerce and economic development in downtown Portsmouth.

This action will require collaboration between Portsmouth, NNSY, Naval Medical Center Portsmouth, and VDOT to confirm conditions and connections, if any, of pipe systems and to ensure any proposed improvements consider impacts on interstate ramps and rights-of-way, installation gate access, and adjacencies. The city's current stormwater modeling effort can provide a solid basis for informing the development of a strategy. Proposed mitigation improvements along Effingham Street could have varying degrees of impact on adjacent land uses, surrounding neighborhoods, connecting streets, access, and utilities. Additional study will be required to fully evaluate long-term solutions, including their benefits and costs, to provide a better understanding of potential social and economic impacts and benefits associated with a solution.

The comprehensive strategy will likely need to combine different infrastructure improvements and options as illustrated on Figure 5.2. The following components or strategies should be considered and further evaluated to mitigate future flooding impacts along Effingham Street:

- Improving storm drain conveyance capacity, in-system storage, or both
- Increasing stormwater pumping capacity, with options for additional pumping capacity at the Olde Town pump station and/or at a new pump station location to be identified and investigated
- Evaluating the feasibility of a new, separate storm drain system for Effingham Street south of I-264, with a dedicated pumping station
- Ensuring that all stormwater outfalls that drain Effingham Street are equipped with tide gates or similar backflow prevention
- Potentially raising the crest elevation of seawalls along the Elizabeth River waterfront, most notably along Crawford Parkway near Naval Medical Center Portsmouth and the Old Town Pump Station, where overtopping of the bulkhead can cause flow overland to flood Effingham Street
- Elevating segments of Effingham Street

Implementation Steps:

1. Form a committee to oversee and coordinate project planning, design, and implementation among partners.
2. Define an outline and approach for the study, including the extent of work to be included, in coordination with the Navy and VDOT. This step will include compiling available topographic and utility surveys of areas within the rights-of-way of Effingham Street and Elm Avenue, as well as ownership and usage information regarding the parcels adjacent to these streets. Recognizing that Portsmouth and its consultants have continued to develop stormwater survey data and stormwater modeling since the initial models were provided to support the JLUS, the approach should consider any additional stormwater modeling that has been completed between Elm Avenue and the Olde Towne waterfront, from NNSY in the south to Naval Medical Center Portsmouth in the north.
3. Based on information developed and evaluated in Step 1, define a detailed scope of work and budget for the study, in coordination with the Navy and VDOT.
4. Pursue funding for the study.
5. Using the information compiled in Step 1, and recognizing that a long-term solution may involve using segments of both Effingham Street and Elm Avenue to create a sustainable corridor from NNSY to Naval Medical Center Portsmouth, develop conceptual mitigation alternative designs for maintaining access along a direct north-south surface route between Naval Medical Center Portsmouth and I-264, and between NNSY and I-264.

6. Jointly evaluate the conceptual mitigation alternative design solutions across city departments and in consideration of other current initiatives that could affect development in the corridor. Changes to roadway geometry should include the development and evaluation of alternatives.
7. Define applicable operating and maintenance parameters as part of any solution.
8. Identify phasing and jointly pursue funding for implementation of the preferred design solutions.

Lead Partner

Portsmouth

Other Partners

U.S. Navy, VDOT

Potential Funding Sources

- Portsmouth CIP Funding
- Virginia Transportation Funding (VDOT, DRPT)
- VA DEQ Stormwater Local Assistance Fund
- VA DEQ Stormwater Loans
- VA Dam Safety and Floodplain Management Grants
- FHWA Defense Access Road Program
- U.S. DoD OLDCC Implementation Grants
- U.S. DoD Community Infrastructure Program
- U.S. DOT Infrastructure for Rebuilding America
- U.S. HUD Community Development Block Grant (CDBG) Entitlement Program
- FEMA BRIC Grant Program
- FEMA Flood Mitigation Assistance Program

2 5.3.2 George Washington Highway Comprehensive Flood Mitigation and Stormwater Management Strategy

Flood Mitigation

George Washington Highway provides a direct connection to the NNSY main gate at Effingham Street and provides access to Scott Center Annex and the New Gosport Navy family housing area. The corridor carries between 12,000 and 33,000 vehicles per day and links to several significant adjacent corridors, such as Frederick Boulevard and Effingham Street. Congestion levels along the corridor are severe in the AM and PM peak periods near NNSY and can be exacerbated by the railroad crossing between Frederick Boulevard and Elm Avenue. The corridor provides an important regional connection to Chesapeake and several commercial areas south of NNSY, ultimately connecting to South Military Highway and I-64.

The Need for Action

The exposure analysis in Section 4.6 showed that George Washington Highway is vulnerable to flooding at key locations between NNSY and Victory Boulevard in several of the tidal and rainfall flooding scenarios. A long-term solution to mitigate flooding on George Washington Highway will require a combination of infrastructure improvements, including backflow prevention on stormwater outfalls, increased capacity in stormwater pipe and/or storage capacity, and elevation of portions of the street.

George Washington Highway is potentially vulnerable to tidal flooding in Scenario 2 and Scenario 3 at its two crossings over Paradise Creek, between the Chesapeake-Portsmouth boundary and the NNSY main gate.

Flooding under Scenario 4 impacts five segments of George Washington Highway north of Victory Boulevard to varying degrees and impacts multiple segments of roadways within the New Gosport family housing area. One segment of George Washington Highway near the intersection with Elm Avenue shows flooding to 12 inches or greater; two segments are flooded between 6 and 12 inches, including the intersection with Frederick Boulevard near the entrance to Scott Center Annex; and two segments are flooded less than 3 inches. The VDOT Six-Year Improvement Program includes a project for improvements along George Washington Highway from Andrews Street to Mulberry Street, which is an area projected to be

Goal Alignment

DOD Mission & Personnel Readiness	●●●●● ●●●●●
Transportation Network Connectivity	●●●
Community Benefits	●●●●
Economic Resilience	●●●●

Strategy Total Score

Estimated ROM Cost:

$$$

Timeframe

SHORT	MID	LONG
0-3 yrs	3-10 yrs	+10 yrs

Back to Priority Actions Map

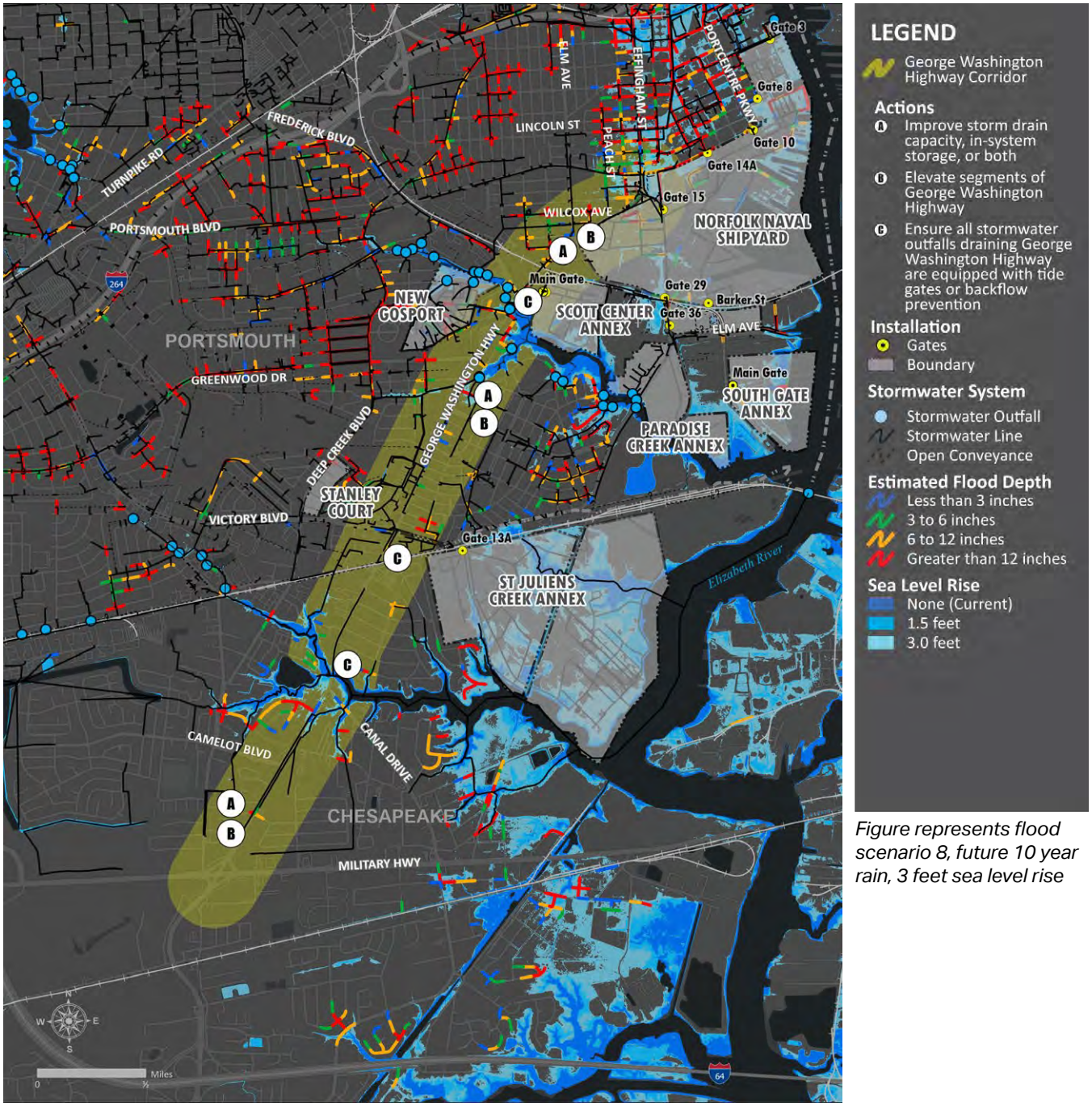


Figure represents flood scenario 8, future 10 year rain, 3 feet sea level rise

Figure 5.3 George Washington Highway Potential Flood Mitigation Improvements

impacted by future flooding.[1] Opportunities to address future flooding should be considered as part of the roadway design and engineering.

Increased tidal flooding and SLR in Scenarios 5 and 6 extends the length and increases the depth of the segments subject to flooding along the corridor. The intersection of George Washington Highway and Frederick Boulevard would be flooded to a depth of 12 inches or greater in Scenario 5, and the length of the corridor that would be flooded under Scenario 6 extends to the entrance to Scott Center Annex.

The increased future rainfall in Scenarios 7 and 8 would increase the depth of peak flooding in some already-flooded segments, and access to the Scott Center Annex and the New Gosport family housing area would be significantly impacted.

The flooding exposure analysis indicated little potential for flooding along George Washington Highway between Victory Boulevard and I-64 in the scenarios evaluated.

1 VDOT. n.d. *VDOT Six-Year Improvement Program: George Washington Highway Corridor Improvements*. http://syip.virginiadot.org/Pages/lineitemDetails.aspx?syp_scenario_id=268&line_item_id=1410957. Accessed 4/12/21.

Future flooding along George Washington Highway will impact DoD personnel readiness by limiting access from the south to NNSY and disrupting regional mobility by limiting access to Frederick Boulevard. It will also affect access to the New Gosport family housing area and Scott Center Annex, both of which are only accessible via George Washington Highway.

A comprehensive strategy is needed to manage current and future flooding along approximately 2 miles of George Washington Highway, from the NNSY pass and ID office south to its intersection with Victory Boulevard. The strategy should combine different infrastructure improvements and options as illustrated on Figure 5.3. The following components or strategies should be considered and further evaluated to mitigate future flood impacts along George Washington Highway:

- Improving storm drain conveyance capacity, in-system storage, or both
- Elevating segments of George Washington Highway
- Ensuring that all stormwater outfalls to which George Washington Highway drains are equipped with tide gates or similar backflow prevention

If deemed appropriate, the installation of backflow prevention on the storm drain outfalls could be implemented to provide near-term, interim benefits while the comprehensive strategy is being developed.

Implementation Steps

1. Form a committee to oversee and coordinate project planning, design, and implementation among partners.
2. Define an outline and approach for the study, including the extent of work to be included, in coordination with the Navy and VDOT. This step will include compiling available topographic and utility surveys of areas within the rights-of-way of George Washington Highway and its intersections with Frederick Boulevard, Victory Boulevard, and Military Highway, as well as ownership and usage information regarding the parcels adjacent to George Washington Highway. Recognizing that Portsmouth and its consultants have continued to develop stormwater survey data and stormwater modeling since the initial models were provided to support the JLUS, the approach should consider any additional stormwater modeling that has been completed relative to the specific project area.
3. Based on information developed and evaluated in Step 1, define a detailed scope of work and budget for the study, in coordination with the Navy and VDOT.
4. Pursue funding for the study.
5. Using the information compiled in Step 1, develop conceptual mitigation alternative designs for maintaining access along George Washington Highway between NNSY and Victory Boulevard, as a first step, and then continued access along George Washington Highway to Military Highway and I-264.
6. Jointly evaluate the conceptual mitigation alternative design solutions across city departments and in consideration of other current initiatives that could affect development in the corridor. Changes to roadway geometry should include the development and evaluation of alternatives.
7. Coordinate with VDOT to evaluate solutions and incorporate improvement concepts into long-term maintenance plans for the bridges along affected segments of the highway.
8. Define applicable operating and maintenance parameters as part of any solution.
9. Identify phasing and jointly pursue funding for implementation of the preferred design.

Lead Partner

Portsmouth

Other Partners

Chesapeake, U.S. Navy, VDOT

Potential Funding Sources

- Portsmouth CIP Funding
- Virginia Transportation Funding (VDOT, DRPT)
- VA DEQ Stormwater Local Assistance Fund
- VA DEQ Stormwater Loans
- VA Dam Safety and Floodplain Management Grants
- FHWA Defense Access Road Program
- U.S. DoD OLDCC Implementation Grants
- U.S. DoD Community Infrastructure Program
- U.S. DOT Infrastructure for Rebuilding America
- U.S. HUD CDBG Entitlement Program
- FEMA BRIC Grant Program
- FEMA Flood Mitigation Assistance Program

3 5.3.3 Victory Boulevard Comprehensive Flood Mitigation and Stormwater Management Strategy

Flood Mitigation

Victory Boulevard provides connection to St. Juliens Creek Annex, NNSY Gates 36 and 29, and the South Norfolk Jordan Bridge. The corridor connects to I -264, Portsmouth Boulevard, and the regional expressway network. It also provides an alternate route from NNSY to I-64 by providing an alternate route to George Washington Highway to bypass congestion or potential future flooding. Victory Boulevard is defined as a secondary evacuation route and has low congestion levels in both the AM and PM peak periods.

The Need for Action

The exposure analysis showed that Victory Boulevard is vulnerable to flooding at a few key locations in several of the combined rainfall and tidal flooding scenarios, primarily near its interchange with I-264. Therefore, Victory Boulevard will require a combination of infrastructure improvements, including increased capacity in stormwater pipe and/or storage capacity, and elevation of portions of the street above current elevations. A short segment of Victory Boulevard and Elm Avenue near NNSY may be vulnerable to tidal flooding in Scenarios 2 and 3, and this vulnerability may be mitigated with tide gates or similar backflow prevention on storm drain outfalls serving that location.

Victory Boulevard between NNSY and I-264 generally does not appear to be impacted by tidal flooding in Scenarios 1, 2, and 3. An exception occurs in Scenario 2 and 3 along a short segment of Victory Boulevard where it intersects Elm Avenue at NNSY, as tidal flooding approaches the road surface and may cause localized impacts. The *2040 Long Range Transportation Plan* includes a project to add roadway capacity to Elm Avenue between Victory Boulevard and George Washington Highway to improve access and incident management and enhance intersection operations and safety at NNSY Gates 29 and 36.[2] Opportunities to address future flood conditions as part of roadway design and engineering should be integrated into this effort.

Goal Alignment

DOD Mission & Personnel Readiness	●●●●● ●●●●●
Transportation Network Connectivity	●●●
Community Benefits	●●●○○
Economic Resilience	●●○○

Strategy Total Score

Estimated ROM Cost:

$$$

Timeframe

SHORT	MID	LONG
0-3 yrs	3-10 yrs	+10 yrs

Back to Priority Actions Map

2 HRTPO. 2016. *Hampton Roads Transportation Planning Organization 2040 Long-Range Transportation Plan: Project Information Guide*. https://www.hrtpo.org/uploads/docs/2040LRTP_Project_Information_Guide_November.pdf. Accessed 4/12/21.

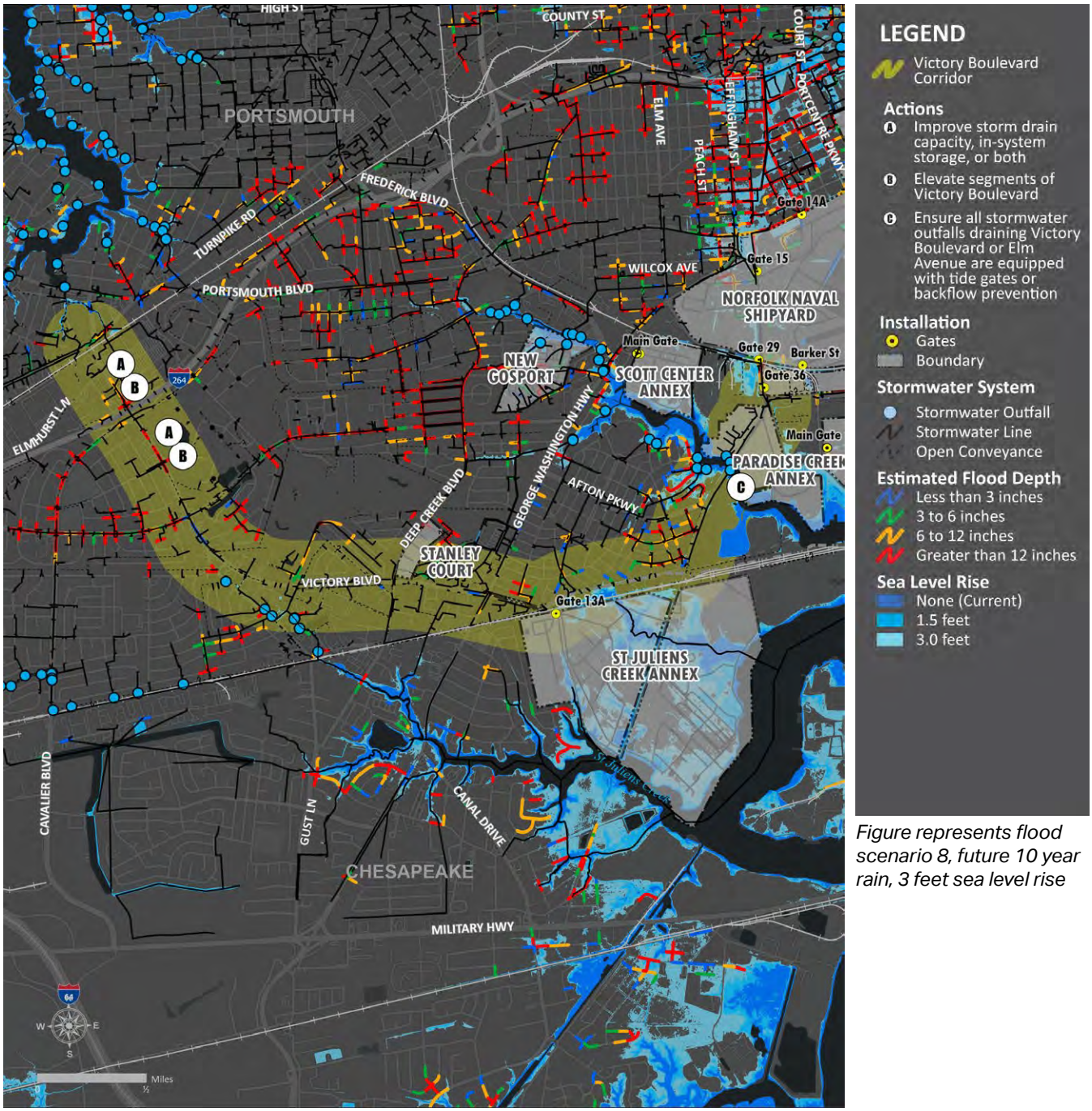


Figure represents flood scenario 8, future 10 year rain, 3 feet sea level rise

Figure 5.4 Victory Boulevard Potential Flood Mitigation Improvements

There is also potential for localized tidal flooding impacts where Victory Boulevard runs parallel to the St. Juliens Creek Annex northern boundary. This segment and the segment near Elm Avenue discussed on the previous page should be investigated more closely during evaluation of the recommended comprehensive strategy.

Victory Boulevard does have some vulnerability to flooding in the combined rainfall and tidal flooding scenarios. Victory Boulevard is shown as flooded by as much as 12 inches (or greater) in Scenario 4 at its ramps with I-264 westbound, and by 6 to 12 inches over a segment just north of the ramps. In the present-day rainfall Scenario 4, one segment of Victory Boulevard south of I-264 is flooded by 12 inches or more and two segments are flooded by less than 3 inches between I-264 and St. Juliens Creek Annex. The addition of SLR to the present-day rainfall scenarios does not appear to increase the flooding extents or depths, which is consistent with the boulevard not being directly impacted by tidal flooding.

While increased flood depths and slight increases in the length of flooded segments along this reach of Victory Boulevard occur in future rainfall Scenarios 7 and 8, the number of segments flooded over the present-day rainfall scenarios does not increase.

With flooding potential on Victory Boulevard confined to a relatively short segment, compared to the vulnerable lengths of other corridors evaluated, a comprehensive flooding mitigation strategy for Victory Boulevard has the potential to maintain a connection between NNSY and St. Juliens Creek Annex to the regional expressway network in events when other corridors may be difficult to utilize.

A comprehensive strategy is needed to manage current and future flooding along Victory Boulevard, focused on an approximate 1.0-mile segment adjacent to its interchange with I-264. The strategy should combine different infrastructure improvements and options as illustrated on Figure 5.4. The following components or strategies should be considered and further evaluated to mitigate future flood impacts along Victory Boulevard:

- Improving storm drain conveyance capacity, in-system storage, or both
- Elevating segments of Victory Boulevard
- Ensuring that all stormwater outfalls draining Victory Boulevard and Elm Avenue adjacent to NNSY are equipped with tide gates or similar backflow prevention

If deemed appropriate, the installation of backflow prevention on the boulevard's storm drain outfalls could be implemented to provide near-term, interim benefits while the comprehensive strategy is being developed.

Implementation Steps

1. Form a committee to oversee and coordinate project planning, design, and implementation among partners.
2. Define an outline and approach and extent of work for the study, in coordination with the Navy and VDOT. This step will include compiling available topographic and utility surveys of areas within the right-of-way of Victory Boulevard and its intersection with Elm Avenue and I-264, as well as ownership and usage information regarding the parcels adjacent to Victory Boulevard. Recognizing that Portsmouth and its consultants have continued to develop stormwater survey data and stormwater modeling since the initial models were provided to the JLUS team, the outline approach should consider any additional stormwater modeling that has been completed relative to the specific project area.
3. Based on information developed and evaluated in Step 1, define a detailed scope of work and budget for the study, in coordination with the Navy and VDOT.
4. Pursue funding for the study.
5. Using the information compiled in Step 1, develop conceptual mitigation alternative designs for maintaining access along Victory Boulevard, with a focus on the 1.0-mile segment near its I-264 interchange.
6. Jointly evaluate the conceptual mitigation alternative design solutions across city departments and in consideration of other current initiatives that could affect development in the corridor. Changes to roadway geometry should include the development and evaluation of alternatives.
7. Coordinate with VDOT to evaluate solutions to keep the Portsmouth Boulevard/I-264 interchange accessible in present and future rainfall scenarios.
8. Define applicable operating and maintenance parameters as part of any solution.
9. Identify phasing and jointly pursue funding for implementation of the preferred design solutions.

Lead Partner

Portsmouth

Other Partners

Chesapeake, U.S. Navy, VDOT

Potential Funding Sources

- Portsmouth CIP Funding
- Virginia Transportation Funding (VDOT, DRPT)
- VA DEQ Stormwater Local Assistance Fund
- VA DEQ Stormwater Loans
- FHWA Defense Access Road Program
- U.S. DoD OLDCC Implementation Grants
- U.S. DoD Community Infrastructure Program
- U.S. DOT Infrastructure for Rebuilding America
- U.S. HUD CDBG Entitlement Program
- FEMA BRIC Grant Program
- FEMA Flood Mitigation Assistance Program
- FEMA BRIC Grant Program

4 5.3.4 Portsmouth Boulevard Comprehensive Flood Mitigation and Stormwater Management Strategy

Flood Mitigation

Portsmouth Boulevard provides a direct connection to NNSY Gates 10 and 14A and provides a regional connection to I-264 and the regional expressway network. The east-west corridor is identified as a secondary evacuation route and carries an average of between 7,500 and 21,000 vehicles per day. The corridor experiences moderate to severe congestion during AM and PM peak periods, with the most severe congestion occurring east of Effingham Street near NNSY.

The Need for Action

East of Elm Avenue, approaching the NNSY main gate location as well as Gate 14A and Gate 10, Portsmouth Boulevard is vulnerable to flooding in Scenarios 3, 6, and 8 from Peach Street to NNSY Gate 10. Approximately half of this segment is indicated as flooded more than 6 inches, with some portions flooded more than 12 inches, in the scenarios that include 3.0 feet of SLR. Within this same segment, the area around Gate 14A on Portsmouth Boulevard is vulnerable to flooding in all of the combined rainfall and tidal flooding Scenarios 4 through 8.

West of its intersection with Frederick Boulevard, Portsmouth Boulevard is vulnerable to flooding in all of the combined rainfall and tidal scenarios (Scenarios 4 through 8). Between I-264 and Frederick Boulevard, Portsmouth Boulevard is indicated as flooded more than 6 inches in multiple locations in Scenarios 4 through 8. In Scenario 4, Portsmouth Boulevard is affected by combined rainfall and tidal flooding at the I-264 ramps and underpass. A segment between I-264 and the intersection with Frederick Boulevard is flooded by 6 to 12 inches in this scenario, as is the intersection with Deep Creek Boulevard. Flooding in Scenario 5 would be similar to that in Scenario 4. With 3.0 feet SLR in Scenario 6, the length of flooding increases, and the depth reaches 12 inches or more near the intersection with Deep Creek Boulevard. The future rainfall Scenarios 7 and 8 increase the flood depths and slightly increase the lengths of flooded segments along Portsmouth Boulevard.

Mitigating flooding along Portsmouth Boulevard would sustain a connection between the NNSY main gate and I-264 and the regional expressway network. A comprehensive strategy is needed to manage current and future flooding along approximately 2.5 miles of Portsmouth Boulevard, from NNSY Gate 10 to I-264. A long-term solution

Goal Alignment

DOD Mission & Personnel Readiness	●●●○○ ●●●○○
Transportation Network Connectivity	●●●
Community Benefits	●●●●
Economic Resilience	●●○○

Strategy Total Score

Estimated ROM Cost:

$$$

Timeframe

SHORT	MID	LONG
0-3 yrs	3-10 yrs	+10 yrs

Back to Priority Actions Map

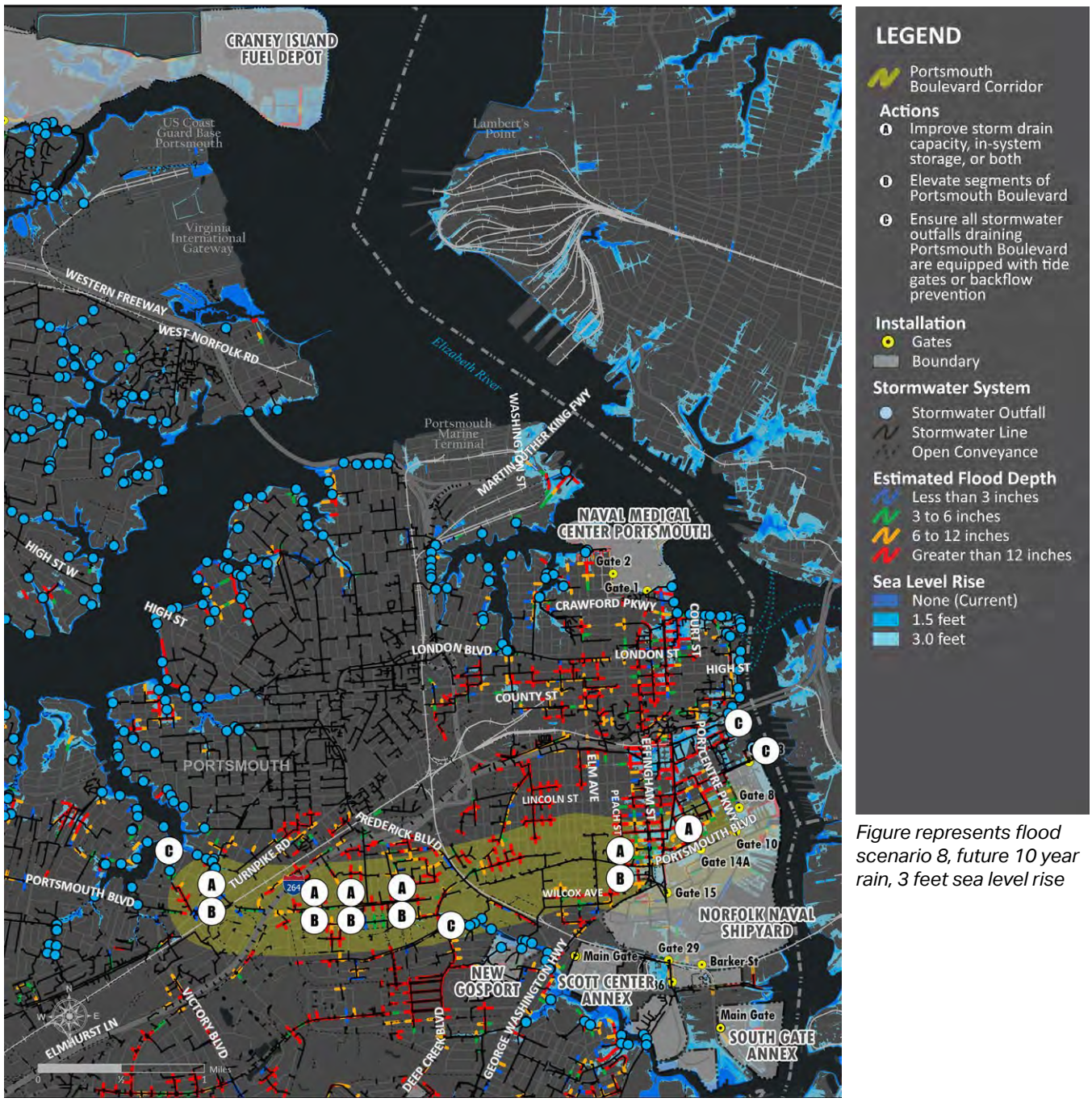


Figure represents flood scenario 8, future 10 year rain, 3 feet sea level rise

Figure 5.5 Portsmouth Boulevard Potential Flood Mitigation Improvements

will require a combination of making infrastructure improvements, including increased capacity in stormwater pipe and/or storage capacity, elevating portions of the street surface above current elevations, potentially operating stormwater pumping systems at the I-264 interchange, and installing backflow prevention on a small number of stormwater outfalls.

A comprehensive flood mitigation and stormwater management strategy should combine different infrastructure improvements and options as illustrated on Figure 5.5. The following components or strategies should be considered and further evaluated to mitigate future flood impacts along Portsmouth Boulevard:

- Improving storm drain conveyance capacity, in-system storage, or both
- Elevating segments of Portsmouth Boulevard
- Ensuring that all stormwater outfalls to which Portsmouth Boulevard drains are equipped with tide gates or similar backflow prevention

If deemed appropriate, the installation of backflow prevention on the boulevard's storm drain outfalls could be implemented to provide near-term, interim benefits while the comprehensive strategy is being developed.

Implementation Steps

1. Form a committee to oversee and coordinate project planning, design, and implementation among partners.
2. Define an outline and approach for the study, in coordination with the Navy and VDOT. This step will include compiling available topographic and utility surveys of areas within the rights-of-way of Portsmouth Boulevard and its intersections with Effingham Street, Frederick Boulevard, and I-264, as well as ownership and usage information regarding the parcels adjacent to Portsmouth Boulevard. Recognizing that Portsmouth and its consultants have continued to develop stormwater survey data and stormwater modeling since the initial models were provided to support the JLUS, the approach should consider any additional stormwater modeling that has been completed relative to the specific project area.
3. Based on information developed and evaluated in Step 1, define a detailed scope of work and budget for the study, in coordination with the Navy and VDOT.
4. Pursue funding for the study.
5. Using the information compiled in Step 1, develop conceptual mitigation alternative designs for maintaining access along Portsmouth Boulevard from the NNSY main gate to I-264. This access may include alternatives that utilize Frederick Boulevard to reach I-264, with improvements along that segment of Frederick Boulevard as well.
6. Jointly evaluate the conceptual mitigation alternative design solutions across city departments and in consideration of other current initiatives that could affect development in the corridor. Changes to roadway geometry should include the development and evaluation of alternatives.
7. Coordinate with VDOT to evaluate solutions to keep the Portsmouth Boulevard/I-264 interchange accessible in present and future rainfall scenarios.
8. Define applicable operating and maintenance parameters as part of any solution.
9. Identify phasing and jointly pursue funding for implementation of the preferred design solutions.

Lead Partner

Portsmouth

Other Partners

U.S. Navy, VDOT

Potential Funding Sources

- Portsmouth CIP Funding
- Virginia Transportation Funding (VDOT, DRPT)
- VA DEQ Stormwater Local Assistance Fund
- VA DEQ Stormwater Loans
- VA Dam Safety and Floodplain Management Grants
- FHWA Defense Access Road Program
- U.S. DoD OLDCC Implementation Grants
- U.S. DoD Community Infrastructure Program
- U.S. DOT Infrastructure for Rebuilding America
- U.S. HUD CDBG Entitlement Program
- FEMA BRIC Grant Program
- FEMA Flood Mitigation Assistance Program

5 5.3.5 Frederick Boulevard Comprehensive Flood Mitigation and Stormwater Management Strategy

Flood Mitigation

Frederick Boulevard provides an important connection to I-264 and can be accessed via Portsmouth Boulevard near the NNSY main gate, or George Washington Highway near the entrance to Scott Center Annex and the New Gosport Navy family housing area. Frederick Boulevard also indirectly connects to the South Norfolk Jordan Bridge, providing access to Chesapeake across the Southern Branch of the Elizabeth River.

The Need for Action

Although the majority of Frederick Boulevard does not appear to be vulnerable to tidal flooding in the absence of rainfall, the intersection of Fredrick Boulevard and George Washington Highway is affected by tidal flooding with 3.0 feet of SLR (Scenario 3). Flooding in this intersection would affect access to Scott Center Annex and points north and potentially impact access to the New Gosport Navy family housing area at Alabama Avenue.

Multiple segments of Frederick Boulevard are indicated as flooded in all of the combined rainfall and tidal flooding Scenarios 4 through 8. In Scenario 4, at its intersection with I-264, Frederick Boulevard is shown as flooded by as much as 6 inches, and three segments between that intersection and I-264 are also flooded: two are flooded between 6 and 12 inches and one is flooded to a depth of 12 inches or greater. The intersection with George Washington Highway is flooded by at least 12 inches in Scenarios 5 through 8. The addition of SLR to the present-day rainfall scenarios does not appear to increase the flooding extents or depths for Frederick Boulevard, which is consistent with the boulevard not being directly impacted by tidal flooding.

In Scenarios 7 and 8 the number of segments flooded does not increase, but the flood depths increase and the length of flooded segments slightly increases.

Keeping Frederick Boulevard accessible from George Washington Highway to the I-264 interchange would maintain a direct route from NNSY, the New Gosport family housing area, and Scott Center Annex to I-264 and beyond. This accessibility becomes more critical should George Washington Highway or Portsmouth Boulevard experience flooding. Frederick Boulevard south of I-264 is also generally less densely developed immediately adjacent to its right-of-way, which

Goal Alignment

DOD Mission & Personnel Readiness ●●●○○ ●●●○○

Transportation Network Connectivity ●●●

Community Benefits ●●●○

Economic Resilience ●●○○

Strategy Total Score

Estimated ROM Cost: $$$

Timeframe

SHORT 0-3 yrs | MID 3-10 yrs | LONG +10 yrs

Back to Priority Actions Map

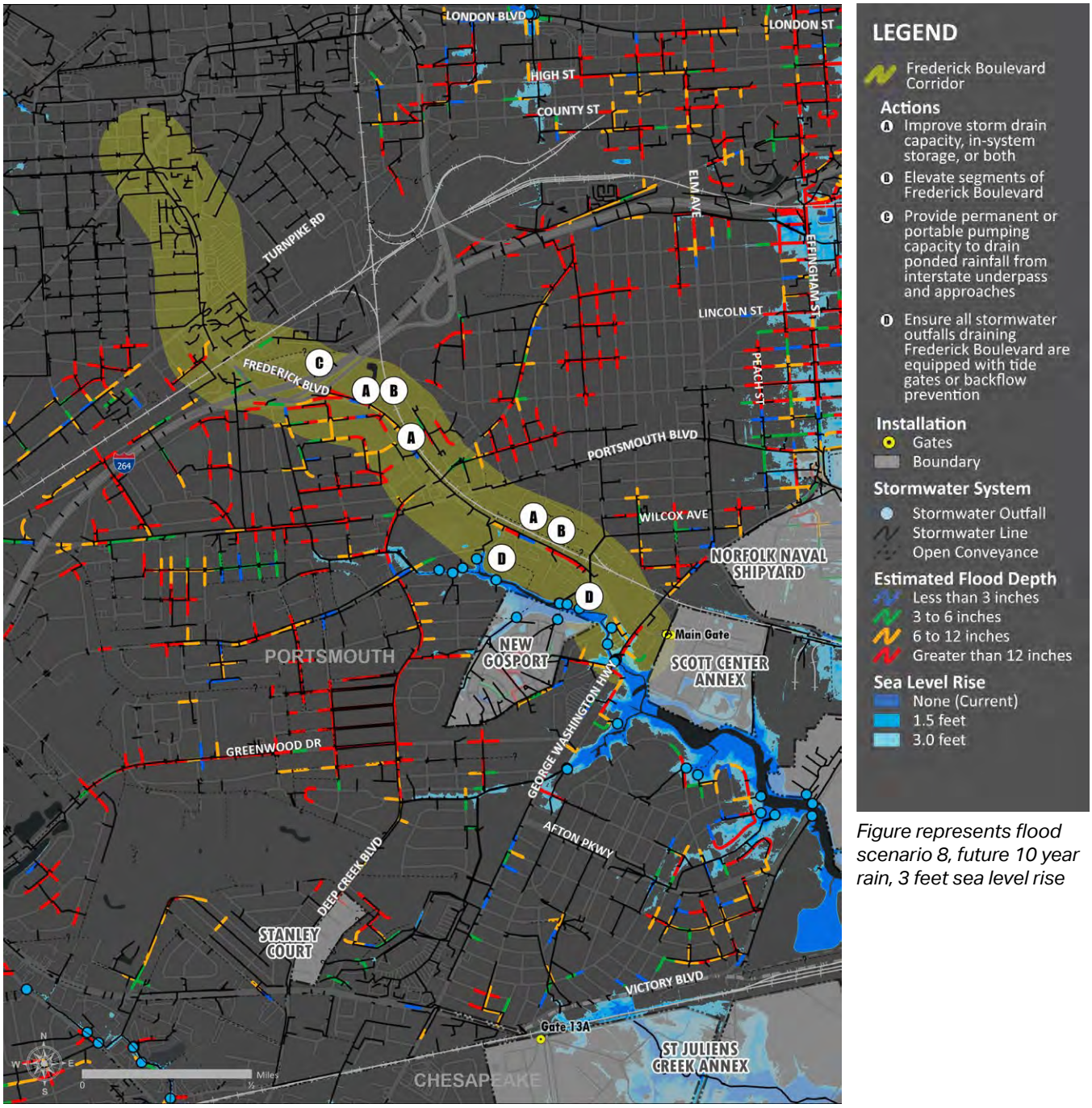


Figure represents flood scenario 8, future 10 year rain, 3 feet sea level rise

Figure 5.6 Frederick Boulevard Potential Flood Mitigation Improvements

could present opportunity for implementation of flooding mitigation measures along the corridor.

A comprehensive strategy for Frederick Boulevard is needed to manage current and future flooding along approximately 1.4 miles of the corridor, from its intersection with George Washington Highway to the I-264 interchange. The strategy will need to combine different infrastructure improvements and options as illustrated on Figure 5.6. The following components or strategies should be considered and further evaluated to mitigate future flood impacts along Frederick Boulevard:

- Improving storm drain conveyance capacity, in-system storage, or both
- Elevating segments of Frederick Boulevard
- Providing for permanent or portable pumping capacity to drain ponded rainfall runoff from the boulevard's I-264 underpass and approaches to the interchange ramps

- Ensuring that all stormwater outfalls to which Frederick Boulevard drains are equipped with tide gates or similar backflow prevention

If deemed appropriate, the provision of portable pumping capacity at the I-264 interchange and installation of backflow prevention on the boulevard's storm drain outfalls could be implemented to provide near-term, interim benefits while the comprehensive strategy is being developed.

Implementation Steps

1. Form a committee to oversee and coordinate project planning, design, and implementation among partners.
2. Define an outline and approach for the study in coordination with the Navy and VDOT. This step will include compiling available topographic and utility surveys of areas within the rights-of-way of Frederick Boulevard and its intersections with George Washington Highway and I-264, as well as ownership and usage information regarding the parcels adjacent to Frederick Boulevard. Recognizing that the Portsmouth and its consultants have continued to develop stormwater survey data and stormwater modeling since the initial models were provided to the JLUS team, the outline approach should consider any additional stormwater modeling that has been completed relative to the specific project area.
3. Based on information developed and evaluated in Step 1, define a detailed scope of work and budget for the study, in coordination with the Navy and VDOT.
4. Pursue funding for the study.
5. Using the information compiled in Step 1, develop conceptual mitigation alternative designs for maintaining access along Frederick Boulevard between George Washington Highway and I-264.
6. Jointly evaluate the conceptual mitigation alternative design solutions across city departments and in consideration of other current initiatives that could affect development in the corridor. Changes to roadway geometry should include the development and evaluation of alternatives.
7. Coordinate with VDOT to evaluate solutions to keep the Frederick Boulevard I-264 interchange accessible in present and future rainfall scenarios.
8. Define applicable operating and maintenance parameters as part of any solution.
9. Identify phasing and jointly pursue funding for implementation of the preferred design.

Lead Partner

Portsmouth

Other Partners

U.S. Navy, VDOT

Potential Funding Sources

- Portsmouth CIP Funding
- Virginia Transportation Funding (VDOT, DRPT)
- VA DEQ Stormwater Local Assistance Fund
- VA DEQ Stormwater Loans
- VA Dam Safety and Floodplain Management Grants
- FHWA Defense Access Road Program
- U.S. DoD OLDCC Implementation Grants
- U.S. DoD Community Infrastructure Program
- U.S. DOT Infrastructure for Rebuilding America
- U.S. HUD CDBG Entitlement Program
- FEMA BRIC Grant Program
- FEMA Flood Mitigation Assistance Program

6 5.3.6 Cedar Lane Flood Mitigation Improvements

Flood Mitigation

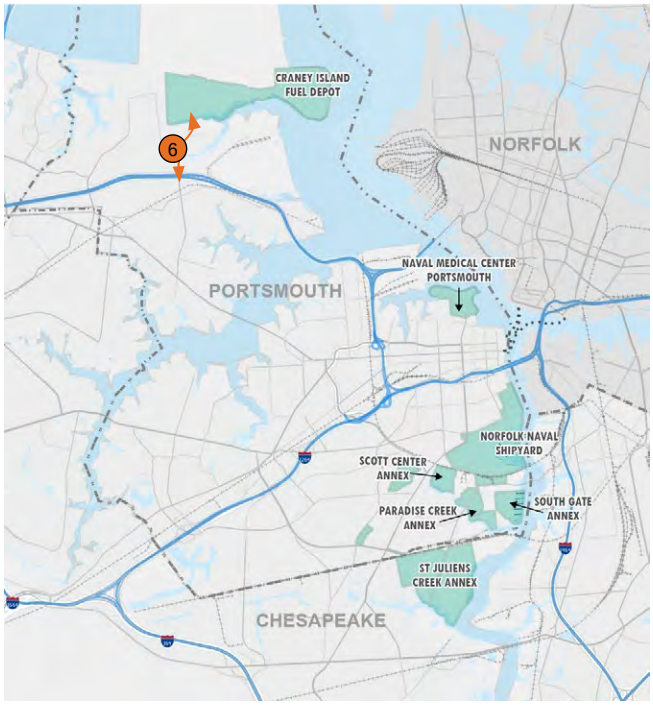
Cedar Lane provides the only connection to the Craney Island Fuel Depot via the Western Freeway and the regional expressway network. The Western Freeway interchange at Cedar Lane is also the entrance to Coast Guard Boulevard that provides access to U.S. Coast Guard Base Portsmouth. Maintaining access along this route is essential for mission readiness.

The Need for Action

Although the exposure analysis did not indicate extensive vulnerability to tidal flooding or combined rainfall and tidal flooding along Cedar Lane between the expressway and the Craney Island Fuel Depot, potential flooding impacts in certain areas could disrupt access. As shown in Figure 5.7, two short segments of Cedar Lane, both at the fuel depot's main gate and at a segment near Greenbrook Drive, are vulnerable to tidal flooding in Scenarios 1, 2, and 3, and a short segment of the road is vulnerable to combined rainfall and tidal flooding. The Cedar Lane interchange with Western Freeway does not appear to be vulnerable to flooding in the scenarios evaluated.

All three of the tidal-flooding-only scenarios (1 through 3) show the potential for tidal flooding on Cedar Lane in the 1-year return period river level, in the area where Cedar Lane crosses into the Craney Island Fuel Depot. In addition, a short segment of Cedar Lane just north of River Shore Road is vulnerable to combined rainfall and tidal flooding in Scenarios 4 through 8.

The exposure analysis also indicates large areas within the fuel depot fence line that appear to be vulnerable to tidal flooding in Scenarios 1 through 3. These conditions could significantly disrupt installation infrastructure and internal access. Additional investigations of the impacts of flooding inside the fuel depot fence line are recommended, and the results of those investigations may have a bearing on the feasibility of the flood mitigation improvements recommended in this action. Strategy 5.3.22 also recommends a joint study between Portsmouth and the installation for a secondary access road to serve the Craney Island Fuel Depot in order to ensure long-term access for the site.



Goal Alignment

DOD Mission & Personnel Readiness	●●●○○ ●●●○○
Transportation Network Connectivity	●●●
Community Benefits	●●●○
Economic Resilience	●●○○

Strategy Total Score

Estimated ROM Cost:

$$$

Timeframe

SHORT 0-3 yrs | MID 3-10 yrs | LONG +10 yrs

Back to Priority Actions Map

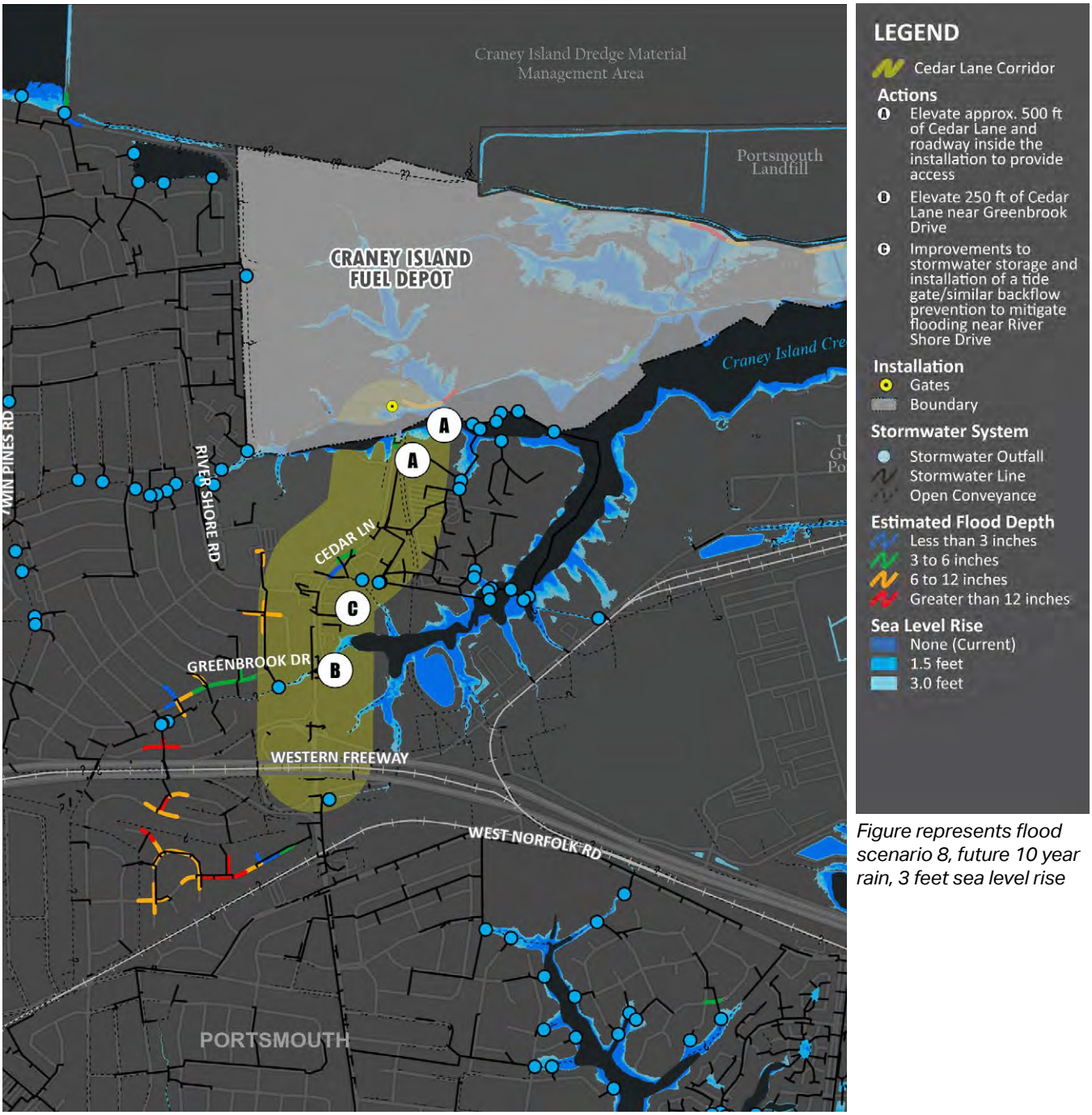


Figure represents flood scenario 8, future 10 year rain, 3 feet sea level rise

Figure 5.7 Cedar Lane Potential Flood Mitigation Improvements

Maintaining access along Cedar Lane is critical to the operational readiness of the depot, which operates on a 24/7 basis. It is the only route currently available and is, therefore, critical for emergency response access. Future flooding will impact access to and through the depot over time.

Providing resilience to flooding along Cedar Lane between the expressway and the Craney Island Fuel Depot will require a combination of elements, including:

- Elevating approximately 500 feet of Cedar Lane and the roadway immediately within the fuel depot fence line to provide access to the installation
- Potentially elevating approximately 250 feet of Cedar Lane near Greenbrook Drive
- Improvements to stormwater storage and installation of a tide gate or similar backflow prevention to mitigate flooding near River Shore Road

If deemed appropriate, the installation of backflow prevention on the storm drain outfall near River Shore Road could be implemented to provide near-term, interim benefits while the feasibility of the other improvements is being evaluated.

Implementation Steps

1. Define an outline and approach for the feasibility study, in coordination with the Navy and VDOT. This step will include compiling available topographic and utility surveys of the area within the rights-of-way of Cedar Lane and its intersections with Greenbrook Drive and River Shore Road, as well as ownership and usage information regarding the parcels adjacent to Cedar Lane. Recognizing that the City of Portsmouth and its consultants have continued to develop stormwater survey data and stormwater modeling since the initial models were provided to the JLUS team, the outline approach should consider any additional stormwater modeling that has been completed relative to the specific project area.
2. Based on information developed and evaluated in Step 1, define a detailed scope of work and budget for the study and for conceptual engineering designs of the improvements to an extent that would support the feasibility analysis.
3. Pursue funding for the feasibility study and design.
4. Using the information compiled in Step 1 and Step 2, develop conceptual mitigation alternative designs for maintaining access along Cedar Lane from Western Expressway to the Craney Island Fuel Depot main gate.
5. Jointly evaluate the conceptual mitigation alternative design solutions across city departments and in consideration of other current initiatives that could affect development in the corridor. Changes to roadway geometry should include the development and evaluation of alternatives.
6. Define applicable operating and maintenance parameters as part of any solution.
7. Identify phasing and jointly pursue funding for implementation of the preferred design solutions.
8. Form a committee to oversee and coordinate project implementation among partners.

Lead Partner

Portsmouth

Other Partners

U.S. Navy, USCG

Potential Funding Sources

- Portsmouth CIP Funding
- Virginia Transportation Funding (VDOT, DRPT)
- VA DEQ Stormwater Local Assistance Fund
- VA DEQ Stormwater Loans
- VA Dam Safety and Floodplain Management Grants
- FHWA Defense Access Road Program
- U.S. DoD OLDCC Implementation Grants
- U.S. DoD Community Infrastructure Program
- U.S. DOT Infrastructure for Rebuilding America
- FEMA BRIC Grant Program
- FEMA Flood Mitigation Assistance Program

7 5.3.7 Jointly study options for an additional HRT pilot MAX route that serves NNSY and Naval Medical Center Portsmouth, and include concepts for allowing the bus to enter the installations

Multi-Modal

The Need for Action

There are no dedicated MAX routes serving the Navy installations in the JLUS. HRT currently operates four routes (Routes 41, 43, 45, and 57) with direct connections to the installations; however, the routes stop near the entry control facilities and do not enter the installations. With route headways as long as 60 minutes, the need for transfers, and a lack of access by bus onto the installations, bus transportation is currently not a reliable mode of transportation for military personnel. Furthermore, as described in Chapter 3, the installations do not have robust internal shuttle services for public transportation users; at NNSY, an internal shuttle service only provides access to specific buildings and is not related to bus transit stops.

No specific MAX routes are proposed to serve NNSY or Naval Medical Center Portsmouth in the HRT Transit Strategic Plan for FY2021–FY 2030. However, MAX Route 970 is proposed as a planned service improvement to serve Newport News Shipyard with access provided in Downtown Portsmouth. The plan recognizes that other routes will be explored by HRT, including connecting Chesapeake to NNSY. A MAX route that serves NNSY and Naval Medical Center Portsmouth should be studied to improve transit reliability and offer a more efficient and direct option for military personnel to get to work. HRT is currently conducting a commuter needs survey directed to NNSY employees which can inform this action. Chapter 6 discusses the need to update the HTRPO Military Commuter Needs Survey on a recurring basis so it can inform transit planning.

Implementation Steps

1. Hold meeting to review NNSY commuter survey results and plan options for an exclusive MAX route to serve NNSY and Naval Medical Center Portsmouth. The route should consider options for bus access onto the installations, similar to that provided at Naval Station Norfolk and define preferred stop locations.
2. Define parameters for pilot route and coordinate promotion of service for Navy personnel. Consider promotional activities and incentives for encouraging use.
3. Evaluate ridership and coordinate on future adjustments, as required.

Lead Partner

HRT

Other Partners

Portsmouth, Chesapeake, U.S. Navy

Potential Funding Sources

- HRT
- VA Commuter Assistance Program Grants
- Virginia Transportation Funding (VDOT, DRPT)
- U.S. DoD OLDCC Implementation Grants
- FTA Integrated Mobility Innovation Grants
- FTA Public Transportation innovation Grants

Goal Alignment

DOD Mission & Personnel Readiness ●●●●●

Transportation Network Connectivity ●●●

Community Benefits ●●○○

Economic Resilience ○○○○

Strategy Total Score

Estimated ROM Cost:

$$$

Timeframe

8 5.3.8 Continue on-going coordination for Enhanced Use Lease opportunities at South Gate Annex and St. Juliens Creek Annex

Land Use & Development

Portions of South Gate Annex in Portsmouth and St. Juliens Creek Annex in Chesapeake are currently underutilized by the Navy. The underutilized areas at both sites present unique opportunities for reuse and redevelopment in the form of an EUL or public-private venture (PPV) that could benefit the Navy, Portsmouth, and Chesapeake.

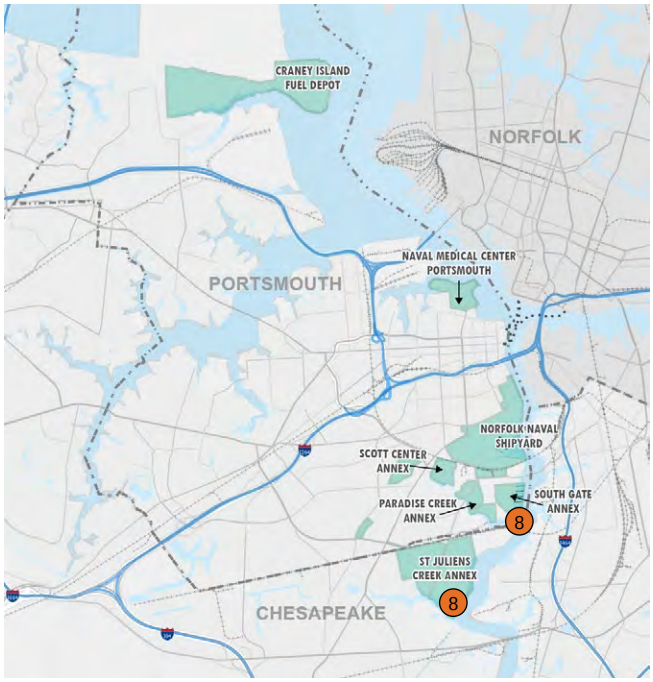
NNSY, Portsmouth, and Chesapeake share an interest in pursuing EULs that would lead to additional compatible industrial development and economic growth for both cities. The sites are situated within a predominantly industrialized working waterfront, and reuse potential could attract interest from both the public and private sectors.

The Need for Action

Redevelopment of an EUL site would allow the Navy to retain rights to the site but could create additional local jobs during construction and over the life of the EUL term. The EUL can include specific requirements to ensure any changes are compatible with adjacent military operations and security requirements. Potential impacts associated with new, more intense uses should be evaluated jointly by the Navy and localities to ensure that necessary infrastructure upgrades and site improvements are identified to mitigate impacts.

The potential EUL sites at South Gate Annex encompass about 16 acres, including Piers D, E, and F. An Environmental Condition of Property assessment and survey work has been funded for the South Gate Annex EUL, and a request for industry input is being developed to understand potential interest in the site. Other areas of South Gate that would not be part of an EUL include remote parking lot #42, which is used for long-term parking, and piers A, B, and C, which the Navy uses for heavy-weather mooring. South Gate Annex is within the Paradise Creek Industrial area, and access to the EUL site is available via Burtons Point Road.

A segment of Burton's Point Road south of Elm Avenue is affected by flooding in Scenarios 4 through 8. East of Burton's Point Road a segment of Elm Avenue would be flooded in Scenarios 3 through 8, and this would impact access to South Gate Annex from NNSY and points west.



Goal Alignment

DOD Mission & Personnel Readiness	●●●○○ ●●●○○
Transportation Network Connectivity	●●○
Community Benefits	●○○○
Economic Resilience	●●●●

Strategy Total Score

Estimated ROM Cost:

$$$

Timeframe

SHORT	MID	LONG
0-3 yrs	3-10 yrs	+10 yrs

Back to Priority Actions Map

However, the corridor from Victory Boulevard to Elm Avenue appears to be an accessible corridor to reach Burton's Point Road. Development of EUL concepts should consider a range of flooding mitigation extents and solutions that provide accessibility and provide for the EULs' sustainable functionality.

EUL opportunities at St. Juliens Annex have not been specifically defined or discussed with Chesapeake or other entities. However, as discussed in Section 3.2.2, a 2001 study conducted by the Urban Land Institute identified several opportunities for redevelopment of the site, noting the proximity to deep water access and adjacent industrial sites as strengths.

Access to St. Julien's Creek Annex is provided by Victory Boulevard, and this corridor is generally not indicated as flooding in the evaluated scenarios except for a few short segments where shallow stormwater related flooding are indicated in Scenarios 4 through 8. However, depending on where the EUL projects would be located within the Annex, the EUL development and design process should consider land uses that would be compatible with periodic flooding and/or should include features that mitigate tidal flooding potential affecting the EUL areas.

Each DoD department defines the process for developing, executing, and managing EULs. The timing for completing an EUL varies (i.e., project identification to closing a lease) and is based on the complexity of the project, length of lease negotiations, and approval processes.[3]

Implementation Steps

1. Explore the creation of an EUL task force with Navy and City representatives to jointly evaluate options and goals for the EULs.
2. Complete a market/feasibility study and/or industry interest market survey for each site.
3. Complete an Environmental Condition of Property assessment/environmental assessment for each site, as required.
4. Secure Navy Regional Commander and Commander Navy Installation Command endorsement to advance EUL.

