APPENDIX – L

MATERIALS MANAGEMENT PLAN

I-64 Hampton Roads Bridge-Tunnel Expansion Project

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ATTACHMENTS

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LIST OF ACRYONMS

BMP	Best Management Practice
CWA	Clean Water Act
Cy	Cubic yard(s)
DGPS	Differential Global Positioning System
DMMP	Dredged Material Management Plan
DO	Dissolved oxygen
DQO	Data quality objective
Ft	Foot or feet
HRBT	Hampton Roads Bridge Tunnel
JPA	Joint Permit Application
mg/L	Milligram(s) per liter
MMP	Material Management Plan
NTU	Nephelometric Turbidity Unit
QA	Quality Assurance
QC	Quality Control
S&TP	Separation and Treatment Plant (for TBM)
STP	Slurry Treatment Plant
TBM	Tunnel Boring Machine
USACE	U.S. Army Corps of Engineers
VDEQ	Virginia Department of Environmental Quality
VMRC	Virginia Marine Resources Commission
VPDES	Virginia Pollutant Discharge Elimination System
WQMP	Water Quality Monitoring Plan
WTP	Water Treatment Plant

L. MATERIAL MANAGEMENT PLAN

This Material Management Plan (MMP) provides a comprehensive overview of potential placement alternatives for upland, on-island, and in-water materials generated during construction activities, describes the material characteristics, as well as describes the construction operational factors used to determine the most feasible placement/disposal options for the various source materials.

L.1 PROJECT DESCRIPTION

The Hampton Roads Bridge Tunnel Expansion Project ("Project") will widen I-64 for approximately 9.9 miles along I-64 from Settlers Landing Road in Hampton, Virginia to the I-64/I-564 interchange in Norfolk, Virginia. The Project will create an eight-lane facility with six consistent use lanes. The expanded facility will include four general purpose lanes, two new HOT lanes, and two new drivable (hard-running) shoulders to be used as HOT lanes during peak usage.

The Project will include full replacement of the North and South Trestle Bridges, two new parallel tunnels constructed using a Tunnel Boring Machine (TBM), expansion of the existing portal islands, and widening of the Willoughby Bay Trestle Bridges, Bay Avenue Trestle Bridges, and Oastes Creek Trestle Bridges. Also, upland portions of I-64 will be widened to accommodate the additional lanes, the Mallory Street Bridge will be replaced, and the I-64 overpass bridges will be improved.

L.1.1 PROJECT PURPOSE AND BACKGROUND

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.

The Intermodal Surface Transportation Efficiency Act of 1991 provided funding for the Hampton Roads Crossing Study (HRCS), which considered potential improvements options to relieve congestion at the HRBT. In 2014, the Hampton Roads Transportation Accountability Commission (HRTAC) included the HRCS in its list of priority projects, which led to the development of the Supplemental Environmental Impact Statement (SEIS) to evaluate options for this crossing. In December 2016, the Commonwealth Transportation Board approved "Alternative A" as the preferred alternative for this study, laying the groundwork to complete the SEIS and obtain a Record of Decision (ROD) in June 2017. An Environmental Assessment (EA) Re-evaluation was prepared in June 2018 to account for changes to managed traffic lanes in the I-64 corridor, resulting in a Finding of No Significant Impact (FONSI) issued by the Federal Highway Administration (FHWA) on October 23, 2018.

As part of this transportation improvement project, various materials will be generated that will require management in accordance with Federal, State and Local regulations. This MMP has been developed to:

- Identify the available onsite reuse or placement options for the HRBT on-island, in-water and upland source materials.
- Identify the available offsite reuse or disposal options for the HRBT on-island, in-water and upland source materials.
- Describe the expected physical and chemical characteristics of the source materials proposed for removal and disposal.
- Provide the proposed placement plan for the primary types of source material.
- Detail the proposed onsite material handling/processing facilities and the offsite transportation methods.
- Detail the proposed on-island and in-water construction methods, schedule, sequence, and equipment.
- Discuss best management practices (BMPs) that will be utilized to avoid and/or minimize aquatic impacts during in-water construction activities and during material removal, processing and transportation.
- Describe monitoring to facilitate corrective actions during in-water activities.

This MMP will be updated and revised as additional information becomes available, if material handling processes are modified, or if new disposal options are identified. The modified MMP will be submitted to all permitting agencies for approval/concurrence.

L.1.2 PROJECT LOCATION

Project improvements will occur in the I-64 corridor between Settlers Landing Road in Hampton and I-564 in Norfolk. The Project lies within the Hampton Roads watershed (HUC 02080208), which is nested at the mouth of the 10,300 square mile James River drainage basin of the Chesapeake Bay (USGS National Water Information System). 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 and served by the Project.

The Project Location and Limit of Disturbance (LOD) determined during the National Environmental Policy Act (NEPA) process are shown on Figure L-1.

Figure L-1: Project Location and NEPA Limit of Disturbance

Source: FHWA (2017) HRBT Expansion SEIS

L.1.3 DESIGN AND CONSTRUCTION OVERVIEW

This Project includes the design and construction of approximately ten miles of improvements to the I-64 corridor between Settlers Landing Road Interchange in Hampton and I-564 in Norfolk.

The Project area is shown in Figure L-1. The improvements include widening I-64 in the Project area to create a consistent six lane facility between the I-64/I-664 and I-64/I-564 Interchange, which could expand to eight-lanes during peak travel periods with the use of two general purpose lanes, one permanent HOT lane, and one drivable shoulder which will be used as a part-time HOT lane each way within the Project limits. The additional lane and part-time shoulder lane in each direction will be operated as high occupancy transport (HOT) managed lanes. The new configuration will result in two general purpose lanes and one new permanent and one part-time 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. A full bridge replacement is planned for the Mallory Street interchange and the remaining bridges, including Willoughby Bay, and roadway within the Project will be widened. During construction the existing tunnels will continue operations. Upon completion of the new tunnels, two tunnels will be used for east bound traffic and two tunnels will be used for west bound traffic. The design is divided into five segments, as shown on Figure L-2, as follows:

- 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 trestle bridges. 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 trestle bridges, including any approach slabs. This segment covers approximately 0.6 miles along I-64.
- Segment 2 (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 Bridges) includes the new south tunnel approach trestles 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 Bridges and ends at the north end of the north approach slabs for the Willoughby Trestle Bridges. 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 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.

Table L-1: HRBT Expansion Project Design Segements

Design Segment	Construction Area
Segment 1a (Hampton)	Area 1
Segment 1b (North Trestle Bridges)	Area 2
Segment 2 (Tunnel)	Area 3
Segment 3a (South Trestle Bridges)	Area 2
Segment 3b (Willoughby Spit)	Area 4
Segment 3c (Willoughby Trestle Bridges)	Area 2
Segment 3d (4th View Street Interchange)	Area 4
Segment 4a (Norfolk-Navy)	Area 4
Segment 5a (I-564 Interchange)	Area 4

Figure L-2: HRBT Design Segments and Key Map

The new parallel tunnels will be bored under the Hampton Roads Channel using a tunnel boring machine (TBM). The 7,900 linear foot (ft) (each way) tunnels will be constructed under the 1,000-ft-wide navigation channel.

The TBM will bore a tunnel approximately 45 feet in diameter in one pass that will accommodate two new lanes of traffic. Two tunnels parallel to each other will be constructed to allow for four new lanes of traffic. The TBM will bore through native sediments below the channel from South to North and then turned around to construct the parallel bore North to South. Material excavated from within the tunnel through the TBM will be transported via a closed slurry piping

system back to the South Island where the excavated materials (approximately 1,416,000 cubic yards (cy) (bulked volume) will be filtered out of the slurry at the Separation and Treatment Plant (S&TP). A separation process will occur at the S&TP, resulting in the generation of three solid waste streams segregated by grain size:

- Coarse-grained (> 0.6 millimeter (mm)) materials will be screened
- Fine-grained materials (<0.6 mm and greater than U.S. No. 200 Sieve) will be removed by hydro-cyclone
- Filter cake will be the final product resulting from a filter press operation.

The solid materials will be characterized for beneficial use or will be disposed offsite at a permitted facility. Slurry, after treatment by the hydro-cyclones, will be partially recycled for the slurry mix for TBM operation. Remaining excess slurry is further processed through a filter press. The filtrate water will go through a Water Treatment Plant (WTP) for final treatment prior to discharge under a Virginia Pollutant Discharge Elimination System (VPDES) Industrial Permit.

In addition to on-island construction of the entry/exit portals, the islands will be expanded to facilitate construction of the Tunnel Approach Structures (TAS) and launch pits. Island expansion will be accomplished using: clean island fill generated by site activities, imported fill material, gravel or crushed rock, and island shore protection including rip rap armor stone. The areas where on-island activities will occur are depicted in Figure L-3 (North Island) and Figure L-4 (South Island).

Figure L-3: North Island Layout

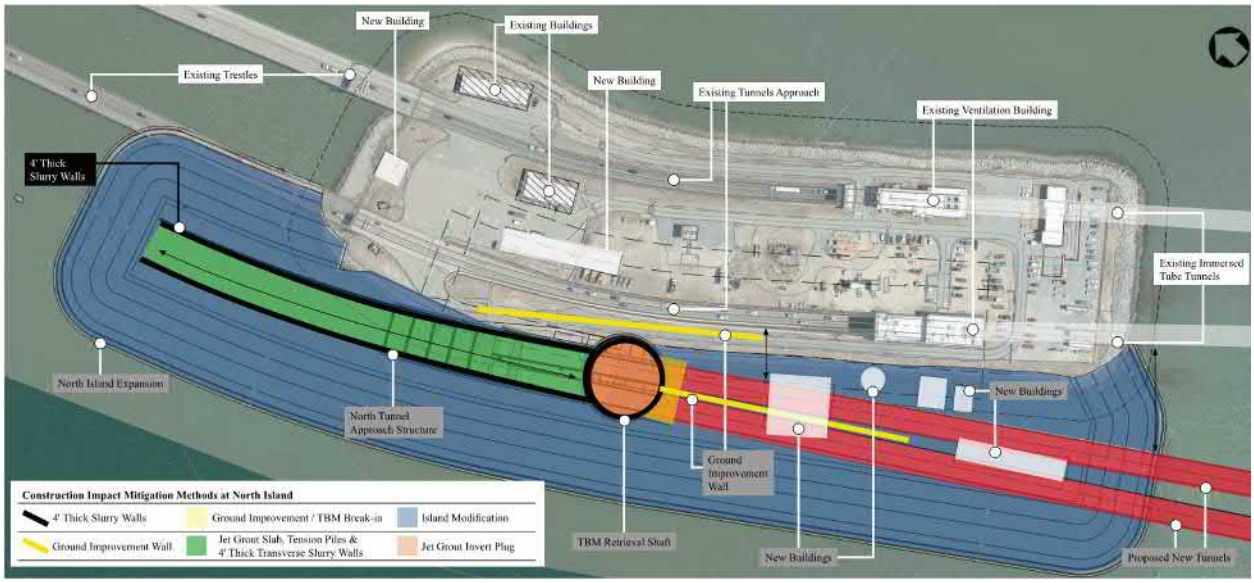
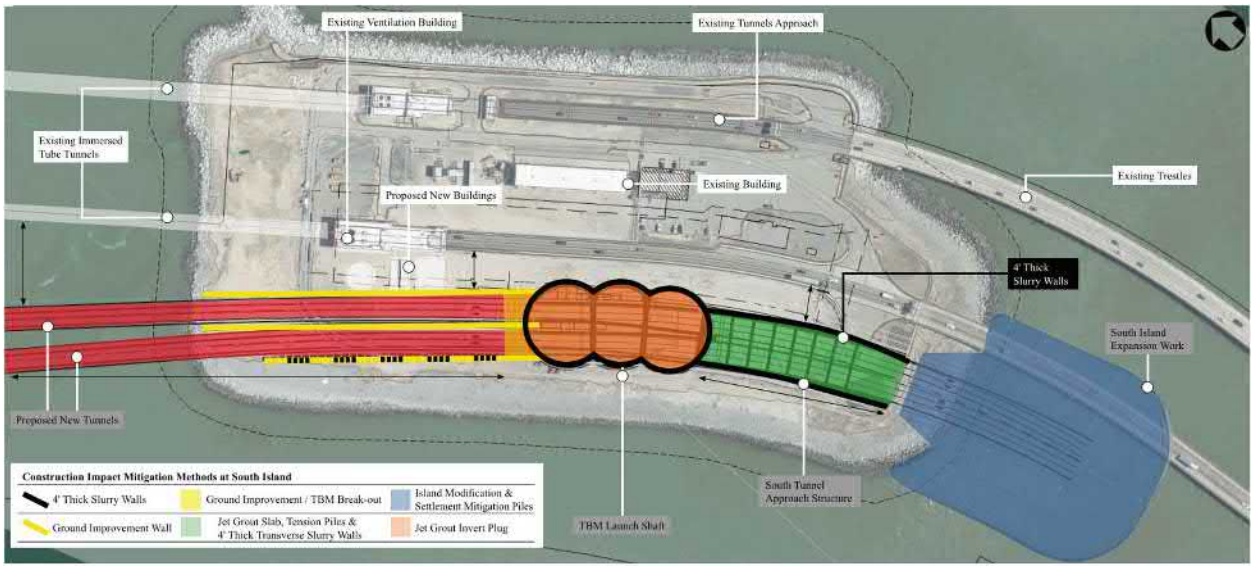


Figure L-4: South Island Layout



On-island, upland construction activities will generate materials requiring management, removal, and disposal. The on-island activities include:

- Jet grouting to stabilize excavation of the portals on both islands
- Slurry wall construction
- Excavation of the entry/exit portals and tunnel approaches at the North and South Islands
- Break-in and Break-out material are captured through TBM boring, and materials separated and treated the same as TBM spoils

Upland construction will consist of cut and fill operations across the segments not associated with the tunnel or tunnel support facilities. The construction of the upland roadway segments identified 102,000 cubic yards (cy) of cut and 97,500 cy of fill indicating an excess of 4,500 cy for disposal. In addition, some upland construction activities will require excavation of 27,500 cy of material. The excess material will be disposed of at a permitted facility. The intent of the final design and groundworks is to minimize excess and reuse as much as possible. Soils located in the right-of-way and material excavated for uplands roadwork may have impacts from adjacent site uses and will require evaluation and characterization prior to excavation or immediately during removal for determining re-use or off-site disposal in accordance with the Virginia Solid Waste Management Regulations (VSWMR).

