APPENDIX – E
PROJECT DESCRIPTION

I-64 Hampton Roads Bridge-Tunnel Expansion Project
Hampton Roads Connector Partners
240 Corporate Blvd. 4th floor
Norfolk, VA 23502

Hampton-Norfolk, Virginia
August 30, 2019
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E. Project Description

E.1 PROJECT OVERVIEW

The Virginia Department of Transportation (VDOT) awarded the design and construction of the Hampton Roads Bridge-Tunnel (HRBT) Expansion project (the Project) in April 2019 to Hampton Roads Connector Partners (HRCP), a design-build joint venture and the permit applicant. The Federal Highway Administration (FHWA) is the lead federal agency for the Project.

The Project will address severe traffic congestion at the existing HRBT crossing by increasing capacity and upgrading approximately ten miles of Interstate 64 (I-64) between the Settlers Landing Road Interchange (Exit 267, MM 267.26) in Hampton and the Interstate 564 (I-564) Interchange (Exit 276, MM 277.19) in Norfolk, Virginia. Over 90,000 vehicles use the HRBT daily, seasonally exceeding 100,000 vehicles per day, which represents about half of all traffic crossing the James River, Hampton Roads water body between South Hampton Roads (“Southside”), and the lower “Peninsula” formed by the James and York Rivers. HRBT is part of the Hampton Roads Beltway, an approximate 55-mile loop of I-64 and I-664, encircling the metropolitan area. Likewise, the HRBT is an important regional transportation link for residential, commercial, industrial, and military mobility. Figure E-1 provides a map of the project location.

The 3.5-mile long HRBT originally opened in 1957, replacing a 30+ minute ferry ride with a seven-minute drive (Bickel, 1958). It opened as a two-lane facility and was the first bridge-tunnel water crossing ever constructed utilizing artificial “portal” islands. The portal islands anchor the ends of the 7,479-foot (2,280 meter) tunnel and serve as the transition to the trestle bridges that connect the islands to the mainland. The facility was expanded to four lanes in 1976 and was incorporated into the interstate system as part of I-64. The 1976 expansion included the construction of new parallel trestle bridges and expansion of the portal islands to accommodate the new parallel tunnel. Both of the current HRBT tunnels, as well as all ten existing traffic tunnels in the region, were constructed using an immersed tube tunnel (ITT) method which requires extensive dredging followed by a fill covering. The four-lane configuration has remained constant since the HRBT expansion in 1976.
The HRBT Expansion will widen I-64 for approximately 9.9 miles to create an eight lane facility with six consistent lanes. The expanded facility will include four general purpose lanes, two new High Occupancy Toll (HOT) lanes and two new drivable (hard-running) shoulders to be used as HOT lanes during certain times of the day. I-64 is currently six-lanes from the I-64/I-664 Interchange to the Settlers Landing Road Interchange in Hampton, which represents the western project limit. The eastern project limit is near Little Creek Road at the I-564/I-64 interchange in Norfolk. The typical roadway section includes the two existing 12-foot general purpose (GP) lanes and the addition of one 12-foot permanent HOT lane and one 12-foot part-time drivable shoulder HOT lane in each direction. The Project will include the construction of two new two-lane tunnels, expansion of the existing portal islands, and full replacement of the existing trestle bridges at the HRBT. The Mallory Street Bridge will be fully replaced and the Willoughby trestle bridges will be expanded. Upland portions of I-64 will be widened to accommodate the additional lanes and overpass bridges will be improved. Figure E-2 provides a graphical representation of project elements.

Two new parallel tunnels will be constructed using a Tunnel Boring Machine (TBM). When complete, four subaqueous tunnels will connect to the two expanded portal islands.

For the purposes of this application the term “trestle bridge” will refer to structures over water that carry traffic. There are nine permanent trestle bridges associated with this project:

- The North Trestle Bridges: From the Hampton shoreline to the North Island
- South Trestle-Bridge: From the South Island to Willoughby Spit
- Willoughby Bay Trestle Bridges: Over Willoughby Bay
- Bay Avenue Trestle Bridges: Over the northern branch of Oastes and Mason Creeks
- Oastes Creek Trestle-Bridges: Over the southern branch of Oastes and Mason Creeks

Additionally, there will be Maintenance of Traffic (MOT) trestle bridges that, while temporary, will be used to phase construction and carry traffic prior to completion of the new structures. “Temporary trestles” are work trestles that will be used to aid in construction and will be removed before Project completion. Temporary trestles will not carry traffic. Landside bridges, such as the Mallory Street Interchange, will be referred to as “bridges.”
HRCP is responsible for obtaining the Section 10, Section 404, Section 401, and Submerged Lands Permits from the U.S. Army Corps of Engineers (USACE), Virginia Department of Environmental Quality (VDEQ), and the Virginia Marine Resources Commission (VMRC), and is submitting this Joint Permit Application (JPA) as the permit applicant in accordance with federal and state statutory requirements. Table E-1 provides contact information for the VDOT Project Director and the HRCP Project Executive.
Table E-1: Project Owner and Design-Builder

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<th>Entity</th>
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<th>Hampton Roads Connector Partners (HRCP)</th>
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<td>Function</td>
<td>Project Owner</td>
<td>Design-Builder</td>
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<tr>
<td></td>
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<td>Construction Joint Venture (CJV)</td>
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<tr>
<td>Representative</td>
<td>James S. Utterback</td>
<td>Jose Ignacio Martin Alos</td>
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<tr>
<td></td>
<td>VDOT Project Director</td>
<td>Project Executive</td>
</tr>
<tr>
<td>Contact details</td>
<td>1401 E. Broad Street</td>
<td>240 Corporate Boulevard</td>
</tr>
<tr>
<td></td>
<td>Richmond, VA 23219</td>
<td>Norfolk, Virginia, VA 23502</td>
</tr>
<tr>
<td></td>
<td>(804) 371-4082</td>
<td>(757) 578-8689</td>
</tr>
</tbody>
</table>

**E.2 PURPOSE AND NEED**

The HRBT Expansion project is the result of years of study, public involvement, federal, state, and local interagency coordination facilitated through the NEPA process and documented over multiple iterations of the Hampton Roads Crossing Study. This section provides a brief summary of the purpose and need defined in the 2017 HRCS Supplemental Environmental Impact Statement (SEIS).

The HRCS SEIS was initiated in 2015 and VDOT, in cooperation with FHWA as the lead federal agency, developed a coordination plan that incorporated elements of the Commonwealth’s NEPA-Section 404 Merge Agreement that was in development at the time. The NEPA coordination plan outlined three major decision points for concurrence by the federal cooperating agencies, which included the USACE. The decision points are:

- Purpose and Need
- Range of Alternatives
- Preferred Alternative

Persistent and significant traffic congestion with vehicles routinely queuing in both directions at the HRBT has been a problem identified by the public and area leaders as an important issue that needed to be addressed for over three decades (2017 HRCS SEIS). The HRBT is the most heavily traveled of the three fixed crossings over the James River-Hampton Roads waterway, servicing about half of all daily traffic trips (90,000-100,000 vehicles per day (vpd)) crossing from the Southside to the Peninsula. Although providing for roughly half of all traffic crossings, the existing four-lane HRBT represents only half of the combined total capacity of the four-lane JRB (~20,000-25,000 vpd [2015]) and (Monitor-Merrimac Memorial Bridge-Tunnel (MMMBT) (~61,000-65,000 vpd [2015]) (2017 HRCS SEIS Traffic and Transportation Report).

As defined in the 2017 HRCS SEIS, the purpose of the Project is to:
Relieve congestion at the I-64 HRBT in a manner that improves accessibility, transit, emergency evacuation, and military and goods movement along the primary transportation corridors in the Hampton Roads region, including the I-64, I-664, I-564, and VA 164 corridors.

Accommodate travel demand – capacity is inadequate on the Study Area Corridors, contributing to congestion at the HRBT.

Improve transit access – lack of transit access across the Hampton Roads waterway;

Increase regional accessibility – limited number of water crossings, inadequate highway capacity, and severe congestion decrease accessibility.

