



APPENDIX - F

ALTERNATIVES ANALYSIS, REV 1

I-64 Hampton Roads Bridge-Tunnel Expansion Project

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Hampton-Norfolk, Virginia
December 19, 2019

DOCUMENT HISTORY

Issue Date	Description	By	Revision
December 19, 2019	Revised to incorporate design refinement and agency comment		1

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F. ALTERNATIVES ANALYSIS

F.1 INTRODUCTION

This appendix provides details on the Hampton Roads Bridge-Tunnel (HRBT) Expansion Project's (Project) design; no build alternative, immersed tube tunnel (ITT) alternative, and the selected bored tunnel alternative and construction alternatives. This section provides a brief overview of the history of alternatives analyzed under National Environmental Policy Act (NEPA) evaluations, primarily associated with the Hampton Roads Crossing Study (HRCS). The Federal Highway Administration (FHWA) is the Federal lead agency, consistent with 23 USC 139(c)(1) for the proposed Project and is responsible for compliance with the NEPA, in cooperation with the Virginia Department of Transportation (VDOT). The Preferred Alternative identified in the HRCS Final Supplemental Environmental Impact Statement (SEIS), which was identified by FHWA in their Record of Decision (ROD) issued on June 12, 2017 as the Refined Selected Action, provides the basis for the proposed HRBT Expansion Project.

The 404(b)1 Guidelines (40 CFR 230.1) were developed to provide the US Army Corps of Engineers (USACE) and the US Environmental Protection Agency (EPA), jointly responsible to promulgate Section 404 of the Clean Water Act (CWA) consistent review standards to limit adverse impacts caused by discharge of dredge and fill material into "waters of the US (WOUS), including wetlands". As a part of the general procedure (Section 230.5(c)) the agencies evaluate whether there are practicable alternatives with less environmentally damaging consequences, with the final selected alternative as the Least Environmentally Damaging Practicable Alternative (LEDPA).

Additionally, Section 401 of the CWA requires applicants to acquire a concurrent State Water Quality Certification, authorized by the Virginia Department of Environmental Quality (VDEQ) for the subject action. The state 401 certification ensures the proposed action meets the state's water quality standards and is documented in a Virginia Water Protection (VWP) permit. An alternatives analysis is also required under Virginia Code (9VAC25-201-80.B.1.g) for compliance with VWP permits. This alternative analysis therefore addresses both Section 404 and 401 criteria as outlined in the Guidelines.

The Preferred Alternative, Alternative A, identified in the 2017 HRCS Final SEIS was developed in a collaborative effort through the NEPA process and in consideration that it should meet LEDPA requirements. Alternative A included additional lanes along I-64 from Settler's Landing Road to the I-564 Interchange and did not include improvements to I-564, I-664, VA 164, or the Bower's Hill (I-664 / I-264 / I-664 / US 460) Interchange, which were components of the other build alternatives under consideration. The Preferred Alternative identified in the Final SEIS had design refinements that included avoidance of any property acquisition from Hampton University, which would have required implementing design changes that further restricted the proposed Limit of Disturbance (LOD) along the University property. The Preferred Alternative also included identification of an inventory corridor in which a new bridge-tunnel would be constructed, parallel to the existing I-64 HRBT, to carry additional lanes across Hampton Roads. The development of an inventory corridor at the HRBT provided design flexibility for the crossing alignment. Other changes to Alternative A from the Final SEIS included a

commitment by VDOT to avoid the Willoughby Boat Ramp (Section 4(f) protected resource) and avoidance of permanent acquisition of U.S. Navy property.

Figure F- 1: Refined Selected Alternative Limit of Disturbance



For more details on all alternatives considered during the NEPA process, see Chapter 2 of the Final SEIS.

F.1.1 PROJECT DESCRIPTION

The proposed HRBT Expansion Project will improve a section of Interstate 64 (I-64) that provides an important regional transportation link between the cities of Hampton and Norfolk, Virginia. The Project will address severe traffic congestion and 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 high-occupancy toll (HOT) lanes, and two new drivable (hard-running) shoulders to be used as HOT lanes during peak usage.