The in-water construction activities that will generate material requiring management, removal, and disposal include:

- Dredging of surficial sediments within the footprint of the island expansions;

- Dredging at select locations along the trestle bridge alignment where water depth is shallow and barge access is necessary;
- Jet grouting operations north of the South Island to improve sediment characteristics for TBM operations;
- Extraction of soil from casing during pile installation;
- Trestle bridge demolition;
- Amended, bored material from the tunnels; and,
- Removal of the existing armor rock associated with the island expansions.

L.1.4 CONSTRUCTION SCHEDULE

Currently, the Project construction is planned to begin at the end of 2019 with preliminary works on South Island (utility relocation, paving, etc.). Marine works are scheduled to begin in the second quarter of 2020, with project completion anticipated in 2025.

The Project construction is divided into three main phases: 1) Design, 2) Permitting, and 3) Procurement and Construction. It should be noted that some activities will occur simultaneously. Phases 1 and 2 (Design and Permitting) were initiated in early 2019 and are expected to continue through 2020 and include the following:

- Baseline Site Instrumentation;
- Geotechnical Investigations (on land in in-water borings);
- Preparation and Submission of Permits Application, and;
- TBM Design and Contract Procurement.

Phase 3 (Procurement and Construction) is anticipated to take place from April 2020 through June 2025. All in-water construction work will occur during Phase 3. A Linear schedule showing the expected duration and concurrent activities across all segments of construction for the Project is provided as Attachment L-1.

L.1.5 CONSTRUCTION EQUIPMENT AND SEQUENCE

On-island and upland construction will require equipment to include, but not be limited to: TBM and support, S&TP, WTPs, STPs, pile drivers, excavators, cranes, bulldozers, and skid steers.

In-water construction will require mobilization of multiple pieces of marine equipment to include, but not be limited to, one or more mechanical bucket dredges, towing 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 Project site and to transport material offsite for stockpiling or for disposal during

the in-water construction period. Tunneling will be performed by the Multi-mode Variable Density TBM.

Materials requiring management, removal, and disposal will be produced during Phase 3 from various construction activities utilizing different equipment. Those activities, equipment and sequence are summarized in the following subsections.

L.1.5.1 JET GROUTING

Jet grouting will be used in areas where the subsurface has insufficient geotechnical properties. In the process of jet grouting, a portion of the in-situ sediments being stabilized is displaced. Jet grouting is a technique used to directly inject a concrete-like material into subsurface environments to stabilize an area (Figure L-5 and Figure L-6). A single fluid system consisting only of air, water and grout will be used for the jet grouting. 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%). The grout column is created by first advancing the drill stem to the design depth, then powerful jets are used to inject the grout and mix the sub-surface soil while the drill stem and grouting monitor are slowly withdrawn. As the drill stem is withdrawn, it is simultaneously injecting, stirring, and mixing the grout and eroded soil materials together to form a solid grout column-like structure within the radius of the mixing/jetting zone. Residuals consisting of residual/displaced materials and water from jet grouting are returned to the surface via a pipe (the outer casing). When jet grouting has been completed to the desired elevation for each hole, the injection will cease, and the drill rod will be raised to the mudline elevation. This will create a plug on each hole several feet below the mudline to prevent the return flow of an adjacent column up to the seabed floor. At this point, water will be injected through the drill rod in order to flush out the casing up to the surface. When the return flow coming to the surface is clean water, the flushing will cease, and the drill rod will be removed from the casing. At this point, the casing will be safely removed from the sediments.

To minimize risk of a release of jet grout residuals (JGR) from the jet grouting operations an initial receiving tank is being sized to add redundancy to the environmental protection measures. The specified storage tank with a capacity of 3,000 gallons will be used, which will not be filled above 75% maximum capacity. The anticipated flow rate of jet grout spoils is to approximate 175 gallons per minute (gpm) while the pump capacity will have a flow rate of 400 gpm. This provides a safety factor greater than 2. Should the pump not be removing material from the initial storage tank, the 3,000 gallons has the capacity to operate for approximately 17 minutes, while the intent is to be pumping continuously, if the storage tanks capacity will be exceeded all the jet grouting operations will be ceased. In addition, during jet grouting operations there will be a minimum of three people on site; the supervisor, the drill rig operator, and the pump operator/laborer. The primary person in charge of the tank and pump is the pump

operator/laborer. Pumping capacity is more than twice the flow rate and the storage tank and ancillary equipment is within direct eye-sight of the drill rig operator who will be able to stop the jet grout operation immediately and stop the flow of JGR into the tank. Additional measures include having other supervisory personnel observe overall operations: these personnel will have stop work authority in the event of an indicated leak or operational issue. Other measures are discussed under BMPs in section L.4.1.

Figure L-5: Schematic of Jet Grouting Process

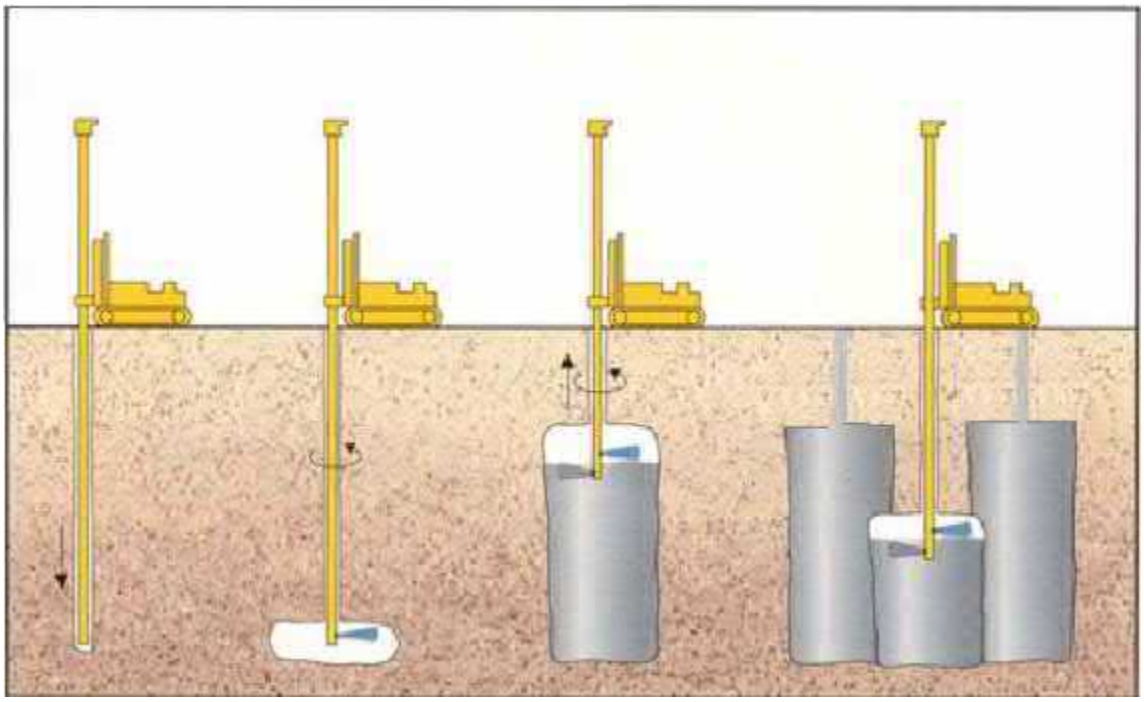
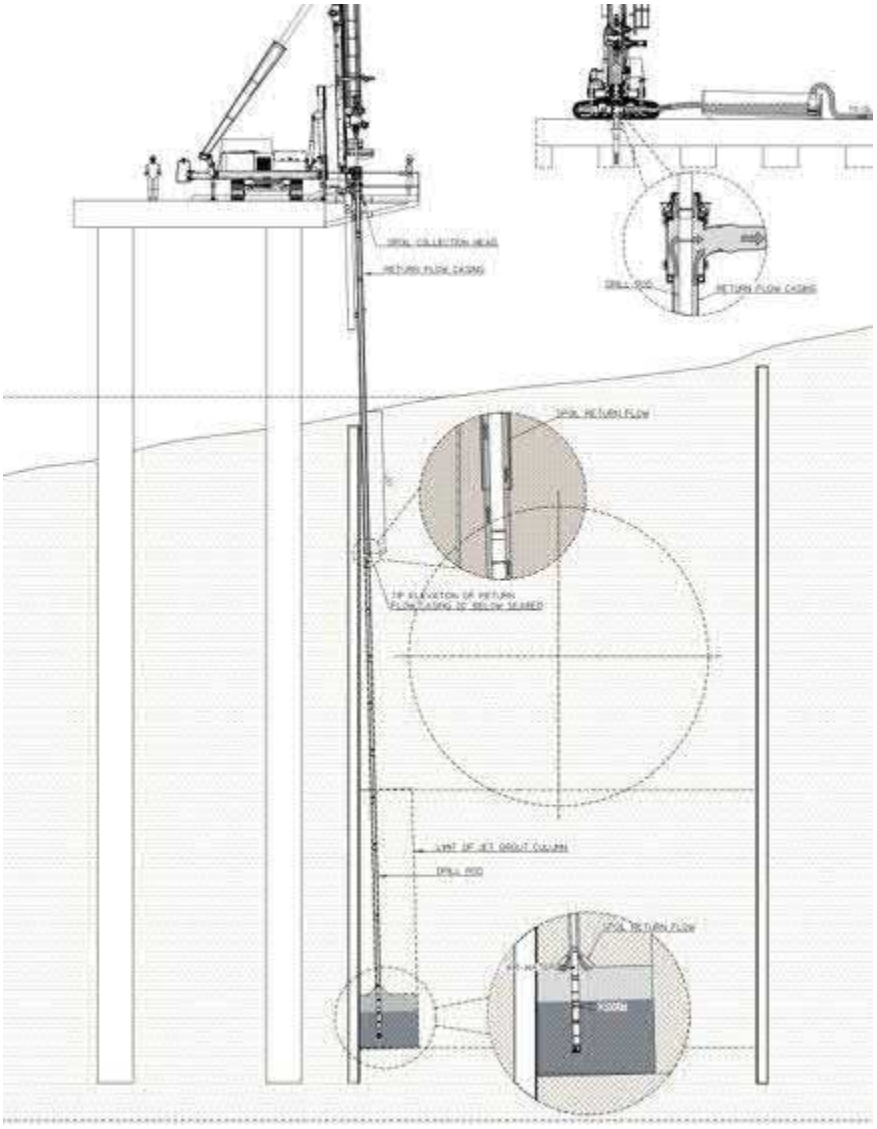


Figure L-6: Jet Grouting from Trestle Bridge Diagram



All spoils will go through the STP. Residual material will be transported to a dedicated disposal area offsite. Water from the spoils will be partially reused for the grout and remaining water will go through the WTP for further treatment (such as pH) prior to discharge under a VPDES permitted outfall.

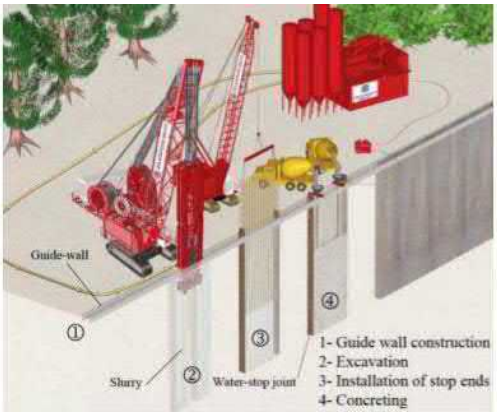
For off-shore Ground Improvements (GI), which is activity being conducted off of the trestles such as jet grouting, will be performed from temporary trestles. A steel casing between the grout plant at trestle bridge level and 20 feet below river bottom is set to control the return of spoils and prevent spillage. Spoil is returned to the island via a double wall slurry pipe with

environmental protection procedures as described above. There will be a STP and a WTP on each island to treat jet grout and slurry wall residuals.

L.1.5.2 SLURRY WALL

As part of the construction of the tunnel entrances, slurry walls are to be constructed to stabilize the surrounding area of the tunnel approach structure TAS. An initial guide wall is constructed, then each panel of slurry wall is excavated, and bentonite slurry is tremied into the void space to maintain excavation competence and prevent collapse of side walls. As the process proceeds there is displacement of slurry and cementitious material which is contained, captured and subsequently treated for separation of solids necessary via de-siltation and de-sanding either by mechanical means or utilizing decanting techniques. The excess water is monitored for pH and adjusted prior to discharge. Similar to JGR capture and control including secondary containment, slurry wall residuals will be contained and containerized for treatment through the WTP.

Figure L-7: Schematic of Slurry Wall Construction



L.1.5.3 ENTRY/EXIT PORTAL CONSTRUCTION

The South Island TAS is 1,130 feet long, 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 a 980 foot long, 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.
- 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%).

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.