Lead Partner

U.S. Navy

Other Partners

Portsmouth, Chesapeake

Potential Funding Sources

- U.S. Navy

The National Defense Authorization Act, Title 10 of the U.S.C. Section 2667, authorizes the DoD to make underutilized, non-excess real property or facilities available for lease to a private or public entity. In return, the government can obtain consideration in cash or through in-kind services. In-kind services can include services listed under a shared agreement; repair or restoration of improvements; construction of improvements; maintenance of improvements; providing facilities with services, utilities, or planning; or other services related to Navy activities approved by the Secretary of the Navy.[4] This authority enables the Navy to maximize the utility and value of installation real property and provide additional tools for managing the installation's real estate assets to achieve business efficiencies.[5] EULs typically have long-term leasing periods and can include specific development requirements.

3 Congressional Research Service. 2019. "Department of Defense Outleasing and Enhanced Use Leases." In Focus. September 13. https://fas.org/sgp/crs/natsec/IF11309.pdf. Accessed 3/29/21.

4 U.S. Navy. 2020. *Naval Air Station Oceana Future Base Design: Making the Most of Options and Opportunities*. October. https://www.wavy.com/wp-content/uploads/sites/3/2021/03/CRE-CC-NAS-Oceana-FBD-Report-2.pdf. Accessed 3/29/21

5 NAVFAC. n.d. "About Enhanced Use Leasing" (webpage). https://www.navfac.navy.mil/products_and_services/am/products_and_services/enhanced_use/About.html. Accessed 3/29/21.

9 5.3.9 Prioritize proposed bicycle routes that are adjacent to Navy installations in adopted locality plans and help create regional connections

Multi-Modal

The Need for Action

As the Navy mission and installations continue to grow and evolve, so does transportation demand, resulting in increased congestion and constraints at entry control points and on roadways adjacent to the installations. This degradation in transportation mobility and accessibility creates a greater reliance and emphasis on providing additional modes of transportation, such as bicycles.

Existing bikeways within the vicinity of the installations along Cedar Lane, Elm Avenue, and the South Norfolk Jordan Bridge include interrupted or incomplete connections to/from the installations. Over 17 percent of the shipyard workforce currently lives in Portsmouth, but very few employees bike to work.

Portsmouth's Bicycle and Pedestrian Plan, developed with stakeholder support from NNSY, outlines and prioritizes recommended bicycle improvements throughout the city. The bicycle improvements build upon previous efforts by the City to create an active community accommodating bicyclists and pedestrians in a safe environment for all skill levels. Although the plan identifies several bicycle improvements, the majority of improvements for improving accessibility and connectivity to the installations were deemed as medium or low priority recommendations with the exception of Victory Boulevard between George Washington Highway and Paradise Creek Nature Park, which was classified as high priority.

Providing and prioritizing bicycle improvements with connections to the installations could provide the following benefits:

- An additional mode of transportation to improve installation access
- Improve the safety of bicyclists
- Help reduce dependency on personal vehicles and the demand for parking
- Create additional opportunities for recreation and physical fitness

Having defined bicycle routes and accessibility internal to the installations is also an important factor for encouraging bicycling as a viable option for commuting. Several other recommendations address bicycle infrastructure upgrades at the installations to further promote the usage of bicycles as an additional mode of travel.

Goal Alignment

DOD Mission & Personnel Readiness	●●●●● ●●●●●
Transportation Network Connectivity	●●●
Community Benefits	●●○○
Economic Resilience	○○○○

Strategy Total Score

Estimated ROM Cost:

$$$

Timeframe

Recommended and Existing Bikeways.

Source: Bicycle and Pedestrian Plan - Portsmouth VA, June 2020.

Implementation Steps

1. Explore the creation of a bicycle task force to consist of installation representatives and stakeholders from both Portsmouth and Chesapeake. This task force should identify and explore the following:
   - Prioritization of proposed City bicycle improvements external to the installations
   - Identification of programs to incentivize bicycle usage for Navy personnel
   - Identification of preferred bicycle entry control point locations and potential modifications
2. Pursue funding for implementing priority bicycle route improvements.
3. Develop conceptual plans and designs for the bicycle improvements.
4. Initiate required permits and approvals.
5. Pursue funding for construction.

Lead Partners

- Portsmouth, Chesapeake

Potential Funding Sources

- Portsmouth CIP Funding
- Chesapeake CIP Funding
- Virginia Transportation Funding (VDOT, DRPT)

10 5.3.10 Pursue a remote parking and shuttle feasibility analysis to evaluate the cost/benefits of each parking site and preferred options for direct shuttle service

Parking

The Need for Action

Parking is a commodity at both NNSY and Naval Medical Center Portsmouth. A lack of available parking is already identified at Naval Medical Center Portsmouth, where staff parking is creating deficiencies for patients and visitors. At NNSY, a 2017 parking study indicated that approximately 20 percent of the total parking supply is unoccupied, largely because of its location in remote areas within the installation fence line. Impacts to parking supply are expected to continue as the shipyard is redeveloped to prioritize land for mission-essential facilities and operations versus parking.

The location of remote parking areas adds considerable time to an employee's commute and ability to reach their ultimate destination within the installation, as discussed in Chapter 2. The inconvenient location(s) also causes behavior that leads to illegal parking in adjacent neighborhoods (i.e., SSPD). An internal shuttle service is currently provided at NNSY; however, it is only able to provide service inside installation boundaries and at specific buildings and facilities, not to remote parking areas. Furthermore, the existing internal shuttle service has low ridership, which is attributable to multiple stops (i.e., 21 stops) and long round-trip times (i.e., 30+ minutes). These constraints, combined with the inability for internal shuttle service to serve remote parking areas, mean that remote parking areas are currently an inconvenient and unreliable option for personnel.

To better utilize existing parking on the installation and to help reduce parking impacts being sustained and/or exacerbated in adjacent neighborhoods, the current shuttle system should be modified to be more efficient, and service should be expanded to include internal/remote parking lots.

To prevent further parking impacts within the neighborhoods surrounding NNSY, and to anticipate further reductions of parking supply on base, a study is needed to evaluate the following:

- Anticipated future parking demand
- Anticipated future parking supply
- Potential consolidation of existing internal shuttle stops at NNSY
- Strategies to reduce roundtrip travel time of the NNSY internal shuttle (i.e., running multiple shuttles that serve every other stop)
- Potential locations for remote parking lots external to the installations
- Strategies and routes for direct shuttle service from remote parking areas to the installation, including capability of access onto the installation

Portsmouth and the Navy have begun discussions regarding potential candidate locations for remote parking areas. These locations range from within 1 mile of an installation (e.g., adjacent to the Bart Street and Court Street intersection or within the Afton Shopping Center) to other locations that are 5 or more miles from an installation (e.g., adjacent to the I-264 and Greenwood Drive interchange). Approximately 10 potential locations have been identified as candidate requiring further study as part of the JLUS, as shown in Figure 5.8.

Goal Alignment

DOD Mission & Personnel Readiness	●●●●● ●●●●●
Transportation Network Connectivity	●●●
Community Benefits	●○○○
Economic Resilience	○○○○

Strategy Total Score

Estimated ROM Cost:

$$$

Timeframe

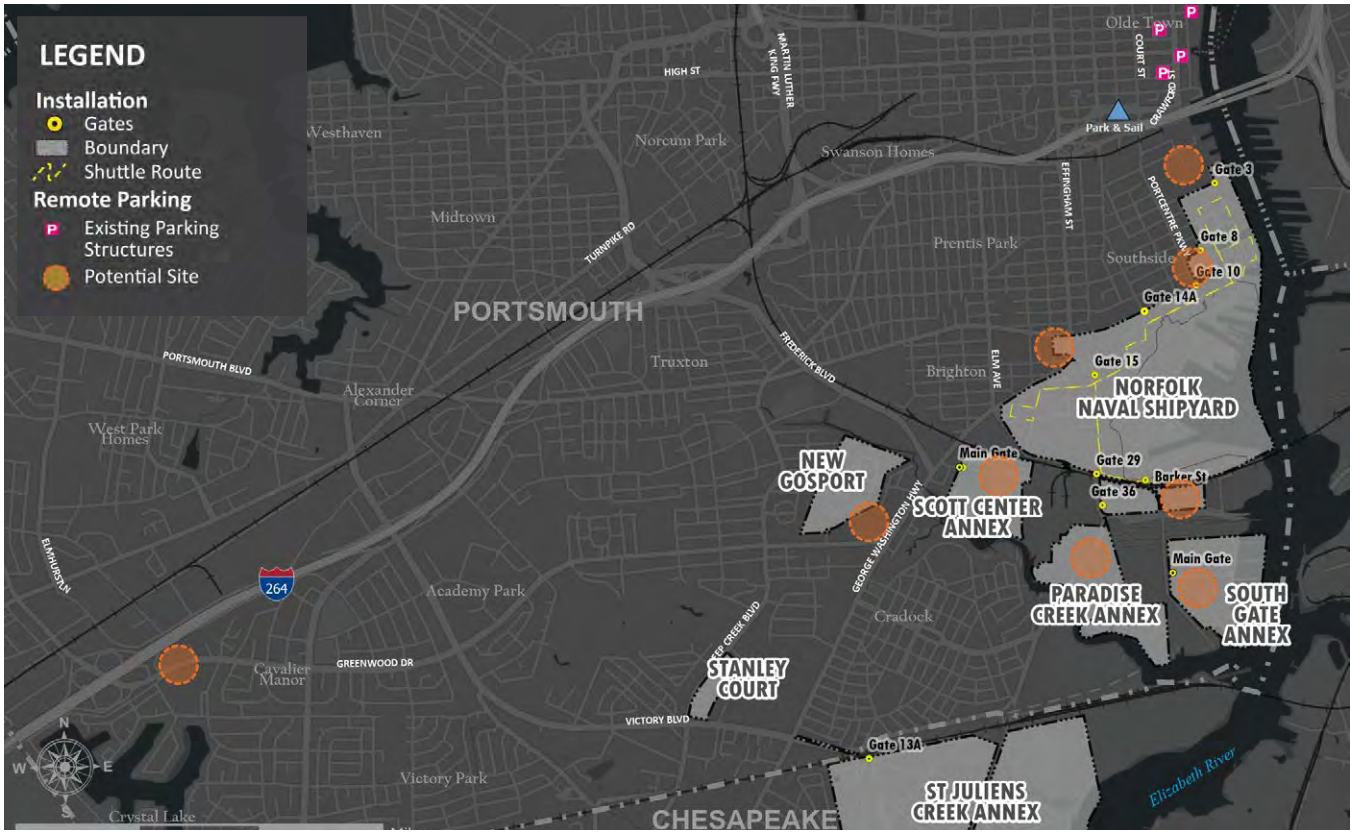


Figure 5.8 Potential Remote Parking Sites

The success of any proposed parking area will be based largely on trip reliability, and more importantly, the reliability of a direct and efficient shuttle service between the parking areas and individual installations. Other amenities like vehicle charging stations could also be considered to incentivize use. The last mile service from a remote parking lot to the installation must be efficient so that remote parking is as competitive as driving alone. Solutions that allow the shuttle to directly enter the installation should be discussed. Gate security and processing requirements for a shuttle should be discussed as part of the feasibility study. The desire for allowing transit bus access onto NNSY is also discussed as part of a pilot MAX route.

Recently, Portsmouth submitted funding applications for a park-and-ride lot adjacent to the I-264 and Greenwood Drive interchange. The proposed parking lot has shuttle/bus/Uber/Lyft accommodations planned and is intended to serve as a multimodal hub and parking lot. NNSY staff have indicated that other remote parking areas that are located farther from NNSY than the Greenwood Drive location (i.e., Greenbrier Mall, approximately 12 miles from NNSY) have been utilized by personnel.

A feasibility analysis could jointly identify suitable alternative sites for remote parking and evaluate the benefits and constraints of each site. Screening criteria for alternatives should consider parameters such as (but not limited to) travel time, trip reliability between the parking area and installation, facility cost, parking capacity, opportunities for shared parking among nearby uses, operations and maintenance costs, and security. Other factors such as ownership, existing and nearby land uses, and underlying zoning regulations should be included. The study should lead to the identification of preferred remote parking sites, so that shuttle service can be properly scaled to be efficient and feasible.

The study should evaluate the feasibility of providing shuttle service to the preferred remote sites, including consideration of access and security screening requirements or infrastructure upgrades that would be needed to support access onto the installation. The cost, ownership, and management of the shuttle service should be evaluated.

Conclusions from the feasibility study must be supported by a data-driven approach such that proposed locations with high benefit-to-cost ratios can be submitted for, and be competitive in, state and federal funding programs (i.e., SMART Scale, DCIP, etc.).

Implementation Steps:

1. Undertake a review of internal shuttle service operations at NNSY to identify opportunities to improve trip travel times. This may include a reduction in stops or a change in shuttle service operations.
2. Form a feasibility study committee, consisting of members from each installation, Portsmouth, Chesapeake, HRPDC, and HRT.
3. Identify a list of potential remote parking areas to be included in the feasibility study and define the study scope of work.
4. Seek funding for the feasibility study.
5. Conduct the feasibility study.

Lead Partner

Portsmouth

Other Partners

- U.S. Navy
- HRTPO
- HRT
- TRAFFIX

Potential Funding Sources

- Portsmouth CIP Funding
- HRT
- Virginia Transportation Funding (VDOT, DRPT)
- VA Commute Assistance Program Grants
- U.S. DoD OLDCC Implementation Grants
- FTA Integrated Mobility Innovation Grants
- FTA Public Transportation Innovation Grants

11 5.3.11 Regularly evaluate parking utilization on base (and commuting trends) and use the data to drive toward a reduction in free parking and an emphasis on remote parking/shuttle strategies

Parking

The Need for Action

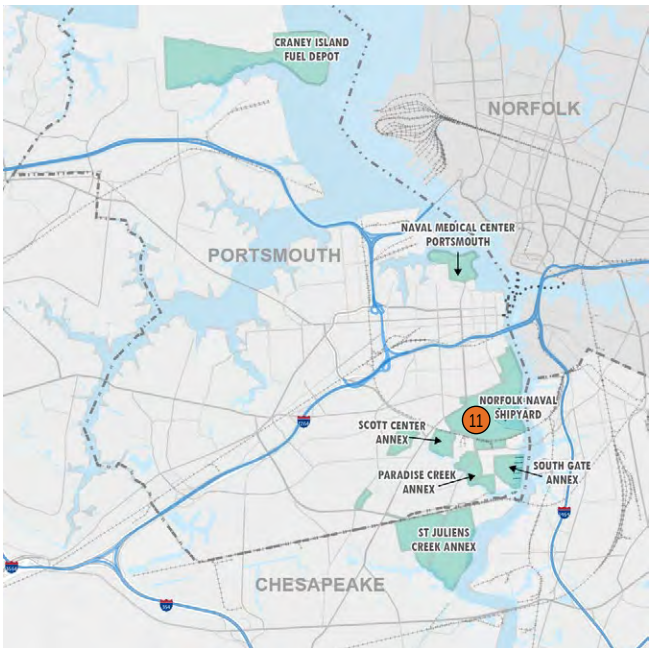
Parking areas within an installation experience varying levels of occupancy throughout a typical day. Some areas consistently experience near 100 percent occupancy, while other areas experience more sporadic occupancies. These trends are largely governed by walkability, which is one of the more significant factors that determines an individual's parking preference. Currently, 10 percent of unoccupied spaces in high-utilization areas is estimated to be attributable to unused reserved spaces.

Currently, parking on NNSY is largely unrestricted and available to employees and visitors. Each installation should perform routine parking occupancy surveys, focused primarily on the average occupancy of open and reserved parking spaces. Minimum guidelines for reserved spaces should be verified and the extent to which illegal parking is occurring should be documented. The installations could conduct a stated preference commuter survey to understand existing commute trends as part of this effort, including the following:

- Where are employees/visitors commuting from?
- Where are employees/visitors destined to on base?
- Does the employee/visitor have a reserved parking space?
- Does the employee/visitor have parking location preference, and if so, what is it?

Insight on existing commute patterns provides installation planners with an understanding of whether potential opportunities for remote parking and accompanying shuttle service could be beneficial and viable. A shift toward remote parking would allow for a potential reduction in open parking on base and provide further opportunities to develop limited space land areas within the installation

To improve overall occupancy consistency across the entire installation, open and restricted parking should be removed, and all parking areas should be managed through a centralized parking permit system. This approach allows parking permits to be issued for individual parking areas/lots that have adequate parking for an intended group of users. The permits would allow for an adequate



Goal Alignment

DOD Mission & Personnel Readiness ●●●●○ ●●●●○

Transportation Network Connectivity ●●●

Community Benefits ●○○○

Economic Resilience ●○○○

Strategy Total Score

Estimated ROM Cost: $$$

Timeframe

SHORT 0-3 yrs | MID 3-10 yrs | LONG +10 yrs

Back to Priority Actions Map

parking supply to accommodate both "open" and "restricted/reserved" users for each group. For example, if a particular building is anticipated to employ 100 staff at full occupancy, a parking area with approximately 100 (or slightly more to accommodate visitors) spaces can be designated for permit parking for the staff of that building only. Therefore, the parking area has the ability to accommodate both "open" and "reserved" parking classifications in a single area without there being a risk that an employee with rights to a reserved spot will not be able to find a parking spot.

A separate strategy that recommends installing real-time parking availability systems with notification boards at installation entry-control points is also discussed in Section 5.3.13.

Implementation Steps:

1. Conduct an analysis to identify an accurate parking demand associated with each major employment center/building on base, including minimum number of reserved parking spaces needed.
2. Conduct an updated parking space inventory and occupancy survey. Occupancy surveys should be conducted at least once a year to confirm any changes in parking patterns.
3. Develop and conduct a stated preference survey to understand existing commuting trends.
4. Adjust parking supply, as needed, to meet minimum reserved parking requirements and as redevelopment projects on base are planned and implemented and develop a zonal parking pilot program for one or two buildings before rolling out an installation-wide program
5. Program routine parking lot maintenance to delineate parking spaces in unmarked areas. This will help to identify an accurate parking inventory.

Lead Partner

- U.S. Navy

Other Partners

- HRTPO
- HRT
- TRAFFIX

Potential Funding Sources

- U.S. Navy

Transportation and Parking Survey Example.

Source: NAVFAC Atlantic, Navy Triangle Influence Area Master Transportation Plan - Naval Station Norfolk, March 2014.

12 5.3.12 Pursue a joint industrial area preservation and improvement plan aimed at promoting the managed growth and redevelopment of the "Paradise Creek Industrial Park" area

Land Use & Development

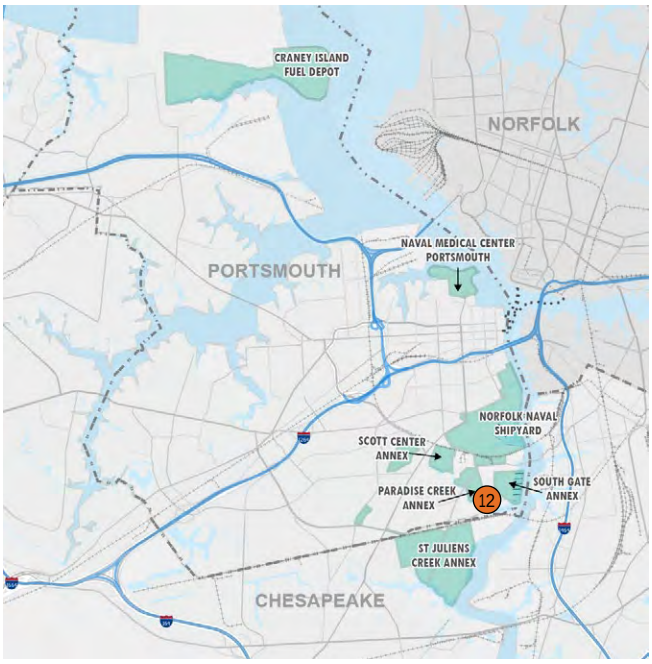
The Paradise Creek industrial area south of Elm Avenue, between George Washington Highway and the Elizabeth River, represents an opportunity for infill and redevelopment that would provide economic value and benefit to Portsmouth through job growth and tax revenues. The future land use of the area is defined by the city as heavy industrial, and several parcels are identified as underutilized,[6] further demonstrating the potential for economic vitality and increased value and benefits for Portsmouth.

Previous planning efforts recognized the underused nature of the area and the underlying environmental contamination that has led much of the area to be in active or planned clean up.[7] For example, a joint effort to remediate the Atlantic Wood Industries Superfund Site is positioning parcels for reuse and reinvestment.[8]

The Need for Action

A coordinated technical planning effort is needed to develop a comprehensive managed growth plan for the industrial area. The planning study should identify opportunities for parcel consolidation, reuse, redevelopment, and potential relocation as part of a long-term growth plan. The study should also consider impacts to the surrounding community and environmental justice impacts.

Access and circulation remain a challenge and internal connectivity through the industrial area is constrained by navy installation fence lines and the Norfolk and Portsmouth Beltline Railroad. The study should consider current and future flood impacts in evaluating access improvements between George Washington Highway and the Jordon Bridge, including consideration of how the industrial area could also support improved or



Goal Alignment

DOD Mission & Personnel Readiness	●●○○○ ●●○○○
Transportation Network Connectivity	●○○
Community Benefits	●●○○
Economic Resilience	●●●●

Strategy Total Score

Estimated ROM Cost: $$$

Timeframe

SHORT	MID	LONG
0-3 yrs	3-10 yrs	+10 yrs

Back to Priority Actions Map

6 City of Portsmouth. 2018. *Build One Portsmouth.* https://www.portsmouthva.gov/396/Comprehensive-Plan. Accessed 4/3/21.

7 City of Portsmouth. 2013. *Paradise Creek Industrial Corridor Future Use Plan: Portsmouth, Virginia*. October. https://semspub.epa.gov/work/03/2186921.pdf. Accessed 4/3/21.

8 Portsmouth Economic Development. 2020. "Department of Environmental Quality, & City of Portsmouth to Celebrate Progress at Superfund Site." Press Release. July 28. https://www.accessportsmouthva.com/news-and-press/environmental-protection-agency-department-of-environmental-quality-and-city-of-portsmouth-to-celebrate-progress-at-superfund-site. Accessed 4/4/21.

expanded access to Scott Center Annex, South Gate Annex, and the main site of NNSY from the south.

The need for a coordinated approach in developing a long-term entry control plan for NNSY is discussed in Strategy 5.3.15. While the industrial area does not have a direct gate into NNSY, areas south of NNSY are potentially less impacted by future flooding and could offer more resilient long-term access solutions to the installation that should be discussed and considered as part of any long-term planning effort in the area. In addition, access improvements should seek opportunities for creating multimodal corridors that connect to the Jordon Bridge multi-use trail and define an overall street and roadway configuration that improves safety and connectivity and supports the unique needs of heavy manufacturing-type land uses.

The study should establish land use compatibility guidelines and recommended zoning updates that reduce the potential for future conflicts as properties redevelop. Other JLUS strategies that could have an impact on the Paradise Creek Industrial Area study include future EUL activity at South Gate Annex and potential reuse opportunities at Paradise Creek Annex, discussed in Strategies 5.3.8 and 5.3.18 respectively. Reuse and redevelopment at these sites could create additional access opportunities or requirements that would influence alternatives or priorities in the planning effort.

Implementation Steps

1. Form a working partnership between NNSY and Portsmouth to coordinate and oversee the study.
2. Develop a scope of work for the study and identify coordination partners.
3. Pursue funding for the study.
4. Determine preferred action.

Lead Partner

- Portsmouth

Other Partners

- U.S. Navy
- Chesapeake

Potential Funding Sources

- Portsmouth CIP Funding
- U.S. DoD OLDCC Implementation Grants

13 5.3.13 Install real-time parking availability systems with notification boards at installation entry-control points for enhanced driver notification of parking supply.

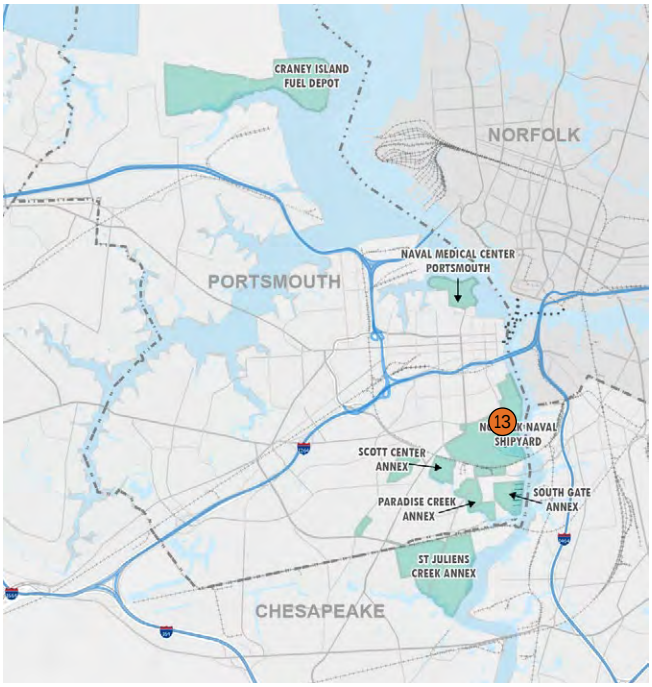
Parking

The Need for Action

At NNSY, parking areas within a 10-minute walk to major employment destinations fill up fast and are nearly 100 percent occupied during a typical day. Determining whether unoccupied open parking spaces are available can be challenging, as many parking lots are large. The potential location of available spaces can impact the route that drivers choose to travel within the installation's internal roadway network and can influence which gate they choose to enter the installation. In general, employees and visitors prefer a gate that is close to where they want to park.

A real-time parking availability system with dynamic message boards is recommended for NNSY to disseminate information about current unoccupied parking space inventories to traffic entering the shipyard.

The JLUS recommends that dynamic message boards be considered at Gate 15 (Main Gate), Gate 10, Gate 14, Gate 3, and Gate 36. Providing information about current parking space occupancy could improve gate utilization and internal roadway operations, and even promote the use of remote parking areas over time. Currently, Naval Medical Center Portsmouth has a real-time parking system in place for its main parking garage, which provides available parking space counts on a level-by-level basis.



Goal Alignment

DOD Mission & Personnel Readiness	●●●●● ●●●●●
Transportation Network Connectivity	●●●
Community Benefits	●○○○
Economic Resilience	○○○○

Strategy Total Score

11

Estimated ROM Cost:

$$$

Timeframe

SHORT	MID	LONG
0-3 yrs	3-10 yrs	+10 yrs

Example parking management message sign.

Source: https://www.shutterstock.com/image-photo/multilevel-garage-smart-guidance-system-led-1419222788

Back to Priority Actions Map

Implementation Steps:

1. Conduct a literature review of available parking count systems to identify one(s) that can address the parking purpose and need of the installation, while also maintaining an acceptable level of security. Most surface lot parking count systems rely on camera technologies, which need to be vetted with base security. Consider a request for a vendor site-visit and demonstration of the technology.
2. Identify parking areas to be monitored by the parking count system, as well as potential locations for the dynamic message boards, and perform an existing conditions infrastructure assessment to identify potential communication and power supply needs. This step would also include cybersecurity reviews and input from installation IT teams.
3. Conduct a preliminary design of the parking availability system and changeable message boards.
4. Request funding for the system.

Lead Partner

- U.S. Navy

Other Partners

- Portsmouth

Potential Funding Sources

- U.S. Navy

14 5.3.14 Evaluate the feasibility of retrofitting or relocating electric substations and/or pump stations located in future flood areas

Utilities

The installations depend upon other providers for power, water, wastewater, and natural gas services that enable the overall mission. Impacts to utility infrastructure could disrupt operations and lead to mission degradation.

The Need for Action

Power supply and wastewater pump station reliability were not identified as current concerns by the installations during the JLUS. However, as described in Section 4.6.5, future flooding associated with flood Scenarios 1 through 3 has the potential to impact some existing electrical substations[9] and wastewater pump stations[10] in the vicinity of the installations. Assets that are affected in all three of the tidal-flooding-only scenarios would also be impacted by flooding in all of the combined rainfall and tidal flooding scenarios.[11]

A more detailed assessment is recommended to evaluate the current condition of each asset, including whether any recent mitigation measures have been implemented, and to determine its vulnerability to current future flooding. The JLUS did not evaluate the ownership of each substation or specific substation components to know the critically of each substation to the installations, or its service area. Rather the proximity of the substation to the installation was used as a condition of analysis to assess potential impact. Input on the current condition and level of mitigation in place can inform what additional efforts may be needed to improve the resiliency of each asset and limit any disruption in service due to future flooding.

Any upgrades to improve the resilience and reliability of the power grid and transmission infrastructure are the responsibility of Dominion Energy. Dominion Energy indicates that it has a standardized process whereby it evaluates a set number of substations annually to determine vulnerability and that the evaluation determines whether the stations must be elevated, floodproofed, or moved, depending on the age and life cycle of the facility.[12] According to Dominion Energy, the life of a new substation is 40 years, and Dominion Energy is currently planning for a 1.5-foot increase in water elevation as it designs improvements to existing stations or designs new stations.[13]

The Navy maintains backup power generation to critical facilities. If power is lost, the backup generation is engaged. NNSY is advancing efforts to improve energy resilience and reliability. NNSY recently broke ground on a new 19-megawatt (MW) combined heat and power plant, a 3 MW battery energy storage system, and a microgrid control system that will provide long-term energy security. The project will provide on-site generation and strengthen overall reliability.

9 Substation location data were sourced from the U.S. Department of Homeland Security.
10 Wastewater pump station location data were sourced from HRSD.
11 The analysis of community facilities, including electrical substations and wastewater pump stations, was completed using flood Scenarios 1 through 3.

12 HRPDC. 2019. Norfolk and Virginia Beach Joint Land Use Study. August.
13 Ibid.

Goal Alignment

DOD Mission & Personnel Readiness ●●○○○ ●●○○○

Transportation Network Connectivity ●○○

Community Benefits ●●●○

Economic Resilience ●●●●

Strategy Total Score

Estimated ROM Cost: $$$

Timeframe

SHORT 0-3 yrs | MID 3-10 yrs | LONG +10 yrs

The JLUS analysis did not identify any pump stations that are vulnerable to flooding under flood Scenarios 1 through 3. However, current and future rainfall combined with SLR may contribute to flooding and should be investigated in more detail. The HRSD is in the process of completing a vulnerability assessment and flood mitigation analysis of 139 HRSD facilities, including treatment plants, pressure-reducing stations, pump stations, and administration/operations sites. The study has an 80-year long-term planning horizon and will identify site-specific flood mitigation measures. In addition, according to HRSD, wastewater pump stations are being upgraded, and new stations are designed with back-up power.

Implementation Steps

1. Request and/or verify that the pump stations that provide service to the military are included in the HRSD vulnerability assessment. Partner with HRSD to facilitate the implementation of flood mitigation projects.
2. Form a working partnership with Dominion Energy to coordinate and oversee a study to evaluate substation vulnerability and identify mitigation strategies. Partner with Dominion Energy to facilitate the implementation of flood mitigation projects.

Lead Partners

- Dominion Energy
- HRSD

Other Partners

- U.S. Navy
- Portsmouth
- Chesapeake

Potential Funding Sources

- Dominion Energy Capital Improvement Program
- HRSD Capital Improvement Program
- U.S. DoD OLDCC Implementation Grants
- U.S. DoD Community Infrastructure Program
- U.S. DOT Infrastructure for Rebuilding America
- FEMA BRIC Grant Program

15 5.3.15 Coordinate on the development of a long-term entry control point/gate plan for NNSY

Access

Future flooding from SLR and future rainfall will reduce capacity and increase congestion around Gate 15 (main gate) and Gate 10 areas, as well along many of the streets used to reach the installation. As a result, traffic patterns will shift as vehicles utilize alternate routes to access NNSY. Increased traffic will likely occur along Victory Boulevard, Elm Avenue (connecting to the Jordan Bridge), and George Washington Highway. Victory Boulevard is projected to experience less future flooding and will likely be one of the least-impacted corridors in the study area.

NNSY has seven vehicle gates that are used to access the installation on a daily basis. The main gate (Gate 15) operates on a 24/7 basis, while others operate only during peak morning and afternoon hours. The volume of vehicles trying to enter the installation often results in long queues at the gates, especially during the morning peak hour, causing traffic to back up onto public streets around NNSY. Gate queuing is influenced by a number of factors: vehicle volume at the gates and the speed of gate operations (processing).

The Need for Action

Flooding from rainfall events already causes impacts at NNSY that affect gate availability and access. In the past, storm events have eliminated the use of specific gates and required traffic rerouting, which contributes to congestion both internal and external to NNSY. When flooding at NNSY occurs, installation personnel are most likely to exit at Gate 36, where flooding is minimal. Future SLR and more intense future rainfall will exacerbate these issues and cause wider-spread impacts and constraints to installation access and local roadways as discussed in Chapter 5 in Strategies 5.3.1 through 5.3.6.

A long-term entry control point/gate plan should be developed for NNSY that integrates an analysis of future flood risk. This would allow NNSY to study the potential impacts that future flooding will have on the main gate and other entry control points and define and plan for mitigation measures to ensure that long-term access is maintained. The study should evaluate the potential need for new entry control points in areas projected to have lower future flood risk, including potentially from the south. The effort should be coordinated with Portsmouth planning, transportation, and public works staff, at a minimum, to allow

Goal Alignment

DOD Mission & Personnel Readiness ●●●●●●●●●●

Transportation Network Connectivity ●●○

Community Benefits ●○○○

Economic Resilience ○○○○

Strategy Total Score

Estimated ROM Cost: $$$

Timeframe

SHORT 0-3 yrs | MID 3-10 yrs | LONG +10 yrs

Back to Priority Actions Map

for a comprehensive understanding of traffic engineering and safety impacts on nearby roadways and intersections that would be associated with proposed entry control point changes.

Entry control points are key nodes on an installation and have a significant impact on base circulation as well as circulation on local roadways. The urbanized context surrounding NNSY means that congestion can quickly spill into nearby neighborhoods. The coordinated planning effort should also consider the future role that transit and remote parking facilities could have on traffic patterns in and around the shipyard. Future gate design should consider dedicated bus and/or shuttle lanes to quickly bring personnel from remote parking lots or public transit/MAX routes into the shipyard. In addition, bicycle and pedestrian infrastructure should be integrated into all future gate designs.

Entry control point planning is driven by several factors, including mission growth. The Navy anticipates significant investment will occur at NNSY as part of the Navy's Shipyard Infrastructure Optimization Plan (SIOP), a 20-year, $20 billion program for modernizing the nation's four public naval shipyards. Future development at NNSY, mission changes, and facility and infrastructure planning and construction as a result of SIOP or other programs, must be synchronized with the installation's circulation system. Similarly, proposed changes to roadway configuration or access outside the gates that could impact circulation on routes used by the installation to reach entry control points should be coordinated through joint planning efforts. Strategy 5.3.12 discusses the need for joint planning within the Paradise Creek industrial area, including the need to consider potential future access to NNSY from the south as part of redevelopment.

Planning for entry control point facilities by the Navy follows specific guidance set forth in the DoD *Unified Facilities Criteria for Entry Control Facilities and Access Points*. The guidance addresses required anti-terrorism force protection standards and other access protocols and procedures that affect gate design. Different types of traffic can be considered in the design of a control point, including bicycles and buses. A primary goal of the JLUS is to maintain access to the installations and expand mobility options for military personnel. To this end, Strategy 5.3.7 recommends additional study of an HRT MAX route to serve the installations, including access onto the installations, and Strategy 5.3.19 recommends targeted analysis of DoD workforce commuting to inform bus route modifications. A long-term entry control point plan should also define approaches for expanded mobility options as part of future gate improvement projects.

Implementation Steps

1. Complete a flood vulnerability and exposure analysis of existing entry control points and internal circulation routes at NNSY to identify risks. Use this report to inform and identify potential future entry control point opportunities.
2. Establish an entry control point working group with Navy, Portsmouth, and HRT representatives to review and discuss the findings from the risk analysis.
3. Develop a scope of work to evaluate long-term access opportunities that reduce flood vulnerabilities and support multi-modal access. Review the work plan with the working group and identify potential funding sources.
4. Secure funding for study.
5. Execute study.

Lead Partner

- U.S. Navy
- Portsmouth

Other Partners

- HRT
- HRTPO

Potential Funding Sources

- U.S. Navy
- U.S. DoD OLDCC Implementation Grants
- U.S. DOT Infrastructure for Rebuilding
- Virginia Transportation Funding (VDOT, DRPT)
- Portsmouth CIP Funding

16 5.3.16 Work with VDOT to pursue a flood risk/ vulnerability assessment of highway interchanges (access ramps) that considers future SLR and future rainfall along with traffic generation patterns

Flood Mitigation

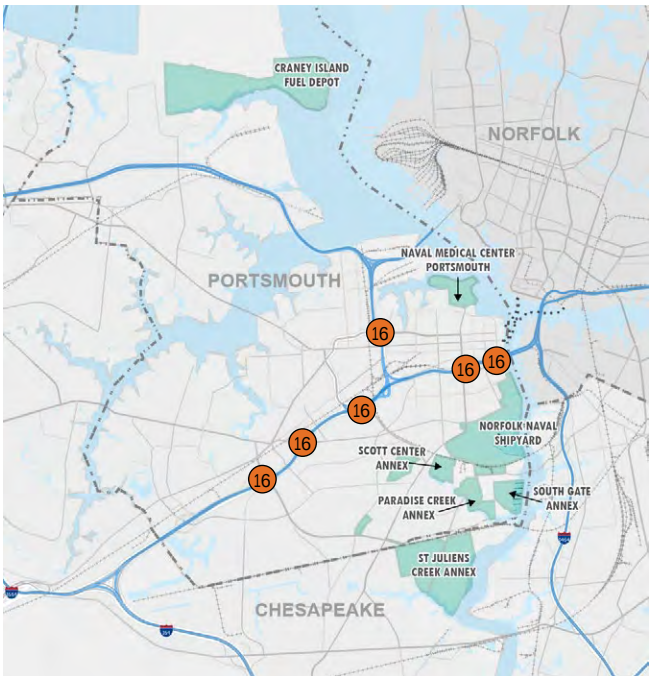
Access to the interstate system is vulnerable to flooding in some locations, which will limit overall mobility across the network and affect access patterns across the area. Since the interstate access ramps and rights-of-way for the expressways are maintained by VDOT, the JLUS recommends that the cities coordinate with VDOT to further investigate the vulnerability of the interchanges to flooding and to jointly pursue improvements to maintain access over time as conditions change. Six interchanges were identified that would benefit from increased coordination.

VDOT has made progress toward addressing resilience and adopted new standards to account for SLR when designing and constructing bridges. And in 2021, the General Assembly passed legislation that directs the Commissioner of Highways to incorporate resiliency into the design standards for all new construction projects.

The Need for Action

The JLUS analysis identified that some surface streets at or near these interchanges are vulnerable to flooding, that the access ramps themselves may be vulnerable to flooding, or that improvements necessary to address flooding on the surface streets may encroach on or otherwise impact the interchange:

- I-264 at Effingham Street: This interchange is vulnerable to flooding in Scenarios 2 and 3 tidal flooding with SLR, and in all of the combined rainfall and tidal flooding Scenarios 4 through 8.
- I-264 at Court Street: This interchange is vulnerable to flooding in all eight of the scenarios evaluated.
- I-264 at Frederick Boulevard: Although not vulnerable to tidal flooding in the absence of rainfall, this interchange is vulnerable to flooding in all of the combined rainfall and tidal flooding Scenarios 4 through 8.
- I-264 at Victory Boulevard: Although not vulnerable to tidal flooding in the absence of rainfall, this interchange is vulnerable to flooding in all of the combined rainfall and tidal flooding Scenarios 4 through 8.



Goal Alignment

DOD Mission & Personnel Readiness ●●●○○ ●●●○○

Transportation Network Connectivity ●●○

Community Benefits ●●○○

Economic Resilience ○○○○

Strategy Total Score

Estimated ROM Cost: $$$

Timeframe

SHORT	MID	LONG
0-3 yrs	3-10 yrs	+10 yrs

Back to Priority Actions Map

- I-264 at Portsmouth Boulevard: Although not vulnerable to tidal flooding in the absence of rainfall, this interchange is vulnerable to flooding in all of the combined rainfall and tidal flooding Scenarios 4 through 8.
- Martin Luther King Freeway at London Boulevard: London Boulevard has segments with flooding vulnerability near the access ramps for this interchange. Improvements that may be necessary to address that flooding vulnerability on London Boulevard may impact or affect the interchange access ramps.

Coordination between the cities and VDOT would help to ensure that development of comprehensive strategies and feasibility analyses, along with subsequent engineering designs, and consider all of the relevant aspects of these interchanges necessary to make informed decisions about strategies to pursue and the relative costs of those strategies.

Implementation Steps

1. Form a steering committee of staff members from the cities, VDOT, and HRTPO to develop an initial outline of goals and objectives for the coordination and to become (or appoint) the direct coordination partners.
2. Hold a kickoff meeting to establish lines of communication, brief all involved on the available information and key findings to date, and develop a process for future coordination.
3. Among other objectives, develop a list of additional investigations or analyses needed to confirm the vulnerability of the interchanges.
4. Make the committee available to consult with teams implementing other actions recommended in the JLUS, such as those to develop comprehensive flood mitigation and stormwater management strategies along the various corridors.

Lead Partners

- VDOT
- HRTPO

Other Partners

- Portsmouth

Potential Funding Sources

- Portsmouth CIP Funding
- Virginia Transportation Funding (VDOT, DRPT)
- VA DEQ Stormwater Local Assistance Fund
- VA DEQ Stormwater Loans
- VA Dam Safety and Floodplain Management Grants
- FHWA Defense Access Road Program
- U.S. DoD OLDCC Implementation Grants
- U.S. DOT Infrastructure for Rebuilding America
- FEMA BRIC Grant Program
- FEMA Flood Mitigation Assistance Program

17 5.3.17 Complete a future flood risk/vulnerability assessment of all public facilities and their associated access corridors

Flood Mitigation

Hospitals, police stations, and fire stations provide vital services and need access 24 hours a day, 7 days a week. Similarly, EOCs and emergency shelters provide essential services during major storm events or other natural (or man-made) disasters. It is essential that life-safety related community facilities are resilient to flooding and that access to and from these facilities is available, especially in the event of an emergency.

The Need for Action

Several facilities were identified as directly exposed to flooding under the exposure analysis described in Section 4.6.5. More importantly, future flooding will have an indirect but significant impact on access to and from community facilities, which will affect the provision of emergency services at the local and regional level. The impacts on access will vary; some areas may be cut off from some services, while others may have reduced levels of service or experience longer response times. Emergency services play a critical role during the flood response process, and access impacts could limit their ability to respond and their overall ability to meet required response times.

A comprehensive vulnerability assessment is needed in each locality to 1) fully analyze and determine the potential impacts of future flooding on community facilities, and 2) determine future access impacts associated with flooding so that appropriate courses of action can be determined. The exposure analysis completed as part of the JLUS was limited to the use of LiDAR-based DEM assuming all structures were at grade because a comprehensive and accurate dataset of facility elevations was not available. More detailed elevation information for first floors, location and elevation of mechanical equipment, structural characteristics, and type, etc., would allow for a more robust analysis and identification of specific mitigation measures within facilities as part of this strategy.

The assessment should coordinate with emergency management personnel in each locality and the Navy to understand the potential impact on cooperative services. The study should evaluate a range of engineering options or mitigation strategies to address identified impacts to facilities, such as facility floodproofing upgrades or potential relocation of the facility to a less vulnerable location. Integrated risk management should be incorporated into the planning of community facilities so that future impacts from flooding can be considered as part of long-term facility investment decisions.

The results of the roadway flooding analysis in the JLUS can be used as an input into the assessment but would need to be updated if different flood scenarios are chosen for the analysis. Analysis of impacts on access can be performed on the roadway network using GIS or other spatial analysis tools that use defined service areas for each community facility type, evaluating the number of road segments serving the facility that are impacted by defined flood scenarios, similar to the analysis described in Section 4.6.5.

Goal Alignment

DOD Mission & Personnel Readiness ●●○○○ ●●○○○

Transportation Network Connectivity ●○○

Community Benefits ●●●○

Economic Resilience ●●○○

Strategy Total Score

Estimated ROM Cost: $$$

Timeframe

Understanding access implications is critical for evaluating community facility impacts from flooding. Although most facilities are not directly vulnerable, their ability to provide services is dependent on maintaining access, which may be affected by flooding.

Implementation Steps

1. Define the community facilities to be included in the study and available data beyond building footprints that can be used to support the analysis. For example, an expanded list of facilities or infrastructure elements that includes other critical assets may be desired. This effort could be coordinated at a regional level to provide consistency across the localities.
2. Develop a scope of work for the study utilizing available data from the localities and region.
3. Pursue funding for the study.
4. Determine preferred solutions to mitigate current and future flood risks to community facilities.
5. Pursue detailed project planning and design for funding and approvals for facility capital investments.

Lead Partners

- Portsmouth
- Chesapeake

Other Partners

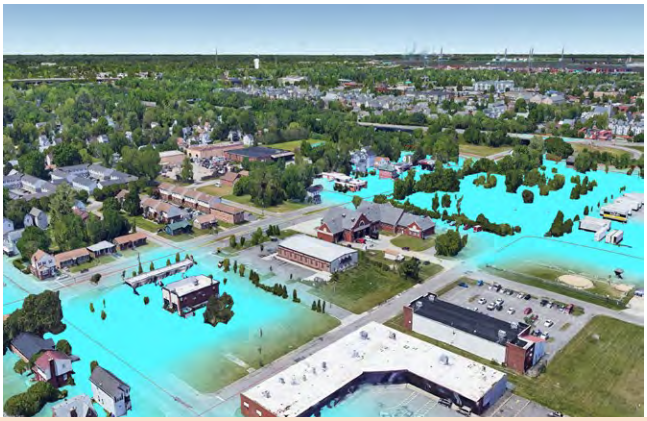
- HRPDC

Potential Funding Sources

- Portsmouth CIP Funding
- Chesapeake CIP Funding
- Virginia Transportation Funding (VDOT, DRPT)
- VA DEQ Stormwater Local Assistance Fund
- VA DEQ Stormwater Loans
- VA Dam Safety and Floodplain Management Grants
- U.S. DoD OLDCC Implementation Grants
- U.S. DoD Community Infrastructure Program
- U.S. DOT Infrastructure for Rebuilding America
- U.S. HUD CDBG Entitlement Program
- FEMA BRIC Grant Program
- FEMA Flood Mitigation Assistance Program
- FEMA BRIC Grant Program

Fire Station #8 in Chesapeake is affected by tidal flooding under Scenario 3.

Source: Google Earth with flood scenario added as KMZ file



Fire Station #1 in Portsmouth is not affected by tidal flooding but surrounding streets are flooded and access would be significantly impacted.

Source: Google Earth with flood scenario added as KMZ file

18 5.3.18 Jointly explore appropriate reuse opportunities for the Paradise Creek Landfill and develop feasibility study of preferred options that can be used to pursue funding

Land Use & Development

Paradise Creek Annex, also referred to as Paradise Creek Disposal Area, encompasses approximately 91 acres and was formerly used for landfilling, solid waste disposal, and petroleum reclamation.[1] The site offers waterfront access to Paradise Creek and acts as a buffer between intense industrial uses to the north and Paradise Creek Nature Park to the south.

The Need for Action

JLUS stakeholders expressed a strong interest in additional passive recreational uses on the site that could contribute to an expanded passive park and trail network along Paradise Creek, potentially linking to Victory Boulevard and the Jordon Bridge trail to the north. Currently, the site has a soil cover that was installed in 2010 over the entire Paradise Creek landfill boundary (access is controlled with a chain-link fence), and low-lying areas have been restored to tidal wetland areas or have stabilized slopes along Paradise Creek.[2] As part of the clean-up remedy, land use controls have been imposed to prevent residential land use at the site, and the Navy adheres to land use controls (LUC)-related procedures pertaining to ground-disturbing activity and changes in land use.[3]

Discussions related to reuse potential and how to define the feasibility study should include environmental compliance, planning, and real estate personnel from NNSY to ensure a comprehensive understanding of required remedial activities and regulatory and legal agreements that govern the site. The reuse of the site for recreational purposes would need to ensure the integrity and protectiveness of the clean-up remedy.[4] A feasibility study should investigate potential passive recreational options;

Goal Alignment

DOD Mission & Personnel Readiness	●●●●● ●●●●●
Transportation Network Connectivity	●●●
Community Benefits	●●●●
Economic Resilience	●●●●

Strategy Total Score

Estimated ROM Cost: $$$

Timeframe

SHORT 0-3 yrs | MID 3-10 yrs | LONG +10 yrs

Back to Priority Actions Map

1 NAVFAC. n.d. "Norfolk Naval Shipyard," Environmental Restoration Program Public Web site. https://www.navfac.navy.mil/products_and_services/ev/products_and_services/env_restoration/installation_map/navfac_atlantic/midlant/norfolk_nsy.html. Accessed. 4/2/21.

2 U.S. Navy. 2016. *Final Second Five Year Review Norfolk Naval Shipyard Portsmouth VA* (Public Document). August 1. https://www.navfac.navy.mil/niris/MID_ATLANTIC/NORFOLK_NSY_PORTS_VA/N00181_001498.pdf. Accessed 4/1/21.

3 Ibid.

4 U.S. EPA. 2001. *Reusing Superfund Sites: Recreational Use of Land Above Hazardous Waste Containment Areas*, EPA 540-K-01-002. March. https://semspub.epa.gov/work/HQ/174085.pdf. Accessed 4/2/21.

evaluate the technical feasibility and cost of the options; identify the associated site constraints, regulatory barriers, or other challenges for implementation; and identify potential funding mechanism and implementation partners.

Implementation Steps:

1. Form a working partnership between NNSY and Portsmouth to coordinate and oversee the study.
2. Develop a scope of work for the study and identify coordination partners.
3. Pursue funding for the study.
4. Determine preferred action.

Lead Partner

- U.S. Navy

Other Partners

- Portsmouth
- HRPDC
- Elizabeth River Project

Potential Funding Sources

- Portsmouth CIP Funding
- VA DEQ Clean Water Revolving Land Fund
- U.S. DoD OLDCC Implementation Grants
- U.S. DoD Community Infrastructure Program
- U.S. HUD CDBG Entitlement Program
- Elizabeth River Project

According to the U.S. EPA, "many cleaned up Superfund sites currently do not support any type of reuse activity. However, EPA expects that a number of these sites may eventually be returned to productive use. Where waste is left on-site at levels that would require limited use and restricted exposure, EPA will conduct reviews at least every five years to monitor the site for any changes. Should land use change, it will be necessary to evaluate the implications of that change for the selected remedy, and whether the remedy remains protective. In many cases, a remedy as designed and constructed may not be able to accommodate the planned use without modification. In some instances, the preferred reuse may not be feasible due to technical or other factors."

Source: U.S. EPA. 2001. Reusing Superfund Sites: Recreational Use of Land Above Hazardous Waste Containment Areas, EPA 540-K-01-002. March. .https://semspub.epa.gov/work/HQ/174085.pdf Accessed 4/2/21.

19 5.3.19 Conduct a joint HRT/NAVY study that targets DoD needs and details workforce points of origin to inform revisions to the stops and frequency of HRT Routes 41, 45, and 43

Multi-Modal

The Need for Action

Transit comprises a very small portion of the mode share of military commuters; over 90 percent drive alone according to the 2012 HRTPO Military Commuter Survey.[5] As discussed in Chapter 3, issues related to conflicting bus service times and work schedules, route locations and convenience, transfers, and overall trip duration are likely factors that contribute to low ridership among military personnel.

A deeper understanding of military commuter needs is needed so that transit is a viable option for DoD personnel. The HRTPO Military Commuter Survey should be completed on a recurring basis, as recommended in Section 6.1. The JLUS also recommends that targeted studies at each installation are developed and used to inform decision-making for any transit service adjustments, or new service proposals. The HRT Transit Strategic Plan identifies specific recommendations that, if implemented, will modify existing bus routes that serve the installations, including Routes 41, 43, and 45 as described in Section 4.4.3. Input from installation-level surveys could lead to the identification of other improvements that take into consideration unique military commuter needs.

A Regional Origin and Destination Study was prepared by HRT in 2016 to gather updated travel information and behavior[6] data for transit riders. The study evaluates trip origins and destinations, park and ride utilization, and transit system utilization, among other factors. As a regional study, the study is not intended to focus on military commuter needs or any specific user group. However, HRT is currently conducting a survey targeted at NNSY employees to better understand mode choice; commute patterns; work schedules; desired services, including convenient park and ride locations; and interest in MAX service or other transit programs. This type of survey should be considered for Naval Medical Center Portsmouth as well. Surveys should also aim to understand preferences and options for teleworking, which could have an impact on transit service and parking.

Goal Alignment

DOD Mission & Personnel Readiness

Transportation Network Connectivity

Community Benefits

Economic Resilience

Strategy Total Score

Estimated ROM Cost: $$$

Timeframe

Next Step

HRT, Navy, and HRTPO form a working group to identify installation survey needs and mechanisms available to administer and promote the survey to all installation employees.

5 2012. *Hampton Roads Military Transportation Needs Study Military Commuter Survey*. September. https://www.hrtpo.org/Documents/Reports/Military%20Commuter%20Survey%202012%20FINAL%20Report.pdf. Accessed 4/15/21.

6 HRT. 2017. *Regional Origin and Destination Study 2016*. April. https://gohrt.com/wp-content/uploads/2018/07/2016-OD-Final-Report.pdf. Accessed 4/15/21.

Lead

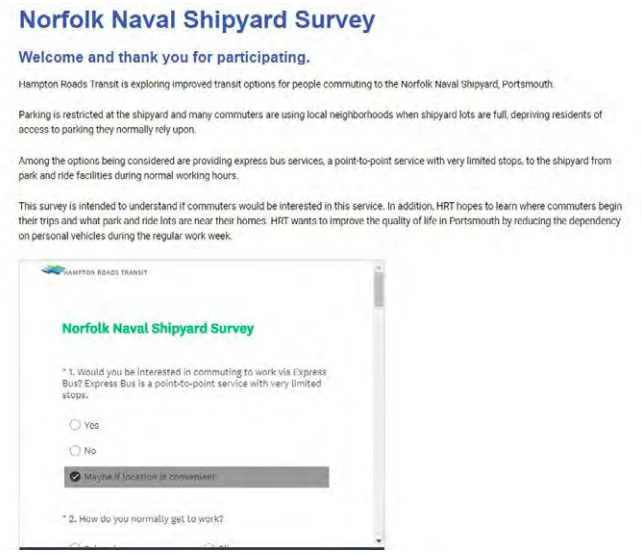
HRTPO

Other Partners

- HRT
- Portsmouth

Potential Funding Sources

- HRT
- VA Commute Assistance Program Grants
- Virginia Transportation Funding (VDOT, DRPT)
- U.S. DoD OLDCC Implementation Grants
- FTA Integrated Mobility Innovation Grants
- FTA Public Transportation innovation Grants



HRT NNSY commuter survey. The survey is available at this link: https://gohrt.com/2021/04/norfolk-naval-shipyard-survey/

20 5.3.20 Perform a study to prioritize changeable message sign location and integration based on anticipated diversion route operations

Access

The Need for Action

Port-related activity is increasing, creating the presence of more frequent and longer trains traversing streets adjacent to NNSY. Portsmouth has received funding through SMART Scale for the installation of a minimum of twelve dynamic and changeable message signs to provide advanced notifications to travelers of the presence of trains at the following crossings:

- High Street near Virginia Avenue
- Frederick Boulevard near I-264
- George Washington Highway near Harley Avenue
- Elm Avenue near Williams Avenue

The primary goal for the signs is to inform travelers of the presence of trains so they may use alternate routes and reduce time waiting for the train to clear the crossing. Portsmouth should perform a study to prioritize the order in which these signs are implemented based on overall delays experienced at each of the four crossings and the available capacity of potential alternative routes (i.e., routes that may be selected by travelers in lieu of waiting for the train to cross). The study could also identify additional infrastructure improvements that could make alternative route decisions easier and more reliable to travelers.

Proposed Message Board Locations
Source: VDOT SMART Scale Portal – City Application Submittal

Goal Alignment

DOD Mission & Personnel Readiness ●●●○○ ●●●○○

Transportation Network Connectivity ●●○

Community Benefits ●○○○

Economic Resilience ●●●●

Strategy Total Score

Estimated ROM Cost: $$$

Timeframe

SHORT 0-3 yrs | MID 3-10 yrs | LONG +10 yrs

Next Step

Based on initial potential sign locations, determine which alternative routes are available to travelers if a train crossing were to occur, and identify any known constraints along the routes to inform future improvement planning (i.e., traffic congestion, pedestrian active corridors).

Lead Partner

- Portsmouth

21 5.3.21 Explore the use of automated vehicles and/or shuttles to carry people from downtown garages to Naval Medical Center Portsmouth

Multi-Modal

The Need for Action

Parking at Naval Medical Center Portsmouth fills up quickly, especially parking spaces in close proximity to the main hospital building. Additional parking spaces in Harbor Court Garage along Crawford Parkway are available but are more than a 10-minute walk from the hospital. Other parking facilities, including Middle Street Garage, County Street Garage, and two garages on Water Street are even further away.

Next Step

The Crawford Corridor Revitalization Plan identifies potential redevelopment opportunities and infrastructure upgrades along Crawford Parkway and Crawford Street that would transform the corridor into a multi-modal, walkable, and safe street for pedestrians and bicyclists. The Plan identifies concepts for linking existing and proposed parking garages to the corridor that would significantly improve connectivity and walkability for those who park in a downtown garage and walk to Naval Medical Center Portsmouth. However, the distance between downtown garages and Naval Medical Center remains a challenge. A parking shuttle that connects Naval Medical Center Portsmouth employees, patients, and visitors to downtown garages could make more parking available by moving employees, patients, and guests to off-site lots. It would also reduce the burden of walking from parking to the hospital, which is an important consideration for those with mobility issues.

Advanced technology, including autonomous vehicles, could be explored as part of a broader initiative to link remote parking facilities to installations.

Lead Partner

- HRT

Goal Alignment

DOD Mission & Personnel Readiness ●●○○○ ●●○○○

Transportation Network Connectivity ●●○

Community Benefits ●○○○

Economic Resilience ●●○○

Strategy Total Score

Estimated ROM Cost: $$$

Timeframe

SHORT	MID	LONG
0-3 yrs	3-10 yrs	+10 yrs

A self-driving, all-electric shuttle provides free rides between a busy Metrorail stop and the emerging Mosaic District in Fairfax County.

Source: https://www.nbcwashington.com/news/local/transportation/self-driving-shuttle-debuts-in-high-traffic-virginia-spot/2451455/

22

5.3.22 Jointly study options for a secondary access road to Craney Island Fuel Depot that does not impact the city landfill and ensures that long-term access to the fuel depot is maintained

Land Use & Development

The Need for Action

The Craney Island Fuel Depot is accessible via Western Freeway and Cedar Lane; there is no redundant access. Although future flooding along Cedar Lane from combined rainfall and tidal effects is anticipated to be relatively minor, flooding inside the installation has the potential to significantly impact the primary internal access route within the installation. A secondary access point to the depot could help reduce the impact of disruptions from future flooding by ensuring redundancy and reliability of the transportation network.

Options for a secondary access road to serve the Craney Island Fuel Depot would need to be studied in collaboration with adjacent landowners, including the residential neighborhood of Merrifield located immediately west of the installation and the Portsmouth City Landfill located to the north. The need for an additional access road to the fuel depot should also be considered as part of ongoing installation planning efforts and in future discussions related to regional access and the future Craney Island Marine Terminal, discussed in Section 3.1.

Next Step

Naval Station Norfolk to discuss the need for a study with Portsmouth, the available data that could support an analysis of alternatives, and the preferred process for coordinating the planning effort.

Lead Partner

- U.S. Navy

Goal Alignment

DOD Mission & Personnel Readiness

Transportation Network Connectivity

Community Benefits

Economic Resilience

Strategy Total Score

Estimated ROM Cost:

$$$

Timeframe

SHORT 0-3 yrs | MID 3-10 yrs | LONG +10 yrs

23 5.3.23 Consider adding bicycle lanes at Gate 2 at Naval Medical Center Portsmouth and evaluate options for upgrading bicycle infrastructure at all installations

Multi-Modal

The Need for Action

Currently, Gate 2 at Naval Medical Center Portsmouth is a completely automated secondary gate utilized during the morning and afternoon peak periods. Gate 2 processes approximately 35 percent of AM inbound traffic and 12 percent of PM outbound traffic. Portsmouth residents of the Park View neighborhood adjacent to Gate 2 have expressed concerns during both peak periods about vehicles cutting and speeding through the neighborhood to access Gate 2.

The overall lower utilization of this gate makes it a candidate for additional transportation modes, such as bicycles. Naval Medical Center Portsmouth should consider providing accommodations that would allow bicycle traffic at Gate 2. Adding bicycle traffic accommodations at Gate 2 could encourage more bicycle trips, allowing the gate to be used more often than just during the peak hours. Additionally, the local street network surrounding Gate 2 includes several connections to major east-west and north-south City-designated bicycle facilities. This strategy could complete a bicycle network connection to a major employment center within the City of Portsmouth, and it could help to separate the addition of increased bicycle traffic from the much more vehicle-active Gate 1.