F.1.2 PROJECT PURPOSE AND NEED

The purpose of the HRCS was to evaluate alternatives that address congestion at the 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” (2001 FEIS and 2017 Final SEIS). The HRCS analyzed alternatives that focused on the following needs (FHWA, 2017 Final SEIS: pg. 1-1):

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

The purpose of the HRBT Expansion Project is to implement the Refined Selected Action, which is based on FHWA’s Selected Alternative A. Subsequent to FHWA’s 2017 ROD and 2018 Environmental Assessment (EA) Reevaluation of the Final SEIS, the design has evolved in response to refinements primarily associated with value engineering improvements. On October 23, 2018, FHWA issued a Finding of No Significant Impact (FONSI) for the 2018 EA Reevaluation. The HRBT Expansion Project remains consistent with Refined Selected Action alternative (FHWA, 2018 EA Reevaluation), and has incorporated all environmental design commitments that resulted from the NEPA process.

F.2 ALTERNATIVES

The following section provides details on the design alternatives considered for the Preferred Alternative and changes from the Refined Selected Action alternative defined in the 2018 HRCS Final SEIS EA Re-evaluation and the Request for Proposals (RFP) Conceptual Plan.

After FHWA issued the FONSI in October 2018 for the Refined Selected Action, a full bridge trestle replacement at the North and South Islands was incorporated into the HRBT Expansion contract. This

provided a degree of flexibility with the new bridge and tunnel design, construction sequencing, and maintenance of traffic, which is considered in this analysis. The environmental impacts from water crossings on structure near the existing alignment are minimal and any impacts would be addressed through avoidance, minimization, and mitigation efforts. These and other design refinements for the Final Selected Action Alternative are presented in detail in Appendix P – Avoidance, Minimization, and Mitigation Plan.

HRCP was limited to one LOD by the SEIS, within which they identified and characterized the physical and biological aspects of the ecosystem, including delineating and classifying the wetlands and waters on the onshore portions and the marine ecosystem, including wetlands, submerged aquatic vegetation, shellfish beds, threatened and endangered species and marine wildlife. Most of the area within the already established LOD is already impacted by the highway, and undisturbed areas were avoided or impacted only if there was no other practicable alternative.

F.2.1 NO BUILD ALTERNATIVE

A no build alternative was analyzed and was determined to not meet the purpose and needs of the Project. Although the no build alternative would have the least amount of environmental impact, it would not address travel demand contributing to congestion at the HRBT, improve transit access, increase regional accessibility, address geometric deficiencies, enhance emergency evacuation capability, improve strategic military connectivity, or increase access to port facilities.

F.2.2 IMMERSED TUBE TUNNEL

An ITT was considered as an option during the planning and procurement stage for the HRBT Project design, similar to the existing tunnel.

The ITT tunnel would require mechanized or hydraulic dredging of approximately 60 acres for a trench the length of the tunnel, which is approximately 6,300 feet. The 1,200,000 cubic yards of dredged material would be removed via barge or truck and disposed of at an offsite location.

An ITT approach would require building tunnel sections on land and sinking them in place in a dredged trench, then backfilling the trench and covering with stones to protect it from impacts once the sections are connected. An ITT is made out of concrete caissons fabricated in a drydock, floated to the project and sunk in place. The Hampton Roads Connector Partners (HRCP) calculated 19 caissons during the bid. Lowering them into place is a complicated and lengthy process. The main risk captured during the risks analysis is in case of emergency (a ship or submarine needs to leave immediately), the Navy could ask to free the way in less than 2 hours. If HRCP is in the process of sinking a caisson in the middle of the navigation channel, it would be impossible to move in less than 2 hours. This construction method would be incongruous with the military connectivity element of the purpose and need, as it could potentially impede military missions.

The total project schedule using the ITT is 77 months, with 61 months for tunnel construction only. In-water work would require 24 months for placing of caissons and 12 months for finishing including

backfilling and armor stone placement. Approximately 810,000 cubic yards of fill and 200,000 cubic yards of armor stone would need to be placed on top of the ITT.

F.2.3 SELECTED BORED TUNNEL ALTERNATIVE

The selected bored tunnel alternative will construct two new tunnels crossing Hampton Roads parallel to the west of the existing HRBT using a Tunnel Boring Machine (TBM). HRCP incorporated a bored tunnel construction method during the initial stages of design. The two new tunnels will have an internal diameter of 41.5 feet and be approximately 7,900 feet in length between the launch and reception shafts located on the North and South Islands. The tunnels will vary in depth from approximately 40 to 150 feet below the water surface. A geologic stratum with weak geotechnical properties exists along a portion of the tunnel alignment just beneath and to the north of South Island. Jet grouting will be used for ground improvement (GI) to strengthen soils in this area prior to advancing the TBM. The anticipated total project schedule encompasses 62 months, with 36 months for tunnel construction only.