L.1.5.4 DOCK AND CONVEYOR BELT CONSTRUCTION

A dock will be constructed on the South Island adjacent to the entry/exit portal to facilitate delivery and removal of the TBM. The TBM dock is a steel structure, approximately 165 feet long by 110 feet wide. Piles will be installed for support from land prior to construction of the dock. Armor rocks may be removed during installation and replaced after pile installation. Installation from a barge may also be required for the in-water piles. An enclosed slurry transfer pipe will convey materials from the tunnel portal to the S&TP. The solids separated from the slurry at the S&TP will be transferred to barges for disposal via a conveyor system. Separated solids for disposal from the S&TP will be transferred via front end loader in the solids contained area to the conveyor loading hopper. The covered conveyor then transfers the solids directly into the barge. The conveyor support is a steel structure of approximately 675 feet long and 27.5 feet wide. The covered conveyor belt structure will be supported with 24-inch piles installed from the land. The conveyor support area will also be used for maintenance and mooring of delivery vessels for TBM delivery, and other construction materials.

Upon completion of the tunnel installation, the quay and conveyor belt will be removed. The piles will be removed or cut 2 to 3-feet below the mudline.

L.1.5.5 TUNNEL BORING MACHINE

Twin 45 feet diameter tunnels will be excavated adjacent to the existing HRBT tunnels between the South and North Island Approach Structures. The tunnels will be excavated using a single multi-mode Variable Density TBM. The main elements of the TBM will be delivered by barge to a temporary dock on South Island with smaller TBM components and parts being delivered by truck. The TBM will be assembled in the launch shaft (Approach Structure) using high capacity cranes.

The TBM will excavate at depths varying from approximately 40 to 150 feet below the water surface, measured at the tunnel axis. At these depths, the geology varies between soft to stiff cohesive material and loose to dense sands, traversing different combinations of mixed-face conditions. Attachment L-2 depicts the tunnel alignment in relationship to the surface of the water. The TBM will also bore through subsurface areas with ground improvements. A geologic stratum with poor geotechnical properties exists along a portion of the tunnel alignment just beneath and to the north of South Island. Ground improvements will be used to strengthen this soil (Sections L.1.5.1, L1.5.2).

Bored material removed from the face of the tunnel will be carried in bentonite-based slurry with other slurry amendments. This slurry mix will be pumped hydraulically to a S&TP located on the South Island near the launch shaft. The S&TP will remove solids, and the treated slurry will be pumped back to the tunnel face to support the excavation. This TBM technology does not use foaming agents. Tunnel lining works will occur behind the TBM drive, followed by finishes, fire and life safety, and mechanical, electrical, and plumbing (MEP) systems. 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 the TBM reaches North Island, a U-turn will be performed within the reception shaft for excavation of the second tunnel. The TBM supply lines and slurry circuit will be through the first tunnel, and therefore the supplies and spoil removal will remain on the South Island.

The TBM delivery and assembly is expected to take 6 months to complete. For the TBM launch and operation, Drive 1 is expected to take approximately 16.5 months to complete, moving south to north, and Drive 2 is expected to take approximately 16 months to complete, moving north to south. Work shifts are under evaluation to optimize costs. Production will occur in 2 shifts per day, 12 hours per shift. Work will occur 5 days per week with maintenance occurring on weekends. In Drive 1 there will be no ballast installation behind the bore. This will be done once the first bore is completed. Drive 2 considers downtime for ballast installation behind the boring. This will be a concurrent activity.

Table L-2 shows the quantity of TBM spoils expected to be processed through the S&TP.

Table L-2: Type and Quantity of TBM Spoils Processed through the S&TP

Type	Quantity
Sand Production	6,290 t/day ~4,110 cy/day
Cakes (bentonite + clay) Production	1,715 t/day ~ 1,300 cy/day
Total Spoils Processed through S&TP	8,000 t/day ~5,400 cy/day
Fresh Water Consumed	2,160 cy/day
Discharge Water	358 cy/day

L.1.5.6 ISLANDS EXPANSION

To provide sufficient space for the construction of the HRBT expansion, including support facilities, both the North and South Islands will be expanded as shown in Figure L-3 and Figure L-4. The launching shaft is located on South Island and doesn't require any island expansion to be built. Depending upon the results of chemical and physical characteristics testing, the material for the North Island expansion may be constructed from spoils material from the excavation of the portal on the South Island. If the material is determined to be unsuitable, acceptable material will be imported to facilitate construction.

North Island: North Island will be expanded to accommodate the new tunnels, the receiving shaft and TAS. Construction activities sequencing includes:

- Installation of a cutoff wall onshore including 170 36-inch piles;
- Installation of offshore steel sheet piles to facilitate island construction;
- Dredging to remove sediment and clean any obstructions;
- Install exterior protection:
    - Armor rock removal as needed;
    - Mooring pile installation;
    - Sheetpiles
    - Bund placement;
    - Underlayer placement;
    - Armor rock placement;
- Install island interior:
    - Armor rock removal
    - Fill material placement and compaction

Mechanical dredging will be required at the North Island to remove surficial materials to create the island expansion to provide a stable toe of the land. A mechanical style grapple bucket will be used to remove any armor stones and obstructions. An environmental bucket will be used to remove the sediments. Sediments will be disposed directly to an approved disposal location via barges.

The armor rock will be removed and disposed to an approved disposal location or reused if compliant with the Technical Requirements.

Mooring piles will be installed every 40 feet around the island expansion footprint. Following construction completion, the piles will be vibrated out or cut 2 to 3 feet below the mudline following standards from the Coast Guard and the Army Corps of Engineers (USACE).

The following items will be placed from barges using a crane or long reach excavator with either a mechanical style grapple bucket, driver hammer or vibratory hammer for the exterior protection:

- Sheet piles along the edge of the future shaft location (seaward side)
- 165,000 cy bund (gravel or crushed rocks, Dmax = 4-inch) along the seaward side of the island extension;
- The underlayer rocks will be installed on the seaward side of the bund and consists of 101,650 tons of the first layer (inner) of armor (W50 = 0.65 tons) and 48,150 tons of underlayer (W50 = 100 lb). Please note W50 is a weight size of rip rap; and,
- 160,000 tons of armor rock.

Existing armor stones at the north-west and south-west corners of the North island will have to be removed to allow for bund placement. To ensure the island will be protected at all times, the stones will be stockpiled for a few days on the North Island in the event of an upcoming weather event. Once the bund has been placed at these corners, the armor stones will be disposed of, or reused for slope protection.

Once the exterior stones protection has been placed (bund, underlayer rocks and armor rocks), the existing armor rocks along the west side of the island will be removed to allow to fill the island interior. Stones will be disposed to an approved disposal location or reused for slope protections. 200,000 CY of clean fill will be installed using several conveyor systems placed on the bund and barges equipped with either a crane or long reach excavation. Vibro-compaction and dozers will be used to compact the fill material within the exterior protection. The dozers will place the soils. Vibro-compaction of the island infill will be performed in a grid pattern over the plan area, lowering a vibratory probe into the ground to densify loose soils. The probe may be advanced through the fill material using water jetting.

South Island: While the South Island is wide enough to accommodate the launching shaft, it needs to be expanded to accommodate the transition between the trestle bridge abutment and the tunnel approach structure.

Mechanical dredging will first be conducted to improve foundation conditions. The spoils will be transported by barge to an offsite disposal location.

Due to poor ground conditions, 24-inch steel pipe settlement reduction piles will be driven to a depth of -95 feet under the footprint of the island expansion. Sheet piling will subsequently be installed followed by the installation of 30-inch pipe piles filled with concrete and a second set of sheet piles to enclose a portion of the tunnel approach structure. All pile and sheet piling installation activities will be conducted from barges using vibratory and impact hammers. All pile and sheet piling will remain after construction is complete.

The sheet-pile enclosure will be filled using clean fill material as designated from the design, bund material (4-5 – inch stone) for outer rim area armored on the edge exposed to the water's edge, and clean general fill for interior of island. This material is installed from a barge using a

crane using a mechanical style grapple bucket or a long reach excavator. Additional sheet pile will be installed onshore along the trestle bridge alignment, and the interior of this area will receive 36” concrete filled pipe piles. The remaining soil fill will be placed from a barge or via truck.

Figure L-8: North Island Expansion Proposed Sheet Pile Wall

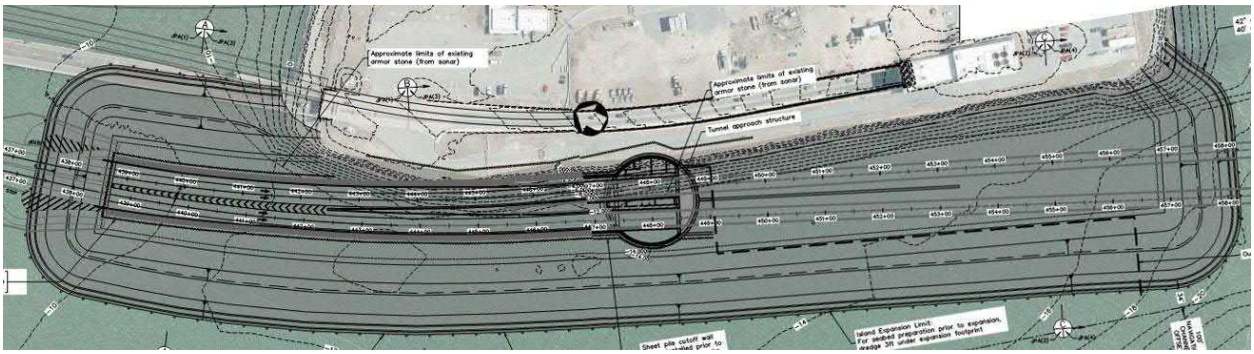
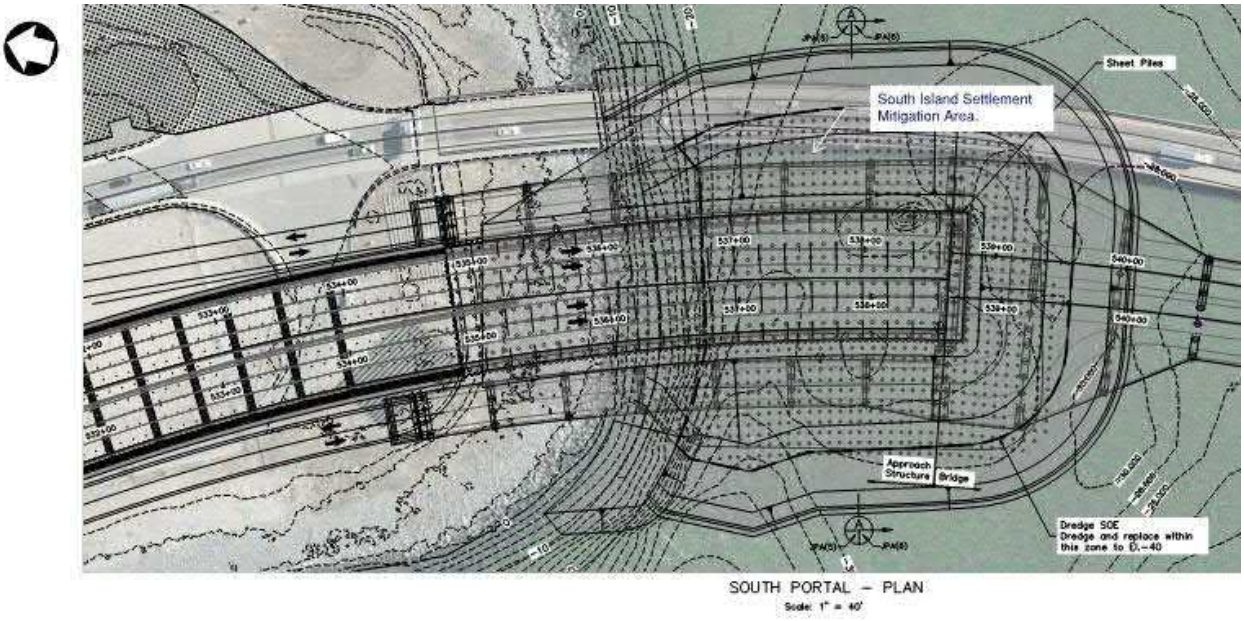


Figure L-9: South Island Expansion Proposed Sheet Pile Wall and Piles



L.1.5.7 MECHANICAL DREDGING

Mechanical dredging will be conducted at the South Island expansion, North Island Expansion and select locations between the South Island and Willoughby Spit. Operational BMPs to minimize turbidity may include: pausing of the bucket after ascent through the water column to allow free water to drain prior to swinging the bucket to the barge; verifying that the bucket is closed prior to raising it to the surface; prevention of overfilling the bucket to minimize additional

loss of material during ascent through the water column; and adjustment (reduction) of bucket ascent rate.

L.1.5.8 TRESTLE CONSTRUCTION

Trestle bridge construction is facilitated by the installation of piles to support temporary and permanent platforms, either for support of construction equipment to conduct construction or the installation of piles and bents designed to support the bridge/roadway structure. For the HRBT the major trestle bridge segments include the North Trestle Bridge from North Island to landfall at the City of Hampton; the South Trestle Bridge structure which is southward from the South Island to landfall at the north end of Willoughby Spit; and the main bridge trestle structure that spans Willoughby Bay.

Construction includes the setting of templates for pile driving which are moved along the length of the trestle bridge as each bent is installed. Across the length of the trestles the size and configuration of the piles placed is designed based on purpose (temporary or permanent) and geotechnical considerations for support of the designed structure. Aspects of pile driving include pile size diameter, material of construction, purpose, length, temporary or permanence, and other criteria dictated by the design. This includes but not limited to such pile structures such as;

- Install TBM Platform 36-in steel pipe, 216 piles
- Install Conveyor Trestle at South Island, 36-in steel pipe, 84 piles
- Install Jet Grouting Trestles, 36-in steel pipe, 204 piles
- Install North Shore Work Trestle 36-in steel pipe, 194 piles
- Install Willoughby Bay Mooring Piles, 42-in steel pipe, 50 piles
- Install and Remove Concrete Test Piles, 54-in concrete cylinder, 4 piles

The installation methods being evaluated include:

- Jetting;
- Vibratory;
- Pre-auguring; and,
- Down the hole hammer[1].