Next Step

Perform an evaluation of existing bicycle infrastructure on-base, at Gate 2, and outside Gate 2 to identify critical infrastructure gaps that would need to be addressed in order to provide a secure, safe, and efficient connection between the City of Portsmouth bicycle network and major destinations on base.

Lead Partner

- U.S. Navy

Goal Alignment

DOD Mission & Personnel Readiness

Transportation Network Connectivity

Community Benefits

Economic Resilience

Strategy Total Score

Estimated ROM Cost:

$$$

Timeframe

24 5.3.24 Jointly identify appropriate locations for secure bicycle parking external to the installations and near the gates

Multi-Modal

The Need for Action

Based on input documented within the Hampton Roads Military Commuter Needs Survey, combined with feedback regarding recent bicycle share pilot programs at NNSY, base personnel are open to using alternative modes of transportation to/from work other than personally owned vehicles. Two hurdles prevent more widespread use of bicycle trips to/from the installations, despite there being a robust bikeway network present throughout Portsmouth: a lack of bicycle parking on the installation and a lack of bicycle accommodations at the gates.

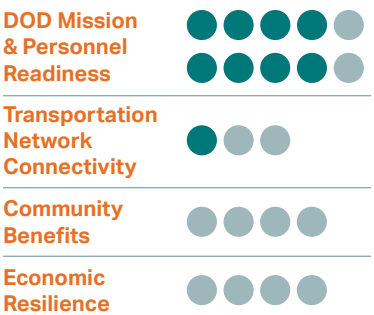
The installation of secured bicycle parking facilities outside the installations, but adjacent to gates, would narrow the existing gap that exists between established citywide bicycle routes and major employment centers on the installations. Potential locations for secure bicycle parking could include areas along Portsmouth Boulevard (east of Effingham Street) and Port Centre Parkway (adjacent to the pedestrian-only turnstile gates that are currently present near Gate 10). Locations for secure bicycle parking near Naval Medical Center Portsmouth could include Park View Avenue. The proposed locations are primarily adjacent to existing pedestrian gates, which are preferred locations for maintaining a separation of bicycle and vehicular traffic.

Portsmouth should work with NNSY and Naval Medical Center Portsmouth to identify suitable locations for secure parking and to discuss the benefit and need for a study to understand how an existing pedestrian gate could be converted into a facility that also serves cyclists (see 5.3.25). Secure bicycle parking combined with other strategies to improve bicycle and pedestrian facilities on roadways adjacent to the installations and within the installation could significantly reduce existing barriers to bicycling. Portsmouth is also exploring a pilot bikeshare/scooter system for the downtown area that extends to Port Centre Parkway. While bikeshares and scooters are not currently permitted on base, bikeshare/scooter parking near installation gates at NNSY and Naval Medical Center Portsmouth could offer military personnel more options for getting around town.

NNSY Gate 10 currently lacks bicycle infrastructure.

Source: Google Maps

Goal Alignment



Strategy Total Score

Estimated ROM Cost:

$$$

Timeframe

Next Step

Portsmouth, NNSY, and Naval Medical Center Portsmouth meet to discuss and identify potential areas for secured bicycle parking, considering proximity to the nearest citywide bikeway connections. This meeting can also be used to discuss the requirements and standards for converting a pedestrian-only gate into a bicycle- and pedestrian-compliant gate and define the basis for a feasibility study.

Lead Partner

- Portsmouth

25 5.3.25 Consider modifying Naval Medical Center Portsmouth Gate 2 to serve specific users only to help reduce neighborhood impacts

Multi-Modal

The Need for Action

As described in 5.3.23, residents of the Park View neighborhood adjacent to Gate 2 have expressed concerns about vehicles cutting and speeding through the neighborhood to access Gate 2. This behavior is driven in part by regular commuters who choose Gate 2 based on the location of their ultimate parking destination on base and commuters who wish to avoid Gate 1 congestion primarily during the AM peak period. More information is needed to fully understand which user type could be contributing to cut-through traffic in the neighborhood.

A gate processing scheme for Gate 2 that limits the use of the gate to specific user groups at Naval Medical Center Portsmouth could be considered as a method for reducing neighborhood impacts. User groups could be defined based work shifts or other factors such as work location. Because Gate 2 is automated, training new staff to recognize specific user types is not necessary given that access control can be programmed directly to user credentials that are electronically scanned at Gate 2. This strategy could help reduce the issue of traffic traversing through the neighborhood.

Next Step

Conduct an origin-destination gate survey to understand commuting trends on base for vehicles entering/exiting at Gate 2.

Lead Partner

- U.S. Navy

Goal Alignment

DOD Mission & Personnel Readiness ●●●●●
●●●●●

Transportation Network Connectivity ●●●

Community Benefits ●●●●

Economic Resilience ●●●●

Strategy Total Score

Estimated ROM Cost:

$$$

Timeframe

SHORT	MID	LONG
0-3 yrs	3-10 yrs	+10 yrs

26 5.3.26 Study options for mixed use development in the vicinity of Gate 10

Land Use & Development

The Need for Action

NNSY Gate 10 is within a 5-minute walking distance of waterfront operational facilities at NNSY and other administrative buildings. Currently, the land uses in this area includes a large NNSY surface parking lot that fronts along Port Centre Parkway, as well as surface parking, some residences, and light manufacturing uses outside the installation. Recognized as underutilized land in the Build One Portsmouth, an opportunity exists to jointly study options for compatible infill commercial or retail redevelopment that could enhance the tax base and take advantage of the proximity that this area has in relationship to the shipyard workforce.

The area outside of Gate 10 is within walking distance for shipyard employees, so the potential for compatible convenience, restaurant, and other support services could be explored as part of a redevelopment project. Redevelopment could consider options to incorporate structured parking to support both new development and NNSY through specially defined context-sensitive urban design guidelines and requirements that aim to minimize impacts on adjacent uses and the public realm. By defining a study area that includes both city and Navy property, opportunities for parcel consolidation, zoning changes, land exchange, or other real estate transactions could be discussed and evaluated more creatively and comprehensively to achieve a more efficient use of land that provides benefits to both partners.

Next Step

NNSY and Portsmouth jointly define study parameters and pursue funding for a study.

Lead Partner

- Portsmouth

Goal Alignment

DOD Mission & Personnel Readiness

Transportation Network Connectivity

Community Benefits

Economic Resilience

Strategy Total Score

Estimated ROM Cost:

$$$

Timeframe

27 5.3.27 Pursue a joint planning and feasibility study for the siting of a regional First Responder Academy, Class A burn building, and emergency vehicle operations course to support multiple jurisdictions and the Navy

Land Use & Development

The Need for Action

The Navy and localities have a number of mutual aid agreements in place related to emergency response, and regular coordination occurs between the Navy and city emergency management personnel. A desire for a regional first responder academy that could serve as a training and education facility for the DoD and localities was identified during the JLUS planning process. The facility could serve as a location to support and enhance joint training exercises among federal, state, and local partners. Additional desired components that could be sited with a regional academy include a Class A Burn building and an emergency vehicle operations course. These types of assets require careful siting considerations because of potential noise and environmental impacts that occur as part of training exercises.

Interest in a regional first responder academy and associated training facilities could be explored through a joint planning process led by a regional entity such as the HRPDC. This approach would better enable the identification of existing resources or facilities across multiple localities that could be used to meet some or all first responder training needs.

Next Step

Convene a panel of locality emergency managers and DoD representatives to discuss the need for joint planning and feasibility study, and work together to jointly define a scope of work for the effort and identify potential funding sources.

Lead Partner

- Chesapeake

Goal Alignment

DOD Mission & Personnel Readiness

Transportation Network Connectivity

Community Benefits

Economic Resilience

Strategy Total Score

Estimated ROM Cost:

$$$

Timeframe

28 5.3.28 Establish a food truck zone adjacent to Gate 10 outside NNSY and pursue development of a food truck program at Naval Medical Center Portsmouth, similar to the one at NNSY

Land Use & Development

The Need for Action

Limited food service options that can be reached by walking within a 30-minute lunch break are available for shipyard personnel. The introduction of food trucks outside of Gate 10 at the terminus of Portsmouth Boulevard could offer additional options for lunch for those working on the northern part of the installation, while also providing business opportunities for the local food truck industry. Portsmouth already has established food truck policies and regulations[7] that specify food truck operating procedures and define restricted and prohibited areas for food trucks in Downtown and Old Towne.[8] A specific zone could be established near Gate 10 to target shipyard employees.

NNSY has a food truck program operating on the installation but outside of the controlled industrial area. The program is funded through the Navy's Morale, Welfare, and Recreation program. Naval Medical Center Portsmouth does not have a food truck program on site but is interested in assessing the viability of one similar to the one at NNSY.

Next Step

Portsmouth to determine if the existing food truck policy and regulation need to be revised to allow food truck service and/or zone near NNSY Gate 10; Naval Medical Center Portsmouth to review NNSY food truck program and explore development of pilot program.

Lead Partner

- Portsmouth

Goal Alignment

DOD Mission & Personnel Readiness

Transportation Network Connectivity

Community Benefits

Economic Resilience

Strategy Total Score

Estimated ROM Cost:

$$$

Timeframe

SHORT 0-3 yrs | MID 3-10 yrs | LONG +10 yrs

7 City of Portsmouth. n.d. City of Portsmouth Food Truck Policies and Procedures Manual. https://www.portsmouthva.gov/DocumentCenter/View/897/Food-Truck-Policies-and-Procedures-Manual-PDF. Accessed 3/31/21.

8 City of Portsmouth. n.d. "Food Truck Program" (webpage). https://portsmouthva.gov/454/Food-Truck-Program. Accessed 3/31/21.

29 5.3.29 Pursue a joint planning study of St. Juliens Creek corridor and/or Blows Creek corridor to explore options for expanded public recreational access to the water around St. Juliens Creek Annex

Land Use & Development

The Need for Action

According to the Public Waterfront Access and Blueways map in Chesapeake's comprehensive plan, *Moving Forward Chesapeake 2035*, there are no public waterfront access, canoe launch, or boat ramp facilities in the vicinity of St. Juliens Creek Annex. The plan identifies a potential waterfront site along St. Juliens Creek[9] and discusses the potential for joint ventures along the Southern Branch of the Elizabeth River for additional water access, depending on the nature of the site.[10]

A joint planning study to evaluate alternatives for public water access around St. Juliens Creek Annex would allow a shared understanding between the Navy and Chesapeake of potential constraints and opportunities affecting access. Issues that should be discussed include, but are not limited to, physical security and force protection requirements for the installation, options for modifications that would allow controlled access in certain areas, shoreline conditions, underlying environmental land use restrictions, water quality impacts, and potential Navy or city real estate tools or programs that could be considered to support access.

Chesapeake will be initiating a Citywide Trails and Open Space Connectivity Plan in the fall of 2021, which presents an additional opportunity for city and Navy coordination on access and connectivity around St. Juliens Creek Annex.

Next Step

Chesapeake to meet with NNSY to discuss its interest in pursuing a joint planning study to evaluate water access opportunities.

Lead Partner

- Chesapeake

Goal Alignment

DOD Mission & Personnel Readiness ●●●●●
●●●●●

Transportation Network Connectivity ●●●

Community Benefits ●●○○

Economic Resilience ●●●●

Strategy Total Score

Estimated ROM Cost:

$$$

Timeframe

SHORT	MID	LONG
0-3 yrs	3-10 yrs	+10 yrs

9 The Chesapeake Planning Department. 2014. *Moving Forward Chesapeake 2035*. February 25. Amended November 15, 2016. https://resources.cityofchesapeake.net/comp-plan-2035/#page=73. Accessed 4/1/21.

10 The Chesapeake Planning Department. 2014. *Moving Forward Chesapeake 2035*. February 25. Amended November 15, 2016. https://resources.cityofchesapeake.net/comp-plan-2035/#page=74. Accessed 4/1/21.

30

5.3.30 Jointly study options for interconnecting water service to St. Juliens Creek Annex and evaluate alternatives for extending water and sewer service eastward toward the Elizabeth River to support future redevelopment

Utilities

The Need for Action

The water distribution system at St. Juliens Creek Annex is oversized for today's mission requirements. As a result, the system must be routinely flushed to maintain water quality and remove any impurities or buildup. Portsmouth physically supplies water to the installation but through an accounting exercise in which Chesapeake purchases the water from Portsmouth and sells it to St. Juliens Creek Annex.

A joint study should be pursued to evaluate options for interconnecting water service to the annex while also creating a more efficient, sustainable, and right-sized water distribution system overall for the installation. The study should include the evaluation of options for extending water and wastewater service east toward the river and land that could offer redevelopment potential for Chesapeake, as suggested in the 2001 Urban Land Institute Study. The expansion of utilities could drive redevelopment activity on land adjacent to the installation. For this reason, defining compatible use guidelines for the area will also be important.

Next Step

Chesapeake to contact NNSY and Portsmouth to initiate efforts for pursuing a joint study.

Lead Partner

- Chesapeake

Goal Alignment

DOD Mission & Personnel Readiness

Transportation Network Connectivity

Community Benefits

Economic Resilience

Strategy Total Score

Estimated ROM Cost:

$$$

Timeframe

SHORT 0-3 yrs | MID 3-10 yrs | LONG +10 yrs

31 5.3.31 Re-evaluate the zoning classification for the area between the railroad and Elm Avenue, east of George Washington Highway

Land Use & Development

The Need for Action

Located between Scott Center Annex to the south and NNSY main site to the north, this triangle-shaped area includes multiple parcels that are currently zoned to support light industrial land uses. Portions of the area are identified as vacant or underutilized in *Build One Portsmouth*, and its future land use is designated as light industrial. However, the proximity and walkability of the area to on-base housing, sailor family support facilities,and logistics and supply facilities within NNSY suggest that this area could create unique future private-sector redevelopment opportunities for compatible uses that complement and support the military mission, such as retail, commercial uses, or other business support services. To realize future redevelopment potential and enable access to and from NNSY, additional access to NNSY would be required, such as a pedestrian gate. A review of the zoning and land use controls for this area is suggested to determine whether any future changes would be required to enable compatible redevelopment.

Opportunities also exist to enhance George Washington Highway so that it is visually recognized for the role it plays as a major gateway corridor to Portsmouth and NNSY from the south. Challenges along the corridor in this vicinity include inadequate pedestrian infrastructure, such as lack of consistent sidewalks, multiple curb cuts, and the Norfolk Portsmouth Belt Line Railroad and associated at-grade crossing along George Washington Highway that contributes to traffic congestion. The VDOT FY 2021-2024 Transportation Improvement Program (TIP) includes a planned project for corridor improvements in this area along George Washington Highway from Andrews Street to Mulberry Street.[11]

11 HRTPO. n.d. UPC# 107035: George Washington Highway Corridor Improvements. https://www.hrtpotip.org/tip-projects/view/107035/george-washington-highway-corridor-improvements. Accessed 3/31/21.

Goal Alignment

DOD Mission & Personnel Readiness ●●○○○ ●●○○○

Transportation Network Connectivity ●●●○○

Community Benefits ●○○○○

Economic Resilience ●●●●

Strategy Total Score

Estimated ROM Cost:

$$$

Timeframe

Next Step

Portsmouth to conduct an evaluation of current zoning and land use controls to determine whether changes are needed to support future compatible redevelopment.

Lead Partner

- Portsmouth

32 5.3.32 Study options for expanded ferry service to Naval Medical Center Portsmouth

Multi-Modal

The Need for Action

Naval Medical Center Portsmouth operates 24/7, providing service to active duty personnel, family members, and retirees throughout the Hampton Roads region. Although limited bus service is available nearby, the majority of the workforce, patients, and visitors arrive by vehicle and park on site. Ferry access would provide an additional option for accessing the installation that could also help reduce parking demand on site and reduce the number of vehicles on local roadways and accessing the gates.

HRT contracts to provide daily passenger ferry service on the Elizabeth River between Downtown Norfolk and Downtown Portsmouth, stopping at High Street and North Landing in Portsmouth, and Waterside in Norfolk.[12] The ferry includes three 100-passenger ferries that operate daily, year-round with a higher frequency in the summer months. The FY 2021-2030 HRT Transit Strategic Plan does not identify any improvement plans for ferry service. However, the Hampton Roads 2045 HRTPO Long-Range Transportation Plan includes a project for a Ferry Service Expansion Study[13] for Southside and between Southside and the Peninsula.

A feasibility study for extending HRT's ferry service to Naval Medical Center Portsmouth should include an evaluation of alternative terminal/dock locations at Naval Medical Center Portsmouth, including security requirements, base access protocols, and processing requirements.

Next Step

Form a working partnership between HRT, Portsmouth, Chesapeake, NSA Hampton Roads, and Naval Medical Center Portsmouth to coordinate and oversee the study.

Lead Partner

- HRT

Goal Alignment

DOD Mission & Personnel Readiness

Transportation Network Connectivity

Community Benefits

Economic Resilience

Strategy Total Score

Estimated ROM Cost:

$$$

Timeframe

12 HRT. 2020. *Transit Strategic Plan FY2021–2030*. https://gohrt.com/tsp/HRT-TSP-Chapter-1.pdf. Accessed 3/31/21.

13 HRTPO. 2021. *Hampton Roads 2045 Long-Range Transportation Plan: Project Information Guide*. https://www.hrtpo.org/uploads/docs/HR_2045LRTP_Project_Info_Guide.pdf Accessed 6/4/21.

33 5.3.33 Refine the NNSY internal shuttle route to be more direct and efficient (connect to parking and explore off-site option)

Multi-Modal

The Need for Action

The internal shuttle at NNSY includes service to 21 locations within the installation. In 2016, ridership was estimated at approximately 300 riders per day, which is relatively low given that over 15,000 staff and visitors access the base each day. This is likely attributable to both the length of the route (i.e., 30 minutes round trip) and the total number/location of stops. The shuttle service is only allowed to provide service (i.e., stops) at physical buildings within the secured perimeter and is not allowed to provide service to parking lots.

Modifications to the internal shuttle operations are needed to promote greater use of the system. Proposed changes include a reduction in the total number of spots to reduce round trip times, as well as an expansion of service to parking lots. The extension of service should also include remote parking areas, particularly those located just south of the installation that provide approximately 2,500 spaces and are located less than 1,000 feet from the existing internal shuttle route. These lots could be better utilized if they were integrated with internal shuttle service that could provide a direct and efficient link to work centers on base.

As discussed in 5.3.11, strategies that recommend specific parking permits and restrictions could induce additional parking demand in currently less-utilized, remote parking areas. Therefore, this strategy to improve internal shuttle service is not a standalone strategy, but one that would be needed to support other strategies. To enable these changes, modifications to policy and/or regulations that affect service areas may be needed.

Next Step

Modify existing policy and/or regulations to allow internal shuttle service to be provided at parking lots. Additionally, perform a survey to identify where employees that work in buildings served by the existing internal shuttle route are parking, and use the information to identify potential stops that could be removed from the existing route.

Lead Partner

- U.S. Navy

Goal Alignment

DOD Mission & Personnel Readiness

Transportation Network Connectivity

Community Benefits

Economic Resilience

Strategy Total Score

Estimated ROM Cost:

$$$

Timeframe

SHORT	MID	LONG
0-3 yrs	3-10 yrs	+10 yrs

34 5.3.34 Expand the shared bicycle program on NNSY and establish a similar program at Naval Medical Center Portsmouth

Multi-Modal

The Need for Action

Bike share programs can offer an efficient, sustainable, and healthy way to move around the installation. An informal bike share program already exists at NNSY, but it is centered mostly within the controlled industrial area; there is no program in place at Naval Medical Center Portsmouth. A more robust program that operates across the entire NNSY (inside and outside the controlled industrial area) could offer increased efficiencies over walking for workers that travel from shop to shop in the controlled industrial area, enabling workers to visit more food service options or other facilities on base more quickly within limited break times. A bike share program at Naval Medical Center Portsmouth could enable more efficient access from the installation into Downtown Portsmouth and nearby restaurants and businesses.

Bike share programs on military bases are becoming more popular. For example, a dock-free bike share program at Naval Base San Diego was launched in 2018 to offer service men and women an easier and smarter way to get around the base.[14] At Joint Base Lewis-McChord, a bikeshare program was developed to provide a source of transportation for Airmen who do not have access to a vehicle. The bikes are placed strategically around the base at five pick up and drop off points, including dormitories and primary work centers.[15]

Bicycling is permitted at both NNSY or Naval Medical Center Portsmouth, but there are no dedicated bike paths or lanes present on the installations. At NNSY, civilian employees, military personnel, and contractors must wear an approved bicycle helmet while operating a bicycle on the installation both inside and outside of the controlled industrial area. In addition, bicyclists are required to wear high visibility belts or reflective vests in darkness or times of reduced visibility.[16]

Goal Alignment

DOD Mission & Personnel Readiness

Transportation Network Connectivity

Community Benefits

Economic Resilience

Strategy Total Score

Estimated ROM Cost:

$$$

Timeframe

Bicycling infrastructure is currently lacking. According to the HRTPO Military Commuter Needs Survey, an overwhelming majority (85 percent) of respondents indicated that bicycle accommodations (sidewalks, bike paths/lanes, shoulders) are not adequate for their commute.[17] Action 5.3.23 recommends upgrading bicycling infrastructure at all the installations so that

14 Lime. 2018. "Lime Opens Military's First Dock-Free Bikeshare On Naval Base San Diego." Lime Newsletter. May 17. https://www.li.me/second-street/lime-military-first-dock-free-bikeshare-naval-base-san-diego. Accessed. 4/5/21.

15 Tobin, Sean. 2012. "What's the deal with all the blue bikes?" Team McChord. October 23. https://www.mcchord.af.mil/News/Features/Display/Article/248835/whats-the-deal-with-all-the-blue-bikes/. Accessed 4/5/21.

16 @NorfolkNavalShipyard1. 2019. "ATTN NNSY." https://www.facebook.com/NorfolkNavalShipyard1/posts/attn-nnsy-effective-aug-12-2019-all-civilian-employees-military-personnel-and-co/10156720819717799/. Accessed 4/5/21.

17 HRTPO. 2012. *Hampton Roads Military Transportation Needs Study Military Commuter Survey.* September. https://www.hrtpo.org/Documents/Reports/Military%20Commuter%20Survey%202012%20FINAL%20Report.pdf. Accessed 4/5/21.

bicycling is a safe and convenient option from the origin to the destination of a trip.

A bike share program that has the flexibility to operate in and outside of the controlled industrial area at NNSY would need to evaluate options for controlled industrial area access and potential gate modification that can accommodate bicycles.

Next Step

Form a working partnership between NNSY and Naval Medical Center Portsmouth (and potentially other Hampton Roads DoD installations) to explore best practices in bike share programs at military installations, including funding options, management, maintenance, and supporting infrastructure.

Lead Partner

- U.S. Navy

35 5.3.35 Expand the comfort rating analysis used in the Portsmouth Bike and Pedestrian Plan and consider adding lighting adequacy into the analysis

Multi-Modal

The Need for Action

The Ports*mouth Bicycle and Pedestrian Plan* included a "barrier assessment" along Effingham Street, between Fort Nelson Park and Portsmouth Boulevard. A crossing "comfort rating" was assessed at major intersections along Effingham Street, as shown in Figure 5.9, and a rating based on crossing distances, pedestrian infrastructure, and concentration of destinations was developed. The ratings are useful tools for identifying needed crossing improvements on arterials throughout the City. The Bi*cycle and Pedestrian Plan* recommends that additional crossing inventory corridor ratings be developed for other corridors, including High Street, Frederick Boulevard, Airline Boulevard, Turnpike Road, and Victory Boulevard. George Washington Highway, Elm Avenue, and Portsmouth Boulevard should also be incorporated into the crossing inventory and improvement assessment. Lighting conditions should also be included in the comfort rating analysis for future corridors. In several instances, inadequate roadway and intersection lighting was referenced as a potential safety concern to individuals considering walking or traveling by bicycle adjacent to the installations, particularly at NNSY.

Next Step

Review and revise the existing comfort rating methodology to consider lighting conditions and define logical terminus locations along George Washington Highway, Elm Avenue, and Portsmouth Boulevard for a barrier assessment to be completed.

Lead Partner

- Portsmouth

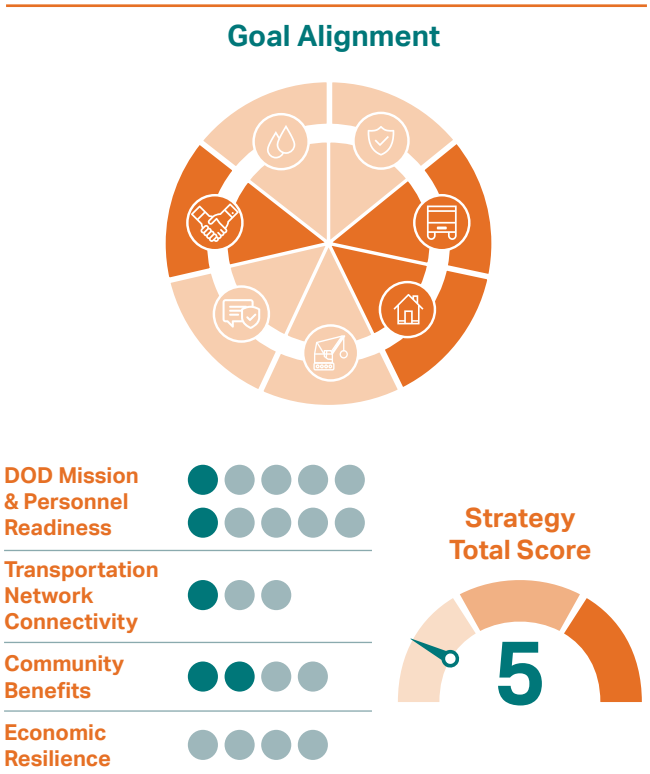


TABLE 4.3 EFFINGHAM STREET CROSSING INVENTORY

Map ID	Cross Street	Crosswalks	Ped Signal	Comfort Rating
1	Crawford Pkwy	Yes	Yes	4
2	Firehouse Ln	No	No	1
3	London St	Yes	Yes	3
4	Queen St	No	No	1
5	High St	Yes	Yes	4
6	King St	No	No	2
7	County St	Yes	Yes	4
8	South St	Yes	Yes	4
9	Henry Street	No	No	1
10	Lincoln St	N & E	No	2
11	Nelson St	No	No	2
12	Palmer St	No	No	1
13	Fayette St	S	No	2
14	Jefferson St	No	No	1
15	Garfield St	No	No	2
16	Coolidge St	No	No	1
17	Portsmouth Blvd	Yes	Yes	4

Figure 5.9 Crossing Inventory along Effingham Street

Source: The City of Portsmouth. 2020. Portsmouth Bicycle and Pedestrian Plan. June.

36 5.3.36 Install additional installation directional signage along key corridors to direct employees and visitors to installations

Access

The Need for Action

Signage is an important aspect of communicating routes and gate locations to drivers traveling to the military installations. A majority of the installations have multiple gates for vehicular and truck traffic, and providing proper signage can improve accessibility and reduce congestion into the installations by distributing the drivers to the appropriate entry points. All installations currently have some advanced directional and/or wayfinding signage along major city roadways, but additional signage is recommended to address existing gaps along the following corridors:

- Portsmouth Boulevard (NNSY)
- Port Centre Parkway (NNSY)
- Court Street (NNSY)
- Victory Boulevard (NNSY and St. Juliens Creek Annex)
- George Washington Highway (NNSY and St. Juliens Creek Annex)
- Elm Avenue (NNSY and Naval Medical Center Portsmouth)
- Western Freeway (Craney Island Fuel Depot)
- Cedar Lane (Craney Island Fuel Depot)

Proposed directional signage does not need to provide reference to specific gates, but should be accurate to allow drivers the ability to change routes if needed.

Next Step

Identify potential locations for additional directional signage along each of the critical roadways referenced in this strategy.

Lead Partners

- Portsmouth
- Chesapeake

Goal Alignment

DOD Mission & Personnel Readiness

Transportation Network Connectivity

Community Benefits

Economic Resilience

Strategy Total Score

Estimated ROM Cost:

$$$

Timeframe

6.0 POLICIES AND PRACTICES

A principle tenant of the JLUS program is to promote partnering among communities and military installations. There are already a number of practices in place that support coordination among Portsmouth, Chesapeake, and the Navy. Such practices can serve as a foundation for partnering on issues of mutual concern in the future or could be expanded and strengthened to address other priority issues or opportunities.

During the JLUS planning process, opportunities to strengthen current policies and practices and improve collaboration were identified that would go beyond current efforts and position both the localities and Navy to be more proactive in the following areas:

- Planning Coordination and Outreach
- Advocacy
- Policy and Development Regulations
- Technology and Data

In addition to the 36 actions described in Chapter 5, the JLUS recommends 36 policies and practices discussed in this chapter that are intended to formalize or increase collaboration among JLUS partners, advocate for the advancement of local and regional priorities, strengthen policies and regulations for long-term community resilience, and leverage technology and data sharing to support decision-making.

Each strategy included in this chapter was designated as high priority by the JLUS Technical and Policy Committees. Tables 6.1 through 6.4 list the recommended policies and practices by topic area.

6.1 Coordination and Outreach

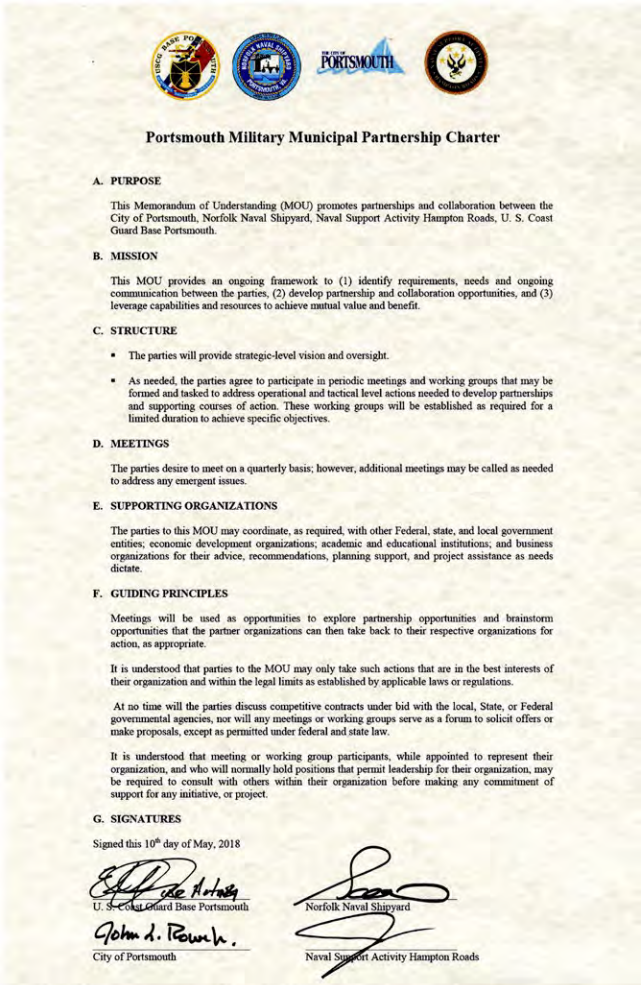
Coordination and outreach strategies are largely targeted at strengthening and formalizing coordination and communication between the JLUS partners, other regional stakeholders, and the public. Several formal and informal mechanisms are already in place to promote coordination between Portsmouth, Chesapeake, and the Navy. In general, these relationships and coordination efforts have been described as very positive, with recognition that there is room for improvement. Planning coordination and outreach strategies are summarized in Table 6.1 on the next page.

Memorandums of Understanding

Both Portsmouth and Chesapeake have existing MOUs in place with the Navy to support coordination efforts beyond the JLUS. The Portsmouth Military Municipal Partnership is governed by a charter, and the MOU, and promotes partnerships and collaboration between Portsmouth, the shipyard, NSA Hampton Roads, and the U.S. Coast Guard Base Portsmouth. The group meets monthly and includes Portsmouth city department heads and Navy CPLO staff that serve as the primary points of contact (POCs) for each installation.

Chesapeake and the Navy signed an MOU in 2013 establishing procedures for joint review of incompatible discretionary land use applications in the Fentress Airfield Overlay District.[1] No formal agreement or MOU focused on St. Juliens Creek Annex; however, Chesapeake has an informal partnership, similar to the Portsmouth Military Municipal Partnership, that could function in this capacity. A formal charter, or MOU, focused on St. Juliens Creek Annex could set forth specific activities for coordination on topics such as planning and utility extensions.

1 City of Chesapeake. 2013. "Resolution Authorizing the City Manager to Execute a Memorandum of Understanding with the Commanding Officer Naval Air Station (NAS) Oceana and Naval Auxiliary Landing Field (NALF) Fentress to Establish Procedures for the Joint Review of Incompatible Discretionary Land Use Applications in the Fentress Airfield Overlay District." July 17. https://www.cityofchesapeake.net/Assets/supporting_docs/actions_council/2013/07-23-13/CA_1.pdf. Accessed 3/19/21.



Portsmouth Military Municipal Partnership Charter

A. PURPOSE

This Memorandum of Understanding (MOU) promotes partnerships and collaboration between the City of Portsmouth, Norfolk Naval Shipyard, Naval Support Activity Hampton Roads, U. S. Coast Guard Base Portsmouth.

B. MISSION

This MOU provides an ongoing framework to (1) identify requirements, needs and ongoing communication between the parties, (2) develop partnership and collaboration opportunities, and (3) leverage capabilities and resources to achieve mutual value and benefit.

C. STRUCTURE

- The parties will provide strategic-level vision and oversight.
- As needed, the parties agree to participate in periodic meetings and working groups that may be formed and tasked to address operational and tactical level actions needed to develop partnerships and supporting courses of action. These working groups will be established as required for a limited duration to achieve specific objectives.

D. MEETINGS

The parties desire to meet on a quarterly basis; however, additional meetings may be called as needed to address any emergent issues.

E. SUPPORTING ORGANIZATIONS

The parties to this MOU may coordinate, as required, with other Federal, state, and local government entities; economic development organizations; academic and educational institutions; and business organizations for their advice, recommendations, planning support, and project assistance as needs dictate.

F. GUIDING PRINCIPLES

Meetings will be used as opportunities to explore partnership opportunities and brainstorm opportunities that the partner organizations can then take back to their respective organizations for action, as appropriate.

It is understood that parties to the MOU may only take such actions that are in the best interests of their organization and within the legal limits as established by applicable laws or regulations.

At no time will the parties discuss competitive contracts under bid with the local, State, or Federal governmental agencies, nor will any meetings or working groups serve as a forum to solicit offers or make proposals, except as permitted under federal and state law.

It is understood that meeting or working group participants, while appointed to represent their organization, and who will normally hold positions that permit leadership for their organization, may be required to consult with others within their organization before making any commitment of support for any initiative, or project.

G. SIGNATURES

Signed this 10th day of May, 2018

U. S. Coast Guard Base Portsmouth

Norfolk Naval Shipyard

City of Portsmouth

Naval Support Activity Hampton Roads

Portsmouth Military Municipal Partnership Charter, enacted May, 2018.

In addition, the Portsmouth Mayor's Military Affairs Committee (PMMAC) meets eight times per year and includes city officials, senior officers, senior enlisted personnel, public affairs officers, and commanders' spouses from the shipyard, Naval Medical Center Portsmouth, U.S. Coast Guard – Atlantic & Fifth District Commands, and the Naval Support Activity Hampton Roads. In addition, the PMMAC includes representatives from the United Service Organizations; Morale, Welfare, and Recreation – Programs, Services, and Facilities; Hampton Roads Chamber of Commerce; and other related community organizations working in support of the military.

The JLUS partners should consider developing an MOU to formalize their commitment to intergovernmental coordination and working together to specifically advance JLUS priorities. Although other MOUs exist between the Navy and each locality as described previously, they are not designed to address JLUS priorities. An MOU among the JLUS partners would formalize the coordination procedures among Portsmouth, Chesapeake, the Navy, and HRPDC, and could be designed to address specific issues or needs, such as establishing the following:

- Dedicated POCs in each city to streamline communication and improve responsivity.
- Procedures for including military planners in city planning processes and city planners in military planning processes to promote information sharing and collaboration, especially on projects that affect land or infrastructure in proximity to the installations.
- Procedures for monitoring future development along the Elizabeth River corridor to prevent impacts on navigation and minimize any encroachment on areas that are used by the military for movements and maneuvers.

An MOU could also be pursued to help address inconsistent stormwater infrastructure maintenance regimens and improve performance of the overall stormwater management system, including ongoing roles and responsibilities for routine maintenance of ditches, culverts, and other drainage. This would have specific benefit and relevance to stormwater management at Craney Island Fuel Depot, where Portsmouth maintains a drainage easement that they regularly clean, mow, and maintain. It could also apply to other installations in areas where storm drainage may flow from Portsmouth or Chesapeake onto the installation or vice versa.

Federal Channel Expansion

The USACE and the Virginia Port Authority, through the "Wider, Deeper, Safer" program, are expanding Norfolk Harbor's shipping channels. "The dredging project will deepen the Inner Harbor channels to 55 feet, Chesapeake Bay's Thimble Shoal Channel to 56 feet and Atlantic Ocean Channel to 59 feet. Thimble Shoal Channel will also be widened up to 1,400 feet in select areas, allowing for ultra-large container vessel two-way traffic."[2]

2 Little, Vince. 2019. "USACE, Port of Virginia ramp up Norfolk Harbor deepening efforts." USACE @NORFOLKDISTRICT. https://www.nao.usace.army.mil/Media/News-Stories/Article/1739330/%20usace-port-of-virginia-ramp-up-norfolk-harbor-deepening-efforts/. Accessed 3/8/21.

Although the wider and deeper channel will improve vessel efficiency, it will also bring the edges of the federal channel closer to the Craney Island Fuel Depot, allowing large ship traffic to pass closer to the fuel depot's piers and wharves. During stakeholder interviews, the Navy indicated concerns about the impacts of hydrodynamic pressure on the wharves and docked ships at the fuel depot.

In addition, the USACE and Virginia Port Authority have completed a Validation Study and Environmental Assessment (EA) to examine navigation improvements to the Elizabeth River and Southern Branch.[3] According to the EA, these deeper channels would allow vessels to fully load various commodities that move in and out of the waterway, and improved channel configuration could possibly allow both commercial and DoD activities to occur simultaneously. Improved anchorages could allow Navy and commercial users of the channels and anchorages to operate more efficiently. The EA also indicates that the Navy separately deepened a portion of the channel to approximately 49 feet, which covers almost the entire width of the federal channel and that the Navy will continue to maintain its channel.

Planning constraints identified in the EA are stated as: "Avoid or minimize impacts to DoD Facilities and activities in the study area. This includes maintaining Antiterrorism/Force Protection buffer space required between the channel and NNSY infrastructure and minimizing the hydrodynamic effects of passing ships. Also avoid or minimize impacts to buried assets (cables, sensors, etc.)."[4] The U.S. Navy was a cooperating agency for the study.

Ongoing monitoring of the channel expansion effort is needed to ensure that it does not adversely impact operations at the Craney Island Fuel Depot or the NNSY. There is also an opportunity to develop guidance that would set forth a framework for how to coordinate on regional projects, such as the Craney Island Marine Terminal expansion discussed in Chapter 3, so that all stakeholders are properly engaged and informed early and throughout the process.

Railroad Growth and Development

No mechanism is currently in place to promote regular coordination between the Navy, cities, and the various railroad operators and owners. As discussed in Chapter 4, activity is expected to increase along the Norfolk and Portsmouth Belt Line Railroad that extends along a portion of the southern boundary of the shipyard before crossing Elm Avenue and passing Scott Center Annex near George Washington Highway. Double stacking and longer trains could result in increased conflicts at the various at-grade crossings.

A formal mechanism for coordination would allow the parties to understand railroad growth plans and any proposed changes by any party that could affect property interests. It could also help provide a shared understanding of required procedures and regulations that apply to railroad facilities, which could affect capital improvement projects by the city or Navy near the rail line. Improved coordination and communication could help proactively address issues, such as a recent right-of-way dispute with the Beltl Line Railroad or signal interference concerns near the Elizabeth River crossing of the railroad. Similarly, issues related to at-grade crossing safety and maintenance could also be discussed.

Utility Providers

The Navy relies upon various utility providers for electric, natural gas, water, and wastewater services and, as a result, is often required to coordinate on projects or issues that arise. The CPLO typically serves as the main Navy POC to receive initial inquiries from utility providers. However, secondary POCs should be defined within Naval Facilities Engineering Systems Command (NAVFAC) to address technical utility issues of concern through direct coordination with utilities. Naval Station Norfolk recently defined a communication protocol with utilities that includes a primary and secondary POC and sets procedures for 24/7 coordination. A similar approach should be pursued for the shipyard and Naval Medical Center Portsmouth to streamline utility coordination and response activities.

3 USACE and Virginia Port Authority, *Elizabeth River and Southern Branch Navigation Improvements, Virginia Validation Study and Environmental Assessment*, July 2018.
4 Ibid.

Regional Industrial Lands Task Force

The Elizabeth River watershed is largely developed, and the Southern Branch of the Elizabeth River has long supported industrial development and military uses. Historical activities have contributed to chemical contamination that has been the focus of large- and small-scale monitoring, remediation, and restoration activities by federal, state, and local partners.

An opportunity exists for city, state, regional, federal, and other local partners to coordinate, plan, and more effectively support a vibrant and resilient industrial sector through a regional industrial lands task force. The large number of industrial users along the river suggests that a multi-jurisdictional approach could be used to coordinate best practices and policies aimed at reducing flood risk and preparing for future events. Vulnerability to SLR and hurricane-driven storm surge flooding are likely to affect many properties with aging building stock, large numbers of commercial vehicles, and/or large amounts of inventory, likely including hazardous materials, along the river corridor.

Such coordinated planning is typically low cost, but savings can be substantial, and a return to normal business operations after a flood event can be expedited by implementing and normalizing pre-flood protective measures, including physical improvements. A review of four case studies from Boston, Los Angeles, and New York City, is included in the Appendix that describes different mitigation strategies and approaches for improving flood resilience of industrial properties. A coordinated task force could include partners such as the Hampton Roads Chamber of Commerce Small Business Development group, Chesapeake's Waterfront Business District alliance, the Virginia Department of Emergency Management's private-sector and critical infrastructure programs, the Virginia Maritime Association, the Virginia Harbor Safety Committee, and other formal and informal business and governmental groups to build the necessary partnerships to get targeted industrial and port-related businesses to participate.

Outreach and Engagement

As Portsmouth and the Navy pursue strategies to address the ongoing parking issues around the shipyard, it will be important to update communication materials about the changes and communicate those changes to installation employees. Any modifications to the SSPD, such as new regulations or restrictions, should be communicated to both installation personnel and nearby residents and businesses. Likewise, as HRT implements changes to its bus routes, information should be made available to all installation personnel. In general, the Navy, cities, and HRT should coordinate on consistent messaging about parking and transit options and in the development of outreach materials and efforts.

In addition, the HRTPO's Military Commuter Survey should be updated on a recurring basis and should include questions about impacts experienced due to flooding. The region-wide commuter survey collects information about the commuting experience of military personnel traveling to and from the region's military bases and could be used to better understand how flooding impacts specific routes used to get to work at an installation.[5]

NNSY is in the process of planning and designing a high-efficiency Combined Heat and Power Plant at the shipyard to improve energy security, conserve energy, and reduce emissions. [6] This project is part of a broader series of investments planned at the shipyard as part of its Energy Services Performance Contract. The proposed plant will be located on the installation and will displace existing surface parking lots north of Elm Avenue and east of Burtons Point Road.

Currently, the shipyard's energy needs are met by the Wheelabrator waste-to-energy plant located directly to the south of the facility. This arrangement is a critical part of the region's solid waste management system. Localities send solid waste to the Wheelabrator facility, which burns the

5 HRTPO. 2018. *Hampton Roads Military Transportation Needs Study. July. https://www.hrtpo.org/uploads/docs/071918%2013%20*Enclosure%20-%20Military%20Trans%20Needs%20Study%20-%202018%20Update%20FINAL%20%281%29.pdf. Accessed 3/22/21.

6 NAVFAC. 2020. *Norfolk Naval Shipyard Combined Heat and Power Plant and Energy Conservation Measures Briefing.* May 21. https://www.navsea.navy.mil/Portals/103/Documents/NNSY/NNSY%20ESCP%20and%20CHP%20Information%20Session%20Briefing%20FINAL%205_21_2020.pdf?ver=2020-05-28-123100-940. Accessed. 3/22/21.

waste to generate steam and power, which is then sold to the Navy. Establishing a new facility on the shipyard property would significantly disrupt the business model for the Wheelabrator facility and the region's management of solid waste. Ongoing coordination is needed regarding the planning, development, and construction of the Navy's new plant to ensure any concerns and issues are proactively addressed. This coordination should build on prior local and regional efforts and could include an assessment of waste disposal options, including a new transfer station, and potential redevelopment options for the Wheelabrator site. The collaboration will build on the existing partnerships to ensure win-win local and regional opportunities.

Emergency Management Coordination

As discussed in Section 3.4.4, the Navy and localities already coordinate on emergency management activities. However, the following additional opportunities were identified to strengthen the capabilities of both the Navy and the cities.

- An increased understanding of the Navy's existing emergency evacuation notification processes and protocols is needed, and an opportunity exists to improve coordination of emergency procedures in Portsmouth that considers both local and federal workers. The goal of this effort would be to help reduce confusion, improve communication, and facilitate improved safety.
- The Defense Support to Civil Authorities (DSCA)[7] is support provided by federal military forces, DoD civilians, or DoD contract personnel in response to a request for assistance from civil authorities for domestic emergencies. DSCA is provided in response to requests from civil authorities and upon approval from appropriate authorities. All local emergency managers are likely aware of DSCA, but a refresher may be beneficial in light of recent events and as a new regional hazard mitigation plan is prepared.
- NNSY currently lacks a mobile rehabilitation truck to support firefighting response and training. While other municipal fire departments have mobile rehabilitation trucks, it is not clear if mutual aid agreements support this specific component to allow those trucks to support military training or response needs. Adjustments to mutual aid agreements could be pursued to help address this need. Action 5.3.27 also recommends the pursuit of a regional First Responder Academy that would support multiple jurisdictions and the Navy. A mobile rehabilitation unit could be discussed as part of that strategy.

7 Joint Chiefs of Staff. 2018. *Defense Support of Civil Authorities. Joint Publication 3-28.* October 29. https://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/jp3_28.pdf. Accessed 3/19/21.

Table 6.1 Planning Coordination and Outreach Strategies

	Strategy	Lead Responsible Party
1.	Adopt an MOU among JLUS partners to commit to working together to advance and implement JLUS priorities.	HRPDC
2.	Establish a formal charter for a Chesapeake Military Municipal Partnership that includes a focus on St. Juliens Creek Annex.	Chesapeake
3.	Designate an individual staff person in each City (e.g., military liaison position) to serve as a single POC for the Navy with a goal of facilitating coordination across departments.	Portsmouth, Chesapeake
4.	Continue to monitor potential impacts from the Federal Channel Expansion on the Craney Island Fuel Depot and NNSY waterfront current and future operations and coordinate with USACE and Virginia Port Authority to address concerns.	U.S. Navy
5.	Continue to monitor navigation impacts along the Elizabeth River during the evaluation of future development and access proposals to prevent navigational trouble spots.	USCG
6.	Develop guidance for regional projects that would define a formal coordination mechanism to ensure all affected parties are sufficiently engaged and consulted in the project.	HRPDC
7.	Include military installation planners in city planning processes (master plans, transportation planning, etc.) and city planners in military planning processes (where possible) to promote information sharing and mutually beneficial outcomes.	Portsmouth, Chesapeake, U.S. Navy
8.	Develop a stormwater systems maintenance MOU for each installation and respective locality to define ongoing roles and responsibilities for routine maintenance of ditches, culverts, and other drainage components that span locality/Navy jurisdiction.	HRPDC
9.	Set quarterly recurring coordination meetings between the Navy, localities, and the Norfolk and Portsmouth Belt Line Railroad.	U.S. Navy, Portsmouth
10.	Continue to monitor communication signal interference near the Elizabeth River crossing of the Norfolk and Portsmouth Belt Line Railroad and work with the Railroad to identify courses of action for reducing impacts.	U.S. Navy
11.	Define Navy primary and secondary utility POCs for each installation and the associated coordination protocols between NAVFAC counterparts and utility providers (natural gas, electric).	U.S. Navy
12.	Consider the formation of a regional industrial lands task force to support the development of guidance for reducing risk along the Southern Branch of the Elizabeth River.	HRPDC
13.	Update the Military Commuter Survey (HRTPO) on a recurring basis so that it can regularly inform regional transportation and transit planning processes.	HRTPO
14	Develop and regularly update outreach materials for NNSY, Naval Medical Center Portsmouth, and St. Julien's Creek Annex employees about appropriate protocols, locations, and enforcement procedures for parking outside the installation and available transit options, and update materials as conditions and options change.	U.S. Navy
15.	Continue ongoing coordination and communication about the future of the Wheelabrator waste-to-energy plant and potential opportunities for reuse.	U.S. Navy
16.	Develop coordinated emergency evacuation protocols for local and federal workers in the downtown area of Portsmouth.	Portsmouth
17.	Explore options for establishing a regional Mobile Rehabilitation Unit (vehicle) that can support emergency response training and incident response needs at DoD installations.	Portsmouth, Chesapeake
18.	Ensure local emergency managers and elected officials are informed about the DSCA as a resource strategy to support local emergency management planning and response activities.	U.S. Navy

6.2 Advocacy

The advocacy strategies described below are aimed at influencing state, federal, and regional actions in support of JLUS priorities. Advocacy efforts should educate policy and lawmakers about the importance of military readiness and resiliency and how the JLUS priorities respond to these objectives. Efforts should engage and align with other supporting organizations, such as the Hampton Roads Military and Federal Facilities Alliance (HRMFFA) and local and regional Chambers of Commerce to help build awareness of plan priorities and the need for funding. Advocacy efforts should establish lines of communication with Virginia's U.S. Congressional delegation, representatives in the Virginia House of Delegates and Senate, and state and federal officials. Advocacy strategies are summarized in Table 6.2.

Federal Funding

A unified and coordinated approach for advancing the JLUS priorities should be developed and used to strategically target federal funding, including the Defense Community Infrastructure Program (DCIP) and the DAR Program. The DCIP program awarded over $50 million nationwide in FY20, and additional funding is expected in FY21. The DAR Program creates a mechanism for projects to be funded by defense funding, but there are no appropriated funds for the Program annually.[8]

State Funding

Changes to the VDOT SMART SCALE evaluation measures should be pursued to promote a more resilient transportation system by requiring that SLR, flooding, and military readiness be considered as core factors for funding eligibility. The purpose of SMART SCALE is to fund transportation projects through a prioritization process that evaluates each project's merits using multiple key factors, which include improvements to safety, congestion reduction, accessibility, land use, economic development, and the environment.[9]

Currently, SMART SCALE does not consider flooding or resiliency in prioritizing projects for funding. The HRPDC and HRTPO Regional Legislative Agenda states that a project's approach to addressing resiliency should be considered in determining SMART SCALE funding.[10]

In 2020, VDOT's Structure and Bridge Division adopted new design standards that direct engineers and designers to account for SLR, water salinity, temperature change, and rainfall intensity when constructing and maintaining bridges.[11] These standards incorporate the NOAA Intermediate-High scenario curve as the state standard for predicting sea level rise.[12] In addition, legislation passed in the 2021 General Assembly session directs the Commissioner of Highways to incorporate resiliency into the design standards for all new construction projects.

The HRTPO Military Transportation Needs Study recommends that relative SLR and potential storm surge impacts be considered when selecting future transportation projects and that VDOT and cities use the latest projections for sea level rise and storm surge when a roadway project is designed. The relationship between flooding and congestion was explored in the JLUS analysis to demonstrate the impact that flooding has on the overall transportation network. The HRTPO is working in partnership with the HRPDC, U.S. Department of Transportation, and Volpe to incorporate resilience and adaptation into decision-making about long-range transportation investments. Volpe's Resilience and Disaster Recovery (RDR) Metamodel enables scenario planning and comparisons of resilience investment return[13] of projects, which can inform project prioritization and performance.

8 Military Surface Deployment and Distribution Command's Transportation Engineering Agency. n.d. "Defense Access Roads Program" (webpage). https://www.sddc.army.mil/sites/TEA/Functions/SpecialAssistant/Pages/DefenseAccessRoadsProgram.aspx. Accessed. 3/16/21.

9 Commonwealth Transportation Board. 2021. *SMART SCALE Technical Guide*. February. http://smartscale.org/documents/2020documents/technical-guide-2022.pdf. Accessed 3/16/21.

10 Hampton Roads Planning District Commission. 2021. *2021 Regional Legislative Agenda for the 757*. https://www.hrpdcva.gov/uploads/docs/HRPDC_HRTPO%202021%20Regional%20Legislative%20Agenda.pdf. Accessed 3/18/21.

11 Turken, Sam. 2020. "VDOT Issues New Design Standards Accounting For Climate Change." June 17. WHRO Public Media News. https://whro.org/news/local-news/10661-vdot-issues-new-design-standard-accounting-for-climate-change. Accessed 3/16.21.

12 VDOT. 2020. Chapter 33, *Considerations of Climate Change and Coastal Storms.* February 14. http://www.virginiadot.org/business/resources/bridge/Manuals/Part2/Chapter33.pdf. Accessed 3/16/21.

13 Hampton Roads Transportation Planning Organization. 2020. *Integrating Resilience into Planning*. October 7. https://www.hrtpo.org/uploads/docs/P9-HRTPO-IntegratingResilience-LRTP-10.07.20.pdf. Accessed 3/16/21.

Flood Risk Disclosure

The General Assembly recently modified the Code of Virginia § 55.1-703 related to required disclosures for flood risk. The change will go into effect January 2, 2022.[14] A new flood risk information form is to be made available by the Real Estate Board in order to provide property owners and potential property owners with information regarding flood risk. A new section, § 55.1-708.2, requires the owner of residential real property located in the Commonwealth who has actual knowledge that the dwelling unit is a repetitive risk loss structure to disclose it to the purchaser, where "repetitive risk loss" means that two or more claims of more than $1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling 10-year period, since 1978. The disclosure is expected to be documented on the new flood risk information form.

These changes are a positive step forward in communicating flood risk to those seeking to purchase a home in the JLUS study area. Flood disclosure remains a legislative priority for the HRPDC and HRTPO and was included on the 2021 Regional Legislative Agenda. Providing flood risk information to aid Navy personnel in making more informed decisions about where to live could help reduce flood risk and the impacts of flooding on sailors and their families. However, the disclosure of flood risk and information about a property's flood history depends on a repetitive loss designation, which has two drawbacks that may exclude many owners of flood-prone structures from having to disclose: 1) previous claims were outside the requisite timeframe or of insufficient quantity to trigger a repetitive loss designation by definition, in which case future floods may trigger such a designation that surprises new homeowners; and 2) floods that occurred but for which claims were not filed for any reason (structure uninsured or insured with non-federal insurer) are not recognized. Although the new law and form recognize that properties outside the Special Flood Hazard Area (SFHA) can flood and encourages owners and buyers to consult with insurance agents about the need for flood insurance, it does not require disclosure beyond repetitive loss properties. Mandatory disclosure for all structures in the SFHA and 500-year floodplain would be a more comprehensive approach to providing buyers with the information they need to protect their investment. Increasing education and outreach to military personnel and real estate professionals would also help address the lack of awareness concerning flood risks.

Similarly, the Virginia Residential Landlord and Tenant Act does not require disclosure of flood risk information or a property's flood history to prospective renters. The Act indicates that the landlord shall provide a written notice about personal property insurance coverages; renter's insurance obtained by the tenant typically does not cover flood damage. The written notice will advise the tenant to contact the FEMA or visit the websites for FEMA's NFIP or the Virginia Department of Conservation and Recreation's Flood Risk Information System to obtain information regarding whether the property is located in an SFHA.

Incorporate Precipitation into Coastal/Storm Surge Analyses

Recent climate change research indicates that precipitation patterns are changing measurably from historic norms. In Hampton Roads, this has resulted in an overall increase in precipitation. Stormwater management systems are designed according to certain standards, so if those standards are too low, the system may be overwhelmed more frequently. This can result in increased vulnerability to flooding outside of the established 100-year floodplain boundaries that are studied, mapped, and regulated through the NFIP and FEMA's Flood Insurance Studies (FISs) and Flood Insurance Rate Maps (FIRMs). When these precipitation events occur in conjunction with other coastal storms such as nor'easters and tropical storms, the resultant backflow occurs in areas not previously thought to be flood prone. The problem is exacerbated as sea level rises.

FEMA's regulatory maps, including coastal storm surge analyses, are required to be based on long-term historical flood elevations from past storms, as well as existing hydrologic and bathymetric conditions. However, as climate change brings more flash floods that overwhelm traditional drainage systems subject to storm surge and rising sea levels, options are needed for redrawing and updating floodplain boundaries to reflect these rapidly changing "existing conditions" so that property owners are alerted to the changing hazard and new development is designed in a flood-safe manner. By combining traditional storm surge analyses with precipitation-based stormwater mapping, 100-year flood zones should be extended to include both types of flooding, reflecting a more accurate and realistic coastal

14 Virginia General Assembly. 2021. "2021 Special Session 1: An Act to amend and reenact § 55.1-703 of the Code of Virginia." https://lis.virginia.gov/cgi-bin/legp604.exe?212+ful+SB1389ER. Accessed 3/16/21.

community floodplain for future planning.

While the states and FEMA are beginning to address these additional considerations for flood risk, communities need to look at a range of strategies to have more influence on how all flood-related mapping and modeling is updated for their community. One strategy for modernizing coastal flood maps to include the combined effects of precipitation and storm surge on 100-year floodplain delineations is to pursue a Cooperating Technical Partner (CTP) relationship with the state and FEMA Region III. Becoming a CTP helps ensure the use of local resources, knowledge, and capability in building flood maps that contain data critical to the local partners. CTP leverages partnerships to deliver high-quality hazard identification and risk assessment products, provide outreach support, and empower communities to take action to reduce risk based on informed, multi hazard-based data and resources. This would allow FEMA to assist on a local scale while incorporating this information into both official FEMA regulatory flood hazard data and supplemental non-regulatory flood risk products that might be used to inform land use planning.

Another strategy for conducting studies that go beyond minimum NFIP requirements is to work directly with the FEMA Region and their contractors in developing scopes during the typical FEMA map update schedule. FEMA has been incorporating more non-regulatory studies as part of the routine map update process that include future conditions when communities specifically request assistance. These new data would not replace FEMA FIRMs, but they could be used to develop supplemental non-regulatory datasets and planning maps that communities could use to develop local regulatory boundaries of their own. For example, this supplemental mapping might include higher Design Flood Elevations more stringent than those provided in the FEMA FIS or the FIRM. Maps of areas experiencing stormwater backflow resulting from combined storm surge and intense precipitation events could also be included in this supplemental mapping and included in a community's floodplain management ordinance.

FEMA's maps are only required to be updated every 5 years, and climate change may be altering the precipitation patterns faster than that. The Association of State Floodplain Managers, among others, recognizes the need for FEMA's maps to reflect future conditions and has been advocating such to Congress.

Expanded Transit Services

The Hampton Roads Transportation Funding Law, effective September 2020, creates the first-ever dedicated Hampton Roads Regional Transit Program and Fund, which will be managed by the Hampton Roads Transportation Accountability Commission.[15] Under the law, the cities that participate in HRT will continue to individually fund public transit, but HRT will implement a new regional program of routes paid for with statewide and regional funding. This new funding approach will support the implementation of HRT's Transit Strategic Plan FY 2021–2030[16] and regional

15 Virginia Department of Rail and Public Transportation. 2020. "Virginia Governor signs Hampton Roads Transportation Funding Law, welcomes new electric transit buses." September 21. Mass Transit. https://www.masstransitmag.com/bus/vehicles/hybrid-hydrogen-electric-vehicles/press-release/21155109/virginia-department-of-rail-and-public-transportation-drpt-virginia-governor-signs-hampton-roads-transportation-funding-law-welcomes-new-electric-transit-buses. Accessed 3/16/21.

16 https://gohrt.com/agency/planning-development/transit-

Table 6.2 Advocacy Strategies

	Strategy	Lead Responsible Party
1.	Continue to explore and pursue funding opportunities through the DoD DCIP and DAR Program.	HRPDC
2.	Pursue an amendment to the VDOT SMART SCALE criteria to include sea level rise, flooding, and military readiness as factors for prioritizing projects for funding.	HRPDC, HRTPO
3.	Pursue an amendment to the Code of Virginia and the Virginia Residential Property Disclosure Act for mandatory disclosure requirements for flood hazard, including 500-year flood, for real estate transactions (purchase and rental).	Portsmouth, Chesapeake
4.	Advocate for FEMA to incorporate precipitation into coastal/storm surge analyses.	HRPDC
5.	Continue to advocate for the development of expanded transit services to NNSY and NMCP and other DoD installations.	U.S. Navy, HRPDC, Portsmouth, Chesapeake

priorities for more inter-jurisdictional bus service. These changes will set the stage for potential bus transit service improvements for NNSY, Naval Medical Center Portsmouth, and other DoD installations in Hampton Roads. The JLUS partners should continue to advocate for expanded transit service that responds to the needs of military personnel, including varying work shift times that may start earlier than typical businesses. Other strategies, including dedicated service routes or the development of bus rapid transit (BRT), could also be explored.