Address geometric deficiencies – insufficient vertical and horizontal clearance at the HRBT contribute to congestion.

Enhance emergency evacuation capability – increase capacity for emergency evacuation, particularly at the HRBT.

Improve strategic military connectivity – congestion impedes military movement missions.

Increase access to port facilities – inadequate access to interstate highway travel in the Study Area Corridors impacts regional commerce.”

A description of the project alternatives and the preferred alternative is discussed in Appendix F.

E.3 PROJECT HISTORY

The HRBT Expansion project is based on FHWA’s Refined Selected Action that resulted from the HRCS. The HRCS included multiple iterations of NEPA analysis over more than two decades, beginning in the mid-1990’s. The HRCS originated with the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) funding to study improvements to relieve traffic congestion at the HRBT. In 1992, the Virginia General Assembly passed a joint resolution directing VDOT to conduct a study on congestion at the HRBT, concluding that a large-scale solution would be required. Figure E-3 provides a timeline of milestones in the development of the HRCS.

The following excerpt from the FONSI issued by FHWA on October 23, 2018 for the EA Re-evaluation of the 2017 HRCS Final SEIS provides a brief background of the HRCS, which ultimately lead to the Refined Selected Action alternative:

Excerpt from the 2018 Finding of No Significant Impact (FONSI):

FWHA issued a Final EIS and ROD in 2001 for the original HRCS. In the ensuing years, VDOT tried to advance the Project as a P3 but cancelled the effort in 2006. In 2011, VDOT tried to advance a portion of the Project and prepared an EA Re-evaluation. The EA was never completed because funding was not identified for construction. In early 2013, the [Virginia] General Assembly approved a transportation funding package which included an increase in the sales tax in the Hampton Roads region dedicated to transportation improvements. In late 2014, because of the additional revenue, the decision was made to revisit the HRCS and prepare a SEIS. The decision was also made to reconsider the three alternatives from the original EIS as well as a forth
alternative that included all of the improvements covered by the previous three alternatives. There were 11 cooperating agencies involved in the SEIS which included six federal agencies and five localities. The federal cooperating agencies either concurred or, while not concurring, did not disagree with the purpose and need, the alternatives carried forward and the Preferred Alternative. A Notice of Intent to prepare the SEIS was issued in June 2015. The Draft SEIS was issued in July 2016, the Final SEIS was issued in April 2017, and the ROD was issued in June 2017.

The HRCS was revisited in 2016-17 with support from Hampton Roads Transportation Accountability Commission (HRTAC), resulting in the development of a Supplemental EIS (SEIS). The 2017 HRCS Final SEIS identified Alternative A, with refinements, as the consensus Preferred Alternative. See the Appendix F – Alternatives Analysis for more information.

On June 12, 2017 the FHWA issued a Record of Decision (ROD) identifying refined Alternative A as the Selected Action, replacing the previous ROD, issued in 2001, for a different alternative. FHWA identified the following reasons for identifying Alternative A (with refinements) as the Selected Action:

- Acceptably addressed the purpose and need to be considered a reasonable alternative under NEPA.
- Had the least environmental impacts.
- Had the lowest estimated cost and would allow other regionally funded transportation priorities to advance.
- Was unanimously endorsed by all the localities comprising the Hampton Roads Transportation Planning Organization (HRTPO) and the HRTAC, which includes the Cities of Chesapeake, Franklin, Hampton, Newport News, Norfolk, Poquoson, Portsmouth, Suffolk, Virginia Beach, and Williamsburg, and the Counties of Isle of Wight, James City, Southampton, and York.
- Was concurred with by the federal cooperating agencies as the recommended Preferred Alternative.
- Had the least aquatic resource impacts, which allowed the USACE to state it appears to be the Least Environmentally Damaging Preferred Alternative (LEDPA).
- Had the second highest number of Public Hearing comments submitted in support of it (Alternative D received the highest number of comments in support, but it could not be the LEDPA per input from the USACE).
Figure E-3: Hampton Roads Crossing Study Timeline

HAMPTON ROADS CROSSING STUDY TIMELINE

1991
I-64 Crossing of Hampton Roads Study Funded
Intermodal Surface Transportation Act of 1991 (ISTEA)

1992
HRBT Congestion Study Completed
Concluded a large scale solution would be required

1993
HRCs Initiated

1994
HRCs Purpose and Need was approved

1995
HRCs Alternatives Developed
Initial list of 45 possible solutions identified

1996
HRCs Alternatives Refined
Alternatives reduced to 11 Individual Transportation Corridors based on screening criteria

1997
I-64 Crossing Major Investment Study (MIS) Completed
HRTO recommended and CTB subsequently endorsed Transportation Corridor 9 as the preferred alternative

1999
HRCs Draft EIS
DEIS was published in October followed by three public hearings in early 2000

2000

2001
HRCs Final EIS (FEIS) and ROD were issued
CBAD was identified as the preferred alternative

2003
Re-evaluation of the HRCs FEIS
Analyzed the implementation of a portion of the preferred alternative

2011
EA Re-evaluation of the HRCs FEIS
Analyzed segment known as "Patriots Crossing"
HRBT EIS Initiated
Focused on HRBT corridor

2012
HRBT Draft EIS Published

2013
Revised EA Re-evaluation of the HRCs FEIS
FHWA did not take action on VDOT's FONSI request because the project did not meet funding requirements

2015
HRCs Supplimental EIS Initiated

2016
HRCs Draft SEIS Published

2017
HRCs Final SEIS issued in April
FHWA issued a NOI identifying preferred Alternative A as the selected action

2018
EA Re-evaluation of the HRCs SEIS
FHWA issues FONSI for refined selected action
The 2017 ROD identified a number of measures that were adopted into the Project, primarily as a result of the NEPA process. They included means to minimize property and cultural resources impacts (a Programmatic Agreement was executed with design commitments); Section 4(f) resource avoidance, noise abatement, minimization of wetland impacts, improvement of water quality with modern stormwater best management practices, avoidance of adverse impacts to protected species, and management of hazardous materials. The 2017 ROD also incorporated design commitments VDOT made to address impacts to specific resources from the selected alternative. The commitments specifically state:

- There will be no permanent impact or acquisition of Hampton University property.
- There will be no permanent impact or acquisition of the Willoughby Boat Ramp property located adjacent to the westbound lane of I-64 on the Willoughby Spit.
- There will be no permanent impact or acquisition of Navy property, which abuts the eastbound lane of I-64 in the City of Norfolk.
- Right-of-way (ROW) impacts will be minimized within the Phoebus-Mill Creek Terrace Neighborhood Historic District and relocations will be avoided.

An Environmental Assessment (EA) NEPA Re-evaluation of the 2017 Final SEIS was conducted in 2018 to address proposed refinements to FHWA's Selected Action. The EA provided an environmental analysis of proposed HOT-managed lanes (permanent HOT lane with part-time HOT drivable shoulders), expanded Limit of Disturbance (LOD) areas for additional improvements at the I-564 Interchange and construction staging areas in the Willoughby Spit area. The FHWA approved the EA Re-Evaluation on June 7, 2018 and issued a Finding of No Significant Impact (FONSI) on October 28, 2018 for the Refined Selected Action. See Appendix F for additional history of the HRCS, alternatives development, and Design of the Refined Selected Alternative.

The Project LOD, as determined during the NEPA process described above, is shown in Figure E-4.
Figure E-4: Refined Selected Action LOD
E.4 PROJECT SCHEDULE
HRCP received Limited Notice to Proceed (LNTP) No. 1 for Early Works in April 2019 from VDOT. Approval of the TBM purchase and commencement of land works for the tunnel shaft are scheduled for September 2019 upon publication of the USACE Public Notice. Full Notice to Proceed (NTP) is scheduled for April 2020 upon receipt of permits from the USACE, VMRC and VDEQ. It is estimated that the Project will reach substantial completion in July 2025 and full completion in November 2025. The Project construction schedule is provided in Appendix N: Project Schedule.