[1]Down the hole hammer (DTH), if used, will be for pile installation through armor stone. DTH operations may require the limited use of vegetable oil and foaming agents which will require agency approval prior to use. If foaming agents are required, this will result in a non-toxic product that will meet agency approval requirements. DTH operations as similar to jet grouting in capture of residuals. The residuals will be captured and separation of water and solids will be performed. Water that is separated will be treated by the WTP.

Extraction of sediment within certain pile casings may be required for 25% of the piles. Material disposal related to this process may be up to 20,000 cy (32,000 cy bulked). This value corresponds to the amount of sand that will be removed inside the casing during this process, for a total depth of 60 feet, and using a casing of 60 inch (to fit inside the 54 inch permanent piles).

L.1.5.9 UPLAND CONSTRUCTION

Excavations will be required along the corridor for roadway widening. Material will also be required for embankment construction. Embankment will be built in 6-inch lifts as prescribed by VDOT. Where possible, upland soil excavated for roadway construction will be reused in the project's fill slopes. Any material found to be out of compliance with VDOT requirements will be disposed of at an Virginia approved landfill.

The construction sequence is as follow:

- 2020: Inside widening of the roadway
- 2020-2022: EB traffic switched to the inside, widening of the EB lanes
- 2022-2024: WB traffic switched to the inside, widening and rehabilitation of WB lanes
- 2024: EB rehabilitation

L.1.6 MATERIAL SOURCES AND VOLUMES

Upland, on-island and in-water construction activities will generate materials requiring management, removal, and disposal. There are six primary types/sources of material requiring management for the Project:

- Dredged material mechanically removed within the limits of the of the North and South Islands' expansions to improve foundation conditions, and to remove obstructions and increase water depth for safe marine construction operations.
- Ground improvement materials, including JGR, displaced during stabilization of unsuitable subsurface material (on-island and in-water), and residuals created during construction of the break in/breakout plug and slurry wall installation.
- Excavated material from the construction of the entry/exit portals and the tunnel approaches (both portal islands).
- Excavated/bored material from the TBM (in-water and subsurface).
- Concrete generated from the trestle bridge demolition and potentially from Willoughby Spit.
- Excavated upland soils from roadway construction.

The volume of material estimated to be generated for each category is provided in Table L-3.

Table L-3: Source and Volume of Material to be Removed and Managed

Source Material		Construction Activity		Category of Material							Total Volume cy (Bulked)	Reuseable Volume by Source Material cy (Bulked)	Disposal Volume by Source Material cy (Bulked)
				Excavated Material cy (Bulked) [a]	Bored Material cy (Bulked) [a]	Dredged Material cy (Bulked) [b]	Armor and Quarry Stone cy [c]	Down the Hole Hammer Cuttings	Jet Grouted Residual Material cy (Bulked) [a]	Debris [c]			
On Island	North Island	Slurry Walls		84,000	-	-	-		-	-			84,000
		Tunnel Approach and Entry Portal		176,760	-	-	-		111,600	-			288,360
	South Island	Slurry Walls		132,000	-	-	-		-	-			132,000
		Tunnel Approach and Entry Portal		206,760	-	-	-		145,800	-		206,000	146,560
In Water	Tunnel Alignment	Tunnel Boring	Coarse Sand	-	316,800	-	-		-	-		316,800	
			Fines	-	739,200	-	-		-	-			739,200
			Filter Cake	-	360,000	-	-		-	-			360,000
	North Island	Dredged Material	Island Expansion	-	-	152,000	40,000		-	-			192,000
	South Island	Dredged Material	Island Expansion	-	-	32,000 to 200,000	30,000		-	-		40,000	22,000 to 190,000
	South Trestle	Dredged Material	Dredging	-	-	40,000	-		-	-			40,000
	Bridge Construction	Pile Installation	Extraction from casing	-	-	32,000	-	1,900	-	-			33,900
	Trestle Concrete	Bridge Demolition		-	-	-	-		-	80,500		80,500	
	Willoughby Spit Offshore	Debris Removal		-	-	-	-		-	13,000			13,000
Upland	Various	Roadway Improvements		27,500	-	-	-		-	-		27,500	
Totals by Category				627,020	1,416,000	256,000 to 424,000	70,000	1,900	257,400	93,500	2,721,520 to 2,889,520	670,800	2,051,020 to 2,219,020

Notes:
a) Bulking Factor = 1.2
b) Bulking Factor = 1.6
c) No Bulking Factor

L.1.6.1 DREDGED MATERIAL

Unsuitable sediment adjacent to the South and North Islands and under the South Trestle Bridge will be removed by mechanical dredging. Dredged material will be transported from the site prior to dewatering.

Armor stone and sediment material proximal to Willoughby Spit will be removed via mechanical dredging. Dredged armor stone that is available for reuse will be stored at a laydown area, either Willoughby Spit or other to be determined site. If the material cannot be reused it will be disposed of at one of the designated facilities. Transport of dredged material will be by barge. Abandoned vessel debris removal will occur at Willoughby Spit to allow for the new South Trestle Bridge to be built (Attachment L-3). The vessel debris will be disposed of at a permitted facility depending on its specific characteristics.

L.1.6.2 GROUND IMPROVEMENT RESIDUAL MATERIAL (ON-ISLAND AND IN-WATER SUBSURFACE)

There will be four types of ground improvements (GIs) in Segment 2a:

- The TAS Jet Grouting (on both islands)
- The Break-in/Break-Out plugs for the TBM (on both islands) installed by Jet Grouting, and
- In-water subsurface jet grouting, which will be performed from two temporary trestles located north of the South Island.

The preferred method for GI is Jet Grout columns. The Jet Grout column is a combination of grout (cement/water), air and water injected under pressure in the ground and mixed in the ground with the in-situ material. Jet grouting is a process where stabilizing material is injected into the subsurface, displacing unsuitable material which is redirected to the surface and contained for disposal. This process will be used on-island at the North and South Island Portals to stabilize subsurface material after to slurry wall construction.

Please see Table L-4 for the estimated volume of material that will be removed from the North and South islands during installation of the slurry walls for construction of the entry/exit portals. Slurry wall construction process is discussed in Section L1.5.2.

The break in/break out includes a block created to allow the TBM to break through the ground and create a seal between the tunnel line and the portal shaft. The volume of material removed from the break-in, break-out blocks is included in the TBM excavated material.

Temporary trestles, approximately 950 feet long, will be installed from the northwest side of the South Island to facilitate jet grouting operations. Jet grouting will be undertaken to improve the existing ground conditions under the James River above the tunnel horizon. This work will occur outside the navigation channel.

All ground improvement residuals will be decanted onsite through the slurry treatment plant (STP) and subsequent water will be monitored and treated for high pH in a WTP as required before discharge. There will be a STP and a WTP on both Islands for the ground improvement residuals. The solids generated will be disposed of offsite at an approved disposal facility.

L.1.6.3 EXCAVATED MATERIAL (ON-ISLAND)

Material will be removed from the South and North Islands to construct the entry/exit portals as well as excavated for the tunnel approaches. A portion of the excavated material if environmentally acceptable from the South Island portal and tunnel approach, is proposed for reuse for the North Island expansion. The acceptable material may be stockpiled at an offsite upland location until North Island is ready for filling. Willoughby Spit has been identified as a laydown and stockpile area, other areas have not been determined. Any transport for stockpile material will be conducted either by barge or truck depended on the specific situation. The remaining materials will be disposed of at offsite upland facilities.

L.1.6.4 EXCAVATED/BORED TUNNEL MATERIAL (IN-WATER - SUBSURFACE)

Subsurface material will be excavated from the face of the TBM as it advances. Excavated material will be mixed with bentonite slurry in the head of the TBM and piped to the S&TP located on South Island near the tunnel portal. The S&TP will separate solids from the slurry allowing for recycling of the slurry to support TBM operation. Solids resulting from the S&TP process will consist of coarse sand, fines and filter cake. If deemed suitable for reuse based on grain size, coarse sand may be reused as tunnel ballast to counteract buoyancy. Other reuse options will be considered, such as bedding material. Coarse sand, unsuitable for reuse, will be disposed of offsite along with the fines and filter cake. Water generated from the S&TP will be processed through the WQTP prior to discharge under a VPDES Industrial Permit.

L.1.6.5 TRESTLE DEMOLITION CONCRETE

Concrete debris will be collected during demolition of the original, permanent trestle-bridges. The concrete debris is planned to be transported offsite to be utilized in an artificial reef (refer to Section L.1.7.3 for artificial reef locations). This activity will be coordinated with the Virginia Marine Resources Commission (VMRC) program. Offsite disposal is a secondary option if the concrete is not suitable for placement at a reef site. All other demolition debris for either the older, permanent or temporary trestles will be disposed of at an approved disposal facility.

L.1.6.6 EXCAVATED UPLAND SOILS FROM ROADWAY CONSTRUCTION

Unsuitable soils encountered throughout the new roadway area will be removed and replaced or amended to attain the required geotechnical characteristics. Mitigation methods will be finalized once additional geotechnical investigations have been conducted and may include undercutting and placement of structural fill, surcharging, installation of wick drains, use of lightweight fill, or in-situ geotechnical improvements.

Upland excavated soils deemed acceptable by analytical testing will be reused, as practicable, during construction. This material may be utilized in areas that require fill. The remainder of removed material will be disposed of at an approved offsite facility.

L.1.7 MATERIAL PLACEMENT OPTIONS

Material placement options include onsite reuse (suitable material only) and offsite disposal at approved locations. Many offsite disposal/placement options were considered for the Project materials, including the following:

- Ocean Placement at Norfolk Offshore Disposal Site (NODS).
- Upland Placement at Port Tobacco at Weanack Land Facility (Shirley Plantation).
- Upland Placement at Dominion Recycling Center (DRC) (former Higgerson-Buchanan site in Chesapeake, Virginia) Borrow Pit and Landfill.
- Upland Placement at Regional Landfills and Borrow Pits, including:
    a. City of Virginia Beach Landfill
    b. Holland Landfill
    c. Hampton Roads Recovery Center – (HRRC) Centerville Turnpike Landfill (Virginia Beach)
    d. Waste Management – Charles City Landfill
    e. Waste Management – Bethel Landfill (Hampton)
    f. Waste Management – Atlantic Waste Disposal Landfill (Waverly)
    g. Southeastern Public Service Authority (SPSA) Suffolk.
- Material Deposit at Artificial Reef Sites.

L.1.7.1 DISPOSAL OPTIONS ELIMINATED FROM FURTHER CONSIDERATION

Several identified disposal options were eliminated from further consideration after additional consultation with the placement facility management. Each eliminated option is discussed briefly in the following paragraphs.

Norfolk Offshore Disposal Site (NODS) is located in the Atlantic Ocean, approximately 17 miles east of Cape Henry (37 miles from the Project Area) and is approximately 50 square nautical miles in size (40 CFR Part 228). The site is circular, with a radius of 4 nautical miles, and the water depth ranges from 43 to 85 feet (USACE-Norfolk District/Virginia Port Authority [VPA] 2008). This site was removed from consideration due to the relatively low volume of materials generated that would meet the site disposal requirements.

The following regional landfills and a borrow pit were eliminated from further consideration, based on either facility permit limitations (such as acceptance of construction and demolition debris only or unlined cells), capacity limitations, or refusal of at least a portion of the materials due to incompatible physical and/or chemical characteristics:

- Holland Landfill;
- Waste Management – Charles City Landfill; and
- SPSA Suffolk.

L.1.7.2 FEASIBLE OPTIONS FOR HRBT MATERIAL

Feasible disposal options for HRBT material types include the following:

- Onsite reuse in construction elements;
- Offsite beneficial reuse (artificial reefs and beach nourishment); and
- Upland placement at select facilities.

A description of the feasible disposal options is detailed in the following paragraphs and/or subsections.

A portion of the volume of material generated from the separation treatment of the TBM will be considered for reuse. The coarse-grained material will be stockpiled as applicable (i.e. suitable material), offsite at an upland facility, for use as ballast in the construction of the tunnel entrances.

A portion of the excavated material from the South Island portal is proposed for reuse in island expansion construction at the North Island.

Soils generated during upland construction of the roadway will be reused as possible in the vicinity of that site work.

It is anticipated that the concrete from the North and South Trestles demolition will be deposited as materials of opportunity within the VMRC artificial reef program.

The Commonwealth of Virginia requires that beach nourishment be given priority consideration for the disposal of dredged material determined to be suitable as beach fill material. Placement options will be considered following outlined procedures in the "Criteria for the Placement of Sandy Dredged Material along Beaches in the Commonwealth"(4VAC20-400-40).

For select dredge material HRCP is coordinating with VMRC and the applicable municipalities to determine if there is an interest in utilizing this material. These dredge materials to be generated from the south trestle bridge area will potentially be used for beach nourishment. In a telephone call with Phil Roehrs, the City of Virginia Beach has declined accepting this planned dredged material. HRCP will inquire with the Cities of Hampton and Norfolk regarding the utilization of the dredged material for beach nourishment. There has been interest expressed for utilization of this material. The MMP will be updated pending the responses from the Cities of Hampton and Norfolk and the analytical results of the sediment sampling.