6.3 Policy and Development Regulations

Land use policies and development regulations are important tools for managing long-term compatible growth and development of a community. Several strategies discussed in Chapter 5 also address land use opportunities, including a special compatible use overlay district/zone around each installation to better inform and guide development opportunities and other strategies that are specific to a certain area near an installation. A focus of the strategies in this section includes opportunities to strengthen floodplain management ordinances and to also build resiliency into planning and design guidelines for roadways. Table 6.3 includes policy and development regulation strategies.

Notification Boundary

Both Portsmouth and Chesapeake have processes in place to comply with Code of Virginia § 15.2-2204, which requires written notice to be provided to military installation commanding officers regarding any proposed comprehensive plan amendment, change in zoning classification, or special exception within 3,000 feet of a military installation boundary.[17] The public notice must be provided at least 30 days before the hearing and gives the military commander an opportunity to submit comments. In Portsmouth, a notification is sent to the CPLO for all applications, not just those within 3,000 feet of an installation. In Chesapeake, notification is provided to the appropriate military installation/designated military contact within 9 business days of the application being submitted to the City. In both localities, City staff review comments, including those from the military installations, and make efforts to resolve the comments before the public hearing.

Both localities also have the 3,000-foot boundary mapped in a geographic information system (GIS) and use it as a reference for planning. An opportunity exists to make the 3,000-foot military notification boundary available for viewing by the public as part of web-based planning services. In addition, the boundary could be referenced in local plans (comprehensive or area plans in proximity to the installations) to raise awareness about proximity to the installation and the importance of coordination with the military for any action within the boundary.

Building Resiliency into Future Planning Efforts

Portsmouth and Chesapeake are making progress in considering the threats from future SLR and flooding as part of local plans and policies. The Code of Virginia §15.2-2223.3 requires localities in the Hampton Roads Planning District to incorporate strategies to address SLR in their comprehensive plans, giving them the express authority to address future climate conditions.

Portsmouth's Comprehensive Plan, *Build One Portsmouth*, includes mapping on flood exposure and storm surge and identifies guidelines to mitigate repeated losses from flooding, including relocating city facilities to higher ground, reviewing and revising city codes so they do not conflict with recovery efforts, and developing relocation and adaptive development plans for areas that are impacted by repeated flooding. The City's 2015 Floodplain Management and Repetitive Loss Plan Update recommends developing policies and regulations that address critical structures and infrastructure, including preparing plans that consider SLR in budgeting and construction and preventing critical structures from being located in flood hazard areas.[18] The plan also recognizes the impact that flooding can have on vehicular circulation and evacuation and emergency services.

Moving Forward: Chesapeake 2035[19] also

strategic-plan/. Accessed 3/16/21.

17 Code of Virginia § 15.2-2204, Advertisement of plans, ordinances, etc.; joint public hearings; written notice of certain amendments. https://law.lis.virginia.gov/vacode/15.2-2204/. Accessed 3/19/21.

18 USACE. 2015. City of Portsmouth, Virginia 2015 *Floodplain Management and Repetitive Loss Plan Update*. August. https://www.portsmouthva.gov/DocumentCenter/View/564/2015-Floodplain-Management-and-Repetitive-Loss-Plan-Update-PDF?bidId=. Accessed 3/19/21.

19 Chesapeake Planning Department. 2014. *Moving Forward:*

recommends that development be designed to mitigate potential impacts from flooding and SLR. The plan includes strategies to direct new development, redevelopment, and critical infrastructure toward higher ground to the extent possible. Chesapeake is in the process of preparing to update its comprehensive plan and two other city studies – an Industrial Waterfront Study and a Citywide Trails & Open Space Connectivity Plan.

Future climate conditions related to rainfall and SLR should continue to be considered by both cities as they update plans or pursue additional studies recommended in this JLUS. However, future flood conditions should do more than serve as a reference; they should inform and influence land use decisions and infrastructure design toward becoming more resilient, especially in areas with higher future flood risk. Future flood conditions are especially important to consider in the siting of public facilities, such as schools, hospitals, fire, police stations, and other critical infrastructure related to transportation and utilities, where even a minor disruption would cause significant impacts. This approach would allow future flood conditions and associated impacts to inform land use policy and development decisions and infrastructure upgrades to reduce risk and promote long-term resiliency.

Guidance for TDM and Roadway Design

Planning for anticipated flood events in advance is the most effective approach to addressing potential impacts to vehicle and roadway operations. Local and regional transportation planning efforts should adjust current approaches to traffic forecasting and infrastructure design. Infrastructure design is largely supported by an understanding of the anticipated amount of traffic forecasted to be serviced. Regional tools such as the TDM are helpful in forecasting future traffic demand, but these tools assume conditions unconstrained by flood impacts, so they do not take into account the effects of inundated roadways due to SLR, rain events, and/or storm surge. The potential exists, however, for a flood event to significantly limit the number of available routes, and therefore future forecasting estimates may have limited accuracy. With an ability to understand potential roadway flooding impacts, decision makers can better understand travel demand that will need to be served by both existing and proposed regional roadway infrastructure. Currently, state agencies and localities are in various stages of developing updated design guidelines that address potential flooding events while also providing the necessary capacity to serve anticipated traffic demands. However, these efforts are not on the same timelines. It is important to coordinate these efforts to promote consistency, reduce potential conflicts, and minimize duplication of effort. To assist in advancing current transportation planning and design throughout the region, the following two strategies are recommended:

- Develop regional guidance for integrating tidal and rainfall scenarios into the regional TDM so that the information can be used in future scenario planning. Specifically, this would include two primary steps: 1) Translating anticipated flood conditions into TDM link adjustments (i.e., reductions in speed and/or capacity) and 2) development of an origin-destination trip summary after the TDM is run. The origin-destination summary would enable TDM users to analyze unmet demand, or trips that are unable to load into the network, under a given flood scenario. Planners would be able to evaluate the magnitude of unmet demand and the destination(s) of those unmet origin trips. This would provide significant insight into potential impacts to roadways that serve as primary and secondary route alternatives for those origin trips.
- Incorporate up-to-date projections for future SLR, rainfall, and storm surge into roadway design guidelines to ensure that changes in climate conditions do not shorten the lifespan of infrastructure projects. Affected design guidelines would apply not only to horizontal and vertical design elements, but also to the materials that are used in construction (i.e., materials that are more resistant to corrosion).

Repetitive Loss

Chesapeake 2035. February 25. Amended November 15, 2016. https://resources.cityofchesapeake.net/comp-plan-2035/#page=68. Accessed 3/19/21.

Federal flood insurance policies include Increased Cost of Compliance (ICC) coverage. Owners of NFIP-insured buildings that are located in SFHAs and that are determined to meet the basic definition of "substantial damage" as a result of damage by flooding are eligible to file ICC claims for up to $30,000 towards the cost of bringing buildings into compliance with the floodplain management requirements for new construction. In communities that adopt specific language addressing "repetitive loss" structures, such structures may be eligible for the ICC claim even if they do not meet the standard 50 percent threshold for substantial damage by a single event. To qualify, communities must adopt and enforce the repetitive loss provision on all buildings in SFHAs, not just those covered by federal flood insurance. The language that defines "repetitive loss" is specified in the National Flood Insurance Reform Act of 1994 (which modified 42 U.S.C. 4121, Definitions), the federal law that authorized the ICC coverage.[20]

The biggest beneficiaries of a repetitive loss provision are the flood-insured property owners, who receive a claim supplemented by up to $30,000 to help with elevation, relocation, demolition, or floodproofing (only non-residential buildings, with limited exceptions, can be floodproofed). Navy personnel and civilian employees who choose to buy homes in the region benefit in two ways: 1) the increased quantity of flood-safe housing in the longrun can provide more housing options that will not be affected when flooding occurs; and 2) in the event a flood occurs and a sailor's home is severely impacted, the availability of up to $30,000 ICC coverage can help the sailor (and his or her family) recover more quickly.

The City of Chesapeake's Zoning Ordinance, Chapter 26 Environment, Article IV Floodplain Management, Section 26-88 provides two conflicting definitions of "repetitive loss." In addition, the term does not show up anywhere else in the ordinance; so repetitive losses are in no way regulated or triggered to comply with ordinance requirements. The City will need to implement an administrative tracking process for monitoring claims and tie those claims to building permit requests. The following definitions should be modified as follows to ensure the ordinance

20 See FEMA 301, Increased Cost of Compliance Coverage: Guidance for State and Local Officials, September 2003.

Table 6.3 Policy and Development Regulations Strategies

	Strategy	Lead Responsible Party
1.	Include the 3,000-foot notification boundary reference in local plans and policy documents.	Portsmouth, Chesapeake
2.	Incorporate future climate conditions (rainfall, SLR) into locality comprehensive plan updates and area plans so that land use policy, growth management strategies, and siting of public facilities (schools, fire, police) consider future conditions for flooding and access constraints caused by flooding.	Portsmouth, Chesapeake
3.	Incorporate up to date projections for future SLR, future rainfall, and storm surge into roadway design guidelines and projects to cover the project's expected service life.	VDOT
4.	Develop regional guidance for integrating tidal and rainfall scenarios into local and regional transportation planning so that the information can be used in future scenario planning.	HRTPO
5.	Develop future base flood elevation design guidelines that incorporate SLR.	Portsmouth, Chesapeake
6.	Strengthen repetitive loss definitions and administrative procedures in local floodplain management ordinances to provide added protections to insured property owners.	Portsmouth, Chesapeake
7.	Require a recorded declaration of land use restriction in SFHAs that prohibits converting areas under elevated structures to habitable space by permanently restricting uses to parking, storage, and access to the building.	Portsmouth

meets the requirement to "adopt and enforce the repetitive loss provision on all buildings in SFHAs, not just those covered by federal flood insurance:"

> *Repetitive loss structure ~~property. Under the National Flood Insurance Reform Act, a repetitive loss structure is:~~ "a building covered by a contract for flood insurance that has incurred flood-related damages on two occasions during a 10-year period ending on the date of the event for which a second claim is made, in which the cost of repairing the flood damage, on the average, equaled or exceeded 25 percent of the market value of the building at the time of each such flood event."*
>
> *~~Under FEMA, a repetitive loss structure is: "a property for which two or more National Flood Insurance Program losses of at least $1,000 each have been paid within any 10-year rolling period since 1978."~~*
>
> *Substantial damage means damage of any origin sustained by a structure whereby the cost of restoring the structure to pre-event condition would equal or exceed 50 percent of the market value of the structure before the damage occurred, and includes repetitive loss structures."*

The City of Portsmouth properly defines "repetitive loss" in Chapter 14.1 Flood Protection, Section 14.1-5 Specific definitions and includes repetitive losses in the definition of "substantial improvement." The City is advised to verify that administrative procedures are established to track flood insurance claims and building permits so that the provision can be enforced uniformly.

Declaration of Land Use Restriction

The NFIP regulations and USBC allow areas under elevated buildings to be wet floodproofed and enclosed with specially designed walls that equalize hydrostatic pressure on both sides of the wall or are designed to break away in Coastal High Hazard Areas (V Zones). Chesapeake and Portsmouth have enclosure standards that substantially conform to the NFIP and USBC requirements, with both communities adding access limitations that allow for parking of vehicles (garage door), limited storage of maintenance equipment (standard exterior door), or entry to the living area (stairway or elevator). Portsmouth has coastal high hazard areas (V Zones) and Coastal A Zones where their ordinance specifies that, in addition to standard NFIP restrictions on use, enclosed areas below the lowest floor cannot be partitioned into multiple rooms, temperature-controlled, or used for human habitation.

The NFIP regulations and these local ordinances do not require any form of owner agreement regarding modification or conversion of enclosures. Some communities elect to require non conversion agreements or declaration of land restriction, recorded on the deed, for all enclosures. The objective is to reduce the likelihood that current and future owners might convert enclosures to uses other than permitted uses, thereby increasing flood risk to the entire structure.

A recorded declaration of land restriction would have two advantages for Navy personnel: 1) the deed would disclose basic flood risk location information; and 2) the deed restriction would highlight the prohibition on conversion to habitable space for areas beneath elevated structures. Converting such space, even unknowingly, is a violation of local floodplain management ordinances.

6.4 Technology and Data

Data sharing between the Navy and localities occurs, but it is typically done at a project level or in response to a specific request. The JLUS partners should define GIS-sharing protocols and permissions to support cross-jurisdictional planning, infrastructure improvements, and design efforts that go beyond a specific project. A more collaborative approach to data sharing will help produce a more comprehensive understanding of conditions and allow the cities and Navy to consider interdependencies and impacts more broadly. For example, sharing stormwater management system or other utility infrastructure data by the Navy could allow the city to complete more technical analyses. Similarly, integrating current or future Navy traffic count data (as available) into city traffic analyses and roadway improvement and safety projects could help the city plan for improvements that also consider mission growth. Established data-sharing protocols and requirements can also help to minimize impacts from leadership and staff changes within the Navy and cities that occur over time. Technology and data strategies are identified in Table 6.4.

Shoreline Mapping

The JLUS process identified a need for a comprehensive, consistent, and up-to-date GIS mapping layer of the Elizabeth River shoreline that provides an understanding of industrial land use, access, environmental conditions, and potential flood risks. The Center for Coastal Resources Management, part of the Virginia Institute of Marine Science, provides some data regarding shoreline inventory and conditions through locality-specific Comprehensive Coastal Resource Management Portals (CCRMPs) (Portsmouth and Chesapeake). These and other data could support coordinated planning by the region and the localities aimed at managing the working industrial waterfront. This type of data could also support decision making, policy development, and regulations, including helping to identify creative solutions to maintain water access for industry and recreational users and improving resiliency for waterfront operations overall. Inventorying and mapping the working waterfront will provide a baseline understanding for tracking change.

In addition to industrial waterfront mapping, the JLUS identified a need for a future floodplain GIS mapping layer. Mapping a zone of inundation subject to flooding with SLR, or the future base flood outside the SFHA, would provide an opportunity to implement design guidelines that reduce the long-term vulnerability of structures built in those areas. Design guidelines could be specifically geared toward the building types of most concern or could apply universally. For example, if the goal is to reduce vulnerability of non-residential structures, then floodproofing or elevation to the future base flood elevation could apply only to that subset of development. Once the mapping is completed, the localities should consider developing proposed ordinance revisions to support local implementation.

What is the Hampton Roads Geospatial Exchange Online?

Future Base Flood Elevation Design Guidelines

In the JLUS study area, development projects outside the FEMA-designated SFHA are currently not subject to ordinance requirements that protect against flood damage. However, as sea levels rise, base flood elevations will increase, flood zone boundaries will move inland, and structures outside the SFHA built to today's standards will be left vulnerable to flood damage.

Anticipated impacts that affect how buildings are designed include:

1. Increasing frequency and severity of coastal storms
2. Increasing frequency and intensity of rainfall events
3. Deeper flooding
4. Larger areas affected by flooding
5. Higher waves
6. Inland movement of the boundary between Zone V and Zone A
7. Increased scour and erosion
8. More frequent and more severe blocking of freshwater runoff during extreme high tides
9. Decreasing depth to groundwater

To account for future SLR, maps and regulations can be adjusted in the near term to account for and decrease the risk of flooding to more structures over the long term. Examples the localities could consider for enhanced code design requirements in the study area include, but are not limited to:

1. ***Building Higher Outside of Mapped SFHA.*** Implementing a building elevation requirement in areas outside the SFHA can be done by adding to local land development regulations that govern grading, drainage, or stormwater management. The Virginia Uniform Statewide Building Code (USBC) could also be modified to define "crown of road" and then require the top surface of floor systems and concrete floors in adjacent structures be elevated to or above the crown of road, protecting new structures from local drainage. This approach is common in South Florida, where everyday flooding from SLR is affecting areas further

and further from the SFHA. Many communities have incorporated a requirement outside the SFHA that requires the floor to be elevated 6 to 18 inches above the crown of the nearest road or at least above natural grade at the site.

2. ***Adopt Supplemental Flood Hazard Maps.*** Communities adopt FISs and FIRMs produced by FEMA in local floodplain management regulations. These studies and maps are the basis for enforcing the flood provisions of local floodplain management regulations and the USBC. Maps that show regulated areas allow the public, design professionals, and builders to identify site-specific flood conditions that influence the design of buildings and structures. Maps also make it easier for community officials to administer the applicable flood hazard area requirements. Modifying the areas regulated or adopting supplemental flood hazard maps may be an effective way to account for changes in future flooding conditions. The NFIP recognizes that some communities may adopt other flood maps or studies that cover all or some areas within their jurisdiction. Use of other maps and supporting studies is allowed, provided the maps show either flood-prone areas that are larger than the SFHA or flood-prone areas that are not identified on FIRMs. However, to satisfy the NFIP requirements, both the FIRMs and the community's flood hazard area delineations or maps must be adopted, and the more restrictive conditions should prevail. Supplemental maps could delineate areas outside the SFHA that are known to experience flooding, show areas inundated by historical floods of record, delineate areas anticipated to be subject to future flooding, or re-delineate the Zone V and Zone A boundaries further inland.

3. ***Expand Area Subject to Floodplain Management Regulations Based on Site Elevations.*** One of the reasons communities adopt requirements for buildings to be elevated higher than the minimum elevation specified by the NFIP (known as freeboard) is to account for future conditions. But if FIRMs are used as the basis for establishing flood hazard areas, then the land area outside of the SFHA yet under the freeboard elevation is not regulated. Figure 6.1 illustrates this concept. Building A is just "outside" of the SFHA and is allowed to be constructed at grade (perhaps with a basement). Building B is "in" the SFHA and must be elevated above the base flood elevation (BFE). In a flood event above the BFE but below the freeboard elevation, Building B

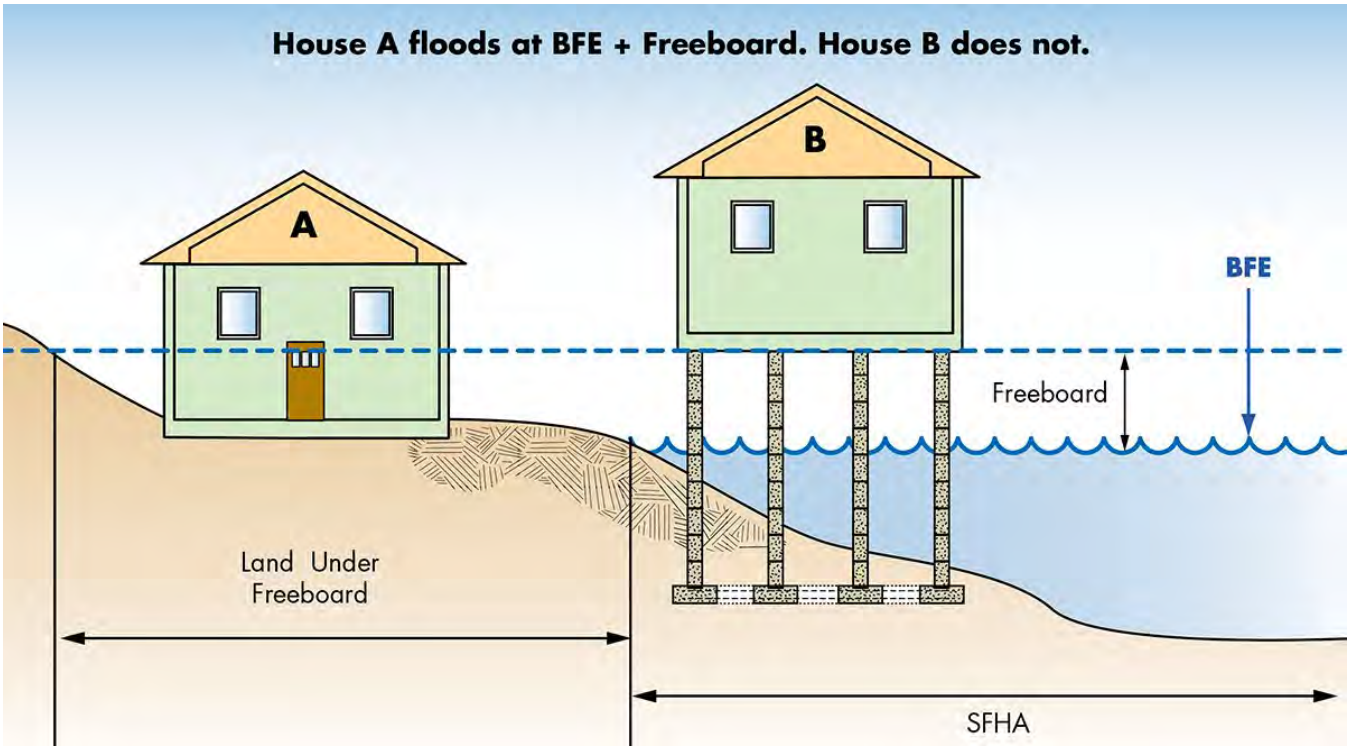


Figure 6.1 Regulating land to Freeboard Elevation

Source: Association of Floodplain Managers, https://www.floodsciencecenter.org/products/elected-officials-flood-risk-guide/moving-beyond-the-essentials/5/#question_44

is not damaged, while Building A is flooded. Regulating land to the freeboard elevation provides an equal level of protection to those who develop in areas just outside the FEMA-designated floodplain. To make this change, communities would need to change the scope language in their floodplain management ordinance that adopts the FIS and FIRM to include the land area below x feet, where x = closest applicable base flood elevation plus freeboard.

Sensors and Notification Systems

Notification systems that warn of potential flooding hazards or congestion enable motorists to make more informed decisions before setting out for a destination or while traveling. Local emergency managers from Chesapeake and Portsmouth can share available tools for flood warning in order to facilitate more effective preparedness planning specific to individual businesses and business types. Flood warning tools are a critical element in emergency action plans, evacuation plans, and other readiness measures, such as shared parking agreements with upland businesses.

A total of 14 flood sensors are installed in Portsmouth that measure water levels along roadways and transmit data that will provide flood depth and street location in real-time conditions. Eleven of the sensors are part of the City's program, while three were installed through direct collaboration with private entities. The data are open source and available to the public to enhance safety. The City partnered with Green Stream Technologies for the installation of the sensors. One of the sensors is located at the Naval Medical Center Portsmouth Gate 1.

The flood sensors installed in Portsmouth can be viewed live at the following link:

http://dashboard.greenstream.io/Sites/index.html?id=HRXURXPUEyZHJw11JKPo

The smart sensors serve as an operational forecasting tool for citizens to alert them to flooded roadway conditions. Efforts to expand the program should consider the DoD, major corridors serving the DoD, and other major employers, including industrial waterfront properties and the Virginia Port.

Similar efforts to install flood sensors are underway elsewhere in the region. These include Storm Sense[21] and a regional roadway flooding sensor network being developed by the HRPDC. Integrating the flood sensor data from the various programs into an application such as Waze or another regional alert system such as VDOT's 511 traffic alert system could warn drivers of flooded roads. Regardless of the application or platform, the alert system should function regionally and be compatible with the DoD. Until a regional alert system is in place, the Navy should consider using electronic signage on base to warn drivers about roadway conditions (flooding and congestion) outside the installation.

An electronic notification system that alerts drivers to the opening of the Elizabeth River drawbridge, north of the Jordon Bridge, is also needed. Operation of the drawbridge is regulated by 33 CFR § 117.997,22 which stipulates the procedures and requirements for the bridge. Per the regulations, the bridge will be left in the open position at all times and will only be lowered for the passage of trains and to perform periodic maintenance. When the bridge is up, trains are held and can sometimes queue back to the George Washington Highway crossing, causing congestion and blocking access along key corridors that connect NNSY with Scott Center and family housing areas. Portsmouth has identified four intersections for the placement of advanced warning signage to inform drivers when trains will be crossing. The crossings at High Street, Elm Avenue, Frederick Boulevard, and George Washington Highway were selected in part because of their proximity to the Navy installation and the city's operation center. Portsmouth has received funding through SMART SCALE for the installation. The signs could be used to alert regional motorists of the bridge opening and could also potentially be used to provide notification of more localized flood hazards. Action 5.2.20 in Chapter 5 discusses prioritizing the location of signs and considering the expansion of this program.

21 Virginia Institute of Marine Science. n.d. "StormSense." https://www.vims.edu/people/loftis_jd/StormSense/index.php. Accessed 3/16/21.

22 33 CFR § 117.997 - A*tlantic Intracoastal Waterway, South Branch of the Elizabeth River to the Albemarle and Chesapeake Canal.* https://www.law.cornell.edu/cfr/text/33/117.997. Accessed 3/16/21.

Table 6.4 Technology and Data Strategies

	Strategy	Lead Responsible Party
1.	Define GIS data-sharing protocols, requirements, and POCs at the cities and the Navy to support cross-jurisdictional technical studies, analyses, and project execution.	Portsmouth, Chesapeake, U.S. Navy
2.	Develop a mapping layer for future flooding with sea level rise for the JLUS study area and, once complete, develop proposed ordinance revisions to support local implementation.	Portsmouth, Chesapeake
3.	Develop/assemble comprehensive mapping of the Elizabeth River shoreline and adjacent industrial properties to support coordinated planning, management of flood risk and hazardous materials, and river access.	HRPDC
4.	Develop an automated parking management system to document/track violations and enforce parking restrictions and then utilize adaptive management to improve the system based on trends.	Portsmouth
5.	Develop a notification system for motorists about the Elizabeth River drawbridge (Belt Line Railroad) north of the Jordan Bridge and tie the notification system to local and regional traffic alert systems.	Portsmouth
6.	Expand the pilot flood sensor program under development by the HRPDC to include routes serving the Navy and ensure the notification system works with DoD and Virginia Port Authority notification systems.	HRPDC

Parking Management

As discussed in Chapter 2, Portsmouth currently does not have an automated parking management system to track parking tickets. An automated system would enable officers and customers to track a ticket from issuance to resolution and could support enforcement within the SSPD and other areas of Portsmouth that have parking restrictions. In 2018, the Portsmouth Police Department responded to approximately 200 parking-related calls within the SSPD, representing approximately 10 percent of the total annual parking calls made within the City. Enforcement is a challenge because the City currently lacks an efficient parking management system to document, track, and enforce restrictions. An automated system would help the city and the Navy understand localized trends in the SSPD that could inform adaptive management strategies.

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7.0 IMPLEMENTATION PLAN

The actions, policies, and practices outlined in the JLUS are intended to support the cities of Portsmouth and Chesapeake in their goal of helping to maintain and enhance the military missions at NNSY, Naval Medical Center Portsmouth, and Craney Island Fuel Depot.

The actions address a wide range of issues and opportunities for ensuring reliable and resilient access to the installations and throughout the study area, reducing flood risk along major corridors, supporting compatible redevelopment that achieves local economic development goals, and reducing impacts on adjacent communities related to parking. Strategies related to policies and practices define approaches for developing or enhancing tools for improved coordination among the JLUS partners to advance priorities.

The SLR ranges used in the JLUS analysis suggest the planning horizon for the JLUS is long term (2065). However, the recommended actions are intended to provide a roadmap for action that can begin today and focuses on the next 10 to 15 years. The top-scoring actions recommend comprehensive flood mitigation and stormwater management approaches for primary corridors that the DoD relies upon. These actions, and others, will require more coordinated and technical analyses in order to identify infrastructure solutions that can be supported and advanced toward implementation. The anticipated impacts from flooding will increase over time, and initiating efforts in the near term is important, as major infrastructure projects are a significant investment that can take many years to plan, design, and build.

The score for each action defines the level of importance for implementation. Table 7.1 shows how the actions break down by Tiers, and Figure 7.1 displays the Tier 1 through Tier 3 actions using shading to help distinguish priority. A higher score indicates a stronger ability to address the JLUS criteria and goals.

7.1 Implementation Factors

The execution of actions can be affected by many different factors, including available funding and the level of coordination required with other parties that could increase the number of approvals or reviews that are required. These factors, discussed below, may allow some actions ranked lower in score to advance faster than those with a higher-ranked score.

Table 7.2, at the end of this chapter, provides an implementation matrix with each Tier 1 through Tier 4 action sorted by score. The table includes additional information that should be considered as a strategy advances, including timeframe, estimated project cost, and level of outside coordination required. Table 7.3 includes a consolidated matrix of the unranked recommended policies and practices organized by strategy type.

Table 7.1 Recommended JLUS Strategies by Tier

	Priority Ranking	Score Range	# of Actions	Ranking Color (See Figure 7.1)
Tier 1	High	15–17	4	
Tier 2	Medium	12–14	7	
Tier 3	Low	10–11	7	
Tier 4		< 10	18	(Not mapped)

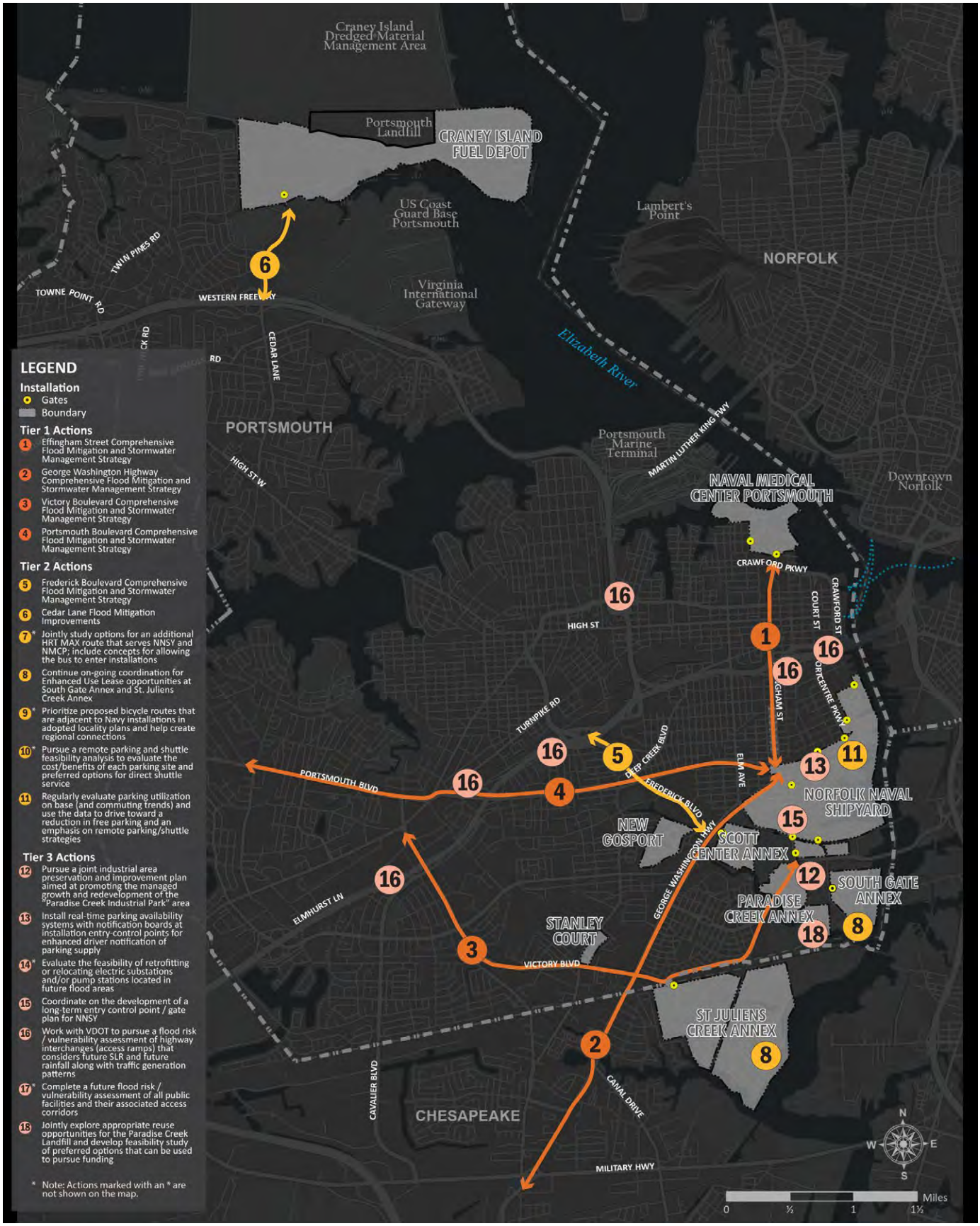

Figure 7.1 Tier 1-3 JLUS Actions

Project Leadership and Supporting Partners

Implementation of the JLUS strategies will require leadership and support from a number of partners. A lead responsible party has been identified along with supporting partner roles for each strategy in the implementation matrices. The lead party is responsible for initiating the recommendation, working to identify and engage various project partners, and seeing the action through to completion. There may be other partners, such as non-profits, state agencies, or federal agencies, beyond those listed, that can be of support and be instrumental to advancing an action forward.

Estimated Project Cost Range

As discussed in Chapter 5, providing a useful cost estimate for implementation is difficult at the early stages of planning. Estimated costs for each strategy were defined in general terms in an attempt to reflect the potential cost for more detailed study, design, and construction of a solution, where applicable. The ranges are as follows:

$	Up to $100K
$$	$100K – $1M
$$$	>$1M

The actual cost to implement an action will be influenced by many factors that are unknown at this stage of the process. These ranges provide a rough order of magnitude estimate that can be refined as project details and scoping are determined. Potential funding sources are identified for each strategy in Chapter 5, and a full list of funding sources, with website links, is included in the Appendix for reference.

Timeframe

Each strategy has been assigned a timeframe associated with when a strategy would be fully implemented or completed, as follows:

Short-term:	< 3 years
Mid-term:	3–10 years
Long-term:	> 10 years

The timeframe indicator is not a prioritization factor like the project ranking score. Rather it takes into consideration the complexity of a project and can be useful to identify strategies that may be more feasible to implement.

> Some projects are more complex than others. While the top-ranking strategies indicate strongest alignment to JLUS criteria, any opportunity to advance a strategy should be embraced and not limited by project ranking.

Figure 7.2 displays the Tier 1 through Tier 4 strategies considering the score, estimated cost range, and timeframe. Each strategy is placed on the diagram based on the cost and proposed timeframe, and the color of the action marker provides an indicator of Tier. This diagram is helpful to illustrate that while Tier 1 projects are longer term and have higher estimated costs, a significant number of actions with lower estimated costs could be advanced in the short term.

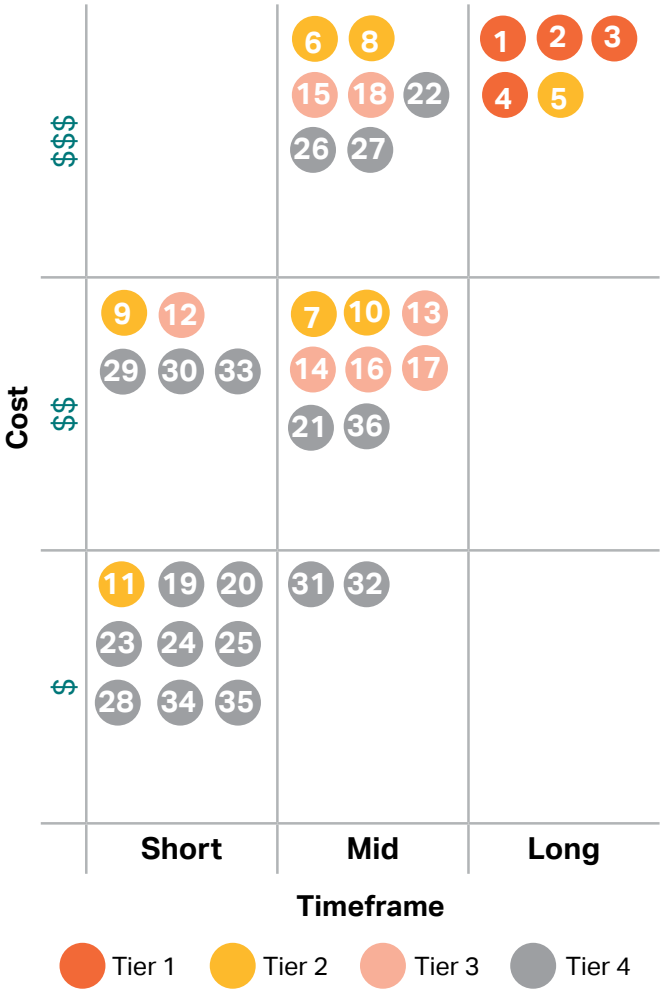

Figure 7.2 Cost Vs. Timeframe of Tier 1-4 Actions

Level of Required Outside Coordination or Cooperation

The level of coordination and cooperation required to implement a strategy can add additional time to project execution. A qualitative assessment of the anticipated level of coordination was completed for each strategy using a range of options, including none, low, medium, and high. Many actions, including all of the Tier 1 actions and half of the Tier 2 actions, are estimated to require a high level of coordination with outside partners because no planning or design activities related to the actions has been initiated and the processes require more detailed planning, preliminary engineering and design, or feasibility analyses and may trigger associated approvals or permits. Coordination will be both critical and beneficial to fully understand and address the interests and perspectives of the parties affected by an action, and to derive solutions that are appropriate and supported. However, not all actions will require as much coordination with outside entities, such as those pertaining to parking internal to NNSY, which can be addressed by NNSY planners and public works, or re-evaluation of the SSPD, which can be initiated by Portsmouth transportation planners and engineers.

Table 7.2 Ranked JLUS Actions (Tiers 1-4)

Action #	Action	Score	Lead Organization	Supporting Partners	Estimated Project Cost $ = <100k $$ = 100k - 1M $$$ = 1M+	Timeframe	Outside Coordination
1	Effingham Street Comprehensive Flood Mitigation and Stormwater Management Strategy.	**17**	Portsmouth	VDOT, U.S. Navy	$$$	Long	High
2	George Washington Highway Comprehensive Flood Mitigation and Stormwater Management Strategy.	**16**	Portsmouth	Chesapeake, VDOT, U.S. Navy	$$$	Long	High
3	Victory Boulevard Comprehensive Flood Mitigation and Stormwater Management Strategy.	**15**	Portsmouth	Chesapeake, VDOT, U.S. Navy	$$$	Long	High
4	Portsmouth Boulevard Comprehensive Flood Mitigation and Stormwater Management Strategy.	**15**	Portsmouth	VDOT, U.S. Navy	$$$	Long	High
5	Frederick Boulevard Comprehensive Flood Mitigation and Stormwater Management Strategy.	**14**	Portsmouth	VDOT, U.S. Navy	$$$	Long	High
6	Cedar Lane Flood Mitigation Improvements	**14**	Portsmouth	U.S. Navy, USCG	$$$	Mid	High
7	Jointly study options for an additional HRT pilot MAX route that serves NNSY and NMCP and include concepts for allowing the bus to enter the installations.	**13**	HRT	U.S. Navy, Portsmouth, Chesapeake	$$	Mid	Medium

Action #	Action	Score	Lead Organization	Supporting Partners	Estimated Project Cost $ = <100k $$ = 100k - 1M $$$ = 1M+	Timeframe	Outside Coordination
8	Continue on-going coordination for Enhanced Use Lease opportunities at South Gate Annex and St. Juliens Creek Annex.	**13**	U.S. Navy	Portsmouth Chesapeake	$$$	Mid	High
9	Prioritize proposed bicycle routes that are adjacent to Navy installations in adopted locality plans and help create regional connections.	**13**	Portsmouth, Chesapeake		$$	Short	Low
10	Pursue a remote parking and shuttle feasibility analysis to evaluate the cost/ benefits of each parking site and preferred options for direct shuttle service.	**12**	Portsmouth	U.S. Navy, HRTPO, HRT, TRAFFIX	$$	Mid	High
11	Regularly evaluate parking utilization on base (and commuting trends) and use the data to drive toward a reduction in free parking and an emphasis on remote parking/ shuttle strategies.	**12**	U.S. Navy	HRTPO, HRT, TRAFFIX	$	Short	Low
12	Pursue a joint industrial area preservation and improvement plan aimed at promoting the managed growth and redevelopment of the "Paradise Creek Industrial Park" area.	**11**	Portsmouth	U.S. Navy, Chesapeake	$$	Short	High

Action #	Action	Score	Lead Organization	Supporting Partners	Estimated Project Cost $ = <100k $$ = 100k - 1M $$$ = 1M+	Timeframe	Outside Coordination
13	Install real-time parking availability systems with notification boards at installation entry-control points for enhanced driver notification of parking supply.	**11**	U.S. Navy	Portsmouth	$$	Mid	None
14	Evaluate the feasibility of retrofitting or relocating electric substations and/or pump stations located in future flood areas.	**11**	Dominion Energy, HRSD	Portsmouth, Chesapeake, U.S. Navy	$$	Mid	Medium
15	Coordinate on the development of a long-term entry control point/gate plan for NNSY.	**11**	U.S. Navy, Portsmouth	HRT, HRTPO	$$$	Mid	Medium
16	"Work with VDOT to pursue a flood risk/vulnerability assessment of highway interchanges (access ramps) that considers future SLR and future rainfall along with traffic generation patterns."	**10**	VDOT, HRTPO	Portsmouth	$$	Mid	High
17	Complete a future flood risk/vulnerability assessment of all public facilities and their associated access corridors.	**10**	Portsmouth, Chesapeake	HRPDC	$$	Mid	Medium

Action #	Action	Score	Lead Organization	Supporting Partners	Estimated Project Cost $ = <100k $$ = 100k - 1M $$$ = 1M+	Timeframe	Outside Coordination
18	Jointly explore appropriate reuse opportunities for the Paradise Creek Landfill and develop feasibility study of preferred options that can be used to pursue funding.	**10**	U.S. Navy	Portsmouth, HRPDC, Elizabeth River Project	$$$	Mid	High
19	Conduct a joint HRT/NAVY study that targets DOD needs and details workforce points of origin to inform revisions to the stops and frequency of HRT Routes 41, 45, and 43.	**9**	HRTPO	HRT, U.S. Navy, Portsmouth	$	Short	Low
20	Perform a study to prioritize changeable message sign location and integration based on anticipated diversion route operations.	**9**	Portsmouth		$	Short	Low
21	Explore the use of automated vehicles and/ or shuttles to carry people from downtown garages to NMCP.	**9**	HRT	U.S. Navy, Portsmouth	$$	Mid	High
22	Jointly study options for a secondary access road to Craney Island Fuel Depot that does not impact the city landfill.	**9**	U.S. Navy	Portsmouth, USACE, HRTPO	$$$	Mid	High

Action #	Action	Score	Lead Organization	Supporting Partners	Estimated Project Cost $ = <100k $$ = 100k - 1M $$$ = 1M+	Timeframe	Outside Coordination
23	Consider adding bicycle lanes at Gate 2 at NMCP and evaluate options for upgrading bicycle infrastructure at all installations.	**9**	U.S. Navy	Portsmouth	$	Short	Low
24	Jointly identify appropriate locations for secure bicycle parking external to the installation gates.	**9**	Portsmouth	U.S. Navy	$	Short	Low
25	Consider modifying NMCP Gate 2 to serve specific users only to help reduce neighborhood impacts.	**8**	U.S. Navy	Portsmouth	$	Short	Low
26	Study options for mixed use development in the vicinity of NNSY Gate 10.	**8**	Portsmouth	U.S. Navy	$$$	Mid	High
27	Pursue a joint planning and feasibility study for the siting of a regional First Responder Academy, Class A burn building, and emergency vehicle operations course to support multiple jurisdictions and the Navy.	**8**	Chesapeake	Portsmouth, HRPDC	$$$	Mid	High
28	Establish a food truck zone adjacent to Gate 10 outside NNSY and pursue development of a food truck program at NMCP similar to the one at NNSY.	**8**	Portsmouth	U.S. Navy	$	Short	Medium

Action #	Action	Score	Lead Organization	Supporting Partners	Estimated Project Cost $ = <100k $$ = 100k - 1M $$$ = 1M+	Timeframe	Outside Coordination
29	Pursue a joint planning study of St. Juliens Creek corridor and/or Blows Creek corridor to explore options for expanded public recreational access to the water around St. Juliens Creek Annex.	**8**	Chesapeake	U.S. Navy	$$	Short	Medium
30	Jointly study options for interconnecting water service to St. Juliens Creek Annex and evaluate alternatives for extending water and sewer service eastward toward the Elizabeth River to support future redevelopment.	**7**	Chesapeake	U.S. Navy	$$	Short	High
31	Re-evaluate the zoning classification for the triangle area between the rail line and Elm Avenue, east of George Washington Highway.	**7**	Portsmouth		$	Mid	Low
32	Study options for expanded ferry service to NMCP.	**7**	HRT	HRTPO, Portsmouth, Chesapeake, U.S. Navy	$	Mid	Medium
33	Refine the NNSY internal shuttle route to be more direct and efficient (connect to parking and explore off-site option).	**5**	U.S. Navy	Portsmouth	$$	Short	None

Action #	Action	Score	Lead Organization	Supporting Partners	Estimated Project Cost $ = <100k $$ = 100k - 1M $$$ = 1M+	Timeframe	Outside Coordination
34	Expand the shared bicycle program on NNSY and establish a similar program at NMCP.	**5**	U.S. Navy		$	Short	None
35	Expand the comfort rating analysis used in the Portsmouth Bike and Pedestrian Plan and consider adding lighting adequacy into the analysis.	**5**	Portsmouth		$	Short	None
36	Install additional installation directional signage along key corridors to direct employees and visitors to installations.	**5**	Portsmouth, Chesapeake		$$	Mid	Low

Table 7.3 Recommended Policies and Practices (Unranked)

#	Policy or Practice Recommendation	Lead Organization	Estimated Project Cost $ = <100k $$ = 100k - 1M $$$ = 1M+	Timeframe	Outside Coordination
	Planning Coordination and Outreach				
1	Adopt an MOU among JLUS partners to commit to working together to advance and implement JLUS priorities.	HRPDC	$	Short	High
2	Establish a formal charter for a Chesapeake Military Municipal Partnership that includes a focus on St. Juliens Creek Annex.	Chesapeake	$	Short	High
3	Designate an individual staff person in each City (e.g. military liaison position) to serve as a single POC for the Navy with a goal of facilitating coordination across departments.	Portsmouth, Chesapeake	$	Short	None
4	Continue to monitor potential impacts from the Federal Channel Expansion on the Craney Island Fuel Depot and NNSY waterfront current and future operations and coordinate with USACE and Virginia Port Authority to address concerns.	U.S. Navy	$	Short	Medium
5	Continue to monitor navigation impacts along the Elizabeth River during the evaluation of future development and access proposals to prevent navigational trouble spots.	USCG	$	Short	High
6	Develop guidance for regional projects that would define a formal mechanism to ensure all affected parties are sufficiently engaged and consulted in the project.	HRPDC	$	Short	High
7	Include military installation planners in city planning processes (master plans, transportation planning, etc.) and city planners in military planning processes (where possible) to promote information sharing and mutually beneficial outcomes.	Portsmouth, Chesapeake, U.S. Navy	$	Short	High
8	Develop a stormwater systems maintenance MOU for each installation and respective locality to define on-going roles and responsibilities for routine maintenance of ditches, culverts, and other drainage components that span locality/Navy jurisdiction.	HRPDC	$	Short	High
9	Set quarterly recurring coordination meetings between the Navy, localities, and the Norfolk and Portsmouth Belt Line Railroad.	U.S. Navy, Portsmouth	$	Short	High
10	Continue to monitor communication signal interference near the Elizabeth River crossing of the Norfolk and Portsmouth Belt Line Railroad and work with the Railroad to identify courses of action for reducing impacts.	U.S. Navy	$	Short	Medium

#	Policy or Practice Recommendation	Lead Organization	Estimated Project Cost $ = <100k $$ = 100k - 1M $$$ = 1M+	Timeframe	Outside Coordination
11	Confirm Navy primary and secondary utility POCs for each installation and the associated coordination protocols between NAVFAC counterparts and utility providers (natural gas, electric).	U.S. Navy	$	Short	Low
12	Consider the formation of a regional industrial lands task force to support the development of guidance for reducing risk along the Southern Branch of the Elizabeth River.	HRPDC	$	Short	High
13	Update the Military Commuter Survey (HRTPO) on a recurring basis so that it can regularly inform regional transportation and transit planning processes	HRTPO	$	Short	Medium
14	Develop and regularly update outreach materials for NNSY, Naval Medical Center Portsmouth, and St. Julien's Creek Annex employees about appropriate protocols, locations, and enforcement procedures for parking outside the installation and available transit options, and update materials as conditions and options change.	U.S. Navy	$$	Short	Low
15	Continue ongoing coordination and communication about the future of the Wheelabrator waste-to-energy plant and potential opportunities for reuse.	U.S. Navy	$	Short	High
16	Develop coordinated emergency evacuation protocols for local and federal workers in the downtown area of Portsmouth.	Portsmouth	$	Mid	Low
17	Explore options for establishing a regional Mobile Rehabilitation Unit (vehicle) that can support emergency response training and incident response needs at DoD installations.	Portsmouth, Chesapeake	$	Short	High
18	Ensure local emergency managers and elected officials are informed about the DSCA as a resource strategy to support local emergency management planning and response activities.	U.S. Navy	$	Short	Low
	Advocacy				
1	Continue to explore and pursue funding opportunities through the DCIP and DAR Program.	HRPDC	$	Short	High
2	Pursue an amendment to the VDOT SMART SCALE criteria to include SLR, flooding, and military readiness as factors for prioritizing projects for funding	HRPDC, HRTPO	$	Mid	High
3	Pursue an amendment to the Code of Virginia and the Virginia Residential Property Disclosure Act for mandatory disclosure requirements for flood hazard, including 500-year flood, for real estate transactions (purchase and rental).	Portsmouth, Chesapeake	$	Mid	High

#	Policy or Practice Recommendation	Lead Organization	Estimated Project Cost $ = <100k $$ = 100k - 1M $$$ = 1M+	Timeframe	Outside Coordination
4	Advocate for FEMA to incorporate precipitation into coastal/storm surge analyses.	HRPDC	$	Short	High
5	Continue to advocate for the development of expanded transit services to NNSY and NMCP and other DoD installations.	U.S. Navy, Portsmouth, Chesapeake, HRPDC	$	Short	High
	Policy and Development Regulations				
1	Include the 3,000-foot notification boundary reference in local plans and policy documents.	Portsmouth, Chesapeake	$	Short	Low
2	Incorporate future climate conditions (rainfall, SLR) into locality comprehensive plan updates and area plans so that land use policy, growth management strategies, and siting of public facilities (schools, fire, police) consider future conditions for flooding and access constraints caused by flooding.	Portsmouth, Chesapeake	$	Short	High
3	Incorporate up-to-date projections for future SLR, future rainfall, and storm surge into roadway design guidelines and projects to cover the project's expected service life.	VDOT	$	Short	High
4	Develop regional guidance for integrating tidal and rainfall scenarios into local and regional transportation planning so that the information can be used in future scenario planning.	HRTPO	$	Short	High
5	Develop future base flood elevation design guidelines that incorporate SLR.	Portsmouth, Chesapeake	$$	Mid	High
6	Strengthen repetitive loss definitions and administrative procedures in local floodplain management ordinances to provide added protections to insured property owners.	Portsmouth, Chesapeake	$	Short	Medium
7	Require a recorded declaration of land use restriction in SFHA that prohibits converting areas under elevated structures to habitable space by permanently restricting uses to parking, storage and access to the building.	Portsmouth	$	Mid	Medium

#	Policy or Practice Recommendation	Lead Organization	Estimated Project Cost $ = <100k $$ = 100k - 1M $$$ = 1M+	Timeframe	Outside Coordination
	Technology and Data Strategies				
1	Define GIS data-sharing protocols, requirements, and POCs at the cities and the Navy to support cross-jurisdictional technical studies, analyses, and project execution	Portsmouth, Chesapeake, U.S. Navy	$	Short	High
2	Develop a future flooding mapping layer for the JLUS study area and once complete develop proposed ordinance revisions to support local implementation.	Portsmouth, Chesapeake	$	Short	High
3	Develop/assemble comprehensive mapping of the Elizabeth River shoreline and adjacent industrial properties to support coordinated planning, management of flood risk and hazardous materials, and river access.	HRPDC	$$	Short	High
4	Develop an automated parking management system to document/track violations and enforce parking restrictions and then utilize adaptive management to improve the system based on trends.	Portsmouth	$$	Mid	Medium
5	Develop a notification system for motorists about the Elizabeth River drawbridge (Beltline Railroad) north of the Jordan Bridge and tie the notification system to local and regional traffic alert systems.	Portsmouth	$$	Mid	High
6	Expand the pilot flood sensor program under development by the HRPDC to include routes serving the Navy and ensure the notification system works with DoD and Virginia Port Authority notification systems.	HRPDC	$	Short	High

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APPENDIX

Appendix A: Industrial Waterfront Properties – Case Study Review

Appendix B: Table of Potential Funding Sources

Appendix C: List of Stakeholders

Appendix D: JLUS Travel Demand Model of Flood Scenarios - Memorandum

APPENDIX A
INDUSTRIAL WATERFRONT PROPERTIES – CASE STUDY REVIEW

Introduction

This memo provides a **case study review** of four documents that are focused on, or have relevance to, flood resilience for industrial properties. This review was undertaken as part of the Joint Land Use Study (JLUS), Phase 3, Task 3.5, after consultation with the Hampton Roads Planning District Commission (HRPDC) to explore best practices for reducing flood risk to waterfront industrial properties and identify potential strategies applicable to Portsmouth, Chesapeake, and the Navy. **The case studies reviewed include:**

- *Resilient Industry Mitigation and Preparedness in the City's Industrial Floodplain*, undated. New York City (NYC) Planning – Coastal Climate Resiliency. Available online at: www.nyc.gov/resilientindustry.
  - Focuses on two broad categories of resiliency strategies: physical strategies, such as vertical evacuation, and preparedness planning. Several of the mitigation strategies are relevant to Hampton Roads industrial properties, and strategies include useful cost assessments and effectiveness measures.
- *Coastal Flood Resilience Design Guidelines,* Draft 2019. Boston Planning & Development Agency. Available online at: http://www.bostonplans.org/getattachment/d1114318-1b95-487c-bc36-682f8594e8b2.
  - Includes resilient design principles for building retrofits and new construction for use with a zoning overlay concept, similar to the Chesapeake and Portsmouth flood ordinances. The study's building-scale resilience solutions apply in areas outside the 100-year floodplain, but vulnerable to sea level rise (SLR) based on future conditions. That study's recommendations also combine flood resilience with actions that address a building's energy efficiency, carbon footprint, and passive survivability.
- *Enhancing Resilience in Boston: A Guide for Large Buildings and Institutions,* 2015. A Better City. Available online at: https://www.abettercity.org/docs-new/resiliency%20report%20web%20FINAL.pdf.
  - Includes recommendations for streamlining permitting, modifying the building code to address resiliency, pooling resilience funds for businesses through a Business Improvement District, and creating a building resilience rating recognition program. The last concept is similar to Norfolk's Resiliency Quotient concept and may have wider applicability in the Hampton Roads region.
- *Pathways to resilience: adapting to sea level rise in Los Angeles*, 2018. Annals of the New York Academy of Sciences (Jeroen C.J.H. Aerts, Patrick L. Barnard, Wouter Botzen, Phyllis Grifman, Juliette Finzi Hart, Hans De Moel, Alyssa Newton Mann, Lars T. de Ruig and Nick Sadrpour). Available online at: https://www.researchgate.net/publication/327751298_Pathways_to_resilience_Adapting_to_sea_level_rise_in_Los_Angeles.
  - Suggests development of regional pathways of adaption to incremental SLR and incorporates mutually agreed upon pathways into local planning efforts that could benefit multiple stakeholders by reducing costs and working jointly toward common goals.

1. CASE STUDY: *Resilient Industry Mitigation and Preparedness in the City's Industrial Floodplain*, New York City (NYC) Planning – Coastal Climate Resiliency

Summary

As a result of historical development patterns in New York City that caused industrial businesses to locate in areas with maritime access, a significant portion of the low-lying neighborhoods heavily impacted by Hurricane Sandy, and in the floodplain generally, contain large concentrations of industrial businesses. These facilities, such as wholesale warehouses, construction yards, and recycling facilities, serve critical functions for the city. The industrial building stock is aging, and most are single-story structures with few options for relocating equipment or inventory above storm flood elevations. Many are not covered, or are insufficiently covered, under flood insurance policies. Elevating whole buildings above storm flood elevations and dry floodproofing are cost prohibitive options.

Fortunately, many businesses in the area have found ways to proactively address flood risk and prepare for future events. Others are looking for solutions that will protect their investments and ensure continuity of operations, even if they are unable to fully meet the required flood-resistant construction standards.

Key Recommendations

The seven detailed case studies provided are broadly representative of the types of businesses and site conditions present in industrial areas, and the types of interventions, including their cost and effectiveness. Case studies include cost estimates for resiliency measures and cover facilities including a construction materials distributor with outdoor storage and a waterfront bulkhead; a brewery with moderately-sized manufacturing buildings that share walls with neighboring facilities; a film studio with three sites near the water and commercial vehicles in the floodplain; a large food distribution business with critical rooms subject to flooding and a fleet of specialized trucks normally parked the floodplain; a ship maintenance and repair facility with seven floating dry docks and several piers and floating barges used for pier-side repair work as well as hazardous materials in the floodplain; an automobile dismantler with a large, unenclosed industrial site that contains immovable machinery and equipment; and an industrial dry cleaner.

Two broad categories of resiliency strategies arose out of this analysis:

- *Physical strategies* include vertical evacuation, or targeted protection of electrical and mechanical systems within buildings, such as elevated platforms or waterproof rooms to house substations; electrical panels; generators; heating, ventilation, and air conditioning (HVAC) systems; and other high-value building components. Actions to address failing docks and bulkheads as well as inadequate stormwater management are included in this category.
- *Preparedness planning* is also an essential strategy to reduce risk and quickly resume operations following a storm. Truck relocation planning, clearly defined protocols to move inventory and equipment out of harm's way, and techniques to secure hazardous materials and unenclosed inventory can ensure that the industrial floodplain is more resilient to future floods and coastal storms.

With regard to Preparedness Planning, the report also acknowledges opportunities for city, state, and federal programs and policies to more effectively support a vibrant and resilient industrial sector. Recommendations are geared toward policymakers at multiple levels of government to provide targeted investments, incentives, and flexibility to allow new and existing industrial businesses to operate safely and effectively in the face of future flooding and coastal storms. Given the high proportion of existing, pre–Flood Insurance Rate Map (FIRM) industrial buildings in these areas and growing flood risks associated with climate change, zoning rules and policies should not constrain, and where possible, should encourage retrofits that reduce flood risk and strengthen the long-term viability of the city's industrial sector. The report encourages finding options that reduce zoning barriers to resilient retrofits, even if the building is not rendered fully compliant with the NYC Building Code in order to further encourage flood mitigation within the city's industrial floodplain.

Preparedness planning includes business emergency action plans that reduce interruptions by, for example, coordinating with other businesses or organizations. Industrial businesses may consider developing relationships with other businesses to share generators, assist with the installation of flood barriers or equipment relocation, or even arrange to temporarily rent other business's facilities in the event of flood damage. Renting space for parking fleets out of the floodplain during floods was recommended in several case studies as a prudent emergency action plan, especially for customized or specialized vehicles.

Relevance to JLUS

The similarities between the Portsmouth-Chesapeake JLUS study area and the NYC industrial waterfront are numerous. Flooding characteristics, including vulnerability to SLR and hurricane-driven storm surge flooding are common to both, thus the warning times for flooding are similar as well. Aging building stock, businesses with large numbers of commercial vehicles, and businesses that store large amounts of inventory, including hazardous materials, in the floodplain are common to both study areas.

With regard to preparedness measures and other regulatory restrictions, both study areas are subject to requirements that meet standards for participation in the National Flood Insurance Program (NFIP). However, when the majority of industrial buildings are existing pre-FIRM buildings (constructed prior to the effective date of the locality's FIRM), and where alterations or repairs do not trigger applicability, such as through "substantial damage" or "substantial improvements," compliance with current flood-resistant construction standards is not required. These older industrial facilities continue to operate in buildings that are less flood-resilient than current building code standards require for new construction unless there is motivation or incentive to change. In the case study, Hurricane Sandy provided that motivation and incentive when many of the businesses flooded and were closed for costly periods of time.

An important preparedness measure for flood-prone structures is maintaining adequate flood insurance coverage to protect against losses due to structural damage, flooded contents, and extended business closures. However, the limits of coverage under the NFIP are insufficient to

cover many industrial businesses. Nonresidential NFIP policies, which include industrial businesses, limit coverage to $500,000 for structural damage to the building and $500,000 for damage to contents, with no loss of income coverage available. Business tenants who rent space are only able to purchase content coverage. Thus, large flood-prone industrial businesses may have significant residual exposure if coverage is solely through the NFIP. The NYC report found that a large portion of industrial businesses that were damaged by Hurricane Sandy were uninsured or held flood coverage through a private insurance or reinsurance carrier. Jumbo policies with excess flood coverage over NFIP minimums are available on the private insurance market and typically include business interruption coverage. These policies must be bought separately and can be more expensive than federal policy coverage.