E.5 PROJECT LOCATION
The HRBT Expansion project is located in Southeastern Virginia, in the Coastal Plain physiographic region. The Project lies within Hampton Roads subbasin (HUC 02080208) and Hampton Roads watershed (HUC 0208020803) which represents the confluence of the James River and Chesapeake Bay. More specifically, the Hampton side falls within Hampton Roads-Hampton River subwatershed (HUC 020802080303), the center channel is in Hampton Roads Channel subwatershed (HUC 020802080304), and the Norfolk side lies in Willoughby Bay subwatershed (HUC 020802080302) (USGS Stream Stats). The James River is the longest river in Virginia, and the associated drainage area is a significant component (about 16%) of the approximately 64,000 square mile Chesapeake Bay Watershed. The Project is located within the core of the Hampton Roads metropolitan area, which is characterized as a heavily urbanized landscape with dense residential, commercial, and industrial facilities, as well as major military installations, all in close proximity to, and served by, the Project.

E.6 DESIGN OVERVIEW

E.6.1 DESIGN SEGMENTS
The design is divided into five segments as seen in Figure E-5 below. Approximate lengths for each segment are indicated. The total length is 9.9 miles. Construction areas (see Section E.8 in this appendix) are also indicated in the figure.

- **Segment 1a (Hampton)** begins at the northern terminus of the Project in Hampton and ends at the north end of the north approach slabs for the north tunnel approach trestles. This segment has two interchanges and also includes improvements along Mallory Street to accommodate the bridge replacement over I-64. This segment covers approximately 1.2 miles along I-64.
- **Segment 1b (North Trestle Bridges)** includes the new and replacement north tunnel approach trestles, including any approach slabs. This segment covers approximately 0.6 miles along I-64.
- **Segment 2a (Tunnel)** includes the new bored tunnels, the tunnel approach structures, buildings, the North Island improvements for tunnel facilities, and South Island improvements. This segment covers approximately 1.8 miles along I-64.
- **Segment 3a (South Trestle Bridge)** includes the proposed south trestle bridge and any bridge elements that interface with the South Island to the south end of the south abutments at Willoughby Spit. This segment covers approximately 1.2 miles along I-64.
- **Segment 3b (Willoughby Spit)** continues from the south end of the south approach slabs for the south trestle and ends at the north end of the north approach slabs for the Willoughby Bay trestles. This segment includes a modified interchange connection to Bayville Street, and has a truck inspection station for the westbound tunnels. This segment covers approximately 0.6 miles along I-64.

- **Segment 3c (Willoughby Bay Trestle Bridges)** includes the entire structures over Willoughby Bay, from the north end of the north approach slabs on Willoughby Spit to the south end of south approach slabs near the 4th View Street interchange. This segment covers approximately 1.0 miles along I-64.

- **Segment 3d (4th View Street Interchange)** continues from the Willoughby Trestle Bridges south, leading to the north end of the north approach slabs of I-64 bridges over Mason Creek Road along mainline I-64. This segment covers approximately 1.0 miles along I-64.

- **Segment 4a (Norfolk-Navy)** goes from the I-64 north end of the north approach slabs at Mason Creek Road to the north end of the north approach slabs at New Gate/Patrol Road. There are three interchange ramps in this segment: westbound I-64 exit ramp to Bay Avenue, eastbound I-64 entrance ramp from Ocean Avenue, and westbound I-64 entrance ramp from Granby Street. The ramps in this segment are all on structure. This segment covers approximately 1.5 miles along I-64.

- **Segment 5a (I-564 Interchange)** starts from the north end of the north approach slab of the New Gate/Patrol Road Bridge to the southern Project Limit. This segment runs along the Navy property and includes an entrance ramp from Patrol Road, access ramps to and from the existing I-64 Express Lanes, ramps to and from I-564, and an eastbound I-64 entrance ramp from Little Creek Road. This segment covers approximately 1.2 miles along I-64.
E.6.2 ISLAND EXPANSIONS

The North and South Island expansions are included in Design Segment 2a. To provide necessary structural support and protection for the new HRBT, both North and South Islands will be expanded and modified.

E.6.2.1 NORTH ISLAND

The North Island will be expanded by 16.41 acres to the west to accommodate the new tunnels and the Tunnel Approach Structure (TAS) (see Figure E-6). The TAS is a concrete structure which connects the at-grade highway to the bored tunnel. The island expansion will be constructed of well-graded and compacted sand fill, surrounded by a rock perimeter made of gravel, stone and armor stone designed to provide scour protection to protect the island from wave action current scour and propeller wash.

Figure E-6: North Island Layout

E.6.2.2 SOUTH ISLAND

The South Island will be expanded by 2.64 acres to the south to accommodate the transition between the trestle abutment and the TAS (see Figure E-7 below). Expanding the island to the south avoids the need to construct a berm on the channel side of the island. The South Island will be made of well-graded and compacted sand inside a rock perimeter similar to the North Island.

Soil conditions in the South Island expansion area will require ground improvement to avoid settlement of the expanded island and surrounding structures, including the trestle bridges. Final design for the ground improvement is dependent on supplement borings which will confirm geotechnical conditions, and is being completed. Alternatives being evaluated include installation of settlement reduction piles (pipe piles) equipped with a cap and a gravel bed, dredging unsuitable sediments and backfilling with...
structurally suitable fill, or a combination of those alternatives. In either case, the footprint of expansion is the same.

**Figure E-7: South Island Layout**

### E.6.3 TUNNELS

The two new tunnels will have an internal diameter of 41.5 feet and be approximately 7,900 feet in length between the launch and reception shafts located on the North and South Islands. The tunnels will vary in depth from approximately 40 to 150 feet below the water surface (as measured from the tunnel axis) (see Figure E-8 below). At these depths, the geology varies between soft to stiff cohesive material and loose to dense sands, traversing different combinations of mixed-face conditions.

**Figure E-8: Key Design and Construction Considerations for the Final Tunnel Grade**

A geologic stratum with weak geotechnical properties exists along a portion of the tunnel alignment just beneath and to the north of South Island. Jet grouting will be used for ground improvement (GI) to strengthen soils in this area prior to advancing the TBM.
E.6.4 TRESTLE BRIDGES

E.6.4.1 NORTH AND SOUTH TRESTLE BRIDGES
The existing two-lane North and South Trestle Bridges will be demolished and reconstructed. The North Trestle Bridges will be replaced by two four-lane structures. It will have spans of 65 to 120 feet long. Final design for the foundation is dependent on supplement borings which will confirm geotechnical conditions, and is being completed. Foundation design alternatives currently being considered include approximately 478 precast 54-inch cylindrical piles or 30-inch precast square piles. Piles will be driven to support approximately 75 spans.

The two existing two-lane South Trestle Bridges will also be demolished. They will be replaced by an eight-lane structure with spans up to 130 feet long. Final design for the foundation is dependent on supplement borings which will confirm geotechnical conditions, and is being completed. Alternatives currently being considered include approximately 680 precast 54-inch cylindrical piles or 30-inch precast square piles. Piles will be driven to support approximately 91 spans.

E.6.4.2 WILLOUGHBY, BAY AVENUE, AND OASTES CREEK TRESTLE BRIDGES
The existing Willoughby Bay Trestle Bridge structure will be modified by widening the two existing structures to the outside in both directions to accommodate new travel lanes, shoulders, and new sound walls. This will require installation of two to three additional piles at each pier location on the outside of both structures. Approximately 350 54-inch precast square piles will be driven to support the expansion.

The trestle bridges crossing Bay Avenue and Oastes Creek will be similarly expanded, with approximately 210 piles driven at the Bay Avenue crossing and 92 at Oastes Creek.

E.6.5 ROADWAY EXPANSION
Improvements along I-64 in the Project Corridor will include highway expansion and bridge improvements. Upland construction will have impacts to wetlands or Jurisdictional Waters of the US (WOUS). All impacts are accounted for and depicted in Appendix G.

Along I-64 in Hampton, the outside shoulders will be widened and improvements will be made to the associated drainage systems. Utilities (VDOT and private) will be relocated as required. The Mallory Street Bridge will be replaced.