Additional Project components will include full replacement of the North and South Trestle Bridges, 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.

Island Expansions

To provide necessary structural support and protection for the new HRBT, both North and South Islands will be expanded and modified. The North Island will be expanded to the west to accommodate the new tunnels and the Tunnel Approach Structure (TAS). The TAS is a concrete structure which connects the at-grade highway to the bored tunnel. The island expansion will be constructed of well-graded and compacted sand fill, and surrounded by a rock perimeter made of gravel, stone and armor stone designed to provide scour protection to protect the island from wave action, current scour, and propeller wash.

The South Island will be expanded to the south to accommodate the transition between the trestle abutment and the TAS. Expanding the island to the south avoids the need to construct a berm on the channel side of the island. The South Island will be made of well-graded and compacted sand inside a rock perimeter similar to the North Island. Soil conditions in the South Island expansion area will require ground improvement to avoid settlement of the expanded island and surrounding structures, including the trestle bridges.

Trestle Bridges

The existing two-lane North and South Trestle Bridges will be demolished and reconstructed. The North Trestle Bridges will be replaced by two new four-lane structures.

The two existing two-lane South Trestle Bridges will also be demolished and replaced by a new single eight-lane structure.

The existing Willoughby Bay Trestle Bridge structure will be modified by widening the two existing structures to the outside in both directions to accommodate new travel lanes, shoulders, and new sound walls. The trestle bridges crossing Bay Avenue and Oastes Creek will be similarly expanded.

Roadway Expansion

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

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

Traffic crossovers for emergency use will be provided at both the Hampton and Norfolk approaches.

F.3 COMPARISON OF ALTERNATIVES

The selected bored tunnel alternative has many advantages when compared to the ITT alternative. A tunnel bored underneath the sediment-water interface will avoid substantial in-water impacts related to dredging and avoid direct navigation impacts to the federally- maintained channel. Less disturbance to the channel and open water reduces concerns to commercial ships and military vessels, which will minimize the impact on the economy, tourism, and national security as the tunnel is being constructed.

The bored tunnel construction also reduces overall costs, shortens schedule, and improves worker safety. The use of a bored tunnel approach would substantially reduce the volume of dredging when compared to the ITT approach minimizing the need for ocean disposal. Construction of the bored tunnel underground results in a reduction of noise, dust, and visual impacts. The tunnel itself will not cause impacts to subaqueous bottom, essential fish habitat, or benthic habitat, nor will additional fill or armor stone be placed on top of the tunnels. Finally, the bored tunnel creates substantially less exposure to weather risks such as wind and wave action during construction as the deeper elevations of the tunnel are constructed under the surface of the James River.

The selected bored tunnel has fewer impacts to WOUS than the ITT, while still meeting the Project purpose and need. Table F-1 provides a comparison of the impacts to WOUS for each alternative. These comparisons represent only the tunnel portion of the Project.

Table F- 1: Comparison of WOUS Impacts for Each Alternative

Resource	No-Build	Immersed Tube Tunnel (ITT)	Selected Bored Tunnel
Dredging	0 acres / 0 cubic yards	60 acres / 1,200,000 cubic yards	0 acres / 0 cubic yards*
Permanent Fill	0 cubic yards	810,000 cubic yards of backfill and 200,000 cubic yards of armor stones	0 cubic yards
Temporary Structure**	0 acres	0 acres	4.03 acres

* Does not include material bored from below the sediment surface.

** For Conveyor Belt, TBM Quay, and Jet Grout Trestles

F.4 DESIGN AND CONSTRUCTION MODIFICATIONS

Once the bored tunnel alternative was selected, every effort was made to avoid and minimize additional impacts to WOUS, navigation, threatened and endangered species, construction schedule, and cost. Alternative design and construction methods are summarized below and the resulting avoidance and minimization of impacts are detailed in Appendix P.

The tunnel grades, and both vertical and horizontal alignments, were selected to minimize and mitigate construction impacts and schedule risks. The alignments were found to reduce impacts to the existing HRBT infrastructure. The final tunnel grades were selected because they allow:

- A reduced island expansion footprint as compared with a berm solution, with less environmental impact. The slope of the island was increased to 5% to avoid berms which would be required if the island slope was 4%.
- Eliminated marine works in the channel, facilitating Section 408 coordination and minimizing impacts to the Navy and other marine stakeholders.
- Reduced depth and extent of the tunnel approach structures (TAS), minimizing potential for settlement impacts to adjacent existing island infrastructure, and VDOT operations.
- Minimized tunnel construction risks by maintaining sufficient tunnel cover, controlling tunnel buoyancy, scour protection, and avoiding areas of poor ground conditions. This benefits the overall durability of the tunnel during its service life.