Given these limitations, the case study puts forth resiliency measures common to the various building types called "partial mitigation strategies." These strategies are described as "partial" because they would help mitigate flood risks for specific systems or portions of a building, but the buildings still would not meet the current flood-resistant construction standards. The measures generally would not decrease insurance premiums through the NFIP. Despite these regulatory constraints and lack of incentives for partial floodproofing, these strategies can be attainable, cost-effective, and practical solutions for many businesses seeking to reduce flood risk by providing an increased level of protection for their existing buildings and their contents.

Partial mitigation strategies identified that were common to several of the building types include:

- Elevating or otherwise protecting mechanical and electrical systems and installing backup generators
- Wet floodproofing industrial space through the use of hydrostatic vents and flood-resistant materials below 100-year flood elevation
- Anchoring and/or securing unenclosed storage
- Constructing waterproof storage for perishables
- Elevating or wet floodproofing workstations
- Adding elevated storage space or a second floor
- Dry floodproofing measures within a building (e.g., flood gates to partition vulnerable spaces, sump pumps, backflow preventors) or on the exterior (e.g., deployable flood panels).

Figures 1 through 6 illustrate examples of mitigation strategies from the report.

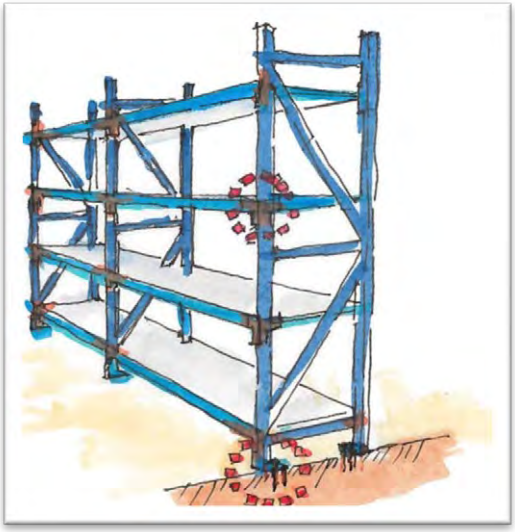


Figure 1. Anchoring and securing unenclosed storage. Source: *Resilient Industry Mitigation and Preparedness in the City's Industrial Floodplain.*

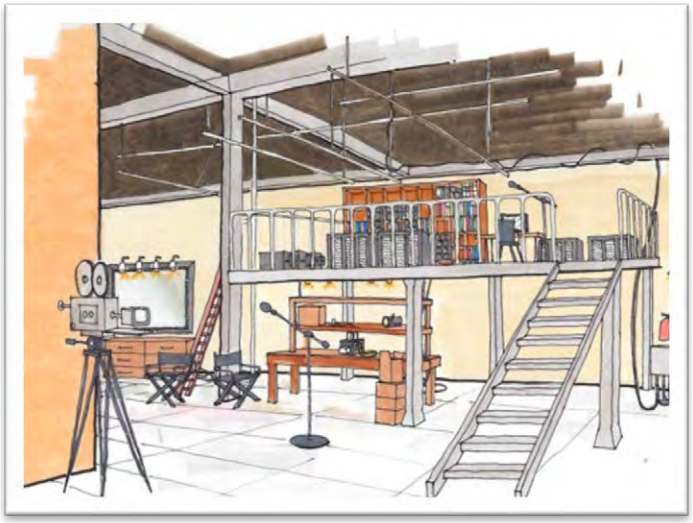


Figure 2. Creating an elevated mezzanine to store assets. Source: *Resilient Industry Mitigation and Preparedness in the City's Industrial Floodplain.*

Figure 3. Wet floodproofing a workspace with vents and elevation of equipment. Source: *Resilient Industry Mitigation and Preparedness in the City's Industrial Floodplain.*

The detailed physical resiliency strategies for the ship maintenance and repair facility are particularly relevant in Hampton Roads, including the relocation of hazardous materials, elevating electrical substations, and replacing stationary piers with flexible piers on spuds. Substations and other permanent electrical equipment can be elevated above the 100-year flood elevation (plus freeboard), either on elevated platforms or on concrete pads where flood elevations are lower. Substations can be elevated most cost-effectively during the initial installation or when electrical equipment is replaced

over time. However, this can also be accomplished as a retrofit for existing equipment to mitigate flood damage.

Where possible, hazardous substances should be permanently stored in areas outside of the floodplain. To prevent leaks during everyday operations, containment bunds can be purchased to place beneath barrels or other containers with hazardous substances. Storage containers should be watertight, sheltered from rain, isolated from stormwater runoff, and stored using overpacks to prevent spills. For smaller containers, flammable and acid cabinets can help secure and contain hazardous substances. Where infeasible to relocate outside of the floodplain, containers and tanks that contain hazardous substances should be elevated, safely secured, and anchored to prevent spills and leaks. Local floodplain ordinances, including Chesapeake's and Portsmouth's, treat storage tanks as "structures" and, therefore, require that above-ground tanks be elevated to the base flood elevation (BFE) plus freeboard, and designed to prevent flotation, collapse, and lateral movement. Petrochemical fuel tanks may also be installed on trailers, making it easier to relocate to higher locations on-site, or to safe locations offsite, in advance of a potential flood or coastal storm.

Figure 4. Elevated electrical substation. Source: *Resilient Industry Mitigation and Preparedness in the City's Industrial Floodplain.*

In NYC after Hurricane Sandy, the NYC Department of Environmental Protection (DEP) took additional steps to reduce the potential for future spills. DEP released recommendations about chemical safety and spill prevention during flood events. During on-site inspections of facilities located in the floodplain, DEP now recommends that business owners, operators, and managers take precautions to reduce chemical spills.

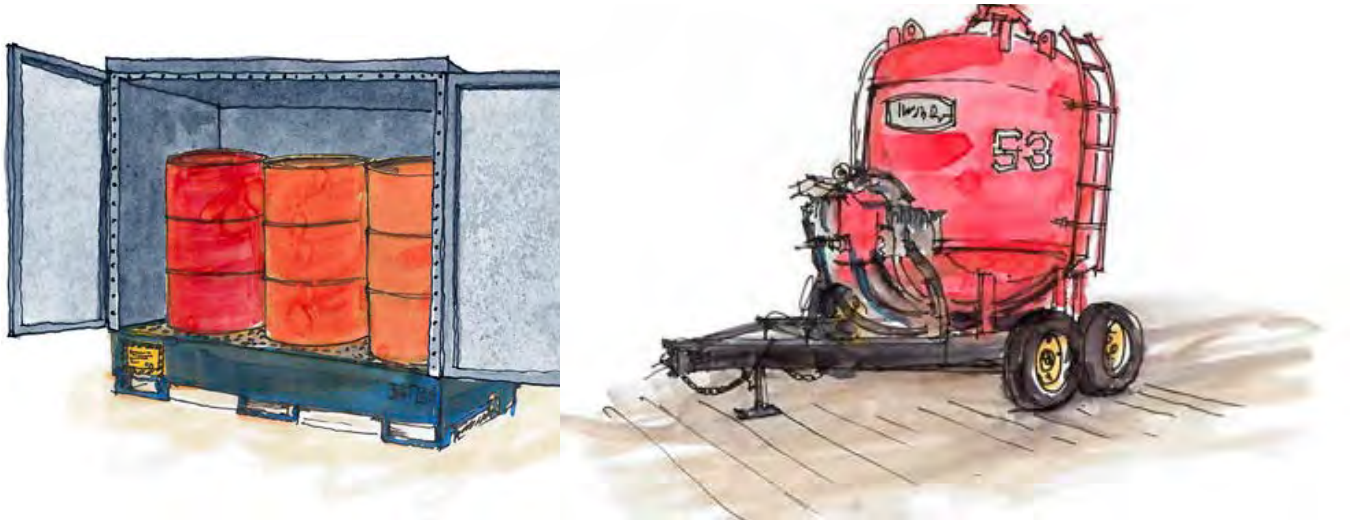


Figure 5. Flood safe storage of hazardous materials. Source: *Resilient Industry Mitigation and Preparedness in the City's Industrial Floodplain.*

When stationary piers are damaged or need to be replaced, mechanisms that allow piers to safely rise and fall with water levels can be an effective form of flood mitigation and SLR adaptation. The ship repair and maintenance facility used as a case study chose to replace several stationary piers with rail barges that are mounted on spuds through the deck. Flexible piers or barges on spuds are more resilient to flooding by allowing for tidal fluctuations, storm surge, and SLR.

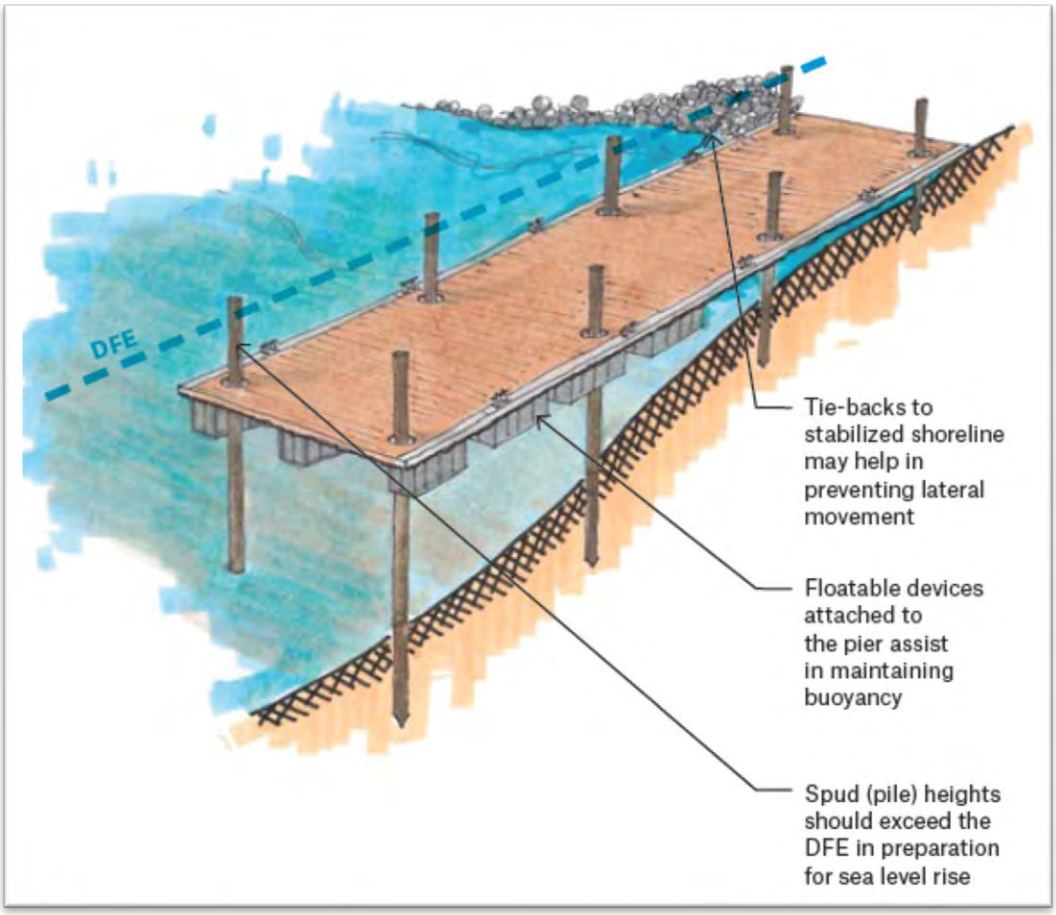


Figure 6. Replace stationary piers with flexible piers. Source: *Resilient Industry Mitigation and Preparedness in the City's Industrial Floodplain.*

Challenges to Local Implementation

Hazardous materials are governed by local flood ordinances, which are typically administered by community planning and zoning staff in the process of issuing permits for development activities. Despite the restrictions in place for new development, long-term storage of hazardous materials in the floodplain is difficult to inspect, regulate, and permit in full compliance with the local ordinance that governs flood-prone development. Opportunities to link to Virginia Department of Environmental Quality's (DEQ) above-ground storage tank inspection process may be more fruitful.

Existing pre-FIRM industrial buildings remain at high risk despite stringent freeboard measures in place in Chesapeake (18 inches) and Portsmouth (3 feet). Unless a triggering event (such as Hurricane Sandy in NYC's case) causes damage or the business seeks to substantially improve a building, risk level is not likely to change. Furthermore, because the triggering regulation (substantial improvement clause) is based on building value, low-value buildings are more likely to trigger the requirement to fully comply by proposing just small changes. Unless there is financial or other motivation on the part of businesses, investment in mitigation measures is

not likely to occur. The challenge will be how to incentivize these property owners to engage in adaptive change without having regulatory tools that mandate change.

Possible Strategies

Physical Improvements

1. **Improve bulkheads in the most vulnerable areas.** Bulkheads serve a number of functions on industrial properties along the water, including retaining land, resisting erosion in order to stabilize a site, and providing access to vessels. Storm surge may overtop bulkheads, which can lead to structural failure when the soil behind the bulkhead becomes saturated and water levels recede, creating pressure between the soil water and sea water. If a bulkhead is in poor condition, the ground landward of the bulkhead may be unstable and prone to future erosion and loss of usable space. Structurally repairing bulkheads that are in poor condition or constructing new bulkheads provides for better grade load capacity, drainage capacity, and protection against soil erosion and water seepage. In NYC, the construction of new bulkheads, or replacement and repair of existing structures, often requires permits from multiple entities, including the New York State Department of Environmental Conservation and the U.S. Army Corps of Engineers. The city created the Waterfront Navigator: NYC's One Stop Waterfront Permit Planner for assistance with permitting.

2. **Make the switch to flexible piers in the most vulnerable areas.** Piers are an essential asset to many maritime businesses, including tug and barge operations and ship maintenance and repair. Stationary piers are situated above the water line and mounted on pilings driven in the ground. During coastal storms with storm surge, stationary piers may be overtopped or damaged by wave action. As sea levels rise, existing stationary piers are likely to be inundated by floodwater more frequently. Damage to piers, or damage to equipment and machinery located on these structures, can hinder operations of the city's port and maritime industry. When stationary piers are damaged or need to be replaced, mechanisms that allow piers to safely rise and fall with water levels can be an effective form of flood mitigation and SLR adaptation. The ship repair and maintenance facility used as a case study in the NYC report chose to replace several stationary piers with rail barges that are mounted on spuds through the deck. Flexible piers or barges on spuds are more resilient to flooding by allowing for tidal fluctuations, storm surge, and SLR.

Preparedness Planning

3. **Convene industrial property owners with resources at risk of flooding in the study area.** Similar to the Business Preparedness and Resiliency Program (Business PREP) offered by the NYC Department of Small Business Services, the group of businesses could work together to better prepare for emergencies. A foundational agency (for example, the HRPDC, the Hampton Roads Chamber, the Chesapeake Department of Economic Development, Portsmouth Economic Development, or the Virginia Department of Small Business and Supplier Diversity) could provide business continuity workshops, on-site risk assessments

with micro-grants to implement specific recommendations for qualifying businesses and online resiliency resources.

Such planning is typically low cost. Savings can be substantial and return to normal business operations is accelerated by implementing and normalizing pre-flood protective measures, including physical improvements such as those implemented in NYC. Business PREP used grant funds from the state to administer its own micro-grant program; a public foundational agency could obtain Hazard Mitigation Grant Program, Flood Mitigation Assistance, or Building Resilient Infrastructure and Communities funds to administer a similar program. The Hampton Roads Chamber of Commerce Small Business Development group, Chesapeake's Waterfront Business District alliance, Virginia Department of Emergency Management's private sector program and critical infrastructure program, the Virginia Maritime Association, the Virginia Harbor Safety Committee and other informal business groups will be critical in building the necessary partnerships to get targeted industrial and port-related businesses to participate.

4. **Use the same business-strengthening platform developed in #3 above to serve as a clearinghouse for information from emergency managers regarding community flood warning tools.** Local emergency managers from Chesapeake and Portsmouth can share available tools for flood warning, such as the flood sensor program being developed, in order to facilitate more effective preparedness planning specific to individual businesses and business types. Flood warning tools are a critical element in emergency action plans, evacuation plans, and other readiness measures, such as shared parking agreements with upland businesses. An example from NYC involves businesses with large fleets of customized vehicles (e.g., refrigerator trucks or hazmat transport vehicles) that are following through on shared/leased parking agreements that allow them to evacuate their vehicles out of the floodplain in advance of flooding in order to protect their investment. Real-time information that indicates predicted flood depths in specific areas at specific times aids businesses who have previously contemplated on-site preparedness measures. Knowledge is critical when installing sandbags, flood barriers for doors and windows, flood gates, computer system backups, disconnecting utilities, or moving critical inventory to higher elevations.

5. **Require lower threshold for triggering elevation compliance in waterfront industrial resilience zone.** Consider changing floodplain ordinance requirements that currently have a 50 percent threshold for "substantial improvement" and "substantial damage," to a lower threshold, such as 35 percent. This regulatory measure has been successful in coastal communities in North Carolina and Florida when there is strong resolve to keep the standard in place despite the financial costs to property owners in the aftermath of a severe flood. The long-term result is lowered vulnerability for the community because more structures are elevated (or floodproofed for non-residential structures) and otherwise compliant with flood design guidelines than would be if the threshold remained at 50 percent. Some communities have been able to partner this more stringent regulation with low-interest loans for businesses that need to bring structures into compliance.

6. **Evaluate hazardous material storage in the floodplain.** Local flood ordinances in both Chesapeake and Portsmouth limit storage of hazardous materials in the floodplain (see table below). However, similar to building codes, recurring or ongoing storage may not trigger City officials to invoke the flood ordinance restrictions, so the application of these rules is relevant for new facilities, not existing facilities.

Table 1. Regulating Critical Facilities through Floodplain Management Ordinances

Community	Defining What is Prohibited	Regulation
Chesapeake	Critical infrastructure fall within the following categories: (1) Governmental facilities: Essential for the delivery of critical services and crisis management, including data and communication centers, key government complexes, and similar facilities as determined by the floodplain administrator. (2) Essential facilities: Those that are vital to health and welfare of entire populations, including hospitals and other medical facilities, retirement homes, police and fire facilities, emergency operations centers, prisons, evacuation shelters, and schools, and similar facilities as determined by the floodplain administrator. (3) Transportation systems: Those systems, and the supporting infrastructure, necessary for transport of people and resources (including airports, highways, railways, and waterways) during major disasters, including flood events up to the 500-year flood. (4) Lifeline utility systems: Those vital to public health and safety, including potable water, wastewater, oil, natural gas, electric power, communication systems, and similar facilities as determined by the floodplain administrator. (5) High potential loss facilities: Failure or disruption of operations may have significant physical, social, environmental, and/or economic impact to neighboring communities, including nuclear power plants, high-hazard dams, urban levees, and military installations. (6) Hazardous material facilities: Involved in the production, storage, and/or transport of corrosives, explosives, flammable materials, radioactive materials, toxins, and similar facilities as determined by the floodplain administrator.	New construction of critical infrastructure will not be permitted within the special flood hazard area (i.e., 100-year floodplain).
Portsmouth	The following uses shall be specifically prohibited within all "A", "AE", "V" and "VE" floodplain districts: a. Sanitary landfills, junkyards, outdoor storage of inoperative vehicles. b. Manufactured homes (except as a temporary use in accordance with subsection 14.1-10(c)). c. Surface mines and borrow pits. d. Manufacture, bulk storage, transformation or distribution of petroleum (except for retail sales), chemical or asphalt products or any hazardous materials as defined in either or both of the following: 1) Superfund Amendment and Reauthorization Act of 1986. 2) Identification and Listing of Hazardous Wastes, 40 CFR section 261 (1987). a. Oil and oil products including petrochemicals. b. Radioactive materials. c. Any material transported or stored in large commercial quantities (such as 55-gallon drums) which is a very soluble acid or base, causes abnormal growth of an organ or organism, or is highly biodegradable, exerting a strong oxygen demand. d. Biologically accumulative poisons.	Uses prohibited in 100-year floodplain through Zoning Ordinance.

	e. Substances containing the active ingredients of poisons that are or were ever registered in accordance with the provisions of the Federal Insecticide, Fungicide, and Rodenticide Act, as amended (7 USC 135 et seq.). f. Substances highly lethal to mammalian or aquatic life. g. Storage or land application of industrial wastes. h. Outdoor storage of equipment, materials or supplies which are buoyant, flammable or explosive.	

A detailed assessment of the effectiveness of these regulations might include clarifying how the regulations are triggered. In other words, the floodplain ordinances broadly define development as "any manmade change to improved or unimproved real estate..." and require permits for any such development. Additional details regarding what permit actions trigger the prohibition on hazardous materials in the floodplain and how these prohibitions are enforced would inform assessments of future vulnerability.

Portsmouth's regulation appears geared toward substances that cause issues if leaked or spilled into floodwaters and waterways. However, the restrictions do not apply to schools, police stations, or emergency operations centers—some of the "essential facilities" listed by Chesapeake. Chesapeake's regulation is very prohibitive for a community with large swaths of flood-prone land and even includes utility systems, such as water and sewer lines. How this regulation is enforced for proposed new subdivisions, new roads, and new schools is not clear. Further application of these regulations in a zone expected to be affected in the future by SLR would also be prudent to prevent construction of important or essential facilities in vulnerable areas, thereby reducing the useful life of the facility to the community.

2. CASE STUDY – *Coastal Flood Resilience Design Guidelines*, Boston Planning & Development Agency. Adopted in draft format, September 2019.

Summary

The strategies within this document build on Climate Ready Boston's initiatives regarding coastal flood resilience, and center on four resilient design principles guiding the design of building retrofits and new construction projects within the Zoning Overlay District (based on the area with a 1-percent-annual-chance flood risk in the year 2070 with 40 inches of SLR). The role of the design guidelines is to raise awareness of future coastal flooding risks for residents and businesses. The guidelines make the following recommendations for Boston:

- Adaptation strategies should be future-looking and draw on best resiliency practices that also respond to the unique condition of Boston's building types.
- Building-scale resilience solutions should contribute to an overall enhancement of the public realm.
- Flood resilience strategies should play a beneficial role in overall building sustainability, such as enhancing surrounding landscapes and improving stormwater management and energy efficiency.

- Individual building upgrades should, wherever possible, relate to adjacent district-scale flood prevention infrastructure investments.

Key Recommendations

The General Industrial Case Study within the report outlines incremental and long-term resiliency measures for structures subject to flooding from the predicted Sea Level Rise – Base Flood Elevation (SLR-BFE), but located primarily outside the Special Flood Hazard Area (SFHA). Communities use a zoning overlay to map and regulate an area designated as vulnerable to SLR based on future conditions. They enforce more stringent design guidelines involving flood protection to or above the SLR-BFE in that zone.

Design guidelines that may apply in the industrial areas of Chesapeake and Portsmouth include:

- Elevating lowest interior floors with exterior circulation that protects to the design flood elevation, for both large and small buildings (see Figure 7)
- For pre-war mixed-use structures, implementing long-term strategies to protect critical systems, enhance and dry floodproof the building envelope, provide backup utility systems, and elevate lowest interior floors
- For industrial structures, prioritizing the protection of critical systems, such as building utility systems, combined with wet floodproofing of the structure in the short term or dry floodproofing in the long term

The study's recommendations strive to, wherever feasible, combine flood resilience measures that enhance a building's energy efficiency, carbon footprint, and passive survivability. Many of the strategies also describe long-term, incremental, and short-term sets of actions that would help attain the same resilience goal. For example, protecting mechanical equipment in sub-grade spaces with flood proofing might protect critical systems in the short term, but the long-term goal is to relocate critical systems to the roof in combination with on-site emergency generation through a grid-connected solar system.

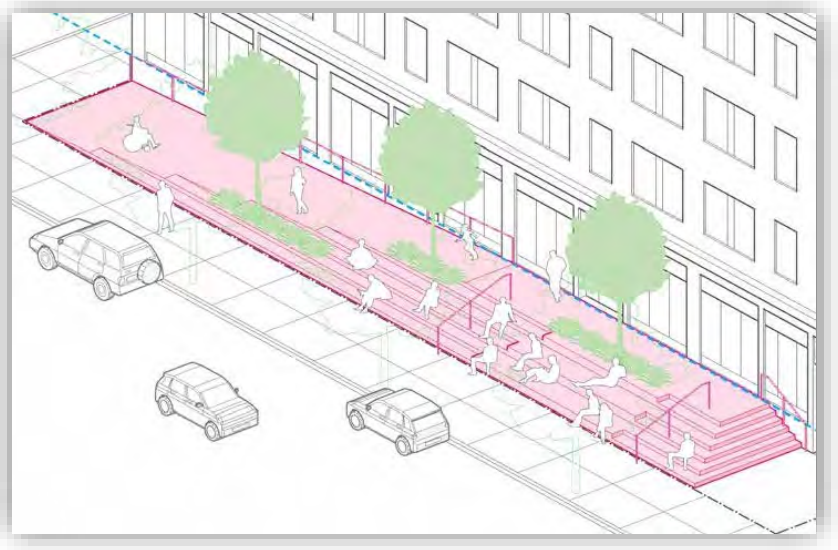


Figure 7. Elevate lowest interior floor and provide exterior circulation to the SLR-BFE. Source: *Coastal Flood Resilience Design Guidelines, Boston Planning & Development Agency.*

Relevance to JLUS

Chesapeake and Portsmouth floodplain management ordinances adopt the FEMA-designated SFHA shown on the Flood Insurance Rate Map as a zoning map. FEMA delineates the boundaries of the base, or 1-percent-annual-chance flood based on an analysis of historical data. In Chesapeake and Portsmouth, a zoning overlay concept is used to divide the SFHA into several zoning districts using the SFHA designation (e.g., AE Zone, VE Zone, AO Zone, A Zone, Floodway). Each ordinance then specifies flood design requirements for each of the flood-related zoning districts. For example, the requirements for the AE Zone are different than the coastal design requirements for the VE Zone. The floodway zone is an overlay on top of the AE Zone, with design requirements that account for the high velocities of floodwater in those areas.

Challenges to Local Implementation

Mapping based on *projections* of flood conditions vs. *current* flood conditions is expensive and potentially subject to legal challenge. Using 500-year floodplain as a proxy is potential low-cost option.

Possible Strategies

1. **Implement SLR-BFE mapping and design guidelines for the JLUS study area.** Mapping a zone of inundation subject to SLR flooding, or the *future* base flood outside the SFHA, would provide an opportunity to implement design guidelines that reduce the long-term vulnerability of structures built in the zone. Design guidelines could be specifically geared toward the building types of most concern, or could apply universally. For example, if the goal is to reduce vulnerability of non-residential structures, then floodproofing or elevation to the SLR-BFE could apply only to that subset of development.

3. CASE STUDY – *Enhancing Resilience in Boston: A Guide for Large Buildings and Institutions*, A Better City. 2015.

Summary

Boston's built infrastructure is at risk from climate stressors, but a series of technologies are currently available to help asset owners increase the adaptability of both existing and new buildings. This report and its associated online toolkit provide building owners with information on 32 available resilience actions and technologies. It also provides a preliminary assessment of potential regulatory "touch points" within the city and state for resilience actions and considers initial ideas for district-level resilience strategies for the Boston area.

Key Recommendations

This report focuses on measures for large buildings and includes many recommendations for regulatory actions among other considerations. It includes a helpful presentation of how various local, state, and federal permitting processes intersect.

Relevant recommendations from the report include:

- Streamline permitting as an incentive to increase private investment in resiliency; providing other incentives discussed such as insurance incentives or municipal development/financial program assistance incentives
- Make building code modifications like those made in NYC:
    - Mandate the installation of backflow valves for buildings located in the flood zone and require elevation (versus protection) of plumbing systems above the design flood elevation in the building code
    - Approve the use of temporary flood barriers and stairs during storm events
    - Allow the use of anchors on sidewalks for periods leading up to and after the storm (the law also established protocols for any barriers that must be manually deployed)
    - Remove barriers to elevating cables and other wiring equipment above BFE in flood zones
    - Regulate height and quantity of fuel that can be stored in buildings subject to flooding
- Implement building resilience rating recognition program similar to Leadership in Energy and Environmental Design (LEED) Climate Resilience Screening Tool (https://www.usgbc.org/articles/new-free-tool-helps-apply-leed-v4-optimize-climate-resilience) or the Insurance Council of Australia's Property Resilience and Exposure Program for residences. (https://www.insurancecouncil.com.au/affordability)
- Create municipal harbor plans (to streamline permitting), business improvement districts (to group funds from all businesses and then redistribute for resilience purposes), or resilience zones.

Possible Strategies

1. **Implement a local Building Resilience Rating recognition program.** Rating development projects based on resiliency concepts incorporated into the design similarly to the resiliency quotient concept introduced in Norfolk's 2018 Zoning Ordinance. Ratings could be linked to various incentive programs such as property taxes, Bay Star Business Partners through HRGreen (a program of the HRPDC), small business recovery funds, or others.

4. CASE STUDY – *Pathways to resilience: adapting to sea level rise in Los Angeles*. Annals of the New York Academy of Sciences, 2018.

Summary

This study describes adaptation pathways and provides estimates of associated costs in order to cope with potential effects of SLR on coastal Los Angeles County, California. "Adaptation pathways" are simply described as a group of measures required to lower flood risk, such as beach nourishment, dune restoration, flood-proofing buildings, and levee construction. However, the strategic thinking behind creating the study's pathways is to enable future transitions from one methodology to another over time as SLR projections are reassessed or realized. These pathways address uncertainty in future projections, allowing for flexibility among policies and potentially spreading the costs over time. Pathways were developed through meetings and seminars with experts and stakeholders in 2015, 2016, and 2017.

Key Recommendations

The research suggests three adaptation pathways, anticipating a +1 foot to +7 foot SLR by year 2100. Each pathway strives to anticipate future needs and future uncertainty, limiting significant investment in strategies that may not provide the necessary resilience in the future, but taking strategic actions early to reduce future costs. An example is reserving or purchasing space now for future levee needs.

While the exact pathways are specific to the geography of Los Angeles and differ from the regional SLR planning metrics adopted by the HRPDC, the concept of the pathways is summarized to explain the concept.

Resilient pathway +1 foot: This pathway aims to retain the coastline in its current position, with open harbors, and maintain sandy beaches with beach nourishment. The proposed adaptation measures are largely a continuation of ongoing efforts in Los Angeles County, and a strengthening of current policies that aim to manage flood risk. Adaptation pathways for each of the five coastal regions consist of the following main policies: beach nourishment; NFIP and flood proofing; flood protection of critical infrastructure; enhancing stormwater management measures (pumps, levees); and some additional measures, such as wetland restoration and reducing salt-water intrusion.

Resilient pathway +1 foot to +3 feet: In this pathway, a continuation of policies is required to retain the current coastline, with open harbors (Resilient pathway). However, because SLR advances, more beach nourishment and flood-proofing of buildings is required. Some measures probably become ineffective and have to be modified (e.g., winter berms transformed into dune restoration). Preparations for a transition are implemented (e.g., reserve space for levees).

Pathways +7 feet: If it appears that sea levels continue to increase to +7 feet in 2100, preparatory activities are needed to advance from the Resilient pathway to facilitate a smooth transition into a different pathway. In such a scenario, the following pathways are suggested for the five coastal regions:

- Adaptation Pathway Seaward Ports: In this pathway, the Ports of Los Angeles and Long Beach will expand towards the ocean, using the perimeter of outer harbor breakwaters. The older—inland—port facilities will be transformed for residential use protected from ocean floods by a dam and a sluice.

- Adaptation Pathway Resilient-Protection: This pathway aims to have the Ports of Los Angeles and Long Beach, Marina del Rey, and Redondo/South-Bay all maintain open access to the ocean. Some low-lying (vulnerable) areas will need to be protected by both elevated roads acting as levees and by re-enforced dunes.

- Adaptation Pathway Protection: In this pathway, Naples and Marina Del Rey may be closed with sluices. Vessels can still navigate to the ocean, but through a sluice complex.

- Adaptation Pathway Malibu Resilient+: Malibu will continue to elevate new buildings to > +7 feet in designated flood zones. However, retreat or relocation for some existing building to nearby higher ground will be necessary, because protection or elevation may not be an option or may prove too expensive. When assuming a SLR scenario of +2 m (7 feet), low-lying stretches of Pacific Coast Highway need to be elevated or relocated landward.

Relevance to JLUS

The concept of regionally relevant "adaptation pathways" could be useful at a similar planning scale for the port and harbor of Hampton Roads overall, or at the local government level as part of comprehensive planning efforts. The concept could also be used for business continuity or master planning for businesses and utilities at a smaller scale.

Possible Strategies

1. **Incorporate the concept of "adaptation pathways" into comprehensive planning for cities of Chesapeake and Portsmouth.** A comprehensive land use plan establishes the overall vision for what a community wants to be and serves as a guide to future governmental decision making. Given the broad nature of the plan and its regulatory standing in many communities, the integration of adaptation measures into the comprehensive plan can

serve as a far reaching, long-term risk reduction tool. Virginia law requires that all communities have a comprehensive land use plan and that it be updated every 5 years.

In the City of Chesapeake's Comprehensive Plan, *Moving Forward: Chesapeake 2035,* one of the action strategies identified in Chapter 2, Responsible Growth, is to "pursue grants and other funding to undertake a comprehensive study of the City's Elizabeth River waterfront, including the Eastern Branch and contributing Indian River, to create a future vision and action plan for the area. According to the input received during the JLUS, Chesapeake is moving ahead with a study of the industrial waterfront. This study could explore using the pathways concept as a methodology for developing a set of adaptation measures.

2. **Introduce the concept of "adaptation pathways" as a business continuity planning tool for local industrial business owners in vulnerable areas.** As part of the offerings to the business community discussed above under the NYC Case Study (#1), assistance in identifying adaptation pathways provides businesses a financial planning tool. With logical pathways to follow, businesses can minimize large near-term investments that fail to provide long-term resilience, while maximizing actions that suit future adaptive needs (such as land acquisition).

   Multiple businesses, localities, and other entities, including the Navy and Port of Virginia, are responsible for managing and maintaining the waterfront. A coordinated and consistent approach to planning, business continuity, and risk management across the various partners could achieve a stronger, more resilient outcome.

APPENDIX B
TABLE OF POTENTIAL FUNDING SOURCES

No.	Program	Eligibility	Website
		Local	
1	City of Portsmouth CIP Funding	In citywide Capital Improvements Plan.	https://www.portsmouthva.gov/DocumentCenter/View/8134/FY-2021-Proposed-Budget-Tabs
2	City of Chesapeake CIP Funding	In citywide Capital Improvements Plan.	https://www.cityofchesapeake.net/government/city-departments/departments/Budget-Department/FY-2018-2022-Approved-Capital-Improvement-Program-CIP.htm
		Regional	
3	Hampton Roads Transportation Fund Revenue Bonds	Managed by the Hampton Roads Transportation Accountability Commission (HRTAC). HRTF Candidate Projects should meet one or more of the following: be included in the HRTPO Board Approved 2034 Long-Range Transportation Plan (LRTP); be supported by HRTPO Resolutions; be legally eligible; meet Regional Project Cost Threshold of $100 million.	https://www.hrtpo.org/page/hampton-roads-transportation-fund/
		Commonwealth of Virginia	
4	Virginia's Transportation Funding (VDOT, DRPT)	The Commonwealth Transportation Fund receives revenues from dedicated state and federal sources. The major state revenues are based on Virginia's official revenue forecast developed by the Department of Taxation. The Virginia Department of Transportation and the Virginia Department of Rail and Public Transportation estimate the federal revenues from the Federal Highway Administration and the Federal Transit Administration. The SMART SCALE prioritization system determines how funds will be programmed to capital improvement projects through the High Priority Project Program and the Construction District Grant Program.	http://www.virginiadot.org/projects/syip/virginia's_transportation_funding.asp
5	Commute Assistance Program (CAP) Grants	Commuter Assistance Program (CAP) is the Virginia Department of Rail and Public Transportation (DRPT) statewide grant program for programs and projects that provide information on commute options to the public, encourage the use of transit, vanpooling, carpooling, and telework, mitigate congestion on Virginia's highways and roads, and improve air quality.	http://www.drpt.virginia.gov/commuter-programs/grants/
6	Transportation Partnership Opportunity Fund (TPOF)	Transportation Partnership Opportunity Fund (TPOF) assistance is awarded at the discretion of the Governor in the form of grants, revolving loans, or other financial assistance to an agency or local government of the Commonwealth for activities associated with eligible transportation projects.	https://www.vedp.org/incentive/transportation-partnership-opportunity-fund-tpof

No.	Program	Eligibility	Website
7	Department of Conservation and Recreation (DCR) - Dam Safety and Floodplain Management Grants	The purpose of this category is to assist local governments with flood prevention or protection studies to prevent loss of life and reduce property damage caused by flooding. Per §10.1-603.16 of the Code of Virginia, flood prevention or protection studies means hydraulic and hydrologic studies of floodplains with historic and predicted floods, the assessment of flood risk and the development of strategies to prevent or mitigate damage from flooding.	http://www.dcr.virginia.gov/form/DCR199-219.pdf
8	Stormwater Local Assistance Fund (DEQ)	Provides matching grants to local governments for the planning, design, and implementation of stormwater best management practices (BMPs) that address cost efficiency and commitments related to reducing water quality pollutant loads.	https://www.deq.virginia.gov/water/clean-water-financing/stormwater-local-assistance-fund-slaf
9	Virginia Clean Water Revolving Land Fund (VCWRLF) (DEQ)	Provides low-interest loans to local governments and municipal public service authorities for the construction of facilities or structures or implementation of best management practices that reduce or prevent pollution of state waters caused by storm water runoff from impervious surfaces. VCWRLF financing of stormwater projects can only be made available in fiscal years when loan requests for eligible wastewater treatment facilities have first been satisfied, unless otherwise required by law.	https://www.deq.virginia.gov/water/clean-water-financing/revolving-loan-funds-rlfs/stormwater
10	Land and Water Conservation Fund (DCR)	The Land and Water Conservation Fund Act of 1965 established a federal reimbursement program for the acquisition and/or development of public outdoor recreation areas. The Land and Water Conservation Fund (LWCF) is administered in Virginia by the Department of Conservation and Recreation (DCR) on behalf of the National Park Service (NPS). The program represents a federal, state and local partnership. A key feature of the program is that all LWCF assisted areas must be maintained and opened, in perpetuity, as public outdoor recreation areas.	https://www.dcr.virginia.gov/recreational-planning/lwcf
11	Virginia Land Conservation Fund (DCR)	The foundation was established to help fund permanent conservation easements and to purchase open spaces and parklands, lands of historic or cultural significance, farmlands and forests, and natural areas.	https://www.dcr.virginia.gov/virginia-land-conservation-foundation/
		Department of Defense	
12	Community Infrastructure Program	Provides funding to address deficiencies in community infrastructure, supportive of a military installation, in order to enhance military value, installation resilience, and military family quality of life.	https://oldcc.gov/defense-community-infrastructure-program-dcip

No.	Program	Eligibility	Website
13	Community Investment	Provides states and communities to undertake necessary investments in public services and infrastructure to support the readiness installations, as well as to provide safe places for services members and their families to live, work, and play. Current efforts support the management of civilian activities to absorb announced mission growth and investments in infrastructure such as the renovation of public schools on military installations, improvement of roads to medical facilities, and outside-the-fence investments in infrastructure.	https://oldcc.gov/our-programs/community-investment
14	U.S. Navy Funding	Unspecified.	https://www.secnav.navy.mil/fmc/fmb/Pages/Fiscal-Year-2021.aspx
	U.S. Economic Development Administration (EDA)		
15	Economic Adjustment Assistance Program	Help regions recover from the economic harm and distress resulting from natural disasters to rebuild stronger, more resilient economies. EDA Disaster Supplemental funding can also be used for infrastructure (water/wastewater, roads, ports, buildings) with an economic development purpose.	https://www.eda.gov/disaster-recovery/supplemental/
16	Economic Development Support for Planning Organizations	Provides essential investment support to district organizations, Native American organizations, states, sub-state planning regions, urban counties, cities and other eligible recipient to assist in planning	https://www.eda.gov/pdf/about/Economic-Adjustment-Assistance-Program-1-Pager.pdf
17	Public Works and Economic Development Facilities	Helps distressed communities revitalize, expand, and upgrade their physical infrastructure. Enables communities to attract new industry; encourage business expansion; diversify local economies; and generate or retain long-term, private-sector jobs and investment through the acquisition or development of land and infrastructure improvements needed for the successful establishment or expansion of industrial or commercial enterprises.	https://www.eda.gov/pdf/about/Public-Works-Program-1-Pager.pdf
	U.S. Federal Emergency Management Agency (FEMA)		
18	Building Resilient Infrastructure and Communities (BRIC)	Supports states, local communities, tribes and territories as they undertake hazard mitigation projects, reducing the risks they face from disasters and natural hazards. BRIC is a new FEMA pre-disaster hazard mitigation program that replaces the existing Pre-Disaster Mitigation (PDM) program.	https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities
19	Flood Mitigation Assistance Grant Program	A competitive grant program that provides funding to states, local communities, federally recognized tribes and territories. Funds can be used for projects that reduce or eliminate the risk of repetitive flood damage to buildings insured by the NFIP.	https://www.fema.gov/grants/mitigation/floods

No.	Program	Eligibility	Website
20	Hazard Mitigation Grant Program	Provides funding to state, local, tribal and territorial governments so they can rebuild in a way that reduces, or mitigates, future disaster losses in their communities. This grant funding is available after a presidentially declared disaster.	https://www.fema.gov/grants/mitigation/hazard-mitigation
21	Intercity Bus Security Grant Program	Protects surface transportation infrastructure and the traveling public from acts of terrorism and increase the resilience of transit infrastructure. This funding provides owners and operators of intercity bus systems with resources for implementation of the National Preparedness System and works toward the National Preparedness Goal of a secure and resilient nation.	https://www.fema.gov/grants/preparedness/intercity-bus-security
22	Public Assistance (PA) grant program (Section 406)	Provides assistance to state, local, tribal, and territorial governments and certain types of private nonprofit organizations respond to and recover from major disasters or emergencies. Eligible costs include debris removal, life-saving emergency protective measures, and restoring public infrastructure.	https://www.fema.gov/assistance/public
23	Transit Security Grant Program	Provides funding to eligible public transportation systems (which include intra-city bus, ferries and all forms of passenger rail) to protect critical transportation infrastructure and the traveling public from terrorism, and to increase transportation infrastructure resilience.	https://www.fema.gov/grants/preparedness/transit-security
Hampton Roads Sanitation District (HRSD)			
24	Capital Improvement Program	For projects on HRSD's CIP.	https://www.hrsd.com/cip
National Oceanic and Atmospheric Administration (NOAA)			
25	The Coastal and Estuarine Land Conservation Program	Lands selected to be protected through the program are ecologically important or possess other coastal conservation values, such as historic features, scenic views, or recreational opportunities.	https://www.coast.noaa.gov/czm/landconservation/
26	Coastal Resilience Grants	This program is intended to build resilience through projects that conserve and restore sustainable ecosystem processes and functions and reduce the vulnerability of coastal communities and infrastructure from the impacts of extreme weather events, climate hazards, and changing ocean conditions.	https://www.fisheries.noaa.gov/grant/noaa-coastal-resilience-grants

No.	Program	Eligibility	Website
		U.S. Army Corps of Engineers (USACE)	
27	Section 14: Emergency Streambank and Shoreline Protection	This authority allows USACE to construct emergency shoreline and stream bank protection works to protect public facilities, such as bridges, roads, public buildings, sewage treatment plants, water wells, and non-profit public facilities, such as churches, hospitals, and schools.	https://www.sas.usace.army.mil/Missions/CAP/Section-14-Emergency-Stream-Bank-and-Shoreline-Protection/
28	Section 103: Hurricane and Storm Beach Erosion	This authority allows USACE to study, design, and construct small coastal storm damage reduction projects in partnership with non-federal government agencies, such as cities, counties, special authorities, or units of state government. Projects are planned and designed under this authority to provide the same complete storm damage reduction project that would be provided under specific congressional authorizations.	https://www.sas.usace.army.mil/Missions/CAP/Section-103-Small-Hurricane-and-Storm-Damage-Reduction-Projects-Beach-Erosion/
29	Section 107: Navigation Improvements	This authority allows USACE to improve navigation, including dredging of channels, anchorage areas, and turning basins and construction of breakwaters, jetties and groins, through a partnership with non-federal government sponsor such as cities, counties, special chartered authorities (such as port authorities), or units of state government.	https://www.sas.usace.army.mil/Missions/CAP/Section-107-Navigation-Improvements/#:~:text=Section%20107%20of%20the%20River,sponsor%20such%20as%20cities%2C%20counties
30	Section 205: Flood Risk Management Program	This authority allows USACE to develop and construct small flood control projects without the need of specific congressional authorization. The program provides local flood risk management by the construction or improvement of flood control works or non-structural measures.	https://www.mvr.usace.army.mil/Business-With-Us/Outreach-Customer-Service/Flood-Risk-Management/Section-205/
31	Flood Plain Management Services Program	Provides technical assistance and planning guidance to Federal agencies, states, local governments, other non-Federal entities, eligible Tribes and the private sector to support effective floodplain management. This may include obtaining, interpreting, or developing data about flood sources and types, flood depths and water surface elevations, floodwater velocity, flooding extent and duration, flood frequency, and obstruction of flood flows. It may also include larger scale "special studies" on all aspects of floodplain management, including floodplain mapping, dam break analyses, regulatory floodway studies, flood warning and emergency preparedness, and flood damage reduction studies. Allows for technical assistance only, cannot conduct site-specific design or fund construction.	https://www.nae.usace.army.mil/Missions/Public-Services/Flood-Plain-Management-Services/

No.	Program	Eligibility	Website
		U.S. Department of Transportation (DOT)	
32	Defense Access Road Program (Federal Highway Administration (FHWA))	The Defense Access Road (DAR) Program provides a means for the military to pay their share of the cost of public highway improvements necessary to mitigate an unusual impact of a defense activity. An unusual impact could be a significant increase in personnel at a military installation, relocation of an access gate, or the deployment of an oversized or overweight military vehicle or transporter unit.	https://flh.fhwa.dot.gov/programs/dar/
33	Congestion Mitigation and Air Quality Improvement Program (FHWA)	Funds may be used for a transportation project or program that is likely to contribute to the attainment or maintenance of a national ambient air quality standard, with a high level of effectiveness in reducing air pollution, and that is included in the metropolitan planning organization's (MPO's) current transportation plan and transportation improvement program (TIP) or the current state transportation improvement program (STIP) in areas without an MPO.	https://www.transit.dot.gov/funding/grants/grant-programs/flexible-funding-programs-congestion-mitigation-and-air-quality
34	Construction of Ferry Boats and Ferry Terminal Facilities Program (FHWA)	Federal-aid highway funds are available, through the State transportation agencies, for designing and constructing ferry boats and for designing, acquiring right-of-way, and constructing ferry terminal facilities. Ferry boats and terminal facilities that serve vehicular travel as links on public highways (other than Interstate highways), as well as ferry boats and terminals only serving passengers as a fixed route transit facility, may be eligible for certain types of Federal-aid highway funding.	https://www.fhwa.dot.gov/specialfunding/fbp/
35	Infrastructure for Rebuilding America (INFRA)	Competitive grant program that fund transportation projects of national and regional significance. USDOT seeks INFRA projects that address climate change and environmental justice. Projects will be evaluated on whether they were planned as part of a comprehensive strategy to address climate change, or whether they support strategies to reduce greenhouse gas emissions such as deploying zero-emission-vehicle infrastructure or encouraging modal shift and a reduction in vehicle-miles-traveled.	https://www.transportation.gov/buildamerica/financing/infra-grants/infrastructure-rebuilding-america
36	Rebuilding American Infrastructure with Sustainability and Equity (RAISE)	Competitive grant program that prioritize projects that can demonstrate improvements to racial equity, reduce impacts of climate change and create good-paying jobs.	https://www.transportation.gov/RAISEgrants

No.	Program	Eligibility	Website
37	Integrated Mobility Innovation (Federal Transit Administration (FTA))	Competitive grant program that funds projects that demonstrate innovative and effective practices, partnerships and technologies to enhance public transportation effectiveness, increase efficiency, expand quality, promote safety and improve the traveler experience.	https://www.transit.dot.gov/IMI
38	Passenger Ferry Grant Program, Section 5307 (FTA)	Funding is made available to designated recipients, eligible direct recipients of Section 5307 funds, States and federally recognized Tribes that operate a public ferry system in an urbanized area.	https://www.transit.dot.gov/passenger-ferry-grants
39	Pilot Program for Transit-Oriented Development Planning – Section 20005(b) (FTA)	Competitive grant program that provides funding to local communities to integrate land use and transportation planning with a new fixed guideway or core capacity transit capital investment. Comprehensive planning funded through the program must examine ways to improve economic development and ridership, foster multimodal connectivity and accessibility, improve transit access for pedestrian and bicycle traffic, engage the private sector, identify infrastructure needs, and enable mixed-use development near transit stations.	https://www.transit.dot.gov/TODPilot
40	Public Transportation Emergency Relief Program (FTA)	Formula grant program that assists states and public transportation systems pay for protecting, repairing, and/or replacing equipment and facilities that may suffer or have suffered serious damage as a result of an emergency, including natural disasters such as floods, hurricanes, and tornadoes. It provides authorization for Section 5307 and 5311 funds to be used for disaster relief in response to a declared disaster.	https://www.transit.dot.gov/funding/grants/grant-programs/public-transportation-emergency-relief-program-5324
41	Public Transportation Innovation - 5312 (FTA)	Competitive grant program that provides funding to public transportation systems, state DOTs, non-profit and for-profit entities etc.... to develop innovative products and services assisting transit agencies in better meeting the needs of their customers.	https://www.transit.dot.gov/funding/grants/public-transportation-innovation-5312
		U.S. Environmental Protection Agency (EPA)	
42	Clean Water Act Nonpoint Source Grant (Section 319 Grants)	Clean Water Act Section 319(h) funds are provided only to designated state and tribal agencies to implement their approved nonpoint source management programs.	https://www.epa.gov/nps/319-grant-current-guidance
43	Clean Water State Revolving Fund	The Clean Water State Revolving Fund (CWSRF) program is a federal-state partnership that provides communities a permanent, independent source of low-cost financing for a wide range of water quality infrastructure projects (can be used to construct wetlands).	https://www.epa.gov/cwsrf

No.	Program	Eligibility	Website
44	Drinking Water State Revolving Fund	The Drinking Water State Revolving Fund (DWSRF) program is a federal-state partnership to help ensure safe drinking water. Created by the 1996 Amendments to the Safe Drinking Water Act (SDWA) the program provides financial support to water systems and to state safe water programs.	https://www.epa.gov/drinkingwatersrf
45	Water Infrastructure Finance and Innovation Act (WIFIA)	Accelerates investment in our nation's water infrastructure by providing long-term, low-cost supplemental loans for regionally and nationally significant projects.	https://www.epa.gov/wifia
U.S. Fish and Wildlife Services (FWS)			
46	North America Wetlands Conservation Act 2019-2 U.S. Standard Grants	The U.S. Standard Grants Program is a competitive, matching grants program that supports public-private partnerships carrying out projects in the United States that further the goals of the North American Wetlands Conservation Act. Projects must involve only long-term protection, restoration, enhancement and/or establishment of wetland and associated upland habitats to benefit migratory birds. The program requires a 1:1 non-federal match and research funding is ineligible. This program supports the DOI and FWS mission of protecting and managing the nation's natural resources by collaborating with partners and stakeholders to conserve land and water and to expand outdoor recreation and access.	https://www.fws.gov/birds/grants/north-american-wetland-conservation-act/how-to-apply-for-a-nawca-grant.php
U.S. Department of Housing and Urban Development (HUD)			
47	CDBG Entitlement Program	Flexible program that provides communities with resources to address a wide range of unique community development needs. Provides annual grants on a formula basis to 1209 general units of local government and states to ensure decent affordable housing, to provide services to the most vulnerable in our communities, and to create jobs through the expansion and retention of businesses.	https://www.hudexchange.info/programs/cdbg-entitlement/cdbg-entitlement-program-eligibility-requirements/

APPENDIX C
LIST OF STAKEHOLDERS

- City of Chesapeake
- City of Portsmouth
- Columbia Gas of Virginia
- CSX
- Craney Island Fuel Depot
- Dominion Energy
- Elizabeth River Project
- Hampton Roads Military and Federal Facilities Alliance
- Hampton Roads Planning District Commission
- Hampton Roads Sanitation District
- Hampton Roads Transit
- Hampton Roads Transportation Planning Organization
- Hampton Roads Transportation Advisory Committee
- Naval Medical Center Portsmouth
- Naval Station Norfolk
- Naval Support Activity Hampton Roads
- Norfolk Naval Shipyard
- Norfolk and Portsmouth Beltline Railroad
- Portsmouth Historic Preservation Commission
- State of Virginia
- U.S. Army Corp of Engineers
- U.S. Coast Guard
- Virginia Department of Transportation
- Virginia Maritime Association
- Virginia Port Authority

APPENDIX D
JLUS TRAVEL DEMAND MODEL OF FLOOD SCENARIOS - MEMORANDUM

April 9, 2021

Mr. Benjamin J. McFarlane, AICP, CFM
Senior Regional Planner
Hampton Roads Planning District Commission
723 Woodlake Drive
Chesapeake, VA 23320

RE: ***Hampton Roads Region Portsmouth and Chesapeake Joint Land Use Study***
Travel Demand Modeling of Flooding Scenarios

In conjunction with the Portsmouth-Chesapeake Joint Land Use Study (JLUS), a Travel Demand Modeling analysis was conducted to understand the impacts of anticipated future flood conditions on vehicle operations throughout the City of Portsmouth and northern sections of the City of Chesapeake. The future flooding analysis conducted as part of the JLUS identified varying levels of future flood conditions (sea level rise and rainfall) throughout the JLUS study area. Based on the anticipated flood conditions, JLUS stakeholders desired to have a more thorough understanding of the potential operational impacts that flooding could have on the existing roadway network, and more specifically, access to the various Naval installations in the study area.

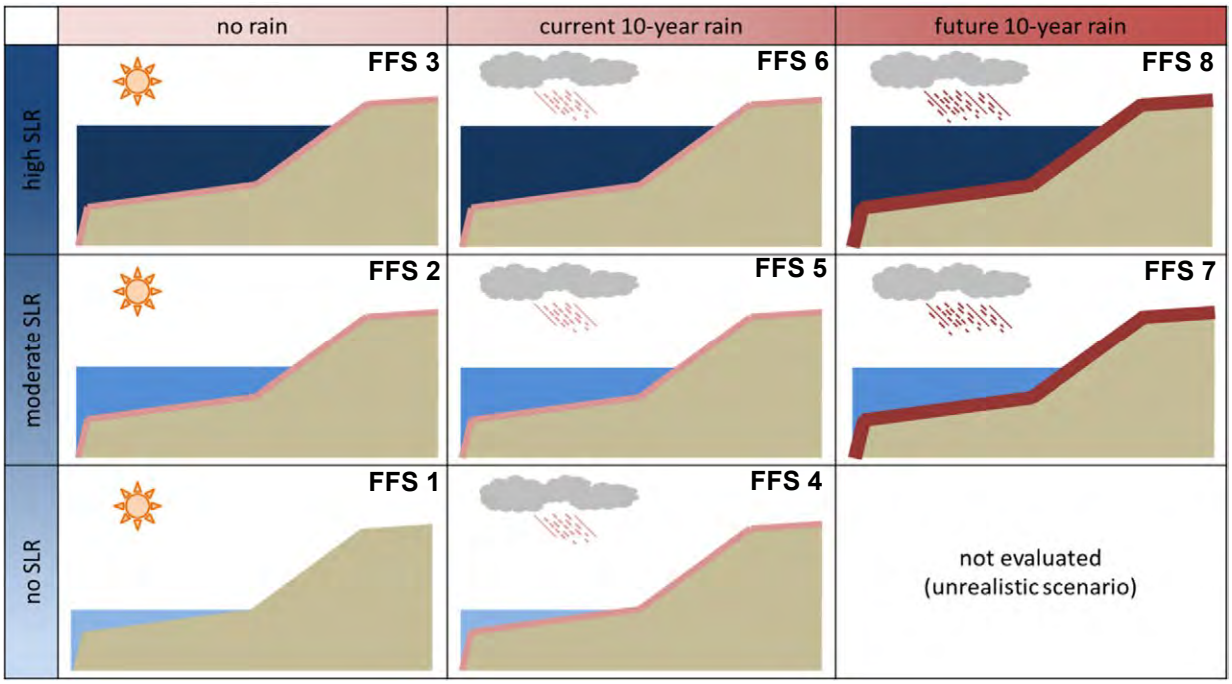
To better quantify potential operational impacts along the City roadway network, the JLUS project team solicited the use of the 2045 Hampton Roads Long Range Travel Demand Model (TDM). The TDM was used to model capacity reductions due to anticipated flood conditions throughout the study area, and then report the resulting traffic operational metrics for further analysis.

This memorandum summarizes the overall TDM analysis methodology, key modeling assumptions that were assumed in the analysis, results and findings from the analyses, and proposed prioritization strategies to address the potential traffic impacts.

Future Flooding Conditions

As part of the JLUS, eight distinct flooding event scenarios (Future Flood Scenarios, or “FFS”) were evaluated based on varying severities of sea level rise (SLR) and rainfall events (see **Figure 1**).

Figure 1 – JLUS Flooding Scenario Combinations



Comparing anticipated future flood depths across each of the eight FFS, it was evident that several critical transportation corridors were anticipated to be impacted. While all eight have varying levels of impact to key transportation corridors, JLUS stakeholders identified the following four FFS for further analysis with the TDM to gain a more thorough understanding of the potential impacts to vehicle operations:

- Future Flood Scenario 2 – Moderate Sea Level Rise (1.5') with No Rain (0")
- Future Flood Scenario 3 – High Sea Level Rise (3.0') with No Rain (0")
- Future Flood Scenario 7 – Moderate Sea Level Rise (1.5') with Future Rain (6.8")
- Future Flood Scenario 8 – High Sea Level Rise (3.0') with Future Rain (6.8")

The graphical summary of anticipated flooding results for the four FFS analyzed in this task are shown in **Attachment A**. Of the FFS identified for further analysis, FFS 2 is expected to be most consistent with the more common and estimated sea level rise conditions, while the other three scenarios represent more severe/intense sea level rise and anticipated rain events.

TDM Analysis Methodology

The TDM analysis methodology generally consisted of six steps:

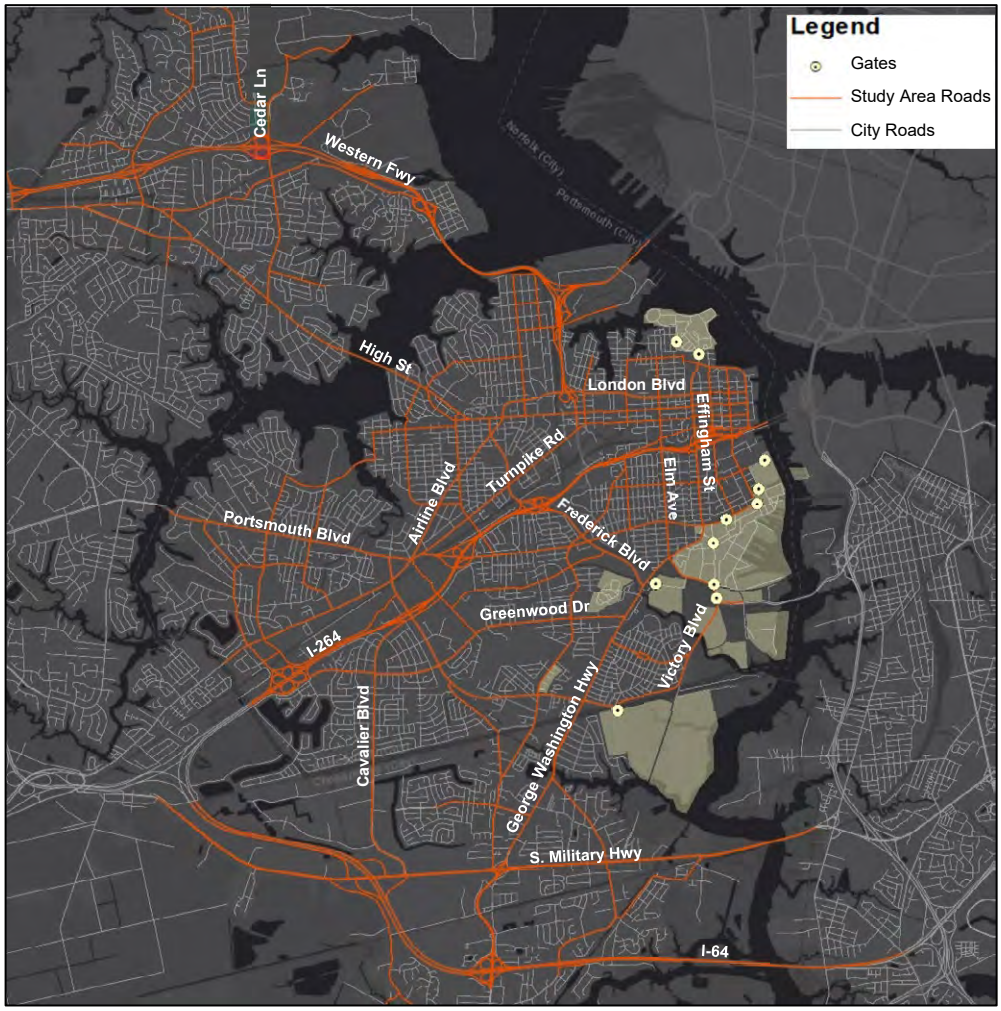
1. Convert each FFS into a Future Critical Corridor Model (FCCM)
2. Translate each FCCM into permeations of the base 2045 TDM model

3. Run each FCCM permeation model and synthesize results
4. Identify sub-areas for further evaluation (if flooding were to be eliminated)
5. Create and analyze sub-area improvement models
6. Develop a list of strategies and prioritization of flood improvements

Each of these steps is outlined in more detail in the subsequent sections.