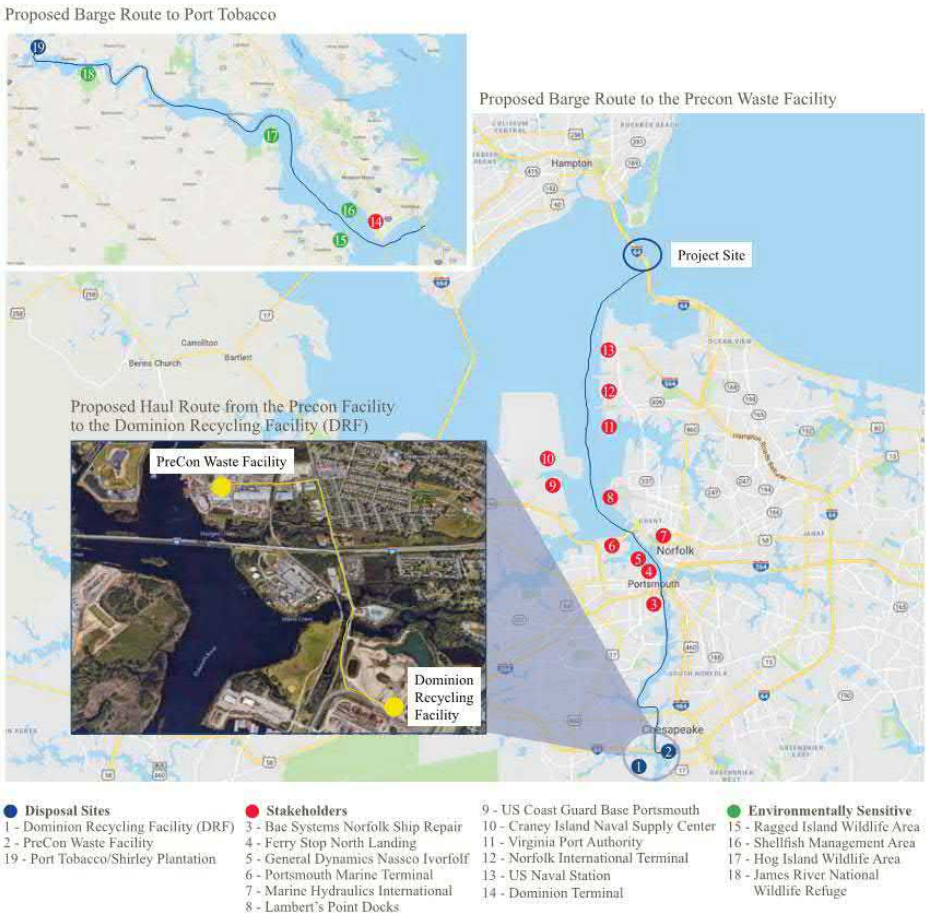
L.1.7.2.1 UPLAND PLACEMENT AT PORT TOBACCO AT WEANACK (SHIRLEY PLANTATION)

The Shirley Plantation is an existing reclamation site in Charles City, Virginia, along the James River (Figure L-10). It is able to accept dredged material via barge or truck. Equipment is located onsite at the Shirley Plantation for mechanical offloading of barges up to 55 feet wide. The facility currently has a Virginia Pollution Abatement permit (VPDES Permit No. VPA00579-Weanack Land LLLP) that allows placement of material from any location that meets permit-specified criteria (VDEQ 2014). The testing requirements for placement at the Shirley Plantation are provided in Attachment L-4. Initial discussions with representatives from the Shirley Plantation indicated that the facility has the capacity to accept the material generated from the Project. A letter of intent (dated 6 November 2018) to accept all soil material within specific guidelines from the Project is provided in Attachment L-5.

L.1.7.2.2 UPLAND PLACEMENT AT DOMINION RECYCLING CENTER

Dominion Recycling Center (formerly Higgerson-Buchanan) owns and operates a permitted landfill and borrow pit facility in Chesapeake, Virginia; adjacent to the Southern Branch of the Elizabeth River (Figure L-10). The construction and demolition debris waste landfill operates under VDEQ Permit No. 493. The borrow pit is permitted by Virginia Department of Mines, Minerals and Energy (DMME) under Permit No. 06183AA. The debris landfill is permitted to receive the following waste categories: construction waste, demolition waste, brush, tree trimmings, stumps, and inert waste materials. The facility can accept materials via truck or barge/truck combination. Barge access is available at Bainbridge Recycling, Inc., located on the Southern Branch of the Elizabeth River across the street from the Dominion Recycling Center. The testing requirements include one toxicity characteristic leaching procedure (TCLP) sample for every 50,000 cubic yards, and one total petroleum hydrocarbons diesel range organics/gasoline range organics (TPH DRO/GRO) sample for every 10,000 cubic yards for material 0-10’ below grade, with less frequent sampling for material deeper than 10’ below grade (one per 50,000 cubic yards). A letter of intent (dated 29 November 2018) to accept all soil material within specific guidelines from the Project is provided in Attachment L-5.

Figure L-10: Material Disposal Sites and Marine Stakeholders

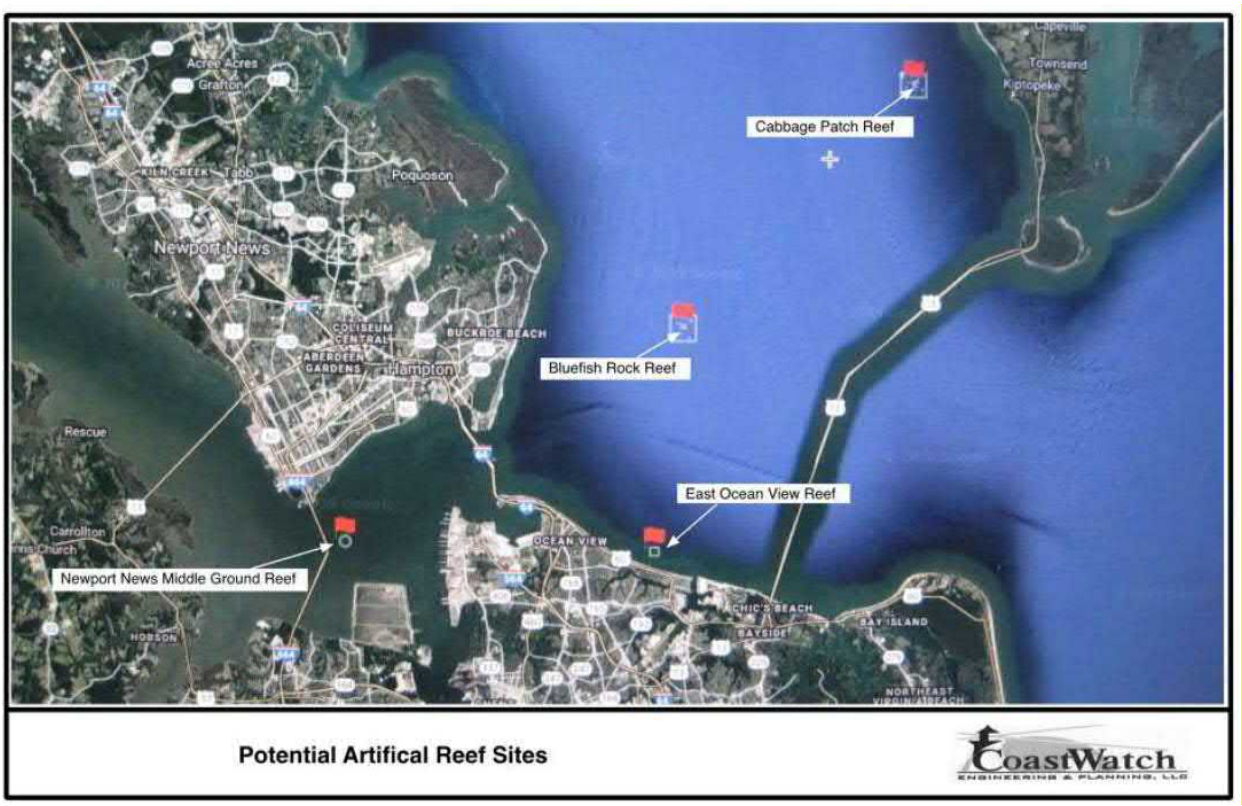


L.1.7.3 ARTIFICIAL REEF

Provided the demolition material is deemed environmentally safe and has the appropriate physical characteristics for beneficial reuse, it is anticipated that the concrete from the North and South Trestles demolition will be deposited as materials of opportunity within the Virginia artificial reef program. Virginia's artificial reef program began as a privately-led effort in the 1950's to replenish fish populations in the area.

Figure L-11 below depicts the approximate locations of the four inshore Virginia artificial reefs being considered.

Figure L-11: Virginia Artificial Reef Sites



Source: Virginia Marine Resources Commission

L.2 CHARACTERISTICS OF SOURCE MATERIALS

Studies for the physical and chemical characteristics of the six primary types of source materials, as identified in Section L.1.6 that require management are ongoing. Existing data includes:

- Physical and chemical data for marine sediments near the Project alignment (*HRBT Expansion Preliminary Sediment Study,* Cardno, 2018) (Attachment L-6)
- Physical and chemical data for solids and elutriates from testing of the on-island source materials at the South Island entry/exit portal (Attachment L-7).

These data are used for initial baseline characterization for soils. The characterization data provides for the basis of waste profiles to describe each source material for determination of appropriate offsite disposal.

The materials derived from the bench scale testing and analyzed (TBM solids and filtrate water) will provide characteristics, and data to determine disposition. The filtrate water analysis data will be used to assist in a specific water treatment plant design.

L.2.1 SAMPLING AND ANALYSIS PLANS

The Sampling and Analysis Plan (SAP), dated July 23, 2019 (revised), is included as Attachment L-8 and outlines sampling efforts to be undertaken for dredge materials, JG SW residuals, TBM materials, and upland materials. The MMP will be updated when data is received.

Baseline characterization environmental sampling of the marine portion of the project will be conducted by HRCP in order to evaluate reuse and disposal options for materials anticipated to be encountered during construction activities. HRCP's environmental sampling will be conducted concurrent with supplemental geotechnical investigation activities scheduled for fall of 2019. HRCP is awaiting receipt of the Nationwide Permit 6 before proceeding. The VMRC permit #2019-0921, applied for as part of the Nationwide Permit 6, received on July 22, 2019.

L.2.1.1 DREDGE MATERIAL SAMPLING

The plan for dredge materials includes the following samples to characterize the sediments for disposal.

- 5 samples in the vicinity of the north trestle bridge to characterize surficial sediments in the occasion that sediments are later identified for removal. This removal may be required as a result of geotechnical testing for constructability. This testing will support the data generated as part of the *HRBT Expansion Preliminary Sediment Study (Cardno 2018).*

- 8 samples to address dredging for foundation improvements at the North Island expansion.
- 7 samples to address dredging for foundation improvements at the South Island expansion.
- 19 samples between the South Island and Willoughby Spit (south trestle) to address sediments removed during dredging for construction access.

Sediments will be analyzed for standard chemistry analytes, which covers all considered disposal facility requirements, and will include the analyses listed in Table 1 of the SAP (Attachment L-8).

L.2.1.2 TBM SAMPLING PLAN

The SAP includes TBM additive testing (bench scale testing) to simulate the anticipated material generation streams from the tunnel boring procedure. Composite soil/sediment samples will be collected from the elevation corresponding to the anticipated elevation of the tunnel bore. They will be analyzed for baseline characterization, material waste profile and subsequent disposal disposition determination purposes. Table L-4 below provides a list of slurry/additives that may be included in the initial bench scale testing. The initial slurry mix for testing will utilize a combination of the additives representative of that which will be used during actual TBM boring.

Certain additives have been eliminated based on review of their Safety Data Sheets (SDS, toxicity), toxicity information, chemical composition compatibility (i.e. inert) and, in comparison to VDEQ VPDES discharge criteria Table 2C-3 (Toxic Pollutants and hazardous substances) and Table 2C-4 (Hazardous substances).

Table L-4: Slurry Additives for Bench Scale Testing

Slurry Additive Name	Additive Type
MAPECOG 10	Coagulant
Mapedrill SV	Rheology agent
MAPEFLOCK 10	Flocculant
MAPEDRILL EX1/P	Rheology agent
MAPEBENT API 5	Bentonite
Mapelog10	Coagulant

**Lime and two sulfate compounds may also be utilized in bench scale testing.*

Pending results of the bench scale testing, additional additives may be considered, if a product exhibits or provides data that is considered detrimental to the environment. The results of the bench scale testing will be used in the design of the treatment train for the WTP to provide correct treatment supporting the VPDES permitted discharge.

L.2.1.3 UPLAND (ROADWAY) MATERIALS SAMPLING PLAN

Baseline characterization environmental sampling of the upland roadway portion of the Project will be conducted by HRCP to evaluate reuse and disposal options for materials anticipated to be encountered during roadway construction activities. HRCP's environmental sampling will be conducted concurrent with geotechnical investigation activities. The SAP for the upland sampling activities is included in Attachment L-8.

HRCP will oversee the collection of 71 upland soil borings. Location of the borings are depicted in Attachment L-8. HRCP will screen the soil borings for evidence of petroleum contamination. If no petroleum impacts are observed, the HRCP will collect 1 composite sample per boring for TPH, TCLP, and the chemicals benzene, toluene, ethylbenzene and xylenes (BTEX) analysis. Additionally, composite samples will be collected at the minimum frequency of: three composite samples in segment 1; seven composite samples in segment 3; three composite samples in segment 4; and, two composite samples in segment 5. Preliminary analysis will be performed as listed in the plan in Attachment L-8. Since waste characterization sampling for parameters including but not limited to TCLP, and RCRA hazardous waste are driven by offsite disposal facility requirements and volume of soil that needs disposal, these analyses will be performed prior to disposal of excavated soils.