This tunnel alignment also reduces the amount of marine work required, minimizing impacts to marine resources and stakeholders. Specifically, the alignments were selected because they allow for:

- Locating the tunnels and TAS (TBM launch and reception shafts) away from the existing infrastructure, including the existing trestles and existing ITT, to minimize impacts to VDOT infrastructure and day-to-day VDOT operations.

- Avoiding direct impacts to the rock protection above the existing ITT; this allows HRCP to perform ground improvement without needing to remove the rock protection and expose the existing ITTs.
- Providing adequate separation between the new bored tunnels, allowing HRCP to quickly separate the tunnels and therefore avoid unnecessary risks associated with the proximity of the two tunnels.
- Minimizing extent of the island modification work.
- Optimizing the roadway alignment and improving overall traffic flow on and off the islands.
- Considering local ground conditions and efficiently determine the extent of the ground improvement work.

Temporary construction trestles will be used to facilitate work over the water and over some wetland locations in shallow areas. The use of temporary construction trestles was chosen over traditional stone or earthen causeways to minimize impacts to Submerged Aquatic Vegetation (SAV) and WOUS. Additionally, temporary trestles minimize impacts to WOUS by reducing the dredging requirement to allow barge access in shallow areas.

To reduce impacts to aquatic resources during pile driving operations, the following mitigation measure will be enforced:

- Avoid Impact and Down-the-hole Hammer of 42-in steel pipe piles
- Ramp up (all piles): Gradual increase in pile driving energy which allows aquatic organisms opportunity to move away from the noise source prior to the onset of full energy pile driving.
- Cushion block (impact driven piles as practical and safe) - Blocks of material placed between the top of the pile and the impact hammer. These blocks reduce the noise levels produced during pile driving.
- Bubble Curtains will be used to minimize noise for steel piles located in deeper water (>20 feet) where sturgeon and other anadromous species are most likely to migrate.
- Vibratory hammers, which emit less noise than impact hammers will be used until refusal. If necessary, impact hammers will be implemented to complete pile driving to the desired depth using the minimization methods listed above.
- Any jetting will occur within a hole through a concrete pile, which will reduce turbidity when compared to jetting outside of the pile.

VDOT acquired Willoughby Spit to accommodate docking and stationing necessary for increased vessel traffic. There are no suitable mooring locations east of the HRBT as the mouth of the river opens to the Chesapeake Bay and offers little protection for vessels. The choppy conditions in the bay and heavily trafficked James River do not allow for many adequate mooring locations near the Project Area. Efforts will be made to avoid and minimize impacts to shellfish grounds and submerged aquatic vegetation through strategic adjacent construction and placement of mooring locations. Locations around Craney Island have been avoided so there will be no impact to Baylor Grounds.

F.5 INDIRECT AND CUMULATIVE EFFECTS

In July 2016, VDOT, in cooperation with the FHWA as the lead federal agency, prepared an Indirect and Cumulative Effects (ICE) Technical Report as part of the HRCS SEIS. The purpose of the ICE

report was to identify and assess the indirect and cumulative effects of the alternatives presented in the SEIS.

As previously mentioned, the HRBT expansion project alignment is a subsection of Alternative A. Since the footprint of the HRBT expansion project lies within the Alternative A study area, the findings from the July 2016 ICE Technical Report apply to the HRBT expansion project. Moreover, the ICE are further reduced given the smaller project area and the use of a TBM for tunnel construction. For detailed information on ICE please see the Indirect and Cumulative Effects Technical Report of the HRCS SEIS.

F.6 CONCLUSION

Based on the extensive and collaborative alternative analysis included in this Appendix and in Appendices E and P, in addition to the NEPA analysis and the Refined Selected Action by FHWA and adherence to the environmental design commitments and supplemental environmental analysis, HRCP believes the proposed selected bored tunnel alternative represents the LEDPA. The selected bored tunnel alternative best balances cost, impacts, and final design considerations while meeting the purpose and need for the Project.

F.7 REFERENCES

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