In Norfolk, I-64 will be similarly widened to the outside. Existing overpass bridges will be widened, and sound walls will be constructed. A hurricane evacuation crossover will also be constructed west of the 4th View Street interchange.

Traffic crossovers for emergency use will be provided at both the Hampton and Norfolk approaches.
E.7 CONSTRUCTION EQUIPMENT OVERVIEW

Tunneling will be performed using a Variable Density TBM. On-island and upland construction will require equipment including, but not limited to, support equipment, a Separation and Treatment Plant (S&TP) for the bored material, a Water Treatment Plant (WTP), a Slurry Treatment Plant (STP) for jet grout and slurry wall residuals, jet grout drills, pile drivers (including impact hammers, vibratory hammers, and down-the-hole (DTH) hammers), excavators, cranes, bulldozers, and skid steers. In-water construction will require mobilization of multiple pieces of marine equipment, including, but not limited to, mechanical bucket dredges, tugboats, dredge tending tugboats, equipment barges, anchor barges, material supply vessels, and survey support vessels. Vessels and barges will be required to deliver the necessary equipment and construction materials to the HRBT Project site and to transport material offsite for stockpiling or disposal at an approved facility.

E.8 CONSTRUCTION AREAS

HRCP has organized the Project into four Construction Areas as shown in Figure E-9. The Construction Areas correspond to the design segment and sub-segments described earlier, and as indicated in Table E-2.
Figure E-9: HRBT Construction Areas
### Table E-2: Relationship between Design Segments and Construction Areas

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<th>Construction Area No.</th>
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<td>Area 1</td>
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<td>Segment 1b</td>
<td>North Trestle-Bridge</td>
<td>Area 2</td>
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<tr>
<td>Segment 2a</td>
<td>Tunnel</td>
<td>Area 3</td>
</tr>
<tr>
<td>Segment 3a</td>
<td>South Trestle-Bridge</td>
<td>Area 2</td>
</tr>
<tr>
<td>Segment 3b</td>
<td>Willoughby Spit</td>
<td>Area 4</td>
</tr>
<tr>
<td>Segment 3c</td>
<td>Willoughby Bay Trestle-Bridge</td>
<td>Area 2</td>
</tr>
<tr>
<td>Segment 3d</td>
<td>4&lt;sup&gt;th&lt;/sup&gt; View Street Exchange</td>
<td>Area 4</td>
</tr>
<tr>
<td>Segment 4a</td>
<td>Norfolk-Navy</td>
<td>Area 4</td>
</tr>
<tr>
<td>Segment 5a</td>
<td>I-564 Interchange</td>
<td>Area 4</td>
</tr>
</tbody>
</table>

### E.9 CONSTRUCTION ELEMENTS AND SEQUENCE

The HRBT Project construction is divided into three main phases: 1) Design, 2) Permitting, and 3) Procurement and Construction. Phases 1 and 2 (Design and Permitting) have already started and will continue through 2020, including the following activities:

- Start of baseline site instrumentation;
- Start of the borings campaign;
- Design and submission of permit applications, and;
- Start of TBM design and contract procurement

Early works at the South Island – including paving and utility relocations – are scheduled to begin at the end of 2019. The remainder of the onshore (upland) construction activities, and the start of off-shore (in-water) construction is planned to begin in the second quarter of 2020. Construction will continue into 2025.

A linear schedule which shows the expected duration of construction activities for the Project, is provided in Appendix N: Project Schedule.

A description of the major construction elements that are part of the HRBT Expansion Project is provided below. This includes island expansions, tunnel boring, Trestle-Bridge construction, and Roadway Expansion. Other project elements described in this appendix include: Materials Management, Marine Operations & Construction Logistics, Removal of Temporary Structures, and Demolition and Removal of Existing Structures.
E.10 CONSTRUCTION MEANS AND METHODS

E.10.1 ISLAND EXPANSION

In-water island expansion activities will occur in Construction Area 3 at both the North and South Islands. Creation of the South Island launch pit, portal and TAS will result in the excavation of approximately 300,000 cubic yards of sandy material. Dependent on the results of chemical and physical analyses, up to 200,000 cubic yards of clean, sandy material from the South Island portal excavation may be reused for the North Island expansion. If the material is determined to be unsuitable, it will be disposed and certified clean fill material will be imported to facilitate construction of the North Island expansion.

E.10.1.1 NORTH ISLAND

Placement of material in waters of the U.S. (WOUS) is regulated under Section 404 of the Clean Water Act regulated by the USACE, VDEQ and VMRC. Clean fill used for this purpose is discussed in Appendix L: Material Management Plan.

Phasing of North Island expansion is as follows:

**Phase 1 – On-shore cutoff wall**

Approximately 170 piles will be driven along the existing west shore to create a cutoff wall. The purpose of the cutoff wall is to protect the existing TAS from settlement that might be induced by the island expansion.

**Phase 2 - Dredging**

The footprint of the future island expansion (16.41 acres or 715,000 SF) will be mechanically dredged (up to 3 feet below seabed plus over dredge) to remove mud and provide improved foundation conditions. Obstructions located within the footprint of the island will also be removed during dredging (i.e. armor rock washed away from shore) with a mechanical style grapple bucket. Sediments will be placed in barges for transport directly to an approved disposal facility. Dredging at the North Island is described in detail in Appendix L: Material Management Plan.

**Phase 3 – Mooring piles**

Mooring piles (80, 42-inch pipe piles) will be driven from a barge with a vibratory hammer every 40 feet along the future footprint of the island. Moorings will keep work vessels stable during construction, and will reduce activity in the adjacent Hampton Creek Approach Channel. Piles will be vibrated out or cut 2-3 feet below the sea bottom once the island expansion is complete in accordance with USCG and USACE guidance.
Phase 4 – Sheetpile wall

A sheetpile wall will be installed west of the future tunnel shaft and TAS. Sheetpile will be driven from a barge with a vibratory hammer. The sheetpile will separate the interior sand (fill) from the perimeter gravel. Separation will prevent the gravel from entering the slurry wall construction area. Slurry walls are required for construction of the future tunnel shaft and TAS.

Phase 5 – Rock perimeter (enclosure)

The rock perimeter will be constructed first to enclose the North Island expansion area. Removal and placement of stone material will start at one extremity of the island and finish at the other. The new bund, rock perimeter and scour toe will be comprised of four stone classes.

- Bund: 2 – 4-inch diameter crushed rock or gravel
- Underlayer rock – Type 3: VDOT Class I riprap, \( W_{50} = 100 \) lbs
- Underlayer rock – Type 2: \( W_{50} = 0.65 \) tons
- Armor rock - Type 1: \( W_{50} = 6.5 \) tons

Schedule constraints might require starting at both extremities at the same time and to complete the rock enclosure in the middle of the island. In either case, the phasing described below is the same.

- Existing rock removal:
  - In order to place the material at each extremity of the North Island, the first layer of existing armor stones located at each corner will be removed.
  - Armor stones will be removed both from shore-based equipment and from a barge with a crane and clamshell or grapple.
  - Armor stones will be stockpiled on North Island until all stones have been placed. In case of a weather event, armor stones can be replaced quickly.

- Retaining Rock Bund placement
  - A retaining rock bund will be constructed in-water, forming the perimeter of the expansion area.
  - Gravel material will be placed from barges using a crane or a long reach excavator with a mechanical bucket.
  - The maximum size of the supply barge will be 360 feet x 60 feet
  - In addition to the mooring piles, barges may need to use anchors (4 per barge) and/or spuds (4 per barge)

- Underlayer stone (Types 2 and 3) placement for the scour protection toe
  - While placement of the bund is progressing, the underlayer material for the scour protection toe will be placed on the seaward side of the bund with the same type of equipment.
  - There are two types of underlayer: small stone with a \( W_{50} = 100\)lb and rock with a \( W_{50} = 0.65 \) tons

- Armor stone (Type 1) placement
- Armor stone placement will follow the underlayer placement per the cross-section drawings in Appendix G.
- The median weight of armor stone (Type 1) is 6.5 tons.