L.2.2 EXCAVATED MATERIAL (ON-ISLAND)

L.2.2.1 TUNNEL APPROACHES, ENTRY/ EXIT PORTALS

An evaluation of the source material from the tunnel approaches and the entry/exit portals indicated that these materials are comprised of approximately a mixture of fines and sands. Table L-5 below provides a breakout of the material types. Attachment L-2 provides a cross-section of the material types that will be encountered during tunnel boring activities.

Table L-5: Anticipated Material Types

Location	% Material	Source Material	Description
South Island Slurry Walls	20	historic island fill materials	Poorly graded sand and gravel, contains trace organic matter, loose to medium dense
	40	Quaternary layers (mostly Qf and Qo)	Qf is a soft to firm lean Clay. Qo is a lean or fat clay with organic matter, very soft to firm.
	40	Tys (YorkTown Course)	Silty Sand, medium dense
South Island Tunnel Approach Structure	50	historic island fill materials	Poorly graded sand and gravel, contains trace organic matter, loose to medium dense
	50	Quaternary layers (mostly Qf and Qo)	Qf is a soft to firm lean Clay. Qo is a lean or fat clay with organic matter, very soft to firm.
Ground Improvement/Jet Grouting North Island	80	Quaternary Qc	Loose Silty Sand, to dense sand.
	20	Tys (YorkTown Course)	Silty Sand, medium dense
North Island Slurry Walls	40	island expansion fill	Likely majority sand
	40	Quaternary layers (mostly Qc)	Loose Silty Sand, to dense sand.
	20	Tys (YorkTown Course)	Silty Sand, medium dense
North Island Tunnel Approach Structure	30-50	island expansion fill	Likely majority sand
	50	Quaternary layers (mostly Qc)	Loose Silty Sand, to dense sand.

Location	% Material	Source Material	Description
	0-20	Tys (YorkTown Course)	Silty Sand, medium dense
Ground improvement/Jet Grouting South Island	10	Quaternary Qc	Loose Silty Sand, to dense sand.
	40	Quaternary Qf	Soft to firm lean Clay.
	50	Quaternary Qo	Lean or fat clay with organic matter, very soft to firm.
Tunnel boring	1	island expansion fill	Likely majority sand
	29	Quaternary Qc	Loose Silty Sand, to dense sand.
	9	Quaternary Qf	Soft to firm lean Clay.
	12	Quaternary Qo	Lean or fat clay with organic matter, very soft to firm.
	43	Tys (YorkTown Course)	Silty Sand, medium dense
	3	Tyf	Stiff Clay, high plasticity
	3	Tye	Loose to medium dense silty Sand
North Island dredging	-	-	Anticipated to be sand
South Island dredging	-	-	Soft clays and some sandy layers
Channel access	-	-	Likely loose sand
Pile installation	-	-	Sand

Chemical testing of composite sediment samples and standard elutriates from the tunnel entry/exit portals was conducted to assess the contaminant characteristics and for determination of a disposal location. Groundwater at the entry/exit portal locations was sampled in order to evaluate potential treatment and disposal options if groundwater is generated during construction activities.

Sediment results indicated PCB exceedances of the Ecological Soil Screening Level (ESSL) and Threshold Effect Level (TEL). Agency approval will be required for reuse of this material. All sediment is acceptable for disposal at the Shirley Plantation. Other facilities will have to be evaluated based on their individual permit criteria with regard to PCBs. The sediment will not be required to be handled or disposed of as Resource Conservation and Recovery Act (RCRA) Hazardous wastes. Figure L-12 depicts the locations of the borings installed.

Groundwater analytical results indicated elevated levels of bromodichloromethane in exceedance of the human health based Public Water Supply standard in sample ENV-081-GW (30'). As the Project area is not located within a Public Water Supply, this standard is not applicable. Endosulfan I was detected in exceedance of the acute and chronic ecological standards in sample ENV-081-GW (127'). Water generated during construction activities from the area of the sample will be required to be evaluated. If necessary, groundwater will be treated through the VPDES Industrial Discharge Permit to address potential Endosulfan I existence.

The *Baseline Characterization Environmental Sample Analytical Results* is provided in Attachment L-7.

Figure L-12: Location of Environmental Borings

L.2.3 TUNNEL BORE AND DREDGING SEDIMENTS

The *HRBT Expansion Preliminary Sediment Study* (Cardno 2018), Attachment L-6 provides preliminary data for the evaluation of the marine sediments in the vicinity of the tunnel alignment. The sediment characteristics within the Project limits is best represented by the following samples:

- North Island dredging: B008 (0-10 feet (represents depth of sample (typ.))
- Tunnel Bore Material: B017 (80-90 feet), B023 (88-98 feet)
- South Island dredging: B030 (0-10 feet)
- Navigation dredging: B033 (0-10 feet), B038 (0-10 feet)

The sample results were compared to the most stringent standard, in units of micrograms per kilogram (µg/kg), when compared to the following:

- Threshold Effect Level (TEL) ecological standard;
- Probable Effect Level (PEL) ecological standard;
- Ground Water Soil Screening Level (GW SSL);
- Ecological Soil Screening Levels (ESSL);
- Industrial Soil Screening Level (ISSL);
- Residential Soil Screening Level (RSSL);
- Effects Range-Median (ERMs);
- Shirley Plantation Exclusion Criteria, and;
- Shirley Plantation Clean Fill Criteria.

Based on a review of the results, exceedances of the most stringent standards were detected at each of the six sample locations (B-008, B-017, B-023, B-030, B-033, and B-038). A summary of the results for each area is detailed below.

- North Island dredging: B008 (0-10 feet): arsenic, cadmium, chromium, cobalt, iron, and manganese.
- Tunnel Bore Material: B017 (80-90 feet), B023 (88-98 feet): arsenic, cadmium, chromium, cobalt, iron, lead, and vanadium.
- South Island dredging: B030 (0-10 feet): 4,4’-DDD, 4,4’-DDT, arsenic, chromium, cobalt, and iron.
- Navigation dredging: B033 (0-10 feet), B038 (0-10 feet): aluminum, arsenic, cadmium, chromium, cobalt, iron, manganese, and vanadium.

An exceedance of the GWSSL, ESSL, ISSL, RSSL, or ERM may not preclude the material being disposed of properly, as these standards are typically the most stringent. For further detail

of contaminant concentrations detected by sample location from the preliminary sediment study, please refer to Attachment L-9.

According to the Cardno report, all sediment is acceptable for disposal at the Shirley Plantation and other upland facilities. Beneficial reuse such as shoreline replenishment or restoration are potential additional options and are under consideration. The sediment will not be required to be handled or disposed of as a RCRA Hazardous waste. However, additional sampling will be performed to confirm these findings and ascertain disposal or reuse options. Agency approval may be required.

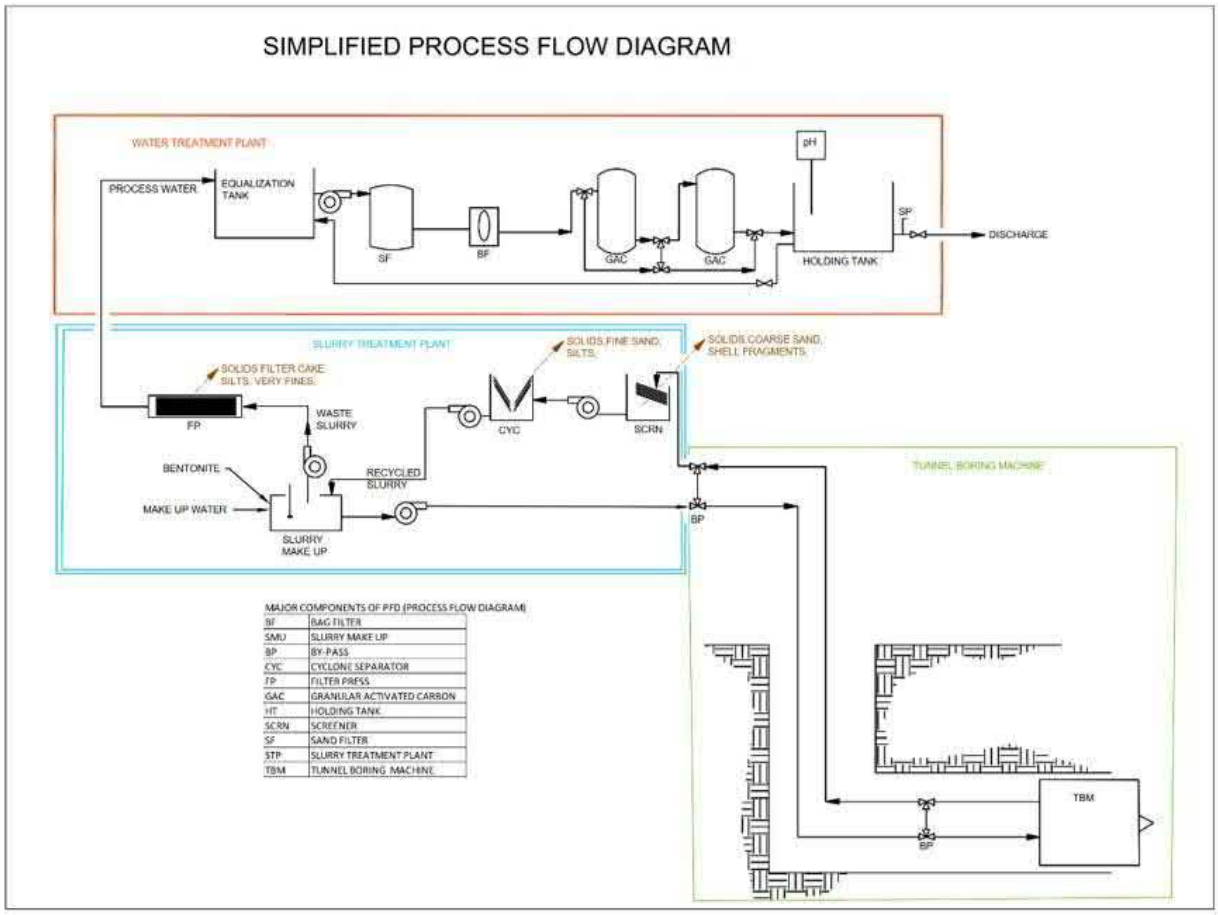
L.2.4 PROCESS FROM JET GROUT, SLURRY WALL AND TBM OPERATIONS

Process water will be generated by Jet Grout, Slurry Wall and TBM Operations. Process water will either be recycled for reuse in these operations or pass through the WTP to remove undesirable compounds and stabilize pH prior to discharge under a VPDES Industrial Permit with monitoring.

Pre-treatment of GI spoils to separate solids and neutralize pH will occur prior to process water passage through the WTP.

Process water generated by the S&TP from TBM operations will be sent to the WTP for processing as depicted in the simplified process flow diagram (Figure L-13).

Figure L-13: Separation and Treatment Flow Diagram



L.3 MATERIAL PROCESSING AND PLACEMENT PLAN

Based on the expected physical and chemical composition of the source materials, onsite reuse, offsite reuse options, and several upland placement options exist for the Project materials. This section details the overall material disposal options for each source material for the Project. Additional details describe the material processing, segregation/de-watering layout plan, and offsite transportation of the materials. Discussion on spill prevention and response is outlined and covered in the Spill Prevention Response Plan (SPRP) and Protection to the Environmental Resources is contained in Section L.4 below. In the SPRP the notification procedures are identified in the event of a spill or release. In addition, an emergency response subcontractor is to be retained to act in the event of a release to control or mitigate. In addition, all work activities associated with or contributory to the spill or release will be immediately stopped so that further release or spill does not continue. Discontinuing of material flow or handling / movement can be stopped in a matter of minutes and conveyors, piping, pumps, and transfer mechanisms are designed with this capability.

L.3.1 MATERIAL PLACEMENT/DISPOSAL LOCATIONS

As discussed in Section L 1.7 the following facilities/ locations have been determined as suitable for receiving the described waste streams.

- Onsite Reuse
- Offsite beneficial reuse: beach fill replenishment and reef creation
- Dominion Recycling Center (former Higgerson-Buchanan, Chesapeake, Virginia)
- Port Tobacco at Weanack (Shirley Plantation, Charles City County, Virginia)

Materials will be shipped directly from the Project to an approved facility including either the Shirley Plantation facility or the PreCon Marine facility, a transfer station for the DRC facility, in Chesapeake. If shipped to the PreCon facility, it will be transferred to watertight trucks and transported to the adjacent DRC. The transfer of material at the facility is conducted under the facilities permit and conditions. Requirements will also include that the facility provide for catchment/containment of any material that is being transferred over water during loading and unloading operations.

The DRC facility is a short 1.6-mile drive from the PreCon facility in a non-residential area where the hauling will cause minimal impacts to the local community (see Figure L-140). If required, DRC is also permitted to construct a lined landfill to accept waste materials that do not meet their existing screening criteria, adding disposal options and flexibility. Additionally, DRC also has one acre of land, and Shirley Plantation has four acres for drying and/ or amending with lime for high moisture content.

L.3.2 MATERIAL HANDLING AND TRANSPORT

L.3.2.1 HANDLING AND STORAGE ONSITE

The coarse-grained material generated form the TBM will be stockpiled as applicable (i.e. suitable material) offsite at an upland facility (Willoughby Spit or other determined laydown area) for later use in construction of the tunnel ballast.

Material determined suitable for reuse will be transported by barge/truck to predetermined offsite stockpile area.

It is anticipated that the concrete from the North and South Trestles demolition will be deposited as materials of opportunity within the Virginia artificial reef program as discussed in Section L.1.7.3.

Armor rocks may be stored offsite or stockpiled on island pending capacity limitations prior to disposal or reuse. Islands expansion works may require disposal or re-use of some of the existing armor rocks. Construction sequence may also require stockpiling of a minor quantity of armor rocks on both islands prior to their disposal to an approved facility, or their reuse onsite for slope protection.