A portion of the 2045 TDM was used for this analysis to focus on roadways in Portsmouth and Chesapeake critical to military operations and mobility. **Figure 2** illustrates the TDM analysis study area. It should be noted that the TDM does not include local roadways as it is meant for macroscopic (e.g., regional) analyses but does include freeways, arterials, and collectors.

Figure 2 – Travel Demand Model Analysis Study Area



Step 1 – Convert each FFS into a Future Critical Corridor Model (FCCM)

The first step of the TDM analysis involved converting each FFS into a database format which would align with the structure of the current 2045 TDM. These database formats were referred to as Future Critical Corridor Models (FCCM) and were assigned as follows:

- FFS 2 – Moderate Sea Level Rise (1.5') with No Rain (0") – ***"FCCM Baseline"***
- FFS 3 – High Sea Level Rise (3.0') with No Rain (0") – ***"FCCM 1"***
- FFS 7 – Moderate Sea Level Rise (1.5') with Future Rain (6.8") – ***"FCCM 2"***
- FFS 8 – High Sea Level Rise (3.0') with Future Rain (6.8") – ***"FCCM 3"***

For each FCCM, flood depth on each roadway link represented within the TDM study area was classified into four categories based on when estimated flood depth would have an impact on vehicle operations. Through discussions with JLUS stakeholders, it was agreed that roadway operational characteristics change (i.e., the extent at which a roadway is traversable) at the following estimated flood depths:

- Flood Depth 1: 0.0"
- Flood Depth 2: 0.01" – 3.0"
- Flood Depth 3: 3.01" – 6.0"
- Flood Depth 4: > 6.01"

Based on the above flood depth, each TDM roadway segment within the four FCCMs was categorized. For segments that had multiple flood depths, the flood depth that was most prevalent along the segment was used to represent the flood depth for the entire link. The conversion of FFS to FCCM was complete once each FFS consisted of a FCCM database containing the full list of categorized TDM links within the JLUS study area.

Step 2 – Translate each FCCM into permeations of the base 2045 TDM model

The second step of the TDM analysis involved translating each FCCM database into a working permeation of the 2045 TDM, with appropriate adjustments made to roadway operations to account for the various flood depth categories from Step 1. This was done by adjusting TDM roadway segment capacities and travel speeds based on the level of flooding anticipated. Through discussions with JLUS stakeholders, the following adjustments were agreed to for each flood depth category:

- Flood Depth 1 (0.0"): No adjustments to link speed or capacity
- Flood Depth 2 (0.01" – 3.0"): Reduction of link speed to 25 miles per hour (MPH)
- Flood Depth 3 (3.01" – 6.0"): Reduction of link speed to 25 MPH and reduction in link capacity by 50%
- Flood Depth 4 (>6.01"): Reduction in link capacity by 100%

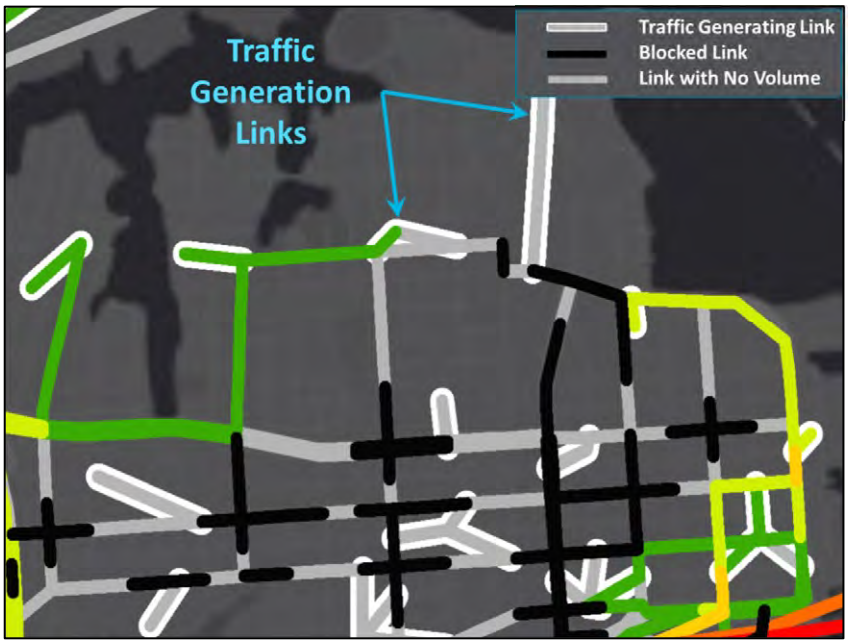
To create individual FCCM TDM models, the 2045 TDM model (without flooding) was replicated four times (i.e., one for each FCCM). Next, a script file was developed to translate the necessary link adjustments (i.e., reductions in speeds and capacity) into each respective FCCM TDM permeation. Once the script file was completely applied to each of the four FCCM permeation models, this step was complete.

Step 3 – Run each FCCM permeation model and synthesize results

Step 3 included the running of each FCCM permeation from Step 2. Each FCCM model was run under AM peak period (6:00 AM – 9:00 AM) and PM peak period (3:00 PM – 6:00 PM) conditions. Under each condition, the following measures of effectiveness were reported:

- *Unmet Demand* – Traffic demand (i.e., trips) not able to load onto the network due to non-traversable links preventing the completion of origin-destination trip pairs, as shown in **Figure 3. Figure 3** illustrates the non-traversable links (in gray) that prevent trips from entering the transportation network. Links in black represent areas that are blocked due to upstream/downstream flooding.
- *Traffic Volume* – Amount of traffic (i.e., able to load onto the network) traversing each link
- *Volume-to-Capacity (V/C) Ratio* – Ratio of traffic volume traversing a link to the available roadway capacity (i.e., available capacity after flooding adjustments had been made)

Figure 3 – Unmet Demand Example



Complete results from each of the FCCM model runs are graphically summarized in **Attachment B**. Overall findings for each FCCM are summarized in **Table 1**. Naval Medical Center Portsmouth (NMCP) access points (i.e., Gates 1 and 2) are expected to become inaccessible under FCCM 1, FCCM 2, and FCCM 3 conditions. At Norfolk Naval Shipyard (NNSY), access points are anticipated to be mostly inaccessible under the scenarios with 3' SLR (i.e., FCCM 1 and FCCM 3). From the FCCM peak period results, the PM peak period demonstrates more significant operational impacts due to flooding than the AM.

Table 1: FCCM TDM Summary of Findings

Facility	Findings	Location	Baseline	FCCM 1	FCCM 2	FCCM 3
			"X" = Facility Inaccessible			
NMCP	Gates	Gates 1 & 2		X	X	X
	Effingham St.	North of London Blvd		X	X	X
		London Blvd to I-264			X	X
	Elm Ave	North of London Blvd		X	X	X
		London Blvd to I-264			X	X
NNSY	Gates	North Gates (3, 10B, 10, & 14A)		X	X	X
		Main Gate (15)		X		X
		South Gates (29 & 36)		X		X
		Scott Center Gate			X	X
		St. Julien's Creek Annex Gate	Accessible in all FCCM			
	Elm Ave	G.W. Hwy to Victory Blvd		X		X
	Victory Blvd	NNSY to G.W. Hwy	Accessible in all FCCM			
	Victory Blvd	G.W. Hwy to I-264			X	X
Craney Island	Gate	Cedar Lane		X		X

Results from each FCCM indicates that there is a significant amount of unmet demand, as summarized in **Table 2**.

Table 2: FCCM Unmet Demand Results (AM and PM Peak Periods)

FCCM	Generated Traffic Volumes			Unmet Demand (FCCM Total - Baseline Total)
	AM Period	PM Period	Total (AM + PM)	
Baseline	108,900	157,200	266,100	0
1	86,400	127,400	213,800	-52,300
2	75,700	109,600	185,300	-80,800
3	61,400	88,100	149,500	-116,600

As displayed in **Table 2**, FCCM Baseline is not expected to experience unmet demand as flooding impacts do not prohibit trips from being completed. FCCM 1, FCCM 2, and FCCM 3 are expected to experience unmet demand, with FCCM 3 consisting of the most of all the scenarios due to the extensive estimated flooding (116,600 trips compared to the FCCM Baseline). With estimated increased flooding impacts anticipated between each scenario, unmet demand is expected to increase under each scenario due to the introduction of additional SLR and/or rainfall.

Similar to unmet demand, traffic volume and volume-to-capacity ratios differ the most when comparing FCCM Baseline to FCCM 3 results (FCCM 1 results are slightly worse than FCCM Baseline and FCCM 2 are slightly better than FCCM 3). Therefore, it was identified that strategies for improvement should be based on the anticipated flooding conditions associated with FCCM 3 during PM peak conditions.

Step 4 – Identify sub-areas for further evaluation (if flooding were to be eliminated)

Step 4, which also serves as the first major step in identifying potential strategies and prioritization for improvements, involved identifying geographic sub-areas which could be looked at in more detail if flooding constraints were removed (i.e., link speed and link capacity reductions eliminated). This step included two iterations in developing the final list of six improvement sub-areas, termed “packages” for the purpose of this study. The first iteration of proposed improvement packages consisted of the following, which are graphically illustrated in **Attachment C**:

- Package 1: Hospital (NMCP)
- Package 2: Norfolk Naval Shipyard (NNSY) North
- Package 3: Frederick Connector
- Package 4: Freeway Network
- Package 5: Norfolk Naval Shipyard (NNSY) South
- Package 6: Craney Island

Each of these initial packages had the removal of flooding impacts under FCCM 3 PM peak period conditions. After review of the initial list of packages, the following findings were made by the project team and JLUS stakeholders:

- Package 1 appeared to be an adequate package, with a few proposed minor edits to the roadways included within the package.
- Package 2 could yield different results based on whether Lincoln Street and Seventh Avenue are included.
- Package 3 should include existing Frederick Boulevard between George Washington Highway and I-264, but not a proposed connection with the South Norfolk Jordan Bridge.

- Package 4 includes several interchanges that are already included with other packages and may be a redundant package.
- Package 5 should be expanded to include more than just the immediate area south of Norfolk Naval Shipyard and should extend further along Victory Boulevard (to I-264) and George Washington Highway (to Canal Street).
- Package 6 results were not significantly different from the base FCCM 3 model results since the flood impacts north of Cedar Lane are very localized to within the Craney Island Fuel Depot.
- It was recommended that a package be considered to analyze an Alexander's Corner sub area (i.e., Victory Boulevard/Portsmouth Boulevard/High Street).

With the findings from the first iteration of sub-area package results, a revised list of packages was developed and approved by JLUS stakeholders (see **Attachment D**):

- Package 1: Hospital (NMCP)
- Package 2A: Norfolk Naval Shipyard (NNSY) North (*with* Lincoln Street and Seventh Avenue)
- Package 2B: Norfolk Naval Shipyard (NNSY) North (*without* Lincoln Street and Seventh Avenue)
- Package 3: Frederick Boulevard
- Package 4: Victory-Portsmouth Sub-Area
- Package 5: Norfolk Naval Shipyard (NNSY) South

Step 5 – Create and analyze sub-area improvement models

In this step, each of the six agreed-to sub-area packages were run and analyzed with the assumptions that flood inundations would be eliminated on the bundled roadways within the respective sub-areas. It is important to note that this step does not offer specific improvements that would be needed to ensure flooding impacts are reduced or eliminated. The modeling effort in this task simply assumed that the estimated flood impacts are addressed to enable an understanding of how the roadway network responds.

To model each sub-area package, the FCCM 3 model was first replicated six times (i.e., one for each package), and then each individual model was revised to remove link capacity and speed reductions that were in place within the sub-areas for FCCM 3. It is important to note that regardless of the anticipated flood depth, inundated links within the sub-areas were revised to Flood Depth 1 (0"). After creating the six FCCM 3 permeation models, each model was run and the outputs reported in the same manner outlined in Step 3 (i.e., unmet demand, traffic volumes, and volume-to-capacity ratios). Operational results for each improvement package run are graphically summarized in **Attachment E**.

Table 3 illustrates the change in overall unmet demand for each package as compared to the unmet demand observed under FCCM 3 conditions.

Table 3: Proposed Improvement Package Results (Unmet Demand)

Package	Unmet Demand	Added Trips (Compared to FCCM 3)
1: Hospital (NMCP)	-58,600	+58,000
2A/2B: NNSY North*	-95,000	+21,600
3: Frederick Boulevard	-103,500	+13,100
4: Victory-Portsmouth Sub-Area	-99,800	+16,800
5: NNSY South	-97,700	+18,900
**Note: Packages 2A and 2B resulted in equal unmet demand and added trips.*		

As shown in **Table 3**, Package 1 resulted in the greatest improvement to unmet demand and the largest number of trips added back to the network when flooding was removed from the package sub area. Package 3 resulted in the highest amount of unmet demand remaining in place amongst all the packages, but still anticipates additional trips added to the network when compared to FCCM 3. Each of the packages adjacent to NNSY (i.e., Package 2A/2B and 5) resulted in similar levels of unmet demand (i.e., approximately 95K – 98K) and added trips (i.e., approximately 19K to 22K).

The following results and findings were concluded from the improvement package model analyses:

Package 1: Hospital (NMCP)

- Provides a direct connection to NMCP, I-264, and U.S. 58
- Increases driver reliance on I-264, U.S. 58, and Western Freeway (State Route 164)
- Reduces driver reliance on several arterials and collectors (e.g., High Street and Victory Boulevard)
- Emphasizes the importance of Effingham Street for overall mobility and accessibility

Packages 2A and 2B: NNSY North

- Provides a direct connection to NNSY and I-264
- Increases driver reliance on I-264
- Reduces driver reliance on U.S. 58, Western Freeway, and several arterials and collectors (e.g., High Street, London Boulevard, and Victory Boulevard)
- Reduces driver reliance on the South Norfolk Jordan Bridge river crossing
- Emphasizes the importance of Effingham Street for overall mobility and accessibility
- Results based on improved accessibility to/from Lincoln Street and Seventh Avenue are negligible

Package 3: Frederick Boulevard

- Provides a direct connection to NNSY and I-264
- Provides both a north-south and east-west connection to/from NNSY and other destinations within the City
- Increases driver reliance on I-264
- Reduces driver reliance on U.S. 58, Western Freeway, and several arterials and collectors (e.g., High Street, London Boulevard, and Victory Boulevard)
- Reduces driver reliance on the South Norfolk Jordan Bridge river crossing

Package 4: Victory-Portsmouth Sub-Area

- Provides multiple connections to I-264 and reduces driver reliance of the Greenwood Boulevard interchange
- Provides a direct connection to NNSY, St. Julien's Creek Annex, and I-264
- Reduces driver reliance on U.S. 58, Western Freeway, and several arterials and collectors (e.g., High Street and Victory Boulevard)
- Reduces driver reliance on the South Norfolk Jordan Bridge river crossing

Package 5: NNSY South

- Provides multiple connections to I-264 and therefore increases driver reliance on the interstate
- Provides a connection to I-64
- Provides a direct connection to NNSY and St. Julien's Creek Annex
- Reduces driver reliance on U.S. 58, Western Freeway, and several arterials and collectors (e.g., High Street and Victory Boulevard)
- Reduces driver reliance on the South Norfolk Jordan Bridge river crossing

Step 6 – Develop a list of strategies and prioritization of flood improvements

In this final step, results from Step 5 were used to prioritize critical study area roadway corridors for flooding improvements. **Table 4** summarizes important factors associated with roadways within each package with regards to length of roadway within each package, percent of roadway with flooding over 6.01", direct accessibility to Naval installation gates, direct accessibility to I-264, volume-to-capacity ratio, transit accessibility, and direct access to potential remote parking opportunities.

Table 4: Critical Corridor Evaluation Matrix

Package	Roadway	Length (Feet)	Percent of Flooding	Direct Access to Gate	Direct Access to I-264	V/C > 1.0	Existing Transit Corridor	Direct Access to Remote Parking
1	Effingham St	4,100	81%	✓	✓	✓	✓	
1	London Blvd	8,170	45%				✓	
2A/2B	Effingham St	5,315	98%	✓	✓		✓	
2A/2B	Port Centre Pkwy	4,450	85%	✓			✓	✓
2A/2B	Portsmouth Blvd	4,075	81%	✓	✓		✓	✓
3	Frederick Blvd	7,450	63%		✓	✓		✓
3	George Washington Hwy	6,560	45%	✓			✓	✓
4	Victory Blvd	6,055	36%		✓		✓	✓
4	Portsmouth Blvd	5,655	60%		✓		✓	✓
4	Deep Creek Blvd	8,095	23%					
5	George Washington Hwy	14,005	27%	✓		✓	✓	✓
5	Victory Blvd	4,890	38%	✓	✓	✓	✓	✓

Through discussions with JLUS stakeholders on October 28, 2020, and based on the flood analysis findings and TDM task findings, the following corridors were given high priority for exploring potential flood mitigation strategies:

- Effingham Street
- Portsmouth Boulevard
- Victory Boulevard
- Frederick Boulevard
- George Washington Highway
- Cedar Lane (While not part of a final improvement package, Cedar Lane serves as the only ingress and egress roadway at Craney Island Fuel Depot)

Follow up discussions with the JLUS stakeholders have been scheduled to specifically discuss potential flood mitigation strategies along the high priority corridors. Input from those sessions will help to define a menu of options for the JLUS stakeholders to consider including in the JLUS Draft document.

Attachment A:

Future Flood Scenario Maps

Figure A-1: FFS 2 – Moderate Sea Level Rise (1.5') with No Rain (0")

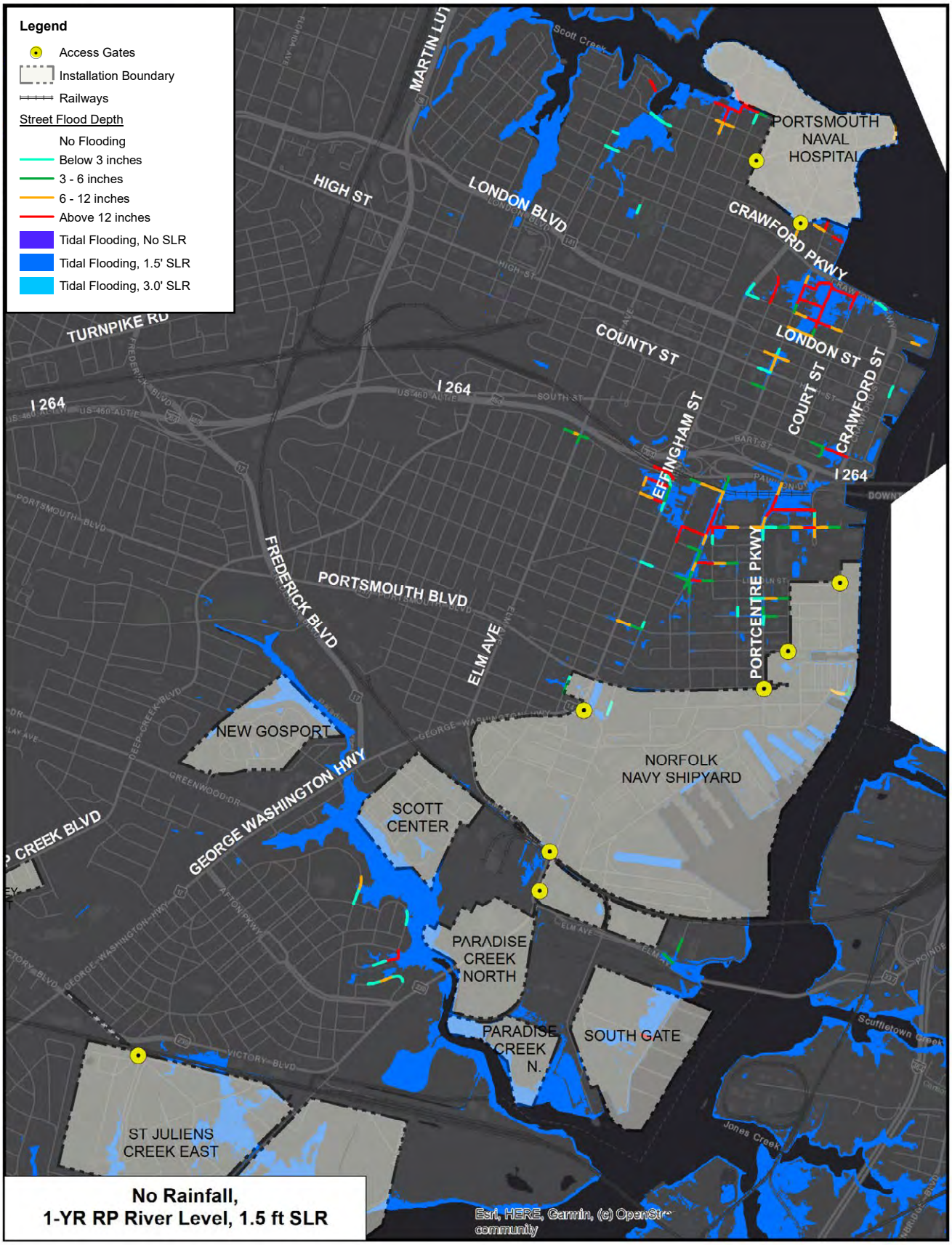


Figure A-2: FFS 3 – High Sea Level Rise (3.0') with No Rain (0")

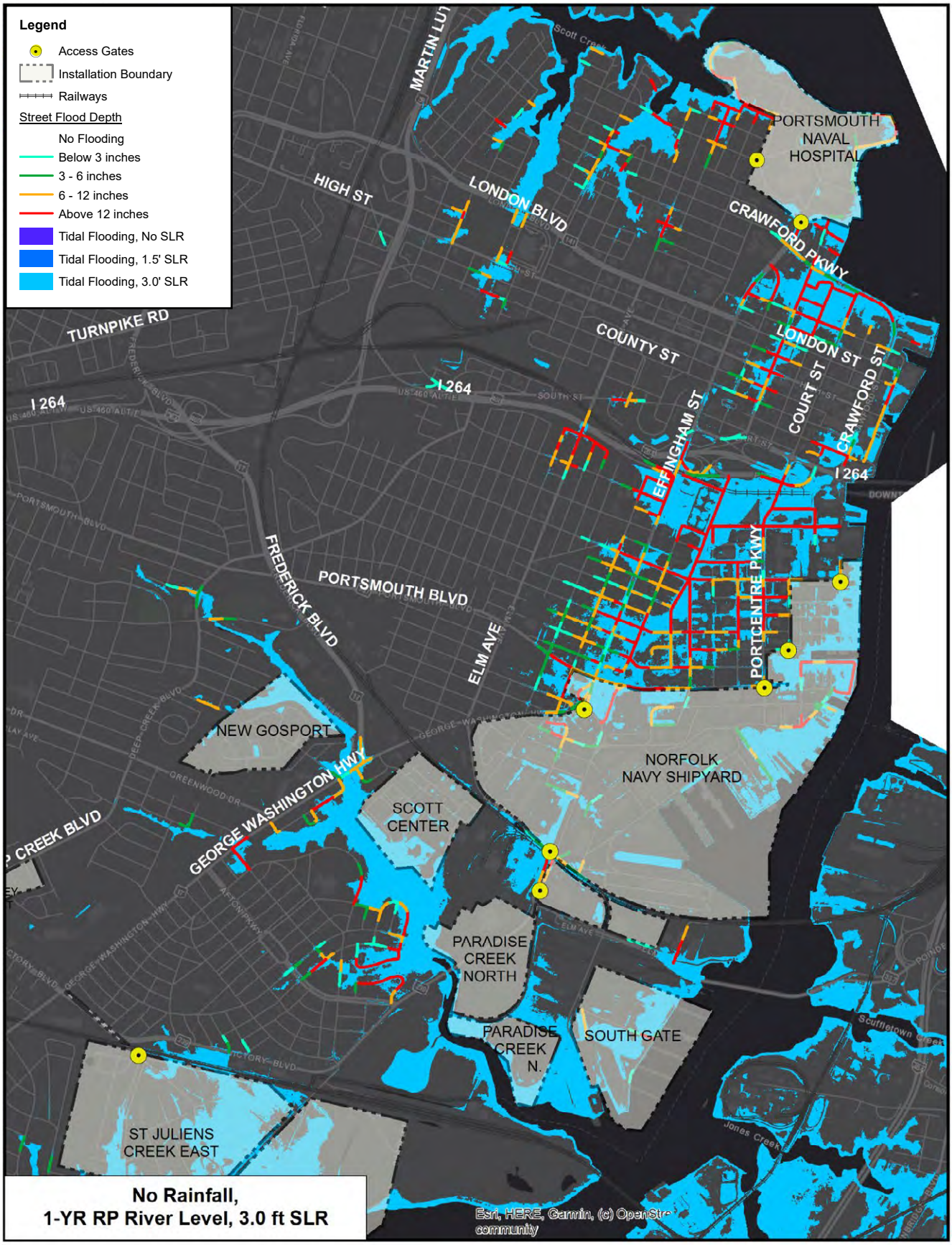


Figure A-3: FFS 7 – Moderate Sea Level Rise (1.5') with Future Rain (6.8")

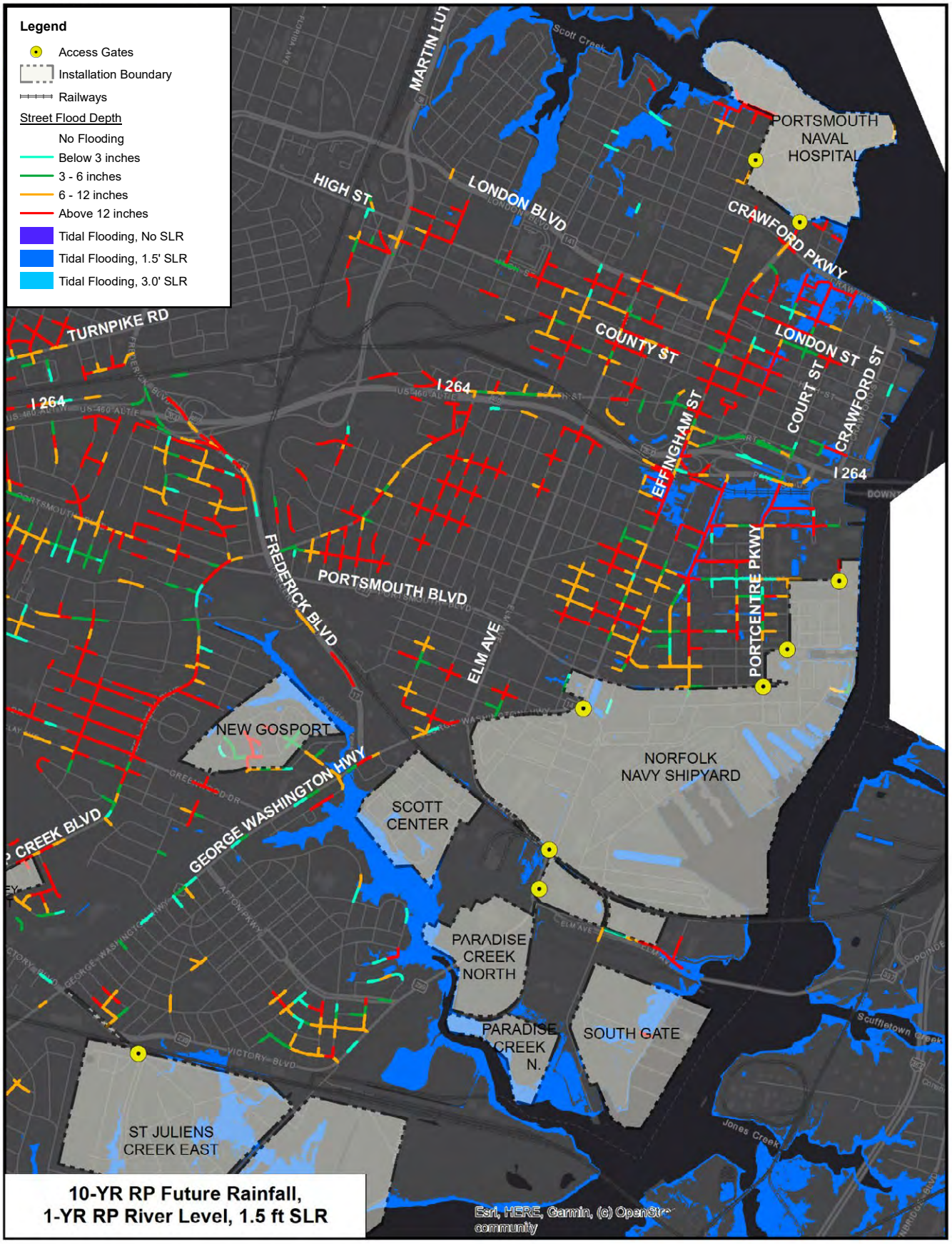
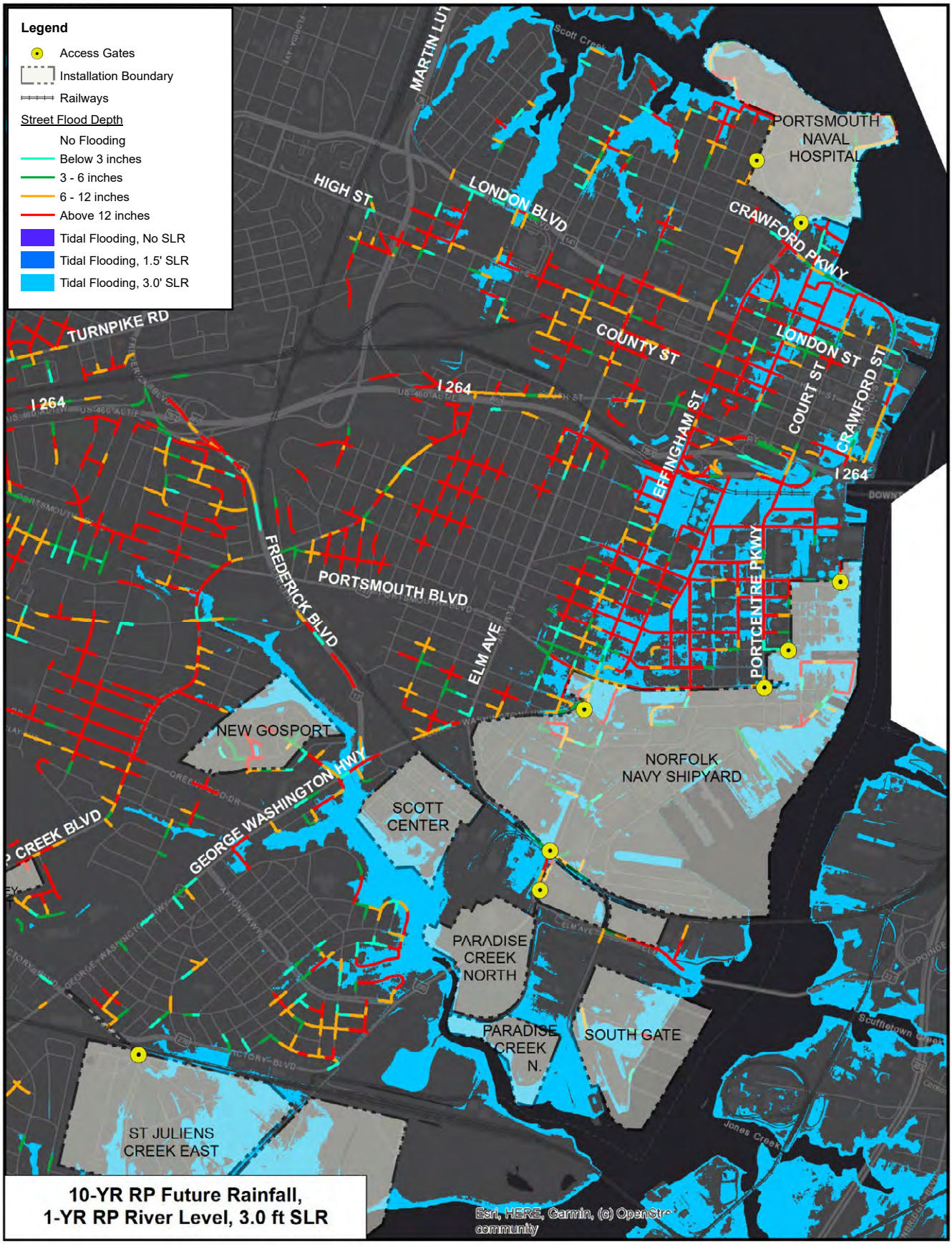


Figure A-4: FFS 8 – High Sea Level Rise (3.0') with Future Rain (6.8")



Attachment B:

FCCM AM and PM Peak Period Model Results

Figure B-1: FCCM Baseline AM Peak Period Volume

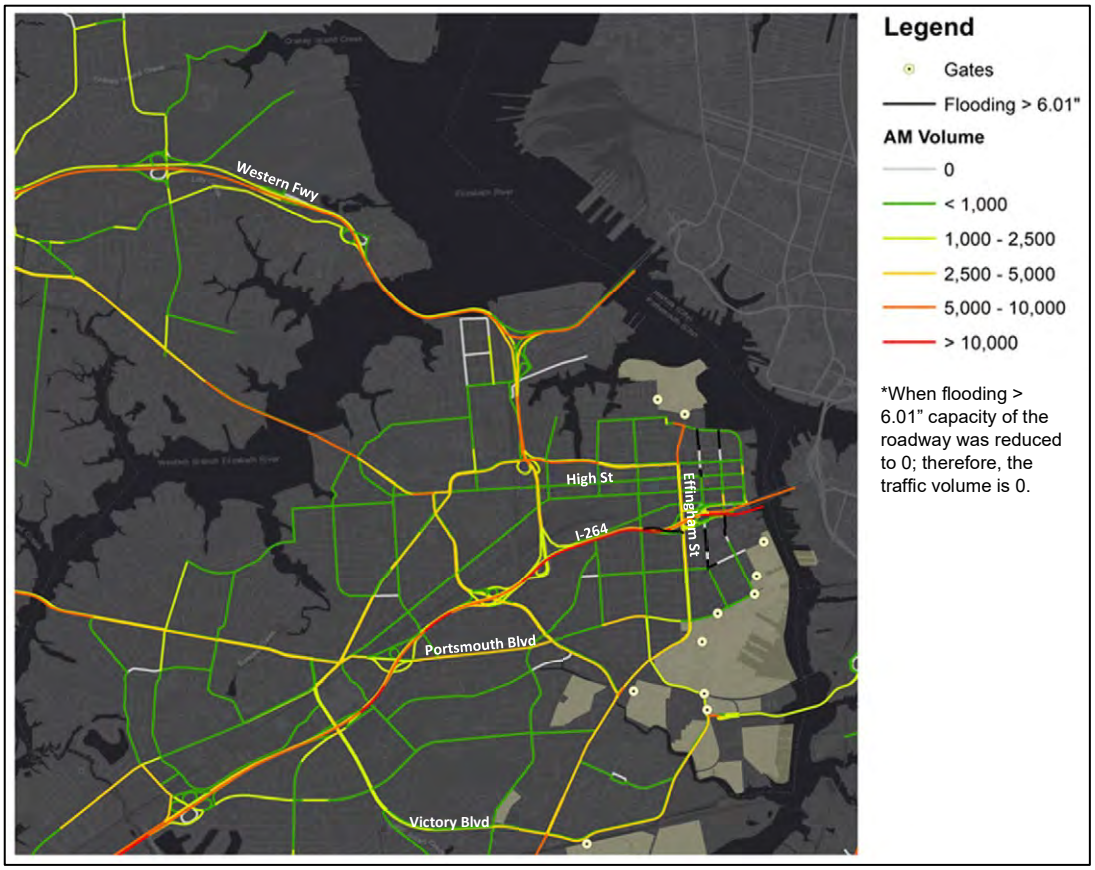


Figure B-2: FCCM Baseline AM Peak Period V/C Ratio

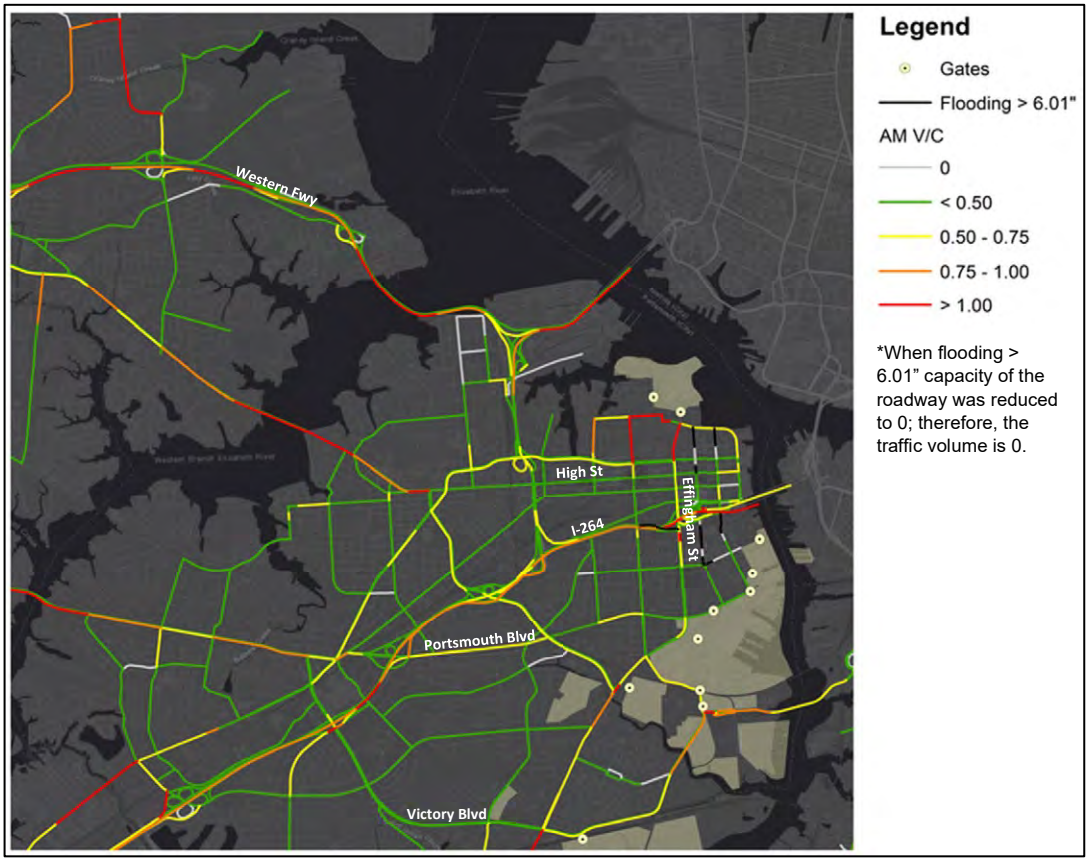


Figure B-3: FCCM Baseline PM Peak Period Volume

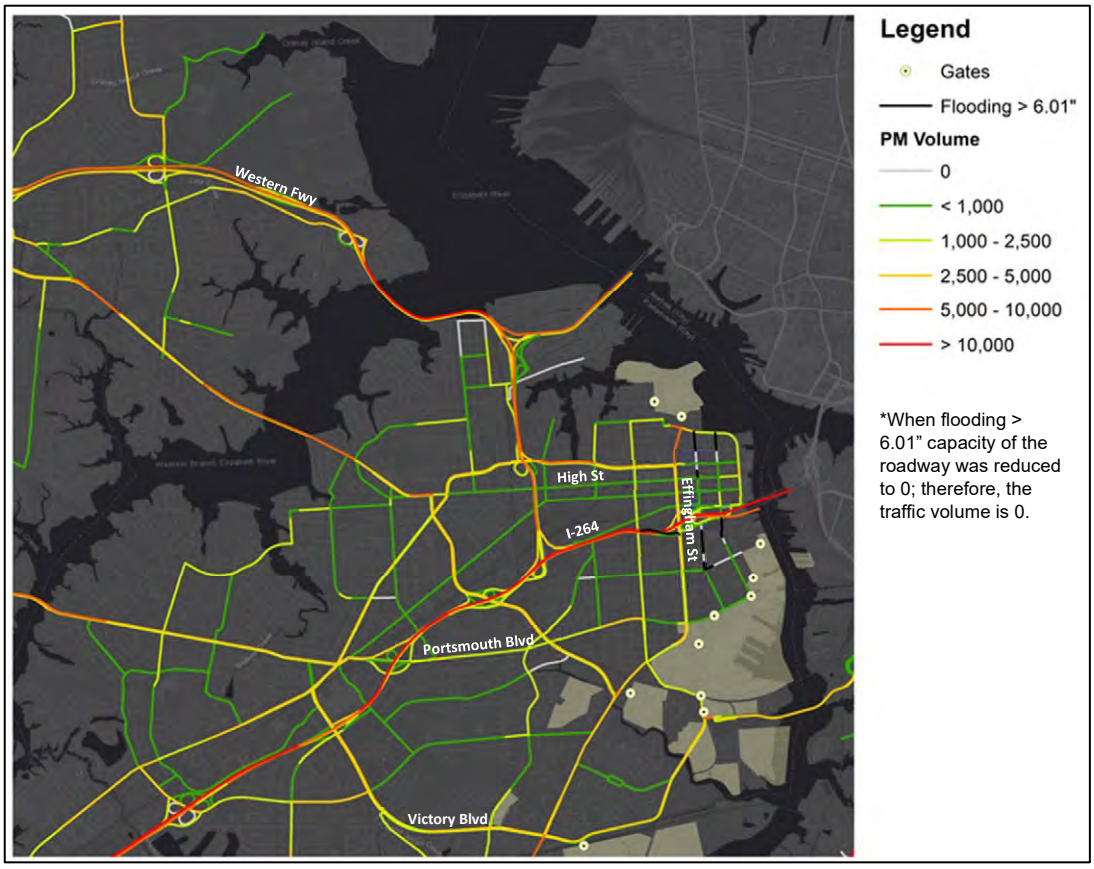


Figure B-4: FCCM Baseline PM Peak Period V/C Ratio

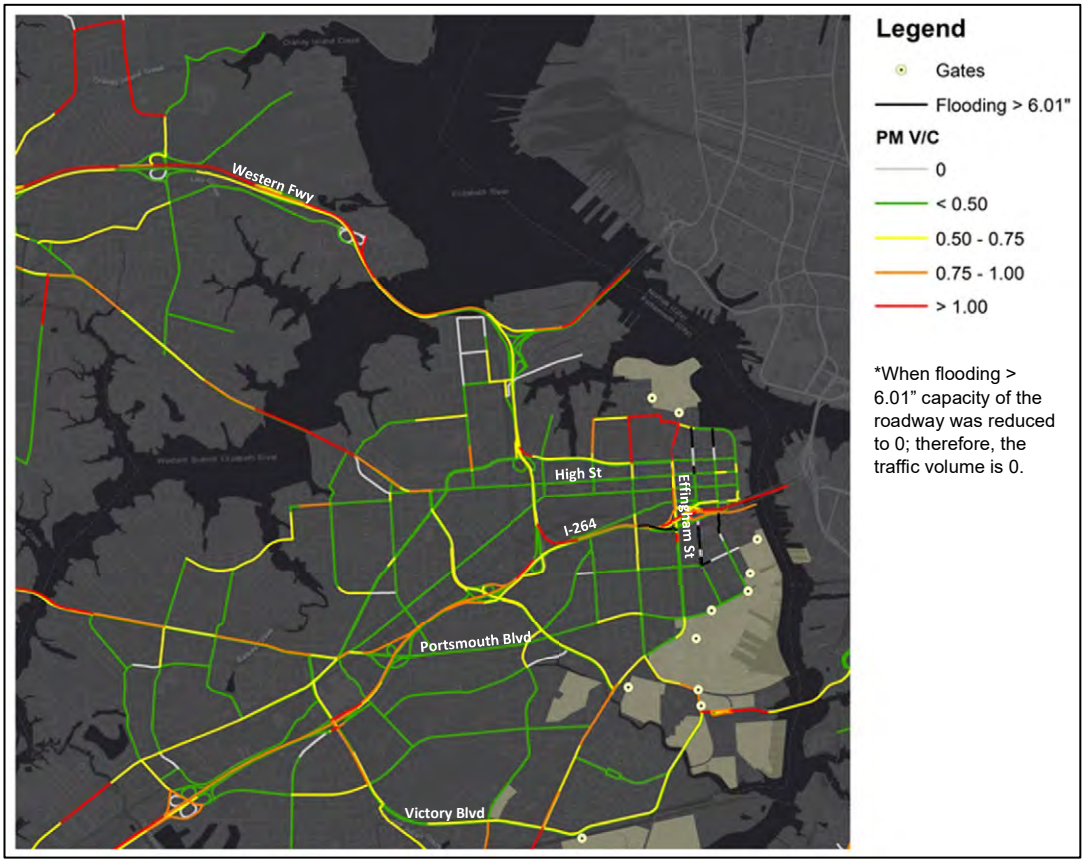


Figure B-5: FCCM 1 AM Peak Period Volume

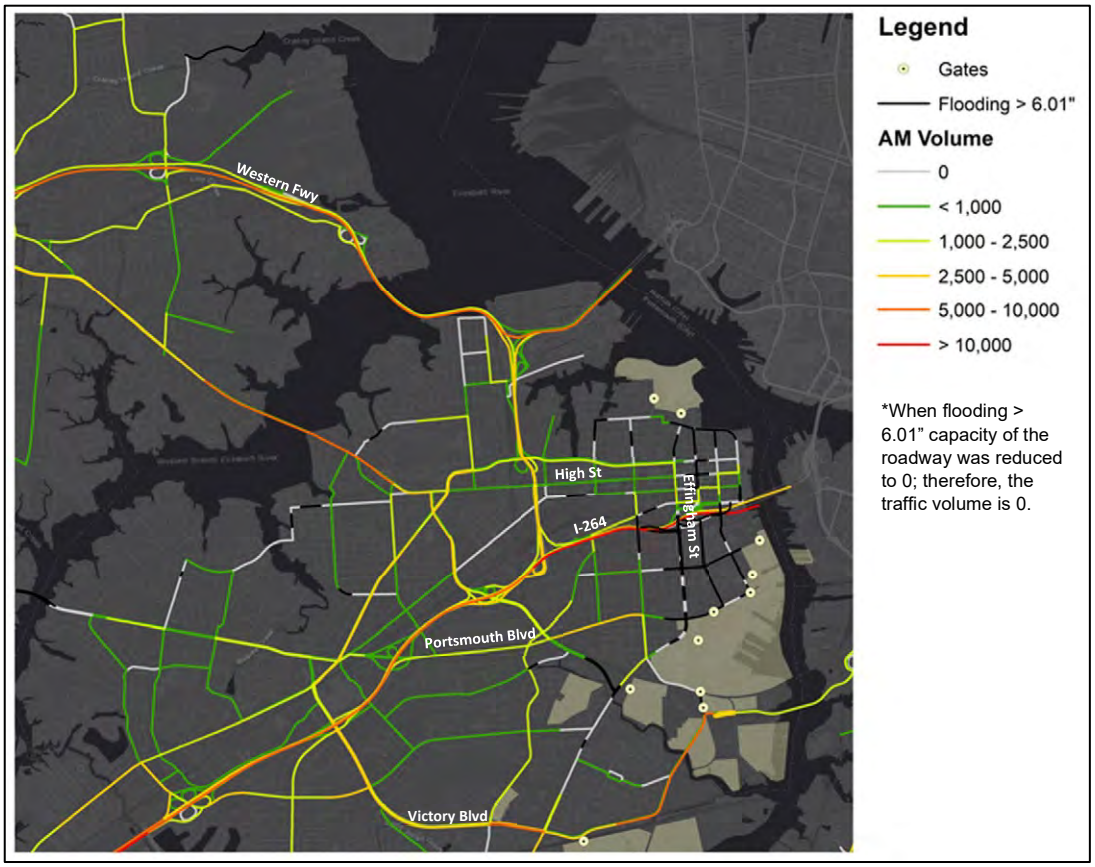


Figure B-6: FCCM 1 AM Peak Period V/C Ratio

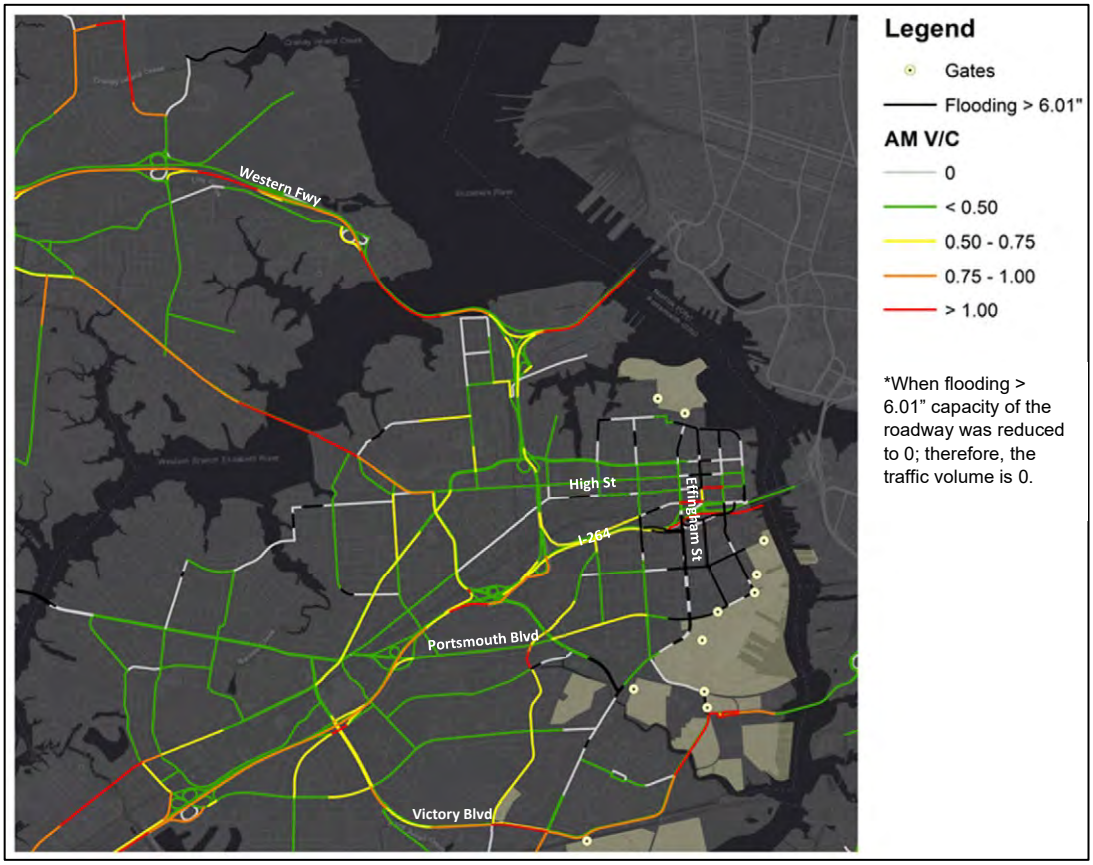


Figure B-7: FCCM 1 PM Peak Period Volume

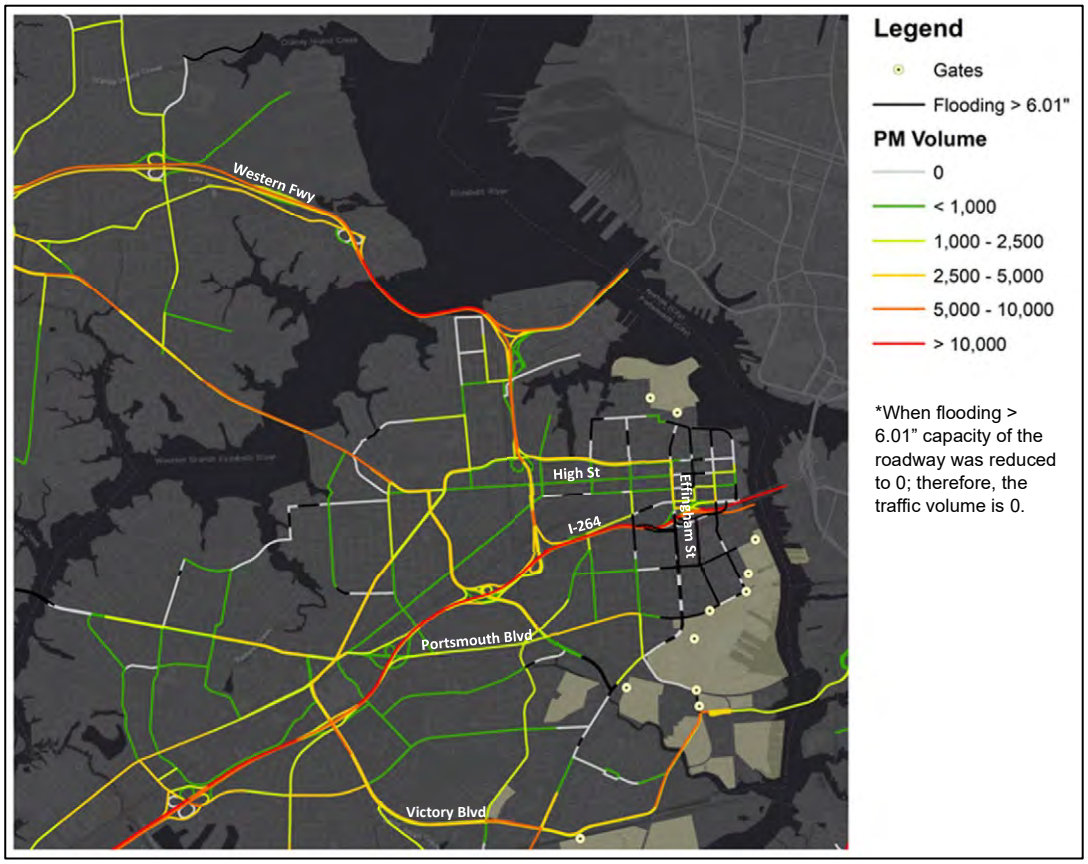


Figure B-8: FCCM 1 PM Peak Period V/C Ratio

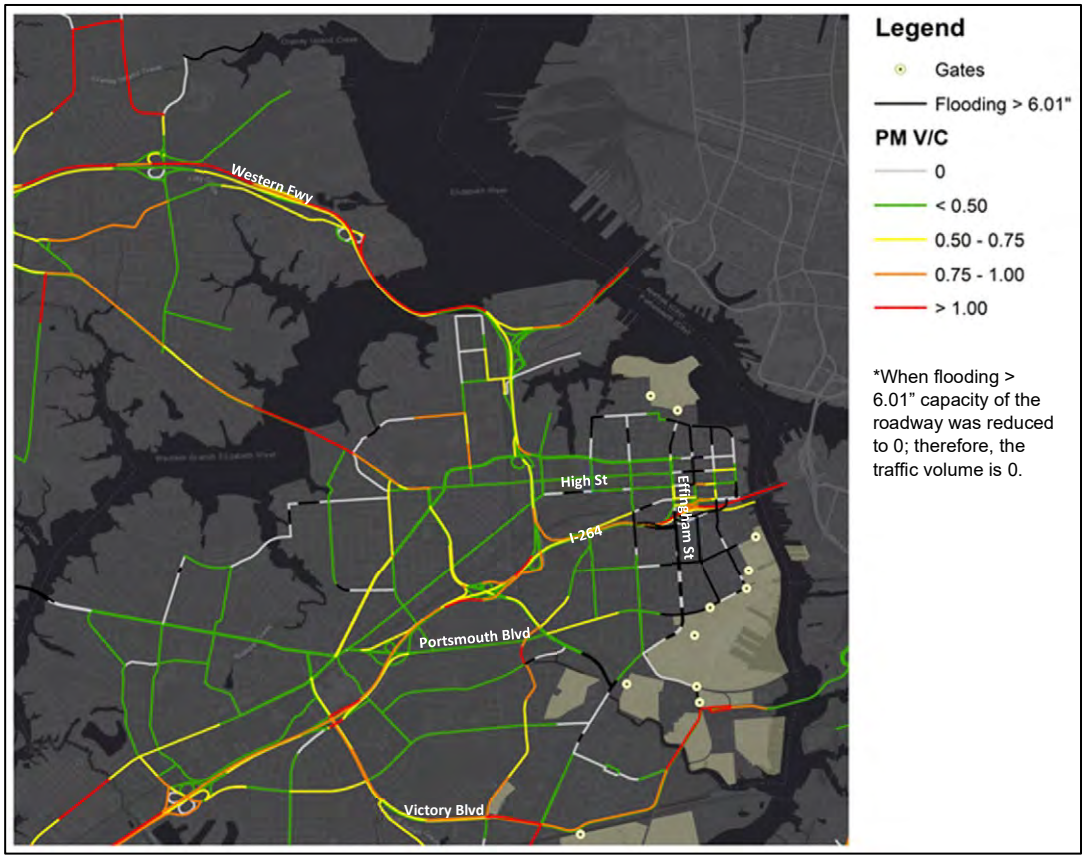


Figure B-9: FCCM 2 AM Peak Period Volume

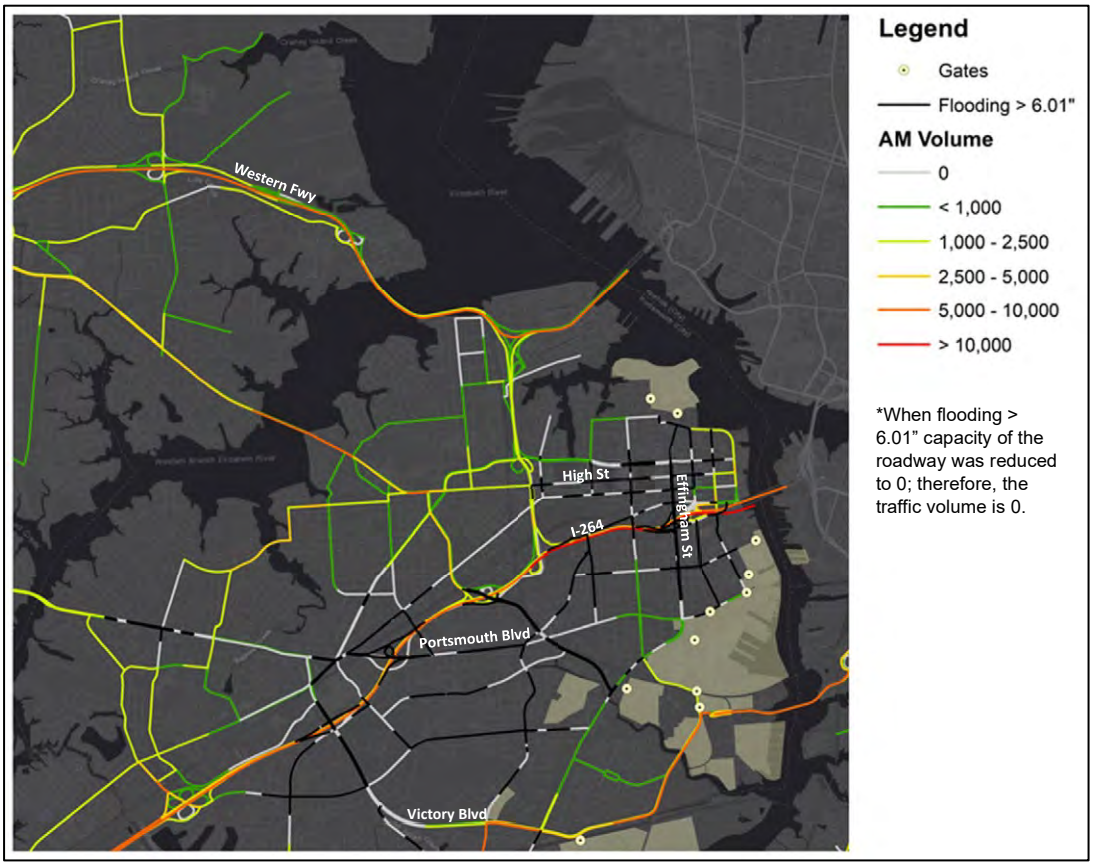


Figure B-10: FCCM 2 AM Peak Period V/C Ratio

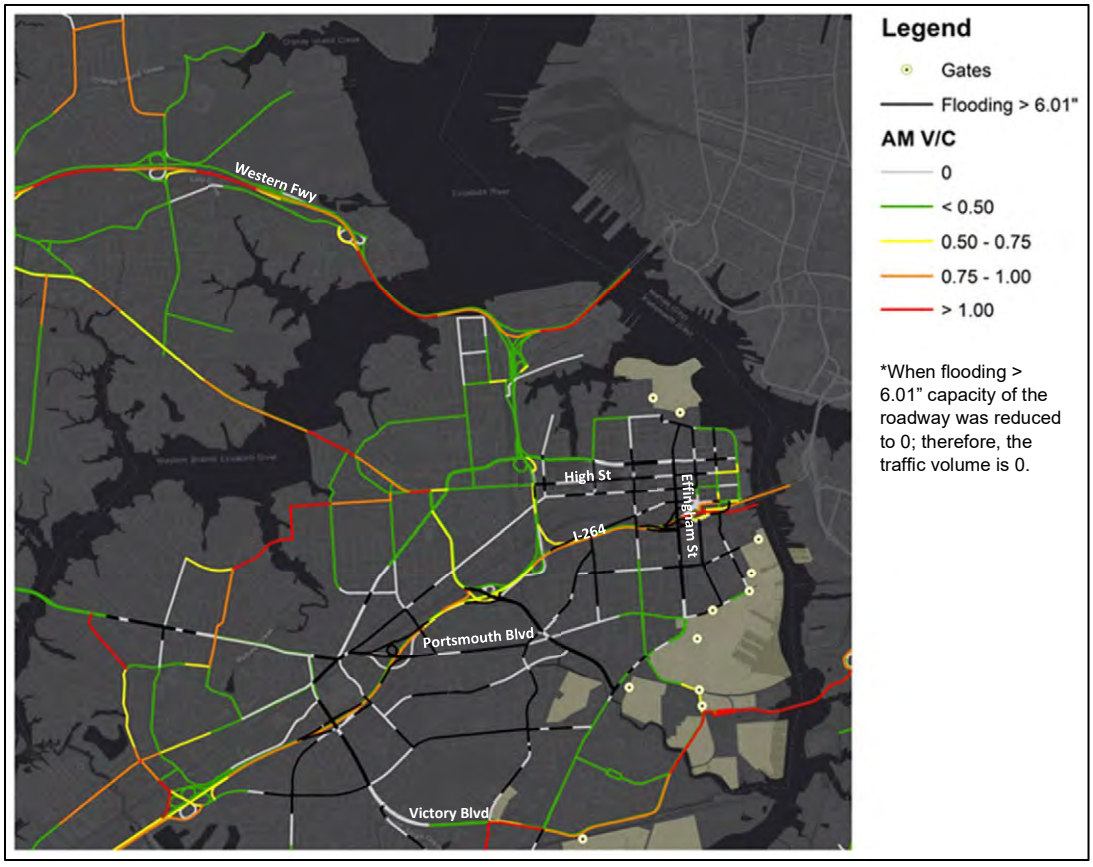


Figure B-11: FCCM 2 PM Peak Period Volume

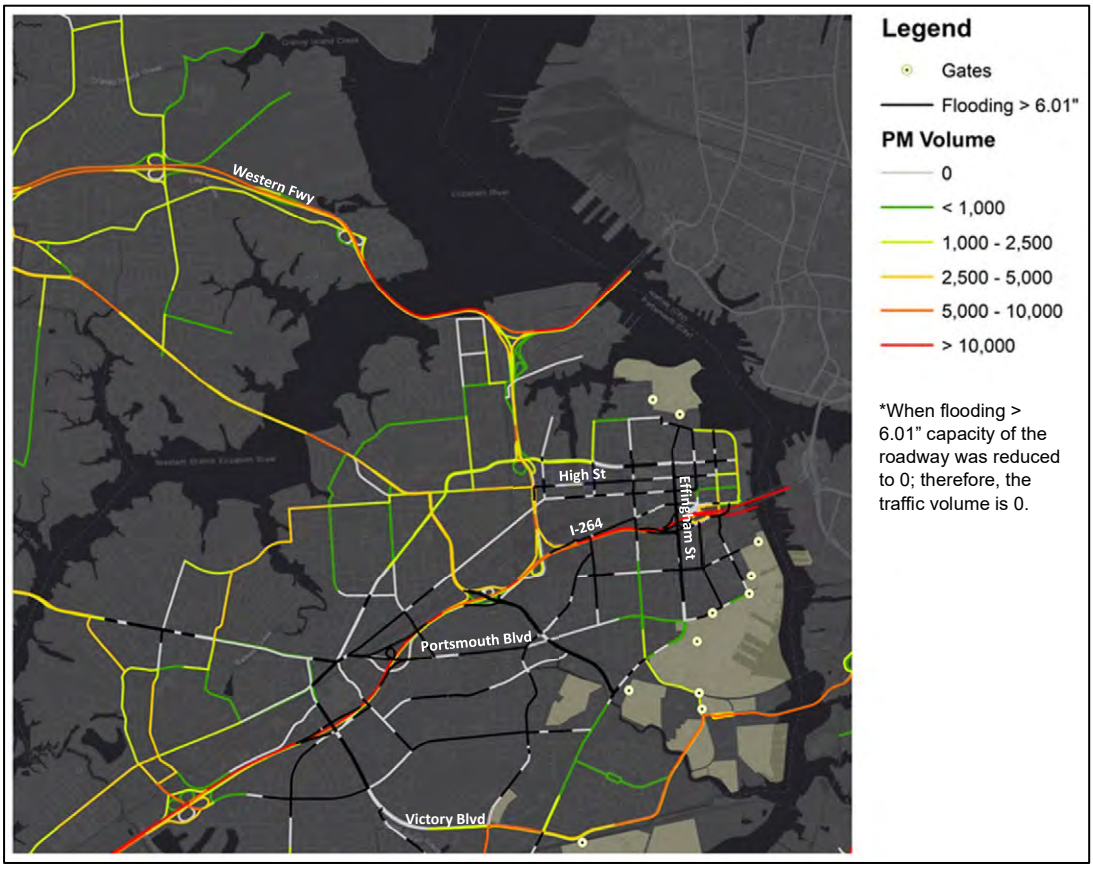


Figure B-12: FCCM 2 PM Peak Period V/C Ratio

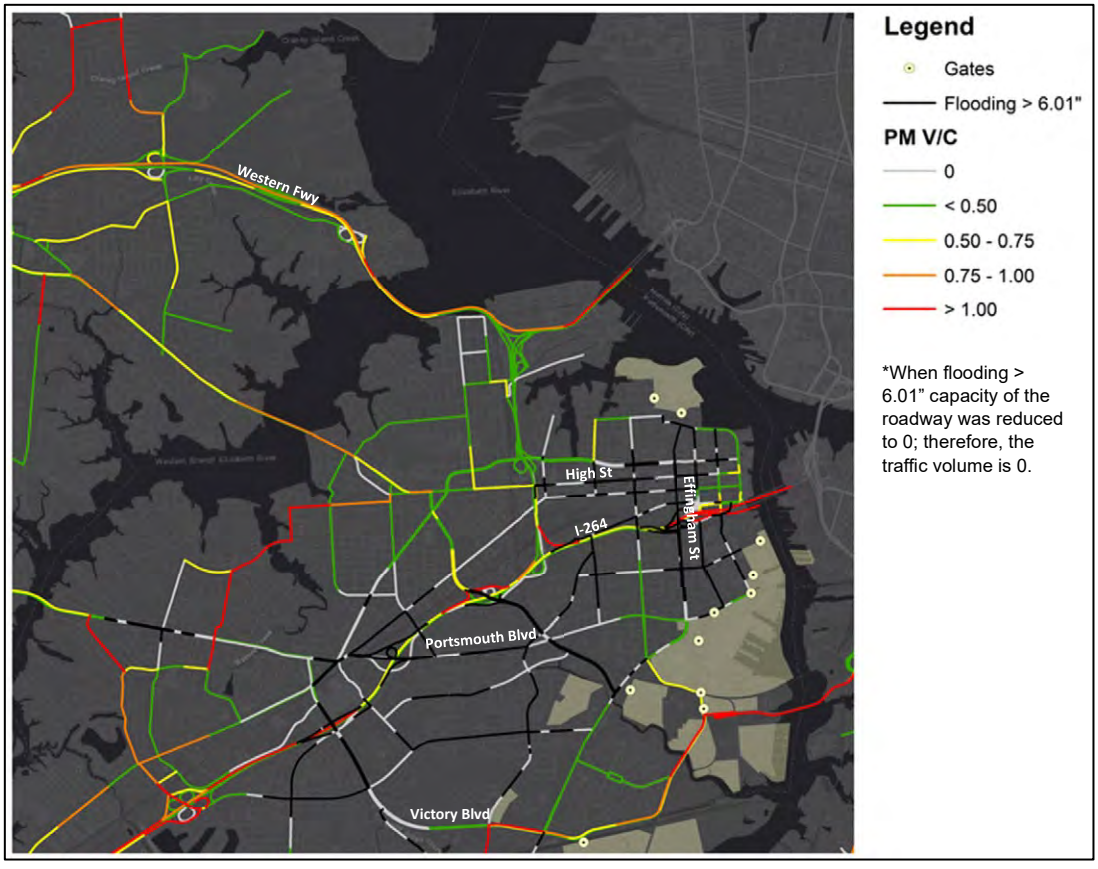


Figure B-13: FCCM 3 AM Peak Period Volume

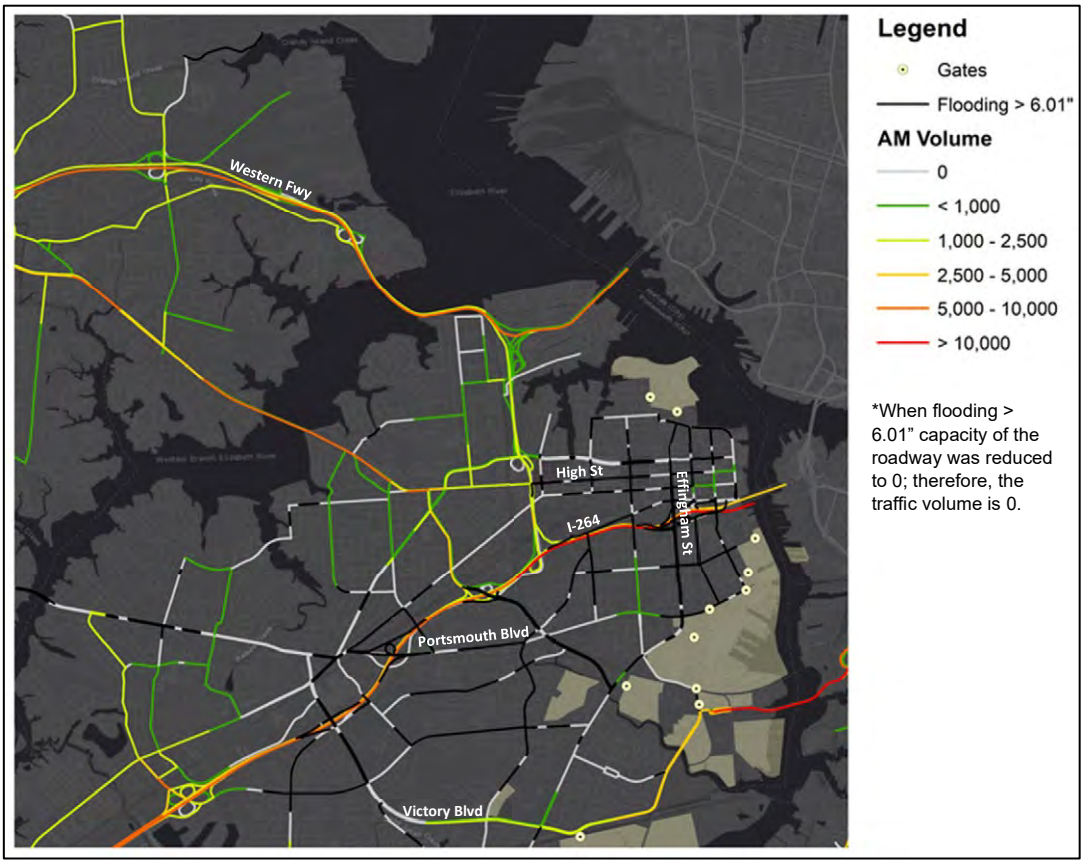


Figure B-14: FCCM 3 AM Peak Period V/C Ratio

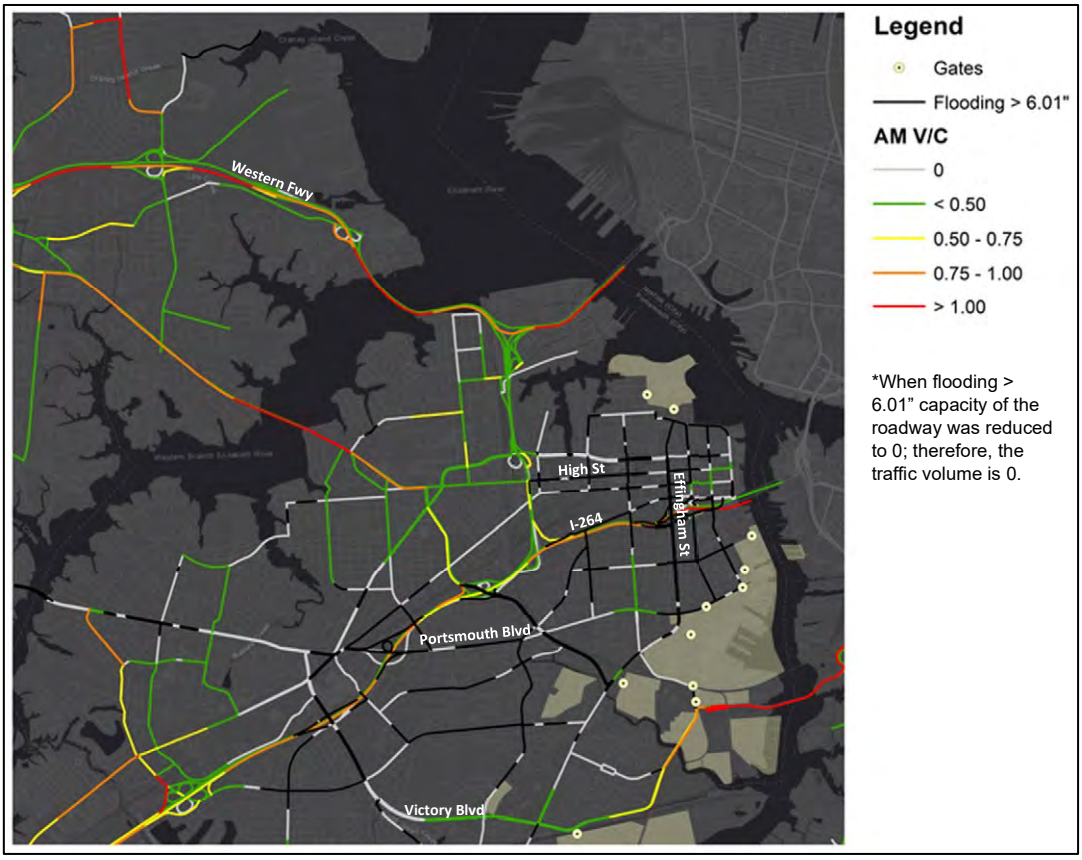


Figure B-15: FCCM 3 PM Peak Period Volume

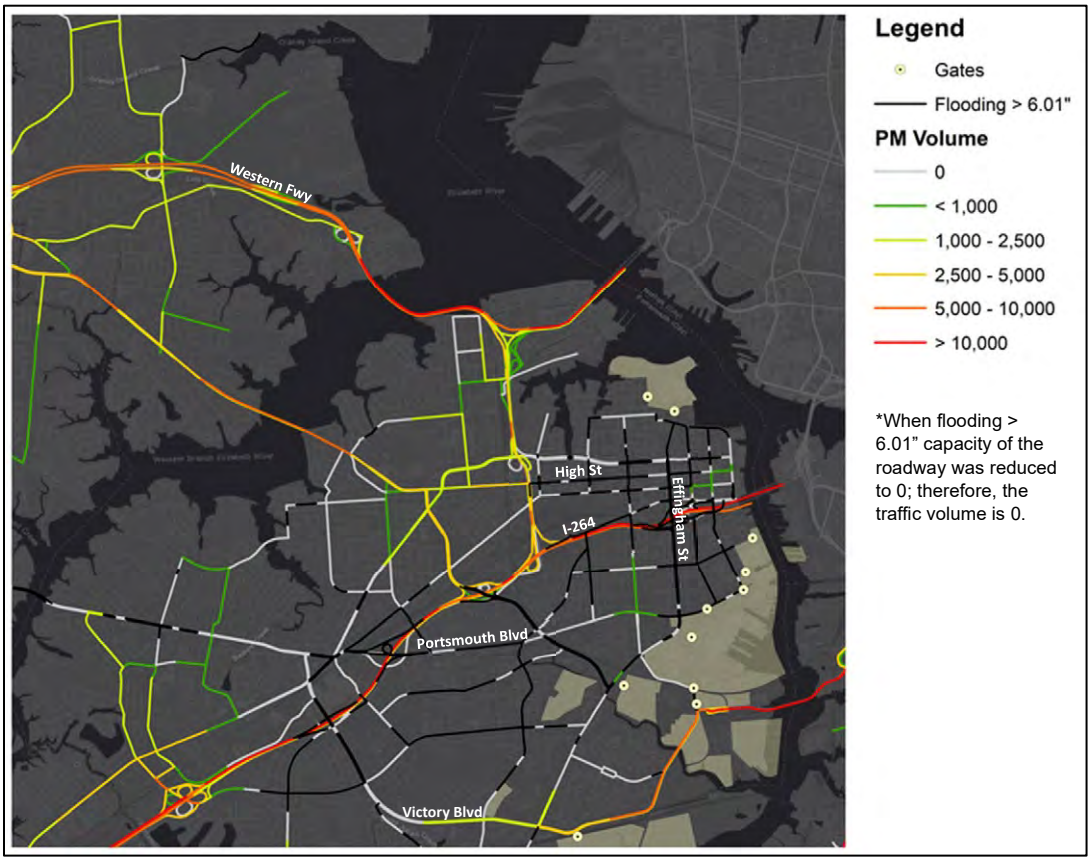
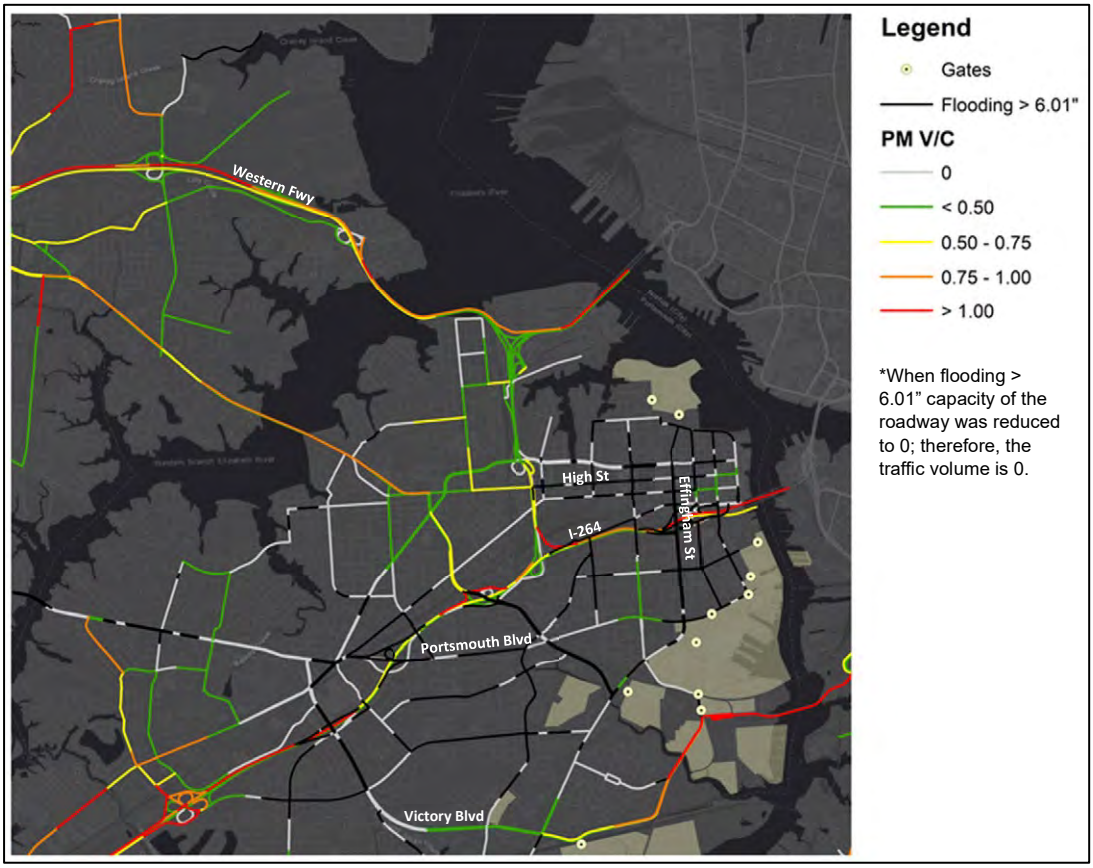


Figure B-16: FCCM 3 PM Peak Period V/C Ratio



Attachment C:

Preliminary Improvement Packages

Figure C-1: Package 1 – Hospital (NMCP)

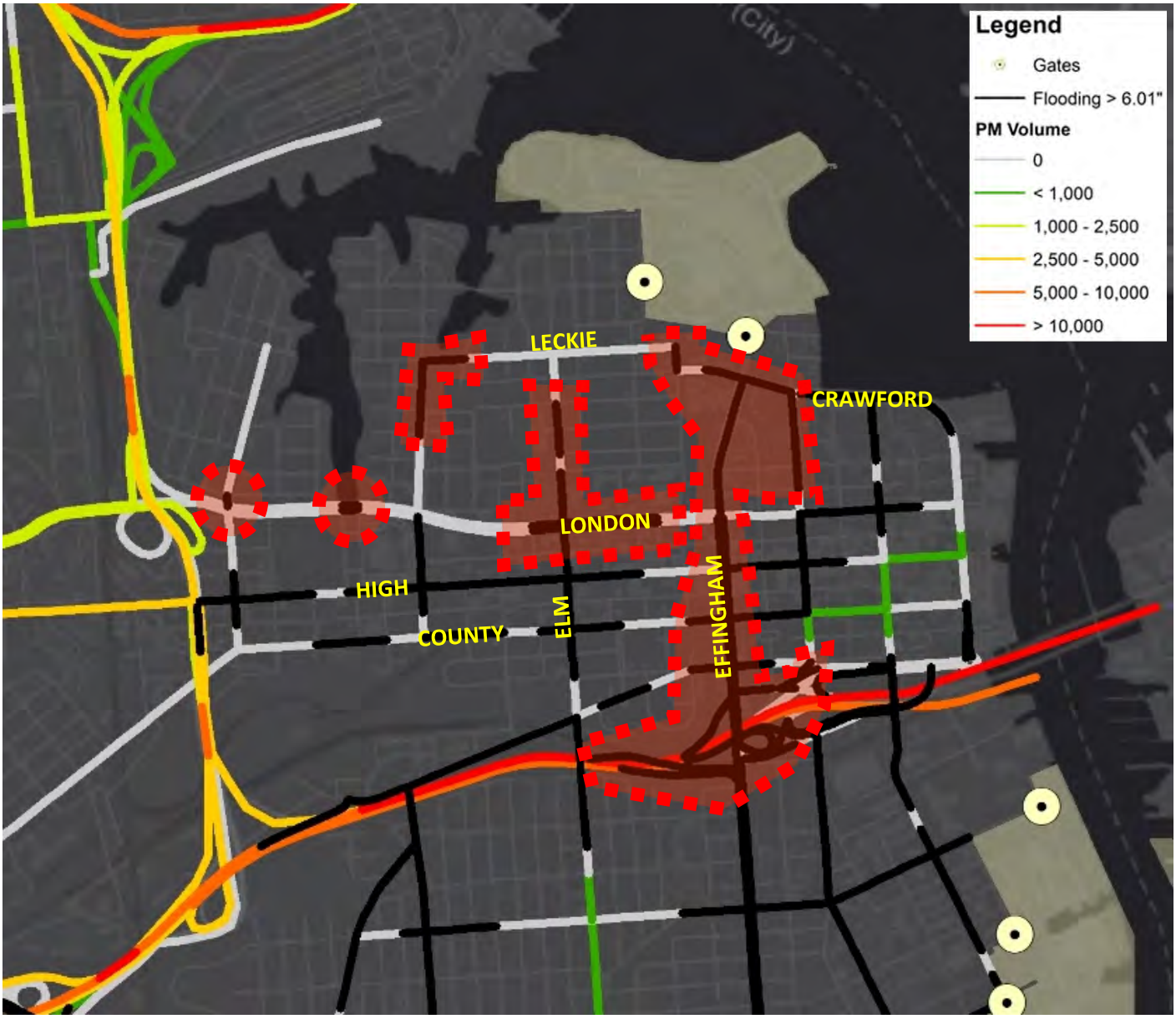


Figure C-2: Package 2 – NNSY North

Figure C-3: Package 3 – Frederick Connector

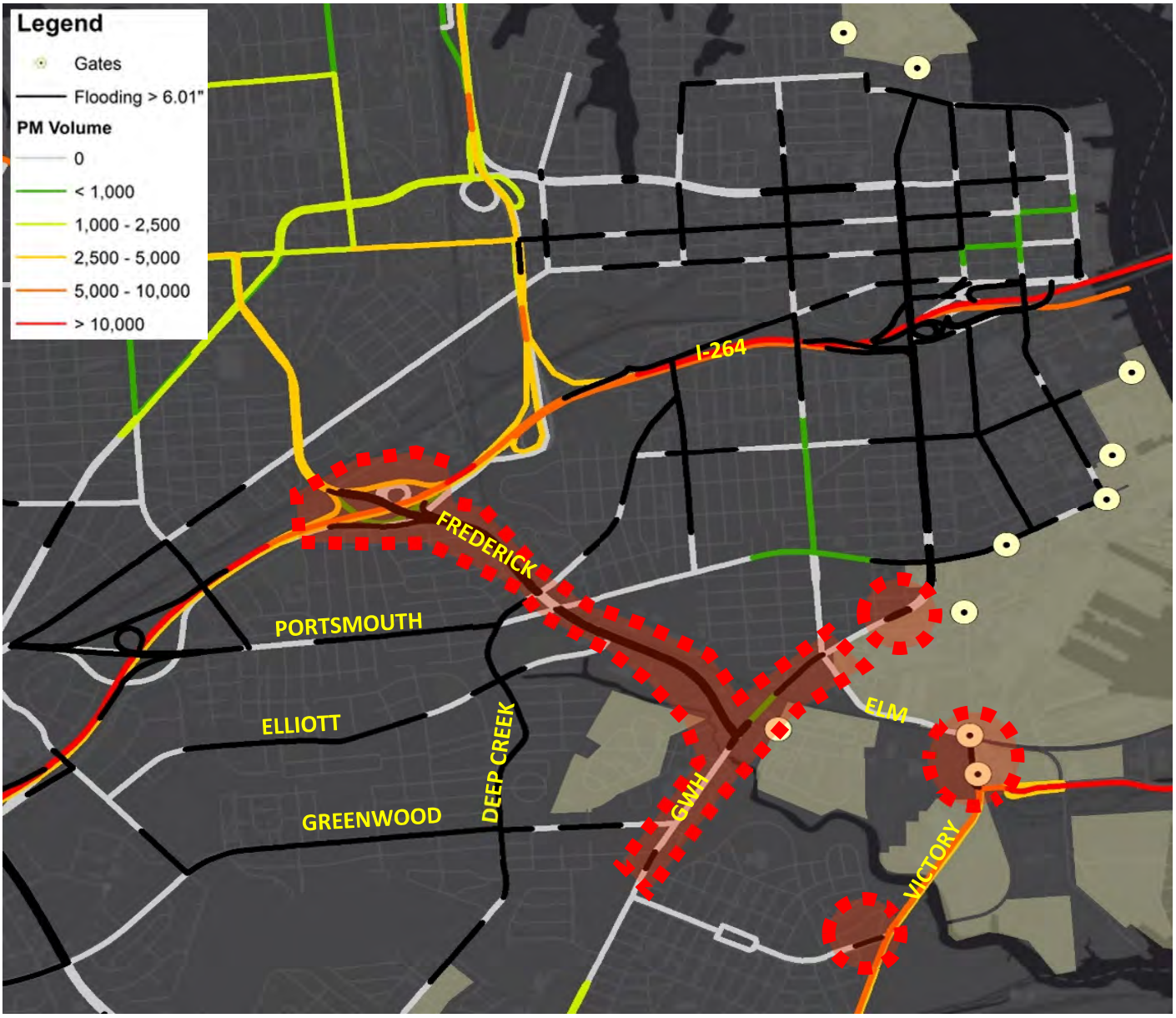


Figure C-4: Package 4 – Freeway Network

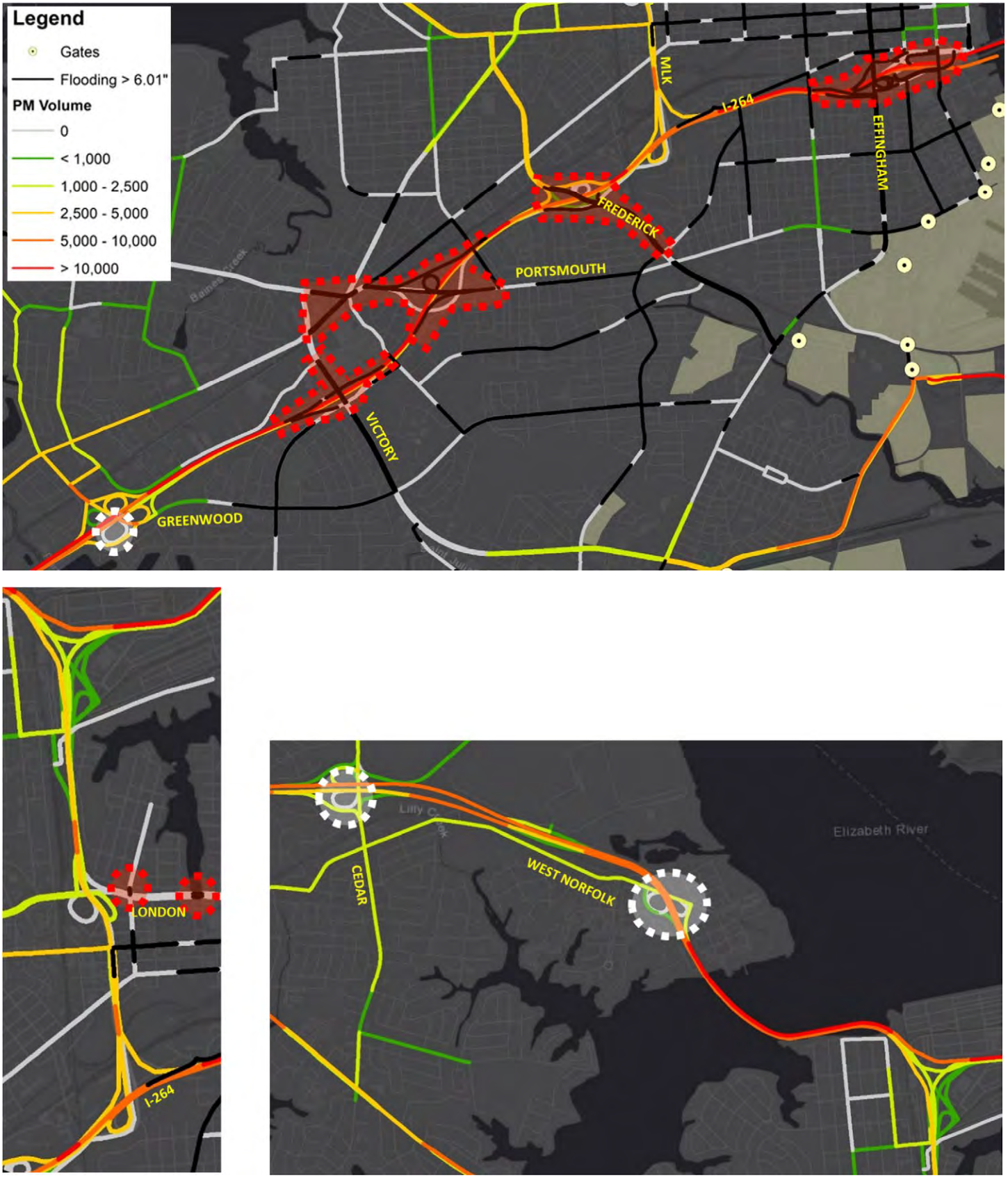


Figure C-5: Package 5 – NNSY South

Figure C-6: Package 6 – Craney Island

Attachment D:

Final Improvement Packages

Figure D-1: Package 1 – Hospital (NMCP)

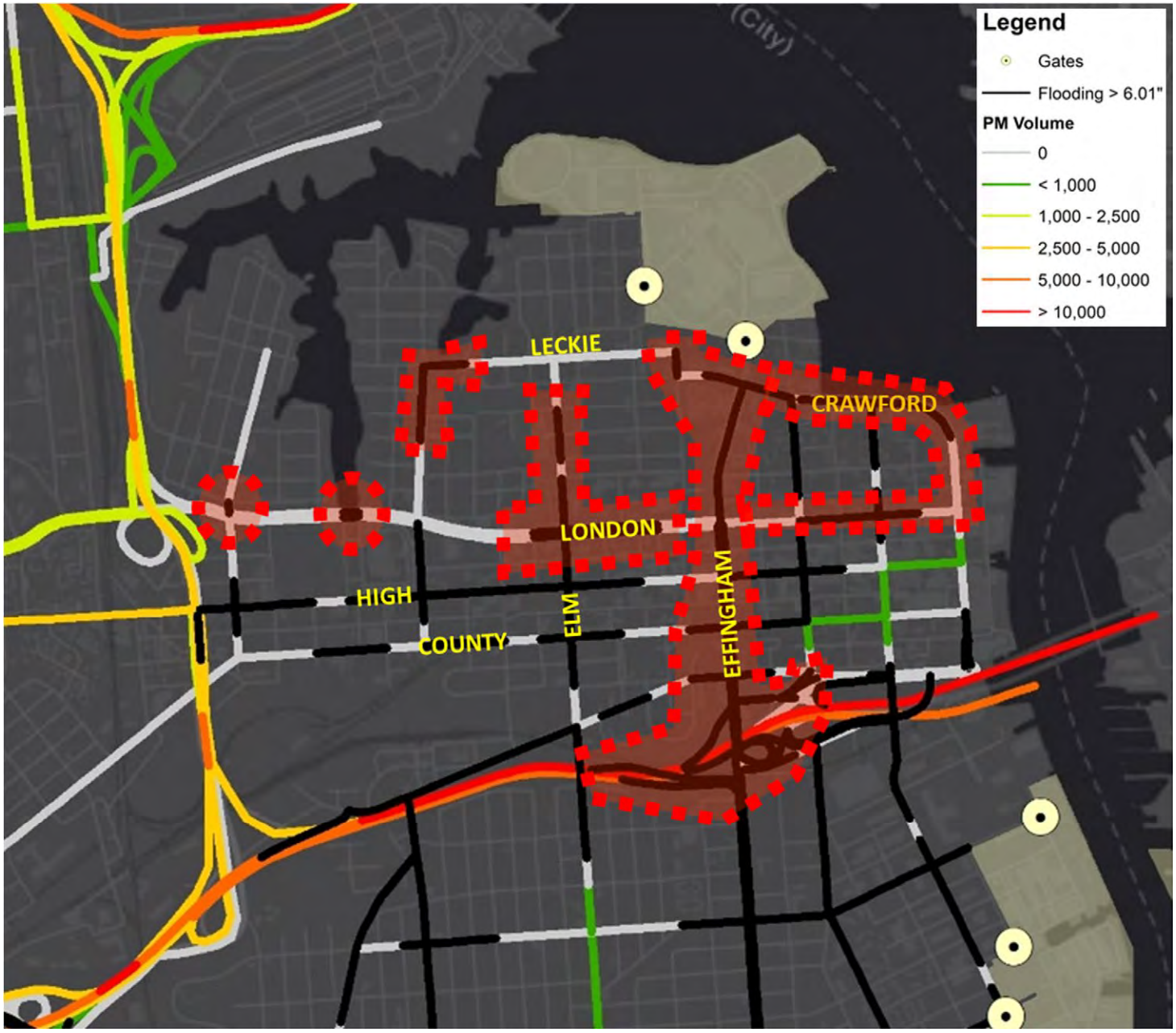


Figure D-2: Package 2A – NNSY North

Figure D-3: Package 2B – NNSY North

Figure D-4: Package 3 – Frederick Boulevard

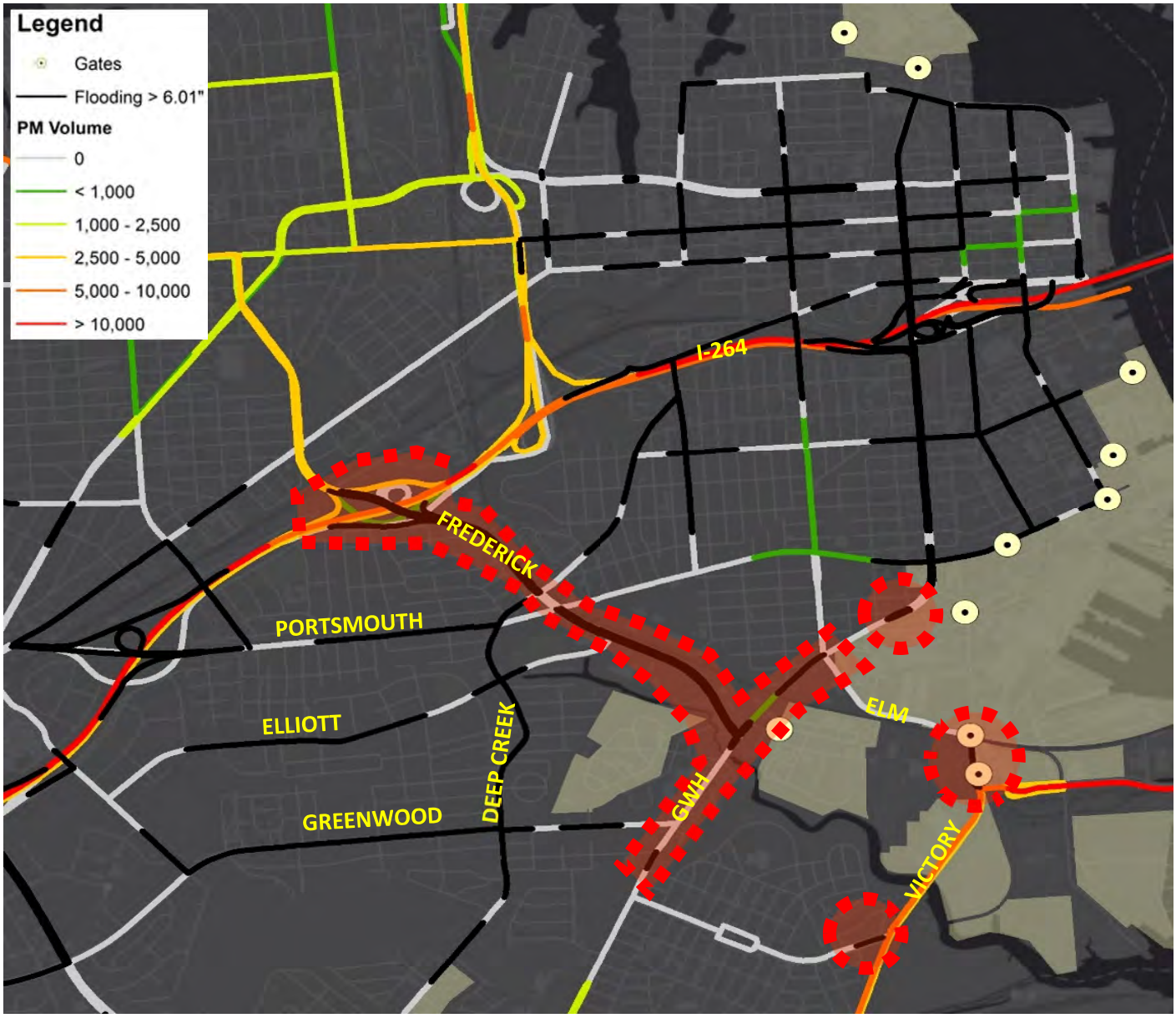


Figure D-5: Package 4 – Victory-Portsmouth Sub-Area

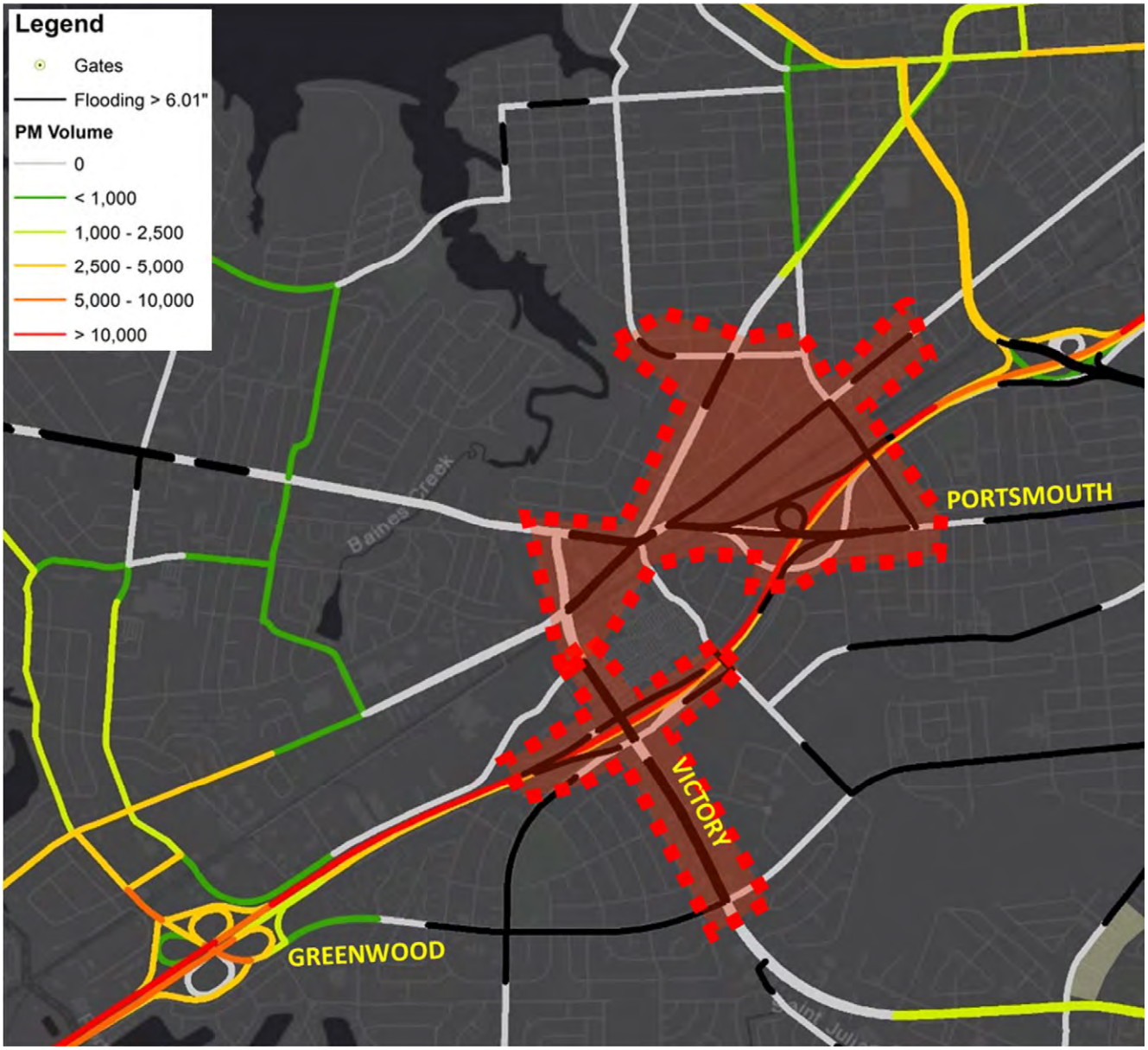
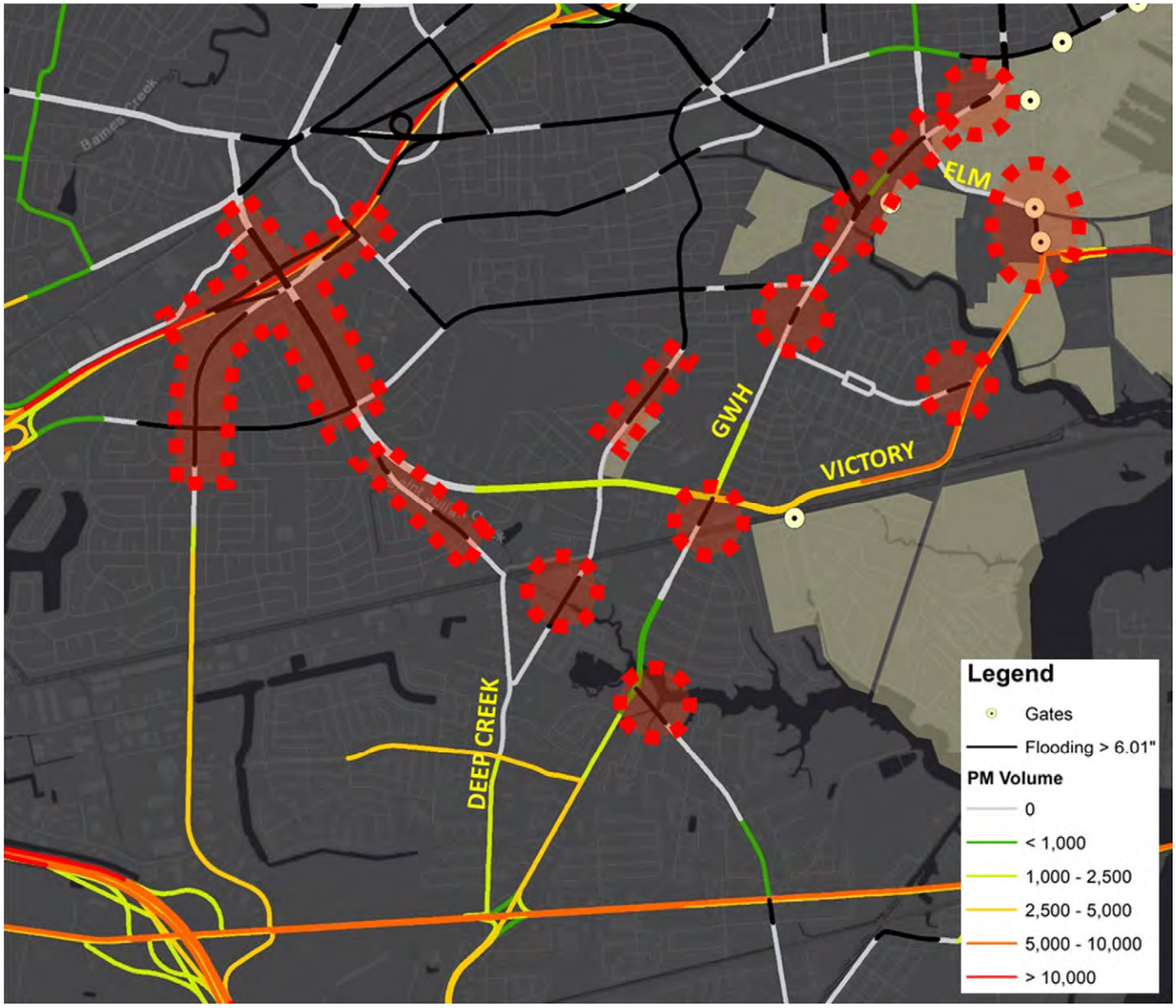


Figure D-6: Package 5 – NNSY South



Attachment E:

Improvement Package AM and PM Peak Period Model Results

Figure E-1: Package 1 Hospital (NMCP) AM Peak Period Volume

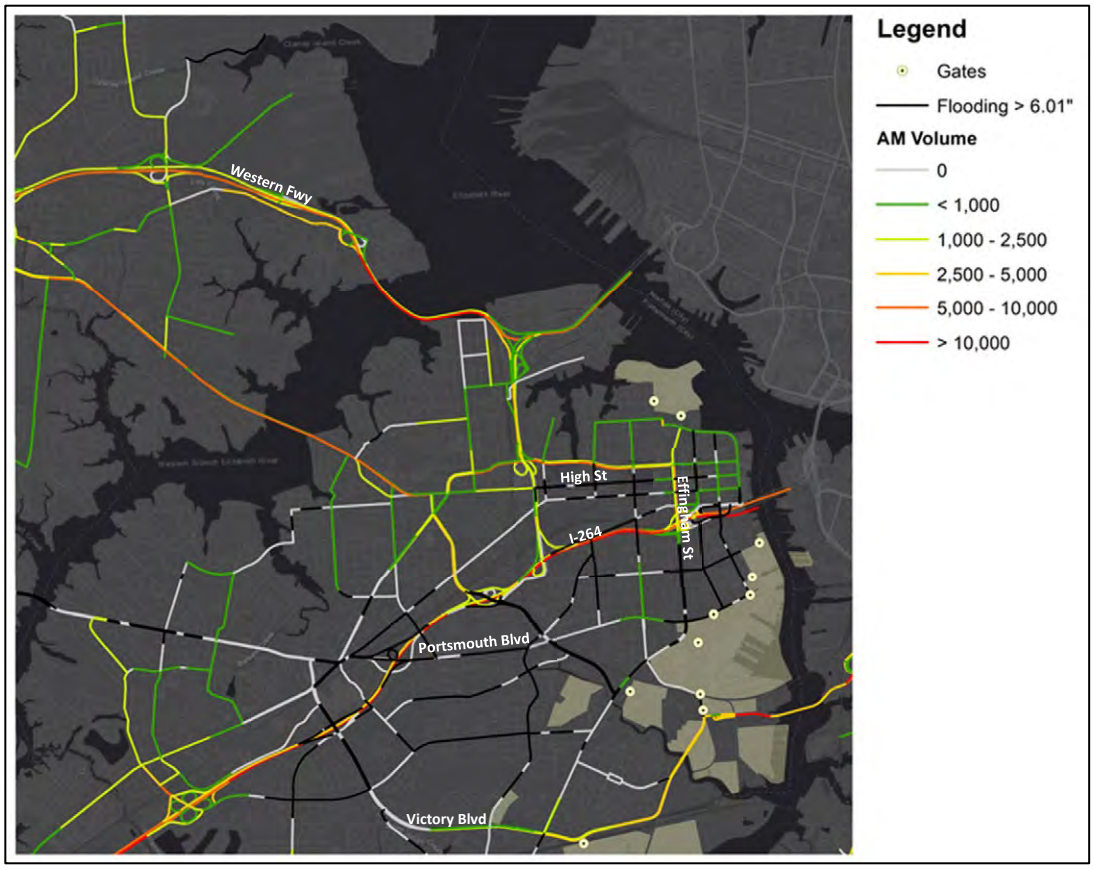


Figure E-2: Package 1 Hospital (NMCP) AM Peak Period V/C Ratio

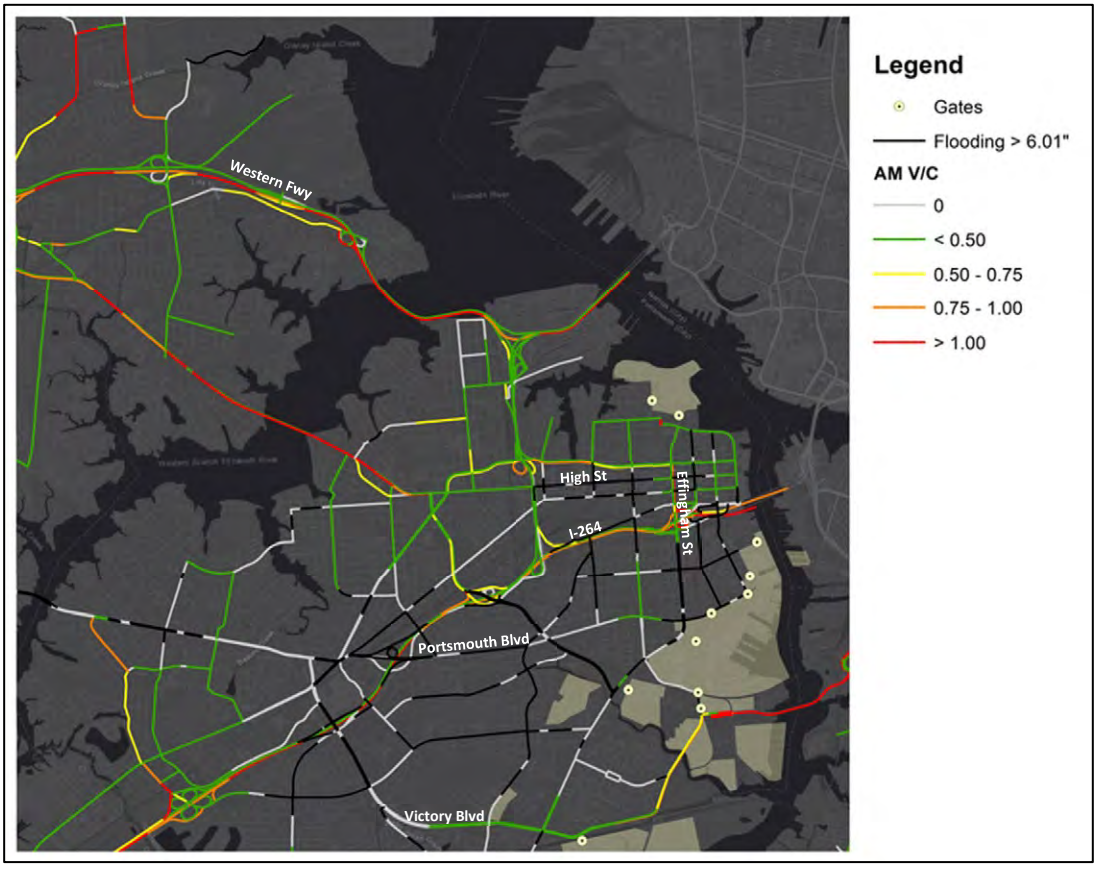


Figure E-3: Package 1 Hospital (NMCP) PM Peak Period Volume

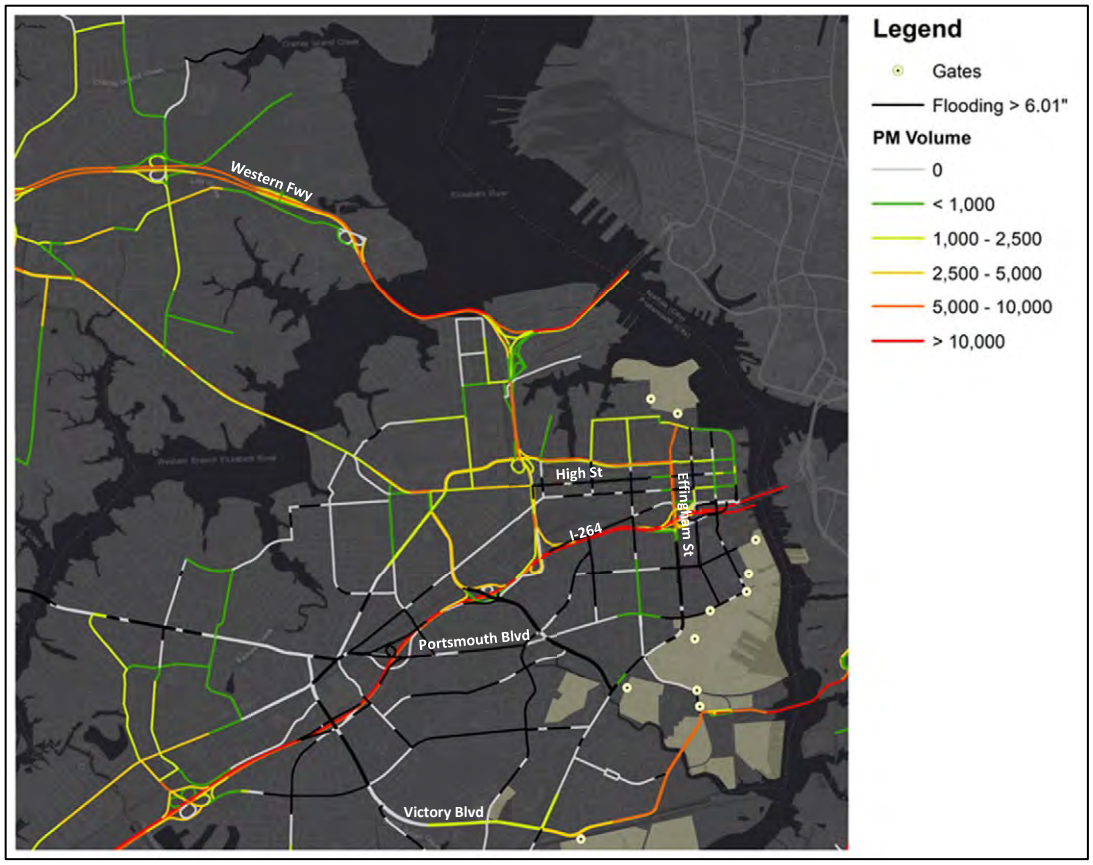


Figure E-4: Package 1 Hospital (NMCP) PM Peak Period V/C Ratio

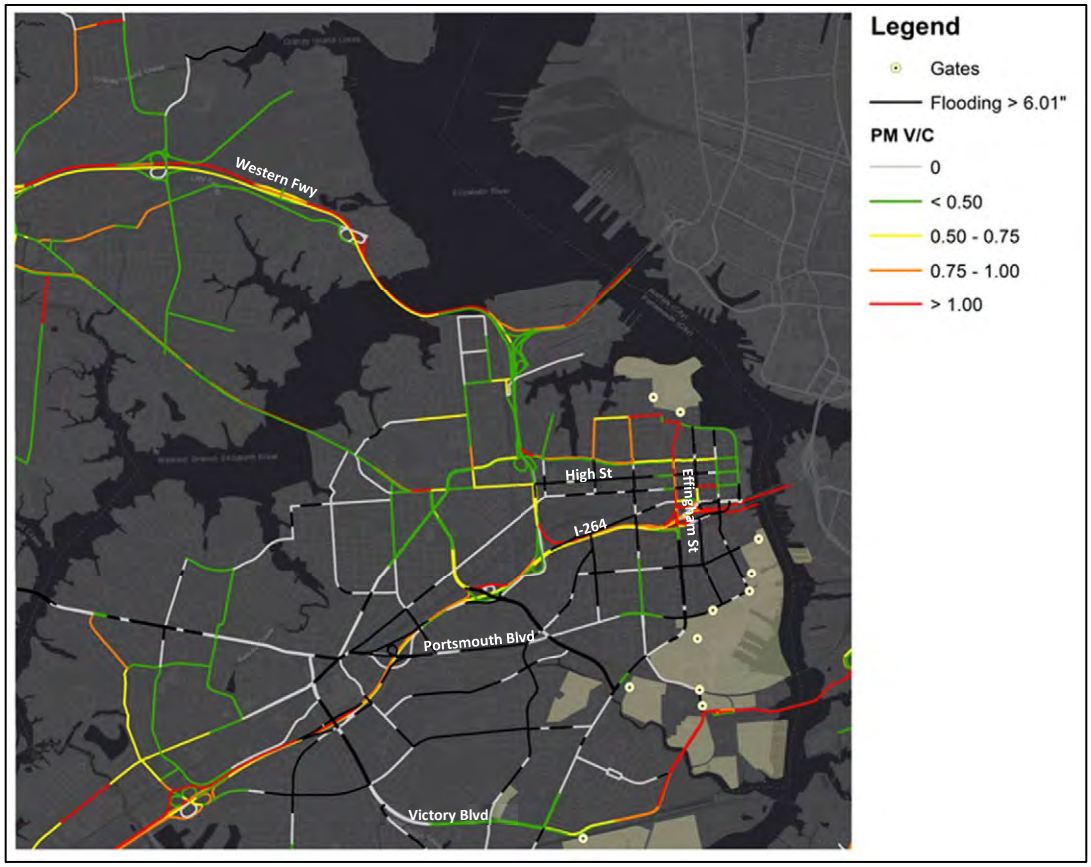


Figure E-5: Package 2A Norfolk Naval Shipyard (NNSY) North AM Peak Period Volume

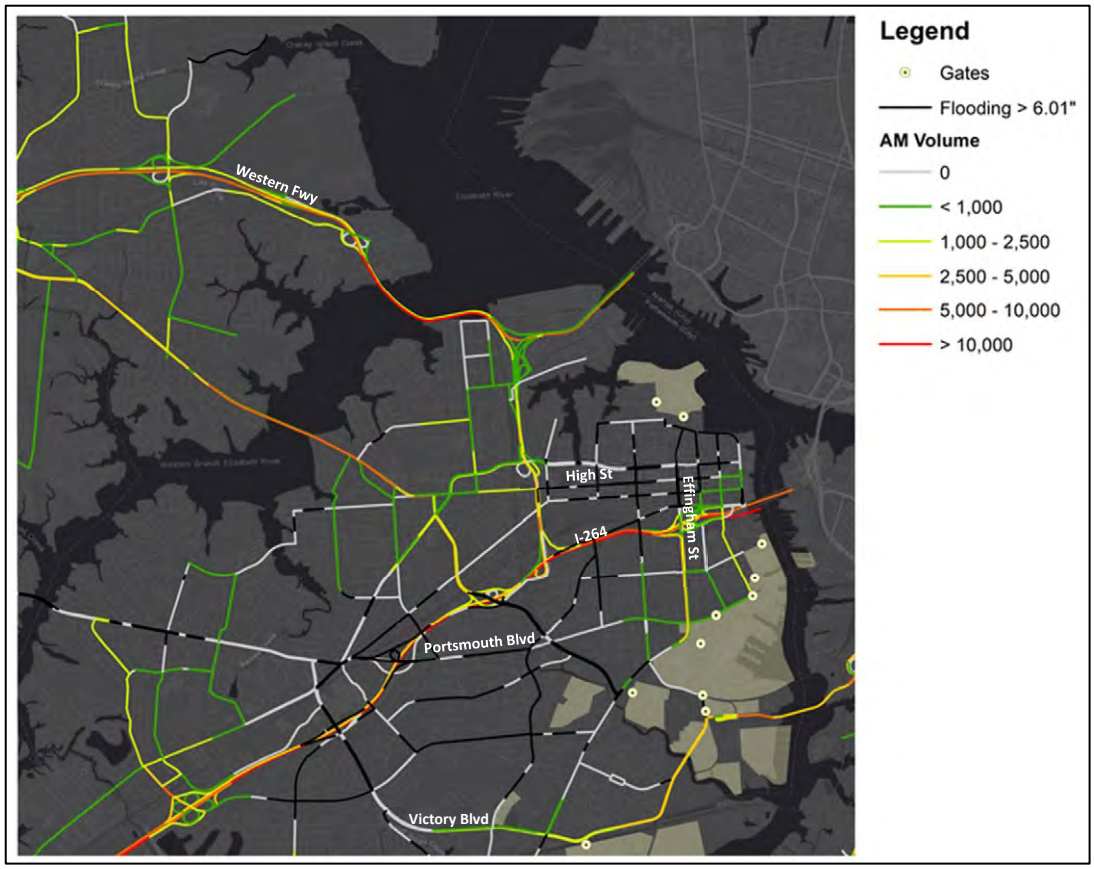


Figure E-6: Package 2A Norfolk Naval Shipyard (NNSY) North AM Peak Period V/C Ratio