Phase 6 – Fill

To construct the island interior, the remaining existing armor rock located along the west slope of the existing island will be removed and transported to an approved disposal location. Approximately 206,000 cy of clean fill will be installed using conveyor systems placed on the rock perimeter enclosure and barges for sand supply and/or equipped with either a crane or long reach excavator. Dozers will be used to place and compact the fill material within the exterior protection. Fill will be vibrocompacted to a depth of 20 feet below the seabed.

E.10.1.2 SOUTH ISLAND

The South Island expansion is in the same location as the existing and new eastbound trestle-bridges. The piles of the new structure are located within the armor protection of the island expansion. Construction will therefore be phased to start the island expansion once the existing eastbound trestle-bridge has been demolished. This will allow driving the new structure concrete piles at the same time as the settlement reduction and deep foundation piles needed for island expansion.

The sequence to build the South Island expansion is as follows:

Phase 1 - Dredging

Dredging is required within the footprint of the expansion area (2.64 acres) to clear the mud, reduce settlement, and remove obstructions (i.e. armor stones washed away from shore). Mechanical dredging will be conducted to improve foundation conditions. Depth of dredging will be determined by the results of the geotechnical borings (currently underway). The dredged sediments will be placed in a barge for transport to an upland, approved disposal facility. Depth of the dredge cut will range from 3 feet to 18 feet depending on results of the supplemental geotechnical boring program.

Phase 2 – Settlement Reduction Piles (SRPs) and Deep Foundation Piles (DFPs)

Due to weak foundation soils, 24-inch steel pipe settlement reduction piles (SRPs) will likely be driven to a depth of 95 feet below grade, except in the area of the future roadway location, where 36-inch concrete-filled pipe deep foundation piles (DFPs) will be driven to the same depth.

After dredging, a gravel bed of 4 to 7 feet will be installed on the seabed. This bedding layer forms the foundation of the new structure and provides separation between the seabed and larger stone above. Both the SRPs and the DFPs will be driven from a barge using vibratory and impact hammers. A pile template will be used to align the piles during driving. The template is placed in the proper location and held in place through the use of spuds (piles). The SRPs and DFPs will be supplied from a barge. Barges will be secured using spuds and anchors.
The SRPs and DFPs are permanent piles and will remain at the end of construction.

**Phase 3 – Sheet Pile Installation**

Following or concurrently with Phase 2, sheet pile walls will be installed from barges with vibratory hammers. Sheet pile will enclose the tunnel approach structure to facilitate construction of the “U” Wall (see Appendix G).

Sheetpiling will remain after construction is complete.

**Phase 4 – Material Placement**

Materials will be placed from shore and from barges.

Placement of material in WOUS are regulated under Section 404 of the CWA and Virginia Water Protection (VWP) Regulations regulated by the USACE, VDEQ and VMRC. Clean fill used for this purpose is discussed in Appendix L: Material Management Plan.

Similar to the North Island, the different layers and materials of the South Island will be placed in phases.

- **Existing rock removal:**
  - In order to place the material at the interface between the existing edge of the island and the expansion, the first layer of existing armor stones will need to be removed.
  - Armor stones will be removed both from shore and from a barge with a crane and clamshell.
  - Armor stones may be stockpiled on South Island until all stones have been placed for the scour protection structure. In case of a weather event, armor stones can be replaced quickly.

- **Retaining Rock Bund placement**
  - A retaining rock bund will be constructed in-water, waterward of the steel sheet pile enclosure.
  - Gravel material will be placed from barges using a crane or a long reach excavator with a mechanical bucket.
  - The maximum size of the supply barge will be 360 feet x 60 feet
  - In addition to the mooring piles, barges may need to use anchors (4 per barge) and/or spuds (4 per barge)

- **Underlayer stone (Types 2 and 3) placement for the scour protection toe**
  - While placement of the bund is progressing, the underlayer material for the scour protection toe will be placed on the seaward side of the bund with the same type of equipment.
There are two types of underlayer: small stone with a $W_{50} = 100\text{lb}$ and rock with a $W_{50} = 0.65\text{ tons}$

- Armor stone (Type 1) placement
  - Armor stone placement will follow the underlayer placement per the cross-section drawings in Appendix G.
  - Median weight of armor stone (Type 1) is 6.5 tons.

- Fill
  - Finally, the sheet-pile enclosure will be filled with clean fill from barges using a crane. The crane will be equipped with a mechanical bucket or a long reach excavator. Work will progress from barges or from the shore.

**Phase 5 – Onshore (upland) works**

Concurrently with in-water work, the island expansion will require DFPs to be driven onshore using impact and DTH hammers. Armor stones will need to be removed to place the new material for the island expansion.

**E.10.2 TUNNELS**

The two new tunnels will be bored using a single Variable Density TBM. The TBM will bore a tunnel in one pass that will accommodate two new lanes of traffic. The tunnel construction activities will occur in Construction Area 3 (Design Sub-Segment 2a). These activities will occur predominantly beneath the subaqueous bottom, with the exception of upland (on-island) construction for the tunnel approach structures (TAS), including the South Portal (launching shaft) and the North Portal (receiving shaft), and in-water subsurface jet grouting at the north end of the South Island.

Tunnel activities include:

- Tunnel boring using the TBM
- Construction of a temporary TBM dock (quay) to receive the TBM components for assembly in the launch portal
- Temporary conveyor trestle for offloading TBM excavated material
- Ground improvement (GI) to support the TBM boring
  - Temporary offshore trestles (extending north from the South Island) for GI
  - On-Island GI using jet grout
- Construction of the TAS (including shafts)
  - Slurry walls and guide wall construction
  - Excavation of material from the shafts and Tunnel Approach Structures (TAS)
  - Break-in / break-out walls (head walls) at the beginning and end of the bore
  - Jet grout plug for water tightness and jet grout struts

Phasing of the tunnel boring activities is as follows:
**Phase 1 – Installation of the TBM**

The TBM will be delivered by barge to South Island to a temporary dock (quay) designed for loading and unloading ships. The TBM will be fully assembled and prepared for launch in the ‘Tri-cell’ launch shaft using high capacity cranes to lower components of the TBM into position. The TBM assembly is expected to take 6 months to complete.

**Phase 2 – First bore**

Construction of the tunnel structures will begin on the South Island and move from south to north to the North Island receiving shaft. The TBM will both excavate material and construct the new tunnel as it progresses from South Island to North Island.

Tunnel lining works will occur behind the TBM as it drives forward. The tunnel lining will be a reinforced, precast concrete lining with a hybrid reinforcement of both steel fibers and conventional reinforcement. A precast invert ballast piece will provide buoyancy control in the temporary condition, a level working platform for construction logistics, and will be incorporated into the final ballast for the finished tunnel structure. Precast segments are supplied from South Island to the TBM by a Multi-Service Vehicle (MSV).

Once launched, the first boring operation, or “Drive 1,” is expected to take 12 months to complete, moving south to north. Production will occur in 2 shifts per day, 12 hours per shift. Work will occur 5 days per week with maintenance occurring on weekends. Ballast installation will be done once the first bore is completed.

**Phase 3 – U-Turn**

Upon reaching the North Island, the TBM will be turned around using high capacity cranes.

**Phase 4 – Second bore**

A parallel tunnel will be bored back to the South Island for the second set of lanes. Drive 2 is expected to take 15.7 months to complete, moving north to south. Drive 2 considers downtime for ballast installation behind the boring, as this will be a concurrent activity.

**Phase 5 – Disassembly of the TBM**

Upon reaching the South Island and completing the second tunnel, the TBM will be disassembled and the components will be removed via the portal on the South Island.

Once the tunnel structure is completed, final upland work for the Project will include installation of the final roadway, lighting, finishes, mechanical systems, and other required internal systems for tunnel use, traffic safety and facility function.
The South Island TAS is 1,130 feet long, comprised of a concrete structure that connects the at-grade highway to the bored tunnels and consists of two primary sections: 1) the U-wall and 2) the tri-cell cut-and-cover section from where the TBM will be launched. This launching shaft (also referred as the South Portal) will be the first activity to start, as South Island does not need to be expanded prior to building the shaft. Having a tri-cell launching shaft allows the full assembly of the TBM and its support before launching.