Upland soils that have been excavated as part of the roadway construction and that are used as backfill for the same excavation or excavations at the same project site and containing similar contaminants, at concentrations of the same level or higher, are excluded from the definition of solid waste per the Virginia Solid Waste Management Regulations 9 VAC 20-81 et. seq. Therefore, upland soils reused onsite (project area only) are not regulated and will not require any analytical testing provided there is no free petroleum product. These soils will be stockpiled proximal to the planned location of reuse.

During times of inclement weather, all operations will cease. However, as transport of materials will not occur it should be noted that the approximate storage capacity on the South Island is 4,300 cy for sand and filter cakes (which would house approximately 1 day of production). Additional capacity can be accommodated through the barge moored on the island. Sand and filter cakes will be safely contained on the South Island on a concrete pad and surrounded by walls. Any accumulation of water will be captured, contained, and transferred to the WTP for treatment.

In case of prolonged weather disruption, trucks may also be used to evacuate spoils of the TBM.

While the TBM is only boring 5 days/week, spoils will continue to be disposed of during the weekend until the weekly production of sand and filter cakes has been evacuated.

Maximum solid waste stream generation will be during TBM operations. The following is a breakdown of anticipated solid waste stream volumes (per day):

- Coarse grain (> 6mm) 262 cy/day
- Fine grain (50um – 6mm) 1,965 cy/day
- Filter cake (< 50um) 393 cy/day
    - Total volume/day 2,620 cy/day

Handling capacity:

- Barge 2,000 cy/barge
- Truck 11 cy/truck

If there are two barges onsite per day, there is capacity to handle up to 4,000 cy of materials. Wastes will be generated only five days per week, while transportation of wastes will occur up to seven days per week, resulting in a greater handling capacity than production of wastes.

Upland soils generated during roadway construction in excess of or unsuitable for reuse will be placed in trucks for disposal at an approved disposal facility.

L.3.2.2 OFFSITE DISPOSAL

The following waste materials are planned for offsite disposal;

- Dredge material not suitable for beach replenishment
- TBM Spoils not reused onsite
- Excavated spoils from portal entry areas and tunnel approach structures deemed unsuitable for reuse
- Jet Grout solids (residuals)
- Slurry Wall solids (residuals)
- Break-in Break-out residuals
- Demolition and concrete material not suitable for artificial reef construction

Both trucking (capacity of 10-12 cy per truck) and barging (capacity of 2,000cy per barge) will be used to transport materials offsite. Upon receipt of the Construction General permit, work will commence on both the South and North Islands. Any material generated for the early portal construction work (such as GI residuals) will be trucked to one of the selected disposal facilities. Upon completion of construction of the temporary conveyor system, barge loading off of the South Island can be conducted.

Barging will be the primary offsite transportation mode for dredged material (Shirley Plantation and DRC). Materials designated for DRC will be transported via barge to Precon’s wharf (adjacent to DRC) on the Southern Branch of the Elizabeth River, where the material will be

offloaded to sealed-bed trucks. Materials designated to the Shirley Plantation facility will be directly barged to this location. Each barge will be filled below the maximum capacity and will be equipped with splash walls to prevent release or spills of the conveyed TBM materials. Barging of material may be suspended on any given day if adverse weather conditions preclude safe marine-based transport and operations. A Severe Weather Plan will be prepared and submitted as part of the Section 408 submittal for review and approval.

When trucking is needed, each truck will be filled to maximum capacity and then will be driven to the approved placement facility. The exterior of each truck will be sprayed down with potable water before leaving the site. Excess water will be containerized and treated at the temporary treatment plant on the South Island. Trucks will be required to abide by federal and state Department of Transportation driving regulations and stop at all open weigh stations if present on route to the offsite disposal location (FMCSA 2016).

Barging Routes to Reef, Shirley Plantation, and Dominion Recycling Center

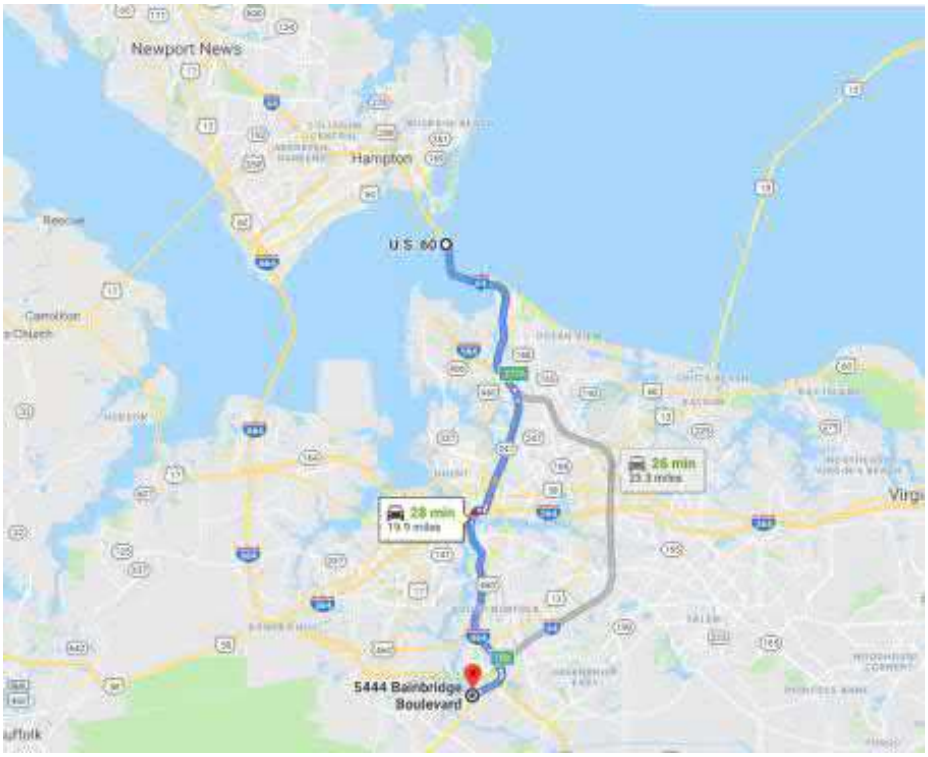
The barge routes and associated distances to the constructed reef will be determined after a location is selected. The barge routes to the Shirley Plantation and to DRC are depicted in Figure L-10. The approximate barge distance to Shirley Plantation is 65 statute miles, and DRC is 17 statute miles.

Driving Directions to Dominion Recycling Center

The most efficient trucking route to DRC is shown on Figure L-14. The travel distance is approximately 20 miles. Expected one-way travel time is approximated at 30 minutes. Depending upon traffic, a single truck may be able to make six round-trips per day.

- Take I-64 East toward Chesapeake/Suffolk
- Take exit 291B to merge onto I-464 S/VA-168 S toward US-17 S/Elizabeth City/Outer Banks
- Continue onto VA-168S
- Use the right 2 lanes to take exit 15B toward US-17 S/Elizabeth City
- Continue onto Dominion Blvd N
- Take the exit toward Bainbridge Blvd
- Turn right onto Bainbridge Blvd
- Arrive at Dominion Recycling Center
  5444 Bainbridge Blvd
  Chesapeake, Virginia 23320

Figure L-14: Driving Route Directions to Dominion Recycling Center



Driving Directions to Shirley Plantation

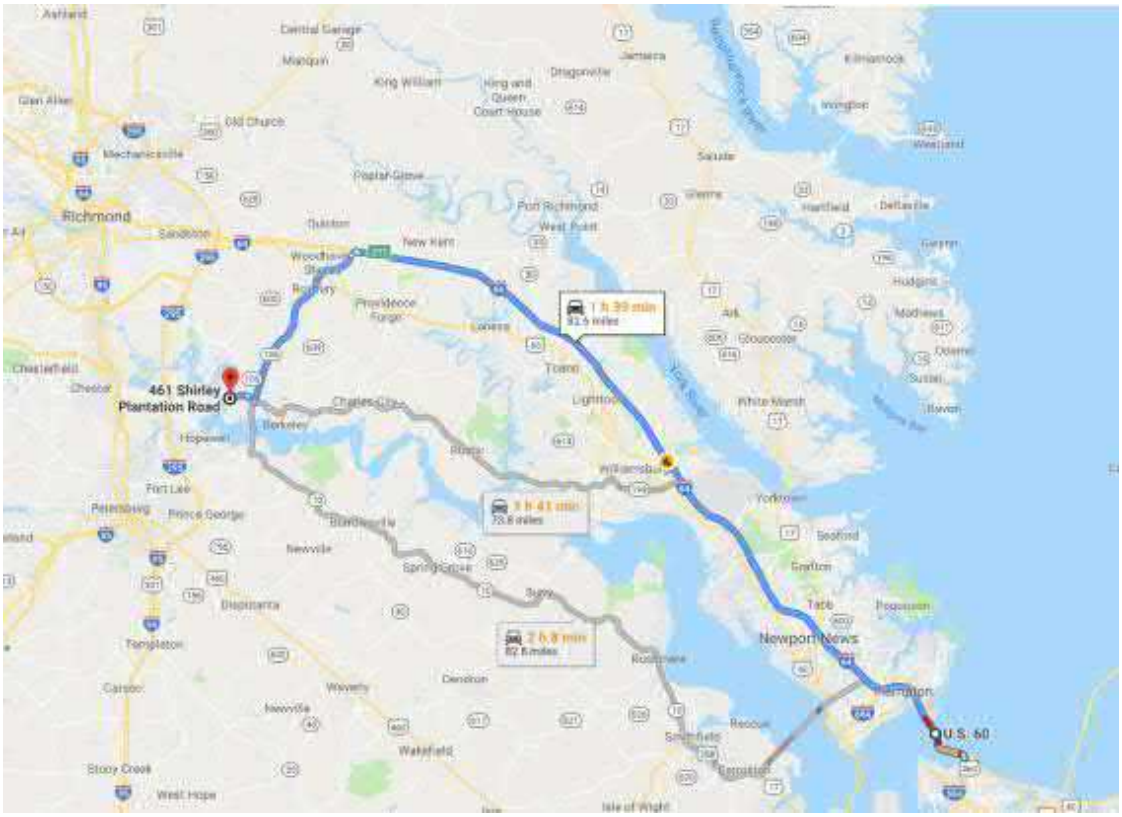
The most efficient route (approximately 85 miles) to the Shirley Plantation is shown on Figure L-15. Expected one-way travel time is approximated at 1.75 hours. Depending upon traffic, a single truck may be able to make two round-trips per day.

- Head west on I-64 W for 59 miles
- Take exit 211 for VA-106 toward Talleysville/Roxbury/Prince George

- Continue on VA-106 to VA-609
- Turn right onto VA-156/VA-5W
- Turn left onto State Rte 608
- Arrive at Shirley Plantation
  461 Shirley Plantation Road
  Charles City, Virginia 23030

If additional facilities are needed or designated for Project materials, this MMP will be amended appropriately. The amended MMP will be submitted to the required regulatory agencies for review and approval.

Figure L-15: Driving Directions to Shirley Plantation



L.4 PROTECTION TO ENVIRONMENTAL RESOURCES

The Project is proposed for construction on the alignment depicted in Figure L-1. In Virginia, Waters of the United States, including wetlands, are regulated by USACE. These resources and remaining State Waters are regulated by VDEQ, and Subaqueous Bottomlands and Tidal Wetlands are regulated by the VMRC. Construction activity within the Chesapeake Bay in Virginia is regulated by USACE, VDEQ, and VMRC. These agencies have jurisdiction under the following regulations:

- Sections 401, 402 and 404 of the Clean Water Act (CWA),
- Section 10 of the Rivers and Harbors Act of 1899,
- The Virginia Water Protection Permit (VWPP) Program Regulation (9 VAC 25-210), and
- The Virginia Wetlands Act (Chapter 13, Title 28.2 of the Code of Virginia).
- State Submerged Lands under 4VAC20 Marine Resources Commission
- Chesapeake Bay Preservation Act (Refer to Appendix C of the JPA) Article 2.5. Chesapeake Bay Preservation Act. § 62.1-44.15:67. Cooperative state-local program.

Coastal Zone Management Act. The Coastal Zone Management Act of 1972 (CZMA; Pub.L. 92–583, 86 Stat. 1280, enacted October 27, 1972, 16 U.S.C. §§ 1451 – 1464, Chapter 33) is an Act of Congress passed in 1972 to encourage coastal states to develop and implement coastal zone management plans (CZMPs).

There are approximately 211 acres of subaqueous bottomlands located within the LOD; subaqueous bottomlands are also classified as navigable waters and under USACE jurisdiction. Water depths within the HRBT construction area range from -0 to 55 feet below MLW. The Norfolk Harbor Entrance Reach Channel is 1,000 wide at the HRBT Crossing and is maintained at a depth of 50 feet Mean Low Low Water (MLLW). Of note, the US Army Corp of Engineers and the Virginia Port Authority are evaluating a plan to deepen the Norfolk Harbor Navigation Channels, which includes the Norfolk Harbor Entrance Reach Channel to a depth of 55 feet MLLW (USACE, April 2018).

Wetlands on the tunnel islands are categorized as either estuarine rocky intertidal or estuarine intertidal sandy shore. Additionally, there is submerged aquatic vegetation on the east side of the north tunnel island and along the Hampton shore. Throughout the LOD, there are approximately 260 acres of estuarine wetlands and waters and 2 acres of palustrine wetlands and waters.