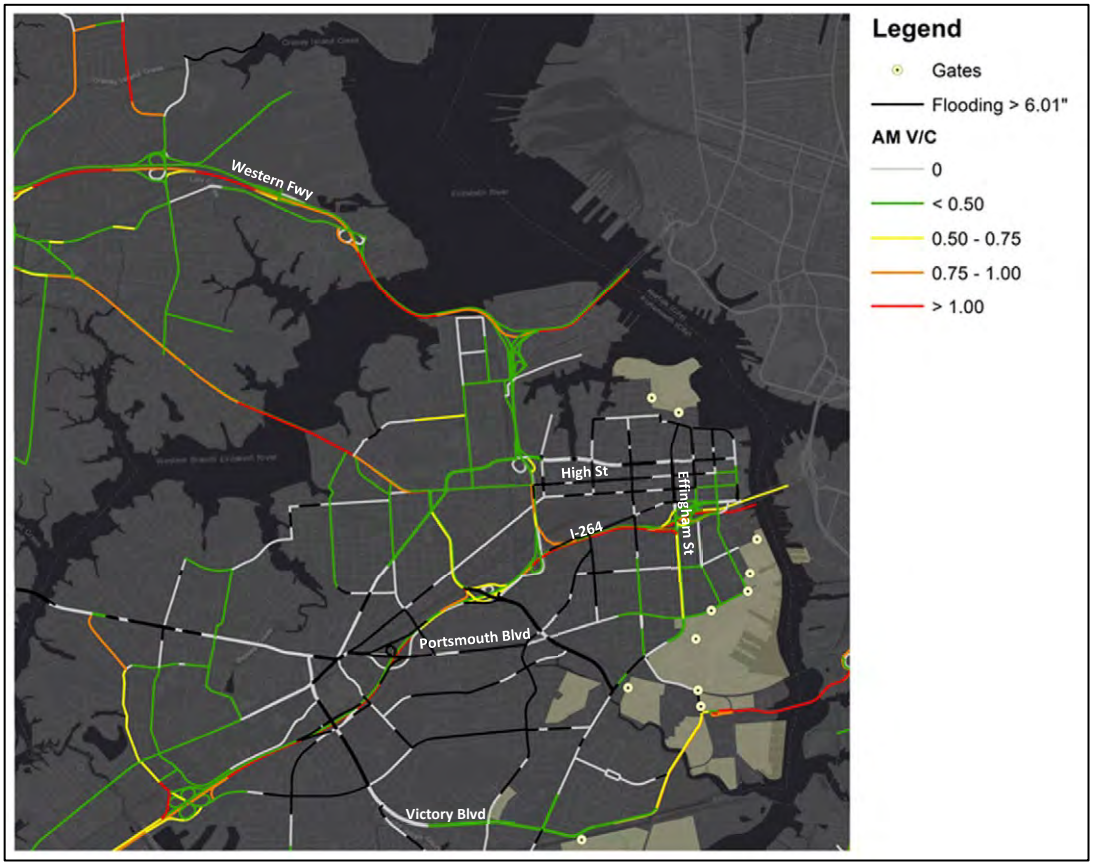


Figure E-7: Package 2A Norfolk Naval Shipyard (NNSY) North PM Peak Period Volume

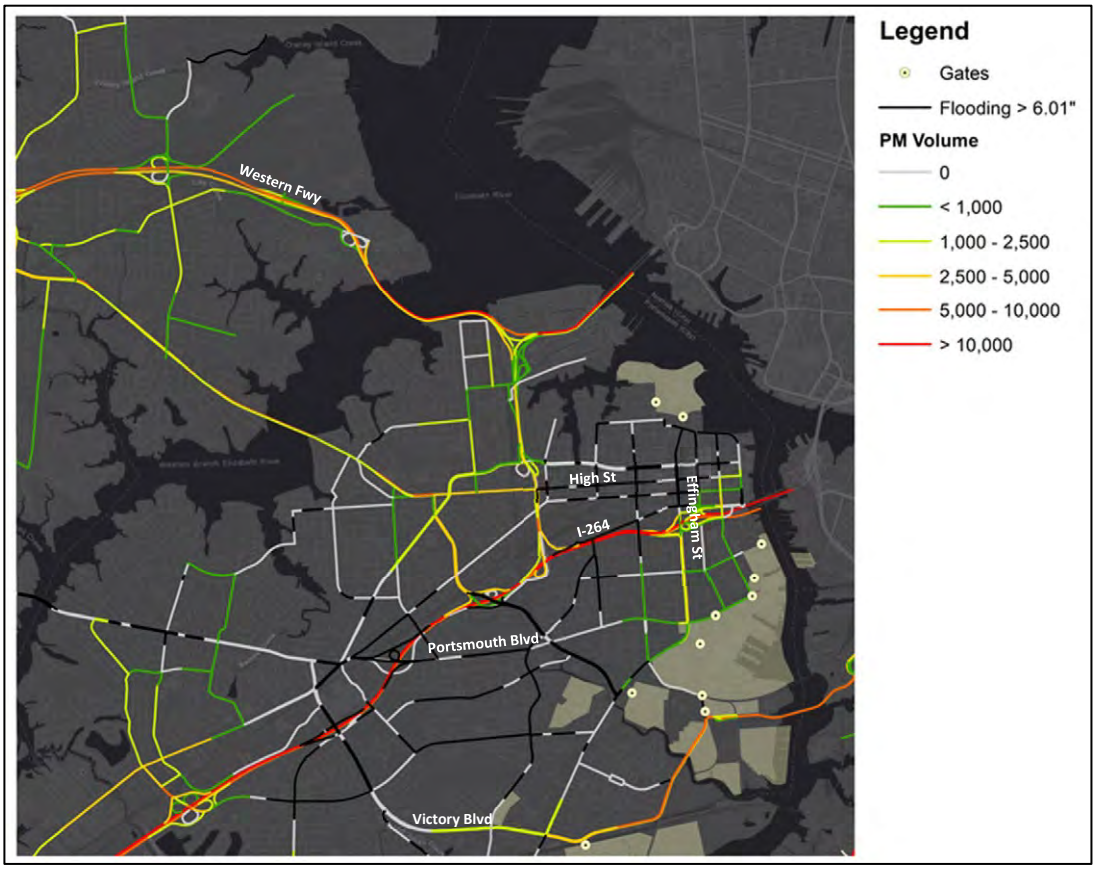


Figure E-8: Package 2A Norfolk Naval Shipyard (NNSY) North PM Peak Period V/C Ratio

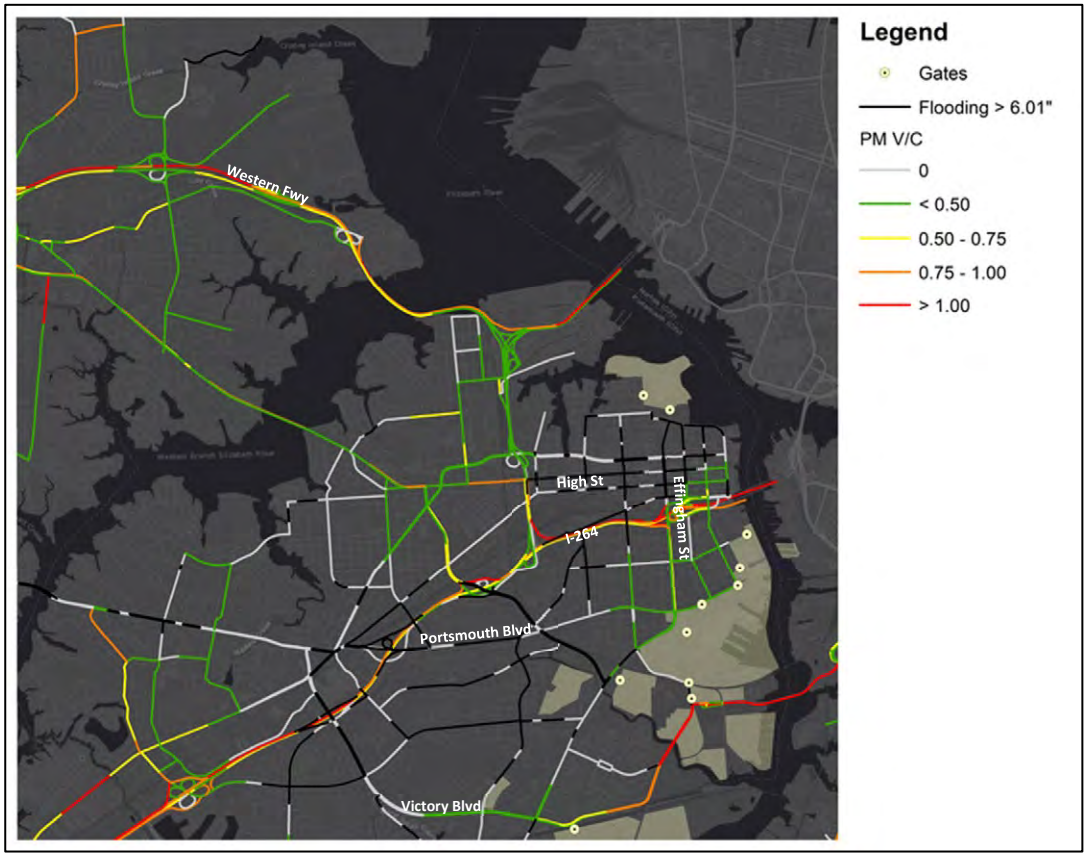


Figure E-9: Package 2B Norfolk Naval Shipyard (NNSY) North AM Peak Period Volume

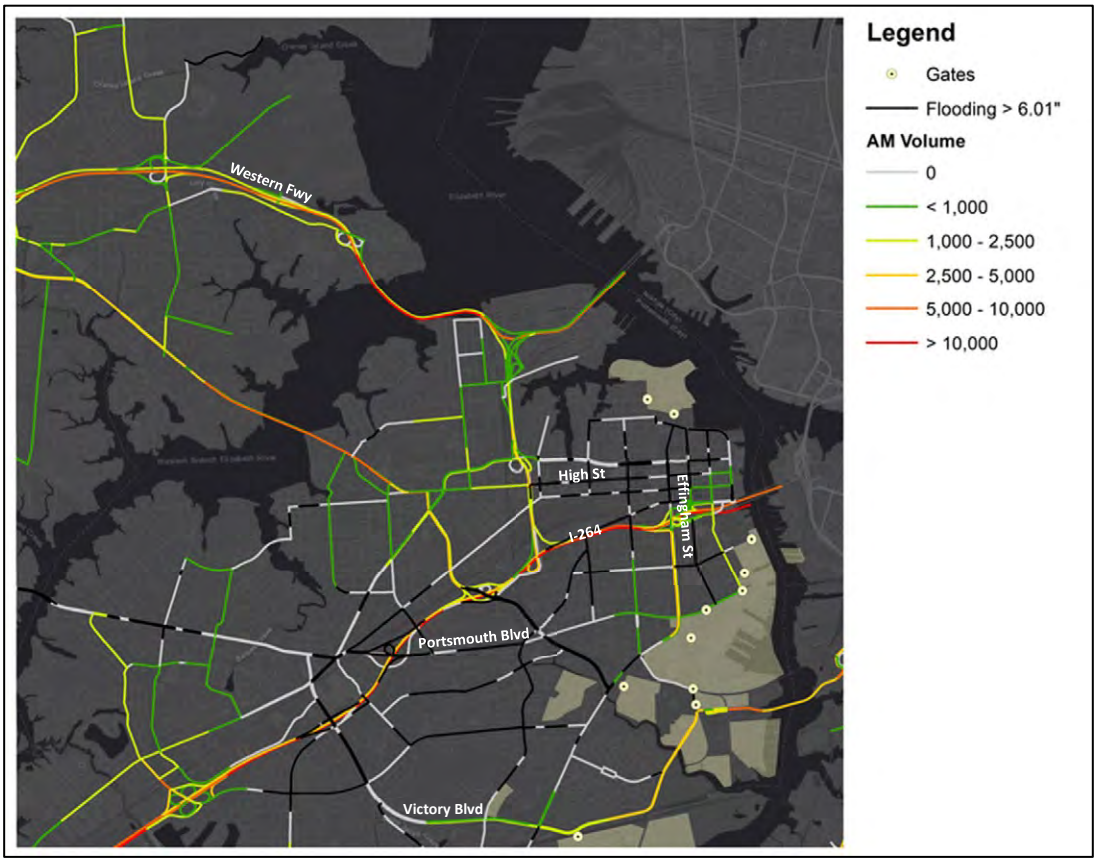


Figure E-10: Package 2B Norfolk Naval Shipyard (NNSY) North AM Peak Period V/C Ratio

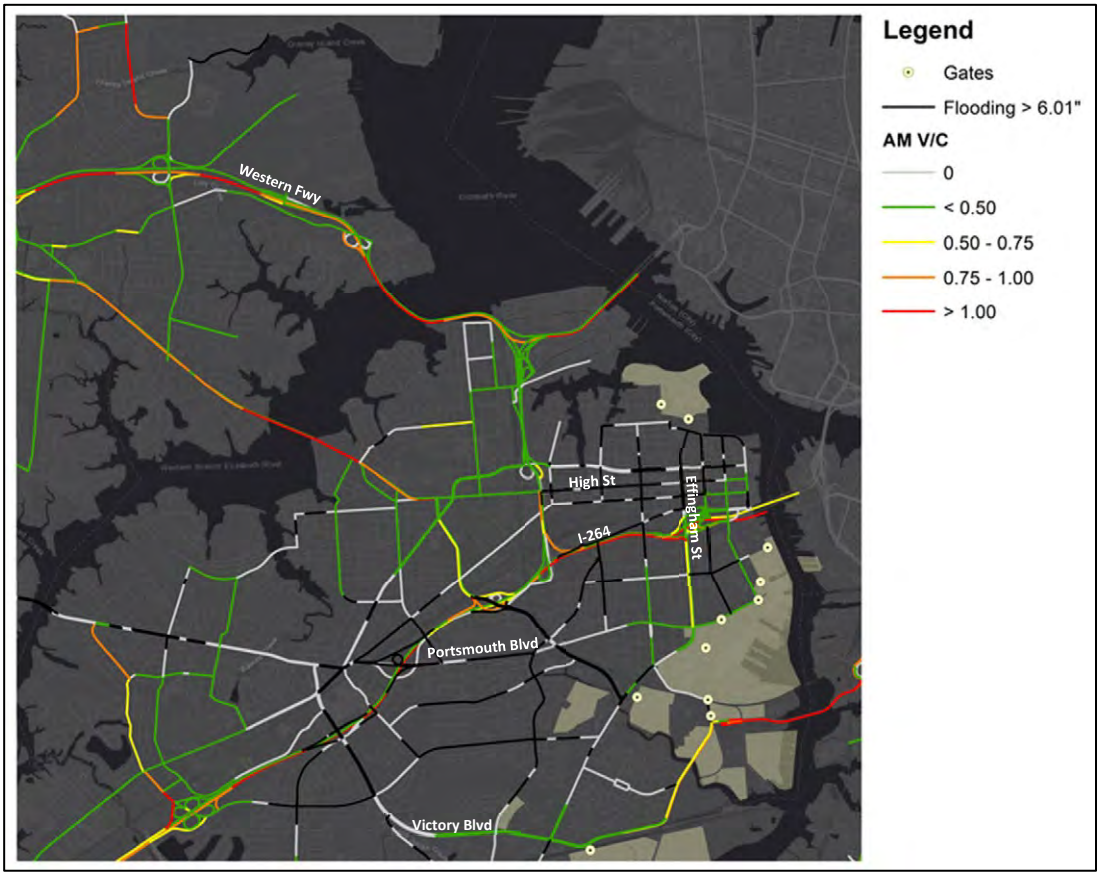


Figure E-11: Package 2B Norfolk Naval Shipyard (NNSY) North PM Peak Period Volume

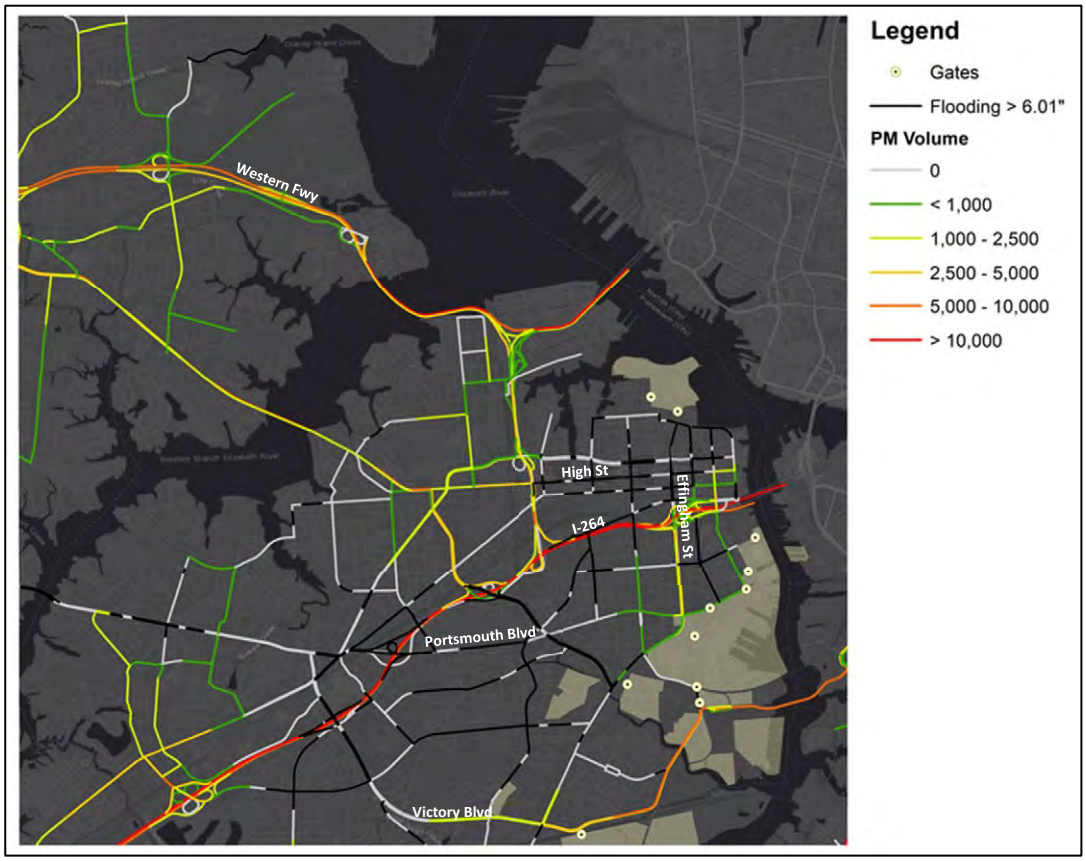


Figure E-12: Package 2B Norfolk Naval Shipyard (NNSY) North PM Peak Period V/C Ratio

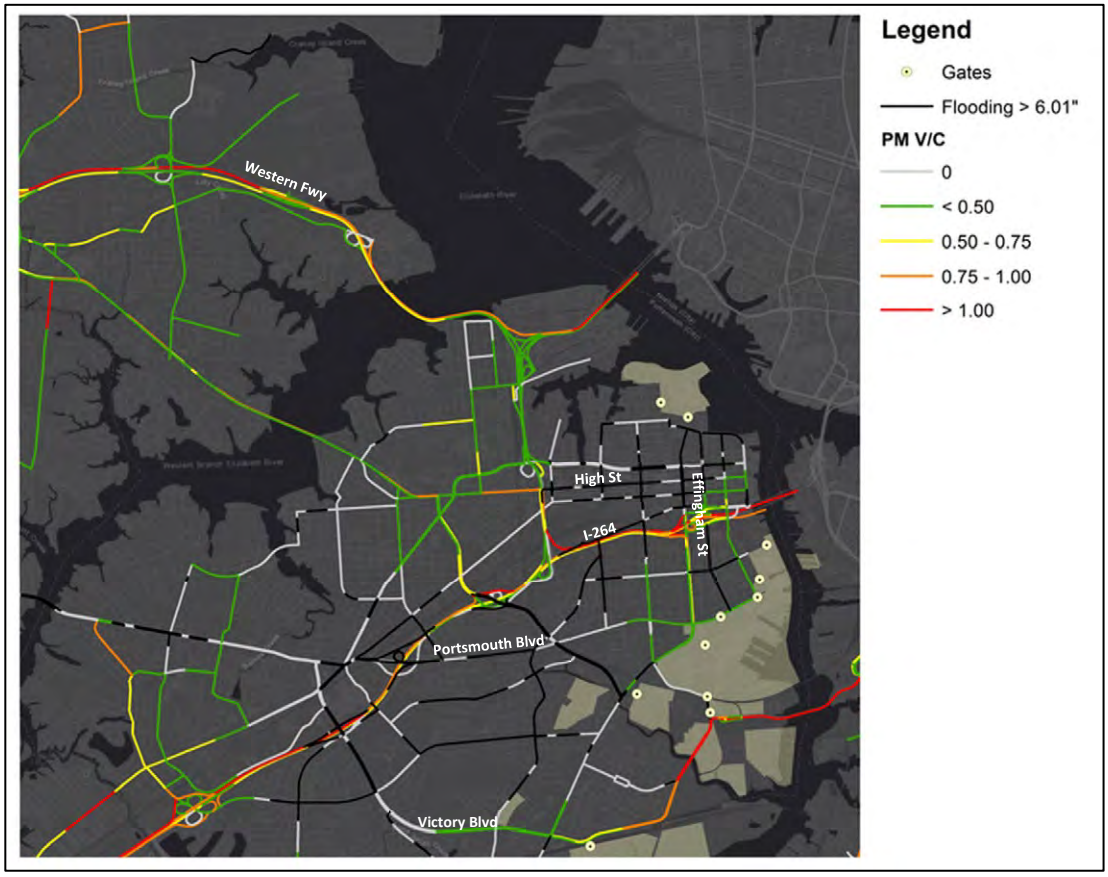


Figure E-13: Package 3 Frederick Connector AM Peak Period Volume

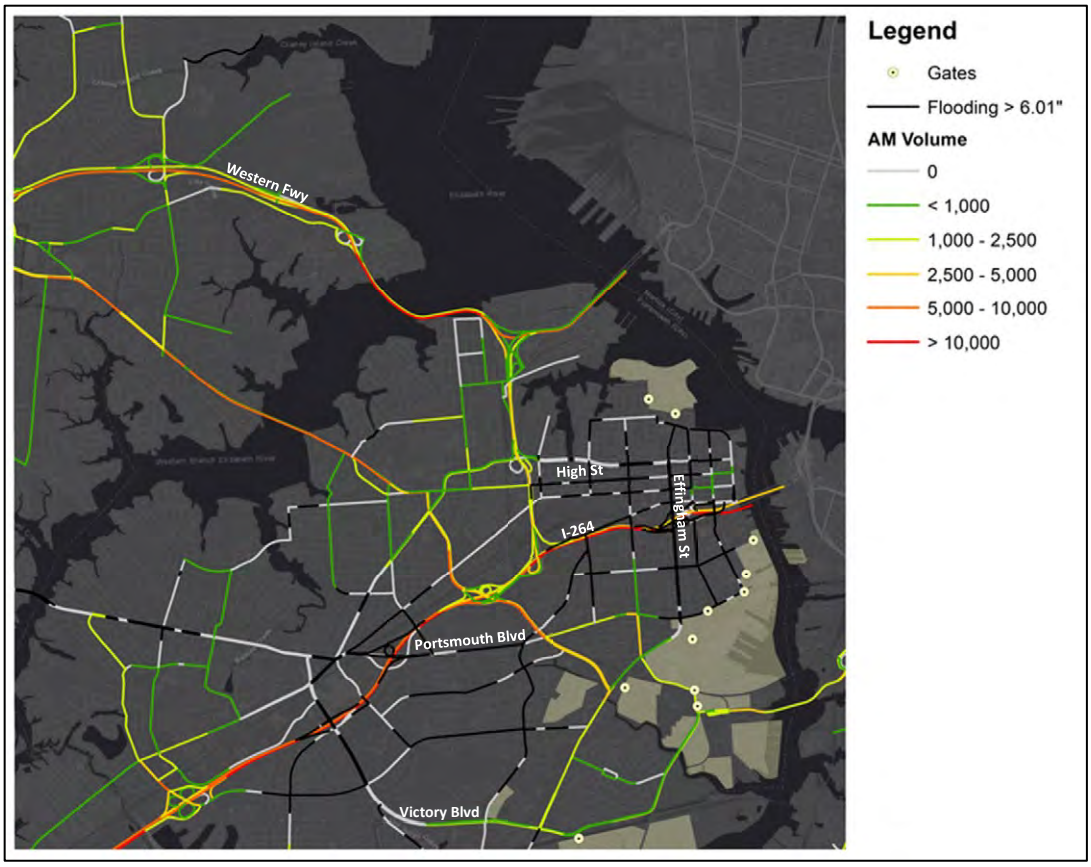


Figure E-14: Package 3 Frederick Connector AM Peak Period V/C Ratio

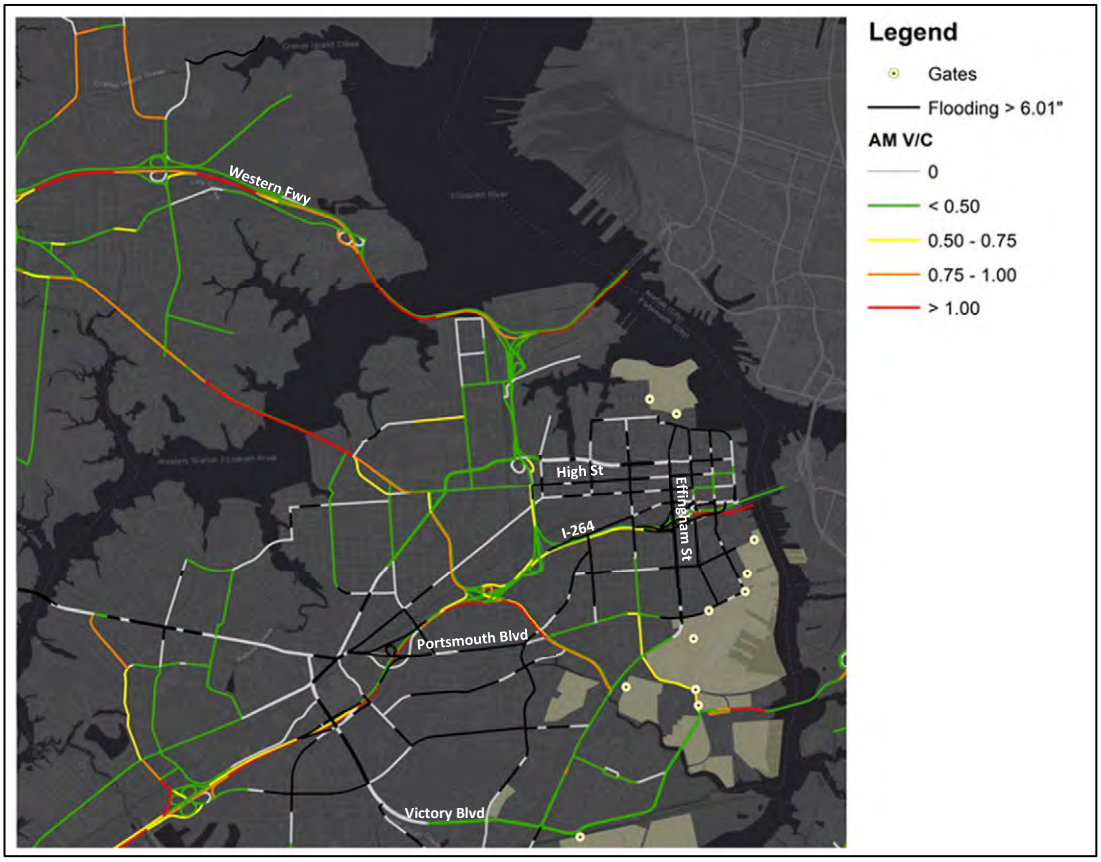


Figure E-15: Package 3 Frederick Connector PM Peak Period Volume

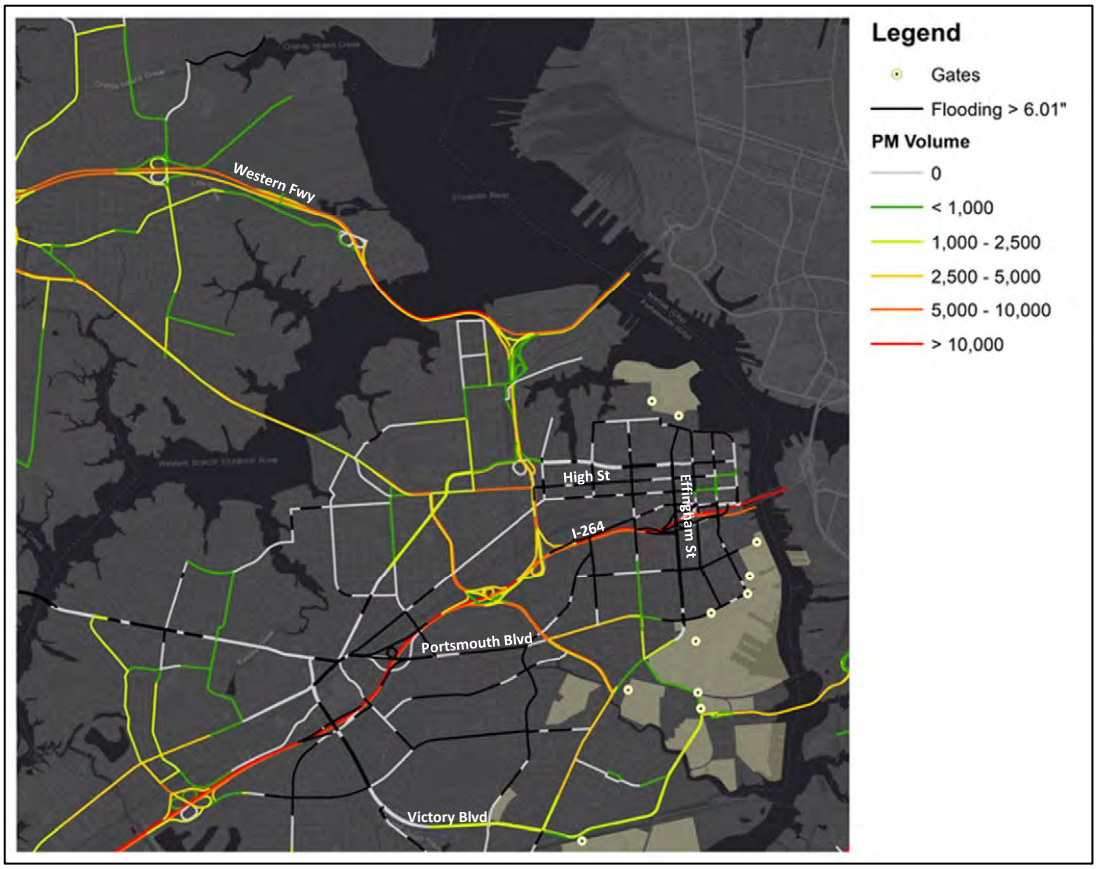


Figure E-16: Package 3 Frederick Connector PM Peak Period V/C Ratio

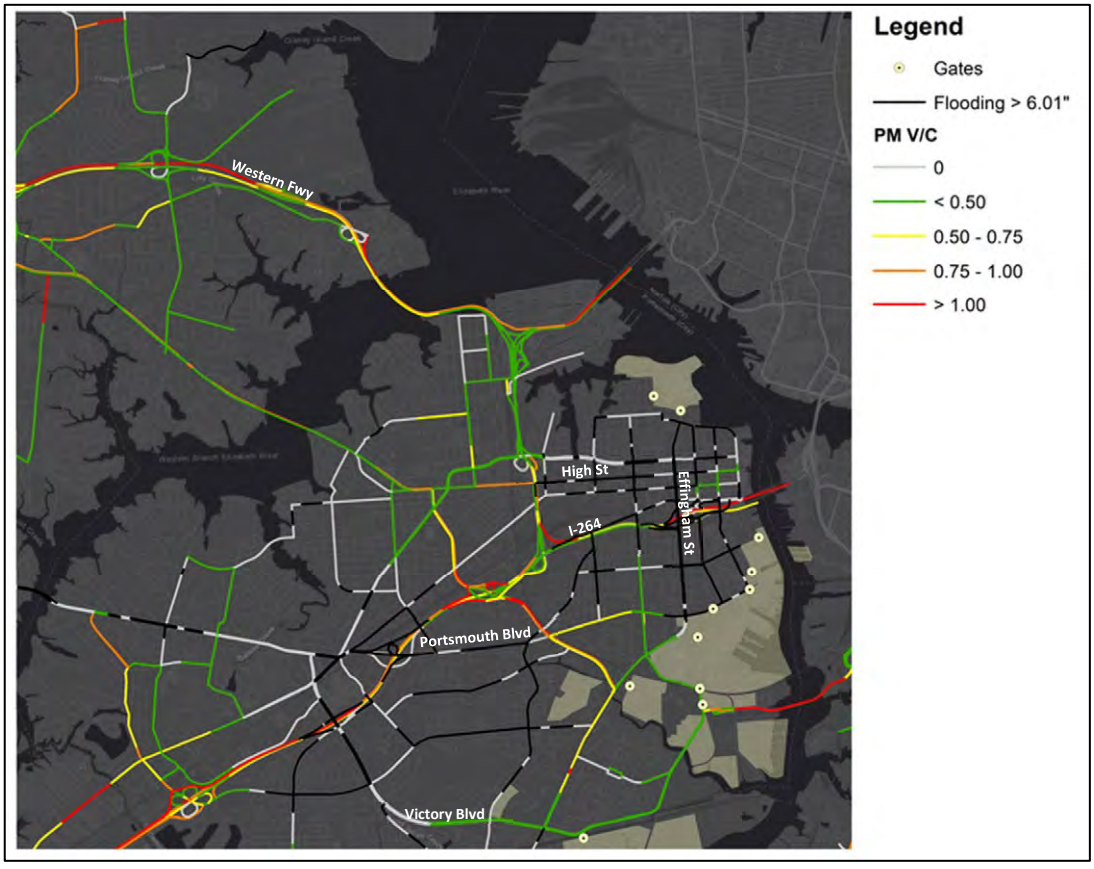


Figure E-17: Package 4 Victory-Portsmouth Sub-Area AM Peak Period Volume

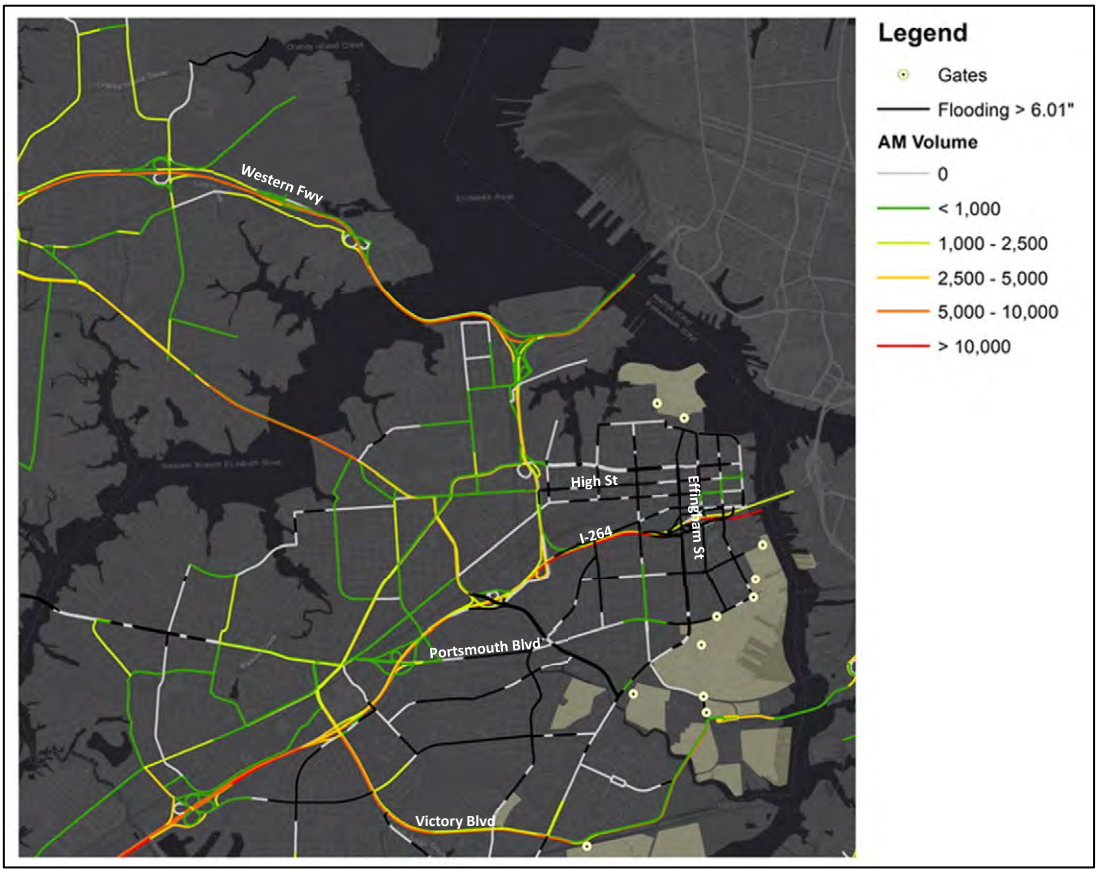


Figure E-18: Package 4 Victory-Portsmouth Sub-Area AM Peak Period V/C Ratio

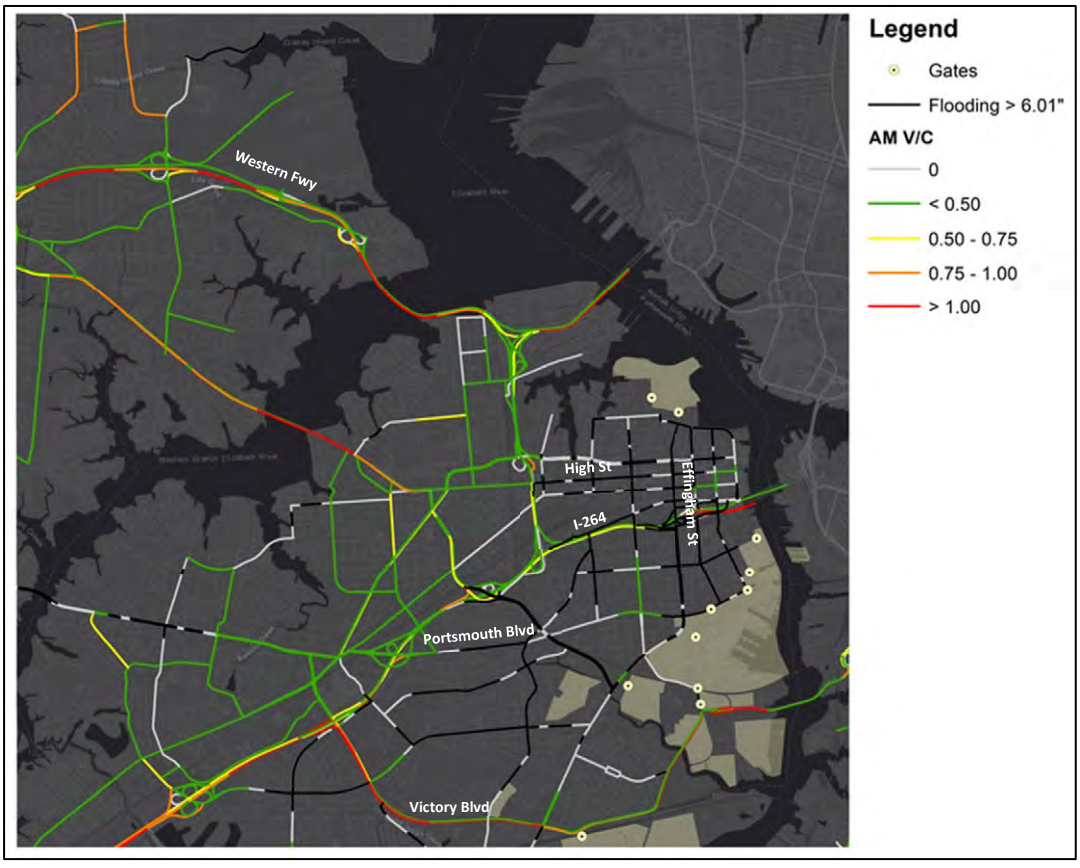


Figure E-19: Package 4 Victory-Portsmouth Sub-Area PM Peak Period Volume

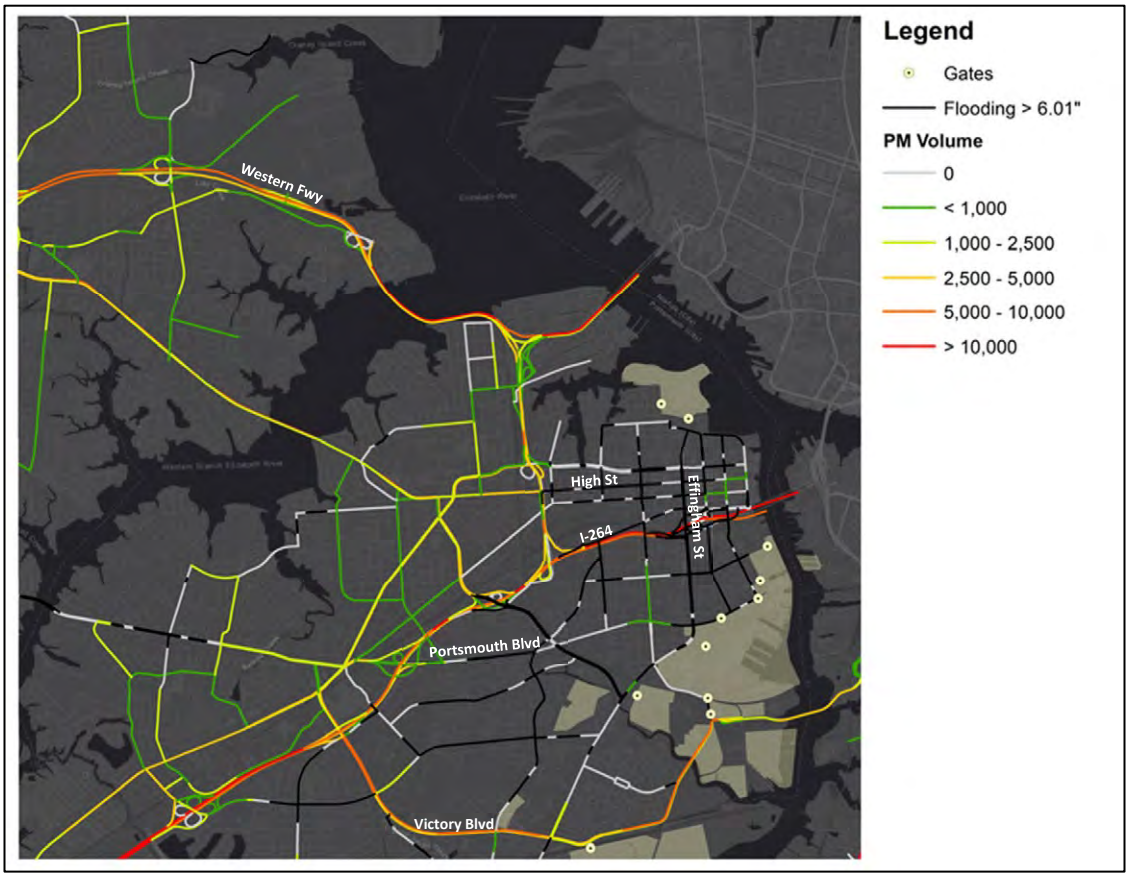


Figure E-20: Package 4 Victory-Portsmouth Sub-Area PM Peak Period V/C Ratio

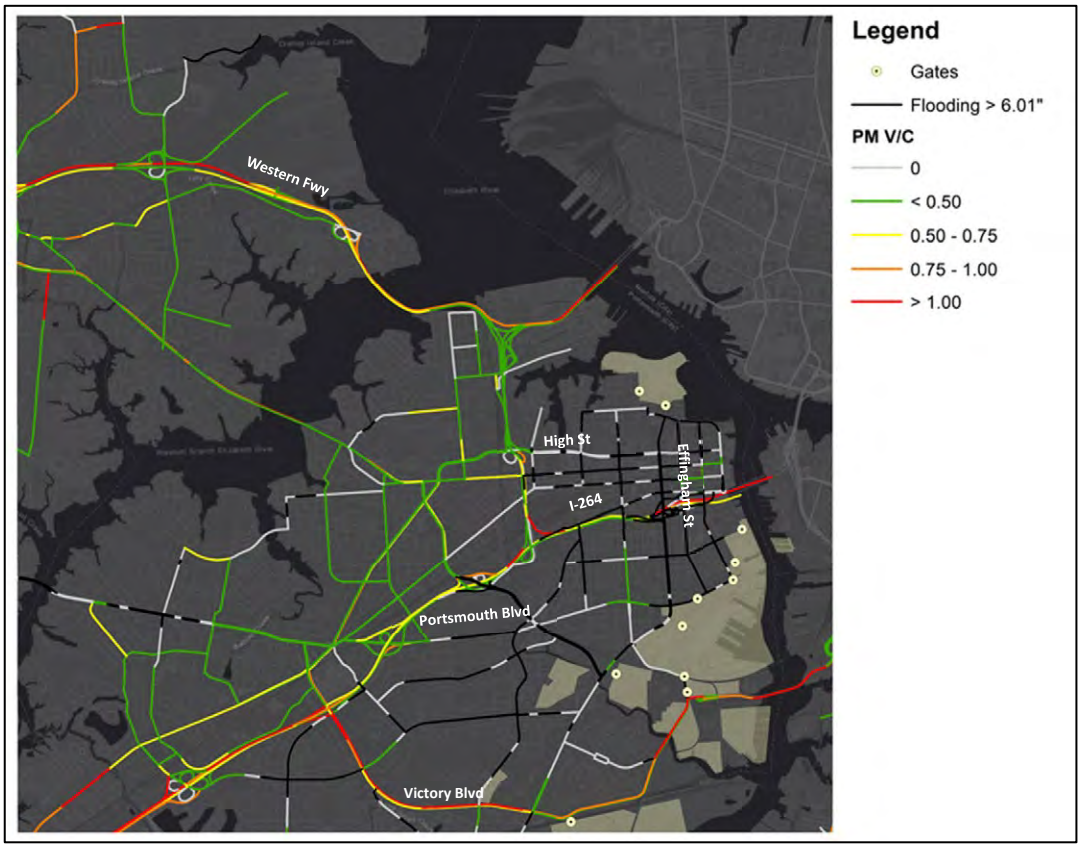


Figure E-21: Package 5 Norfolk Naval Shipyard (NNSY) South AM Peak Period Volume

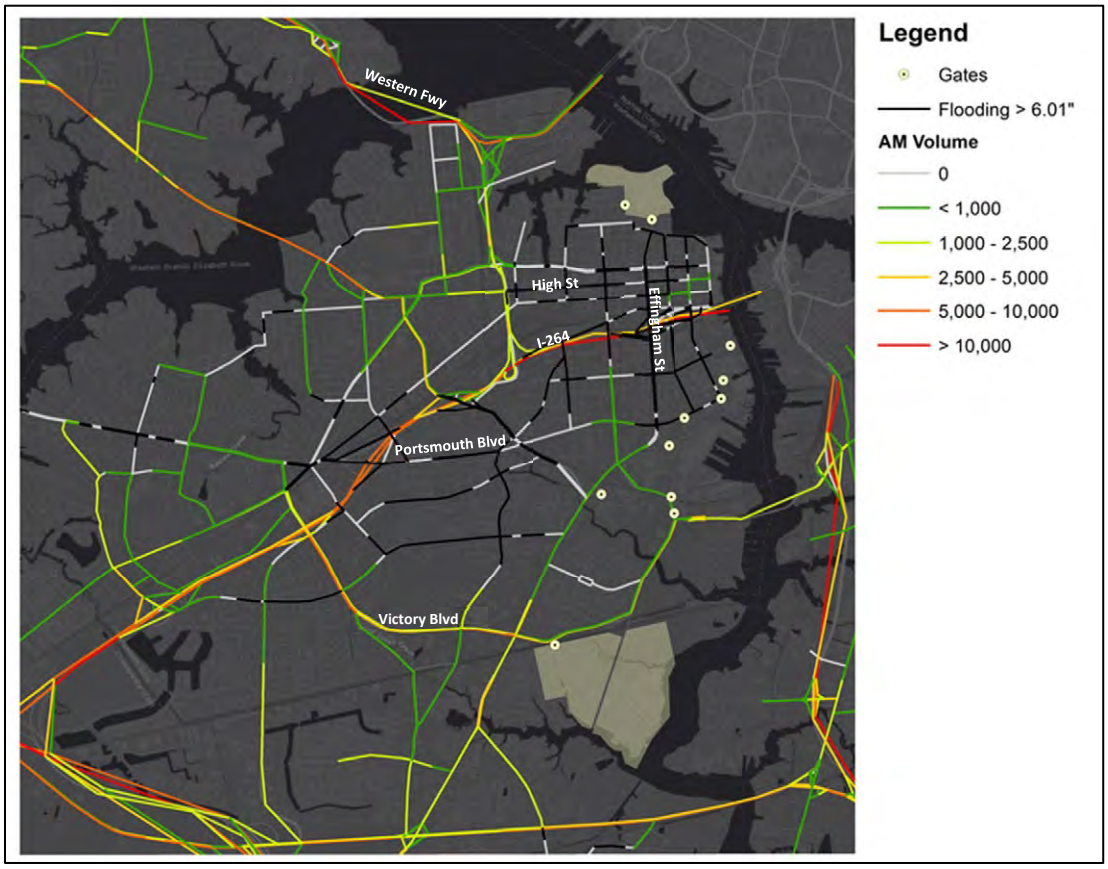


Figure E-22: Package 5 Norfolk Naval Shipyard (NNSY) South AM Peak Period V/C Ratio

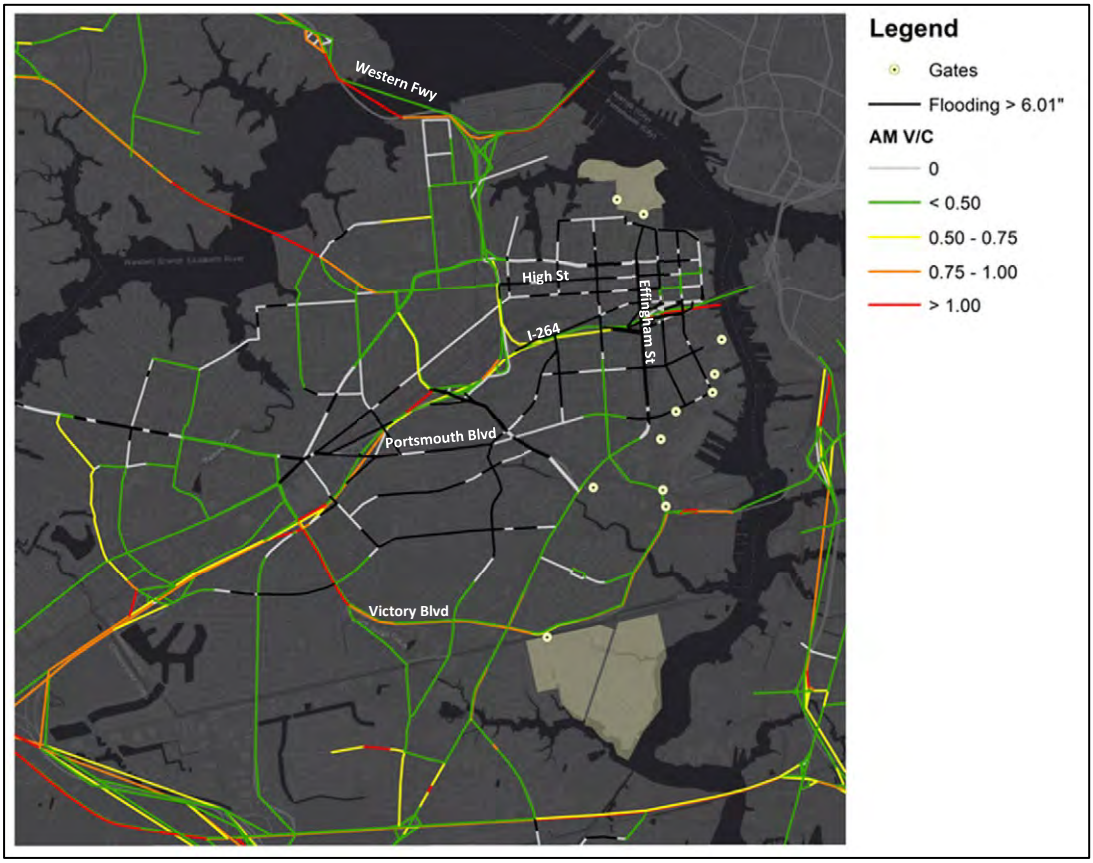


Figure E-23: Package 5 Norfolk Naval Shipyard (NNSY) South PM Peak Period Volume

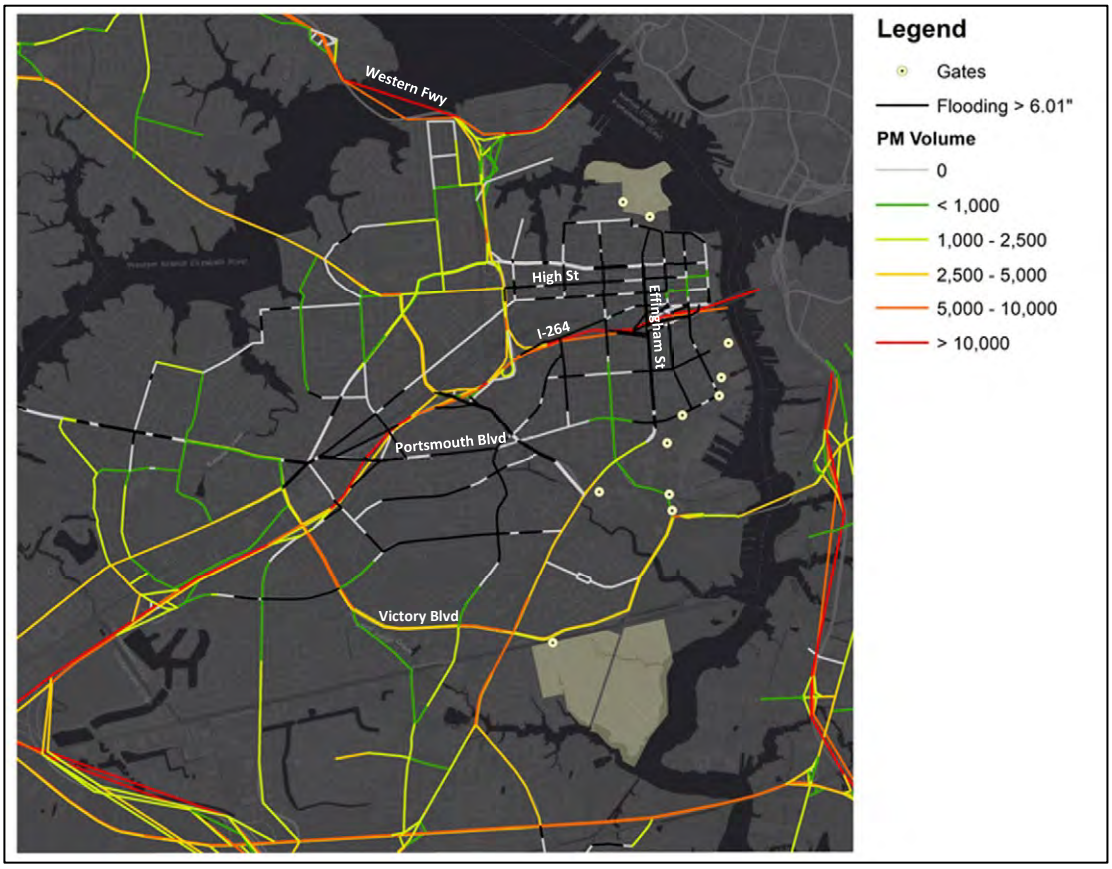
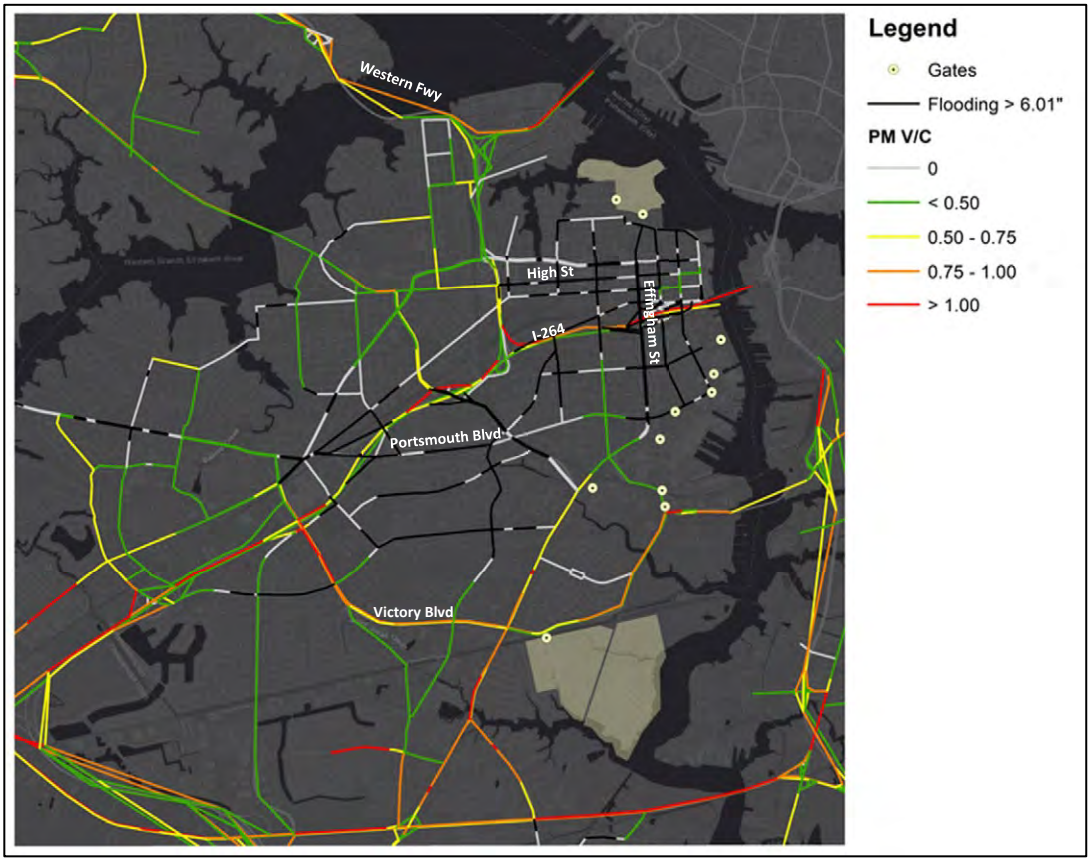


Figure E-24: Package 5 Norfolk Naval Shipyard (NNSY) South PM Peak Period V/C Ratio



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