The North Island TAS is 980 feet long, comprised of a concrete structure that connects the at-grade highway to the bored tunnels. It consists of three primary sections: 1) the U-wall, 2) a rectilinear section, and 3) a circular receiving shaft (also referred to as the North Portal). The receiving shaft is located on the expansion of North Island and therefore can only begin once the expansion is complete.

Both TAS will be built with deep slurry walls and sealed with a watertight jet grout plug.

- A slurry wall is a technique used to build reinforced concrete walls in areas of soft earth close to open water. Guide walls are constructed on the ground surface to outline the desired trench and guide excavation equipment, then a trench is excavated to create a form for a wall while simultaneously being filled with bentonite slurry. The dense slurry prevents the trench from collapsing by providing outward pressure. Once a length of trench is excavated, a reinforcing cage is lowered into the slurry-filled trench and the trench is filled with concrete from the bottom up. The heavier concrete displaces the bentonite slurry, which is pumped out, filtered, and stored in tanks for use in the next wall segment, or properly disposed of. All spoils will be decanted to segregate the material from the slurry and pH neutralized before transport to a dedicated disposal area off site. Additional information on slurry wall waste can be found in Appendix L: Material Management Plan.

- Jet grouting is a technique used to directly inject a concrete-like material into subsurface environments to stabilize an area. A single fluid system consisting only of air, water and grout will be used for the jet. The process uses grout engineered and tested for soil type, design strength, and permeability. It is anticipated that the grout for ground improvement will consist of a mix of Portland cement and water with a cement-to-water ratio weight varying between 1.25 and 1.42, with the possible addition of a small quantity of bentonite (up to bentonite-to-water weight ratio of 4%). Additional information on Jet Grout Residuals can be found in Appendix L: Material Management Plan.

Phasing of works for both shafts is as follow:

- Installation of the guide walls.
- Construction of the slurry walls.
- Once the slurry walls are complete, the bottom of the shaft will be sealed with a watertight jet grout plug.
- The shaft will then be dewatered and excavated (cross walls in the tri-cell shaft allow to avoid having struts in the launching shaft).
• Installation of a waterproofing membrane and construction of the base concrete slab.
• Construction of the head wall.

The shaft is then ready to receive the TBM.

The rest of the TAS (U-walls and cut and cover) will be built as follows:

• Guide walls installation.
• Construction of slurry walls.
• Construction of jet grout plug (for water-tightness) and jet grout struts below the (future) concrete slab.
• Start of dewatering and excavation. Concrete struts are installed during excavation.
• Construction of the concrete base slab and walls.

E.10.2.2 MANAGEMENT OF EXCAVATED MATERIAL
Bored material removed from the face of the tunnel will be amended with bentonite and other soil amendments as detailed in Appendix L: Material Management Plan. Material excavated from within the tunnel will be transported via a closed slurry piping system back to the South Island where the excavated materials will be filtered out of the slurry at the Separation and Treatment Plant (S&TP). Approximately 1,416,000 cubic yards (bulked volume) of material is anticipated to be excavated by the TBM and transported via the slurry plumbing system to South Island. After separation at the S&TP, the solid materials will be characterized for beneficial use or will be disposed off-site at a permitted facility. After separation, the residual water (filtrate) will be processed through the water treatment plant and subsequently discharged under a Virginia Pollutant Discharge Elimination System (VPDES) discharge permit.

Potable water is used for grout, slurry, and TBM slurry for maintaining cutter head pressure. The TBM slurry acts as the carrying media to remove sediment/formation cuttings as the tunnel is bored and to maintain a positive pressure head at the face of the boring machine.

The process water generated from the jet grout (JG) and Slurry Wall (SW) activities will be captured, decanted, physically separated, and will undergo necessary filtration/treatment prior to discharge under a VPDES process water discharge permit. Figure E-10 shows the planned outfall location for the treated VPDES process water discharges (outfalls T-001 and T-002). The JG and SW processes water volume will be up to a combined 350 gallons per minute (gpm) if both jet grout operations (one on each island) are in operation concurrently. A larger treatment system for the TBM excavation process water (WTP) will be constructed on the South Island having a capacity of up to 500 gpm, which provides excess flow capacity. The sequence of flow rates is depicted in Figure E-11.
Figure E-10: Temporary Outfalls for Construction Discharges

**Temporary Outfalls for Construction Discharges at North and South Islands**

- **Outfall T-002**
  - Lat: 37°00'02"
  - Lon: 76°19'07"

- **Outfall T-001**
  - Lat: 36°59'03"'
  - Lon: 76°18'16"

**Note 1:** North Island
Slurry treatment plant for jet grouting and slurry wall construction.

**Note 2:** South Island
Slurry treatment plant for jet grouting, slurry wall construction, separation treatment plant and water treatment plant for TBM.
E.10.2.3 ONSHORE AND OFFSHORE GROUND IMPROVEMENT

A geologic stratum with weak geotechnical properties exists along a portion of the tunnel alignment just beneath and to the north of South Island. Ground improvement will be used to strengthen this soil and support the TBM progress through the soft ground layers.

Two, 1,000 feet long, temporary trestles will be built at the north of South Island to perform the offshore ground improvement. The trestles will be supported by 204, 36-inch pipe piles that will be installed using vibratory and impact hammers, with the help of a pile template. To minimize hydroacoustic impacts caused by impact hammer, a soft bubble curtain will be used for the main structural piles of the temporary trestles. A steel casing between the grout plant at trestle level and 20 feet below river bottom will be set to control the return of jet grout residual (JGR) and prevent spillage. JGR is returned to the island via a slurry pipe.

Ground improvements are further described in detail in Appendix L: Material Management Plan.
E.10.2.4  OFFSHORE (IN-WATER) STRUCTURES FOR TUNNEL SUPPORT

TBM Dock (Quay)

A quay will be constructed on the South Island adjacent to the tri-cell area to facilitate delivery and removal of the Tunnel Boring Machine (TBM).

The TBM quay is a steel structure supported on 36-inch steel pipe piles. Piles will be installed from land and from barges with vibratory and impact hammers, and with the help of a pile template. To minimize hydroacoustic impacts caused by impact hammer, a soft bubble curtain will be used for the main structural piles of the TBM quay. In some cases, a DTH hammer will also be used to drive piles through large armor stone. Approximately 2/3 of the piles of the TBM quay are located offshore (around 216 piles). Armor rock onshore and close to shore will be removed in phases during installation and replaced after pile installation.

Dolphins (sets of three 36-inch steel pipe piles) will also be driven from barges with vibratory and impact hammers.

Installation will last 6 months and the TBM quay is scheduled to be used until the completion of the tunnel activities. Once the TBM has been dismantled, the quay will be removed. The piles will be vibrated out or cut 2 to 3 feet below the seabed.

Conveyor Trestle

The bored TBM material separated from the slurry at the Separation & Treatment Plant (S&TP) will be transferred to barges for disposal via a conveyor system.

The conveyor support is a steel structure. The covered conveyor belt structure will be supported with 84, 36-inch piles installed from land and/or from a barge using vibratory and impact hammers, and with the help of a pile template. The down-the-hole hammer may be required to drive piles near shore (through armor stones). Dolphins (sets of three 36-inch mooring piles) will also be driven from barges with vibratory and impact hammers.

The conveyor support area will also be used for maintenance and mooring of delivery vessels for TBM delivery and other construction materials.

Installation will last approximately 4 months. Upon completion of the tunnel installation, the conveyor will be removed. The piles will be vibrated out or cut 2 to 3 feet below the seabed.

E.10.3  TRESTLE-BRIDGES

The trestle-bridge reconstruction and widening activities will occur in Construction Area 2. These activities will occur entirely in or over the water.
E.10.3.1 NORTH TRESTLE-BRIDGE

The four phases of construction for the North Trestle-Bridge are shown in Figure E-12 and described below.