The vicinity of the Project Area includes habitat that is used by sensitive aquatic resources, including Essential Fish Habitat species, federal and state-listed endangered species, and marine mammals. To avoid and minimize impacts to the sensitive aquatic resources and to ambient water quality standards, protective measures and preventive actions will be incorporated into the Project design and will be implemented throughout the in-water construction process. These measures/actions include: implementation of BMPs for in-water

activities (dredging, pile installation, stone placement and island expansion, jet grouting); an onsite water treatment plant; development/implementation of a water quality monitoring plan during in-water construction activities; and implementation of a marine mammal monitoring plan during pile driving activities (to comply with an Incidental Harassment Authorization (IHA) and Letter of Authorization (LOA) issued through Marine Mammal Protection Act (MMPA) consultation). This section describes corrective actions and practices to adaptively manage in-water construction, dredging, and material placement activities to minimize and avoid environmental impacts throughout the duration of construction.

L.4.1 BEST MANAGEMENT PRACTICES

BMPs are measures or practices used to avoid, minimize, or mitigate environmental impacts related to construction activities such as excavation and placement of material. BMPs have been incorporated into the Project planning and design and will be implemented during construction (equipment and operations) and upland placement activities. BMPs that have been or may be used are detailed in the following sections. Other BMPs may be implemented as needed throughout Project construction.

L.4.1.1 MINIMIZATION OF IN-WATER FOOTPRINT/IMPACTS

Selection of bored tunnel versus the immersed tube tunnel (ITT) substantially reduces in-water impacts related to dredging operations. In-water work areas will only be adjacent to the North and South Islands, along the trestle bridge structures to be widened or built, and the trestle bridges over Mason Creek and Oastes Creek. Substantially less material will require management and disposal (compared to the ITT option). Impediments to navigation in the Norfolk Harbor Entrance Reach Channel—which is heavily trafficked by commercial, military, and recreational users—are also reduced by minimizing in-channel construction activities.

L.4.1.2 ONSITE SEPARATION AND TREATMENT

Excavated material from the TBM will be pumped to a S&TP located at the portal on the South Island, where the material will be separated from the slurry. The S&TP will have a modular container design and will be installed on the South Island near the portal. It will produce bentonite slurry and pump it to the TBM at the required flow. This bentonite slurry at pressure will support the excavation face. The excavated ground will be diluted and mixed with the slurry inside the TBM plenum and will be pumped to the S&TP. The S&TP will remove solids with a minimum loss of suspension and part of the treated suspension will be pumped back to the tunnel face via the feed line of the TBM slurry circuit. This TBM technology was specifically chosen because it does not use surfactants or foaming agents, mitigating associated environmental risks.

L.4.1.3 CONSTRUCTION OPERATIONS

Mechanical Placement of Stone and Fill Material: Stone will be used to create a perimeter bund around the expanded island footprint. Bedding stone and filter stone will be placed in a controlled manner. Each piece of armor stone will be placed individually to attain the desired final design elevation. Clean fill will be placed within the bund and silt curtains will be used at openings to minimize potential turbidity.

Pile Driving: The permanent piles to be used for this project are varied including steel pipe piles, steel sheet piles and concrete cylindrical piles. The permanent concrete piles are expected to be 4 feet in diameter or greater. A Marine Mammal Monitoring Plan will be implemented for both in-water and upland pile driving to identify marine mammals entering the Zone of Impact and to determine appropriate actions to comply with an IHA/LOA (Letter of Authorization) under the MMPA. Pilings to be used at the Project include: the quay and conveyor dock; the temporary construction trestles and roadway trestles; structural stability at the South Island; and for moorings.

Jet Grouting: Multiple BMPs and failure detection features have been included in the jet grouting design/technical approach and will be implemented during jet grout operations to minimize or avoid risk of spill during management of JGR.

- Embed the casing a minimum length of 20 feet below the mudline to ensure the JGR will not be released to the waterway.
- To ensure that no JGR are released into the waterway from the temporary trestle, the following measures will be implemented:
    - Pump out capacity more than twice the anticipated fil rate of the storage tank.
    - Check levels on the storage tank at 50% and 75% capacity. Tank will not be allowed to be filled above its 75% maximum capacity
    - Drill rig operator will have line of sight to the storage tank and will have the ability to stop the jet grout operation, which will stop the flow of the JGR into the tank.
    - Secondary personnel will act as a redundant administrative control to monitor the level of the tank.
    - Secondary spill containment will be placed below the storage tank which will be able to collect any potential spill.
    - The waste line from the tank to the STP will be sleeved along the trestle.
- All flushing of the return flow casing will be conducted inside the casing such that JGR will not flow to the waterway. In addition, all flushing will be completed with fresh water.

L.4.1.4 EXCAVATION EQUIPMENT AND OPERATIONS

Dredged material from the South Island expansion, North Island expansion, and south trestle bridge navigation areas will be mechanically removed and placed directly in a barge for immediate offsite transport to either designated receiving facility.

A mechanical style grapple bucket will be used to remove any armor stones and obstructions. An environmental bucket will be used to remove the sediments. The environmental bucket is designed to reduce the environmental impacts. Operational practices during dredging may be implemented, as needed, to minimize water column turbidity. The dredging contractor may utilize the following operational practices during dredging operations:

- The bucket will be completely closed before raising it to the surface unless it is obstructed by debris.
- The operator will attempt to avoid overfilling of the bucket to prevent additional loss of material over the sides of the bucket as it ascends through the water column. The bucket will be closed to minimize loss of material during ascent through the water column.
- If the bucket is not closed completely because of debris or obstructions, the operator will not drop the load at the water surface to dislodge the debris but will complete the dredge pass and place the debris on the barge or scow.

L.4.1.5 MATERIAL HANDLING AND DISPOSAL

TBM Material Conveyance: The TBM will excavate material and construct the tunnel as it progresses from the South Island to the North Island. Excavated material will be mixed with bentonite slurry in the head of the TBM and piped to the S&TP located on the South Island near the tunnel portal. The conveyance system is enclosed. The slurry will be treated, and excavated materials segregated at the S&TP.

Water/Effluent Treatment: Water generated from the Project will be routed to the WTP and discharged to the river via an outfall authorized under a VPDES Industrial permit. Slurry from jet grout and slurry wall operations on the North Island will be piped to a STP. The treated decant water will be discharged to the river via an outfall authorized under a VPDES Industrial permit.

Offsite Transportation (Truck and Barge): Transportation of material from the islands to approved offsite material disposal locations will be conducted using either sealed-bed trucks with water-tight tailgates to minimize and avoid the incidental release of materials during transport or via barges. Each barge will be filled below the maximum capacity and will be equipped with splash walls (or equivalent) to minimize release, spills, or overflow of materials. Barging of material may be suspended on any given day if adverse weather conditions preclude safe marine-based transport and operations. Trucking will allow disposal operations to continue when barge disposal would not be practical due to weather conditions.

L.4.2 MONITORING

L.4.2.1 EXCAVATION AND CONSTRUCTION OPERATIONS

Contractor conformance to and compliance with BMPs specified in the bid package will be monitored. Proactive monitoring and assessment will allow for BMPs to be adaptively modified

for site-specific conditions, as needs arise. In-water activities and material processing activities will be actively monitored to:

- Identify logistical considerations/constraints for BMP implementation.
- Determine effectiveness of BMPs in relation to avoidance, minimization, and mitigation.
- Verify compliance with: the CWA Section 401 water quality certification; the IHA and MMPA marine mammal monitoring requirements; VSMP General Construction Permit; Stormwater Management Plan / Pollution Prevention Plan; Erosion and Sediment Control Plan, Spill Prevention; Pollution Control and Countermeasures Plans; the Jet Grouting Spill Prevention and Response Plan; and Environmental Management Plan.
- Implement corrective measures and related coordination with the VDEQ, USACE, VMRC, and/or the National Oceanic and Atmospheric Administration Office of Protected Species, when and where necessary.

L.4.2.2 WATER QUALITY

Water Quality will be monitored in accordance with the Water Quality Monitoring Plan (WQMP) (see Appendix O). The WQMP provides for monitoring of water adjacent to where in-water construction is occurring.

In-water activities for the Project will be limited to the following:

- Construction and use of temporary docking, integrated conveyance, and ship mooring areas.
- Construction of temporary construction trestles to facilitate construction and jet grouting.
- Construction of island expansion (one adjacent to each of the portal islands), which will include limited mechanical dredging, sheet pile installation, and controlled placement of fill and stones.
- Construction of the permanent trestles.
- Offshore jet grouting
- Dredging of bottom areas
- Settlement mitigation activities at South Island (pile driving to stabilize subsurface material).

Monitoring during in-water construction activities will include measurements of:

- Turbidity (Nephelometric Turbidity Units)
- Dissolved oxygen (milligrams per liter)
- pH (standard units)
- Temperature (degrees Celsius).

Monitoring locations will be determined each morning based on communication with Project construction managers to determine what, when, and where in-water activities are expected to occur. Monitoring stations will be located approximately 500 feet up-current and down-current from the point of dredging or other in-water activity (e.g., berm construction, in-water sheet piling, armor stone placement, jet grouting). If multiple in-water activities are occurring simultaneously, additional monitoring locations will be sampled. Water quality monitoring locations will be located at the estimated 500 feet up-current and down-current locations adjacent to each of these various concurrent in-water activities.

Daily water quality monitoring per the WQMP will begin 5 days before in-water construction activities are initiated to orient staff with the specified sampling program methods and reporting procedures, and to establish baseline conditions in the Project area.

Water quality monitoring will be conducted once daily during daylight hours at approximate peak flood or peak ebb tidal flow conditions opposite where in water work is occurring. Water current velocity varies daily throughout a tidal cycle, typically reaching a maximum during peak flood or peak ebb conditions before steadily decreasing in between these periods. Sampling at these higher velocity periods will allow the contractor to better characterize the extent of in-water construction related activity.

Based on the results of the monitoring, the frequency of monitoring may be adjusted in consultation with VDEQ and USACE. Adjustments may be requested based on consistent turbidity values that are comparable to background and/or may be applicable to certain types of in-water activities that do or do not generate substantial turbidity. The turbidity monitoring goal will be determined in consultation with VDEQ. Exceedances of the turbidity goal may require work stoppage until values drop to acceptable levels or may require adjustments to equipment or operational BMPs to reduce suspended solids. Exceedances of the turbidity goal will be reported following USACE and/or VDEQ Project-specific protocols/requirements.

L.5 REFERENCES

Cardno. Hampton Roads Bridge Tunnel Expansion Preliminary Sediment Study. July 23, 2018.

Environmental Agency Meeting (PowerPoint Presentation). I-64 Hampton Roads Bridge-Tunnel (HRBT) Expansion Project. April 24, 2019.

Federal Highway Administration (FHWA). 2016. Natural Resources Technical Report: Prepared in Support of the Supplemental Environmental Impact Statement. July 2016. Online at http://www.hrbtexpansion.org/documents/201608/finaltechnicalreports/natural_resources_technical_report.pdf.

Federal Highway Administration (FHWA). 2017. Final Supplemental Environmental Impact Statement. April 2017. Online at http://www.hrbtexpansion.org/environmental_study/default.asp

Federal Highway Administration (FHWA). 2017. Record of Decision for Roadway Improvements to Interstate 64 from Interstate 664 in the City of Hampton to Interstate 564 in the City of Norfolk, Virginia. 12 June 2017. Online at http://www.hrbtexpansion.org/documents/rod_june_12.pdf

Federal Highway Administration (FHWA). 2018. Environmental Assessment Re-Evaluation of the Supplemental Environmental Impact Statement. 23 October 2018. Online at http://www.hrbtexpansion.org/documents/re-evaluation_of_environmental_assessment.pdf

Federal Motor Carrier Safety Administration (FMCSA). 2016. Resources from Drivers. Online at https://www.fmcsa.dot.gov/resources-for-drivers. Accessed 21 December.

Hampton Roads Connector Partners. 2019. Coastal Zone Management Consistency Certification. August 7, 2019.

I-64 Design Joint Venture (2019). Environmental Management Plan. June 6, 2019.

United States Army Corps of Engineers, Norfolk District / Virginia Port Authority (USACE-Norfolk District/VPA). 2008. Dredged Material Management Plan for Craney Island Eastward Expansion and Craney Island Dredged Material Management Area. Prepared by Craney Island Design Partners. June.

United States Environmental Protection Agency (EPA). 2016. Regional Screening Level (RSL) Table. Mid-Atlantic Risk Assessment. Available at http://www.epa.gov/reg3hwmd/risk/human/. Updated May 2016.

USGS National Water Information System Mapper USGS National Water Census Water Budget Data Resources for the Hampton Roads - HUC 02080208 Available at https://**water.usgs.gov**/lookup/getwatershed?**02080208**

Virginia Department of Environmental Quality (VDEQ). 2012. Memo No. LPR-SW-04-2012. Management and Reuse of Contaminated Media. Division of Land Protection and Revitalization State-Wide Variance Guidance. 17 July.

Virginia Department of Environmental Quality (VDEQ). 2014. Permit No. VPA 00579. Weanack Land Reclamation Project. Weanack Land Limited Liability Corporation (LLC), 461 Shirley Plantation Road, Charles City, Virginia 23030-2981. Effective Date: 1 December 2012. Modification Date: 2 December 2014. Expiration Date: 30 November 2022.

Virginia Marine Resources Commission (VMRC). Reef Material. Online at https://mrc.virginia.gov/vsrfdf/reef_other.shtm.

Virginia Department of Environmental Quality (VDEQ). 9VAC25-870-420 – New Sources and New Discharges.Online at https://law.lis.virginia.gov/admincode/title9/agency25/chapter870/section420/.

Virginia Department of Environmental Quality (VDEQ). 9VAC25-870-380 – Stormwater Discharges. Online at https://law.lis.virginia.gov/admincode/title9/agency25/chapter870/section420/.

UA Army Corp of Engineers, Norfolk Harbor Navigation Improvements, April 2018, Online at https://www.nao.usace.army.mil/About/Projects/Norfolk-Harbor-Channel-Deepening/