- **Phase 1:** The new eastbound 4-lane trestle-bridge will be built first with the support of a temporary work trestle-bridge in the shallower areas closer to the North Shore at Hampton. This is to avoid and minimize impacts to Submerged Aquatic Vegetation (SAV). The rest of the eastbound trestle will be built using marine barges and equipment.

- **Phase 2:** Once the new eastbound trestle-bridge is completed, eastbound traffic will be shifted to the new structure using a temporary Maintenance of Traffic (MOT) trestle (shown in yellow in Phase 2 of Error! Reference source not found.), which will transport vehicles back into the existing eastbound tunnel until the new tunnels are ready to receive traffic.

- **Phase 3:** Shifting eastbound traffic will free the existing two-lane eastbound bridge-trestle, which will be used to provide support for the construction of the new westbound four-lane trestle-bridge. Jump trestles will also be used to build the new structure. A combination of jump trestles and working from the existing trestles will be used to build the westbound bridge. Jump trestles are built with a maximum of three spans which are progressively uninstalled and reinstalled one span at a time, moving forward with the construction of the adjacent structure.

- **Phase 4:** Once the new westbound structure has been built, westbound traffic will be shifted to the new four-lane structure. This will allow the demolition of the existing two-lane bridge-trestles. Since the new structures are overlapping with the existing ones at the North Shore, this will also allow completion of the new trestles.
The main stages of Trestle-Bridge construction are: driving of the piles using spudded pile templates, installation of the pile cap, setting of the girder, and completion of the structure with the deck. Pile caps will be installed after piles are cut off to the proper elevations, followed by setting of bearings and girders, installation of the utility system, installation of deck panels, reinforcing steel, and placement of concrete for the bridge deck.

E.10.3.2 SOUTH TREASLE-BRIDGE
A bathymetric survey in 2019 indicates that work barges will have insufficient draft (less than 4.5 feet NAVD ‘88) in several areas around the new and existing South bridge-trestles. To allow for barge access, these areas will be dredged. The total volume of material to be removed is approximately 40,000 cy. The Dredging Plan is provided in Appendix L.
The general phasing of the works of this South Trestle-Bridge are shown in Figure E-13 and described below.

- **Phase 1:** Most of the new 8-lane bridge-trestle will be built starting from South Shore, using a temporary trestle to access shallow areas near South Shore and barges. Necessary dredging will also be performed during this phase, in accordance with the dredge plan contained in Appendix L.

- **Phase 2:** A temporary MOT trestle (depicted in yellow in Error! Reference source not found.) will be built from South Island next to the existing eastbound trestle. The eastbound traffic will be shifted on the new MOT trestle to allow for a partial demolition of the existing eastbound bridge-trestle.

- **Phase 3:** Once the partial demolition is completed, the new eastbound connection to the 8-lane trestle will be built with the support of a jump trestle and eastbound traffic will be shifted on it.

- **Phase 4:** A temporary MOT trestle (depicted in yellow in Error! Reference source not found.) will be built from South Island next to the existing westbound trestle. The westbound traffic will be shifted on the new MOT trestle to allow for a partial demolition of the existing westbound bridge-trestle. A portion of the existing eastbound bridge-trestle will also be demolished to allow to build the new connection between the 8-lane structure and the new westbound bridge-trestle.

- **Phase 5:** Once the partial demolition is completed, the new westbound connection to the 8-lane trestle will be built with the support of a jump trestle and westbound traffic will be shifted on it.

- **Phase 6:** The existing two-lane bridge-trestles will be fully demolished to allow to build the last connection to South Shore of the eight-lane structure.
Figure E-13: South Trestle Bridge Construction Sequence

Phase 1 – Build most of the 8-lane structure using marine methods.

Phase 2 – Widen and shift EB traffic to the widening to demolish part of the EB trestle.

Phase 3 – Build the new EB tie-in while traffic is on the widened section. Shift EB traffic on top.

Phase 4 – Widen and shift WB traffic to the widening and demolish part of EB & WB trestles.

Phase 5 – Build the new WB tie-in while traffic is on the widened section. Shift WB traffic on top.

Phase 6 – Demolish the existing structure and complete the south approach.
Similar to the North Trestle-Bridge, pile caps will be set after piles are cut off to the proper elevations, followed by installation of girder bearings, setting of the girders, installation of the utility system, installation of deck panels, reinforcing steel, and placement of concrete for the bridge deck.

E.10.3.3 WILLOUGHBY BAY TRESTLE-BRIDGE
The existing Willoughby Bay Trestle-Bridge structure will be modified by widening the two existing structures to the outside in both directions to accommodate new travel lanes, shoulders, and new sound walls. This will require installation of two to three additional piles at each pier location on the outside of both structures.

The phasing is described below:

Phase 1 – Eastbound widening: Work sequence at this location requires widening of the eastbound trestle-bridge first. Installation of piling, pouring the pile cap, erection of the precast girders and construction of the deck for the widening of this eastbound trestle-bridge will be performed mainly from barges utilizing barge-mounted cranes and from temporary trestles on the shallow edges.

Phase 2 – Westbound widening: Once the eastbound trestle-bridge is complete, traffic (westbound included) will be shifted onto the widened eastbound trestle-bridge. The existing westbound structure will then be available to support the westbound widening works. In this case, the supply of the precast elements, concrete, and rebar will be done from the existing bridge. Cranes required to perform heavy work, like driving piles, will be mounted on temporary structures (jump trestles) that will be moved forward to follow the advancement of the works.

E.10.3.4 MASON CREEK TRESTLE-BRIDGE
I-64 crosses Mason Creek and Oastes Creek via trestle-bridges in the Northside neighborhood of the City of Norfolk. The Mason Creek and Oastes Creek trestle-bridges will be widened.

Phasing of works is similar to the Willoughby Bay Bridge-Trestle widening.

Phase 1 – Eastbound widening: Work sequence requires widening of the eastbound trestle-bridge first. Installation of piling, pouring the pile cap, erection of the precast girders and construction of the deck for the widening of this eastbound trestle-bridge will be performed from temporary trestles.

Phase 2 – Westbound widening: Once the eastbound trestle-bridge is complete, traffic (westbound included) will be shifted onto the widened eastbound trestle-bridge. The existing westbound structure will then be available to support the westbound widening works. In this case, the supply of the precast elements, concrete, and rebar will be done from the existing bridge. Cranes required to perform heavy work, like driving piles, will be mounted on temporary structures (jump trestles) that will be moved forward to follow the advancement of the works.

E.10.3.5 OASTES CREEK TRESTLE-BRIDGE
Phasing of works is similar to the Willoughby Bay Bridge-Trestle widening.
Phase 1 – Eastbound widening: Work sequence requires widening of the eastbound trestle-bridge first. Installation of piling, pouring the pile cap, erection of the precast girders and construction of the deck for the widening of this eastbound trestle-bridge will be performed from temporary trestles.

Phase 2 – Westbound widening: Once the eastbound trestle-bridge is complete, traffic (westbound included) will be shifted onto the widened eastbound trestle-bridge. The existing westbound structure will then be available to support the westbound widening works. In this case, the supply of the precast elements, concrete, and rebar will be done from the existing bridge. Cranes required to perform heavy work, like driving piles, will be mounted on temporary structures (jump trestles) that will be moved forward to follow the advancement of the works.

E.10.4 ROADWAY EXPANSION
For the Hampton approach, a new bridge will tie-in between the existing I-64 West and I-64 East, requiring roadway realignment. Initial work will start with widening the new I-64 westbound lanes and outside shoulders, associated drainage systems, and relocation of private and VDOT utilities. Construction of the new bridge abutments will start during this phase. I-64 eastbound will be widened to accommodate new lanes and construction of the new area for the inspection station. Once widenings to the outside are complete, traffic and barrier service will be shifted to make way for pavement construction, median barrier removal, and construction of the new median pier for the new Mallory overpass.

For the Mallory Street Bridge replacement, demolition of the existing bridge will be completed in stages, starting with realignments of the existing travel lanes and pedestrian access on the bridge, utility relocations, and adjustment of the traffic signals. Crews will install traffic barriers across the bridge to isolate sections of the bridge to be demolished. Demolition of the structure will be performed during the night shift, with nightly lane closures on I-64 westbound and eastbound. Once partial demolition of the structure is complete, the new bridge will be constructed along the existing trestle-bridge.

For the Norfolk approach, each existing bridge will be widened and sound walls will be constructed. A hurricane evacuation crossover will also be constructed west of the 4th View Street interchange. Crossovers for emergency use will be provided at both the Hampton and Norfolk approaches.

Barricade fencing will be placed around all non-impacted wetlands and streams. Temporarily impacted areas will be restored after construction. Erosion and Sediment Control Best Management Practices (BMPs) will be employed at all construction sites in accordance with the VPDES Construction General Permit. Stormwater Management features are discussed in detail in Appendix T: Stormwater Facilities.

E.10.5 MATERIALS MANAGEMENT
Both on-island (upland) and in-water construction activities will generate materials requiring management, removal, and disposal. There are eight primary types/sources of material requiring management for the HRBT Project:
- Dredged material mechanically removed within the limits of the North and South Island expansions to improve foundation conditions and to remove obstructions, and around the South Trestle-Bridges to increase water depth for safe marine construction operations.
- Ground improvement materials, including jet grout residuals (JGR), displaced during stabilization of unsuitable subsurface material (on-island and in-water), and residuals created during construction of the break in/breakout plug.
- Excavated materials from slurry wall construction.
- Excavated material from the construction of the entry/launch and exit/receiving portals and the tunnel approaches (both portal islands).
- Excavated/bored material from the TBM (in-water and subsurface).
- Concrete generated from the trestle demolition.
- Excavated upland soils from roadway construction.
- Upland cut and fill at select roadway areas.

The in-water construction activities that will generate material requiring management, removal, and disposal include: 1) dredging of surficial sediments within the footprint of the island expansions; 2) dredging at select locations along the trestle alignment where water depth is shallow and barge access is necessary; 3) jet grouting operations north of the South Island to improve sediment characteristics for TBM operations; 4) trestle demolition; 5) amended, bored material from the tunnels; and, 6) removal of the existing armor rock associated with the island expansions. The volume of material estimated to be generated for each category is provided in further detail in Appendix L: Material Management Plan. Material placement options include onsite re-use (suitable material only) and offsite disposal at approved locations.

See Appendix L: Material Management Plan for more information about material placement options.

**E.10.6 MARINE OPERATIONS & LOGISTICS**

All in-water construction activities will take place outside of the Federal navigation channels, and vessels and barges associated with the HRBT project will be required to avoid obstruction and interference to navigation within the channels and F anchorage.

Formal coordination under Section 408 with the U.S. Coast Guard, U.S. Navy and the maritime community will take place prior to initiation of construction activities, and a formal communication plan will be executed to relay in-water project information and to facilitate transfer of information among the maritime users.

**E.10.6.1 MARINE OPERATIONS PLAN**

The Marine Operations Plan for Construction (currently under development as part of the Section 408 process) and Tunnel Construction Plan (TCP) will provide details on vessels and equipment likely to be used, temporary mooring and anchoring areas to be constructed, procedures for daily operations and communications within and outside of the Norfolk Harbor Entrance Reach Channel and Anchorage F, vessel mobility limitations, and contingency plans for weather related incidents. It is the intent of HRCP
to implement operational practices that will either avoid or minimize impacts to navigation within the channel and will allow for safe passage of vessels and safe conditions for work-related vessels.

E.10.6.2 VESSEL FLEET
Vessels for construction include:

- Crane barges
- Supply/material barges
- Tug boats
- Crew boats

Table E-3 presents the estimated number of vessels at peak by structure:

Table E-3: Estimated Number of Vessels at Peak by Structure

<table>
<thead>
<tr>
<th>Location</th>
<th>Vessels at peak</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Trestle-Bridge</td>
<td>15 working barges, including:</td>
</tr>
<tr>
<td></td>
<td>• Crane barges up to 250x350 ft</td>
</tr>
<tr>
<td></td>
<td>• Supply barges, up to 250x350 ft</td>
</tr>
<tr>
<td>South Trestle-Bridge</td>
<td>25 working barges, including:</td>
</tr>
<tr>
<td></td>
<td>• Crane barges up to 250x350 ft</td>
</tr>
<tr>
<td></td>
<td>• Supply barges, up to 250x350 ft</td>
</tr>
<tr>
<td>Willoughby Bay Trestle-Bridge</td>
<td>15 working barges, including:</td>
</tr>
<tr>
<td></td>
<td>• Crane barges up to 250x350 ft</td>
</tr>
<tr>
<td></td>
<td>• Supply barges, up to 250x350 ft</td>
</tr>
<tr>
<td>North Island</td>
<td>15 working barges:</td>
</tr>
<tr>
<td></td>
<td>• Supply barges, up to 360x60 ft</td>
</tr>
<tr>
<td>South Island</td>
<td>15 working barges:</td>
</tr>
<tr>
<td></td>
<td>• Supply barges, up to 360x60 ft</td>
</tr>
</tbody>
</table>

Barge operation areas – including possible anchors – around the North Trestle Bridge, the North Island, the South Island, the South Trestle Bridge, the Willoughby Bay Trestle Bridge and Willoughby Spit are indicated on drawings Figure E-14, Figure E-15, and Figure E-16.
Figure E-14: Barge Operation Areas - North Trestle Bridge
Figure E-15: Barge Operation Areas - South Trestle Bridge
E.10.6.3  WILLOUGHBY SPIT
HRCP has been granted use of property on Willoughby Spit next to the South Trestle-Bridge. It will be used for laydown areas and as a base for marine operations. Two temporary piers will be constructed to allow barge access: one will be a fixed trestle on 36-inch pipe piles, and the other will be a floating dock on 36-inch spuds. Piles will be installed using vibratory and impact hammers, as well as a pile template. The existing bulkheads located on the inside of Willoughby Bay will be replaced, and three timber piers will be built for crew boats access.

E.10.6.4  HARBOR OF SAFE REFUGE
In the case of a significant weather event, two safe harbor locations have been identified in the vicinity of the project.

- Willoughby Bay: Mooring piles (steel pipe piles, 36-inch diameter) will be installed with a vibratory hammer
- Hampton Flats: Anchors and mooring buoys will be used.
- Many vessels will have the option of returning to their homeport

The location of mooring areas is shown in Figure E-17. The schedule for installation of the mooring areas is provided in Appendix N.

Figure E-17: Mooring Areas

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**E.10.7 REMOVAL OF TEMPORARY STRUCTURES**

All temporary structures will be removed once works have been completed, including:

- Temporary work trestles for the construction of the North and South Trestle-Bridges, Bay Avenue Bridge at Mason Creek, Oastes Creek near Bayview Blvd., and the Willoughby Bay Trestle-Bridge
- TBM quay and conveyor trestle
- Temporary trestles for off-shore ground improvement north of the South Island
- MOT trestle-bridges
- Jump trestles

As discussed earlier, jump trestles are built with a maximum of three spans which are progressively uninstalled and reinstalled one span at a time, moving forward with the construction of the adjacent structure. All other piles will be vibrated out or cut two to three feet below the seabed.

E.10.8 DEMOLITION AND REMOVAL OF EXISTING STRUCTURES

Approximately 80,508 cy of concrete debris will be collected during demolition of the permanent trestles. The concrete debris is planned to be transported offsite (Chesapeake Bay and tributaries) to be utilized for the creation of an artificial reef. This idea has been discussed in multiple monthly environmental update meetings with Virginia Marine Resources Commission (VMRC) and other stakeholders. Offsite disposal is a secondary option if the concrete is not suitable for placement at the reef sites. All other demolition debris for either the permanent or temporary trestles will be disposed at an approved disposal facility. See Appendix L: Material Management Plan for more information on beneficial re-use of existing structures to construct an artificial reef.
E.11 REFERENCES


